Module 2: Respiration

5th Grade

Activity Schedule: Days 3, 4, and 5 must be consecutive.

Day 1: Conclusion Assessment/Observations/Variables (60 minutes)
Day 2: Question/Experimental Set-Up/Procedure (60 minutes)
Day 3: Experiment/Conclusion Activity (60 minutes)
Day 4: Conclusion/Question/Experimental Set-Up/Procedure/Experiment (60 minutes)
Day 5: Experiment/Conclusion (60 minutes)
Day 6: Poster Making (60 minutes)
Day 7: Poster Presentations (60 minutes)
Day 8: Conclusion Assessment/Tie to Standards/Content Assessment (60 minutes)

California Science Standards Addressed:

Content

2. Plants and animals have structures for respiration, digestion, waste disposal, and transport of materials. As a basis for understanding this concept:

f. Students know plants use carbon dioxide (CO_2) and energy from sunlight to build molecules of sugar and release oxygen.

g. Students know plant and animal cells break down sugar to obtain energy, a process resulting in carbon dioxide (CO_2) and water (respiration).

Investigation and Experimentation

6. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:

c. Plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure.

h. Draw conclusions from scientific evidence and indicate whether further information is needed to support a specific conclusion.

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 know that a conclusion is a claim supported by data.
4. Students will be able to distinguish between statements that are claim/data/neither.
5. Students will be able to match a claim with supporting data and realize when no match can be made.
6. Students will be able to identify appropriate claims that can be made from a given data set.
7. Students will be able to list at least two ways that they behaved like scientists.

Classroom Teacher Responsibilities:

In order for SciTrek to be a sustainable program SciTrek needs to work with teachers to develop their abilities to run student-centered inquiry-based science lessons in their own classroom. As teachers take over the role of SciTrek lead it will allow SciTrek to be able to expand to additional classrooms. Even when teachers lead the modules in their own classroom SciTrek will continue to provide volunteers and all of the materials needed to run the module. A sample time line for teachers to take over the role as the SciTrek lead is seen below.

1. Module 1 (year 1)
    a. Classroom Teacher Co-Runs Group
        i. Classroom teacher will co-run a group with a SciTrek volunteer. Groups contain ~10 students and will be broken up into three small groups (~4 students) to perform experiments.
2. Module 2 (year 1)
    a. Classroom Teacher Runs Group
        i. Classroom teacher will run a group. Groups contain ~10 students and will be broken up into three small groups (~4 students) to perform experiments.
3. Module 3 (year 2)
    a. Classroom Teacher Runs Group and Starts Leading Class Discussions
        i. Classroom teacher will run a group. Groups contain ~10 students and will be broken up into three small groups (~4 students) to perform experiments.
        ii. Classroom teacher will start leading parts of group discussions (examples: conclusion activity, tie to standards, etc.)
4. Module 4 (year 2)
    a. Classroom Teacher Leads the Class with Co-Lead Volunteer
        i. Classroom teacher will be responsible for leading whole class discussions (examples: conclusion activity, tie to standards, etc.).
        ii. Classroom teacher will be responsible for time management.
        iii. Classroom teacher will be responsible for overseeing volunteers and helping any groups that are struggling.
5. Any Additional Modules (year 3 and beyond)
    a. Classroom Teacher Leads the Class
        i. Classroom teacher will be responsible for leading whole class discussions (examples: conclusion activity, tie to standards, etc.).
        ii. Classroom teacher will be responsible for time management.
        iii. Classroom teacher will be responsible for overseeing volunteers and helping any groups that are struggling.
        iv. It is very important for the classroom teacher to contact scitrekadmin@chem.ucsb.edu if they will be unable to run the module on a specific day.

The SciTrek staff will be counting on teacher involvement after year one. Additional steps can be taken to become a SciTrek lead faster than the proposed schedule above. Please contact scitrekadmin@chem.ucsb.edu to learn more.

In addition, teachers are required to come to UCSB for the volunteer orientation, typically ran ~1 week prior to the start of the module (contact scitrekadmin@chem.ucsb.edu for exact times and dates, or see our website at http://web.chem.ucsb.edu/~scitrek/Module_Times.html under your class's modules

times). At the orientation teachers will meet the volunteers that will be helping in their classroom, go over module content, and learn their responsibilities during the module.

Prior to the Module (at least 1 week):

1. Come to the SciTrek Orientation at UCSB.
2. If you are interested in changing the groups that your students were in for the first module, send the new groups to scitrekadmin@chem.ucsb.edu one week before the start of the module so that we can have nametags/notebooks made for your students. Divide the class into three groups (~10 students each). We find these groups work best when they are mixed levels and mixed language abilities. These larger groups of students will be further broken up into three small groups (~3 students each) when performing experiments. You can also designate the small groups (three/four students) if you wish.

During the Module:

If possible have a document camera available to SciTrek lead every day of the module.

Day 0:

24 hours before the SciTrek module starts, three sets of three bottles and a lamp (with 60 W equivalent compact florescent bulb) will be brought to the classroom. Each set of bottles will contain: one bottle that only has solution, one bottle that has solution/aquatic snail, and one bottle that has 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 the students' desks/tables moved into 3 groups and cleared off. This way each student can have a desk to sit at during SciTrek activities.

Day 2- 6:

Have the students' desks/tables moved into 9 groups and cleared off. This way each student can have a desk to sit at during SciTrek activities and students can get started with the module as soon as SciTrek gets to the classroom.

Day 3-5:

Have a spot in your classroom where 5 Xerox boxes and lights can be plugged in and ~36 bottles can be left under them. These lamps need to be kept on until SciTrek arrives back in the classroom.

Day 7 and 8:

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

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 in 50 mL of concentrated bromothymol blue.
   3. Pour solution into 8 oz. bottles and cap.
2. Bottles (8 oz (Costco), 10 oz (Dasani, Walmart), 16.9 oz/500 ml (Costco), 33.3 oz/500 ml (Costco))
3. Snail 1: Mystery snails
4. Snail 2: Olive snails
5. African frogs
6. Plant 1: Ludwigia
7. Plant 2: Hornswort
8. Plant 3: Anacharis
9. Plant 4: Wisteria
10. Fish 1: Mosquito fish
11. Fish 2: Fat Head Minnow (*Pimephales promelas)*
12. Tree leaf: Any nonpoisonous tree leaf
13. Flower: Daisy
14. Gooseneck Desk Lamps (with adjustable heads) (Target part number: Room Essentials Gooseneck Desk Lamp) with 60 W equivalent compact florescent bulbs. Make sure that you use compact florescent bulbs because these give off less heat than incandescent bulbs.
15. Boxes for different amounts of light hand made 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 polarizing filter over the hole (Education Innovations part number: PF-12). The different amounts of light are then made by having the 60 W equivalent CFL bulb go through: one filter, two filters that are aligned, two filters that are 45° to each other, and two filters that are 90° to each other. All filters are taped to the top of the box so that they will not move. Another Xerox box is available with no holes to provide a dark environment. A picture of one of the boxes is seen below.

*All printed materials used by SciTrek (nametags, material pages, poster parts, student notebooks, or instructions) can be made available for use and/or editing by emailing scitrekadmin@chem.ucsb.edu.

Day 1: Conclusion Assessment/Observations/Variables

Schedule:

Introduction (SciTrek Leader) – 2 minutes
Conclusion Assessment (SciTrek Leader) – 10 minutes
Observation Discussion (SciTrek Leader) – 2 minutes
Observations (SciTrek Volunteers) – 24 minutes
Variable Discussion (SciTrek Leader) – 5 minutes
Variables (SciTrek Volunteers) – 12 minutes
Wrap-Up (SciTrek Leader) – 5 minutes

Materials:

(3) Volunteer Boxes:

- ☐ Student nametags
- ☐ Volunteer lab coat
- ☐ (12) Student notebooks
- ☐ (2) Markers
- ☐ Volunteer instructions

(3) Supplies Already in Classroom:

- ☐ Bottle with blue solution (labeled "Bottle 1")
- ☐ Bottle with blue solution and an aquatic snail (labeled "Bottle 2")
- ☐ Bottle with blue solution and an aquatic plant (labeled "Bottle 3")

Other Supplies:

- ☐ (3) Large group notepads

Lead Box:

- ☐ (5) Blank nametags
- ☐ Lead lab coat
- ☐ Picture of bottles from when dropped off
- ☐ (3) Extra student notebooks
- ☐ (3) Markers (orange, green, blue)
- ☐ (35) Conclusion assessments
- ☐ Lead instructions
- ☐ Straw
- ☐ Time card

SciTrek Notebook Pages Used With Students:

OBSERVATIONS

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

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

	Bottle 1	Bottle 2	Bottle 3
Contents:	None	Aquatic Snail	Aquatic Plant
Conditions:	24 hours under the light	24 hours under the light	24 hours under the light
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:

After 24 hours the bottle with a snail in it turned yellow (the solution color went from blue to yellow). The bottle with a plant remained blue after 24 hours. The bottle with no contents under the light remained blue.

2

Other Observations:

1. All of the bottles are small bottles
2. All of the bottles are capped and have a small piece of tape on them
3. All of the bottles have approximately the same amount of liquid
4. The snail is on the side of the bottle
5. The aquatic plant is green
6. The aquatic snail has a shell
7. The bottles have small openings
8.
9.
10.
11.
12.
13.

3

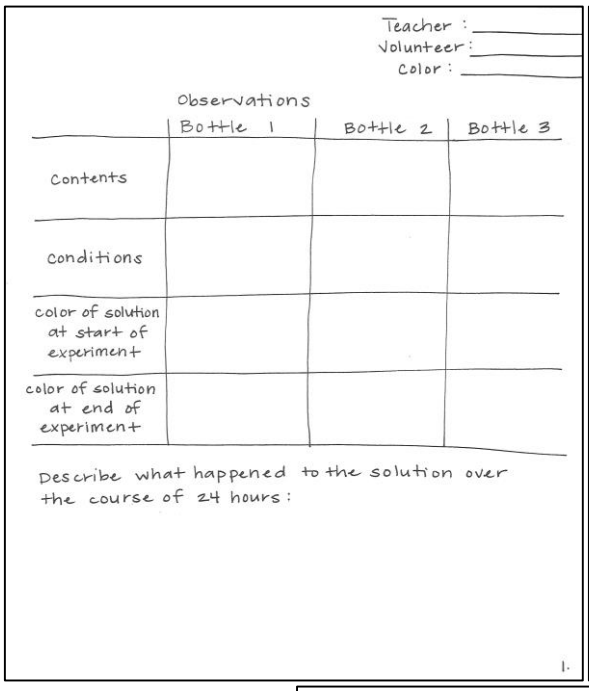
VARIBALES

What do you think might be effecting the color of the solution?

Variable	What color(s) will the solution be after 24 hours and why?
animal	I predict the color of the solution will be yellow because before the snail turned the solution yellow.
plant	I predict the plant will change the color of the sol. in the dark because plants need light and previously the plant in the light stayed blue.
light amount	I predict the light amount will change the color of the solution because all of the bottles were previously under the light.
Bottle size	I predict the bottle size will change less (less yellow) because before all of the small bottles changed color.
Number of animals	I predict the color of the solution to be more yellow because the bottle with one snail turned yellow (light yellow) so the bottles with 2 snails should turn darker yellow.

4

Group Notepad Pages Used With Students:

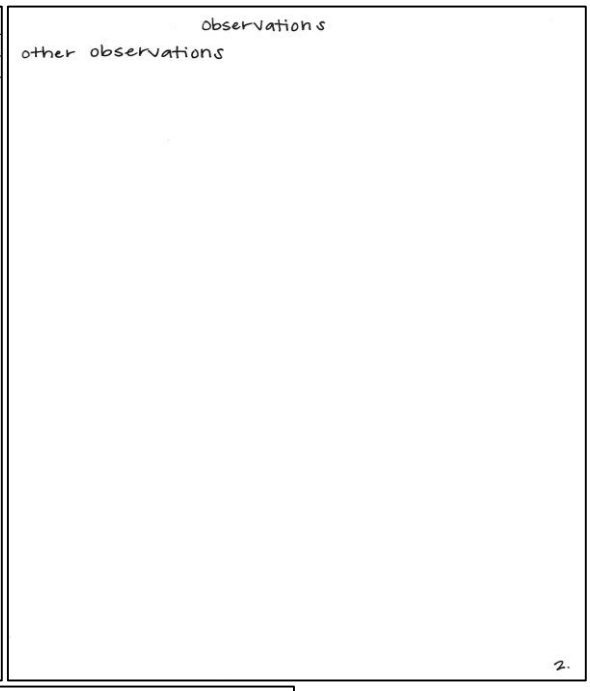

Teacher : _____
Volunteer: _____
Color : _____

Observations

	Bottle 1	Bottle 2	Bottle 3
Contents			
Conditions			
color of solution at start of experiment			
color of solution at end of experiment			

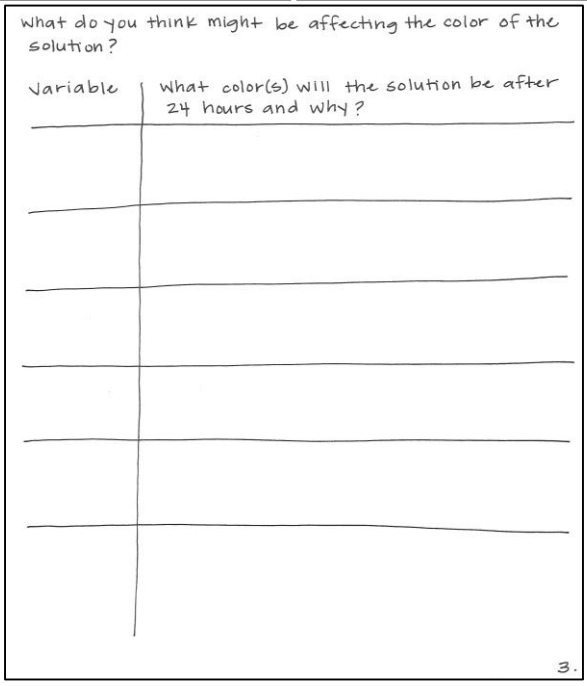
Describe what happened to the solution over the course of 24 hours:

1.


Observations

other observations

2.


What do you think might be affecting the color of the solution?

Variable	What color(s) will the solution be after 24 hours and why?

3.

Set-Up:

SciTrek Leader:

If the classroom has a document camera ask the teacher to use it to show the original picture of the bottles as well as to show the class question. If the classroom does not have a document camera walk around the room during the observations part of the module and show the picture to the students. In addition, write the class question on the board during the observation discussion.

SciTrek Volunteer:

Put your name, the teachers' name, and your group color on the top of your group notepad.

As students are taking the conclusion assessment walk around the room and quietly place the students' nametags, which are in your group box, on each students' desk.

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. Your table will look like the set-up seen below:

Introduction *(2 minutes – Full Class – SciTrek Leader):*

"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 then design your own experiments to help answer the class question. We want to show you that you can do science and that it's fun."

If you are a teacher that is leading the class: tell your class that they are going to start a long term science investigation and you have asked some scientists from UCSB to come and help. Allow the UCSB volunteers to introduce themselves and share their majors.

Conclusion Assessment *(10 minutes – Full Class – SciTrek Leader):*

As the students are taking the assessment the volunteers should get the student nametags out of their group boxes and walk around the room looking for their students. Have the volunteers quietly lay each student's nametag on their desk. If students do not have their name on their paper remind them to put their name on their paper.

"Before we start with the module we want to see how your ideas on conclusions have changed." Pass-out the conclusion assessment and tell students to fill out their name, teacher's name, and date at the top of the assessment. Remind the students that it is important that they fill this assessment out on their

own. For section one read the instructions to the students. Then read each of the statements aloud and tell the students to circle if the statement is an example of a claim, data, or neither. As you are reading the statements walk around the room and verify that students have written their name on the top of the paper. For section two read the instructions to the students and give them a few minutes to make matches between claims and data. You do not need to read the individual claim and data statements to the students. For section three read the instructions to the students and then read each of the statements aloud and tell the students based on the results to circle if the statement is an example of claim, data, opinion, or if it is incorrect. You do not need to read or go over the data tables with the students. Read the last question to the students and have them fill in the blank. When they are finished, collect the papers and verify that the student's name is on the top of the paper.

Observation Discussion *(2 minutes – Full Class – SciTrek Leader):*

Tell the students that scientists make lots of observations. Ask the class, "What is an observation? What are the types of things that you can record for an observation?" If they have trouble with this, show them an object and let them make some observations. Turn these observations into general features of an observation. Examples of possible general observations are: color, texture, size, weight, temperature, material, etc.

"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 blue solution." Hold up one of the bottles and ask the students to identify the contents in that bottle. Example answer: an aquatic plant. "We will use the term conditions to tell other factors that might affect the experimental results that are outside of the bottle." Ask the students to identify the conditions of the bottles. Example answer: under light for 24 hours, room temp, etc.

Tell the class they will now get in their groups and make other observations of the bottle system. To determine their group they will need to look at the color of their nametag. Tell each colored group where to go.

If a student does not have a nametag write the student's name on one of the extra nametags that are in the lead box using the color of marker of the group that you are going to have them join.

Observations *(24 minutes – Large Groups – SciTrek Volunteers):*

Once the students come over to your group have them sit in boy-girl fashion. Make sure the table is set-up as described in the set-up section. A picture of the bottles from day one will be on the document camera (see example below). Pass out the SciTrek notebooks to each student. Make sure students fill out the entire front cover (except for the group number) before beginning with observations. Then have students turn to page 2 of their notebooks.

As a group, have the students fill in the first table about the bottle contents and conditions and the color or the bottle before and after the 24 hours. While you are recording their answers on the group notepad have students fill in the table in their notebook. Then have them write a summary (multiple sentences) of what happened to the color of the solution over the course of 24 hours. Give students a few minutes to try this activity by themselves and then have them share their thoughts. Record a few of their thoughts on the group notepad. By the end of the discussion make sure that students understand that over the course of 24 hours the bottle with the snail in it turned yellow while the bottles with just the blue solution and the plant remained blue. Some groups might notice that the plant bottle is a little lighter blue than the original bottle you can also record this in the table and in the summary. Page 2 should take your group at least 15 minutes. Probe them to write a better description if it takes less than 15 minutes. Example questions to ask students are the following:

What is the biggest difference that you see between the bottles?
How are the bottles different from 24 hours ago?
Why do you think the bottles are changing colors and make a prediction about what is changing the color of the solution?

If students are struggling with writing a description have other group members tell you some of the main points that they included in their summary and write these on the group notepad.

Once groups have finished page 2 have them turn to page 3. As a group record two other general observations of the system on the group notepad. Then have students generate a few more observations themselves and record these in their SciTrek notebook. Have students share these observations with the group. If you run out of time you can leave the other observation section blank because it is more important that they have an accurate description of what happened to the color of the solution.

An example of the group notepad/student notebook for all of the observations is seen below; feel free to deviate from the example.

Teacher : Mrs. Johnson
Volunteer: Breanna
Color : Blue

Observations

	Bottle 1	Bottle 2	Bottle 3
Contents	None	Aquatic Snail	Aquatic Plant
conditions	24 hours under the light	24 hours under the light	24 hours under the light
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:

After 24 hours the bottle with a snail in it turned yellow (the solution color went from blue to yellow). The bottle with a plant remained blue after 24 hours. The bottle with no contents under the light remained blue

1.

OBSERVATIONS

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

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

	Bottle 1	Bottle 2	Bottle 3
Contents:	None	Aquatic Snail	Aquatic Plant
Conditions:	24 hours under the light	24 hours under the light	24 hours under the light
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:

After 24 hours the bottle with a snail in it turned yellow (the solution color went from blue to yellow). The bottle with a plant remained blue after 24 hours. The bottle with no contents under the light remained blue.

2

observations

other observations

1. All of the bottles are small bottles
2. All of the bottles are capped & have a small piece of tape on them.
3. All of the bottles have approximately the same amount of liquid.
4. The snail is on the side of the bottle
5. The aquatic plant is green
6. The aquatic snail has a shell
7. The bottles have small openings.

2.

Other Observations:

1. All of the bottles are small bottles
2. All of the bottles are capped and have a small piece of tape on them
3. All of the bottles have approximately the same amount of liqurd
4. The snail is on the side of the bottle
5. The aquatic plant is green
6. The aquatic snail has a shell
7. The bottles have small openings
8.
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12.
13.

3

At the end of the observation section each group is going to be asked to share one of their observations. Pick one student that will share an observation with the rest of the class.

Variable Discussion *(5 minutes – Full Class – SciTrek Leader):*

Have each group share one of their observations with the rest of the class.

Review with the class how the solution changed over time. Make sure that by the end of the discussion the students have identified that the bottle that just contained blue solution stayed blue. The bottle with the aquatic plant stayed blue (or turned slightly green) and the bottle with the snail turned yellow.

Ask the class what is the most interesting thing that they observed. They should reply that the bottle with the snail turned yellow. Tell the class we will then work together to answer the question: What factors affect the color of the solution? and How? Write this question on an example notebook under the document camera and then have students copy this question onto the front page of their notebook.

Tell students they are now going to discuss variables within their groups.

Ask the class what does the word "variable" mean to a scientist? What is the definition of a variable in science? Possible answer: variables are parts of the experiment that you can change.

Tell the class that they are going to think about variables in the experiment that they could change to help us answer the class question of: What factors affect the color of the solution? and How? In addition to generating variables we should think about why these variables might affect the outcome of the experiment. Ask the class to give you a variable that they think might affect the color of the solution and have them tell you why or how they think that variable would affect the experiment. Then probe them on how they would design an experiment to test if this variable affected the color of the solution. Finally, have the students make a prediction of the results of the experiment that they proposed.

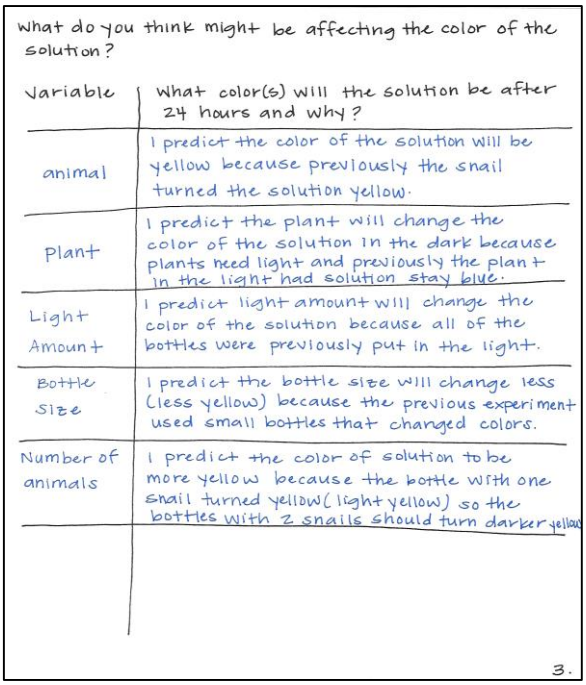
Example:
Variable: animal type
Why this variable might affect color of the solution? The snail turned the color of the solution yellow so maybe all animals will have the same effect.
How would you test this variable? Get bottles with blue solution and put different animals in each of the bottles
Prediction: All bottles will turn yellow because the color is caused by something that all animals are giving off.

Tell the students they will generate more variables and analyze them in their groups.

Variables *(12 minutes – Large Groups - SciTrek Volunteers):*

As a group, come up with a variable and make a prediction about what color the bottle will be after 24 hours. Encourage and challenge students to explain why they think their prediction is correct and how this variable will affect the color of the solution. Repeat this process two more times and record these ideas on the group notepad and then have students copy these into their notebooks. Then have students generate more variables and make predictions about how different values of this variable will affect the color of the solution after 24 hours and record their ideas in their notebook. Have students share these ideas with the small group.

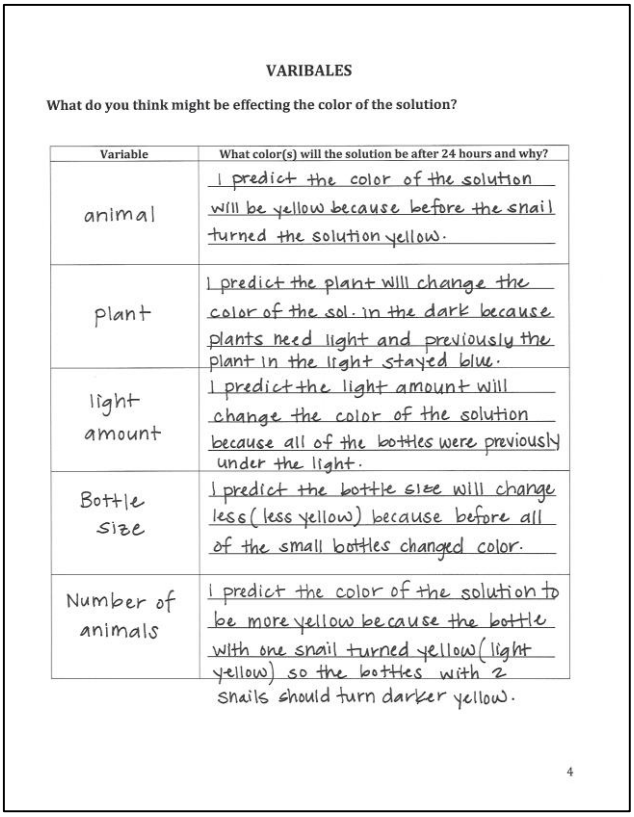
Prepare one student to share one of their variables and why they think it will affect the color of the solution during the group discussion.



What do you think might be affecting the color of the solution?

Variable	What color(s) will the solution be after 24 hours and why?
animal	I predict the color of the solution will be yellow because previously the snail turned the solution yellow.
Plant	I predict the plant will change the color of the solution in the dark because plants need light and previously the plant in the light had solution stay blue.
Light Amount	I predict light amount will change the color of the solution because all of the bottles were previously put in the light.
Bottle Size	I predict the bottle size will change less (less yellow) because the previous experiment used small bottles that changed colors.
Number of animals	I predict the color of solution to be more yellow because the bottle with one snail turned yellow (light yellow) so the bottles with 2 snails should turn darker yellow

3.



VARIBALES

What do you think might be effecting the color of the solution?

Variable	What color(s) will the solution be after 24 hours and why?
animal	I predict the color of the solution will be yellow because before the snail turned the solution yellow.
plant	I predict the plant will change the color of the sol. in the dark because plants need light and previously the plant in the light stayed blue.
light amount	I predict the light amount will change the color of the solution because all of the bottles were previously under the light.
Bottle size	I predict the bottle size will change less (less yellow) because before all of the small bottles changed color.
Number of animals	I predict the color of the solution to be more yellow because the bottle with one snail turned yellow (light yellow) so the bottles with 2 snails should turn darker yellow.

4

Wrap-Up *(5 minutes – Full Class – SciTrek Leader):*

Have one student from each group share a variable that they generated and why/how they think it will affect the color of the solution. Make sure that students tell you their predictions about how different values of that variable will affect the color of the solution. Challenge students to justify their thinking and explore with them how this might help them design an experiment. For example, if a students' variable was animal type and they predicted that any type of animal would produce a change in the color of the solution because all animals might be producing something that changes the color of the solution. Probe the students deeper by asking them questions such as if you designed an experiment to test this do you think it would be easier or harder to see if this variable effected the color of the solution if you also added an plant to the bottle.

Tell the students that the next time we meet they will design an experiment to answer a question that they have about this experiment which will help them learn about what is causing the solution to change color.

Clean-Up:

Before you leave have the students attach their nametag to their notebook and place them in the group box. Put all of the bottles used for observations into your group box. Bring all materials back to UCSB. In addition, put your lab coat back into the box.

Day 2: Question/Experimental Set-Up/Procedure

Schedule:

Introduction (SciTrek Leader) – 13 minutes
Question (SciTrek Volunteers) – 10 minutes
Experimental Set-Up (SciTrek Volunteers) – 15 minutes
Procedure (SciTrek Volunteers) – 14 minutes
Results Table (SciTrek Volunteers) – 5 minutes
Wrap-Up (SciTrek Leader) – 3 minutes

Materials:

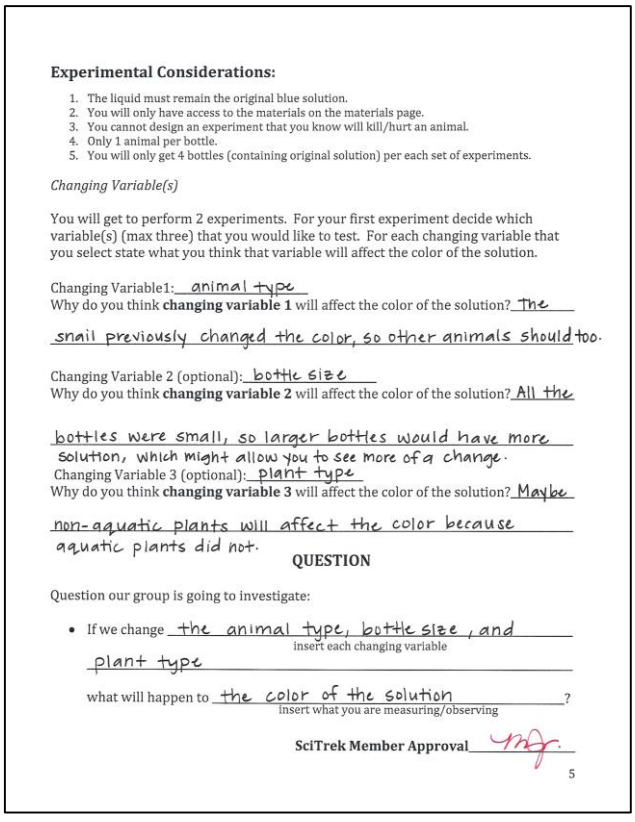
(3) Volunteer Boxes:

- ☐ Student nametags
- ☐ Volunteer lab coat
- ☐ Pencil
- ☐ Student notebooks
- ☐ (2) Red pens
- ☐ (3) Materials pages (group color & number indicated)
- ☐ Volunteer instructions
- ☐ Notepad

Lead Box:

- ☐ (5) Blank nametags
- ☐ Lead lab coat
- ☐ Notepad
- ☐ Time card
- ☐ (3) Extra student notebooks
- ☐ (3) Markers (orange, green, blue)
- ☐ (2) Pencils
- ☐ Lead instructions
- ☐ (2) Red pens
- ☐ (3) Materials pages

SciTrek Notebook Pages Used with Students:



Experimental Considerations:

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

Changing Variable(s)

You will get to perform 2 experiments. For your first experiment decide which variable(s) (max three) that you would like to test. For each changing variable that you select state what you think that variable will affect the color of the solution.

Changing Variable1: animal type
Why do you think **changing variable 1** will affect the color of the solution? The snail previously changed the color, so other animals should too.

Changing Variable 2 (optional): bottle size
Why do you think **changing variable 2** will affect the color of the solution? All the bottles were small, so larger bottles would have more solution, which might allow you to see more of a change.

Changing Variable 3 (optional): plant type
Why do you think **changing variable 3** will affect the color of the solution? Maybe non-aquatic plants will affect the color because aquatic plants did not.

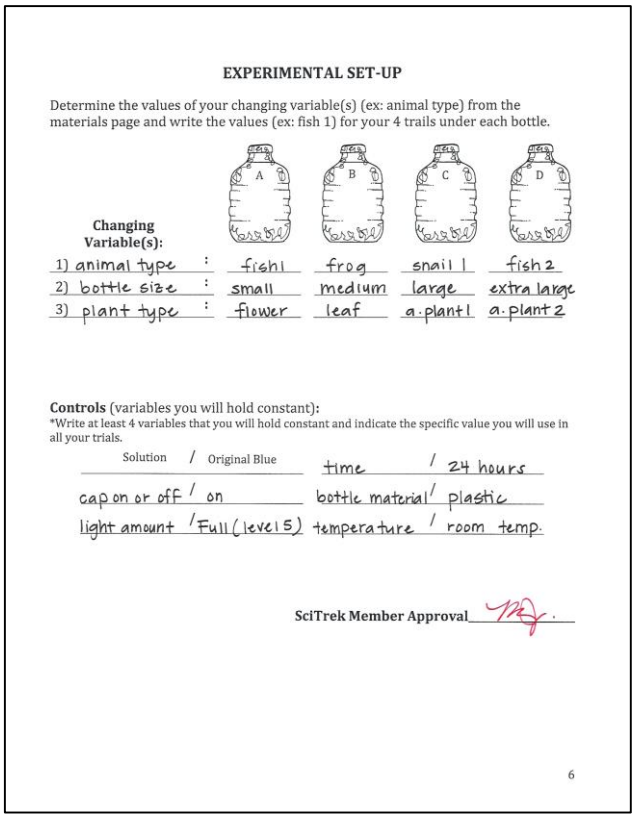
QUESTION

Question our group is going to investigate:

- If we change the animal type, bottle size, and plant type (insert each changing variable)
  what will happen to the color of the solution (insert what you are measuring/observing)?

SciTrek Member Approval MJ.

5



EXPERIMENTAL SET-UP

Determine the values of your changing variable(s) (ex: animal type) from the materials page and write the values (ex: fish 1) for your 4 trails under each bottle.

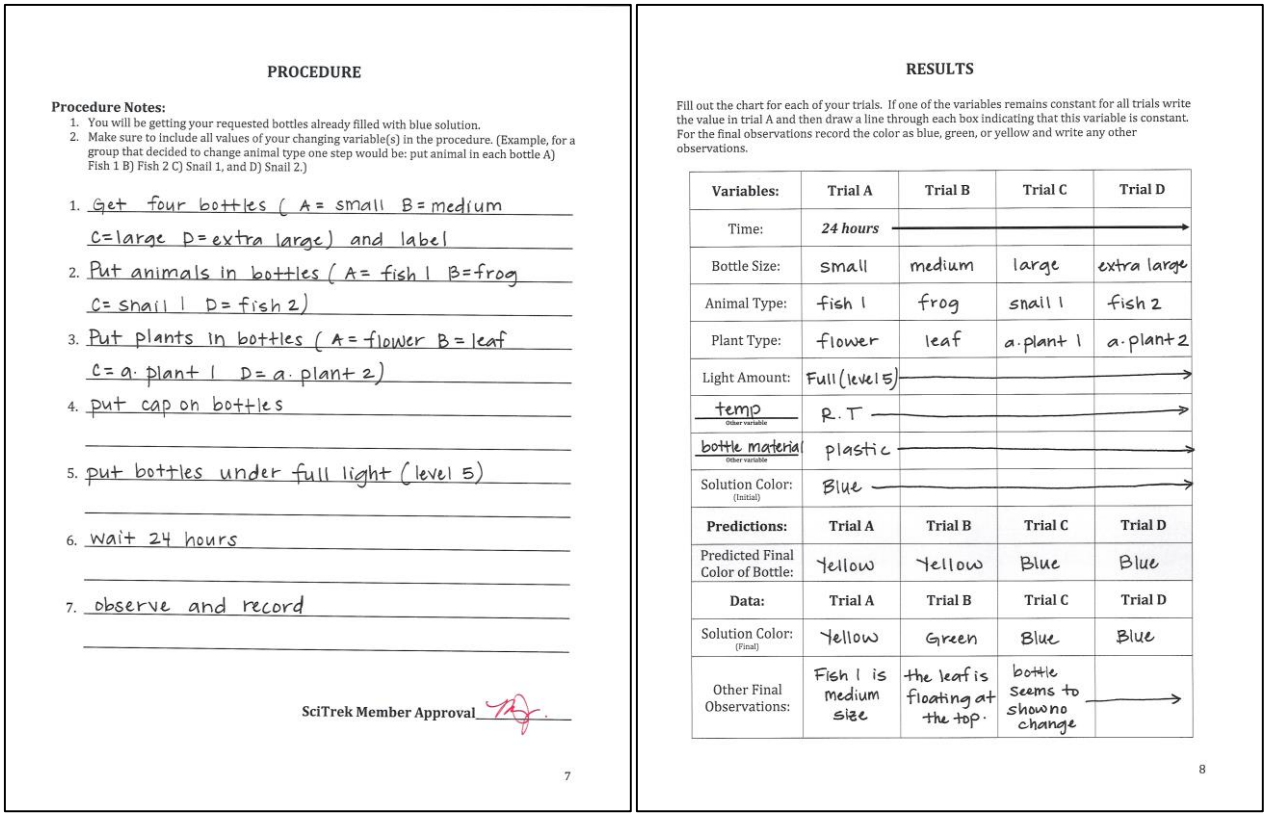
Changing Variable(s):	A	B	C	D
1) animal type :	fish1	frog	snail 1	fish 2
2) bottle size :	small	medium	large	extra large
3) plant type :	flower	leaf	a.plant1	a.plant 2

Controls (variables you will hold constant):
*Write at least 4 variables that you will hold constant and indicate the specific value you will use in all your trials.

Solution / Original Blue	time / 24 hours
cap on or off / on	bottle material / plastic
light amount / Full (level 5)	temperature / room temp.

SciTrek Member Approval MJ.

6



PROCEDURE

Procedure Notes:

1. You will be getting your requested bottles already filled with blue solution.
2. Make sure to include all values of your changing variable(s) in the procedure. (Example, for a group that decided to change animal type one step would be: put animal in each bottle A) Fish 1 B) Fish 2 C) Snail 1, and D) Snail 2.)

1. Get four bottles (A = small B = medium C = large D = extra large) and label
2. Put animals in bottles (A = fish 1 B = frog C = snail 1 D = fish 2)
3. Put plants in bottles (A = flower B = leaf C = a. plant 1 D = a. plant 2)
4. put cap on bottles
5. put bottles under full light (level 5)
6. wait 24 hours
7. observe and record

SciTrek Member Approval

7

RESULTS

Fill out the chart for each of your trials. If one of the variables remains constant for all trials write the value in trial A and then draw a line through each box indicating that this variable is constant. For the final observations record the color as blue, green, or yellow and write any other observations.

Variables:	Trial A	Trial B	Trial C	Trial D
Time:	24 hours →			
Bottle Size:	small	medium	large	extra large
Animal Type:	fish 1	frog	snail 1	fish 2
Plant Type:	flower	leaf	a. plant 1	a. plant 2
Light Amount:	Full (level 5) →			
temp (Other variable)	R. T →			
bottle material (Other variable)	plastic →			
Solution Color: (Initial)	Blue →			
Predictions:	**Trial A**	**Trial B**	**Trial C**	**Trial D**
Predicted Final Color of Bottle:	Yellow	Yellow	Blue	Blue
Data:	**Trial A**	**Trial B**	**Trial C**	**Trial D**
Solution Color: (Final)	Yellow	Green	Blue	Blue
Other Final Observations:	Fish 1 is medium size	the leaf is floating at the top.	bottle seems to show no change →	

8

Set-Up:

SciTrek Leader:

Make sure that each of the larger groups (~10 students) are divided into three smaller groups (3-4 students). When dividing the students into smaller groups, try to form mixed gendered/ability groups. Indicate which group each student is in by putting a corresponding number on the front cover of each student's SciTrek notebook (to be done before arriving to the class).

If the classroom has a document camera ask the teacher to use it for the question, experimental set-up, and results examples (page 5, 6, and 8). If the classroom does not have a document camera, then tape the example poster size notebook pages to the front board.

SciTrek Volunteer:

Set out the SciTrek notebooks/nametags around the table, making sure to set students that are in the same small group next to each other. Have materials pages ready with group numbers and color filled out to give to students after they complete their questions. Have a red pen available to sign-off on students' question, experimental set-up, and procedure (pages 5, 6 and 7).

Introduction *(13 minutes – Full Class – SciTrek Leader):*

Ask the students what they did the last meeting with SciTrek. They should reply that they were looking at bottles and they observed that the bottles with nothing and the bottle with an aquatic plant remained blue while the bottle with an aquatic snail turned yellow over the course of 24 hours. Ask the class if they remember the class question they decided to investigate. They should reply, "What factors affect the color of the solution?" Tell students that one way scientists answer questions is by performing

experiments and today they will design an experiment to help answer the class question. Ask the class if they think there are multiple factors that could affect the color of the solution. They should respond that there probably are multiple factors. Therefore, each group is going to generate a smaller question to investigate. However, once we put all the group's research together we should be able to answer the class question. Once each group has generated a question they will determine the values of their changing variable(s) and then determine their controls, this is sometimes known as an experimental set-up. After they have generated their experiment set-up they will write a list of steps to follow during their experiment, also known as a procedure. Tell the students that they need to keep a few things in mind when they are going through this process of designing their experiment.

Experimental Considerations:

1. The liquid must remain the original blue solution.
2. You will only have access to the materials on the materials page.
3. You cannot design an experiment that you know will kill/hurt an animal.
4. You can only put 1 animal in a bottle.
5. You will only get 4 bottles (containing original solution) per each set of experiments.

Tell the students we are now going to generate an example question/experimental set-up together and that you will fill it in on an example notebook so that they will be able to refer back to it when they are completing the process themselves. Make sure that students DO NOT fill out the example question/experimental set-up in their notebooks.

Ask the students what is one variable that they think might affect the color of the solution (example answer: animal type). For whatever variable is chosen have the students tell you how they think this variable will affect the color (example answer: the snail turned the solution yellow the first day, therefore, maybe all animals will turn the solution yellow). Then ask them if we were to pick values for this variable would we want a narrow or a wide range of values and why (example answer: we would want as many different animal types as possible so that we could see if they all changed the color of the solution). Then write down the suggested variable on the example notebook (page 5) under the document camera. Ask the students if they think any other variable will affect the color of the solution (example answer: bottle size). Then ask them to tell you why they think this variable will affect the color (example answer: the color change in the bottle was very slow with the snail so the larger the bottle the slower the change will be). Finally, ask them if we were to pick values for this variable would we want a narrow or a wide range of values for this variable and why (example answer: we would like a wide range of bottle sizes to see the effects easier). Then write down the second changing variable on the example notebook. Do not fill in the third changing variable blank or the blanks to explain why they think each changing variable would affect the color of the solution. Tell the students when they are going through this process in their small groups they can generate one, two, or three changing variable(s) they will investigate.

Show students how to insert their changing variable(s) into the question frame to find the question they will investigate. For the changing variables above the question would be: If we change the animal type and the bottle size what will happen to the color of the solution?

Tell them once they have determined their question and had it approved by their SciTrek lead, their SciTrek lead will give them a materials page so that they can determine the values of their changing variable(s) and controls. Ask students if they know how scientists define controls. Make sure that by the end of the conversation students understand that controls are variables that are held constant during an experiment. An example would be if the cap was on all of the bottles then one of their controls would be cap on.

Show the students the materials page and have them help you decide the values for the changing variables. Tell them that they need to pay attention to the items that have maximums on them and that they cannot go over the maximums. If they choose a value contrary to how they said they would design the experiment, question them on why they are doing this. Example: if they said they wanted to use a wide range of bottle sizes and then picked two of the bottles to be small bottles ask them why they did this, and if this would allow them to best answer their question. Then allow them to change their values if needed. See example notebook below for possible class choices.

Write these values on the example notebook. In addition, show them how to select the materials that they will need on the materials page.

Once they have determined the values of their changing variables have them generate a list of controls. First generate 5 things that could be controls and then show them the materials page again and have them fill in the values. For example the controls could be: plant type, cap on/off, time, light amount, bottle material. Write these variables on the left side of each of the slashes in the example notebook. Then have them use the materials page to determine the exact values that they will use for each control. After each value is selected ask the class if having that value would make it easier or harder for them to find the answer to their question. For instance, if one of their constants was aquatic plant 1, ask them will it be harder or easier to determine if bottle size and animal type is affecting the color of the solution if you also had aquatic plant 1 in all of the bottles. Hopefully, they will realize that having a plant present will make it harder to analyze their results. If they realize this might make their experiment more difficult, allow them to change their selection to none. Record all of the values of the controls on the right side of the slash. Also fill out the materials page appropriately. See example notebook/materials page below for possible class choices.

Tell students that once they have their experimental set-up complete they will get it approved by their SciTrek volunteer. After which they will write a procedure that they will be able to follow the next day. When writing their procedure they should keep in mind that they will get the bottles with the blue solution already in them. In addition, they should write all of the values of their changing variable(s) in their procedure. Show students the example procedure step on page 7 in their notebooks (put animal in each bottle A) fish 1, B) fish2, C) snail 1, and D) snail 2). Once their procedure is completed they will get it approved by a SciTrek volunteer and then they will fill out their results table so they will be ready to start their experiment during SciTrek's next visit. Put the results table (page 8) under the document camera. Tell students when they have a variable that is a constant they will just write it in trial A and then draw a line through the remaining trials. Put one or two of the class constants in the table. However, if a variable is a changing variable then the values need to be written in all of the boxes. Record the class changing variable values in the appropriate boxes. Tell students the last thing they will need to do is make predictions about the color each of the bottles will be at the end of the experiment. Show them where to fill this in on the results table but do not fill the predictions in for the class.

Tell students that they will now get into groups and design their experiments. Leave the question/experimental set-up on the document camera so that students can refer back to it as they design their experiments. Below is an example of what should be filled in with the students during the introduction. Note that several sections are left blank.

Experimental Considerations:

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

Changing Variable(s)

You will get to perform 2 experiments. For your first experiment decide which variable(s) (max three) that you would like to test. For each changing variable that you select state what you think that variable will affect the color of the solution.

Changing Variable1: animal type
Why do you think **changing variable 1** will affect the color of the solution?_____

Changing Variable 2 (optional): bottle size
Why do you think **changing variable 2** will affect the color of the solution?_____

Changing Variable 3 (optional):_____
Why do you think **changing variable 3** will affect the color of the solution?_____

QUESTION

Question our group is going to investigate:

- If we change the animal type and the bottle size
  (insert each changing variable)
  what will happen to the color of the bottles?
  (insert what you are measuring/observing)

SciTrek Member Approval_____

5

Color:_____
Group:_____

MATERIALS PAGE

You will only have access to the following materials.

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

Size of Bottle	Number of Bottles
Small	1
Medium (Max 1)	1
Large (Max 1)	1
XLarge (Max 1)	1

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

Aquatic Plant	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 Plant	Number of Plants
Tree Leaf (Max 1)	
Flower (Max 1)	

Animals: You may only have a total of 4 animals.

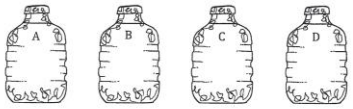
Type of Animal	Number of Animal
Snail 1	1
Snail 2 (Max 1) *You may only select if you are receiving the other snail*	
Fish 1	1
Fish 2	1
Frog (Max 1)	1

Light Amount: Put a check mark next to the amount of light that you would like to use.

Amount of Light	(Place a X here)
Level 5 (Full Light)	X
Level 4	
Level 3	
Level 2	
Level 1	
Level 0 (No Light)	

EXPERIMENTAL SET-UP

Determine the values of your changing variable(s) (ex: animal type) from the materials page and write the values (ex: fish 1) for your 4 trails under each bottle.



Changing Variable(s):	A	B	C	D
1) animal type :	fish 1	frog	snail 1	fish 2
2) bottle size :	small	medium	large	extra large
3) :				

Controls (variables you will hold constant):
*Write at least 4 variables that you will hold constant and indicate the specific value you will use in all your trials.

Solution / Original Blue
plant type / none
cap on or off / on
time / 24 hours
light amount / Full (level 5)
bottle material / plastic

SciTrek Member Approval_____

6

RESULTS

Fill out the chart for each of your trials. If one of the variables remains constant for all trials write the value in trial A and then draw a line through each box indicating that this variable is constant. For the final observations record the color as blue, green, or yellow and write any other observations.

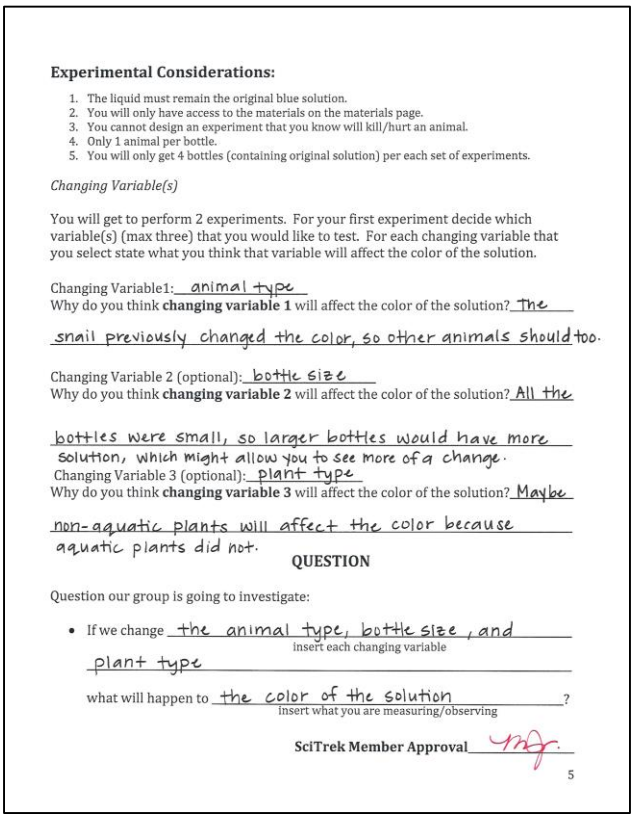
Variables:	Trial A	Trial B	Trial C	Trial D
Time:	24 hours →			
Bottle Size:	small	medium	large	extra large
Animal Type:	fish 1	frog	snail 1	fish 2
Plant Type:	none →			
Light Amount:	Full (level 5) →			
bottle material (Other variable)	plastic →			
(Other variable)				
Solution Color: (Initial)				
Predictions:	**Trial A**	**Trial B**	**Trial C**	**Trial D**
Predicted Final Color of Bottle:				
Data:	**Trial A**	**Trial B**	**Trial C**	**Trial D**
Solution Color: (Final)				
Other Final Observations:				

8

Question *(10 minutes – Small Groups – SciTrek Volunteers):*

Have students get into their small groups. Have them determine the variable(s) that will be their changing variable(s). If they only have one changing variable do not encourage them to have more than one changing variable and if they have three changing variables, do not encourage them to have fewer changing variables. Students will get to analyze their data and then perform an additional experiment to correct any mistakes that they made on their first experiment. Then have each group write why/how they think each changing variable will affect the color of the solution. After this is complete they can fill out their question. When you sign off on their question you can give them a materials page with their group color and number designated in the upper right hand corner. An example notebook is seen below.

Pick one student to share the question that their group is going to investigate during the class discussion.



Experimental Considerations:

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

Changing Variable(s)

You will get to perform 2 experiments. For your first experiment decide which variable(s) (max three) that you would like to test. For each changing variable that you select state what you think that variable will affect the color of the solution.

Changing Variable1: animal type
Why do you think **changing variable 1** will affect the color of the solution? The snail previously changed the color, so other animals should too.

Changing Variable 2 (optional): bottle size
Why do you think **changing variable 2** will affect the color of the solution? All the bottles were small, so larger bottles would have more solution, which might allow you to see more of a change.

Changing Variable 3 (optional): plant type
Why do you think **changing variable 3** will affect the color of the solution? Maybe non-aquatic plants will affect the color because aquatic plants did not.

QUESTION

Question our group is going to investigate:

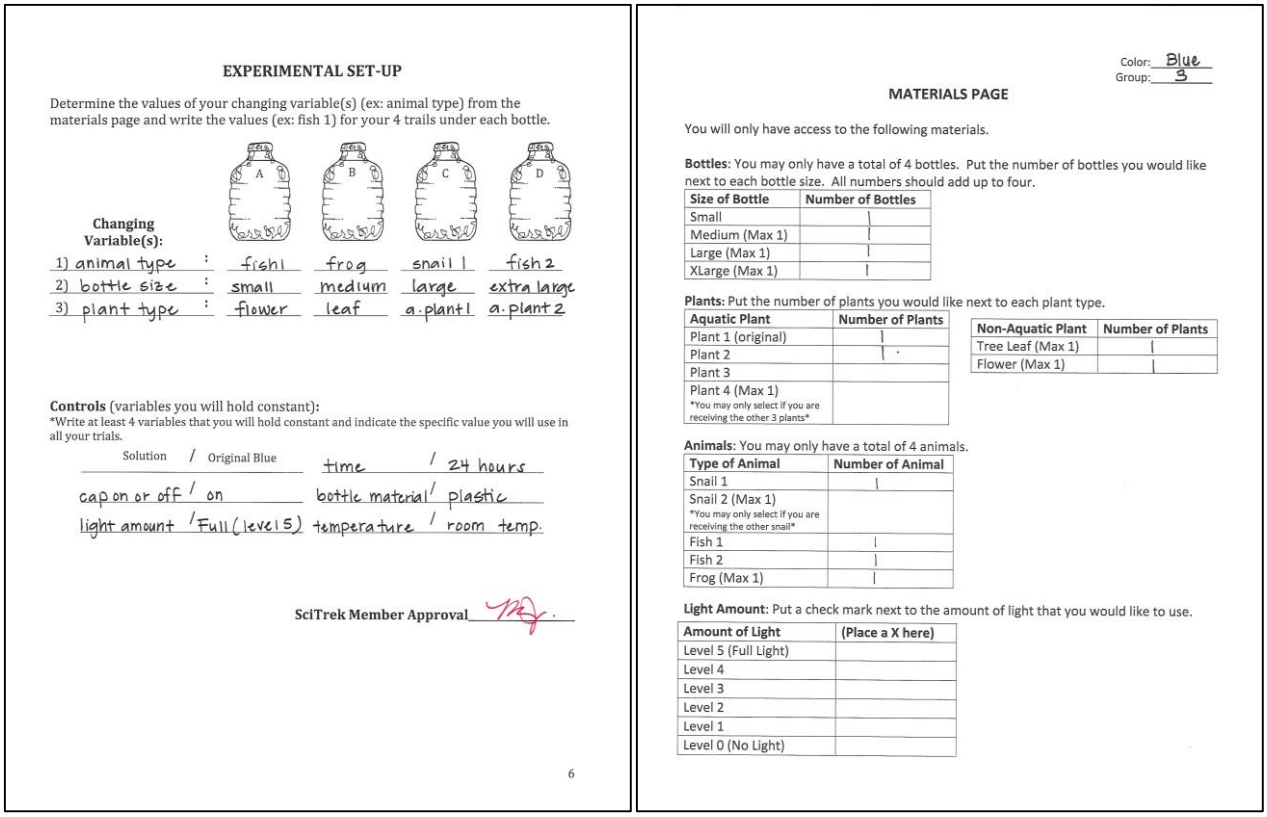
- If we change the animal type, bottle size, and plant type (insert each changing variable)
  what will happen to the color of the solution (insert what you are measuring/observing)?

SciTrek Member Approval MJ

5

Experimental Set-Up *(15 minutes – Small Groups – SciTrek Volunteers):*

Have groups determine the values for their changing variable(s) and record them in their experimental set-up, page 6. Then encourage students to determine what their controls are before they determine the values of their controls. Ask students to justify the values that they have chosen for their controls and have them tell you if these values will make it easier or harder to answer their question. When you sign off on their experimental set-up make sure that they have not gone over the maximum of any of the items on the materials page. In addition, collect the material page and make sure that it is filled out correctly and completely. It is essential for students to do this so that they can start their experiments during the next SciTrek visit. An example of the experimental set-up page in the notebook and materials page are seen below.



EXPERIMENTAL SET-UP

Determine the values of your changing variable(s) (ex: animal type) from the materials page and write the values (ex: fish 1) for your 4 trails under each bottle.

Changing Variable(s):	A	B	C	D
1) animal type :	fish1	frog	snail 1	fish 2
2) bottle size :	small	medium	large	extra large
3) plant type :	flower	leaf	a.plant1	a.plant 2

Controls (variables you will hold constant):
*Write at least 4 variables that you will hold constant and indicate the specific value you will use in all your trials.

Solution / Original Blue — time / 24 hours
cap on or off / on — bottle material / plastic
light amount / Full (level 5) — temperature / room temp.

SciTrek Member Approval

6

Color: Blue
Group: 3

MATERIALS PAGE

You will only have access to the following materials.

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

Size of Bottle	Number of Bottles
Small	1
Medium (Max 1)	1
Large (Max 1)	1
XLarge (Max 1)	1

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

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

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

Animals: You may only have a total of 4 animals.

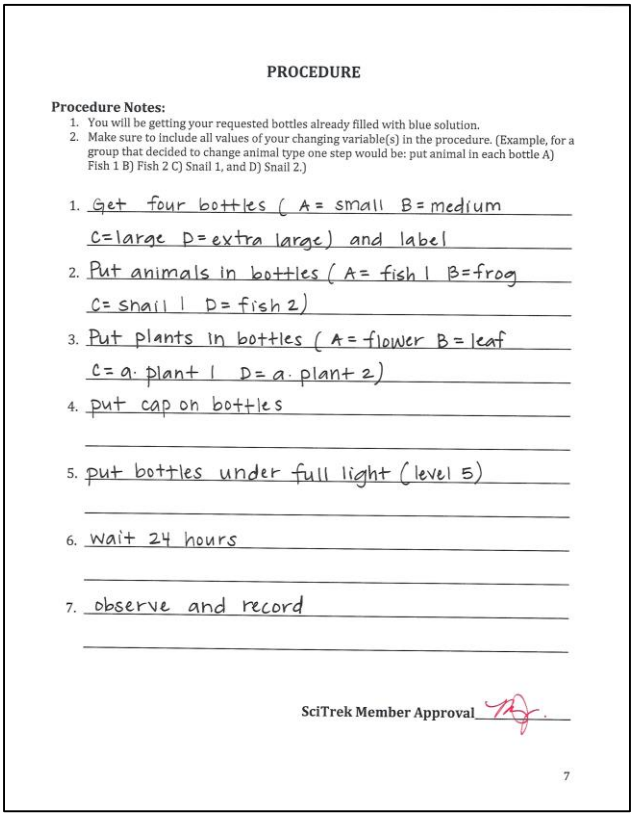
Type of Animal	Number of Animal
Snail 1	1
Snail 2 (Max 1) *You may only select if you are receiving the other snail*	
Fish 1	1
Fish 2	1
Frog (Max 1)	1

Light Amount: Put a check mark next to the amount of light that you would like to use.

Amount of Light	(Place a X here)
Level 5 (Full Light)	
Level 4	
Level 3	
Level 2	
Level 1	
Level 0 (No Light)	

Procedure *(14 minutes – Small Groups – SciTrek Volunteers):*

After each small group has filled out their experimental set-up they can start on their procedure (page 7). Once the students have their procedure written in their notebooks they should raise their hands and get the procedure approved by their SciTrek group volunteer. Some groups may struggle coming up with a procedure. You can have these groups dictate what they want to do for each step and you can write this on a notepad which can be found in your group box. You can then give this sheet to the students to copy into their notebooks. An example procedure can be found below. Make sure that you have students include all changing variables values in the procedure. Example step if animal type was one of the changing variables: put animal in each bottle A) fish 1, B) fish2, C) snail 1, and D) snail 2.



PROCEDURE

Procedure Notes:

1. You will be getting your requested bottles already filled with blue solution.
2. Make sure to include all values of your changing variable(s) in the procedure. (Example, for a group that decided to change animal type one step would be: put animal in each bottle A) Fish 1 B) Fish 2 C) Snail 1, and D) Snail 2.)

1. Get four bottles (A = small B = medium C = large D = extra large) and label
2. Put animals in bottles (A = fish 1 B = frog C = snail 1 D = fish 2)
3. Put plants in bottles (A = flower B = leaf C = a. plant 1 D = a. plant 2)
4. put cap on bottles
5. put bottles under full light (level 5)
6. wait 24 hours
7. observe and record

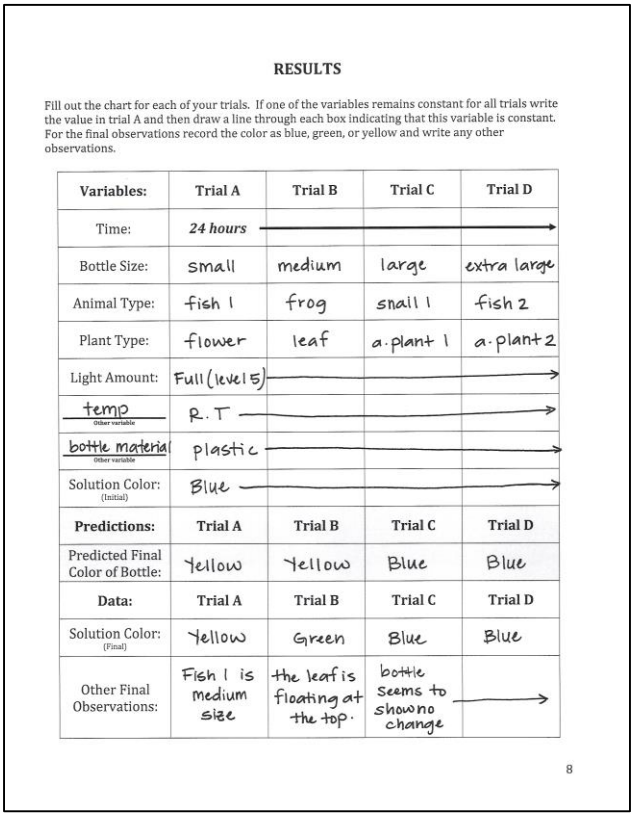
SciTrek Member Approval

7

Results Table *(5 minutes – Small Groups – SciTrek Volunteers):*

Have groups fill in their results table. Make sure that for their controls they are only writing the value of the control in trial A and then drawing a line through the remaining trials. For the changing variable(s) they need to write the value of the variable in each of the boxes. When students have finished have them make predictions about what color the bottles will be in 24 hours. Try to question each group on what their thought process was behind their predicted colors that they selected. See example notebook below.

If there is extra time have the group close their notebook and try to explain to each other what they will do for their experiment.



RESULTS

Fill out the chart for each of your trials. If one of the variables remains constant for all trials write the value in trial A and then draw a line through each box indicating that this variable is constant. For the final observations record the color as blue, green, or yellow and write any other observations.

Variables:	Trial A	Trial B	Trial C	Trial D
Time:	*24 hours* →			
Bottle Size:	small	medium	large	extra large
Animal Type:	fish 1	frog	snail 1	fish 2
Plant Type:	flower	leaf	a.plant 1	a.plant 2
Light Amount:	Full (level 5) →			
temp (Other variable)	R.T →			
bottle material (Other variable)	plastic →			
Solution Color: (Initial)	Blue →			
Predictions:	**Trial A**	**Trial B**	**Trial C**	**Trial D**
Predicted Final Color of Bottle:	Yellow	Yellow	Blue	Blue
Data:	**Trial A**	**Trial B**	**Trial C**	**Trial D**
Solution Color: (Final)	Yellow	Green	Blue	Blue
Other Final Observations:	Fish 1 is medium size	the leaf is floating at the top.	bottle seems to show no change →	

8

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

Have one group from each of the large groups share what question they are investigating. Tell the students that next time that SciTrek is here they will get to start their experiments.

Clean-Up:

Before you leave have the students attach their nametag to their notebook and place them in the group box. Place the materials pages on top of the notebooks in the boxes. Bring all materials back to UCSB. In addition, put your lab coats back into your group box.

Day 3: Experiment/Conclusion Activity

Schedule:

Introduction (SciTrek Leader) – 3 minutes
Experiment (SciTrek Volunteers) – 20 minutes
Conclusion Activity (SciTrek Leader) – 35 minutes
Wrap-Up (SciTrek Leader) – 2 minutes

Materials:

(3) Volunteer Boxes:

- ☐ Student nametags
- ☐ Volunteer lab coat
- ☐ Pencil
- ☐ Student notebooks
- ☐ Notepad
- ☐ Paper towels
- ☐ Volunteer instructions
- ☐ (2) Red pens
- ☐ (3) Black fine tipped Sharpies

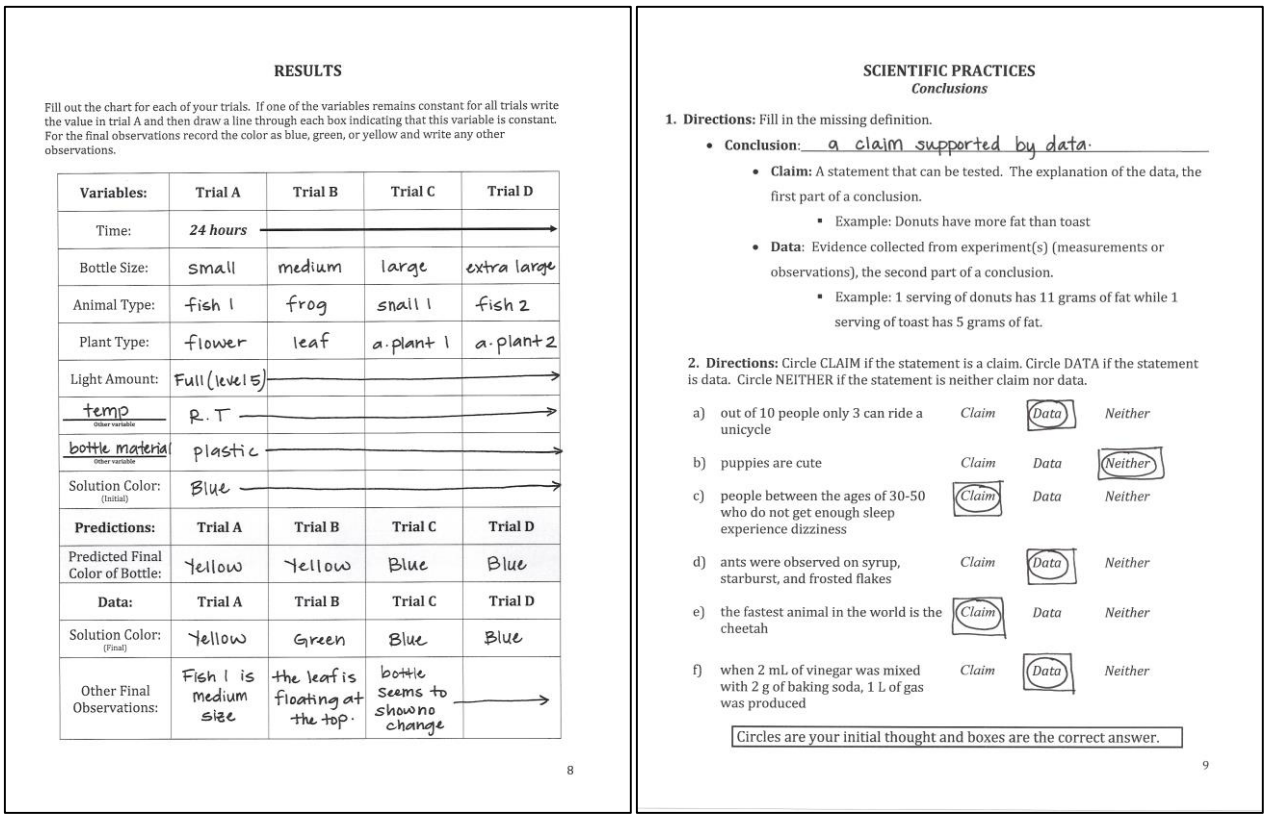
Other Supplies:

- ☐ (36) Bottles of blue solution (make sure to get requested sizes)
- ☐ (3) White rags
- ☐ Box with no holes labeled "level 0"
- ☐ Fish/frog container
- ☐ (4) Boxes with polarizing filter taped to top labeled with light level
- ☐ (2) Extension cords
- ☐ (3) Plant/snail containers that are labeled with the appropriate group color
- ☐ (5) Lamps with 60 W equivalent CFL blubs

Lead Box:

- ☐ (3) Extra notebooks
- ☐ Notepad
- ☐ (3) Black fine tipped Sharpies
- ☐ Time card
- ☐ Lead instructions
- ☐ (2) Red pens
- ☐ Paper towels
- ☐ Lead lab coat
- ☐ (2) Pencils
- ☐ Masking tape

SciTrek Notebook Pages Used With Students:



RESULTS

Fill out the chart for each of your trials. If one of the variables remains constant for all trials write the value in trial A and then draw a line through each box indicating that this variable is constant. For the final observations record the color as blue, green, or yellow and write any other observations.

Variables:	Trial A	Trial B	Trial C	Trial D
Time:	24 hours →			
Bottle Size:	small	medium	large	extra large
Animal Type:	fish 1	frog	snail 1	fish 2
Plant Type:	flower	leaf	a. plant 1	a. plant 2
Light Amount:	Full (level 5) →			
temp (Other variable)	R. T →			
bottle material (Other variable)	plastic →			
Solution Color: (Initial)	Blue →			
Predictions:	**Trial A**	**Trial B**	**Trial C**	**Trial D**
Predicted Final Color of Bottle:	Yellow	Yellow	Blue	Blue
Data:	**Trial A**	**Trial B**	**Trial C**	**Trial D**
Solution Color: (Final)	Yellow	Green	Blue	Blue
Other Final Observations:	Fish 1 is medium size	the leaf is floating at the top.	bottle seems to show no change →	

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SCIENTIFIC PRACTICES

Conclusions

1. **Directions:** Fill in the missing definition.
   - **Conclusion:** a claim supported by data.
     - **Claim:** A statement that can be tested. The explanation of the data, the first part of a conclusion.
       - Example: Donuts have more fat than toast
     - **Data:** Evidence collected from experiment(s) (measurements or observations), the second part of a conclusion.
       - Example: 1 serving of donuts has 11 grams of fat while 1 serving of toast has 5 grams of fat.

2. **Directions:** Circle CLAIM if the statement is a claim. Circle DATA if the statement is data. Circle NEITHER if the statement is neither claim nor data.

a)	out of 10 people only 3 can ride a unicycle	Claim	(Data)	Neither
b)	puppies are cute	Claim	Data	(Neither)
c)	people between the ages of 30-50 who do not get enough sleep experience dizziness	(Claim)	Data	Neither
d)	ants were observed on syrup, starburst, and frosted flakes	Claim	(Data)	Neither
e)	the fastest animal in the world is the cheetah	(Claim)	Data	Neither
f)	when 2 mL of vinegar was mixed with 2 g of baking soda, 1 L of gas was produced	Claim	(Data)	Neither

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

9

SCIENTIFIC PRACTICES
Conclusions

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

Claim	because	Data
1. More people go to soccer matches than basketball games		a. 1 ml of diet coke weighs 5 grams and 1 ml of coke weighs 1.1 grams.
2. Spicy food causes heartburn		b. 50% of people get heartburn when they use hot sauce and 10% of people get heartburn when they don't use hot sauce.
3. Cars increase air pollution		c. smog has been recorded in areas with large numbers of cars.
4. Diet coke weighs less than regular coke		d. 10 people went to the movies while 15 went shopping.

SCIENTIFIC PRACTICES
Conclusions

Variables:	Trial A	Trial B	Trial C
Time:	24 hr	→	→
Berry Type:	None	→	→
Vegetable Type:	None	Eggplant	Red Onion
Light Amount:	Full Light Level 5	→	→
Solution Color: (Initial)	Orange	→	→
Data:	**Trial A**	**Trial B**	**Trial C**
Solution Color: (Final)	Orange	Purple	Purple

Directions: Circle CLAIM if the statement is an appropriate claim that can be made from the given results. Circle DATA if the statement is data that is consistent with the results. Circle OPINION if the statement is an opinion. Circle INCORRECT if the statement does not agree with the data table or has not been tested.

a) the light amount affects the color of the solution C — *Claim* *Data* *Opinion* (*Incorrect*)

b) the solution turns the color of the vegetables' skin C — (*Claim*) *Data* *Opinion* *Incorrect*

c) after 24 hrs in the solution, vegetables will change the color of the solution C — (*Claim*) *Data* *Opinion* *Incorrect*

d) vegetables that taste bad turn the solution purple O — *Claim* *Data* (*Opinion*) *Incorrect*

What data can be used to support the correct claim(s) above? it was observed that both eggplant and red onion (which have purple skin) turned the solution purple after 24 hours.

SCIENTIFIC PRACTICES
Conclusions

Variables:	Trial A	Trial B	Trial C
Time:	24 hr	→	→
Berry Type:	None	Strawberries	Raspberries
Vegetable Type:	None	→	→
Light Amount:	Full Light Level 5	Level 3	No Light Level 0
Solution Color: (Initial)	Orange	→	→
Data:	**Trial A**	**Trial B**	**Trial C**
Solution Color: (Final)	Orange	Red	Dark Red

a) the greater the mass of berries the redder the solution C — *Claim* *Data* *Opinion* (*Incorrect*)

b) it was observed when raspberries were put under level 0 light (no light) the solution turned dark red D — *Claim* (*Data*) *Opinion* *Incorrect*

c) when berries are present the solution stays orange C — *Claim* *Data* *Opinion* (*Incorrect*)

d) the lower the light amount the redder the solution C — *Claim* *Data* *Opinion* (*Incorrect*)

If no claim can be made from the data state why not. No claim can be made because there was more than one changing variable.

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

☐ YES ☒ NO

SCIENTIFIC PRACTICES
Conclusions

Decide if a claim/conclusion can be made for each of the following results tables.

Table A

Variables:	Trial A	Trial B
Time:	24 hr	12 hr
Berry Type:	Blueberries	Strawberries
Vegetable Type:	None	→
Light Amount:	Full Light Level 5	→
Solution Color: (Initial)	Orange	→
Data:	**Trial A**	**Trial B**
Solution Color: (Final)	Orange	Red

Can this person make a claim/conclusion? No

Table B

Variables:	Trial A	Trial B
Time:	24 hr	→
Berry Type:	Strawberries	→
Vegetable Type:	Eggplant	→
Light Amount:	Full Light Level 5	No Light Level 0
Solution Color: (Initial)	Orange	→
Data:	**Trial A**	**Trial B**
Solution Color: (Final)	Orange	Red

Can this person make a claim/conclusion? Yes

Table C

Variables:	Trial A	Trial B
Time:	24 hr	→
Berry Type:	Blueberries	Strawberries
Vegetable Type:	None	→
Light Amount:	Light Level 3	→
Solution Color: (Initial)	Orange	→
Data:	**Trial A**	**Trial B**
Solution Color: (Final)	Orange	Orange

Can this person make a claim/conclusion? Yes

Table D

Variables:	Trial A	Trial B
Time:	24 hr	→
Berry Type:	None	→
Vegetable Type:	Eggplant	Broccoli
Light Amount:	Full Light Level 5	Level 3
Solution Color: (Initial)	Orange	→
Data:	**Trial A**	**Trial B**
Solution Color: (Final)	Orange	Red

Can this person make a claim/conclusion? No

Set-Up:

SciTrek Leader:

If the classroom has a document camera, ask the teacher to use it for the conclusion activity (pages 9- 13). If the classroom does not have a document camera, then tape example poster size notebook pages to the front board.

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. Set up an additional lamp for level 5 lighting, note this will not be in a box. Do not plug extension cords into other extension cords.

SciTrek Volunteers:

Set out the SciTrek notebooks/nametags around the table, making sure to set students that are in the same small group next to each other.

Introduction *(3 minutes – Full Class – SciTrek Leader):*

Ask the class "what is the class question that we are investigating." The students should reply: what factors affect the color of the solution and how? Tell them: today they are going to start their experiment so that they can answer this question. However, before they can start their experiment they need to have their procedure initialed by their SciTrek volunteer as well as their results table filled out (most students will have completed this the day before).

Once this is done students will need to raise their hands and a SciTrek volunteer will bring them their four bottles with blue solution that they requested and a Sharpie. They will need to use the Sharpie to label their bottles with their group color, group number, and trial letter. After completing this they can raise their hand and their SciTrek volunteer will bring around the snails/plants to put in their bottles. Once their bottles are labeled and have plants and snails in them groups will then take any bottles that needs fish/frogs back to the materials table along with their notebook, open to the results table to you so that you can put in the requested fish and frogs. The bottles can then be put under the appropriate light amounts.

Experiment *(20 minutes – Small Groups – SciTrek Volunteers):*

If you still have groups that do not have their results table filled out, help them get it filled out. Once groups have their results table filled out give them their requested bottles and a Sharpie they can use to label bottles. Do not give out plants/snails unless students have their bottles properly labeled with their color, group number, and trial letter. When handing out plants/snails, check groups' results table/materials page to make sure that they requested the given plants/snails. Once groups have put snails/plants into bottles send them to the SciTrek lead to get their fish/frogs. Make sure that groups bring at least one student notebook open to the results table (page 8) with them when going to get fish/frogs. When groups have all materials in their bottles help them put the bottles under the appropriate light amount. If your group finishes early then have them start working on page 9 of their notebooks to determine if each statement is a claim, data, or neither. Then help other groups start their experiments as necessary.

Conclusion Activity *(35 minutes – Full Class – SciTrek Leader):*

Tell the students to turn to page 9 in their notebooks. Place a blank notebook under the document camera and turn to page 9.

Tell the students that before they start drawing conclusions from their own experiment, it is important to be able to recognize and understand other people's conclusions.

Ask the class, "What is a conclusion?"

After listening to the student's answers make sure that the students understand that a conclusion is **a claim supported by data**. Write this definition on page 9 of the example notebook for the students to copy.

Tell the students that in order to make a conclusion we need to make sure that we understand the difference between claim and data. First, read the claim definition and the example. Tell the students that a claim is something that we can verify by testing. Have the class generate approximately four examples of statements that are claims. After a student suggests a possible claim ask the class if the possible claim can be verified by testing. Have the class hold their thumb up if it is a claim and down if it is not. Then ask someone else in the class to propose how you would test this claim. Several examples are seen below.

Examples:
Claim: rabbits are faster than mice
Test: time rabbits and mice running a certain distance

Claim: giraffes are taller than horses
Test: measure the height of a horse and a giraffe

Claim: the average watermelon weighs more than the average pumpkin
Test: weigh pumpkins and watermelons to determine the average weight

Next, read the definition of data and the example aloud. Tell students that data often contains a numerical measurement such as a height (5 m) or a weight (20 kg). Ask the students if data has to contain a numerical measurement? Explain that data can also be in the form of observations. For example, plants are observed to have greener leaves when in direct light than in indirect light. When you want to identify if a statement is data look for measurements or words such as *recorded* or *observed* that allow you to know that an experiment was performed.

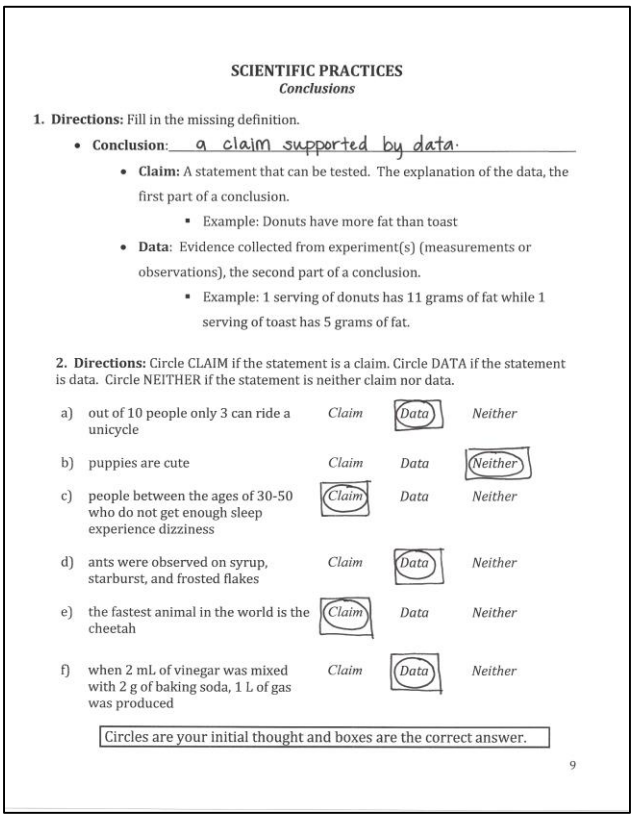
Ask the students if all statements have to be either a claim or data. Lead students into realizing that some statements are neither a claim nor data; a common example of a statement that is not a claim or data is an opinion statement. Have students generate approximately four examples of opinion statements that are neither claims nor data.

Example:
Watermelons taste better than pumpkins.
Rabbits are cuter than cats.

Read the directions to part 2 aloud to the class. Have students work on part 2 by themselves, circling what they think are the correct answers. Tell the students to look for clues in the sentences to identify if the statement is a claim, data, or neither. After everyone has had a chance to work through the activity (~3 minutes) go over the answers as a class.

Tell the students that we are now going to go over each answer and that they shouldn't erase their answers. Instead, tell the students to box the correct answers so that they will have an idea of which

concepts/categories they are struggling with. Have the students share what they think is the correct answer for each statement and why. Then have the class vote using thumbs up/thumbs down if they agree/disagree with what the student said. After the class has come to agreement, mark the correct answer on the example notebook for students to copy. If the statement is a claim, have the students tell what data they would need to collect to support the claim in order to make a conclusion. If the statement is data, have the students generate a claim that could be supported by that data to make a conclusion.



SCIENTIFIC PRACTICES
Conclusions

1. Directions: Fill in the missing definition.

- **Conclusion:** a claim supported by data.
  - **Claim:** A statement that can be tested. The explanation of the data, the first part of a conclusion.
    - Example: Donuts have more fat than toast
  - **Data**: Evidence collected from experiment(s) (measurements or observations), the second part of a conclusion.
    - Example: 1 serving of donuts has 11 grams of fat while 1 serving of toast has 5 grams of fat.

2. Directions: Circle CLAIM if the statement is a claim. Circle DATA if the statement is data. Circle NEITHER if the statement is neither claim nor data.

a)	out of 10 people only 3 can ride a unicycle	*Claim*	(*Data*)	*Neither*
b)	puppies are cute	*Claim*	*Data*	(*Neither*)
c)	people between the ages of 30-50 who do not get enough sleep experience dizziness	(*Claim*)	*Data*	*Neither*
d)	ants were observed on syrup, starburst, and frosted flakes	*Claim*	(*Data*)	*Neither*
e)	the fastest animal in the world is the cheetah	(*Claim*)	*Data*	*Neither*
f)	when 2 mL of vinegar was mixed with 2 g of baking soda, 1 L of gas was produced	*Claim*	(*Data*)	*Neither*

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

9

Below are the answers to part 2 letters a-f on page 9 in detail.

Letter a: out of 10 people only 3 can ride a unicycle
Data (Data Collected: counted number of people)

This is data because a scientist needed to count the number of people that could ride a unicycle and those that could not ride a unicycle. This could be paired with a claim to make the conclusion: more people do not know how to ride a unicycle than do know how to ride a unicycle because out of 10 people only 3 can ride a unicycle.

Letter b: puppies are cute
Neither- Opinion

This statement is neither data nor a claim because it is an opinion, and scientists cannot measure/observe opinions. An opinion can never be supported by data, therefore it cannot be a claim.

Letter c: people between the ages of 30-50 who do not get enough sleep experience dizziness
Claim

This is not an example of data, because this statement was not measured or observed. Instead it is a claim. Tell students that the numbers that are present in this claim are called descriptive numbers because they describe the experiment that would need to be run to test this claim. These are numbers that identify a group; therefore, they are not a collected measurement. Tell students that we need be able to distinguish between descriptive numbers and a collected measurements. Scientists can go out and collect data to support this claim. One piece of data that scientists could collect to support the claim is asking/counting the number of people, between the ages of 30-50, that feel dizzy after getting only 2 hours of sleep. This could be paired with data to make the conclusion: people between the ages of 30-50 who do not get enough sleep experience dizziness because fifty percent of people who only got two hour of sleep reported feeling dizzy while only one percent of people that got eight hours of sleep reported feeling dizzy.

Letter d: ants were observed on syrup, starburst, and frosted flakes
Data (Data Collected: observed ants)

This is an example of data because a scientist went out and observed that ants and saw them on syrup, starburst, and frosted flakes. This could be paired with a claim to make the conclusion: ants are attracted to sugar because ants were observed on syrup, starburst, and frosted flakes.

Letter e: the fastest animal in the world is the cheetah
Claim

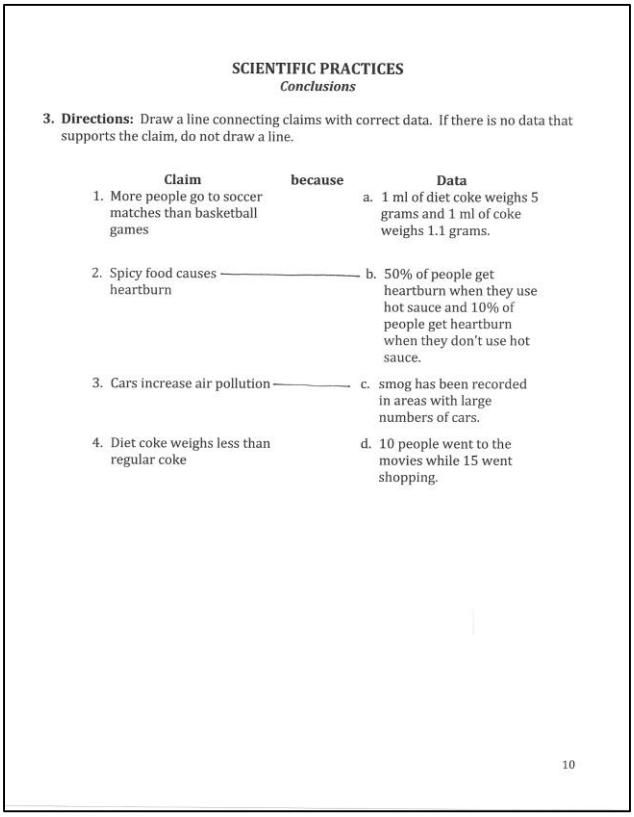
This is not an example of data, because this statement was not measured or observed. Instead it is a claim. Scientists can go out and collect data to support this claim. One piece of data that scientists could collect to support the claim is the speed of animals. This could be paired with data to make the conclusion: the fastest animal in the world is the cheetah because cheetahs can run up to 60 mph while the next fastest animal is the free tailed bat, which can only fly at 55 mph.

Letter f: when 2 mL of vinegar was mixed with 2 g of baking soda 1 liter of gas was produced
Data (Data Collected: measured amount of gas produced)

This is an example of data because a scientist went out and measured the amount of gas produced. This could be paired with a claim to make the conclusion: vinegar and baking soda undergo a chemical reaction when mixed because when 2 mL of vinegar was mixed with 2 g of baking soda 1 liter of gas was produced.

Once part 2 is complete have the students turn to page 10 in their notebooks. Tell the students that now they are going to practice matching claims with supporting data. Tell the class to read the statements carefully because not all of the claims will make a match to the data. Only draw lines between the claims that match up with data. Tell the students to work by themselves for the first couple of minutes (~2 minutes) and that afterwards we will go over the examples as a class.

Ask the class if anyone has identified a match. Read each suggestion that is made by a student and then ask the rest of the class if they agree/disagree using thumbs up/thumbs down. If they disagree, ask a student to tell why. Continue asking students if they are able to make any other connections until all possible matches are made.



SCIENTIFIC PRACTICES
Conclusions

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

Claim	because	Data
1. More people go to soccer matches than basketball games		a. 1 ml of diet coke weighs 5 grams and 1 ml of coke weighs 1.1 grams.
2. Spicy food causes heartburn		b. 50% of people get heartburn when they use hot sauce and 10% of people get heartburn when they don't use hot sauce.
3. Cars increase air pollution		c. smog has been recorded in areas with large numbers of cars.
4. Diet coke weighs less than regular coke		d. 10 people went to the movies while 15 went shopping.

10

Below are the correct matches that can be made from this activity

1. Spicy food causes heartburn because 50% of people get heartburn when they use hot sauce and 10% of people get heartburn when they don't use hot sauce.
   This is a correct match because the data clearly supports the claim using numerical values as data to make a conclusion.

2. Cars increase air pollution because smog has been recorded in areas with large numbers of cars.
   This is a correct match because the data clearly supports the claim using an observation as the data to make a conclusion.

Below are incorrect matches that can be made from this activity

3. Diet coke weighs less than regular coke because 1 ml of diet coke weighs 5 grams and 1 ml of coke weighs 1.1 grams.
   This is an incorrect match because the data does not support the claim. The claim says that diet coke weighs less than regular coke, however, the data supports the opposite claim that diet coke weighs more. Ask students when a claim and a data do not match which one are we allowed to change. Students should realize that claims can be changed but we cannot change data.

4. Soccer is enjoyed by more people than basketball because 10 people went to the movies while 15 went shopping.

This is an incorrect match because the data has nothing to do with and does not support the claim. This is therefore an incorrect conclusion.

Now have the students turn to page 11 in their notebooks. Turn the example notebook to page 11.

Tell the students to look over the data table. Ask a student to explain the experiment that was conducted. Make sure that they identify which are changing variables and which are controls. One possible answer would be: in this experiment different types of vegetables were put into an orange solution and the solution was allowed to sit for 24 hours. The changing variable was the vegetable type and the controls were the time, berry type, light amount, and initial solution color.

Ask students what two types of statements are needed to make a conclusion. Students should tell you that you need both a claim and supporting data to make a conclusion. Now ask students what is a claim. Students should remind you that a claim is the explanation of your data and a statement that can be verified by testing. Ask students what is data. Students should remind you that data is a measurement or observation that is made during an experiment that can be used to support a claim. Ask them if all statements have to be either claim or data. Students should say no; statements can also be opinions. Tell the students that we are now going to look over a list of statements about a given data set and then decide if each statement is an example of claim, data, or an opinion. In addition since we have the results table, we can also check to see if the statement is incorrect; the claim is incorrect if it does not agree with the data or the statement was not tested.

Tell students when determining the class (claim, data, opinion, or incorrect) of each statement the first thing they should do is read the statement and decide if the statements is claim, data, or and opinion. If the statement is a possible claim they should write a "c" by the statement, if the statement is possibly data they should write a "d" by the statement, if the statements is an opinion they should write an "o" by the statement. If they have identified if the statement as claim or data they will need to check to see if it is correct. For claims, the statement will be incorrect if it does not agree with the data or has not been tested. For data, the statement will be incorrect if it does not agree with the results.

Letter a: the light amount affects the color of the solution
Incorrect (Claim/Variable Held Constant)

Students should identify this statement as a possible claim and write a "c" next to the statement. This is a possible claim because the statement was not measured or observed and it is not an opinion. Ask the students if the scientists tested this claim and if the claim is consistent with the data. Students should see that the claim is made about the light amount; however, in the experiment this was a variable that was held constant. Since no data was collected on the effects of changing the light amount there is no data that could support this claim. Therefore, this claim is incorrect because it was not tested and students should circle incorrect.

Letter b: the solution turns the color of the vegetables' skin
Claim

Students should identify this statement as a possible claim and write a "c" next to the statement. This is a possible claim because the statement was not measured or observed and it is not an opinion. Ask the students if the scientists tested this claim and if the claim is consistent with the data. Students should see that the claim is made about vegetable type. Vegetable type was the changing variable in the experiment. In addition, the vegetables that were tested turn the solution the color of their skin, therefore, this claim is consistent with the data and students should circle claim.

Letter c: after 24 hrs in the solution, vegetables will change the color of the solution

Claim

Students should identify this statement as a possible claim and write a "c" next to the statement. This is a possible claim because the statement was not measured or observed and it is not an opinion. The number that is present in this claim (24 hrs) is called a descriptive numbers because it describes the experiment we would need to run to test this claim; therefore, it is not a collected measurement. Ask the students if the scientists tested this claim and if the claim is consistent with the data. Students should see that the claim is made about the vegetable type. Vegetable type was the changing variable in the experiment. In addition, all the vegetables changed the color of the solution, therefore, this claim is consistent with the data and students should circle claim.

Letter d: vegetables that taste bad turn the solution purple

Opinion

Students should identify this statement as an opinion and write an "o" next to the statement. This is an opinion because the statement was not measured or observed and it cannot be tested. The statement cannot be tested because different people will think that different vegetables taste bad, therefore, students should circle opinion.

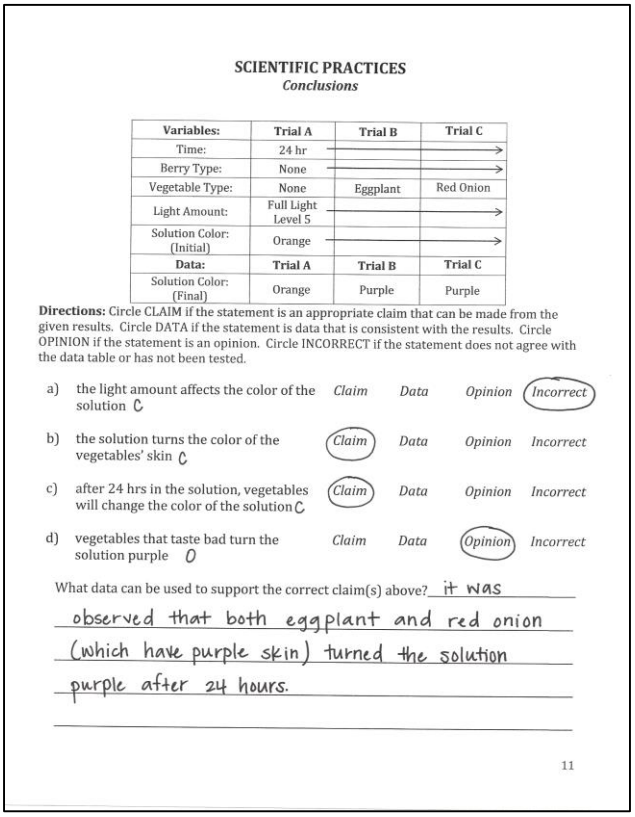
Ask the students if there can be multiple claims that can be made about a given set of results. The students should see that two different claims could be made from the data collected. Read the correct claims that can be made from the data to the students.

b) the solution turns the color of the vegetables' skin

c) after 24 hrs in the solution, vegetables will change the color of the solution

Ask the students which claim do they think gives the most information, or tries to explain why the solution is changing color? Students should realize that the claim, the solution turns the color of the vegetables' skin, gives the most data because it states <u>why</u> the solution might be changing colors. Tell them this type of claim also allows scientists to make predictions about systems that have not been experimented with yet. Encourage students to think about why their solutions are turning colors when they make a claim from their own data.

Ask the class what data from the results table can be used to support both of the claims they circled. Students should realize that both the claims can be supported by the same data because the claims are similar, however, one claim tries to explain <u>why</u> the color of the solution is changing and the other one just states that the color is changing (or <u>what</u> is changing the color of the solution). The data that supports both claims to make a conclusion is: it was *observed* that the eggplant and the red onion, both of which are purple skinned vegetables, turned the solution purple. Have students record this in their notebook.



SCIENTIFIC PRACTICES
Conclusions

Variables:	Trial A	Trial B	Trial C
Time:	24 hr	→	→
Berry Type:	None	→	→
Vegetable Type:	None	Eggplant	Red Onion
Light Amount:	Full Light Level 5	→	→
Solution Color: (Initial)	Orange	→	→
Data:	**Trial A**	**Trial B**	**Trial C**
Solution Color: (Final)	Orange	Purple	Purple

Directions: Circle CLAIM if the statement is an appropriate claim that can be made from the given results. Circle DATA if the statement is data that is consistent with the results. Circle OPINION if the statement is an opinion. Circle INCORRECT if the statement does not agree with the data table or has not been tested.

a) the light amount affects the color of the solution C — *Claim* *Data* *Opinion* (*Incorrect*)

b) the solution turns the color of the vegetables' skin C — (*Claim*) *Data* *Opinion* *Incorrect*

c) after 24 hrs in the solution, vegetables will change the color of the solution C — (*Claim*) *Data* *Opinion* *Incorrect*

d) vegetables that taste bad turn the solution purple O — *Claim* *Data* (*Opinion*) *Incorrect*

What data can be used to support the correct claim(s) above? it was observed that both eggplant and red onion (which have purple skin) turned the solution purple after 24 hours.

11

Have students turn to page 12 in their notebooks. Turn the example notebook to page 12.

Tell the students to look over the data table. Ask a student to explain the experiment that was conducted. Make sure that they identify which are changing variables and which are controls. One possible answer would be: in this experiment different types of berries were put into an orange solution and then put under different light amounts and the solution was allowed to sit for 24 hours. The changing variables were the berry type and light amount and the controls were the time, vegetable type, and initial solution color. Tell the students that we are now going to go through the same process that we went through with the last data set and we will identify if each of the given statements is a claim, data, opinion or if it is incorrect.

Letter a: the greater the mass of berries the redder the solution
Incorrect (Claim/No Data Gathered)

Students should identify this statement as a possible claim and write a "c" next to the statement. This is a possible claim because the statement was not measured or observed and it is not an opinion. Ask the students if the scientists tested this claim and if the claim is consistent with the data. Students should see that the claim is made about the mass of berries, however, this is a variable that was not measured for this experiment. Since no data was collected on the effects of the mass of the berries there is no data that could support this claim. Therefore, this claim is incorrect because it was not tested and students should circle incorrect.

Letter b: it was observed when raspberries were put under level 0 light (no light) the solution turned dark red

Data

Students should identify this statement as possibly data and write a "d" next to the statement. The statement is possibly data because it contains a measurement. Ask the students if the statement is consistent with the results. Students should see that the results agree with the statement, therefore, students should circle data.

Letter c: when berries are present the solution stays orange

Incorrect (Claim /Inconsistent with Data)

Students should identify this statement as a possible claim and write a "c" next to the statement. This is a possible claim because the statement was not measured or observed and it is not an opinion. Ask the students if the scientists tested this claim and if the claim is consistent with the data. Students should see that the claim is made about the berry type. Berry type was one of the changing variables in the experiment. However, when berries were present the solution turned red or dark red and did not stay orange, therefore, the claim is not consistent with the data and students should circle incorrect.

Letter d: the lower the light amount the redder the solution

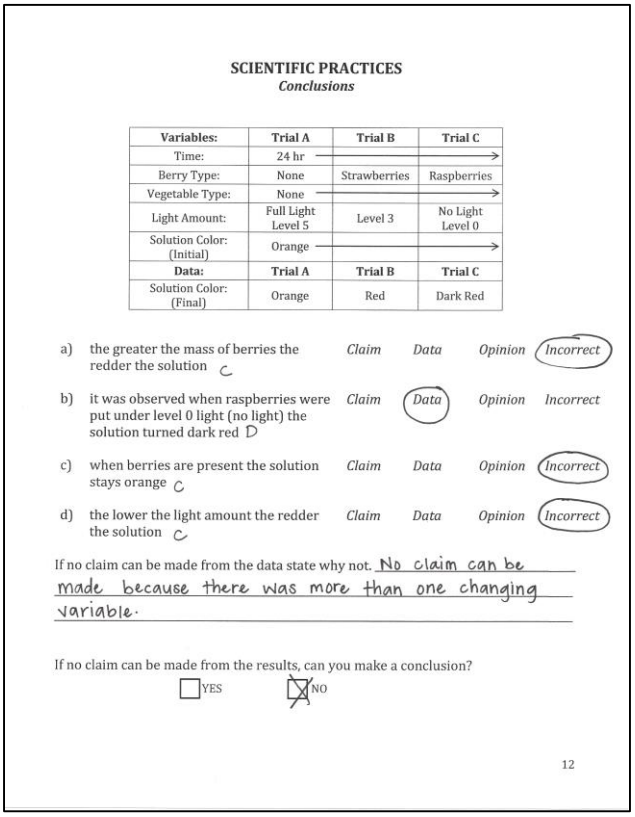
Incorrect (Claim/More than One Changing Variable)

Students should identify this statement as a possible claim and write a "c" next to the statement. This is a possible claim because the statement was not measured or observed and it is not an opinion. Ask the students if the scientists tested this claim and if the claim is consistent with the data. Students should see that the claim is made about the light amount. Light amount was one of the changing variables in the experiment, however, the berry type was also a changing variable and it is impossible to tell which of the two variables affected the solution color. Therefore, this is an inappropriate claim for these results, and students should circle incorrect.

Since none of the claims are correct (for the data in the results table) students should fill out the next question asking why no claim can be made from the data.

Ask the students why no claims can be made from the data. They should say that because there is more than one changing variable you cannot tell which variable affected the results or how/why these changing variables affected the color of the solution. Record this answer on the example notebook and have students copy this into their notebooks.

Ask the students if they think they would be able to make a conclusion when a claim cannot be made from the data. Since a conclusion is defined a claim supported by data, you would need both a claim and data to make a conclusion. Since no claims can be made, a conclusion cannot be made either. Have students check the "no" box in their notebook.



SCIENTIFIC PRACTICES
Conclusions

Variables:	Trial A	Trial B	Trial C
Time:	24 hr	→	→
Berry Type:	None	Strawberries	Raspberries
Vegetable Type:	None	→	→
Light Amount:	Full Light Level 5	Level 3	No Light Level 0
Solution Color: (Initial)	Orange	→	→
Data:	**Trial A**	**Trial B**	**Trial C**
Solution Color: (Final)	Orange	Red	Dark Red

a) the greater the mass of berries the redder the solution C — *Claim* *Data* *Opinion* *Incorrect*

b) it was observed when raspberries were put under level 0 light (no light) the solution turned dark red D — *Claim* *Data* *Opinion* *Incorrect*

c) when berries are present the solution stays orange C — *Claim* *Data* *Opinion* *Incorrect*

d) the lower the light amount the redder the solution C — *Claim* *Data* *Opinion* *Incorrect*

If no claim can be made from the data state why not. No claim can be made because there was more than one changing variable.

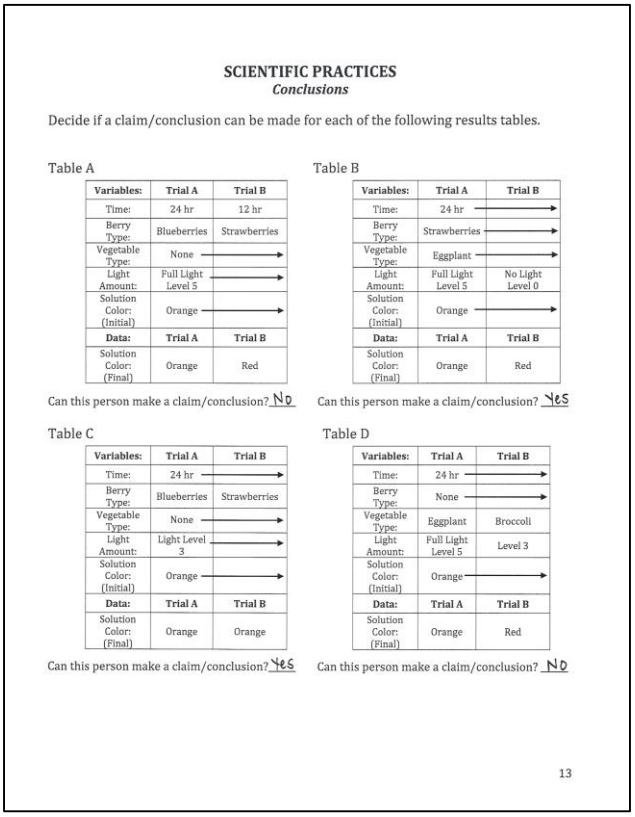
If no claim can be made from the results, can you make a conclusion?

☐ YES ☒ NO

12

Ask the students what did they learn about conclusions from this activity? Make sure by the end of the conversation that students understand that in order to draw a conclusion they must only have one changing variable.

Tell students they are now going to look at four results tables and determine which data sets would allow them to make a claim/conclusion. Tell them to look at data tables A- D, and underline the changing variable(s) for each table. They should then decide if a claim/conclusion can be made from the results. Give students ~1 minute to try the activity by themselves then talk about each of the tables as a class.



SCIENTIFIC PRACTICES
Conclusions

Decide if a claim/conclusion can be made for each of the following results tables.

Table A

Variables:	Trial A	Trial B
Time:	24 hr	12 hr
Berry Type:	Blueberries	Strawberries
Vegetable Type:	None →	
Light Amount:	Full Light Level 5 →	
Solution Color: (Initial)	Orange →	
Data:	**Trial A**	**Trial B**
Solution Color: (Final)	Orange	Red

Can this person make a claim/conclusion? No

Table B

Variables:	Trial A	Trial B
Time:	24 hr →	
Berry Type:	Strawberries →	
Vegetable Type:	Eggplant →	
Light Amount:	Full Light Level 5	No Light Level 0
Solution Color: (Initial)	Orange →	
Data:	**Trial A**	**Trial B**
Solution Color: (Final)	Orange	Red

Can this person make a claim/conclusion? Yes

Table C

Variables:	Trial A	Trial B
Time:	24 hr →	
Berry Type:	Blueberries	Strawberries
Vegetable Type:	None →	
Light Amount:	Light Level 3 →	
Solution Color: (Initial)	Orange →	
Data:	**Trial A**	**Trial B**
Solution Color: (Final)	Orange	Orange

Can this person make a claim/conclusion? Yes

Table D

Variables:	Trial A	Trial B
Time:	24 hr →	
Berry Type:	None →	
Vegetable Type:	Eggplant	Broccoli
Light Amount:	Full Light Level 5	Level 3
Solution Color: (Initial)	Orange →	
Data:	**Trial A**	**Trial B**
Solution Color: (Final)	Orange	Red

Can this person make a claim/conclusion? No

13

Table A

Ask students the following questions

What is/are the changing variable(s)? time and berry type
How many changing variables are there? 2
Can a conclusion/claim be made from this data? no
Why not? This experiment had 2 changing variables and conclusions/claims can only be made when there is one changing variable.

Table B

Ask students the following questions

What is/are the changing variable(s)? light amount
How many changing variables are there? 1
Can a conclusion/claim be made from this data? yes
Did the light affect the color of the solution? yes

Table C

Ask students the following questions

What is/are the changing variable(s)? berry type
How many changing variables are there? 1
Can a conclusion/claim be made from this data? yes
Did the type of berry effect the color of the solution? no

Table D

Ask students the following questions

What is/are the changing variable(s)? vegetable type and light amount
How many changing variables are there? 2
Can a conclusion/claim be made from this data? no
Why not? They had 2 changing variables and conclusions/claims can only be made when there is one changing variable.

Tell students that the next time we are here they will need to see if they can make a conclusion from their own data. Tell the students that the group that comes up with the best conclusion, or claim supported by data, will get a prize on the last day of the module. Remind them that it is okay if they cannot draw a conclusion from their first experiment because they will have the opportunity to run another experiment in which they should only have 1 changing variable so that they will be able to draw a conclusion.

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

Tell students that we will be back tomorrow to record the results of their first experiment. They will then need to decide if their group will be able to draw a conclusion. After which they can design and start their new experiment.

Clean-Up:

Before you leave have the students attach their nametag to their notebook and place them in the group box. Leave the lamps/ Xerox boxes in the classroom until experiments have been completed. Make sure to leave all lights on. Bring back all unused plants/animals and all other materials back to UCSB. In addition, put your lab coats back into your group box.

Day 4: Conclusion/Question/Experimental Set-Up/Procedure/Experiment

Schedule:

Introduction (SciTrek Leader) – 5 minutes
Record Data (SciTrek Volunteers) – 5 minutes
Conclusion (SciTrek Volunteers) – 10 minutes
Question (SciTrek Volunteers) – 5 minutes
Experimental Set-Up (SciTrek Volunteers) – 10 minutes
Procedure (SciTrek Volunteers) – 12 minutes
Experiment (SciTrek Volunteers) – 10 minutes
Wrap-Up (SciTrek Leader) – 3 minutes

Materials:

(3) Volunteer Boxes:

- ☐ Student nametags
- ☐ Volunteer lab coat
- ☐ Pencil
- ☐ (3) Materials pages
- ☐ Student notebooks
- ☐ Notepad
- ☐ Paper towels
- ☐ Volunteer instructions
- ☐ (2) Red pens
- ☐ (3) Black fine tipped Sharpies

Other Supplies:

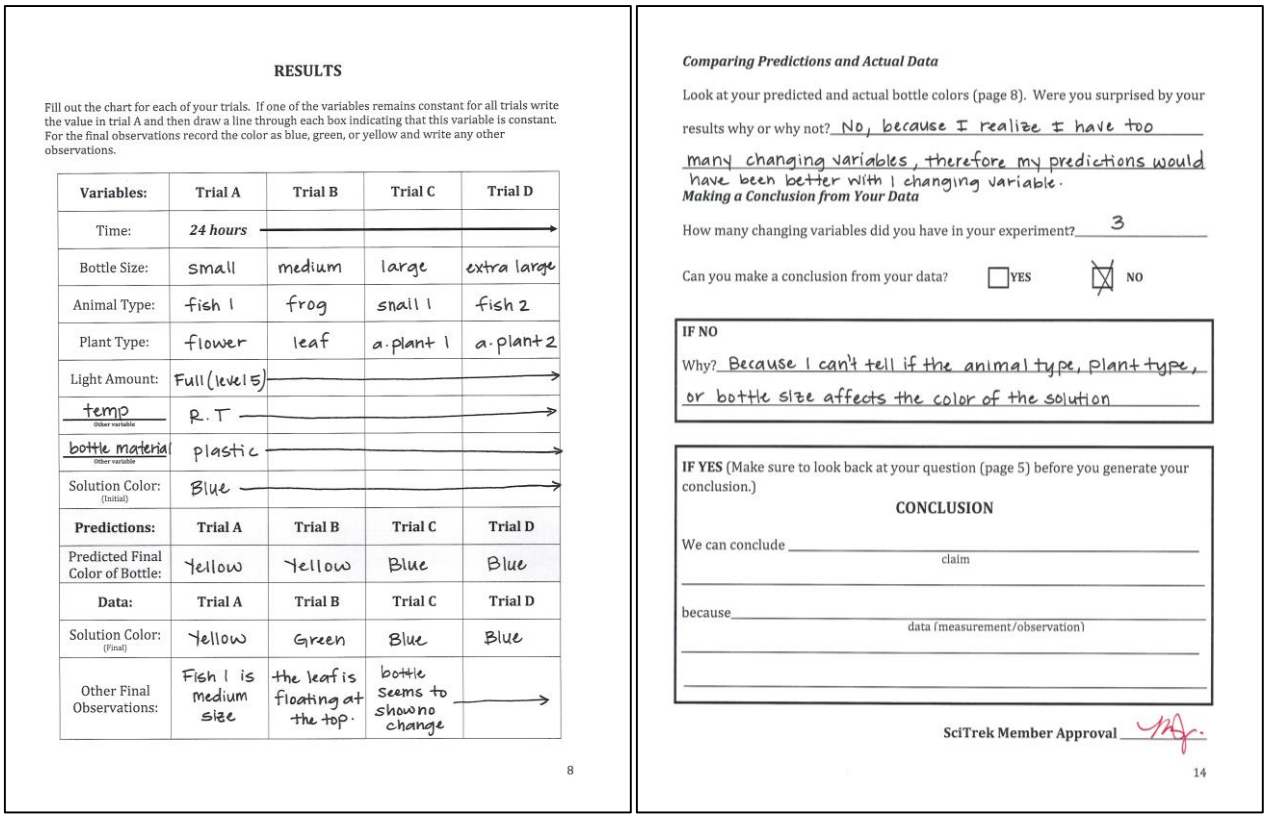
- ☐ (36) Small bottles of blue solution
- ☐ (3) Medium bottles of blue solution
- ☐ (3) Large bottles of blue solution
- ☐ (3) Extra Large bottles of blue solution
- ☐ Fish/frog container
- ☐ Plant/snail container
- ☐ (3) White rags
- ☐(2) Buckets
- ☐ Fish net

Lead Box:

- ☐ (3) Extra notebooks
- ☐ Lead instructions
- ☐ Lead lab coat
- ☐ Notepad
- ☐ (2) Red pens
- ☐ (2) Pencils
- ☐ (3) Black fine tipped Sharpies
- ☐ Paper towels
- ☐ Masking tape
- ☐ (3) Materials pages
- ☐ Time card

Note: The following items should already be in the classroom: 5 Lamps with 60 W equivalent CFL bulbs, 4 Xerox boxes with polarizing filter taped to the top labeled with light level, box with no holes labeled “level 0” and 2 extension cords

SciTrek Notebook Pages Used With Students:



RESULTS

Fill out the chart for each of your trials. If one of the variables remains constant for all trials write the value in trial A and then draw a line through each box indicating that this variable is constant. For the final observations record the color as blue, green, or yellow and write any other observations.

Variables:	Trial A	Trial B	Trial C	Trial D
Time:	*24 hours* →			
Bottle Size:	small	medium	large	extra large
Animal Type:	fish 1	frog	snail 1	fish 2
Plant Type:	flower	leaf	a. plant 1	a. plant 2
Light Amount:	Full (level 5) →			
temp (Other variable)	R. T →			
bottle material (Other variable)	plastic →			
Solution Color: (Initial)	Blue →			
Predictions:	**Trial A**	**Trial B**	**Trial C**	**Trial D**
Predicted Final Color of Bottle:	Yellow	Yellow	Blue	Blue
Data:	**Trial A**	**Trial B**	**Trial C**	**Trial D**
Solution Color: (Final)	Yellow	Green	Blue	Blue
Other Final Observations:	Fish 1 is medium size	the leaf is floating at the top.	bottle seems to show no change →	

8

Comparing Predictions and Actual Data

Look at your predicted and actual bottle colors (page 8). Were you surprised by your results why or why not? No, because I realize I have too many changing variables, therefore my predictions would have been better with 1 changing variable.

Making a Conclusion from Your Data

How many changing variables did you have in your experiment? 3

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

IF NO

Why? Because I can't tell if the animal type, plant type, or bottle size affects the color of the solution

IF YES (Make sure to look back at your question (page 5) before you generate your conclusion.)

CONCLUSION

We can conclude _____ (claim)

because _____ (data (measurement/observation))

SciTrek Member Approval _____

14

Changing Variables

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

Changing Variable1: animal type Changing Variable 2: _____

Changing Variable 3: _____

QUESTION

Question our group is going to investigate:

- If we change the animal type (insert each changing variable)

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

SciTrek Member Approval MJ.

EXPERIMENTAL SET-UP

Determine the values of your changing variable(s) (ex: animal type) from the materials page and write the values (ex: fish 1) for your 4 trails under each bottle.

Changing Variable(s):	E	F	G	H
1) animal type :	Frog	Fish 1	snail 1	snail 2
2) :				
3) :				

Controls (variables you will hold constant):
*Write at least 4 variables that you will hold constant and indicate the specific value you will use in all your trials.

Solution / Original Blue	bottle size / small
plant type / none	light amount / Full (level 5)
time / 24 hours	/

SciTrek Member Approval MJ.

PROCEDURE

Procedure Notes:
1. You will be getting your requested bottles already filled with blue solution.
2. Make sure to include all values of your changing variable(s) in the procedure. (Example, for a group that decided to change animal type one step would be: put animal in each bottle A) Fish 1 B) Fish 2 C) Snail 1, and D) Snail 2.)

1. Get 4 small bottles and label
2. Put animals in bottles (E = Frog F = Fish 1 G = snail 1 H = snail 2)
3. cap all bottles
4. Put bottles under full light (level 5)
5. wait 24 hours
6. observe and record color of solution
7.

SciTrek Member Approval MJ.

RESULTS

Fill out the chart for each of your trials. If one of the variables remained constant for all trails write the value in trial E and then draw a line through each box indicating that this variable is constant. For the final observations record the color as blue, green, or yellow and write any other observations.

Variables:	Trial E	Trial F	Trial G	Trial H
Time:	*24 hours* →			
Bottle Size:	small →			
Animal Type:	Frog	Fish 1	snail 1	snail 2
Plant Type:	none →			
Light Amount:	Full (level 5) →			
_____ (Other variable)				
_____ (Other variable)				
Solution Color: (Initial)	Blue →			
Predictions:	**Trial E**	**Trial F**	**Trial G**	**Trial H**
Predicted Final Color of Bottle:	Yellow	Yellow	Yellow	Yellow
Data:	**Trial E**	**Trial F**	**Trial G**	**Trial H**
Solution Color: (Final)	Yellow	Yellow	Green	Green
Other Final Observations:	Frog is at the top of the bottle.	Fish has gills that are moving very fast.	snail seems to be moving very little.	The snail is on the side of the bottle.

Set-Up:

SciTrek Leader:

If the teacher has a document camera ask them to use it to show students the pages that they will fill out today as part of the introduction (pages 8, 14- 17).

If there is extra time catch and release any living animals and put them into the animal container. If there is not enough time bring bottles, from experiment one, with animals in them back to the SciTrek office.

SciTrek Volunteers:

Set out SciTrek notebooks/nametags around the table making sure to set students that are in the same small group next to each other. Get the bottles from the first experiments and set them next to the appropriate group. Have a red pen available to sign-off on students' question, experimental set-up, and procedure in their SciTrek notebooks (pages 15- 17).

Introduction *(5 minutes – Full Class – SciTrek Leader):*

Note: If you did not have time to go over all of the data tables on page 13 of the student notebook. Start the day off by going over two of the tables.

Ask the class, what question are we working on answering? Students should reply "What factors affect the color of the solution? and How?" Tell the students they are going to record their results from their experiments that they started yesterday which will allow them to start answering the class question. First, they will record the color and other observations about the bottles in their results table. Then they will compare their predicted color of the bottle to the actual color of the bottle and think/write about how the predicted and actual colors compare to each other. Ask the class to look around at the bottles and identify the different colors they are observing. The students should reply blue, green, and yellow. Tell students that they will redesign and start a new experiment today. Ask them what color they think would be appropriate to predict for the colors of the bottles for the new experiment and why. The students should reply blue, green, or yellow because these are the only colors that they have ever seen the bottles change.

Tell students that once they have compared their predicted and actual colors of their bottles they will need to see if they can draw a conclusion from their results (observations). Ask the class what is the definition of a conclusion. They should state that a conclusion is a claim supported data. Therefore, to draw a conclusion first you need to make a claim that tries to explain the results of your experiment and then you need to highlight the appropriate data to back up that claim. Ask the students what we learned about claims the last time we were there. They should reply that in order to make a claim/conclusion you can only have one changing variable. Tell them that groups that had more than one changing variables will not be able to make a claim/conclusion because they will not know which of the changing variables affected the solution color. If there are groups that only had one changing variable they will be able to make a claim/conclusion. Tell the class not to worry if they cannot make a conclusion from their first experiment because they will get to design another experiment in which they will be able to make a claim/conclusion. Tell students to make sure they will be able to make a claim and draw a conclusion from their second experiment. The group that comes up with the best conclusion, or claim supported by data, from their experiments will get a prize at the end of the module.

Tell students that once they have decided if they can/cannot make a conclusion they will either state why they cannot make a conclusion or use their result to make a conclusion. Once this is complete they can move on to designing their new experiment. Tell them that they are going to give poster presentations at the end of the module and the presentations will be more interesting if there are multiple changing variables that have been tested. As a class, if there is a wide range of changing variables we will also be able to better answer the class question. Therefore, they should try to explore a changing variable that they think no one else in the class is investigating.

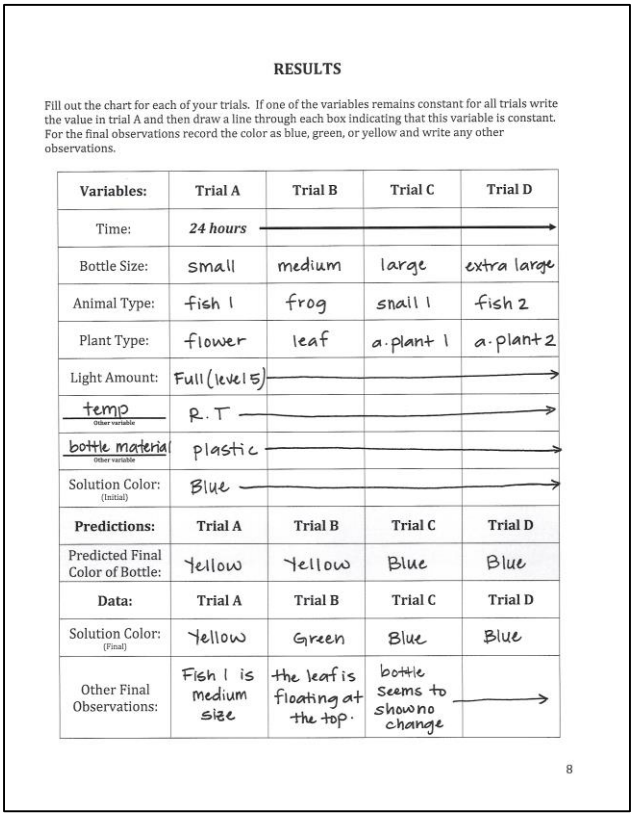
Tell students they will now start working with their group to analyze their old experimental results and start their new experiment.

Note: if the class has a document camera you can turn to the pages that you are talking about under the document camera as you talk with the class.

Record Data *(5 minutes – Small Groups – SciTrek Volunteers):*

If students do not already have their bottles help them get their bottles and record the color and other observations about their bottles in their results table, page 8.

Once the students have recorded their data you should remove their used bottles from them. Give the bottles to the SciTrek lead.



RESULTS

Fill out the chart for each of your trials. If one of the variables remains constant for all trials write the value in trial A and then draw a line through each box indicating that this variable is constant. For the final observations record the color as blue, green, or yellow and write any other observations.

Variables:	Trial A	Trial B	Trial C	Trial D
Time:	24 hours →			
Bottle Size:	small	medium	large	extra large
Animal Type:	fish 1	frog	snail 1	fish 2
Plant Type:	flower	leaf	a.plant 1	a.plant 2
Light Amount:	Full (level 5) →			
temp (Other variable)	R.T →			
bottle material (Other variable)	plastic →			
Solution Color: (Initial)	Blue →			
Predictions:	**Trial A**	**Trial B**	**Trial C**	**Trial D**
Predicted Final Color of Bottle:	Yellow	Yellow	Blue	Blue
Data:	**Trial A**	**Trial B**	**Trial C**	**Trial D**
Solution Color: (Final)	Yellow	Green	Blue	Blue
Other Final Observations:	Fish 1 is medium size	the leaf is floating at the top.	bottle seems to show no change →	

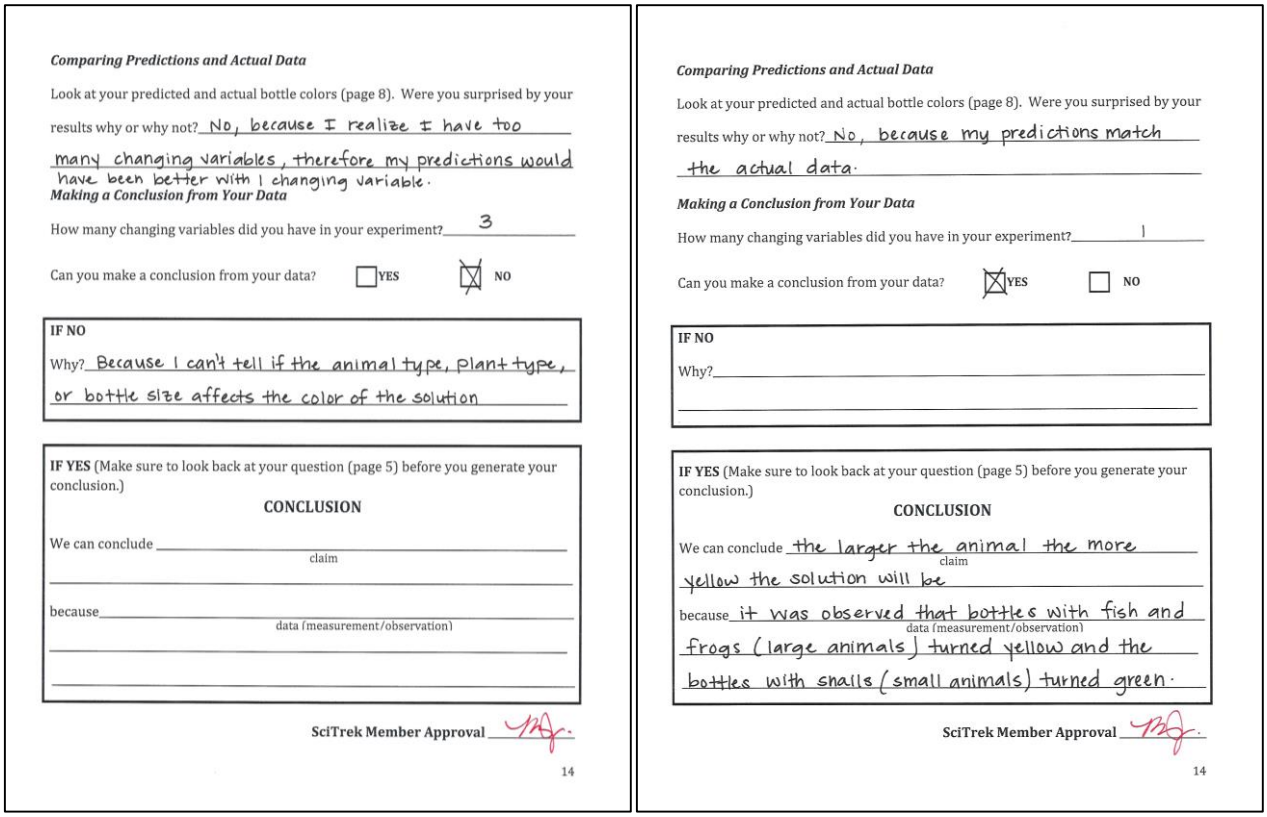
8

Conclusion *(10 minutes – Small Groups -SciTrek Volunteers):*

Have students answer the question about comparing predicted and actual data on page 14.
Once students have finished comparing their predicted and actual bottle colors have them decide if they can draw a conclusion from their data.

If the group has more than one changing variable they will not be able to draw a conclusion. An example of when the students cannot make a conclusion is seen below on the left.

If the group has only one changing variable they will be able to make a conclusion. Make sure that the students have both a claim and supporting data and that these statements are in the appropriately labeled sections. Even if their conclusion is contrary to what you think should be correct, make sure their claim is based on their data, not on what you think it should be. Remind students that they should include the words recorded or observed into their data statement so that other scientists will know that they collected the data. If you think that their data is flawed it is okay to ask them what they think went wrong, and tell the students that they can repeat their first experiment with only one changing variable for their next experiment. An example of when the students can make a conclusion is seen below on the right.



Comparing Predictions and Actual Data

Look at your predicted and actual bottle colors (page 8). Were you surprised by your results why or why not? No, because I realize I have too many changing variables, therefore my predictions would have been better with 1 changing variable.

Making a Conclusion from Your Data

How many changing variables did you have in your experiment? 3

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

IF NO

Why? Because I can't tell if the animal type, plant type, or bottle size affects the color of the solution

IF YES (Make sure to look back at your question (page 5) before you generate your conclusion.)

CONCLUSION

We can conclude _____ (claim)

because _____ (data (measurement/observation))

SciTrek Member Approval _____

14

Comparing Predictions and Actual Data

Look at your predicted and actual bottle colors (page 8). Were you surprised by your results why or why not? No, because my predictions match the actual data.

Making a Conclusion from Your Data

How many changing variables did you have in your experiment? 1

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

IF NO

Why? _____

IF YES (Make sure to look back at your question (page 5) before you generate your conclusion.)

CONCLUSION

We can conclude the larger the animal the more yellow the solution will be (claim)

because it was observed that bottles with fish and frogs (large animals) turned yellow and the bottles with snails (small animals) turned green. (data (measurement/observation))

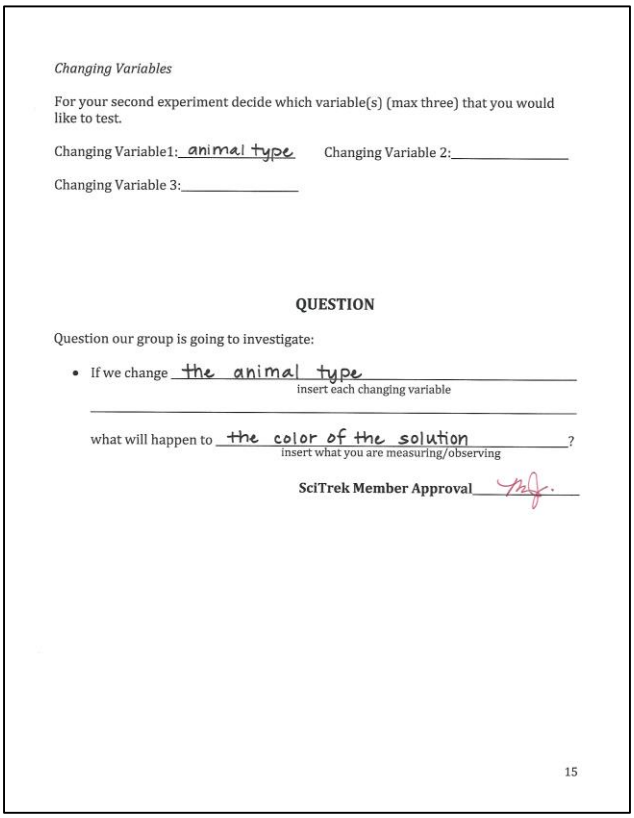
SciTrek Member Approval _____

14

Question *(5 minutes – Small Groups – SciTrek Volunteers):*

Have students determine what their changing variable will be for their second experiment. Make sure each group only has 1 changing variable so they will be able to make a claim/conclusion after their experiment. If possible, encourage your small groups to each have a different changing variable. After groups have decided on their changing variable have them fill out their question. When you sign off on

their question you can give them a materials page with their group color and number designated in the upper right hand corner.



Changing Variables

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

Changing Variable1: animal type Changing Variable 2:_____

Changing Variable 3:_____

QUESTION

Question our group is going to investigate:

- If we change the animal type (insert each changing variable)

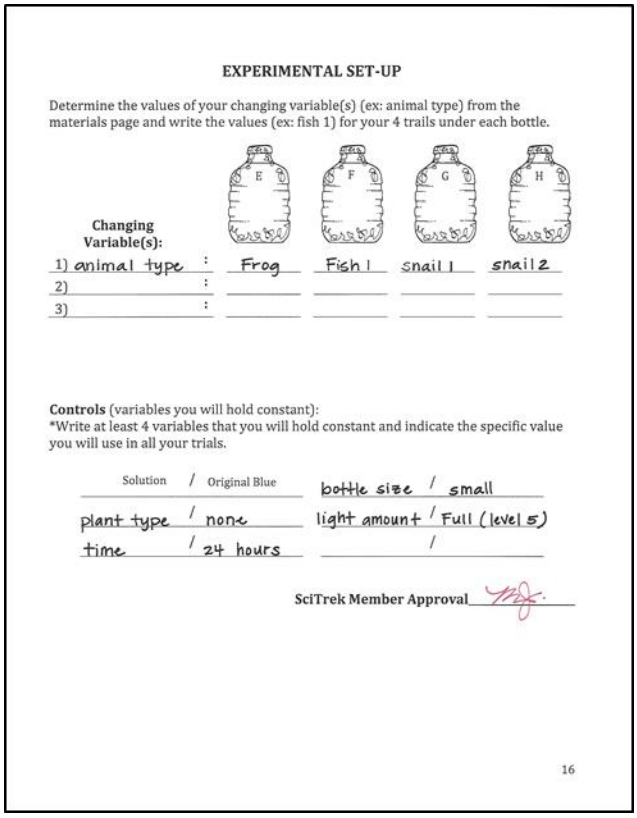
what will happen to the color of the solution (insert what you are measuring/observing)?

SciTrek Member Approval

15

Experimental Set-Up *(10 minutes – Small Groups – SciTrek Volunteers):*

Have groups determine the values for their changing variable and record them in their experimental set-up on page 16. Then encourage students to determine what their controls will be and have them record these constants on the left side of the line in their experimental set-up on page 16. After have the students determine the values of their controls with the help of the materials page. Ask students to justify the values that they have chosen for their controls and have them tell you if these values will make it easier or harder to answer their question. When you sign off on their experimental set-up make sure that they have not gone over the maximum of any of the items on the materials page. An example of notebook is seen below.



EXPERIMENTAL SET-UP

Determine the values of your changing variable(s) (ex: animal type) from the materials page and write the values (ex: fish 1) for your 4 trails under each bottle.

Changing Variable(s):	E	F	G	H
1) animal type :	Frog	Fish 1	snail 1	snail 2
2) :				
3) :				

Controls (variables you will hold constant):
*Write at least 4 variables that you will hold constant and indicate the specific value you will use in all your trials.

Solution / Original Blue	bottle size / small
plant type / none	light amount / Full (level 5)
time / 24 hours	/

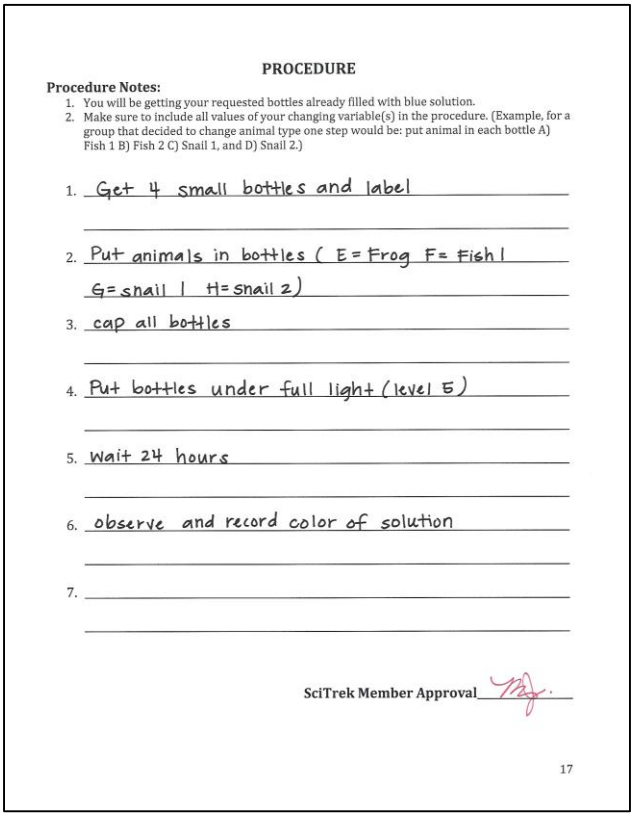
SciTrek Member Approval

16

Procedure *(12 minutes – Small Groups – SciTrek Volunteers):*

After each small group has filled out their experimental set-up they can start on their procedure. Once the students have their procedure written in their notebooks they should raise their hands and get the procedure approved by their SciTrek group leader. If they are having problems with their procedure they should look back at their initial procedure on page 7 of their notebook. If they are still having trouble they can dictate what they want to do for each step and you can write this on the notepad found in your group box. You can then give this sheet to the students for them to copy into their notebooks. An example procedure can be found below. Make sure that you have students include the values of the changing variable in the procedure.

Select one group member to read their question they are going to investigate to the class during the wrap-up discussion.



PROCEDURE

Procedure Notes:

1. You will be getting your requested bottles already filled with blue solution.
2. Make sure to include all values of your changing variable(s) in the procedure. (Example, for a group that decided to change animal type one step would be: put animal in each bottle A) Fish 1 B) Fish 2 C) Snail 1, and D) Snail 2.)

1. Get 4 small bottles and label
2. Put animals in bottles (E = Frog F = Fish 1 G = snail 1 H = snail 2)
3. cap all bottles
4. Put bottles under full light (level 5)
5. wait 24 hours
6. observe and record color of solution
7.

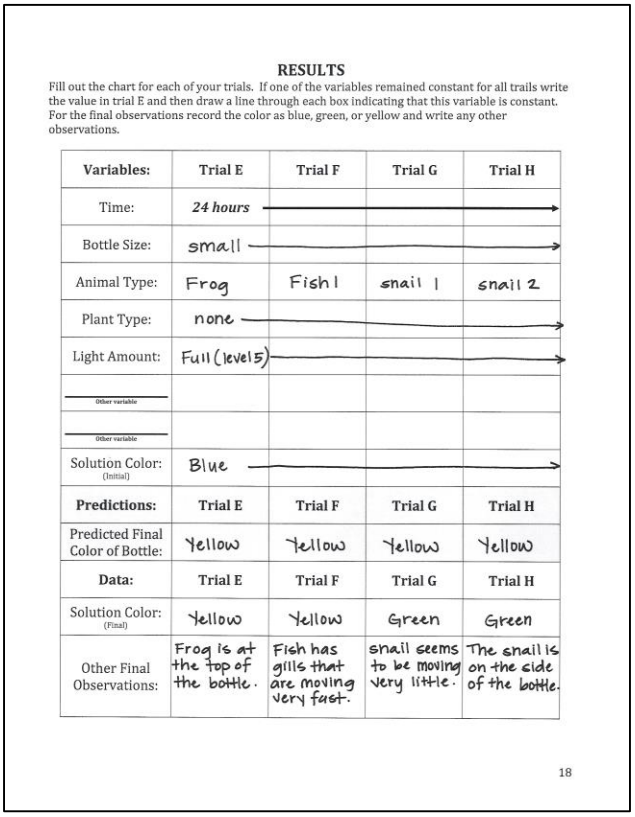
SciTrek Member Approval

17

Experiment *(10 minutes – Small Groups – SciTrek Volunteers):*

Have students fill in the top half of their results table on page 18. Make sure that for their controls they are only writing the value of the control in trial E and then drawing a line through the remaining trials. For the changing variable they need to write the value of the variable in each of the boxes. When students have finished have them make predictions about what color they think each of the solutions will be after 24 hours. Try to question each group on what their thought process was behind the colors that they selected for their predictions.

Once groups have their results table filled out, give them their requested bottles and a black fine point Sharpie found in your group box so that they can use it to label their bottles. Do not give out plants/snails unless students have their bottles properly labeled with their group color, group number, and trial letter. When handing out plants/snails, check groups' results table/materials page to make sure that they requested the given plants/snails. Once groups have put snails/plants into bottles send them to the SciTrek lead to get their fish/frogs. Make sure that groups bring at least one student notebook open to the results table (page 18) with them when going to get fish/frogs. When groups have all materials in their bottles help them put the bottles under the appropriate amount of light. Then help other groups start their experiments as necessary.



RESULTS

Fill out the chart for each of your trials. If one of the variables remained constant for all trails write the value in trial E and then draw a line through each box indicating that this variable is constant. For the final observations record the color as blue, green, or yellow and write any other observations.

Variables:	Trial E	Trial F	Trial G	Trial H
Time:	*24 hours* →			
Bottle Size:	small →			
Animal Type:	Frog	Fish 1	snail 1	snail 2
Plant Type:	none →			
Light Amount:	Full (level 5) →			
_____ Other variable				
_____ Other variable				
Solution Color: (Initial)	Blue →			
Predictions:	**Trial E**	**Trial F**	**Trial G**	**Trial H**
Predicted Final Color of Bottle:	Yellow	Yellow	Yellow	Yellow
Data:	**Trial E**	**Trial F**	**Trial G**	**Trial H**
Solution Color: (Final)	Yellow	Yellow	Green	Green
Other Final Observations:	Frog is at the top of the bottle.	Fish has gills that are moving very fast.	snail seems to be moving very little.	The snail is on the side of the bottle.

18

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

Have one group from each of the large groups read the question that they are going to investigate. Tell the students that SciTrek will be back tomorrow for them to record their results of their experiment.

Clean-Up:

Before you leave have the students attach their nametag to their notebook and place them in the group box. Leave the lamps/Xerox boxes in the classroom until experiments have been completed. Make sure that all lights are left on. Bring back all unused plants/animals and all other materials back to UCSB. In addition, put your lab coats back into your group box.

Day 5: Experiment/Conclusion

Schedule:

Introduction (SciTrek Leader) – 10 minutes
Record Data (SciTrek Volunteers) – 10 minutes
Conclusion (SciTrek Volunteers) – 25 minutes
Verify Classmates' Conclusion (SciTrek Volunteers) – 12 minutes
Wrap-Up (SciTrek Leader) – 3 minutes

Materials:

(3) Volunteer Boxes:

- ☐ Student nametags
- ☐ Student notebooks
- ☐ Volunteer instructions
- ☐ Volunteer lab coat
- ☐ Notepad
- ☐ Pencil

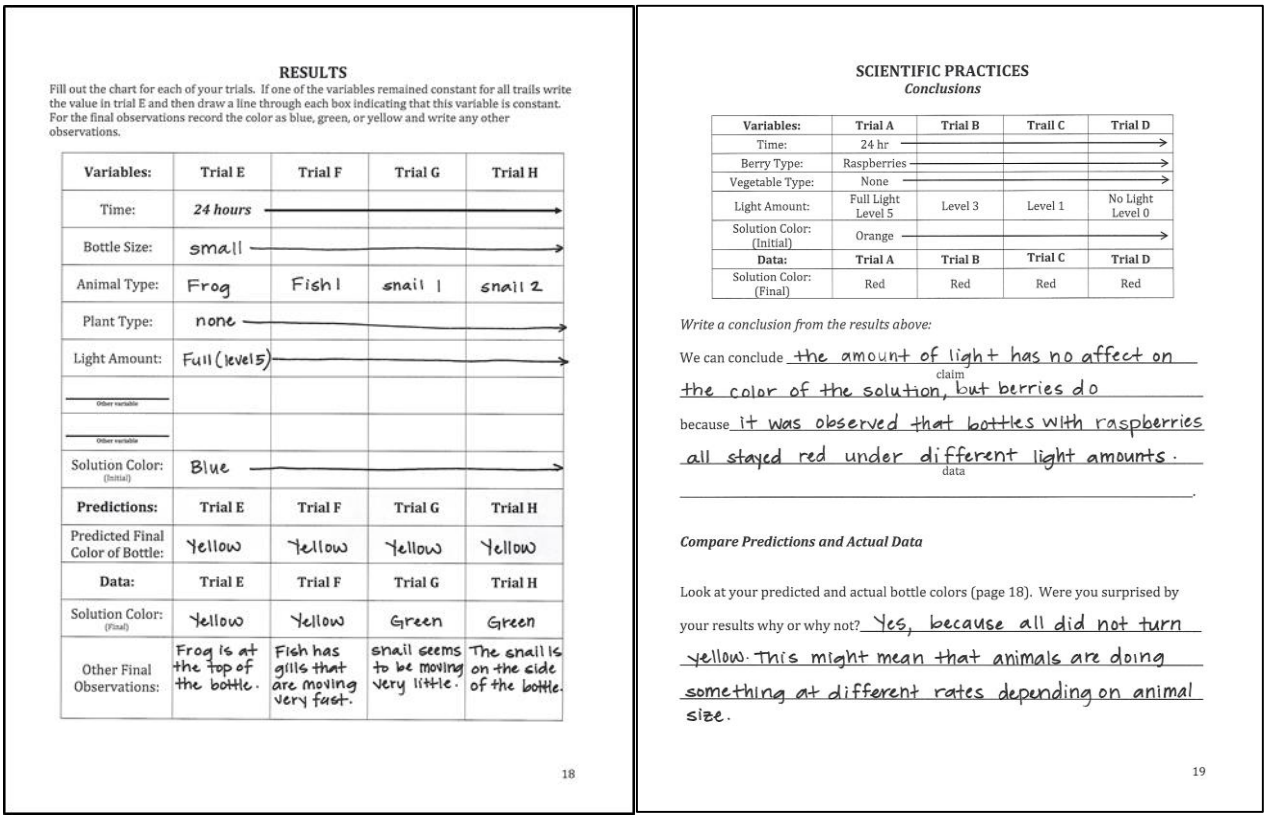
Other Supplies:

- ☐ Animal container with water
- ☐ Plant container with water
- ☐ (3) White rags
- ☐ (2) Bucket
- ☐ Fish net

Lead Box:

- ☐ (3) Student notebooks
- ☐ Lead instructions
- ☐ Lead lab coat
- ☐ Notepad
- ☐ (2) Pencils
- ☐ Time card

SciTrek Notebook Pages Used With Students:



RESULTS

Fill out the chart for each of your trials. If one of the variables remained constant for all trails write the value in trial E and then draw a line through each box indicating that this variable is constant. For the final observations record the color as blue, green, or yellow and write any other observations.

Variables:	Trial E	Trial F	Trial G	Trial H
Time:	24 hours →			
Bottle Size:	small →			
Animal Type:	Frog	Fish 1	snail 1	snail 2
Plant Type:	none →			
Light Amount:	Full (level 5) →			
_____ (Other variable)				
_____ (Other variable)				
Solution Color: (Initial)	Blue →			
Predictions:	**Trial E**	**Trial F**	**Trial G**	**Trial H**
Predicted Final Color of Bottle:	Yellow	Yellow	Yellow	Yellow
Data:	**Trial E**	**Trial F**	**Trial G**	**Trial H**
Solution Color: (Final)	Yellow	Yellow	Green	Green
Other Final Observations:	Frog is at the top of the bottle.	Fish has gills that are moving very fast.	snail seems to be moving very little.	The snail is on the side of the bottle.

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SCIENTIFIC PRACTICES

Conclusions

Variables:	Trial A	Trial B	Trail C	Trial D
Time:	24 hr →			
Berry Type:	Raspberries →			
Vegetable Type:	None →			
Light Amount:	Full Light Level 5	Level 3	Level 1	No Light Level 0
Solution Color: (Initial)	Orange →			
Data:	**Trial A**	**Trial B**	**Trial C**	**Trial D**
Solution Color: (Final)	Red	Red	Red	Red

Write a conclusion from the results above:

We can conclude (claim) the amount of light has no affect on the color of the solution, but berries do because (data) it was observed that bottles with raspberries all stayed red under different light amounts.

Compare Predictions and Actual Data

Look at your predicted and actual bottle colors (page 18). Were you surprised by your results why or why not? Yes, because all did not turn yellow. This might mean that animals are doing something at different rates depending on animal size.

19

What was your question? (page 15)

- If we change the animal type (insert changing variable)
  what will happen to the color of the solution (insert what you are measuring/observing)?

Explain why your changing variable did or did not affect your results. (Example: the solution turns the color of the vegetables skin.) The animals are breathing which is producing carbon dioxide. When carbon dioxide is present the solution turns yellow. (this is your claim)

Can you test the above statement? (Is the above statement a claim?)

☒ YES ☐ NO (If you checked this box go back and revise your statement so that it can be tested/is a claim.)

What data do you have to support your claim? (Remember to include your measurements or observations.) It was observed that fish and frogs (which breathe more than snails) turned the solution yellow and the snails turned the solution green. (this is your data)

How do you know the statement above is data? It contains an observation.

20

Combine your claim and data to get your conclusion.

CONCLUSION

We can conclude animals are breathing which is producing carbon dioxide (claim) which turns the color of the solution yellow

because it was observed that fish and frogs (which breathe more than snails) (data) turned the solution yellow and the snails turned the solution green.

I acted like a scientist when I made a conclusion from my data. A conclusion is a claim supported by data.

21

Have a collaborator (classmate) check your conclusion.
Give your notebook to a collaborator and use their notebook to check their conclusion.

The following section will be filled out by your collaborator.

1. *Read conclusion* (page 20)
2. *Identify claim and data.* I know the data is the second part of their conclusion because they made observations.
3. *Check if the data (in conclusion) matches the results table.* Is the data in the conclusion the same as the results table? ☒Yes ☐No
4. *Identify number of changing variables.* (page 18) The number of changing variables by this group was 1. The changing variable for this group was animal type.
5. *Check if data supports the claim.* Does the data support the claim? ☐Yes ☐No

Coments: Would you predict a shrimp to turn the solution green too?

Collaborating Scientist's Name: [signature]

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Set-Up:

SciTrek Leader:

If the classroom has a document camera, ask the teacher to use it for the conclusion example (page 19). If the classroom does not have a document camera, then tape up the poster size notebook pages on the front board.

If there is extra time, then catch and release any living animals and put them into the animal container. If there is not enough time bring bottles, from experiment one, with animals in them back to the SciTrek office.

SciTrek Volunteer:

Pass out SciTrek notebooks/nametags to students in their regular seats. The first part of the activity will be done in their regular classroom seats, then students will break up into their small groups. Get the bottles form the first experiments and set next the appropriate group.

Introduction *(10 minutes – Full Class – SciTrek Leader):*

Have the students sit down in their regular classroom seats. While you are doing the introduction have the SciTrek volunteers hand out the notebooks/nametags to the students.

Ask the class what is the class question that we have been investigating. Students should tell you, "What affects the color of the solution? and how? Tell the students that today they are going to examine their data and determine what conclusions can be drawn from their results. Tell students that their conclusions will help to answer the class question. Ask the students what is the definition of a conclusion. They should respond that it is a claim supported by data. Ask the students how many changing variables an experiment can have to be able to make a claim/conclusion. They should respond that there can only be one changing variable. Ask them why they can only have one changing variable in order to draw a conclusion. They should say that if there is more than one changing variable they would not be able to tell which one of the multiple changing variables affected the color of the solution.

Tell the students that before they make a conclusion from their own results, as a class they are going to look at another scientists' data and see if they can draw a conclusion from their results. Have students turn to page 19 or their notebook and put an example notebook under the document camera. Tell the students to look over the data in this results table. Ask a student to explain the experiment that was conducted. Make sure that they identify which variables were changing and which were controls. One possible answer would be: in this experiment the light level was the changed and raspberries were put into a bottle of orange solution. The solution was then allowed to sit for 24 hours. The changing variable was light amount and the controls were the time, berry type, vegetable type, and solution color. Ask students if a claim/conclusion can be made from this data? Students should realize that there is only one changing variable so a claim/conclusion can be made from these results.

Tell the class that now that they know a conclusion can be made from the data, you are going to work together to come up with a conclusion. Tell students that when drawing a conclusion from data the first thing that you need to do is make a claim to try to explain the results. "Can anyone look at the data and make a claim that tries to explain these results?" Example claim that state how the solution is affected by the amount of light:

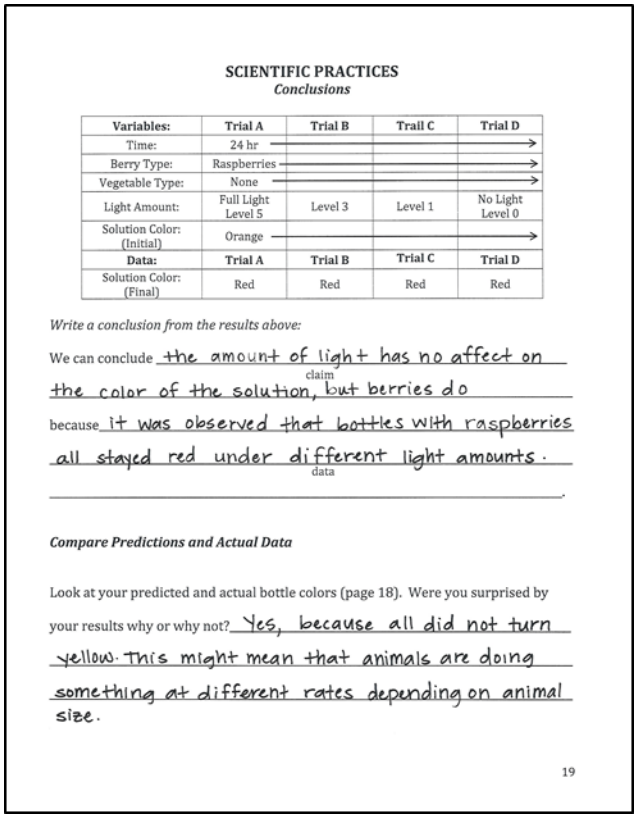
1. raspberries in any amount of light will turn the solution red

Example claim that states what happened:

2. the light level does not affect the color of the solution

If possible try to lead the students to make a claim that states how the solution changed color instead of a claim that just states what happens. Write the claim in the claim section of the conclusion on the example notebook and have students copy it into their notebook. Ask the students what data was collected to support this claim. Students should reply that it was observed that raspberries in any light amount (level 5, 3, 1, or 0) all turned red. Ask students how we know this is data. They should say that this data contains an observation which means that the scientist had to go and physically carry out an experiment to know. Write the data in the example notebook and have students copy it into their notebooks. Again ask students what they learned from this experiment. Students should say that they learned that the light amount did not affect the color of the solution and that they know this because of the data in the results table. Make sure students understand that the conclusion that they made is the outcome of their experiment and should answer what they were hoping to learn. Tell students that the conclusion of an experiment aims to answer their original question, or answer the class question.

Tell students that they will now record their data from their experiments and try to draw a conclusion. When they are done doing this they should challenge themselves to think about why their changing variable is or is not effecting the color of the solution. Remind the students that the group that comes up with the best claim supported by data or conclusion will get a prize the last day. Tell them at the end of the day that they will also get the chance to collaborate with fellow scientists in other groups by trading notebooks with a student in a different group and checking each other's conclusions.



SCIENTIFIC PRACTICES
Conclusions

Variables:	Trial A	Trial B	Trail C	Trial D
Time:	24 hr →			
Berry Type:	Raspberries →			
Vegetable Type:	None →			
Light Amount:	Full Light Level 5	Level 3	Level 1	No Light Level 0
Solution Color: (Initial)	Orange →			
Data:	**Trial A**	**Trial B**	**Trial C**	**Trial D**
Solution Color: (Final)	Red	Red	Red	Red

Write a conclusion from the results above:

We can conclude the amount of light has no affect on the color of the solution, but berries do (claim)

because it was observed that bottles with raspberries all stayed red under different light amounts. (data)

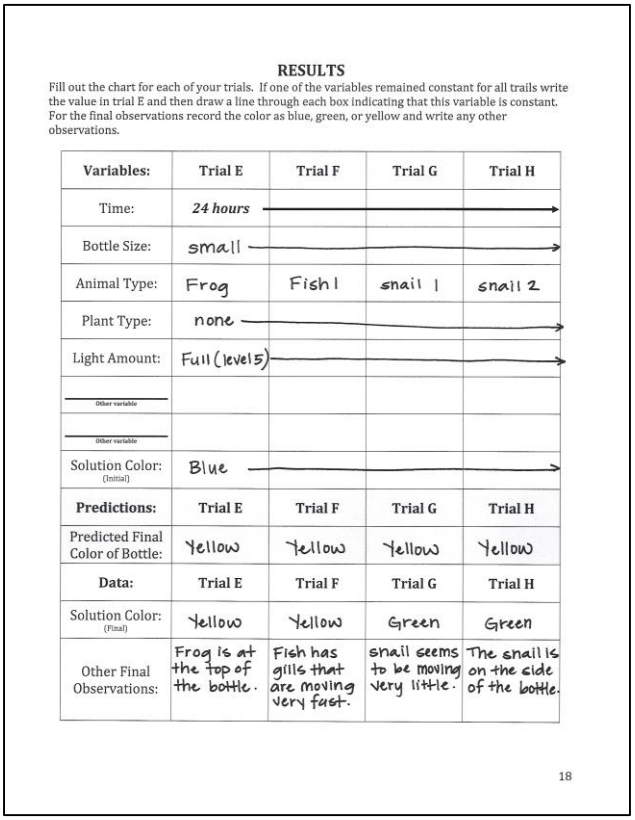
Compare Predictions and Actual Data

Look at your predicted and actual bottle colors (page 18). Were you surprised by your results why or why not? Yes, because all did not turn yellow. This might mean that animals are doing something at different rates depending on animal size.

19

Record Data *(10 minutes – Small Groups – SciTrek Volunteers):*

Have student's record data from their second experiment in their SciTrek notebooks on page 17. As soon as students have recorded their data take their used bottles and give them to the SciTrek lead.



RESULTS

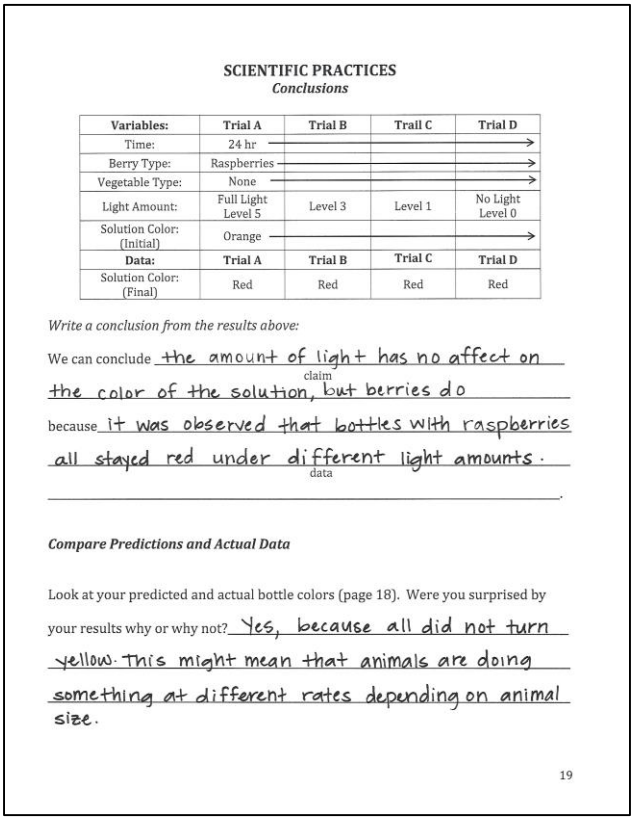
Fill out the chart for each of your trials. If one of the variables remained constant for all trails write the value in trial E and then draw a line through each box indicating that this variable is constant. For the final observations record the color as blue, green, or yellow and write any other observations.

Variables:	Trial E	Trial F	Trial G	Trial H
Time:	24 hours →			
Bottle Size:	small →			
Animal Type:	Frog	Fish 1	snail 1	snail 2
Plant Type:	none →			
Light Amount:	Full (level 5) →			
_____ Other variable				
_____ Other variable				
Solution Color: (Initial)	Blue →			
Predictions:	**Trial E**	**Trial F**	**Trial G**	**Trial H**
Predicted Final Color of Bottle:	Yellow	Yellow	Yellow	Yellow
Data:	**Trial E**	**Trial F**	**Trial G**	**Trial H**
Solution Color: (Final)	Yellow	Yellow	Green	Green
Other Final Observations:	Frog is at the top of the bottle.	Fish has gills that are moving very fast.	snail seems to be moving very little.	The snail is on the side of the bottle.

18

Conclusion *(25 minutes – Small Groups – SciTrek Volunteers):*

Have students compare their predicted color to their actual colors on page 18. Then have students tell/write if they were surprised by their results or not and why on page 19.



SCIENTIFIC PRACTICES
Conclusions

Variables:	Trial A	Trial B	Trail C	Trial D
Time:	24 hr →			
Berry Type:	Raspberries →			
Vegetable Type:	None →			
Light Amount:	Full Light Level 5	Level 3	Level 1	No Light Level 0
Solution Color: (Initial)	Orange →			
Data:	**Trial A**	**Trial B**	**Trial C**	**Trial D**
Solution Color: (Final)	Red	Red	Red	Red

Write a conclusion from the results above:

We can conclude the amount of light has no affect on the color of the solution, but berries do (claim)
because it was observed that bottles with raspberries all stayed red under different light amounts. (data)

Compare Predictions and Actual Data

Look at your predicted and actual bottle colors (page 18). Were you surprised by your results why or why not? Yes, because all did not turn yellow. This might mean that animals are doing something at different rates depending on animal size.

19

Then help the students write their conclusion. First, have students copy their question from page 15 of their notebook onto the conclusions page (page 20). Second, have the students discuss if their changing variable affected the color of the solution and how. Challenge students to think about why their changing variable did or did not affect their measurements. Allow students to think about why their changing variable might be affecting the color of the solution. Challenge students by asking them questions so that they can write a claim that both tries to explain their results and explains why the color of the solution is changing. Once they have discussed their ideas have the students fill out the claim part on the conclusions page (page 20): explain why your changing variable did or did not affect your results (if you cannot explain why, state what happened in your results)?

Example claims that state <u>why</u> the changing variable did or did not affect solution:

Claim 1: animals breathe out CO_2 which is changing the solution color

Claim 2: the larger the animal the more CO_2 the animal will produce and the more yellow the solution

Example claims that state <u>how</u> the changing variable did or did not affect the solution:

Claim 3: the larger the animal the more yellow the solution

Claim 4: having any aquatic plant in the dark will change the solution yellow

Example claims that state <u>what</u> happened to the solution

Claim 5: the amount of light affects the color of the solution when a plant is present

Claim 6: the type of animal did not affect the color of the solution

If possible, have students determine why (claims 1 and 2) their changing variable did or did not affect results. If they cannot determine why, have them state how (claims 3 and 4) their changing variable did

or did not affect their results. As a last option allow students to state what happened to the color of solution. The best claims will allow students to make predictions about systems that they have not experimented with.

Have students verify that their proposed statement is testable. If it is testable then the statement is a claim if it is not testable then they need to revise their statement to be a claim.

After students have determined their claim have them determine the data that supports their claim. Tell students that this is when they look at their results table and record in words their measurements or observations were used to support their claim.

Example data to support the 6 claims that are previously listed:

Data 1: we observed all bottles that contained animals, all which produce CO_2, turned the solution yellow

Data 2: we observed that the largest animal, fish 1, turned the solution yellow while the smaller animal, fish 2, turned the solution green

Data 3: we observed that the largest animal, fish 1, turned the solution yellow while the smaller animal, fish 2, turned the solution green

Data 4: we observed that all the aquatic plants that were in the dark turned the solution yellow regardless of the aquatic plant type

Data 5: we observed that the plant in full light resulted in a blue solution while the plant in no light resulted in a yellow solution

Data 6: we observed that all bottles were yellow, regardless of the animal type

Once students have determined the data needed to back up their claim have them state how they know that the data statement is data. (The statement should have the word recorded or observed in it to let people know that the results were actual recorded.) If the data statement does not have the words observed or recorded in it have students go back and modify their statement. Then have students combine their claim and data to get their conclusion.

Example conclusions:

Conclusion 1: Animals breathe out CO_2 which is changing the solution color because we observed all bottles that contained animals, all which produce CO_2, turned the solution yellow.

Conclusion 2: The larger the animal the more CO_2 the animal will produce and the more yellow the solution because we observed that the largest animal, fish 1, turned the solution yellow while the smaller animal, fish 2, turned the solution green.

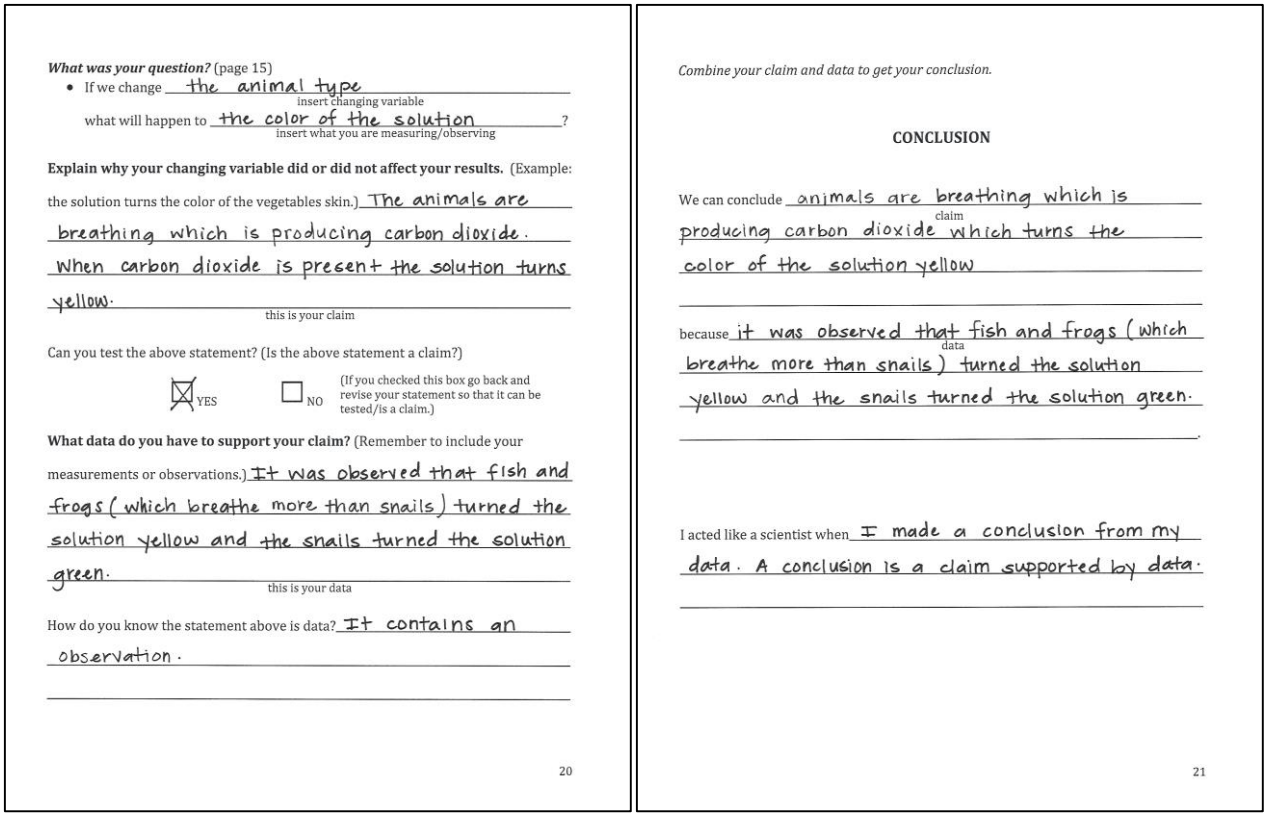
Conclusion 3: The larger the animal the more yellow the solution because we observed that the largest animal, fish 1, turned the solution yellow while the smaller animal, fish 2, turned the solution green.

Conclusion 4: Having any aquatic plant in the dark will change the solution yellow because we observed that all the aquatic plants that were in the dark turned the solution yellow regardless of the aquatic plant type.

Conclusion 5: The amount of light affects the color of the solution when a plant is present because we observed that the plant in full light resulted in a blue solution while the plant in no light resulted in a yellow solution.

Conclusion 6: The type of animal did not affect the color of the solution because we observed that all bottles were yellow, regardless of the animal type.

Example student work for the conclusion section can be seen below.



What was your question? (page 15)

- If we change the animal type (insert changing variable)

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

Explain why your changing variable did or did not affect your results. (Example: the solution turns the color of the vegetables skin.) The animals are breathing which is producing carbon dioxide. When carbon dioxide is present the solution turns yellow. (this is your claim)

Can you test the above statement? (Is the above statement a claim?)

☒ YES ☐ NO (If you checked this box go back and revise your statement so that it can be tested/is a claim.)

What data do you have to support your claim? (Remember to include your measurements or observations.) It was observed that fish and frogs (which breathe more than snails) turned the solution yellow and the snails turned the solution green. (this is your data)

How do you know the statement above is data? It contains an observation.

20

Combine your claim and data to get your conclusion.

CONCLUSION

We can conclude animals are breathing which is producing carbon dioxide (claim) which turns the color of the solution yellow

because it was observed that fish and frogs (which breathe more than snails) (data) turned the solution yellow and the snails turned the solution green.

I acted like a scientist when I made a conclusion from my data. A conclusion is a claim supported by data.

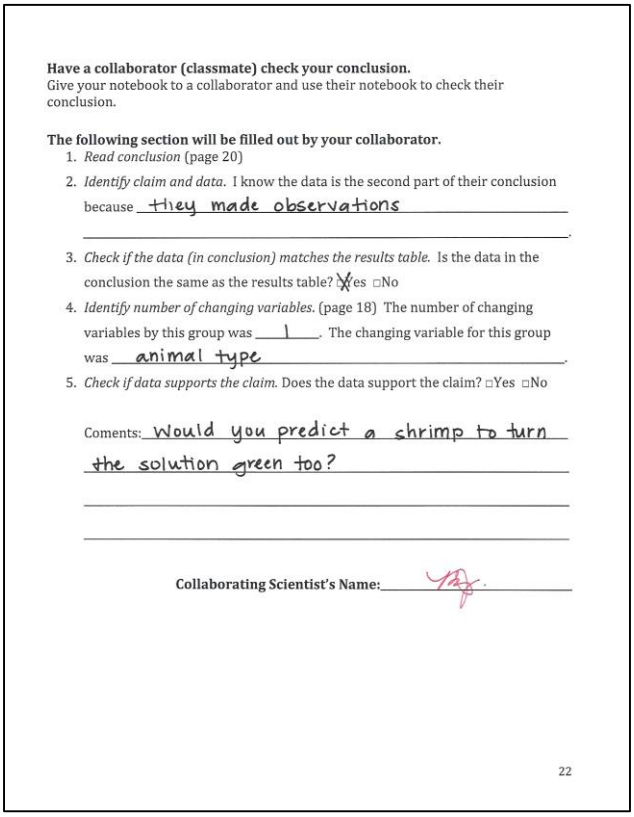
21

Pick one person from your large group to share their conclusion with the rest of the class in the wrap-up discussion.

Once students have filled out their conclusion have them fill in the sentence frame (page 21): "I acted like a scientist when_____." This sentence frame should be unique for each of the students.

Verify Classmates' Conclusion *(12 minutes – Small Groups – SciTrek Volunteers):*

Once students have finished with their conclusions and "I acted like a scientist when_____" have them collaborate with a student from another group. Have the two students switch notebooks and check each other's conclusions (page 20). When they are done have them return the notebook to the original owner. An example of a checked conclusion is seen below.



Have a collaborator (classmate) check your conclusion.
Give your notebook to a collaborator and use their notebook to check their conclusion.

The following section will be filled out by your collaborator.

1. *Read conclusion* (page 20)
2. *Identify claim and data.* I know the data is the second part of their conclusion because they made observations.
3. *Check if the data (in conclusion) matches the results table.* Is the data in the conclusion the same as the results table? ☒Yes ☐No
4. *Identify number of changing variables.* (page 18) The number of changing variables by this group was 1. The changing variable for this group was animal type.
5. *Check if data supports the claim.* Does the data support the claim? ☐Yes ☐No

Coments: Would you predict a shrimp to turn the solution green too?

Collaborating Scientist's Name: [redacted]

22

Wrap-Up *(3 minutes – Small Groups – SciTrek Volunteers):*

Have each of the 3 large groups share one of their conclusions with the rest of the class. Remind students that the next time SciTrek comes they will be putting together a poster to share their results with the rest of the class.

Clean-Up:

Before you leave have the students attach their nametag to their notebook and place them in the group box. Make sure all used bottles are in the used bottle bucket. Bring all experimental materials back to UCSB including lamps and Xerox boxes. In addition, put your lab coat back into your box. If there is time this day living animals should be removed from the bottles and put in the animal container, plants can also be put in the plant container.

Day 6: Poster Making

Schedule:

Introduction (SciTrek Leader) – 2 minutes
Poster Making (SciTrek Volunteers) – 56 minutes
Wrap-Up Discussion (SciTrek Leader) – 2 minutes

Materials:

(3) Volunteer Boxes:

- ☐ Student nametags
- ☐ Student notebooks
- ☐ Volunteer instructions
- ☐ Volunteer lab coat
- ☐ (2) Pencils
- ☐ Highlighter
- ☐ (2) Glues
- ☐ Scissors
- ☐ Poster diagram (full page)
- ☐ (3) Sticker for how to present results (changing contents)
- ☐ (3) Sticker for how to present results (changing conditions)
- ☐ (6) Paperclips

Poster Parts

- ☐ (3) Scientist names
- ☐ (3) Questions
- ☐ (3) Experimental set-ups
- ☐ (3) Procedures
- ☐ (3) Results Tables
- ☐ (3) Conclusions
- ☐ (12) "I acted like a scientist when _____"
- ☐ (12) Picture spaces

Other Supplies:

- ☐ Large poster paper

Lead Box:

- ☐ (3) Extra student notebooks
- ☐ Lead instructions
- ☐ Lead lab coat
- ☐ (2) Pencils
- ☐ (2) Highlighters
- ☐ (2) Glues
- ☐ (2) Scissors
- ☐ Poster diagram (full page)
- ☐ (3) Sticker for how to present results (changing contents)
- ☐ (3) Sticker for how to present results (changing conditions)
- ☐ (6) Paperclips
- ☐ Scotch Tape
- ☐ Time card

Set-Up:

SciTrek Leader:

Ask the classroom teacher for a place to leave the student posters in the classroom.

SciTrek Volunteer:

Set out SciTrek notebooks/nametags around the table making sure to set students that are in the same small group next to each other. Have poster parts ready for students.

Introduction *(2 minutes – Full Class – SciTrek Leader):*

Ask the class what is the class question that we have been investigating. Students should tell you "what affects the color of the solution? and how?" Tell students that today they are going to be putting together a poster to present to the class for the next session which tells the class what you have found out about this question. Tell them that they should write as neatly as possible on the poster parts so that the other

class members can read their poster. In addition, they will pick one of their two experiments to present. Remind them that they should pick an experiment from which they were able to draw a conclusion.

Poster Making *(56 minutes – Small Groups – SciTrek Volunteers):*

Each small group (three/four students) will make one poster on one of their experiments from which they can draw a conclusion. Assign each student a part of the poster to complete. If a student struggles with writing try to give them a shorter writing section to complete (example: experimental set-up). Have the students write their name on the sections that they complete. In the students' notebook highlight the section that they will complete/read. Note: if students are completing multiple sections use the paperclips in your group box to clip together the sections that they are completing/reading so that during the poster presentation day they will not need to flip back and forth between pages. Place the following sentence frame sticker on the top of the book of the student that is completing the results table (page 18).

The bottle that contained the _____ was observed to be _____.
content of bottle color

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

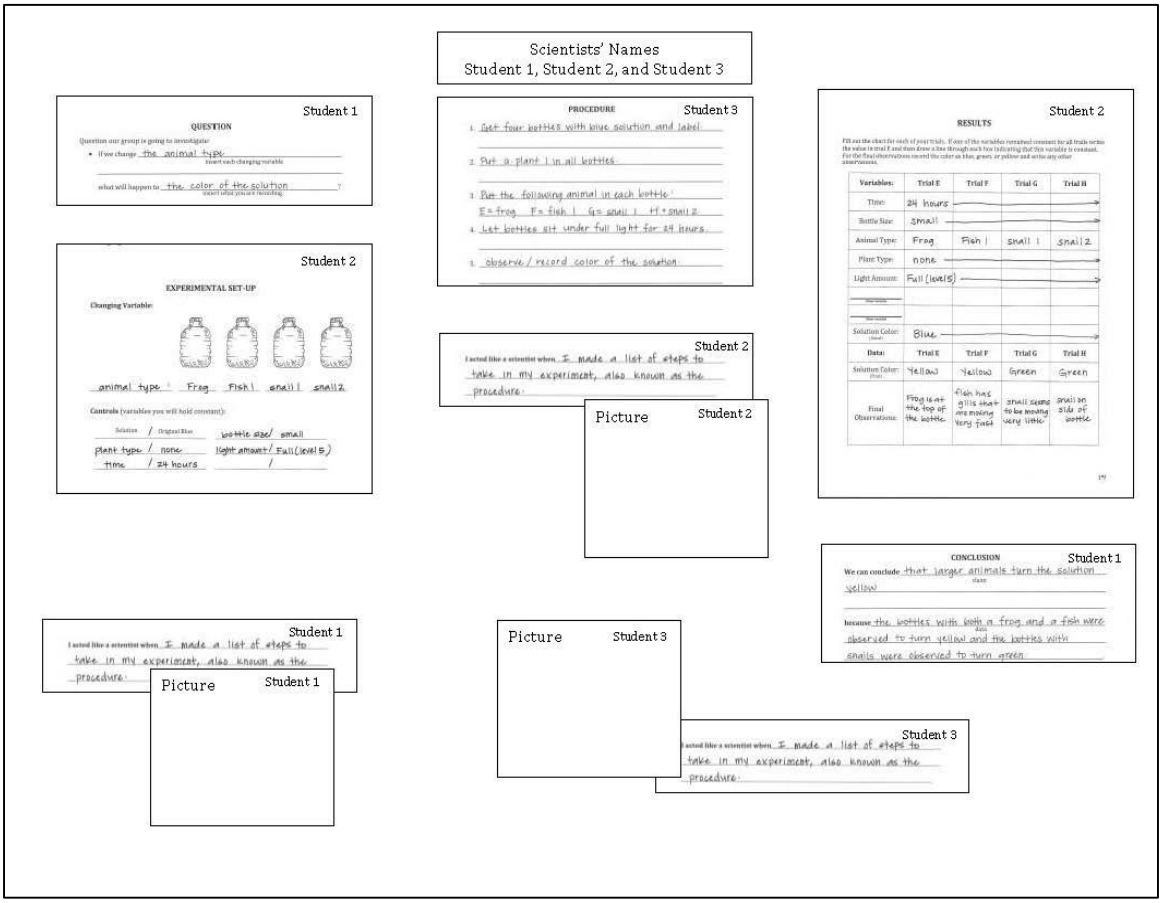
Note: Use the sentence frame for condition of bottle if group changed bottle size.

Then practice reading the four sentences with that student. For the poster below, the sentence frame would be: The bottle that contained the **frog** was observed to be **yellow**. An example sentence frame for a group that changed the conditions would be: The bottle that was in **level 2 light** was observed to be **green**. To make this easier for students you can write level __ light on the first blank of the sentence frame. For groups that changed bottle size cross off the "in" in the conditions sentence frame. An example sentence frame for a group that changed the size of the bottle would be: The bottle that was ~~in~~ **small** was observed to be **yellow**.

When students finish writing their sections, have them draw a picture of their experiment or how they acted like a scientist during the experiment.

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

Once the poster is complete have students start practicing for the poster presentation. Make sure that students know to read from their notebooks instead of from the poster. The poster should be presented in the following order: 1) scientists' names, 2) question, 3) experimental set-up, 4) procedure, 5) results, and 6) conclusion. They will NOT read the "I acted like a scientist when _____" because this will be discussed as a class after all the posters are presented. In addition, it sometimes helps to write a small number (order seen above) on the sections in the students' notebooks in the order that they will be presented.



If there is time try to ask each of your groups a few questions about their poster. Try to have them use their findings to predict the colors of other bottles that they did not try. For instance if the group conclusion was: the bottles will turn yellow regardless of the type of animal that is in the bottle because we observed that all of the bottles turned yellow even though they had different types of animals in them, ask the group to predict what the color of a bottle would be if it contained a crayfish. They should be able to predict that it would be yellow.

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

Tell students that they will present their findings the next meeting and you are looking forward to hearing about all of their experiments.

Clean-Up:

Before you leave have the students attach their nametag to their notebook and place them in the group box. Leave student posters in the classroom. Bring all materials back to UCSB. Look through all of the conclusions and put one of the notebooks of the group that has the best claim supported by data on the top of your box. In addition, put your lab coat back into your group box.

Day 7: Poster Presentations

Schedule:

Introduction (SciTrek Leader) – 2 minutes
Poster Practice (SciTrek Volunteers) – 5 minutes
Poster Presentations (SciTrek Volunteers/SciTrek Leader) – 48 minutes
Wrap-Up (SciTrek Leader) – 5 minutes

Materials:

(3) Volunteer Boxes:

- ☐ Student nametags
- ☐ Volunteer lab coat
- ☐ (6) Paperclips
- ☐ Student notebooks
- ☐ Highlighter
- ☐ Large binder clip
- ☐ Volunteer instructions
- ☐ Pencil

Lead Box:

- ☐ (3) Extra student notebooks
- ☐ (2) Pencils
- ☐ (6) Paperclips
- ☐ Time card
- ☐ Lead instructions
- ☐ (2) Highlighters
- ☐ (4) SciTrek erasers
- ☐ Lead lab coat
- ☐ Scotch tape
- ☐ Teacher evaluation

*Student posters should already be in the classroom.

Set-Up:

SciTrek Leader:

Write the class question on the board "What factors affect the color of the solution?" Leave enough room so that you can record student findings under the question.

Give the teacher the "Evaluation of the SciTrek Program by Participating Teachers" form. Ask teachers to fill this form out and give it back to you the next time you are there.

SciTrek Volunteer:

Set out the SciTrek notebook/nametags. Get your groups' posters. Today students will be sitting in their regular classroom seats during poster presentations.

Introduction *(2 minutes – Full Class – SciTrek Leader):*

Tell students that today they are going to present their posters to the rest of the class.

Tell the students that they are now going to be given 5 minutes to practice presenting their poster before the presentations. Students should first explain to each other what they did for their experiment and what they found out, without looking at their notebook or posters. They should then take the remaining time to practice presenting their poster. Remind students to read from their notebooks when presenting their posters. Tell students that after they have finished practicing they will return to their normal classroom seats.

Practice Poster *(5 minutes – Small Groups – SciTrek Volunteers):*

Make sure that each small group is telling each other what they did and what they found out from their experiment. Then have them practice their poster presentation making sure they are reading the poster parts in the correct order (scientists' names, question, experimental set-up, procedure, results, and conclusion). Make sure the part each student is reading is highlighted in his or her notebook and their notebook is turned to the page they will read from. If students are reading from multiple pages use a paperclip to clip these pages together. Remind students to read from their notebook rather than from their poster.

Poster Presentations *(48 minutes – Full Class – SciTrek Volunteers/SciTrek Leader):*

Have students return to their original class seats. Ask the class, "What is the question that we have been working on solving." Students should tell you: What factors affect the color of the solution? and How? Tell the students that after each presentation you will ask the class what changing variable the group was testing. They will then be given the opportunity to ask scientific questions to the presenting group to help them determine if the variable that that the group was investigating affected the color of the solution. Some examples of scientific questions are: why did your group pick the controls that you did? Can you make a prediction about another bottle that you did not try that would turn yellow after 24 hours? Did your results agree with a previous group's and why? Ask the class, "If a group whose changing variable was animal type would be able to answer questions about changing the amount of light?" They should say no. "Therefore, we should try to ask the group questions that focus on their changing variable." Tell the class once they have finished asking the group questions you will ask them if the groups changing variable affected the color of the solution and how. You will then summarize their ideas on the board under the class question.

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

During the student question time the SciTrek lead and/or volunteers should ask at least one question. Example of possible question are: "How do you know…?" or "Is there anything else you can do to get more information about your question?" Each group should answer approximately 4 questions.

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. Depending on the experiments that the class ran these are the highlights of the experiments.

- The solution will turn color regardless of the type of animal
- The bigger the animal the more yellow the solution
- The amount of light does not affect the color of the solution when only animals are present
- Placing any type of aquatic plants in the light will keep the solution blue
- Placing any type of aquatic plant in the dark will turn the solution yellow
- The amount of light affects the color of the solution when an aquatic plant is present
- Non aquatic plants (flower/leaf) will turn the solution yellow/green regardless of the light amount. (Note: this is because the flowering/petals do not undergo photosynthesis and when the tree leaf is underwater the plant cannot take in CO_2 because its stomata are blocked by the water and it has not adapted to take CO_2 out of the water like aquatic plant have.)
- Combining aquatic plants and animals in the light makes the solution be less yellow (more green) than with the animal alone.

- If an animal is in the bottle the larger the bottle size the less yellow the solutions will be. (This would also hold true if an aquatic plant was put into the dark.)

When reflecting on the summary, use students' collected data and not what they should have found, if the two are in disagreement. Ask students, "If you wanted to get the solution as yellow as possible after 24 hours what values of variables you would use?"

- Animal type: Place the largest animal as possible in the bottle
- Plant type: Place an aquatic plant in the bottle
- Light amount: Place the bottle in the dark.
- Bottle Size: Have the smallest bottle possible

Wrap-Up *(5 minutes – Full Class – SciTrek Leader):*

Ask students the following question:

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

Tell the students that the volunteers that have been working with them are undergraduate and graduate students that volunteer their time so that they can do experiments. Have the students say thank you to the volunteers. Tell the students that this is the last day with their SciTrek volunteers, therefore, they should say goodbye to them. Tell students that you will be back one more time.

Announce the group that came up with the best conclusion or claim supported by data from their experiments. Talk a little about why that group's conclusion was selected. Distribute prizes (erasers) to that group.

Tell students to remove the paper part of their nametag from the plastic holder and that they can keep the paper nametag but to give the plastic sleeve back to their SciTrek volunteer.

Clean-Up:

Before you leave collect plastic parts of nametags and put them in the group box. Students can keep the paper part of their nametag. Also collect notebooks and clip them together with a large binder clip. Leave student posters in the classroom. Bring all materials back to UCSB. Remove tape from the lid of your box and place into your box. In addition, remove all materials from lab coat pockets, remove your nametag, unroll lab coat sleeves, and put your lab coats back into your group box.

Day 8: Conclusion Assessment/Tie to Standards/Content Assessment

Schedule:

Conclusion Assessment (SciTrek Leader) – 10 minutes
Tie to Standards (SciTrek Leader) – 40 minutes
Content Assessment (SciTrek Leader) – 10 minutes

Materials:

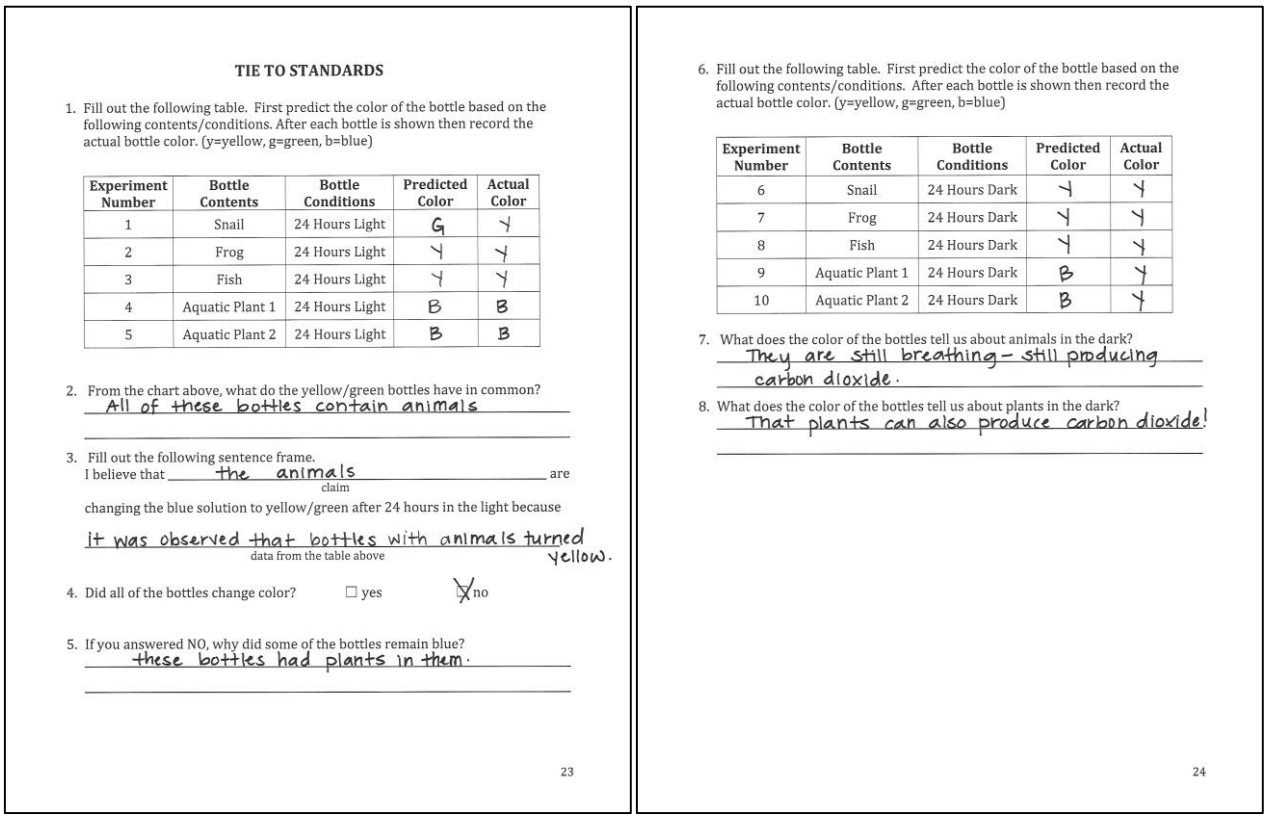
Lead Box:

- ☐ (3) Extra Student notebooks
- ☐ Student notebooks
- ☐ Lead instructions
- ☐ Lead lab coat
- ☐ (2) Pencil
- ☐ Straw
- ☐ (35) Conclusion assessments
- ☐ (35) Content assessments
- ☐Time card

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
- ☐ Balloon with car exhaust
- ☐ Small piece of dry ice

SciTrek Notebook Pages Used With Students:



TIE TO STANDARDS

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

Experiment Number	Bottle Contents	Bottle Conditions	Predicted Color	Actual Color
1	Snail	24 Hours Light	G	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 yellow/green bottles have in common?
All of these bottles contain animals

3. Fill out the following sentence frame.
I believe that the animals (claim) are changing the blue solution to yellow/green after 24 hours in the light because it was observed that bottles with animals turned yellow. (data from the table above)

4. Did all of the bottles change color? ☐ yes ☒ no

5. If you answered NO, why did some of the bottles remain blue?
these bottles had plants in them.

23

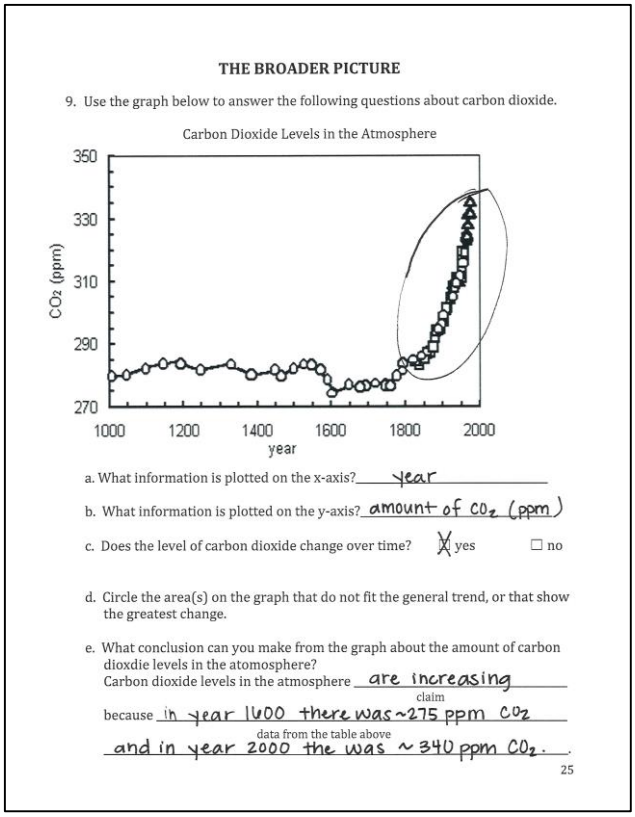
6. Fill out the following table. First predict the color of the bottle based on the following contents/conditions. After each bottle is shown then record the actual bottle color. (y=yellow, g=green, b=blue)

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

7. What does the color of the bottles tell us about animals in the dark?
They are still breathing – still producing carbon dioxide.

8. What does the color of the bottles tell us about plants in the dark?
That plants can also produce carbon dioxide!

24



THE BROADER PICTURE

9. 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? amount of 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. What conclusion can you make from the graph about the amount of carbon dioxdie levels in the atomosphere?
Carbon dioxide levels in the atmosphere are increasing (claim)
because in year 1600 there was ~275 ppm CO_2 (data from the table above)
and in year 2000 the was ~340 ppm CO_2.

25

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

humans / animals
cars / factories
deforestation

11. Whould there be carbon dioxide on the plant if humans did not exist?

☒ yes ☐ no

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

☒ yes ☐ no

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

use cars less — commute by bus or carpool
plant more trees

26

Set-Up:

SciTrek Leader:

Make sure that the only blue bottles are B0, B00, B000, B4, and B5. These are the bottle with nothing in them and the bottles with plants in the light.

Pass out notebooks to students. If you do not have time to get set-up before the start of the module ask the teacher to pass out notebooks during the conclusion assessment.

Have the cardboard boxes with appropriate bottles ready with easy access to grab bottles after students make predictions.

If the classroom has a document camera, ask the teacher to use it to fill out the tie to standard activity pages 23-26. If the classroom does not have a document camera, then tape example poster size notebook pages to the front board.

Collect the "Evaluation of the SciTrek Program by Participating Teachers" form and lab coat from the teacher. If they have not filled out the form ask them to do it during the tie to standards activity.

Conclusion Assessment *(10 minutes – Full Class – SciTrek Leader):*

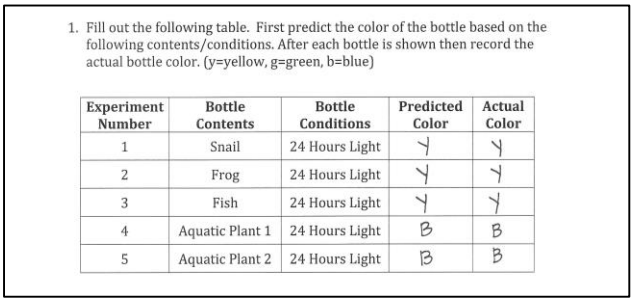
Pass out the Conclusion Assessment to the students. Tell students we are now going to look at how their ideas on conclusions are developing. Tell students one of the ways that we get money for the program is to show that the program is effective so we need them to do their best on the assessment so we can

know the effectiveness of the program. Tell students to put their name, teacher's name, and date on the top of their paper. Remind the students that it is important that they fill this assessment out on their own. For section one read the instructions to the students. Then read each of the statements aloud and tell the students to circle if the statement is an example of a claim, data, or neither. For section two read the instructions to the students and give them a few minutes to make matches between claims and data. You do not need to read the individual claims and data statements to the students. For section three read the instructions to the students and then read each of the statements aloud and tell the students based on the results to circle if the statement is an example of claim, data, opinion, or if it is incorrect. You do not need to read or go over the data tables with the students. Read the last question to the students and have them fill in the blank. Read the directions for the attitudes towards science: fill the chart out for a student that hates ice cream, loves peas, and does not think water tastes good or bad. First read each statement and then circle if the student would agree, disagree or be neutral towards the statement. As a class fill out a-c. Make sure that all students are getting the correct answers for these. For statement "a" (ice cream taste good) students should circle "disagree," for statement "b" (peas taste good) students should circle "agree," for statement c (water taste good) students should circle "neutral." Read the directions for the second half of the attitudes towards science. Tell the students that the rest of the statements are about their attitudes toward science and there are no wrong or right answers. Read each of the statements and then tell students to circle if the agree, are neutral, or disagree with the statement. Read the last two questions to students and have them fill in their answers. When students are finished collect the assessments and verify that they have written their name on the assessment.

Tie to Standards *(40 minutes – Full Class – SciTrek Leader):*

Predictions of Experimental Bottles in the Light: Bottles B1, B2, B3, B4, and B5 *(10 minutes)*

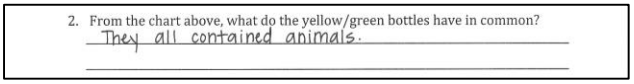
Tell the students that today they are going to talk about their previous experiments and hopefully answer any questions that they may still have about what is changing the color of the solution. Have the students turn to page 23 in their notebooks. Tell the students that you did an experiment the previous day and you brought the bottles from your experiment for the class to observe. Tell the students that they will predict the color of the bottles based on the data from their own experiments and record these predictions into their notebooks. Tell students that for yellow they can record "Y," for blue they can record "B," and for green they can record "G." Have the students do all of the predictions at one time. Then go over each of the bottles with the students. Have one student share what they think the color of the solution will be and why. Then have the class vote, using thumbs up/thumbs down if they agree with the student. If many students are in disagreement ask one of the students that is in disagreement what they think and why. After show the students the experimental bottle and have them record the actual color on their chart as you record the color on the example notebook. After, leave each bottle on the table and continue onto the next bottle until you have gone through bottles B1-B5.



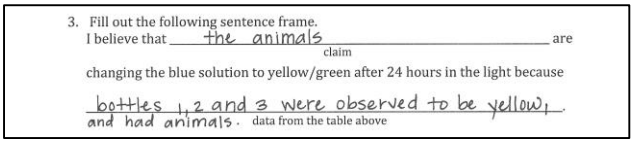
1. Fill out the following table. First predict the color of the bottle based on the following contents/conditions. After each bottle is shown then record the actual bottle color. (y=yellow, g=green, b=blue)

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

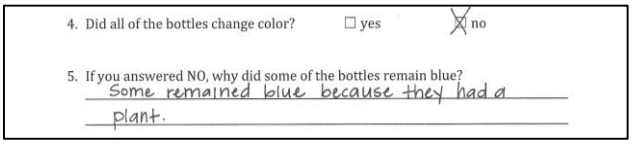
Ask the students what all of bottles that turned yellow/green had in common. Students should say that they all contained animals. If they also bring up the fact that they were all in the light for 24 hours ask students if there were any bottles that were blue after being in the light 24 hours. They should respond that the aquatic plant bottles were blue. Tell them that since the aquatic plant bottles stayed blue it could not be the light alone that was changing the color of the solution. Record this for question 2 in the example notebook under the document camera for students to copy.


2. From the chart above, what do the yellow/green bottles have in common?
They all contained animals.

Next, ask the students to fill out the conclusion sentence frame for question 3. Ask students how can we tell if a statement is data? They should respond that a statement is data if it contains a measurement or an observation. Ask students how can we tell if a statement is a claim? They should respond that a statement is a claim if it is something that can be tested. Tell students to remember this when they are filling in the claim/data portion of the conclusion. Give the students approximately 2 minutes to fill out this sentence frame on their own. After, have a student share his/her sentence frame with the rest of the class. Ask the class what the first part of a conclusion should be? They should respond the claim. Ask the student to read the first part of their conclusion. Example: I believe that the animals are changing the color of the solution. Then ask the class if this statement is a claim and how they know. They should respond yes because this is something that we can test. Ask the class what the second part of a conclusion should be? They should respond the data. Ask the student to read the second part of their conclusion. Example: bottles 1, 2, and 3 were observed to be yellow and contained animals. Then ask the class if this statement is data and how they know. They should respond yes this is data because it contains an observation and we know it is an observation because the sentence had the word observed. Tell the students to look over their conclusion and make sure that it contains the word observed. If not tell them to add this word to the data. Record an example into the group notebook.


3. Fill out the following sentence frame.
I believe that the animals (claim) are
changing the blue solution to yellow/green after 24 hours in the light because
bottles 1, 2 and 3 were observed to be yellow, and had animals. (data from the table above)

Ask the students if all of the bottles that were under the light for 24 hours changed color. Students should say "no" have them check this box in their notebook for question 4. Ask the students why some of the bottles remained blue. Have students record this answer into their notebook. Ask one student to share his/her response and record this answer into the example notebook for question 5 for the students to copy.


4. Did all of the bottles change color? ☐ yes ☒ no

5. If you answered NO, why did some of the bottles remain blue?
Some remained blue because they had a plant.

Determination of What is Causing Color Change: Bottles B0 and B00 *(10 minutes)*

Ask the students what they think the animals are doing to change the color of the solution. Lead a discussion until students say that 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 if there is a way to test this. They should say that if some urine was placed in the solution without an animal then the solution should change yellow. Tell them that you have done this experiment and that there was no observed color change. Therefore, this is not the reason that the solution is changing colors.

Tell the class that their idea that CO_2 is changing the solution color to yellow seems creditable but ask the students if there is any other way that we could show definitely that CO_2 changes the color of the solution. Ask students if we can purchase CO_2 anywhere. If students do not know tell them that dry ice is solid CO_2 and can be purchased at the grocery store. If we get CO_2 gas down to ~-79˚C it will turn into a solid. Show the students the piece of dry ice. Tell students that as the dry ice heats up it turns back into CO_2 gas. Ask the students what should happen if you put the piece of CO_2 into the blue solution. They should respond that if it is CO_2 that is changing the color of the solution that the solution will change color to yellow. Put the piece of dry ice into the solution to verify for students that it is the CO_2 changing the color.

Ask the 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 the students. Remove the lid from the half full bottle, put the straw into the solution and blow into the bottle for approximately 20 seconds. After 20 seconds the solution will be a pale yellow/green color. Ask the students how you were able to change the color of the solution. The students should start to realize that you breathe out the same product (CO_2) as the animals in their experiments. Ask the students why you were able to change the color of the solution much quicker than the animals in their experiment. Students should realize that because your lungs are much bigger than the other animals you are able to produce more CO_2 and therefore change the color of the solution to yellow.

Ask the students why the plant bottles did not change color. Students should respond that 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 you have a bottle of solution that has turned yellow how you could 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 with yellow solution for them to observe.

****Teacher 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:

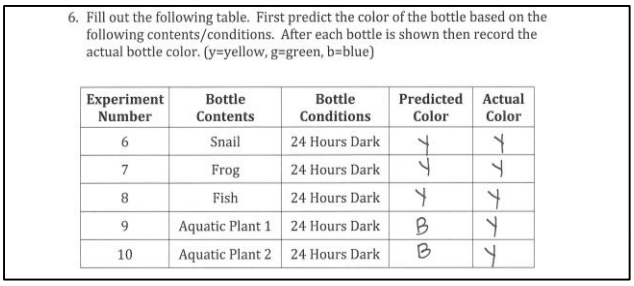
$$CO_2(g) + H_2O(l) \rightleftharpoons H_2CO_3(aq).$$

Carbonic acid (H_2CO_3) is an acid and thus makes the solution in the bottle more acidic. Bromothymol blue is a common pH indicator (which tells the amount of H^+ (or acid) in the solution), which changes colors when the pH of the solution changes. 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 can NOT 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 that we only say to the students that we know if plants or animals are producing carbon dioxide because of the color change.

Prediction of Experimental Bottles in the Dark: Bottles B6, B7, B8, B9 and B10 *(10 minutes)*

Have the students turn to page 23 in their notebooks.

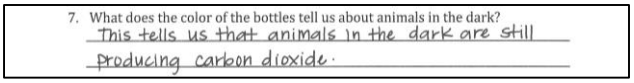
Now tell the students that they are going to make predictions about the experimental bottles that were left in the dark for 24 hours. Similar to before, students will record their predictions first for all of the bottles. You can then have one student share what they think the color of the bottle will be and why and use thumbs up/thumbs down to see if the class agrees. Then show students the bottle and have them record their observations on their chart as you record them in the example notebook for question 6.



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

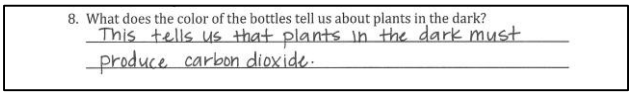
Experiment Number	Bottle Contents	Bottle Conditions	Predicted Color	Actual Color
6	Snail	24 Hours Dark	Y	Y
7	Frog	24 Hours Dark	Y	Y
8	Fish	24 Hours Dark	Y	Y
9	Aquatic Plant 1	24 Hours Dark	B	Y
10	Aquatic Plant 2	24 Hours Dark	B	Y

After completing the table, ask the students what does the color of the bottles tell us about animals in the dark? Students should be able to say that animals are still producing CO_2 in the dark therefore, the bottles changed color. Write this response into the example notebook and have students copy the response into their own notebooks for question 7.



7. What does the color of the bottles tell us about animals in the dark?
This tells us that animals in the dark are still producing carbon dioxide.

Ask the students what does the color of the bottles tell us about plants in the dark? Students should say that the plants in the dark turned the solution yellow. Ask the students what this means. This means that the plants must be producing CO_2 in the dark. Record this response into the example notebook for question 8 and have the students copy this into their notebooks.



8. What does the color of the bottles tell us about plants in the dark?
This tells us that plants in the dark must produce carbon dioxide.

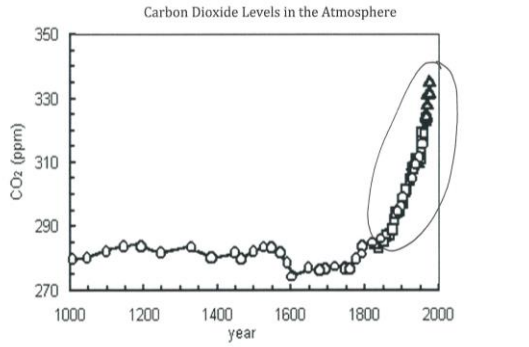
Ask the students what is the process called where plants turn CO_2 into O_2? They should know that this is called photosynthesis. Ask them what is needed for photosynthesis? They should respond light. Tell students that just like animals, plants take in O_2 and produce CO_2 when they are in the dark. 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 *(10 minutes)*

Have the students turn to page 24 in their notebooks.

Have the students look at the graph and answer the following questions (a-d). Go over each of the questions as a class, calling on students to provide the answers. Record the answers in the example notebook for questions 9a-d for students to copy.

9. 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 amount

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.

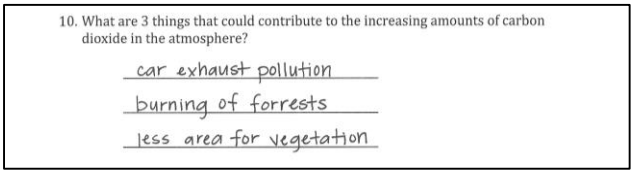
Ask the students what conclusion they can make from the graph. Have students try to make a conclusion on their own first. After that have one student share his/her response and record this answer in the example notebook. Have students copy this answer into their own notebook if they were unable to come up with their own response for question 9e. From this conclusion, point out how you know the first part of the conclusion is a claim (it is something that we can test) and the second part of the conclusion is data (it has a measurement or observation).

e. What conclusion can you make from the graph about the amount of carbon dioxdie levels in the atomosphere?
Carbon dioxide levels in the atmosphere have increased (claim)
because from 1800-2000 levels have gone from ~290 ppm to ~340 ppm. (data from the table above)

Ask the students to think about what is different now than in the 1800's and before. They should be able to come up with the fact that there were no cars in the 1800s. Ask students if they think cars produce CO_2. Tell them that you have some exhaust from a car that you will bubble through the solution to see if cars produced CO_2. If car exhaust has CO_2 what color will the solution turn? (Yellow) If car exhaust does not contain CO_2 what color will the solution be? (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 and inserting the straw into the blue solution. The blue solution will turn yellow. If you do not use the entire amount of 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 the students to compare how long it took you to turn the solution yellow compared to the exhaust from the car. The students should reply that the exhaust turned the solution yellow much quicker. Ask the students what does this mean. They should determine that the car exhaust is producing much more CO_2 than is produced in respiration.

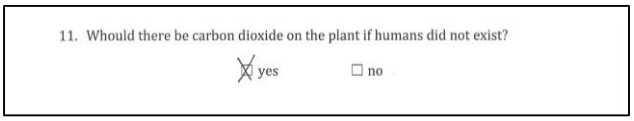
Next have the students turn to page 24 in their notebooks.

Ask the students what are 3 things that contribute to the increasing amounts of carbon dioxide in the atmosphere? Write some of the student ideas onto the example notebook for question 10 and have them copy these or their own ideas into their notebook.


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

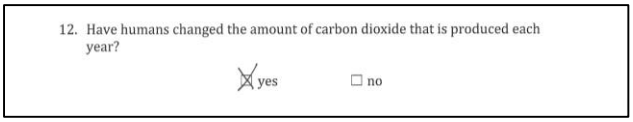
car exhaust pollution
burning of forrests
less area for vegetation

Next ask the students if there would be carbon dioxide on Earth if humans did not exist. Students should be able to answer this question because of their knowledge from their experiments. They should respond that other animals besides humans produce CO_2 and plants produce CO_2 when they are not photosynthesizing. Have student check "yes" in their notebook for question 11.


11. Whould there be carbon dioxide on the plant if humans did not exist?

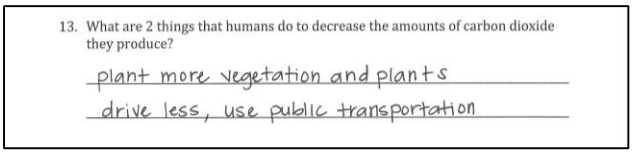
☒ yes ☐ no

Ask the students if humans have changed the amount of carbon dioxide that is produced each year. After hearing student's ideas have them check "yes" in their notebook for question 12.


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

☒ yes ☐ no

Next ask the students what are 2 things that humans can do/already do to decrease the amounts of carbon dioxide they produce? Record two of these responses in the example notebook for question 13 for students to copy.


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

plant more vegetation and plants
drive less, use public transportation

Content Assessment *(15 minutes – Full Class – SciTrek Leader):*

Tell students to close their SciTrek notebooks and to place the notebook in the corner of their desk. Pass out the Content Assessment to the students. Tell students to put their name, teacher, and date on the top of their paper. During the assessment remind students to work by themselves. Read each of the content questions to the students and have them select/fill out the correct answer. When students are finished collect the assessments and verify that they have written their name on the assessment.

Tell the student that you have enjoyed working with them and that you hope they continue to see themselves as scientist and explore the world around them.

Clean- Up:

Bring all materials back to UCSB.