CHAPTER 2

Experimentation: The Process Skills in Action

All organisms respond to changes in their environment, often by changing their rate of respiration. Aerobic respiration is not completely efficient in converting glucose energy into ATP energy, and some is released as heat. Our bodies can respond to a decrease in environmental temperature (within limits) by increasing the rate of aerobic respiration in order to maintain a stable body temperature. Humans are considered endothermic animals, meaning that we control the heat balance from within our bodies.

Body temperature in ectothermic animals rises and falls with their surroundings and they are, figuratively speaking, at the mercy of their environment to a greater extent endotherms. Activity levels may be closely associated with external temperatures. However, ectotherms may make behavioral changes to adjust to changing external temperatures.

Changes in behavior can be correlated with changes in carbohydrate metabolism. The respiration cycle in fish, which accomplishes gas exchange between the environment and the fish, occurs when the water, laden with dissolved in the water diffuses into the capillaries in the gill filaments and enters the blood.

Carbon dioxide, one of the products of respiration, diffuses from the blood across the gill filaments and into the water. The gill cover opens to allow the carbon dioxide-laden water to leave the gill chamber, thus completing the respiratory cycle.

By observing action of the gill cover (determining the gill beat rate) in fishes (which are ectothermic animals) in this experiment, you will determine the effect of temperature on respiratory rate and the correlated metabolism rate. This experiment tests the hypothesis that: fish respiratory rates vary with temperature.

Procedure:

[Note: Read all the instructions before beginning the experiment]

1) Write a prediction regarding the outcome of your experiment. Identify the independent and dependent variables, and enter them in Table 2.1.
2) Lower the thermometer (without touching the goldfish) until the thermometer touch the water. Wait for 2 minutes and record the temperature of the water in Table 2.2.
3) Observer the movement of the operculum (gill cover). Count the movement of the operculum at the starting temperature for 1 minute. Repeat this procedure two more times. Record the gill beat rate data plus the average rate in Table 2.2.
4) Gradually add ice to the plastic dishpan around the fishbowl until the water temperature in it has been reduced to room temperature °C. Wait 1 minute for the fish to adjust to the new temperature. Repeat step 3 and determine the gill rate.
5) Continue to lowering the temperature of the water surrounding the fish with additional ice around the fishbowl every 5°C at a time, wait 1 minute each time a temperature is reached to allow the fish to adjust until the water reaches a temperature of 5°C or 4°C.
6) At the end of this experiment, remove the fishbowl from the plastic dishpan and dispose the ice and water in the sink. Add tap water in the dishpan and place the fishbowl in the dishpan to allow it to warm up gradually to room temperature.
7) Record the average of each temperature from each group on Table 2.3.
8) Complete a laboratory report as directed by your laboratory instructor.
### Table 2.1. Operculum Movement of Goldfish as a Function of Temperature.

<table>
<thead>
<tr>
<th>Prediction:</th>
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<tbody>
<tr>
<td>Independent Variable:</td>
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<tr>
<td>Dependent Variable:</td>
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</table>

### Table 2.2. Results: Operculum Movement of Goldfish as a Function of Temperature.

<table>
<thead>
<tr>
<th>Trail</th>
<th>Room Temperature _______ °C</th>
<th>20 °C</th>
<th>15 °C</th>
<th>10 °C</th>
<th>5 °C</th>
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</thead>
<tbody>
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<td>Average</td>
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</table>

### Table 2.3. Group Average: Operculum Movement of Goldfish as a Function of Temperature.

<table>
<thead>
<tr>
<th>Trail</th>
<th>Room temperature _______ °C</th>
<th>20 °C</th>
<th>15 °C</th>
<th>10 °C</th>
<th>5 °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
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<td>Group 2</td>
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<td>Group 6</td>
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<td>Group 7</td>
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<td>Group 8</td>
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<tr>
<td>Average</td>
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</tbody>
</table>
Review Questions Chapter 2 Experimentation: The Process Skills in Action

1. **List and discuss the basic integrated process skills used in this experimentation.**
   
   [Note: The chapter 2 Experiment consists of a series of biological questions or tasks that involve the use of one or more process skills. In science process skills are classified as basic skills and integrated skills. Basic skills rely on the senses while integrated skills involve inference and interpretation.]

2. State your hypothesis. Was your hypothesis rejected or accepted in your experiment?
   
   [Note: A hypothesis (educated guess/or the answer to your question) is a tentative explanation for an observation.]
3. Identify the control variable, independent variable, and dependent variable utilized in this experiment.

[Note: a dependent variable is the variable being tested in a scientific experiment. The dependent variable is 'dependent' on the independent variable. As the experimenter changes the independent variable, the change in the dependent variable is observed, recorded and measured. A controlled variable is a variable that does not change during an experiment, it remains constant.]

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4. List the variables that may affect the respiration rate of the fish.

[Note: To isolate cause and effect, scientists can eliminate (or screen out) the influence of other factors that may account for the results they observe.]

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5. Discuss how your group’s data results compared to the results of the entire class.

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6. Discuss how the theme of experiment can apply to the natural world and care of aquatic animals.

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7. List some possible sources of error in this experiment.

[Note: A confounding variable is an extraneous in an experiment that correlates (positively or negatively) with both the dependent variable and the independent variable. A perceived relationship between an independent variable and a dependent variable that has been misestimated due to the failure to account for a confounding variable is termed a spurious relationship, and the presence of misestimating for this reason is termed omitted-variable bias.]

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8. Discuss some extensions of this experiment that may be worth investigating?

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