

## Module 1: Mealworms

3<sup>rd</sup> Grade

### **About the Instructions:**

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

### **Activity Schedule:**

*There are no scheduling restrictions for this module.*

Day 1: Question Assessment/Observations/Reproducibility Discussion/Variables (60 minutes)

Day 2: Question Activity/Questions/Materials Page/Experimental Set-Up (60 minutes)

Day 3: Technique/Procedure/Results Table/Experiment (60 minutes)

Day 4: Graph/Results Summary/Poster Making (60 minutes)

Day 5: Poster Presentations (60 minutes)

Day 6: Question Assessment/Tie to Standards (60 minutes)

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

### **Student Groups:**

Students are divided into four groups of approximately five students each, for the entire module. One volunteer is assigned to help each group. We find groups work best when they are mixed levels and mixed language abilities.

### **NGSS Performance Expectation Addressed:**

3-LS4-3 Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

### **Learning Objectives:**

1. Students will know that when habitat changes, the organism populations must move, die, or adapt.
2. Students will know that adaptations take many generations to occur.
3. Students will know the importance of repeating their experiments.
4. Students will be able to find the median number of a given set of numbers composed of an odd number of data points.

5. Students will be able to generate at least two testable questions and recognize when questions are not testable by science.
6. Students will be able to suggest revisions for questions that are not testable by science in order to make them testable.
7. Students will be able to list at least one way they acted like scientists.

### ***Classroom Teacher Responsibilities:***

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

\*Groups are made up of approximately five students.

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

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

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

**Prior to the Module (at least 1 week):**

1. Come to the SciTrek module orientation at UCSB.

**Note for Teacher During the Module:**

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

Days 1-4:

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

Days 5-6:

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

**Scheduling Alternatives:**

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

Day 1:

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

Day 2:

If you would like to have more time for your students to generate testable and non-testable questions and design their experiments, you can go over the question activity (notebook, page 2), **before** SciTrek arrives.

Day 3:

If you would like to have more time for your students to perform their experiments, you can do the technique activity (notebook, page 5), **before** SciTrek arrives.

Day 5:

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

Day 6:

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

**Materials Used for this Module:**

1. Mealworms
2. Magnifying Glasses (Fisher Part Number: S19230C)
3. Pillboxes (Amazon; EZY DOSE Weekly (7-day) Push Button Pill Organizer and Planner (XL) dimensions 8.89 x 2.12 x 0.7 inches) cut to remove Wednesday leaving two 3-compartment boxes. Days of the week are removed with methanol and then a sharpie is used to label the sections 1, 2, and 3. Five, 0.7 cm holes are drilled through three of the side panels to allow the mealworms to crawl between the compartments. Masking tape is put on the end of the pillbox so that the mealworms cannot crawl out of the container. These will be referred to as choice chambers for the rest of the instructions.



4. Bedding Materials (cotton balls, moss, bark, shredded paper [red, yellow, green, white], woodchips, fresh grass, dry leaves, and rocks)
5. Food (Cheerios, Frosted Flakes, pretzels, dried peppers, raisins, mandarin oranges, lettuce, lemons, cookies, sour candy [soft], and oatmeal)
6. MyChron Timers (Fisher Part Number: S65330) and replacement batteries (Fisher Part Number: 50-212-755)
7. Reynolds foil baking cups (Amazon)
8. Sharpies
9. 1 oz Containers with lids to hold mealworms (Smart and Final) (Be sure to poke holes in the lid using a paper clip and store mealworms with a small piece of bread)

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

### ***Types of Documents:***

#### **Notebook:**

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

#### **Notepad:**

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

#### **Picture Packet:**

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

In these instructions, all other example documents are labeled.

## Day 1: Question Assessment/Observations/Reproducibility Discussion/Variables

### Schedule:

- Introduction (SciTrek Lead) – 2 minutes
- Question Assessment (SciTrek Lead) – 5 minutes
- Observation Discussion (SciTrek Lead) – 2 minutes
- Observations (SciTrek Volunteers) – 23 minutes
- Reproducibility Discussion (SciTrek Lead) – 8 minutes
- Variable Discussion (SciTrek Lead) – 2 minutes
- Variables (SciTrek Volunteers) – 13 minutes
- Wrap-Up (SciTrek Lead) – 5 minutes

### Materials:

#### (4) Volunteer Boxes:

- |   |  |   |
|---|--|---|
| <input type="checkbox"/> Student nametags               | <input type="checkbox"/> (2) Grease pencil | <input type="checkbox"/> (6) Magnifying glasses         |
| <input type="checkbox"/> Volunteer instructions         | <input type="checkbox"/> Sharpie           | <input type="checkbox"/> (6) Metal baking cups          |
| <input type="checkbox"/> Picture of experimental set-up | <input type="checkbox"/> Paper towels      | <input type="checkbox"/> (2) Bags of woodchips          |
| <input type="checkbox"/> Volunteer lab coat             | <input type="checkbox"/> Timer             | <input type="checkbox"/> Container of 20 mealworms each |
| <input type="checkbox"/> (2) Pencils                    | <input type="checkbox"/> Water (8 oz)      | <input type="checkbox"/> Container of 10 mealworms      |
|   | <input type="checkbox"/> Choice chamber    |   |

#### Other Supplies:

- |                                       |                                    |
|---------------------------------------|------------------------------------|
| <input type="checkbox"/> (4) Notepads | <input type="checkbox"/> (4) Trays |
|---------------------------------------|------------------------------------|

#### Lead Box:

- |   |  |   |
|---|--|---|
| <input type="checkbox"/> (3) Blank nametags             | <input type="checkbox"/> (2) Pencils                               | <input type="checkbox"/> Masking tape                   |
| <input type="checkbox"/> Lead instructions              | <input type="checkbox"/> (2) Grease pencil                         | <input type="checkbox"/> Choice chamber                 |
| <input type="checkbox"/> Mealworms picture packet       | <input type="checkbox"/> (2) Black pen                             | <input type="checkbox"/> (6) Magnifying glasses         |
| <input type="checkbox"/> Picture of experimental set-up | <input type="checkbox"/> (4) Markers (orange, blue, green, purple) | <input type="checkbox"/> (6) Metal baking cups          |
| <input type="checkbox"/> Lead lab coat                  | <input type="checkbox"/> Sharpie                                   | <input type="checkbox"/> (2) Bags of woodchips          |
| <input type="checkbox"/> (25) Question assessments      | <input type="checkbox"/> Paper towels                              | <input type="checkbox"/> Container of 20 mealworms each |
| <input type="checkbox"/> Time card                      | <input type="checkbox"/> Timer                                     |   |
|   | <input type="checkbox"/> Water (8 oz)                              |   |

**Notepad and Picture Packet Pages:**

**OBSERVATIONS**

Experimental Set-Up:

- Choice chamber with 3 compartments
- 6 holes between each compartment
- 20 mealworms
- Timer
- 6 magnifying glasses

1	2	3
Dry	20 MW	Wet

1

**OBSERVATIONS**

Mealworm Observations:

- Mealworms moving
- Mealworms have 6 legs
- Their legs are in the front of their body
- Have a segmented body
- Mealworms yellow-orange in color

After 5 minutes:

Trial	Dry	None	Wet
1	10	7	3
		10	17
		<del>7</del>	<del>3</del>
		17	20

2

**Class Data Sheet**

Trial	Dry Woodchips	No Woodchips	Wet Woodchips
Lab	11	5	4
1	9	4	7
2	7	7	6
3	13	3	4
4	12	5	3

Dry WC	7	9	11	12	13
	3	4	5	5	7
Wet WC	3	4	4	6	7

**Picture Packet, Page 1** Maximum

1

**VARIABLES**

Variable	How will changing this variable affect the number of mealworms in each compartment?
Length of Container	The longer pillbox will have fewer mealworms in each compartment. 5 Agree, 0 Disagree
Bedding Type	Mealworms might travel to soft bedding so they can burrow in it. 3 Agree, 2 Disagree
Food Type	Mealworms will travel to sweet food because other insects do too. 4 Agree, 1 Disagree
Number of Mealworms	If there are too many mealworms in the pillbox, they won't be able to move. 4 Agree, 1 Disagree
Light Amount	Mealworms will go to the light instead of the dark so they will be able to see. 4 Agree, 1 Disagree

3

**Preparation:**

SciTrek Lead:

1. Outside of the classroom, have the volunteers pour water into one of their bags of woodchips that are in their group boxes. Then, have them fill compartment 1 of the choice chamber three-quarters full of dry woodchips and compartment 3 three-quarters full of wet woodchips.
2. Make sure volunteers are passing out nametags.
3. Make sure volunteers are setting up for the initial observation. Details of how to do this are on a picture in the volunteer boxes.
4. Set up the document camera for the class data (picture packet, page 1).
5. Pass out the question assessments.

SciTrek Volunteers:

1. Do the following outside before arriving to the classroom:
  - a. Pour water into one of the bags of woodchips.
  - b. Verify the choice chamber has masking tape blocking the holes on the ends of the box. If not, ask the lead for tape.
  - c. Fill compartment 1 three-quarters full of dry woodchips.
  - d. Fill compartment 3 three-quarters full of wet woodchips.
  - e. Compartment 2 will be empty.
2. Pass out nametags.
  - a. You may need to do this during the introduction/question assessment. Quietly set each student's nametag on their desk without talking to them. If names are not written on their desk, ask the classroom teacher or lead to help you when they are not talking with the class.
3. Assemble the experimental set-up (shown in picture below as well as in color in the experimental set-up picture in your group box) on a tray.
  - a. Remove the bread (or food) from the containers of mealworms.
  - b. Label the two sets of baking cups with "1," "2," and "3" using the Sharpie.
  - c. Set the choice chamber, container of 20 mealworms, 6 magnifying glasses, timer, and 6 baking cups on the tray.
  - d. Have the container of 10 mealworms close so that you can add/subtract mealworms or replace any dead mealworms.



**Introduction:**

*(2 minutes – Full Class – SciTrek Lead)*

**For UCSB Lead:**

“Hi, we are scientists from UCSB and we want to show you what we do as scientists. We will show you an experiment and then you can make observations, ask questions, and design your own experiment to help answer the class question. We want to show you that you can do science and have fun.”

**For Teacher Lead:**

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

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

**Question Assessment:**

*(5 minutes – Full Class – SciTrek Lead)*

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

Read the instructions aloud to students. Then, read each of the questions and tell students, “Circle “testable” for questions that science can answer or “not testable” for questions that science cannot answer.” When students are finished, collect the assessments and verify students’ names are written on top.

**Observation Discussion:**

*(2 minutes – Full Class – SciTrek Lead)*

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

Tell students, “In this experiment we are going to make observations of mealworms. The mealworms will be put in a central area and then will be able to crawl to one of two variable values, example red or blue paper. These observations will help us determine if this variable affects the number of mealworms in each compartment.” Therefore, as a class we will be answer the question: “What variables affect the number of mealworms in each compartment?”

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

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



**Observations:**

*(23 minutes – Groups – SciTrek Volunteers)*

Once students come over to your group, have them sit in boy/girl fashion. Verify the table is set up as described in the Set-Up Section.

As a group, have the students generate observations about the experimental set-up before they put the mealworms in the choice chamber. This should take you no longer than 10 minutes. Observations should be recorded on page 1 of the notepad. Have students observe the contents of each compartment of the choice chamber before the start of the experiment. Make sure that the students understand that one compartment contains dry woodchips and that one compartment contains wet woodchips. Students should also notice that there are holes between the compartments, which will allow the mealworms to travel between the different variable values. In addition, have students verify that there are actually 20 mealworms in the containers labeled 20 before starting their experiment. If there are not 20 mealworms either add mealworms from the extra mealworms (container of 10) or subtract mealworms by putting them into the extra mealworms.

Once students have exhausted these observations, assign one student to be the timer and one other student to release the mealworms when the timer says go. Have the timer count down by saying, “Ready, set, go.” When the timer says “go,” have the student pour the 20 mealworms into compartment 2 and shut the lid of the choice chamber. Have the students make observations and record these on the group notepad. Once they have exhausted these observations, give each student a mealworm (from the extra container of 10) and a magnifying glass and have them make observations about the mealworms. Remind students if they hurt any of the mealworms they will not be able to participate for the rest of the day. If a student doesn’t want to hold the mealworm, you can put a mealworm in a baking cup and hand it to the student to make observations. Approximately thirty seconds before the timer reaches 5 minutes, collect all the mealworms and put them back in the extra mealworm container. In addition, collect all of the magnifying glasses and put them in the group box.

At 5 minutes, stop the timer and pour each of the compartments of the choice chamber into a separate baking cups labeled with the matching compartment number. Give each pair of students two baking cups, one with the mealworms/woodchips and one empty with the corresponding compartment number. Have students count the mealworms by moving the counted mealworms into the empty baking cup with the corresponding compartment number. Record the number of mealworms in each compartment on the notepad in the appropriately labeled section. Have students confirm that the total number of mealworms adds to 20. If the number of mealworms does not add to 20, have the students recount the mealworms. If the number still does not equal 20, then record the number of mealworms the students counted. **Do not** make up data to make the numbers add to 20. If there is additional time have students summarize what they observed. Ask students, “What claim can you make about the habitat mealworms live in based on our data?”

The lead will come around to write down each group’s data on the class data sheet.

An example filled out initial observations is shown below.

OBSERVATIONS			OBSERVATIONS																																							
<p>Experimental Set-Up:</p> <ul style="list-style-type: none"> <li>• Choice chamber with 3 compartments</li> <li>• 6 holes between each compartment</li> <li>• 20 mealworms</li> <li>• Timer</li> <li>• 6 magnifying glasses</li> </ul>			<p>Mealworm Observations:</p> <ul style="list-style-type: none"> <li>• Mealworms moving</li> <li>• Mealworms have 6 legs</li> <li>• Their legs are in the front of their body</li> <li>• Have a segmented body</li> <li>• Mealworms yellow-orange in color</li> </ul>																																							
<table border="1" style="width: 100%; border-collapse: collapse; margin-top: 20px;"> <thead> <tr> <th style="width: 33%;">1</th> <th style="width: 33%;">2</th> <th style="width: 33%;">3</th> </tr> </thead> <tbody> <tr> <td style="text-align: center; height: 40px;">Dry</td> <td style="text-align: center;">20 MW</td> <td style="text-align: center;">Wet</td> </tr> </tbody> </table>			1	2	3	Dry	20 MW	Wet	<p>After 5 minutes:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Trial</th> <th style="width: 15%;">Dry</th> <th style="width: 15%;">None</th> <th style="width: 15%;">Wet</th> <th style="width: 15%;"></th> <th style="width: 15%;"></th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;"><sup>1</sup> 10</td> <td style="text-align: center;"><sup>2</sup> 7</td> <td style="text-align: center;"><sup>3</sup> 3</td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td style="text-align: center;">10</td> <td style="text-align: center;">17</td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td style="text-align: center;"><del>7</del></td> <td style="text-align: center;"><del>3</del></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td style="text-align: center;">17</td> <td style="text-align: center;">20</td> <td></td> <td style="text-align: right;"><sup>2</sup></td> </tr> </tbody> </table>				Trial	Dry	None	Wet			1	<sup>1</sup> 10	<sup>2</sup> 7	<sup>3</sup> 3					10	17					<del>7</del>	<del>3</del>					17	20		<sup>2</sup>
1	2	3																																								
Dry	20 MW	Wet																																								
Trial	Dry	None	Wet																																							
1	<sup>1</sup> 10	<sup>2</sup> 7	<sup>3</sup> 3																																							
		10	17																																							
		<del>7</del>	<del>3</del>																																							
		17	20		<sup>2</sup>																																					

**Reproducibility Discussion:**  
 (8 minutes – Full Class – SciTrek Lead)

Have students look at the class data sheet (picture packet, page 1) seen below. Ask students, “Did every group get the same results?” They should reply, “No.” Ask students, “Did all of the groups run the same experiment?” Have students explain the experiment they carried out, as well as what they counted in their groups. They should all realize that they did the same experiment. Ask students, “Why did groups get different numbers if they all did the same experiment?” Possible student response: animal motion is not completely predictable.

**Class Data Sheet**

Trial	Dry Woodchips	No Woodchips	Wet Woodchips
Lab	11	5	4
1	9	4	7
2	7	7	6
3	13	3	4
4	12	5	3

Dry WC	7	9	11	12	13
	3	4	5	5	7
Wet WC	3	4	4	6	7

Minimum    **Picture Packet, Page 1**    Maximum

1

Tell students, “Scientists often perform multiple trials of the same experiment to try to account for any error or inconsistency in their data. However, when they present their data, they like to report one number instead of all the numbers they counted.”

Ask the class, “What number would you pick if you had to pick one data point to represent the number of mealworms in each of the three compartments (dry, none, wet)?” Students may say the number that occurs the most, the largest number, the smallest number, or a number that is in the middle. Tell students, “Scientists often take the middle number, the median, because the middle number can be representative of all the collected data.”

Tell students, “You are going to find the median number in each set of numbers.” Starting with the numbers for the dry woodchips compartment, have students rearrange the numbers so they are in increasing order. Then, have students identify the middle number. With both the lab data and the students’ data, there should be five numbers, which will give one middle number. Repeat this process for the empty compartment and the wet woodchip compartment.

Ask students, “What did you learn about the habitat that mealworms live in from this experiment?” Possible student response: mealworms most likely live in a dry environment because more of the mealworms traveled to the dry woodchips than traveled to the wet woodchips.

**Variable Discussion:**

(2 minutes – Full Class – SciTrek Lead)

Tell the class, “We are now going to think about other variables we could test to help us identify other factors in a mealworm’s habitat.”

Lead students through the following questions and explanations.

What does the word ‘variable’ mean to a scientist?

variables are the parts of the experiment you can change

What was the changing variable in the experiment we just did?

moisture amount

Do you think there are multiple variables that will affect the number of mealworms in each compartment?

multiple variables might affect the number of mealworms in each compartment

Explain this is why we will need to work as a class to answer the class question: “What variables affect the number of mealworms in each compartment?”

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

Ex: Variable: food type

*Why might this variable affect the number of mealworms in each compartment?*

The mealworms might travel towards foods they eat in their natural habitat.

*How would you test this variable?* I would choose a wet food (fruit or vegetable) and a dry food (bread or grain) and put one on each side of the container and allow the mealworms to crawl towards one or the other.

*Prediction:* The mealworms will crawl to the bread or the dry food.

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

**Variables:**

(13 minutes – Groups – SciTrek Volunteers)

As a group, generate a variable and make a prediction about the relative number of mealworms in each compartment. Encourage, and challenge, students to explain why they think their prediction is correct, and how this variable will affect the relative number of mealworms in each compartment. Record both the variable and the prediction on the notepad. After each prediction, survey your group and write down how many students agree with the prediction and how many disagree. If there is extra time, go around the table a second time. An example filled out variables is shown below. Students do not need to record the variables or predictions in their notebooks.

Prepare one student to share a variable and why they think it will affect the relative number of mealworms in each compartment during the class discussion.

VARIABLES	
Variable	How will changing this variable affect the number of mealworms in each compartment?
Length of Container	The longer pillbox will have fewer mealworms in each compartment. 5 Agree, 0 Disagree
Bedding Type	Mealworms might travel to soft bedding so they can burrow in it. 3 Agree, 2 Disagree
Food Type	Mealworms will travel to sweet food because other insects do too. 4 Agree, 1 Disagree
Number of Mealworms	If there are too many mealworms in the pillbox, they won't be able to move. 4 Agree, 1 Disagree
Light Amount	Mealworms will go to the light instead of the dark so they will be able to see. 4 Agree, 1 Disagree

3

### Wrap-Up:

(5 minutes – Full Class – SciTrek Lead)

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

Tell students, “Next session, you will design an experiment to answer the class question: What variables affect the number of mealworms in each compartment?, which will help you learn about a mealworm’s habitat.”

### Clean-Up:

1. Collect nametags.
2. Pour the used woodchips into the wet woodchips bag. Make sure to seal the bag so it does not spill.
3. Remove any woodchips from the mealworms and put mealworms back into the containers.
4. Place all materials into your group box, and bring them back to UCSB.

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

### Schedule:

- Introduction (SciTrek Lead) – 2 minutes
- Question Activity (SciTrek Lead) – 20 minutes
- Question Discussion (SciTrek Lead) – 3 minutes
- Testable Questions (SciTrek Volunteers) – 8 minutes
- Question Discussion (SciTrek Lead) – 3 minutes
- Non-Testable Questions (SciTrek Volunteers) – 4 minutes
- Question/Experimental Set-Up Discussion (SciTrek Lead) – 3 minutes
- Question (SciTrek Volunteers) – 4 minutes
- Materials Page (SciTrek Volunteers) – 5 minutes
- Experimental Set-Up (SciTrek Volunteers) – 5 minutes
- Wrap-Up (SciTrek Lead) – 3 minutes

### Materials:

#### (4) Volunteer Boxes:

- |   |   |  |
|---|---|--|
| <input type="checkbox"/> Nametags               | <input type="checkbox"/> Volunteer lab coat | <input type="checkbox"/> (2) Grease pencil |
| <input type="checkbox"/> (NS+1) Notebooks       | <input type="checkbox"/> Materials page     | <input type="checkbox"/> (2) Black pen     |
| <input type="checkbox"/> Volunteer instructions | <input type="checkbox"/> (2) Pencils        | <input type="checkbox"/> Scotch tape       |

#### Other Supplies:

- (4) Notepads


#### Lead Box:

- |   |  |  |
|---|--|--|
| <input type="checkbox"/> (3) Blank nametags       | <input type="checkbox"/> Materials page        | <input type="checkbox"/> (4) Markers (orange, blue, green, purple) |
| <input type="checkbox"/> (3) Extra notebooks      | <input type="checkbox"/> Time card             | <input type="checkbox"/> Scotch tape                               |
| <input type="checkbox"/> Lead instructions        | <input type="checkbox"/> (2) Pencils           | <input type="checkbox"/> (2) Light/Dark choice chambers            |
| <input type="checkbox"/> Mealworms picture packet | <input type="checkbox"/> (2) Wet erase markers |  |
| <input type="checkbox"/> Lead lab coat            |  |  |

**Notebook and Notepad Pages:**

**SCIENTIFIC PRACTICE**  
Questions

Circle TESTABLE if the question can be tested by science. Circle NOT TESTABLE if the question cannot be tested by science.



1.	What is the length of a brown bear's front paw?	Testable	Not Testable	Measure
2.	Do bears like to swim?	Testable	Not Testable	Not Well Defined
3.	Are black bears smarter than brown bears?	Testable	Not Testable	Not Well Defined
4.	How many brown bears are at the Santa Barbara Zoo?	Testable	Not Testable	Count
5.	What type of bear is the most fearsome?	Testable	Not Testable	Not Well Defined
6.	How much honey does Winnie the Pooh eat in 24 hours?	Testable	Not Testable	Can't Acquire Data
7.	In one day, what is the total amount of berries that all brown bears eat?	Testable	Not Testable	Measure
8.	Are polar bears fast?	Testable	Not Testable	Not Well Defined
9.	Is putting panda bears on the endangered species list important?	Testable	Not Testable	Not Well Defined
10.	Can a mother bear find her cub among 6 other cubs?	Testable	Not Testable	Observe

2

**TESTABLE QUESTIONS**

If we change the light amount \_\_\_\_\_, what will happen to the number of mealworms in \_\_\_\_\_? in each compartment?

- What will happen if I change the number of mealworms in the container?
- If I change the bedding, where will more mealworms go to?
- After 5 minutes, will more mealworms be in the grass or the rocks?
- If I change the food type, what will happen to the number of mealworms in each compartment?

4

**NOT TESTABLE QUESTIONS**

- Do mealworms like apples?
- Do mealworms think flowers are pretty?
- Do mealworms have friends?
- Are mealworms fast?

5

Changing Variable: light amount

If your changing variable is bedding type or food type, what properties of materials will you be looking for (ex: soft and hard):  
\_\_\_\_\_ and \_\_\_\_\_

Why do you think your changing variable will affect the number of mealworms in each compartment?  
The light amount affects the mealworms' ability to find food or hide from predators.

**QUESTION**

Question our group will investigate:

- If we change the light amount changing variable, what will happen to the number of mealworms what you are measuring in each compartment ?

Color: blue

**MATERIALS PAGE**

You will only have access to the following materials. Check the materials that you need for your experiment.

**General Materials** (indicate the number of mealworms needed on the line)  
 Timer (\_\_\_ 5 \_\_\_ minutes) (Max 5 min)      Mealworms per Trial \_\_\_ 20 \_\_\_ (Max 30)  
 Choice Chamber      Baking Cups

You can only have a bedding or a food type, you may not have both. We will have:  
 Bedding Type      Food Type      Neither Bedding nor Food Type

**Bedding Type**  
 No Bedding      Moss      Bark  
 Dry Leaves      Woodchips      Fresh Grass  
 Cotton Balls      Rocks      Red Paper  
 White Paper      Green Paper      Yellow Paper

**Food Type** (You do not get to eat these things)  
 No Food      Frested Flakes      Sour Candy (Soft)  
 Cherries      Peppers      Rabbits  
 Pretzels      Lettuce      Lemons  
 Mandarin Oranges      Cookies      Oatmeal

**Light Amount**  
 Light      Dark

6

**Experimental Considerations:**

1. You will only have access to the materials on the materials page.
2. Each student will get one choice chamber.
3. You must run an odd number of trials. If needed, your volunteer will complete a trial.
4. Each trial may take no longer than 5 minutes and must be run at the same time.
5. No more than two versions of the changing variable can be used.
6. You may only have a food or a bedding, but not both (Ex: if your changing variable is food type, your bedding type must be "no bedding").
7. If you are changing the light amount and are using a bedding or a food, the bedding/food must be half-filled in all three compartments.

Changing Variable (Independent Variable): light amount

Discuss with your group how you think your changing variable will affect the direction mealworms travel.

**QUESTION**

Question our group will investigate:

- If we change the light amount insert changing variable (independent variable), what will happen to the number of mealworms insert what you are measuring (dependent variable) in each compartment ?

Fill out the materials page with your SciTrek volunteer before moving onto the experimental set-up.

3

**EXPERIMENTAL SET-UP**

Changing Variable: Light Amount / Light and Dark

**Controls** (variables you will hold constant):  
Insect Type / Mealworms     Time / 5 min  
Number of MW / 20     Food Type / No Food  
Bedding Type / No Bedding     Container / Choice Chamber

1	2	3
Dark	20 MW	Light

**Prediction:**  
I predict the compartment with the most mealworms will be \_\_\_\_\_  
value of changing variable

7

**EXPERIMENTAL SET-UP**

Write your changing variable (Ex: food type) and the values (Ex: cookies) you will use in the compartments.

Changing Variable: light amount / light and dark

**Controls** (variables you will hold constant):  
Write your controls and the values you will use in all your trials (control/value, Ex: insect type/mealworm).  
Insect Type / Mealworm     Time / 5 min  
Number of MW / 20     Food type / No Food  
Bedding Type / No Bedding     Container Type / Choice Chamber

Write what you will put in each compartment of the container at the start of the experiment.

1	2	3
Dark	20 MW	Light

**Prediction:**  
I predict the compartment with the most mealworms will be the dark.  
value of changing variable

4



**Preparation:**

SciTrek Lead:

1. Make sure volunteers are writing their name and group color on the whiteboard.
2. Make sure volunteers are passing out nametags/notebooks.
3. Set up the document camera for the question activity (notebook, page 2).

SciTrek Volunteers:

1. On the front whiteboard in the classroom, write your name and the color of the group (orange, blue, green, or purple) you are working with.
2. Pass out nametags and notebooks.

**Note:** Pass out nametags and notebooks to students. If needed, students will move to their spots after the question activity.

**Introduction:**

*(2 minutes – Full Class – SciTrek Lead)*

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

Ask students, “What did we do and learn during our last meeting?” Possible student response: we did an experiment in which mealworms could travel to dry or wet woodchips, we observed that more of the mealworms traveled to the dry woodchips.” Ask the class, “What is the class question we will be investigating?” Students should reply, “What variables affect the number of mealworms in each compartment?”

Ask students, “Why might scientists study the number of mealworms in each compartment?” Students should explain that studying where mealworms travel will help them predict an ideal mealworm habitat. For instance, the first experiment showed that mealworms travel towards dry woodchips, which suggests that they live in a dry habitat.

Tell students, “One-way scientists answer questions is by performing experiments; today you are going to generate testable questions about the mealworms system. After, you will be able to pick a question and design an experiment to answer that question. First, we are going to look at a list of questions and decide whether each question is testable by science.”

**Question Activity:**

*(20 minutes – Full Class – SciTrek Lead)*

Have students write their name, teacher’s name, group color (color of their name on their nametag: orange, blue, green, or purple), and their volunteer’s name on the front cover of their notebooks.

Ask students, “What type of questions can be tested by science?” You should get answers that revolve around the idea that science can test things that are measurable, observable, or countable. Write on the board:

Testable Questions:  
 Measurable  
 Observable  
 Countable

Ask students, “What type of questions cannot be tested by science?” You should get the following two groups of untestable questions:

- 1) Questions in which the data cannot be acquired.
  - Data cannot be acquired on objects or characters that do not exist. Ex: How many fingers do fairies have? Since we cannot catch fairies, we would not be able to answer this question.
- 2) Questions that are not well defined or are opinions.
  - Opinion questions contain opinion words such as prettier, nicest, better, etc. Ex: Which are prettier, lilies or daisies?
  - Not well defined questions can contain words such as affected, react, etc. Ex: Do squirrels react to dogs?
  - Not well defined questions can contain semi-measurable words such as big, wide, heavy, etc. Ex: Is a peach big? The problem with this question is you do not know how the questioner defines the word big. A scientist could answer this question “yes” if they were comparing a peach to a grape while another scientist could answer the question “no” because they were comparing a peach to a watermelon.

Write on the board:


Not Testable Questions:  
 Can’t acquire data  
 Not well defined/Opinion

Have students turn to page 2 of their notebooks and place page 2 of the class notebook under the document camera. Read the directions aloud to the class. Tell students, “We will go over each of the questions as a class.” Read each of the questions to the class and then ask students, “Is this question testable or not, and why?” After the class has come to a consensus, have students circle the correct answer.

For question that are testable, have students tell you the type of data they would collect (measure, count, or observe) and the specific data needed to find the answer to the question (ex: measure the length of the object). Write the type of data in the margins of the class notebook. For questions that are not testable, have students identify why the question is not testable (can’t acquire data or not well defined) and if applicable, underline the non-testable word in the question. Write why the question is not testable in the margins of the class notebook. Then, have the students propose a related question that is testable.

**SCIENTIFIC PRACTICE**  
Questions

Circle TESTABLE if the question can be tested by science. Circle NOT TESTABLE if the question cannot be tested by science.



1.	What is the length of a brown bear's front paw?	Testable	Not Testable	Measure
2.	Do bears like to swim?	Testable	Not Testable	Not Well Defined
3.	Are black bears smarter than brown bears?	Testable	Not Testable	Not Well Defined
4.	How many brown bears are at the Santa Barbara Zoo?	Testable	Not Testable	Count
5.	What type of bear is the most fearsome?	Testable	Not Testable	Not Well Defined
6.	How much honey does Winnie the Pooh eat in 24 hours?	Testable	Not Testable	Can't Acquire Data
7.	In one day, what is the total amount of berries that all brown bears eat?	Testable	Not Testable	Measure
8.	Are polar bears fast?	Testable	Not Testable	Not Well Defined
9.	Is putting panda bears on the endangered species list important?	Testable	Not Testable	Not Well Defined
10.	Can a mother bear find her cub among 6 other cubs?	Testable	Not Testable	Observe

2

Below are the answers to 1-10 on page 2 in detail.

1: What is the length of a brown bear's front paw?

Is this question testable?

Yes.

What type of data would you collect to answer the question?

Measure.

What could be measured to answer this question?

The length of a brown bear's front paw.

2: Do bears like to swim?

Is this question testable?

No.

Why is the question not testable?

The word "like" is an opinion/not well defined and it is impossible to measure if a bear likes to swim. (A bear could swim because it likes swimming or because it is a necessity in order to get food.)

How can we revise this question to make it testable?

In a 24-hour period, does a bear spend more time in the water or on land?

3: Are black bears smarter than brown bears?

Is this question testable?

No.

Why is the question not testable?

The word "smarter" is not well defined/opinion. (Smarter could mean that the bear is able to gather more food or that more bear cubs are able to make it to adulthood.)

How can we revise this question to make it testable?

Does a black bear eat more berries than a brown bear?

4: How many brown bears are at the Santa Barbara Zoo?

Is this question testable?

Yes.

What type of data would you collect to answer the question?

Count

What could be counted to answer this question?

The number of bears at the Santa Barbara Zoo.

5: What type of bear is the most fearsome?

Is this question testable?

No.

Why is the question not testable?

The word “fearsome” is not well defined/opinion. (Fearsome could mean that other animals run when they see the bear or could mean that a bear can make a very loud noise.)

How can we revise this question to make it testable?

Do other animals run when they see a bear?

6: How much honey does Winnie the Pooh eat in 24 hours?

Is this question testable?

No.

Why is the question not testable?

We will not be able to acquire data on Winnie the Pooh because he is a fictional character.

How can we revise this question to make it testable?

How much honey does a black bear eat in 24 hours?

7: In one day, what is the total amount of berries that all brown bears eat?

Is this question testable?

Yes. (Even though this question is hard to test, it still can be tested.)

What type of data would you collect to answer the question?

Count

What could be counted to answer this question?

The berries that all brown bears for a day ate.

8: Are polar bears fast?

Is this question testable?

No.

Why is the question not testable?

The word “fast” is not well defined/opinion in this context. (Polar bears are fast compared to ants but are slow compared to rockets.)

How can we revise this question to make it testable?

Is a polar bear faster than a cow? Or, what is the top speed of a polar bear?

9: Is putting panda bears on the endangered species list important?

Is this question testable?

No.

Why is the question not testable?

The word “important” is not well defined/opinion. (Important could mean putting panda bears on the endangered species list will increase awareness about hunting practices or could mean more of the bears will be able to survive.) Note: this question is particularly

hard for students because they think the answer to the question is yes. Instead of thinking about if the question is testable or not, they try to argue the answer is “yes.”

How can we revise this question to make it testable?

Did the number of panda bear cubs born in China increase after they were put on the endangered species list?

10: Can a mother bear find her cub among 6 other cubs?

Is this question testable?

Yes.

What type of data would you collect to answer the question?

Observe

What could be observed to answer this question?

If a mother bear could find her cub among 6 other cubs.

### **Question Discussion:**

*(3 minutes – Full Class – SciTrek Lead)*

Tell students, “You are now going to generate your own testable questions about the mealworm set-up you used last session. You will be able to use the variables you generated last time to help you with your questions.” Make sure students understand scientists define a variable as something that can be changed in an experiment to learn something about the system.

Hold up one of the group notepads with the following sentence frame:

If we change the \_\_\_\_\_, what will happen to the \_\_\_\_\_?

variable what you are measuring/observing

Tell students, “You can insert a variable into blank one and something you can measure/observe into blank two to generate a testable question.”

As a class, come up with one question that fits this sentence frame.

Ex: “If we change the light amount, what will happen to the number of mealworms in each compartment?”

Tell students, “You will now work together to generate as many testable questions about the mealworm system as possible.”

### **Testable Questions:**

*(8 minutes – Groups – SciTrek Volunteers)*

As a group, have the students generate a question in the form: “If we change the \_\_\_\_\_, what will happen to the \_\_\_\_\_?” After they have generated one question in this form, they may generate other questions in any form they want. If students do not generate testable questions in the form provided, try to have students identify what data they would need to collect to answer their question. Ex: What is the fastest worm? The data that would need to be collected is the measurements of times for different types of worms to travel a certain distance. If students are having trouble generating questions, have them review the variables that they generated during the previous meeting.

Prepare one student to share a question with the class. An example filled out scientific questions is shown below (left).

TESTABLE QUESTIONS	NOT TESTABLE QUESTIONS
<p>If we change the <u>light amount</u> _____,</p> <p>what will happen to the <u>number of mealworms in _____?</u>  <u>in each compartment?</u></p> <ul style="list-style-type: none"> <li>• What will happen if I change the number of mealworms in the container?</li> <li>• If I change the bedding, where will more mealworms go to?</li> <li>• After 5 minutes, will more mealworms be in the grass or the rocks?</li> <li>• If I change the food type, what will happen to the number of mealworms in each compartment?</li> </ul> <p style="text-align: right;">4</p>	<ul style="list-style-type: none"> <li>• Do mealworms like apples?</li> <li>• Do mealworms think flowers are pretty?</li> <li>• Do mealworms have friends?</li> <li>• Are mealworms fast?</li> </ul> <p style="text-align: right;">5</p>

**Question Discussion:**

*(3 minutes – Full Class – SciTrek Lead)*

Have one student from each group share one of their testable questions with the class. After a group’s question is presented, ask the rest of the class, “Is the question testable, and, if so, what data would the group need to collect to answer the question?”

Tell students, “There are many questions that science cannot answer.” Ask students, “Do you know the types of questions science cannot answer?” They should be able to generate the following two categories of questions:

Category 1: Can’t acquire data

Category 2: Not well defined/opinion

Ask students, “Can someone give an example question about the mealworm set-up that science cannot answer?”

Ex: Category 1 Question: Would Tinker Bell move towards wet or dry woodchips?

Ex: Category 2 Questions: Do mealworms like dry woodchips? Or, Is learning about mealworms important?

Tell students, “You are now going to generate questions that science cannot answer about the mealworm system with your group.”

**Non-Testable Questions:**

*(4 minutes – Groups – SciTrek Volunteers)*

Have students generate a list of questions that science cannot answer and record them on the notepad. Encourage students to generate questions that are in both of the non-testable categories. If they are struggling, have them turn to the question activity and look at the questions that are not testable. Ask students, “Why is this question not testable?” Then, have them use it as a model to generate a question about the mealworm system.

Prepare one student to share one of their questions with the class. An example filled out non-scientific questions is shown above (right).

**Question/Experimental Set-Up Discussion:**

*(3 minutes – Full Class – SciTrek Lead)*

Have each group share one question that they generated that science cannot answer. After a group’s question is presented, ask the rest of the class, “Is the question testable; and, if not, why?”

Tell students, “You are going to design an experiment to determine how one variable affects the number of mealworms in each compartment. First, you will pick a changing variable and record it in your notebooks. Your options for your changing variable are light amount, food type, and bedding type. Second, you will discuss why you think this variable will affect the number of mealworms in each compartment, and determine your experimental question. Third, you will use the materials page to determine the values of your controls and changing variable. Fourth, you will determine your experimental set-up.” Ask students, “How do scientists define controls?” By the end of the conversation make sure students understand that controls are variables that could have changed but are kept constant for their experiment. Go over the experimental considerations with students (notebook, page 3).

Experimental Considerations:

1. You will only have access to the materials on the materials page.
2. Each student will get one choice chamber.
3. You must run an odd number of trials. If needed, your volunteer will complete a trial.
4. Each trial may take no longer than five minutes and be run at the same time
5. No more than two versions of the changing variable can be used.
6. You may only have a food or a bedding, but not both. For example, if your changing variable is food type, your bedding type must be no bedding.
7. If you are changing the light amount and are using a bedding or food, the bedding/food must be filled half-full in all three compartments.

Tell students, “If you pick a food source, you will not be able to eat any of the food that is provided for the mealworms.”

**Question:**

*(4 minutes – Groups – SciTrek Volunteers)*

Have students turn to page 3 of their notebooks. Then, have your group decide (by voting) what changing variable they want to explore for their experiment. If there is a tie, then the volunteer will make the deciding vote. It is best if groups have different changing variables. The lead will help coordinate between groups to ensure there is a variety of changing variables.

As a group, discuss why/how they think their changing variable will affect the number of mealworms in each compartment. Record their thoughts on the notepad; students will not write this in their notebooks. If students choose a changing variable that has many different values, try to get students to determine

the types of values they would like to investigate. You should not show them the materials page yet. For example, if students choose bedding type as their changing variable, have them think about large categories of bedding that they could choose from such as: soft/hard, manmade/natural, large bedding pieces/small bedding pieces. Then, have them choose the two categories they are most interested in, Ex: soft/hard. If applicable, record the large categories they picked as well as why they think their changing variable will affect the number of mealworms in each compartment, in the notepad.

Use their changing variable to generate the question the group is going to investigate. Write the question in the notepad, and have students copy it into their notebooks. An example filled out question is shown below.

Select a student to read the group question during the wrap-up.

Changing Variable: Light amount

If your changing variable is bedding type or food type, what properties of materials will you be looking for (ex: soft and hard):  
 \_\_\_\_\_ and \_\_\_\_\_

Why do you think your changing variable will affect the number of mealworms in each compartment?  
The light amount affects the mealworms' ability to find food or hide from predators.

**QUESTION**

Question our group will investigate:

- If we change the light amount changing variable, what will happen to the number of mealworms what you are measuring in each compartment ?

Color: blue

**MATERIALS PAGE**

You will only have access to the following materials. Check the materials that you need for your experiment.

**General Materials** (indicate the number of mealworms needed on the line)

Timer ( 5 minutes) (Max 5 min)       Mealworms per Trial 20 (Max 30)

Choice Chamber       Baking Cups

You can only have a bedding or a food type, you may not have both. We will have:

<input type="checkbox"/> Bedding Type	<input type="checkbox"/> Food Type	<input checked="" type="checkbox"/> neither Bedding nor Food Type
<b>Bedding Type</b>		
<input checked="" type="checkbox"/> No Bedding	<input type="checkbox"/> Moss	<input type="checkbox"/> Bark
<input type="checkbox"/> Dry Leaves	<input type="checkbox"/> Woodchips	<input type="checkbox"/> Fresh Grass
<input type="checkbox"/> Cotton Balls	<input type="checkbox"/> Rocks	<input type="checkbox"/> Red Paper
<input type="checkbox"/> White Paper	<input type="checkbox"/> Green Paper	<input type="checkbox"/> Yellow Paper
<b>Food Type</b> (You do not get to eat these things)		
<input checked="" type="checkbox"/> No Food	<input type="checkbox"/> Frieded Flakes	<input type="checkbox"/> Sour Candy (Soft)
<input type="checkbox"/> Cherries	<input type="checkbox"/> Peppers	<input type="checkbox"/> Raisins
<input type="checkbox"/> Pretzels	<input type="checkbox"/> Lettuce	<input type="checkbox"/> Lemons
<input type="checkbox"/> Mandarin Oranges	<input type="checkbox"/> Cookies	<input type="checkbox"/> Oatmeal
<b>Light Amount:</b>	<input checked="" type="checkbox"/> Light	<input type="checkbox"/> Dark

**Experimental Considerations:**

1. You will only have access to the materials on the materials page.
2. Each student will get one choice chamber.
3. You must run an odd number of trials. If needed, your volunteer will complete a trial.
4. Each trial may take no longer than 5 minutes and must be run at the same time.
5. No more than two versions of the changing variable can be used.
6. You may only have a food or a bedding, but not both (Ex: if your changing variable is food type, your bedding type must be "no bedding").
7. If you are changing the light amount and are using a bedding or a food, the bedding/food must be half-filled in all three compartments.

Changing Variable (Independent Variable): light amount

Discuss with your group how you think your changing variable will affect the direction mealworms travel.

**QUESTION**

Question our group will investigate:

- If we change the light amount insert changing variable (independent variable), what will happen to the number of mealworms insert what you are measuring (dependent variable) in each compartment ?

Fill out the materials page with your SciTrek volunteer before moving onto the experimental set-up.

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

Get the materials page (shown above left) from your box and tape it into the notepad. Have students use the materials page to choose the values of their controls and changing variable.

For controls in which students can pick more than one value (bedding type, food type, time, etc.), have students discuss if the value that they select for their control would make it easier or harder to answer their question. For example, if students chose a time of 1 min, ask them, "How do you think having a time of 1 minute will affect the experiment?" This might get them to realize that 1 minute is a very short time, resulting in most of the mealworms being in the central compartment at the end of the trial. If they decide a different control value is better, allow them to switch control values.



For changing variables if students chose two broad categories during the predictions section, remind them they should be looking for values that meet that criteria. For instance, if they picked food type and were interested in salty versus sugary foods, they should be looking for a salty (pretzels) and a sugary (cookies) food. Encourage your group to explain why they are picking the values they are selecting. For instance, if they were interested in salty versus sugary, but they chose lettuce as a variable value, ask them, “Does that value fit with the categories you were interested in investigating?”

Make sure your group checked off all of the materials they will need from the materials page, your group color is written on the top of the page, the values are within the limitations set on the materials page and that the materials page is taped onto the notepad.

**Experimental Set-Up:**

*(5 minutes – Groups – SciTrek Volunteers)*

Turn to page 7 of the notepad while students turn to page 4 in their notebooks. Ask your group, “What did we decide was going to be the changing variable and what values of the changing variable did we choose for each compartment?” Record these on the notepad. After, have students copy the changing variable and its values into their notebooks. If your group is changing light amount, get a light/dark choice chamber from the lead box to show students.

Ask your group, “What controls and values did we select?” Write the control on the left side of the slash and the value of the control on the right side of the slash (Ex: bedding type / no bedding). In addition, have students copy these into their notebooks. An example filled out experimental set-up is shown below.

Once your group has filled in their controls and values, have them fill in what they will be putting in each of the choice chamber’s compartments. If your changing variable is light amount, pull out the light/dark choice chamber and have the students tell you which compartment will be light and which compartment will be dark. They should tell you that compartment 1 will be dark, compartment 3 will be light. If you are using a food type or a bedding type, also include that value in the choice chamber picture in each compartment, including compartment 2, as seen in picture below.

1	2	3
Dark + WC	20 MW + WC	Light + WC

Once the experimental set-up is complete, have students predict what will happen in the experiment and fill in the sentence frame on page 4. The prediction sentence can be different in each student’s notebook.

If you have additional time, have your group summarize the experiment that they are going to run and what they are hoping to learn from the experiment.



**Clean-Up:**

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

**Day 3: Technique/Procedure/Results Table/Experiment****Schedule:**

Introduction (SciTrek Lead) – 3 minutes  
Technique (SciTrek Lead) – 7 minutes  
Procedure (SciTrek Volunteers) – 18 minutes  
Results Table (SciTrek Volunteers) – 5 minutes  
Experiment (SciTrek Volunteers) – 25 minutes  
Wrap-Up (SciTrek Lead) – 2 minutes

**Materials:****(4) Volunteer Boxes:**

- |   |  |   |
|---|--|---|
| <input type="checkbox"/> Nametags               | <input type="checkbox"/> (2) Grease pencils  | <input type="checkbox"/> (10) Metal baking cups                               |
| <input type="checkbox"/> Notebooks              | <input type="checkbox"/> Sharpie             | <input type="checkbox"/> (5) Containers of requested number of mealworms each |
| <input type="checkbox"/> Volunteer instructions | <input type="checkbox"/> Paper towels        | <input type="checkbox"/> Other supplies requested                             |
| <input type="checkbox"/> Volunteer lab coat     | <input type="checkbox"/> Timer               |   |
| <input type="checkbox"/> (2) Pencils            | <input type="checkbox"/> (5) Choice chambers |   |

**Other Supplies:**

- (4) Notepads

**Lead Box:**

- |   |   |  |
|---|---|--|
| <input type="checkbox"/> (3) Extra notebooks      | <input type="checkbox"/> Sharpie          | <input type="checkbox"/> (4) Containers of 20 mealworms  |
| <input type="checkbox"/> Lead instructions        | <input type="checkbox"/> Paper towels     | <input type="checkbox"/> Bag of backup materials (contains 3 bedding materials and 3 food types) |
| <input type="checkbox"/> Mealworms picture packet | <input type="checkbox"/> (2) Timers       |  |
| <input type="checkbox"/> Lead lab coat            | <input type="checkbox"/> Masking tape     |  |
| <input type="checkbox"/> Time card                | <input type="checkbox"/> Choice chamber   |  |
| <input type="checkbox"/> (2) Pencils              | <input type="checkbox"/> (10) Baking cups |  |
| <input type="checkbox"/> (2) Grease pencils       |   |  |

**Notebook and Notepad Pages:**

**TECHNIQUE**  
*Median*

When running multiple trials in an experiment it is necessary to find one number to represent all of the data. The middle number, also known as the median number, is sometimes used to represent all the data. To find the median, first place all of the numbers from each trial in increasing order, second circle the middle number.

Bedding:	Final Number of Mealworm: (In Increasing Order)	Median:
Sand	3, 2, 5 <del>2</del> , <b>3</b> , 5	3
Rocks	3, 5, 2, 5, 4 <del>2</del> , <del>3</del> , <b>4</b> , 5, 5	4
Grass	15, 19, 17 <del>15</del> , <b>17</b> , <del>19</del>	17
Dirt	13, 10, 11, 17, 13 <del>10</del> , <del>11</del> , <b>13</b> , <del>13</del> , <del>17</del>	13
Wood Chips	12, 9, 10, 10, 11 9, <del>10</del> , <b>10</b> , <del>11</del> , <del>12</del>	10

5

**PROCEDURE**

1. Get a choice chamber that is dark in compartment 1, and light in compartment 3.
2. Put no bedding, and no food in all compartments.
3. Put 20 mealworms in compartment 2.
4. Wait 5 minutes.
5. Count the number of mealworms in each compartment.
6. Find median of trials.

8

**PROCEDURE**

1. Get a choice chamber that is dark in compartment 1 and light in compartment 3.
2. Put no bedding and no food in all compartments.
3. Put 20 mealworms in compartment 2.
4. Wait 5 minutes.
5. Count the number of mealworms in each compartment.
6. Find median of trials.

6

**RESULTS Table**

Variables	Compartment 1	Compartment 2	Compartment 3
Insect Type:	Mealworms	→	→
Time:	5 min	→	→
Food Type:	No Food	→	→
Bedding Type:	No Bedding	→	→
Light Amount:	Dark	Dark/Light	Light
Container Type:	Choice Chamber	→	→
Data	Compartment 1	Compartment 2	Compartment 3
Initial Number of Mealworms:	0	20	0
Measurements: Final Number of Mealworms:	10	8	2
	7	9	4
	7	8	5
	12	5	2
	13	6	1
Put Final Numbers of Mealworms in Increasing Order:	7,7,10,12,13	5,6,8,8,9	1,2,2,4,5
Median:	10	8	2

9

**RESULTS Table**

Fill out the table for each of your compartments in your container. For the variables that remain constant, write the value in *Compartment 1*. Then, draw an arrow through each box indicating the variable is a control.

Variables	Compartment 1	Compartment 2	Compartment 3
Insect Type:	Mealworm	→	→
Time:	5 min	→	→
Food Type:	No food	→	→
Bedding Type:	No bedding	→	→
Light Amount:	Dark	Dark/Light	Light
Container Type:	Choice Chamber	→	→
Data	Compartment 1	Compartment 2	Compartment 3
Initial Number of Mealworms:	0	20	0
Measurements: Final Number of Mealworms:	10	8	2
	7	9	4
	7	8	5
	12	5	2
	13	6	1
Put Final Number of Mealworms in Increasing Order:	7,7,10,12,13	5,6,8,8,9	1,2,2,4,5
Median:	10	8	2

The independent variable is the changing variable and the dependent variables are the final measurements.

7

**Preparation:**

**SciTrek Lead:**

1. Make sure volunteers are passing out notebooks.
2. Make sure volunteers are labeling baking cups.
3. Set up the document camera for the technique activity (notebook, page 5).

**SciTrek Volunteers:**

1. Pass out notebooks/nametags.
2. Label enough baking cups with "1," "2," and "3" using the Sharpie so each student will have two set.

**Note:** Pass out notebooks to students. If needed, students will move to their groups after the technique activity.

**Introduction:**

(3 minutes – Full Class – SciTrek Lead)

If students are not in their groups, tell them, "You will move into your groups after the technique activity."

Ask the class, "What is the class question we are investigating?" Students should reply, "What variables affect the number of mealworms in each compartment?" Ask students, "Why are we interested in studying this?" Possible student response: exploring the number of mealworms in each compartment will help us learn about a mealworm's habitat. Ask students, "What have we already learned about a mealworm's habitat?" Possible student response: we saw more mealworms went toward the dry

woodchips than wet, therefore, mealworms live in dry environments. Remind students last time they picked another variable they are going to explore today for their experiment. Ask students, “Are you going to run one or multiple trials?” They should reply, “Multiple trials.” Ask students, “If you count multiple different numbers for each trial, what number will you use for your graph?” Students should reply, “The middle number, which is called the median.” Ask students, “Why is the median the best option to graph?” Possible student response: the median is a good representation of the data. Tell students, “We are now going to practice finding the median from other scientists’ data.”

**Technique:**

*(7 minutes – Full Class – SciTrek Lead)*

Have students turn to page 5 in their notebooks while you do the same in the class notebook under the document camera. Tell students, “To find the median, you need to arrange the numbers in increasing order. Once the numbers are arranged in order, the number in the middle is the median number, which you should identify by circling.” Go over how to find the median in the first two examples and then have the students work on the rest by themselves. After students have finished, go over the answers. An example filled in technique activity can be found below.

Tell students, “You will use this technique of finding the median when you perform your experiment. But before you can carry out your experiment, you need to write a procedure.” Ask the class, “What is a procedure?” Lead students to understand it is a set of steps to conduct an experiment. Tell them, “Once you have determined your procedure, you will fill out their results table and carry out your experiment.”

Remind students some of the groups have requested different food types for their experiments. The food they will use in the experiment has been sitting in the lab for a long time and it is important they do not eat any of the food.

**TECHNIQUE**  
*Median*

When running multiple trials in an experiment it is necessary to find one number to represent all of the data. The middle number, also known as the median number, is sometimes used to represent all the data. To find the median, first place all of the numbers from each trial in increasing order, second circle the middle number.

Bedding:	Final Number of Mealworm: (In Increasing Order)	Median:
Sand	3, 2, 5 <del>2</del> , <b>3</b> , 5	3
Rocks	3, 5, 2, 5, 4 <del>2</del> , <del>3</del> , <b>4</b> , 5, 5	4
Grass	15, 19, 17 <del>15</del> , <b>17</b> , <del>19</del>	17
Dirt	13, 10, 11, 17, 13 <del>10</del> , <del>11</del> , <b>13</b> , <del>13</del> , <del>17</del>	13
Wood Chips	12, 9, 10, 10, 11 9, <del>10</del> , <b>10</b> , <del>11</del> , <del>12</del>	10

5

**Procedure:**

(18 minutes – Groups – SciTrek Volunteers)

Ask students, “What did you pick for the changing variable and what do you think we will learn from the experiment?”

Tell students, “You will now generate a procedure for your experiment.” Ask students, “What is a procedure?” Students should reply, “A set of steps to conduct an experiment.” Then, help students generate a procedure. Keep the procedure as brief as possible while still including the important information (control values, changing variable values, and what data they will collect) about the experiment. An example step for a group that had bedding type as the changing variable would be: “Put rocks in compartment 1 and put moss in compartment 3.” Have students dictate the procedure to you while you transcribe it onto the notepad. As each step is completed, have students copy it from the notepad into their notebooks. Make sure that you do not continue on to the next step until each student has completed writing that step. An example filled in procedure is shown below.

PROCEDURE	
1.	<u>Get a choice chamber that is dark in</u> <u>compartment 1, and light in</u> <u>compartment 3.</u>
2.	<u>Put no bedding, and no food in all</u> <u>compartments.</u>
3.	<u>Put 20 mealworms in compartment 2.</u>
4.	<u>Wait 5 minutes.</u>
5.	<u>Count the number of mealworms in each</u> <u>compartment.</u>
6.	<u>Find median of trials.</u>
8	

PROCEDURE	
1.	<u>Get a choice chamber that is dark in</u> <u>compartment 1 and light in</u> <u>compartment 3.</u>
2.	<u>Put no bedding and no food in all</u> <u>compartments.</u>
3.	<u>Put 20 mealworms in compartment 2.</u>
4.	<u>Wait 5 minutes.</u>
5.	<u>Count the number of mealworms in</u> <u>each compartment.</u>
6.	<u>Find median of trials.</u>
6	

**Results Table:**

(5 minutes – Groups – SciTrek Volunteers)

Fill out the variables section of the results table on the notepad while students fill out the same section in their notebooks. When writing the values, make sure, for controls, they only write the value of the control in the compartment A box, then, draw an arrow through the remaining compartments’ boxes. For the changing variable, they should write the value in each compartment’s corresponding box. An example filled out results table is shown in the Experiment section below.

**Experiment:**

(25 minutes – Groups – SciTrek Volunteers)

Once students have completed the variables section of their results table, give students their materials for their experiment. During the experiment, make sure students do not eat any of the food provided for the experiment.

Groups will need to do an odd number of trails. Each student will carry out a trial in their own choice chamber. If there are an even number of students in your group, you the volunteer will also need to complete a trial. If you need additional materials ask the lead for them.

Help students set up and complete their experiment. Record the data the students collect in the notepad. Then, help students copy the data into their notebooks.

When students are finished copying the group data into their notebooks, have students put the number of mealworms for compartment 1 in ascending order and determine the median number for that compartment. Then, have students work independently to find the median number for the other two compartments. After students are finished, go over the median numbers as a group and record the numbers on the notepad. An example filled out results table is shown below.

**RESULTS**  
Table

Variables	Compartment 1	Compartment 2	Compartment 3	
Insect Type:	Mealworms	→	→	
Time:	5 min	→	→	
Food Type:	No Food	→	→	
Bedding Type:	No Bedding	→	→	
Light Amount:	Dark	Dark/Light	Light	
Container Type:	Choice Chamber	→	→	
Data				
	Compartment 1	Compartment 2	Compartment 3	
Measurements:	Initial Number of Mealworms:	0	20	0
	Final Number of Mealworms:	10	8	2
		7	9	4
		7	8	5
		12	5	2
13	6	1		
Put Final Numbers of Mealworms in Increasing Order:	7,7,10,12,13	5,6,8,8,9	1,2,2,4,5	
Median:	10	8	2	

9

**RESULTS**  
Table

Fill out the table for each of your compartments in your container. For the variables that remain constant, write the value in Compartment 1. Then, draw an arrow through each box indicating the variable is a control.

Variables	Compartment 1	Compartment 2	Compartment 3	
Insect Type:	Mealworm	→	→	
Time:	5 min	→	→	
Food Type:	No food	→	→	
Bedding Type:	No bedding	→	→	
Light Amount:	Dark	Dark/Light	Light	
Container Type:	Choice Chamber	→	→	
Data				
	Compartment 1	Compartment 2	Compartment 3	
Measurements:	Initial Number of Mealworms:	0	20	0
	Final Number of Mealworms:	10	8	2
		7	9	4
		7	8	5
		12	5	2
13	6	1		
Put Final Number of Mealworms in Increasing Order:	7,7,10,12,13	5,6,8,8,9	1,2,2,4,5	
Median:	10	8	2	

The independent variable is the changing variable and the dependent variables are the final measurements.

7

If there is additional time, have students explain to you how they set up for their experiment and what they learned from their experiment. Try to have students explain this without looking at their notebooks.

**Wrap-Up:**

(2 minutes – Full Class – SciTrek Lead)



Tell students, "Next session, you will analyze your data by making a graph as well as a poster, which you will use to present your findings to the class. These posters will help us learn about what variables affect the number of mealworms in each compartment."

**Clean-Up:**

1. Collect nametags with attached nametags.
2. Put mealworms back into containers.
3. Place all materials in your group box, and bring them back to UCSB.

**Day 4: Graph/Results Summary/Poster Making**

**Schedule:**

Introduction (SciTrek Lead) – 2 minutes  
 Graph (SciTrek Volunteers) – 10 minutes  
 Results Summary (SciTrek Volunteers) – 10 minutes  
 Poster Making (SciTrek Volunteers) – 33 minutes  
 Wrap-Up (SciTrek Lead) – 5 minutes

**Materials:**

(4) Volunteer Boxes:

- |   |   |  |
|---|---|--|
| <input type="checkbox"/> Nametags                         | <input type="checkbox"/> (2) Pencils        | <input type="checkbox"/> Scotch tape   |
| <input type="checkbox"/> Notebooks                        | <input type="checkbox"/> (Bag) Paperclips   | <input type="checkbox"/> Poster parts pack (scientists' names, question, experimental set-up, procedure, results table, results graph, results summary, (6) <i>I acted like a scientist when</i> , (6) picture spaces) |
| <input type="checkbox"/> Volunteer instructions           | <input type="checkbox"/> (2) Grease pencils |  |
| <input type="checkbox"/> Volunteer lab coat               | <input type="checkbox"/> Highlighter        |  |
| <input type="checkbox"/> Poster diagram                   | <input type="checkbox"/> Scissors           |  |
| <input type="checkbox"/> Sticker for how to present graph | <input type="checkbox"/> (2) Glues          |  |

Other Supplies:

- |                                       |  |
|---------------------------------------|--|
| <input type="checkbox"/> (4) Notepads | <input type="checkbox"/> Poster paper tube |
|---------------------------------------|--|

Lead Box:

- |   |   |   |
|---|---|---|
| <input type="checkbox"/> (3) Extra notebooks      | <input type="checkbox"/> (2) Stickers on how to present graph | <input type="checkbox"/> (2) Black pens                   |
| <input type="checkbox"/> Lead instructions        | <input type="checkbox"/> (2) Pencils                          | <input type="checkbox"/> Scissors                         |
| <input type="checkbox"/> Mealworms picture packet | <input type="checkbox"/> (bag) Paperclips                     | <input type="checkbox"/> (2) Glues                        |
| <input type="checkbox"/> Poster diagram           | <input type="checkbox"/> (2) Grease pencils                   | <input type="checkbox"/> Scotch tape                      |
| <input type="checkbox"/> Lead lab coat            | <input type="checkbox"/> (2) Highlighters                     | <input type="checkbox"/> (1 each color) Poster part packs |
| <input type="checkbox"/> Time card                |   |   |

**Notebook and Notepad Pages:**

**RESULTS**  
Graph and Summary

Light Amount	Number of Mealworms
Dark	10
Dark/Light	8
Light	2

My experiment shows mealworms live in dark  
habitats, like under leaves, because 10  
mealworms went to the dark, and 2  
mealworms went to the light.

10

**RESULTS**  
Graph and Summary

Light Amount	Number of Mealworms
Dark	10
Dark/Light	8
Light	2

My experiment shows that mealworms live in dark  
habitats, like under leaves, because 10  
mealworms went to the dark and 2  
mealworms went to the light.

8

**Preparation:**

SciTrek Lead:

1. Make sure volunteers are setting out notebooks.
2. Find a place to leave student posters.

SciTrek Volunteers:

1. Set out notebooks/nametags.

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

**Introduction:**

*(2 minutes – Full Class – SciTrek Lead)*

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

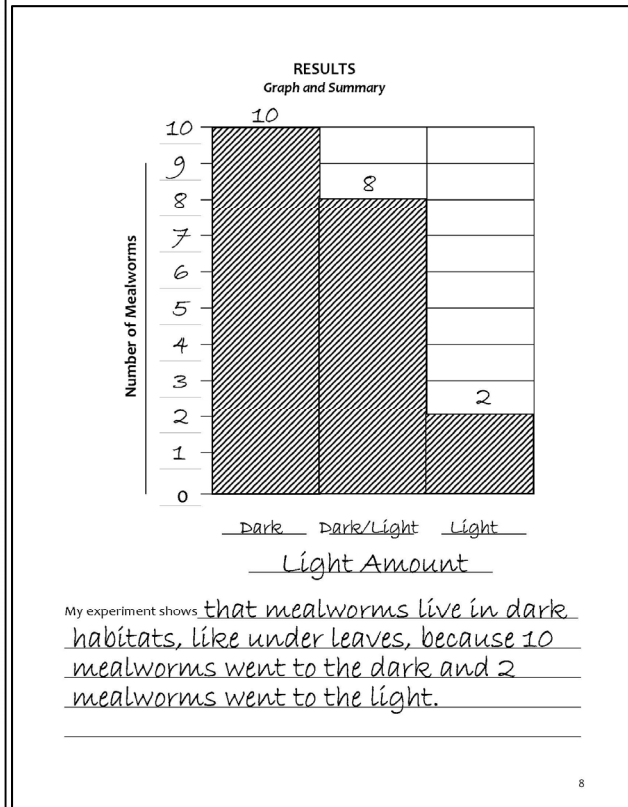
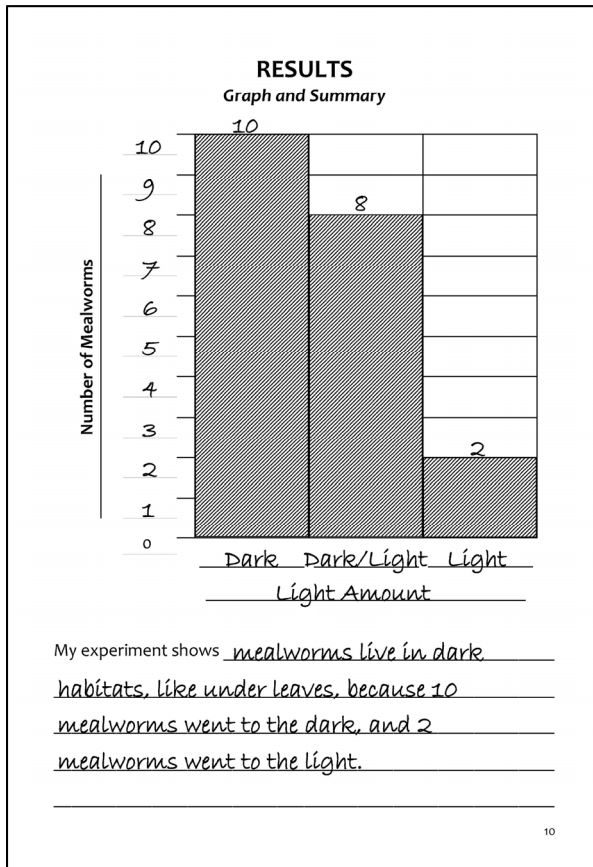
Ask the class, “What is the class question we have been investigating?” Students should reply, “What variables affect the number of mealworms in each compartment?” Ask the class, “Why are we interested in this question?” Possible student response: this will help us learn about mealworms habitats. Tell students, “Today you are going to analyze the results from your experiments, which will allow you to start answering the class question. You will then put together a poster to present your findings to the class. You should write as neatly as possible on the poster parts so that the other class members can read your poster.”

**Graph:**

(10 minutes – Groups – SciTrek Volunteers)

Ask your group, “What did we do last time in SciTrek?” Have them explain their experiment to you without looking at their notebooks.

Help students fill out the graph. First decide on the appropriate scale for the y-axis. You will either count by ones or twos. The example graph has a scale of one. In addition, as a group have students fill out the x-axis (their changing variable and the values of this variable that they used). The values of the changing variable should be filled out in order of compartment. For example, if your group changed food type and you used cookies in compartment 1 and lemons in compartment 3, you would write “cookies” on the first blank, “none” on the second blank, and “lemons” on the third blank. Once the axes are filled out, graph the first compartment with the students. Ask students, “How many mealworms were in compartment 1?” Tell students, “Tell me to stop when my finger gets to the appropriate level on the graph.” Place your finger at zero and slowly move it up the graph until the students tell you to stop. If the students miss the stopping mark, repeat the process. Once you have identified where the line goes, draw a line across the column showing the number of mealworms and write in the numerical value on top of the line. Then, quickly fill in the area below the mark. Tell students, “You should try to beat how fast I filled in under the line when you draw the graph in your notebooks.” Have students attempt to graph the other two compartments on their own and then check their work and record the results in the group notepad. An example filled in graph can be seen below.



**Results Summary:**

(10 minutes – Groups – SciTrek Volunteers)

Have your group use their graph to summarize their findings. Challenge your group to think about how their changing variable relates to the habitat in which they would find a mealworm.

When writing their results summary (notebook, page 10), make sure your group begin the statement with a claim (a statement that can be tested) about the trend or pattern, in their data, and tie their results to the habitat in which mealworms live. An appropriate claim could be: mealworms live in dark habitats, like under leaves. This is an appropriate claim because it allows the students to make a prediction about what would happen if new values of their changing variable were introduced.

After generating a claim about their experiment, write the word “because,” and follow it with supporting data. Make sure your group is using their changing variable values (not trial letters), and specific amounts, to support their claim. The supporting data for the previously mentioned claim would be: because 10 mealworms went to the dark and 2 mealworms went to the light.

Results summaries are still valid, and important, if they show the changing variable tested does not have an effect on the number of mealworms in each compartment. Even if their results summary is contrary to what you think, have your group make a claim based solely on their data. Help students copy this statement into their notebooks.

Once students have filled out the results summary, have them fill in the sentence frame (notebook, page 9), *I acted like a scientist when*. Each student’s response should be unique and specific. They should **not** write, “when I did an experiment,” because this is general and applies to all of the students in the class. If students are having trouble with this sentence frame, ask them, “What did you do during SciTrek?”

**Poster Making:**

(33 minutes – Groups – SciTrek Volunteers)

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

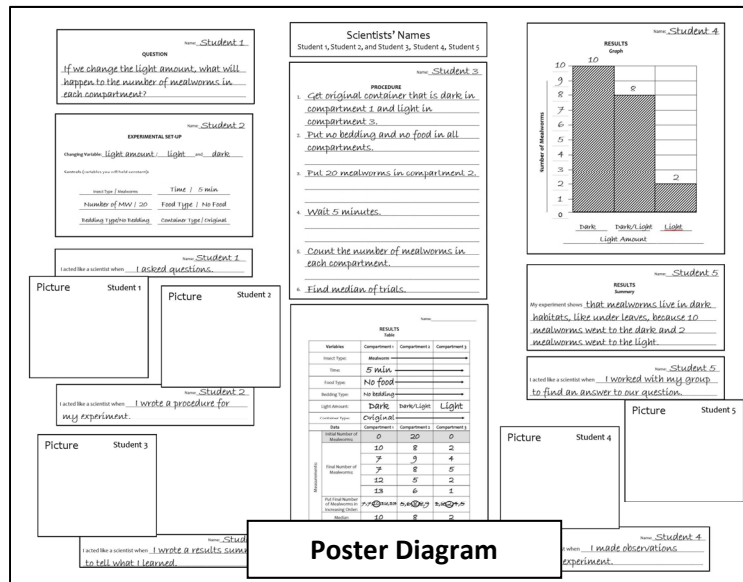
Number of Students in Group	Poster Division Each student gets an <i>I acted like a scientist when</i> and picture space.	
4	1. Question and Experimental Set-Up 2. Procedure 3. Results Graph* 4. Results Summary	Student that finishes 1 <sup>st</sup> completes the results table ( <u>not</u> presented)
5	1. Question 2. Experimental Set-Up 3. Procedure 4. Results Graph* 5. Results Summary	Student that finishes 1 <sup>st</sup> completes the results table ( <u>not</u> presented)
6	1. Question 2. Experimental Set-Up 3. Procedure (Presents 1 <sup>st</sup> half of procedure) 4. Results Table (Presents 2 <sup>nd</sup> half of procedure) 5. Results Graph* 6. Results Summary	

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



As soon as students have completed some of their pieces, start gluing them onto the large poster paper, in landscape orientation, exactly as they are arranged in the example below. Do not allow students to glue the poster parts on the poster. 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 presentation. Make sure students read from their notebooks, instead of from the poster.



Ask your group a few questions about their poster. Have them use their findings to predict what would happen to the number of mealworms in each compartment for other changing variable values they did not perform tests on. In addition, have them state how their findings apply to mealworms in the wild. For instance, if the group's results summary was, "My experiment shows that mealworms eat dry foods, because 12 mealworms went to the cookies (dry) and 5 mealworms went to the oranges (wet)," ask the group, "If there was a bowl of salad and a bowl of crackers on the table which would you be more likely to find a mealworm in?" They should be able to predict that it would more likely be in the crackers.

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

### Wrap-Up:

(5 minutes – Full Class – SciTrek Lead)

Ask students the following questions:

How did you act like a scientist during this project?

What did you do, that scientists do?

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

**Clean-Up:**

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

**Day 5: Poster Presentations****Schedule:**

Introduction (SciTrek Lead) – 2 minutes

Practice Posters (SciTrek Volunteers) – 15 minutes

Poster Presentations (SciTrek Volunteers/SciTrek Lead) – 41 minutes

Wrap-Up (SciTrek Lead) – 2 minutes

**Materials:****(4) Volunteer Boxes:**

- |   |   |  |
|---|---|--|
| <input type="checkbox"/> Nametags               | <input type="checkbox"/> Volunteer lab coat | <input type="checkbox"/> Highlighter                                       |
| <input type="checkbox"/> Notebooks              | <input type="checkbox"/> (2) Pencils        | <input type="checkbox"/> (8) Sharpened SciTrek pencils<br>(all same color) |
| <input type="checkbox"/> Volunteer instructions | <input type="checkbox"/> (2) Grease pencils |  |
|   | <input type="checkbox"/> (Bag) Paperclips   |  |

**Other Supplies:**

- (4) Notepads

**Lead Box:**

- |   |  |   |
|---|--|---|
| <input type="checkbox"/> (3) Extra notebooks      | <input type="checkbox"/> (2) Stickers on how to present<br>graph | <input type="checkbox"/> (2) Black pens   |
| <input type="checkbox"/> Lead instructions        | <input type="checkbox"/> (2) Pencils                             | <input type="checkbox"/> (Bag) Paperclips |
| <input type="checkbox"/> Mealworms picture packet | <input type="checkbox"/> (2) Grease pencils                      | <input type="checkbox"/> (2) Highlighters |
| <input type="checkbox"/> Lead lab coat            |  | <input type="checkbox"/> Scotch tape      |
| <input type="checkbox"/> Time card                |  |   |

\*Student posters should already be in the classroom.

**Picture Packet Page:**

What variables affect the direction mealworms travel?

Group 1:

Changing Variable: <i>light amount</i>	<i>light</i>	<i>light/ dark</i>	<i>dark</i>
Number of mealworms:	<i>2</i>	<i>3</i>	<i>4</i>

Summary: *mealworms live in a dark place*

---

Group 2:

Changing Variable: <i>food type</i>	<i>pretzels</i>	<i>none</i>	<i>cookies</i>
Number of mealworms:	<i>9</i>	<i>2</i>	<i>8</i>

Summary: *mealworms eat both sweet and salty foods*

---

Group 3:

Changing Variable: <i>food type</i>	<i>oranges</i>	<i>none</i>	<i>cookies</i>
Number of mealworms:	<i>5</i>	<i>3</i>	<i>12</i>

Summary: *mealworms eat dry foods*

---

Group 4:

Changing Variable: <i>bedding type</i>	<i>rocks</i>	<i>none</i>	<i>cotton</i>
Number of mealworms:	<i>4</i>	<i>6</i>	<i>15</i>

Summary: *mealworms live in soft places where they can burrow*

**Picture Packet, Page 2**

**Preparation:**

SciTrek Lead:

1. Make sure volunteers are setting out notebooks.
2. Assign volunteers a new group to work with.
3. Set up the document camera for the *Notes on Presentations* (picture packet, page 2).
4. Organize posters so experiments featuring the same changing variable will be presented back-to-back and posters are presented from simplest to understand, to most difficult to understand (suggested order: light amount, food type, bedding type).

SciTrek Volunteers:

1. Today you will initially work with a new group of students. When your original group presents their poster, go up with them.
2. Set out notebooks/nametags.
3. Have pencils ready to distribute to your group **after** the poster presentations.

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

**Introduction:**

*(2 minutes – Full Class – SciTrek Lead)*

Tell students, “Today you will present your posters to the class. This is a common practice in science. Scientists go to conferences where they present posters about the experiments they conducted. At these presentations, other scientists give them feedback on their experiments, which allows them to return to



the lab with new ideas for future experiments. Today, you will work with a new volunteer. You will have 15 minutes to discuss your experiments, and results, as well as practice presenting your posters with your groups. When you present, you should read from your notebooks, not the posters. After practicing, you will return to your normal classroom seats.”

**Practice Posters:**

*(15 minutes – Groups – SciTrek Volunteers)*

Have volunteers rotate groups.

Have students explain what they did and what they learned from their experiment, without looking at their notebooks, if possible. Ask students questions to make sure they understand what they did during their experiment. Make sure you also have them use their results to predict what would happen for other systems they did not actually test. Remind them to think about patterns or trends they saw for their own results and apply these trends to make predictions about the number of mealworms in each compartment. For instance, if the group’s changing variable was food type and their changing variable values were lettuce and Cheerios ask them, “What do you think is another food that mealworms might move towards and why?” Possible student response: Rice Krispies because they are another dry food source. Try to make sure each student in your group answers one question.

Once the group understands their experiment and findings, 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 graph, and results summary). Make sure each student’s part is highlighted in their notebook. If students are reading from multiple pages, use a paperclip to clip these pages together to make it easier for them to flip back and forth. Remind students to read from their notebook rather than from their poster.

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

Do not let poster practice go over 15 minutes.

**Poster Presentations:**

*(41 minutes – Full Class – SciTrek Volunteers/SciTrek Lead)*

Have students return to their original class seats. Ask the class, “What is the question we have been investigating?” Students should reply, “What variables affect the number of mealworms in each compartment?” Ask the class, “Why are we interested in answering this question?” Possible student response: if we can determine the variables that affect the number of mealworms in each compartment, we will be able to predict the mealworms’ ideal habitat. Tell students, “During the presentations, I will take notes, but you will have to help me by telling me the changing variable of the group after they say their question. I will also record the groups’ changing variable values and number of mealworms in each of their compartments.” Turn to page 2 in the picture packet.

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

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

During the student question time, the lead and/or volunteers should ask at least one question. Examples of possible questions are: “How do you know...?” or “Is there anything else you can do to get more information about your question?” Each group should answer approximately five questions (one question per student).

When students are done asking questions, have them summarize what the group found. This is challenging for 3<sup>rd</sup> graders, therefore, you need to break it down into the following five questions 1) What was the group’s changing variable? 2) (point to the notes where you recorded the values of the changing variable) What value of the changing variable did more mealworms travel to? 3) Why did they go to (insert what they went to)? 4) What does this mean about mealworms’ habitats? 5) Can someone put what we learned into a sentence? If they are still having trouble, give them the sentence frame, “Mealworms live in (insert why the mealworm went to the changing variable value) habitat.” Ex: Mealworms live in a dark habitat. Once they have generated a summary, record this on the notes page.

An example filled out notes on presentations, is shown below.

What variables affect the direction mealworms travel?

Group 1:

Changing Variable:	light amount	light	light/dark	dark
Number of mealworms:		2	3	14

Summary: mealworms live in a dark place

---

Group 2:

Changing Variable:	food type	pretzels	none	cookies
Number of mealworms:		9	2	8

Summary: mealworms eat both sweet and salty foods

---

Group 3:

Changing Variable:	food type	oranges	none	cookies
Number of mealworms:		5	3	12

Summary: mealworms eat dry foods

---

Group 4:

Changing Variable:	bedding type	rocks	none	cotton
Number of mealworms:		4	6	15

Summary: mealworms live in soft places where they can burrow

**Picture Packet, Page 2**

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

- The dimmer the *light amount*, the more mealworms there will be.
- Mealworms move towards *food types* that are dry.
  - Note:** Mealworms will travel to both sweet and salty foods.
- Mealworms move towards *bedding types* that are loosely bound or they can burrow into.

When summarizing experiments, use student-collected data and not what they should have found from the list above. Ask students, “What is the ideal habitat for a mealworm?”

- Moisture Level: Dry
- Light Amount: Dark
- Food Type: Dry bread or other bread material
- Bedding Type: Cotton or other materials that they can burrow into

If no one in the class did experiments on one of the variables above, they will not know how that variable affects a mealworm’s motion, and do not expect them to tell you which value to use. Tell students, “You have taught me a lot about mealworms’ ideal habitats.”

**Wrap-Up:**

*(2 minutes – Full Class – SciTrek Lead)*

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

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

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

**Clean- Up:**

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

**Day 6: Question Assessment/Tie to Standards**

**Schedule:**

Question Assessment (SciTrek Lead) – 5 minutes

Tie to Standards (SciTrek Lead) – 55 minutes

**Materials:**

Lead Box:

- |   |  |   |
|---|--|---|
| <input type="checkbox"/> (3) Extra notebooks      | <input type="checkbox"/> Lead lab coat             | <input type="checkbox"/> (2) Pencils        |
| <input type="checkbox"/> Notebooks                | <input type="checkbox"/> (25) Question assessments | <input type="checkbox"/> (2) Grease pencils |
| <input type="checkbox"/> Lead instructions        | <input type="checkbox"/> Time card                 | <input type="checkbox"/> (2) Black pens     |
| <input type="checkbox"/> Mealworms picture packet |  |   |

**Notebook Pages:**

I acted like a scientist when I counted the number of mealworms and recorded the amount in my notebook.

**TIE TO STANDARDS**

1. From the class experiments, write 2 factors you would expect to find in a mealworm's ideal habitat.



a. dry b. dark

2. What would happen if the climate changed where the mealworms lived?

They would have to move.

3. Overall, what are the three things that species can do when the environment changes?

a. move b. die c. adapt

**4. PANDA**



a. What were the environmental changes that caused the panda's habitat to decrease?

hunting deforestation

b. What type of changes were these? POSITIVE  NEGATIVE

c. What was the response of the pandas to this environmental change? move

d. Can this response occur within a panda's lifetime?  YES NO

**5. LOCUST**



a. What was the environmental change that caused the locust's habitat to increase? more resources close by

b. What type of changes were these?  POSITIVE NEGATIVE

c. What was the response of the locusts to this environmental change? move

d. Can this response occur within a locust's lifetime?  YES NO

**6.**

a. What is it called when animals only move temporarily to another location?

migration

b. What is an example of an animal that does this? whales

c. What are possible reasons animals may do this? reproduce

weather food

d. What is the response of migrating animals to environmental changes? move

e. Can this response occur within an animal's lifetime?  YES NO

**7. CAMEL**



a. What does burning fat provide for an animal? energy

b. This can be used by the animal as a substitution for food and water.

c. Would it be a problem if a camel stored fat all over its body?  YES NO

d. What is stored in a camel's hump? fat

e. What was the response of the camels to the environmental conditions? adapt

f. Can this response occur within a camel's lifetime? YES  NO

**8. GIRAFFE**



a. List two other animals that live in this environment.

zebras and gazelles

b. What do the animals listed above eat? grass

c. Is there competition for this food source?  YES NO

d. What other type of food might giraffes eat? leaves on trees

e. What was the response of the giraffes to the environmental conditions? adapt

f. Can this response occur within a giraffe's lifetime? YES  NO

**9. SABER-TOOTHED CAT**



a. What adaptation did the saber-toothed cat have to live in its environment? large teeth

b. What did they eat? large prey

c. What kept the saber-toothed cat from catching smaller prey? its teeth

d. What was the response of the saber-toothed cats to environmental changes?

die

e. Could this response occur within a saber-toothed cat's lifetime?  YES NO

**10. LITTLE SWAN ISLAND HUTIA**



a. Where did the hutia live? an island

b. The two environmental changes to the island were: house cats and hurricane.

c. Adaptations take a long time and must occur over many generations of a species.

d. Are large or small habitat ranges beneficial for survival of species?

LARGE SMALL

e. What was the response of the hutias to environmental changes? die

f. Could this response occur within a hutia's lifetime?  YES NO

**11.**

a. What is it called when an entire species dies off? extinction

b. Does this usually occur over one generation? YES  NO

**Preparation:**

SciTrek Lead:

1. If the teacher is not leading the tie to standards activity, do the following:
  - a. Give the teacher an extra notebook and have them fill it out with their students, to follow along during the tie to standards activity.
  - b. Collect the teacher's lab coat, and put it in the lead box.
2. Pass out the question assessments and notebooks.
3. Set up the document camera for the tie to standards activity (notebook, pages 9-12; picture packet, pages 3-9).
4. Put your lab coat in the lead box at the end of the day.

**Question Assessment:**

*(5 minutes – Full Class – SciTrek Lead)*

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

Read the instructions aloud to students. Then, read each of the questions and tell students, "Circle 'testable' for questions that science can answer or 'not testable' for questions that science cannot answer." When students are finished, collect the assessments and verify students' names are written on top.

**Tie to Standards:**

*(55 minutes – Full Class – SciTrek Lead)*

*A Mealworm's Ideal Habitat (15 minutes)*


Tell the class, "I enjoyed your poster presentations last time. Today, you are going to revisit some of the variables that affected the number of mealworms in each compartment." Have students turn to page 9 of their notebooks. Place the class notebook under the document camera and turn to page 9.

Ask students, "Think back to what we learned for the poster and during this module, what do you think a wild mealworm's habitat is like?" Try to have student revisit all the variables that the class explores. For example, from the observational set-up run the first day, students should know that mealworms move towards dry places as opposed to wet. Therefore, they probably live in a dry habitat. Their experiments should let them determine other things about mealworms' preferred habitats such as light/dark (mealworms move towards the dark), food sources (mealworms move towards dry bread-like foods), bedding materials (mealworms move towards loosely bound beddings like woodchips or dry leaves), etc. Record these for questions 1. If students, generate more than two responses, write them below question 1. After, have students pick two of these responses and copy them into their notebooks. Example student work can be seen below.

I acted like a scientist when I counted the number of mealworms and recorded the amount in my notebook.

**TIE TO STANDARDS**

1. From the class experiments, write 2 factors you would expect to find in a mealworm's ideal habitat.



a. dry                      b. dark

2. What would happen if the climate changed where the mealworms lived?  
They would have to move.

3. Overall, what are the three things that species can do when the environment changes?

a. move                      b. die                      c. adapt

9

Ask students, “What would happen if the climate changed where mealworms lived? For instance, what would happen if the place in which mealworms lived started to get more rain causing their living space to always be wet? What could the mealworms do?” Allow students to talk in groups about this and then have them record some of their ideas into their notebook on page 9. After, have one or two students share. Record one of these responses into the class notebook under the document camera for students to copy. An example of student work can be seen above.


Tell students, “There are three things a species can do when its habitat changes.” Most of the time students will have already come up with two answers for this question, move or die. Have them write these on the first two lines of question 3. Tell students, “The third option for the species can only occur if the habitat change is very slow. Species can slowly adapt to the new environment; however, this cannot happen in one generation. For instance, if a mealworm’s habitat became permanently wet, many of the mealworms would die off. The mealworms that would survive would have adaptations that would allow them to handle the new wetter environment. These mealworms would have offspring that could also deal better with a wetter environment and slowly over many generations the mealworms would adapt to their new, wetter habitat.” Have students fill in “adapt” on the last line of question 3. An example of student work can be seen above.

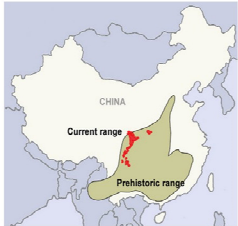
Move/Migration (10 minutes)

Have students turn to page 10 in their notebooks.

Show the students the picture of the Giant Panda (picture packet, page 3).

**Move 1**





**Panda**


- Why do you think the panda's living area got smaller?
  - Deforestation
    - Deforestation caused bamboo plants to decrease significantly- Significant part of Panda Diet
    - Pandas then had to move to where Bamboo grows (couldn't wait for new Bamboo to grow because this can take up to 100 years)
  - Hunted by humans
    - Hunting pandas is now illegal in China

**Picture Packet, Page 3**

Tell students, "Pandas originally lived in all of the green areas on the map but now they only live in the red areas." Ask students, "What were the environmental changes that caused the panda's habitat to decrease?" Allow one or two students to share their answers. Tell students, "The pandas had to move to this new area because of two reasons: deforestation and hunting." Record these answers for question 4a. Ask students, "Was this a positive or negative change for the pandas?" They should respond, negative. Circle this answer for question 4b.

Ask students, "What was the response of the pandas to this environmental change?" They should reply, "Move." Record this answer for question 4c. Then ask students, "Can this response (moving) occur within a panda's lifetime?" They should reply, "Yes". Record this answer for question 4d. An example of student work can be seen below.

**4. PANDA**


a.  What were the environmental changes that caused the panda's habitat to decrease?  
hunting      deforestation

b. What type of changes were these?    POSITIVE    NEGATIVE

c. What was the response of the pandas to this environmental change? move

d. Can this response occur within a panda's lifetime?    YES    NO

**5. LOCUST**

a.  What was the environmental change that caused the locust's habitat to increase? more resources close by

b. What type of changes were these?    POSITIVE    NEGATIVE

c. What was the response of the locusts to this environmental change? move

d. Can this response occur within a locust's lifetime?    YES    NO

**6.**

a. What is it called when animals only move temporarily to another location?  
migration

b. What is an example of an animal that does this? whales

c. What are possible reasons animals may do this? reproduce  
weather      food

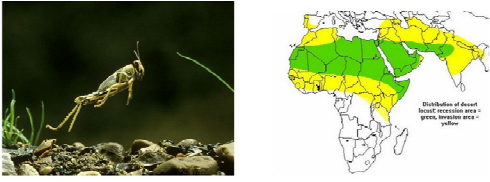
d. What is the response of migrating animals to environmental changes? move

e. Can this response occur within an animal's lifetime?    YES    NO

10

Tell students, “In the pandas’ case the move was a response to a negative change in the pandas’ habitat but there are also positive reasons that would cause an animal to move.”

Show students the picture of the locust (picture packet, page 4).


	<p style="text-align: right;"><b>Move 2</b></p> <p><b>Locust</b></p> <ul style="list-style-type: none"> <li>• Why do you think the locust were able to expand into new areas? <ul style="list-style-type: none"> <li>– Locust moved because there were abundant resources close by.</li> </ul> </li> </ul>
<p><b>Picture Packet, Page 4</b></p>	

Tell students, “Originally, the locusts were in the green area on the map but now they live in both the yellow and the green areas.” Ask students, “What was the environmental change that caused the locusts’ habitat to increase?” Allow one or two students to share their response. Tell students, “The locust moved because there were abundant resources close by. This allowed them to expand their habitat range and the locust population grew.” Record this answer for question 5a.

Ask students, “Was this a positive or negative change for the locusts?” They should respond, “Positive.” Circle this answer for question 5b. Ask students, “What was the response of the locusts to this environmental change?” They should reply, “Move.” Record this answer for question 5c. After, ask students, “Can this response occur within a locust’s lifetime?” Student should reply, “Yes.” Record this answer for question 5d. An example of student work can be seen above.

Tell students, “Some animals only move for part of the year or for a season because the environment they live in becomes temporarily undesirable.” Ask students, “What it is called when animals only move temporarily to another location?” Students should know this is called migration. Record this answer for question 6a. Ask students, “What are examples of animals that migrate?” Allow one or two students to share their responses. Record one of these responses for question 6b (Ex: birds, butterflies, whales, caribou, penguins, and salmon).

Show students the picture of whales and birds, page 5 of picture packet.

	<p style="text-align: right;"><b>Move 3</b></p> <p><b>Whales, Birds, and Butterflies</b></p> <ul style="list-style-type: none"> <li>• Some animals only move for part of the year because the environment that they live in becomes temporarily undesirable.</li> <li>• What do you call it when animals move during specific times of the year? <ul style="list-style-type: none"> <li>– Migration</li> </ul> </li> <li>• What are some animals that migrate? <ul style="list-style-type: none"> <li>– Birds</li> <li>– Whales</li> <li>– Butterflies</li> </ul> </li> <li>• Why do some animals migrate? <ul style="list-style-type: none"> <li>– To reproduce</li> <li>– For a food source</li> </ul> </li> </ul>
<p><b>Picture Packet, Page 5</b></p>	




Ask students, “Why do animals migrate?” Allow students to talk in groups and then allow some students to share. Animals migrate to reproduce, to search for food, or to search for better weather (warmer water). Record these responses for question 6c.

Ask students, “What is the response of migrating animals to environmental changes?” They should reply, “Move.” Record this answer for question 6d. After, ask students, “Can this response (move) occur within an animal’s lifetime?” They should reply, “Yes.” Record this answer for question 6e. An example of student work can be seen above.

*Adapt (15 minutes)*

Have students turn to page 11 in their notebooks.

Show students the picture of the camel (picture packet, page 6).

	<p style="text-align: right;"><b>Adapt 1</b></p> <p><b>Camel</b></p> <ul style="list-style-type: none"> <li>• Describe the environment that camels live in.             <ul style="list-style-type: none"> <li>– Hot, barren, little food and water</li> </ul> </li> <li>• Animals store fat so that when it is needed, their bodies can burn the fat to produce energy</li> <li>• Energy can be a substitute for food and water.</li> <li>• Do you think fat is important for camels?             <ul style="list-style-type: none"> <li>– Yes, it allows them to go for days without eating.</li> </ul> </li> <li>• Why do whales have fat (blubber) all over their bodies?             <ul style="list-style-type: none"> <li>– Whales have fat (blubber) all over their bodies to stay warm.</li> </ul> </li> <li>• Why would fat all over a camel’s body be a problem?             <ul style="list-style-type: none"> <li>– The camel would get too hot.</li> </ul> </li> <li>• What adaptation do camels have?             <ul style="list-style-type: none"> <li>– Hump</li> </ul> </li> <li>• What is stored in a camel’s hump?             <ul style="list-style-type: none"> <li>– Fat</li> </ul> </li> <li>• What would happen if a camel was born without the ability to form a hump?             <ul style="list-style-type: none"> <li>– Might get too hot if fat is stored around its body</li> <li>– Might not be able to go for long periods without food and water</li> </ul> </li> </ul> <p>an area with lots of food and water, would the camels hump generations to develop/lose adaptations.</p>
--	--

**Picture Packet, Page 6**

Ask students, “Can someone describe the environment in which camels live?” Possible student response: camels live in the desert, where it is very hot, and there is little food and water.

Tell students, “Animals store fat so, when needed, their bodies can burn the fat to produce energy.” Have students record this for question 7a. Tell students, “Burning of fat by animals can be a substitute for food and water.” Have students record this for question 7b.

Ask students, “Do you they think fat is important for camels and why?” Make sure by the end of the discussion students understand fat is important for camels because it allows camels to go for long periods of time without eating or drinking.


Ask students, “Why do whales have fat (blubber) all over their bodies?” They should reply, “Whales have blubber all over their bodies to keep warm.” Therefore, animals that do not burn their fat/blubber can use it for insulation. Now ask students, “Would it be a problem if a camel stored fat all over its body and why?” They should realize having fat all over a camel’s body would be a problem because it would make them very hot, and they already live in a warm habitat. Record this response for question 7c.

Ask students, “Why is it important for camels to store fat?” They should realize that camels store fat not to keep warm, but to utilize as food (energy) when they have to go long periods of time without any food or water. Now, ask students, “What adaptation have camels made to survive in the harsh conditions of the desert?” They should reply, “The hump on the camel’s back is its adaptation.” Ask students, “What do you think is stored in the camels’ hump?” By the end of the conversation make sure students understand fat is stored in the camels’ hump which allows camels to have stored energy (food/water) without causing them to overheat, which would happen if fat was evenly dispersed over their bodies. Record this response for question 7d.

Ask students, “What was the response of the camels to the environmental conditions?” They should reply, “Adapt.” Record this answer for question 7e. Then, ask students, “Can this response (adapt) occur within a camel’s lifetime? In other words, if you put a camel in a cold environment would it lose its hump as the fat redistributed around its body?” Students should realize moving a camel to the cold would not make its hump go away. Make sure by the end of the discussion students realize if the habitat for all camels became colder than the camels with more fat on their bodies would do better and therefore, have offspring with more fat on their bodies until the species adapted to have fat distributed around their bodies. This adaptation would need to take place over many generations of camels and would therefore not occur during one camel’s lifetime. Record No for question 7f.

Ask students, “What would happen if a camel was born without a hump?” Possible student response: the camel might not be able to go long periods of time without food/water because they would have no way to store fat (food/water). This might cause the camel to die. Therefore, over time the camels that could store more fat in their humps had more offspring, which lead to the hump adaptation.

**7. CAMEL**



a. What does burning fat provide for an animal? energy

b. This can be used by the animal as a substitution for  
food and water.

c. Would it be a problem if a camel stored fat all over its body?  YES  NO


d. What is stored in a camel's hump? fat

e. What was the response of the camels to the environmental conditions? adapt

f. Can this response occur within a camel's lifetime? YES   NO

**8. GIRAFFE**



a. List two other animals that live in this environment.  
zebras and gazelles

b. What do the animals listed above eat? grass

c. Is there competition for this food source?  YES  NO

d. What other type of food might giraffes eat? leaves on trees

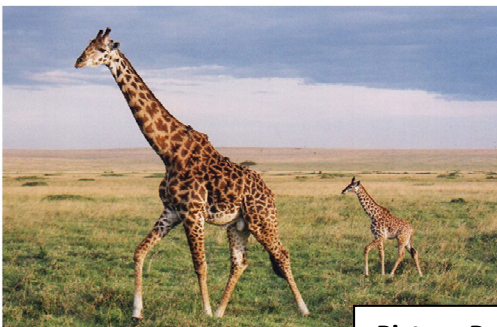
e. What was the response of the giraffes to the environmental conditions? adapt

f. Can this response occur within a giraffe's lifetime? YES   NO

11

**Note:** The camel’s hump stores two different kinds of fat, one of which can be used as a form of energy and the second is very dense and gives the hump its rigidity and shape. When the camel is underfed or has to go long time periods without any food or water the camel can burn the extra stored fat that is in its hump to get energy instead of having to eat food. In addition, when the fat is burned, water is also released as a byproduct. Unlike sheep and cows, which have similar energy needs to the camel, in terms of the amount of food, camels are able to over eat and under eat because they have adapted to survive in an environment where food is limited. The camel’s hump does change size slightly as the camel has more or less fat reserves but since the rigid fat is always there, the hump does not completely go away.

Show students the picture of the giraffe, (picture packet, page 7).

	<p style="text-align: right;"><b>Adapt 2</b></p> <p><b>Giraffe</b></p> <ul style="list-style-type: none"> <li>• Describe the environment that giraffes live in.                     <ul style="list-style-type: none"> <li>– Grass, some tall trees, savannas</li> </ul> </li> <li>• What do giraffes eat?                     <ul style="list-style-type: none"> <li>– Grass</li> </ul> </li> <li>• What other animals live in the same area as giraffes?                     <ul style="list-style-type: none"> <li>– Zebras, lions, gazelles, etc.</li> </ul> </li> <li>• What do zebras and gazelles eat?                     <ul style="list-style-type: none"> <li>– Grass</li> </ul> </li> <li>• Do you think there is competition for food that giraffes might eat?                     <ul style="list-style-type: none"> <li>– Yes, from zebras, gazelles, etc.</li> </ul> </li> <li>• Besides grass, what else could giraffes eat?                     <ul style="list-style-type: none"> <li>– Leaves off of trees</li> </ul> </li> <li>• Why are giraffes better equipped to eat tree leaves?                     <ul style="list-style-type: none"> <li>– They have a long neck and are tall. This is the giraffes adaptation.</li> </ul> </li> <li>• If a giraffe was put in an area with lots of low vegetation, would the giraffes neck shrink?                     <ul style="list-style-type: none"> <li>– No, it takes many generations to develop/lose adaptations.</li> </ul> </li> <li>• Giraffes necks do not continue to get bigger because Giraffe's with longer necks need more nutrients to survive and during a drought it is harder to get these nutrients. Therefore there is a check and balance system. In addition, leaves during a drought grow lower to the ground, which makes competition for the giraffes.</li> </ul> <p>ff was born with a short neck? gh food to survive.</p>
---	--

**Picture Packet, Page 7**

Ask students “Describe the environment where giraffes live.” Possible student response: giraffes live in Africa on the savanna or grassy plains, which have some tall trees. Ask students, “What do giraffes eat?” They should reply, “Grass and leaves.” Ask students, “Do other animals live in this type of environment?” Possible student response: other animals like zebras, lions, and gazelles also live there. Record two of their responses (choose animals that eat grass) for question 8a.

Now ask students, “What do zebras and gazelles eat?” They should realize gazelles and other animals that live in the grassy plains eat grass. Record this answer for question 8b. Ask students, “Is there competition with other animals for the food that giraffes eat?” They should realize, because both of these animals eat grass, there is competition for this food source. Circle this answer for question 8c. Ask students, “Besides grass, what other type of food might giraffes eat?” They should reply, “Giraffes eat the leaves off of trees.” Record this answer for question 8d. Now, ask students, “Why are giraffes better equipped to eat leaves on a tree than gazelle?” Possible student response: giraffes have long necks and long legs to help them reach the tall tree leaves.

Ask students, “What was the response of the giraffes to the environmental conditions?” They should reply, “Adapt.” Record this answer for question 8e. Then ask students, “Can this response (adapt) occur within a giraffe’s lifetime? In other words, if you put a giraffe in an environment with lots of low vegetation would it lose its long neck/long legs?” Make sure by the end of the discussion students realize if the habitat for all giraffes only had food on the ground the giraffes with shorter neck would do better and therefore, have offspring with shorter necks until the species adapted to have shorter necks. Students should be able to realize this adaptation would need to take place over many generations of giraffes. Record No for question 8f. An example of student work can be seen above.


Tell students, “The reason giraffes’ necks don’t just keep evolving to be even longer, is because giraffes with longer necks need more nutrients than giraffes with smaller necks. During drought seasons it is hard for giraffes with long necks to get enough nutrients to sustain them, which causes them to die off. Therefore, there is an ideal neck length that allows giraffes to reach most of the tall leaves without needing too many nutrients. In addition, during a drought, leaves only grow closer to the ground which makes competition for the longer neck giraffes greater.”

Ask students, “What would happen if a giraffe was born with a short neck?” Possible student response: there would be too much competition for food, therefore, the giraffe might not be able to get enough food and would then die.

Die (15 minutes)

Have students turn to page 12 in their notebooks.

Show students the picture of the saber-toothed cat (picture packet, page 8).


	<p style="text-align: right;"><b>Die 1</b></p> <p><b>Saber-Toothed Cat (extinct 7.2 million years ago)</b></p> <ul style="list-style-type: none"> <li>• What adaptation did saber-tooth cats have to live in their environment?       <ul style="list-style-type: none"> <li>– Large teeth to catch prey</li> </ul> </li> <li>• What did saber-toothed cats eat?       <ul style="list-style-type: none"> <li>– Large prey</li> </ul> </li> <li>• Do you think that saber-toothed cats were able to catch smaller prey such as a mouse?       <ul style="list-style-type: none"> <li>– No, it would be hard because their two large teeth would get in the way.</li> </ul> </li> <li>• After all of the large prey died off, saber-toothed cats were not able to catch smaller prey (such as mice) and did not have enough to eat. This led to their extinction.</li> </ul>
<p><b>Picture Packet, Page 8</b></p>	

Ask students, “What adaptation did the saber-toothed cat have to live in its environment?” They should reply, “They had two large front teeth to catch prey.” Record this answer for question 9a. Ask students, “What did the saber-toothed eat?” Possible student response: they ate large prey, such as deer. Record this answer for question 9b. Ask students, “Do you think it was possible for a saber-toothed cat to catch small prey such as mice?” Possible student response: the saber-toothed cat would not be able to catch smaller prey because their two large teeth would get in the way. Record this answer for question 9c.

Tell students, “During the time the saber-toothed cat lived, the weather conditions on the planet changed and the planet became much colder. This caused most of the large prey (deer-like animals) to die off because a lot of the vegetation froze and there was no food for the large herbivores (prey) to eat. Because there was less large prey, this resulted in less food for the saber-toothed cats. Since the saber-toothed cats were not able to catch smaller prey (because of their large teeth), they all died off.” Record this response for question 9d.

Ask students, “What was the response of the saber-toothed cats to environmental changes?” They should reply, “Die.” Record this answer for question 9d. Then, ask students, “Could this response (death) occur within a saber-toothed cat’s lifetime?” They should be able to realize that death (although not favorable) is a possibility within an animal’s lifetime. Record this response for question 9e. An example of student work can be seen below.

9. SABER-TOOTHED CAT



a. What adaptation did the saber-toothed cat have to live in its environment? large teeth


b. What did they eat? large prey

c. What kept the saber-toothed cat from catching smaller prey? its teeth

d. What was the response of the saber-toothed cats to environmental changes?  
die

e. Could this response occur within a saber-toothed cat's lifetime?  YES  NO

10. LITTLE SWAN ISLAND HUTIA



a. Where did the hutia live? an island

b. The two environmental changes to the island were:  
house cats and hurricane.

c. Adaptations take a long time and must occur over many generations of a species.

d. Are large or small habitat ranges beneficial for survival of species?  
 LARGE  SMALL

e. What was the response of the hutias to environmental changes? die

f. Could this response occur within a hutia's lifetime?  YES  NO


11.

a. What is it called when an entire species dies off? extinction

b. Does this usually occur over one generation? YES  NO

12

Show the students the picture of the little swan island hutia (pronunciation: hoo-TEE-uh), (picture packet, page 9).



**Die 2**

**Little Swan Island Hutia (extinct in 1955)**

- Lived on a small island in Honduras
- Hurricane came and devastated the island. In addition, house cats were introduced to the island, which played a role in the extinction.
- This rodent could not adapt quickly enough and thus died off and became extinct.
- How long does it take for a species to make adaptations?
  - It takes a long time! Over several generations.
- Is it beneficial for a species to be in larger or smaller area?
  - It is more beneficial for a species to be spread out over a large area.

**Picture Packet, Page 9**

Tell students, "This rodent lived on a small island in Honduras until a hurricane (Hurricane Janet, 1955) came and devastated the island. In addition, house cats were introduced to the island and they hunted this animal. Because of the hurricane and the addition of house cats, these animals became extinct in 1955." Record these answers for questions 10a and 10b.

Ask students, "Why was the rodent not able to adapt to these new conditions?" They should realize that they did not have enough time to adapt because the hurricane and the house cats were introduced so fast. Ask students, "How long does it take for a species to make adaptations?" They should reply, "It takes many generations for a species to make adaptations." Students should realize that because hutias could not adapt quickly enough, they were not able to survive and died. Fill in the following sentence frame with students (question 10c): *adaptations take a long time and must occur over many generations of a species.*

Ask students, “Are large or small habitat ranges beneficial for survival of species and why?” Possible student response: it is more beneficial for a species to live in a large area in case of an event like a hurricane so an entire species does not die out. Circle the correct answer for question 10d.

Ask students, “What was the response of the hutias to environmental changes?” They should reply, “Die.” Record this answer for question 10e. Then, ask students, “Could this response (die) occur within a hutia’s lifetime?” They should be able to realize that death (although not favorable) is a possibility within an animal’s lifetime. Record this answer for question 10f. An example of student work can be seen above.

Ask students, “What is it called when an entire species dies off?” They should reply, “Extinction.” Record this answer for question 11a. Tell students, “Both the saber-toothed cats and the hutias are examples of animals that became extinct.” Ask students, “Does extinctions usually occur over one generation?” By the end of the conversation, make sure students understand many times there is a slow decline in the number of animals in a species until finally the species becomes extinct and this process can occur over many generations. Tell students, “If the decline in species is slow enough, humans can help prevent extinctions.” Ask students, “Do you know of any ways that humans have been able to help animals from going extinct?” Possible student response: habitat restoration, nature preserves, placing animals on the endangered list, making efforts to stop poaching, and placing animals in zoos to reproduce. Tell the class, “The decline in the number of saber-tooth cats took place over many generations because the changing climate and the death of large prey took place over a long period of time. However, in the hutias case the extinction process took place over a single generation because the effect of the hurricane and introduction of cats was so dramatic. In addition, the habitat size for the hutia was very small, which meant any change affected all of the hutias.”

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

### **Clean-Up:**

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

**Extra Practice Solutions:**

**EXTRA PRACTICE**  
**Questions**

Circle TESTABLE if the question can be tested by science. Circle NOT TESTABLE if the question cannot be tested by science. If the question is NOT TESTABLE change (revise) the question to be something that is testable.

1. How many hours does a giraffe sleep in a day?      Testable      Not Testable  
Revision: \_\_\_\_\_ ?
2. How fast can Wonder Woman run?      Testable      Not Testable  
Revision: How fast can Darby run ?
3. Is learning how to write in cursive valuable?      Testable      Not Testable  
Revision: How many people can write in cursive ?
4. What is the total number of cups of coffee that people in the United States drink in one week?      Testable      Not Testable  
Revision: \_\_\_\_\_ ?
5. Is soap easy to pour?      Testable      Not Testable  
Revision: Is soap easier to pour than water ?
6. What species of animal has the thickest fur?      Testable      Not Testable  
Revision: \_\_\_\_\_ ?
7. Do ants like sugar?      Testable      Not Testable  
Revision: Do ants eat sugar ?

13