

# Vitamins

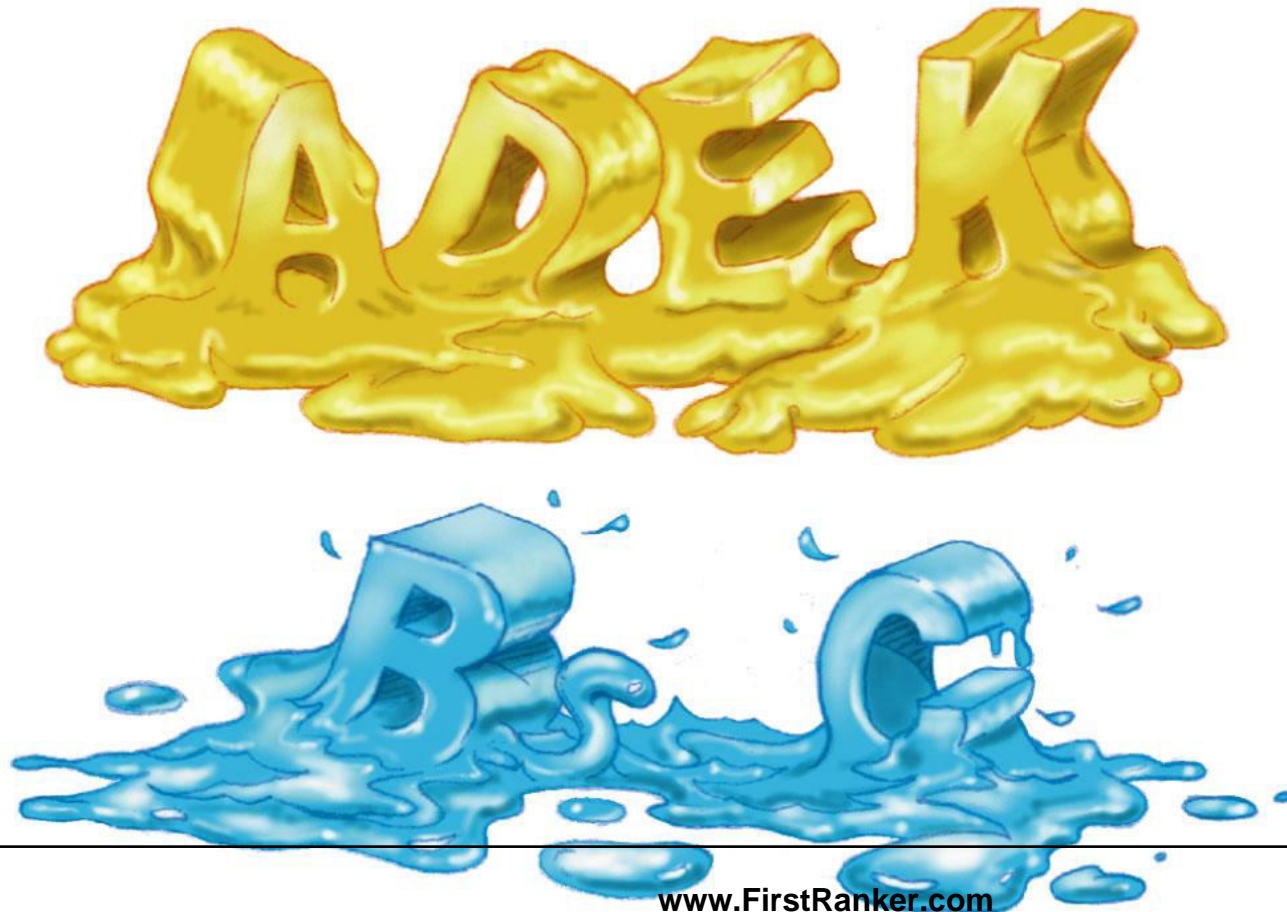
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## Summery of Vitamin Lectures

# Definition and Classification

- Non-caloric organic nutrients
- Needed in very small amounts
- Facilitators – help body processes proceed; digestion, absorption, metabolism, growth etc.
- Some appear in food as precursors or provitamins

# Definition and Classification of Vitamins



# Definition and Classification

- 2 classes
  - ◆ Fat soluble:
  - ◆ Water soluble:

# Fat vs. Water Soluble Vitamins

	Water Soluble	Fat Soluble
Absorption	Directly to blood	Lymph via CM
Transport	free	Require carrier
Storage	Circulate freely	In cells with fat
Excretion	In urine	Stored with fat
Toxicity	Less likely	More Likely
Requirements	Every 2-3 days	Every week

# Definition and Classification

- Fat soluble vitamins
  - ◆ Found in the fats and oils of food.
  - ◆ Absorbed into the lymph and carried in blood with protein transporters = chylomicrons.
  - ◆ \*Stored in liver and body fat and can become toxic if large amounts are consumed.

# Definition and Classification

- Water soluble vitamins
  - ◆ Found in vegetables, fruit and grains, meat.
  - ◆ Absorbed directly into the blood stream
  - ◆ Not stored in the body and toxicity is rare. Alcohol can increase elimination, smoking, etc. cause decreased absorption.

# The B Vitamins

B-1, B-2, B-3, B-6, B-12



# B-1 Thiamin

- Important in:
  - ◆ Producing energy from carbohydrates
  - ◆ nerve function
  - ◆ appetite
  - ◆ growth
  - ◆ Muscle function

# Sources of B-1

- Fish
- Liver
- Legumes
- Nuts
- Whole grain or enriched breads and cereals

# Warnings

- B-1 is nontoxic even at high dosages

# B-1 Deficiency

- Loss of appetite
- Weakness & Feeling tired
- Insomnia
- Loss of weight
- Depression
- Heart & Gastrointestinal problems

# Who's at Risk?

- Malnourished
- Alcoholics
- Malabsorption

# B-2 Riboflavin

- Important in:
  - ◆ energy production
  - ◆ carbohydrate, fat, and protein metabolism
  - ◆ formation of antibodies and red blood cells
  - ◆ cell respiration
  - ◆ maintenance of good vision, skin, nails, and hair

# Sources of B-2

- ◆ Milk
- ◆ eggs
- ◆ meats
- ◆ leafy green vegetables
- ◆ enriched grains

# Warnings

- B-2 is nontoxic at supplemental and dietary levels.
- Light can destroy riboflavin, so purchase milk in opaque containers.



# B-2 Deficiency

- Itching and burning eyes
- Cracks and sores in mouth and lips
- Dermatitis
- Oily skin

# Who's at Risk?

- People with Sickle Cell Anemia
- Alcoholics
- Malnutrition

# B-3 Niacinamide & Niacin

- Important in:
  - ◆ energy production
  - ◆ maintenance of skin and tongue
  - ◆ improves circulation
  - ◆ maintenance of nervous system
  - ◆ health of the digestive track
  - ◆ Lowers cholesterol when used in higher doses

# Warnings

- In very high doses some times (“niacin flush”) occurs

# B-3 Deficiency

- **Pellegra (4 D's)**
- Dermatitis
- Diarrhea
- Dementia
- Death

# Who's at Risk?

- Most people get plenty of B-3 from their diet because it is added to white flour.

# B-6 Pyridoxine

- Important in:
  - ◆ Production of red blood cells
  - ◆ conversion of tryptophan to niacin (B-3)
  - ◆ immunity
  - ◆ nervous system functions
  - ◆ reducing muscle spasms
  - ◆ maintaining proper balance of sodium and phosphorous in the body

# Warnings

- nerve damage.
- Caution for Pregnant women



# B-6 Deficiency

- nervousness, insomnia
- loss of muscle control, muscle weakness
- arm and leg cramps
- water retention
- skin lesions

# Who's at Risk?

- very rare
- alcoholics
- patients with kidney failure
- women using oral contraceptives

# B-12 Cobalamin

- Important in:
  - ◆ proper nerve function
  - ◆ production of red blood cells
  - ◆ metabolizing fats and proteins
  - ◆ prevention of anemia
  - ◆ DNA reproduction
  - ◆ energy production?

# Warnings

- Vegetarians
- Malabsorption

# B-12 Deficiency

- anemia
- nerve damage
- hypersensitive skin

# Who's at Risk?

- pernicious anemia
  - ◆ B-12 injections often taken regularly
- HIV

# Vitamin A

# What is Vitamin A?

- Fat-soluble
- Retinol
  - ◆ One of the most active, usable forms
- Found in animal and plant sources



# What does it do?

- Vision
  - ◆ Generates pigments for the retina
  - ◆ Maintains surface lining of eyes
- Bone growth
- Reproduction
- Cell division and differentiation
- Healthy Skin
- Regulate Immune System

# Where does it come from?

## ■ Animal Sources

- ◆ Eggs
- ◆ Meat
- ◆ Cheese
- ◆ Milk
- ◆ Liver
- ◆ Cod

# Plant Sources

- Carrots
- Potatoes
- Pink Grapefruit
- Spinach

- Beta-Carotene is precursor of Vitamin A

# Signs of Deficiency

- Night blindness
- Decreased resistance to infections
- Extremely dry skin, hair or nails

# Who Is At Risk For Deficiency?

- Young children
- Malabsorption
- Malnutrition

# Too Much Can Be Toxic!!

- **Hypervitaminosis A** leads to toxic symptoms:
  - ◆ Dry, itchy skin
  - ◆ Headaches and fatigue
  - ◆ Hair loss
  - ◆ Liver damage
  - ◆ Blurred vision
  - ◆ Loss of appetite
  - ◆ Skin coloration

# Vitamin A, Beta-Carotene, and Cancer

- Cancer prevention



# Vitamin E

# Vitamin E

*What is it?*

- Fat soluble
- Antioxidant
  - ◆ minimize the damage of free radicals

# Vitamin E

*What does it do?*

- **Protects cell membranes**
- Promotes normal growth and development
- Promotes normal RBC formation
- Acts as anti-blood clotting agent
- Helps in wound healing

# Vitamin E

*What's the difference?*

- Tocopherol
  - ◆ Alpha, beta, gamma

# Vitamin E

*Where does it come from?*

- vegetable oils
- nuts and seeds
- whole grains
- egg yolk
- leafy green vegetables

# Vitamin E

*Other effects:*

- 'E' Enhances immune system

# Vitamin E

*Who is likely to be deficient?*

- Severe vitamin E deficiencies are rare
- Lethargy
- Inability to concentrate
- Muscle weakness

# Vitamin E

## *Miscellaneous:*

- Freezing may destroy Vitamin E
- Avoid too much frying foods that are natural sources of Vitamin E



# Vitamin C

# Vitamin C

- Ascorbic acid (Toxic to viruses, bacteria, and some malignant tumor cells)
- Antioxidant
- water-soluble

# What are C's functions in the body?

- Protects your body from free radicals
- helps form connective tissue (Collagen)
- Helps healing of wounds
- Helps in absorbing iron
- keep your gums healthy
- Immunity
- prevention of heart disease
- prevention of cancer

# Harmful effects in larger doses: (over 1000mg/ dose)

- Diarrhea
- Avoid chewable tablets (may cause damage to teeth)

- Since Vitamin C is water-soluble excess amounts that the body does not need will be excreted, but larger doses can cause some problems. . .

# Sources of Vitamin C

- Leafy Greens vegetables, Citrus Fruits

# Deficiency of C causes:

- Weight loss
- fatigue and joint pain
- **scurvy** (bruising easily, bleeding gums, and tendency for bones to fracture)
- reduced resistance to colds and infections
- slow healing of wounds and fractured bones

# Fat Soluble Vitamins

- Vitamin D – precursor is cholesterol, converted by UV from sunlight exposure, therefore is a “non-essential” vitamin.

- ◆ Roles:

- ☞ Increases calcium removal from bone, absorption from intestines, re-absorption from kidney.
- ☞ Promotes bone growth and maintenance.
- ☞ Stimulates maturation of cells – heart, brain, immune system, etc.



# Fat Soluble Vitamins

- Vitamin D
  - ◆ Deficiencies:
  - ◆ rickets (children)
  - ◆ osteomalacia (adults)

# Fat Soluble Vitamins

- Vitamin K – produced by bacteria in large intestine
  - ◆ Roles
    - ☞ Clotting mechanism
  - ◆ Deficiencies are rare but
  - ◆ seen in infants,
  - ◆ after prolonged antibiotic therapy, and in patients with decreased bile production.
  - ◆ Toxicities (>1000 mg/day): rupture of RBCs and jaundice

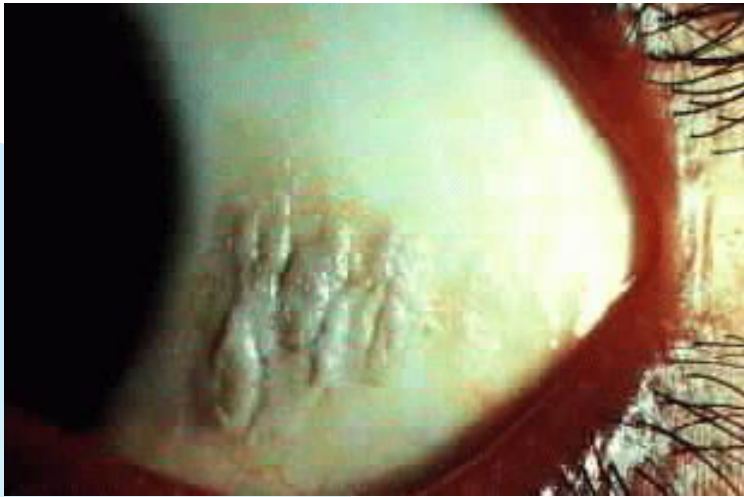
## Diseases due to Vitamins

Scurvy: Vitamin C deficiency

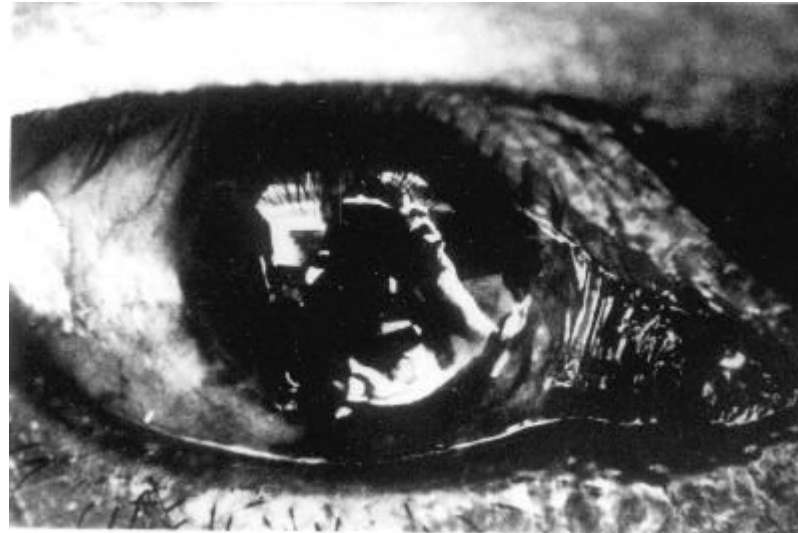
Beriberi: Thiamin deficiency

Rickets: Vitamin D deficiency

Pellagra: Niacin deficiency



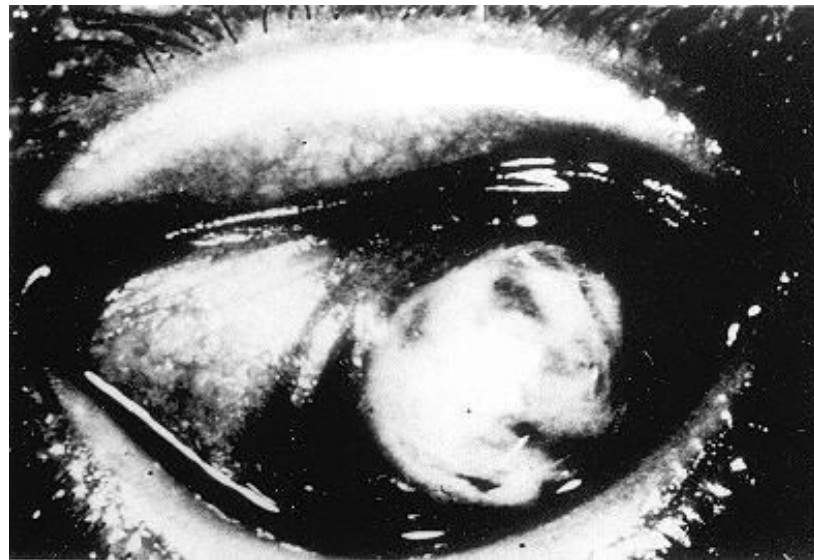
Bitot's Spots



Xerosis Conjunctiva



Corneal Xerosis



Keratomalacia

# Riboflavin deficiency



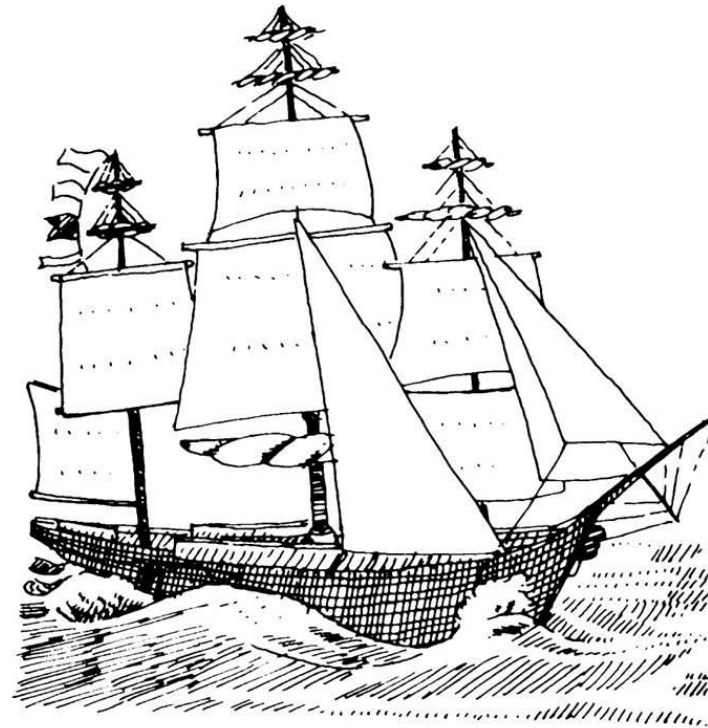
## *Sources of Vitamin K*

- Vitamin K can be made by intestinal bacteria.
- Newborns are given a dose of vitamin K at birth.



## Vitamin C

- More than 200 years ago, any man who joined the crew of a seagoing ship knew he might contract scurvy, which would end up killing as many as 2/3 of the crew.



Long voyages without fresh fruits and veggies spelled death by scurvy for the crew



### Deficiency Symptoms





# Consumer Corner: Vitamin C and the Common Cold

- Do you think vitamin C relieves colds?
  - a. Yes
  - b. No
  - c. I have no opinion

# Consumer Corner: Vitamin C and the Common Cold

- In drug-like doses, vitamin C may act like a weak antihistamine.



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**Can vitamin C ease the suffering of a person with a cold?**

## *Thiamin Deficiency*



■ Pellagra symptoms: 4 “D’s”

- ◆ Diarrhea
- ◆ Dermatitis
- ◆ Dementia
- ◆ Death

*Niacin*





## *Vitamin B<sub>6</sub>*



**TABLE 7-5** The Fat-Soluble Vitamins—Functions, Deficiencies, and Toxicities**VITAMIN A****OTHER NAMES**

Retinol, retinal, retinoic acid; main precursor is beta-carotene

**CHIEF FUNCTIONS IN THE BODY**

Vision; health of cornea, epithelial cells, mucous membranes, skin; bone and tooth growth; regulation of gene expression; reproduction; immunity

Beta-carotene: antioxidant

**DEFICIENCY DISEASE NAME**

Hypovitaminosis A

**SIGNIFICANT SOURCES**

Retinol: fortified milk, cheese, cream, butter, fortified margarine, eggs, liver

Beta-carotene: spinach and other dark, leafy greens; broccoli; deep orange fruits (apricots, cantaloupe) and vegetables (winter squash, carrots, sweet potatoes, pumpkin)

**Blood/Circulatory System****DEFICIENCY SYMPTOMS**

Anemia (small cell type)<sup>a</sup>

**TOXICITY SYMPTOMS**

Red blood cell breakage, cessation of menstruation, nosebleeds

**Bones/Teeth**

Cessation of bone growth, painful joints; impaired enamel formation, cracks in teeth, tendency toward tooth decay

Bone pain; growth retardation; increased pressure inside skull; headaches; possible bone mineral loss

**Digestive System**

Diarrhea, changes in intestinal and other body linings

Abdominal pain, nausea, vomiting, diarrhea, weight loss

**Immune System**

Frequent infections

Overreactivity

**Nervous/Muscular System**

Night blindness (retinal)  
Mental depression

Blurred vision, muscle weakness, fatigue, irritability, loss of appetite

**Skin and Cornea**

Keratinization, corneal degeneration leading to blindness,<sup>a</sup> rashes

Dry skin, rashes, loss of hair; cracking and bleeding lips, brittle nails; hair loss

**Other**

Kidney stones, impaired growth

Liver enlargement and liver damage; birth defects

<sup>a</sup>Corneal degeneration progresses from *keratinization* (hardening) to *xerosis* (drying) to *xerophthalmia* (thickening, opacity, and irreversible blindness).

**TABLE 7-5** The Fat-Soluble Vitamins—Functions, Deficiencies, and Toxicities (continued)**VITAMIN D****OTHER NAMES**

Calciferol, cholecalciferol, dihydroxy vitamin D; precursor is cholesterol

**CHIEF FUNCTIONS IN THE BODY**

Mineralization of bones (raises blood calcium and phosphorus via absorption from digestive tract and by withdrawing calcium from bones and stimulating retention by kidneys)

**DEFICIENCY DISEASE NAME**

Rickets, osteomalacia

**SIGNIFICANT SOURCES**

Self-synthesis with sunlight; fortified milk or margarine, liver, sardines, salmon, shrimp

**Blood/Circulatory System**

**Bones/Teeth**

**Nervous System**

**Other**

**DEFICIENCY SYMPTOMS**

Abnormal growth, misshapen bones (bowing of legs), soft bones, joint pain, malformed teeth

Muscle spasms

**TOXICITY SYMPTOMS**

Raised blood calcium; calcification of blood vessels and heart tissues

Calcification of tooth soft tissues; thinning of tooth enamel

Excessive thirst, headaches, irritability, loss of appetite, weakness, nausea

Kidney stones; calcification of soft tissues (kidneys, lungs, joints); mental and physical retardation of offspring

**VITAMIN E****OTHER NAMES**

Alpha-tocopherol, tocopherol

**CHIEF FUNCTIONS IN THE BODY**

Antioxidant (quenching of free radicals), stabilization of cell membranes, support of immune function, protection of polyunsaturated fatty acids; normal nerve development

**DEFICIENCY DISEASE NAME**

(No name)

**SIGNIFICANT SOURCES**

Polyunsaturated plant oils (margarine, salad dressings, shortenings), green and leafy vegetables, wheat germ, whole-grain products, nuts, seeds

**Blood/Circulatory System**

**Digestive System**

**Eyes**

**Nervous/Muscular System**

**DEFICIENCY SYMPTOMS**

Red blood cell breakage, anemia

Nerve degeneration, weakness, difficulty walking, leg cramps

**TOXICITY SYMPTOMS**

Augments the effects of anticlotting medication

General discomfort, nausea

Blurred vision

Fatigue



**VITAMIN K****OTHER NAMES**

Phylloquinone, naphthoquinone

**CHIEF FUNCTIONS IN THE BODY**

Synthesis of blood-clotting proteins and proteins important in bone mineralization

**DEFICIENCY DISEASE NAME**

(No name)

**SIGNIFICANT SOURCES**

Bacterial synthesis in the digestive tract; green leafy vegetables, cabbage-type vegetables, soybeans, vegetable oils.

**Blood/Circulatory System**

**Bones**

**DEFICIENCY SYMPTOMS**

Hemorrhage

Poor skeletal mineralization

**TOXICITY SYMPTOMS**

Interference with anticlotting medication

## Conclusion

**TABLE 7-6** The Water-Soluble Vitamins—Functions, Deficiencies, and Toxicities

### VITAMIN C

#### OTHER NAMES

Ascorbic acid

#### CHIEF FUNCTIONS IN THE BODY

Collagen synthesis (strengthens blood vessel walls, forms scar tissue, matrix for bone growth), antioxidant, restores vitamin E to active form, hormone synthesis, supports immune cell functions, helps in absorption of iron

#### DEFICIENCY DISEASE NAME

Scurvy

#### SIGNIFICANT SOURCES

Citrus fruits, cabbage-type vegetables, dark green vegetables, cantaloupe, strawberries, peppers, lettuce, tomatoes, potatoes, papayas, mangoes

#### DEFICIENCY SYMPTOMS

#### TOXICITY SYMPTOMS

Digestive System

Nausea, abdominal cramps, diarrhea, excessive urination

Immune System

Immune suppression, frequent infections

Mouth, Gums, Tongue

Bleeding gums, loosened teeth

Nervous/Muscular System

Muscle degeneration and pain, depression, disorientation

Headache, fatigue, insomnia

Skeletal System

Bone fragility, joint pain

Aggravation of gout

Skin

Pinpoint hemorrhages, rough skin, blotchy bruises

Rashes

Other

Failure of wounds to heal

Interference with medical tests; kidney stones in susceptible people

**THIAMIN****OTHER NAMES**

Vitamin B<sub>1</sub>

**CHIEF FUNCTIONS IN THE BODY**

Part of a coenzyme needed in energy metabolism, supports normal appetite and nervous system function

**DEFICIENCY DISEASE NAME**

Beriberi (wet and dry)

**SIGNIFICANT SOURCES**

Occurs in all nutritious foods in moderate amounts; pork, ham, bacon, liver, whole and enriched grains, legumes, seeds

	<b>DEFICIENCY SYMPTOMS</b>	<b>TOXICITY SYMPTOMS</b>
<b>Blood/Circulatory System</b>	Edema, enlarged heart, abnormal heartrhythms, heart failure	(No symptoms reported)
<b>Nervous/Muscular System</b>	Degeneration, wasting, weakness, pain, apathy, irritability, difficulty walking, loss of reflexes, mental confusion, paralysis	
<b>Other</b>	Anorexia; weight loss	

**RIBOFLAVIN****OTHER NAMES**Vitamin B<sub>2</sub>**CHIEF FUNCTIONS IN THE BODY**

Part of a coenzyme needed in energy metabolism, supports normal vision and skin health

**DEFICIENCY DISEASE NAME**

Ariboflavinosis

**SIGNIFICANT SOURCES**

Milk, yogurt, cottage cheese, meat, liver, leafy green vegetables, whole-grain or enriched breads and cereals

Mouth, Gums, Tongue

Nervous System and Eyes

Skin

**DEFICIENCY SYMPTOMS**

Cracks at corners of mouth,<sup>b</sup> smooth magenta tongue<sup>c</sup>; sore throat

Hypersensitivity to light, reddening of cornea

Skin rash

**TOXICITY SYMPTOMS**

(No symptoms reported)

<sup>a</sup>Small-cell anemia is termed *microcytic anemia*; large-cell type is *macrocytic* or *megaloblastic anemia*.

<sup>b</sup>Cracks at the corners of the mouth are termed *cheilosis* (kee-LOH-sis).

<sup>c</sup>Smoothness of the tongue is caused by loss of its surface structures and is termed glossitis (gloss-EYE-tis).

**TABLE 7-6** The Water-Soluble Vitamins—Functions, Deficiencies, and Toxicities (continued)**NIACIN****OTHER NAMES**

Nicotinic acid, nicotinamide, niacinamide, vitamin B<sub>3</sub>; precursor is dietary tryptophan

**CHIEF FUNCTIONS IN THE BODY**

Part of coenzymes needed in energy metabolism

**DEFICIENCY DISEASE NAME**

Pellagra

**SIGNIFICANT SOURCES**

Synthesized from the amino acid tryptophan; milk, eggs, meat, poultry, fish, whole-grain and enriched breads and cereals, nuts, and all protein-containing foods

	<b>DEFICIENCY SYMPTOMS</b>	<b>TOXICITY SYMPTOMS</b>
<b>Digestive System</b>	Diarrhea; vomiting; abdominal pain	Nausea, vomiting
<b>Mouth, Gums, Tongue</b>	Black or bright red swollen smooth tongue <sup>a</sup>	
<b>Nervous System</b>	Irritability, loss of appetite, weakness, headache, dizziness, mental confusion progressing to psychosis or delirium	
<b>Skin</b>	Flaky skin rash on areas exposed to sun	Painful flush and rash, sweating
<b>Other</b>		Liver damage; impaired glucose tolerance

**FOLATE****OTHER NAMES**

Folic acid, folacin, pteroylglutamic acid

**CHIEF FUNCTIONS IN THE BODY**

Part of a coenzyme needed for new cell synthesis

**DEFICIENCY DISEASE NAME**

(No name)

**SIGNIFICANT SOURCES**

Asparagus, avocado, leafy green vegetables, beets, legumes, seeds, liver, enriched breads, cereal, pasta, and grains

**Blood/Circulatory System**

**Digestive System**

**Immune System**

**Mouth, Gums, Tongue**

**Nervous System**

**DEFICIENCY SYMPTOMS**

Anemia (large-cell type),<sup>b</sup>  
elevated homocysteine

Heartburn, diarrhea,  
constipation

Suppression, frequent  
infections

Smooth red tongue<sup>a</sup>  
Increased risk of neural tube  
birth defects

Depression, mental confusion,  
fatigue, irritability, headache

**TOXICITY SYMPTOMS**

Masks vitamin B<sub>12</sub> deficiency



**VITAMIN B<sub>12</sub>****OTHER NAMES**

Cyanocobalamin

**CHIEF FUNCTIONS IN THE BODY**

Part of coenzymes needed in new cell synthesis, helps maintain nerve cells

**DEFICIENCY DISEASE NAME**(No name)<sup>c</sup>**SIGNIFICANT SOURCES**

Animal products (meat, fish, poultry, milk, cheese, eggs)

	DEFICIENCY SYMPTOMS	TOXICITY SYMPTOMS
Blood/Circulatory System	Anemia (large-cell type) <sup>b</sup>	(No toxicity symptoms known)
Mouth, Gums, Tongue	Smooth tongue <sup>a</sup>	
Nervous System	Fatigue, nerve degeneration progressing to paralysis	
Skin	Tingling or numbness	

<sup>a</sup>Smoothness of the tongue is caused by loss of its surface structures and is termed *glossitis* (gloss-EYE-tis).

<sup>b</sup>Small-cell anemia is termed *microcytic anemia*; large-cell type is *macrocytic* or *megaloblastic anemia*.

<sup>c</sup>The name *pernicious anemia* refers to the vitamin B<sub>12</sub> deficiency caused by lack of intrinsic factor, but not to that caused by inadequate dietary intake.

**TABLE 7-6** The Water-Soluble Vitamins—Functions, Deficiencies, and Toxicities (continued)**VITAMIN B<sub>6</sub>****OTHER NAMES**

Pyridoxine, pyridoxal, pyridoxamine

**CHIEF FUNCTIONS IN THE BODY**

Part of a coenzyme needed in amino acid and fatty acid metabolism, helps convert tryptophan to niacin and to serotonin, helps make red blood cells

**DEFICIENCY DISEASE NAME**

(No name)

**SIGNIFICANT SOURCES**

Meats, fish, poultry, liver, legumes, fruits, potatoes, whole grains, soy products

**Blood/Circulatory System****DEFICIENCY SYMPTOMS**Anemia (small-cell type)<sup>a</sup>**TOXICITY SYMPTOMS**

Bloating

**Nervous/Muscular System**

Depression, confusion, abnormal brain wave pattern, convulsions

Depression, fatigue, impaired memory, irritability, headaches, numbness, damage to nerves, difficulty walking, loss of reflexes, restlessness, convulsions

**Skin**

Rashes, greasy, scaly dermatitis

Skin lesions



**PANTOTHENIC ACID****OTHER NAMES**

(None)

**CHIEF FUNCTIONS IN THE BODY**

Part of a coenzyme needed in energy metabolism

**DEFICIENCY DISEASE NAME**

(No name)

**SIGNIFICANT SOURCES**

Widespread in foods

Digestive System

Nervous/Muscular System

Other

**DEFICIENCY SYMPTOMS**

Vomiting, intestinal distress

Insomnia, fatigue

Hypoglycemia, increased sensitivity to insulin

**TOXICITY SYMPTOMS**

Water retention (infrequent)

**BIOTIN****OTHER NAMES**

(None)

**CHIEF FUNCTIONS IN THE BODY**

A cofactor for several enzymes needed in energy metabolism, fat synthesis, amino acid metabolism, and glycogen synthesis

**DEFICIENCY DISEASE NAME**

(No name)

**SIGNIFICANT SOURCES**

Widespread in foods

Blood/Circulatory System

Digestive System

Nervous/Muscular System

Skin

**DEFICIENCY SYMPTOMS**

Abnormal heart action

Loss of appetite, nausea

Depression, muscle pain, weakness, fatigue, numbness of extremities

Dry around eyes, nose, and mouth

**TOXICITY SYMPTOMS**

(No toxicity symptoms reported)

<sup>a</sup>Small-cell anemia is termed *microcytic anemia*; large-cell anemia is *macrocytic* or *megaloblastic anemia*.

## People with Increased Nutrient Needs

- Nutrient needs increase during certain stages of life and so sometimes nutrient supplementation is needed.
  1. Women who lose a lot of blood and therefore a lot of iron during menstruation each month may need an \_\_\_\_\_ supplement.
  2. Newborns require a single dose of vitamin \_\_\_\_ at birth.
  3. Women of childbearing age need supplements of \_\_\_\_\_ to reduce the risk of NTD.

## The Story of Beta-Carotene

