Integrated Science Syllabus
Grade 5

General Objectives of Grade 5 Integrated Science

1. To develop understanding and acquire knowledge of:

- substances and air as a substance, its properties, components and importance, and products of technology that use air
- some common elements and their properties as metals and non metals
- breathing, organs involved in breathing , composition of inhaled and exhaled air, and harmful effects of cigarettes, gaya, suret, and uvular mutilation on the breathing system
- natural waters and the differences between them
- compounds and water as a compound, its importance, wastage, pollution and conservation
- importance of plants to soils and soil to plants, soil profile, depletion and conservation
- fertilizers, their importance and classification
- Ethiopia's forest cover, deforestation and conservation of forests
- biogas as an alternative source of energy
- common weeds, their harms and control methods
- vertebrates and invertebrates and their characteristics
- insects, fishes, amphibians and reptiles, their characteristics, structures and life cycles
- structures and functions of the excretory system and importance and methods of keeping a latrine hygienic
- food hygiene, food preservation, food as a source of energy and food shortage
- mechanisms of heat transfer
- harmful practices related to feeding habit and disposing waste
- ways of transmission and prevention of HIV
- the solar system, its components and celestial bodies
- motion of the earth, its types and effects, eclipses of the sun and moon and uses of artificial satellites

2. To develop skills and abilities of:

- classifying elements into metals and non metals
- demonstrating the breathing mechanism
- demonstrating oxides
- demonstrating methods of water conservation
- classifying fertilizers into natural and man made
- preparing organic manure
- planting tree seedlings, raising vegetable seedlings and growing crops
- classifying animals into vertebrates and invertebrates
- constructing a model pit latrine
- keeping food hygiene and food preservation
- demonstrating the three mechanisms of heat transfer
- making decisions, assertiveness and critical thinking to prevent HIV/AIDS

- locating the position of the eight planets using model
- demonstrate eclipses of the sun and moon
- scientific enquiry: observing, classifying, comparing, making models, communicating, measuring, asking questions, drawing conclusions, applying concepts, interpreting photos and illustrations and relating cause and effect

3. To develop the habit and attitude of:

- appreciating the fact that old scientific ideas are rejected as new scientific findings are published
- love and respect to nature and life
- curiosity to explore new knowledge, every time, in learning science
- working in groups, cooperating with each other and respect and love for each other
- willingness to participate in community activities of protecting the environment by keeping it clean, planting trees and conservation practices

Unit 1: Air *(23 periods)*

Unit Outcomes: Students will be able to:

- define substances and list components of air
- give examples of common elements, classify them into metals and non metals and explain their properties
- explain and demonstrate properties of air and define pressure
- explain the importance of air and identify some products of technology that use air
- define breathing, state organs involved, explain and demonstrate the breathing mechanism and identify composition of inhaled and exhaled air
- describe the harmful effects of cigarette smoking, inhaling gaya and suret and uvular mutilation on health
- demonstrate scientific enquiry skills: observing, classifying, making models, measuring, asking questions and interpreting data.

Competencies	***Contents***	***Suggested activities***
Students will be able to: • define a substance as a solid, liquid or gas that may contain one or a mixture of components • list nitrogen, oxygen, argon and carbon dioxide as components of air	***1. Air*** **1.1 Air as substance** (*6 periods)* • Composition of air – nitrogen, oxygen, argon and carbon dioxide	Draw a simple diagram to show that the Earth is surrounded by a layer of air called the atmosphere. Point out to students that we live at the bottom of this sea of air. Air is colourless substance so we cannot see it, and it doesn't weigh very much so we can't feel it. Students should discuss how we know it is there. One reason is that one of the gases in air is needed for animals to live, and for burning. This gas is called oxygen. Use this to introduce the idea that air is not a pure substance but a mixture of several gases. The composition should be restricted to oxygen, nitrogen, argon and carbon dioxide. There are traces of other noble gases but these should be ignored for the sake of clarity. Students could draw diagrams, such as a pie chart, to illustrate the composition of air using the values: nitrogen 78%, oxygen 21%, argon 1%, carbon dioxide 0.04%.
• give examples of common elements • explain physical properties of metals and non-metals • classify common elements into metals and non-metals	• Other common substances - elements and their physical properties *Common metals* – iron, gold, copper, silver, aluminium, nickel, tin, lead *Common non-metals* – oxygen, nitrogen, hydrogen, carbon, sulphur, chlorine, iodine	Explain to students that all substances are either mixtures or compounds formed from 92 naturally occurring pure substances called elements. Students may be unfamiliar with the term 'compound'. State that these are substances formed in chemical reactions and leave any further explanation until Unit 2. Point out that nitrogen, oxygen and argon are three examples of elements. Ask students to name some other examples. Write a list. Ask students to suggest how elements might be classified into groups. They may suggest solids, liquids and gases as the states of matter will be familiar to them. Explain to them that elements are classified in terms of metals and non-metals. Students should classify the elements in the list into metals or non-metals. Provide students with samples of different metals: iron, aluminium, copper and any others which are available. They should examine them and compile a list of general physical properties e.g. solid, hard, flexible, metallic appearance, can be polished. Some students may mention brass and steel as examples of metals. If so, explain that these are not elements but mixtures of elements called alloys e.g. brass is a mixture of

Competencies	***Contents***	***Suggested activities***
		copper and zinc. Leave any further discussion of alloys until later in their chemistry course. Provide students with samples of different non-metals: carbon, sulphur and iodine. They should examine them and compile a list of general physical properties e.g. solid, rigid, can be crushed into a powder, dull appearance. Show students some examples of gaseous elements such as oxygen, nitrogen and chlorine. Point out that many non-metals are not solids but gases. Students should consider where metals and non-metals are used in everyday life and be able to identify specific examples.
• explain the properties of air • define pressure as a force exerted over an area • demonstrate some of the properties of air	**1.2 Properties of air** *(4 periods)* • Air exerts pressure, is highly compressible, has volume and shape • Activities to demonstrate properties of air	Students should already be aware that air is all around us. It is difficult to appreciate that air exerts a force on us because we feel nothing. Students should carry out simple experiments to demonstrate the presence or air. For example, place a rule in the middle under a sheet of paper and pull up quickly. The sides of the paper bend down as air pushes against them. Using a vacuum pump, evacuate a bell jar and close the tap. When the tap is opened students will hear air rush back into the bell jar. Emphasise to them that the air is forced by inside the bell jar by pressure. Demonstrate the Magdeburg hemispheres experiment in which air is evacuated from a pair of matching hemispheres and it is impossible to pull them apart because of air pressure. Students might reasonably ask why air pressure doesn't crush empty containers. The answer is because the containers aren't empty but have air and therefore the air pressure inside a container is equal to the air pressure outside it. Use the collapsing can experiment to show this. Explain the difference between force and pressure. Pressure is caused by a force being exerted over an area. The greater the force, or the smaller the area, the greater the pressure exerted. Provide students with small syringes. They should pull the piston out, place their finger over the end and then push the plunger back in as far as it will go. Challenge students to explain the observations they make during this experiment. It is possible to push the plunger in even with the end sealed, so air can be compressed. What does this tell us about the distance between the particles in air? When the plunger is pushed in what can you feel at the end of the syringe? Demonstrate that a gas will expand to fill the space available by pouring a small amount of a volatile substance with a characteristic smell (e.g. perfume) into an open dish and placing it at the front of the classroom. Explain to students that liquid evaporates and its vapour soon fills the room. All gases behave in this way. Introduce the term diffusion to describe this behaviour.

Competencies	***Contents***	***Suggested activities***
• explain the importance of air • identify some products of technology that use air	**1.3 Importance of air** *(3 periods)* • For burning and for life • Air and technology (tyres, aeroplanes, sound transmission)	So far the study of air has been limited to physical properties. Students should appreciate that air has a very important chemical property associated with the oxygen it contains. Point out to students that they, like all living things, need oxygen from the air to survive and that is why we breathe in air all of the time. Students should carry out a simple experiment to show that air is necessary for burning. This can be shown by placing a small lit candle in a jar and placing something over the top of the jar. Students could extend this by placing the same candle in different sized jars and looking for a pattern between the size of the jar and how long the candle burns. Students should discuss ways of extinguishing fires by eliminating air – like covering with a blanked or with sand. This could be demonstrated to emphasise the importance of air for burning. Explain to students that air, or some other substance, is essential for the transmission of sound. Sound travels as a series of vibrations. Students could carry out simple experiments making sound with vibrating rulers, or making simple musical instruments with empty boxes and elastic bands. Students should place a finger lightly on their voice box whilst they speak or sing, and see if they can feel their vocal cords vibrating. Demonstrate that sound cannot travel through a vacuum by suspending an electric bell in a bell jar and evacuating the air with a vacuum pump while the bell remains ringing. Students should research the importance of air in technology. Topics could include: • The pneumatic tyre • Vehicle engines • Hovercraft • Flight
• define breathing as the taking in of oxygen and giving out of carbon dioxide • state organs of breathing	**1.4 The human breathing system** *(5 periods)* • The breathing organs and their functions	A lung model or a chart or a preserved/fresh specimen could be used according to their availability. Nasal cavity, pharynx, trachea, bronchus, bronchioles, and alveoli should be stated with their functions. Students can obtain some idea of the capacity of their lungs by exhaling air into a large container of water which is held inverted in a trough of water. The container should be transparent and have a capacity of 3-4 litres. A scale should be marked on it. This does not give a true value since it is impossible to exhale all of the air in the lungs. The lung capacity of all students could be measured and the data used as the basis of an exercise on data presentation.
• identify composition of inhaled and exhaled air	• Components of inhaled and exhaled air.	Carbon dioxide in exhaled air can be demonstrated using lime water (or bicarb indicator). Arrange gas bottles containing lime water so that a student inhales air in through one and exhales air through the other. Carbon dioxide in exhaled air causes the lime water in that gas bottle to cloud more quickly.

Competencies	***Contents***	***Suggested activities***
• explain the breathing mechanism • demonstrate the breathing mechanism using a lung model	• The breathing mechanism – lung model	A simple model to show part of the breathing mechanism can be made using a bell jar. A rubber sheet should be stretched across the bottom of the bell jar to represent the diaphragm and a balloon can be attached to a glass tube and bung, and lowered into the bell jar. Partially inflate the balloon to represent a single lung and seal the tube. When the rubber sheet is pulled down the pressure in the bell jar is reduced and the balloon will increase in size. Point out to students that this causes air to be drawn into the lungs. When the rubber sheet is pushed up the pressure inside the bell jar increases and the balloon becomes smaller. Point out to students that this causes air to be forced out of the lungs. By placing their hands on the sides of their rib cages, students will be able to feel their rib cage expand and contract as they breathe in and out. The expansion of the rib cage works with the lowering of the diaphragm to reduce the pressure in the lung cavity so air
• explain the effects of cigarette smoking on health	**1.5 The effects of smoking on health** *(3 periods)*	Using a water vacuum pump, cigarette smoke can be drawn through a U tube immersed in ice to condense out the tar. Under normal circumstances this condenses out in the lungs of a smoker. Alternatively, a simple smoking machine could be made using a plastic bottle in which a piece of cotton is placed with a cigarette fitted on the cork. Statistical evidence can be used to reinforce the harmful effects of smoking. Data indicates that on average: non-smokers live longer than smokers; the more cigarettes smoked per day the shorter the life expectancy; mothers who smoke during pregnancy have smaller babies; smokers have a greater risk of heart disease than non-smokers; smokers have a greater risk of cancer than non-smokers. Students should discuss personal issues of smoking – e.g. stained fingers, bad breathe, cost of smoking, subjecting non-smokers to smoke. In many countries smoking is now banned in public places. It is no longer permitted to smoke in cafes and restaurants, bars, on public transport or in enclosed public places. Students could debate whether such a ban would be appropriate in Ethiopia and how people would react to it. Students could discuss the benefits to health that would result from fewer people smoking – less smoking-related illness so funds could be directed towards combating other diseases.
• mention inhaling gaya and suret and uvular mutilation of babies as harmful traditional practices • describe the harmful effects of gaya, suret and uvular mutilation on health	**1.6 Harmful traditional practices** *(2periods)* • Inhaling gaya and suret • Uvular mutilation	Students should be aware that inhaling gaya and suret are harmful to the health. Students could discuss the effects of inhaling gaya and suret. Students could discuss the reasons why some people chose to damage their health by inhaling noxious substances, what pleasure they get from it, and what can be done to dissuade people from this practice. Students should be aware that uvular mutilation of babies is a harmful practice. Students should discuss the reasons why parents carry out uvular mutilation of their babies, what benefits they think it gives the baby, and how they can be persuaded to stop this practice.

Assessment

The teacher should assess each student's work continuously over the whole unit and compare it with the following description, based on the Competencies, to determine whether the student has achieved the minimum required level.

Students at minimum requirement level

A student working at the minimum requirement level will be able to: define substances and list components of air; give examples of common elements, classify them into metals and non metals and explain their properties; explain and demonstrate properties of air and define pressure; explain the importance of air and identify some products of technology that use air; define breathing, state organs involved, explain and demonstrate the breathing mechanism and identify composition of inhaled and exhaled air; describe the harmful effects of cigarette smoking, inhaling gaya and suret and uvular mutilation on health.

Students above minimum requirement level

Students working above the minimum requirement level should be praised and their achievements recognized. They should be encouraged to continue working hard and not become complacent.

Students below minimum requirement level

Students working below the minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time during breaks or at the end of the day.

Unit 2: Water *(20 periods)*

Unit Outcomes: Students will be able to:

- list and identify types of natural waters and tell the differences between them
- define and give examples of compound and identify water as a compound
- define and give examples of oxides and demonstrate oxides
- explain the importance of water and the causes and effects of water wastage
- mention the causes of water pollution and explain its effects and methods of prevention
- describe and demonstrate methods of water conservation
- demonstrate scientific enquiry skills: observing, classifying, comparing and contrasting, asking questions, applying concepts and relating cause and effect.

Competencies	***Contents***	***Suggested activities***
Students will be able to: • list types of natural waters • identify types of natural waters • tell the differences between types of natural waters	***2. Water*** **2.1 Water in nature** *(2 periods)* • Oceans, seas, lakes, rivers, springs and ground water	Students could leave equal-sized samples of sea water, tap water and distilled water in watch glasses on a window sill until all of the water has evaporated. This will show the amount of dissolved solids in each. The residue left by the sea water can be tasted to confirm the high proportion of salt it contains. Salt solution could be used to represent sea water. Students could list all of the fresh water bodies in their area and classify them into groups based on some criteria such as whether the water flows, as in a river, or is still, as in a lake. Students could discuss the likely differences between flowing and till water; e.g. oxygen content, mineral content. This could lead to an understanding of why different organisms flourish in flowing and till water.
• define compound as two or more elements chemically combined together • identify water as a compound • give examples of compound	**2.2 Water as a compound** *(4 periods)* • What is compound? • Examples of compound	Demonstrate the differences between a mixture and a compound using a mixture of iron and sulphur, and the compound iron sulphide. Demonstrate different physical properties - students can separate iron and sulphur using a magnet but this has not effect on iron sulphide. Demonstrate different chemical properties – iron (mixed with sulphur) reacts with dilute acids to form hydrogen whereas iron sulphide reacts with dilute acids to form hydrogen sulphide. Students should be shown a number of common examples of compounds and discuss what elements are present in the compounds e.g. water, sodium chloride, copper(II) sulphate.
• define oxides as • give common examples of oxides • demonstrate oxides with • simple practical activities	• Oxides – water, carbon dioxide, iron rust • Practical activities to demonstrate oxides	Use the concept of compounds to introduce oxides as compounds of an element with oxygen. Discuss some common examples of oxides e.g. water (hydrogen oxide), carbon dioxide, rust (iron(III) oxide). Show the difference between metal oxides and non-metal oxides by burning magnesium ribbon, iron wool, carbon powder and sulphur powder in pure oxygen. These reactions produce magnesium oxide, iron oxide, carbon dioxide and sulphur dioxide respectively.

Competencies	***Contents***	***Suggested activities***
		The formation of metal oxides can be shown by heating metals in air. Magnesium ribbon burns with a spectacularly bright flame to give a white powder of magnesium oxide. It can be shown that heated metals react with air by heating copper to make copper(II) oxide. First fold a sheet of copper into an envelope so only the outside is exposed to air. Heat the copper envelope in a strong flame for 10 minutes and then leave to cool. Open the envelop – the outside is covered in black copper(II) oxide while the inside should still have a metallic appearance. The copper(II) oxide only forms where the copper is exposed to air. Iron(III) oxide forms when iron filings are left on a damp filter paper exposed to the air for a few days. This reaction can be used to demonstrate that oxygen is about 21% of air by volume. Suspend a small muslin bag containing iron filings in a long glass tube stood in a trough of water. Initially the level of water in the tube should be the same as in the trough and a bung should be placed in the top of the tube. Over a period of days the water level in the tube will rise as oxygen is used up and rust forms. After several days the water level remains constant as all the oxygen has been used up. By measuring the height of gas in the tube at the start and finish of the reaction a rough estimate for the proportion of oxygen in air can be obtained. This experiment will tie up with the work done in Unit 1.1.
• explain the importance of water	**2.3 Importance of Water** *(2 periods)* • Life activities, industrial utility, agriculture, hydroelectric power, transportation, universal solvent	Students could discuss how they and their family use water at home. They could attempt to quantify how much water is used for each purpose in their household over a period of a week. In the event of a drought they could decide which water uses are essential and which could be reduced or eliminated, and from this calculate how much water they could save. Students could draw a water cycle and from this deduce that some of the energy from the sun (which drives the water cycle) can be converted to electricity as water passes through hydroelectric power plants. Students could carry out research into which crops can be successfully grown in areas where there is limited rainfall and those which need regular supplies of water to grow well. They should discuss the use of pumps and irrigation channels to direct water to growing crops. Students could evaluate the use of water compared to other forms of transportation. The importance of water in transportation varies from country to country depending on the water resources present. Students could consider such factors as availability of water courses, convenience to industrial or farming centres, time taken, cost and impact on the environment. Groups of students could identify industries in their area and find out which rely most heavily on water. Each group could prepare a five minute presentation on the industry with a particular emphasis on the process and why water is so important to that industry. In order to illustrate the use of water as a solvent, let the students give as many examples of substances as possible that are dissolves by water and that are used by humans for different activities.

Competencies	***Contents***	***Suggested activities***
• mention the causes of water wastage • describe the effects of water wastage • indicate ways of using water economically	**2.4 Wastage of Water** *(3 periods)* • Causes and effects • Using water economically	Students could consider three aspects of wastage. • During the rainy season much of the rain that falls passes down rivers into lakes or the sea. How can some of this water be stored for use in the dry periods of the year? Students could consider likely locations for reservoirs and what advantages and disadvantages would result from their use. • Water is stored and sent down pipes to users. How can losses from storage and distribution be reduced? Students could inspect water storage and distribution equipment and identify likely sources of leaks and suggest what should be done to avoid them. • How can each individual household or person reduce the amount of water they waste? Students could identify ways in which water is wasted in the home e.g. leaking taps due to damaged washers, washing under running water rather than in a bowl, taps left on unnecessarily. Students could recommend suitable maintenance e.g. changing the washers on leaking taps, and better practice e.g. turning taps off immediately water is no longer needed.
• mention the causes of water pollution	**2.5 Pollution of Water** *(4 periods)* • Causes of water pollution – domestic and industrial wastes	Students should appreciate that much of the water that leaves their homes is no longer pure. They could make a list of the sources of waste water e.g. water from toilets carrying human waste products, water from cleaning carrying detergents, water from washing, water from cooking. They should also appreciate that there are other sources of water pollution including: • Run off from fields carrying fertilisers which have not been absorbed from soil together with other agricultural chemicals • Liquid waste from factories • Waste gases dissolving in the air to produce acid rain
• explain the effects of water pollution • state methods of preventing water pollution	• Effects of water pollution – on health and aquatic life • Methods of controlling water pollution	Students could investigate the effects of water pollution using the internet or other resources such as the library. They should be given key words such as sewage, eutrofication, effluent, acid rain, agricultural pollution and detergent pollution. They should choose one aspect of water pollution and write a report outlining the causes, effects and how it can be controlled or prevented. Students could visit a local body of water which is polluted. They should try to ascertain the cause of the pollution, observe the effects that the pollution is having on the organisms that live in the water and in surrounding area, and suggest how the pollution could be remedied.

Competencies	*Contents*	*Suggested activities*
• describe methods of water conservation • demonstrate methods of water conservation	**2.6 Methods of water conservation** *(5 periods)* • Dams • Water harvesting ponds • Planting trees • Good farming practice – irrigation and terracing	Students could carry out a simple analysis of a sample of polluted water by comparing it with pure water. They could compare properties such as clarity and smell. Students could visit a local water treatment plant and find out about the processes necessary to turn raw sewage into water that is safe to release into lakes and rivers. Challenge students to explain why an area may receive a large amount of rainfall but still suffer from droughts. Direct them towards the idea that there are periods when there is lots of rain – the rainy season – and periods when there is little or no rain – the dry season. Ask them how the amount of water received annually might be evened out – and lead the discussion into the idea of storing water. Students could identify local water storage facilities and find out the height of water at the end of the rainy season and at the end of the dry season. From this they could estimate the amount of water used. Students could measure the temperature of the soil in different locations, some where it is exposed and some where it is covered in foliage. They should relate the temperature of the soil to the amount of water lost from the surface by evaporation and from this deduce that less water is lost from the ground by evaporation when ground cover plants and trees are present. Students could use a small mound of soil to model a hillside. They can scratch lines from the top to the bottom, gently pour a container of water from the top to simulate rain and observe how quickly the water runs off and how particles of soil are carried down. The process can then be repeated but this time lines should be scratched in contours around the mound of soil. A third experiment can be carried out by fashioning the mound into a series of terraces and observing how water flows over them.

Assessment

The teacher should assess each student's work continuously over the whole unit and compare it with the following description, based on the Competencies, to determine whether the student has achieved the minimum required level.

Students at minimum requirement level
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Students above minimum requirement level
Students working above the minimum requirement level should be praised and their achievements recognized. They should be encouraged to continue working hard and not become complacent.

Students below minimum requirement level
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Unit 3: Plants *(30 periods)*

Unit Outcomes: Students will be able to:

- explain the importance of plants to humans and soil to plants
- describe the soil profile in relation to its significance to plants
- define soil depletion and state its causes and methods of prevention
- define fertilizers, explain their importance and classify them into natural and artificial
- prepare organic manure for use in the school garden
- compare Ethiopia's forest cover past and present, mention the causes and consequences of deforestation, and describe the methods of conservation of forest
- plant tree seedlings in and around their school compound
- describe and demonstrate the biogas technology as an alternative source of energy
- raise vegetable seedlings, grow crops and demonstrate crop protection methods
- explain the harmful effects of weeds, give common examples and describe weed control methods
- discuss the harmful effects of setting forest fires and clearing forests
- demonstrate scientific enquiry skills: observing, classifying, making models, measuring, communicating, asking questions, applying concepts and relating cause and effect.

Competencies	***Contents***	***Suggested activities***
Students will be able to: • explain the importance of plants to humans	***3. Plants*** **3.1 Importance of plants** (*3 periods)* • As sources of food, medicine, clothing, shelter, furniture • Maintain normal climate • Prevent soil erosion • Aesthetic value	Students should identify examples of plants that are used to provide: • Food; Medicines; Clothing; Shelter; Furniture Students could carry out a survey of the plants grown for food in their area including those which are grown to feed the family and those which are grown for sale in the markets. Students could find out more about herbal medicines made from locally grown plants. Which parts of the plants are used, how is the plant processed to obtain the medicine and what illnesses is the medicine used to treat? The results of the whole class could be combined into a data base. Students should be aware that plants maintain normal climate. This could be illustrated by comparing the climate of a given locality well known by students to have intact vegetation with the climate of another locality with little or no vegetation at all. Students could dig up several different common local plants and examine the root systems to see how the roots bind the particles of soil together. They could examine areas where plants are no longer found, due to overgrazing or other causes, and observe the resulting soil erosion. This could be linked into the work on water conservation in the previous unit. Students should identify plants which are grown for their flowers of attractive foliage. They could discuss in groups the reasons why people grow decorative plants and what pleasure is derived from them. Students could organise the planting and maintenance of flowers and foliage plants around the school to improve the environment.

Competencies	***Contents***	***Suggested activities***
• explain the importance of soil to plants	**3.2 Soils and Plants** *(5 periods)* • The importance of soil to plants	Students should appreciate that soil is a growing medium in which plants grow. The soil provides a plant with stability as well as water and minerals essential for growth. Students should be aware of the three main types of soil: sandy, loam and clay, and their characteristics. They should discuss the advantages and disadvantages of each type.
• describe the soil profile in relation to its significance to plants	• Soil profile	Students could investigate the components of soil by placing soil in a jar with water, shaking the mixture and leaving it to settle. They will see a gradation of particles starting with the largest at the bottom the finest at the top. Humus will float on the water. Students can investigate different characteristics of soil: • Water content – by drying a known mass in an oven at 100 °C • Humus content – by heating a known mass of dry soil on a tin lid with a Bunsen burner • Air content – by mixing 50 cm^3 of soil with 50 cm^3 of water and measuring the total volume • Particle size distribution – by passing a known volume of dry powdered soil through a series of sieves • Water retention – by timing how long it takes water to pass down a column of soil These experiments could be carried out on a single type of soil or on different soils and the results for each soil compared.
• define soil depletion as the wearing out of minerals from the soil • state causes of soil depletion • explain methods of prevention of soil depletion	• Soil depletion – causes and prevention	The work on soil depletion can be linked into previous work on water retention and the importance of plants. Students should be able to explain how rain washes top soil away and how this can be avoided by contour ploughing and terracing. Students should also be able to describe how plant roots bind soil together and how the loss of ground cover, due to overgrazing, can result in soil erosion. Extend this work by discussing the problems of erosion by wind. Soil depletion can be linked into human activity. For example, the removal of trees for timber exposes plants that normally flourish in the shade, to the full strength of the sun. These plants eventually die and the soil is then exposed to erosion. Students could carry out research to find the extent of this problem in Ethiopia and in other countries.

Competencies	***Contents***	***Suggested activities***
• define fertilizers as • explain the importance of fertilizers	**3.3 Soil improvement practices** *(5 periods)* • Fertilizers and their uses	Students should be aware that plants need certain minerals in order to grow and remain healthy, and that they obtain these minerals from the soil. Students could research to identify major nutrients and minor nutrients required for growth.
• classify fertilizers as natural and artificial	• Classification of fertilizers	Students should be made aware that there are two main groups of fertilisers: naturally occurring fertilisers and chemical fertilisers. Students could identify different types of naturally-occurring fertilisers such as animal dung. They should also be made aware of green fertilisers. Students could investigate the effectiveness of different types of dung as fertilisers. Students could identify different types of chemical fertilisers such as urea, ammonium nitrate and potassium sulphate. Students should understand what is meant by an NPK fertiliser and understand the significance of the numbers e.g. 20.10.40, associated with these fertilisers. Teacher could demonstrate ammonium nitrate by mixing equivalent amounts of ammonia and hydrochloric acid, and evaporating the solution to dryness. Students could discuss the advantages and disadvantages of the two main groups of fertilizers. The work on fertilisers could be linked in to the work on water pollution in Unit 2. Excessive use of fertilisers is a source of water pollution.
• prepare organic manure for use in the school garden	• Making manures (compost)	Students could make a compost heap either at home or in school and use it to recycle the nutrients in waste plant materials. Students could discuss what materials will compost. Students should find out about: • The importance of ensuring the compost is well aerated • Why it is necessary to water the compost • The function of compost accelerators
• compare Ethiopia's forest cover past and present • mention the causes of deforestation • describe the consequences of deforestation	**3.4 Our forests: The threats on them and conservation** *(5 periods)* • History of our forests • Deforestation – causes and effects	Students could research for old maps or information detailing the areas of Ethiopia covered by forest in the past and in the present day. They could make estimates of the total area of forest in the past and present and from this estimate the extent of deforestation. Deforestation could be linked in to work already carried out on water conservation and soil erosion. Students should already be aware that deforestation has a negative effect on both of these. Students should be aware that trees are cut down to provide firewood and wood for construction and for settlement and agriculture. The result of deforestation includes:

Competencies	***Contents***	***Suggested activities***
• describe the methods of conservation of forest • plant tree seedlings in and around their school compound • describe the biogas technology as an alternative source of energy • demonstrate the biogas technology using a simple model	• Conservation of forests • A tree planting project • Biogas – an alternative source of energy	• Soil degradation and erosion • A loss of habitat for animals and plants • A loss of plants that provide food and medicines Students could devise a strategy for managing forests in such a way as to extract timber without depleting the soil. They should identify local species of trees which will grow well and provide a suitable habitat for animals. As far as possible trees which are cut down should be replaced with trees of the same type. Students could organise a tree planting initiative around the school so that the students in their future academic years will benefit from the shade they provide and the variety of plants and animals which grow amongst them. Identify biogas as one of a range of energy sources which are sometimes referred to as 'alternative' energy sources. Biogas consists mainly of methane, together with a small proportion of carbon dioxide. Show students a diagram of a biogas unit and explain how it works. Students could be asked to design and build a small biogas unit. For example, a large glass jar could be used for the fermenting vessel, a mechanical stirrer to mix the dung and water, and a flexible rubber tube to collect the biogas over water. Students could discuss different uses of dung including: • Burning it as a fuel • Spreading it on fields as a fertiliser • Fermenting it to produce methane They should discuss he advantages and disadvantages of each e.g. burning dung provides heat energy for cooking and warming the home but it means that less fertiliser is available for the fields.
• raise seedlings of vegetables in pots or in school garden • grow crops in school garden	**3.5 Raising vegetable seedlings and crop growing** *(6 periods)* • Raising seedlings of vegetables • Crop growing project	Students could carry out experiments to determine what is needed for seeds to germinate by attempting to germinate batches of seeds in the absence of light, in the absence of water and in the absence of oxygen. Students could carry out experiments to determine whether temperature is a significant factor in germinating seeds by attempting to germinate batches or seeds at different temperatures e.g. on a sunny window sill, in a cool room and in a refrigerator. Students should plan to grow vegetables from seed on a small plot either at school or at their home. They should consider such factors as: • Which vegetables to grow • How long seeds will take to germinate • How long plants will need to grow • How much rooms will individual plants need

Competencies	***Contents***	***Suggested activities***
• demonstrate crop protection methods	• Crop protection	• How to make best use of the plot in terms of obtaining the maximum crop • How to prepare the ground • How and when to apply fertilisers • Which fertilisers they should use Students should plan how to protect their plants from pests. This could include: • Building a fence to keep out animals • Using nets to keep out birds • Constructing bird scaring devices • Applying chemical pesticides – either traditional or commercial • Growing plants that will deter some pests
• give common examples of weeds • explain the harmful effects of weeds	**3.6 Weeds and weed control** *(3 periods)* • Examples of common weeds • Harmful effects of weeds	Students should name some common weeds. Make a list of them. Students could talk a walk in the locality and dig up examples of common weeds that could be brought back to the classroom, identified and drawn. They could also be dried and used in a display. Students could discuss the harmful effects that weeds. These include: • Competition for light • Competition for water • Competition for nutrients from the soil They may also be aware of weeds that can be harmful to animals if eaten of undesirable to humans because of prickles etc. Students could also discuss the characteristics of a successful weed such as: • Grows rapidly • Flourishes in a range of different types of soil • Produces lots of seed
• describe weed control methods	• Weed control methods	Students could inspect a vegetable plot that has not been regularly weeded to observe how weeds overrun the ground and stifle the growth of the crops. Students should be aware that weeds can be controlled by both physical and chemical methods. Physical control involves digging out weeds regularly before they have a chance to flow and seed. Chemical control involves spraying the weeds with chemical weed killers which are absorbed in to the weed and kill it. Students could identify some chemical weed killers and state which weeds they are effective against. Students could discuss the advantages and disadvantages of both physical and chemical weed control.

Competencies	*Contents*	*Suggested activities*
• mention setting forest fires and clearing forest as harmful practices • discuss the harmful effects of setting forest fires and clearing forests	**3.7 Harmful practices** *(3 periods)* • Setting forest fires • Clearing forests	This should be linked in to work on deforestation carried out earlier in this unit. Students should already be aware of the problems associated with deforestation. They could discuss different aspects such as: • Loss of habitats for animals • Loss of plants for food and medicines • Loss of source of firewood • Soil erosion • Loss of water retention • Loss of aesthetic pleasure given by flowers and plants Students should be made aware that setting fire to forest provides additional farming land is a very short-sighted practice. In the short term, the ash provides the ground with nutrients for crop growth but the burning damages the surface soil structure and destroying humus, so after a few years of growing crops the soil is left sterile and open to erosion.

Assessment

The teacher should assess each student's work continuously over the whole unit and compare it with the following description, based on the Competencies, to determine whether the student has achieved the minimum required level.

Students at minimum requirement level

A student working at the minimum requirement level will be able to: explain the importance of plants to humans and soil to plants; describe the soil profile in relation to its significance to plants; define soil depletion and state its causes and methods of prevention; define fertilizers, explain their importance and classify them into natural and artificial; prepare organic manure for use in the school garden; compare Ethiopia's forest cover past and present, mention the causes and consequences of deforestation, and describe the methods of conservation of forest; plant tree seedlings in and around their school compound; describe and demonstrate the biogas technology as an alternative source of energy; raise vegetable seedlings, grow crops and demonstrate crop protection methods; explain the harmful effects of weeds, give common examples and describe weed control methods; discuss the harmful effects of setting forest fires and clearing forests.

Students above minimum requirement level

Students working above the minimum requirement level should be praised and their achievements recognized. They should be encouraged to continue working hard and not become complacent.

Students below minimum requirement level

Students working below the minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time during breaks or at the end of the day.

Unit 4: Animals *(25 periods)*

Unit Outcomes: Students will be able to:

- classify animals into vertebrates and invertebrates, describe their general characteristics and give examples for each
- describe the common characteristics of insects, give examples, and show their external structures with their functions
- diagram the life cycles and explain the importance of locust and silk moth
- mention the general characteristics of fish, give examples, show their external body structures and explain how they breath in water and reproduce
- describe the importance and methods of fish farming
- mention the general characteristics of amphibians, give examples, show their external body structures and explain how they reproduce
- mention the general characteristics of reptiles, give examples, show their external body structures and explain how they reproduce
- demonstrate scientific enquiry skills: observing, classifying, asking questions, applying concepts and relating cause and effect.

Competencies	***Contents***	***Suggested activities***
Students will be able to: • classify animals as invertebrates and vertebrates • describe the general characteristics of invertebrates and vertebrates • give examples of invertebrates and vertebrates	***4. Animals*** **4.1 Invertebrates and vertebrates** *(2 periods)* • General characteristics • Examples	Students could be given pictures of some different animals to study. Preserved/fresh specimens could also be used if available. These should consist of a mixture of invertebrates and invertebrates. From their observations students should be asked to divide the animals into two broad groups on the basis of their observations. Use this exercise to introduce the idea of animals without backbones – invertebrates, and animals with backbones – vertebrates. Students could be asked to give more examples of invertebrates and more examples of vertebrates. Identify some groups of invertebrates including insects. Identify some groups of vertebrates including fish, amphibians and reptiles.
• describe the common characteristics of insects • show the external structures of insects • tell the functions of external structures of insects • give examples of insects	**4.2 Insects** *(8 periods)* • Common characteristics • External body structures • Examples of insects – locust, termite and silk moth (silkworm) • Locust and termites – life cycle, harmful effects, and methods and controlling	Students could identify examples of insects. Some can be caught and brought to the classroom to be identified and drawn. Students should be warned that some types of insects bite or sting and are best left alone. Students could examine several different insects and look for similarities in their external structure such as: • Three body parts – head, thorax, abdomen • Six legs Students should be made familiar with the external structure of the termite and identify the typical insect characteristics. They should observe termite mounds and appreciate that termites live in large colonies where eggs are laid and the young hatch out. Students should discuss the damage done by termites to crops and structures and how termites can be controlled.

Competencies	***Contents***	***Suggested activities***
• diagram the life cycles of locust and silk moth • explain the harmful effects and control methods of locusts and termites		Students should be made familiar with the external structure of the locust and identify the typical insect characteristics. They should see each stage of the locust life cycle – egg, hopper and adult, and be aware that locusts live together in swarms. They should be given data about the locust e.g. • An average swarm of locusts contains 1 500 000 000 insects and covers an • area of 30 km^2 • Each locust eats its own body mass of food each day • An average locust has a body mass of 2 g From this data they can calculate the amount of food eaten by a swarm each day and get some appreciation of the problem they create. Students could carry out research using a locust map to find the position of the locust belt across Africa and which countries are worst affected by them. Students could carry out research into the latest techniques used to combat the locust problem. Students should discuss the damage done by locusts to crops and the problems of controlling them. Students could evaluate the different methods of controlling locusts – baiting, dusting and spraying – and determine at what stage of the life cycle each is most effective. DDT is a very effective insecticide but is harmful to other forms of wildlife. IN some countries is banned whereas in others it is sued to combat locusts. Students could discuss whether it is acceptable to kill other wildlife in order to protect food crops from locusts of not. Students could also discuss whether an cheap, effective insecticide which is poisonous and remains active on the ground a long time after spraying (like dieldrin) is better than a less effective insecticide which becomes inactive soon after spraying (like fenitrothion). Students could discuss one possible result of global warming will be that the area affected by locusts may change in the future.
• describe the importance of silkworm	• Silkworm (silk moth) – • life cycle and importance	Students should be made familiar with the external structure of the silk moth and identify the typical insect characteristics. Preserved or fresh specimens could be used if available. A visit could also be arranged to where silk worms are kept for study or silk production. A documentary video on silk worm (if available) also gives students a good chance of observing the life and importance of silkworms. Students should look at the life cycle of the silk moth – egg, larva, pupa, adult – and be aware that natural silk is obtained by unwinding the silk bobbin that the larva spins around itself when it is ready to become a pupa.

Competencies	***Contents***	***Suggested activities***
		Students should appreciate the importance of mulberry leaves as the source of food for the silk worm. Students could carry out research into how silk is obtained from the pupae and processed into threads to make silk garments. Students could investigate the properties of silk by comparing silk thread with other threads obtained from natural sources like cotton, linen and wool. Such tests could Include: Elasticity; strength; and ease of dying.
• mention the general characteristics of fish • give examples of fishes • show the external body structures of fish • explain how fishes breath in water • explain how fishes reproduce	**4.3 Fishes** *(7 periods)* • General characteristics • Examples of fishes – tilapia • External body parts • Breathing organs • Fertilization • Observing fishes	Students should already be familiar with the external shape of a fish from their everyday experience. They should also know that it is a vertebrate. Students could examine a fish and draw its external structure including: the mouth, eye, gill cover, fins, head, body and tail. Students could dissect a dead fish. By carefully removing the gill cover they could observe the gill rakes and the gill filaments. Using a glass rod, students should follow the path water takes in through the mouth and out through the gills. Students could discuss the features of gill rakes and filaments which make them suitable for gaseous exchange including: • Damp surface • Thin surface layer • Large surface area • Good supply of blood vessels Students could write a list giving examples of fish. Students will have observed no external sex organ during their investigation of the external structure of the fish. From this they could surmise that fertilisation takes place outside the body. Students should learn how the female fish lays her eggs outside the body and these are fertilised by the male who squirts out fluid called milt that contains sperm. Students could be give data to discuss how the number of eggs laid by an animal is related to the amount of parental care after the offspring are born e.g. • fish 3 000 000 eggs • amphibian 1500 eggs • reptile 30 eggs • bird 10 eggs • mammal 1 egg They should discuss why fish lay so many more eggs than some other groups of animals. This work can be used to link into the work on amphibians and reptiles later in the unit.

Competencies	***Contents***	***Suggested activities***
• describe the importance of fish farming • explain method of fish farming	• Fish farming – importance and methods	Describe to students how early man was a hunter-gatherer who gathered food wherever it could be found. Eventually, instead of gathering food, people had the idea to grow food themselves and hence became farmers. Students can apply this idea to farming fish. Students could discuss the advantages and disadvantages of fish farming. Advantages include: • ease of capture • control food supply • harvest at a particular size Disadvantages include: • disease easily spread • build up of waste products • attracts predators such as fish-eating birds Students could study how fish move by observing them in an aquarium or pond. They could discuss the importance of the muscular body to provide power and the fins to provide direction.
• mention the general characteristics of amphibians • give examples of amphibians • show the external body structures of amphibians • explain how amphibians reproduce	**4.4 Amphibians** *(5 periods)* • General characteristics • Examples of amphibians – frog • External body parts • Fertilization	Students could examine a frog and draw its external structure including: the mouth, eye, nostrils, damp skin, short strong front legs, long back legs and webbed feet. Students could write a list giving examples of amphibians. Students might surmise that fertilisation takes place externally since there are no external sex organs. The male mounts on the back of the female. The female lays her eggs and they are fertilised externally by the male. After a short time in the water the familiar jelly-like substances forms around the eggs. Students could link back to work on the fish by comparing the procedure for egg laying adopted by amphibians like the frog, with that of the fish. Students could keep frog spawn in a tank and observe the different stages of development, firstly within the egg, and then as the tadpole hatches. They could observe the external gills and discuss their efficiency when compared with internal gills. They could observe the changes that take place as the tadpole changes into a frog. Students could relate the external structure of the frog to the way in which it breathes. It has small internal lungs but much gaseous exchange takes place through the skin which is why it is always damp. Students could relate the external structure of the frog to the way it moves. On land the long back legs allow the frog to hop while the shorter, stronger front legs absorb the impact when the frog lands. In water the long legs and webbed feet allow the frog to move about very quickly.

Competencies	*Contents*	*Suggested activities*
• mention the general characteristics of reptiles • give examples of reptiles • show the external body structures of reptiles • explain how reptiles reproduce	**4.5 Reptiles** *(3 periods)* • General characteristics • Examples of reptiles – lizards and snakes • External body parts • Fertilization	Students could examine a snake or lizard and draw its external structure. The external structure of the snake includes the mouth, eyes, nostrils and long muscular bodies but legs are absent. The external structure of the lizard includes the mouth, eyes, head, body, legs and tail. Students could write a list giving examples of snakes and lizards. Students could discuss why it is that although there are no obvious external sex organs, as in fish and amphibians, fertilisation takes place internally. Reptiles do not generally live in water. It would not be efficient for the male to try and fertilize eggs which had been laid externally since there would be no water for the sperm to swim towards the eggs. In some reptiles the eggs are laid externally, often buried in warm sand or soil, while in others the eggs remain inside the female body until they hatch, so the young are born alive. Students could discuss the advantages and disadvantages of both methods of hatching. Students could discuss why reptiles produce fewer eggs than amphibians and far fewer than fish. This would link into the work on fish and amphibians already done in this unit. Students could relate the external structure of the snake to the way it moves. The muscular body is able to push on the ground to move the snake forwards while the absence of legs allows it to pass through very small spaces.

Assessment

The teacher should assess each student's work continuously over the whole unit and compare it with the following description, based on the Competencies, to determine whether the student has achieved the minimum required level.

Students at minimum requirement level

A student working at the minimum requirement level will be able to: classify animals into vertebrates and invertebrates, describe their general characteristics and give examples for each; describe the common characteristics of insects, give examples, and show their external structures with their functions; diagram the life cycles and explain the importance of locust and silk moth; mention the general characteristics of fish, give examples, show their external body structures and explain how they breath in water and reproduce; describe the importance and methods of fish farming; mention the general characteristics of amphibians, give examples, show their external body structures and explain how they reproduce; mention the general characteristics of reptiles, give examples, show their external body structures and explain how they reproduce.

Students above minimum requirement level

Students working above the minimum requirement level should be praised and their achievements recognized. They should be encouraged to continue working hard and not become complacent.

Students below minimum requirement level

Students working below the minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time during breaks or at the end of the day.

Unit 5: Our body *(24 periods)*

Unit Outcomes: Students will be able to:

- define excretion, name the organs involved, indicate their structures and tell the functions of the structures
- describe what a hygienic latrine is, explain its importance, discuss the methods of keeping it clean and construct a model pit latrine using cardboard or other available materials
- describe and demonstrate methods of keeping food hygiene and food preservation
- explain how food serves us as an energy source and compare human body with an engine regarding energy change
- explain, give examples and demonstrate the three mechanisms of heat transfer
- explain the causes and recommend solutions of food shortage
- mention eating raw meat, drinking un-boiled milk and disposing waste at wrong places as harmful practices and discuss their harmful effects
- define HIV and AIDS, describe the ways of transmission and prevention, and demonstrate decision making, assertiveness, and critical thinking skills that help them prevent HIV
- demonstrate scientific enquiry skills: observing, comparing, making models, communicating, measuring, asking questions, drawing conclusions, applying concepts and relating cause and effect.

Competencies	***Contents***	***Suggested activities***
Students will be able to: • define excretion as the loss of waste products produced by metabolic processes in the body • name organs of excretion • indicate the structures of organs of excretion • tell the functions of the structures of excretion	***5. Our body*** **5.1 Excretion** *(5 periods)* • What is excretion? • Organs of excretion and their functions	Students often confuse excretion with egestion. Start the topic by explaining the difference between these processes. Egestion is the loss of undigested food from the alimentary canal through the rectum and anus. Excretion is the loss of waste products resulting from metabolic processes in the body. Students could list the waste products including: • Carbon dioxide • Water • Urea Students should determine how each waste product is formed and how it is expelled from the body. Carbon dioxide is excreted by the lungs. The air exhaled by the lungs is about 100 times richer in carbon dioxide than the air inhaled. Remind students about the work done on the human breathing system in Unit 1 section 4. Water is also a waste product. This water, together with excess water taken in with food and drinks, is excreted in a number of ways. Students could be asked to identify them. Water is lost: • In exhaled air – which is always saturated in water vapour • Through the skin during sweating • In faeces

Competencies	***Contents***	***Suggested activities***
• describe what a hygienic latrine is • explain the importance of a hygienic latrine • discuss the methods of keeping a hygienic latrine clean • construct a model pit latrine using cardboard or other available materials	• Hygienic latrines – importance and constructing a model	• As urine Students could show that their exhaled air is saturated in water vapour by breathing out onto a cold surface such as a mirror that has been left in the refrigerator. The water vapour condenses instantly leaving the mirror misted up. Urea is a waste product from the liver. Urea is lost through the skin during sweating and in urine. Students could research into the structure of the skin to discover how excretion takes place. Students should appreciate the importance of the latrine for removing products of excretion and egestion. Students could discuss why human waste has an unpleasant smell and why it attracts insects like flies. This could link into the next section by discussing the transfer of diseases. Students could list the features of a hygienic latrine. Students could be asked their opinions on the quality of the school latrine and make suggestions as to how it could be improved. Students should discuss why it is important to maintain a high level of cleanliness in the latrine and how best to achieve this. Students could carry out a survey of the cleaning materials available in local shops and markets. They should differentiate between detergents, disinfectants and air fresheners. Students should build a model of a pit latrine using cardboard and other available materials. They should highlight what they consider to be the important features shown on their model.
• describe methods of keeping food hygiene • demonstrate some of the methods of keeping food hygiene	**5.2 Food hygiene** *(4 periods)* • Keeping food hygiene	Students should appreciate that food enters the body through the mouth and therefore it has to be free from harmful organisms which could cause illness. Use this idea to generate a discussion of what precautions must be taken when preparing food to ensure good hygiene. These could include: • Clean hands • Clean working surfaces • Clean cooking utensils and dishes • Ensuring ingredients are fresh and of good quality • Ensure clean water is used to wash ingredients • Keeping food covered from flies and other pests • Keeping food refrigerated if necessary • Cooking thoroughly

Competencies	***Contents***	***Suggested activities***
• demonstrate some of the methods of food preservation • describe methods of food preservation	• Food preservation methods	Students should carry out a survey of different methods of preserving food. These should include both traditional and modern methods and could include: • Salting; Pickling in vinegar; Sugaring; Drying in the sun; Smoking; Bottling; Canning; Freezing; Freeze drying Students should be able to describe each process and give examples of foods that are preserved in this way. Students could discuss the advantages and disadvantages of each technique and why some methods of preservation are particularly suitable for certain foods but not others. Students could identify different methods of preserving the foods on sale in the local shops or markets. Students should be shown some different preservation techniques. Students could attempt some different methods of preserving food. These could include: • Pickling small onions or gherkins in vinegar • Making jam by boiling fruit with sugar • Drying thin slices of fruit in the sun
• explain how foods serves as an energy source • compare human body with an engine regarding energy change	**5.3 Food as a source of heat energy** *(6 periods)* • Comparing our body with an engine	Ask students to compare energy production by our body with that of engines. Engines: Fuel + oxygen → carbon dioxide + water + energy Our body: Food + oxygen → carbon dioxide + water + energy From this comparison they should be able to deduce that food in the human body provides a similar function to fuel in an engine. Point out to students that both processes produce heat energy. In the case of the human body, this is essential to maintain body temperature whereas in a car engine it is not desirable and the engine has a cooling system to remove the heat. Use this as an introduction into heat transfer.
• explain the three mechanisms of heat transfer • give examples for the three mechanisms of heat transfer • demonstrate the three mechanisms of heat transfer	• Mechanisms of heat transfer • Activities to demonstrate mechanisms of heat transfer	Students should be able to name the three methods of heat transfer: • Conduction • Convection • Radiation Students should know that conduction is the method by which heat passes through solids, and to a much lesser extend liquids. Metals are all good conductors of heat. Many other materials like glass, plastic, rubber and wood are poor conductors and are called insulators. When a metal rod is heated the atoms at one end of a rod being heated and vibrating with greater energy. They collide with adjacent atoms and in this way, heat is passed down the rod.

Competencies	***Contents***	***Suggested activities***
		Students should be able to give examples where heat is transferred by conduction e.g. through pans for cooking, through pipes and radiators for heating. Students could investigate whether materials are conductors or insulators by standing rods of different materials in a beaker of hot water and feeling the ends of the rods to see which became hot quickly and which did not. Students could compare how well different metals conduct heat by placing them on a tripod so they fan out. At the end where the rods separate out a drawing pin should be attached to each metal rod using candle wax. The rods should be heated at the opposite end where they are all together and the time take for candle wax to melt and the drawing pin to fall off each should be measured. Students could compare how well copper conducts heat compared to wood using a copper pipe with a wooden dowel pushed into one end to make a tube which is half copper and half wood. If a piece of paper is wrapped around the tube and the tube is heated in the middle using Bunsen burner, it will be found that the paper around the wood browns and catches fire more quickly than the paper around the copper pipe. Students should know that convection is the means by which heat is transferred by liquids and gases. To understand convection, students must understand what happens to the density of a Fluid (liquid of gas) when it is heated. When a fluid is heated it expands and its volume increases. Since density = mass/volume this results in a fall in density. The less dense fluid rises and cooler, more dense, fluid takes its place: the result is a convection current. Students should able to give examples where heat is transferred by convection e.g. from a radiator to heat the air in a room, in a kettle where the water at the bottom is heated. Students could observe the effects of heating air by making spirals of cardboard suspended by the middle on a thread. If these are held over a heat source the hot air above rises causing the spirals to rotate. Students could observe how cooler air is drawn in to replace hot air that has risen using a smoke box. A lighted candle is placed below one chimney and some smouldering wooden spills above the other. Students could observe how convection currents arise in liquids by placing a small crystal of a soluble intensely-coloured compound, such as potassium manganate(VII), in a large beaker of water so it is on the bottom of the beaker near the wall. If the part of the beaker that contains the crystal is gently heated the warm water will rise carrying the colour of the chemical. As the water cools it will fall back to the bottom of the beaker again setting up a circular current. Students should know that radiation is a means of transferring heat without the need of a medium. Heat radiation passes across a vacuum and is the way in which heat passes from the sun to the Earth across the vacuum of space.

Competencies	*Contents*	*Suggested activities*
		Students should be able to give examples where heat is transferred by radiation including from a fire into a room, from an electric element to toast in a toaster. Dull dark surfaces are better radiators of heat and absorbers of heat than shiny bright surfaces. Students could investigate radiation/absorption using Leslie's cube. Students could compare the radiation/absorption of dull black surfaces and shiny bright surfaces using two tin cans. The outside of one can should be polished with the outside of the other should be made dull black either by painting in matt black paint of being coated in carbon from a candle flame. To investigate radiation fill the cans with equal volumes of hot water at the same temperature and place a thermometer in each. The temperature of the dull can falls quicker as dull black is a better radiator. To investigate absorption fill the can with equal volumes of cold water, place a thermometer in each and place them on the window sill in the sun. The temperature of the dull can rises more quickly because dull black is a better absorber.
• explain the causes of food shortage • recommend solutions for food shortage	**5.4 Food shortage** *(2 periods)* • Causes and solutions	Students should discuss the reasons for food shortages in areas. Reasons for poor harvests should include: • Insufficient rain • Crop disease • Damage by pests such as locusts • Exceptional weather conditions such as frosts, winds, flooding Students should discuss each of the reasons they have identified and suggest possible solutions. For example, insufficient rain would be less of a problem if there were stored water in reservoirs or ponds that could be used to irrigate fields when necessary. Students could discuss solutions to deal with food shortages at both local and national levels. They could discuss such issues as: • Can farmers work more efficiently to increase crops yields? • Would mechanisation improve yields • Could alternative crops be grown which would give better yields? • Is it possible to store large quantities of foods? This work could link in to previous work on preserving foods.
• Mention eating raw meat, drinking un-boiled milk and disposing waste at wrong places as harmful practices	**5.5 Harmful practices** *(3 periods)* • Eating raw meat • Drinking un-boiled milk	Students should be aware that harmful microorganisms can be ingested with food. Cooking food thoroughly ensures that any microorganisms present are killed. Follow on from this by discussing how diseases can be transmitted by insects such as flies. Flies are attracted to both food and human waste so there is always a danger that diseases can be transferred from the faeces of an infected person to the food of a healthy one.

Competencies	*Contents*	*Suggested activities*
• Discuss the harmful effects of eating raw meat, drinking un-boiled milk and disposing waste at wrong places	• Disposing human waste at wrong places	Students could carry out research into water-borne diseases like cholera, and parasites like bilharzia. They could use their findings to inform a discussion about how disposing of raw sewage in water courses can lead to the spread of disease.
• define HIV as a virus that causes AIDS • define AIDS as a disease caused by HIV and makes the body vulnerable to a wide range of infections • describe the ways of transmission and prevention of HIV • demonstrate decision making, assertiveness, and critical thinking skills that help them prevent HIV	**5.6 HIV and AIDS** *(4 periods)* • Modes of transmission of HIV • Methods of prevention of HIV • Activities to practice life skills that help them to prevent AIDS – decision making, assertiveness, critical thinking, coping with emotions, and interpersonal communication skills	Students should know that HIV is a virus which attacks the body immune system and leaves in vulnerable to attack by a wide range of infections. This condition is called AIDS. Students should know that the HIV virus can be transmitted in the following ways: • Blood contact • Sexual intercourse • From mother to child Students could discuss how to minimise the risk of becoming infected with HIV by each of the methods above. Students could discuss the importance of being assertive in their attitude to preventing the spread of HIV. They could work in groups developing a role play around a situation where careful thought and assertive action could prevent them being exposed to HIV. This could be acted out for the class and discussed by them.

Assessment

The teacher should assess each student's work continuously over the whole unit and compare it with the following description, based on the Competencies, to determine whether the student has achieved the minimum required level.

Students at minimum requirement level

A student working at the minimum requirement level will be able to: define excretion, name the organs involved, indicate their structures and tell the functions of the structures; describe what a hygienic latrine is, explain its importance, discuss the methods of keeping it clean and construct a model pit latrine using cardboard or other available materials; describe and demonstrate methods of keeping food hygiene and food preservation; explain how food serves us as an energy source and compare human body with an engine regarding energy change; explain, give examples and demonstrate the three mechanisms of heat transfer; explain the causes and recommend solutions of food shortage; mention eating raw meat, drinking un-boiled milk and disposing waste at wrong places as harmful practices and discuss their harmful effects; define HIV and AIDS, describe the ways of transmission and prevention, and demonstrate decision making, assertiveness, and critical thinking skills that help them prevent HIV.

Students above minimum requirement level

Students working above the minimum requirement level should be praised and their achievements recognized. They should be encouraged to continue working hard and not become complacent.

Students below minimum requirement level

Students working below the minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time during breaks or at the end of the day.

Unit 6: Earth *(14 periods)*

Unit Outcomes: Students will be able to:

- define the solar system, list the components of the solar system and mention asteroids, comets and meteors as celestial bodies
- indicate the position of the sun in the solar system and explain its importance as a source of energy
- name the eight planets and the three dwarf planets, identify that each have their own satellites and locate the position of each planet using model
- acknowledge that the reported number of planets varies from time to time as new scientific findings are published
- identify the types and effects of motion of the Earth
- explain and demonstrate eclipses of the sun and moon
- explain the uses of artificial satellites
- demonstrate scientific enquiry skills: observing, classifying, comparing and contrasting, making model, interpreting photos and illustrations and relating cause and effect.

Competencies	***Contents***	***Suggested activities***
Students will be able to: • define the solar system as • list the components of the solar system • mention asteroids, comets and meteors as celestial bodies other than the solar system	***6. Earth*** **6.1 The Earth in the Solar System** *(3 periods)* • The solar system • Other celestial bodies – asteroids, comets and meteors	Students should know that the solar system consists of the sun, the 8 planets, the three dwarf planets and the natural satellites or moons which orbit around them and the asteroid belt that exists between Mars and Jupiter. Students should be aware that there are other bodies that enter and pass through the solar system but are not part of it. These include: • Asteroids • Meteors • Comets Students could research to find out more about Halley's comet. They could find out when it was last seen, when it will next be seen and where it goes to during the intervening time.
• indicate the position of the sun in the solar system • explain the importance of the sun as a source of energy	**6.2 Components of the Solar System** *(5 periods)* • The sun – position, temperature, and importance as a source of energy	Students should know that the sun sits are the centre of the solar system and that the planets are in orbit around it. The sun is the source of energy for the solar system. Students could carry out research into early ideas of the solar system in which the Earth was thought to be at the centre of the solar system (geocentric) rather than the sun (heliocentric). This could include the observations made by Galileo on the moons of Jupiter and his conclusions about the heliocentric solar system. Students could discuss the process by which energy is produced by the sun. Early scientists suggested that the sun was a large piece of burning coal. Students could discuss why this could not be true. Students could carry out research into the process of nuclear fusion.

Competencies	***Contents***	***Suggested activities***
• name the eight planets • acknowledge that the reported number of planets varies from time to time as new scientific findings are published • identify the planets that have their own satellites	• The planets – names, position, why the reported number of planets vary	Students should be able to name the 8 planets starting from nearest to the sun: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. Let them know that Pluto was considered as a planet but now studies revealed that it is not. Pluto, Eris, and Ceres are called as dwarf planets because they are too small to be called as true planets. Students could be given data on the planets and asked to identify patterns. For example: • The four inner planets (Mercury, Venus, Earth, and Mars) are smaller and denser than the rest. • The time it takes a planet to orbit the sun increases with distance away from the sun. • The number of moons varies from planet to planet. The larger planets have more moons than the smaller planets. • The day length (the time it takes for a planet to rotate on its axis) varies from planet to planet. Let the students appreciate that until recently the number of planets known was 9. But now we have 11 planets known to us. This is due to new scientific findings. As scientific findings arise our knowledge about nature also increases.
• locate the position of each planet using model	• Model of the solar system	Students could observe some of the planets with the naked eye or using binoculars. Venus is often visible in the evening and morning sky. Jupiter and Saturn are also sometimes visible. Planets show as discs of light whereas even the closest stars (except the sun) are never more than pin points of light. Students could make a scale model of the solar system by making spheres of different diameters to represent the sun and each planet and placing them at appropriate distances from each other. This would have to be done on the school playing field because of the distances involved. This will give them some appreciation of the distances between bodies in the solar system.
• identify the types of motion of the Earth • explain the effects of motion of the Earth • explain eclipses of the sun and moon • demonstrate eclipses of the sun and moon	**6.3 Motion of the earth** *(4 periods)* • Types of Earth motion – rotation and revolution • Effects of Earth motion	Students should appreciate that although it appears that the sun is in motion across the sky, in reality the sun is stationary and the Earth is rotating on an axis. Use a model, such as a football to represent the sun and a tennis ball to represent the Earth, to show how this. Students should know that the Earth rotates on its axis once each day, and orbits the sun once each year. Students could use a torch and a football to simulate the movement of the Earth around the sun and its rotation on its axis. They should mark the position of poles, the equator and Ethiopia. By rotating the ball they can see that each day consists of a period of light, when Ethiopia faces the sun, and a period of dark, when Ethiopia is on the opposite side of the Earth.

Competencies	***Contents***	***Suggested activities***
	• Eclipses – lunar and solar	Students should know that, as the Earth rotates around the sun, so the moon rotates around the Earth. Students should discuss why the sun and moon appears to be the same size when the sun is much bigger than the Earth and the moon much smaller. Students could use a torch, to represent the sun, a football, to represent the Earth, and a tennis ball to represent the moon. They could experiment by placing them in different positions to satisfy themselves that at certain times, the moon passes between the sun and the Earth giving rise to a solar eclipse. During this time the moon casts a shadow on the Earth. At other times the Earth moves between the sun and the moon giving rise to a lunar eclipse. The Earth casts a shadow on the moon making it invisible. Students could use the internet of other resources to find out when the next solar eclipses and lunar eclipses that can be seen from Ethiopia will occur.
• explain the uses of artificial satellites	**6.4 Artificial satellites** *(2 periods)* • Importance – Communication, weather, and space study	Students should know the difference between natural satellites (moons) and artificial satellites which have been put into space by man. Students should understand that artificial satellites can be put in geostationary orbits – in which the move around at the same speed as the Earth rotates so they are always above the same location on the Earth, and polar orbits – in which they orbit over the north and south poles and view a different section of the Earth on each orbit. Students could discuss each of the following uses of artificial satellites and which type of orbit is most appropriate: • Communication satellites – need to be in geostationary orbits to relay information between locations • Weather satellites – polar orbits allow them to view different sections of the Earth on each orbit so a picture of the weather over a large area can be build up. Students should be aware that the Earth is surrounded by a layer of air we call the atmosphere. Air causes a blurring of light coming from space. Students could discuss the advantages of exploring space using telescopes and other detectors which are in orbit above the atmosphere. Students could research on the internet, or other resource, to find out more about the Hubble telescope.

Assessment

The teacher should assess each student's work continuously over the whole unit and compare it with the following description, based on the Competencies, to determine whether the student has achieved the minimum required level.

Students at minimum requirement level

A student working at the minimum requirement level will be able to: define the solar system, list the components of the solar system and mention asteroids, comets and meteors as celestial bodies; indicate the position of the sun in the solar system and explain its importance as a source of energy; name the nine planets, identify that each have their own satellites and locate the position of each planet using model; acknowledge that the reported number of planets varies from time to time as new scientific findings are published; identify the types and effects of motion of the Earth; explain and demonstrate eclipses of the sun and moon; explain the uses of artificial satellites.

Students above minimum requirement level

Students working above the minimum requirement level should be praised and their achievements recognized. They should be encouraged to continue working hard and not become complacent.

Students below minimum requirement level

Students working below the minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time during breaks or at the end of the day.