Testing for relationships between physiological, morphological, and lifestyle parameters

Objectives:

1. Learn how to measure three physiological parameters: blood pressure, pulse rate, and vital capacity.
2. Plan and carry out an experiment, using statistical methods to analyze and represent data.

Introduction:

Lung volumes and capacities, blood pressure, and pulse rate can be indicators of a person's overall health. In this exercise, we will examine whether there is a relationship between any of these three physiological parameters and other lifestyle or morphological parameters which we can measure in lab.

We will choose some lifestyle and morphological factors to measure, discuss how to measure them, collect data from all the individuals in the class, and analyze the data to see if there are relationships between them.

Methods and Materials:

Spirometry: Spirometry is the measure of volume changes in the lungs during breathing. It can be used to assess whether lungs are normal or dysfunctional. For instance, emphysema and chronic obstructive pulmonary disease can be detected by measuring lung volumes with spirometry.

There are several ways to measure the volumes or capacities of the lungs. One measure of lung capacity is called the **Vital Capacity**; this is the largest amount of air that can be exhaled from the lungs at one time. It can also be thought of as the total exchangeable amount of air in the lungs. However, it is not the total capacity of the lungs. There is always some air (normally about a liter in a healthy adult) left in the lungs even after forced expiration.

A wet spirometer is an instrument used to measure lung volumes and capacities. For measurements to be meaningful, they must be repeatable. It is important that everyone uses the spirometer in a similar way, so that the measurements are comparable. Here is the accepted protocol for measuring **vital capacity** with a spirometer:

- During the measurement, back should be straight -- posture affects the amount of air one can get into lungs.
- During the measurement, eyes should be closed. Watching the dial, or shifting posture due to external influences can affect the reading.
- During measurement, the nasal airway should be pinched shut so air from lungs does not escape.

1. Place a personal cardboard mouthpiece into the tube of the spirometer.
   (If for some reason you measure more than once, be sure to always place the same end of the cardboard tube in your mouth.)
2. Sit still in a chair and breathe regularly for 5 breaths.
3. Then, inhale as deeply as you possibly can.
4. Next, blow into the cardboard mouthpiece as much air as your possible can. Blow until you cannot force any more air out of your lungs. (The air that you blow out will be captured in the bell of the wet spirometer, and cause the bell to rise. As it rises, it turns a dial and causes a needle to move on the dial. Vital capacity can be read in **milliliters** off of the dial.)

Pulse rate can be measured by holding digits 2 and 3 over the carotid artery in the neck, or the radial artery in the wrist, and counting the expansions of the artery for 1 minute. Record your pulse in beats per minute (bpm)

Blood pressure can be measured with a sphygmomanometer. A sphygmomanometer uses an inflatable cuff to apply enough pressure on an artery to stop the flow of blood like a tourniquet. As the cuff pressure is slowly released, the blood pressure developed during systole will eventually be sufficient to force blood past the cuff. The spurting of the blood past the cuff constriction makes characteristic sounds, called **Korotkov's sounds**, which can be heard with the aid of a stethoscope in a very quiet room. The cuff pressure at which one first hears Korotkov's sounds is the **systolic pressure**, the greatest pressure of blood in that artery.

As the pressure in the cuff is lowered still further, the blood pressure will eventually be able to force blood past the cuff during both the contraction and the relaxation of the ventricles. When this occurs, Korotkov's sounds are no longer detectable, because the blood is flowing smoothly and continuously through the artery, even when the ventricles are relaxed. The cuff pressure at which Korotkov's sounds disappear is recorded as the **diastolic pressure**, the lowest pressure in that artery. These two values are recorded as:

Systolic pressure
Diastolic pressure

To use the Aneroid Sphygmomanometer:

Swab the ear pieces of the stethoscope with alcohol before inserting them in your ears. Have the subject rest his/her arm palm up on a table top. Place the cuff on the subject's upper arm. Place the stethoscope below the cuff over the brachial artery as demonstrated by your instructor. Close the valve on the bulb. Squeeze the bulb several times to inflate the cuff and occlude the brachial artery (up to about 150 mmHg). Do not exceed 180 mmHg. Release the pressure slowly by opening the valve slightly. If your subject experiences any discomfort, release the pressure quickly. Hold the stethoscope very still and listen for any faint rhythmic sounds in the artery. When you first hear a rhythmic sound, note the **systolic pressure** indicated on the gauge. Continue to release the pressure. Note the **diastolic pressure** at which Korotkov's sounds disappear. Quickly release the rest of the pressure on the cuff. Record the systolic and diastolic pressures.

Systolic = _____
Diastolic

"Normal" resting values are about 120 mmHg for the systolic and about 80 mmHg for the diastolic; however, there is considerable variation within the normal range.

Morphological or Lifestyle Variables:

1. What are some morphological or lifestyle variables that might affect a person's resting pulse rate or resting vital capacity or resting blood pressure? List several.

2. From the list of variables you came up with at #1, choose some that can be measured in class. Decide and describe **exactly** how you will measure them. Directions should be precise enough that another person measuring the same variable on the same person will get the same result. (One of these variable will eventually be your Independent variable.)

3. Your group will pick, or be assigned, a particular hypothesis to test about the relationship between these variables. Your hypothesis will be about whether one of the morphological or lifestyle variables has an effect on a physiological variable. Write your hypothesis. (It should be written as a statement.)

4. Why do you think this independent variable might have an effect on the dependent variable?

5. Write your predictions about the outcome of your experiment, based on your hypothesis. The predictions is a deduction based on your hypothesis.

6. Collect your data. For each person in the class, measure and record the parameters on the available chart.

Results:

1. Determine the nature of your data, (i.e., is your data categorical or numeric?) and decide what kind of statistical analysis is appropriate. Analyze the data and graph the data appropriately. Use the templates available on the computer in class or at the Biology Statistics web page : http://www.radford.edu/~biol-web/stats.html

2. Describe and graph your data. Don't interpret the results yet, just describe them. Where appropriate, include means, standard errors, ranges, and correlation coefficient.

Conclusion:

1. Did the results support your hypothesis or refute it ? Explain how you can tell.

2. Describe how any problems with the procedure might have had an effect on your conclusions ?

3. If you were to repeat this experiment, what could you do to make your results more reliable or convincing ?

Table 1: Selected measurements of students

Name or number	BP (mmHg)	Pulse (bpm)	Vital Capacity (ml)							