Plant and Animal Cells

Teacher's Guide

by Elizabeth Laskey

Poster artwork by Steve P. Wheeler

All living things—from microscopic organisms to giant sequoia trees—are made of one or more cells. Cells are the basic unit of life. Most cells are very tiny and cannot be seen without a microscope. Nevertheless, all cells carry out the basic functions of life such as taking in nutrients, getting rid of wastes, and reproducing. Complex, multicelled organisms such as plants and animals have different kinds of specialized cells that perform these essential functions as well as specialized tasks. Nerve cells in animals, for example, send messages from one point in the body to another. Plants have special water-conducting cells that direct water to different parts of a plant.

Cells come in a wide assortment of shapes and sizes. Most cells have certain structures in common. For example, both plant and animal cells contain a jelly-like fluid known as cytosol that supports the structures inside the cells. (Some sources use the terms *cytosol* and *cytoplasm* interchangeably. To be more exact, *cytosol* refers to the fluid in which the structures inside the cell are located. *Cytoplasm* refers to the cytosol and all the structures inside the cell except the nucleus.)

A cell's nucleus controls the cell's activities and is where the cell's genetic material—its deoxyribonucleic acid, or DNA—is stored. The nucleus often contains a nucleolus, which plays a role in the synthesis of ribosomes, which are structures that manufacture proteins.

All cells need energy or they will not be able to function. In plant cells, structures called chloroplasts absorb energy directly from the Sun and convert it into sugar (food) through the process of photosynthesis. Animal cells do not have chloroplasts. They get energy from the food the animal eats, such as plants or other animals. Cells do not immediately use all of the food they make or take in. They store it. When a cell needs energy, mitochondria convert the stored energy from food and make it available to the cell.

Cells are able to manufacture the substances they need and move them from place to place. The endoplasmic reticulum is where many of these substances are made. The rough endoplasmic reticulum is a network of winding membranes embedded with ribosomes that manufacture certain types of proteins. (Some ribosomes also float freely in the cytosol.) The smooth endoplasmic reticulum is similar in appearance but has no ribosomes. It makes lipids (fats) and other proteins. The endoplasmic reticulum is also a transport system. Bits of it break off and carry packets of lipids and proteins to the cell's Golgi apparatus, where the substances are further processed and released into the cytosol or transported out of the cell.

In order to operate efficiently, cells store needed materials so they will have a steady supply of water, food, and other nutrients. They also store the waste they generate. Plant cells have a large sac-like structure called the central vacuole in which they store water and wastes. The water in the central vacuole helps keep a plant upright. When a plant wilts, it is because there is not enough water in the cells' central vacuoles. In animal cells, lysosomes distributed throughout the cytosol break down wastes and other materials.

Cells do not last forever. In fact, some, such as those that line human intestines, wear out and die in a matter of hours. Old cells are replaced by new cells that are created when existing cells divide. Cell division is also responsible for the growth of organisms. When a cell gets ready to divide, it first duplicates its DNA (genetic material). The DNA moves to the middle of the cell, splits, and is pulled to opposite ends of the cell. Two new nuclei, each containing a full set of DNA, form. In animal cells, the ends of the cell continue pulling away and the cell is pinched into two new daughter cells. In plant cells, a cell plate forms between the two nuclei and becomes part of the new cell wall for each cell.

RELATED ACTIVITIES

To have students view some of their own cells under a microscope, direct them to use clean toothpicks to scrape some cells from the inside of their cheek. Next prepare wet-mount slides of the cells, adding a drop of iodine or food coloring as a stain and have students view the cells through the microscope. Have students draw pictures of the cells they see and label structures such as the nucleus and the cell membrane.

Repeat the above activity this time preparing a wet-mount slide using a thin layer of onion. Have students draw the cells and label the structures they see. As a class discuss the similarities and differences between animal (cheek) cells and plant (onion) cells.

Have students create Venn diagrams illustrating how plant and animal cells are alike and different.

There are actually two types of cells: eukaryotic and prokaryotic. Plant and animal cells are eukaryotic. Bacteria are an example of prokaryotic organisms. Invite a group of students to research prokaryotic organisms and to make their own colossal poster showing the features of such cells.

Have students design a crossword puzzle based on the different structures found within cells.

Ask students to model cell division by giving them each a ball of modeling clay. Have them divide the clay in half. Then ask them to divide each half in half and so on, observing the exponential growth. Have them consider whether their "cells" will be able to divide indefinitely. Guide them in understanding that real cells created through cell division grow before they divide again.

Robert Hooke discovered the existence of cells in the 1660s. Have students research Hooke's life and perform a short skit about his discovery.

Allow students to observe how cell membranes allow for the passage of materials in and out of a cell. Have students weigh a thin slice of potato and place it in a glass of water. Have them put a slice of the same weight in a glass of saltwater. After 24 to 48 hours have them weigh each slice. Students will find that the saltwater potato weighs less because water has been drawn out of its cells.

Give students the following materials and let them decide how to use them to make three-dimensional models of plant and animal cells and their structures: different colors of modeling clay, plastic wrap, marbles, yarn, rubber bands, thin cardboard, bubble wrap, peppercorns, and green lentils. Also provide students with scissors and glue.

Have student pairs research one type of specialized human body cell (e.g., liver cells, blood cells, muscle cells) and create a fact sheet containing information about the size, shape, function, and longevity of the cell.

Yeast is a single-celled fungus that reproduces by budding—a bud forms on a parent cell, grows, and then breaks free, becoming an independent organism. Help students "see" this process in action by having them place a half cup of warm water (40–46 °C [105–115° F]) in a ziplock bag along with a packet of baker's yeast and a teaspoon of sugar. Have them seal the bag and observe it for 20 minutes. Point out that as yeast reproduces and carries out other cellular processes, it produces carbon dioxide gas as a waste product, causing the bag to expand. Challenge students to explain the role the sugar played.