

# How the Sun Works – 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:** How does matter and energy change during combustion?

**Anchoring Phenomenon:** When something burns (or is *combusted*), energy is released in the form of heat and light. Where does this energy come from? *These introductory lessons will prepare us to ask more complicated questions about changes in matter and energy within the sun.*

### 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 – Birthday Candle Energy
- Discussion & Developing Explanations

#### **Part 2: Core Ideas**

- Core Ideas
- Revisions of Part 1 Explanations

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

- Molecular Modeling
- Revisions of Part 1 Explanations
- Optional: Voluntary Quiz

#### **Part 4: Review & Assessment**

- Critiquing Ideas
- Assessment

#### **Part 5: Side Quest**

- Weekly Recap
- Side Quests



#### **NGSS Standards:**

HS-ESS1-1: Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun’s core to release energy that eventually reaches Earth in the form of radiation.

### Semester Schedule

#### **How the Sun Works**

Week 1: What is matter? What is energy?

Week 2: What’s inside the sun?

Week 3: How can we measure the sun?

Week 4: Where does the sun’s energy come from?

Week 5: Unit Assessment

#### **The Life of Stars**

Week 1: How long do stars last?

Week 2: Why do stars die?

Week 3: What happens after stars die?

Week 4: Unit Assessment

#### **How It All Began**

Week 1: How can we determine the universe’s size?

Week 2: How can expansion determine the universe’s age?

Week 3: What can we learn from background radiation?

Week 4: Unit Assessment

#### **Navigating Space**

Week 1: How and why do things orbit in space?

Week 2: How can we predict orbits?

Week 3: Unit Assessments

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# Part 1: Introduction

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**Overview:** In this activity, your group will use a simple example of a birthday candle to record your ideas about matter and energy. This will prepare you to address more complex questions about how matter and energy change within the sun.

**Directions:** Your instructor will provide your group with a small candle. After they ignite the candle, observe the flame. Then work with your group to address the questions below.

1. The fire releases heat and light (and other forms of energy). **Where is this energy coming from?**
2. **What is happening to the atoms within the molecules of the candle as it burns?**
3. As a candle burns, it seems like it disappears. Three students try to explain what happens to the candle as it burns. **Which of the following seems most accurate? Why?**
  - a. Avery thinks that the atoms in the candle were turned into heat and light energy in the flame, and that the energy dissipated away. This causes a loss of mass.
  - b. Bristol thinks that the fire destroys the atoms in the candle, causing a release of energy that can be detected as light and heat.
  - c. Chandra thinks that the molecules that comprise the candle are being rearranged into new molecules that aren't visible to our eyes; this process gives off energy.
4. **What happens to the matter and energy in molecules of the candle when it is combusted?** *It's ok you aren't completely sure about your answer! You will come back and revise this explanation again.*

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5. Like a flame on a birthday candle, the sun also releases light and heat energy. **In the space below, record how these examples are both similar and different.** It is ok if you are unsure at this time – record what you are currently thinking; if your thinking changes, you can revise this portion later.

Similarities

Differences

## Part 2: Core Ideas

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**Overview:** In this activity, 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 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/WUHSAstroSunW1>

### 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 four kinds of energy? How are these all related to each other?
5. How can molecules contain energy if matter and energy are separate things?
6. What makes something a “fuel”? What determines the amount of energy contained within a molecule?
7. What do gasoline, ethanol, and sugar molecules have in common that make them “high energy” molecules?
8. Can we directly use the energy contained within high energy molecules? What has to happen in order for this energy to become available for use?
9. When we see flames during combustion, what is it that we’re actually seeing?
10. Both ethanol and water are clear liquids. Why does ethanol burn but water does not?
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 molecules of the candle when it is combusted?**

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### 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*).
- 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.
- **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 investigation, you will use modeling clay to create physical models to explain how matter and energy change when a substance is combusted. We'll model combustion using simpler ethanol molecules.

**Materials Needed (per group):** modeling clay (such as Playdoh), toothpicks, tape or twist ties, paper towel.

**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. *How can molecules contain energy if matter and energy are separate things?*
2. *What makes something a "fuel"? What determines the amount of energy contained within a molecule?*
3. *Both ethanol and water are clear liquids. Why does ethanol burn but water does not?*
4. *What happens to the matter and energy in molecules when a substance is combusted?*

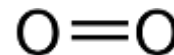
When you think you are ready, **raise your hand**. Your instructor will listen to your verbal responses.

*This activity was completed \_\_\_\_\_ (instructor signature)*

**Directions:** In this investigation, you will create molecular models to explore what happens to matter and energy during combustion. *Scientific models* are tools that help us clarify our thinking and make more accurate predictions. Models can be pictures, examples, scale models, or anything that helps us reason more accurately about a concept. Use the following instructions to create each of your molecules.

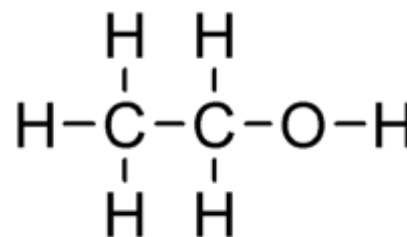
**1. Using the modeling clay provided, create three molecules of oxygen gas (O<sub>2</sub>).**

- a. You will need six 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 three molecules of oxygen (O<sub>2</sub>).



**2. Using the modeling clay provided, create one molecule of ethanol (C<sub>2</sub>H<sub>5</sub>OH).**

- a. Using the same color as you used previously for oxygen, create one ball of that color for the oxygen atom.
- b. Using a different color, create two balls of that color for the carbon atoms.
- c. Using a third color, create six balls of that color for the hydrogen atoms.
- d. Mark any high energy bonds (C-C and C-H) with a twist tie, piece of tape, or any other physical marker that your instructor has provided.
- e. Using the image at the right as a guide, connect these atoms (*one toothpick between each atom*).



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

*This activity was completed \_\_\_\_\_ (instructor signature)*

**4. Disassemble your O<sub>2</sub> and ethanol molecules. Using the same clay atoms you used to create the oxygen gas and ethanol molecules, create CO<sub>2</sub> and H<sub>2</sub>O using the following instructions:**



# Part 4: Review & Assessment

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**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 molecules when a substance is combusted?**

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# Part 5: Side Quest

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**Overview:** For this activity, you will identify topics related to astronomy that you personally find interesting to investigate more deeply over the remainder of the semester.

1. What are three topics within the field of astronomy that you personally find interesting and would like to investigate more deeply? Examples could include the Mars rover missions, the James Webb Telescope, the search for life on other planets, the international space station, and many others.
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2. Of these options, circle or put a star next to the topic that you most find interesting.
  3. Did anyone else in the class identify a similar topic as you for their most interesting option? Could you work as partners or in a team to develop a more in-depth presentation on this topic?
  4. Use a textbook, internet browser, or other acceptable options to learn more about this topic. Use this information to a) determine if you are still interested in this topic, and b) select a narrower scope within this broader topic.
  5. In the space below, summarize the topic that you would like to investigate as a semester-long side quest.
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*Check with your instructor to make sure that this topic is feasible but sufficiently in-depth for a full semester of independent work. If needed, you might consider doing multiple projects based on the other options listed above if this topic is not sufficient to fill a full semester.*



