

Botany Bliss



by: Morgan Cotter

A science unit on plants

For 4th & 5th graders

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Botany Bliss Curriculum Unit

Rationale:

The study of plants is the perfect foray for elementary school students into the study of biology. A closer look at botany reveals numerous overarching concepts that students can transfer to a more advanced study of botany, the broader discipline of biology, or other disciplines. Plants also prove to be a fantastic topic to introduce some of the core knowledge of biology. For example, cell structure, cell function, osmosis, and photosynthesis.

Botany is a great platform for providing students with the opportunity to uncover some important concepts in the broader study of biology. In this unit we focus our attention on the revelation of the concept form facilitates function. How do the xylem and phloem structures enable the plant's function of acquiring the water needed for photosynthesis? How does the structure of the flower allow for the function of pollination and fertilization? These are just two examples of ways we explore this concept in this unit. However, the study of plants lends itself to the revelation of countless other overarching concepts. These include adaptations, symbiotic relationships, systems, and change, to name a few.

Plants are familiar and tangible to students and, are abundant in the students' everyday environment. Yet, there are so many opportunities to investigate more advanced topics in biology with seemingly simple plants. This unit introduces students to both plant and animal cells and provides the opportunity for students to explore the differences in these two types of cells. Students are also exposed to the organelles that make up those cells. This knowledge is essential to further study in the field of biology. Students are also given the opportunity to explore phototropism and they do a great deal of work studying different aspects of photosynthesis.

This unit will enrich students through exposure to transferable concepts. Additionally, it will provide students with the necessary vocabulary and core knowledge of botany which will prove invaluable as they advance to the broader study of biology.

Differentiation:

Several elements of the Botany Bliss unit that make it particularly appropriate for gifted learners. It exposes students to all four dimensions of differentiation including: Content, Process, Product, and Learning Environment. Furthermore, students are challenged using all five features of differentiation including: Complexity, Challenge, Depth, Creativity, and Acceleration.

The dimensions and features of differentiation are evident in this unit. **Content differentiation** is witnessed in the third lesson on photosynthesis. Many students in grades four and five are familiar with photosynthesis. So what is so special about this lesson? In this lesson students delve deeper into the study of photosynthesis than their same-grade peers. For example, many fourth and fifth-graders know that CO₂ is required for photosynthesis. In this lesson, students examine leaves to determine how the plant takes in CO₂ through their stomata. Another example of content differentiation is the study of images of phototropism. Typical fourth and fifth grade students simply learn that sunlight is needed for photosynthesis. This lesson deepens students understanding of that by demonstrating a method plants have for ensuring that they will get the sunlight they require. Learning about stomata and phototropism add depth to the learning. The best example of content differentiation is the study of the chemical formula for photosynthesis that the students study at one of the activity stations in this lesson ($6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$). Study of this formula is typically not taught until high school. Study of this formula adds challenge and to the lesson and accelerates the content to above-grade levels. I observed gifted (fourth and fifth-grade) students struggle with this formula. It was so rewarding to watch students that participated in this lesson persevere and finally figure it out!

Differentiation of Process is the most widely used method of differentiation in this unit. All four lessons in the unit include differentiation of process. In the first lesson (a Taba lesson) higher level thinking skills are employed as students create categories for their works and as they regroup those words into new categories. In the second lesson (VTS & questioning lesson) students are pushed to look deeper at cell models. It is not enough for them to say what they see and move on. The teacher allows time for them to look beyond the obvious and asks questions such as: “What *else* do you see?” or “What makes you say that?” The second lesson also

pushes students to extend their thinking by transferring knowledge about how form facilitates function from one situation (plants) to another situation (neurons). This transfer of knowledge makes the lesson more challenging for the students. The third lesson (a questioning lesson) demonstrates differentiation of process as students use higher level thinking and problem solving skills to come up with methods carnivorous plants use their structures to attract, trap, and retain prey. This lesson pushes students to be creativity as they design and build models of carnivorous plant structures. As in the previous lesson, students are challenged to apply the lesson concept to a different topic. In the fourth lesson (Socratic Seminar) we see differentiation of process as students take a more active role in the learning process by participating in a Socratic Seminar. In this lesson students read articles that have a greater level of complexity than those typically provided in a fourth or fifth grade lesson.

Differentiation of Product is best displayed in this unit in the first lesson. In this lesson students are given the freedom to choose an example of how form facilitates function and use their creativity to design and build a representation of that example.

Differentiation of Learning Environment is demonstrated in this unit in the fourth lesson. This lesson is a Socratic Seminar lesson. This is often a new and challenging learning environment even for gifted learners. The typical classroom environment is altered as the teacher steps out of the role of lecturer and/or questioner. Instead, the students write questions for each other (after reading an article). Furthermore, students discuss and attempt to answer each other's questions using information from the articles and their own background knowledge. The learning environment is also altered as students come out of their typical classroom arrangement to join each other in a circle to facilitate the discussion.

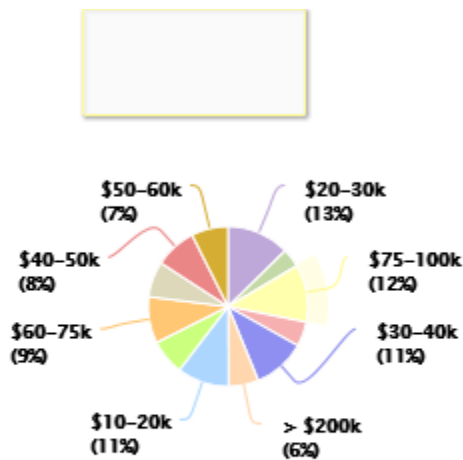
This unit addresses all four dimensions of differentiation as mentioned above. Additionally, the unit addresses the five features of differentiation: complexity, challenge, depth, creativity, and acceleration. I have underlined each of these words above to pin-point examples of these features throughout the unit.

Population for whom the unit is intended:

This unit is intended for Academically Intellectually Gifted (AIG) students attending a summer enrichment camp. The students are all entering fourth or fifth grade and they range in age from nine to eleven. The students have been identified as AIG by their schools on the basis of test scores and teacher recommendations. The cost of the week-long summer camp is \$50, making it affordable for children from families across a wide range of income levels (especially compared with fees of other childcare or summer camp options).

All of the students in the camp attend public schools in Durham, North Carolina. According to www.forbes.com, the median household income in Durham in 2015 was \$54, 871. As the pie graph below shows, household income in Durham is fairly evenly distributed between different income levels.

<http://www.city-data.com/income/income-Durham-North-Carolina.html><http://www.city-data.com/income/income-Durham-North-Carolina.html>



Durham census data from 2013 shows that 48.3% of the population is white, 40.0% of the population is black or African American, and 4.7% of the population is Asian. The remainder of the population is classified as “other” or “multi-race” (<https://durhamnc.gov/DocumentCenter/Home/View/1340>). Given this census data one might expect approximately 40% of the AIG camp class to be African

American. However, this was not the case. Out of the fifteen students in the camp class, thirteen were white and two were Asian.

Although the Botany Bliss unit was written for Durham AIG students, it is appropriate for AIG fourth and fifth-graders of different socioeconomic backgrounds across the country. There is no obvious reference to anything that may be deemed culturally sensitive. Religious issues could be argued in the lesson on cloning.

The Botany Bliss unit will be most successfully implemented with students that need little teacher guidance, are problem-solvers, are analytical, and work well in groups. Students that need little teacher guidance will thrive with this unit. For example, in lesson two, students must walk around the class and answer questions at different activity stations. Problem-solvers are also good candidates for this lesson. In lesson one, students need to figure out ways to group and re-group words. In lesson two, they need to figure out what the formula for photosynthesis means. Furthermore, in lesson three, students must find a way to represent a plant structure to explain how form facilitates function. This unit is also appropriate for analytical thinkers. In lesson two, students analyze the structures of plant and animal cell models. Students best suited for this unit work well in groups. There are several opportunities for group work in this unit. In lesson one students work together as they group words. In lesson two, students are given the option of moving through activity stations as a group in order to work together to answer questions at each station. In lesson three, students may work together to build carnivorous plant models. Finally, in lesson four, students participate in a group discussion in the form of a Socratic Seminar.

In terms of content knowledge necessary for this unit, students should have a strong knowledge of the key roles of roots, stems and leaves. They should also know that cells are the smallest unit of living things and that photosynthesis is the process plants use to make their own food. Knowledge of a broad range of plant types is also beneficial.

Goals and Outcomes:

Content goals for the Botany Bliss unit are to develop an understanding of several key concepts of plant life. This includes how plants interact with their environment and how they perform functions necessary for life.

Students will be able to:

- A. Explain the process of pollination and fertilization
- B. Make observations to determine the differences between plant and animal cells
- C. Define the essential roles photosynthesis, phototropism, and transpiration play in plant life.
- D. Examine structures of several types of carnivorous plants to determine how those structures enable plants to attract, capture and retain prey.
- E. Analyze and discuss the pros and cons of cloning plants.

Process goals for the unit center around engaging students in critical thinking.

Students will be able to:

- A. Draw conclusions about the importance of an organism's structure to its overall role in an ecosystem
- B. Design and create models that depict how plant and animal structure facilitate function.
- C. Analyze plant structures, through images and models, and discuss the relevance of plant structures in carrying out processes essential for plant life.
- D. Craft higher-level questions (for a Socratic Seminar).
- E. Evaluate a partner's contribution to a discussion (in a Socratic Seminar)
- F. Work collaboratively

Concept goal for this unit is gaining a deeper understanding of the concept of Structure; with a particular focus on how structure facilitates function. Many of the processes that foster critical thinking also enhance an understanding of the concept.

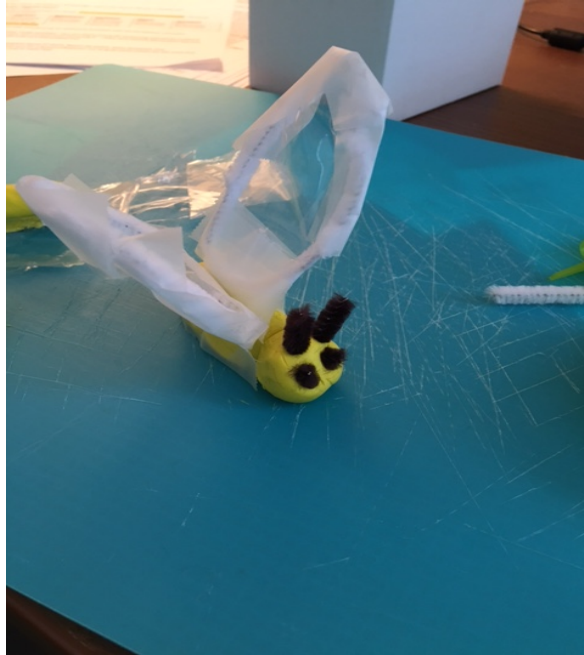
Students will be able to:

- A. Draw conclusions about the importance of an organism's structure to its overall role in its ecosystem.
- B. Analyze plant structures through images and models and discuss the relevance of plant structures in carrying out processes essential for plant life.
- C. Transfer the concept of *structure facilitates function* from one discipline to another.

Assessment Plan:

The Botany Bliss unit includes many formative assessments to monitor student progress during the lessons. It also includes a performance task that acts as a summative assessment at the conclusion of the unit. The performance task can be used to ensure that students have gained a strong understanding of content knowledge and the unit's overarching concept of structure.

In lesson one the students watch a video while looking for, and making a list of, different plant and animal structures. After grouping, and regrouping, the structure words they find, students are asked to think about how different structures facilitate their given function. For the formative assessment, students are given a creative license to choose a method (act out, write story, draw, make model) to demonstrate how one of the structures on their list facilitates its function. In my class, all of the students chose to build a model of a structure (with various art supplies provided) and present their model to the class to explain how the structure they made a model of facilitates a function that the plant or animal performs. For example, Natalie chose to show how a bee's wings are large, flat, and light. As she explained, these structural features of the bee's wings are all necessary for the bee to fly. Natalie further explained that she made the wings out of a plastic bag because it is light, could be cut into a large piece and stretched flat.



In lesson two students moved through different activity stations. Each station provided evidence of how “form facilitates function” can be seen in different parts of the photosynthesis process. For the formative assessment, students wrote an example of how form facilitates function on an index card. The teacher can then review the index cards to ensure that all students in the class are grasping the concept.

In lesson three students used materials from the supply table to build carnivorous plants. This formative assessment demonstrated their understanding of the content knowledge of carnivorous plant structure. The formative assessment was taken one step further as students used their models to explain how form facilitates function.



In lesson four students participated in a Socratic Seminar. The formative assessment for this lesson is quite different than in the previous three lessons. The teacher monitors the discussions and listens for evidence that the students understand the content knowledge and the concept of structure. At times the teacher may need to interject into the conversation to steer the discussion in the direction that promotes these understandings.

In addition to several formative assessments, the Botany Bliss unit includes a summative assessment in the form of a performance task (Appendix A). In this performance task students were given the authentic task of landscaping a piece of property. To make the task more engaging for students, we imagine that the property is owned by Taylor Swift and tell students if they win the contract they get to stay at the house! Students are given two house locations to choose from. Once they pick a location they must research the climate and what plants are indigenous to the area. They also need to use their knowledge from the unit lessons to explain why certain plants would thrive in the location they selected. This explanation ties in the unit's concept of Structure. How does the plants structure facilitate the function of thriving in an area with a given climate and precipitation levels? In addition to strengthening students research skills and demonstrating their knowledge of the unit concept, the performance task taps into their creativity by allowing them to create a landscaping plan for Taylor Swift's house. A rubric will be provided to assist students in meeting the performance task goals (Appendix B).

TEACHER NAME			Lesson #
Morgan Cotter			1
MODEL	CONTENT AREA	GRADE LEVEL	
Taba Concept Development	Ecosystems	5	
CONCEPTUAL LENS		LESSON TOPIC	
Structure		Flower Pollination & Fertilization	
LEARNING OBJECTIVES <i>(from State/Local Curriculum)</i>			
3.L.2 Understand how plants survive in their environment. 5.L.1 Understand how structures and systems of organisms perform functions necessary for life.			
THE ESSENTIAL UNDERSTANDING <i>(What is the overarching idea students will understand as a result of this lesson?)</i>		THE ESSENTIAL QUESTION <i>(What question will be asked to lead students to “uncover” the Essential Understanding)</i>	
Structure Facilitates Function		How does the structure facilitate function?	
CONTENT KNOWLEDGE <i>(What factual information will students learn in this lesson?)</i>		PROCESS SKILLS <i>(What will students be able to do as a result of this lesson?)</i>	
- The flower is the reproductive organ of the plant - Pollination occurs when wind or animals transfer pollen from the stamen to the pistil - Fertilization occurs when the sperm cell from the pollen travels down the pollen tube to the ovary where an embryo is formed - The embryo develops into a seed - The ovary develops into fruit around the seed		Students will be able to: - Draw conclusions about the importance of an organism’s structure to its overall role in the ecosystem - Identify and verbalize common characteristics of items in a group. - Create examples depicting how plant and animal structures facilitate function - Transfer the concept of structure facilitates function to areas other than plant and animal structures.	
GUIDING QUESTIONS <i>What questions will be asked to support instruction?</i> <i>Include both “lesson plan level” questions as well as questions designed to guide students to the essential understanding</i>			
Pre-Lesson Questions:	During Lesson Questions:	Post Lesson Questions:	
What role do flowers play for plants? How is a fruit different from a vegetable? What do fruit seeds have to do with flowers? What is pollination? What is fertilization?	What plant and animal structures do you see in the video? What characteristics do you notice about each of these structures? Can these characteristics help you in forming your categories? How are your categories similar and/or different? Can an item from one category also fit in another category? After categorizing and recategorizing our word list, what generalizations can you make about plant structures?	What can we deduce about the relationship between structure and function? How does a plant’s structure aid in flower fertilization? What other areas (besides plants) can we apply the concept of structure facilitating function? How does structure facilitate function?	
DIFFERENTIATION <i>(Describe how the planned learning experience has been modified to meet the needs of gifted learners. Note: Modifications may be in one or more of the areas below. Only provide details for the area(s) that have been differentiated for this lesson.</i>			
Content	Process	Product	Learning Environment
	Higher level thinking skills are employed as students create categories from their words and regroup those words into new categories.	In the “Evaluate” stage of this lesson students are given an open ended task of selecting a way to represent how form facilitates function. Gifted students are	The learning environment contains different materials to accommodate different learning styles and preferences. Students will be allowed to choose a

	Critical thinking will be activated further when students apply the concept to a different topic.	therefore given a ton of freedom to be creative and push themselves to come up with an exceptional representation of this concept. Each student is able to push themselves to create something at their own best level.	method (drawing, clay, writing, acting out) for representing a plant or animal structure's role in flower fertilization.
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PLANNED LEARNING EXPERIENCES

(What will the teacher input? What will the students be asked to do? For clarity, please provide detailed instructions)

Engage and Connect - *This phase focuses on piquing students' interest and helping them access prior knowledge. This is the introduction to the lesson that motivates or hooks the students.*

Students gather around potted tulips (or other example of a perfect flower). The teacher asks, "What role do flowers play for plants?" The class discusses that flowers create seeds and fruit. The teacher provides various types of fruit (including those commonly mistaken for vegetables) and cuts them open to expose the seeds. How is fruit different from vegetables? How does a flower make the seeds and fruit? Students are given the opportunity to see the different structures of the flower on a real plant as the teacher names them.

Explore - *In this phase, the students have experiences with the concepts and ideas of the lesson. Students are encouraged to work together without direct instruction from the teacher. The teacher acts as a facilitator. Students observe, question, and investigate the concepts to develop fundamental awareness of the nature of the materials and ideas.*

LISTING

Students will watch a "Magic School Bus" video on flower pollination and fertilization.

Video: Magic School Bus, Season 1, Episode 11 "Goes to Seed"

<https://www.youtube.com/watch?v=1d8CFpBJY6>

While watching the video, students will listen for, and list, any flower or animal structures that they see, or hear, in the video.

The teacher will have the students share the structures and list them on the board (making sure to have a minimum of 20 words).

The students will discuss what they learned in the video and have the opportunity to pose questions.

CATEGORIZING & LABELING

The teacher will break the class into small groups of three or four students.

Student groups will work collaboratively to find similarities in the words on the board as they relate to structure.

They will form categories of words based on those similarities of structure.

The teacher will explain that each group must have at least three categories of words and each category must contain at least three words. The teacher will also explain that each word can only be used in one category.

The teacher will circulate through the room and pose questions of the groups to prompt them to think of different categories for the words.

Student groups will then create labels for their categories.

Explain - *Students communicate what they have learned so far and figure out what it means. This phase also provides an opportunity for teachers to directly introduce a concept, process, or skill to guide students toward a deeper understanding.*

The groups discuss their categories with the teacher as he/she guides them to think about the similarities and differences in their categories. Students will be prompted to think of concepts from the categories they created.

The class will come together and discuss their categories and their reasoning behind the categories.

Elaborate — *Allow students to use their new knowledge and continue to explore its implications. At this stage students expand on the concepts they have learned, make connections to other related concepts, and apply their understandings to the world around them in new ways*

The teacher will challenge each group to look at the word list again and create two new categories that relate to structure. Each category must have at least three words. Words that were used in the previous round can be used again in a new category.

The class will discuss the new categories and the relationship between form and structure. The teacher will reinforce (reiterate) strong points the students make and fill in any ideas that they did not think of.

Evaluate: *This phase assesses both learning and teaching and can use a wide variety of informal and formal assessment strategies.*

Students will select one way that a plant or animal's structure facilitates function. They will then choose a method to represent this example of form facilitating function. Students will be permitted to choose a method for this representation. Some ideas are: a drawing, a clay model, writing a story, acting it out. Or, students can think of a new way (or combination of the ways given).

Lastly, students will be challenged to transfer the idea of structure facilitates function to a topic other than plants. The students will share and discuss their ideas. The teacher will wrap up the lesson by pointing out strong examples of how structure facilitates form and stress the relationship between the two.

TEACHER NAME		Lesson #
Morgan Cotter		2 (& part of day3)
MODEL	CONTENT AREA	GRADE LEVEL
Visual Thinking Strategies & Questioning	Science	5
CONCEPTUAL LENS		LESSON TOPIC
Structure		Photosynthesis
LEARNING OBJECTIVES (from State/Local Curriculum)		
3.L.2 Understand how plants survive in their environment		
5.L.1 Understand how structures and systems of organisms perform functions necessary for life		
THE ESSENTIAL UNDERSTANDING (What is the overarching idea students will understand as a result of this lesson?)		THE ESSENTIAL QUESTION (What question will be asked to lead students to "uncover" the Essential Understanding)
Structure Facilitates Function		How does structure facilitate function?
CONTENT KNOWLEDGE (What factual information will students learn in this lesson?)		PROCESS SKILLS (What will students be able to do as a result of this lesson?)
Plant cells differ from animal cells because they have cell walls and chloroplasts Plants make their own food through a process called photosynthesis. In photosynthesis sunlight energy, water, and carbon dioxide are needed for the plant to make carbohydrates. Chloroplasts are necessary for plant cells to perform photosynthesis. Phototropism is the growth of a plant in the direction of its light source. Transpiration is the loss of water vapor primarily from the leaves of plants.		Students will be able to: - Analyze plant structures through images and models - Articulate what they have observed and what they might be able to conclude from those observations. - Reveal, examine and discuss the relevance of plant structures in carrying out processes essential for plant life - Explain ways a plant may adapt its structure to assist in its survival - Transfer knowledge of how structure facilitates function in plants to how structure facilitates function in neurons.

GUIDING QUESTIONS

What questions will be asked to support instruction?

Include both "lesson plan level" questions as well as questions designed to guide students to the essential understanding

Pre-Lesson Questions:	During Lesson Questions:	Post Lesson Questions:
What do you notice about the gelatin molds? What other things do you notice? What is similar about them? What do you think these molds represent? What do you see that makes you say that? What do you notice about the images on the slides? How are they similar? How are they different? In what ways are they like/ dislike the gelatin molds? What do you think you are looking at under the microscope? What makes you say that? How does the difference in their structure effect their function?	What do you notice about these three pictures? What part of the photosynthesis song does this station relate best to? What does this activity tell us about photosynthesis? What does this activity tell us about a plant's <u>structure</u>? Based on the article, what are trees in the rain forest competing for? If these leaves were taken from two different plants growing close to the ground in the rainforest, which would have a better chance of survival? What about the leaf's <u>structure</u> made you select it? If the celery leaves are not touching the blue liquid, how did they get blue? If you cut the celery open, what evidence should you find to support your prediction? What about the plant's <u>structure</u> assists it in performing it's function of photosynthesis? Based on this article, what conclusions can we draw about roots of plants in areas of high precipitation Therefore, what predictions can we make about roots of plants in areas with little rainfall? How can you support that prediction? How might root <u>structures</u> of plant's in different environments vary? What do you notice about the area inside the bag? How did the water droplets get in the bag? Why don't the other leaves have water droplets on them? How can your theory be tied to photosynthesis? How does your theory explain how the <u>structure</u> of the leaf facilitates in	What can we deduce about the structures of plants? How does structure facilitate function?

	the leaf’s function? What do you notice about the underside of a leaf How might the leaf take in the carbon dioxide needed for photosynthesis? How does the <u>structure</u> of the leaf support its role in supplying the plant with carbon dioxide? What do these foods have to do with photosynthesis? How do these foods tie this lesson into our first lesson? In what ways is the potato different than the apple and orange? How do the <u>structures</u> of these foods aid in their greater role in the plant’s life? What is happening in this chemical reaction? How is this reaction related to our photosynthesis song? Applying your knowledge of photosynthesis, what can you conclude about C₆H₁₂O₂ ? In what ways does the structure of the molecules change? How does this change of molecular <u>structure</u> facilitate the plants function?		
DIFFERENTIATION <i>(Describe how the planned learning experience has been modified to meet the needs of gifted learners. Note: Modifications may be in one or more of the areas below. Only provide details for the area(s) that have been differentiated for this lesson.</i>			
Content	Process	Product	Learning Environment
Students are delving into a deeper study of photosynthesis than there same-grade peers.	● Higher level thinking skills are employed as students observe and contemplate the different objects in each of the activities. ● Students must transfer knowledge about how structure facilitates function from one situation (plant cells) to another (neuron)		
PLANNED LEARNING EXPERIENCES <i>(What will the teacher input? What will the students be asked to do? For clarity, please provide detailed instructions)</i>			

TEACHER NAME		Lesson #
Morgan Cotter		3
MODEL	CONTENT AREA	GRADE LEVEL
Questioning	Ecosystems	5
CONCEPTUAL LENS		LESSON TOPIC
Structure		Carnivorous Plants
LEARNING OBJECTIVES <i>(from State/Local Curriculum)</i>		
3.L.2 Understand how plants survive in their environment 5.L.1 Understand how structures and systems of organisms perform functions necessary for life		
THE ESSENTIAL UNDERSTANDING <i>(What is the overarching idea students will understand as a result of this lesson?)</i>		THE ESSENTIAL QUESTION <i>(What question will be asked to lead students to "uncover" the Essential Understanding)</i>
Structure Facilitates Function		How does structure facilitate function?
CONTENT KNOWLEDGE <i>(What factual information will students learn in this lesson?)</i>		PROCESS SKILLS <i>(What will students be able to do as a result of this lesson?)</i>
- Carnivorous plants are plants that derive some of their nutrients by consuming animals (typically insects) - Since plants can't walk around to catch the animals, they must trap the animals - Different carnivorous plants trap animals in different ways - The venus fly trap, the pitcher plant, and the lobster trap are three types of carnivorous plants - Different carnivorous plants have specific structures that help them attract, trap, and retain prey in different ways.		Students will be able to: - Analyze the structures of plants - Construct models of carnivorous plant structures - Explain a method used by carnivorous plants to attract, trap, and retain prey - Draw conclusions about the importance of an organism's structure in relation to its overall role in the ecosystem - Create generalizations about the relationship between form and function.
GUIDING QUESTIONS <i>What questions will be asked to support instruction?</i> <i>Include both "lesson plan level" questions as well as questions designed to guide students to the essential understanding</i>		
Pre-Lesson Questions:	During Lesson Questions:	Post Lesson Questions:
Why did the video provide poor evidence for the existence of man-eating plants? What do plants eat? What is a carnivore? How is a carnivorous plant different than a non-carnivorous plant? What do you think carnivorous plants eat? What type of structures might a carnivorous plant need to trap prey? What functions do plants need to perform to survive?	What unique characteristics do you notice about the carnivorous plant's structure? What questions will you ask yourself as you select materials for a model of the structure of a carnivorous plant? What will you need to know about the function of the structures in a carnivorous plant? How could carnivorous plants use their structures to attract an insect (prey)? How would the carnivorous plant trap/capture an insect? How would the carnivorous plant use their structures to keep the insect from escaping?	What can we deduce about the structure of carnivorous plants? How does structure facilitate function? What other areas (besides plants) can we apply the concept of structure facilitates function to?
DIFFERENTIATION <i>(Describe how the planned learning experience has been modified to meet the needs of gifted learners. Note: Modifications may be in one or</i>		

more of the areas below. Only provide details for the area(s) that have been differentiated for this lesson.

Content	Process	Product	Learning Environment
	Higher level thinking and problem solving skills are employed as students come up with methods plants use for trapping prey. Gifted students will be given less scaffolding from the teacher while problem solving (to determine ways the carnivorous plant uses structure to attract, trap & retain prey). Critical thinking skills will be used to apply the concept to a different topic.		

PLANNED LEARNING EXPERIENCES

(What will the teacher input? What will the students be asked to do? For clarity, please provide detailed instructions)

Engage and Connect - This phase focuses on piquing students' interest and helping them access prior knowledge. This is the introduction to the lesson that motivates or hooks the students.

Students see the an image of a plant eating a human when they come into class:

https://www.google.com/search?q=plant+eating+human+images&rlz=1T4NDKB_enUS549US678&biw=1366&bih=587&tbm=isch&imgil=LDF3HL-uE0n2yM%253A%253BEhyvP7T8IPmcJM%253Bhttp%25253A%25252F%25252Fkarishuker.blogspot.com%25252F2012%25252F11%25252Fthe-madagascar-man-eating-tree-more.html&source=iu&pf=m&fir=LDF3HL-uE0n2yM%253A%252CEhyvP7T8IPmcJM%252C_&usq=_eMmeLbgvqOX5mQ_bwNdEItW1xqM%3D

Written on the board is. "CAN PLANTS REALLY EAT HUMANS?"

Each student is given a piece of paper and asked to fold it in half (hot dog style).

On one side of the paper they write "good evidence" and on the other they write "bad evidence."

The teacher explains that we are going to watch a video about man-eating plants!

The students are asked to evaluate the evidence provided in the video to support the existence of man-eating plants.

When they see strong evidence they should record it on one side of their paper. When they see weak evidence (that is not substantiated by fact or research) they should record it on the other side of the paper.

After the video the students discuss what type of evidence they found.

The teacher asks:

Why did the video provide bad evidence for the existence of man-eating plants?

In what ways was the video convincing that man-eating plants exist?

What functions to plants need to perform in order to survive?

What do plants eat?

What is a carnivore?

How is a carnivorous plant different form a non-carnivorous plant?

What do you think carnivorous plants eat?

The teacher says: Imagine that you are a carnivorous plant. You might live on land or in the water. Think of a way that you would trap an insect so that it could not get away. **What special structures would you need to catch the insect?**

The teacher directs the students to: Use the blank paper and drawing utensils provided to create a drawing of yourself as a carnivorous plant. Be sure to *show your special structures* and *be ready to describe how you would use those structures to catch an insect*.

After the teacher allows time for the students to think about, and create, their drawings. Students are given time to share their drawings with the class, explaining their special plant structures and how they would use them to capture an insect.

Teacher then says: "Now let's explore some ways *real*, carnivorous plants trap their prey!"

Explore - In this phase, the students have experiences with the concepts and ideas of the lesson. Students are encouraged to work together

without direct instruction from the teacher. The teacher acts as a facilitator. Students observe, question, and investigate the concepts to develop fundamental awareness of the nature of the materials and ideas.

The teacher asks the class: What functions does the plant need to perform in order to survive?
(eventually someone will say it needs nourishment – food or water)

What does a carnivorous plant need to survive?
(teacher guides the class to answer animals)

What functions must the plant be able to do to get those animals?
(attract prey, capture prey, keep prey from escaping)

Students are divided up into teams of three to four students.

Each team is given a diagram of a pitcher plant and a photo of a real pitcher plant. The teacher asks each group to study the diagram and photo and discuss four questions:

- 1) What special structures does the pitcher plant have?
- 2) How could the pitcher plant use its structures to **attract** prey?
- 3) How could the pitcher plant use its structures to **capture** prey?
- 4) How could the pitcher plant use its structures to **keep the prey from escaping**?

The teacher circulates and provides limited scaffolding to teams that are struggling.

Students are asked to look at the supplies provided on the supply table.
They are asked to work together to sketch out a design for a model of a pitcher plant.

Each team is then asked to use materials of their choice (provided on supply table) to make a model of a pitcher plant that they can use to explain their theory of how a pitcher plant uses its structure to attract, capture and retain prey.

All steps above are repeated for a venus fly trap.
All steps above are repeated for a lobster trap plant.

Explain - *Students communicate what they have learned so far and figure out what it means. This phase also provides an opportunity for teachers to directly introduce a concept, process, or skill to guide students toward a deeper understanding.*

Each group presents their models to the entire class answering: How does each carnivorous plant (pitcher plant, venus fly trap, and lobster trap) use their unique structures to.....

- attract insects?
- capture insects?
- keep insects from escaping?

The teacher guides the students in their understanding: As the students' present their models the teacher echos, and reinforces, correct hypothesis the students made about they way plants attract, trap & retain prey that are actually true in nature.

Elaborate —*Allow students to use their new knowledge and continue to explore its implications. At this stage students expand on the concepts they have learned, make connections to other related concepts, and apply their understandings to the world around them in new ways*

The teacher and students discuss the following questions:

What can we deduce about the structure of carnivorous plants?

How does structure facilitate function?

What other areas can we apply the concept of structure facilitates function to?

Evaluate: *This phase assesses both learning and teaching and can use a wide variety of informal and formal assessment strategies.*

Students are asked to think of an example of how form facilitates function. They are asked to write, and illustrate, a paragraph explaining their ideas.

The teacher will use these paragraphs to evaluated students understanding of the concept.

Students are given time to share their paragraphs and illustrations with the class.

TEACHER NAME		Lesson #
Morgan Cotter		4
MODEL	CONTENT AREA	GRADE LEVEL
Socratic Seminar	Science	5
CONCEPTUAL LENS		LESSON TOPIC
Structure		Genetics
LEARNING OBJECTIVES <i>(from State/Local Curriculum)</i>		
5.L.3.1 Explain why organisms differ from or are similar to their parents based on the characteristics of the organism		
5.L.3.2 Give examples of likenesses that are inherited and some that are not.		
THE ESSENTIAL UNDERSTANDING <i>(What is the overarching idea students will understand as a result of this lesson?)</i>		THE ESSENTIAL QUESTION <i>(What question will be asked to lead students to “uncover” the Essential Understanding)</i>
Structure Doesn’t Always Facilitate Function		How might structure not facilitate function?
CONTENT KNOWLEDGE <i>(What factual information will students learn in this lesson?)</i>		PROCESS SKILLS <i>(What will students be able to do as a result of this lesson?)</i>
<i>Students will learn about:</i> Cloning is the process of creating genetic duplicates. Cloning can provide us with more plants and better plants. Some plants clone themselves. Some plants are cloned by people. Cloning animals can provide us with food. Cloning animals can help prevent extinction of a species. Cloning plants and animals may result in lack of genetic diversity. Genetic diversity may be need for organisms to thrive in the future. Cloning human organs could help those in need of organ transplants Some people feel cloning animals (including humans) is unethical.		<i>Students will be able to:</i> Craft higher-level questions Work collaboratively Engage in a close reading Participate in a dialogue Evaluate a partners contribution to a dialogue Consider different points of view Apply new concepts to other situations to demonstrate an understanding of the concept
GUIDING QUESTIONS <i>What questions will be asked to support instruction?</i> <i>Include both “lesson plan level” questions as well as questions designed to guide students to the essential understanding</i>		
Pre-Lesson Questions:	During Lesson Questions:	Post Lesson Questions:
●Why do the characters all look the same? ●What is a clone? ●What are your opinions about these characters? ●What can you say about the genetic structure of clones? ●How is your object like a clone of your partner’s object? ●Why is it not a clone of your partner’s object?	●What can you say about the genetic structure of clones? ●How does the genetic structure of clones manifest itself in the characteristics of clones? ●What makes you say that? ●What evidence can you find in the reading to support that? ●In what ways are clones similar? ●How are they different?	●How might structure NOT facilitate function ●How have plants adapted their structure to allow them to function in their unique environment? ●How did the Socratic Seminar enhance your understanding of the issues surrounding cloning? ●How was your opinion of the seminar different when you were in the inner and outer circles? ●How could you apply the essential understanding, perspectives shape

		opinions, to an area other than cloning?
DIFFERENTIATION <i>(Describe how the planned learning experience has been modified to meet the needs of gifted learners. Note: Modifications may be in one or more of the areas below. Only provide details for the area(s) that have been differentiated for this lesson.</i>		
Content	Process	Product
	By participating in a Socratic Seminar, students take a more active role in the learning process (rather than a passive role common in many classrooms)	Students are exposed to three types of learning environments: Small group Large group Independent work (in "Evaluate" phase of this lesson)
PLANNED LEARNING EXPERIENCES <i>(What will the teacher input? What will the students be asked to do? For clarity, please provide detailed instructions)</i>		
Engage and Connect - <i>This phase focuses on piquing students' interest and helping them access prior knowledge. This is the introduction to the lesson that motivates or hooks the students.</i> (Optional: The teacher can wear a Star Wars <i>Clone Wars</i> t-shirt) Students enter the room to find images of clones from Star Wars movies on the SMART Board. The teacher asks: <i>Why do the characters all look the same?</i> <i>What is a clone?</i> <i>What can you tell me about the genetic structure of clones?</i> Students are given a piece of clay and asked to make an object that is small enough to fit in the palm of their hand. While they are doing this the teacher assigns each person a partner. The students swap clay objects with their partners. They are given a new piece of clay and asked to make an exact replica of their partners clay object. The teacher asks: <i>How is your object like a clone of your partner's object?</i> (possible answers: They are made of the same materials. They are the same size and color) <i>Why is it not a clone of your partner's object?</i> (possible answers: They are not living objects so they don't share the same genetic material) Explore - <i>In this phase, the students have experiences with the concepts and ideas of the lesson. Students are encouraged to work together without direct instruction from the teacher. The teacher acts as a facilitator. Students observe, question, and investigate the concepts to develop fundamental awareness of the nature of the materials and ideas.</i> The teacher divides the class into small groups of around 5 students each. The teacher assigns a leader for each group. Each group leader is given two laminated cards: - A card depicting higher level questioning (Bloom's Taxonomy or Costa's Levels) - A card with the rules for Socratic Seminar The teacher passes out an article on cloning to each group. Some groups are given an article showing cloning in a favorable view: Naik, A. (2010, Nov. 27) <i>Benefits of Cloning Plants</i>. Retrieved from http://www.buzzle.com/articles/benefits-of-cloning-plants.html Some groups are given an article showing cloning in an unfavorable view: Park, A. (2006, July 5) <i>The Perils of Cloning; Ten years after Dolly's birth, scientists are learning that clones may not be such perfect copies after all</i>. Retrieved from http://content.time.com/time/magazine/article/0,9171,1209937-3,00.html		

Some groups are given and article discussing both the pros and cons of cloning:

Dilruba, P. (2013, August) Cloning: The pros and cons. Retrieved from www.biotecharticles.com/Others-Article/Cloning-The-Pros-and-Cons-2747.html

The teacher also gives each student a sheet of paper with two large, empty rectangular boxes on it.

The teacher explains that in one of the boxes the students have to describe what their article is about (in a short paragraph or flow chart).

Students are instructed to avoid stating their opinion on the article or topic.

In the second box they are to do an illustration that describes what the article is about.

Students are instructed to do a close reading of their article. The teacher explains that this means that they take notes in the margin, make connections, underline important parts, and come up questions.

Next, they fill out the sheet with rectangular boxes (as instructed).

After everyone in their group has completed the article and filling out their two, rectangular boxes. The students come together as a small group to share their two, rectangular boxes with their group

After everyone in the group has had a chance to present what their article is about, the group leader goes over the two laminated cards with their group (one on higher level questioning and one on rules of Socratic Seminar). Each group is then instructed to create five higher level questions about the articles.

Explain - Students communicate what they have learned so far and figure out what it means. This phase also provides an opportunity for teachers to directly introduce a concept, process, or skill to guide students toward a deeper understanding.

The teacher asks:

What can you say about the genetic structure of clones?

What can you say about how that genetic structure manifests itself in the characteristics of the clones?

Why do you say that?

What evidence can you find in the reading to support that?

How are the clones similar?

How are they different?

Elaborate —Allow students to use their new knowledge and continue to explore its implications. At this stage students expand on the concepts they have learned, make connections to other related concepts, and apply their understandings to the world around them in new ways

The teacher divides the class into two groups.

One group is instructed to arrange their chairs in a circle (this is the inner circle) and sit in their chair.

The other group is instructed to stand behind a person seated in a chair (this is the outer circle).

(You could say, “small groups 1 and 2 are the inner circle and small groups 3 and 4 are the outer circle”)

The outer circle members are told that their job will be to take notes on...

- a) The responses of the inner circle person seated in front of them. For example, is their response a question, a comment, a referral to the text, an agreement or disagreement with previous comment, or a new idea (the teacher writes these examples on the board).
- b) Any questions or comments that they come up with as a result of listening to the dialogue.

The teacher acts as the leader and begins the seminar with a thought-provoking, provocative question. Inner-circle students engage in a dialogue that sparks from this question.

Why might we want plants and animals with a cloned genetic structure?

How might cloned genetic structure facilitate function?

How might structure NOT facilitate structure?

(These questions could also be used by the teacher if the dialogue needs some bolstering.)

Students will engage in a dialogue for 10 to 15 minutes. If needed they are encouraged to use the higher-level questions that they created with their small group.

The teacher acts as a facilitator and/or moderator if needed. After 10 or 15 minutes of dialogue the teacher stops the group at a question. He or she repeats the question to the outer circle. He or she then asks the outer and inner circle participants to switch positions and roles.

The new inner circle begins their dialogue with the question that the teacher posed to them from the previous dialogue.

When the second group has completed their seminar (10-15 min like the previous group), the teacher ends their seminar and poses the following questions:

How might structure NOT facilitate function

*How did the seminar enhance your understanding of the issues surrounding cloning?
Can you think of another example (besides cloning) where structure does not facilitate function?*

Evaluate: *This phase assesses both learning and teaching and can use a wide variety of informal and formal assessment strategies*

(Students return to their original classroom seats)

The teacher explains that a basic plant structure does not work for plants in all types of environments.
Some really cool plants have adapted their structure to survive in their environments (natural selection):

- How might a plant adapt itself to survive in regions with little rainfall?
- How might a plant adapt itself to survive in regions with lots of rainfall?

There are lots of ways a plant can adapt the basic plant structure if it does not help the plant survive in its environment.

Students are asked to read the following article searching for their favorite example of how plants have adapted an insufficient structure to meet their needs.

<http://www.conservatoryofflowers.org/sites/default/files/Plant%20Adaptations.pdf>

Students write down: 1) Why would a basic plant structure be insufficient for this plant & 2) how has this plant adapted itself to perform essential life functions in the environment where it grows.

These responses will be used to evaluate students' mastery of the essential understanding.

Appendix A

Spark Landscaping

401 N. Duke St.

Durham, NC

June 20, 2016

Dear Spark Landscaping,

Congratulations! As Taylor Swift's personal assistant, it is my pleasure to inform you that Ms. Swift has selected your landscaping firm, Spark Landscaping, to submit a proposal to landscape one of her two, luxurious properties. One property is her retreat in the desert of Palm Springs, CA. The other is her expansive ski lodge in the mountains of Aspen, CO. Please select one of these homes and create a landscaping plan of trees and shrubs that are both aesthetically pleasing and able to thrive in the home's environment. If your firm is selected, Ms. Swift will compensate you with a contract worth triple your normal rate in both tree fees and labor fees. She will also reward you with a one week, free vacation at her private retreat.

Please be aware that Ms. Swift is a very busy individual. She does not have time to replace trees that do not survive in the unique environment of her home. So, please research the climate and precipitation of the home and select trees and shrubs carefully. Also, please explain why you have chosen the trees and shrubs that you select. In other words, what about the plants' structure will help them survive in the home's environment?

Ms. Swift has been known to favor companies that represent their projects with creative visual displays! Pictures of the plants as well as a visual representation of how you would landscape the property are sure to help you win this contract!

Both Ms. Taylor Swift and I look forward to meeting you at our bid meeting on June 23rd.

Best of luck and please feel free to contact me if you have any questions about the proposal process.

Sincerely,

Mrs. Morgan Cotter

Personal Assistant to Taylor Swift

Appendix B

Name: _____

Date: _____

Botany Bliss Performance Task Rubric

	Novice - 1	Apprentice - 2	Proficient - 3	Distinguished - 4	Points Earned
Research (30%)	Little to no evidence of research. No trees or shrubs selected are appropriate for the home's environment.	Evidence of some research. Some trees and shrubs selected are appropriate for the home's environment.	Good evidence of research. Most trees and shrubs selected are appropriate for the home's environment.	Unquestionable evidence of diligent research throughout the presentation. All trees and shrubs selected are appropriate for the home's environment.	
Understanding of Content & Concept (30%)	Inadequate explanation of why trees and shrubs selected are appropriate for a landscaping plan in the home's environment.	Adequate explanation most of the time of why trees and shrubs selected are appropriate for a landscaping plan in the home's environment.	Good explanation throughout presentation of why trees and shrubs selected are appropriate for a landscaping plan in the home's environment.	Exceptional explanation for why each tree and shrub selected is appropriate for a landscaping plan in the home's environment.	
Visual Display (20%)	Demonstrates little thought and little effort spent creating. Does not reflect presenter's purpose.	Shows some thought and some effort spent creating. Attempts to define presenter's purpose.	Well thought-out representation of the topic showing adequate effort. Sufficiently reflects the presenter's purpose.	Clearly & cleverly thought-out, insightful representation of the topic with obvious effort. Distinctly reflects presenter's purpose.	
Presentation / Organization (20%)	Information is not well organized. Presentation is choppy or confusing making it difficult to follow.	Information is somewhat organized, but at times the presentation loses focus.	Information is organized. Presentation is clear almost all of the time.	Information is thoughtfully organized in a logical format and easy to follow throughout the entire presentation.	

References

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- Simpson, K. (2008). *Genetics: From DNA to Designer Dogs*. Washington, DC: National Geographic Society.
- Snedden, R. (2003). *Cells & Life; DNA & Genetic Engineering*. Chicago, IL: Reed Educational & Professional Publishing.
- Waldron, M. (2014). *Plant Parts; Flowers*. Chicago, IL: Heinemann Library.
- Waldron, M. (2014). *Plant Parts; Roots*. Chicago, IL: Heinemann Library.
- Waldron, M. (2014). *Plant Parts; Seeds and Fruit*. Chicago, IL: Heinemann Library.
- Waldron, M. (2014). *Plant Parts; Stems and Trunks*, Chicago, IL: Heinemann Library.

Websites:

www.bbc.co.uk/nature/plants

This website has lots of information about plants. There are also some amazing film clips of plants all around the world.

www.cellsalive.com/toc.htm

Student-friendly articles on topics including cell division, plant and animal cells, and bacteria. This website includes great pictures, movies and links.

www.ngfl-cymru.org.uk/vtc/plant_repro/eng/Introduction/activity1pop.htm

This website allows you to dissect a flower on screen and help a flower get pollinated!

www.sciencekids.co.nz/plants.html

This website explains the life cycle of plants and how plants grow. The website also includes games!