

**EVALUATING
ACADEMIC READINESS
FOR APPRENTICESHIP TRAINING**
Revised for
ACCESS TO APPRENTICESHIP

**SCIENCE SKILLS
BASIC CELL STRUCTURE**

**AN ACADEMIC SKILLS MANUAL
for**

The Food Preparation Trades

This trade group includes the following trades:

Baker, Cook and
Retail Meat Cutter

*Workplace Support Services Branch
Ontario Ministry of Training, Colleges and Universities*

Revised 2011

In preparing these Academic Skills Manuals we have used passages, diagrams and questions similar to those an apprentice might find in a text, guide or trade manual.

This trade related material is not intended to instruct you in your trade. It is used only to demonstrate how understanding an academic skill will help you find and use the information you need.

SCIENCE SKILLS

BASIC CELL STRUCTURE

*An academic skill required for the study of the
Food Preparation Trades*

INTRODUCTION

A steer eating grass in a field is alive while a piece of meat ready to be cooked is not. The steer and the steak are both made of cells. What is the difference between the living animal and the non-living meat? The most noticeable difference is that the cells of the steer are still actively carrying out processes such as respiration and growth- processes that are necessary to keep an animal alive. The steak was once part of a living organism, so it retains some of the characteristics of living things. However, the dead cells of the meat are no longer carrying out the functions necessary for life.

The basic structural unit of all living organisms, including plant, animal, bacteria and other microorganisms, is the cell. The organization of a living cell determines how it interacts with the environment. This skills manual looks at the structure of a basic cell and identifies some of the different structures found in it. The following topics are included:

- ◆ Characteristics of living organisms
- ◆ Cell theory
- ◆ Cell structure

CHARACTERISITICS OF LIVING ORGANISMS

Types of organisms

The different types of living organisms include animals, plants, bacteria, viruses, molds and yeasts. Plants and animals provide the many different types of foods we prepare and eat. The smaller, mostly invisible microorganisms also have a role in the food preparation trades. Yeasts ferment products such as wine and vinegar. They also cause bread to rise. Molds give flavor to certain types of cheeses. Bacteria are used to produce thickened dairy items such as yogurt.

However, microorganisms also play another role in the food trades. All cells start to decompose once an organism dies. The primary role of microorganisms such as bacteria is to break down once-living plant and animal tissues and recycle the materials that were incorporated into their cells. This is an important and necessary process in nature but in the food preparation trades, we want to control how and when food starts to decompose. If certain bacteria and molds start growing in foods, they can cause serious illness. It is very important to use the proper sanitation measures when handling foods, especially meats, to prevent them becoming contaminated with harmful microorganisms.

Characteristics of living organisms

All organisms are made of organic molecules that contain the element carbon. Living creatures have properties that distinguish them from dead and non-living things. Organisms that are alive interact with and influence the environment in an active way. Living organisms carry out self-maintaining processes that keep them alive and growing. The essential life-sustaining processes are:

- ◆ **Metabolism**, which includes the many different chemical reactions used to maintain life.
 - **Photosynthesis** is an important reaction carried out by plants which captures the sun's energy.
 - **Respiration** is an essential reaction that enables plants and animals to use that energy.
- ◆ **Homeostasis** is the process in which organisms regulate their internal environment in order to maintain the stable conditions necessary for life.
- ◆ Organisms **respond to stimuli** in various ways in order to maintain homeostasis.
- ◆ Organisms **grow** by developing inside their cells and by dividing their cells into more cells.
- ◆ **Reproduction** involves the creation of new organisms from the parent organism(s). The new organisms can live on after the parents die, keeping the species going.
- ◆ Through natural selection, organisms **adapt** to their environment through the successive generations that are produced by reproduction.
- ◆ More complex organisms can **communicate** in a direct way with other organisms.

Photosynthesis is the process in which the leaves of a plant capture the energy in light waves from the sun and make the energy available to the plant in the form of plant sugars. When the plant absorbs energy from the outside environment, it converts it to a form that it can use for its own needs. During photosynthesis:

- The plant takes in carbon dioxide from the atmosphere and releases oxygen.
- The plant also absorbs water and minerals from the soil to use during this process.
- The sugars (or carbohydrates) produced are used to form cell components such as cell walls and storage areas containing starch.

Respiration is the process in which plants, animals and microorganisms take in oxygen and release carbon dioxide and water. The energy stored in food is released by the process of cellular respiration.

- While photosynthesis uses carbon dioxide and releases oxygen, respiration works in the opposite way – plants and animals take in oxygen and release carbon dioxide.
- During respiration, the organism breaks down stored sugars, releasing energy in the process.
- The energy is used to synthesize needed cell components such as proteins, cell walls and membranes.
- This energy is also used for carrying out all the other metabolic processes listed above.

*An organism can respond to its **environment**.*

- In the autumn, the leaves of deciduous trees such as maple, oak and poplar change colour and fall to the ground. The tree enters a resting state for the winter. As the climate warms up in the spring, sap stored in the roots moves back up to the buds and the leaves open up to begin the process of photosynthesis again.
- Animals such as cattle and sheep grow thicker coats to keep them warm over the winter.

*Organisms use energy to **reproduce**.*

- Most plants produce seeds that develop and then fall to the ground. The seeds have the potential to develop into new plants that are similar to the parent plants. Many of these seeds are eaten as foods such as wheat and various fruits.
- Plants can also reproduce by producing bulbs, tubers, suckers and runners. A good example of this is the potato.
- Animals reproduce by giving birth to new offspring.
- Fungus reproduce by sending up fruiting bodies. These fruiting bodies are the mushrooms that we eat.
- Bacteria spread rapidly because they reproduce by cell division. One cell divides, creating two new cells.

*A living organism eventually **dies**.* Once it dies, it can no longer use energy to maintain its distinct living form or to fend off decomposers.

- The organic (carbon-based) molecules that made up the organism lose their ability to function together as organized units.
- The dead organism is broken down into humus by microorganisms that thrive in moist conditions and eventually it becomes part of the soil.

Because food comes from living organisms, it can start to decay if conditions are suitable for the growth of microorganisms that are adapted to living on dead organic material. Warmth and moisture are two conditions that encourage the growth of many bacteria and molds. E coli and salmonella are common examples of microorganisms found in food that can cause serious illness.

There are many ways to control the growth of bacteria and molds in food products.

- Most meat is kept dry and at a cool temperature.
- Processed meat such as ham is cured in a salt brine and then smoked. This dries and preserves the meat, allowing it to keep better at warmer temperatures.
- Heat used to smoke dried fish kills microorganisms and chemicals in the smoke preserve the fish.
- Fresh fruit and vegetables must be eaten quickly because the moisture and carbohydrates they contain will eventually encourage the growth of mold and bacteria.
- Canning, freezing and drying are methods used to preserve fruits and vegetables.

CELL THEORY

Just as the atom is the basic building block of all matter, the cell is the basic building block of all living objects. The central role of the cell is identified in the cell theory, which states: *all living things are composed of cells and all cells arise from other cells.*

A living plant, animal or microorganism is a highly ordered structure. The basic unit of this structure is the cell. The cell is organized into many different parts. The different parts of the cell have separate functions but all work together for the benefit of the whole organism.

- ◆ Most cells have a regular cycle of growth, division and death.
- ◆ Movement and activity occur inside a cell.
- ◆ Cells contain DNA, complex molecules that contain genetic information used to direct the functions of the organism.
- ◆ This genetic material can replicate itself, so when a cell divides in two, the genetic material is passed on to both new cells.

The number of cells in a living organism varies tremendously. Less complex organisms such as bacteria are composed of only one cell, while more complex organisms such as humans are made of about 100 trillion cells.

CELL STRUCTURE

All living organisms are made of cells, which come in a variety of shapes and sizes. Most cells have certain basic characteristics in common:

- ◆ All cells contain an outside cell **membrane** that can help control what goes into and out of the cell.
- ◆ All cells contain a jelly-like material inside the cell membrane called **cytoplasm**, which consists of water, food, minerals and enzymes.
- ◆ Floating in the cytoplasm are many specialized **organelles** that carry out needed tasks.
- ◆ Most cells have a **nucleus** which controls the production of proteins. The DNA found in the nucleus is replicated during reproduction so that genetic material can be passed on to the next generation.

Below is a diagram of a typical plant cell:

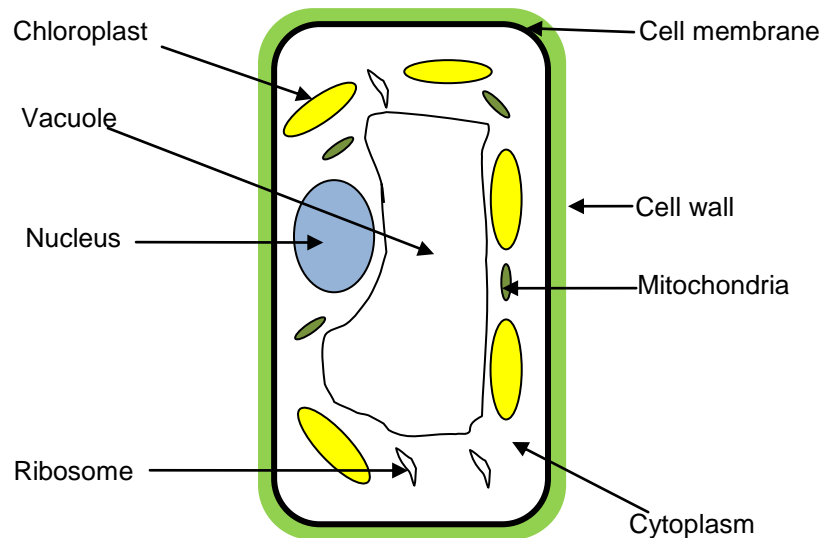


FIGURE 1: Structure of a Plant Cell

Organelles

- ◆ The nucleus controls the cell functions such as production of protein and the replication of genetic material during cell division and reproduction.
- ◆ Chloroplasts in plant cells carry out photosynthesis by capturing the sun's energy and storing it in sugar molecules.
- ◆ Mitochondria, found in all cells, are organelles that carry out cell respiration.
- ◆ Ribosomes make proteins from material floating in the cytoplasm.
- ◆ Endoplasmic reticulum makes cell membranes and other needed cell components.
- ◆ Lysosomes break down food molecules within animal cells.
- ◆ Vacuoles store food and wastes.

Nucleus: The control centre of the cell is called the **nucleus**. The DNA in the nucleus contains the genetic information that directs the activities of the cell. This genetic material is passed on to both cells whenever an original cell divides into two cells. It is also passed on in the reproductive cells that plants and animals produce.

Chloroplasts: A plant cell contains a special organelle called a **chloroplast** that can use the energy from the sun to create food through the process of photosynthesis. The chloroplast contains a special molecule called **chlorophyll** that can capture the energy in sunlight.

- ◆ The cell uses this food to get the energy it needs to maintain itself.

Mitochondria: The food is converted into energy in the **mitochondria** through the process of respiration.

- ◆ The cell uses this energy, along with molecules of plant food, water and minerals, to produce new plant components.

Ribosomes: An organelle called a **ribosome** produces protein substances for the plant.

- ◆ Proteins help direct the complex functions of the cell.

Vacuole: The plant cell has a large storage area called a **vacuole**.

- ◆ Because it is filled with watery cell sap, the vacuole helps a plant maintain its shape.

Lysosomes: Animal can't produce their own food. They need to obtain it from the outside environment. After eating the food, it is digested and then carried to cells by the blood stream. Animal cells use organelles called lysosomes to break down food molecules into products that the cell then uses for other purposes.

Differences between plant, animal and bacteria cells

Although all cells have the same basic structure, bacteria, animal and plant cells differ in some respects:

- ◆ Bacteria cells differ from plant and animal cells in that they lack a nucleus and the structures within the cell do not have membranes. In a bacteria cell, the nuclear material, DNA floats in the cytoplasm. In plant and animal cells, DNA is enclosed in a distinct region called the nucleus.
- ◆ Plant cells have special organelles called chloroplasts which capture the sun's energy during the process of photosynthesis. They have a rigid **cell wall** on the outside of the cell membrane that helps maintain the cell's shape. They also have a large storage area called a central vacuole where sugar molecules are stored.
- ◆ Animal cells do not have chloroplasts or cell walls. Animals usually have a type of skeleton to support themselves. They also have digestive organelles called lysosomes that break down ingested food into available nutrients. Animal cells communicate with each other through specialized cells called nerve cells.

In plants, the parts of the cell are made from molecules obtained from water, air and soil components. A living plant organizes these molecules into the cell structures needed by the plant to function, grow and reproduce. Coordination within the plant cell and between the cells that make up the different parts of a plant is necessary for the plant to stay alive. This coordination allows each plant to function as a unified organism.

Animal cells are made from molecules obtained when the animal eats plants or other animals that in turn live on plant material. They also obtain oxygen from breathing in air. An animal cell uses this material to carry out all the functions necessary for life.

Bacteria cells live on many different materials. They break down plant and animal cells. Some bacteria can carry out photosynthesis. Other bacteria can obtain energy from chemical reactions

that involve molecules of hydrogen, sulfur and minerals. Bacteria cells reproduce quickly by cell division, spreading rapidly when conditions are suitable. Plants and animals reproduce much more slowly by producing offspring.

CONCLUSION

Plants, animals and microorganisms are formed from cells that are organized to carry out the necessary functions of survival, growth and reproduction. The cell is itself highly organized. It consists of a cell membrane that controls what moves in and out of the cell and a liquid cytoplasm. Inside the cytoplasm are specialized organelles.

Chloroplasts contain a molecule called chlorophyll that can capture the energy from sunlight. Inside the chloroplast, the chlorophyll, along with carbon dioxide and water, makes plant food in the form of sugars. Mitochondria use the plant food, along with oxygen, to release energy, water and carbon dioxide. The energy is used to build needed plant structures.

The nucleus contains the genetic instructions that direct the functions of the cell. These instructions are reproduced each time a cell divides. They are also passed on to the next generation.

Living creatures come in many different shapes and sizes. Many are used in the food preparation trades. Meat, fruits, vegetables, grains and sugars all come from living plants and animals. Microorganisms are also an important factor in the food industry. Some microorganisms are helpful in the preparation of food products. Many other decomposers must be controlled so that they do not start breaking down prepared food too quickly.

Answer the following questions by putting the correct word in the blank spaces. Answers are on the next page.

respiration	cells	moisture	chloroplast	carbon	cytoplasm	protein
cell division	membrane		food	photosynthesis	oxygen	nucleus

1. All organisms are made of organic molecules that contain the element _____ .
2. A plant captures the sun's energy in a process called _____ .
3. Photosynthesis takes place inside a special cell structure called a _____ .
4. The energy stored in plant food is released by the process of cellular _____ .
5. During photosynthesis, a plant takes in carbon dioxide and releases _____ .
6. Cell theory states that all living organisms are composed of _____ .
7. The control centre of the cell is the _____ .
8. The _____ contains the organelles that carry out specialized cell functions.
9. The cell _____ helps control what moves in and out of the cell.
10. Ribosomes manufacture _____ molecules needed by the cell.
11. Warmth and _____ are two conditions that encourage the growth of many bacteria and molds
12. Bacteria cells reproduce quickly by _____ , spreading rapidly when conditions are suitable.

ANSWER PAGE

1. carbon
2. photosynthesis
3. chloroplast
4. respiration
5. oxygen
6. cells
7. nucleus
8. cytoplasm
9. membrane
10. protein
11. moisture
12. cell division