How Science Works

Grade 3

Module 1

Class Question:

What variables affect the direction mealworms travel?

Scientist (Your Name): ________________________________

Teacher’s Name: ________________________________

SciTrek Volunteer’s Name: ________________________________
VOCABULARY

Science: The study of the material world using human reason. The scientific method is the way humans reason and apply logic to data to help gain knowledge of the world.

- **Observation**: A description using your five senses. This could include contents, mass, size, color, temperature, smell, texture ...
- **Opinion**: Something you believe or feel. Not a fact or observation.
- **Inference**: A guess based on past experiences.
- **Testable Question**: A question for which an experiment can be designed to answer.
- **Non-Testable Question**: A question for which an experiment cannot be designed to answer. For example questions involving opinions, things that cannot be measured, or words that are not well defined.
- **Experimental Set-Up**: The materials, changing variable, and controls that are needed for an experiment.
- **Experiment**: A test or trial to discover something unknown.
- **Procedure**: A set of steps to conduct an experiment.
- **Controls**: The variables that are not changed in an experiment.
- **Changing Variable (Independent Variable)**: The variable that is changed in an experiment.
- **Results/Data (Dependent Variable)**: The measurements/observations from an experiment.
- **Prediction**: What you expect to happen based off of previous measurements/observations.
- **Scientific Practices**: A series of activities that scientists participate in to both understand the world around them and to communicate their results with others. (The specific practice worked on in this module is identifying testable questions.)
- **Technique**: A method for a specific task.
- **Reproducibility**: The ability to duplicate data from one trial to the next.
- **Median**: The middle number of a given set of numbers listed in increasing order.
- **Maximum**: The largest value in a given set of numbers.
- **Minimum**: The smallest value in a given set of numbers.
- **Compartment**: A section of something.
- **Habitat**: The natural home or environment of an animal, or plant.
- **Mealworm**: A type of insect.
- **Adapt**: The process by which a plant/animal, over many generations, becomes better fit to its environment.
## 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.

<table>
<thead>
<tr>
<th>Question</th>
<th>Testable</th>
<th>Not Testable</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is the length of a brown bear's front paw?</td>
<td><strong>Testable</strong></td>
<td><strong>Not Testable</strong></td>
</tr>
<tr>
<td>Do bears like to swim?</td>
<td><strong>Testable</strong></td>
<td><strong>Not Testable</strong></td>
</tr>
<tr>
<td>Are black bears smarter than brown bears?</td>
<td><strong>Testable</strong></td>
<td><strong>Not Testable</strong></td>
</tr>
<tr>
<td>How many brown bears are at the Santa Barbara Zoo?</td>
<td><strong>Testable</strong></td>
<td><strong>Not Testable</strong></td>
</tr>
<tr>
<td>What type of bear is the most fearsome?</td>
<td><strong>Testable</strong></td>
<td><strong>Not Testable</strong></td>
</tr>
<tr>
<td>How much honey does Winnie the Pooh eat in 24 hours?</td>
<td><strong>Testable</strong></td>
<td><strong>Not Testable</strong></td>
</tr>
<tr>
<td>In one day, what is the total mass of berries that all brown bears eat?</td>
<td><strong>Testable</strong></td>
<td><strong>Not Testable</strong></td>
</tr>
<tr>
<td>Are polar bears fast?</td>
<td><strong>Testable</strong></td>
<td><strong>Not Testable</strong></td>
</tr>
<tr>
<td>Is putting panda bears on the endangered species list important?</td>
<td><strong>Testable</strong></td>
<td><strong>Not Testable</strong></td>
</tr>
<tr>
<td>Can a mother bear find her cub among 6 other cubs?</td>
<td><strong>Testable</strong></td>
<td><strong>Not Testable</strong></td>
</tr>
</tbody>
</table>
Experimental Considerations:

1. You will only have access to the materials on the materials page.
2. You will run an odd number of trials.
3. Each trial may take no longer than 5 minutes.
4. You will only get one pillbox in which you may do two trials at the same time.
5. No more than two versions of the changing variable can be used.
6. You may only have a food or a bedding, not both. For 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.

Changing Variable (Independent Variable): ________________________________

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

**QUESTION**

Question our group will investigate:

- If we change the______________________________,
  insert changing variable (independent variable)
  what will happen to the______________________________
  insert what you are measuring (dependent variable)
  ________________________________?

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

Changing Variable: ____________________________ / _____________________ and ________________

Controls (variables you will hold constant):
Determine the variables that you will hold constant and indicate the specific value you will use in all your trials (control/value, example insect type/mealworm).

<table>
<thead>
<tr>
<th>Insect Type</th>
<th>Mealworm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Su</th>
<th>M</th>
<th>Tu</th>
<th>W</th>
<th>Th</th>
<th>F</th>
<th>Sa</th>
</tr>
</thead>
</table>

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

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

Prediction:

I predict the _________________________ the mealworms will travel to is

changing variable

value of changing variable
PROCEDURE

1. __________________________________________________________
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________

2. __________________________________________________________
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________

3. __________________________________________________________
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________

4. __________________________________________________________
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________

5. __________________________________________________________
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________

6. __________________________________________________________
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________
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.

<table>
<thead>
<tr>
<th>Bedding:</th>
<th>Final Number of Mealworm: (In Increasing Order)</th>
<th>Median:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>2345</td>
<td>3</td>
</tr>
<tr>
<td>Rocks</td>
<td>2, 3, 4, 5, 5</td>
<td></td>
</tr>
<tr>
<td>Grass</td>
<td>15, 17, 19</td>
<td></td>
</tr>
<tr>
<td>Dirt</td>
<td>10, 11, 13, 13, 17</td>
<td></td>
</tr>
<tr>
<td>Wood Chips</td>
<td>9, 10, 10, 11, 12</td>
<td></td>
</tr>
</tbody>
</table>

*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?

<table>
<thead>
<tr>
<th>Temperature:</th>
<th>Final Number of Mealworms:</th>
<th>Median:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warm</td>
<td>10, 12, 9</td>
<td></td>
</tr>
<tr>
<td>Room Temperature</td>
<td>14, 16, 10, 9, 15</td>
<td></td>
</tr>
<tr>
<td>Cold</td>
<td>2, 9, 5, 2, 0, 3, 4</td>
<td></td>
</tr>
</tbody>
</table>
**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.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Compartment A (Su and Th)</th>
<th>Compartment B (M and F)</th>
<th>Compartment C (Tu and Sa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worm Type:</td>
<td><em>Mealworm</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food Type:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bedding Type:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Condition:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Condition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Variable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Data</strong></td>
<td><strong>Compartment A</strong></td>
<td><strong>Compartment B</strong></td>
<td><strong>Compartment C</strong></td>
</tr>
<tr>
<td><strong>Initial</strong></td>
<td><strong>Number of Mealworms:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measurements:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Su(1)</td>
<td>M(1)</td>
<td>Tu(1)</td>
</tr>
<tr>
<td></td>
<td>Th(2)</td>
<td>F(2)</td>
<td>Sa(2)</td>
</tr>
<tr>
<td></td>
<td>Su(3)</td>
<td>M(3)</td>
<td>Tu(3)</td>
</tr>
<tr>
<td></td>
<td>Su(4)</td>
<td>M(4)</td>
<td>Tu(4)</td>
</tr>
<tr>
<td></td>
<td>Th(5)</td>
<td>F(5)</td>
<td>Sa(5)</td>
</tr>
<tr>
<td><strong>Final</strong></td>
<td><strong>Number of Mealworms:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measurements:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Put 1-5 in Order:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The independent variable is the changing variable and the dependent variables are the final measurements/observations.
RESULTS
Graph and Summary

My experiment shows

___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________

Number of Mealworms

0

___________________________________________________________________________________________

___________________________________________________________________________________________

___________________________________________________________________________________________

___________________________________________________________________________________________

___________________________________________________________________________________________
I acted like a scientist when __________________________________________
________________________________________________________________
________________________________________________________________
________________________________________________________________
________________________________________________________________
________________________________________________________________

TIE TO STANDARDS

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

   a. ___________________________   b. ___________________________

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

   a. ___________________________

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

   a. _______________   b. _______________   c. _______________
4. PANDA
   a. What were the environmental changes that caused the panda’s habitat to decrease?
   ____________________________  ____________________________
   b. What type of changes were these?  POSITIVE  NEGATIVE
   c. What was the response of the panda to this environmental change? _________
   d. Can this response occur within the panda’s lifetime?  YES  NO

5. LOCUST
   a. What was the environmental change that caused the locust’s habitat to increase?
   _________________________________
   b. What type of changes were these?  POSITIVE  NEGATIVE
   c. What was the response of the locust to this environmental change? _________
   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? _______________
   b. What is an example of an animal that does this? ___________________________
   c. What are possible reasons animals may do this? ___________________________
      ____________________________  ____________________________
   d. What is the response of migrating animals to environmental changes? ______
   e. Can this response occur within the animal’s lifetime?  YES  NO
7. CAMEL
   a. What does burning fat provide for an animal? ______________
   b. This can be used by the animal as a substitution for ______________ and ______________.
   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? __________________________
   e. What was the response of the camel to its environmental conditions? ______
   f. Can this response occur within the camel’s lifetime?  YES  NO

8. GIRAFFE
   a. List two other animals that live in this environment. _______________________ and ______________________
   b. What do the animals listed above eat? ______________________
   c. Is there competition for this food source?  YES  NO
   d. What other type of food might giraffes eat? ______________________
   e. What was the response of the giraffe to its environmental conditions? ______
   f. Can this response occur within the giraffe’s lifetime?  YES  NO
9. SABER-TOOTHED CAT

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

b. What did they eat? _______________________________

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

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

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? _______________________________

b. The two environmental changes to the island were: _______________________________ and _______________________________

c. Adaptations take _______________________________ and must occur over many _______________________________ 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 environmental changes? __________

f. Could this response occur within the hutia’s lifetime? YES NO

11.

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

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

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

1. How many hours does a giraffe sleep in a day?  
   Testable  Not Testable
   Revision: ____________________________________________________________________________________?

2. How fast can Wonder Woman run?  
   Testable  Not Testable
   Revision: ____________________________________________________________________________________?

3. Is learning how to write in cursive valuable?  
   Testable  Not Testable
   Revision: ____________________________________________________________________________________?

4. What is the total number of cups of coffee that people in the United States drink in one week?  
   Testable  Not Testable
   Revision: ____________________________________________________________________________________?

5. Is soap easy to pour?  
   Testable  Not Testable
   Revision: ____________________________________________________________________________________?

6. What species of animal has the thickest fur?  
   Testable  Not Testable
   Revision: ____________________________________________________________________________________?

7. Do ants like sugar?  
   Testable  Not Testable
   Revision: ____________________________________________________________________________________?
SciTrek is an educational outreach program that is dedicated to allowing 2nd-8th grade students to experience the scientific process first hand. SciTrek partners with local schools to present student-centered inquiry-based modules that not only emphasize the process of science but also specific grade level content standards. Each module allows students to design, carryout, and present their experiments and findings.

For more information please feel free to visit us on the web at http://www.chem.ucsb.edu/scitrek/ or contact us by e-mail at scitrekadmin@chem.ucsb.edu.

SciTrek is brought to you by generous support from the following organizations:

UCSB  karisma  SOUTH COAST
FOUNDATION  SCIENCE PROJECT

If you would like to donate to the program or find out how you can get your company’s logo on our notebooks please contact scitrekadmin@chem.ucsb.edu.