

## Lab: Becoming an Ecologist: Investigation into the Life Cycle of the 17-Year Cicada

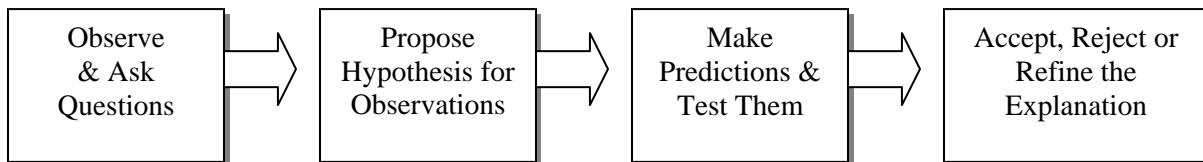
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### Background

An ecologist is someone who tries to explain patterns and relationships among organisms and their environment. Before you begin your ecology unit and begin learning different concepts and content, it's important to become familiar with the process ecologists used to create this knowledge. Although there are many ways to explore our natural world there are several important elements to any scientific process.



Note:

The word 'Hypothesis' generally has two meanings. It can be a:

1. Tentative explanation based on observations
2. Statement of prediction. Describes in concrete terms exactly what you expect to happen in your study. In other words, it is a 'testable' hypothesis.

Every scientific explanation is tested by dozens and sometimes hundreds of other scientists. An explanation is not accepted until it has been rigorously tested. In science, most explanations change through time as new information accumulates. The objective of this lab is to give you the opportunity to become familiar with the above elements of science as a process. This will be done through your investigation of the 17-year Cicada.

### Observations and Questions

The Life Cycle of the 17 year Cicada. *Magicicada septendecim*. This cicada spends the first seventeen years of its life in underground tunnels. After these 17 years, millions of cicadas emerge from the earth in late May. The onslaught of these cicadas is memorable as tremendous numbers cloud the sky echoing with their continual high-pitched sound.

Ecologists noticed that when the seventeen-year cicadas emerge they all feed on the same resource, the sap of trees. *Magicicadas* can number as many as 20,000 to 40,000 to a tree! What would be the negative aspects of such a strategy? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Ecologists also noticed that when *Magicicadas* begin their emergence, predators such as birds, will gorge themselves. Any bird can eat as many cicadas as it can capture because the *Magicicadas* have no anatomical defense mechanisms such as stingers, chemical weapons, or odors. With no anatomical defense mechanisms how is it that some cicadas survive to reproduce?

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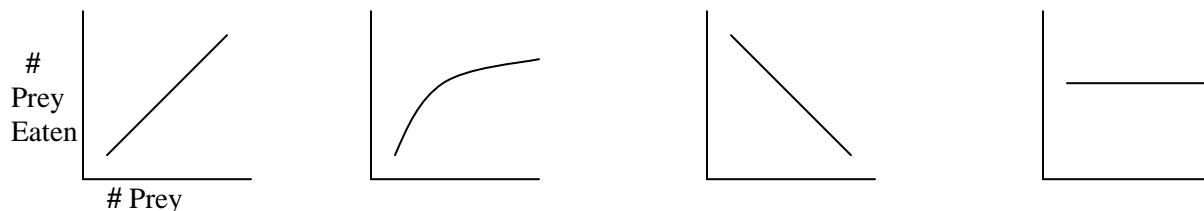
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## Tentative Explanation or Hypothesis

One explanation for this behavior, proposed by some ecologists, is called the Predator Satiation Hypothesis. Wow! That's a mouthful. Lets break it down and find out what it means.

- 1) A predator is an organism that does the killing and eating of its prey.
- 2) Satiation—sounds like satisfied, right? So the predators, which are birds, are satisfied meaning that they have enough to eat.

Based on this Hypothesis, what do you predict to be the relationship between the number of cicadas and the number of cicadas that will be eaten. Which graph below, represents the relationship and Why?



Prediction: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## Testing the Hypothesis

Read the procedure below. If the results of this activity were to support the Predator Satiation Hypothesis what you would hypothesize the relationship to be between the number of prey items and the number of prey items picked up.

### Hypothesis

### Procedure

1. On a piece of paper place 30 identical objects (we are going to be using popcorn kernels.) These objects represent the *Magicicadas*.
2. Select one person in your group to be the predator. The same person must be used as the predator for each trial, for consistent data collection. The predator will have 30 seconds to pick up as many kernels as he/she can. The predator has three restrictions
  - i. Eyes must be closed
  - ii. He/she can only pick one kernel up at a time
  - iii. The predator can only use his pinky finger and thumb to pick up the kernels
3. Repeat steps 1 and 2 using larger population sizes of 45, 60, 75 100 & 125. *Magicicadas*. Be sure to test each population size at least twice time.

## Results

Table 1. The number of Magicicadas eaten at each population size

| # of Prey Items | # Prey Items picked up by predator |         |         |                  |
|-----------------|------------------------------------|---------|---------|------------------|
|                 | Trial 1                            | Trial 2 | Average | Percent Survival |
| 30              |                                    |         |         |                  |
| 45              |                                    |         |         |                  |
| 60              |                                    |         |         |                  |
| 75              |                                    |         |         |                  |
| 100             |                                    |         |         |                  |
| 125             |                                    |         |         |                  |

Draw a line graph and label both axes with the independent variable on the x-axis and the dependent variable on the y-axis. Use appropriate scales and labels. Title the graph.



Examine your graph. Describe the relationship between the number of prey items available and the number of prey items captured by the predator. \_\_\_\_\_

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## Discussion

1. Does your data support the Predator Satiation Hypothesis? Explain.
  2. Not all scientific explanations are accepted by the scientific community. Based on the results of your experiment, would you support, reject the Predator Satiation Explanation.
  3. What yet to be discovered biotic or abiotic factors could give strength to or weaken this hypothesis?
  4. Describe the difference between the two uses of the term “hypothesis”. Give an example of each, as used in this lab
  5. Can you think of any other examples of organisms in nature for which predator satiation would be applicable as either a survival strategy or a reproductive strategy?
  6. Organisms in nature have a variety of different defenses to avoid predation. For instance, some organisms can camouflage with their backgrounds, others like the snuck can secrete a harsh odor. According to the Predator Satiation Hypothesis, what is the defense *Magicicadas* use to avoid predation?

## **Extension. Day 2**

### **Observations**

Years down the road populations of the 17-year cicada dramatically decrease due to human influences. They can no longer rely on numbers for defense. However, cicadas are surviving from generation to generation. You observe an adaptation that the cicada populations evolved. What is this adaptation?

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### **Hypothesis**

Use this adaptation to construct a hypothesis, or tentative explanation to explain why cicadas are continuing to survive and reproduce.

### **Test**

Use the above procedure to test your newly adapted cicadas. Before you carry out the procedure be sure to make a prediction or hypothesis about what you expect to happen in your study

*Hypothesis (Prediction)*

### **Results**

| # of Prey Items | # Prey Items picked up by predator |         |         |                  |
|-----------------|------------------------------------|---------|---------|------------------|
|                 | Trial 1                            | Trial 2 | Average | Percent Survival |
| 30              |                                    |         |         |                  |
| 45              |                                    |         |         |                  |
| 60              |                                    |         |         |                  |
| 75              |                                    |         |         |                  |
| 100             |                                    |         |         |                  |
| 125             |                                    |         |         |                  |

Graph % survival for yesterday's trials and today's trials using a line graph. Use appropriate scales and labels. Number of prey should go on the independent axis and % survival on the y-axis Title the graph.