Module 1: Respiration

4th Grade

About the Instructions:

This document is intended for use by classroom teachers, SciTrek leads, and SciTrek volunteers. The document has been composed with input from teachers, leads, volunteers, and SciTrek staff to provide suggestions for future teachers/leads/volunteers. The instructions are not intended to be used as a direct script, but were written to provide teachers/leads/volunteers with a guideline to present the information that has worked in the past. Teachers/leads/volunteers should feel free to deviate from the instructions to help students reach the learning objectives of the module. Places in which you can be creative and mold the program to meet your individual teaching style, or to meet the needs of students in the class are: during class discussions, managing the groups/class, generating alternative examples, and asking students leading questions. However, while running the module make sure to cover all the material each day within the scheduled 60 minutes. In addition, no changes should be made to the academic language surrounding procedures or the procedure activity.

Activity Schedule:

Day 1 must be scheduled to allow the bottles for the initial observation to be brought to the classroom 24 hours prior to Day 1.

Day 4 must be scheduled to allow students to start their experiment 24 hours prior to Day 4. This is known as Day 3.5 in these instructions.

Day 1: Procedure Assessment/Observations/Variables (60 minutes)
Day 2: Question/Materials Page/Experimental Set-Up/Procedure Activity (60 minutes)
Day 3: Procedure Activity/Procedure/Results Table (60 minutes)
Day 3.5: Experiment (15 minutes)
Day 4: Experiment/Results Summary/Poster Making (60 minutes)
Day 5: Poster Presentations (60 minutes)
Day 6: Procedure Assessment/Tie to Standards (60 minutes)

The exact module dates and times are posted on the SciTrek website (scitrek.chem.ucsb.edu/elementary) under the school/teacher. The times on the website include transportation time to and from outside of Chem 1204. Thirty minutes are allotted for transportation before and after the module. Therefore, if a module was running from 10:00-11:00, then the module times on the website would be from 9:30-11:30.

Student Groups:

For the initial observation (Day 1), students work in three groups of approximately ten students each. After Day 1, the groups of approximately ten students are further subdivided into two subgroups, approximately five students each, for the rest of the module. One volunteer is assigned to help each group (which is made up of two subgroups). We find groups/subgroups work best when they are mixed levels and mixed language abilities.

NGSS Performance Expectation Addressed:

4-LS1-1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

Learning Objectives:

1. Students will know that animals breathe in oxygen and breathe out carbon dioxide.
2. Students will know that plants take in carbon dioxide and release oxygen during photosynthesis.
3. Students will be able to annotate controls, changing variables, and/or data collection within a procedure.
4. Students will be able to determine whether a statement could be a correct step for a procedure from a given question and experimental set-up.
5. Students, in small groups, will be able to select a question and make experiment decision that allows them to answer their question and present their findings to the class.
6. Students will be able to list at least two ways they behaved like scientists.

Classroom Teacher Responsibilities:

In order for SciTrek to be sustainable, the program needs to work with teachers on developing their abilities to run student-centered, inquiry-based science lessons on their own in their classrooms. As teachers take over the role of SciTrek lead, SciTrek will expand to additional classrooms. Even when teachers lead the modules in their own classrooms, SciTrek will continue to provide volunteers and all of the materials needed to run the module. Below is a sample timeline for teachers to take over the role as the SciTrek lead.

*Groups are made up of approximately ten students and are subdivided into two subgroups (approximately five students each) after Day 1 of the module.

1. Year 1
    a. Classroom teacher <u>leads a group</u> (Role: Group Lead; this is referred to as a volunteer in these instructions)
2. Year 2
    a. Classroom teacher <u>co-leads the modules</u> with a SciTrek staff member (Role: Co-Lead)
        i. Classroom teacher will be responsible for leading entire class discussions (Ex: procedure activity).
        ii. Classroom teacher will be responsible for time management.
        iii. Classroom teacher will be responsible for overseeing volunteers and helping any groups who are struggling.
        iv. Classroom teacher will be responsible for all above activities. The SciTrek co-lead will only step in for emergencies.
        v. The SciTrek co-lead will run the tie to standards activity.
3. Year 3 and beyond
    a. Classroom teacher <u>leads the modules</u> (Role: Lead)
        i. Classroom teacher will be responsible for leading entire class discussions (Ex: procedure activity).
        ii. Classroom teacher will be responsible for time management.
        iii. Classroom teacher will be responsible for overseeing volunteers and helping any groups who are struggling.
        iv. For year 3 a SciTrek staff member will co-lead the tie to standards activity with the classroom teacher, for subsequent years they will run the tie to standards independently.

SciTrek staff is counting on teacher involvement. Teachers should notify the SciTrek staff if they will not be present on any day(s) of the module. Additional steps can be taken to become a SciTrek lead faster than the proposed schedule above. Contact scitrekelementary@chem.ucsb.edu to learn more.

In addition, teachers are <u>required</u> to come to UCSB for the module orientation, approximately one week prior to the start of the module. Contact scitrekelementary@chem.ucsb.edu for exact times and dates, or see our website at scitrek.chem.ucsb.edu/elementary under your class's module times. At the orientation, teachers will go over module content, learn their responsibilities during the module, and meet the volunteers who will be helping in their classroom. If you are not able to come to the orientation at UCSB, you must complete an online orientation. Failure to complete an orientation for the module will result in loss of priority registration for the following year.

Prior to the Module (at least 1 week):

1. Come to the SciTrek module orientation at UCSB.

Notes for Teachers During the Module:

If possible, have a document camera available to the SciTrek lead every day of the module. If you do not have a document camera, please tell a SciTrek staff member at orientation.

Day 0:

24 hours before the SciTrek module starts, three sets of three bottles and a lamp (with 60 W equivalent LED bulb) will be brought to the classroom. Each set of bottles will contain: one bottle with only solution, one bottle with solution/aquatic snail, and one bottle with solution/aquatic plant. All of the bottles need to be under the provided light until the module starts the next day. When SciTrek brings the materials to your classroom, they will need 5 minutes to talk to the students to explain the contents and conditions of each bottle.

Day 1:

Have students' desks/tables moved into three groups and cleared off.

Days 2-4:

Have students' desks/tables moved into six groups and cleared off.

Day 3:

Confirm with the SciTrek lead when a SciTrek staff member will come to your classroom to start the experiment. Have a spot in your classroom where five Xerox boxes can sit. These boxes must be near plugs so the lamps, which sit on top of the boxes, can be plugged in (SciTrek will provide extension cords). These lamps need to be kept on from Day 3.5 until Day 4.

Day 3.5:

A SciTrek staff member will be present to help fill the experiment bottles.

Days 5-6:

Have students' desks/tables cleared off. The desks/tables do not need to be moved into groups.

Scheduling Alternatives:

Some teachers have expressed interest in giving the students more time to work with the volunteers throughout the module. Below are options that will allow the students more time to work with the volunteers. If you plan to do any of the following options, please inform the SciTrek staff no later than your orientation date (approximately one week before your module, exact orientation times are found at: scitrek.chem.ucsb.edu/elementary). This will allow the SciTrek staff to provide you with all needed materials.

Day 1:

If you would like to have more time for your students to make observations and generate variables, you may give the procedure assessment to your class, ***before*** SciTrek arrives.

Day 2:

If you would like to have more time for your students to design their experiments, you can do one or both of the following activities:

1) Example question and experimental set-up outlined in the Introduction, ***before*** SciTrek arrives.
2) The first part of the procedure activity, ***after*** SciTrek leaves (notebook, pages 7 and 8).

Day 3:

If you would like to have more time for your students to write their procedures, you can do the second part of the procedure activity (notebook, page 9), ***before*** SciTrek arrives.

Day 4:

If you would like to have more time for your students to analyze their experiments and make posters, you can do the example results summary, ***before*** SciTrek arrives.

Day 5:

If you would like to have more time for your students to discuss their experiments during poster presentations, you may take more time for each presentation and finish the presentations with your class, ***after*** SciTrek leaves.

Day 6:

If you would like more time for the tie to standards activity, you may give the procedure assessment to your class, ***before*** SciTrek arrives.

Materials Used for this Module:

1. Bromothymol blue (Fisher part number 10273370)
   Concentrated Solution
   1. Mix 0.1 g of bromothymol blue powder with 10 ml of 1.0 M sodium hydroxide.
   2. Add 20 ml of ethyl alcohol
   3. The solution should be deep blue
   4. Dilute with deionized water to 1 L

   Solution for Bottles:
   1. Remove 50 ml of water from a gallon bottle of distilled water. (**Note:** The water must be distilled. Drinking water cannot be used, or the experiment will not work.)
   2. Put 50 ml of concentrated bromothymol blue into the remaining water in the gallon bottle.
   3. Shake the solution of water and bromothymol blue.
   4. Pour solution into bottles and cap.
2. Small bottles [8 oz Clear PET French Square Bottle with 38/400 Neck (United States Plastic Corp.: Item 70346)]
3. Medium bottles [12 oz Clear PET French Square Bottle with 38/400 Neck (United States Plastic Corp.: Item 83597)]
4. Large bottles [16 oz Clear PET French Square Bottle with 38/400 Neck (United States Plastic Corp.: Item 70347)]
5. Extra-large bottles [32 oz Clear PET French Square Bottle with 38/400 Neck (United States Plastic Corp.: Item 70348)]
6. Bottle caps [38/400 Red Polypropylene Unlined Ribbed Cap (United States Plastic Corp.: Item 68751)]
7. Mystery snails
8. African frogs
9. Mosquito fish
10. Algae Shrimp
11. Plant 1: Ludwigia
12. Plant 2: Hornswort
13. Plant 3: Anacharis
14. Plant 4: Wisteria

15. Tree leaves: Any two tree leaves should work. Do not use poisonous tree leaves.
16. Flowers: Daisy and Carnation
17. Individual Plant Light (Carolina Biological Supply Company part number: 666900)
18. Light bulbs (60 W equivalent LED (800 lumen) light bulbs) (Philips part number: 046677455507) (Make sure that you use LED light bulbs because these give off less heat than incandescent bulbs. If you use incandescent bulbs you will kill all of the animals.)
19. Extension cord
20. Boxes for different amounts of light are handmade by taking a Xerox box and cutting a 11.5 cm diameter hole in the top of the box (when the box is on its side) and taping on a 13 cm x 14 cm neutral density filter over the hole (Solar Graphics). The different amounts of light are made by having the light from a 60 W equivalent LED bulb go through the filters: SGXND 5 (level 1), SGXND 20 (level 2), SGXND 50 (level 3), and SGXND 70 (level 4). Level 0 is a Xerox box with no holes and no light and level 5 full light and no Xerox box is used. A picture of one of the boxes is shown below.

All printed materials used by SciTrek (notebooks, materials page, picture packet, poster parts, instructions, and nametags) can be made available for use and/or editing by emailing scitrekelementary@chem.ucsb.edu.

Types of Documents:

Notebook:

One given to every student and is filled out by the student. The lead will use a notebook to write in as an example for students. The notebook the lead uses is referred to as the class notebook in these instructions.

Notepad:

One given to every group and is filled out by the volunteer. In these instructions, the examples are narrower and taller than the notebook pages.

Picture Packet:

One per class that, if needed, the lead fills out. In these instructions, the examples are the same size as the notebook pages, but they are labeled.

In these instructions, all other example documents are labeled.

Day 1: Procedure Assessment/Observations/Variables

Schedule:

Introduction (SciTrek Lead) – 2 minutes
Procedure Assessment (SciTrek Lead) – 10 minutes
Observation Discussion (SciTrek Lead) – 4 minutes
Observations (SciTrek Volunteers) – 14 minutes
Variable Discussion (SciTrek Lead) – 8 minutes
Variables (SciTrek Volunteers) – 19 minutes
Wrap-Up (SciTrek Lead) – 3 minutes

Materials:

(3) Volunteer Boxes:

☐ Student nametags
☐ (NS + 1) Notebooks
☐ Volunteer instructions
☐ Volunteer lab coat
☐ (2) Pencils
☐ (2) Dry erase pens

(3) Supplies Already in Classroom:

☐ (3) Bottles with solution (labeled “Bottle 1”)
☐ (3) Bottles with solution and an aquatic snail (labeled “Bottle 2”)
☐ (3) Bottles with solution and an aquatic plant (labeled “Bottle 3”)

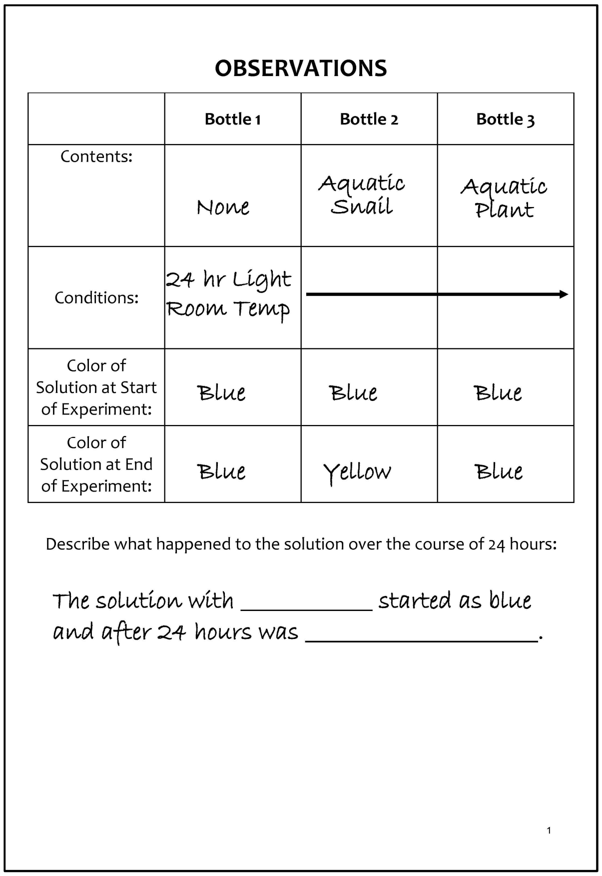
Other Supplies:

☐ (3) Notepads

Lead Box:

☐ (3) Blank nametags
☐ (3) Extra notebooks
☐ Lead instructions
☐ Respiration picture packet
☐ Lead lab coat
☐ (35) Procedure assessments
☐ Time card
☐ (2) Pencils
☐ (2) Wet erase marker
☐ (2) Black pen
☐ (3) Markers (orange, blue, green)
☐ Straw
☐ (9) Caps without holes

Notepad and Notebook Pages:

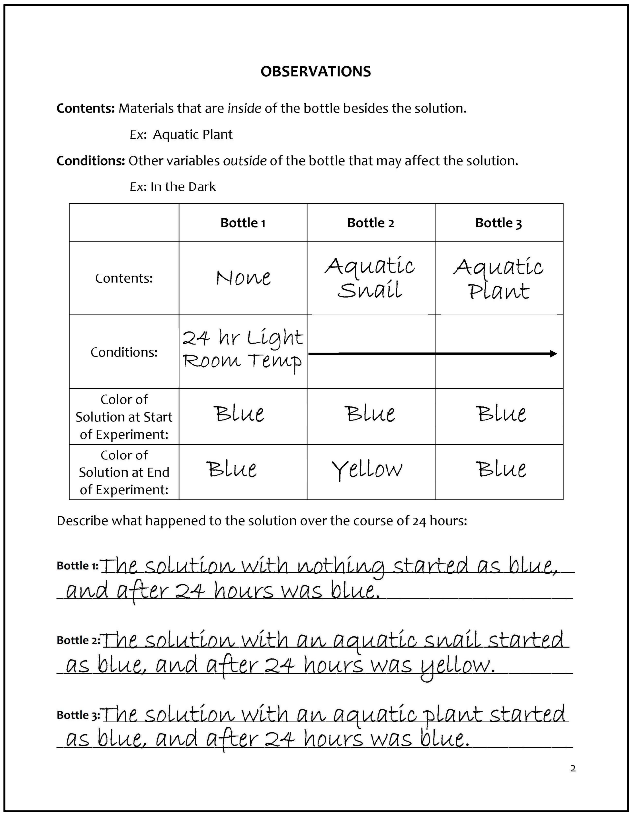


OBSERVATIONS

	Bottle 1	Bottle 2	Bottle 3
Contents:	None	Aquatic Snail	Aquatic Plant
Conditions:	24 hr Light Room Temp	→	→
Color of Solution at Start of Experiment:	Blue	Blue	Blue
Color of Solution at End of Experiment:	Blue	Yellow	Blue

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

The solution with ___________ started as blue and after 24 hours was ___________________.



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

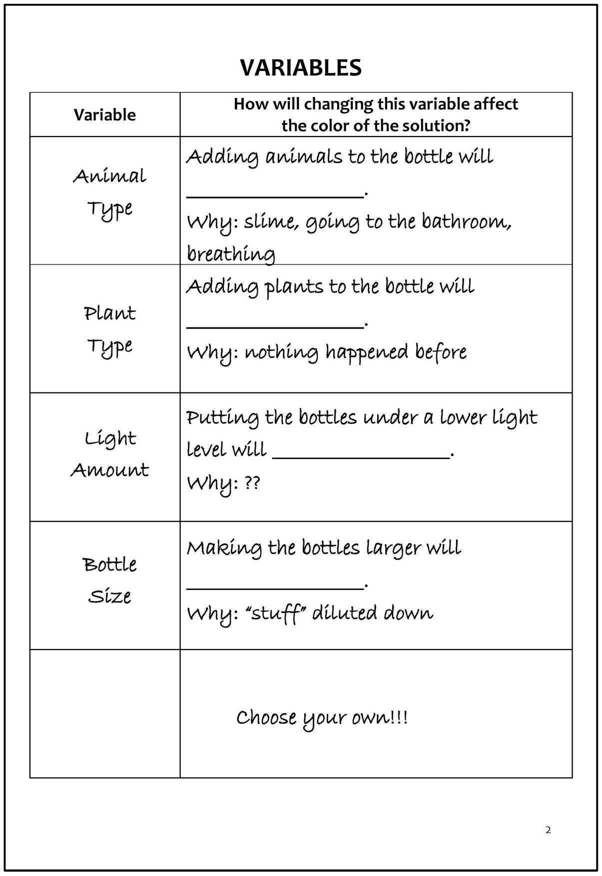
	Bottle 1	Bottle 2	Bottle 3
Contents:	None	Aquatic Snail	Aquatic Plant
Conditions:	24 hr Light Room Temp	→	→
Color of Solution at Start of Experiment:	Blue	Blue	Blue
Color of Solution at End of Experiment:	Blue	Yellow	Blue

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

Bottle 1: The solution with nothing started as blue, and after 24 hours was blue.

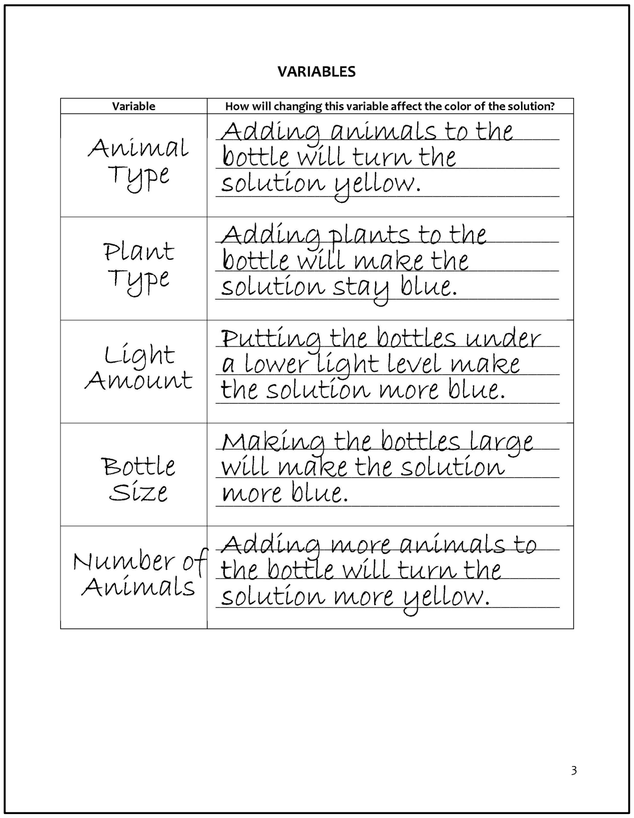
Bottle 2: The solution with an aquatic snail started as blue, and after 24 hours was yellow.

Bottle 3: The solution with an aquatic plant started as blue, and after 24 hours was blue.



VARIABLES

Variable	How will changing this variable affect the color of the solution?
Animal Type	Adding animals to the bottle will ________________. Why: slime, going to the bathroom, breathing
Plant Type	Adding plants to the bottle will ________________. Why: nothing happened before
Light Amount	Putting the bottles under a lower light level will ________________. Why: ??
Bottle Size	Making the bottles larger will ________________. Why: "stuff" diluted down
	Choose your own!!!



VARIABLES

Variable	How will changing this variable affect the color of the solution?
Animal Type	Adding animals to the bottle will turn the solution yellow.
Plant Type	Adding plants to the bottle will make the solution stay blue.
Light Amount	Putting the bottles under a lower light level make the solution more blue.
Bottle Size	Making the bottles large will make the solution more blue.
Number of Animals	Adding more animals to the bottle will turn the solution more yellow.

Preparation:

SciTrek Lead:

1. Make sure volunteers are passing out nametags.
2. Make sure volunteers are setting up for the initial observation.
3. Set up the document camera for the initial bottle picture (picture packet, page 1) and class question (notebook, front cover).
4. Pass out the procedure assessments.

SciTrek Volunteers:

1. Pass out nametags.
    a. You may need to do this during the Introduction/procedure assessment. Quietly set each student's nametag on their desk without talking to them. If names are not written on their desk, ask the classroom teacher or lead to help you when they are not talking with the class.
2. Assemble the experimental set-up (shown in picture below).
    a. Get bottles 1- 3 for your group (under lamp in classroom) and have them ready to put on the table once your students come to your group.

Introduction:
(2 minutes – Full Class – SciTrek Lead)

For UCSB Lead:
"Hi, we are scientists from UCSB and we want to show you what we do as scientists. We will show you an experiment and then you can make observations, come up with a class question, and design your own experiment to help answer the class question. We want to show you that you can do science and have fun."

For Teacher Lead:
"I have asked some scientists from UCSB to come and help us with a long-term science investigation. We will make observations, come up with a class question, and you will design your own experiment to help answer the class question."

Allow the UCSB volunteers to introduce themselves and share their majors.

Procedure Assessment:
(10 minutes – Full Class – SciTrek Lead)

Tell students, "Before we start with the module, we will determine how your ideas on procedures are developing." Have students write their name, teacher's name, and date at the top of the assessment. Tell students, "When doing this assessment, you should work individually, so there should be no talking." As you are giving the assessment, walk around the room and verify students have written their names on their assessments.

For question *1*, have students write in their own words what they think is the definition of a procedure.

For question *2*, read *step 1* of the directions (*Look over the experimental information*); then read the question, changing variable (*solid amount*), and controls (*solid type, liquid type, liquid amount* …) under the experimental information. You do not need to read the values for the changing variable or controls. Read *step 2* to the students (*Read each statement (2-8) and underline controls, circle changing variables and box information about data collection*); then read the statement in question *2* and have students annotate it. Once they are done read *step 3* (*Circle yes if the statement could be a correct step for a procedure about the experimental information below. If not, circle no.*) Have students circle either *Yes* or *No* depending on if they think it is a correct procedural step. For question *3*, read the statement and tell students, "Annotate this statement by underlining controls, circling changing variables, and boxing information about data collection." Once students are done tell them, "Now circle if this could be a correct procedural step or not." Repeat this process for questions *4-8*. When students are finished, collect the assessments and verify students' names are written on top.

Observation Discussion:
(4 minutes – Full Class – SciTrek Lead)

Tell students, "Scientists make many observations." Ask the class, "What is an observation? What are the types of things you can record for an observation?" If they have trouble, show them an object and let them make observations. Turn these specific observations into general features of an observation. Examples of possible general observations are: color, texture, size, weight, temperature, etc. Lead students to understand an observation is a description using your five senses.

Tell students, "In this experiment we are going to use two terms to help us make observations: **contents** and **conditions**. **Contents** are defined as the materials that are *inside* the bottle besides the solution." Hold up one of the bottles and ask students, "What are the contents in this bottle?" Possible student response: an aquatic plant. "**Conditions** are defined as other variables *outside* of the bottle that may affect the solution." Ask students, "What are the conditions of the bottles?" Students should reply, "Under light for 24 hours and at room temperature."

Tell the class, "You will now get in your groups and make observations. To determine your group, you will need to look at the color of your nametag (orange, blue, or green)." Tell each colored group where to go, as well as to bring a pencil.

If a student does not have a nametag, identify the group color with the least number of students in it, and write the student's name on one of the extra nametags in the lead box, using that color of marker.

As students are going to their groups, put the initial bottle picture (picture packet, page *1*) under the document camera. If the classroom teacher took a picture of their bottles, use that picture instead.

Picture Packet, Page 1

Observations:
(14 minutes – Groups – SciTrek Volunteers)

Once students come over to your group, have them sit in boy/girl fashion. Verify the table is set up as described in the Set-Up section. A picture of the bottles from 24 hours earlier will be on the document camera (see example above). Pass out a notebook to each student. Have students write their name, teacher's name, group color, and your name (volunteer's name) on the front cover of their notebooks. Students will leave the subgroup number and class question blank. Then have students turn to page *2* of their notebook.

Have students (as a group) describe the bottle contents and conditions, as well as the color of the solution before and after the 24 hours. Fill this in on the notepad, page *1* while students do the same in their notebook, page *2*.

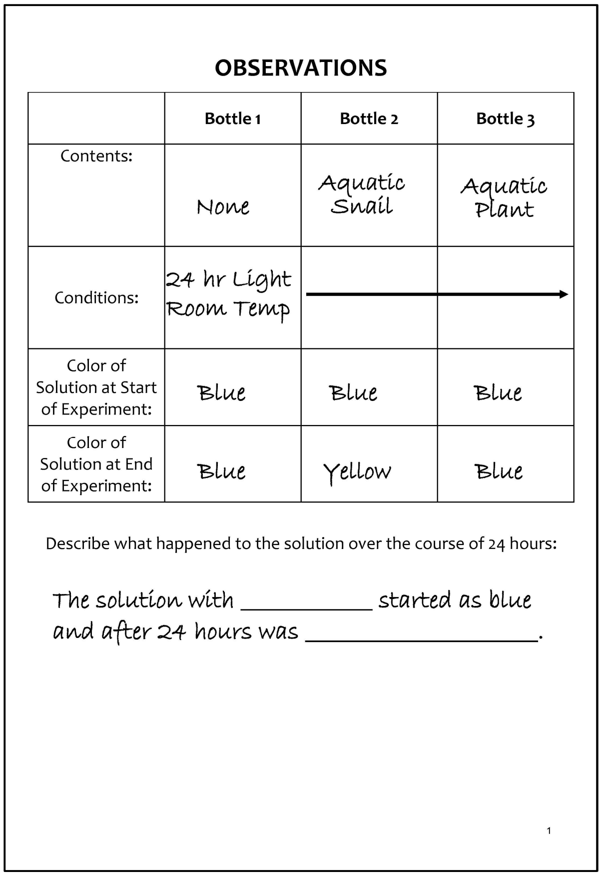
Ask students, "What happened to the solutions over the course of 24 hours?" If needed, probe students with questions such as:

> What is the biggest difference that you see between the solutions?
> How are the solutions different from 24 hours ago?

By the end of the discussion, make sure students understand that over the course of 24 hours, the bottle with the aquatic snail as its contents caused the solution to turn yellow, while the bottle with no contents and the bottle with the aquatic plant as its contents caused the solution to remain blue. Some groups might notice that the solution that had an aquatic plant is a little lighter blue than the bottle with just the solution; you can record this on the table. Have students write one summary sentence about what happened to the solution in each bottle. If students are struggling, write the following sentence frame on the notepad: The solution with ______ started as blue and after 24 hours was ______.

If there is additional time, have students generate a few more general observations about the bottle system.

An example filled out initial observations is shown below.



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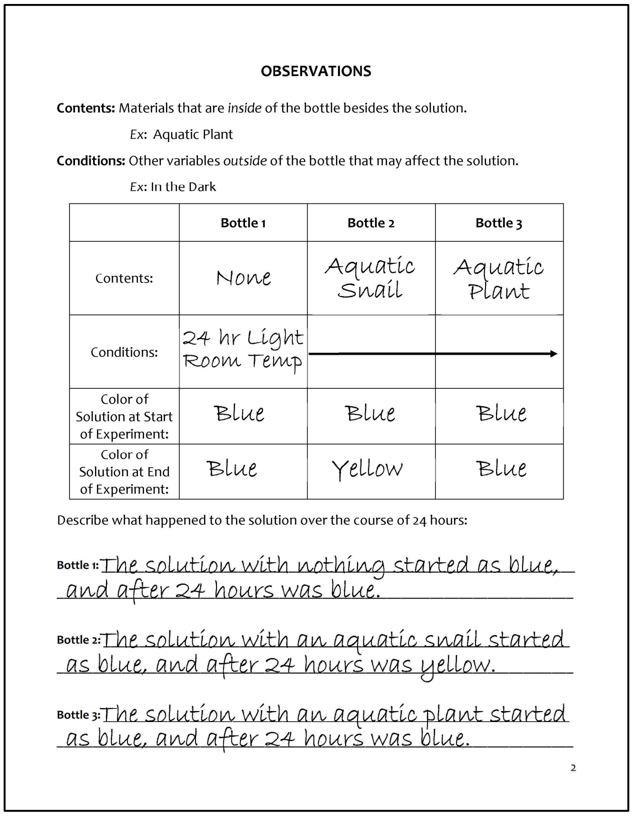
Color of Solution at Start of Experiment:	Blue	Blue	Blue
Color of Solution at End of Experiment:	Blue	Yellow	Blue

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

The solution with ___________ started as blue and after 24 hours was ___________________.

1



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

Bottle 1: The solution with nothing started as blue, and after 24 hours was blue.

Bottle 2: The solution with an aquatic snail started as blue, and after 24 hours was yellow.

Bottle 3: The solution with an aquatic plant started as blue, and after 24 hours was blue.

2

Variable Discussion:
(8 minutes – Full Class – SciTrek Lead)

Ask the class questions to review the experiment they carried out, as well as what they learned. Make sure by the end of the discussion, students have identified that the solution color in the bottle with no contents stayed blue, the solution color in the bottle with the aquatic plant stayed blue (or turned slightly green), and the solution color in the bottle with the snail turned yellow.

Ask the class, “What was the most interesting observation from the experiment?” Possible student response: the solution in the bottle with the aquatic snail turned from blue to yellow. Tell the class, “We will now work together to answer the question, ‘What variables affect the color of the solution?’” Write this question (notebook, frontpage) under the document camera and have students do the same.

Lead students through the following questions and explanations.

What does the word ‘variable’ mean to a scientist?
    variables are the parts of the experiment you can change
What was the changing variable in the experiment we just did?
    contents of the bottle
Do you think there are multiple variables that will affect the solution color?
    multiple variables might affect the solution color
Explain, this is why we will need to work as a class to answer the class question: “What variables affect the color of the solution?”

Tell the class, “You are going to think about variables, in the experiment you could change, in order to help us answer the class question. In addition to generating variables, you should think about how these variables might affect the outcome of the experiment.” Ask the class, “What do you think is a variable that might affect the color of the solution?” Then, have them tell you how and why they think that variable would affect the color of the solution. Probe them on how they would design an experiment to test whether this variable affected the solution color. Finally, have the students make a prediction of the results for the experiment they proposed. Remind students, “Predictions can be wrong, and we will not know the true answers until we carry out the experiment.”

Ex: *Variable:* animal type

Why might this variable affect the solution color? The snail turned the color of the solution yellow, so maybe all animals will have the same effect.

How would you test this variable? Get bottles with blue solution and put different animals in each of the bottles.

Prediction: All solutions will turn yellow because the color change is caused by something that all animals are producing.

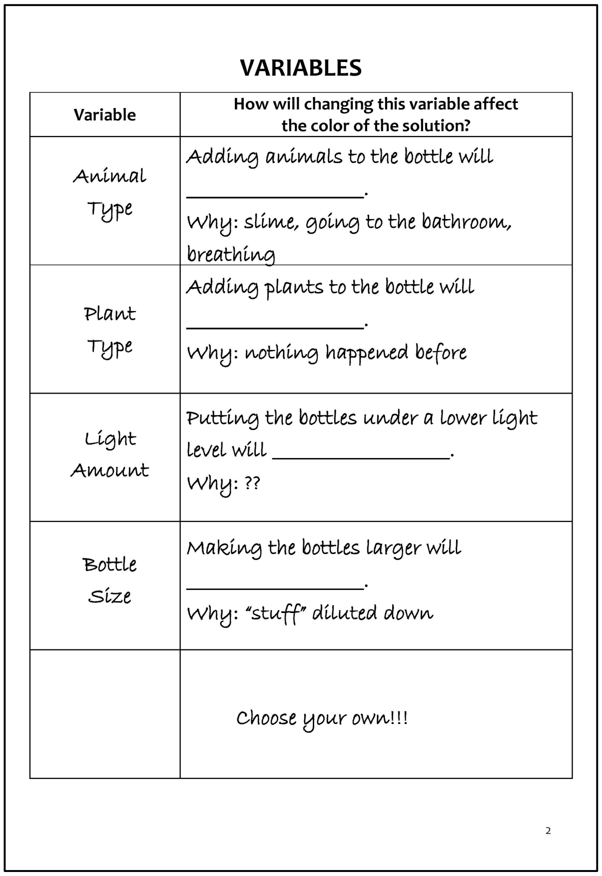
Tell students, “You will now generate more variables and analyze them in your groups.”

Variables:

(19 minutes – Groups – SciTrek Volunteers)

As a group, generate a variable and make a prediction about how it could affect the solution color. Encourage and challenge students to explain why they think their prediction is correct. If needed, you can write down a sentence frame for students to use. Repeat this process three more times, record these ideas on the notepad, and have students copy them into their notebooks. If students have different predictions, they can write their own predictions in their notebooks. Next, students will individually generate at least one additional variable, make a prediction about how different values of this variable will affect the solution color, and record their ideas in their notebooks. Have students share these ideas with the group.

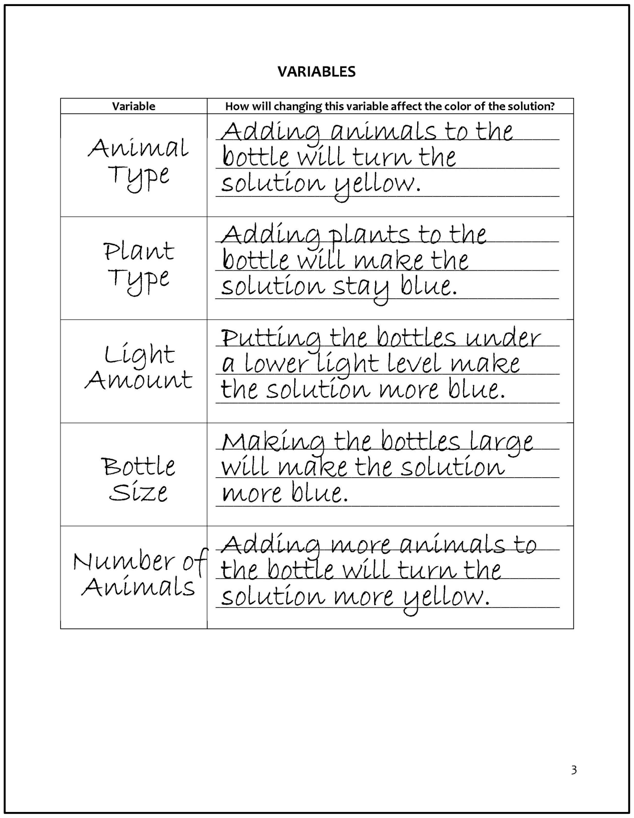
Prepare one student to share a variable and why they think it will affect the solution color during the class discussion.



VARIABLES

Variable	How will changing this variable affect the color of the solution?
Animal Type	Adding animals to the bottle will ________________. Why: slime, going to the bathroom, breathing
Plant Type	Adding plants to the bottle will ________________. Why: nothing happened before
Light Amount	Putting the bottles under a lower light level will ________________. Why: ??
Bottle Size	Making the bottles larger will ________________. Why: "stuff" diluted down
	Choose your own!!!

2



VARIABLES

Variable	How will changing this variable affect the color of the solution?
Animal Type	Adding animals to the bottle will turn the solution yellow.
Plant Type	Adding plants to the bottle will make the solution stay blue.
Light Amount	Putting the bottles under a lower light level make the solution more blue.
Bottle Size	Making the bottles large will make the solution more blue.
Number of Animals	Adding more animals to the bottle will turn the solution more yellow.

3

Wrap-Up:
(3 minutes – Full Class – SciTrek Lead)

Have one student from each group share a variable they generated, as well as how and why they think it will affect the solution color. Make sure students tell you their predictions about how different values of that variable will affect the solution color.

Tell students, "Next session, you will design an experiment to answer the class question: What variables affect the color of the solution?"

Clean-Up:

1. Collect notebooks with attached nametags.
2. Replace the caps with holes with caps without holes on the bottles.
3. Place materials into your group box and bring them back to UCSB.

Day 2: Question/Materials Page/Experimental Set-Up/Procedure Activity

Schedule:

Introduction (SciTrek Lead) – 12 minutes
Question (SciTrek Volunteers) – 5 minutes
Materials Page (SciTrek Volunteers) – 5 minutes
Experimental Set-Up (SciTrek Volunteers) – 10 minutes
Procedure Activity (SciTrek Lead) – 26 minutes
Wrap-Up (SciTrek Lead) – 2 minutes

Materials:

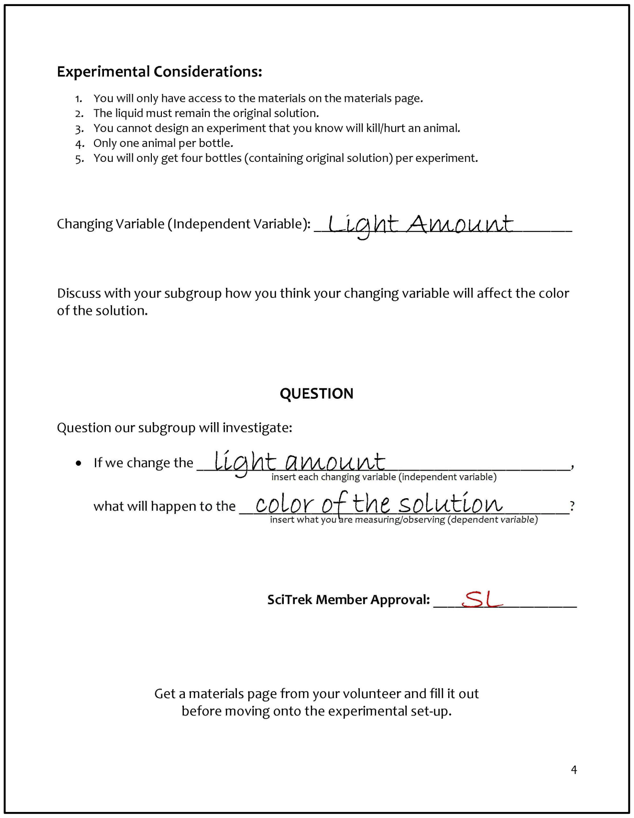
(3) Volunteer Boxes:

- ☐ Nametags
- ☐ Notebooks
- ☐ Volunteer instructions
- ☐ Volunteer lab coat
- ☐ (2) Materials pages (subgroup color & number indicated)
- ☐ (2) Pencils
- ☐ (2) Red pens
- ☐ Paper notepad

Lead Box:

- ☐ (3) Blank nametags
- ☐ (3) Extra notebooks
- ☐ Lead instructions
- ☐ Respiration picture packet
- ☐ Lead lab coat
- ☐ (3) Materials pages
- ☐ Time card
- ☐ (2) Pencils
- ☐ (2) Red pens
- ☐ (2) Wet erase marker
- ☐ (2) Black pens
- ☐ (3) Markers (orange, blue, green)
- ☐ Paper notepad

Notebook Pages:



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): Light Amount

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

QUESTION

Question our subgroup will investigate:

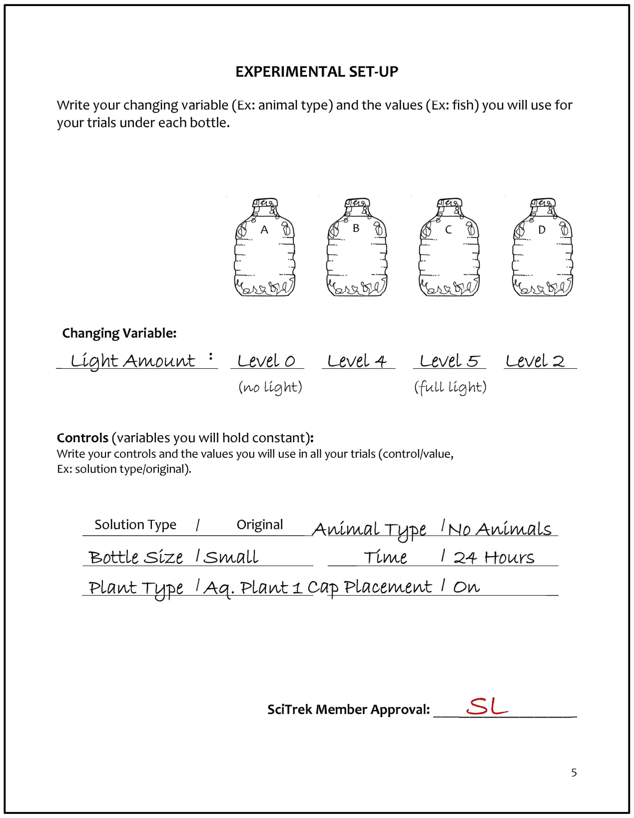
- If we change the light amount (insert each changing variable (independent variable)),

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

SciTrek Member Approval: SL

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

4



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:

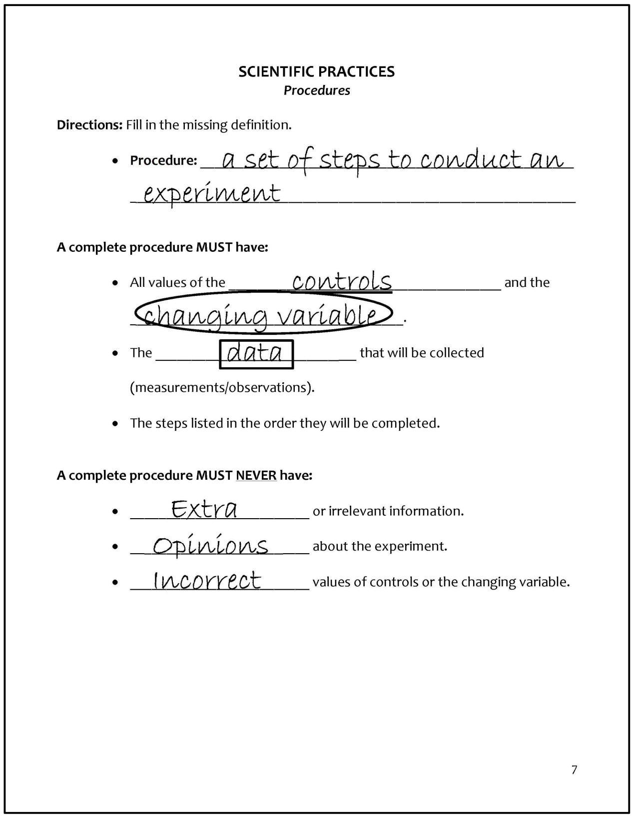
Light Amount :	Level 0	Level 4	Level 5	Level 2
	(no light)		(full light)	

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
Animal Type / No Animals
Bottle Size / Small
Time / 24 Hours
Plant Type / Aq. Plant 1
Cap Placement / On

SciTrek Member Approval: SL

5



SCIENTIFIC PRACTICES

Procedures

Directions: Fill in the missing definition.

- **Procedure:** a set of steps to conduct an experiment

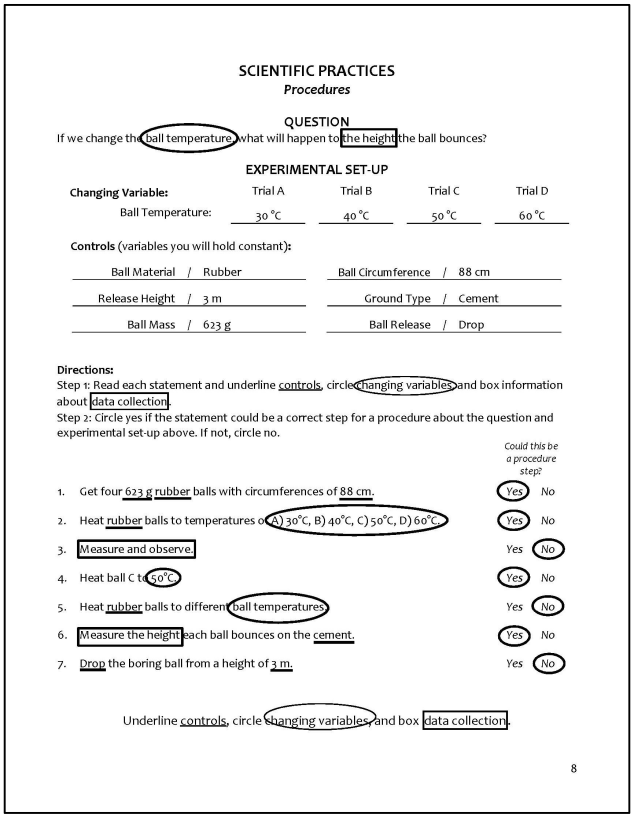
A complete procedure MUST have:

- All values of the controls and the changing variable.
- The data that will be collected (measurements/observations).
- The steps listed in the order they will be completed.

A complete procedure MUST NEVER have:

- Extra or irrelevant information.
- Opinions about the experiment.
- Incorrect values of controls or the changing variable.

7



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.

8

Preparation:

SciTrek Lead:

1. Make sure volunteers are setting out notebooks in such a way that allows students within the same subgroup to work together.
2. Set up the document camera for the Day 1 final bottles picture (picture packet, page 2), question (notebook, page 4), lead materials page (picture packet, page 3), experimental plants pictures (picture packet, page 4), experimental set-up (notebook, page 5), and procedure activity (notebook, pages 7-8).

SciTrek Volunteers:

1. Set out notebooks/nametags to allow students in the same subgroup (same number on the front of their notebook) to work together.
2. Make sure you have two materials pages, each filled out with a subgroup number (1 or 2) and your group's color, to give to subgroups after they complete their question.
3. Have a red pen available to approve subgroups' questions and experimental set-ups (notebook, pages 4 and 5).

Note: Set notebooks where students will sit during the module, even if another student is currently at that desk. If needed, students will move to these spots after the Introduction.

Introduction:

(12 minutes – Full Class – SciTrek Lead)

If students are not in their subgroups, tell them, "A notebook will be put on your desk, which is not your notebook and you should not move it. You will move to your notebook after the Introduction."

Ask students, “What did we do and learn during our last session?” Then show them the picture of the bottles after 24 hours (picture packet, page 2) to help remind them. Possible student response: we observed what happened to the color of solution in bottles over the course of 24 hours. The solution stayed blue in the bottles containing only solution and solution with an aquatic plant. The solution turned yellow in the bottle containing solution with an aquatic snail. Ask the class, “What is the class question we will be investigating?” Students should reply, “What variables affect the color of the solution?”

2

Picture Packet, Page 2

Tell students, “One way scientists answer questions is by performing experiments. Today, you will design an experiment to help answer the class question.” Ask the class, “Do you think there are multiple variables that could affect the solution’s color?” Possible student response: there are probably multiple variables.

Explain to students, “Many times when there is a broad question, like our class question, scientists break it down into smaller, more specific questions which small groups of scientists can investigate. The scientists then compile their work to answer the broader question. Therefore, each subgroup is going to generate a smaller question. Once we put all the subgroups’ research together, we should be able to answer the class question.”

Subgroups will first generate a question based on the changing variable they plan to explore. They will then fill out their materials page, which will allow them to determine their experimental set-up. Tell students, “You will need to keep a few things in mind, while you are going through this process.”

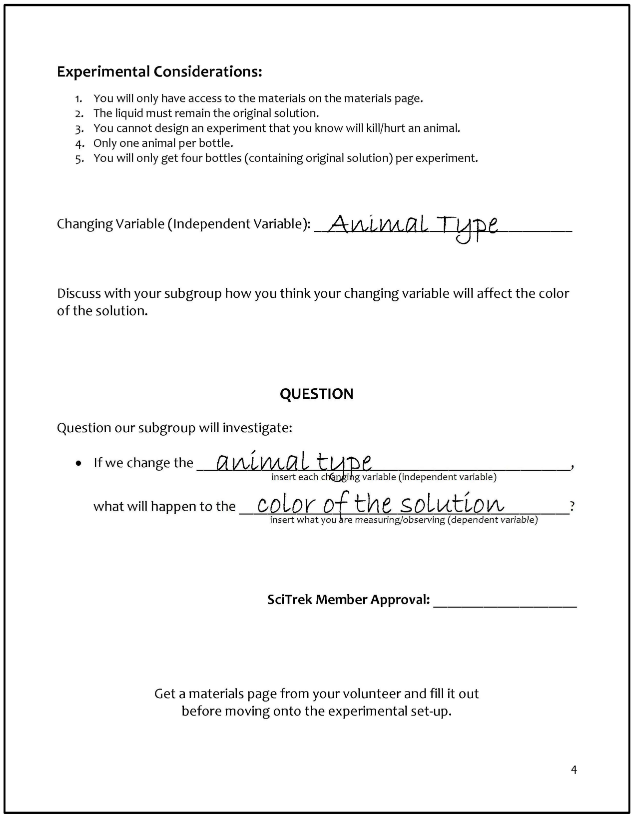
Experimental Considerations:

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.*

Tell students, “We are now going to generate a class research question/experimental set-up together. I will write it in the class notebook, so you will be able to refer back to it when you are completing the process yourselves.” Make sure students **do not** fill out the class question/experimental set-up in their notebooks, as they will be completing these pages for their own experiments in subgroups.

Tell students, “We first need to decide what the changing variable will be for the class experiment.” Ask students, “What are some of the variables you discussed last meeting?” Make a list of them on the board. Make sure “animal type” is one of the variables on the list. Ask students, “Which variable are you most interested in?” Most, if not all, students will say animal type. Tell students, “Since everyone is interested in animal type, this is what we will investigate as a class. Therefore, when you design an experiment with your subgroup, you will need to pick a variable other than animal type to investigate. This will allow us to have a wide range of variables tested, making poster day more interesting.” Record “animal type” for the changing variable (notebook, page *4*) under the document camera.

Show students how to insert the changing variable and what they plan to observe into the question frame to generate the question that will be investigated, “If we change the <u>animal type</u>, what will happen to the <u>color of the solution</u>?”



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): Animal Type

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 animal type, (insert each changing variable (independent variable))
  what will happen to the color of the solution? (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.

4

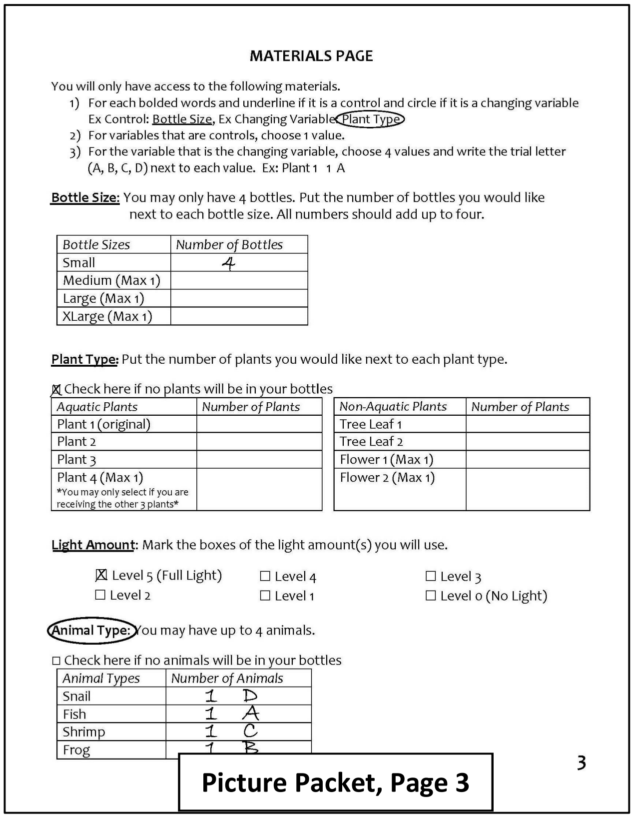
Tell students, “Once you have determined your question, and have approval, your volunteer will give you a materials page for determining the values of your controls and changing variable.” Ask students, “What is a control?” Make sure, by the end of the conversation, students understand controls are variables that are held constant during an experiment. For example, if the caps were on all of the bottles, then one of their controls would be cap placement. These controls, and control values, can be different from the original experiment they conducted on Day 1, but must remain constant throughout all the trials they do for this experiment.

Show students the lead materials page (picture packet, page 3) and read the first step (*For each bolded word, underline if it is a control and circle if it is a changing variable.*). Then, have students tell you what to do for each bolded word. Read steps *2* and *3* on the materials page (*For variables that are controls, choose 1 value. For the variable that is the changing variable, choose 4 values and write the trial letter next to each value.*). Tell students, “You must also pay attention to notes on the material page about restrictions in materials.” Go through the remaining items on the materials page. Have them decide the values for the changing variable and controls, making sure to write the trial letter next to the changing variable values.

After each control and/or changing variable value is selected, assign it to one student to remember so that they can share it out when you are filling in the experimental set-up.

When selecting the value for plant type, show students the experimental plant pictures (picture packet, page *4*). Lead students to understand it will be difficult to determine what is affecting the color of the solution if we use both plants and animals; then try to get students to choose no plants.

When selecting the value for light amount, tell students, "Light amount is changed by having light go into a box with a filter. Therefore, unless you pick full light (level 5), you will not be able to see the animals." Most classes will pick full light.



MATERIALS PAGE

You will only have access to the following materials.

1) For each bolded words and underline if it is a control and circle if it is a changing variable Ex Control: Bottle Size, Ex Changing Variable [✓ Plant Type]
2) For variables that are controls, choose 1 value.
3) For the variable that is the changing variable, choose 4 values and write the trial letter (A, B, C, D) next to each value. Ex: Plant 1 1 A

Bottle Size: You may only have 4 bottles. Put the number of bottles you would like next to each bottle size. All numbers should add up to four.

Bottle Sizes	*Number of Bottles*
Small	4
Medium (Max 1)	
Large (Max 1)	
XLarge (Max 1)	

Plant Type: Put the number of plants you would like next to each plant type.

☒ Check here if no plants will be in your bottles

Aquatic Plants	*Number of Plants*
Plant 1 (original)	
Plant 2	
Plant 3	
Plant 4 (Max 1) *You may only select if you are receiving the other 3 plants*	

Non-Aquatic Plants	*Number of Plants*
Tree Leaf 1	
Tree Leaf 2	
Flower 1 (Max 1)	
Flower 2 (Max 1)	

Light Amount: Mark the boxes of the light amount(s) you will use.

☒ Level 5 (Full Light)
☐ Level 2
☐ Level 4
☐ Level 1
☐ Level 3
☐ Level 0 (No Light)

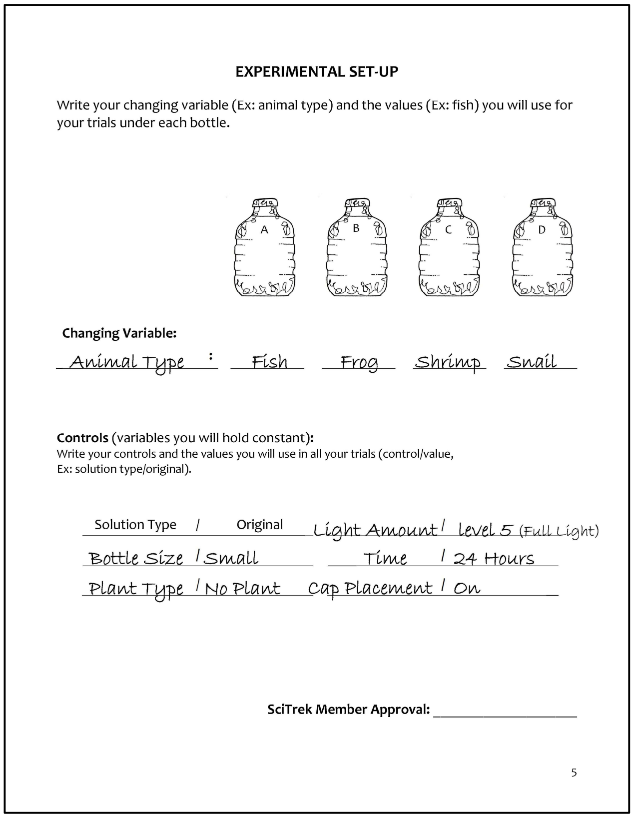
[✓ **Animal Type:**] You may have up to 4 animals.

☐ Check here if no animals will be in your bottles

Animal Types	*Number of Animals*
Snail	1 D
Fish	1 A
Shrimp	1 C
Frog	1 B

3

Picture Packet, Page 3



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:

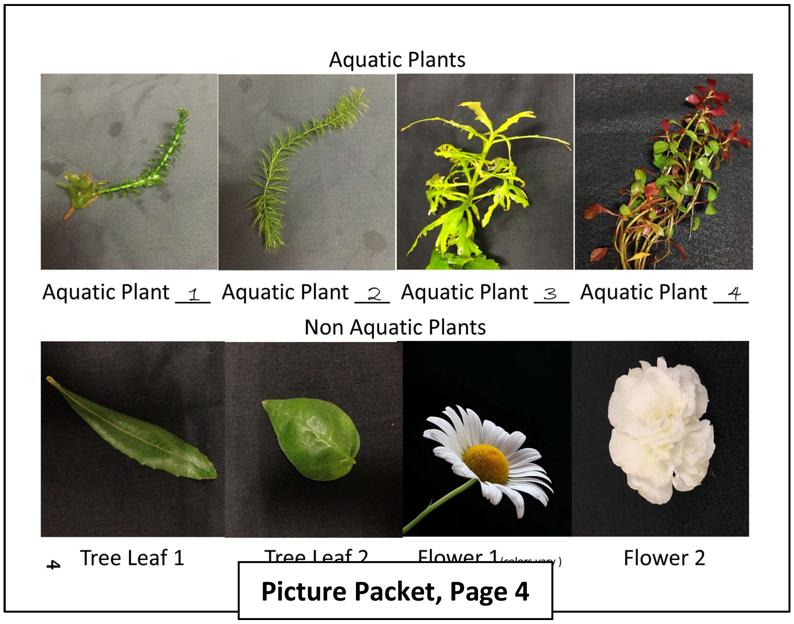
Animal Type : Fish Frog Shrimp Snail

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
Light Amount / level 5 (Full Light)
Bottle Size / Small
Time / 24 Hours
Plant Type / No Plant
Cap Placement / On

SciTrek Member Approval: ___________________

5



Aquatic Plants

Aquatic Plant 1 Aquatic Plant 2 Aquatic Plant 3 Aquatic Plant 4

Non Aquatic Plants

Tree Leaf 1 Tree Leaf 2 Flower 1 (colors vary) Flower 2

4

Picture Packet, Page 4

Tell students, “Once you have completed your materials page, you will fill out your experimental set-up. First, you will fill out the information on the changing variable.” Ask students, “What is the changing variable for our class experiment, and what values did we select?” Then, fill in the values for all of the trials (notebook, page 5). Tell students, “Second, you will fill in information about your controls.” Ask students, “What is one of our controls, and its value, for the class experiment?” Show students how to record the control on the left side of the slash (Ex: plant type) and the value of that control on the right side of the slash (Ex: no plants) by doing so in the class notebook. There are four possible variables to choose from on the materials page. Subgroups will be left with two control blanks empty after inserting in the information from the materials page. Since all control blanks must be filled out, tell students, “You need to generate two additional controls that do not come from the materials page.” Lead students to realize these should be “time/24 hours” and “cap placement/on.”

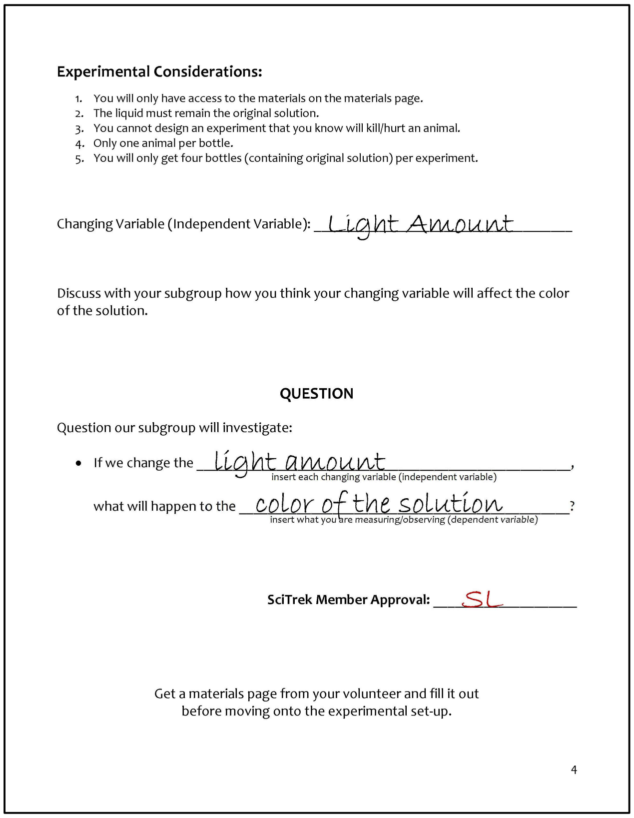
Ask students, “Should everyone choose the same changing variable and why or why not?” Possible student response: no, because we will not learn as much about the class question. Tell students, “This means you should try to explore a changing variable you think few other subgroups are exploring. Remember, because we are exploring animal type as a class, you will not be able to change this variable, and the only animals you will have access to are snails. Therefore, you will get a slightly modified materials page. Once your subgroup has completed your experimental set-up, you should raise your hands and get it approved by your volunteer.” Above is an example of what should be filled out for the experimental set-up in the class notebook.

Have students start the design process. Place the class example question (notebook, page 4) under the document camera so students may refer back to it as they design their experiments. As subgroups move onto their materials page, put the plant pictures (picture packet, page 4) under the document camera so that students can refer to it as they choose their materials. As subgroups move onto their experimental set-up, put the class experimental set-up (notebook, page 5) under the document camera.

Question:
(5 minutes – Subgroups – SciTrek Volunteers)

Have subgroups decide what changing variable they want to explore for their experiment. Encourage your subgroups to have different changing variables. The lead will help coordinate between groups to ensure there is a variety of changing variables.

After subgroups have decided on their changing variable, have them fill out their question. When you sign off on their question, give them a materials page with their subgroup color and number, designated in the upper right-hand corner. An example filled-out question is shown below.



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): Light Amount

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 light amount (insert each changing variable (independent variable)),

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

SciTrek Member Approval: SL

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

4

Materials Page:

(5 minutes – Subgroups – SciTrek Volunteers)

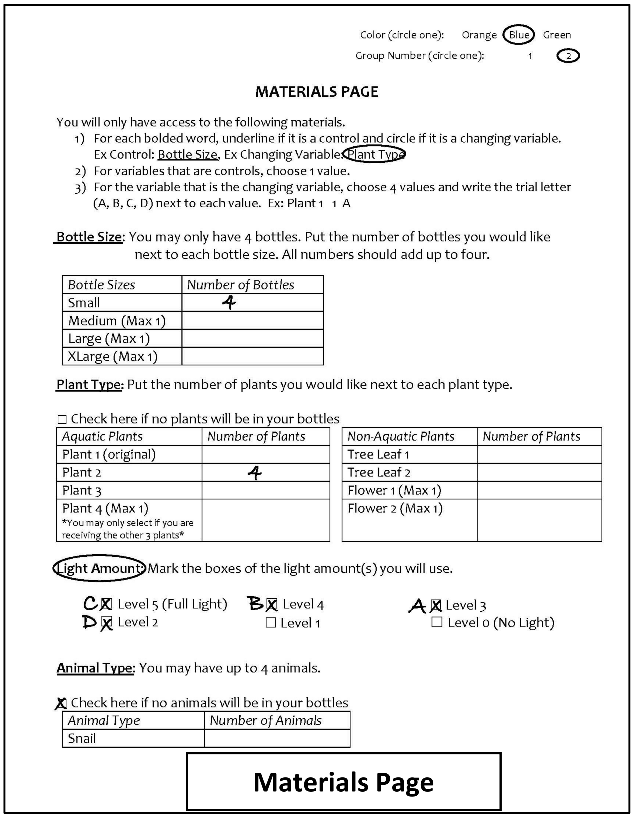
Have subgroups underline their controls and circle their changing variable on the materials page. Then, have them use the materials page to choose the values for their controls and changing variable. For the changing variable values, have students write the trial letter (A, B, C, D) next to the value they select. Ask students, “Why did you choose the values you did for your controls and changing variable? Will these values make it easier or harder to answer your question?”

Make sure students have **not gone over the maximum** number of any of the items on the materials page. An example filled-out materials page is shown below (left).

Experimental Set-Up:

(10 minutes – Subgroups – SciTrek Volunteers)

Have subgroups use their materials page to fill in their experimental set-ups (notebook, page 5). There will be two control blanks that will not come from the materials page. For these controls students should write “time/24 hours” and “cap placement/on.” If students do not have any animals in their bottle, they can also pick for their cap placement to be off. When you sign off on their experimental set-ups, ensure that all students within a subgroup have the same trial letters corresponding to the same changing variable values; then, collect the materials page and verify that it is filled out correctly and completely. Filling out the materials page is essential for students to obtain the correct materials for their experiments on Day 3.5. An example filled out experimental set-up is shown below (right).



Color (circle one): Orange [✓ Blue] Green

Group Number (circle one): 1 [✓ 2]

MATERIALS PAGE

You will only have access to the following materials.

1) For each bolded word, underline if it is a control and circle if it is a changing variable. Ex Control: <u>Bottle Size</u>, Ex Changing Variable: Plant Type
2) For variables that are controls, choose 1 value.
3) For the variable that is the changing variable, choose 4 values and write the trial letter (A, B, C, D) next to each value. Ex: Plant 1 1 A

Bottle Size: You may only have 4 bottles. Put the number of bottles you would like next to each bottle size. All numbers should add up to four.

Bottle Sizes	*Number of Bottles*
Small	4
Medium (Max 1)	
Large (Max 1)	
XLarge (Max 1)	

Plant Type: Put the number of plants you would like next to each plant type.

☐ Check here if no plants will be in your bottles

Aquatic Plants	*Number of Plants*
Plant 1 (original)	
Plant 2	4
Plant 3	
Plant 4 (Max 1) *You may only select if you are receiving the other 3 plants*	

Non-Aquatic Plants	*Number of Plants*
Tree Leaf 1	
Tree Leaf 2	
Flower 1 (Max 1)	
Flower 2 (Max 1)	

Light Amount: Mark the boxes of the light amount(s) you will use.

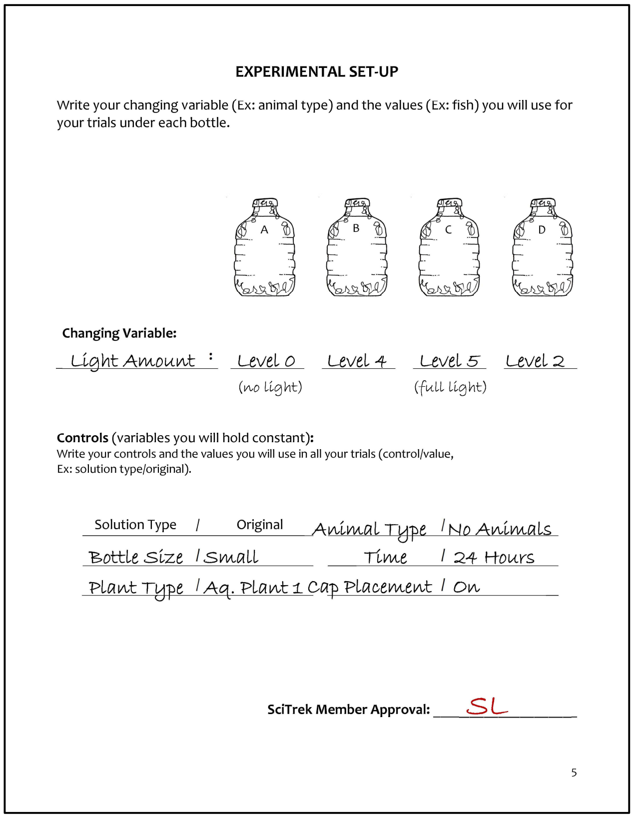
C ☒ Level 5 (Full Light)
B ☒ Level 4
A ☒ Level 3
D ☒ Level 2
☐ Level 1
☐ Level 0 (No Light)

Animal Type: You may have up to 4 animals.

☒ Check here if no animals will be in your bottles

Animal Type	*Number of Animals*
Snail	

Materials Page



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:

Light Amount : Level 0 (no light) | Level 4 | Level 5 (full light) | Level 2

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
Animal Type / No Animals
Bottle Size / Small
Time / 24 Hours
Plant Type / Aq. Plant 1
Cap Placement / On

SciTrek Member Approval: SL

5

Procedure Activity:
(26 minutes – Full Class – SciTrek Lead)

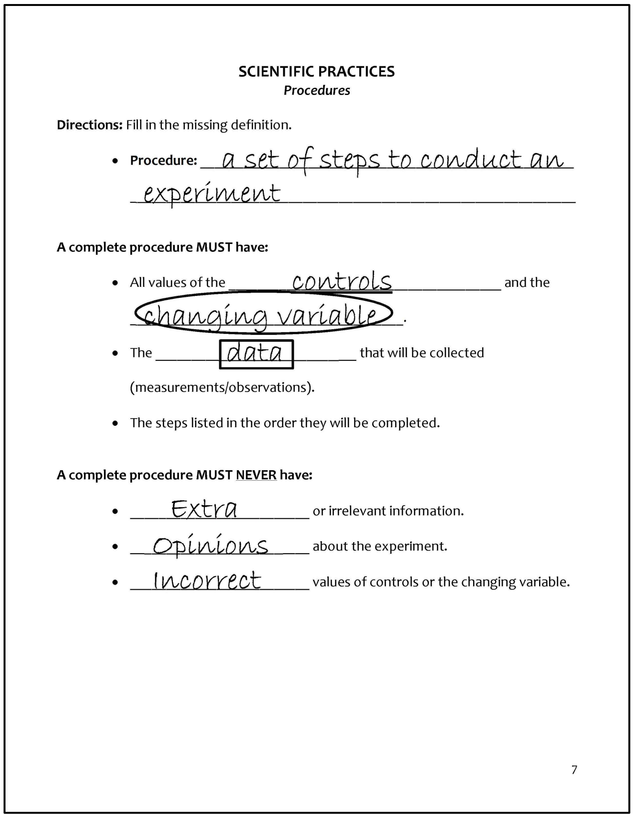
Tell students, "I have heard some great experiments being designed and I am excited to see the outcomes of your experiments. Now that you have determined your experimental set-ups, you are going to write procedures." Ask the class, "What is a procedure?" After listening to the students' answers make sure students understand that a procedure is **a set of steps to conduct an experiment**. Write this definition on page 7 of the class notebook for the students to copy.

Tell students, "In order to write a procedure, we need to make sure that we understand what information MUST be included in a procedure." Ask students, "What information do you think a complete procedure should have?" Make sure that students generate the following three items: *1) all values of the <u>controls</u> and the <u>changing variable</u>, 2) what <u>data</u> will be collected (measurements and observations), and 3) the steps listed in the order that they will be completed.* If students are having trouble generating these ideas, have them think back to the information they put into their questions and experimental set-ups. Once students have generated these ideas, have them fill in the blanks in their notebooks with the underlined words above, while you fill in the values in the class notebook. Tell students, "To help us recognize control values, changing variable values, and data collection information in procedural steps, we will underline information about controls, circle information about changing variables, and box information about data collection." On the class notebook, underline the word controls, circle the words changing variable, and box the word data.

Tell students, "We also need to discuss items that MUST NEVER be included in a procedure." Ask students, "What information do you think a complete procedure should not have?" Make sure students generate the following three items: *1) <u>extra</u> or irrelevant information, 2) <u>opinions</u> about the experiment, and 3) <u>incorrect</u> values of controls or the changing variable.* Have students fill in the blanks in their notebooks with the underlined words above, while you fill in the values in the class notebook.

Note: If students need help understanding what it means to have opinions or irrelevant information in a procedure, you can give them the following example: a scientist was designing an experiment to test which laundry detergent will have the largest reduction in the size of grass stains on cotton. Below are examples of steps containing an opinion and irrelevant information:

> Step with an Opinion: Get three brands of good smelling laundry detergent A) Tide, B) Gain, C) All.
> Step with Irrelevant Information: Put on cotton pants and play soccer in them until you get a grass stain.



SCIENTIFIC PRACTICES

Procedures

Directions: Fill in the missing definition.

- **Procedure:** a set of steps to conduct an experiment

A complete procedure MUST have:

- All values of the controls and the changing variable.
- The data that will be collected (measurements/observations).
- The steps listed in the order they will be completed.

A complete procedure MUST NEVER have:

- Extra or irrelevant information.
- Opinions about the experiment.
- Incorrect values of controls or the changing variable.

7

Have students turn to page 8 in their notebooks while you put page 8 of the class notebook under the document camera. Tell students, “We are now going to look at a group of scientists’ question and experimental set-up, then we will decide if the following seven statements would be appropriate procedural steps for those scientists’ experiment. These steps are not meant to be a full procedure and are therefore not in any order. We are just trying to determine whether they could be correct steps in a procedure for this experiment.” Go over the question, changing variable, changing variable values, controls, and control values, with the students.

Tell students, “The first thing you should do when looking at a possible procedural step is identify the information within that statement. You will do this by underlining any information about controls, circling information about the changing variable, and boxing information about data collection.” To practice, have students look at the question on page 8 and tell you what should be underlined, circled, or boxed. Within the question, students should circle *ball temperature* and box *height the ball bounces*. Once they have determined what information is in the step, they will have to check whether the statement could be a possible procedural step by looking at the information in the question and experimental set-up. If the statement could be a possible procedural step, they will circle *Yes*, if not, they will circle *No*. Tell students, “We will now go over all of the statements together.”

Below are the explanations and answers to questions *1-7* on page 8.

1. Get four 623 g rubber balls with circumferences of 88 cm.
Correct – Step with Controls Only

What should be underlined, circled, and/or boxed?
623 g, *rubber*, and *88 cm* should be underlined.

Are there any opinions, incorrect, or extra/irrelevant information, in this statement?
No.

What is this step about?
This step is about the ball that will be used in the experiment.

Is there any other information which should have been included in this step?
No.

Could this be a correct procedural step?
Yes (have students circle *Yes*).

2: Heat rubber balls to temperatures of A) 30°C, B) 40°C, C) 50°C, D) 60°C.
Correct – Changing Variable with Values

What should be underlined, circled, and/or boxed?
Rubber should be underlined and *A) 30°C, B) 40°C, C) 50°C, D) 60°C* should be circled.

Are there any opinions, incorrect, or extra/irrelevant information, in this statement?
No.

What is this step about?
This step is about getting each ball ready to be bounced by heating them.

Is there any other information which should have been included in this step?
No. Students may bring up that the ball is not fully described. If they do, ask them, “Could the ball have been described in a previous step?” Since the answer is yes this does not need to be included.

Could this be a correct procedural step?
Yes (have students circle *Yes*).

3: Measure and observe.
Incorrect – Vague Data Collection

What should be underlined, circled, and/or boxed?
Measure and observe should be boxed.

Are there any opinions, incorrect, or extra/irrelevant information, in this statement?
No.

What is this step about?
This step is about data collection.

Is there any other information which should have been included in this step?
Yes, this step does not include what data will be collected. Ask students, “What data should be collected to answer the scientists’ question?” Students should reply, “The height the ball bounces.”

Could this be a correct procedural step?
No (have students circle *No*).

4: Heat ball C to 50°C.

Correct – One Changing Variable Value Explained

What should be underlined, circled, and/or boxed?

50˚C should be circled.

Are there any opinions, incorrect, or extra/irrelevant information, in this statement?

No.

What is this step about?

Getting ball C ready to be bounced by heating it.

Is there any other information which should have been included in this step?

No. Students may bring up that only one changing variable value is listed. Ask students, “Could the rest of the values have been listed in other steps?” They should answer yes, therefore, this information does not need to be included.

Could this be a correct procedural step?

Yes (have students circle *Yes*).

5: Heat rubber balls to different ball temperatures.

Incorrect – Changing Variable with No Values

What should be underlined, circled, and/or boxed?

Rubber should be underlined and *ball temperatures* should be circled.

Are there any opinions, incorrect, or extra/irrelevant information, in this statement?

No.

What is this step about?

Getting each ball ready to be bounced by heating them.

Is there any other information which should have been included in this step?

Yes, this step does not include the temperature the balls should be heated to. Since this information is missing, scientists who attempt to perform this experiment may use different temperatures from one another.

Could this be a correct procedural step?

No (have students circle *No*).

6: Measure how high each ball bounces on the cement.

Correct – Measurement

What should be underlined, circled, and/or boxed?

Cement should be underlined and *measure how high each ball bounces* should be boxed.

Are there any opinions, incorrect, or extra/irrelevant information, in this statement?

No.

What is this step about?

This step is about data collection.

Is there any other information which should have been included in this step?

No. The step is about data collection and includes what data will be collected.

Could this be a correct procedural step?

Yes (have students circle *Yes*).

7: Drop the boring ball from a height of 3 m.

Incorrect – Opinion during Experiment

What should be underlined, circled, and/or boxed?

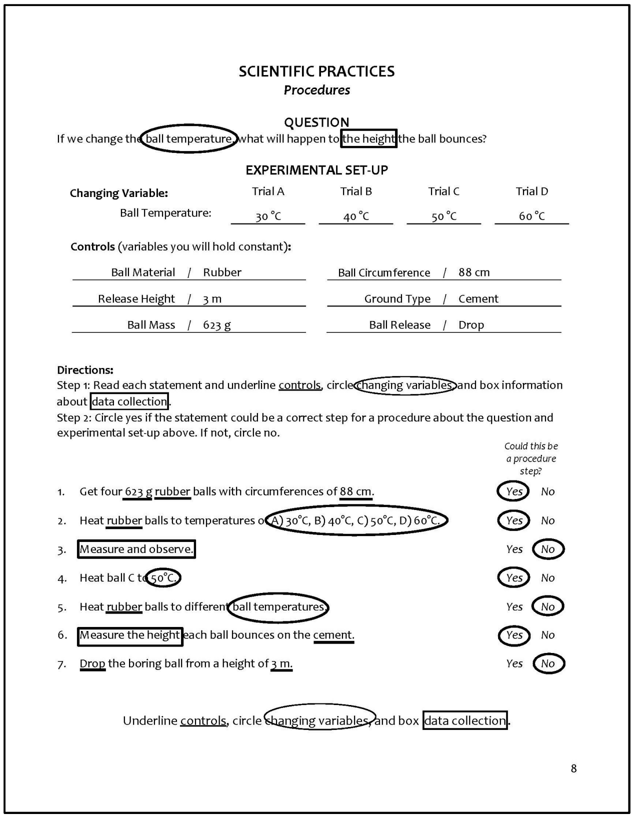
Drop and *3 m* should be underlined.

Are there any opinions, incorrect, or extra/irrelevant information, in this statement?

Yes, the word boring is an opinion and should not be included in a procedure.

Could this be a correct procedural step?

No (have the students circle *No*).



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.

8

Wrap-Up:

(2 minutes – Full Class – SciTrek Lead)

Tell students, “Next session, you will write a procedure for your experiment. All of your experiments will help us answer the class question: What variables affect the color of the solution?”

Clean-Up:

1. Collect notebooks with attached nametags.
2. Place materials into your group box and bring them back to UCSB.

Day 3: Procedure Activity/Procedure/Results Table

Schedule:

Introduction (SciTrek Lead) – 3 minutes
Procedure Activity (SciTrek Lead) – 15 minutes
Procedure Discussion/Procedure (SciTrek Lead/SciTrek Volunteers) – 35 minutes
Results Table (SciTrek Volunteers) –5 minutes
Wrap-Up (SciTrek Lead) – 2 minutes

Materials:

(3) Volunteer Boxes:

- ☐ Nametags
- ☐ Notebooks
- ☐ Volunteer instructions
- ☐ Volunteer lab coat
- ☐ (2) Pencils
- ☐ (2) Red pens
- ☐ Paper notepad

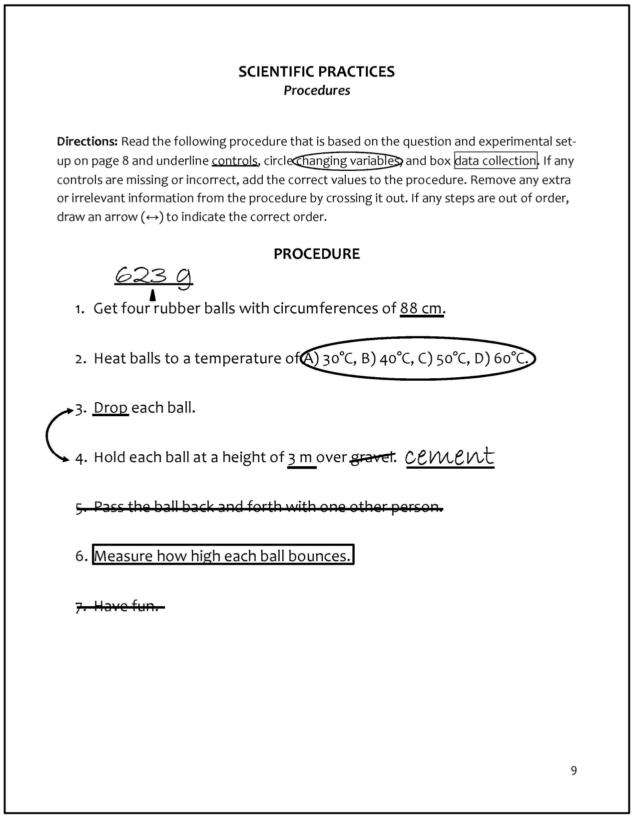
Other Supplies:

☐ (28) Labeled bottles (with group color, number, and trial letter) including class experiment bottles in a bucket
☐ (7) Extra Bottles (1XL, 1L, 1M, 4S)
☐ (2) Extension cords
☐ (6) Lamps with 60 W equivalent LED bulbs
☐ (4) Boxes with filters with light levels labeled
☐ Box with no holes labeled "level 0"

Lead Box:

☐ (3) Extra notebooks
☐ Lead instructions
☐ Respiration picture packet
☐ Lead lab coat
☐ Time card
☐ (2) Pencils
☐ (2) Red pens
☐ (2) Wet erase markers
☐ (2) Black pens
☐ Paper notepad
☐ Day 3.5 instructions

Notebook Pages:



SCIENTIFIC PRACTICES

Procedures

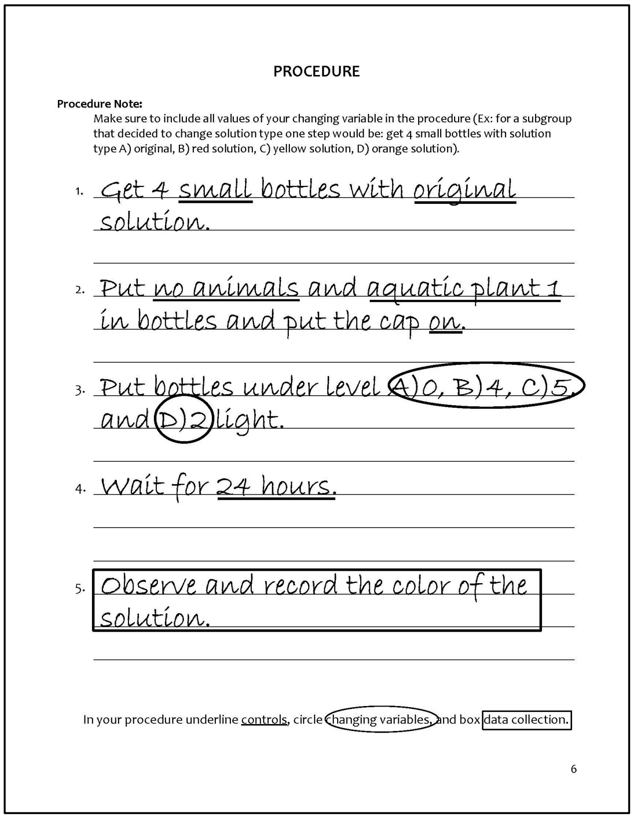
Directions: Read the following procedure that is based on the question and experimental set-up on page 8 and underline controls, circle changing variables, and box data collection. If any controls are missing or incorrect, add the correct values to the procedure. Remove any extra or irrelevant information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

PROCEDURE

623 g

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.~~ cement
5. ~~Pass the ball back and forth with one other person.~~
6. Measure how high each ball bounces.
7. ~~Have fun.~~

9



PROCEDURE

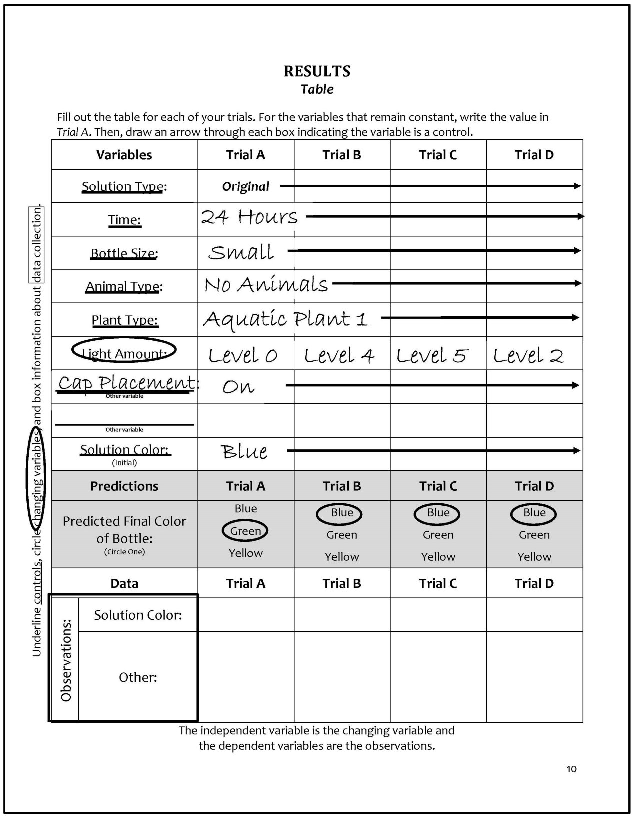
Procedure Note:

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, D) orange solution).

1. Get 4 small bottles with original solution.
2. Put no animals and aquatic plant 1 in bottles and put the cap on.
3. Put bottles under level A)0, B)4, C)5, and D)2 light.
4. Wait for 24 hours.
5. Observe and record the color of the solution.

In your procedure underline controls, circle changing variables, and box data collection.

6



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
Solution Type:	*Original* →	→	→	→
Time:	24 Hours →	→	→	→
Bottle Size:	Small →	→	→	→
Animal Type:	No Animals →	→	→	→
Plant Type:	Aquatic Plant 1 →	→	→	→
Light Amount:	Level 0	Level 4	Level 5	Level 2
Cap Placement: Other variable	On →	→	→	→
Other variable				
Solution Color: (Initial)	Blue →	→	→	→
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:				

The independent variable is the changing variable and the dependent variables are the observations.

10

Preparation:

SciTrek Lead:

1. Make sure volunteers are passing out notebooks.
2. Set up the document camera for the procedure activity (notebook, page 9; picture packet, page 5), procedure (notebook, page 6), and results table (notebook, page 10).
3. Put the supplies (boxes, lamps, and bottles) for Day 3.5 in a convenient spot. Teacher Leads: If you do not know when Day 3.5 is, email: scitrekelementary@chem.ucsb.edu. SciTrek Leads: Verify the teacher knows when Day 3.5 will occur.
4. Get a small bottle to show students during the procedure discussion/procedure.

SciTrek Volunteers:

1. Pass out notebooks/nametags.

Note: Pass out notebooks to students. If needed, students will move to their subgroups after the procedure activity.

Introduction:
(3 minutes – Full Class – SciTrek Lead)

If students are not in their subgroups, tell them, “You will move to your subgroups after the procedure activity.”

Ask the class, “What is the class question we are investigating?” Students should reply, “What variables affect the color of the solution?” Tell them, “Today, you are going to get to write procedures for your experiments.” Ask students, “What is a procedure?” Students should reply, “A set of steps to conduct an experiment.”

Procedure Activity:
(15 minutes – Full Class – SciTrek Lead)

Tell students, “We are now going to look at a complete procedure for the experimental set-up that we were working with last session.” Show students the experimental set-up and review the question, changing variable, and controls (notebook, page 8; or picture packet, page 5). Tell students, “Last session, we looked at individual steps to see if they could be correct for the given question and experimental set-up, today we are going to correct a possible complete procedure for the same experiment.” Have students turn to page 9 in their notebooks while you do the same in the class notebook. Read each step of the procedure and have students tell you what you should underline/circle/box (controls/changing variable/data collection) for each step (shown below). Ask students, “What should you include in a procedure?” Students may answer with any of the following listed in bold below. Cover each of them in the order they are brought up, not the listed order, but make sure to cover all of them by the end of the conversation.

A complete procedure must have all values of the controls and the changing variable.

Ask students, “Are all control values listed in the procedure?” Go through the list of controls and put a check by them on the experimental set-up as students identify them in the procedure. Students should notice one of the controls, *ball mass*, is not included. Ask students, “What step should the ball mass be included in?” They should reply, “Step 1.” Have students use a caret to write in 623 g before *rubber balls* in step 1 so that it reads: *Get four 623 g rubber balls with circumferences of 88 cm.*

A complete procedure must have the data that will be collected (measurements/observations).

Ask students, “Is the data that will be collected listed in the procedure and if so, in what step?” Students should reply, “Yes, the data that will be collected is listed in step 6.” Students should notice that all of the information needed in step 6 is present, and that this aspect of the procedure is complete.

A complete procedure must have the steps listed in the order that they will be completed.

Ask students, “Are the steps listed in the correct order?” Go through the procedural steps once more and the students should notice that steps 3 and 4 are listed in an incorrect order. Draw a double-headed arrow to indicate that steps 3 and 4 should be switched with one another.

A complete procedure must never have extra or irrelevant information.

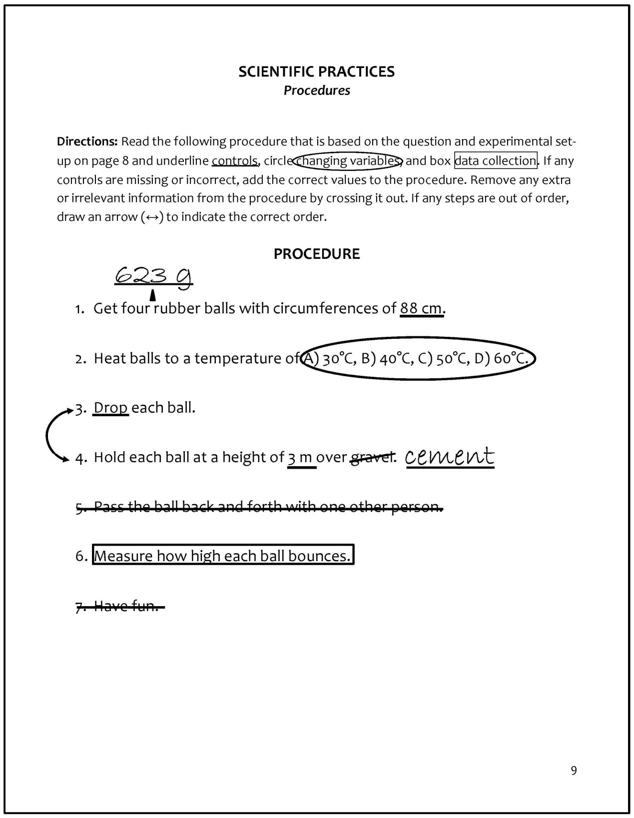
Ask students, “Is there any extra or irrelevant information about the experiment in this procedure?” Students should notice that *passing the ball back and forth with one other person* (step 5) does not help the scientist answer their original question, so this step is irrelevant. Have students cross out this step.

A complete procedure must never have opinions about the experiment.

Ask students, “Are there any opinions in the procedure?” Students should notice that step 7, *Have fun*, is an opinion. Students should say that not every scientist who performs this experiment will think that bouncing different temperature rubber balls is fun, therefore, this is an opinion. Because opinions cannot be tested, this step is incorrect. Have students cross out this step.

A complete procedure must never have incorrect values of the controls or the changing variable.

Ask students, “Are all control and changing variable values correct in the procedure?” Go through the list of controls and confirm that all but one of the controls is correct. Students should identify that the ground type listed in step 4 is incorrect. Have students cross out *gravel* and write “cement.”



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

623 g

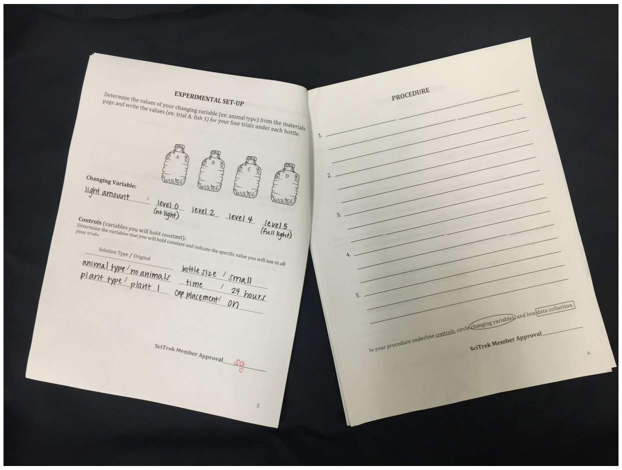
1. Get four rubber balls with circumferences of 88 cm.
2. Heat balls to a temperature of A) 30°C, B) 40°C, C) 50°C, D) 60°C.
3. Drop each ball.
4. Hold each ball at a height of 3 m over ~~gravel~~. cement
5. ~~Pass the ball back and forth with one other person.~~
6. Measure how high each ball bounces.
7. ~~Have fun.~~

9

Procedure Discussion/Procedure:

(35 minutes – Full Class/Subgroups – SciTrek Lead/SciTrek Volunteers)

Tell students, “In order to give you an example of how to write a procedure for your experiments, we will write a procedure together for the class experiment. It is helpful to be able to see both your procedure and your experimental set-up at the same time.” Have students open their notebooks as shown in the picture below so that they can see both page 5 and 6. Place the class notebook under the document camera open to page 9. Ask students, “What is the class research question?” Students should reply, “If we change the animal type, what will happen to the color of the solution? Ask students, “What must a complete procedure have?” Make sure students come up with the following three items: 1) all values of the controls and changing variable, 2) the data that will be collected, and 3) the steps listed in the order they will be completed.



EXPERIMENTAL SET-UP

Determine the values of your changing variable (ex: animal type) from the materials page and write the values (ex: trial A: fish 1) for your four trials under each bottle.

Changing Variable:
light amount : level 0 (no light) level 2 level 4 level 5 (full light)

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
animal type / no animals
plant type / plant 1
bottle size / small
time / 24 hours
cap placement / on

SciTrek Member Approval sg

5

PROCEDURE

1.

2.

3.

4.

5.

In your procedure underline controls, circle changing variables, and box data collection.

SciTrek Member Approval

6

Go over the experimental set-up (notebook, page 5) from Day 2 for the class experiment. Tell students, “I will write down a step of the procedure for the class experiment, then you will write a step for your experiments. Remember, you should **not** copy the class procedure into your notebooks.”

Inform students, “Your requested bottles will already be labeled and contain solution when you get them.” Show them a small bottle of blue solution. Ask them, “Knowing this, what should the first step of the procedure be about?” Lead them to understand that it should be about getting the bottles. Then, turn to the experimental set-up (notebook, page 5) and ask them, “Which controls or changing variable should be included in the first step?” Put a small horizontal line next to each one they suggest (*solution type* and *bottle size*). Ask students, “Can someone put these variable values into a complete sentence for me?” Possible student response: get 4 small bottles with original solution. Write the step in the class notebook, then ask students, “What should we underline, circle, or box in this step?” Then underline/circle/box the correct information. (Get 4 small bottles with original solution.) Tell students, “In your subgroups you will now write the first steps of your procedures, focusing only on bottle size and solution type as well as underline, circle, and box the correct information. Remember, if your changing variable was bottle size, you will need to include all of the bottle sizes in your first step.” Read the example step on page *6* of the notebook to give students an example of how to do this. Give students a few minutes to work in their subgroups to finish step one. While subgroups are working, their volunteers should help them. If needed, subgroups can dictate the step to volunteers, and they can write it on the paper notepad found in their box and give it to them to copy into their notebooks. If a volunteer is working with multiple subgroups, they should help the subgroup with a changing variable, in the current step, first.

Once students have written their first step, ask them, “What should the second step in the procedure be about?” Lead them to understand that it should be about filling the bottles with the needed materials. Then, turn to the experimental set-up (notebook, page 5). Turn the horizontal lines, next to the variables used in step 1, into plus signs by drawing a vertical line through them. Tell students, “This indicates these variables have already been used in the procedure.” Ask students, “Which controls or changing variable should be included in the second step?” Put a small horizontal line next to each one they suggest (*animal type*, *plant type*, and *cap placement*). Ask students, “Can someone put these variable values into a complete sentence for me?” Possible student response: put A) fish, B) frog, C) shrimp, and D) snail and no plants in bottles and put the cap on. Write the step in the class notebook, then ask students, “What should we underline, circle, or box in this step?” Then underline/circle/box the correct information. (Put A) fish, B) frog, C) shrimp, and D) snail and no plants in bottles and put the cap on.) Tell students, “In your subgroups you will now write the second steps for your procedures, focusing only on animal type, plant type, and cap placement as well as underline, circle, and box the correct information.”

Once students have written their second step, ask them, “What should the third step in the procedure be about?” Lead them to understand that it should be about putting the bottles under the correct light.

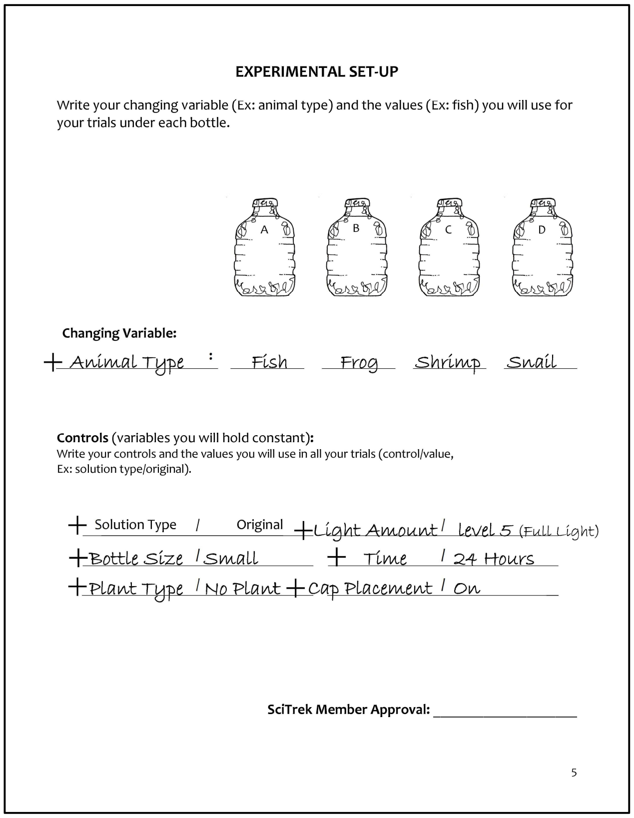
Then, turn to the experimental set-up (notebook, page 5). Turn the horizontal lines next to the variables used in step *2* into plus signs. Ask students, “Which controls or changing variable should be included in the third step?” Put a small horizontal line next to each one they suggest (*light amount*). Ask students, “Can someone put this variable value into a complete sentence for me?” Possible student response: put bottles under level 5 (full) light. Write the step in the class notebook, then ask students, “What should we underline, circle, or box in this step?” Then underline/circle/box the correct information. (Put bottles under level 5 (full) light.) Tell students, “In your subgroups you will now write the third steps for your procedures, focusing only on light amount as well as underline, circle, and box the correct information.”

Once students have written their third step, ask them, “What should the fourth step in the procedure be about?” Lead them to understand that it should be about letting the bottles sit. Then, turn to the experimental set-up (notebook, page *5*). Turn the horizontal lines next to the variables used in step 3 into plus signs. Ask students, “Which controls or changing variable should be included in the fourth step?” Put a small horizontal line next to each one they suggest (*time*). Ask students, “Can someone put this variable value into a complete sentence for me?” Possible student response: wait for 24 hours. Write the step in the class notebook, then ask students, “What should we underline, circle, or box in this step?” Then underline/circle/box the correct information. (Wait for 24 hours.) Ask students, “Will all subgroups be waiting for 24 hours?” Students will reply, “Yes.” Tell them, “Since we are all doing the same thing, for this step, we can all copy this exactly as it is into our notebooks.” Give students a couple minutes to write this in their notebook and underline/circle/box the correct information.

Once students have written their fourth step, ask them, “What should the fifth step in the procedure be about?” Lead them to understand that it should be about data collection. Ask students, “Can someone tell me, in a complete sentence, what we will record at the end of the experiment?” Possible student response: observe and record the color of the solution. Write the step in the class notebook, then ask students, “What should we underline, circle, or box in this step?” (Observe and record the color of the solution.) Then underline/circle/box the correct information. Ask students,” Will all subgroups observe the color of the solution?” Students will reply, “Yes.” Tell them, “Since we are all doing the same thing, for this step, we can all copy this exactly as it is into our notebooks.” Give students a couple minutes to write this in their notebook and underline/circle/box the correct information.

Flip back to page 5 in the notebook. Turn the horizontal line next to the variable used in step 4 into a plus sign and ask students, “Do we have all the variable values in our procedure?” Students should reply, “Yes.” This indicates that the procedure is completed.

Below is what the class experimental set-up should look like with plus signs next to all controls and changing variable values, to indicate they have been included in the procedure. In addition, there is an example of a subgroup’s procedure.



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:

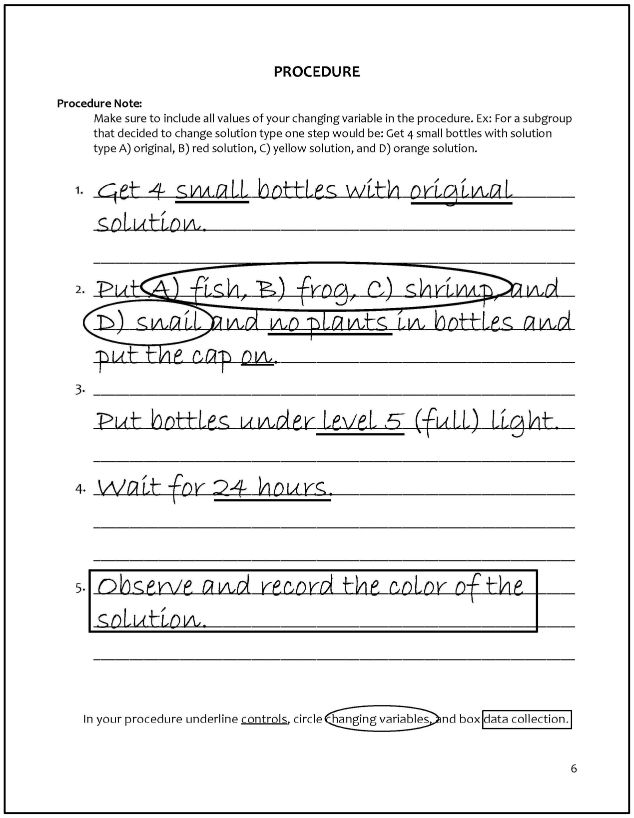
+ Animal Type : Fish Frog Shrimp Snail

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 + Light Amount / level 5 (Full Light)
+ Bottle Size / Small + Time / 24 Hours
+ Plant Type / No Plant + Cap Placement / On

SciTrek Member Approval: ____________________

5



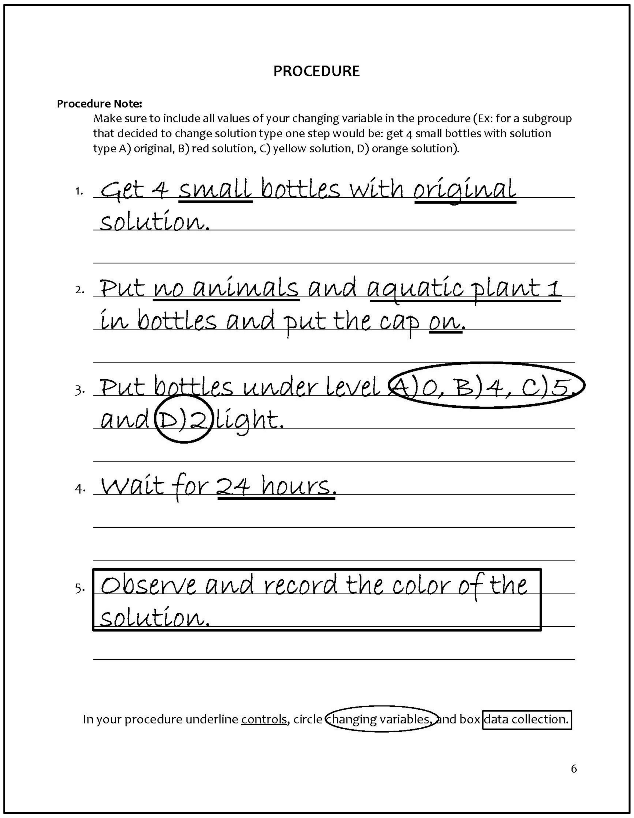
PROCEDURE

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. Get 4 small bottles with original solution.
2. Put A) fish, B) frog, C) shrimp, and D) snail and no plants in bottles and put the cap on.
3. Put bottles under level 5 (full) light.
4. Wait for 24 hours.
5. Observe and record the color of the solution.

In your procedure underline controls, circle changing variables, and box data collection.

6



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, D) orange solution).

1. Get 4 small bottles with original solution.
2. Put no animals and aquatic plant 1 in bottles and put the cap on.
3. Put bottles under level A)0, B)4, C)5, and D)2 light.
4. Wait for 24 hours.
5. Observe and record the color of the solution.

In your procedure underline controls, circle changing variables, and box data collection.

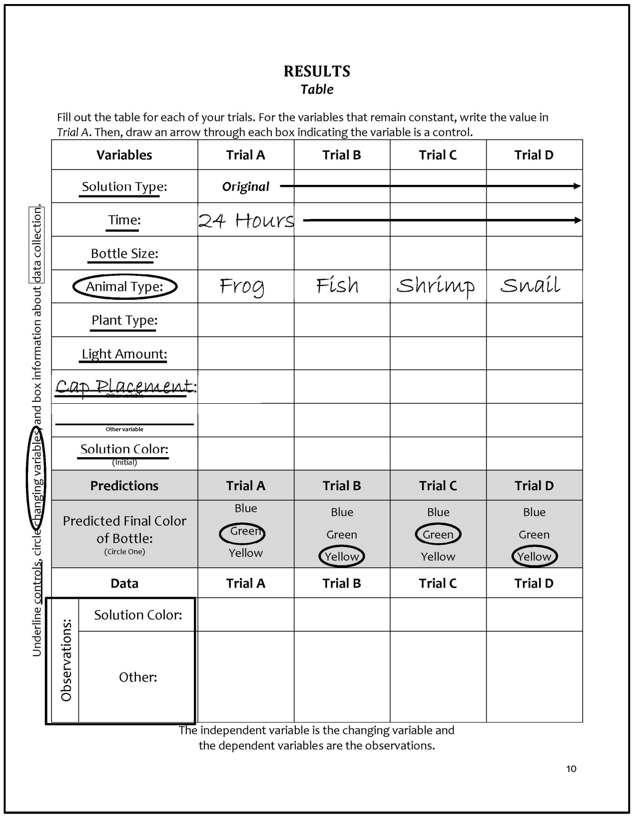
6

Tell students, "Now that we have our procedure done, we need to fill out our results table." Put the results table (notebook, page 10) under the document camera. Go through the variables and the data and have students tell you, for the class experiment, if they are controls, changing variables, or data collection and underline, circle, or box them. Tell students "For controls, we will just write the value in the trial A box and then draw an arrow through the remaining trials' boxes. For the changing variable, you will write the value in each box." Record an example control value and changing variable values on the results table with the students, see example below (left). Tell students, “Once you have filled out the results table, you will make predictions about what color the solution will be after 24 hours.” Have the class predict the color of the solution in the bottles after 24 hours for the class experiment by voting. Then record the answer that gets the most votes. After, allow a few students to share their reasoning for their prediction. While students are filling out their results table, fill in the rest of the results table for the class experiment.

Results Table:
(5 minutes – Subgroups – SciTrek Volunteers)

Have students underline the variables that are controls, circle the variable that is their changing variable, and box information about data collection. When writing the values make sure for controls, they only write the value of the control in the *Trial A* box, then, draw an arrow through the remaining trials’ boxes. For the changing variable, they should write the values in each trial’s corresponding box.

When students have finished, have them make predictions about what the color of the solution will be after 24 hours by circling the predicted color. It is okay if the students in a subgroup have different predictions. An example filled-out results table is shown below (right).



RESULTS
Table

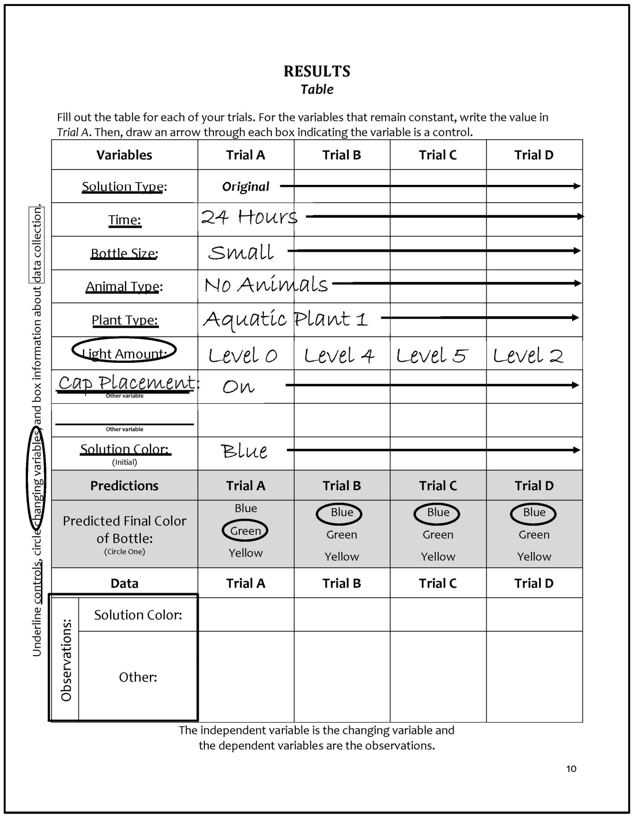
Fill out the table for each of your trials. For the variables that remain constant, write the value in *Trial A*. Then, draw an arrow through each box indicating the variable is a control.

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

Variables	Trial A	Trial B	Trial C	Trial D
Solution Type:	***Original***	→	→	→
Time:	24 Hours	→	→	→
Bottle Size:				
Animal Type:	Frog	Fish	Shrimp	Snail
Plant Type:				
Light Amount:				
~~Cap Placement~~: 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:				

The independent variable is the changing variable and the dependent variables are the observations.

10



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
Solution Type:	***Original***	→	→	→
Time:	24 Hours	→	→	→
Bottle Size:	Small	→	→	→
Animal Type:	No Animals	→	→	→
Plant Type:	Aquatic Plant 1	→	→	→
Light Amount:	Level 0	Level 4	Level 5	Level 2
Cap Placement: Other variable	On	→	→	→
Other variable				
Solution Color: (Initial)	Blue	→	→	→
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:				

The independent variable is the changing variable and the dependent variables are the observations.

10

Wrap-Up:
(2 minutes – Full Class – SciTrek Lead)

Tell students, “24 hours before the next session, you will start your experiments, without your volunteers. When SciTrek comes back, you will be recording the color of the solution and any observations about the bottles.”

Clean-Up:

1. Collect nametags and put in boxes.
2. **Collect notebooks and give to the teacher for setting up the experiments on Day 3.5.**
3. Leave the lamps, Xerox boxes, and bottles in the classroom.
4. Place all other materials into your group box and bring them back to UCSB.

Lead Note: Give the class notebook and picture packet to the teacher for setting up experiments on Day 3.5.

Day 3.5: Experiment

*Day 3.5 must be completed approximately 24 hours before Day 4. A SciTrek staff member will bring in all the plants/animals for the experiments on this day and student's help fill their bottles.

Schedule:

Experiment (SciTrek Staff Member/Classroom Teacher) – 15 minutes

Materials Already in Classroom:

☐ (28) Labeled bottles (with group color, number, and trial letter) including class experiment bottles divided in two buckets
☐ (7) Extra Bottles (1XL, 1L, 1M, 4S)
☐ (2) Extension cords
☐ (6) Lamps with 60 W equivalent LED bulbs
☐ (4) Boxes with filters with light levels labeled
☐ Box with no holes labeled "level 0"
☐ Notebooks
☐ Class notebook
☐ Respiration picture packet
☐ Day 3.5 instructions

Materials:

☐ Day 3.5 instructions
☐ (2) Sharpies
☐ Masking tape
☐ (3) White rags
☐ Tupperware with requested aquatic plant 1 (plus 4)
☐ Tupperware with requested aquatic plant 2 (plus 4)
☐ Tupperware with requested aquatic plant 3 (plus 4)
☐ Tupperware with requested aquatic plant 4 (plus 2)
☐ Bag with requested tree leaf 1 (plus 2)
☐ Bag with requested tree leaf 2 (plus 2)
☐ Bag with requested flower 1 (plus 2)
☐ Bag with requested flower 2 (plus 2)
☐ Tupperware with requested snails (plus 4)
☐ Tupperware with lead animals (2 snails, 2 fish, 2 frogs, 2 shrimp)
☐ (35) Caps with holes

Preparation:

1. Verify the variable section of the class results table is completely filled in.
2. Set up the light level boxes (levels 0-4) in ascending order with the light turned on sitting on top of the boxes with the front lids removed (see picture right). Set-up two additional lamps for level 5 lighting (this will not be in a box). Do not plug extension cords into other extension cords.
3. Set out the bottle, organized by subgroup, in an area that is easy for students to access.

4. Have the plant and animal Tupperwares ready to pass out plants and animals to students.
5. Have notebooks in stacks by subgroups. Students will not need these until they fill their bottles.

Experiment:
(15 minutes – Full Class – SciTrek Staff Member/Classroom Teacher)

Tell students, "Today you are going to start your experiment." Place the class procedure under the document camera (notebook, page 6). "We will first set up the class experiment together, then you will be called by subgroup to start your experiments."

Read step 1 of the class procedure, "Get 4 small bottles with original solution." Show students the bottles for the class experiment.

Read step 2 of the class procedure, "Put no plants and A) fish, B) frog, C) shrimp, and D) snail in the bottle and put the cap on." Put the animals in each bottle, then put the caps with holes on the bottles. Tell students, "When you start your experiment, you will all get to look at the animal bottles up close."

Read step 3 of the class procedure "Place the bottle under level 5 (full) light." Show students where the light level boxes are and put the class bottles under the appropriate light.

Read steps 4 and 5, "Wait 24 hours. Observe and record the color of the solution." Tell students, "Your volunteers will be back tomorrow to help you record your data."

The teacher can give the class something to work on while each subgroup is called one by one to fill and place their bottles under the appropriate light. Have students read and follow the steps of their procedure.

Once a subgroup is done, call the next subgroup to start their experiment.

Collect notebooks from students.

Leave bottle caps with no holes and bucket in the classroom for Day 4.

Day 4: Experiment/Results Summary/Poster Making

Schedule:

Introduction (SciTrek Lead) – 7 minutes
Experiment (SciTrek Volunteers) – 5 minutes
Results Summary (SciTrek Volunteers) – 10 minutes
Poster Making (SciTrek Volunteers) – 33 minutes
Wrap-Up (SciTrek Lead) – 5 minutes

Materials:

(3) Volunteer Boxes:

- ☐ Nametags
- ☐ Volunteer instructions
- ☐ Volunteer lab coat
- ☐ Poster diagram
- ☐ (2) Sticker sets on how to present results (changing conditions/changing contents)
- ☐ (2) Pencils
- ☐ Paper notepad
- ☐ (Bag) Paperclips
- ☐ Highlighter
- ☐ Scissors
- ☐ (2) Glues
- ☐ (2) Poster parts packs (scientists' names, question, experimental set-up, procedure, results table, results summary, (6) *I acted like a scientist when*, (6) picture spaces)

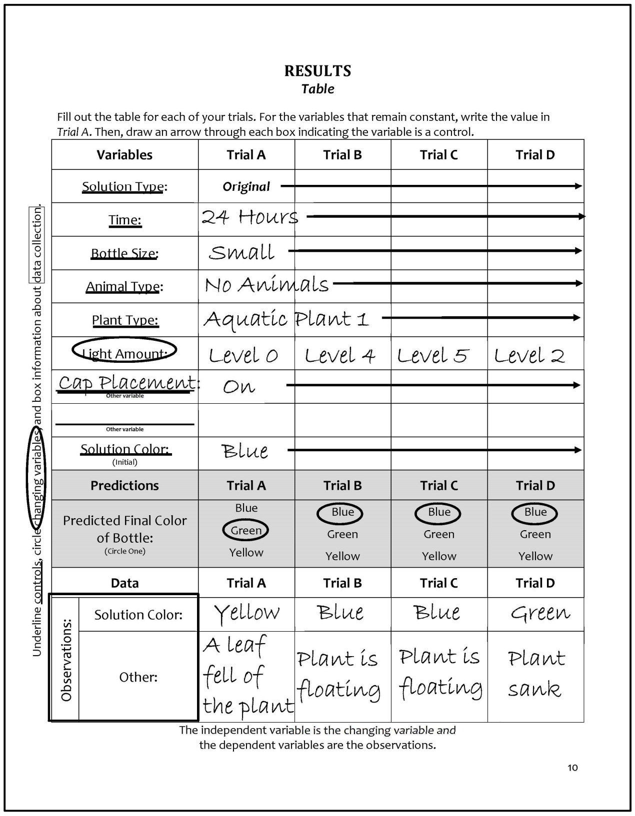
Other Supplies:

- ☐ Poster paper tube

Lead Box:

- ☐ (3) Extra notebooks
- ☐ Lead instructions
- ☐ Respiration picture packet
- ☐ Lead lab coat
- ☐ Poster diagram
- ☐ Time card
- ☐ (2) Sticker sets on how to present results (changing conditions/changing contents)
- ☐ (2) Pencils
- ☐ (2) Wet erase markers
- ☐ (2) Black pens
- ☐ Paper notepad
- ☐ (Bag) Paperclips
- ☐ (2) Highlighters
- ☐ (2) Scissors
- ☐ (2) Glues
- ☐ Scotch tape
- ☐ (2 each color) Poster part packs
- ☐ (28) Caps with no holes

Notebook Pages:



RESULTS

Table

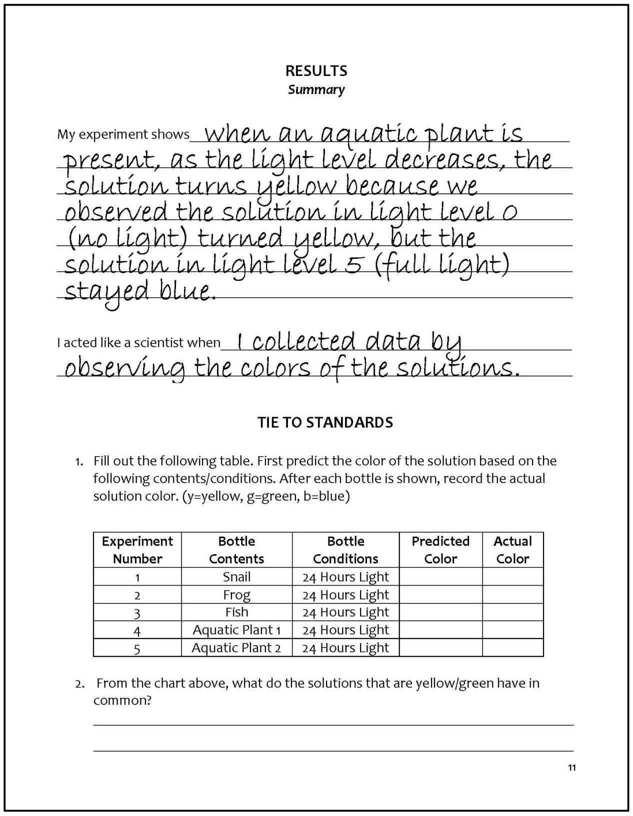
Fill out the table for each of your trials. For the variables that remain constant, write the value in *Trial A*. Then, draw an arrow through each box indicating the variable is a control.

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

Variables	Trial A	Trial B	Trial C	Trial D
Solution Type:	*Original*	→	→	→
Time:	24 Hours	→	→	→
Bottle Size:	Small	→	→	→
Animal Type:	No Animals	→	→	→
Plant Type:	Aquatic Plant 1	→	→	→
Light Amount:	Level 0	Level 4	Level 5	Level 2
Cap Placement: Other variable	On	→	→	→
Other variable				
Solution Color: (Initial)	Blue	→	→	→
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:	Yellow	Blue	Blue	Green
Observations: Other:	A leaf fell of the plant	Plant is floating	Plant is floating	Plant sank

The independent variable is the changing *variable and* the dependent variables are the observations.

10



RESULTS

Summary

My experiment shows when an aquatic plant is present, as the light level decreases, the solution turns yellow because we observed the solution in light level 0 (no light) turned yellow, but the solution in light level 5 (full light) stayed blue.

I acted like a scientist when I collected data by observing the colors of the solutions.

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?

11

Preparation:

SciTrek Lead:

1. Get students' notebooks and give them to the volunteers to separate into their subgroups, attach nametags, and set out.
2. Make sure volunteers get bottles for their subgroups and replace the caps with holes with caps without holes.
3. Find a place to leave student posters.
4. Set up the document camera for the results table (notebook, page 10) and results summary (notebook, page 11).

SciTrek Volunteers:

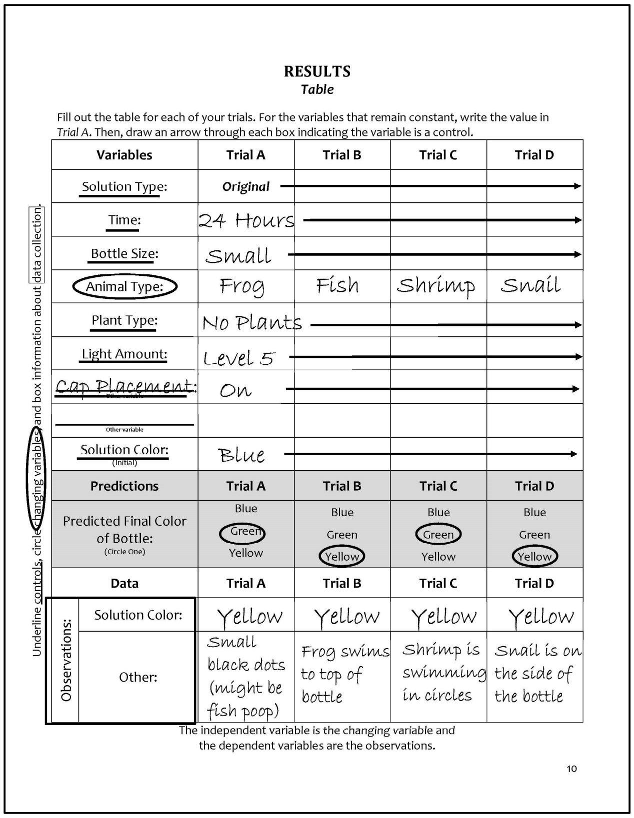
1. Get notebooks from the lead, separate them into subgroups, and attach nametags.
2. Set out notebooks/nametags.
3. Get bottles for your subgroups. Replace caps with holes with caps without holes.

Note: Set notebooks where students will sit during the module, even if another student is currently at that desk. If needed, students will move to these spots after the Introduction.

Introduction:
(7 minutes – Full Class – SciTrek Lead)

If students are not in their subgroups tell them, "A notebook will be put on your desk, which is not your notebook and you should not move it. You will move to your notebooks after the Introduction."

Ask the class, "What is the class question we have been investigating?" Students should reply, "What variables affect the color of the solution?" Tell students, "Today, you are going to record your data and analyze the results from your experiments which will allow you to start answering the class question. Before you record your data, as a class we will record the data from the class experiment." Show students the four bottles from the class experiment and record the colors of the solutions, as well as any additional observations. An example of the class results can be seen below on the left.



RESULTS

Table

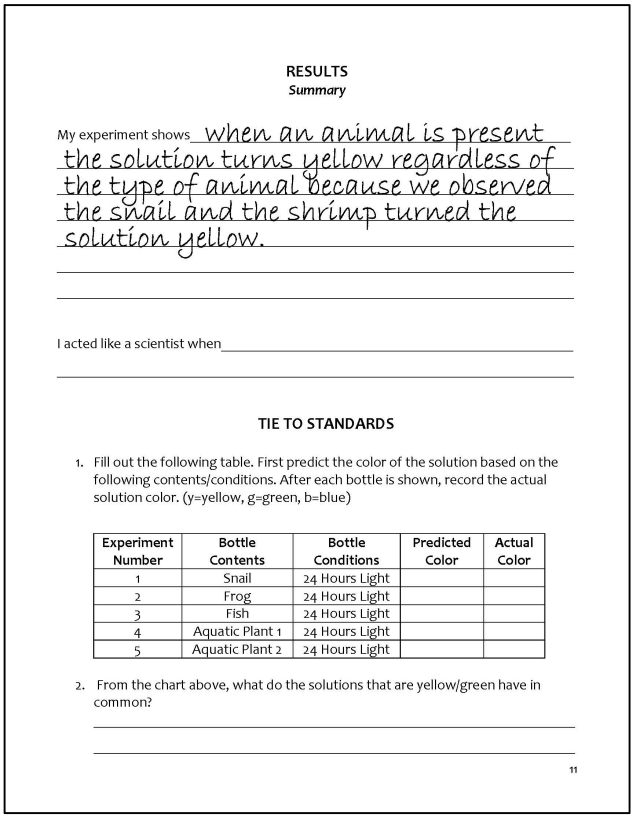
Fill out the table for each of your trials. For the variables that remain constant, write the value in *Trial A*. Then, draw an arrow through each box indicating the variable is a control.

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

Variables	Trial A	Trial B	Trial C	Trial D
Solution Type:	***Original***	→	→	→
Time:	24 Hours	→	→	→
Bottle Size:	Small	→	→	→
Animal Type:	Frog	Fish	Shrimp	Snail
Plant Type:	No Plants	→	→	→
Light Amount:	Level 5	→	→	→
Cap Placement:	On	→	→	→
Other variable				
Solution Color: (Initial)	Blue	→	→	→
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:	Yellow	Yellow	Yellow	Yellow
Observations: Other:	Small black dots (might be fish poop)	Frog swims to top of bottle	Shrimp is swimming in circles	Snail is on the side of the bottle

The independent variable is the changing variable and the dependent variables are the observations.

10



RESULTS

Summary

My experiment shows when an animal is present the solution turns yellow regardless of the type of animal because we observed the snail and the shrimp turned the solution yellow.

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?

11

Tell students, “We will now analyze the class data together.” Put the filled-out results table from the class experiment under the document camera (notebook, page 10). Have students compare the actual and predicted colors to see if they match. Tell students, “We will now work together to try to determine any patterns that cause the solutions to change colors.”

Ask students, “What patterns do you see in the data?” Possible student response: all the solutions which had animals turned yellow. Ask students, “Can we test if all animals will turn the solution yellow?” Students should reply, “Yes.” Tell students, “If a statement is testable, then it is a claim and claims are the first part of results summaries.” Write “when an animal is present the solution turns yellow regardless of the animal type” in the class notebook.

Note: If you would like to push student thinking further you can have them make a claim about why they think the solution is turning color. Such as these example claims:

- My experiment shows that when animals go to the bathroom the solution turns yellow
- My experiment shows that when animals breathe the solution turns yellow

Tell students, “Now we need to use data to support the claim. There are two forms of data: observations and measurements.” Ask students, “What type of data will we use to support our claim?” Students should reply, “Observations.” Tell students, “In order for everyone to know that we carried out the experiment, we will start the data statement with we observed.” Lead students to select the two most convincing data points to support their claim, in this case usually the largest and smallest animals. Then have students determine the data statement and write it in the class notebook. An example of an appropriate data statement is: because we observed the snail and the shrimp turned the solution yellow.

Tell students, “Result summaries are strongest when they allow us to make predictions.” Ask students, “Based on our results summary, can you predict something else that would turn the solution yellow?” Possible student response: worm.

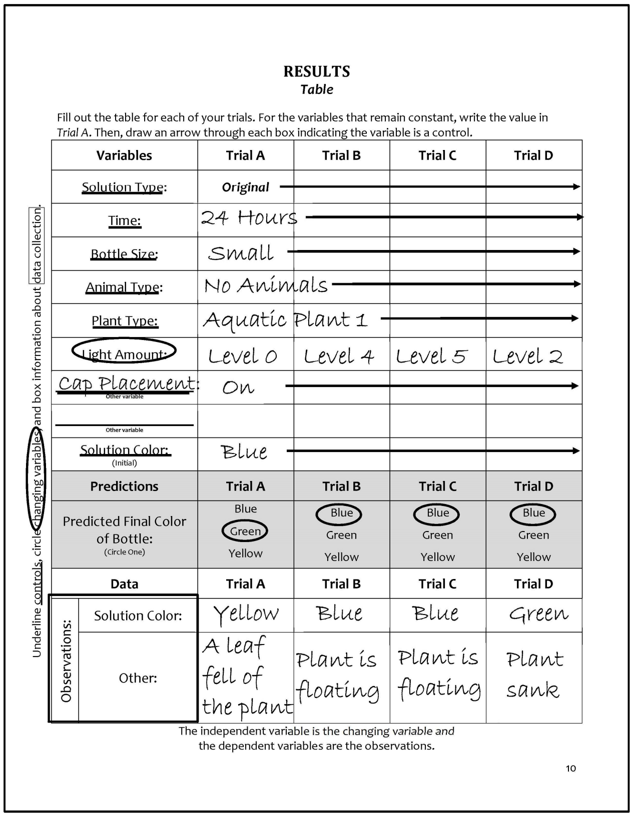
Tell students, “After you summarize your experimental findings, you will fill in the sentence frame *I acted like a scientist when*, stating how you acted like a scientist during your SciTrek experience. Try to come up with a unique answer that is something besides ‘I did an experiment.’”

Tell students, “When scientists complete their experiments, they make posters to present their findings to other scientists. Each subgroup will create a poster to present to the class during the next session. This presentation will be your chance to tell the class what your subgroup has discovered about the class question. You should write as neatly as possible on the poster parts, so the other class members can read your posters. You will now start working with your subgroup to analyze your experimental results and make a poster.”

Experiment

(5 minutes – Subgroups – SciTrek Volunteers)

Have students observe their experiment bottles and record their results. All members of a subgroup should agree on the colors they record. If students are having difficulty, place a white sheet of paper (or your lab coat) behind the bottles to allow students to see the color better. An example of a student’s results table can be seen below, left.



RESULTS
Table

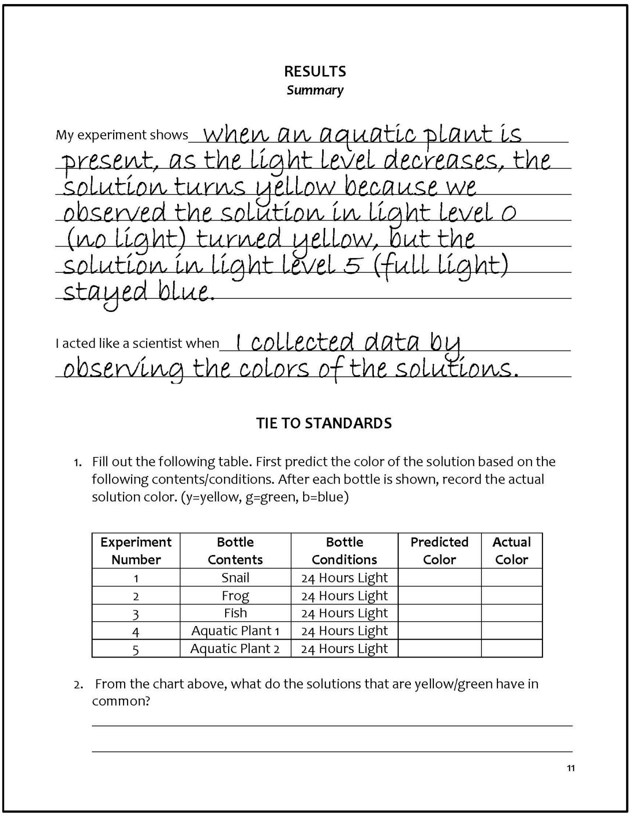
Fill out the table for each of your trials. For the variables that remain constant, write the value in *Trial A*. Then, draw an arrow through each box indicating the variable is a control.

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

Variables	Trial A	Trial B	Trial C	Trial D
Solution Type:	*Original*	→	→	→
Time:	24 Hours	→	→	→
Bottle Size:	Small	→	→	→
Animal Type:	No Animals	→	→	→
Plant Type:	Aquatic Plant 1	→	→	→
[✓ Light Amount:]	Level 0	Level 4	Level 5	Level 2
Cap Placement: Other variable	On	→	→	→
Other variable				
Solution Color: (Initial)	Blue	→	→	→
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:	Yellow	Blue	Blue	Green
Observations: Other:	A leaf fell of the plant	Plant is floating	Plant is floating	Plant sank

The independent variable is the changing *variable and* the dependent variables are the observations.

10



RESULTS
Summary

My experiment shows when an aquatic plant is present, as the light level decreases, the solution turns yellow because we observed the solution in light level 0 (no light) turned yellow, but the solution in light level 5 (full light) stayed blue.

I acted like a scientist when I collected data by observing the colors of the solutions.

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?

11

Results Summary:

(10 minutes – Subgroups – SciTrek Volunteers)

Have subgroups summarize their findings. Challenge subgroups to think about how their changing variable did or did not affect the solution color.

When writing their results summary (notebook, page 11), make sure subgroups begin the statement with a claim (statement that can be tested) about the trend or pattern in their data. If possible, try to have students generate a claim that allows them to make predictions about something that they have not tested. An appropriate claim could be: when an aquatic plant is present, as the light level decreases the solution turns yellow. This is an appropriate claim because it allows the students to make a prediction about what would happen if new values of their changing variable were introduced.

After generating a claim about their experiment, subgroups will write the word “because,” and follow it with supporting data. Their supporting data should include at least two pieces of data, typically the colors that are the most different from each other. Make sure subgroups are using their changing variable values (not trial letters) and specific colors to support their claim. Since the data is in the form of observations, all data statements should include the words “we observed.” The supporting data for the previously mentioned claim would be: because we observed that the solution in light level 0 (no light) turned yellow, but the solution in light level 5 (full light) stayed blue.

Results summaries are still valid, and important, if they show the changing variable tested does not have an effect on the color of the solution. Even if their results summary is contrary to what you think, have subgroups make a claim based solely on their data. An example filled out results summary is shown below.

Once students are done with their results summary, take away their experimental bottles and put them in the bucket.

Once students have filled out their results summary, have them fill in the sentence frame *I acted like a scientist when* (notebook, page 11). Each student’s response should be unique and specific. They should **not** write, “when I did an experiment,” because this is general and applies to all of the students in the class. If students are having trouble with this sentence frame, ask them, “What did you do during SciTrek?”

Poster Making:
(33 minutes – Subgroups – SciTrek Volunteers)

Each subgroup (four/five/six students) will make one poster for their experiment.

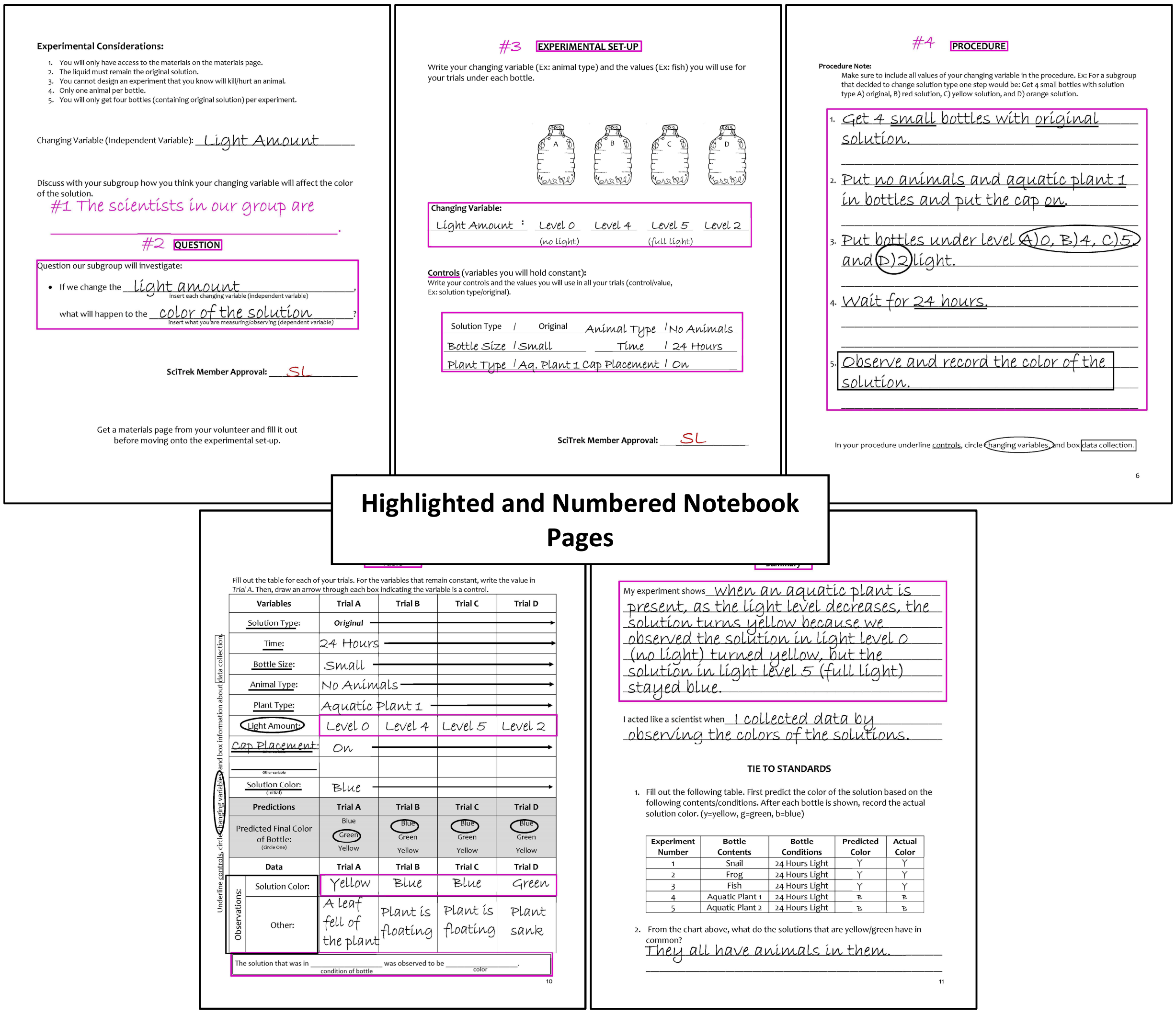
Pass out the writing portions (general poster parts and *I acted like a scientist when*) and have students write their names on them and complete them. In addition, have each student write their name on the scientists’ names poster part. Use the following guidelines when assigning poster parts:

Number of Students in Subgroup	Poster Division Each student gets an *I acted like a scientist when* and picture space.
4	1. Question and Experimental Set-Up 2. Procedure 3. Results Table* 4. Results Summary
5	1. Question 2. Experimental Set-Up 3. Procedure 4. Results Table* 5. Results Summary
6	1. Question 2. Experimental Set-Up 3. 1st Half of Procedure 4. 2nd Half of Procedure 5. Results Table* 6. Results Summary Procedure can be cut in half.

***Give the results table to the student who is most confident in presenting.**

Once students have finished their written section(s), have them draw a picture of their experiment or how they acted like a scientist.

In the students' notebooks, **highlight and number the section(s) that they will present**. The parts should be numbered as follows: 1) scientists' names, 2) question, 3) experimental set-up, 4) procedure, 5) results table, and 6) results summary (see example below). Students will **not** present *I acted like a scientist when* parts from their poster. If a student is presenting multiple sections, use the paperclips in your group box to clip together the sections they are reading, so when presenting it will be easy for them to flip back and forth between the pages.



Highlighted and Numbered Notebook Pages

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): Light Amount

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

#1 The scientists in our group are ______.

#2 QUESTION

Question our subgroup will investigate:

- If we change the light amount (insert each changing variable (independent variable)),
  what will happen to the color of the solution (insert what you are measuring/observing (dependent variable))?

SciTrek Member Approval: SL

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

#3 EXPERIMENTAL SET-UP

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

A B C D

Changing Variable:

Light Amount : Level 0 (no light) Level 4 Level 5 (full light) Level 2

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
Animal Type / No Animals
Bottle Size / Small
Time / 24 Hours
Plant Type / Aq. Plant 1
Cap Placement / On

SciTrek Member Approval: SL

#4 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. Get 4 small bottles with original solution.
2. Put no animals and aquatic plant 1 in bottles and put the cap on.
3. Put bottles under level A)0, B)4, C)5, and D)2 light.
4. Wait for 24 hours.
5. Observe and record the color of the solution.

In your procedure underline controls, circle changing variables, and box data collection.

6

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
Solution Type:	*Original*	→	→	→
Time:	24 Hours	→	→	→
Bottle Size:	Small	→	→	→
Animal Type:	No Animals	→	→	→
Plant Type:	Aquatic Plant 1	→	→	→
Light Amount:	Level 0	Level 4	Level 5	Level 2
Cap Placement: (Other variable)	On	→	→	→
____ (Other variable)				
Solution Color: (Initial)	Blue	→	→	→
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:	Yellow	Blue	Blue	Green
Observations: Other:	A leaf fell of the plant	Plant is floating	Plant is floating	Plant sank

The solution that was in ______ (condition of bottle) was observed to be ______ (color).

10

My experiment shows when an aquatic plant is present, as the light level decreases, the solution turns yellow because we observed the solution in light level 0 (no light) turned yellow, but the solution in light level 5 (full light) stayed blue.

I acted like a scientist when I collected data by observing the colors of the solutions.

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	Y	Y
2	Frog	24 Hours Light	Y	Y
3	Fish	24 Hours Light	Y	Y
4	Aquatic Plant 1	24 Hours Light	B	B
5	Aquatic Plant 2	24 Hours Light	B	B

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

11

Place one of the following sentence frame stickers on the notebook page of the student who is presenting the results table (notebook, page 11). If your group is testing bottle size, write "the _____ bottle" in the first blank in the conditions sentence frame.

Changing Bottle Content (plant type):

The solution that contained ____________________ (content of bottle) was observed to be ____________________ (color).

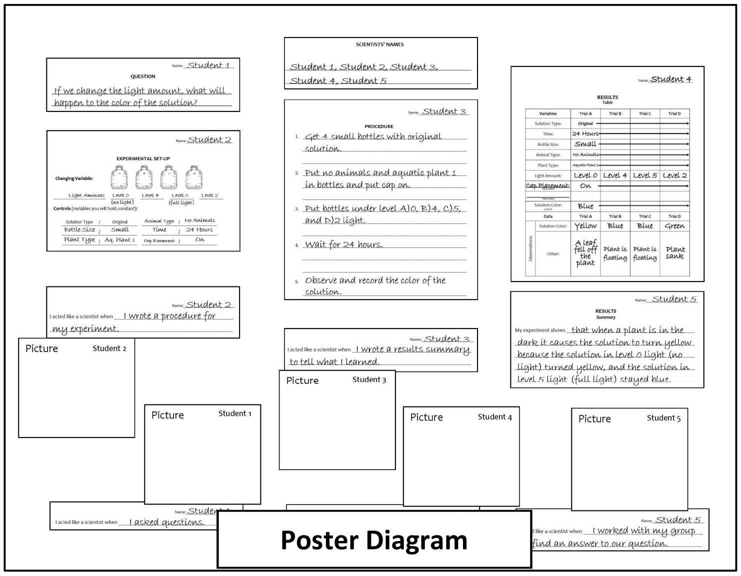
Changing Conditions (light amount or bottle size):

The solution that was in ____________________ was observed to be ____________________.
condition of bottle color

Then, practice reading the four sentences with that student. For the results table above, the first sentence would read: The solution that was in **level 0 light** was observed to be **yellow**. To make this easier for students you can write level __ light on the first blank of the sentence frame if the group's changing variable was light level. An example sentence frame for a group that changed bottle size would read: The solution that was in *the* **small** *bottle* was observed to be **yellow** (words in italics were written-in to sticker)**.**

As soon as students have completed some of their pieces, start gluing them onto the large poster paper, in landscape orientation, exactly as they are arranged in the example below. Do not allow students to glue the poster parts on the posters. Do not wait until students have completed all the pieces to start gluing them onto the posters.

Once the poster is complete, have students start practicing for the presentation. Make sure students read from their notebooks, instead of from the poster.



Poster Diagram

Ask each of your subgroups a few questions about their posters. Have them use their findings to predict what would happen to the color of the solution for other changing variable values they did not perform tests on. For instance, if the subgroup's results summary was, "My experiment shows that when aquatic plants are in the bottles the solution stays blue, because we observed that all of the solutions stayed blue even though they had different types of aquatic plants (aquatic plant 2 and aquatic plant 3) in them," ask the subgroup to predict what the color of a bottle would be if it contained aquatic moss. They should be able to predict that it would be blue.

If there is additional time, tell each subgroup, "Other students will ask you questions during your poster presentations. You should think about what questions you might be asked, and think of the answers to those questions, so you will be prepared during your presentation."

Wrap-Up:

(5 minutes – Full Class – SciTrek Lead)

Ask students the following questions:

How did you act like a scientist during this project?
What did you do, that scientists do?

After discussing how they acted like scientists, and talking about how everyone does things scientists do in their everyday lives, tell students, “Next session, you will present your findings to the class, and I am looking forward to hearing about all of your experiments.”

Clean-Up:

1. Collect notebooks with attached nametags.
2. Leave posters in the classroom.
3. Place all other materials into your group box and bring them back to UCSB.

Day 5: Poster Presentations

Schedule:

Introduction (SciTrek Lead) – 2 minutes
Practice Posters (SciTrek Volunteers) – 10 minutes
Poster Presentations (SciTrek Volunteers/SciTrek Lead) – 46 minutes
Wrap-Up (SciTrek Lead) – 2 minutes

Materials:

(3) Volunteer Boxes:

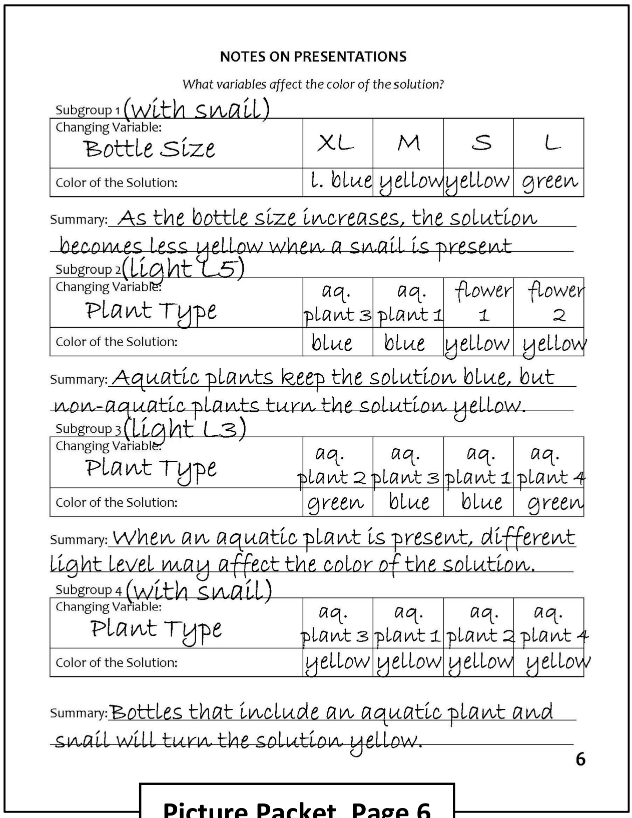
☐ Nametags
☐ Notebooks
☐ Volunteer instructions
☐ Volunteer lab coat
☐ (2) Pencils
☐ (Bag) Paperclips
☐ Highlighter
☐ (12) Sharpened SciTrek pencils (all same color)

Lead Box:

☐ (3) Extra notebooks
☐ Lead instructions
☐ Respiration picture packet
☐ Lead lab coat
☐ Time card
☐ (2) Sticker sets on how to present results (changing conditions/changing contents)
☐ (2) Pencils
☐ (2) Wet erase markers
☐ (2) Black pens
☐ (Bag) Paperclips
☐ (2) Highlighters
☐ Scotch tape

*Student posters should already be in the classroom.

Picture Packet Pages:



NOTES ON PRESENTATIONS

What variables affect the color of the solution?

Subgroup 1 (with snail)

Changing Variable: Bottle Size	XL	M	S	L
Color of the Solution:	l. blue	yellow	yellow	green

Summary: As the bottle size increases, the solution becomes less yellow when a snail is present

Subgroup 2 (light L5)

Changing Variable: Plant Type	aq. plant 3	aq. plant 1	flower 1	flower 2
Color of the Solution:	blue	blue	yellow	yellow

Summary: Aquatic plants keep the solution blue, but non-aquatic plants turn the solution yellow.

Subgroup 3 (light L3)

Changing Variable: Plant Type	aq. plant 2	aq. plant 3	aq. plant 1	aq. plant 4
Color of the Solution:	green	blue	blue	green

Summary: When an aquatic plant is present, different light level may affect the color of the solution.

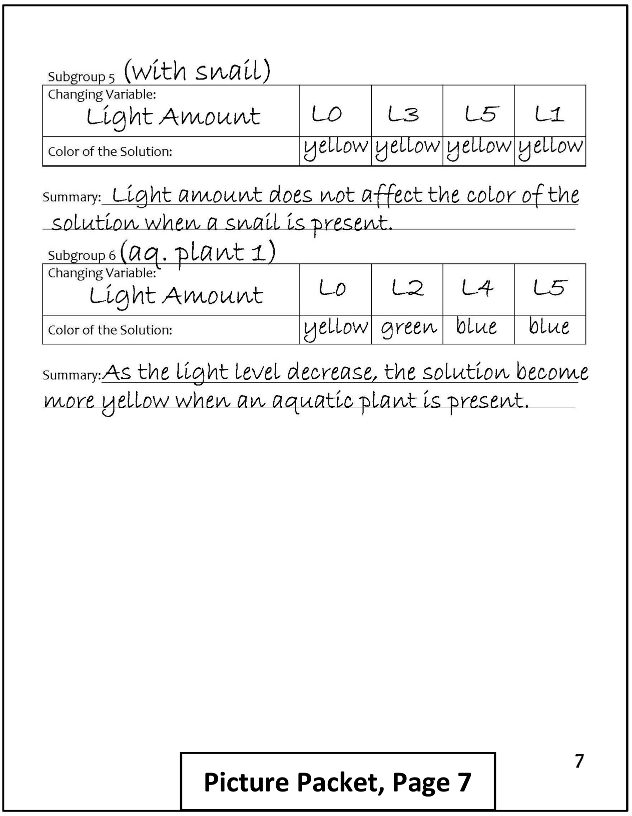
Subgroup 4 (with snail)

Changing Variable: Plant Type	aq. plant 3	aq. plant 1	aq. plant 2	aq. plant 4
Color of the Solution:	yellow	yellow	yellow	yellow

Summary: Bottles that include an aquatic plant and snail will turn the solution yellow.

6

Picture Packet, Page 6



Subgroup 5 (with snail)

Changing Variable: Light Amount	L0	L3	L5	L1
Color of the Solution:	yellow	yellow	yellow	yellow

Summary: Light amount does not affect the color of the solution when a snail is present.

Subgroup 6 (aq. plant 1)

Changing Variable: Light Amount	L0	L2	L4	L5
Color of the Solution:	yellow	green	blue	blue

Summary: As the light level decrease, the solution become more yellow when an aquatic plant is present.

7

Picture Packet, Page 7

Preparation:

SciTrek Lead:

1. Make sure volunteers are passing out notebooks.
2. Set up the document camera for the *Notes on Presentations* (picture packet, pages 6 and 7).
3. Organize posters so experiments featuring the same changing variable will be presented back-to-back and posters are presented from simplest to understand, to most difficult to understand [suggested order: bottle size, plant type, light amount (animal), light amount (plant), light amount (animals and plants)].

SciTrek Volunteers:

1. Pass out notebooks/nametags.
2. Have pencils ready to distribute to your group after the poster presentations.

Note: Today, students will sit in their regular classroom seats during poster presentations.

Introduction:

(2 minutes – Full Class – SciTrek Lead)

Tell students, "Today you will present your posters to the class. This is a common practice in science. Scientists go to conferences where they present posters about the experiments they conducted. At these presentations, other scientists give them feedback on their experiments, which allows them to return to the lab with new ideas for future experiments. You will have 10 minutes to practice presenting your poster with your subgroup. When you present, you should read from your notebooks, not your poster. After practicing, you will return to your normal classroom seats."

Practice Posters:

(10 minutes – Subgroups – SciTrek Volunteers)

Have subgroups practice their poster presentation, making sure they are reading the poster parts in the correct order (scientists' names, question, experimental set-up, procedure, results table, and results summary). Make sure each student's part is highlighted in their notebook. If students are reading from multiple pages, use a paperclip to clip these pages together, to make it easier for them to flip back and forth. Remind students to read from their notebooks rather than from their posters.

Do not let poster practice go over 10 minutes.

Poster Presentations:

(46 minutes – Full Class – SciTrek Volunteers/SciTrek Lead)

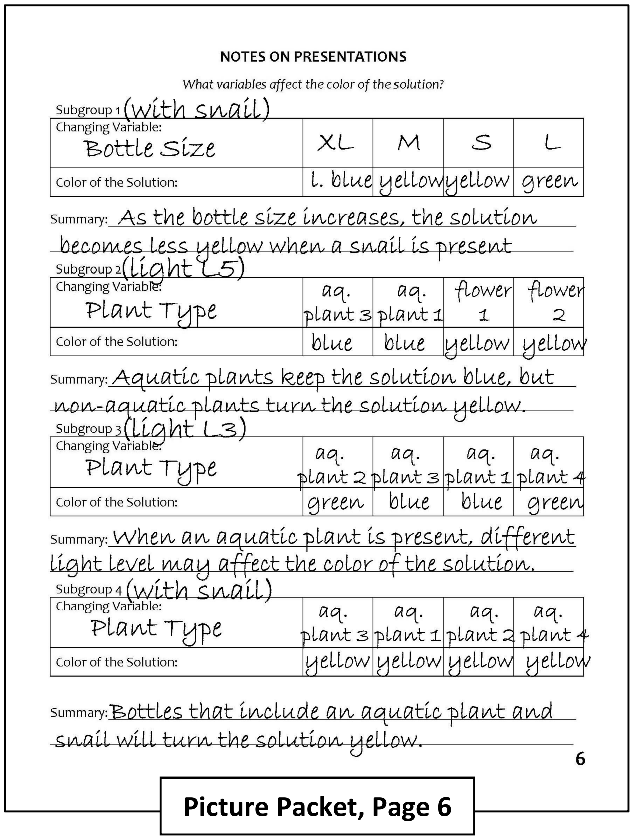
Have students return to their original class seats. Ask the class, "What is the question we have been investigating?" Students should reply, "What variables affect the color of the solution?" Tell students, "During the presentations, I will take notes, but you will have to help me by telling me the changing variable after the subgroup says their question. I will also record the subgroups' changing variable values and the corresponding color of the solution." Turn to page 7 in the picture packet.

Tell students, "You will get the chance to ask scientific questions after each presentation. These questions are important, because you will have to summarize what you learned from the subgroup so I can record it on the *Notes on Presentations*. Therefore, your questions should focus on helping you be able to summarize the subgroup's findings. If you ask a scientific question during the presentation, you will get a SciTrek pencil at the end of the presentations."

Volunteers should make sure students are quiet and respectful when other subgroups are presenting. When one of your subgroups is presenting, go to the front of the room with them; prompt students if they do not know who talks next and remind them to read from their notebooks.

During the student question time, the lead and/or volunteers should ask at least one question. Examples of possible questions are: "How do you know…?" or "Is there anything else you can do to get more information about your question?" Each subgroup should answer approximately five questions (one question per student). When students are done asking questions, have them summarize what the subgroup found.

An example filled out *Notes on Presentations,* are shown below.



NOTES ON PRESENTATIONS

What variables affect the color of the solution?

Subgroup 1 (with snail)

Changing Variable: Bottle Size	XL	M	S	L
Color of the Solution:	l. blue	yellow	yellow	green

Summary: As the bottle size increases, the solution becomes less yellow when a snail is present

Subgroup 2 (light L5)

Changing Variable: Plant Type	aq. plant 3	aq. plant 1	flower 1	flower 2
Color of the Solution:	blue	blue	yellow	yellow

Summary: Aquatic plants keep the solution blue, but non-aquatic plants turn the solution yellow.

Subgroup 3 (light L3)

Changing Variable: Plant Type	aq. plant 2	aq. plant 3	aq. plant 1	aq. plant 4
Color of the Solution:	green	blue	blue	green

Summary: When an aquatic plant is present, different light level may affect the color of the solution.

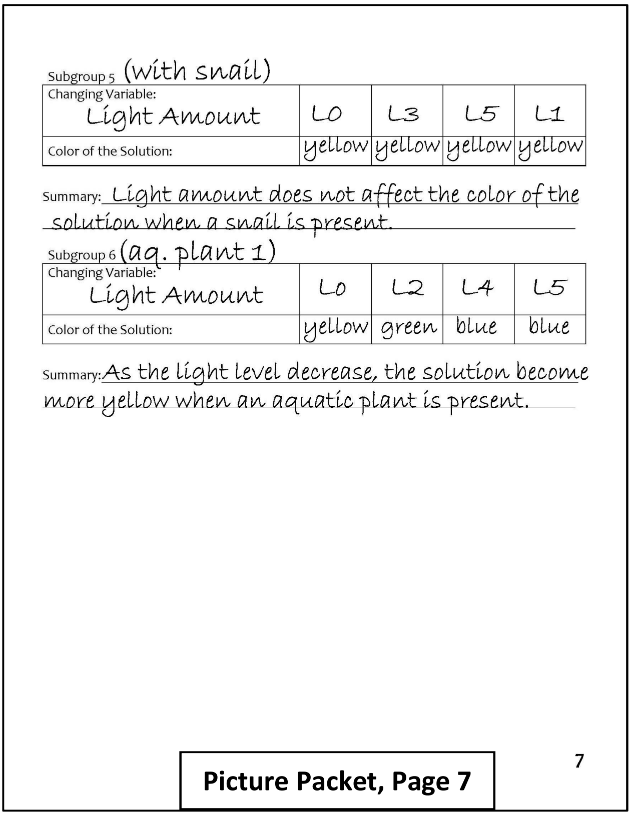
Subgroup 4 (with snail)

Changing Variable: Plant Type	aq. plant 3	aq. plant 1	aq. plant 2	aq. plant 4
Color of the Solution:	yellow	yellow	yellow	yellow

Summary: Bottles that include an aquatic plant and snail will turn the solution yellow.

6

Picture Packet, Page 6



Subgroup 5 (with snail)

Changing Variable: Light Amount	L0	L3	L5	L1
Color of the Solution:	yellow	yellow	yellow	yellow

Summary: Light amount does not affect the color of the solution when a snail is present.

Subgroup 6 (aq. plant 1)

Changing Variable: Light Amount	L0	L2	L4	L5
Color of the Solution:	yellow	green	blue	blue

Summary: As the light level decrease, the solution become more yellow when an aquatic plant is present.

7

Picture Packet, Page 7

After all poster presentations have been given, ask the class, “What did we learn about the color of the solution?” Have them summarize the class findings. The highlights from many experiments are shown below. Do not expect students to know highlights from experiments that were not run.

- The larger the *bottle size* the bluer the solution.
- When the *plant type* is a non-aquatic plant (leaves/flowers), the solution will turn yellow/green regardless of the light amount. (Note: In general, flowers do not undergo photosynthesis, but they do undergo respiration. Tree leaves have not adapted (like aquatic plants have) to be able to take in CO_2 from the water. This is because their stomata are blocked by the water, which results in the leaf only undergoing respiration.)
- The *light amount* will not affect the color of the solution (all solutions will be yellow) if only snails are present.
- The *light amount* affects the color of the solution when an aquatic plant is present.
  - Placing any type of aquatic plant in the light will keep the solution blue.
  - Placing any type of aquatic plant in the dark will turn the solution yellow.
- The *light amount* affects the color of the solution when an aquatic snail and plant are both present.
  - Placing any type of aquatic plant and a snail in the light will cause the solution to be less yellow (more green) than with the animal alone.
  - Placing any type of aquatic plant and a snail in the dark will make the solution yellow.

When summarizing experiments, use student-collected data and not what they should have found from the list above. Ask students, “If you want to get a solution to turn as yellow as possible, what values of the variables should you use?”

- Animal Type: Any animal
- Bottle Size: Small
- Plant Type: Any aquatic plant.
- Light Amount: Dark

If no one in the class did experiments on one of the variables above, they will not know how that variable affects the color of the solution, and do not expect them to tell you which value to use. Tell students, "You have taught me a lot about what causes the solution to change colors."

Wrap-Up:
(2 minutes – Full Class – SciTrek Lead)

Tell students, "The mentors who have been working with you are undergraduate and graduate students who volunteer their time, so you can do experiments. This is the last day you will see your volunteers, so we should say thank you and goodbye to them. I will come back and work with you one more day."

Have students remove the paper parts of their nametags (which they can keep) from the plastic holders and return the plastic holders to their volunteers.

Have volunteers pass out pencils to the students that asked questions. If a student did not ask a question during the poster presentations, have them ask/answer a question about the experiments before the volunteer gives them a pencil.

Clean-Up:

1. Collect plastic nametag holders and allow students to keep the paper part of their nametags.
2. Collect notebooks.
3. Leave posters in the classroom.
4. Place all other materials into your group box and bring them back to UCSB.
5. If you will not be attending the tie to standards day, remove all materials from your lab coat pockets, remove your nametag, unroll your lab coat sleeves, and put your lab coat into the dirty clothes bag at UCSB.

Day 6: Procedure Assessment/Tie to Standards

Schedule:

Procedure Assessment (SciTrek Lead) – 10 minutes
Tie to Standards (SciTrek Lead) – 50 minutes

Materials:

Lead Box:

☐ (3) Extra notebooks
☐ Notebooks
☐ Lead instructions
☐ Respiration picture packet
☐ Lead lab coat
☐ (35) Procedure assessments
☐ Time card
☐ (2) Pencils
☐ (2) Wet erase markers
☐ (2) Black pens
☐ Straw
☐ Tongs

Other Materials: (these bottles should be in a cardboard box so students cannot see them)

☐ B0, B00, and B000: 3 bottles of blue solution (half full)
☐ B1: snail/light for 24 hrs
☐ B2: frog/light for 24 hrs
☐ B3: fish/light for 24 hrs
☐ B4: plant 1/light for 24 hrs
☐ B5: plant 2/light for 24 hrs
☐ B6: snail/dark for 24 hrs
☐ B7: frog/dark for 24 hrs
☐ B8: fish/dark for 24 hrs
☐ B9: plant 1/dark for 24 hrs
☐ B10: plant 2/dark for 24 hrs
☐ Small piece of dry ice
☐ Balloon with car exhaust

Notebook Pages:

RESULTS

Summary

My experiment shows when an aquatic plant is present, as the light level decreases, the solution turns yellow because we observed the solution in light level 0 (no light) turned yellow, but the solution in light level 5 (full light) stayed blue.

I acted like a scientist when I collected data by observing the colors of the solutions.

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	Y	Y
2	Frog	24 Hours Light	Y	Y
3	Fish	24 Hours Light	Y	Y
4	Aquatic Plant 1	24 Hours Light	B	B
5	Aquatic Plant 2	24 Hours Light	B	B

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

11

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

4. If you answered NO, why did some of the solutions remain blue?
They did not have animals in them.

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	Y	Y
7	Frog	24 Hours Dark	Y	Y
8	Fish	24 Hours Dark	Y	Y
9	Aquatic Plant 1	24 Hours Dark	B	Y
10	Aquatic Plant 2	24 Hours Dark	B	Y

6. What does the color of the solution tell us about animals in the dark?
Animals still breathe (produce carbon dioxide) in the dark.

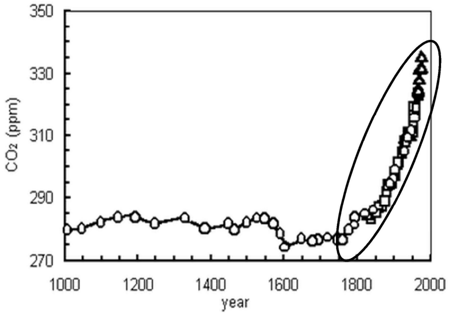
7. What does the color of the solution tell us about plants in the dark?
Plants produce carbon dioxide.

12

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? year

b. What information is plotted on the y-axis? CO_2 (ppm)

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 are increasing because in 1800, there were $\sim$280 ppm of CO_2, and in 2000, there were $\sim$340 ppm of CO_2.

13

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

More humans
Cars/factories
Deforestation

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?

Use cars less (carpool, bike, walk)
Plant more trees

14

Preparation:

SciTrek Lead:

1. If the teacher is not leading the tie to standards activity, do the following:
    a. Give the teacher an extra notebook and have them fill it out with their students, to follow along during the tie to standards activity.
    b. Collect the teacher's lab coat and put it in the lead box.
2. Pass out the procedure assessments and notebooks.
3. Set up the document camera for the tie to standards activity (notebook, pages 11-14).
4. Make sure the only bottles with the solution color still blue are B0, B00, B000, B4, and B5. These are the bottles with nothing in them and the bottles with plants in the light.
5. Have the cardboard box with bottles ready with easy access to grab bottles after students make predictions.
6. Put your lab coat in the lead box at the end of the day.

Procedure Assessment:

(10 minutes – Full Class – SciTrek Lead)

Tell students, "Before we start our activity, we will determine how your ideas on procedures are developing." Have students write their name, teacher's name, and date at the top of the assessment. Tell students, "When doing this assessment, you should work individually, so there should be no talking." As you are giving the assessment, walk around the room and verify students have written their names on their assessments.

For question *1*, have students write in their own words what they think the definition of a procedure is.

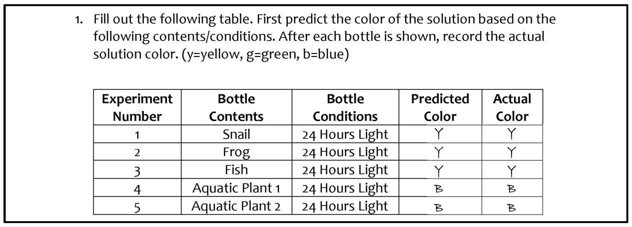
For question *2*, read *step 1* of the directions (*Look over the experimental information*); then read the question, changing variable (*liquid type*), and controls (*liquid amount, container type, object type…*) under the experimental information. You do not need to read the values for the changing variable or controls. Read *step 2* to the students (*Read each statement (2-8) and underline controls, circle changing variables and box information about data collection*); then read the statement in question *2* and have students annotate it. Once they are done read *step 3* (*Circle yes if the statement could be a correct step for a procedure about the experimental information below. If not, circle no.*) Have students circle either *Yes* or *No* depending on if they think it is a correct procedural step. For question *3*, read the statement and tell students, "Annotate this statement by underlining controls, circling changing variables, and boxing information about data collection." Once students are done tell them, "Now circle if this could be a correct procedural step or not." Repeat this process for questions *4-8*. When students are finished, collect the assessments and verify students' names are written on top.

Tie to Standards:

(50 minutes – Full Class – SciTrek Lead)

Predictions of Experimental Bottles in the Light: Bottles B1, B2, B3, B4, and B5 (12 minutes)

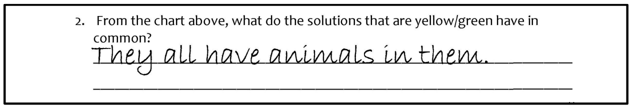
Have the students turn to page 11 in their notebooks. Tell students, "Today we are going to talk about your previous experiments and hopefully answer any questions you still have about what is changing the color of the solution. Yesterday I started an experiment and brought the bottles in for you to observe. These bottles all have different contents in them, but they were under the same conditions: under the light for 24 hours. Before I show you the bottles, I want you to predict the color of the solutions based on what you learned from the poster presentations. If you think the solution will be yellow you can record 'Y,' if you think the solution will be blue you can record 'B,' and if you think the solution will be green you can record 'G.'" Have students make all of the predictions at one time. Then, for each bottle have one student share what they think the color of the solution will be and why. Have the class vote, using thumbs up/thumbs down if they agree/disagree with the student. If many students disagree, ask one of the students that disagrees what they think and why. After, show students the experimental bottle and have them record the actual color of the solution on their chart as you record the color in the class notebook. Then, leave each bottle on the table and continue onto the next bottle until you have gone through bottles B1-B5.



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	Y	Y
2	Frog	24 Hours Light	Y	Y
3	Fish	24 Hours Light	Y	Y
4	Aquatic Plant 1	24 Hours Light	B	B
5	Aquatic Plant 2	24 Hours Light	B	B

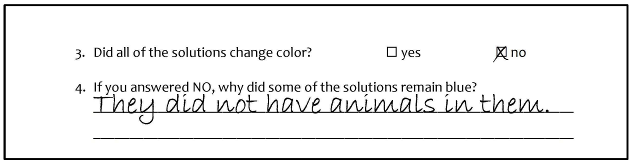
Ask students, “What do the solutions that turned yellow/green have in common?” Students should reply, “They contained animals.” If they bring up the fact that they were all in the light for 24 hours, ask students, “Was there any solution that was blue after being in the light 24 hours?” Students should reply, “The solutions with aquatic plants.” Tell them, “Since the aquatic plants’ solutions stayed blue it could not have been the light alone that was changing the color of the solution; therefore, the color change must have been caused by the animals themselves.” Record this for question *2* in the class notebook under the document camera for students to copy.



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

Have the students turn to page 12 in their notebooks.

Ask students, “Did all of the solutions that were under the light for 24 hours change color?” Students should reply, “No.” Have them check this box in their notebook for question *3*. Ask students, “Why did some of the solutions remain blue?” Possible student response: they did not contain animals. Have students record their answer into their notebook. Ask one student to share their response and record this answer into the class notebook for question *4* for the students to copy.



3. Did all of the solutions change color? ☐ yes ☒ no
4. If you answered NO, why did some of the solutions remain blue?
They did not have animals in them.

Determination of What is Causing Color Change: Bottles B0 and B00 (12 minutes)

Ask students, “What do you think the animals are doing to change the color of the solution?” Lead a discussion until students say the animals are breathing in O_2 and producing CO_2 and the CO_2 is changing the color of the solution to yellow.

Many times, students suggest that the animals are going to the bathroom and this is what is changing the color of the solution to yellow. If this comes up, ask them, “Is there is a way to test this?” Possible student response: if urine was placed in the solution without the animal, and the solution changes to yellow, then it would be urine that was changing the color of the solution. Tell them, “I have done this experiment and there was no observed color change. Therefore, this is not the reason that the solution is changing color.”

Ask students, “Is there any way we could confirm that CO_2 changes the color of the solution?” Possible student response: if CO_2 was placed in the solution without the animal and the solution turned yellow, then it would be CO_2 that was changing the color. Ask students, “Is there someplace that I can purchase CO_2?” Lead student to understand dry ice is solid CO_2 and can be purchased at the grocery store. Show students the piece of dry ice. Tell students, “As the dry ice heats up, it turns back into CO_2 gas.” Ask students, “What should happen if I put a piece of the dry ice into the solution?” Possible student response: if CO_2 is changing the color of the solution, the solution’s color will change to yellow. Put the piece of dry ice into bottle B0 to verify for students that CO_2 is changing the color of the solution.

Ask students, “Do you think I could change the color of the solution if I blew into the solution with a straw?” Have a few students share their ideas with the class and their reasoning behind the ideas. Do the experiment for students. Remove the lid from the bottle B00, put the straw into the solution, and blow into the straw for approximately 20 seconds. After 20 seconds the solution will be a pale yellow/green color. Ask students, “How come I was able to change the color of the solution in very little time, but the other animals took 24 hours?” Possible student response: your lungs are much bigger than the other animals; therefore, you are able to produce more CO_2, and this changes the color of the solution faster.

Ask students, “Why did the solutions with plants in them not change color?” Possible student response: plants in the light take in CO_2 and give off O_2 in a process called **photosynthesis**. Therefore, since they are not producing CO_2, they should not change the color of the solution.

Ask the class, “If I have a solution that has turned yellow, how can I get it to turn back to blue?” Lead the students in coming up with the idea that if a plant was put into the bottle and it was left in the light it should turn back to blue. **Note:** if the class would like to see this happen you can leave an aquatic plant in a yellow solution for them to observe.

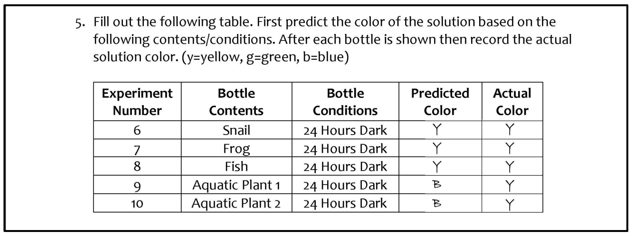
Note: *Why **only** CO_2 can be detected in the bottles (not to be discussed with students).*
When CO_2 dissolves in liquid water (H_2O) it produces carbonic acid (H_2CO_3) by the following reaction:

$$CO_2(g) + H_2O(l) \rightleftharpoons H_2CO_3(aq)$$

Carbonic acid (H_2CO_3) is an acid and thus makes the solution in the bottle more acidic. Bromothymol blue (the solution in the bottles) is a common pH indicator which tells the amount of H^+ [or acid] in the solution by changing colors. Thus, the yellow color in the bottles indicates the presence of an acid (H_2CO_3) in the solution. With the bromothymol blue indicator, we **cannot** tell anything about the presence of oxygen (O_2), since O_2 does not form an acid or a base when dissolved in the solution. Therefore, it is important when referring to the color change we only talk about carbon dioxide amounts and not oxygen amounts.

Prediction of Experimental Bottles in the Dark: Bottles B6, B7, B8, B9, and B10 (12 minutes)

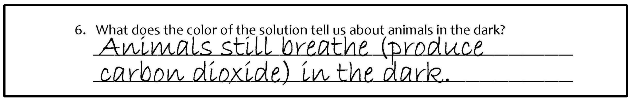
Tell students, “We are now going to make predictions about the experimental bottles that were left in the dark for 24 hours.” Similar to before, students will record their predictions first for all of the bottles. You can then have one student share what they think the color of the solution will be and why and use thumbs up/thumbs down to see if the class agrees. Then show students the bottles and have them record their observations on their chart as you record them in the class notebook for question *5*.



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)

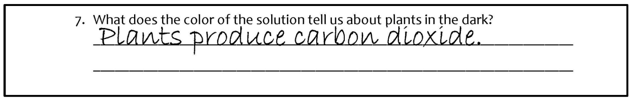
Experiment Number	Bottle Contents	Bottle Conditions	Predicted Color	Actual Color
6	Snail	24 Hours Dark	Y	Y
7	Frog	24 Hours Dark	Y	Y
8	Fish	24 Hours Dark	Y	Y
9	Aquatic Plant 1	24 Hours Dark	B	Y
10	Aquatic Plant 2	24 Hours Dark	B	Y

After completing the table, ask students, “What does the color of the solution tell us about animals in the dark?” Possible student response: since the solution changed colors, the animals are still producing CO_2, or breathing, in the dark. Write this response into the class notebook and have students copy the response into their own notebooks for question *6*.



6. What does the color of the solution tell us about animals in the dark? Animals still breathe (produce carbon dioxide) in the dark.

Ask students, “What does the color of the solution tell us about plants in the dark?” Possible student response: the plants in the dark turned the solution yellow therefore, the plants must be producing CO_2. Record this response into the class notebook for question *7* and have the students copy this into their notebooks.



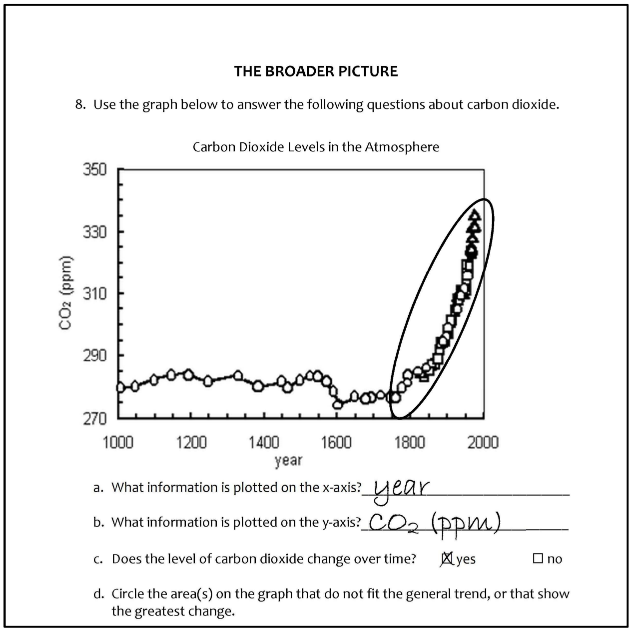
7. What does the color of the solution tell us about plants in the dark? Plants produce carbon dioxide.

Ask students, “What is the process called where plants turn CO_2 into O_2?” Students should reply, “Photosynthesis.” Ask students, “What is needed for photosynthesis?” Students should reply, “Light and CO_2.” Tell students, “Just like animals, plants take in O_2 and produce CO_2. However, when there is light, plants are able to photosynthesize and the amount of CO_2 that they produce is less than the amount of CO_2 that they consume.”

The Broader Picture: Bottle B000 (14 minutes)

Have the students turn to page 13 in their notebooks.

Have students look at the graph and answer questions *8a-d*. Go over each of the questions as a class, calling on students to provide the answers. Record the answers in the class notebook for questions *8a-d* for students to copy.



THE BROADER PICTURE

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

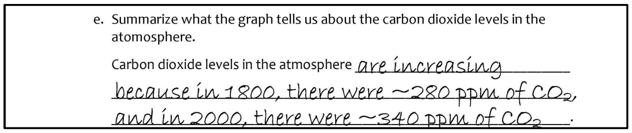
a. What information is plotted on the x-axis? year

b. What information is plotted on the y-axis? CO_2 (ppm)

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.

Ask students, “Can someone summarize what the graph tells us about the CO_2 levels in the atmosphere?” After students have told you their ideas, write the answer in *8e*.



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

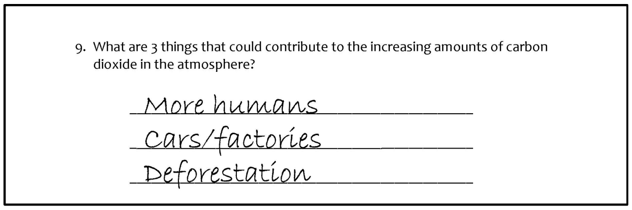
Carbon dioxide levels in the atmosphere are increasing because in 1800, there were ~280 ppm of CO_2, and in 2000, there were ~340 ppm of CO_2.

Ask students, “What is different now than in the 1800’s and before?” Possible student response: there were no cars in the 1800s. Ask students, “Do you think cars produce CO_2?” Tell them, “I have some exhaust from a car that I will bubble through the solution to see if cars produce CO_2.” Ask students, “If car exhaust has CO_2, what color will the solution turn?” Students should reply, “Yellow.” Ask students, “If car exhaust does not contain CO_2, what color will the solution be?” Students should reply, “Blue.” Get bottle B000 and bubble the exhaust through the solution. Do this by removing the binder clip from the balloon and carefully placing the opening over the straw. Insert the straw into the blue solution to allow the exhaust to go through the straw into the solution. The blue solution will turn yellow. If you do not use all of the exhaust, replace the binder clip on the balloon to reseal the balloon. Because the solution turned yellow from the car exhaust, we can conclude that cars are also producing CO_2.

Ask students, “What was the difference between the time it took my breath to turn the solution yellow compared to the time it took the car exhaust to turn the solution yellow?” Possible student response: the exhaust turned the solution yellow more quickly. Ask students, “What does this mean?” Possible student response: the car exhaust is producing much more CO_2 than what is produced during respiration.

Next, have the students turn to page 14 in their notebooks.

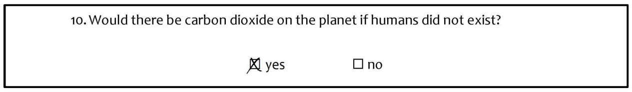
Ask students, “What are three things that contribute to the increasing amounts of carbon dioxide in the atmosphere?” Write some of their ideas onto the class notebook for question *9* and have them copy these or their own ideas into their notebook.



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

More humans
Cars/factories
Deforestation

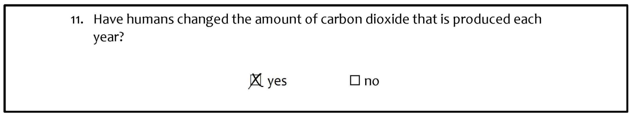
Next, ask students, “Would there be CO_2 on Earth if humans did not exist?” Possible student response: other animals besides humans produce CO_2 and plants produce CO_2 when they are not photosynthesizing, so there would be CO_2 without humans. Have student check *yes* in their notebook for question *10*.



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

☒ yes ☐ no

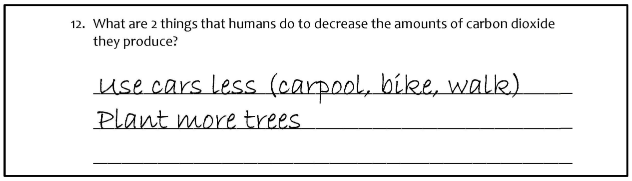
Ask students, “Have humans changed the amount of carbon dioxide that is produced each year?” After hearing students’ ideas have them check *yes* in their notebook for question *11*.



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

☒ yes ☐ no

Next, ask students, “What are two things that humans can do/already do to decrease the amounts of carbon dioxide they produce?” Record two of these responses in the class notebook for question *12* for students to copy.



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

Use cars less (carpool, bike, walk)

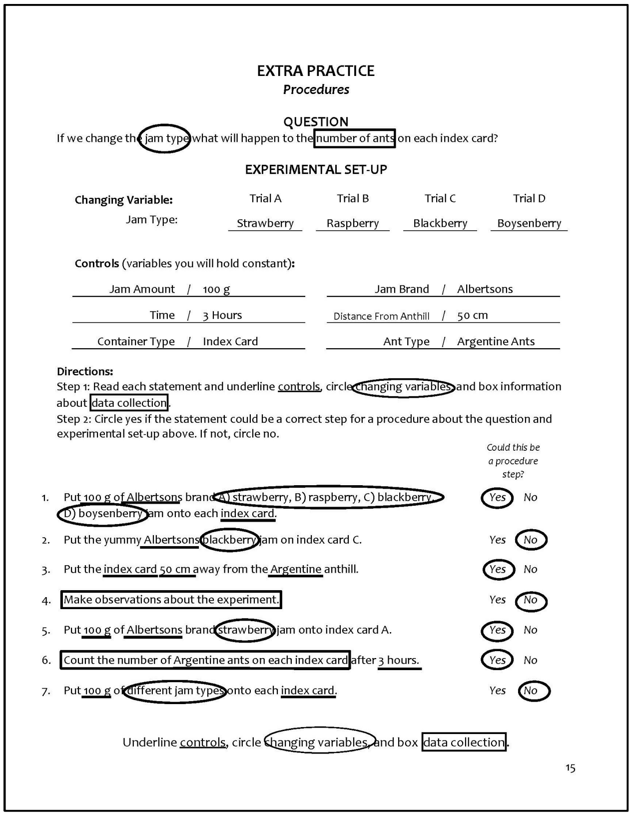
Plant more trees

Tell students, “You can keep your notebooks, I have enjoyed learning science with you. I hope you will continue to see yourselves as scientists and explore the world around you. You will get another opportunity for SciTrek to come to your class, and run another long-term investigation with you, later in the year, so it is important that you remember what you learned for your next module.”

Clean-Up:

1. Leave notebooks with students.
2. Place all other materials into the lead box and bring them back to UCSB.
3. Remove all materials from your lab coat pockets, remove your nametag, unroll your lab coat sleeves, and put your lab coat into the dirty clothes bag at UCSB.

Extra Practice Solutions:



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.

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