

Einführung: Schwache Wechselwirkungen und Membranen

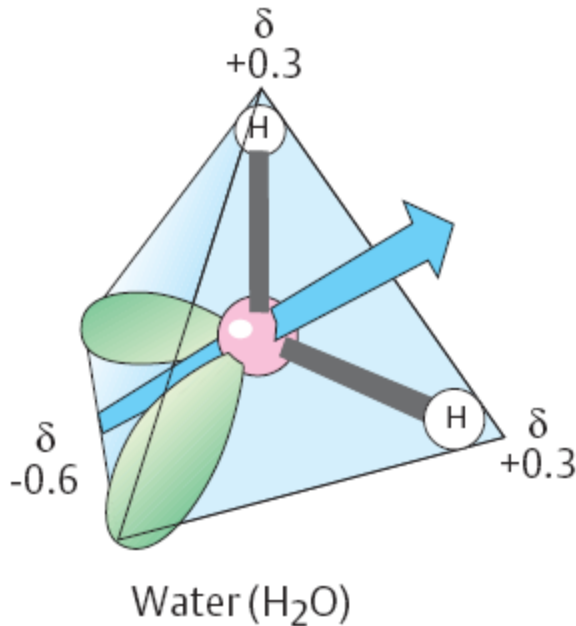
**Dr. Kristian M. Müller
Institut für Biologie III**

Einführung 1. Semester 2007/2008

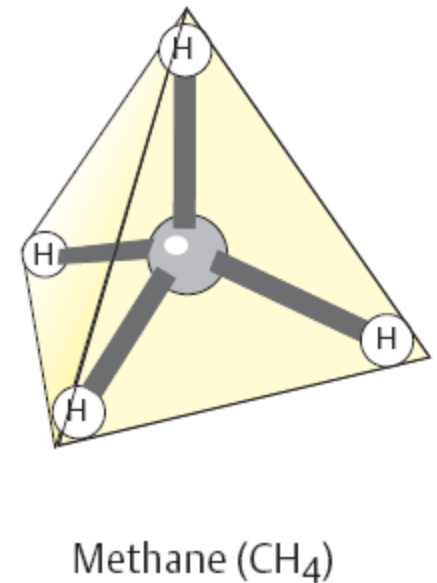
Zum Nachschlagen

- **Campbell et al., Biologie (Überblick)**
- **Koolman , Röhm, Taschenatlas der Biochemie (schöne Bilder, gute Zusammenfassung der Biochemie)**
- **Lodish et al., Molecular Cell Biology**
- **<http://www.molbiotech.uni-freiburg.de/km> ; Lehre**

Wasser im Vergleich zu Methan (Wiederholung)



H ₂ O		CH ₄
18 Da	Molecular mass	16 Da
+100 °C	Boiling point	-162 °C
41	Heat of vaporization (kJ · mol ⁻¹)	8
6.2	Dipole moment (10 ⁻³⁰ C · m)	0



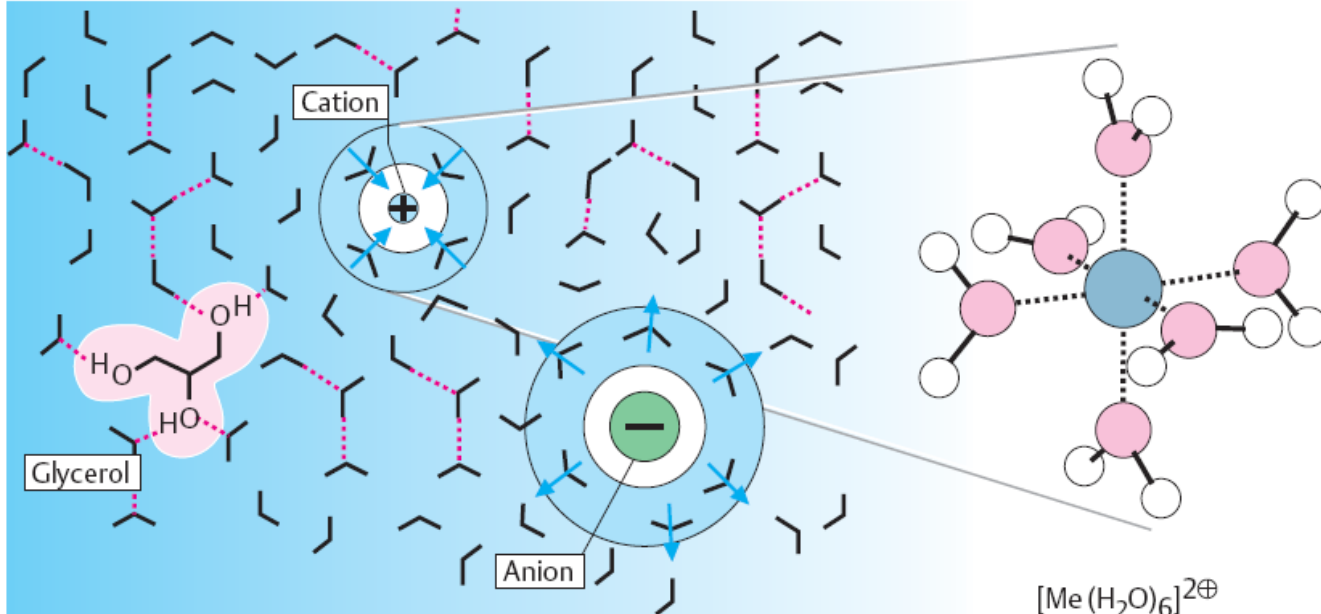
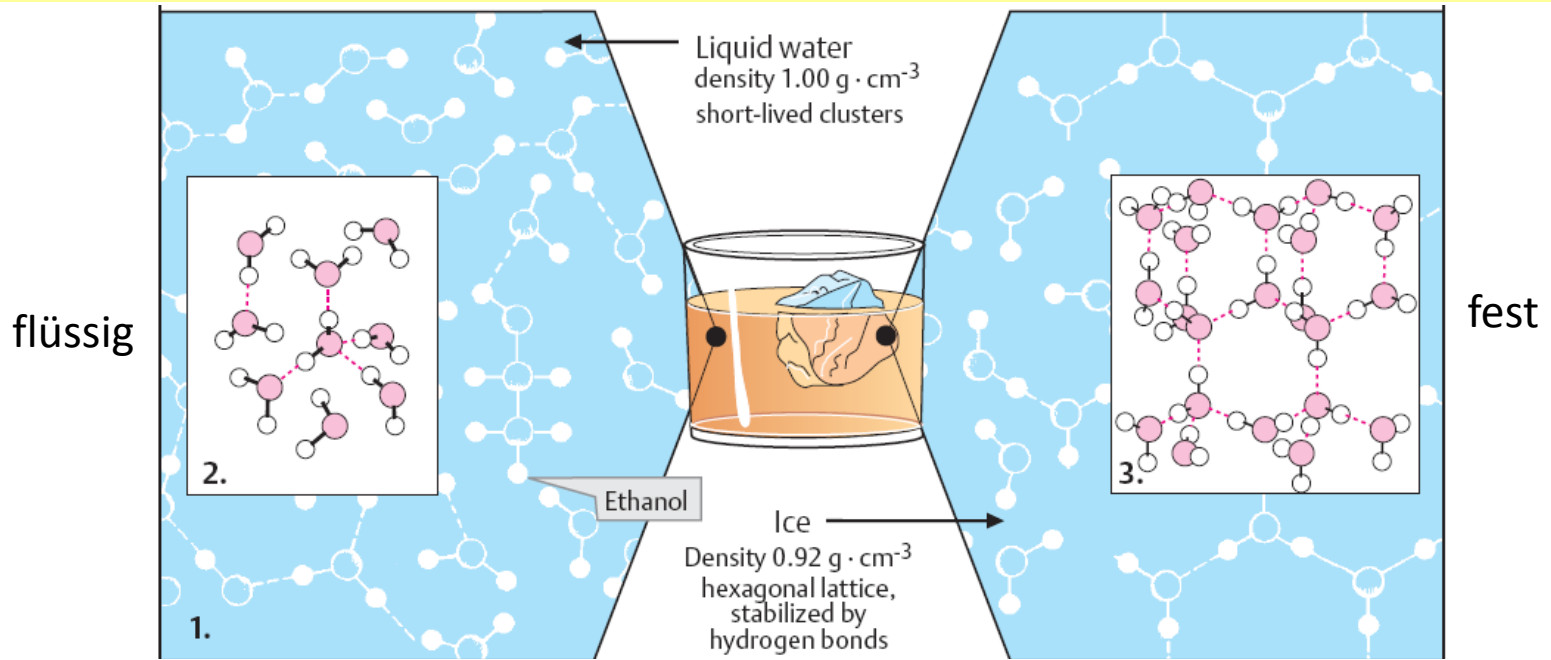
Wasser mit Partialladungen und Dipol

Wasser ist polar.

Polare Moleküle sind hydrophil.

Unpolare Stoffe sind hydrophob bzw. lipophil.

Struktur von Wasser und Solvatisierung



Enthalpie, Entropie, Gibbssche freie Energie (Wiederholung)

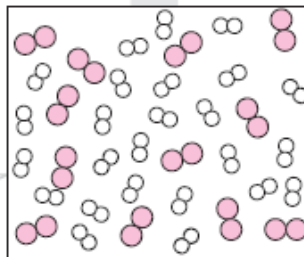
ΔH : change of enthalpy, heat exchange

$$\Delta G = \Delta H - T \cdot \Delta S$$

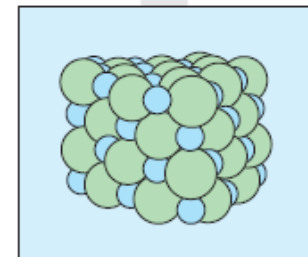
Gibbs-Helmholtz equation

ΔS : change of entropy, i.e. degree of order

1 mol H_2
1/2 mol O_2



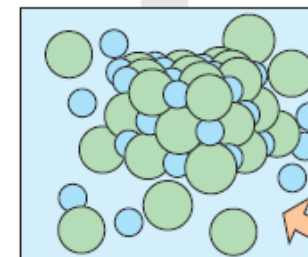
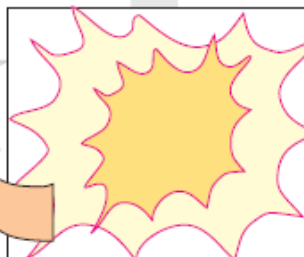
Low degree of order



1 mol NaCl (crystalline)

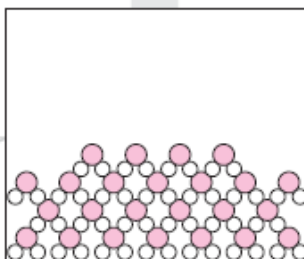
High degree of order

System releases heat, $\Delta H < 0$ (exothermic)

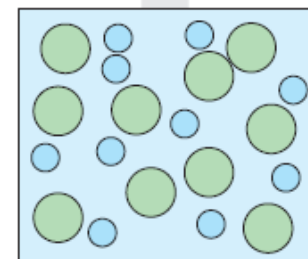


System absorbs heat, $\Delta H > 0$ (endothermic)

1 mol H_2O (liquid)

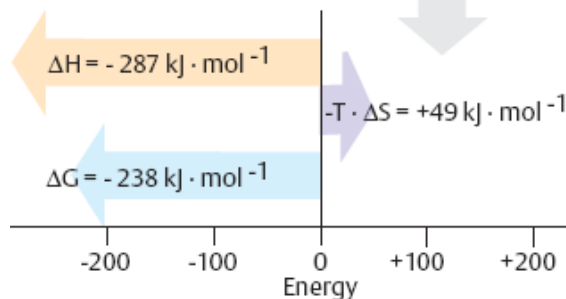


Higher degree of order, $\Delta S < 0$

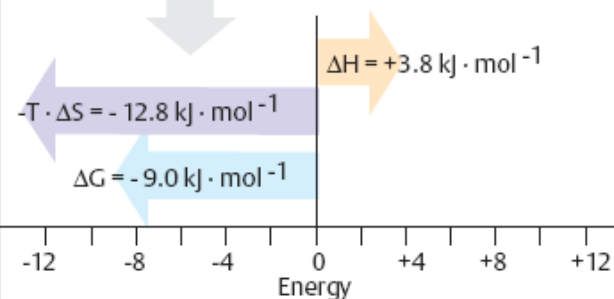


1 mol Na^+
1 mol Cl^-

Lower degree of order $\Delta S > 0$

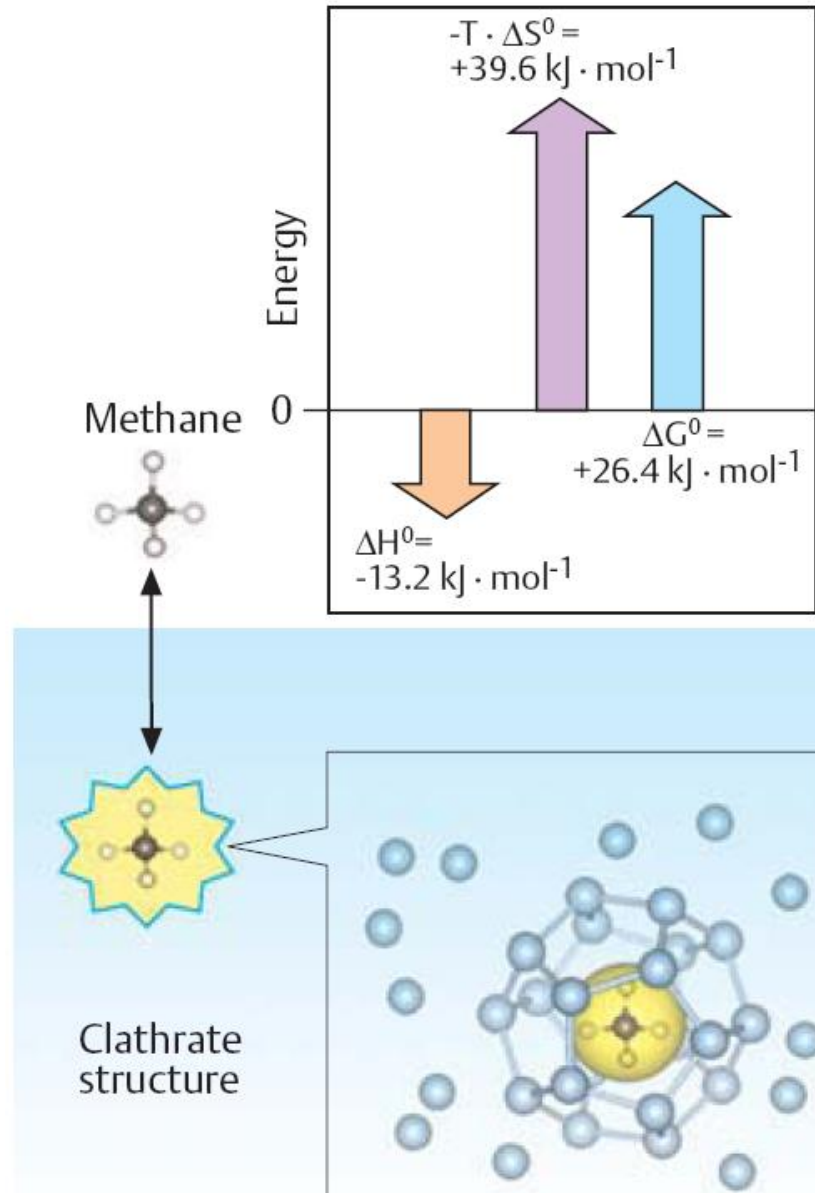


1. "Knall-gas" reaction

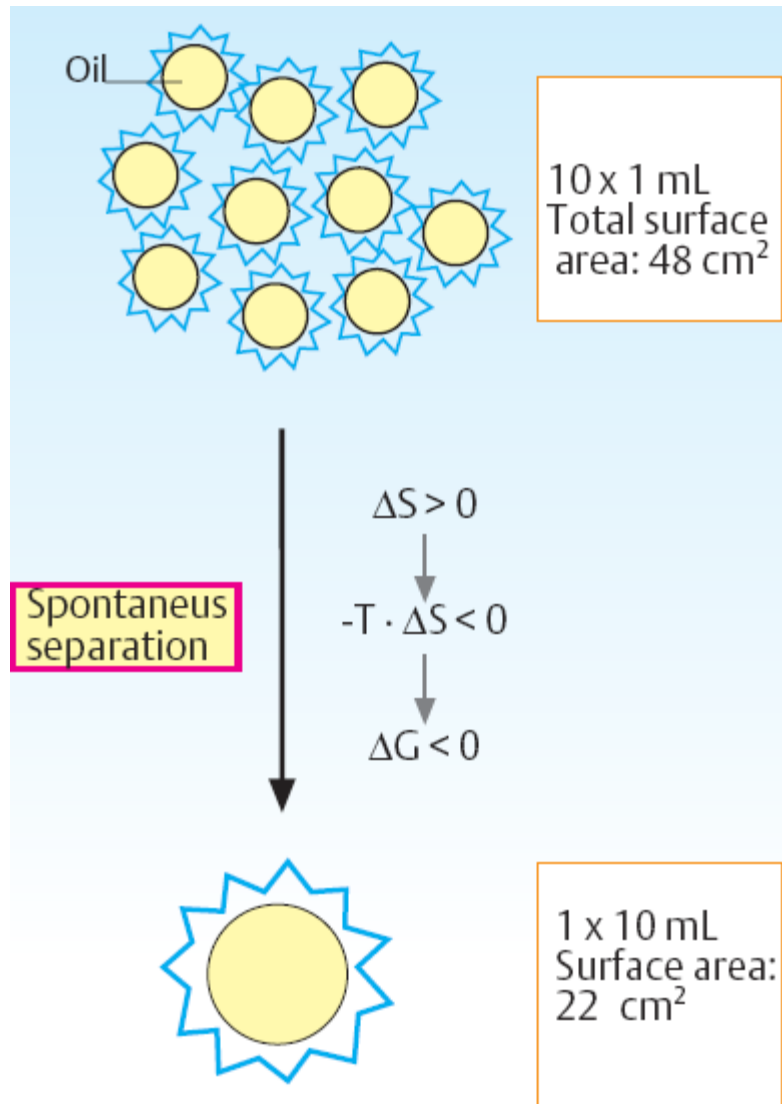


2. Dissolution of NaCl in water

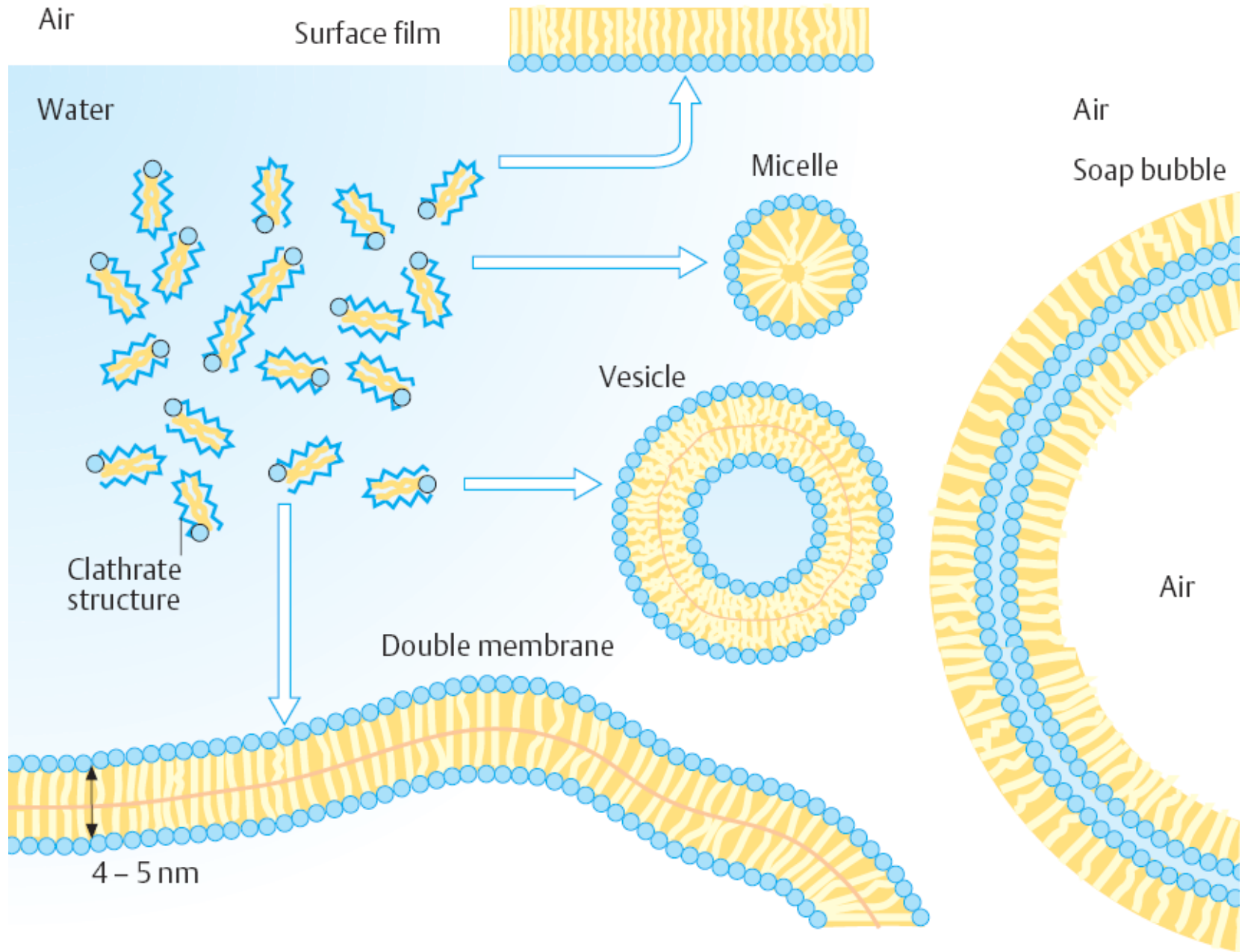
Hydrophobe Stoffe lösen sich schlecht in Wasser



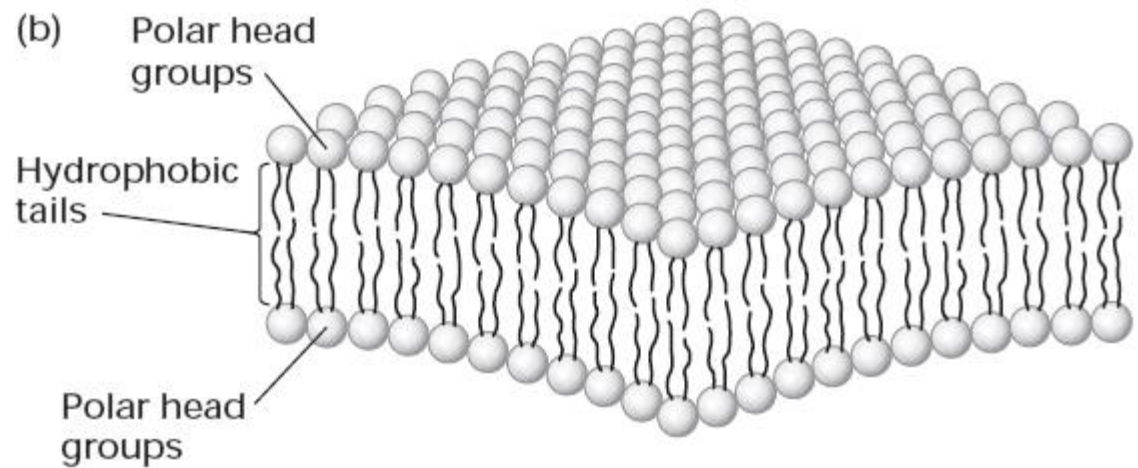
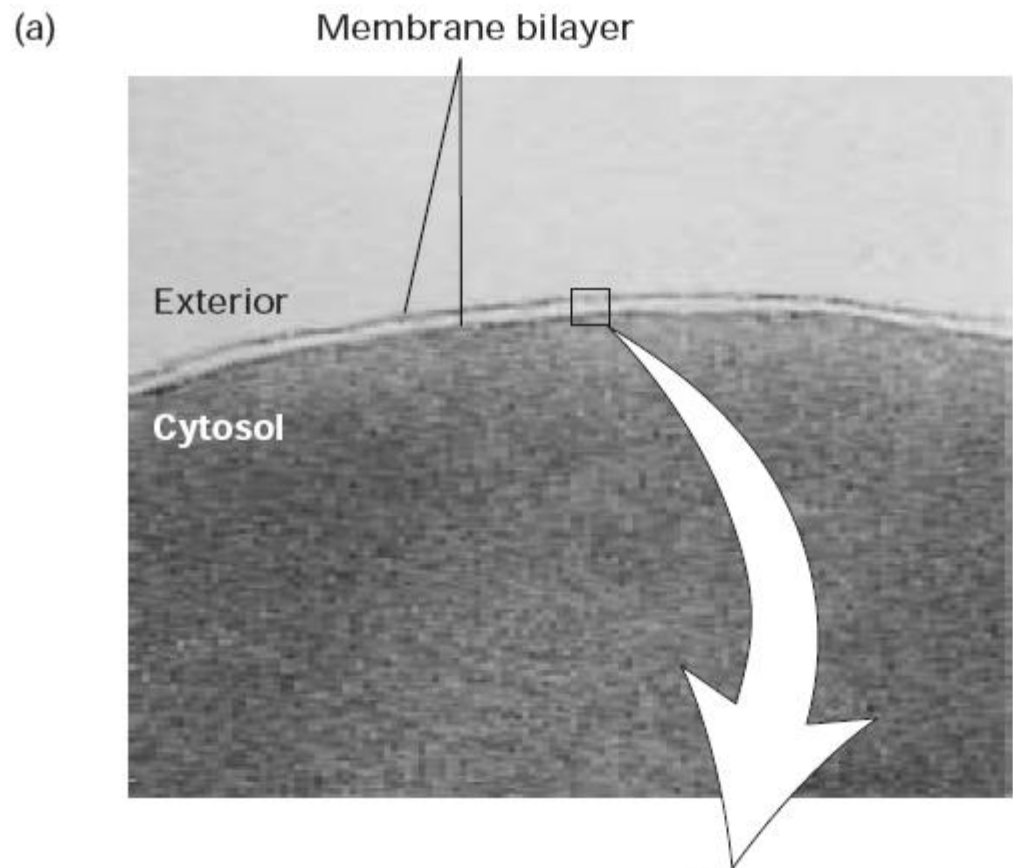
Entmischung vergrößert die Unordnung



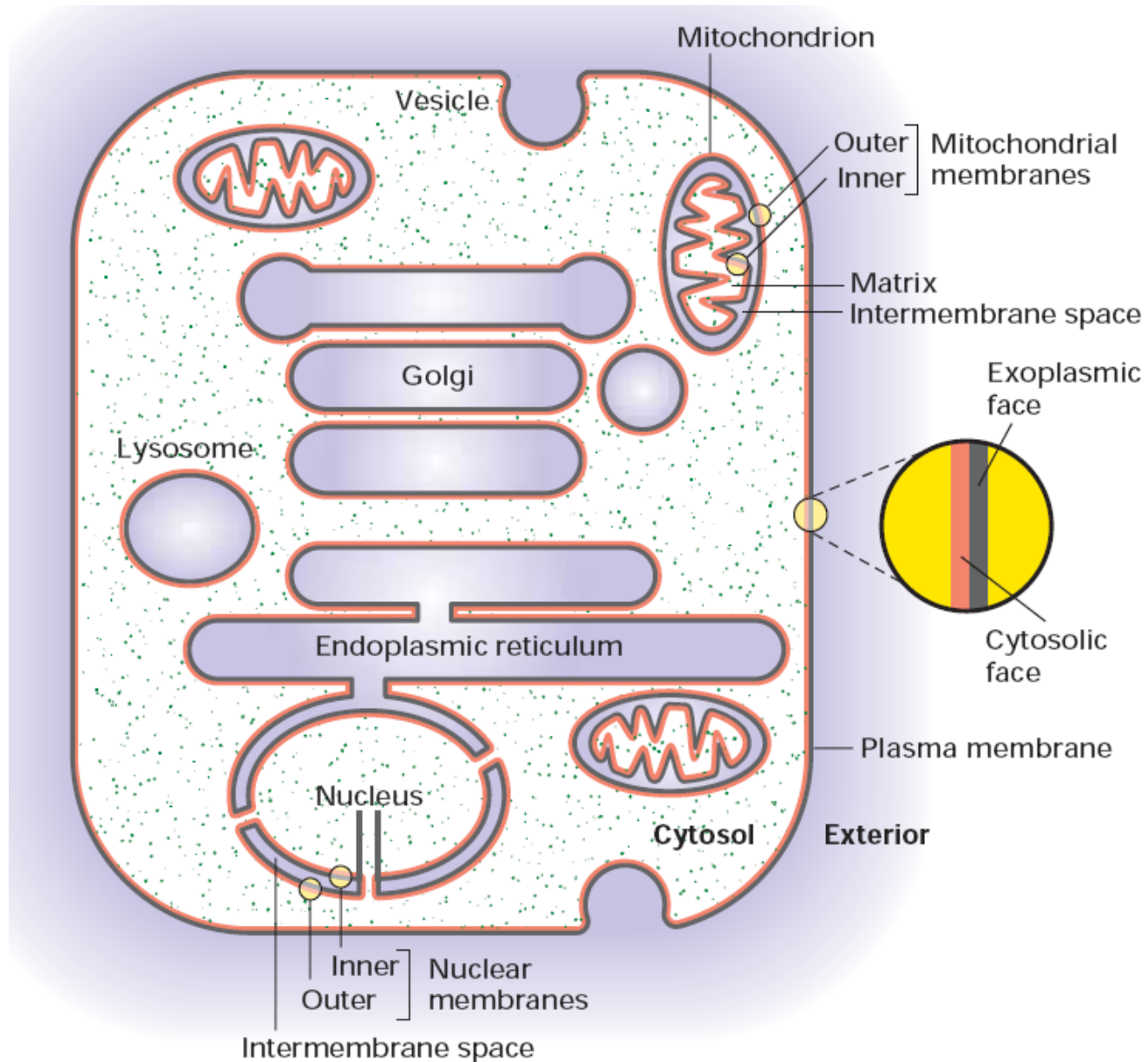
Amphiphile Stoffe können Membranen bilden



Membranen in der Biologie

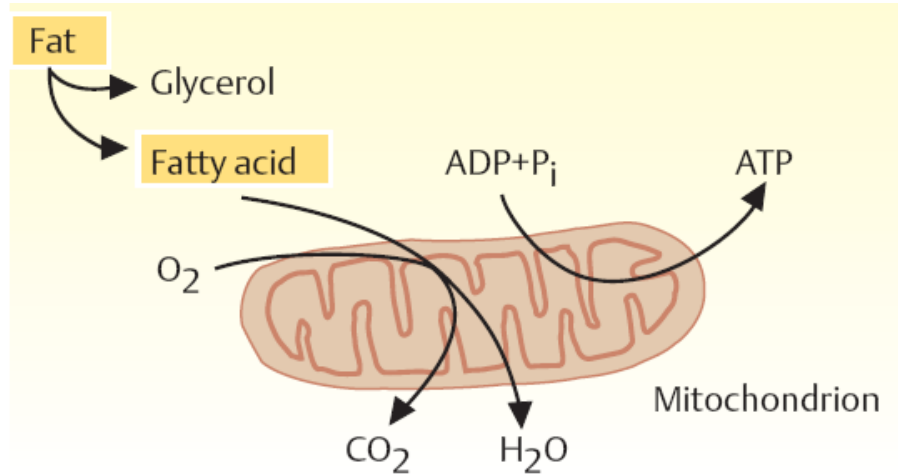


Membranen sind wichtig für die Integrität der Zelle

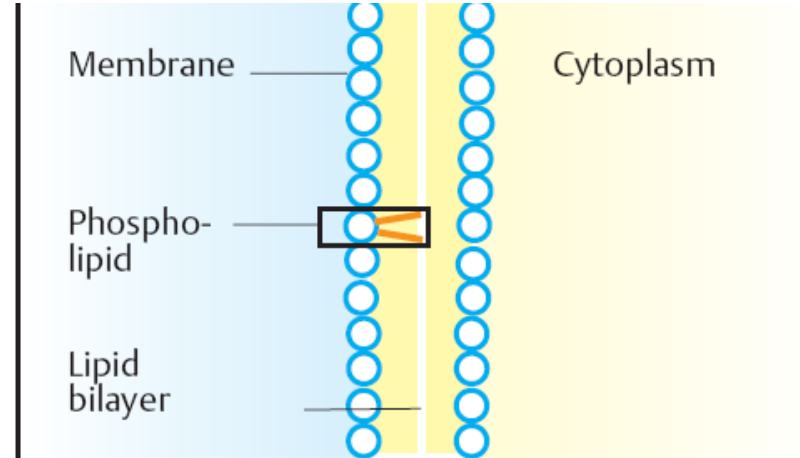


Lipide

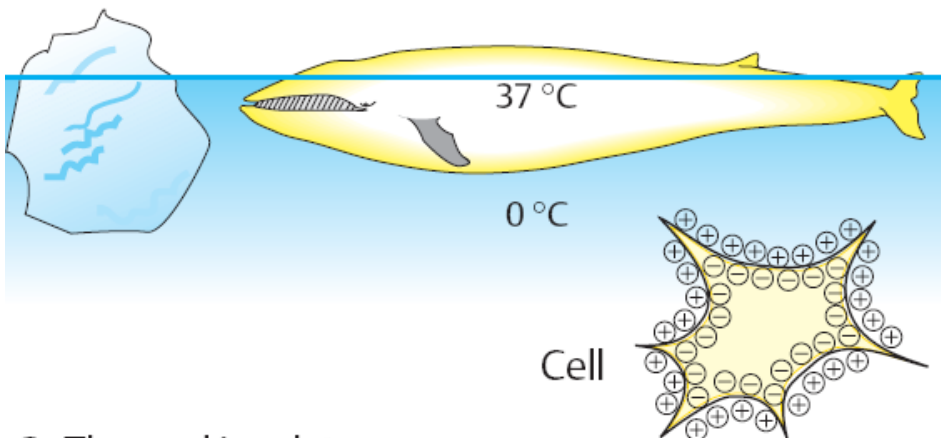
- Lipide sind eine heterogene Substanzklasse die viele nicht oder nur eingeschränkt wasserlösliche Moleküle umfasst.
- Lipide besitzen zahlreiche Funktionen



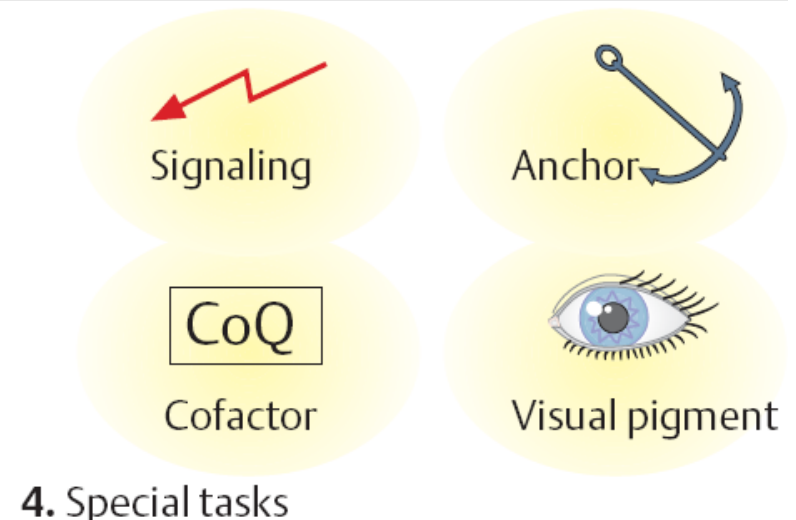
1. Fuel



2. Building block



3. Thermal insulator

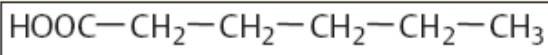


4. Special tasks

Fettsäuren

Name	Number of carbons		Number of double bonds	Position of double bonds
Formic acid	1	0	0	
Acetic acid	2	0	0	
Propionic acid	3	0	0	
Butyric acid	4	0	0	
Valerianic acid	5	0	0	
Caproic acid	6	0	0	
Caprylic acid	8	0	0	
Capric acid	10	0	0	
Lauric acid	12	0	0	
Myristic acid	14	0	0	
Palmitic acid	16	0	0	
Stearic acid	18	0	0	
Oleic acid	18	1; 9	1	9
Linoleic acid	18	2; 9,12	2	9,12
Linolenic acid	18	3; 9,12,15	3	9,12,15
Arachidic acid	20	0	0	
Arachidonic acid	20	4; 5,8,11,14	4	5,8,11,14
Behenic acid	22	0	0	
Erucic acid	22	1; 13	1	13
Lignoceric acid	24	0	0	
Nervonic acid	24	1; 15	1	15

Not contained in lipids



Caproic acid

ungesättigte Fettsäuren
(in Natur fast immer cis)

Essentielle
Fettsäuren für
Menschen



Ungesättigte Fettsäuren

- **Viele tierische Fette sind gesättigt, d.h. die enthaltenen Fettsäuren enthalten keine Doppelbindungen.**
- **Fette aus Pflanzen, Fischen und Walen sind im Allgemeinen ungesättigt.**
- **Ungesättigte Fettsäuren haben einen „Knick“, und lagern sich daher nicht so gut zusammen.**
- **Öle und Trane sind bei Raumtemperatur normalerweise flüssig aufgrund ihres Gehalts an ungesättigten Fettsäuren.**

„Trans“ (mono) Fette werden heftig diskutiert

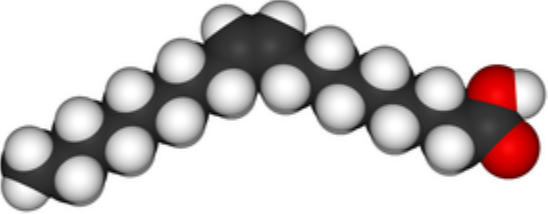
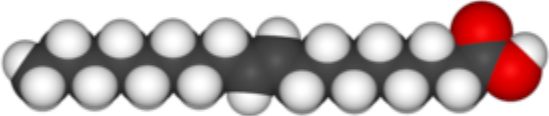
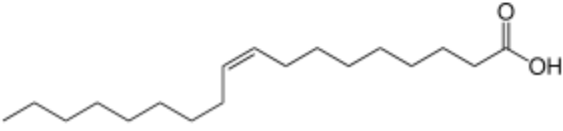
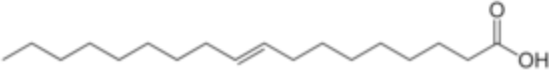
<http://www.bantransfats.com>



- **Cancer:** There is no scientific consensus that consumption of trans fats significantly increases [cancer](#) risks across the board.^[27] The American Cancer Society states that a relationship between trans fats and cancer "has not been determined."^[33] However, one recent study has found connections between trans fat and prostate cancer.^[34]
- **Diabetes:** There is a growing concern that the risk of [type 2 diabetes](#) increases with trans fat consumption.^[27] However, consensus has not been reached.^[3] For example, one study found that risk is higher for those in the highest [quartile](#) of trans fat consumption.^[35] Another study has found no diabetes risk once other factors such as total fat intake and BMI were accounted for.^[36]
- **Obesity:** Research indicates that trans fat may increase weight gain and abdominal fat, despite a similar caloric intake.^[37] A 6-year experiment revealed that monkeys fed a trans-fat diet gained 7.2% of their body weight, as compared to 1.8% for monkeys on a mono-unsaturated fat diet.^[38] Although obesity is frequently linked to trans fat in the popular media,^[39] this is generally in the context of eating too many calories; there is no scientific consensus connecting trans fat and obesity.
- **Liver Dysfunction:** Trans fats are metabolized differently by the [liver](#) than other fats and interfere with delta 6 [desaturase](#). Delta 6 desaturase is an [enzyme](#) involved in converting essential fatty acids to [arachidonic acid](#) and [prostaglandins](#), both of which are important to the functioning of cells.^[40]
- **Infertility:** One 2007 study found, "Each 2% increase in the intake of energy from trans unsaturated fats, as opposed to that from carbohydrates, was associated with a 73% greater risk of ovulatory infertility..."^[41]

(englisches wikipedia Nov 2007)

Eigenschaften von cis und trans-Fetten

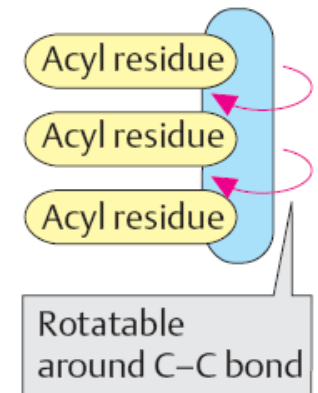
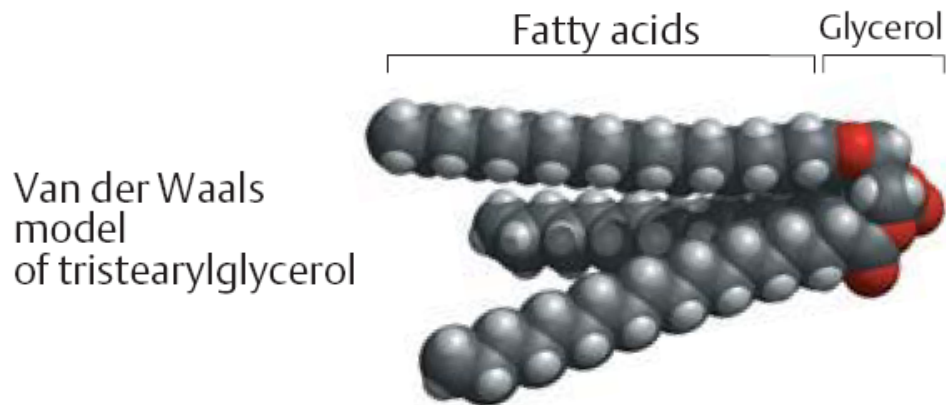
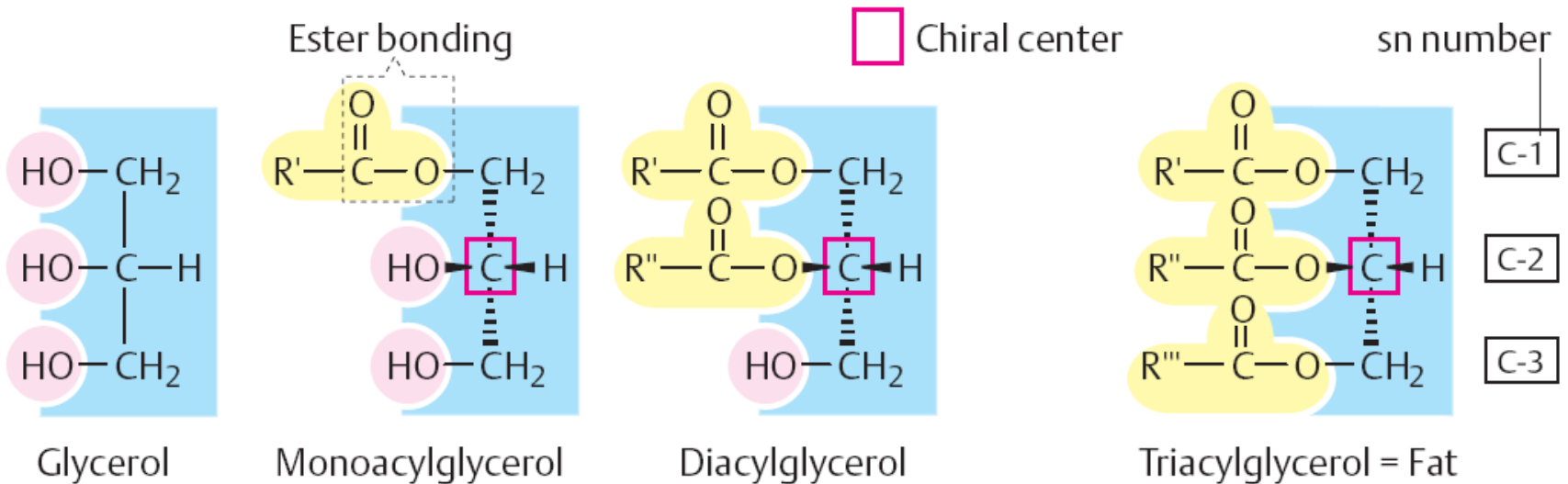
Oleic acid	Elaidic acid
Oleic acid is a <i>cis</i> unsaturated fatty acid that comprises 55–80% of olive oil.	Elaidic acid is a <i>trans</i> unsaturated fatty acid often found in partially hydrogenated vegetable oils.
	
	

Hydrierungsschema eines Pflanzlichen Öls

18:3	→	18:2	→	18:1 c9	→	18:1 t9	→	18:0
α -Linolensäure		Linolsäure		Ölsäure		Elaidinsäure		Stearinsäure
Schmelzpunkt: -11°C		-5°C		+16°C		+51°C		+69,6°C

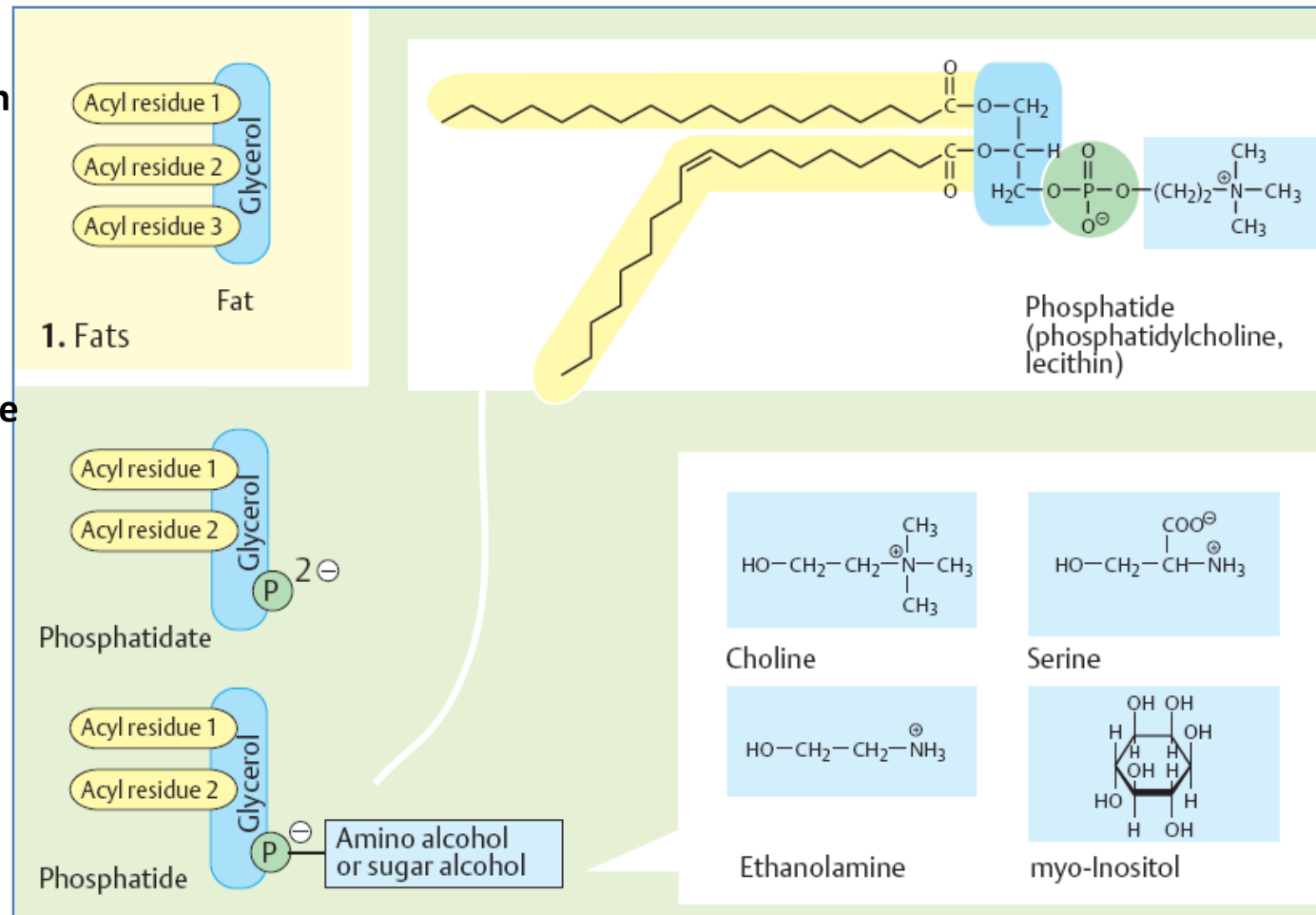
Fette

- Fette sind Ester der Fettsäuren mit Glycerin.
- Im Blut werden Fette in Lipoproteinen transportiert.



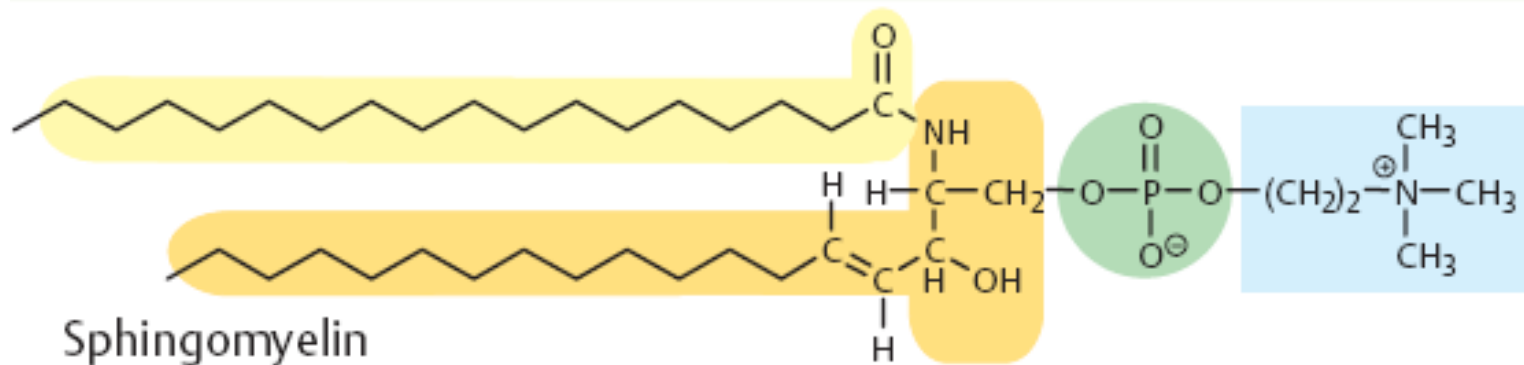
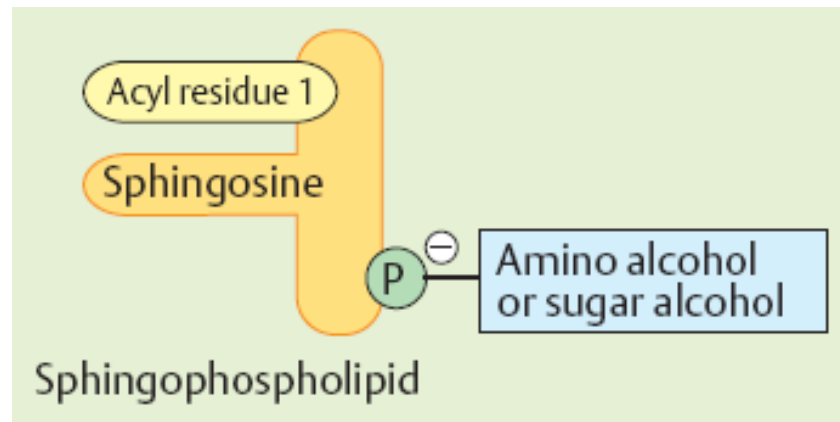
Phospholipide

- Phospholipide tragen ein Phosphat am C3.
- Phospholipide sind der Hauptbestandteil der Membranen in Wirbeltieren.
- Bei neutralem pH sind sie negativ geladen.
- Phosphatidate sind die einfachste Form eines Diacyl-glycerin-Phosphatesters.
- In Phosphatiden ist das Phosphat nochmals verestert.



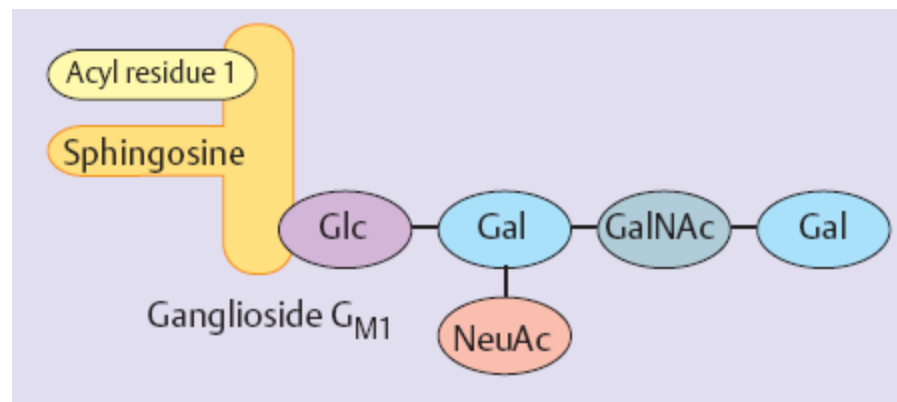
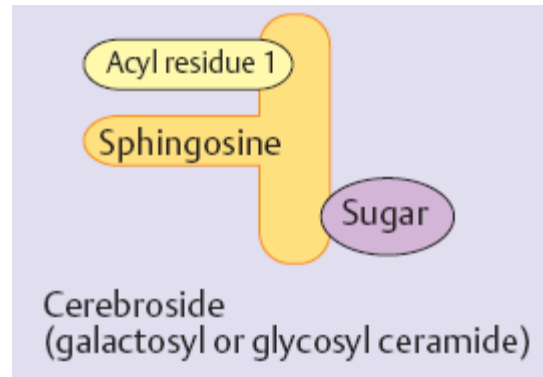
Sphingophospholipide

- Sphingolipide bestehen aus Fettsäure, Glycerin und dem Aminoalkohol Sphingosin
- Sie kommen in Nerven und Gehirn vor.



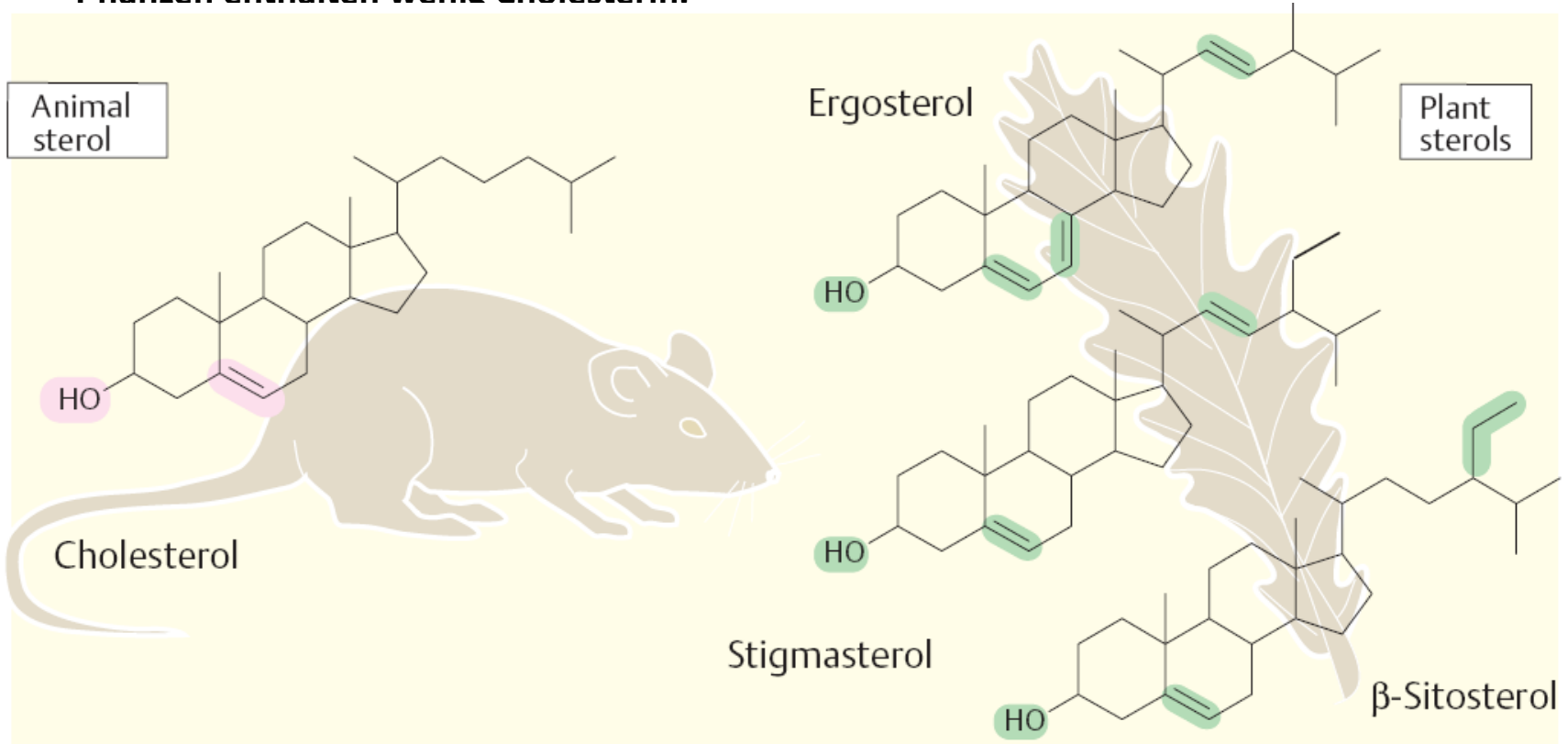
Glycolipide

- Glycolipide sind Sphingolipide mit einem Zucker
- Sie kommen überwiegend an der Außenseite von Membranen vor.

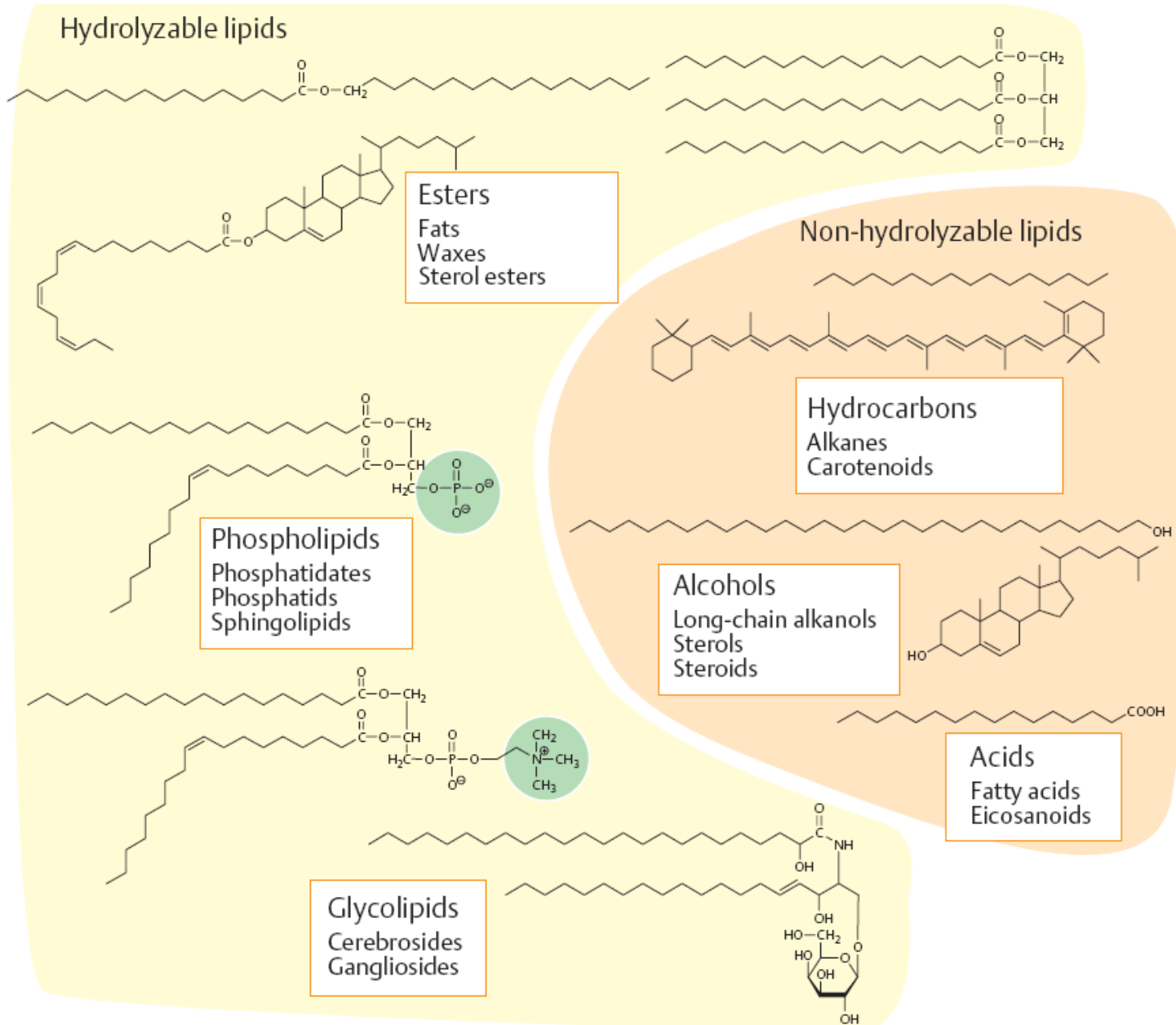


Cholesterin

- Cholesterin (neu: Cholesterol) ist ein Lipid und kommt in allen Tierischen Geweben vor.
- Cholesterin ist ein Steroid und beruht auf dem Cholestan Grundkörper.
- Es regelt die Fluidität der Membranen.
- Speicher und Transportform sind Ester mit Fettsäuren
- Cholesterinreiche LDL (-Lipoproteine) sind an der Arteriosklerose beteiligt.
- Pflanzen enthalten wenig Cholesterin.



Lipide: Einteilung, Übersicht



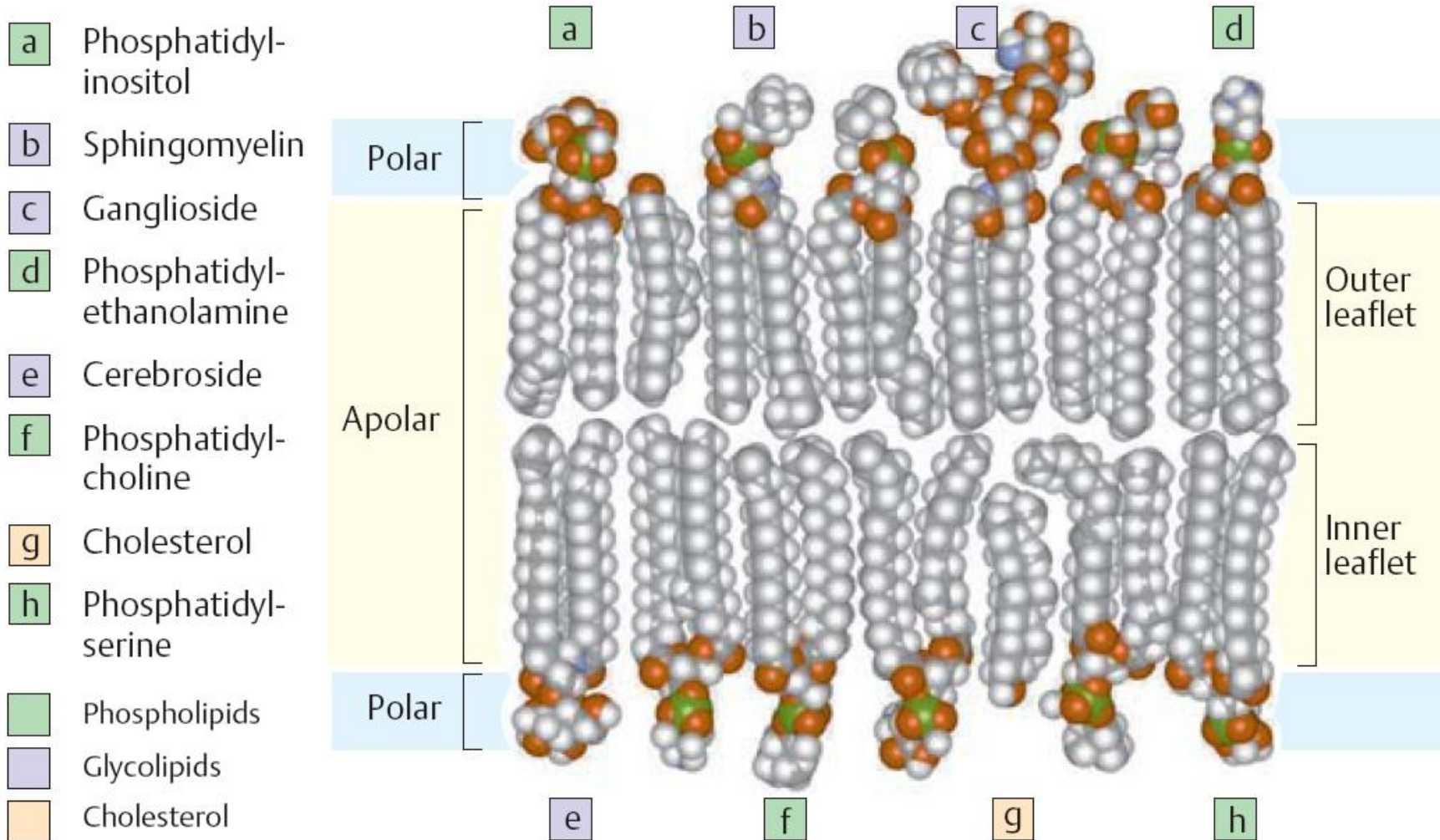
Zusammensetzung von Membranen

TABLE 5-1 Major Lipid Components of Selected Biomembranes

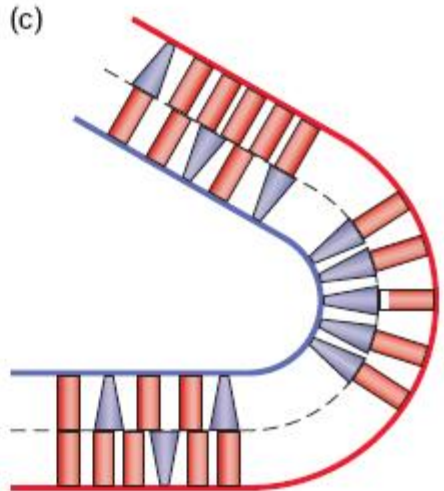
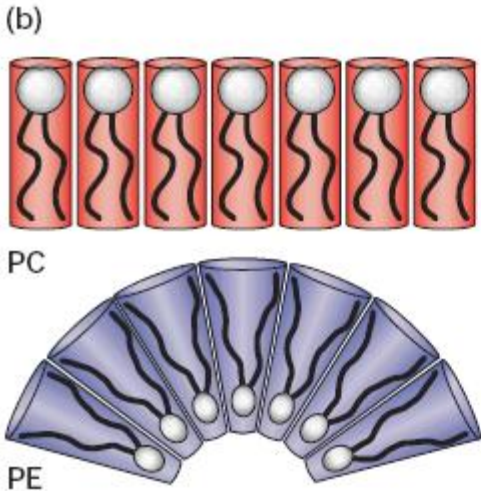
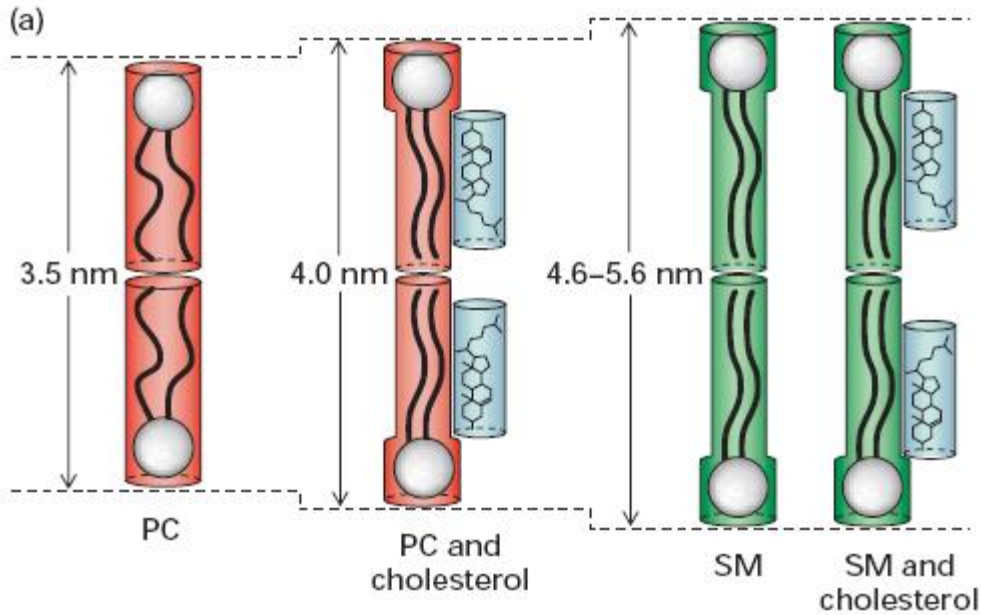
Source/Location	Composition (mol %)			
	PC	PE + PS	SM	Cholesterol
Plasma membrane (human erythrocytes)	21	29	21	26
Myelin membrane (human neurons)	16	37	13	34
Plasma membrane (<i>E. coli</i>)	0	85	0	0
Endoplasmic reticulum membrane (rat)	54	26	5	7
Golgi membrane (rat)	45	20	13	13
Inner mitochondrial membrane (rat)	45	45	2	7
Outer mitochondrial membrane (rat)	34	46	2	11
Primary leaflet location	Exoplasmic	Cytosolic	Exoplasmic	Both

PC = phosphatidylcholine; PE = phosphatidylethanolamine; PS = phosphatidylserine; SM = sphingomyelin.
 SOURCE: W. Dowhan and M. Bogdanov, 2002, in D. E. Vance and J. E. Vance, eds., *Biochemistry of Lipids, Lipoproteins, and Membranes*, Elsevier.

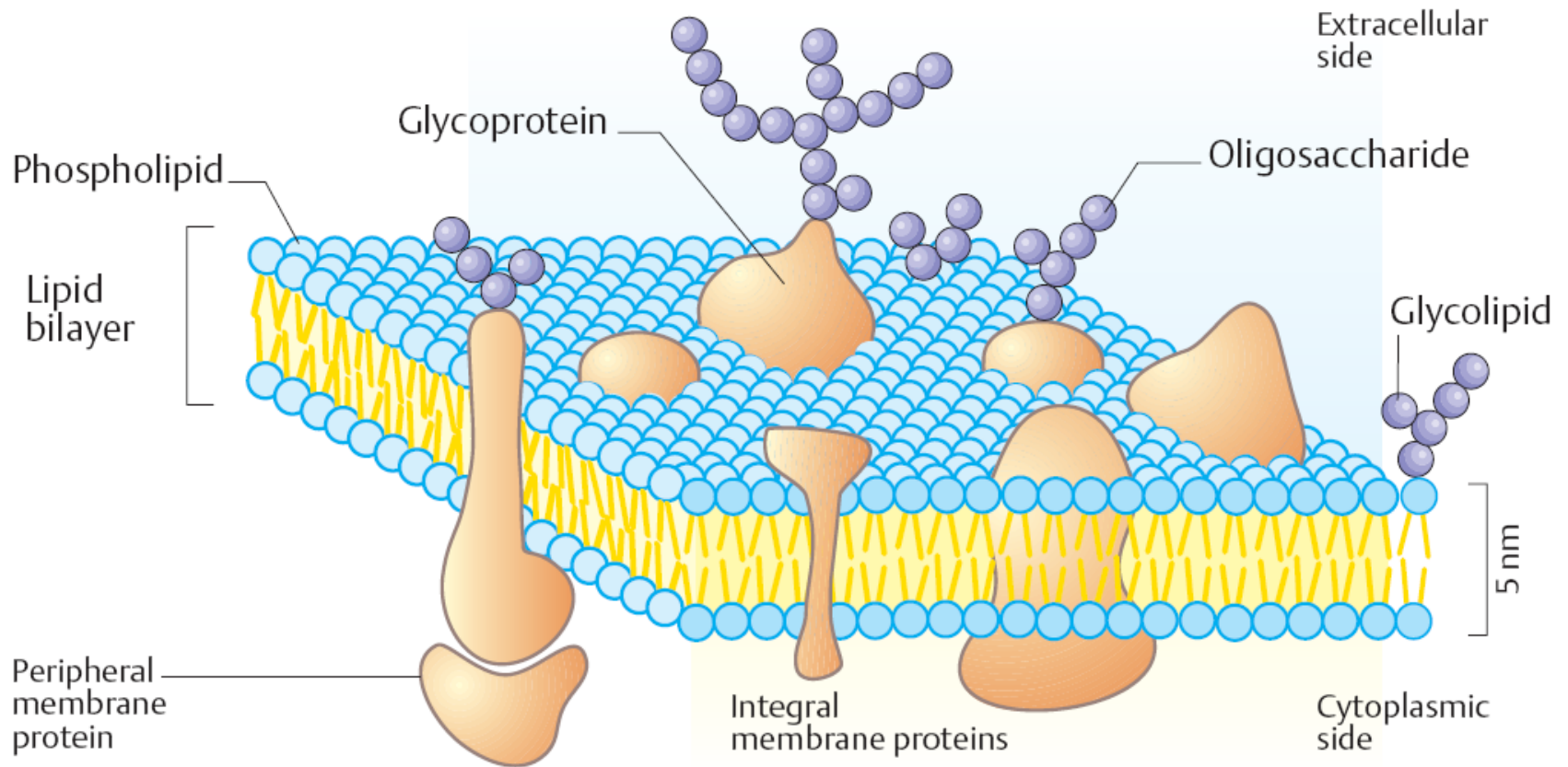
Eine Membran im Modell



Die Membranzusammensetzung bestimmt die Eigenschaften



Struktur einer Plasmamembran



Proteine siehe nächste Woche

Ende