

**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 us 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:** Something for which an experiment can be designed to answer.
- **Non-Testable Question:** Something for which an experiment cannot be designed to answer the question. For example questions involving opinions, things that cannot be measured, or word that are not well defined.
- **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 changed in an experiment.
- **Dependent Variable:** The variable that is influenced/determined by the changing variable; the variable that is measured/observed.
- **Prediction:** What you expect to happen based off of previous measurements/observations.
- **Results/Data:** The measurements or observations of the dependent variable. The recorded information from an experiment.
- **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 procedures.)
- **Technique:** A method for a specific task.
- **Content:** Something that is inside the bottle. For example, aquatic plant.
- **Conditions:** Things outside the bottle that may have affected the color of the solution. For example, in the dark.
- **Aquatic:** Plants and/or animals that live in the water.
- **Solution:** Two things mixed together that look like one.
**OBSERVATIONS**

**Contents:** Something that is inside the bottle. *Example:* Aquatic Plant

**Conditions:** Things outside of the bottle that may have affected the color of the solution. *Example:* In the Dark

<table>
<thead>
<tr>
<th>Contents:</th>
<th>Bottle 1</th>
<th>Bottle 2</th>
<th>Bottle 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conditions:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Color of Solution at Start of Experiment:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Color of Solution at End of Experiment:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Describe what happened to the solution over the course of 24 hours:

**Bottle 1:**
________________________________________________________________________
________________________________________________________________________

**Bottle 2:**
________________________________________________________________________
________________________________________________________________________

**Bottle 3:**
________________________________________________________________________
________________________________________________________________________
### VARIABLES

<table>
<thead>
<tr>
<th>Variable</th>
<th>How will changing this variable affect the color of the solution?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
Experimental Considerations:

1. You will only have access to the materials on the materials page.
2. The liquid must remain the original blue solution.
3. You cannot design an experiment that you know will kill/hurt an animal.
4. Only one animal per bottle.
5. You will only get four bottles (containing original solution) per experiment.

Changing Variable (Independent Variable): ________________________________

Discuss with your group how you think your changing variable will affect the color of the solution.

QUESTION

Question our group 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

Determine the values of your changing variable (ex: animal type) from the materials page and write the values (ex: fish) for your four trials under each bottle.

Changing Variable:

_________________ __________ __________ __________

Controls (variables you will hold constant):
Determine the variables that you will hold constant and indicate the specific value you will use in all your trials.

Solution Type / Original __________________ / __________________
________________ / __________________
________________ / __________________
________________ / __________________

SciTrek Member Approval____________________
PROCEDURE

Procedure Note:
Make sure to include all values of your changing variable(s) in the procedure. (Example, for a group that decided to change solution type one step would be: get 4 small bottles with solution type A) original, B) red solution, C) yellow solution, D) orange solution and label them.)

1. _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________

2. _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________

3. _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________

4. _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________

5. _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________

In your procedure underline controls, circle changing variables, and box data collection.
Directions: Fill in the missing definition.

- **Procedure:** ____________________________________________________________
  _______________________________________________________________________

A complete procedure MUST have:

- All values of the _________________________ and the _______________________

- What __________________ will be collected (measurements/observations).

- The steps listed in the order that they will be completed.

A complete procedure MUST NEVER have:

- __________________________ or irrelevant information.

- __________________________ about the experiment.

- __________________________ values of controls or the changing variable.
SCIENTIFIC PRACTICES

Procedures

QUESTION

If we change the ball temperature what will happen to the height the ball bounces?

EXPERIMENTAL SET-UP

<table>
<thead>
<tr>
<th>Changing Variable:</th>
<th>Trial A</th>
<th>Trial B</th>
<th>Trial C</th>
<th>Trial D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ball Temperature:</td>
<td>30 °C</td>
<td>40 °C</td>
<td>50 °C</td>
<td>60 °C</td>
</tr>
</tbody>
</table>

Controls (variables you will hold constant):

- Ball Material / Rubber
- Ball Circumference / 88 cm
- Release Height / 3 m
- Ground Type / Cement
- Ball Mass / 623 g
- Ball Release / Drop

Directions:

Step 1: Read each statement and underline controls, circle changing variables, and box information about data collection.

Step 2: On the line write (C) if you underlined anything, (CV) if you circled anything, and/or (D) if you boxed anything.

Step 3: Circle yes if the statement could be a correct step for a procedure about the question and experimental set-up above. If not, circle no.

<table>
<thead>
<tr>
<th>Is the statement about CV, C, and/or D?</th>
<th>Could this be a procedure step?</th>
</tr>
</thead>
<tbody>
<tr>
<td>a Get four 623 g rubber balls with circumferences of 88 cm.</td>
<td>Yes</td>
</tr>
<tr>
<td>b Heat rubber balls to temperatures of A) 30°C, B) 40°C, C) 50°C, D) 60°C.</td>
<td>Yes</td>
</tr>
<tr>
<td>c Measure and observe.</td>
<td>Yes</td>
</tr>
<tr>
<td>d Heat ball C to 50°C.</td>
<td>Yes</td>
</tr>
<tr>
<td>e Heat rubber balls to different ball temperatures.</td>
<td>Yes</td>
</tr>
<tr>
<td>f Measure how high each ball bounces on the cement.</td>
<td>Yes</td>
</tr>
<tr>
<td>g Drop the boring ball from a height of 3 m.</td>
<td>Yes</td>
</tr>
</tbody>
</table>
**SCIENTIFIC PRACTICES**

*Procedures*

**Directions:** Read the following procedure that is based on the question and experimental set-up on page 8 and underline controls, circle changing variables, and box data collection. If any controls are missing or incorrect, add the correct values to the procedure. Remove any extra or irrelevant information from the procedure by crossing it out. If any steps are out of order, draw an arrow (↔) to indicate the correct order.

**PROCEDURE**

1. Get four rubber balls with circumferences of 88 cm.

2. Heat balls to a temperature of A) 30°C, B) 40°C, C) 50°C, D) 60°C.

3. Drop each ball.

4. Hold each ball at a height of 3 m over gravel.

5. Pass the ball back and forth with one other person.

6. Measure how high each ball bounces.

7. Have fun.
SCIENTIFIC PRACTICES

Procedures

**Directions:** Read the following procedure and underline controls, circle changing variables, and box information about data collection and then answer the questions.

**PROCEDURE**

1. Pour 100 mL of water into three bowls.

2. Freeze water at a temperature of 0°C.

3. Sprinkle 30 g of solid A) sugar, B) salt, C) baking soda on top.

4. Observe the order the ice melts in.

   a. What was the changing variable for this experiment? ___________________________

   b. What was one of the controls for the experiment?

      _______________________________  /  _______________________________

      Control  Value

   c. What was the method of data collection? Measurement Observation

      Circle One

   d. What data was collected? ________________________________________________

      What was measured/observed.

   e. What was the question the scientists were investigating?

      If we change the __________________________ what will happen to the ____________

      _____________________________________________________________?
RESULTS

Table

Fill out the chart for each of your trials. If one of the variables remains constant for all trials write the value in trial A and then draw a line through each box indicating that this 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>Solution Type:</td>
<td><strong>Original</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bottle Size:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animal Type:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant Type:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light Amount:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other variable</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other variable</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solution Color:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Initial)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<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>Predicted Final Color of Bottle:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Circle One)</td>
<td>Blue</td>
<td>Blue</td>
<td>Blue</td>
<td>Blue</td>
</tr>
<tr>
<td>Green</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
<td></td>
</tr>
<tr>
<td>Yellow</td>
<td>Yellow</td>
<td>Yellow</td>
<td>Yellow</td>
<td></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>Final Observations:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solution Color:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The independent variable is the changing variable and the dependent variables are final solution color and other final observations.
RESULTS

Summary

My experiment shows

I acted like a scientist when

TIE TO STANDARDS

1. Fill out the following table. First predict the color of the bottle based on the following contents/conditions. After each bottle is shown then record the actual bottle color. (y=yellow, g=green, b=blue)

<table>
<thead>
<tr>
<th>Experiment Number</th>
<th>Bottle Contents</th>
<th>Bottle Conditions</th>
<th>Predicted Color</th>
<th>Actual Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Snail</td>
<td>24 Hours Light</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Frog</td>
<td>24 Hours Light</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Fish</td>
<td>24 Hours Light</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Aquatic Plant 1</td>
<td>24 Hours Light</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Aquatic Plant 2</td>
<td>24 Hours Light</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. From the chart above, what do the yellow/green bottles have in common?
3. Did all of the bottles change color? ☐ yes ☐ no

4. If you answered NO, why did some of the bottles remain blue?

___________________________________________________________________________________________
___________________________________________________________________________________________

5. Fill out the following table. First predict the color of the bottle based on the following contents/conditions. After each bottle is shown then record the actual bottle color. (y=yellow, g=green, b=blue)

<table>
<thead>
<tr>
<th>Experiment Number</th>
<th>Bottle Contents</th>
<th>Bottle Conditions</th>
<th>Predicted Color</th>
<th>Actual Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Snail</td>
<td>24 Hours Dark</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Frog</td>
<td>24 Hours Dark</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Fish</td>
<td>24 Hours Dark</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Aquatic Plant 1</td>
<td>24 Hours Dark</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Aquatic Plant 2</td>
<td>24 Hours Dark</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. What does the color of the bottles tell us about animals in the dark?

___________________________________________________________________________________________
___________________________________________________________________________________________

7. What does the color of the bottles tell us about plants in the dark?

___________________________________________________________________________________________
___________________________________________________________________________________________
8. Use the graph below to answer the following questions about carbon dioxide.

**Carbon Dioxide Levels in the Atmosphere**

a. What information is plotted on the x-axis?____________________________

b. What information is plotted on the y-axis?____________________________

c. Does the level of carbon dioxide change over time?  □ yes  □ no

d. Circle the area(s) on the graph that do not fit the general trend, or that show the greatest change.

e. Summarize what the graph tells us about the carbon dioxide levels in the atmosphere.

Carbon dioxide levels in the atmosphere ________________________________

____________________________________________________________________

____________________________________________________________________.
9. What are 3 things that could contribute to the increasing amounts of carbon dioxide in the atmosphere?

________________________________________________

________________________________________________

________________________________________________

10. Would there be carbon dioxide on the planet if humans did not exist?

☐ yes      ☐ no

11. Have humans changed the amount of carbon dioxide that is produced each year?

☐ yes      ☐ no

12. What are 2 things that humans do to decrease the amounts of carbon dioxide they produce?

___________________________________________________________________________________________

___________________________________________________________________________________________
EXTRA PRACTICE

Procedures

QUESTION

If we change the jam type what will happen to the number of ants on each index card?

EXPERIMENTAL SET-UP

Changing Variable:

<table>
<thead>
<tr>
<th>Trial A</th>
<th>Trial B</th>
<th>Trial C</th>
<th>Trial D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jam Type</td>
<td>Strawberry</td>
<td>Raspberry</td>
<td>Blackberry</td>
</tr>
</tbody>
</table>

Controls (variables you will hold constant):

<table>
<thead>
<tr>
<th>Jam Amount / 100 g</th>
<th>Jam Brand / Albertsons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time / 3 Hours</td>
<td>Distance From Anthill / 50 cm</td>
</tr>
<tr>
<td>Container Type / Index Card</td>
<td>Ant Type / Argentine Ants</td>
</tr>
</tbody>
</table>

Directions:

Step 1: Read each statement and underline **controls**, circle **changing variables**, and box **data collection**.

Step 2: On the line write (C) if you underlined anything, (CV) if you circled anything, and/or (D) if you boxed anything.

Step 3: Circle yes if the statement could be a correct step for a procedure about the question and experimental set-up above. If not, circle no.

<table>
<thead>
<tr>
<th>Is the statement about CV, C, and/or D?</th>
<th>Could this be a procedure step?</th>
</tr>
</thead>
<tbody>
<tr>
<td>a Put 100 g of Albertsons brand A) strawberry, B) raspberry, C) blackberry, D) boysenberry jam onto each index card.</td>
<td>Yes No</td>
</tr>
<tr>
<td>b Put the yummy Albertsons blackberry jam on index card C.</td>
<td>Yes No</td>
</tr>
<tr>
<td>c Put the index card 50 cm away from the Argentine anthill.</td>
<td>Yes No</td>
</tr>
<tr>
<td>d Make observations about the experiment.</td>
<td>Yes No</td>
</tr>
<tr>
<td>e Put 100 g of Albertsons brand strawberry jam onto index card A.</td>
<td>Yes No</td>
</tr>
<tr>
<td>f Count the number of Argentine ants on each index card after 3 hours.</td>
<td>Yes No</td>
</tr>
<tr>
<td>g Put 100 g of different jam types onto each index card.</td>
<td>Yes No</td>
</tr>
</tbody>
</table>

Underline **controls**, circle **changing variables**, and box **data collection**.
SciTrek is an educational outreach program that is dedicated to allowing 2nd-8th grade students to experience the scientific process first hand. SciTrek partners with local schools 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 http://www.chem.ucsb.edu/scitrek/ or contact us by e-mail at scitrekadmin@chem.ucsb.edu.

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