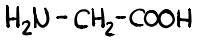
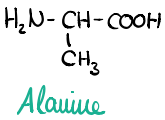
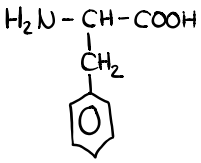
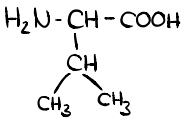
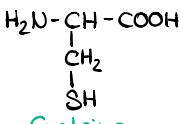
AMINOACIDS

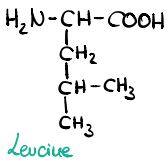

Glycine

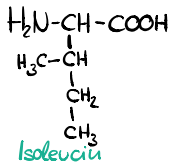

Alanine

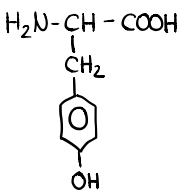

Phenylalanine

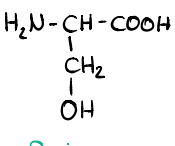

Valine

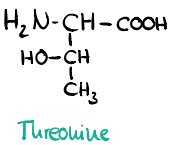

Cysteine

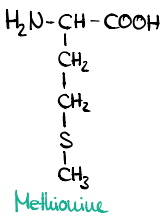

Leucine

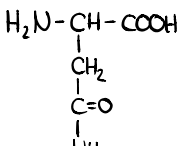

Isoleucin

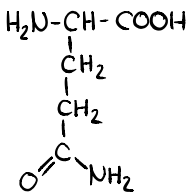

Tyrosine

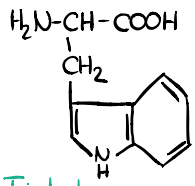

Serine

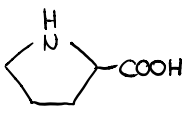

Threonine

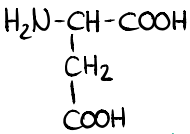

Methionine

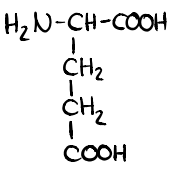

Asparagine

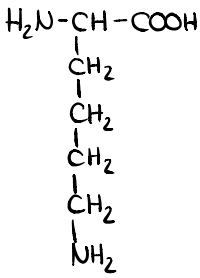

Glutamine

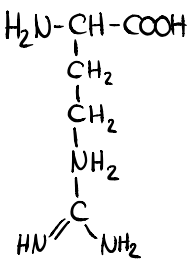

Triptophan

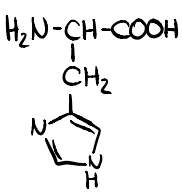

Proline


Aspartic acid

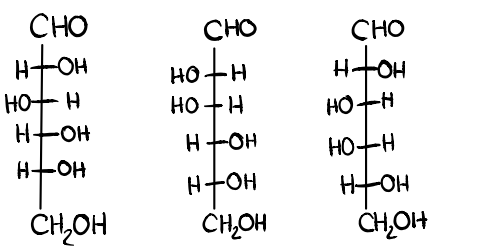

Glutamic acid


Lysine

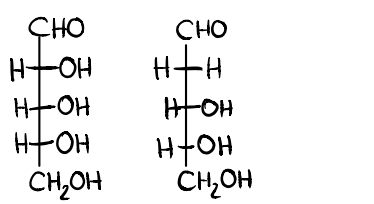

Arginine

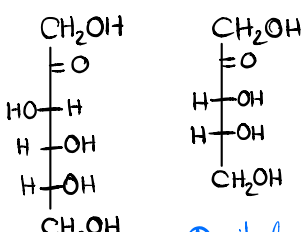

Histidine

CARBOHYDRATES

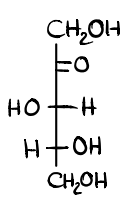

D-glucose D-mannose D-galactose

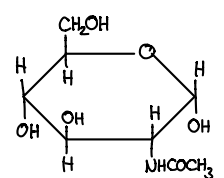
Epimers
differ only at a single carbon atom

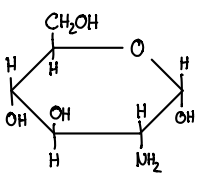

D-ribose D-2-deoxyribose

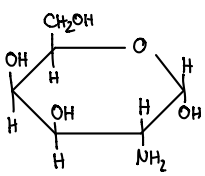

D-fructose

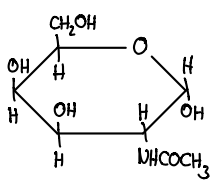
D-ribulose


D-xylulose


D-acetylglucosamine


D-glucosamine


D-galactosamine

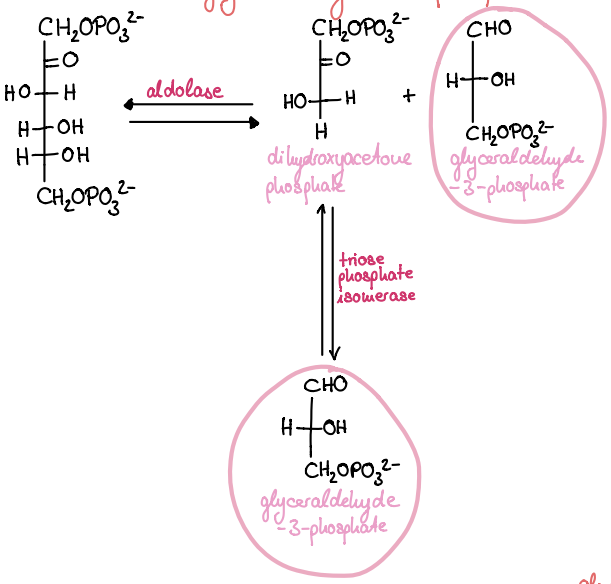

D-acetylgalactosamine

GLYCOLYSIS:

1. Formation of Fructose 1,6 diphosphate

glucose → glucose-6-phosphate → fructose-6-phosphate → fructose-1,6-diphosphate

2. Formation of glyceraldelyde - 3-phosphate

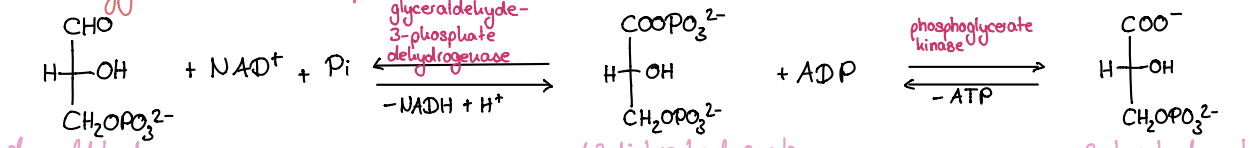


2 glyceraldelyde-3-phosphate entstehen von fructose 1,6 phosphate

Enzyme → aldolase & triose phosphate isomerase

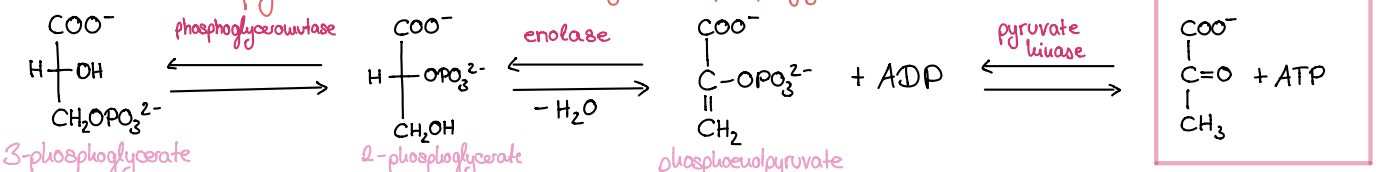
glyceraldelyde-3-phosphate → 3-phosphoglycerate Enzyme: glyceraldelyde-3-phosphate delydrogenase + phosphoglycerateliase

3. Energy conservation steps



glyceraldelyde-3-phosphate → 1,3 diphosphoglycerate → 3-phosphoglycerate

4. Formation of pyruvate and ATP (starting from 3-phosphoglycerate)



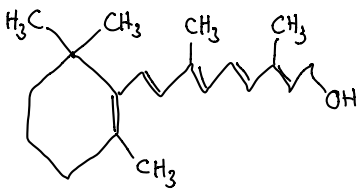
3-phosphoglycerate → 2-phosphoglycerate → phosphoenolpyruvate

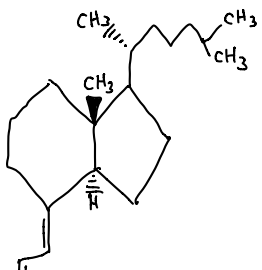
!ENDE!

Enzyme: phosphoglyceromutase + enolase + pyruvate liuase

VITAMINS

FAT-SOLUBLE:



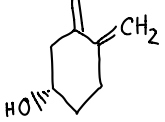


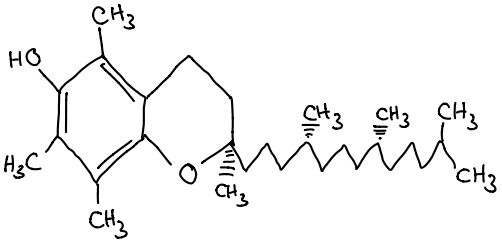
Vitamin D (ergocalciferol)

- 5/10 µg - 50 µg
- ↳ Richets & Osteomalacia
- Absorption of calcium → strong bones

Vitamin A (Retinoid)

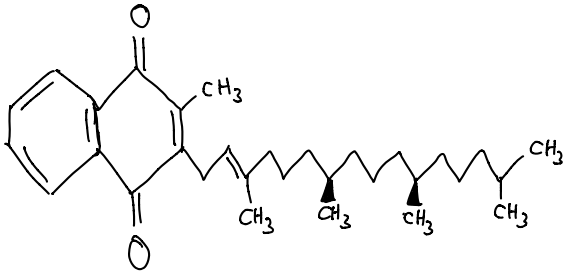
- 900µg – 3000 µg
- ↯ Night-blindness
- Sightability





Vitamin E (Tocopherol)

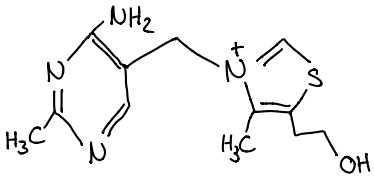
- 15mg – 1000mg
- ↯ rare, but if: mild hemolytic anemia
- antioxidant, protect cells from free radicals



Vitamin K (Naphtoquinone)

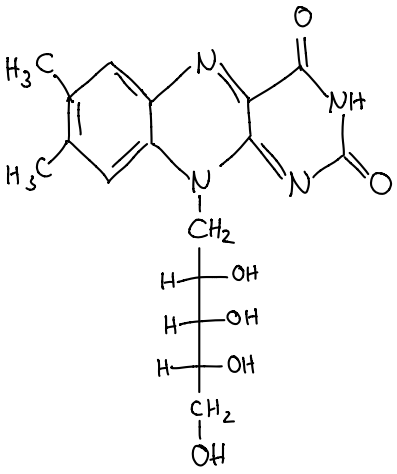
- 120µg
- ↯ Bleeding diathesis
- Blood clotting

WATER-SOLUBLE:



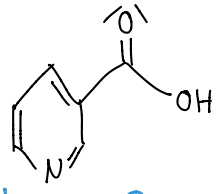
Vitamin B1 (Thiamine)

- 1,2 mg
- ↯ Beriberi
- glucose metabolism



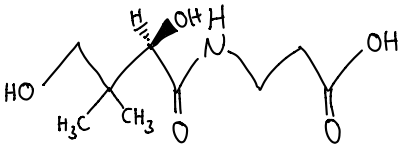
Vitamin B2 (Riboflavin)

- 1,3 mg
- ↯ Ariboflavinosis
- helps break down fats, proteins, ch. coverts ch → ATP



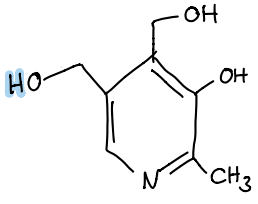
Vitamin B3 (Niacin)

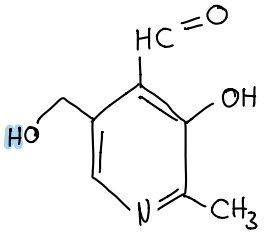
- 16 mg – 35 mg
- ↯ Pellagra
- food → glucose, normal function of nervous system

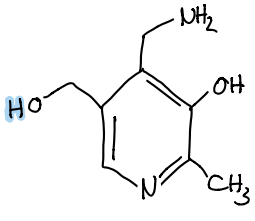


Vitamin B5 (Pantothenic acid)

- 5mg
- ↯ Paresthesia
- food → energy, production blood cells







Vitamin B6 (Pyridoxine)

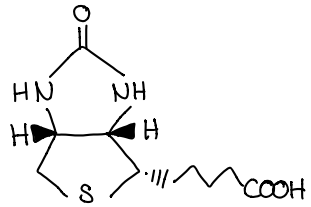
- 1,3 | 1,7 mg – 100mg
- ↯ Anaemia

Pyridoxal

Pyridoxamine

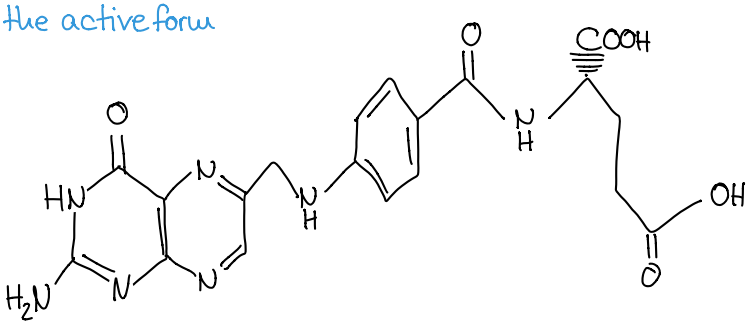
- brain development & function

→ replace H with Phosphate to get the active form



Vitamin B7 (Biotin)

- 30 µg
- ↯ Dermatitis
- health of skin, hair, nails

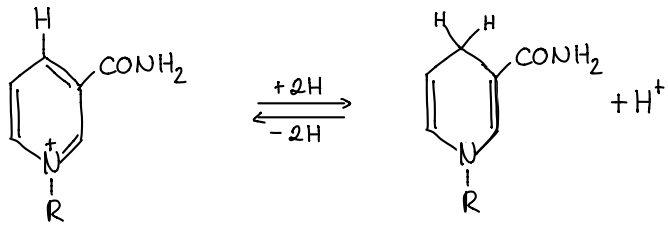


Vitamin B9 (folic acid)

- 400 µg - 1000 µg
- ↯ during pregnancy → birth defects
- proper brain function

BIOLOGICAL OXIDATION

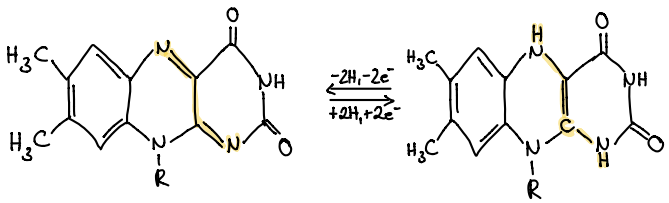
NAD^+ / NADH



NAD NADH

$$H_3C-CH_2-OH + NAD^+ \longrightarrow H_3C-CH=O + NADH + H^+$$

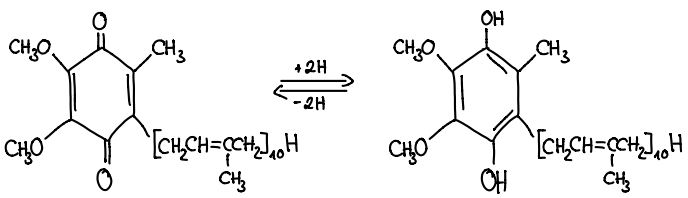
FAD / $FADH_2$



FAD $FADH_2$

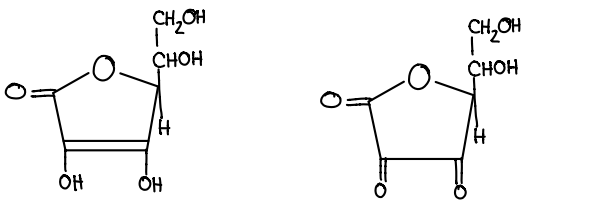
$$R-CH_2-CH_2-COOH + FAD \longrightarrow R-CH=CH-COOH + FADH_2$$

CoQ / $CoQH_2$



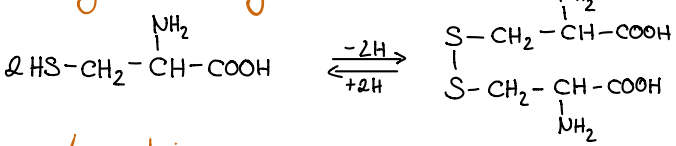
CoQ $CoQH_2$

Ascorbic acid (Vitamin C)



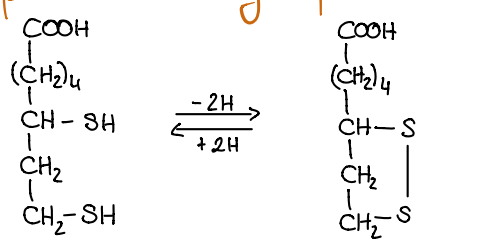
L-ascorbic acid L-dehydroascorbic acid

L-cystein / L-cystine



L-cystein L-cystine

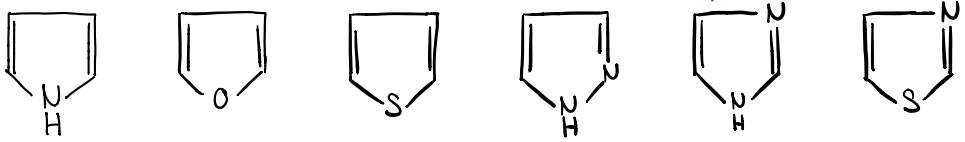
Lipoic acid / Dehydrolipoic acid



Lipoic acid Dehydrolipoic acid

AROMATIC HETEROCYCLES

Five-membered heterocyclic compounds:



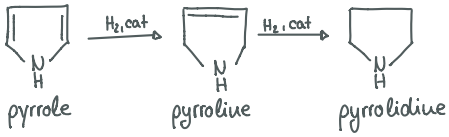
pyrrole | furan | thiophene | pyrazole | imidazole | thiazole

Aromaticity

- pyrrole: weak basic properties; weak acid
- furan: basic properties; CH acid
- thiophene: weak base; CH acid
- pyrazole: analgesic, anti-inflammatory, antipyretic, muscle relaxing, anti-bacterial activities
- imidazole: base & weak acid; antifungal drugs; histidine

- all take place in reaction with electrophilic reagents
- can be nitrated, sulfonated, alkylated, acylated
- nucleophilic substitution, order of reactivity: furan > thiophene > pyrrole

Hydrogenation of Pyrrole



pyrrole → pyrroline → pyrrolidine

Basic properties increase

Important compounds:

Hemoglobin:

- iron containing oxygen transport
- Fe = central metal → binding of O_2
- protoporphyrin = ligands
- each heme group binds O_2 → 4x O_2
- Women: 12.1 to 15.1 g/dl
  - pregnant 11 to 12 g/dl
- Men: 13.8 to 17.2 g/dl
- Children: 11 to 16 g/dl

CO – hemoglobin has a higher binding affinity (200x > O_2)

0,02% CO cause already headache
0,1% unconsciousness

Bilirubin:

- breakdown product of heme catabolism
- 4 pyrrole-like rings (open chain)
- capture light energy

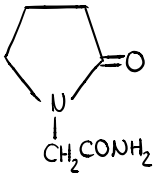
Cytochrome:

- membrane-bound hemoproteins
- contain heme groups, covalent bonded by SH groups, histidine and methionin
- electron transport
- catalyze redox reactions
- found in mitochondrial inner membrane, and endoplasmatic reticulum of eukaryotes, chloroplasts of plants

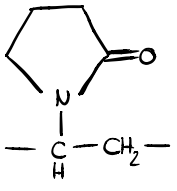
Vitamin B12:

- Co = central metal atom
- protoporphyrin ring
- Cyanocobalamin

Pharmaceutical products with Pyrole-structure

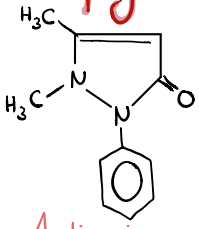


Pyracetam
- nootropic drug
- mental function, working memory, motivation & attention

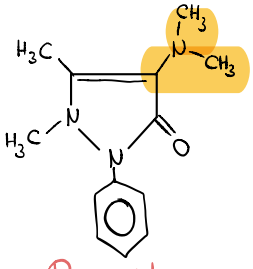


Polyvinyl pyrolidone (PVP)
- plasma volume expander for trauma victims after 1950s
- binder in pharmaceutical tablets

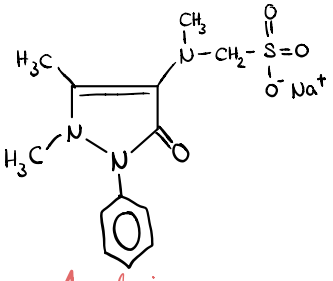
Antipyretics



Antipyrin

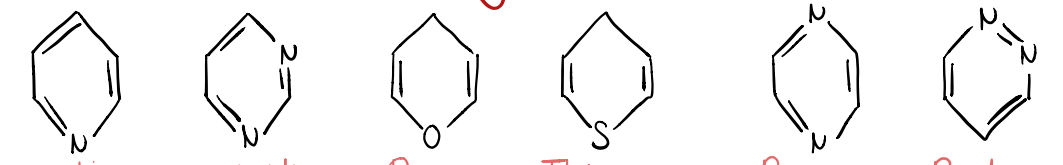


Pyramidone



Analgin

Six-membered heterocyclic compounds



pyridine | pyrimidine | pyran | thiopyran | pyrazine | pyridazine

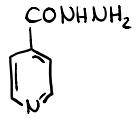
- pyridine: basic; protonated by reactions with

acids and forms a positively charged aromatic pyridinium cation

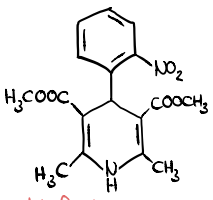
↳ Vitamin B6, B3

Important compounds:

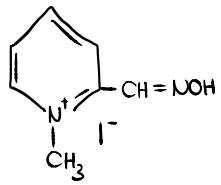
Medicines:



Rimifon
→ treatment of tuberculosis

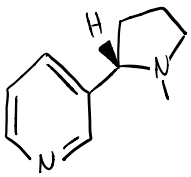


Nifedipine
↳ calcium channel blocker
↳ angina pectoris treatment

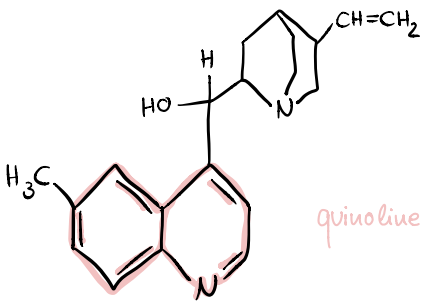


Pralidoxime
↳ combat poisoning by organophosphates in conjunction with atropine

Alkaloids:

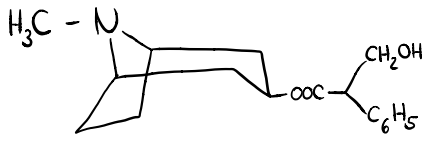


Nicotine
↳ neurotoxin
- one cigarette ≈ 1 mg absorbed nicotine

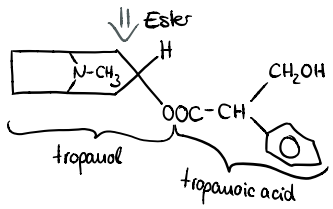


quinoline

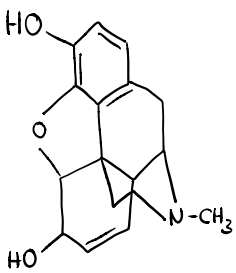
Quinine
- fever-reducing
- antimalarial
- analgesic
- stereoisomer of quinine



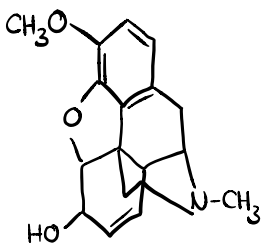
Atropine
↳ Atropa belladonna
↳ dilates pupils, increasing heart rate



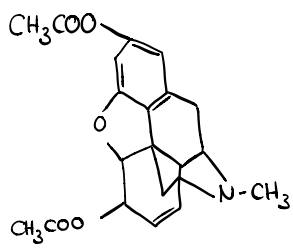
Opium alkaloids:



Morphine
- opioid analgesic drug
- treat acute and chronic pain

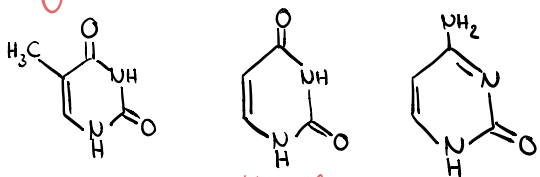


Codeine
- antidepressant/hypnotic properties
- suppress myocardial infarction
- causes pain

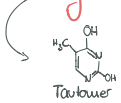


Heroin

Pyrimidine bases in nucleic acids

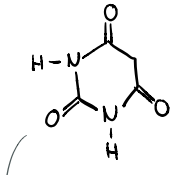


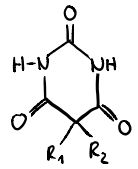
Thymine
Uracil
Cytosine



Tautomer

Barbituric acid

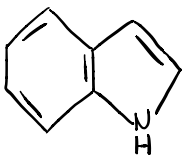




Generic structure

→ treat sleep disorders
→ general anaesthetics / anticonvulsants
→ enzyme inductors

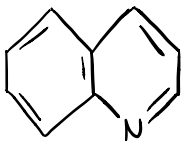
With fused/condensed cycles:



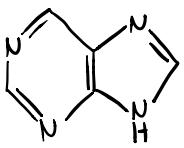
indole

↳ Triptophan

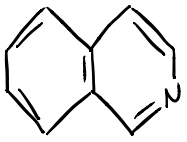
↳ Triptamine



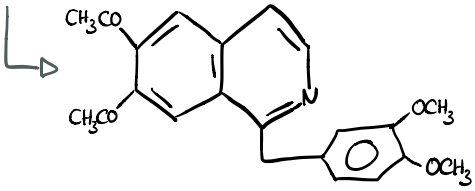
quinoline



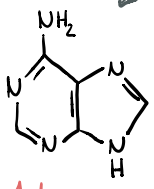
purine



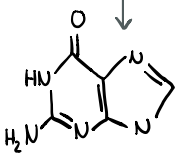
isoquinoline



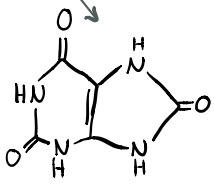
Papaverine



Adenine



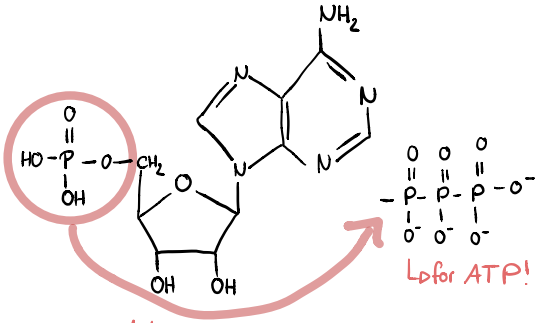
Guanine



Uric acid

Nucleotides

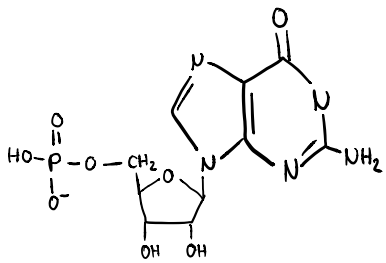
sugar + nitrogen base + phosphate group



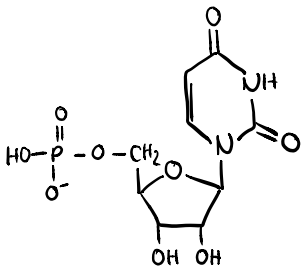
Adenilic acid

(Adenosine monophosphate)

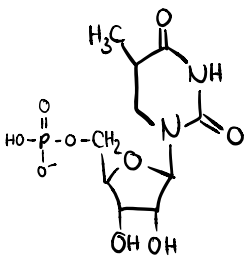
↳ for ATP!



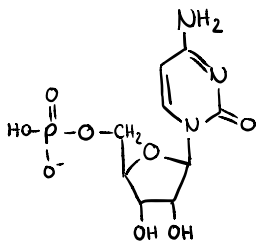
Guanosine monophosphate



Uridine monophosphate



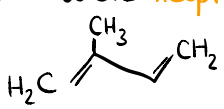
Thymidine monophosphate

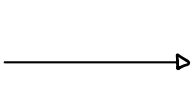


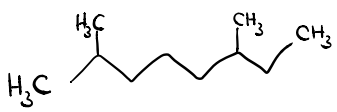
Cytidine monophosphate

TERPENES

Two or more isoprenes

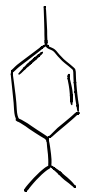




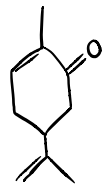


Terpene (Monoterpenes, 2 isoprene units)

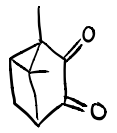
Monoterpenes



Eucaliptus

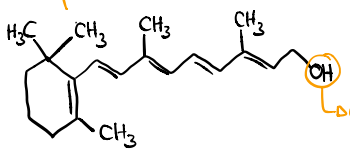


Carvone



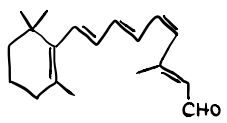
Camphorquinone

Diterpenes

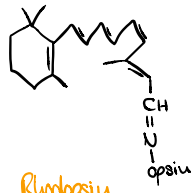


└CHO = All-trans-Retinal

Vitamin A

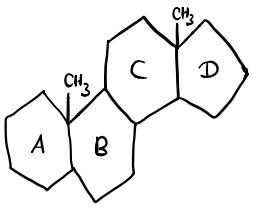


Cis-11-retinal

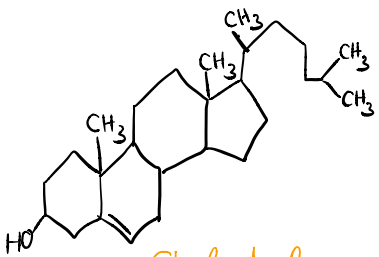


Rhodopsin
└absorbs visible light
└visual receptor

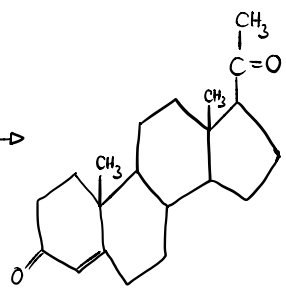
Steroids



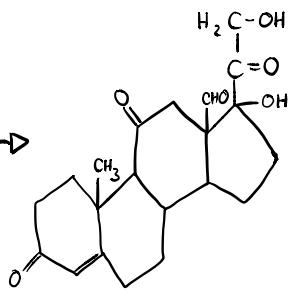
Steroid ring system



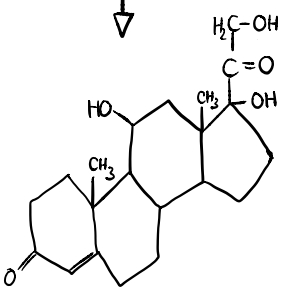
Cholesterol
└brain is 10%



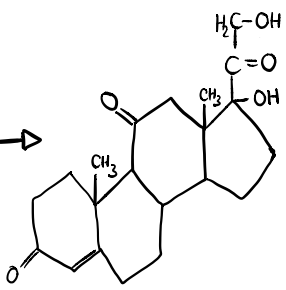
Progesterone



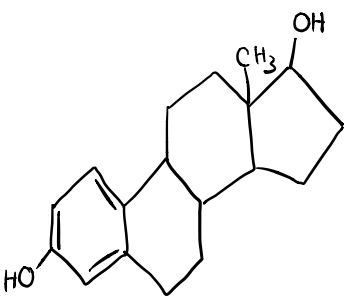
Aldosterone



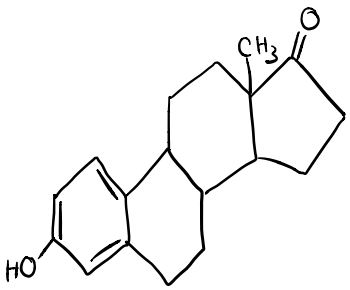
Cortisol



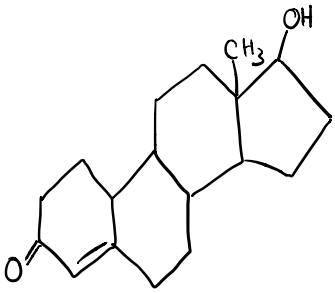
Cortisone



Estradiol



Estrone



Testosterone