Plants Unit – Packet 2

Score
- ☐ Above & Beyond
- ☐ Fully Complete
- ☐ Mostly Complete
- ☐ Incomplete – *fix the following pages*:

Name: _____ Hour_____Date: _____

Date Packet is due: *after Part 5* Why late? _____
If your work was late, describe why

Driving Question: How do plants get their food and gain mass?

Anchoring Phenomenon: Last week we learned that plants can rearrange the atoms in carbon dioxide and water to form glucose and oxygen during photosynthesis. However, we also know that all cells need proteins and fats to function. How do plants acquire these macromolecules 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?
3. How do enzymes work?

Schedule

Part 1: Introduction
- Initial Ideas – How do fertilizers work?
- Data Dive – Analyzing fertilizers.
- Discussion & Developing Explanations

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

Part 3: Investigation
- Molecular Modeling - Photosynthesis

Part 4: Review & Assessment
- Ranking Your Readiness
- Assessments (Formative Assessment & Mastery Check)

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

NGSS Standards: 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

Matter & Energy
Week 1: What happens when something burns?
Week 2: What happens to molecules during burning?
Week 3: Unit Assessment

Animals
Week 1: What are animal cells made from?
Week 2: What happens to food when it is consumed?
Week 3: What happens inside animal cells?
Week 4: Unit Assessment

Plants
Week 1: How do plant cells differ from animal cells?
Week 2: How do plants get their food and gain mass?
Week 3: How do plants get other needed molecules?
Week 4: Unit Assessment

Ecosystems
Week 1: Why do some places have more species than others?
Week 2: How does human activity affect living species?
Week 3: Unit Assessment

Part 1: Introduction – Analyzing Fertilizers

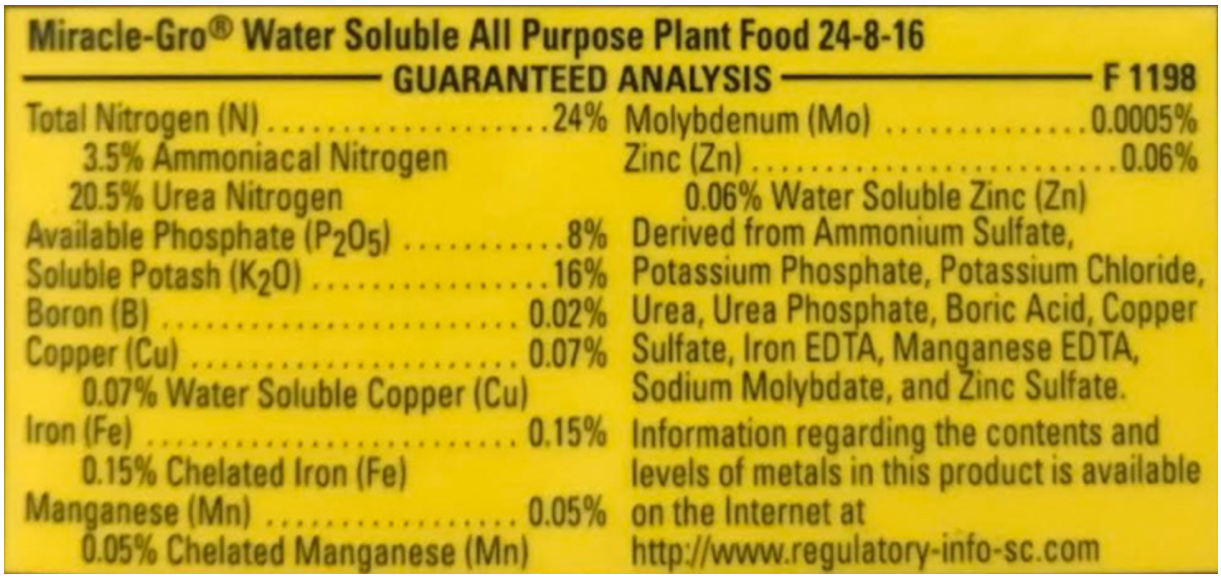
Overview: In this activity, you will begin by discussing your initial ideas about what fertilizers do for plants. You will then analyze data and work in teams to develop your initial explanations.

Initial Ideas:

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: Here you can see data showing the primary ingredients found in a common type of garden fertilizer. What conclusions can you draw from this data?



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

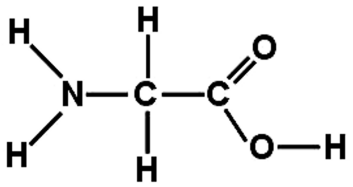
GUARANTEED ANALYSIS — **F 1198**

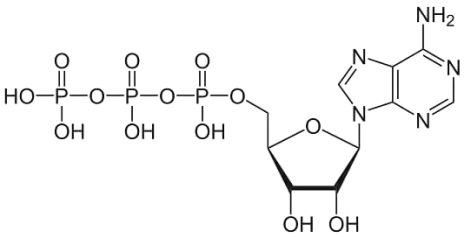
Total Nitrogen (N)	24%
3.5% Ammoniacal Nitrogen	
20.5% Urea Nitrogen	
Available Phosphate (P_2O_5)	8%
Soluble Potash (K_2O)	16%
Boron (B)	0.02%
Copper (Cu)	0.07%
0.07% Water Soluble Copper (Cu)	
Iron (Fe)	0.15%
0.15% Chelated Iron (Fe)	
Manganese (Mn)	0.05%
0.05% Chelated Manganese (Mn)	
Molybdenum (Mo)	0.0005%
Zinc (Zn)	0.06%
0.06% Water Soluble Zinc (Zn)	

Derived from Ammonium Sulfate, Potassium Phosphate, Potassium Chloride, Urea, Urea Phosphate, Boric Acid, Copper Sulfate, Iron EDTA, Manganese EDTA, Sodium Molybdate, and Zinc Sulfate.

Information regarding the contents and levels of metals in this product is available on the Internet at http://www.regulatory-info-sc.com

Data Dive 2: These images 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?





Questions: Record your group's ideas using materials provided by your instructor (such as a dry erase board).

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 or 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. **How does this data pertain to claims from Avery, Bristol, and/or Chandra on the previous page?**

6. **<u>Discussion & Developing Ideas</u>**: 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 all agree that…	We disagreed or are unsure about…

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

_____

_____

Throughout this packet, you will be updating this explanation as you gain more information and more experience. When you complete this packet, compare your early versions to your final version. You should see distinct improvement with each revision.

Part 2: Core Ideas

Overview: In this activity, you will begin with a short slideshow presentation. This will provide you with core ideas that will help you clarify your initial ideas. Your instructor will decide on how to implement this portion depending on your previous experience and capabilities with this content.

You will then work in small teams to answer the questions listed below. You should take notes in a notebook, on a dry erase board, or on scratch paper so that you are prepared to deliver your responses during the class discussion that will follow. *Note: your instructor may assign specific questions to your group if time is limited.*

Core Ideas Presentation: Plants Packet 2 Core Ideas

Driving Questions:

1. 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?
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? What are examples of decomposers?
12. Why are decomposers important for species interactions?
13. **Revising Explanations**: Return to your original explanation that you created at the end of Part 1. Based on this new information, how would you now respond to this question?

How does a plant acquire molecules like protein and fat?

_____

_____

Throughout this packet, you will be updating this explanation as you gain more information and more experience. When you complete this packet, compare your early versions to your final version. You should see distinct improvement with each revision.

Part 3: Molecular Modeling (Photosynthesis)

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.

Pre-Investigation Questions: Work as a group to determine the best response to each question. Be prepared to provide verbal responses for these questions for your instructor before you complete the investigation.

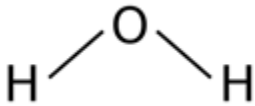
1. *Summarize four possible outcomes for the glucose that is produced during photosynthesis.*
2. *How do some enzymes assemble macromolecules from individual molecules? How do enzymes disassemble macromolecules into molecules?*
3. *Both animal cells and plant cells need carbs, fat, and protein to function.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

When you think you are ready, **raise your hand**. Your instructor will listen to your verbal responses.

This activity was completed _____ (*instructor signature*)

Methods: In this investigation, you will create molecular molecules to explore what happens to matter and energy during cellular respiration. Scientific models are tools that help us clarify our thinking and make more accurate predictions. Use the following instructions to create each of your molecules.

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.



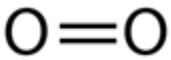
2. ☐ **Create six molecules of water vapor (H_2O).**
   a. Create six more oxygen atoms.
   b. Using a third color, create 12 hydrogen atoms.
   c. Using the image at the right as a guide, connect an oxygen atom to two hydrogen atoms using two toothpicks.
   d. Repeat until you have six H_2O molecules.
   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.**

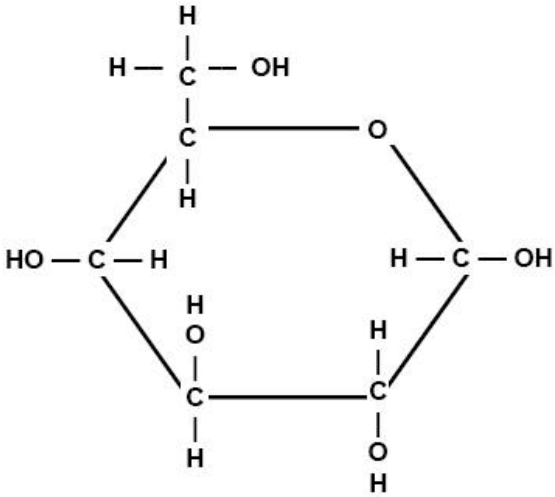
   This activity was completed _____(*instructor signature*)

4. ☐ **Disassemble your CO_2 and H_2O molecules and set aside your clay atoms. Using the <u>same</u> clay atoms, create glucose and O_2 using the following instructions.**

5. ☐ **Using the modeling clay provided, create <u>six</u> 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 <u>six</u> molecules of oxygen (O_2).



6. ☐ **Using the modeling clay provided, create <u>one</u> 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

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 4: Review & Assessment

Overview: Rank each Driving Question in Part 2 as a 1 (*completely unsure*), 2 (*somewhat unsure*), or 3 (*completely sure*) based on your comprehension. Then work in teams to review each item and prepare a response. Next, write a final explanation below. You will conclude by completing a formative assessment.

How does a plant cell acquire macromolecules like protein and fat?

_____

_____

Go back and compare your early versions of your explanation to your final version above. You should see distinct improvement compared to your first attempts.

Part 5: Life Connections – Interview An Expert

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 2 Formative Assessment

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

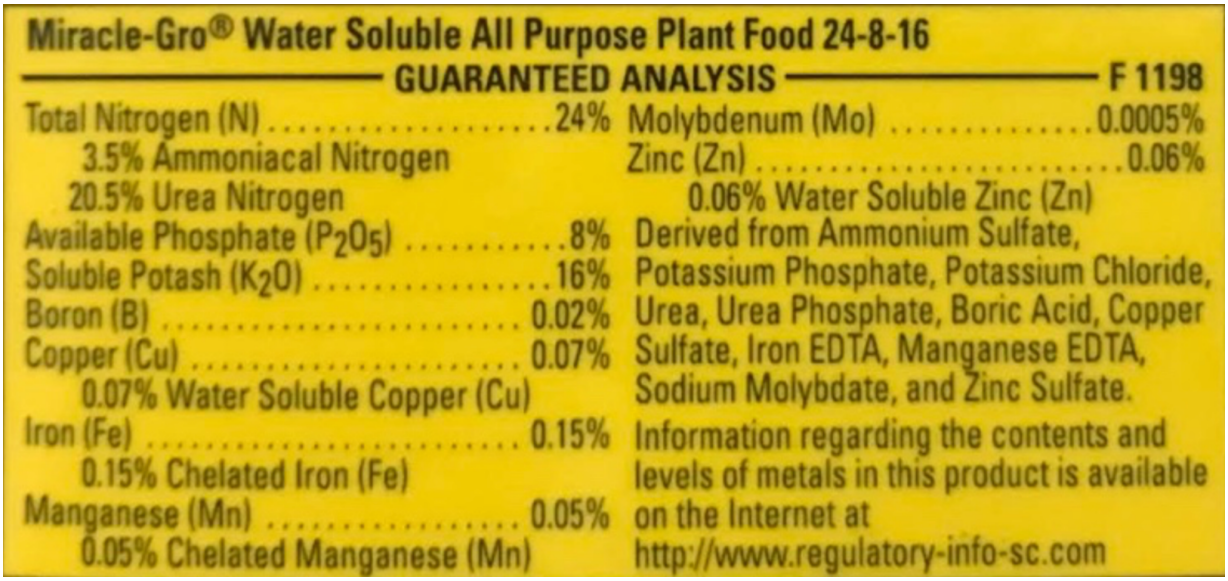
5. The ingredients of a common fertilizer are shown in this image. How does a plant cell use these ingredients? How does fertilizer improve the function and performance of plants?

_____

_____

_____

Writer:



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

GUARANTEED ANALYSIS — **F 1198**

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