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NEWS FROM THE WONDERFUL WORLD OF SOIL AND PLANTS

MINERALS - The Elements and What They Do

Today we continue with our study of all the minerals (elements) in the human body, what they do. See previous newsletters (9/17/21 and 9/24/21) for a list of references and introduction to the Periodic Table.

Today we look at elements 48-55 which are cadmium, indium, tin, antimony, tellurium, iodine, xenon and cesium.

48) **Cadmium (Cd) -** Cadmium is a silvery metal that will tarnish in air (like silver). It will dissolve in acids but not in alkalis. It is a heavy metal that damages all cells in the human body.

It is found in igneous rocks at 0.2 ppm, shale at 0.3 ppm, sandstone at 0.05 ppm, and limestone at 0.035 ppm. It occurs in fresh water at 0.08 ppm and seawater at 0.00011 ppm (fresh water is slightly acidic and seawater is slightly alkaline). Coal can contain 0.05- 175 ppm.

In marine plants, we find 0.4 ppm and land plants at 0.6 ppm. However, in marine animals, the cadmium will bioaccumulate and ranges from 0.15 to 3.0 ppm, which is one of the reasons why there is little cadmium in seawater. In land animals, we see 0.5 ppm where it tends to accumulate in the kidneys.

Cadmium has a +2 electrical or oxidation state, which is the same as zinc which cadmium mimics in nature as it is in the same column on the periodic table (hence similar chemical properties). Cadmium is rarely found in nature in a pure form but combines easily with many other elements.

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Cadmium is used in batteries (Ni-Cd) to televisions and many other electrical devices. Cadmium telluride is used to make solar panels. Cadmium sulfide is used to make a yellow pigment. A lot of cadmium coated bolts and nuts are used on airplanes, as it is extremely resistant to corrosion.

Cadmium is found in the bodies of microorganisms that live in the soil. Some-microbes have the ability to hyper-accumulate cadmium. Some actinomycetes strains can have 1,120 ppm in their tissues.

Cadmium is not required for the majority of life forms. However, a marine diatom *Thalassiosira weissflogii* produces a cadmium specific enzyme which catalyses the conversion of carbon dioxide and carbonic acid.

Cadmium is highly toxic if we have too much, where it will damage kidneys and other organs (in high levels it is also toxic to plant tissue). The human body tries to remove cadmium from our bodies by transporting it to our kidneys in an attempt for it to be eliminated. However, in binds tightly to many enzymes and can be stored for over 30 years! Cadmium replaces zinc and binds over 300 times tighter to the enzymes. This is why having sufficient zinc in our diets is very important as it prevents most cadmium from being absorbed. For a more detailed discussion, see page 90-91 in "Nature's Building Blocks - An A-Z Guide to the Elements, John Emsley, Oxford University Press, 2011, ISBN 978-0-19-960563-7".

All types of *artificial* fertilizers appear to increase cadmium levels in our soils. Phosphate rocks from which we get phosphorous for artificial fertilizers often has lots of cadmium in it. For example, a source of phosphate rock from Morocco can have over 50 grams per ton (an extremely high amount of cadmium).

Cadmium contamination is increasing in our soils from airborne deposition where the main sources are metal smelters, volcanic eruptions, burning of coal and burning of municipal waste (garbage).

If our soils contain the salt sodium chloride (NaCl), it stimulates the formation of cadmium-chloride complexes, which are very soluble and phytoavailable. One should not use high salt products (poultry manure fertilizers, cow manure, etc.) along the Gulf Coast, as many of our soils are already high in salt. Any food crop from vegetables to fruits will absorb more cadmium that we do not want in our bodies. Chlorine also comes from municipal water systems and becomes available to form cadmium-chloride molecules when we water our lawns and gardens if one has used artificial fertilizers. More reasons to only use good organic fertilizers.

Cadmium in our bodies interferes with the mechanisms responsible for DNA repair and it disrupts mitochondrial activity leading to many degenerative diseases. The World Health Organization has recognized cadmium as a carcinogen.

The University of Missouri Medical School has found that cadmium mimics estrogen in women's bodies. This leads to endometrial cancer in the uterus. Drinking sugary beverages increased the chance of this cancer by 78%!

The book "Chemical Exposure and Human Health, Cynthia Wilson, McFarland Publishers, 1993, ISBN: 0-89950-819-3" lists hundreds of health issues associated with excess cadmium in our bodies.

Gardening and Landscaping Problems Associated with Cadmium (Cd)

Cadmium content in plants is directly related to the amount in our soils and as little as 3 ppm will depress growth in many species of plants.

Symptoms of cadmium toxicity are leaf chlorosis and necrosis. This is followed by leaf abscission as cadmium interferes with photosynthetic processes and the uptake and absorption of other required nutrients.

Some plants like turnips and leafy vegetables like spinach will absorb enough cadmium to be a health risk. Cadmium contamination is much higher in vegetables grown with artificial fertilizers. Many of the synthetic nitrogen sources are strong acidifiers (why farmers have to lime their fields) which then causes the plant to absorb more cadmium. In addition, cadmium stimulates the growth and hatching of nematodes (cysts) in the soil.

Some mushrooms (fungi) can have 30 ppm in their tissues even when growing on soils with only 0.3 ppm cadmium. Tobacco plants tend to absorb larger amounts of cadmium and is one of the reasons smoking causes cancer.

If you notice that cadmium is directly below zinc in the periodic table, hence it has similar chemical properties. Thus, a zinc deficiency in the soil can lead plants to absorb more cadmium.

Lettuce grown on agricultural fields where Biosolids (sewage sludge), where once applied, can have over 30 ppm of cadmium.

Coal can have very high levels of cadmium, which become concentrated in the ash when coal is burned for fuel. Many companies use the extreme alkalinity of coal ash to chemically burn the mulch made from raw wood, black. Coal as is also used to burn pine bark black to mimic aged (partially composted) pine bark.

Sources: rubber tire mulch, sewage sludge (Biosolids) and compost made from Biosolids, black mulch treated with coal ash, some artificial fertilizers

49) Indium (In) - Indium was named for the strong indigo-blue spectral emission line produced when heated. Indium is soft and silvery, a good conductor of electricity and a fun metal. When bars or rods of indium are bent, they "cry" producing a crackling sound.

Indium is found in igneous rocks at 0.5-1.0 ppm, shale at 0.1 ppm, sandstone and limestone at 0.05 ppm. In land animals, indium averages 0.016 ppm.

The electrical or oxidation states of Indium range from +1 to +3 with +3 being the most common. Indium often forms compounds with iron (Fe) and manganese (Mn) hydroxides. Indium is often found in nature in association with sulfide minerals hence indium is often

recovered from the mining of other minerals. Indium is also found in coal and in some crude oil.

Indium is used alloys, solders, many types of electronics, coatings of high-speed bearings, transistors, and photoconductors. A common usage is in making touch screens. Indium oxide is used to make LCD televisions and computer monitors as it bonds to glass, is transparent and conducts electricity.

Indium is a super conductor and many of its alloys with other metals are used to make super conducting materials. My research in graduate school on superconductivity was published as a small book titled "Magnetization Studies of Superconducting Ternary Alloys of Lead, Indium, and Tin".

Indium is not known to have any biological function in humans. However, its salts in small doses, stimulates metabolism. If even a few milligrams are consumed it will cause a toxic reaction in our kidneys, heart and liver. In high amounts, it causes focal necrosis in the liver.

However, indium compounds have been found to be an effective treatment for the disease called "sleeping sickness".

Gardening and Landscaping Problems Associated with Indium (In)

Indium occurs in soils in a form that could readily be absorbed by plants, however, that does not occur. Most plants have only 1-2 ppm of indium in their tissues.

If indium levels are 5-9 ppm in soils, it inhibits the activity of nitrogen fixing bacteria to fix nitrogen. Indium toxicity in plants can occur in acidic soils where the symptoms are similar to aluminum (Al) as both are in the same column on the periodic table with similar properties.

Indium has been found to stimulate growth of plants in laboratory cell cultures.

Beets grown in soils amended with sewage sludge have 80-300 micrograms per kilogram.

Sources: sewage sludge, compost from sewage sludge (Biosolids)

50) Tin (Sn) - Tin is a silvery white metal that is soft and pliable. It becomes unreactive in air and water as a thin film of oxide forms preventing additional reactions, however tin will dissolve in acids and bases.

Tin is found in igneous rocks at 2 ppm, shale at 6 ppm, sandstone and limestone at 0.05 ppm and very little in fresh or seawater. In soils, tin ranges from 2-200 ppm as it is strongly absorbed by humus.

Most land plants have 0.3 ppm and marine plants at 1 ppm. Marine animals have 0.2-20 ppm tin and land animals only 0.15 ppm. The mobility of tin is directly related to the pH of the soil.

Tin is complexed by organic matter hence it can accumulate in some soils. Tin is absorbed by plants where it accumulates in the roots but very little is translocated to above ground parts of a plant.

The most common mineral form of tin is cassiterite (SnO_2) a tin oxide.

Tin was first used to harden copper to form bronze, over 5,000 years ago which led to the development of civilizations called "The Bronze Age". It is also used in making bronze, pewter, and tin-plated steel for food packaging. Glass when applied to molten tin would not stick thus providing a way to make perfectly smooth glass for windows. Tin is used to make cans and as a

coating on metal cans since it is non-corrosive (which is the major source of tin in humans). Tin compounds are used in ceramics and to make dyes. Tin is the main component in lead free solder as tin melts easily. A tin-indium oxide has the unique properties of being electrically conductive and optically transparent, hence it is used in all types of flat panel displays from cell phones to televisions and monitors.

Tin is not used to make coins or jewelry since at winter temperatures the atoms slowly change from a metal crystal arrangement to a cubic crystal arrangement or structure where the tin becomes a dark grey powder.

Tin is an essential trace element in small amounts. Studies where rates were fed a diet with zero tin caused rats to not grow properly. However, very small amounts of tin caused accelerated growth in rats. Too much tin in the rodent studies showed poor growth, reduced feeding efficiency, hearing loss, and hair loss.

Tin has been shown to exhibit a strong effect on the enzyme heme oxygenase, enhancing heme breakdown in the kidneys. There is evidence that tin has cancer prevention properties. Tin deficiencies have been linked to male pattern baldness and deafness in humans. Tin is also known to affect the metabolism of other metals like copper, zinc, and iron.

In animals and humans tin is required, but too much can be toxic. When tin is complexed with organic compounds it is easily absorbed. Inorganic compounds of tin are not easily absorbed. Very little of the tin ingested is absorbed (less than 3%) and most of what is absorbed is excreted in our urine.

Tin is found in the bodies of many microorganisms that live in the soil. In soils contaminated with excess tin, it was discovered that some bacteria are immune to the toxic effects of tin, and will concentrate tin up to 7,700 ppm in their tissues.

High levels of tin in the soil are toxic to some species of fungi. Triphenyl-tin is used as a fungicide for agricultural crops. Research in 2002 showed that it suppressed the human body's production of natural killer cells, which are the first line of defense against cancer. This compound also damaged the nervous system of tadpoles and frogs.

Tin fluoride (SnF_2) and tin chloride ($SnCl_2$) are known to inhibit the functions of our liver. Additionally, too much tin will compete with the required nutrient zinc preventing its absorption. Tin is commonly used in dentistry under the name stannous fluoride.

Tin tartrate was found to cause a decrease in the antioxidant glutathione leading to liver damage in animal studies.

Gardening and Landscaping Problems Associated with Tin (Sn)

There is no evidence that tin is required or used by plants, however tin is easily absorbed by plants where it accumulates in the roots and very little is translocated to above ground parts of a plant. The amount of tin in plants varies between 1-300 ppm but 5-10 ppm is the most common. Sedges and mosses tend to be high accumulators of tin.

Whole grains can have 7 ppm and corn 3 ppm of tin. Measurements have shown that sugar beets grown on contaminated soil can have 1,000 ppm of tin.

There is no evidence of toxicity to plants unless there are extremely high levels of tin in the soil.

Sources: coal, coal ash, smelters, mine tailings

51) Antimony (Sb) - Antimony is an element sometimes referred to as a metalloid. It is metallic in appearance (bright and silvery) but brittle, and with more of a crystal structure than other metals.

Antimony is found in igneous rocks at 0.2 ppm, shales at 1.5 ppm, and limestone at 0.2 ppm. In soil, antimony ranges from 2-10 ppm. Very little antimony is in fresh or seawater.

Adding a little antimony to lead makes it harder and is commonly used in making bullets. The electro-plates used in lead acid batteries in our automobiles use antimony. When antimony is cast, and as it cools, it emits melodic sounds. Unlike most elements, antimony expands as it cools.

Antimony is below and in the same column on the periodic table as arsenic hence, it has similar properties. The most common electrical or valence state of antimony is +3.

In nature, antimony is often found with sulfite minerals like stibnite (Sb_2S_3) and may substitute for arsenic (As) in other minerals. Over 100 known minerals contain antimony. Antimony is sometimes concentrated in coals, carbonaceous shale, and sewage sludge.

In addition to hardening lead antimony is used in making flame resistant clothing, other fabrics, and even children's toys. It is found in some semi-conductors and other electrical devices.

Archaeologists have found that the lead pipes used in Pompeii dating to 79 A.D. contained antimony at very high levels which is naturally abundant in the area due to volcanic activity. The toxic levels of antimony are believed to contribute to the decline of the Roman empire.

The composer Mozart is believed to have been killed by antimony poisoning. Mozart ingested a compound of antimony "tartar emetic" (an antimony potassium salt) which doctors prescribed as a hangover cure. Mozart was a heavy drinker.

Antimony in the form of lead antimonate was used as a yellow pigment on ornamental bricks in the Babylonian King Nebuchadnezzar's palace.

Antimony often occurs in soluble forms of which some may be complexed by humates which increase its mobility in the soil. Antimony is easily absorbed hence clay sediments may become enriched with this element. Depending on other soil minerals, antimony may be fixed or readily move through the soil profile.

Antimony contamination is becoming a major problem from land applications of sewage sludge and the burning of coal.

In humans, antimony is found in our bones and other tissues. However, antimony does not seem to accumulate in our bodies. Historically antimony compounds have been used to treat several medical problems. Some antimony compounds have been found to cause cancer in rodent studies when breathed.

Gardening and Landscaping Problems Associated with Antimony (Sb)

Antimony is not considered an essential element for plants; however, it is easily absorbed by plants, if present in the soil, and in soluble forms.

One study found increased auxin production by rhizobacteria with increased antimony concentration in the soil (Picard and Bosco 2006).

There is no evidence of toxicity to plants unless extremely high levels of antimony are encountered. Most plants have from 1-30 ppm in their tissues. Spinach grown on contaminated soils had 1,130 ppm of antimony.

Sources: coal, sewage sludge, Biosolids compost (compost made from sewage sludge), metal smelters

52) Tellurium (Te) - Tellurium is known as a silvery white, semi-metal. Tellurium is in the same column of the periodic table as selenium at the boundary between metals and non-metals and has properties of both.

Tellurium is found in igneous rocks at 0.001 ppm, land plants at 2-25 ppm, and in land animals at 0.02 ppm. Very little tellurium is found in fresh or seawater. Tellurium is rarer on Earth than the universe in general.

Tellurium is used in making rubber, tinting glass and ceramics, electronic devices, and as a catalyst in oil refining. Tellurium is used as an alloying agent as it makes alloys easier to machine and mill. Tellurium is also used to make our Blu-ray players.

Tellurium is found in tumor suppression protein sequences, as it works with selenium to help the body fight cancer, tumors and viruses.

There is limited known biological roles for tellurium. It is found in human blood at only 6 ppb, in tissue at 15 ppb, and none in our bones. When we ingest tellurium, it is slowly excreted in our urine with some being converted to a obnoxious and volatile dimethyl telluride ($Te(CH_3)_2$) which is then expelled in our breath and sweat glands and has a pungent garlic like odor. This odor can last for weeks.

Microorganisms can absorb tellurium and then emit it in a volatile form by methylating it to dimethyl telluride ($Te(CH_3)_2$). Tellurium is fixed by organic matter and some coals can have 20-2,000 ppm of tellurium.

Recent studies have found that tellurium compounds have anti-oxidant properties including anti-tumor and chemo protective effects (Zemolin et al. 2013).

Gardening and Landscaping Problems Associated with Tellurium (Te)

Tellurium has no known biological function. However, new research has found that fungi can incorporate it in place of sulfur and selenium into some of their amino acids.

Plants absorb tellurium easily and the amount in their tissues is related to the amount in the soil. Plants can absorb tellurium from the soil and have been found with levels of 6 ppm, although most plants have far less. Onions and garlic can have 300 ppm and is what give them their strong odor.

Sources: coal and fly ash from coal, smelters

53) Iodine (I) - "As one moves down the Halogen column on the periodic table, the elements mellow a bit, from vicious fluorine (#9) to deadly chlorine (#17) to barely-liquid bromine (#35) - until you reach iodine, an element so comparatively benign that it is used to cure hoof fungus in horses."

Iodine is gray-black substance that is barely solid at room temperatures; however, with a little heat it quickly evaporates (sublimates) into a beautiful violet vapor without going through a liquid phase. This effect is increased in areas of high humidity.

Iodine is released from rocks during weathering, where it is rapidly transported to ocean basins. Most of the iodine in nature (70%), is found in ocean sediments.

Iodine occurs in igneous rocks at 0.5 ppm, shale at 2.3 ppm, sandstone at 1.7 ppm, limestone at 1.2 ppm, and soil at 5 ppm. Very little iodine is found in fresh or seawater as it is readily absorbed into plants and animals. Marine plants can have 30-1,500 ppm, and marine animals 1-150 ppm. Land animals only have 0.43 ppm but iodine is essential to their health.

Soil's average 2.8 ppm of iodine but it varies widely from 0.1-10 ppm. Soils derived from volcanic ash may have 100 ppm of iodine. Iodine binds readily to organic matter hence tend to accumulate on the surface of soils ("O" horizon).

Under anaerobic conditions, iodine is leached out of our soils. Depending on the chemical form of iodine, it may very stable or very mobile in soils and water. The most common electrical or valence state for iodine is -1.

Iodine is used in colorants, inks, many common chemicals, pharmaceuticals, and used as a catalyst in several applications. When I was a boy, a tincture of iodine was used to treat cuts and scrapes.

Iodine is essential for mammals, especially humans. The World Health Organization estimates that ***2 Billion people*** **are deficient in iodine**, which is over 30% of the world's population.

The most famous health problem caused by a lack of iodine is goiter. Many years ago, we used to get it from chewing gum (Iodigum) which was later replaced by iodized salt.

Natural occurring salt has iodine in it, but the common manufactured white or bleached salt (sodium chloride - NaCl) does not, as all the trace minerals have been removed, hence iodine has to be added back. However, only 20% of the brands of "iodized" salt have enough iodine to meet even the minimum daily requirement if you eat salt.

Note: Potassium iodate when stabilized with calcium carbonate as found in sea salt at the end of 8 months only 3.5 % of the iodine was lost.

Iodine is essential for proper brain functioning and intelligence, it is important for the metabolism of fats, and it helps with the assimilation of phosphorous and the utilization of calcium. Iodine is essential for the human body's immune system to fight off viruses.

The human thyroid gland requires iodine to make hormones like thyroxine andtriiodothyronine which are required for metabolic functioning. Iodine also blocks toxins from accumulating in our thyroid gland.

A deficiency of iodine is associated with the occurrence of many forms of cancers, intellectual impairment, severe mental retardation, growth stunting, apathy, impaired movement, impaired speech, and impaired hearing. Iodine has been shown to help prevent cancer and breast cancer cells to not die unless they have iodine. Iodine deficiencies have been associated with goiter, cretinism, and numbness in one's fingers, nervousness, flabby skin, drooling, and childlike behavior. Even a small deficiency of iodine can reduce ones IQ by up to 15 points.

A lack of iodine can cause cravings for chocolate (particularly in women), weight gain, fatigue, intolerance of cold, and prenatal deficiency leads to brain damage in infants. Deficiencies of iodine may also lead to dry eyes, dry mouth, and fibromyalgia.

Many forms of pollution displace iodine in our bodies or prevent us from absorbing it. Fluoride added to our public water systems prevents the body from absorbing iodine in the thyroid gland. This is another reason to filter fluoride out of our water systems and not use toothpaste or other items with fluoride added. Note: Consuming foods with high levels of iodine helps the body get rid of toxic fluoride.

Bromine, which is added to flour and bread, also blocks iodine from being absorbed in our bodies. Then we have many synthetic chemicals called xenoestrogens that are used in hand lotions and other personal care products prevent the absorption of iodine. Other chemicals found in air pollution prevent iodine absorption.

Perchlorate a chemical used in many products (rocket fuel, fireworks, flares, explosives, plastic and paper liners, etc.). This chemical interferes with the uptake or absorption of iodine. Thiocyanate from cigarette smoke and nitrates from artificial fertilizers also prevent proper iodine absorption by our bodies.

Selenium deficiency excavates the effects of iodine deficiency and in humans; we cannot use iodine efficiently if we do not have sufficient copper.

Humans lose a lot of iodine when we sweat and it must be replaced, especially in hot and humid weather (e.g., Houston and Gulf Coast).

Food sources of iodine are seaweed, oysters, milk (grass fed), eggs (free range), pink sea salt, liver, cheeses, shrimp and tuna.

Iodine occurs in soils mainly in fixed forms where it is readily absorbed by humic and fresh organic matter. Iodine is also absorbed onto clays and in the lattice of many minerals. Hence, the phytoavailability of iodine is low.

Gardening and Landscaping Problems Associated with Iodine (I)

Historically iodine was not considered essential for plants, however some new studies have found that in small amounts iodine has a stimulating effect on growth. However, how iodine influences plant growth is not fully understood. However, a lack of iodine in the soil reduces plant vigor and fruit quality and slows development.

Cabbages, onions, and mushrooms raised in good soil can have 10 ppm of iodine. Other foods are codfish, oysters, shrimp, herring, lobster, sunflower seeds, organic grass-fed butter, kelp, strawberries, and cranberries.

The lack of iodine in our food is an example of why we need to grow food organically. Farmers use artificial fertilizers which acidify the soil, then they have to lime the fields to raise the pH where the lime reduces the uptake of iodine by plants. Nitrates also prevent humans from absorbing iodine from our food.

Toxicity issues are rare under normal conditions, as the soil cannot hold enough soluble iodine to cause a problem. Iodine tends to bind tightly to soils hence the phytoavailability is low and not available to roots and not easily volatized. The few rare cases of toxicity reported were from agricultural fields near coastlines where large amounts of kelp were used as fertilizers. The physical symptoms were chlorosis in the older leaves while the younger leaves became dark green.

Plants more easily absorb soluble forms of iodine; thus, marine plants tend to have more iodine than land plants. Marine plants range from 53-8,800 ppm of iodine.

The decomposition of organic matter by bacteria allows soil iodine to become phytoavailable where most of it is in the plant's roots. Foliar application of iodine in the form of potassium iodide (KI) has been found to increase the nitrate accumulation in spinach and to increase the vitamin-C content of radishes.

Iodine content of vegetables was found to be lower in summer and higher in winter.

Plants are also capable of absorbing iodine from the atmosphere and can absorb iodine from foliar applications.

Sources: seaweed, saltwater fish emulsion, sewage sludge

54) Xenon (Xe) - Xenon is the fifth member of the inert gases that we call "noble gases" as they do not react with anything, and is located in the far-right column of the periodic table. However, in 1962 xenon was found to react with fluorine to form various compounds.

A recent study has found that up to 22% of the earth's xenon may have come from comets.

Xenon is used in incandescent light bulbs as it lets them burn hotter and brighter. It is used in arc lighting to make special hi-intensity light like those used in projectors at I-max theaters and in flash bulbs for cameras. Most recently, xenon is being used in thin film technology. Xenon is also being used to make ion propulsion systems for spacecraft.

Xenon is believed to have no biological role and the amount found in the human body is from dissolved xenon from the air. However, researchers found that Xenon does bind to mammalian hemoglobin and myoglobin producing an anesthetic affect.

Most of the xenon on Earth is found in our atmosphere and it is the 85th most abundant element on earth (i.e., vary rare) even though we have 2 billion tons of it in the atmosphere.

The amount of xenon in rocks, soils, or water is extremely small.

Gardening and Landscaping Problems Associated with Xenon (Xe)

Xenon does not affect plants good or bad. Many herbs contain small amounts of xenon with Egyptian onions having some of the highest levels.

Sources: atmosphere

55) Cesium (Cs) - Cesium is found in igneous rocks at 1 ppm, shales at 5 ppm, coal at 1 ppm, but only 0.5 ppm in sandstones and limestones. Very little cesium is found in fresh or seawater. Cesium in soils can range from 0.3 to 25 ppm. There is less than 1 ppm in land or marine plants. Land animals may have 0.064 ppm in their muscles.

Cesium is a shiny gold colored metal that reacts with oxygen. Cesium is the most reactive of all the alkali metals. If one drops a piece of cesium into a bowl of water, it will explode. Cesium most commonly occurs with a +1 electrical or valence state. Cesium is strongly sorbed to mica or clay minerals in the soil.

All elements have a natural vibration or frequency that can be used to measure time. Cesium is used in atomic clocks to calculate and provide a global time reference. Powdered cesium formate is used in oil well drilling.

There is some evidence that cesium helps mammalian immune systems.

Cesium tends to accumulate in the organic horizon in soils.

Gardening and Landscaping Problems Associated with Cesium (Ce)

Cesium is not required by plants thus it has not been studied. However, roots take up cesium, as it is in the same column on the periodic table as potassium, hence has similar chemical properties.

Members of the Amaranthus and Helianthus species tend to hyper-accumulate cesium and can be used for phytoremediation of polluted sites.

Sources: radioactive fallout, coal ash