

# **I LIPIDI**

## **FUNZIONE**

- **RISERVA ENERGETICA → grassi ed oli**
- **ELEMENTI STRUTTURALI → lipidi di membrana**
- **SEGNALI, COFATTORI → ormoni, vitamine, pigmenti**

## **STRUTTURA CHIMICA**

- **SEMPLICI → lipidi di riserva ovvero trigliceridi o triacilgliceroli**
- **COMPLESSI o CONIUGATI → lipidi di membrana**
- **DERIVATI → steroidi, chinoni, carotenoidi**

## • SEMPLICI →

**Lipidi di riserva (neutri)**

Triacilgliceroli

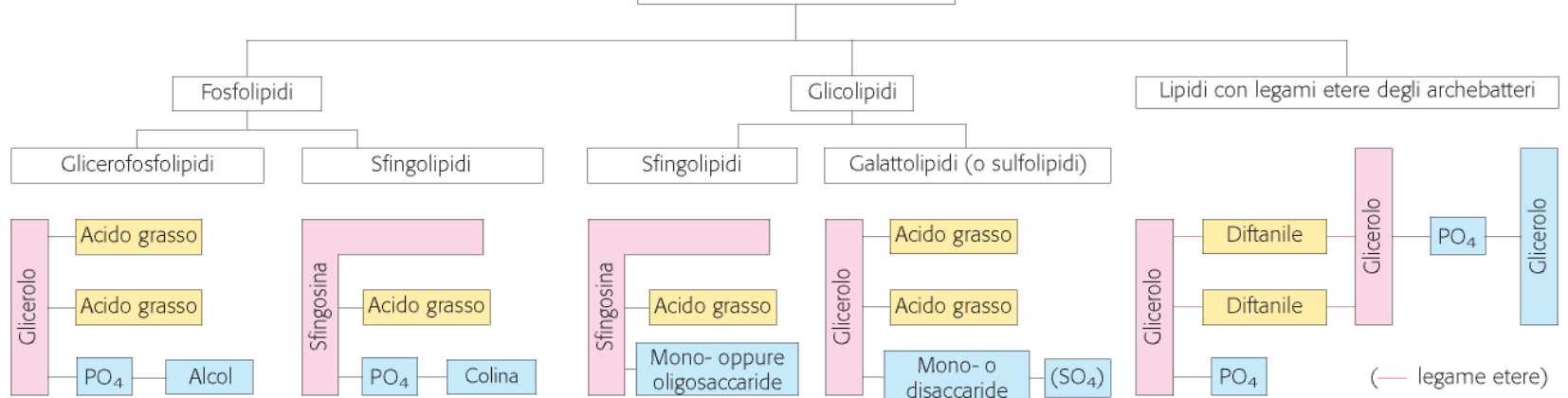
Glicerolo

Acido grasso

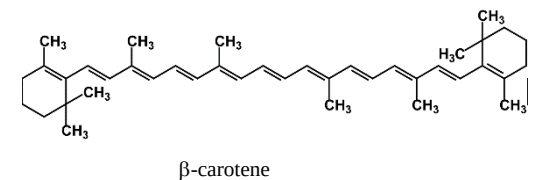
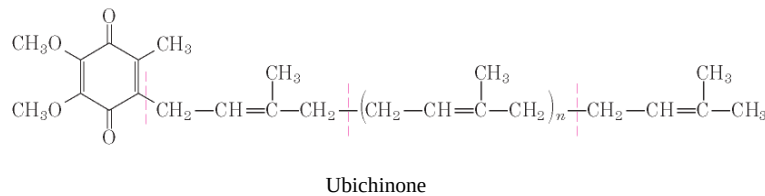
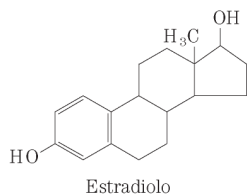
Acido grasso

Acido grasso

## • COMPLESSI o CONIUGATI → **Lipidi di membrana (polari)**



## • DERIVATI → steroidi, chinoni, carotenoidi

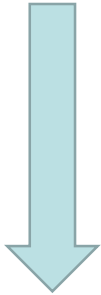


# I LIPIDI

## ORIGINE BIOSINTETICA

### Da unità di ACETATO

- SEMPLICI
- COMPLESSI o CONIUGATI



### Unità costitutiva

- Acidi grassi

### Dall'acido MEVALONICO

- DERIVATI

## Acidi grassi più diffusi in natura

| Scheletro Carbonioso          | Nome sistematico                                         | Nome comune                |
|-------------------------------|----------------------------------------------------------|----------------------------|
| 12:0                          | Acido <i>n</i> -dodecanoico                              | Acido laurico              |
| 14:0                          | Acido <i>n</i> -tetradecanoico                           | Acido miristico            |
| 16:0                          | Acido <i>n</i> -esadecanoico                             | Acido palmitico            |
| 18:0                          | Acido <i>n</i> -ottadecanoico                            | Acido stearico             |
| 20:0                          | Acido <i>n</i> -eicosanoico                              | Acido arachidico           |
| 24:0                          | Acido <i>n</i> -tetraecosanoico                          | Acido lignocerico          |
| 16:1 ( $\Delta^9$ )           | Acido <i>cis</i> -9-esadecenoico                         | Acido palmitoleico         |
| 18:1 ( $\Delta^9$ )           | Acido <i>cis</i> -9-ottadecenoico                        | Acido oleico               |
| 18:2 ( $\Delta^9, 12$ )       | Acido <i>cis,cis</i> -9,12-ottadecadienoico              | Acido linoleico            |
| 18:3 ( $\Delta^9, 12, 15$ )   | Acido <i>cis,cis,cis</i> -9,12,15-ottadecatrienoico      | Acido $\alpha$ -linolenico |
| 20:4 ( $\Delta^{5,8,11,14}$ ) | Acido <i>cis,cis,cis,cis</i> -5,8,11,14-icosatetraenoico | Acido arachidonico         |

**acidi grassi poliinsaturi (PUFA, PolyUnsaturated Fatty Acids)**

**18:3 ( $\Delta^{9,12,15}$ )**

lunghezza della catena ←

numero di doppi legami ←

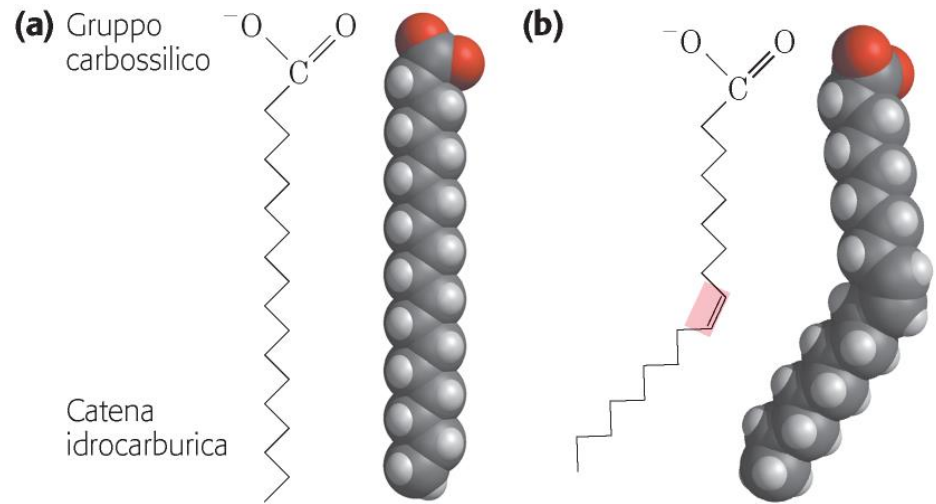
posizione dei doppi legami ←

## Strutture degli acidi grassi

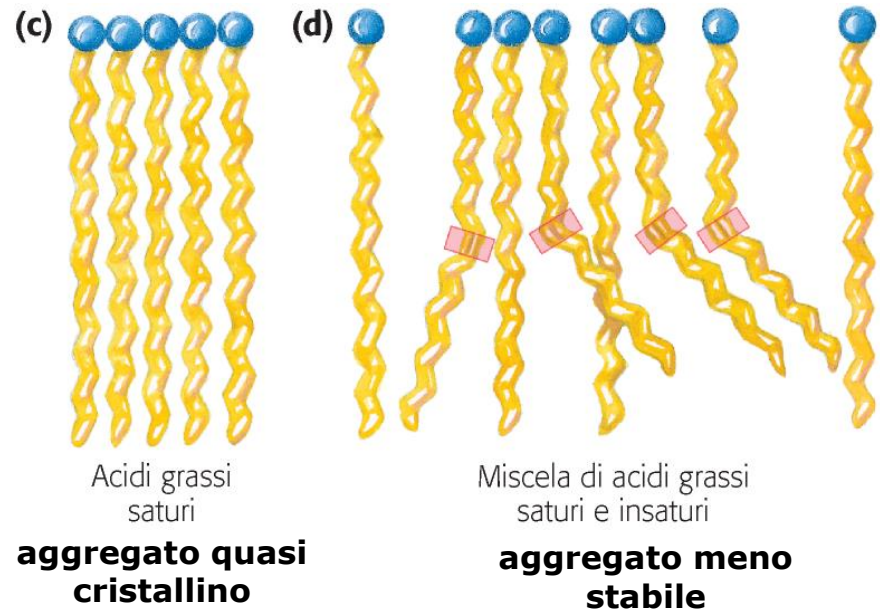
**La struttura degli acidi grassi dipende dal grado di insaturazione**

**a) acido stearico 18:0**

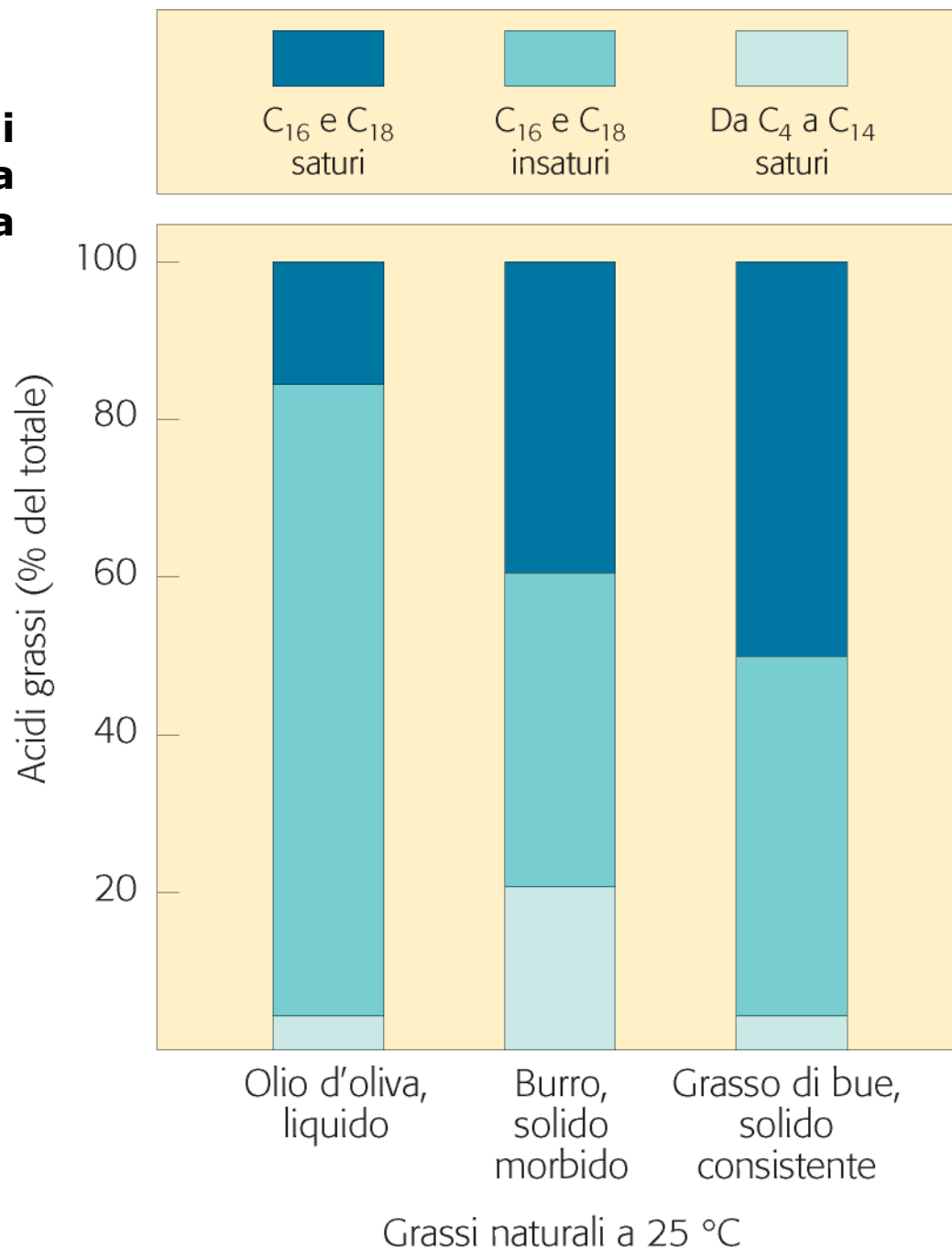
**b) acido oleico 18:1 ( $\Delta^9$ )**



**L'impacchettamento ovvero il modo in cui gli acidi grassi si dispongono per formare strutture organizzate dipende dal grado di insaturazione**

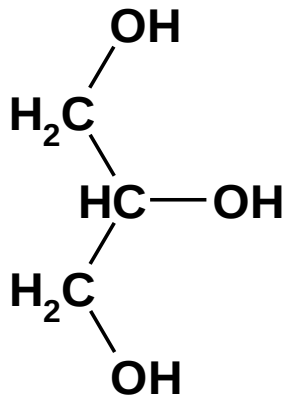


**Lo stato di aggregazione degli acidi grassi dipende dalla presenza di insaturazioni nella catena carboniosa**

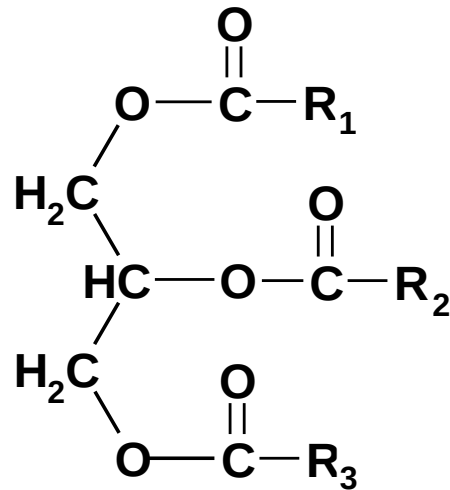


# I LIPIDI SEMPLICI

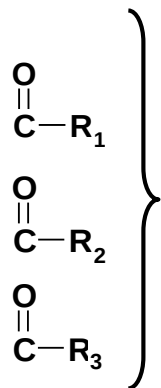
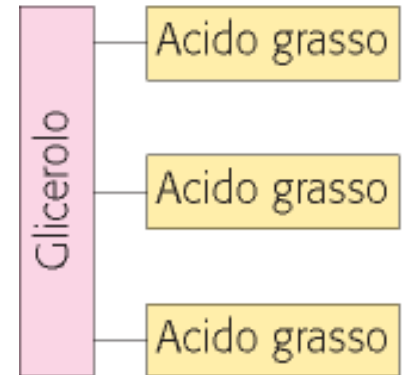
**trigliceridi o triacilgliceroli: molecole APOLARI**



**glicerolo**

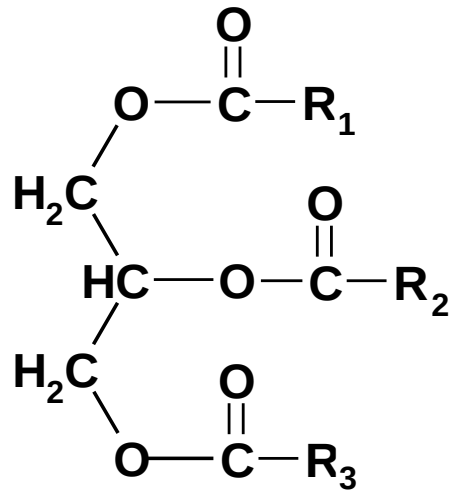


**Trigliceride: estere del glicerolo**



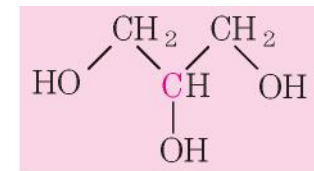
rappresentano molecole di **acido grasso**  
(acido carbossilico a lunga catena, da 4 a 36 atomi di C)

## LIPIDI SEMPLICI

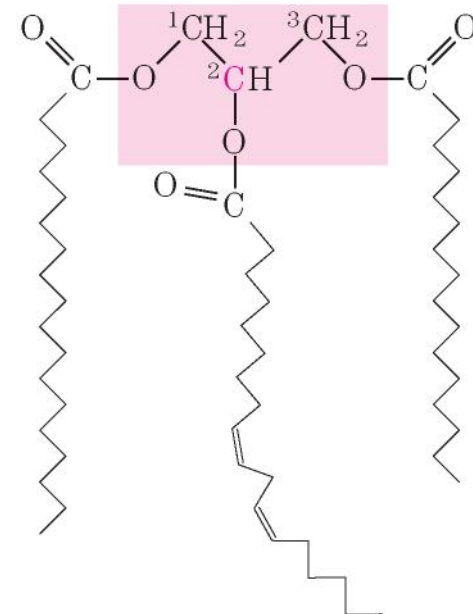
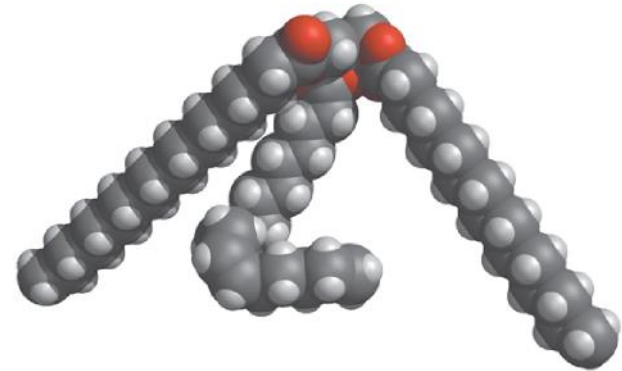


**triacilglicerolo**

- **semplice:**  $\text{R}_1 = \text{R}_2 = \text{R}_3$
- **misto:** gruppi R diversi



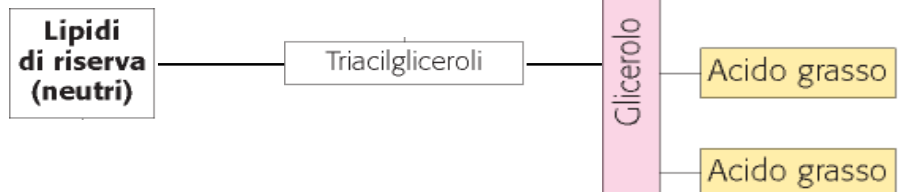
Glicerolo



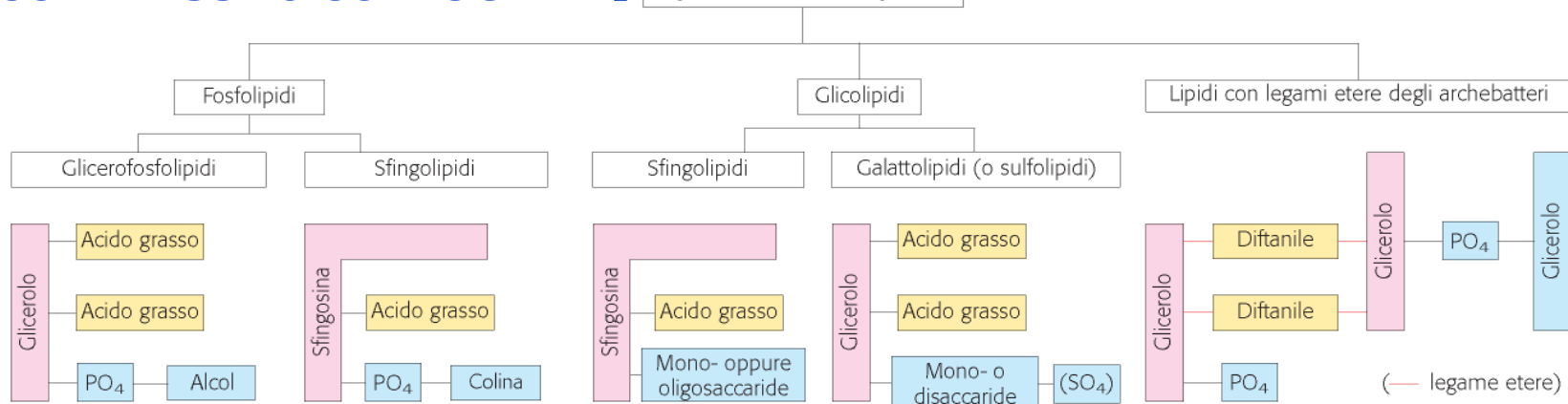
1-Stearil,2-linoleil,3-palmitil glicerolo,  
un triacilglicerolo misto



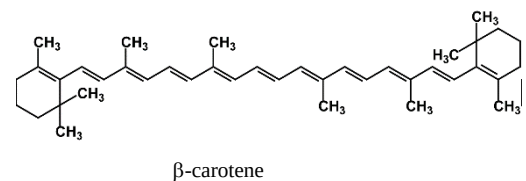
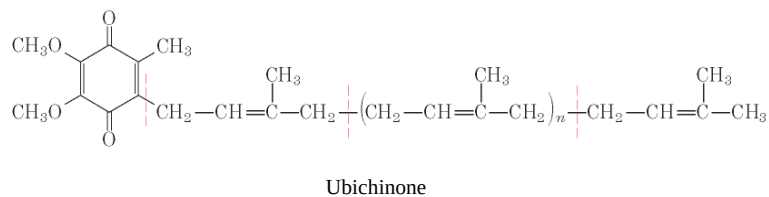
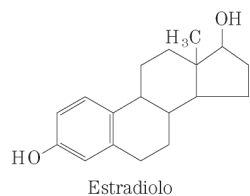
- **SEMPLICI** ➔



• **COMPLESSI o CONIUGATI** ➔ **Lipidi di membrana (polari)**

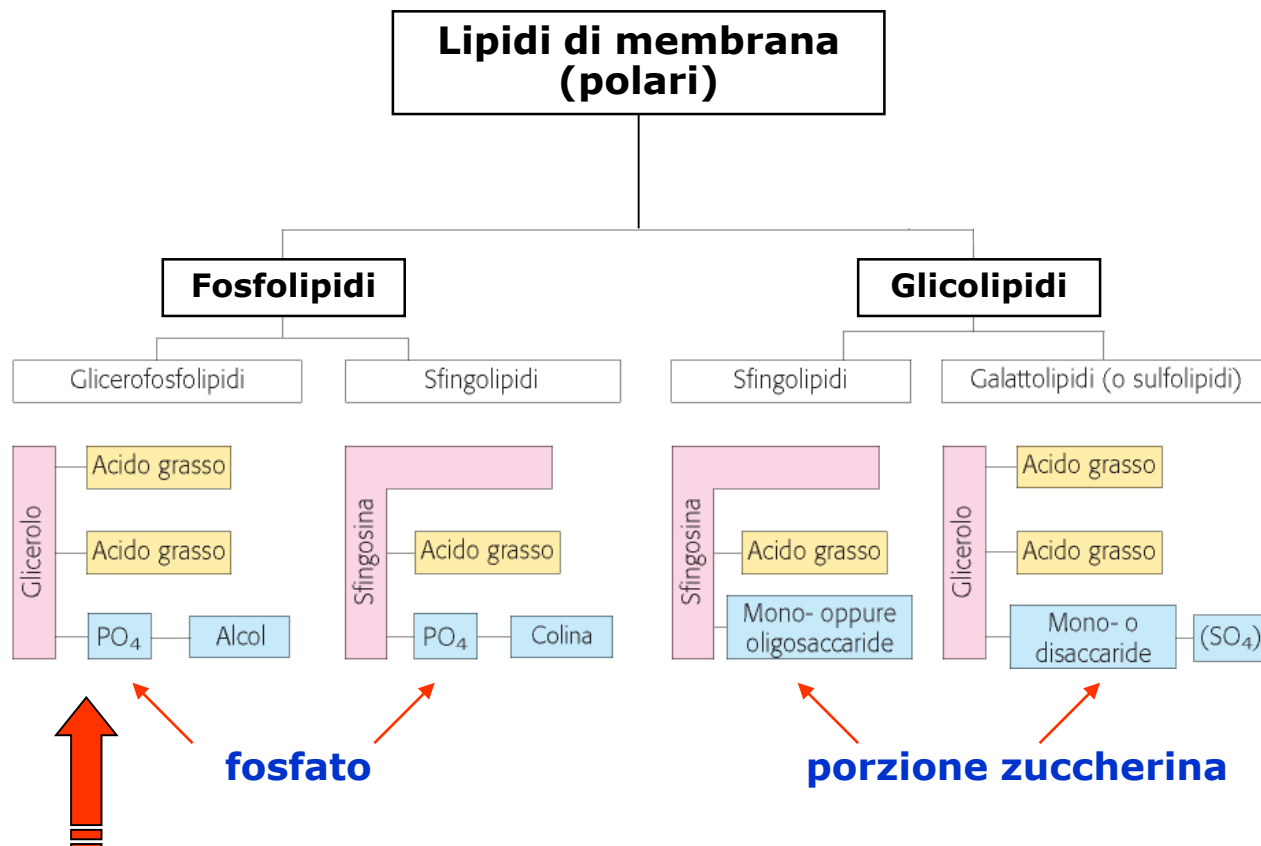


- **DERIVATI → steroidi, chinoni, carotenoidi**



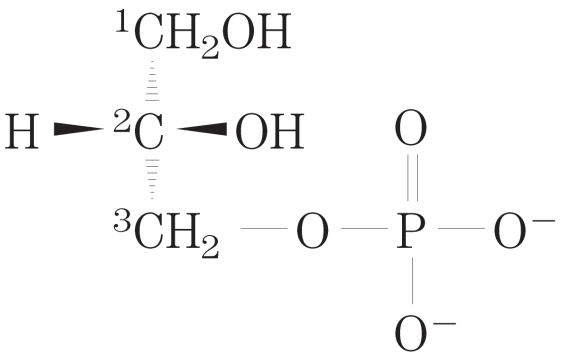
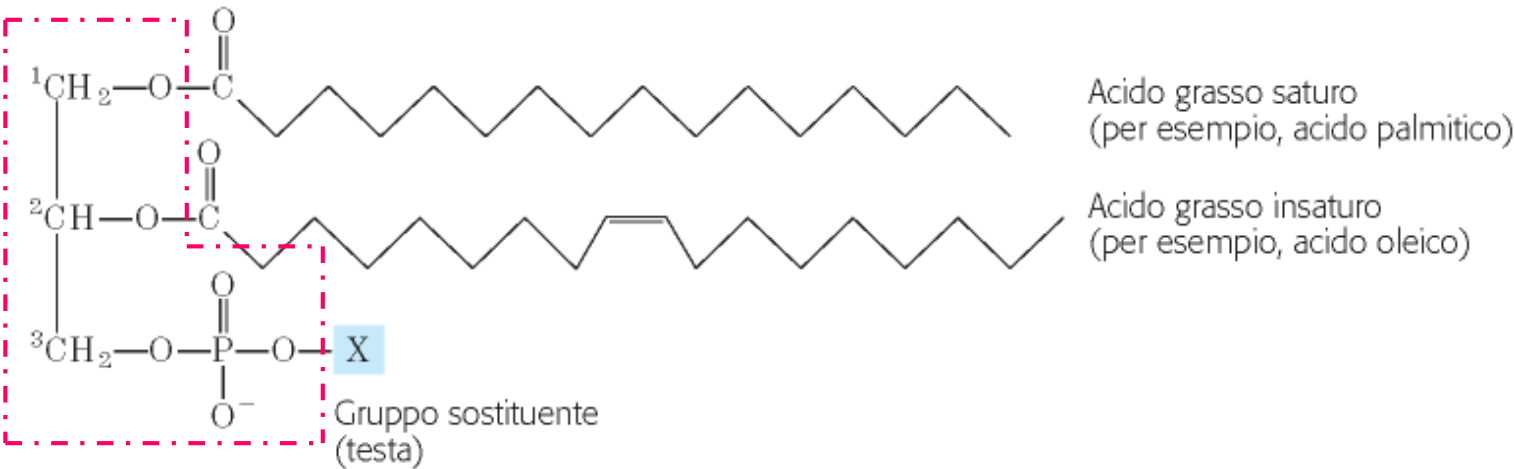
# I LIPIDI COMPLESSI O CONIUGATI

molecole ANFIPATICHE

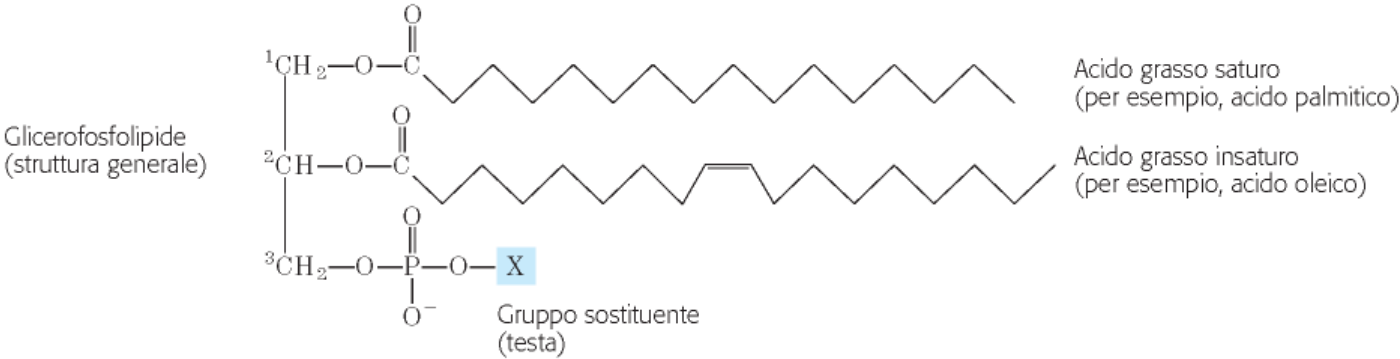


Glicerofosfolipidi o fosfogliceridi

Glicerofosfolipide  
(struttura generale)

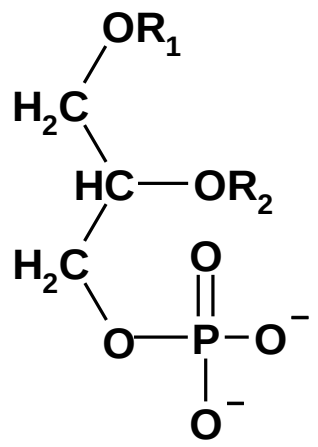
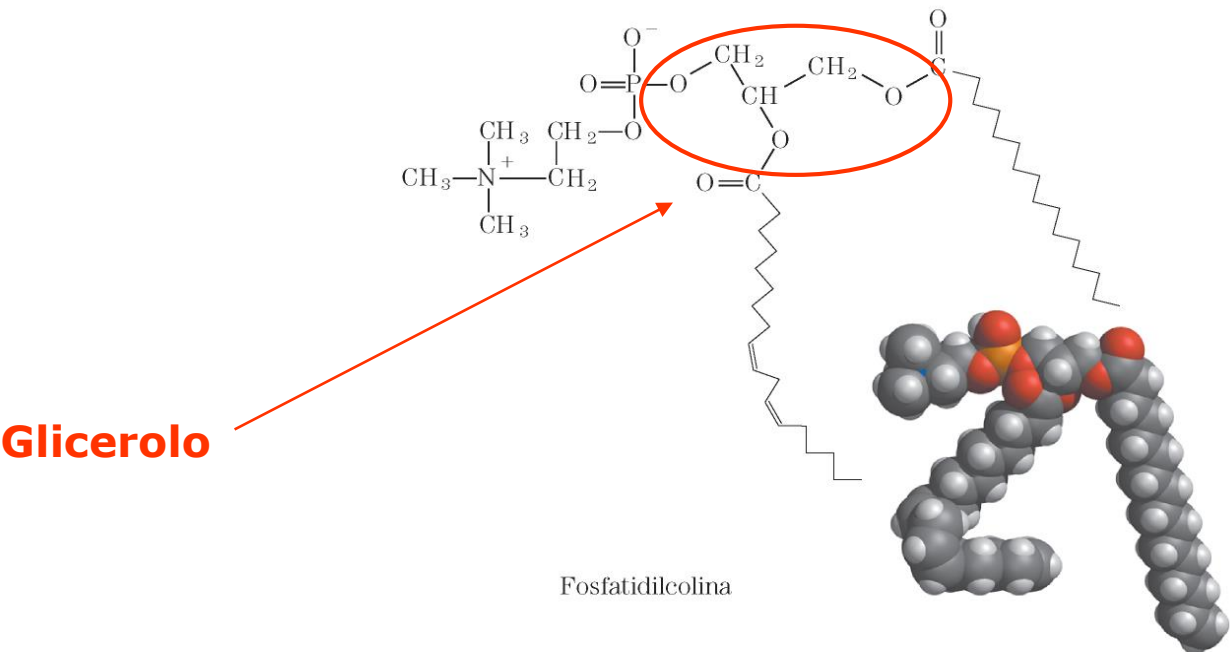


L-Glicerolo 3-fosfato  
(*sn*-glicerolo 3-fosfato)



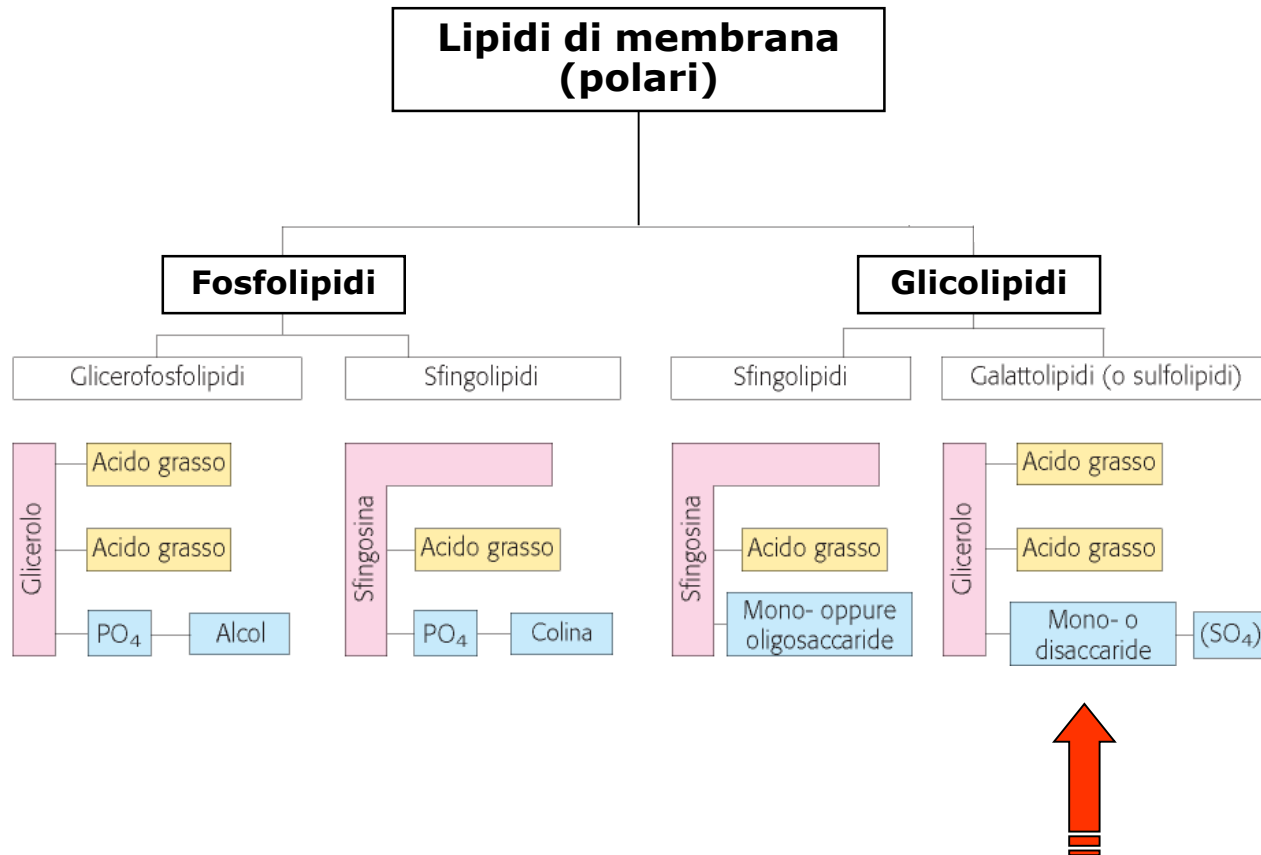
| Nome del glicerofosfolipide        | Nome di X                            | Formula di X                                                                       | Carica netta (a pH 7,0) |
|------------------------------------|--------------------------------------|------------------------------------------------------------------------------------|-------------------------|
| Acido fosfatidico                  | —                                    | — H                                                                                | — 1                     |
| Fosfatidiletanolamina              | Etanolamina                          | — CH <sub>2</sub> —CH <sub>2</sub> —NH <sub>3</sub> <sup>+</sup>                   | 0                       |
| Fosfatidilcolina                   | Colina                               | — CH <sub>2</sub> —CH <sub>2</sub> —N <sup>+</sup> (CH <sub>3</sub> ) <sub>3</sub> | 0                       |
| Fosfatidilserina                   | Serina                               | — CH <sub>2</sub> —CH—NH <sub>3</sub> <sup>+</sup><br> <br>COO <sup>-</sup>        | — 1                     |
| Fosfatidilglicerolo                | Glicerolo                            | — CH <sub>2</sub> —CH—CH <sub>2</sub> —OH<br> <br>OH                               | — 1                     |
| Fosfatidilinositolo 4,5-bisfosfato | <i>mio</i> -Inositolo 4,5-bisfosfato |                                                                                    | — 4                     |

Glicerofosfolipidi: fosfatidilcolina

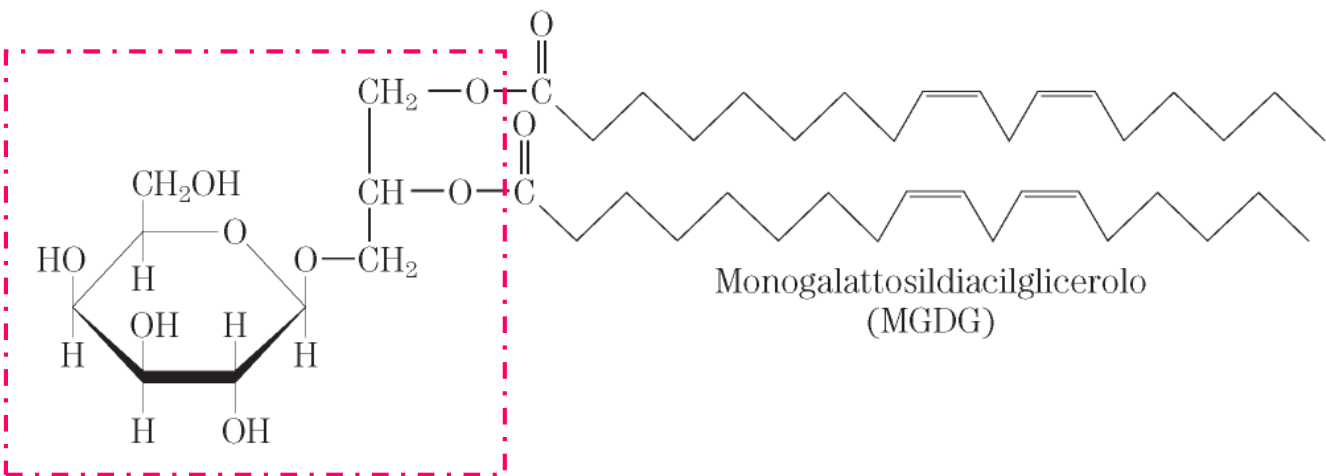


FOSFATIDATO: diacilglicerolo fosfato

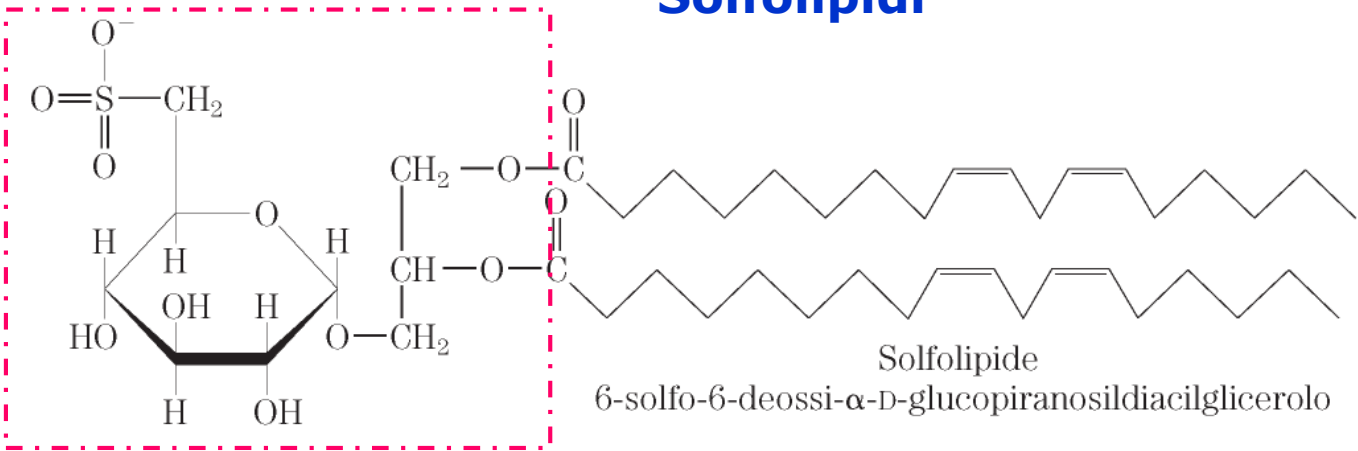
# I LIPIDI COMPLESSI O CONIUGATI



Galattolipidi



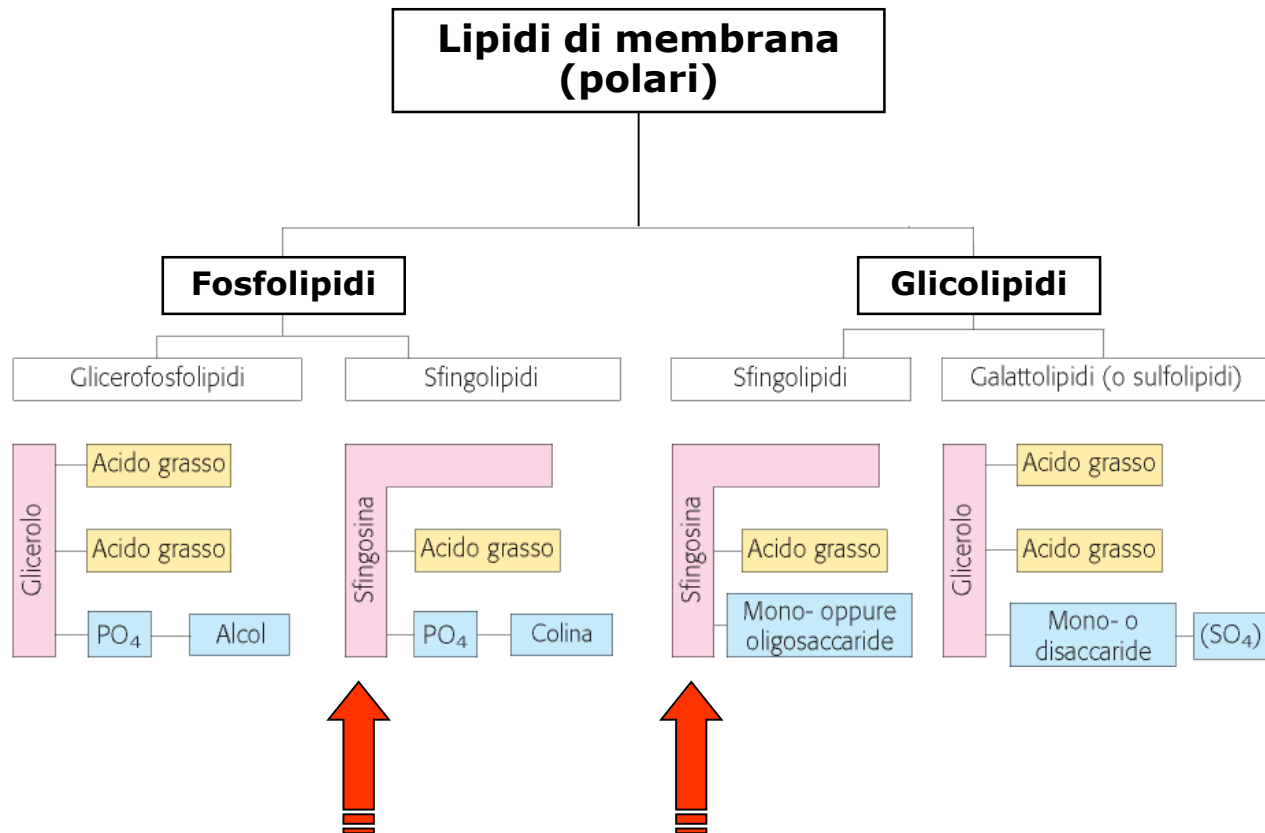
Solfolipidi



Lipidi di membrana nelle piante

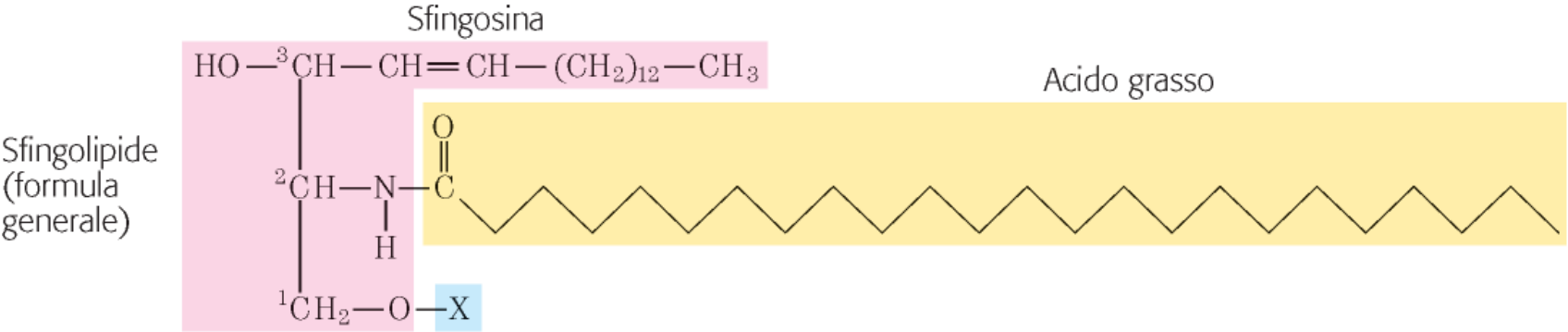
# I LIPIDI COMPLESSI

molecole ANFIPATICHE

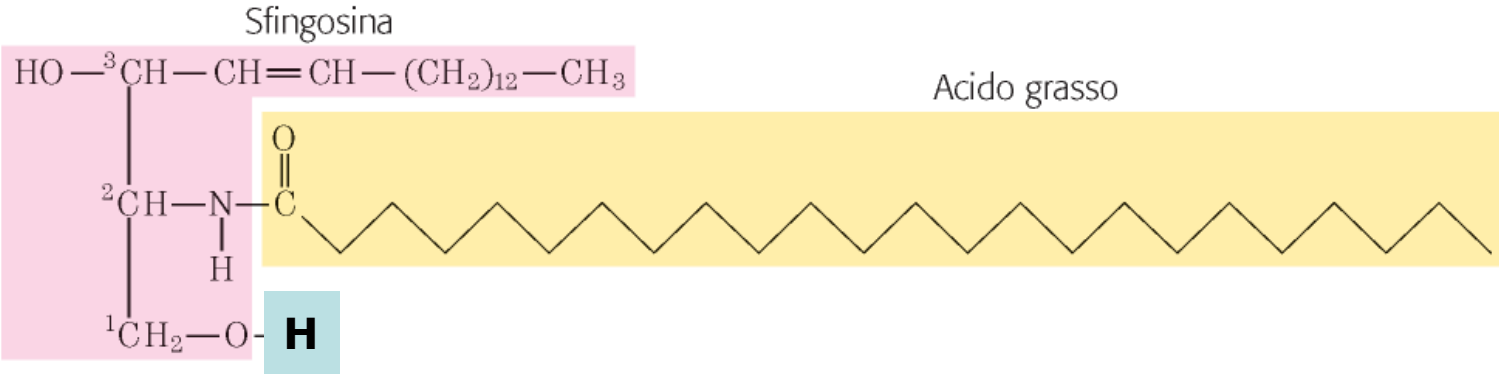




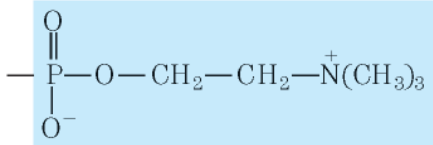
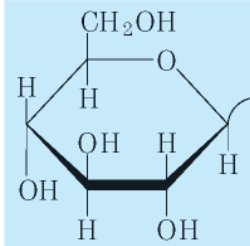
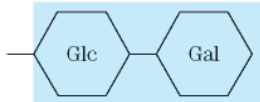
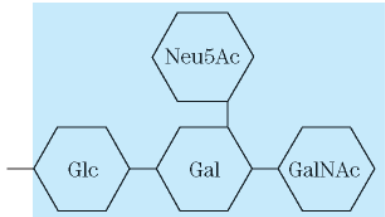
**Sfingolipidi**



**Ceramide: unità fondamentale degli sfingolipidi**  
**(N-acil sfingosina)**



Sfingolipidi: 3 sottoclassi

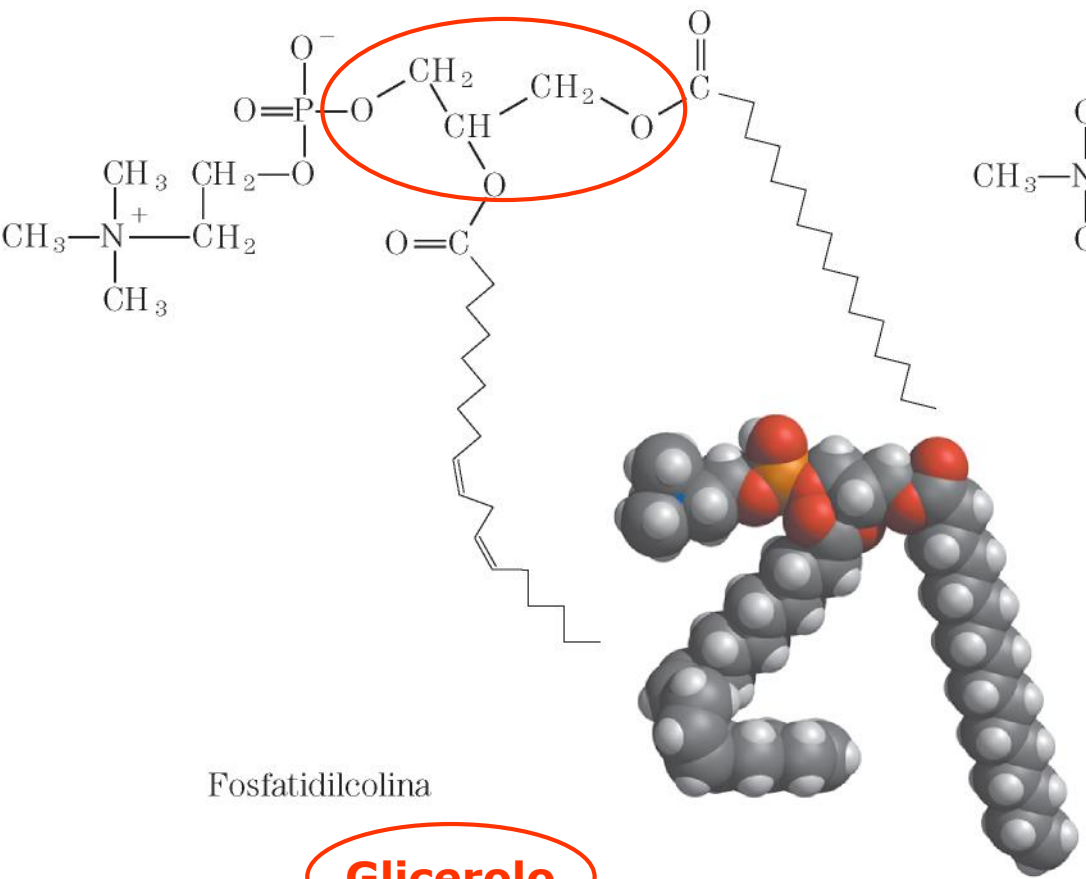
|                                                                 | Nome dello sfingolipide                   | Nome di X                          | Formula di X                                                                         |
|-----------------------------------------------------------------|-------------------------------------------|------------------------------------|--------------------------------------------------------------------------------------|
|                                                                 | Ceramide                                  | —                                  | — H                                                                                  |
| <b>Sfingomieline<br/>(fosfolipidi)</b>                          | Sfingomielina                             | Fosfocolina                        |   |
| <b>Glicosfingolipidi<br/>lipidi neutri<br/>(glicolipidi)</b>    | Glicolipidi neutri<br>Glicosilcerebroside | Glucosio                           |   |
|                                                                 | Lattosilceramide<br>(un globoside)        | Di-, tri- oppure<br>tetrasaccaride |   |
| <b>Gangliosidi<br/>carica negativa a pH 7<br/>(glicolipidi)</b> | Ganglioside GM2                           | Oligosaccaride<br>complesso        |  |

**Presenti sulla superficie cellulare con la funzione di sito di riconoscimento, si trovano anche nella membrana plasmatica di cellule animali e nella guaina che circonda gli assoni**

**LIPIDI COMPLESSI O CONIUGATI**

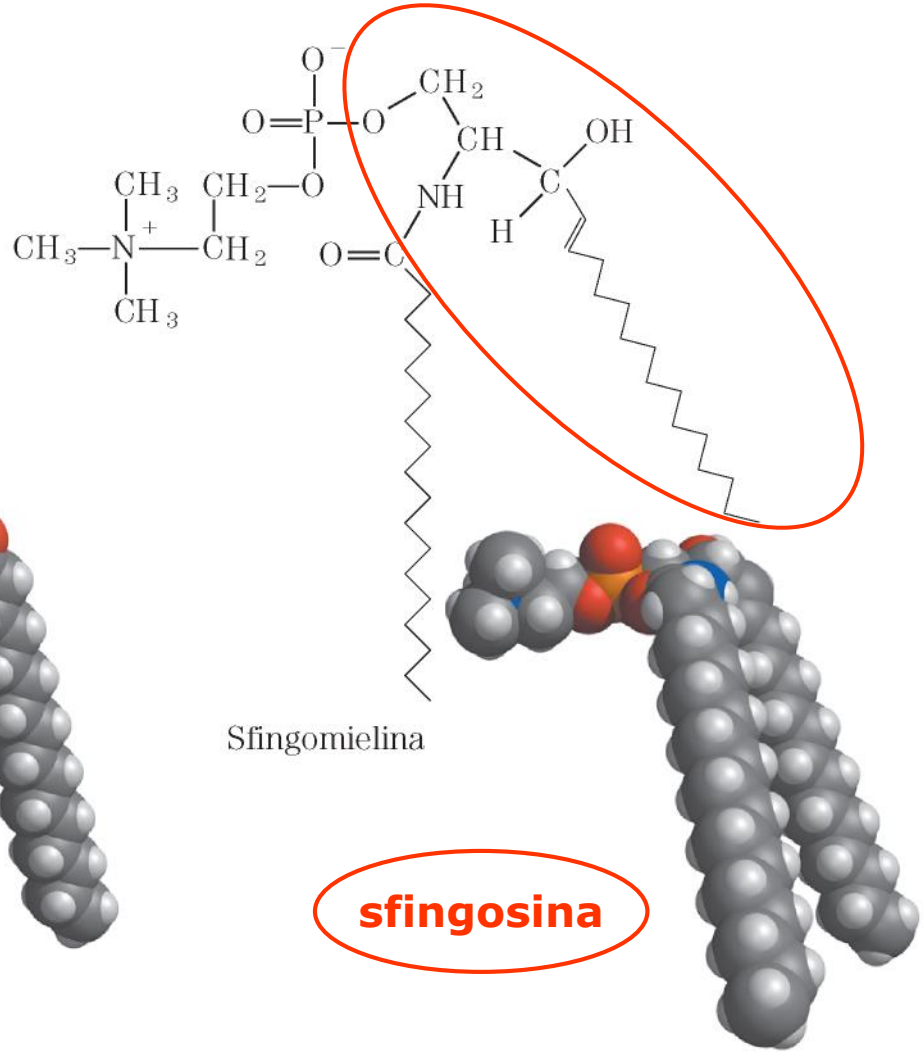
**Esempi di fosfolipidi**

**Glicerofosfolipidi: fosfatidilcolina**



Fosfatidilcolina

**Sfingolipidi: sfingomielina**



Sfingomielina

# **I LIPIDI**

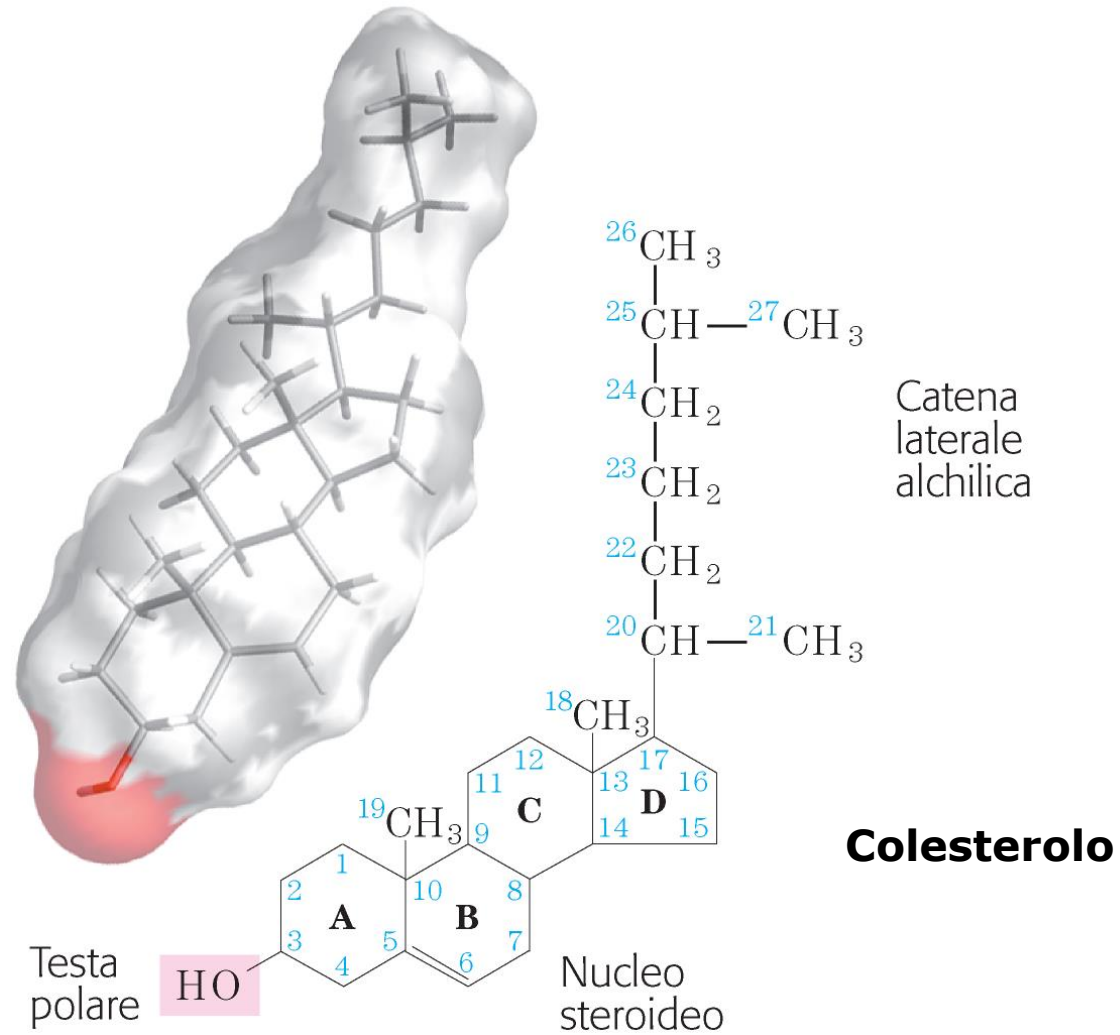
## **STRUTTURA CHIMICA**

- **SEMPLICI → lipidi di riserva ovvero trigliceridi o triacilgliceroli**
- **COMPLESSI o CONIUGATI → lipidi di membrana**
- **DERIVATI → steroidi, chinoni, carotenoidi**

## **Origine biosintetica**

- **SEMPLICI e COMPLESSI → da unità di acetato**
- **DERIVATI → da unità di mevalonato o a biogenesi mista ovvero da shikimico e mevalonato**

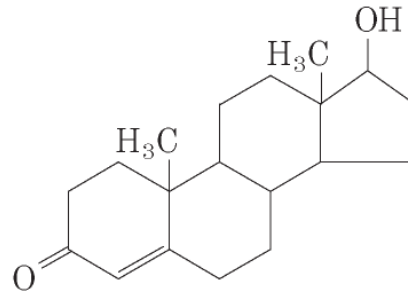
## STEROIDI (C<sub>18-30</sub>)



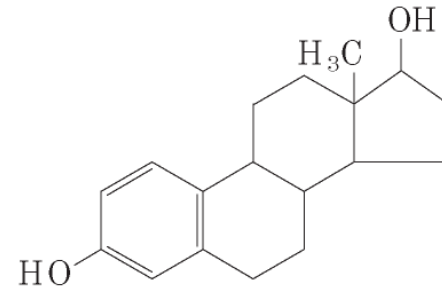
**STEROIDI ( $C_{18-30}$ )**  
**ormoni**

**ORMONI SESSUALI**

**androgeni ed estrogeni**



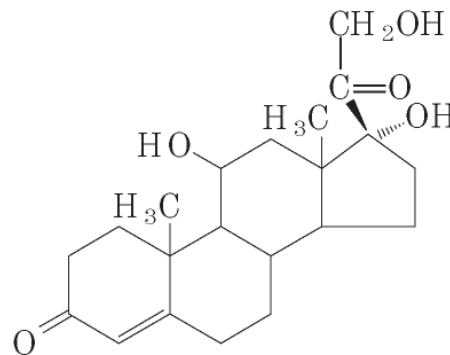
Testosterone



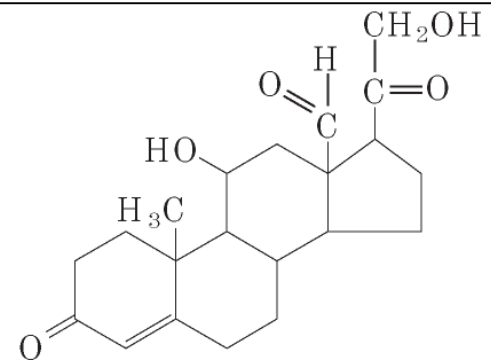
Estradiolo

**GLUCOCORTICOIDI**  
**MINERAL CORTICOIDI**

**corteccia surrenale**  
**antiinfiammatori**



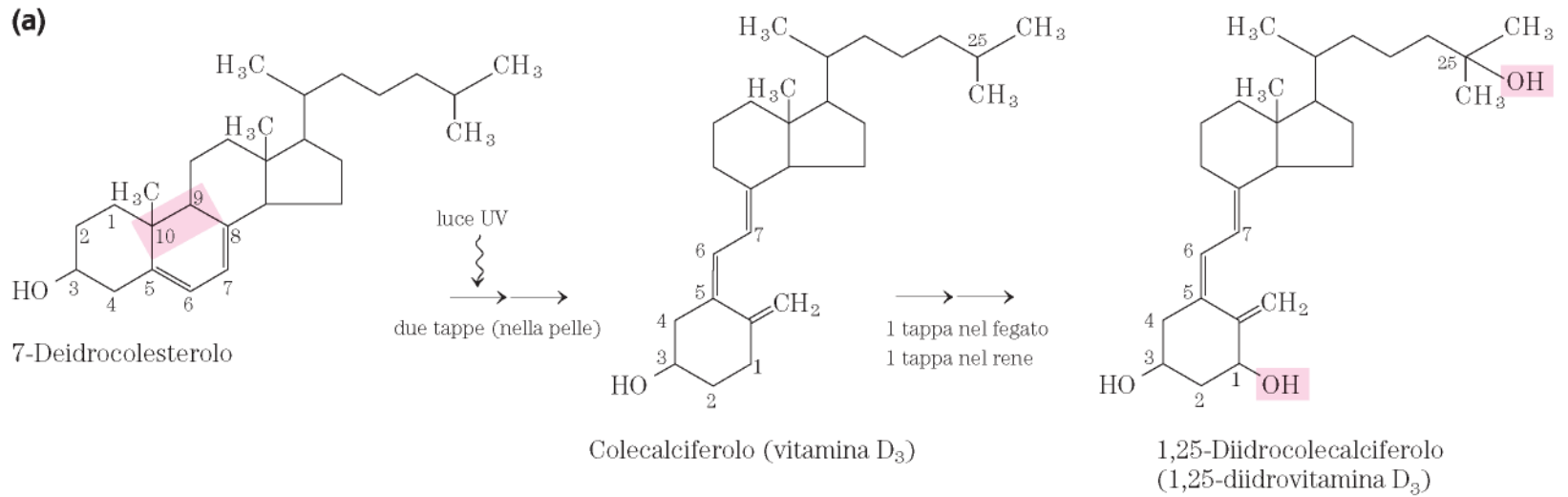
Cortisolo



Aldosterone

## STEROIDI ( $C_{18-30}$ )

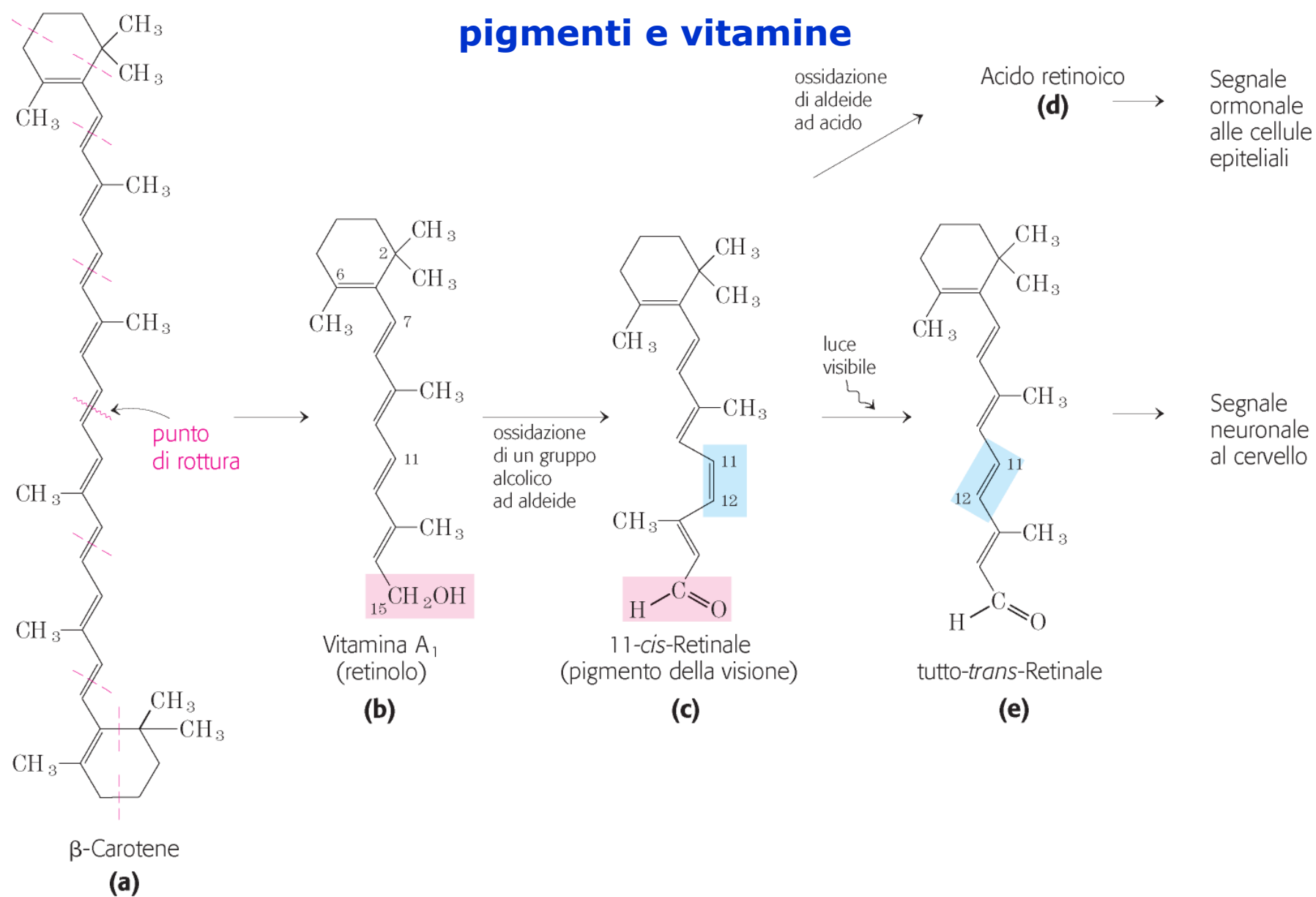
### Vitamine liposolubili



## Vitamina D

# CAROTENOIDI (C<sub>40</sub>)

pigmenti e vitamine

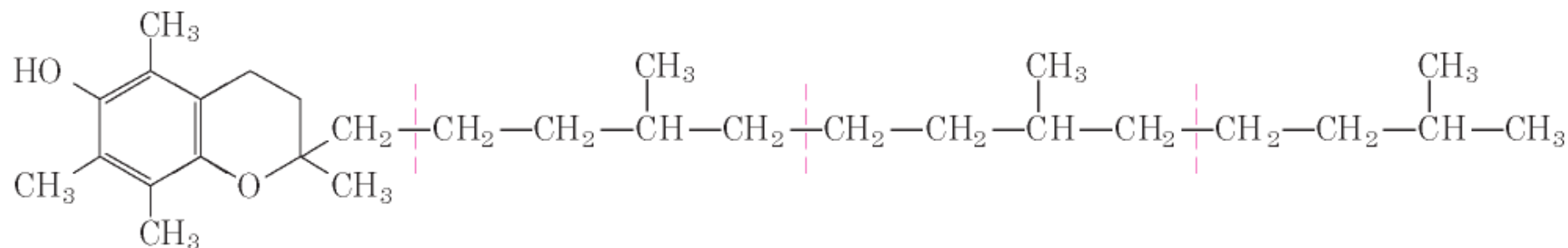




## LIPIDI DERIVATI

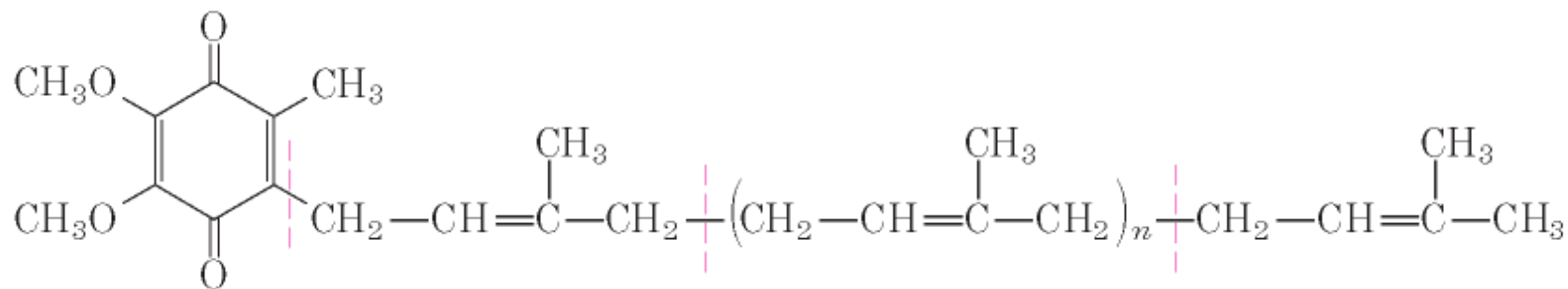
## Lipidi a biogenesi mista ovvero da shikimico e mevalonato

## TOCOFEROLI



## Vitamina E

## CHINONI TERPENOIDICI



## Ubichinone (coenzima Q)