Exercise 1
Discussion

Everything within an orange box
is exam material

All the rest is context,
related content &
fun facts

Q1

Are viruses living organisms? Elaborate.

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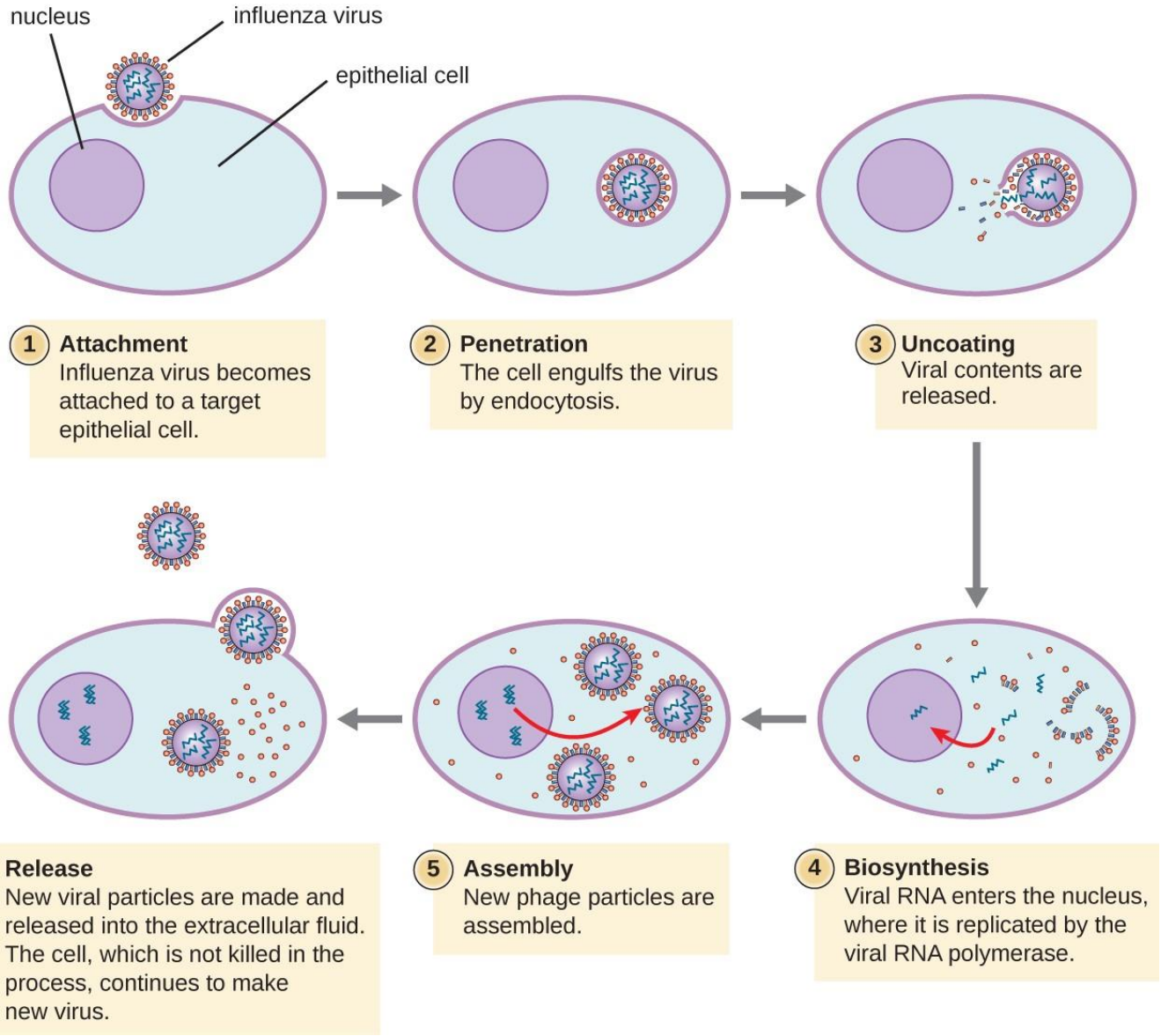

Q2

What are the major differences between prokaryotes and eukaryotes?

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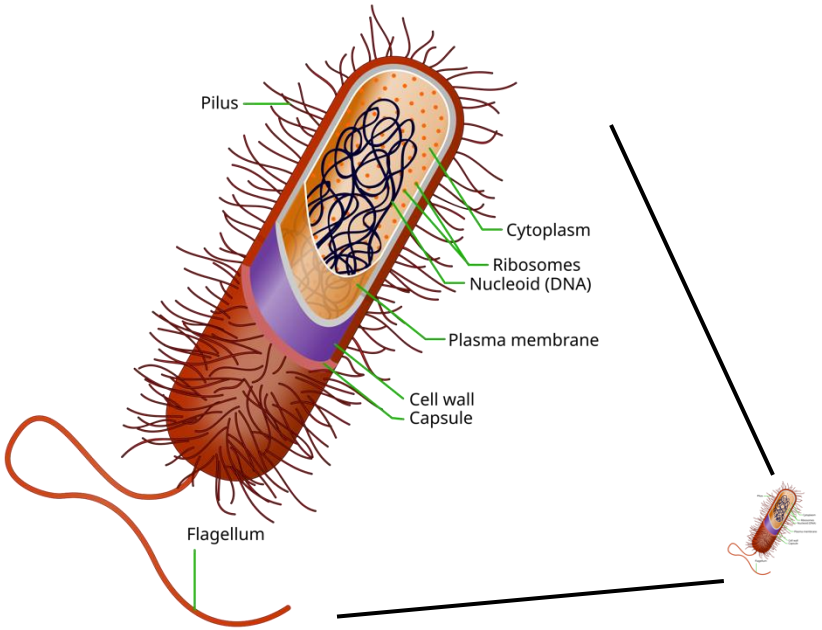
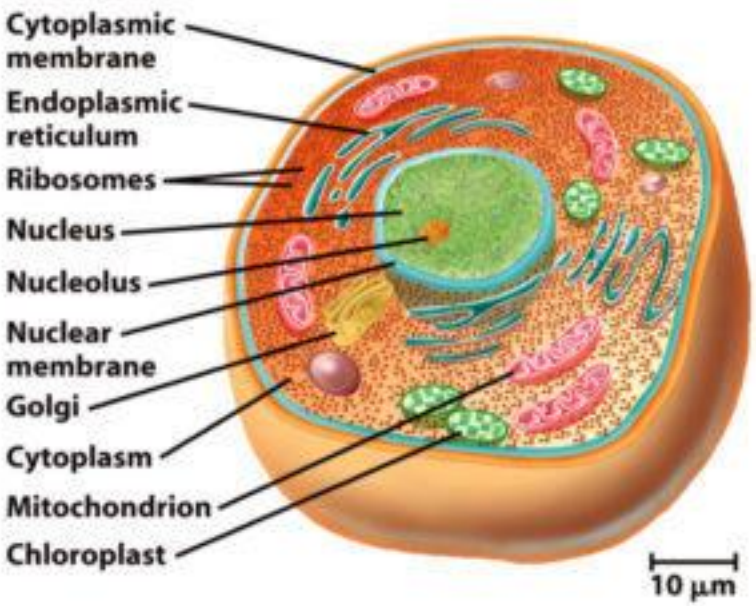
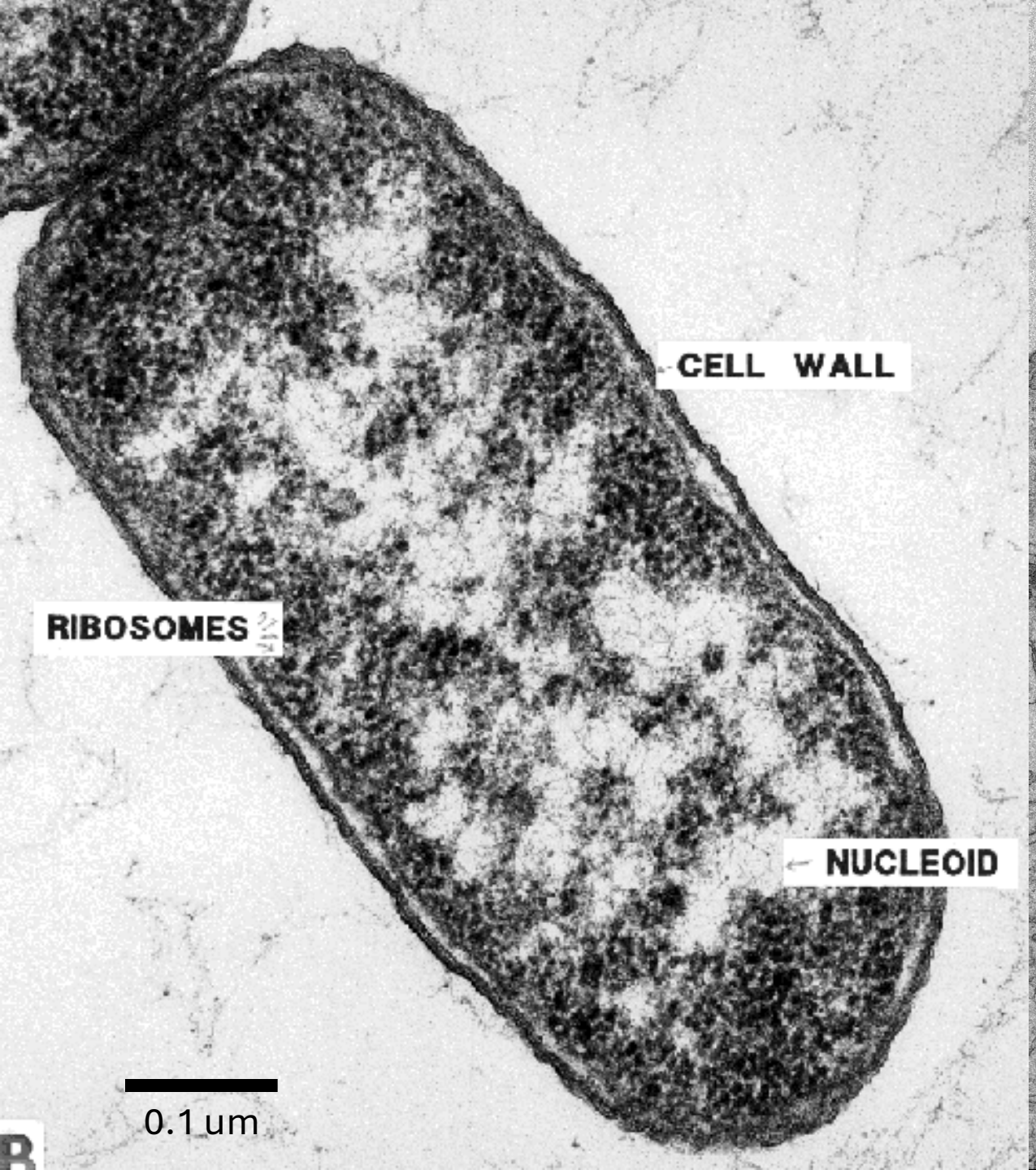
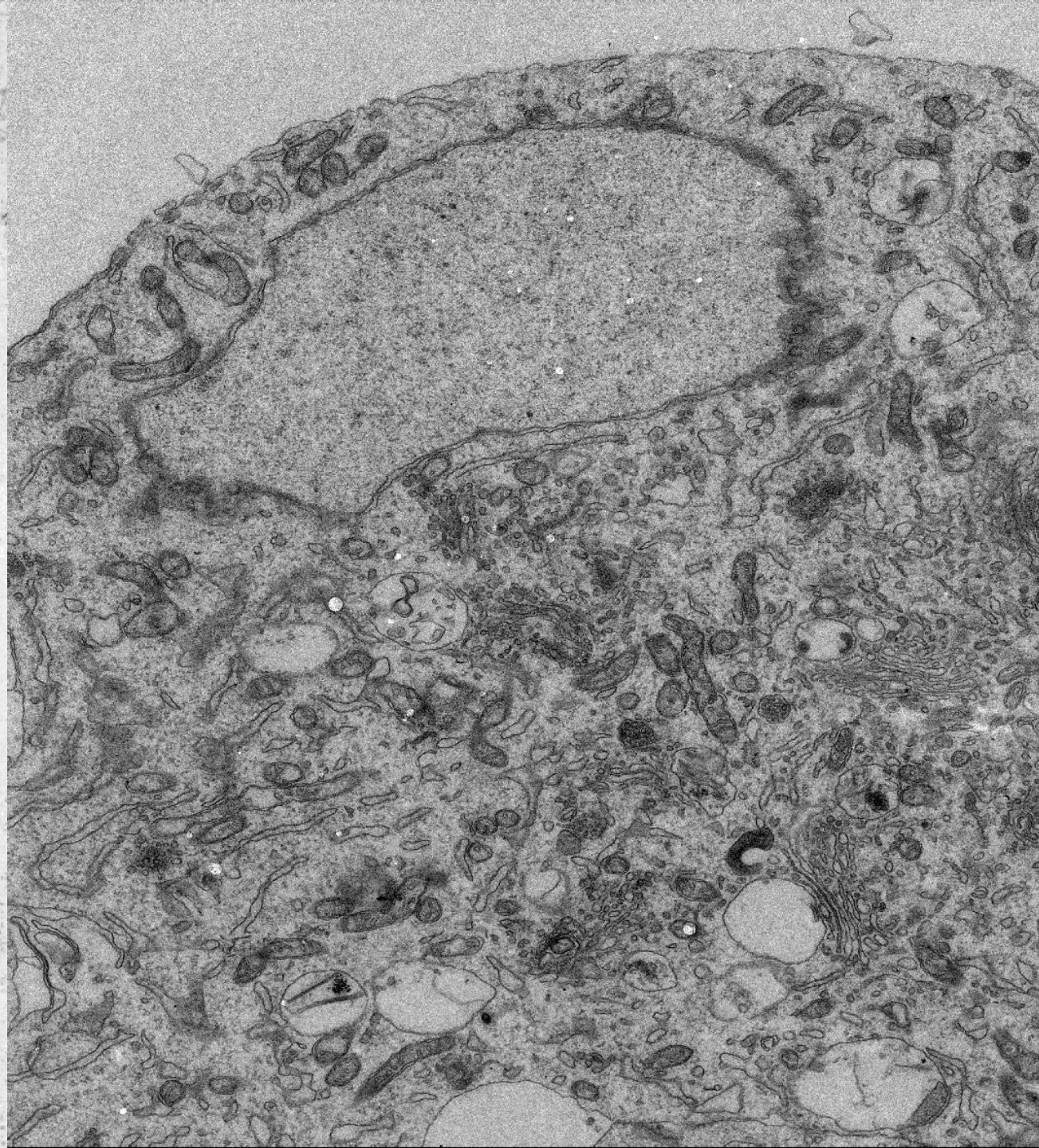


Prokayote



Eukayote


CELL WALL
RIBOSOMES
NUCLEOID
0.1 um



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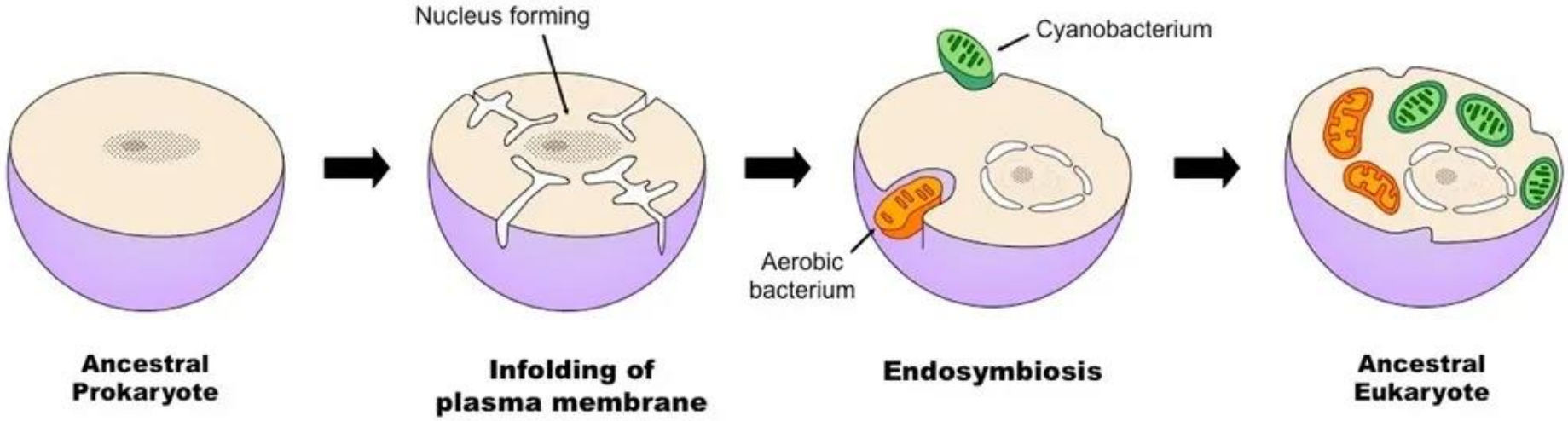
Endosymbiotic “theorem”



On the Origin of Mitosing Cells

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Department of Biology, Boston University
Boston, Massachusetts, U.S.A.

(*Received* 8 *June* 1966)

A theory of the origin of eukaryotic cells (“higher” cells which divide by classical mitosis) is presented. By hypothesis, three fundamental organelles: the mitochondria, the photosynthetic plastids and the (9+2) basal bodies of flagella were themselves once free-living (prokaryotic) cells. The evolution of photosynthesis under the anaerobic conditions of the early atmosphere to form anaerobic bacteria, photosynthetic bacteria and eventually blue-green algae (and protoplastids) is described. The subsequent evolution

Evidence for endosymbiosis:

- **Mitochondrial DNA**
- Mitochondria have a **double bilayer** membrane
- Mitochondria can **reproduce** separately

Q2

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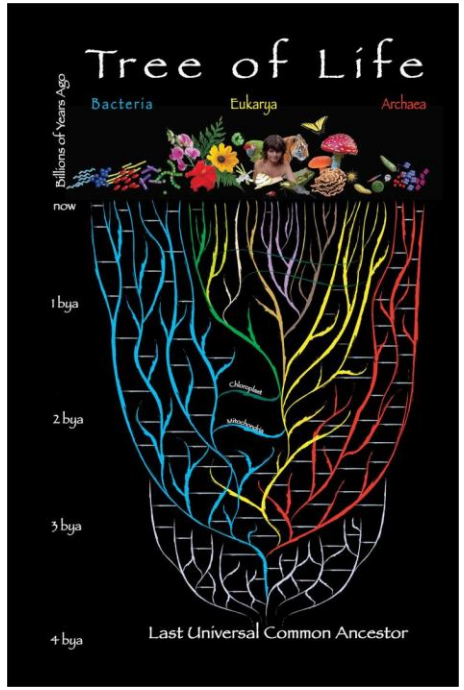
Differences:

	Prokaryotes	Eukaryotes
Packaging of genetic material	DNA floating in the cytoplasm	Packed DNA inside a membrane compartment (nucleus)
Organization within the cell	Diffuse	Membranous compartments

Similarities:

- **DNA** as genetic material
- **Ribosomes** to make **proteins**
- Cell **membrane**
- **Cytoplasm**



Q3

The formation of membranes allows for compartmentalization in 3D within the cell and in 2D within the membrane. Describe the advantage of this step, name two examples and describe their function.

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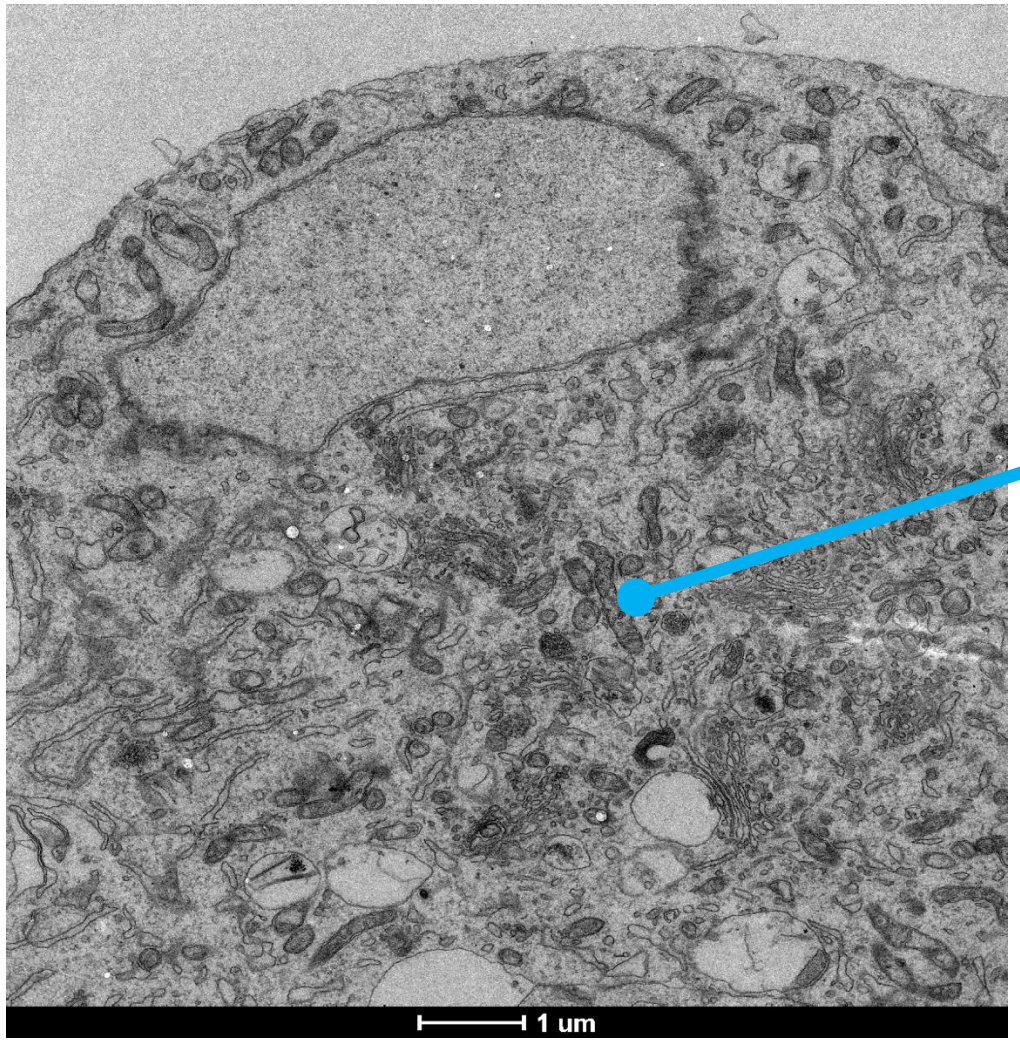
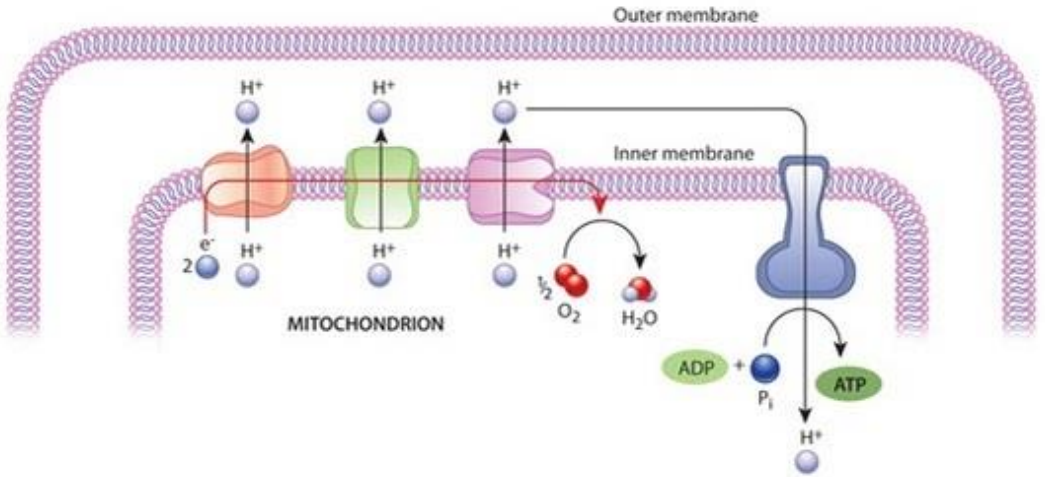
Organelles, such as mitochondria:



Example:
proton gradient in the inter-membrane space of mitochondria allows for the generation of energy.



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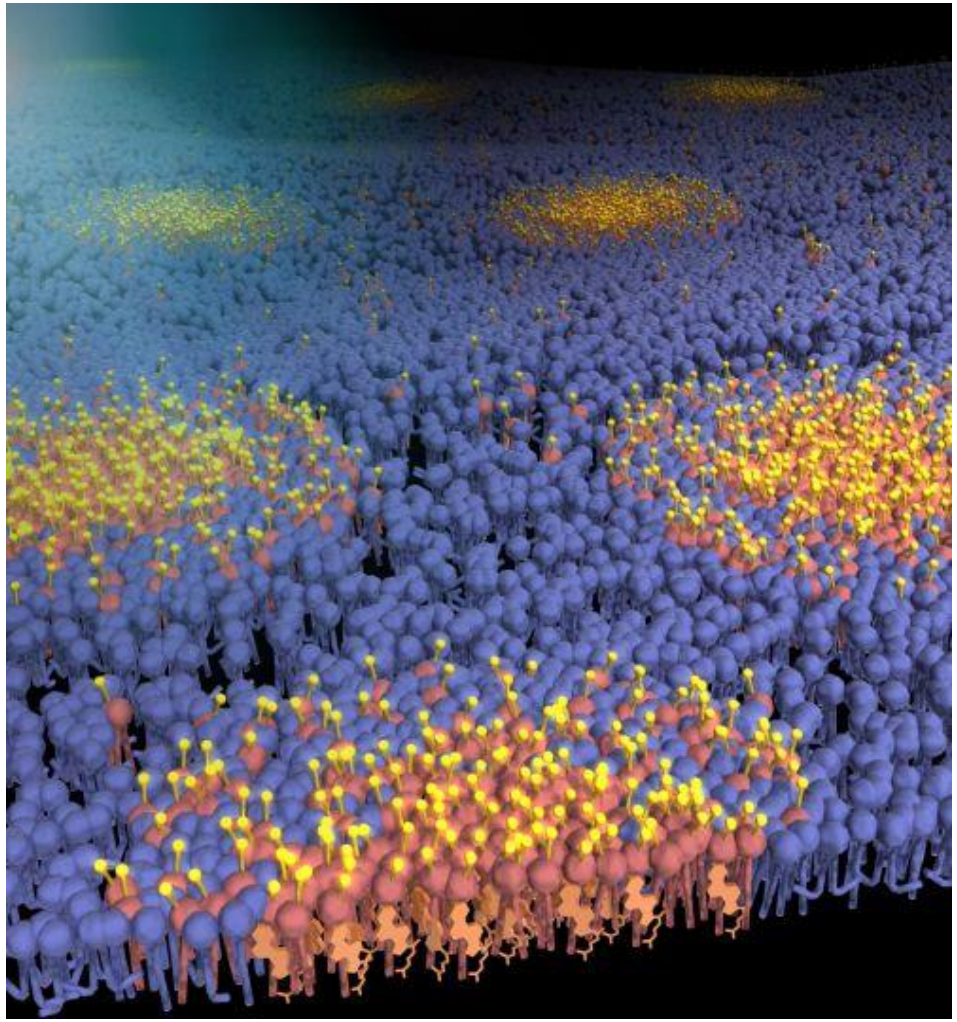
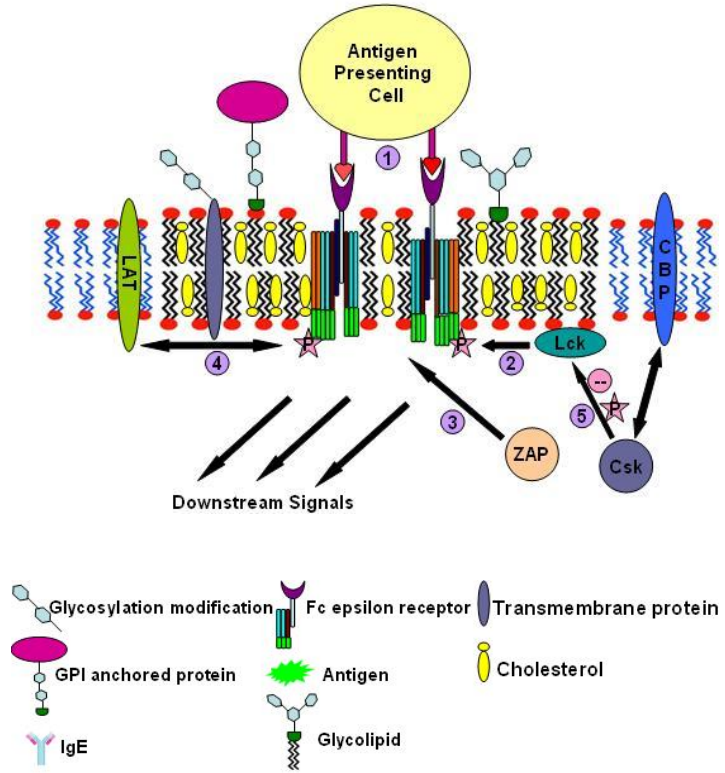
Lipid rafts:



Example:
Immune cell signaling in lipid rafts



Q4

Phospholipids have the ability to form membranes.

Discuss how the characteristic of a membrane is altered if you change the composition of the phospholipids.

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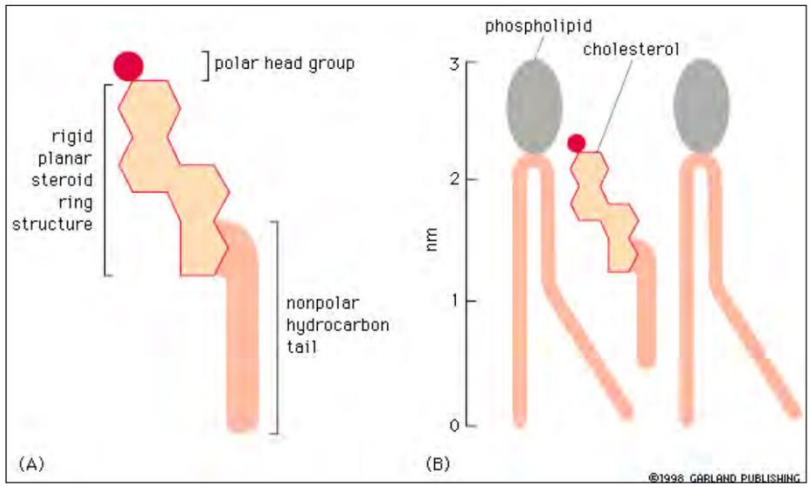
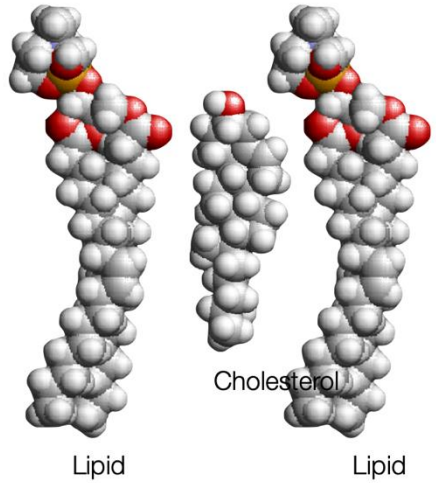
Fluidity of the membrane depends on the lipid composition and cholesterol





Factors that affect membrane fluidity:

- Length of the fatty acyl chains
- Degree of saturation of the fatty acyl chains
- Presence of cholesterol

The rigid cholesterol ring system interferes with the close packing of phospholipid fatty acid tails and thus inhibits the transition from the liquid-crystal to the crystalline state upon temperature decrease.

At the same time, the rigid cholesterol makes the membrane somewhat less fluid.

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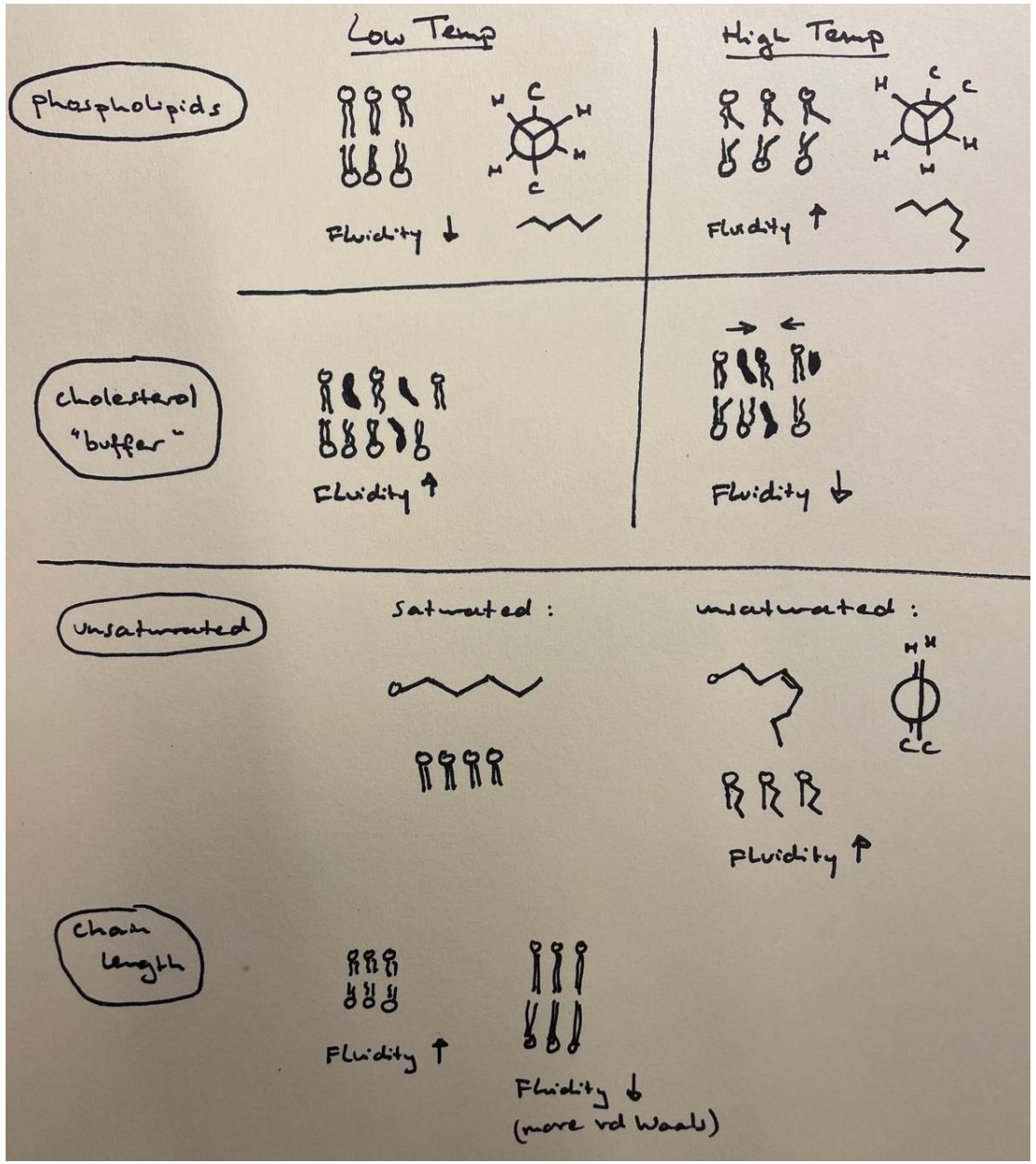

Q5

What key characteristics are needed for membrane proteins to be embedded in a lipid bilayer and to fulfil a generalized function?

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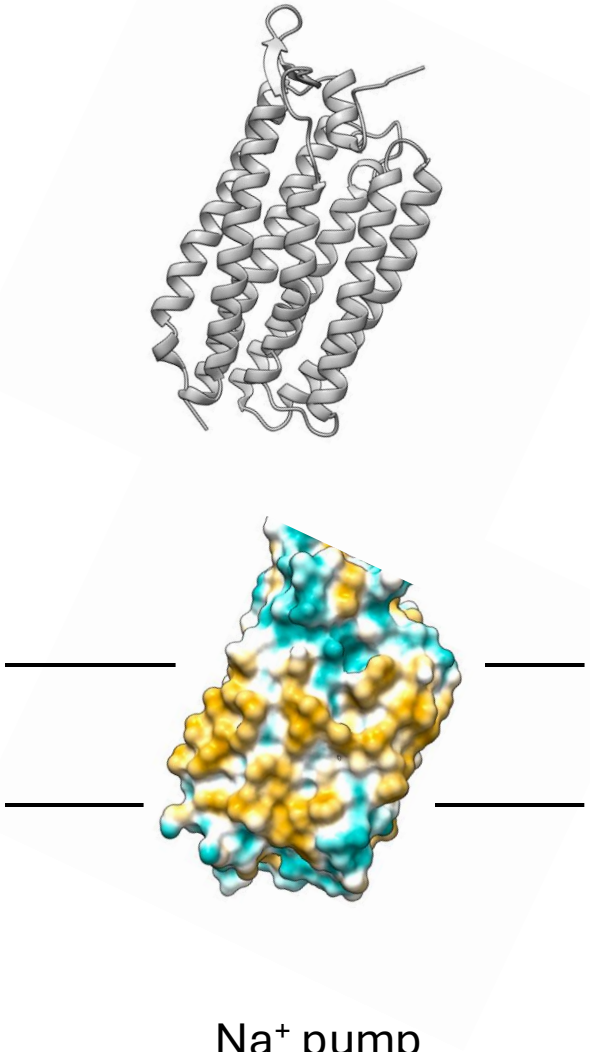
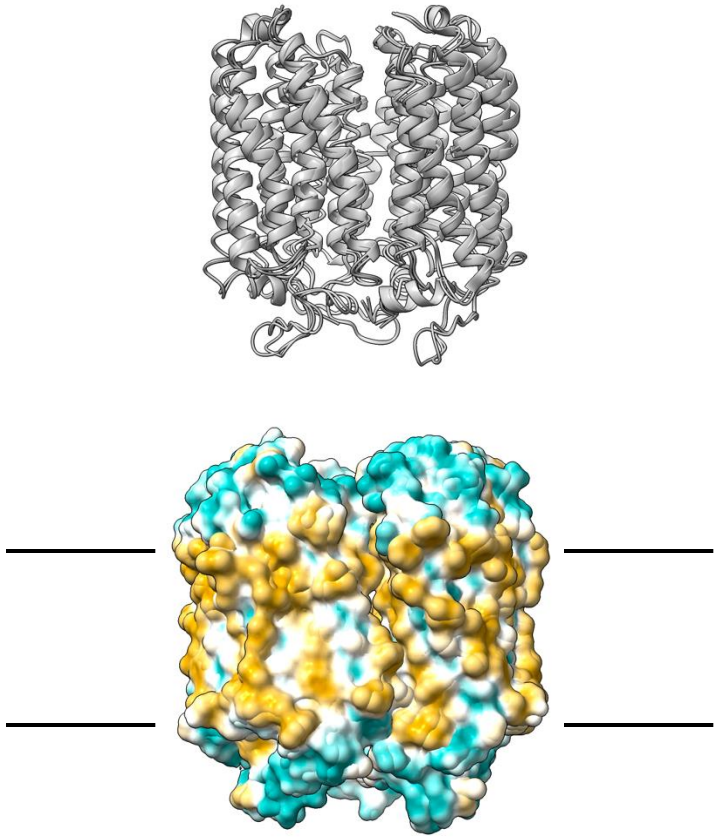
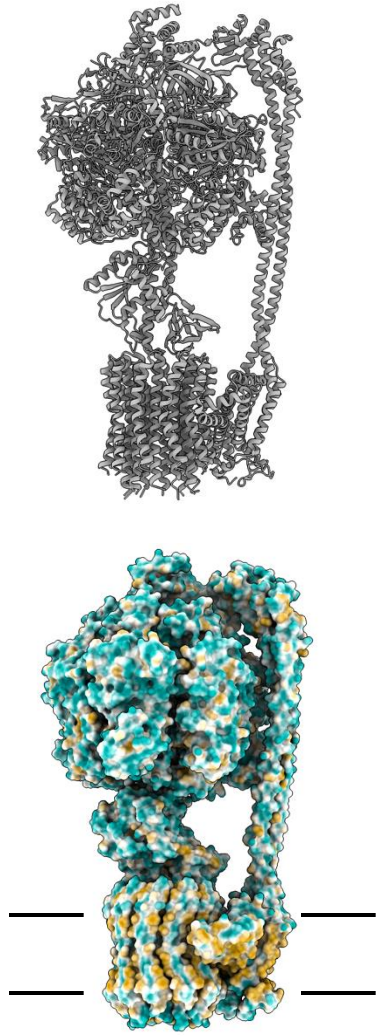


Na^+ pump



GPCR
(signaling receptor)



ATP synthase

Q6

Describe the 2D phase states *Disordered Liquid-Crystalline* and *Ordered Gel* phase that a lipid membrane can have. Describe, what happens at the phase transition temperature.

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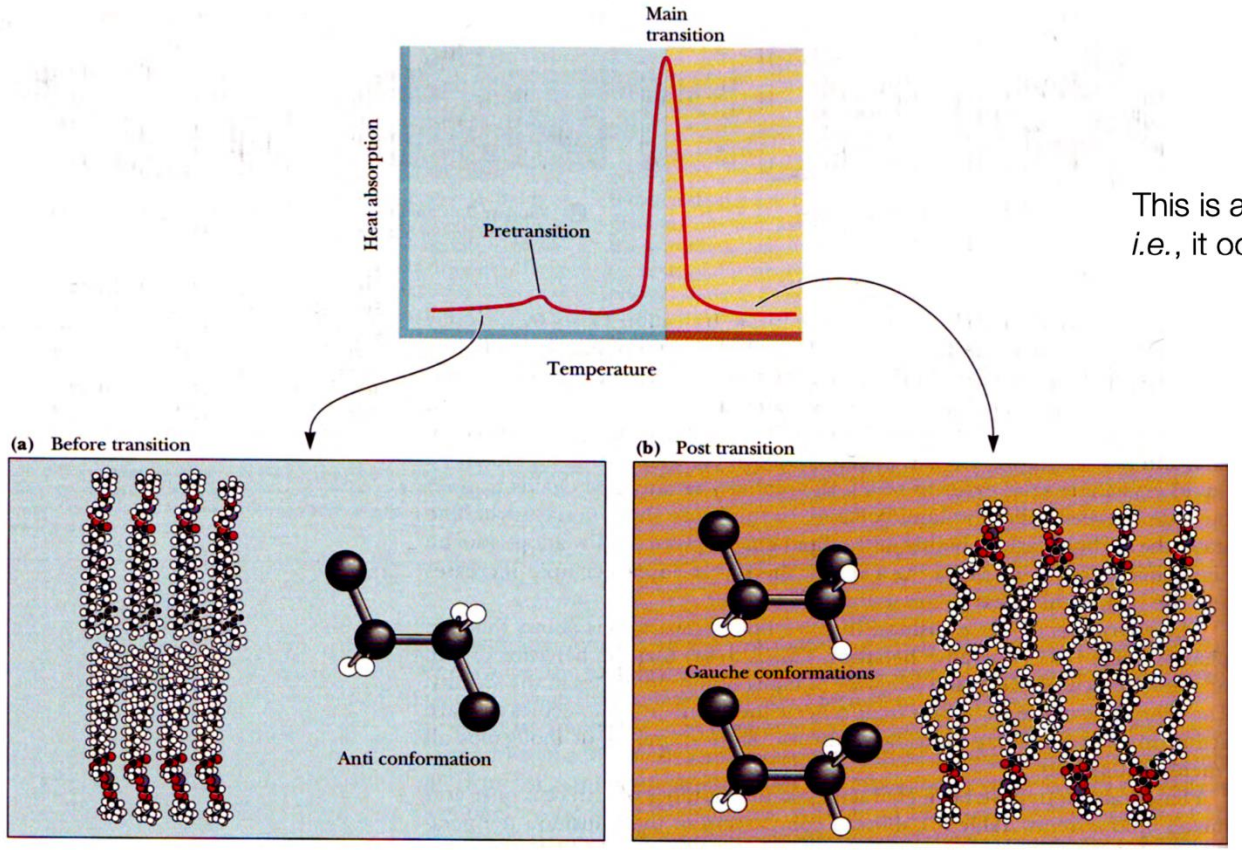
Membrane Phase Transition



This is a first-order phase transition, *i.e.*, it occurs gradually.