Pathways of Exposure
Toxins reach receptor through skin, lungs, gastro-intestinal track, roots, gills, etc.

Source of metals and inorganics may be water, soil, plants, animals, airborne particulates

Dust from arsenic-rich gold mine tailings (1000-10,000 ppm As vs. 12 ppm criteria)
Access is limited to Giant Mine, Yellowknife

Children on dirt bikes in Nova Scotia

Unusual pathways
Geophagia – Humans or animals compelled to eat soil (Clay in southern USA, Elephants in Kenya)

Eating kaolin in Georgia, USA
Clay may absorb beneficial trace elements within gut, creating deficiencies in Zn, Fe

Unusual pathways, cont’d
• Pharmaceuticals – Conventional or Homeopathic (Gold as anti-arthritic, Zinc as nutritional supplement, Magnesium in epsom salts as antacid, laxative). Individuals may overdose, children may accidentally ingest medications (e.g. Fe in vitamins cause internal bleeding, liver damage. >100,000 cases in last decade in USA)

• Elements used in trace amounts in manufactured items – Antimony used as flame retardant in crib mattresses. A study in 1989 showed that fungus combined with antimony to produce stibine, a toxic gas, and linked this to crib deaths. Results were later challenged.

Cadmium
• Highly toxic, accumulates in kidney
• Released to environment through mining and metal processing
• Used to harden steel
• Taken up in food, esp. rice, grain, yams
• Closely associated with zinc in natural environment and within human body
Lead, continued

Effects on humans include neurological damage and behavioural effects in young children such as attention deficiency. Prenatal exposure is also a concern. The lower limit of toxic effects is under discussion – it can be considered toxic at any concentration.

Lead is not very mobile in the aquatic environment because it is insoluble except under acid conditions such as acid mine drainage. Wildlife exposure is usually due to ingestion of lead shot, especially by waterfowl.

Famous cases of lead poisoning

- Decline of the Roman Empire – Sweet syrup "sapa" made by boiling grapes in lead vats, then added to wine. Lead also used in plumbing. Wealthier people were those most exposed. Lead has been found in skeletons.

- George III of England thought to be insane. He loved sauerkraut which was cooked in lead pots.

- Beethoven suffered from many illnesses including gastrointestinal problems and irritability. His hair was tested in 1990’s for mercury (used to treat syphilis) – instead found to be rich in lead.

Modern lead exposure

- Lead additives to gasoline (mostly discontinued), still found in soils and dusts near roads
- Paint in older homes, or exposed during renovations (children ingest paint flakes)
- Ammunition – hunters and police officers, but also communities who eat wild game

Lead exposure through eating game birds

- Research done in Cree communities in western James Bay (Jim Karagatzides, PhD Geography)
- Lead concentrations in teeth and blood of children is elevated
- Soil, air and fish are low in lead
- Lead shot is found in geese, ducks, grouse that formed part of children’s diet
- Researchers suggest that lead shot should be replaced by steel shot
Developing Countries and Indigenous Populations

People in some communities eat game or “country food” and may be exposed to contaminants or deficiencies not in store food.

- Lead in birds in Northern Ontario,
- Cadmium in caribou in the Yukon
- Mseleni joint disease in South Africa

(attributed to Calcium, Phosphorus, Potassium, Zinc, Copper deficiency in soils and crops)

Cadmium is higher in older animals

Government considers this cadmium to be natural. This is disputed by some Northerners, who think it is related to mining.

TEK or Traditional Environmental Knowledge now recognized by government and industry as a tool for environmental assessment.

Metal Cookware – which is safest?

- Need efficient and consistent conduction of heat
- Silver is ideal – too expensive!
- Copper works well, but dissolves in food to toxic levels, unless copper pans are lined
- Aluminum is good, and most researchers agree that there is no connection to Alzheimer’s disease
- Cast iron has benefit of added iron to diet
- Enameded cookware is safe if glazes are lead-free

Dental fillings and Tattoos

- Dental amalgam is ~50% Hg
- Experiments with artifical mouth at New Jersey Dental School suggest 135 fillings are needed to produce toxic levels of Hg in saliva

- Ink used in tattooing contains Mg, Cr, Cd and Ti
- Exposure may be greatest when fillings and tattoos are removed

*Both subjects are controversial, research ongoing*