<table>
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<tr>
<th><strong>Problem-Based Unit Proposal: MATTER</strong></th>
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</thead>
</table>

| **Grade Level:** | 2nd grade |
| **Local Partners:** | Virginia Aquarium |

| **Theme**  
(*Science Topic*) | Matter |
| **Problem**  
(*Real scientific problem with multiple solutions stated as a question that will be solved over time*) | How can the Virginia Aquarium scientifically study and classify a mystery substance? |
| **Student Roles**  
(*Authentic scientist roles for students*) | Student Physicists |
| **Scenario**  
(*Real situation and setting that is interesting and plausible*) | The Virginia aquarium found a mysterious substance in their tanks. The biologists need help classifying the mysterious substance and have reached out to the local 2nd graders since they are studying matter. Their task is to help design a classification system to find out what this mystery substance is. Students will present a solution to the problem to scientifically classify objects. |
| **Resources**  
(*Identify and evaluate likely places students will seek information to solve the problem - internet, books, expert*) | Techbook, library books, Google Classroom, PebbleGo |
| **Culminating Project/Assessment**  
(*Develop a final project that poses a solution*) | Students will create a presentation of the properties of each state of matter and how to classify an object as a solid, liquid, or gas. |
| **Safety**  
(*Identify safety issues that might arise as students gather information*) | Wear rubber gloves, don’t touch or taste a substance if you aren’t sure what it is. |
| **Story** | The students will receive a letter from the Virginia Aquarium explaining that they found a mystery substance in the seal tanks. They are asking the 2nd graders how to classify the mystery substance since they are studying matter. The aquarium will even send over “samples” of the substance for them to examine. This way the students can get a hands on experience with the substance and looks for key properties to focus on. They should be able to see if the substance changes volume or takes the shape of its container. Students will also have the chance to add or take heat away to see the physical changes. Students will gather the data from their observations and be able to record, present, and explain their data. The aquarium will also send a letter asking the students to design a way to remove the substance from the tank without touching it (since they have run out of rubber gloves and aren’t sure if it’s safe to touch). This will be the engineering piece. Students will... |
present a solution to the problem presented by the aquarium. Students will present a way to scientifically classify objects (into solids, liquids, or gases).

**SWIRL PBL Lesson Plan**

**Day one**

**SOL Content Standard(s):**

SCI.2.0  The student will demonstrate an understanding of scientific inquiry by asking and answering questions, collecting data, and communicating information. (SOL 2.1)

SCI.2.0.4  Make careful observations using senses.

**Level 1 Question:**

How can we scientifically classify this mystery substance?

**Level 2 Question:**

What does classify mean?

What do we know about this substance?

**Level 3 Question(s):**

How do we classify substances?

What do we observe?

How do we observe?

**Student Objective(s):**

By the end of this lesson, students will be able to explain that we make observations using our 5 senses and will be able to list physical properties of given objects.

**NOS tenets:**

The natural world is understandable.

Scientific knowledge is the product of observation and inference.

**Materials:**

Set of pictures of random objects

Objects for students to observe (cotton balls, stuffed animals, flowers, etc.)

**Safety:**

Remind students to never touch or taste anything unless they are sure of what it is and that is is safe AND have permission to do so.
### Activities:

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<tr>
<th>Time</th>
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<th>Guiding Questions (Teacher talk)</th>
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<tbody>
<tr>
<td>5 min</td>
<td>Present letter and problem to the class.</td>
<td>What is the problem?</td>
<td>The problem is we have an unknown substance.</td>
<td>N/A</td>
</tr>
<tr>
<td>5 min</td>
<td>Pose question to students. Let them think brainstorm ideas. Ask students what classify means?</td>
<td>How can they scientifically classify the mystery substance? How would you solve this problem? What does classify mean?</td>
<td>We group things together because they are the same or similar. Scientists look for patterns or characteristics that are the same.</td>
<td>N/A</td>
</tr>
<tr>
<td>10 min</td>
<td>Give students a set of random pictures (no particular format) and have them sort the pictures. Then define classify.</td>
<td>Why did you put those objects together?</td>
<td>We group things together because they are the same or similar.</td>
<td>N/A</td>
</tr>
<tr>
<td>10 min</td>
<td>Have students look at their sorts and have them explain to partner how they sorted the pictures. Make a class list of how students sorted, then label the class list physical properties. Have students define physical properties.</td>
<td>Why did you group these together? What did you notice/observe about those objects? What else did you observe? What is a physical property?</td>
<td>We made groups because they had the same characteristics such as...... We saw........</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### Strategies for SPED and ELL Modification and Differentiation:

Students will work in small groups or with a partner. Students can make verbal observations instead of writing them down.

### Check for Understanding:

Give students an object to make observations and have them record the observations.

### SWIRL PBL Lesson Plan

**Day two**

**SOL Content Standard(s):**

SCI.2.0.4 Make careful observations using senses.

SCI.2.1.1 Identify the distinguishing characteristics of solids, liquids, and gases.

**Level 1 Question:**

How can we scientifically classify this mystery substance?

**Level 2 Question:**

What groups/ways do we classify matter?
Level 3 Question(s):
What is matter?
What is mass?
How do we classify matter?
What are the traits of solids, liquids, gases?

Student Objective(s):
By the end of this lesson, students will be able to define matter, mass, and describe the three states of matter.

NOS tenets:
The natural world is understandable.
Scientific knowledge is the product of observation and inference.

Materials:
Matter sort

Safety:
Remind students to never touch or taste anything unless they are sure of what it is and that is is safe AND have permission to do so.

Activities:

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<tr>
<td>5 min</td>
<td>Remind students of problem. Give students a sort of pictures that can be sorted into 3 states of matter, but don’t tell them how to sort. Students sort.</td>
<td>What was the problem we are trying to solve? How can we classify these?</td>
<td>We have a mystery thing? It looks like..... I may want to put in this group</td>
<td>All scientists stick to their first observations to find answers</td>
</tr>
<tr>
<td>5 min</td>
<td>Go over how students classified objects and what they observed about the different objects. Have students sort again as physicists.</td>
<td>How did you classify the objects? What did you observe? How would a physicist sort these?</td>
<td>I sorted this because....... A scientist will classify based on.......</td>
<td></td>
</tr>
<tr>
<td>20 min</td>
<td>Define matter and the three states of matter. Chart them.</td>
<td>What is matter? What is mass? What can we observe about the solids? Liquids? Gases?</td>
<td>I think matter is “stuff” and takes up space. I can feel and touch it.</td>
<td></td>
</tr>
</tbody>
</table>

Strategies for SPED and ELL Modification and Differentiation: Students will work in small groups or with a partner. Students can make verbal observations instead of writing them down.

Check for Understanding: Students sort pictures into solid, liquid, and gas.

SWIRL PBL Lesson Plan
Day three

SOL Content Standard(s):
SCI.2.0.4 Make careful observations using senses.
SCI.2.1.1 Identify the distinguishing characteristics of solids, liquids, and gases.

Level 1 Question:
How can we scientifically classify this mystery substance?

Level 2 Question:
What do we know about the substance?

Level 3 Question(s):
What do we observe?
What does it look like?
How do we classify matter?

Student Objective(s):
By the end of this lesson, students will be able to make observations and describe the physical properties of the “mystery substance.”

NOS tenets:
The natural world is understandable.
Scientific knowledge is the product of observation and inference.

Materials:
Mystery substance, gloves, hand lens

Safety:
Remind students to never touch or taste anything unless they are sure of what it is and that is is safe AND have permission to do so.

Activities:

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<tr>
<td></td>
<td>Remind students of the problem we are trying to solve. Explain that we have a sample of the substance to observe today.</td>
<td>How can we scientifically classify the mystery substance? What does observe mean? How do we observe?</td>
<td>I think we can do this.......</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Students make observations.</td>
<td>What do you observe? What do you notice?</td>
<td>I saw this and that means......</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Students write questions they still have about substance.</td>
<td>What questions do you still have? What do you want to know about this mystery substance?</td>
<td>I have a question. Why is the substance........??</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Students write prediction/classification and explain why.</td>
<td>How would you classify this substance? Why would you classify it that way?</td>
<td>I can classify my substance in this way because...........</td>
<td>N/A</td>
</tr>
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</table>
**Strategies for SPED and ELL Modification and Differentiation:** Students will work in small groups or with a partner. Students can make verbal observations instead of writing them down.

**Check for Understanding:** Students can explain the state of matter they think the substance is with a reasonable explanation.

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**SWIRL PBL Lesson Plan**

**Day four and five**

**SOL Content Standard(s):**
- SCI.2.0.1 Ask questions related to science topics.
- SCI.2.0.2 Form simple hypotheses.
- SCI.2.0.4 Make careful observations using senses.
- SCI.2.0.5 Record collected data in simple graphical representations.
- SCI.2.1.1 Identify the distinguishing characteristics of solids, liquids, and gases.
- SCI.2.1.2 Describe the transformation of matter from one phase to another.

**Level 1 Question:**
How can we scientifically classify this mystery substance?

**Level 2 Question:**
What do we know about the substance?
What affects the substance?

**Level 3 Question(s):**
How does….affect the substance?
What do we observe?

**Student Objective(s):**
By the end of this lesson, students will be able to design an experiment to test the affects of outside factors on the mystery substance.

**NOS tenets:**
- The natural world is understandable.
- Scientific knowledge is the product of observation and inference.
- Science uses a blend of logic and the imagination.
- Science demands evidence.
- Scientists use many methods to develop scientific knowledge.

**Materials:**
Will vary based on student design.

**Safety:**
Remind students to never touch or taste anything unless they are sure of what it is and that is is safe AND have permission to do so.
Activities:

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<tr>
<td>10 min</td>
<td>Remind students of the problem we are trying to solve. Have students look at questions they still have about the substance. Are there any questions they can find the answer to?</td>
<td>What did you observe? What do we know about the substance? What do we need to know still? How can find that out?</td>
<td>What other things do we need to find out?</td>
<td>N/A</td>
</tr>
<tr>
<td>5 min</td>
<td>Lead discussion to what affects the substance. Brainstorm ideas.</td>
<td>What did you observe when...? What do you think would happen if...?</td>
<td>I think this will happen</td>
<td>N/A</td>
</tr>
<tr>
<td>15 min</td>
<td>Students design experiment to see what affects the substance.</td>
<td>What are you changing? What stays the same? What are you looking for?</td>
<td>How can we test our ideas?</td>
<td>N/A</td>
</tr>
<tr>
<td>30 min</td>
<td>Students perform experiments.</td>
<td>What did you observe? What did you find out? What does that tell you? How will you show your data?</td>
<td>I found this out.... My evidence is .....</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Strategies for SPED and ELL Modification and Differentiation: Students will work in small groups or with a partner. Teacher may guide some students in a more direct way than others. Ask questions leading them to think about the affects of temperature on the substance.

Check for Understanding: student experiments and conclusions.

SWIRL PBL Lesson Plan

Day six

SOL Content Standard(s):

Level 1 Question:
How can we scientifically classify this mystery substance?

Level 2 Question:
What do we know about this substance?

Level 3 Question(s):
What do we observe?

Student Objective(s):
By the end of this lesson, students will be able to engineer a way to remove the substance from the tank without using their hands or putting their hands in the water.

NOS tenets:
The natural world is understandable.
Scientific knowledge is the product of observation and inference. Science is a blend of logic and imagination. Scientists use many methods to develop scientific knowledge. Science is a social activity. Science demands evidence.

**Materials:**
- 3” wide and approx. 22” long strips of cardboard—5 or so
- Binder clips (different sizes)—8 or more
- Brads—@10
- Clothespins—6
- Craft sticks—10-15
- Fishing line—3-4 feet
- Hangers—1 or 2
- Paper clips (diff. Sizes)—10-15
- Pencils—3-4
- Rubber bands (different sizes)—15
- Tape—clear and masking (partial rolls should be fine)
- Twine—3-4 feet
- Various size scraps of cardboard—10 assorted

**Safety:**
Remind students to never touch or taste anything unless they are sure of what it is and that it is safe AND have permission to do so.

**Activities:**

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<tr>
<td>5 min</td>
<td>Present students with new letter to students from aquarium asking them to engineer a way to remove the substance from the tanks without touching it or getting their hands wet.</td>
<td>Let’s read the letter. What do you think the engineer is asking us? How can we do this? What do you think we need to remove the substance?</td>
<td>I think the letter is asking us to do........ I want to complete this by........ We can remove the substance by ........</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Students design and build.</td>
<td>What are we going to build? How would you as the engineer do this?</td>
<td>I want to build ......because it will........ My design will work because I have done</td>
<td>N/A</td>
</tr>
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</table>
Strategies for SPED and ELL Modification and Differentiation: Students will work in small groups or with a partner. Students can make verbal observations instead of writing them down.

Check for Understanding: Student designs.

SWIRL PBL Lesson Plan

Day seven and eight
SOL Content Standard(s):

Level 1 Question:
How can we scientifically classify this mystery substance?

Level 2 Question:
What do scientists do with their data?

Level 3 Question(s):
What is data?
How do scientists collect data?
How do scientists record data?
How do scientists explain their data?

Student Objective(s):
By the end of this lesson, students will be able to summarize all of the data they have collected about the mystery substance and then be able to make a presentation of how to classify matter.

NOS tenets:
The natural world is understandable.
Scientific knowledge is the product of observation and inference.
Science is a blend of logic and imagination.
Scientists use many methods to develop scientific knowledge.
Science is a social activity.
Science demands evidence.

Materials:
Materials will vary based on students needs.

Safety:
Remind students to never touch or taste anything unless they are sure of what it is and that it is safe AND have permission to do so.

Activities:

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<td></td>
<td>Ask students to summarize all the data they have gathered on</td>
<td>What do you do next? What do scientists do with</td>
<td>Our data shows us that the</td>
<td>N/A</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>the mystery substance. Ask what to do next.</th>
<th>data? How do scientist explain data?</th>
<th>substance has .......... Based on our data we need to do this.........</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ask students how to scientifically classify matter. Students need to work on how to present their answer/solution to the aquarium.</td>
<td>How do you classify matter? How will you present this to the aquarium staff?</td>
<td>Our group’s solution is ........ We would like to tell you about our solution.</td>
</tr>
</tbody>
</table>

**Strategies for SPED and ELL Modification and Differentiation:** Students will work in small groups or with a partner. Students can choose how to present classification.

**Check for Understanding:** Final project/solution