3.2 - Plants Unit, Packet 2

Score
□ Above & Beyond
□ Meets Expectations
□ Near Expectations
□ Incomplete – *fix the following pages:*

First & Last Name: _____ Period/Hour:_____

NOTE: Packets are due after completing Part 5. Check each page to be sure all blanks are completed.

Driving Question: How do plant cells obtain matter and energy?

Anchoring Phenomenon: Previously we learned that plants can form glucose and oxygen from CO_2 and H_2O. If plants can produce their own food, why do they need fertilizer (which is often called "plant food"). And how do plants acquire macromolecules like fat & protein if they don't consume other organisms?

Deeper Questions

1. How do plants acquire carbs, fats, and proteins their cells need?
2. How do plants use soil minerals and fertilizer?
3. How do enzymes work?

Schedule

Part 0: Planting Seeds
Part 1: Introduction
- Initial Ideas & Data Dive
- Discussion & Developing Explanations

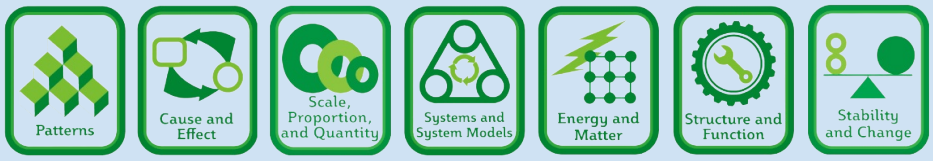
Part 2: Core Ideas
- Core Ideas
- Revisions of Part 1 Explanations

Part 3: Investigation
- Part A: Molecular Modeling - Photosynthesis
- Part B: Plant Cell Microscopy

Part 4: Review & Assessment
- Ranking Your Readiness, Formative Assessment & Mastery Check

Part 5: Life Connections
- Life Connections - Interview an Expert

NGSS Standards (*PEs* & *CCCs are summarized below. SEPs are noted throughout the packet*).
HS-LS1-2. Organization of interacting systems in multicellular organisms. HS-LS1-6. How carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. HS-LS1-5. How photosynthesis transforms light energy into stored chemical energy. HS-LS1-7. Cellular respiration is a chemical process whereby food molecules and oxygen molecules form new compounds resulting in a net transfer of energy.



Semester Schedule

1. Matter & Energy
1.1: What happens when something burns?
1.2: How does burning change matter & energy?
1.3: Unit Assessment

2. Animals
2.1: How do animal cells use food?
2.2: What happens to food when it is consumed?
2.3: How do cells acquire atoms from food?
2.4: Unit Assessment

3. Plants
3.1: How do plant cells differ from animal cells?
3.2: How do plant cells obtain matter and energy?
3.3: How can we investigate plant growth and function?
3.4: Unit Assessment

4. Ecosystems
4.1: Why do different places have different amounts of species?
4.2: How does human activity affect species?
4.3: Unit Assessment

Resource Links: Class Website; Core Ideas; Summary Video; Practice Test; Part 1 Video 1 - Video 2 - Video 3; Xylem Video; Part 3A,C Data; Part 3B Data; Poster - Comparing CR & PS;

Part 1: Introduction – Analyzing Fertilizers (3.2.1)

Overview: In this activity, you will begin by discussing your initial ideas about what fertilizers do for plants. You will then analyze data and work in teams to develop your initial explanations.

Initial Ideas - *Record your ideas separately (e.g., on a white board or scratch paper).*
SEP: Engaging in Argument from Evidence

1. Bristol is helping her mother in the garden. As she is fertilizing the plants, she realizes that she doesn't understand what the fertilizer actually does. **Do you agree or disagree with each student's claim**?
    a. Avery: "I think that the fertilizer provides the food the plant consumes." Agree/ Disagree
    b. Bristol: "Maybe fertilizers have atoms a plant needs to make some molecules." Agree / Disagree
    c. Chandra: "I think fertilizers change the soil so the plant grows better." Agree / Disagree
2. **Work in your small groups to discuss your ideas.** How are your ideas similar or different? Decide as a group whether each statement is correct (and why). Be prepared to present your ideas to the class.

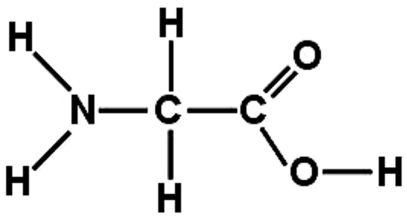
Data Dive 1 - *Read the directions below.* *SEP: Analyzing & Interpreting Data*

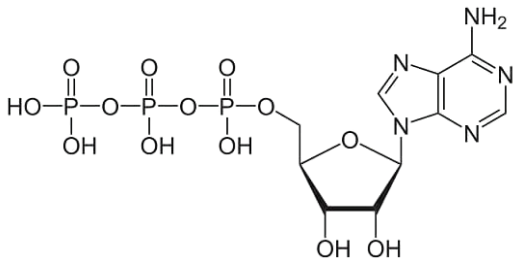
The top image shows the primary ingredients found in a common type of garden fertilizer. The images beneath show two molecules that are commonly found in all cells. The left image shows an amino acid. The right image shows ATP. How might these molecules relate to the data above? What conclusions can you draw from this data?

Miracle-Gro® Water Soluble All Purpose Plant Food 24-8-16

GUARANTEED ANALYSIS — **F 1198**

Total Nitrogen (N)	24%	Molybdenum (Mo)	0.0005%
3.5% Ammoniacal Nitrogen		Zinc (Zn)	0.06%
20.5% Urea Nitrogen		0.06% Water Soluble Zinc (Zn)	
Available Phosphate (P_2O_5)	8%	Derived from Ammonium Sulfate, Potassium Phosphate, Potassium Chloride, Urea, Urea Phosphate, Boric Acid, Copper Sulfate, Iron EDTA, Manganese EDTA, Sodium Molybdate, and Zinc Sulfate.	
Soluble Potash (K_2O)	16%		
Boron (B)	0.02%		
Copper (Cu)	0.07%		
0.07% Water Soluble Copper (Cu)			
Iron (Fe)	0.15%	Information regarding the contents and levels of metals in this product is available on the Internet at http://www.regulatory-info-sc.com	
0.15% Chelated Iron (Fe)			
Manganese (Mn)	0.05%		
0.05% Chelated Manganese (Mn)			





Data Dive Questions - *Record your ideas separately (e.g., on a white board or scratch paper).*

1. **Begin by individually attempting to make sense of this data**. What trends or patterns do you notice? How does this relate to any prior knowledge or experience that you have?
2. **Next, work in your teams to discuss your ideas**. Where do you agree? Where do you disagree? Can you use this data to reach an agreement? Do others have prior knowledge/experience that could help?
3. **Based on this data, what is one conclusion that would be supported by this data?** How is this conclusion supported by this data? What specifically suggests that your claim is accurate?
4. **Based on this data, what is a second conclusion that would be supported by this data?** How is this conclusion supported by this data? What specifically suggests that your claim is accurate?
5. **Does this data support or refute any of the initial claims on the previous page?** If so, explain.

Discussion - *Record your ideas in the spaces below.* *SEP: Asking Questions & Defining Problems*

As a class, discuss your ideas about this data. What are the ideas that most agreed on? Where did your ideas differ as a class? Record your ideas in the spaces below.

We generally agree that…	***We disagreed or were unsure if…***

Initial Explanations - *Record your ideas in the spaces below.* *SEP: Constructing Explanations & Designing Solutions*

How does a plant cell acquire macromolecules like protein and fat? Write down an initial explanation in the space below. Don't worry if you aren't completely sure about this. You will come back and revise this explanation as you gain more information during this unit.

Part 2: Core Ideas (3.2.2)

Overview: In this activity, you will use a short presentation to provide you with information that will help you improve and revise your initial ideas. Your instructor will decide on how to implement this portion. You will then work in small teams to address the questions listed below.

Driving Questions - *Record your ideas separately (e.g., on a white board or scratch paper).*
SEP: Developing & Using Models

1. How do plants acquire carbs, fats, & proteins if they cannot consume other organisms?
2. How do plant cells produce carbohydrates?
3. How do plant cells produce fatty acids?
4. How do plant cells produce amino acids?
5. How do the atoms in glucose and soil minerals relate to all the molecules found within a plant cell?
6. True or false: an enzyme has a completely different molecular structure after a reaction is completed. Explain.
7. How many different types of enzymes are found in plant cells? Why?
8. How do some enzymes assemble macromolecules from individual molecules?
9. How do some enzymes disassemble macromolecules into individual molecules?
10. How do enzymes enable species to interact with each other?
11. What are decomposers? Provide examples.
12. Why are decomposers important for species interactions?

Revising Explanations - *Record your ideas in the spaces below.* *SEP: Constructing Explanations & Developing Solutions*

How does a plant acquire molecules like protein and fat? Based on this new information, how would you now respond to this question?

_____

_____

_____

Part 3A: Molecular Modeling (Photosynthesis) (3.2.3a)

Pre-Investigation Questions - *Prepare verbal responses as a group for these questions. Raise your hand when you're ready to present your explanations. Your instructor will provide feedback and decide if you can proceed to the investigation.* *SEP: Developing & Using Models*

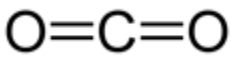
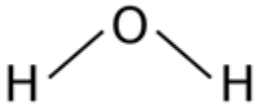
1. Summarize four possible outcomes for the glucose that is produced during photosynthesis.
2. How do some enzymes assemble macromolecules from individual molecules? How do enzymes disassemble macromolecules into molecules?
3. Both animal cells and plant cells need carbs, fat, and protein to function. How do plants acquire these molecules if they cannot consume other organisms?
4. How do enzymes enable species to interact with each other?

This activity was completed _____ (*instructor signature*)

Overview: In this investigation, you will use modeling clay to create physical models to explain how matter and energy change during photosynthesis.

Materials Needed (per group): modeling clay (such as Playdoh), toothpicks, tape or twist ties, paper towel.

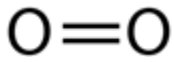
Directions - *Carefully read the directions below before beginning. Record info where prompted.*
SEP: Developing & Using Models

1. ☐ **Create six molecules of carbon dioxide (CO_2).**
   
   a. Choose one color to represent carbon and another color to represent oxygen.
   b. Create six carbon atoms and 12 oxygen atoms.
   c. Using the image at the right as a guide, connect a carbon atom to two oxygen atoms using four toothpicks (two toothpicks for each oxygen atom).
   d. Repeat until you have six CO_2 molecules.
   e. Mark any high energy bonds (C-C and C-H) with a twist tie or other physical marker that your instructor has provided.
2. ☐ **Create six molecules of water vapor (H_2O).**
   
   a. Create six more oxygen atoms.
   b. Using a third color, create 12 hydrogen atoms.
   c. Using the image at the right as a guide, connect an oxygen atom to two hydrogen atoms using two toothpicks.
   d. Repeat until you have six H_2O molecules.
   e. Mark any high energy bonds (C-C and C-H) with a twist tie or other physical marker that your instructor has provided.
3. ☐ **When you think you are finished, raise your hand and show your instructor.**

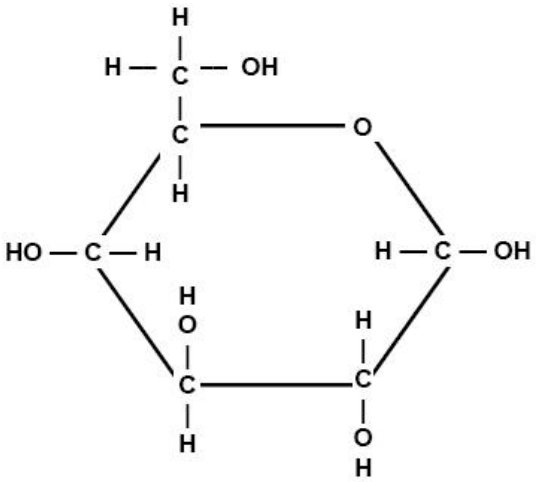
This activity was completed _____(*instructor signature*)

Directions - *Carefully read the directions below before beginning. Record info where prompted.*

4. ☐ **Disassemble your CO_2 and H_2O molecules and set aside your clay atoms. Using the same clay atoms, create glucose and O_2 using the following instructions.**
5. ☐ **Using the modeling clay provided, create six molecules of oxygen gas (O_2).**
   a. Using this image as a guide, connect two oxygen atoms using two toothpicks.
   b. Repeat these instructions until you have six molecules of oxygen (O_2).



6. ☐ **Using the modeling clay provided, create one molecule of glucose ($C_6H_{12}O_6$).**
   a. Connect the remaining atoms using the image as a guide (1 toothpick between each atom).
   b. Mark any high energy bonds (C-C and C-H) with a twist tie or other physical marker that your instructor has provided.
7. ☐ **When you think you are finished, raise your hand and show your instructor.**



This activity was completed _____(*instructor signature*)

Post-Investigation Questions - *Record your ideas in the spaces below.*
SEP: Engaging in an Argument from Evidence. Constructing Explanations & Designing Solutions.

1. **Were there any high energy bonds in water or carbon dioxide? *Yes / No (circle one)***
   Where did the energy found in the high energy bonds of glucose come from?

   _____

2. **What are four different ways this glucose molecule could be used by a cell?**

   1. _____
   2. _____
   3. _____
   4. _____

3. **How do enzymes change glucose molecules to create macromolecules like cellulose or starch?**

   _____

   _____

4. **How does the nitrogen and phosphorus in fertilizer affect the function of plant cells?**

   _____

   _____

Part 3B: Plant Cell Microscopy (3.2.3b)

Overview: In this activity, you will be comparing plant and animal cells under a microscope at varying magnifications. You will try to identify as many organelles as you can within each cell.

Materials needed (per group of 4): A light microscope, microscope slides of plant & animal cells.

Directions - *Carefully read the directions below before beginning. Record info where prompted.*
SEP: Developing & Using Models

Methods: Check each box as you complete each step.

1. ☐ Place the prepared microscope slide on the microscope's stage (the flat space with clips beneath the lenses). Turn on the microscope's light.
2. ☐ Switch to the lowest magnification (lens with the smallest number). Use the coarse and then the fine adjustment knob to focus the image.
3. ☐ Switch to the middle-range magnification(s). Use the coarse and then the fine adjustment knob to focus the image.
4. ☐ Finally, switch to the highest magnification (lens with the highest number). ONLY use the fine adjustment knob to focus. Record your observations in the space provided.
5. ☐ Turn off your microscope's light. Return your prepared slide to the appropriate location as determined by your instructor.
6. ☐ If your instructor has provided additional slides, repeat the steps above with the new slides.

Observations: Describe what organelles could you identify within the cells at each level of magnification. Examples include: *cell membrane, nucleus, mitochondria, ribosomes, etc*.

Plant cell organelles seen at highest magnification: _____

_____

How do plant cells differ from animal cells? _____

_____

How do plant cells get fat & protein for their organelles? _____

_____

_____

Part 4: Review & Assessment (3.1.4)

Step 1: Rank each Driving Question in Part 2 based on your comprehension (you can rank them as *1,2,3* or *green/yellow/red*, or any other method). Then work in teams to review anything that is still unclear.
Step 2: Identify any remaining areas of confusion or concern. Then review these topics with your instructor.
Step 3: Complete the Formative Assessment (*last page of the packet*). Your instructor will determine if you will work individually, in pairs, or in small groups. Then compare and evaluate your responses as a class.
Step 4: Individually complete a Mastery Check. If your performance indicates that additional support is needed, your instructor will determine how to help you move forward.

Part 5: Life Connections – Interview An Expert (3.2.5)

In this activity, you will have an opportunity to interview an individual with professional expertise in this week's content topics, or watch a pre-recorded video. This activity will be reflective of *social science* research, or gathering, analyzing and interpreting information about human interactions. Often this work is conducted using *qualitative interviews*, which are interviews designed for research and data collection.

Part 1 - Planning

1. Briefly summarize the topics that were covered in class this week in one sentence:

   This week in class, we studied _____

   _____

2. As a group, discuss what questions you still have about this week's topics. Ideally, use some of the following to start your questions: *Who, What, When, Where, Why, How*

   _____

   _____

   _____

   Once you have developed three questions, ask for your instructor to provide you with some feedback.

3. From this list, choose a research question for your group and complete the prompt below:

   We are unsure _____

   _____

4. Turn your research question into a hypothesis. What do you think is the answer to your research question given what you currently know?

   We hypothesize that _____

   _____

5. Create three interview questions that you could ask this individual that may provide information related to your research question. Try to focus on their particular area of expertise as you craft your questions.

   1. _____

   2. _____

   3. _____

6. Be prepared to briefly describe your research question and hypothesis. Explain how your interview questions will provide you with information that will help to address your research question.

Part 2 – Interview Field Notes - Use the space below to record some field notes as the guest speaker presents to the class. Record anything that you hear or observe that might be relevant to your research question.

_____

_____

_____

_____

_____

_____

Part 3 – Analysis & Debrief *(your instructor may choose to use verbal discussion instead of written responses)*

7. Does your data (your observations and field notes from this interview) support or refute your hypothesis? Circle one: Supports it / Refutes it / Not sure

   Explain: _____

   _____

Plants Unit, Packet 3.2 Formative Assessment (3.2.4)

Name: _____Hour____Date:_____Score:_____

Directions: A 3x5 notecard with *handwritten* notes can be used to guide your answers. Your instructor may allow you to work in assigned groups. If so, have a different person write each response while others assist.

1. Bristol is fertilizing the plants in her garden. She realizes that she doesn't understand what the fertilizer actually does and discusses this with her friends. **Do you agree or disagree with each student's claim**?

A) Avery: "I think that the fertilizer provides the food the plant consumes." Agree/ Disagree
B) Bristol: "Maybe fertilizers have atoms a plant needs to make some molecules." Agree / Disagree
C) Chandra: "I think fertilizers change the soil so the plant grows better." Agree / Disagree

2. Provide an explanation. Why did you agree or disagree with each student's claim?

a) _____

b) _____

c) _____

Writer:

3. Plants produce glucose in their chloroplasts during photosynthesis. Summarize four different ways that glucose is used by plant cells in the space below.

1. _____

2. _____

3. _____

4. _____

Writer:

4. Most of a plant's mass consists of cellulose macromolecules. How does a plant cell use enzymes to assemble glucose into cellulose?

_____

_____

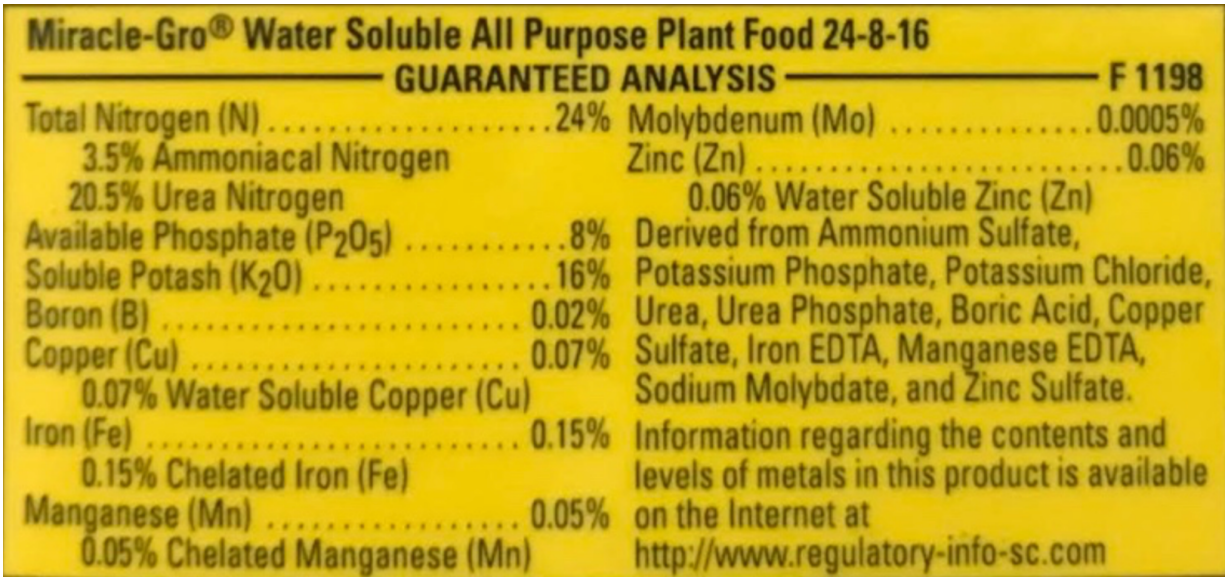
_____

Writer:

Continued on the back

5. The ingredients of a common fertilizer are shown in this image. How does a plant cell use these ingredients? How does fertilizer improve the function and performance of plants?

Writer:



Miracle-Gro® Water Soluble All Purpose Plant Food 24-8-16

GUARANTEED ANALYSIS — **F 1198**

Total Nitrogen (N)	24%	Molybdenum (Mo)	0.0005%
3.5% Ammoniacal Nitrogen		Zinc (Zn)	0.06%
20.5% Urea Nitrogen		0.06% Water Soluble Zinc (Zn)	
Available Phosphate (P_2O_5)	8%	Derived from Ammonium Sulfate,	
Soluble Potash (K_2O)	16%	Potassium Phosphate, Potassium Chloride,	
Boron (B)	0.02%	Urea, Urea Phosphate, Boric Acid, Copper	
Copper (Cu)	0.07%	Sulfate, Iron EDTA, Manganese EDTA,	
0.07% Water Soluble Copper (Cu)		Sodium Molybdate, and Zinc Sulfate.	
Iron (Fe)	0.15%	Information regarding the contents and	
0.15% Chelated Iron (Fe)		levels of metals in this product is available	
Manganese (Mn)	0.05%	on the Internet at	
0.05% Chelated Manganese (Mn)		http://www.regulatory-info-sc.com	

6. Plants, animals, and decomposers must be able to interact with each other in order to survive. How do enzymes make these interactions possible?

Writer: