

2.2 - Animals Unit, Packet 2

Score
<input type="checkbox"/> Above & Beyond
<input type="checkbox"/> Meets Expectations
<input type="checkbox"/> Near Expectations
<input type="checkbox"/> 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.

<p>Driving Question: What happens to food when it is consumed?</p>	<p>Semester Schedule</p> <p>1. Matter & Energy</p> <p><u>1.1:</u> What happens when something burns?</p> <p><u>1.2:</u> How does burning change matter & energy?</p> <p><u>1.3:</u> Unit Assessment</p> <p>2. Animals</p> <p><u>2.1:</u> How do animal cells use food?</p> <p><u>2.2:</u> What happens to food when it is consumed?</p> <p><u>2.3:</u> How do cells acquire atoms from food?</p> <p><u>2.4:</u> Unit Assessment</p> <p>3. Plants</p> <p><u>3.1:</u> How do plant cells differ from animal cells?</p> <p><u>3.2:</u> How do plant cells obtain matter and energy?</p> <p><u>3.3:</u> How can we investigate plant growth and function?</p> <p><u>3.4:</u> Unit Assessment</p> <p>4. Ecosystems</p> <p><u>4.1:</u> Why do different places have different amounts of species?</p> <p><u>4.2:</u> How does human activity affect species?</p> <p><u>4.3:</u> Unit Assessment</p>
<p>Anchoring Phenomenon: We have recently considered why diets vary based on activity. Using cattle as an example, we will now explore how animal cells acquire the atoms they're made from and the energy they need to function from food. We will also investigate how the amount of food animals consume relates to the amount of mass their bodies gain.</p> <p>Deeper Questions</p> <ol style="list-style-type: none"> How is food digested after it is consumed? How do cells acquire the energy they need to function? Why do animals only keep a small amount of the mass of the food that they consume? 	
<p style="text-align: center;">Schedule</p> <p>Part 1: Introduction</p> <ul style="list-style-type: none"> Initial Ideas & Data Dive Discussion & Developing Explanations <p>Part 2: Core Ideas</p> <ul style="list-style-type: none"> Core Ideas Revisions of Part 1 Explanations <p>Part 3: Investigation</p> <ul style="list-style-type: none"> Mealworm Mass Investigation <p>Part 4: Review & Assessment</p> <ul style="list-style-type: none"> Ranking Your Readiness Formative Assessment & Mastery Check <p>Part 5: Life Connections</p> <ul style="list-style-type: none"> Life Connections - Interview An Expert 	
<p>NGSS Standards (<i>PEs & CCCs are summarized below. SEPs are noted throughout the packet.</i>)</p> <p>HS-LS1-2. How bodily systems interact in multicellular organisms. HS-LS1-6. How carbon, hydrogen, and oxygen from sugar molecules form amino acids and/or other molecules. HS-LS1-7. How bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> Patterns</div> <div style="text-align: center;"> Cause and Effect</div> <div style="text-align: center;"> Scale, Proportion, and Quantity</div> <div style="text-align: center;"> Systems and System Models</div> <div style="text-align: center;"> Energy and Matter</div> <div style="text-align: center;"> Structure and Function</div> <div style="text-align: center;"> Stability and Change</div> </div>	
<p>Resource Links: Class Website; Pt 1 Video; Core Ideas; Summary Video; Practice Test; Part 3 Sample Data; Part 3 Instructions; Part 5 Video; Summary of Digestion;</p>	

Part 1: Introduction – Growing Cows (2.2.1)

Overview: In this activity, you will begin by discussing your initial ideas about what happens to food when it is consumed. 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).

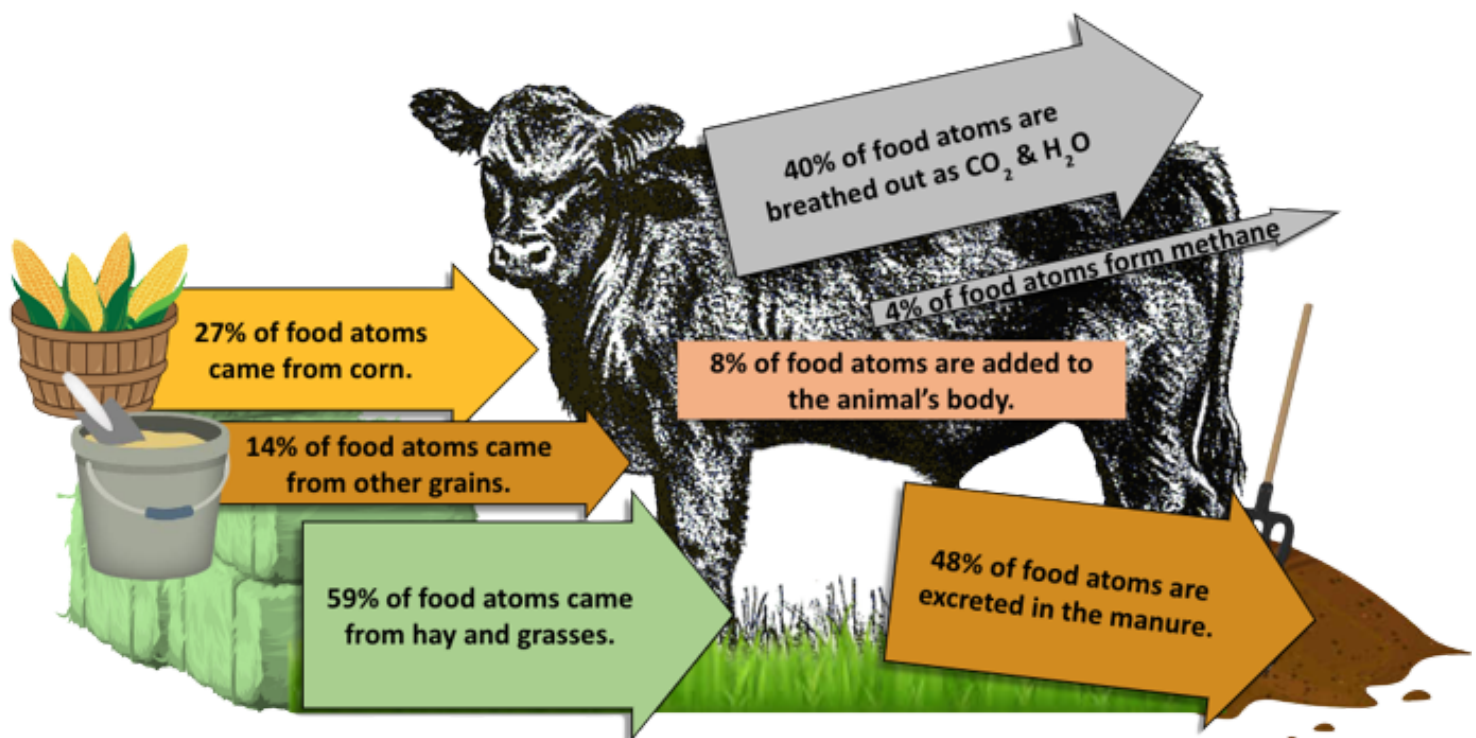


- Students are visiting a farm. The farmer explains that a growing cow eats about 15 lbs. of food a day! However, it gains less than 1.5 lbs. in body mass. Three students are unsure why this is. **Do you agree or disagree with each student's claim?**
 - Avery thinks that the matter (atoms) in the food is turned into energy used by the cow to grow.
 - Bristol thinks that most atoms in food are eventually breathed or pooped out by the cow.
 - Chandra thinks that almost all the atoms in the food are excreted as feces and urine.
- 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.

Data Dive - Read the directions below.



Begin by starting the [Data Dive Video](#) on a device all students can observe. Next, look at the data shown below. This shows the sources of atoms in a growing cow's diet and what happens to the food atoms after they are consumed. *NOTE: All values are estimates based on movement of carbon-based molecules - see data at [Kohn, 2018](#).*



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 image.** 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.
6. **Why do you think only a small percent of the consumed atoms stayed in the cow's body?**



Discussion - Record your ideas in the spaces below.

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.

How does food change after it is consumed, and why do animals only gain a small percentage of the food's mass? 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 throughout this unit.

Part 2: Core Ideas (2.2.2)

Overview: In this activity, you will begin with 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).

- | | |
|---|--|
| <ol style="list-style-type: none">1. What are the two primary purposes of consumed food?2. What do each of the following macromolecules provide to cells?
<i>Fat, Protein, Carbohydrates.</i>3. What is digestion? How does digestion change macromolecules?4. What are enzymes? What is the primary function of enzymes during digestion?5. What happens to food molecules after enzymes break apart macromolecules?6. What are examples of molecules that the blood transports to <i>and</i> from cells? | <ol style="list-style-type: none">7. What happens to most glucose molecules after being absorbed by cells?8. How are the carbon dioxide (CO₂) and water vapor (H₂O) that an organism breathes out related to the food molecules and oxygen that it consumes?9. What is ATP? What does ATP do for the cell?10. Summarize what occurs during cellular respiration. What happens to the matter and energy in glucose?11. Where does cellular respiration occur?12. Why do animals only gain 10% of the mass of the food they consume? What happens to the other 90%? |
|---|--|

Revising Explanations - Record your ideas in the spaces below.



How does food change after it is consumed, and why do animals only gain a small percentage of the food's mass? Based on this new information, how would you now respond to this question?

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

Part 3A: Mealworm Mass Set-up (2.2.3a)

Pre-Investigation Questions - *Work as a group to prepare verbal responses for these questions. When you think you are all ready to provide responses, raise your hand. Your instructor will listen to your explanations, provide feedback, and determine if you are ready to move on to the investigation.*



1. Summarize how digestive enzymes change macromolecules in consumed food.
2. How are the carbon dioxide (CO₂) and water (H₂O) that an organism breathes out related to the food molecules and oxygen that it consumes?
3. Summarize what occurs during cellular respiration. What happens to the atoms and energy in glucose?
4. Why do animals only gain 10% of the mass of the food they consume? What happens to the other 90%

This activity was completed _____ (instructor signature)

Overview: We are trying to figure out what happens to matter and energy in food after it is consumed. In this investigation, you will collect data as worms consume potatoes. You will compare the change in the mass of the potatoes to the change in mass of the worms. You will also measure changes to CO₂ levels in the air. (*We are using worms for this investigation because cows are too big and expensive for our classroom.*)

Materials needed for both investigations (per group): [mealworms](#) (at least a dozen per group); gallon-sized sealable bags (e.g., [Ziplock](#) freezer bags); 25 ml of [BTB](#) per group (pre-measured in 50 ml [centrifuge tubes](#) if possible); 2-3 shallow disposable plastic cups; a chunk of potato; paper towel; digital balance; tweezers; marker and tape for labeling. *Instructor Note: prepare sealable bags with materials in advance if possible. Verbally remind and confirm that students wash their hands after handling the worms.*

Hypothesis - *Discuss your ideas and record your predictions in the spaces below.*



1. Which of the following will occur as the worms eat the potatoes? **Circle one.**
 - a) *The mass gained by the worms will be the same as the mass of the potatoes they consume.*
 - b) *The mass gained by the worms will be less than the mass of the potatoes they consume.*
 - c) *The mass gained by the worms will be greater than the mass of the potatoes they consume.*
2. How will CO₂ levels change inside the sealed bag as the worms eat the potatoes? **Circle one.**
CO₂ levels will: a) *Increase* b) *Decrease* c) *Stay the same*
3. Explain your reasoning: _____

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

1. Acquire the needed materials from your instructor as directed.
2. Your mealworms may still be in bedding (such as shredded paper or sawdust shavings). If so, separate the worms from their bedding using a pencil or tweezers.
3. Place a disposable cup onto the digital balance. “Zero” out the scale (by pressing T or “tare”). Then gently pour about 15 g of mealworms into this container. Record this data in the Results section (p. 7).

4. Place another disposable cup onto the digital balance. “Zero” out the scale (by pressing T or “tare”). Then place your chunk of potato in the cup and record its mass in the Results section.
5. Gently place the cup of worms into the sealable plastic bag. Then remove the chunk of potato from the cup and gently lower it into the cup with the worms.
6. Rinse or use paper towel to wipe out the cup that contained the potato. Pour the BTB into the cup.
7. Place a piece of tape on the sealable plastic bag. Add a) your the last names of your group members, b) your class period & teacher; and c) the date.
8. Gently lower the cup of BTB into the sealable plastic bag (be careful not to spill). Tightly seal the bag; make sure some air remains inside (*your worms need air to breathe!*).
9. “Zero” out the scale. Carefully place the sealable plastic bag containing the worms, potato, and BTB onto the scale. If this is too large for the scale, place a small tray on the scale and zero out the scale (press T or “tare”). Record this mass in the Results section (Total Bag Mass).
10. Place your sealed plastic bag and all other materials in the location determined by your instructor.

Part 3B: Mealworm Mass Final Data Collection (2.2.3b)

Overview: You will determine whether the mass gained by the worms is equivalent to the mass lost by the potatoes. You will also determine how CO₂ levels changed as the worms ate the potato.



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

1. After 24⁺ hours, acquire your sealed bag. Before opening the bag, zero your balance, and carefully place the sealable plastic bag containing the worms, potato, and BTB onto the scale. If this is too large for the scale, place a small tray on the scale and zero out the scale (press T or “tare”). Record the final mass in the data table on the previous page.
2. Observe the inside of your bag of worms. Is there now water vapor inside? Record this in Results.
3. Remove the cup of BTB. Did it change color? Record this information in the Results section.
4. Dispose of your BTB in the manner determined by your instructor. Rinse and wipe out the cup.
5. Place this disposable cup onto the digital balance. “Zero” out the scale (by pressing T or “tare”). Remove what remains of your chunk of potato from the cup of worms and place in the cup on the balance. Record the final mass of the potato in the Results section.
6. Dispose the potato in the manner determined by your instructor. Rinse/wipe out the cup.
7. Place this disposable cup onto the digital balance. “Zero” out the scale (by pressing T or “tare”). Pour your cup of mealworms into this cup. Record the final mass of the worms.
8. Clean up all remaining items in the manner determined by your instructor.

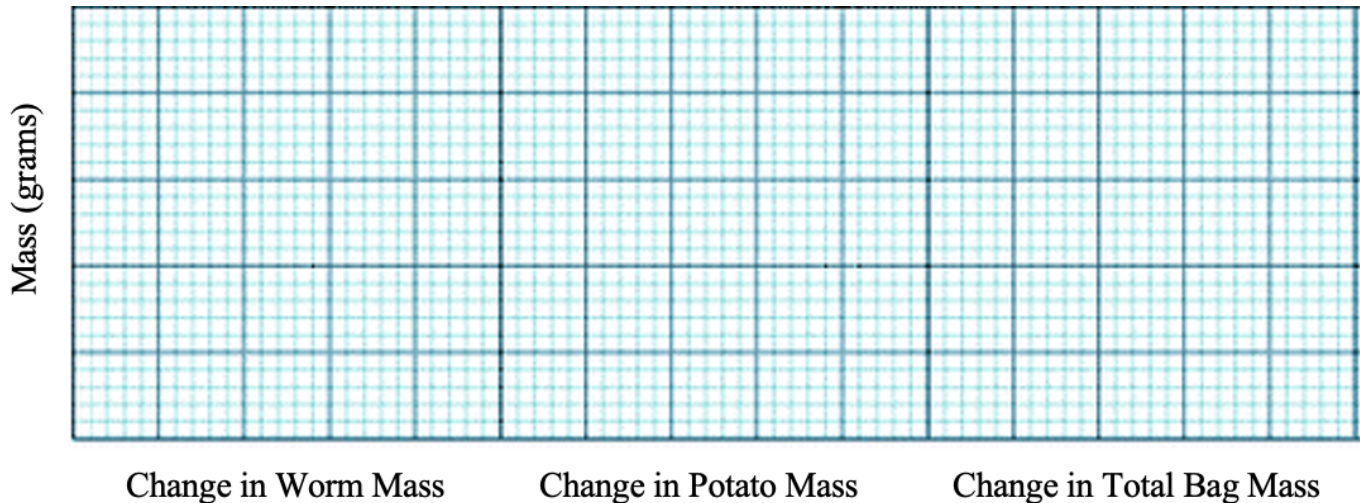
Results - Record your data below. Record the Final Mass & Change in Mass after 24⁺ hours.

Item	Initial Mass (g)	Final Mass (g)	Change in Mass (g)
Worms			
Potato			
Total Bag Mass (worms, potato, & BTB)			

Was water vapor present inside of your bag of worms after 24 hours? Yes No (*circle one*)

Initial Color of BTB: _____ Final Color of BTB: _____

Use your data to create a bar graph below based on the change in mass. Be sure to label your data with specific units (in grams) from your data table.



Post-Investigation Questions - Record your ideas in the spaces below.



- The change in potato mass was **equal to/different from** (*circle one*) the change in worm mass.
- Based on your data, the amount of atoms in the potato (*circle one*): increased / decreased / didn't change.
Hint: what happened to the mass of the potato? Remember - if something gains mass, it gains atoms. If it loses mass, it loses atoms.
- Based on your data, the amount of atoms in the air (*circle one*): increased / decreased / didn't change.
Hint: did the BTB change color? What does this indicate?
- Based on your data, the amount of atoms inside the bag (*circle one*): increased / decreased / didn't change.
Hint: what happened to the mass of the bag? Was it roughly the same mass as when you started (assuming no one opened the bag; disregard minor changes in mass if the scale is not fully accurate).
- If the mass lost by the potato did not equal the mass gained by the worms, where did these atoms go? What do you think happened to the atoms in the potato that were not added to the body of the worms?

6. If something loses mass, it loses atoms. If something gains mass, it gains atoms. Based on this information, what happened to the atoms in the potato as it was consumed? Explain using data.

7. You likely observed that animals moved as they consumed the potato (*kinetic energy*). The bag was likely also slightly warmer (*thermal energy*) than before. Where did this energy come from? Explain.

8. Animal cells are primarily made from water, fat, and protein. Where did the worms acquire these macromolecules to make their cells & gain more mass? Defend your ideas with evidence & reasoning.

Revising Explanations: Return to your original explanation from Parts 1 & 2. Based on this new information, how would you now respond to this question?

9. **How does food change after it is consumed, and why do animals only gain a small percentage of the food's mass?**

10. Use arrows, labels, and brief explanations to show how matter and energy in the potato was transformed as it was eaten by a worm. Include all of the following: 1) carbohydrates, 2) glucose, 3) oxygen (O_2), 4) CO_2 , 5) H_2O , 6) high energy bonds, 7) motion, 8) heat. [\(Image Source\)](#)



Part 4: Review & Assessment (2.2.4)

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 (2.2.5)

Background - Complete the reading before answering the questions below.



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 tried to figure out _____

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: _____



Animals, Packet 2 Formative Assessment (2.2.4)

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. Students are visiting a farm. The farmer explains that a growing cow eats about 15 lbs. of food a day! However, it gains less than 1.5 lbs. in body mass per day. Three students are unsure why this is. Do you agree or disagree with each student’s claim?

- a. Avery thinks that the matter in the food is turned into energy used by the cow to grow. *Agree/Disagree*
- b. Bristol thinks that most atoms in food are eventually breathed or pooped out by the cow. *Agree/Disagree*
- c. Chandra thinks that almost all the atoms in the food are excreted as feces and urine. *Agree/Disagree*

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

- a) _____
- b) _____
- c) _____

Writer:

3. What happens to fats, proteins, and carbohydrates in the cow’s food immediately after being consumed? Include and underline the following: molecules, enzymes, bloodstream, cells.

Writer:

4. A cow consumes 15 lbs. of food daily, but only gains 1.5 lbs. per day. The cow produces 7 lbs. of feces (dry weight). What is happening to the 5.5 lbs. of atoms that weren’t added to the animal’s body or feces?

Writer:

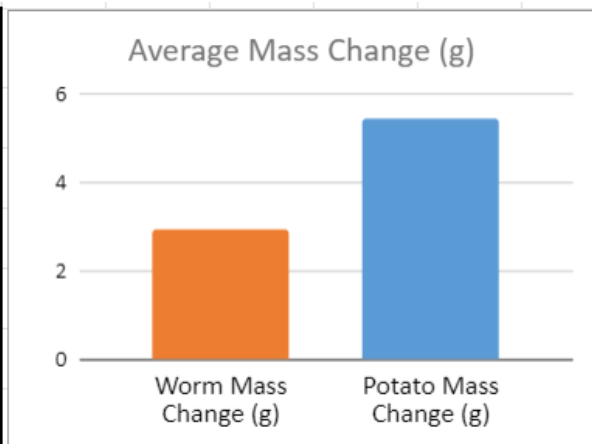
5. Summarize what occurs during cellular respiration. Include and underline each of the following:

- a) glucose & oxygen, b) CO₂ & H₂O, c) high energy bonds, d) ATP.

Writer:

Background: A class recorded the initial mass of mealworms and potato chunks. They then fed the potato to the worms and measured the final mass of the worms (including their feces) and the potato. Here is their data:

	Worm Mass Change (g)	Potato Mass Change (g)
Group 1	2	4.8
Group 2	2.4	6.3
Group 3	4.4	5.2
Group 4	2.8	5.2
Group 5	3.1	5.7
AVERAGE	2.94	5.44



This data shows the average mass gained by worms compared to the average mass lost by the potatoes they consumed.

6. Four students make claims about what happened to the potato as it was consumed by the worms:

- Student 1: The same atoms the potato lost were all added to the worms' bodies.*
- Student 2: Some atoms from the potato were rearranged to form water vapor.*
- Student 3: Some atoms from the potato were rearranged to form carbon dioxide.*
- Student 4: Some atoms from the potato were broken down by the worms' digestive tracts.*

Determine whether each argument is backed by a) this data and b) your knowledge of cellular respiration, and explain why.

1) Supports/Refutes. Why?

2) Supports/Refutes. Why?

3) Supports/Refutes. Why?

4) Supports/Refutes. Why?

Writer:

7. How does cellular respiration help explain the “missing mass” of the potato that wasn’t added to the worms? Describe the process of cellular respiration and its connection to the observed trends in the data.
