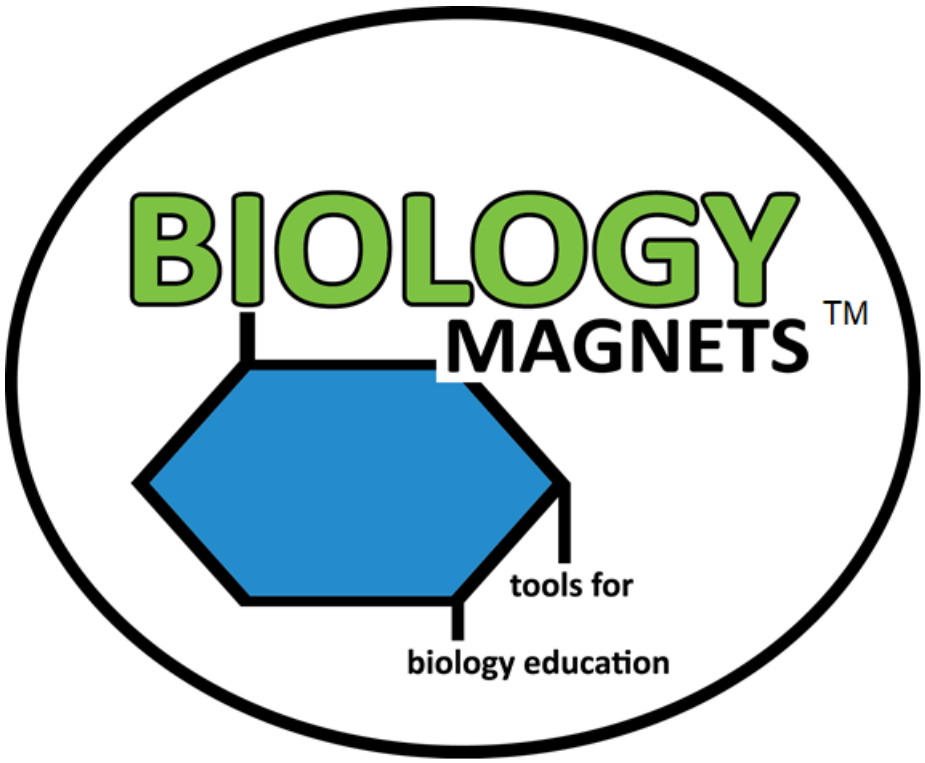
Biology Magnets Module 2: Parts of a Cell - Teacher and Student Guides



Teacher Information

This module uses magnets designed for teacher and student interaction to guide learning the various parts of a cell. Contained in this guide is an outline for a lesson that can last from 10 minutes to approximately 80 minutes depending upon teacher preference. The lesson has both teacher-centered and student-centered activities. The student-centered activities are most effective if students are in small groups. It may be necessary to have multiple magnet sets for large classes. A student handout is provided which can be printed out and given to each student group to help guide their progress as they work with the magnets. If budget or white board space is limited, groups can alternate between using a set of magnets and doing other activities. Teachers can refer to the videos posted at the BIOmagnet web site at Biologymagnets.com for further teaching instructions.

Magnet Care and Maintenance

Biology magnets are made to last for years. Periodically magnets will fall off or are knocked off the plastic. A piece of magnetic tape is included with each module, which should be able to replace around 10-12 magnets if necessary. Simply cut a new magnet and peel off the back to replace. Magnetic tape can be purchased from a hobby store to replace magnets lost over time. Laminate may peel off, especially on small pieces. Transparent tape can be used as a replacement or to re-attach laminate that comes loose by curling the tape over the back of the magnet. The machines used to cut Biology Magnets are not always perfectly accurate. Sometimes a bit of white or black outline on the edges occurs or a cut might be slightly off center. Use scissors to remove extra outline that is unnecessary if desired. Store magnets in the clasp envelopes in which they arrived for easy organization.

Copyright and Licensing Information – Module 2 - Parts of a Cell

Cilia - This work is free and may be used by anyone for any purpose. This file is licensed under the Creative Commons Attribution 3.0 Unported license. By BruceBlaus. When using this image in external sources it can be cited as:Blausen.com staff (2014). "Medical gallery of Blausen Medical 2014". WikiJournal of Medicine 1 (2). DOI:10.15347/wjm/2014.010. ISSN 2002-4436. - Own work, CC BY 3.0, https://commons.wikimedia.org/w/index.php?curid=28086433. Modified to remove cilia from cell and remove labeling, border placed around cilia. The new work is released with the above license.

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Cell Membrane Proteins - This file is licensed under the Creative Commons Attribution-Share Alike 4.0 International license. By This vector image is completely made By OpenStax - https://cnx.org/contents/FPtK1zmh@8.25:fEI3C8Ot@10/Preface, CC BY 4.0, https://commons.wikimedia.org/w/index.php?curid=30131170. Modified by background removed, shading added, edges added, binding sites added.

Glycoproteins, Glycolipids - This file is licensed under the Creative Commons Attribution-Share Alike 4.0 International license. By This vector image is completely made By OpenStax - https://cnx.org/contents/FPtK1zmh@8.25:fEI3C8Ot@10/Preface, CC BY 4.0, https://commons.wikimedia.org/w/index.php?curid=30131170. Modified by adding new carbohydrate chains over old chains, shading added, edges added.

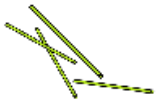
Water molecules: This file is made available under the Creative Commons CC0 1.0 Universal Public Domain Dedication.The person who associated a work with this deed has dedicated the work to the public domain by waiving all of their rights to the work worldwide under copyright law, including all related and neighboring rights, to the extent allowed by law. You can copy, modify, distribute and perform the work, even for commercial purposes, all without asking permission.

Sodium and Potassium Ions - ©2022 Tom Willis all rights reserved

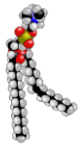
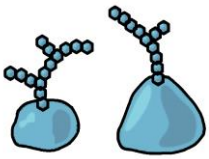
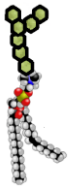
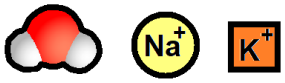
Bacterial Membrane, Cell Wall, Capsule, **Nucleoid, Plasmid** - ©2020 Tom Willis all rights reserved

Biology Magnets Module 2 Materials List

Magnet Name	Quantity	Picture	Function	Type of Cell
Nucleus, Nucleolus, Nuclear Membrane, Nuclear Pores	1		Nucleus - Holds DNA, chromosomes Nucleolus – Makes ribosomes	Eukaryotic - Plant and Animal
Mitochondrion	2		Puts together ATP for the cell	Eukaryotic – Plant and Animal
Chloroplast	2		Performs photosynthesis	Eukaryotic – Plant
Rough and Smooth Endoplasmic Reticulum	2		Rough ER – Makes and stores proteins bound for membranes Smooth ER – Makes and stores lipids	Eukaryotic – Plant and Animal
Golgi Apparatus	1		Packages lipids and proteins for distribution or use in the cell	Eukaryotic – Plant and Animal
Water Vacuole	1		Stores water in the cell, creates turgor pressure	Eukaryotic – Plant
Lysosome	2		Breaks down/digests food and foreign particles	Eukaryotic – Animal
Peroxisome	2		Breaks down hydrogen peroxide, breaks down lipids	Eukaryotic – Plant and Animal
Vesicle	2		Stores and transports materials in cell	Eukaryotic – Plant and Animal

Free Ribosomes	4		Makes proteins used in cytoplasm	Prokaryotic and Eukaryotic – Plant and Animal
Flagellum	1		Causes movement of cells	Prokaryotic and Eukaryotic – Plant and Animal
Cytoskeleton	2		Forms scaffolding in cell for support and movement	Eukaryotic – Plant and Animal
Centrioles	1		Involved in cell reproduction	Eukaryotic – Animal
Cilia	1		Causes movement of cells or of material around cells	Eukaryotic – Plant and Animal
Nucleoid	1		Chromosomal loop of DNA coiled within cell	Prokaryotic
Plasmid	2		Small loops of DNA within cell	Prokaryotic
Plasma membrane (green), cell wall (red), capsule (blue)	1		Cell membrane – Controls what enters and exits the cell Cell Wall – Peptidoglycan layer for protection and support Capsule – gel layer for protection	Prokaryotic
Pili	2		Causes cell to attach to surfaces and other cells; some used to pass plasmids to other cells	Prokaryotic
3” Magnetic Tape Strip	1		Used to replace lost magnets	Abiotic!
Total Pieces	**31**			

Module 2 Cell Membrane Supplement Materials List

Magnet Name	Quantity	Picture	Function
Phospholipid	14		Forms basic structure of the plasma membrane. Has hydrophilic head and hydrophobic tails
Cholesterol	4		Stabilizes the membrane (animal cells)
Channel Protein	1		Allows movement of molecules through the membrane
Integral Protein	1		Various functions
Sodium/Potassium Pump	2		Active Transport, moves sodium and potassium across membrane
Peripheral Protein	2		Various functions
Glycoproteins	2		Identification/communication/other
Glycolipid	1		Identification/communication/other
Sodium, Potassium, Water	18		Water, Ions pumped through the membrane
Total Pieces	**45**		

Lesson 2A – Parts of a Cell (10-80 minutes)

Teacher-Centered Activity (10-40 minutes): This lesson reviews all of the parts of the cell using the Biology Magnets from Module 2 as shown in the table above. Start the lesson by going over all of the parts of a **prokaryotic cell** (**Figure 2.A.1**). It would be helpful to have a diagram showing all of the cell parts as well, which students can refer to, either in their textbook or on the overhead projector. This way students can see different depictions of the same cell parts. Draw an oval on the board representing the cell membrane. One by one, starting with the nucleoid, move the parts of the prokaryotic cell into the oval (or attach them to the membrane) and discuss the function of each part. After adding the cell membrane, wall, and capsule magnet, draw the remainder of those structures around the entire cell with matching colored markers (if available). If time allows, repeat this, calling on students to recall the parts and functions as you move them into the cell. Next, draw a bigger oval and build the **eukaryotic cell**. Leave the prokaryotic cell on the board for comparison if there is room. Repeat the same process, discussing the function of each organelle as they are placed within the cell. Lastly, show the differences between the **animal cell** (**Figure 2.A.2**) and the **plant cell** (**Figure 2.A.3**). The cell wall for the plant cell will have to be hand drawn outside the cell membrane as there is no cell wall magnet for the eukaryotic cell. If time is available, change the shape of the membrane to wavy, with extensions, and discuss surface area to volume ratio and how it changes with the shape of the membrane (example **Figure 2.A.4**).

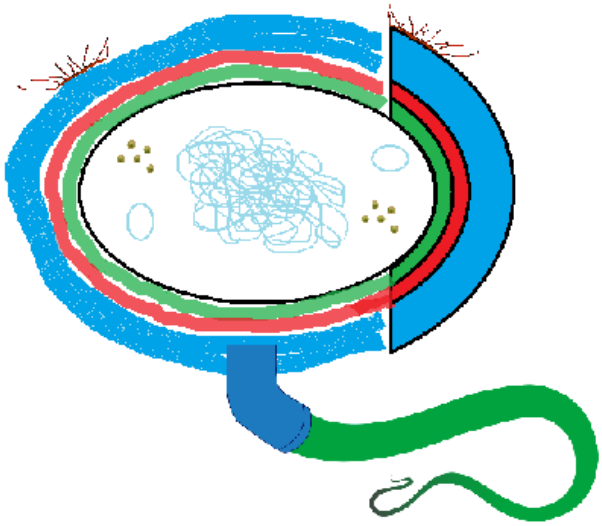
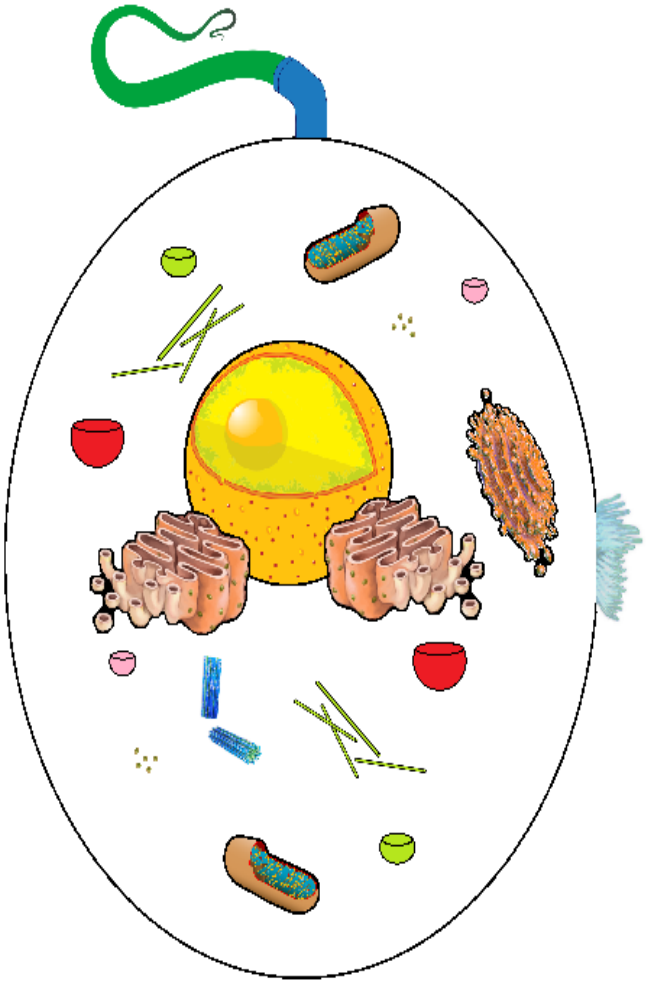
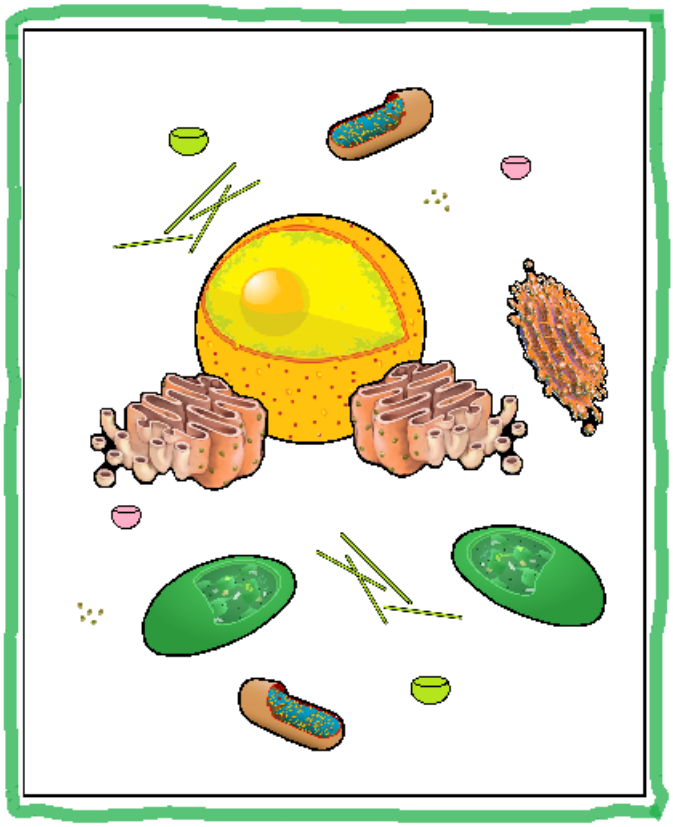
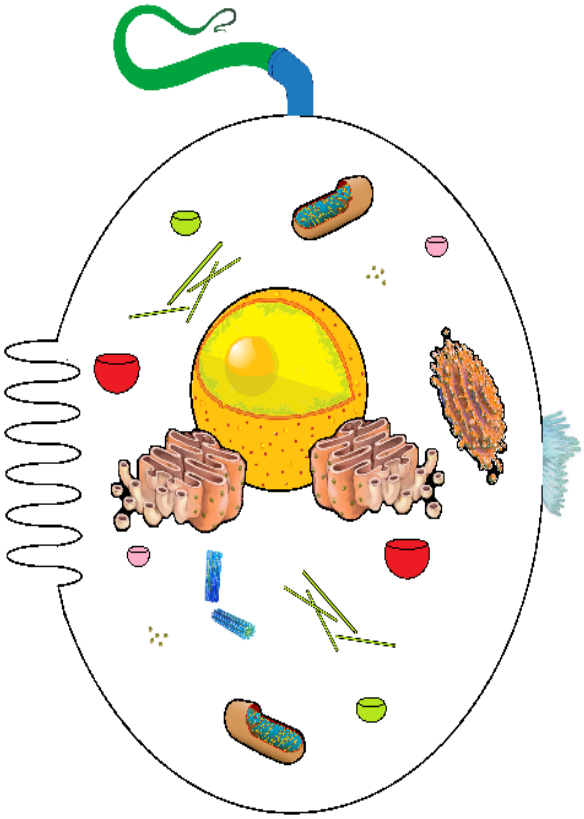
Figure 2.A.1 – Sample Prokaryotic Cell	Figure 2.A.2 – Sample Animal Cell
	

Figure 2.A.3 – Sample Plant Cell	Figure 2.A.4 – Animal Cell With Increased Surface Area to Volume Ratio
	

Student Centered Activity (10-40 minutes): After teaching the parts of the cell, put students into small groups and have them take turns building the three types of cells (prokaryotic, animal, plant) and naming the parts and the function of those parts. Allow the students to help one another. It may be helpful if the students have the student handout to act as a guide the first time they do the activity and then graduate to doing it without help. After all groups have shown mastery, have the students re-draw the cell membrane so it has greater surface area to volume ratio.

Extra exercises:

Research Organelles: Have students go online and find other organelles not represented in the cells the students have built. Have them draw these organelles with markers in their cells. If extra magnetic tape is available, have the students draw the organelles they researched onto index cards and attach magnets to the back to create their own magnets for their cells. Have each student report the organelle they researched and made to the rest of the class.

Oral Quiz: Give an oral quiz by calling out names of organelles and having students or groups move organelles into it as they are called. This can be done individually or in groups. Alternatively, have the students give oral quizzes to one another.

Lesson 2B – Parts of the Cell Membrane (10-60 minutes)

Teacher-Centered Activity (10-20 minutes): This lesson reviews all of the parts of the cell membrane using the Biology Magnets from the Module 2 supplement package as shown in the table at the beginning of this document. Start the lesson by going over the phospholipid and discussing its parts (**Figure 2.B.1**). Several phospholipids can be placed to show the bilayer which naturally forms in a watery medium (**Figure 2.B.2**).

Figure 2.B.1 – Parts of a Phsopholipid

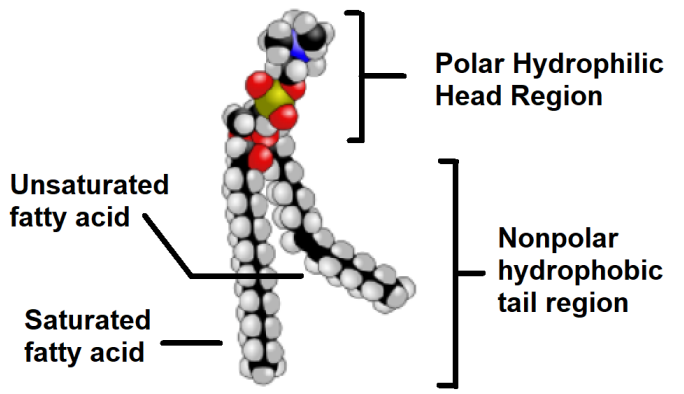
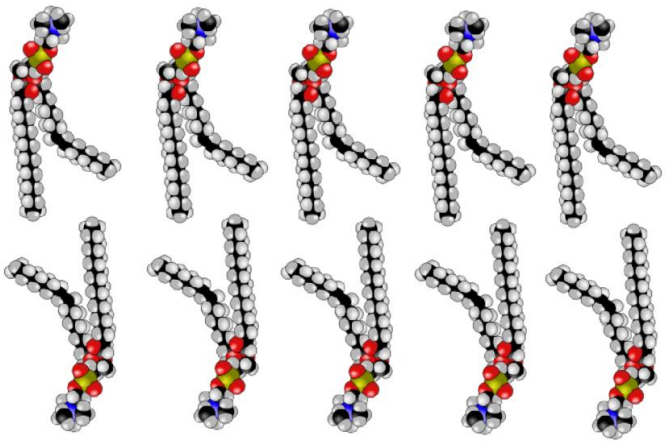


Figure 2.B.2 – Phospholipid Bilayer



Next, insert cholesterol into the membrane and discuss its ability to stabilize membranes (**Figure 2.B.3**). Increase the complexity by adding several proteins to the structure and discuss protien functions **(Figure 2.A.4)**.

Figure 2.B.3 – Cholesterol in Membrane

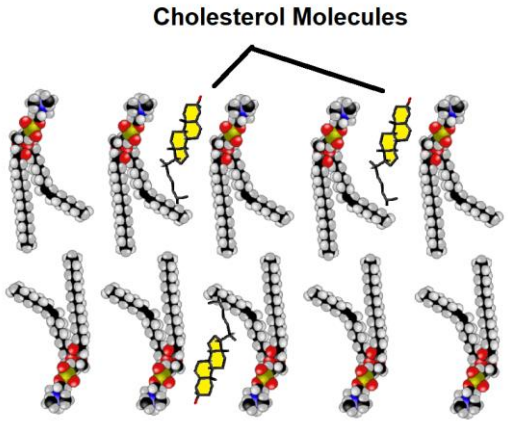
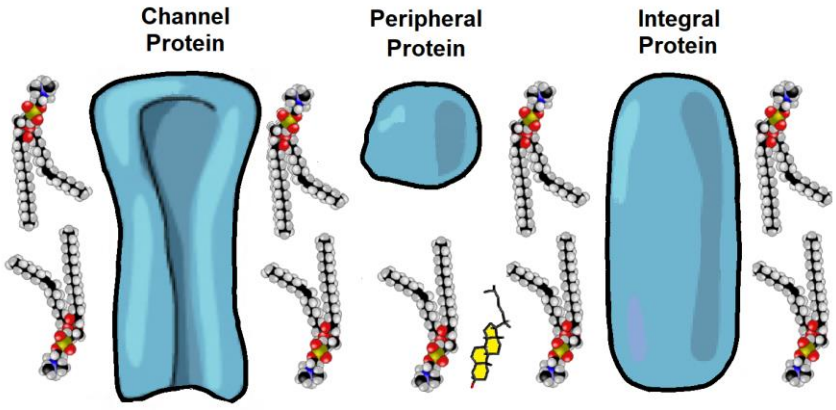
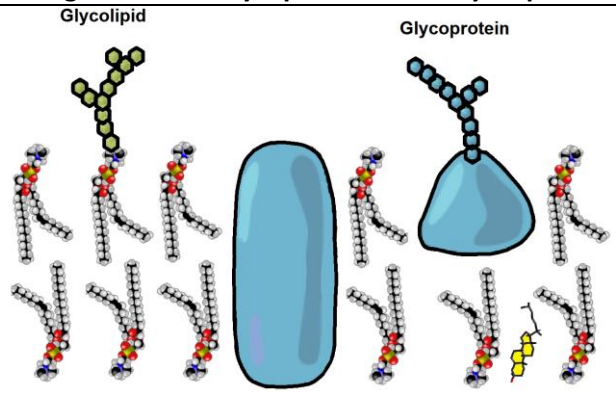


Figure 2.B.4 – Membrane Proteins



Next, add glycoproteins and glycolipids and discuss their functions. These can be added to the growing structure or discussed separately from the others membrane structures (**Figure 2.B.5).**

Figure 2.B.5 – Glycoproteins and Glycolipids



Next, use the sodium-potassium pump protein to demonstrate the movement of ions across the membrane. First, the protein is open to the inside of the cell. Sodium attaches to the binding sites (1) and ATP attaches to the protein (2) **(Figure 2.B.6)**. The ADP then dissociates from the ATP (3) and the protein changes configuration to allow the sodium ions to exit (4). Potassium ions bind to the binding sites (5) **(Figure 2.B.7)**. The phosphate falls away from the protein (6), and the protein changes shape again back to the original configuration, leaving the potassium ions to enter the cell (7) **(Figure 2.B.8)**. The net effect is active transport using ATP to concentrate the ions on either side of the membrane.

Figure 2.B.6 – Sodium Potassium Pump Steps 1-2

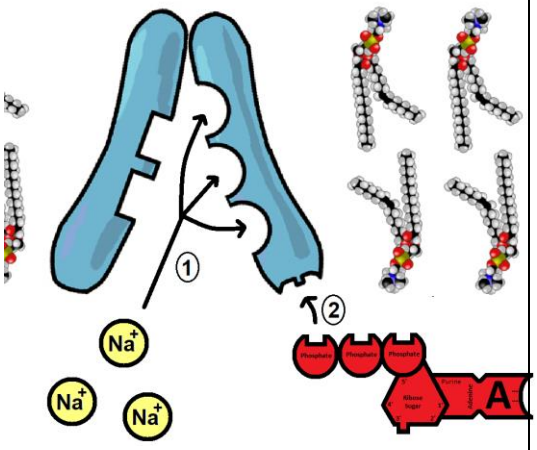


Figure 2.B.7 – Sodium Potassium Pump Steps 3-5

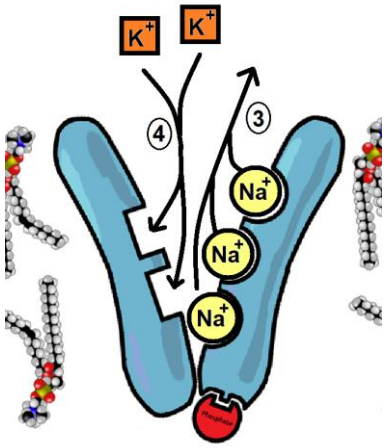
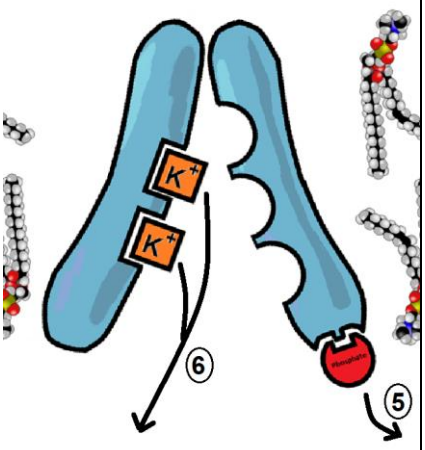


Figure 2.B.8 – Sodium Potassium Pump Steps 6-7



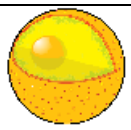
Student Centered Activity (10-40 minutes): After teaching the parts of the cell membrane, put students into small groups and have them take turns building the membrane, naming the parts, and describing the function of those parts. Allow the students to help one another. It may be helpful if the students have the student handout to act as a guide the first time they do the activity and then graduate to doing it without help.

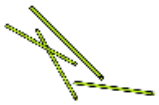
Extra exercises:

Research Other Membrane Parts: Have students go online and find other parts of the cell membrane not represented by the Biology Magnets. This might include internal structures that attach to the inside of the membrane or external structures in the matrix outside the cell. Have them draw these with markers on the membranes, or, if extra magnetic tape is available, have the students draw the parts they researched onto index cards and attach magnets to the back to create their own magnets for their membranes. Have each student report the membrane part they researched to the rest of the class.

Biology Magnets Module 2A – Parts of a Cell – Student Handout

Student Centered Activity: Draw a large oval on the board that will represent the plasma membrane of a cell. Use the chart below to help you learn the organelles. Move the magnets one at a time into your cell membrane and build your cell. First, build a prokaryotic cell. You will have to finish drawing the cell membrane, cell wall, and capsule layer with colored markers. Make sure you can say all of the parts and their function to your group members without looking at the chart. After everyone has mastered the prokaryotic cell, build an animal cell. Again, try to name the organelle and its function without looking at the chart. Then build the plant cell and repeat the process with it. You will have to draw a cell wall around the cell membrane with a marker. Can you name the differences between an animal cell and a plant cell? Once you have finished tell your teacher that you have mastered the organelles!

Magnet Name	Picture	Function	Type of Cell
Nucleus, Nucleolus, Nuclear Membrane, Nuclear Pores		Nucleus - Holds DNA, chromosomes Nucleolus – Makes ribosomes	Eukaryotic - Plant and Animal
Mitochondrion		Puts together ATP for the cell	Eukaryotic – Plant and Animal
Chloroplast		Performs photosynthesis	Eukaryotic – Plant
Rough and Smooth Endoplasmic Reticulum		Rough ER – Makes and stores proteins bound for membranes Smooth ER – Makes and stores lipids	Eukaryotic – Plant and Animal
Golgi Apparatus		Packages lipids and proteins for distribution or use in the cell	Eukaryotic – Plant and Animal
Water Vacuole		Stores water in the cell, creates turgor pressure	Eukaryotic – Plant
Lysosome		Breaks down/digests food and foreign particles	Eukaryotic – Animal
Peroxisome		Breaks down hydrogen peroxide, breaks down lipids	Eukaryotic – Plant and Animal
Vesicle		Stores and transports materials in cell	Eukaryotic – Plant and Animal
Free Ribosomes		Makes proteins used in cytoplasm	Prokaryotic and Eukaryotic – Plant and Animal

Flagellum		Causes movement of cells	Prokaryotic and Eukaryotic – Plant and Animal
Cytoskeleton		Forms scaffolding in cell for support and movement	Eukaryotic – Plant and Animal
Centrioles		Involved in cell reproduction	Eukaryotic – Animal
Cilia		Causes movement of cells or of material around cells	Eukaryotic – Plant and Animal
Nucleoid		Chromosomal loop of DNA coiled within cell	Prokaryotic
Plasmid		Small loops of DNA within cell	Prokaryotic
Plasma membrane (green), cell wall (red), capsule (blue)		Cell membrane – Controls what enters and exits the cell Cell Wall – Peptidoglycan layer for protection and support Capsule – gel layer for further protection	Prokaryotic
Pili		Causes cell to attach to surfaces and other cells; some used to pass plasmids to other cells	Prokaryotic

Extra exercises:

Research Organelles: Go online and find other organelles not represented by the Biology Magnets. Draw these organelles with dry erase markers in the cells. Alternatively, if magnetic tape is available, draw the organelles researched onto index cards and attach magnets to the back to create magnets for your cells. Each student can report the organelle researched and its function to the rest of the class.

Oral Quiz: Give an oral quiz to another student or another group by calling out names of organelles and having the student or group move the organelles into it as they are called. Try to see if your group can get all of the organelles correct.

Biology Magnets Module 2B – Parts of the Cell Membrane Student Handout

Start the lesson by placing a phospholipid on the board and naming its parts (**Figure 2.B.1**). Then place Several phospholipids to show the bilayer which naturally forms in a watery medium (**Figure 2.B.2**).

Figure 2.B.1 – Parts of a Phsopholipid

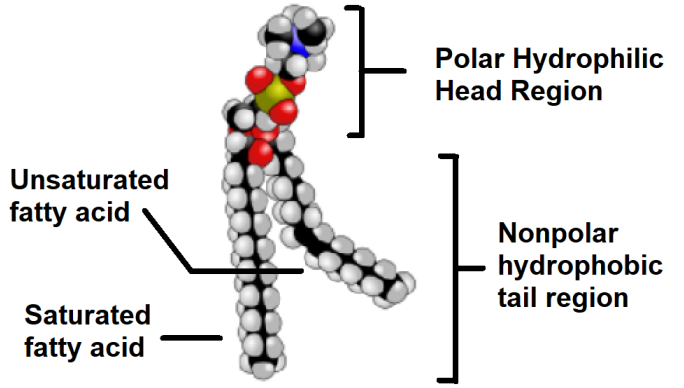
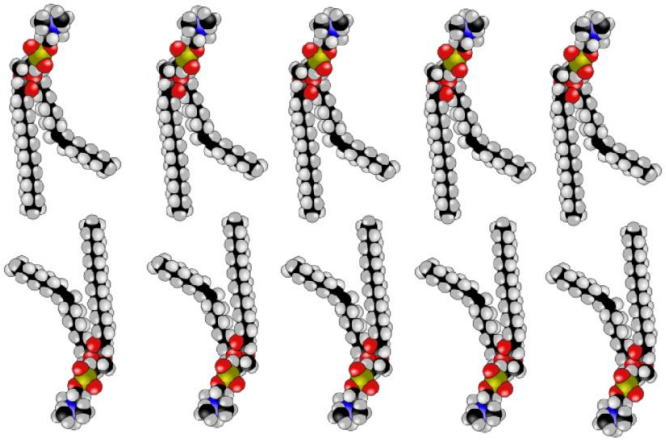


Figure 2.B.2 – Phospholipid Bilayer



Next, insert cholesterol into the membrane and discuss its ability to stabilize membranes (**Figure 2.B.3**). Increase the complexity by adding several proteins to the structure and discuss protien functions **(Figure 2.A.4)**.

Figure 2.B.3 – Cholesterol in Membrane

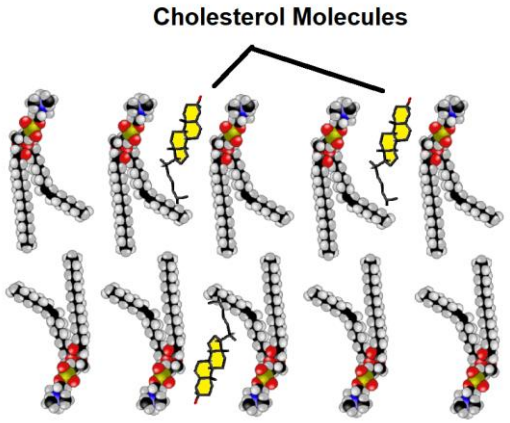
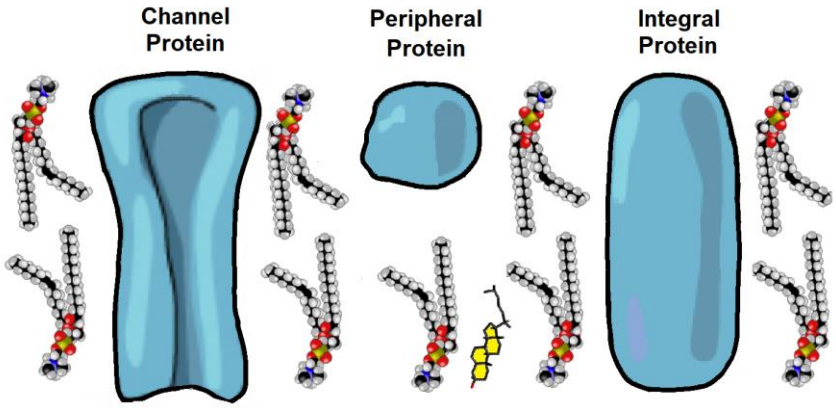
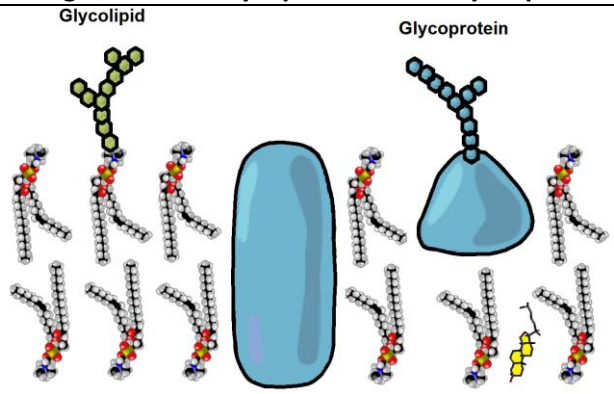


Figure 2.B.4 – Membrane Proteins



Next, add glycoproteins and glycolipids and discuss their functions. These can be added to the growing structure or discussed separately from the others membrane structures (**Figure 2.B.5).** Go back over all of the parts of the membrane with your group members until everyone knows all of the parts and their functions. When you are ready, tell them to your teacher or members of the other groups.

Figure 2.B.5 – Glycoproteins and Glycolipids



Next, use the sodium-potassium pump protein to demonstrate the movement of ions across the membrane. First, the protein is open to the inside of the cell. Sodium attaches to the binding sites (1) and ATP attaches to the protein (2) **(Figure 2.B.6)**. The ADP then dissociates from the ATP (3) and the protein changes configuration to allow the sodium ions to exit (4). Potassium ions bind to the binding sites (5) **(Figure 2.B.7)**. The phosphate falls away from the protein (6), and the protein changes shape again back to the original configuration, leaving the potassium ions to enter the cell (7) **(Figure 2.B.8)**. The net effect is active transport using ATP to concentrate the ions on either side of the membrane. Show your teacher or other group members all of the steps in order after you have practiced them a few times.

Figure 2.B.6 – Sodium Potassium Pump Steps 1-2

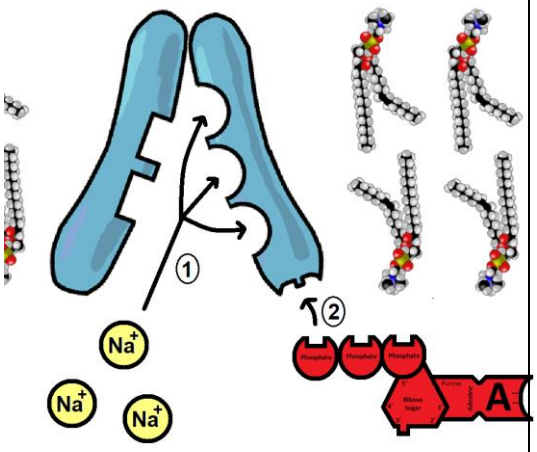


Figure 2.B.7 – Sodium Potassium Pump Steps 3-5

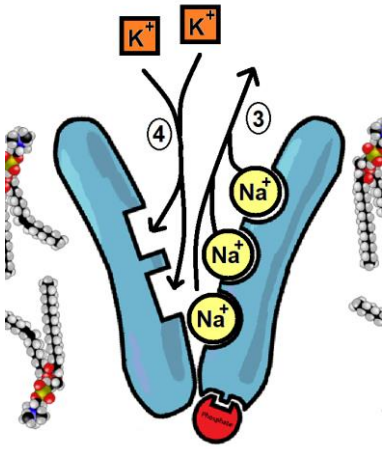
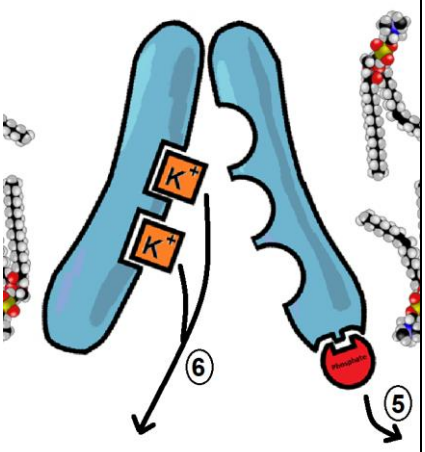


Figure 2.B.8 – Sodium Potassium Pump Steps 6-7



Extra exercises:

Research Other Membrane Parts: Go online and find other parts of the cell membrane not represented by the biology magnets. This might include internal structures that attach to the inside of the membrane or external structures in the matrix outside the cell. Draw these with markers on the membranes, or, if extra magnetic tape is available, draw the parts you researched onto index cards and attach magnets to the back to create your own magnets for the membranes. Report the membrane part you researched to the rest of the class or the teacher.