Instructor version

Title: “Impact of exercise on cardiopulmonary function, a practice in integration”

Goal: Place cardiovascular and pulmonary variables in a functional context.

Discipline and courses: Upper division physiology, exercise physiology

Degree of difficulty: I-M (Introductory-Intermediate)

Materials: Blood pressure cuff and spirometer

Material required for this activity can be easily obtained from commercial suppliers or laboratory material if offered by your institution. Suggested and alternative materials are provided below. Cost of materials may change from the date this activity was written.

Cardiovascular measurements:

Suggested materials:

Digital blood pressure cuff from Amazon: Omron upper arm blood pressure monitor, $39.00/unit.

Benefits: Allows for measurement of systolic and diastolic blood pressure without having technical training. Less cumbersome. Records blood pressure and heart rate. Allows focus to be on significance of physiological parameters and less on the technical aspect.

Drawbacks: Slightly more expensive, does not provide technical training for students interested in health care.

Alternative materials:

Manual blood pressure cuff: Lumiscope sphygmomanometer, $20.17/unit.

Stethoscope: MDF acoustical light weight stethoscope, $24.99/unit.

Benefits: Allows technical training in use of the devices for those interested in health care.

Drawbacks: More cumbersome and prone to errors in data collection. Requires use of both the blood pressure cuff and stethoscope to measure cardiovascular values. Requires a quiet room.

Pulmonary measurements:

Suggested materials:

Baseline Windmill spirometer: $139.50/unit, plastic mouth pieces $26.00/100.

Benefits: Accurately measure lung volumes. Clear instructions are provided with the device.

Drawbacks: Cost may be prohibitive

Alternative materials:

1. Laboratory digital spirometers: Vernier spirometer, $219.00/unit, in addition to the initial software purchase.

Benefits: Procedures are often included, and more accurate values will be obtained.

Drawbacks: Supplier software required. Cost may be prohibitive if a laboratory is not offered at instructor institution. Students may be distracted by the instructions and technique rather than interpretation of physiological parameters.

2. Disposable spirometer: Voldyne 5000 volumetric exerciser, $6.88/unit

Benefits: Cost is significantly lower than the materials mentioned above.

Drawbacks: Values returned may not be as accurate as hand-held or digital spirometers.

Background required: Cardiovascular and pulmonary physiology

Assignment summary:

In this project, students will carry out a procedure to integrate cardiovascular and pulmonary organ systems response to exercise. In this effort students measure cardiovascular and pulmonary parameters at rest and post-exercise. Students will be expected to predict and record values from the two different physiological states. Once data is collected students will use the data to calculate other parameters in an effort to emphasize the significance of organ system integration. The integration of cardiovascular and pulmonary systems is exemplified during exercise and this activity should provide context for the integration of these two organ systems.

Duration: 2 50-minute class periods: Class one will focus on collection of data. Class two will include a group discussion interpreting the results.

Alternative activity duration: Omit day two and do not go over interpretation with students.

Project instructions for the instructor:

In this project students will collect cardiovascular and pulmonary physiological parameters and calculate other variables of interest. This project emphasizes the cardiovascular and pulmonary function before and following exercise.

This project will require students to prepare for the activity by completing the Pre-activity worksheet as homework. Assign students “Part 1: Pre-activity worksheet”. The worksheet helps make sure the students are familiar with the various variables that will be needed for the entire activity. The worksheet and an answer key to the worksheet are provided in separate documents with this project.

On class period one, students will collect cardiovascular and pulmonary measurements, perform required calculations using provided equations, and record data into a table. For data taking, refer to “Part 2: Post-exercise worksheet”. This worksheet gives the students detailed instructions on what to measure.

Post-exercise questions are included at the end of “Part 2: Post-exercise worksheet” and should be addressed by students following data collection. The questions should be completed prior to the next

class as homework. The worksheet and an answer key to the discussion questions are provided in separate documents with this project.

On class period two, the instructor and students will have a group discussion to share and explain findings.

Activity instructions:

Revision and Continuation:

Activity level can be incorporated in order to determine the impact exercise training has on cardiopulmonary measurements. Students may select from categories of fitness level (exercise training). An example for this would be offering options for fitness level:

1. I do not exercise at all, 0 days per week.
2. I exercise on an infrequent basis, 1-2 days per week.
3. I exercise frequently, 3-4 days per week.
4. I am on a very scheduled exercise regimen, 5 or more days per week.

Once students have taken data, the data from the whole class can be aggregated and categorized based on fitness level. Then, cardiopulmonary measurements can be compared across fitness-level categories, and the class can discuss what can be learned from the differences.

Discussion suggestions for the instructor:

- Have students enter data into a shared spreadsheet, the instructor could generate averages and figures to aid in leading the discussion of the data.
    - If the instructor had students indicate their fitness level, data can be broken down by this categorization, emphasizing the impact of exercise training.
- Additional questions for the instructor to lead discussion.
    - What is the significance of the cardiovascular and pulmonary response to exercise?
    - Why was stroke volume estimated rather than measured?
    - We could have measured metabolic rate with the use of additional more complicated tools.
        - What is metabolic rate?
        - How would metabolic rate to be affected by exercise?
        - Do the values you collected support this prediction? Why?
    - If the instructor chose to have students indicate their fitness level, the following question can be asked.
        - Did the level of fitness affect cardiopulmonary measurements?
        - What changes were likely made to physiological function that may contribute to any observed differences due to fitness level?