Lead Information Packet
Module 1: Respiration
4th Grade

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 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. The lead will use a student notebook to write in as an example for students. The notebook that the lead uses is referred to as the class notebook in these instructions.

Notepad:
One given to every group and is filled out by the volunteer. In these instructions, the examples are 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. Make sure volunteers are passing out nametags.
2. Make sure volunteers are setting up for the initial observation.
3. Set up the document camera to show the initial bottle picture (page 1, picture packet) and class question (front cover, student notebook).
**Notebook Pages and Notepad Pages:**

### 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:</td>
<td>None</td>
<td>Aquatic Grass</td>
</tr>
<tr>
<td>Conditions:</td>
<td>24 hours under light</td>
<td></td>
</tr>
<tr>
<td>Color of Solution at Start of Experiment:</td>
<td>Blue</td>
<td>Blue</td>
</tr>
<tr>
<td>Color of Solution at End of Experiment:</td>
<td>Blue</td>
<td>Yellow</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>
</table>
| Animal Type | Adding animals to the bottle will turn the solution ________.
| Plant Type | Adding plants to the bottle will turn the solution ________.
| Light Amount | Putting the batter under a lower light level will turn the solution ________.
| Bowl Size | Leaving the batter longer will turn the solution ________.

Choose your own!
**Introduction:** (2 minutes – Full Class – SciTrek Lead)

- Allow volunteers to introduce themselves.
- Introduce the module.

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

- Pass out assessments.
- Read the question, changing variable (Ex: the changing variable was solid amount), and controls (Ex: 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 a conditions of the bottles (Ex: 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 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 solution in the bottle with the aquatic snail turned yellow and the bottles with nothing and the aquatic plant stayed blue.
- Ask students, “What is the most interesting thing you observed?” Lead them to decide to investigate the question, “What variables affect the color of the solution?”
  - Write the class question on the front cover of the class notebook and have students copy it onto their notebooks.
- 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.
- Tell students what they will do next session.

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. Make sure volunteers are setting out notebooks to allow students in the same subgroup to work together.
2. Set up the document camera to use for 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).
Notebook Pages and Picture Packet Page:

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

Changing Variable (Independent Variable): **Animal Type**

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

**QUESTION**

Question our group will investigate:
- If we change the **animal type**, what will happen to the **color of the solution**?

SciTrek Member Approval

Get a materials page from your SciTrek volunteer and fill it out before moving onto the experimental setup.

MATERIALS PAGE

You will only have access to the following materials:
- Go through the bolded words and circle if it is a changing variable and underline it if it is a control.
- (example: control: bottle size, changing variable: plant type)
- For variables that are controls, select 1. For variables that are the changing variable, select 4 and write the letter (a, b, c, d) next to each value. Example: Plant 1 - c.

**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.

<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 1)</td>
<td></td>
</tr>
<tr>
<td>Large (Max 1)</td>
<td></td>
</tr>
<tr>
<td>X-Large (Max 1)</td>
<td></td>
</tr>
</tbody>
</table>

**Plant Types:** Put the number of plants you would like next to each plant type.
- If there are no plants, circle **No plants**.
- Check here if no plants will be in your bottles.
- Aquatic Plants | Number of Plants
  - Plant 1 (Original): 8
  - Plant 2: 3
  - Plant 3: 5
  - Plant 4 (Max 1): 6
- Non-Aquatic Plants | Number of Plants
  - Tree Leaf 1: 1
  - Flower 1 (Max 1): 7
  - Flower 2 (Max 1): 8

**Light Amount:** Mark the boxes of the light amount(s) you will use.
- [ ] Level 1 (No Light)
- [ ] Level 2
- [ ] Level 3
- [ ] Level 4
- [ ] Level 5 (Full Light)

**Animal Types:** You may have up to 4 animals.
- Check here if no animals will be in your bottles.
- Animal Types | Number of Animals
  - Small: 10
  - Fish: 4
  - Shrimp: 1
  - Frog: 6

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
- Light Amount: Level 5 (Full Light)
- Water Size / Small
- Time: 24 hours
- Plant type: no plants
- Top placement: On

SciTrek Member Approval

SCIENTIFIC PRACTICES

Procedures

Directions: Fill in the missing definitions.
- Procedure: A set of steps to conduct on an experiment.

A complete procedure MUST have:
- All values of the **controls** and the **changing variable**.
- What **data** 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)

- Put the Day 1 final bottle picture (page 2, picture packet) under the document camera.
- Review the class question and what they learned/did last session.
- 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 how animals affect 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 (Ex: 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.
- 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 (Ex: the color of the solution instead of 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 and request the proper number of each item.

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

- Walk around and help subgroups that are struggling.
- Make sure 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).
  - Tell students these steps are not a full procedure for the experiment and are therefore not in any order.
- 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 session.

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. Make sure volunteers are setting out notebooks.
2. Set up the document camera 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).
3. Verify when supplies will be dropped off for Day 3.5.
4. Get a small bottle to show students during the procedure discussion.
5. Set up the light level boxes (levels 0-4) in ascending order with the light turned on sitting on top of the boxes with the front lids removed (see picture below). Set up two additional lamps for level 5 lighting (this will not be in a box). Do not plug extension cords into other extension cords. (This can be done after the module.)

6. Make sure you leave the classroom teacher the class notebook, students’ notebooks, respiration picture packet, Day 3.5 instructions, light boxes, lights, and bottles.
Introduction: (3 minutes – Full Class – SciTrek Lead)

- Review the class question, what they learned/did last session, and what they will do today.
- 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 their set-up. Today we will examine a full procedure for that same question and experimental set-up and determine if it is correct (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: 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.
  ○ Volunteers should make sure students do not get ahead of you.
• Repeat this process for each procedure step.
  ○ 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.
  ○ Step 2: Information about putting animals and plants in bottles and then capping them.
  ○ Step 3: Information about the light amount bottles will be under.
  ○ Step 4: Information about how long bottles should sit.
  ○ 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 the changing variable, and boxing data collection.
• Make sure control values are written in the trial A box with an arrow through the rest of the trials’ boxes 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 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 (SciTrek Staff Member/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. Group bottles
3. Set out the bottles of solution, organized by subgroup, in an area that is easy for students to access.
4. Have the plant and animal Tupperwares ready to pass plants and animals out to students.
5. Have notebooks in stacks by subgroup. Students will not need these until they fill their bottles.
Experiment: (15 minutes – Full Class – SciTrek Staff Member/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 who are 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 students read each step and then follow them.
  - Make sure 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. Get students’ notebooks and give them to the volunteers to separate into their subgroups, attach nametags, and set out.
2. Make sure volunteers are get bottles for their subgroups and replace the caps with holes with caps without holes.
3. Find a place to leave student posters.
4. Set up the document camera to show the results table (page 10, student notebook) and the results summary (page 11, student notebook).
Notebook Page, Poster, and Highlighted/Numbered Notebook:

RESULTS

<table>
<thead>
<tr>
<th>Variables</th>
<th>Trial A</th>
<th>Trial B</th>
<th>Trial C</th>
<th>Trial D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solution Type</td>
<td>Original</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>24 hours</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bottle Size</td>
<td>Small</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animal Type</td>
<td>Fish</td>
<td>Frog</td>
<td>Shrimp</td>
<td>Small</td>
</tr>
<tr>
<td>Plant Type</td>
<td>no plants</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light Exposure</td>
<td>level 5 (full light)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tap Placement</td>
<td>on</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Predictions

<table>
<thead>
<tr>
<th>Predicted Final Color of Bottle:</th>
<th>Trial A</th>
<th>Trial B</th>
<th>Trial C</th>
<th>Trial D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow</td>
<td>Yellow</td>
<td>Yellow</td>
<td>Yellow</td>
<td>Yellow</td>
</tr>
<tr>
<td>Blue</td>
<td>Blue</td>
<td>Green</td>
<td>Blue</td>
<td>Green</td>
</tr>
<tr>
<td>Red</td>
<td>Red</td>
<td>Red</td>
<td>Red</td>
<td>Red</td>
</tr>
</tbody>
</table>

Data

<table>
<thead>
<tr>
<th>Trial A</th>
<th>Trial B</th>
<th>Trial C</th>
<th>Trial D</th>
</tr>
</thead>
<tbody>
<tr>
<td>yellow</td>
<td>yellow</td>
<td>yellow</td>
<td>yellow</td>
</tr>
<tr>
<td>yellow</td>
<td>red</td>
<td>red</td>
<td>red</td>
</tr>
<tr>
<td>blue</td>
<td>green</td>
<td>blue</td>
<td>green</td>
</tr>
<tr>
<td>red</td>
<td>red</td>
<td>red</td>
<td>red</td>
</tr>
</tbody>
</table>

Find Observations:

- Solution Color:
  - yellow
  - red
- Bottle Color:
  - yellow
  - blue
- Other:
  - small, black, frog, small, shrimp, on top of bottle
  - swimming in circles

### 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, g-green, b-blue)

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

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

A larger version of this poster is in your lead box.

Example Highlighted Notebook Pages
**Introduction:** (7 minutes – Full Class – SciTrek Lead)

- Review the class question and what they learned/did last session.
- 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 result table (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 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 subgroups are generating a claim (ideally the claim will allow them to make a prediction about future experiments) and use at least two data points to support it.
  - The claim should include information about the contents and conditions of the bottles, if possible.
  - The data statement must include “we observed.”
  - Do not reference trial letters in the results summary.
- Volunteers struggle with results summaries, therefore, check at least one results summary from each group.
- Make sure 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 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 the student in each subgroup who is presenting the results table has the appropriate 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).
  - Remind the volunteers that if a student is presenting multiple parts, they should have multiple sections highlighted and numbered in their notebook.
- 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. Make sure volunteers are setting out notebooks.
2. Set up the document camera to use for the Notes on Presentations (pages 6 and 7, picture packet).
3. Organize posters so experiments featuring the same changing variable are presented back to back and posters are presented from easiest to understand to hardest to understand (suggested order: bottle size, plant type, light amount (animal), light amount (plant), light amount (animals and plants)).
Notes on Presentations

What variables affect the color of the solution?

Group 1 (with snail)
Changing Variable: Light Amount
Color of the Solution: L0 L3 L5 L1
Summary: As the light amount increases, the solution becomes less yellow when a snail is present.

Group 2 (light vs.
Changing Variable: Plant Type
Color of the Solution: Blue blue yellow yellow
Summary: Aquatic plants keep the solution blue, but non-aquatic plants turn the solution yellow.

Group 3 (light, L3)
Changing Variable: Plant Type
Color of the Solution: Green blue blue green
Summary: When an aquatic plant is present, different light levels may affect the color of the solution.

Group 4 (with snail)
Changing Variable: Plant Type
Color of the Solution: Yellow yellow yellow yellow
Summary: Plants that include an aquatic plant and snail will turn the solution yellow.

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

- Tell students that they will have 10 minutes to discuss their experiment and practice their posters.

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

- DO NOT GIVE STUDENTS MORE THAN 10 MINUTES TO PRACTICE OR YOU WILL RUN OUT OF TIME FOR PRESENTATIONS.
- 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 subgroups read their question, stop the presentation and have the class identify the changing variable. Then record it in the picture packet.
  - When subgroups read their experimental set-up, record the values of the changing variable.
  - When subgroups read their results table, record the solution color.
- After each presentation, ask students:
  - What questions do you have for this subgroup?
  - Can someone summarize what we learned from this subgroup?
- 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 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 teacher is not leading the Tie to Standards Activity do the following:
   a. Give the teacher an extra student notebook and have them fill it out with their students during the Tie to Standards Activity.
   b. Collect the teacher’s lab coat and put it in the lead box.
2. Pass out Procedure Assessments and notebooks.
3. Set up the document camera for the Tie to Standards Activity (pages 11-14, student notebook).
4. Make sure the only bottles with blue solution are B0, B00, B000, B4, and B5.
5. Have the cardboard box with bottles ready with easy access to grab bottles after students make predictions.
6. Put your lab coat in the lead box at the end of the day.
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 (cell 4 low light) stayed yellow, but the solution in light (cells 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, g-green, b-blue)

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

2. From the chart above, what do the yellow/green bottles have in common? All yellow/green bottles have no animal in them.

3. Did all of the bottles change color? [ ] yes [ ] no

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

   The bottle that stayed blue did not have animals in them.

5. 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, g-green, b-blue)

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

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

   Animals will become primary carbon dioxide in the dark.

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

   Plants can produce carbon dioxide (CO2).

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

   Carbon Dioxide Levels in the Atmosphere

   - What information is plotted on the x-axis? Year
   - What information is plotted on the y-axis? CO2 (ppm)
   - Does the level of carbon dioxide change over time? [ ] yes [ ] no
   - Circle the area(s) on the graph that do not fit the general trend, or that show the greatest change.
   - 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 2000, there were 340 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 (Ex: the changing variable was liquid type), and controls (Ex: 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 do all of solutions that turned yellow/green have in common?” Possible student response: they all contained animals.
- Fill in question 2.
  - Ask students, “Did all of solutions, which were under the light for 24 hours, change color?” Students should reply, “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, “Is there a way to 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, “Do you think I could change the solution color if I 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 because you are much larger than the animals.
• Ask students, “Why did the solution in the bottles with plants not change color?” Possible student response: plants take in light and carbon dioxide and give off oxygen in a process called photosynthesis.
• Ask students, “How could we change a solution that was yellow back to blue?” Possible student response: we 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 does the color of the solution tell us about animals in the dark?” Possible student response: animals still breathe in the dark. Then fill in question 6.
• Ask students, “What does the color of the solution tell us about plants in the dark?” Possible student response: plants can produce carbon dioxide. Then fill in question 7.
• Ask students, “What is the process is called where plants turn carbon dioxide into oxygen?” Students should reply, “Photosynthesis.”
  o Have a discussion about photosynthesis with students. Make sure by the end they understand that light is needed for plants to do photosynthesis; therefore, at night plants cannot do photosynthesis. In addition, plants must undergo respiration (like animals) but during the day they take in more carbon dioxide than they give off.

The Broader Picture: Bottle B000 (14 minutes)

• Have students look at the graph and answer questions 8a-d.
• Have students summarize what the graph tells us about carbon dioxide levels in the atmosphere.
• Fill in question 8e.
• Have students discuss 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.
• Ask students, “Do cars produce carbon dioxide?”
• 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.
• Have students generate three things that contribute to increasing amounts of carbon dioxide in the atmosphere and fill in question 9.
• Discuss if there would be carbon dioxide on the planet if humans did not exist.
• Discuss if humans have changed the amount of carbon dioxide produced each year.
• 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 Solutions

#### Procedures

**EXTRA PRACTICE**

**QUESTION**

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

#### EXPERIMENTAL SET-UP

<table>
<thead>
<tr>
<th>Changing Variables:</th>
<th>Trial A</th>
<th>Trial B</th>
<th>Trial C</th>
<th>Trial D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jam Type:</td>
<td>Strawberry, Raspberry, Blackberry, Boysenberry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jam Amount:</td>
<td>10g</td>
<td>10g</td>
<td>10g</td>
<td>10g</td>
</tr>
<tr>
<td>Jam Brand:</td>
<td>Abarros</td>
<td>Abarros</td>
<td>Abarros</td>
<td>Abarros</td>
</tr>
<tr>
<td>Time:</td>
<td>3 Hours</td>
<td>3 Hours</td>
<td>3 Hours</td>
<td>3 Hours</td>
</tr>
<tr>
<td>Container Type:</td>
<td>Index Card</td>
<td>Index Card</td>
<td>Index Card</td>
<td>Index Card</td>
</tr>
<tr>
<td>Ant Type:</td>
<td>Argentine Ants</td>
<td>Argentine Ants</td>
<td>Argentine Ants</td>
<td>Argentine Ants</td>
</tr>
</tbody>
</table>

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

- Jam Amount / 10g
- Jar Brand / Abarros
- 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.

<table>
<thead>
<tr>
<th>Step</th>
<th>Statement</th>
<th>Yes/No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Put type of <strong>strawberry</strong> jam onto each index card.</td>
<td>No</td>
</tr>
<tr>
<td>2.</td>
<td>Put the type of <strong>raspberry</strong> jam on index card C.</td>
<td>Yes</td>
</tr>
<tr>
<td>3.</td>
<td>Put the index card 2 cm away from the <strong>ant</strong> on trial A.</td>
<td>No</td>
</tr>
<tr>
<td>4.</td>
<td>Make observations about the experiment.</td>
<td>Yes</td>
</tr>
<tr>
<td>5.</td>
<td>Put type of <strong>boysenberry</strong> jam onto index card A.</td>
<td>No</td>
</tr>
<tr>
<td>6.</td>
<td>Count the number of <strong>ant</strong>s on each index card after 1 hour.</td>
<td>No</td>
</tr>
<tr>
<td>7.</td>
<td>Put type of <strong>blackberry</strong> jam onto each index card.</td>
<td>No</td>
</tr>
</tbody>
</table>

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