**Investigation 12: Animal Behavior**

(adapted from Mealworm Behavior by J. Pickett; modified by A. Winward)

**Background:**

**Ethology** is the study of animal behavior. Behavior is an animal's response to sensory input and falls into two basic categories: **learned** and **innate**. **Orientation behaviors** place the animal in its most favorable environment. In **taxis**, the animal moves toward or away from a stimulus. Taxis is often exhibited when the stimulus is light, heat, moisture, sound, or chemicals. **Kinesis** is a movement that is random and does not result in orientation with respect to a stimulus. If an organism responds to bright light by moving away, that is a taxis. If an animal responds to bright

light by random movements in all directions, that is kinesis. Movement toward a substance is a positive taxis. Consistent movement or orientation away from a substance is a negative taxis. Animals move in response to many different stimuli. A **chemotaxis** is a movement in response to the presence of a chemical stimulus. The organism may move toward or away from the chemical stimulus. What benefit would an organism gain by responding to chemicals in their environment? A **phototaxis** is a movement in response to light. A **geotaxis** is a movement in response to gravity. **Agonistic behavior** is exhibited when animals respond to each other by aggressive or submissive responses. Often the agonistic behavior is simply a display that makes the organism look big or threatening. (It is sometimes studied in the laboratory with Bettas, or Siamese Fighting Fish.) **Mating behaviors** may involve a complex series of activities that facilitate finding, courting, and mating with a member of the same species.

The mealworm is not a worm; it is a larva. Both the dark and the yellow species of mealworm are the larval form of the darkling beetle (Genus *Tenebrio),* which belong to Phylum Arthropoda and Class Insecta. Mealworm larvae are shiny, smooth, hardened "worms." They have three pairs of segmented thoracic legs, and two short, horn-like appendages on the tip of the abdomen. Full grown larvae are 1 to 1 1/4" in length. Dark mealworms are dark brown; yellow mealworms are honey-yellow in color.



Mealworms are rarely seen in the wild, but when they are, it is likely to be in a field where wild grasses flourish and seeds are plentiful. Mealworms are scavengers and are most commonly found in spoiled grain and grain products. This organism has benefited by living close to human enterprises, because we unwittingly provide a much better environment for the success of mealworms than could be found in the natural world. For this reason mealworms have become a pest in grain storage areas. Mealworms can go through their complete life cycle without any added water, as they are very efficient at extracting water from the food. The mealworm's preferred environment is dry, moderately warm, and dark. Mealworms also show great potential as a source of protein for human nutrition.

**Learning Objectives:**

• To investigate the relationship between a model organism, Tenebrio, and its

response to different environmental conditions

• To design a controlled experiment to explore environmental factors that either attract

or repel Tenebrio in the laboratory setting

• To analyze data collected in an experiment in order to identify possible patterns and

relationships between environmental factors and a living organism

• To work collaboratively with others in the design and analysis of a controlled

experiment

• To connect and apply concepts (such as animal behavior, development, and evolution).

**General Safety Precautions:**

• Do not add substances to the choice chamber unless your teacher has approved them.

• If the substance you add is flammable, such as ethanol, use precaution and do not

conduct your experiment near a heat source or flame.

• Many of the substances used in this experiment are food items, but you should not

consume any of them.

• Mealworms are living organisms that should not be released to the environment. After

all the investigations are complete, mealworms should be tapped into a “morgue”, typically a 150-mL beaker that contains about 50 mL of salad oil.

**Materials:**

mealworms choice chamber filter paper dropper pipette

distilled water forceps brushes beakers

petri dish magnifier timer etc.

**Investigations:**

**Part 1**

1. Place 8-10 mealworms in a small petri dish.

2. Observe the mealworms for 5 minutes. Make notes on their general appearance,

movements about the dish, and interactions with each other. Notice if they seem to

prefer one area over another, if they keep moving, settle down or move sporadically.

Note any behaviors that involve 2 or more mealworms. Do not interfere with the

specimens in any way.

3. Make a detailed sketch of a mealworm.

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**Part 2**

1. Prepare a choice chamber. Place a piece of filter paper in the bottom of each chamber. You might need to trim the paper to fit. Moisten the filter paper in each chamber with 5-10 drops of distilled water.

2. Gently transfer 4-5 mealworms into each chamber. Do not disturb them for the next 5 minutes, then count how many mealworms are on each side of the choice chamber. Create a data table to record the number of worms you observe on each side.

3. Return your mealworms to the petri dish from Part 1.

**Part 3**

1. Carry out your self-designed investigation, using 3 different approved conditions. Use the procedures in Part 2 as a guide.
2. Record data on your data table. Quantify the results and express them graphically.
3. Complete a chi-square analysis of your results. Remember: your hypotheses about condition preference may not be the same as the “null hypothesis” that you will use in the chi-square analysis!

**Analyze and conclude:**

Consider and discuss the following questions in your lab report discussion.

* Which conditions did mealworms prefer? Which did they avoid?
* Were your hypotheses about the preferences of mealworms supported or not? Did the worms demonstrate a taxis in relation to any of the conditions you chose? Refer to your data.
* Can you think of any reasons for their preferences?
* What other factors might affect whether or not the mealworms moved from one part of

your choice chamber to another?

**References:**

College Board, *AP Biology Lab Manual*, <http://media.collegeboard.com/digitalServices/pdf/ap/bio-manual/Bio_Lab12-FruitFlyBehavior.pdf>

FOSS Web, *Mealworms and Darkling Beetles,* <http://lhsfoss.org/fossweb/teachers/materials/plantanimal/tenebriobeetles.html>

Penn State Entomology, *Dark and Yellow Mealworms*, <http://ento.psu.edu/extension/factsheets/mealworms>