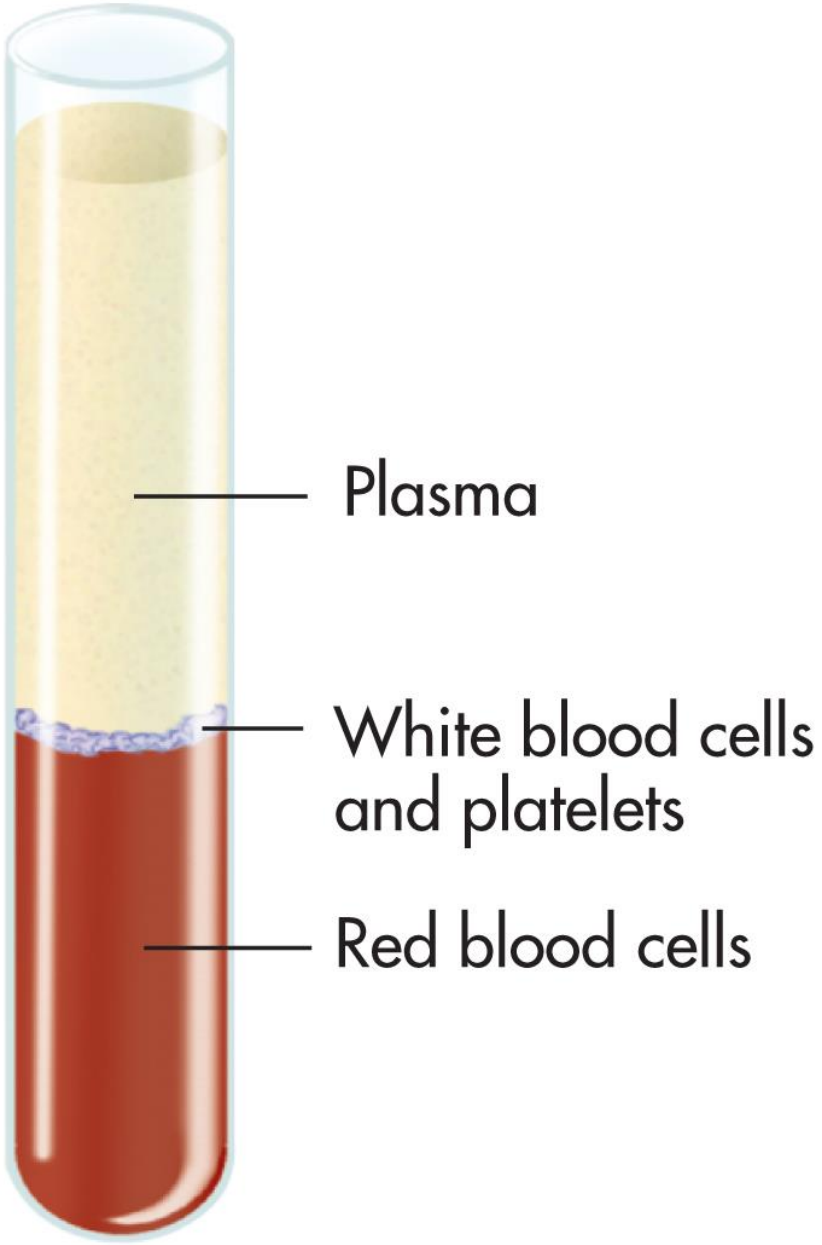
Nutrients That Support Blood Health

Learning Objectives

- Describe the composition of blood.
- List and describe the functions of vitamins and minerals in the maintenance of blood health.
- Describe food sources, dietary requirements, deficiency, and toxicity of the nutrients involved in blood health.
- Understand how deficiencies of specific nutrients are associated with various forms of anemia.

Blood Health: Overview

- Transport medium for nutrients, oxygen, wastes, hormones, and cells
- Body keeps 100 trillion cells alive, functioning
- Only through nutrients and oxygen transported in circulatory system

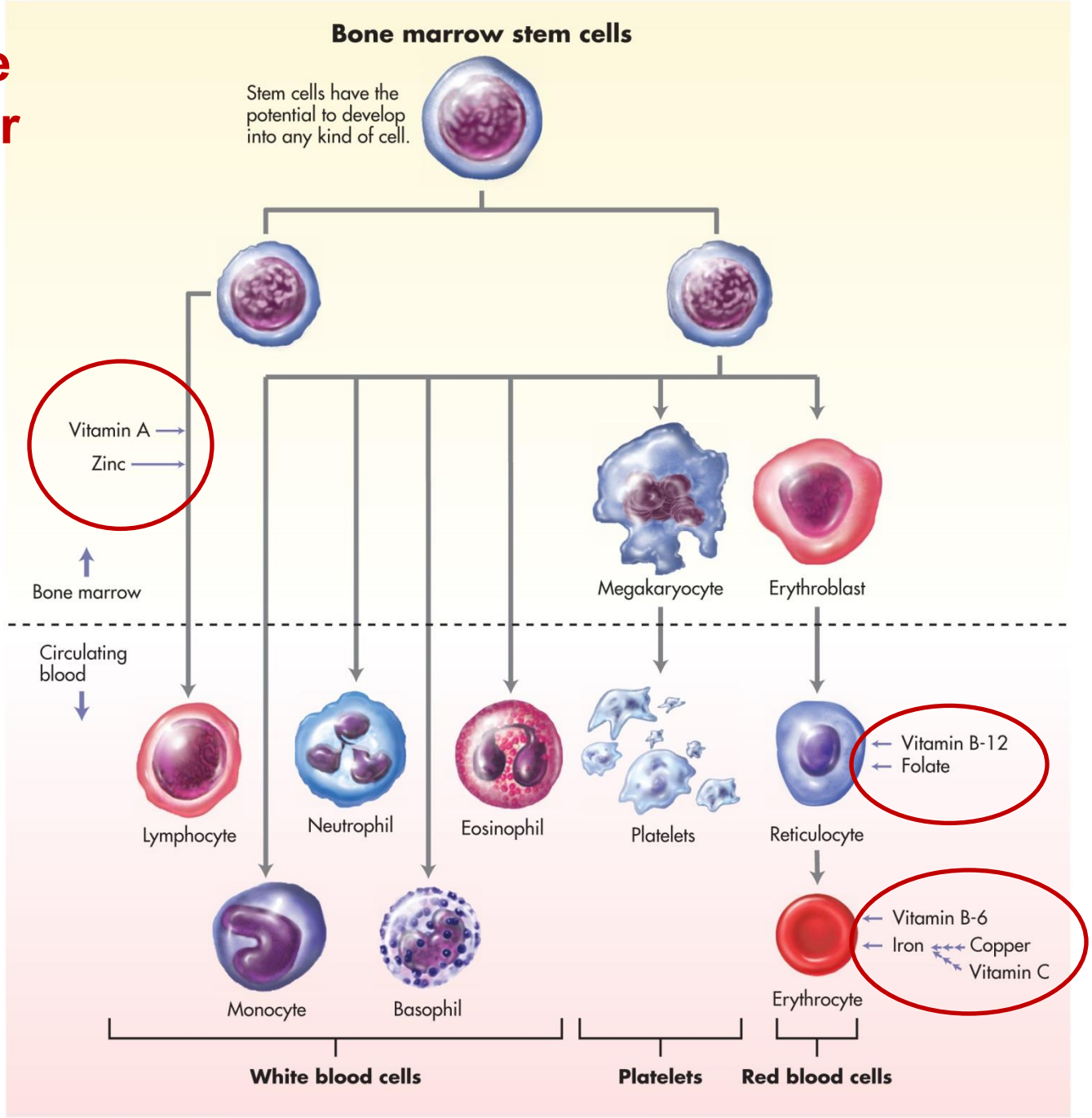


Plasma: fluid, extracellular portion of blood

Erythrocytes

red blood cells are the most prevalent contain **hemoglobin**, transports oxygen from lungs to all body cells

Nutrients Are Necessary for Hemostasis



Blood Cell Types

- **Leukocyte**
  - white blood cell; immune system
- **Neutrophil**
  - white blood cell fights infections; levels rise during bacterial or fungal infections
- **Lymphocyte**
  - white blood cell responsible for immune response; regulates antibody production
- **Monocyte**
  - white blood cell ingests foreign cells; also called a phagocyte

Blood Cells and Components

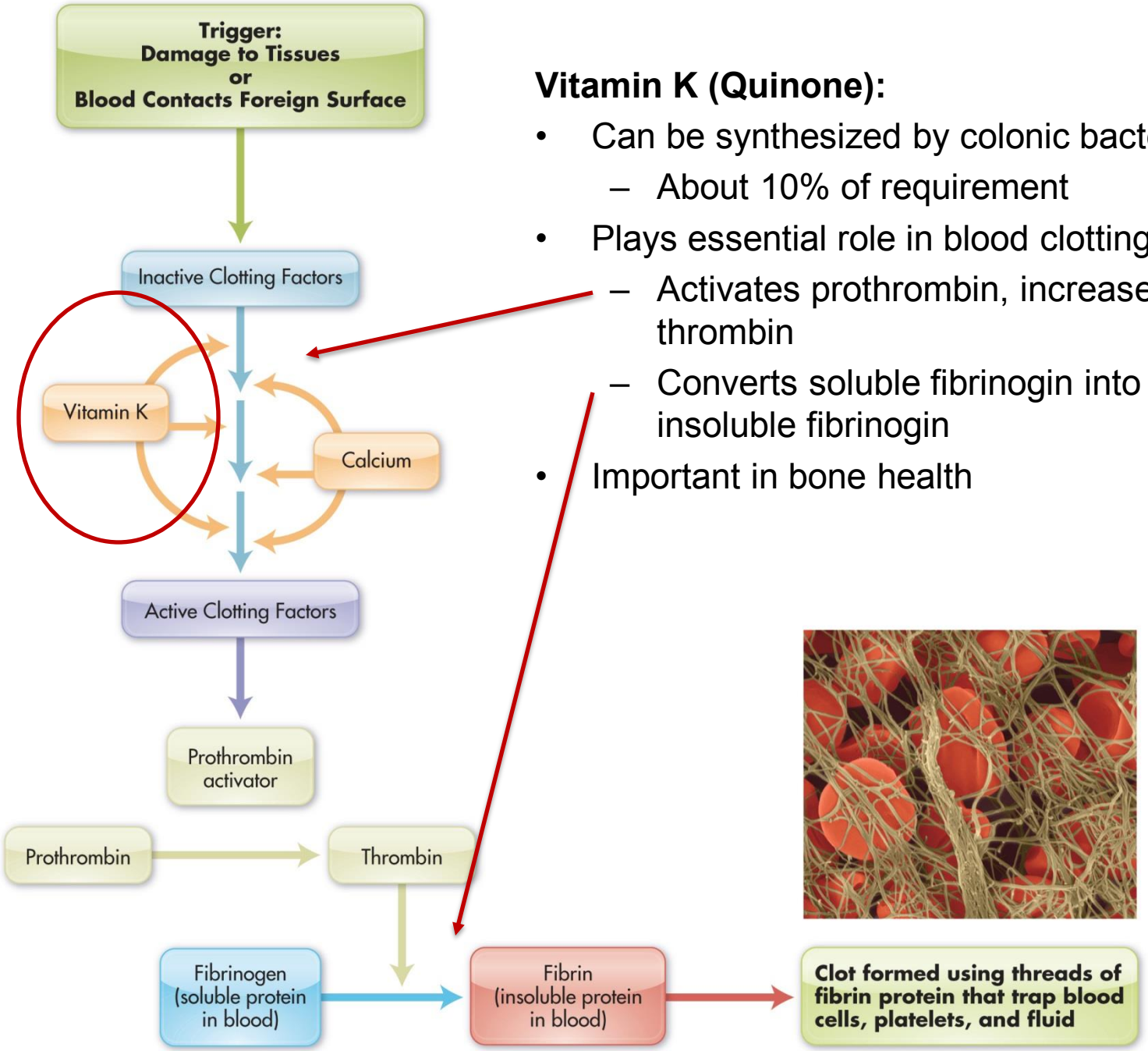
- **Eosinophil**
  - white blood cell type of phagocyte increases in number during allergic reactions
- **Basophil**
  - white blood cell controls inflammation; level increases with poisoning
- **Thrombocyte (platelet)**
  - protoplasmic disc smaller than red blood cell; promotes coagulation
- **Plasma**
  - fluid, extracellular portion of blood

TABLE 13-2 ▶ Micronutrients That Support Blood Health

Nutrient	Primary Roles in Blood Health
Vitamin B-6	• Synthesis of heme
Vitamin B-12	• DNA synthesis; allows proper cell division
Vitamin C	• Enhances absorption of nonheme iron
Vitamin K	• Activates clotting factors
Iron	• DNA synthesis • Imparts iron-binding capacity to heme
Copper	• Transports iron

Mechanisms to Stop Bleeding

- **Hemorrhage:** blood loss
  - if not controlled, blood supply depleted
- **Hemostasis:** process of stopping blood loss
  - **Vasoconstriction**: narrowing of the blood vessels, which limits the blood flow to damaged tissue
  - **Platelet plug:** platelets stick to damaged tissue and each other, creating temporary seal that stops bleeding
  - **Coagulation (blood clotting)**
    - changes from liquid to solid
    - result is reinforcement of platelet plug with protein, fibrin



Vitamin K (Quinone):

- Can be synthesized by colonic bacteria
  - About 10% of requirement
- Plays essential role in blood clotting:
  - Activates prothrombin, increases thrombin
  - Converts soluble fibrinogin into insoluble fibrinogin
- Important in bone health

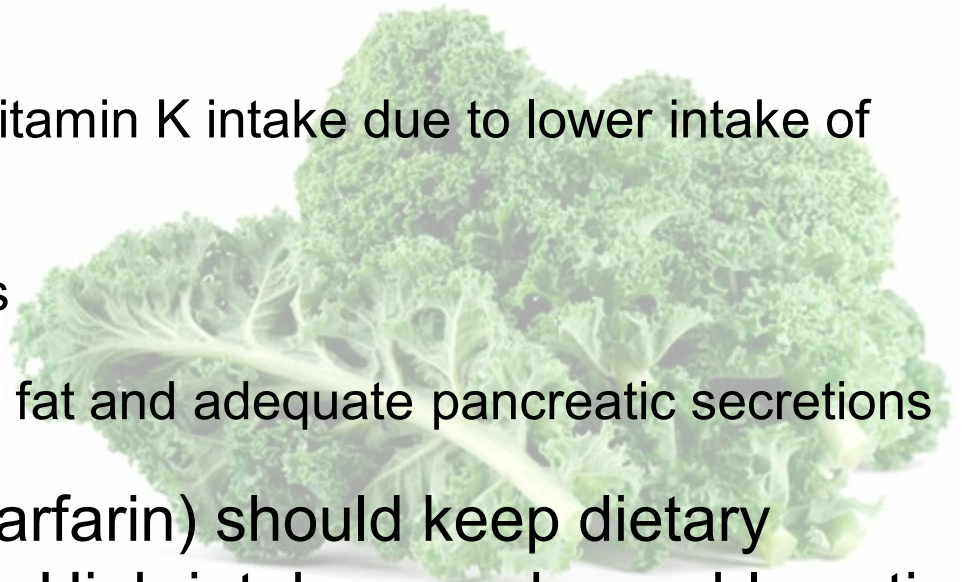
(right): ©Dennis Kunkel/Visuals Unlimited

Vitamin K: Deficiency

- In infants:
  - Infant's gut at birth is sterile (GI tract doesn't have bacteria)
  - Can't synthesize vitamin K needed for clotting if infant injured or needs surgery
  - Vitamin K routinely administered by injection shortly after birth
- In adults: deficiency after long-term antibiotic use and when fat malabsorbed

Getting Enough Vitamin K

- Food sources: liver, dark green leafy vegetables, broccoli, asparagus, peas
  - Elderly adults have lower vitamin K intake due to lower intake of vegetables
  - Resistant to cooking losses
  - Absorption requires dietary fat and adequate pancreatic secretions
- Patients on Coumadin (warfarin) should keep dietary Vitamin K intake constant. High intakes can be problematic if not the norm.



Perfect Green Smoothie

Ingredients:

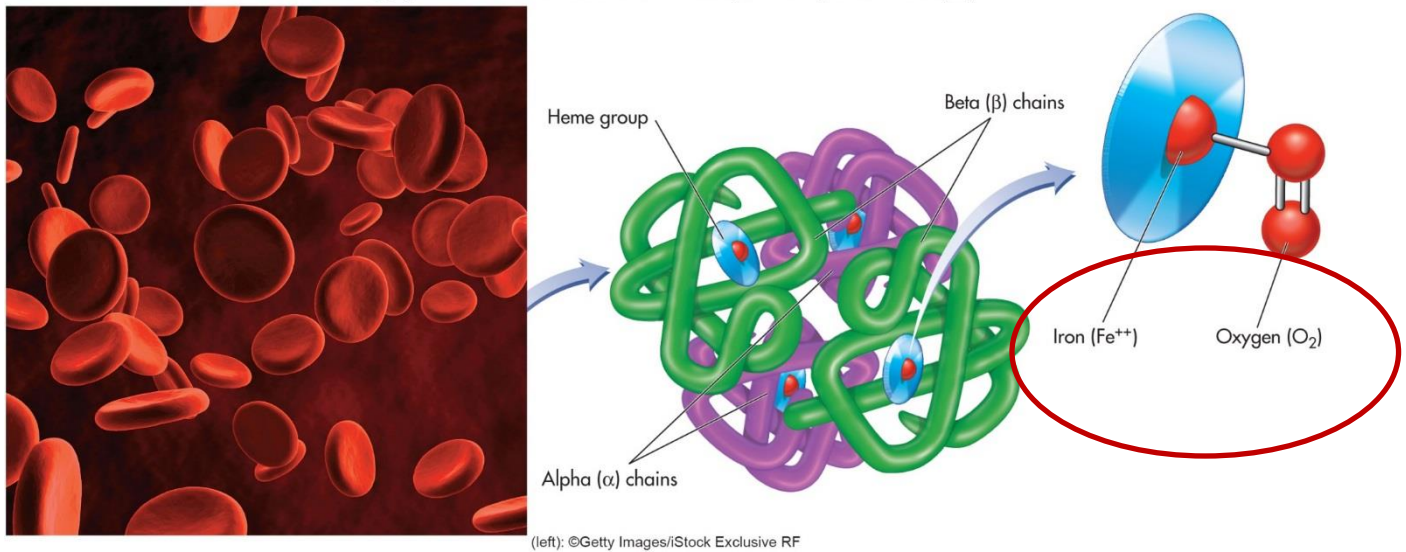
1 cup water
2 ice cubes
2/3 cup frozen pineapple
1/3 cup frozen mango
½ cup parsley
1 stalk celery
1 hearty handful spinach

Directions:

1. Blend greens, celery and water first
2. Add frozen fruit and ice cubes and blend again (30 seconds-1 minute) until smooth

Red Blood Cells (RBC)

- Erythropoiesis: formation of RBCs
- RBC functions
  - Primary: carry O_2 from lungs → tissues
  - Secondary: carry CO_2 from tissues → lungs
- Contain hemoglobin: large iron-containing protein
  - Iron in hemoglobin binds and carries 4 molecules of O_2



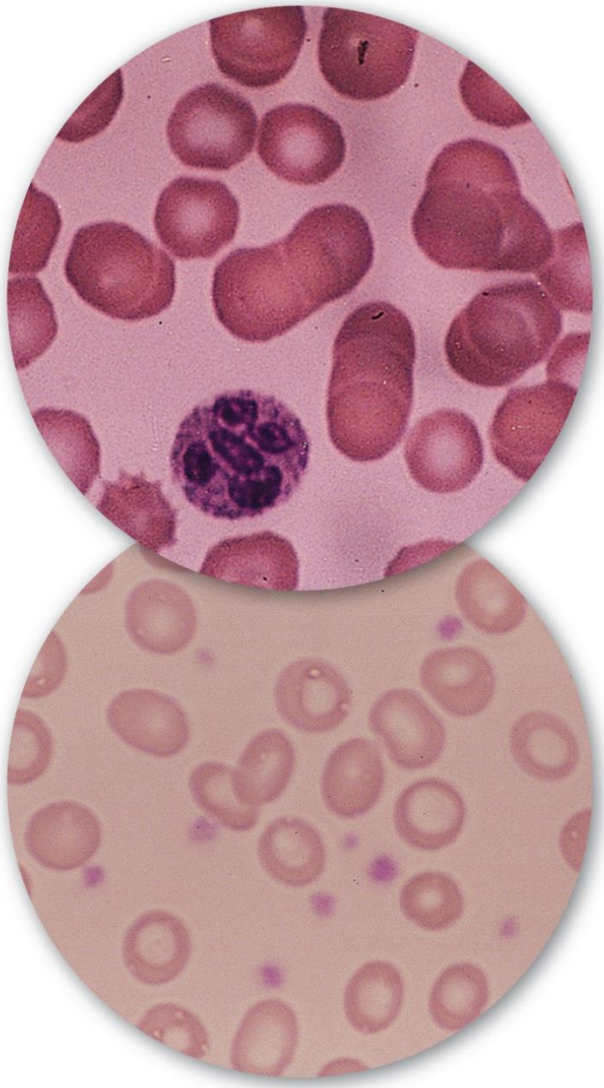
Anemia

- Inadequate healthy RBCs is called anemia
- Anemia can be caused by:
  - Low RBC production or low hemoglobin production in RBCs
  - Loss or destruction of blood
- Symptoms result from inadequate O_2 to organs

Appearance of blood cells indicates type of anemia:

- Normal RBCs: normocytic and normochromic
- Large red blood cells, **macrocytic** or **megaloblastic,** are signs of <u>folate or vitamin B-12 deficiencies</u>

(a) Macrocytic (or megaloblastic) anemia



(b) Microcytic, hypochromic anemia

a: ©SPL/Science Source; b: ©Omikron/Science Source

Iron (Fe)

Functions

- Used as part of many enzymes, proteins
- Needed for brain and immune function
- **Helps detoxify drugs in the liver**
- Iron is part of red and white blood cells

Needs

- Male and post-menopausal female RDA: 8 mg/day
- Female RDA: 18 mg/day for 18-50 y.o.
- Average intake: 13 mg for women, 18 mg for men per day

Iron Deficiency Anemia

- Iron deficiency anemia caused when:
  - O_2 carried in bloodstream is decreased

Stage 1: Depleted body stores but no physical symptoms

Stage 2: Depleted circulating iron and some physiological impairment

Stage 3: RBCs are small (microcytic) and pale (hypochromic) and ↓ in number

Iron Deficiency Anemia

- Most common micronutrient deficiency worldwide, 30% of world population
- Can be caused by:
  - Growth and increased blood volume (ex: pregnancy)
  - Blood loss during menstruation
  - Blood loss from ulcers, colon cancer, hemorrhoid
- Symptoms: fatigue, pale skin, always cold, loss of appetite, reduced work capacity

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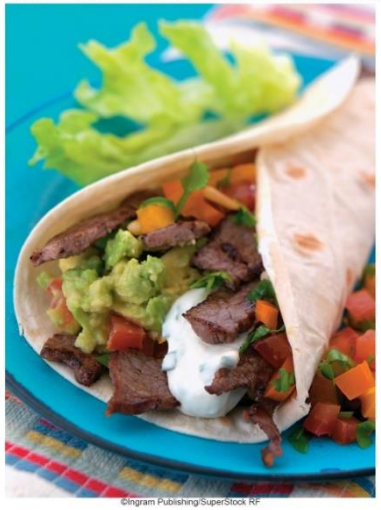
Dietary Sources of Iron

- Heme, animal source
- Non-heme, plant source
  - Fruits and vegetables
  - Fortified foods
  - Vitamin C enhances absorption



Nonheme Inhibitors

- Tannins (found in tea)
  - Can lower absorption up to 60%, so drink tea between meals. Does not apply to herbal "tea," which contains no tea leaves.
- Oxalates (spinach, rhubarb, chard)
- Phytates (whole grains, bran, soybean)
- Megadoses of zinc, calcium, or copper

Microwave Egg Scramble

Ingredients:

2 eggs

1/3 cup spinach sliced

Add ins:

- 1 tbsp. shredded cheese
- Salt, pepper
- Diced onion, red pepper

Instructions:

1. Add all ingredients to bowl
2. Lightly scramble
3. Cook for 30 seconds in micro, scramble and cook for 1 minute or until egg is fully cooked

Avoiding Too Much Iron

- UL: 45 mg/day
- High iron can → stomach irritation
- Iron pills are common cause of iron toxicity in children who accidentally overdose
- Vitamin C increases iron absorption