REPUBLIC OF YEMEN
21September UMAS

الجمهوريـــة اليمنيـة
جـــامعـــة 21 سبتمبر للعلوم
الطبية والتطبيقية

General Nutrition

L5: Vitamins 2

Dr. Samah Al-Sufi

The Fat-Soluble Vitamins

- A, D, E, and K

The Fat-Soluble Vitamins

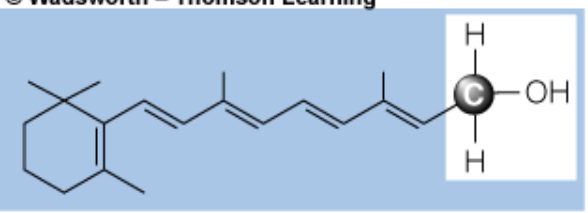
	Water-Soluble Vitamins: B Vitamins and Vitamin C	Fat-Soluble Vitamins: Vitamins A, D, E, and K
Absorption	Directly into the blood.	First into the lymph, then the blood.
Transport	Travel freely.	Many require protein carriers.
Storage	Circulate freely in water-filled parts of the body.	Stored in the cells associated with fat.
Excretion	Kidneys detect and remove excess in urine.	Less readily excreted; tend to remain in fat-storage sites.
Toxicity	Possible to reach toxic levels when consumed from supplements.	Likely to reach toxic levels when consumed from supplements.
Requirements	Needed in frequent doses (perhaps 1 to 3 days).	Needed in periodic doses (perhaps weeks or even months).

NOTE: Exceptions occur, but these differences between the water-soluble and fat-soluble vitamins are valid generalizations.

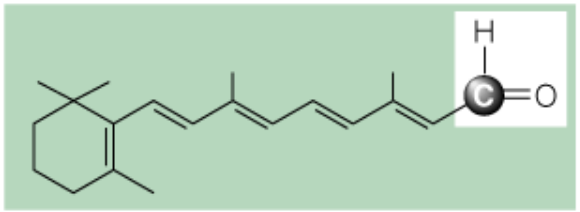
Vitamin A and Beta-Carotene

- Retinoids and carotenoids
  - Vitamin A activity

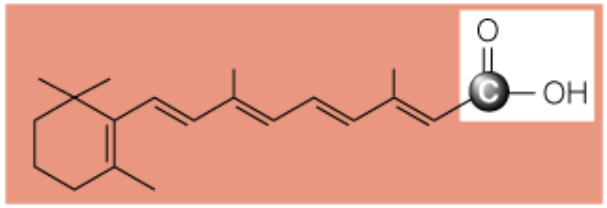
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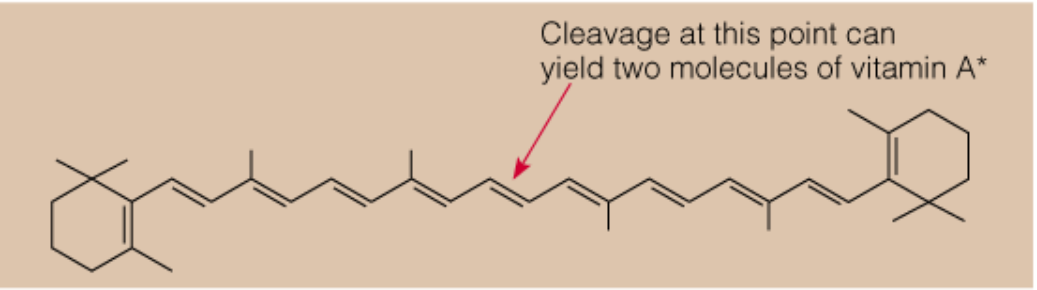
Retinol, the alcohol form



Retinal, the aldehyde form



Retinoic acid, the acid form

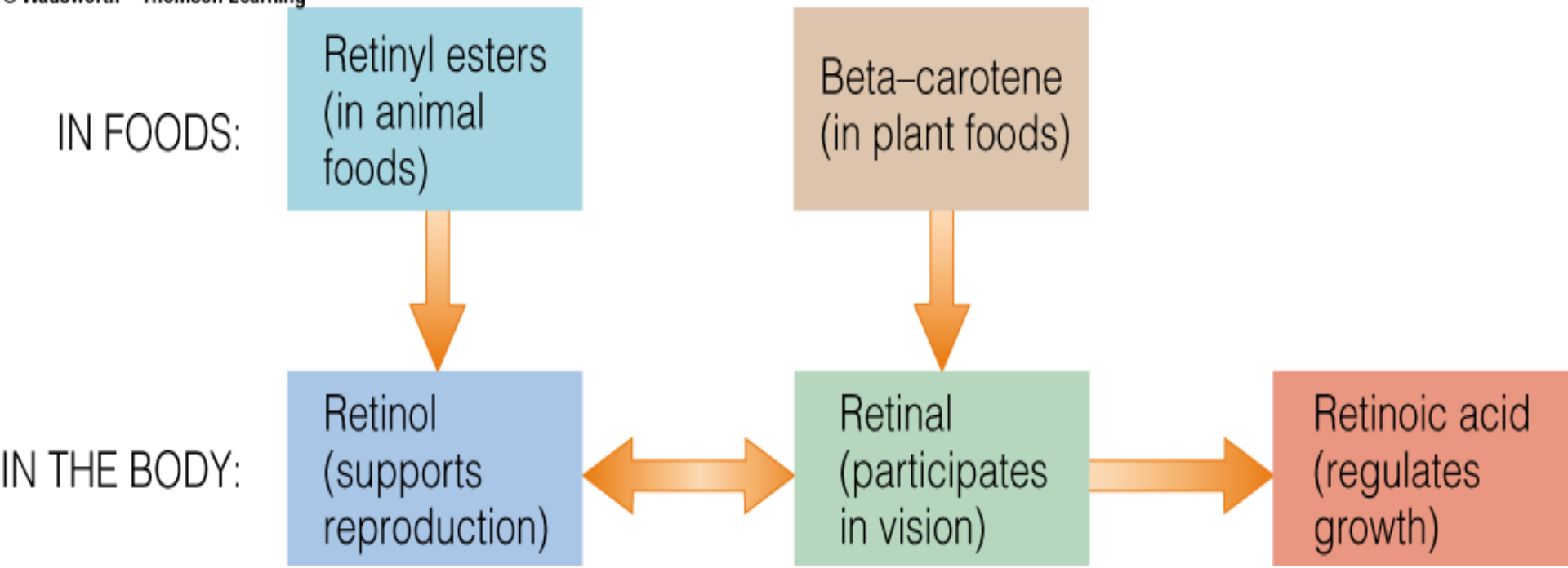


Beta-carotene, a precursor

*Sometimes cleavage occurs at other points as well, so that one molecule of beta-carotene may yield only one molecule of vitamin A. Furthermore, not all beta-carotene is converted to vitamin A, and absorption of beta-carotene is not as efficient as that of vitamin A. For these reasons, 12 ∝g of beta-carotene are equivalent to 1 ∝g of vitamin A. Conversion of other carotenoids to vitamin A is even less efficient.

Vitamin A And Beta-Carotene

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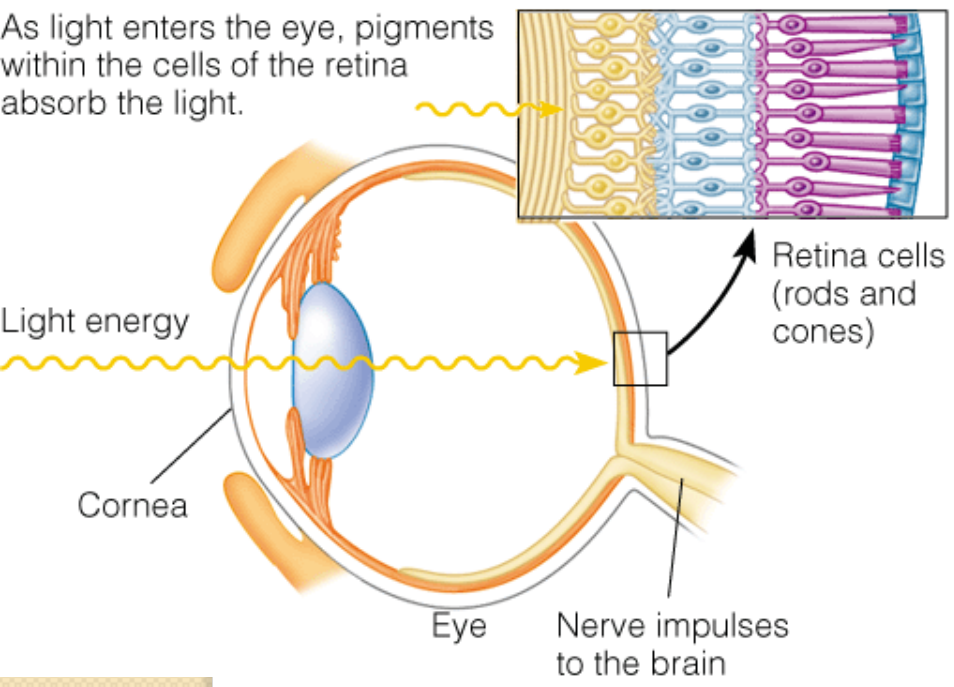


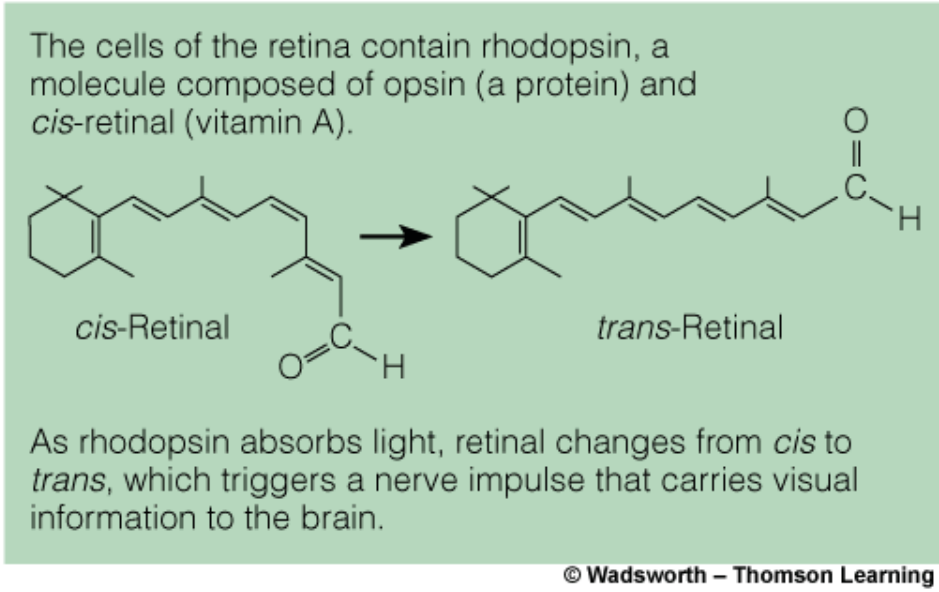
- Other names
  - Retinol
  - Retinal
  - Retinoic acid
  - Precursors are carotenoids such as beta-carotene
- 2001 RDA
  - Men: 900 μg RAE/day
  - Women: 700 μg RAE/day

- Upper level for adults: 3000 μg/day
- Chief functions in the body
  - Vision
  - Maintenance of cornea, epithelial cells, mucous membranes, skin
  - Bone and tooth growth
  - Reproduction
  - Immunity

Vitamin A And Beta-Carotene

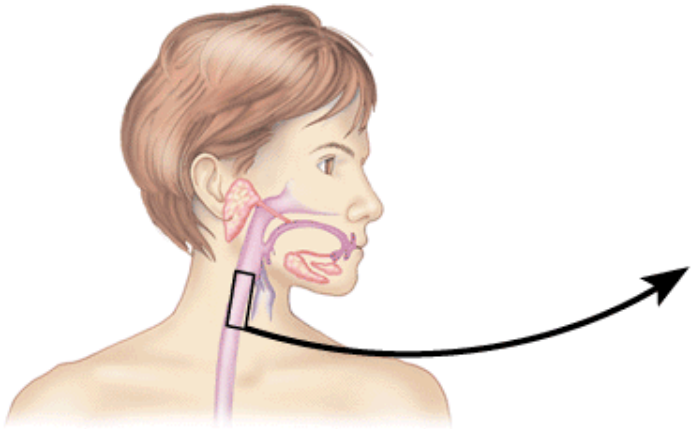
- Roles in the body
  - Vitamin A in vision



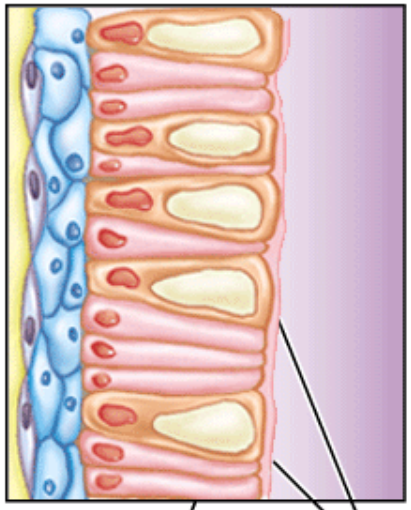


- Roles in the body
  - Vitamin A in protein synthesis and cell differentiation

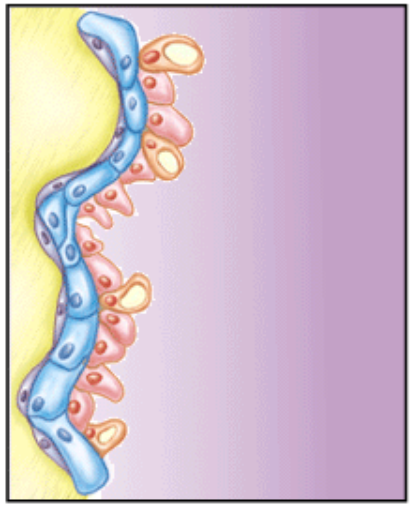
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Vitamin A maintains healthy cells in the mucous membranes.



Without vitamin A, the normal structure and function of the cells in the mucous membranes are impaired.



Mucus

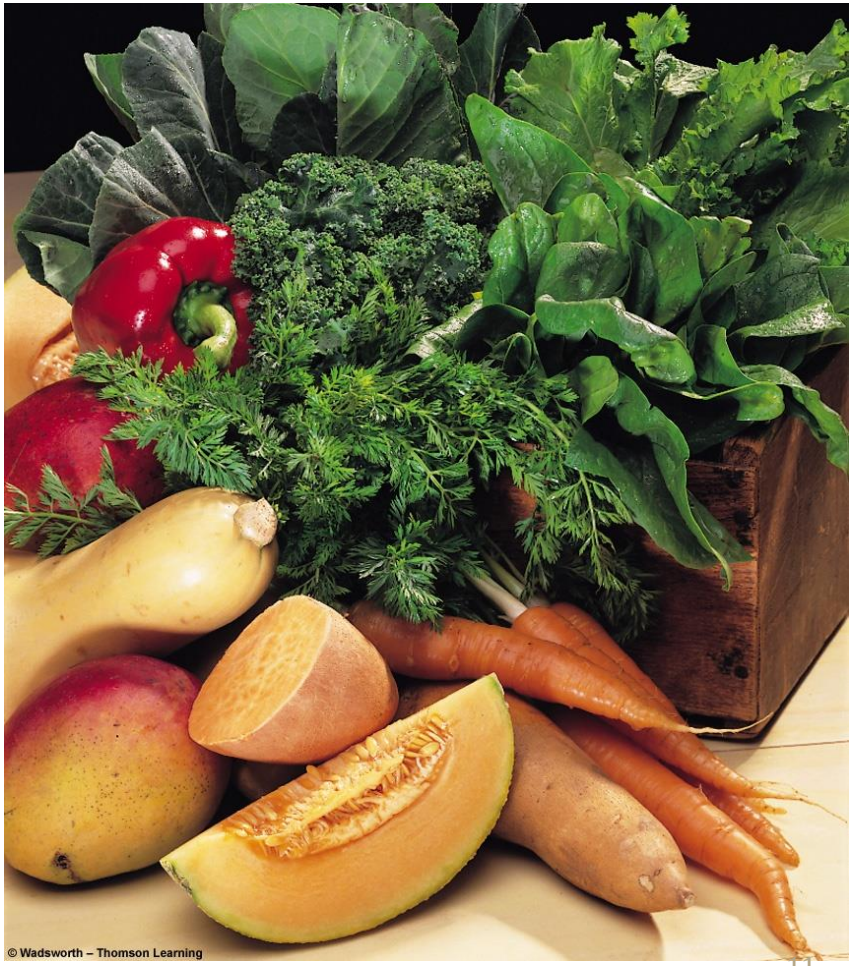
Goblet cells

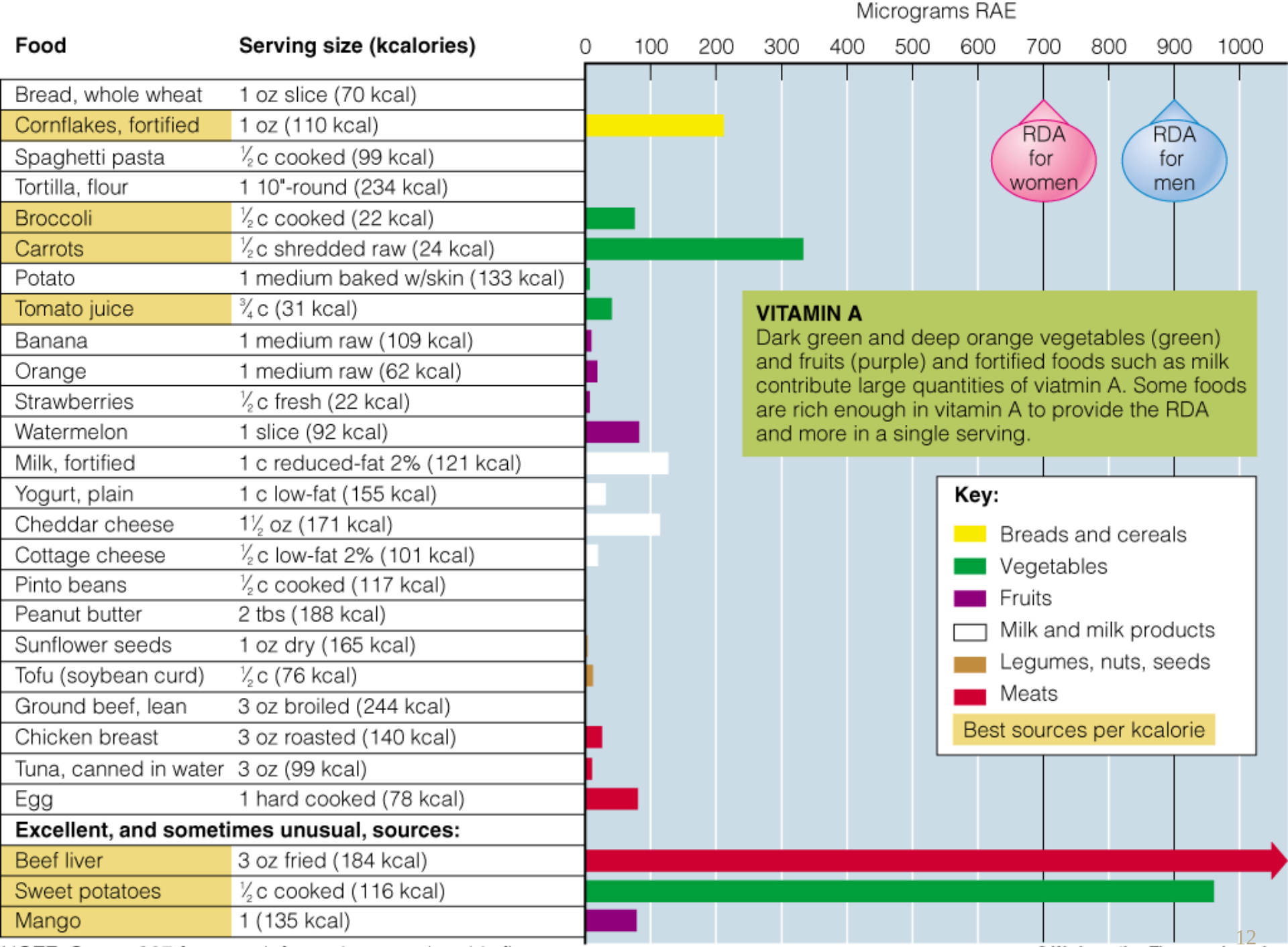
Vitamin A And Beta-Carotene

- Roles in the body
  - Vitamin A in reproduction and growth
  - Beta-carotene as an antioxidant

Vitamin A And Beta-Carotene

- Vitamin A in foods
  - The colors of vitamin A foods
  - Vitamin A-poor: fast foods
  - Vitamin A-rich: liver





Food	Serving size (kcalories)
Bread, whole wheat	1 oz slice (70 kcal)
Cornflakes, fortified	1 oz (110 kcal)
Spaghetti pasta	½ c cooked (99 kcal)
Tortilla, flour	1 10"-round (234 kcal)
Broccoli	½ c cooked (22 kcal)
Carrots	½ c shredded raw (24 kcal)
Potato	1 medium baked w/skin (133 kcal)
Tomato juice	¾ c (31 kcal)
Banana	1 medium raw (109 kcal)
Orange	1 medium raw (62 kcal)
Strawberries	½ c fresh (22 kcal)
Watermelon	1 slice (92 kcal)
Milk, fortified	1 c reduced-fat 2% (121 kcal)
Yogurt, plain	1 c low-fat (155 kcal)
Cheddar cheese	1½ oz (171 kcal)
Cottage cheese	½ c low-fat 2% (101 kcal)
Pinto beans	½ c cooked (117 kcal)
Peanut butter	2 tbs (188 kcal)
Sunflower seeds	1 oz dry (165 kcal)
Tofu (soybean curd)	½ c (76 kcal)
Ground beef, lean	3 oz broiled (244 kcal)
Chicken breast	3 oz roasted (140 kcal)
Tuna, canned in water	3 oz (99 kcal)
Egg	1 hard cooked (78 kcal)
Excellent, and sometimes unusual, sources:	
Beef liver	3 oz fried (184 kcal)
Sweet potatoes	½ c cooked (116 kcal)
Mango	1 (135 kcal)

NOTE: See p. 327 for more information on using this figure.

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- 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 (squash, carrots, sweet potatoes, pumpkin)

Vitamin A deficiency

- Deficiency disease: hypovitaminosis A
- Deficiency symptoms
  - Night blindness, corneal drying (xerosis), triangular gray spots on eye (Bitot's spots), softening of the cornea (karatomalacia), and corneal degeneration and blindness (xerophthalmia)

Vitamin A deficiency

- Deficiency symptoms (continued)
  - Impaired immunity (infections)
  - Accumulation of keratin in a tissue (hyperkaratosis) = rough skin

Deficiency Symptom: Keratinization



Vitamin A toxicity

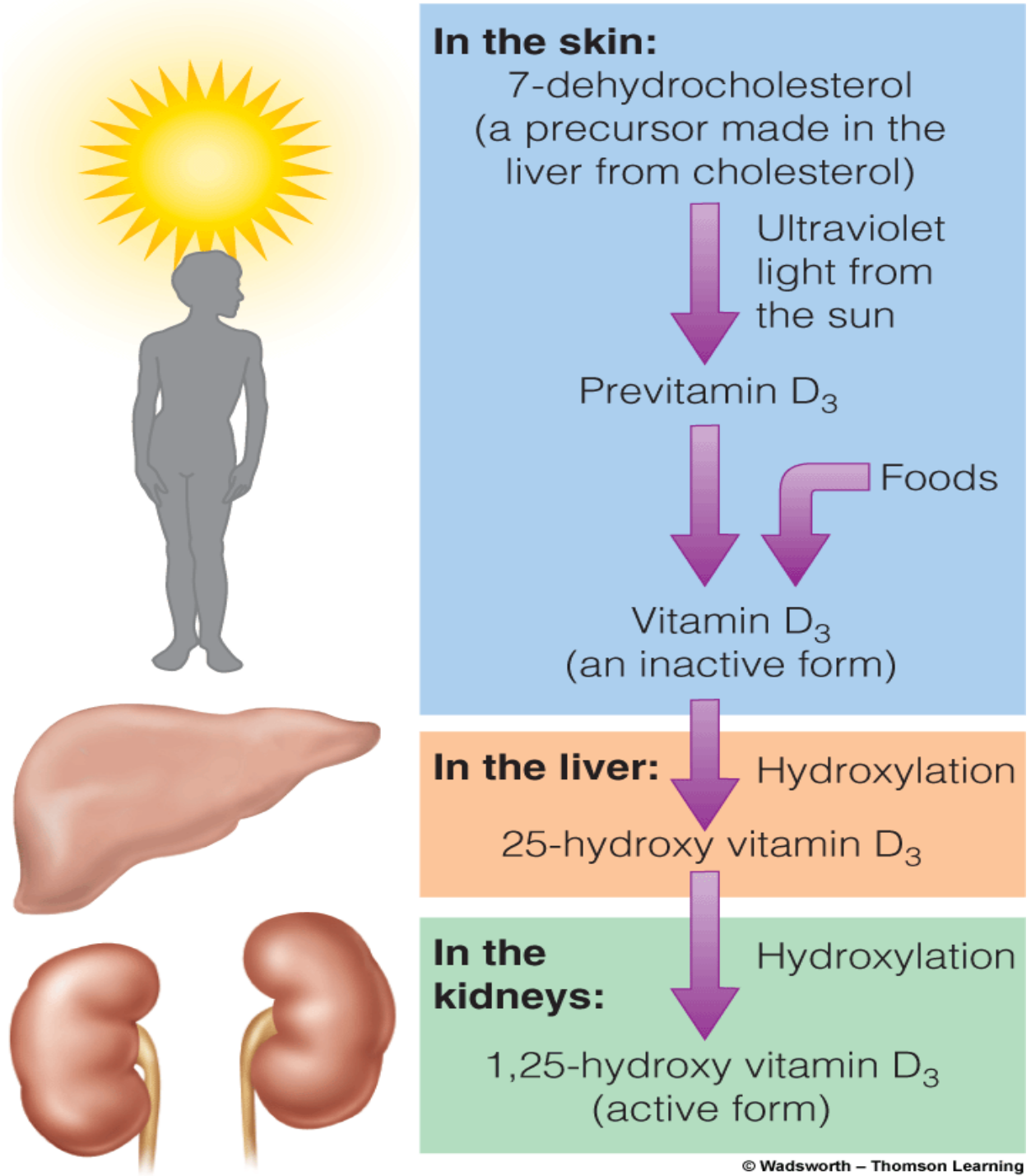
- Toxicity disease: hypervitaminosis A
- **Chronic** toxicity symptoms
  - Increased activity of osteoclasts causing reduced bone density
  - Liver abnormalities
  - Birth defects = teratogenic risk

Vitamin A toxicity

- **Acute** toxicity symptoms
  - Blurred vision
  - Nausea, vomiting, vertigo
  - Headaches

Vitamin D

- Other names
  - Calciferol
  - 1,25-dihyroxy vitamin D (calcitriol)
  - Animal version: vitamin D_3 or cholecalciferol
  - Plant version: vitamin D_2 or ergocalciferol
  - Precursor is the body's own cholesterol



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Vitamin D

- 1997 adequate intake (AI)
  - 19-50 years: 5 μg/day
  - 51-70 years: 10 μg/day
  - more than 70 years: 15 μg/day
- Upper level for adults: 50 μg/day

Vitamin D

- Chief functions in the body
  - Mineralization of bones (raises blood calcium and phosphorus)

Vitamin D

- Significant sources
  - Synthesized in the body with the help of sunlight
  - Fortified milk, margarine, butter, cereals, and chocolate mixes
  - Veal, beef, egg yolks, liver, fatty fish (herring, salmon, sardines) and their oils

Vitamin D

- Deficiency diseases
  - Rickets
  - Osteomalacia



Bowed legs. In rickets, the poorly formed long bones of the legs bend outward as weight-bearing activities such as walking begin.

Vitamin D

- Deficiency symptoms: rickets in children
  - Inadequate calcification, resulting in misshapen bones (bowing of legs)
  - Enlargement of ends of long bones (knees, wrists)
  - Deformities of ribs (bowed, with beads or knobs)

Vitamin D

- Deficiency symptoms: osteomalacia in adults
  - Loss of calcium, resulting in soft, flexible, brittle, and deformed bones

Vitamin D

- Deficiency symptoms: osteomalacia in adults (cont.)
  - Progressive weakness
  - Pain in pelvis, lower back, and legs
- Toxicity disease: hypervitaminosis D

Vitamin D

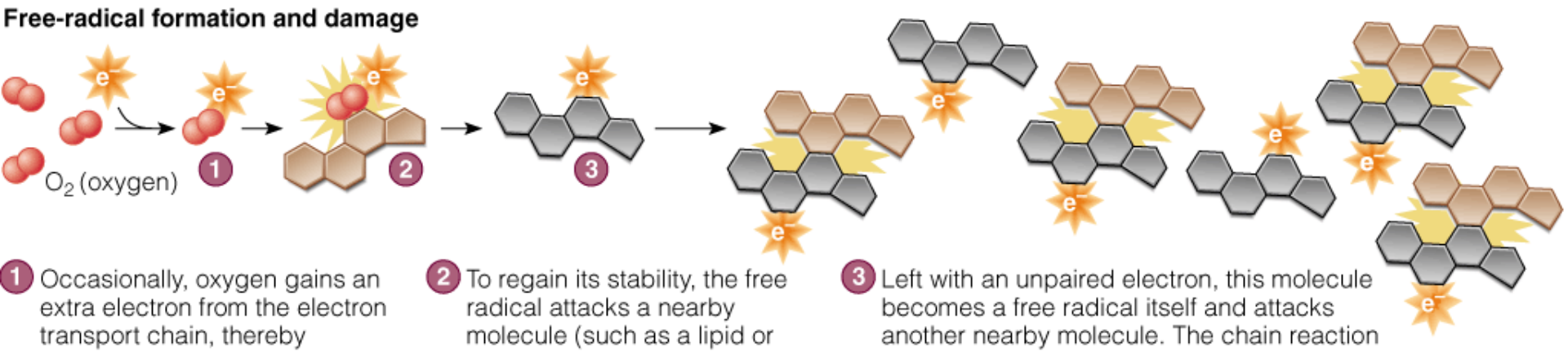
- Toxicity symptoms
  - Elevated blood calcium: hypercalcemia
  - Calcification of soft tissues (blood vessels, kidneys, heart, lungs, tissues around joints)
  - Frequent urination

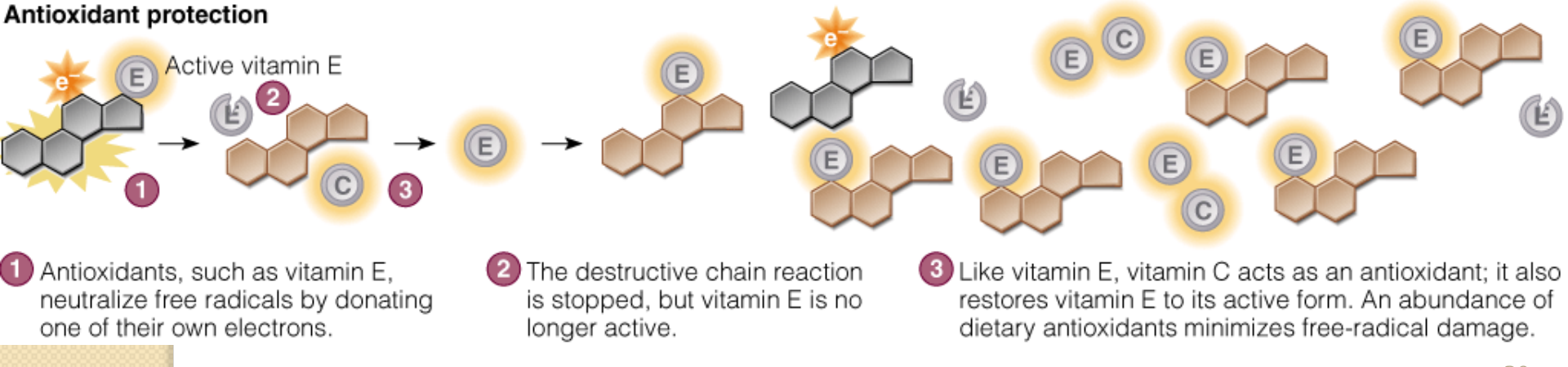
Vitamin E

- Other name: alpha-tocopherol
- 2000 RDA
  - Adults: 15 mg/day
- Upper level for adults: 1000 mg/day
- Chief function in the body
  - Antioxidant (stabilization of cell membranes, regulation of oxidation reactions, protection of polyunsaturated fatty acids and vitamin A)

Vitamin E

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Vitamin E



Significant sources

- Polyunsaturated plant oils (margarine, salad dressings, shortenings)
- Leafy green vegetables, wheat germ, whole grains, liver, egg yolks, nuts, seeds

Vitamin E

- Deficiency symptoms
  - Red blood cell breakage = erythrocyte hemolysis
  - Nerve damage

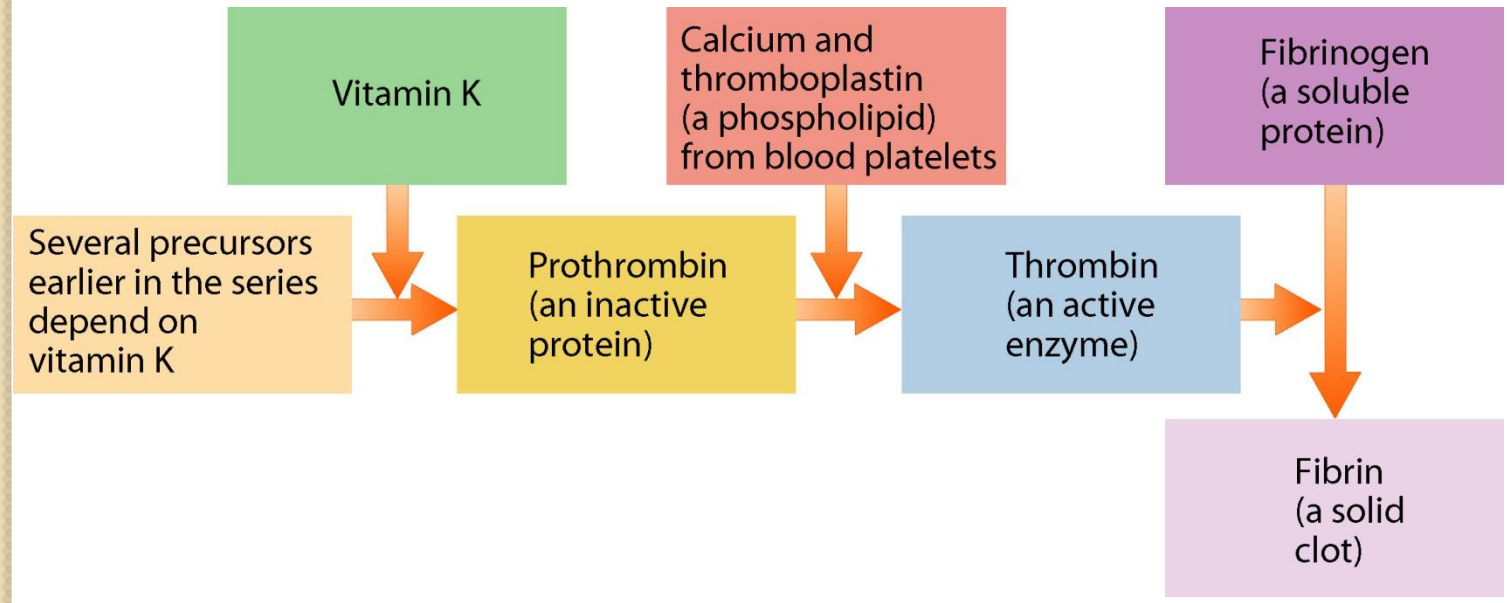
- Toxicity symptoms
  - Increases the effects of anticlotting medication

Vitamin K

- Other names
  - Phylloquinone
  - Manaquinone
  - Menadione
  - Naphthoquinone
- 2001 AI
  - Men: 120 μg/day
  - Women: 90 μg/day

Vitamin K

- Chief functions in the body
  - Synthesis of blood-clotting, proteins and bone proteins that regulate blood clotting



Vitamin K

- Significant sources
  - Bacterial synthesis in the digestive tract
  - Liver
  - Leafy green vegetable cabbage-type vegetables
  - Milk



Vitamin K

- Deficiency symptoms
  - Hemorrhaging
- Toxicity symptoms
  - None known