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.
## OBSERVATIONS

**Experimental Set-Up:** __________________________________________________________

________________________________________________________________________________

________________________________________________________________________________

________________________________________________________________________________

________________________________________________________________________________

<table>
<thead>
<tr>
<th>Time:</th>
<th>Time 0</th>
<th>Time 1</th>
<th>Time 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Picture:</strong></td>
<td><img src="image1" alt="Image" /></td>
<td><img src="image2" alt="Image" /></td>
<td><img src="image3" alt="Image" /></td>
</tr>
</tbody>
</table>

**Measurements/Observations:**

<table>
<thead>
<tr>
<th>Measurements/Observations:</th>
<th>Time 0</th>
<th>Time 1</th>
<th>Time 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
# VARIABLES

<table>
<thead>
<tr>
<th>Variable</th>
<th>How will changing this variable affect the smears?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>
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).

<table>
<thead>
<tr>
<th>Container / Test Tube</th>
<th>Container / Test Tube</th>
</tr>
</thead>
<tbody>
<tr>
<td>/</td>
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<tr>
<td>/</td>
<td>/</td>
</tr>
</tbody>
</table>

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. ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
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4. ________________________________________________________________
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   ________________________________________________________________
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5. ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
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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.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Trial A</th>
<th>Trial B</th>
<th>Trial C</th>
<th>Trial D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Container</td>
<td>Test Tube</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquid Type:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquid Amount:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paper Type:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pen Color:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pen Type:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial Dot Height:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Other Variable

<table>
<thead>
<tr>
<th>Predictions</th>
<th>Trial A</th>
<th>Trial B</th>
<th>Trial C</th>
<th>Trial D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Put a “S” in the trial that will give the shortest smear and an “T” in the trial that will give the tallest smear.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Data

<table>
<thead>
<tr>
<th>Measurements</th>
<th>Trial A</th>
<th>Trial B</th>
<th>Trial C</th>
<th>Trial D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smear Height:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquid Height:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Observations

<table>
<thead>
<tr>
<th>Other:</th>
<th>Trial A</th>
<th>Trial B</th>
<th>Trial C</th>
<th>Trial D</th>
</tr>
</thead>
</table>

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.

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<table>
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</tbody>
</table>

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|       :       |       |       |       |
|-------:-------|-------|-------|-------|
| Changing Variable #1 :       |       |       |       |
|       :       |       |       |       |
| Changing Variable #2 :       |       |       |       |
|       :       |       |       |       |
| Changing Variable #3 :       |       |       |       |

<p>| | | | |</p>
<table>
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</tbody>
</table>

8
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.

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

Conclusions

<table>
<thead>
<tr>
<th>Variables</th>
<th>Trial A</th>
<th>Trial B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time:</td>
<td>5 min</td>
<td></td>
</tr>
<tr>
<td>Liquid Type:</td>
<td>Water</td>
<td></td>
</tr>
<tr>
<td>Liquid Amount:</td>
<td>2 ml</td>
<td></td>
</tr>
<tr>
<td>Paper Type:</td>
<td>Original</td>
<td></td>
</tr>
<tr>
<td>Pen Color:</td>
<td>Black</td>
<td></td>
</tr>
<tr>
<td>Pen Type:</td>
<td>Mr. Sketch</td>
<td>Crayola</td>
</tr>
<tr>
<td>Initial Dot Height:</td>
<td>2 cm</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Data</th>
<th>Trial A</th>
<th>Trial B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smear Height:</td>
<td>3 cm</td>
<td>2 cm</td>
</tr>
<tr>
<td>Liquid Height:</td>
<td>5 cm</td>
<td>4 cm</td>
</tr>
<tr>
<td>Other:</td>
<td>Green Blue Red</td>
<td>Yellow Blue Red</td>
</tr>
</tbody>
</table>

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.

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

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

____________________________________________________________________________________
## SCIENTIFIC PRACTICES

### Conclusions

<table>
<thead>
<tr>
<th>Variables</th>
<th>Trial A</th>
<th>Trial B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time:</td>
<td>5 min</td>
<td>4 min</td>
</tr>
<tr>
<td>Liquid Type:</td>
<td>Water</td>
<td>Soap</td>
</tr>
<tr>
<td>Liquid Amount:</td>
<td>2 ml</td>
<td></td>
</tr>
<tr>
<td>Paper Type:</td>
<td>Original</td>
<td></td>
</tr>
<tr>
<td>Pen Color:</td>
<td>Black</td>
<td>Red</td>
</tr>
<tr>
<td>Pen Type:</td>
<td>Mr. Sketch</td>
<td></td>
</tr>
<tr>
<td>Initial Dot Height:</td>
<td>2 cm</td>
<td></td>
</tr>
</tbody>
</table>

### Data

<table>
<thead>
<tr>
<th>Measurements</th>
<th>Trial A</th>
<th>Trial B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smear Height:</td>
<td>3 cm</td>
<td>1.5 cm</td>
</tr>
<tr>
<td>Liquid Height:</td>
<td>5 cm</td>
<td>3.5 cm</td>
</tr>
<tr>
<td>Other:</td>
<td>Green, Blue, Red</td>
<td>Red, Orange</td>
</tr>
</tbody>
</table>

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

**Table A**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Trial A</th>
<th>Trial B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time:</td>
<td>3 min</td>
<td>2 min</td>
</tr>
<tr>
<td>Pen Type:</td>
<td>Crayola</td>
<td>Mr. Sketch</td>
</tr>
<tr>
<td>Pen Color:</td>
<td>Black</td>
<td></td>
</tr>
<tr>
<td>Paper Type:</td>
<td>Original</td>
<td></td>
</tr>
<tr>
<td>Liquid:</td>
<td>Water</td>
<td></td>
</tr>
<tr>
<td>Liquid Amount:</td>
<td>2 ml</td>
<td>4 ml</td>
</tr>
<tr>
<td>Data Smear Height:</td>
<td>3 cm</td>
<td>4 cm</td>
</tr>
</tbody>
</table>

**Table B**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Trial A</th>
<th>Trial B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time:</td>
<td>5 min</td>
<td></td>
</tr>
<tr>
<td>Pen Type:</td>
<td>Mr. Sketch</td>
<td></td>
</tr>
<tr>
<td>Pen Color:</td>
<td>Blue</td>
<td></td>
</tr>
<tr>
<td>Paper Type:</td>
<td>Newspaper</td>
<td>Original</td>
</tr>
<tr>
<td>Liquid:</td>
<td>Vinegar</td>
<td></td>
</tr>
<tr>
<td>Liquid Amount:</td>
<td>5 ml</td>
<td></td>
</tr>
<tr>
<td>Data Smear Height:</td>
<td>3.5 cm</td>
<td>4 cm</td>
</tr>
</tbody>
</table>

**Table C**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Trial A</th>
<th>Trial B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time:</td>
<td>5 min</td>
<td></td>
</tr>
<tr>
<td>Pen Type:</td>
<td>Rose Art</td>
<td>Expo</td>
</tr>
<tr>
<td>Pen Color:</td>
<td>Black</td>
<td></td>
</tr>
<tr>
<td>Paper Type:</td>
<td>Original</td>
<td></td>
</tr>
<tr>
<td>Liquid:</td>
<td>Soap</td>
<td></td>
</tr>
<tr>
<td>Liquid Amount:</td>
<td>2 ml</td>
<td></td>
</tr>
<tr>
<td>Data Smear Height:</td>
<td>3 cm</td>
<td>3 cm</td>
</tr>
</tbody>
</table>

**Table D**

Can this scientist make a claim/conclusion? _____

**Graph D**

Can this scientist make a claim/conclusion? _____

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 ____________________________________________

_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________

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.

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).

<table>
<thead>
<tr>
<th>Container</th>
<th>Test Tube</th>
<th>Container</th>
<th>Test Tube</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</table>

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. ____________________________________________________________
   ____________________________________________________________
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2. ____________________________________________________________
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   ____________________________________________________________
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3. ____________________________________________________________
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   ____________________________________________________________

4. ____________________________________________________________
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   ____________________________________________________________
   ____________________________________________________________

5. ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

6. ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

SciTrek Member Approval: __________________________
Question: If we change the __________________________________________ what will happen to the liquid height?

<table>
<thead>
<tr>
<th>Variables</th>
<th>Trial A</th>
<th>Trial B</th>
<th>Trial C</th>
<th>Trial D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Container:</td>
<td>Test Tube</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time:</td>
<td>5 min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquid Type:</td>
<td>Water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquid Amount:</td>
<td>2 ml</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paper Type:</td>
<td>Original</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pen Color:</td>
<td>Black</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pen Type:</td>
<td>Mr. Sketch</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial Dot Height:</td>
<td>2 cm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paper Height:</td>
<td>5 cm</td>
<td>10 cm</td>
<td>15 cm</td>
<td>20 cm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Data</th>
<th>Trial A</th>
<th>Trial B</th>
<th>Trial C</th>
<th>Trial D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smear Height:</td>
<td>3 cm</td>
<td>8 cm</td>
<td>9 cm</td>
<td>9 cm</td>
</tr>
<tr>
<td>Liquid Height:</td>
<td>5 cm</td>
<td>10 cm</td>
<td>11 cm</td>
<td>11 cm</td>
</tr>
<tr>
<td>Other:</td>
<td>blue orange red</td>
<td>blue orange red</td>
<td>blue orange red</td>
<td>blue orange red</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Trial E</th>
<th>Trial F</th>
<th>Trial G</th>
<th>Trial H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Container:</td>
<td><em>Test Tube</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquid Type:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquid Amount:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paper Type:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pen Color:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pen Type:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial Dot Height:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Predictions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Data</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smear Height:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquid Height:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Other Variable</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Put a “S” in the trial that will give the shortest smear and an “T” in the trial that will give the tallest smear.

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.

<table>
<thead>
<tr>
<th>Changing Variable #1</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Changing Variable #2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Changing Variable #3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>0</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>
CONCLUSION

Generate a claim about how your changing variable affected your results. (Ex: the shorter the paper the shorter the smear height.)

We can conclude _____________________

______________________________

______________________________

______________________________

______________________________

because _____________________

______________________________

______________________________

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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 __________________________

_________________________________________________________

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### NOTES ON PRESENTATIONS

*What variables affect smears?*

<table>
<thead>
<tr>
<th>Changing Variable:</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Smear Height (cm):</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Summary: ____________________________________________________________
____________________________________________________________________

<table>
<thead>
<tr>
<th>Changing Variable:</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Smear Height (cm):</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Summary: ____________________________________________________________
____________________________________________________________________

<table>
<thead>
<tr>
<th>Changing Variable:</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Smear Height (cm):</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Summary: ____________________________________________________________
____________________________________________________________________

<table>
<thead>
<tr>
<th>Changing Variable:</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Smear Height (cm):</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Summary: ____________________________________________________________
____________________________________________________________________
### What variables affect smears?

<table>
<thead>
<tr>
<th>Changing Variable:</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Smear Height (cm):</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Summary:

________________________________________________________________________

________________________________________________________________________

<table>
<thead>
<tr>
<th>Changing Variable:</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Smear Height (cm):</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Summary:

________________________________________________________________________

________________________________________________________________________

<table>
<thead>
<tr>
<th>Changing Variable:</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Smear Height (cm):</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Summary:

________________________________________________________________________

________________________________________________________________________

<table>
<thead>
<tr>
<th>Changing Variable:</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Smear Height (cm):</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Summary:

________________________________________________________________________

________________________________________________________________________
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.

<table>
<thead>
<tr>
<th>Time:</th>
<th>3 min</th>
<th>5 min</th>
<th>10 min</th>
<th>All would give similar height smears</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid Type:</td>
<td>Water</td>
<td>Soap</td>
<td>Syrup</td>
<td>All would give similar height smears</td>
</tr>
</tbody>
</table>

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 ___________________________ because ____________________________________________

___________________________________________________________________

__________________________________________________________________.

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 used 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.

<table>
<thead>
<tr>
<th>Mixture</th>
<th>List 3 Physical Properties of each part of the mixture</th>
<th>Helpful in Separating (circle one)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Pure Substance</th>
<th>Physical Properties</th>
<th>Unknown Letter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baking Soda</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn Starch</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
EXTRA PRACTICE

Conclusions

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

<table>
<thead>
<tr>
<th>Variables</th>
<th>Trial A</th>
<th>Trial B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time:</td>
<td>5 min</td>
<td></td>
</tr>
<tr>
<td>Liquid Type:</td>
<td>Water</td>
<td>Soap</td>
</tr>
<tr>
<td>Liquid Amount:</td>
<td>2 ml</td>
<td></td>
</tr>
<tr>
<td>Paper Type:</td>
<td>Original</td>
<td></td>
</tr>
<tr>
<td>Pen Color:</td>
<td>Red</td>
<td></td>
</tr>
<tr>
<td>Pen Type:</td>
<td>Mr. Sketch</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measurements</th>
<th>Trial A</th>
<th>Trial B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smear Height:</td>
<td>4 cm</td>
<td>0.5 cm</td>
</tr>
<tr>
<td>Liquid Height:</td>
<td>6 cm</td>
<td>3 cm</td>
</tr>
<tr>
<td>Other:</td>
<td>Green, Blue,</td>
<td>Pink, Orange</td>
</tr>
</tbody>
</table>

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

1. the height of the smear in water was 4 cm and the height of the smear in soap was 0.5 cm
   
   Step 1: Statement Type: C or D
   Correct Claim Correct Data Incorrect

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 (CO₂); Helium (He); Water (H₂O)
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.
SciTrek is an educational outreach program that is dedicated to allowing 2nd-12th grade students to experience scientific practices firsthand. SciTrek partners with local teachers to present student-centered inquiry-based modules that not only emphasize the process of science but also specific grade level NGSS performance expectations. Each module allows students to design, carryout, and present their experiments and findings.

For more information, please feel free to visit us on the web at scitrek.chem.ucsb.edu or contact us by e-mail at scitrekelementary@chem.ucsb.edu.

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