Conservation of Matter Unit – Week 2

Score
- □ Above & Beyond
- □ Fully Complete
- □ Mostly Complete
- □ Incomplete – *fix the following pages*:

Name: _____ Hour_____ Date: _____

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

Driving Question: Why do some substances change with heat?

Anchoring Phenomenon: Mixing cookie dough results in different kinds of changes than when you bake cookie dough. How can we explain these differences? In this unit, we will investigate different ways in which matter can change. We will use this as a basis for reasoning about how chemical reactions differ from other ways matter can change.

Deeper Questions

1. What are different ways in which we can describe and classify matter?
2. What is the difference between a physical change and a chemical change?
3. How does matter change when something melts or freezes?
4. What are different ways that different forms of matter can mix?

Weekly Schedule

Part 1: Introduction
- Initial Ideas – How does baking change cookie dough?
- Data Dive – Is baking reversible?
- Discussion & Developing Explanations

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

Part 3: Investigation
- Separation Techniques

Part 4: Review & Assessment
- Ranking Your Readiness
- Assessment

Part 5: Life Connections
- Weekly Recap
- Life Connections – Midwest Mining

NGSS Standards:
HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Semester Schedule

Conservation of Matter
Week 1 - What happens to a substance when it dissolves?
Week 2 – Why do some substances change with heat?
Week 3 – How can we know what is in substances?
Week 4 – Assessment

Atoms & Its Parts
Week 1: What are atoms?
Week 2: Electrons & Energy
Week 3: How do the parts of an atoms determine its properties?
Week 4 - Assessment

Periodic Table
Week 1: Why do elements have unique properties?
Week 2: What does the periodic table tell us?
Week 3: How do atomic properties relate to the PT?
Week 4 - Assessment

Bonding
Week 1: Why do atoms bond?
Week 2: How do atoms bond?
Week 3: How do atomic properties predict formulas?
Week 4 - Assessment

Part 1: Intro – Making Dough & Baking Cookies

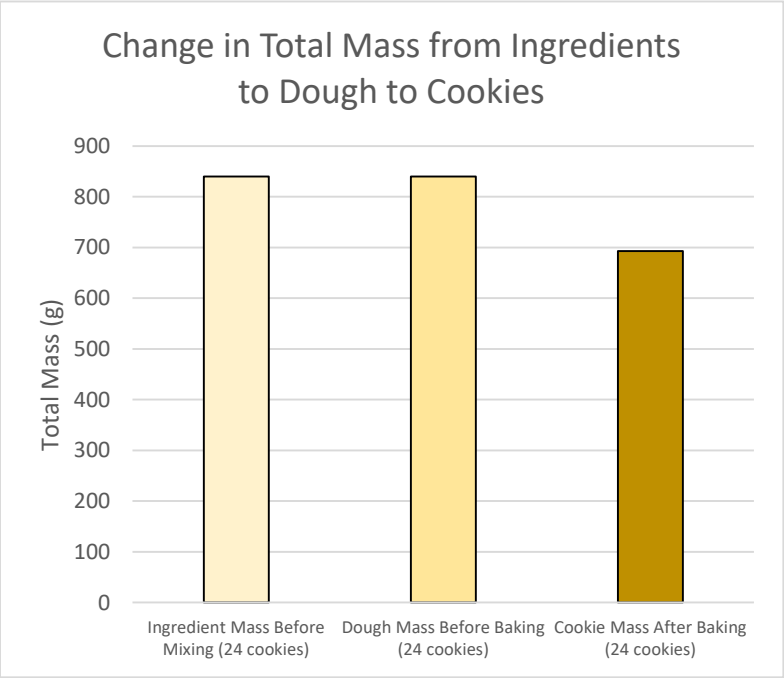
Overview: In this activity, you will begin by discussing your initial ideas about the differences in how matter changes when mixing dough as compared to when you bake cookies.

Initial Ideas: Nina is making cookies with her family. As she is mixing the ingredients to make the cookie dough, she wonders about how the different ingredients change as she follows each step of the recipe. For example, she realizes that she could probably separate the individual grains of sugar, salt, and flour from each other before baking the cookies, but not after. She's not sure why this would be. Her friends come over to eat the cookies, and they discuss their ideas.

1. Three students shared their ideas. **Do you agree or disagree with each student's claim?**
   a. Nina: "I think that the salt, flour, and sugar dissolve in the milk and eggs when they heat up." Agree/ Disagree
   b. Daryll: "I think that the heat causes these substances to evaporate into the air." Agree / Disagree
   c. Marisol: "I think that the atoms in the salt, sugar, and flour molecules are rearranged to form new molecules." Agree / Disagree

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: Nina is very interested in science and decided to record some data and observations. She used a kitchen scale to record changes in mass before mixing ingredients, before baking the dough, and after baking. She also recorded other observations, including changes in color, odor, and texture.



Type of Observation	While Mixing Ingredients	After Baking Dough
Color	Blend of ingredients' colors	Dough color darkened after baking
Odor	Blend of ingredients' odors	Baked cookies smell different than dough
Texture	Mixture of liquids and solids	All solid (once cooled)
Other	Solid ingredients could be separated	Visible bubbles formed during baking

1. **Begin by individually attempting to make sense of this data**. 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 agreement? Can others' prior knowledge/experience help?

3. **Based on this data, what is one conclusion that would be supported by this data?** How is your conclusion supported by data? What specifically suggests your claim is accurate?

4. **Based on this data, what is a second conclusion that would be supported by this data?** How is your conclusion supported by data? What specifically suggests your claim is accurate?

5. **Would you change any of your responses to the Initial Ideas questions on the previous page?** Discuss as a team.

6. **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…

7. **How did the matter in the cookies change when it was mixed to form the dough compared to when the dough was baked into cookies? Why did these differences occur?** Record your initial explanation in the space below. It's ok if you aren't completely sure! You will revise this explanation over time.

_____

_____

_____

_____

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-Chem-MatterW2

Driving Questions:

1. Summarize four different kinds of phase changes in matter.
2. How do the interactions between atoms change depending on if a substance is a solid, liquid, or gas? How do the physical properties of a substance change if a substance is a solid, liquid, or gas?
3. What is the difference between elements and compounds?
4. What is the difference between a mixture and a pure substance? What is one way in which we could determine if a substance is pure or a mixture?
5. What is the difference between a heterogeneous and homogeneous mixtures?
6. What is the difference between a physical change and a chemical change? What is the most important criteria for making this determination? What are other forms of evidence that can be used?
7. Develop a conceptual model to predict and explain whether changes to matter result in elements, compounds, heterogeneous mixtures, or homogenous mixtures. Identify specific criteria needed to make these determinations. Then test your conceptual model with the following scenarios:
    a. Water (H_2O) is a liquid, but oxygen and hydrogen exist as gases. How is this possible?
    b. Brass contains both copper and zinc. Is brass an element, a compound, or a mixture? Defend your claims with evidence and reasoning.
    c. During photosynthesis, molecules of water are rearranged with molecules of carbon dioxide to form glucose and oxygen molecules. Alternatively, seltzer is water mixed with carbon dioxide. Why do the same ingredients form very different products in each case?
    d. How would you determine if milk is an element, a compound, or a mixture? Summarize the criteria you would use to make this determination.
    e. How does mixing salt with water differ from mixing salt with sand? Why do these differences occur?
8. **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?

How did the matter in the cookies change when it was mixed to form the dough compared to when the dough was baked into cookies? Why did these differences occur?

_____

_____

Part 3 Investigation: Separation Techniques

Overview: In this investigation, you will investigate how changes to matter can be classified based on your conceptual models from Part 2.

Pre-Investigation Questions: Work as a group to determine the best response to each question. Be prepared to provide verbal answers for some of these questions for your instructor before you complete the investigation.

1. *How could you determine whether a sample of matter is a pure substance or a mixture?*
2. *How could you determine whether a pure substance is an element or a compound?*
3. *How could you determine whether a mixture is heterogeneous or homogeneous?*
4. *How could you determine whether reaction is a chemical change or a physical change?*

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

This activity was successfully completed _____ (*instructor signature*)

Materials: one test tube per group containing a mixture of salt, sand, iron filings, and polystyrene/Styrofoam; magnets; evaporating dishes; filter paper; tweezers; beakers; stir rods; funnels; scoops; hot plates; ring stand; water.

Methods: Check each box as you complete each step.

1. ☐ For each component in your mixture, determine if it is an a) element, b) compound, c) heterogeneous mixture, or d) homogeneous mixture. Then provide a justification based on evidence, reasoning, and your conceptual models. You may need to use an internet search engine to gain more information.

   Salt - a) element, b) compound, c) heterogeneous mixture, or d) homogeneous mixture - _____

   How you know: _____

   Sand - a) element, b) compound, c) heterogeneous mixture, or d) homogeneous mixture - _____

   How you know: _____

   Iron - a) element, b) compound, c) heterogeneous mixture, or d) homogeneous mixture - _____

   How you know: _____

   Polystyrene - a) element, b) compound, c) heterogeneous mixture, or d) homogeneous mixture - _____

   How you know: _____

   Mixture - a) element, b) compound, c) heterogeneous mixture, or d) homogeneous mixture - _____

   How you know: _____

2. ☐ Develop a plan to separate each component from the rest of the mixture. Start with items that will be easiest to separate. Determine whether this plan reflects a physical or chemical change and explain.

Component: _____ How will you separate it from the rest of the mixture?

_____

_____

Does this process reflect a physical or a chemical change? _____ How do you know?

_____

_____

Component: _____ How will you separate it from the rest of the mixture?

_____

_____

Does this process reflect a physical or a chemical change? _____ How do you know?

_____

_____

Component: _____ How will you separate it from the rest of the mixture?

_____

_____

Does this process reflect a physical or a chemical change? _____ How do you know?

_____

_____

Component: _____ How will you separate it from the rest of the mixture?

_____

_____

Does this process reflect a physical or a chemical change? _____ How do you know?

_____

_____

3. ☐ You will need approval from your instructor before you can begin your work. When you think you are ready, **raise your hand**. Your instructor will listen to your verbal responses. All group members should be involved in providing verbal responses.

   This was successfully completed _____ (*instructor signature*)

4. ☐ Before starting your approved separation techniques, record the mass of your test tube and mixture in the space provided. As you separate each substance from the mixture, record its mass in the space provided.

Data and Post Lab: Complete the following

Preliminary Masses	Post Separation Masses	Instructors Inspection
Mass of test tube and Sample (g)	Mass of Salt (g)	Salt:
Mass of empty Test Tube (g)	Mass of Sand (g)	Sand:
Calculate: Mass of Sample (g)	Mass of Iron (g)	Iron:
	Mass of Styrofoam (g)	Styrofoam:

5. Calculate the total mass of the 4 samples you collected. Show your work.

6. Calculate the percent difference / error of the amount your group collected. (How far "off" was the final total mass compared to the original total mass of the mixture?)

$$\%Difference = \left(\frac{|Difference\ in\ Mass|}{Original\ Mass}\right) x100$$

7. What are some reasons why a group's final mass might be LESS than the original mass? _____

   _____

8. What are some reasons why a group's final mass might be MORE than the original mass? _____

   _____

9. Is it possible that atoms were created or destroyed as you were completing these steps? Explain. _____

   _____

   _____

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.

How did the matter in the cookies change when it was mixed to form the dough compared to when the dough was baked into cookies? Why did these differences occur?

_____

_____

Part 5: Life Connections – Midwest Mining

Directions: For this activity, you will consider a real-world scenario related to our topics this week. You will use your understanding of this week's content to develop an explanation based on the evidence provided.

Background: The upper Midwest has a long and rich history of mining. States like Wisconsin, Minnesota, and the upper peninsula of Michigan contain abundant deposits of iron and copper. In fact, the term *Wisconsin Badgers* was not actually a reference to the animal; initially it was the nickname for early miners in the state who lived in their mines during the winter. Minerals found in these areas are important for manufacturing. In particular, iron is needed for the steel that is needed for automobiles, trains, heavy equipment, and other forms of manufacturing.

Initial Questions: work in your assigned groups to answer the questions below. Record your group's ideas using scratch paper, a dry erase board, a digital document, or another option.

1. Do you think that mining entails physical changes, chemical changes, both, or neither?
2. What evidence and reasoning support your claims?
3. What additional information would you need to confirm your ideas?
4. How might your ideas be inaccurate? What assumptions are making that might be inaccurate?

Going Deeper: Next, read the excerpts below. These are challenge texts that will generally be above your capacities as a high school student. As you read the texts, underline any words that are challenging or unfamiliar. Complete an initial read-through, and check with your group to reach an initial consensus about the key points of the excerpt. Then use an internet search engine to look up unfamiliar terms and/or find additional information to help you make sense of these readings. *(Adapted from a post by Monroe).*

Steel and iron are two of the most common materials used in the manufacturing industry. They are used to make a wide range of products and components. While iron and steel look similar, though, they are two unique materials with their own respective characteristics and qualities.

Iron is a lustrous and ductile metal with the atomic number 26. It has a chrome-colored appearance that reflects a significant amount of light. Iron is also a ferromagnetic metal, meaning it's magnetic and attracts other ferromagnetic metals.

Steel, on the other hand, is a ferrous alloy consisting primarily of iron and carbon. Many people assume that steel is a metal, but this isn't necessarily true. While it exhibits similar properties as metals, it's technically classified as an alloy. Metals occur naturally as an element, whereas alloys consist of multiple mixed elements and components that aren't found naturally as an element. You can find iron naturally as an element. In fact, it's the most abundant element on Earth. But you won't find steel anywhere in Earth's outer or inner core, as it's a man-made alloy that requires mixing iron and carbon.

All steel contains iron, but it also contains carbon. The addition of carbon is what distinguishes iron from steel. By weight, steel contains about 2.14% carbon. Although that's a relatively small amount of carbon, it results in significant physical changes. Steel, for example, is both harder and stronger than pure iron. And unlike iron, steel isn't an essential mineral. You don't need to consume steel as part of your diet.

The primary difference between iron and steel is that the former is a metal, whereas the latter is an alloy. Iron is simply a metal element that occurs naturally on Earth. In comparison, steel is a man-made alloy that's made by mixing iron and carbon together.

Deeper Questions: work in your assigned groups to answer the questions below. Record your group's ideas using scratch paper, a dry erase board, a digital document, or another option.

1. Summarize this excerpt. What are the key points?
2. How might this information relate to our content from this week?
3. How could you use this information to improve your hypotheses about this case?
4. How might your ideas be inaccurate? What assumptions are making that might be inaccurate?
5. How would you classify iron and steel? a) element, b) compound, c) heterogeneous mixture, or d) homogeneous mixture. Explain.
6. When you think you are ready, **raise your hand**. Your instructor will listen to your verbal responses. All group members should be involved in providing verbal responses.

This was successfully completed _____ (*instructor signature*)

Cultural Connections: the SS *Edmund Fitzgerald* was American freighter ship that sank during a storm on November 10, 1975 in Lake Superior. When it first launched in 1958, it was the largest ship on the Great Lakes at 222 meters (729 feet) long. It is still the largest ship to have ever sunk on the Great Lakes. This inspired Gordon Lightfoot's hit song "*The Wreck of the Edmund Fitzgerald*" in 1976, making it one of the most famous shipwrecks in history.

The *Edmund Fitzgerald* left Superior, WI with a full cargo of iron ore pellets on November 9, 1975. These were intended to be used at a steel mill in Detroit, MI. By the second day, a strong storm resulted in hurricane force winds and waves as high as 11 meters (35 feet). Shortly after 7:00 p.m. on November 10th, the *Edmund Fitzgerald* suddenly sank 27 kilometers (17 miles) from Whitefish Bay, MI. The exact cause of the sinking is not known, but it is evident that the intense storm conditions on Lake Superior played a significant role.

(Info Sources: Britannica; UW-Madison. Image source: Wikimedia)

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Conservation of Matter - Week 2 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.

1. **Water vapor in the air condenses and forms rain. As the temperature decreases, puddles of rainwater freeze to form ice. Do these changes reflect a physical or a chemical change? How do you know?** Include and underline the following terms: *phase, atoms, molecules.*

   _____

   _____

   _____

   Writer's Name:

2. Three students shared their ideas about changes to matter that result from baking. **Do you agree or disagree with each student's claim**?
   a. Nina: "I think that the salt, flour, and sugar dissolve in the milk and eggs when they heat up." Agree/ Disagree
   b. Daryll: "I think that the heat causes these substances to evaporate into the air." Agree / Disagree
   c. Marisol: "I think that the atoms in the salt, sugar, and flour molecules are rearranged to form new molecules." Agree / Disagree

   Which claim(s) is/are most accurate? _____**Why**? _____

   _____

   _____

   _____

   Writer's Name:

3. **Some of cars in the school parking lot are old and have a lot of rust. A) Use evidence to explain whether this reflects a physical or a chemical change. B) Then use evidence to explain if the rust is an element, compound, homogeneous mixture, or a heterogeneous mixture.**

   _____

   _____

   _____

   _____

   Writer's Name:

4. **An egg falls into a hot frying pan, resulting in observable changes (e.g., the clear portion turns white; liquid components turn into solids). Use evidence to explain whether this reflects a physical or a chemical change.**

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_____

_____

_____

_____

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Writer's Name:

5. **A classmate has what they assumed to be a ring made of pure gold. A) Use evidence to explain whether the gold ring is an element, compound, homogeneous mixture, or a heterogeneous mixture. B) When a small drop of nitric acid was applied to a scratch on the ring, it turned green. Would this be a physical or a chemical reaction? How do you know?**

_____

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Writer's Name: