

JUNIOR SECONDARY LEVEL SCIENCE - BIOLOGY



MODULE 1 – Introduction to Biology and the Classification of Living Things

Unit 1 The Science of Life

Unit 2 Biological Skills

MODULE 2 – The Living Cell

Unit 1 Cell Structure and Organisation

Unit 2 Levels of Organisation

Unit 3 Compounds of Life

MODULE 3 – Energy and Life

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Unit 2 Respiration

MODULE 4 – Nutrition and Digestion

Unit 1 Nutrition in Living Organisms

Unit 2 Human Digestive System

MODULE 5 – Transport

Unit 1 Transport in Plants

Unit 2 Transport in Humans

MODULE 6 – Support, Movement and Control

Unit 1 Support and Movement

Unit 2 Hormonal and Nervous Control

Unit 3 Control and Regulation

MODULE 7 – Continuity of Life

Unit 1 Reproduction

MODULE 8 – Organisms and the Environment

Unit 1 Ecological Principles

Unit 2 Population Growth and Regulation

Unit 3 Human Influence on the Environment

INTRODUCTION TO BIOLOGY AND THE CLASSIFICATION OF LIVING THINGS

MODULE INTRODUCTION

Biology is the study of life. We study Biology to understand our own body, to know how it functions. We interact with the living and non-living components around us. Biology helps us to understand all this so that we respect our environment and ourselves. We can also make maximum use of all our resources most efficiently.

Look at all the living organisms around you. All of them have certain common characteristics. There is such a wide variety of living organisms on earth that they have been grouped together according to common features they possess. This is ***classification***.

Biology is a science. We therefore need to know how to use biological apparatuses safely, record observations and interpret them properly.

MODULE OBJECTIVES

At the end of this Module, you should be able to

- identify living things
- define Biology
- describe the characteristics of organisms
- explain the scientific method
- describe a controlled experiment.

UNIT 1

THE SCIENCE OF LIFE

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UNIT 1

THE SCIENCE OF LIFE

INTRODUCTION

Biology is the study of life. Look around you. Can you distinguish between the **living** and **non-living** things? I'm sure you can. This is because the living organisms have certain characteristics which non-living things don't possess.

In this Unit, you will learn about their characteristics and the way in which we study them.

OBJECTIVES

At the end of this Unit you should be able to:

- identify living things
- describe the **characteristics** of living things
- solve a biological problem
- explain a **variable**, **dependent variable** and an **independent variable**
- assess the importance of a controlled experiment
- design and carry out an experiment.

1.0 WHAT IS BIOLOGY?

The term biology comes from Greek-Bios: life, Logos: study. Biology therefore means the study of living things or organisms.

We can now proceed with the following investigation. It will assist you with deciding whether something is living or not. This issue is taken up in 1.1.



INVESTIGATION 1: Identifying living things

<p>For each investigation you will require the materials indicated.</p>	<p>Materials needed:</p> <ul style="list-style-type: none"> • Paper • Pen <p>Method:</p> <p><i>Take a walk outside and make a list of 10 objects you consider as living things. Now make a table as shown below to give the reasons why you considered the objects as living things.</i></p> <p>Here is an example.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: center;">Name of Object</th> <th style="text-align: center;">Reason</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1. Dog</td> <td style="text-align: center;">It feeds, runs, barks</td> </tr> <tr> <td style="text-align: center;">2.</td> <td></td> </tr> <tr> <td style="text-align: center;">3.</td> <td></td> </tr> <tr> <td style="text-align: center;">4.</td> <td></td> </tr> <tr> <td style="text-align: center;">5.</td> <td></td> </tr> <tr> <td style="text-align: center;">6.</td> <td></td> </tr> <tr> <td style="text-align: center;">7.</td> <td></td> </tr> <tr> <td style="text-align: center;">8.</td> <td></td> </tr> <tr> <td style="text-align: center;">9.</td> <td></td> </tr> <tr> <td style="text-align: center;">10.</td> <td></td> </tr> </tbody> </table>	Name of Object	Reason	1. Dog	It feeds, runs, barks	2.		3.		4.		5.		6.		7.		8.		9.		10.	
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<p>You will have to record your answers in the space provided.</p>																							

I'm sure you have given many similar reasons for each of the living things you noticed i.e., that is, they move about, they rely on ready-made food, they sing, chirp, grow bigger in size, etc.

Living things have certain features that are common to all of them. These are called the ***characteristics of life***.

Let's now turn to them.

1.1 CHARACTERISTICS OF LIVING ORGANISMS

1.1.1 NUTRITION

Nutrition is the way in which living organisms obtain their food.

Food:

- provides energy for daily activities,
- supplies materials for growth and
- keeps the body healthy.

Animals and plants feed in different ways. You obtain your food from other animals or from plants.

Plants are different. They make their own food by a process called ***photosynthesis***.

1.1.2 RESPIRATION

During respiration, living things break down food substances in the presence of oxygen to release energy. Carbon dioxide and water are also produced.

Respiration: Food + Oxygen → Energy + Carbon Dioxide + Water

The organisms use this energy to move, grow and repair worn-out tissues.

1.1.3 EXCRETION

Excretion is the removal of waste products from the body. If these are allowed to accumulate in the body they become poisonous and can kill.

Let us have a look at the waste substances that your body produces:

1. Carbon Dioxide

It is removed through the lungs.

2. Urea

It is removed through the kidneys in the form of urine.

A little urea is also excreted through the skin as sweat.

3. Salts and Water

These are excreted in urine and sweat.

1.1.4 IRRITABILITY (OR SENSITIVITY)

It is the process by which organisms sense and feel changes in their environment and respond to them.

Let's illustrate this with something very simple which you must have experienced time and time again. What happens to you when you see or smell food? Your mouth starts to water, doesn't it? In other words, you detect changes in your environment through your sense organs.

Plants don't have sense organs but they too can respond to stimuli. For example, the shoot of the plant grows towards light.

1.1.5 GROWTH

Growth is the increase in size and development of an organism. Animals stop growing once they reach their adult size while plants keep on growing all through their life.

1.1.6 MOVEMENT


Movement is easy to see in animals. You can move from one place to another, or you can move only your body parts like your arms or your legs. Most animals can move in the same way.

Movement in plants however, is not very obvious. Only part of a plant can move.

For example, if you place a potted plant near a window, after a few days you'll observe that it has grown and bent towards the light. Try it for yourself to confirm what we've said.

1.1.7 REPRODUCTION

Living things produce young ones similar to themselves. Both animals and plants reproduce. Animals lay eggs or have babies. Many plants produce seeds which grow into new plants.

 Before proceeding further, complete the following activity.

ACTIVITY 1

1. *Define the term Biology.*

.....

2. *List three functions of food in the bodies of living organisms.*

.....

3. *Give two ways that urea is excreted from the body.*

.....

4. *What are the differences in movement between animals and plants?*

.....

You will find the answers at the end of the Module.

1.2 BIOLOGY AS A SCIENCE

Any biological problem that arises must be solved following a scientific process. Scientists first observe things and then ask questions about them. Then, to answer these questions they must use the scientific method.

1.2.1 THE SCIENTIFIC METHOD

Now we will have a look at the steps involved in the scientific method.

These are as follows:

- Making observations.
- Coming up with a **Hypothesis***.
- Designing and carrying out an experiment.
- Recording the results.
- Deducing from the results whether the experiment supports or rejects the hypothesis.

NOTE: *Don't worry too much about the term Hypothesis now. It will become clearer soon.*

I will now illustrate the above with an example: - *You must have observed that seeds germinate only in wet soil. So you may put forward a hypothesis that seeds need water for germination.*

1.2.2 INDUCTION - DEDUCTION

The scientific method is not complete without two important concepts i.e.

- Induction and
- Deduction

Let's now differentiate between the two:

Induction is a reasoning process by which we start from particular experiences and proceed to generalisation. It is the basis of common sense on which we act. It is not a certainty.

Deduction is a process of reasoning by which we draw conclusions by logical inference from given assumptions.

Progress in science is due to these two combined together.

Let us make this clearer.

Induction is used together with deduction to make scientific discoveries. By using induction, scientists obtain general theories. From these theories, they then deduce new predictions. These predictions are then tested by observations and experiments.

1.2.3 DOING THE EXPERIMENT

To prove your hypothesis you will have to design an experiment.


Take some seeds and sow them in a pot containing dry soil. Then you water the soil daily and observe if the seeds germinate. If they do, you conclude that water is required for germination. However, your experiment needs a **control**.

A control provides a standard with which to compare the result of your experiment.

In this experiment, your control will be another batch of seeds which you'll sow in dry soil without watering.

It is very important that both groups of seeds are kept in the same conditions except for the water they receive or not. That is, all the other experimental conditions or **variables** of the experiment must be constant.

We shall now look at variables in slightly more detail.

 *Before proceeding further, complete the following activity.*

ACTIVITY 2

1. *List five steps which are involved in the scientific method:*

.....
.....
.....
.....
.....

2. *Complete the following sentences:*

(a) *Induction is a.....*

.....

(b) *Deduction is a.....*

.....

3. *Why is a control important to your experiment?*

.....

.....

You will find the answers at the end of the Module.

1.3 VARIABLE

A **variable** is a factor which may change during an experiment. Examples of variables in your experiment are light intensity and temperature.

A variable can be a dependent **variable** or an **independent variable**.

1.3.1 DEPENDENT VARIABLE

The **dependent variable** is what you measure during an experiment, the readings depend on something which you are varying.

1.3.2 INDEPENDENT VARIABLE

The **independent variable** is what you control and vary during the experiment.

Such an experiment where you control the conditions is called a **controlled experiment**. This is important because then you are making sure that no other factor is influencing your results.

Result

Let us come back to our experiment. After a few days, you will observe which batch of seeds has germinated. This will be your result.

 **Before proceeding further, complete the following activity.**

ACTIVITY 3

1. *What is a variable?*

2. *Mention two types of variables:*

3. *Complete the following:*
The values of a depend on something which you vary during an experiment.
4. *What is an independent variable?*

You will find the answers at the end of the Module.

1.4 INTERPRETATION AND CONCLUSION

Now you will see whether your results support your hypothesis or reject it.

For example, let us imagine the results of your experiment as follows: the batch of seeds, which received water germinated, and the batch, which did not receive water, failed to germinate.

This result therefore shows that water is required for germination. This supports your hypothesis.

1.5 HYPOTHESIS - WHAT IS IT?

We can say that a hypothesis is a trial idea made in science which needs further investigation. During and after the investigation, we can either confirm or reject a hypothesis. In fact a hypothesis is an intelligent or educated guess.

Every scientific discovery begins with a hypothesis. Let's illustrate this with an example:

A scientist name John Priestley put forward the following hypothesis while working with an unknown gas. He got the idea that the gas would make a glowing candle burn brighter. It did when he tested his idea. This gas was later named oxygen.

We can now proceed with the following investigation.



INVESTIGATION 2

<p>You will have to record your answers in the space provided.</p>	<p>Now design and carry out a controlled experiment.</p> <p><i>Write up an experiment using the example we have just considered on seed germination. This must include the following headings:</i></p> <p>1. Aim of experiment</p> <p><i>Why did you do the experiment?</i></p> <p>.....</p> <p>.....</p> <p>.....</p> <p>2. Procedure</p> <p><i>What did you do?</i></p> <p><i>Give your method step by step and remember to include your control</i></p> <p>.....</p> <p>.....</p> <p>.....</p> <p>3. Results</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>
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	<p>4. Interpretation and Conclusion</p> <p><i>After designing your experiment, carry it out!</i></p> <p><i>Make observations daily, record them and state your conclusions.</i></p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>
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1.6 A THEORY

J.Priestley was able to prove his hypothesis using a very direct method. But it's not always as clear cut as that. Scientists sometimes have to rely on the accumulation of indirect evidence to give the hypothesis its acceptance. As more and more indirect evidence becomes available, the hypothesis gains increasing acceptance. We can say it gains a promotion to become a **theory**.

A theory is therefore a set of consistent scientific assumptions supported by evidence.



POINTS TO REMEMBER

- Biology is the study of life.
- The characteristics of living things are nutrition, excretion, respiration, irritability, growth, movement and reproduction.
- The scientific method used is to solve biological problems.
- The scientific method involves the following steps:
 - Making observations
 - Stating a hypothesis
 - Doing experiments
 - Interpreting the results
 - Concluding whether we have proved the hypothesis or not.
- A variable is a factor which can change during an experiment.
- The values of a dependent variable depend on something which you vary during an experiment.
- An independent variable is a factor which you control and vary during your experiment.
- Experiments must be controlled to get reliable results.

UNIT 2

BIOLOGICAL SKILLS

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