THE DEVELOPMENT OF A PRIMARY SCIENCE CURRICULUM PACKAGE FOR THE NOMADIC PASTORAL FULBE IN NIGERIA

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DECLARATION

The author hereby declares that the whole of this work now submitted to the Faculty of Education, Ahmadu Bello University, Zaria for the award of the degree Doctor of Philosophy in Science Education (Curriculum and Instruction) is an original work which was not presented to any university for the award of any degree or certificate in any form, and all references are fully acknowledged.

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CERTIFICATION

This thesis entitled "The Development of A Primary Science Curriculum Package for the Nomadic Pastoral Fulbe in Nigeria" meets the regulations governing the degree of Doctor of Philosophy of the Ahmadu Bello University, Zaria, and is hereby approved for its contribution to the scientific knowledge of literary presentation.

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Abstract

With the aid of a synthetic research methodology the study was set out to develop a culturally relevant primary science curriculum for the nomadic pastoral Fulbe.

After an ethnographic study was carried out a cognitive preference test called Science Cognitive Preference Test Before Treatment (SCPTBT) was designed to map out the science cognitive preferences of the nomadic pastoral Fulbe children. Mundane Scenarios which are familiar to the child in the environment were used to form the contents of the SCPTBT. This test was used to achieve two objectives: (1) to test the homogeneity of the group and (,2) to use the cognitive preferences as a guide to the process of curriculum development. After the analysis of variance (ANOVA), the preferences of practical Application and Critical Questioning were found to be dominant. The least preferred preference was Recall of Facts. These dominant preferences were thought to be desirable in the learning of science, particularly in the present dispensation of the developing nations. Consequently, they were reinforced in the new Curriculum.

The selected instructional materials and the cultural method of teaching earmarked from the ethnographic study were combined with the discovered learner-characteristics of cognitive preference to design and develop a new and

culturally relevant curriculum referred to in this study as 'TSTP Curriculum' (Teaching Science Through Pulaaku). The curriculum was designed on the five seasons of the nomadic pastoral Fulbe Calendar. The themes from the national syllabus were chosen in accordance with the activities prominent in each of the seasons. The entire framework of the curriculum was built on a traditional story telling strategy of teaching. The main characters are two little girls TUMBA and her sister GENO.

Through experimentation, the 'TSTP' curriculum was compared with the curricular materials already in use through out the country. These curricular materials are referred to in this study as- 'TSTM' (Teaching Science Through Traditional Method).

Another cognitive preference test referred to as Science Cognitive Preference Test After Treatment (SCPTAT) was administered to the two groups. After the analysis of variance (ANOVA), the TSTP group scored significantly higher mean scores in the Practical Application and Critical questioning scales whereas, the'TSTM' group scored significantly higher means in the Recall scale. There was no significant difference between the two groups in the scale of Fundamental Principles.

A test, Primary Science Achievement Test (PSAT) was developed and the two groups were accordingly tested. After the test analysis, it was found out that the TSTP group

performed significantly better in seven out of ten tests. Their mean scores were also higher in nine out of ten tests. From the results obtained in the study, similar approach to curriculum development and renewals in other subjects was recommended.

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Definition of Terms

Pulaaku	The Fulbe Cultural way of life.
Birdude	A milk calabash container.
Sauru	A Stick
Faggo	Household Junks carried in the process of Barto.
Jolluru	A calabash container.
Maaji	Early Morning Browse.
Dongoli	A rope used for teething caives.
Barkehi	A shrub found accross the savannah.
Gelode	A shrub found accross the savannah.
Badoje	A watter lily found in Ponds.
Duman Kada	A Creeping flowering plant found in Sahel Savannah.
Churadam	Milk.
Nebban	Butter.
Barto	The seasonal transhumance movement from one settlement to another.
Looru	The wind which blows from the south before the rainy season (the South-North trade winds).
Faandu	Calabash container.
Metre-Sauru	Metre.

Milifaaudu	1 mililitre measured by a small calabash container.
Centifaaudu	1 centilitre measured by a small calabash container.
decifaandu	1 decilitre measured by a small calabash continer.
Litre faandu	1 litre measured by a small calabash continer.
Milifaggo	1 milligram
Centifaggo	1 centigram
decifaggo	1 decigram
One faggo	1 gram
Kilo faggo	1 kilogram
Dabirde	Spatial settlement in the season of ndabbunde (harmattan).
Rumirde	Spatial settlement in the season of Ndungu (rainy season).
Yawirde	Spatial settlement in the season of Yawal (hot season after the rains).
Yawoli	Hot season
Seeto	Leading to the beginning of rainy season.
Settinirde	Spatial settlement in Seeto.
Ndabbu'nde	Harmattan season.
Ndungu	Rainy season.

Cheedu	Hot season proper
Cheedirde	Spatial settlement in Cheedu.
Nyaile	A short season after harvest.
Nduddooli	A traditional fire set to light coral by the sun set.
Shantali	A small pot container.
Minaye	Name of a Cow.
Bijaye	Name of a Cow.
Danwari	The name of a particular Dog.
Wurgu	A fodder grass.
Dabagi	Upland, usually for grazing in the rainy season.
Ngarso	A prestigious title given to a groomed and old herder.
Jonwuro	Title.
Ruggah	Title.
Ardo	Title.
Dikko	Title.
Domdo	Name of a place.
Binjije	Name of a place.
Gesalodi	Name of a place.
Daraye	Name of a place.
Ertonga	Name of a place.
Wobaye	The Name of a Cow.

Tumba	A name of a girl.
Geno	A name of a girl.
Julde	A name of a man.
Kwairanga	A name of a man.
Loddo	A name of a woman
Jehwu	A name of a woman.
Njiddare	A name of a woman.
Motti	A name of a woman.
Nyalli	A name of a person.
Forliti	A period after the cattle have been watered in the afternoon
Kappe	A Yam tuber.
Dankali	Potato
Albasaje	Onion
Bokkol	A name of a local tree.
gudai	A name of a local tree.
Zogale	A name of a local tree.
Dabbaji Wuro	Domestic Animals
Dabbaji ladde	Wild animals
Rammol	Name of a local plant
Rogoje	Cassava
Yodo	A name of a local plant.
Tafasa	A name of a local plant.
Alayyafu	Spinarch plant.
Guavaje	Guava fruits.
Gwaddaje	A name of a local edible fruit

lemuje	lemon fruits
Mangoroje	mango fruits.
Finaye	Name of a Cow..
milisauru	one milimetre measured by a stick.
centisauru	one centimetre measured by a stick.
decimetresauru	one decimetre measured by a stick.
kilometresauru	one kilometre measured with a stick.
Tisla	A name of a cow.
Tiggere	a big peg used for the tithing of a cow.

Abbreviations.

SCPTBT	Science Cognitive Preference Test Before Treatment.
SCPTAT	Science Cognitive Preferences Test After Treatment.
TSTP	Teaching Science Through Pulaaku.
TSTM	Teaching Science through Traditional Method.
PSAT	Primary Science Achievement Test.
NEP-CP-RAI	Nomadic Education Primary Science Curriculum Package: Readability Assessment Inventories.

CHAPTER 1

STATEMENT OF THE PROBLEM

1.1 Introduction

The Nomadic Pastoral Fulbe have been moving from their putative homeland in the Western Sudan over many centuries. The need for better pasture and water for their animals has scattered them far and wide that today, they are found across the entire West African Savannah zone (Frantz, 1980: 64; 1979: 100). In Nigeria, they are found throughout the Northern States and they number between six to ten millions and control most of the livestock animals especially cattle (Ribadu,1986).

That, the pastoral Fulbe are nomadic, poses the special problem of breaking a self-reinforcing cycle. The pastoral Fulbe continue to be nomadic because they do not receive the education that would result into their assimilation by a modern society. The nomadic pastoral Fulbe never remain long enough in one place so as to benefit from the delivery of such social services provided by the government of a modern state like Nigeria. In this regard, it is generally acknowledged, that attempts to provide effective education for pastoral societies have not been particularly very

at least three reasons why mobile education, even though, a well intended idea, failed to deliver the goods. They are:

1. the lack of willing teachers to serve in the scheme;
2. the inavailability and reliability of transportation system to consistently follow the pastoral nomads; and
3. the difficulties in locating the new site of the moved camps (Rugga).

Gorham (1978:2-5) also identifies various constraints which militate against successful implementation of educational programmes in pastoral societies. They include

1. Institutional:
   - (a) Practical relevance to pastoral economy.
   - (b) Incompatibility with the pastoral culture.
2. Ecological:
   - (a) Demographic - low density population.
   - (b) Infrastructural conditions.
   - (c) Settlement patterns.
   - (d) Pastoral herdind practices - constant mobility.
   - (e) Labour requirement.

Despite the prevailing conditions of these variables, some measure of success has been reported in some countries such as: China, Kenya, Iran, Mauritania, Soviet Union, Mongolia, and Algeria (Gorham 1978: 19-21). The absence of such a programme hitherto in Nigeria, is clearly indicated by the absence of any clause in the National Policy on Education which specifically mentions the plight of the nomadic pastoral Fulbe as a disadvantaged minority in need of special arrangement for such educational services (Junaid & Ardo 1985: 11-15).

This neglect and subsequent exclusion of the pastoral Fulbe from having access to modern education runs contrary to the conferences of African States, (starting from the Addis Ababa conference in 1961) which upheld the enhancement of universal primary education in all member states. Even though some form of Universal Primary Education was introduced in the defunct Western and Eastern regions in the early 1960s, the universalization of primary education for the entire nation became fully effective in Nigeria only in 1976. The nomadic pastoral Fulbe did not however, benefit from the scheme even though, most sedentary Nigerians benefitted from it (Junaid and Ardo 1985: 11-15). In the same vein, the Nairobi conference held in July 1968, emphasized the productive nature of education and

its essential role in economic, social and technological development. The Lagos conference held in February 1976, stressed the need to democratize education systems and to aim at a system of mass education from which no social class would be excluded. The Harare conference held in 1982, reaffirmed the commitments of the earlier conferences.

It is clear from these conferences, that the African States were poised to provide science education to all their citizens so as to uplift them economically and culturally. It is the most effective way of getting the people more politically and socially conscious, so as to play a more active part in nation-building. To exclude any social group would be contrary to the spirit ofthe conferences. In this respect, the Federal Government of Nigeria embarked upon a nation-wide programme for the pastoral nomads, after many years of neglect. In his opening address to the 1986 Yola workshop, the Minister of Education further stated that "In pursuit of such objectives, special budgetary allocations are being made to provide for educational facilities for nomadic children, even as we elaborate a Nomadic Education Policy."

Since the blue print of the policy and a decree to this effect are now ready and the government is focusing its attention on the plight of these people, more research is needed in the field of curriculum development, so as to arrive at a viable delivery system.

One of the areas which demand such research attention is in the field of primary science education curriculum. Since the Addis Ababa and Nairobi conferences of African Ministers, science education has been given greater attention and its introduction in the primary school was the subject of declarations in all subsequent conferences. The Nairobi conference was particularly emphatic on the problems of scientific and technical training from primary level to higher education. An international conference on Research and Training held in (Nigeria) Lagos in 1964, recommended among other things, the teaching of science in the early years of schooling and called for materials and methods which are more relevant and related to the local conditions of the learners.

Consequently, the research problem was based on the objectives of designing Primary Science Curriculum which draws its materials from the local and cultural

environment. These specific objectives of the study would seem to call for an ethnographic study before the development of the curriculum. They equally sought to find out the cognitive preferences of the pastoral Fulbe Children before and after the development of the curriculum. Cognitive Preference Tests were used in the past to evaluate and compare two or more curricula (Heath, 1964: Atwood, 1971; Kempa and Dube 1973). In this study, however, the need to use cognitive preference test 'CPT' as a tool for both curriculum development and evaluation would clearly seem to be in line with the goals and objectives of the study.

Cognitive preference is a learner-chatavteristic which ought to be clearly ascertained if a suitable curriculum is to be developed for a minority educational clientelle like the nomadic pastoral Fulbe. The development of a culturally relevant curriculum necessistates the undertaking of a thorough study of all the prevailing socio-economic and socio-cultural patterns and cognitive styles of the nomadic pastoral Fulbe.

Lennon (1988) says the need to undertake a socio-cultural and cognitive research to inform educational planning is butressed by the findings of the educational research which have amply demonstrated

"that the outcome of the transmission of knowledge in school depends to a large extent on the cultural characteristics of the pupils". To understand the cultural characteristics of the nomadic pastoral children, one needs to study the child rearing and socialization practices of such a pastoral society. In the nomadic pastoral Fulbe society, the study of Pulaaku (the Fulbe way of life) becomes imperative here. This aspect of the study could only be realized through an ethnographic study of the nomadic Pastoral Fulbe. From findings of the ethnography relevant curricular materials could be selected.

The processes entailed in the development of such a curriculum like the one developed under this study call for a synthetic research methodology where both qualitative and quantitative research paradigms are triangulated to complement each other in illuminating and bringing to focus different areas of the research problem. This type of research methodology has gained currency in recent times with many Scholars advocating for its employment in curriculum research (Gage, 1989: Noland and Short, 1985: and Jegede, 1990).

In line with the National Policy on Education, and the need for the total mobilization of all sectors of the Nigerian populace toward scientific and technological development, any form of formal education

earmarked for the children of pastoral Fulbe must include Science and science teaching even if the Federal Government limits its nomadic education activities to primary schools for the time being. The need to draw up suitable curricular materials for the primary school science will certainly deserve the attention of the planners of Nomadic education for the pastoral Fulbe. Theirs is a special problem which needs to be tackled by incorporating their cultural elements and their environment.

In this regards, the need to design a new and relevant elementary science curriculum for such a people rests on empirical evidence (which brings out significant findings). One area which is probably likely to demonstrate such a significance would appear to be in the cognitive preference dimension of cognitive style. Understanding the idiosyncrasy of a learner will defintely go along way in helping the teacher in the selection of learning materials and the appropriate pedagogical presentation which is in harmany with such learning modes or idiosyncrasies. For a smooth and meaningful transition from pastoral nomadism to sedentarization, there is a strong need for careful intervention, so as to take care of concomitant variables

which accompany such a social change. The research problem was located and situated within the locus of this transitional period.

The argument is that, any curriculum meant for this period of the pastoral society is an intervention tool and therefore has to differ in some respects with the normal curriculum interms of its content to fit local situations. These changes are engendered by the necessity to accomodate the cultural environment of the nomadic child in order to make the curriculum relevant to his experiences. The introduction of the pastoral child to the modern science with its rationalistic and empirical mode of inquiry, to say nothing of its evolutionary epistemology, needs special curriculum-tailoring so as to achieve the desired objectives for integratin such societies within the fabric of the main stream culture.

1.2 The Problem

Prior to 1981, the problem of educating minority peoples such as the nomadic pastoral Fulbe was almost unheard of in Nigeria. However, it was only in 1986 that the Federal Government of Nigeria embarked upon a national programme with the specific

objective of providing educational facilities to nomadic peoples in the country. Since then various conferecnes and workshop (Yola 1986, Maiduguri 1988, Bauchi 1989) were held to deliberate on an appropriate curriculum for the nomadic schools. Yet, there has been no curriculum developed in Primary Science to specifically address the children of the nomadic pastoral Fulbe through their cultural filter.

Also there has been no study conducted to find out their cognitive preferences in science with a view to using these preferences as tools for curriculum development and evaluation.

Consequently, this study was undertaken to develop a culturally relevant primary science curriculum package. The study was undertaken as an attempt to come to grips with a recurrent problem which has hitherto bedevilled many attempts to provide educational facilities to nomadic pastoral societies (Gorham,1978: Heron, 1983;). The development of a relevant curriculum has eluded many educational planners to the deteriment of their entire programmes. In this scenario, the provision of education to nomadic pastoral societies has become a trial and error business. Under this type of arrangement, lack of objectives and overall understanding of the pastoral system are

what characterize educational strategies (Nkinyangi, 1981).

To break away from this cycle of trial and error, there would be need to undertake a study that subject the economic and social aspects of pastoralism under close examination. In this way, both suitable and relevant curricular materials could be drawn up (Saron Ole Sena 1981).

In Nigeria, early efforts to provide religious education (Islamic) to the nomadic pastoral peoples were largely successful, probably because the proselytizing wandering catechists new exactly the objective economic laws governing the existence of their clientelle (Von Ardo, 1988).

To develop a culturally relevant curriculum for the nomadic Pastoral Fulbe, the laws of their social and economic callings ought to be understood properly as in the words of Taylor (1982:57), "that curriculum is an embeded feature of the educational system and a critical pivot of educational practices needs little urging, the curriculum is institutionally and socially contained culturally and historically confined. Any research called Curriculum Research must in some way acknowledge this".

Consequently, this study was designed to achieve the following specific objectices and attempted to answer the accompanied specific questions.

1.3. Specific Objectives

(1) To find out the cognitive preferences of the nomadic pastoral Fulbe (Children) with a view to designing an appropriate curriculum.

(2) To test the curriculum developed with a concomitant strategy of teaching science through Pulaaku (TSTP) and to compare it with the existing curriculum through its concomitant teaching strategy (Teaching Science through traditional method (TSTM).

(3) To find out the difference if any in the recall of Scientific facts between the children exposed to TSTP and those exposed to TSTM primary science curricular materials.

(4) To find out the difference if any in the comprehension of fundamental principles of science between the pastoral children exposed to TSTP and TSTM primary science curricular materials.

(5) To find out the difference if any in the practical application of science between the pastoral children exposed to TSTP and TSTM primary science curricular materials.

(6) To find out the difference if any in the application of critical questioning of information between the pastoral children exposed to TSTP and TSTM primary science curricular materials.

1.4 Specific Questions

(1) In view of their child rearing and socialization practices, do the nomadic children of the pastoral Fulbe possess desirable cognitive preferences in science which can be used as pillars to build a new and relevant curriculum in primary science?

(2) To what extent is the developed curriculum more effective or otherwise than the existing curriculum?

(3) Is there any difference in the recall of scientific facts between the pastoral children exposed to TSTP and TSTM primary science curricular materials?

(4) Is there any difference in the comprehension of fundamental principles of science between the nomadic pastoral children exposed to TSTP and TSTM primary science curricular materials?

(5) Is there any difference in the practical application of science between the nomadic pastoral children exposed to TSTP and TSTM primary science curricular materials?

(6) Is there any difference in the application of critical questioning of information in science between the nomadic pastoral children exposed to TSTP and TSTM primary science curricular materials?

1.5 The Null Hypotheses

The null hypotheses were stated and tested with respect to the specific questions of the research problem. The hypotheses were tested using the 0.05 level of significance. The null hypotheses were stated as follows:

1. There is no significant difference in the cognitive preferences of two nomadic pastoral Fulbe groups in the Recall of Scientific facts, fundamental principles in science, practical application in science and critical questioning of scientific information.
2. There is no significant difference between the cultural model approach and the traditional model approach of teaching primary science in

terms of effectiveness in the acquisition of science skills and knowledge by the nomadic pastoral Fulbe.

3. There is no significant difference in the cognitive preference for recall of facts in science between the pastoral children taught by the cultural model approach (TSTP) and those taught by the traditional approach (TSTM).

4. There is no significant difference in the cognitive preference for fundamental principles in science between the pastoral children taught by the cultural model approach (TSTP) and those taught by the traditional approach (TSTM).

5. There is no significant difference in the cognitive preference for practical application in science between the pastoral children taught by the cultural model approach (TST P) and those taught by the traditional approach (TSTM).

6. There is no significant difference in the cognitive preference for critical questioning of information in science between the pastoral children taught by the cultural model approach (TSTP) and those taught by the traditional approach (TSTM).

1.6 Basic Assumptions

In carrying out this study, the following basic assumptions were made:

1. Education is a cultural tool of intervention so as to achieve an integrated society which is indispensable to modern nation-building.
2. The pastoral child, like any other child in the contemporary world, needs to master some scientific skills and knowledge.
3. Science skills and knowledge are best understood and acquired when presented through a cultural filter.
4. The knowledge of science is a key to understanding the motion of the modern world.
5. The local environment of the pastoral Fulbe can be exploited to design relevant curriculum for the teaching of science to their children.
6. In view of the differences in TSTP and TSTM primary science curricular materials the pastoral children exposed to these materials have different cognitive preferences and achievements.

1.7 Significance Of The Study

The successful execution of the Federal Government's nation-wide programme for educating the nomadic pastoral

Fulbe, calls for the development of proper curricular materials which are both relevant and related to the environment of the pastoral child. In this respect, the Minister of Education stated in 1986 that: "A thorough understanding of the nomadic way of life helps us to draw educational plans for the nomad which stand the chance of being successful. Previous plans for educating the nomadic children appeared to have failed largely because they failed to demonstrate this understanding". It was indicated by the Minister that a special curriculum is needed for the pastoral Fulbe. The Minister was also quoted earlier in this report, on page four that the Federal Government will start the programme at the level of primary education, before embarking on other levels. The study of science is one of the core subjects in the primary school curriculum, outlined by the National Policy on Education in section 3 (15:2). What one could infer from the Minister's speech with respect to science is a need for curricular materials to be drawn whenever possible from the environment of the nomadic pastoral child. In this way, relevant curricular materials are to be selected and presented to the child. This perhaps calls for a cultural model approach. It is hoped that the advantages of this

model would facilitate learning through a cultural background. This model could only be employed however, when a separate curriculum is developed for the nomadic pastoral child. This curriculum will undoubtedly be rooted in the national policy on education, which means, it has to include the study of science.

To this angle and direction, this research study is needed, for successful delivery to the pastoral Fulbe.

Heron (1983:61-68) says "the relevance and value of curriculum to pastoral society is very often a problem in developing schools for nomads."

In this respect, a study on curriculum development for the pastoral nomads such as the pastoral Fulbe will greatly contribute to the existing literature on the subject of pastoral/nomadic education. The existing literature is both inadequate and scarce (Heron 1983:61-68). In the field of science education, the study is very significant, in the sense that recent trends in science education argue in favour of seeing science as a venture rooted in the social melieu whose particular characteristics it must adapt to. For science teaching to be effective, it must take the object of its study from the local environment,

and adapt its explanations to the locally available materials (UNESCO 1983:54; Layton, 1986; Jegede 1986 and 1987). The learner should feel at home with both the materials and the methodology through which science is presented to him. This cultural dimension in science teaching, constitutes a corner stone to this study, which makes it a valuable material in the recent literature on science and society. A science curriculum designed specially for the pastoral Fulbe will be of great value to the planners and teachers of the proposed nomadic education under the aegis of the Federal Ministry of Education. Technological and economic developments for industrial growth and progress cannot be achieved without proper knowledge of science and technical education as noted by the various conferences of African member states' Ministers which culminated into the formulation of a science policy enumerated by the 'Dakar Declaration'. To this end, the proper understanding of scientific principles at an early age will be pertinent to such technological and economic development.

The understanding of scientific principles and methodology at an early age can only be achieved through relevant curricular materials and methodology which are properly synchronized with the child's environment and culture. The study is therefore significant in this direction.

The research methodology which centred around the synthesis of two research paradigms: the quantitative and qualitative research methods is equally an important development in curriculum research. Also equally important is the selection and treatment of socio-cultural data in the development of primary science curriculum package for a minority group such as the nomadic pastoral Fulbe. The significant results in favour of a cultural strategy of teaching science have further demonstrated the need to select an appropriate pedagogical strategy which is synchronized to the cultural climate of educational clientelle.

The entire process of building a science curriculum through a cultural filter would seem to be a profiting venture as demonstrated by this study. The design of the curriculum framework was itself conceived on the story of two girls: Toumba and Geno.

Appropriate curricular scenarios based on the nomadic pastoral calendar were carefully hatched and set in as real life a situation as possible. The two girls moved with their parents from one place to another according to the dictate of the five seasons of the pastoral calendar. The themes of the lessons were chosen in accordance with the dominant activities of each season. In this way, the curriculum was spirally built to accomodate recurrent topics contained in the 1984 primary science core curriculum.

This type of curriculum design contrasts heavily with the traditional curriculum design where the curriculum is conceived and built without regard to the cultural ways of teaching and acquiring knowledge.

1.8 Scope and Delimitations Of The Study.

1. The ethnographic study was conducted in two local governments of Sokoto State: Bagudo and Wamakko Local Governments.
2. The population from which the samples were drawn came from the two oldest nomadic education schools, located at Mazat Ropp and Dogo Gashish all in Barkin Ladi Local Government in Plateau State.

1.9 Limitations of the Study

3. The contents of the curriculum as outlined in the national primary science core curriculum (1984) seems to be too ambitious for a primary child. This may have some readability implications on the children, even though attempts were made to monitor the readability of the curricular materials developed.

4. The rate of attrition in the two schools selected for the study. And

5. The small size of the experimental and ethnographic samples.

CHAPTER 2

REVIEW OF RELATED LITERATURE

2.0 Pastoral Nomadic Peoples, Social Change And Developments

2.1 Introduction

In this epoch, pastoral nomadic societies every where are under threat from competitive and large scale commercial production, enhanced by new technology in the fields of agriculture and industry. Pastoral economy and other precapitalist forms of production are being articulated by the capitalist mode of production. What is now obtained therefore, is a pastoral economy which operates within the boundaries of capitalist relations of production. In this regard, the classical model of pastoralism is no longer possible. In Syria and Iraq herding is mostly done by the dependants of migrants to the Arabian petro-economies. In Western China and Kenya, the situation of these marginal peoples is very precarious in the face of government sanctioned cultivation schemes which are swallowing the best watered of the traditional rangelands (Aronson 1984: 73; Rigby 1985: 169). In China the Hans-Chinese were settled in the land which traditionally belonged to the pastoral communities of the western provinces (Butterfield 1982:427-429). Cameline

pastoralism of the Northern Somali is almost ruined by the labour migration of the people to the oil-rich gulf-states. In the USSR, large scale sedentarization of the Kazakhs pastoral nomads took place with far reaching reforms of the system of ownership and management of animals (Konzacki, 1978: 151-152).

In Isreal, the bedouin Arabs of the Negav desert are virtually enclosed and are only allowed access to government parcels of pasture land when the right fees are paid. In The Southern Sudan, the Baggara and other nomadic pastoralists have been subjected to various schemes aimed at altering their mode of living (Adams, 1982: 259-289).

However, inspite of these massive attempts to destroy the pastoral form of production, it has continued to survive. This resilience attracted many scholars, who came to propose theoretical explanations as to why the pastoral system continues not only to be viable in the developing countries but in fact to withstand the destructive and consuming effects of both capitalism and socialism. The proponents of modernization theory like Taylor (1979), and Rostow (1960) argued in favour of total 'Westernization' or industrialization as a solution to such conservative forms of production like the peasant and pastoral

productions. The proponents of the dependency model continue on the other hand to argue out their theories against the unequal development engendered by the global capitalist developments. Amin (1975) and Frank (1967) continue to reproduce this view in their voluminous writings.

Both pastoral economy and peasant economy since Chayanov (1925) continue to be central to the agricultural production in the developing countries, which, albeit, have so far failed to reproduce the historial path to industrialization followed by the Western European nations. The governments of these developing countries continue to plan their economies in the pattern of the developed nations which in most cases sell such plans to them through economic aids and world bank projects. The target of these plans are mostly the peasants and pastoralists living in the frontier zones of these countries.

Education is one area which has in recent times come to be a potent weapon in the hands of development agencies and government sponsored projects.
Under this chapter, related literature on the nomadic pastoral economy, planning for a minority education curriculum and social change, development in primary science education, cognitive preference research and tests, and

teaching science through a cultural filter are reviewed.

2.2 Pastoral Economy

Pastoral economy dates to antiquity, precisely from the primitive-communal mode of production, which emerged about two million years ago (Ryndina 1980: 17-19). The main stages in the development of productive forces in this epoch could be divided into two, whereas the first stage consisted mainly in the appropriation of natural products, the second stage marked the transition to a productive economy. In the first stage, the means of subsistence were secured mainly by gathering fruits, grains, vegetables and hunting. The gathering of fruits, and grains led to the development of arable farming, while hunting gave rise to livestock domestication and breeding. From this point, two distinct economic groups emerged; those who took to agricultural production and those in the livestock production. The latter group became the first pastoralists, hence the emergence of various pastoral tribes (Toynbee, 1963:11-12). This division, according to Marx and Engels (1977:21) constituted the first major social division of labour.

The task of keeping animals, soon made the pastoralists to study their environments and the specific

needs of their animals. The need for pasturage and water-points necessitated the pastoralists to move from place to place. This type of movement is called "nomadism", which Toynbee (1967:395) says is a Greek term meaning "cattle-driving". It is a crisis management tool for the pastoralist, which he employs whenever the climatic screw is turned on.

von Renesse & Sponeck (1967) indicate the original home of the pastoralists to be in the open regions of the world, more specifically North Western India, Iran, Turan and South West Siberia where in the second and first millenia BC, nomadism constituted a special form of agriculture adapted to the ecological environments of these regions. Pastoralism is therefore, essentially an economic activity which requires a cultural system with a characteristic ecology. This economic activity has been responsible for the movements of pastoralists into every corner of the earth which has climatic conditions similar to those open regions. Toynbee (1967:7) again, refers to these movements as <u>"tour de force".</u> They are so designated by Toynbee because of the economic advantages of such movements and the climatic screw which necessitated them. Krader (1968:453) defines pastoralism as "an economic activity involving the care of herds of domesticated livestock". Pastoralism in its traditional form, according

to Krader (1963:453) is either practiced as the main mode of subsistence or combined with agriculture. Krader (1968:456-459) outlines two major forms of pastoralism. They are:

2.2.1 Nomadic Pastoralism

This form of pastoralism is called traditional pastoralism, and currently practiced by the mongol, turkic, uralic and various semitic and hemitic nomadic peoples including the pastoral Fulbe.

2.2.2 Transhumance and Estivation

This is a highly developed form of pastoralism and is practiced by sedentary cultures whose major economic activity is agriculture.

2.2.3 Pastoralism In Africa

The precise historic formation of the African pastoral societies is only dimly known. Archaelogical evidence however, suggests the existence of livestock in Africa for several millenia. Domesticated cattle, goat and sheep bones in North Africa date as far back as 7,000 (Frantz: 1975:7-8). According to evidence available by the start of the Christian era, there existed livestock domestication in Kenya and that in the last

two millienia, the herding of cattle seems to have spread throughout the continent (Frantz 1975:7-8). The continent of Africa is most closely associated with traditional pastoralism, its culture and institutions appear to be most influenced by this pastoral form of production. Twelve point six percent (12.6%) of the world cattle population is provided by African pastoralists (Crotty 1980:117). In the supply of beef and milk, Africa depends heavily on pastoralism. This is so because the bulk of the cattle in Africa are owned by pastoralists. Nations such as Somalia and Ethiopia are predominantly pastoral. The savanna zones of the West and East African regions shelter the largest number of the African pastoral societies such as the pastoral Fulbe, the Maasai, the Turkana, the Karamajong and many other groups. Most of these pastoral societies constitute significant minorities in many African countries particularly in West Africa, and pastoralism remain a viable economic venture in such countries even though, it is now threatened by the process of agricultural mechanization and industrialization going on in these countries.

2.3 The Pastoral Fulbe

The pastoral Fulbe are variously known as Fulani, Fellata and Peuls. They refer and call themselves Fulbe (Sing. Pullo); they are the most predominant pastoralists in the West African region, (Stenning 1965:363; Meek 1971, Haffenden 1967: & Hopen 1958:1). They are the subject of this research. The pastoral Fulbe constitute one major segment of the entire ethnic group known as Fulbe or Fulani as the Hausa people call them. The other group is designated as Fulbe siire (the settled Fulbe). The pastoralists in this respect include both the Fulbe na'i, who mainly practice transhumance and estivation pastoralism, and the Bororo'en, who practice both the traditional and nomadic pastoralism. The dessication in the North Africa probably drove the pastoral Fulbe to the Senegal valley from where they spread to the whole of the West African Savanna region between the twelveth and nineteenth centuries (Ajayi & Crowder 1976:98). Their earliest arrival in Nigeria dated to the fourteenth century (Palmer 1967:79). By the beginning of the nineteenth century their number was large enough to enable them undertake a holy war (Jihad) against the Hausa people of the Hausa city states. Their victory

in the war left them with the largest empire in West Africa. The Sokoto caliphate lasted for a century from 1804 to 1903 when the caliphate was conquered by the British invading soldiers. The area covered by the present Northern states of Nigeria (with the exception of some few parts) was part of the caliphate.

The effect of the Jihad on the pastoralists was the reduction in their number, since some of them never returned to the pastoral way of life and instead took up chieftancy titles and benefitted from other bureaucratic and aristocratic privileges, calling themselves Fulbe siire (town Fulani or settled Fulbe). The process of sedentarization was therefore accelerated by the Jihad. However, the rest of the pastoral Fulbe continued with their pastoral way of ;life to this day, and are only marginally affected by the modernizing processes going on around them.

2.3.1 Social Structure And Production

The pastoral Fulbe is one of the non-farming ruralites which are referred to as "analytically marginal groups" in relation to the peasantry (Shanin 1971:15-16). In this respect, the pastoralists share some traits of the basic characteristics of peasant societies as well as differing fundamentally in some traits. For example the pastoral household is

the dominant unit of production and social organisation. Their culture is related to the way of life of small communities, they are also politically dominated and are subjected to such economic exploitation in form of cattle and community taxes. These traits the pastoralists share with the peasantry, but they differ fundamentally and decisively in the way they eke out their subsistance through livestock production pastorally; instead of farming and tilling the ground. This difference is the most important factor in the identities of the peasantry and the pastoralists.

In the Fulbe pastoral society, cattle form the main production factor, the process of which is labour intensive. The central role which the cattle play is reflected in the family organization. The family head assisted mostly by his children, and wives run the household on the basis of a clear division of labour.

The household head is responsible for the logistics of pasture and the pattern of the nomadic orbit, also he is to give general leadership to the household. He is to be assisted in the daily grazing of the herd by his male children, where there is need for extra labour, he employs other

herd attendants (biro - sing, biire - Pl) (Hopen 1958:68). The female members of the household are responsible for milking and marketing the produce for exchange with other goods, such as grains. They are also responsible for cooking and other domestic chores (Stenning, 1959:103). The homestead of the pastoral Fulbe is known as Ruggah. It is usually formed by several agnatically - related families who live and move together. Each Ruggah is led by a leader variously called Ardo, Dikko, Jonworu or Rugga, who settles disputes and other minor quarrels and also together with other elders adjudicate on matters pertaining to the Fulbe way of life (Pulaaku). Social stratification on age is very distinct and many putatively related lineages form a clan.

The clan is a significant unit of pastoral production (Ajayi & Crowder 1976:99). Marriage is contracted usually from these lineages of the clan. The pastoral Fulbe prefer the endogamous form of marriage whenever possible (Stenning 1965:379). The preferable age for marriage is between twenty and twenty five years of age for boys (Hopen 1958:70), and much lower age for girls.

The very nature of pastoralism involves some form of nomadism which makes it difficult for the pastoral Fulbe to be pinned down in any one

particular geographical area for a long time. In view of this, the pastoral Fulbe are stateless or else they belong to all the countries and states within their annual orbit of movements (Lewis 1965: 426; Ajayi & Crowder 1976:98-100). However, the pastoral Fulbe do not bother about this elusiveness and fluidity as long as their cattle get good pasture and water. Their entire life depends on the cattle. Social prestige is usually tied to the number of cattle one owns. It is almost immoral for the Pullo (sing.) to rear his cattle with the sole purpose of selling them for money or slaughtering for meat of his own consumption. His cattle are not for sale but a means of subsistence and prestige which is potrayed as the best way of life by Pulaaku (Bello 1986:3). The relationship between pastoral Fulbe and their cattle can only be so, since it is an expression of the objective laws of pastoral economy, which govern the pastoral form of production, and just like any other economy, it is determined historically in accordance with the stage of development of the forces of production. The cattle in this respect are both a means of production and also constitute the forces of pastoral production.

2.4 Planning For A Minority Education

2.4.1 Introduction

Planning for a minority Education the world over, has not been very easy or successful. There are many factors which militate against it's planning. Consequently, this sub-section discusses Pastoral Nomadic Peoples and the question of minority groups, the origin of minority groups, the process of integration, intervention theory and lastly, planning for a minority Education.

2.4.2 Pastoral Nomadic Peoples And The Question of Minority Groups

Change engendered by and associated with the market and the state is widely seen to have some rippling effects across the nomadic pastoral societies (Galaty and Salzman 1981:13). The nomadic pastoral societies are a minority in most of the modern states they are found today. The fact that they are citizens of these states imposes a moral obligation on the states to deliver such social services like education, health care, bovine disease control and the rest of them. The benefits they will receive from such interventions are many, including greater participation and articulation in the political processes f of their states.

In the long run, the minority groups cannot escape the process of integration, they can only delay it through their isolation from participation in the main stream culture. The nomadic pastoral societies in particular, are prone to isolation due to the nature of their economic activity - pastoralism. However, the nomadic pastoral societies are no longer living alone. Population explosion and deliberate government efforts to increase agricultural production, has encouraged the encroachment of sedentary cultivators on the traditional grazing lands.

2.4.3 The Origin of Minority Groups

The problem of the minorities has been compounded according to Simpson et al (1972) from the emergence of the modern states. The nation-state system has been the most influential factor in the origin of minorities. Simpson et al (1972) further argue, that both the spread of dominance over formerly separate groups and the common desire to create a homogenous nation through cultural repression have greatly contributed to the emergence of the minority-majority situation. In this regard, the dominant groups have tended to act as if the state-society consisted only of their own cultural heritage. Modern technology and transportation

have further accentuated the processes of migration and cultural contact, sometimes by the employment of conquering armies to bring diverse peoples together (Hicks, 1981:3).

The partition of Cyprus, the dismantling of the ottoman empire; the fate of the aboriginal people of Australia; the travails of the Kurdish people, who form a minority in five countries; the similar travails of the pastoral fulbe in North, West and Central African countries; and the marginalization of the East African pastoral peoples; can only be understood in the light of colonial conquests aided by the development of new technologies and the subsequent creation of the present nation-states. The forceful bringing together of a minority within a majority group has sometimes resulted into a violent situation such as the saharan pastoral nomads of the former Spanish Colony of Western Sahara and the Moroccan Monarchy.

The definition of a minority is by now clear, from the preceding paragraphs. The term however, has attracted many definitions, such as reported by Wagley and Haris, (1958): (1) "Minorities are subordinate segments of complex state societies. (2) Minorities have special physical or cultural traits

which are held in low esteem by the dominant segments of the society. (3) Minorities are self-conscious units bound together by the special traits which their members share and by special disabilities which these bring".

The crucial issue in the study of minority groups does not however, revolve around their definitions but rather around the objective deprivation which is common to all such groups. The main point about this objective deprivation is that it relates to a measurable situation that can be readily observed by outsiders. Their socio-economic disadvantage constitutes this objective deprivation, and it is thus a key part of the minority experience (Hicks, 1981:7; Ezeomah, 1985:6).

To address this socio-economic imbalance within the majority/minority situation, the dominant group plays a major part in determining the climate of negotiations and the subsequent change. Thus in many cases, the process of assimilation or integration into the dominant culture will be expected to be part of the package. This is even more pronounced in the case of indegenous minorities (Hicks, 1981:11). Also Hicks (1981:15) outlines four questions which he addresses as fundamental to any attempt in dealing

with the minority problem; they are:

(1) "what are the problems (the minority experience)?

(2) what is the background to these problems?

(3) what is being done about them?

(4) what sort of image of society/value positions does this involve?"

2.4.4 Intervention Theory

"Intervention theory" owes its existence largely to Chris Argyris and Garth Jones in the late 1960s (Moris, 1981:9). Among many things intervention denotes an array of measures-training, job satisfaction, procedural changes, structural reorganisation and so on. All these are at least partial substitute to one another and all have face validity which denotes increased efficiency (Moris, 1981:9). The second concept of intervention is that it employs and incorporates several elements, so as to have an instrumental framework which considers the combined effect of a number of proposed changes. The third concept of intervention recognises that different contexts should condition one's choice of particular reform devices. In the case of pastoral societies a basic delimma common to them is the natural exponential growth of human and animal populations

against a limited resource base. For example, the large fluctuations in the animal production of Maasai land have occured over the past few decades largely as a result of government interventions and the incursions of other peoples (Helland, 1980:175). The typical approach to the development of pastoralists has been termed "the treatment of symptoms" (Baker, 1975:188). According to Helland (1980:23) the "treatment of symptoms" approach is often superficial and therefore leaves the root causes of the problems unattended to. It could also engender new problems totally unexpected by the planners. The solution to the delimmas inherent in this approach are presented as more information, better understanding more comprehensive and detailed planning (Baker, 1975:200-201).

The limits of this type of approach conceived and geared towards solving some human problems are aptly stated by Popper (1976:88) in the following words:

> As in all other sciences, we are in the social sciences, either successful or unsuccessful, interesting or dull, fruitful or unfruitful, in exact proportion to the significance or interest of the problems we are concerned with, and also, of course, in exact proportion to the honesty, directness and simplicity with which we tackle these problems.

2.4.5 Planning For A Minority Education

Universal primary education is a cry heard from all the developing countries of Africa and Asia. Harris (1985:4) says there are two reasons for this cry: (1) "Education has come to be regarded as a natural right and (2) It is also conceived as a national need". In this regard, overzealous politicians have often exceeded the bounds of prudent planning, thereby confounding the task of educators. In the ensuing confusions, social and cultural conditions are often ignored in favour of European and North American models (Harris, 1985:4). The entrenchment of these foreign models cause great traumatic experiences for those cultural groups outside the culture of the ruling class. Their subjugation to this experience in education is however not surprised, since throughout the history of human society, education has been a product of social relations of production . It is an ideological super-structure determined and dependent upon the economy, The social classes in power always determine its content. In this respect education functions as a component of the ruling culture and represents the ideas, values, beliefs and ethos of the ruling class, which controls the material base of production. To bring modern education to pastoral

societies, would definitely mean the process of getting the pastoralists integrated into the modern society. However, this is not the issue at stake, because the pastoralists cannot continue to remain outside and unaffected by the motion of the modern society. The most fundamental issue is therefore; the mode and method of imparting this education in their transitional stage. The options are likely to be only three, they are: (i) mobile education (in which case the pastoralists continue with their annual transhumance); (ii) permanent settlement in clusters with minimum transhumance, and (iii) permanent settlement with no transhumance (in which case ranching becomes an alternative to transhumance). The first option calls for the use of unconventional school, while the second and third options call for conventional schooling as is known today. At this transitional period, no one method may be adequate, hence the recommendation of a multi-approach system in the Federal Government blue print on the Policy on Nomadic Education (1986). What is needed is that, both the curriculum and pedagogy have to be modified so as to suit the pastoral child at this stage of his development.

The problems of sedentarization and its concomitant social change, should be handled carefully. Planners can encourage voluntary sedentarization as in the case of the Pastoral Fulbe of the Mambila Plateau, Gongola State of Nigeria (Frantz, 1980:62). They can also apply anyone of the following models of sedentarization, whenever the situation demands for such a model. According to Salzman (1980:11), the models are:

1. "Drought and decline model".
2. "Defeat and Degradation model" and,
3. "Failure and fall away model".

Even though the second model is out of time, because there are no longer any tribal wars, the first and third models are possible in Nigeria and other West African countries. There is also the need to make provisions for the attendant social change and the restructuring of the Pastoral Fulbe socio-economic system that will emerge as result of receiving modern education. These problems are concomitant to the process of educating the pastoral Fulbe. They have to be studied and understood properly (Von Ardo, 1986:6). Gorham, (1978) and Heron (1983) have adequately shown that, education programmes have not been particularly

successful in the nomadic pastoral societies due to variables, such as:

1. Demography
2. Mobility
3. Absence of infrastructural facilities and
4. Lack of relevant curricular materials.

The low density of the pastoral nomadic settlements adversely affects the attendance of the schools. The constant mobility of the pastoral households contributes to the low attendance in the schools. The inaccessible nature of their settlements makes it difficult for delivery and other inspection and supervision works. Above all, curricular materials are mostly out of touch with the realities of the nomadic pastoral environments. In this direction, relevant curricular materials tailored to meet the culture and demands of the nomadic pastoral child are sine qua non to any meaningful education programmes in the nomadic pastoral societies, such as the nomadic pastoral Fulbe. The dynamics and configurations of social change and development in these societies will determine the nature and direction of such curricular change.

2.5 The Provision of Educational Facilities To Nomadic Pastoral Peoples

2.5.1 Introduction

The provision of mobile education was long established by the wandering catechists in pastoral areas of Northern Europe and Pre-colonial Africa before the establishment of formal education systems. Travelling schools have been used or are in use in the pastoral regions of Mongolia, Soviet Central Asia, Mainland China, the Western Sahel and South-West Asia. In the early 1920s initial attempts to sell and promote literacy in the Soviet Republics of Kazakhstan and Kirghizia relied mostly on two types of mobile facilities known as the Kyzyel Kerum or 'Red Caravans' and the Kyzyel Otau or 'Red Yurtas'. These facilities were both used to establish educational contact with the local nomadic pastoralists. According to Gorham (1979:20), these facilities were most active during a ten year period before the large scale collectivization: that is, before 1930.

Attempts to provide more structured forms of mobile schooling for nomadic pastoralists in West Africa took place in the 1920s in the Franchophone West Affican countries. According to Kitchen (1962:509),

the first recorded school was established in 1924 among the Sahelian nomads in the republic of Mauritania. The Mauritanian efforts were continued and later neighbouring countries such as Chad, Mali and Niger adopted and tried the Mauritanian experience with verying success. The difficulties encountered by these mobile schools were in the area of teacher-recruitment, where teachers were not ready to serve in the programme because of the absence of such social services like health care and potable water facilities. The programme planners therefore, looked inward in the tribal pastoralist societies to recruit the teaching staff. Tribal chiefs made this approach also difficult by way of favouring relations and friends who can themselves hardly read or write.

In the Hoggar region of Algeria, UNESCO sponsored an educational project which was geared towards a mechanized service to Tuareg nomads in their traditional camping grounds and oases. Reports in the late 1940s showed some measure of success achieved by the project in the area of students recruitment. The success might be due to the internal stratification of the Tuareg society, where children of noble leneages were freed from the labour requirements by the servant-class (Blangnernon and Gast; 1954).

In China, about a hundred tent schools were by 1965 in use in Shanghai province, moving with the pastoralists in the grazing areas. Children were expected to attend school in two sessions. The early morning session and the evening session provided the teaching periods. The children then spend their time for the greater part of the day with the livestock.

In Iran portable schools have been adopted to the prevailing patterns of pastoral mobility. In Kenya, educational provision to pastoralists take place in conventional facilities.

Increasing efforts by government and development planners to provide basic education for nomadic peoples have variously been called 'education of Travellers Children' in the United Kingdom, 'education of rural Migratory people' in Alaska, 'education for tribal populations' in Iran, and 'nomadic education' in Nigeria. Many countries with a reasonable population of nomadic peoples have embarked on this programme. According to a survey of literature on this subject, conducted by Heron (1983:61), "two distinct geographical areas emerge as focal points for the development of schools for nomads". These countries are Iran and Kenya. While there are many similarities in the general

problems encountered and the goals of educational development elaborated by the two countries, the strategies and outcome are quite different and therefore provide important clues for successful approaches to pastoral or nomadic education in all countries. In this respect, a brief discussion on the position of educational provision to nomadic pastoral peoples in the two countries will suffice here, before the Nigerian experience so far is considered.

2.5.2 The Iranian Experience

The efforts to provide education for the nomadic pastoralists in South Persia began in the 1950s. The purpose of education was closely tied to providing conditions for eventual sedentarization of the nomadic pastoral peoples such as the Qashqai, Bkhtiari, Lurs, Baluchi and Kohkilooyeh (Varlet and Massoumian, 1975). This perspective of government planners ran contrary to the pastoralists' perspective. The perspective also raised difficult, yet essential questions. Must nomads settle? Should education lead to sedentarization? and does development in education necessarily include change for pastoralists? (Heron, 1983:63).

Primary schooling took place in tents which accompanied the pastoralists in their movements. In the summer and winter when the pastoralists were highly mobile, the classes were not held. The curriculum of these 'tent schools' emphasized, reading, writing and arithmetic in addition to history, geography and the basics of hygiene. The language of instruction was persian, even though, a second language for most tribal children, did not however, appear to be a major difficulty (Varlet and Massonmian, 1975). The tribal identity of the nomads, however, attracted the programme planners and efforts were not spared in this direction. This might be one of the reasons why parents were so attracted to the schools as to follow the lessons from a short distance trying to repeat what the teacher was teaching.

In Shiraz, an urban centre in the pastoral area of South Persia, boarding schools provide secondary education in general and vocational studies. Carpet-making, teacher training, midwifery and industrial apprenticeship form part of the vocational courses which provide employment in the local communities. The student-teachers came from the tribes and return to them when their courses which lasted for a year were over. The student-teachers were selected on the

basis of their personality and standard of education. Varlet and Massoumian (1975) refer to the importance of teachers through the examples they set by their behaviour in the 'tent schools'.

'Tribal education in Iran was to a large extent able to achieve its main aim to increase the level of literacy in the pastoral societies. According to Gorham (1979:36) a recent survey of 3,000 households involving seven years of age and older, with a ceiling of 25 to 29 years Cohorts indicates this success by achieving an average of fourty four point five percent of the male in this category literate, seven point four of the female population literate and a total average of twenty six percent of the households population literate.

These figures indicated clearly the success of 'tribal education' in South-West Iran.

2.5.3 The Situation In Kenya

In Kenya, unlike Iran, conventional facilities have been used instead of mobile schools. The instruction was tailored to follow the national syllabus. No special curriculum provision for pastoral children was made, even though, many administrative devices were employed at one time or another with the aim of

encouraging pastoralists participation in schooling. The pastoral children were made to compete with non-pastoralists children and they had to take the same school leaving certificate examination. After passing the school leaving certificate examination, the children would then go to boarding secondary schools. In Kenya therefore, the two organisational frameworks for the provision of educational facilities to pastoral areas were stationary schools and boarding schools. However, because of friction with other ethnic groups, the maasai schools' have developed into a mono-ethnic institutions. Sectional chiefs were required to provide lists of potential school children. The chiefs in their selection of these children selected only those that were least useful to the traditional pastoralists life (King, 1972; Heron, 1983:64). The parents of those selected were not often ready to pay the required school fees, as a result of which these students escaped going to school which resulted in low attendance. Most of these Primary Schools in the Maasai districts (Kajiado and Narok) had only four grades compaired to the seven grades obtained in other non-maasai schools. Accept teaching jobs,other employment opportunities were almost absent in the maasai society. According to King (1972), the Maasai

could not have generated any participation rate higher than the five percent rate. This was so, because there were conflicting social goals between the provision of modern education and Maasai traditional pastoralism.

These attempts to provide education for the pastoralists in Iran and Kenya have brought out three major organisational frameworks in the provision of modern education to nomadic pastoral peoples. In Iran, the mobile programme form the organisational framework for the planners, whereas, in Kenya the organisational frameworks of stationary and boarding facilities were utilized. The general problems encountered by both approaches have been very similar, for example, low attendance from low density population of pastoralists, high mobility, settlement patterns and herding practices. The sum total of the common problems is the recurrent conflicting social goals of the planners perceptions and the pastoralists persistent attachment to the values of their society which are centred on their livestock. According to Sarone (1981), the objectives of education in the view of planners are reflected in the curriculum of schools for the nomadic pastoralists. The skills

contained in this curriculum do not help in the ways of pastoral life, and school experiences encourage a distaste for pastoralism and its goals. The language of instruction is also often different from the children's mother tongue. There is also the difficulties in finding capable and willing teachers to stay and follow the pastoralists in their seasonal movements.

2.5.4. The Nomadic Education Programme in Nigeria

The organisational framework of mobile education dates back to pre-jihad times in the Hausa city states. Islamic wandering catechist scholars such as Al-Maghili roamed the length and breadth of North and West Africa (Western Sudan) teaching scholars and other interested peoples from one town, settlement or village to another. The governments of Hausa States patronized such scholars. Muslim clerics, especially those of Fulani (Fulbe) stock followed their nomadic kinsmen in their seasonal movements or even migratory drifts with the sole purpose of teaching them Islamic education. This situation continued to operate even after the Sokoto Jihad and probably upto this time.

The provision of modern educational facilities to nomadic pastoralists gained currency in Nigeria

from about 1980. The experiences of some states that started to operate some form of this programme even before the Federal Government's recent policy are discussed below. From the reports read at the Yola Workshop in 1986 by the delegates from Plateau, Gongola, Borno and Bauchi states, it was clear that nomadic education project was initiated by the Plateau State Government in October 1980, in keeping with the Government Policy to provide education to all its citizens. Consequently, the project was launched on the 9th of February 1981. The project was to be executed in six phases namely: Research, Curriculum Development, Teacher preparation, Experimental implementation and evaluation.

Since most of the nomadic pastoral Fulbe in Plateau State are almost settled, the research recommended the utilization of three organisational frameworks. They are: the Rugga school, the vocational school utilizing the rugga or any other stationary school and the mobile school.

In this regard, Rugga schools were established in Zomo, Mazat-Ropp, Gashish and also in Wase grazing reserve. The vocational schools were meant for the

permanently assigned children to herding where it was hoped that these schools could attract their attention when they were not very busy, normally in the July - September, December - January and March - April periods.

The mobile schools were to move along with the movements of the nomadic pastoral Fulbe and the teachers were also to move along with them. The vacational and mobile schools could not be operated however because of the financial predicaments.
The problems encountered during the research include:

(a) Difficulties in tracing the nomadic pastoralists movements.

(b) More difficult to locate at a certain time of the year due to high mobility.

(c) No motorable roads to their locations.

Phase two of the project was concerned with the development of suitable curricular materials. Its objectives include:

(a) To plan suitable and relevant curricular materials with a nomadic background.

(b) To select and modify the existing curriculum to reflect the pastoral Fulbe cultural background.

(c) To design usable booklets and workbooks.

(d) To determine teaching materials; and

(e) To provide training for selected teachers.

In line with these objectives, the project embarked on the teaching of the following subjects:

(1) Language - Fulfulde, Hausa and English.

(2) Reading - Writing and Creative activities.

(3) Mathematics.

(4) Social Studies - History of nomadic peoples, Fulani culture, Nigerian History and Geography.

(5) Elementary science - This includes animals management; Agricultural Science, Home economics.

(6) Health and Physical education including games; and

(7) Religious and moral instruction.

The experimental stage, that is phase four came into being in 1982, ayear after the programme was lanuched. The pilot phase started with the Rugga schools in Shendam and Barkin Ladi Local Governments with the following intakes:

Figure 2.2: The Rugga Pilot Schools Enrollment

Local Government	No.	Rugga	Enrollment
B/Ladi	1	*Mazat-Ropp	150
	2	*Gashish	120
Shendam	1	Zomo	35
Nassarawa	1	Gidan Biri	-

*Selected schools for the experimentation in this study.

Four Rugga Pilot schools were opened, even though, that of Zomo was blown off by wind and subsequently was lost. At Gidan Biri, the school had to be closed down after it was discovered that the nomadic people have moved away from the site. The project also conducted workshops and demonstration-teaching for the teachers in these Rugga schools. Seminars were also organised for the parents, particularly directing its content to their cattle economy.

A Nomadic Education Unit was established in the Ministry of Education, Yola, in 1980. The programme was officially launched in June, 1983 two years after it was launched in Plateau State. In line with the Gongola State Government's Policy of providing

educational facilities to all its citizens, the nomadic education programme was launched to enable the government to provide modern education to nomadic pastoral Fulbe who incidently form a very large number of the state's population.

The primary aim of the programme was to introduce functional literacy through the 3 Rs, especially in the area that affects their traditional pastoral practices. In this regard, such sujects like Health Care, language, arts, social studies, elementary science, home economics, moral instruction and physical and health education were to form the curriculum of the nomadic education in the state.

Borno State is one of the states that have a large population of nomadic peoples undertaking different means of livelihood. They are spread along the shores and on the Islands of Lake Chad. Here, one finds the Buduma fishermen, and the Kwayam, Kanembu and Badawi herdsmen who normally migrate from the northern parts of the Chad basin in the dry seasons. The other nomadic pastoralists who are found in the Southern part of Lake Chad are the Shuwa Arabs.

The nomadic pastoral Fulbe are the largest pastoral people in the state. They are found in all

the local government areas of the state. Their highest concentration is however in the local government areas of Fune, Nguru, Geidam, Damaturu and Gujba. The government set up two Committees one at the state level and the other at the local government level to look into ways and means of delivering educational services to these peoples.

Bauchi State has a large population of nomadic pastoral Fulbe. Inspite of this, the programme was only introduced in 1987. Like Gongola State, zoning was also introduced. Ningi Local Government was one of the first to build stationary schools along the nomadic orbits. The schools started well but could not continue due to lack of funds. The State Government is also currently making arrangements to establish similar schools to that of Ningi in Wawa Zange under Dukku Local Government Area.

2.5.5 Summary

With the launching of the programme by the Federal Government in 1987 and with the guidelines contained in the blue print of the policy on nomadic Education, all states in the federation were such

establish schools for them. Many states have already launched the programme and are working on the modalities of operating it. The recurrent issues of teachers, relevant curriculum, conflicting aims between the government planners and the pastoralists, labour depletion in the pastoral activities and lack of funds to execute the programme; will certainly confront the planners. How these issues are understood and studied very carefully will go along way in spelling out the success to be achieved by the programme. A relevant curriculum is seen here as a pivotal point for the programme to achieve its goals and objectives.

2.6 Curriculum And Social Change

2.6.1 Introduction

Curriculum is seen here as a function of social change. It is embedded in social transformation which is both commulative and continuous. The section is organized under the following topics:

1. Curriculum as a field of inquiry.
2. Perspectives in curriculum scenarios.
3. The dynamics of curriculum change.

4. Curriculum articulation and Decision Screens.
5. The historical conditions of curriculum development.

2.6.2 Curriculum As A Field of Inquiry

Bobbitt's book "The curriculum" published in 1918 and Charter's book "Curriculum construction" published in 1923; launched curriculum as a new field of inquiry and study. By 1942 a major progress in this new field of studies was recorded when the eight year study Committee comprising Giles, H.H. Mccutchen, S.P. and Zechiel, A.N. submitted their report to the American Progressive Education Association, which sponsored the study. Some portion of the report drew heavily from Dewey's "Science of education". For example, the three fundamental approaches or sources to the organisation and analysis of curriculum construction were listed on page 22-48 of their reports as follows:

1. The social-demands approach
2. The Adolescent - needs approach and
3. The specialized subject-matter approach.

Tanner and Tanner (1980) also hold the view that these approaches clearly correspond to Dewey's three sources, namely: the 'learner', 'society', and 'organised subject-matter'. Taba (1945) had earlier elaborated on the significance of these three sources of data in curriculum planning in the following way:

1. Studies of society
2. Studies of learners and
3. Studies of subject-matter content.

In 1949, Raph Tyler, a student of Bobbitt, published what was to become a milestone in the field of curriculum studies and development. The content of his book "Basic Principles of Curriculum and Instruction" subsumed the work of the eight year study and all other previous and subsequent works on curriculum development. He lucidly outlined the importance of objectives in the process of curriculum development. The backbone of this seminar work are four fundamental questions:

1. What educational purposes should the school seek to attain?
2. What educational experiences can be provided that are likely to attain these purposes?
3. How can these educational experiences be effectively organised? And

4. Howcan these determine whether these purposes are being attained.

Tyler (1949) considers the above questions crucial to any process of curriculum construction and also considers the problem of stating objectives to be helpful in selecting learning experiences and also in guiding teaching activity. From this way of approaching curriculum design and construction, the work of Tyler is often referred to as Tylers' 'Rationale' and the Bobbitt/Taba/Tyler curriculum model is referred to as Tylerian paradigm'. Since then and for the first time, the study and development of curriculum can be pursued in a systematic way and the practitioners have one common way of approaching the problematics of curriculum development, through the 'objectives model'. The model was later to be popularized through the works of Bloom et al (1956) - 'the taxonomy of educational objectives'- covering the cognitive domain appearing in the first volume and the affective domain appearing in the second volume edited by Krathwohl et al (1964). A third volume covering psycho-motor domain is yet to appear. It is important to state that the Tylerian paradigm is not without its criticisms. One of its major drawback is said to be its linearity which

contradicts the real life situations behind curriculum development.

2.6.3 Curriculum Planning And Organization

Curriculum defined as "the course of events" does not resolve the confusion over its meaning.

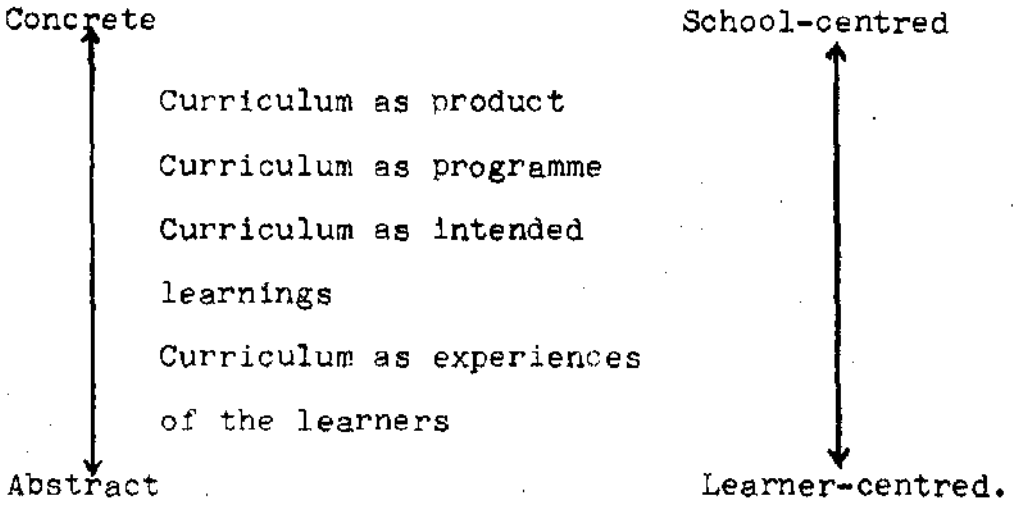
Beane et al (1986:29) are of the opinion that with few exceptions, definitions of curriculum fall into one of four categories; they are:

1. Curriculum as product
2. Curriculum as a programme
3. Curriculum as intended; and
4. Curriculum as the experience of the learner.

However, even with this approach, it is unlikely that the differences of opinion about the meaning of curriculum will be resolved. Beane et al (1986:33) again raise two observations which according to them deserve consideration in any attempt to analyse the four categories. In their view therefore, these definitions can be placed on a continuum ranging from the concrete to abstract level. Another observation calls for a continuum ranging from a school centred focus to a focus on the learner. A modified version

of Beane et al (1986:34) impression is depicted below:

Category



It is common knowledge that at the elementary level, the tasks of curriculum organization, planning and development are different from what is obtained in the Junior Secondary, which is also different from that of the Senior Secondary School. It is important to understand the three organisational scenarios which have their focus on subject - centred situations, experience - centred situations and situations that modified and combined both approaches. These are organisational patterns of curriculum, which reflect both the stage and objectives of the school. In the elementary school emphasis is placed on learning the

content area. Each teacher organises his own lesson. The approach is generally based on subject-centred situation. One way of organising curriculum plans therefore is around separate subject areas; when this is done, learning objectives and activities involved mastering subject matter and skills. Proponents of the philosophy of realism particularly favour this approach as it defines important learning activities in terms of subject matter. The broad-fields approach on the other hadn depicts a situation where subject may exist separately but their inter connections are brought out to the learners. In this regards, related subjects may be combined to forma a particular programme or course. The emphasis here is on broad ideas and concepts. The approach is particularly favoured by the proponents of the philosophy of idealism. A third way in which curriculum plans can be organised is the social - problems approach. In this scenario, curriculum is planned around major problems in society. Units may be developed around environmental sanitation. Aparthied and many other problems in the society. The purpose of using this approach is to create awareness in the learners, so as to appreciate crucial social issues and the skills they might use in the future for solving such issues. Proponents of the reconstructionist

philosophy are in favour of this approach. Emerging needs approach is according to Benne et al (1986:169) the fourth way of organising curriculum plans. Units for use with transcends may centre on topics which are partinent to the learners development stage. The major focus is to prepare learners to come to grips with issues in their present lives. This approach draws its support largely from the paragmatic and existential philosophy.

Apart from these curricular approaches there are other curricular paradigms which have become popular in recent times. At least two of these models: the objectives-model and the process-model are prominent.

The objectives model has its origin in Bobbitt/ Tyler/Taba model and later given more support from the works of Bloom et al (1956) and Krathwohl et al (1964). Other proponents of the model include Popham through his paper published in 1968 "probling the validity of arguments against Behavioural Goals". Popham (1968) attempts in this paper to defend the 'objectives model' against eleven criticisms. Earlier Taba (1962) had enumerated the importance of the objectives model in her book titled "Curriculum Development: Theory and practice".

Stenhouse (1975:62) refers to "Science 5-13 project" as a good example of objectives model.

The objectives model however, has been criticized. Eisner (1967: 258-259) thinks that curriculum theory as it pertains to educational objectives has some significant limitations. According to Eisner (1967) educational objectives confused measurement with judgement. The solution proposed by Eisner did not do away with objectives model but rather strengthened it. Eisner (1969) outlines two types of objectives, 'Expressive' and ' instructional' objectives. For Young (1971), Bernestein (1971) and Esland (1971) objectives model constitutes a principal course of distortion in knowledge, hence the need for a different model such as the process model, which is not based on objectives.

Curriculum projects like 'Man: a course of study' and the 'humanities curriculum project', were designed on a basis other than that of the behavioural objectives. These projects were built on the process model of curriculum design. In this context, the building of curriculum rests on such structures like procedures, concepts and criteria. The weakness of the process model

however, is that it is difficult to evaluate, which is the strength of objectives model. Curriculum evaluation therefore is seen to be difficult when the objectives are not there. Stenhouse (1975:97) says on the logical grounds, process model of curriculum design and development is more appropriate than the objectives model, especially in curriculum which centres on knowledge and understanding. The objectives model on the other hand, Stenhouse (1975) maintains, is more appropriate for curriculum which centres on areas which emphasize information and skills.

2.6.4. The Dynamics Of Curriculum Change

Two models of planned change can be applied to curriculum change with some consequences. The 'systems model' when applied to curriculum change entails internal struggle within the system to make some adjustments so as to allow the continuation of the former system in a new situation. In short, it means retaining and maintaining the status quo. On the other hand the 'developmental model' calls for a permanent change from the former system which means a complete displacement of the status quo qith a new system of influence. In this respect, 'Developmental model' sees curriculum change as embedded in social transformation

which is both cummulative and continous. No society is static in absolute sense of the word. Every society therefore is in a state of motion which is trigard by both the internal contradictions in its dynamics and configurations and also exogenuous variables or forces such as conquests and colonizations. In this manner, various modes of production have appeared as dominant in one epoch only to be a catalyst to the appearance of another dominant mode of production with its new relations of production. In this regard, the role of education and its content have to change so as to reproduce the cultural apparatus of the new society (Althusser, 1971:123; Bowles and Gintis, 1976:131-2; Chanan, 1976:109-110).

Education is an essential feature of the superstructure. Superstructural institutions develop according to qualitative historical change and depend upon as well as maintain the existing economic system of production (Marx, 1904:11). Cremin (1971:123) aptly captures this process of curriculum change in response to an overall social change when he says: "Fredrick Taylor's concept of scientific management swept not only industry but education as well, leaving in its wake certain characteristic notions of economy and efficiency."

The need for an efficient work force in the capitalist mode of production cannot be over-emphasized hence the need for an efficient school management in the distribution of the required skills and techniques which are needed in the industry and state bureaucracy. It is in this regard, that the pioneers of curriculum development, Bobbitt (1918) and Charters (1923) tended to draw their analogies or models, from the world of factory, to the world of school, conceiving the child to be a raw material and an adult a finished product. Bobbitt/Charters managerial model of curriculum was concerned in this context with a process of converting raw materials into a finished product.

Consequently, fundamental to any consideration of why various forms of curricular take the forms which make them different from other curricular are:

1. Ways of conceptualising the nature of knowledge
2. The process of acquiring such knowledge in the surrounding locality, and
3. The extent to which 1 and 2 are available for inclusion in the curriculum (Reid, 1978:83-84).

Reid (1978:83) further says every curriculum offered by the school will be to a large extent

dependent on the following factors:

(i) The stock of knowledge, ideas, images, styles and models available in its environment (for most schools in society at large);

ii) The nature of the input of students it receives;

iii) The nature of the output of students it receives;

iv) The influence channelled towards the school by other institutions;

v) The strength of the boundary around the school;

vi) The need for congruence between theory, social system and technology within the school;

vii) The need for congruence between the activities of the school and the demand of outside forces.

Reid (1978) further indicates that a major limiting factor on the form of any particular curriculum is the variety of models which are available to influence it. He maintains that models relevant to the shaping of curricula are:

(i) models of the nature of knowledge;

(ii) models of truth-seeking strategies within the subjects to be taught;

iii) models of the nature of children;

iv) models of desirable adult characteristics;

v) models of relationships between people and particularly between adults and children;

vi) models of the role of the teacher and of effective teaching;

vii) models of the curriculum itself.

2.6.5 The Social Conditions Of Curriculum Development

According to Berger and Luckman (1966:53) - "All human activity is subject to habitualization. Any action that is repeated, frequently becomes cast into a pattern, which can then be reproduced with an economy of effort and which ipso facto, is apprehended by its performer as that pattern." Through these habitualizations, institutions are created where both primary and secondary socializations take place. Secondary socialization can hardly be successful without such vital instruments in the form of curriculum paradigms, which are reciprocal typications of habitualized actions in the course of history. These curriculum paradigms are therefore reflections at

every stage of a dilectical development between man and his world.

In this regard, curriculum is a tool through which formal educational objectives are realised. "curriculum issues", argued Reid (1978:70), "are moral issues"; since by and large they are concerned with what form of knowledge to include in the curriculum and the type of methodology through which such contents are to be dessiminated. In reacting to the selection of these forms of knowledge, Hudson and Prophet (1983:6) hold the opinion that in the science curriculum, the two fundamental questions which could be raised are:

1. 'How does the selection of what is to count as worthwhile knowledge take place? And
2. "How is this selected knowledge presented to the learner?"

These questions can be applied to any curriculum hence the fundamental issue is therefore, not their commonality, but the epistemological question which they raise. The sociology of knowledge has a long history that an exhaustive discussion of what constitutes 'worthwhile knowledge' or which form of knowledge is to be selected for inclusion in the curriculum is not possible here

Along this direction, two fundamental problems have bedevilled classical epistemology and continue to be recurrent to date. The advocates of the 'logic of discovery' insist that, there is a direct correspondence between knowledge and reality, hence the discoverable nature of knowledge. The advocates of the 'logic of justification' on the other hand, argue, that all knowledge is socially constructed and may be understood only by reference to the social, cultural, and historical contexts in which such knowledge arose (Lakatos, 1978:129; Hudson and Prophet, 1983:6). On the social construction of knowledge, Lucas (1923) asserts that consciousness and consequently knowledge of all forms or kind, is a product of inter action between men, reality and interest, Lucas position, stems from the unity of theory and practice in knowing and prefer to see knowledge in relation to its action.

This perspective, resolved the two problems encountered earlier. Knowledge to this third position, is both discovered and socially constructed. The variable of 'interest' which Lucas has mentioned is an important tool in determining which form of knowledge is worh knowing, hence its selection in the curriculum contents. This variable is also

important since it brings out the class structure of such a society. The interest criterion is however not in a vacuum and is itself historically determined by the development of the productive forces. This historical determinism brings out the question of culture under which education is only a component. In this respect the contents of any curriculum have to be drawn from the cultural elements of its society. In this respect, curriculum is like a container which empties its content for a fresh refill whenever the historical circumstances make the former contents obsolete.

The curriculum of the indigenous education in pastoral Fulbe contained only the knowledge available to the pastoral Fulbe in accordance with the motion or development of his society. Pulaaku determined most of the contents and the rest is determined by physical constraints such as the needs of his cattle, which are good pasture and water. In this era however, science holds the key to modern development and even the nomadic peoples cannot escape from its influence. In this context science and technology are sine quonon in the curriculum contents.

2.7 Development In The Primary Science Curriculum

2.7.1 Introduction

Social, cultural and economic changes are taking place faster and faster due to the impact of rapid science and technological development. Education should prepare people to face new situations and changing social conditions so as to satisfy both the individual needs of the learner and the collective needs of society. To face this changing situations, science educators are required to sharpen their theoretical and practical tools, if they are to match with the challenges. The developments in school science was aptly reported by Uzzell (1978:7-20), where he traced the changing aims of science education right from the early days of school science in the nineteenth century to the Nuffield Projects in the 1960s and the more recent Schools Council Project in Integrated Science (SCISP). In trying to grapple with the rapid change, a plethora of science curriculum packages for the primary school and junior secondary school emerged from different countries in the world. The planners of these curricular materials were motivated by various theories and ideas as to

how best the concepts of science can be acquired. In this respect two approaches to change seem to be popular and also two models of curriculum development the process model and the content model became prominent. Although in reality many of the curriculum projects are best located in the not too extreme end of the content process continuum.

2.7.2 Perspectives In Primary School Science Programmes

In what is nearly three decades now, a number of curricular materials and packages specifically designed for Primary Science have been developed. This development is however skewed in favour of the developed western European countries. Most of these curricular materials came from the United States and United Kingdom. Martin (1983:55) says the perspectives of these programmes range from - "what is the most valuable contribution Science can make to the development of the primary school child? How do children learn Science best? and what is the role of the teachers in Science activities in the Primary School?"

In contrast to the lack of pupil materials in the United Kingdom, many of the new programmes for

primary science in the United States were developed along with a range of educational media, such as students' texts, record books and kits of apparatus as an integral part of the curricular materials. In this respect, the United States Government Sponsored three new programmes, namely: Elementary Science Study (ESS), Science - A Process Approach (SAPA) and Science Curriculum Improvement Study (SCIS). They all emphasise concepts formation, and were also process oriented. Even though processes and concepts were not explicitly emphasised in (ESS) programme, they are however taken care off by providing a range of activities diverse in style and materials, where the opportunity for practice with the process of Science and an acquisition of understanding of concepts, is provided. In the programme, Science - A Process Approach, more emphasis were placed on the processes of science and less on concepts. SCIS on the other hand emphasized a three-phased learning cycle, which are: 'exploration','invention' and 'discovery'. In the seventies however, SAPA continued to have influence on many new programmes such as: Exploring Science; Science: people, concepts, processes; and Science: understanding your Environment.

2.7.3 Primary Science Programmes In Africa And Asia

The Primary Science Curriculum packages developed in the United Kingdom and the USA have various impact on other countries of the word, especially the former colonized countries of Africa and Asia. In this respect, ESS programme was widely used in the Latin American Countries. In Nigeria, the African Primary Science Programme (APSP) was heavily influenced by the ESS. SAPA has also influenced many programmes in Africa and Asia. In Nigeria, the influence of SAPA can easily be felt from such programmes like Primary Education Improvement Programme - (PEIP) and the Nigerian Integrated Science Project (NISP). The Nuffield Junior Science gave impetus to Primary Science curriculum programmes developed for Primary Schools in Australia. The Audio-Tutorial Elementary Science Project, developed at Cornell University was successfully adapted for the Isreali Primary Schools. In 1965, these curricular reforms in the United States and the United Kingdom acted as catalyst to the inauguration of African Primary Science Programme (APSP) which was later changed to Science Education Programme for Africa (SEPA) in 1970.

2.7.4 Approaches To Primary Science Curriculum Development

There are two functionalist approaches to Science Curriculum which are based on social systems theory. The first approach takes a holistic view of the learning system. The boundaries of the system are permeable enough to allow the motion of ideas, values, and people in and out of the system (Chen, 1983:17-18). A change vector in the form of new objectives, new curricular materials or new methodology of teaching musttake into account not only all the elements in the learning system such as curriculum, teacher, students, processes, organisation, classroom environment and equipment, but also the nature of the output and its implications on the outside environment. The second approach, the 'pragmatic approach' is rather mundane, hence the commonest approach. It entails the detection of a curricular problem followed by an effort to cater for the solutions. The two approaches are complementary, in the sense that the pragmatic approach is short-range oriented and suits small scale and immediate problems and supplies quick and precise operational and rewarding solutions. The first approach on the other hand is suitable for wide-scale, long-range oriented problems. It gives an overall change

and a steady state of affairs. This approach is therefore a preferred strategy when dealing specifically with curricular problem (Chen, 1983:17-19). This is however, where the problems do not call for a radical departure with existing system but rather aim to provide remedy to a particular deficiency in the system.

After an approach to change is chosen according to the nature of the curricular problem, that is to say whether it involves wide-scale planning and therefore has a long-range objectives or whether it is a small scale problem which can easily be solved; the next area of concern to the science curricular planner is whether his curriculum is to place more emphasis on the processes of science or on its content domain. Most science curricular materials developed recently put more emphasis on the acquisition of process skills, even though, Freyberg et al (1983:111-119) observe that Science teaching is still dominated by content-oriented methods. They attribute this situation to the difficulties involved in organising a science lesson which allows each member of the class to develop specific skills. The teachers, are also uncertain as to what those skills involve.

They further maintained that, the objectives relating to skills are in many curricular materials confused with those relating to attitudes, Young (1983:7) says most of the recently produced curricular programmes seem to lie at some positions along the process-content continuum avoiding the two extreme ends. The reason behind this strategy according to Young (1983) is because no curriculum can be exclusively process-oriented only, since subject matter is obviously needed as a vehicle for developing such processes. It is equally valid that content-oriented curriculum must engage in some skills to achieve its goals. In spite of this blend however, some curricular projects are identified with one of the extreme ends of the process-content continuum. For example, projects such as:

1. Science - a process Approach - SAPA.
2. Nuffield Junior Science.
3. Science 5/13.
4. The Process way to Science.
5. Science Education Programme for Africa- SEPA.
6. PEIP - Primary Education Improvement Programme and
7. NISP - Nigerian Integrated Science Project.

all emphasized the process-approach or are rather tilted towards the process position in the process-content continuum. SAPA is the most typical of a

process approach, as its name suggests. Young (1983:7) simply defines process in this way: "the intellectual skills and attitudes required to find things out or approach problems scientifically". Science - A Process Approach (SAP) specified fourteen of such skills, some of which are: Classifying, measuring, inferring, using operational definitions and so forth.

In the area of content, many issue arises, such as the contextual relevance of content to the learners environment, the needs for suitable equipment, structured curricular materials, cultural relevance, the synchornization of methodology with the content, proper application of developmental psychology to the learner and also understanding the learners personal ideosyncracies such as cognitive styles and cognitive preferences.

Some of these issues such as cultural relevance and the learners personal ideosyncracies in learning in the form of cognitive styles and cognitive preferences, have received serious attention in recent years.

2.8 Teaching Science Through A Cultural Filter

2.8.1 Introduction

The culture of a people defines their entire way of life including their processes of production, which is to say how they eke out their livelihood.

The tools employed for this cultural reproduction are to a large extent derived from the experiences of the people in how they relate to their environment. Science is one of such tools in the present epoch, hence the emphasis on it is in the school curriculum. Consequently, this section treats Science Education from a cultural perspective, the teaching of Pulaaku and their implications in the teaching and learning of science, and also their implications in curriculum development.

2.8.2 Science Education From A Cultural Perspective

In his famous study of the Trobriand Islanders in Papua New Guinea, Malinowski (1948) indicated that primitive people, however primitive they might be, do have science as part of their culture, Malinowski, maintained that no art or craft could be maintained or invented without careful observation of the natural phenomena and the processes therein, entailed by the situation. Activities such as fishing, hunting, farming, pastoralism or any search for food are not possible without the power of reasoning and careful study of their dynamics and configurations. Science education like these activities, is also a systematic and sustained attempt to communicate about nature and natural phenomena, through reasoning and careful observation of the processes through which the phenomena are manifested. In this regard,

both the peoples of Africa and the other parts of the world share one common ground in discovering what is real and how knowledge is organised about this real world. The major difference between these two societies however, lies in their modes of though which are guided by their definitions of nature (Urevbu, 1984:314). Elkana (1977:161) says the difference between the two modes of thought could be accounted for, by the traditions of literacy and educational experiences. It is however, not to infer that Elkana means these variables to be the sole determinant forces independent of the historical conditions underlying the motions of the two societies.

The crucial point to science educators hinges around the differences in the modes of though of the various societies in the world. Their traditional ways of mapping out their experiences leading to the organisation of knowledge which gives structure to their thought-systems. It is in this respect that our reflection on the African thought system is of immense importance to the teaching and learning of science. It is imperative therefore, that science curriculum development addresses this issue properly, if any measure of success is to be recorded. Urevbu, (1984:318) aptly states: "the African child can

be helped to achieve or preserve a co-existence that does not violate his cultural values as he tries to assimilate western science and scientific viewpoint". Science should therefore be taught so as to complement the cultural methods already acquired by the child rather than to uproot them violently (Dart and Paradhem; 1967:649-656). The pastoral pullo has a good case here, to maximize support of his material life. Pulaaku is directed towards the conditions which facilitate the reproduction of his life. More easily conceived is its role in the reproduction of culture.

Indigenous pastoral education is to be understood in this context. It is meant to equip the pastoral child with the necessary knowledge so as to enable him to understand the demand of his pastoral life and to cope with these demands in the most efficient ways possible. This form of education, like all the other forms of education, is part and parcel of culture; in this respect the pastoral Fulbe culture (Pulaaku). The indigenous education of the Pastoral Fulbe is meant to reproduce and maintain their pastoral form of production and also serve as a vehicle for the transmission of Pulaaku from one generation to another. Their education, is therefore, an education produced by the laws of their pastoral

economy. This economy is different from the peasant economy and also markedly different from either the capitalist economy, or the socialist economy. The aims and objectives of education in the three economies will have to be different since the three socio-economic formations do not have the same living-conditions or objective economic laws. In this regard, the aims and objectives of education are geared towards the inculcation of the principles of Pulaaku, the Fulbe cultural way of life.

2.8.3 The Teachings of Pulaaku And Their Implications For Science Teaching And Learning

Pulaaku is a word loarded with values. It describes the ethos of Fulbe. Among other things, it connotes that the Pullo (Pl. Fulbe) is expected to be honest, modest, courageous, self-denying, generous and humble. He is not expected to be greedy, panicky, interfere in the affairs of other people or express pleasure, pain or anger, let alone behave in a disgraceful manner (Mukoshy, 1986:2; Bello, 1986:3).

When a child is born to a Fulbe family, the circumstances of his birth determine his or her name say for example a visitor or stranger arrives in the

home that day, the child is said to welcome the visitor and gets the name Jabbi if a male, and Jabbo if a female. The name may also denote the nature or form of marriage, especially in the endogamous marriage which the Fulbe favour. In this respect, the first child gets the name of Bandado if a male and Tumba if a female. This kind of nomenclature is called Jammore, which precedes the name given on the day of the naming ceremony, which is always a week after birth. In the naming ceremony an Islamic name is given. This is because the pastoral Fulbe are largely Muslims, even though they may not be strict ones, hence the mistake of sometimes referring to some of them as pagans. From the day of the naming ceremony, the child will start possessing his own cattle, sheep or goats which come in form of customary gifts (naan-nganaye) by his older relations. By the time he is of the primary school age (6 - 7 years), he will have animals numbering more than his age. About this age, the child starts to be introduced to the art of cattle rearing and tendering. He follows his elders in the morning when the cattle leave the coral or gange and are spending time around the homestead vicinity. This morning browse is called Maaji after which the cattle attendants take

their breakfast-cum-lunch (in advance) and head for a far distant pasture. The small children do not follow their elders to this distant pasture but rather remain at home with the female members of the family and only join the elders when the cattle are back again in the coral. A child by this age learns from three fronts. There are the cattle tenders who are mostly his senior brothers and other relations. He is full of curiousity to imitate them in every aspect and he sees his future self in them, since he will soon be responsible for tendering and rearing cattle. He learns rather discretely the knowledge of herding whenever he is with them in the coral or during the maaji period. The second front is that constituted by the female members of the household. He learns how to behave like a pullo in the way he eats, drinks and even how he looks at a particular object. His language and his entire behaviour are slowly couched in the pulaaku way. The third front is the one constituted by his father and uncles. He learns of great men of wisdom in the pastoral family, some of them in control of an uncountable number of cattle and other excelled in bravery, yet those were great men of medicine and charms. These legendary figures may or may not have existed, but nevertheless,

form a myth which is always believed. He learns this form of mythology from the folktales, and other story telling sessions mostly in the night just after dinner when all the family members are at home, and just before the herd attendants go to their sleeping ground near the coral (daddoo). The heroes are usually such figures who possess characteristics like bravely, honestly, modesty, alertness and so forth, which are the cornerstone of Pulaaku. Hakillo (alertness) is a trait which the Fulbe regard as one of the highest virtues of their society. They believe that a pullo is more alert than any being, hence the feeling of superiority. Every pullo should therefore display this virtue in any situation, the failure of which earns contempt and disgrace for a person.

Pulaaku has many desirable qualities in its teachings which could be used in science teaching and learning. The principle of alertness (hakkilo) is one such desirable quality. It inculcates the virtue of careful observation which is equally needed in science. The use of folktales and story sessions to teach children could also have positive implications for curriculum development.

Another quality which is equally desirable is the principle of Perserverance which could be used in continuous search for experimental results.

These and many other qualities in the teachings of Pulaaku could contribute postively to promote science learning among the pastoral Fulbe children. The inculcation of all these virtues is a familial responsibility to a large extent (Stenning, 1965:369). Another important aspect of Pulaaku is the Fulbe pastoral Calendar which is made up of five eco-climatic seasons. The periods of the seasons reported below are from Hopen(1958) which reflect the situation in Gwandu (Southern Sokoto). See table below.

Name of Season	Name of Spatial Settlment	Duration
Ndungu	Rumirde	The wet season proper which begins late in June or in July and ends late in September or early October (3-4 months)
Yawal	Yawirde	The hot season after the rains. This begins late in October and ends about the end of December (1-1½ months).

Ndabbu'nde	Dabirde	This is the Harmattan season which starts from December to February (3 months).
Cheedu	Chedirde	The hot season after the Harmattan. The beginning and ending varies just like the other seasons. It begins late in February or early in March and ends about the latter part of April (2 months).
Seeto	Seetinirde	The windy and stormy period leading into the rains. From early May to June (1-1½ months).

2.8.4. Implications for Curriculum Development.

The beginning and ending of the five seasons in the pastoral Fulbe calendar vary from one eco-climatic zone to another. The period quoted here reflect Hopen (1958) study of the pastoral Fulbe of Gwandu in Sokoto State. The periods of duration from one season to another are therefore only accurate

in Sokoto State. The words in bracket indicate the names given to the spatial settlement (rugga) in every season. In this respect, rumirde is not a season but the spatial settlement which goes with the season ndungu. In this way, rumirde may last for three to four months. All the five seasons apply to all the communities of the pastoral Fulbe in the West African Savanna zone. It is also important to note, that even within one eco-climatic zone like that of Sokoto and Gwandu where Hopen's study was carried out, there may be some slight variations from year to year.

Science lessons can adequately be planned so as to take the major seasonal activity as the centre of the topics to be taught. For example the ndungu season is ideal for such topics like germination of seeds and planting of seedlings, geotropism, photosynthesis and many other topics. Since this season starts in June and ends in September, which is the rainy season period, flowering, plants and various flowers can also be taught around its end when the flowers are in full bloom. The types of fodder, grass and weed, plus little shrubs which are browsed and preferred by the cattle and other small livestocks like sheep and goats can form the core of many related topics to be taught in this period.

2.9 Eco-cultural Variables And Their Effects On Cognitive Styles

2.9.1 Introduction

New science curricula have placed increased emphasis on concept formation, scientific principles and processes of scientific thinking. These emphasis in turn, have led to detailed studies on the learner-characteristics determined by his socialization practices and the entire socio-cultural environment. Research has shown that variables, such as field dependence/independence, breadth of categorization (category width), convergence and divergence or impulsiveness, are all indicators of personal mode of learning, (Witkin, 1967: Dawson, 1967: Gadner, 1975, Goldstein & Blackman, 1978). The concept of cognitive style has been widely examined in terms of its relations to a variety of dimensions of academic success, since it was introduced in the literature of educational psychology by Gadner (1953). It is an integrated concept, combining perceptive, cognitive preference, and other personality elements yielding a stable pattern of individual mode of learning. Cronbach and Snow (1977:375) define cognitive style as "a habitual pattern or preferred strategy of information processing". One of the most widely discussed aspects of cognitive style is Cognitive

Preference'. Other dimensions of cognitive style which attracted attention are field dependence and field independence. Field-dependence/independence describes a generalized approach of one's interaction with his environment, including such cognitive levels as problem-solving activities and other complex analysis in this direction.

Field dependent individuals rely on the surrounding perceptual field; experience their environment in a relatively global fashion by conforming to the effects of the prevailing field or context; depend on authority; search for facial cues in those around them as a source of information; are strongly interested in people; get closer to the person with whom they are interacting; have a sensitivity to others which help them to acquire social skills; and prefer occupations which require involvement with others.

Field independent individuals on the other hand, perceive objects as separate from the field; can abstract an item from the surrounding field and solve problems that are presented and reorganised in different contexts, experience an independence from authority which leads them to depend on their own standards and values; are oriented towards active striving; appear to be cold and distant;

are socially detached but have analytic skills; and prefer occupations that allow them to work by themselves.

2.9.2 Child Rearing, Socialization Practices, And Learner-Characteristics.

The ability or inability to perceive items as separate from their context is seen by Witkin (1967: 102) as diverse expressions of an underlying process of personality development which he calls "psychological differentiation", and goes further to link these differences directly to the different patterns of mother-child interaction. These patterns of mother-child interaction are also seen by Witkin (1967) to be related to the nature of the physical environment. In this manner, socialization practices are dictated, and skills and personality traits needed for a given environment developed accordingly. Berry et al (1959) studied 104 societies with subsistence economies. The subsistence economies were classified into high food accumulation (for example agricultural communities and pastoral peoples) and low food accumulation (for example hunting and fishing communities). Their findings revealed; that adults in low food accumulation socieities were found to be

individualistic, assertive and venturesome; when rated against six aspects of socialization (Training in obedience, responsibility, nurturance, achievement, self-reliance and general independence). High food accumulation societies rated against the six aspects of socialization were found to be conscientious, compliant and conservative. This research illustrated the degree of differentiation in survival techniques and personality traits depending on the nature of the environment.

Dawson (1967) reported a study on the Tamne and Mande societies of Sierra Leone. The results of the study indicated that the two societies have different cognitive orientations according to their child-rearing and socialization practices. The Tamne were found to incorporate and encourage their children to severe discipline, great measures to conform to adult authorities and were not encouraged to adopt an adult role. Individual competition was also discouraged and group reliance sanctioned. The mother played a dominant role in child-rearing. Dawson (1967) therefore, found the Tamne to be field dependent. The Mande on the other hand were found to encourage their children to develop individual intiative. The child was also given responsibility at an early age and less dominated by the mother.

The Mande were consequently found to be field-independent.

Ehindero (1982:451-457) found out that the cognitive achievement of Nomadic Fulani (educated and uneducated) was sharply different from that of the sedentary Yoruba children (educated and uneduated). Ehindero attributed the differences in achievement to ecocultural factors which produced differences in the cognitive achievements of the two groups.

These studies indicate clearly, that cognitive style is a variable of culture. If we know the cognitive styles of children, then it is easier to plan curricular materials which are in line with their mode of learning. Knowledge of children's cognitive styles can also have positive impact on the methodology of teaching. Claudia and Kahle (1978: 407-412) reported on two teaching approaches: inductive approach which proceeds from particular facts or cases to general conclusion, and deductive approach which proceeds from a general overview to individual cases or examples. Claudia and Khale (1978) found that field-dependent individuals achieve higher scores with a deductive method whereas field-

independent achieve higher scores with an inductive method.

2.9.3 Tools Of Curriculum Development And Evaluation: The Significance Of Cognitive Preference Tests (CPTs)

Cognitive preferences tests (CPTs) are unlike most school achievement tests which focus on what the student can do; rather what cognitive preference tests attempt to measure, is what the student typically does do. The interest is not in whether the student can identify correct or incorrect information but what he does with the information intellectually (Heath, 1964: 241; Tamir and Kempa, 178:143). In this respect, cognitive preference tests (CPTs) have been in use in science education research for over two decades, since Heath (1964) research carried out to determine the cognitive preference of the Physical Science Study Curriculum(PSSC) students so as to compare them with other students following traditional curriculum. Heath (1964) was therefore the first to use a CPT to compare the impacts of two Physics Curricula. Heath (1964) used four modes of attending to Scientific information which were later reformulated by Van den Berg et al (1978) as:

Factual information or Recall (R)

Acceptance of Specific information for its own sake, i.e. without consideration of its implications or application. A preference for Recall indicates an interest in learning a name, a number, a definition, a formula, an observation or a fact.

Principles (P)

Representation or explanation of fundamental scientific principles or relationships. A preference for principles indicates an interest in identifying a relationship between variables, or an interest in explaining phenomena.

Questioning (Q)

Critical questioning of information for completeness, general validity, or limitations. A preference for questioning indicates an interest in critically analysing and commenting on the validity of scientific information and/or in generating suggestions and hypotheses for further research.

Application (A)

Application of scientific information in problem solving in real-life situations. A preference for application indicates an interest in using scientific information to solve problems in commerce, industry, farming, or in daily life.

A typical CPT has a stem which presents the information and is sometimes accompanied with a diagram or graph to make the information clear.

The four options that follow the stem are all correct and each represent one of the four modes (R,P,Q, and A). A typical CPT item from Heath (1964) is as follows:

> The pressure of a gas is directly proportional to its absolute temperature.
>
> (a) The statement, as given above, fails to consider effects of volume changes and change of state.
>
> (b) Charles' or Gay-Lussac's Law
>
> (c) The statement implies a lower limit to temperature.
>
> (d) This principle is related to the fact that over heated automobile tires may "blow out".

2.9.4 Cognitive Preference Research Findings In Science Education

Ever since Heath (1964) pioneer research in Cognitive Preference in Science Education, many scholars have shown considerable interest in this area. Heath (1964) used cognitive preference test (CPT) to compare the effectiveness of two curricula (PSSC and Traditional Physics). Van den berg et al (1978) completed a very lengthy research where the aim was validation of CPT in science. The authors studied one hundred and fourty four (N = 144) science -oriented students at a summer workshop. Their instrument was called Science Cognitive

Preference Test (SCPT) and contained thirty items. Their major findings were narrowed to:

(1) High results on the Questioning-Recall (Q-R) Scale.

(2) Poor results on the Principles-Application (P-A) Scale.

(3) The Q-R dimensions appear to have a stronger construct validity than the P-A dimensions.

In their conclusion, they recommended more research in the interpretation of cognitive preference modes. Tamir and Kempa (1978) found some differences in CPR among three types of school. The schools were those inclined to (1) Occupational training. (2) Agricultural training and (3) Liberal City-schools. Their sample consisted one hundred and fifty nine students (N = 159) drawn from the three schools. The aim of the study was to determine the reliability, validity and correlation of cognitive preference (CP) with students characteristics. Their findings showed:

(1) A preference by the group as a whole for Q-R.

(2) A higher preference in P-R for students in higher grades.

(3) A higher preference for questioning (Q) among students from inquiry - based biology curricula.

(4) Difference in preference across topics in biology.

(5) No differences were found in preference according to gender, region, or hobby.

Tamir and Lunetta (1978) administered two forms of the Biology Cognitive Preference Test (BCPT) to a sample of one hundred and seventy seven (N = 177) secondary students in a summer school workshop. The aim of the study was to find out and determine if any relationship exist between several student characteristics and cognitive preference (CP). Specifically the study was aimed at:

(1) Comparing the results obtained by normative with those obtained by ipsative procedures.

(2) Identifying the relationships between cognitive preference patterns and certain background variables, namely: gender, year in high school, general achievement, achievement in high school Biology course, location of residence, hobbies, science reading, and prospective major field of study of college.

(3) Identifying the degree of cognitive preference dependence on specific biological topics.

Their findings revealed the following:

(1) That no significant difference exist between ipsative and normative procedures in three out of the six mean scores.

Both the ipsative and normative procedures gave the same rank order of mean scores.

(2) Students who studied BSCS biology curriculum showed higher preference for "questioning" than did students who studied traditional biology who showed higher preference for "recall". Tamir and Lunetta (1978) therefore recalled that since the study of Heath (1964) this pattern of cognitive preference where students who follow "inquiry-oriented" Curricula show more inclinations for questioning than students who follow traditional curricula and who show higher preference for recall than students who folow the new "Inquiry-Oriented" curricula has been consistent.

(3) That students who are talented showed greater preference for "Principles" than less talented students. This finding was also observed by Tamir and Lunetta (1978) to be consistent with previous findings.

(4) Non-=Science majors have the lowest preferences for "recall" whereas prospective medical students had generally higher preference for "principles" and"Questioning".

(5) Students in senior grades had higher preference scores for "Principles". This tendency was also noted to have featured in previous studies. And

(6) Students displayed different cognitive preference patterns in relation to different topics in biology. This also confirms similar findings carried out by Tamir (1975).

Schmedemann and Shier (1967-68) studied the relationship between four variables of PSSC teachers and the cognitive preference scores of their students. The aim was to test the following null-hypotheses:

(1) There is no relationship between cognitive preferences of teachers and the cognitive preferences of the students.

(2) There is no relationship between teacher warmth and the cognitive preferences of the students.

(3) There is no relationship between teacher demand and the cognitive preferences of the students. And

(4) There is no relationship between teacher use of motivation and the cognitive preferences of the students.

Both teachers and students cognitive preferences were measured by the cognitive preference test developed by Heath (1964). The scoring pattern was however altered from ipsative to a weighted scoring system. Students warmth, demand and teacher use of motivation were measured by an instrument called student inventory. The null-hypotheses were treated with a non parametric statistical technique - the Kendall rank correlation coefficient. The technique was adopted in view of the ordinality of the data in question. All the null hypotheses were accepted since the results did not make room for their rejection.

Atwood (1971) following his earlier study Atwood (1967-68), which used a cognitive preference test (cognitive preference examination: Chemistry (CPEC) observed, that earlier efforts to apply the CP concept in evaluation of curricula and instruction focussed on particular science fields such as physics content or Chemistry content. The utility of these kinds of tests would be limited, he noted, because they will only apply to the subjects who are familiar with the discipline. In view of this short-comings, Atwood (1971) constructed the (CPE-II) which aimed at measuring the subject matter content from "general Science" and "social science". The test's content featured only three modes of cognitive preference, namely: memory, application and questioning. No principles mode was included. Thirty four items were administered in four groups of students enrolled in four different courses. After an item analysis,seven items were eliminated because they functioned poorly and twenty seven items survived.

2.9.5 Criticisms Of Cognitive Preference Research (CPR) - Findings

Jungwirth (1980), criticized some major CPT findings. Consequently, he proposed alternative

interpretations. The bipolar 'R-Q' axis which is termed the "Scientific Curiosity Scale" by Kempa and Dube (1973) has been seen to appear almost invariably in CPT-mode intercorrelations and factor analyses. In this respect dervied 'Q-R' Scores are sometimes used to characterize students or students populations. Kempa and Dube (1973:287) describe these scores in the following lines:

> A high positive (Q-R) score difference may be taken as an indication of a student's willingness and desire to acquire scientific knowledge beyond that already possessed. A high negative (Q-R) score difference, in turn, would suggest an intrinsic satisfaction with knowledge already gained and hence memorized. The quality of ambition to learn more would be lacking in such a student.

Jungwirth (1980) challenged the interpretation of these findings and also failed to agree with what most CPT workers subscribe to in the construction of CPTS. For example, Atwood (1971 believed that "examinees must be familiar with an item's content to make a valid preference choice". And Tamir and Kempa (1978) said a CPT must not be a "learning situation" or in other words "all information incoporated in these test fall within the cognitive framework of the students". On the basis of his data and the reinterpreted findings of others, Jungwirth (1980)

suggested the following alternative interpretations:

> High Q scores indicate a willingness to go beyond the familiar, low R scores indicate a distaste for the already familiar-an intrinsic dissatisfaction with "Knowledge already gained and hence memorized". High R scores indicate the opposite a penchant for the hitherto unfamiliar. High Q's and High R's may thus be regarded as manifestations of the same cognitive preference, i.e. the "quest for the unknown". High R students can thus not simply be described as "lacking the ambition to learn more".

To support his interpretations of CPT findings, Jungwirth (1980) quoted a ninth grader in his reaction to interviews carried out by Jungwirth (1978) as follows: "I gave first choice to questions or problems to which I didn't know the answers or to factual sentences about which I didn't know the answers or to factual sentences about which I didn't know before. Last choice were factual sentences which were well known to me". Jungwirth (1980) therefore concluded with the following suggestions for further research in CPTs.

(a) Construction of CPTs with predetermined informative content, i.e. graded levels of (un) - familiarity, keeping topics constant, and adapted to curricular content and educational level of target populations.

(b) Construction of CPTs with the degree of familiarity held constant across different topics, again adapted to educational levels, etc.

(c) Use of parallel versions of CPTs with one verson keywords, changed to non-sense words, but keeping the structure of the statements constant. This author's findings obtained by this method are being published elsewhere (Jungwirth, 1978).

(d) Execution of longitudinal studies taking the individual subject as a unit of observation. One longitudinal study is already in progress in the United Kingdom (Kempa, personal communication).

In carrying out research on the above (a) - (e) suggestions, Jungwirth (1980) says "one should concentrate on the type of reasoning that accompanies individual responses to CPTs by means of the type of ancillary questionnaires and strctured interviews mentioned in this paper."

Brown (1975) made a critical review of cognitive preferences in Science; their nature and analysis. Brown (1975) started his review from Heath (1964) pioneering research. Some issues raised by this review include:

(1) That the relationship of cognitive preference with achievement reported by Kempa and Dube (1973) might be indicative of the cognitive nature of cognitive preference.

(2) There appears to be an extensive empirical data on cognitive preference with little or no commensurate effort to discuss the nature of pupils cognitive preference.

(3) It was long overdue for theoretical interpretations of cognitive preferences.

(4) No evidence yet to suggest that particular cognitive preference choices are related to particular cognitive activities.

2.9.6 A Summary Of The Literature Reviewed

Literature reviewed in this chapter indicates that education is a tool of intervention and the nomadic pastoral peoples are affected by the process of development which includes the provision of educational

facilities to their society. The planning of these educational facilities is however, fraught with difficulties which come largely from the conflicting aims of the programmes and the nomadic pastoralists. One area with a major short coming in many educational programmes meant for the nomadic pastoral peoples has been the curriculum of the nomadic schools. The curriculum in many instances failed to reflect the cultural background of the Clientelle. Curriculum planning and development for the nomadic pastoral peoples need a careful study of the socio-cultural environment of the pastoralists. Other factors which equally militate against the implementation of these programmes are the thin demography and mobility characteristics of the nomadic pastoral societies.

Inspite of these difficulties, educational programmes mounted for the nomadic pastoral peoples have achieved some measure of success in Iran, USSR, China, Mauritania, Algeria, Kenya and Nigeria. Curricular issues and the need to understand learner characteristics such as the cognitive preference and other cognitive style dimensions before designing any minority education curriculum need to be addressed properly if the programmes are to achieve their goals

and objectives. Curriculum should be seen as embedded in social transformations and therefore an avenue for building cultural ferrays for a smooth transition from a nomadic society to a sedentary society.

The logic of a state, the citizenship and the need to forge a homogenous population all make it necessary for the minority peoples like the nomadic pastoral Fulbe to study the subjects outlined in the National Core Curriculum. In Nigeria, like in many other countries, primary science is a Core Curriculum which makes it one of the Core Subjects of the nomadic education programme. Developments in the primary science curriculum since 1960 have now come to recognize the need for cultural relevance in the production of curricular materials. This awareness has largely come from a deeper understanding of social and cultural systems.

CHAPTER 3

3.0 METHODOLOGY

3.1 Introduction

Educational research is one arena where both the quantitative and qualitative research paradigms are employed. The controversy is still going on however, as regards the suitability of their applications. The practical necessity of this research however, suggests the application of the two models. One cannot design suitable curricular materials for a people he does not study and understand their culture. In the same vein, one cannot design and develop curricular materials without relevant investigations into the students mode of cognitive styles and preferences.

In view of this particularly, a synthetic approach method was chosen. The essence of this combined approach is to ascertain if there were different aspects of the problems that can be illuminated by the two approaches. According to Rist (1982:448) "the piecing together of two perspectives is perhaps one of the most challenging methodological issues that confronts the research community". For instance in contrast to quantitative approach, a qualitative

mode of inquiry is tendam can lead to core complete and comprehensive understanding of educational programs.

In pursuance of the objectives set out for this study and the research methodology entailed there in, this chapter outlines a brief review of a synthetic methodology, the samples and their selection, the instrumentations of Science Cognitive Preference Test before Treatment, (SCPTBT). The development of a cultural model Curriculum-Teaching Science through 'Pulaaku' (TSTP), and the instrumentations of Science Cognitive Preference Test After Treatment (SCPTAT) and the Primary Science Achievement Test (PSAT).

3.2 The Samples

Three samples were selected for the purposes of the study. The first sample consisted of five families chosen from a population of three nomadic pastoral Fulbe settlements locally referred to as Rugga (sing.). The five families were selected from Domdo in Wammakko Local Government area; Sanabai in Bagudo Local Government area; all in Sokoto State. The sample provided information for the ethnographic study which constituted one component of the research study.

approach like a cultural or semiotic perspective, emphasizes the importance of segmentary and other Models in defining interests as illustrated by Galaty (1981).

In pursuance of the need for flexibility in applying research paradigms and in particular in support of the Synthetic approach, Salzman (1984:38) states:

> But what exactly would constitute a model based upon a Synthetic pluralistic approach? Primary in such a model and that which distinguishes it from monistic, reductionist models, is the partial independence and self contained causal power of a variety of factors: cultural models, established organisational forms, demographic patterns, psychological complexes, available resources and so on. The nature of any particular society at any particular time is a result of the conunction and interaction of these factors. Change is understood as coming from the dynamics of any one or comibation of these factors such as symbolic elaboration, resource expansion or contraction, organisational refinement, or psychological innovation...which shift the system as a whole through impact upon the other.

In the same vein Nolan and Short (1985:16) hold the opinion that "the use of qualitative and quantitative

The population of the second sample was of pupils from classes four, five and six of nomadic education schools, located at Mazat Ropp Dogo Gashish: all in Barkin Ladi Local Government area of Plateau State. The population of the pupils in classes four, five and six in the two schools came to be sixty six as of the time the research was conducted. The Mazat school had thrity two pupils spread in the three classes. This low population is not surprising in a typical nomadic school where the drop out rate is high due to their mobility, high labour demand on the children and the characteristic low demographic density of the pastoral nomadic settlements (Gorham, 1972:2-5). Ten pupils were chosen from each school at random through a hat-draw method where all those pupils who picked the option card formed the sample. Only ten pupils were selected from each school because The Science Cognitive Preference Test before Treatment (SCPTBT) was a ten- item test. Consequently each pupil responded to only one item of the test.

The third sample came from the same population of the second sample. The entire population of sxity six pupils was used as a sample in this respect. The

subjects were then assigned to two groups by the use of random numbers (Kellinger, 1973). These groups were exposed to two different curricular materials (TSTP and TSTM).

3.3 Ethnography

The study was carried out at Sanabai in Bagudo Local Government, and Domdo in Wammakko Local Government. Sanabai is along the river Niger valley, whereas Domdo is a dabagi land suitable for rainy season grazing. The researcher started visiting these areas in 1984 before the commencement of the research. It was not until 1986 however, that the real study started. Five families were selected from each of these areas. This was necessary because it was not possible to follow and observe all the families even in one Rugga not to talk of three large concentrations of such Rugga.

The researcher spent time with the families and followed them to such places like the market, grazing ground and water points. A typical day normally starts as early as six, when the coral is visited by the senior member of the household to see to the welfare of the animals. The milking is done around seven a.m. and by eight O'clock a.m. the cattle are on their way to early morning browse otherwise known as maaji. The container used for the milking process is called Birdude and is of various sizes depending on the

season when the milch cows either have plenty or low supply of milk. Birdude was quickly selected as a useful curricular material for the concept of volume. The herd boys carry sticks of various sizes and this was also noted as a good way of introducing the concept of measurement. A stick is called Sauru and in this respect, a metre, it was reasoned by the researcher, could also be called metre-sauru, since it is also a kind of stick for the teacher.

Suitable materials were slected through this study and whenever possible simple questions were asked on how the herd boys (who are normally of school age) consider the importance of the objects. The herd boys were also asked many questions pertaining to their knowledge of various grasses and shrubs along their grazing orbits. Where they cannot answer the questions an elder was normally around to assist them with the answers.

The study lasted for two years (June 1986 to July 1988). In the course of the study it was also discovered that the nomadic pastoral Fulbe have a systematic way of treating time. This calendar is made up of five seasons. Each season brings different eco-climatic characteristics, which have varying consequences on

the pastoral or savanna ecology. From these observations, it was felt that a primary science curriculum package can be organized according to their calendar. The five seasonsare:

1. Seete - April, May and June
2. Ndungu - June, July, August and September
3. Yamde (Yawal) - September, October and December
4. Ndabbu'nde - December, January and February
5. Cheedu - February, March and April.

3.4 Instrumentation

3.4.1 The Development Of SCPTBT

The Science Cognitive Preference Test before Treatment (SCPTBT) reported in appendix (i) of this study, was a ten- item instrument which was developed from the scenes and objects familiar in the environment of the children. The test was designed on the model of Heath (1964) to test the four attributes of Scientific enterprise; namely:

1. Recall;
2. Identification of fundamental Principles;
3. Practical application of knowledge and
4. Critical questioning of information

Each item has a statement which formed the stem with four options which were all correct and where each option was testing one of the four attributes named above. Simple drawings depicting the substance of each statement were placed before it as shown in appendix (i) of this study.

3.4.1.1 The Validation Of SCPTBT

The SCPTBT was administered before the commencement of the study. The test items were validated by three experts in science and two experts in Fulfulde language. The initial version was also tried out with some selected pastoral nomadic children found attending sedentary schools.

3.4.1.2 The Reliability Of SCPTBT

Using the spearman Brown prophecy formula for estimating reliability; the reliability of the instrument was found to be 0.61. This reliability co-efficient was considered adequate for the purpose of SCPTBT.

3.4.1.3 Administrative And Scoring

The SCPTBT was administered by the researcher assisted by one research assistant. There are two procedures of scoring the Cognitive Preference Tests (CPTs), the normative and the ipsative procedures. The

normative method involves rating the choices whereas ipsative involves ranking of the choices. The normative method was used in this study ro rate the SCPTBT by asking the subjects to award four points to their last choice. The total points for all the four attributes (Recall, Critical questioning, Application and Fundamental principles) in the ten questions were calculated. The attribute with the highest points was then deemed to have been most prominent in the group and the attribute with the least points was equally deemed to be the least prominent.

3.4.1.4 The Development Of 'TSTP' Curriculum

The TSTP curriculum covers the last three years of the primary school. From the notes and observations during the ethnographic study carried out at Bagudo and Wamakko Local Government areas of Sokoto State, materials were carefully listed as suitable for curriculum development in science. Also from their pastoral calendar which is divided into five seasons, each season is classified according to its climatic conditions which affect the pastoral ecology either negatively or positively and which neccessitate them

either to move towards the river valleys or down south or to move northwards into Dabagi lands.

This calendar is exploited in the development of TSTP, where each season has one module which teach a theme which is the dominant activity in that season. In this manner TSTP materials were in five modules which make one cycle of a calendar year. The selected materials were carefully arranged so as to form harmonious or synchronized activities with the seasons.

3.4.1.5 The Validation Of The TSTP Curriculum

TSTP Curriculum was sent to two lecturers, one in Usmanu Danfodiyo University, and the other from Ahmadu Bello University Zaria. The two validators checked the cultural suitability of the materials and also the accuracy of the scientific information contained. Later the Curriculum was presented at a national Education workshop for the production of reading and learning materials, held at Maiduguri in 1988. After the presentation of TSTP to workshop participants, the materials were then collected back for further considerations.

3.4.1.6 Readability Instruments

To measure the readability of TSTP Curriculum a package of Readability Assessment Inventories called Nomadic Education Primary Science Curriculum Package: Readability Assessment Inventories (NEPS-CP-RAI) reported in appendix (IV)was developed and sent out to Primary Science Specialists to score the TSTP curricular materials. The comments were later used to modify the vocabulary of the TSTP.

Another instrument used to further improve the quality and readability level of the TSTP curriculum was the specialist/teacher's questionnaire reported in appendix (v). It was given to the research assistant and other primary science teachers for comments. Their comments were also used in modifying the TSTP curriculum.

3.4.1.7 The TSTM Curricular Materials.

Teaching Science Through Traditional Method (TSTM) was a collection of elementary science text materials from the Ilesanmi primary science set books. The books were selected because they were already being used by the two schools where the research experiment took place.

The two groups were selected from one sample by a random number method (Kellinger, 1973).

3.4.2.2. The Development Of PSAT

The Primary Science Achievement Test reported in appendix (vii) of this study, was designed to test the acquisition of knowledge and skills contained in the national primary science curriculum. PSAT was desgined to test units which make up modules. Consequently, each unit in the curriculum has an accompanied test. The tests for the selected units formed the PSAT package.

3.4.2.3 The Validation Of PSAT

PSAT package was sent to five selected primary science teachers for comments on its construction and appropriateness in terms of readability and relevant evaluation of the subject matter contained in the primary science syllabus. The vocabulary of the test was further scrutinized and edited on the spot before the commencement of the test. In this respect, each question was read to the subjects and the research assistant rendered verbally the meaning of each term in Fulfulde and later asked the subjects if any word was difficult to them. Those words which were considered difficult or ambigous by the testees were immediately

changed with more appropriate pnes by the researcher himself. The final version was then written on the board and the testees were allowed to respond to the test.

3.4.2.4 The Reliability Of PSAT

The reliability coefficient of the test was found by the split half method using Spearman Brown prophecy formula. The reliability coefficient came to be 0.86.

3.4.2.5 Administration And Scoring

Each unit taught was tested. Each test was scored out of a hundred and recorded in the column provided. A total of ten such tests were recorded. All subjects in the two groups were given the same tests. Again the tests were administered by the researcher and his research assistant. The averages of the two groups were compared using the t-test statistic.

3.4.2.6 The Development Of SCPTAT

The Science Cognitive Preference Test After Treatment (SCPTAT) reported in appendix (vi) was a thirty three item test which was developed on the Heath (1964) model and drew its contents mostly from the 1984 National Primary Science Core Curriculum. Relevant drawings were used where ever possible to further explain the questions to the respondents.

3.4.2.7 The Validation of SCPTAT

The contents of the thirty-three-item Science Cognitive Preference Test After Treatment (SCPTAT) were drawn from the National Primary Science Syllabus. Two Fulfude speakers, one an Educationalist and the other a linguist all from Usmanu Danfodiyo University, Sokoto checked the test items after they were intimated with the meanings and aims of Cognitive Preference Tests in general and this one in particular. Initially the items were forty, but after a series of validation seven were dropped and thirty three items retained. These surviving items were again checked by two Science Educationalists from Usmanu Danfodiyo University, Sokoto. The thirty-three items were finally produced.

3.4.2.8 The Reliability of SCPTAT

There are many factors which affect the reliability of an instrument. The length of a test, the heterogenity of the subjects, the ability of the subjects, the specific technique used for the estimation of reliability and also the nature of the variable being measured are some of such factors which determine the reliability of a test. The technique of estimation was the split-half method. Consequently the Spearman Brown prophecy formula was employed and yielded a co-efficient of 0.82.

3.4.2.9 Administration And Scoring

The SCPTAT was administered to pupils in classes four, five and six from the two nomadic primary schools in Mazat Ropp and Dogo Gashish, all in Barkin Ladi Local Government area of Plateau State.

The test was administered by the researcher and his assistant. The diagram below depicts the position of the test in the experimentation process:

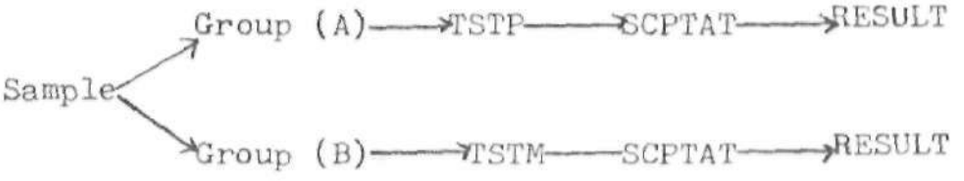


Figure 3.4.2.9 Administration Of SCPTAT

Where:

TSTP Stands for 'Teaching Science Through Pulaaku'.

TSTM Stands for Teaching Science Through Traditional Method. And

SCPTAT Stands for 'Science Cognitive Preference Test After Treatment

A total of thirty-three questions were given to thirty-three subjects. Each subject was asked to score

only one item. All the items were explained to the subjects. The responses of all the students were added to give a total score of each scale. The most preferred option was also allocated a maximum of four marks whereas the least was awarded one mark by the subjects.

Analysis of variance (ANOVA) was employed to analyse the data collected from the SCPTAT instrument.

CHAPTER 4

4.0 DATA ANALYSIS

4.1 Introduction

This chapter reports the analysis carried out on the research data collected by the SCPTBT, SCPTAT and PSAT instruments. Consequently, the six null hypotheses were tested accordingly.

4.2 The SCPTBT Data

The Science Cognitive Preference Test before Treatment was administered to pupils in classes four, five and six from the two nomadic education schools in Mazat Ropp and Dogo Gashish under Barkin Ladi Local Government in Plateau State. The purposes of this test were:

(1) to find out the variance if any between the two schools in their cognitive preferences in science, (a test of homogeneity which is null hypothesis one of this study).

(2) to use their cognitive preferences as aguide in the development of the 'TSTP' curriculum.

Consequently, the responses of the subjects in the two schools were recorded as shown in the following tables:

Table 4.1: SCPTBT Scores from The Nomadic Education School Mazat Ropp.

Serial No	Recall	Application	Critical Questioning	Fundamental Principle
1	2	3	4	1
2	1	2	3	4
3	2	1	3	4
4	1	4	3	2
5	2	4	1	2
6	3	4	1	3
7	2	3	4	1
8	3	1	4	2
9	2	1	3	4
10	2	4	3	1
Total	20	27	29	24

Table 4.2: SCPTBT Scores From the Nomadic Education School Dogo Gashish

Serial No	Recall	Application	Critical Questioning	Fundamental Principles
1	1	4	3	2
2	2	4	3	1
3	2	4	3	1
4	1	3	4	2
5	1	4	2	3
6	2	4	2	3
7	2	4	3	1
8	2	3	4	1
9	1	4	2	3
10	1	2	4	3
Total	14	35	30	19

Table 4.3: The SCPTBT Mean scores of Mazat Ropp and Dogo Gashish Nomadic Education Primary Schools.

School	Recall	Application	Crtical questioning	Fundamental Principles
Mazat Ropp	2.00	2.7	2.9	2.4
Dogo Gashish	1.4	3.5	3.0	1.9
F	2.03	1.64	1.05	1.61

Significant at p.$\angle$.05

4.3 The Analysis of SCPBT Data

Ho:1: There is no significant difference in the cognitive preferences of nomadic pastoral Fulbe in the Recall of Scientitific facts. Fundamental Principles in Science, Practical Application in Science, and Critical questioning of Scientific information.

From the tables of responses shown above, it could easily be seen that the most favourable responses were given to application and critical questioning scales. Their mean scores as indicated in the two tables were the highest. The scales of Fundamental principle and Recall followed as third and fourth preferenced scales respectively.

After the analysis of variance (ANOVA), the null hypothesis was not rejected. The similarity of trends in the cognitive preferences of the two groups further testifies to their homogenity which is a prerequisite for the application of parametric statistics in the subsequent experiments. The dominant preferences were reimposed in the 'TSTP' curriculum.

The dominance of Practical Application and Critical questioning could be linked to the teachings of Pulaaku. Particularly the amphasis on Hakkilo which connotes both alertness and careful observations. This could naturally lead to critical questioning. The preference of Practical Application could also be explained by the applications of local plants and other materials found locally to solve various problems encountered in the nomadic pastoral environment.

4.4 The PSAT Data

The Primary Science Achievement Test (PSAT) was designed to test the second null hypothesis which was stated as follows:-

Ho:2: There is no significant difference between the cultural model approach (TSTP) and the traditional model approach of teaching primary science in items of effectiveness in the acquisition of science skills and knowledge by the nomadic pastoral Fulbe.

The PSAT scores for the two groups exposed to TSTM and TSTP Curricular materials are presented below.

Table 4.4 PSAT 'T' Scores from Mazat Ropp and Dogo Gashish Nomadic Primary Schools.

Test	TSTM Group Mean	TSTP Group Mean	df	t
t_1	71.43	89.64	28	-1.67*
t_2	74.29	60.36	28	-1.11
t_3	43.57	90.71	28	-4.19*
t_4	52.86	88.57	28	-3.00*
t_5	45.7143	88.57	28	-3.69*
t_6	35.71	88.57	28	-4.77*
t_7	43.57	85.7	28	-3.19*
t_8	32.67	67.50	27	2.62*
t_9	32.143	46.66	27	-1.04
t_{10}	29.33	59.64	27	2.17*

*Significant at p 05

4.5 PSAT Data Analysis

In all the ten tests only in one test the TSTP group scored lower than the TSTM group. The TSTP group had evidently performed better than the TSTM in nine out of ten tests. This was a very significant development, and the results clearly indicate the superiority of the TSTP group over the TSTM group.

The test for the difference of two means indicated a significant difference in seven and no significant difference in three tests. The TSTP group has therefore performed significantly better in seven out of ten cases. The null hypothesis was consequently rejected and the conclusion made that the cultural model approach (TSTP) was more effective in teaching science to nomadic pastoral Fulbe than the traditional model approach TSTM.

4.5 The SCPTAT Data

The data collected with the science Cognitive Preference Test After Treatment (SCPTAT) was used to test the remaining four null hypotheses. The SCPTAT data was organized according to the order the null hypotheses were stated in chapter one. The null hypotheses were therefore stated as follows:-

No: 3: There is no significant difference in the cognitive preferences for recall of facts in science between the pastoral children taught by the cultural model approach (TSTP) and those taught by the traditional approach (TSTM).

Table 4.5a: Descriptive Statistics of SCPTAT Scores (Recall Scale)

Statistics	Sample	
	TSTM N = 32	TSTP N = 33
Mean	3.22	1.36
Standard deviation	0.83	0.69

These scores were then compared using a one-way analysis of variance (ANOVA) as indicated in the table below.

Table 4.5b: Analysis of Variance Among SCPTAT Scores (Recall) of TSTM and TSTP Groups.

Source	Sum of squares	df.	Mean square	f
Between groups	53.91	1	55.910	49.93*
Within groups	37.10	63	0.59	

*Significant at p/.05

The null hypothesis was consequently rejected. The TSTM group has demonstrated higher preference for recall than the TSTP.

Ho: 4: There is no significant difference in the cognitive preference for Fundamental Principles in Science between the pastoral children taught by the cultural model approach (TSTP) and those taught by the traditional approach (TSTM.

Descriptive statistics of Fundamental Principles Scale were calculated as shown below.

Table 4.6a: Descriptive Statistics of SCPTAT Scores (Fundamental Principles Scale)

Statistics	Sample	
	TSTM	TSTP
	N = 32	N = 33
Mean	2.00	2.55
Standard deviation	1.16	1.12

Table 4.6b: Analysis of Variance Among SCPTAT Scores (Fundamental Principle Scale) of TSTP and TSTM Groups.

Source of Variance	Sum of squares	df	Mean squares	f
Between groups	4.83	1	4.83	3.71
Within groups	82.18	63	1.30	
Total	87.01	64		

Significant at $p < .05$

This null hypothesis was not rejected and consequently, concluded that there was no significant difference in the Cognitive Preference for Fundamental Principles in Science between the TSTM and TSTP groups.

Ho:5 There is no significant difference in the cognitive preference for Practical Application in Science between the pastoral children taught by the cultural model approach TSTP and those taught by the traditional approach (TSTP).

SCPTAT Scores (Practical Application) were analysed as indicated by the tables below:

Table 4.7a: Descriptive Statistics of SCPTAT Scores (Practical Application Scale).

Statistics	Sample	
	TSTM group	TSTP group
	N = 32	N = 33
Mean	2.34	3.20
Standard deviation	1.04	0.98

These scores were then compared as indicated below.

Table 4.7b: Analysis of Variance Among SCPTAT Scores (Application Scale) of TSTM and TSTP Group.

Sources of Variance	Sum of squares	df	Mean square	f
Between groups	11.41	1	11.410	11.21*
Within groups	64.13	63	1.02	
Total	75.53	64		

*Significant at p./.05

The null hypotheses was rejected and the conclusion was made, that there was a significant difference in the cognitive Preference for Practical Application in Science between the tTSTM and TSTP groups. The TSTP group had demonstrated higher performance for the practical application scale than the TSTM group.

Ho: 6: There is no significant difference in the cognitive preference for critical questioning of information in science between the pastoral children taught by the cultural model approach (TSTP) and those taught by the traditional approach (TSTM).

Table 4.8a. Descriptive Statistics of SCPTAT Scores (Critical Questioning Scale).

Statistics	Sample	
	TSTM	TSTP
	N = 32	N = 33
Mean	2.09	2.82
Standard deviation	1.23	0.73

The scores were then compared in the following table.

Table 4.8b. Analysis of Variance Among SCPTAT Scores (Critical Questioning Scale) of TSTM and TSTP Groups.

Sources of Variance	Sum of squares	df	Mean square	f
Between groups	8.53	1	8.53	8.44*
Within groups	63.63	63	1.01	
Total	72.15	64		

*Significant at p./.05

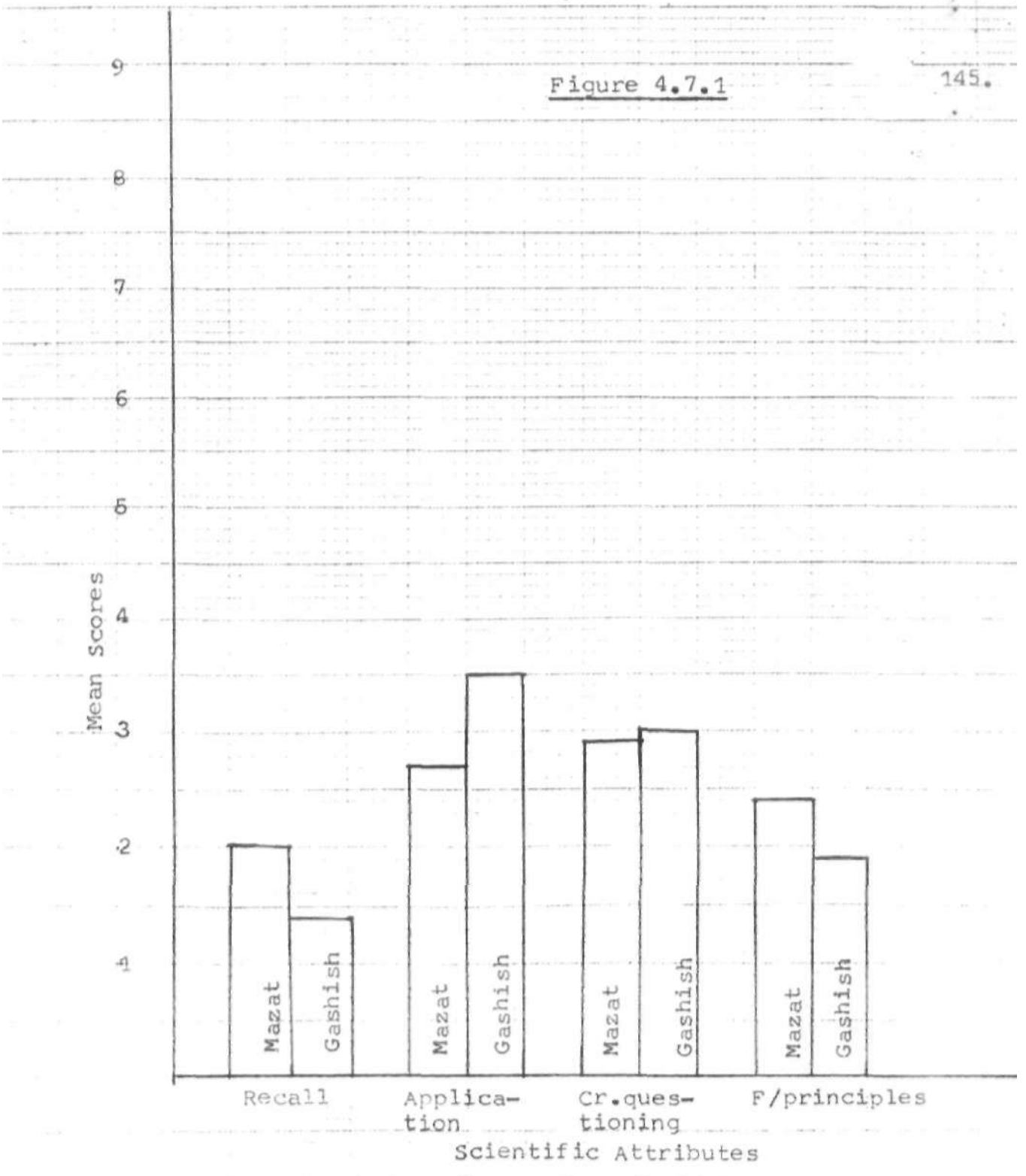
The null hypothesis was rejected and consequently concluded that a signifiant difference existed in the two groups. The TSTP groups had demonstrated higher preference for critical questioning scale than the TSTM group.

4.7 Summary of Findings.

The higher preferences shown by the 'TSTP' group in the scales of Practical Application and Critical Questioning correlated highly with the earlier findings in this research by the SCPTBT data. This relationship could be seen from the graphs on pages 160 and 161. The graph on page 161 depicts the Cognitive Preferences of 'TSTM' and 'TSTP' groups from the SCPTAT data. The TSTP preferences in SCPTAT are similar to the SCPTBT preferences. The dominant preferences in the SCPTBT were reinforced in the 'TSTP' curriculum. This was why the group maintained the similar trends whereas the TSTM group clearly lost the trends after the TSTM treatment.

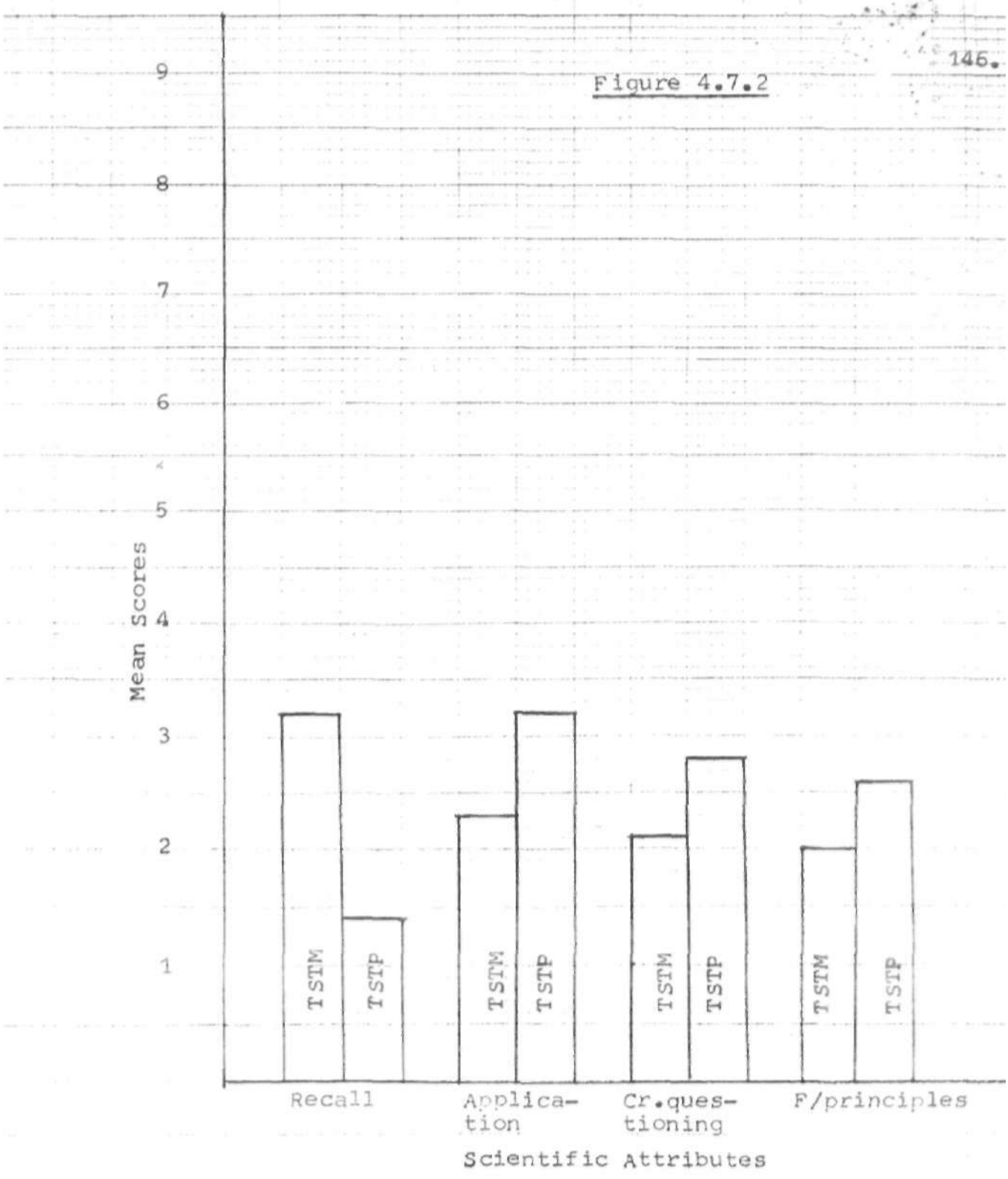
There was no significant difference between the two groups in the fundamental Principles. The TSTP curriculum did not evoke the acquisition of Fundamental Principles in its design. This was because it was considered adequate enough at this stage of the children to have critical questioning preference rather than Fundamental Principles. The TSTM material also failed to develop Fundamental Principles.

Figure 4.7.1



SCPBT: Mazat Ropp Versus Dogo Gashish

Figure 4.7.2



SCPTAT: TSTM Versus TSTP

CHAPTER 5

5.0 DISCUSSIONS, SUMMARY AND RECOMMENDATIONS.

5.1 Introduction

This chapter discusses the research findings and summarizes the important aspects of the research. In conclusion it made some recommendations on the use of the curriculum package developed in this study and lastly, outlined some suggested ares for further research.

5.2 Discussions

The peculiarities of a research, define its methodological tools. Various research designs and their accompanied statistical measures are only applicable where the utility and superiority in bringing out the research problem clearly into focus is attested to, by the functional unity of the instruments in their mapping operations. The canon of parsimony the burden of proof is the concern of every scientific research. In a research like the one being reported here, where the research problem is located in a particular society with certain distinct characteristics calls for a synthetic methodology capable of bringing together many approaches to the problem, so that in the end, a cluster of systematic data is collected. The benefits derivable from this

kind of multi-approach Methodology are many and immense. It is in this regard, that the approach was chosen for this research.

The difference in the ontological stance of scholars since the days of Francis Bacon have largely been responsible for the polarization of research methodologies into two competing paradigms viz: quantitative and qualitative research models. From the assumptions and goals of the scientic methods, scholars take their departure. Some believe that the natural science method is suitable for both the natural science and the social science. This stance gave rise to 'empiricism' from the days of Francis Bacon (1561-1626) and later to 'positivism' since the days of Auguste Comte (17-1857). This tradition of research sees the application of natural science Methodology to the study of man, yielding a positive science of society. In this regards many quantitative research techniques were developed. The positivists approach has appeared dominant in the works of prominent functionalists, such as, Emile Durkheim. According to Smith (1973:9) Functionalism is responsible for the development of multivariate statistics and cybernatics models.

Other scholars do not believe that the natural science method (quantitative) could be employed successfully in the social sciences. They argued that man is capable of reasoning and therefore unlike matter or other animals, he gives meaning to situations and also knows the right behaviour to apply to any situation according to what his culture has taught him. In this direction, Atkinson (1971 and 1978) rejects the logic and procedures of the positivist methodology. This school came to be known as phenomenology. The phenomenologists call for a separate methodology (qualitative) for the Social Sciences.

The triangulation of the qualitative and quantitative research paradigms has benefitted the study in so many ways. In the first instance, the ethnographic data furnished the study with relevant cultural materials that were used to give the curriculum a cultural flavour. In this regards, cultural items like birdude, sauru, jolloru etcetera, were adequately utilized. The nomadic pastoral Fulbe calendar, was also another relevant information collected from the ethnographic study, and which determined the design pattern of the curriculum. Names of people and places collected during the ethnographic study period were also used in the curriculum. The Cultural Story telling

sessions in the night used by the nomadic pastoral Fulbe to impart knowledge to their children was equally used in the design and development of the curriculum. Two little girls, Tumba and Geno are the main characters in the curriculum.

The quantitative method equally benefitted the study tremendously. The Cognitive Preferences of the children were mapped out even before the development (building) of the curriculum. Furthermore, their Cognitive Preferences were collected after the treatment of the curriculum to the experimental group. The comparison of the TSTP and TSTM groups and their subsequent evaluation with PSAT were all provided by the quantitative method.

The use of qualitative and quantitative modes of inquiry in tandem has fruitfully provided a proper blending of the curriculum with adequate cultural flavour based on precise knowledge of the learner-characteristics. Nolan and Short (1985:16) report the benefits of this type of research in the following:

> The use of qualitative and quantitative modes of inquiry in tandem can lead to a more complete and comprehensive understanding of educational programs. According to Madey (1982), the complementary use of

> qualitative and quantitative modes of inquiry can improve the sampling framework, help to establish the priority of information needs, improve instruments for data collection, help to derive the conceptual framework for data analysis directly from the data, make use of case studies to illustrate statistically derived models -, identify, representative and non-representative cases and correct the holistic fallacy of qualitative designs.

The results of this study have clearly testified to the advantages of the triangulation of the two methods just referred to by Nolan and Short (1985:16). The widening of the research sample and population by the employment of an ethnographic case study of some selected families has clearly complemented the small samples of the research experimental designs. The information gathered by the ethnography has further complemented the data collected by the instruments of SCPTBT and SCPTAT.

The selection and treatment of eco-cultural data in the development of primary science curriculum package derived from this research study has come at a time when educationalists are realizing the importance of the socio-cultural filter in the development of any educational programme even if it is science. In this regards, Lennon (1988) states; "It has been amply demonstrated through educational research that the

outcome of the transmission of knowledge in school depends to a large extent on the cultural characteristics of the pupils". In the same vein Jegede (1990:10) and Urevbu (1984) are of the opinion that it is imperative to take into consideration the African thought system in relation to curriculum development.

The first null hypothesis to be tested was aimed at (1) testing the homogeneity of the populations in the two schools and (2) finding out the pattern of cognitive preference in the two schools. The SCPTBT instrument was specifically designed to test this hypothesis. The results indicated that there was a homogenous performance in the two schools and that further indicated that the pattern of cognitive preference was also the same in the two schools. The only slight difference was that the bipolar Q - A (Questioning -application) scale was generally slightly higher in the Gashish group than in the Mazat group.

The results failed to establish any significant difference between the two schools in the pattern of their cognitive preference. Similar trends were earlier discovered by Tamir and Kampa (1978) when they compared three types of schools with a view to

correlating the cognitive preference with the students characteristics (such as gender, region or hoppy). Similar findings were also obtained by Tamir and Lunetta (1978).

The higher preference for the Q-A scale as against their low preference for the P-R scale may also be gleaned from Kampa and Dube (1973) which suggests that:

> A high positive (Q-R) Score difference may be taken as an indication of a students' willingness and desire to acquire scientific knowledge beyond that already possessed. A high negative (Q-R) score difference, in turn, would suggest an intrinsic satisfaction with knowledge already gained and hence memorized. The quality of ambition to learn more would be lacking in such a student.

From this g suggestion or interpretation of Kampa and Dube (1973), the Mazat and Gashish children have demonstrated an indication or willingness to learn more and go beyond the knowledge they have already possessed from their environment. Also Jungwirth (1980) offered what he saw as an alternative interpretation to the findings of cognitive Preference Test (CPT). According to Jungwirth (1980):

> High Q scores indicates a willingness to go beyond the familiar, low R scores indicate a distaste for the already familiar - an intrinsic dissatisfaction with "knowledge already gained and hence memorized". High R scores indicate the opposite, a penchant for the hitherto unfamiliar. Hig Q's and High R'S may thus be regarded as manifestations of the same cognitive preference, i.e. the "quest for the unknown" High R students can thus not simply be described as "lacking the ambition to learn".

According to this interpretation both high R's and Q's scores mean the same thing - "the quest for the unknown". Even in this regards, the mazat and Gashish groups have qualified to be considered willing to learn further. The bipolar R-Q scale termed as "the curiosity scale" by Kampa and Dube (1973) has been noted to feature prominently in the 'CPT' mode inter correlations and factor analyses. From these trends, Kampa and Dube used the derived Q-R scores to characterize students or their populations, as earlier quoted in this section.

The almost identical score of the mazat and Gashish children on the P - A scale was however difficult to explain. It is simply in contradiction with CPT research findings. For example Vanden berg

et al (1978) found out that from their science cognitive preference Test 'SCPT' data analysis, the Q-R scale appeared to have higher or stronger construct validity than the P-A scale. This situation does not suggest itself in the present study.

A possible explanation on the P - A scale here, could be that the children at this level could easily be confused in sorting out the fundamental principles scale from that of the questioning. It could also be inferred that their high scores on Q and A scales might have some correlations with the teachings of Pulaaku which regards the principle of alertness and observation Hakkilo as its corner stone.

The second null hypothesis to be tested was aimed at finding out the difference, if any in achievement, between the TSTP group and the TSTM group. The TSTP group performed significantly better in seven out of ten tests and had higher means, in nine out of the ten tests. This superiority of the TSTP measured by PSAT has clearly linked their achievement with the actual cultural blending of the curriculum materials. This further suggests the need to ascertain learner-characteristics before the development of any primary science curriculum.

The third nullhypothesis to be tested was aimed at finding out the difference if any, in the recall of scientific facts between the children exposed to TSTP

curriculum and those exposed to TSTM curriculum. This nullhypothesis was rejected. The TSTM group scored higher in the recall scale than the TSTP group. This pattern of findings where students who follow traditional curriculum obtain higher scores in recall scale than those who follow inquiry oriented curriculum has been consistent since Heath (1964) according to Tamir and Lunetta (1978). The TSTM group had evidently lost the earlier pattern in the SCPTBT where Application and Questioning scales were the most preferred preferences. The TSTP group however retained this pattern and the only possible explanation could be that the TSTM curriculum depressed their traditional preferences of Application and Questioning in favour of recall scale. On the other hand the TSTP group could only have maintained the traditional pattern of low preference for recall with the aid of the TSTP Curriculum, which was specifically designed to perform this function. Again, this pattern of preference between the students who followed traditional curriculum and those who followed the new curriculum has been a recurrent issue from Heath (1964) to Tamir and Kampa (1978) and Tamir and Lunetta (1978).

The fourth nullhypothesis to be tested and the second to be tested with the 'SCPTAT was aimed at finding out the difference if any, in the fundamental principles scale between the TSTP and TSTM groups.

There was no significant difference between the two groups in this scale. It was earlier stated in this section that even in the SCPTBT data analysis the 'P' scale was second to the least preferred scale ('R'). This could be explained as earlier pointed out due to the age of the children. It could be difficult for them probably to differentiate between the 'P' and the 'Q' scale. This argument may even be more credible if it is considered that the two groups after being treated separately still maintained the same pattern of 'P' scale preference. From the CPT research findings, Tamir and Lunetta (1978) indicated that senior grades had higher preference scores for "Principles" and they said this tendency was also noted in the previous CPT studies.

The fifth nullhypothesis was aimed at finding out the difference if any, in the practical application scale between the two groups. The TSTP group scored significantly higher than the TSTM in this scale. The TSTP group has maintained the same pattern from the SCPTBT analysis.

The sixth nullhypothesis tested for the scale of critical questioning. It was found out that the TSTP demonstrated significantly higher preference for critical questioning scale than the TSTM group.

The SCPTAT data analysis indicated a general trend in the TSTP group with higher derived "curiosity scale" - the Q-R bipolar scale, on the other hand the

TSTM group came out with a high negative Q-R.

The higher scores by TSTP group in the Application and Questioning scales were considered desirable scientific attributes in this study because the developing nations probably need scientists that can address the needs of their societies. In this regards, the modes of critical questioning and practical application of science are two cognitive preferences which could lead to the development of science education for development and transformation.

It is perhaps, in this direction that the new developments in science education are focusing more attention on the inter relationship of science, technology and society. Such an emphasis is at the centre of science-technology-society (STS) curricula.

The better performance of the students exposed to the cultural model approach (TSTP) in this study as against those exposed to conventional approach of teaching science referred to here as (TSTM) is ample evidence to suggest the need for the incorporation of the pupils cultural environment in the development and teaching of science curricular materials. The need to understand from the scientific point of inquiry, the pupils learning characteristics is equally an important dimension which this research study has accomplished.

The study has achieved its objectives and has demonstrated significant difference in the cognitive preferences of recall, application and critical questioning, whereas it has demonstrated the non-significance of difference in the fundamental principles of science in the two groups exposed to two curricular materials (TSTP) and (TSTM).

The achievement of the TSTP group was also much higher than the TSTM group. Analysis of the Primary Science Achievement Test has shown that the TSTP group had greater mean score in nine out of ten tests. The application of the test has further strengthened this position by returning significant difference of means, in seven out of ten tests.

The research study has demonstrated a viable method of encapsulating curricular materials with relevant cultural filters. The results of the study are good testimonies for understanding some of the processes involved in designing and developing a curriculum which is in harmony with the environmental conditions of the learner.

The nomadic Education programme will require this type of curriculum venture since the programme requires new curricular materials which fit the immediate cultural environment of the pastoralists.

It is important to understand that the business of curriculum Planning and Development requires the articulation of curriculum elements into a pgoramme that can deal effectively with emerging situations. The specific areas which require articulation are: (1) Organisational structure. (2) Relationships and involvement of line and staff personnel in curriculum planning processes and activities (3) The organisation of subject matter, instructional activities and materials across the grades of schools in the same developmental levels such as all the elementary schools in a local government, state or country. Another aspect of this area is the similar concern across elementary schools, secondary schools and tertiary institutions. (4) The mechanisms for curriculum renewal by utilizing curriculum elements and processes.

Specific Organisational settings can be developed to achieve the articulation of the four areas highlighted above (Beane et al). Apart from components such as the foundation (Psychology, Sociology and Philosophy) areas, development of goals and the statement of objectives, there are other aspects of curriculum development and planning which should be carefully considered by any curriculum worker. These other components are called 'decision screen'. In specific teaching-learning situations at least five decision screens are stated by Beane et al (1986: 173-174), they are:

1. The characacteristics of learners - which focus on understanding the children for whom the curriculum is intended.
2. The nature of learning - which involves the understanding of the learners ideosyncracies in processing learning materials.
3. General resources - focuses on such areas as finances, time, equipment, facilities and the curriculum.
4. Curriculum approaches - which involves the selection of an organisational pattern around which the curriculum is developed.
5. Organised knowledge - this provides specific concepts or techniques that guide teachers and inform learners in the process of instruction.

The decision screens which pose greatest challenge to the nomadic education planning and organization are: (1) the characteristics of the learners, and (2) the nature of learning.

The nomadic education programme or any minority education programme derives its essence from the disadvantaged position of its subjects in the society. An education conceived for a culturally disadvantaged minority group ought to understand necessarily the cultural apparatus of the minority group with specific reference to their mode of cognition before embarking on the programme.

Consequently, the entire social and economic systems of the group should be vigorously excoriated so as to arrive at the nexus which capture the real life problems on which education could be designed either to perpetuate or gradually eliminate them. The education of the minority peoples is a complex and challenging issue. It is more than mere teaching and learning reading, writing and arithmetic (the so called 3Rs) skills. This is not to suggest that the teaching of the 3Rs is not needed but to say that the concept of minority education is built on the ground that the main education programme is conceived from the cultural background of the majority group and therefore cannot adequately cater for a minority group, hence the need for an educational programme which specifically take the culture and the entire living conditions of the minority into account.

From this perspective it is imperative to study carefully the cultural characteristics of the learner. The cultural characteristics considered in this study could possibly be selected. They are: (1) the cognitive nature of the learner with special emphasis on his/her cognitive preferences. (2) the physical environment of the learner, and (3) the occupation/subsistence means of the learner. A curriculum built from the perspectives of these three cultural characteristics will surely achieve any minority education goals and

objectives. Fleming (1987) testifies to this approach when he says:

"For the designers of curricula with a socio-scientific focus, the issues are more complex. Such science curricula require as content both knowledge of the physical world and knowledge of the social world. Pedagogy in such curricula would require students to integrate knowledge from the two areas or domains".

5.3 Summary Of Findings

The study was set to test six null hypotheses. Four were rejected and two were not rejected. After carrying out analysis of variance (ANOVA) on the SCPTBT data, it was found out that the nomadic pastoral Fulbe children have higher preferences for Practical Application and Critical Questioning. They have their lowest preference score in Recall. Fundamental Principle was the second least preference. After the TSTP materials were developed and tested against the TSTM materials, SCPTAT was administered in the two groups. After an analysis of variance (ANOVA) was carried out, the results demonstrated significant difference in three out of four cognitive preference scales, namely: Recall, Application and Critical Questioning. There was no significant difference between the two groups in the scale of Fundamental Principles. The TSTM group has higher preference for Recall whereas the

TSTP had higher Preference for Application, and Critical questioning. These were the preferences of the two groups even before the TSTP materials were developed. The TSTP materials were infact developed to reimpose the earlier findings of the SCPTBT. It could be seen that the TSTM has lost the preferences after they were treated with ordinary curricular materials (TSTM), whereas the TSTP group has maintained their preferences as they were before the treatment of TSTP materials.

The Primary Science Achievement Test PSAT was administered to the two groups and after the test analysis, results indicated that the TSTP has significantly done better in seven tests out of ten.

5.4. A Brief Guide For Using The TSTP Curriculum Package.

The Primary Science Curriculum Package for the Nomadic Pastoral Fulbe enrolled in the nomadic Education programme, developed in this study is presented in appendix II. The design pattern was as follows: The entire Curriculum was built on a story of two girls Tumba and Geno who move with their parents according to the dictates of the five seasons of the pastoral Fulbe calendar and each season forms one module which is divided into a number of Units. The five modules make up one cycle. Each module covered one major theme which is the most

prominent phenomenon in that season of the year. The same themes were taken up for the second year in cycle two but with more emphasis on them. The frame provides for a spiral curriculum. Consequently, the same theme continued up to the sixth cycle which marks the end of Primary Education. Each succesive year puts more emphasis on one major topic under the theme. In this way, the curriculum is both spiral and continuous. Each module is accompanied by an integrated process-skill test with some items drawn also from the content domain requiring the student to satisfy one of the Bloom's level of Educational objectives in the cognitive domain. The Piagetian cognitive development stages were also utilized in a similar fashion to that employed by the Australian Science Education Project. Eggleston (1975:117) reported a modified model of the Australian Project, which provided a guide to the selection of aims and the sequencing of learning experiences as shown below.

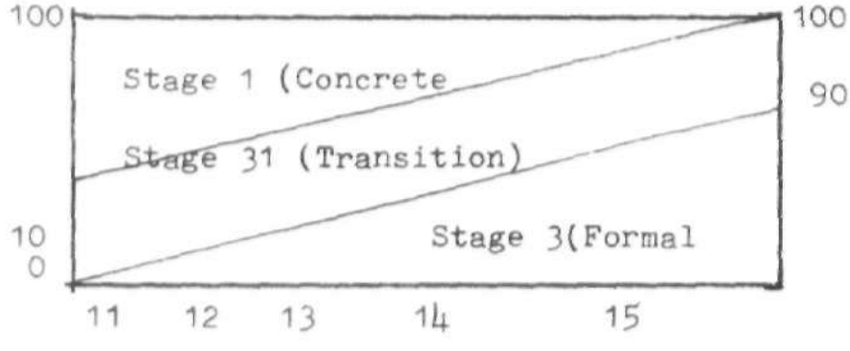


Figure 5.4.1 Sequencing of learning experiences

As the years increased the contents of the curriculum became more formal and less concrete through a transitional stage as indicated in the above diagram. In this manner the modules and cycles were arranged into a hierarchical order as could also be depicted in the diagram below:

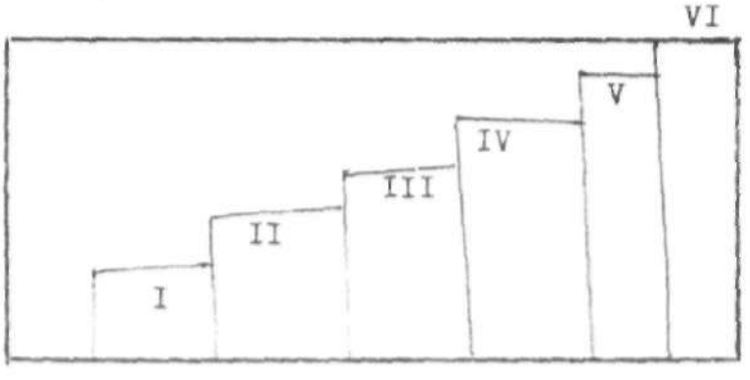


Figure 5.4.2 A hierarchical Development

The topics covered for the six year schooling were drawn from the national Primary Education Science Core Curriculum as outlined by the Federal Ministry of Education (1984:13-14) titled "Core Content Syllabus for Primary Science Education.

A readability assessment inventory also designed to accompany the curriculum is found in appendix IV of this study.

The readability assessment inventory consists of a recommended study method (the SQ3R). This study

method was first developed by Robinson (1961) the SQ3R formula stands for survey, question, Read, Recite, Review. The other inventories contained here are: the Observation Check list, the Group Reading Inventory (GRI) and the Skill Inventory. The readability of the TSTP curricular materials could therefore be measured by applying the inventories whenever required.

5.5 Suggestions For Further Research

1. From the evidence presented by this study there is need to carry out similar research design so as to develop Primary School Curriculum for the nomadic pastoral children in the areas of Social Studies, Health and Physical Education, and Mathematics.

2. The evidence also suggests the need for this type of curriculum research to cover the entire groups in the country whether nomadic or sedentary.

3. There is also the need to engage in similar research with a view to adapting a curriculum renewal methodology.

4. The building of curricular materials through relevant cultural filters ought not to stop at the level of Primary School alone, but needs to cover the entire fabric of the educational system.

REFERENCES

Abah, O.C. (1988) "A study of the cognitive preferences of students exposed to two different" Biology syllabuses in selected Nigerian secondary schools. - Unpublished Ph.D. Thesis, ABU, Zaria.

Adams, M. (1982) "The Baggara Problem: Attempts at Modern Change in Southern Darfus and Southern Korodofan (Sudan)". In Development and Change, SAGE Publishers: London, Vol. 13 pp.259.289.

Ajayi, J.F.A. and Crowder, M. (1976) History of West Africa: Longman; London, Vol.1 pp. 98-102.

Althusser, L. (1971), "Ideology and State": In: Lenius and Philosophy and other Essays. New Left Books: London. pp. 123.173.

Amin, S. (1975), Unequal Development. Monthly Review Press; New York.

Atkinson, J.M. (1971), Societal Reactions to Suicide in Conen Macmillan; London.

Atkinson, J.M. (1978), Discovering Suicide. Macmillan London.

Atwood, R.K. (1968), "A Cognitive Preference Examination". Journal of Research in Science Teaching. 5: pp. 34-35.

Atwood, R.K. (1971) "Development of a Cognitive Preference Examination utilizing General Science and Social Science Content". Journal of Research in Science Teaching. Vol. 8, No. 3, pp. 273-275.

Aronson, D.R. (1984) "Pastoralism in Contemporary Development Perspective". In Nomadic Peoples. No. 16, October 73-83.

Ary, D. et al (1979): Introduction to Research in Education. Holt Rinehart and Winstor, NY, p. 255.

Baker, R. (1975): 'Development' and the Pastoral Peoples Karamoja, North Eastern Uganda: An Example of the Treatment of Symptoms. In Monod T(Ed) Pastoralism in Tropical Africa, Oxfort University Press Ibadan.

Bello, G.A. (1986), "The Fulani way of life (Lawol Pulaako) A paper presented at Yola Workshop, on Nomadic Education, December, 1986.

Beany A.J. et al (1986), Curriculum stanning and Development Allyn & Bacon; Boston.

Benstein, B. (1971) "On the classifications" and framing of Educational Knowledge". In Young; D.F.M. (Ed) Knowledge and Control. Collier 26 - Macmillian; London, pp. 47-69.

Berger, P. and Luckman T. (1967), The Social Construction of Reality, Ancher Books; New York.

Bernal, J.D. (1969), Science in History The M.I.T. Press, Cambridge, Massachusetts.

Bernstein. H. (1977) African Peasantries: a Theoretical Framework. In The Journal of Peasnt Studies. 421-443.

Blalock,/Jn. and Blalock, A.B. (1971), Methodology in Social Research. McGraw-Hill; London, p. 248.

Boulding, E.K. (1982), "Social Ecosystems". In Society Vol. 20, No.1, Nov/December, pp. 14-16.

Bowles, S. and Gintis, H. (1976), Schooling in Capitalist America. Routledge and Kegan Paul Ltd; London, pp. 131-132.

Brown, S.A. (1975), "Cognitive Preferences in Science: Their Nature and Analysis, Studies in Science Education, Vol. 2, pp. 43-65.

Blangnernon, C. (1954) - "The Schools for Nomads in the Hoggar", in Unesco's Fundamental and Adult Education, Vol. Vi, No. 1.

Bobbitt F., (1918) The Curriculum Houghton Mifflin; Boston.

Butterfield, F. (1982), China: A life in the bitter Sea. Times Books; New York, pp. 427-429.

Chanan, G. (1976), "Culture and Equality in Education". The Journal of Educational Research. No. 18, Vol. 2, 109-110.

Chaynov V.A. (1966) The Theory of peasant economy. Irwin; London.

Chen, D. (1983), Organising Science in the Primary School. In Harl N.W. (Ed) New Trends in Primary School Science Education, Unesco; Paris, pp. 17-23.

Caludia B.D. and Kahle B.J. (1978), The effect of instructional sequence and cognitive style on the achievement of High School Biology students. Journal of Research in Science Teaching. Vol. 15 Issue 5. pp. 407-412.

Cobern, W.W. (1983) "The Fulani dilemma: Nomadism and Education". West Africa Magazine. p. (1983).

Cremin, L. (1971), "Curriculum Making in the United States". Teachers College Record, 2 (12), p.213.

Cronbach, L.J. & Snow, R.E. (1977) Aptitude and Instructional Methods. A Handbook for Research on Interactions. Irvington Pubs; New York.

Crotty, R. (1980) Cattle economics and development Common Wealth Agric Bureau. London.

Dart E.F. and Pradham L.P. (1967) Cross Cultural Teaching in Science. Science 155 pp. 649-56.

Dawson,M.J.(1967) Cultural and Physiological Influences on Spatial Perceptual Processes in West Africa. International Journal of Psychology, Vol. 2

Davis, S. Haris, J: Traynor, S. (1980), Community based Science Programmes for Aboriginal Schools. Developing Education Vol. 7, pp. 205-212.

Ebel, L.R. (19) "Some Limitations of Basic Research in Education" in Anderson C.R. et al (Eds) Current Research on Instruction. Prentic-Hall Inc. Englewood Cliffs, N.J. p.18.

Eisner, E.W. (1967), Instructional Objectives: help or hindrance. The School Review, 75, 250-260.

Eggleston, J.F. (1974) "Principles of Curriculum Design". In Sutton, C.R. and Haysom, J.T. (Eds). The art of science teacher. McGraw Hill; London, p. 117.

Elkana, Y.(1978) Toward A Metric of Science: The Advent of Science Indicators. John Wiley and Sons, NY.

Ehindero (1982), "Efects of ecocultural Factors in Operational thought among some Nigerian Adolescents". In The Journal of Research in Science Teaching, Vol. No. p. 451-457.

Esland,M.G. (1971), "Teaching and learning as the Organization of knowledge". In Young D.F.M. (ed) Knowledge and Control. Collier Macmillan London.

Ezeomah, C. (1985) Participation in the Education of mobile minority groups; The Nomadic Fulani of Nigeria. International Journal of Nomadic and Minority Education. Introductory Issue. pp. 6-15.

Field, W.T. and Cropley, J.A. (1969), "Cognitive style and Science Achievement". Journal of Research in Science Teaching. Vol. 6, pp. 2-10.

Fleming, R (1987) 'How students reason in socio-scientific issues in Iowe (ed) Teaching the intractions of science Technology and society.

Frank, A.G. (1967), Capitalism and Underdevelopment in Latin America: Historical Studies of Chile and Brazil. Monthly Review Press; New York.

Frantz, C. (1975), "Pastoral Societies, Stratification, and National Integration of Africa". Research Report No. 30 by Scandivanian Institute of African Studies, p.

Frantz, C. (1980), The Open Niche, Pastoralism and Sedentarization in the Mambila Grasslands of Nigeria. In Zaizman C.P. (Ed) When Nomads settle: Processes of Sedentarization as adaptation and Response, J.F. Bergin Publishers Inc. New York, p.64.

Frantz, C. (1978), Ecology and Social Organisation among the Nigeria Fulbe, (Fulani). In Weissleder W. (1978) "The Nomadic alternatives: Modes and Methods of Interaction in the African-Asian Deserts and Steppes" World Anthropology Mouton Publishers; Paris p. 100.

Freyberg, P. et al (1983), "The Learning in Science Project". In Harlen, W. (Ed). New Trends in primary School Science Education. UNESCO, Paris. pp. 111-119.

Gage, L.N. (1989) "The paradigms wars and their aftermath. A Historical Sketch of Research on Teaching Since 1989, Educational Researcher.

Galaty, G.J. and Salzman, C.R. (1981), Change and Development in Nomadic and Pastoral Societies, E.J. B rill; Leiden, the Netherlands, p. 13.

Goldstein K.M. and Blackman, S. (1978) Cognitive Style. J. Wiley and Sons; New York.

Gorham, A.B. (1978), "The Design and Management of Pastoral Development: The Provision of Education in Pastoral areas". Pastoral Network Paper 6b/1978 Overseas Development Institute, London, 44 pages.

Haffenden, W. Jr. (1967), The Redmen of Nigeria Frank CAS and Co. Ltd, London, pp.

Harris, H.T.B., (1985), "In Defence of Minorities. International Journal of Nomadic and Minority Education. Introductory Issue, pp. 4-5.

Heath, W.R. (1964) "Curriculum Cognition, and Educational Measurement". Educational and Psychological Measurement, Vol. XXIV, No. 2, pp. 239-253.

Helland J. (1980): Five Essays on the Study of Pastoralists and the Development of Pastoralism, African Savannah Studies Occasional Paper No. 20 March BSI.

Hedlund, H. (1977), Contradictions in the Peripheralization of a Pastoral Society: The Maasai, A review of African Political Economy, No. 15/16 May - December.

Heron, P. (1983), "Education for Nomads". In Nomadic Peoples. No. 13, July pp. 61-68.

Hicks, W.D. (1981), Minorities. A Teachers Resource Book for the Multiethnic Curriculum. Heineman Educational Books; London, pp. 3-15.

Hudson D. and Prophet, R.B. (1983) "Why Science Curriculum Changes - Evolution or Social Control?" In The School Science Review. Vol. 65, No. 230. pp. 5-18.

Iffih, B.N. (1983), "Ethnography and Major Approaches in Ethnographic Research". In Journal of Liberal Studies. Vol.1, No.1 and 2 October.

Jegede; J.O. and Okebukola, P.A. (1989), Some socio-cultural factors militating against Drift Towards Science and Technology in Secondary Schools. Research . Journal of Research in Science and Technology Education.

Jegede, J.O. (1990), Eco-cultural pradigm and Science Technology and Mathematics Education in contemporary Nigeria. Journal of Research in Science and Technology Education. 7(2).

Junaid, M.I. and Ardo G.V. (1985), The Need for a Policy on Nomadic (Fulani) Education. In International Journal of Nomadic and Minority Education.

Jungwirth, E. (1980), "Alternative Interpretations of Findings in Cognitive Preferences Research in Science Education". Science Education Vol. 64 (1) pp. 85-94.

Kampa, R.F. and Dube G.E. (1973), "Cognitive Preference Research in Students of Chemistry", British Journal of Educational Psychology; Vol. 43, pp. 279-288.

Krader, (1968), Encyclopaedia of Social Sciences. London.

Koncacki, Z.A. (1978), The Economics of Pastoralism, Frank CASS: London, pp. 151-152.

Kitchen ,H. (1962) (ed.)- The Educated African, Praeger Publishers Inc., New York, pp. 509.

Lakatos, I. (1978) Mathematics, Science and Epistemology. Vol. 2, Cambridge University Press, London.

Lawson, E.A. (1980), "Relationships among level of Intellectual Development, Cognitive Style and Grades in a College Biology Course". Science Education, 64(1), pp. 95-102.

Lennon, O. (1989), Cultural Variations, Cognitive Styles and Education in Latin America. Prosepectus, Vol. XVIII, No. 3.

Lewis M.I. (1975), The Dynamics of Nomadism: Prospects for Sedentarization and Social Change. In Monod T (Ed) Pastoralism in Tropical Africa. Oxford University Press, Ibadan.

Lukacs G. (1923) History and Class Consciousness. Merhing Press, London.

Maddock, M. (1984), Culture and Attitudes to Enveroment, Health and Religion. 3rd International Symposium on World Trends in Science and Technology Education. Proceedings papers Vol. 1, p. 162.

Malinowski, B. (1944), A Scientific Theory of Culture and Other Essays. The University of North Carolina Press, Cape Hill. Chapel

Marjory-Dore, M. (1984), Recent trends in the Nature of Curriculum Porgramees and Materials. In Harlen, W. (Ed). New trends in primary science Education. Vol.I, UNESCO; Paris pp. 55-67.

Marx, K. (1901) Das Kapital Vol. I Progress Publishers Moscow.

Meek, K.C. (1971), The Northern Tribes of Nigeria (Vol. I): Frankcass and Co. Ltd., Ibadan.

Misnan, E.J. (1977), The Economic Growth Debate: An Assessment. George Allen & Unwin Ltd., London, pp.

Moris, J. (1981), Managing Rural Development. International Development Institutes: Bloomington Indiana.

Mukoshy, I.A. (1986), "The Transiency of Nomadism and Mobile Education" A paper delivered at the Yola Workshop on Nomadic Education, December 1986.

Nkanyangi, J.A. (1981) Education For Pastoralist: Development Planning by trial and error. In the Future of pastoralists people (eds) Galaty

Nolan, F.J. and Short, C.E. (1985), Combining Qualitative and Quantitative Modes of Inquiry to inform Curriculum Deliberation: A proposed Framework, Curriculum Perspectives Vol.5.

Ogunsola, M.F. (1981), "A study of cognitive styles among S.B.S. ABU Chemistry Students". Unpublished M.Ed. project, Ahmadu Bello University, Zaria.

Palmer, H.R. (1967), Sudanese Memoirs. London, p.79

Popper, K.R. (1976), "The logic of the Social Sciences". in Adorno et al : The Positivist Dispute in German Sociology, London.

Pratt, D. (1987), Curriculum design as humanistic technology. Journal of Curriculum Studies, Vol. 19, No. 2, pp. 149-162.

Reid, W.A. (1978), The Nature and Treatment of Curriculum Problems. Routledge Kegan Paul. London, pp.

Ribadu A. (1986) Education For Nomadic Fulani. A paper presented at the National Workshop on Nomadic Education held at Yola 4-6 November

Rigby, P. (1985), The Persistent Patrolists: Nomadic Societies in Transition. Zedbooks; London. p. 169.

Rist, R.C. (1977), "On the relations among educational research paradigms: from distain to detente". Anthropology and Education Quarterly. 8, pp.42-49.

Rostow W.W. (1960) The stages of Economic Growth The economic History Review 12 (1 -16).

Rist, R.C. (1982), "On the Application of Ethnographic inquiry to Education: Procedures and possibilities." Journal of Research in Science Teaching. Vol. 19, No. 6, pp. 439-450.

Ryndina, M.N. (1980) Fundamentals of Political Economy. Progress Publishers. Moscow. pp. 17-19.

Sarone Ole Sena (1981) "Education and socio-economic change: Maasai Responses In Kenya". Unpublished Ph.D. dissertation, Montreal.

Salzman, C.P. (1980), When Nomads Settle. Praeger Publishers; New York, p. 11

Salzman, CP. (1984) "Synthetic and multi causal approaches to the study of Nomadic peoples." Nomadic Peoples No. 16.

Schmedemann, G. and Lashier,Jr. W.S. (1967-68) Cognitive Preferences of Student's and Selected Characteristics of their PSSC Teachers. Journal of Research in Science - Teaching Vol. 87, No.1, pp.40.

Shanin T(1971) p.35 Peasants and Peasant Societies Penquin Books NY.

Shenton, R.W. and Lennihan L. (1977). Capital and Class: Peasant Differentiation in Northern Nigeria. Journal of peasant Studies.

Simpson et al- (p.38), Racial and Cultural Minorities; An Analysis of Prejudice and Discrimination. Harper and Row. New York.

Smith, D.A. (1973), The Concept of Social Change Routledge & Kegan Paul, London

Stenning, D.J. (1954), Pastoral Fulani of Northern Nigeria, Holt Rinehart and Wilson Inc; London, pp. 362-400.

Stenhouse, L. (1975), An Introduction to Curriculum Research and Development, Rciahrd Richard Clay Ltd; London, pp.

Taba, H. (1962), Curriculum Development: Theory and Practice. Harcourt Brace and World; New York, pp. 12-198.

Taylor, G. (1979), From Modernisation to Modes of Production: A Critique of the Sociologies of Development and Underdevelopment. Macmillan; London.

Tamir, P. (1975), "The Relationship Among Cognitive Preference, School Environment, Teachers' Curricular Bias, Curriculum and subject matter", American Educational Research Journal Vol. 12, No. 3, pp. 235-264.

Tamir, P. and Kempa, R.F. (1978). "Cognitive Preference in Biology of a group of talented high school students". Journal of Research in Science Teaching, Vol. 15, No.1, pp. 59-64

Tamir, P. and Kempa, R.F. (1978). Cognitive Preferences Styles Across three Science Disciplines". Science Education Vol. 62, pp. 143-152.

Tanner, D. and Tanner, L. (1980), Curriculum Development Theory and Practice. Coller Macmillan; London.

Toynbe, A.J. (1963), Study in History, Oxford University Press, London, Vol. III, pp. 7-22.

Tyler, R.W. (1949), Basic Principles of Curriculum and Instruction. University of Chicago Press, Chicago.

UNESCO, (1983), Science, Technology and Society, UNESCO; Paris.

Urevbu, A.O. (1984), "Cross-Cultural Teaching of the Interactions of Science: African Perspectives". In 3rd International Symposium on World Trends in Science and Technology Education; Proceeding Vol.1, pp. 313-320.

Uzzell, P.S. (1978), "The Changing Aims of Science Education". In School Science Review, No. 210, Vol. 60, pp. 7-20.

Van den berg et al (1978), Cognitive Preferences: Validation study. Paper delivered at the annual meeting of the National Association for Research in Science Teaching, Toronto, Ontario.

Varlet, H., and Massoumian, J. (1975),Education for Tribal Populations in Iran" in Unesco's Prospects, Vol. V, No. 2.

Von Ardo, G. (1989) Pastoralist and Educationalist: Notes, Analysis and Lessons from two dialogical meetings. A paper presented at HAEC Kano.

Von Renesse and Sponeck (1967) pg. 29.

Von Renesse, A.G. and Sponeck H.C. (1969): Nomadism in Afghanistan: A Socio-economic Problem - An attempt to analyse the Bachum Confrence.

Weiner, M. (1971), "Political Integration and Political Development, in Finkle L.J. and Gable W.R. (Eds) Political Development & Social Change, John Wiley & Sons Inc; New York, pp. 643-669.

West, D. (1982), The Environment and Ecology of Pastoralists in Arid Savannas. In The Journal of Development and Change. Vol. 13, SAGE Publishers, London, pp. 182-211.

Witkin, H.A. Dyk, R.B. Fasterson J.F. Goodenough, D.R. and Karp, S.A. (1962) Psychological Differentiation, John Wiley; New York.

Unpublished reports on the Nomadic Education Programme in Plateau, Gongola, Borno and Bauchi States read by their states delegates at the National Nomadic Education Workshop held at Yola in 1986.

Young F.D. (1971) Knowledge and Controll, Collier Macmillan; London.

APPENDIX I

The English translation of Science Cognitive Preference Test Before Treatment (SCPTBT)

Instructions

In this test ten major statements in Science are given. Each statement has four comments (a b c d) after it. All the four comments refer to the statement and they are all correct. You are expected to show how much you like each of the comments by way of awarding 4 points to the one you like best, 3 points to your second choice, 2 points to the third choice and 1 point to the statement you like least.

In the answer sheet you will find a space provided after each option that is:

1. a( ) b( ) c( ) d( ).

Your points should be written in these spaces for example if you like c best in the above example followed by d, b and a, then you will score it in this fashion:

1. a(1) b(2) c(4) d(3).

This example shows that a is the least preferred hence it has only 1 point and d is the second choice with two points. Thank you for your co-operation.

School ----------

Name ----------

Class ----------

Gender ----------

(1) a b c d

(2) a b c d

(3) a b c d

(4) a b c d

(5) a b c d

(6) a b c d

(7) a b c d

(8) a b c d

(9) a b c d

(10) a b c d



1. Ibrahim is taller than Sani

   (a) This means Ibrahim can reach an object hung on a tree which Sani cannot reach.

   (b) Ibrahim is not necessarily older than Sani. ✗

   (c) Since Ibrahim is taller than Sani he might be older than him.

   (d) The difference in height between the two boys could be correctly measured by a metre-rule.



2. A Camel is bigger than a Donkey.

   (a) Even though, a camel's load is heavier than a donkey's load, it could not be heavier than a lorry load.

   (b) The difference in weight could be found if a weighing machine (scale) is used.

   (c) It means a camel's load of thatch could be enough for one Bukka and that of a donkey wouldn't.

   (d) Since a camel is bigger than a donkey its load will also be heavier.



3. Two cups of water would not satisfy Ibrahim when he is thirsty.

   (a) If two cups of water are not enough for Ibrahim, he could be given a gallon of it.

   (b) Ibrahim eats too much because he drinks too much water.

   (c) The amount of water Ibrahim takes in a day could be known if the amount of water in the cups he drinks are added.

   (d) Ibrahim drinks too much water.





4. The water from a River is different from that of a Well.

   (a) One is obtained from deep down in the ground, the other lies at the surface.

   (b) This difference notwithstanding, a small quantity of salt could disolve in any one of the two types of water.

   (c) The difference lies in their colour.

   (d) The water from a river is useful in preparing mud for building whereas the well-water is used for drinking and other domestic washings.



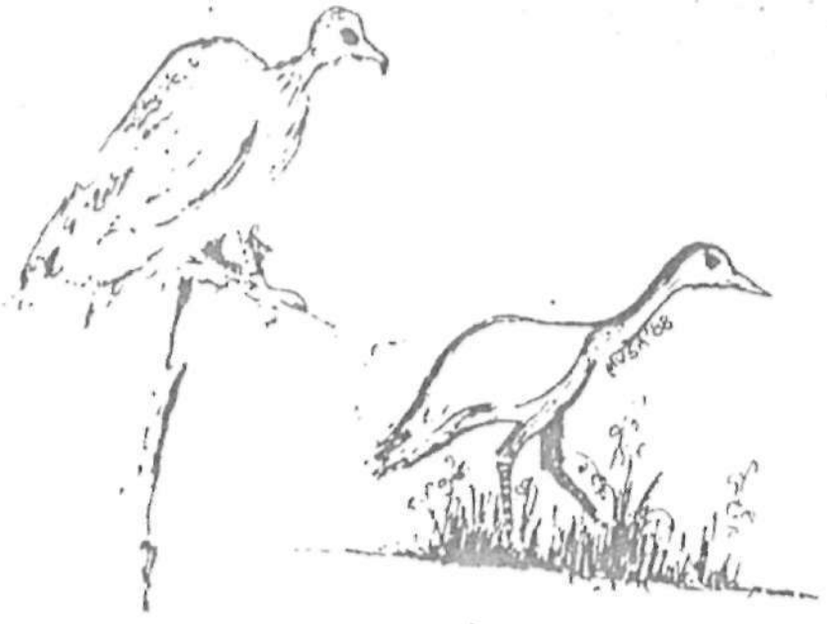
5. The Dog and the Cow are domestic animals.

   (a) The cow is however, bigger than a dog.

   (b) But the dog has claws and the cow has hooves.

   (c) The two animals are useful to man:
   We drink milk from the cow and also
   use its dung for manuring our farms,
   whereas, we use dog for hunting and guarding
   our premises.

   (d) Even though the two are domestic animals;
   the dog eats meat and other cooked foods
   whereas the cow eats only grass.



6. The vulture and Cattle Egret are all birds.

   (a) The vulture is bigger than the cattle egret.

   (b) The cattle egret follows herds of cattle whereas the vulture lookds around, for dead animals carcases.

   (c) Even though, we eat birds such as chikens and guinea fowls we do not eat vultures and cattle egrets.

   (d) Although, the vulture and cattle egret are different in terms of size and colour, they nevertheless use wings in flying.



7. Air and Water.

   (a) We inhale air (oxygen) so as to avoid suffocation and drink water when we are thirsty and after our meals.

   (b) Air and water are natural elements.

   (c) We may not say which one of the two is more useful to man.

   (d) Air and water are essential ingredients to all living things.



8. Rainy season is a useful period to us.

   (a) We plant our crops in the rainy season.

   (b) Rainy season is a period for rainfall.

   (c) Rainy season however, does not last for the whole year.

   (d) Each of the seasons - rainy season and dry-season has its own time in the year.



9. When Salt dissolves in Water.

   (a) The solution will then have a salty taste.

   (b) The salt can dissolve in water but the stone does not dissolve in it.

   (c) Because a salt can dissolve in water to give it a salty taste, it is used in our cookings.

   (d) Water has such a wonderful behaviour that it dissolves many elements.



10. The rain storm is destructive.

    (a) It destroyes our houses or make shift settlements because of its force.

    (b) It could be possible to measure this force.

    (c) The rainstorm has a force equal to its accelaration and mass of the wind.

    (d) The rainstorm is always destructive.

APPENDIX II

NATIONAL SYLLABUS FOR PRIMARY SCIENCE

YEAR ONE

1. Exploring the environment: A nature discovery walk around the school compound.
2. Using the senses: seeing, hearing, touching.
3. Modelling with clay.
4. Simple properties of air - its existence
   - it occupies space.
5. Identifying and classifying objects by their properties.
6. Water - Its uses
   Sinking and floating
   Playing with water
   Blowing bubbles.

YEAR TWO

1. Using the senses: touching, tasting and smelling
2. Further activities with water
3. Grouping by shape, size and colour (for example, leaves, buttons, etc) making leaf print.
4. Ordering of objects by comparing volume weight and lengths.
5. Growing plants from seeds
6. Air and Wind: moving air from one container to another.
7. Making simple objects and figures using match box and clay.

8. Observing animals from the local environment.

YEAR THREE

1. Further activities on plants and animals
   - comparison of major characteristics e.g seeding.
2. Further activities on Air and Water
3. Measurement - length (standard Unit)
   - Comparing volume, time and weight
4. Simple activities with mirrors and images
5. Making sound with different local materials e.g. paw-paw stalk
6. Colour - dyes from plants and soil

YEAR FOUR

1. Soil: - types and constituents
2. Gardening - growing better plant, growth and food (practically by observation and measurement)
3. Water Cycle - Evaporation and Condensation
   : - Things which dissolve and things which do not. Filtering and purification
4. Simple ideas on heat and temperature
5. Weather - regular observation and recording
6. Measurement in standard Unit (Metric) length in metre, centimetre; volume in litre.
7. Names of colours, different shades of the same colour, making rainbow, observing natural colour and changes.

8. Food types and uses - Food gives us energy which we need to grow and work
9. Observing changes: in animals; in plants, due to heating; due to rusting.
10 Exploring the human body-bones, joints, muscles and movement.

YEAR FIVE:

1. Air - Pressure
   - Propulsion, glider, flight of birds and kites
   - Burning
2. Domestic Farm Animals: Visit to farms, Raising and maintenance of chicken poultry
3. Bulb and battery; ways of lightening bulb
4. Heat, energy and temperature
5. Rocks: classification - Constituents - uses of rocks.
6. Soap and Alkali
7. My body at work - Breathing system: need for Oxygen: effect of exercise on rate of breathing;
   - Feeding system: changes on chewing food; teeth and digestion
   - Excretary system: types of waste. Importance of good hygiene.

8. How life begins: simple activities on flowering plants.

YEAR SIX

1. Making our task easier - pulleys, levers friction etc.
2. Growing better crops (Project essential)
3. Simple ideas about megnetism
4. Our earth and sky - Sun, the 4 points of direction, raising and setting heat effect. Moon: different shapes. The stars: finding and identifying well-known stars and using them to find directions, Revolution and rotation of heavenly bodies.
5. Minerals: Uses (emphasis on coal, petroleum and iron)
6. Us and where we live: Changes caused by man in his environment, Rubbish its problem, disposal of rubbish, things which burn and things which can't. Turning plant rubbish into compost. Smoke and changes on burning something. Oil smoke, Danger of using water to put out oil fire; nature of smoke, harmful effects of smoke and cigarette smoking.

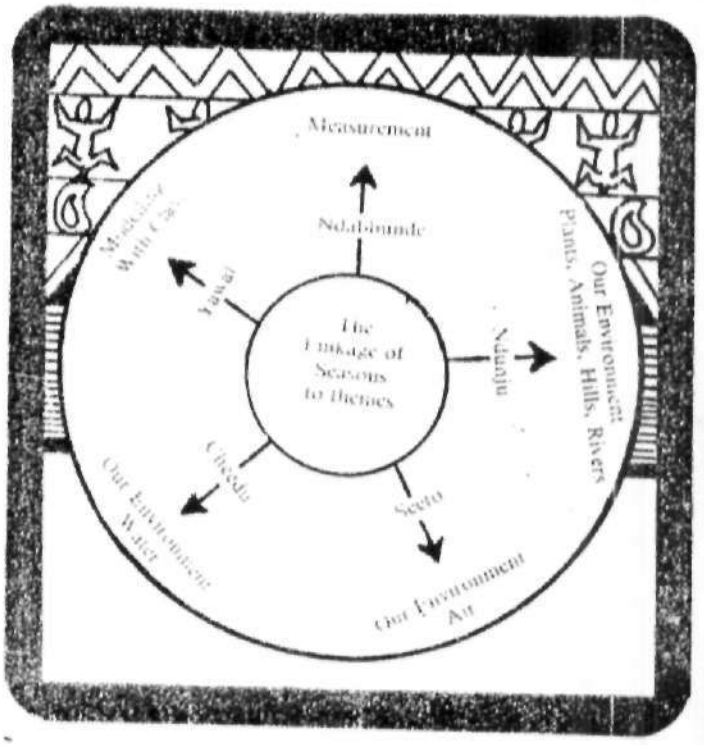
These topics will be chosen in accordance with the seasonal variations and will be modified or substituted where they are either not relevant like

"the disposal of rubbish" or where already known, like "a visit to farms."

The pastoral children are quite familiar with farms and also they do not stay long in one place so as to accumulate a heap of rubbish. Since the science core curriculum is meant for a sedentary child; modifications, sequencing and additions will be made so as to make it suitable for a pastoral environment.

LAWOL KIMIYYA:
Learning Science Through PULAAKU.

1





nGhadjhaam von Ardo

THEMES FROM THE NATIONAL SYLLABUS

Modules I-V Cycle I

" I-V Cycle II

" I-V Cycle III

" I-V Cycle IV

" I-V Cycle V

" I-V Cycle VI

THEMES

YEAR ONE

(1) Measurement I

- (a) Length
- (b) Volume
- (c) Weight

(2) Our Environment I: Plants, animals, Hills and rivers.

- (a) Weeds
- (b) Shrubs
- (c) Trees
- (d) Animals
- (e) Rivers
- (f) Ponds
- (g) Hills
- (h) Birds

(3) Our Environment I:

Air

- (a) It's existence
- (b) It occupies space

(4) Our Environment I:

Water

- (a) It's uses
- (b) Sinking and Floating

(5) Modelling with clay

(6) Using the senses: seeing, hearing and touching.

YEAR TWO

1. Measurement II

   Measurement Temperature

   Measurement Time

2. Our Environment:

   Living and Non-living things

3. Air:

   (1) Burning

   (2) Breathing

   (3) Rusting

4. Water:

   (1) Water in the atmosphere

   (2) Pure and impure water

5. Making simple objects with clay, paper and other materials.

YEAR THREE

1. Measurement III

   (1) Volume

   (2) Distance

2. Our Environment III

   Classification of living things.

3. Air III

   (1) The composition of Air.

4. Water III

   Water Cycle

5. Making objects

YEAR FOUR

1. Measurement IV

2. Our Environment IV

   Animal Kingdom

3. Air V

   Air Pressure

4. Water IV

   Water Pressure

5. Making things,

YEAR FIVE

1. Measurement V

   Density

2. Our Environment V

   Plant Kingdom

3. Air V

4. Water V

   Water as

   Universal Solvent

5. Making Objects

YEAR SIX

1. Measurement VI
   Speed Velocity
   Acceleration and Time.

2. Our Environment VI
   Energy and its sources

3. Air VI
   gas, liquid - solid

4. Water VI
   Solutions

5. Making Objects.

Season: Ndabbu'nde (December to February)

Module I,

Cycle I.

Measurement

Unit 1: Measurement:

Introduction:

This module is made up of one unit and in this unit the concept of legth, mass and volume are carefully built on such local materials like:-

Sauru - the stick which every animal rearer carries along with him at any given time. You will be asked to to cut your new sticks so that they look similar to the teachers - sauru, which is called metre - sauru in this experiment. The concept of volume, and weight have also been introduced in this fashion. Birdude and Faggo equally serve, respectively as measures of volume and weight.

Objectives:

At the end of this unit you should be able to:

(1) describe the units of time

(2) measure the heights of your brothers/sisters using your sticks.

(3) distinguish between the sizes of Birdude and the amount of milk the contain.

(4) demonstrate an experiment to categorize hot warm and cold water.

(5) Explain how we measure the weights of objects around us.

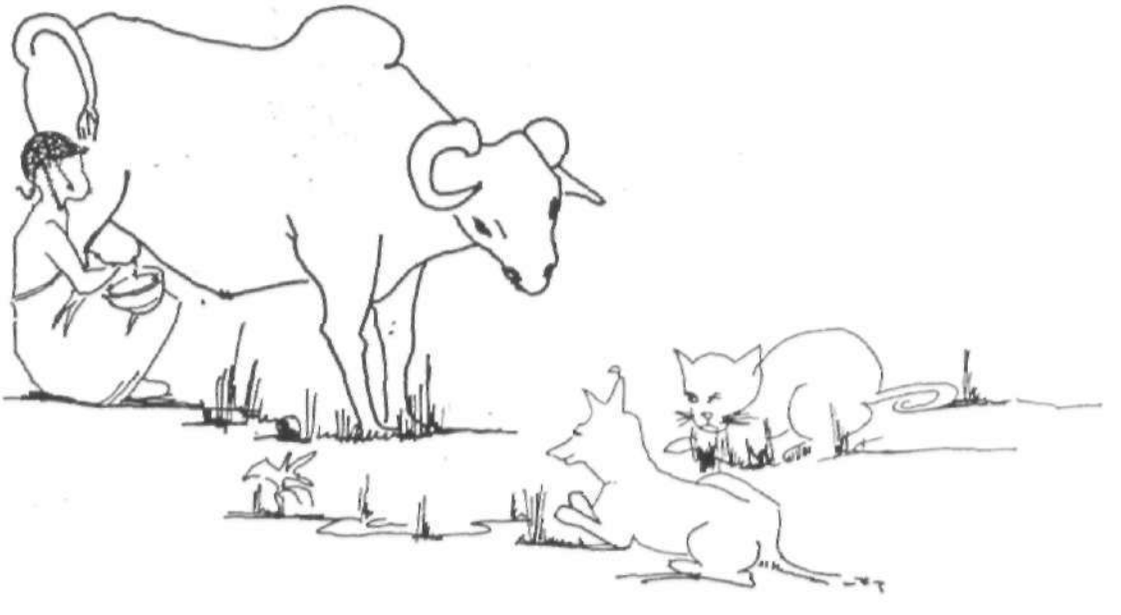
(6) distinguish between light and heavy objects either by carrying them as faggo or by measuring the with special instruments.

Measuring Time

Our day is divided into five periods, namely: Safiya, Azahar Laasar, Magrib and Isha'l. In accordance with these five periods you must have noticed your Bappa and Dada saying their prayers. You can see Tumba's father saying his morning prayers near his cattle coral just before they leave for maaji.



Tumba's mother Motti milks her cows twice in a day one in the morning before the cattle leave the coral and the second in the evening when the cattle are back again in the coral.



We work in the day time and sleep in the night. Our entire life passes through days and nights. Your teacher has a special device which measures time in the day and night. This device is called 'watch' it is small and clock if it is big. You can see its drawings below:



Your teacher will explain to you how works. He will therefore tell you that it measures time on equal intervals according to the following divisions and intervals.

60 seconds	=	1 minute
60 minutes	=	1 hour
24 hours	=	1 day
7 days	=	1 week
4 weeks	=	1 month
12 months	=	1 year and
365 days	=	1 year
10 years	=	1 decade
100 years	=	1 century.

There are equal intervals between the divisions of a watch or clock. It has also two hands, the long and the shorthand. The former measures seconds and minutes when it makes a complete circle. The shorthand measures hours. Your teacher will expoain all this to you.

Activity I

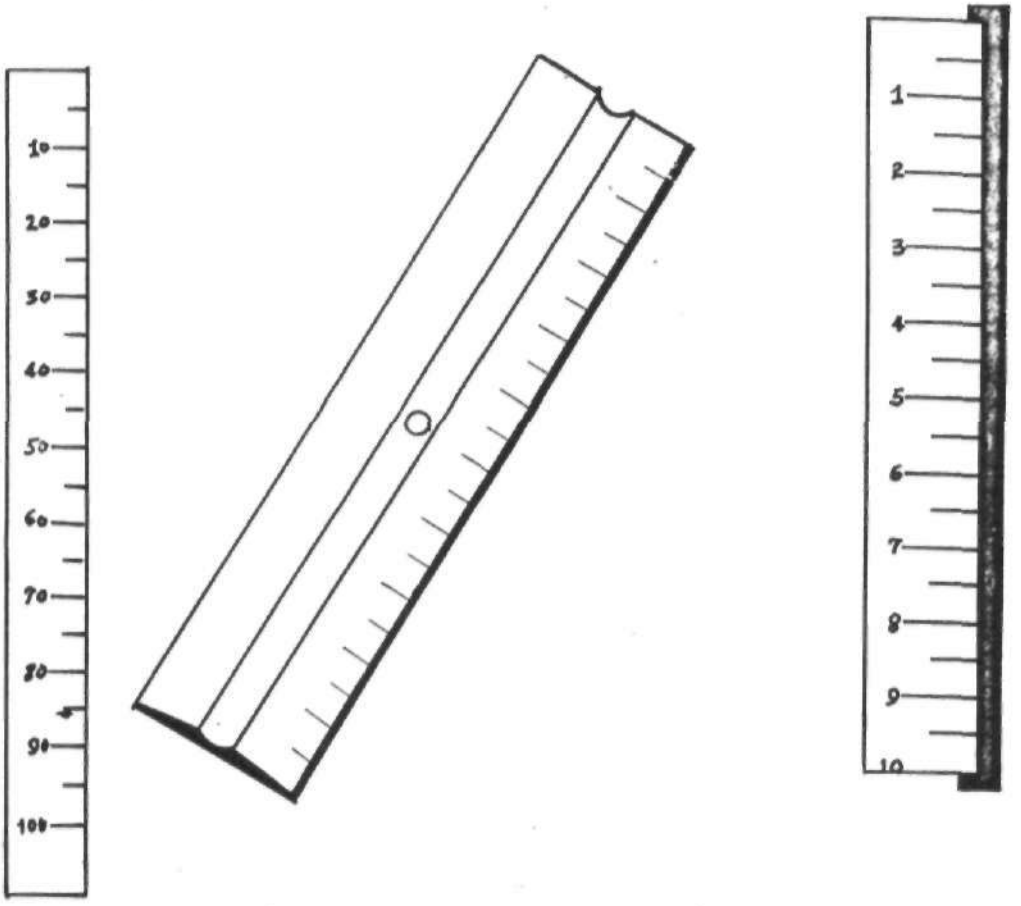
1. Compare your stick (Sauru) with your friend's and find out which of the two sticks is longer.

2. Your teacher has a special stick called a 'metre'. Is the teacher's stick longer or shorter than your stick, or is it equal to your stick?

3. How does the teacher's stick differ from yours.

Demonstration I

Metre - Sauru



Home work

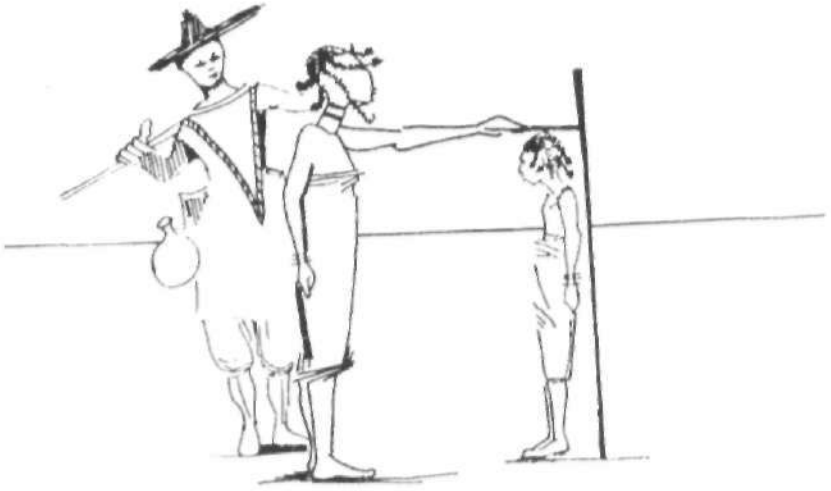
1. Bring a stick equal in length to your teacher's sauru.
2. Compare it with your (1) father's sauru; and (2) brother's sauru.

Activity 2

1. Find out how tall your friend is by measuring his height with the equivalent of teacher's sauru.
2. Find out the tallest and shortest boy or girl by this method.

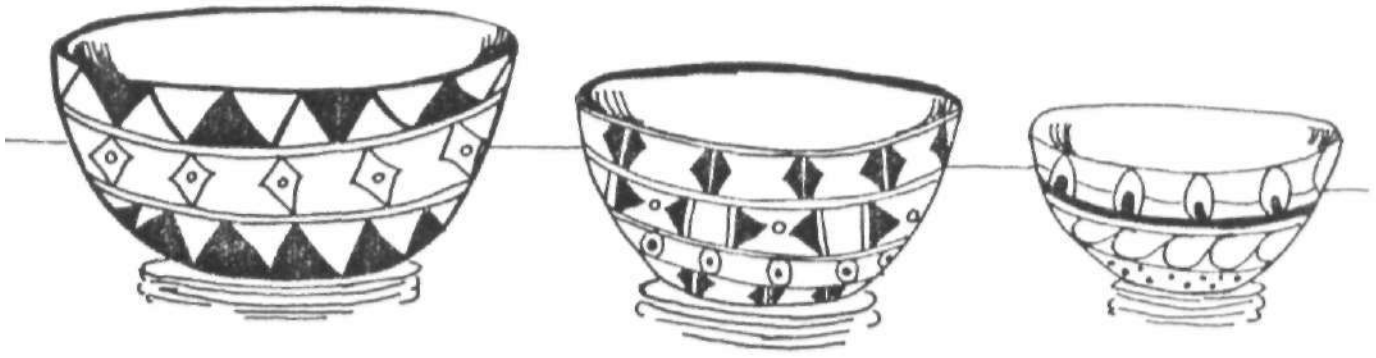
Demonstration 2

This drawing depicts Tumba in the process of finding out the height of her sister - Ngeno, while uncle Ngerey Bado looks on.

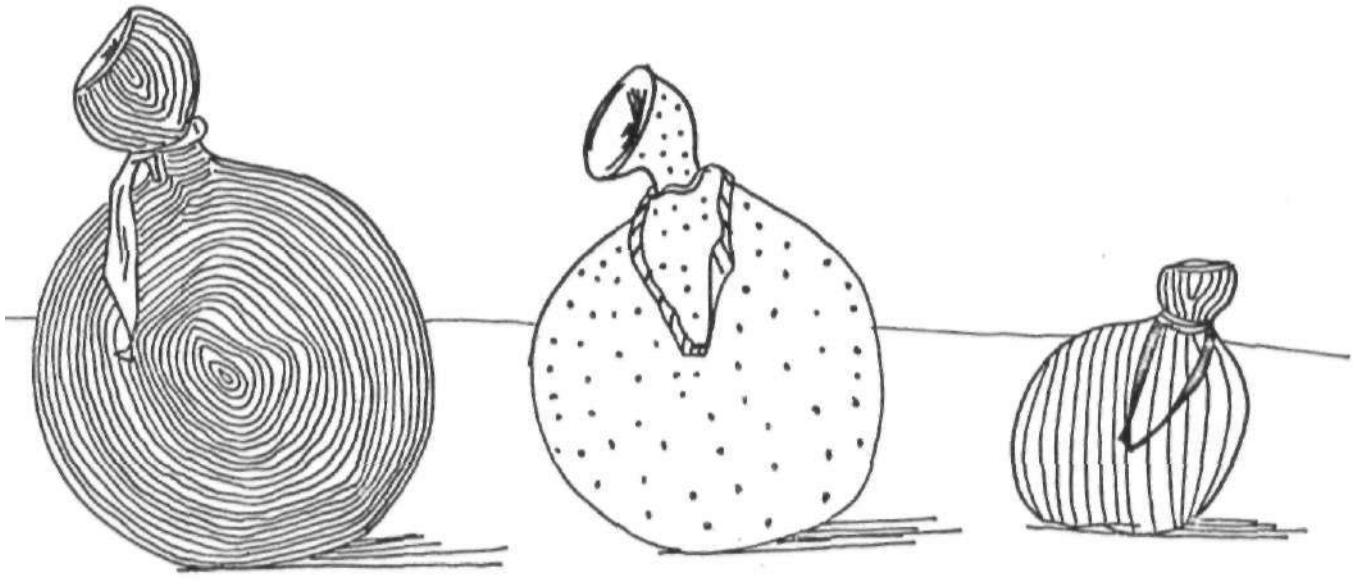


Activity 3

1. How big is your mother's milking container (Burdude). See the drawings below and choose one which approximates in size to the burdude used by your mother.



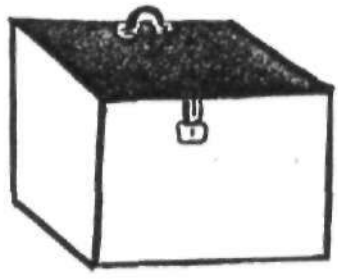
2. Do you have a goard container (Jallo)? Look at the drawings below and see if any one approximates to your jallo or that of your brother.



3. Tell your teacher the uses of (1) Burdude, and
(2) Jallo.

Demonstration 3

Your teacher has a special container. See the drawing below.

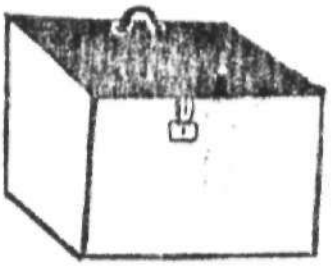


Demonstration h

Look at the drawing below. It depicts Tumba and her sister Ngeno carrying their Fagro.

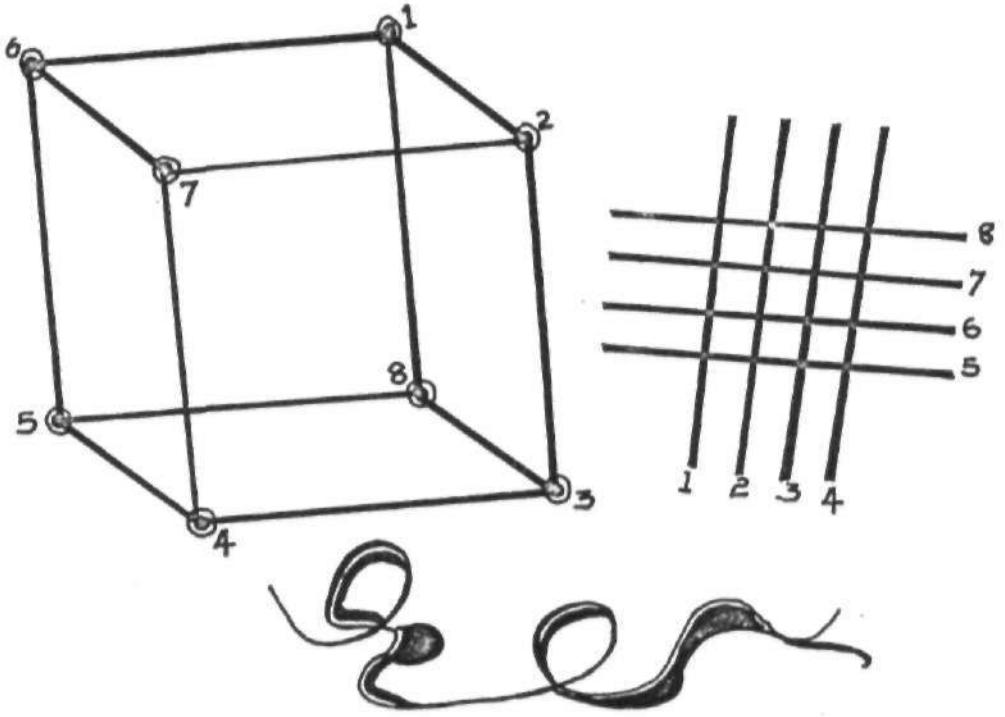


Who's Fagro is bigger?
Look at your Teacher's Fagro, can you lift it?



Home work:

Find 8 sticks of metre sauru and join them with a thread as shown below.



Is your new container similar to your teacher's container?

Activity 4

1. What do you normally carry (Faggo) during a change of settlement in the process of your transhumance (Barti).
2. If your father has a donkey what and what does it carry (Faggo)?
3. What does your pack ox carry on this day.
4. How about your mother and sisters. Do they carry any belongings (Faggo).

Activity 5

1. How cold is it in your Dabirde (the spatial settlement in this season - Ndabbunde)? How many clothes do you use to cover yourself at night?

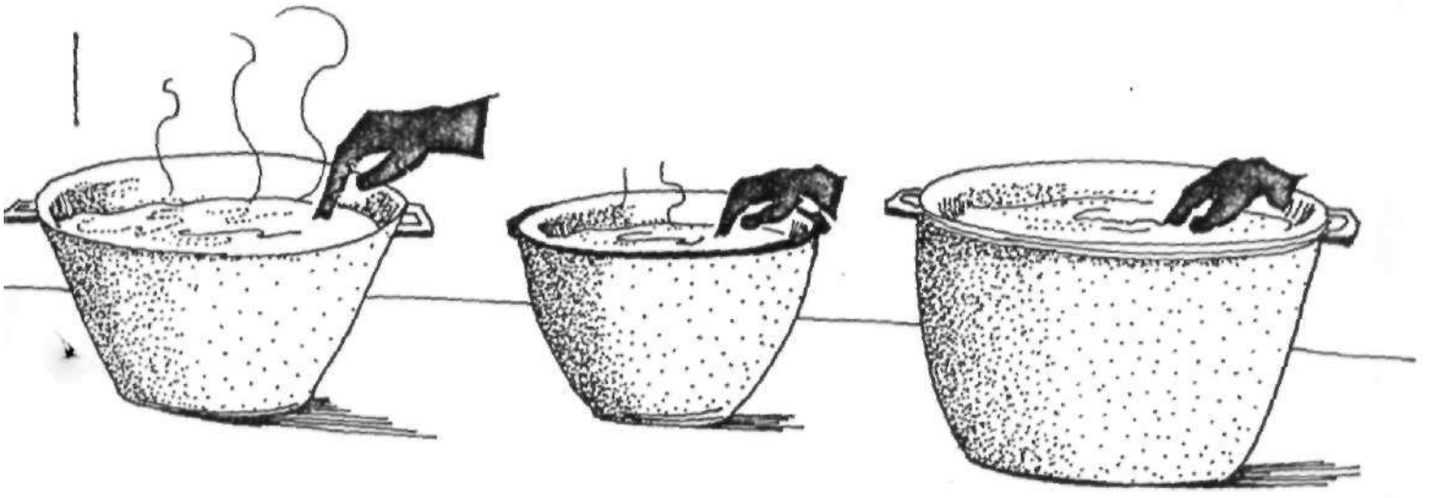
2. Do you follow your father or brothers to Maaji (an early browse near the homestead before noon)?

3. If you do how cold do you find it? If you don't, try it.

4. The period after 12 noon is not as cold as before noon.

Demonstration 5

Your teacher has three containers of water. Put your hands as indicated in the drawings and explain your feelings.



Summary of Activities

1. Where is your new metre sauru?

2. Which container does your mother use for milking and how big is it?

3. Where is the teacher's container?

4. Do you take bath with cold water in the early hours of the morning before maaji? If no, why?

5. Look at the drawing below. You can see Tumba, her sister Ngeno, their father Ngajam and their mother Motti together with their cattle, a donkey and a pack ox moving to a new settlement (Cheedirde). It is time for cheedu the hot season after (Ndabbunde) hammattan. You can see them carrying their Faggo.*



Season: - Sheedu

Module 2

Cycle I

Water

Unit 2: Water

Introduction:

Water could be very scarce in nomadic pastoral areas at certain seasons such as cheedu - the dry season. It's availability determines where we stay at this period. This module is made up of one unit and it highlights the importance of water to us and our animals. It also draws on simple experiments which we can use with water to show the nature of different materials, those that float, sink or dissolve completely.

Objectives:

At the end of this unit you should be able to:

(1) state the importance of water to us and our animals.

(2) demonstrate why certain objects float, sink or dissolve in water.

(3) see water as a solvent which can be used to make simple solutions which sometimes form our meals.

Activity 1

1. How many times do you drink water in a day?

2. From where do your mother or father fetch water for cooking. Is it a river, fond or well?

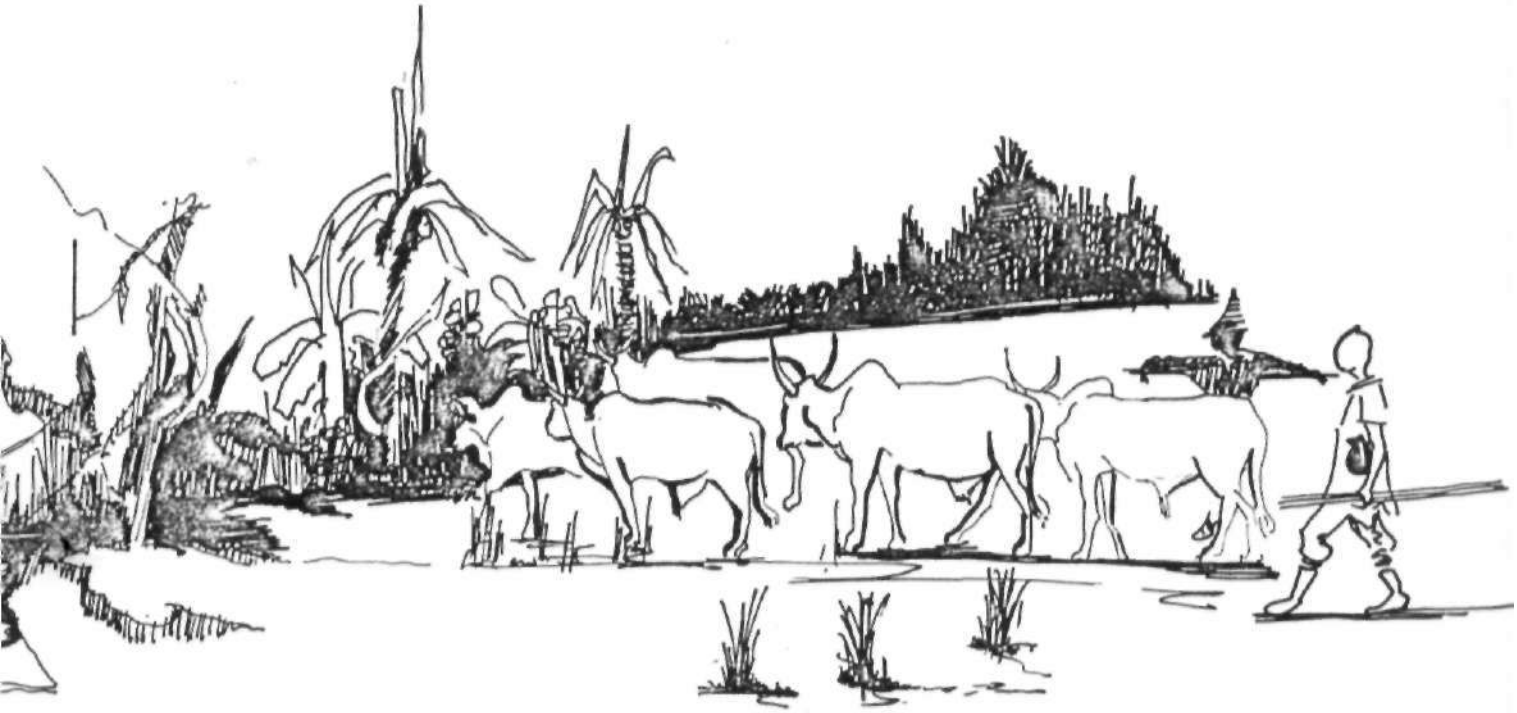
3. How about the cattle where do they get their drinking water from?

4. Explain to your teacher if your settlement has any difficulties in getting water for your animals and cooking.

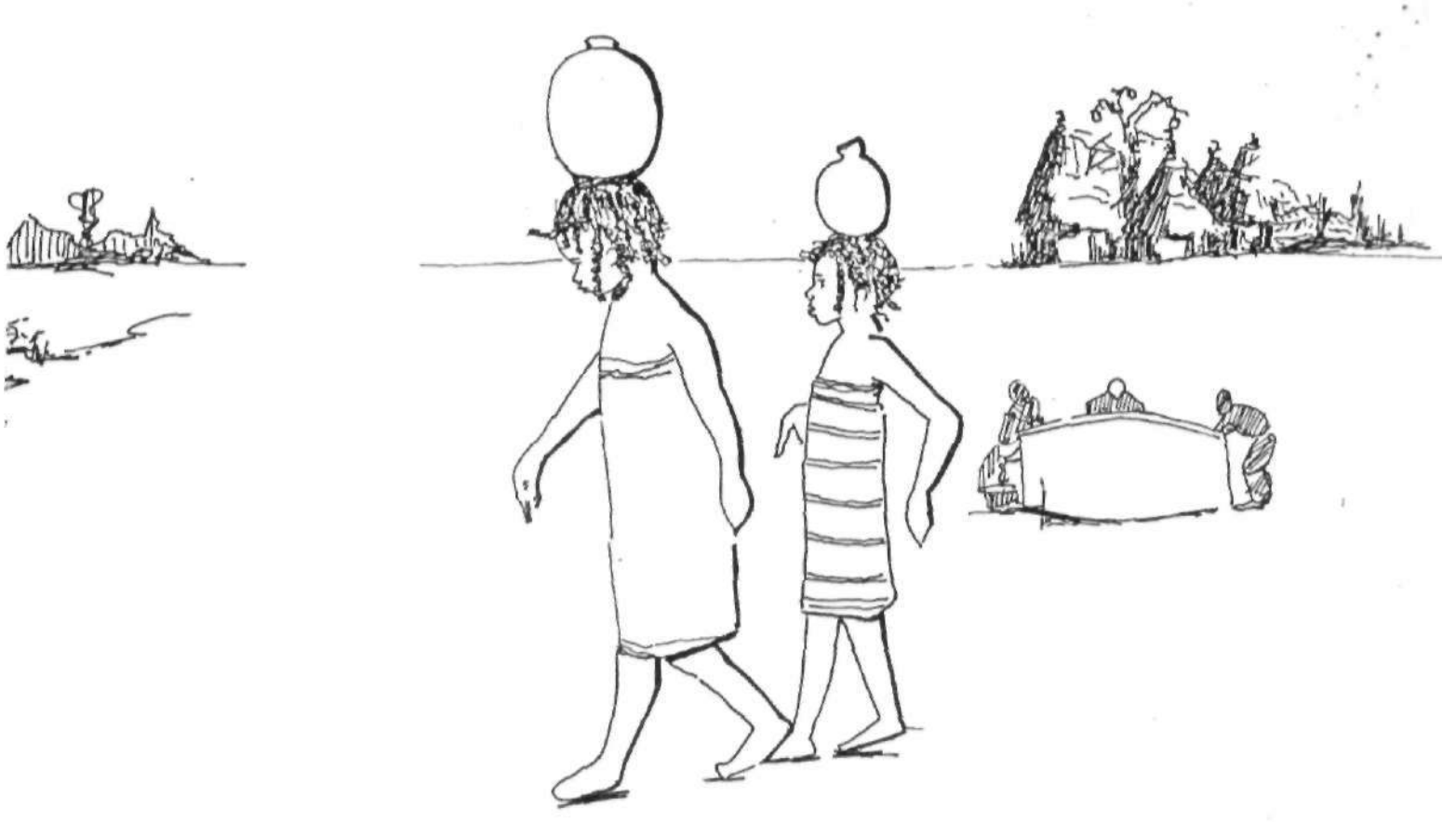
5. Tell your teacher the uses of water.

Demonstration 1

The picture below is showing the cattle of Tumba's father (Ngajam) heading for the river with bijaye leading the cattle. You can see Ngajam and Ngane Bado following and guarding the cattle to the river.



You can also see Tumba and her sister Ngeno carrying their pots of water from a well close to their chedirde (settlement in the cheedu season - hot season).



The drawing below shows Tumba and Ngeno washing their cooking pots and other domestic utensils.



Here Ngajam and Ngarey are watering their sheep from the well near their chedirde.





Activity 2

1. Compare the water from a river or lake near your settlement (chedirde) with the water from a well.

2. Which one is clearer?

3. Does the water from the well tests like that of the river? In otherwords can you tell the difference between the two types of water?

Demonstration 2

Your teacher has a special water. Observe how colourless it is and compare it with the previous ones from the river and well. Which one is closer to it, the river or the well's water?

Your teacher will tell you the difference and also give you some talk on water which is called 'pure' and that which is called 'inpure'.

Homework

1. Mix sour milk (Kosam) with water and you will produce Churadam. How is it different from water. List or tell the teacher your observations.

2. Observe how your mother chung out butter and see if she uses water in the process. If she does, you will get a very sweet white liquid known as Jawadami. Say how it differs from water.

Demonstration 3

Your teacher will take you to the river or any lake near your chedirde. You will take along with you the following objects;

1. a piece of calabash
2. a small stone
3. a feather
4. a small salt
5. a little milk.

Activity 4

1. Put the piece of calabash in the water and observe what happens. Does it float or sink in the water?

2. Put the small stone and observe immediately what happens to it. Does it float or sink in the water?

3. Throw your feather in the water and watch it.

4. Take the salt you have brought and drop it in the water.

5. Do the same with your milk. Pour it in the river and observe what happens.

Activity 5

1. Tell the teacher your observations from the five objects.

2. Why does the stone sink and the calabash and feather float about?

3. Can you recover all of them? If not which ones can you not recover from the river and why?

Activity 6

Think of many objects around you and those at home and see if you can classify them into the following groups from your experiment.

1. The calabash and feather group.

2. The stone group.

3. The salt and milk group.

Activity 7

1. Find out the sources of water. See if you come out with the followings:

   (a) Water from the well.

   (b) Water from the river.

   (c) Water from the rains.

Think hard if there are other sources not mentioned above.

Demonstration 4

Below, Tumba and Ngeno with their father and mother are moving for a new settlement because they have no water for their cattle as the lakes, ponds and the river near their settlement are all dried up. You can see them carrying their Faggo'. You can also see Ngerey carrying water in his container.



Season: Seeto

Module 3,

Cycle I

Our Environment: Air

Unit 3: Air:

Introduction:

This module consists of only one unit. Like the previous modules it is very short and only meant to introduce you to natural elements such as air. The module treats simple activities which could be carried out by you so as to feel the presence of air. The windy-stormy season - seeto is chosen for this topic because the force of windstorms is very visible in this period.

Objectives:

At the end of the unit you should be able to:

(1) describe the importance of air to living things.

(2) perform simple experiments to demonstrate the presence of air.

(3) demonstrate with the help of your kite the motion of air.

Activity 1

1. Where do you hide when the wind strom is around.

2. What happens to the trees and shrubs near your settinirde when the wind blows.

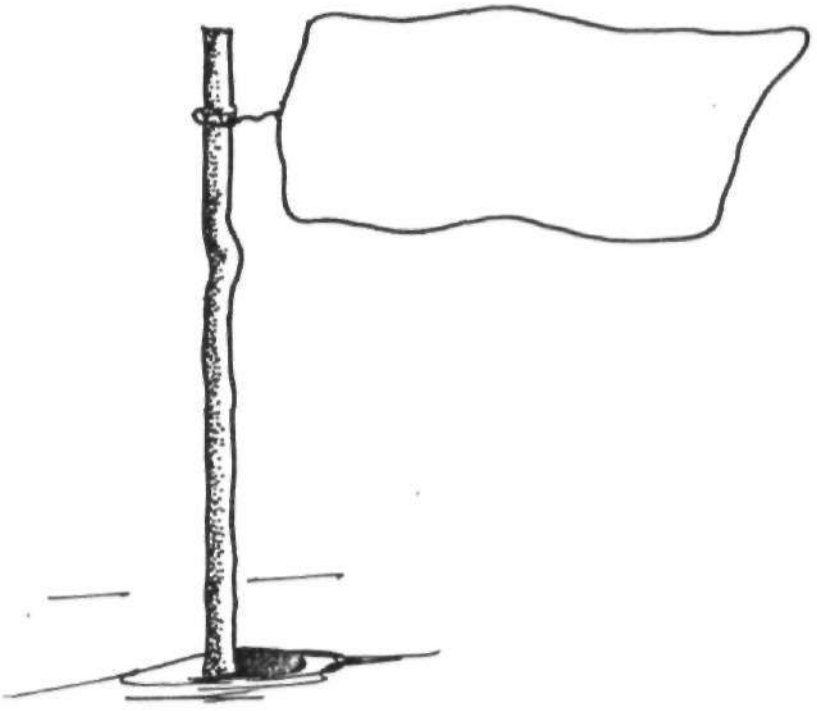
3. Tie a piece of cloth on your sauru (stick) and see what happens to it.

4. Run a short distance and see if the cloth moves faster.

5. Dig a small hole and peg your sauru with the cloth and watch it for sometime.

Demonstration 1

See the diagram below.



Activity 2

1. Tell your teacher how you feel after diving under the river or lake close to your settinirde.

2. Wet your hands and blow out air from your mouth to them. Tell your teacher your feelings and observations.

Demonstration 2

The drawing below, shows Tumba's father Ngajam, his wife Motti, uncle Ngarey and the two children Tumba and Ngeno. Their pack oxen are carrying their faggo. They are moving to a new settlement where grasses have already started growing. It is time for Ndungu - the rainy season. The dry season had been very harsh to their cattle.



Season - Ndungu

Module 4.

Cycle I

Our Environment: Plants, Animals, Rivers and Hills

Activity 1

1. Rainy season has already begun and if you look around your dabirdé (the homestead during this season) you will notice many green plants, weeds and animals. Tell your teacher the various kinds of plants and animals around your dabirde.

2. Tell your teacher the tallest and shortest trees around your homestead.

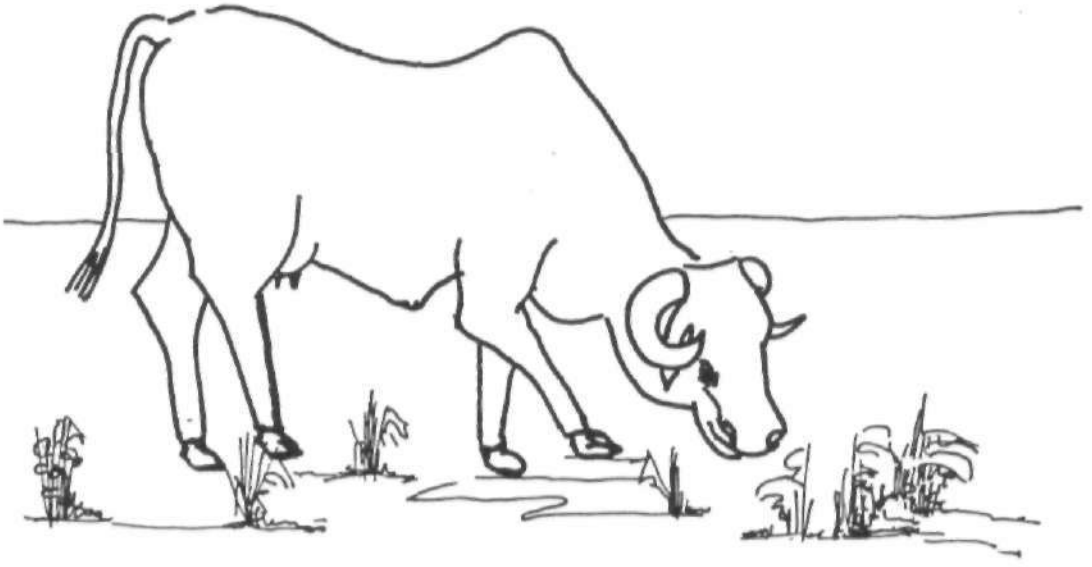
3. How many types of weeds or grasses do you know.

4. How many shrubs do you know by their names?

5. Tell your teacher the names of the biggest and smallest birds you have ever seen.

Demonstration I

The drawing below shows Bijaye (the name of a cow which has horns falling to its face) eating wurgu ( ).



Tell your teacher the names of other grasses, weeds and shrubs that are eaten by Bijaye.

Unit 4: Our Environment, Plants and Animals, Hills and Rivers in our Neighbourhood.

Introduction:

Plants and animals constitute the environment of the nomadic pastoral people. You have by this stage come to regard plants and animals very important to the realities of our life. In this unit which covers the whole of module 4 some simple and typical scenes are depicted where animals, plants, rivers and hills feature prominantly. The rainy season - ndungu is believed to offer the best learning and teaching opportunities for this topic.

Objectives:

At the end of this module you should be able to:

(1) describe your environment and say weather it is made up of plants, animals, hills, or rivers.

(2) State the sources of food of different animals around our dasirde.

(3) Explain why ponds, lakes, and rivers dry up in cheedu.

(4) Describe the characteristics of living and non-living things.

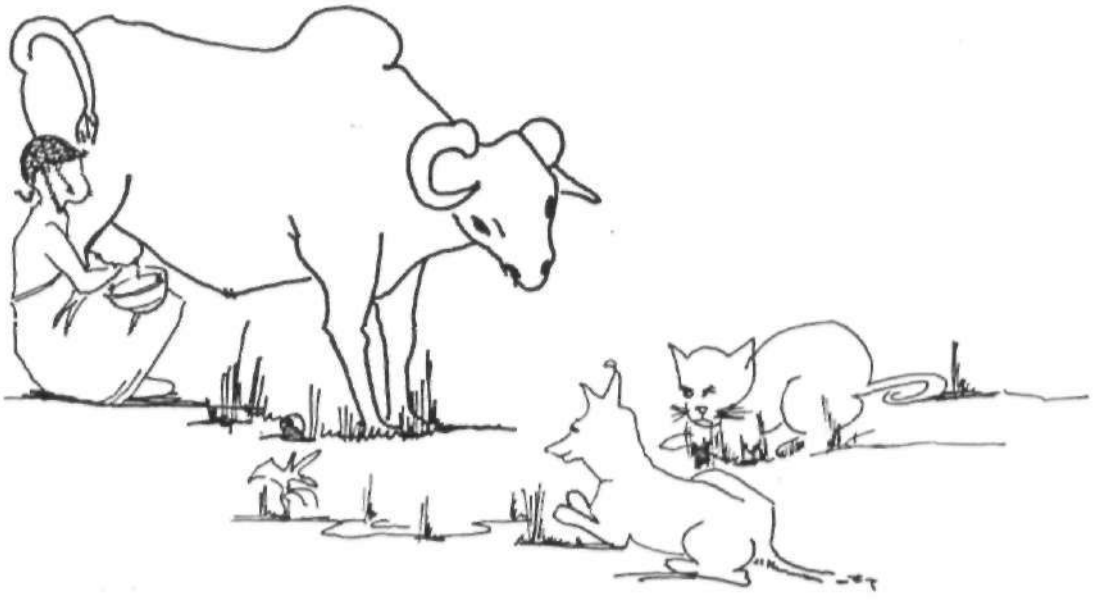
Activity 2

1. How many types of animals do you know?

2. Can you classify them into the group of Bijaye which eat grass weeds and shrubs and also the group of non-Bijaye which do not eat grass, weeds or shrubs?

Demonstration 2

The drawing below shows Bijaye eating corn flower, whereas Motti (Tumba's mother) is doing the milking with her burdude and their dog Danwari and a cat are laying down. Danwari (the dog's name) and the cat are waiting for their own share of Bijaye's milk. Are they in Bijaye or non-Bijaye group?



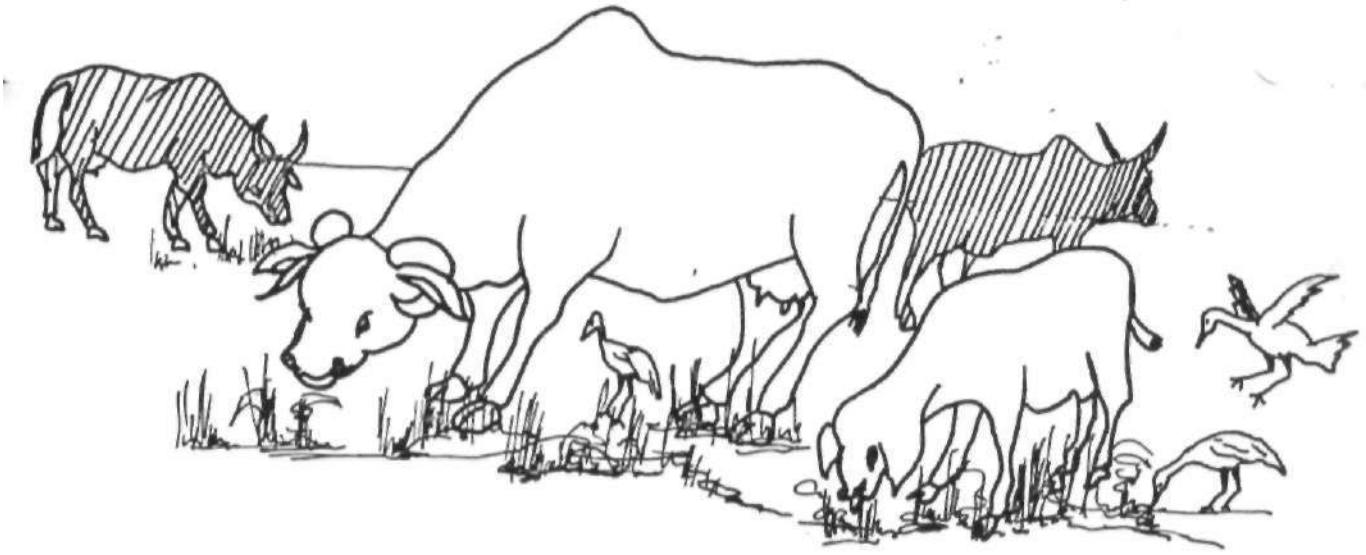
Activity 3

1. The cattle egret is a white bird, how about the voltures, are they white?

2. The cattle egret is always found near the cattle when they are grazing. What is the reason for this.

Demonstration 3

See the drawing below, it shows Bijaye with other cattle grazing along the route to the river, and you can also see the cattle egrets together with them.



The cattle egrets find it easy to follow the cattle because they can always fly and locate the cattle in their grazinglands. In this manner, they spend their day flying from one grazingland to another.

4. Can you mention any other bird which flows the cattle apart from the cattle egret? If any, is it smaller or bigger than the cattle egret?

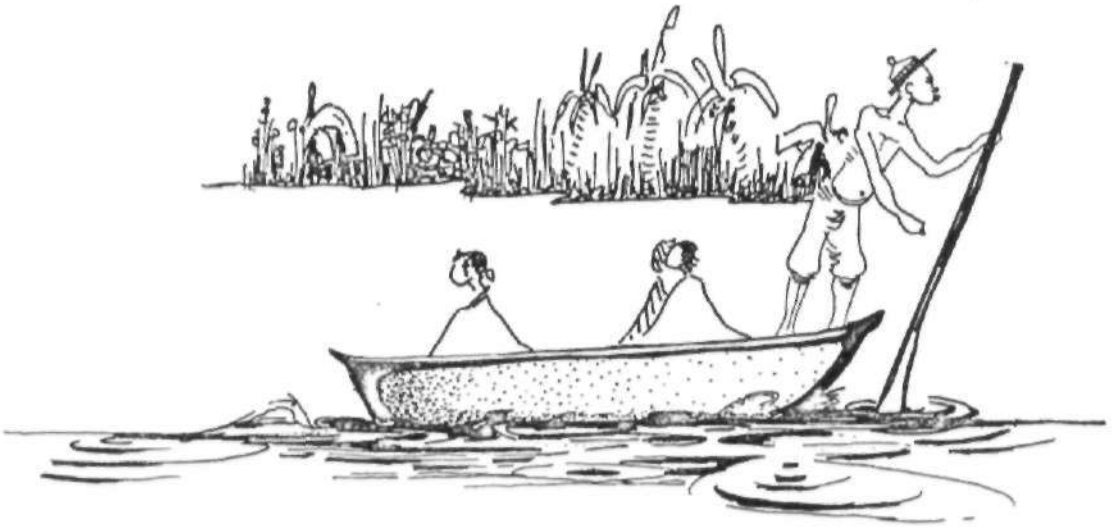
Activity 4

1. Is there any river, lake or pond near your dabirde?

2. What happens to them after each rainfall?

3. Where do you water your cattle? Is it near or far away from your dabirde?

4. The drawing below shows Tumba, her sister Ngeno and their mother Motti crossing a river in a small boat.



Activity 5

1. Are there any hills near your dabirde?

2. Do you graze your cattle on them?

Living and non living things

When the Elementary Science teacher entered Tumba's class at Binjiji nomadic education primary school, the children noticed a piece of stone and a small drawing of a cow in his hands. He carefully kept these items on the teachers table with full view from all the students. You can see these objects below:

The teacher immediately started his lesson after the usual roll call. The lesson was on 'living and non living things". He asked his students to mention their differences. After he has heard their answers, he told them that some of the answers were correct even though they could be arranged in this way.

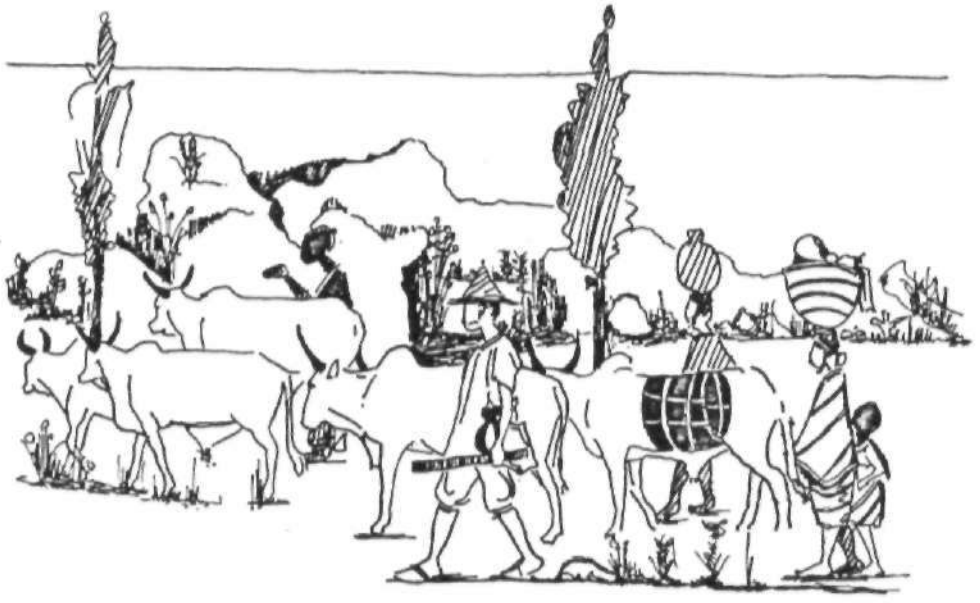
S/No	Living things	S/No	Non living things
1	They need food	1	They don't need food
2	They grow	2	They don't grow
3	They reproduce their kinds	3	They don't reproduce
4	They respond to stimulus	4	They don't respond to stimulus

The teacher told his students that living and non living things are easily known and differentiated through their characteristics as tabulated above.

Activity 6

Draw a table and state the likes of a cow and those of a stone starting from the example given in number one below:

S/No	Living things (the likes of a cow)	S/No	Non living things (the likes of a stone)
1	A man	1	A piece of cloth
2		2	
3		3	
4		4	
5		5	
6		6	
7		7	
8		8	
9		9	
10		10	



Demonstration 5

The drawing above shows Tumba, her sister Ngeno, their mother and father together with uncle Ngarey Bado heading for a new settlement through the hills towards a more valley area since the rains have finished and it is now time for yawal.

Season: Yawal

Module 5,

Cycle 1

Activities.

Activity 1

1. See the drawing below and make similar objects such as:

   (a) a cow such as Bijaye

   (b) a goat

   (c) a ram.

Demonstration 1

You can see Tumba and Ngeno using clay from a small pond in the fadama to mould objects.



Activity 2

1. Your teacher will teach you how to make kites using a paper which is carefully folded.

Demonstration 2

You can see Tumba and Ngeno playing kites below.

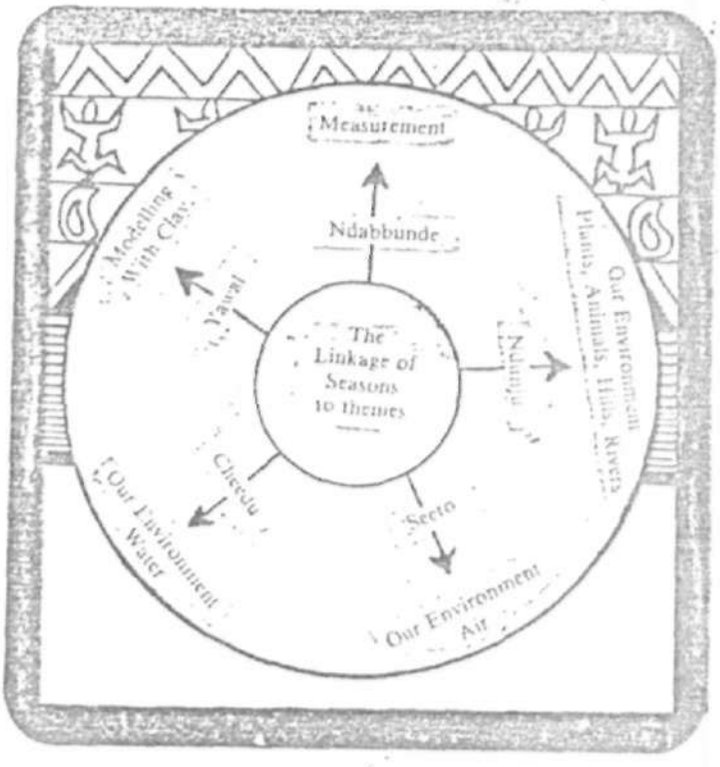


Look at the drawing below. You can see Tumba, her sister Ngeno, their father Ngajam and their mother Motti together with their cattle, a donkey and a pack ox moving to a new settlement (Cheedirde). It is time for cheedu the hot season after (Ndabbunde) hammattan. You can see them carrying their Faggo.



LAWOL KIMIYYA:
Learning Science Through PULAAKU:

2





nGhadjhaam von Ardo

Cycle: Two

Module: One

Season: Ndungu

Unit 1 - Plants in our Neighbourhood

Unit 2 - Animals in our Neighbourhood

Unit 3 - The Interrelationships of living things in our Environment.

Unit I: Plants in our Neighbourhood

Introduction

You live amids plants and animals. You sometimes know each plant by its local name and you also know their usefulness to us and our animals. We are so close to animals that our entire living depends on our cattle and other small ruminants. We cross rivers and lakes in our seasonal migrations and observe the annual appearance of thunder storms, lightening and subsequent rainfall. We live near hills and rocks.

This background favours the teaching of science. In this regard, you can be guided to make useful observations and study of the plants, animals, and their entire environment.

Objectives

By the end of this unit you should:

1. be more aware of the differences between local plants.
2. be able to explain the functions of the three parts: Leaf, stem, and roots of a flowering plants.
3. draw a flowering plant, its leaf and roots separately.
4. state the economic importance of plants to man.

Some Broad Concepts:

The plant kingdom
The seed plants
The flowering and
non-flowering plants -
angiosperms and gymnosperms
Leaf, stem, and roots.
Plants manufacture their
own food.

Human beings and other
Animals depend on plants.

Common Plants around our Rumirde:

Activity 1: Tumba and Geno have just been transfered to Mashekarin Baro Nomadic Education Primary School located at Domdo. They are now in class two. It is time for Ndungu - the rainy, season after seeto. The lesson today is on common plants around their settlement and school.

1. You can see Tumba and Geno together with their classmates observing different plants around their Jan girde (school).



Their Teacher has told them that plants like animals could be classified according to the following order:

Kingdom

Phylum

Class

Order

Family

Genus

Species.

The teacher has also informed them that this method of classification reveals that as we proceed from kingdom to species, we have fewer and fewer kinds in each group where the members are more a like.

The seed plants are the most complex of all plants. The shrubs, trees and the common herbs, all belong to this group. Seedplants are divided into two major groups according to their method of seed production. In one group there are flowers, whereas in the other group there are no flowers. The group with flowers is known as angiosperms and simply called the flowering plants. The group without flowers is called gymnosperms or simply non-flowering plants.

The lesson today is on non-flowering plants. The class has been asked to study and examine the following plants found around their school:

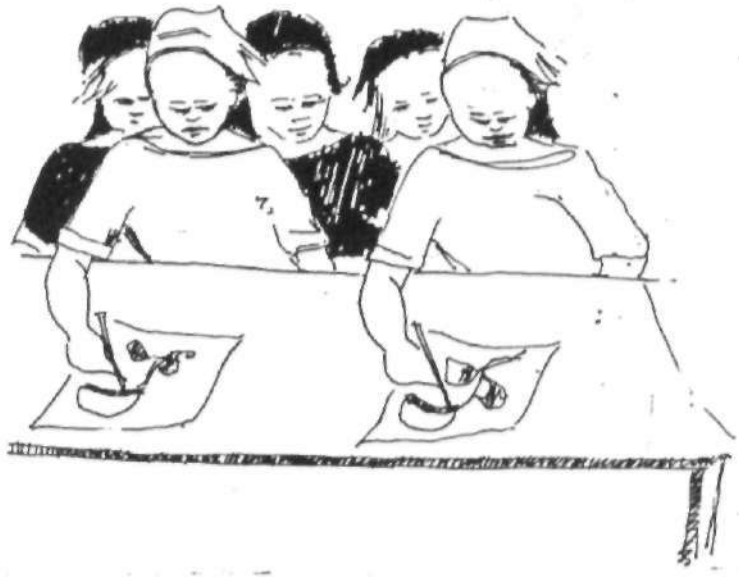
1. Barkehi
2. Gelode

They are to arrange their observations as follows:

Structure	Barkehi	Gelode
Leaf		
Steem		
Roots		
Seed		

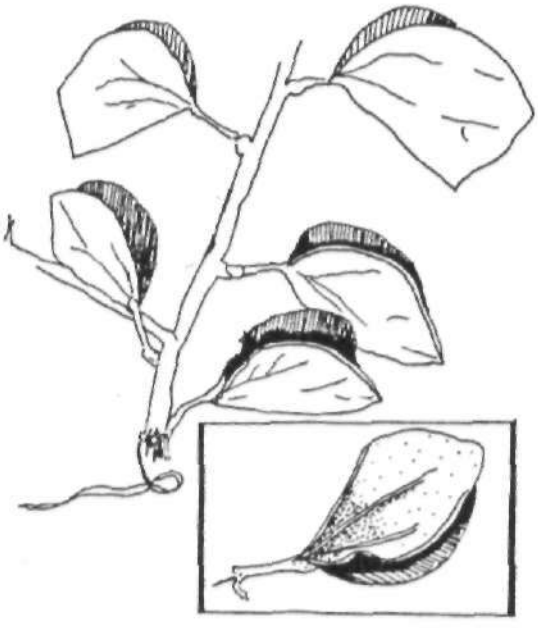
Local economic uses	Barkehi	Gelode

Below Tumba and Geno are seen drawing their own Barkehi and Gelode which they have brought from the outside.



Draw your own Barkehi just like Tumba and Geno.

Does your drawing look like the teachers drawing below?





It is now time for maaji. You are free to go but make sure you carry out the following activities:

1. Compare the leaves of Barkehi with those of other shrubs and trees found in the same neighbourhood.
2. Bring to the classroom the ones which are closest in resemblance to those of Barkehi.
3. Do the samething for Gelode

4. Bring the leaves which interest you most and inform the class the local name of the plant.
5. What are the economic uses of the plant whose leaves you brought to the classroom?

Flowering Plants: A part from the non-flowering plants discussed in the previous lesson, there is the second category of plants called 'flowering plants'.

The landscapes of our Earth are bedecked with an infinite variety of flowering plants. Their diversity of form, size, colour and the nature of their shrubs, herbs and trees give appearance to our forests, farm fields, rivers and lake sides.

Basically each flowering plant is made up of four parts, namely: roots, stem, leaves and flowers.

Our lesson today is on waterlily locally called Badoje.

Your teacher will take you to the river or pond near your settlement so as to observe this flowering plant in its natural habitat. The teacher will also provide you with small glassjars which you will use to bring the plant to your jangirde.

When you are back in the classroom, the teacher will then ask you to:

1. observe the parts of the plant in your glassjar.
2. Identify, its roots, stem, leaves and flowers.
3. State the part which interests you most and
4. inform the class why you are fascinated by this part of Badoje.

At Domdo, Tumba and Geno asked their teacher to inform them on the functions of roots, stem, leaves and flowers of their Badoje.

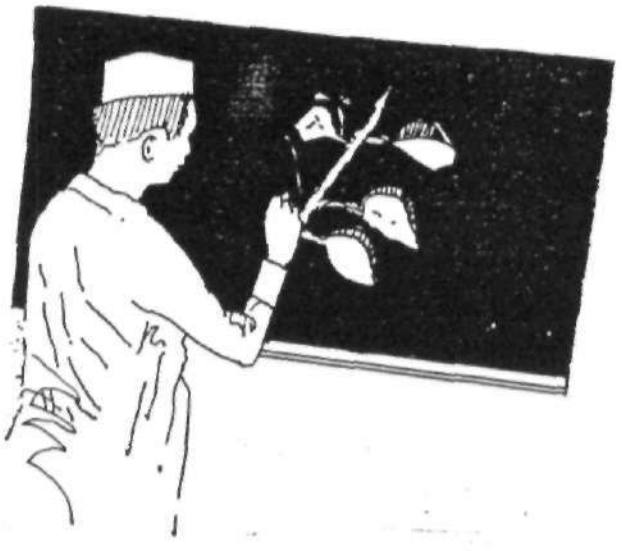
Their teacher chose to start with the leaf of their Badoje as follows:

1. Leaf

   The leaf provides the dominant colour of the meadows in the countryside. This colour is the green colour which comes from the chlorophyll. The food of the plant is manufactured in the leaf by means of the chlorophyll: the green Pigment. The process through which the green leaf manufactures food is known as photosynthesis.

You will be told more of chlorophyll and photosynthesis in the future lessons, but for now do understand that the chief function of the leaf is to manufacture food for the whole plant.

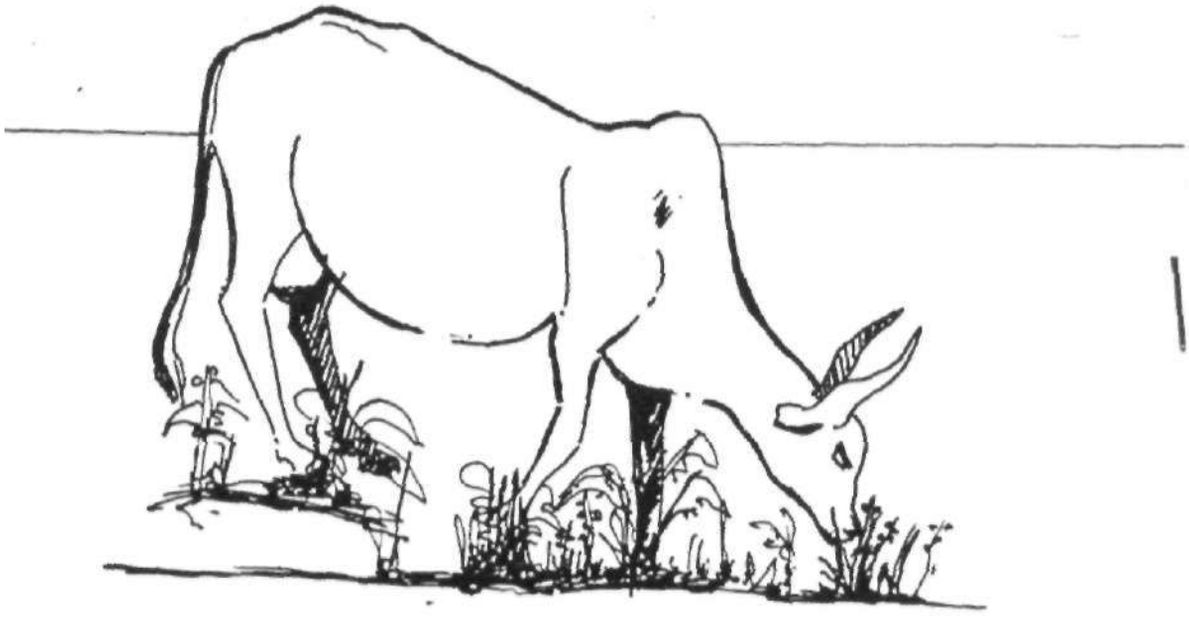
The drawing below is that of a Badoje leaf.

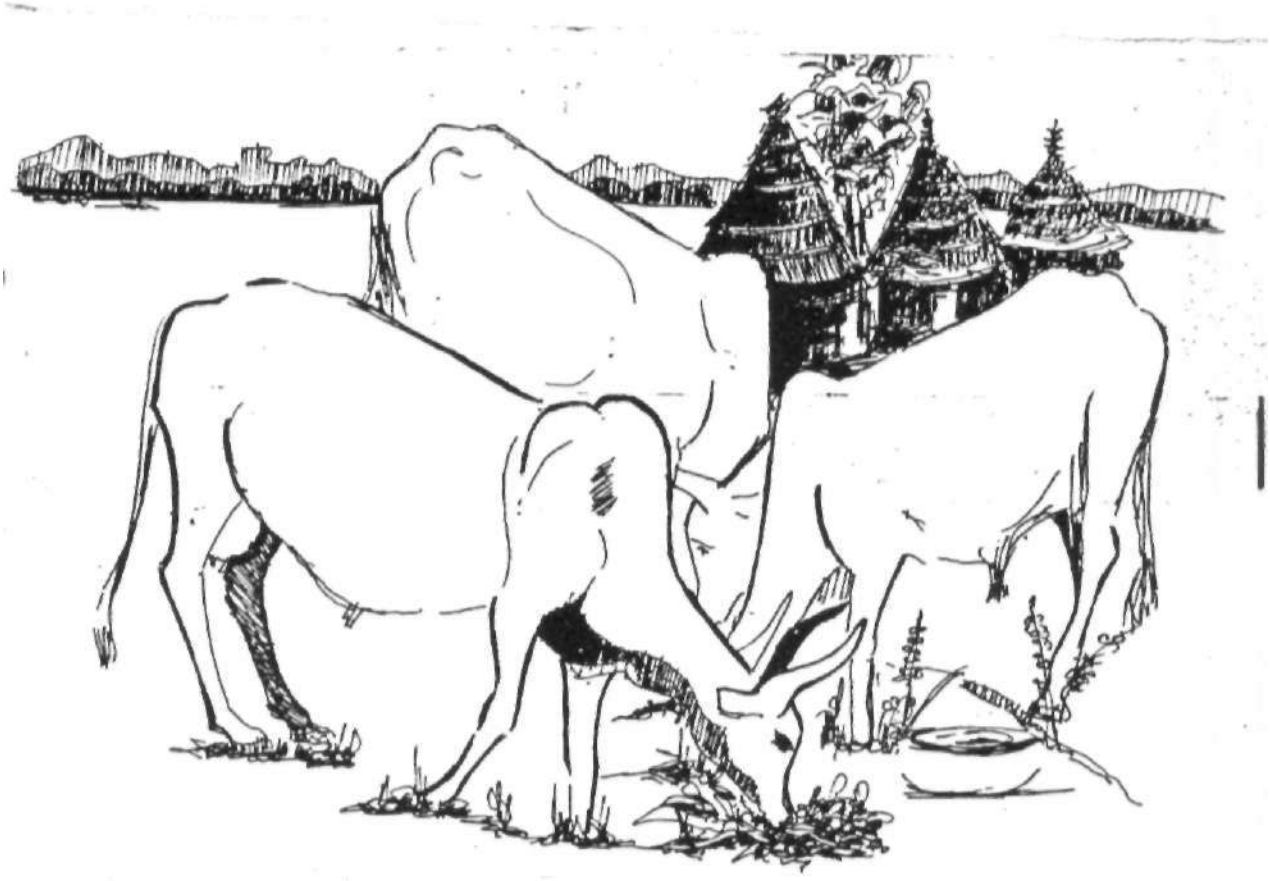


1. Draw your own Badoje leaf and see if it is similar to the teachers' drawing.
2. When you leave the classroom go with the Badoje plant in your glassjar and keep it in the sun without water so that it dries up.
3. What do you notice from the dried leaf?

4. Is the colour still green?
5. Which one does the cow prefer for browse: is it green or dried leaves?
6. Does your cow eat both green and dried leaves.
7. How about your sheep and goats; which one do they prefer?
8. Ask your father, uncle or brother, the importance of leaves to livestock animals.
9. Ask him also the importance of green and dried leaves to man.

See the drawings below:





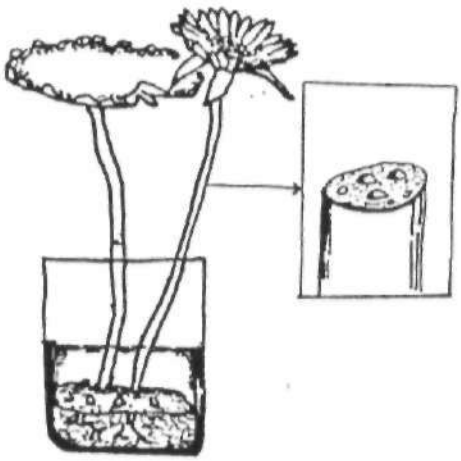
In (a) Finaye is seen eating green plants in the day time and in (b) it is seen eating dried matter in the evening when the cattle are in coral (garge).

10. Does your mother cook green leaves? Do you eat them?
11. If so, name the plants from where your mother gets the leaves you eat.

2. The Stem

The next part of a flowering plant which the teacher explained to Tumba and Geno was the stem. The stem, the teacher explains, is the transporter of materials such as water from the roots to the leaves and also transports food and sugar from the leaves to the flowers and other parts of the plant. The stem also supports the leaves and flowers of the plant. The stem is the body of the plant. Transportation of food and water and the support of the entire plant leaves and flowers, are the principal functions of the stem.

You can see the stem of Badoje shown in the drawing below:



You can also see the stem of: (a) a baobab tree (b) a corn and (c) a fodder grass (wurgu).



Activity:

1. Draw the stem of your own Badoje.

2. Draw the stem of any tree near your settlement.

3. When you climb trees, do you do so with the help of the stem?

4. Have you ever realized the importance of stems to human beings?

5. Is your stick (Sauru) made out of a stem?

6. How about your Sudu (room) is it made out of stems?

7. How about the firewoods your mother uses for cooking? are they also stems?

8. Find out the various uses of stems from your father, uncle or brother.

9. Below is a drawing of Wobaye tithered to tuggere which is also a stem from a nearby tree. You could see it browsing corn and beans stems.

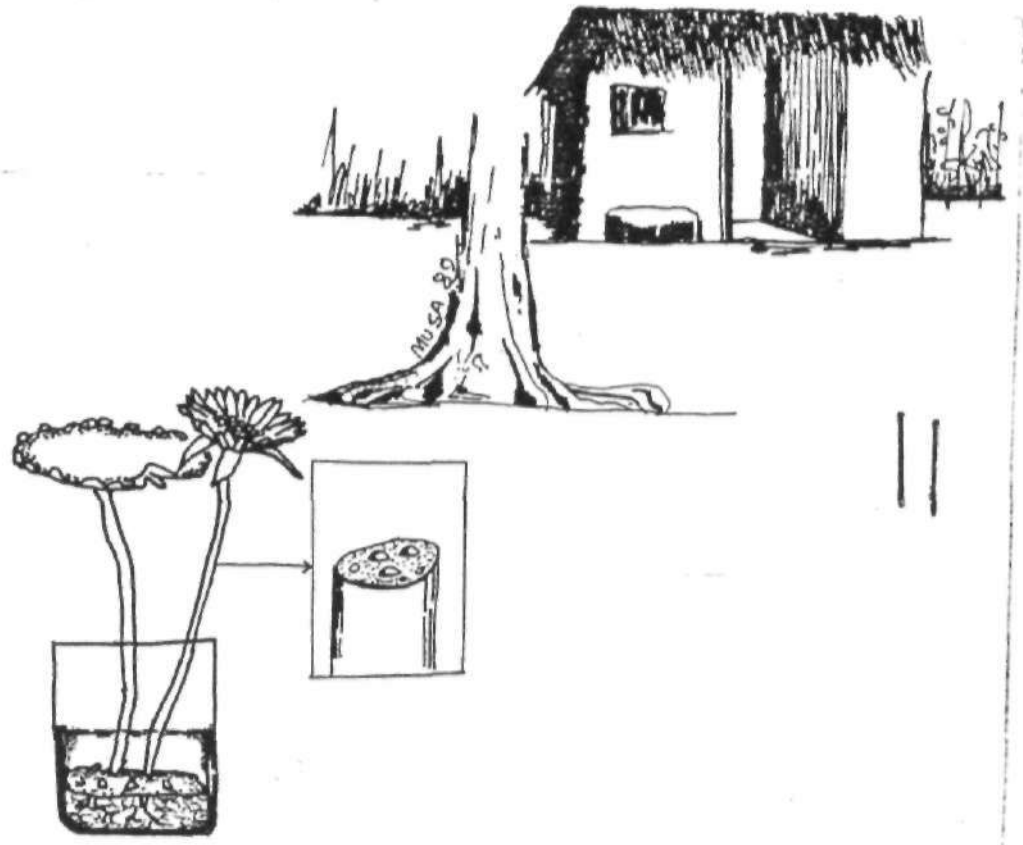
Drawing

The Root

The next organ of a plant which the teacher explained to his pupils at Domdo nomadic Education Primary School was the 'root'. The roots anchore the plant to the ground and they also absorb water from the ground. The water is then passed through the stem to the leaves. Anchoring the plant and absorbing water and other materials are the main functions of the root.

Activity:

Look through your glass-jars you can see the roots of your Badoje. The drawings below depict (a) the roots of Badoje and (b) the roots of a tree near the teachers house.



Activity:

1. Draw the roots of your Badoje.
2. Also draw the roots of any fodder grass such as Wurgu.
3. Draw the roots of any felled tree you have ever seen.
4. Ask your father, uncle or brother, the importance of roots to our health.
5. Through the help of your father, uncle or brother identify a plant which has medicinal roots. Also, find out the ailment it is supposed to cure.

Useful plants

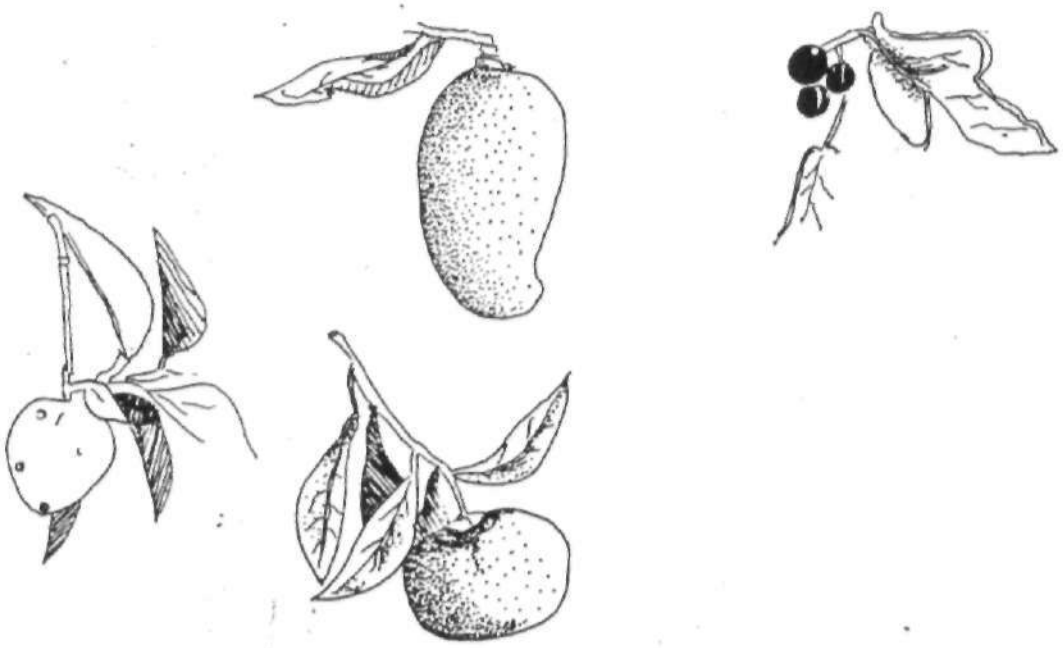
Since the beginning of man, he has always depended on plants to provide him with:

1. Food
2. Shelter
3. Fuel
4. Clothing
5. dyes
6. oils and
7. fire, etcetra.

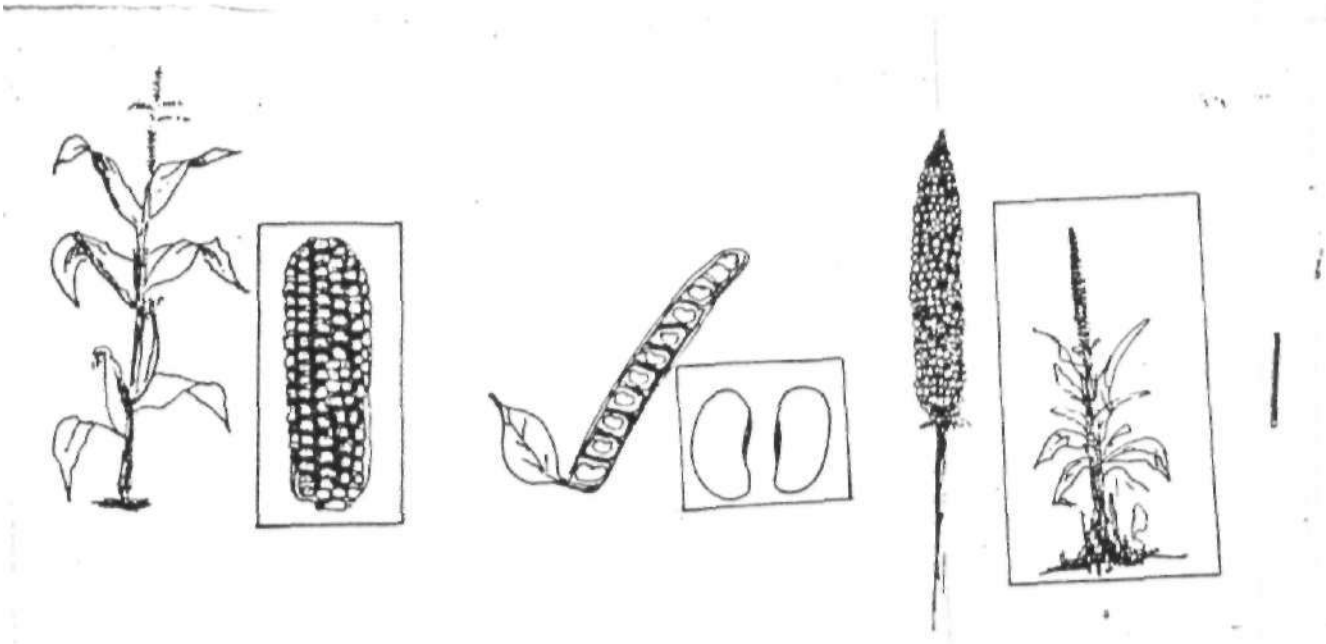
We take fruits of various plants, trees and shrubs. Example of common fruits we eat are:

1. Mangoroje
2. bummaje
3. Gwaddaje
4. Lemuje
5. Guavaje
6. Banana and
7. Tomato, etcetra.

You can see the drawings below of some of these fruits we eat.



We also eat various seeds of plants, for example: beans, groundnuts, rice, maize, guinea corn, millet and many other ones. Some of these plant seeds are shown in the drawings below:



Plants, therefore, provide us with fruits and grains. They also provide us with the vegetables we eat in our soup and other dishes. Some of the vegetables we eat are:

1. Alayyafu
2. Tomato
3. Tafasa
4. Polle (Yakuwa)
5. Yodo and
6. rammol.

These vegetables (4 & 1) are also depicted in the drawings below:





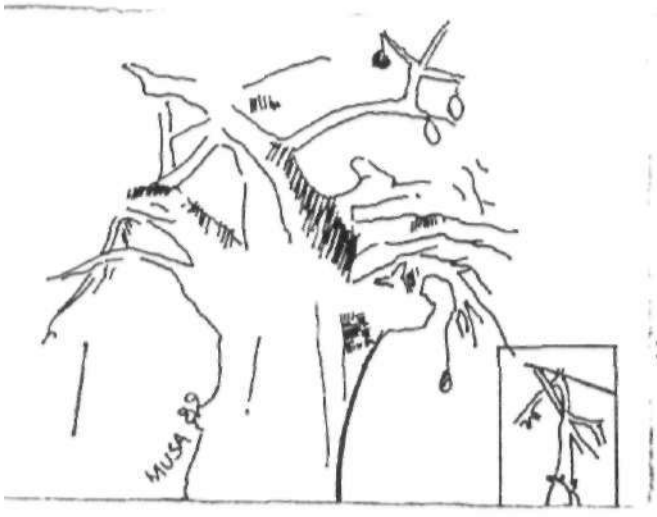
In yet another group of plants, we drive our food from their tubers. Such plants are:

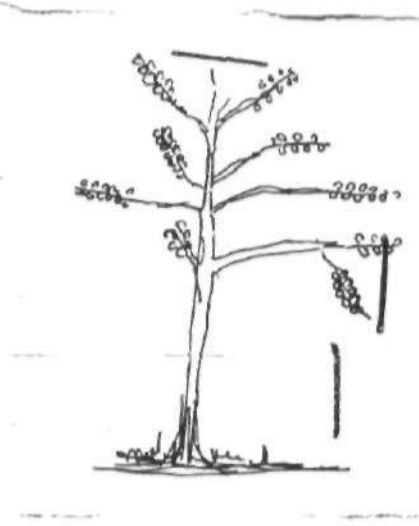
1. Cassava - Rogoje
2. Yam - Kappe
3. Potato - Dankali and
4. Onion - Albasaje

Again you can see some of these plant tubers in the drawings below:



A part from the vegetables, we also eat the leaves of some trees and shrubs. In the case of trees we all know the huge ba'obab tree known as Bokkol. The leaves of Bokkol are used for cooking soup in our dinner. A part from bokkol, we also eat the leaves of gudai and zogale. You can see these trees in the drawings below.





By now you have realized how useful plants are to us.

Activity:

1. Classify the plants we eat in the following order.
   (a) those that provide us with fruits
   (b) those that provide us with vegetable
   (c) those that provide us with grains
   (d) those that we eat their tubers
   (e) those that provide us with firewoods and
   (f) those we use for our shelter.

2. Write a short poem for any of the plants you are interested in. Your poem should be composed in fulfulde, and you are to make it sound as beautiful as you can. Compare your poem with those of your classmates. Below, you can read the teacher's poem in (a) and Tumba's poem in (b). Which one do you like better?



(a) Teachers poem on Duman kada.

O you flowering thing
when ever I see your fascinating
flowers and your ever green
leaves creeping over our
bare sand, I am tempted to
touch you.

Your presence makes our environment
cool and greenish.

Tell me, O you my creeping flowering friend,
how many crawling animals you shelter. I often
wonder how related you are to waterlily
(Badoje). Creep, creep, creep your answer when
I come to see you tomorrow on my way from the
distant pasture. For now, goodnight.



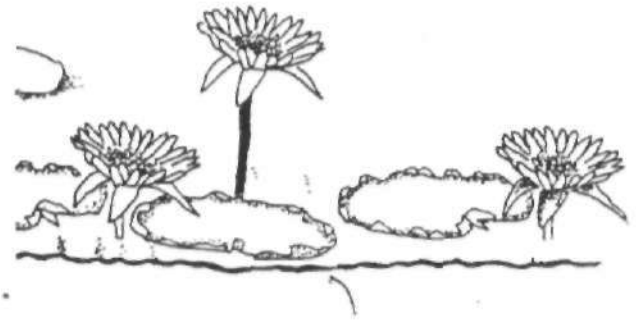
Tumba's Poem on Barkehi

Barkehi, Barkehi, Barkehi,
our saviour. We rely on you to put
our shelter together. We relay on you for
our various needs.
We are always cutting and removing your
branches for one reason or the other.
We are indeedlucky to have your shrubs
near our compound.
Barkehi, you are a pullo other wise, how else
could one describe your invaluable
contributions to us.

Longlive Barkehi, longlive
our saviour. I hear the voice
of my mother, she is calling me, it is
good day Barkehi, till I see you in the
evening when I am less busy.

Tell your teacher if you have ever heard of this song and complete the missing lines.

Bado, Badoje, Bado
Badoje bendi Bado
Badoje hikka, Bado
Badoje fouru, Bado
De nyammatako Bado
_ _ _ _ _ _ _ _ _
_ _ _ _ _ _ _ _ _
_ _ _ _ _ _ _ _ _



Unit 2: Animals in our Neighbourhood

Introduction

As Nomadic pastoral children, you are very familiar with animals. You live with them and attend to their needs in your daily routines. You know that Animals are of different sizes and shapes. You must have noticed these differences at a very early age. However, you will need to be guided in making classifications of animals into groups such as mammals and their sub-divisions; reptiles, birds; amphibians insects; and other smaller groups like the centipedes and milipedes.

You should specifically understand the functions of the body organs common to each group and the absence of such organs in other groups. You should learn how to depict the animals or the organ of their body in the form of drawings. You should also engage in other simple activities such as watching and observing animals in their natural habitat.

Objectives

At the end of this unit, you should be able to:

1. Classify animals into groups and sub-divisions.
2. depict animals in simple drawings
3. state the characteristics of each group or sub-division of a group.
4. describe their modes of feeding
5. list the places which provide them with their natural habitat.

Some Broad Concepts:

Mammals

Rep tiles

Amphibians

Fishes

Birds

Anthropods (insects)

Centipedes

Millipedes

Vertebrates

Invertebrates

Cold-blooded

Warm-blooded, etcetra

Animals Around our Rumirde:

Tumba's teacher at Domdo has just asked his class to mention all the animals they know. The class started with familiar animals such as cattle, sheep

goats, dogs, and cats. "These animals", they insisted, "constitute a group called Dabbaji-Wuro (the domestic animals). The other group comprising the hyna, lion, elephant, hippopatamus, jackal and so on, constitute - Dabbaji-Ladde (wild-animals) "they informed their teacher enthusiastically.

The teacher thanked the children for classifying the animals according to whether they are domestic or wild. He then proceeded to inform them of another method of classification, which groups the animals according to how closely they resemble each other. The teacher reminded the children that this method of classification was earlier mentioned to them when they treated plantkingdom in Unit 1. He said this method is the one used by scientists in the study of living things. It is outlined as follows:

Kingdom
Phylum
Class
Order
Family
Genus
Species.

If we want to classify man according to this method it will then be:

Kingdom: Animal

Phylum: Chordates

Class: Mammals

Order: Primates

Family: Hominidae

Genus: Homo

Species: Sapiens

We will mostly be concerned in this unit with the class of animals. This is to say that animals will be grouped according to their class. We will therefore start with the class of animals called mammals and proceed to treat other classes such as the reptiles, amphibians, fishes, birds, and anthropods (insects as the typical representative of this class).

Out of these classes five belong to the category of animals which possess a back bone and generally referred to as the vertabrates. Members of the class of anthropods however, do not posses any backbone and

are therefore generally called the invertebrates.

The Vertebrates: Mammals

1. Mammals are animals with the following characteristics:

    1. They have bony skeleton
    2. They are warm-blooded
    3. They have a covering of hair or fur
    4. Their young are borne alive
    5. The mother feeds the young on milk
    6. They have a highly developed brain

Human beings belong to this group of animals and in addition to the above characteristics they have their own distinguishing features.

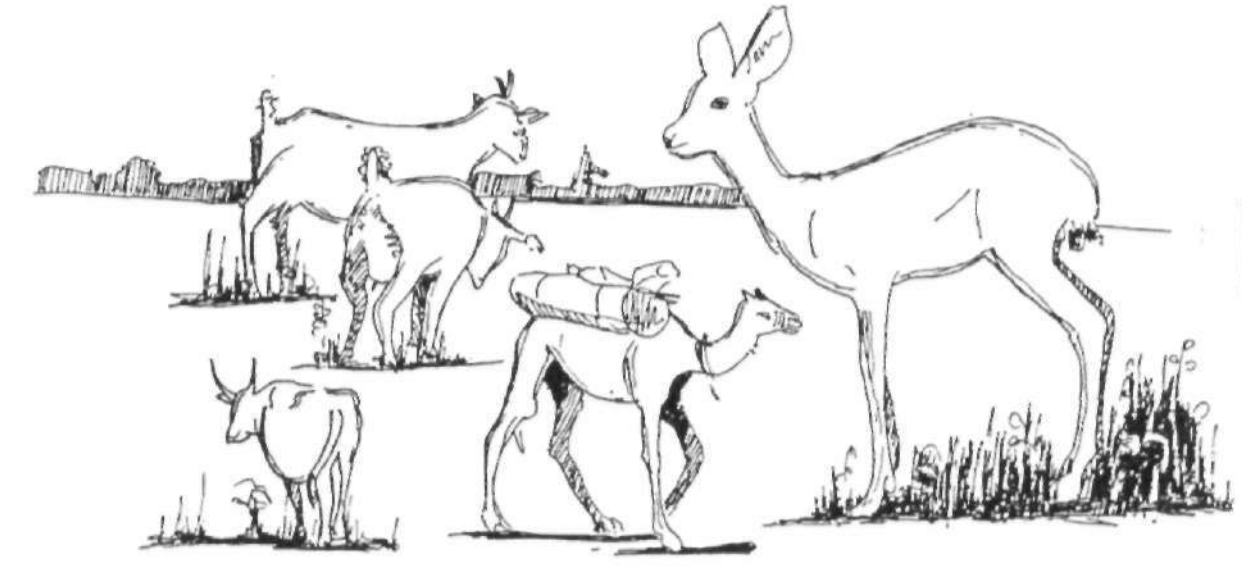
The class of mammals is a very large class consisting of many animals, domestic and wild. All the animals classified into domestic and wild groups by you at the beginning of this unit are infact members of the same class. That is, they are all mammals.

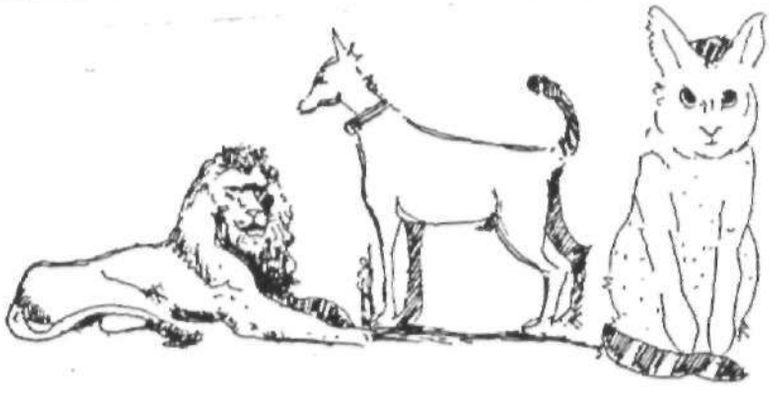
We can also divide this large class of mammals into many sub-divisions according to likeness and the manner of feeding. If we place in each sub-division mammals that are like each other: in their structure,

habits and in the kind of food they eat; at least five sub-divisions or groups are possible in Africa, namely:

1. The flesh-eating mammals, e.g. the lions, hynas, leopards, cats, dogs and so on.
2. The grass-and leaf-eating mammals, e.g. the cow, sheep, goat, antelope, camel and so on
3. The monkeys
4. The bats
5. The gnawing mammals e.g. rats, mice, squerrels and so on.

You can see the mammals in (these two) groups in the drawings below:





Activity:

1. Draw one animal from each of the two groups of mammals outlined above.
2. Ask your father, uncle or brother to explain to you more about anyone of the mammals in the drawings above, which you are not very familiar with.

3. Tell your teacher the names of other mammals you could think of which are not included in the two groups above.

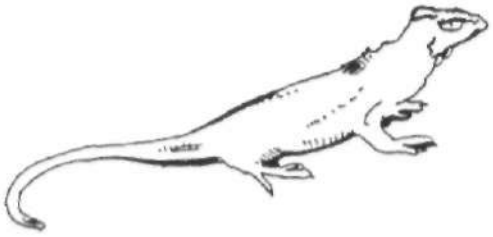
4. Also tell your teacher the mammal you like best and state your reasons for liking the mammal.

2. Reptiles:

Reptiles are creeping animals and favour a warm climate like that of tropical Africa. Reptiles include such animals as lizards, snakes, crocodiles, monitor, allegator and the tortoises. The reptiles like the mammals also possess bony skeleton even though, they differ greatly in other respects. They have the following characteristics:

1. a covering of scales
2. they are cold-blooded and
3. produce their young by means of eggs.

The commonest reptile in West Africa is the house lizard which is depicted in the drawing below.



lizard feed mainly on insects and worms. Crocodiles and snakes provide man with leather which is mostly used for decorative purposes.

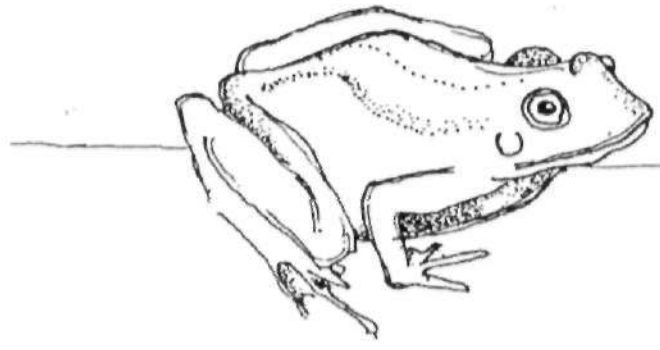
3. Amphibians:

Amphibians are animals which can live on land and in water. They have some common characteristics such as:

1. moist skins
2. lay eggs
3. cold-blooded and

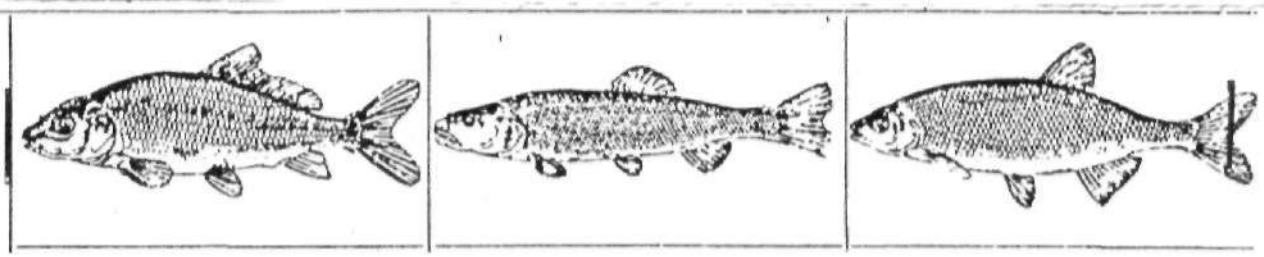
4. spend part of their life in water and part of it on land.

Almost all amphibians mate in water and lay their eggs there. The frog is the commonest member of this group.



Amphibians possess a bony skeleton just like the mammals and the reptiles, discussed above. Frogs feed mainly on insects. They are useful to man in that the insects they eat are mainly harmful insects to man or his farm.

4. Fishes:



This group of animals live entirely in water. Their shape is made for swimming. Like mammals, reptiles and amphibians discussed earlier, fishes also have a bony-skeleton. Their main features are:

1. slippery scales as body covering
2. fins instead of legs
3. gills instead of lungs

Fishes lay their eggs in thousands at a time. The eggs hatch out without any care from the parents. However, the young ones are watched over by the father. In the case of some freshwater

fish, a hole or nest is made in which the eggs are laid.

Fish may live in the sea, lakes and rivers. It is important however, to note that the fish that live in the sea will die if put into the freshwater of rivers. Fish move about in great numbers, referred to as shoals. Some fish live only near the surface of the water while some other kinds can only live at great depths in the ocean.

Fish is an important source of food for man.

They also produce their young by laying eggs just like the reptiles.



5. Birds

Birds differ from all other animals in respect of the following two characteristics:

1. They possess feathers instead of hair
2. They have beak instead of teeth.

Birds are of great interest to man. They feed on harmful insects and warms which harm man and also destroy his crops. Some of the birds however, are also dangerous to crops, a good example here is the queler birds which come in swarms of thousands and usually destroy many farms. On the other hand the cattle egret removes small parasites which suck the blood of cattle and consequently make them sick.

Birds are also an important source of food for man. Examples: guinea fowl, chicken, duck and so on.

Activity:

1. Name the domestic birds you eat
2. Make a drawing of one of them
3. Which bird do you like best and why?

6. The Invertebrates: Insects (Anthropods)

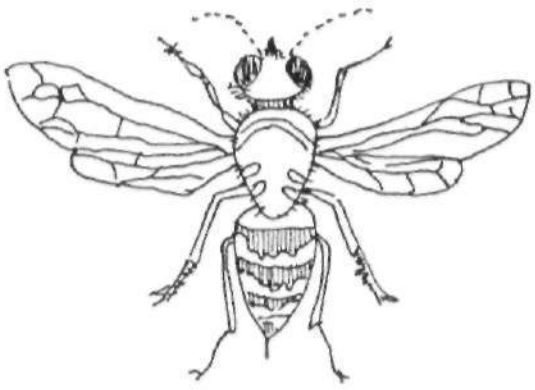
This group of animals is the most numerous in the world. The insects belong to the class of anthropods (jointed-legged animals). They are one of three major divisions of this class, namely:
crustaceans, arachnuids, and the Insects.
The insects are the most popular group of this class and it is because of this reason that they are chosen here. Another reason is that they are more numerous in tropical Africa.

The insects unlike the mammals, reptiles, birds, amphibians and fish posses no bony skeleton. Some of their typical characteristics are:

1. three pairs of legs, and
2. their body is divided into three parts namely: head, thorax and abdomen.

Some insects are very harmful to human beings and others are helpful to man. Bees, wasps and butterflies help in the pollination of many flowers that we depend on for food. The products of the honey bee are used directly. In the next season we will learn more about insects, particularly their life history. Suffice it to say the

drawing below represents a typical insect with all the six jointed legs and the three parts of the body-head, thorax and abdomen shown. It is a drawing of a tse-tse fly which kills our cattle, hence our enemy:



Activity:

1. Try to catch as many insects as possible, but mark you some are very dangerous because they can either bite or sting you.
2. Identify the six jointed legs and also the three parts of the body.
3. Make a list of all the local insects you know and present to the teacher.

4. Name the insect you hate most and the one you like best.
5. Explain to the class your reasons for the choice in (4) above.

Other Animals in the Kingdom:

There are other animals in the kingdom which have not been mentioned. The invertabrates which have more than six legs are a good example here. The scopions, the centipedes, the milepedes and many other ones have not been included in our discussions so far. You will learn more about these animals later. You can however, see the drawing of a scopion and a centipedes.

Unit 3: The Interrelationships of living-things in our neighbourhood.

Introduction

The aim of this unit is to draw your attention to the interdependence of all livingthings (including man) on each other. You should specifically be made to understand some few common food chains, which form familiar scenarios in your environment. You should understand the linkage between food chains and daily struggle for survival of all living things. Your neighbourhood should be seen as an arena for this struggle.

Objectives

At the end of this unit, you should be able to:

1. explain our existence on other living things.
2. recall that all living things are related to each other and to their environment. And
3. explain the struggle for survival through one's position in the food chain. And
4. describe the interrelationships of living things with each other and with their physical environment.

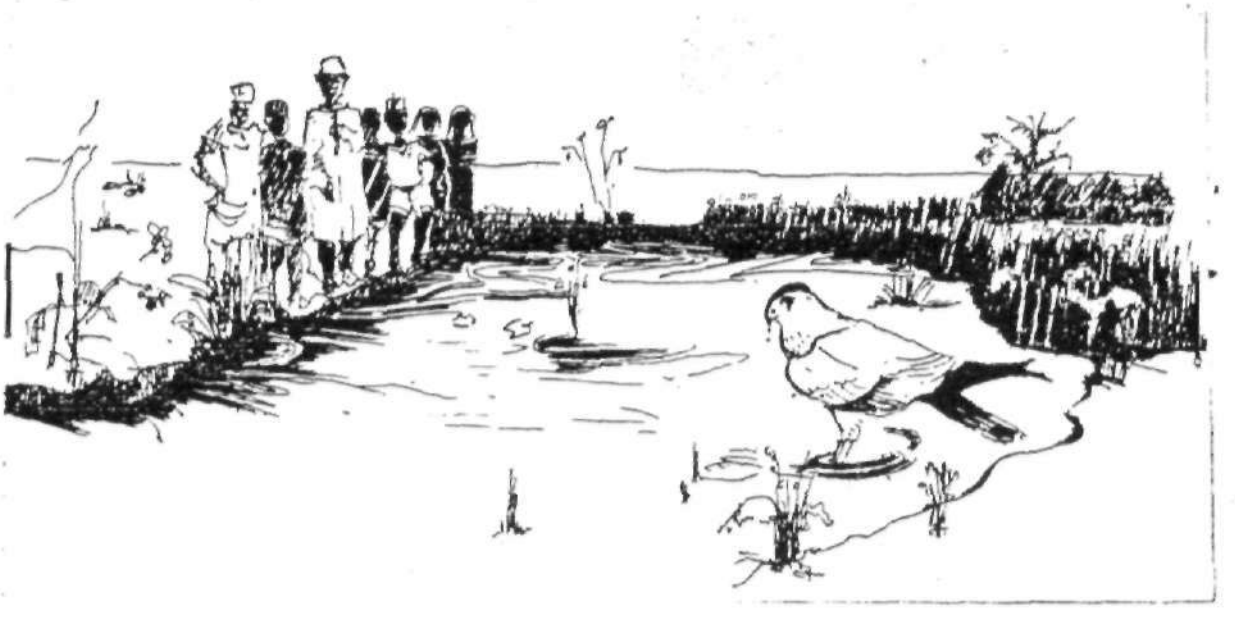
Some broad concepts:

Food chain

Ecology

Struggle for survival

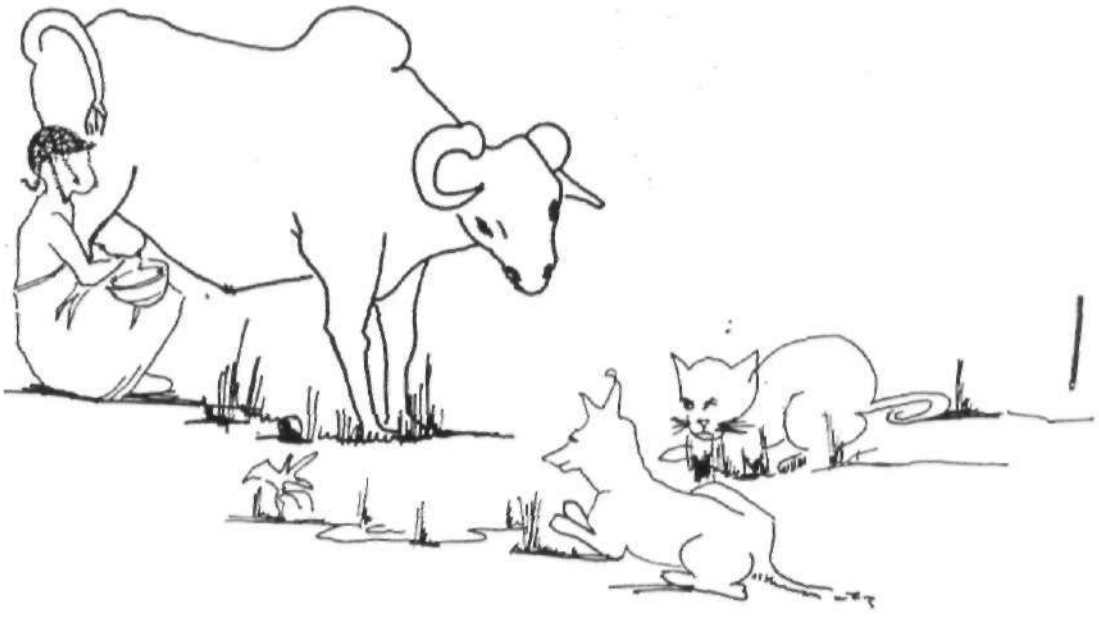
At Domdo, Tumba's teacher asked his class to follow him to a nearby pond where the cattle and all other animals drink their water. Below you can see Tumba, Geno and their classmates together with their teacher watching a predatory hawk which has just flown in to drink water.



The teacher asked his class to tell him how the hawk finds its daily food and how the little animals it feeds on find their food in return and so on. After the students have briefly consulted each other, they informed their teacher that the hawk feeds on mice, little chickens and other small animals. And mice eat grass, whereas chickens feed on grains and little worms. The teacher praised the children for their information and further asked them to depict their information and further asked them to depict their answer in a diagram similar to the one he has already produced as shown below.



By the time the children have just finished their drawings, the cattle of Tumba's father, nGajam came in to drink water for the day (folliti). The teacher shifted his attention to the cattle and immediately asked the children to tell him all the benefits which man derives from the cattle. And in turn to also tell him other animals that also benefit from the cattle. You can see a drawing of a cow - Bijaye, the grass it eats and a woman, a dog and a cat, which either drink the cows milk or use its manure for the farm.



The teacher then drew the attention of his children to the interdependence of living things with their physical environment. This interdependence is best understood in studying it through food chains - "who eats whom". The hawk eats chickens and the chickens eat grains and warms. This is an example of simple food chain. Elsewhere in the early part of this module you have seen how man depends on other living things such as plants for his food. We also depend on water and air for our survival.

In this regard every living and non living things in our environment has its functions in the environment and therefore its proper utilization is the key to the maintenance of a natural environment fit for life and living. In this respect Tumba's parents are leaving Domdo for a place which is located near a river basin because the environment of Domdo could no longer support them and their animals. This is because the ndungu season has come to an end and a new season 'yawoli has already started. You can therefore see Tumba, Geno, and their parents moving with their cattle to another place near the fadama where water and pasture will be more readily available.



Cycle - Two

Module - Two

Season - Yawal

Unit 1 - Non-living materials around our yawirde

Unit 2 - The Sun and our Environment

Unit 3 - Heat and Temperature

Drawing

The table below shows the units we use in measuring volume of various liquid substances. Your teacher will tell you more about these units.

Measurement of Volume:

10 mililitres (ml) = 1 centilitres (cl)

10 centilitres (cl) = 1 decilitre (dl)

10 decilitres (dl) = 1 litre (l)

100 centilitres (cl) = 1 kilolitre (kl)

Activity

Get a big faandu (Jolloru) which is tentimes as big as another small faandu which is also ten-times as big as another smaller faandu. With your three faandu you can measure your own milifaandu, centifaandu decifaandu and litrefaandu

Unit 3: Density

Introduction: The children will learn that density unlike the previous measurements is a derived measurement. It is mass per unit volulume, put simply as mass Density. It's units are therefore grams/litre.
volume

Objectives: At the end of this unit the children will be able to:

(1) measure or find out the density of various liquid substances.

(2) know that density is a derived measurement. And

Unit 1 Non-living materials around our yawirde

Introduction

In this unit you will learn the three states of matter and their general properties, drawing examples from the materials which are already familiar to You will also be given opportunity to make your own observations and experiments on the three states of matter.

Objectives

After you have gone through this unit, you should be able to:

(1) Classify some common materials on the basis of the three states of matter: Solids, Liquids and gases.

(2) Explain the phenomona of melting, boiling, evaporation and freezing. And

(3) Apply simple activities to show the processes of change from one state to another.

Some broad concepts

Matter,

Liquid, solid, Gas.

Matter exists as liquids, solids and gases, matter can be changed from one state to another. Matter is composed of molecules which are made up of atoms.

The parents of Tumba and Geno have just arrived at Binjije. They have come here because it is close to a river basin which has an extensive fadama land. A part from the parents of Tumba and Geno, there were other families in this yawirde, most of whom are related to Tumba's parents. This period of yawoli is characterized by high temperatures in the day time and relatively low temperatures in the night. This is why fadama grazing is preferred at this time.

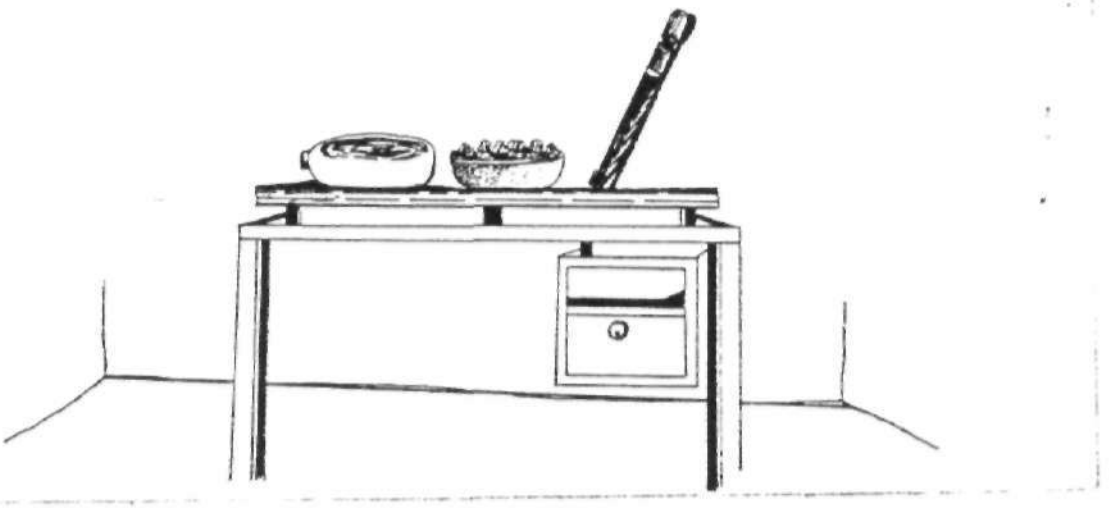
The two girls have brought along with them their transfer certificates and continuous assessment record cards from Domdo nomadic education school. The headmaster of Binjije nomadic education school has accepted them to continue in class two and has also accepted other children whose parents have equally just arrived to Binjije.

The Particulate Nature of Matter

The elementary science teacher at Binjije nomadic education primary school set his experiment in the following order:

(1) three containers were provided where one contained water, the second contained some small pieces of stones and the third was a special container, in that it was a bicycle hand pump.

The teacher asked his students to observe what was provided in the three containers which were laying on his table. You can see the teacher's three containers which are depicted here in the drawing.



The students have been told to observe the continuous nature of the substance of water and the discrete nature of stones in the other container, whereas the substance in the special container is not visible to

the eye but could only be felt when it is pumped out. All the three substances are called matter. They all have weight and also occupy space in the three containers. Matter includes all materials which make up our earth and the universe. All the materials around us could be classified into the three states of mater namely: liquid, solid and gas.

Activity 1

Find some common materials around your yawirde and classify them into those that look like water, those that look like stones and those that are similar to the substance contained in the special container - air. You can arrange your observations into a table like this:

No	Liquid (water)	Solid (Stones)	Gas (Air)
1			
2			
3			
4			
5			

At this stage before the students embarked on their observations, Tumba asked their teacher to

explain to them the characteristics of liquids, solids and gases so that these characteristics could guide them in their observations; The teacher responded with the following note:

(1) Solids, liquids have fixed volume whereas that of a gas is difficult to fix.

(2) Solids have a fixed shape but they can also be cut, broken or in some cases meltted.

(3) The shape of a liquid depends on the container and it does not have to be closed at the top. And

(4) The shape of a gas depends on its container which must be completely closed at the top.

After the teacher has stated these characteristics of solids, liquids and gas, the students went into their observations.

When the students came back to the class with a list of their observations each, Tumba suggested to the teacher that she has another way of classifying the three states from a local material namely:

"Churadam (milk), Nebban (butter) and

Mhm mhm -- vapour when butter is meltted"

The teacher praised Tumba for her good example and said her example will be used for their next experiment to show how matter changes from one state to another.

Churadam (milk) - changes - to Nebban (solid butter) changes through heating to liquid nebban (liquid butter) and vapour released in the process of meltting.

All the students said they have been very familiar with these changes even though they have never contemplated its scientific significance. The teacher then said the experiment will not be performed in the classroom since the students are very familiar with it. However the teacher proceeded to inform the students that matter in all the three states consists of small particles which are joined together either closely as in the case of continuous substances like the liquids or joined loosely as in the case of the discrete substance such as the stones and sand, whereas in the case of air they are widely separated. These particles are too small to be seen by the naked eye.

The teacher then asked the students to take note of the following general characteristics of matter, viz:

(1) Matter is composed of exceedingly small separate particles called molecules, which are further made up of yet smaller particles called atoms.

(2) Each different kind of matter is made up of its own particular kind of molecules.

(3) Milecules are in rapid and ceaseless motion. And

(4) Milecules attract each other.

More will be said on molecules and atoms in future. The following experiment shows that particles of matter are capable of constant motion which can be accelerated when a source of energy like fire is used to heat a substance such as air.

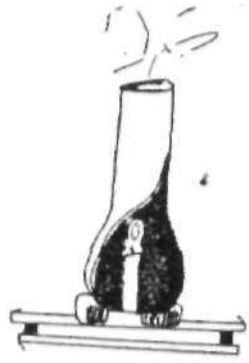
Experiment

(1) Find a small candle, a small pot cylinder (shantali) opened at two ends, a match box and two pieces of wood.

(2) Place the pot cyclinder on the two pieces of wood so that it is raised as shown in the drawing below. Light the candle with your matches and place it inside the cylinder through the lower open end of the cylinder.

Your teacher will perform this experiment for you and later provide you with similar items to carry out the same experiment. You will notice the heated

air soon spreads heat in the room, an indication that the heated particles of air are in random motion.



Activity

1. Ask your father or uncle the importance of Duddooli to the cattle.
2. Is there any similarity between Duddooli and the above experiment
3. Explain to your class the areas of similarities

Unit 2 The sun and our enviornment.

Introduction

You are already aware of the use of fire for cooking and warming the rooms in the harmattan period. The severity of heat, particularly in this season of yawoli must not be unnoticed by you. However, the importance of this unit lies in guiding you to appreciate morefully the various sources of heat and its uses and distructions. You will be made to see heat as a source of energy, which varies accordingly.

The unit starts with the sun as a natural source of heat and therefore energy.

Objectives

At the end of this unit you should be able to:

(1) Explain the importance of sun to us and other living things - such as plants and animals.

(2) Recognize the sun as a natural source of nergy supply.

(3) Examine the various uses and distructions of fire.

(4) Explain why we were clothes.

Some Broad Concepts

Heat is a form of energy - the energy of moving particles. Clothing helps us to regulate the heat to our body.

The sun is a giant source of heat

Various substances change their color when heated.

The Sun and Our Environment

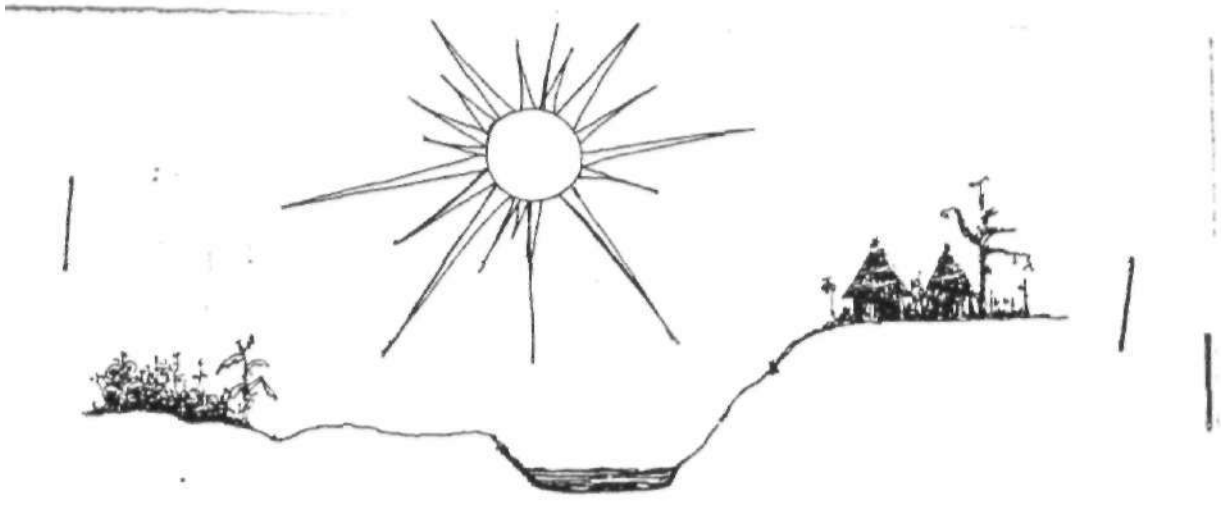
nGarso Baron Jedo is a parternal uncle to Tumba's father and is one of the leaders of their yawirde at Binjije. The title of ngarso is in appreciation of his immense knowledge about the cattle and the climate. He has spent more than eight decades moving and living with the cattle according to the dectates of the climatic changes. Ngarso is therefore an ultimate title which is very rare to comeby . It signifies accumulated knowledge through experience, foresightedness and general wisdom in the realms of life.

This eminant personality was the one invited by the elementary science teacher at Binjije nomadic education primary school to talk to the children on the topic: The sun and our environment.

Ngarso informs the children who are largely his grandchildren, that the sun is a huge ball of fire

located about 150 million kilometers away from the earth - our home. The sun is the center and head of a family of heavenly bodies known as the solar system. The principal members of this family are the nine known planets (including our earth) which revolve around the sun. In this way of revolving round the earth we have Days and Nights. You will learn more about the sun and the nine planets which consitute what is generally referred to as the solar system in the near future - probably next year.

The sun has been radiating energy for billions of years. The visible light rays which reach us in the Day-time are one form of this energy. These sun rays that reach us here on the earth are the source which supplies green plants with the essential light for the manufacture of food and thereby makes plant and animals life possible on earth. We, inturn get our food and therefore energy to work from these plants and animals.



The sun rays could be very hot especially to a naked body in such seasons like the yawoli which we were now in. To protect our body from these rays we were clothes so as to regulate the heat or cold to our body.

When Ngarso finished his levture, he asked the students at Binjije if they had any questions. They asked him some few questions which he answered. Their teacher then thanked Ngarso Baron Jedo for his well delivered lecture. When he was about to go, the students requested their teacher to invite him again for another topic. On hearing the students request, Ngarso promised to come again when ever he was invited.

Activity

The teacher asked his students to find out other sources of heat a part from Sun. He also asked them to find out the various sources of fire.

Fire: A Common Source of Heat

When the students came to the classroom the following day the teacher reminded them of their assignment about fire and its sources. Tumba asked the teacher to allow her to tell the class what she learnt from her father about fire in the previous night.

She said "we use fire for our cooking and duddooli. We also use fire to burn unwanted rubbish. Fire could however, be destructive if not properly watched. She said the bushes we graze our cattle are sometimes destroyed by fire set by some careless individuals who hunt for little bush animals. She further said there are at least three ways of obtaining fire:

(1) through the use of a match.

(2) through the use of burkake and

(3) through the use of kyastu.

The first one is the conventional method of geeting fire, the second and third were mostly employed in the past when matches were not available. The two had served nomadic pastoralists greatly in the past.

The teacher praised Tumba for her homework and asked other students if they had all heard her properly. He said from Tumba's homework we now know that fire produces heat and this is why it is capable of burning.

Unit 3 Heat and Temperature.

Introduction

The nomadic pastoral environment is full of materials which undergo either physical or chemical changes. Your experience in clay - moulding, cooking and burning of woods could serve as starting points for the teaching of heat. The season of yawoli also provides a good opportunity for the teaching of both heat and temperature since it is a hot season. It is in this regard that the season is chosen for this and other related topics.

You should be guided to use your daily experiance in understanding the nature of heat and the measurements of temperature.

Objectives

At the end of this unit, you should be able to:

(1) interpret heat as the energy of moving molecules.

(2) recognize that different materials vary in their ability to conduct heat.

(3) explain the motion of molecules in cool and warm substances.

(4) demonstrate that substances generally expand when heated and contract when cooled.

(5) use thermometer to measure temperatures.

Some Broad Concepts

Heating and cooling change the size of substances.

Temperature

Heat is a form of energy.

Particles of a body move more rapidly when heated.

Cooling is the loss of heat.

Substances generally expand when heated.

Two Ways of Changing our Substances

Malam Njidda, the elementary science teacher at Binjije nomadic education primary school has invited another guest lecturer today. He is Malam Ibrahim, a blacksmith from a nearby village called Runjin Machchuunga. He was invited by Malam Njidda to bring all his instruments so as to explain and talk to the students on how heat is used in changing different substances.

Malam Ibrahim started his lecture by demonstrating to the students the simple process of burning a piece of wood to ashes. He asked his students to note and call this, "experiment - one". He then

heated a small iron rod till when it became red. He asked the students to take note of the change of color. Then he allowed it to cool by putting it in a large bowl of water. The red color then disappeared and the original color restored. The students were again asked to mark this, "experiment - two".

Malam Ibrahim explained to his audience that "experiment - one" is an irreversible experiement: that is the change which took place is irreversible and is therefore known as 'shemical change'. "Experiment - two" on the other hand involves a reversible process where the original substance is not changed and is therefore called a 'physical change'. He asked his audience if they have any questions. After he answered their questions, Malam Nijidda thanked him for his lecture and said he would invite him again for another lecture in future.

Malam Njidda asked his students to take note of the two changes and said the changes involved in "Experiment one" and "Experiment two" are different because the nature of the substances in one and two are different. He then asked the students to list all the substances and materials they know under the two experiments as shown below and complete the table.

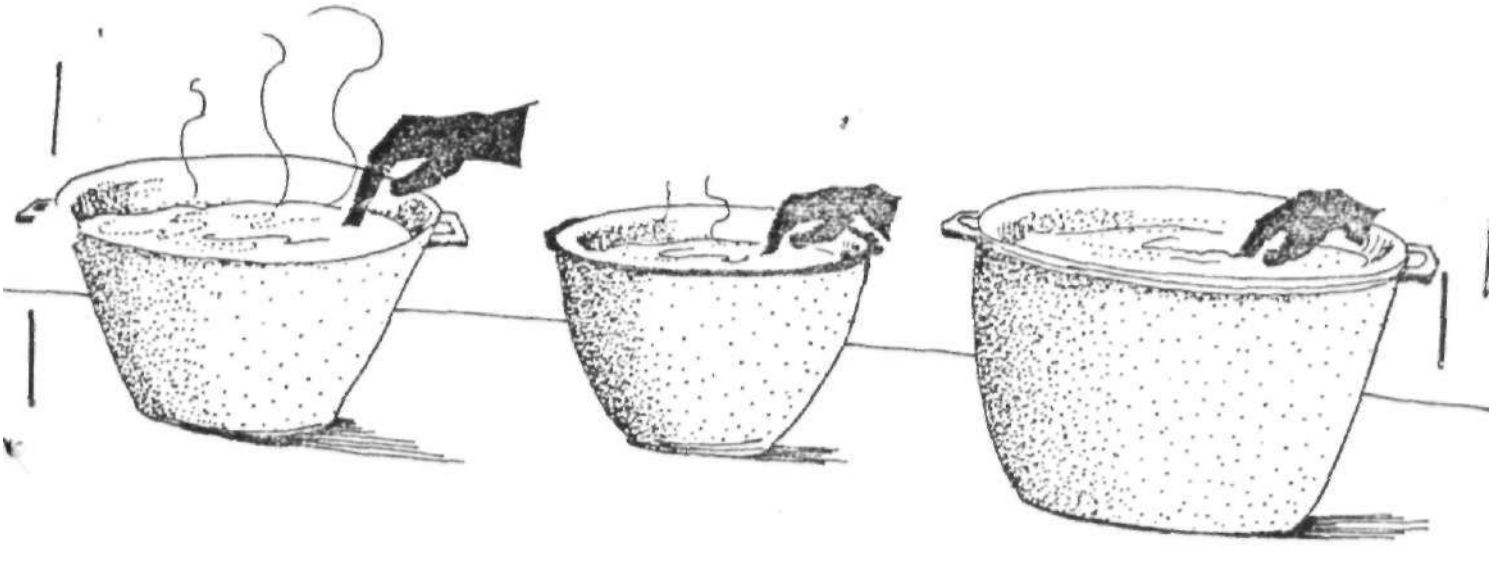
Serial No	Experiment - one	Experiment - two
1	Wood	Iron rod
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

The teacher asked if any body knows which of the two experiments a moulded clay could be classified under when it is heated. In a onerous chorous, the class responded by shouting "Experiment - two". Tumba asked him to explain to her why one end of an iron rod becomes unbearable to hold immediately after the other end is placed in fire. He quickly responded by saying that heat travels through the molecules. When they are heated become agitated and move rapidly. This movement further pushes other molecules to

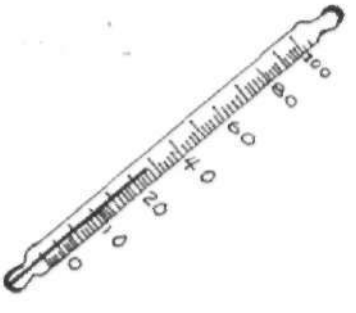
move faster and faster. In this way the heat travels to the other end of the rod which is not in fire. He further said many substances and materials expand when heated and contract when cooled. When the blacksmith malam Ibrahim dropped the hot iron rod in the water, it was one way of cooling it. This means cooling is the loss of heat.

Temperature

You can remember the experiment of three containers of water where one container was full of cold water, the second full of luke warm water and the third one full of warm water. I am sure you did this experiment last year. Tumba said she could remember they did the experiment last year in the season of dabbu'nde and she even has a drawing of it which looks like this:



The warm, luke warm and cold water could easily be differentiated when one dips his hand in each of the containers. Equally we feel cold on a cold night and hot on a hot day. Time variations are caused by the change in temperature. Temperature is therefore a degree of hotness or coldness and could be measured by a special device which the teacher has brought to the classroom so that they can see how it works. This special instrument is shown below.



You will learn more about this instrument which is called "thermometer" next year.

Activity

Make a table similar to the one shown here and keep a record of hot cold and medium days at the beginning of ndabbunde season which is just about to start.

Days	Hot	Medium	Cold
Mon		✓	
Tue			✓
Wed	✓		
Thu	✓		
Fri			
Sat			
Sun			

You can see Tumba's parents moving with their cattle in the process of Barto to another place called Daraye. It is time for nDabbu'nde the cold hámattan season.

Cycle: Two

Module: Three

Season: Ndabbu'nde

Unit 1: Measurement: Length and distance

Unit 2: Measurement: Weight and Volume

Unit 3: Measurement: Density

Unit 1 Measurement: Length and Distance

Introduction: You have learnt how to measure the height of your sister or brother through the help of a metre-sauru in the previous year. This unit is therefore a continuation of that module. Under this unit you will learn more on how to measure the length of various objects and the distance between two objects. Since you are already used to metre-sauru you will then learn the SI Units which make up a metre and a kilometre.

Objectives: After you have gone through this unit, you should be able to:

(1) Measure the length of various objects.

(2) Measure the distance between two objects. And

(3) Describe the SI units of length and distance.

Some Broad Concepts

Length, distance, milimetre, centimetre kilometre, SI units.

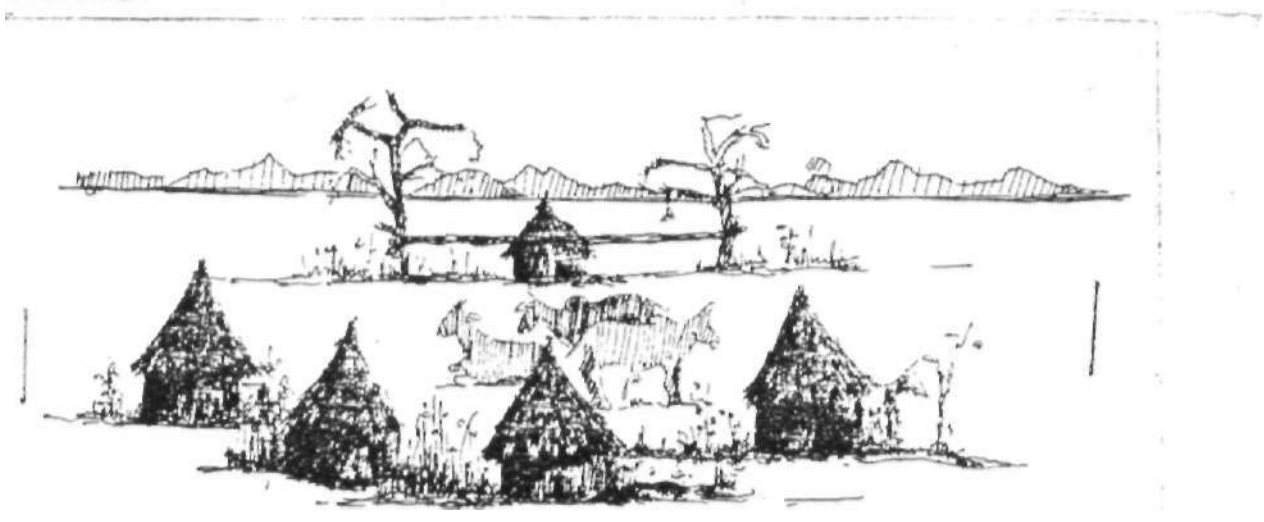
Measuring Length and Distance Between Objects:

After Tumba's parents have chosen a suitable place for their dabirde, the huts were constructed in such away that a certain distance was left between each hut to another.

There were five huts altogether built for the following people:

1. Motti and her children (Tumba and Geno)
2. Loddo
3. Jehwu
4. Njiddare and
5. The herd attendants (Kwairanga and Nyalli)

You can see the position of these huts in the drawing:



Activity

(1) Find the distance between motti and loddo's huts using

(a) your sauru

(b) an equivalent of the teacher's metre-sauru

(2) Measure the distance between Njiddare and Motti's huts using

(a) your sauru and

(b) An equivalent of the teachers' metre-sauru

The teachers metre-sauru as you have already seen earlier, is made up of small units called milimetres (mm) and bigger units called centimetres (cm). You can see the teacher's special sauru called metre-sauru depicted below:



Activity:

(1) Your teacher will tell you the importance of the following table:

Measurement of Lengths

10 milimetres (mm) = I centimetre (I cm)

10 centimetres (cm) = I decimetre (I dm)

10 decimetres (dm) = I metre (m) teachers (metre-sauru)

100 cm = Im (teachers metre-sauru)

100 metres (100m) = 1 kilometre (km)

(2) Try and see if you can make your own milimetres, centimetres and metres. Call them milisauru, centisauru, metre sauru decimetre sauru and kilometre sauru.

(3) Your teacher will take you out to measure a distance of one kilometre (100 metre-sauru).

(4) Having seen a distance of one kilometre, tell your teacher an estimate of the distance, you think your cattle can cover from morning to evening.

(5) What is the distance between your dabirde and the nearest market to it? Tell your teacher your guess and find out the guesses of your classmates.

Unit 2 Measurements of Weight and Volume

Introduction: The children will learn in this unit, the measurements of weight and volume. The concepts will be built on the traditional container Birdude for volume and Faggo for weight. You could recall, the children were introduced to these concepts last year.

Objectives: At the end of this unit, the children should be able to:

(1) measure the weight of various objects in miligrams centigrams, decigrams, grams and kilograms.

(2) measure the volume of various liquid substances in mililitres, centilitres decilitres, litres and kilolitres.

The measurement of Weights

You could remember that this drawing was shown to you last year. You can see the sizes of their faggo.

Activity

(1) Which faggo is the smallest? Amd which one is the biggest?

(2) Can you carry a faggo as big as Tumba's faggo? Find one and try it.

(3) When you go on barto do you normally carry any faggo? If you do, explain to the class the kind of items or objects it contains.

(4) You could also remember teachers special instrument for measuring the weight of an object, which can also compare it with the weight of another object. You can see this measuring instument below: which is called a weighting balance.



Your teacher will have a practical class with you so as to allow you each to measure your own faggo and compare in turn with another pupil's faggo in your class.

The table below indicates the units used by the teachers special instrument and therefore your teacher will tell you all about it and expects you to learn it.

Measurement of weights

10 miligrams (mg)	=	1 centigram (cg)
10 centigrams (cg)	=	1 decigram (dg)
10 decigram (dg)	=	1 gram (g)
1,000 grams (g)	=	1 kilogram
1,000 kilograms (kg)	=	1 tonne

Activity

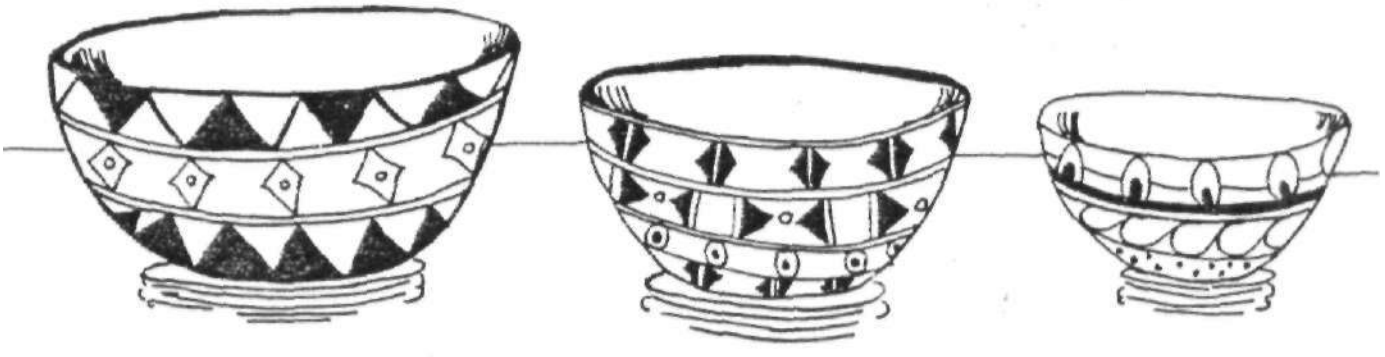
(1) Try and see if you can construct a very simple measuring device so that you can measure your objects in terms of milifaggo, centifaggo decifaggo one faggo and kilofaggo.

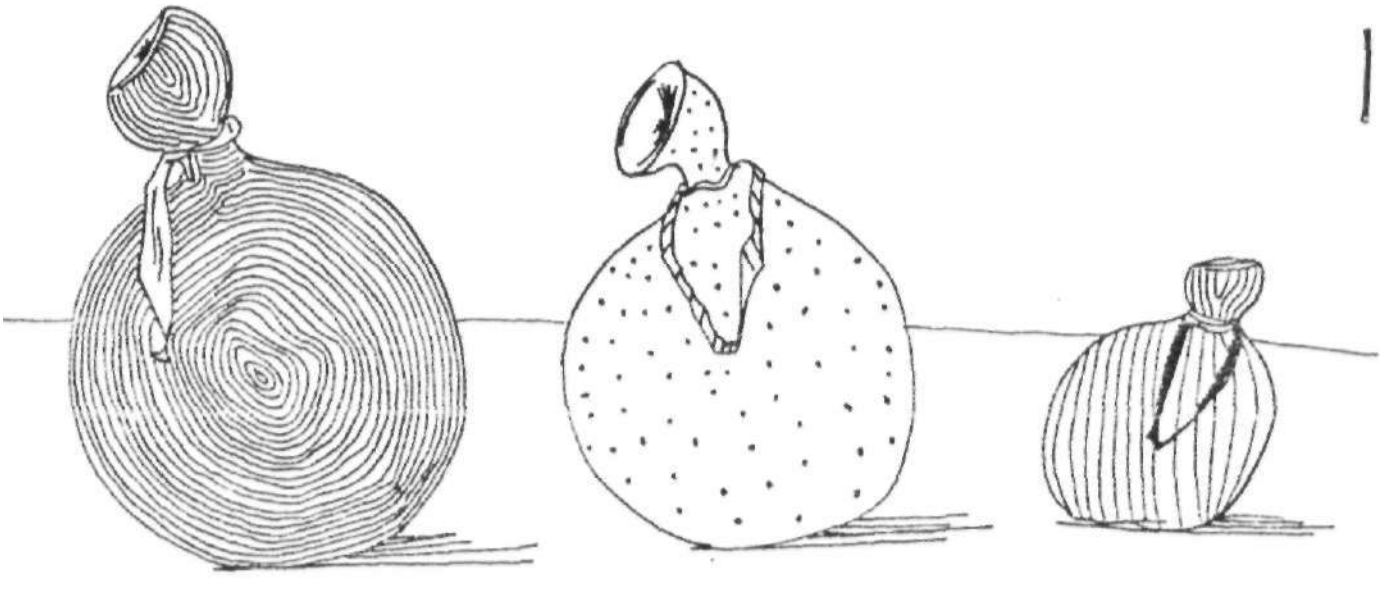
Inform your teacher if you run into any difficulties in your constuction.

(2) Can a donkey carry a faggo as big as that of a camel? How about a man and a donkey which one can carry a bigger faggo?

The Measurement of Volume

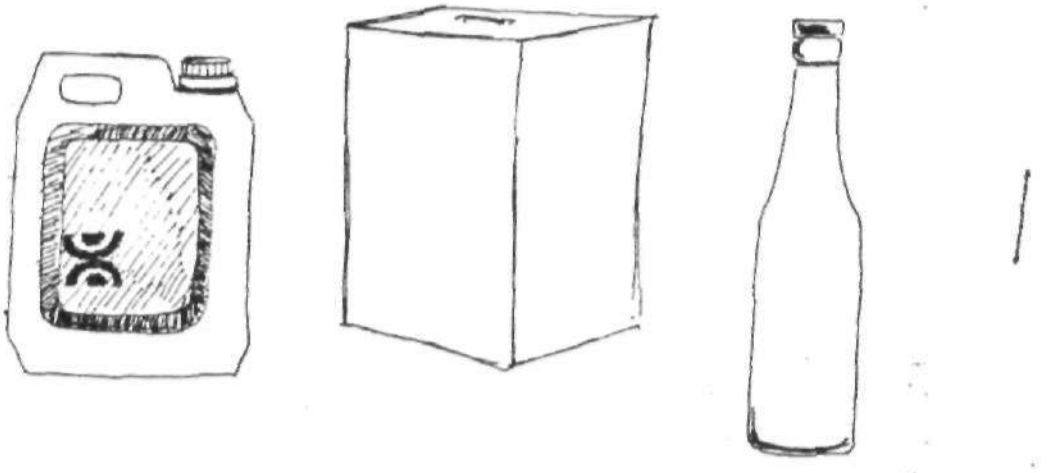
You could remember last year you were introduced to the use of two containers: Birdude and Jolloru (faandu). You can see these containers below:





Activity:

You will learn more about the measurement of volume next year. For now, you can see the other three containers in the diagram below. When you go home try and see how many bottles can fill a gallon and how many gallons can fill a kerosine tin.



The drawing below depicts Tumba's parents in the process of Barto. They were heading for Daraye to settle for the season of ndabbu'nde.



Cycle - Two

Module - Four

Season - Cheedu

Unit 1 - Hard and Soft Water

Unit 2 - Water Pressure

Unit 3 - Clean water in our homes

UNIT 1: Hard and Soft Water

Introduction: Water sustains our lines and therefore it is always with us. It is not equally distributed on the earth surface however, In some seasons it may be found in abundance whereas it may be difficult to find in other seasons of the year. In this respect every year has its dry and rainy seasons. In the Fulbe pastoral calender Cheedu is the hot season and therefore the pick of the dry season period. In this season water is difficult to find and therefore the nomadic pastoral Fulbe always migrate to a source of water for the needs of their animals and themselves. The rationale of teaching water in this season resides in its scarcity which makes it very valuable at this period. Students will learn in this unit the hardness and sofness of water and the disadvantages of hardwater particularly in our washings.

Objectives: At the end of this unit students should be able to:

(1) Understand the properties of hard and soft water and their effect on the water we use for washing and drinking.

(2) Understand the need for boiling untreated water before drinking.

Some Broad Concepts

Hard water

Soft water

Clean water for drinking.

Hard and Soft Water:

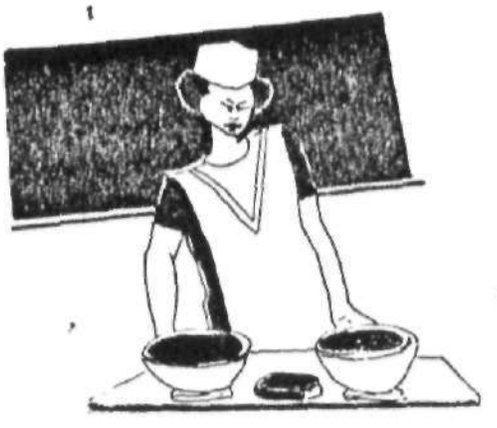
The parents of Tumba and Ngeno have a long with other families migrated to Sanabai just some few kilometres away from the river Niger. Recause of the availability of water, Sanabai attracts many pastoralists. They spend the Cheedu season here and start to move in the early part of seeto eventhough, some families remain at Sanabai until the early part of ndungu when the place becomes inhabitable due to the presence of fleas and other biting insects.

Their animals are watered from the river Niger or its tributeries. As for their drinking water a well has just been due and the local government has promised to die two more wells. There is also a nomadic education school built by the local government.

The headmaster at Sanabai has just registered the new arrivals after he has gone through their Continuous Assessment Record Cards which they have brought along with them from their former schools. It is how a week since Tumba and Ngeno have arrived at Sanabai. They have already

made new friends and they have learnt ensusiastically from their friend that the elementary science teacher has asked them to get ready for a lesson on Hard and soft water, to begin on this day.

Teacher Julde came to his classroom with two containers of water and an ordinary washing soap. You can see Julde and his two containers of water together with a piece of soap kept on the teachers demonstration table.



The teacher started performing his experiment by dipping a piece of cloth in one container and applying soap. A foam was quickly formed and he then washed his hands with clean water and took another piece of cloth and dip it in the second container and applied soap again. This time it took him a longtime before the formation of a foam. He informed his students that the first water in the container is a soft water whereas the water in the second container is a hard water. He further told his students that with hard water one has to waste a large quantity of soap whereas with soft water a smaller quantity of soap is required. He then assigned them to the following activities:

Activity:

(1) When you go home repeat the teachers experiment with an equal quantity of water from two different sources, say well water and river water.

(2) Find out from your parents or guardians, brothers or sisters, what causes hardness and softness of water.

Unit 3: Water Pressure

Introduction: The aim of this unit is to intimate the students with the force exerted by water. They might have noticed some natural springs and wonder how water gushes out with such force which causes bubles at the

water surface. The concept of pressure as a force per unit area will be introduced in this unit.

Objectives: At the end of this unit students should be able to:

(1) Understand the concept of pressure in water.

(2) Conduct simple experiments to show how pressure is affected by the level of water. And

(3) Conduct an experiment to show that pressure is really force per unit area.

Some Broad Concepts

Pressure in water

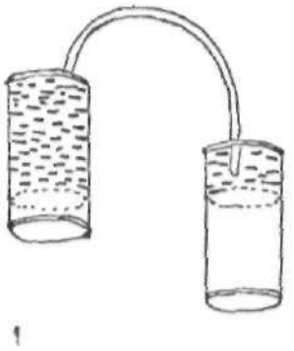
Pressure in water

The elementary science teacher at Sanabai nomadic education school went to his classroom feeling very happy and confident that he had arranged and tested his experiments before coming to the classroom. He told his students to watch him carefully because he will ask them questions at the end of the experiments. His first experiments went like this:

Experiment I:

Apparatus: Two transparent rubber containers and a rubber tube.

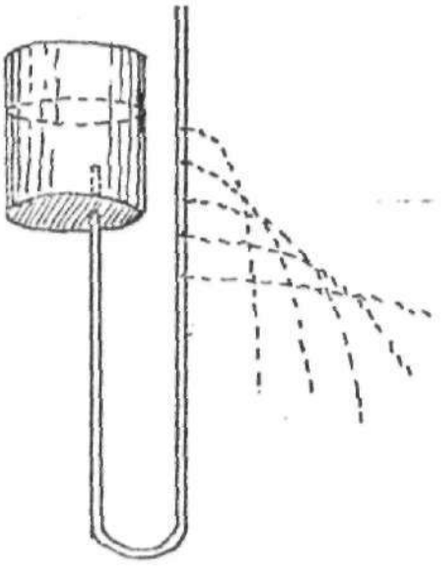
Procedure: Make a hole in each of the two containers, so that the opening is just enough for the tube to be inserted tightly. Fill one container with water. By varying the relative heights of the two rubber containers water may be made to pass from one to the other at will, and flow may only ceases when water levels in the containers are the same. See the set up of the experiment below



Experiment 2:

Apparatus: A transparent rubber container and a rubber tube of about 50cm.

Procedure: Put one end of the tube in the hole made through the base of the container. Make sure it is tightly fixed. Using a red-hot knitting needle make holes 2cm apart along apart measuring 15cm. Fill the can with water and bend the tube into a U-form. Continue to raise and lower the free end of the tube. You can see the set up of this experiment below.



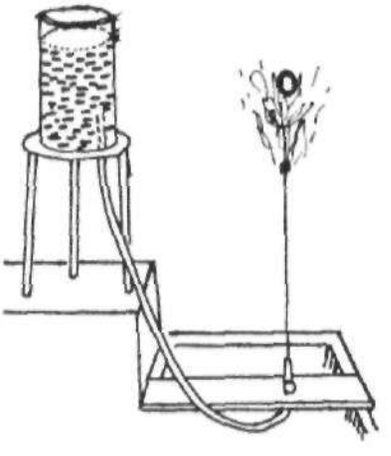
Activity: (1) Tell the teacher your observations about the experiment.

(2) What can you say about the lowest and furthest jets of water coming from the 2cm holes.

Experiment 3:

Apparatus: A tall plastic container, a rubber tube with a glass nozzle and ping-pong ball.

Procedure: Set up the experiment as shown in the diagram below:



Fit the rubber tube with a glass nozzle in order to produce a narrow jet of water. Continue to raise and lower the container. You will notice that the raising and lowering of the container produces variations in the height of the jet, however, the jet can never rise quite as high as the level of water in the container.

Activity: (1) When you go home try to make your own fountain using similar apparatus.

(2) Have you ever seen a natural fountain? If yes tell your teacher the description of the place the fountain is situated.

The lessons you can draw from these experiments is that water has its own pressure which causes it to behave the way it does in the three experiments. Your teacher will tell you more about pressure and will also explain to you that the reason why you have a jet of water or a fountain is because the hole it comes out is very small that is to say pressure is a force per unit area. A big force acting on a small area will produce greater pressure than the same force on a a bigger area.

Unit 3: Clean water in our homes:

Introduction: Clean water is very essential for our health. This is because unlean water brings many diseases to us.

In the pastoral communities unclean water may not be uncommon hence the imperative of this until.

Objectives: At the end of this unit students should be able to:

(1) Appreciate the need for a lcean drinking water in our homes.

(2) Understand the danger posed by unclean water.

Some Broad Concepts

Clean water

Conterminated water

Water-borne diseases.

Clean water:

Bagudo local government has just dug one well out of three set aside for Sanabai. The pastoral communities here cluster around this well to fetch water for their domestic cookings and drinking. The well is not far from Tumbas home. The school is also very close to this well. The science teacher today has decided to talk on the importance of clean water in our homes. This idea came to him when he saw three children bathing and drinking water from a small staguant pond near the school.

As a result of this experiance the teacher thought it better if the students attending his school are taught on the danger posed by drinking such conterminated water.

In the nomadic environment clean water could be obtained by the use of a simple process of boiling and filtering.

First water is put in a pot and boiled for some minutes, it is then allowed to cool and then it is filtered using a very clean white cloth. You can see an example of Tumba filtering her drinking water.



This simple treatment of water is capable of preventing Tumba from getting any of the following water borne diseases:

Cholera

Diarrhoea

Dysentery

Guinea-worm

At this juncture of the lesson students noticed an old man approaching their classroom. Some students immediately recognised him to be Ngarso Baron Jedo. Tumba was quick to ask the teacher whether he has invited granny Baro to talk to them. The teacher leaned forward to the small window to catch a glinse of Ngarso. When he saw him coming he told his students that he has invited Ngarso to talk to them about clean water.

Many students knew Ngarso Baron Jedo except the new arrivals who of course must have noticed him in the few days they have spent at Sanabai.

Their teacher went out to receive Ngarso who is also accompanied by some edlerly people. The teacher introduced him to the students and the lecture started immediately. Ngarso told the students that he values clean water more than anything in the world because without good drinking water, people cannot be healthy and we all know the importance of our health. He said many sickness have their origin in conterminated water. He specifically singled out Guinea-worm as one such dangerous disease carried from drinking conterminated water. The students

were then advised not to drink conterminated water and to always boil and filter their drinking water. Ngarso said throughout his life up to this point he had never drink any stream water which was not bioled and filtered. He then showed them his cattle which he uses to boil his drinking water. He said their culture pularku prohibits drinking conterminated water. He also ascribed the good healt he has enjoyed so far to his well cultivated habit of drinking clean water.

Ngarso finished his lecture by inviting students to ask him questions and after he had answered these questions the teacher thanked him for finding time to deliver this interesting and aducative lecture and hoped that from this day his students will take to the habit of boiling and filtering their drinking water.

Activity:

(1) When you go home inform your parents, brothers and sisters, the reasons why it is always good to boil and filter water from the wells and streams before drinking. And

(2) Ask your health science teacher to tell you more about clean and conterminated water.

Cycle - Two

Module - Five

Season - Seeto

The air and the weather.

Unit 1: The Air and the weather.

Introduction:

The nomadic pastoral children are exposed to the cyclical changes of the weather because of their living conditions which make them experiance the stormy, the cold and the hot wheather year and year out. The teaching of air and the wheather should therefore draw heavily on their experiances. The object of the topic should be geared towards the co-ordination of their experiances so as to focus it on some fundamental concepts of the air and the weather.

Objectives:

The children should at the end of t is unit be able to:

(1) Understand that the seasons of the year vary due to change in weather.

(2) Understand that the pastoral calender has five seasons precise by because of the change in wheather.

(3) Understand air masses in their local names.

(4) Understand that air supports burning. And

(5) Understand air pressure.

Some Broad Concepts:

Changes in the condition of the air determine the weather.

Wind is air in motion Air is a mixture of gases - Nitrogen, oxygen and carbon.

Calender.

Kinds of Weather

The Seeto period in the pastoral Fulbe calender is characterised by stormy wind and rainstorms which eventually leads to rainy seasons (ndungu).
The elementary science teacher at the nomadic education primary school at Gese lodi has prepared his lessons on weather and the air. He understands from the moment seeto period begins, these topics will be ideal for teaching, since the children will physically experience the local conditions.

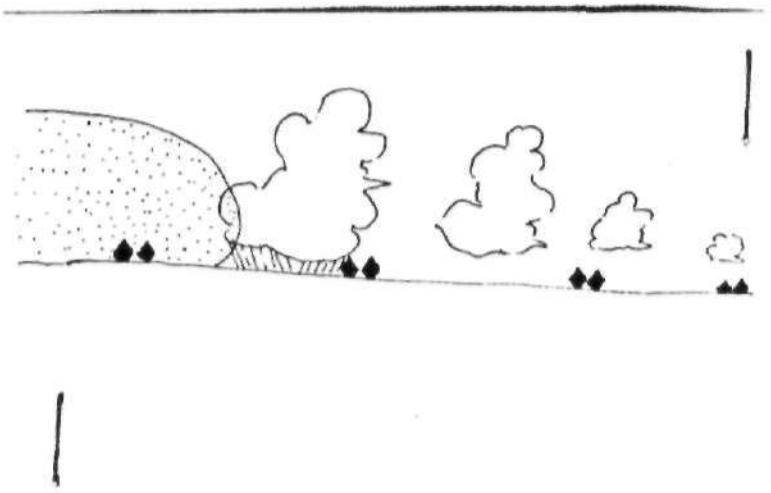
He started by asking his class the kind of weather they experienced last evening. One of his female students Geno, Tumba's sister, quickly responded by saying that the weather was stormy, windy and dusty. She said the windstorm was to severe that some trees near their settinirde were uprooted to the ground.

Ngeno and her classmates responded in a chorous voice by saying that there was a loud thunder which frightened all of them and there was also lightning. The rain they said did not fall very much as the wind was carrying it away. However they were of the view that some distant place from their settinirde someheavy rain must have fallen according to the thunder they were hearing and the now and then lightning they were seeing.

The teacher then cut in to inform them of the nature of thunderstorms which he said are very destructive as Ngeno had already mentioned about the trees uprooted. Thunderstorms, he continued, have a beginning in the rising of a large mass of warm, moist air to higher levels where it becomes cooker due to its expansion under reduced pressure (adiabatic cooling). As the air cools at this point, the water vapour in it condenses to form towering thunder clouds.

A thunderstorm may also form when the topography of the land causes the movement of moist air across the slopes of hills and mountains which accelerates the formation of cumulus and cumulonimbus clouds. The third cause of a thunderstorm could be the local heating of the ground and the moist air above it on a warm, sunny day.

You can see clouds which cause the formation of a thunderstorm in the drawing below:

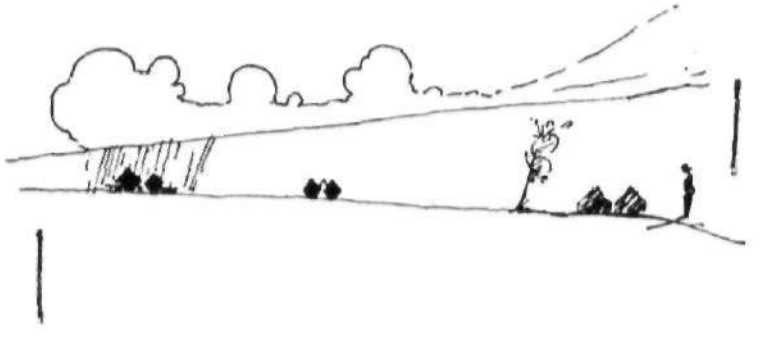


Wind:

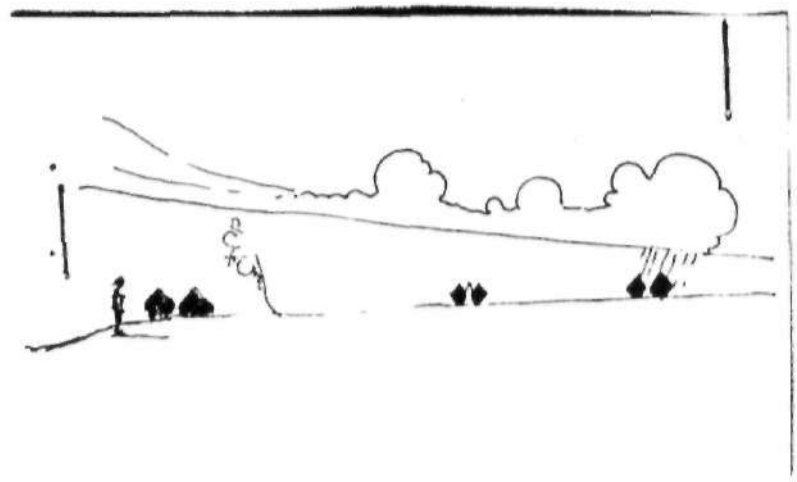
Looru is a wind which blows from the South to the North and is associated with rainfall. Looru is in short a South-North trade wind. The elementary science teacher at Geselodi nomadic primary school uctured his

students on winds and chose to start with this trade wind they locally call looru in fulfulde. The teacher talked on the difference in pressure which cause the winds blow. He said they will learn more of pressure next year. The teacher asked his students to note that winds are also generated by the seasonal variations of the year. Below you can see the position of looru blowing against the settinirde of Tumbas Parents. You can also see another tradewind from North - to South blowing dust against their dabirde in the season of ndabbunde.

(a)



(b)



Seasons of the year: The Fulbe Pastoral Calender

You can recall that last year you learnt about time. You learnt about seconds, minutes hours, days, weeks, months and year. Our lunar calender is made up of twelve months.

The lesson today is on seasons and their variations. It is also to address the number of visible seasons in a year. Our traditional pastoral calender consists of five seasons namely:

Ndungu (the rainy season), 'Yawal (hot season) Ndabbunde (the cool harmattan season), cheedu (the hot season proper) and seeto (the windy and stormy period which leads to rain)

Each of this season is different because it has a different weather from the other four. Some of you who were at Binjije in the last Yawal season could remember our distinguished and respected guest lecturer Ngarso Baron Jedo who lectured us on Sun. We have today invited Ngarso Baron Jedo again to talk to us, this time on the five seasons of the pastoral Fulbe Calender.

Ngarso started by saying that the ndungu season of the Fulbe calender is the rainy season which has a very special wheather. This season is very important to the pastoralists since in it the weeds and the entire animal pasture becomes greenish with the growing plants. Ndungu season is also a very important to human beings since our crops are grown and harvested in it.

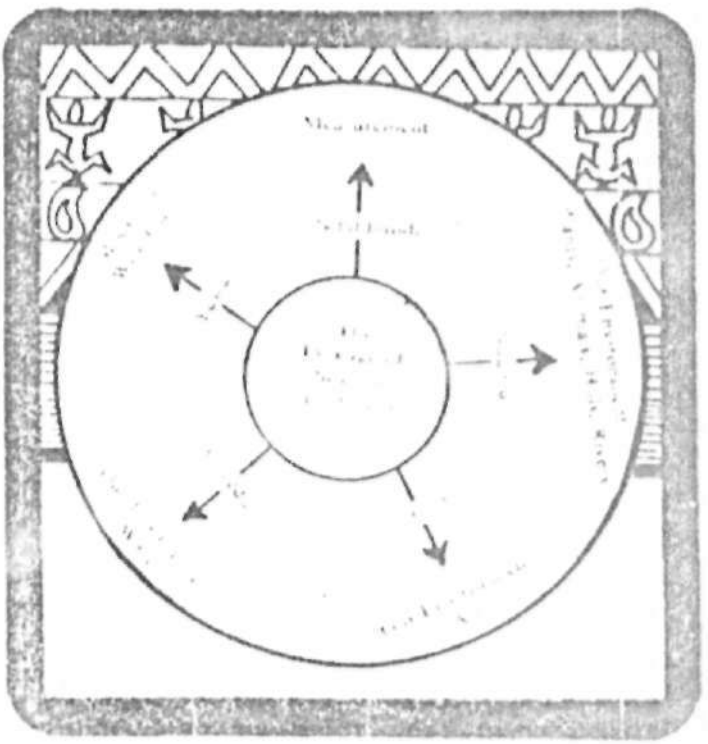
The season of 'Yawoli' is the hot season after rains. It is about one to one and a half months. In this season the sun is very hot and you could remember it was the season when last year I delivered a lecture to you in Binjije about the sun. The next season is

ndabbunde which is the period of cool dry harmattan. It is about three months. Cheedu is the fourth season and it is a hot season proper. It comes after the harmattan. It lasts for about two months. The fifth season is seeto which is the windy and stormy period just before the rains. It lasts one to one and a half months.

When Ngarso finished his lecture he told the students that last 'yawal season he mentioned something about the solar system eventhough he unde stood that they are to treat the topic next year. He said by the time they treat solar system they will then come to know that due to the heating from the sun the wind pressure is built up and causes wind to blow and also causes rainfall and harmattan. The variations in wheather is therefore essentially due to this heating process. He assured the students that their leader had earlier told him that they will learn more of this subject matter next year and he concluded by asking the students if they had any questions.

When he finished answering the questions the teacher thanked him for his usual co-operation and again promised to invite him later for yet another topic.

LAWOL KIMIYYA:
Learning Science Through PULAAKO.





nGhadjhaam von Ardo

Cycle - Three

Module - One

Season - Ndungu

Unit 1 - Germination of Seeds

Unit 2 - Pollination

Unit 3 - Seeds dispersal.

Unit I: Germination of Seeds

Introduction

We have already discussed in the first year of your school, that one of the characteristics of living things is that, they all grow. The process of germination of seeds is the first stage in the growth developments of seed plants.

You live in a natural environment where you watch the beginning of each rainy season and the subsequent germination of uncountable specie of seeds which grow into plants to bedeck your environment with green and red colours. This unit is to compliment and harmonize your observations with acceptable scientific explanations of the processes involved in the period of seed germination.

Objectives

At the end of this unit you should be able to:

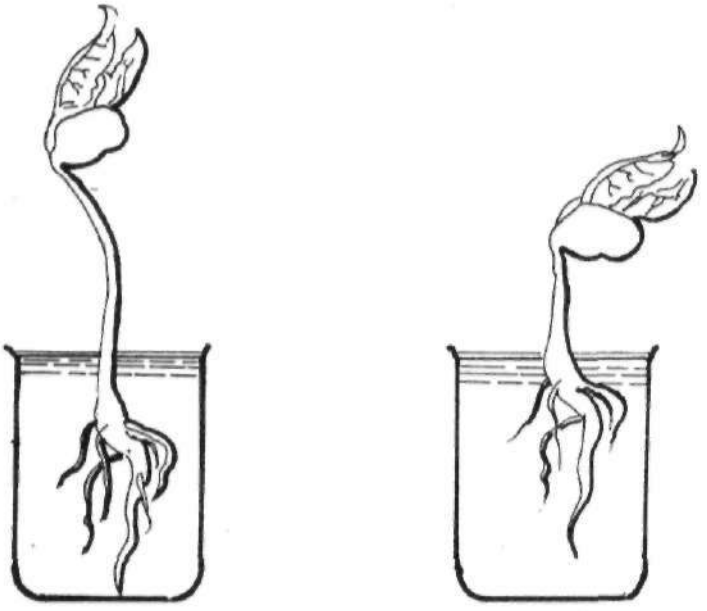
1. Explain the process of germination.
2. Test the conditions required for germination.

Some Broad Concepts

Germination

Shoot

Root



The Dungu season has just begun in ernest. Shoots are sprouting everywhere and nomadic pastoralists and farmers in Daraye are all very happy. Mallam Kwairanga is a new Elementary Science teacher who has just joined the nomadic education department. He was to assist Mallam Julde in teaching elementary science. Since he reported for duty about a fortnight ago, Mallam Julde had taken him round the school and also briefed him on what the children had covered in their two previous years of learning elementary science. According to the national syllabus they will be treating germination, pollination and seed dispersal during this season.

Germination

Mallam Kwairanga had already prepared his lesson on germination he came to the classroom with two covered containers. After the normal rollcall he responded the children's greetings and asked them to sit down. Ngeno raised up her hand and asked him about his two containers. Mallam Kwairanga opened the two containers to reveal two new shoots of beans. He explained to his children that when beans are planted after about two to three days they send a shoot just like the ones in the two tins. The conditions needed before their shoots come out are (1) soil, (2) water, and time to enable the seeds germinate. When the shoots come out we say germination has taken place. Mallam Kwairanga told his children that this is what is meant by germination. He then asked

them to go out with him to a short walk around the school premises so as to see the very many shoots of various plants which have come out as a result of germination. He divided the class into small groups and appointed group leaders to guide the observation exercise. Both Tumba and Ngeno were appointed group leaders. He then gave the children about half an hour for the observation.

When they came back to the classroom he listened to their questions and answered them accordingly. He asked them to carry out the following activity when they go back home.

1) Find two different seeds and plant them in two separate containers.
2) Which of the seeds germinates faster?
3) Why is water necessary for the germination to occur?
4) Why are we happy when Dungu season comes about?
5) Is it because our animals find planty weeds and grasses to browse after germination?
6) Make a table like the one below, and list the names of these seeds and the time they take to germinate. Also observe the differences if any between the shoots when they are fully opened.

S/No.	Name of Seed	Time taken to germinate
1	Beans	23 days
2	Millet	2 days
3		
4		
5		

Unit 2: Pollination

Introduction

Pollination is a vital process in the development of seeds. There are many agents which help in bringing about pollination. You live in an environment where flowers are quite common sites. This unit is based on your familiarity with flowers to further sharpen your observational techniques and inform you on the need for pollination. You will also be told why insects visit flowers.

Objectives

At the end of this unit you should be able to:

1. Explain the process of pollination.
2. interpret why insects visit flowers.
3. relate the attractive codours of flowers and their smells to insects visits.
4. recognize that there are many agents of pollination.

Some Broad Concepts

Pollination

Agents of pollination

Necter

Pollination

Mallam Kwairanga has prepared his lesson for this unit on pollination. He entered his classroom feeling good and confident. He has always liked talking about flowers. Infact he loves flowers and he intends to specialize in Botany when he goes to University after one or two years of teaching. When he was in the College of Education he did not play, as such he was one of those who collected prizes at their convocation ceremonies where they were confered with the Nigerian Certificate in Education (N.C.E.).

He went quickly through the rollcall register and noticed that he has two new students who have just arrived with their parents from a place called Bangi. They produced their transfer certificates and continuous assessment record cards and handed them over to him. He noticed that they were taught science last year. They however needed a repeat of the last unit on germination which they had missed. He then told them to see him later for the unit they lost.

The students were all very attentive and eager to start a new unit. He wrote the topic of the lesson on the board and told them that it was about flowers.

He asked them to follow him outside so as to go on the fields arround the school to see flowers. They all came out and followed him. Mallam Kwairanga settled near a very beautiful flower and asked the children for

He then told his children that pollination is a process which leads to fertilization and consequently the seed formation. He also informed them that pollination takes place through different means. According to Mallam Kwairanga, all the insects we see visiting flowers are agents of pollination even though they go there for their food which is the necter of a flower. In the above drawing you can see honey bee sucking necter from the flower. Flowers are therefore very beautifully made so as to attract insects. We are all familiar with the sights of butterflies on flowers. There are again other flowers which are not very attractice. This group of unattractive flowers are pollinated by wind instead of insects. Flowers according to Mallam Kwairanga could be classified as:

1. Wind pollinated flowers
2. Water pollinated flowers
3. Birds pollinated flowers, and

4) Insect pollinated flowers - this group of flowers is the largest and has some of the most beautiful flowers around our environment. Prominent insect pollinated flowers are:
   (a) Moth pollinated flowers
   (b) Butterfly pollinated flowers, and
   (c) Bee pollinated flowers.

Your teacher will tell you more about pollination.

Activity

1) Tell your brothers/sisters the purpose of the beautiful colours they see on flowers.
2) Also inform them that flowers need insects to visit them so as to be pollinated.
3) Tell them the name of the food contained by flowers which the insects including honeybee go out to find.
4) Make a table like this one below and list your observations as shown:

S/No.	Name of Flower	Attractive	Unattractive	Agent of pollination
1	Maize			Wind
2	Badoje			Insect and water
3	Balasaya			Insect
4				
5				
6				
7				
8				
9				
10				

Unit 3: Seeds Dispersal

Introduction

Plants are found every where because of this process. When we eat their fruits we often throw them away, sometimes on our way home or even carry them to a distant place. In this way seeds are so dispersed. The aim of this unit will be to further explain to you the implications of our actions and those of our animals.

Objectives

At the end of this unit you should be able to:

1. explain the process of seed dispersal.
2. categorize the agents of seed dispersal.
3. recognize the importance of seed dispersal.

Some Broad Concepts

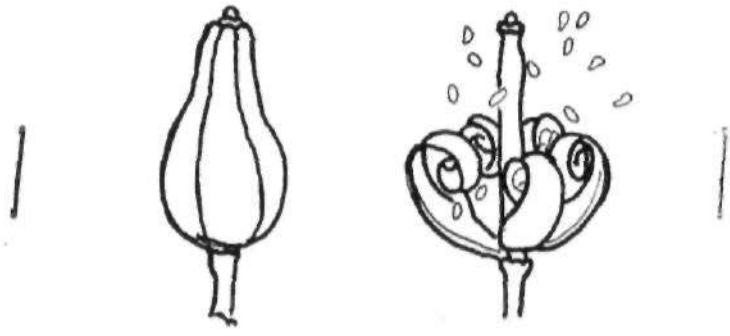
Seed Dispersal

Agents of Dispersal

Dispersal of Seeds

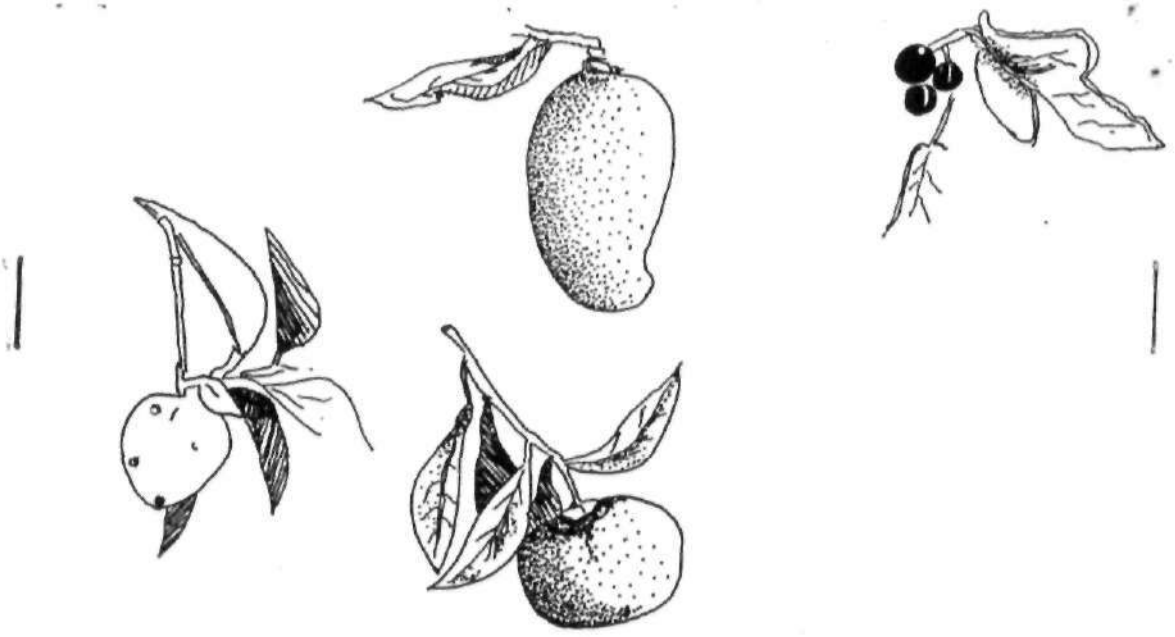
Dungu season was about to come to an end. Rains have started to fall less frequently. Mallam Kwairanga held two fruits of gwaddaji ladde and headed to his classroom. When he entered the room the children greeted him with the usual -- A jabba ma, A waali jam -- Modibbo kimiyya? He answered in the same tune and replied their greetings. He told them that the lesson was on the

Dispersal of Seeds. "This is a process where seeds are taken away from their local places" he said. Mallam Kwairanga also told them that there are many agents of seeds dispersal such as man, animals, water and wind. Yet other flowers disperse their seeds by opening their pods or capsules abruptly so as to throw the seeds away. You can see such a seed capsule bearing flower in the drawing below:



Seeds dispersed by man are those that are contained by the various fruits we eat. We sometimes carry these fruits to the market and when they are bought they are carried to a very distant place where the fruit is eaten and the seeds thrown away or planted. Animals also eat or carry seeds by their fur to other places. Water and wind also perform similar function by carrying seeds away from their local places. In this manner plants are found everywhere. The importance of seeds dispersal lies in spreading plants and thereby preserving and protecting some of them from destruction even if those in one place are all destroyed.

You can see some of the fruits we eat in the drawing



These fruits contain seeds in them and when the seeds are thrown away they germinate in dungu season and therefore grow into other trees which beer fruits after some few years.

Activity

1) Have you ever eaten fruits bought by your mother? If you have not ask your mother to buy some from the nearest market to your Rumirde and see if you have similar fruits in the locality.

2) When your cattle are back in the coral in the evening see if their fur, particularly their tails carry dried fruits or seeds of some plants.

3) Make a table like the one below and complete it. List seeds and their agents of dispersal.

S/No.	Seeds	Agent of dispersal
1	Mango	Man
2	Dunya	Man
3	Tunfafiya	Wind
4		
5		
6		
7		
8		
9		
10		

Cycle - Three

Module - Two

Season - Yawal

Unit 1 - Water in the atmosphere

Unit 2 - The Sun and our Environment

Unit 3 - Heat and Temperature.

Units: Water in the atmosphere.

Introduction:

Last year you had treated water from familiar sources such as Wells, rivers ponds and lakes. This unit has its focus on other natural sources of water such as water in the atmosphere. In this regard, mist, dew and fog are treated briefly here.

Objectives:

At the end of this unit, students will be able to:

( ) Explain that the atmosphere provides a natural source of water.

(2) Explain the formation of fog, mist and dew. and

(3) Explain the process of evapouration which sends water vapour in the atmosphere.

Some Broad Concepts:

Dew, Mist, Fog, evaporation, water vapour.

Fog, Mist and Dew:

At Domdo where Tumba's parents have been spending t their dungu season, it has recently been very foggy and Tumba has been noticing some water droplets on leaves particularly on Barkeji leaves which are wide enough to keep the droplets till the sun is high in the morning. she has observed that before she goes to sleep in the night such droplets are always not there but in the morning when she wakes up she gets her feet and dresses

wet when she moves from her mother's to her step mother's hut. This morning he has made up her mind to ask her science teacher all about her observations.

The ndungu period is geeting to an end and it is getting to the time of Nyaile a very short period before ndabbun'de. Nyaile is the time when the pastoralists have the usufract to graze their animals on the harvested farm lands. It is at this time one finds the whether full of mist, dew and fog.

Tumba came to the class just before their teacher and immediately he is in she asked him to please inform them on the formation of fog, mist and dew. He started by explaining that water exists in the atmosphere inform of dew, mist and fog. As a result of heat received on the earth surface by the sun, some water is evaporated in the air and becomes water vapour in the atmosphere. This vapour is made up of tiny drops of moisture. When these tiny drops condense on cool surfaces in the night, we discover that these surfaces are wet in the morning. You can then say there was a dew formation in the night. Remember that grasses and leaves of shrubs and trees around our compounds are always wet in the morning when a dew formation takes place in the night.

The tiny water vapour particles in the atmosphere form a cluster which is called mist. When the mist becomes thicker it is difficult of seeing through and is therefore called fog.

The fog, mist and dew are all water vapour in its various stages in the atmosphere.

Your teacher will tell you more on water in the atmosphere.

Activity:

Open a dairy and record the mornings you observe dew formation, mist or fog, your dairy should therefore have the following column:-

Days	Dew	Mist	Fog
Monday			
Tuesday			
Wednesday			
Thursday			
Friday			
Saturday			
Sunday			

Use a tick as shown in the example here to indicate the presence of each of the three conditions.

Unit 2: The Sun and our Environment

Introduction

You are already aware of the use of fire for cooking and warming the rooms in the harmattan period. The severity of heat, particularly in this season of yawoli must not be unnoticed by you. However, the importance of this unit lies in guiding you to appreciate morefully the various sources of heat and its uses and distructions. You will be made to see heat as a source of energy, which varies accordingly.

The unit starts with the sun as a natural source of heat and therefore energy.

Objectives

At the end of this unit you should be able to:

1. explain the importance of sun to us and other living things - such as plants and animals.
2. recognize the sun as a natural source of energy supply.
3. examine the various uses and distructions of fire.
4. explain why we wear clothes and

Some Broad Concepts

Heat is a form of energy - the energy of moving particles. Clothing helps us to regulate the heat to our body.

The sun is a giant source of heat

Various substances change their color when heated.

The Sun and Our Environment

nGarso Baron Jedo is a parternal uncle to Tumba's father and is one of the leaders of their yawirde at Binjije. The title of ngarso is in appreciation of his immense knowledge about the cattle and the climate. He has spent more than eight decades moving and living with the cattle according to the dictates of the climatic changes. Ngarso is therefore an ultimate title which is very rare to (comeby). It signifies accumulated knowledge through experience, foresightedness and general wisdom in the realms of life.

This eminant personality was the one invited by the elementary science teacher at Binjije nomadic education primary school to talk to the children on the topic: The sun and our environment.

Cycle - Three

Module - Three

Season - ndabbu'nde

Unit 1 - The effects and sources of forces.

Unit 2 - Measuring Forces.

Unit 3 - Kinetic and Potential Energy.

Unit I: The Effects and Sources of Forces

Introduction

In our daily activities we frequently make statements to express what we are doing or about to do tomorrow. We make such statements as - 'going to work' 'using a force to remove it', 'this ox is more powerful than the other ox' or 'the energy possed by a stone in motion'. We can afford to use these words carelessly in our every day speech; but in science, we must make sure what each word or expression stands for. In this lesson our attention is on the word "force". Examples of the effects of force will be given from the natural environment where you live. The aim is to assist you in offering a scientific analyses and descriptions of what you have already been seeing around.

Objectives

At the end of the unit you should be able to:

1. relate forces to their sources and uses.
2. Explain the effects of such forces.

Some Broad Concepts

Force

Sources of Force

Effects of Force.

Mallam Julde has just been posted to Dabagi nomadic Education Primary School from Gesalodi where he had spent three years teaching Elementary Science to nomadic pastoralist children. Just like in Gesalodi nomadic Primary School, he is the only teacher elementary science in this school.

Tumba and nGeno are meeting him for the second time since he taught them science when their parents were in Gesalodi. Tumba and Geno have therefore told their classmates that Malam Julde is a wonderful teacher who keeps their interest perpetually a float. The news have gone round even to the children's parents that their children were going to encounter an exciting science teaching on areas which many parents express their interest in. It is the season of Ndabbunde (the harmattan season). Their settlement - dabirde will remain in Dabagi for about three months, before the Cheedu (hot season) period forced to move to river valleys to look for water and pasture.

Mallam Julde came to the classroom with a small Bindo which is depicted below:

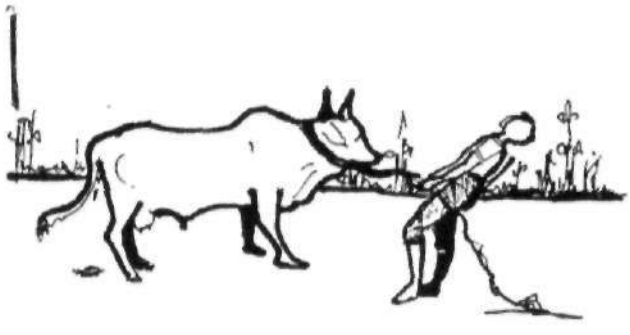
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He saw the intensity of the children's attention on it and quickly asked them if they have ever used the device in their own time. Tumbe, put up her hand and told him how her uncle NGarey had once used it to kill a little bird called Cherr which pecks constantly on his cattle,

causing them injuries. She said before she could notice anything the bird was dead on the ground.

Mallam Julde then, used this opportunity to explain to his children, that this device is based on the effect of a force which comes from our hand muscles to pull the strings and then release them so as to shoot up the stone kept in the nozle of these strings. He then, used two stones to demonstrate the effect of the muscles' force through the device. After this demonstration, Mallam Julde showed the children another way of using the effects of our hand muscles through our actions in pulling and pushing an object. Specifically he showed to the children two drawings which depicted Tumba's uncle - Ngarey pulling his cow (minaye) and another person rolling a stone from a hill.





Again, Mallam Julde asked the children to look at the drawing which depicts uncle NGarey digging the ground so as to erect tiggere for another cow named - tisla.

Drawing



He then asked the children to name other activities which involve the force of our muscles. Ngeno, suggested the process of peddling a boat across a river as she saw on their way to Dabagi. The teacher quickly agreed that it is a good example and brought out a drawing of this activity, showing a board being peddled across a river. You can see the drawing below:



Another device which Mallam Julde brought to show the effect of force is a small spring with a hole at the end. It is depicted by the drawing below:



This is a simple device which consists of a wire spring only. The effect of a force can easily by seen by hanging it on a ceiling and using its hook to hold a piece of load as shown below:



Activity

1. Classify the sources of force into those that come from the human muscles, animal's muscles, spring wire and other sources. Form a table similar to the one shown in this diagram:

Serial No	Activity	Source of Force
1.	Digging to erect	Human muscles
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

2. Device an instrument in which you apply a small force to move a heavy object.

Unit 2: Measuring Forces

Introduction

Forces like other activities in our daily life can also be measured. We use special devices to measure different forces. Our knowledge of these devices can assist us in understanding the nature of these forces. Forces due to winds, or those which come from our deliberate actions such as pushing and pulling are encountered daily by

nomadic pastoral children. This unit is therefore aimed at intimating the children with methods and devices of measuring these forces.

Objectives

At the end of this unit the children should be able to:

(1) Explain the workings of common measuring devices such as the spring balance.

(2) State common units used in measuring forces.

Some Broad Concepts

Units of Measurement

Measuring Device.

When Mallam Julde entered his classroom he was holding a spring balance, a metre rule, a stand trot, a clamp and a scale pan. He was also holding a weighing balance. He quickly asked his children to sit down and watch him. He carefully arranged and set the instruments as shown below, and placed the weighing balance near them as depicted in the diagram.

He then asked his children to go out and bring a small stone each. He took their stones one by one and asked them to watch the behaviour of the spring balance and the pointer. He also weighed each stone on the weighing balance. He recorded the two sets of readings of all the stones on a paper and made a table as shown below:

Serial No	Name of Child	Reading on the metre rul from the child's stone	Reading of the child's stone from the weighing balance
1.	Tumba	5cm	1gram
2.	NGeno	5.6cm	1.5grams
3.	Njiddere	6cm	2grams
4.	Buba	4cm	0.8grams
5.	Motti	8cm	4grams
6.	Sume	7cm	3grams
7.	Loddo	9cm	5grams
8.	Asma'u	11cm	7grams
9.	Boddo	12cm	8grams
10.	Gidado	10.6cm	6.5grams

Mallam Julde then told his children that they should have noticed during the experiment that the heavier stones have higher readings on the metre rule than the smaller ones. 'Weight, is therefore a kind of force which Mallam Julde emphasized to his class'. In this regard, he asked the children to note the following:

1gram = 1gram weight

2grams = 2gram weight

6grams = 6gram weight

8grams = 8gram weight, etc.

From this unit of force, Mallam Julde promised his children that next year when they will be in Junior Secondary School they will be taught the scientific unit of force, which is called the Newton (N). 'The Newton (N)' said Mallam Julde, is defined as "the force excerted when one kilogram mass of an object falls with an acceleration of 9.8 metre per second^2. You will learn more about it later" he said.

After entertaining many interesting questions from the class, Tumba asked him whether they will have an assignment. He quickly responded by assuring her that their assignment is ready, but the following activities before the assignment.

(a) Activity

(1) Use the teachers two devices and also use different sizes of stones and, record your readings on the two scales. Form a similar table like the one shown in the class.

(2) What is the weight of your biggest stone?

(3) What is also the reading of this stone on the spring balance?

(4) Is it true that the stone with the biggest weight also has the highest reading on the spring balance? Find if your classmates have similar results on this issue and discuss the question.

(b) Assignment

(1) When you go home tell your sisters and brothers that there are devices which can measure the weight and force of an object.

(2) If they doubted you, ask your parents to find out in the market where similar devices are used to measure items for sale, such as beef and grains.

(3) Inform the teacher the result of your discussions at home.

Unit 3: Kinetic and Potential Energy

Introduction

In the previous year the sun was discussed and presented to the children as one source of energy. In this Unit types of Energy will be considered.

Objectives

At the end of this Unit children should be able to:

(1) Recognise two types of energy, viz: Kinetic Energy and Potential Energy.

(2) Demonstrate the applications of these forms of energy.

Some Broad Concepts

Energy

Kinetic Energy

Potential Energy

Mass, Velocity.

When Mallam Julde entered his classroom he took out the class register and quickly made a rollcall, where he found only two students - Gabdo and Buba were absent. He told the children to follow him outside the classroom to a big shady mango tree which has very many fruits.

He climbed the tree and asked the children to take note of a particular mango fruit which he plucked and released to the ground. You can see the drawing of the mango tree showing the fruit coming down to the ground.



Mallam Julde told the children that the moving mango fruit possessed strength which is called Kinetic Energy. This form of energy, he continued, is possessed by all moving objects, according to both the speed and mass of an object. In the language of Science it is represented as follows:

$$K.E = \tfrac{1}{2} Mu^2 \quad \text{where}$$

'K.E' stands for Kinetic Energy,

'M' stands for the mass of an object and

'U' stands for the 'speed' (Velocity) of an object.

Throughout this period all the students listened to Mallam Julde with rapt attention except Tumba who was trying to come to the front row so as to ask Mallam Julde a question which is disturbing her mind. Mallam Julde had already noticed her difficulty in trying to move through the students to the front row and also realized that she was eager to ask a question. He therefore asked the students to make a way for her and asked her to say what she wanted to ask. The girl, then asked him "whether the mango tree had no energy when it was hanging and also when it reached the ground?" This she said, puzzles her because she didn't know where the mango tree got its energy from. Mallam Julde said Tumba had asked a right question which was going to lead him to the next form of energy called - Potential Energy. This form of energy, he explained, "is an energy possessed by an object due to its position of rest". He said initially when the mango fruit was hanging it possessed potential energy

and immediately when it was plucked and released down the energy changed into Kinetic Energy (K.E). Again when the mango fruit touched the ground then the K.E. changed into Potential Energy (P.E).

The Potential Energy in the Science language is represented as follows:

$$P.E. = Mgh \quad \text{where}$$

P.E. stands for Potential Energy
'M' stands for the mass of an object
'g' stands for the force of gravity
(which your teacher will explain to you) and
'h' stands for the height of the object above the ground.

Mallam Julde answered many questions from the children and asked them to do the following activity:

Activity

(1) When you go home find objects of various sizes and try to throw them to a particular object and see which has the highest Kinetic Energy.

(2) Inform your brothers, father or uncle about the two forms of Energy and see if they can assist you.

(3) Make a table like the one below of all the objects you see on your way to the waterpoint with the cattle:

Serial No	Name of Objects	Moving	Resting
1.	Dog		
2.	Abeehive		
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

Cycle - Three

Module - Four

Season - Cheedu

Unit 1 - The parts of a human body

Unit 2 - The human body systems

Unit 1: The parts of a human body

Introduction

Our body consists of many parts which constitute the body of a human being. Your attention will be drawn in this unit to the importance of these parts in the functions of the whole body. Every part has its role in the overall body functions and roles.



Objectives

At the end of this unit, you should be able to:

1. examine the functions of each body part.
2. relate the functions of each part to the whole body, and
3. draw a human body showing its parts.

Some Broad Concepts

Hands, eyes, mouth, legs and ears.

When Malam Julde entered his class he was singing a song which attracted the attention of the entire class. Some curious students could not hide the urge to ask him to sing it once more to their hearings in the class.

This was exactly the kind of reaction Malam Julde wanted to arise in the students. If no body had asked him to repeat it he would have no option other than to ask them if they have heard him singing any song and if they did who will be ready to sing it, so that if nobody does he will then sing the song.

Malam Julde repeated the song in the following lines:

Tnis is my head
I am touching my head.
This is my ear
I am touching my ear
This is my eye
I am touching my eye
This is my nose
I am touching my nose
This is my mouth
I am touching my mouth.
This is my neck
I am touching my neck
This is my leg
I am touching my leg
All belong to me.

When he finished the students were already in chorus singing with him. He then told Tumba to come out and sing the song for the class. You can see Tumba in the drawing below singing the song. You can also see her parts of the body named.



Malam Julde told his students that the lesson for today is on the parts of a human body. He immediately asked his students to tell him the functions of the following parts:

(1) Head
(2) Ear
(3) Nose
(4) Mouth
(5) Neck
(6) Hand
(7) Legs.

The students reacted by informing him what they consider as appropriate functions of all these parts. After listening carefully to all the functions he reminded them of one or two such functions they forgot to mention. Your teacher will discuss all the functions with you and in addition ask you to undertake the following homework.

Activity

(1) When you go home think how all these parts of a human body are able to unite and work together with each part putting its own contributions at the right time when demanded.

(2) Think on what happens in the absence of any one of these parts. That is due to illness or accident.

(3) Consider how lucky we are to have all our parts intact.

(4) Do you now see the reasons why we should always be kind and help our brethren who have lost one or two of their body parts? This people are called Disabled people and they need your sympathy and under standing of their predicaments.

Unit 2: The human body systems

Introduction

The human body works by the means of nine systems. These systems are:

(a) Skeletal system

(b) Muscular system

(c) Nervous system

(d) Digestive system

(e) Endocrine system

(f) Respiratory system

(g) Circulatory system

(h) Excretory system, and

(1) Reproductory system.

Out of these systems only four systems namely: Skeletal system, Digestive system, Respiratory system and Circulatory system will be considered in this unit. Their treatment will also be very brief, even though it will introduce to you some of their functions and how the systems can be represented in a drawing.

Objectives

At the end of this unit you should be able to:

1. Explain the major functions of these systems.
2. draw simple structures of the systems.

Some Broad Concepts

Skeletal system

Digestive system

Respiratory system and

Circulatory system.

Mallam Julde was very happy when he woke up. This was because it was a day for the naming ceremony of his newly born baby. It has been one solid week since the baby was born. He had already given the child a traditional name (Jammore) - Gidado. What will be given to the child today will be an Islamic name which comes traditionally one week after birth.

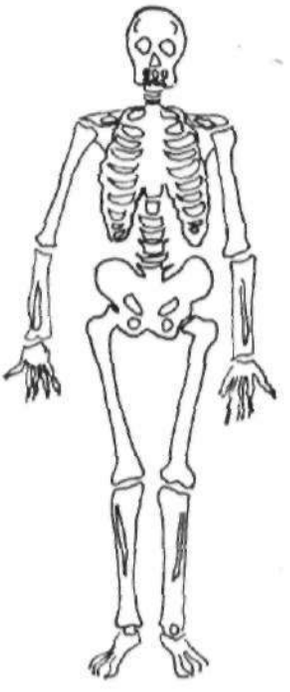
Mallam Julde was also happy that the naming ceremony has come in a good time for him to teach a lesson on "The human body systems". he would therefore use the opportunity to conduct his class around the slaughtered ram for skinning. He would show to the students the skeletal system, the digestive system, the respiratory system and the heart for the circulatory system. The students would be made to understand the

similarities between these systems of the animal and that of the man (remembering that they are all mammals).

The naming ceremony took just ten minutes to name the child Ibrahim and to say three sermons for him which asked the Almighty Allah to bestow heath on the child and his mother longivity and prosperity of the child, the ceremony ended. After this, Malam Julde gathered his students and took a roll call. He then conducted them to the spot of the slaughtered ram. He asked the butcher to start skinning while the students kept watching attentively. When the butcher finished skinning he started his lesson from the frame of the animal that is the skeletal system even though at this juncture covered with flesh but they could see its out line and also the bones of the legs and other parts of the body. After this he took on the digestive system and so on. He went like this:

1. The Skeletal system

   You must have observed that our body is made up of bones which are then covered by the skin. We can not stand or walk without having bones in our body to support the flesh and carry our weight. You can see below the drawing of a frame of bones we call the skeleton.



The skeleton performs the following functions

(a) It protects the delicate organs of our body such as the hurt, lungs and the brain.

(b) It helps the body to move erect. And

(c) It gives shape to our body.

2. The Digestive System:

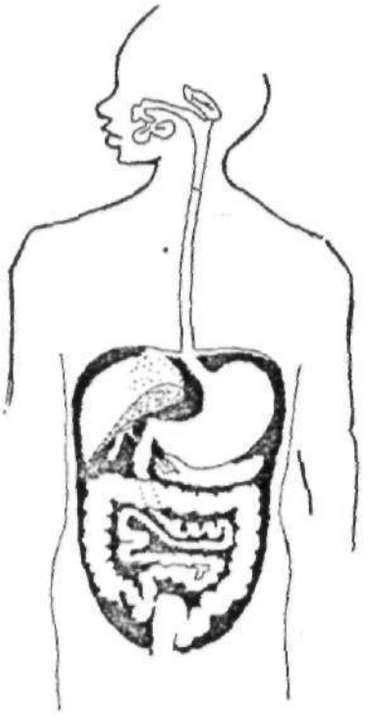
The digestive system otherwise known as alimentary canal performs the following functions:

(a) Break down the food we eat

(b) Absorb the nutrients in the body. And

(c) send out the waste matter as faeces.

The digestive system consists of the following organis: Mouth, stomach, small intestine, and large intestine. You can see a representation of a digestive system below:



3. The Respiratory System

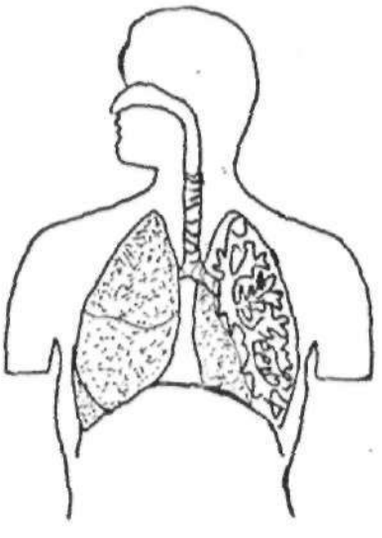
This system consists mainly of the nose, the wind pipe and the lungs. It has the following function:

(a) It takes in air to the blood.

(b) Produces energy for the body to do work. And

(c) It expels used air from the body.

You can see a representation of the Respiratory system in the drawing below:



4. The Circulatory System

The circulatory system consists principally of the heart and its arteries veins and their chambers. The system has the following major function:

(a) Its distributes blood to all parts of the body and back to the heart.

You can see a drawing of the circulatory system below:



You will learn more of these systems in the future.

It is time for Seeto and you see Tumba's parents moving away to their Settinirdè.

Cycle - Three

Module - Five

Season - Seeto

Unit 1 - The Existence of Air

Unit 2 - Air Supports burning

Unit 3 - Electrical Energy

Unit 4 - Playing with Magnets.

Unit I . The existence of air around us:

Introduction: This unit consists of only one unit. Like the previous units it is very short and only meant to introduce you to natural elements such as air, The module treats simple activities which could be carried out by children so as to feel the presence of air. The windy-stormy season - seeto is chosen for this topic, because the force of windstorms is very visible in this period.

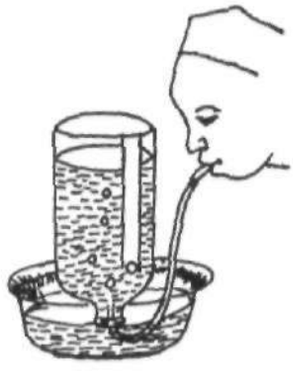
Objectives: At the end of the unit you should be able to:

(1) recognise the importance of air to human beings.

(2) perform simple experiments to demonstrate the presence of air.

(3) demonstrate the existence of air pressure, and the diffusion of air. And

(4) demonstrate that air supports burning.



The above experiment demonstrates the existence of air. You need a bowl of water, a small jar filled with water, and tube inserted through the mouth of the jar. Invert the jar as shown in the drawing and blow bubbles with your mouth through the tube.

Air Pressure

Activity:

This is a very simple experiment to demonstrate that air has pressure. Fina a jar, a glass tube, a colored wood and a cork. Set the experiment as shown below. Immediately the cork which before, trapped the air inside tube was removed, the air in the tube now escapes and therefore the small colored wood is free to move upwards since the force on it has now been released.

Diffusion

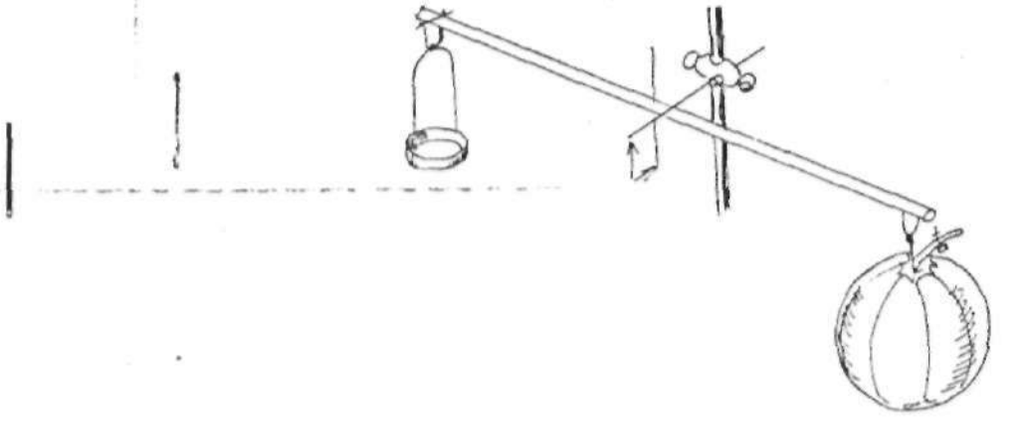
Air particles are capable of moving far and near, in a random motion. They can also easily spread without our notice. One way we can easily notice this phenomenon is whenever we smell of something. We may observe that what we are smelling is not necessarily something which is very close to us. It could be coming from quite some distance from our position. How do we smell it then? We smell it because air particles are widely separated and they move in every direction particularly the direction in which the wind is blowing.

In this manner we are able to smell a rotten egg in our home whenever it is broken. We call this process diffusion. We therefore live in a sea of air and the particles of other materials are randomly diffused through those of air. You can see a drawing of a broken rotten egg below:

Air has weight:

Activity: Weight a depleted fottball case. Record Your readings from a weighing balance. Pump the ball with air and weight it again on the balance see the drawing below. Record your readings. Subtract your first reading from the second reading. The remainder is the weight of the volume of air you had pumped in the football case.

This experiment shows that air has weight and occupies space.



Unit 2. Air Supports Burning:

Introduction: Burning is a natural phenomenom which occurs daily. The nomadic pastoral children are not knew to burning processes, but they may need to be informed on the activities of air in the process of burning. This unit is designed to draw their attention to the connection of air with burning.

Objectives: At the end of this unit the students should be able to:

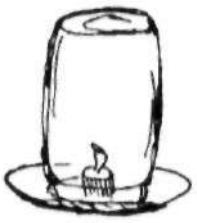
(1) Understand that air supports burning.

Some Broad concepts Air supports burning

Oxygen, carbondioxide.

Air Supports Burning:

Activity: Find a small plate preferably an earth plate locally called Kasko and a small candle. Light your candle and bring a small glass jar and invert it over the lighted candle. Initially the candle will continue to burn but when that part of air (Oxygen) which supports burning is finished and more and more carbondioxide is now produced in the glass jar, the light goes off. You can see the drawing below.



This experiment explains how air supports burning. The part of air which specifically supports burning is called oxygen. You will learn more on the properties of air next year but for how your teacher will give some brief explanations on the composition of air with particular reference to two of its constituents - that is the oxygen gas and the carbondioxide gas..

Unit 3. Electrical Energy

Introduction

Electrical energy provides light in the town when night falls. In the nomadic pastoral areas Electrical Energy (EE) can be shown through touch lights.

Objectives

At the end of this unit children should be able to:

1. Name applications of Electrical Energy.
2. Explain how chemical energy is used to produce Electrical Energy.
3. Describe how the touch light batteries are able to light our surroundings because of chemical actions going on in the battery cells.

Some Broad Concepts

Electrical Energy

Chemical Energy

Electric Bulb

Electric Wire

Electrical Energy

After spending their rainy season (Ndungu) at Daraye, Tumba's parents have just moved to Ertonga which is by a large fadama due to the confluence of two rivers (Rima and Sokoto) which flows through this fadama. As usual Tumba and Ngeno have come along with their transfer certificates and continuous assessment record cards. They have now been in school for six years and

at the end of this season they will be ready to go to Junior Secondary School to continue with their studies.

Mallam Julde who spent the rainy season (Ndungu) at Mashekarin Baro Nomadic Education Primary School Domdo has also just moved to Ertonga

In addition to teaching Elementary Science he has also been promoted to a headmaster and also a zonal inspector in charge of five Nomadic Education Primary Schools.

Mallam Julde marked his class register and collected their record cards. He told them that the topic of the lesson was on Electrical Energy. He took out the touch light he brought to the classroom and lighted it. He then removed the batteries and kept them on the table. He explained to them how chemical energy in the batteries is converted into Electrical energy when they are arranged and connected together with a wire.

At this juncture Mallam Julde went back to his office and came back with a big glass beaker, a bottle of sulphuric acid (H_2SO_4), two plates of lead, three bulbs placed on a wooden plate and also connected in series, and two electrical wires. Mallam Julde poured the dilute Sulphuric Acid (H_2SO_4) into the beaker and dipped the two places of lead into the solution. He then connected their terminals with the bulbs on the wooden plate. The bulbs light instantly and continue to illuminate the room. The students shouted instantly with a chorous voice Laila illalahu! You can see a drawing of Mallam Julde's experiment below:

The children asked Mallam Julde many questions on what they consider the wonders of the solution (Sulphuric Acid (H_2So_4). After answering their questions one by one he then asked them to carry out the following activities when they go hom.

Activity

1. Explain to your brothers and sisters the teachers (Mallam Julde) experiment.
2. Ask your father to buy a touchlight for you.
3. Compare your touchlight with one which uses three batteries or more.

Unit 4. Playing with Magnets

Introduction

Magnets could be a source of enthusiasm to you. You could therefore easily understand the working of a magnet. The object of this unit is to farmiliarize you with the workings of a magnet.

Objectives

At the end of the unit you should be able to explain:

1. What makes a magnet different from other pieces of iron.
2. That magnets attract only iron-made objects.
3. That magnets have two poles - north and south poles.
4. That the north pole of one magnet attracts the south pole of another magnet and repels the north pole, and
5. How to make iron objects magnetized so as to behave as magnets.

Playing with Magnets

When Mallam Julde entered his classroom, he marked his register and divided his students into four groups. He appointed a group leader for each group and then

gave the leaders a magnet each. He asked them to go out and try the magnet on all objects they could find around the school and come back later to narrate their experiences.

Both Tumba and Ngeno were appointed group leaders and they took their groups along the sourthern parts of the school. They immediately discovered the puzzling movements of the magnet. They found out that it catches any material made of iron and that it doesn't attract non iron materials. You can see their magnet below:

When they came back to the classroom Mallam Julde asked them to narrate their experiences group by group. After all the narrations they found out that their experiences were very similar. Mallam Julde then asked them to get ready for the next activity:

Activity

1. Make a table like the one below and fill it.

S/No	Name of objects	Attracted by magnet	Unattracted by magnet
1	Stone		
2	A knife		
3			
4			
5			
6			
7			
8			
9			
10			

After the students activities, Mallam Julde then told them that a magnet is made up of two poles called north and south poles. The north pole of one magnet attracts the south pole of another magnet. The north pole of one magnet however, repels the north pole of another magnet. In a simple rule, Mallam Julde states: "Like poles repel and unlike poles attract one another".

He then told them that a magnet is different from other iron objects because it possesses a force with which it attracts other iron objects.

Making a Magnet

We may find it difficult to break a piece of magnet into many pieces. We can however, easily make any piece of iron magnetized and therefore become a magnet if only we follow simple instructions.

Instruction

Take a magnet and hold it.

Hold a needle with one hand.

Rub your magnet from one of the poles in one direction only. Remember do not rub it back and front. Drop your magnet and take your needle to another needle or iron. What do you notice? Is your needle now a magnet? It must be; if it is not, then see your teacher you must have made some mistakes in the process of magnetization.

There are many interesting experiements we can do with a magnet. Try and see that you perform the following experiement:

Experiment

Get a big bowl of water, a small piece of paper, a needle, a small piece of wood and a magnet. Pass your needle vertically through the piece of cloth and stick the needle to the piece of wood. Now, place the wood with the needle and the cloth in the water; you will notice that the wood floats on it. Now, take your magnet and approach the needle. You will also notice that the presence of the magnet makes the wood float in the direction of the magnet. So you have made a boat which goes to the direction you want it to go with the help of your magnet.

After the experiment, Mallam Julde called his students and told them to study harder so as not to disappoint him in the common entrace examination coming up soon. He also told them about the school's speech day where the best students will be given gifts as rewards for hard work. The students have now spent six years in the school and are therefore ready to proceed to Junior Secondary School.

Tumba and Ngeno Ready for Junior Secondary School

Mallam Julde received two officials from the Nomadic Education Unit. They told him that their purpose was to convey the ministry's happiness and appreciation of his schools performance in the common entrance examination which had just taken place some few months ago. His school has come up with the best students. Infact two of them have already been choosen to report for final selection for special schools earmarked for the gifted. Very many of his students have also passed with very high aggregate grades.

At this juncture the entire list of the student's result was handed over to him and after further clarifications, the two officials drove away in a landrover jeep.

Mallam Julde sent his messenger Gidado to inform the parents of the schools about the speech day scheduled to take place on the following week. The staff were equally notified. At the speech day, Mallam Julde will spend his time talking about the excellent performance of his students, nothing more delinghtful to a headmaster than this.

At the speech day, Mallam Julde announced to the gathering that two of his students, Tumba and Ngeno have done so well that they have been short listed for special schools meant for the gifted children. Consequently, he called them out to receive their prizes. The father of Tumba and Ngeno was at this occasion and he was extremely very happy for the performance of his children.

APPENDIX IV

Nomadic Education Primary Science Curriculum Package: Readability Assessment Inventories - (NEPS-CP-RAI)

1 Recommended study method

2 Observation checklist

3 Nomadic Education Primary Science

4 Group Reading Inventory (NEPS-GRI)

5 Skill Inventory (NEPS-SI)

Nomadic Education Primary Science Curriculum Package Readability Assessment Inventories - (NEPS-CP-RAI)

The NEPS-CP-RAI contained one recommended study method and three inventories namely:-

1. Study method - the SQ3R
2. Observation checklist
3. Group Reading Inventory and
4. Skill inventory.

It was thought more rewarding to use the above four techniques in order to assess the readability or suitability of the developed materials, than to use readability formulas which ignore the participation of both the learner and the teacher. In this regard, Newton (1984) in Bishop (1984:368-369) has adequately expressed the limitations of readability formulas in science textbooks.

Recommended Study Method: The SQ3R

There are many methods of study such as SQ3R, EVOKER SQRQCQ, REAP, and PANORAMA. These study methods help the students in the comprehension and retention of information contained in the instructional materials.

A curriculum package like the one developed in this study need an accompanied method of study. In this regard, the SQ3R method developed by Robinson (1961) was chosen because it is probably the best known and above all the most appropriate in science studies. SQ3R stands for: Survey, Question, Read, Recite, Review - SQ3R.

The teacher in this study was given specific instructions such that the children were told the importance of SQ3R, its meaning and appropriateness in remembering the information contained in the curricular materials. The teacher was himself taught by the researcher on the use of this study technique.

After the children have been couched on the use of SQ3R study method, the following assessment inventories were then administered so as to find out the suitability of the curricular materials developed in this study.

Observation Checklist

Decisions about students reading ability should not be taken without involving and taping the teachers careful observations of his students ability to handle the learning materials/instructional realities. In the classroom the teacher has the opportunity to see the performance of each student on a daily basis.

Observation checklists are informal measures that are very useful in revealing students reading ability of an instructional material. Observation checklists therefore provide a possible source of diagnostic information.

In this study observation checklist was used by the teacher throughout the period of treatment. The teacher was given specific instructions to systematically record observations for each lesson/unit. The teacher was asked to record his observations on the following checklist, modified from Roe et.al (1987:371). The checklist is as follows:

S/No.	Oral Report	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
1	Pronunciation					
2	General vocabulary					
3	Specialized vocabulary					
4	Sentence structure					
5	Organization of ideas					
6	Interests					
	Oral reading					
1	Methods of word attack					
2	Word recognition problems					
3	Rate of reading					
4	Phrasing					
5	Peer reactions					

Group Reading Inventory (GRI)

This is another informal method of assessing readability of instructional materials. It is a simple inventory which attempts to assess three main areas: (1) Vocabulary, (2) Literal Comprehension and (3) Interpretive Comprehension. These main areas specifically aim at finding students understanding in the following areas:

1. Vocabulary
   - (a) Word meaning
   - (b) Word recognition
   - (c) Context
   - (d) Synonyms
   - (e) Antonyms
   - (f) Syllabication
   - (g) Accent, and
   - (h) Affixes.

2. Literal Comprehension
   (a) Main ideas
   (b) Significant details
   (c) Sequence, and
   (d) Following directions.

3. Interpretive Comprehension
   (a) Evaluative, and
   (b) Inferential.

The students are normally asked to read a passage of 1,000 to 2,000 words and the time taken by the students to finish the passage is recorded. After this, they are asked to close the passage and questions based on the three main areas stated above are asked and their responses recorded. Materials are suitable for instructional purposes if the students can comprehend seventy five percent of what they read.

In this study the teacher was asked to employ the following GRI and award ten marks for each correct response:

Nomadic Education Elementary Science Group Reading Inventory

(NEES-GRI)

	Cycle: ____ Module: ____ Units				
1. Vocabulary	1	2	3	4	5
(a) What is meant by the theme of the unit					
(b) Define the broad concepts outlined in the unit					
(c) Which other words can you give which are similar to the broad concepts					
(d) Divide the broad concept words into syllables					
(e) Award marks for good pronunciations and accent					
2. Literal Comprehension					
(a) Give details of what the unit has taught you					
(b) State the areas of the unit which you consider very significant to you					
(c) Award marks for sequence in the student's responses and also in how well he/she follows the question asked					
3. Interpretive Comprehension					
(a) Do you agree with the teachings of the unit?					
(b) What makes you agree or disagree with the teachings of the unit?					

Skill Inventory

Reading skills are necessary to understanding content areas such as science. In science where graphs, diagrams, drawings, special symbols, charts, formulae and abbreviations are used, it is important to find out if students can interprete these symbols, formula or charts. Skill inventories are particularly very important in science teaching. These inventories serve as part of a total assessment in readability of instructional materials.

The following skills are specifically important in science content area:

1. Understanding
2. Interpretation
3. Knowing specialized vocabulary
4. Using reference materials
5. Recognizing special symbols, formulas and abbreviations.

In this study the teacher was specifically asked to use the following skill inventory and to award five marks for each correct response.

Nomadic Education Elementary Science Skill Inventory

(NEES-SI)

	Cycle: ____ Module: ____ Units				
1. Understanding	1	2	3	4	5
(a) Understanding tables in the unit					
(b) Understanding illustrations in the unit					
(c) Understanding terms used in the unit					
(d) Award marks for special qualities in skill manipulations					
2. Interpretation					
(a) Interpreting tables in the unit					
(b) Interpreting diagrams in the unit					
(c) Interpreting drawings in the unit					
(d) Award marks for eloquence in the interpretation					
3. Knowing Specialized Vocabulary					
(a) Knowing the outlined broad concepts in the unit					
(b) Knowing parts of a flower or human body presented in the unit					
(c) Knowing apparatus which are used in a particular experiment in the unit					
4. Using Reference Materials					
(a) Ability to find out from parents /brothers the solution of a problem given out as assignment in the unit					
(b) Ability to recall a similar past experience					
(c) Award marks for ability to refer to a printed material					
5. Recognizing Special Symbols					
(a) Ability to recognize formulae in the unit					
(b) Ability to recognize special symbols in the unit					
(c) Ability to recognize abbreviations in the unit					

APPENDIX V

Specialists/Teachers Questionnaire on the Appropriateness of the Materials.

This questionnaire is designed to find out your opinion about the Nomadic Education Elementary Science Curriculum Materials. Your opinion is specifically needed on the following:

(1) The language level of the materials
(2) The relevance of the examples
(3) The difficulty of the concepts, and
(4) The general presentation of the materials.

1. Please briefly and precisely comment on the size of the units:_____

State the criteria you used:_____

2. Does the si,e accommodate illustrations?

3. Are illustrations displayed appropriately?

4. Are the Units easy to handle?

5. Do the titles of the units describe them correctly?

6. Are the titles generally attractive and intriguing?

7. Are the presentations of the contents logically arranged? If no, explain why not

8. Are the contents tailored to meet the needs of the learners?

9. Are the contents accurate? If no, please state possible areas of error

10. Please underline incorrect spelling in the text.

11. Circle errors of punctuation in the text.

12. Comment on the cover design of the materials.

13. What is your overall impression of the materials?

PSAT

		TEST GUIDE
	Cycle	1
	Modules	1 - 5
	Seasons	Ndabbu'nde, Cheedu, Seeto, Dungu, Yawal
Module	Units	Unit outline
1	1	Measurement
2	2	Water
3	3	Air
4	4	Plants, Animals, Hills and rivers in our neighbourhood
5	5	Moulding objects with clay

Cycle: 1

Module: 1

Season: Ndabbu'nde

Unit 1: Measurement of height, volume and weight.

TEST 1:

(1) How would you measure the height of your brother or sister?

(2) Can a small Burdude contain as much volume of milk as a big Burdude?

(3) How would you distinguish between hot, warm and cold water?

(4) We can distinguish between a light and a heavy faggo by carrying them on our heads. Which special instruments would you use to measure their weights?

Cycle: 1

Module: 2

Season: Cheedu

Unit 2: Water

TEST 2

(1) What is the importance of water to us and our animals?

(2) State what happens to salt, a piece of calabash and a stone when put in a river or a large container of water.

(3) How do we make jawadami?

Cycle: One
Module: 3
Season: Seeto

Unit 3: Air

Test 3

(1) State the importance of air to human beings.

(2) Describe a simple experiment you would use to show the presence of air.

(3) After burning some small firewood what is left behind?

(4) Describe how you can explain to your friend that air has weight and also exert pressure.

Cycle: One
Module: 4
Season: Dungu

Unit 4: Our Environment, Plants and Animals, Hills and Rivers in our neighbourhood.

TEXT 4

(1) Are there hills, rivers, plants and animals in your environment?

(2) Our cattle eat weeds and grasses, how about cats and dogs, what do they eat?

Cycle: One
Module: 5
Season: Yawal

Unit 5: Moulding objects from clay

TEST 5

(1) Using Fadama clay mould a cow of your choice and show it to your teacher for assessment.

(2) Also make simple kites from a paper your teacher provides to you.

(3) What happens to the cow you have moulded from clay when placed in the sunlight for a period of say three hours?

		TEST GUIDE: _____
	Cycle	2
	Modules	6 - 10
	Seasons	Ndabbu'nde, Cheedu, Seeto, Dungu, Yawal
Module	Units	Unit outline
6	6	Measurement: length and distance
	7	Measurement: weight and volume
	8	Measurement: Density
7	9	Hard and soft water
	10	Water Pressure
	11	Clean water
8	12	The air and the wheather
	13	Air and its Existence
	14	Air supports burning
9	15	Plants in our neighbourhood
	16	Animals in our neighbourhood
	17	The interrelationships of living things in our neighbourhood
10	18	Non living materials around our Yawirde
	19	The sun and our environment

Cycle: Two

Module: One

Season: Ndabbu'nde

Unit 6: Measurement: length and Distance

TEST 6

(1) How do you measure the length of your dongoli?

(2) How would you measure the distance between Motti's and Loddo's huts?

(3) What is meant by the SI units of length and distance?

Unit 7: Measurements of Weight and Volume

TEST 7

(1) If you have fibe objects which have their weights measured as: (1) one milligram, (2) one centigram, (3) one decigram, (4) one gram and (5) one kilogram, which one is the heaviest object?

(2) What are the units of measurement employed in measuring the volume of liquid substances?

Unit 8: Measurement of Density

TEST 8

(1) How would you find out the density of water and that of kerosine if you are given one litre of each substance?

(2) In the language of science, density is represented as $D = \frac{M}{V}$. Explain what is meant by this statement.

(3) What are the units of density?

Cycle: Two

Module: Two

Season: Cheedu

Unit 9: Hard and Soft Water

TEST 9

(1) State how we can easily distinguish hard from soft water.

(2) Give at least one reason why we boil and filter our water before drinking it.

Unit 10: Water Pressure

TEST 10

(1) How would you conduct an experiment to show the existence of pressure in water?

(2) Also draw a diagram to show how pressure is affected by the level of water in a cylinderical container.

(3) Which experiment would you use to show that 'pressure is force per unit area?'

Unit 11: Clean Water

TEST 11

(1) State two reasons why we need clean drinking water in our homes.

(2) What is the danger posed by drinking unclean water?

Cycle: Two

Module: Three

Season: Seeto

Unit 12: The Air and the Weather

TEST 12

(1) In our Fulbe pastoral calender, we have five seasons. State the weather of these seasons.

(2) Do our seasons come because of the change in weather?

(3) When does Looru blow? and from which direction? Also what does it bring?

(4) Describe an experiment to show that air supports burning.

(5) Also describe an experiment to show the existence of pressure in air.

Unit 13: Air and its Existence

TEST 13

(1) Write a very short statement to convince your teacher that air is everywhere.

(2) Also describe an experiment to show that air has weight and therefore occupies space.

(3) What is meant by the term air pressure? Explain.

Unit 14: Air Supports Burning

TEST 14

(1) Conduct a small experiment to show that air supports burning. Your teacher will come to and listen to your explanations and also see how you have arranged your experiment. Marks will then be awarded.

(2) Explain to your teacher what is meant by Diffusion.

Cycle: Two
Module: Four
Season: Dungu

Unit 15: Plants in our Neigbourhood

TEST 15

(1) State at least two differences between Barkehi and Gelode plants.

(2) Explain the function of leaves in a flowering plants.

(3) Draw a leaf of any plant of your choice.

(4) What is the economic importance of plants to man?

Unit 16: Animals in our Neighbourhood

TEST 16

(1) Mention any two groups of animals

(2) Draw any animal of your choice.

(3) What are the characteristics of reptiles?

(4) What do we mean by the terms vertebrates and invertebrates?

(5) Some insects are important to man. Give two examples of such insects.

Unit 17: The Interrelationships of Living Things in Our Neighbourhood

TEST 17

(1) State at least one reason why we cannot exist without other living things.

(2) How is man related to other animals and to his environment?

(3) In our struggle to survive we depend on other animals and plants for our food. Mention the food of one such animals which we inturn eat for food.

(4) Mention one area in which the understanding of our interrelationships with all living things and our environment helps us to live better.

Cycle: Two
Module: Five
Season: Yawal

Unit 18: Non-living Materials Around our Yawirde

TEST 18

(1) What are the three states of matter?

(2) Which process is involved when Nebban is heated?

(3) How will you locally show the process of change from liquid to gas?

Unit 19: The Sun and our Environment

TEST 19

(1) What is the importance to sun to us and other living things like the plants?

(2) Summarise the lecture on 'sun and our environment' given by Ngarso Baron Jedo

(3) Give two uses and two harful effects of fire.

(4) What is the use of thermometer to us?

(5) Are clothes the only material we can use to protect our body from cold or heat?

(6) How do we use heat energy to our advantage?

Unit 20: Heat and Temperature

TEST 20

(1) Describe what you see when water is boiling.

(2) Also describe what happens to your hand when you hold a rod of iron which has one of its end in fire and a piece of wood with its end also in fire.

(3) Compare boiling water with warm water and state your observations.

(4) What happens when Nebban is heated and when it is observed the following day?

(5) Briefly describe the two experiments conducted by the blacksmith Mallam Ibrahim from Runjin Macchunga

(6) How do we measure the temperature of a body?

		TEST GUIDE --------
	Cycle	3
	Modules	11 - 15
	Seasons	Ndungu, Yawal, ndabbu'nde, Cheedu, Seeto
Module	Units	Unit outline
11	1	Germination of seeds
	2	Pollination
	3	Seeds dispersal
12	1	Water in the atmosphere
	2	The Sun and our environment
	3	Heat and Temperature
13	1	The Effects and Sources of Forces
	2	Measuring Forces
	3	Kinetic and Potential Energy
14	1	Parts of a human body
	2	The human systems
15	1	The Existence of air
	2	Air supports burning
	3	Electrical Energy
	4	Playing with magnets

Unit 11: Germination of Seeds

Test 21

1. Why is water necessary for the germination of seeds.
2. Why are we happy when rainy season (ndungu) comes around?
3. Which one germinates faster, the beans or the millet?

Unit 12: Pollination

Test 22

1. Name at least one wind pollinated flower.
2. Explain why flowers are beautifully coloured.
3. Why do the insects visit flowers?

Unit 13: Seeds dispersal

Test 23

1. Name one agent of seeds dispersal apart from man.
2. Explain how man acts as an agent of dispersal.
3. Explain the advantages of seeds dispersal.

Module 11

Unit 14: Water in the atmosphere

Test 24

1. What is fog?
2. Explain how water exists in the atmosphere?
3. How is mist formed?

Module 13

Unit 15: The Effects and Sources of Forces

Test 25

1. Classify the sources of force into those that come by the human muscles, animals

muscles and other sources.

2. Why do we use animals to carry our loads?

3. Can a camel carry a load as big as that of a lorry?

Unit 16: Measuring Forces

Test 26

1. What are the units used in measuring forces?

2. Why is spring balance useful to us.

Unit 17: Kinetic and Potential Energy

Test 27

1. What is a kinetic Energy?

2. What do we mean by potential energy?

Module 14

Unit 28: The Parts of a human body

Test 28

1. State the names of at least four parts in a human body.
2. Explain the importance of one of the parts in (1) above.
3. Explain the importance of legs to us.

Unit 29: The human body systems

Test 29

1. Name two systems in a human body.
2. What is the importance of the digestive system to us.
3. Draw a simple diagram of a circulatory system.

Module 15

Unit 30: The existence of air, Electrical Energy and Playing with Magnets

Test 30

1. Explain a Simple Experiment to demonstrate the existence of air.
2. Name the applications of Electrical Energy.
3. How can you identify a magnet amongst other irons?

APPENDIX IX: Science Cognitive Preference Test After Treatment (SCPTAT).

Instructions.

In this test thirty three major statements in Science are given. Each statement has four comments (A b c d) after it. All the four comments refer to the statment and they are all correct. You are expected to show how much you like each of the comments by way of awarding 4 points to the one you like best, 3 points to your second choice, 2 points to the third choice and 1 point to the statement you like least.

In the answer sheet you will find a space provided after each option that is:

1. a( ) b( ) c( ) d( ).

Your points should be written in these spaces for example if you like c best in the above example followed by d, b and a, then you will score it in this fashion:

1. a(1) b(2) c(4) d(3).

This example shows that a is the least preferred hence it has only 1 point and d is the second choice with two points. Thank you for your co-operation.

ANSWER SHEET

NAME:.....

SEX:..... AGE:.....

SCHOOL:.....

.....

VILLAGE:..... STATE:.....

1. A( ) B( ) C( ) D( )
2. A( ) B( ) C( ) D( )
3. A( ) B( ) C( ) D( )
4. A( ) B( ) C( ) D( )
5. A( ) B( ) C( ) D( )
6. A( ) B( ) C( ) D( )
7. A( ) B( ) C( ) D( )
8. A( ) B( ) C( ) D( )
9. A( ) B( ) C( ) D( )
10. A( ) B( ) C( ) D( )
11. A( ) B( ) C( ) D( )
12. A( ) B( ) C( ) D( )
13. A( ) B( ) C( ) D( )
14. A( ) B( ) C( ) D( )
15. A( ) B( ) C( ) D( )
16. A( ) B( ) C( ) D( )
17. A( ) B( ) C( ) D( )

18. A( ) B( ) C( ) D( )
19. A( ) B( ) C( ) D( )
20. A( ) B( ) C( ) D( )
21. A( ) B( ) C( ) D( )
22. A( ) B( ) C( ) D( )
23. A( ) B( ) C( ) D( )
24. A( ) B( ) C( ) D( )
25. A( ) B( ) C( ) D( )
26. A( ) B( ) C( ) D( )
27. A( ) B( ) C( ) D( )
28. A( ) B( ) C( ) D( )
29. A( ) B( ) C( ) D( )
30. A( ) B( ) C( ) D( )
31. A( ) B( ) C( ) D( )
32. A( ) B( ) C( ) D( )
33. A( ) B( ) C( ) D( )

1.



The simplest way of measuring time is by means of a watch or clock. This is because:

(a) A watch or clock can measure the time in seconds, minutes and hours.

(b) Sixty seconds make one minute and sixty minutes make one hour.

(c) It enables us to measure the time of the day and night.

(d) The hands of a watch or clock move at equal internals continuously.

2.



A metre rule is used to measure length.

(a) A metre rule is divided into millimetres and centimetres.

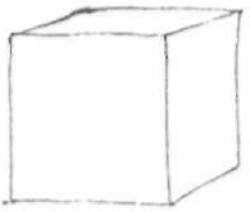
(b) A hundred centimetres make one metre and ten millimetres make one centimetre.

(c) The accuracy of a metre rule in measurement is because it is based on a system of units (the metric) which can be divided or multiplied by 10.

(d) A metre rule used to measure the length and height of objects so as to help us know their sizes.

(d) A metre rule is used to measure the length and height of objects so as to help us know their sizes.

3.



This figure of a box or cube contains space in it, which is called its volume.

(a) If the box is filled with water we can easily find the volume of water it contains by measuring the sides of the box.

(b) The volume of water in the box is equal to the volume of the box.

(c) The volume of any liquid depends on the size of its container.

(d) The area of base and height of a container determines its volume.

4.



One of the characteristic of living things is that they grow.

(a) Living things need food for their growth.

(b) Some of them move so as to find food

(c) They gain energy from the food they take

(d) This means they increase in size.

5. 

Non living things do not die.

(a) They have no life.

(b) They do not grow.

(c) Non living things do not move by themselves because they do not have energy to do so.

(d) They constitute one class of matter which posseses mass and occupies space.

6. 

Roots, flowers and leaves are all parts of a flowering plant.

(a) Roots, flowers and leaves have different functions.

(b) They are located at different parts of a flowering plant.

(c) The roots take in water through the stem to different parts of the plant.

(d) Where as leaves manufacture food for the plants through sun-shine, the roots anchor the stem and the flowers produce fruits or seeds as the case might be.



7. Fungi belongs to the plant kingdom.

   (a) Fungi is a plant without flowers or seeds but with spores.

   (b) Fungi reproduce through their spores which can grow to form new plants.

   (c) Fungi grow on food or on decaying matter on which they produce their food, in this respect fungi do not have roots, leaves or flowers.

   (d) Since fungi do not have leaves, they don't need sunshine hence they often grow in very dark places.

8. The air which you feel when a wind blows, has weight.

   (a) Air occupies space since it has weight.

   (b) When a wind blows, it can move some light objects.

   (c) The speed of a wind depends on the mass of the wind molecules.

   (d) The molecules of the air are in a state of perpetual motion because they possess kinetic energy.



9. Water is said to be a universal solvent.

   (a) Because water dissolves other solutes (substances)

   (b) The formula of water is H_2O.

   (c) It dissolves many substances especially in organic substances but why does it not dissolve the organic ones?

(d) Oxygine can be obtain from the



10. Water and a piece of stone are different because

(a) Water is a liquid and a stone is a solid.

(b) We drink water and use it in our washings where as a stone is used in building.

(c) Water in its liquid form is different from a stone but how is it different from a stone when it is in its solid form - ice.

(d) The difference is in the arrangement of their molecules.



11. We are able to roll a big stone because we use force which

(a) has a formula - F = Ma.

(b) comes from the energy we possess from the food we eat.

(c) Implies that a strong person can roll a biger stone than a weak person.

(d) Means the total force of any object not only human beings will come from the size and speed of that object.



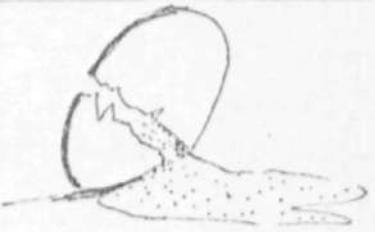
12. A falling mangoe fruit is said to:

(a) Possess kinetic energy which has a formula $K.E=\frac{1}{2}Mu^2$

(b) be falling to the ground because of the gravitational force which pulls all objects to wards the ground.

(c) have no minetig energy when it reaches the ground.

(d) be falling due to gravity but what about such a mangoe fruit in a world where there is no gravitational force.



13. We are able to know the presence of a rotten-egg in our surroundings because:

(a) We smell it

(b) The smell is carried by the air we inhale

(c) The molecules of air are diffused and travel in various directions

(d) The person who stands in the direction where the air blows will therefore smell more of it than



14. Various liquids are said to have different densities, because:

(a) The density of a liquid is easily known by dividing its mass with its volume.

(b) Density can help in identifying unknown substance.

(c) The effect of temperiture of decreasing the density of a substance.

(d) The density of a substance is proportional to its mass.

15. 

The settling down of the heavier dust particles at the bottom of the container, leaving the clean water above.

(a) Whereas such dust particles are indissolvable in water. They will be dissolved in kerosene.

(b) This process is called sedimentation.

(c) The dust particles are heavier than water because they have higher specific gravity than water.

(d) In this way we can collect clean water from muddy water if we allow it to settle down.



16. When water is heated stean is seen to be coming out of it.

(a) This is because water molecules are changed into air molecules.

(b) This process is called evaporation

(c) This takes place only when the water starts to boil

(d) Our wetclothes are easily dried up when we bring them near fire or we hang them outside or a hot day.

17. All living things grow

(a) They increase in size

(b) This is because they eat food

(c) Even though, they are all living things, the pattern of growth in plants and animals seems to differ

(d) The food is digested and assimilated in the body as a result of which the body gets its energy and vitality.

18. Crop rotation has its advantages in Agriculture.

(a) By changing the crop grown from year to year the soil will not be depleted of one particular group of minerals

(b) It brings better yield for the farmer

(c) But the constant cultivatiob of the plots will certainly put the soil under stress.

(d) It is mostly applied where there is not enough manure.



19. This device is used to measure the weight of objects as shown in the diagram; therefore:

(a) Weight is a kind of force

(b) The device is used in the market where the weight of an object determines its price.

(c) When a very heavy weight is placed on it, the spring can break down, since its limit of streching is reached.

(d) The device does not however, compare the weight of two objects at the same time.

20. Animals and plants are all divided into different classes.

(a) In this way, we group similar animals into one group and give them a name.

(b) The frog belongs to the group of amphibians.

(c) Some fundamental features like mode of feeding, structure of the body and so on, determine the class of an animal.

(d) There may be animals which could be difficult to classify in one group.



21. The respiratory system of a human body has many functions.

(a) It takes in air to the blood.

(b) The respiratory system consists of the nose, the windpipe and the lungs.

(c) Through this process energy is produced for the body, which enables it to do work.

(d) The human body is complex and the respiratory system alone cannot explain all the functions of the body.



22. The human body is different from the system of a plant.

(a) The human body takes in food directly through the mouth.

(b) This is because the human body is a more developed system than the plant system.

(c) The two systems may be different but they are all living things.

(d) Through these differences, we can classify living things into animal and plant kingdoms.

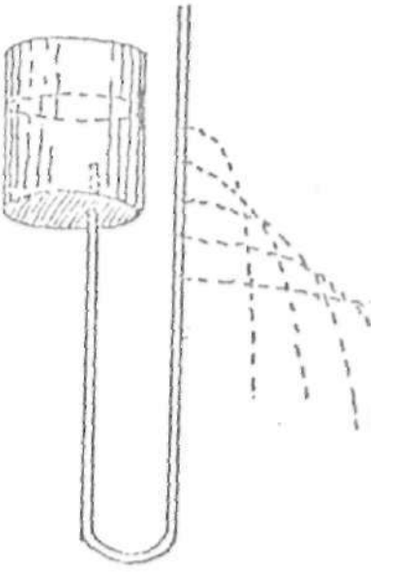
23. Filtered and boiled drinking water is very important to our health.

(a) In this way, we can avoid vector-deseases such as cholera, dirrhea and guinea worms.

(b) Filtering and boiling are necessary if the water is not pipe borne water.

(c) These processes remove dirt particles and also kills the germs in the water.

(d) Filtering is done with a clean cloth and boiling by heating the water.



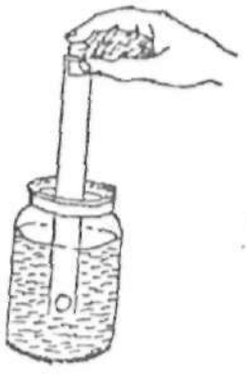
24. The drawing above shows the existence of water pressure.

(a) The pressure is strongest at point 'C'

(b) Pipe borne water used in big towns and cities uses this principle of water pressure.

(c) Water pressure increases with increasing depth of water.

(d) What causes water to flow out of the can can equally cause other liquids to flow out in the same process.



25. Pressure is force per unit area.

(a) The smaller the area the greater the pressure.

(b) Since air has force, it must have pressure also.

(c) $\text{Pressure} = \frac{\text{Force}}{\text{Area}}$

(d) Since air acts in all directions we must therefore be living under its pressure from all sides.

26. It is possible to change a substance from solid to liquid and then to gas.

(a) This change represents the change in the three states of matter, namely, solid, liquid and gas.

(b) Even though it is possible to change a substance into all the three states of matter, it is not possible to riverse the process in some substances.

(c) Through this process water is changed into steam when heated.

(d) This change affects the arrangement of the molecules and atoms in the three states of matter.



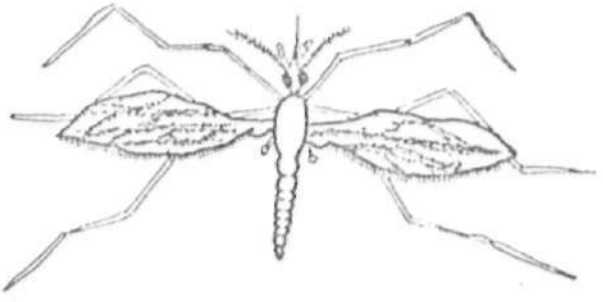
27. Living in a clean environment is very important to our health.

(a) We breath healthy and clean air.

(b) A clean environment means a clean compound.

(c) Even though a clean environment is important to our health we also need to eat good food to maintain a good body.

(d) A clean environment is important because it prevents us from getting infected with deseases such as cholera, diarrhea and guinea worms.



28. Mosquito bites are dangerous to our health.

(a) Mosquito bites give us fever.

(b) When mosquitoes bite us they inject into our body a parasite which causes us fever.

(c) When we fall sick as a result of mosquito bites we cannot go out to follow our cattle to the grazing lands.

(d) Without a standing water in our environment mosquitoes cannot breed so as to multiply in number.

29. A housefly is a dirty insect which conterminates our food and give us diarrhea.

(a) House flies lay their eggs on rubbish, hence the importance of clearing our compounds from all surch dirty places.

(b) When we are infected with diarrhea we cannot go out to follow our cattle to the grazing lands.

(c) A housefly is an insect which has its body divided into three parts namely: head, thorax and abdomen.

(d) A part from sweeping our compounds to keep them clean, we should also cover our food to prevent flies getting in.





30. Germination of seeds takes place after heavy rain falls.

(a) After the germination of seeds our grazing lands are covered with new green grasses which are good pasture for our cattle.

(b) The process of germination needs water, warmth and soil.

(c) After the seeds have germinated and the seedlings have come out, they still need water and manure to continue growing.

(d) Through the process of germination the plants are reproduced again for another life period.

32. Energy exists in different forms.

(a) We have potential and kinetic energy.

(b) We use heat energy for our cookings.

(c) We can convert one form of energy to another form of energy.

(d) Many forms of energy may therefore be very useful to man.



of this flower

33. Flowers are always visited by many insects.

(a) The insects go there to find food.

(b) The honey we drink comes indirectly from flowers necter.

(c) Apart from their sweet smell, flowers are also usually beautifully coloured, which further assists in attracting the insects.

(d) Not all flowers are visited by insects.