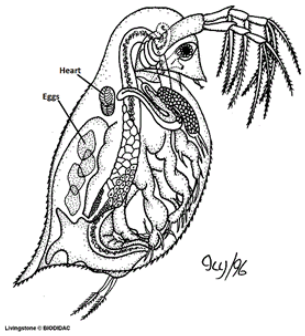
Class Handout- Please do not write on this paper!

Investigation: What Factors Affect the Heart Rate of Daphnia?



MATERIALS

Daphnia in culture liquid (per table)	Transfer pipette	Depression slide
Compound microscope		
Petri Dish	5% ethanol	

ETHICAL and SAFETY

Daphnias are simple organisms often used in toxicology and environmental research. *Daphnia* are living organisms and although they may not "suffer" in the same way as higher animals, they still deserve respect. Animals should be returned promptly to the culture liquid after being examined.

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

1. Using a clean pipette, add culture water into a petri dish. This will be your "used" container. In a second petri dish, carefully transfer 3 *Daphnia* and culture liquid into a petri dish.
2. Carefully, transfer one *Daphnia* and ONE drop of liquid onto a depressed slide. DO NOT place a coverslip on it! Keep the drop small so that the *Daphnia* can't swim out of your field of view. If your pipette is too narrow, snip the end of the pipette. **DO NOT FORCE THE *DAPHNIA* INTO A NARROW PIPETTE!**
3. 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!
4. 3. Count the number of heartbeats that occur in 10 seconds. Have your lab partner time 10 seconds for you as you count heartbeats. If you want, you can place dots on a scratch paper to help you count the number of beats. You want to make your measurements quickly so that the *Daphnia* does not become stressed in the small volume of water.
5. Record the number of heartbeats in the data table on the next page. Multiply the number by 6 to get the number of beats per minute. Turn the light OFF.
6. Add ONE DROP of the **5% ethanol** solution 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. Multiply each count by 6 to get the heart rate per minute. Record in the data table.
8. Rinse the *Daphnia* into the "used" container, then repeat steps # 2-7 with a new *Daphnia*. Repeat one more time for 3 trials. Calculate the average heart rate (in 10 seconds) and beats per minute. This will be your baseline at homeostasis.
9. Let the *Daphnia* rinse off in the "used" container for 5 minutes. Then, retrieve a *Daphnia* and count the number of heartbeats for 10 seconds. Multiply by 6 to get the heart rate per minute. Return to the "used" container.

Repeat step 9 every minute until the heart rate returns to the average baseline or until 15 minutes has passed, whichever occurs first.

Investigation: What Factors Affect the Heart Rate of Daphnia?

A *Daphnia* is a tiny, filter-feeding crustacean (related to shrimp) that has a clear outside skeleton (carapace) and joined legs. Like other arthropods, its heart is on its back. The single. The small heart is easily visible when viewed under a low power microscope. The heart rate (which can be up to 300 beats per minute) can be monitored and counted as the *Daphnia* respond to different environments such as the air, the water, heat and light, and the chemicals.

Chemicals that enter their bodies 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**.

Pre-Lab Question

1. What is your independent variable? _____
2. What is your dependent variable? _____
3. Develop a **hypothesis** that predicts how the heart rate of the daphnia will change when it is exposed to a depressant.

_____

_____

Data Table:

Table 1: Qualitative Observations:

Daphnia in control environment (water):	Daphnia in experimental environment (5% EtOH):

Quantitative data

Table 2: *Daphnia* heart rate in control environment (water- baseline) and experimental environment (ethanol)

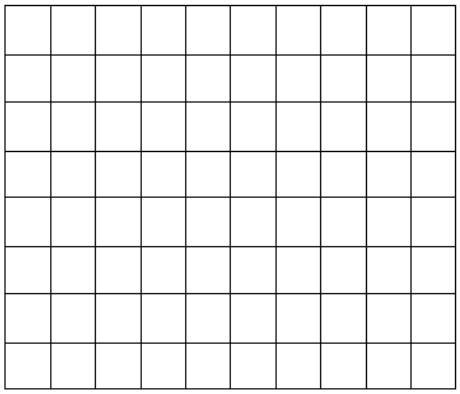
	Water		5% Ethanol	
	10 sec.	BPM (x6)	10 sec.	BPM (x6)
Trial 1				
Trial 2				
Trial 3				
Average				

Table 3: Amount of time for *Daphnia* heart rate to return to homeostasis.

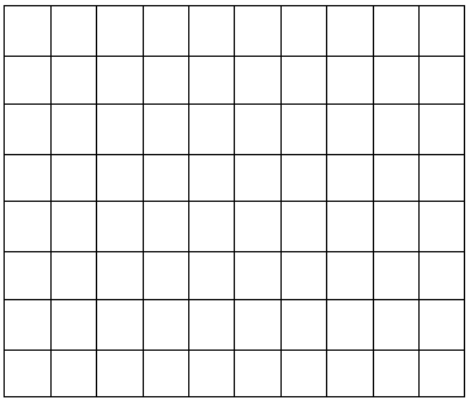
Time (min)	5	6	7	8	9	10	11	12	13	14	15
Heart Rate (10 sec)											

Analysis

Graph 1: Effect of *Daphnia* heart rate (BPM) in water and in 5% ethanol.



Graph 2: Amount of time for *Daphnia* heart rate To return to homeostasis.



Post Lab CER

Question: How did the *Daphnia* respond after a stressful event such as being exposed to ethanol?	
Claim:	
Evidence:	Reasoning: Be sure to discuss *depressants* or *stimulants* and *homeostasis*

RESEARCH ALCOHOL POISONING: Excessive alcohol use is attributed to more than 80,000 deaths yearly in the U.S. Drinking too much too quickly can affect breathing, heart rate, body temperature, body's ability to reabsorb water and many more. Research ONE specific way in which alcohol impacts homeostasis. Be sure to label **receptors/sensors, control center, and effector**.

RESEARCH ALCOHOL POISONING: Excessive alcohol use is attributed to more than 80,000 deaths yearly in the U.S. Research alcohol poisoning to answer the following:

a. What are symptoms of alcohol poisoning?

b. How does alcohol impact homeostasis? Specifically, how does excessive alcohol inhibit feedback mechanisms?

d. What are treatment options for someone suffering from alcohol poisoning? How do these treatment options impact homeostasis?

ORIGINAL

Investigation: What Factors Affect the Heart Rate of Daphnia?

A *Daphnia* is a tiny crustacean (related to shrimp) that has a clear outside skeleton (carapace) and jointed legs. Like other arthropods, its heart is on its back. 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)?

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**.

Develop a **hypothesis that predicts how the heart rate of the daphnia will change when it is exposed to a depressant.

MATERIALS

Daphnia in culture liquid (per table) | Transfer pipette / depression slide
Compound microscope or Stereoscope | A small container for “used” *Daphnia*
1% ethanol in a dropper bottle

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

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 heart beats 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 heart beats in the data table on the next page. Multiply the number by 6 to get the number of beats per minute.
5. Take at least **three** separate heart rate measurements for each individual *Daphnia* and calculate the average of the three measurements.
6. When you have finished recording the heart rate in water (the CONTROL solution), add ONE DROP of the **1% ethanol** solution to the slide. Turn the light OFF and wait 30 seconds.
7. Turn the light back on and count the number of heart beats for 10 seconds again, repeating at least 3 times. Multiply each count by 6 to get the heart rate per minute. Record in data table.
8. Rinse the *Daphnia* into the "used" container, then repeat steps # 3-9 with a new *Daphnia*.

HR = Heart Rate BPM = Beats per Minute

	Water		Ethanol	
	10 sec.	BPM (x6)	10 sec.	BPM (x6)
Trial 1				
Trial 2				
Trial 3				
Average				

Analysis and Conclusion

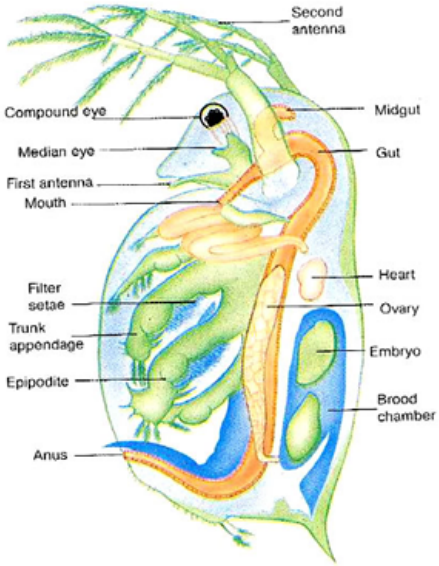
Average BPM in Water: _____ **Average BPM in Ethanol: _____**

1. Did the ethanol increase or decrease the heart rate?

2. Did the data support your hypothesis?

What was the independent (manipulated) variable in your experiment?

What was the dependent variable?



3. Would you classify the ethanol as a **stimulant** or a **depressant**? Why?

4. Compare your results with your lab partner. Did you get similar results? If no, propose an explanation for why your results might have been different.

Part 2: Design an Experiment

Now that you have an idea how to measure the heart rate of the daphnia, choose ONE new variable to test. Your instructor will provide you with additional materials. Variables: temperature, sugar, artificial sweetener, caffeine. You will turn in a lab report that includes:

- Introduction which includes a hypothesis (or prediction)
- A summary or sketch of your experimental design
- Data table
- Summary / Conclusion that discusses the results of your experiment.