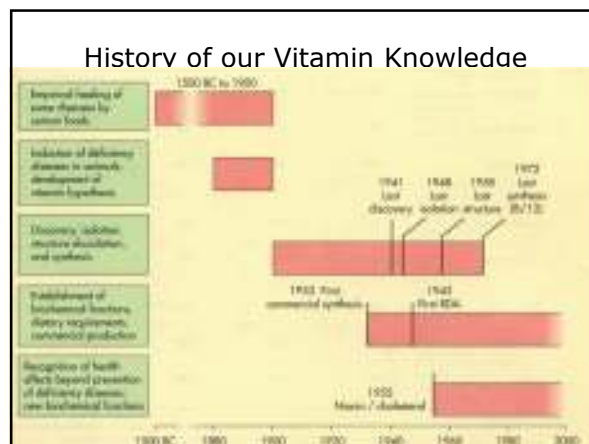


Chapter 10

The Water-Soluble Vitamins: B Vitamins and Vitamin C



The Vitamins--An Overview

- Vitamins differ from carbohydrate, fat and protein in structure, function and food contents.
- Vitamins are similar to the energy-yielding nutrients in that they are vital to life, organic and available from foods.
- Both deficiencies and excesses of the vitamins can affect health.

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The Vitamins--An Overview

- Bioavailability is the rate and extent that a nutrient is absorbed and used.
- Precursors, also known as provitamins, are consumed in an inactive form and become active vitamins in the body.

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The Vitamins--An Overview

- The organic nature of vitamins means they can be destroyed by exposure to light, oxidation, cooking, and storage.
- There are methods used to minimize nutrient losses.
 - ✓ Refrigerate fruits and vegetables.
 - ✓ Store cut fruits and vegetables in airtight wrappers or closed containers and refrigerate.
 - ✓ Clean fruits and vegetables before they are cut.
 - ✓ Use a microwave, steam, or simmer in small amounts of water.
 - ✓ Save cooking water for other uses.
 - ✓ Avoid high temperatures and long cooking times.

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The Vitamins--An Overview

- Solubility and storage
 - ✓ Water-soluble vitamins (B vitamins and vitamin C) are absorbed directly into the blood and travel freely.
 - Circulate freely
 - Excreted in urine
 - ✓ Fat-soluble vitamins (vitamins A, D, K and E) are absorbed first into the lymph, then the blood.
 - Many require protein carriers.
 - Stored in cells associated with fat
 - Less readily excreted

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The Vitamins--An Overview

- Toxicity
 - ✓Water-soluble vitamins can reach toxic levels with supplement use.
 - ✓Fat-soluble vitamins are likely to reach toxic levels with supplement use.
 - ✓DRI Committee has established Tolerable Upper Intake Levels for niacin, vitamin B₆, folate, choline and vitamin C.

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Vitamins and Metabolism

Vitamins and minerals

- ✓Are required for proper metabolism
- ✓Do not directly provide energy
- ✓Are necessary for obtaining energy from the macronutrients
- ✓Often function as coenzymes

Create Vitamin and Mineral Charts

Common Name	Function	Found in:	Toxicity Symptoms?	Deficiency symptoms?
Vitamin A				
Vitamin D				
Vitamin E				
Vitamin K				
Vitamin C				
Vitamin Bs...				

B-complex Vitamins

The B-complex vitamins are especially important for energy metabolism.

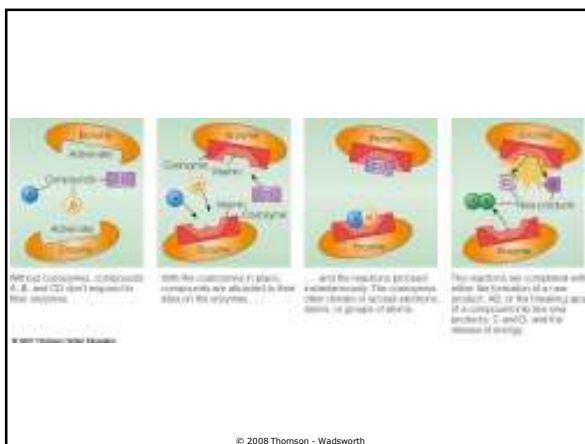
The B-complex vitamins include:

- | | |
|-----------------|------------------|
| thiamin (B1) | folate |
| riboflavin (B2) | vitamin B12 |
| niacin | pantothenic acid |
| vitamin B6 | biotin |

The B Vitamins--As Individuals

- The B vitamins are very active in the body. Several of the B vitamins form part of the coenzymes that assist enzymes in the release of energy.
- Other B vitamins participate in metabolism and cell multiplication.
- Recommendations for the B vitamins come from RDA, AI, and Tolerable Upper Intake Levels.
- There are deficiencies, toxicities and food sources that are unique for each vitamin.

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Riboflavin (Vitamin B₂)

- Other information
 - ✓ Easily destroyed by ultraviolet light and irradiation
 - ✓ Not destroyed by cooking

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Niacin (Vitamin B₃)

- Niacin is involved in the metabolism of glucose, fat, and alcohol.
- Nicotinamide adenine dinucleotide (NAD), and NADP, the phosphate form of NAD, are the coenzyme forms.
- Niacin Recommendations (1998 RDA)
 - ✓ The body can obtain niacin from dietary niacin and dietary tryptophan (60 mg of dietary tryptophan = 1 mg niacin); therefore niacin intake is measured in niacin equivalents (NE).
 - ✓ RDA Men: 16 NE/day
 - ✓ RDA Women: 14 NE/day
 - ✓ Upper level of 35 mg/day for adults

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Niacin (Vitamin B₃)

- Niacin Deficiency
 - ✓ A deficiency of niacin results in the disease pellagra.
 - ✓ Deficiency Symptoms
 - Diarrhea, abdominal pain, and vomiting
 - Inflamed, swollen, smooth and bright red tongue
 - Depression, apathy, fatigue, loss of memory, and headache
 - Rash when exposed to sunlight

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Niacin (Vitamin B₃)

- Niacin Toxicity
 - ✓ Niacin flush dilates the capillaries and may be painful.
 - ✓ Toxicity Symptoms
 - Painful flush, hives and rash
 - Excessive sweating
 - Blurred vision
 - Liver damage
 - Impaired glucose tolerance

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Niacin (Vitamin B₃)

- Niacin Food Sources
 - ✓ Milk
 - ✓ Eggs, meat, poultry and fish
 - ✓ Whole-grain and enriched breads and cereals
 - ✓ Nuts and all protein-containing foods

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Pantothenic Acid

- Pantothenic Acid Deficiency and Toxicity
 - ✓ Deficiency is rare.
 - ✓ Deficiency Symptoms
 - Vomiting, nausea, and stomach cramps
 - Insomnia and fatigue
 - Depression, irritability, restlessness, and apathy
 - Hypoglycemia and increased sensitivity to insulin
 - ✓ No reported toxicities

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Pantothenic Acid

- Pantothenic Acid Food Sources
 - ✓ Widespread in foods
 - ✓ Organ meats
 - ✓ Mushrooms, avocados, and broccoli
 - ✓ Whole grains
 - ✓ Can be destroyed by freezing, canning, and refining

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Vitamin B₆

- The coenzyme forms of vitamin B₆ (pyridoxal phosphate [PLP] and pyridoxamine phosphate [PMP]) are involved in amino and fatty acid metabolism, the conversion of tryptophan to niacin or serotonin, and the production of red blood cells.
- Vitamin B₆ Recommendations (1998 RDA)
 - ✓ RDA Adults 19-50 years: 1.3 mg/day

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Vitamin B₆

- Vitamin B₆ Deficiency
 - ✓ Deficiency Symptoms
 - Scaly dermatitis
 - Anemia – small cell type
 - Depression, confusion, abnormal brain wave pattern, and convulsions
 - ✓ Alcohol destroys the vitamin
 - ✓ INH drug used for tuberculosis acts as an antagonist.

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Vitamin B₆

- Vitamin B₆ Toxicity
 - ✓ Toxicity Symptoms
 - Depression, fatigue, irritability, and headaches
 - Nerve damage causing numbness and muscle weakness leading to inability to walk
 - Convulsions
 - Skin lesions
 - ✓ Upper level for adults: 100 mg/day

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Vitamin B₆

- Vitamin B₆ Food Sources
 - ✓ Meats, fish, poultry and liver
 - ✓ Legumes and soy products
 - ✓ Non-citrus fruits
 - ✓ Fortified cereals

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Vitamin B₁₂ (Cobalamin)

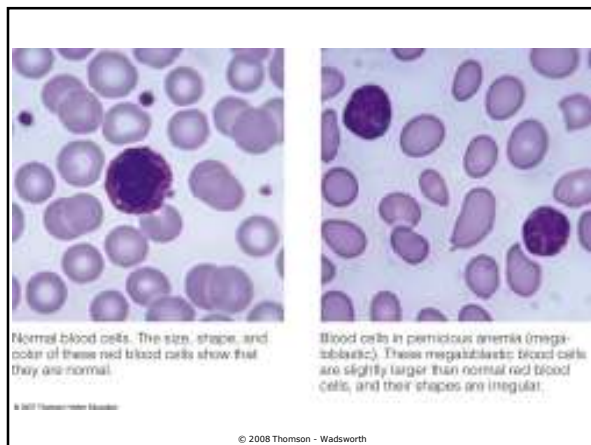
- Vitamin B₁₂ is involved in the synthesis of new cells, maintains nerve cells, reforms folate coenzymes, and helps break down some fatty acids and amino acids.
- Methylcobalamine and deoxyadenosylcobalamin are the coenzyme forms.
- Vitamin B₁₂ Recommendations (1998 RDA)
 - ✓ RDA Adults: 2.4 µg/day

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Vitamin B₁₂ (Cobalamin)

- Vitamin B₁₂ Deficiency and Toxicity
 - ✓ Deficiency Symptoms
 - Anemia - large cell type
 - Fatigue and depression
 - Degeneration of peripheral nerves progressing to paralysis
 - ✓ Atrophic gastritis in older adults destroys stomach cells, which diminishes intrinsic factor and hydrochloric acid production.
 - ✓ Deficiency disease is called pernicious anemia
 - ✓ No known toxicities

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Vitamin B₁₂ (Cobalamin)

- Vitamin B₁₂ Food Sources
 - ✓ Meat, fish, poultry, and shellfish
 - ✓ Milk, cheese and eggs
 - ✓ Fortified cereals

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Vitamin B₁₂ (Cobalamin)

- Other Information
 - ✓ Binds with intrinsic factor in the small intestine for absorption
 - ✓ Easily destroyed by microwave cooking

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Non-B Vitamins

- Choline
 - ✓ Choline is involved in the synthesis of acetylcholine and lecithin.
 - ✓ Choline Recommendations (1998 Adequate Intake)
 - AI Men: 550 mg/day
 - AI Women: 425 mg/day

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Non-B Vitamins

- Choline Deficiency and Toxicity
 - ✓Deficiencies are rare.
 - ✓Deficiency symptom is liver damage
 - ✓Toxicity Symptoms
 - Body odor and sweating
 - Salivation
 - Reduced growth rate
 - Low blood pressure
 - Liver damage
 - ✓Upper level for adults: 3500 mg/day

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Non-B Vitamins

- Choline Food Sources
 - ✓Milk
 - ✓Liver
 - ✓Eggs
 - ✓Peanuts

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Non-B Vitamins

- Inositol and Carnitine
 - ✓Inositol is made from glucose and is part of the cell membrane structure.
 - ✓Carnitine is made from lysine and transports long-chain fatty acids to be oxidized.
- Vitamin imposters are substances needed by other forms of life but not human beings.
- They can be potentially dangerous when used by humans.

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The B Vitamins--In Concert

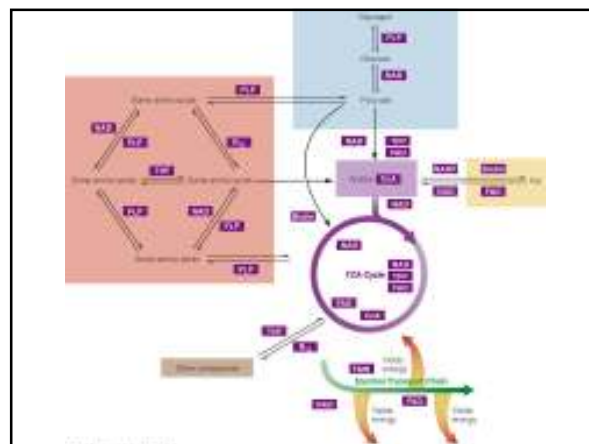
- The B Vitamins are interdependent. The presence of one may affect the absorption, metabolism and excretion of another.
- A deficiency of one may affect the functioning or deficiency of another.
- A variety of foods from each food group will provide an adequate supply of all the B vitamins.

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The B Vitamins--In Concert

- B Vitamin Roles
 - ✓Coenzymes involved directly or indirectly with energy metabolism
 - ✓Facilitate energy-releasing reactions
 - ✓Build new cells to deliver oxygen and nutrients for energy reactions

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The B Vitamins--In Concert

- B Vitamin Deficiencies
 - ✓Deficiencies rarely occur singly except for beriberi and pellagra.
 - ✓Can be primary or secondary causes
 - ✓Glossitis and cheilosis are two symptoms common to B vitamin deficiencies.
- B vitamin toxicities can occur with supplements.

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The B Vitamins--In Concert

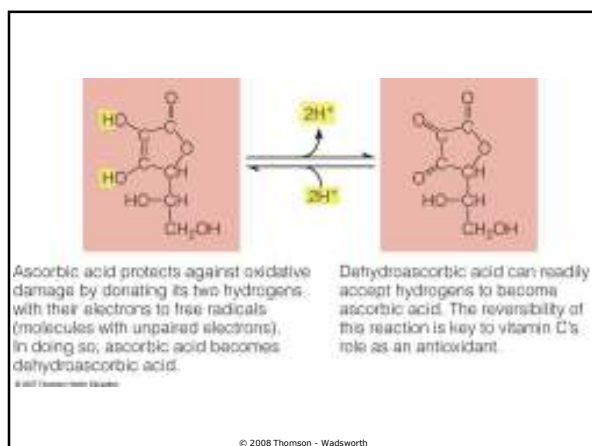
- B Vitamin Food Sources
 - ✓Grains group provides thiamin, riboflavin, niacin and folate.
 - ✓Fruits and vegetables provide folate.
 - ✓Meat group provides thiamin, niacin, vitamin B₆ and vitamin B₁₂.
 - ✓Milk group provides riboflavin and vitamin B₁₂.

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Vitamin C

- Antiscorbutic factor is the original name for vitamin C.
- Vitamin C serves as a cofactor to facilitate the action of an enzyme and also serves as an antioxidant.

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Vitamin C

- Vitamin C Roles
 - ✓As an Antioxidant
 - Defends against free radicals
 - Protects tissues from oxidative stress
 - ✓As a Cofactor in Collagen Formation
 - Collagen is used for bones and teeth, scar tissue, and artery walls.
 - Works with iron to form hydroxiprolinone which is needed in collagen formation

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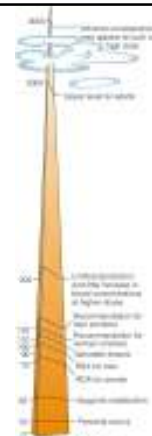
Vitamin C

- Vitamin C Roles
 - ✓ As a Cofactor in Other Reactions
 - Hydroxylation of carnitine
 - Converts tryptophan to neurotransmitters
 - Makes hormones
 - ✓ Vitamin C needs increase during body stress, i.e. infections, burns, extremely high or low temperatures, heavy metal intakes, certain medications, and smoking.
 - ✓ As a Cure for the Common Cold
 - Some relief of symptoms
 - Vitamin C deactivates histamine like an antihistamine.
 - ✓ Disease prevention is still being researched.

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Vitamin C

- Vitamin C Recommendations (1998 RDA)
 - ✓ RDA Men: 90 mg/day
 - ✓ RDA Women: 75 mg/day
 - ✓ Smokers: +35 mg/day



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Vitamin C

- Vitamin C Deficiency
 - ✓ Deficiency disease is called scurvy
 - ✓ Deficiency Symptoms
 - Anemia – small cell type
 - Atherosclerotic plaques and pinpoint hemorrhages
 - Bone fragility and joint pain
 - Poor wound healing and frequent infections
 - Bleeding gums and loosened teeth
 - Muscle degeneration and pain, hysteria, and depression
 - Rough skin and blotchy bruises

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Scurvy gums. Unlike other lesions of the mouth, scurvy presents a symmetrical appearance without infection.



Pinpoint hemorrhages. Small red spots appear in the skin, indicating spontaneous bleeding internally.

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Vitamin C

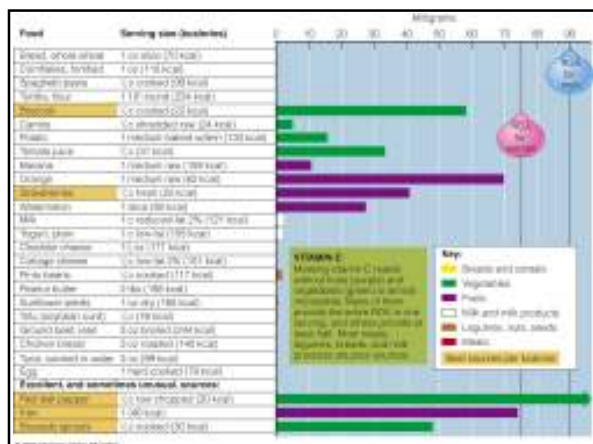
- Vitamin C Toxicity
 - ✓ Toxicity Symptoms
 - Nausea, abdominal cramps, diarrhea, headache, fatigue and insomnia
 - Hot flashes and rashes
 - Interference with medical tests, creating a false positive or a false negative
 - Aggravation of gout symptoms, urinary tract infections, and kidney stones
 - ✓ Upper level for adults: 2000 mg/day

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Vitamin C

- Vitamin C Food Sources
 - ✓ Citrus fruits, cantaloupe, strawberries, papayas and mangoes
 - ✓ Cabbage-type vegetables, dark green vegetables like green peppers and broccoli, lettuce, tomatoes and potatoes
- Other Information
 - ✓ Also called ascorbic acid
 - ✓ Easily destroyed by heat and oxygen

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Vitamin and Mineral Supplements

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Vitamin and Mineral Supplements

- Many people take dietary supplements for dietary and health insurance.
- Some take multinutrient pills daily.
- Others take large doses of single nutrients.
- A valid nutrition assessment by professionals determines the need for supplements.
- Self-prescribed supplementation is not advised.
- There are many arguments for and against supplements.

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Arguments for Supplements

- Correct Overt Deficiencies
- Support Increased Nutrient Needs
- Improve Nutrition Status
- Improve the Body's Defenses
- Reduce Disease Risks

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Arguments for Supplements

- Who Needs Supplements?
 - ✓ People with nutritional deficiencies
 - ✓ People with low energy intake – less than 1600 kcalories per day
 - ✓ Vegans and those with atrophic gastritis need vitamin B₁₂
 - ✓ People with lactose intolerance, milk allergies, or inadequate intake of dairy foods

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Arguments for Supplements

- Who Needs Supplements?
 - ✓ People in certain stages of the life cycle
 - Infants need iron and fluoride
 - Women of childbearing age need folate
 - Pregnant women need folate and iron
 - Elderly need vitamins B₁₂ and D
 - ✓ People with diseases, infections, or injuries, and those who have had surgery that affects nutrient digestion, absorption or metabolism
 - ✓ People taking medications that interfere with the body's use of specific nutrients

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Arguments against Supplements

- Toxicity
- Life-Threatening Misinformation
- Unknown Needs
- False Sense of Security

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Arguments against Supplements

- Other Invalid Reasons:
 - ✓ Belief that food supply and soil contain inadequate nutrients
 - ✓ Belief that supplements provide energy
 - ✓ Belief that supplements enhance athletic performance or lean body mass without physical work or faster than work alone
 - ✓ Belief that supplements will help a person cope with stress
 - ✓ Belief that supplements can prevent, treat or cure conditions
- Bioavailability and Antagonistic Actions

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Selection of Supplements

- What form do you want?
- What vitamins and minerals do you need?
 - ✓ Do not exceed Tolerable Upper Intake Levels.
 - ✓ Be careful about greater than 10 mg of iron.

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Selection of Supplements

- Are there misleading claims?
 - ✓ Ignore organic or natural claims.
 - ✓ Avoid products that make high potency claims.
 - ✓ Watch fake preparations.
 - ✓ Be aware of marketing ploys.
 - ✓ Be aware of preparations that contain alcohol.
 - ✓ Be aware of the latest nutrition buzzwords.
 - ✓ Internet information is not closely regulated.
- What about the cost?
 - ✓ Local or store brands may be just as good as nationally advertised brands.

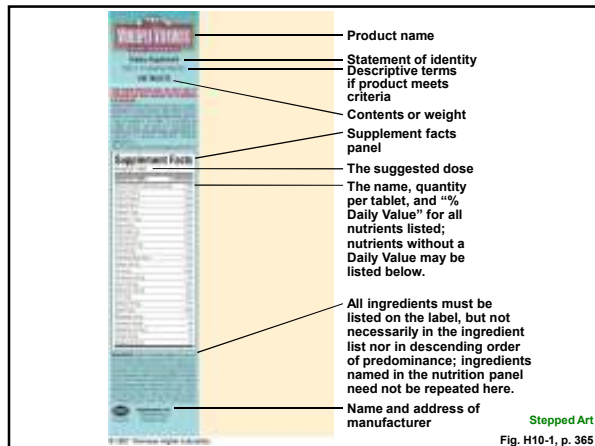
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Regulation of Supplements

- Nutritional labeling for supplements is required.
- Labels may make nutrient claims according to specified criteria.
- Labels may claim that lack of a nutrient can cause a deficiency disease and include the prevalence of that disease.
- Labels may make health claims that are supported by significant scientific agreement.

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Regulation of Supplements

- Labels may claim to diagnose, treat, cure, or relieve common complaints but not make claims about specific diseases.
- Labels may make structure-function claims if accompanied by Food And Drug Administration (FDA) disclaimer.
 - ✓ Role a nutrient plays in the body
 - ✓ How the nutrient performs its function
 - ✓ How consuming the nutrient is associated with general well-being

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