This document is not intended to give you all of the information you need to lead the module. It is only intended to be a reference during the module. You can find the complete instructions at http://www.chem.ucsb.edu/scitrek/module as well as the student notebook and the picture packet used during the module.

Important Things to Remember During the Module

1. You are responsible for keeping track of time in the classroom and making sure that ALL activities run smoothly. There will be a time card in the lead box with suggested times to start/stop each activity.
2. You are responsible for keeping volunteers and students on track.
3. Walk around during times volunteers are working with students and help struggling groups/subgroups.

Types of Documents:

- **Student Notebook:** One given to every student and is filled out by the student. In these instructions, the examples are rectangular and filled out in black.
- **Notepad:** One given to every group and is filled out by the volunteer. In these instructions, the examples are squarer and filled out in blue.
- **Picture Packet:** One per class that, if needed, the lead fills out. In these instructions, the examples are rectangular, labeled, and, if applicable, filled out in blue.

In these instructions, all other example documents are labeled.

Day 1: Procedure Assessment/Observations/Variables

**Schedule:** You are responsible for **BOLD** sections

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

**Preparation:**

1. If the classroom has a document camera, ask the teacher to use it to show the initial bottle picture (page 1, picture packet) and class question (front cover, student notebook).
2. Make sure that volunteers are setting up for the initial observation.
**OBSERVATIONS**

**Contents:** Materials that are inside of the bottle besides the solution.
- Example: Aquatic Plant

**Conditions:** Other variable outside of the bottle that may affect the solution.
- Example: In the Dark

<table>
<thead>
<tr>
<th>Bottle 1</th>
<th>Bottle 2</th>
<th>Bottle 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contents: None</td>
<td>Aquatic plant</td>
<td>Aquatic plant</td>
</tr>
<tr>
<td>Conditions: 24 hours under light</td>
<td>24 hours under light</td>
<td>24 hours under light</td>
</tr>
<tr>
<td>Color of Solution at Start of Experiment: Blue</td>
<td>Blue</td>
<td>Blue</td>
</tr>
<tr>
<td>Color of Solution at End of Experiment: Blue</td>
<td>Yellow</td>
<td>Blue</td>
</tr>
</tbody>
</table>

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

The bottle with ________ started as blue, and after 24 hours ________. 

---

**VARIABLES**

<table>
<thead>
<tr>
<th>Variable</th>
<th>How will changing this variable affect the color of the solution?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal Type</td>
<td>Adding animals to the bottle will turn the solution _________.</td>
</tr>
<tr>
<td>Plant Type</td>
<td>Adding plants to the bottle will turn the solution ________.</td>
</tr>
<tr>
<td>Light Amount</td>
<td>Putting the bottle under a lower light level will turn the solution ________.</td>
</tr>
<tr>
<td>Bath Size</td>
<td>Soaking the bottle longer will turn the solution ________.</td>
</tr>
<tr>
<td>Number of Animals</td>
<td>Bottles with more animals will cause the solution to turn more ________.</td>
</tr>
</tbody>
</table>

---

**Notebook Pages and Notepad Pages:**
Introduction: (2 minutes – Full Class – SciTrek Lead)

- Introduce the module/SciTrek volunteers.

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

- Pass out assessments.
- Read the question, changing variable (example: the changing variable was solid amount), and controls (example: the controls were liquid type, time, container type...). Do not read values of the changing variable or controls.
- Read each statement and have students underline controls/circle changing variables/box data collection, and then have students circle if the statement could be an appropriate procedure step.
- Collect assessments.

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

- Review the definition of an observation (a description using your five senses).
- Tell students that the term contents refers to materials inside the bottle besides the solution.
  - Have them identify the contents in one of the bottles (nothing or aquatic snail or aquatic plant).
- Tell students that the term conditions refers to other variables outside of the bottle that may affect the solution.
  - Have students identify the conditions of the bottles that have been in their room (24 hours full light).
- Have students move to their groups.
  - If a student does not have a nametag, identify the group with the least number of students in it and write the student’s name on one of the extra nametags that are in the lead box using that color of marker.

Observations: (14 minutes – Groups – SciTrek Volunteers)

- Put up the initial bottle picture (page 1, picture packet) on the document camera.
- Walk around and help groups that are struggling.
- Make sure that groups are moving along and only spending ~5 minutes filling out the table and ~9 minutes describing what happened to the solution over the course of 24 hours.

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

- Have groups share what they did/learned.
  - After 24 hours, the solutions in bottle with the aquatic snail turned yellow and the bottles with nothing and the aquatic plant stayed blue.
- Ask the students what the most interesting thing they observed was and have them decide as a class to investigate the questions: “What variables affect the color of the solution?”
  - Write the class question on the front cover of the class notebook and have students copy the question onto their notebook.
- Review the definition of a variable (something in an experiment that can be changed).
- Explore one possible changing variable with the class and have students share how this variable might affect the color of the solution.
**Variables:** (19 minutes – Groups – SciTrek Volunteers)

- Walk around and help groups that are struggling.
- Make sure volunteers are having their group come up with four possible variables as well as how these variables might affect the color of the solution.
- Make sure students are generating at least one additional variable by themselves.

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

- Have each group share one variable with the class and how they think it will affect the color of the solution.

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

**Schedule:** You are responsible for **BOLD** sections

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

**Preparation:**

1. If the classroom has a document camera, ask the teacher to use it to show the Day 1 final bottles picture (page 2, picture packet), question (page 4, student notebook), lead materials page (page 3, picture packet), experimental plants pictures (page 4, picture packet), experimental set-up (page 5, student notebook), and procedure activity (pages 7-8, student notebook).
2. Have volunteers set out notebooks to allow students within the same subgroup to work together.
   a. If students are not in the classroom before SciTrek starts, have volunteers set out the notebooks where students should sit when they come into the classroom.
   b. If students are in the classroom before SciTrek starts, have volunteers set out the notebooks where they want students to sit and students will move to these spots after the introduction.
Experimental Considerations:
1. You will only have access to the materials on the materials page.
2. The liquid must remain in the original container.
3. You cannot design your own experiment that you know will kill an animal.
4. Only one animal per bottle.
5. You will only get four bottles (including original solution) per experiment.

Changing Variable (Independent Variable): Animal Type

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

Question our group will investigate:

- If we change the Animal Type, what will happen to the color of the solution?

Scitrek Member Approval

EXPERIMENTAL SET-UP

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

Changing Variable: Animal Type: Fish, Frog, Shrimp, Snail

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

Solution Type / Original Liquid Amount: Level 5 (full light)

Bottle size / Small Time / 24 hours

Plant type / No plants Clay Pot: On

Scitrek Member Approval

MATERIALS PAGE

You will only have access to the following materials:

1. Go through the labeled worksheets (circle if it is a changing variable and underline if it is a control).
2. Example Control: Bottle size, Example Changing variable: Plant type.
3. If variables that are controls, write down.
4. For variables that are changing variables, select one value and write the letter (a, b, c, d) next to each value. Example: Plant 1 =

<table>
<thead>
<tr>
<th>Bottle Sizes</th>
<th>Number of Bottles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>4</td>
</tr>
<tr>
<td>Medium (Max)</td>
<td></td>
</tr>
<tr>
<td>Large (Max)</td>
<td></td>
</tr>
<tr>
<td>XLarge (Max)</td>
<td></td>
</tr>
</tbody>
</table>

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

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

- Level 5 (full light)
- Level 4
- Level 3
- Level 2
- Level 1
- Level 0 (no light)

Animal Type: You may only have up to 4 animals.

- Check here if no animals will be in your bottles

<table>
<thead>
<tr>
<th>Animal Types</th>
<th>Number of Animals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td></td>
</tr>
<tr>
<td>Fish</td>
<td>1</td>
</tr>
<tr>
<td>Shrimp</td>
<td>1</td>
</tr>
<tr>
<td>Frog</td>
<td>1</td>
</tr>
</tbody>
</table>

Scitrek Member Approval

SCIENTIFIC PRACTICES

Procedures

Directions: Fill in the missing definition.

- Procedure: A set of steps to conduct an experiment.

A complete procedure MUST have:

- All values of the Controls
- Changing variable will be collected (measurements/observations).
- The steps listed in the order that they will be completed.

A complete procedure MUST NEVER have:

- Extra or irrelevant information.
- Opinions about the experiment.
- Incorrect values of controls or the changing variable.
**Introduction: (12 minutes – Full Class – SciTrek Lead)**

- If needed have volunteers set out notebooks so students are sitting next to members of their subgroup.
- Put the Day 1 final bottle picture (page 2, picture packet) under the document camera.
- Review the class question and what they learned last SciTrek visit.
- Review the terms: **contents** and **conditions**.
- Review experimental considerations with the class (top of page 4, student notebook):
  - You will only have access to the materials on the materials page.
  - The liquid must remain the original blue solution.
  - You cannot design an experiment that you know will kill/hurt and animal.
  - Only one animal per bottle.
  - You will only get four bottles (containing original solution) per experiment.
- Design an example experiment with the class.
  - For the changing variable, pick **animal type** (page 4, student notebook).
  - Show students how to write the question.
    - If we change the animal type, what will happen to the color of the solution?
  - Fill out the materials page for the example experiment (page 3, picture packet).
    - First: underline controls and circle the changing variable.
    - Second: select values for the controls and changing variable.
      - Try to convince students to pick the following two controls: plant type/no plants (easier to see what animals do to the solution if no plant is present) and light amount/level 5 (if any other light level is chosen, bottles will be in boxes and students will not be able to see the animals).
      - Write trial letters next to the changing variable values (Example: Frog A).
    - When talking about plants, show students the plants that they will have access to (page 4, picture packet).
  - Fill out the experimental set-up for the example experiment (page 5, student notebook).
If you have no plants, the control will be *plant type* and the value will be *no plants*. You must do it in this format so that it will fit into the procedure. The format would be similar if you had no animals.

There will be two additional blanks for controls. Lead students to come up with the following: Time/24 hours, Cap placement/on.

- Tell students that since the class is changing animal type, no other group will be able to have animal type as a changing variable and the only animals they will have access to are snails.

**Question: (5 minutes – Subgroups – SciTrek Volunteers)**

- Walk around and help subgroups that are struggling.
- Try to encourage subgroups to pick different changing variables.
- Make sure for the second part of the question (what you are measuring/observing) that students are specific (example: they should write, “the color of the solution,” not just “the solution”).

**Materials Page: (5 minutes – Subgroups – SciTrek Volunteers)**

- Walk around and help subgroups that are struggling.
- Make sure subgroups are underlining their controls and circling their changing variable.
- Make sure subgroups fill out the materials page correctly and completely.
  - Make sure subgroups do not exceed any limits set on the materials page.

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

- Walk around and help subgroups that are struggling.
- Make sure that within one subgroup, all students have the same order for their changing variable values.
- Make sure all control blanks are filled out.

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

- Review the definition of a procedure (a set of steps to conduct an experiment) (page 7, student notebook).
- Go over what procedures should include:
  - All values of the controls and the changing variable (*independent variable*).
  - What data will be collected (*dependent variable*).
  - The steps listed in the order that they will be completed.
- Go over what procedures should not include:
  - Extra or irrelevant information.
  - Opinions about the experiment.
  - Incorrect values of controls or the changing variable.
- Tell students that we will underline controls (underline the word control), circle changing variables (circle the words changing variable), and box information about data collection (box the word data).
- Tell students that they were given a scientist’s question and experimental set-up and they will need to determine if statements could be possible procedure steps (page 8, student notebook).
- Read the question.
  - Have students circle *ball temperature* and box *height the ball bounces*.
- Read the changing variable and control values.
- Read each statement.
Questions used for each statement:
  o What should be underlined, circled, and/or boxed?
    ▪ Have students underline controls/circle changing variables/box data collection.
  o Are there any opinions, incorrect, or extra/irrelevant information in this statement?
    ▪ If yes
      ▪ Could this be a correct procedural step?
    ▪ If no
      ▪ What is this step about?
      ▪ Is there any other information that should have been included in this step?
      ▪ Could this be a correct procedural step?
• Number 1: Get four 623 g rubber balls with circumference of 88 cm.
  o Correct – Step with Controls Only
• Number 2: Heat rubber balls to a temperature of [A] 30°, B) 40°C, C) 50°C, D) 60°C.
  o Correct – Changing Variable with Values
• Number 3: Measure and observe.
  o Incorrect – Vague Data Collection
• Number 4: Heat ball C to 50°C.
  o Correct – One Changing Variable Value Explained
• Number 5: Heat rubber balls to different ball temperatures.
  o Incorrect – Changing Variable with No Values
• Number 6: Measure how high each ball bounces on the cement.
  o Correct – Measurement
• Number 7: Drop the boring ball from a height of 3 m.
  o Incorrect – Opinion during Experiment

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

  • Tell students what they will do next time.

Day 3: Procedure Activity/Procedure/Results Table

Schedule: You are responsible for BOLD sections

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

Preparation:

1. If the classroom has a document camera, ask the teacher to use it for the procedure activity (page 9, student notebook), procedure activity experimental set-up (page 5, picture packet), procedure (page 6, student notebook), and results table (page 10, student notebook).
2. Verify when supplies will be dropped off for day 3.5
3. Set-up the light level boxes (level 0-4) in ascending order with the light turned on sitting on top of the boxes with the front lids removed (see picture below). Set-up two additional lamps for level 5 lighting (this will not be in a box). Do not plug in extension cords into other extension cords.
4. Make sure that you leave the classroom teacher the class notebook, students’ notebooks, respiration picture packet, Day 3.5 instructions, light boxes, lights, and bottles.

5. Have volunteers set out notebooks.
   a. If students are not in the classroom before SciTrek starts, have volunteers set out the notebooks where students should sit when they come into the classroom.
   b. If students are in the classroom before SciTrek starts, have volunteers set out the notebooks where they want students to sit and students will move to these spots after the introduction.

**Notebook Pages:**

---

**SCIENTIFIC PRACTICES**

**Procedures**

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

**PROCEDURE**

1. Get four rubber balls with circumferences of 58 cm.

2. Heat balls to a temperature of (90°C, 40°C, C 60°C, 0°C).

3. Drop each ball.

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

5. Pass the ball back and forth with another person.

6. Measure how high each ball bounces.

---

**Procedure**

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

1. Get 4 small bottles with original solution.

2. Put no plants and 3 tin, 5 mg, 0 string, and 7 nail in the bottles and put cap on.


4. Wait for 24 hours.

5. Observe and record the color of the solution.

---

In your procedure underline controls, circle *changing variables* and box *data collection.*
Introduction: (3 minutes – Full Class – SciTrek Lead)

- If needed, have volunteers set out notebooks.
- Review the class question.
- Review the definition of a procedure (set of steps to conduct an experiment).
- Review what should and should not be in a procedure.

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

- Tell students that last time they were given a scientist’s question and experimental set-up and they then decided if statements could be possible procedure steps for them. Today we will correct a full procedure for that same question and experimental set-up (page 9, student notebook).
- Have students open their notebook to page 9.
  - A copy of the experimental set-up from page 8 is in the picture packet on page 5 which can be put under the document camera if needed.
- Read through the procedure and have students underline controls/circle changing variables/box information about data collection.
  - After each step have students tell you what they underlined/circled/boxed and fill out the class notebook with this information.
- Have students tell you what should and should not be in a procedure and correct the procedure accordingly.

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

- Remind students that we had already decided on an experimental set-up for the class question of “If we change the animal type what will happen to the color of the solution?”
• Show students one of the bottles and explain that the bottles will be labeled and come with solution already in them.
• Have students determine step one for the class experiment and write it in the class notebook, remembering to underline controls/circle changing variables/box information about data collection. Once each step is done, allow students to write that step for their experiment in their notebook.
  o Do not let students get ahead of you.
• Repeat this process for each procedure step.
  o Step 1: Information about getting bottles.
    ▪ After determining step 1 for the class experiment show students the example step at the top of the procedure page (page 6, student notebook) and tell them that this step shows them how they will incorporate their changing variable into the procedure by using the trial letters.
  o Step 2: Information about putting animals and plants in bottles then capping them.
  o Step 3: Information about the light amount bottles will be under.
  o Step 4: Information about how long bottles should sit.
  o Step 5: Information about data collection.
• When writing each procedure step, make sure volunteers are helping their subgroups who have a changing variable in the step before helping subgroups with only controls in the step.
• Show students how to fill out the results table (page 11, student notebook).

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

• Walk around and help subgroups that are struggling.
• Make sure students are underlining controls, circling changing variables, and boxing data collection.
• Make sure that control values are written in trial A with an arrow through the rest of the trials and that changing variable values are written in each trial’s box.

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

• Tell students what they will do next time.
• Make sure that you leave the classroom teacher the class notebook, students’ notebooks, respiration picture packet, Day 3.5 instructions, light boxes, lights, and bottles.

Day 3.5: Experiment

Schedule: You are responsible for BOLD sections

Introduction (Classroom Teacher) – 15 minutes

Preparation:

1. If light boxes are not set up, see Day 3 for instructions on how to set them up.
2. Set out the bottles of solution, organized by subgroup, in an area that is easy for students to access.
3. Have the plant and animal Tupperware’s ready to pass plants and animals out to students.
4. Have notebooks in stacks by subgroup so students can get them when they come to start their experiments.
Experiment: (15 minutes – Full Class – Classroom Teacher)

- As a class, set-up the class experiment.
  - Read through each step of the procedure and follow the steps.
    - Get four small bottles of original solution.
      - Show students the bottles labeled class A, class b, class C, and class D
    - Put A) fish, B) frog, C) shrimp, and D) snail (or whatever order the class chose in the experimental set-up) and no plants (or whatever plant the class chose in the experimental set-up) into the bottles and put cap on.
      - Put the animals into the bottles and seal the bottle with the caps with holes.
    - Put bottles under light level 5 (full) (or whatever level the class chose in the experimental set-up)
      - Show students were the light level boxes are and put the bottles under level 5.

- Tell students that you will now call groups back one by one to start their experiment.
  - Have students not working on filling their bottles, work on an independent activity.
- Have groups set up their experiment.
  - Assign each student a bottle to be in charge of.
  - Have student read each step and then follow them.
  - Make sure that all bottles that need caps have caps with holes on them (any bottle containing a snail must have a cap on it.)

Day 4: Experiment/Results Summary/Poster Making

Schedule: You are responsible for **BOLD** sections

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

Preparation:

1. If the classroom has a document camera, ask the teacher to use it for the results table (student notebook, page 10) and the results summary (page 11, student notebook).
2. Place group bottles together so that each group can easily get all of their bottles when they start their experiment.
3. Ask the classroom teacher for a place to leave the student posters.
4. Have volunteers set out notebooks.
   a. If students are not in the classroom before SciTrek starts, have volunteers set out the notebooks where students should sit when they come into the classroom.
   b. If students are in the classroom before SciTrek starts, have volunteers set out the notebooks where they want students to sit and students will move to these spots after the introduction.
A larger version of this poster is in your lead box.
**Introduction:** (7 minutes – Full Class – SciTrek Lead)

- If needed, have volunteers set out notebooks.
- Review the class question. 
- Review the class experimental question. 
- Tell students that today they are going to record the data from their experiment and then generate a results summary. 
- Before they record their data, as a class they will record the data from the class experiment and come up with a results summary for it. 
- Show the students the four bottles from the class experiment and record the color of the solutions as well as any additional observations. 
- Have students generate a results summary from the data (page 11, student notebook). 
  - My experiment shows that when an animal is present, the solution turns yellow regardless of the animal type because we observed that the fish, shrimp, frog, and snail turned the solution yellow. 
  - Remind students that their data statement must contain the words “we observed.” 
- Tell the students once they finish their results summary, they will make a poster.  

**Experiment:** (5 minutes – Subgroups – SciTrek Volunteers)

- Help subgroups get their experiment bottles. 
- Walk around and help subgroups that are struggling. 
- Make sure that all students within the same group are recording the same color for each trial. 

**Results Summary:** (10 minutes – Subgroups – SciTrek Volunteers)

- Walk around and help subgroups that are struggling. 
- Make sure that subgroups are generating a claim (ideally the claim will allow them to make a prediction about future experiments) and using data to back it up. 
  - The data statement must include “we observed.” 
  - Do not reference trial letters in the results summary. 
- Volunteers struggle with results summaries, therefore, try to check at least one results summary from each group. 
- Have students fill out the sentence frame on page 11, “I acted like a scientist when”
**Poster Making:** (33 minutes – Subgroups – SciTrek Volunteers)

- Help volunteers glue poster pieces onto the posters. When gluing, make sure that you or the volunteers (not the students) are gluing the poster in the exact order that is shown on the diagram and that the poster has a landscape orientation.
- Make sure that the student in each subgroup who is presenting the results table has a sentence frame sticker in their notebook and the volunteer has gone over how to present the four sentences with the student several times.
- Each student should have the part(s) that they are presenting highlighted and numbered in their notebook. (1) scientists’ names, 2) question, 3) experimental set-up, 4) procedure, 5) results table, and 6) results summary) (see pictures above)
- Volunteers often forget to highlight student notebooks, so make sure this is done before Day 5.

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

- Ask students the following questions:
  - How did you act like a scientist during this project?
  - What did you do that scientists do?

**Day 5: Poster Presentations**

**Schedule:** You are responsible for **BOLD** sections

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

**Preparation:**

1. If the classroom has a document camera, ask the teacher to use it for the notes on presentations (pages 6 and 7, picture packet).
2. Organize posters so that experiments featuring the same changing variable will be presented back to back.
3. Have volunteers pass out notebooks.
**Picture Packet Pages:**

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

- If needed, have volunteers pass out notebooks.
- Tell students that they will have 10 minutes to discuss their experiment and practice their posters.
- **DO NOT GIVE STUDENTS MORE THAN 10 MINUTES OR YOU WILL RUN OUT OF TIME FOR PRESENTATIONS.**

### Practice Posters: (10 minutes – Subgroups – SciTrek Volunteers)

- Organize posters so that experiments featuring the same changing variable are presented back to back.
- Make sure students are reading from their notebook and practicing the poster in the following order: 1) scientists’ names, 2) question, 3) experimental set-up, 4) procedure, 5) results table, and 6) results summary. They will NOT read the “I acted like a scientist when” from their poster.

### Poster Presentations: (46 minutes – Full Class – SciTrek Volunteers/SciTrek Lead)

- Tell students that if they ask a scientific question (a question that helps summarize what the subgroup did/learned) they will receive a SciTrek pencil after the presentations are done.
- Have students present their posters.
- While posters are being presented, record each subgroup’s changing variable values and their data on pages 6 and 7 of the picture packet.
  - After the subgroups read their question, stop the presentation and have the class identify the changing variable. Then record it in the picture packet.
  - When groups read their experimental set-up, record the values of the changing variable.
  - When groups read their results table, record the solution color.
• After each presentation, ask students:
  o What questions do you have for this group?
  o Can someone summarize what we learned from this group?
• Record what they learned under the summary on pages 6 and 7 of the picture packet.
• After all presentations are over, have students tell you the variable values that they would select to make the solution the most yellow.

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

• 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. This is the last day with their SciTrek volunteers, therefore, they should say goodbye to them.
• Have volunteers give students SciTrek pencils.
• Tell students to remove the paper part of their nametag from the plastic holder and that they can keep the paper nametag but need to give the plastic holder back to their SciTrek volunteer.

Day 6: Procedure Assessment/Tie to Standards

Schedule: You are responsible for BOLD sections

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

Preparation:

1. If the classroom has a document camera, ask the teacher to use it for the Tie to Standards activity (pages 11-14, student notebook).
2. Have the bottles in the cardboard box available to show students the bottles during the Tie to Standards activity.
3. Pass out the procedure assessments and notebooks.
4. If the teacher is not leading the Tie to Standards activity, give them an extra student notebook and have them fill it out with the students to follow along.
5. Remind the teacher to give you their lab coat at the end of the day.
RESULTS
Summary

My experiment shows that when an aquatic plant is present as the light level decreases, the solution turns yellow because we observed that the solution in light (label 3 in light) stayed yellow, but the solution in light with 4 and 5 stayed blue after 24 hours.

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

TIE TO STANDARDS

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

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

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

All yellow bottles have no animal in them.

THE BROADER PICTURE

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

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

b. What information is plotted on the y-axis? **CO₂ (ppm)**

c. Does the level of carbon dioxide change over time? **Yes**

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

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

Carbon dioxide levels in the atmosphere are increasing because in 1800 there were ~280 ppm of CO₂ and in 2019 there were ~410 ppm of CO₂.

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

- **Humans/animals**
- **Cars/factories**
- **Deforestation**

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

- **Yes**
- **No**

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

- **Yes**
- **No**

12. What are 3 things that humans do to decrease the amounts of carbon dioxide they produce?

- **Use cars less (carpool, commute by bus, walk)**
- **Plant more trees**
**Procedure Assessment:** (10 minutes – Full Class – SciTrek Lead)

- Pass out assessments.
- Read the question, changing variable (example: the changing variable was liquid type), and controls (example: the controls were liquid amount, container type, object type...). Do not read changing variable or control values.
- Read each statement and have students underline controls/circle changing variables/box data collection, and then have students circle if the statement could be an appropriate procedure step.
- Collect assessments.

**Tie to Standards:** (50 minutes – Full Class – SciTrek Lead)

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

- Remind students they have been observing the color of the solution and trying to determine why the color is changing.
- Tell the students that you did an experiment the previous day and you brought the bottles from your experiment for the class to observe.
- On their own, have students predict the color of the solution in each bottle.
  - Have one student share what they think the color will be and explain why.
  - Use thumbs up/thumbs down to see if the rest of the class agrees or disagrees.
    - Record “Y” for yellow
    - Record “G” for green
    - Record “B” for blue
- After each prediction, show the experimental bottle for that prediction, and have students record the actual color on their chart.
- Ask students what all solutions that turned yellow/green had in common. Students should say that they all contained animals.
- Fill in question 2.
  - Ask students if all solutions that were under the light for 24 hours changed color. Students should say “no.”
- Check “no” for question 3.
- Lead students to understand that the solutions that remained blue did so because they did not have animals in them.
- Fill in question 4.

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

- Lead students to understand that the animals breathe in oxygen and breathe out carbon dioxide, which is why the solution is changing colors.
  - Students may suggest that animals going to the bathroom changes the color of the solution. Tell students that you have put urine into the solution without an animal and did not observe a color change.
- Ask students if there is a way that we can test if carbon dioxide is causing the color change.
  - Lead students into generating the idea of putting dry ice in the solution.
- Put the piece of dry ice into the solution to verify for students that carbon dioxide is changing the color.
- Ask students if they think you could change the solution color if you blew into it with a straw.
- Get a straw and blow into the solution, proving that you can change the color.
  - Discuss that you can change the solution color faster than the animals can.
• Ask students why the solution in the bottles with plants did not change color.
  o Students should respond that plants take in light and carbon dioxide and give off oxygen in a process called photosynthesis.
• Ask students how they could change a solution that was yellow back to blue.
  o They can put a plant in it and leave it under light.

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

• Tell students that you did an additional experiment with the same contents, but this time they were in the dark for 24 hours.
• On their own, have students predict the color of the solution in each bottle.
  o Have one student share what they think the color will be and explain why.
    ▪ Record “Y” for yellow
    ▪ Record “G” for green
    ▪ Record “B” for blue
• After each prediction, show the experimental bottle for that prediction and have students record the actual color on their chart.
• Ask students what the color of the solution tells us about animals in the dark (animals still breathe in the dark) and fill in question 6.
• Ask students what the color of the solution tells us about plants in the dark (plants can produce carbon dioxide) and fill in question 7.
• Ask students what the process is called where plants turn carbon dioxide into oxygen (photosynthesis).
  o What is needed for photosynthesis? (light). Plants cannot do photosynthesis in the dark, but they must be undergo respiration (like animals) in the dark (and also in the light but photosynthesis takes in more carbon dioxide than respiration give off).

The Broader Picture: Bottle B000 (14 minutes)

• Have students look at the graph and answer questions 8a-d.
• Ask students to summarize what the graph tells us about carbon dioxide levels in the atmosphere.
• Fill in question 8e.
• Ask students what is different now than in the 1800’s and before.
  o Lead students to understand that cars did not exist yet.
  o Note: Students may also respond that there were less people, less buildings, and more farmland. While these are correct responses, focus on cars first and use these answers as reminders when you get to question 9.
• Do cars produce carbon dioxide?
  o Yes
• Bubble car exhaust through a straw into the bottle to show that car exhaust contains carbon dioxide.
  o If you do not use all of the car exhaust, replace the binder clip on the balloon to reseal the balloon.
  o Students should see that the car exhaust turned the solution yellow faster than you did, so the car exhaust produces much more carbon dioxide than is produced in respiration.
• Ask students for three things that contribute to increasing amounts of carbon dioxide in the atmosphere and fill in question 9.
• Ask if there would be carbon dioxide on the planet if humans did not exist (yes).
• Ask if humans have changed the amount of carbon dioxide produced each year (yes).
• Have students come up with several ways to decrease the amounts of carbon dioxide humans produce, and record two of them in question 12.
EXTRA PRACTICE

Procedures

QUESTION

If we change the _____ what will happen to the _____ on each index card?

EXPERIMENTAL SET-UP

Changing Variables: Trial A Trial B Trial C Trial D

Jam Type: Strawberry Raspberry Blackberry Boysenberry

Controls (variables you will hold constant):

Jam Amount: 10g

Time: 3 Hours

Container Type: Index Card

Ant Type: Argentine Ants

Directions:

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

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

Could this be

1. Put jam of __________ brand on ________ onto each index card.
   Yes No

2. Put the jam on index card C.
   Yes

3. Put the index card to far away from the jam on index card.
   Yes No

4. Make observations about the experiment.
   Yes

5. Put jam of ________ brand on ________ onto index card A.
   Yes No

6. Count the number of ____________ on each index card after 3 hours.
   Yes No

7. Put jam of ________ brand onto each index card.
   Yes No

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

21