Name _____ Period _____ Date _____

Laboratory Activity #2 — Student Laboratory Packet

Making Connections

A Laboratory Activity for the Living Environment

Discovering Connections

As they make observations, scientists are always looking for patterns in the natural world. For instance, researchers have observed that pregnant women who smoke cigarettes have a higher incidence of low-birthweight babies and that people with high-fat diets have a greater risk of developing heart disease. Many similar medical discoveries are a result of the patterns that can be observed when studying people and their lifestyles.

Discovering and explaining connections is one of the basic methods by which our knowledge of the world advances. It is what science is all about! Sometimes the connections are not what we expect or would predict, and sometimes we may have a hard time explaining the connections. Nevertheless, that is how science makes progress.

In this part of the laboratory activity, you will make a few observations about yourself and your classmates; then you will look for patterns or connections.

Safety

Safety is important during any laboratory activity. Although no dangerous chemicals or heat sources are used in this investigation, be sure you are careful and behave responsibly.

Another concern is health. If you have health reasons for not performing the exercises called for in this activity, tell your teacher so that other arrangements can be made for you to successfully complete the investigation. If you are excused from gym class for medical reasons, for example, or if you have asthma, tell your teacher about it before beginning the laboratory activity.

Important Note: *Record all of your data and answers on these laboratory sheets. You will need to keep them for review before the Regents Examination. Later you will need to transfer your answers to a separate Student Answer Packet. Your teacher will use that packet in grading your work, and the school will retain it as evidence of your completion of the laboratory requirement for the Living Environment Regents Examination.*

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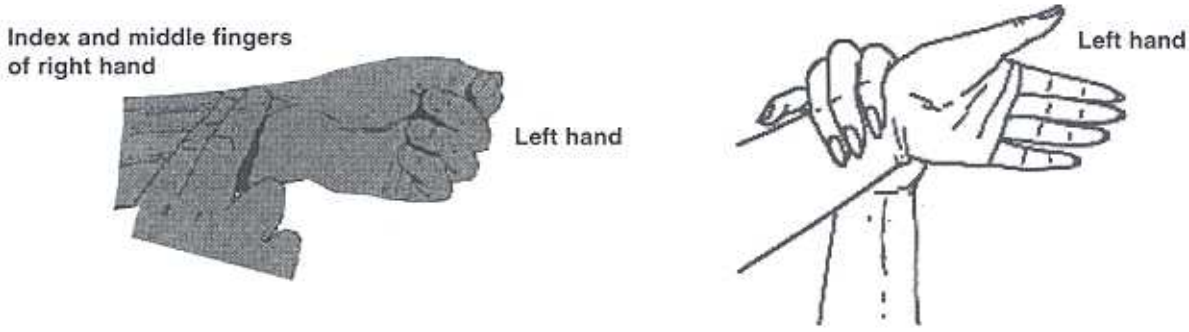
Part A. Looking for Patterns

A1. What Is Your Pulse Rate?

Your pulse is a result of the expansion of blood vessels that occurs each time your heart beats to send a surge of blood through your body. You can feel certain blood vessels "pulse" as this happens. Two different ways to take your own pulse are illustrated below. Choose the one that works best for you. As you press lightly, you should feel the pulsing of the blood. If you cannot locate your pulse after a short time, ask your teacher for help.

Two Methods of Taking Your Own Pulse



Your pulse rate is a measure of how many times a minute your heart beats. Count the number of pulses you can feel in 20 seconds. Record the number below and then multiply it by 3 to determine how many times your heart beats in 60 seconds. Wait a minute and measure your pulse again. Wait another minute and measure your pulse a third time.

- Record your pulse rates for three trials below:

  Trial 1 (20-second count) _____ X 3 = _____ per minute

  Trial 2 (20-second count) _____ X 3 = _____ per minute

  Trial 3 (20-second count) _____ X 3 = _____ per minute

Your pulse rate should be about the same each time. For accuracy, it is often better to take two or three readings, about a minute apart, and average them.

- Calculate and record your average pulse rate per minute: _____
- Record your average pulse rate on the board or on a transparency provided by your teacher so that everyone can see the pulse-rate data for the entire class.

Complete a Data Table

Use the average pulse rate for each student in the class to complete the data table below.

Class Results: Average Pulse Rates

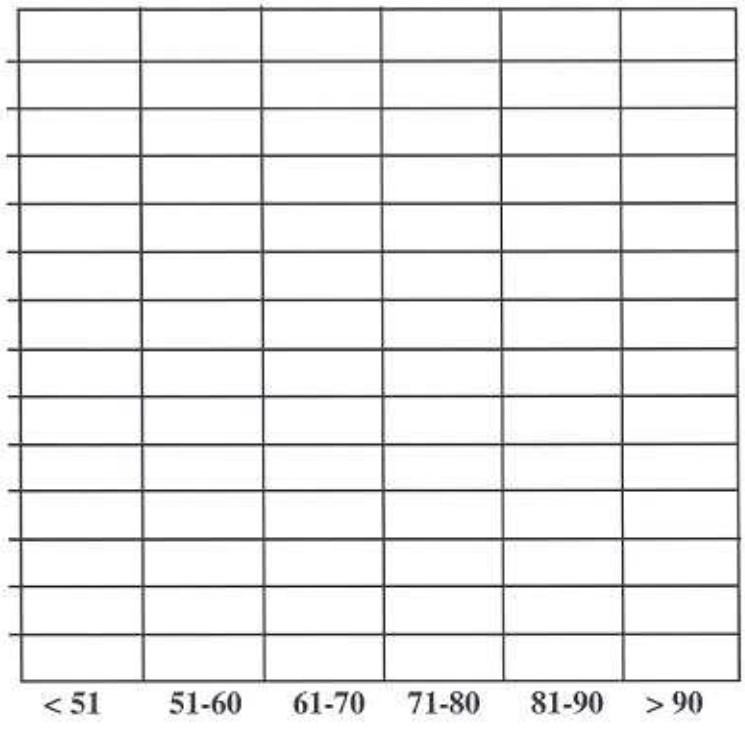
Pulse rate per minute (range of averages)	< 51	51-60	61-70	71-80	81-90	> 90
Number of students in this range						

Prepare a Histogram

Use the information in the data table to prepare a histogram of the class results. Use the grid below.

- Provide a title for the histogram.
- Label the vertical axis and mark an appropriate scale on the vertical axis.
- When you have determined the height of each column, shade in the vertical bars.

Histogram Title: _____



Answer the Following Questions

Do you see a pattern to the class data? _____ If so, what is it? If not, explain why you think a pattern does not exist.

A question that someone might ask about pulse rate is, "Is there a connection between height and pulse rate?" Based on the information obtained from this activity, can you tell if there is a connection between a person's height and the person's average pulse rate? _____ If so, explain the relationship and how you can tell it exists. If not, what additional data would you need to collect to find out if there is a connection?

State another question that someone might ask about pulse rate that could be answered by doing an experiment.

Some people have suggested that someone's pulse rate will increase if he or she becomes more active. Try this: Once you have found your resting pulse rate, run in place for one minute. As an alternative, you can dance or do knee bends, jumping jacks, or push-ups.

Did your pulse rate increase? _____ Ask four classmates if they got similar results. Did their pulse rates increase after exercise? _____

Pulse rates increase for most people after exercise. Explain why this connection between pulse rate and activity makes sense.

A2. How Does Fatigue Affect Muscle Performance?

A condition known as *muscle fatigue* occurs when certain waste products of muscle cell activity build up in the cells. Until these waste chemicals are removed, the fatigue will continue.

Do the Following Activity

Hold a spring-type clothespin between your thumb and index finger. Pinch the ends together completely (until the two ends touch) and release them. Do this as rapidly as possible for one minute. Record the number of times you could squeeze the clothespin in one minute: _____

Try the activity again, doing it the same way and using the same two fingers as before.

Record the number of times you could squeeze the clothespin the second time: _____

Answer the Following Questions

Some people are able to squeeze the clothespin more times in a minute than others. Suggest a possible explanation for this.

_____

_____

_____

Could you do as many in a minute the second time as you could do the first time? _____

Provide a biological explanation for these results.

_____

_____

_____

Part A. Questions *(Answer each of the following questions in the spaces provided. You will need to turn in your final answers in a separate answer packet.)*

1. What does an increased pulse rate indicate about the heart rate and flow of blood in someone's body?

2. When muscles are active, cells use nutrients and oxygen at a higher rate and produce waste chemicals and heat more rapidly. Describe how the interaction of two or more body systems helps to maintain homeostasis during periods of high muscle activity. (Be sure to identify the two systems you refer to in your answer.)

3. A student in your class suggests that when most people watch exciting sporting events on television, their pulse rates increase. What is a reliable way to find out if this statement is correct?

4. What specific evidence would you need in order to determine if what the student suggests in question #3 can be supported?

5. If you wanted to increase your clothespin-squeezing rate, would you suggest exercising or resting before you did it? Explain why you think your choice is the correct one.

Part B. Investigating Claims

You hear many claims made every day. Advertisers make claims about the usefulness or effectiveness of their products. Your friend may claim to be able to do something that you do not think he or she can really do. Do you believe all the claims that people make? Have you ever bought a product based on a claim made in an advertisement, only to find that the product did not work as you expected it to?

When does a *claim* become a *fact*? Scientists look for evidence to support or refute a claim. Evidence can help you determine which claims are facts and which are opinions or even misrepresentations. For example, if one of your classmates claims to be the fastest runner in the class, you could gather evidence by holding a series of races. If your classmate's claim is true, that person should win all of the races. If another individual wins the races, your classmate's claim was simply an opinion not supported by the evidence.

In this part of the laboratory activity, you will conduct an investigation to determine which of two opposing claims can be supported with evidence. First read the section below. It describes two opposing claims. Then investigate to see which claim (if either) is supported.

Conflicting Claims About the Effect of Exercise on the Rate of Clothespin Squeezing

Student A claims that a person will be able to squeeze a clothespin more times in a minute if the person exercises first. Student A suggests that exercising produces a faster pulse rate, which indicates that the blood is getting to the muscles faster.

Student B claims that a person will be able to squeeze the clothespin more times in a minute if the person does *not* exercise first. Student B suggests that exercise takes energy away from the muscles, and a person who has been resting will have more energy.

Which of the two students do you agree with? _____ How could you find out for sure which claim is correct ?

_____

_____

_____

Design an Experiment

You must now design and conduct a controlled experiment to gather evidence that will determine which of the two claims is correct. Use the information on the next page to help you design your controlled experiment. Be sure your experimental methods will provide enough data upon which to base a valid conclusion. You will have to conduct several trials.

Guidelines for Designing a Controlled Experiment

Scientists follow certain guidelines when they conduct and report on a controlled experiment. These are provided below. As you work through this section to design your experiment, make notes as you go along. Your notes will become the outline for your investigation, and you can use them to prepare a final version at the end.

1. **Determine the question you are trying to answer.** The question should be directly related to what you want to find out. For example, if you want to know whether or not light intensity affects tomato seed germination (the emergence of a plant from the seed), you might ask, "Does light intensity affect tomato seed germination?"

   Write in your notes the question you will be attempting to answer.

2. **Formulate the hypothesis you will be testing with your experiment.** The *hypothesis* is a tentative statement about the expected relationship between the variables. This statement must be written in a way that allows the relationship to be tested. It often suggests that there is a connection between two factors. For example, "Light intensity will influence the germination of tomato seeds."

   Write in your notes the hypothesis you will be testing.

3. **Formulate a title for your investigation.** A title addresses specifically what is being investigated. The title should be a statement in the form of "The effect of....on...." You should specify the organism(s) you are using as well. For example, "The effect of light intensity on seed germination in tomato plants."

   Write the title of your experiment in your notes.

4. **Plan the design of your experiment.** In the planning of your experiment, consider each of the following. Make notes of your ideas to use later.

   a. You need to decide what data you will collect. The *dependent variable* is the one you measure. In this investigation, the number of times the clothespin can be squeezed in a minute is the dependent variable.

   b. What is to be your *independent variable*—the one you will vary to see how it may affect the dependent variable? In this investigation, you might make the independent variable the subject's level of activity just before each of the trials during which you measure that subject's clothespin-squeezing rate.

   c. To do a fair test (controlled experiment) and obtain a valid conclusion, you must keep all but the independent variable constant. What other variables will it be important to keep constant to obtain meaningful data?

   d. Decide how many individuals you will test, how many trials you will conduct with each, and the conditions to which they will be subjected. In this case, you need to determine how many people you will test and what you will have them do.

   e. Make note of safety precautions that will be necessary.

   Write out the steps of your experimental design in your notes.

5. **Design one or more data tables that you will use to record the data as it is collected.** Your data table(s) should also have sections for summarizing or averaging the data, as appropriate. Your data table(s) must be designed and finalized before you begin the experiment.

   Sketch in your notes the data table(s) you plan to use. Be sure to include appropriate headings and units.

6. **Write out the steps you will follow to conduct your experiment.**

7. **Have your experimental design plan approved by your teacher.**

8. **Conduct your experiment.** Gather the materials you will need, arrange for your "test subjects," and do the experiment.

Organization of the Final Report

When you are finished, organize your data and determine what the data "tells you." Also, review what you did and think about whether or not some procedures should have been done differently to give you more reliable results. Your final report should have the following sections:

- **Title** — Use your notes from the previous section. (Refer to Guideline 3.)
- **Hypothesis** — Use your notes from the previous section. (Refer to Guideline 2.)
- **Methods and Materials** — Describe the materials (what you used) and procedures (what you did) in your experiment. This may be done in the form of a list, a paragraph, or a combination of both. Use your notes from the previous section to guide you in this. (Refer to Guidelines 4 and 6.) Be sure to identify the dependent and independent variables.
- **Data Collected** — Include your completed data table(s) and, if appropriate, a graph or graphs to summarize the data for easier understanding of what you found.
- **Discussion and Conclusions** — These will relate back to the title and hypothesis for the investigation. Be sure to note whether your data supports or does not support your hypothesis. You also need to include an explanation of how or why this conclusion follows from the data you collected.
- **Suggestions for Improvement** — Discuss any possible sources of error that may make your data less reliable. Include a discussion of controlling the variables when investigations involve human subjects. State three additional variables that may have influenced the outcome of your experiment.
- **Suggestions for Further Research** — Nearly any experiment that is done produces new questions that could be answered with new investigations. Include two suggestions for other investigations that could be done or additional data that needs to be collected to further support your findings or to answer any new questions that came up during the experiment.

Note: You will need to make two copies of the report—one to hand in and one for exam review.

Prepare To Present Your Research to the Class

Just as scientists must always defend their claims and conclusions to their peers, you should be prepared to report on and defend your findings before the class. If you are chosen to do a presentation to the class, you should be able to address each of the sections of the final report and to answer questions about your data and conclusions. You should prepare some visual aids to make the presentation clear and understandable.