Oxygen consumption is frequently used when discussing exercise, but what it is, what it means, and why it is important is often misunderstood.

**BACKGROUND**

Our bodies need a constant supply of energy to sustain life. Energy is used to contract skeletal muscles, pump blood, sustain tissues, and many other functions. The form of energy the body needs for these processes is adenosine triphosphate (ATP). This high-energy compound is split apart, releasing energy to perform cellular work. Think of it as the gasoline for your cells. Because the body does not store large quantities of ATP, our bodies must continually make more. Although there are processes that can produce ATP without oxygen (O₂), these anaerobic systems are limited in their capacity to produce ATP. The greatest capacity to produce ATP is through the breakdown of carbohydrates, fats, and to some extent proteins. To make ATP from these nutrients, O₂ is required. Ultimately, oxygen-requiring — also known as **aerobic** — processes are necessary to sustain the body’s energy needs.

**WHAT IS OXYGEN CONSUMPTION?**

Oxygen consumption (VO₂) is the amount of oxygen taken in and used by the body per minute; thus, it is the rate of oxygen use. VO₂ is sometimes expressed in liters of O₂ per minute (liters per minute). Alternately, it can be expressed as a function of body weight, frequently as milliliters of O₂ per kilogram per minute. Expressing VO₂ as a function of body weight is important when comparing people of different sizes during exercises such as running.

**HOW IS OXYGEN CONSUMPTION MEASURED?**

When we inhale, 20.93% of the air that we bring into our lungs is O₂ and 0.03% of the air is carbon dioxide (CO₂). When we exhale, the percentage of O₂ is lower (we consume O₂), and the percentage of CO₂ is higher (we produce CO₂). In exercise physiology laboratories, machines that measure the amount of air inhaled or exhaled and devices that measure the percentage of O₂ and CO₂ in expired air are used to calculate VO₂. There also are portable devices that can be used outside laboratory settings to measure VO₂ during various types of activities (e.g., playing golf, performing yard work, etc).

**WHY IS IT IMPORTANT?**

VO₂ reflects energy expenditure, meaning that measuring VO₂ provides an estimate of calories burned. Approximately 5 kcal of energy are expended for every liter of O₂ consumed. Thus, a person with a VO₂ of 1 L/min is burning 5 kcal each minute. As one exercises harder, VO₂ rises, meaning that energy expenditure is higher. The interrelationship of the type and intensity of activity, O₂ consumed, and energy used allows researchers to estimate the caloric expenditure for different tasks. This information can be used to shape exercise plans to meet weight control goals.

Information about VO₂ also can be useful for athletes. Economy tests examine the relationship between work performed and energy expenditure during exercise. Athletes who are able to move smoothly, without wasting energy, perform better. For example, a person who runs with his arms out to the side of his body uses extra energy but that doesn’t help him run faster. Coaches closely examine the movement patterns of athletes to improve the economy of effort. Maximal VO₂ (VO₂max) is another measurement often used by coaches and athletes (see Fitness Focus from issues 9:3, 9:4, and 9:5 published in 2005). VO₂max provides a measure of the maximal ability to perform high-intensity aerobic work. This value is strongly associated with performance and health.

Dixie L. Thompson, Ph.D., FACSM, is the director of the Center for Physical Activity and Health and department head for the Department of Exercise, Sport, and Leisure Studies at the University of Tennessee, Knoxville.