**AP Biology**
**Animal Behavior Lab**

## Introduction

Ethology is the study of animal behavior. Many behaviors involve the movements of the animal within its environment. In this lab you will investigate some innate (inherited, as opposed to learned) behaviors.

Orientation is the process by which animals position themselves with respect to spatial features of their environments. **Taxis** involves the turning of an animal's body relative to a stimulus. The animal may turn away from, toward, perpendicular to (etc.), the stimulus. The turning may or may not be followed by a corresponding movement of the animal in relation to the stimulus. **Kinesis** is random turning or movement of an animal in relation to a stimulus. Consider the following experiment: a researcher places a dead, rotting mouse in the center of a test surface of 1 $m^2$. The researcher then places a carrion beetle (an insect that eats dead animal tissue) somewhere on the test surface and observes. The beetle crawls forward for three seconds, turns, and crawls in a different direction for three seconds, and so on. The researcher concludes that the beetle is moving randomly in relation to the dead mouse. Continued observation reveals that the beetle crawls faster (and covers more ground) when it happens to turn in the direction of the dead mouse. In addition, the beetle crawls more slowly (and covers less ground) when it happens to crawl away from the mouse. In this way, the beetle's random movements will eventually bring it to the dead mouse, at which point other behavior patterns, such as feeding, will take over.

**Agonistic** behaviors are aggressive or submissive displays. A common example is a cat's response to an aggressive dog. The cat fluffs its fur and stands sidewise to the dog. This makes the cat appear larger and stronger than it really is.

**Mating** behaviors may involve a complex series of activities that facilitate finding, courting, and mating with a member of the same species.

## Activity A1: Initial Observation of Isopod Behavior

### Materials

10 isopods in a petri dish (with a damp substrate)

### Procedure

1. Place 10 isopods and a small amount of damp substrate into a petri dish. Cover the dish with the lid.

2. Observe the isopods for 10 minutes. Your goal is to observe their undisturbed behavior, so do not bump the container.

3. Make detailed 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, if they settle down, or if they move sporadically. Pay close attention to any behaviors that involve two or more isopods. Record your observations.

**Activity A1 Analysis**

- Review your notes. Did you observe an agonistic behavior? If so, explain the behavior.
- Are the movements of the isopods better described as taxis or kinesis movements? Give details to support your answer.

**Activity A2: Orientation Behavior of Isopods**

In this activity, you will observe isopods as they respond to humidity differences in their environment.

**Scientific Question**

How do differences in humidity affect isopod behavior?

**What is the Hypothesis?**

Hypothesis:

**Identify the Variables**

Independent:

Dependent:

**Materials**

10 isopods in a petri dish, choice chamber, two pieces of filter paper, dropping pipette, water, stopwatch or timer

**Procedure**

1. Take a choice chamber from the prep area. The choice chamber consists of two large plastic petri dishes with a hallway connecting them.
2. Place a moist piece of filter paper on one side and a dry one on the other.
3. Use a soft brush to transfer ten isopods from the stock culture into chamber. Transfer 5 isopods to each side of the chamber. Put on the lids.
4. Count and record the number of animals on each side of the choice chamber every 30 seconds for 10 minutes. Record your data in the table below. Continue to record even if they all move to one side or stop moving.
5. Return your isopods to the stock chamber.

**Activity A2 Data Table: Orientation Behavior of Isopods**

| Time | Number in Wet Chamber | Number in Dry Chamber | Other Observations |
|---|---|---|---|
| 0:30 | | | |
| 1:00 | | | |
| 1:30 | | | |
| 2:00 | | | |
| 2:30 | | | |
| 3:00 | | | |
| 3:30 | | | |
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| 5:00 | | | |
| 5:30 | | | |
| 6:00 | | | |
| 6:30 | | | |
| 7:00 | | | |
| 7:30 | | | |
| 8:00 | | | |
| 8:30 | | | |
| 9:00 | | | |
| 9:30 | | | |
| 10:00 | | | |
| Mean | | | |
| Standard Deviation (SD) | | | |
| Standard Error of the Mean (SEM) | | | |

**Activity A2 Analysis: Orientation Behavior of Isopods**

- **Create** an appropriately labeled graph to illustrate the sample means of the two environments to within 95% confidence (i.e., sample mean ± 2 SEM).
- Make a **claim** that answers the scientific question.
- **Justify** the claim by using the data as evidence.
- Explain your **reasoning** and why the evidence supports the claim. Connect the data back to what you learned about humidity and orientation behavior in isopods.
- **Justify** the isopod's behavior as taxis or kinesis.

**Activity A3: Design an Experiment to Test Isopod Behavior**

In this activity, you will design and conduct your own experiment investigating isopod behavior.

**What variable will you test?**

Variable:

**Scientific Question**

Scientific Question:

**What is the Hypothesis?**

Hypothesis:

**Identify the Variables**

Independent:

Dependent:

**Materials**

10 isopods in a petri dish, choice chamber, stopwatch or timer, list other materials required:

**Sketch of Experimental Design**

**Procedure (WRITE UP THE PROCEDURE YOU FOLLOWED FOR A3)**

1. Select one factor and develop a scientific question and a hypothesis concerning the isopods' response to that factor.

2. List the materials needed for the experiment.

3. Describe the procedure to be followed.

**Activity A3 Data Table:** _____

| Time | | | Other Observations |
|---|---|---|---|
| 0:30 | | | |
| 1:00 | | | |
| 1:30 | | | |
| 2:00 | | | |
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| 8:00 | | | |
| 8:30 | | | |
| 9:00 | | | |
| 9:30 | | | |
| 10:00 | | | |
| Mean | | | |
| Standard Deviation (SD) | | | |
| Standard Error of the Mean (SEM) | | | |

**Activity A3 Analysis: Design an Experiment to Test Isopod Behavior**

- **Create** an appropriately labeled graph to illustrate the sample means of the two environments to within 95% confidence (i.e., sample mean ± 2 SEM).

- **Calculate** the chi-squared value for Activity A3. Use the following tables to organize your data for **Activity A3** and show all your work to the right of the tables.

A. Specify the **null hypothesis** you are testing:

| | | |
|---|---|---|
| **Observed** (Find the mean (average) number of isopods on each side during the 10 minute time period) | | |
| **Expected** | | |

| | |
|---|---|
| **Degrees of freedom (n):** | |
| **Critical value:** | |
| **Calculate the chi-squared ($X^2$) value:** | |

B. Do you accept or reject the null hypothesis for the isopod data collected for Activity A3? (This is your **Claim**)

C. **Justify** the claim by using the calculated chi-square values.

D. Explain your **reasoning**.

E. **Propose a refinement** to your experimental design.

# AP Biology
# Chi-Square Notes

## Null Hypothesis

The null hypothesis predicts that you will not see a change in your data due to the independent variable.

As background information, first you need to understand that a scientist must create **a null hypothesis** prior to performing their experiment. If the **dependent variable** is not influenced by the **independent variable**, the **null hypothesis** will be accepted. If the dependent variable is influenced by the independent variable, the data should lead the scientist to reject the **null hypothesis**.

### Chi-Square Distribution Table

| Degrees of freedom | Probability (p) value | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0.99 | 0.95 | 0.80 | 0.70 | 0.50 | 0.30 | 0.20 | 0.10 | 0.05 | 0.01 |
| 1 | 0.001 | 0.004 | 0.06 | 0.15 | 0.46 | 1.07 | 1.64 | 2.71 | 3.84 | 6.64 |
| 2 | 0.20 | 0.10 | 0.45 | 0.71 | 1.30 | 2.41 | 3.22 | 4.60 | 5.99 | 9.21 |
| 3 | 0.12 | 0.35 | 1.00 | 1.42 | 2.37 | 3.67 | 4.64 | 6.25 | 7.82 | 11.34 |
| 4 | 0.30 | 0.71 | 1.65 | 2.20 | 3.36 | 4.88 | 5.99 | 7.78 | 9.49 | 13.28 |
| 5 | 0.55 | 1.14 | 2.34 | 3.00 | 4.35 | 6.06 | 7.29 | 9.24 | 11.07 | 15.09 |
| 6 | 0.87 | 1.64 | 3.07 | 3.38 | 5.35 | 7.23 | 8.56 | 10.65 | 12.59 | 16.81 |
| 7 | 1.24 | 2.17 | 3.84 | 4.67 | 6.35 | 8.38 | 9.80 | 12.02 | 14.07 | 18.48 |

p = 0.05 is setting a hypothesis that the difference between the observed data and expected data is entirely due to chance.

**Look at the critical value.**

If the chi-squared value is **greater than** the critical value, then you **reject** the null hypothesis. This means that the variation in the data is due to a variable.

$$\chi^2 > \text{critical value}$$

If the chi-squared value is **less than** the critical value, then you **accept** the null hypothesis. This means that the variation in the data is due to chance.

$$\chi^2 < \text{critical value}$$