Module 1: Mealworms

3th Grade

Activity Schedule: There are no scheduling restrictions for this activity.

Day 1: Question Assessment/Observations/Reproducibility Discussion/Variables (60 minutes)
Day 2: Question Activity/Questions/Experimental Set-Up (60 minutes)
Day 3: Procedure/Technique/Experiment (60 minutes)
Day 4: Graph/Poster Making (60 minutes)
Day 5: Poster Presentations (60 minutes)
Day 6: Question Assessment/Tie to Standards (60 minutes)

Next Generation Science Standard Addressed:

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

Learning Objectives:

1. Students will know that when an organism's habitat changes the organisms can move, die, or adapt.
2. Students will know that adaptations take many generations to occur.
3. Students will be able to understand 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 come up with at least two testable questions and recognize when questions are not testable.
6. Students will be able to suggest revisions for questions that are not testable in order to make them testable.
7. Students will be able to list at least two ways that they behaved like scientists.

Classroom Teacher Responsibilities:

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

1. Module 1 (year 1)
    a. Classroom Teacher Co-Runs a Group
        i. Classroom teacher will co-run a group with a SciTrek volunteer. Groups contain ~5 students.
2. Module 2 (year 1)
    a. Classroom Teacher Runs a Group
        i. Classroom teacher will run a group. Groups ~5 students.
3. Module 3 (year 2)
    a. Classroom Teacher Runs a Group and Starts Leading Class Discussions

i. Classroom teacher will run a group. Group contains ~5 students.
ii. Classroom teacher will start leading parts of group discussions (examples: question activity, tie to standards, etc.).

4. Module 4 (year 2)
   a. Classroom Teacher Leads the Class with Co-Lead Volunteer
      i. Classroom teacher will be responsible for leading whole class discussions (examples: question activity, tie to standards, etc.).
      ii. Classroom teacher will be responsible for time management
      iii. Classroom teacher will be responsible for overseeing volunteers and helping out with any groups that are struggling.
5. Any Additional Modules (year 3 and beyond)
   a. Classroom Teacher Leads the Class
      i. Classroom teacher will be responsible for leading whole class discussions (example: question activity, tie to standards, etc.).
      ii. Classroom teacher will be responsible for time management.
      iii. Classroom teacher will be responsible for overseeing volunteers and helping out with any groups that are struggling.
      iv. It is very important for the classroom teacher to contact scitrekadmin@chem.ucsb.edu if they will be unable to run the module on a specific day.

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

In addition, teachers are required to come to UCSB for the volunteer orientation, typically ran ~1 week prior to the start of the module (contact scitrekadmin@chem.ucsb.edu for exact times and dates, or see our website at http://web.chem.ucsb.edu/~scitrek/Module_Times.html under your class's modules times). At the orientation teachers will meet the volunteers that will be helping in their classroom, go over module content, and learn their responsibilities during the module.

Prior to the Module (at least 1 week):

1. Come to the SciTrek Orientation at UCSB
2. Divide the class into four groups (~5 students each). We find these groups work best when they are mixed levels and mixed language abilities. Send your class list with the groups denoted to scitrekadmin@chem.ucsb.edu one week before the start of the module so that we can have nametags/notebooks made for students.

During the Module:

Days 1-4:

Have the students' desks/tables moved into 4 groups and cleared off. This way each student can have a desk to sit at during SciTrek group activities.

Days 5 and 6:

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

Days 1-3 and 6:

If possible have a document camera available to the SciTrek leader.

Materials Used for this Module:

1. Mealworms
2. Magnifying Glasses (Fisher Part Number: S19230C)
3. Pillboxes (Weekly Classic Pill Planner Clear – 2XL dimensions $9\frac{1}{8}$"x $1\frac{3}{4}$" × 1") with (60 0.7 cm holes drilled through all of the days. Masking tape is put on the two ends of the pillbox and on both of the Wednesday sides this keep the mealworms contained to Sunday, Monday, and Tuesday or Thursday, Friday, and Saturday (Apothecary Products part number 67198)
4. Bedding Materials (cotton balls, moss, bark, shredded paper (red, yellow, green, purple, white), woodchips, fresh grass, rubber, dry leaves, and rocks)
5. Food (Cheerios, Frosted Flakes, almonds, pretzels, marshmallows, raisins, mandarin oranges, lettuce, crackers, sunflower seeds, cookies, and oatmeal)
6. MyChron Timers (Fisher part number: 08-572-5A)
7. 5 oz Plastic Bowls (Smart and Final) with days of the week written on the bottom in Sharpie
8. 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)

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

Schedule:

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

Materials:

(4) Volunteer Boxes:

- ☐ Student nametags
- ☐ (2) Markers
- ☐ (6) Magnifying glasses
- ☐ Water
- ☐ (2) Sets of 6 bowls labeled: Su, M, Tu, Th, F, Sa
- ☐ Volunteer instructions
- ☐ Paper towels
- ☐ Pillbox with tape
- ☐ Container of 10 mealworms
- ☐ Volunteer lab coat
- ☐ Timer
- ☐ (2) Bags woodchips
- ☐ (2) Containers of 20 mealworms each

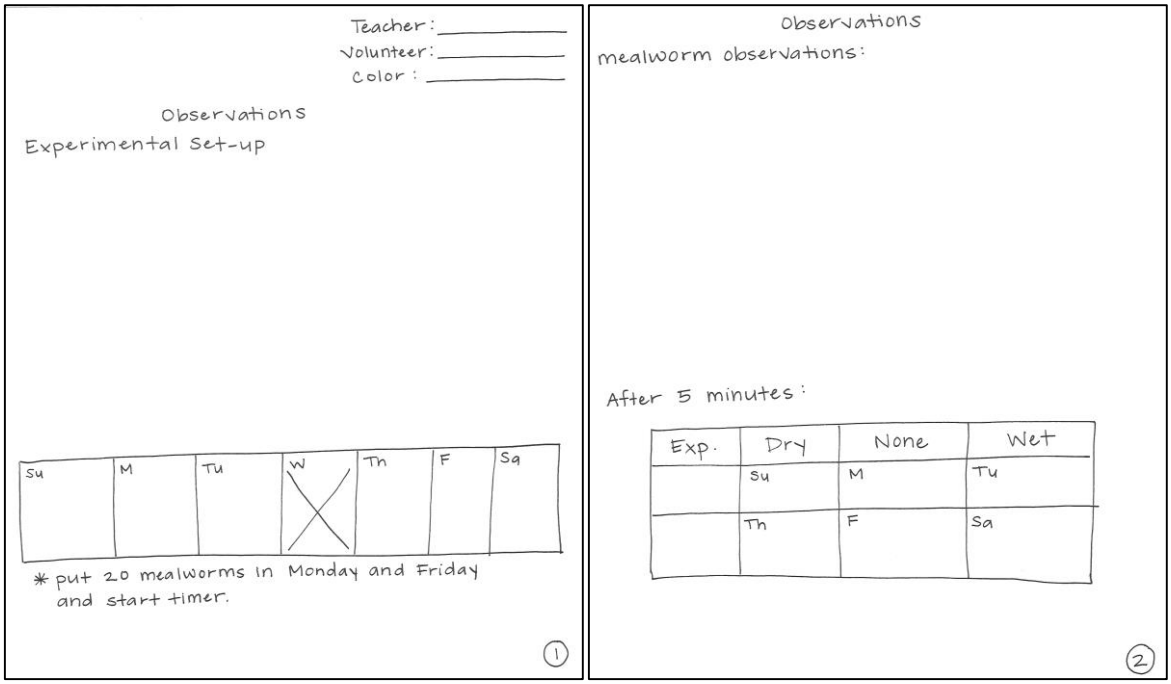
Other Supplies:

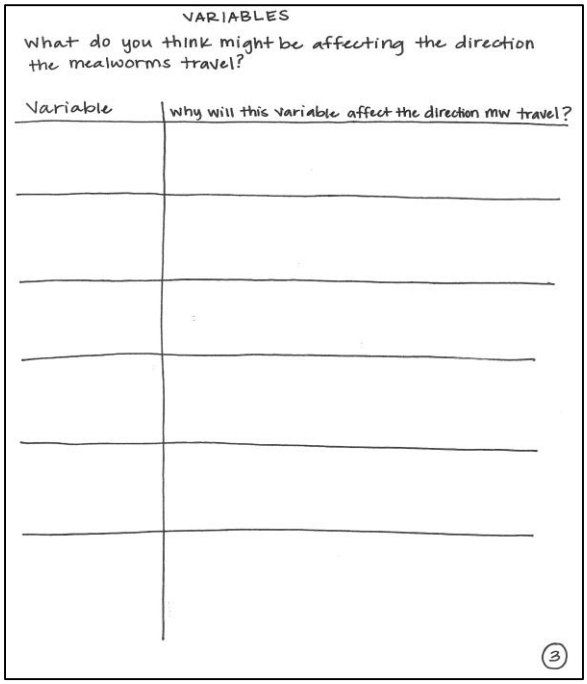
- ☐ (4) Large group notepads
- ☐ (4)Trays

Lead Box:

- ☐ (5) Blank nametags
- ☐ Lead instructions
- ☐ Lead lab coat
- ☐ (4) Markers (red, green, blue, orange)
- ☐ Paper towels
- ☐ Timer
- ☐ (6) Magnifying glasses
- ☐ Pillbox with tape
- ☐ (2) Bags of woodchips
- ☐ Water
- ☐ (2) Containers of 20 mealworms each
- ☐ (2) Sets of 6 bowls labeled: Su, M, Tu, Th, F, Sa
- ☐ (2) Pencils
- ☐ Masking tape
- ☐ Class data sheet
- ☐ (25) Question assessments
- ☐ Time card

SciTrek Group Notepad Pages Used with Students:





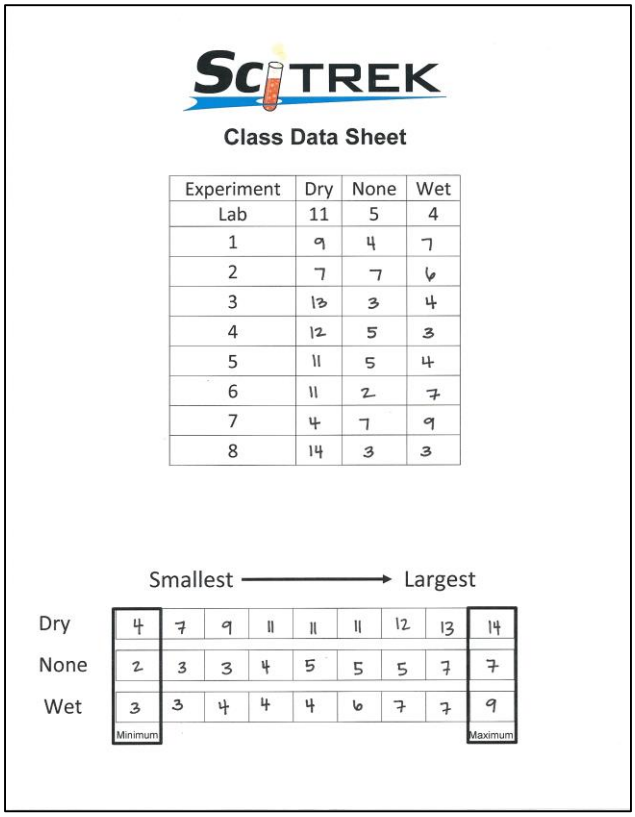
Set-Up:

SciTrek Leader:

Before arriving to the classroom, on the group notepads turn to page 2 and under the section "after 5 minutes" number the experiments 1-8, so that each notepad has two consecutive numbers.

As volunteers are signing into the school office have them pour water into one of their bags of woodchips that are in their group boxes. Then have the volunteers put the woodchips into the compartments of the pillbox (dry woodchips in Su and Th and wet woodchips into Tu and Sa). Make sure the compartments are only filled approximately three quarters full so that the mealworms can still travel through the bedding (woodchips).

If the classroom has a document camera ask the teacher to use it to record the group data. If the classroom does not have a document camera, then tape the example poster sized group data chart to the front board.



SciTrek

Class Data Sheet

Experiment	Dry	None	Wet
Lab	11	5	4
1	9	4	7
2	7	7	6
3	13	3	4
4	12	5	3
5	11	5	4
6	11	2	7
7	4	7	9
8	14	3	3

Smallest → Largest

Dry	4	7	9	11	11	11	12	13	14
None	2	3	3	4	5	5	5	7	7
Wet	3	3	4	4	4	6	7	7	9
	Minimum								Maximum

SciTrek Volunteer:

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

Before arriving to the classroom, pour water into one of the bags of woodchips to make the wet woodchips (make sure that this is done outside). Take the pillbox with holes in it and make sure that there is masking tape blocking the holes on the ends of the boxes and between Tuesday and Wednesday and Wednesday and Thursday. If not, ask for some tape from the SciTrek lead. Fill up the Sunday and Thursday compartments no more than three quarters full with dry woodchips and the Tuesday and Saturday compartments no more than three quarters full with wet woodchips. The compartments Monday, Wednesday and Friday will be empty.

As students are taking the question assessment walk around the room quietly place the students' nametag, which is in your group box, on each students' desk.

On the tray place the pillbox, two containers of 20 mealworms each, 6 magnifying glasses, timer, and 12 bowls. This set-up will be referred to as the experimental set-up and will look like the set-up seen below:

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

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

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

Tell the class that for this module we are going to work together to try to answer the question: "What factors affect the direction a mealworm travels?"

Question Assessment *(5 minutes – Full Class – SciTrek Leader):*

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

"Before we start with our module we want to see how your ideas on questions are developing." Pass-out the question assessment to each student. Tell students to fill out their name, teacher's name, and date at the top of the assessment. Remind the students that it is important that they fill out this assessment on their own. Read the instructions to the students. Then read each of the questions aloud to the students and tell them to circle "testable" for questions that science can answer or "not testable" for questions that science cannot answer. When they are finished, collect the papers and verify that the student's name is on the top of the paper.

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

Tell the class that for this module we are going to work together to try to answer the question: "What factors affect the direction the mealworms will travel?" Tell students we are going to carry out a set of experiments in which mealworms are put in a central area and then are able to crawl to one of two environments. Ask the class why we might be interested in this question. By the end of the conversation make sure that students understand that this study will help them learn things about mealworms' habitats. Tell student's the experiments that they are going to do requires them to make observations.

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

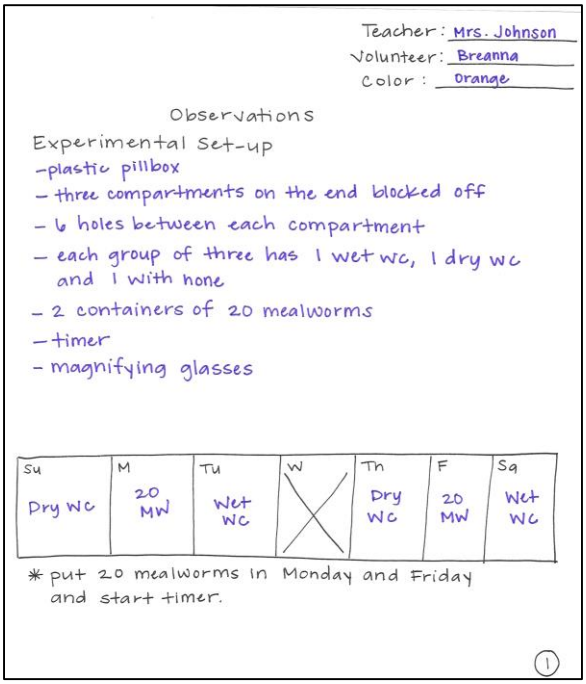
Tell the class they will now get in their groups and make observations of the mealworm experimental set-up and then they will make observations of the mealworms as they crawl between two different environments. These observations will help us answer the class question of what factors affect the direction mealworms travel? To determine their group they will need to look at the color of their nametag. Tell each color group where to go.

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

Observations *(23 minutes – Small Groups – SciTrek Volunteers):*

Once the students come over to your group try to have them sit in boy/girl fashion. Make sure the table is set-up as described in the set-up section.

As a group, have the students come up with observations about the experimental set-up before they put the mealworms in the pillbox. As the students make observations, record them in the group notepad. Have students observe the contents of each compartment of the pillbox 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 so that the worms are able to travel to different environments. In addition, have students verify that there are actually 20 mealworms in each of the containers labeled 20 before starting their experiment. If there are not 20 mealworms either add mealworms from the extra mealworms (contanier of 10) or subtract mealworms by putting them into the extra mealworms. Students do not need to record any observations into their own notebooks. An example group notepad is seen below.



Teacher: Mrs. Johnson
Volunteer: Breanna
Color: Orange

Observations

Experimental Set-up
- plastic pillbox
- three compartments on the end blocked off
- 6 holes between each compartment
- each group of three has 1 wet wc, 1 dry wc and 1 with none
- 2 containers of 20 mealworms
- timer
- magnifying glasses

Su	M	Tu	W	Th	F	Sa
Dry WC	20 MW	Wet WC	X	Dry WC	20 MW	Wet WC

* put 20 mealworms in Monday and Friday and start timer.

1

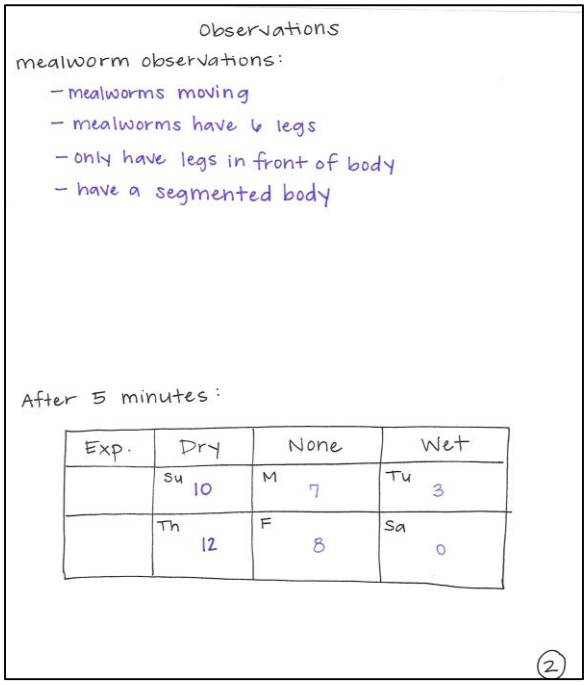
Once students have exhausted these observations, assign one student to be the timer and two other students to release the mealworms when the timer says go. Make sure that the food has been removed from the 20 mealworms container before pouring the mealworms into the pillbox. Have the timer count down by saying ready, set, go. When the timer says “go” have the two student pour 20 mealworms each into Monday and Friday at the same time and shut the lid of the pillbox. Have the students make observations and record thse 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 the students that if they hurt one of the mealworms they will not be able to participate for the rest of the day. Approximately thirty seconds before the timer reaches 5 minuntes collect all the mealworms and put them back in the extra mealworm container, in addtion collect all of the magnifying classes and put them in the group box.

At 5 minutes stop the timer and pour each of the compartments of the pillbox into a separate bowl labeled with matching days of the week. Give each student a bowl to count the number of mealworms in each compartment and a bowl to put the mealworms in, that have already been counted. Each student should have two bowls total. Record these numbers/observations on the group notepad. Add the numbers of mealworms in each days that one set of mealworms had access to (dry, none, and wet) to make sure that the total number of mealworms is 20. It if it not 20 have the students recount the number of mealworms. If the number still does not equal 20 then record the number of mealworms that the students counted, do NOT make up data so that the numbers add to 20 mealworms. An example of the group notepad can be see below. If there is additional time have the students summarize what they observed. Ask students what does this tells you about the habitat that mealworms live in.

Prepare one student to share an observation about the mealworm system with the rest of the class.

As soon as your group has finished counting the mealworms from the two trials go to the document camera or board and record the numbers on the group chart. This should be done by you (the volunteer) and not the students.

An example of a group notepad is seen below; feel free to deviate from the example. Students do not need to record their observation into their notebooks.



Observations

mealworm observations:

- mealworms moving
- mealworms have 6 legs
- only have legs in front of body
- have a segmented body

After 5 minutes:

Exp.	Dry	None	Wet
	Su 10	M 7	Tu 3
	Th 12	F 8	Sa 0

(2)

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

Have one student from each group share an observation that they made of the mealworm system.

Have the students look at the class data sheet. Ask the students if every group got the same results? The students should be able to respond "No." Ask the groups if they all took the same measurements. Have students tell you what they measured/counted in their groups. They should all realize that they did the same experiment. Ask the students why different groups got different numbers. A possible response might be because animal motion is not completely predictable.

Tell students that scientists often preform multiple trials 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 of the numbers they measured/counted.

Ask the class what number they would pick if they had to pick one data point to represent the entire set. For example ask the students, "If I had to pick one number from the trials in the wet woodchips, which number would I pick that represents them all?" Students may say numbers that are repeated, the largest number, the smallest number, or a number that is in the middle. Tell the students that scientists often take the middle number, the median, because the middle number can be representative of all of the collected data.

Tell the students that they are going to find the median number in each set of numbers. Start with the trial with the dry woodchips, have the students rearrange the numbers so that they are in increasing order from smallest to largest. Then have the students pick the middle number. Because there are nine

numbers it will be easy to find the middle number. Repeat this process for the wet woodchips and for the empty compartment.

Ask the students what we learn about mealworm habitat from this experiment? Students should be able to tell you that mealworms live in a dry environment because more of the mealworms traveled to the dry woodchips instead of the wet woodchips.

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

Tell the class that they are now going to think of other variables they could test to help them understand the mealworm's habitat better.

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

Tell the class that they are going to think about variables in the experiment that they could change to help us answer the class question of: What factors affect the direction a mealworm travels? In addition to generating variables they should think about why these variables might affect the outcome of the experiment. Ask the class to give you a variable that they could test for their experiment. Have the class come up with one variable and then have them tell you why they think that variable would affect the direction a mealworm travels, how they would design an experiment to test this variable, and make a prediction of the results of the experiment that they proposed.

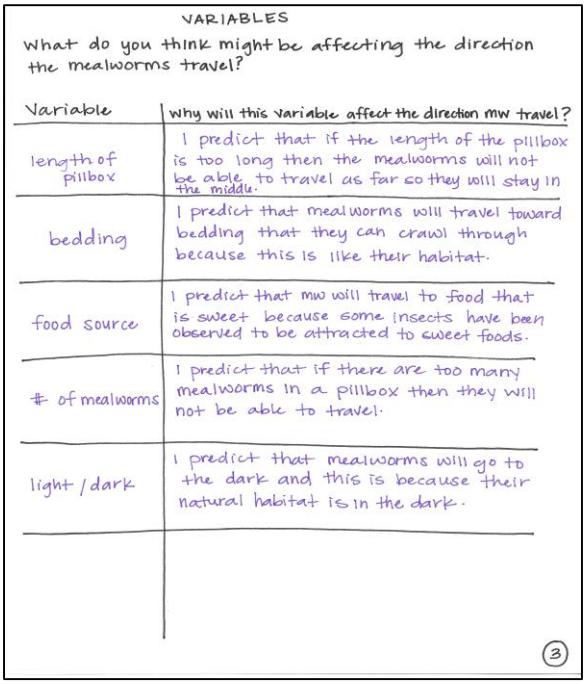
Example: *Variable:* Food Type
Why might the variable affect the direction a mealworm travels? The mealworms might travel towards foods that they eat in their natural habitat.
How would you test this variable? I would choose a wet food (fruit or vegetable) and a dry food (bread or grain) and put one on each side of the container and then allow the mealworms to crawl to the two environments.
Prediction: The mealworms will craw to the bread or the dry food.

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

Variables *(13 minutes – Small Groups – SciTrek Volunteers):*

Go around the table and have each student tell you one variable and make a prediction about which direction the mealworms will travel. Record both the variable and the prediction on the group notepad. If there is extra time go around the table a second time. An example of the group notepad can be seen below. Students do not need to record the variables or predictions into their notebooks.

Prepare one student to share a variable and why they think it will affect the direction the mealworm travels during the group discussion.



VARIABLES

What do you think might be affecting the direction the mealworms travel?

Variable	Why will this variable affect the direction mw travel?
length of pillbox	I predict that if the length of the pillbox is too long then the mealworms will not be able to travel as far so they will stay in the middle.
bedding	I predict that mealworms will travel toward bedding that they can crawl through because this is like their habitat.
food source	I predict that mw will travel to food that is sweet because some insects have been observed to be attracted to sweet foods.
# of mealworms	I predict that if there are too many mealworms in a pillbox then they will not be able to travel.
light / dark	I predict that mealworms will go to the dark and this is because their natural habitat is in the dark.

3

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

Have one student from each group share a variable they generated and how/why they think it will affect the direction the mealworms will travel. Make sure that students tell you their predictions about how different values of that variable will affect the direction the mealworms travel. Challenge students to justify their thinking and explore with them how this might help them design an experiment. For example, if a students' variable was food type ask them what type of foods they expect mealworms to eat. If they list off food types have them determine why they think these food types will attract mealworms. Is it because the foods are all: sugary, salty, wet, or dry. Help them to see that they should pick two food types that are in different classes when doing their experiment.

Tell the students that the next time they will come up with testable questions about the mealworms set-up that they saw today. They will also plan an experiment around one of the variables that they are interested in exploring. Tell students that these experiments will help us answer the question, what factors affect the direction a mealworm travels?

Clean-Up

Before you leave collect student nametags and place them in the group box. Pour the used woodchips into the wet woodchips bag. Make sure to seal this bag so that water does not spill in your box. Remove any woodchips from the mealworms and put 20 mealworms back into the two containers labeled 20 with a small piece of bread. Put the remaining mealworms in the container labeled 10 with a small piece of bread. Bring all materials back to UCSB. In addition, put your lab coat back into the box.

Day 2: Question Activity/Questions/Experimental Set-Up

Schedule:

Introduction (SciTrek Leader) – 2 minutes
Question Activity (SciTrek Leader) – 20 minutes
Question Discussion (SciTrek Leader) – 3 minutes
Testable Questions (SciTrek Volunteers) – 8 minutes
Question Discussion (SciTrek Leader) – 3 minutes
Non-Testable Questions (SciTrek Volunteers) – 4 minutes
Question/Experimental Set-Up Discussion (SciTrek Leader) – 3 minutes
Question (SciTrek Volunteers) – 4 minutes
Experimental Set-Up (SciTrek Volunteers) – 10 minutes
Wrap-Up (SciTrek Leader) – 3 minutes

Materials:

(4) Volunteer Boxes:

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

Other Supplies:

- ☐ (4) Large group notepads

Lead Box:

- ☐ (5) Blank nametags
- ☐ (3) Extra student notebooks
- ☐ Lead instructions
- ☐ Lead lab coat
- ☐ (4) Markers (red, green, blue, orange)
- ☐ (2) Pencils
- ☐ Materials page
- ☐ Time card

SciTrek Notebook Pages Used With Students:

SCIENTIFIC PRACTICIES
Testable Questions

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

a)	What is the length of a brown bear's front paw?	*Testable*	*Not Testable*
b)	Do bears like to swim?	*Testable*	*Not Testable*
c)	Are black bears smarter than brown bears?	*Testable*	*Not Testable*
d)	How many brown bears are at the Santa Barbara Zoo?	*Testable*	*Not Testable*
e)	What type of bear is the most fearsome?	*Testable*	*Not Testable*
f)	How much honey does Winnie the Pooh eat in 24 hours?	*Testable*	*Not Testable*
g)	In one day, what is the total mass of berries that all brown bears eat?	*Testable*	*Not Testable*
h)	Are polar bears fast?	*Testable*	*Not Testable*
i)	Are putting panda bears on the endangered species list important?	*Testable*	*Not Testable*
j)	Can a mother bear find her cub among 6 other cubs?	*Testable*	*Not Testable*

2

Experimental Considerations:

1. You will run an odd number of trials.
2. You will only get one pillbox in which you may do two trials at the same time.
3. You will only have access to the materials on the materials page.
4. No more than two versions of the changing variable can be used.
5. Each trial may take no longer than five minutes.
6. You may only have a food or a bedding not both. Example if your changing variable is food, your bedding must be none.
7. If you are changing the conditions and you have a constant bedding or food, it must be filled half full in all three compartments per trial.

Changing Variable: light amount

Why do you think your changing variable will affect the direction mealworms travel? I think that mealworms will travel to the dark because mealworms normal habitat is in dark places.

QUESTION

Question our group is going to investigate:

- If we change the light amount (insert changing variable) what will happen to the direction the mealworms (insert what you are measuring) travel?

3

EXPERIMENTAL SET-UP

Changing Variable: light amount / dark and light

Controls (variables you will hold constant):

Worm Type / Mealworms	time / 5 minutes
# of mw / 20	# of holes / 6
material / wood chips	pillbox / original

Determine the values of your changing variable (ex: food type) from the materials page and write the values (ex: cookies) for what you will put in each compartment of the pillbox at the start of the experiment. Draw an "X" in any compartment that will not be used.

Su	M	Tu	W	Th	F	Sa
Dark + WC	20 MW + WC	Light + WC	X	Light + WC	20 MW + WC	Dark + WC

If your changing variable is not light amount
- The following days should start with the same materials
  - Sunday and Thursday
  - Monday and Friday
  - Tuesday and Saturday

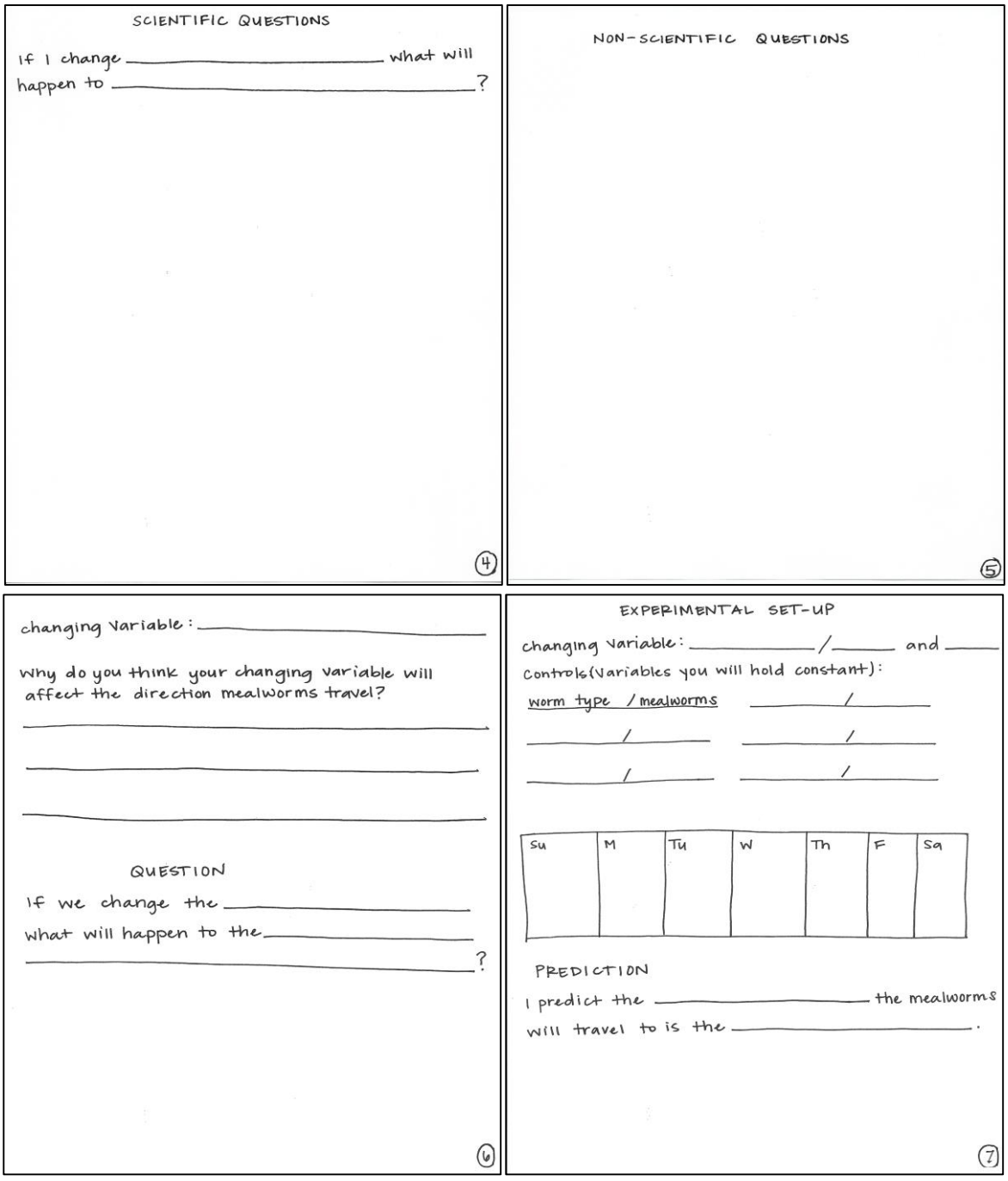
If your changing variable is light amount
- Sunday and Saturday will be dark
- Tuesday and Thursday will be light

Predictions

I predict the light amount (changing variable) the mealworms will travel to is the dark (value of changing variable).

4

SciTrek Group Notepad Pages Used With Students:



SCIENTIFIC QUESTIONS

if I change _____ what will happen to _____?

④

NON-SCIENTIFIC QUESTIONS

⑤

changing variable: _____

Why do you think your changing variable will affect the direction mealworms travel?

_____

_____

_____

QUESTION

If we change the _____

what will happen to the _____

_____?

⑥

EXPERIMENTAL SET-UP

changing variable: _____ / _____ and _____

Controls (variables you will hold constant):

worm type / mealworms _____ / _____

_____ / _____ _____ / _____

_____ / _____ _____ / _____

Su	M	Tu	W	Th	F	Sa

PREDICTION

I predict the _____ the mealworms will travel to is the _____.

⑦

Set-Up:

SciTrek Leader:

If the classroom has a document camera ask the teacher to use it for the question activity (page 2). If the classroom does not have a document camera, then tape the example poster sized pages to the front board.

SciTrek Volunteer:

Attach a nametag to each of the blank notebooks in your group box. Quietly pass out notebooks/nametags to students in their regular seats while the SciTrek leader is doing the introduction. The first part of the activity will be done in their regular classroom seats, after students will break up into their groups.

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

While the lead is giving the introduction, the SciTrek volunteers should get the blank SciTrek notebooks out of their boxes and attach them to a blank notebook. The volunteer will then pass out a notebooks/nametags to the students that are in their group. Note students will be sitting in their regular classroom seats for the question activity after which they will move to their SciTrek groups.

Ask the class what is the class question that we are investigating? The students should reply: What factors affect the direction the mealworms travel? Ask the students what they did the last SciTrek meeting. They should reply that they made observations about mealworms and if they would travel to wet or dry woodchips. If they do not bring it up ask them what we learned about mealworm habitat during the last meeting. Students should say that they learned that mealworms live in dry environments because more of the mealworms traveled to the dry woodchips instead of the wet woodchips. In addition, students should say that they came up with variables that might affect the direction a mealworm would travel. Tell students that today they are going to generate testable questions about the mealworms system. After which they will be able to pick a question and design an experiment to answer that question. But, 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 Leader)*

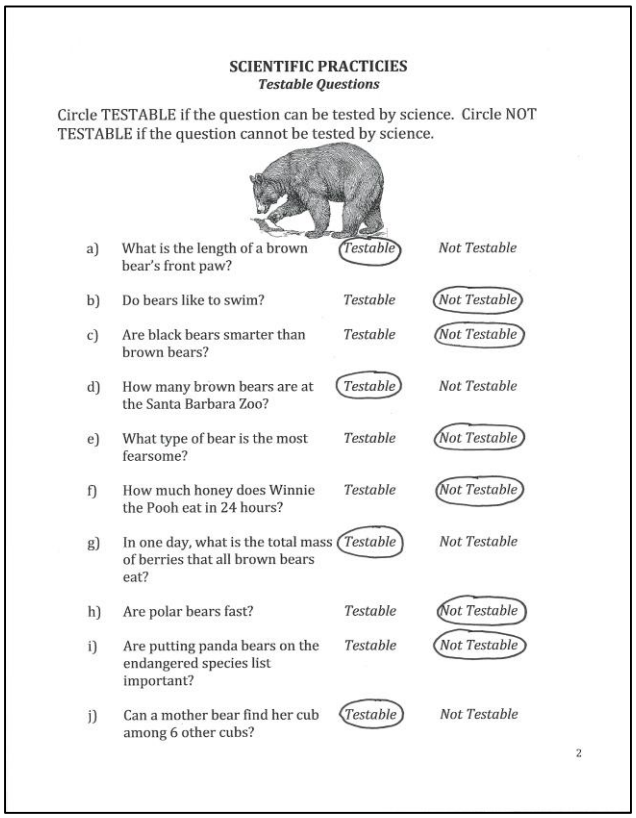
Have students write their name and their teacher's name on the front of their SciTrek notebooks.

Ask the students what type of questions can be tested by science? You should get answers that revolve around "science can test things that are measurable/countable or observable."

Ask the 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. Example: How many fingers do fairies have? Since we cannot catch fairies we would not be able to answer this question. 2) Questions that contain opinions, are ambiguous, or are not well defined. Opinion questions contain opinion words such as prettier, nicest, better, etc.. Example: Which are prettier lilies or daisies? Not well defined/ambiguous questions contain words such as affected, react, etc.. Example: Do squirrels react to dogs? In addition, not well defined/ambiguous question can contain semi measurable words such as big, wide, heavy, etc.. Example: Is the Golden Gate Bridge wide? The problem with this question is you do not know how the questioner defines the word wide. A scientist could answer this question "yes" if they were

comparing the Golden Gate Bridge to a typical overpass bridge while another scientist could answer the question "no" because they were comparing the Golden Gate Bridge to the Pacific Ocean.

Tell the students to turn to page 2 of their notebooks and place a blank notebook under the document camera and turn to page 2. 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 for a student to tell you whether it is testable or not and why. If the question is testable have students tell you what they would measure/count/observe to find the answer to the question. If the question is not testable first have the students identify the part of the question that is not testable, and then have the students propose a related question that is testable. Sometimes it is helpful to underline the word in the question that is making the question not testable. As you go over each question circle the correct answer on the example notebook under the document camera.



SCIENTIFIC PRACTICIES
Testable Questions

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

a)	What is the length of a brown bear's front paw?	*Testable*	*Not Testable*
b)	Do bears like to swim?	*Testable*	*Not Testable*
c)	Are black bears smarter than brown bears?	*Testable*	*Not Testable*
d)	How many brown bears are at the Santa Barbara Zoo?	*Testable*	*Not Testable*
e)	What type of bear is the most fearsome?	*Testable*	*Not Testable*
f)	How much honey does Winnie the Pooh eat in 24 hours?	*Testable*	*Not Testable*
g)	In one day, what is the total mass of berries that all brown bears eat?	*Testable*	*Not Testable*
h)	Are polar bears fast?	*Testable*	*Not Testable*
i)	Are putting panda bears on the endangered species list important?	*Testable*	*Not Testable*
j)	Can a mother bear find her cub among 6 other cubs?	*Testable*	*Not Testable*

2

Below are the answers to a-j on page 2 in detail.

Letter a: What is the length of a brown bear's front paw?
Testable (Easy to Test-Measurement)

This is a testable question because it is possible to capture one brown bear measure the length of his front paw in cm.

Letter b: Do bears like to swim?
Not Testable (Opinion/Not Well Defined-Contains the Word Like)

This is not a testable question because the word like is an opinion and it is impossible to measure if a bear *likes* swimming. A bear could swim because it likes swimming or because it is a necessity

for that bear to do in order to get food. Since this question contains an opinion/not well defined word (like), it is not testable. Instead, a testable question could be: In a 24 hours period does a bear spend more time in the water or on land?

Letter c: Are black bears smarter than brown bears?
Not Testable (Opinion/Not Well Defined-Opinion Comparison)

This is not a testable question because the word smarter is an opinion. Many people have different meanings of the word smarter. Does smarter mean that the bear is able to gather more food, or does smarter mean that more bear cubs are able to make it to adulthood? Since this question contains an opinion/not well defined word (smarter), this question is not testable. Many times questions that are comparisons are testable, but they must not contain opinion/not well defined words. Instead, a testable question could be: Does a black bear eat more berries than a brown bear?

Letter d: How many brown bears are at the Santa Barbara Zoo?
Testable (Easy to Test-Counting)

This is a testable question because it is possible to go to the zoo and count the number of brown bears.

Letter e: What type of bear is the most fearsome?
Not Testable (Opinion/Not Well Defined-Contains an Opinion/Not Well Defined Word)

This is not a testable question because the word fearsome is not well defined. Does fearsome mean that other animals run when they see the bear or does it mean that a bear can make a very loud noise? Since this question contains an opinion/not well defined word (fearsome), this question is not testable. Instead, testable questions could be: Which is bigger a bear or a dog? or Do other animals run when they see a bear?

Letter f: How much honey does Winnie the Pooh eat in 24 hours?
Not Testable (Can't Acquire Data-Fictional Character)

This question is impossible to test because we will not be able to acquire data on Winnie the Pooh because he is a fictional character. Since we cannot measure how much honey Winnie the Pooh eats this question would be impossible to test. Instead, a testable question could be: How much fish does a black bear eat in 24 hours?

Letter g: In one day, what is the total mass of berries that all brown bears eat?
Testable (Hard to Test)

This is testable question because scientists could get a team together and observe all brown bears for a day and determine the amount of berries that they all ate. Students sometimes struggle with the difference between questions that are hard to collect data for (but are still testable) and questions that are not testable. Even though this question would be difficult to collect data for it is still testable.

Letter h: Are polar bears fast?
Not Testable (Opinion/Not Well Defined-Semi Measurable)

This is not a testable question because the word fast is not well defined. Polar bears are fast compared to ants but are slow compared to rockets. Since this question did not define what fast is, it is not testable. Instead testable questions could be: What is the top speed of a polar bear? or Is a polar bear faster than a cow?

Letter i: Are putting panda bears on the endangered species list important?
Not Testable (Opinion/Not Well Defined-Students Think the Answer is Yes)

This is not a testable question because important is a matter of opinion. Many people have different meanings of the word important. Does important mean that putting panda bears on the endangered species list will increase awareness about hunting practices or does it mean that more of the bears will be able to survive? Since this question contains an opinion/not well defined word (important), this question is not testable. Note: this question is particularly hard for students because they think that the answer to the question is yes. Because students think the answer to the question is yes, they do not think about whether it is testable or not testable. Instead, a testable question could be: Did the number of panda cubs born in China increase after they were put on the endangered species list?

Letter j: Can a mother bear find her cub among 6 other cubs?
Testable (Easy to Test-Observation)

This is a testable question because it is possible to observe if a mother bear could find her cub among 5 other cubs.

Question Discussion: *(3 minutes – Full Class – SciTrek Leader)*

Tell the students that they are now going to generate their own testable questions about the mealworm set-up that they used the last time that you were there. Tell them that they are going to use the variables that they generated last time to help them with their questions. Make sure that students understand that scientists define a variable as something that can be changed in an experiment to learn something about the system. Have a few students share variables that they generated last class session.

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

If I change _____ what will happen to_____?
variable — what you are measuring/observing

Tell students that they can insert a variable into blank 1 and something that they can measure/observe into blank 2 to generate a testable question.

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

Example:

"If I change the light amount, what will happen to the number of mealworms in each compartment?"

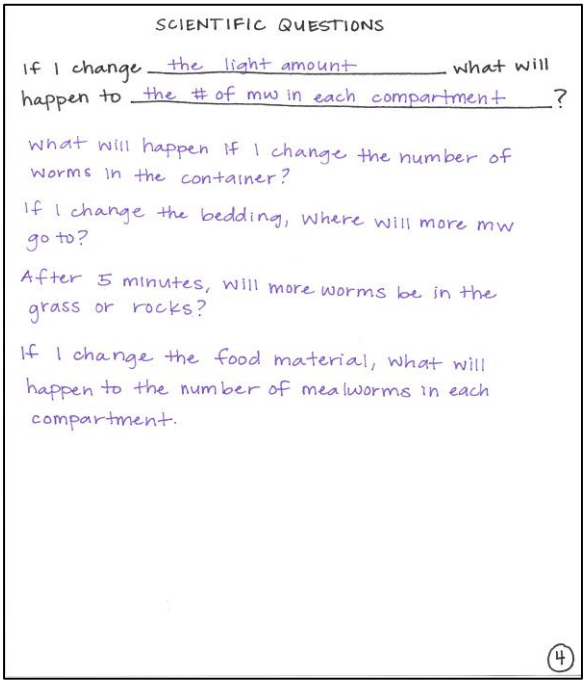
Tell the students that they will now get into their groups and work together to generate as many testable questions about the mealworm system as possible. Inform the students that the group that comes up with the most testable questions will get a prize the next meeting. Inform the students that non-testable questions will not be counted towards the prize.

Testable Questions *(8 minutes – Small Groups – SciTrek Volunteers):*

As a group, have the students come up with a question in the form "If I change _____ what will happen to _____?" 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 state what they would desire to measure in their testable question. If students are having trouble generating questions, have them review the variables that they generated the previous meeting.

Prepare one student to share a question with the class. An example notepad can be seen below.


SCIENTIFIC QUESTIONS

If I change the light amount what will happen to the # of mw in each compartment?

What will happen if I change the number of worms in the container?

If I change the bedding, where will more mw go to?

After 5 minutes, will more worms be in the grass or rocks?

If I change the food material, what will happen to the number of mealworms in each compartment.

4

Question Discussion: *(3 minutes – Full Class – SciTrek Leader)*

Have one student from each group share one of their testable questions with the class. After a groups' question is presented ask the rest of the class if the question is testable and if so what data the group would need to collect to answer the question.

Tell students there are a lot of questions that science cannot answer. Ask the students if they know the type of questions science cannot answer? They should be able to generate the following two categories of questions that science cannot answer:

Category 1: Questions in which data cannot be acquired.
Category 2: Questions that contain words that are opinions or are not well defined.

Ask the students if someone can give an example question about the mealworm set-up that science cannot answer.

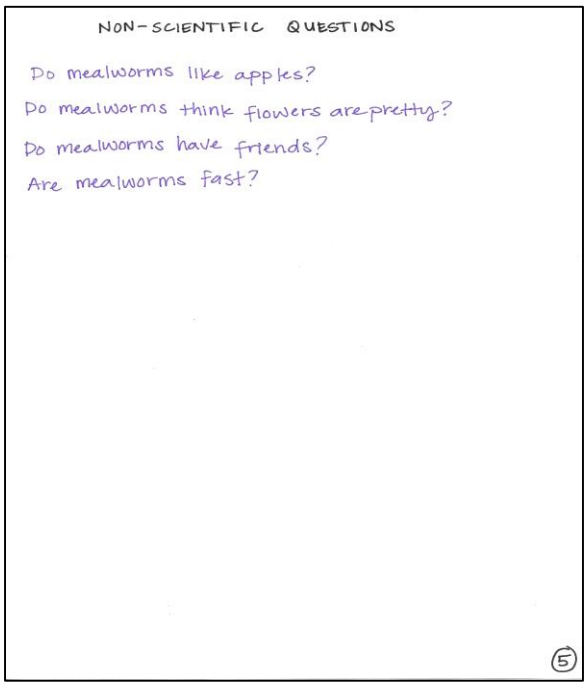
Example Category 1 Question: Would Tinker Bell move towards wet or dry woodchip?
Example Category 2 Questions: Do mealworms like dry woodchips? or Is learning about mealworms important?

Tell the students that they are now going to get back in their groups and generate questions that science cannot answer about the mealworm system.

Non-Testable Questions *(4 minutes – Small Groups – SciTrek Volunteers):*

Have the students generate a list of questions that science cannot answer and record them on the group notepad. Try to 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 these questions are not testable and then have them use these 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 notepad can be seen below.



Question/Experimental Set-Up Discussion *(3 minutes – Full Class – SciTrek Leader):*

Have each group share one question that they came up with that science cannot answer. After a groups' question is presented ask the rest of the class if the question is non-testable and if so why.

Tell the class that they are now going to start to design an experiment. Ask the class, what are we working on understanding for this module? Students should reply that we are trying to determine the ideal habitat for a mealworm. Tell the students that they should think about what variable they are interested in testing. Remind them of the definition of a variable (something that you can change in an experiment). Once they have decided on the variable they would like to experiment with they will write it in their notebook under the changing variable. They should then discuss, as a group why they think this variable might affect the direction the mealworms travel and write their answer in their notebook. They will then be able to fill in their question. After they fill in their question their volunteer will give them a materials page so that they will be able to choose the values of their changing variable as well as their controls.

Tell students there are a few things they will need to keep in mind while they are going through the process of designing their experiment.

Experimental Considerations:

1. You must run an odd number of trials.
2. You will only get one pillbox in which you may do two trials at the same time.
3. You will only have access to the materials on the materials page.
4. No more than two versions of the changing variable can be used.
5. Each trial may take no longer than five minutes.
6. You may only have a food or a bedding not both. Example if your changing variable is food, your bedding must be none.
7. If you are changing the conditions and you have a constant bedding or food, it must be filled half full in all three compartments per trial.

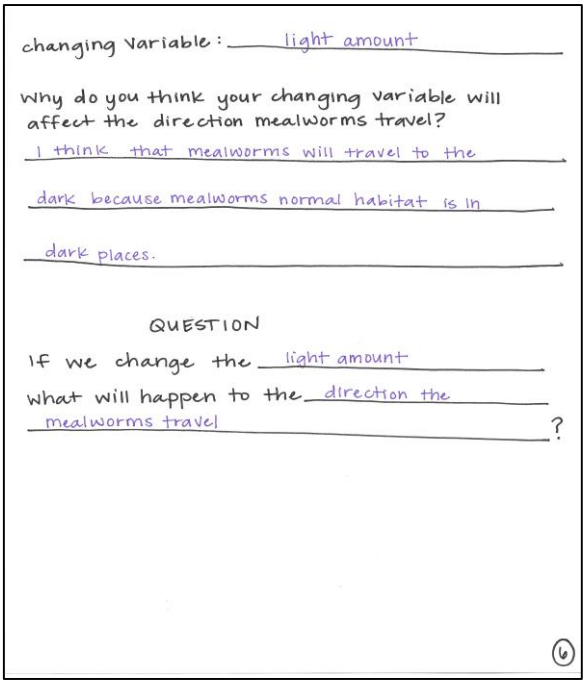
Question *(4 minutes – Small Groups – SciTrek Volunteers):*

Have your group decide which changing variable they are interested in investigating. Record this on the group notepad and have them record it in their SciTrek notebooks.

As a group discuss why the students think that this changing variable will affect the direction the mealworms travel. Record their thoughts on the group notepad and then have them record some of these ideas in their notebook.

Use their changing variable to generate the question that the group is going to investigate and have students copy this into their notebooks.

Prepare one student to share the group question during the wrap-up.



changing variable: light amount

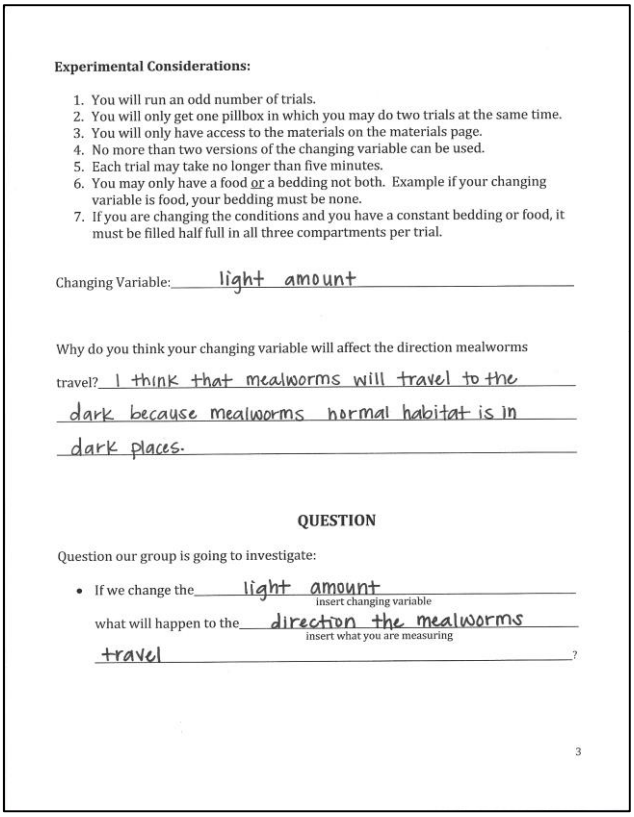
Why do you think your changing variable will affect the direction mealworms travel?

I think that mealworms will travel to the dark because mealworms normal habitat is in dark places.

QUESTION

If we change the light amount what will happen to the direction the mealworms travel?

6



Experimental Considerations:

1. You will run an odd number of trials.
2. You will only get one pillbox in which you may do two trials at the same time.
3. You will only have access to the materials on the materials page.
4. No more than two versions of the changing variable can be used.
5. Each trial may take no longer than five minutes.
6. You may only have a food or a bedding not both. Example if your changing variable is food, your bedding must be none.
7. If you are changing the conditions and you have a constant bedding or food, it must be filled half full in all three compartments per trial.

Changing Variable: light amount

Why do you think your changing variable will affect the direction mealworms travel? I think that mealworms will travel to the dark because mealworms normal habitat is in dark places.

QUESTION

Question our group is going to investigate:

- If we change the light amount (insert changing variable) what will happen to the direction the mealworms (insert what you are measuring) travel?

3

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

Have your group turn to page 4 in their notebook and turn to page 7 of the group notepad. Ask your group what they decided to have for a changing variable and record this on the top of the page. Then have your group use the materials page to select the values of their changing variable that they are going to use and record these on the same line. Encourage your group to explain why they are picking the values that they are selecting. For instance if they pick food type they might pick a salty food and a sugary food to see if mealworms travel to salty or sugary substances.

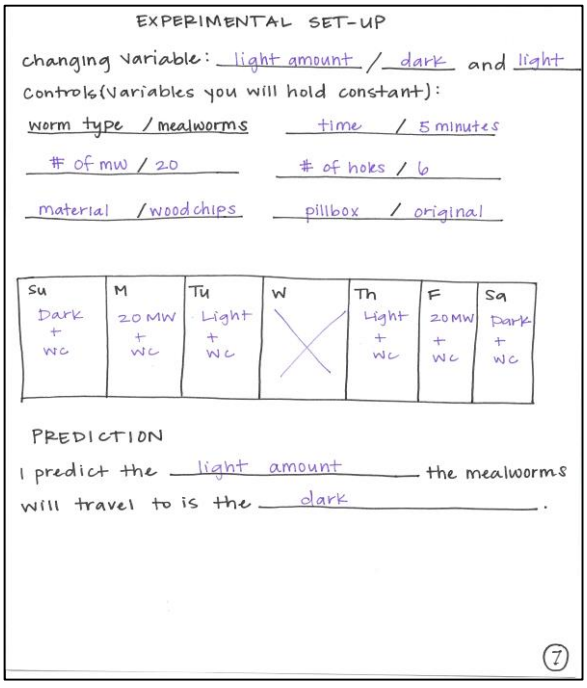
Then have your group determine a list of variables that they will hold constant, these will be your groups' controls (type of worm, bedding, food type, time, *temperature, moisture, size of holes*). Record these controls on the left side of the slash (leave the right side of the slash blank to put in the value of the controls after you have generated all controls). Try to come up with at least one control that is not on the materials page (examples are controls that are in italics). If your group is struggling to generate controls turn the group notepad back to the variables on page 3. As your group is determining controls, question the group about what they think might be a good value and why. For instance if the control is time, ask the students if they think a shorter or a longer time will help them answer their question easier. Once they have generated their controls bring out the materials page and determine the value of the controls that they will use and record these on the right side of the slash (type of worm/mealworm, bedding/none, food type/crackers, time/5 minutes, *temperature/room temperature, moisture/dry, size of holes/original*). Make sure that students copy the experimental set-up information onto page 4 of their notebook. An example of the experimental set-up can be seen below.

Make sure that your group circles all of the materials that they will need from the materials page and that their group color is written on the top of the page.

Once your group has selected their controls have them fill in what they will be putting in each of the pillbox compartments. Make sure that if your changing variable is not light amount that Sunday and Thursday have one value of your changing variable and Tuesday and Saturday have the other value of your changing variable and Monday and Friday contain the mealworms. If your changing variable is light amount then Sunday and Saturday will be dark and Tuesday and Thursday will be light and Monday and Friday will contain the mealworms.

Once this is complete have a group discussion on what the students think will happen during the experiment. Then have each student fill in the sentence frame on page 4. The prediction sentence can be different in each student's notebook.

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



EXPERIMENTAL SET-UP

changing variable: light amount / dark and light

controls(variables you will hold constant):

worm type / mealworms — time / 5 minutes

# of mw / 20 — # of holes / 6

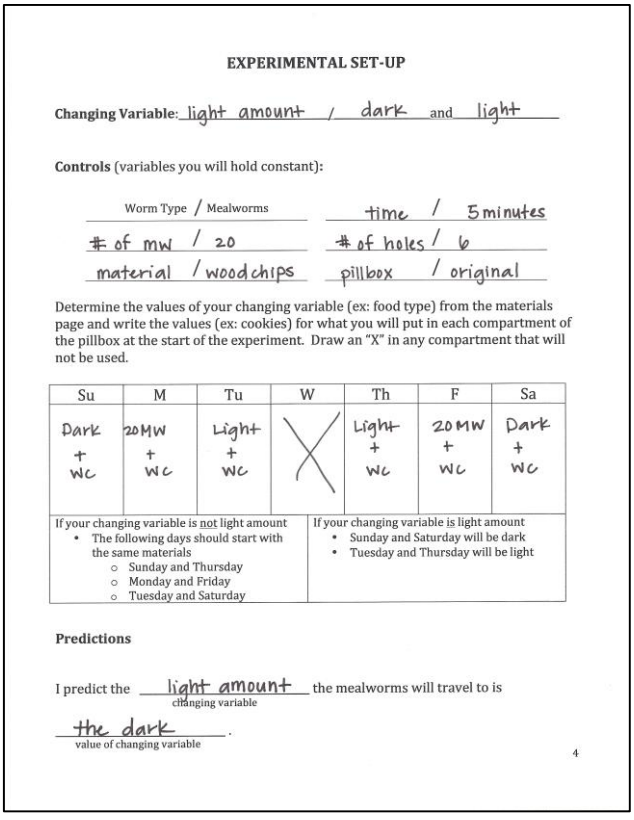
material / woodchips — pillbox / original

Su	M	Tu	W	Th	F	Sa
Dark + wc	20 MW + wc	Light + wc	X	Light + wc	20 MW + wc	Dark + wc

PREDICTION

I predict the light amount the mealworms will travel to is the dark.

7



EXPERIMENTAL SET-UP

Changing Variable: light amount / dark and light

Controls (variables you will hold constant):

Worm Type / Mealworms — time / 5 minutes

# of mw / 20 — # of holes / 6

material / woodchips — pillbox / original

Determine the values of your changing variable (ex: food type) from the materials page and write the values (ex: cookies) for what you will put in each compartment of the pillbox at the start of the experiment. Draw an "X" in any compartment that will not be used.

Su	M	Tu	W	Th	F	Sa
Dark + wc	20MW + wc	Light + wc	X	Light + wc	20 MW + wc	Dark + wc

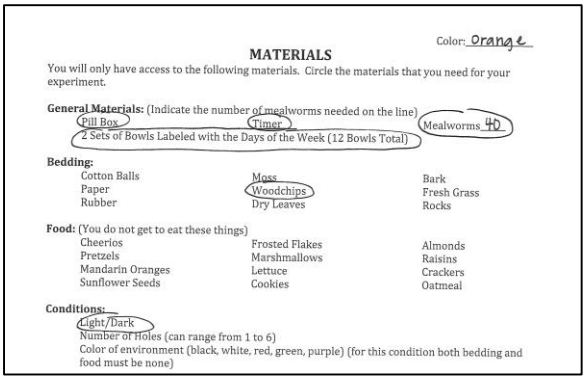
If your changing variable is not light amount
- The following days should start with the same materials
  - Sunday and Thursday
  - Monday and Friday
  - Tuesday and Saturday

If your changing variable is light amount
- Sunday and Saturday will be dark
- Tuesday and Thursday will be light

Predictions

I predict the light amount (changing variable) the mealworms will travel to is the dark (value of changing variable).

4



Color: Orange

MATERIALS

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

General Materials: (Indicate the number of mealworms needed on the line)

Pill Box | Timer | Mealworms 40

2 Sets of Bowls Labeled with the Days of the Week (12 Bowls Total)

Bedding:

Cotton Balls	Moss	Bark
Paper	Woodchips	Fresh Grass
Rubber	Dry Leaves	Rocks

Food: (You do not get to eat these things)

Cheerios	Frosted Flakes	Almonds
Pretzels	Marshmallows	Raisins
Mandarin Oranges	Lettuce	Crackers
Sunflower Seeds	Cookies	Oatmeal

Conditions:

Light/Dark

Number of Holes (can range from 1 to 6)

Color of environment (black, white, red, green, purple) (for this condition both bedding and food must be none)

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

Have one student from each group share the question that they are going to investigate. Tell students that the next time that SciTrek is here they will be running their experiments. Tell students that all of the class experiments will help us be able to answer the question, what factors affect the direction the mealworms travel? This will help us learn about the habitat that mealworms live in.

Clean-Up:

Before you leave have students attach their nametag to their notebook and place them in the group box. Place the materials page on the top of the notebooks in the box. Count the number of testable questions that your group generated and write it on the front page of your notepad. Bring all materials back to UCSB. In addition, put your lab coat back into your group box.

Day 3: Procedure/Technique/Experiment

Schedule:

Introduction (SciTrek Leader) – 3 minutes
Procedure (SciTrek Volunteers) – 18 minutes
Technique (SciTrek Leader) – 7 minutes
Experiment (SciTrek Volunteers) – 30 minutes
Wrap-Up (SciTrek Leader) – 2 minutes

Materials:

(4) Volunteer Boxes:

- ☐ Student nametags
- ☐ Volunteer lab coat
- ☐ Timer
- ☐ (2) Sets of 6 bowls labeled: Su, M, Tu, Th, F, Sa
- ☐ Student notebooks
- ☐ (2) Markers
- ☐ Pillbox with tape
- ☐ Other supplies requested
- ☐ Volunteer instructions
- ☐ Paper towels
- ☐ (2) Containers of 20 mealworms each

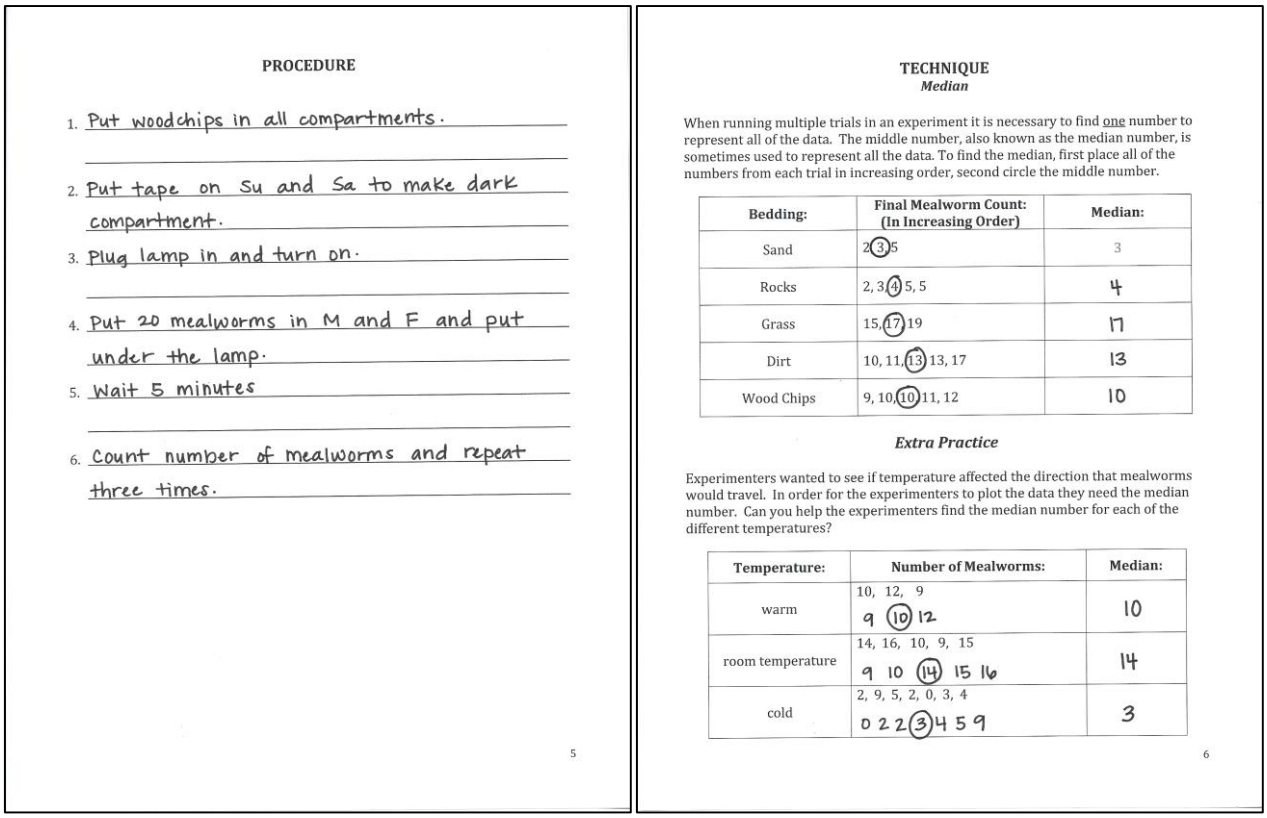
Other Supplies:

- ☐ (4) Large group notepads

Lead Box:

- ☐ (3) Extra student notebooks
- ☐ (4) Markers
- ☐ Pillbox with tape
- ☐ (2) Pencils
- ☐ Bag of backup materials (contains 3 bedding materials and 3 food types)
- ☐ Lead instructions
- ☐ Paper towels
- ☐ (4) Containers of 20 mealworms
- ☐ Masking tape
- ☐ Time card
- ☐ Lead lab coat
- ☐ (2) Timer
- ☐ (2) Sets of 6 bowls labeled: Su, M, Tu, Th, F, Sa
- ☐ (6) Erasers for prizes

SciTrek Notebook Pages Used with Students:



PROCEDURE

1. Put woodchips in all compartments.
2. Put tape on Su and Sa to make dark compartment.
3. Plug lamp in and turn on.
4. Put 20 mealworms in M and F and put under the lamp.
5. Wait 5 minutes
6. Count number of mealworms and repeat three times.

5

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 Mealworm Count: (In Increasing Order)	Median:
Sand	2, (3), 5	3
Rocks	2, 3, (4), 5, 5	4
Grass	15, (17), 19	17
Dirt	10, 11, (13), 13, 17	13
Wood Chips	9, 10, (10), 11, 12	10

Extra Practice

Experimenters wanted to see if temperature affected the direction that mealworms would travel. In order for the experimenters to plot the data they need the median number. Can you help the experimenters find the median number for each of the different temperatures?

Temperature:	Number of Mealworms:	Median:
warm	10, 12, 9 9 (10) 12	10
room temperature	14, 16, 10, 9, 15 9 10 (14) 15 16	14
cold	2, 9, 5, 2, 0, 3, 4 0 2 2 (3) 4 5 9	3

6

RESULTS
Table

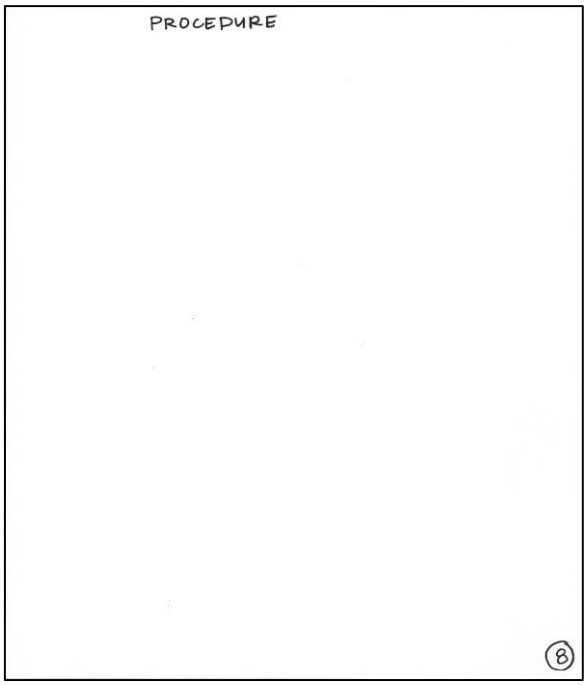
Fill out the chart for each of your compartments in your pill box. For the variables that remain constant, write the value in compartment A and then draw a line through each box to indicate the variable is a control.

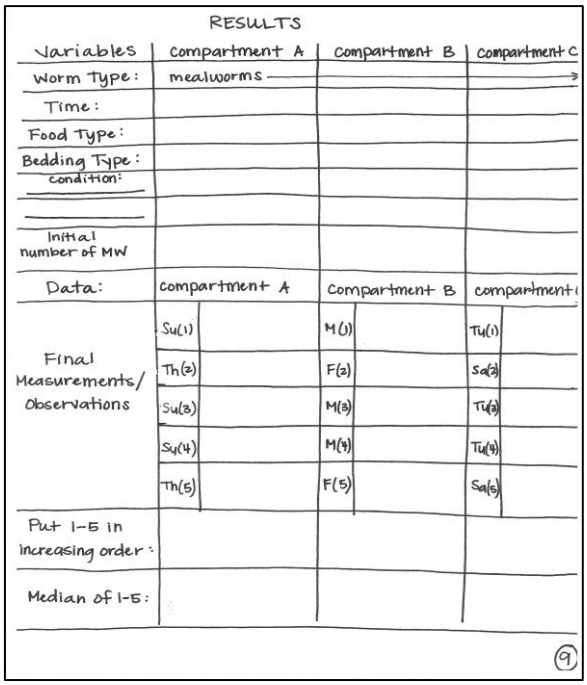
Variables:	Compartment A	Compartment B	Compartment C
Worm Type:	*Mealworm*	→	→
Time:	5 minutes	→	→
Food Type:	none	→	→
Bedding Type:	woodchips	→	→
Condition: light/dark (Control)	dark	dark/light	light
_____ (Other Variable)			
Initial Number of Mealworms:	0	20	0

Data:	Compartment A		Compartment B		Compartment C	
Final Measurements/ Observations:	Su(1)	10	M(1)	8	Tu(1)	2
	~~Sa~~(2)	7	F(2)	9	~~Th~~(2)	4
	Su(3)	7	M(3)	8	Tu(3)	5
	Su(4)	12	M(4)	5	Tu(4)	2
	~~Sa~~(5)	13	F(5)	6	~~Th~~(5)	1
Put 1-5 in Increasing Order:	7 7 (10) 12 13		5 6 (8) 8 9		1 2 (2) 4 5	
Median of 1-5:	10		8		2	

7

SciTrek Group Notepad Pages Used with Students:





Set-Up:

SciTrek Leader:

Make sure that you have identified the group with the most testable questions so that you can give the prize (erasers) to that group.

If the classroom has a document camera ask the teacher to use it for the technique discussion (page 6). If the classroom does not have a document camera, then tape the example poster sized notebook page to the front board.

SciTrek Volunteer:

If your group is experimenting with light/dark you need to modify both the group notepad and the student notebooks so the days under compartment 1 (which must be dark) are a) Su, b) Sa, c) Su, d) Su, and e) Sa and compartment 2(which must be light) are a) Tu, b) Th, c) Tu, d) Tu, and e) Th. The example notebook below has the corrections made in it as an example.

Set out the SciTrek notebooks/nametags around the table having students sit in boy/girl fashion.

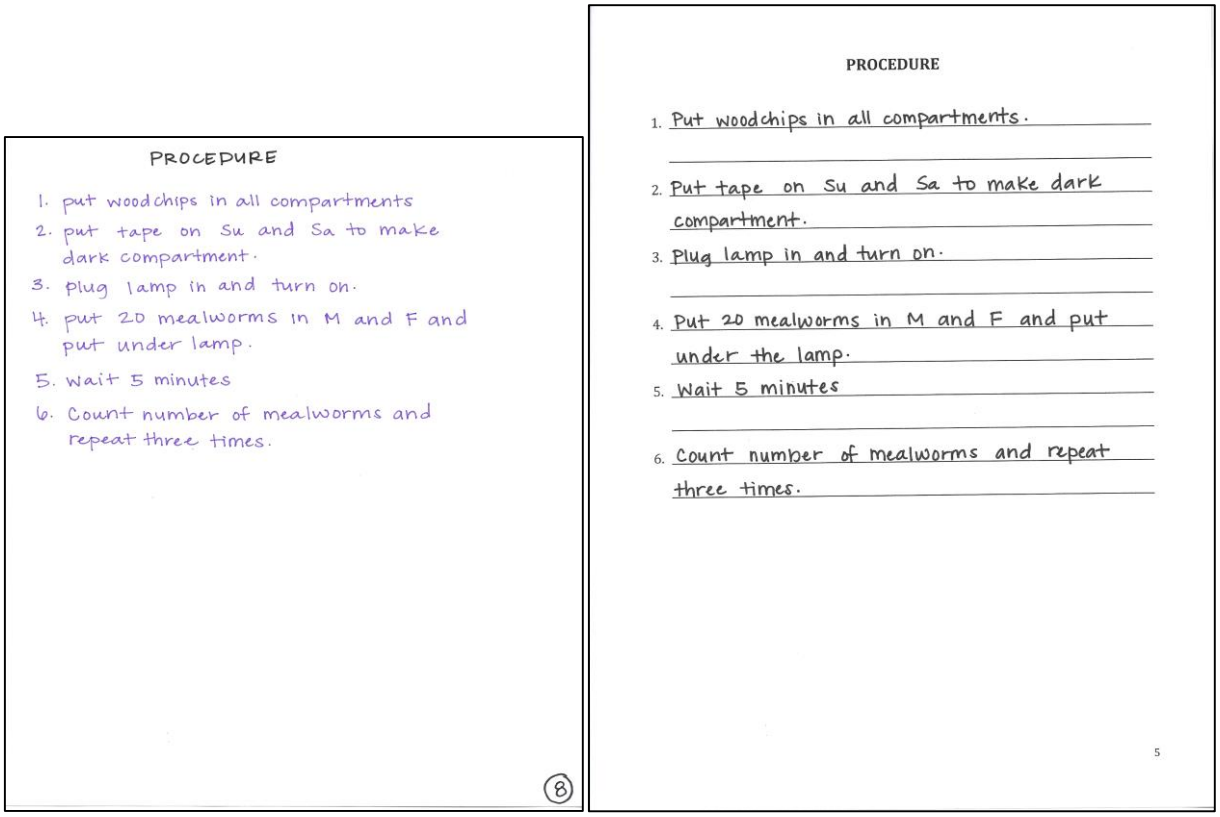
Introduction *(3 minutes – Full Class – SciTrek Leader):*

Announce the group that generated the most testable questions from the previous session and distribute prizes (erasers) to that group.

Ask the class what we have been working on the last two meetings. They should be able to tell you that they have been exploring which direction mealworms travel and they have found out that mealworms travel towards dry environments. This shows us that mealworms most likely live in a dry location. They should also state that they were starting to design an experiment to look at other variables that might affect the direction that the mealworms travel to learn more about mealworms habitats. Have each group tell you the variable that they are going to investigate. Tell the class that today they are going to design a procedure to test their changing variable. Ask the class what is a procedure. They should tell you it is a list of steps to complete during an experiment. Tell them once they have determined their procedure they will get to carry out their experiments. Tell students to go back to their groups and work on their procedures.

Procedure *(18 minutes – Small Groups – SciTrek Volunteers):*

Ask the students to tell you what they had decided to test and what they think they will learn from their experiment. Then help students come up with a step-by-step procedure of how to answer their question and conduct their experiment. It is helpful to have the students dictate the procedure to you while you copy it on the group notepad. Once the procedure is complete have students copy it from the group notepad into their notebooks. Try to keep the procedure as short as possible while still including the important information. Make sure to record all of the values for the changing variable in the procedure. A sample of an appropriate procedure can be seen below.



PROCEDURE

1. put woodchips in all compartments
2. put tape on Su and Sa to make dark compartment.
3. plug lamp in and turn on.
4. put 20 mealworms in M and F and put under lamp.
5. wait 5 minutes
6. Count number of mealworms and repeat three times.

8

PROCEDURE

1. Put woodchips in all compartments.
2. Put tape on Su and Sa to make dark compartment.
3. Plug lamp in and turn on.
4. Put 20 mealworms in M and F and put under the lamp.
5. Wait 5 minutes
6. Count number of mealworms and repeat three times.

5

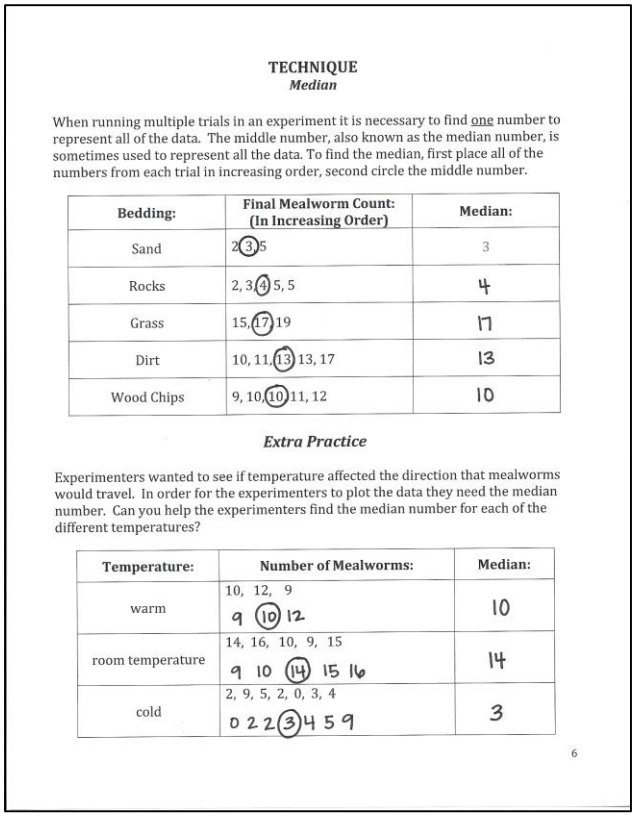
If there is extra time have the students start filling in their results table on page 7 of their notebooks. DO NOT HAVE THEM START THEIR EXPERIMENT UNTIL AFTER THE TECHNIQUE DISCUSSION.

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

Tell the students that during their experiment they will perform multiple trials but they will want to be able to plot one number on the graph. Ask the students what number they think they will use for their graph. Students should respond the middle number, which is called the median. Tell students you will now work with them to determine the median number from example data so they will be able to determine the median once they collect their own data.

Tell the class to turn their notebook to page 6. Place an example SciTrek student notebook under the document camera and turn to page 6. Tell the students that to find median, they should first arrange the numbers in increasing order (which has already been done for them). Once the numbers are arranged in order, the number in the middle is the median number, which they should identify by circling. Go over how to find the median in the first example and then have the students work on the next three examples by themselves. After students have finished, go over the answers. Tell students if they have extra time today they can work on the extra practice problems. An example of a student notebook page can be found below.

Tell students that will use this technique of finding the median when they perform their experiment.



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 Mealworm Count: (In Increasing Order)	Median:
Sand	2, 3, 5	3
Rocks	2, 3, 4, 5, 5	4
Grass	15, 17, 19	17
Dirt	10, 11, 13, 13, 17	13
Wood Chips	9, 10, 10, 11, 12	10

Extra Practice

Experimenters wanted to see if temperature affected the direction that mealworms would travel. In order for the experimenters to plot the data they need the median number. Can you help the experimenters find the median number for each of the different temperatures?

Temperature:	Number of Mealworms:	Median:
warm	10, 12, 9 9 10 12	10
room temperature	14, 16, 10, 9, 15 9 10 14 15 16	14
cold	2, 9, 5, 2, 0, 3, 4 0 2 2 3 4 5 9	3

6

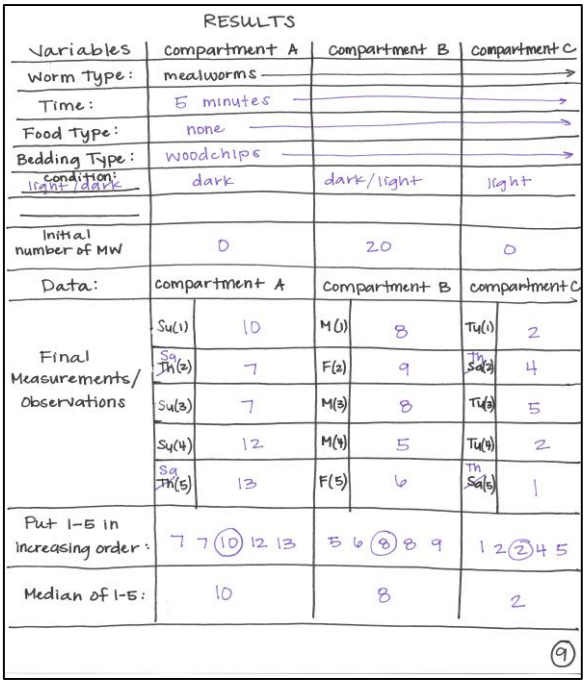
Experiment *(30 minutes – Small Groups – SciTrek Volunteers):*

Before students start their experiment make sure that they have filled out the variable section of the results table on page 7.

Help the students' set-up and complete their experiments. Record the data that the students collect in the group notepad (see sample group notepad below). Help students copy the data into their notebooks.

Groups will be doing 3 or 5 trials. Make sure to perform the first run with both sides of the pillbox filled. The second run will be performed with only 1 side of the pillbox filled. If there is time students can perform a third run with both sides of the pillbox filled. It is fine if groups only get to do 2 runs (3 trials).

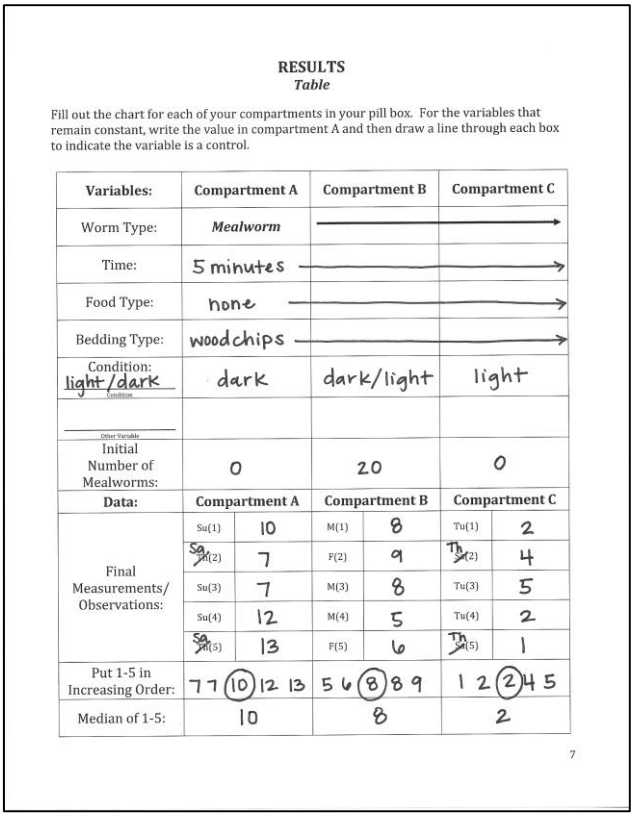
When you are finished with the experiment as a group have students put the number of mealworms for compartment A in order and determine the median number for that compartment. Then have students work independently to find the median number for the other two compartments. After students are finished go over the median numbers as a group and record the numbers on the group notepad. An example group notepad and student notebook can be seen below.



RESULTS

Variables	compartment A	compartment B	compartment C
Worm Type:	mealworms →		
Time:	5 minutes →		
Food Type:	none →		
Bedding Type:	woodchips →		
condition: light / dark	dark	dark/light	light
Initial number of MW	0	20	0
Data:	compartment A	compartment B	compartment C
Final Measurements/ Observations	Su(1) 10	M(1) 8	Tu(1) 2
	Sa Th(2) 7	F(2) 9	Th Sa(2) 4
	Su(3) 7	M(3) 8	Tu(3) 5
	Su(4) 12	M(4) 5	Tu(4) 2
	Sa Th(5) 13	F(5) 6	Th Sa(5) 1
Put 1-5 in increasing order:	7 7 (10) 12 13	5 6 (8) 8 9	1 2 (2) 4 5
Median of 1-5:	10	8	2

(9)



RESULTS
Table

Fill out the chart for each of your compartments in your pill box. For the variables that remain constant, write the value in compartment A and then draw a line through each box to indicate the variable is a control.

Variables:	Compartment A	Compartment B	Compartment C
Worm Type:	*Mealworm* →		
Time:	5 minutes →		
Food Type:	none →		
Bedding Type:	woodchips →		
Condition: light / dark	dark	dark/light	light
Other Variable			
Initial Number of Mealworms:	0	20	0
Data:	**Compartment A**	**Compartment B**	**Compartment C**
Final Measurements/ Observations:	Su(1) 10	M(1) 8	Tu(1) 2
	Sa Th(2) 7	F(2) 9	Th Sa(2) 4
	Su(3) 7	M(3) 8	Tu(3) 5
	Su(4) 12	M(4) 5	Tu(4) 2
	Sa Th(5) 13	F(5) 6	Th Sa(5) 1
Put 1-5 in Increasing Order:	7 7 (10) 12 13	5 6 (8) 8 9	1 2 (2) 4 5
Median of 1-5:	10	8	2

7

If there is extra time have students explain to you what they did 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 Leader):*

Tell the students that the next time that SciTrek is there they will analyze their data by making a graph. They will then make a poster to present their finding to the rest of the class. These posters will help us learn about what factors affect the direction that the mealworms travel.

Clean-Up:

Before you leave have students attach their nametag to their notebook and place them in the group box. Put the correct number of mealworms back into each container and place a small piece of bread in the container with the mealworms. Bring all supplies back to UCSB. In addition, put your lab coat back into your group box.

Day 4: Graph/Poster Making

Schedule:

Introduction (SciTrek Leader) – 2 minutes
Graph (SciTrek Volunteers) – 20 minutes
Poster Making (SciTrek Volunteers) – 36 minutes
Wrap-Up (SciTrek Leader) – 2 minutes

Materials:

(4) Volunteer Boxes:

- ☐ Student nametags
- ☐ Student notebooks
- ☐ Volunteer instructions
- ☐ Volunteer lab coat
- ☐ (2) Markers
- ☐ Highlighter
- ☐ (2) Glues
- ☐ Scissors
- ☐ Poster diagram (full page)
- ☐ Sticker for how to present graph
- ☐ (2) Paperclips

Poster Parts

- ☐ Scientists' names
- ☐ Question
- ☐ Experimental set-up
- ☐ Procedure
- ☐ Results table
- ☐ Results graph
- ☐ (6) " I acted like a scientist when _____"
- ☐ (6) Picture spaces

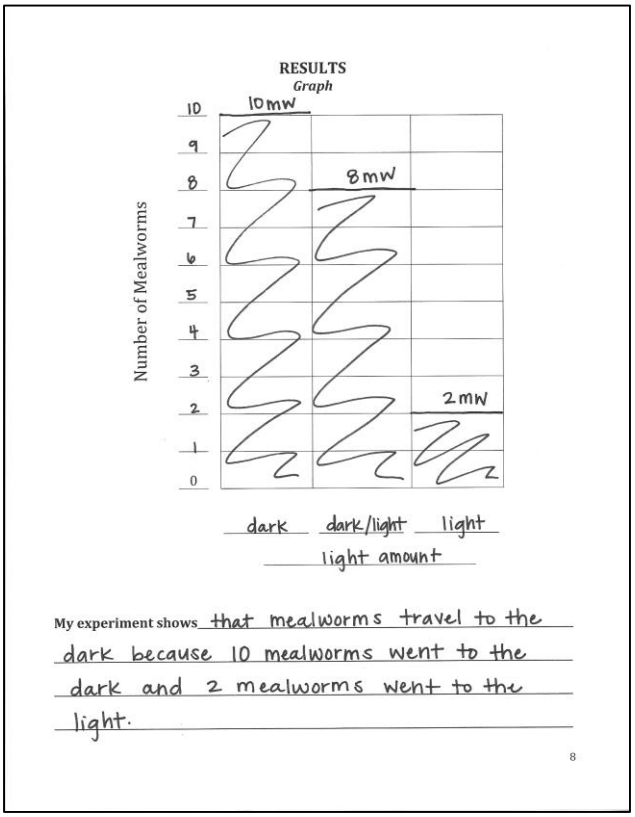
Other Supplies:

- ☐ (4) Large group notepads
- ☐ Large poster paper

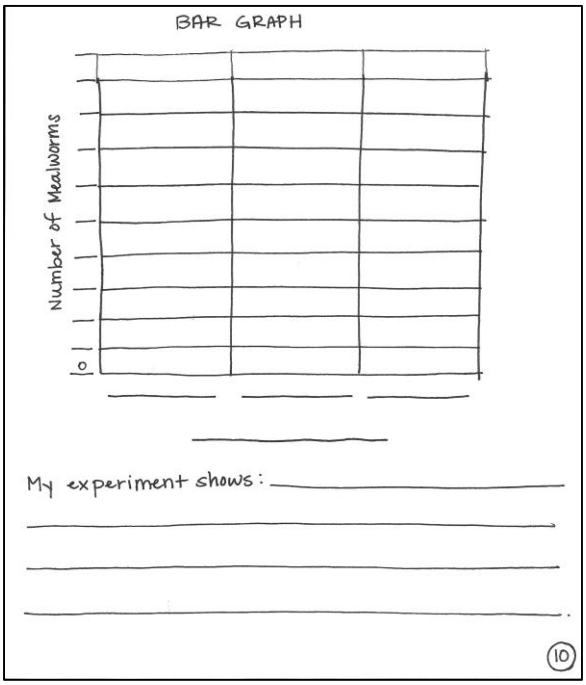
Lead Box:

- ☐ (3) Extra student notebooks
- ☐ Lead instructions
- ☐ Lead lab coat
- ☐ (4) Markers
- ☐ (2) Highlighters
- ☐ (2) Glues
- ☐ Scissors
- ☐ Poster diagram (full page)
- ☐ (2) Stickers for how to present graph
- ☐ (5) Paperclips
- ☐ Scotch Tape
- ☐ Time card

SciTrek Notebook Page Used with Students:



SciTrek Notepad Page Used with Students:



Set-Up:

SciTrek Leader:

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

SciTrek Volunteer:

Set out SciTrek nametags/notebooks around the table having students sit in boy/girl fashion. Have poster parts ready for students.

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

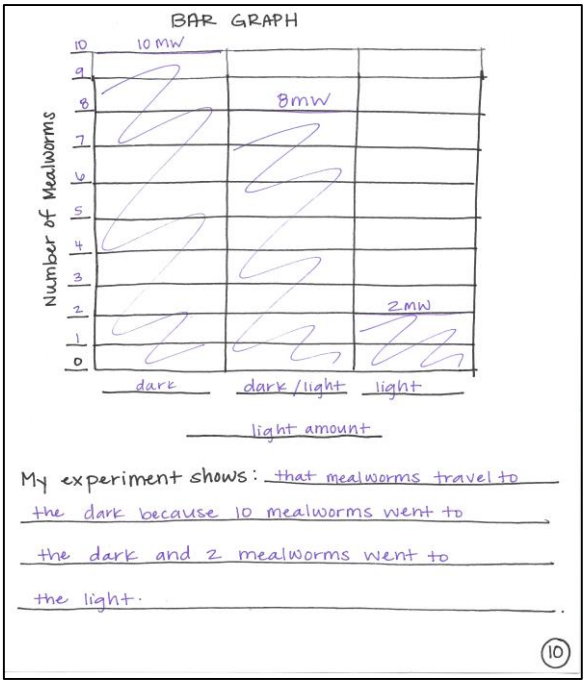
Ask the class, "What is the class question that we have been investigating?" Students should tell you "what factors affect the direction the mealworms travel?" Tell students that you saw some great experiments the last session and you are excited to hear about what they have learned about the direction mealworms travel and how this applies to a mealworms ideal habitat.

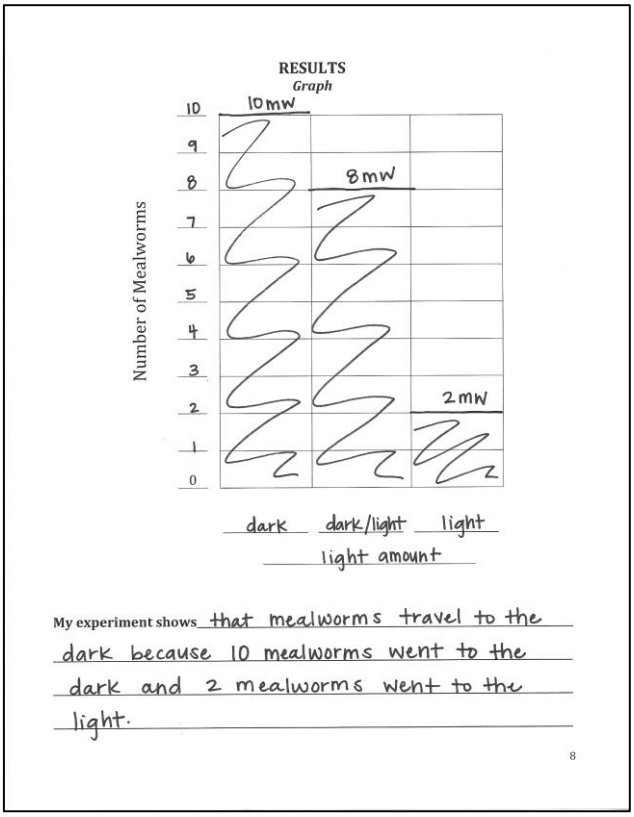
Tell them that today they are going to analyze their data by making a bar graph. Then they will put together a poster to show the rest of the class what they have learned from their experiment. Tell them that they should write as neatly as possible on the poster parts so that the other class members can read their poster.

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

Ask your group what they did the last time. Have them explain their experiment to you without looking at their notebooks.

Have the 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 1. In addition, as a group have the students fill out the x axis (their changing variable and the values of this variable that they used). Once the axes are filled out, graph the first compartment with the students. Ask the students how many mealworms were in compartment A. Tell students to tell you to stop when your 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 and write the number on top of the line. Then quickly fill in the area below the mark. Tell students that they should try to beat how fast you filled in under the line when they draw the graph in their notebooks. Have students attempt to graph the other 2 compartments on their own and then check their work and record the results in the group notepad. An example of a filled in group notepad and notebook can be seen below.





Once all the students have completed their graph as a group fill in the sentence frame "My experiment shows _____." See sample above. Do not simply record that the graph shows the x value vs. the y value. Instead, make sure that students try to make a claim about what happened. An appropriate claim could be: mealworms travel to the dark. 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 or a prediction about what the experiment shows, write the word "because" and follow it with supporting data or values from the graph (10 mealworms went to the dark and 2 mealworm went to the light). Help students copy this statement into their notebooks on page 8. Prepare one student to share this sentence frame with the rest of the class during the wrap-up discussion.

Once students have filled out "My experiment shows_____" have each student individually fill in the sentence frame (page 9): "I acted like a scientist when_____." This sentence frame should be unique for each of the students. If students are having trouble with this sentence frame ask them what they did during each SciTrek visit.

Poster Making *(36 minutes – Small Groups – SciTrek Volunteers):*

Assign each student one of the poster sections to complete. If a student struggles with writing try to give them a shorter writing section to complete (example: question). If you have more students than there are poster pieces then cut the poster piece with the graph and "my experiment shows_____" into two parts so that one student can complete/present the graph and another student can complete/present "my experiment shows_____." Have the students write their name on the section that they will complete. In the students' notebook highlight the section that they will complete/present. Note: if a student is completing/presenting multiple sections use the paperclips in your group box to clip together

the sections that they are completing so that during the poster presentation day they will have an easier time flipping back and forth between pages. Place the following sentence frame sticker on the top of page 8 in the notebook of the student that is completing the graph.

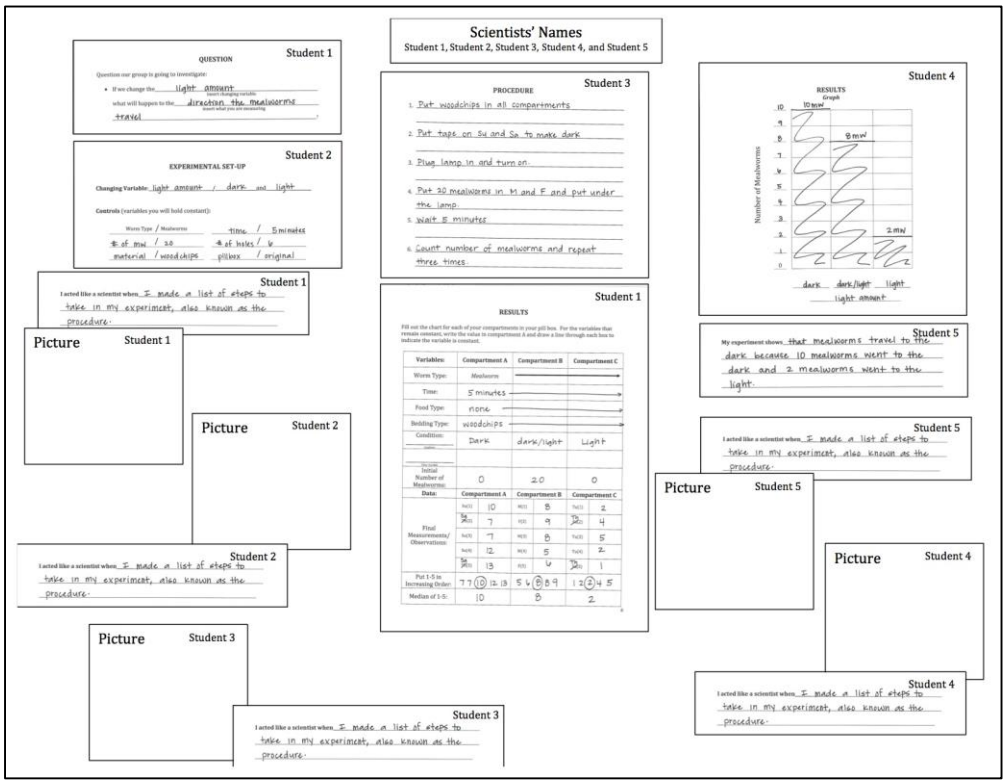
The compartment with _____ had _____ mealworms.
changing variable value number of mealworms

If your group is testing light amount cross out the "with" on the sticker and write in "in the" instead. Practice reading the three sentences with the student that is presenting the graph. For the poster below, the sentence frame would be: the compartment ~~with~~ **in the dark** had **10 mealworms.**

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

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

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



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

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

Clean-Up:

Before you leave have students attach their nametag to their notebook and place them in the group box. Leave student posters in the classroom. Bring all materials back to UCSB. In addition, put your lab coat back into your group box.

Day 5: Poster Presentations

Schedule:

Introduction (SciTrek Leader) – 2 minutes
Practice Posters (SciTrek Volunteers) – 15 minutes
Poster Presentations (SciTrek Volunteers/SciTrek Leader) – 38 minutes
Wrap-Up (SciTrek Leader) – 5 minutes

Materials:

(4) Volunteer Boxes:

- ☐ Student nametags
- ☐ Student notebooks
- ☐ Volunteer instructions
- ☐ Volunteer lab coat
- ☐ Highlighter
- ☐ (2) Paperclips
- ☐ Large binder clip
- ☐ (8) Sharpened SciTrek pencils (all same color)

Lead Box:

- ☐ (3) Extra student notebooks
- ☐ Lead instructions
- ☐ Lead lab coat
- ☐ (2) Highlighters
- ☐ Scotch tape
- ☐ (4) Paperclips
- ☐ Time card

*Student posters should already be in the classroom.

Set-Up:

SciTrek Leader:

Write the class question on the board “What factors affect the direction a mealworm travels?” Leave enough room so that you can record student findings under the question.

SciTrek Volunteer:

Hand out the student notebooks/nametags to students. Get your groups’ poster. Today students will be sitting in their regular classroom seats during poster presentations.

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

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

Tell the students that they are now going to be given 15 minutes to practice their poster before starting the presentations. Tell students before they practice their poster they need to explain to their volunteer what experiment they did and what they learned from their experiment. After that their SciTrek volunteer will ask them questions about their experiment. Tell students to pay attention to the type of questions their volunteer is asking because these are scientific questions and if they ask a scientific question during the poster presentations they will get a SciTrek pencil at the end of the day. After the 15 minutes students will return to their original class seats. They will sit in these seats during the presentations.

Practice Posters *(15 minutes – Small Groups – SciTrek Volunteers):*

Once students have gotten to your group have students explain to you what they did for their experiment and what they learned about the direction that mealworms travel. Ask students questions to make sure that they understand what they did during their experiment. Make sure that you also have them use their results to predict what would happen for other systems that they did not test. Remind them to think about the pattern or the trend that they saw for their own results and apply this trend to make other predictions about the direction that the mealworms travel. For instance if the group's changing variable was food type and their changing variable values were lettuce and Cheerios ask them to predict another food that mealworm might move towards and why. Possible answer: Rice Krispies because they are another dry food source. Try to make sure that each student in your group answers one question. Once your group has an understanding of their experiment have them start practicing their poster.

Make sure students are reading the poster parts in the correct order (scientists' names, question, experimental set-up, procedure, graph, and "my experiment shows _____") and out of their notebook, not off the poster. If the students' section is not highlighted in their notebook, highlight the section for them. If they are reading multiple sections paperclip the sections together.

Poster Presentations *(38 minutes – Full Class – SciTrek Volunteers/SciTrek Leader):*

Have students return to their original class seats. Ask the class, "What question have we been working on to solve?" Students should tell you: what factors affect the direction the mealworms travel? Ask the class, "Why are we interested in answering this question?" Students should say that if they can determine the factors that affect the direction the mealworms travel they will be able to predict the mealworms ideal habitat. Tell the students that after each presentation you will ask the class what changing variable the group was testing. They will then be given the opportunity to ask scientific questions to the presenting group to help them determine if the variable that the group was investigating affected the direction that the mealworms traveled. Tell the students that anyone that asks a scientific question will get a SciTrek pencil after the presentations are over.

Scientific questions are the type of questions that your group leader was asking you about your experiment to learn more about your trials. Ask the class, "If the group experimented with food type do you think that they would be able to answer questions about the bedding? They should say no. "Therefore, we should try to ask the group questions that focus on their changing variable." Tell the class once they have finished asking the group questions you will ask them if the group's changing variable affected the direction the mealworms travelled and if so how. You will then summarize their ideas on the board under the class question.

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

During the student question time, the SciTrek 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 5 questions (1 question per student).

After all poster presentations have been given, ask the class "what did we learn about the direction that a mealworm will travel?" Have them summarize the class findings. Depending on the experiments that the class ran these are the highlights of the experiments.

- Mealworms move away from the light and into the dark
- Mealworms move into bedding that is loosely bound or bedding they can burrow into
- Mealworms move toward food that is dry.
- Mealworms will be equally split between crackers and cookies showing they do not have a strong attraction to sugar

When reflecting on the summary, use students' collected data and not what they should have found, if the two are in disagreement. Ask students, "If you had to design the ideal habitat for a mealworm what would it look like?"

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

Tell students they have taught you a lot about what a mealworm's ideal habitat is like.

Note: if no one in the class did experiments on one of the variables above, then they will not know how that variable affects mealworms motion and do not expect them to tell you which value to use.

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

Ask students the following wrap-up questions:

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

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

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

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 answer a question from the volunteer and then they can have a pencil.

Clean- Up:

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

Day 6: Question Assessment/Tie to the Standards

Schedule:

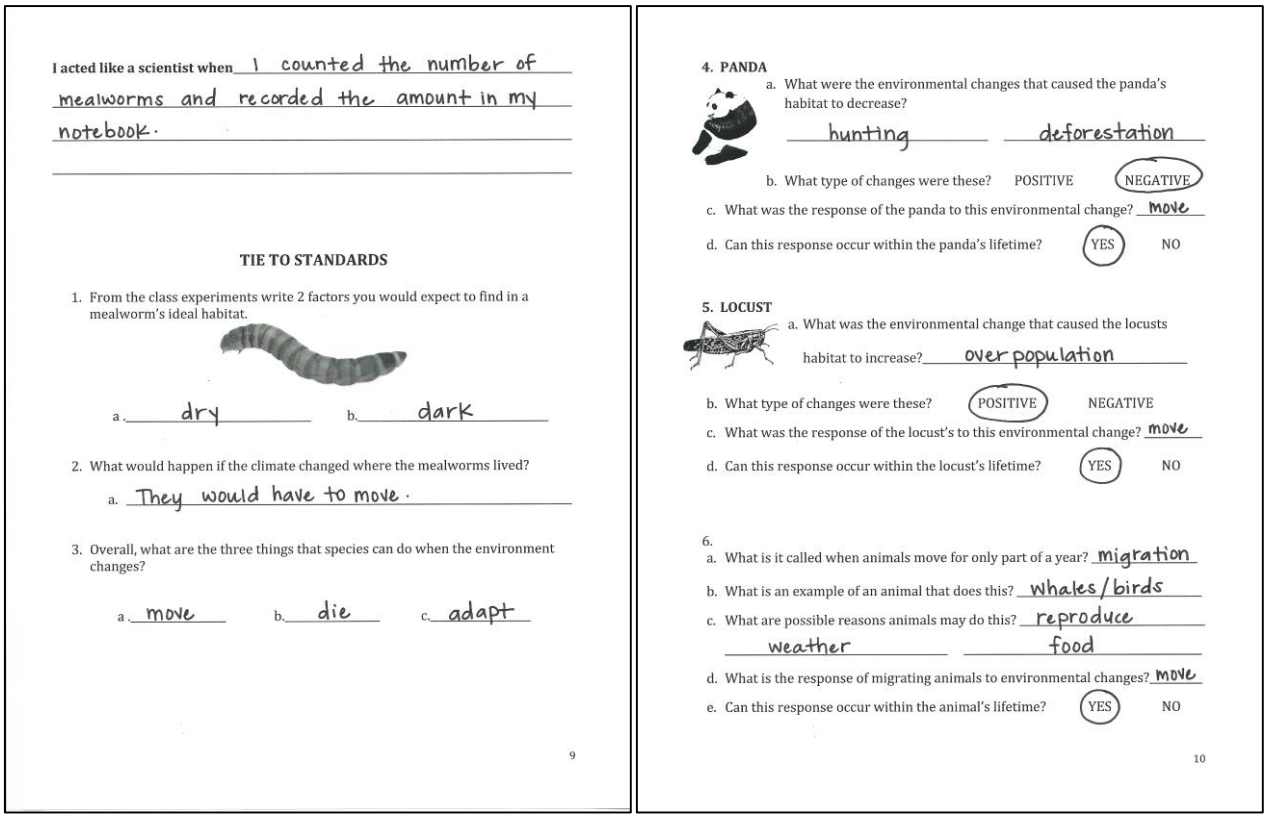
Question Assessment (SciTrek Leader) – 5 minutes
Tie to Standards (SciTrek Leader) – 55 minutes

Materials:

Lead Box:

- ☐ (3) Extra student notebooks
- ☐ Lead lab coat
- ☐ (25) Question assessments
- ☐ Student notebooks
- ☐ (2) Pencils
- ☐ Time card
- ☐ Lead instructions
- ☐ (7) Animal picture cards

SciTrek Notebook Pages Used with Students:



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?

a. 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

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 panda to this environmental change? move

d. Can this response occur within the panda's lifetime? (YES) NO

5. LOCUST

a. What was the environmental change that caused the locusts habitat to increase? over population

b. What type of changes were these? (POSITIVE) NEGATIVE

c. What was the response of the locust's to this environmental change? move

d. Can this response occur within the locust's lifetime? (YES) NO

6.

a. What is it called when animals move for only part of a year? migration

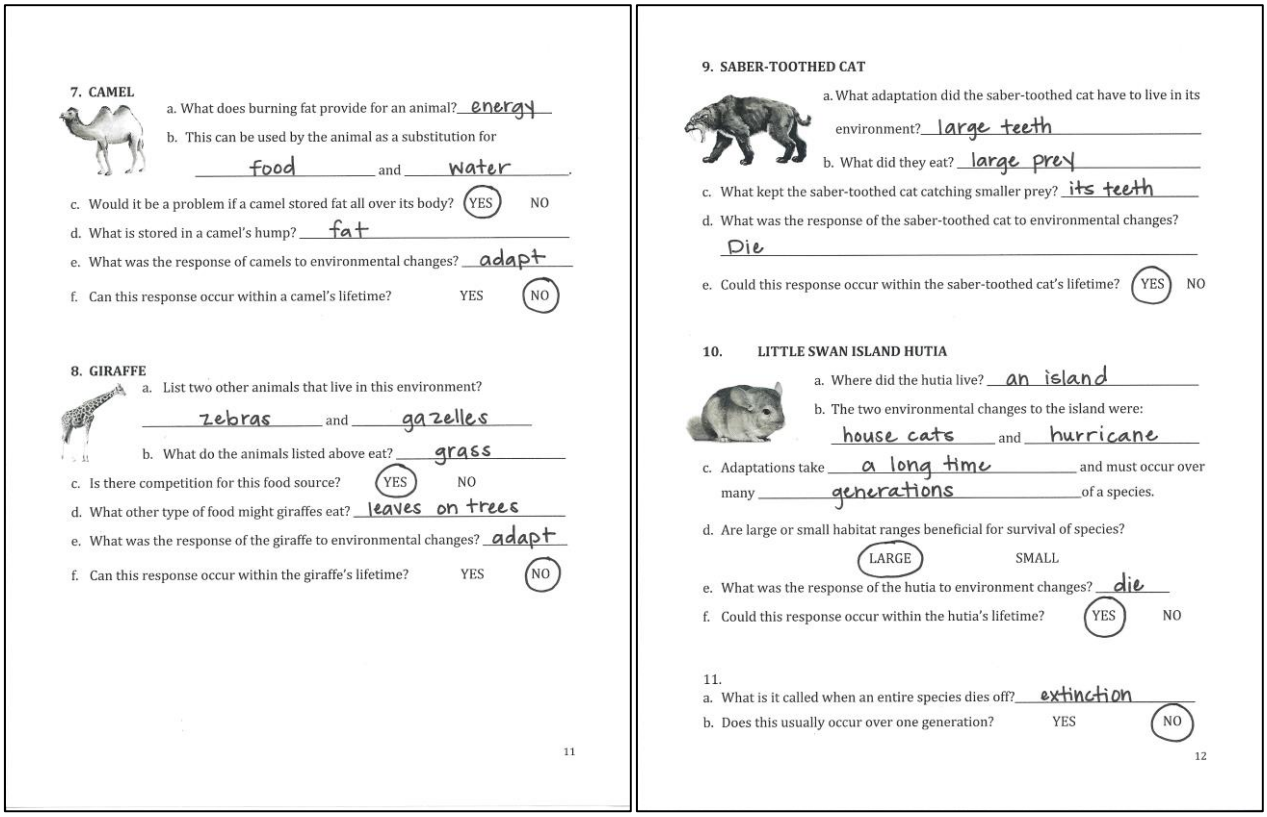
b. What is an example of an animal that does this? whales / birds

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 the animal's lifetime? (YES) NO

10



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 camels to environmental changes? 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 giraffe to environmental changes? adapt

f. Can this response occur within the giraffe's lifetime? YES (NO)

11

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 catching smaller prey? its teeth

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

e. Could this response occur within the 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 hutia to environment changes? die

f. Could this response occur within the 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

Set-Up:

SciTrek Leader:

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

If the classroom has a document camera, ask the teacher to use it to fill out the tie to standards activity with students on pages 9-12. If the classroom does not have a document camera, then tape the example poster size notebook pages to the front board.

Have animal picture cards ready and available.

Question Assessment *(5 minutes – Full Class – SciTrek Leader):*

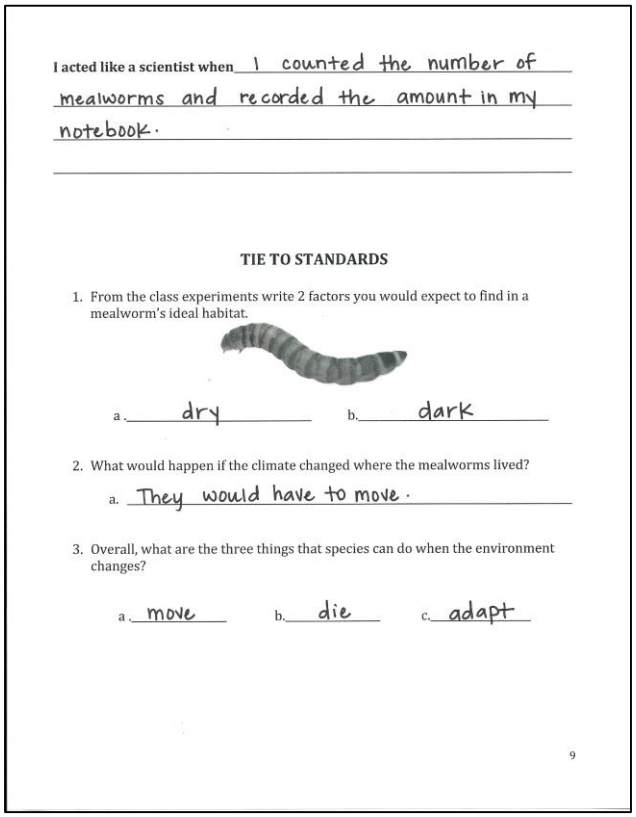
"Before we start with our activity we want to see how your ideas on questions are developing." Pass-out the question assessment to each student. Tell students to fill out their name, teacher's name, and date at the top of the assessment. Tell students one of the ways that we get money for the program is to show that the program is effective and that we need them to do their best on the assessment so we can know the effectiveness of the program. Remind the students that it is important that they fill out this assessment on their own. Read the instructions to the students. Then read each of the questions aloud to the students and tell them to circle "testable" for questions that science can answer or "not testable" for questions that science cannot answer. When they are finished, collect the papers and verify that the student's name is on the top of the paper.

Tie to Standards *(55 minutes – Full Class - SciTrek Leader):*

A Mealworm's Ideal Habitat

Tell the class that you enjoyed their poster presentations the last time you were there. Tell the students that today we are going to revisit some of the factors that affected the direction that mealworms travelled. Have students turn to page 9 of their notebooks. Place an example notebook on the document camera and turn to page 9.

Ask the students where they would expect to find a mealworm living in the wild. Tell students to think about all of the experiments that their class did and record student ideas on the board (or on the bottom of page 9). Students should be able to use their experimental evidence they gathered to determine an ideal mealworms' habitat, or the factors that would affect the direction the mealworm would travel. 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 environment. 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. After, have students pick two of these responses and copy them into their notebook for question 1. 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?

a. 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 the students what would happen if the climate changed where mealworms lived? For example, what would happen if the place in which mealworms lived started to get more rain so that their living space

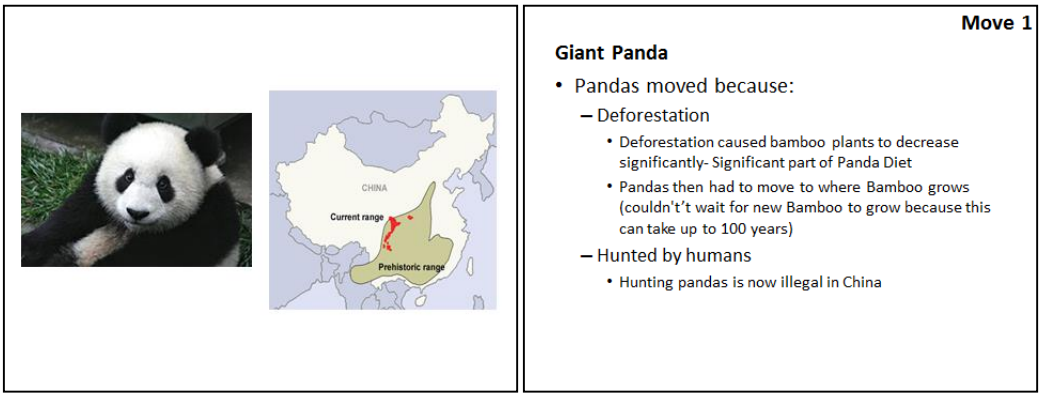
was always wet? What could the mealworms do? Allow students to talk in small groups about this and then have them record some of their ideas into their notebook on page 9. After have one or two students share. Record one of these responses into the example notebook under the document camera for students to copy. An example of student work can be seen above.

Tell the students that 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 them that 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 better deal 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

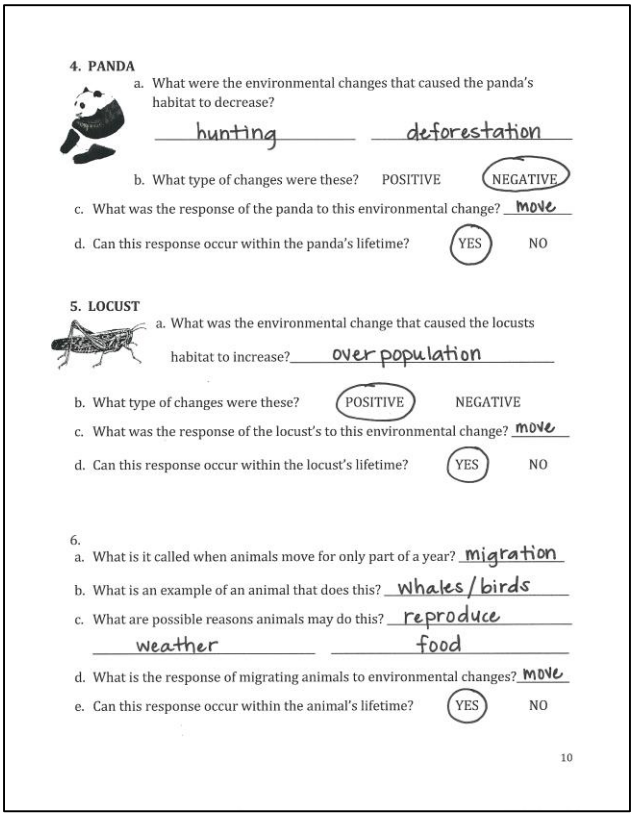
Have the students turn to page 10 in their notebooks.

Show the students the picture of the Giant Panda (Move 1)



Tell students that Pandas originally lived in all of the green areas on the map but now they only live in the red areas. Ask students why the panda's living area got smaller? Allow one or two students to share their answers. Tell students that the pandas had to move to this new environment because of two reasons: deforestation and hunting. Record these answers for question 4a. Ask students if they think this was a positive or negative response to the changes in the panda's environment. Students should say this is a negative response. Record this answer for question 4b.

Ask students what was the pandas' response to the change in their environment. Students should say that the pandas had to move. Record this answer for 4c. Then ask students if this response (moving) is an option a panda can do within its own lifetime and record this answer for 4d (Yes). Record student answers in the example notebook under the document camera for students to copy. An example of student work can be seen below.



4. PANDA

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hunting deforestation

b. What type of changes were these? POSITIVE (NEGATIVE)

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

d. Can this response occur within the panda's lifetime? (YES) NO

5. LOCUST

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b. What type of changes were these? (POSITIVE) NEGATIVE

c. What was the response of the locust's to this environmental change? move

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6.

a. What is it called when animals move for only part of a year? migration

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

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

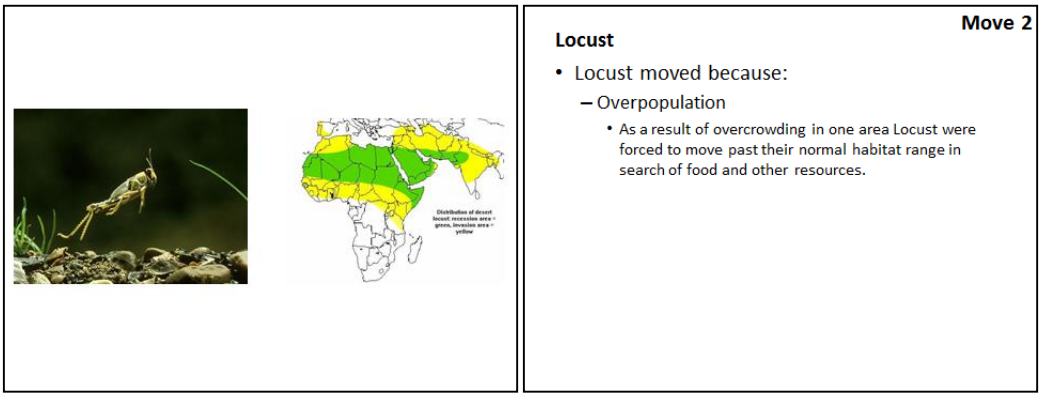
d. What is the response of migrating animals to environmental changes? move

e. Can this response occur within the animal's lifetime? (YES) NO

10

Tell students that although in the panda's case the move was a response to a negative change in the panda's habitat that there are also positive reasons that would cause an animal to move.

Show the students the picture of the locust (Move 2).

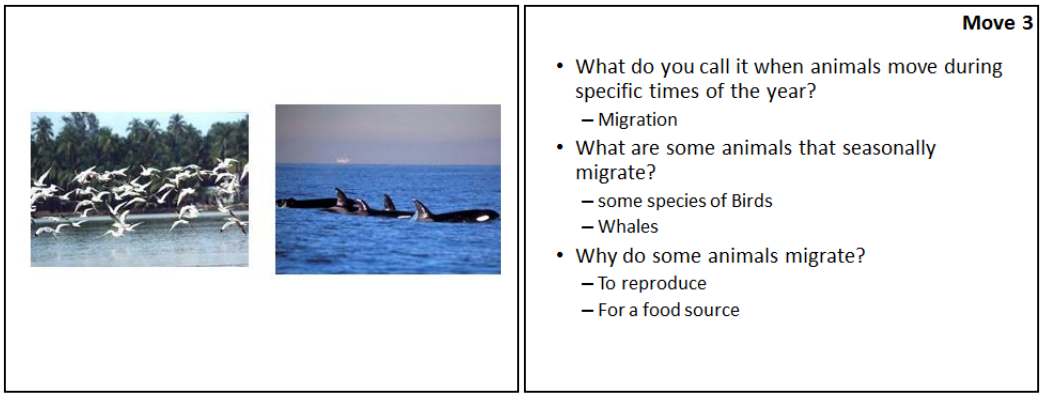


Tell the students that originally the locusts were in the green area on the map but now they live in both the yellow and the green areas. Ask the students what do they think is the reason for the expansion of the locust into new areas? Allow one or two students to share their response. Tell students that the locust moved because there was too many of them for one area and they needed to expand their living area to find more food. Record this answer for question 5a.

Ask students if this was an example of a positive response to a changing environment or a negative response. Students should realize that unlike the panda's response this is a positive example of moving because of a changing environment for the locust. Record this answer for 5b. Ask students what was the response that locust did when their environment changed (moved). Record this answer for 5c. After ask students if a locust was able to do this response (move) within its lifetime and record this answer for 5d (Yes). Record student answers in the example notebook under the document camera for students to copy. An example of student work can be seen above.

Tell students that some animals only move for part of the year, or for a season because the environment that they live in becomes temporarily undesirable. Ask students what it's called when animals only move temporarily to another location. Students should know that this is called migration. Record this answer for question 6a. Ask students what types of animals migrate. Allow one or two students to share their responses. Record one of these responses for answer 6b (example: birds, butterflies, whales, caribou, penguins, salmon)

Show students the picture of whales and birds (Move 3).

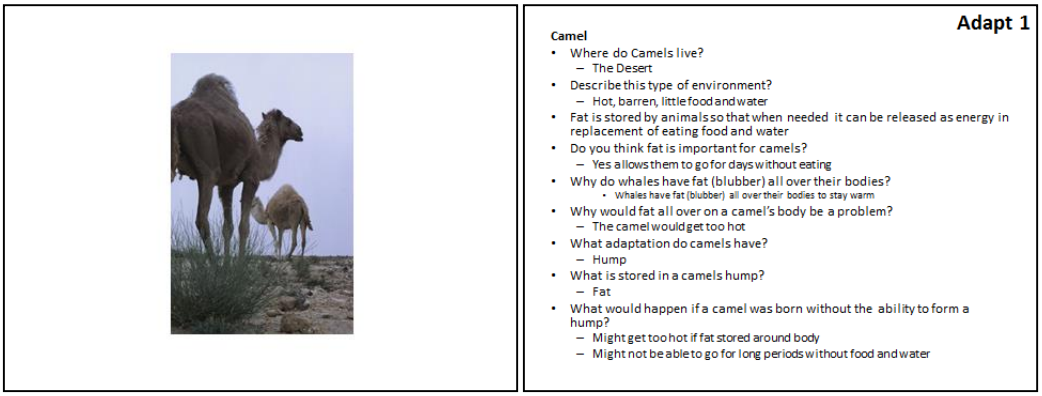


Ask the students what are the possible reasons that animals migrate? Allow students to talk in small groups and then allow some students to share. Animals migrate to reproduce, to search for food, or to search for better weather (warmer water). Record these responses for question 6c.

Ask students what was the response of migrating animals to environmental changes and record this answer for 6d. After that ask students if this response (move) can occur within the animal's lifetime and record this answer for 6e (Yes). An example of student work can be seen above.

Adapt

Have the students turn to page 11 in their notebooks. Show the students the picture of the camel (Adapt 1)



Ask the students to describe the environment in which camels live. Students should be able to respond that camels live in the desert, where it is very hot, and there is little food and water.

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

Ask students if they think fat is import for camels and why. Make sure by the end of the discussion that students understand that fat is important for camels because it allows camels to go for long periods of time without having to eat or drink.

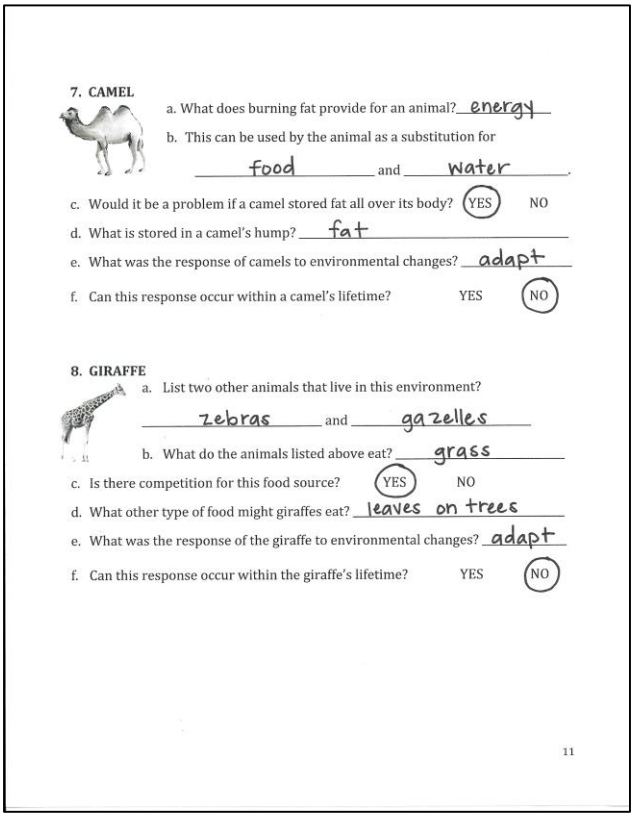
Ask students why whales have fat (blubber) all over their bodies. Whales have blubber all over their bodies to keep warm. Therefore, animals that do not burn their fat/blubber can use it for insulation. Now ask students if it would be a problem if camels had fat all over their bodies and why. Students should realize that 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 environment. Record this response for question 7c.

Ask students why is it important for camels to store fat? Students should realize that camels store fat not to keep warm, but to utilize as food (energy) when they have to go long time 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. Students should say that the hump on the camel's back is its adaptation. Ask students what they think is stored in the camels hump. By the end of the conversation make sure that students understand that fat is stored in the camel's 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 camel's response to the harsh environmental conditions and record this answer for question 7e. Then ask students if this response (adaptation) can occur within one camel's lifetime and record this response for question 7f. In other words, if you put a camel in a cold environment would it loose its hump as the fat redistributed around its body? Students should be able to realize that this adaptation would need to take place over many generations of camels, and would therefore not occur during one camel's lifetime.

Ask students what would happen if a camel was born without a hump? The camel might not be able to go long periods of time without food because they would have no way to store fat (food). This might cause

the camel to die. Therefore, overtime 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 camels to environmental changes? 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 giraffe to environmental changes? adapt

f. Can this response occur within the giraffe's lifetime? YES (NO)

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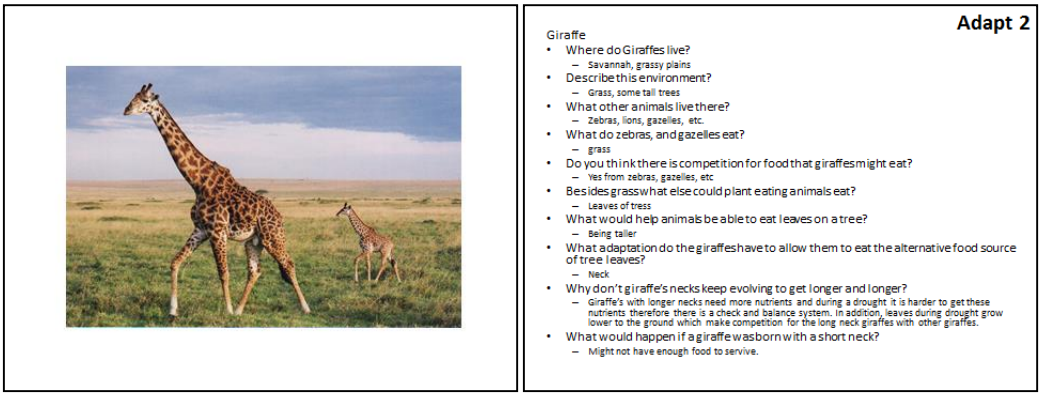
Teachers Note About Camels: The camels' hump stores two different kinds of fats, one of which can be used as a form of energy and the second, which is very dense and gives the hump its rigidity and shape. When the camel is underfed or has to go long time periods without any food or water the camel can 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 the conditions have changed. 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 (Adapt 2).



Ask students to describe the environment in which giraffes live. Giraffes live in Africa on the savannah or grassy plains, which have some tall trees. Ask students what giraffes eat. They should respond grass and leaves. Ask students if other animals live in this type of environment. Students should say that a lot of other animals live there for example zebras, lions and gazelles. 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 that gazelles and other animals that live in the grassy plains eat grass. Record this answer for question 8b. Ask students if they think there is competition with other animals for the food that giraffes might eat. Students should realize that 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. Giraffes eat the leaves off of trees. Record this answer for question 8d. Now ask students why giraffes are better equipped to eat leaves on a tree than gazelles. Giraffes have a long necks and long legs to help them reach the tall tree leaves.

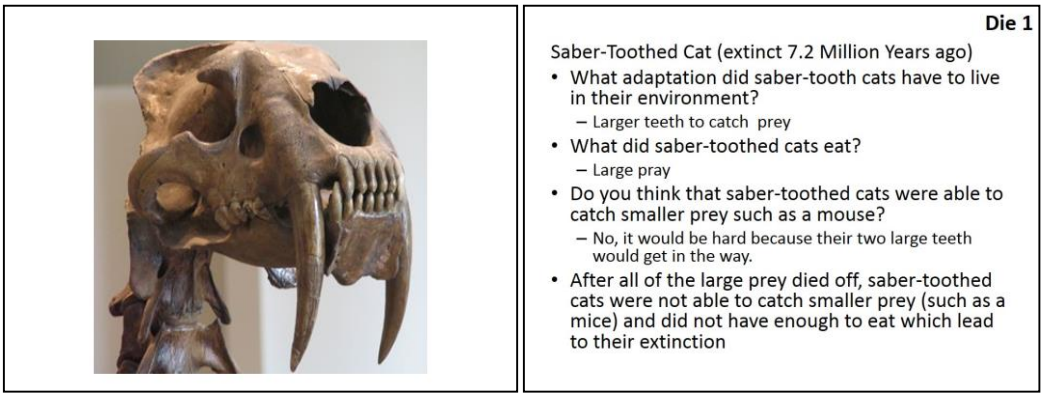
Ask students what was the giraffe's response to a harsh environment and record this answer for question 8e. Then ask students if this response (adaptation) can occur within one giraffes' lifetime and record this response for question 8f. In other words if you put a giraffe in an environment with lots of low vegetation would it loose its long neck/long legs? Students should be able to realize that this adaptation would need to take place over many generations of giraffes. An example of student work can be seen above.

Tell students that if they are wondering why a giraffes' necks don't just keep evolving to be even longer it is because giraffes with longer necks would need more nutrients than giraffes with smaller necks. During drought seasons it is hard to get enough nutrients to sustain large giraffes, 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 much nutrients. In addition, during a drought leaves only grow closer to the ground which makes competition for the longer neck giraffes greater.

Ask the students what would happen if a giraffe were born with a short neck? Students might say that there would be too much competition for food and therefore the giraffe might not be able to get enough food and would then die.

Die

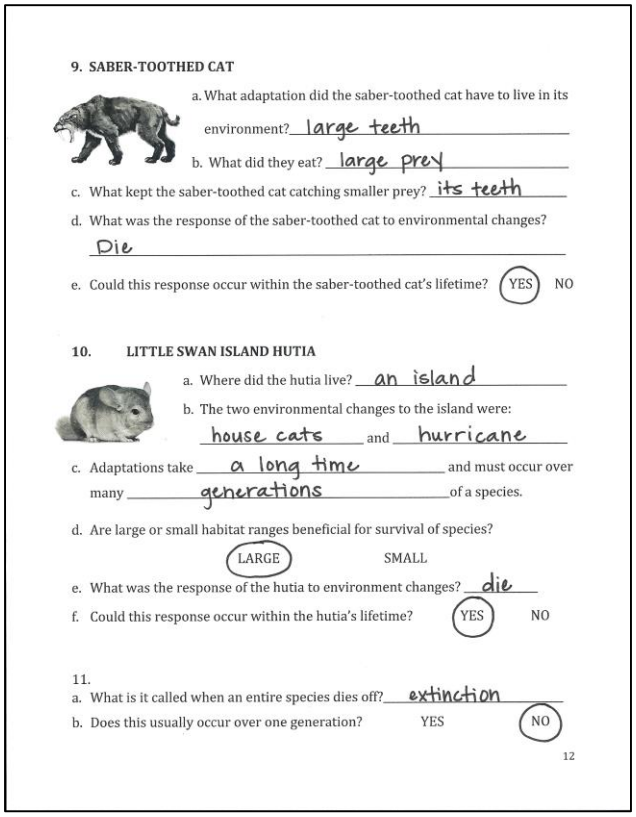
Have the students turn to page 12 in their notebooks. Show students the picture of the saber-toothed cat (Die 1)



Ask the students what adaptation the saber-toothed cat had to live in its environment. Students should say that they had two large front teeth to catch prey. Record this answer for question 9a. Ask students what saber-toothed cats ate. Students should say that they ate large prey, such as deer. Record this answer for question 9b. Ask students if they think it was possible for a saber-toothed cat to catch smaller prey such as a mouse. They should say that the saber-toothed cat would not be able to catch smaller prey, such as a mouse, because their two large teeth would get in the way. Record this answer for question 9c.

Tell students that during the time the saber-toothed cat lived the weather conditions on the planet changed and the planet became much colder. This caused many large prey (deer like animals) to die off because much 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, they all died off (became extinct). Record this response for question 9d.

Ask students how the saber-toothed cat was able to respond to its changing environment (death of its food supply). Then ask students if this response (death) is an option a saber-toothed cat can do within its own lifetime. Students 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 catching smaller prey? its teeth

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

e. Could this response occur within the 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 hutia to environment changes? die

f. Could this response occur within the hutia's lifetime? (YES) NO

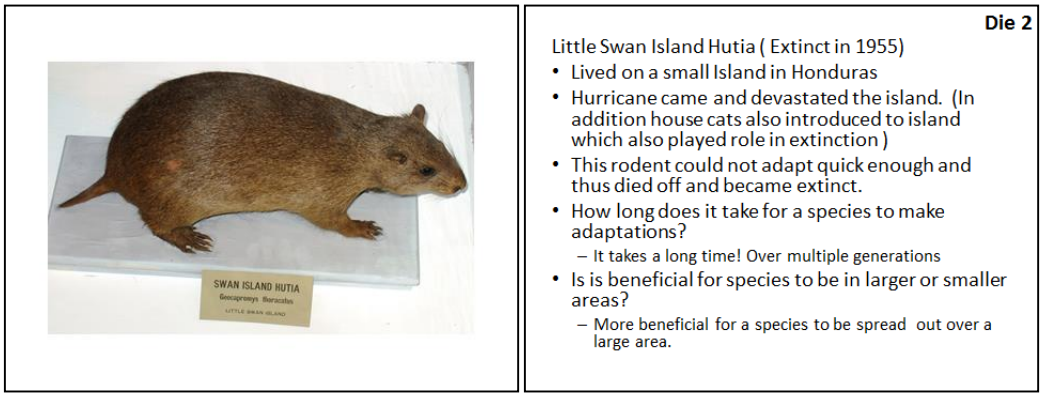
11.

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 hutia (Die 2).



Tell students that this rodent type creature lived on a small island in Honduras until a hurricane 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 the students why the rodent was not able to adapt to these new conditions. Students 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. Students should realized that because this species of rodent could not adapt quick enough it was not able to survive and became

extinct. Fill in the following sentence frame with students (10c): adaptations take **a long time** and must occur over many **generations** of a species.

Ask students if they think it is beneficial for a species to live in a larger or smaller area and why. It is more beneficial for a species to live in a large area in case of an event like the hurricane so that an entire species does not die out. Circle the correct answer for 10d.

Ask students how little island hutia responded to its changing environment (hurricane/house cats). Then ask students if this response (death) is an option it could do within its own lifetime. Students should be able to realize that death (although not favorable) is a possibility within an animal's lifetime. Record these answers for questions 10e and 10f. An example of student work can be seen above.

Ask the students what it is called when an entire species dies off and record this answer for question 11a. Tell students that both the saber toothed cats and the little swan island hutia are example of animals that became extinct. Ask students, if they think extinctions usually take place during the lifetime of one animal or over many generations of a species. By the end of the conversation make sure that students understand that many times there is a slow decline in the number of animals in that species until finally the species becomes extinct and this process can occur over many generations. Tell students that if extinction is slow enough humans can help animals not become extinct by restoring and protecting their current habitats. Tell the class that the example of the saber-toothed cat extinction took place over many generations, because of the changing climate and the death of large prey. However, the example of the little swan island hutia extinction took place over a single generation because the hurricane and house cats were introduced so fast.

Tell students that they can keep their SciTrek notebooks and that you have enjoyed working and learning with them and that SciTrek will be back later in the year to run another module.

Clean- Up:

Bring all materials back to UCSB.