LEAD CONCENTRATION IN PRIMARY SCHOOL SOIL-DUST IN NIGERIA, AFRICA

By

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Fig. 1: Map of Nigeria Showing Kaduna State

INTRODUCTION

- Lead constitutes 0.002% of the Earth's crust, and exists mainly as lead sulphide in nature.
- Prior to human exploitation there was little or no contact between human and lead.
- Currently, it has become widely distributed in the biosphere almost entirely as a result of human activities.
- Once lead is introduced into the environment, it persists because it is not biodegradable (National Research Council, 1972).

INTRODUCTION CONT.

- Lead poisoning is one of the most common and best-recognised childhood diseases of toxic environmental origin.
- Children around the world today are at risk of exposure to lead from multiple sources.
- Lead poisoning accounts for about 0.6% of the global burden of disease
- Patterns and sources of exposure to lead, prevalence rates of lead poisoning and the severity of outcomes vary greatly from country to country and from place to place within countries (WHO, 2009).

INTRODUCTION CONT.

- Countries also vary greatly in their degree of recognition of the problem and in the strength and effectiveness of their lead poisoning prevention programme.
- In countries where the potential problem of lead poisoning has not yet been recognised, there are no screening or surveillance programme as a result, public health authorities have little or no knowledge of the existence of childhood lead-poisoning problems.

INTRODUCTION CONT.

- Due to this heterogeneous situation, the true picture of global and regional lead poisoning in children is not yet fully defined.
- The contribution of lead poisoning to the global burden of disease and its effect on the global economy and human development are probably still underestimated.
- Numerous international conferences and declarations have recognised the importance of childhood lead poisoning and the need to intervene to prevent it.

CURRENT ENVIRONMENTAL CRISIS IN NIGERIA AND NEED FOR ANALYSIS

- The need to assess lead level in classroom soil-dust in Nigeria was necessary due to the fact that the risk that toxic heavy metal pollution poses to humans was tragically demonstrated by the lead poisoning disaster that unfolded in Zamfara State, Nigeria in 2010.
- Investigations by the Joint United Nation Environment Programme/United Nation Office for the Coordination of Humanitarian (UNEP/OCHA) Environment Unit revealed that the cause of the health problems is acute lead poisoning from the processing of lead-rich ore used in the gold extraction process in homes and compounds in the affected areas.

CURRENT ENVIRONMENTAL CRISIS IN NIGERIA AND NEED FOR ANALYSIS CONT.

- More than 18,000 people were affected and 200 children reportedly died as a result of the poisoning.
- The United Nations urged Nigeria to prevent further lead poisoning and implement measures to limit lead ore processing at sensitive sites, such as water sources which could easily become contaminated with heavy metals.
- This incident led to many uncertainties and questions about lead in the environment.
- There was therefore the need to assess the concentration of lead in environmental samples for instance classroom soil-dust.

Fig. 2: Zamfara state in Northern Nigeria

Fig. 3: A child carrying processed ore in a calabash

Fig. 4: A young man processing ore at sight

Fig. 5: Confused villagers in Zamfara state, Nigeria

THE STUDY AREA

- Five primary schools were randomly selected from each of the six geopolitical zones in Nigeria namely Northeast (NE), Northwest (NW), Northcentral (NC), Southsouth (SS), Southeast (SE) and Southwest (SW).
- Six soil-dust samples were randomly collected from six classrooms of each of the schools selected for the studies.
- These six samples from each primary school were pooled to form a single composite sample by the method of coning and quartering and stored in plastic vials.

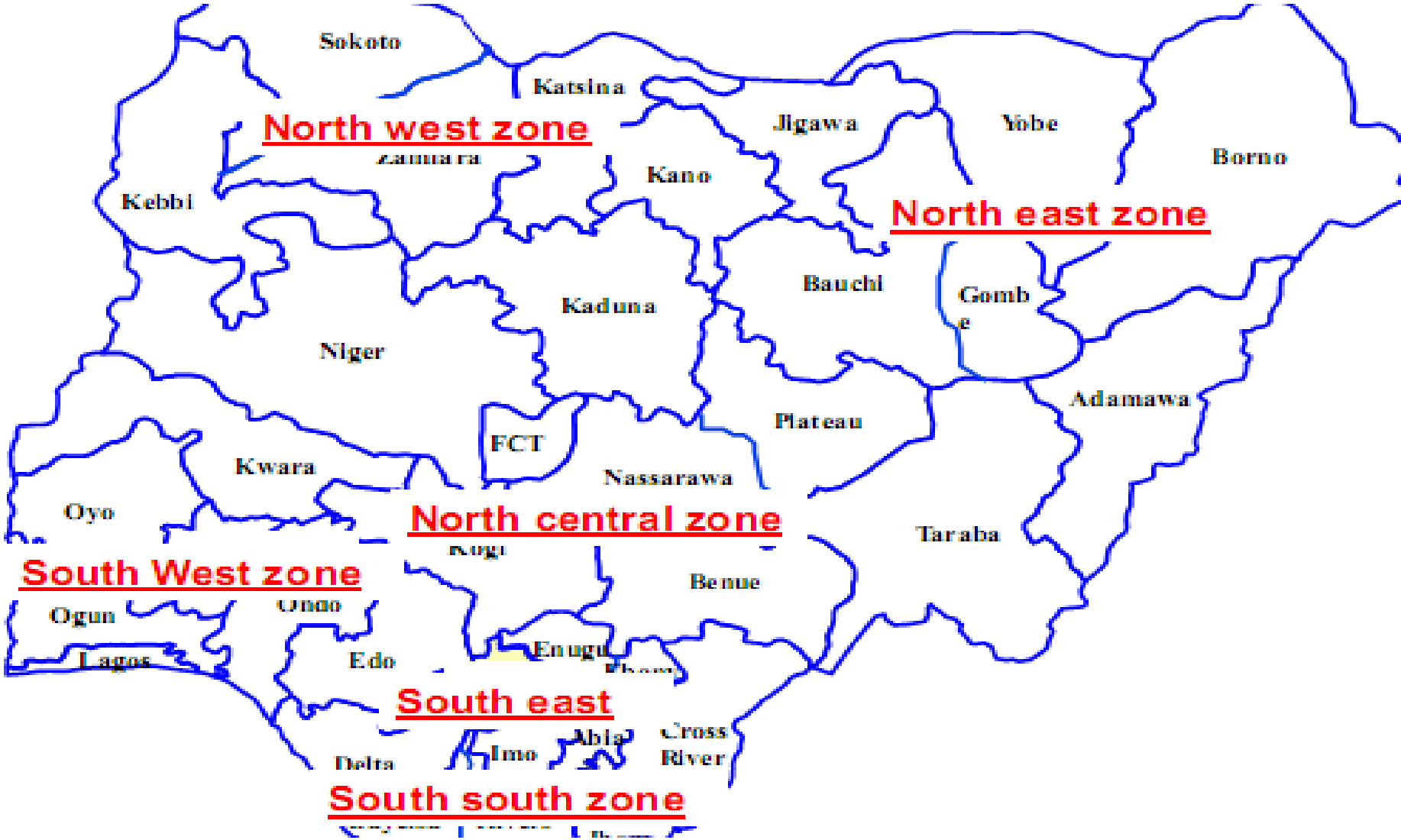


Fig. 6: The study area

ANALYTICAL PROCEDURE

- The samples were air dried in the laboratory, ground manually with mortar and pestle and sieved with a 2.00 mm mesh sieve.
- Samples were oven dried at 105°C ± 0.5°C to a constant mass and stored in plastic vials.
- Digestion was with 10.00 cm^3 of 40.00 % hydrofluoric acid and 1.00 cm^3 of 70.00 % perchloric acid mixture
- The digest were stored in plastic vials until analysis
- Absorbance measurements were made at 217 nm using a single element hollow cathode lamp on a Basic Pye unicam model 192 Atomic absorption spectrophotometer (AAS),

ANALYTICAL PROCEDURE CONT.

- The result of each sample was the average of ten sequential readings.
- Standard reference materials obtained from Institute of Agricultural Research (IAR) Ahmadu Bello University, Zaria in Nigeria, were used as a quality assurance measure for the analysis of total lead concentration.

RESULTS

Table 1 : Lead concentration in soil-dust samples from classrooms in Nigeria (mg/kg)

Zones	Dry season			Raining season			
	Min.	Max.	Mean ± SD	Min.	Max.	Mean ± SD	CC
NE	33.30	233.90	131.60±70.98	32.80	232.90	130.78±70.80	+0.939
NW	23.50	132.30	108.06±47.33	22.30	131.40	106.24±47.02	+0.920
NC	30.60	135.80	72.94±55.45	28.80	133.80	70.96±55.52	+0.913
SS	12.70	131.80	66.14±43.90	10.60	128.50	64.12±48.00	+0.879
SE	15.80	124.90	45.98±34.60	15.00	124.20	44.58±28.90	+0.789
SW	18.90	128.80	67.98±34.89	17.80	126.20	66.26±41.87	+0.879

CC= Correlation coefficient between dry and raining season

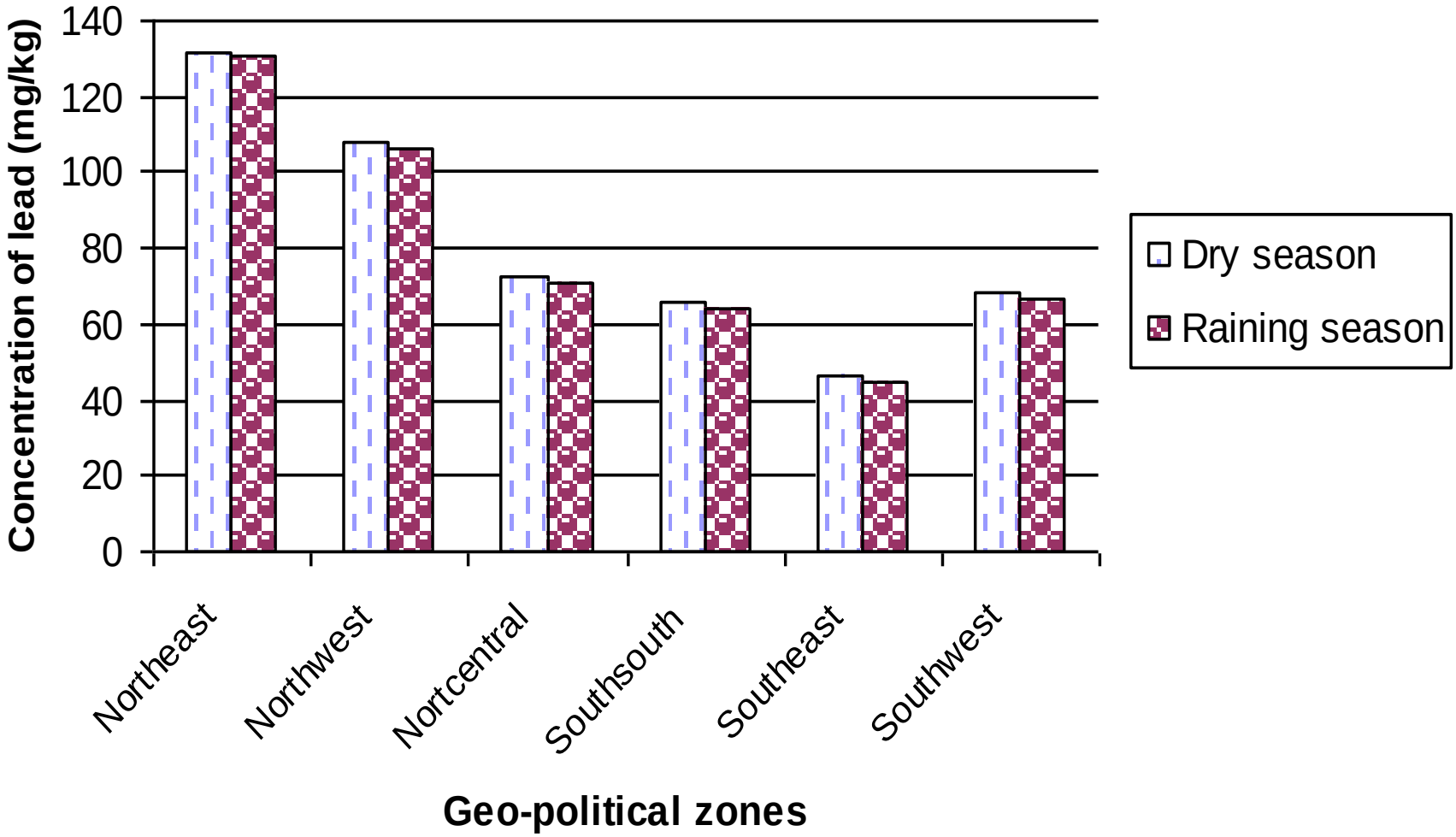


Fig. 7: Mean Concentration of Lead in the samples from the Geo-political Zones at two seasons (mg/kg)

DISCUSSIONS

- The ranking for the loading of lead in the samples of the six geo-political zones is SE < SS <SW <NC <NW < NE.
- This could be accounted for by the fact that dry season is occasioned by wind that carries particulates containing several metal ions and the fact that dry season would facilitate the peeling of the surface of paint coatings that could release lead into classroom environment.
- The concentration of lead in the samples analysed were above the estimated natural lead concentration range of 5.00 mg/kg to 25.00 mg/kg.

DISCUSSIONS CONT.

- The concentration of lead in some locations were above the maximum tolerable (permissible) limit of 100 mg/kg according to World Health Organization (Osoi, 2009).
- According to Shantha *et al.* (2005) who recommended maximum permissible levels of lead in soil based on the dose-response relationship of lead in soil and blood lead in children.
- An acceptable level of 600 mg/kg of lead in soil is a “safe” level and would contribute no more than 5.00 mg/l to total blood lead of children under 12 years of age.

DISCUSSIONS CONT.

- It is pertinent to state that recent data indicates that there may be neurotoxic effects of lead at lower levels of exposure than previously anticipated (Vasudevan and Streekumari, 2000).
- Blood lead levels that were considered previously to be safe are now understood to compromise health and injure multiple organs, even in the absence of unconcealed symptoms.
- The most critical consequence of low level lead toxicity during childhood is damage to the developing brain and nervous system.
- The immune, reproductive and cardiovascular systems are also adversely affected by relatively low levels of exposure to lead – that is, less than 10.00 mg/l.

DISCUSSIONS CONT.

- The consequences of brain injury from exposure to lead in early life are loss of intelligence, shortening of attention span and disruption of behaviour.
- Because the human brain has little capacity for repair, these effects are untreatable and irreversible.
- They cause reduction in brain function and decrease in achievement that last throughout life
- Recent research indicates that lead is associated with neurobehavioural damage at blood levels of 5.00 mg/l and even lower.
- There appears to be no threshold level below which lead causes no injury to the developing human brain.

DISCUSSIONS CONT.

- The Joint Food and Agriculture Organisation of the United Nations and World Health Organization (FAO/WHO) Expert Committee on Food Additives re-evaluated lead in June, 2010 and withdrew the provisional tolerable weekly intake guideline value on the grounds that it was inadequate to protect against IQ loss.
- Intense, high-dose exposure to lead causes acute poisoning, characterized by anaemia, and depression of the central nervous system that may result in coma, convulsions and death.

DISCUSSIONS CONT.

- Acute, lead poisoning still occurs today and is most commonly detected among children in low-income countries and marginalized populations or in children living in lead-polluted sites.

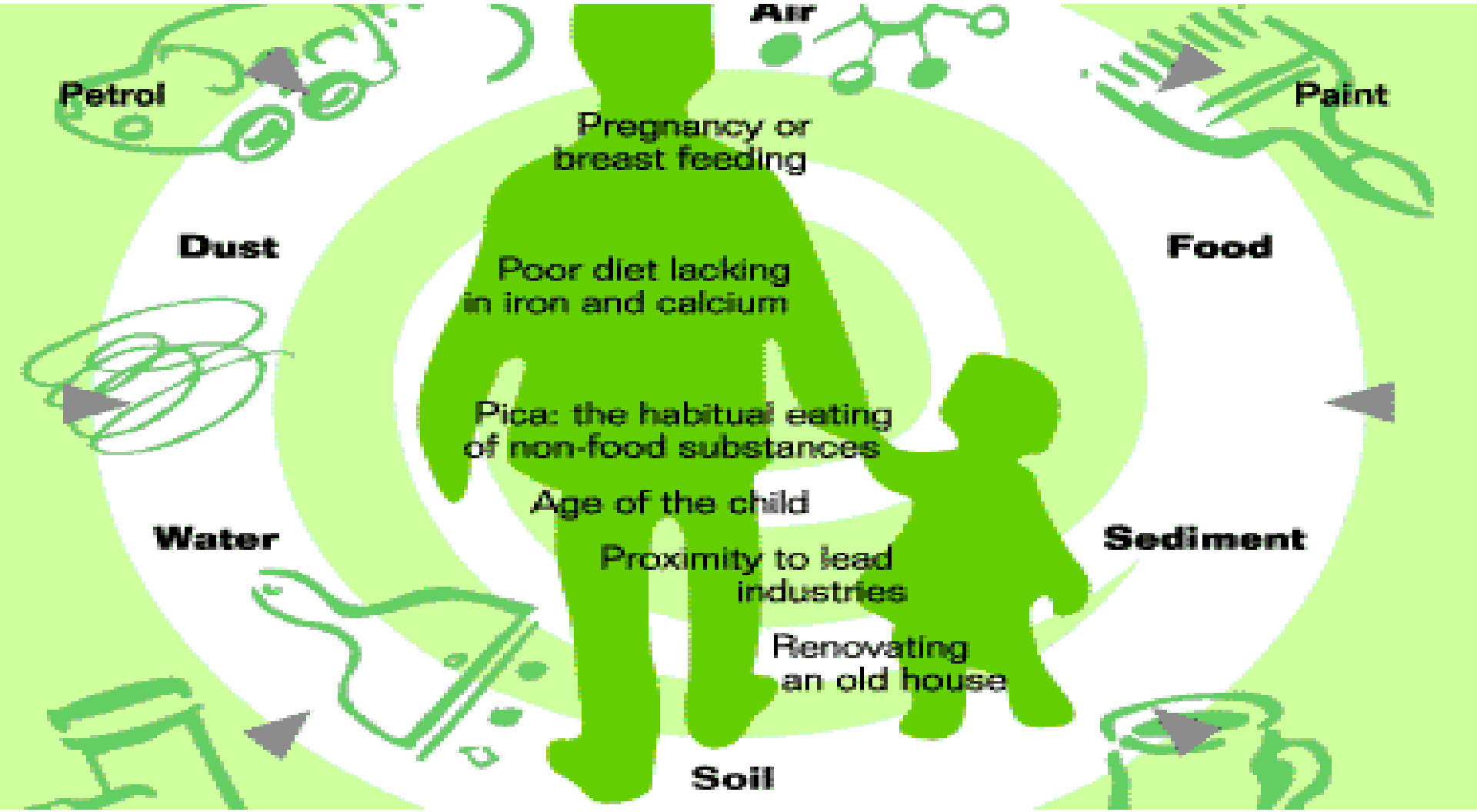
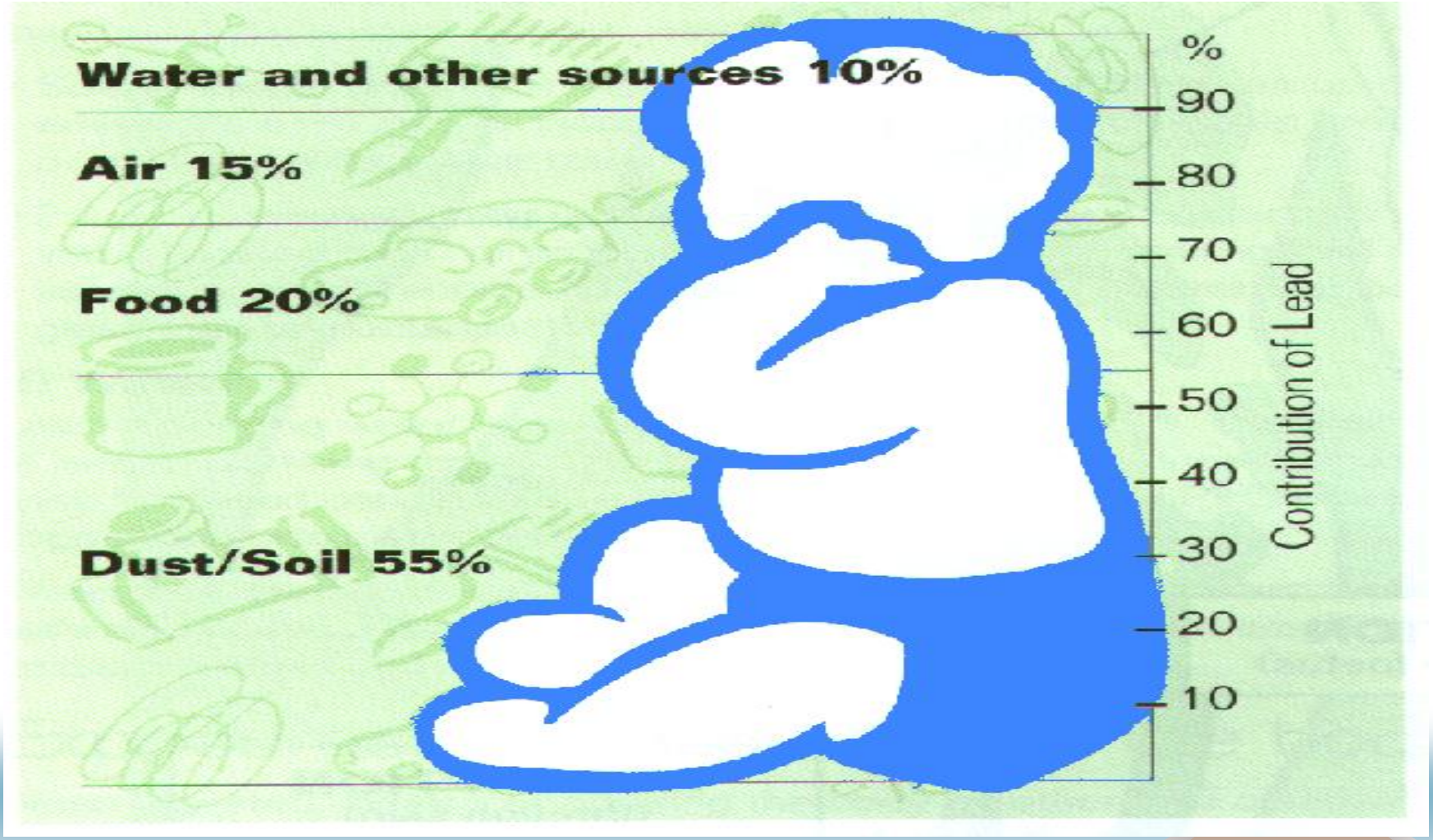


Fig. 9: Absorption of Lead

Contribution of Sources



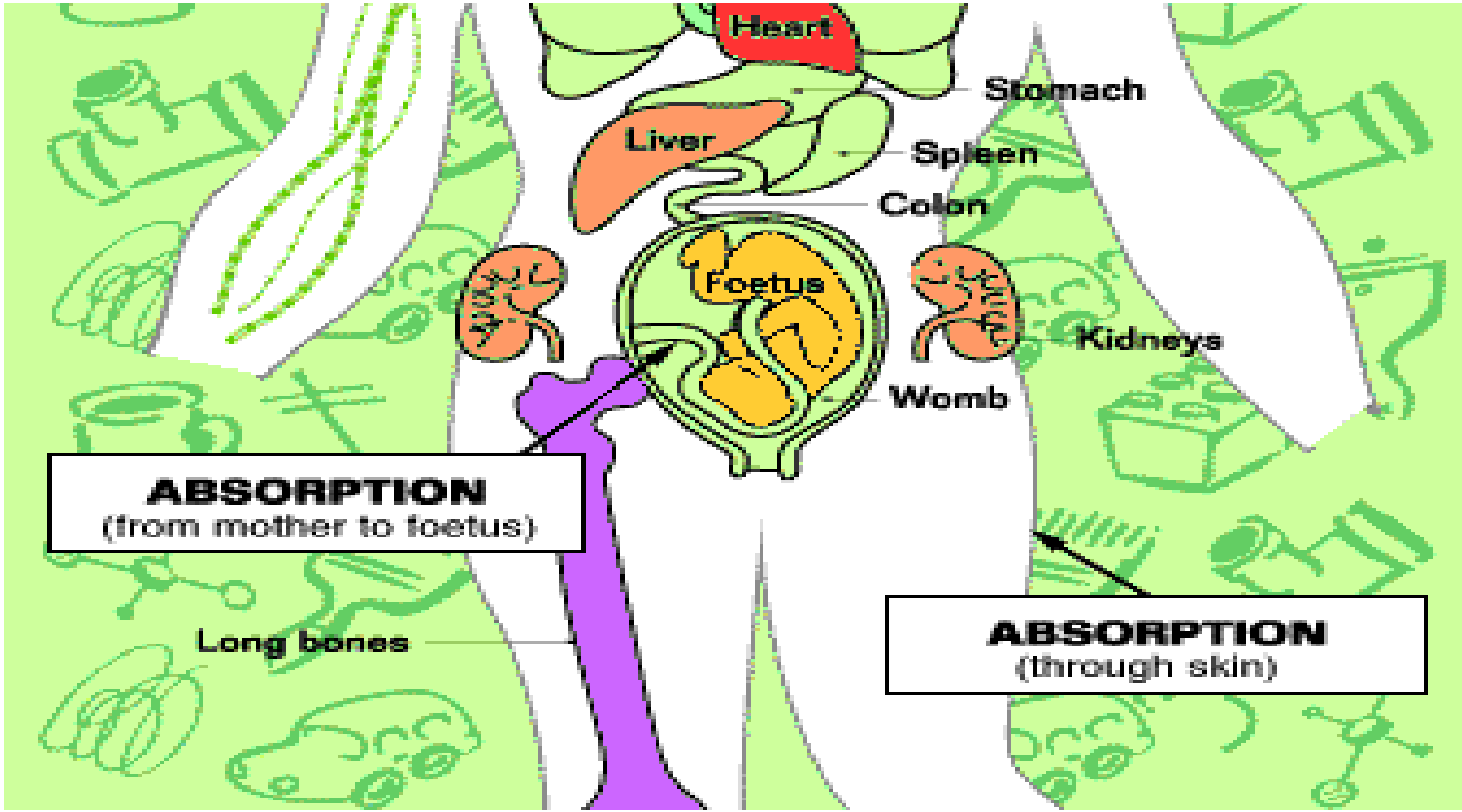


Fig. 10: Distribution of Lead

TOXICOLOGY OF LEAD

- Lead disrupts the main structural components of the blood-brain barrier
- Although the molecular targets for lead are unknown, a vast amount of evidence accumulated over many years has shown that lead disrupts processes that are regulated by calcium, it goes down iron or calcium absorption pathway.
- Picomolar concentrations of lead can replace micromolar concentrations of calcium which leads to neurotoxicity (Bressler *et al.,* 19999)

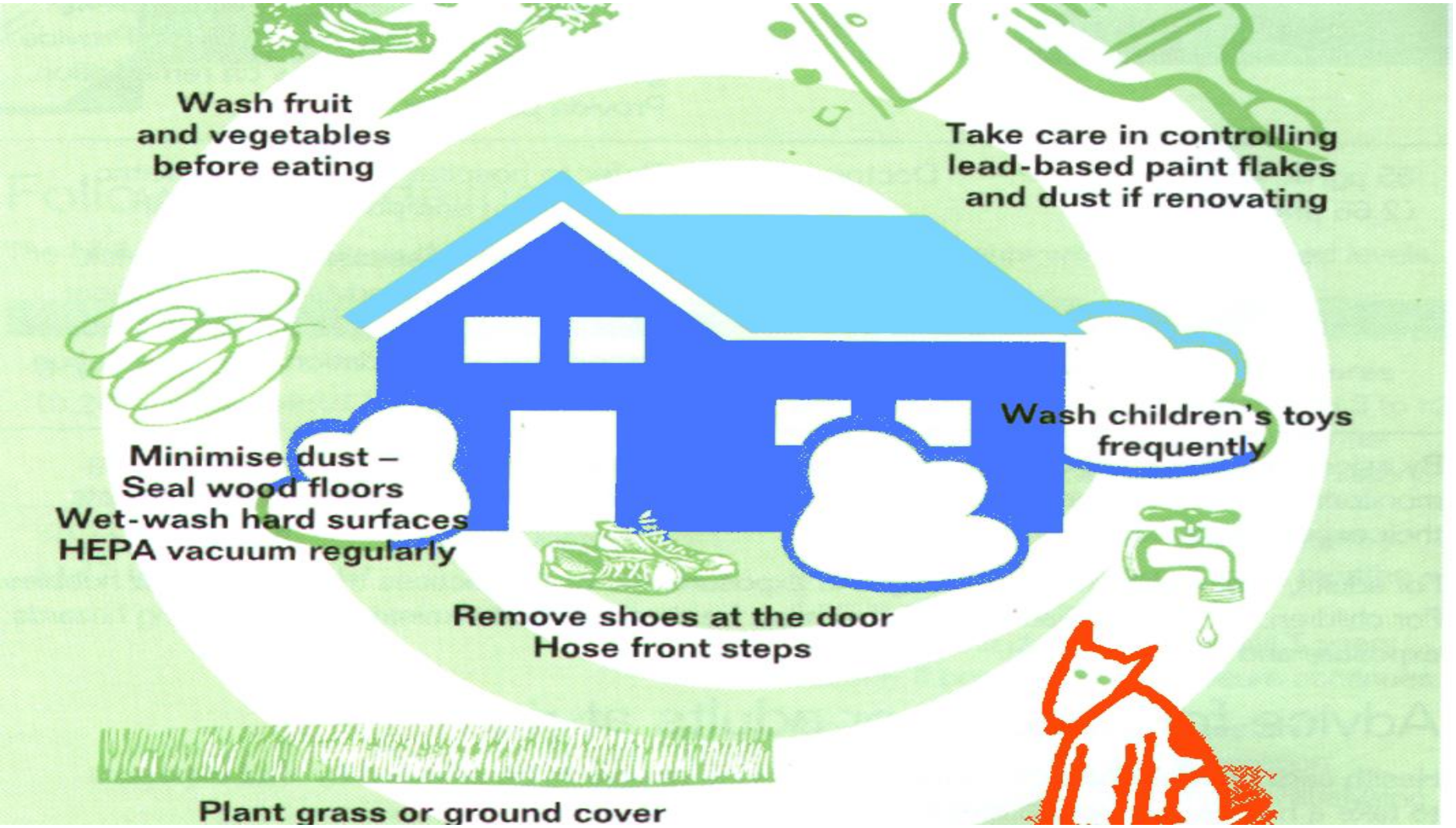


Fig. 11: Reduction of Lead hazards in the classrooms

CONCLUSIONS

- The wide range in lead concentration in the classroom soil-dust from the five schools of each of the geo-political zone, call for caution in the schools with exceptionally high values of lead to avert the means responsible for the elevation.

PROPOSED SOLUTION TO LEAD POLLUTION PROBLEM

- Provision of health rationale to government and other stakeholders to stimulate action and develop legislation to eliminate lead in the environment
- Encourage health care providers/public health practitioners to take a leadership role in promoting the elimination of lead
- Build capacity in hazard assessment, lead poisoning prevention, blood lead measurement and surveillance, laboratory analysis, exposure assessment and exposure reduction by sharing information and leveraging the expertise and experience of Alliance members and provide best practices to promote the public awareness of the hazard of lead

APPRECIATION

THANK YOU FOR LISTENING!