Group Color: _____
Subgroup Number: _____

How Science Works

Grade 4

Module 1

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 procedures.
- **Technique:** A method for a specific task.
- **Contents:** Materials that are inside of the bottle besides the solution.
- **Conditions:** Other variables outside of the bottle that may affect the solution.
- **Aquatic:** Plants and/or animals that live in the water.
- **Solution:** Two things mixed together that look like one.

OBSERVATIONS

Contents: Materials that are *inside* of the bottle besides the solution.

Ex: Aquatic Plant

Conditions: Other variables *outside* of the bottle that may affect the solution.

Ex: In the Dark

	Bottle 1	**Bottle 2**	**Bottle 3**
Contents:			
Conditions:			
Color of Solution at Start of Experiment:			
Color of Solution at End of Experiment:			

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

Bottle 1: _____

_____

Bottle 2: _____

_____

Bottle 3: _____

_____

VARIABLES

Variable	How will changing this variable affect the color of the solution?
	_____ _____ _____
	_____ _____ _____
	_____ _____ _____
	_____ _____ _____
	_____ _____ _____

Experimental Considerations:

1. You will only have access to the materials on the materials page.
2. The liquid must remain the original 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 subgroup how you think your changing variable will affect the color of the solution.

QUESTION

Question our subgroup will investigate:

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

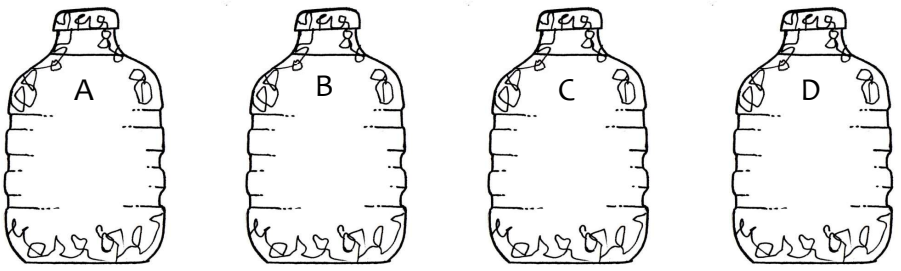
  what will happen to the _____?
  insert what you are measuring/observing (dependent variable)

SciTrek Member Approval: _____

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

EXPERIMENTAL SET-UP

Write your changing variable (Ex: animal type) and the values (Ex: fish) you will use for your trials under each bottle.



Changing Variable:

_____ **:** _____ _____ _____ _____

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

Solution Type	/ Original		/
	/		/
	/		/

SciTrek Member Approval: _____

PROCEDURE

Procedure Note:

Make sure to include all values of your changing variable in the procedure. Ex: For a subgroup 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, and D) orange solution.

1. _____

_____

_____

2. _____

_____

_____

3. _____

_____

_____

4. _____

_____

_____

5. _____

_____

_____

In your procedure underline <u>controls</u>, circle changing variables, and box data collection.

SCIENTIFIC PRACTICES

Procedures

Directions: Fill in the missing definition.

- **Procedure:** _____

  _____

A complete procedure MUST have:

- All values of the _____ and the

  _____.

- The _____ that will be collected

  (measurements/observations).

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

A complete procedure MUST <u>NEVER</u> 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

Changing Variable:	Trial A	Trial B	Trial C	Trial D
Ball Temperature:	30 °C	40 °C	50 °C	60 °C

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: 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.

		Could this be a procedure step?	
1.	Get four 623 g rubber balls with circumferences of 88 cm.	*Yes*	*No*
2.	Heat rubber balls to temperatures of A) 30°C, B) 40°C, C) 50°C, D) 60°C.	*Yes*	*No*
3.	Measure and observe.	*Yes*	*No*
4.	Heat ball C to 50°C.	*Yes*	*No*
5.	Heat rubber balls to different ball temperatures.	*Yes*	*No*
6.	Measure the height each ball bounces on the cement.	*Yes*	*No*
7.	Drop the boring ball from a height of 3 m.	*Yes*	*No*

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

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.

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.

Variables	**Trial A**	**Trial B**	**Trial C**	**Trial D**
Solution Type:	***Original*** →			
Time:				
Bottle Size:				
Animal Type:				
Plant Type:				
Light Amount:				
_____ Other variable				
_____ Other variable				
Solution Color: (Initial)				
Predictions	**Trial A**	**Trial B**	**Trial C**	**Trial D**
Predicted Final Color of Bottle: (Circle One)	Blue Green Yellow	Blue Green Yellow	Blue Green Yellow	Blue Green Yellow
Data	**Trial A**	**Trial B**	**Trial C**	**Trial D**
Observations: Solution Color:				
Observations: Other:				

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

The independent variable is the changing variable and the dependent variables are the 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 solution based on the following contents/conditions. After each bottle is shown, record the actual solution color. (y=yellow, g=green, b=blue)

Experiment Number	Bottle Contents	Bottle Conditions	Predicted Color	Actual Color
1	Snail	24 Hours Light		
2	Frog	24 Hours Light		
3	Fish	24 Hours Light		
4	Aquatic Plant 1	24 Hours Light		
5	Aquatic Plant 2	24 Hours Light		

2. From the chart above, what do the solutions that are yellow/green have in common?

_____

_____

3. Did all of the solutions change color? ☐ yes ☐ no

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

_____

_____

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

Experiment Number	Bottle Contents	Bottle Conditions	Predicted Color	Actual Color
6	Snail	24 Hours Dark		
7	Frog	24 Hours Dark		
8	Fish	24 Hours Dark		
9	Aquatic Plant 1	24 Hours Dark		
10	Aquatic Plant 2	24 Hours Dark		

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

_____

_____

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

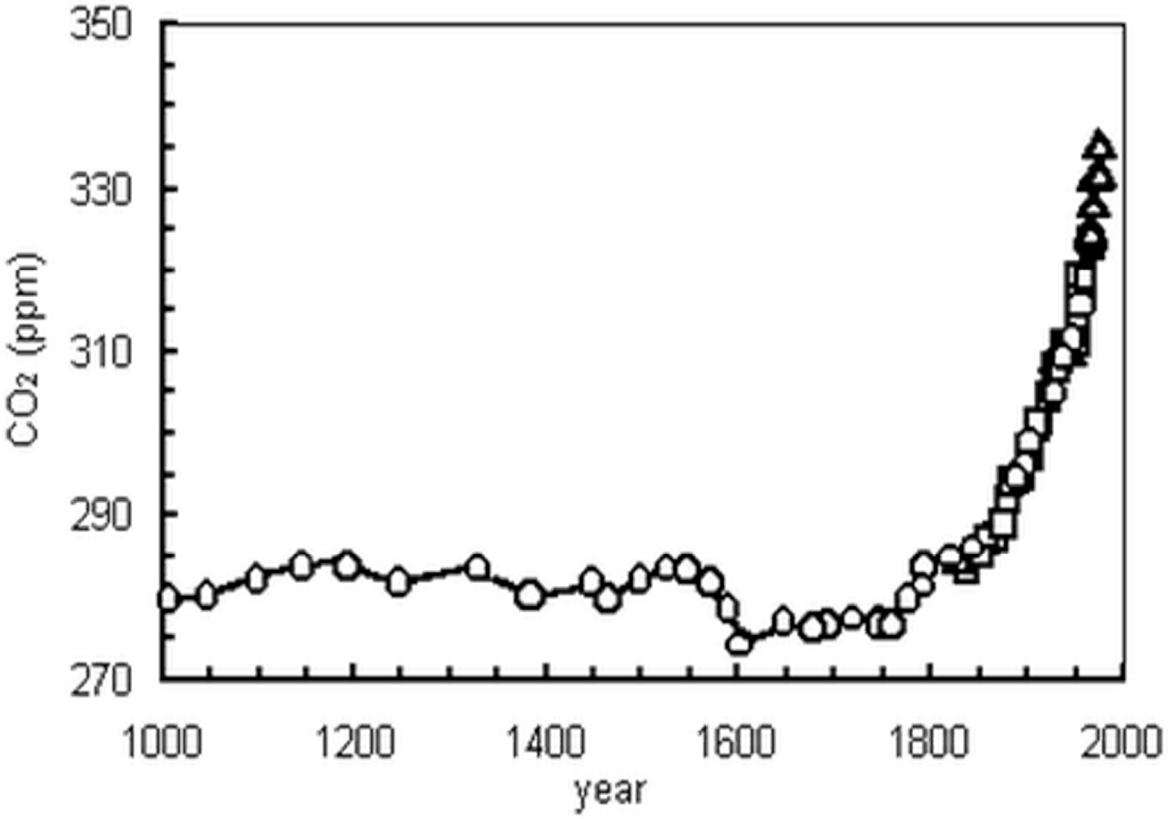
_____

_____

THE BROADER PICTURE

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 atomosphere.

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:	Trial A	Trial B	Trial C	Trial D
Jam Type:	Strawberry	Raspberry	Blackberry	Boysenberry

Controls (variables you will hold constant)**:**

Jam Amount / 100 g	Jam Brand / Albertsons
Time / 3 Hours	Distance From Anthill / 50 cm
Container Type / Index Card	Ant Type / Argentine Ants

Directions:

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

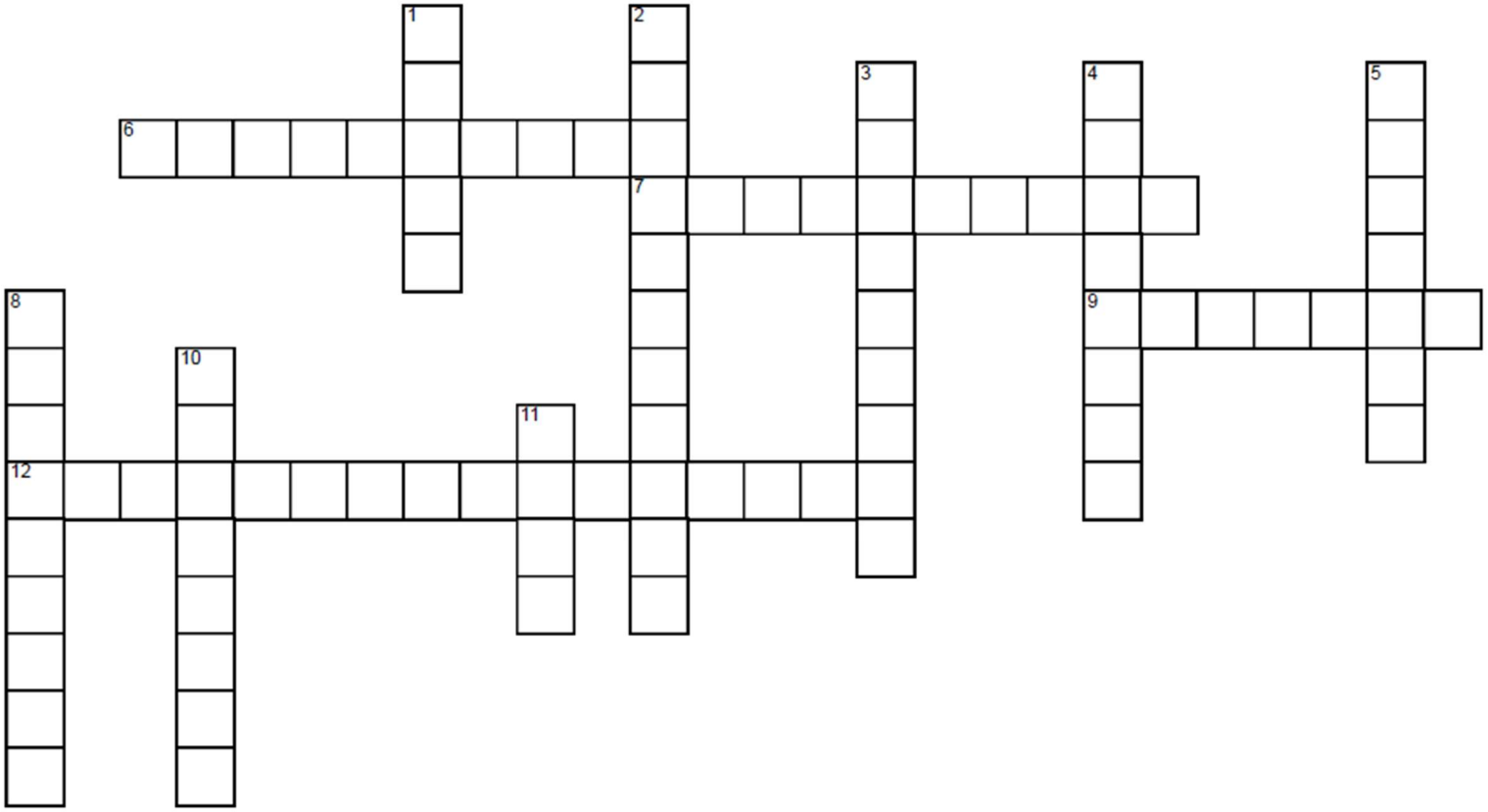
Step 2: Circle yes if the statement could be a correct step for a procedure about the question and experimental set-up above. If not, circle no.

		Could this be a procedure step?	
1.	Put 100 g of Albertsons brand A) strawberry, B) raspberry, C) blackberry, D) boysenberry jam onto each index card.	*Yes*	*No*
2.	Put the yummy Albertsons blackberry jam on index card C.	*Yes*	*No*
3.	Put the index card 50 cm away from the Argentine anthill.	*Yes*	*No*
4.	Make observations about the experiment.	*Yes*	*No*
5.	Put 100 g of Albertsons brand strawberry jam onto index card A.	*Yes*	*No*
6.	Count the number of Argentine ants on each index card after 3 hours.	*Yes*	*No*
7.	Put 100 g of different jam types onto each index card.	*Yes*	*No*

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

CROSSWORD PUZZLE

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



Across

6) "Under the light" or "in the dark" are examples of _____ outside of the bottle

7) You designed an _____ to help answer the class question

9) The final color of the solutions are the _____ for this experiment

12) In this experiment, we will see how your _____ will affect the color of the solution

Down

1) Opinions, _____, and incorrect information should not be included in a procedure

2) Noticing that the plant is floating in the solution is an example of an _____ made during this experiment

3) Things you can change in an experiment

4) The values of your _____ are not changed in an experiment

5) Plants and/or animals that live in the water

8) A set of steps to conduct an experiment

10) Something that is inside the bottle

11) Observations or measurements collected in an experiment

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, carry out, 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.

SciTrek is brought to you by generous support from the following organizations:

UCSB

karisma FOUNDATION

SOUTH COAST SCIENCE PROJECT

Department of Defense DoDSTEM Science · Technology · Engineering · Mathematics

If you would like to donate to the program or find out how you can get your company's logo on our notebooks please contact scitrekelementary@chem.ucsb.edu.