Matter & Energy Unit – Week 1 Labwork

Name: _____ Hour_____Date: _____

Date Packet is due:_____ Why late? _____Score: _____
Day of Week Date If your project was late, describe why

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?

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
- Data Dive – Lost Lumber
- Discussion & Developing Explanations

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

Part 3: Investigation
- Ethanol Combustion
- Revisions of Part 1 Explanations
- Optional: Voluntary Quiz

Part 4: Review & Assessment
- Critiquing Ideas
- 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 and food 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: What are plant cells made from?
Week 2: How do plants get their food?
Week 3: What happens inside plant cells?
Week 4: Unit Assessment

Ecosystems

Week 1: How do living organisms affect each other?
Week 2: Tracing Matter
Week 3: Global Biodiversity
Week 4: Humans & Biodiversity

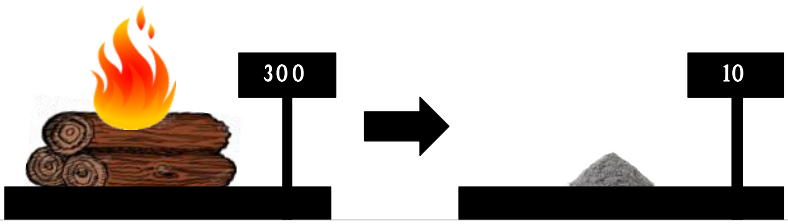
Part 1: Introduction

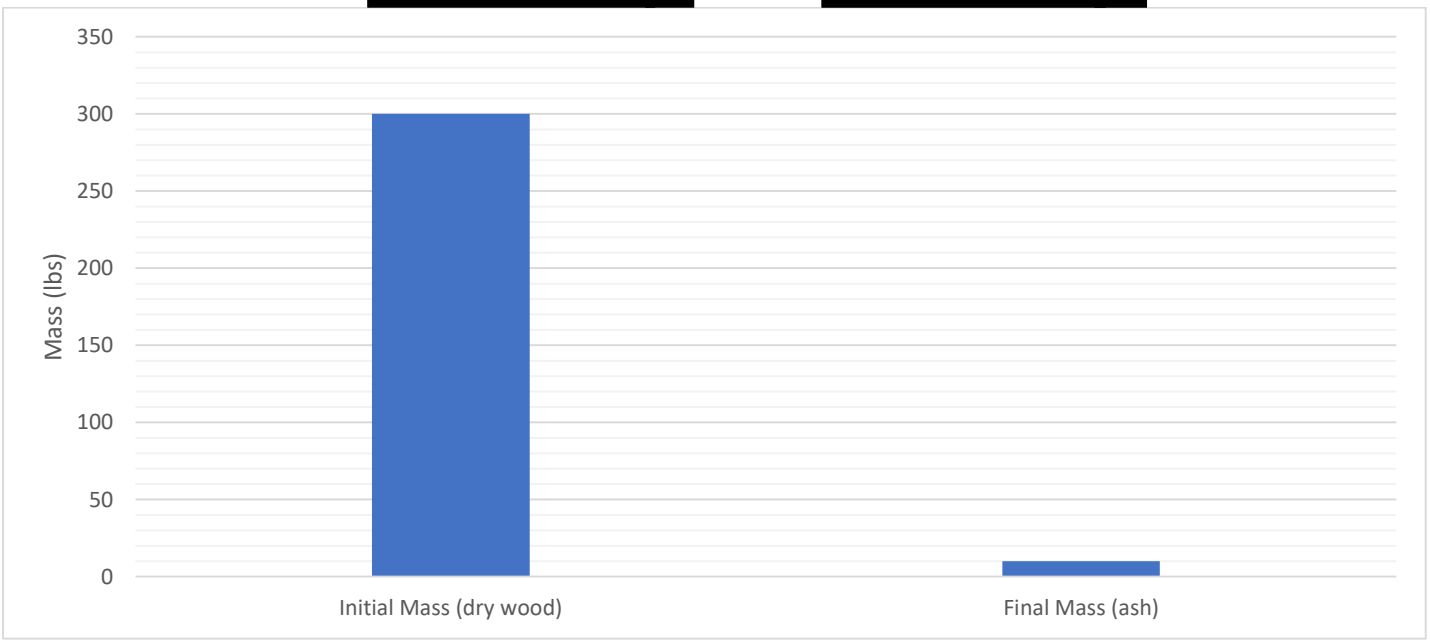
Overview: In this activity, your group will review data from two different scenarios in order to identify patterns and trends that you will use to develop an explanatory model. You will then compare your observations and explanations to those of other groups in order to check your accuracy and refine your explanatory model.

Data Dive: Lost Lumber

Directions: Begin by reading the hypothetical scenario below. Then look at the data provided below. Use this information to answer the questions on the following page. If you are unsure about how to interpret the data, work with your group and seek help from your instructor if necessary. Your instructor will decide if you should record your answers using the space provided in this packet, a dry erase board, a digital document, or another option.

Introduction: A high school student sells firewood to a state park campground as a part time job. This student must weigh the wood on a large scale at the state park 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. Because the wood is dry, it burns rather quickly. After a while, all that remains are 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 column aligns with the value of 300 lbs. 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 column only goes up to 10 lbs. on the y-axis.

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. **A group of students are asked to explain what happened to the mass of this wood. Read the following responses from students.**
    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.

3. **For each response, decide as a group whether you agree, partially agree, or disagree. Then briefly provide your reasoning for your decision. If you are unsure, provide your best guesses at this time.**

    Avery: agree partially agree disagree

    Reasoning: _____

    _____

    Bristol: agree partially agree disagree

    Reasoning: _____

    _____

    Chandra: agree partially agree disagree

    Reasoning: _____

    _____

4. **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?

    _____

    _____

    _____

Be prepared to discuss your ideas with other groups and/or as a class. If you have prior experiences or knowledge that can be helpful, please share this with when you are discussing your ideas.

Part 2: Core Ideas

Overview: In this activity, you will begin by watching a short video. This will help to clarify some of the questions you may have had yesterday.

Next, you will look at 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 a digital document 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.*

Nutshell Video: https://www.youtube.com/watch?v=ktFZTp9ZUbQ

Core Ideas Presentation: https://bit.ly/wuhsbio-me-w1

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.

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?

I think that when the wood burned… _____

Remember the following "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*). If something gains mass, it gains atoms. If it loses mass, it loses atoms. 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 3: Investigation

Overview: In this activity, you will be collecting two forms of evidence to determine what happens to the mass of a substance during combustion. The first source of evidence is the change in mass; if something gains mass, it gains atoms. If it loses mass, it loses atoms. The second is a chemical called BTB. When you start the investigation, it should be green. If it turns yellow, the surrounding air gained CO_2 molecules. If it turns blue, the surrounding air lost CO_2 molecules. (*Overview video*: https://www.youtube.com/watch?v=TZ6rlZdwDzU).

Materials Needed (per group): glass petri dishes (2); ethanol; digital scale or balance; lighter (your instructor may choose to light your petri dishes for you); a large container (to put out the flame); safety glasses/goggles

Directions:

1. **Begin by reviewing the ideas from Parts 2 with your group**. Check to see if anyone is unsure about any of these concepts.
2. **Next, briefly return to the data and questions from Part 1.** Briefly address each question as a team.
    a. Are you better able to answer these questions now than the first time you tried?
    b. How have your answers changed since you first saw these questions?
3. **Next, complete the predictions questions below:**

    A. How do you think that the mass of the ethanol and petri dish will change as a result of combustion?

    *I think that the mass of the petri dish and ethanol will*_____ *because* _____

    _____

    B. **What do you think will happen to the matter in the ethanol when it is combusted?** Will it disappear? Will it become something else? Be as specific as you can:

    _____

    _____

    C. **What will happen to the amount of energy in the petri dish?** Will it increase, decrease, or stay the same? Explain:

    _____

    _____

    D. **How will you be able to tell if energy and/or matter is being transformed?** List all the things that you could observe or measure that would suggest that energy and matter are being changed:

    _____

    _____

4. **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.
    a. ☐ Add ethanol to an open glass Petri dish.
    b. ☐ Turn on a digital scale so that it reads "0" g. Place the Petri dish with ethanol on the scale. Record the mass of the ethanol and Petri dish below:

       Starting mass of ethanol and petri dish: _____ *g*
    c. ☐ Fill another Petri dish with fresh blue BTB. Record the time and color of the BTB below.

       Time: _____ *Color:* _____
    d. ☐ Place the Petri dish with BTB next to the Petri dish with ethanol. Be sure the large container fits on top of the two dishes.
    e. ☐ 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. Observe: the flame will go out quickly inside the container.
    f. ☐ If time allows, your instructor may guide a class discussion about your predictions. If so, pay attention to see if others had similar or different ideas as each group presents their results.
    g. ☐After about 20 minutes, remove the container. Observe the color of the BTB. Record this in Part C.
    h. ☐ Place the Petri dish with ethanol on the digital scale and record the mass below.

       Ending mass of ethanol and petri dish: _____ *g*

       Time: _____ *Color:* _____
5. **Answer the questions on the next page** after reviewing the "rules" for matter and energy below.

Remember the following "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*). If something gains mass, it gains atoms. If it loses mass, it loses atoms. Atoms found on molecules can be rearranged to form new molecules.
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6. A. If mass changes, matter has moved. If something gains mass, it gains matter. If something loses mass, it loses matter. **Did matter move from one place to another in this activity? Explain using data.**

B. **If there was matter movement, where did the atoms in the fuel go? Did they disappear, or did something else happen?** Explain using evidence from the investigation.

C. **What changes did you observe in the BTB**? _____

What does this indicate? _____

D. 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?
    b. Did everyone have similar results for changes to BTB?
    c. What similarities were there among the ideas of different groups? How did they differ?

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?

8. ***I think that when something burns***… _____

9. A friend explains to you that when something is burned, that substance is "used up" and the matter and energy in that substance disappears as it is burned. **Are they correct? Explain.**

Part 4: Review & Assessment

Overview: you will begin by reviewing the driving questions below in your small groups. For each objective, rank it as a 1 (*completely unsure*), 2 (*somewhat unsure*), or 3 (*completely sure*) based on your comfort with that objective. Then work in teams to create responses to the questions (your instructor will determine if you will answer all the questions or only a portion).

After you have had time to create your responses, you will critique the responses of another group before coming together as a whole class. Be sure to use the "rules" for matter and energy as you do so. You will conclude by completing an assessment for this week's ideas.

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.
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7. True or false: when something burns, the energy in that substance is destroyed.
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Remember the following "rules" for energy and matter:

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- 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 5: Life Connections

Overview: For this activity, you will begin with a recap of the things that you learned in this packet. You will then have a discussion to see how this relates to your life in general. If time is limited, your instructor may decide to postpone some of these options.

Weekly Recap (use a whiteboard, scratch paper, online document, etc.)

1. Summarize everything that you have learned through this packet within your group. Try to identify the common themes, major ideas, and most important concepts from the content you have learned.

2. Is there anything that anyone still doesn't completely understand? Is there anything that anyone maybe disputes or disagrees with? Did anything seem particularly surprising or noteworthy?

3. What you think are the most important ideas and concepts that you have learned so far. Aim to have at least 5 or 6 ideas written down. It is ok to have more than this.

Life Connections: In this activity, students will break into teams based on their personal interests and/or career aspirations. They will then work in their assigned teams to address the questions below. After a sufficient amount of time, students will summarize their discussions for the class.

1. As a group, try to determine how these ideas relate decisions you will make in your future life. Specifically…
   a. How do these concepts relate to prior knowledge or experiences from your life?
   b. How could your prior knowledge and experience help you to better understand these concepts?
   c. How might your daily activities in your life be affected by these concepts?
   d. How might the decisions you make as part of your career be influenced by these ideas?

2. As you listen to the ideas presented by other groups, listen for any ideas you might have missed that might be relevant to your life.