Democratic and Popular Republic of Algeria

Ministry of Higher Education and Scientific Research

University 8 May 1945 Guelma

Faculty of Natural and Life Sciences and Earth and Universe Sciences

Department of Biology

For Students: 1st Year Master Applied Immunology

# Scientific English

SHV : 45 hours, WHV: 1.5 hours

Credit: 2, Coefficient: 1

Course Developed by Dr. Marwa YAKHLEF

Academic year: 2023/2024

## Preface

The mastery of scientific English is a critical skill for biology students, particularly at the master's level, where students are expected not only to consume but also to contribute to scientific literature.

The course: Scientific English, has been specifically designed for immunology 1 st year master's students to equip them with the specialized vocabulary and language structures essential for navigating the vast body of scientific literature in biology. By focusing on scientific terminology, students will develop the language proficiency needed to read, analyze, and present complex scientific concepts with confidence.

Through this course, students will gain an in-depth understanding of key scientific words and phrases, enabling them to read scientific papers and other scholarly documents in English with increased comprehension and precision. Emphasis will be placed on building students' ability to present scientific findings accurately, both orally and in writing, which is a crucial skill for their future research and professional endeavors. Each chapter of the course will end with exercises to reinforce key concepts, aiding students in understanding, memorizing, and actively applying what they've learned. This approach supports hands-on engagement, helping students build confidence in using scientific English effectively.

The course is divided into five chapters: General introduction, Basic concepts of biology, Writing in a scientific style, The main parts of a scientific paper and finally, How to write and publish a scientific paper.

The course does not rely on a single reference. Instead, it is built upon a range of textbooks and authoritative sources in the field. Together, these resources provide a comprehensive foundation and practical insights into the concepts of biology, research and scientific writting covered in the course.

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# Chapter 1. General introduction

## 1. Definition of biology

The word biology is derived from the greek words /bios/ meaning /life/ and /logos/ meaning /study/. It is defined as the science of life and living organisms.

An organism is a living entity consisting of one cell e.g. bacteria, or several cells e.g. animals, plants and fungi.

## 2. Who is a biologist?

- A biologist is a scientist who conducts research in biology.

Biologists are interested in studying life on Earth, whether it is an individual cell, a multicellular organism, or a community of interacting populations.

They usually specialize in a particular branch in biology (e.g., molecularand cellular biology, immunology, and biochemistry.

Most biologists have one or more academic degrees such as a bachelor's degree plus an advanced degree like a master's degree or a doctorate.

Like other scientists, biologists can be found working in different sectors of the economy such as in academia (teaching), medical laboratory, food safety and control laboratory.

## 3. Branches of biology

The field of biology spans many scales, from the molecular level (like DNA and proteins) to the ecosystem level, where biologists study how different organisms interact within their environments.

Biology is multidisciplinary science that encompasses different branches. Table 1 below summarizes some of the main biology branches and their focus:

**Table 1. Some of the main branches of biology and their focus.**

| Branches | Focus |
|---|---|
| **Cell Biology** | Studies the structure and function of cells, the basic units of life. |
| **Genetics:** | Focuses on heredity and the variation of inherited traits. |
| **Evolution:** | Examines how species change over time and adapt to their environments. |
| **Ecology:** | Studies how organisms interact with each other and with their environment. |
| **Physiology:** | Looks at how the systems within an organism function. |
| **Microbiology:** | Focuses on microscopic organisms, like bacteria and viruses. |
| **Zoology and Botany** | Study animals and plants, respectively. |

## 4. Definition of molecular and cellular biology

Cell and Molecular Biology studies the structure and function of the cell, which is the basic unit of life. Cell biology is concerned with the physiological properties, metabolic processes, signaling pathways, life cycle, chemical composition and interactions of the cell with their environment.

This is done both on a microscopic and molecular level as it encompasses prokaryotic cells and eukaryotic cells.

Knowing the components of cells and how cells work is fundamental to all biological sciences; it is also essential for research in bio-medical fields such as cancer, and other diseases.

## 5. Definition of immunology

Immunology is the study of the immune system and is a very important branch of the medical and biological sciences. The immune system protects us from infection through various lines of defense.

If the immune system is not functioning as it should, it can result in disease, such as autoimmunity, allergy and cancer.

It is also now becoming clear that immune responses contribute to the development of many common disorders not traditionally viewed as immunologic, including metabolic, cardiovascular, and neurodegenerative conditions such as Alzheimer's.

## 6. Exercises

### Exercise 1

As a biologist and according to what you learned about biology, explain what you like or dislike about the field of biology. Tell us what are your plans for the future in the field of biology.

### Exercise 2

In a table, classify those rules into: **do** and **don't**

1. eat or drink in the lab
2. use your mouth for pipetting substances
3. Locate Safety Equipment
4. Wear Proper Clothing
5. handle broken glass with bare hands
6. Handle chemicals with caution
7. operate lab equipment without permission
8. Keep your work area clean and organized
9. place flammable substances near heat
10. engage in childish actions such as: horseplay or pranks

### Exercise 3: choose the correct answer

- The branch of biology, which involves the study of immune systems in all organisms is called_________.

(a) Zoology

(b) Microbiology

(c) Immunology

(d) Biotechnology

# Chapter 2. Basic concepts of biology

## I. The immune system

### 1.Definition

The immune system is the body's defense network that protects against infections, diseases, and foreign substances. It consists of various cells, tissues, and organs that work together to identify and neutralize harmful pathogens like bacteria, viruses, fungi, and parasites.

The main components of the immune system include:

1. **White Blood Cells**: Also known as leukocytes, they detect and attack foreign invaders.
2. **Lymphatic System**: A network of tissues and organs that transport immune cells and remove toxins and waste.
3. **Antibodies**: Proteins that recognize and neutralize specific pathogens.
4. **Thymus and Bone Marrow**: Organs where immune cells are produced and mature.
5. **Spleen**: Filters blood, removing pathogens and damaged cells.

### 2.Types of immunity

There are three types of immunity Each type of immunity is essential to the body's defense and plays a unique role in protecting against infections and maintaining health.

- **Innate Immunity**: This is the body's first line of defense, providing a quick, non-specific response to pathogens. It provides general protection against a wide range of pathogens without prior exposure.

Innate immunity includes:

- **Physical Barriers**: These include the skin, mucous membranes in the respiratory, gastrointestinal, and urogenital tracts, and hair-like structures like cilia that trap and remove pathogens.
- **Chemical Barriers**: Enzymes in saliva, tears, and stomach acid help destroy pathogens on contact.
- **Cellular Defenses**: Specialized white blood cells, such as:

    - **Macrophages**: Engulf and digest foreign particles and cellular debris.
    - **Natural Killer Cells**: Target and destroy infected or abnormal cells.
    - **Neutrophils and Eosinophils**: Attack pathogens and contribute to inflammation.
- **Inflammatory Response**: When tissues are injured, they release chemicals that trigger inflammation, increasing blood flow to the area and bringing immune cells to fight infection.

Innate immunity serves as the body's initial response to pathogens and can work within minutes to hours after infection.

- **Adaptive (Acquired) Immunity**

This type of immunity develops over time and provides a specific response to pathogens. Adaptive immunity is more targeted and is characterized by the action of lymphocytes (T cells and B cells) and antibodies. It has a "memory," meaning it can respond more rapidly to pathogens the body has encountered before.

The main components of this type of immunity are:

- **Lymphocytes**: Key players in adaptive immunity, which include:
    - **B Cells**: Produce antibodies specific to the pathogens they encounter. When activated, B cells differentiate into plasma cells that secrete antibodies and memory B cells that provide long-term immunity.
    - **T Cells**: Divided into:
        - **Helper T Cells**: Aid in the activation of B cells and other immune cells.
        - **Cytotoxic T Cells**: Directly destroy infected cells and cancerous cells.
- **Antibodies**: Y-shaped proteins produced by B cells that bind to specific antigens (foreign substances) on pathogens, marking them for destruction or neutralizing them directly.
- **Memory Cells**: After an initial infection, the body produces memory B and T cells that "remember" the pathogen and can quickly respond to future infections by the same pathogen.

Adaptive immunity is slower to respond initially (days to weeks), but it creates a more precise, long-lasting response. Its "memory" allows for a faster, more efficient response upon subsequent exposures to the same pathogen.

The figure 1 bellow summarizes the main componants of the immune system with the main types.

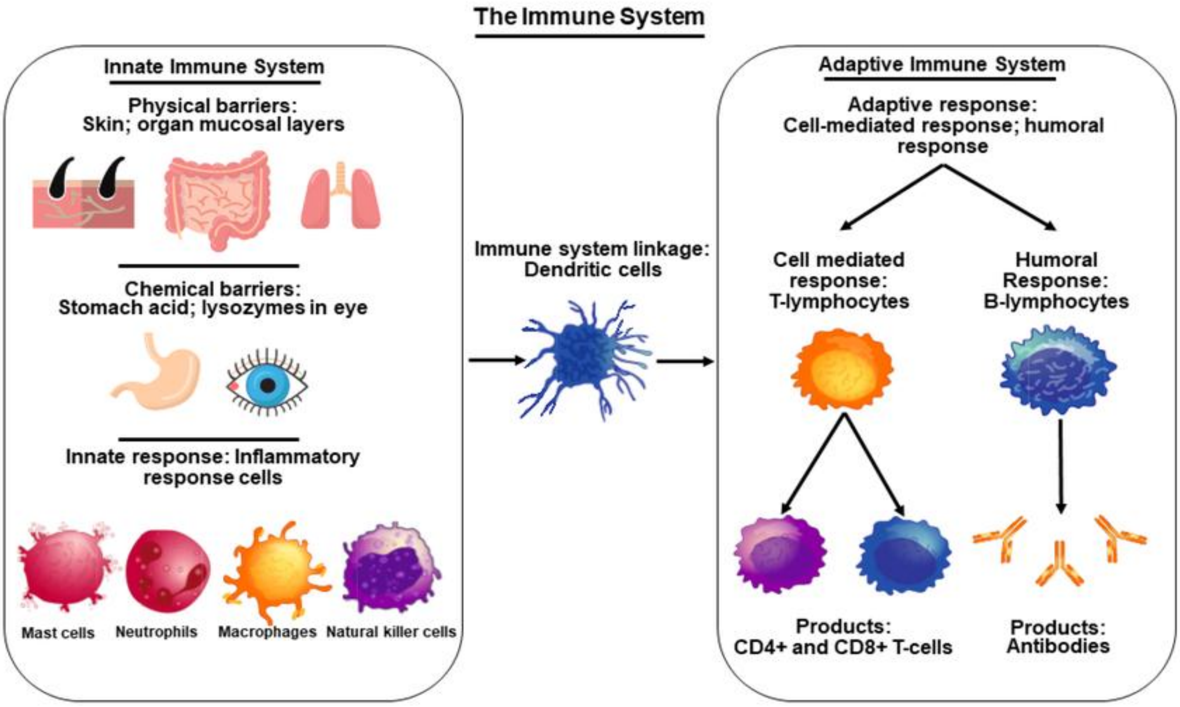



**Figure 1. Summary of the main types of immunity and their main components.**

- **Passive Immunity**: This is temporary immunity obtained from another source, rather than being produced by the body's own immune system. Passive immunity provides immediate protection, but it fades over time as the borrowed antibodies are eventually broken down. This type of immunity does not involve the body's own immune system producing a response.

- **Natural Passive Immunity**: Occurs naturally, such as the transfer of antibodies from mother to child. For example:
    - **Placental Transfer**: Maternal antibodies cross the placenta during pregnancy, providing the baby with immunity at birth.
    - **Breastfeeding**: Antibodies in breast milk continue to protect the infant.

- **Artificial Passive Immunity**: Occurs when antibodies are given through medical intervention. Examples include:
  - **Immunoglobulin Therapy**: Provides patients with ready-made antibodies to protect against specific infections or toxins.
  - **Antiserum Injections**: Antibodies injected to treat conditions like snake bites, rabies, or tetanus.

Passive immunity provides immediate but short-term protection, lasting only as long as the antibodies remain active in the body (typically weeks to months). It does not create memory cells, so the protection does not persist once the borrowed antibodies degrade.

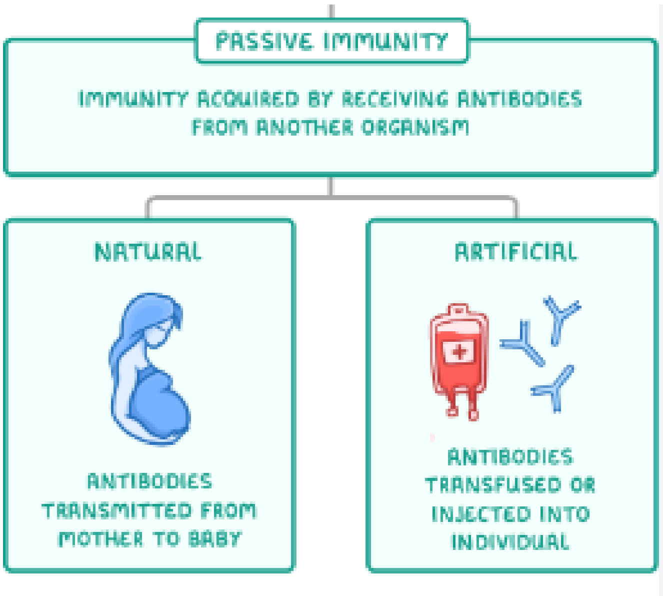



**Figure 2. Main sources of the passive immunity.**

## 3.Lymphoid organs

Lymphoid organs are structures in the body that play a key role in producing, maturing, and housing immune cells, especially lymphocytes (T cells, B cells, and natural killer cells). They are essential for maintaining immune function and initiating responses to infections.

Lymphoid organs are divided into two main types:

- **Primary Lymphoid Organs**

These are the organs where immune cells are produced and undergo maturation.

- **Bone Marrow**
  - **Function**: Bone marrow is the soft tissue inside bones and is the primary site for the production of all blood cells, including immune cells like lymphocytes.
  - **Role in Immunity**: It's where B cells mature and where all immune cells, including T cells, originate.
- **Thymus**:
  - **Function**: The thymus is a small organ located in the upper chest, behind the sternum.
  - **Role in Immunity**: It is where T cells mature and become capable of recognizing specific antigens. Immature T cells (produced in the bone marrow) travel to the thymus, where they undergo a selection process to ensure they can effectively recognize pathogens while ignoring the body's own tissues.

### 6.4. Secondary Lymphoid Organs

These are sites where immune cells are activated and interact with antigens to initiate immune responses.

- **Lymph Nodes**
  - **Function**: Lymph nodes are small, bean-shaped structures located along lymphatic vessels throughout the body.
  - **Role in Immunity**: They filter lymph (a fluid that circulates immune cells and antigens) and contain high concentrations of lymphocytes and macrophages. When pathogens or antigens are detected in lymph, they trigger an immune response in the nodes, leading to lymphocyte activation and antibody production.
- **Spleen**
  - **Function**: The spleen is located in the upper left abdomen and filters blood.
  - **Role in Immunity**: It clears out old or damaged red blood cells and stores white blood cells. It also helps initiate immune responses to blood-borne pathogens by capturing antigens from the blood and providing a site for lymphocyte activation.
- **Mucosa-Associated Lymphoid Tissue (MALT)**

- **Function**: MALT includes lymphoid tissues associated with mucous membranes in the respiratory, digestive, and urogenital tracts, such as the tonsils, Peyer's patches in the intestines, and appendix.
- **Role in Immunity**: MALT protects mucosal surfaces, which are common entry points for pathogens. It contains immune cells that can quickly respond to antigens at these vulnerable sites.

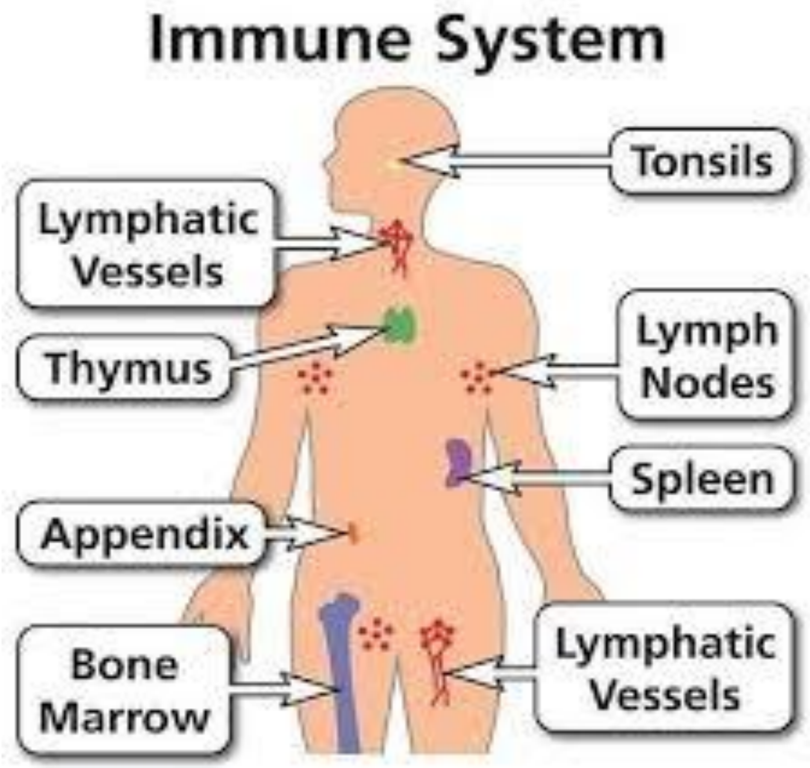



**Figure 3. Localization of primary and secondary organs of the immune system.**

### 4.Presentation of lymphocytes B

B lymphocytes, or B cells, are a type of white blood cell essential for adaptive immunity. They play a key role in producing antibodies, which help neutralize pathogens and toxins in the body. B cells are primarily involved in the "humoral" immune response, meaning they work by targeting antigens circulating in bodily fluids (or "humors") rather than within cells.

- B cells originate from stem cells in the bone marrow, where they also undergo maturation.

- During maturation, B cells develop unique receptors on their surfaces called B cell receptors (BCRs), which allow them to recognize and bind specific antigens.

- B cells are activated when their B cell receptors recognize and bind to a specific antigen (like a protein on the surface of a virus or bacterium).
- In most cases, B cells require help from helper T cells (CD4+ T cells) to become fully activated. Helper T cells release cytokines that promote B cell activation and differentiation.

➢ **Differentiation into Plasma Cells and Memory B Cells**

- **Plasma Cells**: Once activated, some B cells differentiate into plasma cells, which are antibody-secreting cells. Plasma cells produce large quantities of antibodies specific to the antigen that triggered their activation, which helps neutralize pathogens or mark them for destruction by other immune cells.
- **Memory B Cells**: Other activated B cells become memory B cells. These cells "remember" the specific antigen and persist in the body for long periods. If the same pathogen re-enters the body, memory B cells can rapidly respond, producing antibodies more quickly and providing immunity against future infections by the same pathogen.

**5.Antibodies**

Antibodies, also known as immunoglobulins (Ig), are Y-shaped proteins produced by B cells that play a crucial role in the immune system. They circulate in the blood and lymph and bind specifically to antigens (foreign substances, such as pathogens or toxins), neutralizing them or marking them for destruction by other immune cells.

**5.1.Structure of Antibodies**

An antibody has a basic Y-shaped structure made up of four protein chains (figure 5)

- **Two Heavy Chains**: These are larger protein chains that form the core of the antibody.
- **Two Light Chains**: Smaller protein chains that attach to each heavy chain.

- **Variable Regions**: Located at the tips of the Y, these regions differ between antibodies and are what give each antibody its specificity. The variable regions form the "antigen-binding sites," where the antibody attaches to a specific antigen.
- **Constant Region**: The rest of the antibody structure, which is more consistent among antibodies of the same type, determines the antibody's class and can interact with other immune system components to help remove the antigen.

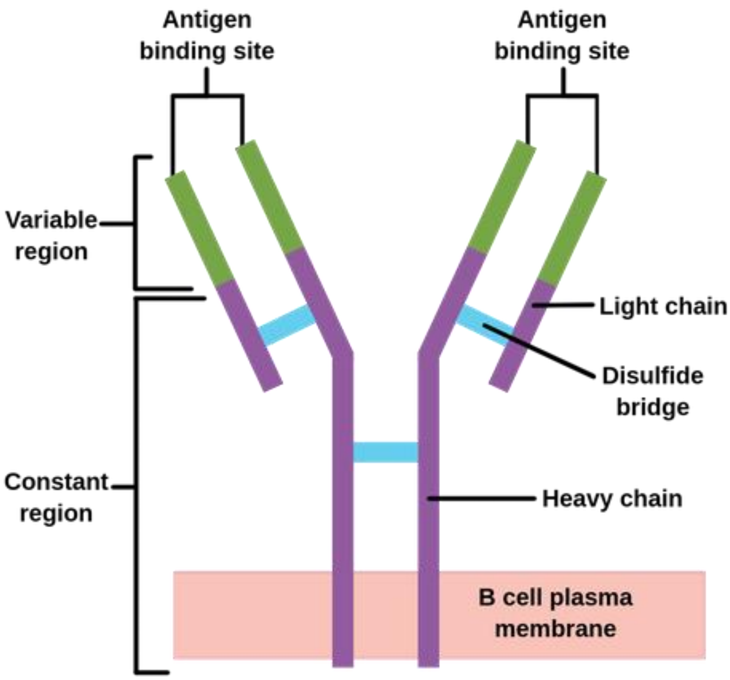



**Figure 4. Structure of antibody.**

### 5.2.Types of Antibodies

There are five main types of antibodies, each with a unique structure and function:

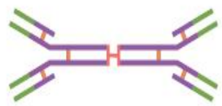
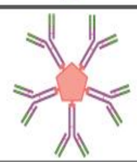
1. **IgG (Immunoglobulin G)**
   - **Function**: The most common antibody in the blood and tissue fluids, IgG provides long-term immunity and is produced in large quantities during a secondary immune response.
   - **Role**: Neutralizes toxins, binds to pathogens, and facilitates their clearance by immune cells.
2. **IgM (Immunoglobulin M)**

- **Function**: The first antibody produced in response to an infection and is mainly found in the blood.
- **Role**: IgM is very effective at forming complexes with pathogens and activating complement proteins, which help destroy microbes.

3. **IgA (Immunoglobulin A)**
    - **Function**: Found primarily in mucous membranes, such as in the respiratory and digestive tracts, and in bodily secretions like saliva, tears, and breast milk.
    - **Role**: Protects mucosal surfaces by preventing pathogens from adhering to and infecting cells, providing local immunity in areas exposed to the environment.
4. **IgE (Immunoglobulin E)**
    - **Function**: Involved in allergic reactions and defense against parasites.
    - **Role**: IgE binds to allergens and triggers the release of histamine and other chemicals from immune cells, which causes symptoms of an allergic reaction. It also plays a role in combating parasitic infections.
5. **IgD (Immunoglobulin D)**
    - **Function**: Found on the surface of immature B cells.
    - **Role**: Plays a role in B cell activation and signaling, but its precise function is less well understood compared to other antibody classes.

The table bellow summarizes the properties and the structure of each antibody.

**Table 2. Properties and structure of the five antibodies.**

| Name | Properties | Structure |
|---|---|---|
| IgA | Found in mucous, saliva, tears, and breast milk. Protects against pathogens. |  |
| IgD | Part of the B cell receptor. Activates basophils and mast cells. |  |
| IgE | Protects against parasitic worms. Responsible for allergic reactions. |  |
| IgG | Secreted by plasma cells in the blood. Able to cross the placenta into the fetus. |  |
| IgM | May be attached to the surface of a B cell or secreted into the blood. Responsible for early stages of immunity. |  |

### 5.3.Functions of Antibodies

7. **Neutralization**: Antibodies can bind directly to pathogens or toxins, blocking their ability to enter cells and causing them to become inactive.
8. **Opsonization**: By coating pathogens, antibodies mark them for easier recognition and ingestion by immune cells such as macrophages and neutrophils.
9. **Activation of Complement System**: Certain antibodies (especially IgM and IgG) activate the complement system, a group of proteins that assist in destroying pathogens by promoting inflammation, enhancing phagocytosis, or directly lysing the pathogen.
10. **Agglutination and Precipitation**: Antibodies can bind multiple antigens simultaneously, clumping them together. This agglutination makes it easier for immune cells to clear large groups of pathogens.
11. **Antibody-Dependent Cellular Cytotoxicity (ADCC)**: Some antibodies can signal natural killer (NK) cells to destroy infected or abnormal cells by binding to the cell and marking it for destruction.

## 6. Immune system disorders

Immune system disorders occur when the immune system malfunctions, either by attacking the body itself, becoming overactive, or by being unable to respond effectively. These disorders are generally grouped into three categories: autoimmune diseases, allergic and hypersensitivity reactions, and immunodeficiency disorders.

### 6.1. Autoimmune Diseases

Autoimmune diseases occur when the immune system mistakenly attacks the body's own cells and tissues, seeing them as foreign invaders. This self-attack leads to chronic inflammation and tissue damage. Common autoimmune diseases include:

- **Rheumatoid Arthritis**: The immune system attacks the joints, leading to inflammation, pain, and eventual joint damage.
- **Type 1 Diabetes**: The immune system targets and destroys insulin-producing cells in the pancreas, resulting in high blood sugar levels.
- **Systemic Lupus Erythematosus (SLE)**: Affects multiple organs, including the skin, kidneys, heart, and lungs, causing widespread inflammation and tissue damage.
- **Multiple Sclerosis (MS)**: The immune system attacks the protective covering (myelin) of nerve fibers, disrupting communication between the brain and body.
- **Psoriasis**: Causes skin cells to grow too quickly, resulting in red, scaly patches on the skin.

### 6.2. Allergic and Hypersensitivity Reactions

In these conditions, the immune system overreacts to harmless substances, such as pollen, dust, food, or medications. These reactions are often caused by an antibody called IgE, which triggers inflammation and allergic responses.

- **Allergic Rhinitis (Hay Fever)**: An allergic reaction to pollen, dust, or animal dander that causes sneezing, itching, and watery eyes.
- **Asthma**: Often triggered by allergens, asthma causes inflammation and narrowing of the airways, leading to difficulty breathing.
- **Eczema (Atopic Dermatitis)**: A chronic skin condition characterized by itchy, inflamed skin, often triggered by allergens or irritants.

- **Food Allergies**: Immune response to certain foods (like nuts, shellfish, or dairy), which can range from mild itching and swelling to severe anaphylaxis.
- **Anaphylaxis**: A severe, life-threatening allergic reaction that can lead to shock, difficulty breathing, and loss of consciousness.

### 6.3. Immunodeficiency Disorders

Immunodeficiency disorders occur when part of the immune system is missing or dysfunctional, making the body more susceptible to infections. These disorders can be **primary** (genetic or congenital) or **secondary** (acquired due to other factors like infections or medications).

- **Primary Immunodeficiency Disorders**
    - **Severe Combined Immunodeficiency (SCID)**: A rare, genetic disorder where patients lack functional T and B cells, leading to severe infections.
    - **Common Variable Immunodeficiency (CVID)**: Characterized by low levels of antibodies, making individuals prone to recurrent infections.
    - **Selective IgA Deficiency**: The most common immunodeficiency, where the body lacks IgA antibodies, increasing susceptibility to respiratory and gastrointestinal infections.
- **Secondary Immunodeficiency Disorders**
    - **HIV/AIDS**: Human Immunodeficiency Virus (HIV) targets and destroys T cells, weakening the immune system and making the body vulnerable to infections and certain cancers. Acquired Immunodeficiency Syndrome (AIDS) is the advanced stage of HIV.
    - **Immunosuppression**: Caused by medications (like chemotherapy, corticosteroids, or anti-rejection drugs for organ transplants) that intentionally suppress the immune response to avoid rejection or control autoimmune activity.
    - **Malnutrition and Chronic Illnesses**: Conditions such as diabetes, liver disease, and malnutrition can weaken the immune system.

## Exercises

### Exercise 1: choose the correct answer

- How many types of antibodies are there?

  (a) Five.

  (b) Three.

  (c) Two.

  (d) Four.

- Which of the following protects our body against disease-causing pathogens?

(a) Respiratory system

(b) Immune system

(c) Digestive system

(d) Respiratory system

- B and T cells are produced by stem cells that are formed in:
  a. Bone marrow
  b. The liver
  c. The circulatory system
  d. The spleen
  e. The lymph nodes
- B cells mature in the……….. while T cells mature in the …………
  a. Thymus/bone marrow
  b. Spleen/bone marrow
  c. Bone marrow/ Thymus
  d. Liver/kidneys

# II. The cell

## 1. Definition

It is the basic structural, functional, and biological unit of all living organisms. Cells are the smallest units capable of performing life processes, and every living organism is made up of one or more cells. They carry out all the necessary functions of life, from energy production to reproduction. Cells come in a variety of types, each specialized for different functions, but they all share common features.

The study of cells from its basic structure to the functions of every cell organelle is called Cell Biology.

There are different types of cells depending on the criteria of classification

## 2. Animal cell

It is a type of eukaryotic cell that makes up the tissues and organs of animals. Unlike plant cells, animal cells lack a rigid cell wall and chloroplasts, giving them a flexible structure and an ability to adopt various shapes. Animal cells are specialized for a variety of functions, such as energy production, nutrient absorption, waste removal, and cell communication, enabling complex processes and behaviors within multicellular organisms (Figure 5).

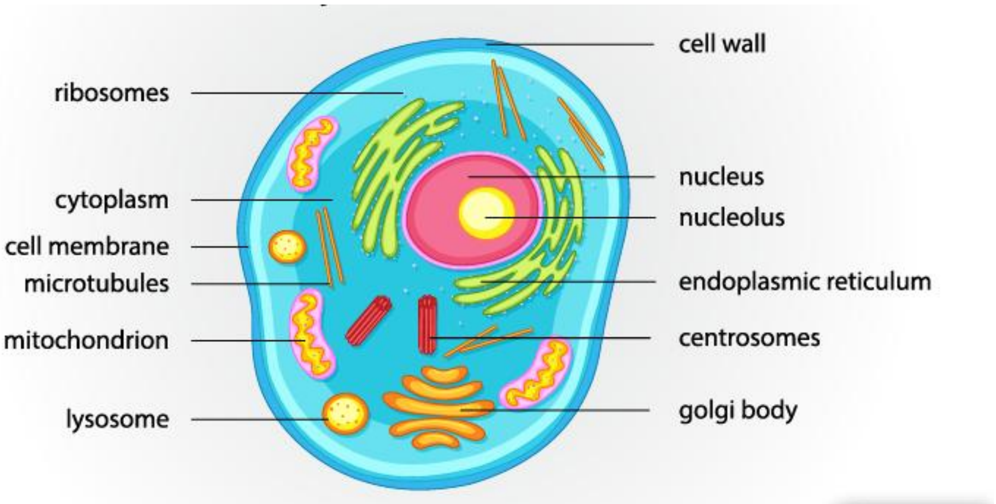



**Figure 5. Animal cell structure.**

## 3.Plant cell

It is a type of eukaryotic cell found in plants, characterized by a rigid cell wall made of cellulose, which provides structural support and shape. Plant cells also contain chloroplasts, the organelles responsible for photosynthesis, allowing them to convert sunlight into energy. The large central vacuole stores water and nutrients and maintains turgor pressure for rigidity. Plant cells work together to form the tissues and organs that support the life and growth of plants (Figure 6).

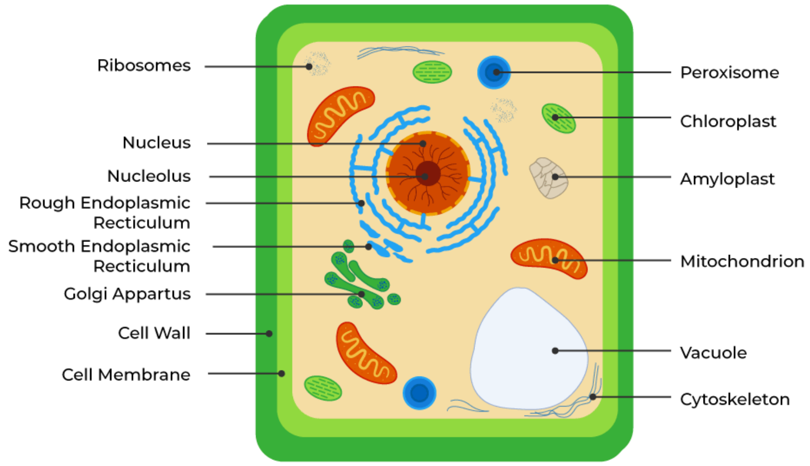



**Figure 6. Plant cell structure.**

Animal and plant cells are both eukaryotic, meaning they have a true nucleus and complex structures. However, they have some key differences as well as similarities (figure 7)

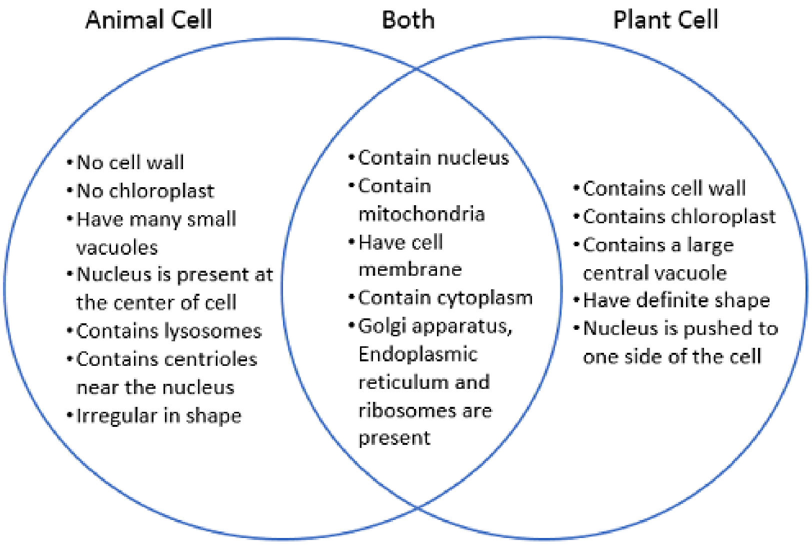



**Figure 7. Venn diagram of key features of animal and plant cells.**

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## 4.Basic Structure of a Cell

Cells can be broadly classified into two main types:

1. **Prokaryotic Cells**: These are simpler cells, found in organisms such as bacteria and archaea. They do not have a defined nucleus or membrane-bound organelles.
2. **Eukaryotic Cells**: These are more complex cells, found in plants, animals, fungi, and protists. They contain a defined nucleus and various membrane-bound organelles.

Despite the differences between prokaryotic and eukaryotic cells, all cells have some basic structural components in common:

## 5.Common Cell Structures

1. **Cell Membrane (Plasma Membrane)**:
   - A flexible, semi-permeable membrane that surrounds the cell, controlling what enters and exits the cell (such as nutrients, gases, and waste products).
   - Made up of a lipid bilayer with embedded proteins, which helps in communication with other cells and the external environment.
2. **Cytoplasm**:

- The gel-like substance inside the cell, between the cell membrane and the nucleus (in eukaryotes). It contains water, salts, and various molecules.
- In prokaryotic cells, the cytoplasm is where all metabolic processes occur since there are no membrane-bound organelles.
- In eukaryotic cells, it contains organelles suspended within it.

3. **Genetic Material (DNA)**
   - **Prokaryotic Cells**: DNA is typically found in a single circular chromosome located in a region called the **nucleoid**, which is not enclosed by a membrane.
   - **Eukaryotic Cells**: DNA is found in the **nucleus**, a membrane-bound organelle, organized into chromosomes.

**6.Organelles in Eukaryotic Cells**

1. **Nucleus**
   - The control center of the cell, containing the cell's genetic material (DNA).
   - It regulates gene expression and cell activity and is surrounded by a double membrane with pores that control the flow of materials in and out.
2. **Mitochondria**
   - Often called the "powerhouses" of the cell, mitochondria are responsible for producing ATP (adenosine triphosphate), the cell's primary energy source.
   - They have their own DNA and are thought to have originated from an ancient symbiotic relationship with a prokaryotic cell.
3. **Endoplasmic Reticulum (ER)**
   - **Rough ER**: Studded with ribosomes, it is involved in protein synthesis and modification.
   - **Smooth ER**: Lacks ribosomes and is involved in lipid synthesis and detoxification.
4. **Golgi Apparatus (Golgi Body)**
   - The Golgi apparatus processes, packages, and distributes proteins and lipids synthesized in the ER to other parts of the cell or outside the cell.
5. **Lysosomes**
   - Contain enzymes that break down waste materials, cellular debris, and foreign substances (like bacteria or viruses).
   - They are involved in the cell's "clean-up" and recycling processes.

6. **Ribosomes**
    - The site of protein synthesis. Ribosomes can be found either floating freely in the cytoplasm or attached to the rough ER.
7. **Cytoskeleton**
    - A network of protein fibers (actin filaments, microtubules, and intermediate filaments) that provide structural support to the cell, help in cell division, and facilitate intracellular transport and movement.
8. **Peroxisomes**
    - Contain enzymes that break down fatty acids and detoxify harmful substances, such as hydrogen peroxide, by converting it into water and oxygen.
9. **Vacuoles**
    - Storage vesicles within the cell. In plant cells, a large central vacuole helps maintain turgor pressure and stores water, nutrients, and waste products.

The figure 8 bellow shows the main components in each cell and the components in common

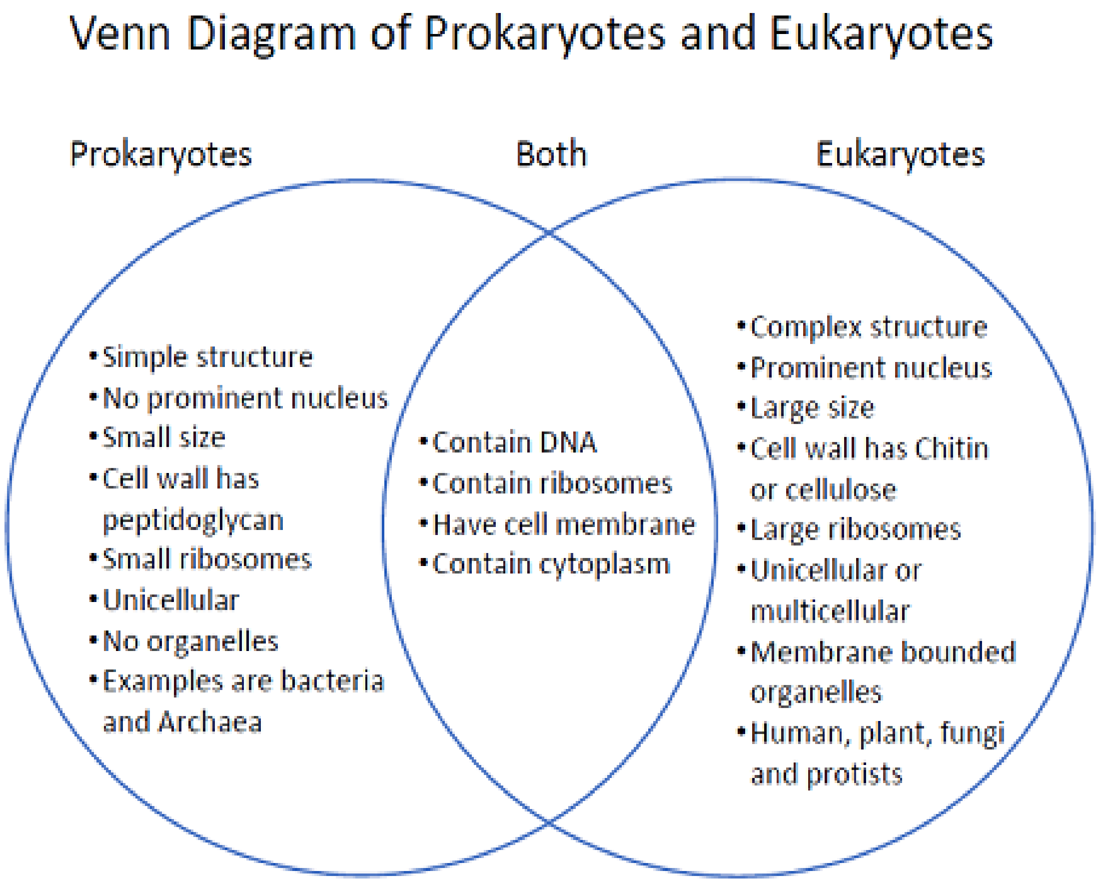


**Figure 8. Venn diagram of prokaryotes and eukaryotes.**

# III.Viruses

## 1. Definition

The name is from a Latin word meaning "slimy liquid" or "poison."

**Virus** is a microscopic infectious agent that is incapable of independent life and can only replicate inside the living cells of a host organism. Viruses are considered to be at the border of living and non-living entities because they cannot carry out the basic processes of life, such as metabolism or reproduction, on their own. Instead, they hijack the machinery of a host cell to replicate and produce new virus particles (virions).

## 2.Structure of a Virus

Viruses have a simple structure (figure 9) that consists of:

1. **Genetic Material**
   - Viruses contain either **DNA** or **RNA** as their genetic material, but not both. The genetic material carries the instructions for making new virus particles.
   - This genetic material can be single-stranded or double-stranded and may be linear or circular, depending on the virus type.
2. **Capsid**
   - The viral genetic material is encased in a protective protein coat called a **capsid**. The capsid is made up of protein subunits called **capsomers** that assemble into a symmetrical structure.
   - The capsid helps protect the viral genome and plays a role in attaching the virus to a host cell.
3. **Envelope (in some viruses)**
   - Some viruses have an **envelope**, which is an outer lipid membrane derived from the host cell's membrane. The envelope may contain viral proteins that assist in recognizing and binding to host cells.
   - Enveloped viruses are more sensitive to environmental conditions (like heat or detergents) compared to non-enveloped viruses.
   - Examples of enveloped viruses include the influenza virus and HIV.

4. **Surface Proteins**
   - Viruses often have specific proteins on their surface that bind to receptors on the host cell's surface. These proteins are crucial for the virus's ability to infect a specific type of host cell. For example, the spike proteins of the SARS-CoV-2 virus bind to receptors on human cells, allowing the virus to enter.

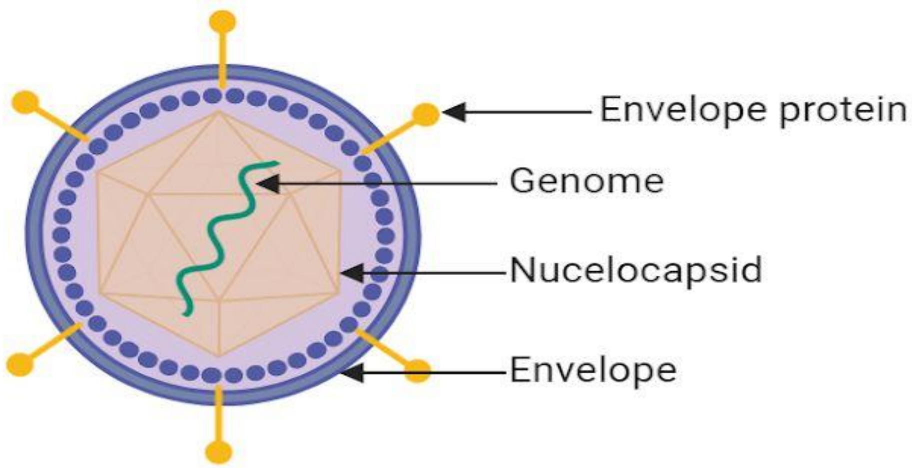


**Figure 9. Simple structure of a virus.**

**3.Types of Viruses**

Viruses can be classified in several ways, including based on their genetic material (DNA or RNA), their shape, and the type of host they infect. Some common types of viruses include:

1. **DNA Viruses**
   - These viruses use DNA as their genetic material. Examples include the **Herpesvirus** (which causes cold sores and chickenpox) and **Adenovirus** (which can cause respiratory infections).
2. **RNA Viruses**
   - These viruses use RNA as their genetic material. Examples include the **Influenza virus**, **HIV**, and **SARS-CoV-2** (which causes COVID-19).
3. **Retroviruses**
   - A subtype of RNA viruses, retroviruses carry an enzyme called **reverse transcriptase** that allows them to convert their RNA into DNA once inside a host cell. This DNA is then integrated into the host's genome. **HIV** is a well-known retrovirus.

4. **Bacteriophages (Phages)**: These are viruses that specifically infect bacteria. Bacteriophages are widely used in research and biotechnology, and they can sometimes be used to target and kill antibiotic-resistant bacteria.

**4.Viral Replication Cycle**

The replication of viruses inside host cells follows several general steps (figure 10):

1. **Attachment**
   - The virus attaches to a specific receptor on the surface of the host cell using its surface proteins.
2. **Penetration**
   - The virus or its genetic material enters the host cell. In enveloped viruses, the virus may fuse with the host cell membrane, releasing its contents into the cell. Non-enveloped viruses may be taken up by endocytosis (cellular ingestion).
3. **Uncoating**
   - The viral genome is released from the capsid and enters the host cell's cytoplasm or nucleus, depending on the type of virus.
4. **Replication and Transcription**
   - The viral genome takes over the host cell's machinery. If it is a DNA virus, the genome is often transported to the nucleus for replication and transcription. RNA viruses typically replicate in the cytoplasm.
   - The host cell's machinery transcribes viral RNA and synthesizes viral proteins necessary for building new virus particles.
5. **Assembly**
   - Newly synthesized viral genomes and proteins are assembled into new viral particles (virions) in the host cell's cytoplasm.
6. **Budding/Release**:
   - New virions are released from the host cell. This can occur by budding (in the case of enveloped viruses) or by lysis (destruction of the host cell, often associated with non-enveloped viruses).
   - The release of new virions can kill or damage the host cell, and the cycle can start again with infection of new host cells.

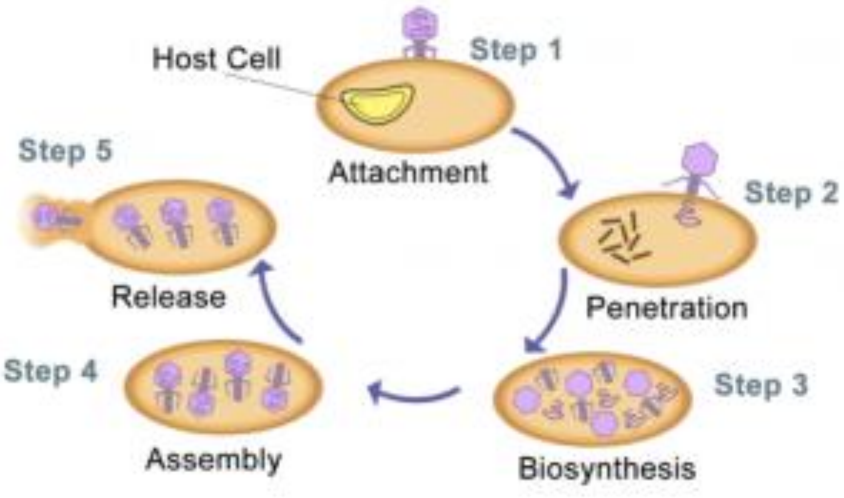


**Figure 10. Main steps of viral replication cycle.**

## 5. Diseases Caused by Viruses

Viruses can cause a wide range of diseases in humans, animals, and plants. Some examples of viral diseases include:

- **Influenza** (flu) caused by the influenza virus.
- **COVID-19** caused by the SARS-CoV-2 virus.
- **Common cold** caused by rhinoviruses and other viruses.
- **HIV/AIDS** caused by the human immunodeficiency virus.
- **Hepatitis** caused by various types of hepatitis viruses (e.g., hepatitis B, C).
- **Herpes infections** caused by herpes simplex virus (HSV).
- **Chickenpox and shingles** caused by varicella-zoster virus.

**Exercises**

**Exercise 1.** Choose the correct answer

- The ___________ is the basic unit of life.

A. organism
B. cell
C. tissue
D. organ

- Which of these do all prokaryotes and eukaryotes share?

  A. nuclear envelope

  B. cell walls

  C. organelles

  D. plasma membrane

**Exercise 2.** Answer the following questions

What are the main differences between eukaryotic cell and prokaryotic cell?

Give examples for each type.

What are the types of viruses?

# Chapter 3. Writing in a scientific style

## 1. What is scientific writing?

It is a form of writing that is used to communicate scientific research, ideas, and findings to a wider audience, including other researchers, professionals, and sometimes the general public. The primary goal of scientific writing is to present information in a clear, concise, and objective manner, enabling readers to understand, evaluate, and potentially build upon the research. It adheres to specific conventions and styles to ensure clarity, reproducibility, and credibility.

## 2.Features of scientific writing

Scientific writing has certain features that help set it apart from other technical documents and styles of writing. These features typically include 6 elements :

### 1. Precision

Precision in scientific literature can take the form of the following writing elements:

- **Objectivity:** A scientific paper takes an objective viewpoint toward the subject, meaning that it doesn't offer the author's opinion. Instead, the author focuses on presenting and analyzing facts.
- **Thoroughness:** Scientific writers offer as many details in their publications as are necessary for their readers to thoroughly understand the subject.
- **Exact language:** A scientific paper minimizes the use of figurative or imaginative language. Scientific writers use words and phrases that convey their literal meaning.

### 2. Clarity

Writers explain any experimentation and its results, using the metric system for measurements to ensure consistency and readability for a worldwide audience. Clarity also helps the writer establish a trusted voice within the scientific community.

### 3. Peer-review

Some scientific documents contain peer-reviewed changes or information directly within the document. Colleagues in the same industry often review one another's work to verify the results of experiments, confirm hypotheses or hold one another accountable for honesty and clarity.

**4. Primary audience**

A scientific document is almost always for a specific audience. Good scientific writing includes information that applies to the audience and is easy to understand. For example, if a pharmaceutical scientist is creating a scientific document for a drug in the approval stage, the primary audience is the drug evaluation board. However, colleagues may also read the document for peer review and consumers may view it for personal interest.

**5. Formal language**

Keeping language formal in scientific writing helps maintain professionalism on behalf of the writer. Formal language also includes proper punctuation and grammar, so check your work before you submit it.

6. **Awareness of existing scientific literature**

A scientific author references the existing studies or experiments related to their findings and explains how their research connects to, revises or builds upon previous knowledge.

**3.Common Types of Scientific Writing:**

1. **Research Papers/Articles**
   - These are detailed accounts of original research, usually published in academic journals. They follow a standardized format that typically includes sections such as the introduction, methods, results, discussion, and conclusion.
2. **Lab Reports**
   - Often written by students or researchers after conducting experiments, lab reports document the process, results, and conclusions of the experiments. They generally follow a similar format to research papers but are often shorter.
3. **Literature Reviews**
   - These summarize and analyze existing research on a specific topic. The goal is to provide a comprehensive overview of what is known, highlight gaps in knowledge, and suggest areas for further research.

4. **Theses/Dissertations**
    - These are extensive research documents written by graduate students (Master's or PhD) that describe their original research in-depth. They typically include a detailed literature review, research methodology, findings, and conclusions.
5. **Scientific Proposals**
    - These are documents that outline a plan for a scientific study or experiment. Proposals include objectives, methodology, expected outcomes, and the potential significance of the research.
6. **Technical Reports**
    - These are written for specific audiences (e.g., engineers, industry professionals, or policymakers) to communicate technical information about research, experiments, or developments

**4.Importance of Scientific Writing**

- **Communication of Knowledge**: Scientific writing allows researchers to share their findings, contributing to the broader scientific community's understanding of a particular topic.
- **Advancement of Science**: Clear, well-documented research facilitates further studies, new experiments, and the development of new technologies.
- **Professional Development**: Writing scientifically helps researchers sharpen their analytical and communication skills, which are crucial for publishing and gaining recognition in their fields.

Scientific writing is an essential skill for anyone involved in research or science-related fields, providing a means of sharing discoveries, collaborating with others, and advancing knowledge.

**5.Common Tips for Effective Scientific Writing**

1. **Use Active Voice**
    - While passive voice is often used in scientific writing, the active voice can make the writing clearer and more direct. For example, "We measured the temperature" instead of "The temperature was measured."
2. **Be Consistent with Terminology**

   - Use the same terms and definitions throughout the paper to avoid confusion. Define technical terms when they first appear.
3. **Avoid Ambiguity**
   - Be specific and clear about methods, results, and interpretations to avoid ambiguity in your conclusions.
4. **Use Figures and Tables Effectively**
   - Visual aids like graphs, tables, and charts can help communicate complex data quickly and clearly. Be sure to explain these figures in the text and label them clearly.
5. **Revise and Edit**
   - Good scientific writing requires multiple revisions. Proofreading for clarity, grammar, and consistency is crucial to producing a polished, professional document.

**6. Exercise.** Which element of the features of scientific writing is not respected in each paragraph? **(4pts)**

a. The method used in this research is ELISA, It is my favorite technique i like it so much.

b. Macrophages.are!!, responsible for the phagosytosis. They eat microbs LOL??.

b. The marked cells are very shiny like the sun in summer day. The values of fluorescence are measured using a spectrophotometer.

d. This scientific paper starts with material and methods, followed by showing the results then comes a general introduction of the topic and finally a conclusion

# Chapter 4. The main parts of a scientific paper

## 1. Structure of a Scientific Paper

The **structure of a scientific paper** typically follows a standardized format, known as **IMRAD**, which stands for **Introduction, Methods, Results, and Discussion**. This structure helps ensure that the research is presented in a logical, clear, and systematic way, allowing readers to easily understand the purpose, approach, findings, and implications of the study.

Here’s a breakdown of the main sections of a scientific paper:

### 1. Title

- The title should clearly and concisely reflect the subject and focus of the research. It often includes the main variables or the research question.
- Example: *"Effects of Light Exposure on Plant Growth in a Controlled Environment."*

### 2. Abstract

- The abstract is a brief summary of the entire paper, typically 150-250 words.
- It should include:
    - **Objective or purpose** of the research
    - **Methods** used to carry out the study
    - **Key results** found
    - **Conclusions** or implications of the study
- The abstract provides readers with a snapshot of what to expect in the paper and helps them quickly determine if the paper is relevant to their interests.

### 3. Introduction

- The introduction provides the **background information** on the research topic, explains the **research question** or **hypothesis**, and outlines the **purpose** of the study.
- It should:
    - Identify the **problem** or gap in knowledge that the study aims to address.
    - Provide a brief **literature review**, summarizing relevant previous research.
    - State the **objective** or hypothesis of the study.

- Discuss the **significance** of the research (why it is important or what contribution it will make).

**Example**

**Structure of Introduction**:

- Background and context
- Statement of the research problem
- Review of relevant literature
- Research question or hypothesis
- Objectives and goals of the study

## 4. Methods (Methodology)

- This section explains how the research was conducted. It describes the **experimental design**, **materials**, **procedures**, and **data analysis methods**.
- It should provide enough detail so that others can **replicate the study**. The methods section can be subdivided based on the complexity of the study (e.g., Participants, Materials, Procedure, Data Analysis).
- Key components include:
  - **Participants**: If applicable, information about the sample size, selection criteria, and demographic characteristics.
  - **Materials and Equipment**: Tools, instruments, or chemicals used in the study.
  - **Procedure**: Step-by-step description of the experimental or research process.
  - **Data Collection**: How data was gathered, including surveys, interviews, experiments, etc.
  - **Data Analysis**: Statistical methods or other analysis techniques used to interpret the data.

## 5. Results

- In the results section, the findings of the research are presented **objectively** and without interpretation.
- It should include:

    - **Data**: Raw data or summarized data in tables, figures, graphs, or charts.
    - **Observations**: Important trends, patterns, or phenomena observed during the research.
    - **Statistical Analysis**: If applicable, the results of statistical tests (e.g., p-values, confidence intervals).
- This section is purely descriptive, without subjective analysis or discussion.

**Example of Results**

- **Table 1**: Growth rates of plants under different light conditions.
- **Figure 1**: Bar graph showing the average plant height over time.
- **Text**: Describes trends or notable observations from the data.

**6. Discussion**

- The discussion section interprets and analyzes the results, explaining what they mean in the context of the research question and existing knowledge.
- It should:
    - **Interpret the results**: What do the findings imply? Are they consistent with the hypothesis or previous studies?
    - **Compare with other research**: Discuss how the results align with or differ from existing literature.
    - **Address limitations**: Acknowledge any weaknesses or limitations of the study (e.g., sample size, methodology, external factors).
    - **Suggest future research**: Propose areas for further investigation based on the findings.
    - **Conclude**: Summarize the key findings and their significance.

**Example of Discussion**

- Interpretation of results
- Comparison with prior research
- Limitations of the study
- Recommendations for future research
- Final conclusions about the study’s significance

**7. Conclusion**

- In some papers, a separate conclusion section may be included. It provides a **summary** of the main findings and the **implications** of the research.
- It may also restate the **research question** and the **contribution** of the study to the field.
- Some papers may include a conclusion within the discussion section.

**8. References (Citations)**

- The references section lists all the **sources** cited in the paper, such as books, journal articles, and other research.
- Each source is formatted according to a specific citation style (e.g., APA, MLA, Chicago, or IEEE). This allows readers to find the original sources for further reading.
- Proper citation ensures **academic integrity** by giving credit to the original authors and allowing others to verify sources.

**9. Acknowledgments (optional)**

- In this section, the author(s) may thank individuals or organizations who contributed to the research but did not qualify for authorship. This could include funding agencies, mentors, or colleagues who provided assistance.

**10. Appendices (optional)**

- Appendices contain **supplementary materials** that are relevant to the study but too detailed or lengthy to include in the main sections (e.g., raw data, additional tables, technical details).
- These should be referred to in the main text, but they are usually placed at the end of the paper.

2. **Exercise.** The paragraphs bellow are parts of a scientific paper. What is the title of each paragraph?

1. In total, 20 foods were cited 62 times. Chocolate was mentioned9 times (1.7%), wheat 7 times (1.3%), milk, eggs and strawberries6 times each (1.1%). Greater detail is provided in Table 2.

2. We sincerely thank all the primary schools' directors and teachers for facilitating the run of the study in the schools in a short time and during the period of exams
3. Allergologie–Pneumologie, Hopital des Enfants, Toulouse Cedex, France and Unite´ INSERM 558, Laboratoire d'epidemiologie, Toulouse Cedex, France
4. This research was partly supported by Faculty of Medicine Siriraj Hospital, Mahidol University, Thailand through grant number R016034012.

# Chapter 5. How to write and publish a scientific paper

The **paper publication process** is a series of steps through which a research paper is submitted, reviewed, revised, and eventually published in a scientific journal. This process ensures the quality, accuracy, and relevance of the research before it reaches the scientific community and broader audiences. Below is a detailed overview of the typical stages involved:

### 1. Preparation of the Manuscript

- **Writing the Paper**: Once the research is completed, the first step is to write the paper following the structure outlined in the previous response (e.g., Title, Abstract, Introduction, Methods, Results, Discussion, References). It's important to write clearly and concisely, ensuring all necessary details are included, and the paper is free from errors.
- **Choosing the Right Journal**: Researchers should select an appropriate journal for their work based on the journal's focus, target audience, impact factor, and scope. The journal's guidelines (e.g., formatting, word count, reference style) should be carefully followed to increase the likelihood of acceptance.
- **Preparing Supplementary Materials**: Some journals may require supplementary files, such as datasets, additional tables or figures, or code (for computational studies).

### 2. Submission

- **Online Submission**: Most journals use online submission systems, where authors submit their manuscripts along with any required supplementary materials. The submission process typically includes uploading:
  - The manuscript file
  - A cover letter (optional, but often required), explaining why the paper is important, how it fits the journal's scope, and confirming no conflicts of interest
  - Any necessary copyright transfer or conflict of interest forms
- **Initial Screening**: After submission, the journal's editorial team may conduct an initial review to ensure that the paper fits within the journal's scope, adheres to the

formatting guidelines, and does not have any major issues (e.g., plagiarism or ethical violations).

### 3. Peer Review Process

The peer review process is the backbone of scientific publishing. It ensures that the paper has been critically evaluated by experts in the field before publication.

- **Assignment to Reviewers**: If the manuscript passes the initial screening, the editor assigns it to **peer reviewers**—experts in the research topic who will evaluate the paper's validity, originality, and significance.
  - Typically, two to four reviewers are chosen. Reviewers are usually anonymous (in **single-blind review**) or both anonymous (in **double-blind review**), meaning that the identity of the authors and reviewers may be concealed from one another.
- **Reviewer Evaluation**: Reviewers assess the paper’s:
  - **Scientific validity**: Are the methods sound? Is the data correctly analyzed?
  - **Clarity**: Is the writing clear and well-structured?
  - **Significance**: Does the study contribute meaningfully to the field?
  - **Ethical considerations**: Are there any ethical issues related to the research, such as human or animal subject approval, data integrity, or conflicts of interest?
  - Reviewers will then provide feedback and make recommendations:
    - **Accept**: The paper is accepted as is.
    - **Minor revisions**: The paper requires small changes or clarifications.
    - **Major revisions**: Substantial revisions are needed before the paper can be considered for publication.
    - **Reject**: The paper is not suitable for publication in that journal.
- **Editorial Decision**: After receiving feedback from the reviewers, the editor decides whether to accept the paper, request revisions, or reject it.

### 4. Revision

- **Addressing Reviewer Comments**: If the paper is not immediately accepted, the author must revise the manuscript based on the reviewers' comments and suggestions. This process often involves:
    - Revising the text to clarify certain points.
    - Conducting additional experiments or analyses if requested.
    - Rewriting sections for better clarity or accuracy.
- **Resubmission**: Once the revisions are made, the manuscript is resubmitted for further review. The editor may send the revised manuscript back to the original reviewers to ensure that the changes adequately address their concerns.
- **Iterative Process**: This process may go through several rounds of revision and review before the paper is accepted for publication.

### 5. Acceptance

- **Final Decision**: If the revisions meet the reviewers' and editor's expectations, the paper is accepted for publication. At this stage, the author may be asked to sign a **copyright transfer agreement** or **licensing agreement**, transferring the rights to the journal for publication.
- **Proofreading**: The manuscript goes through **copyediting** and **typesetting**, where the journal's editorial team checks for grammar, formatting, and consistency. Authors are usually sent a **proof** (a draft version of the article) to approve before final publication. This is the last chance to make minor corrections (e.g., typos, formatting issues).

### 6. Publication

- **Online First/Advance Online Publication**: Many journals publish accepted papers online before they appear in print. This is known as "Online First" or "Advance Online Publication," allowing the research to be accessed by the scientific community immediately, even before the print version is ready.
- **Final Publication**: The paper is assigned a **volume** and **issue number** and is published in the next available issue of the journal, both in print and online.

### 7. Post-Publication

- **Dissemination**: Once published, the paper becomes available to the scientific community and beyond. Researchers may promote their paper on social media, academic networking sites (like ResearchGate), or through academic conferences.
- **Impact**: The paper may be cited by other researchers, contributing to the ongoing scientific dialogue. The **impact factor** or **altmetric scores** may track the paper's influence over time.

### 8. Open Access and Licensing

- Many journals now offer **open-access** options, where the paper is freely available to the public. In some cases, authors may need to pay publication fees to make their paper open access.
- Some journals may have specific licensing agreements, such as **Creative Commons licenses**, which allow authors to retain certain rights while making the paper freely accessible.

### 9.Challenges and Considerations

- **Rejection**: It is common for papers to be rejected, especially in highly competitive journals. Rejection is not necessarily a reflection of the paper's quality; it could be due to factors like journal scope, reviewer feedback, or the paper's relevance at the time.
- **Peer Review Delays**: The peer review process can be lengthy, with delays between submission, revisions, and final decisions, depending on the availability of reviewers and the complexity of the revisions required.

The paper publication process is essential for validating scientific research and ensuring its reliability before being shared with the broader scientific community. Authors must be prepared for a thorough and often lengthy process, but successful publication provides significant visibility and recognition within the scientific field.

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