INE | INSTITUTE OF NUTRITIONAL ENDOCRINOLOGY

Micronutrients: Vitamin A

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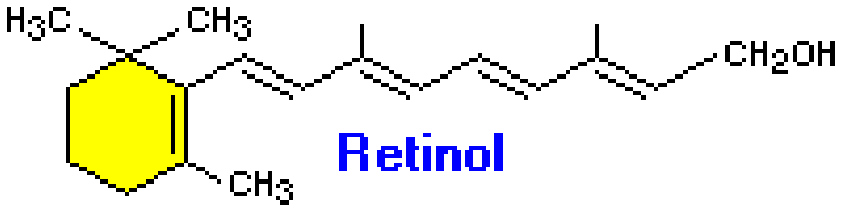
Vitamin 

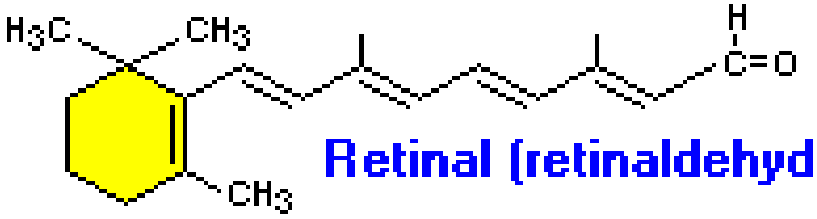
Fat soluble vitamin – actually a group of compounds, that includes:

- Retinol
- Retinal
- Retinoic acid
- Provitamin A carotenoids
  - Beta-carotene
  - Alpha-carotene
  - Gamma-carotene
  - Lutein
  - Lycopene
  - Zeaxanthin

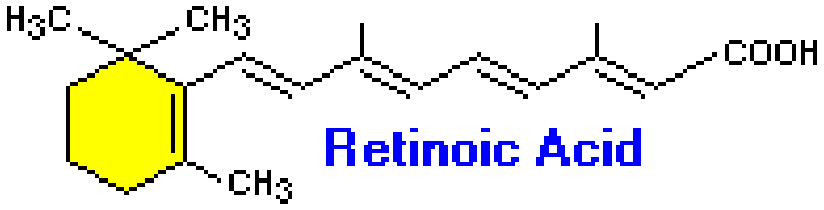
Vitamin A Structure



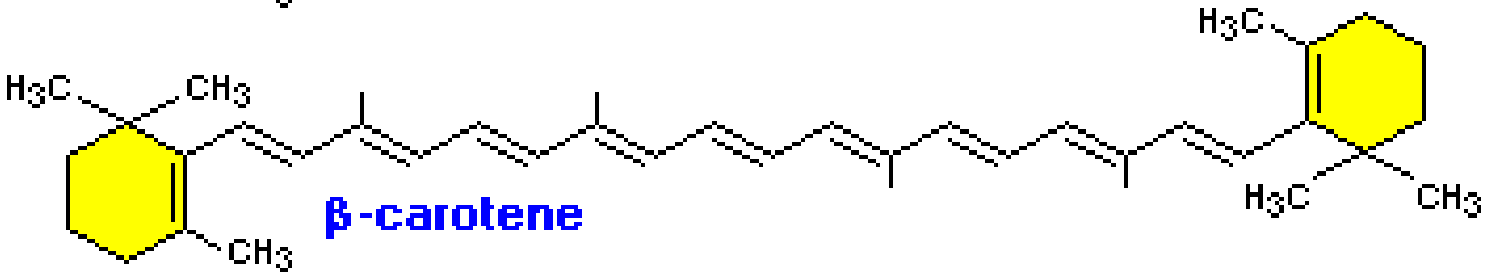
Retinol



Retinal (retinaldehyde)



Retinoic Acid

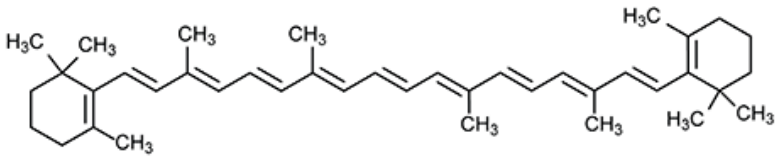


β-carotene

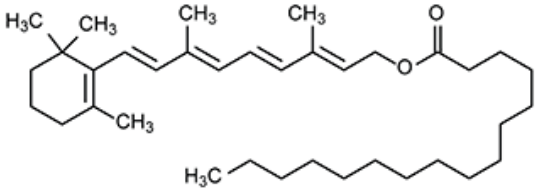
Main Functions of Vitamin A

- ✓ Vision
- ✓ Gene transcription
- ✓ Embryonic development and reproduction
- ✓ Hematopoiesis
- ✓ Protein synthesis
- ✓ Cell-differentiation
- ✓ Integrity of skin and epithelial tissues
- ✓ Immune function
- ✓ Bone metabolism
- ✓ Antioxidant activity

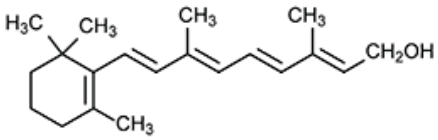
Vitamin A Chemical Structure



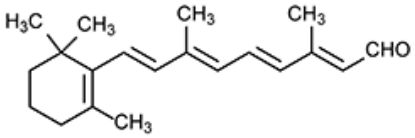
beta-carotene



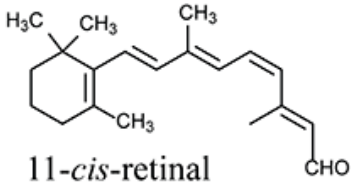
retinyl palmitate



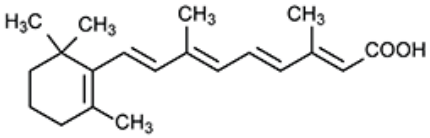
all-*trans*-retinol



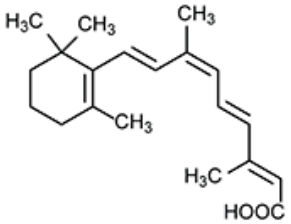
all-*trans*-retinal



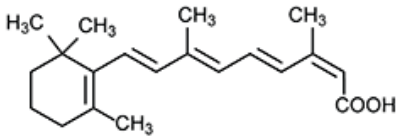
11-*cis*-retinal



all-*trans*-retinoic acid

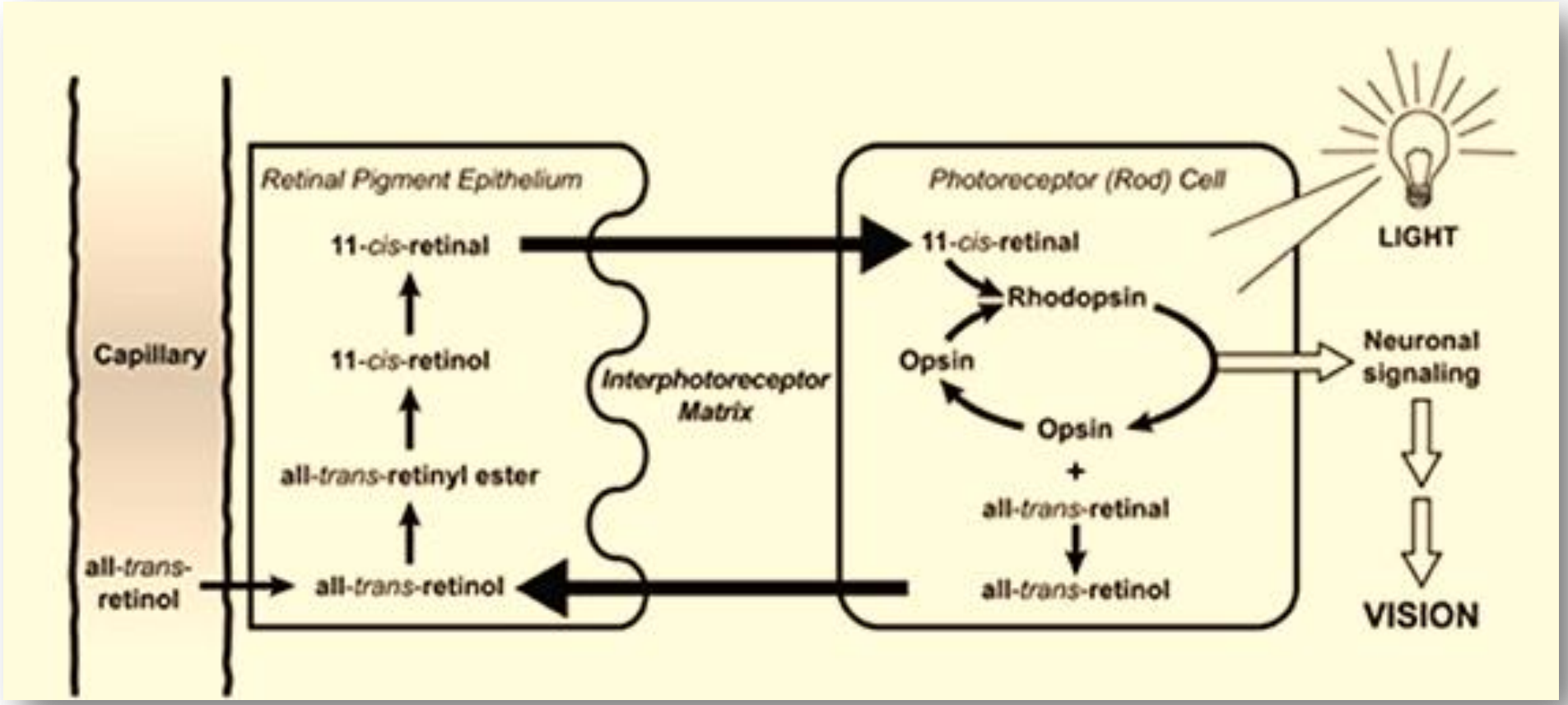


9-*cis*-retinoic acid

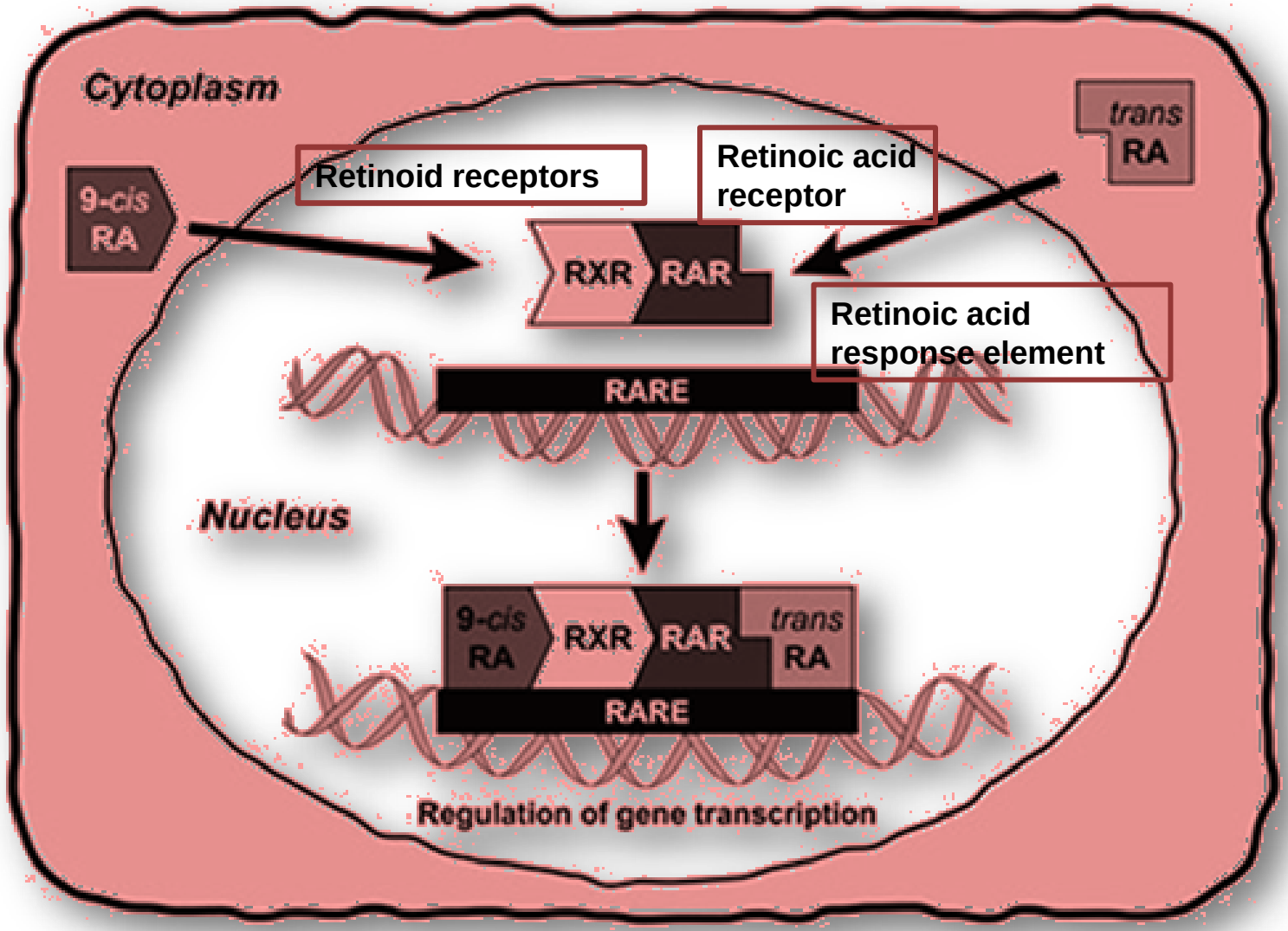


13-*cis*-retinoic acid

Vitamin A and Vision



Vitamin A and Gene Transcription



Vitamin A and Immunity

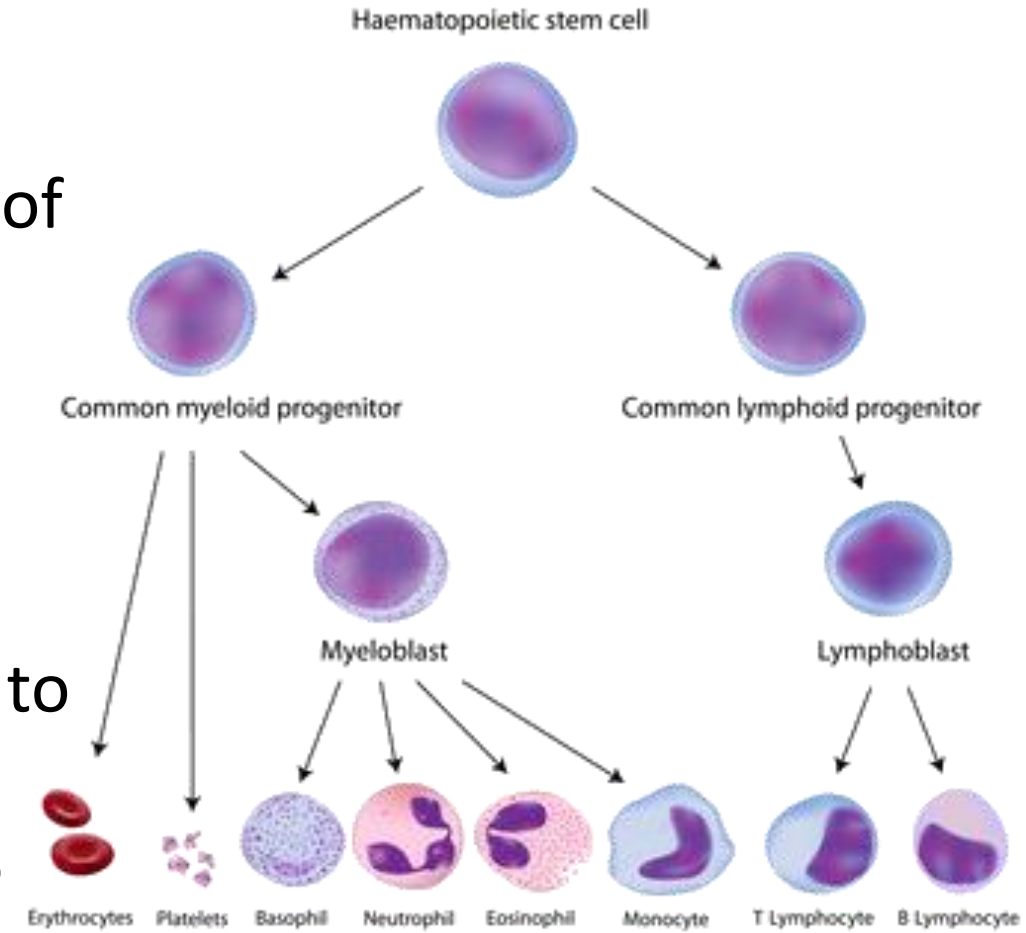
- ✓ Retinoic acid produced by antigen-presenting cells (APCs), including macrophages and dendritic cells
- ✓ Retinoic acid acts on dendritic cells to regulate differentiation, migration, and APC
- ✓ Retinoic acid required for differentiation of naïve CD4 T-lymphocytes into regulatory T- lymphocytes
- ✓ All-trans-RA/RARα signaling promotes conversion of naïve CD4 T-lymphocytes into effector helper T-cells (Th1) and induces proinflammatory cytokines
- ✓ Vitamin A may play a role in autoimmunity

Embryonic Development And Reproduction

- ✓ Both vitamin A excess and deficiency are known to cause birth defects.
- ✓ Retinoic acid is critical for development of heart, eyes, ears, lungs, limbs, and visceral organs.
- ✓ Vitamin A has been implicated in fetal lung maturation - lower in preterm newborns.
- ✓ Supplementation may help reduce incidence of chronic lung disease and mortality in preterm newborns.

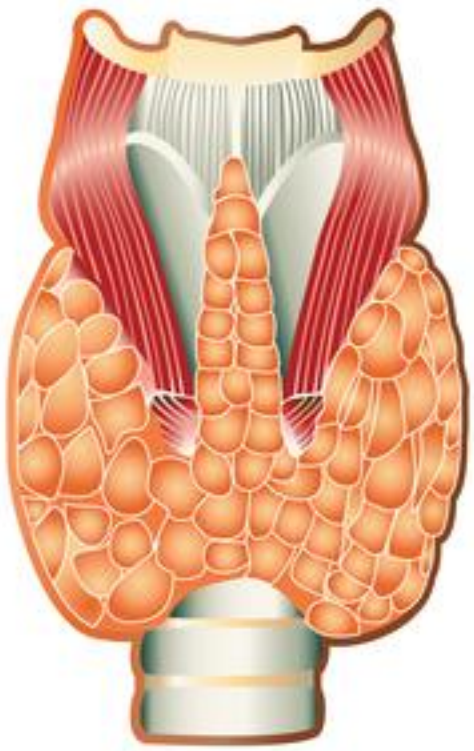
Hematopoiesis

- ✓ A role in stem cell commitment and differentiation
- ✓ Regulates apoptosis (programmed cell death) of red blood cell precursors
- ✓ Increases hemoglobin concentration
- ✓ Facilitates mobilization of iron from storage sites to the developing red blood cell for incorporation into hemoglobin



Vitamin A Deficiency and Thyroid

- ✓ Increases TSH
- ✓ Increases the size of the thyroid gland
- ✓ Reduces iodine uptake by the thyroid gland
- ✓ Impairs the synthesis and iodination of thyroglobulin
- ✓ Increases circulating concentrations of thyroid hormones



Nutrient Interactions: Vitamin A and Zinc

- ✓ Zinc deficiency results in decreased synthesis of retinol-binding protein, which transports retinol to peripheral tissues and protects against potential toxicity of retinol
- ✓ Zinc deficiency results in decreased activity of retinyl palmitate, the enzyme that releases retinol from its storage form
- ✓ Zinc is required for the enzyme that converts retinol into retinal

Nutrient Interactions: Vitamin A and Iron

- ✓ Vitamin A deficiency may exacerbate iron deficiency anemia by altering iron metabolism
- ✓ Vitamin A improves iron status among children and pregnant women
- ✓ Vitamin A and iron together seem to reduce anemia more effectively than either alone
- ✓ Studies in rats: iron deficiency alters plasma and liver levels of vitamin A

Deficiency of Vitamin

- ✓ Night blindness (nyctalopia)
- ✓ Blindness
- ✓ Keratomalacia: softening of the cornea
- ✓ Xerosis: dry skin
- ✓ Rough/dry skin
- ✓ Reduced sense of smell
- ✓ Fatigue
- ✓ Keratinization: skin becomes hard, dry, rough and scaly due to secreting in keratin

Recommended Daily Allowance (RDA) of Vitamin A

- ✓ 3,000 IU per day for men
- ✓ 2,300 IU per day for women
- ✓ 2,600 IU per day for pregnant women 19 years and older
- ✓ 4,300 IU per day for lactating women 19 years and older

Carotenoids

- ✓ Precursors to vitamin A
- ✓ Antioxidant activity of their own
- ✓ Protect the eye
- ✓ Two classes: carotenes (α-carotene, β-carotene, and lycopene) and xanthophylls (β-cryptoxanthin, lutein, and zeaxanthin)
- ✓ Lutein, lycopene, and zeaxanthin cannot be converted to retinol, so they have no vitamin A activity

Toxicity/Excess of Vitamin A

- ✓ High intake of vitamin A may accumulate in the liver and build up to toxic levels
- ✓ Children are the most sensitive
- ✓ Excess worse for smokers (based on controversial testing)
- ✓ May lead to birth defects

- ✓ Signs of toxicity may include: nausea, coarse hair, loss of hair, dry/scaling skin, fatigue, blurry vision, drowsiness, enlarged liver, headaches, bone pain

Sources

Vitamin A as retinol (animal sources) and carotene (vegetable sources) from highest to lowest

Highest

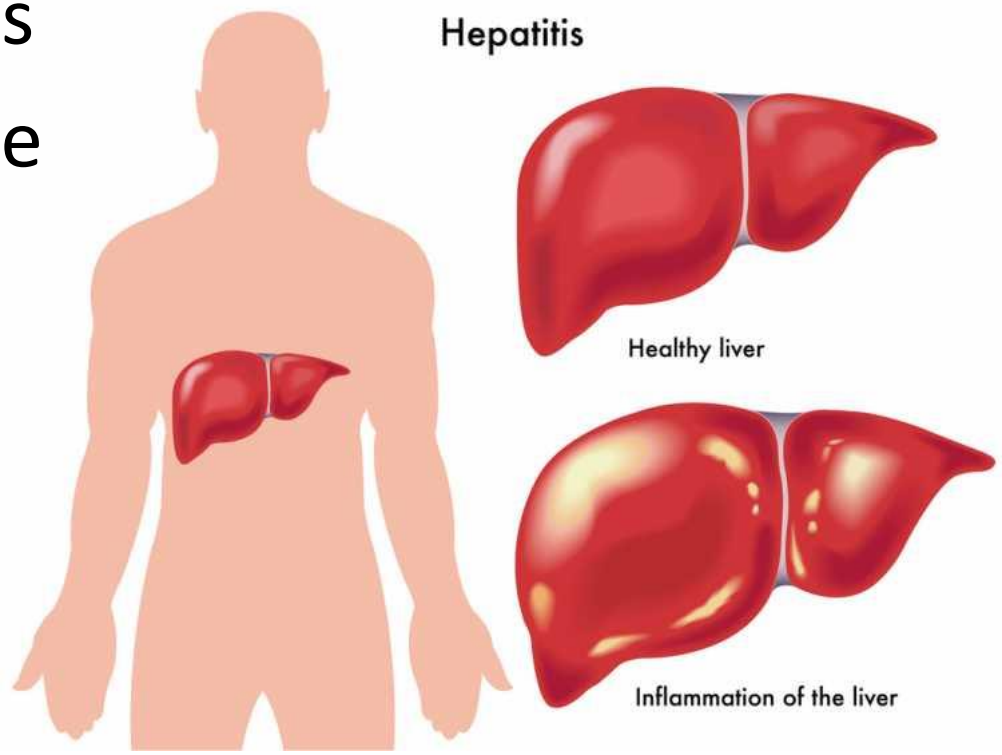
- ✓ Liver
- ✓ Peppers, red chili
- ✓ Dandelion greens
- ✓ Sea buckthorn fruit
- ✓ Pomegranate
- ✓ Carrot
- ✓ Apricot, dried
- ✓ Collared leaves
- ✓ Kale
- ✓ Sweet potato
- ✓ Parsley
- ✓ Spinach
- ✓ Turnip greens
- ✓ Mustard greens
- ✓ Swiss chard
- ✓ Beet greens
- ✓ Chives
- ✓ Butternut squash
- ✓ Watercress
- ✓ Mango
- ✓ Peppers, sweet red
- ✓ Hubbard squash
- ✓ Cantaloupe
- ✓ Endive
- ✓ Apricot
- ✓ Broccoli spears
- ✓ Whitefish
- ✓ Green onion
- ✓ Romaine lettuce
- ✓ Papaya
- ✓ Nectarine
- ✓ Prunes
- ✓ Pumpkin
- ✓ Swordfish
- ✓ Peaches
- ✓ Acorn squash
- ✓ Eggs
- ✓ Chicken
- ✓ Cherry , sour red
- ✓ Butterhead lettuce
- ✓ Asparagus
- ✓ Tomato, ripe
- ✓ Chili pepper
- ✓ Kidney
- ✓ Peas
- ✓ Green bean
- ✓ Elderberry
- ✓ Watermelon
- ✓ Brussels sprouts
- ✓ Cornmeal

Lowest

World's Healthiest Foods ranked as quality sources of vitamin A						
Food	Serving Size	Cals	Amount (mcg RAE)	DRI/DV (%)	Nutrient Density	World's Healthiest Foods Rating
Sweet Potato	1 medium	180.0	1921.80	213.53	21.4	excellent
Carrots	1 cup	50.0	1019.07	113.23	40.7	excellent
Spinach	1 cup	41.4	943.29	104.81	45.6	excellent
Kale	1 cup	36.4	885.36	98.37	48.6	excellent
Mustard Greens	1 cup	36.4	865.90	96.21	47.6	excellent
Collard Greens	1 cup	62.7	722.00	80.22	23.0	excellent
Turnip Greens	1 cup	28.8	549.00	61.00	38.1	excellent
Swiss Chard	1 cup	35.0	535.85	59.54	30.6	excellent
Winter Squash	1 cup	75.8	535.36	59.48	14.1	excellent
Romaine Lettuce	2 cups	16.0	409.37	45.49	51.2	excellent
Bok Choy	1 cup	20.4	361.16	40.13	35.4	excellent
Cantaloupe	1 cup	54.4	270.56	30.06	9.9	excellent
Bell Peppers	1 cup	28.5	144.03	16.00	10.1	excellent
Parsley	0.50 cup	10.9	128.04	14.23	23.4	excellent
Broccoli	1 cup	54.6	120.74	13.42	4.4	very good

Vitamin A and Infectious Disease

- ✓ High doses for Hepatitis
- ✓ Deficiency increases the risk of:
  - ➢ Pneumonia
  - ➢ Severe diarrhea
  - ➢ Measles
  - ➢ Malaria
  - ➢ …and a variety of other infections



Therapeutic Uses Of Vitamin A

- ✓ Infections disease
- ✓ Hepatitis
- ✓ Leaky gut repair
- ✓ Acne
- ✓ Restoring night vision
- ✓ Eczema

Forms of Vitamin A Supplements

- ✓ Synthetic: Acetate and Palmitate
- ✓ Natural source: Animal derived – derived from fish liver oil
- ✓ Mycelized liquid
- ✓ Capsules: Soft gels
- ✓ Cod liver oil