Developed by 2015 Submarine Force Library and Museum STEM –H Teacher Fellow
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Lesson Name ___It's Not Your Property___ Number of minutes in the Lesson __65___

Intended Audience _____Grades 7-9__

Content Standards:

Identify state **CCSS content and literacy standards** (when applicable) **and** national curricular standards this lesson is designed to help students attain. Also include **state and district standards** as well as the **Technology Standards** and **CCSS Math Standards** when applicable.

CCSS.ELA-LITERACY.RST.6-8.3
Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

CCSS.ELA-LITERACY.RST.6-8.4
Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context

CCSS.ELA-LITERACY.RST.6-8.9
Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

CCSS.ELA-LITERACY.RST.9-10.5
Analyze the structure of the relationships among concepts in a text, including relationships among key terms

CCSS.ELA-LITERACY.RST.9-10.7
Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

5-PS1-4.
Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

5-PS1-3.
Make observations and measurements to identify materials based on their properties.

MS-PS1-2.
Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

Pre-Visit Materials/Activities:

Describe the students' prior knowledge or skill related to the learning objective(s) and the content of this lesson, using data from pre-assessment as appropriate. What background knowledge or skills do you want students' to come to the museum prepared with, and what materials will you provide to groups ahead of time so they are prepared for this lesson?

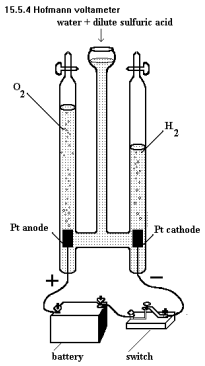
Students should have basic knowledge of solids, liquids and gases. Students should also have a basic understanding of the kinetic theory of matter (The kinetic theory of matter states that all matter is made of small particles that are in random motion and that have space between them. This means that no matter what phase matter is in, it is made of separate, moving particles). Students should be familiar with common physical properties

Set up Before the Lesson Begins: Describe any preparation that is necessary before the lesson.

PART I A:
Web-Based alternative for lesson:
*The written lesson follows the web-based activity
https://www.fossweb.com/delegate/ssi-wdf-ucm-webContent/Contribution%20Folders/FOSS/multimedia/Mixtures_and_Solutions/separatingmixtures/index.html

*As an alternative to using an evaporating dish, the process can be accelerated by placing the dish on a hot plate, or simply discussing what would happen with the salt and water mixture if the dish were left to stand overnight.

PART 1 C: Enrichment Demonstration: Hoffman Electrolysis Demonstration
The Hoffman Electrolysis Demonstration can be setup and running while the students are completing **PART 1A** and **PART 1B**



1. Setup distillation apparatus. Most distillation apparatus require a flow of cold water through the condensing tube. Access to a sink is necessary.
2. To prepare the salt solution you will need access to a scale precise to 0.1 grams and graduated glassware for the solvent
3. To run the distillation apparatus you will need access to a heat source.

Content Objective(s): Identify specific and measurable learning objectives for this lesson. Remember only one for a 45 minute class, two for a 90 minute class.

In this lesson students will be able to….

1. Separate various mixtures based on their properties
2. Differentiate between a heterogeneous and homogenous mixture.
3. Explain the difference between a chemical change and a physical change

Language Objective(s): Distinguish between receptive skills (**listening and reading**) and productive skills (**speaking and writing**). Please **include how you would use them all where appropriate**: Listening, reading, speaking and writing.

Students will work collaboratively in small lab groups, therefore required to implement the following skills:

1. **Collective Intelligence:**
    a. Students will be able to work respectfully and responsibly with others, exchanging and evaluating ideas to achieve a common objective.
        i. Student works respectfully and responsibly with others to achieve a common objective by:
            1. exchanging and evaluating ideas critically and respectfully with a keen sense of which ideas will best achieve a common objective
            2. listening carefully to and valuing other members' contributions and synthesizing them with personal knowledge and insightful ideas
            3. showing leadership by employing the expertise of members when equitably dividing the roles/responsibilities.

2. **Suspending Judgment:**

    a. Students will be able to forgo decision making while considering and finding value in the contributions of other team members in order to grapple with complex issues.
        i. Student is able to grapple with complex issues by:
            1. actively valuing and seeking contributions from others
            2. synthesizing them with personal knowledge/ideas, as a way of reaching a well-informed decision,
            3. addressing complex issues in a comprehensive manner from various angles/viewpoints.

3. **Justifying & Contextualizing**

    a. Students will be able to choose and justify the most effective medium to interactively and purposefully share important findings in various contexts as well as adjust style and tone with consideration to audience and purpose.
        i. Student chooses the most effective medium
            1. to share findings and present them in an interactive, engaging, purposeful manner, choosing more than one medium, when appropriate,
            2. to clearly communicate important findings, adjusting style and tone with clear focus on audience and purpose,
            3. can clearly explain why a medium was chosen in regard to audience and purpose.

Differentiation: Think about:

Students with special needs How will you differentiate this lesson for special education students?

Gifted students- Students can be given specific tasks within a collaborative group that suits their learning style and academic aptitude. These students can help the group reach Webb's DOK complexity level 3 and 4 to meet the engineering component of a STEM lesson

Regular education students: Think about how you would differentiate the lesson for all students on all levels:

High- Webb DOK level 3 or 4 (Short-Term Strategic Thinking and Extended Thinking)
Middle- Webb DOK level 2 or 3 (Skills and Concepts and Short-Term Strategic Thinking)
Low- Webb DOK level 1 or 2 (Recall and Reproduction and Skills and Concepts)

*The DOK level should reflect the complexity of the cognitive processes demanded by the task outlined by the objective, rather than its difficulty. Ultimately the DOK level describes the kind of thinking required by a task, not whether or not the task is "difficult"

Sheltered Instruction Observation Protocol (SIOP) Strategies for ELL and regular Ed Students: Identify the S.I.O.P features that support English Learners and all learners including thorough and accurate explanations on how they will assist English Learners. Identify Sheltered Instruction strategies throughout the lesson.

- Preparation
- Building Background
- Comprehensible Input
- Strategies
- Interaction
- Practice/Application
- Lesson Delivery
- Review/Assessment

Initiation: Briefly describe how you will initiate the lesson. (Set expectations for learning; articulate to learners what they will be doing and learning in this lesson, how they will demonstrate learning, and why this is important)

1. Initiate the lesson by reviewing key concepts in the prior knowledge requirements: **(10 min)**

    a. Students should have basic knowledge of solids, liquids and gases. Students should also have a basic understanding of the kinetic theory of matter (The kinetic theory of matter states that all matter is made of small particles that are in random motion and that have space between them. This means that no matter what phase matter is in, it is made of separate, moving particles). Students should be familiar with common physical properties

    b. **Introductory activity**: Bozeman Science (Introduction to Matter)
    https://www.youtube.com/watch?v=jEoQ6TNLJI8
    Anderson, Paul. "Matter." *YouTube*. YouTube, Sept. 2010. Web. 14 July 2015.

2. Explain the learning activities, their purpose, and the culminating design application of the following lesson, and how it relates to the critical function of a submarine. **(5 min)**
3. Articulate the collaborative working expectations by reviewing the **Language Objectives** **(5 min)**

Lesson Development: (Add a Time for Each Segment of the Lesson)

Performance Tasks: Describe in outline how you will develop the lesson and what learning activities students will be engaged in order to gain the key knowledge and skills identified in the student learning objective(s).

PART I A – Differentiate between mixtures and solutions (30 min)

Introductory activity: Bozeman Science (Introduction to Matter)
https://www.youtube.com/watch?v=jEoQ6TNLJl8
Anderson, Paul. "Matter." *YouTube*. YouTube, Sept. 2010. Web. 14 July 2015.

Web-Based alternative for lesson:
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Procedure:

1. Gather (3) plastic cups:
    a. Cup 1 – include small amount of the following items (recommended Tbsp.)
        i. Iron Filings
        ii. Sand
        iii. Salt
    b. Cup 2 – include small amount of the following items (recommended Tbsp.)
        i. Lentils
        ii. Pepper
        iii. Salt
    c. Cup 3 – include small amount of the following items (recommended Tbsp.)
        i. Safety pins
        ii. Beads
        iii. Glitter

2. Ask students to identify each mixture in the three cups as homogenous or heterogeneous?

    The mixtures in each cup are heterogeneous because you can visibly see each of the substances within in cup.

3. Gather items used in the investigation to separate mixtures
    a. Water
    b. Coffee filter
    c. Evaporating dish (hot plate to expedite process)
    d. Magnet
    e. Screen

4. Ask students to think about the best way to separate each mixture. Using the items provided experiment with the most effective order for separating the contents of each mixture based on the different physical properties. Complete the data table

NOTE The highlighted processes are used to make connection to the **Distillation Lesson**

Separation Method	Cup 1		Cup 2		Cup 3	
	Order	Substance Separated	Order	Substance Separated	Order	Substance Separated
Water	2	Sand and salt	1		2	Beads and glitter
Filter	3	Sand	3	pepper	4	glitter
Evaporating Dish	4	Salt	4	Salt		
Magnet	1	Iron filings			1	Safety pins
Screen			2	Lentils	3	beads

5. Revisit the terms homogenous and heterogeneous. Think about each of the separation methods used. Did any method result in the formation of a homogenous mixture? Explain how it was different.

In Cup 1 and Cup 2 water was eventually added to dissolve the salt, which created a solution. A solution is a homogenous mixture. The combination of water and salt dissolved the salt to make it look the same throughout, unlike a homogenous mixture where you can clearly see the different substances in the mixture.

PART 1 B - Differentiate between a physical and chemical change (10 min)

1. Collect one (1) Tbsp. of iron filings and one (1) Tbsp. of sulfur, and combine them on a piece of paper. Be sure to thoroughly mix them together. Choose a separation method used in **PART 1 A** and separate the mixture. Which method did you use, and why?

Iron is magnetic, so using a magnet is the most effective way to separate the iron particles from the sulfur particles

2. Collect one (1) Tbsp of Iron Sulfide "FeS", also a combination of iron and sulfur. Try separating the two substances using the **same method** as you did in the previous step. What are your observations? Explain

Iron Sulfide is chemical combination of iron and sulfur. The physical properties of the iron and of the sulfur change when the two substances are chemically combined. Therefore, a chemical change results in the change of the physical properties of the substances involved in the chemical reaction

3. In your own words explain what occurs in a chemical reaction that causes a change to the physical properties of the substances.

The difference between a physical reaction and a chemical reaction is composition. In a chemical reaction, there is a change in the composition of the substances in question; in a physical change there is a difference in the appearance, smell, or simple display of a sample of matter without a change in composition.

4. Collaborate with your group members and try to identify as many physical properties as you can. List them below.

Be sure to include boiling/condensing, and melting/freezing points to establish a seamless continuation into Part II; Distillation as a form of separating a solution. Below is a list of some common physical properties that students may identify

absorption (physical)
absorption (electromagnetic)
albedo
angular momentum
area
brittleness
boiling point
capacitance
color
concentration
density
dielectric
ductility
distribution
efficacy
elasticity
electric charge
electrical conductivity
electrical impedance
electric field
electric potential
emission
flow rate
fluidity
frequency
hardness
inductance
Intrinsic impedance
intensity
irradiance
length
location
luminance
luminescence
luster
malleability
magnetic field
magnetic flux
mass
melting point
moment
momentum
opacity
permeability
permittivity
plasticity
pressure
radiance
solubility
specific heat
resistivity
reflectivity
refractive index
spin
strength
stiffness
temperature
tension
thermal conductivity
velocity
viscosity
volume
wave impedance

PART I C: Enrichment Demonstration (reinforce physical and chemical changes) **(10 min)**
The use of the Hoffman Apparatus can demonstrate the electrolysis of water; alternatively, a power source and electrodes can show the same demonstration in a Petri dish.

Web-Based alternative for Hoffman apparatus demonstration:
https://www.youtube.com/watch?v=OTEX38bQ-2w
"Hygrogen and Oxygen from Water." *YouTube*. YouTube, 28 Aug. 2008. Web. 14 July 2015.

Explanation:
For Hoffman apparatus, hook up leads to DC power supply (potential of 20 V). Observe bubbles forming (H2 and O2 separately). After some time, a difference in the volume of the two gases will be observed. If testing for pH at each electrode, 0.05% bromothymol blue solution (acid/base indicator) can be added. A yellow color will be observed at the anode (acidic) and a blue color will be observed at the cathode (basic). The gases generated in this reaction can be collected by opening the stopcock into an inverted test tube and testing the presence of a flammable gas using a glowing wood splint.

Discussion: Water is separated into hydrogen and oxygen using electricity. The Hoffman apparatus allows for the separation of these gases as their generation occurs at separate electrodes. H2 is produced at the cathode while, O2 is produced at the anode. Over time a difference in the individual volumes of the two gases is observed in a ratio of 2:1. The two substances, oxygen and hydrogen, regain their properties of flammability and combustibility when chemically separated through the electrolysis process.

Submarine Force Museum Lesson Plan

Teaching and Learning Strategy: Strategies that you used during the lesson, including **modeling, guided practice and independent practice** where applicable.

1. **Teaching Clarity** - Provide explicit criteria on how students can be successful. Present **models** or examples (exemplars) to students so they can see what the end product looks like.

2. **Feedback** - provide whole-group feedback on patterns observed. Students also need to be given opportunities to provide feedback to the teacher to be able to adjust the learning process, materials, and instruction accordingly

3. **Formative Assessment** - assess frequently and routinely where students are in relation to the lesson's learning goals or end product (summative assessment).
    a. Use of white-boards and response cards can be useful tools for formative assessments

4. **Independence, control and active engagement –** Give students opportunities to plan and organize, monitor their own work, direct their own learning, and to self-reflect.

Monitoring and Adjusting: How do you know the students have learned what you taught them and that they have achieved the objective?

1. Questioning students during classroom discussions to check their understanding of the material being taught Circulating around the
2. Conducting periodic reviews (during lesson) with students to confirm their grasp of learning material and identify gaps in their knowledge and understanding
3. Reviewing student performance data collected and recorded and using these data to make needed adjustments in instruction
4. Paying close attention to who is answering questions during classroom discussion and calling upon non volunteers
5. Asking students to comment or elaborate on one another's answers
6. Initiate more interactions with students, rather than waiting for students to ask for help
7. Have systematic procedures for supervising and encouraging students while they work
8. Asking students to interpret or summarize material presented to them in the lesson

Assessment: How will you ask students to demonstrate mastery of the student learning objectives? Attach a copy of any assessment materials you will use, along with assessment criteria.

1. Evaluate students' understanding by examining performance data and response to performance data questions

Closure: Briefly describe how you will close the lesson and help students understand the purpose of the lesson. (Interact with learners to elicit evidence of student understanding of purpose(s) for learning and mastery of objectives)

One of the most effective methods to assessing student learning in a short-term period of time is to develop a set of assessment questions using response cards, or more traditional use of small white boards. If applicable, visit the Submarine Force Museum exhibits to show application of student learning objectives

Submarine Force Museum Lesson Plan

Post-Visit Materials/Activities: Provide additional materials if they would reinforce a good learning experience after leaving the museum.

Technology: Please explain the technology used: why you will use it, how you will use it and how you will assess the results of using this technology.

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Key Vocabulary: Words students need to know in order to reach the objectives.

1. Solid
2. Liquid
3. Gas
4. Vaporization
5. Boiling
6. Physical change
7. Chemical change
8. Homogenous
9. Heterogeneous
10. Distillation
11. Electrolysis

Extension: What do you have in place in case during the lesson you finish early, run out of time or need to accommodate students who complete the class work before other students, or your technology fails?

Finish Early:
Run out of time:
Technology Fails:

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Materials: List the materials you will use in each learning activity.

PART IA:

- Sulfur powder **FLINN CATALOG # S0140**
- Iron filings **FLINN CATALOG # I0011**
- Standard Magnet
- Iron Sulfide **FLINN CATALOG # F0042**
- Screening material
- Plastic cups (6oz minimum)
- Fine grain sand
- Salt
- Water
- Coffee filter
- Evaporating dish
- Lentils
- Pepper
- Safety pins (or other metallic, magnetic substance)
- Beads
- Glitter

PART IC: Hoffman Electrolysis Demonstration

- Hoffman apparatus **FLINN CATALOG # AP5439**
- DC power supply **FLINN CATALOG # AP5375**
- 1 M Na2SO4 (alternative) **FLINN CATALOG # S0352**
- Bromothymol blue (alternative) **FLINN CATALOG # B0047**

Resources: Include any resources you may use such as textbooks and any technological resources.