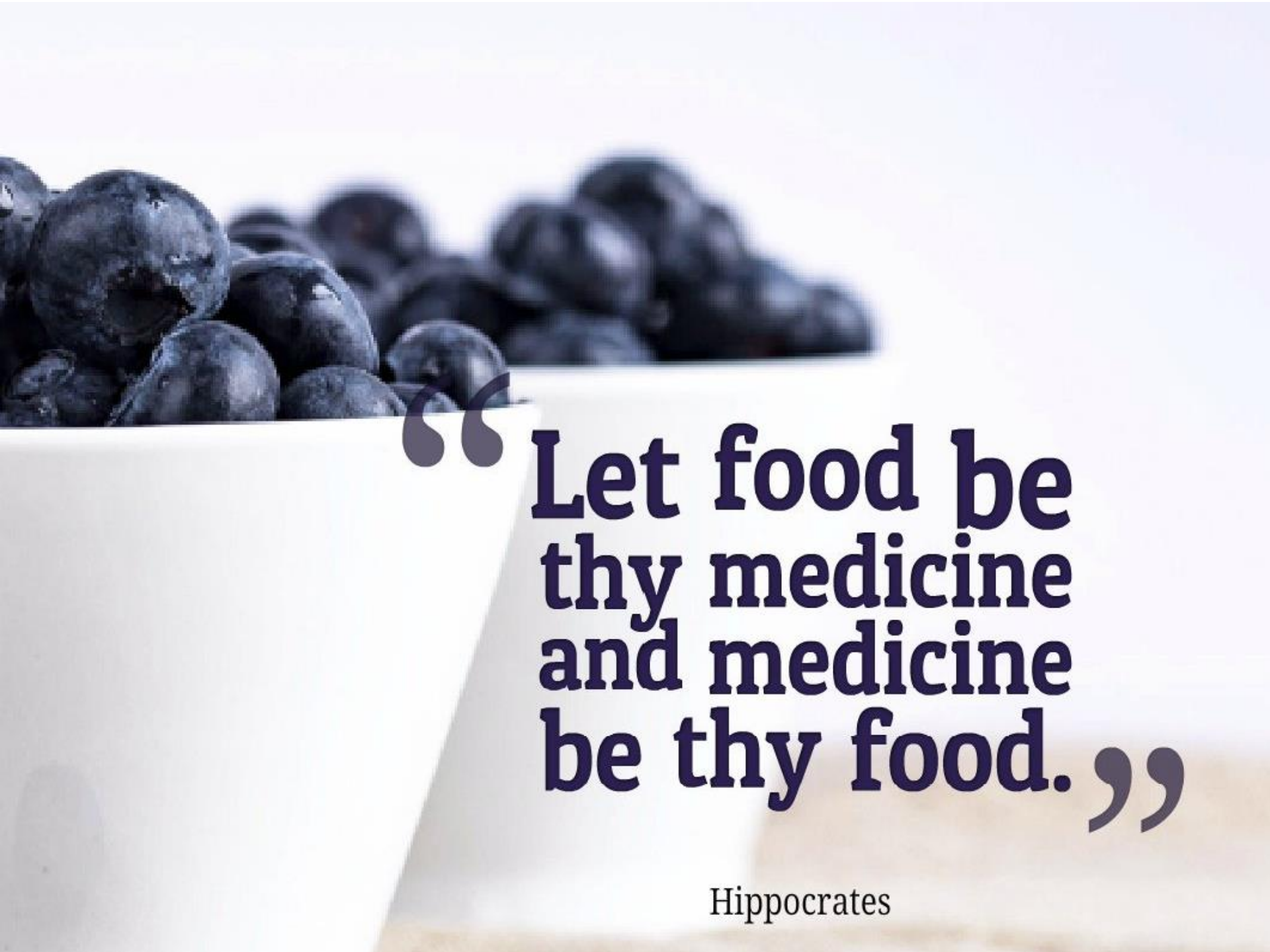
Overview of the Vitamins & Minerals

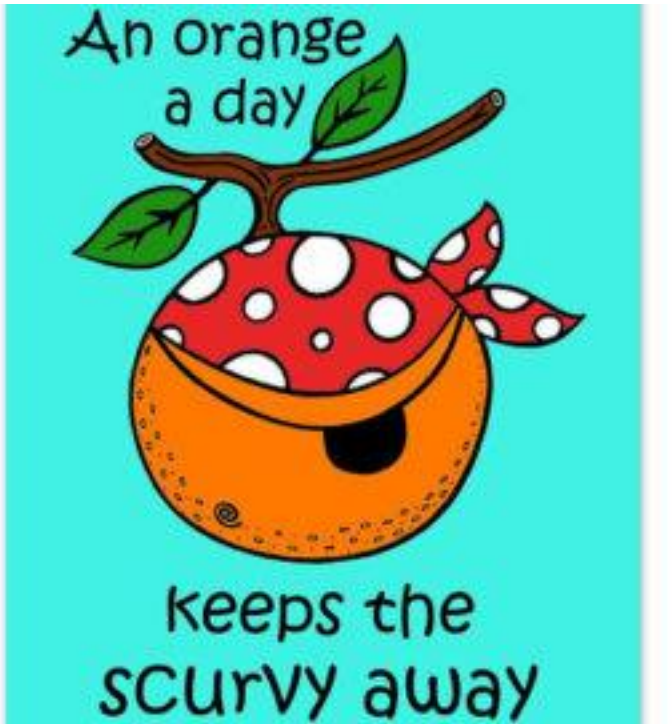
Learning Objectives

- Describe the characteristics, categories, and functions of vitamins.
- Illustrate the digestion, absorption, transport, and storage of vitamins.
- Identify sources of vitamins in the diet.
- Discuss vitamin toxicity.
- Describe the characteristics, categories, and functions of minerals.
- Illustrate the digestion, absorption, transport, and storage of minerals.
- Identify sources of vitamins in the diet.
- Discuss mineral toxicity.
- Evaluate the use of vitamin and mineral supplements with respect to their potential benefits and risks to health.


“Let food be thy medicine and medicine be thy food.”
Hippocrates

Can Food Be Medicine?

- **Scurvy**
  - fatigue, bleeding gums, bruising
  - 1753, James Lind, British Navy physician found citrus fruit prevents disease
- **Rickets**
  - bone disease in children
  - 1922, cod liver oil an effective treatment
- **Chlorosis**
  - 1700's Physician Sydenham prescribed, "mineral water impregnated with the Iron Mine"



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Vitamins and minerals work together to perform various physiological functions

Vitamins

- Carbon-containing (organic) substances needed in small amounts by the body
- Essential: can't be synthesized by body
- To be a vitamin:
  1. Body can't make enough to maintain health
  2. Absence → deficiency that can be cured if vitamin is resupplied in time

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TABLE 8-1 ▶ Summary of the Fat-Soluble Vitamins

Vitamin	Major Functions	RDA or Adequate Intake	Dietary Sources	Deficiency Symptoms	Toxicity Symptoms
Vitamin A (preformed vitamin A and provitamin A)	• Promotes vision: night and color • Promotes growth • Prevents drying of skin and eyes • Promotes resistance to bacterial infection and overall immune system function	*Men:* 900 micrograms RAE (3000 IU preformed vitamin A) *Women:* 700 micrograms RAE (2300 IU preformed vitamin A)	Preformed vitamin A: • Liver • Fortified milk • Fortified breakfast cereals Provitamin A: • Sweet potatoes • Spinach • Greens • Carrots • Cantaloupe • Apricots • Broccoli	• Night blindness • Xerophthalmia • Poor growth • Dry skin	• Fetal malformations • Hair loss • Skin changes • Bone pain • Fractures • Upper Level is 3000 micrograms (10,000 IU) of preformed vitamin A based on the risk of birth defects and liver toxicity.
Vitamin D	• Increases absorption of calcium and phosphorus • Maintains optimal blood calcium and calcification of bone • Regulation of cell development	15 micrograms (600 IU)	• Vitamin D fortified milk • Fortified breakfast cereals • Fish oils • Sardines • Salmon	• Rickets in children • Osteomalacia in adults	• Growth retardation • Kidney damage • Calcium deposits in soft tissue • Upper Level is 100 micrograms (4000 IU) based on the risk of elevated blood calcium

Abbreviations: RAE = retinol activity equivalents; IU = international units.

Exceptions to Essential Vitamins "Conditional"

- Vitamin A can be synthesized from plant pigments
  - Beta carotene to vitamin A
- Vitamin D can be synthesized by skin in the presence of sunlight
- Niacin can be synthesized from the amino acid tryptophan
- Vitamin K and biotin can be synthesized by gut bacteria to some extent

Vitamins Classification

- **Fat Soluble Vitamins**
  - Vitamin A
  - Vitamin D
  - Vitamin E
  - Vitamin K

- **Water Soluble Vitamins & Choline**
  - Vitamin C
  - B Vitamins
    - Thiamin
    - Riboflavin
    - Niacin
    - Pantothenic acid
    - Biotin
    - Vitamin B-6
    - Folate (folic acid)
    - Vitamin B-12
  - Choline

Absorption and Storage of Vitamins in the Body

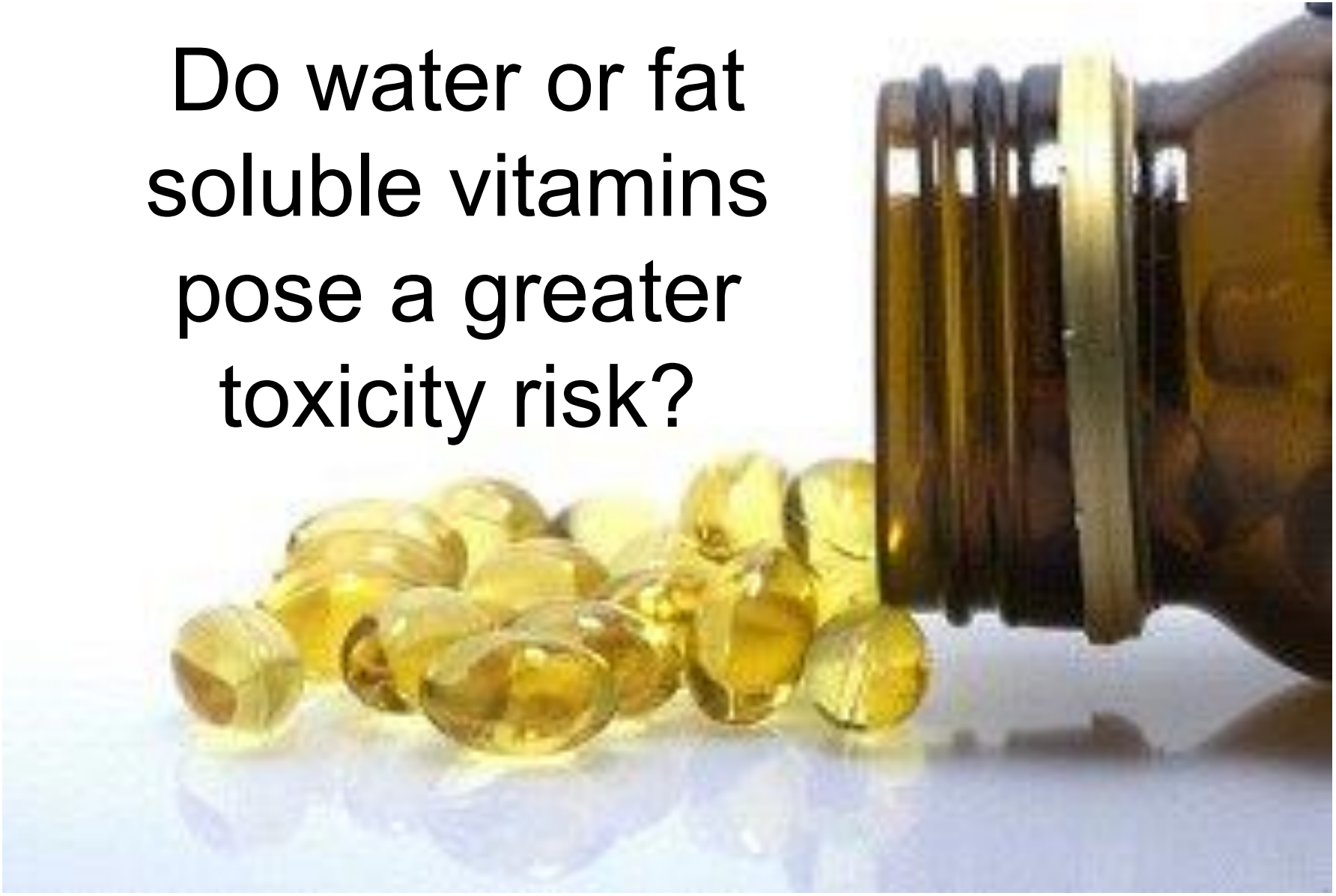
Fat-soluble:

- Absorbed with dietary fat
- Anything interfering with fat absorption will impair fat soluble absorption
- Stored in fat

Water-soluble:

- Absorbed primarily in small intestine
- Transported to liver via portal vein & distributed to body tissues
- Tissue saturation

Do water or fat soluble vitamins pose a greater toxicity risk?



Vitamin Toxicity

- **Fat-soluble**:
  - A, D, E not readily excreted from the body
  - **Toxicity by vitamin A most frequently observed (2X the RDA)**
- **Water-soluble**:
  - Excess excreted in urine
  - Exception: B6 & B12 stored in liver
- Vitamin toxicity most frequently from supplemental sources; avoid megadoses

Vitamin Preservation in Foods

- The more ripe a fruit or vegetable is, the more vitamin content it has
- Freezing can help retain nutrients
  - Often blanched first, increasing vitamin content
- Water-soluble particularly susceptible to destruction by heat, light, air exposure, cooking in water and alkalinity

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TABLE 8-3 ▶ Tips for Preserving Vitamins in Fruits and Vegetables

Preservation Methods	Why?
Keep fruits and vegetables cool until eaten.	Enzymes in fruits and vegetables begin to degrade vitamins once they are harvested. Chilling limits this process.
Refrigerate fruits and vegetables (except bananas, onions, potatoes, and tomatoes) in moisture-proof, airtight containers or in the vegetables drawer.	Nutrients keep best at temperatures near freezing, at high humidity, and away from air.
Trim, peel, and cut fruits and vegetables minimally—just enough to remove inedible parts.	Oxygen breaks down vitamins faster when more of the food surface is exposed. Whenever possible, cook fruits and vegetables in their skins.
Microwave, steam, or stir-fry vegetables.	More nutrients are retained when there is less contact with water and shorter cooking time.
Minimize cooking time.	Prolonged cooking (slow simmering) and reheating reduce vitamin content.
Avoid adding fats to vegetables during cooking if you plan to discard the liquid.	Fat-soluble vitamins will be lost in discarded fat. If you want to add fats, do so after vegetables are fully cooked and drained.
Do not add baking soda to vegetables to enhance the green color.	Alkalinity destroys vitamin D, thiamin, and other vitamins.
Store canned and frozen fruits and vegetables carefully.	To protect canned foods, store them in a cool, dry location. To protect frozen foods, store them at 0° F (–32°C) or colder. Eat within 12 months.

Minerals Overview

- Individual chemical elements: can't be broken down further
- Essential when:
  - Dietary inadequacy → physiological or structural abnormality
  - And addition to diet reinstates health
- Categorized by amount needed in diet each day:
  - **Major**: need 100 mg+ per day
  - **Trace**: need less than 100 mg per day
  - **Ultratrace**: trace amounts in diet, not essential to human health

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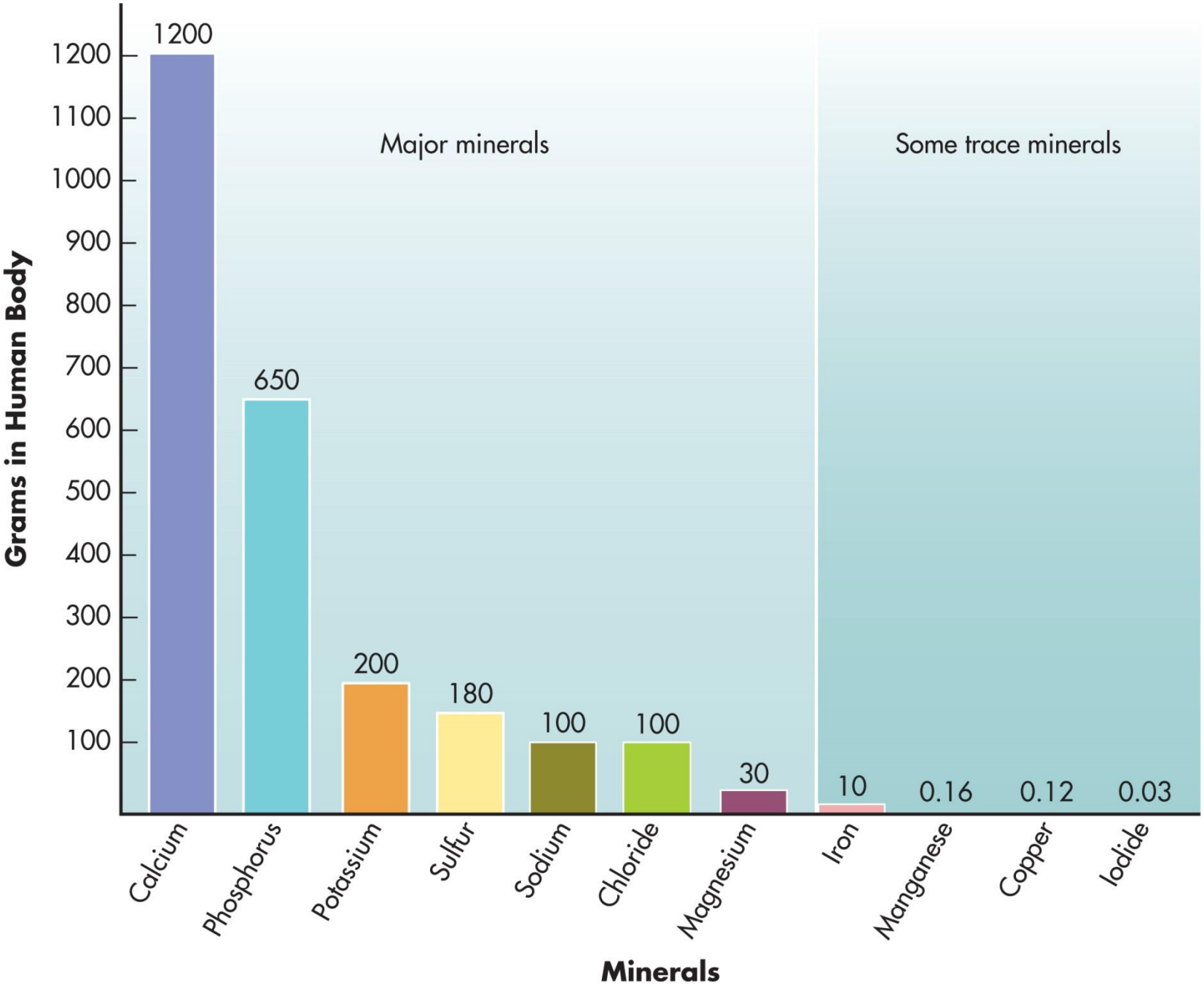

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TABLE 8-4 ▶ Summary of the Major Minerals

Mineral	Major Functions	RDA or Adequate Intake	Dietary Sources	Deficiency Symptoms	Toxicity Symptoms
Sodium	• Major positive ion of the extracellular fluid • Aids nerve impulse transmission • Water balance	*Age 19–50 years:* 1500 milligrams *Age 51–70 years:* 1300 milligrams *Age > 70 years:* 1200 milligrams	• Table salt • Processed foods • Condiments • Sauces • Soups • Chips	• Muscle cramps	• Contributes to hypertension in susceptible individuals • Increases calcium loss in urine • Upper Level is 2300 milligrams.
Potassium	• Major positive ion of intracellular fluid • Aids nerve impulse transmission • Water balance	4700 milligrams	• Spinach • Squash • Bananas • Orange juice • Milk • Meat • Legumes • Whole grains	• Irregular heartbeat • Loss of appetite • Muscle cramps	• Slowing of the heartbeat, as seen in kidney failure
Chloride	• Major negative ion of extracellular fluid • Participates in acid production in stomach • Aids nerve impulse transmission • Water balance	2300 milligrams	• Table salt • Some vegetables • Processed foods	• Convulsions in infants	• Linked to hypertension in susceptible people when combined with sodium • Upper Level is 3600 milligrams.

Minerals: Absorption

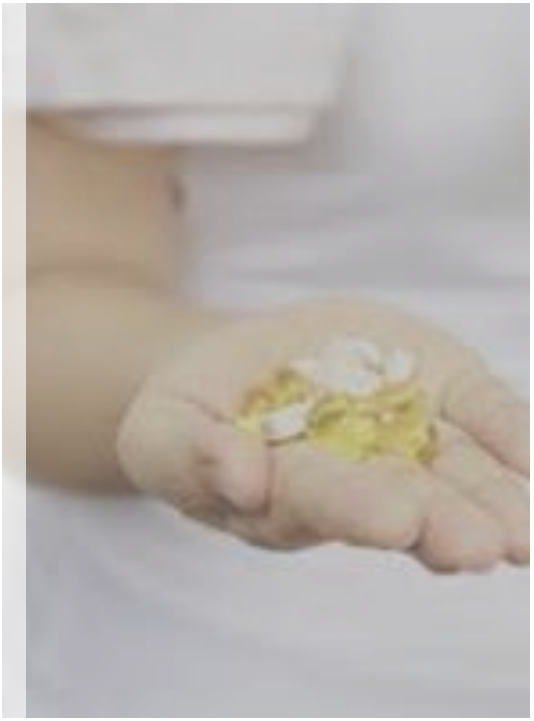
- Majority absorbed in small intestine
- Fiber-mineral interactions
  - Fibers phytic acid and oxalic acid decrease some mineral absorption
    - Soaking beans, nuts and grains can decrease phytic acid content
- Vitamin-Mineral Interactions:
  - Vitamin C intake increases iron absorption
  - Vitamin D intake increases calcium absorption

Minerals: Storage

- Muscle tissue, organs, glands
- Bloodstream – fluid balance and supply body functions
  - Sodium, potassium
- Bone
  - Calcium, phosphorus, magnesium

Mineral Toxicities

- Supplements pose biggest problem for toxicity
  - Use supplements under the care of a knowledgeable professional
    - Functional and Integrative Medicine
      - Physician
      - Advanced Practice Clinician (NP/PA)
      - Dietitian
- Harmful interactions with other nutrients can occur



Preservation of Minerals in Foods

- Not typically lost from animal foods during processing
- Are lost from plant foods during processing
- Refined grains = lower levels of vitamins and minerals
  - Enriched to add vitamins and minerals back

Functional Roles of Micronutrients: Overview

- Enzymes, coenzymes, and cofactors
- Fluid and electrolyte balance
- Antioxidant systems
- Building bones
- Energy metabolism
- Blood health

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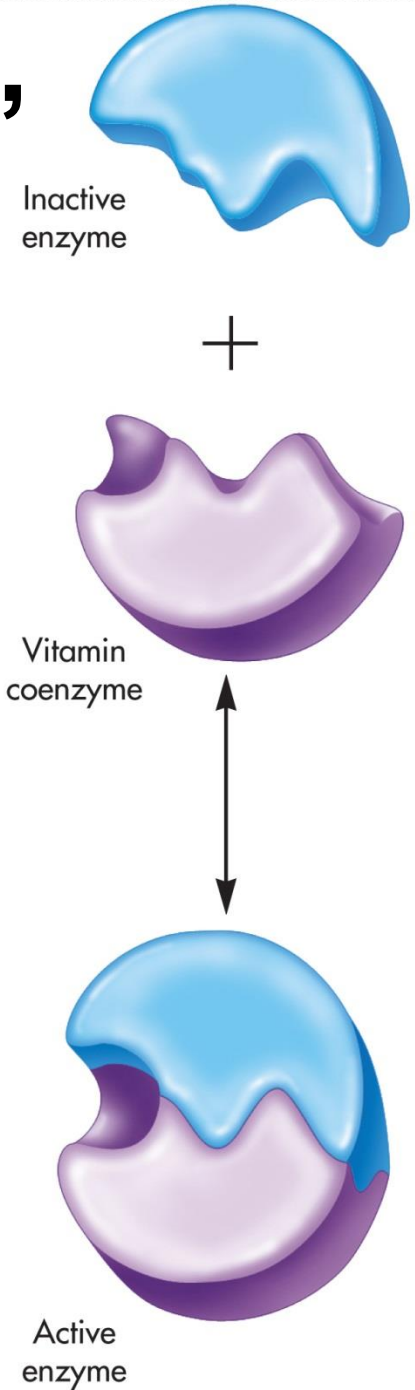
Enzymes, Coenzymes, and Cofactors

- Enzymes: catalysts for biochemical reactions
- Enzymes typically made of proteins
- Require a cofactor for biological activity
- Minerals: inorganic molecules are **cofactors**
- Vitamins: organic molecules are **coenzymes**
- The B-vitamins function as coenzymes



Dietary Supplement Health and Education Act of 1994

A supplement contains one or more ingredients:

- Vitamin
- Mineral
- Herb or another botanical
- Amino acid
- Dietary substance to supplement the diet, which could be an extract or a combination of the first four ingredients in this list

Supplement Industry

- Generates about $35 to $36 billion annually in U.S.
- Supplements can be sold without proof they are safe and effective
- FDA provides little regulation unless shown to be inherently dangerous, or makes illegal claim

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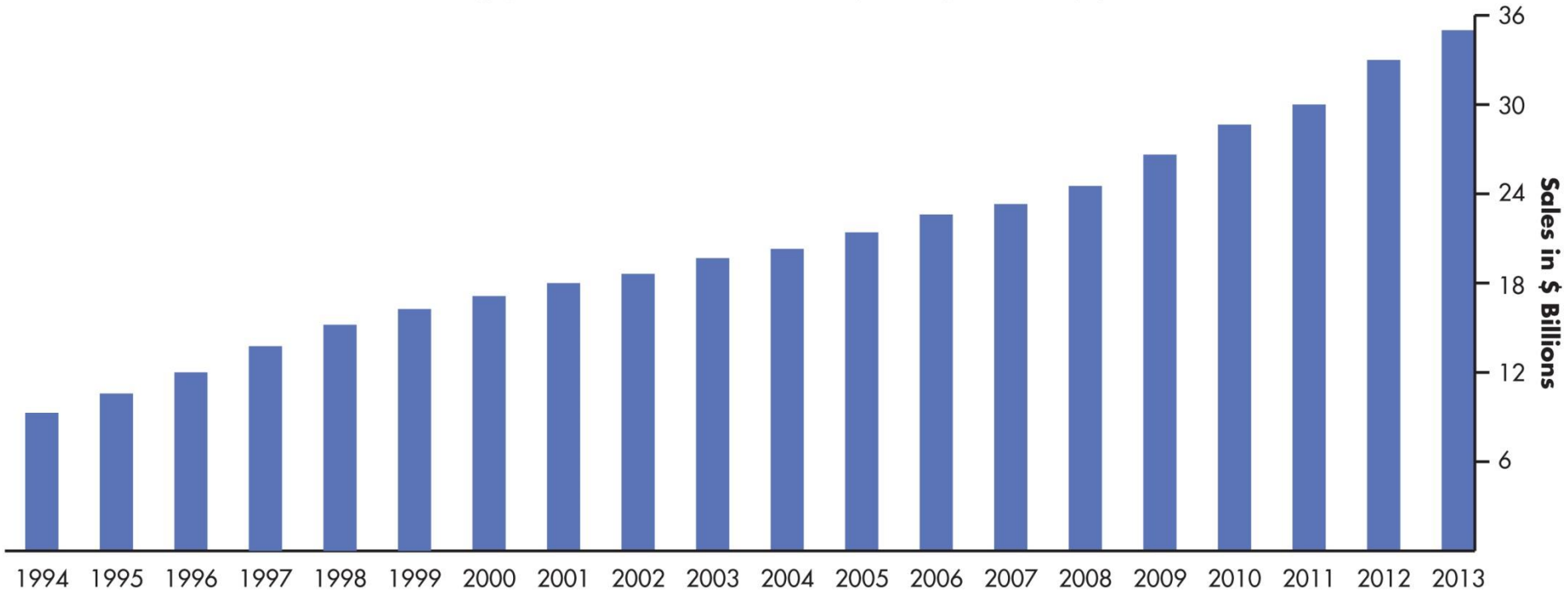

The dietary supplement industry is a growing multibillion-dollar business

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Healthy Diet Rich in Vitamins and Minerals

Fortified Foods

Possible Multivitamin and Mineral Supplement Use

Individual Supplements in Some Cases

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Which Supplement Should You Choose?

- No skip batch testing
- Take according to provider and package instructions
- Know what excipients are used
- Independently verified
  - Read labels carefully, look for USP symbol
    - United States Pharmacopeial Convention
    - Reviews product strength, quality, purity, packaging, labeling, speed of dissolution, shelf-stability

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Reputable Brands

- Metagenics
- Thorne
- Pure Encapsulations
- Designs for Health
- Klaire Labs
- NOW
- Garden of Life
- Some Nature Made products