Unit 1: Scientific Investigation

What practices do scientists and engineers follow?

Directions: As a class we will watch video clips that describe what different scientists and engineers do. We will have a class discussion about what they do, and then we will fill in the Venn diagram below.

Practices of Scientists

Practices of Engineers

7. In your own words: What does it mean to think like a scientist?

8. Do scientists always follow the exact same procedures or “methods”?

9. Compare and contrast how scientists and engineers think:

10. In what ways did you act/think like a scientist during the puzzle warm up today?

11. In what ways did you act/think like an engineer during the puzzle warm up today?
**Scientific Method: Paper Tower**

**Objective:**
Build the tallest free-standing tower.

You will ultimately will be building a tower with a partner assigned to you by your teacher

*You may not tape your tower to the table in any way! You tower must also stand on its own long enough to be measured.*

**Materials:**
1 piece of paper, 6 inches of tape, scissors, ruler

**Approaching the problem in a scientific manner: Do Steps 1-3 on your own**

Step 1: State the question or the problem to be solved.

Step 2: Research the methods of successful construction and describe your findings below

Step 3 on your own draw / describe what you think the best design with your limited supplies will be

(FLIP THE PAPER OVER!)
Step 4: Scientists and engineering rarely try their very first idea, they often talk to others and edit their plan. Now, discuss your design with the partner(s) assigned to you by the teacher, and develop a design that you think will most likely be the tallest tower based on what everyone found out through their research.

Step 5: If we look at what the class is doing as a scientific process:

What is the independent variable? ___________________________________________________

What is the dependent variable? ___________________________________________________

Step 6: If you have completed steps 1-6 in detail bring your sheet up to the teacher to have her look over your work so far, and to get your materials.

Step 7: Test your idea by building your design
What changes to your original design did you make while building it to try and make it taller? If you finish way before the timer runs out then get another set of supplies and try one more time (you may only try a second time, so make sure you really think through your design).

Step 8: When the timer runs out have the teacher measure the height of your tower
_________________________cm

Step 6: Analysis.

Write down 2 problems or difficulties that you encountered while building your tower:

1. ____________________________________________________________________________

2. ____________________________________________________________________________

Step 7: State your conclusions: Based on what you observe in the classroom what methods of construction contributed to the best design?
# Glacier Data Sheet

<table>
<thead>
<tr>
<th>Time (s)</th>
<th>Distance (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total time for glacier to flow to reach bottom:

Total distance glacier traveled:

Calculate the flow rate (speed) of the glacial flow: Hint: Flow rate = distance/time

<table>
<thead>
<tr>
<th>Model Glacier</th>
<th>Observations</th>
<th>Inferences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Real Life Glacier</th>
<th>Observations</th>
<th>Inferences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Reflection**

Once you’ve completed the table on the previous side, answer the following reflection questions. Make sure to answer the following questions by describing evidence that you saw in your models and the videos we watched.

1. Glaciers have large boulders, rocks, and gravel. What would all this rock material do to the valley surface underneath the glacier?

2. What happens over a long period of time if the glacier continues to scratch the ground?

3. What causes striations (stripes) in glaciers?

4. What do you think the different GAK represented in relation to a real glacier?

5. Use evidence from your models and the videos you saw to explain how the landscape in the Yosemite picture may have formed.

Elaborate:
- How did your actions and reflections today connect to scientific practices like the ones we explored in the previous lesson?
**Observation vs. Inference:**

Define the following:

Observation –

Inference –

Looking at the picture on the screen, UNDERLINE OR CIRCLE which statements are **OBSERVATIONS.**

1. There is smoke coming from the oven.  
2. The woman is frowning.  
3. The mother is displeased.  
4. It is springtime.  
5. The kitchen is dirty.  
6. The kids were left alone in the house.  
7. The kids were baking a birthday cake.  
8. There is a cake with a candle in it.  
9. The woman was grocery shopping.  
10. There is a cat.

**Graphing:**

TAILS - the parts of a good graph!

**LABEL** which axis the independent and dependent variables go on.**

What does TAILS stand for?

T –  
A –  
I –  
L –  
S –
Variable Practice

What is an independent variable? ____________________________________________________________
                                                                                           ___________________________________________________________________________________

What is a dependent variable? ______________________________________________________________
                                                                                           ___________________________________________________________________________________

What is a control group? __________________________________________________________________
                                                                                           ___________________________________________________________________________________

What is an experimental group? ______________________________________________________________
                                                                                           ___________________________________________________________________________________

What is a constant? ______________________________________________________________________
                                                                                           ___________________________________________________________________________________

1) **Puzzle Example:** Students of different ages were given the same jigsaw puzzle to put together. They were timed to see how long it took to finish the puzzle.

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Dependent Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2) **Electromagnetic Example:** An investigation was done with an electromagnetic system made from a battery and wire wrapped around a nail. Different sizes of nails were used. The number of paper clips the electromagnet could pick up was measured.

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Dependent Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3) **Egg Example:** The higher the temperature of water, the faster the egg will boil.

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Dependent Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4) **Depth Example:** The temperature of water was measured at different depths of a pond.

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Dependent Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
More Variable Practice

1) I want to see if different colors of light help plants grow better. I’m going to take four plants (all the same type) and set them up underneath different lights. One will be a white light, one will be red, one will be blue, and one will be green. Every day, I will water them the same amount, at the same time. I will also record how high each plant grows for two weeks and then look at my results.

Independent variable: __________________________________________________________

Dependent variable: __________________________________________________________

Constants:  a. _________________________________________________________________
             b. _________________________________________________________________
             c. _________________________________________________________________

Control:  _____________________________________________________________________

2) I want to see if taping my thumbs will affect the time it takes to button up a shirt. I will test the same person – they will do three trials buttoning up the same shirt with their thumbs taped to their palms. Then I will do three trials where their thumbs are not taped. I will average the time in seconds that it takes to button up a shirt with their thumbs taped and without their thumbs taped.

Independent variable: _________________________________________________________

Dependent variable: __________________________________________________________

Constants:  a. _________________________________________________________________
             b. _________________________________________________________________

Control: _____________________________________________________________________

3) I want to see if drinking a glass of milk before bedtime affects how quickly a person falls asleep. I’ll recruit five volunteers. Every night for a week, I will give them a glass of milk to drink before they lay down in bed. They will drink the same type of milk, at the same time every night, and I will time how long it takes them to fall asleep. The next week they will go to bed without having a glass of milk, and I will again time how long it takes them to fall asleep. Then I will compare my results.

Independent variable: _________________________________________________________

Dependent variable: __________________________________________________________

Constants:  a. _________________________________________________________________
             b. _________________________________________________________________
             c. _________________________________________________________________

Control: _____________________________________________________________________
Scientific Method – Jedi Senses Lab

Purpose: ________________________________________________________________

Hypothesis: ______________________________________________________________

Materials: ________________________________________________________________

Procedures:

Two students, one who drops the ruler and one that catches the ruler are present. Both students can use the results of the student who catches the ruler.

The student, who is dropping the ruler, holds the top of ruler vertical at the 30 cm end. The student, who is catching the ruler, puts the top of their index finger at the 0 cm mark and their thumb on the other side of the ruler. This lets the student grab or pinch the ruler. The catching student has their fingers close to the ruler, but not touching it. Once the other student drops the ruler, the catcher tries to catch the ruler with their same fingers. The highest point on the ruler where the catching student’s index finger is, is recorded on the handout. Repeat three times.

Sight  The student who catches the ruler puts their finger on the 0 cm mark. The dropping student drops the ruler without any other clues. The catcher tries to grab the ruler once it is dropped. Record your results. Repeat three more times.

Touch  The student who catches puts their finger on the 0 cm mark and closes his/her eyes. The student who drops the ruler taps the catcher on the arm and drops the ruler at the same time. Once the catcher’s arm is touched, they try to grab the ruler. Record your results. Repeat three more times.

Sound  The student who catches puts their finger on the 0 cm mark and closes his/her eyes. The student who drops the ruler says “now” and drops the ruler at the same time. Once the catcher hears “now,” they try to grab the ruler. Record your results. Repeat three more times.

*** Write “30” down if the ruler is dropped***

Data:

<table>
<thead>
<tr>
<th>Trial</th>
<th>Sight</th>
<th>Touch</th>
<th>Sound</th>
<th>“Jedi”</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Analysis:
Answer the following questions in complete sentences

1. What is the independent variable in this experiment?

2. What is the dependent variable?

3. Which sense was best for you? Which sense was worse? Explain what data you used to determine that.

4. How did your personal results compare to the class averages?

5. Did the ruler drop to the floor during any of the trials?

6. Why did you perform five trials for each sense?

7. What could be some possible sources of inaccuracies in your data?

8. **Conclusion**: State whether or not your hypothesis was correct.

Graphing:
- Create a bar graph with the “sense” on the x-axis, and “where you caught the ruler” on the Y-axis
- There must be two columns for each sense – your average, and the class average (look at the board for these numbers)
- Don’t forget TAILS… make sure your graph has a title, that everything is labeled, and you are making the most of your graph paper space!