

Heartbeat in *Daphnia*

Background

In this experiment you will study some of the factors which can alter the heartbeat of an animal. Since it would be dangerous (illegal) for you to apply these treatments to the human subjects, you will observe instead a relatively simple model system, the *Daphnia* or water flea.

Daphnia is an ideal experimental animal for this study because its body is flattened sideways and its shell is transparent. Thus, you can look right through the shell and observe the beating heart.

Procedure - Work in pairs.

1. Using a eye dropper/Pasteur pipette, withdraw a *Daphnia* from the container found on the table. Place the *Daphnia* on a depression slide and add a **few** fibers of cotton. The fibers serve to trap the animal so that it cannot swim out of the view. Too much cotton will obscure your sight. Do not add a cover slip.
2. Using the microscope, focus on the *Daphnia* under low power. With the aid of the classroom chart and the instructor, find and focus on the heart. Note: the *Daphnia* has a dorsal heart; do not count leg beats!
3. The heartbeat is extremely rapid. Once you have the heart in focus, decide on some method for counting the beats. Possible methods are: count alternate beats; count every four beats; using pen or pencil, tap a piece of scrap paper every time the heart beats and count the marks afterwards.
4. Counting - Cold
 - A. Using a fresh *Daphnia*, count the heartbeat for 10 seconds. Record each count on the data sheet. Take three counts in all.
 - B. Place the *Daphnia* slide on a bag of **ice** for five minutes and then take a ten second count. Return it to the ice bag for two minutes, then take a second count. Again return to the ace bag for two minutes and take the third count.
 - C. Place the *Daphnia* in the recovery tank.
5. Counting - Ethanol (EtOH)
 - A. Using a fresh *Daphnia*, count the heartbeat for 10 seconds. Record each count on the data sheet. Take three counts in all.
 - B. Draw off the water with a Pasteur pipette and add a drop of 5% **alcohol**. Immediately take a ten second count. (Some *Daphnia* are extremely sensitive to alcohol, so do not delay at this point.) Take and record two more
 - C. Place the *Daphnia* in the recovery tank.

6. Counting - Adrenalin

- A. Using a fresh *Daphnia*, count the heartbeat for 10 seconds. Record each count on the data sheet. Take three counts in all.
- B. Draw off the water with a Pasteur pipette and add a drop of **adrenalin**. Record three counts.
- C. Place the *Daphnia* in the recovery tank.

7. Counting - Caffeine

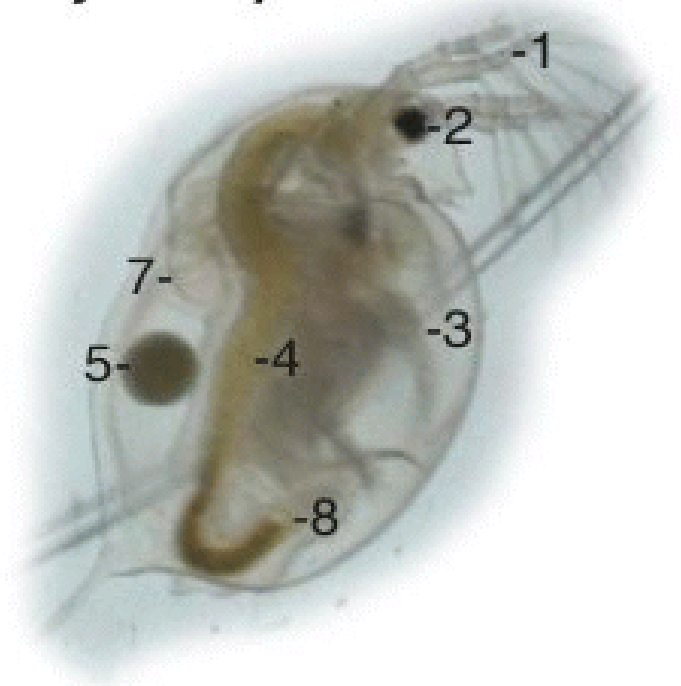
- A. Using a fresh *Daphnia*, count the heartbeat for 10 seconds. Record each count on the data sheet. Take three counts in all.
- B. Draw off the water with a Pasteur pipette and add a drop of **caffeine**. Record three counts.
- C. Place the *Daphnia* in the recovery tank.

8. To calculate the average heartbeat in a series of three counts:

$$\text{Average} = \frac{\text{Count \#1} + \text{Count \#2} + \text{Count \#3}}{3}$$

Round off to the nearest whole number (No decimal points!).

Anatomy of *Daphnia*



http://www.sci-journal.org/reports/a8/daph_html_m7de4482f.jpg

- (1)-Second antenna, used for swimming and sensing the environment
- (2)-Eye controlled by muscles with nerve connections to the brain
- (3)-Legs used for collecting food and stabilizing the animal
- (4)-An intestine where ground up food particles are digested
- (5)-A brood pouch for incubating young that hatch from the large eggs
- (6)-A protective outer shell
- (7)-A heart that pushes clear circulatory fluid around the body
- (8)-Undigested material is eliminated out the anus

Conclusions

- A. According to your individual results, summarize the effect of each of the four treatments. If the heart beat changes by 2 beats or less, consider this as no change.

Cold	-
Alcohol	-
Adrenaline	-
Caffeine	-

- B. Summarize the class results in the chart below. For each treatment, count the number of *Daphnia* which increased, decreased, or showed no change.

	Decreased	No Change	Increased
Cold	_____	_____	_____
Alcohol	_____	_____	_____
Adrenaline	_____	_____	_____
Caffeine	_____	_____	_____

Questions

- A. How much variety was there among your four *Daphnia* heart rates before treatment?

Slowest _____ Fastest _____ Average _____

A variation of ten beats, for example, might seem insignificant. But this would be sixty beats per minute – quite a difference!

- B. Which of these treatments would you expect to have a similar effect on humans?

Which might have a different effect, or not effect? Why?

- C. Why was it necessary to establish the normal heartbeat for **each** *Daphnia* before treatment?