CO2 und Citronensäurecyclus (Krebs-Cyclus)

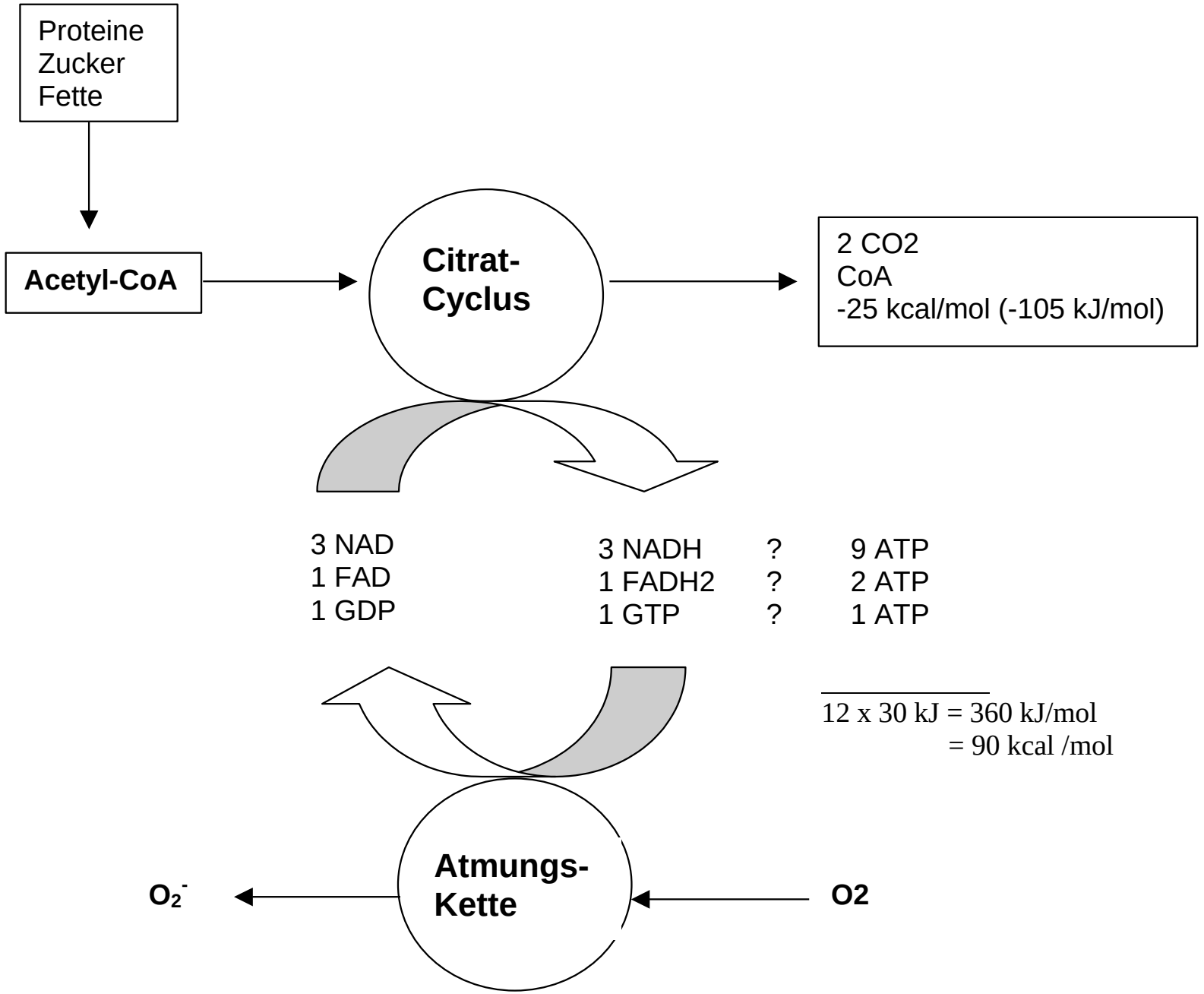
Sir Hans Adolf Krebs
1900-1081
Nobelpreis 1953

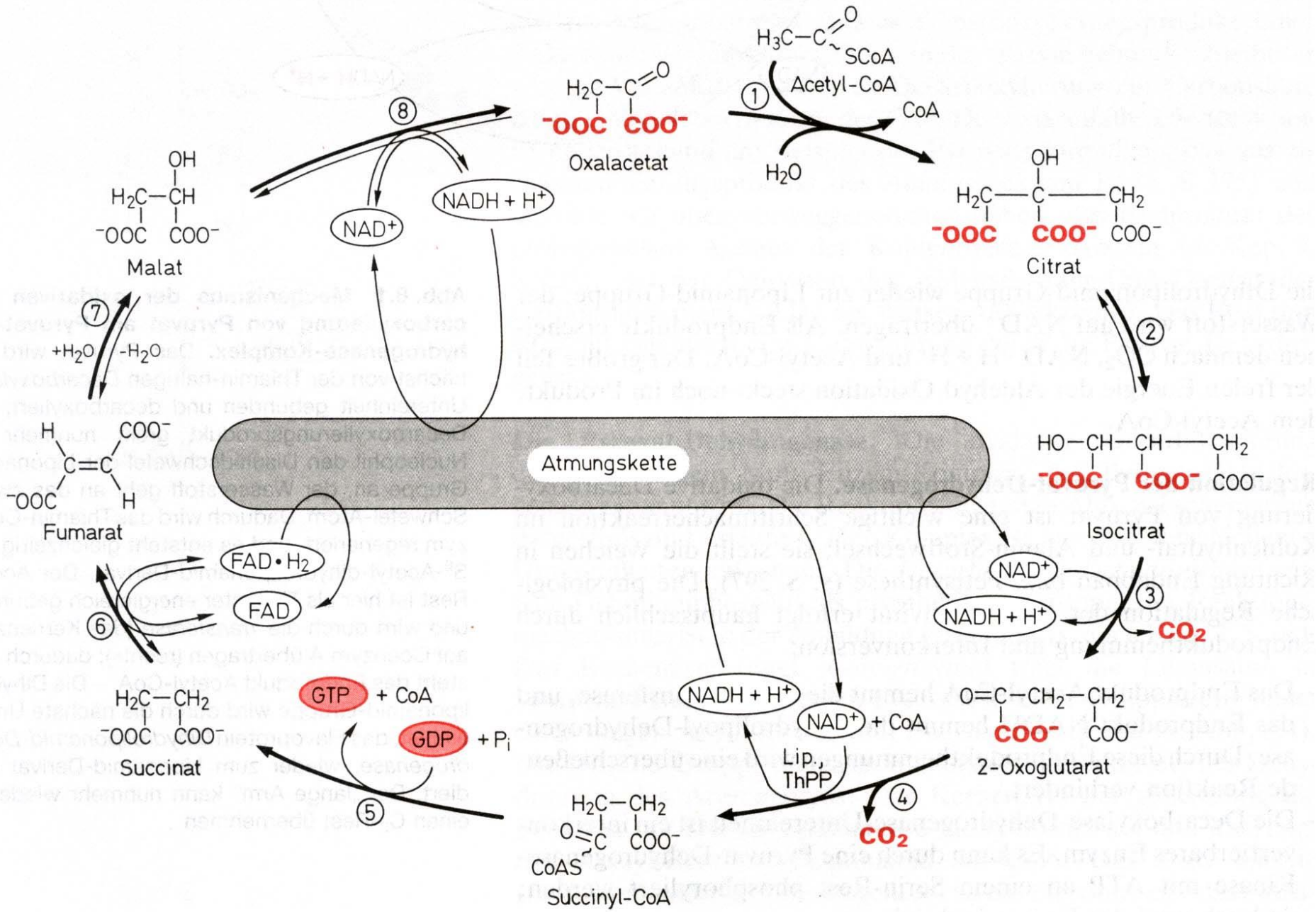
Endprodukt des aeroben Stoffwechsels (Atmung) ist CO2 und Wasser.

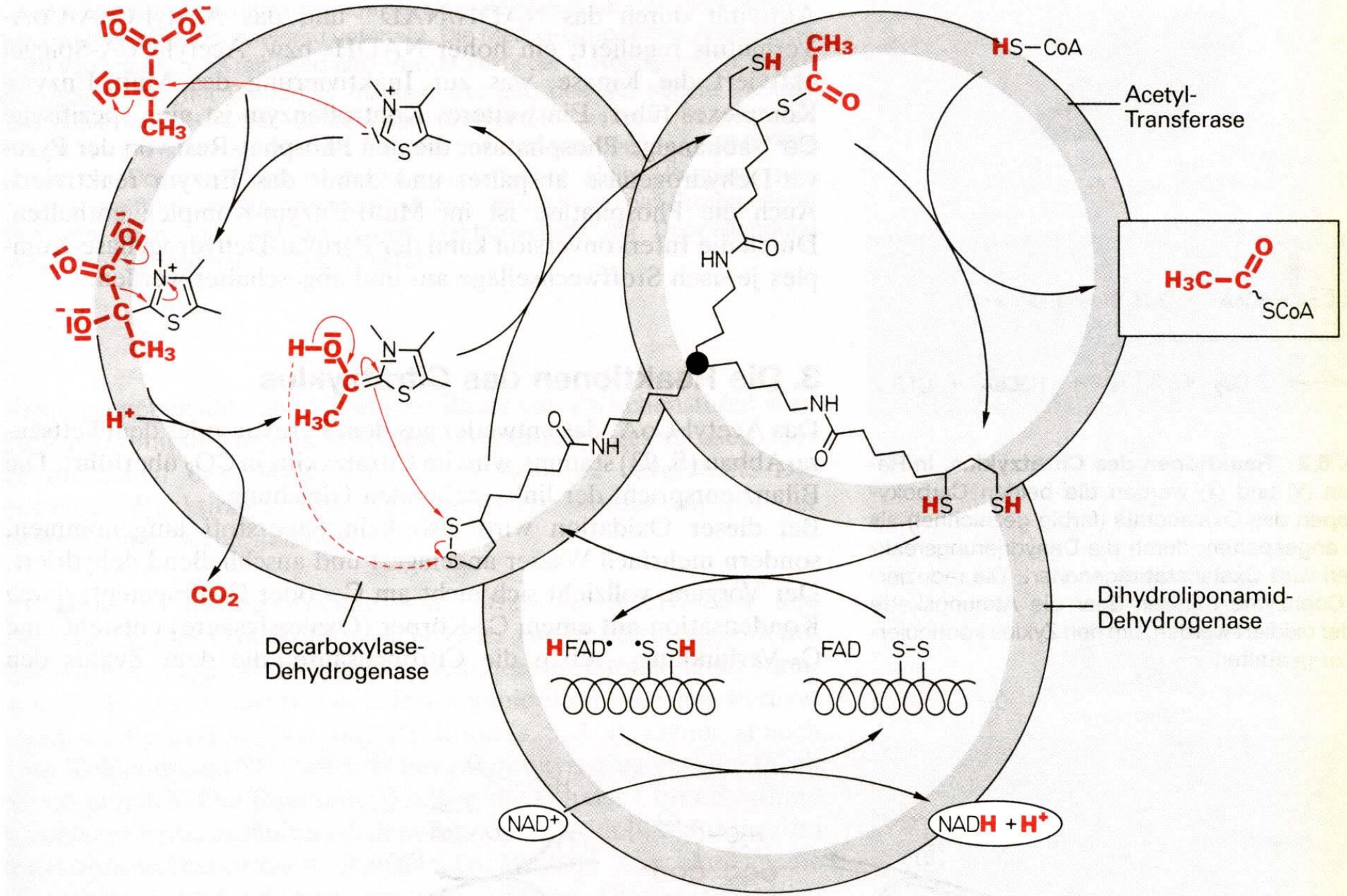
z.B. Glucose + 6 O2 → 6 CO2 + 6 H2O + 674 kcal/mol
Palmitinsäure + 23 O2 → 16 CO2 + 16 H2O + 2379 kcal/mol

<u>Citratcyclus:</u>

merke! Citratcyclus läuft anaerob (ohne O_2) und ist mit der Atmungskette gekoppelt


Proteine
Zucker
Fette
Acetyl-CoA
Citrat-
Cyclus
2 CO2
CoA
-25 kcal/mol (-105 kJ/mol)
3 NAD
1 FAD
1 GDP
3 NADH ? 9 ATP
1 FADH2 ? 2 ATP
1 GTP ? 1 ATP
12 x 30 kJ = 360 kJ/mol
= 90 kcal /mol
Atmungs-
Kette
O2-
O2


Acetyl-CoA
SCoA
CoA
H2O
Oxalacetat
Citrat
Isocitrat
2-Oxoglutarat
Succinyl-CoA
Succinat
Fumarat
Malat
NAD+
NADH + H+
CO2
Lip., ThPP
CoAS
GTP
+ CoA
GDP
+ Pi
FAD • H2
FAD
+H2O
-H2O
Atmungskette
1
2
3
4
5
6
7
8


HS—CoA
Acetyl-
Transferase
SCoA
Decarboxylase-
Dehydrogenase
Dihydroliponamid-
Dehydrogenase
HFAD•
•S SH
FAD
S–S
NAD+
NADH + H+
CO2
H+

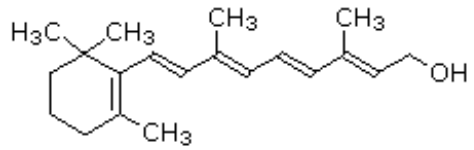
Fette und Lipide

Stoffklassen

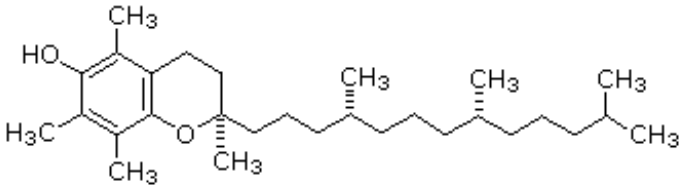
A. nicht hydrolysierbar

- Langkettige Alkane, Carotinoide, Vitamine
- Terpene, Steroide
- Fettalkohole >C10
- Fettsäuren >C10

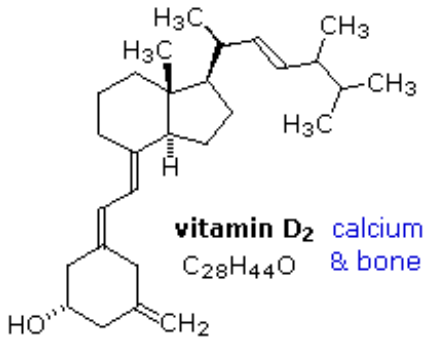
Lipid Soluble Vitamins



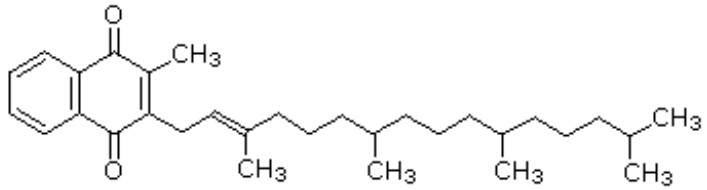
vitamin A
$C_{20}H_{30}O$ part of the visual pigment



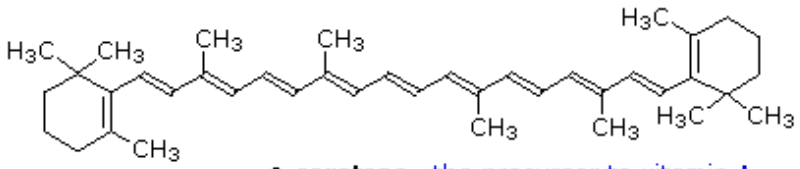
$C_{29}H_{50}O_2$ **vitamin E** an antioxidant



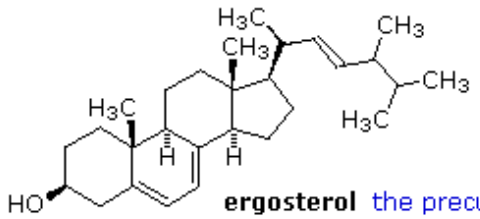
vitamin D_2 calcium metabolism
$C_{28}H_{44}O$ & bone growth



vitamin K_1 a blood clotting factor
$C_{31}H_{46}O_2$

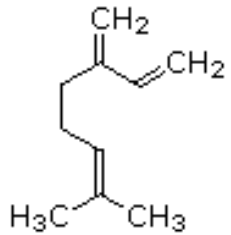


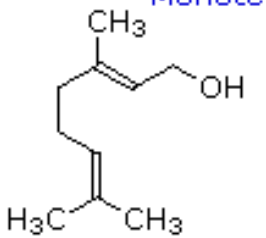
β-carotene the precursor to vitamin A

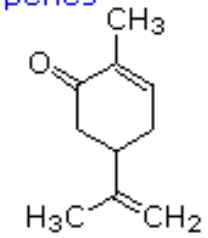


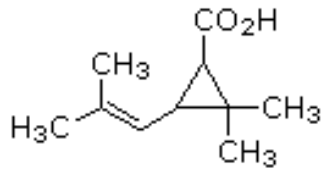
ergosterol the precursor to vitamin D_2

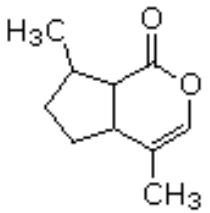
Monoterpenes

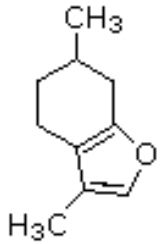

myrcene

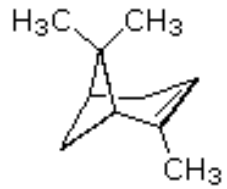

geraniol

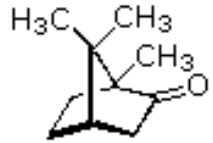

carvone


chrysanthemic acid

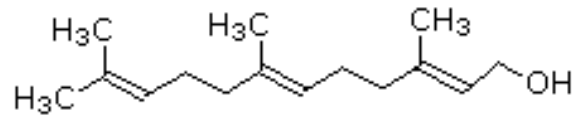

nepetalactone

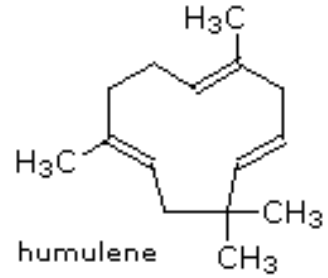

menthofuran

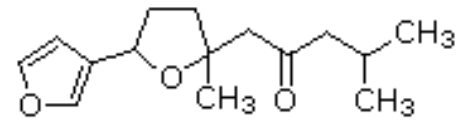

α-pinene

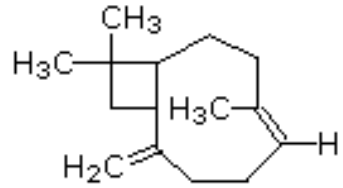

camphor

Sesquiterpenes

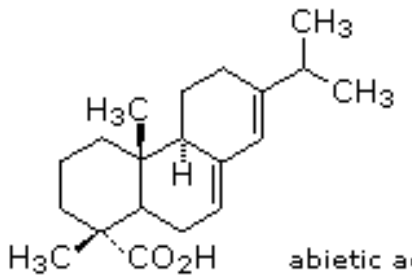

farnesol

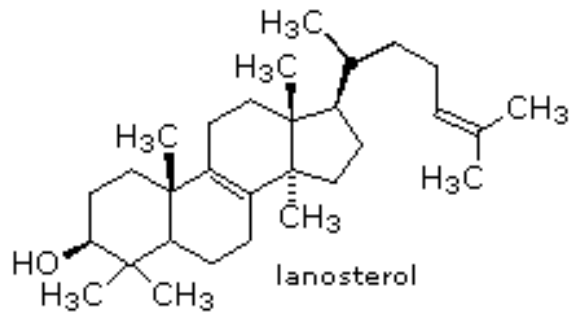

humulene

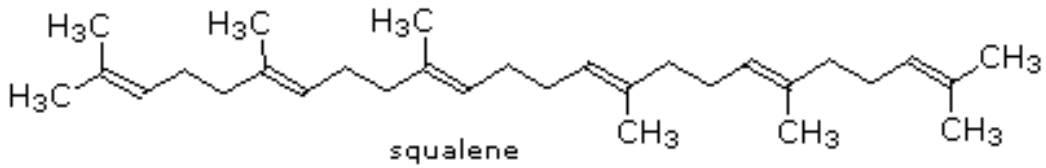

ngaione

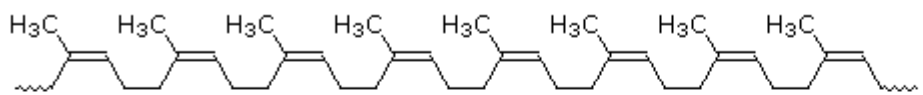

caryophyllene

Diterpenes & Triterpenes

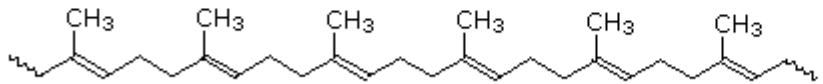

abietic acid


lanosterol


squalene

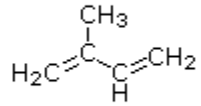


Natural Rubber

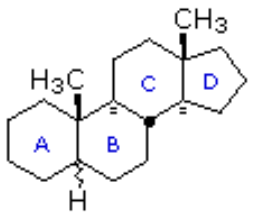


Gutta-percha

pyrolysis

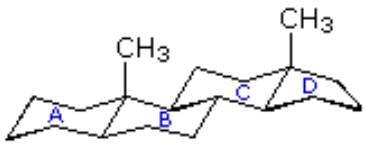


isoprene

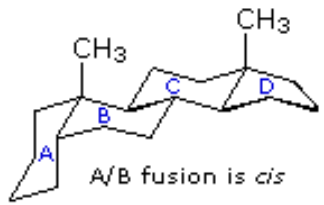


A/B ring fusion
may be *cis* or *trans*

The B/C & C/D ring fusions are *trans*

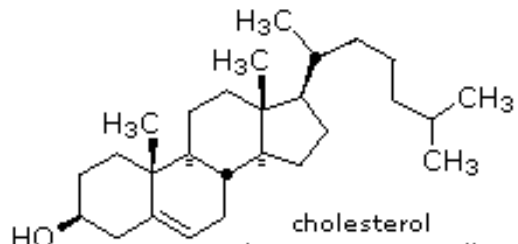


A/B fusion is *trans*

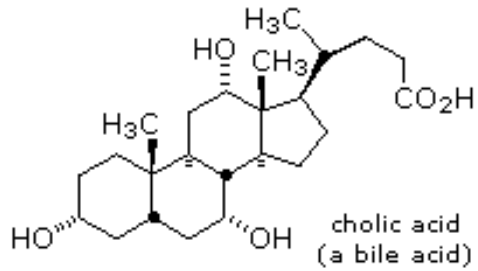


A/B fusion is *cis*

Common Steroid Conformations

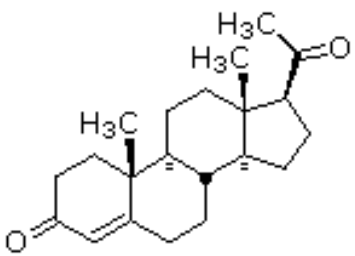


cholesterol
(a common sterol)

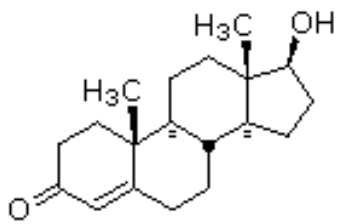


cholic acid
(a bile acid)

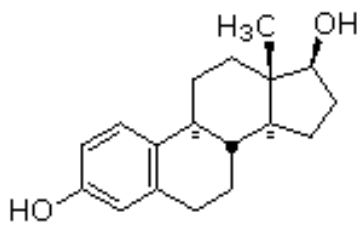
Typical Animal Steroids



progesterone

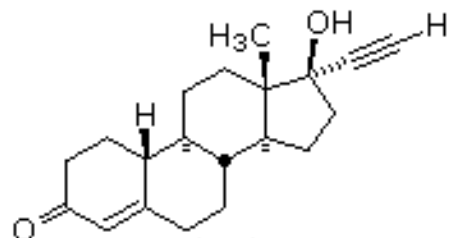


testosterone

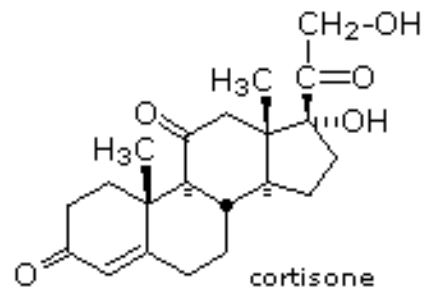


estradiol

Steroid Sex Hormones



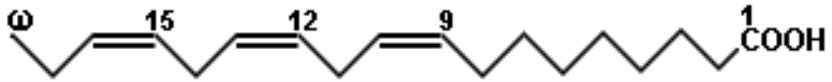
norethindrone
(an oral contraceptive)



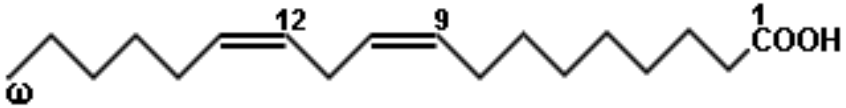
cortisone
(an anti-inflammatory hormone)

Medicinally Useful Steroids

Common Fatty Acids



Alpha-Linolenic Acid (omega-3)

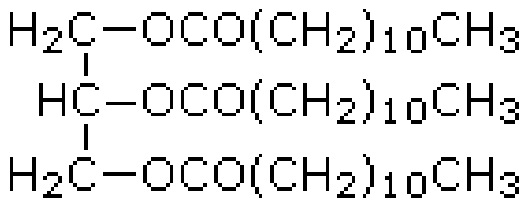


Linoleic Acid (omega-6)

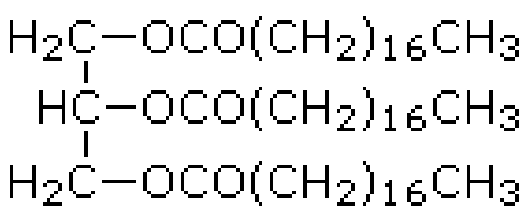
Chemical Names and Descriptions of some Common Fatty Acids				
Common Name	Carbon Atoms	Double Bonds	Scientific Name	Sources
Butyric acid	4	0	butanoic acid	butterfat
Caproic Acid	6	0	hexanoic acid	butterfat
Caprylic Acid	8	0	octanoic acid	coconut oil
Capric Acid	10	0	decanoic acid	coconut oil
Lauric Acid	12	0	dodecanoic acid	coconut oil
Myristic Acid	14	0	tetradecanoic acid	palm kernel oil
Palmitic Acid	16	0	hexadecanoic acid	palm oil
Palmitoleic Acid	16	1	9-hexadecenoic acid	animal fats
Stearic Acid	18	0	octadecanoic acid	animal fats
Oleic Acid	18	1	9-octadecenoic acid	olive oil
Vaccenic Acid	18	1	11-octadecenoic acid	butterfat
Linoleic Acid	18	2	9,12-octadecadienoic acid	safflower oil
Alpha-Linolenic Acid (ALA)	18	3	9,12,15-octadecatrienoic acid	flaxseed (linseed) oil
Gamma-Linolenic Acid (GLA)	18	3	6,9,12-octadecatrienoic acid	borage oil
Arachidic Acid	20	0	eicosanoic acid	peanut oil, fish oil
Gadoleic Acid	20	1	9-eicosenoic acid	fish oil
Arachidonic Acid (AA)	20	4	5,8,11,14-eicosatetraenoic acid	liver fats
EPA	20	5	5,8,11,14,17-eicosapentaenoic acid	fish oil
Behenic acid	22	0	docosanoic acid	rapeseed oil
Erucic acid	22	1	13-docosenoic acid	rapeseed oil
DHA	22	6	4,7,10,13,16,19-docosahexaenoic acid	fish oil
Lignoceric acid	24	0	tetracosanoic acid	small amounts in most fats

B. hydrolysierbar

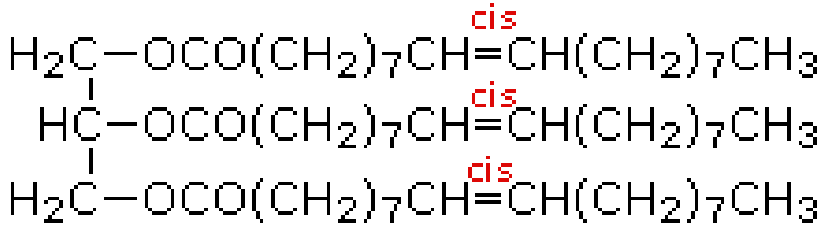
- **Fette (Fettsäure + Glycerin)**
- **Waxe (Fettsäure + Fettalkohol)**
- **Sterolester (Fettsäure + Cholesterin s.o.)**



trilaurin
mp 45° C



tristearin
mp 71° C

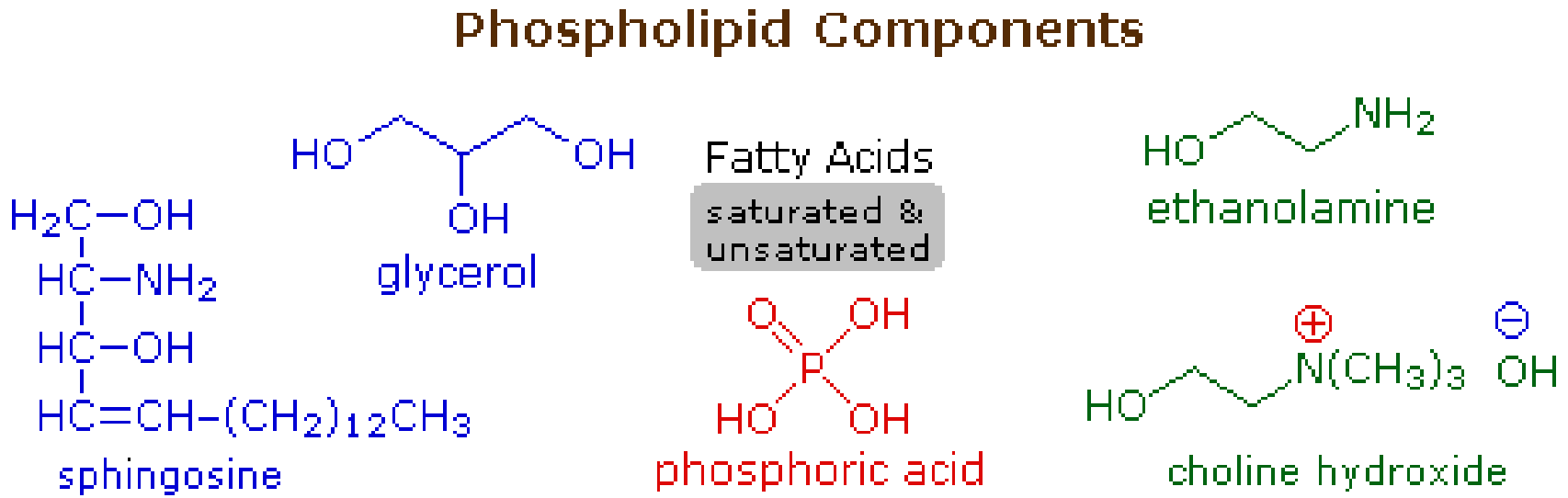


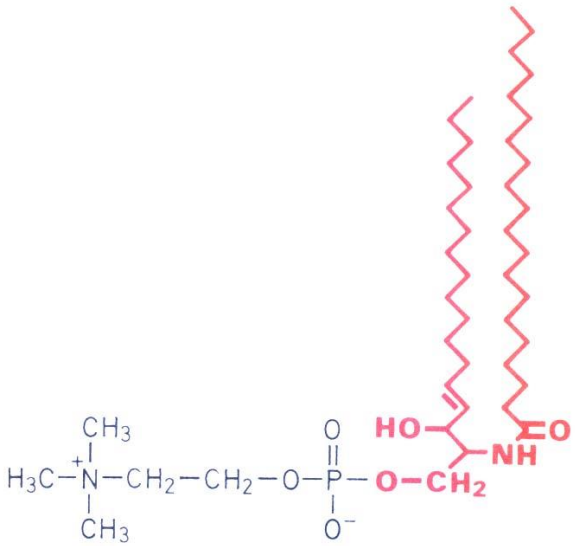
triolein
mp -4° C

spermaceti: $CH_3(CH_2)_{14}CO_2$-$(CH_2)_{15}CH_3$
beeswax: $CH_3(CH_2)_{24}CO_2$-$(CH_2)_{29}CH_3$
carnuba wax: $CH_3(CH_2)_{30}CO_2$-$(CH_2)_{33}CH_3$

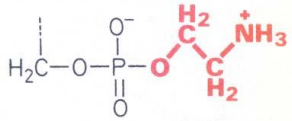
C. Phospholipide

- **Phosphatidsäuren (Fettsäure + Glycerin + Phosphat)**
- **Phosphatide (Fettsäure + Glycerin + Cholin)**

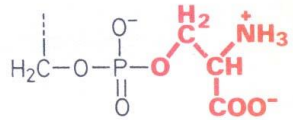




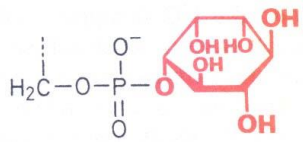
Sphingomyelin



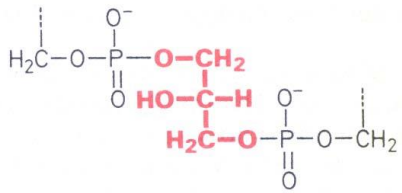
Phosphatidylethanolamin



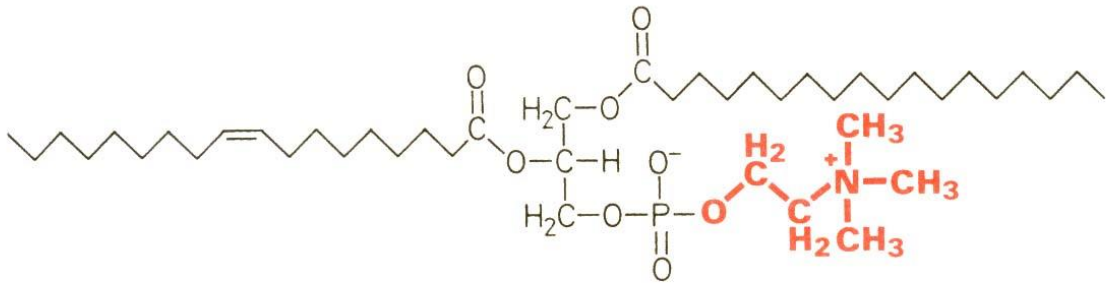
Phosphatidylserin



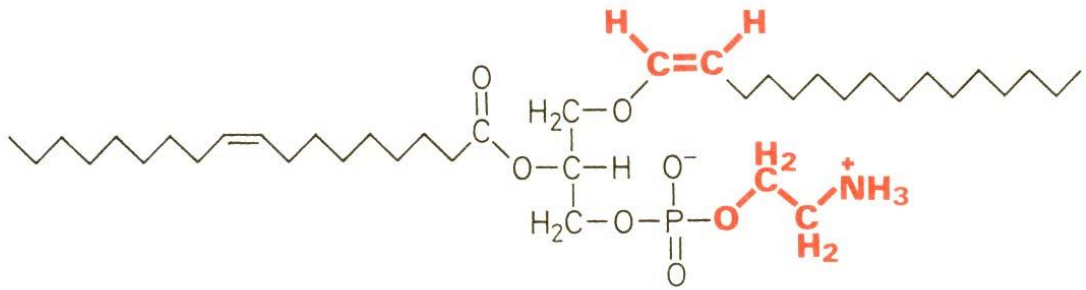
Phosphatidylinositol



Bisphosphatidylglycerol
(Cardiolipin)

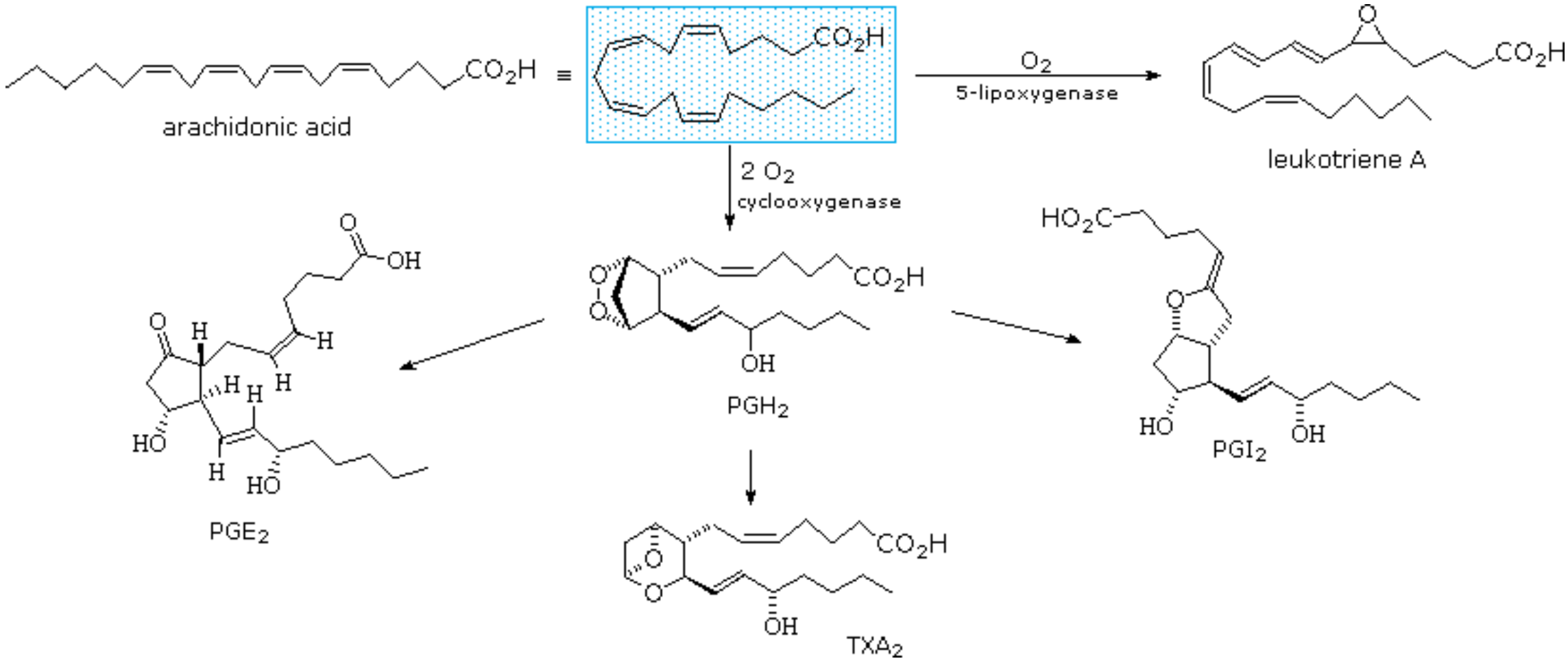


Phosphatidylcholin (Lecithin)



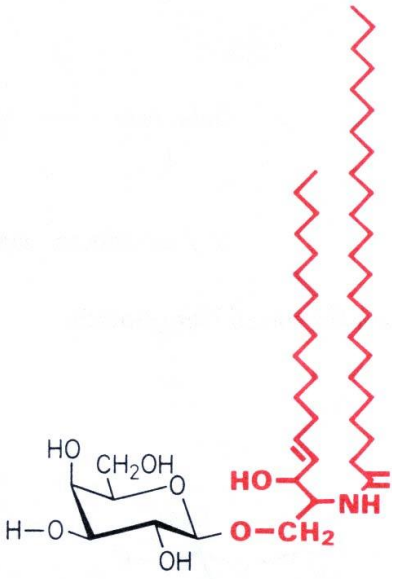
Plasmalogen, Plasmenylethanolamin
[1-(1-Alkenyl)-2-acyl-*sn*-glycerol-3-phospho-ethanolamin]

D. Prostaglandine, Tromboxane, Leukotriene

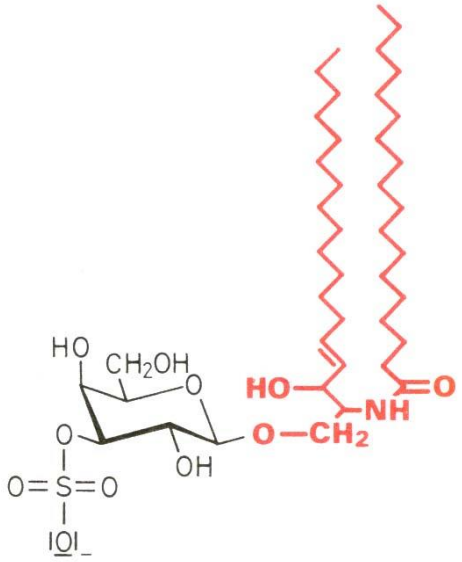


E. Glycolipide

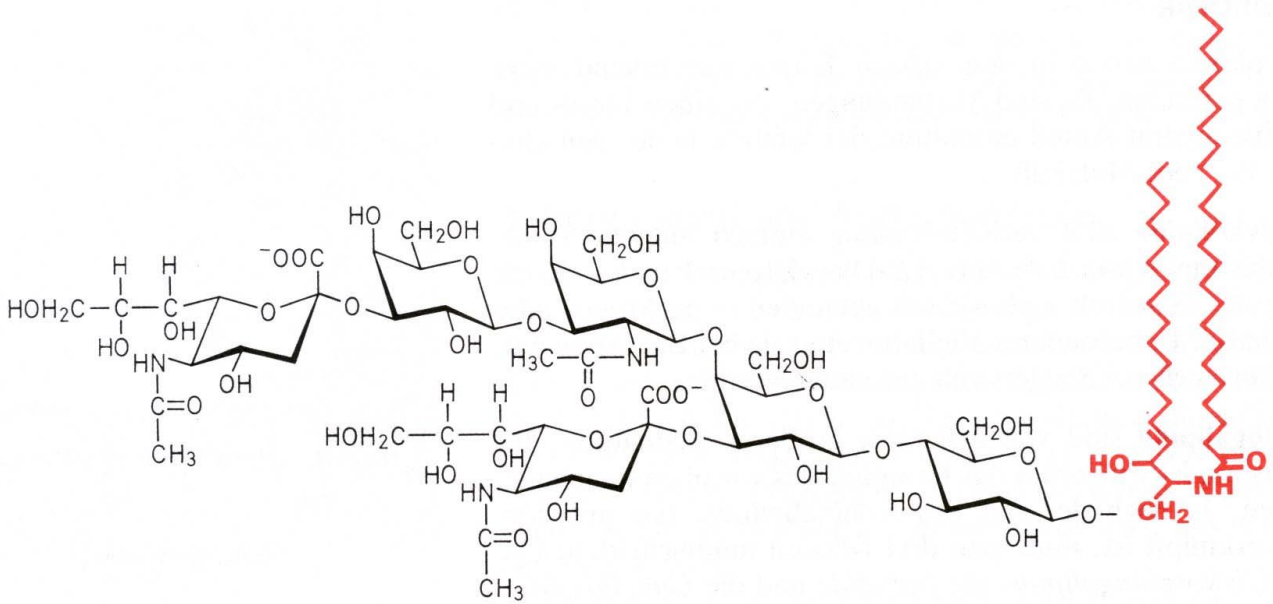
- **Cerebroside (Fettsäure + Sphingosin s.o. + Zucker)**
- **Ganglioside (Fettsäure + Sphingosin s.o. + Zucker + Neuraminsäure)**



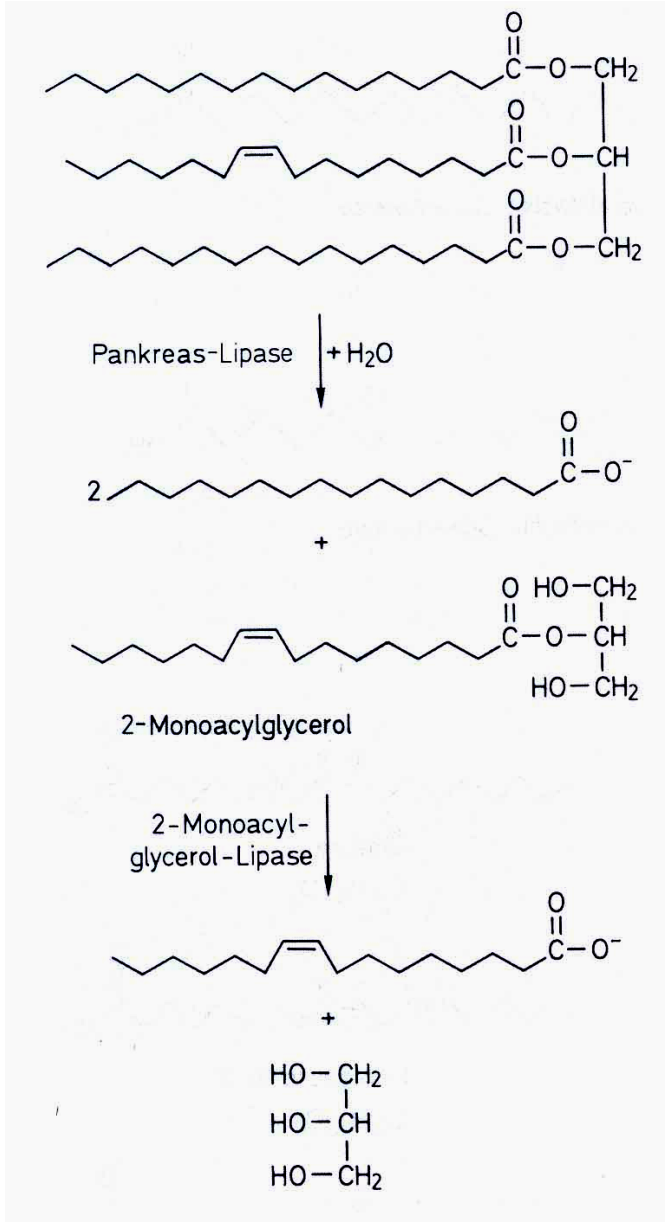
Cerebrosid



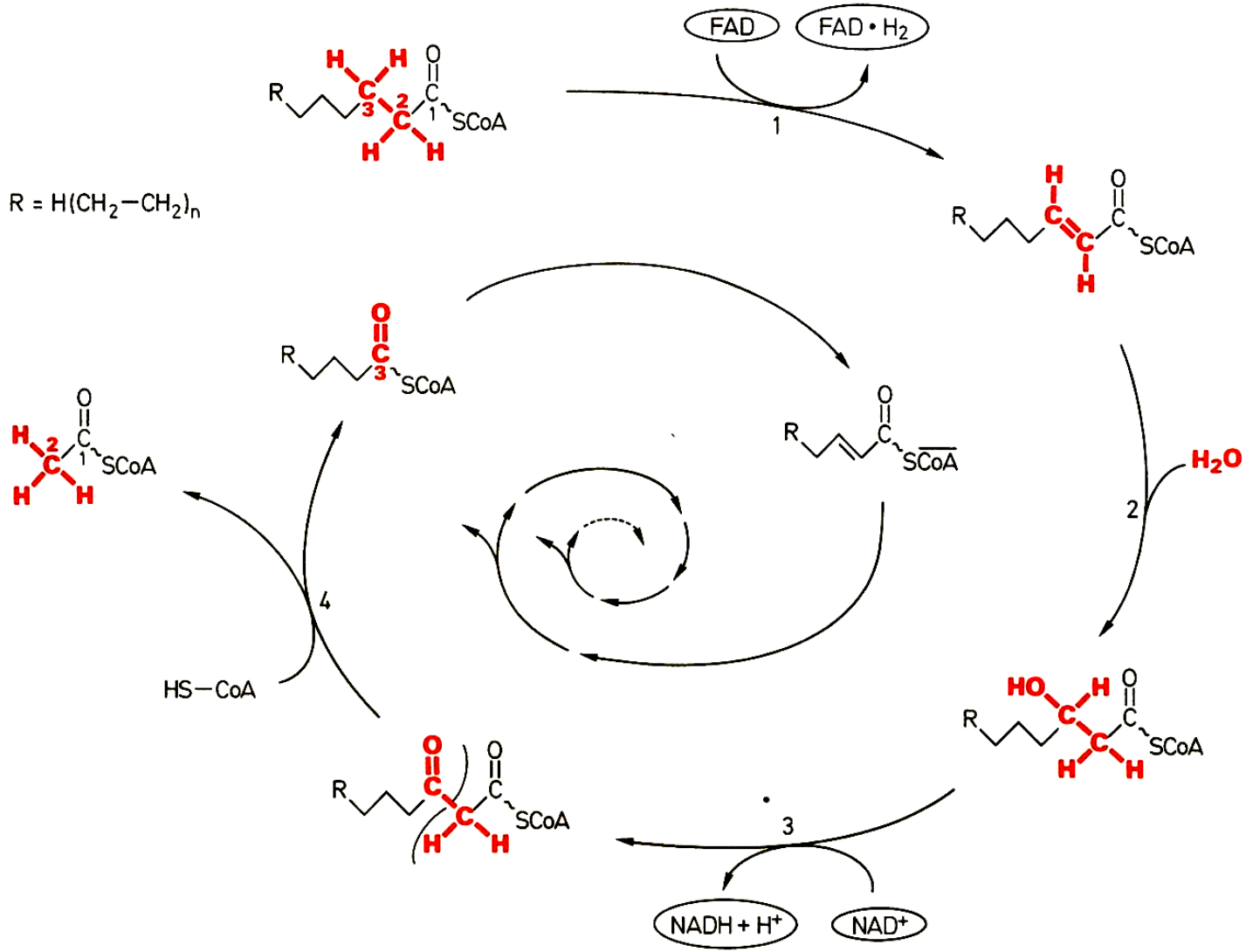
Sulfatid



Aufbau und Abbau von Fetten und Lipiden



- **Abbau: Hydrolyse, ß-Oxidation**



•**Synthese von Lipiden (mehrere Wege) Vergleich (Laborsynthese / Biosynthese)**