



AN ROINN OIDEACHAIS  
AGUS EOLAÍOCHTA

# BIOLOGY

**Leaving Certificate**

Ordinary Level and Higher Level

# GUIDELINES FOR TEACHERS

## **THESE GUIDELINES**

### **INTRODUCTION**

*practical approach*

### **SYLLABUS STRUCTURE**

*Chemistry content*

### **DIFFERENTIATION**

*between Higher level and  
Ordinary level*

- *range of topics*
- *Depth of treatment*

### **TEACHING METHODS**

*class preparation material*

### **RESOURCES**

- *laboratory equipment*
- *chemicals*

### **TIMETABLING**

*contact time  
class periods*

### **MIXED ABILITY TEACHING**

*team work*

**DART**

### **PLUS**

*helpful hints,  
real samples,  
lots, lots more...*

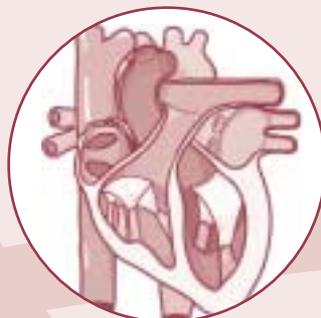
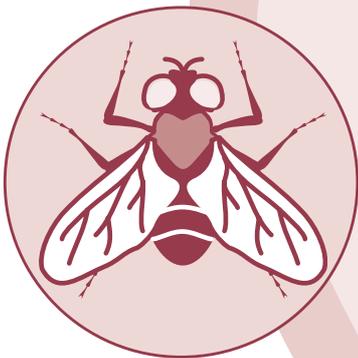
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# Introduction

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# 1. INTRODUCTION

*This material is designed to help the teacher in a very practical manner to work through the syllabus.*

The former Leaving Certificate Biology syllabus was introduced in 1975 and first examined in 1977. In the intervening years many changes have occurred in the knowledge and application of biology and in the needs of new cohorts of students.

This revised syllabus has been developed in response to:

- new knowledge, understanding and application of biology
- comparative studies of world syllabi
- submissions from and consultations with individuals, relevant organisations and Government Departments
- the terms of reference provided by the National Council for Curriculum and Assessment.

The Course Committee noted in particular a number of key issues in the development of this syllabus including:

- the need to give a greater vocational orientation to the curriculum
- the needs, not only of students who proceed to higher education but also of those who enter the workforce directly on completion of the Leaving Certificate
- the particular needs of those students who present at Ordinary level

- the perception that the previous Biology course was too long and too broad
- the necessity to modernise Biology e.g. the inclusion of contemporary biological issues and technology and the highlighting of its scientific nature
- the need to reduce the overlap in content between the Biology and the Agricultural Science syllabi.

The aims and objectives of the syllabus provide a clear specification of its ethos. Particular emphasis is placed on the following components which are integrated throughout the syllabus in percentage proportions as indicated in brackets:

- science for the enquiring mind or pure science (70%)
- science for action, application and its interface with technology (22.5%)
- science which is concerned with issues - political, social and economic - of concern to citizens (7.5%)

In addition the syllabus emphasises

- skill attainment, with particular reference to practical activities
- health and safety issues.

# 2. SYLLABUS STRUCTURE

The syllabus consists of three units:

- Unit One:           Biology - The Study of Life**
- Unit Two:           The Cell**
- Unit Three:         The Organism**

The syllabus is presented in four columns:

- Sub-unit and Topic
- Depth of Treatment
- Contemporary Issues and Technology
- Practical Activities.

### 3. CHEMISTRY CONTENT

The content of modern biology is increasingly biochemical. A prior knowledge of basic chemistry and knowledge of the topics listed below are useful in the study of biology.

1. Composition of matter, atoms and ions.
2. Isotopes and radioisotopes.
3. Electronic configuration of atoms and ions.
4. Bonding - ionic, covalent and hydrogen bonds.
5. Acids, bases, pH and neutralisation.
6. Oxidation and reduction.
7. Water as a solvent and its role in hydration, dehydration reactions and hydrolysis.
8. The notion of hydrophilic substances and hydrophobic substances. The nature of lipids as hydrophobic substances. The hydrophilic and hydrophobic nature of proteins.
9. For Higher level students an appreciation of the peptide bond, three dimensional nature of proteins - a linear molecule folded up to give very different three dimensional shapes.

### 4. DIFFERENTIATION BETWEEN HIGHER LEVEL AND ORDINARY LEVEL

The syllabus is offered at two levels: Ordinary and Higher.

The syllabus distinguishes Ordinary level from Higher level by

- (i) Range of topics: The Higher level incorporates the Ordinary level. At Higher level an extended range of topics is required.
- (ii) Depth of treatment: The Ordinary level course provides an overview of biology and its application to everyday life. At Higher level a deeper, more quantitative treatment of biology is required.

The differences are stated throughout the syllabus and throughout these teacher guidelines in preambles to each sub-unit, depth of treatment and assessment statements. Orientation of the Ordinary level towards a more concrete and applied approach is enhanced by the inclusion of non-prescriptive material in these guidelines. The equivalent of 45 class periods has been allocated at Ordinary level to this non-prescriptive material.

### 5. TEACHING METHODS

The sequence in which the syllabus is presented does not imply any particular order of teaching. Teaching strategies should promote the aims and objectives of the syllabus. One of the primary objectives in the production of these detailed guidelines is to allow

the teaching of the course to be syllabus led rather than textbook led. Teachers are strongly advised to familiarise themselves with the syllabus content and these guidelines so as to promote professional teaching methods.

Ideally teachers teach biology from an interest in and mastery of the subject. Their proficiency in the teaching and learning process should ensure that textbooks are used as a reference, resource and study material only.

## 6. RESOURCES

The term 'resources' covers both the laboratory equipment and chemicals needed to teach the syllabus and any other materials e.g. books, videos, software, wall charts and slides that support the teaching of biology. The revised syllabus has some resource implications even where a school is fully equipped to teach the former syllabus. Laboratory access is essential for the full implementation of

the syllabus. The laboratory equipment required for student experiments and teacher demonstrations is very similar. Normal maintenance of such equipment and replacement, where necessary, will be required. Resource requirements for the prescribed activities of the course are listed in the Resources Section of these guidelines (Section Four).

## 7. TIMETABLING

The syllabus is designed to be taught in 180 hours of class contact time (the equivalent of 270 class periods of 40 minutes duration or five class periods per week, to include at least one double period). A specific

number of class periods for each subsection of the syllabus is recommended. This specification is intended only to indicate the approximate amount of time needed. Teachers are encouraged to exercise

discretion when allocating time periods to the various elements of the syllabus. This includes, at Ordinary level, the equivalent of 45 class periods of non-prescriptive material which is included in these guidelines.

## 8. MIXED-ABILITY TEACHING

The reality of most classrooms is that they contain students of varying ability. Teamwork as referred to in the aims of the syllabus allows for different learning outcomes, which are vital in mixed-ability classes.

To cater for this reality these guidelines suggest both a differentiated and undifferentiated task approach to classroom organisation in group-work or pair-work.

### **Differentiated:**

Students of similar abilities and aptitudes could be allocated tasks to work on in pairs. Such tasks, for Ordinary level students in particular, are suggested throughout these guidelines. This would allow them to work at their own pace. Another pair or group could work simultaneously at a Higher level topic or task. Through whole class activities resultant information could be pooled in a co-operative team-spirited way.

### **Undifferentiated:**

Alternatively students of very different abilities could work in pairs. The student of higher ability helps the student of lower ability.

Directed Activities Relating to Text (DART) may also be used to enhance their study of topics.

## 9. CONCLUSION

In this section a brief overview of the syllabus has been given and the implications for the teaching of the syllabus are drawn out. The syllabus aims to contribute to the students' general education; to encourage in students an attitude of scientific enquiry, of curiosity and self-discovery; to develop an understanding of biological facts

and principles; to enhance an interest in and develop an appreciation of the nature and diversity of living organisms; to create an awareness of the application of knowledge of biology to modern society and to develop in students an ability to make informed evaluations about contemporary biological issues.

# Section one

## class preparation material for

### unit one: biology – the study of life



**T**eachers are reminded, prior to reading this section, that the syllabus is the definitive prescribed material.

It is hoped that this section will help promote professional teaching methods as distinct from textbook methodology. This section could be used as a class guide through the syllabus. It is not intended to be a text for students as it contains both non-prescribed and prescribed material.

To assist and support you in class preparation:

- The preamble to each subunit gives a broad insight into the central ideas of the syllabus depth of treatment.
- The suggested 'texted' and practical detail should be used as suggestions to support you in:

**Depth of prescribed and non-prescribed material you wish to use.**

**Methodology practice to include practical activities.**

**Suggested resources.**

**Time parameters.**

Special attention in class preparation should be given to the use of **5 class periods** for non-prescriptive material at Ordinary level.

You may wish to use the non-prescribed activities and resources marked by an asterisk \* or use other materials such as DART.

# PREAMBLE TO SUB-UNIT 1.1: THE SCIENTIFIC METHOD

1. Biologists seek solutions to problems that relate to the living world and employ processes of science that lead to the discovery of new knowledge.
2. The processes of science can be termed the scientific method. Even though the scientific method is quite variable, it is possible to point out certain steps that characterise the scientific method: making observations, formulating hypotheses to explain the observations, testing the validity of the hypotheses, coming to a conclusion.
3. A good experiment requires a sufficiently large sample. Typically it is controlled so that one variable at a time is assessed.
4. The observations, hypotheses and experiments are documented in accessible sources where all can examine them. These results are expected to be repeatable, that is, to be obtained by anyone following the same procedure.
5. It is the aim of enquiry to formulate theories and principles to explain the existence, development and functions of the natural world.
6. The value of the scientific method is limited by (a) the extent of our own basic knowledge, (b) the basis of investigation, (c) our ability to interpret results, (d) its application to the natural world that is always subject to change, and (e) accidental discoveries.
7. The scientific method may be used in areas that raise ethical issues. In recent years such contentious issues have been mainly related to the origin of life, human reproduction, medicine and developments in biotechnology.

## 1.1 THE SCIENTIFIC METHOD / SUGGESTED CLASS PERIODS: 2 0L, 2 HL

### 1.1.1 BIOLOGY

#### DEPTH OF TREATMENT

**D**efine “biology”.  
Give specific examples of areas of study encompassed by the term "biology".

### 1.1.2 SCIENTIFIC METHOD

#### DEPTH OF TREATMENT

**T**he scientific method involves making observations, formulating an hypothesis, designing a controlled experiment, collecting and interpreting data, reaching conclusions, placement of conclusions in the context of existing knowledge, reporting and publishing results, development of theory and principle.

#### ACTIVITIES

The process of the scientific method should be developed as much as possible in all activities throughout the course.

### 1.1.3 EXPERIMENTATION

#### DEPTH OF TREATMENT

**A** full understanding of the principle of experimentation to include: careful planning and design, safety of procedure, necessity and selection of an experimental control, explaining why sample size, random selection, replicates and double-blind testing are important.



#### *Contemporary Issues & Technology*

*Limitations of the scientific method: the extent of our basic knowledge, the basis of investigation, our ability to interpret results, application to the natural world in a state of change, accidental discovery.*

## PREAMBLE TO SUB-UNIT 1.2: THE CHARACTERISTICS OF LIFE

- All living organisms share a functional need for metabolism and continuity.
- The organism's way of fulfilling this functional need allows us to identify certain common characteristics which we classify as the characteristics of life.
- All living organisms share the following:
  - organisation
  - nutrition
  - excretion
  - response
  - reproduction
- No one characteristic is enough to qualify something as being "alive". Life involves the interaction of these characteristics. A completely satisfactory and universally acceptable definition of life has not yet been formulated.

### 1.2 THE CHARACTERISTICS OF LIFE / SUGGESTED CLASS PERIODS: 3 OL, 3 HL

#### 1.2.1 A SEARCH FOR A DEFINITION OF LIFE

##### DEPTH OF TREATMENT

**G**eneral outline of the diversity of living organisms about us.

Introduce the terms

**metabolism**

**continuity.**

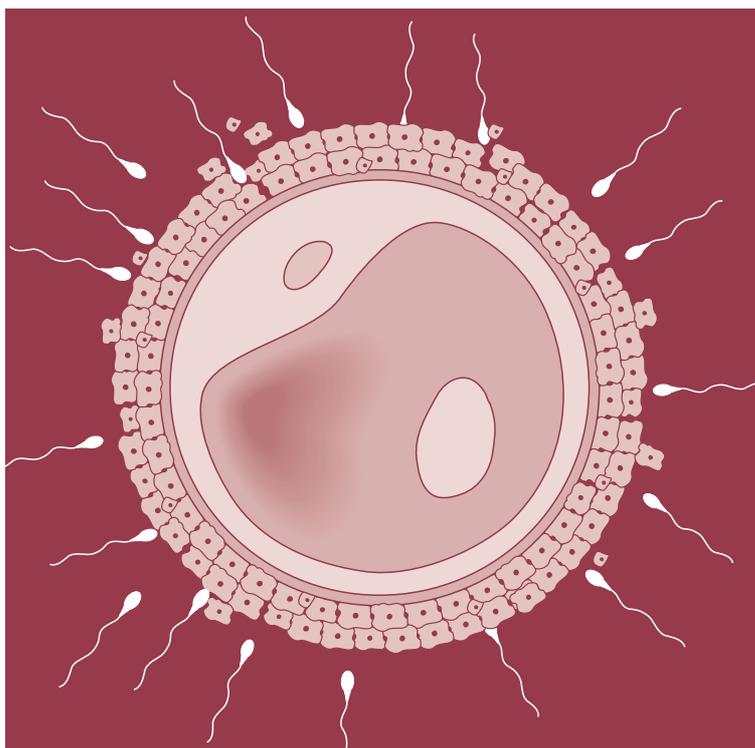
##### ACTIVITIES

\*Students are brought to an ecosystem and asked to list the common behavioural features, visible and non-visible, that identify with the term 'living'.

#### 1.2.2 DEFINITION OF LIFE

##### DEPTH OF TREATMENT

**D**efinition and concept of “**life**”.



## 1.2.3 CHARACTERISTICS OF LIFE

### DEPTH OF TREATMENT

The characteristics of life: defined as the common characteristic ways of fulfilling the organism's functional need for metabolism and continuity identified by the fundamental principles and interactions of:

**organisation**  
**nutrition**  
**excretion**  
**response**  
**reproduction**

#### Organisation

The complex organisation of living organisms begins with the cell – even though the cell can be broken down into smaller structures such as molecules, it is the cell that possesses its characteristics not the parts.

Definition.

Develop cell organisation to the level of tissues, organs, organ systems, individuals, populations (details of which will follow in later units).

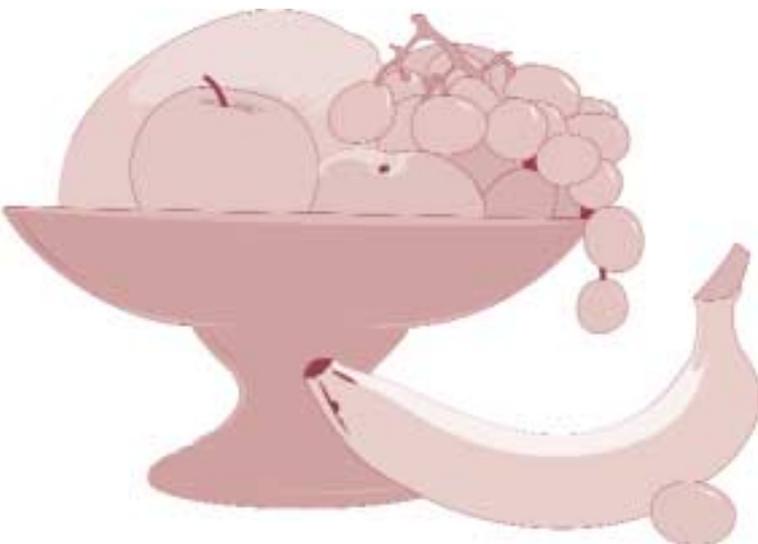
Structural organisation ties to the functions of metabolism and continuity. Disrupt the structural plan and function ceases.

#### Nutrition

Organisation and growth of a living organism are maintained by nutrition.

Definition.

Basic outline of the different sources of nutrition: in animals, by feeding on other organisms; in plants, by photosynthesis and absorbing chemicals from the environment. For each case, the flow of energy from one organism to another from its ultimate source, the sun, should be stressed.



### ACTIVITIES

\*An investigation into the life processes of a living organism:

A large range of possible organisms is suitable for use in this topic e.g. frogs, fish in a school aquarium, small mammals, woodlice or insects in a perspex animal container. A wide variety of plants could also be used.

The purpose of the investigation is to learn to make detailed observations of the development and life processes of an organism. Records should be kept of any observations made to include the following or any other important observations:

the name of the species and a description of the organism, including diagrams continued overleaf.

### SUGGESTED RESOURCES

Suitable container to the specification of the supplier of organisms. Suitable feed to the specification of the supplier.

Any other resource specified by the supplier for maximum care and safety of the organism under investigation and the investigator.

#### Excretion

In order to survive, living organisms must maintain a fairly constant balance between their internal and external environments. Excretion helps in that process.

Definition.

Basic outline of the different methods of excretion: in animals, by organised structures e.g. the urinary system, the skin, the lungs; in plants, by organised structures e.g. the stomata.

## Response

In order to function, living organisms behave in a variety of ways so as to respond to changing environments.

Definition.

Basic outline of the different methods of behaviour: in animals, by organised structures e.g. in response to light, sound, touch; in plants, by growth and movement e.g. in response to light, temperature, water availability.



## Reproduction

Life comes from life. In order to continue, organisms must therefore be capable of reproducing.

Definition.

Basic outline of different methods of reproduction: asexual e.g. in bacteria and protista – simple division in two; sexual e.g. in animals and plants – involving two parents one of which produces the male gamete and the other the female gamete.

It is necessary to state that one characteristic alone is not enough to qualify something as being alive. Life involves an interaction of processes towards metabolism and continuity e.g. metabolism requires an interaction of organisation, nutrition, excretion and behaviour for complete function. Continuity requires organisation, nutrition, behaviour, and reproduction.

### ACTIVITIES

A record of any changes which may occur in shape, size or colour; growth changes may be recorded in terms of length, height, mass or any other measurement which would be suitable;

a description of any feeding activity or movements;

a list of the ways in which the organism differs from non-living material.

A record of the investigation should be presented as part of a portfolio.

### SUGGESTED RESOURCES

\*Notes on the maintenance of the organism e.g. type of container used, type and frequency of food required, water supply, light and humidity levels.

Appropriate measuring instruments, record sheets and graph paper.

Portfolio file.

## PREAMBLE TO SUB-UNIT 1.3: NUTRITION

- All living organisms need nutrients. Nutrients provide the materials and energy necessary for the processes of metabolism and continuity.
  - carbohydrates
  - fats and oils (lipids)
  - proteins
  - vitamins.
  - be rearranged to form new molecules.
- Living organisms are composed of elements. The six most important elements in all living organisms are carbon, hydrogen, nitrogen, oxygen, phosphorus and sulphur.
- Atoms of these elements combine (or bond) together in different ratios to form molecules which in biology are called biochemicals or biomolecules.
- There are four major types of biomolecules found in food:
  - In living cells biomolecules can
    - be built up to form larger biomolecules (anabolism)
    - be broken down into smaller units (catabolism)
    - be involved in the release or absorption of energy
    - act as the structural units of cells
    - regulate and participate in the key functions of life - metabolism and continuity
  - Minerals which are not necessarily integrated into biomolecules are needed in small amounts by organisms. These include sodium, magnesium, chlorine, potassium and calcium that occur mainly as dissolved salts. The metals iron, copper and zinc also play specific roles.
  - Water is essential for life comprising 70–95% of cell mass.

### MANDATORY ACTIVITY

### LABORATORY ACTIVITY

Conduct a qualitative test for (i) starch, (ii) fat, (iii) a reducing sugar and (iv) a protein.

## 1.3. NUTRITION / SUGGESTED CLASS PERIODS: 11 OL, 11 HL

### 1.3.1 FUNCTION OF FOOD

#### DEPTH OF TREATMENT

**E**xplain in simple terms why food is required by all living organisms – place specific emphasis on provision of materials and energy for the processes of metabolism and continuity.

### 1.3.2 CHEMICAL ELEMENTS

#### DEPTH OF TREATMENT

**S**tate the chemical elements present in food

- the six common elements: carbon, hydrogen, nitrogen, oxygen, phosphorus and sulphur
- sodium, magnesium, chlorine, potassium and calcium are present in dissolved salts
- iron, copper and zinc are found in trace amounts.

### 1.3.3 BIOMOLECULAR STRUCTURES

#### DEPTH OF TREATMENT

**S**imple statement to note that these elements combine (join or bond) together in different ratios to form simple biomolecular units e.g. carbohydrates  $C_x(H_2O)_y$ .

For instance, a common monosaccharide is glucose when  $x = y = 6$ .

## 1.3.4 BIOMOLECULAR SOURCES AND THE COMPONENTS OF FOOD

### DEPTH OF TREATMENT

#### Carbohydrates

Carbohydrates contain the elements carbon, hydrogen and oxygen. The smallest unit of a carbohydrate is called a monosaccharide.

Two monosaccharides can join together to form a disaccharide. Many saccharides can join together to form a polysaccharide e.g. starch. Test for and list the sources of carbohydrates.

#### Fats and oils (lipids)

Fats contain the elements carbon, hydrogen and oxygen but in a different ratio to carbohydrates. Fats are solids at room temperature.

The basic unit of fat is called a triglyceride.

A triglyceride is made of three molecules of fatty acids joined to one molecule of glycerol.

Oils have the same basic structure as fats but contain different types of fatty acids and remain in a liquid state at room temperature.

Phospholipids are fat-like substances where one of the fatty acid groups in the triglyceride is replaced with a phosphate group.

Test for and list sources of lipids.

#### Proteins

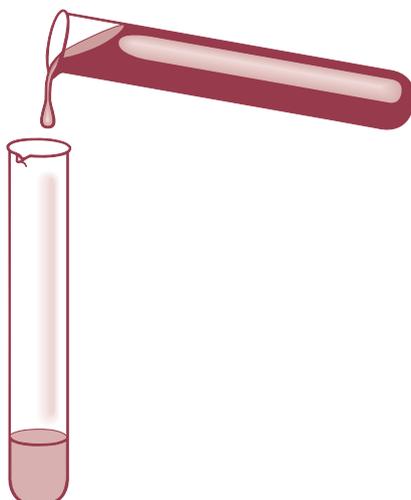
Proteins contain the elements carbon, hydrogen, oxygen and nitrogen. In addition they may also contain sulphur, sometimes phosphorus or other elements.

The smallest unit of a protein is called an amino acid. There are twenty common and several rare amino acids found in proteins. Many more amino acids are known to occur free in different cells and tissues but not in proteins.

Test for and list sources of proteins.

#### Vitamins

Vitamins differ chemically from each other and are required in only small quantities. They may be referred to by letters or by names based on their chemical structure. Refer to water-soluble and fat-soluble, with one example of each.



#### ACTIVITIES

##### Food Tests

\*Teacher demonstrates positive test for food biomolecules.

Students then test a variety of foods for the presence/absence of food biomolecules.

The use of a control should be stressed in each test for the following:

##### Carbohydrates

Monosaccharide (reducing sugar) glucose, Benedict's or Fehling's tests

##### Polysaccharide iodine test

Fats  
brown paper test or Sudan III test (caution, toxic)

##### Proteins biuret test

\*Vitamin C  
DCPIP test

#### SUGGESTED RESOURCES

Variety of food samples  
Recording chart  
Test tubes  
Heat source  
Dropping pipettes  
Spatula

Glucose, Benedict's or Fehling's solutions

Starch suspension (starch, NaCl, water), iodine solution

Fat source, Sudan III or brown paper and heat source

10% Sodium hydroxide or Potassium hydroxide solution

1% Copper sulphate solution

Protein source e.g. egg albumen suspension.

Dichlorophenol indophenol solution (DCPIP)

Vitamin C source e.g. lemon or orange juice.

### 1.3.5 ENERGY TRANSFER REACTIONS

#### DEPTH OF TREATMENT

**A**nabolic reactions are the energy requiring pathways that build large molecules from small ones using enzymes. Catabolic reactions are energy releasing pathways that break down large molecules into their smaller component units using enzymes (different pathways from those of anabolism, therefore catabolism is not the opposite of anabolism).

#### Energy transfer reactions

Energy release as exemplified by catabolic reactions to include respiration (at this stage by a simple statement, for detail see respiration, Unit Two).

Energy absorption as exemplified by anabolic reactions to include photosynthesis (at this stage by a simple statement, for detail see photosynthesis, Unit Two).

### 1.3.6 STRUCTURAL ROLE OF BIOMOLECULES

#### DEPTH OF TREATMENT

**B**iomolecular cell structural units:

**Carbohydrates** e.g. cellulose is a polysaccharide. It is a component of cell walls in plant cells.

**Proteins** are fibrous in nature, found in skin, muscle and other internal organs e.g. keratin in hair and skin, myosin in muscles.

**Lipids** are important as storage molecules in organisms. Insulating properties e.g. under the skin; as a protective layer e.g. surrounding the kidney and other organs of the body; as structural components linked with phosphorus, nitrogen e.g. phospholipids and lipoproteins in cell membranes.

### 1.3.7 METABOLIC ROLE OF BIOMOLECULES

#### DEPTH OF TREATMENT

**C**arbohydrates and lipids  
A simple statement of the importance of carbohydrates and lipids in metabolic activities as exemplified in catabolic, anabolic, photosynthetic, respiratory functions.

#### Proteins

A simple statement of the importance of proteins in metabolic activities e.g. as enzymes (for detail see Unit Two).

Hormones as regulators of metabolic activity.

#### Vitamins e.g. C and D

Vitamin C for the growth of connective tissue especially in skin and blood vessels.

Vitamin D for the uptake of calcium and leading to the maintenance of healthy teeth and bones.

Disorders associated with deficiency of a water-soluble and a fat-soluble vitamin.

### 1.3.8 MINERALS

#### DEPTH OF TREATMENT

**M**inerals required in small amounts by organisms are used in three ways:

- to form part of the rigid body structures e.g. calcium in bones and cell walls
- to form soft body tissues
- to function in cellular and body fluids.

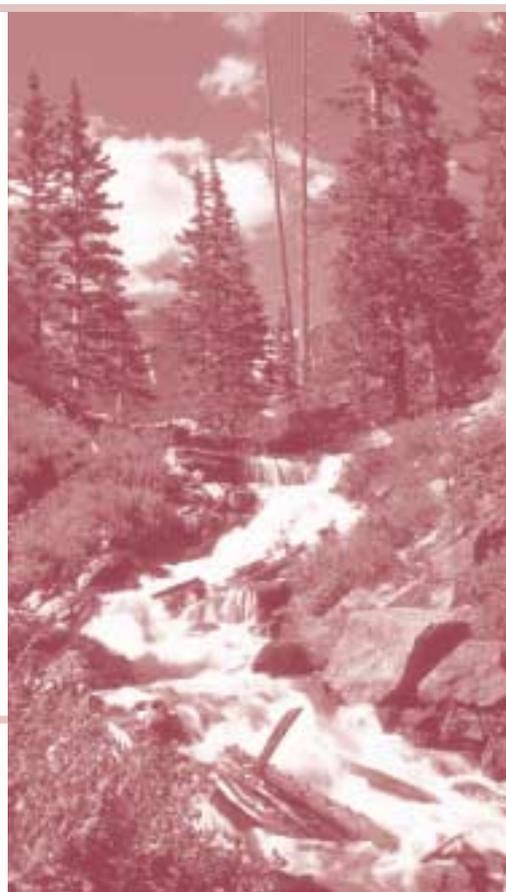
Name any two minerals required by (a) plants and (b) animals and relate to any of the three functions mentioned above.

### 1.3.9 WATER

#### DEPTH OF TREATMENT

**I**mportance of water as:

- a component of cytoplasm and body fluids (70 – 95% of cell mass)
- a solvent and medium in which chemical reactions take place
- a participant in chemical reactions
- a participant in the movement of materials in and out of cells, control of cell shape (detailed study in Unit Two, Sub-unit 2.2, Cell Metabolism)
- a good absorber of energy (high specific heat capacity).



## PREAMBLE TO SUB-UNIT 1.4: AN INTRODUCTION TO THE GENERAL PRINCIPLES OF ECOLOGY

1. The entire earth is itself a true ecosystem - a biosphere, as no part of it is completely isolated from the rest.
2. The distribution of the total number and types of living organisms within an ecosystem may be represented by ecological pyramids.
3. The life of an organism is affected by components of the environment which may include abiotic and biotic, climatic and edaphic.
4. For survival, an organism attempts to reach dynamic equilibrium with the other components in an ecosystem by:
  - (a) management of energy flows
  - (b) nutrient recycling.
5. An organism's dynamic equilibrium with other components in an ecosystem may be affected by human interference:
  - (a) pollution
  - (b) conservation and waste management.

### Higher Level Extension

6. Students should be capable of outlining the contributory factors, interactions and variables in:

Competition

Predation

Parasitism

Symbiosis

Predator/Prey relationships.

**Note:** Activities related to topics in this subunit are best put into practice during '1.5 A study of an ecosystem'.

### 1.4 GENERAL PRINCIPLES OF ECOLOGY / SUGGESTED CLASS PERIODS: 8 OL, 13 HL

#### 1.4.1 ECOLOGY

##### DEPTH OF TREATMENT

**D**efinition.

#### 1.4.2 ECOSYSTEM

##### DEPTH OF TREATMENT

**D**efinition and diversity of "ecosystems".



### 1.4.3 BIOSPHERE

#### DEPTH OF TREATMENT

**D**efinition.

The entire earth is itself a true ecosystem as no part is completely isolated from the rest. This global ecosystem is termed the biosphere.

### 1.4.4 HABITAT

#### DEPTH OF TREATMENT

**D**efinition.

### 1.4.5 ENVIRONMENTAL FACTORS

#### DEPTH OF TREATMENT

**T**he life of an organism is affected by:

#### **Environmental factors**

Definition and examples of the term “**abiotic**”.

Definition and examples of the term “**biotic**”.

#### **Climatic factors**

Climate influences the life and distribution of organisms on our planet e.g. temperature, rainfall, humidity, day length, light intensity (including seasonal variations).

#### **Edaphic factors**

Definition should refer to various soil factors e.g. soil type, soil pH, soil moisture, mineral content.

#### **Aquatic environmental factors**

An awareness that in aquatic environments other factors such as light penetration, currents and wave action are considered factors.

#### ACTIVITIES

\*Students should be asked to list how they themselves are affected in their own lives by abiotic, biotic and climatic factors. Some may also contribute to a knowledge of some edaphic factors that influence garden or farm management.

\*Demonstrate soil pH testing from a number of sample areas. Students may carry out the test themselves.

#### SUGGESTED RESOURCES

pH test:

Universal or soil indicator solution

Test tube

Barium sulphate

Spatula

pH chart

## 1.4.6 ENERGY FLOW

### DEPTH OF TREATMENT

Ecosystems are unable to function unless there is a constant input of energy from an external source. The sun is the primary source of energy for our planet.

Feeding as a pathway of energy flow in an ecosystem.

Grazing food chains, the simplest form.

Food web.

Pyramid of numbers based on the number of organisms at each trophic level and constructed as follows:

count the primary producers and place them at the base of the pyramid

count each consumer and include them according to their status in the pyramid

the apex of the pyramid should include tertiary or top carnivores.

## 1.4.7 NICHE

### DEPTH OF TREATMENT

An understanding that a niche in ecological terms is the functional role of an organism in an ecosystem.

## 1.4.8 NUTRIENT RECYCLING

### DEPTH OF TREATMENT

Identify the role of organisms in the pathway of an inorganic nutrient cycle as demonstrated by each of the following: the carbon cycle and the nitrogen cycle.

#### ACTIVITIES

\*View and discuss audio-visual material on the recycling of nutrients.

#### SUGGESTED RESOURCES

Drawing sheets    Video

## 1.4.9 HUMAN IMPACT ON AN ECOSYSTEM

### DEPTH OF TREATMENT

**H**uman impact on an ecosystem as exemplified by:

#### **Pollution** – definition

State that pollution affects air, fresh water, sea and land.

Give the effects of one pollutant from any of the following areas: domestic, agricultural, industrial.

Give an example of one way in which pollution may be controlled in the selected area.

#### **Conservation** – definition

#### **Waste Management**

Give one example of waste management in agriculture, fisheries, forestry.

The problems associated with waste disposal.

Suggestions for waste minimisation.

### *Contemporary Issues & Technology*

*Pollution: The ecological impact of one human activity.*

*Outline of any one conservation practice from one of the following areas:*

*agriculture e.g. mixed farming, crop rotation, biological controls, gene banks*

*fisheries e.g. net size, quotas, re-stocking*

*forestry e.g. re-planting, broadleaf/conifer mix.*

*There should be an emphasis on the need for continual monitoring of the environment.*

*Role of micro-organisms in waste management and pollution control.*

### ACTIVITIES

\*Research project on any of the following: pollution, conservation or waste management.

\*Pollution:

write an essay on one possible ecological impact that modern human activity has had or could have on planetary life –

the source of pollution

the ecological effects

"indicator species".

Discuss possible methods of reducing or eliminating the pollution source.

\*Conservation:

visit or alternatively show a video on one nature reserve in Ireland followed by a student essay on the topic:

"Nature Reserves in Ireland"—

their number and county locations

their function

their uniqueness

their success.

\*Waste Management:

Examine:—

composting

role of renewable energy sources in waste management e.g. biogas generator.



## HIGHER LEVEL EXTENSION

## H.1.4.10 PYRAMID OF NUMBERS (EXTENDED STUDY)

## DEPTH OF TREATMENT

Ecological pyramids may be defined as a way of comparing different communities of the ecosystem in order of different trophic (feeding) levels.

**Note:** Limitation of use.

Relationship of body size to position in the pyramid.

Refer also to an inverted pyramid of numbers.

## H.1.4.11 ECOLOGICAL RELATIONSHIPS

## DEPTH OF TREATMENT

Factors that control populations.

Definition of “**competition**”

**Examples:**

**contest competition** – an active physical confrontation between two organisms which allows one to win the resource

**scramble competition** – each organism tries to acquire as much of the resource as possible.

Relate competition to size of population.

Outline one adaptive technique of an organism to survive competition.

Definition of “**predation**”.

Examine any three adaptive techniques of (a) predators and (b) prey. Give one simple example of a predator/prey relationship to illustrate population control.

Definition of “**parasitism**” with example.

Definition of “**symbiosis**” with example.

## H.1.4.12 POPULATION DYNAMICS

## DEPTH OF TREATMENT

Students should be capable of outlining the contributory factors or variables in predator/prey relationships e.g. food availability, concealment, movement to a more abundant location.

*Contemporary Issues & Technology*

*The effect on the human population of:*

*war*

*famine*

*contraception*

*disease.*

# PREAMBLE TO SUB-UNIT 1.5: A STUDY OF AN ECOSYSTEM

- In their investigation of an ecosystem, students become familiar, through first hand observation, with the flora and fauna of their selected ecosystem.
- About them, students observe a diversity of life forms, their inter-relationships with each other (biotic) and with non living (abiotic) components including the following:
  - their numerical distribution
  - their choice of habitat
  - their structural, competitive and behavioural needs for survival and continuity
  - their role in
    - the pathway of energy flow
    - the pathway of an inorganic nutrient cycle.
- By an investigative and experimental approach, students should experience experimental design, data collection and interpretive techniques.
- Through these techniques students learn to handle, assess and evaluate numerical and non-biological information in a coherent way, using a combination of continuous prose, tables, diagrams, graphs and other descriptive modes.
- It is intended that students will gain an appreciation of the wide range of organisms within the ecosystem in their natural environment rather than through studying them solely using textbooks.
- Students will be required to
  - identify ambiguities, assumptions and mistakes throughout all aspects of the investigation and conclusions
  - suggest and explain how error in a measurement technique might be minimised
  - apply and relate knowledge, understanding and skills of their ecosystem study to other ecosystems.

## Note:

- The results of this special investigation should be presented in the form of a report or portfolio.
- Suitable ecosystems include:
  - hedgerow
  - stream
  - rock pool
  - rocky seashore
  - old wall
  - grove or small woodland
  - small meadow
  - freshwater pond
  - waste land
  - an overgrown garden
  - soil
  - peatland
  - grassland
- Students should apply and relate, where possible, their knowledge and understanding of their ecosystem study to other units of the course whether approached separately or integrated throughout the course.
- Teachers should impress upon their students the importance of
  - obtaining the owner's permission to carry out an investigation on private property
  - leaving the habitat undisturbed, as far as possible e.g. closing gates after each visit
  - being aware of dangers such as depth of water in ponds and streams (they may look shallow, but they could be deep) also the possibility of encountering dangerous animals e.g. bulls, fierce dogs.
- Because the terms 'flora' and 'fauna' predate the Whittaker Five Kingdom System their usage and meaning will remain as before.

## MANDATORY ACTIVITIES

### FIELDWORK ACTIVITIES

*Students should:*

- Identify and use various apparatus required for collection methods in an ecological study.
- Use simple keys to identify any five fauna and any five flora.
- Conduct a quantitative study of plants and animals of a sample area of a selected ecosystem.
- Investigate any three abiotic factors.

## 1.5 A STUDY OF AN ECOSYSTEM / SUGGESTED CLASS PERIODS: 11 OL, 11 HL

### 1.5.1 BROAD OVERVIEW OF A SELECTED ECOSYSTEM



#### DEPTH OF TREATMENT

Identification of different ecosystems and selection of one.

General overview of the diversity of life forms, their inter-relationships with each other and the non-living components of one selected ecosystem.

Study a minimum of ten organisms to include five fauna and five flora from the selected ecosystem. Appreciate the range of variation of any single species: height, mass and any other estimable character.

### 1.5.2 OBSERVATION AND SCIENTIFIC STUDY OF A SELECTED ECOSYSTEM

#### DEPTH OF TREATMENT

Identify a number of habitats from the chosen ecosystem.

#### Specimen identification

Collection methods: mammal trap, pitfall trap, cryptozoic trap, pooter, nets (to include – sweep net, insect net, plankton net or fish net), direct search, Tullgren funnel.

#### ACTIVITIES

Emphasis in this study should be placed on the techniques of field work, recording and analysis of collected data.

Select and visit one ecosystem.

On site, form a general overview of the ecosystem – the diversity of life forms, their inter-relationships with each other and the non-living components of the ecosystem.

Identify a selection of fauna and flora from the ecosystem using keys.

Use drawings or photographs of the organisms.

Identify and classify organisms.

In a simple map drawing of the ecosystem, position the habitat of each organism selected.

Following a teacher demonstration of the skills used in the methods of specimen collection, students should practice these to collect organisms.

#### SUGGESTED RESOURCES

A number of guidebooks to identify fauna and flora.

Drawing sheets/pencils or camera

Guidebooks or simple key charts

Long pieces of string or rope

bamboo canes

compass

tape measure

graph paper/pencil

Sets of the following:

mammal trap, jam jar, stones, cover (piece of wood), pooters, sweep net, insect net, plankton net or fish net

Tullgren funnel

### 1.5.3 ORGANISM DISTRIBUTION

#### DEPTH OF TREATMENT

Distinguish between qualitative and quantitative surveys of a selected ecosystem for plants and animals:

organism distribution

quantitative survey of the selected ecosystem using frequency and percentage cover techniques.



#### ACTIVITIES

Quantitative study of plants and animals in a sample area of the ecosystem: using quantitative quadrat frame and recording sheet;

transfer results to percentage cover defined as an area of ground occupied by aerial parts of individual plants of the species examined and counted, expressed as a percentage of the total quadrat area;

transfer results to frequency defined as the chance of finding the species of a plant within the sample area in a number of quadrats.

Using any one method:

line transect

belt transect

examine and record plant and animal distribution in a sample area along an environmental gradient; transfer results to tables, diagrams, graphs, histograms or any other relevant mode.

Identification of possible sources of error that might accompany selected measuring techniques:

human error,

application to the natural world in a state of change,

accidental discovery,

limitation of sample size.

#### SUGGESTED RESOURCES

Marked strings

tent pegs

quadrat frames

recording sheets

pencil

ICT facility

Lengths of marked string

metre sticks

quadrats

ICT facility

## 1.5.4 CHOICE OF HABITAT

### DEPTH OF TREATMENT

**R**elationship between an organism's suitability to its habitat and abiotic factors to include measurement of any three of the following:

pH, temperature (air and ground, or aquatic), light intensity, water current, air current, dissolved oxygen, mineral content, percentage air in soil, percentage water in soil, percentage humus, salinity, degree of exposure, and slope.

## 1.5.5 ORGANISM ADAPTATIONS

### DEPTH OF TREATMENT

**N**ecessity for structural, competitive or behavioural adaptation by organisms.

## 1.5.6 ORGANISM ROLE IN ENERGY TRANSFER

### DEPTH OF TREATMENT

**I**dentify the role of the organisms studied in the pathways of energy flow by construction of:

- food chains
- food web
- pyramid of numbers.

## 1.5.7 ANALYSIS

### DEPTH OF TREATMENT

**A**nalysis and assessment of all results obtained during this special investigation of an ecosystem.

### *Contemporary Issues & Technology*

*Identification of local ecological issues related to the selected ecosystem.*

### ACTIVITIES

Investigate any three abiotic factors present in the selected ecosystem as listed.

Relate results to choice of habitat selected by each organism identified in this study.

From observation, data collection or interpretative techniques of the investigative study of the ecosystem, note any one structural or behavioural adaptation of any organism selected.

Using the information previously gathered in the study of the selected ecosystem construct:

- food chains
- food web as energy flow through the ecosystem
- pyramid of numbers.

Prepare a portfolio/brief report of the results obtained.

### SUGGESTED RESOURCES

Soil test kit box per station to include:

#### **pH measurement**

universal or soil indicator solution  
test tubes  
barium sulphate  
spatula  
pH chart.

#### **Mineral content/humus content**

plastic sample bags  
labels  
pencil.

#### **Temperature**

soil thermometer/air thermometer

#### **For percentage air**

tin cans  
spade or trowel  
bucket (large)  
plastic bags  
graduated cylinder.

#### **For light intensity per station**

light meter  
recording sheet.

#### **For water/air current per station**

anemometer  
compass  
recording sheet  
stop watch.

#### **Water samples per group**

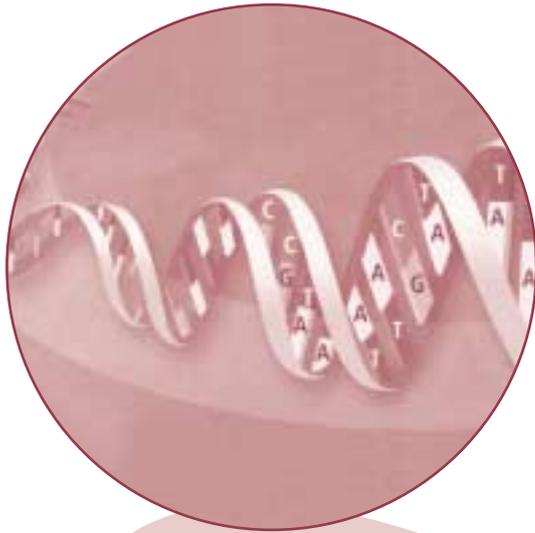
small bottles.  
Note book or drawing sheets

ICT facility



# Section two

## class preparation material for unit two: the cell



Teachers are reminded, prior to reading this section, that the syllabus is the definitive prescribed material.

It is hoped that this section will help promote professional teaching methods as distinct from textbook methodology. This section could be used as a class guide through the syllabus. It is not intended to be a text for students as it contains both non-prescribed and prescribed material.

To assist and support you in class preparation:

- The preamble to each subunit gives a broad insight into the central ideas of the syllabus depth of treatment.
- The suggested 'texted' and practical detail should be used as suggestions to support you in:

**Depth of prescribed and non-prescribed material you wish to use.**

**Methodology practice to include practical activities.**

**Suggested resources.**

**Time parameters.**

Special attention in class preparation should be given to the use of **18 class periods** for non prescriptive material at Ordinary level.

You may wish to use the non-prescribed activities and resources marked by an asterisk \* or use other materials such as DART.

# PREAMBLE TO SUB-UNIT 2.1: CELL STRUCTURE

- The cell is the smallest unit of living matter that exhibits the characteristics of life.
- All cells have structures in common to carry out basic life processes.
- Structural similarities and differences exist between cells of different organisms of all the major groups.
- Where a nucleus exists, the gene expression which leads to the phenotype begins in this organelle. This has led scientists to consider the nucleus as the control centre of the eukaryotic cell. A parallel system of control, though not yet confirmed, is thought to exist in prokaryotic cells.

## Higher Level Extension

- There are two major types of cells:
  - eukaryotic cells have a membrane-bound nucleus and other organelles
  - prokaryotic cells do not have such a membrane-bound nucleus and organelles.

## MANDATORY ACTIVITIES

### MICROSCOPY

*Students should:*

Be familiar with and use the light microscope.

Prepare and examine one plant cell – unstained and stained – using the light microscope ( $\times 100$ ,  $\times 400$ ).

Prepare and examine one animal cell – unstained and stained – using the light microscope ( $\times 100$ ,  $\times 400$ ).

## CELL STRUCTURE / SUGGESTED CLASS PERIODS: 9 OL, 9 HL

### 2.1.1 MICROSCOPY

#### DEPTH OF TREATMENT

**A** general introduction to the microscope.

Specific reference to the light microscope and the transmission electron microscope.

### 2.1.2 CELL STRUCTURE AND FUNCTION

#### DEPTH OF TREATMENT

**C**omponents of the cell under the light microscope and their functions:

**Plant cells:** cell wall, cytoplasm, nucleus, vacuole, chloroplast.

**Animal cells:** cytoplasm, nucleus.

In both cases indicate the position and function of the cell membrane.

#### ACTIVITIES

Start with a hand lens and develop a familiarity with and procedural use of the light microscope.

Examine the microscopic structure of any one animal cell and any one plant cell e.g. own cheek cells, onion cells, elodea leaf, potato tissue, moss leaf; to observe, draw and identify the following:

the existence of cells

simple structures to include in plant cells: cell wall, cytoplasm, nucleus, vacuole, chloroplast; in animal cells: cytoplasm, nucleus. In both cases indicate the position of the plasma membrane.

The advantage and use of simple stains to facilitate observation e.g. Methylene blue or  $I_2/KI$  dilute solution.

\*Visual identification of the listed cell ultra structures as illustrated by use of published electron micrographs.

#### SUGGESTED RESOURCES

Hand lenses  
Microscopes

Boxes of glass slides  
Boxes of cover slips  
Forceps

$I_2/KI$  solution  
stain \*\*

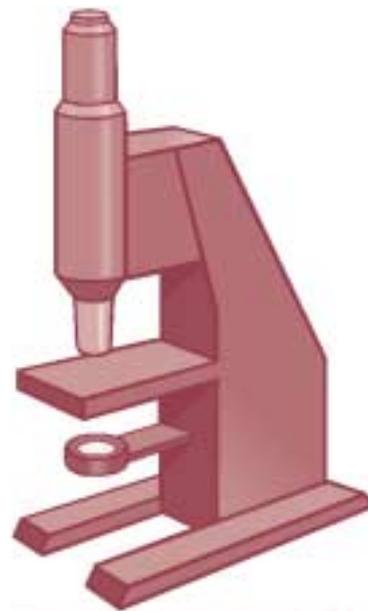
(\*\* Health caution)  
Methylene blue stain,  
droppers, filter paper

Projector and slides

## 2.1.3 CELL ULTRA STRUCTURE

### DEPTH OF TREATMENT

**I**dentification and function of cell membrane, mitochondrion, chloroplast, nucleus, nuclear pores, ribosomes, DNA.



### HIGHER LEVEL EXTENSION

## H.2.1.4 PROKARYOTIC AND EUKARYOTIC CELLS

### DEPTH OF TREATMENT

**E**xistence and definition: eukaryotic cells have a membrane-bound nucleus and other organelles  
prokaryotic cells do not have such a membrane-bound nucleus and organelles.

## PREAMBLE TO SUBUNIT 2.2: CELL METABOLISM

- Cellular activities require energy. Ultimately all of this energy comes from the sun. Some energy from sunlight is trapped in carbohydrates and other biomolecules. (Subsequently these biomolecules are broken down to release energy for use by the cell).
- Metabolism is the collective term for reactions that take place within living cells. The reactions of metabolism are catalysed by enzymes.
- The activity of enzymes is based upon
  - active site(s)
  - a suitable environment.
- Enzymes mediate the release of energy particularly in respiration.
- Enzymes are essential in the energy transfer process of photosynthesis.
- A dynamic balance exists between cells and their environment through cell membranes
  - in controlling the passage of materials in and out of cells
  - in recognising foreign particles
  - in sensing.
- Movement of water has specific significance for cell shape and activity.

### Higher Level Extension

- Enzyme activity is "specific" for one reaction or one type of reaction.
- Adenosine triphosphate (ATP) has a special role as an intermediary in the trapping and transferring of energy for cell activities. NAD/NADP<sup>+</sup> has a special role as an intermediary in the trapping and transferring of electrons and hydrogen ions for cell activities.

## MANDATORY ACTIVITIES

### LABORATORY ACTIVITIES AND INVESTIGATIONS

*Students should:*

Investigate the effect of pH on the rate of one of the following: amylase, pepsin or catalase activity.

Investigate (a) the effect of temperature on the rate of one of the following: amylase, pepsin or catalase activity and (b) the effect of denaturation by heat application on the activity of one enzyme (part (b) for H.L. only).

Prepare one enzyme immobilisation and examine its application

Investigate the influence of light intensity or carbon dioxide concentration on the rate of photosynthesis.

Prepare and show the production of alcohol by yeast.

Conduct any activity to demonstrate osmosis.

## CELL METABOLISM / SUGGESTED CLASS PERIODS: 24 OL, 32 HL

## 2.2.1 CELL METABOLISM

## DEPTH OF TREATMENT

**D**efinition of “**metabolism**”.

## 2.2.2 SOURCES OF ENERGY

## DEPTH OF TREATMENT

**S**olar energy

Sunlight is a source of energy capable of being absorbed by cellular pigments e.g. chlorophyll.

**C**ellular energy

Cell sources of energy capable of release by metabolic processes in cells.

## ACTIVITIES

\*Investigate by designing and carrying out experiments to show:-

- that light is a form of energy

e.g. movement of lightmeter needle

- that plants are a source of energy

e.g. burn a nut to show energy conversion

or

show that heat is evolved from germinating peas.

## SUGGESTED RESOURCES

Lightmeter.

Peanut, mounted needle, test tube, ignition source, test tube clamp.

Vacuum flasks, peas, cotton wool, thermometers.

## 2.2.3 ENZYMES

### DEPTH OF TREATMENT

**D**efinition of enzyme to refer to protein nature and folded shape.

Role in plant and animal, special reference to their role in metabolism:

Amylase, pepsin or catalase as examples of enzymes involved in chemical breakdown.

Other enzymes, such as potato phosphorylase, are involved in synthesis.

Effect of pH and temperature range on enzyme activity.

#### ACTIVITIES

Prepare one enzyme immobilisation and examine its application.

#### SUGGESTED RESOURCES

Enzyme, sodium alginate, calcium chloride, enzyme substrate, beakers, syringes or droppers, stirring rods, sieve, thermometer, graduated cylinders.

### Contemporary Issues & Technology

*Bioprocessing with immobilised enzymes – procedure, advantages and use in bioreactors.*

*Procedure: beads prepared using sodium alginate, enzyme and calcium chloride solutions.*

*Advantages: gentle procedure, easily recovered, reusable. Use in bioreactors.*

#### ACTIVITIES

\*The activity of catalase on hydrogen peroxide solution.

\*The presence of urease in melon seeds or beans.

\*The activity of amylase on starch, or pepsin on protein.

\*The anabolic activity of potato phosphorylase on glucose 1 – phosphate.

Investigate the effect of pH on the rate of amylase or pepsin or catalase activity.

Investigate the effect of temperature on the rate of any one of the following: amylase, pepsin or catalase activity.

#### SUGGESTED RESOURCES

Sticks of celery or liver, knife, large graduated cylinder, hydrogen peroxide solution.

Melon seeds, soya beans or jack beans, powdered urea, pH meter.

2% diastase (amylase) or pepsin (protease) solution (fresh and boiled), starch suspension or protein source, biuret solutions, iodine solution, thermometer, test tubes, petri dishes, pipette or syringe. Starch or milk-agar plates, or hydrogen peroxide, cork borer, diastase, protease or catalase solution.

Potatoes, glucose 1-phosphate, iodine solution, blender, muslin, ice, distilled water, pipette.

Buffer solutions: pH 4, pH 7, pH 10, distilled water, timer.

Liver or celery, pestle and mortar, buffer (pH as required) centrifuge, distilled water, substrate (H<sub>2</sub>O<sub>2</sub>), refrigerator, waterbath at 20°C and 40°C, test solutions.

ICT facility

## 2.2.4 PHOTOSYNTHESIS

### DEPTH OF TREATMENT

**P**hotosynthesis definition, the overall sequence of reactions as represented by the equation:  
 $6\text{CO}_2 + 6\text{H}_2\text{O} + \text{light/chlorophyll} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$ .

A simple treatment of photosynthesis as follows:

Chlorophyll in chloroplasts traps sunlight energy. This trapped energy splits water to release electrons, protons and oxygen. These electrons are passed to chlorophyll, the protons are released to a general pool of protons. The oxygen is either released to the atmosphere or it may be used within the cell. Electrons from chlorophyll are used with protons from the pool of protons to reduce carbon dioxide to form a carbohydrate  $\text{C}_x(\text{H}_2\text{O})_y$ .

Location of chlorophyll within cells.

Identify the sources of light, carbon dioxide and water for photosynthesis in leaf cells.

### Contemporary Issues & Technology

**Human intervention:** Use of artificial light and carbon dioxide enrichment to promote crop growth in greenhouses.

#### ACTIVITIES

To investigate the influence of light intensity or carbon dioxide concentration on the rate of photosynthesis.

\*Design and carry out an investigation to demonstrate the need for any one of the following in photosynthesis: chlorophyll, light or carbon dioxide.

#### SUGGESTED RESOURCES

Elodea, test tubes, buffer solution, warm water, sodium hydrogen carbonate solution(s), lamps of different wattage, or 1 lamp at different distances away from plant, timer, or use of computer interfacing.

## 2.2.5 RESPIRATION

### DEPTH OF TREATMENT

**D**efinition and role of aerobic respiration, the overall sequence of reactions as represented by the equation:  
 $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + \text{energy}$ .

Respiration may occur as a one or two-stage process:

the first stage does not require oxygen and releases a small amount of energy;

the second stage does require oxygen and releases a large amount of energy.

Anaerobic respiration may occur in the presence of oxygen but does not use oxygen. It is therefore a first-stage process. The products of anaerobic respiration are lactic acid or alcohol and carbon dioxide. Refer to fermentation.

Aerobic respiration uses oxygen and is described as a two-stage process.

Cellular location of the first and second-stage process. The first stage process occurs in the cytosol (the cytoplasm minus the organelles). The second stage process occurs in the mitochondrion.

#### ACTIVITIES

\*Conduct an experiment to demonstrate the release of carbon dioxide by respiring cells; the release of heat energy from respiring cells e.g. germinating peas or barley or yeast fermentation.

Prepare and show the production of alcohol by yeast.

#### SUGGESTED RESOURCES

Germinating peas or barley, limewater, vacuum flasks, cotton wool, thermometers.

Yeast, sugar solution, conical flasks, thermometers.

Yeast, sugar solution, flasks, tubing, test tubes, Iodoform test solutions, lime-water or bicarbonate indicator.

### Contemporary Issues & Technology

*Examine the role of micro-organisms in industrial fermentation and include bioprocessing with immobilised cells: procedure, advantages and use in bioreactors.*

*Procedure: beads prepared using sodium alginate, yeast cells and calcium chloride solutions in industrial fermentation of alcohol. Advantages: gentle procedure, easily recovered, reduction in filtration procedure, reusable. Use in bioreactors.*

## 2.2.6 MOVEMENT THROUGH CELL MEMBRANES

### DEPTH OF TREATMENT

**S**elective permeability of cell membranes, surrounding the cells and within the cells.

**Diffusion** – definition, passive transport e.g. movement of oxygen and carbon dioxide.

**Osmosis** – a special case of diffusion – the movement of water across biological membranes by a form of diffusion.

Definition of “**turgor**”.

Simple explanation of how plant cells remain turgid:

plant cells containing more concentrated solution than their surroundings – water flows in, vacuoles collect this water and the cells swell against their restraining cell walls.

Plant cells containing less concentrated solution than their surroundings – water flows out of the vacuole and the cell shrinks.

### *Contemporary Issues & Technology*

*Describe the application of high salt or sugar concentration in food preservation.*

### ACTIVITIES

\*Any simple experiment to demonstrate diffusion.

Design and carry out an investigation to demonstrate osmosis e.g. cell models made from Visking tubing using starch or glucose.

\*Design and carry out an investigation into the response of plant cells to different concentrations of saline or sucrose solutions e.g. using living beetroot cells or tulip petals or rhubarb epidermis.

\*A piece of wilted lettuce placed in water becomes crisp as the individual cells expand like inflated balloons.

### SUGGESTED RESOURCES

Visking tubing, water, starch suspension, glucose solution, iodine solution, syringe, clip.

Beetroot cells, rhubarb epidermis, microscopes, microscope slides, cover slips, forceps, mounted needle, scissors, dropper, filter paper, 3% salt solution, sucrose solution. Lettuce

## HIGHER LEVEL EXTENSION

## H.2.2.7 ENZYMES (EXTENDED STUDY)

### DEPTH OF TREATMENT

**A**ctive site theory to explain enzyme function, its flexibility, 3D molecules with variable domains and "specificity".

Enzymes are proteins whose activity is affected by: environmental pH, temperature.

Explain the term "**optimum activity**" under specific conditions applied to pH range.

Heat denaturation of protein.

### ACTIVITIES

Investigate the effect of denaturation on the activity of one enzyme by heat application.

### SUGGESTED RESOURCES

Starch agar plates or milk agar plates	oven
liver or celery	Iodine/KI solution
cork borer	hydrogen peroxide
diastase or protease solution	distilled water
incubator at 37°C	water baths
fridge	timer.

## H.2.2.8 ROLE OF ADENOSINE TRIPHOSPHATE (ATP) AND NICOTINAMIDE ADENINE DINUCLEOTIDE (NAD/NADP<sup>+</sup>)

### DEPTH OF TREATMENT

In order for photosynthesis and respiration to occur (both high energy reactions) the role of ATP and NAD/NADP<sup>+</sup> needs to be understood.

Word structure of ATP.

Adenosine triphosphate has a special role in the trapping and transferring of energy for cell activities.



Role of NAD/NADP<sup>+</sup>

Nicotinamide adenine dinucleotide has a special role in trapping and transferring electrons and hydrogen ions in cell activities.

## H.2.2.9 PHOTOSYNTHESIS (EXTENDED STUDY)

### DEPTH OF TREATMENT

Photosynthesis is a two-stage process:

the first stage, driven by light energy, is called the light stage or light-dependent stage;

the second stage is dependent upon the products of the light stage, does not require light and is called the dark stage or light-independent stage.

In the light stage, light energy is absorbed and then passed on from one pigment molecule to other pigment molecules in the chloroplast until it reaches a reaction centre chlorophyll molecule.

From here energised electrons enter two pathways:

they return to chlorophyll releasing their surplus energy for the formation of ATP

two electrons are trapped by NADP<sup>+</sup> forming NADP<sup>-</sup>.

This leaves the chlorophyll molecules electron deficient.

These are replenished from the splitting of water into 2H<sup>+</sup>, electrons and oxygen

H<sup>+</sup> ions from a pool of H<sup>+</sup> ions are attracted to NADP<sup>-</sup> to form NADPH.

In the dark stage NADPH supplies H<sup>+</sup> ions and electrons (reducing power) which are used to convert CO<sub>2</sub> to carbohydrates, C<sub>x</sub>(H<sub>2</sub>O)<sub>y</sub>.

The energy to achieve this conversion comes from ATP.

ADP and NADP<sup>+</sup> return to the light stage to be re-used.

## H.2.2.10 RESPIRATION (EXTENDED STUDY)

### DEPTH OF TREATMENT

The first-stage process, referred to as glycolysis, converts a six-carbon carbohydrate to pyruvate with the release of ATP.

Under anaerobic conditions:

the pyruvate molecule is converted or reduced to alcohol and carbon dioxide

or

the pyruvate molecule is reduced to lactic acid.

In the second-stage process, under aerobic conditions, a series of reactions occurs:

the pyruvate molecule is broken down to one molecule of carbon dioxide and a two-carbon acetyl group, Acetyl Co-enzyme A

this Acetyl Co. A enters a series called Krebs Cycle and leaves it later as  $\text{CO}_2$  and  $\text{H}_2\text{O}$

during this cycle an electron transport system operates to remove electrons from the substrate intermediates

electrons from the cycle are transferred through an electron transport chain

ultimately these are transferred to oxygen which combines with hydrogen to form water

the energy released by these electrons through the chain is used in the production of ATP molecules.

(Further biochemical references not required).

# PREAMBLE TO SUB-UNIT 2.3: CELL CONTINUITY

1. Mitosis is a form of cell replication in which the chromosome number remains constant in each of two identical cells generated from one.

2. Meiosis, a second form of cell division associated with reproduction, halves the number of chromosomes to form parental half cells (n), sex cells or gametes.

3. In single-celled organisms mitotic division allows the organism to reproduce. In multicellular organisms mitosis is primarily for growth and repair.

4. Cell continuity involves growth, synthesis and reproduction. It can be summarised in a cycle called the "cell cycle". The cell cycle describes

a cell's state of non-division (interphase) and division (mitosis) See Fig. 1.

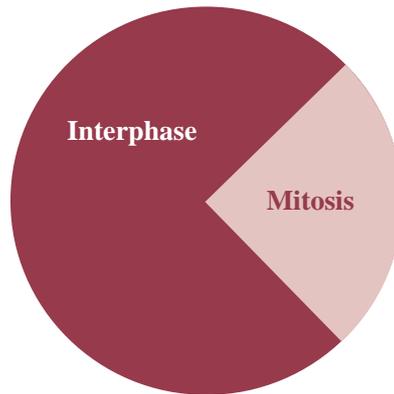


Fig. 1

5. During mitosis the genetic material divides and the cytoplasm, organelles and biomolecules are partitioned into two cells.

6. The process of meiosis is important in multicellular organisms for the purposes of:

(a) maintaining the parental chromosome number by gamete or haploid cell production in sexual reproduction

(b) introducing variation in the species by exchange of genetic material between homologous chromosomes.

7. Cancer is a group of disorders in which certain cells lose normal regulation over both the mitotic rate and the number of divisions they undergo. This results in uncontrolled multiplication of abnormal cells.

### Higher Level Extension

8. The process of mitosis, a continuous process, is arbitrarily divided into four stages for convenience of description.

## 2.3 CELL CONTINUITY / SUGGESTED CLASS PERIODS: 3 OL, 4 HL

### 2.3.1 CELL CONTINUITY AND CHROMOSOME

#### DEPTH OF TREATMENT

**E**xplanation of the terms "cell continuity" and "chromosome".

### 2.3.2 HAPLOID, DIPLOID

#### DEPTH OF TREATMENT

**D**efinition of

“haploid number”

“diploid number”.

### 2.3.3 THE CELL CYCLE

#### DEPTH OF TREATMENT

The cell cycle describes the cell's activities in the state of non-division (interphase) and division (mitosis).

#### ACTIVITIES

\*Mixed card illustrations of mitosis to be placed in correct sequence and drawn.

#### SUGGESTED RESOURCES

Card illustrations

#### Contemporary Issues & Technology

##### Cancer

*Professional discretion should be shown when dealing with this sensitive topic.*

##### Defined as:

*a group of disorders in which certain cells lose normal regulation over both the mitotic rate and the number of divisions they undergo. This results in the uncontrolled multiplication of the abnormal cells. Two possible causes.*

### 2.3.4 MITOSIS

#### DEPTH OF TREATMENT

Definition of “mitosis”.

Simple treatment, with the aid of diagrams, to show chromosome behaviour (names of stages or chromosome parts are not required).

Just before the cell divides, chromosomes become visible in the nucleus (short, thick and duplicated). The nuclear membrane disappears, and fibres are formed to which the chromosomes attach. Chromosomes are pulled apart to opposite ends of the cell. A nuclear membrane forms around each set of chromosomes and the cell divides in two. Each new daughter cell now contains the same number of chromosomes as the parent cell.

### 2.3.5 FUNCTION OF MITOSIS

#### DEPTH OF TREATMENT

In single-celled organisms, mitosis allows the organisms to multiply.

In multicellular organisms, mitosis is primarily for growth.

### 2.3.6 MEIOSIS

#### DEPTH OF TREATMENT

Definition of “meiosis”.

## 2.3.7 FUNCTIONS OF MEIOSIS

### DEPTH OF TREATMENT

**F**unctions of meiosis in multicellular organisms:

to maintain parental chromosome number by gamete or haploid cell production in sexual reproduction

to introduce variation in the species by re-arrangement of genetic material.

### HIGHER LEVEL EXTENSION

## H.2.3.8 STAGES OF MITOSIS (EXTENDED STUDY)

### DEPTH OF TREATMENT

**D**etailed study with the aid of labelled diagrams of the stages of mitosis:

#### **Prophase**

recognised by the presence of condensed chromosomes, disappearance of nuclear membrane and formation of spindle.

#### **Metaphase**

presence of a fully formed spindle apparatus with chromosomes located at the equator of the cell.

#### **Anaphase**

centromeres split, chromosomes pulled back to each end of the cell.

#### **Telophase**

chromosomes are positioned within new nuclei. Cleavage furrow formation in animal cells, cell plate formation in plant cells.

#### ACTIVITIES

\*Examine suitably prepared plant or animal cells to show various stages of mitosis.

#### SUGGESTED RESOURCES

Film strips or slides of cell mitosis, projector, microscope.

## PREAMBLE TO SUB-UNIT 2.4: CELL DIVERSITY

1. Groups of similar cells are arranged into tissues, modified to perform specialised functions. When tissues are therefore discussed, function takes a special position of emphasis.
2. Organs are made up of several different tissues each of which contributes to the overall function of the organ as a whole within an organism.
3. Several organs working in conjunction form an organ system.

### CELL DIVERSITY / SUGGESTED CLASS PERIODS: 3 OL, 3 HL

#### 2.4.1 TISSUES

##### DEPTH OF TREATMENT

**D**efinition of a “**tissue**”.

Exemplify using four tissue types, two each from a plant and an animal.

##### ACTIVITIES

\*Visual recognition of three selected tissue types from both plants and animals.

##### SUGGESTED RESOURCES

A selection of plant and animal tissues.

#### *Contemporary Issues & Technology*

##### *Tissue culture:*

*Explanation: a technique in which individual cells are grown and divide in a bath of sterile nutritive fluid which often contains hormones and growth substances.*

*Reference to any two applications: cancer research, plant breeding, routine analysis of chromosome karyotypes.*

#### 2.4.2 ORGANS

##### DEPTH OF TREATMENT

**D**efinition of an “**organ**”.

Exemplify by using two kinds of organs, one each from a plant and an animal.

##### ACTIVITIES

\*Visual recognition of any three organs of plant or animal, to include naming of tissue components.

##### SUGGESTED RESOURCES

A selection of real or model organs, ICT, video.

#### 2.4.3 ORGAN SYSTEMS

##### DEPTH OF TREATMENT

**D**efinition of an “**organ system**”.

Exemplify using any two animal organ systems.

##### ACTIVITIES

\*Broad introduction to organ systems. (For detailed structure see Unit Three – the human).

## PREAMBLE TO SUB-UNIT 2.5: GENETICS

- Given the wide-ranging diversity of organisms, classification is an attempt, initially, to have an orderly system of cataloguing organisms and also an attempt to assemble related organisms.
- Characteristics result from heredity and environment.
- Heredity is the transmission of characteristics controlled by a genetic code contained within the chromosome structure.
- The genetic code controls the life processes within cells e.g. simple concept of protein synthesis: DNA sends out an instruction on how to link amino acids together to form proteins:  
DNA → RNA → protein.
- Students should therefore develop an appreciation and understanding of:  
The structure and role of DNA.  
The Mendelian concept of a gene.  
Expression of genes in the life of organisms.  
Transmission of genetic information from generation to generation.  
The influence of the environment and other factors in gene expression.
- Today's uniqueness in species represents the accumulated changes of a life process which is still changing, albeit slowly.
- Evolutionary theory tries to trace or link common origins for many of today's highly specialised organisms.
- Modern technological developments of genetics have led to an increasing influence of genetics on human life – commercial, social and ethical – that needs or demands informed debate.
- Further studies on nucleic acid structure and function, including protein synthesis, will enhance the student's knowledge of this topic.

### Higher Level Extension

- The science of genetics developed from the studies of Gregor Mendel who expressed his findings in two laws:-
  - The Law of Segregation
  - The Law of Independent Assortment.
- Diploid organisms inherit pairs of genes on pairs of homologous chromosomes. The two genes segregate from each

*Special Note:* While differentiation should be made between probabilities and certainties when teaching genetics, particular attention should be paid to this when considering sensitive aspects of human inheritance.

### MANDATORY ACTIVITY

#### LABORATORY INVESTIGATION

*Students should:*

Isolate DNA from a plant tissue.

## 2.5 GENETICS / SUGGESTED CLASS PERIODS: 27 OL, 36 HL

### 2.5.1 VARIATION OF SPECIES

#### DEPTH OF TREATMENT

Diversity of organisms that necessitates sub-classification to species level.

Definition of “**species**”. Refer also to the uniqueness or individuality found within species.

#### ACTIVITIES

\*Visit fieldwork site, zoo, natural history museum, botanic garden to observe the diversity of species.

\*Identify differences within species: tongue rolling, hair colour, skin colour, leaf shape, flower colour etc.

Show results by histogram.

## 2.5.2 HEREDITY AND GENE EXPRESSION

### DEPTH OF TREATMENT

**D**efinition and example of “heredity” and “gene expression”.



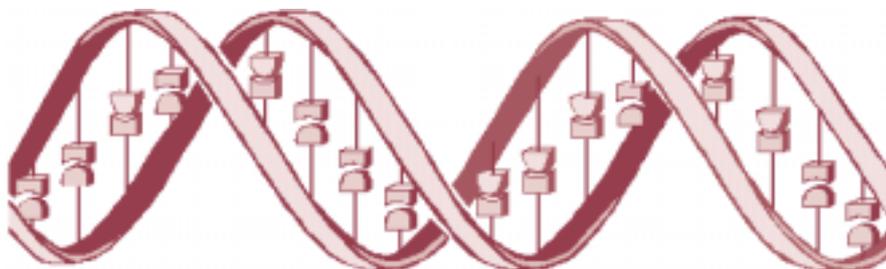
## 2.5.3 GENETIC CODE

### DEPTH OF TREATMENT

**D**efinition and role of a “gene”.

#### Chromosome structure

Refer to DNA and protein nature.



## 2.5.4 DNA STRUCTURE, REPLICATION AND PROFILING

### DEPTH OF TREATMENT

**S**imple structure of DNA:

DNA is a very long molecule. It consists of two strands. The two strands are linked together by paired bases. There are four different bases: Adenine (A), Thymine (T), Guanine (G) and Cytosine (C). Each base can only link with one other type, A with T and C with G.

Coding and non-coding structures.

Triplet base code.

Chromosome sequence of coding and non-coding (junk DNA) sequences.

RNA as a complementary structure to DNA. Refer to Uracil (U). Function of messenger RNA (mRNA) in protein synthesis.

Replication of DNA involving the opening of the helix followed by the synthesis of complementary nucleic acid chains alongside the existing chains to form two identical helices.

### ACTIVITIES

Isolate DNA from a plant tissue.

### SUGGESTED RESOURCES

Blender, sharp knife, chopping board, water bath at 60°C, ice in a jug, thermometer, beakers, coffee filter papers, onion, washing-up liquid, sodium chloride, distilled water, glass rod, syringe, boiling tube, protease enzyme, ice cold 95% ethanol.

### OTHER SUGGESTED RESOURCES

DNA model, video, CD, ICT.

### *Contemporary Issues & Technology*

*DNA profiling: definition, any two applications e.g. forensic and medical.*

*Stages involved:*

*cells are broken down to release DNA*

*DNA strands are cut into fragments using enzymes*

*fragments are separated on the basis of size*

*the pattern of fragment distribution is analysed.*

*Genetic Screening: diagnostic test(s) to identify the presence or absence of changed genes (detail of process not required).*

## 2.5.5 PROTEIN SYNTHESIS

### DEPTH OF TREATMENT

**D**NA contains a code for proteins.  
This code is transcribed to mRNA.

The transcribed code goes to a ribosome.

The code is translated and the amino acids are assembled in the correct sequence to synthesise the protein.

The protein folds into its functional shape.

### ACTIVITIES

\*Design or play a game to help understand protein synthesis.

## 2.5.6 GENETIC INHERITANCE

### DEPTH OF TREATMENT

**G**amete formation and function in plants and animals –

in sexual reproduction cells that transmit genes from one generation to another are called sex cells or gametes. During meiosis the diploid number of chromosomes (2n) is reduced to one set and gametes are formed. This single set is called the haploid number (n).

Definition of the following terms:

**fertilisation**  
**allele**  
**homozygous and heterozygous**  
**genotype**  
**phenotype**  
**dominance**  
**recessive**  
**incomplete dominance**

Study of the inheritance to the first filial generation (F1) of a single unlinked trait in a cross involving:

*homozygous parents*  
*heterozygous parents*

Genotype for each parent.

Representation of possible gametes resulting from meiotic separation or division of each parent cell.

Prediction of genotype(s) of the first filial generation (F1) using Punnett square.

Relation of phenotype(s) to genotype(s).

Sex determination –

the control of maleness and femaleness by genes located on sex chromosomes designated X and Y.  
A human male body cell has one X and one Y chromosome. A human female body cell has two X chromosomes.  
However bird, butterfly and moth females are XY and their males are XX.

Prediction of sex by genetic cross mechanism using Punnett square.

### ACTIVITIES

\*Place photographic or simulated models at different work stations in the laboratory to exemplify each of the terms, accompanied by test card questions and problems.

\*Perform simulations to investigate different crosses using Punnett squares.

\*Class project on sex ratio differential throughout the human life cycle. Communicate the results in a clearly written report.

### SUGGESTED RESOURCES

Test cards and questionnaires

## 2.5.7 CAUSES OF VARIATION

### DEPTH OF TREATMENT

Variation from: sexual reproduction and mutations.

#### Mutations

characteristics of mutant alleles e.g. random occurrence, low frequency.

Types of mutation:

gene mutation e.g. sickle-cell anaemia

chromosome mutation e.g. by number change in Down's syndrome.

#### Contemporary Issues & Technology

*Study any two agents responsible for increased mutation rates e.g. chemicals, radiation.*

## 2.5.8 EVOLUTION

### DEPTH OF TREATMENT

Definition of “**evolution**”.

Broad outline of Darwin and Wallace Theory of Natural Selection.

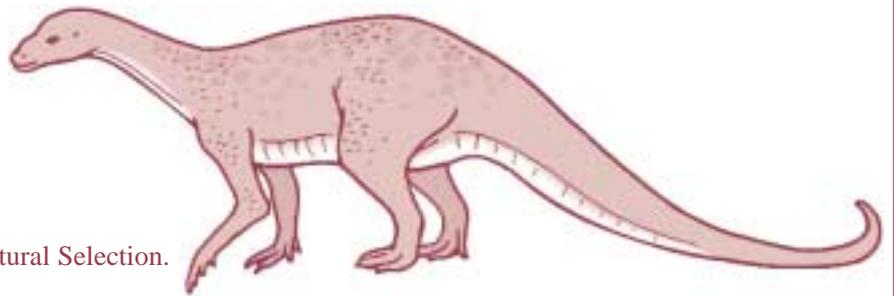
Evidence from any one source:

fossil studies of any one anatomical characteristic

comparative studies of the embryos of fish, tortoise, chick, rabbit, human

any plant or animal adaptation e.g. from aquatic to terrestrial life

genetics.



#### SUGGESTED RESOURCES

Games, videos, ICT.

## 2.5.9 GENETIC ENGINEERING

### DEPTH OF TREATMENT

Genetic engineering defined as the manipulation and alteration of genes. Process involves some or all of the following:

isolation, cutting (restriction), transformation (ligation),

introduction of base sequence changes, expression.

#### Contemporary Issues & Technology

*Three applications of genetic engineering: one plant, one animal, one microorganism.*

## HIGHER LEVEL EXTENSION

## H.2.5.10 ORIGIN OF THE SCIENCE OF GENETICS

## DEPTH OF TREATMENT

Work of Gregor Mendel leading to the expression of his findings in two laws.

## ACTIVITIES

\*Communicate the work of Gregor Mendel in a clearly written report.

## H.2.5.11 LAW OF SEGREGATION

## DEPTH OF TREATMENT

Law of Segregation:

each cell contains two factors for each trait, these factors separate during the formation of gametes so that each gamete contains only one factor from each pair of factors. At fertilization the new organism will have two factors for each trait, one from each parent.

## H.2.5.12 LAW OF INDEPENDENT ASSORTMENT

## DEPTH OF TREATMENT

Law of Independent Assortment:

members of one pair of factors separate independently of members of another pair of factors at gamete formation.

## H.2.5.13 DIHYBRID CROSS

Study of the inheritance to the second filial generation (F<sub>2</sub>) of two unlinked traits using the Punnett square technique.

## ACTIVITIES

\*Perform simulations to investigate Punnett square technique. Examination of cross to F<sub>2</sub> generation.

Definition of “**linkage**”.

Explanation of change in 1:1:1:1 probability for a dihybrid heterozygote crossed with a dihybrid recessive organism. (Knowledge of crossing over is not required).

Definition of “**sex linkage**”.

Common sex-linked traits: red-green colour blindness, haemophilia.

Non-nuclear inheritance:

existence of DNA in non-nuclear components of a cell e.g. mitochondrial and chloroplast DNA.

## H.2.5.14 NUCLEIC ACID STRUCTURE AND FUNCTION (EXTENDED STUDY)

### DEPTH OF TREATMENT

#### D<sup>NA</sup> –

Nucleotide structure:

one deoxyribose sugar, one phosphate,  
one of four named nitrogenous bases.

Specific purine and pyrimidine couples - complementary base pairs.

Hydrogen bonding.

Double helix.

#### ACTIVITIES

\*Use of a computer programme,  
video or biokits.

#### SUGGESTED RESOURCES

Video, ICT.

## H.2.5.15 PROTEIN SYNTHESIS (EXTENDED STUDY)

### DEPTH OF TREATMENT

#### P<sup>rocess of protein synthesis:</sup>

Enzymes unwind the DNA double helix.

Transcription – RNA nucleotide bases bond with one strand of exposed DNA. The enzyme RNA polymerase assembles these bases to form mRNA. mRNA, therefore, has a series of bases that are complementary to those in DNA.

mRNA moves into the cytoplasm. Each three base sequence of mRNA carries a genetic code or codon that specifies a starting codon, a particular amino acid or a stop codon.

Ribosome subunits (rRNAs) attach to the mRNA. These subunits form the ribosome, the site of protein synthesis.

Free-floating tRNAs with their attached amino acids, within the cytoplasm, are attracted by their 'binding site' to complementary mRNA already attached to the ribosome. This ensures the amino acids are aligned in a sequence determined by the codons of the mRNA.

Aligned amino acids bond to form links of the new protein molecule.

tRNAs continue to move to the ribosome, until a stop codon on the mRNA is reached. The protein is released when the mRNA code sequence is complete and the protein is synthesised.

#### ACTIVITIES

\*Use simulated modes to demonstrate the  
process of protein synthesis.

Communicate the result in a clearly  
written report.

#### SUGGESTED RESOURCES

Models, ICT, video.



# Section three

## class preparation material for unit three: the organism



**T**eachers are reminded, prior to reading this section, that the syllabus is the definitive prescribed material.

It is hoped that this section will help promote professional teaching methods as distinct from textbook methodology. This section could be used as a class guide through the syllabus. It is not intended to be a text for students as it contains both non-prescribed and prescribed material.

To assist and support you in class preparation:

- The preamble to each subunit gives a broad insight into the central ideas of the syllabus depth of treatment.
- The suggested 'texted' and practical detail should be used as suggestions to support you in:

**Depth of prescribed and non-prescribed material you wish to use.**

**Methodology practice to include practical activities.**

**Suggested resources.**

**Time parameters.**

Special attention in class preparation should be given to the use of **22 class periods** for non-prescriptive material at Ordinary level.

You may wish to use the non-prescribed activities and resources marked by an asterisk \* or use other materials such as DART.

# PREAMBLE TO SUB-UNIT 3.1: DIVERSITY OF ORGANISMS

1. We share this planet with a variety of organisms which are classified in five kingdoms: Monera (Prokaryotae), Protista (Protoctista), Fungi, Plant and Animal.
2. From the origin of the prokaryotic Monera, the eukaryotic Protista, Fungi, Plants and Animals have developed functional multicellular organisation.
3. Micro-organisms may be beneficial or harmful and must be handled with care.
4. Beneficial use is made today of micro-organisms, this requires detailed understanding of their life characteristics and how they function.
5. Safety precautions should be rigidly observed in all microbiological activities.

## MANDATORY ACTIVITIES

### LABORATORY INVESTIGATIONS

*Students should:*

Investigate the growth of leaf yeast using agar plates and controls.

*Students may refer to 2.2.5:*

Prepare and show the production of alcohol by yeast.

## 3.1 DIVERSITY OF ORGANISMS / SUGGESTED CLASS PERIODS: 14 OL, 17 HL

### 3.1.1 DIVERSITY OF ORGANISMS

#### DEPTH OF TREATMENT

**G**eneral introduction to microbial life and the five kingdom system of classification – Monera (Prokaryotae), Protista (Protoctista), Fungi, Plant and Animal. (Further sub-classification not required).

#### ACTIVITIES

\*Classify a number of organisms from each kingdom.

#### SUGGESTED RESOURCES

Microscopes  
Prepared slides or acetates

### 3.1.2 MICRO-ORGANISMS

#### DEPTH OF TREATMENT

**D**istribution of bacteria and fungi in nature – salt water, fresh water, terrestrial, air-borne.



### 3.1.3 MONERA, e.g. BACTERIA

#### DEPTH OF TREATMENT

**B**asic structure to include: cell wall, cell membrane, genomic material including plasmid, cytoplasm, flagella, capsule.

Three main types of shapes: cocci, spirals, rods.

Reproduction – asexual by binary fission.

Binary Fission: DNA replicates

cell elongates pushing the replicated DNA apart

ingrowths of cell membranes (and cell walls) occur forming two identical cells or organisms.

Because of their short life cycles and multiple generations, mutation becomes a very important feature.

Endospore formation: formed in unfavourable environments.

Here the cell shrinks, rounds up and forms a thick wall within the original structure.

When conditions are favourable, the spores absorb water, break their walls and reproduce by binary fission.

Nutrition — definition and examples of:

autotrophic - photosynthetic and chemosynthetic

heterotrophic – saprophytic and parasitic.

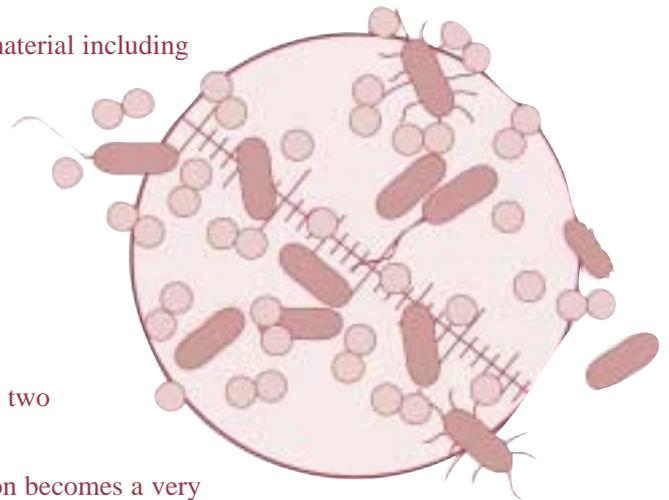
Factors affecting growth:

temperature, oxygen concentration, pH, external solute concentrations, and pressure.

Beneficial and harmful micro-organisms.

Understanding of the term "pathogenic".

Definition and role of "antibiotics". Need to refer to antibiotic resistance and competition between sensitive and resistant strains.



#### *Contemporary Issues & Technology*

*Economic importance of bacteria: examples of any two beneficial and any two harmful bacteria.*

*Potential abuse of antibiotics in medicine.*

### 3.1.4 FUNGI

#### DEPTH OF TREATMENT

**S**aprophytic and parasitic forms.

#### Rhizopus

Structure to include:

- hyphae and mycelium
- rhizoids
- sporangiophores
- stolon
- apophysis
- columella
- sporangium
- spores

Reproduction and life cycle:

Asexual reproduction — sporulation.

Some hyphae grow upwards and form a sporangium. The stalk of the sporangium is called a sporangiophore. Within the sporangium mitotic division occurs to produce a mass of cells. Penetration hyphae at the base of the sporangiophore are called rhizoids.

Each cell develops a resistant wall – now to be called a spore. If, when spores are dispersed by wind, they fall on a suitable substrate, they begin to germinate and give rise to new mycelia.

Sexual reproduction —

- production of progametangia
- formation of gametangia and suspensors
- zygospore formation
- germination of zygospore.

Mode of nutrition.

#### Yeast

Structure: unicellular nature, cell wall, nucleus, granular cytoplasm, vacuoles.

Reproduction by budding:

- a small extension (bud) is formed on the cell
- this bud enlarges and is filled with cytoplasm
- the nucleus of the parent cell divides by mitosis
- one of the nuclei formed moves into the bud
- which may remain attached to the parent and undergo further budding to form a colony
- or break free of the parent and form a new colony itself.

#### *Contemporary Issues & Technology*

*Edible and poisonous fungi:  
knowledge, methods of distinction  
and examples.*



#### *Contemporary Issues & Technology*

*Economic importance of fungi:  
examples of any two beneficial and any two  
harmful fungi.*

### 3.1.5 LABORATORY PROCEDURES WHEN HANDLING MICRO-ORGANISMS

#### DEPTH OF TREATMENT

**P**recautions when working with micro-organisms: assume that all are hazardous until otherwise proven.

Definition of the terms:

“**asepsis**” and “**sterility**” as applied to living organisms.

Sterilisation of working area, all equipment, instruments and materials before and after use.

Flaming of containers and loops during use.

Containment methods and safe disposal of unwanted materials after use.

### 3.1.6 PROTISTA, e.g. AMOEBA

#### DEPTH OF TREATMENT

**A**moeba – cell organisation to include nucleus and sub-cellular structures.

#### *Contemporary Issues & Technology*

*\*Mention of amoeboid diseases.*

### 3.1.7 PLANT, e.g. THE FLOWERING PLANT

#### DEPTH OF TREATMENT

**P**lant kingdom as exemplified by the flowering plant. (Refer to the remaining sub-units of Unit Three).

### 3.1.8 ANIMAL, e.g. THE HUMAN

#### DEPTH OF TREATMENT

**A**nimal kingdom as exemplified by the human. (Refer to the remaining sub-units of Unit Three).

#### ACTIVITIES

\*Prepare nutrient agar plates for inoculation.

Investigate the growth of leaf yeast using agar plates and controls.

#### SUGGESTED RESOURCES

Petri dishes  
Nutrient agar  
Autoclave or pressure cooker  
Alcohol  
Aseptic wash solutions  
Parafilm  
Glassware

Prepared nutrient agar plates  
Autoclave or pressure cooker  
Oven  
Alcohol  
Inoculating loops  
Heat source  
Aseptic wash solutions  
Leaf yeast source  
Parafilm  
Forceps.

## HIGHER LEVEL EXTENSION

## H.3.1.9 NATURE OF BACTERIA AND FUNGI

## DEPTH OF TREATMENT

**P**rokaryotic nature of bacteria. Eukaryotic nature of fungi.

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## H.3.1.10 GROWTH CURVES

## DEPTH OF TREATMENT

**P**lot a growth curve to include five phases – lag, log, stationary, decline/death, survival. Explanation of microbial behaviour in each stage.

***Contemporary Issues & Technology***

*Batch and continuous flow food processing. Batch – organisms in a five phase growth curve. Continuous – organisms maintained in a particular growth phase.*

# PREAMBLE TO SUB-UNIT 3.2: ORGANISATION AND THE VASCULAR STRUCTURES

In Unit One organisation was classified as a ‘characteristic of life’.

In Unit Two cellular organisation was examined in depth.

In this sub-unit we examine, with functional emphasis, organisation in organisms with special reference to the vascular system.

1. From the origin of the prokaryotic Monera and the eukaryotic Protista, Fungi, Plants and Animals have developed functional multicellular organisation.

2. Multicellular organisation involves tissues, organs, organ systems, individual organisms and populations.

3. Structural organisation relates to the functions necessary for metabolism and continuity.

### Higher Level Extension

4. A more detailed knowledge and understanding of specific functions of the vascular system in the human should be developed.

## MANDATORY ACTIVITIES MICROSCOPY, DISSECTION AND LABORATORY INVESTIGATION

*Students should:*

Prepare and examine microscopically the transverse section of a dicotyledonous stem ( $\times 100$ ,  $\times 400$ ).

Dissect, display and identify the parts of an ox’s or a sheep’s heart.

Investigate the effect of exercise on the breathing rate or pulse rate of a human.

### 3.2 ORGANISATION AND THE VASCULAR STRUCTURES / SUGGESTED CLASS PERIODS: 21 OL, 24 HL

#### 3.2.1 ORGANISATIONAL COMPLEXITY OF THE FLOWERING PLANT

##### DEPTH OF TREATMENT

Organisational complexity of the flowering plant as exemplified by the root, stem, leaf, flower, seed, and transport (vascular) structures.

Division into two portions – root system and shoot system. Describe the structures and function of each portion to include all outer stem parts and root zonations.

Explain the term “meristem”. Identify its location in the shoot and root apices.

Meristematic tissue divides to produce new cells in-situ, differentiation of which leads to:

dermal tissue — forms the protective covering of plants

ground tissue — fills the interior

vascular (transport) tissue — conducts water and nutrients in a plant.

Location of three tissue types – dermal, ground and vascular in transverse sections of the root, stem and leaf and in longitudinal sections of the root and stem.

Xylem and phloem form the two vascular tissues in angiosperms.

Describe each of their functions.

Draw and identify each tissue type.

##### ACTIVITIES

\*From a supply of plants, identify the root and shoot systems - locate the meristematic regions.

\*Draw and identify the position of each of these tissue types – dermal, ground and vascular in transverse and longitudinal sections of the root, stem and leaf.

\*Using prepared slides microscopically examine longitudinal view of xylem tracheid and xylem vessel cells, phloem sieve tube and companion cells.

Prepare and examine microscopically the transverse section (T.S.) of a dicotyledonous stem.

\*Examine and identify monocot. and dicot. leaves and seeds from a variety of plants.

##### SUGGESTED RESOURCES

Variety of plant material

Microscopes (or bioviewers), prepared slides

Microscopes, glass slides, cover slips, forceps, scalpels or backed blades, dissecting boards, petri dishes, filter paper, variety of plant material

Distinguish between xylem tracheid cells and xylem vessel cells, phloem sieve tube cells and companion cells.

Identification of dicotyledons (dicots): may be woody or herbaceous, have flower parts usually in units of fours and fives, have net leaf veins, have vascular bundles localised in an orderly array, which may be circular or opposite in the stem, have two cotyledons or seed leaves.

Identification of monocotyledons (monocots): are almost always herbaceous, have flower parts usually in units of threes, have parallel leaf veins, have scattered vascular bundles in the stem, have one cotyledon or seed leaf.

### 3.2.2 ORGANISATIONAL COMPLEXITY OF THE HUMAN

#### DEPTH OF TREATMENT

**O**rganisational complexity of animals as exemplified by the circulatory structures of the human system by brief reference to the efficiency of a closed circulatory system in humans.

Describe the structures and organisation of tissues in the closed circulatory system in humans.

The strong muscular heart in which the atria receive blood and the muscular ventricles pump the blood through the vessels.

Vessels of the human circulatory system. Draw, label and give the functions of the artery, vein and capillary. Refer to the existence and position of arterioles and venules – the role of muscle tissue and valves in the heart and circulatory tissues.

The existence of a two-circuit circulatory system in humans:

the pulmonary, pumping blood from the heart to the lung tissues and back.

the systemic, pumping blood from the heart to the remaining body tissues and back.

Draw the structure of the heart and the main pathways of blood circulation through the pulmonary and systemic pathways. Include the portal system – one that begins and ends in capillaries e.g. the hepatic portal vein.

As a living organ of the body the heart has its own blood supply through the coronary arteries and cardiac veins.

#### ACTIVITIES

\*Use models or charts to highlight the heart, arteries, arterioles, capillaries, venules and veins in the human.

\*Microscopic examination of an artery (T.S.) and a vein (T.S.).

Following the dissection of an ox's heart and attached vessels by the teacher, students should dissect an ox's or a sheep's heart and attached vessels in order to learn the skills of dissection and reinforce their knowledge of the heart structure by practical observation, labelling and drawing.

Investigate the effect of exercise on the breathing or pulse rate of a human.

\*Microscopic examination of prepared blood smear to identify the different blood cell types and platelets.

#### SUGGESTED RESOURCES

Models of heart and circulatory system.

Microscope, slides, scalpels, cover slips, boards, material for T.S.

Fresh ox/sheep hearts

Dissecting kits

Dissecting boards/

Dissecting trays

Coats or aprons

Pins and flag labels

Washing facilities.

Data logging, ICT

Set of leaflets from the Health Education Bureau and Irish Heart Foundation etc.

Microscopes

Prepared slides or bioviewers and slides.

#### *Contemporary Issues & Technology*

*Knowledge of the effects of smoking, diet and exercise on the circulatory system.*

Simple understanding of the following:

**Heartbeat and its control:** heartbeat is controlled by the pacemaker, situated in the right atrial wall. It initiates a wave of muscular contraction through the heart from atria to ventricles. The heartbeat sound is caused by the closing of valves in the heart.

**Pulse:** a wave of vibrations that passes down the walls of arteries when the aorta expands following a ventricular contraction.

**Blood pressure:** blood is forced into arteries under pressure from the left ventricle, the region of highest pressure, eventually reaching the right atrium, the region of lowest pressure. As it passes from arteries to arterioles to capillaries to venules and to veins the pressure decreases. Human blood pressure is taken normally for reference from an artery of the upper arm – it measures the amount of pressure required

to stop the flow of blood through this artery.

**The lymphatic system:** the lymphatic system is a one way system of vessels that returns excess tissue fluid to the blood circulatory system. The lymph nodes assist in fighting infection in the body. Description of any three functions of the lymphatic system is sufficient.

**Composition of blood, role of red blood cells, white blood cells, platelets and plasma:**

(classification of white blood cells not required).

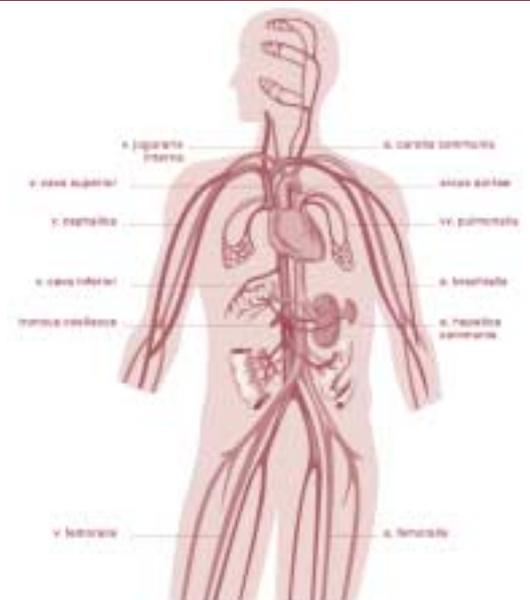
**Blood grouping:** names of the common blood groups A, B, AB, O and the Rhesus factor.

## HIGHER LEVEL EXTENSION

### H.3.2.3 BLOOD CELLS (EXTENDED STUDY)

#### DEPTH OF TREATMENT

**M**ore detailed treatment of red blood cells – e.g. absence of nucleus, absence of mitochondria, affinity for oxygen. White blood cell classification as lymphocytes and monocytes.



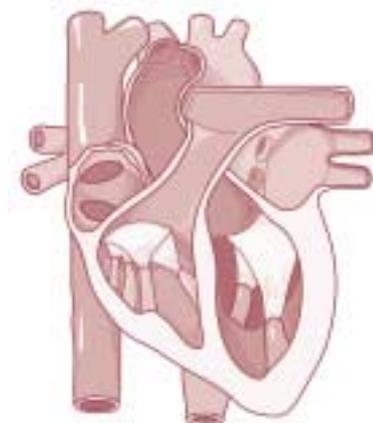
### H.3.2.4 HEARTBEAT CONTROL

#### DEPTH OF TREATMENT

#### **H**earbeat control

An awareness of:

- specialised heart muscle tissue
- the existence and location of pacemaker nodes
  - the SA (sinoatrial) node
  - the AV (atrioventricular) node.



#### **The heart cycle**

The functioning of the SA and AV nodes in relation to systole and diastole periods in the heart cycle.

# PREAMBLE TO SUB-UNIT 3.3: TRANSPORT AND NUTRITION

1. Plants are autotrophic and require the transport of water, carbon dioxide, oxygen and certain minerals for metabolism, growth and reproduction. This sub-unit examines how plants acquire and transport these substances to the site of photosynthesis and the distribution of photosynthetic products.
2. Leaf organisation in relation to its photosynthetic function.
3. Modification of leaves, stems and roots as food storage organs.
4. Animals are heterotrophic and must absorb preformed food. The variety of adaptations by animals to this function varies greatly. This sub-unit specifically examines the acquisition and transport of nutrients in humans.
5. The concept of a balanced diet.

### Higher Level Extension:

6. The cohesion – tension model of xylem transport.

## MANDATORY ACTIVITIES

### LABORATORY SKILLS

*Students may refer to 2.2.6:*

Conduct any activity to demonstrate osmosis.

## 3.3 TRANSPORT AND NUTRITION / SUGGESTED CLASS PERIODS: 15 OL, 16 HL

### 3.3.1 NUTRITION IN THE FLOWERING PLANT

#### DEPTH OF TREATMENT

Plants are autotrophic and require the transport of water, carbon dioxide, oxygen and certain minerals for metabolism (e.g. photosynthesis, respiration), growth and reproduction.

Description of the uptake and transport of the following through the plant:

#### Water

Water moves into the root hair cells from the soil, by osmosis.

Water diffuses from cell to cell across the ground or cortex tissue until it reaches the vascular tissue – the xylem.

Xylem vessels now form the best route for the transport of water to all parts of the plant.

They form a continuous hollow pipeline from roots to leaves.

The transport of water up through the xylem is helped by root pressure generated by water entering the root cells by osmosis which pushes the water up the xylem.

When water evaporates from the cells in the leaf (transpiration), the cells become less turgid. This creates an osmotic gradient that causes the water to move from the xylem cells out to these cells.

#### ACTIVITIES

Carry out an experiment to demonstrate osmosis using an artificial cell or living material (as in Unit Two, sub-unit Two).

\*Demonstrate the pathway of water in plants using dye experiments.

\*Demonstrate the use of the potometer and atmometer to investigate the rate of transpiration.

#### SUGGESTED RESOURCES

Visking tubing, glucose solution, iodine solution\*\*

Plant stem, leaf or flower, food dye

Leafy shoot, potometer, atmometer, vaseline

ICT

The loss of water from the leaves is controlled by a waxy cuticle and by the opening and closing of the stomata.

### Minerals

Minerals dissolved in water are transported from the roots to all parts of the plant by the same route as water.

### Carbon dioxide

Carbon dioxide can be obtained directly from respiring cells or enter the leaves through open stomata.

### Photosynthetic products

Within the primary photosynthetic organ of the plant, the leaf, the photosynthetic process occurs in chlorophyll containing cells. The product is stored as starch or transported from the leaves to other plant cells through phloem sieve tube cells.

#### ACTIVITIES

\*Microscopically examine the transverse section of a leaf. Draw and label its cell parts.

#### SUGGESTED RESOURCES

Microscopes, slides, cover slips, scalpels or backed blades, dissecting boards, petri dishes, filter paper.

## 3.3.2 MODIFIED PLANT FOOD STORAGE ORGANS

### DEPTH OF TREATMENT

One example of a root, stem and leaf modification as a food storage organ should be examined.

#### Root modification

In some plants e.g. dicots, the first root grows straight down to form the main root of the plant. This root may become fleshy and modified to store food.

#### Stem modification

Modified swollen terminal bud or modified stems called tubers that function in the storage of food e.g. potatoes.

#### Modified leaves

Leaves can be modified for food storage e.g. onion bulbs, celery or rhubarb leaf petioles .

#### ACTIVITIES

\*Examine a selection of modified roots, stems and leaves.

#### RESOURCES REQUIRED

Selection of modified roots, stems and leaves.

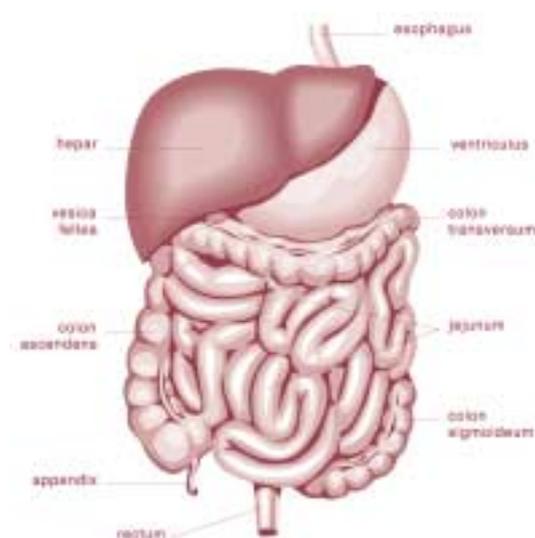
## 3.3.3 NUTRITION IN THE HUMAN

### DEPTH OF TREATMENT

Animals are heterotrophic organisms that must take in preformed food. Whilst humans and some other animals are omnivores most animals are either herbivores or carnivores. Simple definition of each of these terms.

Explain the term "digestion". Outline the need for digestion and a digestive system.

Explain the terms "ingestion", "digestion", "absorption" and "egestion" as related to the sequence in the human digestive tract.



### 3.3.4 HUMAN DIGESTIVE SYSTEM

#### DEPTH OF TREATMENT

**M**acrostructure and basic function of the alimentary canal and associated glands in digestion and transport of nutrients.

Explanation of the mechanical breakdown and transport of food, to include the role of teeth (dental formula for humans only), the term peristalsis and a description of its effects, the contractions of the stomach and how they help in the breakdown of food.

Explanation of the chemical breakdown of food, to include:

- bile salts
- the role, production site, pH at a named location of action, and products of an amylase, a protease and a lipase enzyme.

Refer to the presence and two functions of symbiotic bacteria in the digestive tract.

Outline the benefits of dietary fibre.

Explain how the structure of the small intestine is related to its function (villi and associated structures – digestion, absorption and transport of food).

Describe the role of the large intestine in water absorption and elimination of faeces.

### 3.3.5 BLOOD TRANSPORT OF NUTRIENTS

#### DEPTH OF TREATMENT

**D**escribe the composition of blood fluid as a transport system of nutrients in the human body.

Describe the absorption of the nutrients in the digestive tract into the blood vessels and lacteals of the villi.

Transfer of nutrients from the villi through the hepatic portal vein to the liver.

Describe the functions of the liver (without detailed biochemical pathways) in list format.

The transport of nutrients from the liver to all nutrient-requiring cells of the body.

The transport of waste products to the kidney for filtration and excretion.

#### ACTIVITIES

\*In order to highlight the characteristic teeth of herbivores, carnivores and omnivores – examine various representative skulls.

\*Use a model display of the human alimentary canal to identify its main parts.

\*Examine a prepared section of the small intestine using prepared slides, transparencies or other suitable visual aids to gain a general understanding of its structure in relation to its function. Detailed histology not required.

\*Examine a prepared blood smear slide to determine the composition of blood fluid. (Students should not use fresh blood samples).

\*Note the size and position of the liver in a model of the human system.

\*Write an essay on medical disorders as outlined.

#### SUGGESTED RESOURCES

Various skulls of herbivores, carnivores and omnivores.

Model of human alimentary canal.

Microscopes, prepared slides of the small intestine

Microscopes, prepared blood slides

Model of the human system.

Portfolio file.

#### *Contemporary Issues & Technology*

\* *Medical disorders of the digestive system.*

\* *Brief note (one paragraph each in essay format) of the symptoms, cause and prevention of the following: dental decay / stomach ulcers / appendicitis / dietary – any one vitamin or one mineral deficiency /slimming disorders.*

### 3.3.6 BALANCED HUMAN DIET

#### DEPTH OF TREATMENT

**E**xplain the concept of a balanced diet, variety and moderation.

Relate its importance to age, sex and activity — simple treatment only.

#### Variety from food groups

- milk and milk products
- meat, fish and poultry
- bread and cereals
- fruit and vegetables
- others e.g. fats, oils, alcohol.

Refer to the food pyramid.



#### HIGHER LEVEL EXTENSION

### H.3.3.7 COHESION–TENSION MODEL OF XYLEM TRANSPORT

#### DEPTH OF TREATMENT

**T**he cohesion – tension model explains how water is transported in plants to extreme heights against the force of gravity.

It relates to:

the attractive forces between water molecules

the ability of these forces to hold water molecules in a column without breaking when a tension is applied (cohesive property)

transpiration that causes this tension

how tension can pull a column of water of very small diameter up to great heights in xylem vessels.

Refer to the work of Dixon and Joly.

## PREAMBLE TO SUB-UNIT 3.4: BREATHING SYSTEM AND EXCRETION

- All organisms have the ability to maintain constant conditions in their cells and bodies such as temperature, fluid balance and chemistry. This is achieved by homeostasis e.g. by diffusion, by developing exchange systems which include the respiratory and excretory systems.
- In all organisms adequate amounts of gases, nutrients and toxic wastes are exchanged by diffusion between cells and their environment. The efficiency of exchange is proportional to the surface area over which diffusion can take place.
- In large organisms, such as plants and animals, the problem of size in relation to diffusion and exchange have been overcome by various means such as:
  - the body may be flattened, thus reducing the distance between the two surfaces e.g. the leaves of plants.
  - increasing the surface area e.g. alveoli in the respiratory system.
  - the body may develop systems where the material is brought to the body surface e.g. by respiratory and excretory systems.
- Because diffusion can only effectively distribute materials over a short distance, about 0.5 mm, large active animals such as humans also require a circulatory system to help in the transport of gaseous materials and toxic waste.
- Following an understanding of the role of the breathing and excretory systems, students should understand the structures and functioning of these systems.

### Higher Level Extension

- Controlling factors in gaseous exchange and excretory functions.

### MANDATORY ACTIVITY LABORATORY INVESTIGATION

*Students may refer to 3.2.2:*

Investigate the effect of exercise on the breathing rate or pulse rate of a human.

## 3.4 BREATHING SYSTEM & EXCRETION / SUGGESTED CLASS PERIODS: 12 OL, 14 HL

### 3.4.1 HOMEOSTASIS

#### DEPTH OF TREATMENT

**D**efinition of "homeostasis".

### 3.4.2 NECESSITY FOR HOMEOSTASIS

#### DEPTH OF TREATMENT

**N**ecessity to maintain constant conditions in the cells and bodies of living organisms such as temperature, fluid balance and chemistry.

### 3.4.3 THE STRUCTURE OF AN EXCHANGE SYSTEM IN FLOWERING PLANTS

#### DEPTH OF TREATMENT

**E**xamination of the structure of a leaf in relation to gaseous exchange of oxygen and carbon dioxide through the stomata. Mention the role of lenticels in stem structure.

#### ACTIVITIES

\*Examine microscopically a T.S. of a leaf blade. Note the intercellular air spaces allowing free diffusion of carbon dioxide and oxygen.

\*Examine stomata distribution on a leaf blade.

#### SUGGESTED RESOURCES

Microscopes  
Leaf blades  
Backed blades  
Raw potato  
Glass slides  
Cover slips  
Sellotape

### 3.4.4. THE BREATHING SYSTEM IN THE HUMAN

#### DEPTH OF TREATMENT

**M**acrostructure and basic function of the breathing tract in humans. (Nasal and buccal cavities, pharynx, epiglottis, glottis, larynx, trachea, bronchi, bronchioles, alveoli).

Essential features of the alveoli and capillaries as surfaces through which gaseous exchange takes place.

Describe the mechanism of the breathing system in the exchange of gases to include:

the role of the diaphragm, the intercostal muscles and brain (exclude CO<sub>2</sub> levels) in breathing

pressure changes in the thoracic cavity

gaseous exchange in alveoli

role of haemoglobin in oxygen transport

source of carbon dioxide from the plasma

water vapour exhalation.



#### *Contemporary Issues & Technology*

*Breathing disorders: one example from the following:*

*Asthma or bronchitis*

*One possible cause — triggering agents e.g. pollen, dog and cat dander, house mites, infections, drugs, vigorous exercise and psychological stress.*

*Prevention, treatment e.g. use of inhalers.*



#### ACTIVITIES

\*Use models or charts to highlight the main parts of the respiratory system in humans.

\*Demonstrate the mechanism of breathing using the "Artificial Lung Experiment".

\*Students may carry out the breathing exchange experiment using limewater or bicarbonate indicator.

Experiment to show the effect of exercise on the breathing rate.

\*By a series of acetates compare healthy lungs with lungs of unhealthy respiratory systems.

\*Demonstrate the effect of cigarette smoke using cotton wool, bicarbonate indicator etc.

#### SUGGESTED RESOURCES

Model of respiratory system in the human

Bell jar and artificial lung attachments

Large test tubes

Rubber tubing

Clips

Double-holed stoppers

Limewater or bicarbonate solution

Apparatus to measure breathing rate.

Data logging, ICT

Leaflets from the Asthma Society of Ireland and the Health Education Bureau, Department of Health.

Acetates and overhead projector.

### 3.4.5 PLANT EXCRETION

#### DEPTH OF TREATMENT

**E**xamine the role of leaves and lenticels as excretory organs of plants. Students should appreciate however that excretion is an animal function and that secretion or loss from plant would be more appropriate.

#### ACTIVITIES

\*Conduct experiments to show that plants lose gases through the stomata of leaves.

#### SUGGESTED RESOURCES

Limewater or bicarbonate indicator

Test tubes or conical flasks

Corks, potted plants, light source, vaseline.

### 3.4.6 THE EXCRETORY SYSTEM IN THE HUMAN

#### DEPTH OF TREATMENT

The role of the excretory system in homeostasis:

a very simple introduction to the role of the excretory system in humans by reference to homeostasis – the ability and necessity to maintain constancy of body temperature, fluid balance and chemistry.

#### Body temperature

Temperature influences the rate of the chemical reactions that sustain life.

Refer to the different methods of temperature regulation in animals.

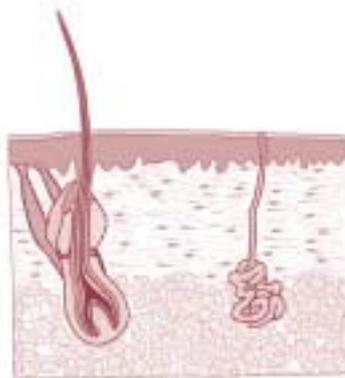
Ectotherms – lose or gain heat by moving into areas where temperature is suitable.

Endotherms – source of heat is internal from its own metabolic heat.

#### Temperature regulation in humans

Refer to piloerection, vasoconstriction and brain initiated increased metabolic rate as responses to cold conditions.

Refer to perspiration as a response to warm conditions. Include the evaporation of sweat, position of sweat glands in the skin, components of sweat and the necessity to drink water before, during and after exercising to maintain the balance of water and salts in the body.



#### Fluid balance and chemistry

Macrostructure and basic function of the urinary excretory system in humans (kidneys, ureters, urinary bladder, and urethra).

Role of the kidney in extracting wastes and toxins from the blood and recycling valuable substances by filtration, reabsorption and secretion – thus regulating the body fluids and chemistry of the body.

By reference only to the cortex, medulla and renal pelvis identify the positions of filtration, reabsorption and secretion in the kidney.

Describe the pathway of urine from the kidney to the urethra.



#### ACTIVITIES

\*Use acetates or videos to refer to different methods of body temperature control in animals, include the human.

\*Use photographs or acetates or model to show T.S. of human skin.

\*Examine model or chart display of excretory system of the human.

\*Write an essay report on "Unhealthy Urinary Systems".

#### SUGGESTED RESOURCES

Acetates and overhead projector  
Video

Acetates and overhead projector  
T.S. of human skin

Model or display chart of human excretory system.

Portfolio

#### Contemporary Issues & Technology



\*Unhealthy urinary systems.

Paragraph reference to:

*bacterial urinary tract infections*

*formation of kidney stones*

*renal tubule failure*

*dialysis*

*kidney transplants*

## HIGHER LEVEL EXTENSION

### H.3.4.7 CARBON DIOXIDE: A CONTROLLING FACTOR IN GASEOUS EXCHANGE

#### DEPTH OF TREATMENT

Carbon dioxide concentration is a controlling factor in stomatal opening and in the human breathing (respiratory) system.

### H.3.4.8 THE NEPHRON AS A UNIT OF KIDNEY FUNCTION

#### DEPTH OF TREATMENT

The nephron structure and its associated blood supply.

#### Formation of urine

Blood enters the glomerulus under pressure which force-filters the plasma minus proteins and other large molecules into the lumen of the Bowman's capsule.

The glomerular filtrate passes from the Bowman's capsule into the proximal convoluted tubule where reabsorption of substances needed by the body takes place.

Glucose, amino acids, some salts and water are reabsorbed back into the blood by osmosis, diffusion, and active transport.

More water is reabsorbed in the Loop of Henle and the distal convoluted tubule.

The remainder, now called urine, passes into the pelvis of the kidney and to the bladder for storage.

Reabsorption of water in the collecting duct is under hormonal influence (ADH). Its secretion depends on the water content of the blood.

#### ACTIVITIES

\*Examine a nephron structure using photographs, acetates, microslides.

\*Use video for kidney functions.

#### SUGGESTED RESOURCES

Acetates or microslides and overhead projector

Video



# PREAMBLE TO SUB-UNIT 3.5: RESPONSES TO STIMULI

- Living organisms sense and respond to certain environmental changes, responding in a variety of ways.
- Plants and animals respond in complex ways, for example, by growth and movement.
- Response is a form of defense that allows organisms to survive.
- Some structures of behaviour include:
  - chemical or hormonal system
  - nerve and sense organ system
  - muscular and skeletal systems
  - an immune system e.g. response to viral infection.

## Higher Level Extension

- Extended study of response in plants and animals.

## MANDATORY ACTIVITY LABORATORY INVESTIGATION

*Students should:*

Investigate the effect of IAA growth regulator on plant tissue.

### 3.5 RESPONSES TO STIMULI / SUGGESTED CLASS PERIODS: 32 OL, 37 HL

#### 3.5.1 STRUCTURES FOR RESPONSE

##### DEPTH OF TREATMENT

**C**hemical or hormonal system.

Nerve and sense organ systems.

Movement to include growth, muscular and skeletal.

An immune system.

#### 3.5.2 RESPONSES IN THE FLOWERING PLANT

##### DEPTH OF TREATMENT

**G**rowth regulation

Some external factors that regulate the growth of plants are light intensity, day length, gravity, temperature.

Among the principal internal factors that regulate these responses is the production of a series of chemicals called growth regulators in regions of the plant called meristematic regions. Give examples of some meristematic regions.

##### Tropisms

Definition of the following tropisms:

"phototropism"

"geotropism"

"thigmotropism"

"hydrotropism"

"chemotropism"

Emphasise the significance of phototropism and geotropism, with examples.

##### ACTIVITIES

\*Draw the external structure of a flowering plant. Highlight and identify meristematic regions.

\*Conduct a series of simple experiments to demonstrate phototropism.

##### SUGGESTED RESOURCES

Plant samples.

Plant material

Growing boxes

Light sources

**Regulatory system**

Definition of growth regulator, transport through the vascular system.  
Different combinations of regulators bring about different effects.

Some regulators promote growth e.g. auxins.

Others inhibit growth e.g. ethene and abscisic acid.

Describe any four methods by which plants protect themselves from adverse external environments – anatomical/chemical e.g. heat shock proteins or stress proteins.

**Contemporary Issues & Technology**

*Use of plant growth regulators: any two examples.*

*Commercial preparation e.g.  
as rooting powders*

*in tissue culturing*

*ethene in green banana ripening*

## ACTIVITIES

\*Use acetates to show the variety of effects of plant growth regulators.

Investigate the effect of IAA growth regulator on plant tissue.

\*Demonstrate the skill of taking plant tissue cuttings and the use of rooting powders to promote growth.

\*Examine and identify a number of plant protective measures (use living samples or video).

## SUGGESTED RESOURCES

Acetates and overhead projector

Plant material

Hand sprayer

Beaker

Spatula

Mask

IAA

Plant material

Secateurs

Rooting powder

Compost

Flower pot

Visit a habitat

Video

**3.5.3 RESPONSES IN THE HUMAN**

## DEPTH OF TREATMENT

**The nervous system**

The division of the human nervous system into two parts – the central nervous system (CNS) and the peripheral nervous system (PNS).

Receptor messages are carried through these systems by nerve cells or neurons.

Neuron structure with reference only to cell body, dendrites, axon, myelin sheath, Schwann cells and neurotransmitter vesicles.

The structure and function of a neuron:  
variation in size and shape.

Three part structure —

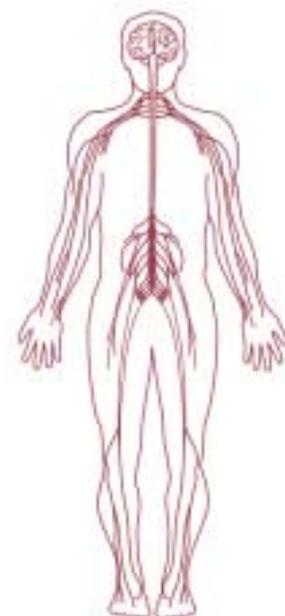
dendrite(s) receive information and carry it towards the cell body,  
the axon conducts nerve impulses away from the cell body,  
the cell body contains the nucleus and other organelles and produces neurotransmitter chemicals.

## ACTIVITIES

\*Use acetates to highlight and identify CNS and PNS.

## SUGGESTED RESOURCES

Acetates and overhead projector.



Knowledge that the conduction of nerve impulses along a neuron involves movement of ions (details not required). The region where two neurons come into close contact is called the synapse. Refer to the gap between the neurons as the synaptic cleft.

When neurotransmitters are activated by the ions they are released into the cleft for a very short time, transmitting the impulse to the next neuron.

After transmission, the neurotransmitter is inactivated by an enzyme and reabsorbed by the presynaptic neuron and used to make new neurotransmitter substance.

Three types of neurons - sensory, motor and interneuron:

- sensory neurons - carry messages from the sense organ to the CNS
- motor neurons - carry messages from the CNS to muscle fibres and glands
- interneurons - carry messages within the CNS.

The sense organs contain receptors.

The brain acts as the interpreting centre for received information.

Knowledge of the five senses and related organs.

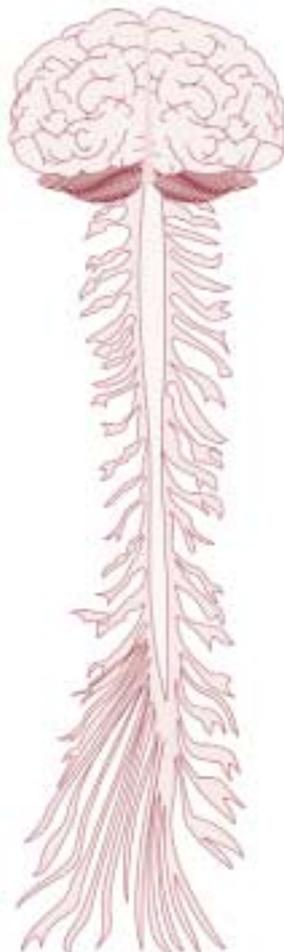
Recognition of the main parts of the eye and ear. Single statement of function related to each part.

Corrective measures for long sightedness and short sightedness or for a hearing defect.

**Note:** The following are not required:  
 biochemical action  
 detailed structure of cochlea and semi-circular canals in ear  
 names of sensory receptors in the skin.

Central nervous system: the brain and spinal cord.

Recognition of location and function of the following parts of the brain: cerebrum, hypothalamus, pituitary gland, cerebellum, and medulla oblongata.



ACTIVITIES

SUGGESTED RESOURCES

\*Examine a prepared slide of a neuron, draw and identify its parts.

Microscopes  
 Prepared slides of neuron or bioviewers

\*Use the drawing of the neuron from the previous activity to highlight the path direction of a nerve impulse with a coloured pencil.

Drawing sheets  
 Coloured pencils

\*Draw, from an acetate, a synapse and with a different pencil colour shade in the release of the neurotransmitter across the synaptic cleft, its breakdown using an eraser, and re-absorption. Mention how some drugs inhibit or prolong this effect.

\*Simple experiments on taste, smell, touch, temperature and pressure.

Different taste solutions  
 Droppers  
 Needles  
 Cold object

\*Use of convex or concave lenses as a corrective measure for sight defects

Warm object  
 Convex and concave lenses  
 Lighted candle

\*Study the structure of the ear using charts or models.

Screen  
 Stands

\*Refer to possible hearing disability as a result of excessive noise levels.

Model of ear.

\*Use of hearing aids.

\*Use model of skin to revise structure as a sense organ.

Model of skin.

\*Using a model of the brain to show its major parts in relation to function.

Model of the brain or charts

Cross-section of the spinal cord indicating the following:  
 white matter (containing axons only), grey matter (cell bodies and dendrites), central canal (filled with cerebrospinal fluid)  
 three-layered protective tissue, the meninges (spinal meningitis is an infection of these layers)  
 spinal nerves containing dorsal and ventral roots that project from the spinal cord.

ACTIVITIES

\*Use a prepared slide to identify, draw and label the main parts of a T.S. of the spinal cord.

\*Write a brief note on paralysis or Parkinson's disease.

SUGGESTED RESOURCES

Prepared slide of T.S. of spinal cord, microscopes or bioviewer.

**Contemporary Issues & Technology**

*Nervous system disorders:*

*any one example of a nervous system disorder from the following: paralysis or Parkinson's disease; one possible cause, prevention, and treatment.*



The peripheral nervous system:

important to emphasise that the PNS contains nerve fibres – structures of long dendrites and/or long axons. There are no cell bodies in nerves as cell bodies are only found in the CNS or in ganglia (collection of cell bodies within the PNS e.g. the dorsal root ganglion).

Role, structure and mechanisms of the reflex arc/action.

**Note:** Cranial nerves, sympathetic and parasympathetic systems are not required.

ACTIVITIES

\*Demonstration of the reflex action.

**The endocrine system**

Definition of a “**hormone**”.

Refer to the protein nature of many hormones.

**Contemporary Issues & Technology**

*Hormone supplements: two examples of their use.*



Emphasise the general slow and sustained nature of hormone action as compared with nerve action.

Distinguish between exocrine and endocrine glands, with examples.

Locate the principal endocrine glands in the human.

For each of the glands name one hormone and give its function. For one hormone give a description of its deficiency symptoms, excess symptoms, and corrective measures.

**The musculoskeletal system**

Functions of the skeleton:

- framework of the body
- protection of internal organs
- assists in movement.



ACTIVITIES

\*Use model of the human skeleton to identify the axial and appendicular regions and their main parts.

SUGGESTED RESOURCES

Model of human skeleton.

Structural division of the skeleton into two parts – the axial and the appendicular .

Component parts of the axial skeleton: skull, vertebrae, ribs, and sternum.

Detail of skull not required.

Position and function of discs in relation to vertebrae.

Vertebrae:

cervical (7), thoracic (12), lumbar (5), sacrum (5), and coccyx (4).

Component parts of the appendicular skeleton:

pectoral and pelvic girdles and their attached limbs.

Pectoral girdle:

clavicle (collar bone)

scapula (shoulder blade).

Attached appendages:

humerus, radius, ulna, carpal, metacarpals, digits (fingers) containing phalanges.

Pelvic girdle:

innominate bones (hip bones) attached to the sacrum surrounding a cavity.

Attached appendages:

femur, patella, tibia, fibula, tarsals, metatarsals, digits (toes)

containing phalanges.



Macroscopic anatomy of a long bone:

not solid but contains a cavity called the medullary cavity bounded by compact bone tapering to spongy bone, a further layer of compact bone and finally a layer of cartilage.

Structure and function of parts as follows–

Cartilage:

acts as a shock absorber

composed of protein fibres and is flexible.

Compact bone:

gives strength and rigidity

consists of living cells which are supplied by blood vessels and nerve fibres.

Spongy bone:

gives strength and rigidity

contains bony bars and plates separated by irregular spaces.

These spaces are filled with:

red marrow that produces blood cells

yellow marrow that contains fat-storage tissue.

**Note:** T.S. of bone is not required.

#### ACTIVITIES

\*Macroscopic examination of a long bone to identify the main parts.

\*Show the mineral content in bone and consequently the organic component.

#### SUGGESTED RESOURCES

Model or longitudinal section of bone

Bone

Acid solution

Tongs

Classification, location and function of joints—

Immovable: between skull bones.

Slightly movable: between the vertebrae and also between hip bones.

Free moving or synovial: describe the structure of one synovial joint. Hinge: e.g. knee or elbow, ball and socket e.g. hip or shoulder.

#### ACTIVITIES

\*Use model of the skeleton to highlight (a) position and (b) function of each type of joint

#### SUGGESTED RESOURCES

Model of skeleton

### Contemporary Issues & Technology

*Disorders of the musculoskeletal system: one example of a musculoskeletal disorder, from the following: arthritis and osteoporosis; one possible cause, prevention, and treatment.*

Role of cartilage and ligaments in joints.

Role of tendons.

General relation of muscles to the skeleton – antagonistic muscle pairs as exemplified by one human pair e.g. one muscle bends the joint and brings the limb towards the body, the other muscle straightens the joint and extends the limb.

#### The defence system in humans

The human body is designed to protect itself from foreign bodies and cells in two orders of defence – general and specific.

General defence system consists of:

Barrier to entry: the skin and mucous membrane lining of the respiratory, digestive and reproductive tract. The skin, acting as a structural barrier, secretes chemicals from the sebaceous glands that harm or kill bacteria. The respiratory and digestive tracts as well as other organs of the body secrete mucus and/or further chemicals that may remove foreign particles.

Phagocytic white blood cells: some types engulf bacteria and viruses upon contact. Others secrete chemicals that stimulate general defence and cause fever to destroy microbes at high temperatures.

Specific defence system:

Organs specific to the immune system: the spleen, thymus and lymph nodes.

Lymph and blood vessels contain cells called lymphocytes and monocytes. Lymphocytes and monocytes are produced in the bone marrow. These cells respond to antigens.

Antigens are defined as foreign molecules capable of eliciting an antibody response.

These may be found in bacterial cell walls, viral coats, foreign cells or produced in cancerous cells.

Antigen immunity usually lasts for a long time.

Induced immunity: there are two types of induced immunity – active and passive.

Active immunity —

develops after vaccination or after an infection  
provides long lasting protection.

Passive immunity —

occurs when individuals are given antibodies to combat the disease, since these are not produced by the body's cells, they are short lived.

#### ACTIVITIES

\*Investigate and discuss the work of Edward Jenner (1749-1823).

\* Investigate antigen/antibody reactions

#### SUGGESTED RESOURCES

ELISA project



### Contemporary Issues & Technology

*Vaccination and immunisation.*

### 3.5.4 VIRUSES

#### DEPTH OF TREATMENT

**V**iruses:

identify the problem of definition - living or non-living?

awareness of the variety of shapes

basic structure of a virus

viral reproduction only within living cells therefore can be called obligate parasites.

#### *Contemporary Issues & Technology*

*Briefly outline the medical and economic importance of viruses to humans, plants, animals. Include reference to two harmful examples, one beneficial example e.g. foot and mouth, rabies, polio, influenza, common cold, mosaic diseases of tobacco, tomato, potato, AIDS etc.*

#### ACTIVITIES

\*Teachers may take this opportunity to discuss a historical or present day human viral infection, such as AIDS, with their students

- its nature
- its transmission
- its effects: individual and numerical
- methods of transmission, control and protection.

#### SUGGESTED RESOURCES

Refer to Advisory, Research & Developmental Units of the Department of Health, university research units etc.

### HIGHER LEVEL EXTENSION

### H.3.5.5 AUXINS

#### DEPTH OF TREATMENT

**S**tudy auxin as an example of a plant growth regulator:

production site(s)

function

different effects.

### H.3.5.6 PLANT GROWTH REGULATORS AND ANIMAL HORMONES (EXTENDED STUDY)

#### DEPTH OF TREATMENT

**E**xplain the mechanism of plant response to any one external stimulus.

Description of the feedback mechanism of any one animal hormonal system.

### H.3.5.7 HUMAN IMMUNE SYSTEM (EXTENDED STUDY)

#### DEPTH OF TREATMENT

**R**ole of lymphocytes:

There are two types of lymphocyte cells: B cells and T cells.

B cells produce antibodies – proteins capable of combining with and inactivating antigens by surface recognition. Each B cell produces just one type of antibody.

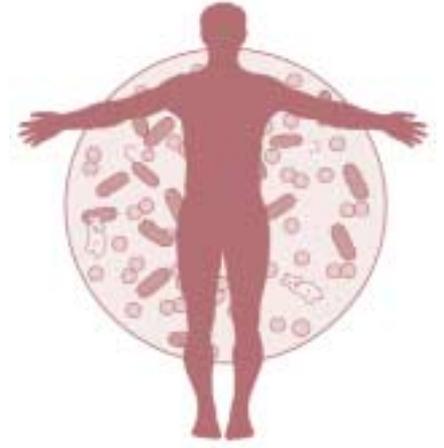
T cells do not produce antibodies instead they act in one of four processes:

as helper T cells which recognise antigens, enlarge, and secrete chemicals, such as interferon, which stimulate the production of B cells

as killer T cells which attack cells containing a foreign antigen, secrete a chemical called perforin that perforates the membranes of cells

as suppressor T cells which stop immune responses

as memory T cells which can memorise the immunity, even for life.



### H.3.5.8 GROWTH AND DEVELOPMENT IN BONES

#### DEPTH OF TREATMENT

**B**one-forming cells are called osteoblasts which replace cartilage with bone during the growth stage in a human. The bone eventually stops increasing in size and limits the individual adult's height.

In adults, bone is continually being broken down and replaced.

As osteoclasts break down bone, osteoblasts build it up. The broken down bone is absorbed by osteoclasts. Osteoclasts remove worn cells and deposit calcium into the blood.

The continued renewal of bone is dependent upon physical activity, hormone levels, and diet.

Role of calcium in bone.

# PREAMBLE TO SUB-UNIT 3.6: REPRODUCTION AND GROWTH

In Unit One reproduction was classified as a "characteristic of life".

In Unit Two cellular reproduction was examined in depth.

In this sub-unit we examine reproduction and growth in organisms.

1. Sexual reproduction involving the production and transfer of gametes, fertilisation, and development of the embryo as exemplified by the flowering plant and the human.

2. Outline growth and development of the embryo as exemplified by the flowering plant and the human.

3. Influence of humans on the continuity of organisms of:  
(a) their own species  
(b) plants.

## MANDATORY ACTIVITIES LABORATORY INVESTIGATION

*Students should:*

Investigate the effect of water, oxygen, and temperature on germination.

Use starch or skimmed milk agar plates to show digestive activity during germination.

### 3.6 REPRODUCTION & GROWTH / SUGGESTED CLASS PERIODS: 30 OL, 38 HL

#### 3.6.1 REPRODUCTION IN THE FLOWERING PLANT

##### DEPTH OF TREATMENT

It is advisable to start with an activity that allows students to discover the variety of flowers, structures, colours etc.

##### Flower structure

Describe the structure and function of the flower parts: sepal, petal, stamen, filament, anther, stigma, style, ovary, carpel, receptacle.

**Note:** The terms calyx, corolla, androecium, gynoecium are not required.

Pollen grain produces male gametes (statement only).

Embryo sac produces an egg cell and polar nuclei (statement only).

Definition and methods of **"pollination"**: self-pollination and cross-pollination, to include wind and animal pollination.

##### Contemporary Issues & Technology

*\*Hay fever and pollen:*

*brief reference to relationship between pollen and hay fever.*



##### ACTIVITIES

\* Examine a variety of flowers, ask the students to draw what they see, use a key to name the parts and discover their functions.

\* Discuss the evolutionary development and diversity from wind pollination to animal pollination, relate to place (habitat), position and function.

\*Examine microscopically a T.S. of an anther to highlight only the position of the pollen sacs and contents.

\*Examine a L.S. of a carpel, identify and label its parts.

\*Examine:  
– the structure of grass to show adaptation for wind pollination  
– the structure of a flower adapted for animal pollination e.g. primrose, snapdragon etc.

\*Play a video on co-evolution between plants and their animal pollinators.

##### SUGGESTED RESOURCES

Variety of flowers

Key to flower parts and functions

Microscopes,  
Slides,  
Dissection kits,  
Anthers.

Hand lens  
Carpels

Grass flowers

Primrose

Snapdragon etc.

Video

“**Fertilisation**” definition.

When the pollen grain lands on the stigma it germinates forming a pollen tube which grows down through the style to the opening of the embryo sac.

The generative nucleus divides by mitosis in the tube to form two male gametes.

One of these gametes fertilises the female gamete or egg to form a diploid zygote.

After such fertilisation the zygote develops into an embryo.

A second fertilisation with polar nuclei results in the formation of the endosperm.

Seed structure and function of the following parts: testa, plumule, radicle, embryo, and cotyledon attachments by reference to epicotyl and hypocotyl.

As the ovule develops, a seed is formed which consists of an embryo and a food supply. The food supply is contained either in an endosperm or in seed leaves (the cotyledons).

Classification of seeds as monocotyledons containing one seed leaf and dicotyledons containing two seed leaves.

Further distinguishing features–

In monocots, the cotyledon rarely stores food; rather it absorbs food molecules from the endosperm and passes them on to the embryo.

In dicots, the cotyledons usually store the food that the embryo uses.

This is typical of non-endospermic seeds e.g. broad bean seeds.

### Fruit formation

Developing seeds produce growth regulators to stimulate growth of the fruit tissues.

Seeds are protected by a seed coat and may be contained within a fruit.

A fruit is a mature ovary or sometimes a modified floral part (e.g. the receptacle) that may contain seeds.

**Note:** classification of fruits not required.

### Fruit and seed dispersal

Seeds are dispersed to ensure a better chance of survival.

Dispersal avoids overcrowding and minimises competition.

#### ACTIVITIES

\*Examine, draw and label the parts of one example of a dicotyledonous non-endospermic seed.

#### SUGGESTED RESOURCES

Sunflower seeds

Broad bean seeds

Dissecting kits

#### ACTIVITIES

\*Examine a variety of fruits and seeds to observe dispersal mechanisms of wind, water, animal – internal, animal - external to examine how their structures are related to survival in the habitat.

#### SUGGESTED RESOURCES

Variety of fruits and seeds

### Contemporary Issues & Technology

*Seedless fruit production caused by genetic variety of plants and growth regulators.*

*Highlight the role of genetics and growth regulators in seedless fruit production, bigger and larger fruit and vegetable production.*

*Use of ethene to ripen bananas, melons, tomatoes, and to degreen oranges, lemons, grapefruit.*

Highlight the wide variety of seed dispersal techniques and examine examples of wind, water, animal and self-dispersal.

“**Dormancy**” definition.

Outline the advantages of dormancy.

“**Germination**” definition.

Factors necessary for germination include water, oxygen, and a suitable temperature.

Describe the effect of each of the factors listed on the process of germination.

### ***Contemporary Issues & Technology***

*Mention of dormancy in agricultural and horticultural practices.*

Outline the role of digestion and respiration.

Stages of seedling growth.

Asexual reproduction in plants. A very basic knowledge of vegetative propagation.

One example each from stem, root, leaf, and bud.

Compare reproduction by seed with reproduction by vegetative propagation.

### ***Contemporary Issues & Technology***

*Artificial propagation in flowering plants.*

*Exemplify any four methods used by horticulturalists to artificially propagate plants e.g. cuttings, layering, grafting, tissue culturing (micro-propagation).*

#### ACTIVITIES

Investigate the effect of water, oxygen, and temperature on germination.

Use starch or skimmed milk agar plates to show digestive activity during germination.

\*Examine the stages of: epigeal seedling growth e.g. sunflower;

hypogeal seedling growth e.g. broad bean.

Include labelled diagrams of each stage examined.

\*Demonstrate the techniques of artificial propagation in flowering plants (details not required by students).

#### SUGGESTED RESOURCES

Test tubes/petri dishes

Cotton wool or absorbing paper

Oxygen controls

Temperature controls

Starch/  
skimmed milk  
agar plates

Germinating  
barley seeds

Iodine solution\*\*

Potting compost

Containers

Broad bean seeds

Sunflower seeds

Samples of stems,  
roots, leaves and  
buds suitable for  
vegetative  
propagation.

### 3.6.2 SEXUAL REPRODUCTION IN THE HUMAN

#### DEPTH OF TREATMENT

The human reproductive system is organised as follows:

male/female paired structures in which male gametes, sperm/female gametes, eggs (ova), are produced  
a series of transport tubes

glandular structures for the secretion of various hormones that control the entire process.



#### The human male reproductive system

Identify and draw the main parts of the human male reproductive system and associated glands.

Describe the function of each labelled part.

Particular emphasis should be placed on the role of meiosis in the production of sperm cells in the testis.

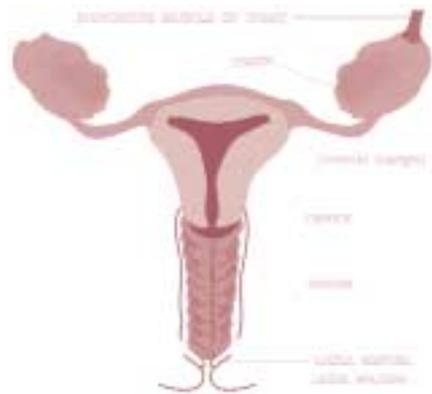
(Note: Detailed treatment of spermatogenesis is not required).

Definition of “secondary sexual characteristics”.

The role of the male reproductive hormone, testosterone, in the development and maintenance of the adult male.

#### Contemporary Issues & Technology

*One cause of male infertility from the following disorders:  
low sperm count, low sperm mobility, endocrine gland failure.  
Availability of corrective measures.*



#### The human female reproductive system

Identify and draw the main parts of the human female reproductive system and associated glands.

Describe the function of each labelled part.

Particular emphasis should be placed on the role of meiosis in the production of egg cells (ova) in the ovary.

(Note: Detailed treatment of oogenesis is not required).

The role of the female reproductive hormones, oestrogen and progesterone, in the development and maintenance of the adult female.

The events of the menstrual cycle including the role of oestrogen and progesterone.

#### ACTIVITIES

\*From diagrams or model of the male reproductive system:

- draw and label the main parts
- describe their functions.

#### SUGGESTED RESOURCES

Charts

Models

Outlined stages of copulation in both male and female to include:

- sexual arousal
- copulation
- orgasm.

Survival time for sperm and ova.

Location of fertilisation.

Implantation, placenta formation and function (detailed embryological terms not required).

Birth and lactation.

Outline how birth occurs.

Role of hormones in the process of birth and lactation.



### Contemporary Issues & Technology

*One cause of female infertility from the following disorders:  
blocked fallopian tubes, endocrine gland failure*

*Availability of corrective measures.*

*Birth control:*

*natural, mechanical, chemical and surgical methods of contraception.*



*In-vitro fertilisation and implantation:*

*outline the biological principles underlying in-vitro fertilisation and the implantation of embryos.*

*Biological benefits of breastfeeding.*



### ACTIVITIES

\*From diagrams or model of the female reproductive system:

- draw and label the main parts
- describe their functions.

\*Use acetates to highlight the hormonal control associated with the menstrual cycle.

\*Use acetates, videos or samples to identify and explain methods of contraception.

\*Use acetates or models of the female reproductive system to show the development of the embryo to the end of the third month.

### SUGGESTED RESOURCES

Chart  
Models

Acetates  
Overhead projector  
Leaflets on "periods" from the Council for the Status of Women and Health Promotion Unit, Department of Health.

Acetates  
Overhead projector  
Video or samples  
Leaflets on "Family Planning and Contraception", Health Promotion Unit, Department of Health.

Acetates  
Overhead projector  
Models of the female reproductive system

Leaflets from Health Promotion Unit, Department of Health. "Breast feeding – the early days of getting started" – Cuidiú (Irish Childbirth Trust), La Leche League.

## HIGHER LEVEL EXTENSION

### H.3.6.3 SEXUAL REPRODUCTION IN THE FLOWERING PLANT (EXTENDED STUDY)

#### DEPTH OF TREATMENT

**P**ollen grain development from microspore mother cells: meiotic division, mitotic division, generative nucleus and tube nucleus production, formation of pollen grain.

Embryo sac development: megaspore mother cell, meiotic division, cell disintegration, mitotic division in the production of eight cells in the embryo sac, one of which is the egg cell.

(Note: Antipodal cells and synergids not required.)

### H.3.6.4 HUMAN EMBRYO DEVELOPMENT (EXTENDED STUDY)

#### DEPTH OF TREATMENT

**S**equence of development from fertilised egg, morula, blastocyst, implanted blastocyst.

Existence of amnion.

Mention of placenta formation from embryonic and uterine tissue.

Significance of organisation of the embryo cells into three germ layers: endoderm, mesoderm and ectoderm.

List of basic organ systems that arise from each of the primary germ layers.

By the end of the third month –

the eyes are low and widely spaced

bone tissue appears, grows and cartilage is replaced by harder tissue

nerves and muscles become co-ordinated, arms and legs move

sex organs differentiate, male or female is obvious in the twelfth week

the foetus sucks its thumb, kicks, begins to grow baby teeth

breathes amniotic fluid in and out, urinates and defecates into it

in the remaining months the baby grows.

## H.3.6.5 SEXUAL REPRODUCTION IN THE HUMAN (EXTENDED STUDY)

### DEPTH OF TREATMENT

**D**etailed study of the menstrual cycle and hormonal control.

#### *Contemporary Issues & Technology*

*Menstrual disorders:*

*Choose one example of a menstrual disorder from the following: endometriosis and fibroids;  
one possible cause, prevention and treatment.*

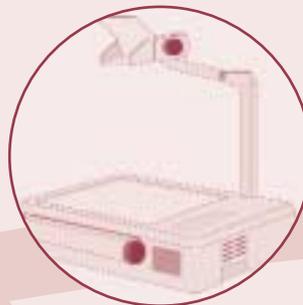
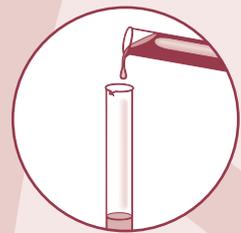




# Section four

## resources

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## 4.1 INTRODUCTION

Many resources are available for the teaching of biology at Leaving Certificate level. This section suggests how such resources may be found and evaluated. The use of information and communication technology in the teaching of biology is briefly considered.

## 4.2 USING RESOURCES

The term 'resources' is used here to cover anything that supports the teaching of biology. Resources include e.g. slides, wall charts, books, videos, CDs, and laboratory equipment. Each teacher will collect resources that suit his or her style of teaching. Any change in the syllabus requires that such material be reviewed to see whether or not it suits the syllabus.

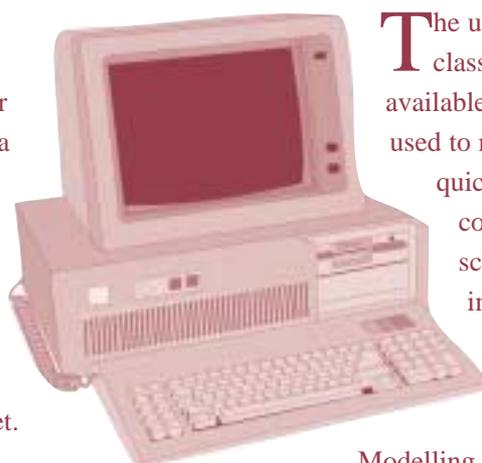
Resources can be found through many journals such as those of the Irish Science Teachers Association and the Association for Science Education. Both journals review

books, posters, videos and software. Both contain relevant articles on different aspects of biology and science and are an excellent source of ideas. Newspapers are a valuable source of ideas. Newspapers such as *The Irish Times* and *The Guardian* have special days for science and education. Television and radio programmes, both school programmes and programmes of special interest, are suitable resources. Many large industries, public companies and local authorities also have educational resources.

Any resource, whether a video, a CD or an overhead slide has to be evaluated by the teacher to see how it fits the syllabus, their teaching scheme, their style of teaching and their students. Many suitable resources are produced in Britain and America and need to be adapted for use in Ireland. Finally, it is always useful to re-evaluate any resource after a period to see if it is still useful.

## 4.3 INFORMATION AND COMMUNICATION TECHNOLOGY

The use of information and communication technology in the teaching of biology has been explored for many years. The use of spreadsheets, data logging, computer-aided learning, modelling and simulating may be helpful in the teaching of biology. These suggestions will be gradually incorporated in the biology teacher's repertoire. Other uses of ICT that can be explored are CDs, e-mail, and the Internet.



The use of computers in the biology classroom will depend on resources available to the teacher. Data loggers may be used to record measurements and plot graphs quickly. Modems may be used to communicate and interact with other schools. Word-processors may be used in writing biology notes or examination questions, while spreadsheets may be used to analyse data and see the patterns in a given set of data.

Modelling and simulations may be useful where the concepts discussed are beyond the scope of the school laboratory. Educational software is often reviewed in journals as previously mentioned.

## 4.4 THE NATIONAL BIOLOGY SUPPORT SERVICE

The nbss was established in January 2001 under the auspices of the In-career Development Unit of the Department of Education and Science and is administered by The Education Centre, Dromtacker, Tralee, Co. Kerry.

The aim of the service is to support biology teachers in the teaching of this Leaving Certificate Biology Syllabus.

The Support Service consists of a National Co-ordinator, eleven Regional Development Officers, and an Administrator.

For further details visit the nbss website at [www.nbsstralee.ie](http://www.nbsstralee.ie)

Telephone: 066 719 5050

Fax: 066 719 5090

E-mail: [admin@bsstralee.ie](mailto:admin@bsstralee.ie)

## 4.5 OTHER RESOURCES

### In classroom/laboratory:

- A number of guidebooks to identify fauna and flora, reference books
- Wall charts, posters
- Models
- Games
- Television set
- VCR, tapes
- Slide projector, slides
- Computer and software, printer, scanner
- CD Rom, DVD
- Multimedia projector
- Overhead projector
- Microscopic eye or visiview camera
- Videologging system
- Datalogging systems

### In preparation room:

- Laboratory equipment to include **all** materials listed in the *Biology Leaving Certificate Practical Handbook*
- Oven
- Fridge-freezer









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