1.1 - Matter & Energy Unit, Packet 1

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: What happens when something burns?

Anchoring Phenomenon: As a log burns on a fire, it seems like it gradually disappears. What is actually happening to the log? Is it disappearing? Is it becoming energy? Or is something else happening? We'll explore these questions while deepening our understanding of matter and energy.

Deeper Questions

1. What is matter? What is energy? How are they different?
2. What is the mass? How does burning affect an object's mass?
3. What are atoms and molecules? How do these change when an object is burned?

Schedule

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

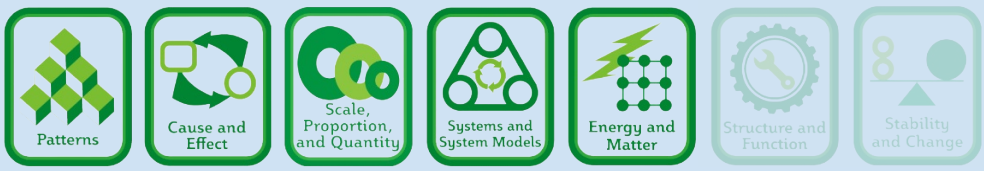
Part 2: Core Ideas
- Core Ideas
- Revisions of Part 1 Explanations

Part 3: Investigation
- Part 3A: Combustion & Changes in BTB
- Part 3B: Combustion & Changes in Mass

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

Part 5: Life Connections
- Life Connections - Fill'er Up!

NGSS Standards (*PEs & CCCs are summarized below. SEPs are noted throughout the packet*).
HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy. HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction



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 enzymes change molecules?
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; Pt 1 Video; Core Ideas; Summary Video; Practice Test; Mastery Check; Part 3 Sample Data;

Part 1: Introduction – Lost Lumber (1.1.1)

Overview: In this activity, you will begin by discussing your initial ideas about what happens when something burns. 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).*

1. A group of students are asked to explain what happens to a log when it is burned. **Do you agree or disagree with each student's claim**?
    a. Avery thinks that the atoms in the wood were turned into heat and light energy when the wood was on fire, and that the energy dissipated away. This causes a loss of mass.
    b. Bristol thinks that the fire destroys the atoms in the wood, causing a release of energy that can be detected as light and heat.
    c. Chandra thinks that atoms in the wood molecules are being rearranged to form new molecules that aren't visible to our eyes; this process gives off energy.
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.*

Begin by starting the Data Dive Video on a device all students can observe. Next, look at the data shown below. This shows the change in mass after a pile of logs started on fire. When the student first weighed the dry wood, the scale reads 300 lbs. A spark from a nearby fire caused it to burst into flames. Eventually, all that remains is a pile of ashes weighing 10 lbs.

To read this graph, look at the leftmost bar labeled "Initial Mass." The top of this bar corresponds to 300 pounds on the left-side scale. To find the final mass of the wood (ashes), look at the bar on the right. Notice that this bar only goes up to 10 pounds on the scale.

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

Analyzing and Interpreting Data

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.

Discussion - *Record your ideas in the spaces below.*

Asking Questions and 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.*

Constructing Explanations and Designing Solutions

What happens to the matter (atoms) in a log when it burns? 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.

_____

_____

_____

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 2: Core Ideas (1.1.2)

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).*

1. What is the difference between matter and energy?
2. How are the following different from each other? *Atoms, mass, elements, molecules.*
3. If a substance gains *mass*, what is happening to the amount of *atoms* in that substance?
4. What are the four kinds of energy? How are these all related to each other?
5. True or false: when something burns, the atoms in that substance are destroyed. Explain
6. True or false: if something burns, the its atoms become energy. Explain.
7. True or false: when something burns, its energy is destroyed. Explain.
8. True or false: when something burns, the carbon atoms in that substance are turned into oxygen and hydrogen atoms. Explain.
9. True or false: some atoms that were found in dinosaurs exist in organisms that are alive today. Explain.
10. True or false: the amount of energy in the universe at the time of the dinosaurs is the same today. Explain.

Revising Explanations - *Record your ideas in the spaces below.*

What happens to the matter (atoms) in a log when it burns? 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.

HINT - Remember the "rules" for energy and matter:

- All solids, liquids, and gases are made of tiny particles called atoms. Multiple atoms can bond together to form molecules (e.g., water molecules consist of 1 oxygen atom & 2 hydrogen atoms).
- In biology, atoms last forever. Atoms cannot be created or destroyed (e.g., a carbon atom is always a carbon atom). Atoms found on molecules can be rearranged to form new molecules.
- In biology, energy lasts forever. Energy cannot be created or destroyed. Energy can exist as light, heat, motion, or as chemical energy stored in the bonds of molecules. Energy in one form can be transferred into a different form (e.g., light energy can be transformed into heat energy).

Part 3A: Combustion & Changes in BTB (1.1.3a)

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.*

Developing and Using Models

1. What is the difference between matter and energy?
2. How are the following different from each other? Atoms, mass, elements, molecules.
3. If a substance gains mass, what is happening to the amount of atoms in that substance?
4. True or false: when something burns, the atoms in that substance are destroyed. Explain.

This activity was completed _____ (*instructor signature*)

Overview: In this investigation, you will determine how ethanol combustion affects a chemical called BTB. When you start, the BTB should be green. If the air *loses* CO_2, BTB turns blue. If the air *gains* CO_2, BTB turns yellow. If the amount of CO_2 *doesn't change*, the BTB will stay green.

Materials needed for both investigations (per group): a glass fuel burner; ethanol; digital scale; lighter; petri dishes; ethanol; BTB; a large container (to put out the flame); safety glasses/goggles; fire extinguisher & safety items; two 50 ml centrifuge tubes with caps (to store ethanol & BTB).

Planning and Carrying Out Investigations

Hypothesis - *Record your ideas in the spaces below.*

As ethanol burns, I think the amount of CO_2 in the air will ***increase / decrease / stay the same.*** *Explain:*

_____

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

1. ☐ Fill glass Petri dish with 35 ml of green BTB. Record the time and color of the BTB below.

   Time: _____ *Color:* _____

2. ☐ Add 5 ml of ethanol to a glass petri dish. Set it next to your Petri dish of BTB.
3. ☐ Make sure you are aware of where all fire safety items are located in your room. Then ask your instructor to ignite the ethanol as you observe from a safe distance. They will immediately put the large container on top of both the glass Petri dish with burning ethanol and the Petri dish of BTB. The flame should extinguish quickly inside the container. DO NOT lift the container!
4. ☐ The inside of the container should now have visible water vapor. Where did this vapor come from?

   I think that the water vapor comes from… _____

   _____

5. ☐ Do not lift the container over the petri dishes. Wait 20 minutes to remove the container. Continue on to Part B on the next page while you are waiting.
6. ☐ After 20 minutes, observe the color of the BTB (it may help to place the petri dish on a white sheet of paper). Record your data.

   Time: _____ *Color:* _____

Results - *Record your ideas in the spaces below.*

Constructing Explanations and Designing Solutions

Based on the results, the amount of CO_2: **increased / decreased / didn't change**. *(circle one)*
Explain why this outcome occurred. Check your notes and resources from this packet if needed.

_____

_____

Part 3B: Combustion & Changes in Mass (1.1.3b)

Overview: You will determine how mass changes as a substance combusts. Remember: if something gains mass, it gains atoms. If it loses mass, it loses atoms.

Materials needed for both investigations (per group): a glass fuel burner; ethanol; digital scale; lighter; petri dishes; ethanol; BTB; a large container (to put out the flame); safety glasses/goggles; fire extinguisher & safety items; two 50 ml centrifuge tubes with caps (to store ethanol & BTB).

Planning and Carrying Out Investigations

Hypothesis - *Record your ideas in the spaces below.*

As ethanol burns, I think the mass of the fuel burner will ***increase / decrease / stay the same.*** *Explain:*

_____

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

1. ☐ Turn on a digital scale so that it reads "0" g. Place the glass fuel burner with ethanol on the scale (ethanol should already be added). Record the mass of fuel burner with ethanol below.

   Starting mass of fuel burner with ethanol: _____ *g*

2. ☐ Remove the burner from the scale. Be aware of where all fire safety items are located in your room. Then ask your instructor to ignite the ethanol as you safely observe. Make sure the flame is under an inch in size. If it is too large, use the cap to extinguish the flame and ask for assistance.

   Time glass fuel burner was ignited: _____

3. After a period of 5-10 minutes, use the cap of the glass fuel burner to extinguish the flame. Record the final mass of the petri dish and the time. (While waiting, you can most on to the Post-Investigation Questions below.

   Final mass of fuel burner: _____ *g* *Time fuel burner was extinguished:* _____

Results - *Record your ideas in the spaces below.*

Based on the results, the mass of the fuel burner: **increased / decreased / didn't change**.
Explain why this outcome occurred. Check your notes and resources from this packet if needed.

_____

_____

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

1. 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 ethanol as it burned? Explain using data.**

   _____

   _____

2. Can atoms disappear or be destroyed? _____ **Where did the atoms in the fuel go? Did they disappear, or did something else happen?** Explain using evidence from the investigation.

   _____

   _____

3. What did your changes to your BTB **indicate about changes to the amount of CO_2 in the air**? _____

   _____

4. Based on our data, the amount of atoms in the ethanol (*circle one*): **increased / decreased / didn't change**.
5. Based on our data, the amount of atoms in the air (*circle one*): **increased / decreased / didn't change**.
6. Movement, light, an increase in temperature, or a chemical reaction are indicators of energy transformation. **Was there any evidence that energy was transformed in this activity? Explain**.

   _____

   _____

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

7. **What happens to the matter (atoms) in a substance when it burns?** _____

_____

_____

Part 4: Review & Assessment (1.1.4)

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 (link on pg. 1). If your performance indicates that additional support is needed, your instructor will determine how to help you move forward.

Part 5: Life Connections – Fill'er up! (1.1.5)

Adopted with permission from Carbon TIME.

Engaging in Argument from Evidence

Background - *Complete the reading before answering the questions below.*

Luis and his family stopped at a gas station. Luis noticed that they had to refuel the 12 gallon tank every week, which seemed like a lot (12 gallons of milk was equivalent to the amount of milk he would drink in about 3 months). He asked his family what happened to all that gasoline. Here's what each thought…

Luis: I think some of the gasoline turns into energy that makes the car go. So, you start with gasoline and you end up with motion and some heat.

David: I think some of the gasoline turns into carbon dioxide.

Elena: I think some of the gasoline ends up as water that goes into the air.

Mom: I think the gasoline evaporates and becomes fumes that pollute the air.

Dad: I think some of the gasoline just burns up and disappears.

Who do you *most* agree with and why? Explain your thinking. Be prepared to share your ideas as a class.

We most agree with _____ because _____

_____

Matter & Energy, Packet 1 Formative Assessment (1.1.4)

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.

	Initial Mass of Ethanol	Final Mass of Ethanol	Initial BTB	Final BTB
Group 1	22 g	18 g	Green	Yellow
Group 2	25 g	22 g	Green	Yellow
Group 3	20 g	17 g	Green	Yellow

1. A class is determining what happens to the mass of ethanol as it combusts. They recorded data, which is shown here. **Based on their data, we can conclude that as ethanol burns…**
    a. Its mass **decreases,** meaning the number of atoms in ethanol *increases*.
    b. Its mass **increases,** meaning the number of atoms in ethanol *increases*.
    c. Its mass **decreases,** meaning the number of atoms in ethanol *decreases*.
    d. Its mass **increases,** meaning the number of atoms in ethanol *decreases*.

2. If the air *loses* CO_2, BTB turns blue. If the air *gains* CO_2 BTB turns yellow. If the amount of CO_2 *doesn't change*, the BTB will stay green. **Based on their data above we can conclude that…**
    a. The amount of CO_2 in the air increased.
    b. The amount of CO_2 in the air decreased.
    c. The amount of CO_2 in the air did not change.

3. Avery thinks that the atoms in the burning ethanol were turned into heat and light energy, and that the energy dissipated away. This causes a loss of mass because there are now fewer atoms.

    I **agree / disagree** *(circle one)* with this statement because _____

    _____

4. Bristol thinks that the fire destroys the atoms in the ethanol, causing a release of energy that can be detected as light and heat.

    I **agree / disagree** *(circle one)* with this statement because _____

    _____

5. Chandra thinks that atoms in the ethanol molecules are being rearranged to form new molecules that aren't visible to our eyes; this process gives off energy.

    I **agree / disagree** *(circle one)* with this statement because _____

    _____

6. **What do you think is happening to the atoms in the ethanol as it burns?** Use the "rules" of matter and energy below to guide you as you write your response.

7. **How is what happened to the ethanol similar to what happens to a log when it burns on a fire and to gasoline that is combusted inside of a car's engine?** Explain how changes to matter and energy are similar in all three examples.

Remember the following "rules" for energy and matter:

- **All solids, liquids, and gasses are made of tiny particles called atoms**. Atoms can bond together to form molecules (*e.g., water molecules consist of 1 oxygen atom & 2 hydrogen atoms*).

- In biology, **atoms last forever**. Atoms cannot be created or destroyed or turned into energy (*e.g., a carbon atom is always a carbon atom*). If something gains mass, it gains atoms. If it loses mass, it loses atoms. Atoms found in molecules can be rearranged to form new molecules.

- In biology, **energy lasts forever**. Energy cannot be created or destroyed. Energy can exist as light, heat, motion, or as chemical energy stored in the bonds of molecules. Energy in one form can be transferred into a different form (*e.g., light energy can be transformed into heat energy*).

