ZIAUDDIN UNIVERSITY
EXAMINATION BOARD

Biology
IX
Teacher Resource

Table of Contents

ZIAUDDIN UNIVERSITY EXAMINATION SYLLABU

BIOLOGY CURRICULUM DISTRBUTION

GRADE 9

Sections	Chapters	Weightage in Evaluation
Section 1 Study of Life	Introduction to Biology Solving Biological Problem	09 %
Section 2 Cell Biology	Cells and Tissues Cell Cycle	11 %
Section 3 Life Processes	Nutrition Transport Gaseous Exchange	20 %
Section 4 Continuity of Life	Continuity of Life: Reproduction	7%
Section 5 Ecology	Humankind and Environment	06 %

SYLLABUS

CHAPTER	TOPIC	STUDENT LEARNING OUTCOMES
1. Introduction to Biology	Definition of Biology. Divisions and Branches of Biology. Relation of Biology to other sciences. The Levels of Organization	UNDERSTSANDING Define biology its major divisions i.e. botany, zoology and microbiology. Define the branches of biology i.e. morphology, anatomy, physiology, embryology, taxonomy, cell biology, histology, paleontology, environmental biology, biotechnology, socio-biology, parasitology, immunology, entomology, genetics, pharmacology. Explain how the study of biology can lead to Medicine / Surgery, Fisheries, Agriculture, Animal husbandry, Biotechnology, Horticulture, Farming, Forestry. Identify that living organisms are divided in five groups i.e. prokaryotes, protists, fungi, plants and animals. Describe bioelements as the most the most basic level of biological organization. Define biomolecules and distinguish them as micromolecules and macromolecules. Describe the level of organization of life (organelles, cells, tissues, organs and organ systems and individuals). SKILLS Identify different organs and organ systems in a dissected frog. • Draw a linkage chart connecting different organs with the relative organs systems.
2. Biological PROBLEM	Biological Method. Scientific problem, Hypotheses, Deductions and Experiments Theory, Law and Principle Data organization	UNDERSTSANDING Describe how science(biology) knowledge has been developed i.e recognition of a biological problem, observation and identification, building up hypothesis, drawing deductions, devising experiments, and inferring results (malaria) Explain the importance of data analysis for confirming, modifying, or rejecting a hypothesis. Justify mathematics as an integral part of the scientific process

	and Data analysis Mathematics as an integral part of the Scientific Process	SKILLS Identify and pose meaningful, answerable scientific questions. For a given biological problem; Formulate and test a working hypothesis. Write instructions for conducting investigations or following a procedure. Select appropriate instruments and materials to conduct an investigation. Describe laboratory procedures Organize data appropriately using techniques such as tables and graph Analyze data to make prediction, decisions Use ratio and proportion in appropriate situations to solve problem.
7. HUMAN RESIRATORY SYSTEM	GASEOUS EXCHANGE IN MAN AIR PASSAGE WAY AND LUNGS MECHANISM OF BREATHING RESPIRATORY DISORDERS AND THEIR CAUSES (ASTHMA, BRONCHITIS, PNEUMONIA, LUNG CANCER) EFFECTS OF SMOKING	UNDERSTANDING Describe the roles of the parts of air passageway and of lungs. Describe the mechanism of breathing in term of movements of ribs and diaphragm. state the rate of breathing at rest and after exercise. Differentiate between the composition OF inspired and expired air. Describe briefly diseases related to respiratory system like bronchitis, emphysema, pneumonia, asthma, and lung cancer. Describe the biological consequences of smoking in relation to the lungs and circulatory system. SKILLS (analyzing and interpreting) Draw diagram of organs of human respiratory system from model/chart. Identify the structure of air sac in humans by slide/photomicrograph. Identify larynx, trachea, bronchi, bronchioles, alveoli and associatedcapillaries in the chart of human respiratory system. (Performing and recording)

		Investigate the breathing rate at rest and after exercise. Find out how much air a person can take into his lungs. Demonstrate through experiment of breathing out air into limewater that carbon dioxide is exhaled during respiration. Use model to show the action of diaphragm and ribs. 4- respiratory disorders è understanding student will: SKILLS (initiating, recognition and communication) Establish the importance of breathing in fresh air. Establish the importance of keeping nasal and oral cavity clean to avoid diseases. STS CONNECTIONS Outline the concept of Artificial Ventilator for artificial breathing in patients. Assess the adverse effects associated with smoking on health. Point out bad social aspects of smoking.
8. CONITNUITY OF LIFE: REPRODUCTION	Reproduction Asexual Reproduction in Animals Sexual Reproduction in Animals	Understanding Define reproduction and describe itsimportance. Outline the binary fission, multiple fission, budding and fragmentation as asexual methods of reproduction in animals. Define fertilization and differentiate between external and internal fertilization. Describe different organs of the male and female reproductive systems of rabbit. Describe the processes of gametogenesis in rabbit. Rationalize the need for population planning. Explain AIDS as an example of sexually transmitted diseases. State the role of National AIDS Control Program and different NGOs in educating people with reference of AIDS.

		Skills (Performing and Analyzing) Draw different stages of binary fission in amoeba after observing them through slides or charts. STS Connections: Justify cloning as a form of asexual reproduction. State the advantages and disadvantages of having large families. Debate the social implications of AIDS and other sexually transmitted diseases
9 HUMAN AND THEIR ENVIRONMENT	The Ecosystem: Levels of Ecological Organization; Components Flow of materials and energy in the ecosystem Biogeochemical Cycles (Carbon Cycle & Nitrogen Cycle) Interactions in the Ecosystem Ecosystem Balance and Human impact on environment: Population growth, urbanization, industrialization, deforestation Pollution, its consequences and control Conservation of Nature	UNDERSTANDING: Describe levels of ecological organization. Define ecosystem. Describe the interrelationships between different components of the ecosystem. Explain that the sun is the principal source of energy for all biological systems. Compare and contrast the flow of materials (cyclic) and the flow of energy (non-cyclic) in the ecosystem. Describe food chains and food webs. Describe and compare energy relations between different trophic levels. Interpret pyramids of numbers and biomass. Explain competition, predation and symbiosis (parasitism, mutualism, commensalisms). Relate competition, predation, and parasitism with population growth Describe the importance of balance in nature. Explain the human impact on environment. Explain some global and regional environmental problems

		(population growth, urbanization, global warming, deforestation, acid rain). Eplain causes of air, water, and land pollution. Describe effects of pollution on plants, animals and human beings. Describe possible actions to control pollution. Skills (Observing, Analyzing and Interpreting) Identify and list producers and consumers in pond ecosystem and describe the interrelations among biotic and abiotic factors, involved here. Relate biogeochemical cycles with flow of energy and ecological balance. Interpret the data about local environmental problems. (data may be collected through surveys or literature search) • plan and carry out simple investigations to determine the nature and effects of pollutants. State the names of endangered and threatened species of Pakistan (data maybe collected through internet or literature search). STS CONNECTIONS Describe the possible consequences of competition (due to limited resources and overpopulation) in human society. Interpret population growth trends and its possible consequences on our society, through data from internet and literature search on population growth in Pakistan from 1990 to 2000. Identify environmental problems in your community. what are possible causes? suggest measures to solve the problems become familiar with and be sensitive to local environmental problems. Actively participate in the community efforts for conservation of nature. Organize/ actively take part in poster or picture exhibition at school.

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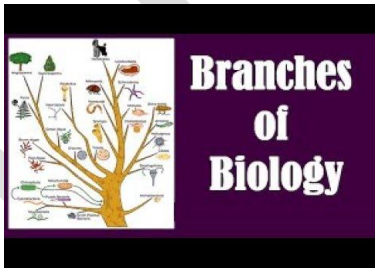
SECTION ONE: STUDY OF LIFE

CHAPTERS:

Introduction to Biology

Solving a Biological Problem

	CHAPTER	STUDENT LEARNING OUTCOMES	Reference Materials
1.	Introduction to Biology	UNDERSTSANDING Define biology its major divisions i.e. botany, zoology and microbiology. Define the branches of biology i.e. morphology, anatomy, physiology, embryology, taxonomy, cell biology, histology, paleontology, environmental biology, biotechnology, socio-biology, parasitology, immunology, entomology, genetics, pharmacology. Explain how the study of biology can lead to Medicine / Surgery, Fisheries, Agriculture, Animal husbandry, Biotechnology, Horticulture, Farming, Forestry. Identify that living organisms are divided in five groups i.e. prokaryotes, protists, fungi, plants and animals. Describe bioelements as the most the most basic level of biological organization. Define biomolecules and distinguish them as micromolecules and macromolecules. Describe the level of organization of life (organelles, cells, tissues, organs and organ systems and individuals). SKILLS Identify different organs and organ systems in a dissected frog. • Draw a linkage chart connecting different organs with the relative organs systems.	  

OVERVIEW of the Chapter:

This Chapter introduces different branches of biology so that students can have a broad view of different

Nature, scope and importance of Biology:

Biology is a branch of science that deals with the study of life. Scientific study of life.

(What is life? The condition that distinguishes animals, plants and microorganisms from inorganic matter. This includes capacity for growth, reproduction, functional activity, and continual change).

• Biology helps to know about the diversity in the living world, the ways by which it can be conserved, more about ourselves. • Biology is a vast field. It includes the study of various aspects of living organisms and their interactions with the non-living components.

• Biology has three primary branches – Botany (the study of plants), Zoology (the study of animals) and Microbiology (the study of microorganisms)

• Some areas of study in these branches: Taxonomy (classification), Morphology (study of external form), Anatomy (study of internal structure), Histology (study of tissues), Cell Biology (Study of cells), Genetics (study of how characters pass to the next generation), Physiology (study of how the animals and plant function) etc. • Interdisciplinary branches indicate the relationship of Biology with other branches of science. Some common interdisciplinary branches are Biophysics, Biochemistry, Biometry and Bioinformatics. Psychology and Sociobiology are interdisciplinary branches involving Biology and Social Sciences. • Applied branches enable us to apply the knowledge gained from different areas to be used for welfare of man, animals and plants. These include branches like Agriculture, Animal husbandry, Aquaculture, Entomology, Aquaculture, Food technology and Biotechnology.

• Biology is important to everyday life in many ways.

• It helps to understand how our body is made, how it functions and how it could be maintained in a healthy manner

• it helps to understand the resources we use and potential threats to those resources

• it helps to understand our environment we live, threats to our environment and how we could conserve our environment. • it helps to understand how life originated on earth and how it has evolved over time.

• it helps to understand how the characters pass from generation to generation.

• It helps to improve our health

• It helps to increase food production

Issues pertaining to Biology: Understanding Biological Diversity

•Biological Diversity:

The variety of life on earth; The number of species of plants, animals, and microorganisms, the diversity of genes in these

species, the different ecosystems on the planet, such as deserts, rainforests and coral reefs are all part of a biologically diverse Earth.

• Diversity of these is huge – Hence, it is very difficult to understand all of them

• Number of species on earth: • Estimated Number: 10 -100 million

• Described and catalogued: 1.2 million

• Number of genes in humans: 19,000-20,000

• Number of ecosystems: An ecosystem includes all of the living things (plants, animals and microorganisms) in a given area, interacting with each other, and also with their non-living environments : How many ??? How challenges could be overcome by new technologies?:

Molecular Biology, genetic engineering,

Understanding the human body and how it functions

• Many things are not known yet.

• New research is continuously being done; understand what triggers ageing, how cancer originates, how it can be suppressed/controlled, how brain works, the interrelationship between an individual's characteristics (phenotype) and its DNA sequence, - Use of molecular Biology, Nanotechnology, Biophysics, DNA Technology Understanding the plant life • Many are not known about plant life too. • How plants function? • How they synthesize various material in their bodies?

How challenges are over come by new technologies?: Use of molecular Biology, Nanotechnology, Biophysics, DNA TechnologyEnvironmental biology

Management of natural resources and environment

• Very important issue • Must fill existing gaps in our understanding of the processes that produce biodiversity and contribute to its loss, and to gain a fundamental understanding of how diversity affects productivity, and invasive ability of certain species and anthropogenic impacts

• How utilization of natural resources could be managed to get the benefits in a sustainable manner

• How environment could be managed

• How degraded environments could be restored

• What are the current environmental issues and how they could be solved/mitigated.

Use of Bioinformatics - an interdisciplinary field that develops methods and software tools for understanding biological data. It combines computer science, statistics, mathematics, and engineering to analyze and interpret biological data.

Sustainable food production

• Human population is ever increasing

• Environment is getting degraded

• How these affect food production?

• How Biology can contribute to increase food production?

• Improving the quality of the soil by biological methods e.g. Using microorganisms Biotechnology

• Improving the productivity of plants and animals that are used as food: Breeding techniques, Genetical improvement – Genetic engineering, molecular biology

• Reducing losses due to pests and diseases or in storage.

• Sustainability is also important in food production – the methods that are used must be useful for many future generations rather than for few seasons. • Sustainability includes reducing the carbon footprint of the farming methods also. • The amount of carbon dioxide released into the atmosphere as a result of the activities of a particular individual, organization, or community. Use of Biotechnology – Give examples; Nanotechnology - nanocapsules containing herbicides; bionanosensors

Understanding diseases and causes

• Emerging diseases – Give some current examples

• Leishmaniasis - caused by the protozoan Leishmania parasites which are transmitted by sand flies.

• Dengue – Dengue virus Transmitted by Aedisaegyptii and Aedisalbopictus –

change in feeding pattern – Use of Biotechnology

Use of Bioinformatics, Computational Biology

• Cancer – Many research is being done - Use of Nanomedicine –

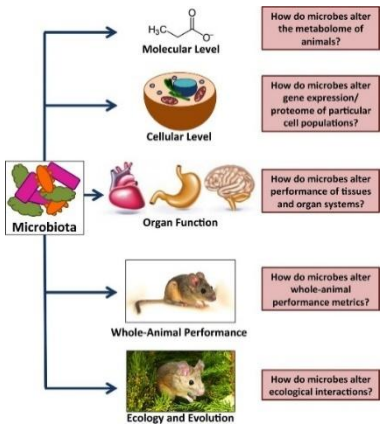
Nanorobots Legal and ethical issues

Give current examples where modern technology in Biology has been used in legal matters

– Identifying criminals, paternity tests Ethical issues in Biology

– Discuss giving examples; killing animals for research, asking highly personal questions in research, Killing endangered animals for research, etc., How challenges could be overcome by new technologies?: DNA Technology etc.

The Levels of Organization



In order to understand the various phenomena of life, biologists' study biological organization at different levels, which are as follows.

1. Subatomic and Atomic level All types of matter are made up of elements and each element contains a single kind of atoms ('a': not, 'tom': cut). The atoms are actually made up of many subatomic particles. The most stable subatomic particles are electrons, protons and neutrons. Out of the 92 kinds of elements that occur in nature, 16 are called bioelements. These take part in making the body mass of a living organism (Figure 1.2). Out of these bioelements; Only six (O, C, H, N, Ca, & P) make 99% of the total mass. Other ten (K, S, Cl, Na, Mg, Fe, Cu, Mn, Zn, & I) collectively make 01% of the total mass.

Recalling Protons and neutrons are located inside nucleus of atom while electrons orbit in energy levels (electrons shells) around the nucleus. The number of electrons in the outermost shell determines the manner in which atoms react with each other.

2. Molecular level In organisms, bioelements usually do not occur in isolated forms rather they combine through ionic or covalent bonding. The stable particle formed by such bonding is called as molecule or biomolecule.

An organism is formed by enormous number of biomolecules of hundreds of different types. These molecules are the building material and are themselves constructed in great variety and complexity due to specific bonding arrangements. Biomolecules are classified as micromolecules and macromolecules. Micromolecules are with low molecular weight e.g. glucose, water etc. and macromolecules are with high molecular weights e.g. starch, proteins, lipids etc.

Recalling A molecule is the smallest part of a compound that retains the properties of that compound.

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3. Organelle and Cell level Biomolecules assemble in a particular way and form organelles. The organelles are actually subcellular structures and when they assemble together, units of life i.e. cells are formed.

Each type of organelle is specialized to perform a specific function. For example; mitochondria are specialized for cellular respiration and ribosomes are specialized for protein synthesis. In this way, functions of the cell are accomplished by these specialized structures. It is an example of the division of labour within the cell.

In the case of prokaryotes and most protists, the entire organism consists of a single cell. In the case of most fungi, all animals and all plants, the organism consists of up to trillions of cells.

4. Tissue level In multicellular organisms, similar cells (performing similar functions) are organized into groups, called tissues. We can define a tissue as a group of similar cells specialized for the performance of a common function. Each cell in a tissue carries on its own life processes (like cellular respiration, protein synthesis), but it also carries on some special processes related to the function of the tissue. There are different types of plant tissues e.g. epidermal tissue, ground tissue, etc. Animal tissues are also of different types e.g. nervous tissue, muscular tissues etc.

5. Organ and Organ system level In higher multicellular organisms more than one type of tissue having related functions are organized together and make a unit, called organ. Different tissues of an organ perform their specific functions and these functions collectively become the function/s of that organ. For example stomach is an organ specialized for the digestion of proteins and for storing food. Two major types of tissue are present in its structure. Epithelial (glandular) tissue secretes gastric juice for the digestion of proteins.

Muscular tissue performs contractions of stomach walls for grinding of food and moving food to posterior end. So two tissues perform their specific functions, which collectively become the function of stomach.

The next level of organization in multicellular organisms is the organ system level. Different organs performing related functions are organized together in the form of an organ system. In an organ system, each organ carries out its specific function and the functions of all organs appear as the function of the organ system. For example, digestive system is an organ system that carries out the

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process of digestion. Major organs in its framework are oral cavity, stomach, small intestine, large intestine, liver, and pancreas. All these organs help in the process of digestion.

The organ system level is less complex in plants (e.g. root system) as compared to animals. This is due to a greater range of functions and activities in animals than in plants.

6. Individual level Different organs and organ systems are organized together to form an individual or organism. In organism, the functions, processes and activities of various organs and organ systems are coordinated. For example, when a man is engaged in continuous and hard exercise, not only his muscles are working but also there is an increase in the rate of respiration and heart beat. This accelerated rate of respiration and heart beat supplies more oxygen and food to the muscles which they need for continuous work.

7. Population level Biologists extend their studies to the population level where they study interactions among member of the same species living in the same habitat. A population is defined as a group of organisms of the same species located at the same place, in the same time. For example, human population in Pakistan in 2010 comprises of 173.5 million individuals (according to the Ministry of Population Welfare, Government of Pakistan).

Habitat means the area of the environment in which organism lives.

A species is defined as a group of organisms capable of interbreeding and producing fertile offspring.

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V: 1.1

8. Community Level A community is an assemblage of different populations, interacting with one another within the same environment. A forest may be considered as a community. It includes different plant, microorganisms, fungi and animal species. Communities are collections of organisms, in which one population may increase and others may decrease. Some

communities are complex e.g. a forest community, a pond community etc. Other communities may be simple e.g. a fallen log with various populations under it. In a simple community number and size of populations is limited. So any change in biotic or abiotic factors may have drastic and long lasting effects.

9. Biosphere level The part of the Earth inhabited by organisms' communities is known as biosphere. It constitutes all ecosystems (areas where living organisms interact with the nonliving components of the environment) and is also called the zone of life on Earth. 1.3.1 Cellular organizations

All the organisms have been divided into five major groups i.e. prokaryotes, protists, fungi, plants and animals. All organisms are made of cells. There are two basic types of cells. The organisms in first group are made of prokaryotic cells while all other groups have eukaryotic cells.

Cells organize in three ways to make the bodies of organisms. Cells make unicellular, colonials and multicellular organizations and the organisms formed through these organizations are unicellular organisms, colonial organisms and multicellular organisms.

In unicellular organisms, only one cell makes the life of an organism. All the life activities are carried out by the only cell. Amoeba, Paramecium, and Euglena are common examples (Figure 1.4).

Figure 1.3: Levels of organization

References:

http://nie.lk/pdffiles/other/eOM%20U01IntroToBiology.pdf

http://rms.rsccd.edu/faculty/kimomorris/bio109/online/openstax/cob-ch01_scientific_method.pdf

https://www.blinklearning.com/Cursos/c474459_c20211819__Bioelements_and_biomolecules.php

https://pctb.punjab.gov.pk/system/files/Biology%209.pdf

SAMPLE LESSON PLAN FOR TEACHERS

Branches and Subdisciplines of Biology

The field of biology can be divided into various branches and subdisciplines, which leads to careers that result in more focused fields.

LEARNING OBJECTIVES

Recognize the various subfields of biology; e.g. microbiology, genetics, evolutionary, etc.

KEY TAKEAWAYS

Key Points

Biology is broad and focuses on the study of life from various perspectives.

The branches and subdisciplines of biology, which are highly focused areas, have resulted in the development of careers that are specific to these branches and subdisciplines.

Branches of biological study include microbiology, physiology, ecology and genetics; subdisciplines within these branches can include: microbial physiology, microbial ecology and microbial genetics.

Key Terms

genetic engineering: the deliberate modification of the genetic structure of an organism

forensic: Relating to the use of science and technology in the investigation and establishment of facts or evidence in a court of law.

Branches of Biological Study The scope of biology is broad and therefore contains many branches and subdisciplines. Biologists may pursue one of those subdisciplines and work in a more focused field. The biological branches are divided according to the focus of the discipline and can even be divided based on the types of techniques and tools used to study that specific focus. However, with the increasing amount of basic biological information growing due to advances in technology and databases, there is often cross-discipline and collaboration between branches. For instance, molecular biology and biochemistry study biological processes at the molecular and chemical level, respectively, including interactions among molecules such as DNA, RNA, and proteins, as well as the way they are regulated. Microbiology, the study of microorganisms, is the study of the structure and function of single-celled organisms. It is quite a broad branch itself, and depending on the subject of study, there are also microbial physiologists, ecologists, and geneticists, among others.

Biological Disciplines and Careers

Forensic science is the application of science to answer questions related to the law. Biologists as well as chemists and biochemists can be forensic scientists. Forensic scientists provide scientific evidence for use in courts, and their job involves examining trace materials associated with crimes.Their job activities are primarily related to crimes against people such as murder, rape, and assault. Their work involves analyzing samples such as hair, blood, and other body fluids, including the processing of DNA found in many different environments and materials associated with the crime scenes.

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materials associated with the crime scenes.

Forensic Science: This forensic scientist works in a DNA extraction room at the U.S. Army Criminal Investigation Laboratory at

Fort Gillem, GA.

Another field of biological study, neurobiology, is the study of the nervous system, and although it is considered a branch of biology, it is also recognized as an interdisciplinary field of study known as neuroscience. Because of its interdisciplinary nature, this subdiscipline focuses on different functions of the nervous system using molecular, cellular, developmental, medical, and computational approaches.

Additional branches of biology include paleontology, which uses fossils to study life's history; zoology, which studies animals; and botany, which studies plants. Biologists can also specialize as biotechnologists, ecologists, or physiologists. This is just a small sample of the many fields that biologists can pursue.

Paleontology: Researchers work on excavating dinosaur fossils at a site in Castellón, Spain.

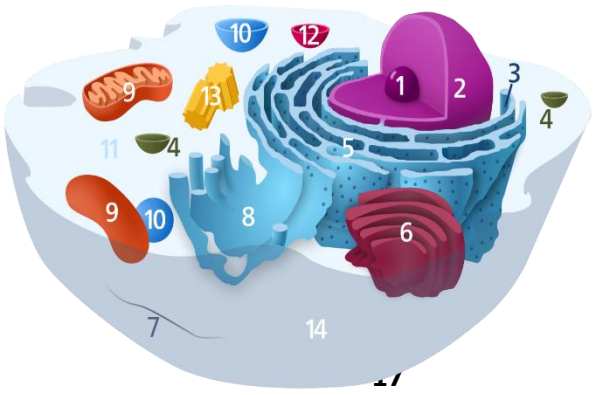
Biology is the culmination of the achievements of the natural sciences from their inception to today. Excitingly, it is the cradle of emerging sciences such as the biology of brain activity, genetic engineering of custom organisms, and the biology of evolution that uses the laboratory tools of molecular biology to retrace the earliest stages of life on earth. A scan of news headlines—whether reporting on immunizations, a newly discovered species, sports doping, or a genetically-modified food—demonstrates the way biology is active in and important to our everyday world.

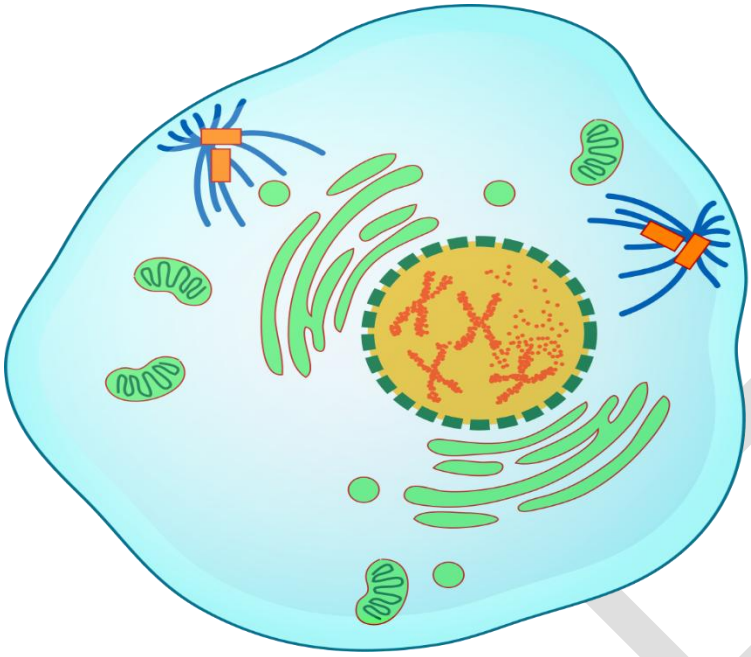
SECTION TWO: CELL BIOLOGY

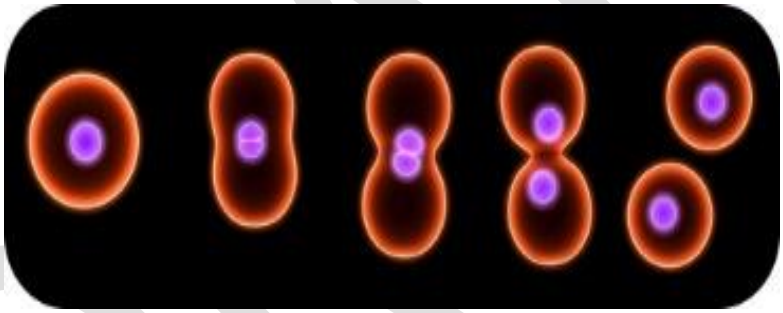
CHAPTERS INCLUDE:

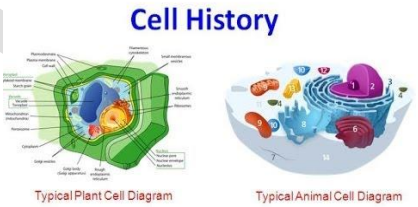
Cells and Tissues

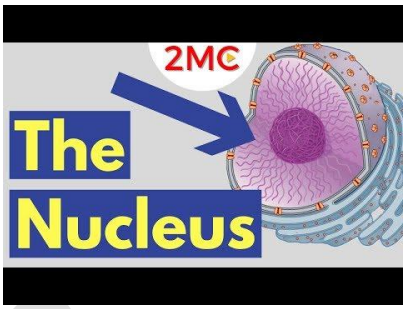
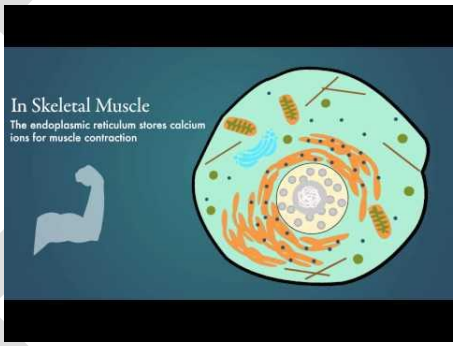
Cell Cycle







CHAPTER	Topic	STUDENT LEARNING OUTCOMES	Reference Materials
CELL AND TISSUES	Microscopy and the Emergence of Cell Theory Cellular Structures and Functions Tissues (types of Animal Tissues)	Understanding Explain the concepts of light microscopy and electron microscopy. Trace the development of the cell theory: from Aristotle to Hooke, Pasteur, Brown, and Schwann and Schleiden. Rationalize that there are sub-cellular particles, such as viruses and prions, which have some characteristics of living things. Identify the structure and describe, in general terms, the functions of the components of plant and animal cell. Determine ways in which various types of cells contribute to the healthy functioning of the human body (e.g., describe the roles of individual cells in nerves, muscle, blood, skin and bone).	 

		Describe the differences in the structure and function of Prokaryotic and Eukaryotic Cells. • Describe cell size and shape as they relate to surface area to volume ratio. Describe the phenomena of diffusion, facilitated diffusion, osmosis, filtration, active transport, endocytosis and exocytosis. Compare passive transport of matter by diffusion and osmosis with active transport (e.g. Diffusion of glucose from intestine to villus epithelium and active transport of Sodium ions from nerve cell to outside.) Define tissue as the group of similar cells, performing the same function. Describe the major animal tissues (epithelial, connective, muscular and nervous) in terms of their cell specificities, locations and functions. SKILLS Use a microscope to observe movement of	  

		small objects. Estimate quantities e.g., Compare sizes of various types of cells under the microscope. Describe the function of cell organelles and structures in a cell, in terms of life processes, and use models to explain these processes and their applications. STS Connection Investigate careers that require an understanding of cell biology. Describe ways in which research about cells, organs and systems has brought about improvements in human health and nutrition (e.g., development of medicines; immunization procedures; diets based on the needs of organs, such as the heart). Describe how knowledge about semi-permeable or differentially permeable membranes, diffusion and osmosis is applied in various contexts (e.g., separation of	

		bacteria from viruses, purification of water, cheese making, use of honey as an antibacterial agent)	

CELLBIOLOGY

Cell biology is the study of cell structure and function, and it revolves around the concept that the cell is the fundamental unit of life.

INTERESTING TO KNOW

The human body is composed of trillions of cells. They provide structure for the body, take in nutrients from food, convert those nutrients into energy, and carry out specialized functions. Cells also contain the body's hereditary material and can make copies of themselves.

CELL

The cell (from Latin cella, meaning "small room") is the basic structural, functional, and biological unit of all known organisms. A cell is the smallest unit of life. Cells are often called the "building blocks of life".

HISTORICAL PERSPECTIVE

Robert Hooke's initial observation in 1665 of plant-cell walls in slices of cork was followed shortly by Antonie van Leeuwenhoek's first descriptions of live cells with visibly moving parts. In the 1830s two scientists who were colleagues — Schleiden, looking at plant cells, and Schwann, looking first at animal cells — provided the first clearly stated definition of the cell. Their definition stated that that all living creatures, both simple and complex, are made out of one or more cells, and the cell is the structural and functional unit of life — a concept that became known as cell theory.

CELL THEORY

By the middle of the nineteenth century, biologist Schleiden and Schwann had formulated Cell Theory which is a fundamental concept in biology. The generally accepted portions of the modern cell theory are as follows:

The cell is the fundamental unit of structure and function in living things

All organisms are made up of one or cells

Cells arise from other cells through cellular division

Cells carry genetic material passed to daughter cells during cellular division

All cells are essentially the same in chemical composition.

ROLE OF MICROSCOPE IN THE DISCOVERYOF CELL

Cells are so small (microscopic) that they cannot be seen with the naked eye. It was, therefore, natural that their existence could not be detected by humans until they invented magnifying aids in the form of microscopes.

(a) An English scientist, called Robert Hooke, discovered the cell in 1665 while examining thin

sections of cork under his simple microscope by using two lenses for achieving greater magnification.

(b) In 1674, Anton van Leeuwenhoek discovered free living cells such as bacteria and spermatozoa and also observed some organelles within cells, particularly the? nucleus in red blood cells. Leeuwenhoek prepared a light microscope (with single biconvex lens) which is comparable'to today’s compound microscope. However, the compound microscope is much advanced in comparison to the microscope of Robert Hooke and Leeuwenhoek.

Working of a Microscope

The object on a glass slide is kept on a stage bearinga central hole under an objective lens.

Light is retracted through the specimen with thehelp of a mirror and condenser from below the

stage.Through an eyepiece at the top of the microscopeone can see the magnified image of the object.Focusing is done by adjustors in the microscope.

Prokaryotic and Eukaryotic cells

Superficially at least, cells exhibit a staggering diversity. Some lead a solitary existence;others live in communities; some have defined, geometric shapes; others have flexibleboundaries; some swim, some crawl, and some are sedentary; many are green (some areeven red, blue, or purple); others have no obvious coloration. Given these differences, it isperhaps surprising that there are only two types of cell (Fig. 1.7). Bacterial cells are said tobeprokaryotic (Greek for "before nucleus") because they have very little visible internalorganization so that, for instance, the genetic material is free within the cell. They are alsosmall, the vast majority being 1–2 μm in length.The cells of all other organisms, from protists to mammals to fungi to plants, are eukaryotic(Greek for "with a nucleus"). These are generally larger (5–100μm, although someeukaryotic cells are large enough to be seen with the naked eye; Fig. 1.1) and structurallymore complex. Eukaryotic cells contain a variety of specialized structures known collectivelyasorganelles, surrounded by a viscous substance called cytosol. The largest organelle,thenucleus, contains the genetic information stored in the molecule deoxyribonucleic acid (DNA). The structure and function of organelles will be described in detail in subsequent chapters. Table 1.1 provides a brief glossary of the major organelles and summarizes the differences between prokaryotic and eukaryotic cells.

TECHNIQUES TO ISOLATE COMPONENTS OF CELL:

Isolation of cellular components to determine their chemical composition, is called cell fractionation. For cell fractionation, first of all it is necessary to break/ open a large number of similar type of cells in ice cold environment. The cells are usually placed in a homogenizer or mortor are broken. The 'freed' content of the cells are subjected to a spinning action known as centrifugation. At a low speed, large particles like, cell nuclei, settle down are in the sediment. Smaller particles are still in the supernatant (fluid) which can be poured into a fresh tube and subjected to centrifugation at a higher speed until the smallest particles have been separated out, the various cell fractions can then be biochemically analysed.

EUKARYOTIC CELL

The typical Eukaryotic cells contain three major parts, but 4th component i.e. cell wall is only found in plant cells.

1. Plasma membrane.

2. Nucleus.

3. Cytoplasm and Cytoplasmic Organelles.

4. Cell Wall

PLASMA MEMBRANE:

All cells are enclosed in a membrane that serves as their outer boundary, separating the cytoplasm from the external environment. This membrane is known as the plasma membrane. It allows the cell to take up and retain certain substances while excluding others. All biological membranes have the same basic molecular organization. They consist of a double layer (bilayer) of phospholipids interspersed with proteins.

The phospholipid molecules in the plasma membrane are arranged in two parallel

layers. Their non-polar hydrophobic ends face each other, whereas their polar hydrophilic ends are associated with carbohydrate, protein etc. Plasma membrane also contains several types of lipids like cholesterol. In certain animal cells cholesterol may constitute upto 50 percent of the lipid molecules in plasma membrane It is absent from the plasma membrane of most plant and bacterial

cells.

FLUID MOSAIC MODEL

(characteristics, properties and functions)

In 1972 Singer and Nicolson proposed a working model of plasma membrane known as fluid mosaic model. In the fluid mosaic model, the lipid bilayer is retained as the core of the membrane. These lipid molecules are present in a fluid state capable of rotating and moving laterally within the membrane. The structure and arrangement of membrane, proteins in the fluid-mosaic model are like icebergs in the sea. The proteins occur as a 'mosaic' of discontinuous particles that penetrate deeply into and even completely through the lipid sheet. The components of plasma membrane are mobile and capable of coming together to engage in various types of transient or semi permanent interaction.

PLASMA MEMBRANE FUNCTIONS:

The plasma membrane performs several functions but the main and the most important functions are protection of cell cytoplasm, to regulate the flow of solutions and material in an out of the cell with certain limitation. These limitations or check in flow across the membrane is called differential or selective permeability. Transport across membranes is necessary to maintain suitable pH, ionic concentration for enzyme activity and excrete toxic substances etc. For entry or exit there are two main processes, passive transport i.e. diffusion and osmosis and active transport, the passive processes do not require energy while active require energy with these, there are two other phenomenon i.e. endocytosis and exocytosis.

i) Diffusion: It occurs spontaneously, and no extra energy is required to bring it about. A few substances freely diffuse across plasma membrane e.g. the respiratory gases (0 2 and C0 2) diffuse in and out of the cells.

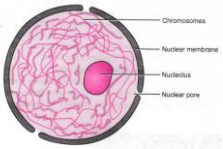
ii) Osmosis: It maintains a balance between the osmotic pressure of the intracellular fluid and that of interstitial fluid, known as Osmoregulation.

iii) Active transport: Movement of molecules from lower concentration to the higher concentration by consuming energy called active transport.

iv) Endocytosis: It is the process in which the cell membrane helps to take in material by infolding in the form of vacuole. Endocytosis maybe (a) phagocytosis in which solid particles are picked and ingested by the cell e.g. W.B.C picked up foreign bodies from the blood stream. In this way they destroy the harmful bacteria which enter into our body. It is also called cell eating process (b) pinocytosis when liquid material in bulk, in the form of vesicles is taken in by endocytosis, the process is called pinocytosis which is also called cell drinking process.

v) Exocytosis: The process of membrane fusion and the movement of material out of a cell is called exocytosis.

NUCLEUS



Nucleus was discovered by Robert Brown in 1831. It is the most important and prominent part of the cell which controls all its activities. It is commonly spherical or oval in shape, but may be lobed or elongated and is surrounded by a membrane called nuclear membrane. It is

double-membraned structure. Usually cells have one, some have two or more nuclei. Some small organisms have several small nuclei per cell (coenocytic). The nuclear membrane is not a complete barrier. It is perforated by nuclear pores. Certain substances pass freely through these pores between the nucleus and the surrounding cellular substances.

The Nucleus is filled with a protein rich substance called Nucleoplasm or Karyolymph. In the nucleoplasm are numerous fine strands in the form of network called chromatin network or nuclear reticulum, which is composed of nucleic acid. Deoxyribo-nucleic acid (DNA) and protein. During cell division, the chromatin changes to form chromosomes. Chromosomes contain the hereditary units called genes that carry the hereditary information from generation to generation. The chromosomes vary in number from species to species, e.g. 8 in the fruit fly, 46 in humans, 20 in corn etc. Chromosomes are elongated structure, visible during cell-division. A typical chromosome is composed of two parts the arm and centromere. Before cell division each chromosome consists of two threads called chromatids. These two chromatids are joined by centromere. Each chromatid has one DNA molecule. The part of chromatids from centromere to end is called arm. The chromosomes are of different types, depending on the position of centromere.

https://www.youtube.com/watch?v=8yLNC2BPnyM

Chromosomes Are Of Different Types

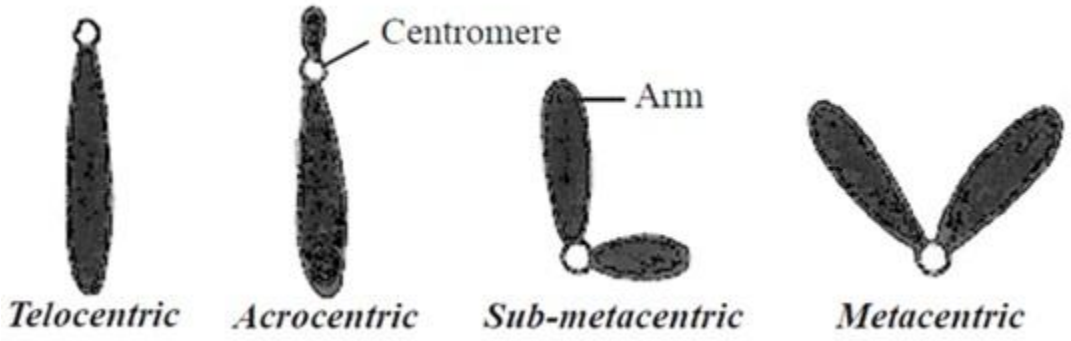
These types are:

(i) Metacentric: Chromosome with equal arms.

(ii) Sub-metacentric: Chromosome with unequal arms.

(iii) Acrocentric or Sub-telocentric: Rod like chromosome with one arm very small and the other very long. The centromere is subterminal.

(iv) Telocentric: Location of centromere at the end of chromosome.



NUCLEOLUS

Also, within nucleus is a spherical body called nucleolus. There may be more than one nucleoli in one nucleus. The number varies in different kinds of cells. It disappears during cell division and reappears afterwards. The nucleolus is believed to play an important role in the synthesis of ribonucleic acid and ribosome in Eukaryotic cells.

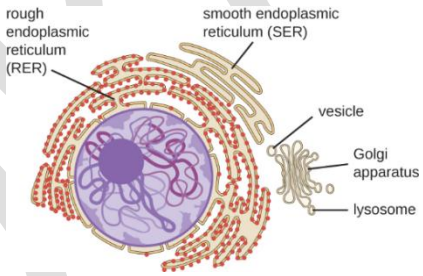
CYTOPLASMIC ORGANELLES AND MEMBRANE SYSTEM

The part between nuclear membrane and cell membrane is called cytoplasm. In some cells, e.g. Amoeba, the cytoplasm has two distinct parts an, outer clear ectoplasm and an inner granular endoplasm in most cells. Under light microscope, cytoplasm appears as a semi-fluid colloid that fills the cell. The cytoplasm exhibits active streaming movements around the inner surface of the cell. This movement is known as cyclosis.

Cytoplasm is consist of several types of organelles, occupying as much as half of the volume of the cell, and a fluid matrix, the cytosol (literally 'cell solution') in which the organelles reside. The cytosol is a watery solution of salts, sugar, amino acids, proteins, fatty acids, nucleotides and other materials.

Observations under electron microscope, however, reveal that cytoplasm is not a simple colloid since it contains many different kinds of minute organelles and also a mesh of tiny filaments, the microfibrils that form a sort of skeleton, giving rigidity to cell and helping unicellular organisms in movement. Many of the organelles and even individual molecules of the cytoplasm are thought to be attached to the cytoskeleton.

A variety of cytoplasmic organelles are present in cells, majority of them are membrane bound.



(i) Endoplasmic Reticulum:

The electron microscope reveals a complex network of channels, the endoplasmic reticulum (ER) which extends from plasma membrane to the nuclear membrane. It is an elaborate, tube like system of lipoprotein.

There are two types of endoplasmic reticulum:

(a) Agranulated or Smooth endoplasmic reticulum (SER)

and (b) Rough or granulated endoplasmic reticulum (RER).

Smooth endoplasmic reticulum

Smooth endoplasmic reticulum is not associated with ribosomes. It is foundin steroid producing cells like adipose cells (fat cells), interstitial cells, glycogen storing cells (liver) and the muscle cells. Smooth E.R. in the skin converts cholesterol into the lipid compound called vitamin D whenever sunlight strikes the skin; this vitamin helps to maintain strong, healthy bones. North African women of Bedouin tribe, who wear dark, full length garment get very little exposure to sun light and thus the smooth E.R. in their skin cells cannot make vitamin 0. As a result, these women sometimes develop soft, weak bones.

Rough or granular endoplasmic reticulum (RER),

Rough or granular endoplasmic reticulum (RER), is heavily coated with ribosomes on its outer surface towards cytoplasmic surface. Rough ER, occurs mostly in protein synthesizing cells. Such as those of the mammalian salivary glands and pancreas. Although most cells contain both rough and smooth ER but they vary from cell to cell.

Endoplasmic Reticulum Functions

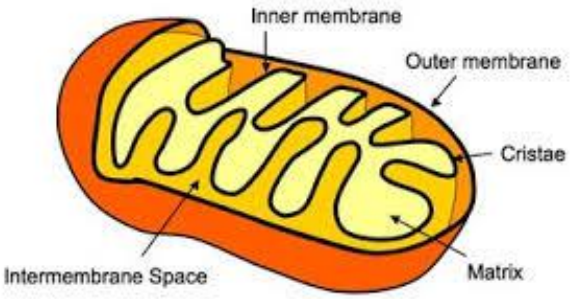
The endoplasmic reticulum has many important functions. Primarily, it serves as a supporting platform for the ribosomes. The ER, forms a structural framework of the cell with increased surface for various metabolic reactions, and they themselves take an active part by means of attached enzymes. ER also provide conducting pathways for import-export and intracellular circulation of various substances. ER also provides passage for Ribonucleic acid (RNA) to pass from the nucleus to various organelles in the cytoplasm, thereby, controlling chiefly the synthesis of proteins. It also helps in detoxification of harmful drugs, storage and release of Ca +2 ions and manufacture lipids.

(ii) Mitochondria:

Mitochondria or Chondriosomes are universally present in the cytoplasm of animals and plants. They appear as minute granules, vesicles, rodlets, threads or strings depending upon physiological conditions of the cells. They are seen to be in constant motion in living cells Mitochondria are the centre of aerobic respiration. Each mitochondrion is approximately about 0.2 to 1.0 nm in diameter and about 10 pm long. There are two thin membranes which form the boundary of themitochondrion. Both membranes are formed of lipids and proteins. The inner membrane forms irregular, incomplete partitions called Cristae. The interior of the mitochondrion contains fluid like organic matrix, with a number of chemical compounds in it. On the cristae are located enzymes and co-enzymes by means of which carbohydrates (starch) fatty acids (lipids) and amino acids (proteins) are metabolized to C0 2 and H 2 0. Energy in the form of ATP is released in this process which is stored within mitochondria.

Adenosine triphosphate (ATP) is energy rich compound and it provides energy to the cells of organs for various activities. Hence mitochondria are known as "Power House" where energy is stored and released wherever and whenever required by a living body. Mitochondria have a semi-autonomous existence in the cell; they have their own DNA that directs production of some of their component proteins and they can divide in half and thus reproduce independently of the cell's normal cell-division cycle.

Surprisingly, mitochondria are passed to an animal only by mother, since mitochondria are present in eggs but not in the part of the sperm that enters the egg. Thus, people can trace their mitochondria back to their mothers, grandmothers, great grand mother etc.



(iii) Golgi apparatus (Dictyosome):

The Golgi apparatus, like the endoplasmic reticulum, is a canalicular system with sacs, but unlike the endoplasmic reticulum it has parallel arranged, flattened, membrane bound vesicles which lack ribosomes. After the name of its discoverer Golgi, it was named as Golgi-body. The Golgi complex of the plants and lower invertebrates cells is usually referred as dictyosome. The Golgi bodies of plant cells and Golgi complex of animal cells basically have same morphology. Each of them is disc-shaped and consists of central, flattened, plate like compartments called cisternae, peripheral network of inter connecting tubules and peripherally occuring vesicles and Golgian vacuoles.

Usually in animal cells single Golgi apparatus is found in each cell, in plant cell, they may be more. Golgi apparatus are especially prominent in glandular cells.

The products of E.R. are modified and stored, and then sent to other destinations.

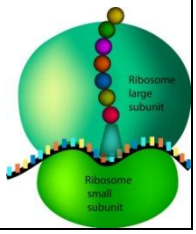
They perform the function of collection, packaging and distribution. In addition to its finishing work, the Golgi apparatus manufacture certain macro molecules by itself. Many polysaccharides secreted by cells, like cell-wall and cell plate material in plant cell are Golgi products.

(iv) Lysosomes:

These are spherical bodies, a few micrometer in diameter, surrounded by a single membrane, originated by Golgi apparatus and containing digestive enzymes. They occur only in the cytoplasm of animal cells, and function in the digestion of material taken into the cell by phagocytosis, as bacteria are ingested by white blood corpuscles. Normally they function as destroyers of foreign particles and worn out cellular components. When the membrane of lysosomes is ruptured, the cell undergoes chemical breakdown, or lysis. Since release of the enzymes, cause a cell to destroy itself by digesting its own proteins, lysosomes have been referred as "suicide sacs" and this process is called autophagy.

Lysosomal storage diseases:

Disturbance in lysosome function has profound effects on human health. In 1965 W.G.Hers of Belgium explained how the absence of apparently unimportant lysosomal enzyme, a-glucosidase, could lead to the storage of undigested glycogen accumulate in lysosome causing swelling of the organelles and irreversible damage to the cells and tissues. Diseases of this type, characterized by the deficiency of a lysosomal enzyme, and the corresponding accumulation of undegraded substrate are called lysosomal storage disorder, over 30 disorders have been reported, out of them some are described in the following table.



iii) Leucoplast (Gr: Leuco=white): These are colourless plastids which develop in the absence of sunlight and are thus commonly found in all under-ground parts of the plants. They store the food material as

carbohydrates,

lipids and proteins.

(viii) Ribosomes:

These are so named because they contain high concentration of Ribonucleic acid (RNA). These small structures are sites of protein synthesis in all cell types, prokaryotic as well as eukaryotic cells. Ribosomes are found freely dispersed in the cytoplasm in prokaryotic cells. But in eukaryotic cells they are found free as well as attached to endoplasmic reticulum. They are composed of about 50 or more different kinds of proteins. There are millions of these per cell, and they are all identical. Ribosomes may be regarded as "Protein factories". Under the direction of the nucleus they produce the protein needed by the cell.

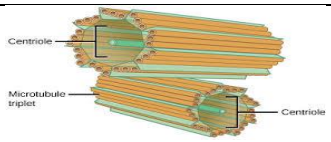
Each ribosome consists of two unequal subunits. The larger summit is dome-shaped and smaller one forms a cap on the flat surface of larger subunit. Some ribosomes adhere themselves to endoplasmic reticulum by the larger subunits. Although ribosomes are among the smallest organelles, they are among the most vital cellular components. Recent investigations reveal that the ribosomes are manufactured in the nucleolus from where they are transferred to the cytoplasm through nucleopores.

(ix) Centriole:

In animal cell, microtubules radiate from a microtubule organizing centre near the nucleus called centrosome (centre = nucleus, soma = body). Within the centrosome of an animal cell is a pair of centrioles. Centrioles are short; barrel - shaped structures of microtubules, lying perpendicular to one another. Each centriole is composed of nine sets of triplet microtubules arranged in a ring. When a cell divides, the centrioles replicate, move to opposite side of the cell and thread like fibres begin to radiate from centrioles in all directions called astral rays.

(x) Vacuoles:

Generally vacuoles (except food vacuole) are nonprotoplasmic liquid filled cavities



in the cytoplasm and are surrounded by a membrane called the tonoplast. The

tonoplast is selectively permeable, it allows certain substances to enter in the

vacuole. In animal cells they are temporarily formed at the time of their need.

These are conspicuous organelles of plant cells. They are more prominent in

mature cells whereas less prominent in immature cells. The vacuoles in plant cells

are filled with cell sap and act as store house, which often plays role in plant

defence, which is necessary for plant cell enlargement. In animal cells, lysosomes are rich in hydrolytic enzymes, including proteases, ribonucleases and glycosidases. Plant vacuoles sometimes act as lysosome as they contain hydrolytic enzymes and after death of cells tonoplast lose its differential permeability and its enzyme causes lysis of the cell.

REFERENCES- CELL STRUCTURE AND FUNCTION

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https://www.nature.com/scitable/topic/cell-biology-13906536/

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https://www.youtube.com/watch?v=kGd-5HSDo6g (video link)

http://www.tutorsglobe.com/homework-help/botany/types-of-chromosomes-71746.aspx(types of chromosomes diagram)

https://ask.learncbse.in/t/write-short-notes-on-the-following-cytoplasm-nucleus-of-a-cell/28023(nucleus diagram)

https://www.youtube.com/watch?v=8yLNC2BPnyM (nucleus video link)

https://openoregon.pressbooks.pub/mhccmajorsbio/chapter/4-9-the-endoplasmic-reticulum/

http://biology4alevel.blogspot.com/2015/08/94-structure-and-function-of.html (MITOCHONDRIA DIAGRAM)Sindh text book board.

Lesson Plans and Other Resources

SAMPLE LESSON PLAN ONE

Estimated Time: 4–5 class periods.

CELL AS A SYSTEM

Within the cell are specialized parts for the transport of materials, energy capture and release, protein building, waste disposal, information feedback, and even movement. In addition to these basic cellular functions common to all cells, most cells in multicellular organisms perform some special functions that others do not.

Objective

Students will be able to explain how the components of a cell operate as a system.

Advance Preparation

Students should have had many experiences using the microscope to observe different kinds of cells. They should know that the processes necessary for life take place within each cell.

List of Materials

For the class:

Bicycle picture

The Bicycle as a System Questions to Ask About Systems Paramecium

For each group of four students:

An item which may be considered a system, such as the classroom aquarium, the classroom pencil sharpener, a clock or watch, a plant, a student's notebook, a balance, a mechanical toy,

a model of the human eye, a hot plate, a flashlight, etc.

A microscope and slide-making equipment (deep well slides may be desirable) Culture of paramecia

Prepared slides of human body cells

For each student:

HANDOUT:

The Bicycle as a System Questions to Ask About Systems Paramecium

It is important throughout this lesson that students focus on functions of parts of systems

rather than on names of parts of systems. Students will need to name such cell parts as nucleus and cell membrane. However, it is not necessary for students to memorize the names of many cell organelles. For example, rather than learn the name endoplasmic reticulum, students should know that there are paths through a cell by which materials move.

Motivation

Presenter: You have all heard the terms ecosystem, school system, sound system, solar system, and other kinds of systems. Let's explore today what we mean when we say something is a system.

Have students work in pairs to develop a definition of "system." Have several responses shared. Focus on a definition that suggests that a system is something made of parts in which the parts interact.

Development

1. Looking at a bicycle as a system.

Display the bicycle.

Say: Is this bicycle a system?

Have students justify responses. (Some students may say that a rider is necessary to have a system. If students suggest this, ask someone to act as the rider during the following discussion.)

Continue: Let's think of the bicycle as a system. What is the function of this system? (Probable response: To transport someone.)

Show the TRANSPARENCY and distribute the HANDOUT: The Bicycle as a System.

Have students respond to the listed questions about the bicycle as a system. In addition to the sample answers, below, other answers also are acceptable if justified by students.

a. Identify at least six parts of the bicycle. If you don't know the name of a part, make up a name. Tell what function each part has. (Sample answer: The seat provides a place for the rider in the system.)

b. The seat is one part of the bicycle. Tell me three words or phrases that describe the seat. Do any of these words or phrases also describe the whole bicycle? (Possible answers: cloth- covered, uncomfortable, smaller in front than in back, etc. Most words that describe the seat do not also describe the whole bicycle.)

c. Could any part of this bicycle be made of a different material and still help the

bicycle carry out its function? (Possible answer: The seat could be made of leather or plastic.)

d. Can any one part of the bicycle carry out the job of the whole bicycle? Explain your answer. (Possible answer: No one part can do the job of the whole bicycle. If you consider one part, such as the pedal, it is easy to see that that part cannot by itself transport anyone anywhere.)

e. What parts of the bicycle must work together if you want to ride around a corner? (Probable answer: handlebar, pedals, possibly the brake. Point out that the interaction of parts makes turning the corner possible.)

f. Can you take a part from another bicycle and use it to replace a part in this bicycle and still have the bicycle carry out its function? (Possible answer: Yes. For example, a wheel could be replaced by a wheel from another bicycle as long as the two wheels are the same size.)

g. Could some parts of the bicycle be arranged differently and the system still carry out its function? Explain your answer. (Possible answer: In some cases, yes. You might replace the left handlebar grip with the right handlebar grip. However, some parts cannot be rearranged.)

h. Can you identify any subsystems within the whole bicycle system? If so, describe one subsystem. (Possible answer: The pedal might be considered a subsystem. It in itself has parts that work together to perform the function of a pedal.)

i. Does the bicycle require symmetry among any of its parts? If so, describe the symmetry. (Possible answer: Radial symmetry is present in the wheels; bilateral symmetry is present in handlebars and pedals.)

j. What will happen to the bicycle if one part, such as a spoke, breaks? What if all the spokes on a wheel break? (Possible answer: The bicycle may still go if only one spoke breaks, at least for a while. It will not be able to transport someone if all the spokes break.)

k. Is it useful to think of a bicycle as a system? Justify your answer. (Possible answers: It helps you understand what each part does; knowing how the parts must work together may help you repair it, etc.)

2. Examples of systems.

Have students work in pairs to brainstorm a list of at least ten systems. Each pair should then share its list with another group. Have each group confirm that they agree that the items listed can be considered as systems.

3. Analyzing a system.

Organize the class into small groups of three or four students. Give or assign to each group an item that can be considered a system (see the List of Materials).

Show the TRANSPARENCY and distribute the HANDOUT: Questions to Ask About Systems. Have students work in their groups to answer the questions. Answers will vary according to the system being analyzed.

Have each group share its answers with another group. If there are differences of opinion, have these discussed by the whole class.

4. Looking at a one-celled organism as a system. Say: Let's analyze a one-celled organism as a system.

Show the TRANSPARENCY and distribute the HANDOUT: Paramecium.

Continue: We have looked at paramecia with the microscope many times. Now let's look at a paramecium as a system and analyze this system using the same questions we used to analyze the items on which you have just worked. Tell students they may examine live paramecia cultures and use printed reference materials as they complete their systems analysis of a paramecium.

Have students write answers on large charts. Post these around the room. Have a whole-class discussion of the responses. Answers other than the examples below are acceptable if students justify them. Be sure the following points are made:

a. When the parts are working together the paramecium is kept alive.

b. Materials such as food and water must enter the organism from outside.

c. Waste materials must leave the organism.

d. Be sure the functions described include transporting materials, capturing and releasing energy, building proteins, waste disposal, information feedback, and movement.

e. Except for "made of protoplasm," most words or phrases do not describe the whole organism as well as they describe a particular part.

f. No.

g. No. Each part has a specialized function. Only when they all work together does the organism live.

h. Students may reason that, since organ transplants can sometimes succeed in

humans, transplants of cell parts might also be possible in paramecia.

i. Among possible answers: The cilia and the oral groove must work together to help the paramecium obtain food. The beating of the cilia not only helps the paramecium move, but also sweeps food into the oral gullet. Some parts can and do move to different places in the paramecium and still carry out their functions.

j. The cell membrane may be considered a boundary for the paramecium. Some may say that the boundary must include enough of the surrounding medium to provide food and a watery environment for the paramecium.

k. Systems within the system of the paramecium can be identified. For example, an atom can be considered a system.

l. Students may mention the symmetry seen in mitosis as the paramecium is dividing by binary fission.

m. If one of the parts of the paramecium wears out, it may not be able to move (cilia) or get rid of water (contractile vacuole) or divide (nucleus).

n. If this system stops working, the paramecium would be dead.

o. If the paramecium contains excess water, it will respond by emitting water through a contractile vacuole.

p. The paramecium might respond to the presence of food by moving toward it or it might change its direction when it strikes a barrier.

q. Thinking of the paramecium as a system helps you understand how each part contributes to the functioning of the whole thing.

r. Perhaps, but the model might not be able to simulate all of the functions.

s. Answers will vary.

Emphasize that the property of being alive belongs to the whole cell, the paramecium, and results from the interaction of its parts, rather than being a property of the separate parts. You may wish to use the following line of questioning:

- Are the cilia of the paramecium alive? (No.)
- Is the part that squeezes out extra water (the contractile vacuole) alive? (No.)
- Is the macronucleus alive? (No.)

- Is the whole paramecium alive? (Yes. But each of the parts by itself is not alive.)
- What makes the whole paramecium alive? (When the parts all interact, the paramecium is alive.)

5. Looking at a cell of a multicellular organism as a system.

Say: Now let's work in our groups to analyze a single cell from a multicellular organism as a system.

Tell students they may choose any kind of cell they wish from the human body. They are to think of a single cell of this type and analyze its activities using the same questions with which they analyzed the activities of the paramecium.

Ask groups to share their answers to the first question before continuing. Make sure students understand the functions of a specialized cell. The cell will carry out a specialized process; a nerve cell, for example, will carry stimuli. The cell will also complete general life processes common to all cells, including transporting materials, capturing and releasing energy, building proteins, disposing of waste, providing information feedback, and sometimes moving.

Tell students they may examine prepared slides of human body cells and use printed reference materials as they complete their analysis.

Again have students write answers on large charts. Post these around the room. Have a whole- class discussion of the responses. Answers to the questions will vary somewhat according to the cell type chosen.

Defer discussion of question (k) (What is the boundary of this system?) to the end of the class discussion. Begin the discussion of this question by asking whether the single cell the students have analyzed is alive. Help students reason that, if it is carrying out life processes, it cannot be dead. However, it cannot sustain itself independently, either. Ask students at what organizational level in the human body life becomes a property of the system: the cell, tissue, organ, organ system, or whole organism.

Discuss how it might be useful to consider any of these levels as a system.

Summary

Have one or two students describe the activities completed in this lesson.

Evaluation

- Have each student complete a journal entry listing at least five generalizations about

systems.

- Have students compare the functions that occur inside a cell with the functions that occur in a factory where some item is manufactured. Have students use graphics in presenting their comparison.

Extensions

- Have students investigate feedback and control in the regulation of body temperature in humans.
- Have students research regeneration, as in starfish or worms.
- Have students research genetic engineering.

SAMPLE LESSON PLAN TWO

Using A Microscope

Outcomes:

Use a light microscope or micro-viewer correctly to produce a clear image of cells

Lesson Activity Overview

This strand is focused around view different types and phases of cells. Since cells are microscopic, the best activity to begin this section is to introduce students to using the microscope. Every school has its individual challenges in terms of the science equipment available to them. Microscopes are no exception. Plan this lesson to include as many students as possible. meaning design the activity to have as many students using the equipment as possible. If you can go 1 to 1 with microscopes, that would be ideal, so try to keep that activity as inclusive so that students can perform that tasks.

1.Introduce students to the parts of the microscope. Not in terms of having them be able to label the parts, rather the focus should be on understanding how each part contributes to being able to correctly use the microscope. Simply, the focus should be on understanding the difference of the fine and coarse adjustment knobs, not being able to label them on a diagram.

2. Once students have been introduced to microscope, a great initial activity is to give students a pre-made slide with a letter on it (typically letter e is used). The purpose of this activity is to have student use a familiar object as their topic so they will understand what they are looking for. Students will realize that the image is inverted from the way they put it on the stage.

3.Next, if students are using a light microscope, then try using an American Penny. Students should try to find Abraham Lincoln sitting.

4. Finally, students should be giving a sample slide of either a plant or animal cell. Similar to the activity with letter e, students should be able to bring a slide of a cell into focus.

Assessment: Informal /Formative

Ensure that students are able to identify the essential parts of the microscope

Types of Cells

Lesson Activity Overview

Students have been given the opportunity use a microscope to view a cell. This lesson has the specific purpose of having students differentiate between plant and animal cells.

1. A discussion should take place to assess the students prior knowledge of the difference between a plant and an animal cell.

2. Based on the results of the discussion, lead students to understand that plants have two major differences: the need for a cell wall and chloroplasts. 109-13

3.Depending on the teachers assessment of what students know about cells, teachers will have to present the organelles that differentiate the cells (Cell Wall and Chloroplasts) and the organelles in common (cell membrane, nucleus, vacuoles, cytoplasm). 304-5

4.Have students view a collection of pre-made plant and animal cells. The purpose of this activity is to have students identify if the slide is a plant or an animal and add their justification/Illustration of what they are seeing. Students should be encouraged to label the parts they can identify (use the attached work sheet)

a.Set up the room in stations so that each student/group of students, depending on numbers, views the same cells, therefore there can be some consistency to what the students view.

b.Students should be identifying cell walls, cell membrane, vacuoles, nucleus, cytoplasm, and chloroplasts as justification for plant cells.

5.Have students create a journal entry where they compare and contrast the differences between plant and animal cells (organelles).

6. Have students create a three-dimensional model of an animal and/or plant cell illustrating the cell wall, cell membrane, nucleus, cytoplasm, vacuoles, and chloroplasts. To avoid redundancy, divide the class into larger groups to assemble their models.

Assessment: Informal Formative

Ensure that students have used a light microscope to correctly produce a clear image of a cell - 209-3

Ensure that students completed the work sheet where students identify plant and animal cells and add their justification/Illustrations

Ensure that students work co-operatively with team members to develop and construct models of cells - 211-3

Assessment: Formal Formative

Ensure that students have created a journal entry that compares and contrasts the differences between plant (cell wall and chloroplasts) and animal cells

Ensure that 3-D models of cells are appropriately created and labeled

Cell Station – 1

Plant Cell _____ Animal Cell _____

Cell Station - 2

Plant Cell Animal Cell

Cell Station - 3

Plant Cell Animal Cell

Cell Station - 4

Plant Cell Animal Cell

Cells as Living Things

Outcomes:

illustrate and explain that the cell is a living system that exhibits the following characteristics of life:

growth movement

stimulus/response reproduction

Lesson Activity Overview

Students should be given opportunities to investigate and observe examples of cells that are or have demonstrated the basic characteristics of life: growth, locomotion, stimulus/response, and reproduction. 304-4

There are many different virtual examples of these features that can be used.

As a UDL design, students should be given the opportunity to express what they know about cells as living things. It should be noted that regardless of type of selection they make, students must make evidence of growth, movement, stimulus/response, and reproduction

Write a poem about cells andhow they exhibit characteristics of life

Create a cartoon or a series or cartoons/sketches that illustrate the basic characteristics of life

Assessment: Formal Formative

Ensure that students are able to identify growth, movement, stimulus/response, and reproduction from the activity they chose.

STS - Careers Exploration Outcomes:

Provide examples of careers that are associated with the health of body systems

Lesson Activity Overview

Students should be invited to provide examples of careers that deal directly or indirectly with the health of body systems such as lab and X- ray technicians, physiotherapists, nutritionists, doctors, and public- health nurses. People with these careers may be invited to class to share what they do and how it involves the body systems investigated in this unit of study. The expression of interest in science- and technology- related careers is an indication of a positive attitudinal outcome.

UDL Activity - Students will choose one of the two options Option 1 - Create a mural of careers that deal with the health of body systems.

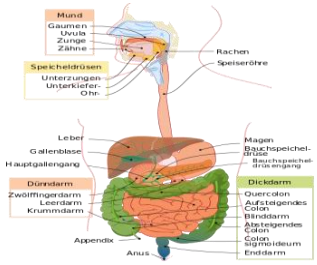
Option 2 - Interview someone working in a STEM career that is associated with the health of body system, report your results to the class.

Reference:

http://stemnorth.nbed.nb.ca/sites/stemnorth.nbed.nb.ca/files/doc//y2015/Nov/grade_8_-_cells_lesson_guide_.pdf

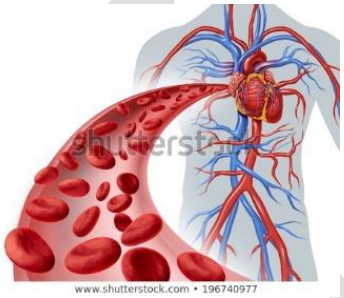
SECTION THREE: LIFE PROCESSES

CHAPTER INCLUDES:



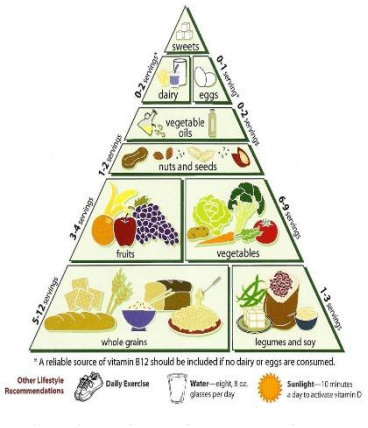
NUTRITION

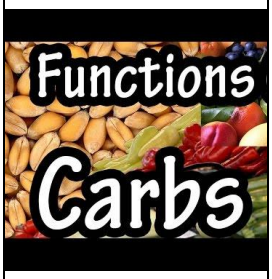
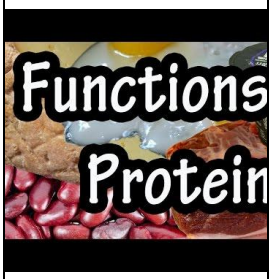
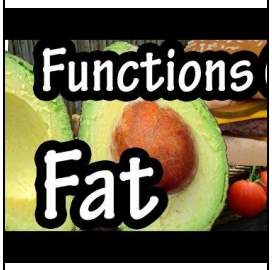
CIRCULATION

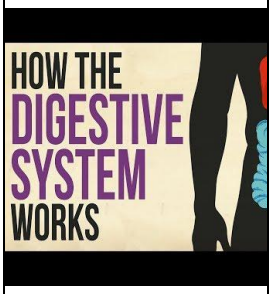


IMMUNITY

RESPIRATION



NUTRITION	Nutrition in Man Components of Human Food Balanced Diet Problems related to Nutrition. Ingestion, Digestion and Absorption of Food in Man. Disorders of Gut.	**UNDERSTANDING** Distinguish among carbohydrates, proteins and fats in terms of their sources, energy values and metabolic functions. Specify the food sources and metabolic functions of Vitamins A, C and D. Describe the food sources and metabolic functions of Calcium and Iron. Describe the deficiency symptoms of Vitamins A, C and D and of Calcium and Iron. Specify the sources and metabolic functions of Water and Dietary fibers. Describe the concept and need for a balanced diet. Explain the components of a balanced diet with relation to age, sex and activity. Explain why diet, especially energy intake, should be related to age, sex and activity of an individual. Describe the problems of Protein Energy Malnutrition (PEM), Mineral Deficiency Diseases (MDD), and Over Intake of Nutrients (OIN). State the effects of malnutrition in relation to starvation, heart disease, constipation and obesity. Rationalize the unequal distribution of food, drought and flooding, and increasing population as the factors that contribute to famine. Describe the needs of ingestion, digestion, absorption, assimilation and egestion. Identify and describe the structures of the main regions of the alimentary canal and the associated organs. Describe the main functions of these parts in relation to ingestion, digestion, absorption, assimilation and egestion of food. Sort out the action of enzymes in specific regions of alimentary canal, with respect to their substrates and products. State the role of the liver in the metabolism of glucose and amino acids, and in the formation of urea. Describe the structure of a villus, including the roles of capillaries and lacteals.	  

		Describe the significance of villi in increasing the internal surface area. State the signs and symptoms, causes, treatments and preventions of the disorders of gut i.e. diarrhea, constipation, and ulcer. <u>STS CONNECTION</u> Describe ways in which research about nutrition has brought about improvements in human health (e.g., development of nutritional supplements, and diets based on the needs of age, sex and activity). • Exemplify the societies suffering from famine due to unequal distribution of food and due to over-population. Explain how the customary food habits contribute to digestive tract disorders (e.g. diarrhea, constipation). Skills (Analyzing and Interpreting) Investigate and present in a tabulated data form his daily food intake (in terms of nutrients and calories).	  

NUTRITION	Nutrition in Man Components of Human Food Balanced Diet Problems related to Nutrition. Ingestion, Digestion and Absorption of Food in Man. Disorders of Gut.	UNDERSTANDING Distinguish among carbohydrates, proteins and fats in terms of their sources, energy values and metabolic functions. Specify the food sources and metabolic functions of Vitamins A, C and D. Describe the food sources and metabolic functions of Calcium and Iron. Describe the deficiency symptoms of Vitamins A, C and D and of Calcium and Iron. Specify the sources and metabolic functions of Water and Dietary fibers. Describe the concept and need for a balanced diet. Explain the components of a balanced diet with relation to age, sex and activity. Explain why diet, especially energy intake, should be related to age, sex and activity of an individual. Describe the problems of Protein Energy Malnutrition (PEM), Mineral Deficiency Diseases (MDD), and Over Intake of Nutrients (OIN). State the effects of malnutrition in relation to starvation, heart disease, constipation and obesity. Rationalize the unequal distribution of food, drought and flooding, and increasing population as the factors that contribute to famine. Describe the needs of ingestion, digestion, absorption, assimilation and egestion. Identify and describe the structures of the main regions of the alimentary canal and the associated organs. Describe the main functions of these parts in relation to ingestion, digestion, absorption, assimilation and egestion of food. Sort out the action of enzymes in specific regions of alimentary canal, with respect to their substrates and products.

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Food, Nutrition and Diet

What is in a balanced diet?
All organisms require food to survive. It provides energy and the raw materials for growth. We take our food in ready-made as complicated organic molecules. These food molecules can be placed into seven main groups. A balanced diet needs the correct amounts of each of these types of food molecules.

A balanced diet is the correct amount of each food, not simply 'enough' food

Carbohydrates(sometimes referred to as Starch) are required by our bodies as a source of energy. Example of food which carbohydrates can be found in are pasta, potatoes and rice.

Fatsare needed to insulate our bodies and to make cell membranes. They also contain fat-soluble vitamins.

Example of food which fats can be found in are cheese, butter, oils and margarine.

Proteinare required for growth and repair. Examples of food which contain protein are meat, fish, eggs and cheese.

Fibre is important because it allows the muscles in our intestines to move the material along (called peristalsis) and prevents constipation. Fibre is not digested in our diet. Examples of food which contain fibre are wholemeal products e.g. bread, fruit and vegetables.

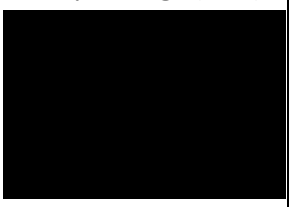
Minerals - different elements, e.g. iron iron is used to make haemoglobin

Vitamins - different structures, e.g. vitamin C Vitamin C prevents scurvy

Water- water all chemical reactions take place in water

The exact amount of each substance that is needed in a balanced diet will vary. It depends on how old the person is, whether they are male or female and how active they are. For example, teenagers need a high-protein diet to provide the raw materials for growth. You can estimate the recommended daily average (RDA) protein intake for a person using the formula:

RDA in g = 0.75 × body mass in kg



Video on

Balanced diet

The amount and type of protein is important. Proteins from animals are called first class proteins because they contain more variety of amino acids compared with plant proteins. Some people's diet may be influenced by other factors than just their daily requirements. Some people may be vegetarians or vegans and some religions require certain diets to be followed. Some people may have to avoid certain foods to prevent them becoming ill.

Macronutrients

Nutrients are substances needed for growth, metabolism, and for other body functions. Macronutrients are nutrients that provide calories or energy. The prefix makro is from the Greek and means big or large, used because macronutrients are required in large amounts. There are three broad classes of macronutrients: proteins, carbohydrates, and fats.

Food Tests

Protein can be tested using the Biuret test. This involves adding the piece of food to a copper sulphate solution with a little sodium hydroxide added. The light blue colour changes to purple if proteins are present.

Fat can be seen to be present in food if a white emulsion (tiny droplets of fat in water) is made after mixing the food with water and ethanol. This is called the alcohol emulsion test.

Carbohydrates come either as starch or sugars. If you add a few drops of iodine to food it will go blue/black if starch is present.

Underweight / Overweight

Reaching and maintaining a healthy weight is important for overall health and can help you prevent and control many diseases and conditions. If you are overweight or obese, you are at higher risk of developing serious health problems, including heart disease, high blood pressure, type 2 diabetes, gallstones, breathing problems, and certain cancers. That is why maintaining a healthy weight is so important: It helps you lower your risk for developing these problems, helps you feel good about yourself, and gives you more energy to enjoy life.

Overweight is having extra body weight from muscle, bone, fat, and/or water.

Obesity is having a high amount of extra body fat. Body mass index (BMI) is a useful measure of overweight and obesity.

Body mass index (BMI) is a measure of body fat based on height and weight that applies to adult men and women.

BMI Categories:

Underweight = <18.5

Normal weight = 18.5–24.9

Overweight = 25–29.9

Obesity = BMI of 30 or greater

Many factors can contribute to a person's weight. These factors include

environment

family history and genetics

metabolism (the way your body changes food and oxygen into energy)

behaviour or habits.

Energy balance is important for maintaining a healthy weight. The amount of energy or calories you get from food and drinks (energy IN) is balanced with the energy your body uses for things like breathing, digesting, and being physically active (energy OUT):

The same amount of energy IN and energy OUT over time = weight stays the same (energy balance)

More energy IN than OUT over time = weight gain

More energy OUT than IN over time = weight loss

To maintain a healthy weight, your energy IN and OUT don't have to balance exactly every day. It's the balance over time that helps you maintain a healthy weight.

You can reach and maintain a healthy weight if you:

Follow a healthy diet, and if you are overweight or obese, reduce your daily intake by 500 calories for weight loss

Are physically active

Limit the time you spend being physically inactive

Reference

https://revisionworld.com/gcse-revision/biology/human-body/food-nutrition-and-diet