Unit Title: Microbiology	**Content Area:** Biology	**Grade Level:** 9-12

Unit Summary: The unit introduces the students to the cells by first evaluating the characteristics of all living things. Students will then differentiate between the major organelles within the cell followed by identifying characteristics that vary amongst different types of cells. The cell membrane and types of transport are then discussed. The final portion of the unit concludes two lab investigations where the students must model osmosis and diffusion and explore how plant and animal cells react in hypertonic and hypotonic solutions. The cross cutting concepts that this unit includes are patterns, cause and effect, scale, proportion and quantity, systems and system models and structure and function. There is a heavy focus within the unit specifically with the structure and function cross cutting concept.

Science Practices Addressed: Asking questions (for science) and defining problems (for engineering). Developing and using models, Planning, and carrying out investigations, Analyzing and interpreting data, Using mathematics and computational thinking, Constructing, explanations (for science) and designing solutions (for engineering), Engaging in argument from evidence, Obtaining, evaluating, and communicating information

Cross-Cutting Concepts Addressed: Patterns, Cause and Effect, Systems and System Models, and Structure and Function.

Unit Essential Questions:	**Unit Enduring Understandings:**
• How does the structure relate to function in living systems from organismal to the cellular level? • What is the difference between prokaryotes and eukaryotes? • What characteristics do all living things have? • How does structure of the cell membrane relate to its function? • How can we model osmosis and diffusion?	• All living things share common characteristics (Specifically: Made of Cells, Cell Specialization, Levels of Organization, and Homeostasis). • The cell membrane is the site of regulation of some cell processes and aids in homeostasis (Specifically: Membrane Structure, Osmosis, Diffusion, and Active Transport).

Possible Student Misconceptions: Osmosis and diffusion are the same. Molecules cease to move at equilibrium. Osmosis is limited to mixtures in the liquid state. All living things need water and oxygen. All eukaryotic organisms are multicellular.

NJCCCS: 5.3.12.A.1, 5.3.12.A.2, 5.3.12.A.3, 5.3.6.A.1,5.3.4.A.1

NGSS Performance Expectations: *Students who demonstrate understanding can…*

- HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
- HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

Primary CCSS ELA/Literacy Connections: CCSS.ELA-Literacy.WHST.9-10.1, CCSS.ELA-Literacy.WHST.9-10.2, CCSS.ELA-Literacy.WHST.9-10.4, CSS.ELA-Literacy.RI.9-10.1, CCSS.ELA-Literacy.SL.9-10.1, CCSS.ELA-Literacy.SL.9-10.4,	**Primary CCSS Mathematics Connections:** CCSS.Math.Content.HSS.ID.A.1

Lesson Pace & Sequence

Lesson Title/Number: Characteristics of Living things and Homeostasis, Lesson 1	**Learning Objective(s)**: Conclude the characteristics that all living things share by doing quick lab and through class discussion.	**Lesson Duration:** 80 minutes

Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***Science and Engineering Practices*** ***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***
Elicit: How will you access students' prior knowledge?	Do Now: What characteristics must all living things share?			LS1.A: Structure and Function	Patterns. Observed patterns of forms and events guide

Engage: How will you capture students' interest and get students' minds focused on the concept/topic?	KWL Chart: Write what students say they know all living things must have on the board in the knowledge sections of the chart ("K" in KWL). Ask and document what students want to know about the characteristics that all living ("w" in KWL).	• KWL Chart Template: http://www.eduplace.com/graphicorganizer/pdf/kwl.pdf	Asking questions (for science) and defining problems (for engineering)		organization and classification, and they prompt questions about relationships and the factors that influence them.
Explore: What hands-on/minds-on common experience(s) will you provide for students?	Students will be asked to go to a series of items around the room (about 10 living and non-living things.) Prior to exploring these items, ask students in small groups to "Discuss the criteria for living things with your group. Come to a consensus on at least five or more necessary characteristics of a living thing." As students go from station to station, they will use the criteria they've developed as a group to determine if the organism is living or nonliving.		Planning and carrying out investigations		Systems and system models. Defining the system under study —specifying its boundaries and making explicit a model of that system —provides tools for understanding and testing ideas that are applicable throughout science and engineering.
Explain: How will you help students connect their exploration to the concept/topic under investigation?	After students have explored each station ask them to now revise their criteria as a group and defend their thoughts to one another using evidence from their stations.		Engaging in argument from evidence		Patterns. Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them. Stability and change. For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.
Elaborate: How will students apply their learning and develop a more sophisticated understanding of the concept/topic?	Class Discussion: Characteristics of Living Things. Prior to a formal discussion have students read independently and generate questions.	• Ch. 1-3	Asking questions (for science) and defining problems (for engineering)		
Evaluate: How will students demonstrate their mastery of the learning objective(s)?	Finalize criteria required to assess if an organism is living or nonliving by revising their criteria and the completing the KWL chart.		Obtaining, evaluating, and communicating information.		

Extend: How will students deepen their conceptual understanding through use in new context?	Watch and discuss the homeostasis video. Write two discussion questions while watching the movie.	• Homeostasis Video: http://www.bbc.co.uk/schools/gcsebitesize/science/edexcel/responses_to_environment/homeostasisact.shtml	Asking questions (for science) and defining problems (for engineering)		
Lesson Title/Number: Introduction to the cell, Lesson 2		**Learning Objective(s):** Differentiate between prokaryotic cells and eukaryotic cells by completing a Venn diagram and between the different cell organelles by completing a graphic organizer.			**Lesson Duration:** 80 minutes
Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	**Science and Engineering Practices** **What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?**	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***
Elicit: How will you access students' prior knowledge?	Do Now: Write down as much as you know about the characteristics of a cell.			LS1.A: Structure and Function	
Engage: How will you capture students' interest and get students' minds focused on the concept/topic?	Using a 3-D model or visual of a cell, ask students, " Is this an animal cell or plant cell, defend your response?"		Engaging in argument from evidence		Systems and system models. Defining the system under study —specifying its boundaries and making explicit a model of that system —provides tools for understanding and testing ideas that are applicable throughout science and engineering
Explore: What hands-on/minds-on common experience(s) will you provide for students?	Inquiry Activity, "What is a cell?" Students will be able to form an operational definition of the term cell and classify the cells they observe into two or more groups.	• Ch. 7-1, Pg. #168	Constructing explanations (for science) and designing solutions (for engineering		Structure and function. The way in which an object or living thing is Shaped and its substructure determine many of its properties and functions
Explain: How will you help students connect their exploration to the concept/topic under investigation?	Class Discussion: Prokaryotic cells vs. Eukaryotic Cells (Ch. 7-1) and create a Venn diagram of the two.	• Prokaryote vs. Eukaryote Venn Diagram: http://www2.mbusd.org/staff/pware/pdf/ProkaryoticEurkaryoticVenn.pdf	Obtaining, evaluating, and communicating information		

Elaborate: How will students apply their learning and develop a more sophisticated understanding of the concept/topic?	Cell Structure Graphic Organizer (Ch. 7-2)	• Cell Structure Graphic Organizer: http://www.evergladeshs.org/ourpages/auto/2013/8/14/42654941/Cell%20Structure%20Graphic%20Organizer%20_Ch_7%20Biology_.pdf			Structure and function. The way in which an object or living thing is Shaped and its substructure determine many of its properties and functions
Evaluate: How will students demonstrate their mastery of the learning objective(s)?	Exit Ticket: Without looking at your graphic organizer, what are three organelles found in the eukaryotic cell and what is their function?				
Lesson Title/Number: Introduction to the cell membrane, Lesson 3		**Learning Objective(s):** Explain the different parts of the cell membrane and their functions by completing activity.			**Lesson Duration:** 160 minutes
Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***Science and Engineering Practices*** ***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***
Elicit: How will you access students' prior knowledge?	Do Now: How do you think molecules move across a membrane?			LS1.A: Structure and Function	
Engage: How will you capture students' interest and get students' minds focused on the concept/topic?	Febreeze Activity: Have students stand up next to their seat. Spray the Febreeze in the corner of the room and have students sit down once they smell the scent. Then ask, "what happened to the molecule of Febreeze?" "What can we say the molecules have done?" Then ask the students, "what would happen if I sprayed this and there was a screen between you and me?"		Asking questions (for science) and defining problems (for engineering)		Systems and system models. Defining the system under study —specifying its boundaries and making explicit a model of that system —provides tools for understanding and testing ideas that are applicable throughout science and engineering.

Explore: What hands-on/minds-on common experience(s) will you provide for students?	Quick Lab: Ask students to predict and draw what they expect to happen in three steps when they put 5 drops of food dye in water. Have the students place the 5 drops and ask follow up questions.	• Beaker with water and food dye	Asking questions (for science) and defining problems (for engineering) Developing and using models		
Explain: How will you help students connect their exploration to the concept/topic under investigation?	Class Discussion (PPT): Cell boundaries. Ask students to write a summarizing paragraph using key vocabulary after the formal presentation.	• Ch. 7-3	Obtaining, evaluating, and communicating information		Cause and effect: Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.
Elaborate: How will students apply their learning and develop a more sophisticated understanding of the concept/topic?	Comparing osmosis and diffusion by completing cellular transport problem set.	• Cellular Transport Problem Set: http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CB0QFjAA&url=http%3A%2F%2Fmrsebiology.weebly.com%2Fuploads%2F5%2F1%2F4%2F8%2F5148626%2Fcelltransportproblems_2.doc&ei=oeHWU_H3M-bNsQSwzoCQCg&usg=AFQjCNFqQgASJWE1Kni5WDmOqJK3dNaGlA&sig2=LY0TBHN0OnvopsIS7cJnPA			
Evaluate: How will students demonstrate their mastery of the learning objective(s)?	Accurate completion of Cellular Transport Problem Set				

Extend: How will students deepen their conceptual understanding through use in new context?	Exit Ticket: The kidney's job is to filter the waste product out of our blood and release it through urine. When someone has kidney failure, they have to undergo a medical procedure called dialysis. This will do the kidneys job for you. Describe how osmosis and diffusion might play an important role in dialysis.		Constructing explanations (for science) and designing solutions (for engineering)		
Lesson Title/Number: Design Osmosis Lab, Lesson 4		**Learning Objective(s):** Design a lab experiment that applies their knowledge of osmosis, diffusion and the cell membrane to answer the lab question, "How can we model osmosis and diffusion?"			**Lesson Duration:** 80 Minutes
Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***Science and Engineering Practices*** ***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***
Elicit: How will you access students' prior knowledge?	Do Now: What is the difference between osmosis and diffusion?			LS1.A: Structure and Function	

Engage: How will you capture students' interest and get students' minds focused on the concept/topic?	Demonstration: Using dialysis tubing, demonstrate how to tie off one end of the tubing and place water and iodine inside the tube. Tie off the other end and place it in a beaker of water. As students to predict in their lab group after 24 hours, what they expect to happen and have student draw in their notebook the predicted outcome. Then show them a model of the same scenario that has been sitting for 24 hours. Ask students, "Was this what you predicted?" "I placed the same amount of dye in both bags, what can you tell about the concentration of color?" "What can we say has happened in this process?" "What caused this phenomenon to occur?"	• Dialysis tubing • Dye • Water • Beaker	Asking questions (for science) and defining problems (for engineering) Analyzing and interpreting data Engaging in argument from evidence Obtaining, evaluating, and communicating information		Cause and effect: Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts
Explore: What hands-on/minds-on common experience(s) will you provide for students?	Provide students with literature regarding dialysis tubing, iodine, diffusion and osmosis. Ask them to complete the "background information" of their lab.	• Osmosis/Diffusion Lab: http://www.flinnsci.com/media/452838/bf10936.pdf	Obtaining, evaluating, and communicating information		
Explain: How will you help students connect their exploration to the concept/topic under investigation?	Give students the list of available materials: iodine, beakers, pipets, Sucrose solutions (.2 mol, .4 mol., .8 mol and 1.0 mol), water, dialysis, tubing, potatoes, starch solution, etc. Have students in lab groups develop hypothesis, variables, and control to answer the lab question, "how can we model osmosis and diffusion."	• Ch. 1-2. Quick lab or diffusion on pg. 187.	Planning and carrying out investigations.		Patterns. Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them. Cause and effect: Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major

Elaborate: How will students apply their learning and develop a more sophisticated understanding of the concept/topic?	Design procedures, identify materials and specify methods of collecting data that aligns with proposed hypothesis.		Developing and using models Planning and carrying out investigations.		activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts Systems and system models. Defining the system under study —specifying its boundaries and making explicit a model of that system —provides tools for understanding and testing ideas that are applicable throughout science and engineering. Structure and function. The way in which an object or living thing is Shaped and its substructure determine many of its properties and functions
Evaluate: How will students demonstrate their mastery of the learning objective(s)?	Pre-lab questions: How do osmosis and diffusion similar and different? What does the dialysis tubing represent? What is (are) your investigation (s) modeling? What do you expect to happen in your investigation? What aspect of your investigation is modeling osmosis, and which is modeling diffusion?		Obtaining, evaluating, and communicating information		
Lesson Title/Number: Implement Osmosis/Diffusion Lab, Lesson 5		**Learning Objective(s):** Create and implement a lab design that models osmosis and diffusion.			**Lesson Duration:** 160 minutes
Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***Science and Engineering Practices*** ***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***
Elicit: How will you access students' prior knowledge?	Do Now: What did you and your group hypothesize for today's lab?			LS1.A: Structure and Function	Patterns. Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

					Cause and effect: Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts Systems and system models. Defining the system under study —specifying its boundaries and making explicit a model of that system —provides tools for understanding and testing ideas that are applicable throughout science and engineering. Structure and function. The way in which an object or living thing is Shaped and its substructure determine many of its properties and functions
Engage: How will you capture students' interest and get students' minds focused on the concept/topic?	Watch Bozeman video on osmosis diffusion lab. Ask student to work in groups and revise their procedures if necessary prior to beginning lab investigation.	• Osmosis/Diffusion Lab Demo: https://www.youtube.com/watch?v=LeS2-6zHn6M	Asking questions (for science) and defining problems (for engineering) Planning and carrying out investigations Developing and using models		
Explore: What hands-on/minds-on common experience(s) will you provide for students?	After teacher approval of procedures and data collection methods, students can begin their investigation.	• All necessary lab equipment. Quick lab on pg. 187.			

Explain: How will you help students connect their exploration to the concept/topic under investigation?	Accurately creating procedures and methods of data collection that aims to address the lab question, "how can we model osmosis and diffusion?"				
Elaborate: How will students apply their learning and develop a more sophisticated understanding of the concept/topic?	Classroom data analysis: Students will share their conclusions and support it with evidence to the class.		Analyzing and interpreting data Engaging in argument from evidence		
Evaluate: How will students demonstrate their mastery of the learning objective(s)?	Answer post lab questions: What were your final results? Was your hypothesis correct? Using specific evidence how did your data support, or not support, your hypothesis? If you were teaching an AP biology class, what would you change about this lab to make it more advanced?		Engaging in argument from evidence Obtaining, evaluating, and communicating information		
Extend: How will students deepen their conceptual understanding through use in new context?	Unit conclusions: First have students write a one paragraph answer to the following question: How do you the kidneys use the phenomena of osmosis to function? After reading the homeostasis and kidney webpage, ask students to re-write/revise their response to the initial question.	• Homeostasis and the Kidney: http://www.abpischools.org.uk/page/modules/homeostasis_kidneys/kidneys3.cfm?coSiteNavigation_allTopic=1	Constructing explanations (for science) and designing solutions (for engineering) Obtaining, evaluating, and communicating information		
Lesson Title/Number: Investigating cell structures and processes, Lesson 6		**Learning Objective(s):** Draw conclusions about how differences in structure between plant and animal cells affect the ways they respond to hypertonic and hypotonic solutions.			**Lesson Duration:** 80 minutes

Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***Science and Engineering Practices*** ***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***
Elicit: How will you access students' prior knowledge?	Do Now: How are plant cells and animal cells different?			LS1.A: Structure and Function	
Engage: How will you capture students' interest and get students' minds focused on the concept/topic?	Pre lab discussion: Read lab and ask, "why is the iodine solution used to stain the piece of onion? What is osmosis? How do the differences in the concentration of molecules of a substance affect diffusion across a cell membrane?		Asking questions (for science) and defining problems (for engineering)		Patterns. Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.
Explore: What hands-on/minds-on common experience(s) will you provide for students?	Microscope exploration: Review proper microscope usage and safety.	• How to Use a Microscope: http://www.biologycorner.com/worksheets/microscope_use.html			Cause and effect: Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.
Explain: How will you help students connect their exploration to the concept/topic under investigation?	Plant and Animal Cell Structures: Observe and draw the differences between a human cheek cell and an onion cell at three different magnifications for each.	• "Investigating Cell Structure and Processes" Ch.7, pg. #194.	Developing and using models		Structure and function. The way in which an object or living thing is Shaped and its substructure determine many of its properties and functions.

Elaborate: How will students apply their learning and develop a more sophisticated understanding of the concept/topic?	Effects of hypertonic and hypotonic solutions: Using different concentrations of salt solution identify the effects on both plant and animal cells under a microscope.	• "Investigating Cell Structure and Processes" Ch.7, pg. 194-195.	Planning and carrying out investigations		Cause and effect: Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to and explain events in new contexts. Structure and function. The way in which an object or living thing is Shaped and its substructure determine many of its properties and functions.
Evaluate: How will students demonstrate their mastery of the learning objective(s)?	Analyze and Conclude Questions relating to the above activity and found on pg. 195	• Ch. 7, pg.195	Obtaining, evaluating, and communicating information. Analyzing and interpreting data. Engaging in argument from evidence.		
Extend: How will students deepen their conceptual understanding through use in new context?	Lab Design: How would you design a lab investigation such as this to test the differences between a prokaryotic and eukaryotic cell?		Planning and carrying out investigations		Structure and function. The way in which an object or living thing is Shaped and its substructure determine many of its properties and functions.