

# Matter & Energy Unit – Week 3

Name: \_\_\_\_\_ Hour \_\_\_\_\_ Date: \_\_\_\_\_

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

<p><u>Score</u></p> <p><input type="checkbox"/> Above &amp; Beyond</p> <p><input type="checkbox"/> Fully Complete</p> <p><input type="checkbox"/> Mostly Complete</p> <p><input type="checkbox"/> Incomplete – <i>fix the following pages:</i></p>
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**Driving Question:** What happens to the matter and energy contained in molecules when a substance is combusted?

**Anchoring Phenomenon:** Throughout this unit, we have explored what happens when something burns. In this final week, we will put all the pieces together to develop sophisticated explanations for the phenomena we have encountered in this unit.

### Deeper Questions

1. What happens to the atoms in molecules during combustion?
2. What happens to energy in molecules during combustion?
3. Why do some things burn and not others?

### Weekly Schedule

#### **Part 1: Introduction**

- Comparative Data Dives.

#### **Part 2: Critiquing Responses**

- Evaluating Sample Responses
- Writing a “Level 3” Response

#### **Part 3: Investigation**

- Combustion Connections

#### **Part 4: Review**

- Jeopardy Review Game

#### **Part 5: Final Review**

- Review of Driving Questions
- Final Q&A



#### **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 combustion?

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

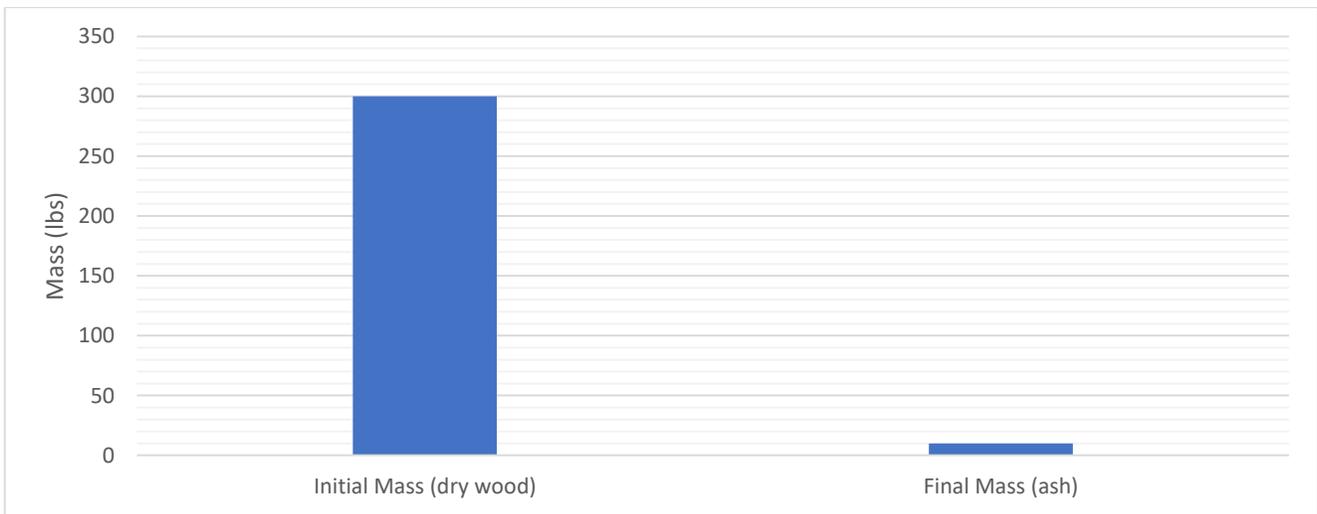
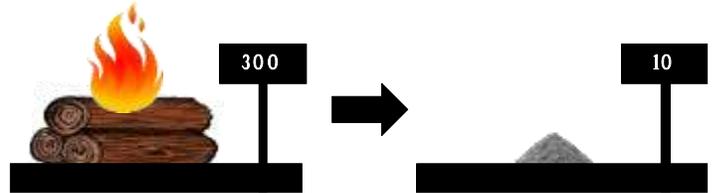
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# Part 1: Introduction – Comparative Data Dives

**Directions:** The following address phenomena we encountered throughout this unit. Construct explanations for each phenomenon and driving questions using the provided terms.

1. Three students share their ideas about combustion. **Do you agree or disagree with each 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. *Agree/Disagree*
  - 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. *Agree/Disagree*
  - 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. *Agree/Disagree*

2. **Burning Logs:** 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.



**What do you think happened to the wood when it burned? What happened to the 290 lbs. of matter that didn't become ashes?**

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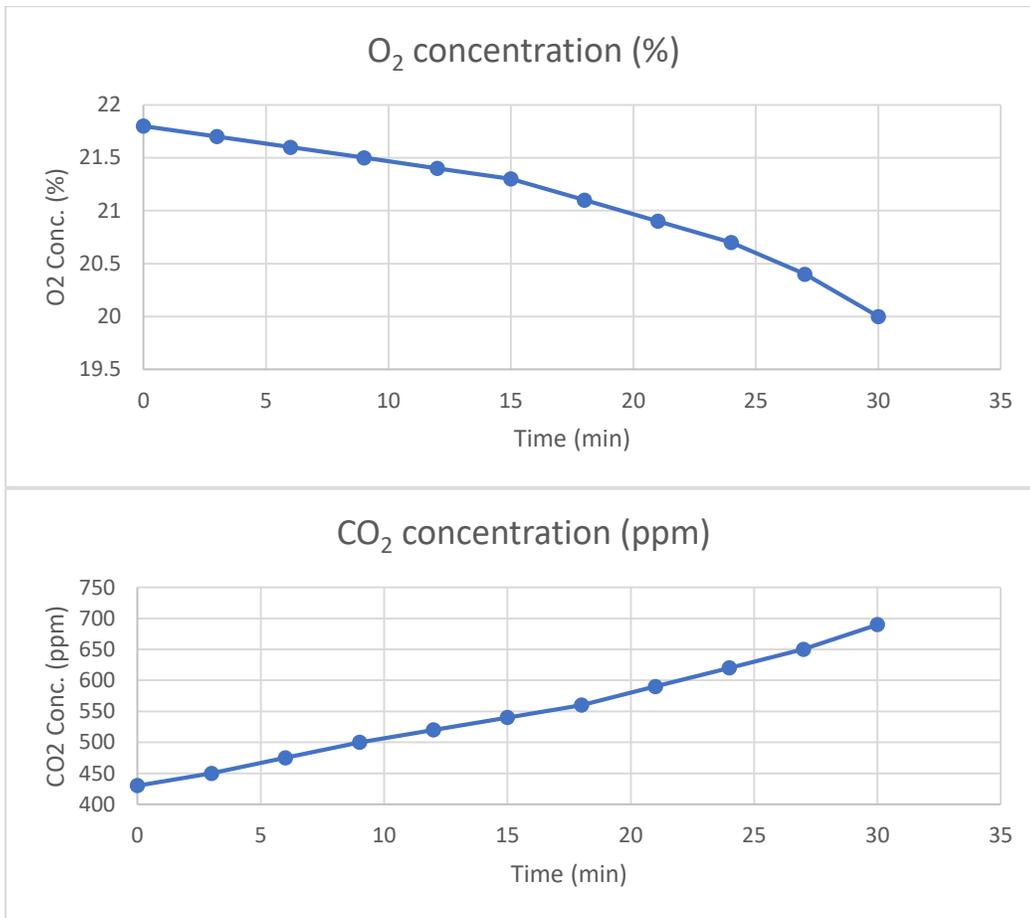
Score this response (1,2,3) - Complete:

Accurate:

Precise:

Overall:

3. A group of students are asked to explain where the energy of a flame comes from as a petri dish of ethanol burns. **Do you agree or disagree with each student's claim?**
- Daryll: "The energy comes from the match or spark used to light the ethanol." *Agree/Disagree*
  - Nina: "The energy comes from the ethanol molecules and is transformed." *Agree/Disagree*
  - Oscar: "The energy of the flame comes from the oxygen in the air." *Agree/Disagree*
4. A class is conducting an experiment. They ignited a petri dish of ethanol inside of a sealed box. The box contained sensors that recorded changes in the amount of oxygen (O<sub>2</sub>) and carbon dioxide (CO<sub>2</sub>) in the air within the box. These changes were recorded in 3-minute intervals. The data is shown below.



**How to read these graphs:** The top graph shows changes in the oxygen (O<sub>2</sub>). The bottom graph shows changes in carbon dioxide (CO<sub>2</sub>). The horizontal x-axis for each graph shows the change in time. The vertical y-axis for each graph shows the change in the amount of each gas (% O<sub>2</sub> and ppm of CO<sub>2</sub>).

To determine trends in each graph, match each point on each line with where it lines up on the x- and y-axis. For example, at three minutes, O<sub>2</sub> was at 21.7% and CO<sub>2</sub> was at 450 ppm. At 6 minutes, O<sub>2</sub> was lower and CO<sub>2</sub> was higher.

**Why do you think that levels of O<sub>2</sub> and CO<sub>2</sub> changed in these ways during combustion? How can we explain these outcomes using what we know about combustion?**

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Score this response (1,2,3) - Complete:      Accurate:      Precise:      Overall:

## Part 2: Critiquing Responses

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**Directions:** Rate each of the following responses and provide a brief written justification for why you think they earned a 1 (*still learning*), 2 (*acceptable*), or 3 (*sophisticated*). If time allows, repeat this same process with your responses on the previous page.

**Q: What is happening to matter and energy when a log burns on a fire?**

**Bristol:** The atoms in the log are turned into energy, which is why we see a flame.

3 2 1 Complete: Do they fully address the entire question and explain all changes to matter & energy?

3 2 1 Accurate: Is every aspect of the written response factually correct?

3 2 1 Precise: Are they effectively using terms from the course in a clear and specific manner?

Overall Score: \_\_\_\_\_ /3 Comments: \_\_\_\_\_

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**Nina:** The atoms from the log are turned into CO<sub>2</sub> and the energy in the log is what makes the fire.

3 2 1 Complete: Do they fully address the entire question and explain all changes to matter & energy?

3 2 1 Accurate: Is every aspect of the written response factually correct?

3 2 1 Precise: Are they effectively using terms from the course in a clear and specific manner?

Overall Score: \_\_\_\_\_ /3 Comments: \_\_\_\_\_

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**Avery:** The atoms in the log's molecules are rearranged with oxygen to form CO<sub>2</sub> and H<sub>2</sub>O. The high energy bonds (C-C, C-H) in the log's molecules are transformed into heat, light, and motion energy of the flame.

3 2 1 Complete: Do they fully address the entire question and explain all changes to matter & energy?

3 2 1 Accurate: Is every aspect of the written response factually correct?

3 2 1 Precise: Are they effectively using terms from the course in a clear and specific manner?

Overall Score: \_\_\_\_\_ /3 Comments: \_\_\_\_\_

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**Chandra:** The energy of the fire comes from the spark that lit the fire, which destroys any atoms that aren't turned into ashes.

3 2 1 Complete: Do they fully address the entire question and explain all changes to matter & energy?

3 2 1 Accurate: Is every aspect of the written response factually correct?

3 2 1 Precise: Are they effectively using terms from the course in a clear and specific manner?

Overall Score: \_\_\_\_\_ /3 Comments: \_\_\_\_\_

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## Part 3: Combustion Connections

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**Directions:** In this activity, you will watch a documentary about combustion and energy production. This will provide an opportunity to connect what you have learned in this unit to real-world considerations.

Movie URL: [Treasures of the Earth – Power History Documentary](#)

**Questions:** Work individually and in small groups to record your answers using scratch paper, a dry erase board, or a digital document. Be prepared to discuss your ideas as a class.

1. How are some substances (like fossil fuels) capable of storing so much energy? How are the molecules within these substances different from non-combustible substances?
2. How does the energy found within fossil fuel become transformed into the electricity used to power our homes and businesses?
3. Where did fossil fuels come from? How did they form?
4. What concerns are associated with the use of fossil fuels? How do we know if these concerns are legitimate?
5. How does the use of fossil fuels correlate to recent changes in atmospheric concentrations of carbon dioxide?
6. Do you think we should continue to use fossil fuels? Why or why not?

## Part 4: Jeopardy Review

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**Overview:** In this activity, you will be playing a Jeopardy-style game to review key concepts from the course. This presentation can be accessed at <https://bit.ly/WUHS-Bio-M&E-Jeopardy>. The rules for this review game are posted within the presentation. You can also use this presentation outside of class to help prepare you for the unit test. Your instructor may decide to use an alternative option (like Gimkit or Kahoot).

# Part 5: Review

**Overview:** For each objective, rank it as a 1 (*completely unsure*), 2 (*somewhat unsure*), or 3 (*completely sure*) based on your comfort with that objective. Pay special attention to **bold** items.

- 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.
5. True or false: when something burns, the atoms in that substance become energy. Explain.
6. True or false: when something burns, the energy in that substance is destroyed. Explain.
7. True or false: when something burns, the carbon atoms in that substance are turned into oxygen and hydrogen atoms. Explain.
8. True or false: some atoms that were found in dinosaurs exist in organisms that are alive today. Explain.
9. True or false: the amount of energy in the universe when dinosaurs existed is the same today. Explain.
- 10. What happens to the matter and energy in wood when it burns?**
11. What is a chemical bond? If we look at a model of a molecule, what represents a chemical bond?
12. How can molecules contain energy if matter and energy are separate things?
- 13. What is a high energy bond? How would we know if something contains high energy bonds?**
14. What makes something a “fuel”? What primarily determines the amount of energy within a molecule?
15. What must happen to high energy molecules in order to transform its chemical energy into other forms of energy (such as light, heat, and motion)?
16. Where does the energy of a fire come from?
- 17. Both ethanol and water are clear liquids. Why does ethanol burn but water does not?**
18. What must happen to molecules with high energy bonds to transform its chemical energy into other forms of energy (such as light, heat, and motion)?
19. Where does the heat, light, and motion energy of a flame come from?
20. “Combustion reactions are rearrangement reactions.” What does this mean? Explain in your own words.
21. Both ethanol and water are clear liquids. Why does ethanol burn but water does not?
22. True or false: the amount of atoms and the amount of energy that exists after combustion ends is the same as before combustion occurs. Explain.
23. Explain combustion in a way that specifically addresses our “three rules” of matter and energy:  
1) All matter is made of atoms. 2) Atoms last forever. 3) Energy lasts forever.
- 24. What happens to the matter and energy in molecules when a substance is combusted?**

**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.