

# 2019

## Bruce the Bearded Dragon



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HLMS/6 & 7th grade

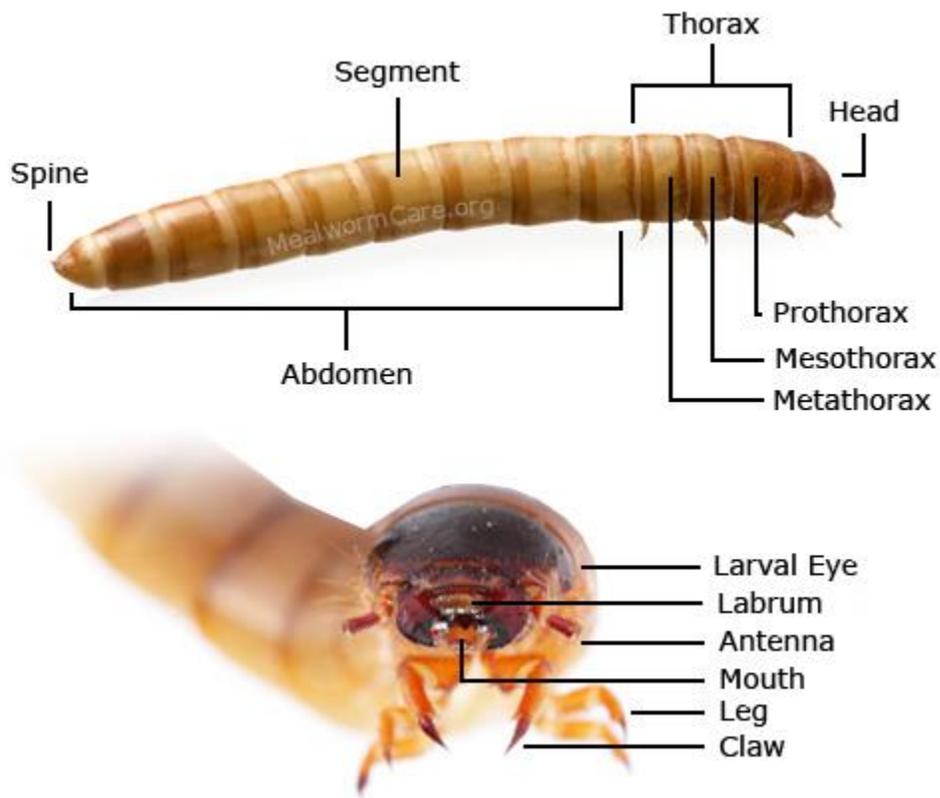
5/2/2019

Bruce needs to eat

## Biology and Raise Mealworms Guide

### Observation and Classroom Farm

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The **mealworm** is a worm-like larva with a hard exoskeleton. Its body is designed to burrow, eat, and store fat. There are three distinct sections which are the head, thorax, and abdomen.

#### Head

The head of the mealworm has the mouth and labrum, a lip-like mouth part, to aid in its voracious eating habits. The mouth and its parts are quite small and designed to eat small pieces of food.

There is also a pair of antennae and larval eyes. The antennae act as feelers for the worm as it digs in search of food. The eyes are small and poorly developed due to the insect's burrowing nature.

### **Thorax**

The thorax consists of three segments called the prothorax, mesothorax, and metathorax. Each segment has a pair of short legs. A mealworm doesn't walk very well, but its legs and claws are perfectly suited for burrowing.

### **Abdomen**

The abdomen has nine segments with the last segment containing the anus and a spine. The abdomen contains the digestive tract and stores lots of fat from all the food the mealworm eats. This fat will eventually be used for the worm's transformation into a pupa and then a beetle

## **Raising & Breeding**

Raising mealworms is fairly easy since they are prolific breeders and are hardy insects. It is also fairly inexpensive and can save you quite a bit of money if you use a lot of worms every month. They rarely smell, are easy to care for, and don't take much work.

Breeding will take a while to get started, but once there are plenty of beetles laying eggs you will have worms for as long as you need. You should start with at least one hundred mealworms, but can begin with many more. Then, all you need is a container, substrate, and a source of food and water.

### **Container**

The container should have a large surface area and smooth sides. The sides of the container only need to be a couple inches higher the substrate in order to prevent the worms from escaping. An aquarium, terrarium, plastic box, or Sterilite container will make an excellent home.

The container will also need a screened lid to prevent other insects and creatures from getting in and to allow airflow. Good ventilation is needed to prevent the container from getting to warm and to prevent the buildup of humidity and mold growth. If you are using an aquarium, there are screened lids available. For a plastic box you can cut away most of the lid and attach some window screen.

### **Food Substrate**

The substrate of the container will be the food. You can use wheat bran, oatmeal, cornmeal, wheat flour, Wheaties, Cheerios, ground up dry dog food, or a mixture of these dry foods. Fill the bottom of the container two or three inches deep with the food substrate. You will have to add more food regularly since mealworms are big eaters.

### **Water**

Slices of potatoes, apples, carrots, lettuce, cabbage, or other fruits and vegetables can supply

water to your worms. Potatoes are often preferred since they last a while and do not mold quickly. Do not use a bowl of water since mealworms will crawl in and drown.

### **Temperature, Lighting & Humidity**

The ideal temperature for growing your colony is around 75 degrees F. A heat emitter may be necessary if you are in a cold climate. You will want to keep the container away from windows and direct sunlight to prevent it from becoming too warm.

Light is not necessary. A normal day and night cycle of light will be fine.

Your colony of mealworms will reproduce more quickly with a higher humidity, but for most areas the natural humidity in the air will be sufficient. If you live in a dry climate, you can place a smooth glass or bowl of water into the container to raise the humidity. Make sure the water container is tall enough to prevent the worms from crawling in.

### **Maintenance**

Any dead worms, pupae, or beetles should be removed from the container regularly. If the container begins to smell like ammonia or becomes moldy, it is time to clean the container. You will need to remove all of the mealworms, beetles, and pupae, discard the food and waste, and clean the container. Once clean, replace the food substrate and return the insects to the container.

It is helpful to have a second container to aid in raising mealworms and keeping them odor free. After your colony is going strong, you can move any beetles to the second container where they will begin a new colony.

By the time the second colony is established, the original container should have very few mealworms. You can move any remaining worms to the second container and the original container can then be cleaned and prepared to repeat the cycle.

## **Life Cycle**

Mealworms that birds, reptiles, and other animals love aren't really worms. They are the larvae of darkling beetles. There are over 20,000 different types of darkling beetles and mealworms come from the species: *Tenebrio molitor*.

A darkling beetle experiences complete metamorphosis which means that it has four distinct stages of life. The four stages are egg, larva, pupa, and adult. The amount of time a darkling beetle spends in each stage can vary greatly due to environmental factors like temperature, humidity, food, and water.

### **Egg**

The first stage of life is spent as an egg. The white bean-shaped egg is tiny and about the size of a speck of dust. The egg is sticky and is quickly concealed by dirt, dust, and substrate. It will take around one to four weeks for an egg to hatch and the larva to emerge.

**Larva**

The second stage of life lasts about eight to ten weeks and is spent as a brown larva. This is the stage where the insect is a mealworm. When first hatched, it is quite small but will grow to one to one and a half inches long.

Since it has a hard exoskeleton, the worm will need to molt and shed its hard outer shell in order to grow. Molts will occur ten to twenty times during this stage of life. A recently molted worm will be soft and white, but the exoskeleton will quickly harden.

A mealworm spends its time eating and growing in order to save up energy for the next transformation.

**Pupa**

During a mealworm’s last molt it will turn into a white alien-like pupa. It has no mouth or anus so does not eat. It does have leg and wing buds, but they do not function. The pupa is quite helpless and the only movement it can do is wiggle. This stage of life will last one to three weeks as the pupa transforms its organs and body into an adult.

**Adult**

The final stage of the insect’s life is as the darkling beetle and lasts one to three months. The beetle will be white with a soft exoskeleton. As the outer shell hardens, it will turn brown and then black. The beetle does have hard wings, but it is unable to fly.

After about one to two weeks of adult life, beetles will begin to mate and reproduce. A few days after mating, female beetles will burrow into soil or substrate and lay eggs. Darkling beetles are prolific breeders and females can lay hundreds of eggs during their adult lives.

3-2-1

Three things you learned:

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Two

Questions have:

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One goal you are making:

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Class will utilize Fluker's Mealworm project (Free)

<https://documentcloud.adobe.com/link/track?uri=urn%3Aaaid%3Ascds%3AUS%3A89a19295-c961-499c-ac2f-cf8507f08e50>

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In this guide we will explore the yellow mealworm, *Tenebrio molitor*. These beetles are believed to be indigenous to Europe. They were introduced into the United States around the time of the Revolutionary War. By the early 1800's, mealworms were being raised as a food source for pets, especially birds. Over the years, mealworms have escaped into the environment and are now commonly found all over the world. Here in the United States, they are more likely to be found in the northern states as a grain and stored product pest because they prefer cooler climates.

*Tenebrio molitor* is a species of darkling Beetle in the family Tenebrionidae. They belong to the order Coleoptera (see figure 1.1). Coleoptera is the largest order in the class Insecta. Like all holometabolous insects, *Tenebrio molitor* go through four life stages: egg, larva, pupa and adult. The larva of the adult beetle is called a mealworm. Students will enjoy being able to observe and identify all stages of their life cycle through the included Mealworm Life Cycle Observation Kit.

### Included Materials:

- 25 or 35 – 2 oz. cups and lids
- 1 – push pin
- 50 – large mealworm larva
- Mealworm Rearing Medium

### Getting Started:

With the included push pin, punch several holes in the lid. This will allow an adequate air supply. Place a small amount of mealworm rearing medium in the cup, just enough to cover the bottom surface. Place one large larva into the cup and seal with the lid. Complete metamorphosis should take approximately 3 to 4 weeks, depending on the maturity of the larva. Ideal temperatures range from 80-85 degrees Fahrenheit. You will be able to observe *Tenebrio molitor* in each stage of its life cycle. The larva may not be in its last instar. If that is the case, you will see it molt when the cuticle is shed. Once pupation starts, you will observe the larva begin to curl up and change shape. This is the beginning of the pupa stage.

Over the next 1 – 2 weeks signs of leg and wing development will appear. You will also notice the color begin to darken as they near the adult stage. When metamorphosis is complete the beetle will emerge. They will appear off white with brown points and within a few hours, will fade from light brown to black. Once your beetle is black, you will need to add a source of water (ex: produce or wet paper towel). Sample investigations, photographs, and an assessment are included in the kit.

## ACTIVITY 1

### Overview:

Students will observe their mealworm and record their observations on a data table.

### Materials:

- Mealworm and bedding in 2 oz. cup
- Observation sheet

### Directions:

Students will observe their mealworm weekly and record their observations. These can include descriptions of size, color, movement, and any other detail the student may deem important. Students should also try to identify the development stage the mealworm is in at the time of the observation. Continue to make weekly observations until the beetle emerges.

## ACTIVITY 2

### Overview:

Students will work through the steps of the scientific method to determine if a mealworm prefers moist or dry surfaces.

### Materials:

- Mealworm
- Damp paper towel
- Dry paper towel

### Directions:

Pose the question “Do mealworms prefer moist or dry surfaces?” Have students write a hypothesis and work with a group to determine the procedure they will follow to determine the conclusion. For example, students can gently place the mealworm on the damp paper towel and observe its reaction, then do the same on a dry paper towel. Another strategy may be placing the meal worm in between the dry and damp paper towel to see to which the mealworm moves. After conducting the experiment, students will write their conclusion, including an explanation of how they came to that conclusion.

## ACTIVITY 3

### Overview:

Students will create a line plot based on observations

### Materials:

- Mealworm
- Metric ruler

### Directions:

Each student will measure the length of their mealworm in millimeters. Create a class line plot and have students place their measurement on the line plot. Discuss the mode and any outliers. Smaller groups can create line plots and find the mean length of the mealworms for their group.

## ACTIVITY 4

### Overview:

Students will use a Venn diagram to compare and contrast life cycle stages of the mealworm

### Materials:

- Three circle Venn Diagram: label one circle “Pupa”, one circle “Larva”, and one circle “Adult”
- Samples of each stage of the life cycle
- Pictures or illustrations of each life cycle stage

### Directions:

Students work in pairs or groups of three to compare and contrast the three stages of the mealworm’s life cycle.

## ACTIVITY 5

### Overview:

Students will use voice and perspective to write a postcard from the mealworm’s point of view

### Materials

- 5”x 7” index card, lined on one side

### Directions:

Students will write a postcard as though they are the mealworm. Have them write a letter on the lined side of the index card to the mealworm’s family, as though the mealworm is on vacation in the classroom. The postcard should include details about the setting and the activity that may not be the norm for a mealworm “in the wild”. On the blank side, the student should illustrate a scene from the mealworm’s “vacation”.

## ACTIVITY 6

### Overview:

Students will display their knowledge of the life cycle

### Materials:

- Blank sheet of 8 ½” x 11” paper

### Directions:

Students will illustrate the life cycle of the mealworm. All four stages should be included, as well as appropriate labels and vocabulary.

## WEEK OBSERVATIONS LIFE CYCLE STAGE

### Listed below are some of the 4th Grade Louisiana Science Level Expectations that are covered using Fluker's Mealworm Biology Guide and Observation Kit activities and assessment.

- Pose questions that can be answered by using students' own observations, scientific knowledge, and testable scientific investigations (SI-E-A1)
- Use observations to design and conduct simple investigations or experiments to answer testable questions (SI-E-A2)
- Predict and anticipate possible outcomes (SI-E-A2)
- Identify variables to ensure that only one experimental variable is tested at a time (SI-E-A2)
- Select and use developmentally appropriate equipment and tools (e.g., magnifying lenses, microscopes, graduated cylinders) and units of measurement to observe and collect data (SI-E-A4)
- Express data in a variety of ways by constructing illustrations, graphs, charts, tables, concept maps, and oral and written explanations as appropriate (SI-E-A5) (SI-E-B4)
- Sequence stages in the life cycles of various organisms (LSE-B1)
- Compare similarities and differences between parents and offspring in plants and animals (LS-E-B3)

### Listed below are some of the 4th Grade Common Core State Standards that are covered using Fluker's Mealworm Biology Guide and Observation Kit activities and assessment.

- Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience.
- Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why

**Mealworms have indirect development, which means that the larvae do not resemble the adults. This type of development is termed complete metamorphosis. There are four stages of development: egg, larva, pupa and adult. Only the adults have wings and can reproduce. In this species, insects in the larva and adult stages are active during both the day and the night.**

- Egg: The eggs are oval in shape and milky white in color with a slight shine. They are found singly or in a cluster. They are deposited directly into the rearing medium. The eggs are small, about 1.8 x 0.7mm.

The incubation time at 80 degrees Fahrenheit is approximately 7 days.

- Larval Stage: The egg hatches into the first instar larva. After feeding, the larva molts into the next instar. At each molt, the cuticle is shed and a new, larger one is formed. The larvae eat and grow in each instar until the limit for that cuticle is reached, then molt again. The number of larval instars vary from \*8-12; depending on temperature and available food. The duration of the larval stage is from a few weeks to several months depending on temperature. A full-grown final instar larva is about 30mm long and approximately 4mm in diameter.

- Pupal Stage: The full-grown last larval instar molts into a pupa. The pupa is quite vulnerable. They remain completely inactive and do not feed until the adult emerges. If rearing conditions are poor, the larvae and/or the adults will feed on the immobile pupa. During the pupal stage, the internal organs of the larva are digested and the adult internal organs develop. The color of the pupa is off-white, grading into dark brown as they pupate. They are approximately 25mm long and 7mm in width. The duration of the pupal stage is approximately 6 days at 80 degrees F.

- Adult Stage: This is when the pupa emerges as a beetle. The adult male lives approximately 2 months, while the female lives 3 months. The mealworm beetles are prolific breeders. Mating starts within a few days after emergence and is repeated at intervals throughout the life of the beetle.

### **Use the following questions to supplement your assessments on the mealworm unit.**

1. Name the four developmental stages of the mealworm.

2. Draw and label the life cycle of the mealworm.

3. Why do some insects, such as the mealworm, molt?

4. Your teacher asks you to determine if a mealworm prefers to be in an environment that is light or dark.

What steps would you take to find out the answer for her? Include your question, hypothesis, materials and procedure.

5. Name one reason a mealworm burrows.