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The Chemistry of Making Soap: Chemical and Physical Changes in 6th Grade Science

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Chemistry of Soap

UbD Template 2.0

<table>
<tr><th colspan="3">Stage 1 – Desired Results</th></tr>
<tr><td rowspan="6">Established Goals

6th Grade
112.18b 1,2, 4 (scientific process)
112.18b
(5) Matter and energy. The student knows the differences between elements and compounds. The student is expected to:
(A) know that an element is a pure substance represented by chemical symbols;
(C) differentiate between elements and compounds on the most basic level; and
(D) identify the formation of a new substance by using the evidence of a possible chemical change such as production of a gas, change in temperature, production of a precipitate, or color change.

10th Grade
112.35c 1 & 2 (scientific process)
112.35c
(4) Science concepts. The student knows the characteristics of matter and can analyze the relationships between chemical and physical changes and properties. The student is expected to:
(A) differentiate between physical and</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will independently use their learning to…
Explain how the combination of lye and oils creates soap (after making soap themselves) by describing how the compounds of lye and oils create a new substance with new properties.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>Understandings
Students will understand that….

Everything is made up of elements/elements are the most basic pure substance

When elements are combined into compounds, they have different characteristics than their original elemental properties

When substances react in a chemical reaction, a new substance is created with characteristics different from the original substances; a physical change does not create a new substance</td><td>Essential Questions

What are the foundations of all matter?

What does a safe experiment look like?

How are complex substances created?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Knowledge
Students will know…

Vocabulary:
Substance
Atom
Matter & Mass (learned in 5th)
Precipitate
Acid
Base
Element
Compound</td><td>Skills
Students will be able to…

Measure liquids and weigh solids using scientific tools

Use correct grammar and complete sentences to express their ideas

Use the periodic table to identify elements</td></tr>
</table>

chemical changes and properties; (7) Science concepts. (B) write the chemical formulas of common polyatomic ions, ionic compounds containing main group or transition metals, covalent compounds, acids, and bases; (10) Science concepts. The student understands and can apply the factors that influence the behavior of solutions. The student is expected to: (H) understand and differentiate among acid-base reactions, precipitation reactions, and oxidation-reduction reactions; (I) define pH and use the hydrogen or hydroxide ion concentrations to calculate the pH of a solution	Elements can be found on the periodic table (complete compounds cannot be found there) The four signs of a chemical change are: • Formation of a gas • Temperature change • Formation of a precipitate • Color change • Bonus: light Element symbols are comprised of one or two letters (only one capital letter) A low pH is a sign of a strong acid, while a high pH is a sign of a strong base	Write and balance chemical equations for acids and bases Use litmus paper to determine the pH of a substance Design and conduct a science experiment using safety precautions

Stage 2 – Evidence

CODE (M or T)	**Evaluative Criteria** (for rubric)	
T	See rubric	Performance Task(s) *Students will demonstrate meaning-making and transfer by…* Completing the Soap Lab and be able to explain how the compounds of lye and the oils are able to rearrange to make soap and glycerin --- Other Evidence (e.g., formative) Chemical Change Demonstration Post-Lab Chemical Change v. Physical Change Quiz Exit Tickets

Stage 3 – Learning Plan

CODE (A, M, T)	Pre-Assessment *How will you check students' prior knowledge, skill levels, and potential misconceptions?*

M	Conduct an inductive example/non example discovery activity in which students are given a series of clues and attempt to match the vocabulary word to the set of clues.	
M	**Learning Activities –** **<u>6th Grade</u>** **Day 1 – Pre-assessment** • To review material of 5th grade, students will participate in an inductive example/nonexample activity. • Post on the wall or provide each group with a list of vocabulary words that will be used in this activity. Words include: matter, mass, atom, mixture, substance, element, compound, chemical property, physical property, acid, base. • Have the students follow along in the power point to determine which word fits the description of each slide. • As students discover what each word is, provide a tangible example of each to show the students (i.e. aluminum for element).	Progress Monitoring (e.g., formative data) Students will write their answers on white boards that they will then show the teacher. Suggested materials: classroom materials (matter & atom; physical property); trail mix (mixture; substance); balance beam (mass); aluminum foil (element; substance); salt (compound; substance); lemon juice (acid; substance); cleaning solutions (base; substance); rusted metal (chemical change)
A M	**Day 2 – What are elements and compounds?** • Students complete the Part II: *Elements, Compounds, Mixtures, Oh My!* Activity in the Explore Section of Stemscopes 6.5ABC Elements and Compounds. • Students complete the Part III: *Elements Make Compounds* Activity in the Explore Section of Stemscopes 6.5ABC Elements and Compounds. • For a similar activity outside of the Stemscopes curriculum, please see the activity by Liz Larosa: Elements, Compounds, Mixtures Activity	Students answer questions in their student journals as part of activities.
M	**Day 3 – How can compounds break down into elements?** • Students complete the Next Step Inquiry activity in the Elaborate Section of Stemscopes 6.5ABC Elements and Compounds. • For an alternative to the Stemscopes lab, please see this lab from Sean Gillette at Vanguard Preparatory, Apple Valley, CA: Decomposing Water Lab **(while 6th Grade is learning about elements v. compounds, 10th Grade should be learning/reviewing how to write formulas for chemical reactions)**	Students answer questions in their student journals as part of activities.

A	**<u>6th Grade (10th Grade optional)</u>** **Day 4 – Chemical Change = Formation of a new substance** • Speed Dating Review of Vocabulary: Students will be put into two facing rows, and will provided with one vocabulary word at a time to discuss. One row of students will rotate, and a new vocabulary will be given each round. Students will be given 2 minutes to discuss the term and provide examples. • Students will take brief notes on the signs of a chemical change. • Students will prepare the *Part 1: Plan Your Investigation* in the Explore Section of Stemscopes 6.5D Formation of a New Substance	Teacher will informally observe student understanding and randomly select a student after each round to define each word.
A/T	**Day 5 – Chemical Change = Formation of a new substance** • Students will observe and complete the data table for *Part 2: Implement Your Investigation* in the Explore Section of Stemscopes 6.5D Formation of a New Substance • As an alternative to the Stemscopes Lab, please see this lab looking at signs of a chemical change from Ann Anderson at Glenwood City School District: Chemical Change Lab	Students answer questions in their student journals as part of activities.
A/M	**Day 6 – Chemical Change v. Physical Change Stations** • Students can be partnered or work individually to identify whether the substances at each station are undergoing (or have underwent) a chemical change or a physical change. Students must justify their answers and then complete the back of the sheet with other examples of chemical and physical changes in life. • Chemical Changes/ Physical Changes Quiz	Students will complete the back of the stations worksheet with their own generated examples. Suggested materials: apple slices; oil and vinegar in a jar; baking soda; vinegar; salt; penny in vinegar; burnt paper; lemon and milk; ice or access to a way to boil water; melted plastic
	<u>6th Grade & 10th Grade Together</u> **Day 7 – What is pH and how is it used?** • Students will take notes on acids, bases, and the pH scale as the definitions are explained via power point and a demonstration is conducted using a light bulb conductivity tester, a strong acid such as HCl and a strong base such as ammonia.	Students will turn in litmus worksheet. Suggested materials: distilled water; vinegar; lemon juice; soda; milk; baking soda; aspirin;

A	• Working in pairs or in groups, students will analyze the prepared labeled solutions using litmus paper to determine the pH of the solutions. **Day 8 – Safety Discussions & Pre-Lab Notes** • Students should be given the lab and discuss the serious safety precautions needed due to the use of lye. • Using the vocabulary from the previous day, note that lye is a strong base and is very caustic. Review safety procedures of what to do if the lye is spilled on someone. • As a class, complete the pre-lab questions and read through the procedures of the lab. • *The lab will take an entire 45 minute class period, so students need to have all procedural questions answered the day before. • To show a useful video of what "trace" looks like in soap making, please go here: https://www.youtube.com/watch?v=X5zPU_7u0i4 • Students will complete an exit ticket answering questions about the safety precautions and procedures in making soap. **Day 9 (and potentially 10 if large group) – Soap Making Lab** • One group at a time, students will add lye into water in the vent hood; making sure to be careful of spilling; observations will be noted • When not using the vent hood, students will be measuring out the required amount of each oil to mix into the lye & will heat required oil • If necessary to complete in two days due to large groups, then students who are not making soap should complete the Post-Lab Explanation of how soap is made. Students should write in complete sentences and will be graded on their inclusion of key vocabulary and necessary information. **Day 10 and 11 – Post-Lab Write Up and Product**	coffee; milk of magnesia; shampoo Summative Assessment Summative Assessment
T	• Students will complete post-lab write up and create a brief product explaining the process of making soap and whether making soap is a chemical or physical change. **Day 12** • Students will present their product to a younger audience and explain how they understand a chemical change has taken place.	Summative Assessment Summative Assessment

Names of Students in Groups: Date:

Chemical Changes of Making Soap

Begin the Investigation

Question of Inquiry:

_____
_____
_____

List the variables in this experiment:

_____
_____
_____

List the materials and equipment needed for this lab:

_____
_____
_____

List the safety precautions needed in this lab:

_____
_____
_____

Procedure

1. Prepare the working surface by making sure that there is nothing on the table. All lab members have safety goggles, and gloves to work with the lye.

Lye Solution

1. Within the safety vent, measure out 13.2 grams of water into a large heat-resistant beaker.
2. In a separate container, weigh 6.55 grams of lye (still working in the safety vent). Be sure to set the scale to 0.0 before weighing the lye so the weight of the container is not included in your measurements.

3. Slowly add the lye to the water (**never the over way around**). The solution may smoke, and the container will become very hot. If lye is splashed onto the skin or eyes, be sure to wash them out immediately.
4. Once all the lye has been completely mixed into the water, the solution may be removed from the vent and set aside to cool.

Oil Solution

1. In a new large heat-resistant container, measure 40 grams of coconut oil.
2. Place the container on a Bunsen burner, heating the oil while stirring constantly.
3. Heat the oil to 105° F.

Making Soap

1. Once the lye and the oil both reach approximately 105° F, they are ready to be mixed.
2. Slowly pour the lye solution into the oil container.
3. Stir the solution until the liquid thickens to pancake-batter consistency and leaves behind a trail when the mixing instrument is lifted from the solution.
4. At this time, add any fragrances or essential oils, if desired.
5. Pour the solution into the mold.

Curing Soap

1. After 24-48 hours, remove the soap from the mold.
2. Cut the soap into desired number of soap bars.
3. Set aside the soap for 3-4 weeks in a cool dark place, allowing the soap to cure.

Do Not Use Soap If…

- When cut into, the soap has large bubbles or crystals (these are pockets of lye and are caustic).

Conclusions and Reflections

Complete each question using complete sentences. Students may work together to complete the following section.

1. Was there a relationship between the variables observed (hint: what would have happened if there was too much of one of the variables)?

_____
_____
_____

_____
_____

2. What sources of error that could have happened during data collection or recording?

_____
_____
_____
_____
_____

3. What conclusions can be made about this investigation?

_____
_____
_____
_____
_____

4. What could be done differently if the investigation was conducted again?

_____
_____
_____
_____
_____

Name: **Date:**

After the Investigation

Complete each question using complete sentences. Students are expected to complete the following section independently.

1. Sodium Hydroxide is the scientific name for the lye used to make soap; its chemical formula is NaOH. **Is lye an element or a compound? How do you know?**

_____
_____
_____

_____
_____

2. In the first part of the lab, lye was mixed with water. **Did a chemical reaction take place? How do you know (hint: did you see any of the signs of a chemical change)?**

_____
_____
_____
_____
_____

3. In the second part of the lab, the oil was heated up. **Did a chemical reaction take place? How do you know (hint: did you see any of the signs of a chemical change)?**

_____
_____
_____
_____
_____

4. In the third part of the lab, the lye was added to the oil and stirred until thickened. Eventually this substance will harden and become soap. **Did a chemical reaction take place? How do you know (hint: did you see any of the signs of a chemical change)?**

_____
_____
_____
_____
_____

Chemical Changes Presentation

Using your answers on the other side of this document, create a presentation that answers the following questions:

Is the overall creation of soap a chemical reaction? **Which stages in making soap are physical changes and which are chemical changes? How do you know? Be sure to use at least 3-5 vocabulary words in your description of making soap.**

Your presentation can be a poster, a powerpoint, an essay, or a project of your choice (get teacher approval before starting new project).

You will be responsible for presenting your information to an A Core student, so please make sure that you are able to explain your vocabulary words.

Understandings	Exceeds Expectations (5 points)	Meets Expectations (3 points)	Does Not Yet Meet Expectations (1 point)
After Investigation Write-Up	Student writes using specific words, prepositional phrases, adverbs, complex sentences, etc.	Student writes in complete sentences.	Student writes in fragments or incomplete sentences.
Use of Vocabulary Words	Student uses more than 5 vocabulary words and clearly understands the relationship between the vocabulary words.	Student includes 3-5 vocabulary words in presentation; it is evident that students can use vocabulary words in context.	Student uses fewer than 3 vocabulary words or does not understand the meaning of the vocabulary words used.
Recognition of Signs of a Chemical Change v. Physical Change	Student correctly identifies all three stages in making soap as chemical or physical changes.	Student correctly identifies 2 of the stages in making soap as chemical or physical change.	Student identifies only 1 stage correctly as a physical or chemical change.
Evidence Provided	In depth analysis of evidence demonstrates understanding of relationship between evidence and claim.	Evidence is used to support the answer to prompt (the claim).	The presentation lacks evidence to support claim.

Other Comments:

Name: Date:

At each station, decide if the items are the result of a chemical or physical change. Then **provide a reason to support your logic.** If a chemical change has happened, **provide one of the four signs that a chemical change has taken place**.

Station	Chemical or Physical Change	Reason
Browning Apple Slices		
Oil and Vinegar		
Baking Soda and Vinegar		
Salt and Water		
Penny in Vinegar		
Burnt Paper		
Lemon and Milk		
Melting Ice Cube/Boiling Water		
Melted Plastic		
Bonus: Thermite Reaction (on iPad)		

Name: Date:

What are the four signs that a chemical change may have taken place?

1. _____
2. _____
3. _____
4. _____

What are 3 other examples of physical change in everyday life?

1. _____
   _____
2. _____
   _____
3. _____
   _____

What are 3 other examples of chemical change in everyday life?

1. _____
   _____
2. _____
   _____

3. _____
_____

Name: Date:

At each station, decide if the items are the result of a chemical or physical change. Then **provide a reason to support your logic.** If a chemical change has happened, **provide one of the four signs that a chemical change has taken place**.

Station	Chemical or Physical Change	Reason
Browning Apple Slices	Chemical Change	Color change
Oil and Vinegar	Physical Change	They will settle and do not mix
Baking Soda and Vinegar	Chemical Change	Gas & Temperature
Salt and Water	Physical Change	Mixture; the two can be separated
Penny in Vinegar	Chemical Change	Gas
Burnt Paper	Chemical Change	Color
Lemon and Milk	Chemical Change	Precipitate
Melting Ice Cube/Boiling Water	Physical Change	Still water
Melted Plastic	Physical Change	Still just plastic
Bonus: Thermite Reaction (on iPad)	Chemical Change	Temperature change (and light)

Name: Date:

What are the four signs that a chemical change may have taken place?

5. ___formation of a precipitate_____
6. ____formation of a gas (bubbles)_____
7. ____color change _____
8. ____temperature change _____

What are 3 other examples of physical change in everyday life?

4. ___Answers will vary. _____
   _____
5. _____
   _____
6. _____
   _____

What are 3 other examples of chemical change in everyday life?

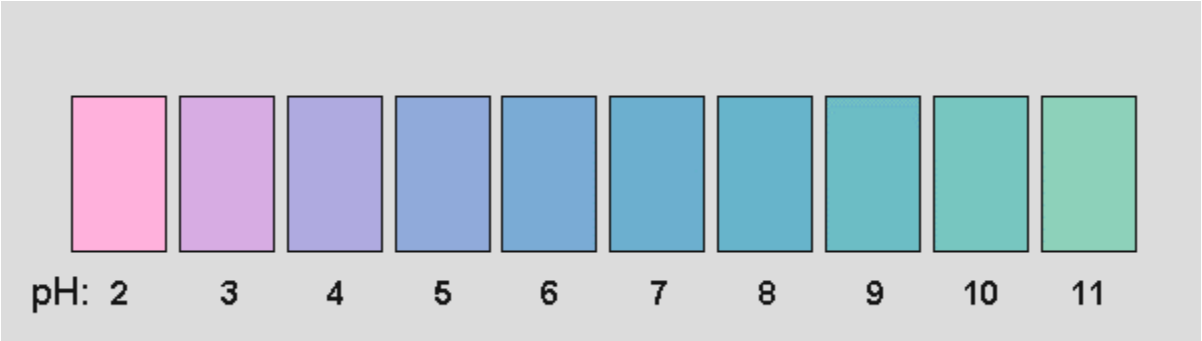
4. _____Answers will vary. _____
   _____
5. _____
   _____

6. _____
_____

Names of Group Members:

Directions: Using the litmus papers, determine the pH of the following substances.

1. Dip each litmus strip into the liquid.
2. Describe the color that it most closely resembles.
3. Determine the pH of the substance.



Substance	Color (light pink, dark blue, etc.)	pH of substance
Ex: Tomato Juice	Light pink	3
Distilled water		
Vinegar		
Lemon juice		
Soda		
Milk		
Baking Soda		
Aspirin (dissolved in water)		
Coffee		
Milk of magnesia		
Shampoo		