Group Color: _____
Subgroup Number: _____

How Science Works

Grade 5

Module 2

Class Question:

Scientist (Your Name): _____

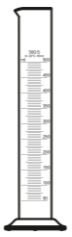
Teacher's Name: _____

SciTrek Volunteer's Name: _____

VOCABULARY

Science: The study of the material world using human reason. The scientific method is the way humans reason and apply logic to data to help gain knowledge of the world.

- **Observation:** A description using your five senses. This could include contents, mass, size, color, temperature, smell, texture …
- **Opinion:** Something you believe or feel. Not a fact or observation.
- **Inference:** A guess based on past experiences.
- **Testable Question:** A question for which an experiment can be designed to answer.
- **Non-Testable Question:** A question for which an experiment cannot be designed to answer. For example, questions involving things that cannot be measured/observed or things that are not well defined/opinions.
- **Experimental Set-Up:** The materials, changing variable, and controls that are needed for an experiment.
- **Experiment:** A test or trial to discover something unknown**.**
- **Procedure:** A set of steps to conduct an experiment.
- **Controls:** The variables that are not changed in an experiment.
- **Changing Variable (Independent Variable):** The variable that is purposely changed in an experiment.
- **Results/Data (Dependent Variable):** The measurements/observations of the experiment, which are influenced/determined by the changing variable.
- **Prediction:** What you expect to happen based off of previous measurements/observations.
- **Scientific Practices:** A series of activities that scientists participate in to both understand the world around them and to communicate their results with others. (The specific practice worked on in this module is conclusions.)
- **Technique:** A method for a specific task.
- **Conclusion:** A claim supported by data.
- **Claim:** A statement that can be tested. The explanation of the data, the first part of a conclusion.
- **Data:** Evidence collected from experiment(s) (measurements or observations), the second part of a conclusion.
- **Matter:** Substances that occupy space and have mass.
- **Mixture:** A material made up of two or more substances. (Examples: trail mix or Kool-Aid)
- **Pure Substance:** A material made up of only one substance. (Examples: helium or oil)
- **Physical Property:** A property that can be measured or observed without changing the substance. Physical properties can be used to separate mixtures or identify pure substance. (Example: color or boiling point)
- **Graduated Cylinder:** A piece of laboratory equipment used to measure the volume of a liquid.
- **Test Tube:** A piece of laboratory equipment that is a cylinder with one end open and the other end rounded.



Graduated Cylinder

Test Tube

OBSERVATIONS

Experimental Set-Up**:** _____

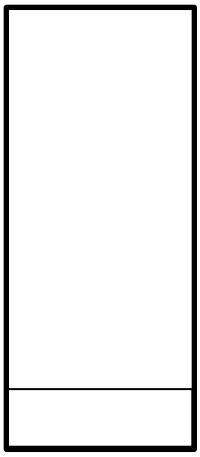
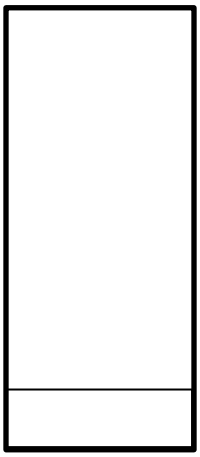
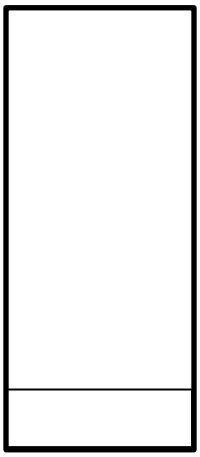
_____

_____

_____

_____

_____

	Time 0	**Time 1**	**Time 2**
Time:			
Picture:			
Measurements/ Observations:			

VARIABLES

Variable	How will changing this variable affect the smears?
	_____ _____ _____ _____
	_____ _____ _____ _____
	_____ _____ _____ _____
	_____ _____ _____ _____
	_____ _____ _____ _____

Experimental Considerations:

1. You will only have access to the materials on the materials page.
2. The strips of paper cannot be in the liquid for more than 5 minutes.
3. All strips of paper must be put into the liquid at the same time.

Changing Variable(s) (Independent Variable(s))

You will get to perform two experiments. For your first experiment, decide which variable(s) (max three) that you would like to test. For each changing variable that you select, discuss with your subgroup why you think that variable will affect the smear.

Changing Variable 1: _____
Discuss with your subgroup how you think **changing variable 1** will affect the smear.

Changing Variable 2 (optional): _____
Discuss with your subgroup how you think **changing variable 2** will affect the smear.

Changing Variable 3 (optional):_____
Discuss with your subgroup how you think **changing variable 3** will affect the smear.

QUESTION

Question our subgroup will investigate:

- If we change the _____
  insert each changing variable (independent variable)

  _____,

  what will happen to the _____
  insert what you are measuring/observing (dependent variable)

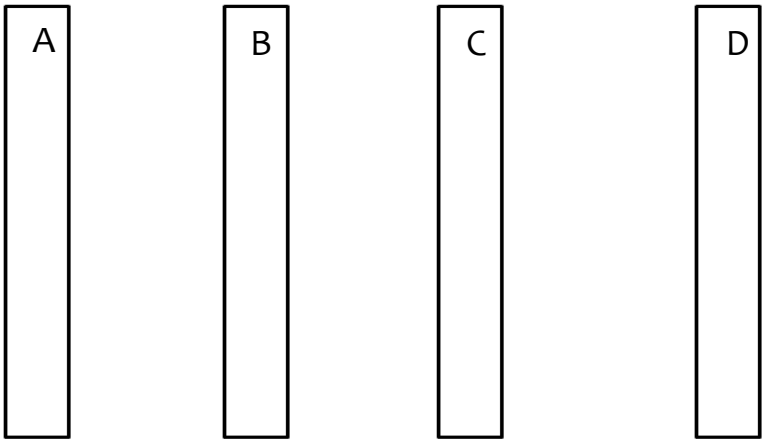
  _____?

SciTrek Member Approval: _____

Get a materials page from your SciTrek volunteer and fill it out before moving onto the experimental set-up.

EXPERIMENTAL SET-UP

Write your changing variable(s) (Ex: pen color) and the values (Ex: blue) you will use for your trials under each strip of paper.



Changing Variable(s):

1) _____ : _____ _____ _____ _____

2) _____ : _____ _____ _____ _____

3) _____ : _____ _____ _____ _____

Controls (variables you will hold constant)**:**
Write the controls and the values you will use in all your trials (control/value, Ex: container/test tube).

Container	/ Test Tube		/
	/		/
	/		/

SciTrek Member Approval: _____

PROCEDURE

Procedure Note:

Make sure to include all values of your changing variable(s) in the procedure (Ex: For a subgroup that decided to change pen color, one step would be: Put colored dot with Mr. Sketch pens A) red, B) blue, C) green, and D) yellow on original paper at 2 cm.).

1. _____

_____

_____

2. _____

_____

_____

3. _____

_____

_____

4. _____

_____

_____

5. _____

_____

_____

6. _____

_____

_____

SciTrek Member Approval: _____

RESULTS

Table

Fill out the table for each of your trials. For the variables that remain constant, write the value in *Trial A*. Then, draw an arrow through each box indicating the variable is a control.

Underline controls, circle changing variables, and box information about data collection.

Variables		Trial A	Trial B	Trial C	Trial D
Container:		***Test Tube*** →			
Time:					
Liquid Type:					
Liquid Amount:					
Paper Type:					
Pen Color:					
Pen Type:					
Initial Dot Height:					
_____ Other Variable					
Predictions		**Trial A**	**Trial B**	**Trial C**	**Trial D**
Put a "S" in the trial that will give the shortest smear and an "T" in the trial that will give the tallest smear.					
Data		**Trial A**	**Trial B**	**Trial C**	**Trial D**
Measurements:	Smear Height:				
	Liquid Height:				
Observations:	Other:				

The independent variable(s) is(are) the changing variable(s) and the dependent variables are the final measurements/observations.

RESULTS

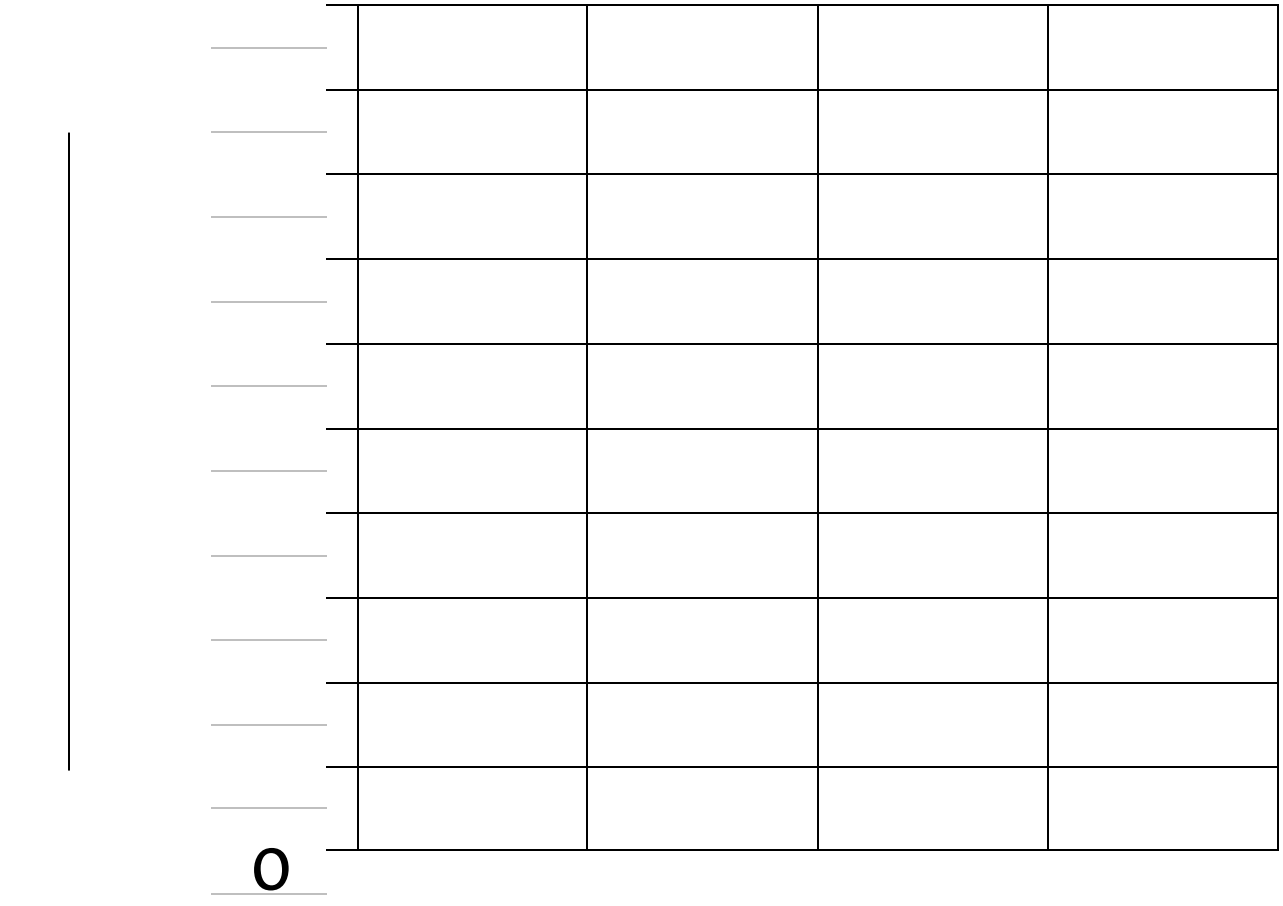
Graph

Set up your graph. (Check off the steps as you complete them.)

- ☐ Label the y-axis (vertical) with what you measured, including units (Ex: Smear Height (cm)).
- ☐ Determine an appropriate scale which will allow you to graph all of your data points and write the numbers on the given lines.
- ☐ Label the x-axis (horizontal) with your changing variable(s) #1, #2, and #3 (Ex: Liquid Type). Changing variable #2 and #3 will only be filled in if you have 2 or 3 changing variables.
- ☐ On your results table, label your measurements from 1 to 4, with 1 being the trial with the smallest measurement, and 4 being the trial with the largest measurement.

Plot your data in increasing order.

- ☐ Write the changing variable value(s) (Ex: Soap) for the trial that you labeled 1 under the first column.
- ☐ Graph your data for that trial and write the measurement above the bar.
- ☐ Repeat the process for the other trials.



_____ : _____ _____ _____ _____

Changing Variable #1

_____ : _____ _____ _____ _____

Changing Variable #2

_____ : _____ _____ _____ _____

Changing Variable #3

SCIENTIFIC PRACTICES

Conclusions

1. **Directions:** Fill in the missing definition.
   - **Conclusion:**_____
     - **Claim:** A statement that can be tested. The explanation of the data, the first part of a conclusion.
       - Ex: Cats, on average, weigh less than dogs
     - **Data:** Evidence collected from experiment(s) (measurements or observations), the second part of a conclusion.
       - Ex: the average weight of a dog is 14 kg, and the average weight of a cat is 5 kg.

2. **Directions:** Circle if the statement is a CLAIM, DATA, or an OPINION.

a.	McDonald's served 100 customers, and Taco Bell served 75 customers	*Claim*	*Data*	*Opinion*
b.	blue is the best color	*Claim*	*Data*	*Opinion*
c.	butterflies that are larger than 15 cm, are attracted to bright colors	*Claim*	*Data*	*Opinion*
d.	ice was observed floating on water	*Claim*	*Data*	*Opinion*
e.	people buy more pizza than hamburgers	*Claim*	*Data*	*Opinion*
f.	the average male blue whale weighs 91,000 kg, while the average female blue whale weighs 122,000 kg	*Claim*	*Data*	*Opinion*
g.	the tastier the fruit, the more bugs on the fruit	*Claim*	*Data*	*Opinion*

Circles are your initial thoughts and boxes are the correct answer.

SCIENTIFIC PRACTICES

Conclusions

3. **Directions:** Draw a line connecting claims with the correct data. If there is no data that supports the claim, do not draw a line.

Claim	because	Data
1. People read more from electronic devices than books		a. Sony TVs give off 20 lumens of light and Samsung TVs give off 10 lumens of light.
2. Sony TVs are brighter than Samsung TVs		b. when blue and red paint were mixed, the paint was observed to turn purple.
3. The color purple is made from blue and red		c. wind turbines produce 6,000 MW of energy, and solar panels produce 5,000 MW of energy in California.
4. Wind turbines produce less energy than solar panels in California		d. the speed of light is measured to be $3\times10^8 \frac{m}{s}$.

SCIENTIFIC PRACTICES

Conclusions

Variables		Trial A	Trial B
Time:		5 min	→
Liquid Type:		Water	→
Liquid Amount:		2 ml	→
Paper Type:		Original	→
Pen Color:		Black	→
Pen Type:		Mr. Sketch	Crayola
Initial Dot Height:		2 cm	→
Data		**Trial A**	**Trial B**
Measurements:	Smear Height:	3 cm	2 cm
Measurements:	Liquid Height:	5 cm	4 cm
Observations:	Other:	Green Blue Red	Yellow Blue Red

4. **Directions:** ***Step 1:*** Identify the following statements as either CLAIM or DATA and write a C or D on the line. ***Step 2:*** Look at the results table and circle if the statement is a correct claim, correct data, or incorrect. Statements are INCORRECT if the statement does not agree with the data table or has not been tested.

		Step 1: *Statement Type: C or D*	***Step 2:*** *Based on the table, is the statement a correct claim, correct data, or Incorrect?*		
a.	the paper type affects the height the liquid travels up the paper	_____	*Correct Claim*	*Correct Data*	*Incorrect*
b.	black pen types are made up of different dye colors	_____	*Correct Claim*	*Correct Data*	*Incorrect*
c.	when a black dot sits in water for 5 min, different pen types give different smear heights	_____	*Correct Claim*	*Correct Data*	*Incorrect*
d.	the black Crayola was observed to contain green dye	_____	*Correct Claim*	*Correct Data*	*Incorrect*

What data can be used to support claim b above? _____

_____

_____

SCIENTIFIC PRACTICES

Conclusions

Variables		**Trial A**	**Trial B**
Time:		5 min	4 min
Liquid Type:		Water	Soap
Liquid Amount:		2 ml	→
Paper Type:		Original	→
Pen Color:		Black	Red
Pen Type:		Mr. Sketch	→
Initial Dot Height:		2 cm	→
Data		**Trial A**	**Trial B**
Measurements:	Smear Height:	3 cm	1.5 cm
	Liquid Height:	5 cm	3.5 cm
Observations:	Other:	Green Blue Red	Red Orange

5.

		Step 1: *Statement Type: C or D*	***Step 2:*** *Based on the table, is the statement a correct claim, correct data, or Incorrect?*		
a.	the stronger the pen odor the larger the smear height	_____	*Correct Claim*	*Correct Data*	*Incorrect*
b.	the black pen had a smear height of 3 cm, and the red pen had a smear height of 1.5 cm	_____	*Correct Claim*	*Correct Data*	*Incorrect*
c.	black and red pens are made from green dye	_____	*Correct Claim*	*Correct Data*	*Incorrect*
d.	the thicker the liquid, the shorter the smear height	_____	*Correct Claim*	*Correct Data*	*Incorrect*

If no claim can be made from the data state why not. _____

_____

_____

If no claim can be made from the results, can you make a conclusion?

☐ YES ☐ NO

SCIENTIFIC PRACTICES

Conclusions

6. **Directions:** Decide if a claim/conclusion can be made for each of the following results tables and graph.

Table A

Variables	**Trial A**	**Trial B**
Time:	3 min	2 min
Pen Type:	Crayola	Mr. Sketch
Pen Color:	Black	→
Paper Type:	Original	→
Liquid:	Water	→
Liquid Amount:	2 ml	4 ml
Data	**Trial A**	**Trial B**
Smear Height:	3 cm	4 cm

Can this scientist make a claim/conclusion? _____

Table B

Variables	**Trial A**	**Trial B**
Time:	5 min	→
Pen Type:	Mr. Sketch	→
Pen Color:	Blue	→
Paper Type:	Newspaper	Original
Liquid:	Vinegar	→
Liquid Amount:	5 ml	→
Data	**Trial A**	**Trial B**
Smear Height:	3.5 cm	4 cm

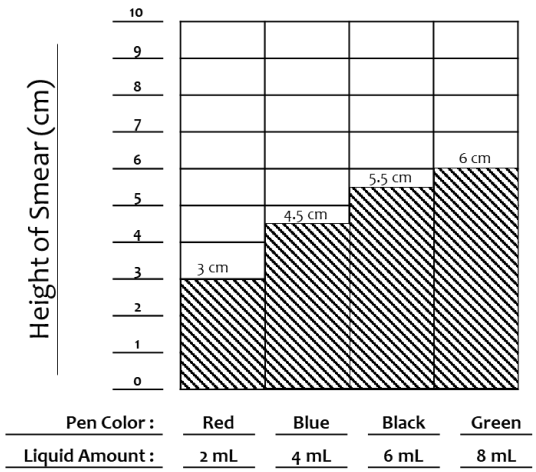
Can this scientist make a claim/conclusion? _____

Table C

Variables	**Trial A**	**Trial B**
Time:	5 min	→
Pen Type:	Rose Art	Expo
Pen Color:	Black	→
Paper Type:	Original	→
Liquid:	Soap	→
Liquid Amount:	2 ml	→
Data	**Trial A**	**Trial B**
Smear Height:	3 cm	3 cm

Can this scientist make a claim/conclusion? _____

Graph D



Can this scientist make a claim/conclusion? _____

Making a Conclusion from Your Data

How many changing variables did you have in your experiment**?** _____

Can you make a conclusion from your data? ☐ **YES** ☐ **NO**

IF NO

Why?_____

_____

_____

IF YES

CONCLUSION

We can conclude _____
claim

_____

_____

because_____
data (measurement/observation)

_____

_____

SciTrek Member Approval: _____

Changing Variable(s) (Independent Variable(s))

For your second experiment, decide which variable(s) (max three) that you would like to test.

Changing Variable 1: _____

Changing Variable 2 (optional): _____

Changing Variable 3 (optional): _____

QUESTION

Question our subgroup will investigate:

- If we change the _____,
  insert each changing variable (independent variable)

  what will happen to the _____
  insert what you are measuring/observing (dependent variable)

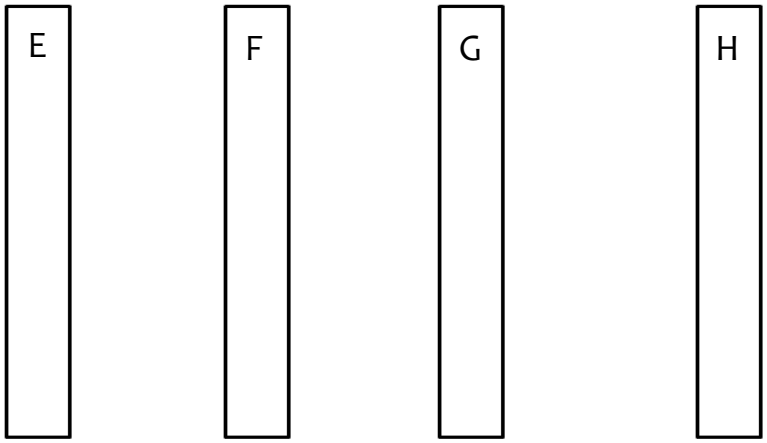
  _____?

SciTrek Member Approval: _____

Get a materials page from your SciTrek volunteer and fill it out before moving onto the experimental set-up.

EXPERIMENTAL SET-UP

Write your changing variable(s) (Ex: pen color) and the values (Ex: blue) you will use for your trials under each strip of paper.



Changing Variable(s):

1) _____ **:** _____ _____ _____ _____

2) _____ **:** _____ _____ _____ _____

3) _____ **:** _____ _____ _____ _____

Controls (variables you will hold constant)**:**
Write the controls and the values you will use in all your trials (control/value, Ex: container/test tube).

Container / Test Tube	/
/	/
/	/
/	/

SciTrek Member Approval: _____

PROCEDURE

Procedure Note:

Make sure to include all values of your changing variable(s) in the procedure (Ex: For a subgroup that decided to change pen color, one step would be: Put colored dot with Mr. Sketch pens E) red, F) blue, G) green, and H) yellow on original paper at 2 cm.).

1. _____

_____

_____

2. _____

_____

_____

3. _____

_____

_____

4. _____

_____

_____

5. _____

_____

_____

6. _____

_____

_____

SciTrek Member Approval: _____

SCIENTIFIC PRACTICES

Conclusions

Question: If we change the _____ *what will happen to the liquid height?*

Variables		**Trial A**	**Trial B**	**Trail C**	**Trial D**
Container:		Test Tube	→	→	→
Time:		5 min	→	→	→
Liquid Type:		Water	→	→	→
Liquid Amount:		2 ml	→	→	→
Paper Type:		Original	→	→	→
Pen Color:		Black	→	→	→
Pen Type:		Mr. Sketch	→	→	→
Initial Dot Height:		2 cm	→	→	→
Paper Height:		5 cm	10 cm	15 cm	20 cm
Data		**Trial A**	**Trial B**	**Trial C**	**Trial D**
Measurements:	Smear Height:	3 cm	8 cm	9 cm	9 cm
	Liquid Height:	5 cm	10 cm	11 cm	11 cm
Observation:	Other:	blue orange red	blue orange red	blue orange red	blue orange red

Write a conclusion from the results above:

We can conclude _____
claim

_____

because_____
data

_____

_____

_____

_____

RESULTS

Table

Fill out the table for each of your trials. For the variables that remain constant, write the value in *Trial E*. Then, draw an arrow through each box indicating the variable is a control.

Variables		**Trial E**	**Trial F**	**Trial G**	**Trial H**
Container:		***Test Tube*** →			
Time:					
Liquid Type:					
Liquid Amount:					
Paper Type:					
Pen Color:					
Pen Type:					
Initial Dot Height:					
_____ Other Variable					
Predictions		**Trial E**	**Trial F**	**Trial G**	**Trial H**
Put a "S" in the trial that will give the shortest smear and an "T" in the trial that will give the tallest smear.					
Data		**Trial E**	**Trial F**	**Trial G**	**Trial H**
Measurements:	Smear Height:				
	Liquid Height:				
Observations:	Other:				

Underline controls, circle changing variables, and box information about data collection.

The independent variable(s) is(are) the changing variable(s) and the dependent variables are the final measurements/observations.

RESULTS

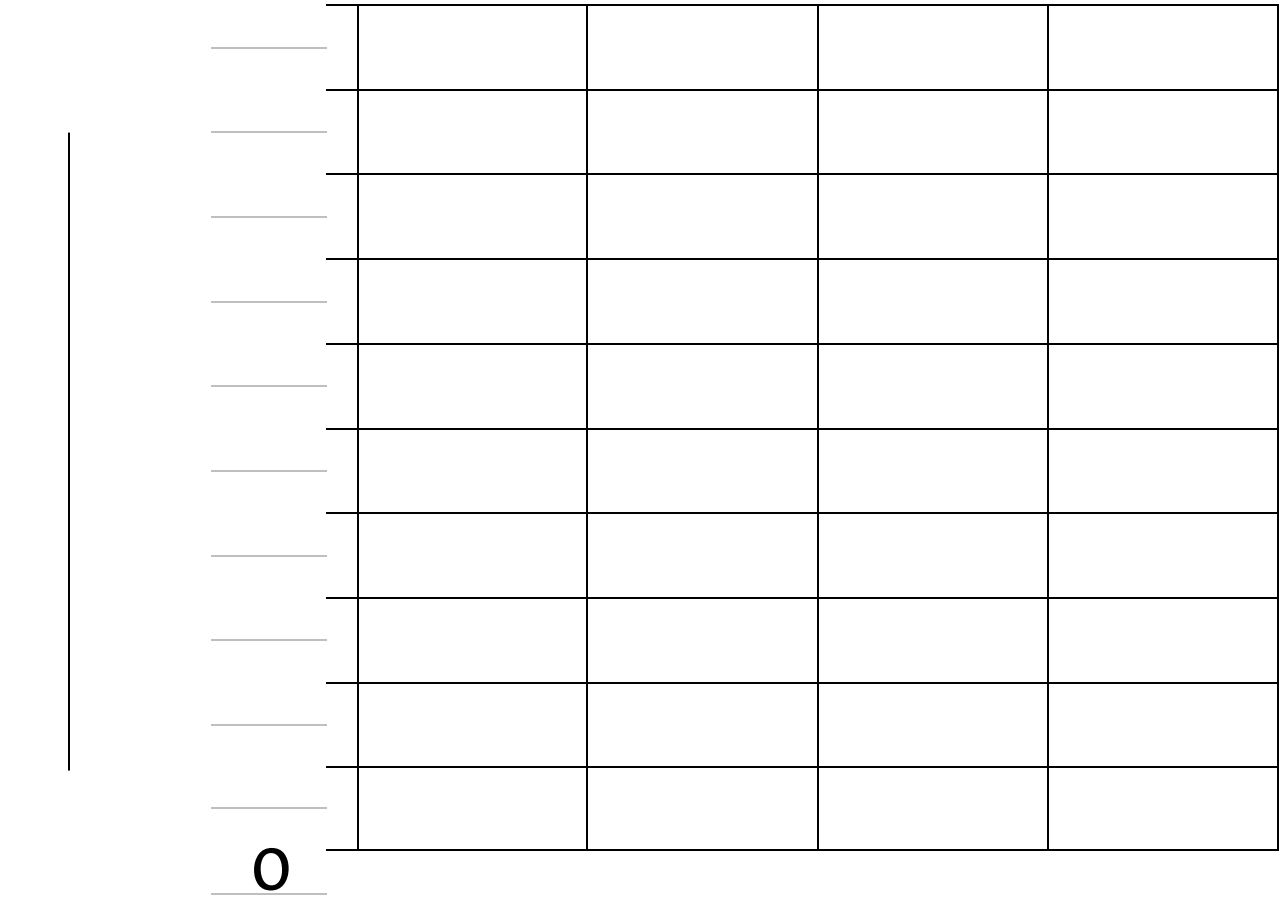
Graph

Set up your graph. (Check off the steps as you complete them.)

- ☐ Label the y-axis (vertical) with what you measured, including units (Ex: Smear Height (cm)).
- ☐ Determine an appropriate scale which will allow you to graph all of your data points and write the numbers on the given lines.
- ☐ Label the x-axis (horizontal) with your changing variable(s) #1, #2, and #3 (Ex: Liquid Type). Changing variable #2 and #3 will only be filled in if you have 2 or 3 changing variables.
- ☐ On your results table, label your measurements from 1 to 4, with 1 being the trial with the smallest measurement, and 4 being the trial with the largest measurement.

Plot your data in increasing order.

- ☐ Write the changing variable value(s) (Ex: Soap) for the trial that you labeled 1 under the first column.
- ☐ Graph your data for that trial and write the measurement above the bar.
- ☐ Repeat the process for the other trials.



_____ : Changing Variable #1				
_____ : Changing Variable #2				
_____ : Changing Variable #3				

CONCLUSION

Generate a <u>claim</u> about how your changing variable affected your results. (Ex: the shorter the paper the shorter the smear height.)	We can conclude _____ (claim) _____ _____ _____ _____ _____
What <u>data</u> do you have to support your claim? (Remember to include your measurements and/or observations, <u>not trail letters</u>.)	because _____ (data) _____ _____ _____ _____ _____.

Can you test the first part (claim) of the conclusion?

☐ YES ☐ NO (If you checked this box go back and revise your claim so that it can be.)

The second part of the conclusion is data because it contains a _____.

I acted like a scientist when_____

_____

_____

NOTES ON PRESENTATIONS

What variables affect smears?

Changing Variable:				
Smear Height (cm):				

Summary:_____

_____

Changing Variable:				
Smear Height (cm):				

Summary:_____

_____

Changing Variable:				
Smear Height (cm):				

Summary:_____

_____

Changing Variable:				
Smear Height (cm):				

Summary:_____

_____

What variables affect smears?

Changing Variable:				
Smear Height (cm):				

Summary:_____

_____

Changing Variable:				
Smear Height (cm):				

Summary:_____

_____

Changing Variable:				
Smear Height (cm):				

Summary:_____

_____

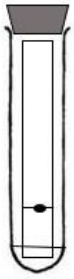
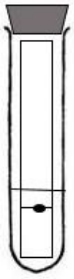
Changing Variable:				
Smear Height (cm):				

Summary:_____

_____

TIE TO STANDARDS

1. Circle the value of the variable that the police should use to process the evidence from the suspects that would give them the tallest smear.

Time:	3 min	5 min	10 min	All would give similar height smears
Liquid Type:	Water	Soap	Syrup	All would give similar height smears
Amount of Liquid/Line Level:				All would give similar height smears

2. What conclusion can you make from the results the police collected?

We can conclude that the robber was number _____
claim

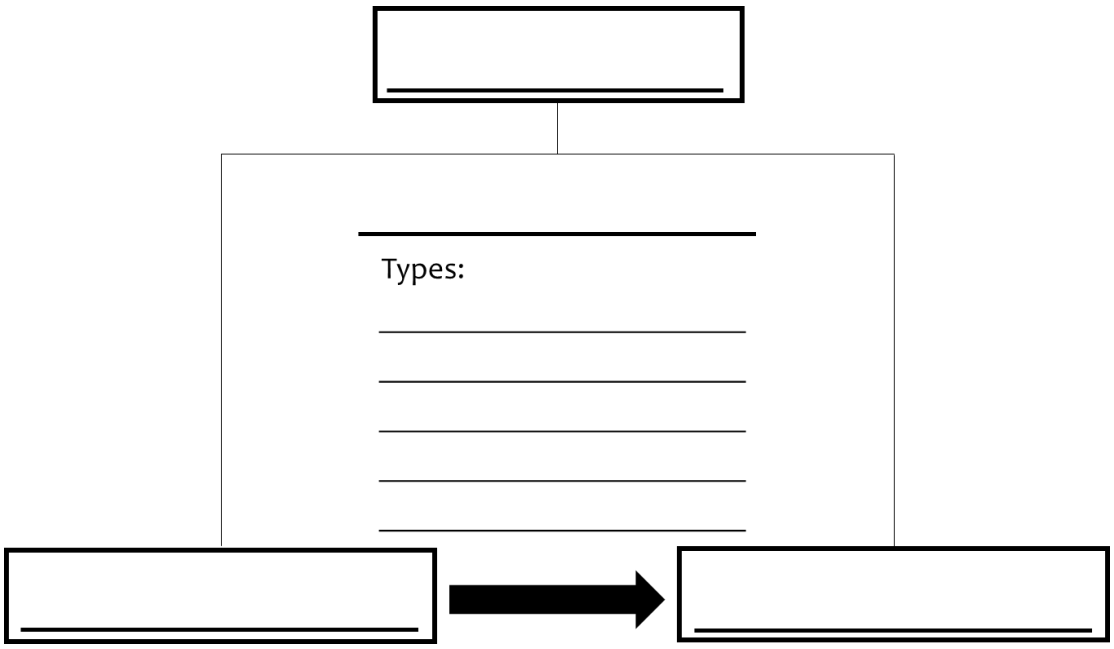
because_____
data

_____

_____.

3. What did we learn about black ink? _____

4. Fill in the following words on the chart: physical properties, pure substance, matter, mixture.



5. Physical property: Property that can be _____ or _____ without _____ the substance.

6. Physical properties of black ink are: _____ and _____

7. Physical properties of paper are: _____ and _____

8. Can all physical properties be used to separate mixtures? Yes No

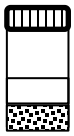
9. What type of physical property was use to separate the black ink?

_____

10. What do we know about the yellow ink? _____

11. What do we know about the blue ink? _____

12. Determine how you would separate each mixture into two parts.

Mixture	List 3 Physical Properties of each part of the mixture		Helpful in Separating
			(circle one)
			Yes **No**
			Yes **No**
			Yes **No**

Is water a pure substance? Yes No

Is sand a pure substance? Yes No

13. _____ can be used to separate mixtures and identify pure substances.

14. Write down physical properties of the four substances. You will use these to identify four unknown substances. You will not have access to the labeled substances when you are identifying the unknown substances.

Pure Substance	Physical Properties	Unknown Letter
Sugar		
Salt		
Baking Soda		
Corn Starch		

EXTRA PRACTICE

Conclusions

Directions: On the results table, underline each control, circle each changing variable(s), and box information about data collection.

Variables		**Trial A**	**Trial B**
Time:		5 min	→
Liquid Type:		Water	Soap
Liquid Amount:		2 ml	→
Paper Type:		Original	→
Pen Color:		Red	→
Pen Type:		Mr. Sketch	→
Data		**Trial A**	**Trial B**
Measurements:	Smear Height:	4 cm	0.5 cm
	Liquid Height:	6 cm	3 cm
Observations:	Other:	Green Blue Red	Pink Orange

Can this group make a claim/conclusion? Yes No I Don't Know

		Step 1: *Statement Type: C or D*	***Step 2:*** *Based on the table, is the statement a*		
			Correct Claim	*Correct Data*	*Incorrect*
1.	the height of the smear in water was 4 cm and the height of the smear in soap was 0.5 cm	_____			
2.	the type of liquid does not affect the smear height	_____	*Correct Claim*	*Correct Data*	*Incorrect*
3.	with 2 mL of liquid, the thicker liquid results in a shorter smear height	_____	*Correct Claim*	*Correct Data*	*Incorrect*
4.	the color of the pen affects the smear height	_____	*Correct Claim*	*Correct Data*	*Incorrect*
5.	the liquid type affects the smear height	_____	*Correct Claim*	*Correct Data*	*Incorrect*

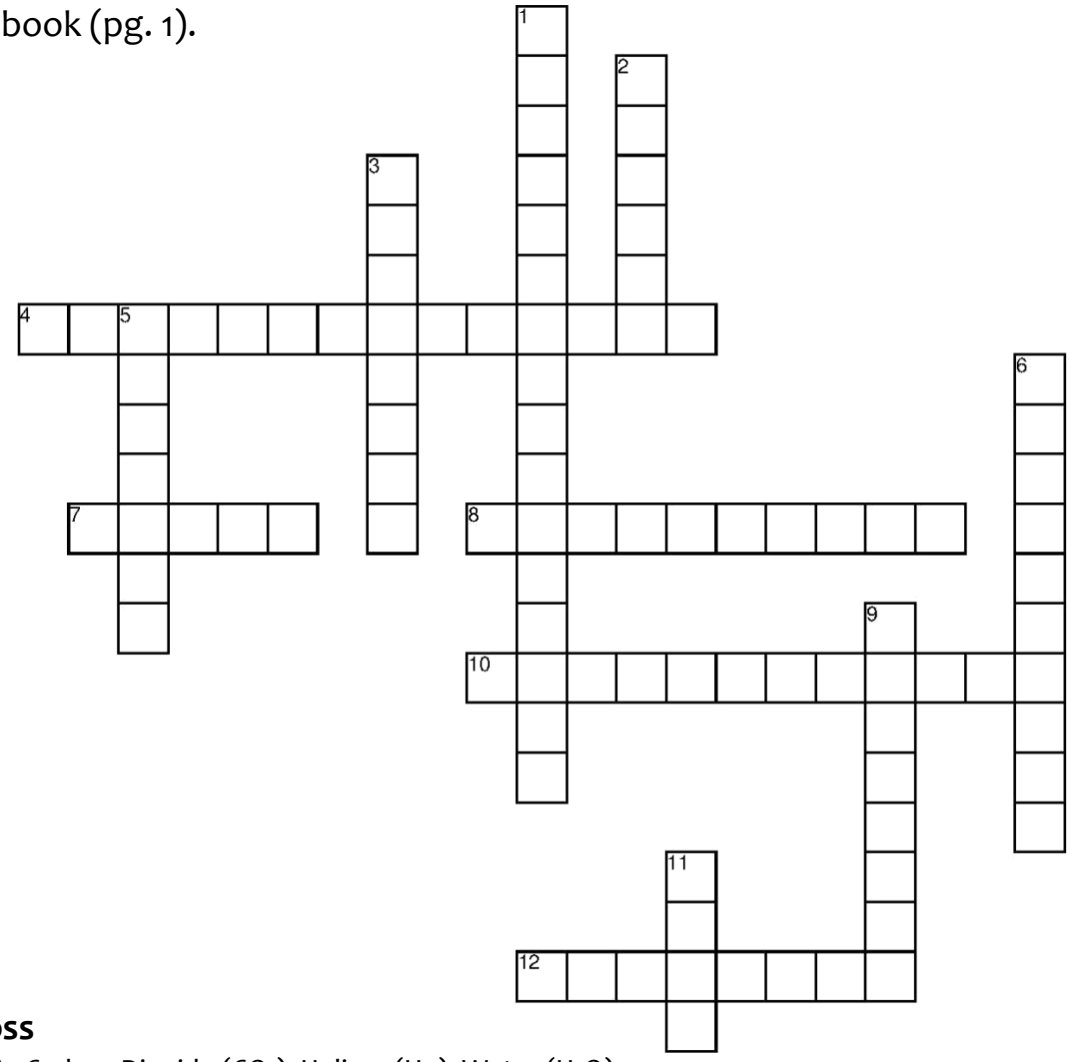
What data can be used to support the correct claim(s) above? _____

_____

_____

CROSSWORD PUZZLE

Directions: Fill out the following crossword puzzle using the clues below. The list of words used for the word search can be found on the vocabulary page of your notebook (pg. 1).



Across

4) Carbon Dioxide (CO_2); Helium (He); Water (H_2O)
7) If you are unable to make a _____ from a set of data, you will be unable to make a conclusion.
8) We use data from previous experiments to come up with a _____, or what we expect to happen in our next experiment.
10) Color and size of smear are examples of _____ made during this experiment.
12) The values of your _____ can make it easier or harder for you to tell what was happening in your experiment.

Down

1) An experimental set-up must indicate the materials needed, the controls and the _____ _____.
2) A graduated cylinder is used to measure _____.
3) We take advantage of this type of property to separate a mixture.
5) Another word for the data recorded during your experiment.
6) There can only be one changing variable in order to make one of these.
9) Lucky Charms, Apple Pie, Air
11) Measurements or observations.

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