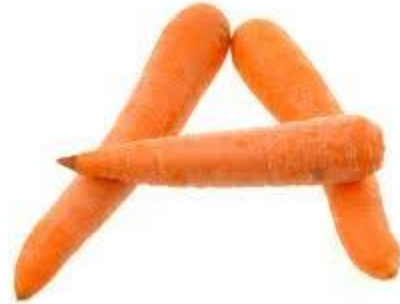


Vitamin



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Outlines

- **General biochemistry and types**
- **General functions**
- **Functions in the vision cycle**
- **Deficiency and diseases**

Vitamins

- Organic compounds present in small quantities in different types of food
- Help in various biochemical processes in cell
- Most act as coenzymes
- Important for growth and maintaining good health
- Essential
- Non-caloric
- Required in very small amounts

Vitamins - Classified Based on Solubility

- **Fat-Soluble Vitamins**
 - A, D, E, and K
- **Water-Soluble Vitamins**
 - ascorbic acid (vitamin C)
 - thiamin (vitamin B₁)
 - riboflavin (vitamin B₂)
 - niacin
 - pyridoxine (vitamin B₆)
 - biotin
 - pantothenic acid
 - folate
 - cobalamin (vitamin B₁₂)

Fat-soluble Vitamins

- Stored in the liver and adipose tissue
- Excess may accumulate and cause toxicity
- Cases of toxicity with vitamin A and D have been reported
- Do not need to be consumed each day due to storage in the body
- Absorbed slowly with fats
- Diseases due to deficiency are rare as large amounts are stored in the body

Vitamin A from plants

Provitamin

- **Are inactive but can be converted into retinoids when metabolized in the body**
- **Carotenoids (b-carotene) and cryptoxanthin**
 - **One molecule of b-carotene can be cleaved into two molecules of retinal in the intestine. (but an inefficient process)**

Vitamin A from animal sources

Preformed

- Are metabolically active
- Three preformed compounds (retinoids)
 - *retinol* – is convertible to other forms of vit A
 - found in animal tissues as retinyl esters
 - *retinal or retinaldehyde* – essential in vision
 - *retinoic acid* – essential for skin health and bone growth
 - cannot be reduced in the body and therefore cannot give rise to either retinal or retinol

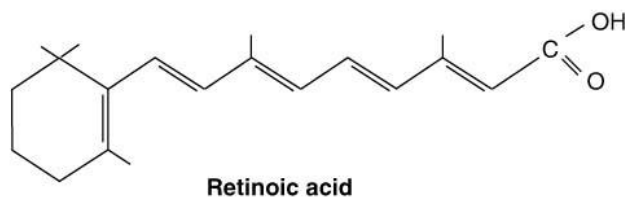
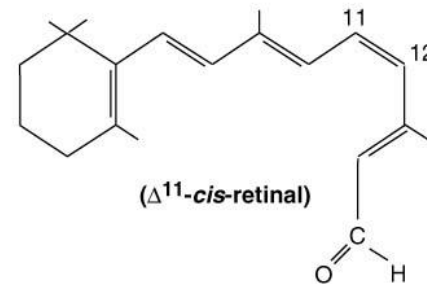
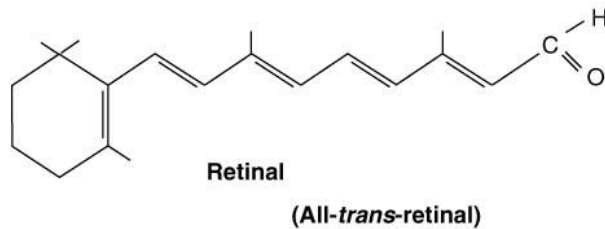
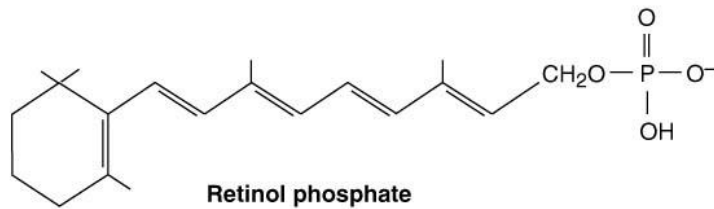
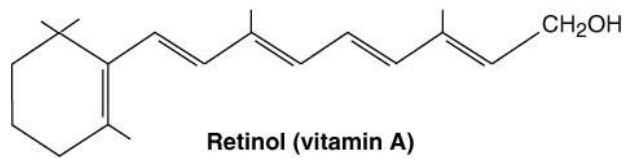
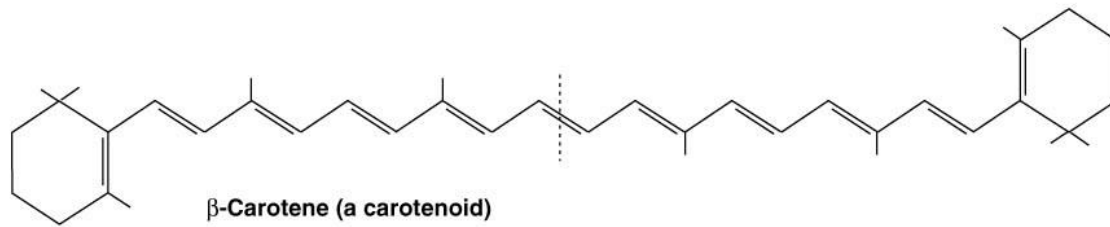
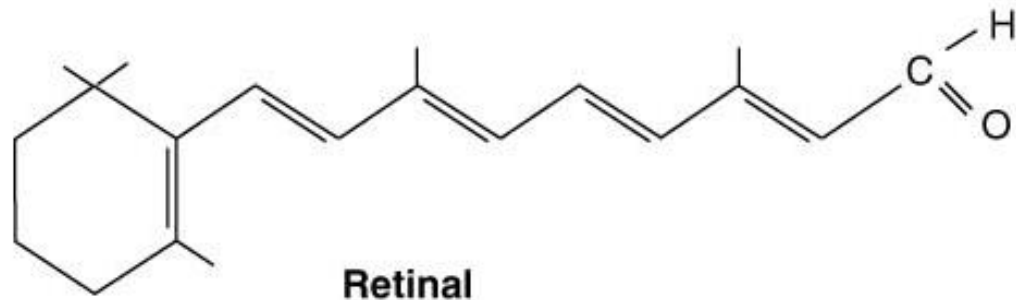
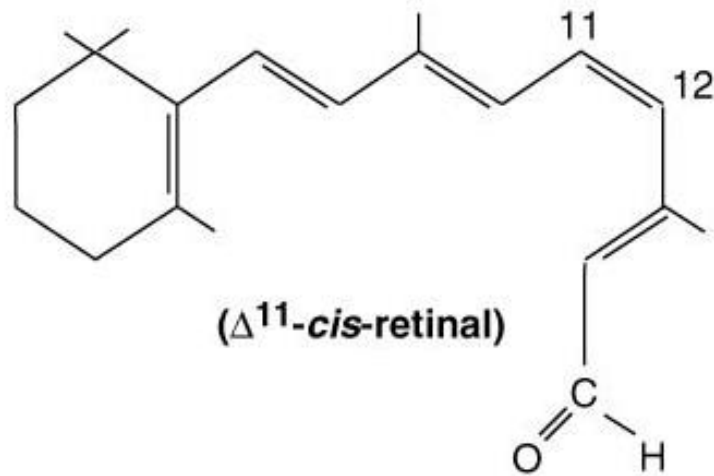
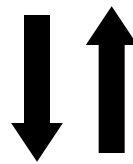


Figure 28.2. Structures of vitamin A and related compounds.



Retinal

(All-*trans*-retinal)



(Δ^{11} -*cis*-retinal)

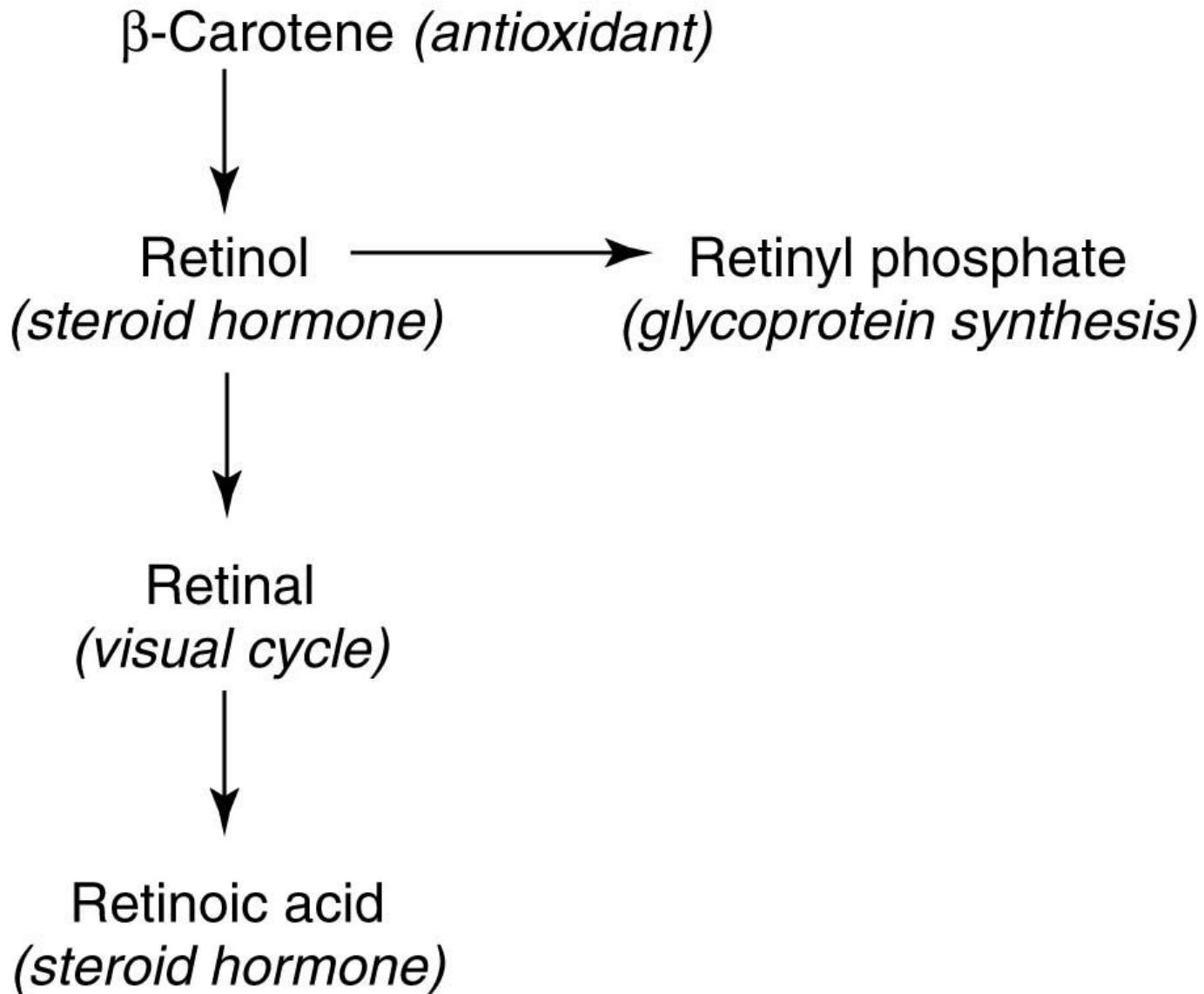
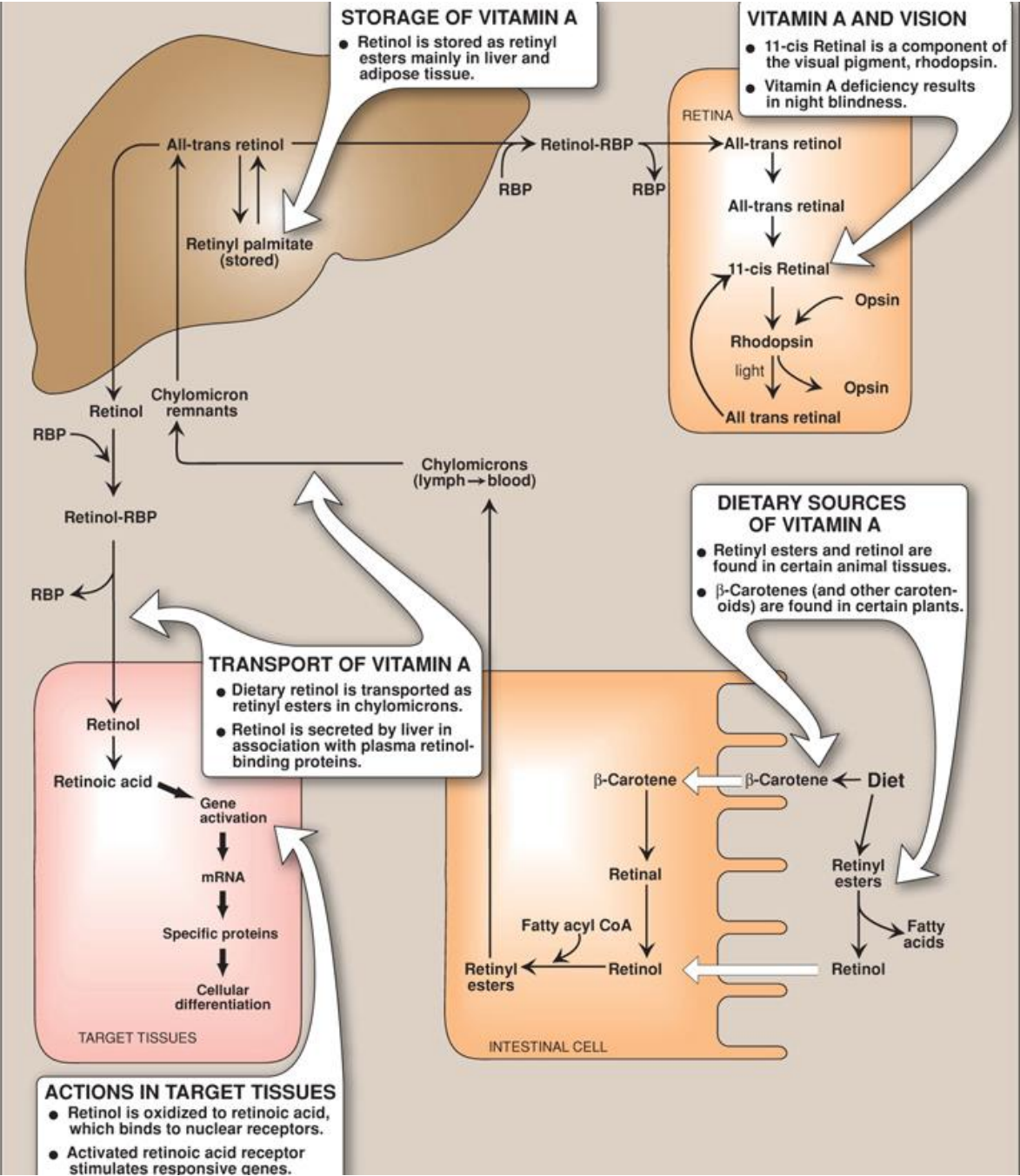
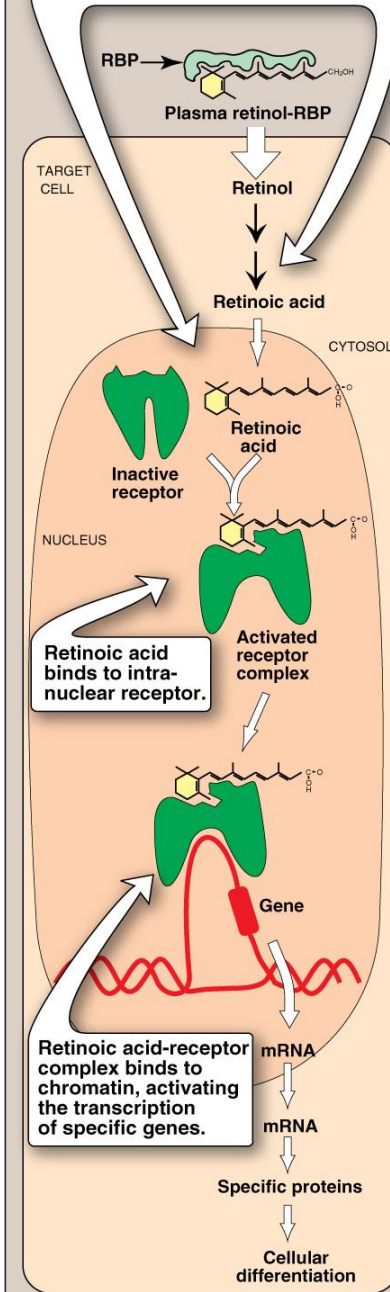


Figure 28.3. Vitamin A metabolism and function.



Retinol is oxidized to retinoic acid. Movement from cytosol to nucleus is guided by cellular retinol-binding proteins and cellular retinoic acid-binding proteins.



Functions of Vitamin A

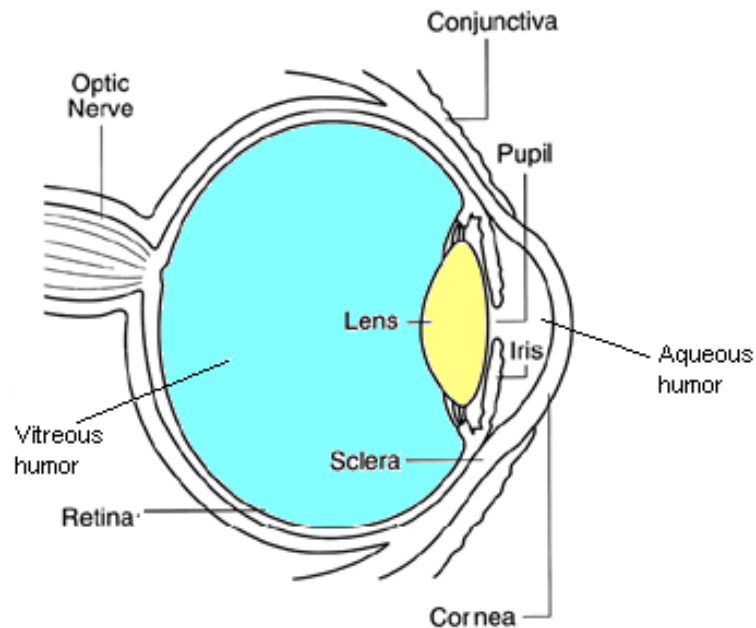
- Vision**
- Gene transcription**
- Immune function**
- Embryonic development and reproduction**
- Bone metabolism**
- Skin Health**
- Antioxidant activity**

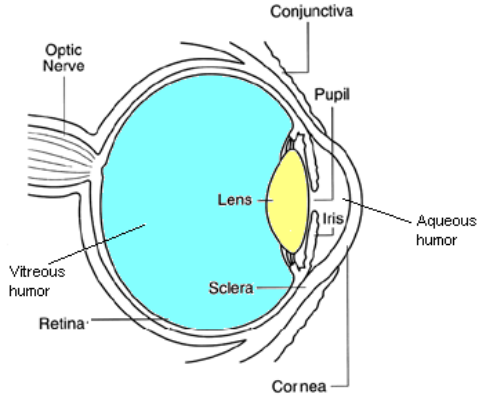
Vitamin A

- **Essential role in vision and normal cell differentiation**
- **Deficiency most significant cause of blindness in the developing world**
- **Large doses over a prolonged period of time can produce intoxication and eventually lead to liver disease**
- **Excessive carotenoids intake can result in yellowing of the skin, but appears to be harmless**

Role of Vitamin A in Vision

- **Normal vision depends on the retina and on adequate vitamin A**
- **George Wald was awarded Nobel Prize in 1967, for identifying the role of vitamin A in vision**





Role of Vitamin A in Vision

- **Retina is a light-sensitive layer of cells at the back of the eye where an image is formed**
- **Retina consists of: Rod and cone cells (photosensitive cells)**
- **Rod cells process black & white image**
- **Cone cells process color image**
- **Vitamin A in the form of retinal binds opsin proteins to make rhodopsin (in rods) and iodopsin (in cones)**

Microscopic Anatomy of the Retina

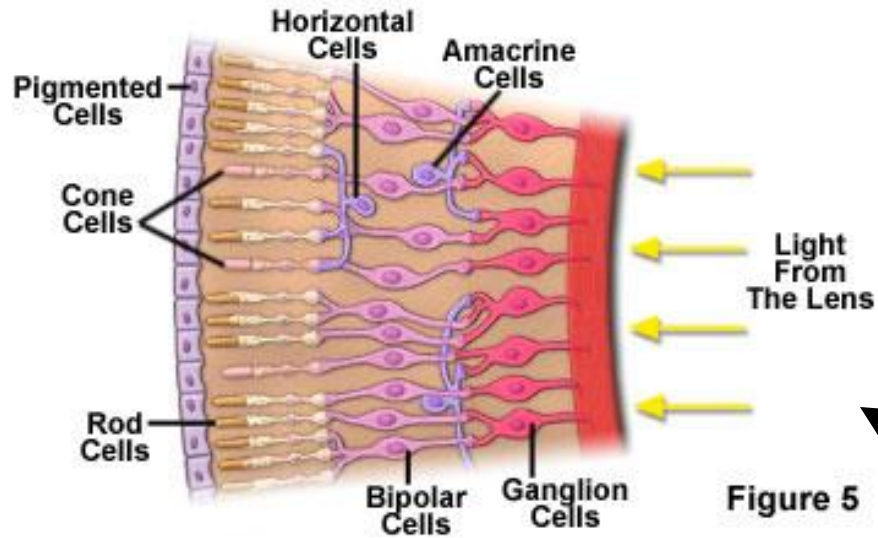
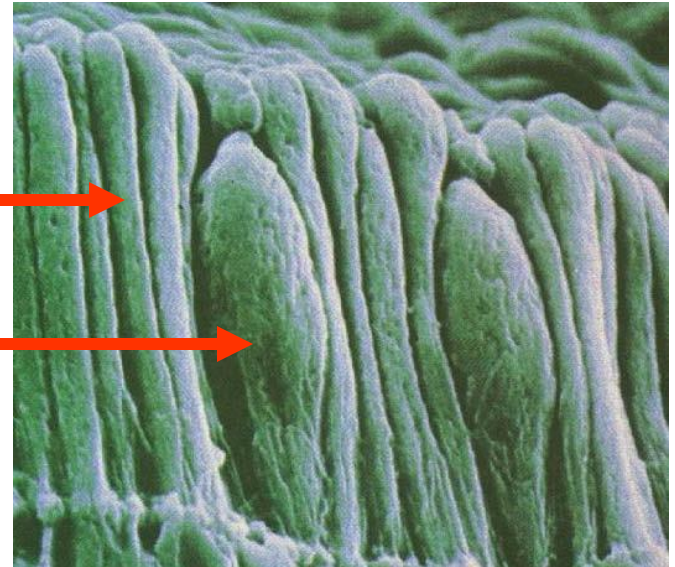


Figure 5

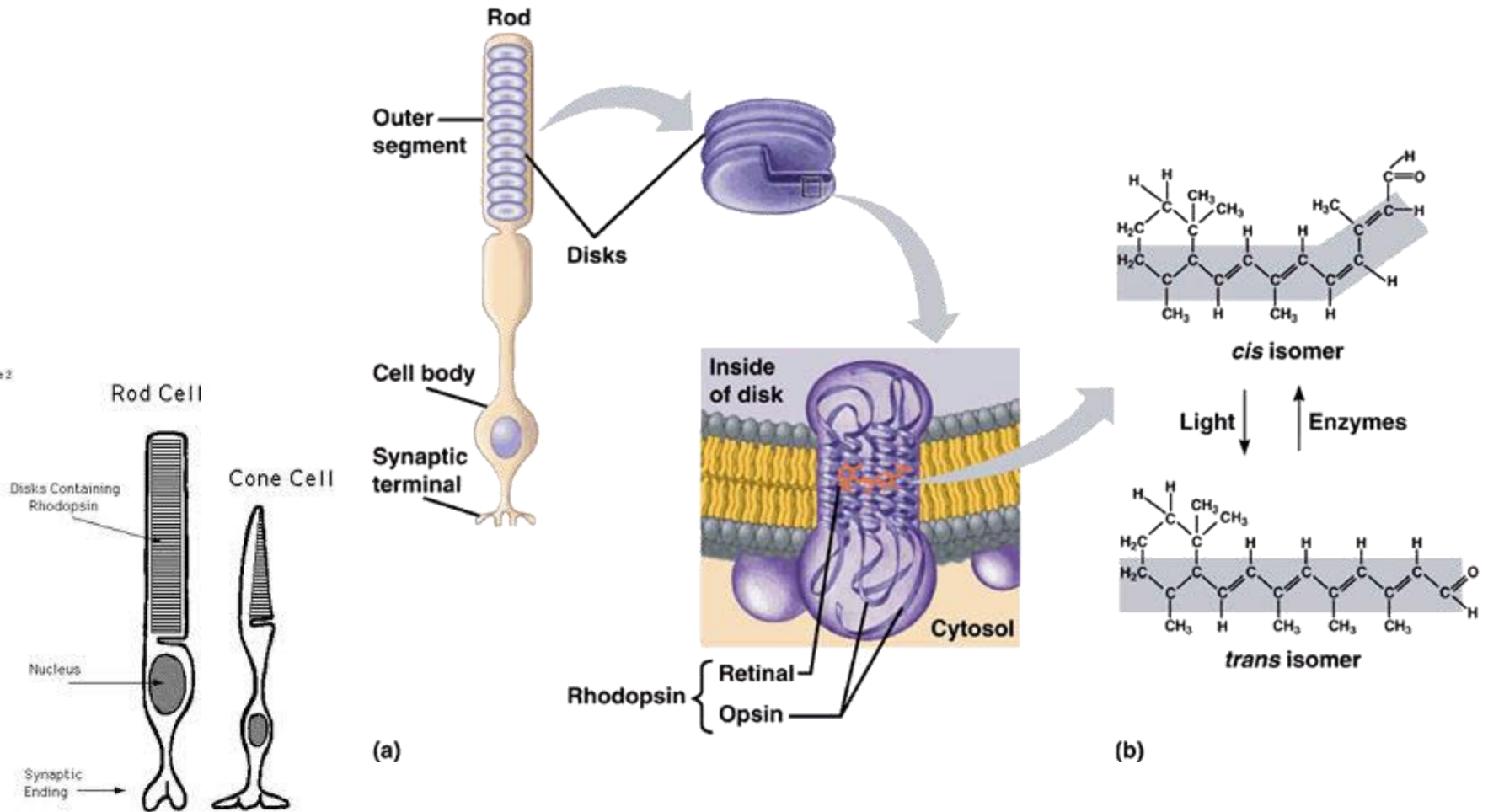
Rod Cell →

Cone Cell →



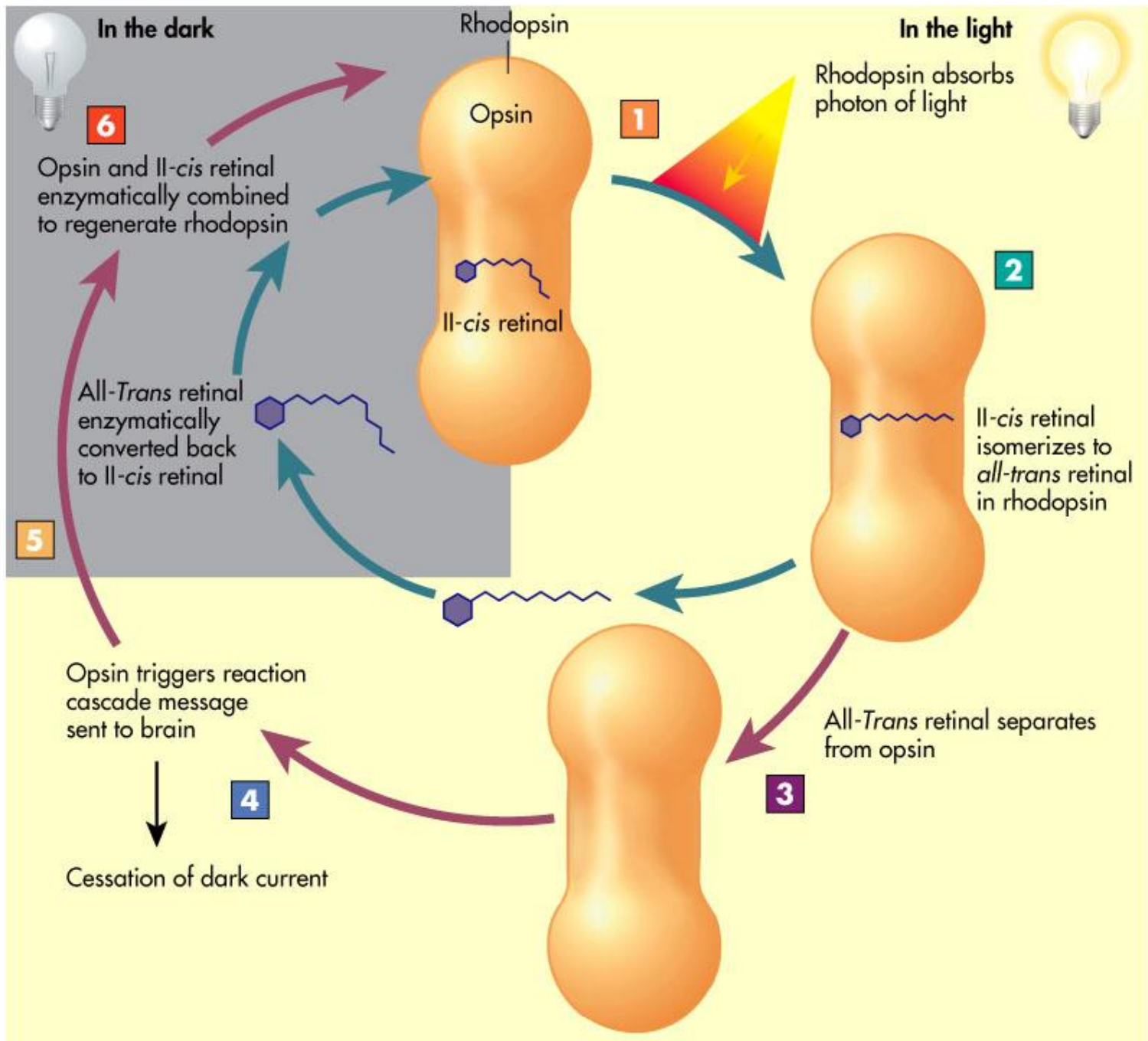
Rhodopsin and retinal structures

Figure 2



Visual Cycle

- **It is the process where light impacting on the photosensitive cells of the retina is converted into an electrical signal to the optic nerve**
- **The nerve impulse generated by the optic nerve is conveyed to the brain where it can be interpreted as vision.**



Fat-Soluble Vitamins - Vitamin A and the
Visual Cycle.webarchive

Role of Vitamin A in Vision

- **When stimulated by light vitamin A changes (or isomerizes) from its bent ‘cis’ form to a straighter ‘trans’ form and detaches from opsin**
- **The opsin molecule changes shape, which sends a signal to the brain and an image is formed**
- **Most retinal released in this process is quickly converted to trans-Retinol and then to cis-Retinal, to begin another cycle**

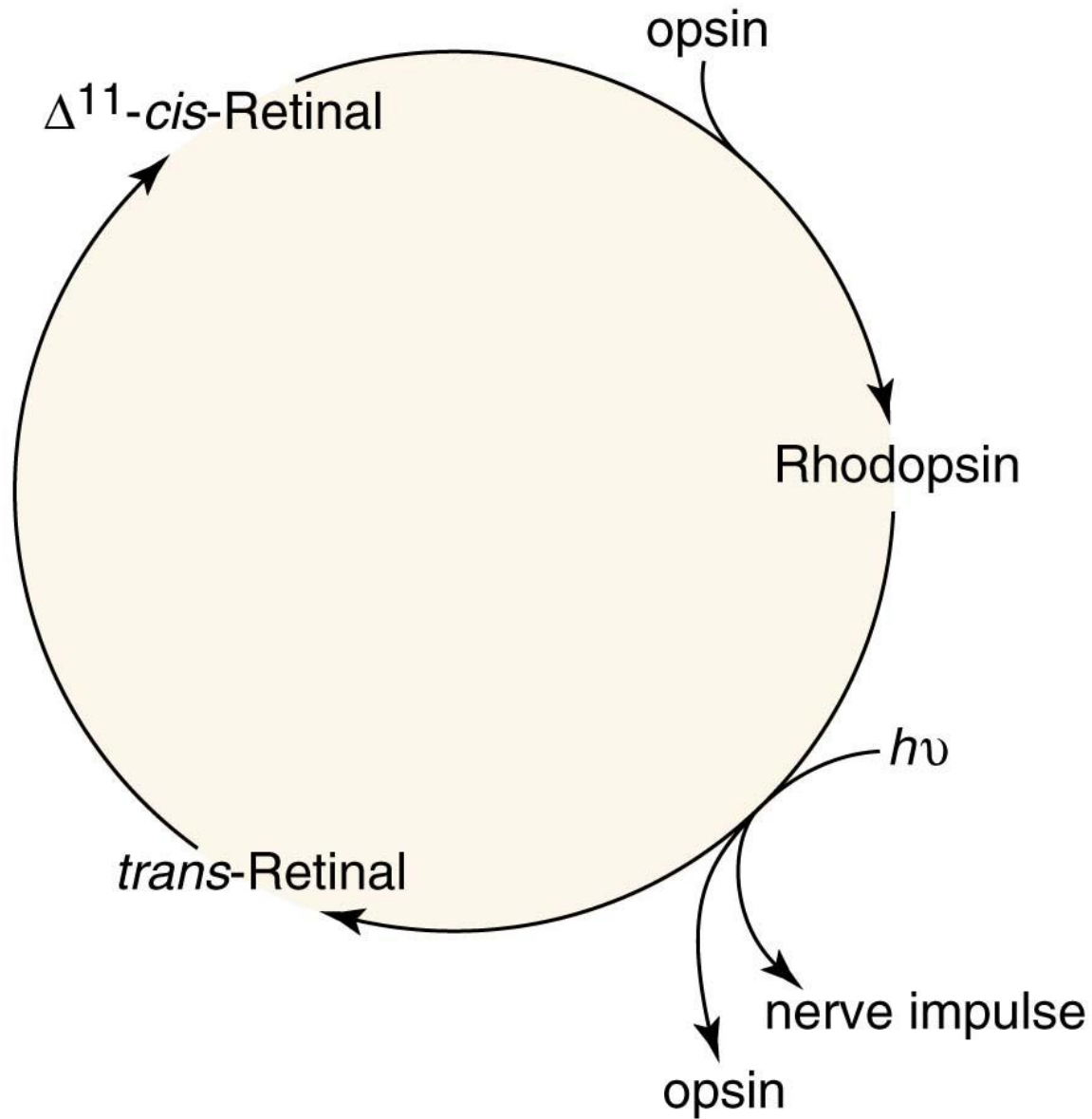


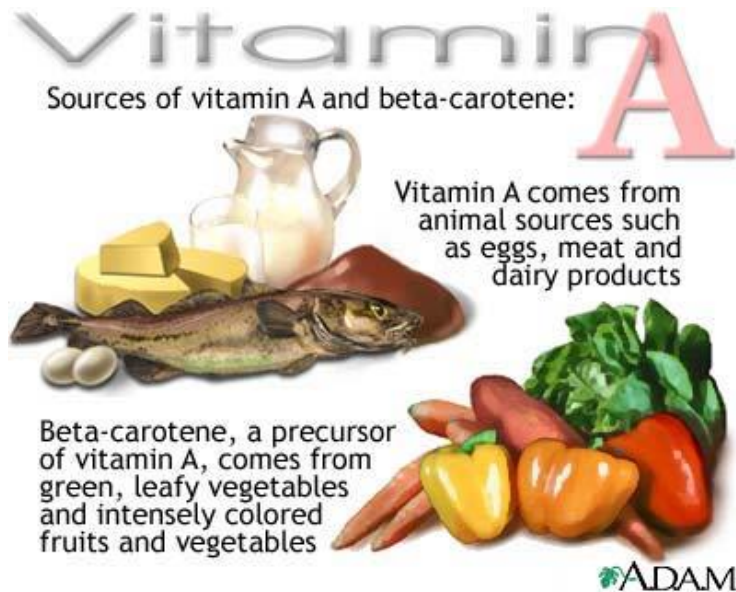
Figure 28.4. Role of vitamin A in vision.

Dark Adaptation time

- **Bright light depletes stores of rhodopsin in rods**
- **A sudden shift from bright lights to dimly lit area causes difficulty in seeing**
- **Rhodopsin is synthesized in few minutes and vision is improved**
- **This time is called the dark adaptation time**
- **Dark adaptation time is increased in vitamin A deficiency**

Recommended Dietary Allowance (RDA)

- ***Vitamin A for Adults***
 - **Women: 700 μg or 2,330 IU μg**
 - **Men: 900 μg or 3,000 IU**
 - **UL Men or Women: 3,000 μg or 10,000 IU**



Vitamin A Deficiency and Diseases

- **Night blindness or Nyctalopia** -patient cannot see in low light or near darkness conditions
- **Xerophthalmia** - dryness of the conjunctiva and cornea
- **Bitot' s spots**- localized increased thickness of conjunctiva
- **Keratomalacia** – prolonged xerophthalmia leads to drying and clouding of cornea
- **Blindness**

Thank You

