Plants Unit – Packet 1

Name: _____ Hour_____Date: _____

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

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

Driving Question: How do plant cells differ from animal cells?

Anchoring Phenomenon: We know all living things are made from cells. In this unit, we will focus on how plant cells function, and how this compares to animal cells. In particular, we will focus on the largest tree in the world, the General Sherman sequoia. How did it grow from a tiny seed into a tree weighing millions of kilograms?

Deeper Questions

1. What organelles are found only in plants cells?
2. How does a plant cell acquire the chemical energy it needs to function?
3. How do plants function without organs found in many animals (like a skeleton, a heart, or a kidney)?

Schedule

Part 0: Planting Seeds (for use later in Packet 3)

Part 1: Introduction
- Initial Ideas – How do plants acquire mass?
- Data Dive – The General Sherman
- Discussion & Developing Explanations

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

Part 3: Investigation
- Part A: Bright/Dark Investigation Set-up
- Part B: Seedling Mass
- Part C: Bright/Dark Investigation Data Collection

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

Part 5: Life Connections
- Life Connections - Plant Cell Microscopy

NGSS Standards: HS-LS1-2. Oorganization 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 0: Planting Seeds

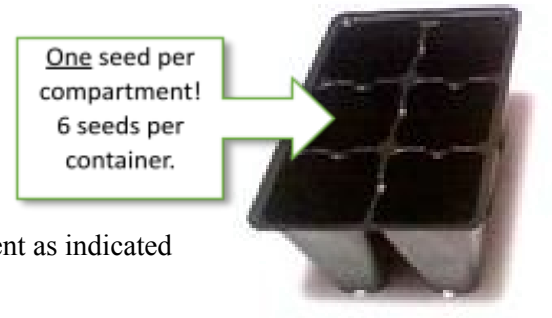
Overview: In this activity, you will plant radish seeds under two different conditions. You will use these plants for investigations that you will be conducting in Packet 3.

Materials: radish seeds; planting containers; potting soil; markers & tape or sticks for labeling.

Investigation Directions:

1. □ You will be planting two containers of radishes. One container will be changed in some way to help the radishes grow larger. Decide as a class what your treatment will be for one of your containers of radish seedlings. The other container will act as a control (*an untreated group used for comparison*).
2. □ Acquire two planting containers (with six-compartments) like the one shown here →
    a. If your experimental methods call for something else, acquire the specific kind of planting tray that you'll need.
2. □ Add soil to the planting containers so that it is level with the top of the tray. Lightly pat the soil. *Image Source*
3. □ Make a pinky-fingernail-sized depression in each compartment of the planting containers.
    a. Each of the six compartments of the containers should have only one depression.
4. □ Add ONE radish seed to each fingernail-sized depression. Each compartment should have only ONE seed.
5. □ Fill in the soil on top of the seed. Pat lightly with your hand.
6. □ In a location with drainage, lightly water the soil so that it is moist (not soaking wet).

7. □ Label your radish trays with your…
    a. Class Period & Teacher
    b. Group Names
    c. *Treated* or *Control* labels



8. □ Move your radishes to the appropriate location for your experiment as indicated by your instructor.
9. □ Repeat these instructions for the container of radishes that will receive the treatment you decided as a class.
10. □ Give your radishes 3-4 weeks to grow before recording your data. Determine your plan as a class to care for your plants.

Part 1: Introduction – The General Sherman

Overview: In this activity, you will begin by discussing your initial ideas about how plant cells acquire matter and energy. You will then analyze data and work in teams to develop your initial explanations.

Initial Ideas:

1. A group of students are asked to explain how plants acquire their mass. Read the following responses from students. **Do you agree or disagree with each student's claim**?
    a. Avery: "I think a growing plant gets most of its mass from nutrients in the soil." Agree/ Disagree
    b. Bristol: "I think a plant gains most of its mass from gasses in the air." Agree / Disagree
    c. Chandra: "I think a plant gains most of its mass from the sunlight." 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.

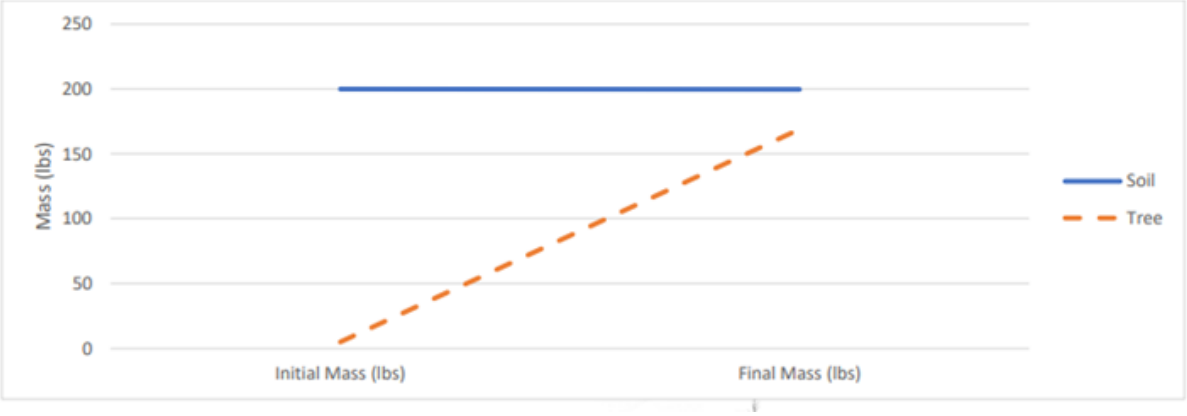
Videos: Next, watch the following videos individually or as a class (based on your teacher's instructions):
Video 1 – Comparing heights of trees: https://www.yout-ube.com/watch?v=JyjHtxAOhP4
Video 2 - The General Sherman: https://www.yout-ube.com/watch?v=S9LIFRwE8Jo
Video 3 - National Geographic: Photographing Sequoias: www.yout-ube.com/watch?v=vNCH6uhB_Bs

Data Dive 1: Here you can see data comparing the mass of the General Sherman to a sequoia seed. How did this tree get so big? Where did the atoms in this tree come from?

General Sherman (Sequoia Tree)
Live Weight: 5.6 million kg (12.4 million lbs.).
Dry weight: 3.1 million kg (6.8 million lbs.).

Sequoia Seed
Weight: 0.005 g.

Data Dive 2: Jean Baptista van Helmont (1577-1644) planted a tree in a large container and recorded the initial mass of the tree and soil. After 5 years, he recorded the final mass of each item. His data is shown below.



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. **Discussion & Developing Ideas**: 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…

9. **How did the General Sherman get so big? Where does the mass (atoms) of plant cells come from?** 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.

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 1 Core Ideas

Driving Questions:

1. True or false: animal cells and plant cells are mostly similar in terms of what they are made from and how they function. Explain.
2. Do plant cells have mitochondria? If so, what process occurs in their mitochondria? How does this relate to the functions of a plant cell?
3. What are three organelles found in plant cells that are not found in animal cells?
4. What is a cell wall? What is cellulose? How do both of these affect the function of plants & plant cells?
5. What is a vacuole? What is its purpose and function in a plant cell?
6. What is a chloroplast? What process occurs in chloroplasts? How does this affect the function of plants and plant cells?
7. Most of the glucose produced during photosynthesis is used for what purposes?
8. True or false: just like animal cells, plant cells are organized into tissues, organs, and systems.
9. What is xylem? What is its purpose and function?
10. What is phloem? What is its purpose and function?
11. How do plants move molecules like glucose and water if they lack a heart to pump fluids? Include the following terms in your response: *xylem; evaporation; leaf pores; phloem; gravity*.
12. Cells in the roots and inside the stems of plants do not have access to light. How do these cells acquire the glucose they need for cell respiration and for other purposes?
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 did the General Sherman get so big? Where does the mass (atoms) of plant cells come from?

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 3A Investigation: Bright/Dark Set-up

Adapted from materials by Carbon TIME

Overview: In this activity, you will set up an experiment where you measure how BTB changes depending on whether plants are kept in light or dark conditions.

Materials: radish seeds; aluminum pans; BTB; disposable cups; resealable bags; markers & tape.

Background: In this experiment, you will place some plants in a bright location with lots of light (e.g., a window, greenhouse, or under a grow light), and some in a darkened location (e.g., a box or closet). These plants will be inside sealed containers with blue and yellow BTB.

Investigation Directions: Two weeks prior, your instructor filled small foil trays half full with soil. They added a dozen seeds and covered them with a small amount of soil. They then watered the soil and allowed the plants to grow in a sunny location. Follow the directions below to set up the rest of your experiment.

1. □ **Acquire a large resealable bag. Label the bag** with your A) class period, B) group number, C) last names, and D) today's date.
2. □ **Acquire a foil tray with radish seedlings**. Make sure the soil is moist.
3. □ **Place the tray of radish seedlings into a large resealable bag.**
4. □ **Label a cup with a "Y". Pour yellow BTB into this cup. Place this cup inside the bag.**
5. □ **Label a cup with a "B". Pour blue BTB into this cup. Place this cup inside the bag.**
6. □ **Tightly seal the bag.** Make sure some air remains inside the bag so that the seedlings are not crushed.
7. □ **Carefully move your bag of seedlings and BTB to the location chosen by your instructor.** Half of the bags will be placed in dark conditions; the other half will be placed in conditions with lots of light.

8. □ **Make predictions (below) for how the levels of CO_2 will change for each treatment.**

   I think that CO_2 levels in bags with plants in a bright location will: *increase / decrease / not change*

   I think that CO_2 levels in bags with plants in a dark location will: *increase / decrease / not change*

9. □ **Explain your prediction for the plants in bright conditions.** Why do you expect these outcomes? What evidence or reasoning supports your ideas?

   _____

   _____

10. □ **Explain your prediction for the plants in dark conditions.** Why do you expect these outcomes? What evidence or reasoning supports your ideas?

    _____

    _____

11. □ **Keep your plants inside the sealed bags for at least 24-48 hours.** Complete Part 3C after this time.

Part 3B Investigation: Seedling Mass

Adapted from materials by Carbon TIME

Overview: In this activity, you will compare the mass of radish seeds to the mass of seedlings that have sprouted. You will then develop evidence-based arguments to explain your findings.

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. *What process occurs in a plant cell's mitochondria? How does this relate to the functions of a plant cell?*
2. *What process occurs in chloroplasts? How does this affect the function of plants and plant cells?*
3. *How does a plant cell use the glucose it produces in its chloroplasts? Describe two purposes.*
4. *How do plants move molecules like glucose and water if they lack a heart to pump fluids? Include the following terms in your response: xylem; evaporation, leaf pores; phloem; gravity*

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

This activity was completed _____ (*instructor signature*)

Materials: radish seeds; resealable bags; digital balance; paper towel.

Background: About 1-2 weeks prior to this, your instructor placed moistened paper towels and 12 radish seeds in a sealed plastic bag (like a sandwich bag). They ensured the seeds remained moist and had access to light. During this time, most of the seeds should have begun to *germinate*, or grow into seedlings.

Directions:

1. □ First, acquire 12 radish seedlings and 12 radish seeds from your instructor.
2. □ Place a cup (or other container) on a digital balance. Zero out the balance (press T, or "tare").
3. □ Place 12 seeds in the container and record the mass (in grams) in the space below.
4. □ Place a new cup on the balance and press tare. Place 12 seedlings in the container. Record the mass.

   Total Seed Mass: _____ g **Total Seedling Mass**: _____ g

5. □ Next, calculate the average mass of the seeds and seedlings by dividing the total mass by the number of individual seeds or seedlings.

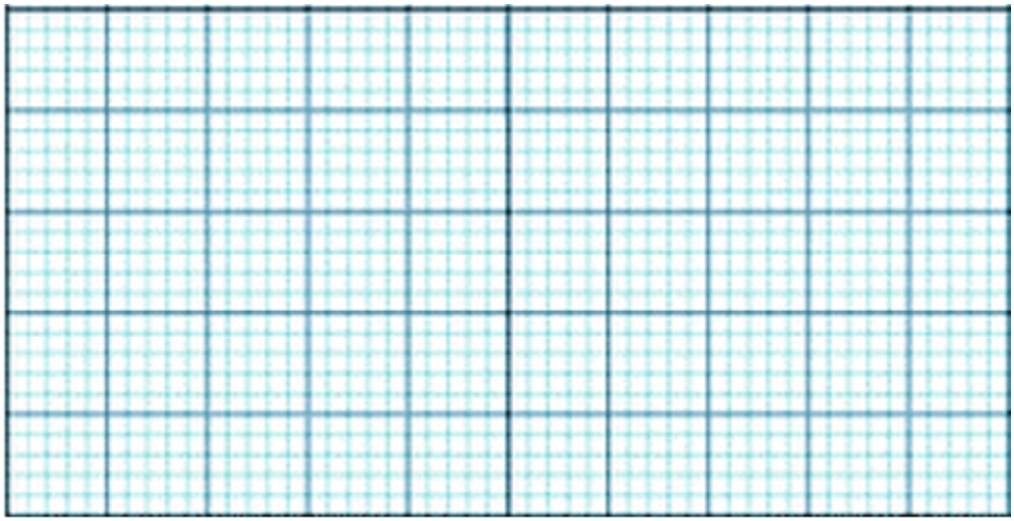
   Average Seed Mass: _____ g (*Total Seed Mass* ÷ 12)

   Average Seedling Mass: _____ g (*Total Seedling Mass* ÷ 12)

6. □ Determine the *dry mass* of the radish seedlings (*this is the mass of radishes without the mass of water*). This tells us how much mass the radish gained that wasn't water. Multiply the average seedling mass by 0.09 to determine the average dry mass (*because dry mass is 9% of total mass on average*).

   Average Seedling Dry Mass: _____ g (*Average Seedling Mass* x 0.09)

7. □ Create a bar graph for 1) **average seed mass** and 2) **average seedling dry mass**. To create a graph:
   A) Find your largest value in your data. Use this to determine the units you'll use to label the y-axis (left side).
   B) Use your data to determine the height of the bar for each item.
   C) Create a bar for each item based on your data.



Average Seed Mass Average Seedling Dry Mass

8. □ Create a caption for your graph. A caption describes what the graph is telling us. Specifically, a caption should explain any relevant trends or patterns in the data. The caption is started for you below.

   In this graph you can see… _____

   _____

   _____

9. Was the average mass of the seedlings greater than the average mass of the seeds? Yes / No (*circle one*)

10. Our seedlings were grown in sealed ziplock bags without any soil. Where did the mass of the seedlings come from? Explain below. Consult your notes and discuss with your group if you are unsure.

    _____

    _____

    _____

    _____

Be prepared to discuss and defend your ideas in small groups and as a class.

Part 3C Investigation: Bright/Dark Data

Adapted from materials by Carbon TIME

Overview: In this activity, you conclude the experiment you started in Part 3A. You will observe how BTB changes depending on whether plants are kept in light or dark conditions.

Investigation Directions: Earlier you placed cups of BTB inside a resealable bag with radish seedlings. Some were kept in the dark; others had access to light. Follow the directions below to conclude this experiment.

1. □ Acquire your bag of radish seedlings from your instructor. Carefully move it to your group so that you do not spill your BTB. Do NOT open your bag yet.

2. □ Observe the BTB in your bag. Record your observations below in the appropriate location. Use another group's data to complete the remaining questions.

Plants in Light Conditions

- Date BTB was added to the bright plant bags: _____ Date removed:_____

- Final color of the blue BTB in the bright plants bag: _____

- Final color of the yellow BTB in the bright plants bag: _____

Plants in Dark Conditions

- Date BTB was added to the dark plant bags: _____ Date removed:_____

- Final color of the blue BTB in the dark plants bag: _____

- Final color of the yellow BTB in the dark plants bag: _____

Whole-Class Data: Describe patterns in your class data.

1. Final color of the BTB and CO_2 concentrations for plants in the <u>bright plants</u>:

BTB:_____ CO_2: _____ (*yellow = CO_2 increased; blue = CO_2 decreased*)

2. Final color of the BTB and CO_2 concentrations for plants in the <u>dark plants</u>:

BTB:_____ CO_2: _____ (*yellow = CO_2 increased; blue = CO_2 decreased*)

Post-Investigation Questions:

1. **How did your final results in Part 3C compare to your predictions in Part 3A?** Were your predictions accurate or inaccurate? Explain. (*Yellow BTB = CO_2 increased; Blue BTB = CO_2 decreased*).

   _____

   _____

2. **Briefly summarize the processes that occur in each of the following organelles inside plant cells:**

   Mitochondria: _____

   Chloroplast: _____

3. **Summarize what molecules are absorbed and what molecules are released from each organelle:**

   Absorbed by mitochondria: _____; Released by mitochondria: _____

   Absorbed by chloroplasts: _____; Released by chloroplasts: _____

4. **Can photosynthesis occur if the plants do not have access to light?** Yes / No (*circle one*)

5. **Can cellular respiration occur if the plants do not have access to light?** Yes / No (*circle one*)
   Note: In plant cells, glucose can be stored as starch, which can be broken down back into glucose for later use.

6. **How did your data from plants in the light differ from your data for plants in the dark? Explain why any differences occurred.** In your explanations, address how differences in light affected the function of the chloroplasts and/or the mitochondria.

   _____

   _____

   _____

   _____

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 did the General Sherman get so big? Where does the mass (atoms) of plant cells come from?

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 - Cell Microscopy

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: After your instructor provides a demonstration**, follow the steps below to view your specimens.**

Methods: Check each box as you complete each step.

1. ☐ Place the prepared microscope slide on the microscope's stage. 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. Record your observations in the space provided.
3. ☐ Switch to the middle-range magnification(s). Use the coarse and then the fine adjustment knob to focus the image. Record your observations in the space provided.
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.
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 plant cells at each level of magnification. Examples include: *cell membrane, cell wall; nucleus, chloroplast; mitochondria, vacuole; ribosomes, etc*.

Organelles seen at highest magnification: _____

How did plant cells differ from animal cells? _____

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Plants Unit, Packet 1 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. Three students are looking at a tall tree and are discussing how a plant gains mass. Do you agree or disagree with what each student claims? Circle "Agree" or "Disagree" for each of the three claims below.

A) Avery: "I think a growing plant gets most of its mass from nutrients in the soil." Agree/ Disagree
B) Bristol: "I think a plant gains most of its mass from gasses in the air." Agree / Disagree
C) Chandra: "I think a plant gains most of its mass from the sunlight." Agree / Disagree

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

a) _____

b) _____

c) _____

Writer:

3. Plant cells have three organelles that animal cells do not. List these organelles and summarize their function in the space below.

_____

_____

_____

Writer:

4. CO_2 concentrations will increase in a sealed container of plants if kept in the dark; CO_2 concentration decrease if the sealed container is kept in the light. Why? Explain both outcomes below.

_____

_____

_____

Writer:

5. How do plant cells that lack access to light (like roots) acquire glucose for cellular respiration?
Include and underline the following in your response: *xylem, phloem, evaporation, gravity, leaves.*

_____

_____

_____

Writer: