

Human Metabolism

Real World Energy
Activity
Grade Level: 9-12



Main Objectives

This activity provides three basic learning approaches. The first is based on the learner's reading of the backgrounder and answering the questions that follow it. The second part is applying this knowledge to a hands-on investigation of metabolism in muscles. The third part is an investigation of metabolic rates.

Learning Outcomes

By the end of this activity, learners will:

- Compare daily energy requirements of individuals at various stages of growth and activity levels
- Describe metabolism (catabolic and anabolic)
- Describe the factors that affect metabolism
- Describe the metabolic process in muscles

Length of Activity

3 hours

Materials List

Human Metabolism Backgrounder
Human Metabolism Learner Activity Instructions
Human Metabolism Learner Worksheet
Aquarium thermometers

Background

Muscle cells use up very large amounts of glucose when they are working. In fact, no other task done by any cells consumes energy as quickly as muscle contraction. In the process, the muscle cells also

consume large quantities of oxygen and release large amounts of heat. The circulatory system is responsible for bringing fresh supplies of glucose and oxygen and for carrying away the excess heat. It is easy to see why the heart rate increases and the body begins to sweat during heavy exercise! The glucose supplied to the muscles comes from several places. Some are stored in the muscle cells themselves, in the form of a starch called glycogen. Glucose is also stored in the liver and is quickly released to the bloodstream when needed. Glucose can also be released from body fat and, when all other sources are depleted, from body tissues themselves. The oxygen comes from the respiratory system. During exercise, the rate and depth of breathing increase dramatically to keep up with the demand for the oxygen needed by working muscles.

In this exercise, learners will be observing the temperature change on the surface of a muscle in response to exercise. The heat released by the skin over the muscle comes partly from the muscle itself, while some are delivered to the skin by the circulatory system as the body tries to dissipate the excess heat generated during exercise. Muscles store glycogen for later use as a source of energy. During exercise and the metabolic process, heat energy is released. To get a more visible change in temperature, use the triceps in the investigation.

Procedure

Period 1 (Part 1):

1. Have learners review the backgrounder and answer the appropriate questions on the worksheet part 1.
2. Prepare the learners by reviewing the instructions in the learner materials. Ensure that the learners understand that during exercise heat is released from the body in the process of metabolism.
3. Learners will be testing the temperature change of muscles before, during and after exercise.
4. Use the comprehension questions under Part 1 to check learners' understanding of the concepts.

Period 2 Part 2:

1. Prepare the learners by reviewing the instructions in the learner materials.
2. Using the information provided on the worksheet, have learners calculate for one day the number of calories they use for a variety of activities. Learners will need to use the rate of energy use for different activities (calories burned per minute) and then determine the amount of time they spend doing each activity.
3. Have learners complete their daily food intake. They will need to use the common food calorie table to then calculate their calorie intake for one day.
4. Individual learner's calorie usage and intake should be considered confidential.
5. Use the comprehension questions under Part 2 to review learners' understanding of the concepts.

Tips and Extensions

- Make sure learners are doing strenuous exercises to obtain a clear temperature change.
- Have learners bring food labels from home, or supply some from your own home. As a class, look at the labels. Examine what information they provide and how the information can help people have a healthy diet.

- Have learners prepare a well-balanced diet using the Canada Food Guide.
- To calculate learners' daily calories there are a number of websites that will calculate this for them.

Comprehension

You may wish to test learners' comprehension of the basics of human metabolism using the following questions:

Part 1:

- What is metabolism? (all of the chemical reactions that take place in a living organism)
- What are the two types of metabolic reactions? (anabolic and catabolic)
- When we talk about food and energy what type of metabolic reaction is it? (catabolic reactions)
- What happens in a catabolic reaction? (large molecules broken down into smaller ones, the energy released)
- What factors affect metabolism and body weight? (basal metabolic rate, diet, exercise, age, gender, emotional state and hormones)

Part 2:

- What you need to eat to remain healthy varies depending on what factors? (how old you are, your body size, your level of activity and whether you are a man or woman)
- What does having a balanced diet mean? (every day we have food from the four basic food groups: grain products, vegetables and fruits, milk and milk products, and meat and alternatives)