**Topic Review Guide**: Membranes, Transport and Communication

**To Think About**: How do surface-area-to-volume ratios affect the ability of biological systems to obtain necessary resources or eliminate waste products? How is growth and dynamic homeostasis maintained by the constant movement of molecules across membranes? In what ways do eukaryotic cells’ internal membranes and organelles contribute to cell functions? How do cells communicate, transmit and receive chemical signals, and how does signal transmission within and between cells mediate gene expression and cell function?

**Watch:**

**First:**  [Mr. Andersen’s “Cell Membranes” video](http://viewpure.com/y31DlJ6uGgE)

Next: [Mr. Andersen’s “Transport Across Cell Membranes” video](http://quietube4.com/v.php/http%3A//www.youtube.com/watch?v=RPAZvs4hvGA)

Then: [Mr. Andersen’s “Cell Communication” video](http://quietube4.com/v.php/http%3A//www.youtube.com/watch?v=xnGXItWrJ3k)

Last: [Mr. Andersen’s “Signal Transduction Pathways” video](http://quietube4.com/v.php/http%3A//www.youtube.com/watch?v=qOVkedxDqQo&list=PLFCE4D99C4124A27A&index=46)

**Read:** Chapter 5, Hillis, et. al. Principles of Life (2012).

**Supplementary Resources**: Click the links below for more information to help you learn more about this lesson.

* BFW Publishers: [Principles of Life Chapter 5 Online Resources](http://bcs.whfreeman.com/hillis1e/#667501__669665__)
* Crash Course Biology: [In Da Club—Membranes and Transport](http://quietube4.com/v.php/http%3A//www.youtube.com/watch?v=dPKvHrD1eS4&list=EC3EED4C1D684D3ADF)
* Pearson BioCoach: [Membrane Structure and Transport](http://www.phschool.com/science/biology_place/biocoach/biomembrane1/intro.html)
* Pearson BioCoach: [Membranes and Communication](http://www.phschool.com/science/biology_place/biocoach/biomembrane2/intro.html)
* McGraw Hill: [Osmosis](http://highered.mcgraw-hill.com/sites/0072495855/student_view0/chapter2/animation__how_osmosis_works.html)
* Georgia State University Hyperphysics: [Diffusion and Osmosis (from a physicist’s point of view)](http://hyperphysics.phy-astr.gsu.edu/hbase/kinetic/diffus.html)
* Wisc-Online: [Passive Transport-Osmosis (simulation)](http://www.wisc-online.com/objects/ViewObject.aspx?ID=ap11003)
* Northland College: [Active Transport Animation](http://programs.northlandcollege.edu/biology/Biology1111/animations/active1.swf)
* McGraw Hill: [Membrane-Bound Receptors that Activate G Proteins](http://highered.mcgraw-hill.com/sites/0072507470/student_view0/chapter17/animation__membrane-bound_receptors_that_activate_g_proteins.html)

**Listen and Look**: Here is a list of key terms and concepts you will hear about and see during these podcasts and chapter readings. Get to know them! Be able to connect them to one another using a concept map. **Don’t just simply define the terms—you must understand the relationships among and between them!**

**KEY TERMS**

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| Cell membrane | Passive transport | Fluid mosaic model | Selectively permeable |
| Phospholipid  | Amphipathic  | Glycolipids  | Glycoproteins |
| Diffusion | Hypotonic solution | Isotonic solution  | Hypertonic solution |
| Aquaporin  | Integral protein  | Peripheral protein  | Facilitated diffusion  |
| Osmosis | Phagocytosis | Ion-gated channel | Active transport |
| Endocytosis | Exocytosis | Protein kinase | Receptor-mediated endocytosis |
| Pinocytosis | Cotransport  | Second messenger | G-protein linked receptor  |
| G-protein  | Receptor protein  | Phosphorylation  | Signal transduction pathway  |
| cAMP (cyclic AMP) | Ligand  |  |  |

**Recall and Review:** Use the lecture in the videos and your textbook reading to help you answer these questions in your BILL.

1. In the context of cell membranes, **explain** why Mr. Andersen uses shampoo as a chemical component in his DNA extraction experiment.
2. Using the components of the cell membrane, **explain** why the cell membrane is referred to as a “fluid mosaic model.” **Describe** the role of cholesterol in maintaining the cell membrane’s structural integrity.
3. **Explain** why are carbohydrates and proteins important to cell membrane function.
4. Create a graphic organizer that illustrates the differences in cell walls for the following organisms:
5. plants
6. fungi
7. bacteria
8. When phospholipids are placed in an aqueous environment and agitated, they arrange themselves into vesicles surrounded by a lipid bilayer. **Explain** how the properties of phospholipids allow this to happen.
9. Using a Venn Diagram, **illustrate** the differences and similarities of the following forms of cellular transport:
10. passive transport
11. active transport
12. **Create** an illustrated representation of hypertonic, hypotonic and isotonic solutions.
13. A chef is busily preparing a dish that requires celery as one of its ingredients.  However, when she goes to the refrigerator to retrieve the celery stalks, she notices that the stalks are limp and floppy.  She does not have time to go to the store to buy more celery.  **Describe** how she can revive her celery stalks to complete the dish, and explain the biological principles behind why the method you chose will work.
14. **Explain** how a concentration gradient represents potential energy.
15. **Create** a graphic organizer that illustrates the similarities and differences between endocytosis (including phago- and pinocytosis), exocytosis, receptor-mediated endocytosis.
16. The compound digoxin, derived from the foxglove plant is a sodium-potassium (Na-K) pump inhibitor.  When digoxin acts on the Na-K pump of cardiac muscle cells, it inhibits the pump so that sodium ions cannot be removed.  **Describe** what will happen to the concentration of sodium and potassium ions inside and outside a cardiac muscle cell that has been exposed to digoxin.
17. In the “Cell Communication” video, Mr. Andersen explains analogies between various methods of communication humans use and methods of cell communication. **Create** an illustration of each type that explains how the human communication method he describes is like a cell communication method.
18. **Describe** a signal transduction pathway.  **Create** an illustration that represents what one of these might look like, and **describe** the three major steps that occur in this pathway that allow communication to occur.
19. Using a t-chart, **compare** and **contrast** protein kinases to G-protein linked receptors.
20. **Explain** why communication pathways regulated by protein kinases act like falling dominoes.
21. If a living cell was treated with protease enzymes that hydrolyzed external membrane proteins, **describe** what would happen to the cell’s ability to receive signals from its environment.
22. **Explain** what a second messenger molecule’s role is in signal transduction, and give an example.

**Describe** how signal information is transduced into cellular responses in the cytoplasm and nucleus.

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| Learn More: For more information about membrane structure and function, use the links below: * [OsyOsmosis](http://www.osyosmosis.com/): A game that allows you to control a character, Osy, by controlling how much water she takes up from her environment
* [Nobel Prize in Chemistry, 2003](http://www.nobelprize.org/nobel_prizes/chemistry/laureates/2003/announcement.html): Peter Agre and Roderick MacKinnon, “for discoveries concerning channels in cell membranes.”
* [Nobel Prize in Physiology and Medicine, 1994:](http://www.nobelprize.org/nobel_prizes/medicine/laureates/1994/)  Alfred Gilman, Martin Rodbell, “for their discovery of G-proteins and the role of these proteins in signal transduction in cells.”
* [Nobel Prize in Physiology and Medicine, 1998:](http://www.nobelprize.org/nobel_prizes/medicine/laureates/1998/) Louis Ignarro, Robert Furchgott, and Ferid Murad, “for their discoveries concerning nitric oxide as a signaling molecule in the cardiovascular system.”
* Nobel Prize in Physiology and Medicine, 2000: Arvid Carlsson, Paul Greengard, and Eric Kandel, “for their discoveries concerning signal transduction in the nervous system."
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