

Matter & Energy Unit – Week 1

Name: _____ Hour _____ Date: _____

Date Packet is due: after Part 5 Why late? _____

If your work was late, describe why

Score
<input type="checkbox"/> Above & Beyond
<input type="checkbox"/> Fully Complete
<input type="checkbox"/> Mostly Complete
<input type="checkbox"/> Incomplete – <i>fix the following pages:</i>

Driving Question: What happens when something burns?

Anchoring Phenomenon: When something burns (or is combusted), it seems like that substance disappears. What actually happens to the matter and energy within a substance during combustion? Does it disappear? Does it turn into something else? And what actually is a flame? Is it matter, or energy, or something else?

Deeper Questions

1. What happens to matter during combustion?
2. What happens to energy during combustion?
3. How are matter & energy different from each other?

Weekly Schedule

Part 1: Introduction

- Initial Ideas – What is combustion?
- Data Dive – Lost Lumber
- Discussion & Developing Explanations

Part 2: Core Ideas

- Core Ideas
- Revisions of Part 1 Explanations

Part 3: Investigation

- Ethanol Combustion
- Revisions of Part 1 Explanations

Part 4: Review & Assessment

- Ranking Your Readiness
- Assessment

Part 5: Life Connections

- Weekly Recap
- Life Connections



NGSS Standards:

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

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

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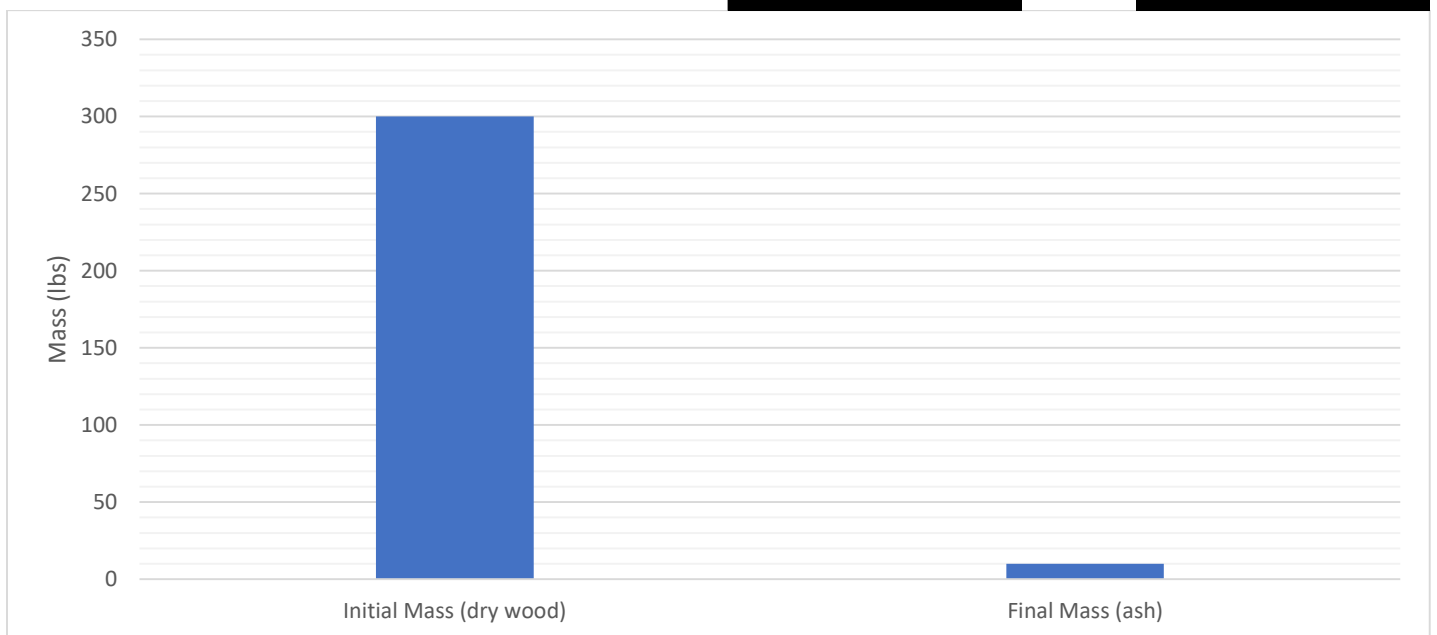
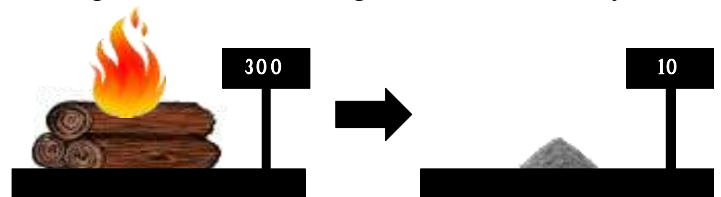
Part 1: Introduction – Lost Lumber

Overview: In this activity, you will begin by discussing your initial ideas about what happens when a substance like a log burns in a fire. 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 happens to wood when it combusts. Read the following responses from students. **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: A high school student sells firewood and must weigh the wood on a large scale because they are paid by the pound. When the student weighs the dry wood, the scale reads 300 lbs. Unfortunately, a spark from a nearby fire lands on some dry leaves on the wood, causing it to burst into flames. Eventually, all that remains is a pile of ashes weighing 10 lbs.



How to read this graph: The initial weight (or *mass*) of the wood can be determined by looking at the first bar on the left (labeled *Initial Mass*). The top of this bar aligns with the value of 300 pounds on the y-axis (the scale on the left-hand side). The final mass of the wood (the ashes) can be determined by looking at the bar on the right. You can see that this bar only goes up to 10 pounds on the y-axis.

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

1. In your groups, answer the following questions:

- a. What was the initial mass of the wood? In other words, how much did the wood weigh initially?
- b. What was the final mass of the wood (i.e., the weight of the ashes)?
- c. What was the total change in mass? (Initial mass – Final mass = Total Change in Mass).

2. What do you think happened to the wood when it burned? As a group, discuss what you think happens when a substance when it burns. Why isn't the mass of the ashes equivalent to the mass of the dry wood? What happened to the other 290 lbs. of matter that was in the wood before it burned?

3. Does this data support or refute any of the claims from Avery, Bristol, and/or Chandra on the previous page? If so, explain.

Discussion & Developing Ideas

1. As a class, discuss your ideas about this data. What are 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...

What happens to the matter and energy in wood when it burns? Write down your initial explanation in the space below. Don't worry if you aren't completely sure about your answer! You will come back and revise this explanation as you gain more information during this unit.



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

Part 2: Core Ideas

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

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

Core Ideas Presentation: <https://bit.ly/WUHS-Bio-MEW1>

Driving Questions:

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?
For each of the following, justify your answer with an explanation.
5. True or false: when something burns, the atoms in that substance are destroyed.
6. True or false: when something burns, the atoms in that substance become energy.
7. True or false: when something burns, the energy in that substance is destroyed.
8. True or false: when something burns, the carbon atoms in that substance are turned into oxygen and hydrogen atoms.
9. True or false: some atoms that were found in dinosaurs exist in organisms that are alive today.
10. True or false: the amount of energy in the universe at the time of the dinosaurs is the same today.
11. **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?

What happens to the matter and energy in wood when it burns?

Remember the following “rules” for energy and matter:

- **All solids, liquids, and gases 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*).

Part 3 Investigation: Combustion Data

Adapted from materials by Carbon TIME

Overview: You will collect evidence to determine what happens to the mass of a substance during combustion.

Materials Needed (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.

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 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.*

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

This activity was completed _____ (instructor signature)

Part A: Combustion & Changes in BTB: 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* CO₂, BTB turns blue. If the air *gains* CO₂, BTB turns yellow. If the amount of CO₂ *doesn't change*, the BTB will stay green.

1. Fill glass Petri dish with green BTB. Record the time and color of the BTB below.
Time: _____ *Color:* _____
2. Acquire a glass Petri dish of ethanol from your instructor. 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 with a lighter 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:* _____

7. **Based on the results, the amount of CO₂ in the air** (*circle one*): increased / decreased / didn't change.

Part B: Combustion & Changes in Mass: In this investigation, you will determine how mass changes as a substance combusts. Your data and observations will help you to determine what is happening during combustion. Remember: if something gains mass, it gains atoms. If it loses mass, it loses atoms.

Methods: Check each box as you complete each step.

8. First, predict how you think that the mass of the fuel will change as it is combusting:

I think that as the ethanol burns, the mass of the fuel burner will _____ because _____

Next, complete each of the following steps for the ethanol combustion lab. Check the box as you complete each step. Your instructor may decide to complete some of these steps for you.

9. 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. Then remove the burner from the scale.

Starting mass of fuel burner with ethanol: _____ g



10. Make sure you are aware of where all fire safety items are located in your room. Then ask your instructor to ignite the ethanol with a lighter 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: _____

11. Observe the burning ethanol and explain what you think is happening to the matter (atoms) in the ethanol as it burns. Are the atoms disappearing? Are they become something else? Be specific.

I think that as the ethanol burns, the atoms in the ethanol... _____

12. Observe the burning ethanol and explain where you think the energy of the fire comes from.

I think that the energy of the fire comes from... _____

13. Observe the burning ethanol; explain what happens to the energy in the fire after the flame goes out.

After the flame goes out, I think that the energy of the fire... _____

14. 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 finish Part B if time allows).

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

15. **Based on the results, the amount of atoms in the ethanol** (circle one): increased / decreased / didn't change

Questions:

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 CO₂ 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.**

7. When your instructor signals that everyone is ready, discuss your findings as a class. **Be sure to address the following:**

- a. Did everyone have similar results for changes in mass and for changes to BTB?
- b. What similarities were there among the ideas of different groups? How did they differ?

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

8. **What happens to the matter and energy in a substance when it burns?** _____

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

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.

What happens to the matter and energy in a substance when it burns?



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 – Fill'er up!

Adopted with permission from [Carbon TIME](#).

Directions: Complete the reading below. Then work in small groups to determine whether you agree or disagree with each stance.

Luis's family stopped at the gas station on the way home one day. Luis's mom filled up the tank with 12 gallons of gasoline. Luis realized that his mom had to fill up the tank every week. He knew that 12 gallons was a pretty big amount. It would take him about 3 months to drink 12 gallons of milk! Where did all that gasoline go? The family started talking about what happens to the gasoline when you drive a car. Here's what they 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 agree with and why? It's ok to pick more than one person. Explain your thinking.



We most agree with _____ because _____

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



Matter & Energy Unit, Week 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.

	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

- A class is determining what happens to the mass of ethanol as it combusts. They recorded data, which is show here. **Based on their data, we can conclude that as ethanol burns...**
 - Its mass **decreases**, meaning the number of atoms in ethanol *increases*.
 - Its mass **increases**, meaning the number of atoms in ethanol *increases*.
 - Its mass **decreases**, meaning the number of atoms in ethanol *decreases*.
 - Its mass **increases**, meaning the number of atoms in ethanol *decreases*.
- If the air *loses* CO₂, BTB turns blue. If the air *gains* CO₂ BTB turns yellow. If the amount of CO₂ *doesn't change*, the BTB will stay green. **Based on their data above we can conclude that...**
 - The amount of CO₂ in the air increased.
 - The amount of CO₂ in the air decreased.
 - The amount of CO₂ in the air did not change.

Determine whether you agree or disagree with each explanation below and provide a justification.

- 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 _____

- 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 _____

- 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.

Remember the following “rules” for energy and matter:

- **All solids, liquids, and gases 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*).