Demonstrating and Predicting Aerobic Power

Charles E. Geach
Irvin High School
El Paso, TX

Research Host:

R. Jorge Zeballos, M.D., D. M. Sc.
William Beaumont Army Medical Center
El Paso, TX

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Most students are familiar with or have some understanding of the concepts of aerobic and anaerobic respiration at the cellular level. During exercise, muscle contraction requires energy (ATP), which is supplied by both the aerobic and anaerobic metabolism of nutrients. Short bursts of high intensity exercise mainly utilize anaerobic energy sources, while exercise enduring longer than three to five minutes will utilize energy provided by aerobic metabolism. Students often have a difficult time being able to see an application of these concepts in human physiology. This lab activity will demonstrate anaerobic power in a physiologic way to which students may be able to relate.

Aerobic power may be illustrated physiologically by the running of longer than three to five minutes. In order to run a marathon, much oxygen will be required to complete the race. Long distance runners train their bodies to utilize oxygen in the most efficient way to be able to win the race.

Anaerobic power may be illustrated by running a short distance (sprint) race. In order to run a 100-meter dash, very little oxygen is required. Your body is running almost totally on anaerobic power because the race is over by the time your body has a chance to replenish oxygen to the cells

The Wingate Anaerobic Test is a measure of this anaerobic power. The Wingate test uses an exercise bike that can be weighted for resistance and also has a counter for revolutions of the flywheel per second. A person pedals all out for 30 seconds against a resistance set by percent of body weight. The test can measure:

- **Peak power:** the highest mechanical power that is elicited during the test.
- **Mean power:** the average power sustained throughout the 30-second period.
- **Percent fatigue:** the degree of power drop off during the test. The decline in power output from the beginning to the end of the test represents this percent fatigue. This fatigue factor can be an indicator of anaerobic power. A high peak power and a low fatigue factor may indicate a person with good anaerobic power.

Objectives:
Students will be able to:

- describe and attain an understanding for anaerobic power.
- predict anaerobic power.

Materials:

- exercise Bicycle
- stopwatch

Preparation:
This lab activity uses a modification of the Wingate test as a means of demonstrating and predicting anaerobic power. This test is modified so that a simple exercise bicycle, one that might be available to the average teacher, may be used. It also uses percent fatigue as

a predictor of anaerobic power. The exercise bicycle needs to be able to measure MPH or RPMs and also have a means of arbitrarily setting resistance (weights or belt). The resistance must be set at a challenging setting, that is, a setting at which the student will have to pedal the full 30 seconds at a maximum effort. Use of the same resistance setting for all students will reduce the number of variables in the test. Generally, the higher the resistance, the higher the peak power.

A stopwatch will be needed to time the 30 second test. A recorder needs to view the speedometer during the test and record MPH or RPM during the test. At the end of the test a comparison of the maximum (peak power) to the minimum MPH or RPM is made. There should be a significant drop off in speed. This difference is the fatigue factor and can be a predictor of anaerobic power. The students with the highest peak power and higher fatigue factors should do better at anaerobic activities (Bar Or, 1987). This lab may require some pilot testing in order to find a resistance setting most suitable to a given individual and for a particular exercise bicycle.

I did some preliminary testing with my own students at school. The test turned out to be reproducible. I had a student do the test one day and get a 44% fatigue factor and two days later get another 44% factor. The test tended to be predictable. A cross country track student had a 17% fatigue factor while a student who is a sprinter on the track team achieved a 55% factor. The test also seems to have a correlation to the actual Wingate test. I tested myself at school and I had a 41% fatigue factor. During my summer research testing using the exercise bicycle equipment at the Human Performance Lab I had a 45% fatigue factor. Further testing needs to be done fully to validate this protocol, but I believe it is a way to demonstrate to your students the concept of anaerobic power.

Procedure:

1. Have student warm up at a moderate resistance for five minutes on the exercise bike.
2. The student should then rest for five minutes.
3. The student should then pedal as fast as possible. Once the maximum speed has been reached, apply the bike's resistance to start the test. The resistance should be such that the student will have difficulty pedaling at maximum effort for 30 seconds. As soon as the resistance is applied a timer should begin timing the 30-second test. Pedaling should be continued as fast as possible for the full 30 seconds. Highest and lowest MPH or RPM should be recorded during the 30-second portion of the test. The fatigue factor should be calculated by finding the difference between the highest and lowest MPH or RPM and dividing by the highest number, that is, (Highest Speed - Lowest Speed) / Highest Speed.
4. The students should then make a chart comparing peak power and the fatigue factors for the entire class.
5. The same students, on another day, will be timed in a 100-meter dash and a correlation should be made to their bicycle test results.

Questions for Assessment:

1. Why is this test an example of anaerobic power?
2. Give examples of other activities that use anaerobic power.
3. Explain why bursts of intense exercise are not completely anaerobic.
4. Give examples of aerobic power activities.
5. Based on the chart you made, theorize which students in the class would do better in sprinting events.
6. What other factors beside anaerobic power might effect how fast a person can run sprinting events?
7. Why is sprinting considered an anaerobic activity?
8. Design an activity the track coach could use to predict who his sprinters and long distance runners are before they even run a race.

Where to Go From Here:

Have students test members of the track team comparing sprinters to long distance runner using runners the modified Wingate test.

References:

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