

# **Grade 9 Science (10F)**

A Course for  
Independent Study





GRADE 9 SCIENCE (10F)

A Course for Independent Study

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# INTRODUCTION

## Overview

Welcome to *Grade 9 Science: A Course for Independent Study!*

In this course, you will examine the very atoms that make up all matter on Earth, discover how electricity has been harnessed to operate machinery, uncover how our body tissues grow and regenerate, and explore the far-off stars and planets of our galaxy.

By enrolling in an independent study course, you take on the roles and responsibilities of both student and teacher. As a student, you are responsible for mastering the lessons and completing the learning activities and assignments. As a teacher, you are responsible for checking your work carefully, noting your areas of weakness, and motivating yourself to succeed.

## What Will You Learn?

In each lesson, you will read a few pages and then complete a learning activity and/or assignment. Some lessons will have hands-on experiments for you to perform, while others may require you to do some investigative research or observation work in the community. There are four modules in this course:

- Module 1: Reproduction
- Module 2: Atoms and Elements
- Module 3: The Nature of Electricity
- Module 4: Exploring the Universe

The modules in this course are not cumulative; in fact, feel free to approach the modules in any order you prefer. Keep in mind that the astronomy module, “Exploring the Universe,” will require you to observe planets and constellations in the night sky. You may wish to schedule this module for the fall and winter months when you will have the most nighttime hours at your disposal.

## What Will You Need?

- A learning partner should be available to help you to complete some learning activities (see page xvi for a further description of your learning partner). An adult should also be available to supervise certain assignments that involve hands-on experiments.
- Each module has a list of equipment required for completing its learning activities (LA) and assignments (A). Plan out the order in which you will complete each module and make a point of having your materials ready when you begin a new module.
- The supply list below identifies the items required for the hands-on experiments found in either Learning Activities (LA) or Assignments (A) for the whole course. In some circumstances you have a choice of experiments (e.g., in Module 2, Assignment 2.4; in Module 3, Assignment 3.2, Learning Activity 3.7, Learning Activity 3.12, and Learning Activity 3.13).

Item Required	Module 1	Module 2	Module 3	Module 4
masking tape	LA 1.14		LA 3.13, Option 2	
4 pennies	LA 1.14			
salt		A 2.4, Option 1		
water		A 2.4, Option 1		
teaspoon		A 2.4, Option 1		
glass tumbler		A 2.4, Option 1	LA 3.3	
stir stick		A 2.4, Option 1		
magnifying glass		A 2.4, Options 1 and 2		
1 effervescent tablet		A 2.4, Option 2		
scraping tool		A 2.4, Option 2		
candle		A 2.4, Option 3		
candle holder		A 2.4, Option 3		
matches		A 2.4, Option 3		
steel wool pad		A 2.4, Option 4		
thermometer		A 2.4, Option 4		
vinegar		A 2.4, Option 4		

*continued*

<b>Item Required</b>	<b>Module 1</b>	<b>Module 2</b>	<b>Module 3</b>	<b>Module 4</b>
airtight jar		A 2.4, Option 4		
small cup		A 2.4, Option 4		
plastic straw			LA 3.1, 3.3, 3.5 A 3.2, Option 1	
paper bits			LA 3.1, 3.5	
wool cloth/fabric			LA 3.1, 3.3, 3.5	
transparent tape (packing tape)			LA 3.1; 3.3; 3.12, Option 2; 3.13, Option 2 A 3.2, Options 1 and 2; A 3.5, Option 2	LA 4.2
15 cm of copper tubing (1 cm in diameter)			LA 3.3	
30 cm string			LA 3.3	
thread			LA 3.5 A 3.2, Option 1	
pith ball or piece of foam			LA 3.3	
foam cup			A 3.2, Options 1 and 2	
aluminum foil			A 3.2, Options 1 and 2	
soda can with pull tab			A 3.2, Option 2	
lemon			LA 3.7, Option 1	
copper wire			LA 3.7, Option 1	
neon bulb, ammeter, galvanometer, or multimeter			LA 3.7, Option 1	
iron nail, plus welding rods, wires, or other metals			LA 3.7, Option 1	
2 D cell batteries			LA 3.12, Option 2 LA 3.13, Option 2 A 3.5, Option 2	
2 small flashlight bulbs			LA 3.12, Option 2 LA 3.13, Option 2 A 3.5, Option 2	
insulated copper wire			LA 3.13, Option 2 A 3.5, Option 2	

*continued*

Item Required	Module 1	Module 2	Module 3	Module 4
light gauge wire			LA 3.12, Option 2	
thick corrugated cardboard				LA 4.2
scissors				LA 4.2
20 cm of thin string or coloured fishing line				LA 4.2
small weight (e.g., washer, nickel)				LA 4.2
large drinking straw at least .5 cm in diameter				LA 4.2
glue stick				LA 4.2
orienteeering-type compass				LA 4.5, A 4.2
metre stick				LA 4.10
small protractor				LA 4.10, A 4.6
centimetre ruler				LA 4.10, A 4.6

### Is access to the Internet required?

- Internet access is required to download *Crocodile Clips* software from [www.yenka.com/en/Free\\_student\\_home\\_licences/](http://www.yenka.com/en/Free_student_home_licences/), which is needed if you choose Option 1 of Learning Activities 3.7, 3.12, and/or 3.13 and/or Assignment 3.5.
- In Module 3, Lesson 15, you will require a home hydro bill. If you do not have one, a sample Manitoba Hydro bill is available online at [www.hydro.mb.ca/mybill/sample\\_bill.pdf](http://www.hydro.mb.ca/mybill/sample_bill.pdf).
- Internet access is required to attain a simplified star chart or planisphere online for Assignment 4.2 and Learning Activity 4.5. Please contact your tutor/marker if you are unable to obtain one.
- A **computer with Internet access** would be beneficial throughout the course. Additional support materials for the course are provided on websites that are listed.

A **note about Internet sites:** All of the URLs listed in this course were working when this course was written, but, since Internet sites come and go, you might find that some of these sites are no longer active or appropriate. If that happens, you could use a search engine (e.g., [www.google.ca](http://www.google.ca)) to find the information that you are looking for.

## What optional resources are recommended?

Access to the following resources would be beneficial in completing this course:

- a computer and **word processing software** like Microsoft Word, which you can use to write your assignments electronically, and then you can attach them to your email to send in for assessment
- a computer and **an email account**, which will allow you to email your assignments to the Independent Study option office (more instructions on how to email assignments to your tutor marker will be explained later in this Introduction)
- **local resource people** such as teachers, school counsellors, librarians, and so on, who can help you complete the course
- a **photocopier** so that you can photocopy assignments before mailing them to the Independent Study Option office

## How Will You Know How You Are Doing?

You will know how well you are learning by your assessment of the following:

### Learning Activities



One of the easiest and fastest ways to find out how much you have learned is by completing the learning activities. These have been designed to let you assess yourself by comparing your answers with the answer keys at the end of each module. Some lessons have more than one learning activity. You will need a notebook to write down your answers.

Besides giving you feedback, the learning activities will help you practise what you have learned and prepare you to successfully complete your assignments and exam. Many of the questions on the exam will be similar to the questions in the learning activities. Remember that you **do not mail learning activities to your tutor/marker**.

### Assignments



Some lessons contain assignments that you will be sending to your tutor/marker for assessment. The assignment component of this course is worth 75 percent of your final mark. In order to do well on each assignment, you should complete all learning activities first and check your answers in the answer key provided. Remember to keep all assignments that have been marked and returned to you, as you will need to review them for the exam.

## Plagiarism

Plagiarism is taking someone's ideas or words as if they you're your own, without giving credit where credit is due. Some examples include the following:

- downloading material in whole or part from the Internet and submitting it as your own
- copying word-for-word from published or unpublished work
- paraphrasing, or using ideas from, published or unpublished work without giving credit

How can you avoid plagiarism?

1. Begin early because research takes time. In addition to the time needed to search for, evaluate, and read sources, you also need to remember to allow time to get help if you need it. Always document your sources immediately.
2. Incorporate information using quotations or paraphrases. A quotation uses exactly the same words and puts them in quotation marks. A paraphrase uses an author's idea, but expresses it in your own words – without quotation marks, since it is no longer a word-for-word quotation. And just changing a few words from the original does not count.
3. Discover how to use various citation styles like MLA to cite your sources.
4. Give credit where credit is due!

The above is **not** a complete list because using citations could be a lesson in itself. This is a quick guide to help you research ethically and efficiently. When in doubt, talk to your tutor/marker, your librarian, a family member, or a teacher.

## Final Exam



The final exam is based on all four modules and is worth 25 percent of the final mark of the course. In order to do well on the final exam, you should review all of the work that you have completed from Modules 1 to 4, including all learning activities and assignments. You should also complete and check your answers for the Final Practice Exam (more about this below).

You are responsible for applying for your exam and making arrangements to have the exam sent to your proctor from the Independent Study Option office. You should make arrangements to write your exam before you finish the final module. When you write your exam, you will be supervised by a proctor.



- **If you are attending school**, ask your school's Independent Study Option (ISO) school facilitator to add your name to the ISO examination eligibility list.
- **If you are not attending school**, check the **Examination Request Form** for options available to you. The form was mailed to you with this course. **Three weeks before** you are ready to write the final examination, fill in the Examination Request Form and mail or fax it to  
ISO Registration  
555 Main Street  
Winkler MB R6W 1C4  
Fax: 204-325-1719  
Telephone: 1-800-465-9915

## Final Practice Exam and Answer Key

To help you succeed in your final exam, you need to write the Final Practice Exam that is found at [www.edu.gov.mb.ca/k12/dl/downloads/index.html](http://www.edu.gov.mb.ca/k12/dl/downloads/index.html).

This practice exam is very similar to the actual final exam that you will be writing. An answer key is also provided so that you can check your answers when you have finished writing it. This will give you the confidence that you need to do well on your exam. If you do not have access to the Internet, contact the Independent Study Option at 1-800-465-9915 to get a copy of the practice exam.

## What Is a Typical Lesson Like?

Each module in this course is made up of several lessons, which are organized as follows:

- **Introduction:** Each lesson begins by outlining what you will be learning.
- **Lesson Focus:** Each lesson focuses on learning outcomes which are goals you should have accomplished by the end of the lesson as prescribed by Manitoba Education.
- **Lesson:** The main body of the lesson is made up of the content that you need to learn. It contains explanations, diagrams, and fully completed examples.
- **Summary:** Each lesson ends with a brief review of what you just learned.
- **Learning Activities:** Most lessons have a learning activity. These include questions that you should complete in order to help you practise or review what you have just learned. Once you have completed a learning activity, you should check your answers with the answer key provided at the end of the module.

- **Assignments:** Assignments are found at the end of lessons. In all, the assignments will be worth a total of 75 percent of your final mark. You will mail or email all of your completed assignments to your tutor/marker for assessment.

## Who Can Help You with This Course?

There are at least two people who can help you to succeed in this course:

### Your Tutor/Marker

Tutor/markers are experienced educators who tutor independent students and mark assignments and examinations. When you are having difficulty with something in this course, be sure to contact your tutor/marker, who is there to help you. Your tutor/marker's name and contact information were sent to you with this course. If you are not sure how to contact your tutor/marker, phone the ISO office at 1-800-465-9915.

### Your Learning Partner(s)



A learning partner is someone **you choose** who will help you learn. It may be someone who knows something about science, but it doesn't have to be. A learning partner could be someone else who is taking this course, a teacher, a parent or guardian, a sibling, a friend, or anybody else who can help you. Most importantly, a learning partner should be someone with whom you feel comfortable, and who will support you as you work through this course.

Your learning partner can help you keep on schedule, check your work, help you make sense of assignments, read the course with you, or look at your learning activities and respond to them. You may even study for your exam with your learning partner.

If you like, you may choose more than one learning partner – sometimes one person may have more of an interest in a particular topic than your usual learning partner or sometimes one person may have more time available when you need help.

If your learning partner is not an adult, you will also need an adult available to supervise some of the hands-on learning activities.

## How Much Time Will You Need?

Learning through independent study has several advantages over learning in the classroom. You are in charge of how you learn and can choose how quickly you will complete the course. You do not have to wait for your teacher or classmates, and can read as many lessons as you wish in a single session.

Read the next few pages to get a recommendation on how to pace yourself.

### Chart A: Semester 1

Here is a **suggested timeline** that you can follow if you start your course in September and need to complete it by the end of January.

Module	Completion Date
Module 1	late September
Module 2	early November
Module 3	early December
Module 4 and Final Exam	mid January

### Chart B: Semester 2

Here is a **suggested timeline** that you can follow if you start your course in January and need to complete it by June.

Module	Completion Date
Module 1	late February
Module 2	early April
Module 3	early May
Module 4 and Final Exam	late May

## Chart C: Full School Year (Not Semestered)

Here is a **suggested timeline** that you can follow if you start your course in September and need to complete it by June.

Module	Completion Date
Module 1	late October
Module 2	mid January
Module 3	mid March
Module 4 and Final Exam	late May

Do not wait until the last minute to complete your work, since your tutor/marker may not be available to mark it immediately. Make sure that you leave enough time for your work to travel through the mail, as it might take over a week. It may also take a few weeks for your tutor/marker to mark everything and send the marks to your school.

If you need this course to graduate this school year, remember to schedule and complete your final exam by the end of May.

## How and When Do You Send Assignments to Your Tutor/Marker?

### When to Submit Assignments

While working on this course, you will mail or email completed assignments to your tutor/marker four times. Each time you send an assignment, you must include the Module Cover Sheet, which you will find at the end of this Introduction. The following chart shows you exactly what you will be mailing in at the end of each module.

Mailing	Modules	Assignments You Will Mail In
Mailing 1	Module 1	Assignments 1.1 – 1.4
Mailing 2	Module 2	Assignments 2.1 – 2.4
Mailing 3	Module 3	Assignments 3.1 – 3.6
Mailing 4	Module 4	Assignments 4.1 – 4.8

## How to Submit Assignments?

In this course, you have the choice of either mailing or emailing your assignments.

- Each time that you **mail** something, you must include the print version of the applicable Module Cover Sheet (found at the end of this Introduction).
- Each time that you **email** something, you must include the electronic version of the applicable Module Cover Sheet (found at [www.edu.gov.mb.ca/k12/dl/downloads/index.html](http://www.edu.gov.mb.ca/k12/dl/downloads/index.html)).

Complete the information at the top of the Module Cover Sheet before mailing or emailing it along with your assignments.

### Mailing Your Assignments



If you choose to mail your completed assignments, please photocopy all of the materials first so you will have a copy in case your package goes missing. You will need to place the applicable Module Cover Sheet and assignments in an envelope and address it to

ISO Tutor/Marker  
555 Main Street  
Winkler MB R6W 1C4

Your tutor/marker will mark your work and return it to you by mail.

### Emailing Your Assignments



If you choose to email your assignments, make sure you have saved copies of them before you send them. That way, you can refer to your assignments when you discuss them with your tutor/marker.

To email your completed assignments, you will first need to do **one** of the following:

- **If you are attending school**, please ask your ISO school facilitator (the person who signed your ISO Registration/Admission Form) for permission to email your assignments and to determine your school's procedure for emailing assignments/unsupervised tests. Contact your tutor/marker to confirm that the course material can be marked electronically.
- **If you are not attending school**, please obtain permission directly from your tutor/marker to submit your assignments electronically.

*How to Submit Your Work* (files must not exceed 5 MB)

Please submit your work in the file types shown below:

- **Written work:** Microsoft Word files (doc) or RTF files
- **Spreadsheets:** Microsoft Excel files (xls)
- **Pictures and graphics:** JPEG or GIF files
- **Scanned work:** PDF files (save multiple pages on one file)

*How to Send Your Email*

1. Use the following format to compose your email.

**To:** distance.learning@gov.mb.ca  
**Cc:** [your ISO school facilitator's email address if you attend school]  
**Subject:** [your Name] Grade 9 Science  
**Attach:** Assignment 1.1.doc, Assignment 1.2.doc, Assignment 1.3.doc,  
Assignment 1.4.doc

Message: Assignments 1.1, 1.2, 1.3, and 1.4  
Tutor/marker \_\_\_\_\_  
School \_\_\_\_\_

2. Attach your files (files must not exceed 5 MB).
3. Email your assignments to <distance.learning@gov.mb.ca> only. Do **not** email your assignments directly to your tutor/marker. Emails sent directly to tutor/markers will be returned unread.

**Your tutor/marker will mark your work and return it to you by email.**

## What Are Guide Graphics For?

Guide graphics are used throughout this course to identify and guide you in specific tasks. Each graphic has a specific purpose, as described below.



**Learning Outcomes:** This graphic appears at the beginning of each lesson, indicating the specific learning outcomes targeted for the lesson.



**Key Words:** This graphic also appears at the beginning of each lesson, listing the new words and terms that will be defined within.



**Internet:** If you have access to the Internet, you can use it to get more information. Internet access is optional.



**Learning Partner:** Ask your learning partner to help you with this task.



**Learning Activity:** Complete this learning activity to help you review or practise what you have learned and to prepare for your assignment or examination. You will not send learning activities to your tutor/marker.



**Check Your Work:** This graphic reminds you to check your work using the answer key.



**Assignment:** This guide graphic tells you that there is an assignment you must complete.



**File Assignment:** File your completed assignments in a safe place until you have finished the next module of this course.



**Submit Assignment:** It is now time to submit your assignment for tutor/marker assessment.



**Exam:** Prepare to write your final exam.

**Good luck with the course!**

**Remember:** If you need help at any point during this course, contact your tutor/marker.





# GRADE 9 SCIENCE (10F)

## Module 1

### Reproduction

This module contains the following:

- Introduction
- Lesson 1: Introduction to the Cell
- Lesson 2: Cell Division
- Lesson 3: Asexual Reproduction
- Lesson 4: Sexual Reproduction
- Lesson 5: Sexual Reproduction in Plants and Animals
- Lesson 6: Reproductive Success
- Lesson 7: Human Reproduction—The Male Reproductive System
- Lesson 8: Human Reproduction—The Female Reproductive System
- Lesson 9: Conception through Birth
- Lesson 10: Single Trait Inheritance
- Lesson 11: Single Trait Inheritance—A Closer Look
- Lesson 12: Inheritance of Sex-Linked Traits
- Lesson 13: Sex-Linked Traits and Your Pedigree
- Lesson 14: Genetic Mutation—Choices and Environmental Factors
- Lesson 15: Canadian and International Contributions to Genetics and Reproduction
- Lesson 16: Potential Applications and Implications of Biotechnology
- Lesson 17: Reproduction Review



# MODULE 1

## REPRODUCTION

### Introduction

When you think about how a plant begins to grow, or how your baby brother came to be, you are thinking about reproduction. There are different types of reproduction used by different species. It is difficult to really understand how the reproductive cycles work, since it all begins in the cells of the organism.

You first began learning about cells and systems in Grade 8. You will carry on this work with this module. You may want to go back to your notes from Grade 8 Science to refresh your memory.

In this module, you will be using your understanding about cells and applying it to the reproduction of cells. You will learn about the reproductive system, conception through birth, and inheritance of traits.

You will need the following materials to complete this module:

- masking tape
- four pennies

You will notice that some of the lessons are accompanied by learning activities and assignments for you to complete. Complete the learning activities to help you learn about the information from the module and check the answer key in order to assess your understanding. Complete the assignments and hand them into your tutor/marker according to the instructions at the end of this module.



### Learning Activities

There are several learning activities placed throughout this module, which will help you practise using the information you will learn. The answer keys for each of these learning activities are found in Module 1 Learning Activity Answer Key. Check the answer key carefully and make corrections to your work.



A **computer with Internet access** would be beneficial throughout the course. Additional support materials for the course are provided on websites that are listed. All of the URLs listed in this course were working when this course was written, but, since Internet sites come and go, you might find that some of these sites are no longer active or appropriate. If that happens, you could use a search engine (e.g., <www.google.ca>) to find the information that you are looking for.



## Assignments

You will also find assignments throughout this module. Assignments need to be completed and *handed in* to your tutor/marker once you have completed this module. The following assignments will need to be completed during your study of Module 1:

## Assessment Checklist

- Lesson 1      *There is no assignment in this lesson.*
- Lesson 2      *There is no assignment in this lesson.*
- Lesson 3      *There is no assignment in this lesson.*
- Lesson 4      *There is no assignment in this lesson.*
- Lesson 5      *There is no assignment in this lesson.*
- Lesson 6      Assignment 1.1: Dual Option Assignment  
(30 marks)
- Lesson 7      *There is no assignment in this lesson.*
- Lesson 8      *There is no assignment in this lesson.*
- Lesson 9      Assignment 1.2: From Conception to Birth  
(40 marks)
- Lesson 10     *There is no assignment in this lesson.*
- Lesson 11     *There is no assignment in this lesson.*
- Lesson 12     *There is no assignment in this lesson.*
- Lesson 13     *There is no assignment in this lesson.*
- Lesson 14     Assignment 1.3: Mutagens Investigation  
(24 marks)
- Lesson 15     *There is no assignment in this lesson.*
- Lesson 16     Assignment 1.4: Research into Genetics  
(14 marks)
- Lesson 17     *There is no assignment in this lesson.*

You will find instructions on how to hand in these assignments at the end of the module.

These assignments will be worth a portion of the 75 percent of the total marks you will receive for assignments in this course.

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## Notes

# LESSON 1: INTRODUCTION TO THE CELL



## Lesson Focus

**After completing this lesson, you will be able to**

- list the three main parts of plant and animal cells
- describe the function of the cell membrane
- describe the function of cell organelles



## Key Words

- cell membrane
- nucleus
- cytoplasm
- organelles
- cellulose
- DNA
- genes
- nuclear envelope
- nucleoplasm
- chromosomes
- nucleolus
- ribosomes
- Golgi body
- lysosomes

## Introduction

You have already learned about the structure of the cell. This section will serve as a review.

The cell is the basic unit of life. The individual cell performs the same life functions as a whole organism.

In fact, some organisms are made of only one cell. Every cell goes about the functions of

- using food for energy
- getting rid of waste
- reproducing itself
- creating material for growth and repair

In this lesson, you will learn about the cell structures that allow these functions to take place.

## Basic Building Blocks

Cells are the basic building blocks of all life. Some organisms are composed of a single cell whereas others contain millions of cells.

A typical cell is made of three main parts.

- A **cell membrane** surrounds the cell. This membrane has small openings that provide places where the cell has contact with the environment outside.
- The **nucleus** directs the activities of the cell.
- The **cytoplasm** is a thick fluid inside the cell that, with the nucleus, makes up its total contents. The cytoplasm in turn is filled with **organelles** (little organs) that perform cell activities.

These common elements are found in most cells. Cells exist in many different shapes, however, and have many different functions.



The diagrams that follow show the structures present in plant and animal cells. Can you see any differences between the two diagrams?

Figure 1.1

### Plant Cell

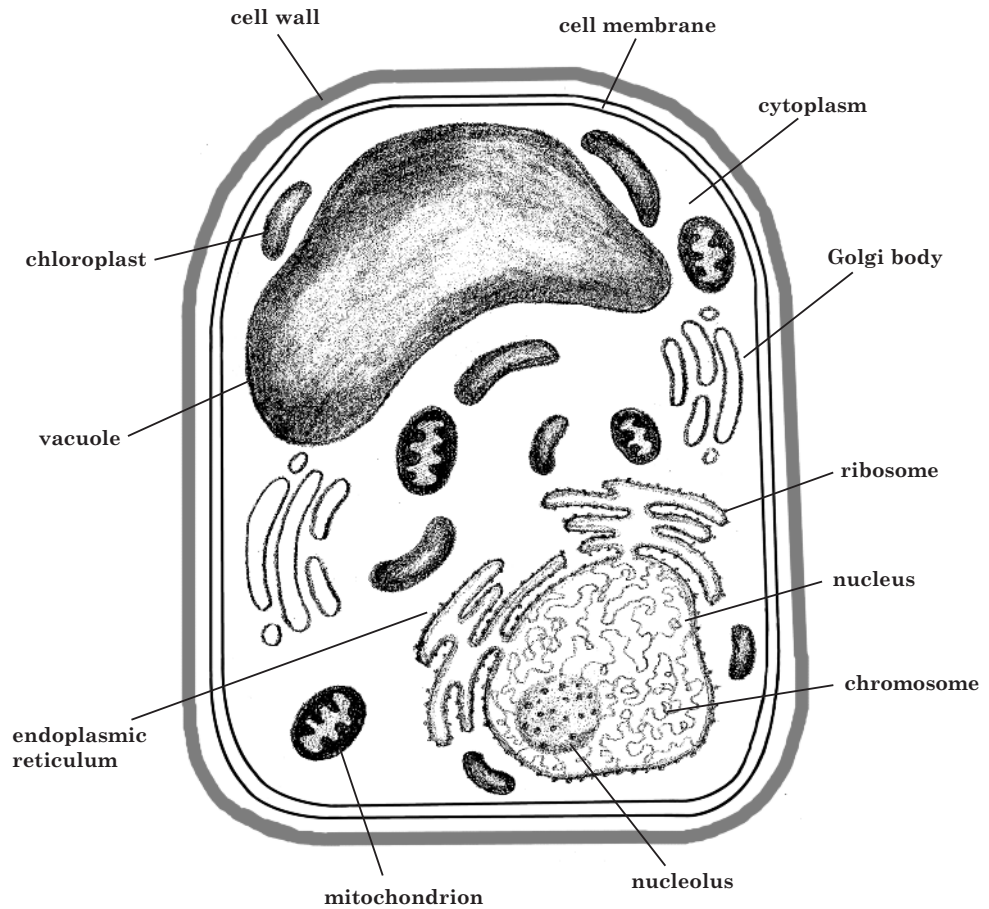
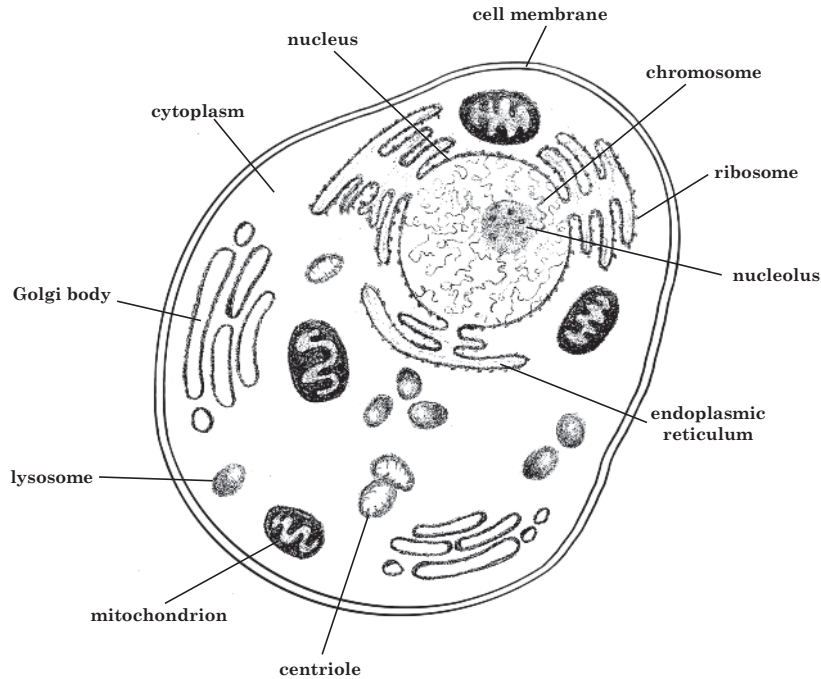


Figure 1.2

**Animal Cell**

Plant and animal cells have many similar parts. Plant cells, however, have chloroplasts and cell walls. Animal cells do not have these features.

The previous cell drawings contain the standard parts of the two cell types. When looking at cells through a microscope, they will not be identical to the drawings. The parts in the drawing have been clarified and are easy to see and identify. Structures in real cells are harder to see. Some structures can only be seen with an electron microscope.

The organelles help the cell perform life functions including taking in food for energy and growth, eliminating waste, and adjusting to the environment.

## Cell Membrane

The cell membrane is the thin, flexible material that surrounds the contents of the cell and allows it to make contact with its surroundings. The cell membrane consists of two layers of fat, with proteins located throughout the fat layers. The cell is able to control what substances pass through the membrane, allowing it to keep materials that are necessary for growth and survival, while eliminating materials that are harmful.

The cell membrane is considered to be selectively permeable; that is, it lets some materials pass through but not others. A cell wall found in plant cells but not in animal cells is composed of a non-living material called **cellulose**.

The cellulose is quite rigid and supports the shape of the plant cells. Cell walls allow the passage of all materials and are considered to be permeable.

## Parts of the Cell

A cell can be an independent unit or it can be part of a system that has a specific function in a more complex organism. In this lesson, you will first study the nucleus and various organelles, all of which have specific functions within the cell.

### Nucleus

The nucleus is the largest of the cell organelles and acts as the cell's command centre.

The nucleus uses **DNA** (deoxyribonucleic acid) to command the activities of the cell. DNA is located in the nucleus and is used when a cell reproduces itself. DNA also builds proteins which allow the cell to adjust according to its surroundings. Packages of DNA are called **genes**.

The three parts to a nucleus are:

1. **Nuclear Envelope**

The **nuclear envelope** is similar to the cell membrane except it covers the nucleus. It contains many selectively permeable pores that allow only certain proteins to pass through into the nucleus. The fluid material inside the nucleus is called the **nucleoplasm**.

2. **Chromosomes**

**Chromosomes** contain all the information the cell needs to reproduce itself and produce proteins. Chromosomes are made of genes. Chromosomes replicate themselves prior to cell reproduction.

Most cells are able to reproduce. A notable exception is red blood cells. Red blood cells are without a nucleus and are the only cells that can survive for any length of time without a nucleus. Their survival time is about two months.

3. **Nucleolus**

There are several nucleoli in the nucleoplasm. These structures are not fully understood. Some scientists feel they are responsible for producing some proteins and **ribosomes** that pass out through the nuclear membrane into the cytoplasm.

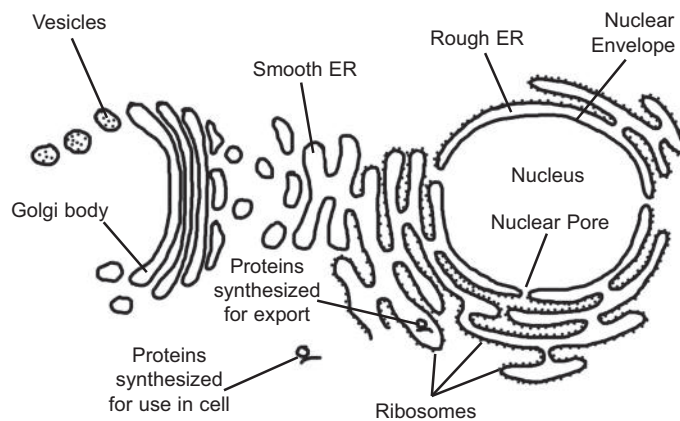
## Cell Organelles

Cell organelles are located in the cytoplasm of the cell.

### Endoplasmic Reticulum

The endoplasmic reticulum (ER) is responsible for moving proteins throughout the cell. It is a series of tubes and flattened sacs that connect to the nuclear envelope. Some of the ER is smooth and some is rough and dotted with ribosomes. Ribosomes are produced by the nucleus and settle onto the rough ER in order to build proteins.

Figure 1.3 **Golgi Body**



### Golgi Body

The **Golgi body** is responsible for the packaging and storage of proteins transported by the endoplasmic reticulum. The Golgi body looks like a series of folds, one on top of the other (see Figure 1.3 above). It is both structurally and functionally connected to the nucleus and the endoplasmic reticulum.

The Golgi body wraps the protein in packages. These packages are stored until needed or transported out of the cell if not needed. The Golgi body also packages certain enzymes into separate organelles called **lysosomes**.



## Learning Activity 1.1

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1. Describe the path of a protein molecule from the place where they are produced to the place where they are used in the cytoplasm.
  2. If the endoplasmic reticulum is the transportation system, then the Golgi complex is the warehousing and packaging system. Explain this statement.
  3. What part of the nucleus replicates itself as part of the reproductive process?
  4. Why is the packaging of proteins in the Golgi complex an important part of the cell's function?
- 



Check the answer key.

## Summary

When viewing cells under a simple microscope, the nucleus can easily be seen as a dark spot in the cell. The nucleus is held together by the nuclear envelope. Within the nucleus there are other structures: the chromosomes, which contain all the information the cell needs to reproduce itself, and the nucleolus, which is not fully understood. Be careful not to confuse the nucleus with the nucleolus.

Other important organelles are the endoplasmic reticulum, which is responsible for protein manufacturing, and the Golgi body, which packages and stores protein.

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## Notes



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