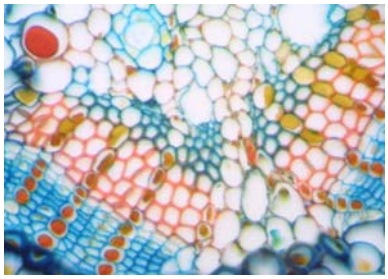
The Incredible Edible Cell

TEACHER WORKSHEET
Years 5-10

OBJECTIVES



1. Identify the structure of a cell
2. Describe components of a cell including cell membrane and cytoplasm
3. Describe appearance and function of different organelles within a cell including nucleus and mitochondria
4. Identify the differences between a plant and animal cell

BACKGROUND INFORMATION

The **cell** is the structural and functional unit of all known living organisms. It is the smallest unit of an organism that is classified as living, and is sometimes called the building block of life. Some organisms, such as most bacteria, are unicellular (consist of a single cell). Other organisms, such as humans, are multicellular. (Humans have an estimated 100 trillion or 10^{14} cells; a typical cell size is 10 μm; a typical cell mass is 1 nanogram.) The largest known cell is an ostrich egg.

In 1837 before the final cell theory was developed, a Czech Jan Evangelista Purkyně observed small "granules" while looking at the plant tissue through a microscope. The cell theory, first developed in 1839 by Matthias Jakob Schleiden and Theodor Schwann, states that all organisms are composed of one or more cells. All cells come from preexisting cells. Vital functions of an organism occur within cells, and all cells contain the hereditary information necessary for regulating cell functions and for transmitting information to the next generation of cells.

Each cell is at least somewhat self-contained and self-maintaining: it can take in nutrients, convert these nutrients into energy, carry out specialized functions, and reproduce as necessary. Each cell stores its own set of instructions for carrying out each of these activities.

All cells have several different abilities:

- Reproduction by cell division: (binary fission/mitosis or meiosis).
- Use of enzymes and other proteins coded for by DNA genes
- Metabolism, including taking in raw materials, building cell components, converting energy, molecules and releasing by-products.
- Response to external and internal stimuli such as changes in temperature, pH or levels of nutrients.

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Specialised cells

Cells vary widely in form and function, even within the same organism. The human body, for example, is made up of about two hundred different types of specialized cells, ranging from foot-long nerve cells to tiny, disk-shaped blood cells. At first glance these cells appear to have little in common other than the body or body part that houses them. For all their differences, though, different types of specialized cells have a lot in common. Even plant and animal cells have far more structural similarities than they have differences.

Structure and function of parts of an animal cell

The cytoplasm of a cell is surrounded by a *plasma membrane*. This membrane serves to separate and protect a cell from its surrounding environment and is made mostly from a double layer of lipids (hydrophobic fat-like molecules) and hydrophilic phosphorus molecules. Embedded within this membrane is a variety of protein molecules that act as channels and pumps that move different molecules into and out of the cell. The membrane is said to be 'semi-permeable', in that it can either let a substance pass through freely, pass through to a limited extent or not pass through at all. Cell surface membranes also contain receptor proteins that allow cells to detect external signalling molecules such as hormones.

Within this membrane are the cells organelles which perform specific functions to keep the cell alive. (Table 1 Structure and function of parts of an animal cell)

Animal versus plant cells

Plant and animal cells have nearly all of the most important cell structures in common. For example, both plant and animal cells have a nucleus, which contains the cell's genetic material, or DNA. Plant and animal cells also have some of the same organelles floating in the cytoplasm, the fluid-filled region between the cell membrane and the nucleus. Indeed, even under a microscope it is difficult to tell apart many plant organelles from the same organelles found in animals.

Despite all their similarities, plant cells and animal cells differ in three important ways:

Plant cells have **cell walls**, which make them appear rectangular-shaped. These structures are composed of cellulose, hemicellulose, and a variety of other materials. The cell wall provides plant cells with a protective covering and gives the plant the rigidity it needs in order to stand up even under pressure from wind, rain, and snow.

Plant cells have chlorophyll, the light-absorbing pigment required for photosynthesis. This pigment is contained in structures called **chloroplasts**, which makes plants appear green.

Plants cells have a large, central **vacuole**. While animal cells may have one or more small vacuoles, they do not take up the volume that the central vacuole does (up to 90% of the entire cell volume!). The vacuole stores water and ions, and may be used for storage of toxins

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Table 1: Structure and function of parts of an animal cell

Cell part	Structure	Function
Plasma membrane (cell barrier)	Membrane made of a double layer of lipids (phospholipids, cholesterol, etc) within which proteins are embedded; proteins may extend entirely through the lipid bilayer or protrude on only one face; externally facing proteins and some lipids have attached sugar groups	Serves as an external cell barrier; acts in transport of substances into or out of the cell; maintains resting potential that is essential for functioning of excitable cells; externally facing proteins act as receptors (for hormones, neurotransmitters etc) and in cell to cell recognition.
Cytoplasm (scaffolding)	Cellular region between the nuclear and plasma membranes; consists of fluid cytosol, containing dissolved solutes, inclusions (stored nutrients, secretory products, pigment granules), and organelles, the metabolic machinery of the cytoplasm.	Holds organelles within the cell
Cytoplasmic organelles	(the metabolic machinery of the cell)	
The cell nucleus (the information centre)	The cell nucleus is largest organelle found in the cell. The nucleus is spherical in shape and separated from the cytoplasm by a double membrane called the nuclear envelope. The nuclear envelope isolates and protects a cell's DNA from various molecules that could accidentally damage its structure or interfere with its processing.	It houses the cell's chromosomes, and is the place where almost all DNA replication and RNA synthesis occur.
Mitochondria (the power generators)	Rodlike, double-membrane structures; inner membrane folded into projections called cristae.	Site of ATP synthesis; powerhouse of the cell
Ribosomes (protein production centres)	Dense particles consisting of two subunits, each composed of ribosomal RNA and protein; free or attached to rough ER	The sites of protein synthesis
Endoplasmic reticulum (macromolecule managers)	Membranous system of sacs and tubules.	Transport network for molecules targeted for certain modifications and specific destinations, as compared to molecules that will float freely in the cytoplasm. The ER has two forms: the rough ER, which has ribosomes on its surface, and the smooth ER, which lacks them
Golgi apparatus (macromolecule managers)	A stack of smooth membrane sacs and associated vesicles close to the nucleus.	Packages, modifies, and segregates proteins for secretion from the cell, inclusion in lysosomes, and incorporation into the plasma membrane.
Lysosomes (cell destroyer)	Membranous sacs containing acid hydrolases	Sites of intracellular digestion.
Vacuoles (food and waste storage)	A vacuole is a membrane-bound sac. In animal cells, vacuoles are generally small Vacuoles tend to be large in plant cells.	The vacuole plays a role in intracellular digestion and the release of cellular waste products. In plant cells vacuoles play a role turgor pressure. When a plant is well-watered, water collects in cell vacuoles producing rigidity in the plant. Without sufficient water, pressure in the vacuole is reduced and the plant wilts.

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ACTIVITY

Students will create their own edible cell using materials/lollies supplied. Provide each student with the lollies they need in plastic cup.

Have students complete the "My Cell" table to label the function of the cell parts and explain how the lollies they used relate to the structure and/or function of each organelle.

You will need to prepare jelly/gelatine moulds in advance. Make enough jelly so that there is 300mL per model/student. This can be poured into a zip lock bag and set in the fridge.

ACTIVITY EXTENSION

Have students make a plant cell, with the following differences:

- Cell wall
  Use a takeaway container to represent the cell wall.

- Vacuoles
  Provide chocolate coated almonds to replace the smaller chocolate coated raisins.

- Chloroplasts
  Provide mint leaves to be used as chloroplasts in the cell.

QUESTIONS/ANSWERS

1. What are the three differences between an animal and plant cell?
   Cell wall, size of vacuoles, presence of chloroplasts.

2. Why are these differences necessary? *Plant*

3. How would you represent these differences? *As above*

4. What is the purpose of the nucleus envelope?

CURRICULUM

Essential Learnings Year 5:
Structures of living things have particular functions.

Essential Learnings Year 7:
Cells are the basic unit of all living things and perform functions that are needed to sustain and reproduce life.

REFERENCES

Marieb, E. 2004. *Human anatomy and physiology*. 6th edition.
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