STUDY GUIDE - *Ch. 7.1 - Cellular Membranes are Fluid Mosaics of Lipids and Proteins* **NAME:** ______________________

- **PHYSICALLY PRINT OUT this PDF and HANDWRITE (with a black or blue pen) your answers directly on this PDF.** *Typed or digitally-written work is **not** accepted. Do **not** answer questions on separate paper.*
- **Importantly, study guides are NOT GROUP PROJECTS!!!** *You, and you alone, are to answer the questions as you **read** your assigned textbook. You are **not** to share answers with other students. You are **not** to copy any answers from any other source, including the internet.*
- **Get in the habit of writing LEGIBLY, neatly, and in a medium-sized font.** *AP essay readers and I will skip grading anything that cannot be easily read so start perfecting your handwriting, and don't write so large you can't add all the relevant details and key elaborations in the space provided.*
- **SCAN physical documents in color and with good resolution. Then, upload your final work as PDFs to Archie.** *Avoid uploading dark, shaded, washed-out, sideways, or upside-down scans of homework. Keep completed physical study guides organized in your biology binder to use as future study and review tools.*
- **READ FOR UNDERSTANDING and not merely to complete an assignment.** ***First**, read a section quickly to get an overview of the topic covered. Then, read it a **second** time slowly, paraphrasing each paragraph **out loud** and analyzing every figure. Finally, read it a **third** time as you answer the study guide questions if assigned and start building your memory. Try to write answers out in your own words, when possible, and try to purposefully and accurately use all new terminology introduced.*

For a cell to function properly, the cytosol of the cell (and the lumen of organelles in eukaryotes) must be able to maintain appropriate concentration of desired solutes. This means, the cell must be able to control what enters and exists the cell (or organelle). **All membranes are, therefore, said to be selectively permeable**: Only certain substances can pass through a given membrane at a given time while others cannot.

1. a. Membranes are composed of mostly lipids and proteins, with some carbohydrate moieties (groups) present as well. What is the **most abundant lipid in most membranes**?

   b. Most membrane proteins and membranes lipids are said to be **amphipathic**. Explain the meaning of this term.

   c. In what way are the **phospholipids** amphipathic? *(Revisit Ch.5 to review the detailed make up of this molecule!).*

   d. **How** does the amphipathic nature of phospholipids effect **how phospholipids arrange themselves in membranes**?

   e. **How** does the fact that **membrane proteins are amphipathic** effect how these proteins are embedded in membranes?

2. a. Membranes are not static, lipids and several proteins can move laterally in the plane of the membrane. Since membranes are said to be "fluid," **what holds membranes together**?

   b. Some membrane proteins drift laterally and randomly due to thermal energy, causing random collisions with their neighbors. Still **other membrane proteins seem to move with clear directionality or seem to not move at all**. What may be the reason for these latter observations?

c. Given what you know about the properties of and interactions between water and phospholipids (Ch.5), why do **you** think it is **rare for a phospholipid to flip from being in one phospholipid layer of a membrane bilayer to the other, despite the thermal energy that causes movement of and collisions between these molecules with in the membrane**? *Be sure to explain the properties of the different regions of the phospholipid molecule and how those would or would not interact with the charges on neighboring lipids within and water molecules surrounding the membrane should a phospholipid start flipping.*

3. a. **The lateral movement of proteins and lipids is caused by the thermal energy present in the environment.** When temperatures drop too much, a membrane stops being fluid and can even "solidify" - get too stiff. Why does **membrane fluidity decrease with decreased temperature**?

b. Some organisms, certain plants and animals, control membrane fluidity by altering their membrane phospholipids as the seasons pass. Explain below how a **membrane maintains proper fluidity even at LOWER temperatures** based on its type of phospholipid composition. *To properly explain, your answer should tackle the following two aspects:*

What is changed in the membrane during cold seasons? Be specific.

Why does this change help ensure the membrane stays fluid in colder weather? Explain the details.

c. Given what you now know, how do you think the **relative RATIO of saturated to unsaturated phospholipids** in the plasma membranes of a **plant that was native to growing in warm climates compares** to the relative RATIO of saturated to unsaturated phospholipids in the membranes of a **plant that was native to growing in cold climates**?

d. Draw what you think the plasma membranes of these two species of weather-adapted plants would look like.

Warm-Weather-Adapted Plant Cell Membrane Cross Section	**Cold-Weather-Adapted Plant Cell Membrane Cross Section**

4. a. Unlike plant cells which contain other types of membrane steroids, **animal cells also contain cholesterol molecules in their cell membranes**. Cholesterol is a "**fluidity buffer**" in animal cell membranes. What does this mean?

   b. How does **cholesterol prevent the animal cell membrane from becoming too fluid at high temperatures**?

   c. How does **cholesterol prevent the animal cell membrane from becoming too rigid at low temperatures**?

5. Name two reasons **why it matters that proper membrane fluidity be maintained**?

   1.

   2.

6. Remember, cells respond to their environment. ***Extreme temperatures pose a challenge for life.*** If it gets **too hot**, membranes become **too fluid**, the membrane becoming **too porous** or **not staying intact at all**. If it gets **too cold**, the membranes become **too stiff** and substances **cannot cross** through them, **membrane proteins unable to perform their function by not being able to change shape properly** as needed. **Natural selection will, therefore, favor different membrane compositions in different environments or favor the ability of an organism to change its lipid composition in response to changing external temperatures.** In what type of an environment would you expect this **ability to alter lipid composition throughout the year or the lifetime of the organism to be a more prevalent (common) adaptation**?

7. a. What do we mean by **cell-to-cell recognition**?

   b. Cell-to-cell recognition often involves lipids and proteins in the plasma membrane that have short carbohydrate moieties (short chains of fewer than 15 carbohydrate monomers called oligosaccharides) attached to them. What do we call **lipids with sugars covalently attached to them**?

   c. What do we call **proteins with sugars covalently attached to them**?

   d. On **what side of the PLASMA membrane are these carbohydrate chains usually found**?

   e. Which **two processes utilize cell-to-cell recognition**?

      1.

      2.

8. a. What is meant by membranes having **<u>sidedness</u>** in terms of its lipids and its proteins?

b. Study Figure 7.9. Where in the cell are some plasma membrane **<u>proteins converted initially into glycoproteins</u>**?

c. Study Figure 7.9. Where in the cell are some plasma membrane **<u>phospholipids converted into glycolipids</u>**?

d. How is the endomembrane (and thus also plasma) **<u>membrane sidedness established</u>**?

e. Draw the endomembrane system of a cell. Draw it as <u>large</u> as possible. **<u>Label</u>** the parts of your drawing. Add a **<u>glycoprotein</u>** in the correct <u>location and orientation</u> immediately after it has just formed. Add a **<u>glycolipid</u>** in the correct <u>location and orientation</u> immediately after it has just formed. Add to your drawing at least one **<u>secretory vesicle</u>**, which originated at the Golgi and is currently <u>fusing</u> with the plasma membrane while also carrying both a <u>mature glycoprotein and glycolipid</u> in its membrane. *Ensure the orientation of the glycoprotein and glycolipid are correct.*