Assessing Aerobic Power during Different Forms of Exercise

Name_____ Lab Partners_____

NOTE: FORMAL LAB REPORT DUE ON THIS LAB IN 2 WEEKS!
**Week May 7th - 11th Data collection**
Week May 14th – 18th Data analysis in class
Week May 21st – 25th Formal lab report due

INTRODUCTION

In many situations where an assessment of human functional capacity is desired it is not possible to measure oxygen consumption directly. Widespread use has been made of a procedure for predicting maximal aerobic capacity from observations of heart rate during submaximal work. This is justified because the relationship between heart rate and oxygen uptake is linear over a wide range (see figure below).
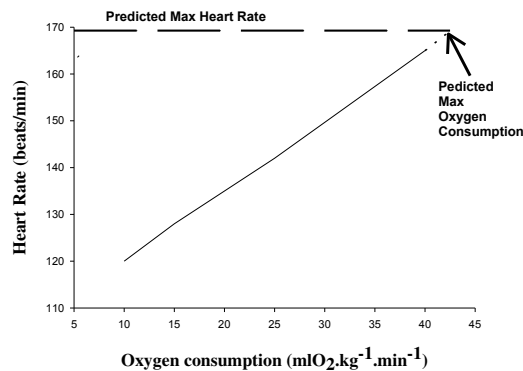
The slope of the heart rate-o_2 uptake line and extrapolation to a pre-determined maximal heart rate permit the individual's maximum oxygen consumption to be predicted. The error of the method is influenced by such factors as age, mechanical efficiency, type of exercise, training, etc. and may range from 10-15% for trained and untrained individuals, respectively. Despite the possible errors, the submaximal test provides a practical method of testing large groups of individuals quickly and without maximal effort, which may be contraindicated in some conditions.

The purpose of this laboratory will be to determine the inter-relationships between heart rate, respiratory frequency, biomechanics and exercise intensity. Three forms of exercise will be compared (swimming, running and biking) to assess the effects of type of sport on these relationships in yourself.

In this Laboratory you will measure cardiovascular and respiratory functions during swimming. These results will be compared to measurements during exercise on a bicycle and on a treadmill. At the completion of these laboratories you will have a comparison of your

physiological and biomechanical responses to three forms of exercise: swimming, running, and biking. (Note if you have injuries or illnesses that precludes you from one of these types of exercise you may substitute another (i.e. elliptical trainer, skating if you can measure all of the required parameters (speed, respiration rate, movement mechanics, heart rate)

Protocol.

Heart rate and respiratory observations are made under steady state conditions during continuous work lasting 4-5 minutes. Metabolic processes are essentially aerobic, with ventilation, heart rate, cardiac output and oxygen uptake relatively constant during the last 2-3 minutes of the test.

SWIM, BIKE, & RUNNING TESTS

1. Each team will need 4-5 people. For each team select the subject, a person with a stopwatch who will record total time and stroke frequency, a person who will write on the data sheet and count breaths, and a person who will determine heart rate by palpating the carotid artery on the side of your neck. You should practice this at rest before you being the actual exercise test. Note if there are enough people in your group you may further divide out these tasks.

2. Once the team is established, the subject will perform a 4 – 5 minute warm up swim. They can select any stroke or speed so long as they keep moving. This is a good time for the subject to determine their preferred exercise loads (slow, moderate, fast swim). Also the subject should determine if they want to perform a 50m or 100m test for each load. Note that the calculations will change if they select a 50m swim!

3. Following the warm up the subject will begin the exercise session. At the signal from the stopwatch monitor the subject will perform a 100 m slow swim (4 lengths). During the entire test swim the recorders will count the **total number of breaths** and **strokes taken** by the swimmer, and the **total time** it took to complete the swim. Note that stroke frequency is determined by counting the movements of each arm!

4. **Immediately** following the swim, heart rate will be measured by having the swimmer come to the edge of the pool and having a group member measure heart rate by palpation. The trick is that heart rate **must be determined within 10 – 30 sec** of completion of the swim in order to reflect the steady state heart rate.

5. Give the subject a short rest and repeat the test at a moderate swim speed and finally at a fast speed. Each test should be run for 100m (or 50m if selected for the first trial). **Must be the same distance for each test!!**

6. After the test have the subject complete a cool down lap and then switch recording positions for the next subject.

7. Once the swim test has been completed, collect identical data (heart rate, respiration rate, pedaling frequency) for three speeds on the exercise bicycle at the Wellness Center. Do the same for the treadmill. On these tests you should be able to work on your own since you are now familiar with treadmill and bicycling protocols for steady state exercise. Still work in groups as it is difficult to monitor physiological parameters on yourself. **Choose bikes and treadmills with heart rate monitors on them.** Alternatively heart rate can be determined by your lab mates palpating the carotid artery on the side of your neck.

8. On separate graphs plot the following. Include data for the swim test as a dashed line connecting the points, and data for the bicycle test as a solid line connecting the points on the same graphs. Add a dotted line for your running data. Make sure the units are the same for each exercise type (i.e. convert speed to m/sec for the bike, run and swim.)

A. Heart rate in relation to speed (Include resting values as 0 speed.)
B. Stroke and stride frequency in relation to speed
C. Respiratory rate in relation to speed
D. Heart rate in relation to respiratory rate
E. Other graphs that you think will be interesting

SAMPLE GRAPHS
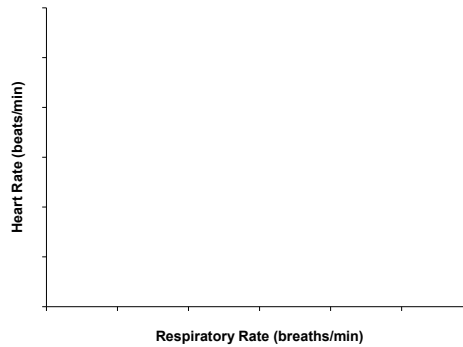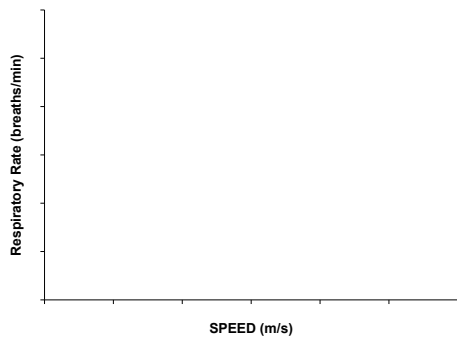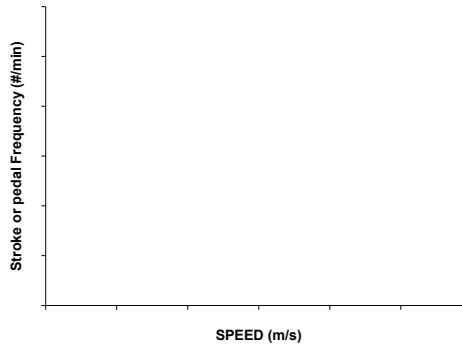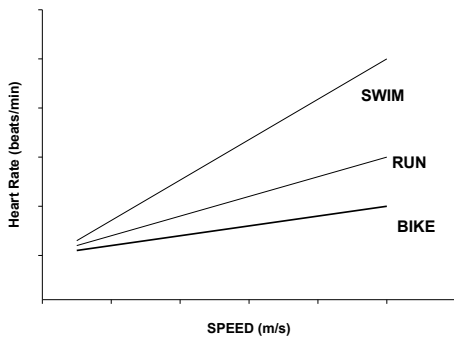
THESE GRAPHS AND THE FOLLOWING CALCULATIONS WILL FORM THE BASIS OF YOUR FORMAL REPORT

DATA SHEET   Name_____

I. Resting Heart Rate and Respiratory Rate. (Determine this yourself at home by counting your heart beats over 15 sec by palpation. Multiply this number by 4. Count the total number of breaths taken in 1 minute at rest. Your pre-exercise levels at the pool and gym will undoubtedly be too high to use.)

Resting Heart Rate_____ beats for 15 sec x 4 = _____ beats/min

Resting Respiratory rate _____ breaths per minute

II. Target Heart Rate Range. Calculate your target heart rate range for cardiovascular fitness from the following equation. This assumes that maximum fitness is achieved with exercise levels between 60 and 80% of maximum heart rate.

Target Heart Rate = [(220 – age – Resting Heart Rate) x % effort] + Resting Heart Rate

Minimum
Target Heart Rate = [(220 - _____ - _____) x 0.60] + _____ = _____ beats/min

Maximum
Target Heart Rate = [(220 - _____ - _____) x 0.80] + _____ = _____ beats/min

III. Pool Session.
Fill out the following information for the swimmer performing three exercise loads. For each level record total time to complete 100 m, total number of strokes, total number of breaths, and final heart rate. The subject will complete the following calculations for each exercise level: (note that the calculations must be adjusted if only 50 m are completed).

Speed = distance/time   **where distance is in meters and time is in sec.**

Stroke frequency = # of strokes/time x 60   **where recorded time is in sec.**

Respiratory rate = # of breaths/time x 60   **where recorded time is in sec.**

	Time (sec)	Distance (meters)	Speed (m/sec)	Strokes #	Stroke Freq (strokes/min)	Breaths #	Resp Rate (breaths/min)	Final HR (beats/min)
Slow								
Mod								
Fast								

IV. Bike Session.

Fill out the following information for three exercise loads during biking. For each level record speed, pedaling frequency, total number of breaths taken for 1 minute, and steady state heart rate from the panel. Complete the following calculations for each exercise level:

Speed = distance/time where <u>distance is in meters and time is in sec.</u>

Pedaling frequency = revolutions per minute.

Respiratory rate = # of breaths/time x 60 where recorded time is in sec.

	Speed (m/sec)	Pedal Freq (revolutions/min)	Breaths (# /time)	Resp Rate (breaths/min)	Heart Rate (beats/min)
Slow					
Mod					
Fast					

V. Treadmill Session.

Fill out the following information for three exercise loads during running. For each level record speed, stride frequency, total number of breaths taken for 1 minute, and steady state heart rate from the panel or by palpation immediately after each bout. Complete the following calculations for each exercise level:

Speed = distance/time where <u>distance is in meters and time is in sec.</u>

Stride frequency = # footfalls per minute.

Respiratory rate = # of breaths/time x 60 where recorded time is in sec.

	Speed (m/sec)	Stride Freq (footfalls/min)	Breaths (# /time)	Resp Rate (breaths/min)	Heart Rate (beats/min)
Slow					
Mod					
Fast					