

# ZOO-585 Ecophysiology

## Worksheet no:2

Name:

Date:

## Lab Bench Activity-2

### Measuring the effect of Temperature on Metabolic Rate

The rate of metabolism in ectothermic animals increases as the environmental temperature increases. This rise occurs because the reactants in the cell have greater thermal energy, and many cellular enzymes are more active as temperature increases.

This effect is noticeable in a range from approximately 5°C to 35°C; at temperatures much higher than this, enzymes become denatured.

**Key Concept:** The relationship between temperature and metabolic rate is often measured as  $Q_{10}$ . If the metabolic rate doubles with a 10°C increase in temperature, then  $Q_{10} = 2$ .

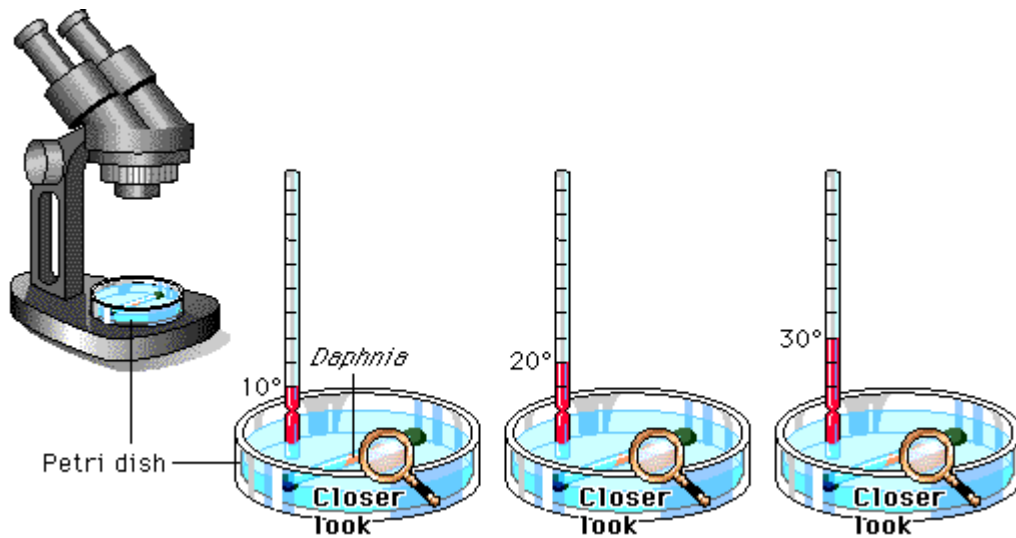
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### Design of the Experiment

It is possible to measure metabolic rate indirectly by measuring heart rate. In this activity, you will gauge the effect of temperature on metabolic rate by counting the heartbeats of *Daphnia*.

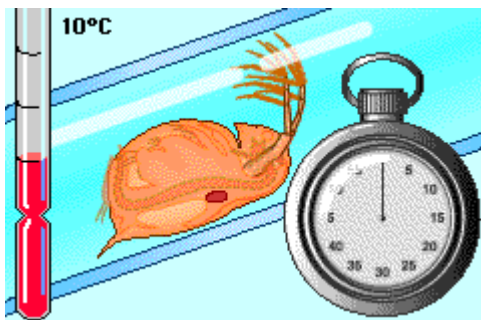
There are a number of possible procedures for "trapping" the *Daphnia* so that you can observe its heart under a dissecting microscope.

Observe the *Daphnia* in a petri dish of water at three different temperatures. Select each magnifying glass to practice timing the *Daphnia* heart rate.

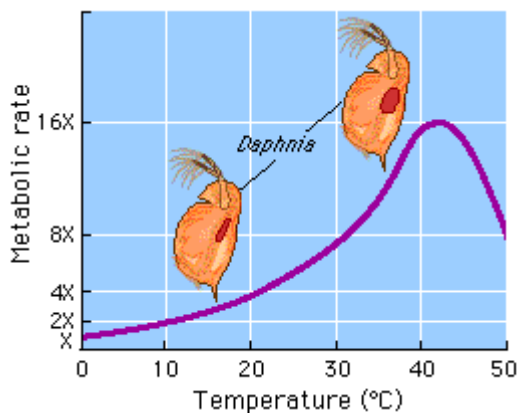


## Measuring Temperature and Metabolic Rate

The time on the stopwatch represents 10 seconds. Count the number of heartbeats during this time and multiply by six to get the heart rate for one minute. Record the number; you will need it for the next exercise.



The graph below illustrates the effect of increased temperature on metabolic rate in an aquatic ectotherm, *Daphnia magna* (water "flea").



**Question 1: Describe the trend observed in the graph.**

**Question 2: Define the term *metabolic rate*.**

**Question 3: Differentiate between an *ectotherm* and *endotherm*.**

### **QUIZ**

1. Which of the following organisms would show the greatest fluctuation in body temperature hour by hour?

- a. dolphin
- b. mouse
- c. lake trout
- d. rattlesnake

2. What is the relationship between metabolic rate and body temperature in *Daphnia*?

- a. As the body temperature increases, the metabolic rate decreases.
- b. An increase of 10°C results in a doubling of metabolic rate.
- c. Heart rate increases as body temperature decreases.

d. Cellular enzymes are less active at 35°C than at 20°C, resulting in decreased metabolic rate.

3. If  $Q_{10} = 2$ , then an enzymatic reaction that takes place at a given rate at 5°C would take place approximately how many times faster at 25°C?

- a. Twenty times
- b. Eight times
- c. Four times
- d. Three times e. Two times

4. Which of the following experimental conditions would be most life-threatening for an ectothermic organism?

- a. Temperatures that exceed 40°C
- b. Temperatures that are between 3°C and 8°C.