Daphnia Heart Rate Lab

INTRODUCTION:

A Daphnia is a tiny crustacean (related to shrimp) that has a clear outside skeleton (exoskeleton) and jointed legs. Like other arthropods, its heart is on its back. The most obvious structure is the eye. The brain is the light-colored organ lying above the eye. Two pairs of antennae protrude from the head. These are used for locomotion and to sense the environment. Inside the exoskeleton are 5 pairs of legs. Comb-like gills are attached to some of the legs. When the legs kick forward, they bring a stream of water across the gills and wash bits of food up to the mouth, which lies just beneath the beak. From the mouth, the esophagus runs up into the head and then down into the body, where it widens into the stomach which connects to the intestine. In females, a large brood chamber is located behind the heart. Usually, it will contain eggs, but occasionally a fortunate student will find it filled with baby Daphnia. Label the picture of the Daphnia below with the structure and function.

The environment challenges each living thing to respond. It includes the air, the water, heat and light, and the chemicals which enter our bodies. Because Daphnia are ectotherms (cold-blooded), their body temperature changes with the surrounding environment. Since chemical reactions are speeded up in warmer temps, what would you predict the effect of temperature changes would be on their rate of metabolism (and heart rate)?

I PREDICT THAT…………………………………………………………………………………………
………………………………………………………………………………………………………………
………………………………………………………………………………………………………………

In any investigation, predictions are stated in an “IF………….IS RELATED TO………………, THEN……..” format. Restate your prediction above, using this format:

IF _______________________________________________________________, IS RELATED
TO ________________________________________________________________, THEN
______________________________________________________________.
Chemicals which enter their bodies can also change their heart rate by interfering with the chemicals that nerves use to transmit signals. Chemicals that speed up heart rate are known as **stimulants**, whereas chemicals that slow down the heart rate are known as **depressants**.

**MATERIALS:**

*Daphnia* in culture liquid  
Transfer pipette (dropper)  
A clean depression slide – Sketch a depression slide here:  
Compound microscope  
A container for “used” Daphnia = INTENSIVE CARE  
Ethanol, nicotine, and caffeine

**PROCEDURE:**

1. Using a clean pipette, carefully transfer a *Daphnia* and ONE drop of liquid onto a slide. Keep the drop small so that the *Daphnia* can’t swim out of your field of view.  
2. Place the slide under the microscope and focus on the *Daphnia* so that you can see the beating heart. **REMEMBER:** its heart is on its back!  
3. Count the number of heartbeats that occur in 10 seconds. Have your lab partner time 10 seconds for you as you count heartbeats. You want to make your measurements quickly, so that the Daphnia does not become stressed in the small volume of water.  
4. Record the number of heartbeats in the data table. Multiply the number by 6 to get the number of beats per minute.  
5. Take at least three separate heart rate measurements for your Daphnia and calculate the average of the three measurements. **REMEMBER:** If the three numbers are NOT within 10% of each other, repeat your trials!  
6. When you have finished recording the heart rate in water (the CONTROL solution), add ONE DROP of your chosen stimulant or depressant to the slide. TURN THE LIGHT OFF AND WAIT 30 SECONDS.  
7. Turn the light back on and count the number of heartbeats for 10 seconds again, repeating at least 3 times. Multiply each count by 6 to get the heart rate per minute. Record in the data table.  
8. Rinse the Daphnia into the “Intensive Care” container for recovery.  

*Keep the light for your microscope OFF as much as possible to avoid overheating your *Daphnia*!*

What is the total magnification you are using? _________________________________

What stimulant or depressant will you use on your *Daphnia*? _________________________________

In the space below, write your hypothesis about how this will affect the heart rate of your Daphnia. Be sure to write your hypothesis in the “If………. then………..” format.
OBSERVATIONS:

<table>
<thead>
<tr>
<th>Trial</th>
<th>Group: 10 seconds</th>
<th>BPM = rate at 10 seconds x 6</th>
<th>Group: 10 seconds</th>
<th>BPM = rate at 10 seconds x 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trial 1</td>
<td></td>
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<tr>
<td>Trial 2</td>
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<td>Trial 3</td>
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<tr>
<td>Average</td>
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</tbody>
</table>

CONCLUSIONS:
1. Did you use a stimulant or a depressant? ________________________________

2. Did your experiment prove your hypothesis correct? ________________________________

3. Which of the groups was your control group? ____________________________Which group was your experimental group ____________________________

4. In your experimental trial, what was the independent variable? ____________________________

5. What was your dependent variable? ____________________________

6. What were some of the constants or control variables (things that you kept the same) between your control trial in just water and your experimental trial?

7. What were some sources of error?

8. Write a statement of data.

8. Write a four to five sentence conclusion.

9. On the back of this lab, create a bar graph of the heart rate in bpm of the control group and the experimental group. Get out your TAILS rules and make sure you follow the RULES