2.3 - Animals Unit, Packet 3

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 cells acquire atoms from food?

Anchoring Phenomenon: Bears gain fat before hibernation by dramatically increasing their food consumption. They must double or triple their daily food intake to accumulate a thick layer of fat, which serves as their primary energy source during hibernation. How do bears change the food molecules they consume into a layer of fat? How do animal cells use food to gain atoms?

Deeper Questions

1. How do cells assemble the macromolecules they're made from?
2. How do cells change macromolecules into other macromolecules?
3. Where do cells assemble the macromolecules they're made from?

Schedule

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

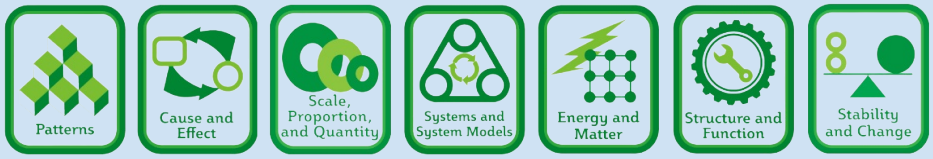
Part 2: Core Ideas
- Core Ideas
- Revisions of Part 1 Explanations

Part 3: Investigation
- A: CR Molecular Modeling
- B: BS Molecular Modeling
- C: Dissections

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

Part 5: Life Connections
- Life Connections - Weight Loss

NGSS Standards (*PEs* & *CCCs are summarized below. SEPs are noted throughout the packet*).
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. HS-LS1-3. Provide evidence that feedback mechanisms maintain homeostasis. HS-LS1-4. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.



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; Part 2 Video; Part 3A Data; Part 3B Data; Macromolecule Images;

Part 1: Introduction – Fat Bear Week (2.3.1)

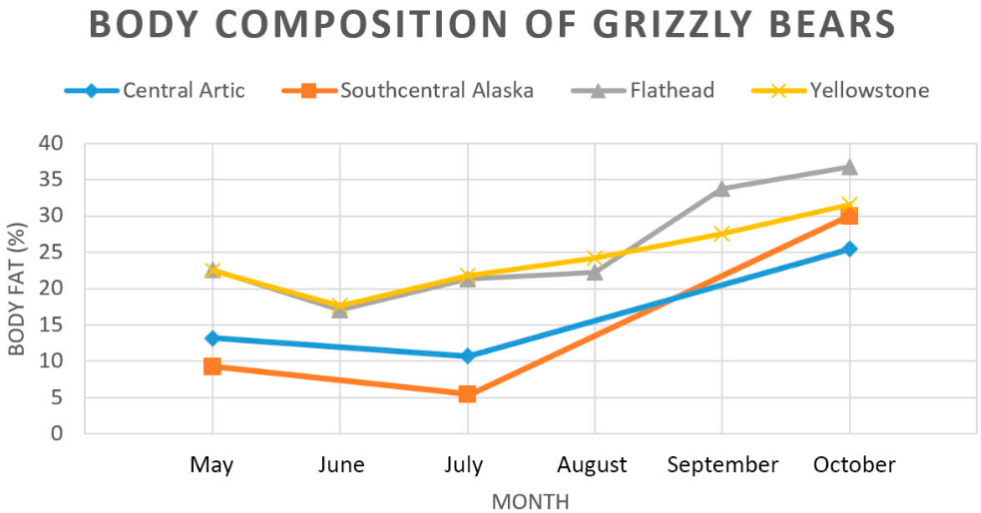
Overview: **Overview**: In this activity, you will begin by discussing your initial ideas about what happens when we consume food. You will then analyze data and work in teams to develop your initial explanations.

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

1. A group of students are asked to explain how a bear gains the fat it needs for hibernation from the food it eats. **Do you agree or disagree with each student's claim**?
   a. Avery thinks that any fat in the bear's food mostly just stays inside its body.
   b. Bristol thinks that the bear is changing carbs and protein in its diet into fat molecules.
   c. Chandra thinks that the bear's cells are changing high energy bonds into fat.
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 - *Read the directions below.* *SEP: Analyzing & Interpreting Data*

Video: Next, watch this video individually or as a class (based on your teacher's instructions). Then, examine the data below. The data on the left shows how the body fat (or *body composition*) of grizzly bears in four different regions changes between May and October. On the right you can see a nutrition label for salmon. Pay particular attention to the grams of carbs, fats, and proteins in these fish. *Data 1 Source; Data 2 Source.*



References:
McLellan (2011). "Implications of a high-energy and low-protein diet on the body composition, fitness, and competitive abilities of black (Ursus americanus) and grizzly (Ursus arctos) bears."
Gau and Case (1999). "Grizzly bear (Ursus arctos) studies in the Northwest territories: final report to the West Kitikmeot/Slave study component No. 1, Nutrional ecology."
Farley (2003). "Impacts of heavy huting pressure on the density and demographics of Brown bear populations in Southcentral Alaska."
Schwartz et al. (2014). "Body and diet composition of sympatric Black and Grizzly bears in the Greater Yellowstone ecosystem."

Salmon Nutrition Label

Nutrition Facts

Serving Size	**100 g**
Amount Per Serving	
Calories	**179**
	% Daily Value *
Total Fat 10g	**13 %**
Saturated Fat 3.1g	**16 %**
Cholesterol 50mg	**17 %**
Sodium 47mg	**2 %**
Total Carbohydrate 0g	**0 %**
Dietary Fiber 0g	**0 %**
Sugar 0g	
Protein 20g	**40 %**
Vitamin D 0mcg	0 %
Calcium 26.00mg	2 %
Iron 0.25mg	1 %
Potassium 394mg	8 %

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contribute to a daily diet. 2,000 calories a day is used for general nutrition advice.

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.
6. **How does a bear gain this much fat if the salmon they eat is mostly comprised of protein?**

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 do cells acquire atoms from food? 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 (2.3.2)

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. Food consumed by an animal is used for what two primary purposes?
2. Most of the food consumed by an animal is not added to its body mass. Why?
3. What is biosynthesis? How does it affect cells?
4. An animal must first do what to its food before biosynthesis can occur?
5. What is protein biosynthesis? What occurs in this process? Why is this important for a cell?
6. Where does protein biosynthesis occur?
7. What is fat biosynthesis? What occurs in this process? Why is this important for a cell?
8. Where does fat biosynthesis occur?
9. What happens if an animal consumes too much protein or carbohydrates?
10. How can a bear gain fat by eating salmon, which are mostly protein?
11. What is homeostasis? Explain with an example.
12. What is mitosis? Why is it necessary? How does it relate to biosynthesis?

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

How do cells acquire atoms from food? 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: Cell Respiration Molecular Modeling (2.3.3a)

Pre-Investigation Questions - *Work as a group to prepare verbal responses for these questions. When you think you are <u>all</u> 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.*
SEP: Developing & Using Models

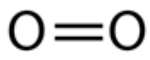
1. What is biosynthesis? Why is it important for cells?
2. How does protein biosynthesis differ from fat biosynthesis? (*e.g., what occurs in each, and where?*)
3. What happens if an animal consumes too much protein or carbohydrates?
4. What is homeostasis? Why is it important for cells?
5. What is mitosis? Why is it important for cells?

This activity was completed _____ (*instructor signature*)

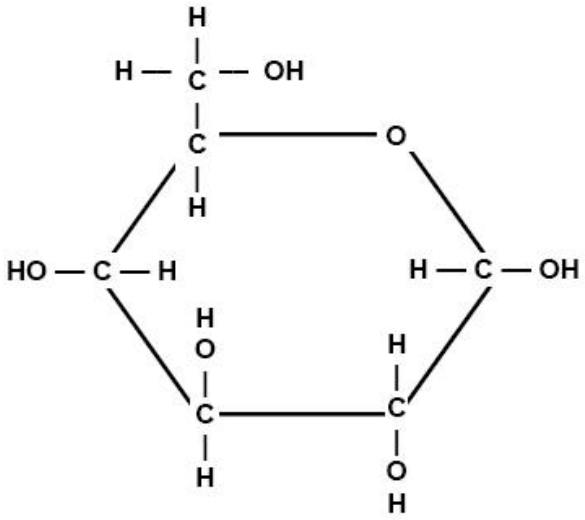
Overview: In this investigation, you will create molecular models to explore what happens to matter and energy in food used by cells. In science, *models* are tools that help us clarify our thinking and make more accurate predictions. This will help you to better comprehend how prior content relates to this week's content.

Materials needed for both investigations (per group): modeling clay (such as PlayDoh or Plastilina) with at least three different colors; toothpicks; gold twist-ties or tape; paper towel (to protect tabletops from residue).

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

1. **Using the modeling clay provided, create <u>six</u> molecules of oxygen gas (O_2).**
   
   a. You will need 12 balls of one color to represent oxygen atoms.
   b. Using this image as a guide, connect two oxygen atoms using two toothpicks.
   c. Repeat these instructions until you have <u>six</u> molecules of oxygen (O_2).

2. **Using the modeling clay provided, create <u>one</u> molecule of glucose ($C_6H_{12}O_6$).**
   a. Using the same color as you used previously for oxygen, create six balls of that color for the oxygen atoms.
   b. Using a different color, create six balls of that color for the carbon atoms.
   c. Using a third color, create 12 balls of that color for the hydrogen atoms.
   d. Connect these atoms using the image as a guide (1 toothpick between each atom).
   e. Mark any high energy bonds (C-C and C-H) with a twist tie or other physical marker that your instructor has provided.

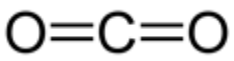
   

3. **When you think you are finished, raise your hand and show your instructor.**

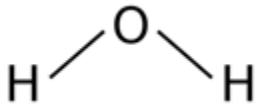
This activity was completed _____ (*instructor signature*)

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

4. **Disassemble your O_2 and glucose molecules. Using the same clay atoms you used to create the oxygen gas and glucose molecules, create CO_2 and H_2O using the following instructions.**
5. **Create six molecules of carbon dioxide (CO_2).**
    a. 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).
    b. Repeat to create six CO_2 molecules.



6. **Create six molecules of water vapor (H_2O).**
    a. Using the image at the right as a guide, connect an oxygen atom to two hydrogen atoms using two toothpicks.
    b. Repeat to create six H_2O molecules.



7. **Mark any high energy bonds** (C-C and C-H) with a twist tie, piece of tape, or any other physical marker you received.
    a. Make a separate pile for any unused high energy bonds.
8. **Based on the core ideas from this unit's packets, explain how each of these molecules relates to what happens to food molecules in cells.** Explain what happens to any leftover high energy bonds.
9. When you think you are finished, raise your hand and show your instructor.
    a. While you are waiting for their approval and after they give their approval, complete the post-investigation questions in the next section.
    b. Disassemble your molecules and put away materials only *after* you get approval.

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. **What is the relationship between a) the atoms in glucose and oxygen that an animal consumes/ breathes in, and b) the atoms in the carbon dioxide and water vapor that the animal exhales?**

_____

_____

2. **Are there any high-energy bonds (C-C or C-H) in glucose and/or oxygen (O_2)?** Yes / No

   Are there any high-energy bonds (C-C or C-H) in carbon dioxide (CO_2) or water (H_2O)? Yes / No

   How do you think that this relates to how animals get energy from the food that they consume?

_____

_____

3. **What do you think happens to the atoms and energy in glucose molecules when consumed?**

   Atoms: _____

   Energy: _____

Part 3B: Biosynthesis Molecular Modeling (2.3.3b)

Overview: In this investigation, you will create physical models to explain how matter and energy in food molecules changes during biosynthesis.

Materials Needed (per group): modeling clay (such as Playdoh or Plastilina) toothpicks, tape or twist ties, paper towel; OR paper printouts of amino acids, fatty acids, and glucose molecules.

Methods: In this investigation, you'll build molecular models to explore the changes in matter and energy during biosynthesis. Scientific models are tools that help us clarify our thinking and make accurate predictions.

You'll create your own protocol and collaborate with your team to demonstrate your understanding of biosynthesis. Collaboratively decide how to convey this understanding using your materials. You will need to collectively reason about these concepts and work together to find solutions, which are valuable skills for your future beyond high school. Answer the questions below *before* starting your demonstration.

1. **What is biosynthesis?** Briefly summarize this concept in the space below:

   _____

   _____

2. **How could you use the resources provided to demonstrate your understanding of this idea?** Briefly outline your plan below.

   _____

   _____

3. **How does biosynthesis relate to the concept of *homeostasis*?** Briefly summarize these connections.

   _____

   _____

4. **How might biosynthesis be affected if an organism consumes excess glucose?**

   _____

   _____

5. **How does biosynthesis relate to the concept of *mitosis*?** Briefly summarize these connections.

   _____

   _____

6. **When you're ready to show your understanding of biosynthesis, raise your hand and display your work to the instructor. Wait for approval before taking apart your molecules.**

   This activity was completed _____(*instructor signature*)

Part 3C: Dissections (2.3.3c)

Overview: In this activity, you'll use a dissection (real or simulation) of a fetal pig or grasshopper to show your understanding of how animal cells support bodily functions. Your instructor will give you the needed materials and instructions. As a team, be ready to use the dissection to answer these questions using your specimen:

1. **Summarize the relationship between each of the following:** *atoms, molecules, macromolecules, organelles, cells, tissues, organs, systems, and organisms.*
2. **How did the molecules in its food change as it passed through its digestive tract?**
3. **How did this organism move food molecules from the digestive tract to its cells?**
4. **How did the organism's cells acquire more mass to enable it to grow to its full size?**
5. **How did this organism's cells acquire the chemical energy needed to function?**
6. **Did most of the atoms found in the food molecules remain within the organism?** Explain.
7. **Does this organism have any stored fat? Where did this come from? How was it used?**
8. This organism is no longer alive. **What do you think will happen to the matter & energy in its cells?**

Part 4: Review & Assessment (2.3.4)

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 – Weight Loss (2.3.5)

Background: Most diets aim to reduce daily calorie intake. However, fad diets (or "quick fix" diets) often fail because they disrupt the body's internal balance (homeostasis). Drastically cutting calories slows down cellular respiration, prompting our cells to signal the body to conserve energy. This makes it harder to lose weight.

These diets can also reduce intake of the amino acids and fatty acids needed for cell and tissue repair (biosynthesis). To succeed long-term, it's better to stick to balanced, sustainable eating habits that support the body's natural processes. Some popular diets are listed below. As a group, evaluate one diet below using your background knowledge and credible sources. Determine if it is justifiable and effective, and defend this stance using evidence & reasoning. Then answer the questions below.

1) Ketogenic Diet; 2) DASH Diet; 3) Fasting; 4) Mediterranean Diet; 5) Alkaline Diet; 6) Paleo Diet

1. Summarize the overall idea behind this diet. How and why might this diet work?
2. How does this diet affect a) cellular respiration, b) biosynthesis, *and* c) homeostasis?
3. Based on credible sources, does this seem to be an effective weight to support healthy weight loss?
4. How might this idea be improved to better support the goal of long-term healthy weight loss?

Animals, Packet 3 Formative Assessment (2.3.4)

Name: _____ Hour____ Date:_____ Score:_____

Directions: If you are allowed to work in groups, have a different person write each response as others assist.

1. A group of students are asked to explain how a bear gains the fat it needs for hibernation from the food it eats. **Do you agree or disagree with each student's claim**?

a. Avery thinks that any fat in the bear's food mostly just stays inside its body. *Agree / Disagree*
b. Bristol thinks that the bear is changing carbs and protein in its diet into fat molecules. *Agree / Disagree*
c. Chandra thinks that the bear's cells are changing high energy bonds into fat. *Agree / Disagree*

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

a) _____

b) _____

c) _____

3. Data on bear body composition and salmon macromolecule content is shown below. Briefly explain whether each of the arguments above are supported by this data and/or content from this class.

a) Supports/Refutes. Why? _____

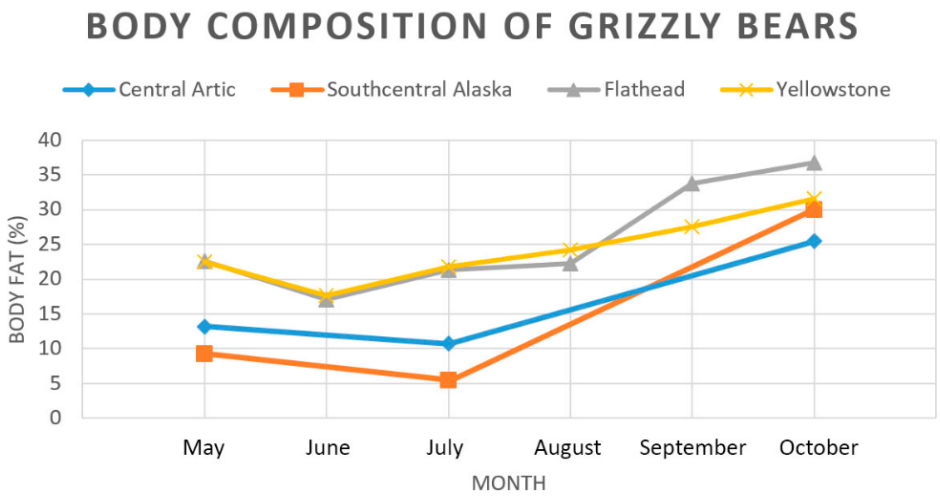
_____

b) Supports/Refutes. Why? _____

_____

c) Supports/Refutes. Why? _____

_____



Salmon Nutrition Label

Nutrition Facts	
Serving Size	**100 g**
Amount Per Serving	
Calories	**179**
	% Daily Value *
Total Fat 10g	**13 %**
Saturated Fat 3.1g	**16 %**
Cholesterol 50mg	**17 %**
Sodium 47mg	**2 %**
Total Carbohydrate 0g	**0 %**
Dietary Fiber 0g	**0 %**
Sugar 0g	
Protein 20g	**40 %**
Vitamin D 0mcg	0 %
Calcium 26.00mg	2 %
Iron 0.25mg	1 %
Potassium 394mg	8 %

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contribute to a daily diet. 2,000 calories a day is used for general nutrition advice.

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Farley (2003). "Impacts of heavy huting pressure on the density and demographics of Brown bear populations in Southcentral Alaska."
Schwartz et al. (2014). "Body and diet composition of sympatric Black and Grizzly bears in the Greater Yellowstone ecosystem."

4. What is biosynthesis? Why is it important for a cell?

Writer:

5. Sometimes more carbohydrates are consumed than are needed to recharge ATP. **What happens to excess carbohydrates in the diet? Include and <u>underline</u> the following:** *enzymes, glucose, fatty acids.*

Writer:

6. Stan and Jan disagree on whether a bear's annual weight gain supports or contradicts the idea of homeostasis. <u>Stan</u> thinks weight gain disproves homeostasis due to visible body changes (which doesn't seem like it reflects the idea of internal balance).

<u>Jan</u> argues that bears gaining weight for winter survival is an example of homeostasis because the bears' bodies need the long-term supply of chemical energy to survive the winter.

Who do you think is correct? First, define homeostasis in your own words. Then determine whose claim is most accurate based on this definition and defend your stance with evidence and reasoning.

Image Source

Writer:

4. A full-grown bear has more cells and a much larger mass than a newborn bear cub. How did the bear obtain more atoms and more cells? Address biosynthesis and mitosis in your explanation.

Writer: