Heather Mellor

NGSX Final Assignment

Storyline: How do redwood trees grow so tall?

Identification of Relevant Standards for Part One of Unit

Students who demonstrate understanding can:

HS-LS1-2. **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.** [Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.] [*Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. • Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.	**LS1.A: Structure and Function** • Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.	**Systems and System Models** • Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.

Connections to other DCIs in this grade-band: N/A

Articulation of DCIs across grade-bands:
MS.LS1.A

Common Core State Standards Connections:
ELA/Literacy -
SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. *(HS-LS1-2)*

* The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

NGSS Performance Expectation:

HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

NGSS Science and Engineering Practice:

Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-2)

NGSS Disciplinary Core Ideas:

Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. (HS-LS1-2)

NGSS Cross-Cutting Concepts:

Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. (HS-LS1-2)

NGSS Evidence Statements:

Observable features of the student performance by the end of the course:			
1	Components of the model		
	a		Students develop a model in which they identify and describe* the relevant parts (e.g., organ system, organs, and their component tissues) and processes (e.g., transport of fluids, motion) of body systems in multicellular organisms.
2	Relationships		
	a		In the model, students describe* the relationships between components, including:
		i.	The functions of at least two major body systems in terms of contributions to overall function of an organism;
		ii.	Ways the functions of two different systems affect one another; and
		iii.	A system's function and how that relates both to the system's parts and to the overall function of the organism.
3	Connections		
	a		Students use the model to illustrate how the interaction between systems provides specific functions in multicellular organisms.
	b		Students make a distinction between the accuracy of the model and actual body systems and functions it represents.

Possible student misconceptions/naïve models:

1. Trees obtain water from the air.
2. Trees get all the other nutrients they need from the ground, including carbon.
3. Carbon/carbon dioxide is absorbed by the roots.
4. Air does not have enough mass to be transformed into the mass of a tree.

Anchor Phenomenon – Redwood tree growth:

1. Show "Redwoods: The Tallest Trees | National Geographic" on youtube. https://www.youtube.com/watch?v=C9LHjV48e9s
2. Ask the question: **How do redwood trees grow so tall?**

Story Line Question: How do redwood trees grow so tall??

Develop Their Own Model To Assess and Apply Prior Knowledge (approx. time frame: 2 class periods) :

1. Use the whiteboards to construct a diagram to explain how a redwood tree obtains the nutrients to grow. Begin with individual models in the corners of the white board and then develop group model in the center. *Instructor uses productive talk to ensure that water is included in each group model.*

2. Have students write a driving question based on their modeling and discussion.
    a. **Expected Categories of Questions on Driving Question Board:**
        i. Nutrient needs
            1. What does a plant need to grow?
        ii. Recombination of chemicals
            1. How does something that is non-living (oxygen, carbon dioxide, water) transform into something that is alive?
        iii. Nutrient availability
            1. How do the conditions of the environment affect how tall a plant grows?
        iv. Difference in growth rate
            1. Do all redwood trees grow tall all the time and everywhere?
        v. Structure of plants
            1. What systems are in plants that help them grow?
            2. What is in a plant that moves the water or carbon dioxide?
            3. Are there different structures in redwoods to get all of the carbon dioxide, water, etc?
            4. What are the structures made of that help them to perform their jobs?
        vi. Different types of plants

3. Complete the gallery walk to share individual and group models.
4. Work with students to fill out the driving question board.

Student Question: How does water reach the tops of the redwood trees?
Note: This is preparing them to learn about photosynthesis later in the unit.

Investigation:

DAY 1 – Set-up carnation experiment

1. As a group, set up a white carnation with food coloring overnight.
2. In journal during class time, students write out the question and predict what the carnation will look like tomorrow. They also will write out their materials and methods.
3. When finished, students choose to complete the Water/cell transport POGIL or complete a reading on water properties in the textbook.

DAY 2 – Observations & notebook

4. Students write observations of their carnations and <u>write out</u> how their observations related to the dye/water movement up to the carnation. At this point, I will be having them self-assess their journal/notebook work.

DAY 3 (BLOCK DAY) – Consensus Model Building

5. Use the whiteboards to construct an individual diagram to explain how the redwood tree obtains the water needed to grow. Begin with individual models in the corners of the white board and then develop group model in the center.
6. Complete the gallery walk to share individual and group models.
7. Complete group discussion to produce a consensus model.
8. Fill out summary table.
9. Return to driving question board to point out questions we have addressed.
10. Have students review work completed to date and develop a Google doc "word wall".

DAY 4 – Formative assessment on water transport

11. Formative assessment – students sketch the redwood and try to apply important water transport terms to explain how water moves within the redwood tree.
12. <u>Homework:</u> Students read microscope usage section in textbook (or an online resource) and watch microscope video for homework.

Student Question: What are the structures within the redwood that help to move water to where it is needed?

Investigation:

DAY 1 – Observation of macroscopic living plant specimen and microscope practice

1. In their notebooks, students draw the plant specimen in front of them and label the three macroscopic systems (stems/roots/leaves) of the plant.
2. Teacher provides demo and tutorial about how to use the sophomore microscopes.

DAY 2 – Microscopic structure jigsaw

3. Students are assigned to be in one of four groups: leaf cross-section, stem cross-section, stem longitudinal section, and root hair.
    a. Textbooks and online resources will be provided so that each student becomes an expert on their structure and its function.
    b. In their notebooks, they will be asked to accurately draw what they see and clearly describe how this structure is used to transport water within the plant.

DAY 3 (BLOCK) – Microscopic structure jigsaw and consensus model building

4. Students will return to their original groups of four and will share what they have learned about their structure with the rest of the group, recording what they learned in their notebooks.
5. They will be asked to use the whiteboards to synthesize what they have learned and then construct an individual diagram to explain how the macroscopic and microscopic structures of the redwood tree obtain the water needed to grow. Begin with individual models in the corners of the white board and then develop group model in the center.
6. Complete the gallery walk to share individual and group models.
7. Complete group discussion to produce a consensus model.
8. Fill out summary table.

DAY 4 – Catch-up day if needed and/or review

9. Have students work on Google doc "word wall" and provide a review sheet with sketch of redwood tree and fill-ins for each group to work on together.
10. Homework: watch a video about lab report writing in biology.

Student Question: How does water "know" where to go in the tree?

Investigation:

DAY 1 – Set-up osmosis in potato experiment

1. As a group, set up osmosis experiment (weigh potato pieces, place them in various percent sucrose solutions, create hypothesis).
2. When finished, students work together to create a draft of their introduction for their lab report.
3. Homework: individualize and revise draft of introduction

DAY 2 – Data Collection & Interpretation

4. Students develop a data table in their notebooks, weigh the potato pieces and perform percent change in weight calculations.
5. Homework: draw graph and re-read water transport POGIL or section on water transport in textbook.

DAY 3 (BLOCK DAY) – Formative Assessment & Formative Assessment

6. Students spend the first part of class discussing the importance of their osmosis in potatoes experiment and relating it to the redwood tree.
    a. I will be using this discussion as a formative assessment for the science and engineering practice (Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-2)). Please see attachment 1 at the end of the dopcument for grading criteria.
7. Use the whiteboards to construct an individual diagram to explain how water "knows" where to go in the redwood tree. Begin with individual models in the corners of the white board and then develop group model in the center.
8. Complete the gallery walk to share individual and group models.
9. Complete group discussion to produce a consensus model.
10. Fill out summary table.

11. Return to driving question board to point out questions we have addressed.
12. Have students review work completed to date and add to the Google doc “word wall” and review sheet.
13. <u>Homework:</u> Complete draft of lab report for workshop day.

DAY 4 – Catch-up day if needed and/or lab report writing workshop day

14. Teacher provides feedback by projecting one lab report to critique. Students use Chromebooks to modify their own lab reports.
11. Homework: Students work on review sheet for summative assessment

DAY 5 – Summative assessment

12. Provide them with another phenomenon related to water transport in plants and ask them to explain how the properties of water and the macroscopic and microscopic structures of that plant contribute to the phenomenon.
13. Performance assessment:
    a. Here is a peace lily that has not been watered in a while:

    

    b. Apply the information you learned about how water moves in the redwood tree to model how the water will move in this peace lily after you have watered it. Your model should include drawings and words. Include macroscopic and microscopic structures and all relevant processes discussed in class. Refer to rubric to understand grading expectations.
    c. Summative assessment will be graded based on the rubric in Attachment 2.

What did we do?	**What did we observe? What patterns did we notice?**	**What have we figured out?**	**How does this help us explain the phenomenon?**	**What questions do we have?**
Anchoring phenomenon: Modeling of redwood growth after watching video.	Redwoods grow very tall and are able to obtain enough nutrients to support that growth/keep tree alive.	Trees need nutrients to grow from a smaller plant to a large tree (may have structures to support this).	Not applicable – this is the anchoring phenomenon.	How does water reach the tops of the redwood tree?
Observations of food coloring movement in carnations. (Homework assignment on water properties)	Flowers with stems in food coloring change color.	Using its unique properties (cohesion, adhesion, polarity, capillary action), water can move from the base of the stem to the flower petals.	This shows how the properties of water helps it move from the roots up through the tree. Water molecules adhere to the roots of the tree and cohere to each other to travel up the tree.	What systems are in plants that help them grow?
Observation of living specimens (Homework assignment on microscope parts and usage)	There appear to be three separate parts of a plant that look different from each other.	Plants (and probably other biological systems) have a hierarchy of organization, some that one can see and probably some that we can't see.	The redwood tree probably has three large parts organized in a manner that is similar to the classroom plants.	What structures exist in the redwood trees to deliver water to the tops of the trees?

Microscopic observation of vascular system in leaf cross-section (Homework assignment on plant anatomy)	Plants have microscopic structures to deliver water to the leaves.	Plants have tube-like vascular organ system structures known as the xylem to throughout the organism.	This is the “straw” that delivers water from the roots to the leaves.	How does the plant form from oxygen, water, and carbon dioxide?
Osmosis in potato lab (Lab report writing and review water properties and transport for homework) Formative performance assessment	Potato pieces in a certain percentage of sucrose do not gain weight.	Water moves until there is an equilibrium.	Osmosis provides the process for water movement from its source to where it is needed.	How does the water travel such long distances?
Summative performance assessment – water movement in the peace lily after watering				

Attachment 1. Rubric for formative performance assessment.

Name________________________________ Period_________ Date___________________

NGSS Water Transport Model Formative Assessment Rubric

NGSS Strand	Not Yet	Approaches Expectation	Meets Expectation	Advanced
Science and Engineering Practices Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-2)				
ANALYZE & INTERPRET DATA	Attempts to analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to identify patterns, to make scientific claims, or to determine an optimal design solution. Analysis or explanation includes major errors or omissions.	Analyzes and explains data using tools, technologies, and/or models (e.g., computational, mathematical) in order to identify patterns, to make reasonable scientific claims, or to determine an optimal design solution. Analysis or explanation includes minor errors or omissions.	Analyzes and explains data using tools, technologies, and/or models (e.g., computational, mathematical) in order to identify patterns, to make reasonable and supported scientific claims as to how water is transported in the redwood tree.	Analyzes and evaluates data using tools, technologies, and/or models (e.g., computational, mathematical) in order to identify patterns, to make reasonable and well-supported scientific claims as to how water is transported in the redwood tree.
EVALUATE DATA ANALYSIS	Identifies the limitations of the data analysis (e.g., measurement error, sample selection) with incomplete or inaccurate elements	Identifies the limitations of the data analysis (e.g., measurement error, sample selection).	Evaluates the limitations of the data analysis (e.g., measurement error, sample selection) and identifies some implications for the findings.	Thoroughly evaluates the limitations of data analysis (e.g., measurement error, sample selection) and provides a detailed explanation of the implications on the findings, including the limitations of the relationship between the potato and the redwood tree.
USE MATHEMATICS AND COMPUTATIONAL THINKING	Identifies mathematical concepts or methods (e.g., ratio, rate, percent, basic operations, algebra, and functions) relevant to scientific questions or engineering problems, but applies them with major errors or omissions.	Applies appropriate mathematical concepts or methods (e.g., ratio, rate, percent, basic operations, algebra, and functions) relevant to scientific questions or engineering problems, but applies them with minor errors or omissions.	Accurately applies appropriate mathematical concepts and methods (e.g., ratio, rate, percent, basic operations, algebra, and functions) to answer scientific questions or engineering problems.	Accurately applies appropriate mathematical concepts and methods (e.g., ratio, rate, percent, basic operations, algebra, and functions) to represent and solve scientific questions or engineering problems and explains whether the answer "makes sense".

Comments:

Attachment 2. NGSS Water Transport in Redwood Trees Summative Assessment

Name_________________________ Period__________________ Date____________________

NGSS Water Transport in Redwood Trees Summative Assessment Rubric

	Not Yet	Approaches Expectations	Meets Expectations	Advanced
Integration of NGSS Strands: *How well does the student integrate disciplinary core ideas, cross cutting concepts, and science/ engineering practices?*				
Overall	*Uses science/engineering practice(s) to demonstrate and apply content OR makes connections to the cross cutting concepts with major errors or omissions.*	*Uses science/engineering practice(s) to demonstrate and apply content while making connections to the cross cutting concepts with minor errors.*	*Uses science/engineering practice(s) to demonstrate and apply accurate content and makes connections to the cross cutting concepts*	*Uses science/engineering practice(s) to demonstrate and apply accurate content and explains the connections (relationships) to the cross-cutting concepts.*
NGSS Strand	**Not Yet**	**Approaches Expectations**	**Meets Expectations**	**Advanced**
Disciplinary Core Ideas HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.	Identifies or otherwise applies irrelevant content OR relevant content with major errors or omissions.	Identifies or otherwise applies relevant content with minor errors or omissions.	Explains or otherwise applies relevant and accurate content but model may be unclear or difficult to interpret.	Thoroughly explains and applies relevant and accurate content to produce a clear and accurate model with the following: three macroscopic structures of the peace lily, at least three microscopic structures of the peace lily, how the properties of water contribute to the movement of water in these structures, and why the water moves in the plant after watering.
Cross Cutting Concepts Cause & Effect; Systems & System Models; Energy & Matter; Structure & Function; Stability & Change	Identifies or makes connection to irrelevant cross cutting concept(s) OR to relevant cross cutting concept(s) with major errors or omissions.	Identifies or makes connection(s) to relevant cross cutting concept(s) with minor errors or omissions.	Explains OR makes accurate connections to at least four relevant cross cutting concept(s).	Using the disciplinary core ideas, the model explains and makes accurate connections to at least four relevant cross cutting concept(s), such as cause & effect, systems, energy & matter, structure & function, and/or stability & change.