

## **Experiment AM-1: Skeletal Muscle, Weight and Work**

### **Background**

About 40% of the total body mass of a human is skeletal muscle. Skeletal muscle is intimately associated with the skeletal system and, combined, these muscles and bones are responsible for supporting and moving the body. While skeletal muscle fibers have sarcomeres and the same banded appearance, different muscles can function in different ways. For example, some are relatively weak and fatigue resistant, while others are strong but fatigue quickly. These features may be explained in terms of the biochemical properties of muscles.

The muscle fibers found in most mammalian skeletal muscles are either fast or slow twitch-types. Each type has a different myosin isoform, with different rates of ATPase activity and cross-bridge binding. Within the group of fast-twitch fibers, there are fibers that use glycolysis and oxidative phosphorylation. There are also fast-twitch fibers that just use glycolysis; this group is less reliant upon oxygen and is much stronger than the fibers using phosphorylation. However, these stronger “glycolytic” fibers breakdown glucose very inefficiently; so, that a burst of contractile activity diminishes glucose levels, causes lactic acid to accumulate, and leads to fatigue.

When a muscle tries to lift any weight, the muscle first shortens to put tension on the tendons which hold the muscle to the bones. Development of this tension before movement occurs takes time, known as the latency period, which is directly proportional to the weight attached to the muscle. Once the tension exceeds the weight of the object, any further muscle contraction produces a shortening of the muscle and a movement of the weight. The time that a muscle is in its active state (contracting) is finite; so, muscles have less time to shorten when they move heavier weights.

In this experiment, you will use a displacement transducer to determine how weight affects the shortening of a muscle. Weight influences the time that a muscle has to shorten, the speed at which the muscle shortens, the distance that the muscle shortens or moves the weight, and the amount of work the muscle completes. You will also compare the difference between: afterloading, supporting the weight before contraction; and preloading, hanging the weight on the muscle without support before contraction.