Chapter 10: Minerals—Mining for Minerals

All minerals

- Retain their chemical identity in the body.
- Can be either water or fat-soluble.
- Can reach toxic levels in the body - pay attention to RDA!
- Are classified in one of two mineral groups:
  1. macrominerals (a/k/a major minerals)
  2. microminerals (a/k/a trace minerals)
- Help maintain the body's fluid balance.
- Are called cofactors when they assist enzymes.
- Cannot be destroyed by heat, cold, acid, air, or mixing.
- Are excreted from the body without being altered in any way.
- Are lost from foods when they leak into water and the water is later discarded.
- Bioavailability can be limited if and when they bind to substances that prevent them from reacting.

(A) Major (macro-) minerals are those that are present in the body structure in amounts greater than 5 grams. Macrominerals include:

1. Calcium

   Is the most abundant major mineral in the body. Calcium helps with the (a) hardening of bones, (b) blood clotting, (c) nerve and (d) muscle function, (e) cell communication, (f) immune defense, (g) forms and maintains bones and teeth, and (h) assists with acid-base balance.

Bone structure: 1) provides strength to support the body; 2) allows for flexibility; 3) contains about 65% minerals ("hydroxyapatite") providing the hardness of bone; 4) contains 35% organic structures for strength, durability, flexibility; and 5) has collagen fibrous protein in bone tissue.

Hormones regulate calcium levels in the blood

<table>
<thead>
<tr>
<th>Hormone</th>
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<tr>
<td>Parathyroid Hormone (PTH)</td>
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<td>Calcitonin</td>
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Bone density is at its peak before the age of 30. Remodeling maintains bone density during early adulthood. Density begins to decrease after age 40 because reabsorption exceeds new bone formation.

There are several methods for assessing bone density:

<table>
<thead>
<tr>
<th>Method</th>
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<tbody>
<tr>
<td>DEXA Scan (DXA, or Dual Energy X-ray Absorptiometry)</td>
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<tr>
<td>Quantitative Ultrasound</td>
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<tr>
<td>Peripheral Dual Energy X-ray Absorptiometry (pDXA)</td>
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<td>Single X-ray Absorptiometry</td>
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</table>
(2) Phosphorus

Second most abundant macromineral. Most of our phosphorus is in our bones. NOTE: phosphorus is spelled phosphorous when used as an adjective.

(3) Magnesium

Magnesium helps with enzyme action, hardening of bone, muscle contraction and the operation of body's immune system. A mineral found in bone structure. Cofactor for over 300 enzyme systems. Required for the production of ATP, DNA, and proteins.

(B) Microminerals are those that are present in the body structure in amounts less than 5 grams. Microminerals can reach toxic levels at dosages not too far above their RDA.

Many diet supplements contain microminerals and this makes it very easy to reach dangerous dosage levels. Microminerals commonly interact with one another. Therefore, balanced daily intake is essential.

Too much of one micromineral will inhibit the intake/operation (limit bioavailability) of another micromineral leading to health problems.

EX: overloading magnesium will lead to an iron deficiency and increasing your intake of vitamin C will enhance iron uptake, but as the iron level increases the uptake of copper becomes limited. Follow RDA values for all nutrients to avoid such problems.

Microminerals include:

(1) Iron

Part of hemoglobin in RBC's, part of myoglobin in muscles, used in cell respiration as cofactor for many enzymes and works with cytochromes in ETS (ETC). Toxicity: Hemochromatosis, a genetic disorder that causes too much absorption of iron. Also joint disease, loss of hair and death by poisoning in kids.

There are two dietary sources of iron: heme bound and non-heme. The heme bound accounts for only about 10% of your daily dietary intake of iron but 23% of it will be absorbed; whereas the non-heme iron is about 90% of your daily intake but only 2 to 20% of it will be absorbed. Heme iron comes from animal sources.

Meat, fish and poultry also contain MFP, a factor that promotes absorption of non-heme iron. Vitamin C also helps with the absorption of non-heme iron.

Taking iron supplements with orange juice will not work because the vitamin C in the juice only helps with absorption of dietary iron - not supplemental iron. Foods cooked in iron cookware will absorb iron salts from the cookware.

Iron is absorbed into the body by special cells in the small intestine called mucosal cells. These mucosal cells are replaced about every three days. When shed in the feces they carry some iron with them. It is part of what gives the coloration to the feces.

Specific proteins called mucosal ferritin proteins get iron from the GI tract and store it in the mucosal cells.
When the body needs iron, mucosal ferritin releases some iron to another special protein called *mucosal transferrin*, which moves the iron to another protein, *blood transferrin*. Blood transferrin will transport the iron to the rest of the body. Much of the iron is moved into the bone marrow cells that help produce new red blood cells (*erythrocytes*, which contain *hemoglobin*).

(2) **Zinc**

In structure of many enzymes, the hormone insulin and genetic materials. It is also involved in sperm production. It is a *metalloenzyme*.

Zinc can be absorbed into intestinal cells, or carried in the blood by attachment to *albumin* (a plasma protein).

A diet with too much zinc will limit the bioavailability of copper because copper competes with zinc to bind with *metallothionein*, the binding protein that brings zinc into the intestinal cells.

Zinc also competes with iron to bind with blood transferrin, so too much zinc in the diet can affect your iron levels as well. DO NOT take excessive amounts of zinc in daily supplements - it can seriously impair the uptake of copper, which can lead to heart muscle cell degeneration.

High doses of zinc also enhance the development of *atherosclerosis*. Lozenges containing *zinc gluconate* can reduce head cold symptoms, but lozenges with zinc gluconate bound to flavor-enhancers have no value.

(3) **Copper**

Helps absorb iron into hemoglobin. Copper works with some enzymes (*ceruloplasmin* and *ferroxidases*) to catalyze the oxidation of iron. Copper also works with other enzymes (*superoxide dismutase*) to help them act as antioxidants.

Still other copper/enzyme combinations (such as *lysyl oxidase*) help with the production of big protein molecules called collagen molecules, which are used for support in many of the body's connective tissues.

Others are involved in structure of the enzyme *cytochrome-C oxidase*, which is an important enzyme in the electron transport system (ETS, ETC) of the cell respiration process.

(4) **Selenium**

Part of an enzyme that works with vitamin E. Selenium works with an enzyme known as *glutathione peroxidase* to act as an *antioxidant*. In parts of the world that have selenium-poor soil Keshan disease is a relatively common form of heart disease. Selenium-poor soil also seems to correlate with high occurrence rates for certain cancers.

(5) **Iodide**

In structure of thyroid (T₃ and T₄) hormones. Deficiency will produce an enlarged thyroid (*goiter*). A deficiency during childhood can cause severe retardation (*cretinism*).
(6) Fluoride

Helps harden tooth enamel and bones. Also acts as a cofactor for enzymes. Addition of fluoride to drinking water is a widespread practice but it does have some critics. Some research has revealed the possibility of kidney damage with long-term exposure to fluoride.

(7) Chromium

Associated with insulin to help regulate blood sugar levels. Chromium picolinate supplements are advertised as (1) terrific fat burners and (2) muscle builders. There is ABSOLUTELY NO SCIENTIFIC EVIDENCE FOR EITHER of these supposed benefits of such supplements.

Review these mineral-related diseases:

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<tr>
<th>Disease</th>
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<tbody>
<tr>
<td>Calcemia</td>
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<td>Hypercalcemia</td>
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<td>Hypocalcemia</td>
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<td>Cretinism</td>
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<td>Fluorosis</td>
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<td>Goiter</td>
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<td>Hemochromatosis</td>
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<td>Hypomagnesemia</td>
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<tr>
<td>Osteoporosis</td>
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<tr>
<td>Pre-Eclampsia</td>
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Discussion Topics/Questions:

*Can calcium decrease body weight or prevent obesity?* - p. 282
*Does hard water protect against heart disease?* - p. 287
*Can a lack of dietary copper lead to heart disease?* - p. 294
*Can chromium picolinate supplements increase lean tissue in your body?* - p. 297