Lab 1: Mealworm Behavior: Science as a Process

I. Framing the Investigation:

Introduction: **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** (inherited).

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.

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 (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.

Background: The mealworm is a larval larval form of the darkling beetle (*Tenebrio molitor*), from the Kingdom: Animalia, Phylum: Arthropoda, and Class: Insecta. Two species of mealworms, the dark mealworm and the yellow mealworm occur in Michigan. The dark mealworm occurs throughout the U.S., while the yellow mealworm is absent from the southern states. Mealworm adults are robust, slightly flattened, 3/4 - 1" long beetles. The dark mealworm adult is a dull, black color, while the yellow mealworm adult is a shiny, polished dark brown or black. 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 - 1 1/4" in length. Dark mealworms are dark brown; yellow mealworms are honey-yellow in color. Mealworms overwinter as partially grown larvae. The overwintered larvae complete their development in the spring, pupate, and emerge as adults during the summer (mid July to early August in Michigan). Adults live for 2 to 3 months. After mating the females deposit 275 to 500 eggs, either singly or in small batches. The eggs are deposited in areas where the larvae will find ample food. The eggs hatch in about two weeks. The larvae feed and grow over a period of 6 to 9 months (as long as 20 months in some cases), molting a total of 14 or 15 times. The complete life cycle, therefore, requires 6 months to 2 years for completion. One generation per year is normal. Mealworms are scavengers and are most commonly found in damp, spoiled grain and grain products. Adults and larvae hide in refuse, sacks, bins, grain and similar undisturbed situations. Adults and larvae are also found in cereal products, macaroni, meal, bran, meat scraps, feathers and dead insects. Mealworms are popular as fish bait and as food for many types of small pets. They are easy to raise and there is information available on this subject. Mealworms also show great potential as a source of protein for human nutrition.
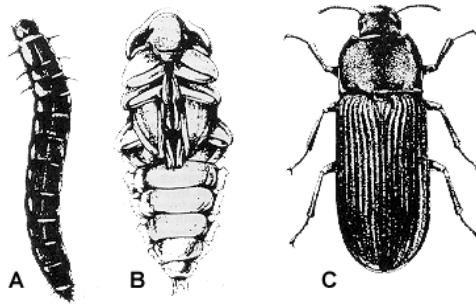
Several stages in the life history of a mealworm: A. full grown larva, B. pupa, and C. adult beetle (Dupree 1988)**.**

Hypothesis:
Using variable assigned, develop a hypothesis, using the **If**, and, **then** concerning the mealworm's response to the factor.

_____
_____
_____
_____

II. Designing the Investigation:
Materials: Below make a list of materials used.

Procedures: Part I: Observations
1. Place 10 mealworms and a small amount of bedding material in a small petri dish. They generally try to get out so cover the dish with a petri dish cover.

2. Observe the mealworms for 20 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.

Procedures: Part II: *Kinesis in Mealwormss:*

1. Prepare a choice chamber. The choice chamber consists of two large plastic petri dishes taped together with an opening cut in between. Several alternatives to this concept can be produced. Take 2 plastic petri dishes and cut out one 1/2 inch openings at the side. Place the petri dishes together, matching the cut ends. Now tape the petri dishes together by placing a strip of tape under each one. The dishes now can be used to test for the variables.

2. Teacher will assign one variable to be tested: Moisture, warm temperature, cool temperature, light, and set up the adjacent room accordingly.

3. Gently transfer ten mealworms from the stock culture into the center choice chamber. Cover all chambers being used.

4. Count how many mealworms are on each side of the choice chamber every minute for 20 minutes. Record your data in Table 1.1. Continue to record even if they all move to one side or stop moving**.**

5. Return your mealworms to the stock chamber.

6. Complete Table 1.2 of class data from each of the variable, the data from two groups with the same variable must be averaged before data is recorded into Table1.2:

7. Graph both the number of mealworms in wet chamber, dry chamber using the graph below.

III. Collecting and Presenting Data:

Table 1.1: Group data showing mealworm activity, during exposure to _____ variable.

Time (Mins)	Control:	Variable:	Other Notes
0	4	4	
1.0			
2			
3.0			
4.0			
5.0			
6.0			
7.0			
8.0			
9.0			
10.0			
11.0			
12.0			
13.0			
14.0			
15.0			

Table 1.2: Class data showing mealworm activity, during exposure to all variables.

Time (Mins)	Control Average	Moisture Average	Hot Average	Darkness Average	Cold Average
0					
1.0					
2					
3.0					
4.0					
5.0					
6.0					
7.0					
8.0					
9.0					
10.0					
11.0					
12.0					
13.0					
14.0					
15.0					

Graph Below

For this graph you will need to determine the following:

    a. The *independent* variable_____
        Use this to label the horizontal *x*-axis.
    b. The *dependent* variable_____
        Use this to label the vertical *y*-axis.

Graph 1 Title: _____.

IV. Analyzing and Interpreting Results:

1) State the variable your group tested. From each group list the variables which best suit the natural conditions of a mealworm's habitat.

List all variables in this investigation:	List variables of a mealworms **NATURAL** habitat:

2) What was the independent variable? What was the dependent variable?

3) Explain the importance to having only one independent variable. What are the implications to multiple variables?

4) Is the mealworms response to your group's variable best classified as kinesis, or taxis? Explain your response.

5) What conclusions do you draw from the data? Explain physiological reasons for the behavior observed in this activity.

V. References:
Animal Web Diversity, *Tenebrio molitor* [online], accessed 22 August 2004, available from
http://animaldiversity.ummz.umich.edu/site/accounts/information/Tenebrio_molitor.html

Michigan State University Extension , *Mealworm* [online], accessed 22 August 2004, available from http://www.msue.msu.edu/msue/imp/mod02/01500532.html

VI. TEKS/TAKS:
TEKS: 1A, 1B, 2A, 2B, 2C, 2D, 3C, 3A, 3F, 11A, 11B, 11C
TAKS: 1, 2, 3