

# VITAMINS

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## OBJECTIVES/RATIONALE

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Knowledge of nutrients is important in understanding energy production and use. The student will identify vitamins necessary for health and wellness and relate their function to physiological processes.

TEKS 121.24 1C, 6A

TAKS ELA 1, 3, 4, 5, 6  
Science 2, 4

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## KEY POINTS

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### Vitamins and Minerals RDA Table

#### I. Overview

- A. Vitamins are essential nutrients. They are required in small amounts, but have important and specific functions such as promoting growth, reproduction and the maintenance of health.
- B. Although needed to stay healthy they are not a cure all and do not have magical powers to prevent diseases.
- C. Vitamins do NOT give you energy.
- D. Like other nutrients
  1. You must have them - essential
  2. They are organic - easily destroyed (Heat, UV radiation and O<sub>2</sub>)
  3. Are available in foods
  4. Vitamin deficiencies should be corrected by eating certain foods, NOT from taking pills.
  5. Vitamins only occur naturally in foods. “Natural vitamins” do NOT come in a bottle.
- E. Different from other nutrients in:
  1. Structure – they are individual units and not linked together
  2. Function – when broken down, no useable energy is available. (They assist the enzymes that release the energy from other nutrients. Coenzymes)
  3. Amount needed – the amount needed to maintain health is measured in micrograms and milligrams instead of grams.
  4. Precursor – an inactive form of a vitamin that the body can convert into an active form.
- F. Solubility
  1. Water soluble – Hydrophilic
    - a. B complex and Vitamin C
    - b. Found in the watery part of foods
    - c. Move into the bloodstream on absorption.
    - d. May circulate freely in the water-filled compartments of the body.

- e. Any excess is removed by the kidneys and excreted in urine.
  - f. Retained for varying periods so they must be eaten more often than fat soluble vitamins
  - g. Deficiencies seldom occur from eating alone because the excess from food is excreted.
2. Fat soluble – Hydrophobic
- a. Vitamins A, D, E & K
  - b. Have specific roles in growth and maintenance of the body.
  - c. Found in oils and fats
  - d. Enter the lymphatic system when absorbed
  - e. Many require protein carriers in order to be transported
  - f. May get trapped in fat storing cells and remain there
  - g. Since the body can store them, toxic levels can be reached faster than the water-soluble vitamins.

## II. Water soluble vitamins

### A. B complex

1. Thiamin
  - a. Part of the coenzyme, TPP which promotes the conversion of pyruvate to acetyl CoA.
  - b. Necessary for proper nerve function
  - c. Deficiency leads to Beriberi
2. Riboflavin
  - a. Two forms FMN & FAD
  - b. Necessary for the release of energy from nutrients.
  - c. Supports normal vision and healthy skin.
  - d. Deficiencies may cause cracks in the corners of the mouth and a painful purplish tongue.
3. Niacin
  - a. Two forms NAD & NADP take part in energy metabolism
  - b. Supports nervous and digestive system and promotes healthy skin.
  - c. The body can make niacin from the amino acid tryptophan.
  - d. Toxic if taken in extremely large doses. Symptoms may include a niacin flush and drug like affect on blood lipids and blood glucose.
  - e. Deficiency causes Pellagra
4. Biotin
  - a. Functions in energy metabolism as a coenzyme that carries CO<sub>2</sub> and keeps the TCA Cycle going by giving a C to pyruvate.
  - b. Plays a role in gluconeogenesis, metabolism of fatty acids and the breakdown of amino acids.
  - c. Can be synthesized by bacteria in the GI tract.
  - d. Deficiencies rarely occur. A deficiency may occur if more than 24 raw eggs are eaten. They contain a protein that binds biotin and prevents its absorption.
5. Pantothenic acid
  - a. Found in the synthesis of many lipids, neurotransmitters, steroid hormones and hemoglobin.

- b. Part of CoA.
  - c. Deficiencies rarely occur, but when it occurs there is a general failure of all systems of the body.
6. Vitamin B 6
- a. A family of compounds
  - b. PLP is the coenzyme form
  - c. Unlike other water-soluble vitamins, B6 can be stored in muscles.
  - d. Important in the metabolism of amino acids and fatty acids
  - e. It influences cognitive development, immune function and steroid development.
  - f. Initially, symptoms of a deficiency include weakness, irritability and insomnia.
  - g. In advanced stages, symptoms include failure to grow, motor function impairment, convulsions and immune system compromise.
  - h. Toxic symptoms include neuromuscular disorders and nerve damage leading to numbness and muscle weakness.
  - i. Interactions
    - aa. Alcohol promotes destruction and loss of Vitamin B6.
    - bb. INH binds to Vitamin B6 (isonicotinic acid hydrazide is used to treat infections caused by *Microbacterium Tuberculosis*).
7. Folate – folic acid
- a. Coenzyme form is THF
  - b. Important in metabolism and important in DNA synthesis
  - c. Aids in the development of the neural tube. Females of childbearing age should take 0.4 mg/day but should not exceed 1mg/day (5 fruit and vegetable servings) to prevent spina bifida and anencephaly.
  - d. Helps convert Vitamin B12 into its coenzyme form.
8. Vitamin B 12 – closely related to folate
- a. helps folate work
  - b. Needed for DNA and RNA synthesis, maintains and protects nerve fibers and promotes their normal growth.
  - c. Deficiencies occur mainly because of inadequate absorption caused by atrophic gastritis (lack of HCl) or a lack of the intrinsic factor (Pernicious Anemia)
  - d. Inadequate absorption may be caused by drug interactions such as those taken during chemotherapy, salicylates (aspirin and antacids) and oral contraceptives.
  - e. Deficiencies impair cell division and protein synthesis.
    - aa. Most obvious symptom of a deficiency is the anemia of folate deficiency with its large immature RBC's.
    - cc. Production of DNA slows down and body cells can't divide.
    - dd. Anemia develops because RBC's aren't replaced and GI problems develop because cells in the GI tract aren't replaced.

B. Vitamin C

1. Functions

- a. antioxidant
- b. aids in the formation of collagen
  - aa. serves as a matrix to form teeth and bone
  - bb. important in wound healing
  - cc. holds cells together
- c. helps to make the hormones norepinephrine and thyroxine.
- d. Helps absorb iron and increase resistance to infections.
- e. May have some benefit in disease prevention. Thought by some to cure and prevent the common cold.
- f. A deficiency causes scurvy.
- g. Toxic symptoms include nausea, vomiting and diarrhea. Toxic levels may also interfere with certain medications (Warfarin, dicumarol heparin and coumadin) and cause false readings on lab test.

III. Fat soluble vitamins

A. Vitamin A

- 1. Occurs in the precursor form as Beta Carotene
- 2. Foods from animals supply preformed Vitamin A, foods from plants provide Beta Carotene.
- 3. Functions
  - a. Vision – keeps the cornea clear
  - b. Cell differentiation of epithelial cells
  - c. Immunity and Growth
  - d. Antioxidant
  - e. Deficiencies cause hypovitaminosis A
    - aa. A major problem in developing countries
    - bb. Symptoms include night blindness, xerophthalmia, keratinization of cells, anemia, kidney stones, poor bone growth and tooth enamel formation
  - f. Toxicity is called hypervitaminosis A
    - aa. Affects all body systems
    - bb. May cause birth defects.
    - cc. Symptoms include decalcification of bone, RBC's lose hemoglobin and potassium, slowed clotting time, cessation of menstruation, skin rashes, nausea, vomiting blurred vision and appetite loss. The liver enlarges due to fat and Vitamin A accumulating in large amounts and jaundice develops.

B. Vitamin D

- 1. The body can synthesize Vitamin D when exposed to sunlight.
- 2. Functions
  - a. Promotes cell differentiation.
    - aa. target organs are intestines, kidneys and bone.

- bb. chief role is to help make calcium available for bone mineralization and growth.
  - 3. Deficiencies
    - a. may occur as a result of diseases in the liver and kidney
    - b. occur more often in elderly
    - c. the symptoms are those of a calcium deficiency
    - d. rickets – occurs in children
    - e. osteomalacia – adult form of rickets
  - 4. Toxicities – Hypervitaminosis D
    - a. Causes an increase in calcium absorption
    - b. Kidney stones
    - c. Calcification of blood vessels
- C. Vitamin K
  - 1. Chief function is its role in blood clotting.
    - a. Vitamin K is involved in the synthesis of four of the thirteen proteins involved in blood clotting (Prothrombin is one).
  - 2. Deficiencies may occur if absorption of fat is impaired.
    - a. Can be fatal since blood clots will not form.
  - 3. Toxicities are uncommon unless supplements are being taken.
    - a. Will interfere with anticoagulant therapy
    - b. Symptoms include RBC hemolysis, jaundice, and brain damage.
- D. Vitamin E
  - 1. Chief functions
    - a. antioxidant
    - b. stabilize cell membranes
    - c. regulate oxidation reactions
    - d. Protects polyunsaturated fatty acids and vitamin A
  - 2. Deficiencies are usually caused by diseases that cause malabsorption of fat, such as cystic fibrosis.
    - a. Symptoms include Erythrocytic hemolysis (RBC's break apart)
    - b. Neuromuscular dysfunction of the spinal cord and retina.
  - 3. Toxicities are rare but extremely high doses may interfere with Vitamin K.
  - 4. Vitamin E does NOT
    - a. improve physical performance
    - b. enhance sexual performance in men
    - c. does not prevent aging, graying of the hair, or wrinkling of the skin.
    - d. Cure Parkinson's disease.
  - 5. Vitamin E may
    - a. benefit fibrocystic breast disease
    - b. intermittent claudication (cramping of legs caused by abnormal blood flow).

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## ACTIVITIES

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- I. Survey recent literature for information related to selected vitamin(s). Develop a multimedia presentation.

***Teacher Note***

*Separate class into groups of 2-3. Assign each group vitamin(s).*

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**MATERIALS NEEDED**

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Internet  
Periodicals  
Journals

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**ASSESSMENT**

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**Multimedia Rubric**

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**ACCOMMODATIONS**

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For reinforcement, the student will develop a chart outlining each vitamin listing RDA, deficiency, and toxicity.

For enrichment, the student will develop an awareness pamphlet relating vitamins to health and wellness.

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**REFLECTIONS**

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**VITAMINS and MINERALS: RECOMMENDED DAILY  
ALLOWENCES  
and CONDITIONS RELATED to DEFICIENCIES**

|                              | <b>RDA<br/>70 kg males / 60 kg<br/>females<br/>20 - 50 years</b> | <b>Conditions Related to Deficiency</b>                     |
|------------------------------|--|---|
| Vitamin A                    | 1000 (800) mcg   | night blindness, dry skin, decreased epithelial cell growth |
| Vitamin C                    | 60 (60) mg   | bleeding gums, loosening teeth, increased bruising          |
| Vitamin D                    | 200 (200) IU   | bone loss, serum calcium                                    |
| Vitamin E                    | 12 (15) IU   | possible anemia   |
| Vitamin K                    | 80 (65) mcg  | decreased coagulation, increased risk of hemorrhage         |
| Vitamin B1 (thiamine)        | 1.5 (1.1) mg   | anorexia, constipation, peripheral neuritis                 |
| Vitamin B2 (riboflavin)      | 1.7 (1.3) mg   | glossitis, ocular itching, vascularization                  |
| Vitamin B3 (pyridoxine)      | 2 (1.6) mg   | anemia, convulsions   |
| Folate (folic acid)          | 200 (180) mcg  | macrocytic anemia, neuropathy                               |
| Vitamin B12 (cyanocobalamin) | 2 (2) mcg  | macrocytic anemia, poor muscle coordination                 |
| calcium                      | 800 (800) mg   | bone loss   |
| iron                         | 10 (15) mg   | microcytic anemia   |

Hitner - Nagle: Basic Pharmacology, 4th edition, Glencoe