KENAN FELLOWS PROGRAM
FOR TEACHER LEADERSHIP

Membrane Madness

I. Introduction: This 8-day unit on cell organelles, types and transport is intended for a high school honors biology course consisting of 9th and 10th grade students. However, with a few modifications some of these lessons could also be modified for a regular biology or an AP biology course. Each day is designed to be implemented in an 85-minute block period.

II. Unit Summary:
- Day 1-2: Overview of cell organelles, types of cells and cell specialization
- Day 3-4: Introduction to cell membrane structure and function and cell transport
- Day 5-7: in-depth discussion of cell transport and advanced practice of scientific literacy skills (reading and writing scientifically)
- Day 8: unit review day to check for student understanding

III. Misconceptions: According to the American Association for the Advancement of Science (AAAS) regarding 9th-12th grade students...
1. 68% believe that "cells of living organisms do not make molecules for their own growth and repair"
2. 43% believe "animal cells do not eliminate their own wastes" and 31% believe the same about plant cells
3. 37% believe "All cells are the same size and shape"
4. 35% believe "bacteria do not carry out essential life functions for themselves"

IV. Prior knowledge:
- Students should already have completed lessons on the four macromolecules - proteins, lipids, nucleic acids and carbohydrates. They should know their subunits, functions, and some examples of each.
- Students should already know how to use the microscope and prepare wet mount slides.
- Students should already have the app "Stop Motion" or one of these other apps on their phones and know how to use it. They will need it to create stop motion videos of cell secretion. See this tutorial if you need assistance with the app.
- Sometime before this lesson student should take the "pretest assessment" which is the same as the post-test assessment described in this outline

V. NC Essential Standards Addressed:

Overarching Standard	**Sub Standards**	**Unpacking** What does this standard mean a child will know?
Bio.1.1 Understand the relationship between the structures and functions of cells and their organelles.	Bio.1.1.1 Summarize the structure and function of organelles in eukaryotic cells (including the nucleus, plasma membrane, cell wall, mitochondria, vacuoles, chloroplasts, and ribosomes) and	Explain how the structure of the organelle determines it function.). Summarize how these organelles interact to carry out functions such as energy production and use, transport

	ways that these organelles interact with each other to perform the function of the cell.	of molecules, disposal of waste, and synthesis of new molecules.
Bio.1.2 Analyze the cell as a living system.	Bio.1.2.1 Explain how homeostasis is maintained in a cell and within an organism in various environments (including temperature and pH).	Compare the mechanisms of active vs. passive transport (diffusion and osmosis). Conclude how the plasma membrane structure functions.
Bio.3.1 Explain how traits are determined by the structure and function of DNA	Bio.3.1.2 Explain how DNA and RNA code for proteins and determine traits.	Explain the process of protein synthesis Amino acids are linked by peptide bonds to form polypeptides. Polypeptide chains form protein molecules. Proteins can be structural (forming a part of the cell materials) or functional (hormones, enzymes, or chemicals involved in cell chemistry).
Bio.4.1 Understand how biological molecules are essential to the survival of living organisms	Bio.4.1.1 Compare the structures and functions of the major biological molecules (carbohydrates, proteins, lipids, and nucleic acids) as related to the survival of living organisms. Bio.4.1.2 Summarize the relationship among DNA, proteins and amino acids in carrying out the work of cells and how this is similar in all organisms.	Bio.4.1.1 Compare the structure and function of each of the organic molecules in organisms Bio.4.1.2 Recall that the sequence of nucleotides in DNA codes for specific amino acids which link to form proteins.
Bio.4.2 Analyze the relationships between biochemical processes and energy use in the cell.	Bio 4.2.2 Explain ways that organisms use released energy for maintaining homeostasis (active transport).	Conclude that energy production by organisms is vital for maintaining homeostasis and that maintenance of homeostasis is necessary for life

VI. Essential Vocabulary: click HERE to see teacher-made definitions or click below for official versions.

• Prokaryote • Eukaryote • Organelle • Specialized • Lipid • Protein	• Mitochondria • Nucleus • Chloroplast • Cell Wall • Membrane • Golgi Body	• Diffusion • Osmosis • Active Transport • ATP • Transmembrane protein • Peripheral protein

• Nucleic Acid • Carbohydrate	• Endoplasmic Reticulum • Ribosome	• Hydrophobic • Hydrophilic

VII. Outline View of Unit

Day	Lesson Outline and Teacher Notes	Activity Descriptions and Links
1	• Warm-Up 1: think-pair-share (5 min) • Make Cell Organelle Foldable and go through Cell Organelle Notes (30 min) • Secretory Stop Motion Videos (50 min). Access key and teacher notes here.	• Warm-Up 1: students will fill out a "think-pair-share" sheet regarding cell organelles in order for the teacher to assess prior knowledge. • Cell Organelle Foldable: students will make an 8-tab foldable for the locations/functions of the 8 major organelles. Teacher should stress that not ALL cells have each of these organelles it's just that these are the most common. • Cell Organelle Notes: after the foldable is made, teacher will take students through this powerpoint. The slides that include what students should write down have a pencil gif in the top right hand corner. Make sure students have colored pencils available at their desks. On each organelle slide the teacher will draw a small sketch of the organelle for students to include in their foldable. • Secretory Stop Motion Video: students will use the app "Stop Motion", legos/beads, dry erase markers and mini whiteboards to make videos of the secretory pathway for a basic cell.
2	• Warm-Up 2: organelle tweets (5 min) • Cell Type Investigation 1: prokaryotes vs. eukaryotes (25 min). Access teacher notes here. • Padlet and discussion 1 (15 min) • Cell Type investigation 2: specialized cells (25 min) • Discussion 2 (15 min)	• Warm-Up 2: students will compose 2 tweets about the function of 2 organelles of their choice and share out on a padlet projected on the board for their classmates to see. • In Cell Type Investigation 1, students will get into teams of 3. Each team will have two prepared slides: one prokaryote and one eukaryote (although they don't know that). After making observations, students share out their observations on a padlet and teacher leads the class in a discussion. The terms "prokaryote" and "eukaryote" will be introduced. • In Cell Type Investigation 2, student teams will trade slides until they have made observations on each eukaryote in the room. Although most

		of the bacteria slides appear similarly (at least on the magnification possible for us) the eukaryotes do not. • Discussion 2: After students finish making observations, teacher leads students in a discussion of cell specialization. Specifically, plant vs. animal cells and ways in which even cells of the same type can differ (size, shape, types or number of organelles.
3	• Warm-Up 3: cell type venn diagram (10 mins) • Cell membrane mini lesson (10 min) • Bubble lab and discussion (40 min). Access teacher notes here. • Work on cell membrane building activity (25 mins)	• Warm-Up 3: students will complete a venn diagram comparing plant, animal and bacterial cells. • Membrane Mini Lesson: a short pre-lab introduction to membranes and some of the terminology students will be seeing in lab. Students should take notes during the lesson. • Bubble Lab: students will use soap bubbles to simulate properties of cell membranes. This activity has been adapted from a more thorough investigation for the needs of this lesson. • Cell Membrane Build: students can do the paper activity or the virtual activity. The virtual activity will save time if the bubble lab takes longer than expected. The paper activity could be offered as an extension for students who finish more quickly.
4	• Warm-Up 4: cell membrane review (10 mins) • Dialysis tubing experiment (60 mins) and discussion (15 mins). Access teacher notes here.	• Warm-Up 4: cell membrane review in the form of a kahoot. • Dialysis Tubing Experiment: this experiment guide was adapted from this document in order to make it more inquiry based.
5	• Warm-Up 5: Gummy Bears (10 mins) • Notes on types of transport (20 mins) • Egg Osmosis Lab Phase 1 (30 mins). See teacher notes. • Begin Literature Analysis (25 mins). See teacher notes.	• Warm-Up 5: student pairs weigh a gummy bear and place it in a dixie cup full of water. They will make predictions and observe changes in the gummy bear weight after notes are finished. • Notes on Types of Transport: a series of notes/video clips demonstrating the three major types of transport (diffusion, osmosis and active). Teacher can have students write notes on paper or modify the lesson by using this guided note sheet.

		• Egg Osmosis Lab Phase 1: Teacher should already have soaked eggs in vinegar for 2 days to remove the shell (tell students this and explain why). Today students will weigh eggs, put them in either corn syrup or salt water (their choice), and make predictions about the outcome. One group member will type their hypotheses/data into a google doc to use in a formal lab report at the end of this lab. • Guided Reading and Analysis: students will compare two scientific articles in order to get a sense of the format. After the class discusses to ensure accuracy, students will choose one article to analyze in-depth.
6	• Warm-Up 6: egg lab discussion (10 mins) • Phase 2 of egg osmosis lab (15 mins) • Guided Literature Analysis Continued (60 mins). Access teacher notes.	• Warm-Up 6: poll everywhere quiz asking students what they think happened to the egg overnight and how they will know. Teacher should relate the discussion to the cell membrane. • Egg Osmosis Lab Phase 2: Today students will weigh their egg again and determine what happened to the egg and why. Then they will repeat the experiment but put the egg in a solution of water. Teacher should show students the sample data table to support those that struggle with organization. • Guided Literature Analysis: students continue the work they did yesterday.
7	• Warm-Up 7 (10 mins) • Phase 3 of egg osmosis lab (15 mins) • Write lab reports and prepare infographic posters (60 mins). Access teacher notes here.	• Warm-Up 7: Four osmosis practice problems. Have students do two on their own and then go over the answers. Allow them to finish the other two while you circulate and help. • Egg Osmosis Lab Phase 3: Today students measure the results of their egg in the water and record in data tables. Finally they clean up the experiment. • Lab Reports: Students work in their egg teams to write a lab report together based on the egg lab rubric. Most of the information has already been put into a shared google doc so they must simply make a copy. They can work together but their conclusions must be unique. • Posters: once their reports are complete and have been shared with the teacher, students

		will work together to make one poster per team about their egg laboratory here. The poster guidelines can be found in the teacher notes. You can provide students with a sample lab report poster here (provided by Mr. Vance Kite, City of Medicine Academy).
8	• Warm-Up 8 (5 mins) • Poster Session (20 mins) • Cell Unit Review Sheet (45 mins). See key here. • Post-Test Assessment (15 mins)	• Warm-Up 8: Five practice EOC questions in the form of a kahoot. • Poster Session: 1 person per team stays with the laptop and infographic to answer questions. All others rotate on 5 minute intervals until all posters have been seen. Rotating team members must bring back 1 thing from each infographic to tell the partner that remained behind. • Cells Unit Review Sheet: Students will work together to complete the review sheet and halfway through the time the teacher will go over the answers. This would be good preparation for a unit test if the teacher chooses to administer one. • Post-Test Assessment: same as the pre-test assessment given before this unit began. Using this assessment teacher can see if the AAAS misconceptions were addressed and get student feedback on the unit.

VIII. Author Information

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IX. Acknowledgements

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