



## Chapter 1: Introduction to biology

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Earth's most incredible feature is the presence of life. The probability of life existing is so small that it is remarkable to exist at all, yet we take it for granted every day. We are surrounded by life everywhere we turn. Plants grow in our gardens, paddocks and forests; birds sit on our power lines; spiders inhabit the corners of our homes; ants find their way into our kitchens; bacteria help us to digest food in our stomachs and intestines. In many ways, life defines this planet, yet so many of us know so little about it.

Biology is the field of science that investigates all aspects of life. The life of a human being – biology. Learning about microscopic bacteria, algae, or fungi – biology. Studying how rain and sunlight influences the growth of a plant, this is biology. This field of science incorporates anything and everything imaginable that is related to life on Earth.

Through biology, we can gain an understanding of the life that Earth has supported for 4 billion years. From microscopic bacteria in your stomach to active, intelligent animals and giant trees. There is an incredible array of life existing on this planet and learning about it can change the way you see and think about the world that you live in.

Our understanding and knowledge of the living world is continuously changing. There are, however, a few key principles that define how life is organized on Earth. These are:

1. Cells are the basic unit of life.
2. Genes are the basic units for the passing of traits from parent to offspring.
3. Evolution by natural selection is the process that has led to the great diversity of species on Earth.
4. Living things maintain the environment within their cells and bodies.
5. Living things can acquire and transform energy.

Each of these five universal truths of biology describes an important aspect of life on Earth and are the focus of this first chapter. The first three principles identify the importance of cells, genes, and evolution to life on Earth. The last two principles are mostly concerned with how organisms interact with their environment, both internally and externally.

Biology is a massive field of study. This is only the introduction of an introductory book and we will barely scratch the surface of everything there is to learn but we will cover the basics and discuss the information that everyone should know about the life on Earth. It is virtually impossible to know everything about life on Earth but everyone must start somewhere and this is as good a place as any.

Biology can be challenging. With complicated lingo, names, and processes, there are plenty of difficult topics to tackle. I myself dropped biology in my last year of high school because I found math and chemistry easier. In the end, my passion and appreciation of the natural world brought me back to biology. My advice, don't give up, be patient with challenging topics, and work through issues one step at a time because, if you can stick at it, you will be rewarded with an enlightened

understanding of your surroundings and gain a new perspective of the world around you.

## **Glossary**

Biochemistry – a field of biology that studies the molecules and chemical reactions within organisms

DNA – a type of molecule found in cells that contains genetic information. DNA is short for deoxyribonucleic acid

Habitat – the place or environment where an organism or multiple organisms live

Heredity – the passing of genetic material from parents to offspring

Membrane – a thin and pliable boundary, lining, or barrier

Microscopic – only visible with the use of a microscope

Molecule – a group of atoms bonded together

Organism – a living thing

Photosynthesis – the process of making sugars and other nutrients using carbon dioxide, the sun's energy, and water

Physiology – a field of biology that studies how organisms function

Respiration – the exchange of gases between an organism and the environment

## **Life is Earth's greatest phenomenon**

Of the trillions of planets known to science, only one is so far known to support life, Earth. Life makes Earth unique within our solar system and probably our galaxy. Chances are that there are other life-supporting planets in the universe but they are incredibly rare and the presence of life on Earth makes this planet very special.

Living things are known as organisms. To be considered 'alive', an entity must be able to perform seven processes referred to as the seven processes of life. The ability to perform these seven processes is what separates organisms

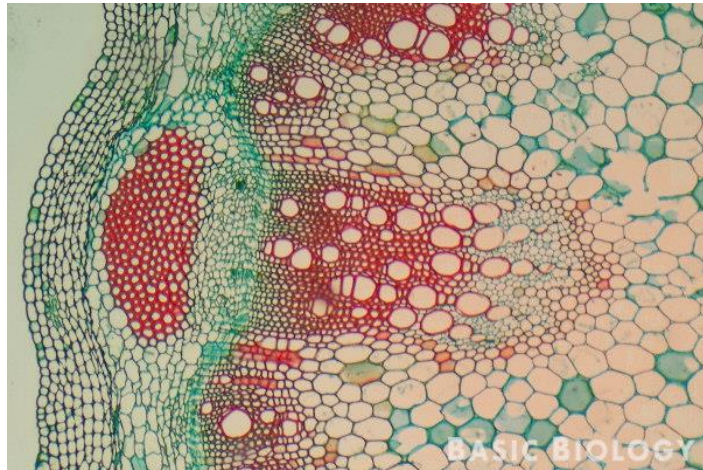


from non-living objects such as water and rocks. The seven processes are movement, respiration, sensitivity, growth, reproduction, the release of wastes (i.e. excretion), and the consumption of food (nutrition). Another collective name commonly used for the seven processes of life is MRS GREN, an acronym of the first letters of each process.

Life has evolved into an incredible array of shapes and forms. Humans belong to the most advanced group of organisms, the animals. Other higher-level organisms include plants and fungi. More primitive life forms include microscopic groups such as bacteria and archaea. Viruses are an unusual group because they are unable to reproduce without the use of a host. As such, viruses are classed by some biologists to be living and by others to be not.

## **Cells are the basic unit of life**

A single cell has the potential to sustain life and is the simplest structure capable of doing so. Many living things, such as bacteria, yeasts, algae, and archaea, live their entire lives as a single cell. Animals, including humans,



begin their lives as a single cell which reproduces into two cells. Those two cells reproduce into four cells, then eight cells, and so on until incredibly intricate animals are created from trillions of microscopic cells that can all be traced back to that single original cell.

Cells are typically divided into two main categories: prokaryotic cells and eukaryotic cells. Prokaryotic cells are found in two groups of microscopic organisms (bacteria and archaea) and have never evolved into multi-celled organisms. Eukaryotic cells are found in more advanced organisms such as animals, plants, and fungi. The main difference between the two types of cells is that eukaryotic cells have a nucleus and organelles. The nucleus of a eukaryotic cell contains the cell's DNA. Organelles are specialized structures within eukaryotic cells that perform specific functions such as photosynthesis and protein production. In prokaryotic cells, the DNA isn't encapsulated within a nucleus and organelles are absent.

## **Genes are the basic units for the passing of traits from parents to offspring**

Genes are the basic unit for heredity. A single gene provides the genetic information for the expression of a single trait. A complete set of genes provides all the necessary information to keep an organism functioning and alive. When organisms

reproduce, the information from genes is passed from parent to offspring. The genes that are passed from parent to offspring then provide the information for cells to keep the new organism alive. Genes are the reason why children look similar to their parents.

## **Evolution by natural selection explains the great diversity of species on Earth**

The traits of an organism determine how well they are adapted to certain environmental conditions. Different traits provide advantages in some habitats and disadvantages in other habitats. Traits that provide advantages make an individual better adapted to their environment. Natural selection is a process that occurs because individuals that are better adapted to their environment have a greater chance of surviving and reproducing. Because traits are passed from parents to offspring and individuals with beneficial traits are more likely to reproduce, beneficial traits spread through populations over multiple generations. Over time, this gradual change in traits in different environments due to natural selection leads to the evolution of new species.

With the help of genetic mutations, evolution has driven the development of species capable of thriving in almost any environment on Earth. Evolution is visible in all aspects of life and the collection of evidence supporting the theory of evolution has become undeniable. Evolution by natural selection has been sculpting life for over 4 billion years and is the cornerstone of modern biology.

## **Living things maintain the environment within their cells and bodies**

Homeostasis is the act of maintaining the internal environment within an organism's cells. Cells function most efficiently in a certain range of conditions and as the environment changes around them, they constantly work to keep their internal

environment in an optimal condition. Cells are working to maintain factors such as the concentrations of water, salt, sugars, the temperature within the cell, and oxygen concentrations.

## **Living things can acquire and transform energy**

The final letter of MRS GREN stands for nutrition and all living things require nutrients to survive. Organisms collect nutrients from the environment and use the energy provided by nutrients to fuel the processes of life such as movement, growth, and reproduction. For organisms to use the energy of the nutrients they collect, however, they are required to transform the energy into usable cellular energy. When organisms collect nutrients from the environment, the energy within them is typically stored in large molecules. Organisms breakdown large molecules, through processes such as digestion and respiration, and transform the energy into a form that is usable by their cells.



## **Fields of biology**

Biology is a huge field of science. Considering that there are millions of different animal species, hundreds of thousands of plant species, and millions of species of microorganisms, it is understandable that biology is split into various different fields of study. Many have been around for hundreds of years whilst others are far newer and are often developing very rapidly with new technology.

Biology can broadly be separated into three areas of study:

1. Research into the microscopic world of life
2. The study of large organisms
3. The study of the interactions between organisms and their environment

Research into the microscopic world of life includes studying topics such as cells, genetics, microorganisms, physiology, biochemistry. Many biologists focus their study on large organisms like plants and animals. The study of animals is known as zoology and the study of plants is known as botany. The life of an organism is greatly influenced by other organisms and the environment that it lives in. Many biologists study these interactions in a field of study known as ecology.

Areas of study such as evolution, ecology, and genetics are themselves very broad topics and contain many specializations within each field. For example, an ecologist, who looks at how organisms interact with each other and the environment, might specialize in marine ecology, population ecology, plant ecology, or freshwater ecology.

As biology is such a broad field of study, the work from one biologist to another may be completely different. An agriculturalist, for example, who is interested in the production of crops, will focus on very different topics to that of an ethologist, who studies the behavior of animals. To be a well-rounded biologist, however, it is a good idea to have an understanding of the basics of the broad fields within biology.