

ELEMENTARY SCIENCE PROGRAM
MATH, SCIENCE & TECHNOLOGY EDUCATION

A Collection of Learning Experiences on
MEET THE CREATURES

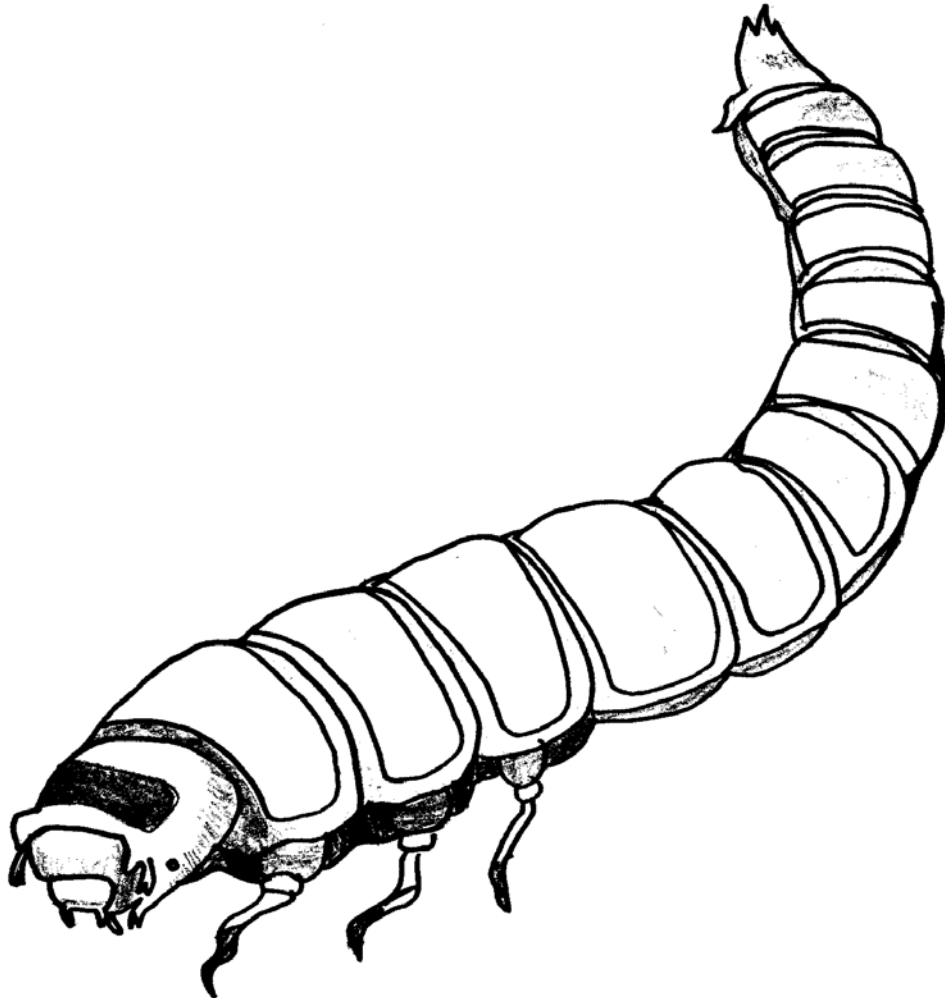


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MEET THE CREATURES

GRADES 5/6

Unit Overview

“Meet the Creatures” stimulates students to ask questions about the observable behavior of an unfamiliar organism and then directs them to ways of finding answers for themselves. As students observe and experiment, they learn some things about the process of scientific inquiry and about the sensory perception of the mealworm. The skills emphasized in this unit are: observing, collecting and organizing data, measuring, predicting, formulating hypotheses, identifying variables and inferring.

Scheduling

This unit may take from five to nine weeks to complete depending upon the goals of the teacher and interests of the students. Use of the section included in this manual called More Ideas may extend the time span of this kit.

Materials to be

obtained locally:

Please make **one** student activity book for **each** student.

notebooks
potatoes or apples
chart paper
felt tip markers
scotch tape
scissors
metric rulers
8 cm. x 8 cm. square red, yellow, black, blue, and white
construction paper
watch/clock
tape or glue
paper towels
pencils
materials necessary for experiment

Caution

Remind students to wash their hands after handling any of the materials in the kit.

About the Format

Each learning experience is numbered and titled. Under each title is the objective for the learning experience.

Each learning experience page has two columns. The column on the left side of the page lists materials, preparations, basic skills processes, evaluation strategy, and vocabulary. The evaluation strategy is for the teacher to use when judging the student’s understanding of the learning experience.

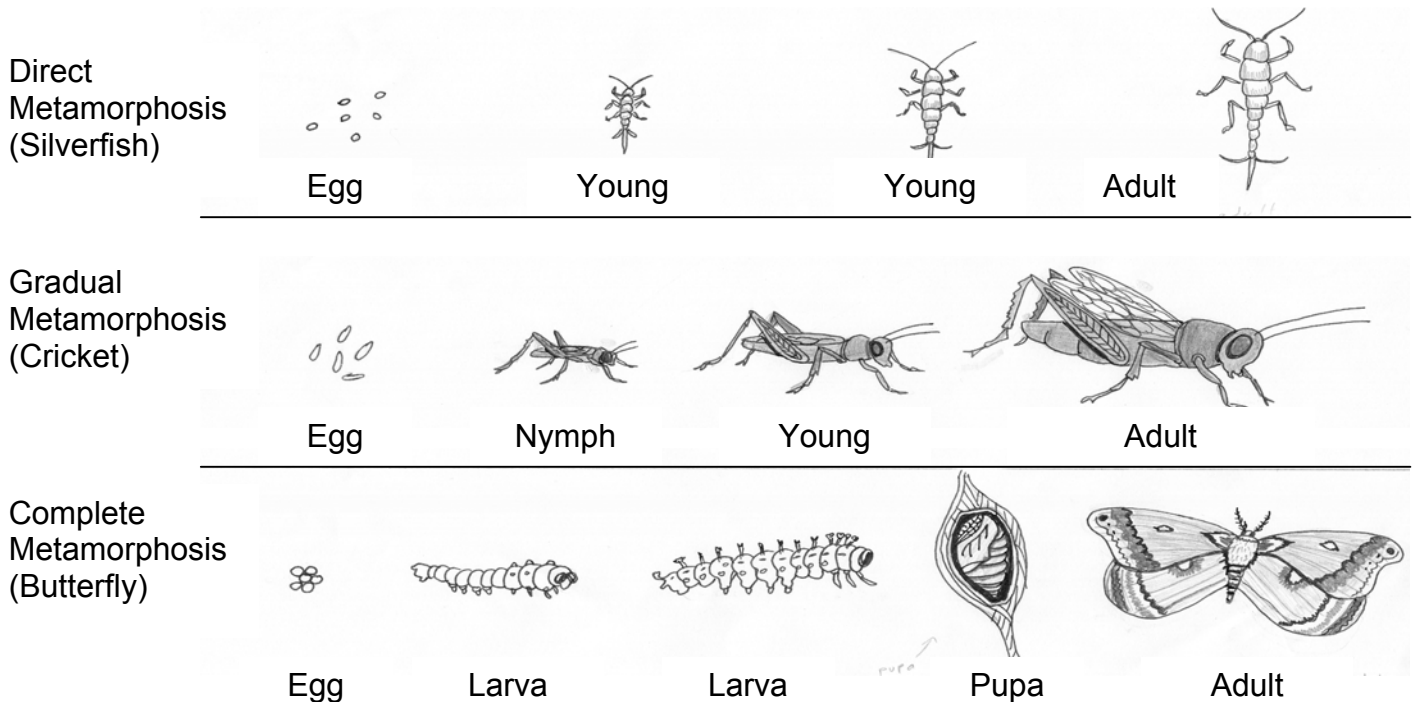
The right column begins with a “Focus Question” which is typed in italicized print. The purpose of the “Focus Question” is to guide the teacher’s instruction toward the main idea of the learning experience. The “Focus Question” is not to be answered by the students. The learning experience includes direction for students, illustrations, and discussion questions. These discussion questions can be used as a basis for class interaction.

A **Student Assessment** has been included in the **Teacher’s Manual** and the **Student Activity Manual**. If you do not want the students to have the assessment beforehand, remove it from the **Student Activity Manual** before printing a class set of the student manuals.

Background Information

Lifecycle of the Grain Beetle

Mealworms are the larvae of grain beetles (*Tenebrio molitor*). As most beetles, the grain beetle has four stages in its life cycle or **metamorphosis**. The four stages are egg, larva, pupa, and adult. These four stages indicate a **complete metamorphosis**. Other insects have a three stage metamorphosis. The three stages are egg, nymph, and adult. This three stage metamorphosis is called a **gradual metamorphosis**. The silverfish’s life cycle is a **direct metamorphosis**. In a direct metamorphosis, the insect hatches out of its egg and looks like an adult of that insect only smaller. It then grows to adult size.



Egg

The tiny eggs of the grain beetle are white, oval shaped and about one to one and a half millimeters long. They are covered with a sticky substance that causes them to become coated with foreign matter under favorable conditions. The eggs hatch in one-two weeks.

Larva

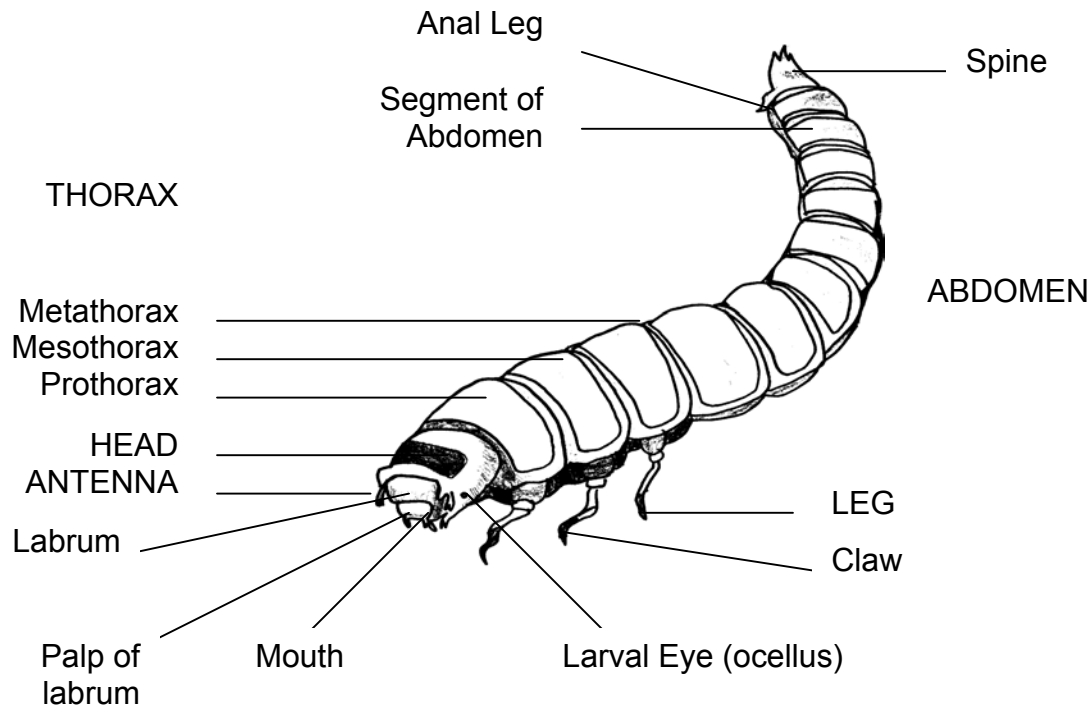
The newly hatched larvae are whitish in color, shading to a dark yellowish-brown with darker areas where their thirteen segments join. This stage lasts about four to five months under favorable conditions. The larvae (mealworm), which emerge from the egg, are capable of eating immediately. As the larvae grow, they become too big for their hard skin. Mealworms shed their skin or molt nine to twenty times, which allows them to grow larger. When fully grown, mealworms are about two and a half centimeters long and three millimeters in diameter.

Pupa

Fully developed mealworms change into inactive pupae. In the pupa stage, mealworms are changing to the adult beetle. Pupae are whitish in color at first and slowly turn yellowish brown in color. Pupae are inactive, but will react to being touched by flipping their hind segments back and forth. The pupae are shorter and fatter than fully grown mealworms. This stage lasts one to three weeks.

Adult

When the adult beetle emerges from the pupae they are completely white, but turn brown and finally black. The beetle's wings are vestigial, as they are not used in flight, and their movements are restricted to running on their three pairs of legs. Hops of 5-8 centimeters seem to be their limit. Their life span is only a few months. A single female beetle may lay up to five hundred eggs during her lifetime.



Natural Habitats of the Mealworm

Mealworms usually live in dark, damp places. They can be found in grain mill corners, under bags of feed, in warehouses, or in the litter of chicken houses. Mealworms are

scavengers who prefer to eat rotting grain, cereal, flour, bran, crackers, meal scraps, feather, and bodies of dead insects.

Helpful Hints

Mealworms are convenient subjects for experimentation both in school and at home since they are clean and odorless, requiring practically no care and are relatively inexpensive. In order to teach a successful unit you must have active mealworms. Mealworms are usually shipped in a plastic container and four or five handfuls of bran are added to the container. This amount will support 500 mealworms for many weeks. Fresh bran should be added when most of the old bran is powdery in appearance.

Very little water is needed by mealworms since they have the ability to extract/metabolize their water from the carbohydrates in their food. In spite of this fact, mealworms do seem to be attracted to moisture. It is be advisable to make water available by placing in their petri dish a small piece of potato or apple. Take care that the bran does not become too wet for it will become moldy and the mealworms will not grow well. The beetles must have a good supply of moisture in order to live and lay eggs. After their eggs have been deposited, the beetles die on top of the bran and should be removed. In order for the eggs to hatch, the bran should be left undisturbed for several weeks.

Inquiry/Scientific Method/Guided Inquiry

Experiments are often designed after making observation that leads to further questions. Experiments are designed to help answer those questions. This process is called inquiry and results in experiment design and utilizes the scientific method.

Experimental Design

This unit with begins students observing powders and crystals. Then students write experiments in which the powder and crystal has changed. As students begin to learn how to write experiments, you may find that teacher guidance will be necessary. The key to success is to start with simple experiments (like the ones in this unit) and give them time to practice and work with others as they are learning. With time and guidance, you will begin to see students understanding the concept of experimental design and be able to apply their knowledge to writing their own experiments.

There are five main components of experimental design:

1. Independent Variable
2. Dependent Variable
3. Control
4. Constants
5. Repeated Trials

A **variable** is the factor(s) that change in the experiment.

Independent Variable

The **independent variable** is the variable in the experiment that is purposefully changed or manipulated. All other factor should remain constant during the experiment. If you ask the question, “what did you change in the experiment?” your answer will lead

you to the independent variable. For example, let's say that you wanted to know if different amounts of fertilizer given to a plant effects its growth (height). You could set up an experiment with twenty identical plants and you fertilize five of the plants with five grams of fertilizer, five with ten grams of fertilizer, five with fifteen grams of fertilizer, and there are five plants that receive no (zero grams) of fertilizer. The different amounts of fertilizer you give to the various plants is the independent variable. The different amounts of fertilizer is the part of the experiment that you control. You made the change on purpose! It is important that there is only one independent variable in an experiment. If you have more than one independent variable, when you look at the results, you will not know which independent variable caused the results to occur. For example, if you give the plant different amounts of fertilizer and different amounts of plant food in the experiment, you will not know if it is the fertilizer or the food that causes the plant to grow taller.

Dependent Variable

The **dependent variable** is the variable that responds to the independent variable. The dependent variable occurs because you changed something in the experiment. In the experiment mentioned previously, we added different amounts of fertilizer to twenty plants. We are observing how the different amounts of fertilizer effects the growth (height) of the plant. The height that the plant grows is the dependent variable – it is the variable that you observe.

Title of Experiment

When you write the **title** of an experiment, it should include the independent variable and the dependent variable. The title is written in the following format:

The effect of the (Independent Variable) on the (Dependent Variable).

If we were to write a title for the plant experiment it would read:

The effect of different amounts of fertilizer given to a plant on the growth (height) of the plant.

Notice that the independent variable (different amounts of fertilizer given to a plant) effects the dependent variable (growth (height) of the plant).

Hypothesis

Students formulate a **hypothesis** “educated guess” or prediction before beginning their experiment that is designed to test the prediction. The hypothesis is a prediction about the relationship between the variables. The hypothesis is usually based on background knowledge and experiences with the materials/events of the experiment.

The hypothesis is written in the following format:

If I change an independent variable then the dependent variable will change.

If (Independent Variable) then (Dependent Variable).

If we were to write a hypothesis for the plant experiment it could read:
If I add ten grams of fertilizer to a group of five plants, then it will cause that group of plants to grow the tallest of all the groups (30 cm).

Some students may write “I think . . .” as the beginning of their hypothesis. When writing a hypothesis for experimental design the If ... then statement is preferred. Each student in the class may have a different hypothesis based upon what they believe will happen in the experiment.

Control

The **control** in an experiment is the standard for comparing the effects of the experiment. It is needed in all experiments because all the results are compared to it. For example, in the plant experiment, we added different amounts of fertilizer to the plants. The plant that receives no fertilizer (zero grams) is the control because it is unchanged and the growth of the other plants are compared to it. If the plant that receives no fertilizer hardly grows and the plants that received fertilizer do grow, then we know that the fertilizer had an influence on the growth of the plant.

Constants

The **constants** are all the factors that remain the same in an experiment. When an experiment is created, there is one variable or change that we make (independent variable.) Everything else in the experiment must stay the same. If it does not, then another variable is added into the experiment and, again, we will not know which variable caused the results.

Plant experiment:

Independent Variable – Different amounts of fertilizer.

Constants – Same type of plant, same soil used for each plant, same amounts of water given to each plant, same amounts of sunlight provided for each plant, plants located in same place.

Any one of the constants of an experiment could be made into an independent variable and another experiment would evolve.

Ex: Independent Variable – ***Different amounts of water for each plant.***

Constants – ***same amount of fertilizer***, same type of plant, same soil used, same amounts of sunlight provided for each plant, plants located in the same place.

This results in an unending supply of ideas/extensions of experiments.

Procedure

Every experiment needs to have a detailed list of procedures. The procedures in an experiment provide step-by-step direction of how the experiment was conducted. The steps should be detailed enough so someone else could read the procedure and be

able to recreate the experiment exactly how it was done. Asking students to write procedures to tasks they are familiar with may help them in writing scientific procedures for an experiment. Once students begin writing procedures, they begin to see that they should not “assume” the reader will conduct the next step as they did. If they do, they will see that the reader will vary from what the original experimenter did.

Repeated Trials

Repeated trials are the number of experimental repetitions. They increase the confidence of the results and conclusions by reducing the effects of chance or random errors that may occur in a single trial. In our plant experiment, we are added five grams of fertilizer to five plants, ten grams of fertilizer to five plants, etc. The five plants represent the repeated trials. Students should be asked the question, “How many times did you perform the experiment before making a conclusion?” In this unit, students repeat each level of the independent variable three times. More trials may be necessary if no conclusion can be made from those trials. The amount of repeated trials in an experiment should be determined by time, expense, the amount of variation in the organisms used, and the consequences of coming to a wrong conclusion. The reliability factor of repeated trails makes it a necessary part of results from an experiment.

Results

The results are the outcome of the experiment. The results are the collected data or information found by observing, measuring, and carefully recording the date.

Conclusion

A **conclusion** in an experiment describes the major findings of an experiment, an explanation for those findings, and recommendations for further study. Students should remember that there is no such thing as a perfect experiment so there is always ways it can be improved. In this unit, students answer three questions in their conclusions to summarize the results of their experiment. The results of the experiment are to also be provided in a table and graph format that proceeds the conclusion. Analyzing their table and graph will help students in writing their conclusions.

Dear Parent:

Your child is now working on a science unit entitled **Meet the Creatures**.

Meet the Creatures stimulates children to ask questions about the observable behavior of an unfamiliar insect, mealworms, and then directs them to ways of finding answers to those questions.

Mealworms are clean, odorless and require practically no care, so they are excellent for experimentation.

In their attempt to solve these problems, the pupils ask questions, devise experiments, isolate and control variables, observe, measure, make charts, keep records, design and build equipment, predict, and draw conclusions. This process of investigation is the most important thing that children will learn from this unit. An advantage of using mealworms is that pupils must rely on their own evidence, since little information on mealworms is available. Humane treatment of animals is stressed throughout this unit.

Most of the investigations are done at school, but follow-up experimentation at home is sometimes desirable or necessary. Therefore, we are planning to give your child his/her own mealworms which he/she may take home. However, this can only be allowed if written permission is given. If you give your child consent to bringing their mealworms home, please sign the lower portion of this letter and return it to school with your child.

Your encouragement of your child's experimentation with mealworms in your home should be a satisfying experience for both you and your child.

Sincerely,

_____ has my permission to
bring mealworms home for experimentation.

Signature of Parent/Guardian

Learning Experience 1: Care of Mealworms

Objective: Students will prepare a mealworm culture and discuss the humane treatment of mealworms.

Materials:

For each student:

Meet the Creatures Student Activity

Book

3-5 mealworms

Petri dish

Double lens magnifier

Oatmeal

Popsicle stick

Notebook*

Piece of potato or apple*

For the class:

Chart paper*

Felt tip markers*

*provided by teacher

Preparation:

Read background information on mealworms on pages 4-6. This unit lends itself to individual experimentation and the keeping of individual notebooks.

Small pieces of apple or potato will need to be cut and be placed in the petri dish.

Basic Skills Development:

Discussing

Observing

Brainstorming

Evaluation Strategy:

Students will demonstrate the proper care of mealworms for the duration of this unit.

Vocabulary:

humane

care

handle

adopt

How should we take care of our mealworms?

Each student is to use a popsicle stick to remove three to five mealworms from the large container to their petri dish. Before students add the oatmeal to the petri dish, ask students to observe the mealworm's behavior, especially how it walks, with a double lens magnifier. Because the petri dish is clear, students could even observe how it walks from underneath the petri dish.

Discussion Questions:

Is there anything unusual about how the mealworm walks?

What are the steps it takes? Describe them.

Does it use the back of its legs?

Small handfuls of oats and a piece of apple or potato then can be added to the petri dish for food and moisture for the mealworms. Students can observe their mealworms again for different behaviors.

Discussion Questions:

How do the mealworms react to the bran?

Where do they seem to go in the petri dish?

How do they react to each other?

Discuss the handling and humane treatment of the mealworms. (A discussion of the care of other animals can be incorporated into this learning experience.)

As a class, brainstorm possible rules for humane treatment of mealworms.

Learning Experience 1 continued

Page 2

Combine student ideas into a list of 3-4 rules to be posted in the classroom or written in a notebook.

HUMANE TREATMENT OF MEALWORMS (Sample)

- 1. Handle your mealworm with care.**
- 2. Keep chemicals and other harmful substances away from the mealworms.**
- 3. Provide the mealworm with proper food and shelter.**

Once the class has come to a conclusion on some rules to follow on how to treat the mealworms, they can “formally” adopt them by using the adoption certificate on their activity sheet for Learning Experience #1 in the Meet the Creatures Student Activity Book.

Learning Experience 2: “Meet the Creatures”

Objective: Students will observe and identify the body parts of the mealworm, and explain their function.

Materials:

For each student:

Meet the Creatures Student Activity Book

Mealworm culture (petri dish)

Double lens magnifier

For the class:

Mealworm pictures

Preparation:

Read background information on of the parts of a mealworm on pages 4-6.

Basic Skills Development:

Observing

Discussing

Describing

Evaluation Strategy:

Students will accurately observe and identify the parts of the mealworm and correctly label the body parts of a mealworm.

Vocabulary:

segment

antennae

skeleton

magnify

observe

thorax

abdomen

What does the mealworm look like?

Students are to observe the mealworms without the double lens magnifiers and on the activity sheet for Learning Experience #2 in the Meet the Creatures Student Activity Book check off on the chart what parts of the mealworm they are able to observe. They are to then observe the parts of the mealworm with the double lens magnifiers and check off on the chart on their activity sheet what parts of the mealworm they observe with the double lens magnifier. Students are to make any notes of mealworm behavior in the last column of the chart on the activity sheet. Students may also make drawings to show details of the structures that they find on the mealworm’s head and body.

Discussion Questions:

Are there hairs on the mealworm? If so, where are they located?

How many segments does the mealworm have?

Does the mealworm have eyes?

Do all mealworms look alike?

How many legs does a mealworm have?

Describe how they walk/move?

Do the mealworms turn left or right most often?

How long is your mealworm?

How fast does your mealworm move?

Students are then to complete page 2 of the activity sheet for Learning Experience #2 in the Meet the Creatures Student Activity Book and label the parts of the mealworm.

Learning Experience 2 continued

Page 2

Answers to Activity Sheet (See page 5)

1. antennae
2. head
3. thorax
4. abdomen
5. anal leg
6. segment of abdomen
7. leg
8. claw
9. larval eye
10. mandible (jaw)

Learning Experience 3: Life Cycle of the Grain Beetle

Objective: Students will identify the stages of the lifecycle of the grain beetle and explain the importance of each stage.

Materials:

For each student:

Meet the Creatures Student Activity Book

*provided by teacher

Preparation:

See background information on lifecycles on pages 4 and 5. Students will observe these stages of the grain beetle's lifecycle throughout the unit.

Basic Skills Development:

Gathering & Organizing Data
Discussing

Evaluation Strategy:

The students will identify and place in the correct order the four stages of growth of the grain beetle and explain the importance of each stage.

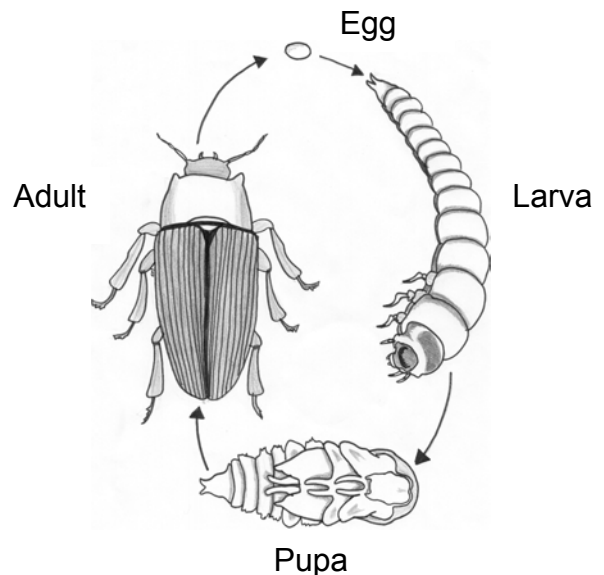
Vocabulary:

metamorphosis
larva (larvae)
pupa (pupae)
population

What is a grain beetle?

Discuss with students that metamorphosis means "change," and that insects go through a life cycle that results in many changes in the insect's development. The mealworm is the larva state of the grain beetle.

Eventually, it will go into a pupa stage where it will transform into a grain beetle. This adult insect will lay the eggs that the mealworms hatch from.



Students are to complete the activity sheet for Learning Experience #3 in the Meet the Creatures Student Activity Book. The second part of the activity sheets (pages 2 and 3) asks students to tally and graph the mealworm population in the classroom.

Discussion Questions:

How does the grain beetle's metamorphosis compare with the metamorphosis of other insects?
Is there a pattern that you observe in the mealworm population in your class?
Approximately how long have you found each part of the cycle to last?

Learning Experience 4: Mazes and Mealworms

Objective: Students will construct a maze, observe a mealworm's behavior in the maze, and formulate a hypothesis as to how it senses where to move.

Materials:

For each student:

Meet the Creatures Student Activity Book

Mealworms

White construction paper*

Scotch tape*

Scissors*

Metric ruler*

*provided by teacher

Preparation:

A sample of the finished maze may help students construct their maze.

Basic Skills Development:

Measuring

Observing

Describing

Discussing

Evaluation Strategy:

Students will accurately measure and construct a maze for their mealworms and make detailed observations of the mealworm's behavior in the maze and base their hypothesis on their observations.

Vocabulary:

maze

accurate

hypothesis

centimeters

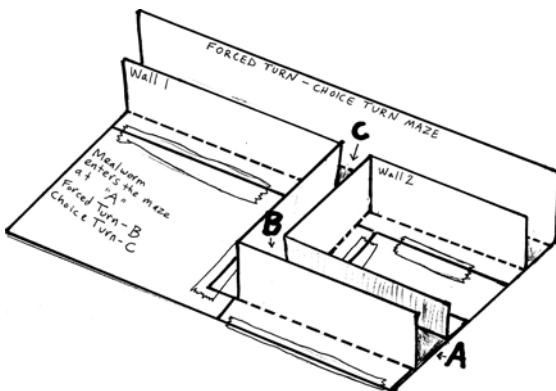
How do mealworms find their way in a maze?

Discuss with students what a maze is and if they think their mealworm could find its way through a maze.

Students will use the diagrams provided on their activity sheet for Learning Experience #4 in the Meet the Creatures Student Activity Book and their metric rulers to create the maze base and walls out of white construction paper.

There is a fold at the bottom of each strip used for a wall so the piece can be taped onto the base of the maze. Students must remember to make a cut at the vertical folds (1 cm) so the pieces will attach properly.

Notice the wall at the top of the maze base simply folds up. The dotted line illustrates the fold. (Technique: If students place their ruler on any of the fold dotted lines and use their pencil to draw over the dotted line several times, then the piece will fold up easily and accurately.)



Learning Experience 5: Writing Experiments

Objective: Students will demonstrate their understandings of the types of variables in an experiment by identifying the variables in sample scenerios and explaining their importance.

Materials:

For each student:

Meet the Creatures Student Activity Book

For the class:

Chart paper*
Felt tip markers*

*provided by teacher

Preparation:

Read background information on writing experiments on pages 6-9.

Basic Skills Development:

Brainstorming
Observing
Discussing
Identify Variables

Evaluation Strategy:

Students will identify the variables and constants of sample experiments and explain the importance of having only one variable in an experiment.

Vocabulary:

variables
independent variable
dependent variable
fair test
constant

How are variables used in an experiment?

On chart paper, make a list of observations that the students have made about their mealworms. (e.g. prefer dark places, how they walk, how they find their way through a maze, behaviors, etc.)

Explain to students that now that we have observed the mealworms in its natural environment, we are going to change its environment and make some new observations. Discuss with students their knowledge about writing experiments. Introduce the word **variable** to the class. Explain that there are two kinds of variables in an experiment: independent variable and dependent variable. Define each with students. Remind students that even though we change one thing in an experiment. There are many things that need to remain the same in order for the experiment to represent a fair test. These items that remain the same are the constants.

Read each scenerio to students on their activity sheet for Learning Experience #5 in the Meet the Creatures Student Activity Book and identify the independent variable, dependent variable, and constants for each.

Learning Experience 5 continued

Page 2

Answers to activity sheet:

Scenerio 1 –

Independent Variable - Colored mashed potatoes

Dependent Variable – Student choice of color of mashed potatoes

Sample constants – same amount of food coloring, same amount of potatoes, same students to choose colors if experience is done over several days, same kind of potatoes used, same brand of food coloring, each mashed potato sample must show same consistency, must be displayed the same way

Scenerio 2 –

Independent Variable - Amount of water added to the pots

Dependent Variable – Height of plants

Sample constants – same seeds, same pots used, same soil used, same amount of soil, watered at same time of day, same amount of light, plants in the same location, same instrument used daily to measure height, same person to measure the height

Scenerio 3 –

Independent Variable - Different brands of oil

Dependent Variable – Number of popcorn kernals popped after five minutes

Sample constants – same brand of popcorn, same amount of oil, same amount of popcorn (number of kernals), same amount of heat to pop kernals, same type of heat (gas or electric)

Discussion Questions:

Why is it important to have only one independent variable in an experiment? (We know that it is truly causing the results to occur.)

What if we have two independent variables? (We are not sure which variable is causing the results.)

Why is it important to have constants in an experiment? (Make sure the experiment is a fair test and the results are accurate and only one variable has been changed.)

Learning Experience 6: Mealworm Color Preference

Objective: Students will identify the variables and constants for an experiment concerning color preference of their mealworms and develop title and hypothesis using the variables. Students will conduct an experiment and gather and analyze data from the results to formulate a conclusion.

Materials:

For each pair of students:

2 Meet the Creatures Student Activity Books

Mealworms

8 cm x 8 cm squares of red, yellow, blue, black, and white construction paper*

Watch/clock*

Tape or glue*

Metric ruler*

Scissors*

*provided by teacher

Preparation:

Read background information on writing an experiment on pages 6-9. A model of the color block may help students put together their color block.

Basic Skills Development:

Formulating Hypothesis

Predicting

Measuring

Observing

Identifying Variables

Gathering & Organizing Data

Interpreting Data

Discussing

Evaluation Strategy:

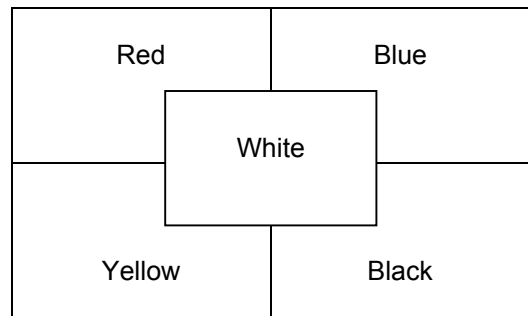
Students will accurately identify the variables, constants, title and hypothesis for the experiment and analyze the data collected to make a conclusion based on the data.

Vocabulary:

variable	constant
results	independent variable
conclusion	dependent variable
hypothesis	data
prediction	repeated trials

Do mealworms prefer certain colors?

Ask student pairs to put together their color block as shown in the picture below.



Explain that we are using the color block to see if the mealworm has a color preference. The mealworms will be placed on the white square and then students will observe where it moves. Students will tally how many times the mealworm moves to each color.

Have students complete the activity sheet for Learning Experience #6 in the Meet the Creatures Student Activity Book. With this information, ask students to identify the independent variable and dependent variable for this experiment. (Independent variable – five different color choices provided red, yellow, blue, black, and white. Dependent variable – which color the mealworm goes to. Constants – same mealworm used, same amount of time given for mealworm to make its choice, same surface used, same amount of light in the room, point the mealworm in the same direction each trial.

Learning Experience 6 continued

Page 2

Students are then to write a title for this experiment. A title is written with the independent variable and dependent variable in mind so the reader knows what is involved in an experiment. It is written as: The effect of the independent variable on the dependent variable.

A sample title for this experiment could be: The effect of providing different color walking surfaces for the mealworm on the color preference the mealworm will choose.

Next, students must make an educated guess about the effect of the change they made based on previous observation of the mealworm. Which color do they think the mealworm will go to the most?

A hypothesis is an if...then statement. If independent variable then dependent variable.

A sample hypothesis for this experiment could be: If the mealworm is given the color choices of red, blue, yellow, and black to walk on, then the mealworm will choose black most often. (15 out of the 20 trials) Student hypotheses will vary.

Students are to perform the experiment with their mealworms and color squares. Students are to tally on their data chart on their activity sheet the number of times the mealworm walks to each color. As a class, decide how many trials will be completed and how many minutes each trial will last. Graph final results on the activity sheet.

In writing the conclusion to the experiments, students are to answer three essential questions. What were the major findings? What possible explanation can you give for the findings? How could this experiment be improved? Discuss these questions with students after they have completed the experiment. Students may identify ways to improve their experiment from their behaviors (timing was not accurate, mealworm pointed in different directions) or based on the structure of the experiment.

Discussion Questions:

Compare your results with the results others in the class. How do they compare? Why are results different than others?

Do you think the mealworm has a sense of sight? Why or why not?

Extension:

What kind of change could we make to this experiment to take this experiment further? (Students sometimes say that whatever color is in front of the mealworm is the one it goes to. Try turning the color block and point the mealworm in the same direction to see if this is true.)

Learning Experience 7: Backing Up

Objective: Students will identify the variables, constants, control, title, and hypothesis for an experiment that helps identify if the mealworm has a sense of smell.

Materials:

For each pair of students:

2 Meet the Creatures Student Activity

Books

Alcohol dropper bottle

Vinegar dropper bottle

Ammonia dropper bottle

7 oz. paper cup (for water)

Eyedropper (for water drops)

4 Q-tips

Metric ruler*

Paper towel*

Water*

*provided by teacher

Preparation:

Read background information on writing an experiment on pages 6-9.

Demonstrating the set up of the experiment on the paper towel may help the students with their setup.

Basic Skills Development:

Formulating Hypothesis

Predicting

Measuring

Observing

Identifying Variables

Gathering and Organizing Data

Interpreting Data

Discussing

Evaluation Strategy:

Students will accurately formulate the variables, constant, control, title and hypothesis for the experiment and analyze the data collected to make a conclusion based on the data.

Vocabulary:

variable

constant

independent variable

control

dependent variable

hypothesis

constant

ammonia

Does the mealworm have a sense of smell?

Ask students “what could we do to find out if the mealworm has a sense of smell.” Discuss with students. Creating an experiment with strong smelling liquids is provided in this learning experience to see if the mealworm has any sense of smell. The experiment could be altered or changed to meet the students’ ideas for an experiment to discover the mealworm’s sense of smell.

Demonstrate for students the set up of the experiment and review the steps. Place four “X’s” on the paper towel (5 cm. apart) where the mealworm will be placed and place a dot 1 cm. away in front of “X” to show where each Q-tip will be placed. Then students will place three drops of water on a Q-tip, three drops of alcohol on a Q-tip, three drops of vinegar on a Q-tip, and three drops of ammonia on a Q-tip. They should place only the water Q-tip on a dot first. And then they should place the mealworms on the “X” in front of the water Q-tip.

Students will then count how many steps the mealworm moves backwards away from the Q-tip. Repeat three times and find the average number of steps. Complete the same procedure for alcohol, vinegar, and ammonia, at different “X’s” on the paper towel each time.

Ask students to identify the variables and constants for this experiment and record their information on their activity sheet for Learning Experience #7 in the

Learning Experience 7 continued

Page 2

Meet the Creatures Student Activity Book.

Answers to activity sheet:

Independent variable – placing drops of alcohol, vinegar, ammonia, and water in the mealworm's path.

Dependent variable – number of steps the mealworm walks backwards.

Constants – same mealworm used, same criteria for a step backwards, same surface used, same number of liquid drops to Q-tip, placing mealworm in same location for each liquid at each trial, placing Q-tip the same distance away from the mealworm.

Students will see a new word on their activity sheet – **control**. The control of an experiment is the Q-tip that was with plain water. It is used to detect or measure the influence of the Q-tips with the liquids added. If the mealworm does not move backwards with the Q-tip treated with water (a liquid with no odor), but does when the vinegar Q-tip is used, then the vinegar may have affected the mealworm. If the mealworm walks backwards with the Q-tip treated with water, then it may not be the smells that is making the mealworm walk backwards. It may just see the Q-tip as an obstacle.

Sample: **Title of Experiment:**

The effect of various strong smelling liquids placed in the mealworm's path on the number of steps the mealworm walks backwards.

Sample: **Hypothesis:**

If the ammonia is placed in the mealworm's path, then it will result in the greatest number of steps taken backwards by the mealworm (8 steps).

Sample: **Conclusions:**

Answers will vary.

Learning Experience 8: Procedures

Objective: Students will develop a procedure for an experiment.

Materials:

For each pair of students:

2 Meet the Creatures Student Activity Books
Pencil*

For the class:

Materials for introductory task of choice*

*provided by teacher

Preparation:

Read background information on procedure on pages 8 and 9.

Basic Skills Development:

Communicating
Discussing
Describing
Observing

Evaluation Strategy:

Students will develop a procedure for an experiment that includes the information needed to answer the four questions provided.

Vocabulary:

procedure
repeated trials

What are the steps for conducting an experiment?

Have students complete the activity sheet for Learning Experience #8 in the Meet the Creatures Student Activity Book. In the experiments the students have completed so far, there has been no written procedure included in the report. To help students understand the importance of a procedure in an experiment, ask for a volunteer to write the directions to complete a task. (ex. making a peanut butter and jelly cracker sandwich, tying a shoe, washing a blackboard).

Collect papers and ask several students to try to complete the task following their own directions. Do not let them do any part of the task until the directions tell them so. In the example of making a peanut butter and jelly sandwich, students will find they are forgetting steps like opening the jar of peanut butter or opening the box or crackers. If they forget a step, the student sits down and another student tries. After several attempts, repeat the exercise again after groups of students have worked on writing a thorough procedure.

Explain to students that the procedures they write for their experiments must allow anyone to conduct their experiments exactly as they did.

Ask students to refer back to the last experiment they did in Learning Experience #7. Ask students to reread their experiment to recall what they did so they are able to work with a partner and write a procedure for that experiment.

Learning Experience 8 continued

Page 2

Students should ask themselves four questions after writing a procedure.

1. Did I include all the steps?
2. Did I include a list of materials/equipment?
3. Did I indicate the number of repeated trials?
4. Could someone else read this procedure and complete this experiment?

Sample procedure:

Materials: mealworm, alcohol dropper bottle, vinegar dropper bottle, ammonia dropper bottle, paper towel, four Q-tips, ruler, activity sheet, pencil.

Step 1: Place four "X's" on the paper towel (5 cm. apart) where the mealworm will be placed and place a dot 1 cm. away in front of "X" to show where each Q-tip will be placed.

Step 2: Add three drops of each liquid to a Q-tip.

Step 3: Pick up the mealworm and place it on the first "X" on the paper towel.

Step 4: Place the Q-tip with the water drops added to it in front of the mealworm on the dot in front of the first X.

Step 5: Count how many steps backwards the mealworm takes and record it on data chart.

Step 6: Repeat steps 4 and 5 for two more trials.

Step 7: Repeat steps 4-6 with the Q-tips that have the drops of alcohol, vinegar, and ammonia on them.

Learning Experience 9: Writing Your Own Experiments

Objective: Students will write a new experiment by changing one of the variables/constants in a previously conducted experiment.

Materials:

For each pair of students:

2 Meet the Creatures Student Activity Books

Materials necessary for experiment *

*Some materials may need to be provided by teacher/student

Preparation:

Read background information on writing experiments on pages 6-9. Depending on the comfort level of the students, they may need to be guided in writing their own experiments, as in Learning Experiences 5 and 6. The brainstorming list they create in this learning experience can result in multiple experiments students can try.

Basic Skills Development:

Brainstorming
Discussing
Formulating Hypothesis
Measuring
Describing
Gathering & Organizing Data
Identifying Variables
Interpreting Data

Evaluation Strategy:

Students will write their own experiment to include the variables, constant, control, hypothesis, procedure, and conclusion.

Vocabulary:

variable	control
independent variable	data
dependent variable	hypothesis
procedure	prediction
constant	results

How do I begin writing my own experiments?

Ask students to refer back to Learning Experiences #6 and #7 when we completed our experiments and ask them to identify the variables. Have students complete the activity sheet for Learning Experience #9 in the Meet the Creatures Student Activity Book

Learning Experience #6

Independent variable – five color choices provided (red, yellow, blue, black, and white)

Dependent variable – which color does the mealworm go to.

Learning Experience #7

Independent variable - placing drops of water, alcohol, vinegar, and ammonia in the mealworm's path.

Dependent variable – number of steps the mealworm takes backwards.

Explain that scientists, after completing an experiment, will change the variables and try the experiment a little differently to verify the results.

Ask students how we could change the variable/constants to change the experiment.

Same list:

Independent variable from Learning Experience #6 – use colors in different order on the color mat, create a color

Learning Experience 9 continued

Page 2

mat with only black and white construction paper. Create mat with the two highest color choices to see which one the mealworm really likes, change the mealworm, use sandpaper and waxed paper instead of construction paper, use black in the center of the color mat instead of white, turn the mealworm in the opposite direction from the last experience.

If the materials constant/variable changes, it changes the whole experiment. Results can be compared. The same can occur with the experiment in Learning Experience #7. Instead of the items used in this experiment: use different liquids, use types of spices, use perfume, put drops directly on paper towel, use a different mealworm.

Students can create an experiment of their choice that is a spin off of Learning Experience #6 and 7 or they can use the brainstormed list to help them choose their focus. Some students may feel comfortable with developing an experiment completely different from the experiments already done and may want to bring materials from home. It is suggested that students share their experimental ideas with you before they begin. They should develop an independent variable and dependent variable that is acceptable before bringing in materials. If students are not yet ready to develop their own experiments, their brainstormed lists can offer ideas for additional whole class experimentation.

Name: _____

Date: _____

Meet the Creatures Student Assessment

Directions: Read the question carefully and answer based on your knowledge about meet the creatures. Circle the correct answer.

1. Four stages in an insects life cycle would suggest the insect would go through:
 - a. partial metamorphosis
 - b. incomplete metamorphosis
 - c. complete metamorphosis
 - d. direct metamorphosis

2. The final stage in any metamorphosis is the
 - a. egg
 - b. pupa
 - c. larva
 - d. adult

3. The factor that is changed in an experiment is the
 - a. hypothesis
 - b. variable
 - c. control
 - d. constant

4. A prediction about the relationship between an independent and a dependant variable is also known as the
 - a. hypothesis
 - b. conclusion
 - c. title
 - d. procedure

5. The standard to which you compare the results of your experiment is called the
 - a. hypothesis
 - b. variable
 - c. control
 - d. conclusion

6. The variable in an experiment that you purposely change is called the
 - a. constant variable
 - b. independent variable
 - c. dependant variable
 - d. static variable

7. The variable that responds when you change something in an experiment is called the
 - a. constant variable
 - b. independent variable
 - c. dependant variable
 - d. static variable

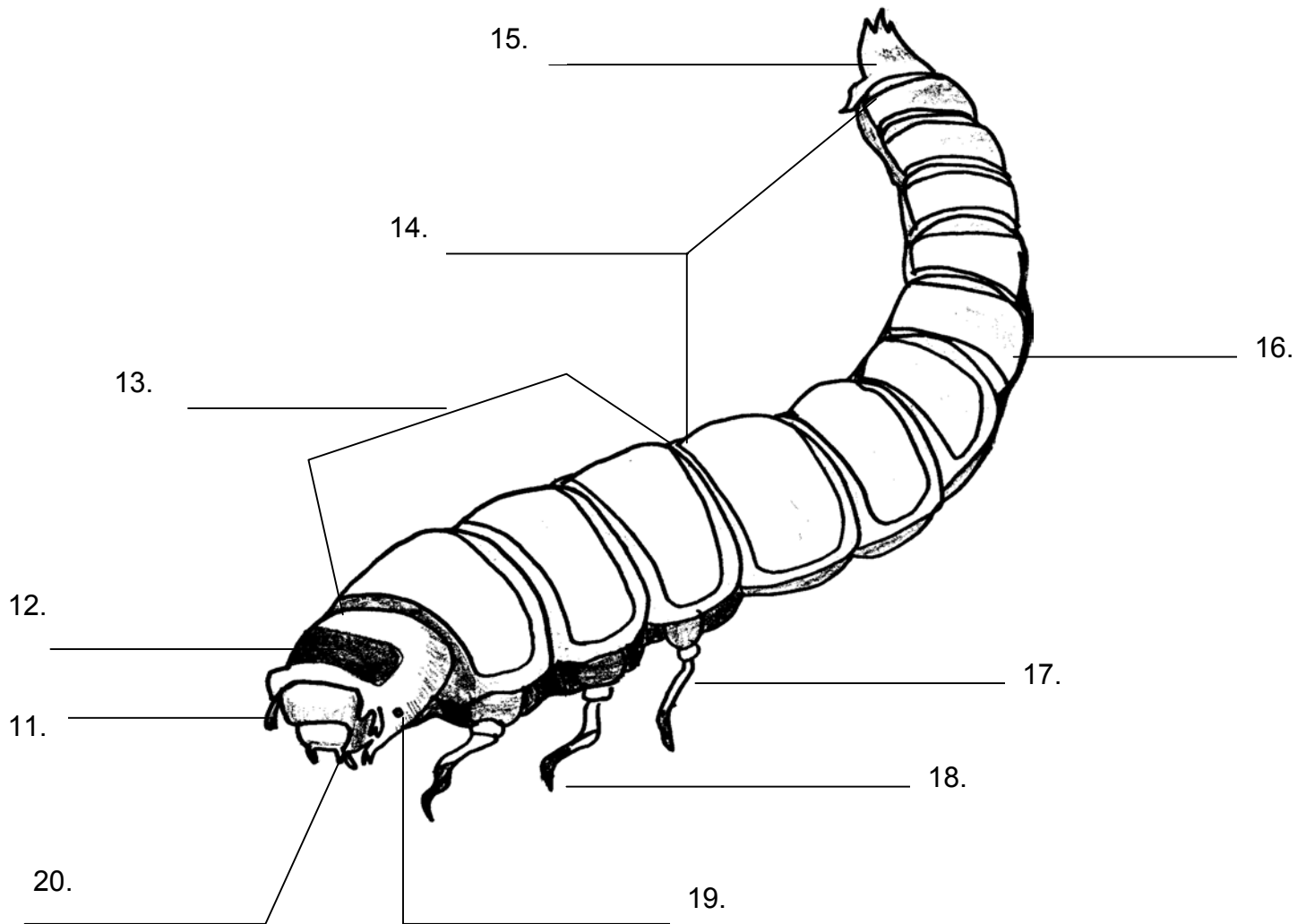
8. All the factors that remain the same in an experiment are called the
 - a. hypothesis
 - b. variable
 - c. control
 - d. constants

9. The step-by-step set of instructions that tell how the experiment was conducted is the
 - a. hypothesis
 - b. conclusion
 - c. title
 - d. procedure

10. In an experiment, the major findings and results are summarized with an explanation of the findings in the

- a. hypothesis
- b. conclusion
- c. title
- d. procedure

Label the diagram of the mealworm with the appropriate body parts.



21. Why is it important to have only one independent variable in an experiment?

22. What if we have two independent variables?

23. Why is it important to have constants in an experiment?

Meet the Creatures Student Assessment Key

1. C
2. D
3. B
4. A
5. C
6. B
7. C
8. D
9. D
10. B
11. Antenna
12. Head
13. Thorax
14. Segments of abdomen
15. Spine
16. Abdomen
17. Keg
18. Claw
19. Larval Eye
20. Mouth
21. So we know that it really is the variable that is causing the results to occur.
22. We cannot be sure which variable is causing the results to occur.
23. Constants show the experiment is a fair test, the results are accurate, and that only one variable is being tested.

MORE IDEAS

Language Arts

- ◆ Write a report on an insect of choice. Reports should include information about the insect's life cycle, physical characteristic, unique features, and its effect on man. This can be shared with the class orally using a power point presentation.
- ◆ Students can write a biography for their mealworms. They could even write it for a different audience (first graders) then share it with the first grade class.
- ◆ Create a database of different insects.
- ◆ Pretend you are only one half a centimeter tall. Write about what your day would be like, what you would see down there.

Book Suggestions: Mason, Adrienne. Mealworms: Raise Them, Watch them, See Them Change
 Schaffer, Donna. Mealworms
 Kalman, Bobbie and Jacqueline Langille. What Is A Life Cycle (Science of Living Things)
 Sill, John and Catherine P. Sill. About Insects: A Guide for Children
 Greenaway, Theresa. 3D Eyewitness
 Mount, Laurence. Amazing Insects
 Stone, Rosetta. Because A Little Bug Went Ka-Choo
 Naylor, Phyllis Reyonds. Beetles Lightly Toasted

Art

- ◆ Create an insect collage based on an insect (e.g. grasshopper theme, green pictures, people hopping)
- ◆ Design an imaginary mechanized insect (drawing in 3D) that includes head, thorax, and abdomen and other body parts that have a specific function. Be prepared to explain the function of those parts.

Social Studies

- ◆ Research how insects can be harmful or helpful to humans or plants and any major role they played in history.
- ◆ Discuss colonies and how they work or do not work together.

Math

- ◆ Measure the length of the mealworm every other day and graph the results over 2-3 weeks.
- ◆ Measure the distance the mealworm moves in one minute. Use a venn diagram to compare mealworms to other worms.

Science

- ◆ Research a variety of insects to create an insect dictionary that includes a description of the insect and the type of metamorphosis it goes through.
- ◆ Write stories about your mealworm – “A Day in the Life of the Mealworm” or write a story from the point of view of the mealworm.
- ◆ Write a poem about your mealworm after making your observations.
- ◆ Compare body structures, life histories, and habitats of insects and spiders.
- ◆ Provide a variety of food choices for the mealworm to see what other kinds of food it prefers. (different cereals, bran flakes, dry dog food, carrot). Create an experiment.
- ◆ Place bran at one end of a piece of paper and the mealworm at the other end. Trace the mealworm’s path as it is looking for its food. Use the different color pencils for different mealworms and compare paths.

INQUIRY AND PROCESS SKILLS

Classifying	Arranging or distributing objects, events, or information in classes according to some method or system.
Communication	Giving oral and written explanations or graphic representations of observations.
Creating Models	Displaying information by means of graphic illustrations or other multi-sensory representations.
Formulating Hypothesis	Constructing a proposition or assumption of what is thought likely to be true based on reasoning, which serves as a tentative testable theory.
Gathering & Organizing	Collecting information about objects and events which show a specific situation.
Generalizing	Drawing general conclusions from information.
Identifying Variables	Recognizing the characteristics of objects or events which are constant or change under different conditions.
Inferring	Making a statement or conclusion based on reasoning or prior experience to explain an observation.
Interpreting Data	Analyzing information that has been collected and organized by describing apparent patterns or relationships in the information.
Making Decisions	Choosing an alternative from among several and basing the judgment on defensible reasons.
Manipulating Materials	Handling or treating materials, equipment or procedures skillfully and effectively.
Measuring	Making quantitative observations by comparing to a standard.
Observing	Becoming aware of an object or even by using any of the senses to identify properties.
Predicting	Making a forecast or estimate of what future events or conditions may occur.

GLOSSARY

Abdomen:	the lower portion of an insect's body, below the thorax.
Accurate:	correct, exact, or precise.
Adopt:	to take as one's own.
Ammonia:	a strong smelling liquid used in the manufacturing of chemicals.
Antenna:	moveable sense organ on the head of insects.
Care:	protecting or to watch over
Centimeters:	one hundredth of a meter.
Conclusion:	a statement based upon the results of data.
Constant:	the factors that remain the same in the experiment.
Data:	facts or information collected for analysis.
Dependent variable:	the variable that responds to the change of the independent variable.
Fair test:	a scientific test where there are specific items that remain constant.
Handle:	to touch, pick up, or handle with the hands.
Humane:	characterized compassion and sympathy for human beings and animals.
Hypothesis:	an educated guess which the researcher tells how he/she thinks the independent variable will affect the dependent variable.
Independent variable:	the variable that is purposely changed in an experiment.
Larva (Larvae):	the worm-like stage of most insects following the egg and before the pupa stage.
Magnify:	to increase the size of an object as with a lens.
Maze:	a confusing network of paths or passages.

Metamorphosis:	a change in body structure from egg to adult.
Observe:	to become aware of an object or event by using any of the senses to identify properties.
Population:	the number of people or animals living in one place.
Prediction:	an educated guess.
Procedure:	a step-by-step course of action in an experiment.
Pupa (Pupae):	the stage between the larva and adult stages characterized by long period of rest.
Repeated trials:	to complete an experiment over and over again to increase the confidence in the conclusion and reduce effects of human error.
Results:	the outcome or effect of an experiment.
Segment:	one of the parts of something naturally divided.
Skeleton:	the bony framework of an animal's body.
Thorax:	the portion of an insect's body between the head and abdomen.
Variables:	changes in an experiment that are either purposely changed or a response to a change.

TEACHER REFERENCES

Bug Book: Hands-On-Activities, Background Information, Literature Links by Robin Bernard

Bugs: The Encyclopedia of Creepy-Crawlies by Tony Gibbons

Media Library

Call the media library to order media materials and to check on new materials that are available. The number to be reached is (716) 376-8212.

Web Sites

<http://bugbios.com>

<http://www.ex.ac.uk/bugclub/>

<http://www.yucky.com>

Major Science Concepts To Be Addressed

Living objects, including plants and animals, live and thrive when their needs are met.

Each animal, including humans, has properties that enable the animal to meet its needs.

The parts of animals have functions which help the animal to live and thrive.

Wings, legs or fins enable some animals to seek shelter, and to escape predators.

The mouth, including teeth, jaws and tongue enables some animals to eat and drink.

Eyes, nose, ear, tongue and skin of some animals enable the animal to sense their surroundings.

Each kind of animal goes through its own stages of growth and development during the life span of the animals.

Animals go through a particular set of stages from infancy to adult.
For example:

Many insects go from egg to larva to pupa to adult

Animals have life spans of varied length.
For example:

a mealworm compared to a dog
one mealworm compared to another mealworm

Some animals, including humans, move about and meet their needs.
For example:

seeking shade, food or water
seeking escape from danger

Each kind of plant or animal continues beyond the life span of the individuals because each kind is able to produce offspring.

Adult female animals are able to produce enough young suited to survive to produce the next generation of that kind of animal.

Each generation of animals goes through changes in form from young to adult. The adult gives rise to the young of the next generation. This completed sequence of changes in form is called a life cycle.

Some types of young animals are able to live and thrive without depending on adults of the previous generation for care. For example:

Mealworms

Animals have the potential to produce numerous offspring during their adult stage.

Under actual conditions, not all of the young produced by the female grow and become adults.

Living things are affected by and affect the environment.

The life of an animal is affected by the environmental conditions.

Animal health, growth and development are affected by environmental conditions.

For example:

food available
air available
water available
space available
shelter available
temperature fluctuations
sunlight available

The behavior of animals may change when environmental conditions change.

Animals move to find optimal environmental conditions within an area.

Animals carry out certain routine behaviors that are influenced by changing environmental conditions.

Animals obtain energy in various forms from the environment.

Animals including humans, obtain energy that has been stored in food.