Scaffolding for Claims, Evidence and Reasoning
An Introduction to Science Unit

Purpose - In this sampling from an Introduction to Science Unit for Middle School students, 7 experiment activities are showcased which build up students abilities to make claims, support them with factual, scientific evidence and then provide reasoning, a scientific concepts which will tie together their claim and evidence.

Connection to PA Common Core: Writing in Science and Technical Subjects – In Common Care 3.6.6-8.A students are to be able to write arguments focused on disciple specific content. The subsections of this common core ask that students, "introduce claim(s) about a topic or issue" and "support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic," as well as "use words, phrases and clauses to create coheseion and clarify the relationships among claim(s), counterclaims, reasons and evidence." Through the Claims, Evidence and Reasoning (C-E-R) model used in this unit, students are creating claims that they support with evidence and provide scientific facts as reasoning.

Scaffolding - Listed below is a lab-by-lab explanation of the verbal directions and modifications used to support students understanding and abilities in each of the labs. Many pair and group sessions are utilized to allow students to become comfortable with the model and support one another as they learn.

1. Pendulum Lab
    a. Summary: Students will use teacher constructed pendulums to investigate "how does the height the pendulum is dropped from change the number of swings of the pendulum?" by manipulating the height they drop the washer from and count a timed number of swings. The teacher should demonstrate all methods before having students begin.
    b. Teaching and Instruction: During this lab I pre-teach the meanings of Claims, Evidence and Reasoning. I remind them that the claim should answer their question, and not include any of their data or explanation. Their evidence should come from the data on the front of the page (and "the evidence is in the data table is not sufficient.) Reasoning we discuss as being a fact, from science, that explains what happened.
    c. Modifications/Scaffolding: At this stage, each portion of the C-E-R is discussed generally as a class, and then students work in their groups of 4 to decide which of the multiple choice options are best fits for the Claim, Evidence and Reasoning. They are then also asked to determine why the other options are not viable. Some options are opinions, some are false information, some do not fit the experiment, etc.

2. Penny Lab
    a. Summary: Students will change surface tension of water using liquid dish soap and measure the change through the number of drops of water that will fit onto the head of a penny. I also take this opportunity to begin graphing introduction by creating a double bar graph of each trial.
    b. Teaching and Instruction: A suggestion to make this run smooth is to remind students to dry the penny between trials. I also do a mini lesson on averages, and supply a calculator. This is an activity I use to support volume, by adding in the step of measuring the volume of the number of drops. This requires at maximum a 10mL graduated cylinder, as the volume is usually about 1mL. I use the first part of the analysis as a formal, formative assessment for types of observations and variables.
    c. Modifications/Scaffolding: First, students graph their data. This is the first time we graph, so I give them the graph, with labels and they only need to make a title (done as a group), fill in the key, and graph. We discuss X and Y axes. During this part, I ask students to independently select their claim. We then discuss as a group why B was the best claim, therefore using A, C and D as counter examples. Students then work in pairs to generate two pieces of evidence that support the class's claim. We then share out as a group and create a list on the board of possible pieces of evidence. If there are pieces of evidence suggested that don't work, we discuss why. Next, they work as a table to select the reasoning that is best suited to support the class's claim. We again discuss the choice, and why the other choices are not a best fit.
3. Disappearing Act
    a. Summary: Students will view a demonstration of Alka-Seltzer tablets dissolving in three varied temperatures of water, hot (but not boiling), room temperature (sits out on counter top during day) and cold (left in refrigerator when not in use.) We then create a bar graph of the data.
    b. Teaching and Instruction: This is done as a demonstration and only the teacher handles the hot water. Students have jobs to record the temperature, place the Alka-Seltzer in the water, watch the Alka-Seltzer and yell "stop," and measure the time with a stop watch. We record all the numbers on the board. I also do a mini lesson here on controls and reading a thermometer, as well as lab safety. When they have collected the data we set up our first graph on graph paper as a group, identifying the variables that belong on each axis, and the units to use. They write a title themselves. At the conclusion of this activity students come up with a second independent variable they could test with Alka-Seltzer dissolve time, which we use in the next lab.
    c. Modification/Scaffolding: For the graphing, I will give special education students pre-made graphs with the units, and blanks to add in the axis labels and title. Students work in pairs to make a claim, with no multiple choice options, which is followed up by a class discussion, and consensus of what claim the class will use. Then they independently come up with evidence that will support their claim. This is

not discussed this time, utilized as a formal, formative assessment. They then independently select a reason from the list after a class discussion of what a good "reason" would look like: science fact, supports the claim and evidence, provides explanation. Finally, they come up with a new variable at their table to test the following day.

4. Disappearing Act Part 2
    a. Summary: In this second half of "Disappearing Act" students use their own variables to write a question, design their experiment, formulate their hypothesis, test it and write up a claim, evidence and reasoning.
    b. Teaching and Instruction: In this activity students must first create their question with the Part 1 question as their model. They then create their experimental design, identify their variables and set up their data table. I circulate the room, monitoring, providing guidance and do not supply their materials until they have shown they are fully prepared with the front part of the page. After they complete the experiment, they are allowed to formulate their claim, evidence and reasoning as a table.
    c. Modification/Scaffolding: Most of the scaffolding here comes in the form of peer-support. They are allowed to work as a group to come up with their claim, evidence and reasoning and receive guidance and support from the teacher as needed. Depending on the needs of special education students, I have done this activity where we choose one variable to test as a class (by vote) so that we can work through together and support each other as needed.
5. Wash your Hands
    a. Summary: This long-term lab is started earlier in the unit, but the analysis comes after "Disappearing Act." Students seem to really enjoy their ability to get "dirty." In groups, they select one student to go to the hall/bathroom and touch as many "dirty" things as they can. Then they rub their hands all over a potato, place it in a plastic bag and promptly wash their hands with hot, soapy water for 20 seconds (timed.) They then handled a second potato and placed it a second plastic bag. They monitor color, texture, smell and mass over 8 days.
    b. Teaching and Instruction: This is a formative assessment of their triple beam balance skills that I monitor with a check list. I have a rotating schedule of which students in the groups use the scale and have a checklist to ensure they are using it correctly throughout. I also use this lab as a supplement when teaching both hypotheses and variables; those are done independently with guidance for the group.
    c. Modeling/Scaffolding: At this stage students are now expected to write claims and evidence independently, and we discuss the reasoning together, but they must do the writing on their own. This is again used as a formative assessment of the C-E-R concept.
6. Gummi Bear Summative Lab
    a. Summary: This lab is utilized as a summative assessment for my students. Students measure all facets of a gummi bear, measure a specific volume of water (50mL

usually works well) and leaver the gummi bear in that water over night. The next day they measure again, and then determine the changes in mass, length, width, volume of bear, volume of water and color.

b. Teaching and Instruction: Though this is mostly independent, students are working in groups to measure the bear. I assign student numbers at random to the measurement task when I see a need for that. After the day 2 measurements are complete I will briefly ask students to remind me what it means to find the difference.
c. Modification/Scaffolding: At this point students are expected to complete their writing independent of their table mates. In the case of special needs students I may discuss so reasoning ideas with them, but do not give away a "correct" answer. You will also see that claim and evidence have been combined into one question/paragraph at this point, encouraging the idea of paragraphs in place of isolated sentences.

Name: _____ Date: _____ Period:_____

6th Grade Science: Pendulum Lab

Problem: How does the height the pendulum is dropped from change the number of swings of the pendulum?

Hypothesis:

IF the height the pendulum is dropped from increases,

THEN _____

_____

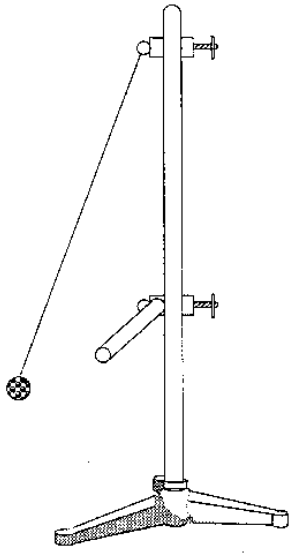
BECAUSE _____

_____

_____

Procedure

1. Tie your string to the ring stand. Measure the height of the ring stand: _____
2. Measure the length of the string: _____
3. Tie the washer to the swing.
4. Practice dropping the washer with the string straight. How many times does the pendulum swing back and forth?
5. Drop the pendulum from 10cm, 20cm and 30cm, 2 times each. Put the number of swings the pendulum completes in 30 seconds in the data table below.



Data

Number of swings (in 30 seconds)	Trial 1	Trial 2
10cm		
20cm		
30cm		

With your group, you will need to create an argument that answers the following question: How does the height the pendulum is dropped from change the number of swings of the pendulum?

CLAIM (Circle ONE of the following which answers the question.)

A. The pendulum swings more when the string is longer.
B. Our pendulum was better than other groups because we worked hard to get it all right.
C. The height the pendulum is dropped from did not affect the number of times it swung in 30 seconds.

EVIDENCE (Circle TWO of the following facts from the data that support your claim.)

A. We built several pendulums in class and they were all different numbers of swings.
B. In each of the trials, the pendulum swung between 24 and 25 times.
C. The pendulum was made with string, washers and ring stands, and that affected the number of swings.
D. The pendulum swung the same in each of the trials for each length.
E. This was really fun to do because we got to count the number of swings and it was easy to do.

REASONING (Circle ONE of the following, looking for a scientific fact that explains your claim and evidence.)

A. Even though we tried really hard to get the lab right, we made errors in our lab and that made the swings the same. If we did this again and fixed the errors, we would see a different number of swings for each length because that is what should have happened.
B. The length of the string did not affect the number of swings because we did not change the weight of the washer, which is what controlled the number of swings.
C. Gravity caused this.

Name:_____ Date:_____ Period:_____

6th Grade Science: Penny Lab

Introduction: Surface tension is water's ability to "stick to itself." Surface tension can be measured and observed by dropping water (drop by drop) onto a penny. The number of water drops that can fit on a penny will surprise you.

Initial Observation: Observe surface tension by seeing how many drops of water can fit on a penny.
Number of Drops _____

Question: How does soap change the water's how many drops of water fit on a penny?

Next, develop a hypothesis that answers the experimental question. Write your hypothesis below.

If we add soap to the water

then _____

*because*_____

_____

3. Test your hypothesis by comparing the number of drops of tap water that can fit on a penny to the number of drops of soapy water that can fit on a penny. Because water drops may vary depending on how well you drop the water, **it is best to run many trials and take an average**. Record your data in the table below.

	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	**Average**
Tap Water						
Soapy Water						

4. Using your _____ find the volume of your average number of drops. Remember to use your units!

	Average Number of Drops	Volume of the drops
Tap Water		
Soapy Water		

Analysis

1. Was the data collected **quantitative or qualitative**? _____
2. Identify the **independent** variable in the experiment. _____
3. Identify the **dependent** variable in the experiment. _____

With your group, you will need to create an argument that answers the following question: How does soap change the water's how many drops of water fit on a penny?

CLAIM (Circle ONE of the following)

A. More drops of water fit on the head of the penny when there was soap in the water. Less drops of water fit on the head of the penny when there wasn't soap in the water.
B. Less drops of water fit on the head of the penny when there was soap in the water. More drops of water fit on the head of the penny when there wasn't soap in the water.
C. It made more fit.
D. More drops fit with soap, less without.

EVIDENCE (write TWO facts from your data that support your claim in the space below)

1. _____
   _____
   _____
2. _____
   _____
   _____

REASONING (Circle ONE of the following that give a science fact to back up your claim and evidence.)

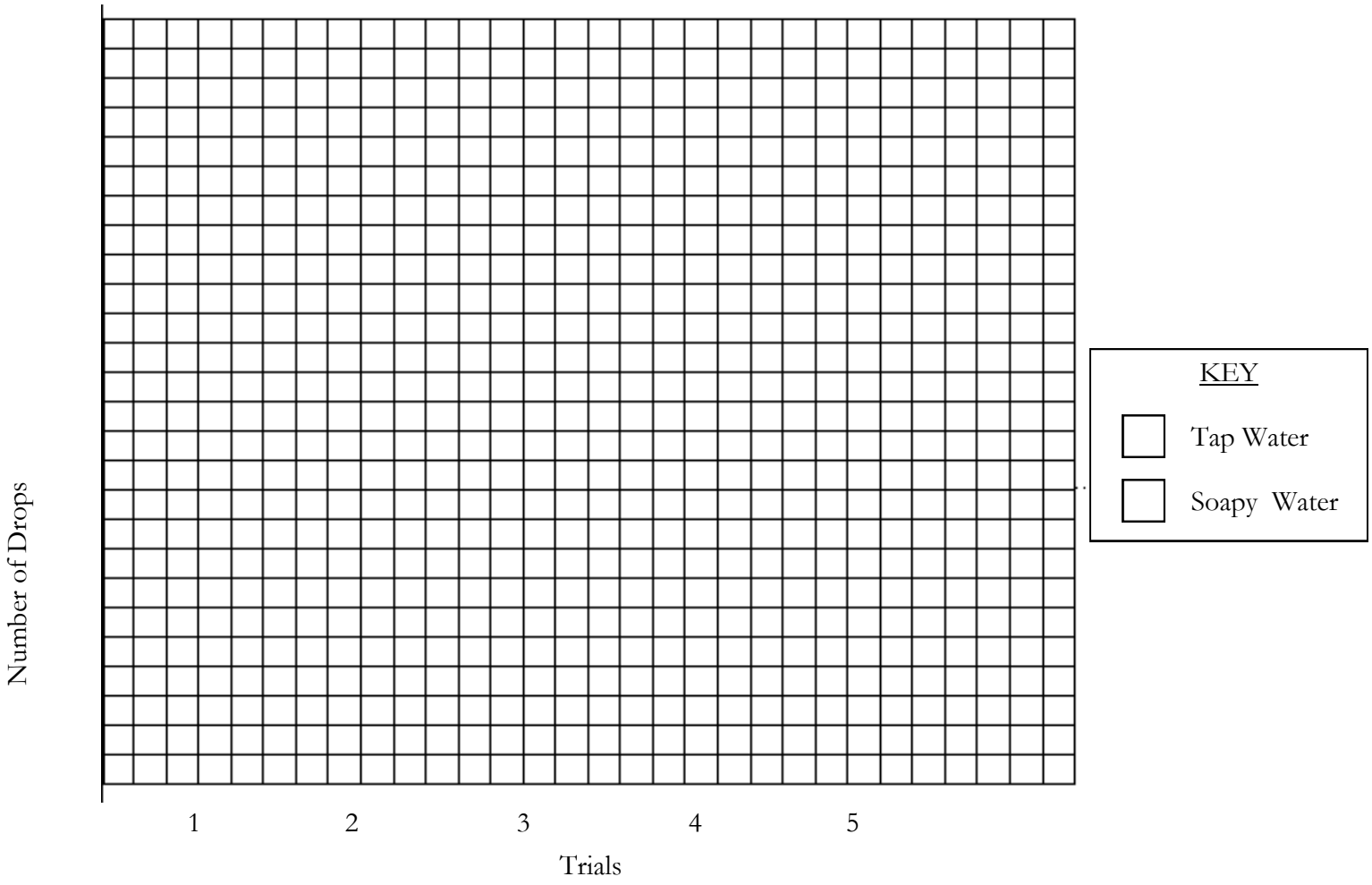
A. More drops fit on the head of the penny when there was no soap in the water. This happened because water is special and able to sit on the head of the penny, but this isn't what we thought would happen so we were wrong.
B. The soap washed away the glue, so it wasn't sticky any more.
C. The surface tension of the water was broken by the soap's molecules.

Name: _____ Date:_____ Period:_____

6th Grade Science: Penny Lab Graph

How do I illustrate/quantify what happened? Do the results make sense?

Instructions: Create a **double bar graph** of your 5 trials from the data. Be sure to fill in the key as well.



Name: _____ Date:_____ Period:_____
6th Grade Science: Disappearing Act

Problem: How does temperature change how fast Alka-Seltzer will dissolve in water?

Hypothesis:

IF:
THEN:
BECAUSE:

Procedure:

1. Fill 3 beakers. One with hot water, one with cold water and one with room temperature water.
2. Measure the temperature of each beaker. Record in the table below.
3. Place one Alka-Seltzer tablet in each beaker. Record the time in the table below.
4. Graph data in a bar graph on the graph paper supplied.

Data Table 1– Temperature and Time to Dis-

Beaker	Volume of water added	Temperature	Time to Dissolve Tablet
Hot			
Room Temp.			
Cold			

Analysis Questions:

1. What was your independent variable? _____
2. What was your dependent variable? _____
3. What was the control? _____

Make a CLAIM about your data (what can you state about dissolve time and temperature?)

What EVIDENCE will support the claim you made (what data from the experiment helps us know your claim is correct.)

Select one REASON from those listed below that explains your claim and evidence.

A. The heat is melting the Alka-Seltzer.

B. The water molecules move faster when they are hot, and can break down the Alka-Seltzer faster.

C. When we added heat to the Alka-Seltzer, the Alka-Seltzer dissolved faster than when the water was cold or at room temperature.

What is INDEPENDENT VARIABLE you could test? (What else could we change?)

Name: _____ Date:_____ Period:_____
6th grade Science: Disappearing Act- Part 2

In this activity you will use what we learned in the first part, "Disappearing Act" to change our variables and create a new question and design how to test it.

Problem

_____

_____

Hypothesis

If:_____

Then:_____

Because: _____

_____

Independent Variable: _____

Dependent Variable: _____

Data

Claim: _____

_____

_____

Evidence: _____

_____

_____

Reasoning:

_____

_____

_____

_____

_____

_____

Name: _____ Date:_____ Period: _____

6th grade science: Wash Your Hands Lab

In this lab you will use "clean" and "dirty" hands to handle someone's food- a potato. We will observe the potato for 8 days, taking data along the way.

Problem: Will washing your hands prevent "germs" from growing on your food?

Hypothesis:

If _____

Then_____

Because _____

Procedure

1. Label your plastic bags with your group period and color. Then label one "Clean" and one "Dirty."
2. Rub one person's hands over many places (sink, handles, etc.) in the bathroom.
3. Have that person touch the first potato all over and then place in plastic bag labeled "dirty."
4. Have that person wash their hands with soap and hot water and then touch the other potato all over. Then place the potato in the bag.

5. Place the potatoes in their bags, sealed on the window sill.
6. Observe the potatoes each day. Write down their mass, color, texture (from outside the bag) and smell.

Data

(write the date under day number) →		Day 1	Day 2	Day 3	Day 4
"Clean"	Mass (g)				
	Color				
	Texture				
	Smells like				
"Dirty"	Mass (g)				
	Color				
	Texture				
	Smells like				

(write the date under day number) →		Day 5	Day 6	Day 7	Day 8
"Clean"	Mass (g)				
	Color				
	Texture				
	Smells like				
"Dirty"	Mass (g)				
	Color				
	Texture				
	Smells like				

Analysis and Conclusion

1. Label each piece of data collected below as quantitative or qualitative.
    a. Mass: _____
    b. Color: _____
    c. Texture: _____
    d. Smell: _____
2. List your independent variable: _____
3. List your dependent variable: _____
4. What CLAIM can you make about the question "will washing your hands prevent germs from growing?"

_____

_____

5. What EVIDENCE from your data supports to claim you made?

_____

_____

_____

_____

6. What REASON can you give for this claim and evidence? (What science fact do you know?)

_____

_____

_____

_____

Name: _____ Date:_____ Period: _____

6th Grade Science: Gummi Bear Summative Lab

Problem: How will a Gummi Bear change when left overnight in water?

Hypothesis: If _____

then _____

because _____

Independent Variable: _____

Dependent Variable: _____

Procedure:

1. Label your paper cup with your group color and period.
2. Observe the gummi bear. Record it's color in the data table below.
3. Measure the gummi bear in the following order:
    A. length (Tool used: _____)
    B. Width (Tool used: _____)
    C. Height Tool used: _____)
    D. Mass (Tool used: _____)
    E. Volume (Tool used: _____)

3. Place the bear in 50mL of water and place cup in designated area.

4. Allow bear to sit overnight.

5. Remove bear from water. Measure the same areas as step 3 and record in "Day 2" section of data table.

6. Find the change between the two days by finding the difference between them. Label growth with a + and loss with a –.

Data Table

	Bear color	Length	Width	Height	Volume Of bear	Mass	Volume of water
Day 1 Data							
Day 2 Data							
Change							

Analysis Questions:

1. What can you CLAIM about "How will a Gummi Bear change when left overnight in water?" Then, use at least TWO pieces of EVIDENCE to support your claim.

2. REASONING: What do you think caused the change in the gummi bear? Give a scientific fact that can help support your claim and evidence.