Federal Democratic Republic of Ethiopia
Ministry of Education
Special Capacity Building Training Program for Secondary School Teachers

Biology Trainees' Module

June, 2024
Ministry of Education
Addis Ababa

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Contributors:

Part I- Teaching Biology Trainees' Module

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Part I- Teaching Biology

Module Introduction

Dear trainees!

Welcome to this module which deals with content, pedagogy and technology related to secondary school biology. The study of living organisms and their essential functions is known as biology. Our scientific understanding of living entities and their interactions with one another and the environment is greatly enhanced by studying biology. The field of biology also includes various domains and current concerns pertaining to the sustainability of life, including the environment, food security and quality, diseases, drug development, climate change, biodiversity, and conservation. This module is intended to develop conceptual understanding, skills in teaching biology and digital skills for improving secondary school biology teachers practice in delivering biology for students. It focuses on difficult concepts and misconceptions, applying different pedagogical techniques and use of technologies so that secondary school teachers will acquaint with knowledge and skills in teaching secondary school biology. This module covers selected challenging biology contents from grade 9-12, effective learner centered pedagogies and technologies in an integrated manner to deliver biology in secondary schools. Moreover, some of the possible misconception that secondary school students face during learning biology will be addressed and different method of teaching strategies and technologies to solve the problem will be suggested.

Various literatures showed that there are a variety of instructional strategies that can be used in biology classes to support students' complete understanding of new material and enable them to apply what they have learned in the classroom to answer new questions and solve new problems in their everyday life. These modern strategies foster in the students an interest in learning, creativity and teamwork. Because of its distinct nature, biology may require the use of particular teaching techniques to assist students comprehend the idea, the workings of biology and its nature.

In addition to content knowledge of a subject, currently, modern education requires integration of technology and pedagogy in teaching science. Technological Pedagogical Content Knowledge (TPACK) is a framework that assists educators in effectively incorporating technology and pedagogy into their lessons. In order to develop efficient teaching techniques that improve learning, meet the diverse needs and learning styles of students, integrating

technology (T), pedagogy (P), and content knowledge (CK) is mandatory. The following figure shows the relationship between them.

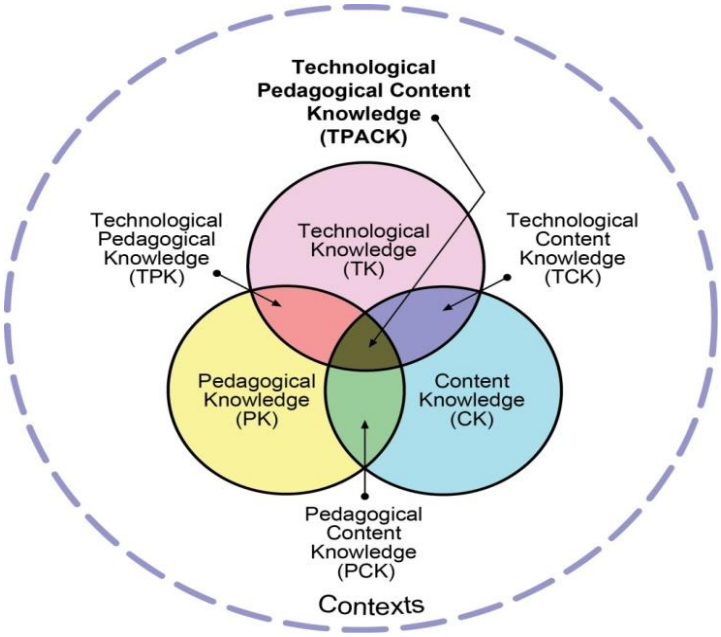


Figure 1: Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2008)

Research indicates that a competent teacher should possess a broad understanding of the subject matter, pedagogical expertise, improved problem-solving techniques, flexibility in accommodating a diverse student body, sound decision-making skills, a better understanding of classroom activities, increased context sensitivity, and a greater sense of respect for their students. But these knowledges alone do not constitute professional competence of teachers. It also includes elements related to motivation, attitudes, and skills that support teaching and learning proficiency.

According to a model proposed by Blömeke and Delaney (2012), there are two main components of teachers' professional competence. These are cognitive skills and affective-motivational factors, as shown below.

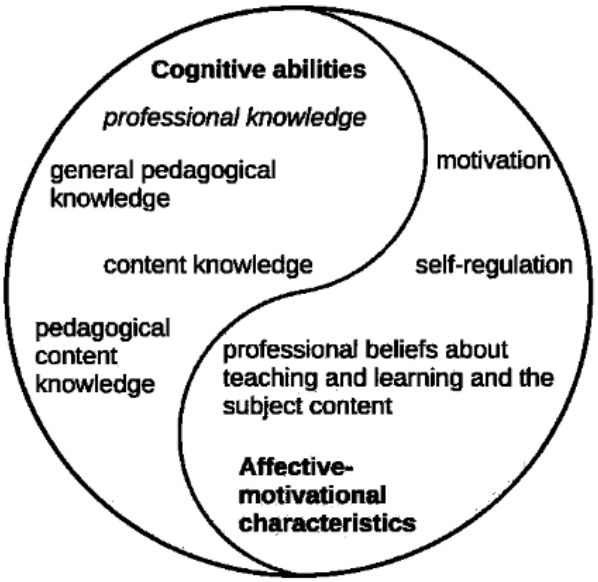


Figure 2: Professional competence of teachers, Adapted from Blömeke and Delaney (2012)

Hence, the contents of this module also contribute for professional development of teachers in their career development.

In recent years, scholars emphasized the need of revising in-class activities for meaningful scientific content teaching and developing conceptual understanding focusing on quality (Mintzes, Wandersee& Novak, 2001). In line with this, the Ethiopian government has developed a new curriculum that aligns with the 21 century needs and encourages classroom activities with inquiry based learner centered approaches and started to implement. These needs include updating the curriculum in response to the rapidly advancing field of knowledge, instructional and educational technology, improving relevance and delivery methods.

Additionally, the new curriculum also addressed core competencies such as critical thinking and problem solving, creativity, communication skills, teamwork and collaboration, indigenization and digital literacy. Furthermore, the curriculum reform also emphasized on inclusion of pressing and cross-cutting issues such as psychosocial support, gender, indigenous knowledge, 21st century skills, etc.

Hence, to implement the new curriculum introducing the teachers about the current curriculum reform are very fundamental ones. As a result, the MoE has chosen to hold an official, 20-day in-person training session for all biology teachers working in secondary schools.

This training module is prepared based on a new curriculum started to be implemented in this academic year, 2016. It mainly addresses those concepts identified as challenging to teach from grade 9-12 biology syllabi, text book and teachers guide. A survey study was conducted by experts from ministry of education and the following contents were ranked 1-11 with regards to be challenging to teach in secondary school. These are 1) Characteristics and classification of organisms 2) Human health, nutrition and disease 3) Biochemical molecules 4) Cell reproduction 5) Nature, biology and technology 6) Enzymes, 7) Genetics, 8) Microorganisms,

9) Energy transformation, 10) Evolution and 11) Human body systems.

This module is organized in twelve units. The first unit is about the teaching - learning of biology and misconceptions including technology. The remaining Units deal with the contents indicated above. Each unit has its own introduction, objectives, sessions with activities, common misconceptions, key ideas, implication to teaching, takeaway materials and summary and reference. The module mainly focuses on the teaching approaches, assessment strategies and technologies suitable for teaching secondary school biology using contents in the new curriculum. However, this doesn't mean that only these methods and technologies are suitable for teaching each unit. You can use different active learning method and technologies which you think useful to teach the contents in secondary school biology.

Therefore, this training module will help trainees to fill the gap observed in relation to subject matter knowledge, pedagogical knowledge, technological knowledge, motivation, attitudes, and skills and be creative in their endeavors. This training will also be part of the package for the big secondary school teachers' professional development (TPD) system aimed to produce competent professionals in teaching.

We hope that the material provided, the activities, the reflections you made during the training, and the tasks you accomplished will help you to become a better secondary school biology teacher as you go through this module. Reading other relevant materials is expected from you in order to enrich the information contained in this module.

Time frame

You will be required to spend three weeks with a total of 84 contact hours, 6 hours per day.

Wish you all the best training time!

Purpose of the Module

The main purpose of this module is to enable trainees acquire in-depth understanding of biological concepts in secondary school, different learner centered teaching approaches, assessment strategies and develop digital skills in teaching secondary school biology.

In order to attain the main purpose of this module, trainees will be able to:

- Explain biological concepts in secondary school biology textbooks.
- Recognize common misconceptions in secondary school biology.
- Evaluate the contribution of various theories of learning in teaching biology.

- Analyze how secondary school students learn biology.
- Explain the learner-centered methods of teaching secondary school biology.
- Apply various strategies in teaching secondary school biology.
- Evaluate the effectiveness of various learner-centered methods of teaching secondary school biology.
- Apply different technologies in teaching secondary school biology.
- Practice reflective approaches of teaching of biology.
- Design a lesson integrating active learning methods and technologies to teach secondary school biology.
- Implement effective teaching strategies and technologies while teaching biology.
- Apply indigenous knowledge and locally available resources in teaching secondary school biology

Pedagogical Approaches

Throughout this module, an active and participatory ways of training will be practiced. The majority of the activities are designed based on the principles of experiential learning and trainees are expected to participate fully in each class because their experiences play a greater role in making the training more effective. Since the trainees are secondary school teachers, this module focuses on how, why and what to teach and expects trainees to learn about teaching based on their own practice. According to Dawit (2023) and Loughran (2006), teaching about teaching and learning about teaching are two interconnected forms of knowledge and practice that form the foundation of teacher education pedagogy.

Assessment Recommendations

In order to check whether the trainees are equipped with the necessary knowledge, skills, and attitudes or not, both formative and summative assessment methods will be used. The formative assessment will focus on assessment for learning and assessment as learning (self-assessment).

Unit 1: The Teaching - Learning of Biology and Misconceptions (4hr)

Introduction

This unit aimed at equipping trainees with in-deep understanding of concept related to teaching, learning, way of learning, teaching strategies and technologies. It deals with learning theories mainly behaviorism, constructivism and connectivism with relation pedagogies and technologies used to teach biological concepts in secondary schools. It also addresses common misconceptions, their source, identification and minimizing strategies.

Unit outcomes

At the end of this unit, trainees will be able to:

1. Compare learning theories with respect to teaching and learning biology.
2. Apply pedagogical approaches and technologies in teaching secondary school biology.
3. Explain how students learn biology in secondary school.
4. Design a lesson by integrating effective teaching strategies and technology to teach secondary school biology.
5. Address individual needs and learning styles by using different teaching methods and assessments.
6. Develop skills to create reflective, engaging and interactive biology lessons.
7. Design mechanism of identifying and minimizing misconceptions to enhance conceptual understandings.

Session 1:1 Teaching-Learning and the way Students Learn (1hrs)

Session Objectives

At the end of this session, the trainees will be able to:

1. Define teaching and learning.
2. Explain how students learn biology.
3. Differentiate between behaviorism, constructivism, and connectivism learning theories.
4. Explain different learner centered teaching approaches.
5. Describe technologies used in teaching learning of secondary school biology.

1.1.1 What is teaching?

Teaching is an integral part of the process of education in which one provides assistance to another in order to make learning happen by imparting knowledge and engaging learners in productive activities. There are two ways of understanding teaching: Teaching as a teacher-centered knowledge transmission and teaching as learner-centered assisted knowledge creation. In teacher centered approach, teaching is considered as imparting instruction and knowledge to the learners in a classroom where students are considered to be passive listeners. Where as in learner centered approach, teaching is considered as a learner-centered activity in which the instructor ensures that learning is made possible for learners and supports, guides, and encourages them in their active and independent creation of new knowledge.

Teaching is regarded as both an art and science. As an art, it lays stress on the imaginative and artistic abilities of the teacher in creating a worthwhile situation in the classroom to enable students to learn. As a science, it sheds light on the logical, mechanical, or procedural steps to be followed to attain an effective achievement of learning objectives.

1.1.2 What is learning?

Learning has been defined in numerous ways by many different theorists, researchers and educational practitioners. Although universal agreement on any single definition is nonexistent, many definitions employ common elements. The definition by Schunk (1991) states that learning is a permanent change in behavior, or in the capacity to behave in a given fashion, which results from practice or other forms of experience. In modern view, learning happens when learners construct meaning and their own understandings by interpreting information in the context of their own experiences.

1.1.3 How do Students Learn Biology?

There are two prominent learning theories in relation to learning and how learning occurs. These are behaviorism and constructivism. In addition, there is a learning theory known as connectivism that emphasis on the role of connections in the learning process through different technologies.

Brain Storming Question

On which of the above learning theories does the Ethiopian education system rely?

A. Behaviorism

Behaviorism is a theory that focuses on how people learn and states that learning occurs form the observation of the environment and responding to it. According to behaviorists, learning is dependent on a person's interactions with their external environment. As people experience consequences from their interactions with the environment, they modify their behaviors in reaction to those consequences (McLeod, 2015).

Because it emphasizes the external environment, behaviorism largely ignores or discounts the role of internal influences such as prior knowledge and emotion (Popp, 1996). To an extent, behaviorists view learners are born as blank slates (tabula rasa) and emphasize the role of the teacher in the classroom. Using rewards and punishments as a basis of conditioning, people slowly learn appropriate behavior. The commonly used method of teaching is teacher centered, lecture method in which learners are passive participants simply expected to absorb the knowledge transmitted by the teacher.

Activity - Reflecting on Behaviorism

Think of some of your own teaching experiences and try to identify a few examples where you used behaviorism in your teaching experiences and reflect on the following questions:

- Have you used behaviorism learning theory principles to guide your teaching practice? How?
- Did you find behaviorism learning theory useful and motivating to you and your learners? Why or why not?

B. Constructivism

Constructivism learning theory focuses on how students actively create or construct knowledge based on their background, prior experience/knowledge and new experiences and social interaction or collaboration (Mercadal, 2018). Contrary to behaviorism, constructivism acknowledges the role of prior knowledge and the role of the mind in learning, believing that individuals interpret what they experience within the framework of what they already know (Kretchmar, 2019a). The commonly used method of teaching is learner centered method that actively engage learners.

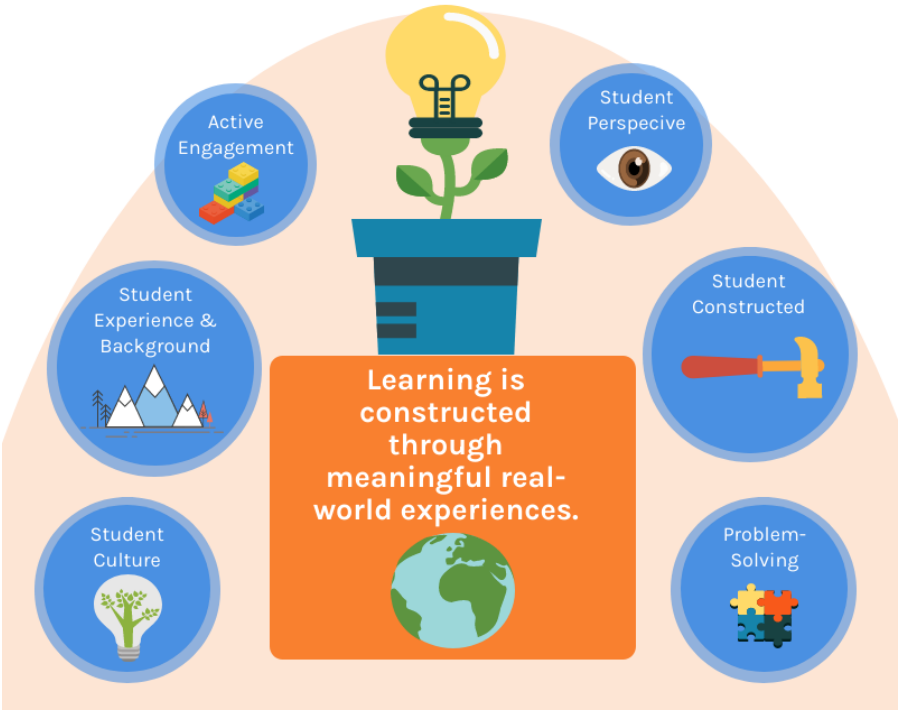


Figure 3. Constructivism learning theory

Hence, the role of the teacher in the constructivist classroom is to show students how to construct knowledge, encourage collaboration to share multiple perspectives, inspire self-exploration and inquiry, design authentic experiences and monitor learning.

Activity - Reflecting on constructivism

Think of some of your own teaching experiences and try to identify a few examples where you used constructivism in your teaching experiences and reflect on the following questions:

- Have you used constructivism learning theory principles to guide your teaching practice? How?
- Did you find constructivism learning theory useful and motivating to you and your learners? Why or why not?

C. Connectivisim

It is obvious that twenty first century is considered as digital era. Connectivism was built on the idea that digital technology brings people together and creates new learning opportunities.

Connectivism accepts technology as a major factor in our learning process. George Siemens (2004) and Stephen Downes (2005) said connectivism begins when an individual turns to digital technology to solve a problem.

In fact, this theory promotes the idea that learning can successfully happen through digital channels, including social media (face book, telegram, WhatsApp, you tube, twitter), videos, and blogs, mobile devices, virtual digital libraries, virtual labs, computers, audio-visual aids, computer aided networks, graphics search engines, and multimedia software (Meletiou, Boyatzis, Stavroulaki&Sgouropoulou, 2012).

The following figure shows connectivism learning network.

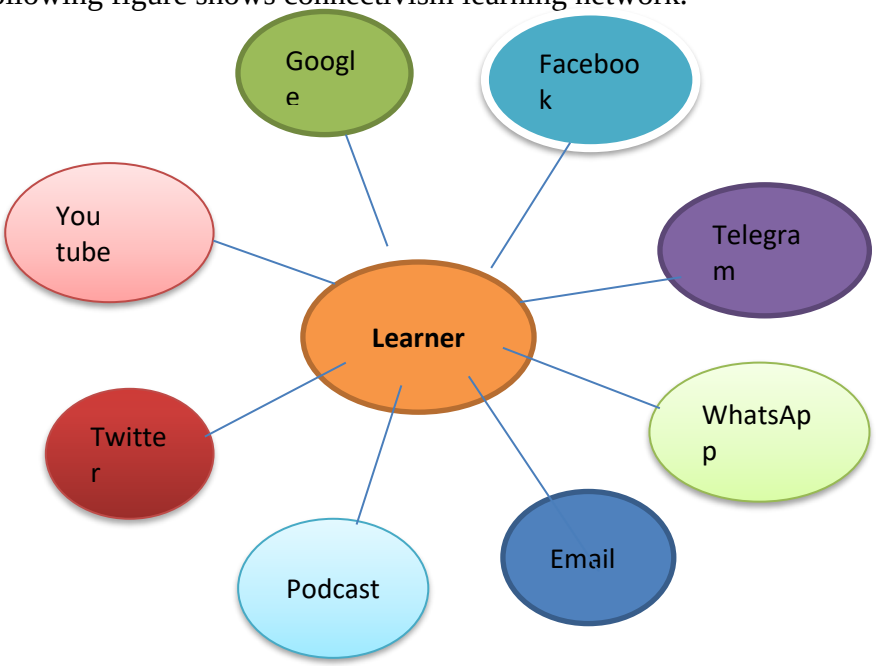


Figure. 4. Connectivism network

Activity - Reflecting on connectivism

Think of some of your own teaching experiences and try to identify a few examples where you used connectivism in your teaching experiences and reflect on the following questions:

- Have you used connectivism learning theory principles to guide your teaching practice? How?
- Did you find constructivism learning theory useful and motivating to you and your learners? Why or why not?

Key Ideas

- Behaviorism - when a new behavior is learned, it is the result of a mechanical process that links a stimulus and a response. Teachers have used the strategies of reinforcement and punishment in the classroom to encourage students' desired behavior and discourage their undesirable behavior.
- Constructivism - the study of how students create their own knowledge. One builds this knowledge via their own experiences and interactions with the outside world.
- Connectivism - knowledge is created by the learner through making connections between different pieces of information. Students build their own learning networks through the connections they make. Learners will have the ability to access updated content via this interconnected web as it changes.

Implications to teaching

- What new things did you learn from this session?
- How these learning theories will help you to design and teach biology?
- How can you help your students benefit from this lesson in your school?

Takeaway resources

- Video link- https://www.youtube.com/watch?v=CyoN6HsZUXA,
- Reading materials on learning theories (behaviorism, constructivism and connectivism).

Session 1.2: Teaching-learning strategies (2:30hrs)

Session Objectives

At the end of this session, the trainees will be able to:

1. Explain learner centered teaching method.
2. Differentiate between learner centered and teacher centered methods of teaching.
3. Explain technologies used in teaching biology.
4. Apply specific teaching method and technologies to teach biology.

1.2.1 Learner-centered approaches or active learning methods

As stated in the above session, teaching-learning methods can be categorized into two types:

teacher-centered (behaviorism) and student-centered (constructivism) teaching-learning methods. Scholars criticize that the first type of teaching-learning method is not effective in the 21stcenturybecauseit does not allow learners to actively engage in their learning. Hence, contemporary scholars have recommended the second teaching-learning approaches such as learner-centered or active learning methods that allow learners to actively engage in their learning, construction of knowledge. This approach is based on constructivist learning theory.

Constructivism learning theory recommends various teaching learning strategies, learner centered approaches, commonly known as active learning methods. This section focuses on some of these strategies useful to teach secondary school biology.

Research shows that active learning is strongly associated with conceptual understanding, problem-solving skills and higher retention rates. The typical learner retention rates for different types of learning activities are illustrated in the learning pyramid indicated below.

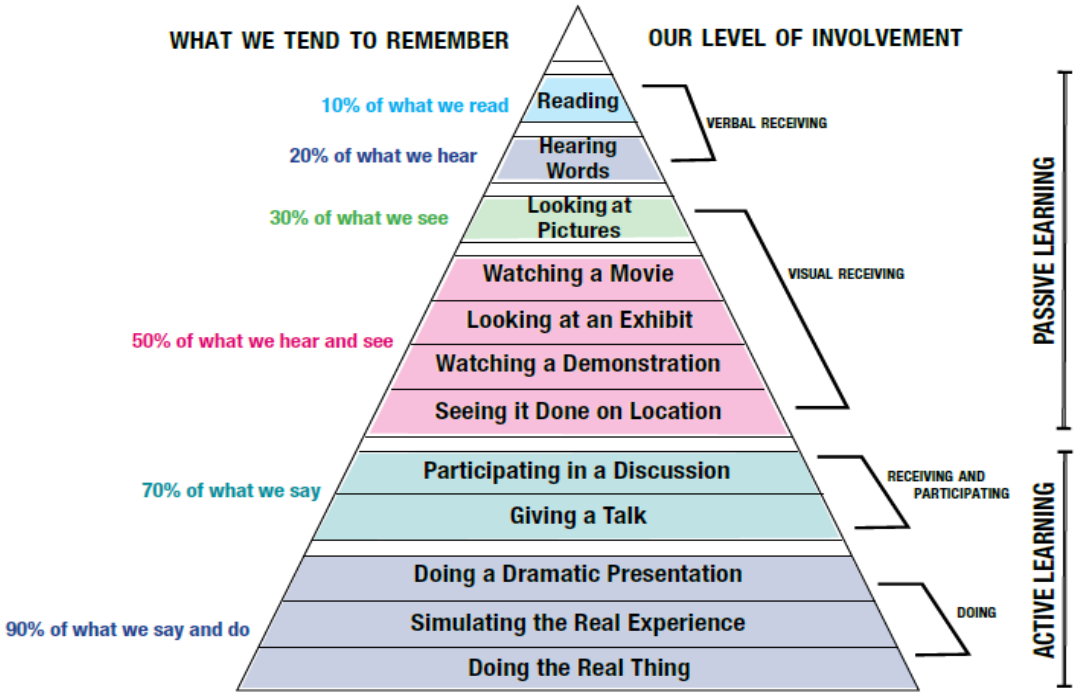


Figure5. Learning pyramid

1.2.1.1 Types of learner-centered teaching methods

The following sections will provide you a brief description of some of the learner centered - active learning methods.

Brainstorming - is a strategy or teaching tool used by a teacher in which most or all of the students participate to generate several ideas, respond, and present views on a topic or problem.

Think-pair-sharemethod- is a cooperative learning strategy that helps students to think individuallyabout a topic or answer a question then share ideas with classmates to learnconcepts and develop oral communicationskills. The following figure shows the strategy.

Figure4.Think– pair –share method

Jigsaw method- is a collaborative learning that helps students to cooperate and learn concepts. In a jigsaw method, students in class will be divided into groups as home group, a task will be given and then expert group will be formed. It has the following steps.

1. Allocate students to **"home" groups** of 4 or 5 students. Provide a task to discuss and share ideas.
2. Give a number or letter to each member in each group.
3. All students with the same number join together to form **"expert" groups** and discuss on the task given
4. Return students to their "home" group and present to their team members what they have found out.
5. Share with whole class

The following figure shows the structure of Jigsaw method, step 1 represents **"home"** group whereas step 2 represents **"expert"**groups.

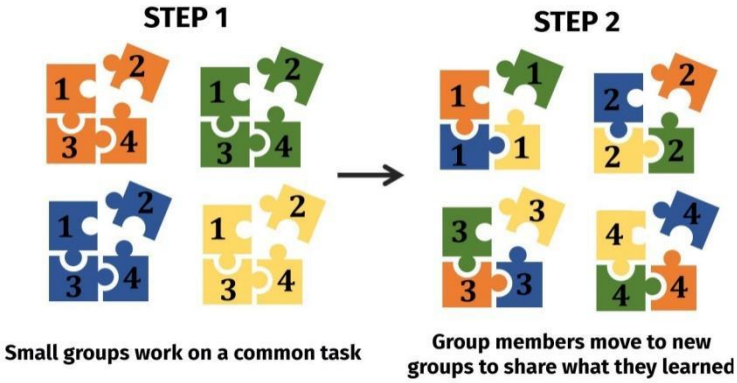


Figure6.Jigsaw group arrangements

Debating- is a discussion on a topic in which two or more people advocate opposing positions on the topic or question in an attempt to make an audience (or the other advocates) accept their position. Debates can be organize as shown below:

Preparation

- Divide students into two groups – For and Against.
- Assign or let students to choose roles in the debate.

During debate

- Write the topics of debate on the board or provide written form.
- Monitor time limits, participation and debate structure.

After debate

- Open up the debate for comments for all students.

Project method-The project method is a collaborative student-centered method facilitated by the teacher. It can be carried out individually or in a group of students for approximately half a week, a week, or even a month or months. At the end of the investigation, the project reports are collected and discussed with the entire class.

7E instructional model -is one of the inquiry based learner centered teaching learning method or an active learning method. This model, as the name implies, consists of seven phases, which are designated after the beginning letter of each phase, with an English letter 'E'.

The**7Es** stand for:

Elicit - to find out what the students know (prior knowledge).

Engage -to arouse interest and curiosity and introduce new learning to help the leaners make a prediction or to support the exploration stage.

Explore - help to give opportunities for learners to work together following the initial teacher's in put to solve/explore problems, build concepts through first-hand experience.

Explain - help to use what students have discovered to help them build the concept/knowledge further.

Elaborate - help to demonstrate learning.

Extend - to encourage students to apply or extend the concepts and skills in new situations.

Evaluate - help to assess or evaluate the learning.

The following figure shows the model

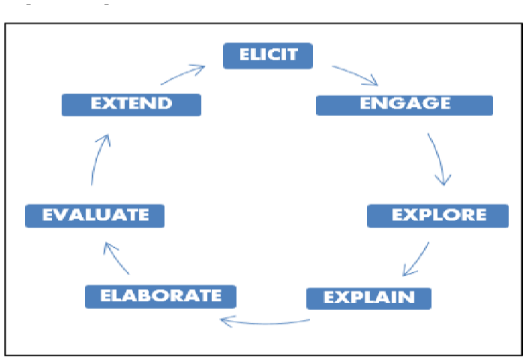


Figure7.The7EInstructionalmodel

KWLchart-is a teaching learning strategy that helps students organize information before, during, and after a unit or a lesson. It is often used to guide students about a topic through the use of a three columns.

K (What they **Know**) - Students begin by brainstorming everything they know about a given topic, which is recorded under the K column (The first column).**W (**what they **Want** to know**)** - Studentsthengeneratealistofquestionsorconcernsaboutwhattheywanttoknowaboutthe topic, which is recorded under the W column (The second column).

L (what they have **Learned**) - New information that they learn is recorded in the L column (The third column).

K	**W**	**L**

Laboratory Method- is a practical hands on and minds on approach to teach biology that involves experimental work that follows specific procedures depending on the issue to be investigated.

Virtual lab- Virtual labs are online simulations and animation implemented as soft ware

programs to learn biology. It allows students to complete laboratory experiments online without having to face physical, face-to-face laboratory activity in a physical classroom. It is a better alterative in schools where laboratory, equipment and chemicals are not available. Examples for this are PhET Colorado website (https://phet.colorado.edu/) and you tube channels.

Concept map- is a visual tool that represents how ideas and concepts are related to each other. A concept map can enrich students' understanding of a new concept.

Steps to follow:

1. Identify the major ideas or concepts
2. Organize the ideas in to categories.
3. Use lines or arrows on the map to represent how ideas are connected

Example of photosynthesis concept map

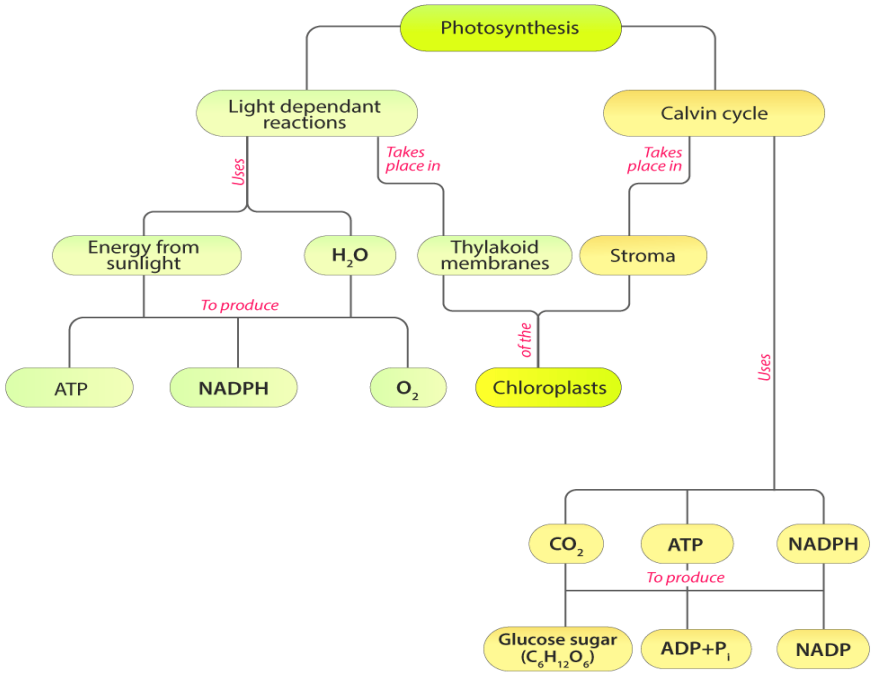


Figure8.Concept map of photo synthesis

The inquiry method- is a method in which students are provided with opportunities to investigate at opicora problem.

A. **Structured inquiry-** learners are provided with questions and procedures (methods)
B. **Guided inquiry-** learners are provided with only the research question but design the procedure (methods) to investigate.
C. **Open ended inquiry-** learners form questions, design procedures to carry out the investigation.

The following figure shows inquiry model

Figure 9. A model of Inquiry process

Integrated science process skill – is a way of investigation through data gathering, interpretation and drawing conclusions. The scientific method is one of the integrated science process skills in which natural world is investigate systematically. The following figure shows the steps in scientific method.

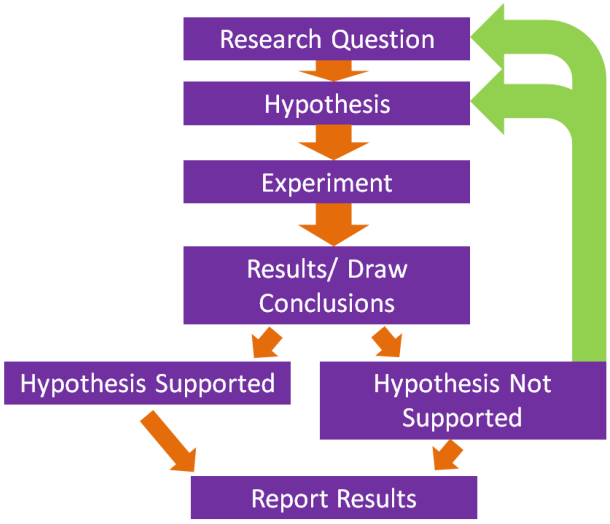


Figure10. Scientific method

Case study method - is a teaching method that involves the analysis of a particular case, scenario or situation, either real or imagined/constructed for the application of knowledge in similar situations. The case study can be presented as a form of narrative, dialogue, video clipor movie,audio tape,etc.

Buzz group method - is a small, intense discussion group that usually involves 4 to5 persons to discuss specific questions or issues for a few minute and then discuss the questions or issues with the whole class and repeat this for different questions/topics.

Fieldtrip -is any teaching and learning outside of the classroom to make aconnection between reality and theory. It provides students with a better understanding of the topic as they have learned through their hands-on experience.

Fishbowl - is a method of discussion. It has the following steps

1. More students sit in a large circle
2. A smaller group of participants sit inside the circle.
3. Select a moderator
4. The groups around the outside circle act as observers.
5. Anyone sitting inside the fishbowl can comment, offer information, respond to someone else in the center, or ask a question.
6. When someone from the outside circle has a point to make, he or she taps the shoulder of someone in the center and takes that person's seat.
7. This continues until all the people from the outside tap and replace people on the inside.
8. Process many ideas after the fishbowl exercise.

The following figure shows fishbowl group structure

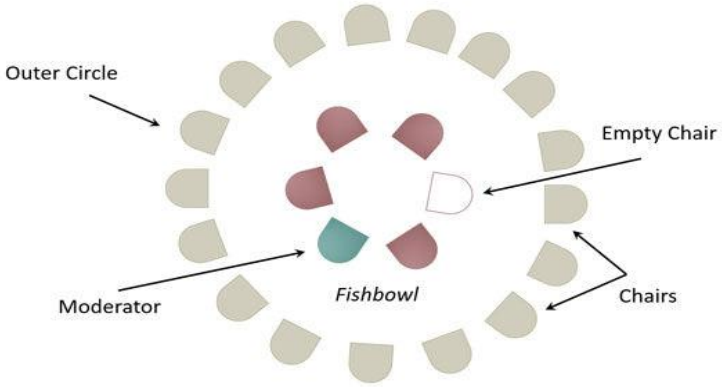


Figure11.Fishbowl group arrangement

Demonstration-is a process by which the teacher shows or illustrates a skill or a principle for learners in a particular setup. It is used for explaining how to use equipment, how to carry out an experiment, how to solve problem, or how to do anything in a specified way. The teacher demonstrates while the learners observe.

Demonstration is necessary when materials are insufficient, activity may be dangerous to the students, time is not adequate, introducing a new skill or concept and to teach manipulative and operative skills.

Role play-is a method of teaching in which one or more participants adopt a specified role and try to behave in ways characteristics of a person in that role. The role players use their own experience and creativity to imitate a real life situation. Students act out what they would say or do in a given situation. Other students watch and listen carefully. After the role play, they discuss the performance, situations and questions raised altogether.

Experiential learning model- is learning through reflection on doing that enable students actively learn and share their experiences, reflect on its importance, connect it to real world examples and apply the resulting knowledge to other situations.

The experiential learning model contains five steps but can be summarized into three main processes: Do, Reflect, and Apply (Figure 12).Reflect is further divided into "Share" and "Process". Apply is further divided into "Generalize" and "Apply" to have five steps.

Figure.12. Experiential learning model

The five steps are:

1. **Do**-is to experience some thing. Students will be provided with experience or activity and perform or do a hands-on, minds-on experience with little or no help from the teacher.
2. **Share –** students will share their experience and their reaction to the experience or activity, results and observations with their peers after they have completed the activity
3. P**rocess** - is discussing, analyzing examining and reflecting on the shared experience.
4. G**eneralize**: is generalizing on implications of experience and how it might be extended to real life.
5. **Apply:** is applying the newly acquired information or skill in other parts of their lives.

Analogy Method - is a comparison of the similarities of two concepts. The familiar concept to learners is called the analog (a house) and the unfamiliar one, that you are going to teach, is the target (cell).

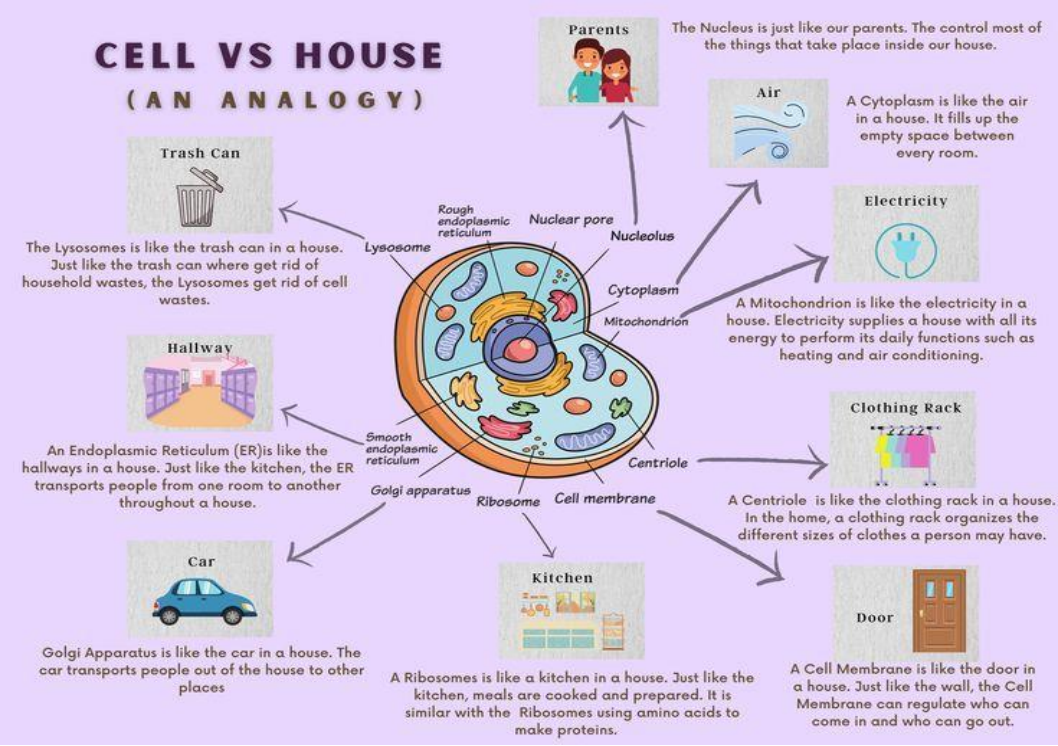


Figure 13. Analogy between cell and house

5E Learning Model- inquiry learning model with 5 phases,each starting with letter 'E'.

Engage –the teacher assesses the learners' prior knowledge and helps them become engaged in a new concept through the use of short activities that promote curiosity and elicit prior knowledge.

Explore - the students have the opportunity to get directly involved with phenomena and materials such as laboratory activities, explore questions and possibilities, and design and conduct a preliminary investigation.

Explain –the learner begins to explain their result in exploration phase through presentation.

Elaborate - the students expand on the concepts they have learned, make connections to other related concepts, and apply their understandings to the world around them.

Evaluate –assess students understanding and abilities to check their progress toward and attainment of competencies.

The following figure shows the 5E model

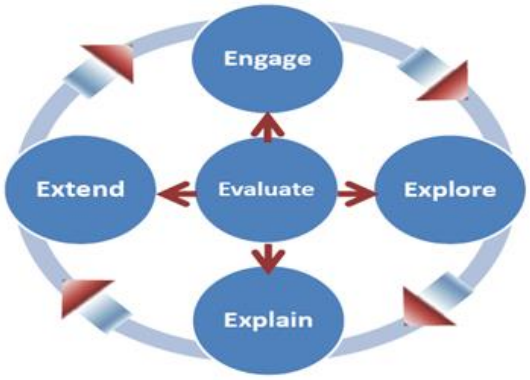


Figure14. 5E's learning cycle model

Group Discussion -is a teaching strategy in which students collaborate to discuss problems and concepts. In groups, students solve problems and share knowledge. It supports the growth of students' communication, critical thinking, and problem-solving skills.

Figure 15. Group discussion

The process of discussion consists of topic announcement, preparation for discussion, starting discussion, conducting discussion and presenting results of discussion to the class as shown in the figure below.

Figure 16. Group discussion process

Flipped classroom - is a setting in which what is traditionally, done in class is performed at home and vice versa. The students attend classes after they have watched their videos at home. They spend the class hours discussing concepts they find difficult to understand with their teachers and other students. They are indulged in more activities which promote their understanding in a better manner. The availability of videos recorded is a vital factor in a flipped classroom and empowers teachers to facilitate engaging, student-centered learning experiences, especially when teaching complex topics like the inorganic biomolecules of life.

Heuristic method - is a pure discovery method of learning biological sciences independent of teachers. It involves students by placing them in the attitude of discoverer aimed at findings instead of being merely told about things. Heuristic method of teaching initiates the students to solve a number of problems experimentally, which is also intended to provide a laboratory-based training exclusively. The basic idea of this method is that students should discover everything they learn from their observations and experiments. As a result, their powers of observation, experimentation and critical thinking and reasoning will develop.

Technologies as instructional approach - Technology provides instant accessibility to information, which is why its presence in the classroom is so vital. Smart phones, computers, and tablets are already an omnipresent element of everyday life for students and teachers alike. Integrating simple technologies, online courses, online tools, interactive videos, virtual classrooms, electronic whiteboards, power points, games, internet homework assignments, or online grading systems can be difference maker instructional technologies in students' growth in the classroom. Moreover, locally available technologies, digital channels including social media, forums, videos, personal blogs, mobile devices, virtual digital libraries, computers, audio-visual aids, multimedia, software, etc are important technologies that enhance students learning. The figure below shows examples of instructional technologies.

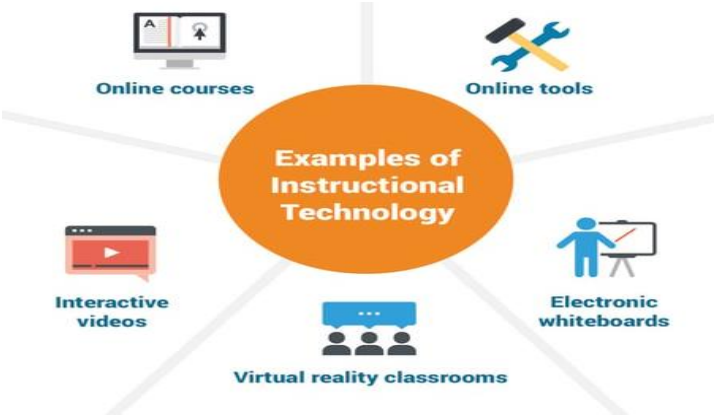


Figure 17. Instructional technologies

Locally available resources -Locally available resources for biology education refer to the materials, tools, facilities, and expertise that are accessible within a particular community or region and can be used to enhance biology learning and teaching.

These resources can include natural materials such as rocks, air, plants and animals, as well as human resources such as scientists, educators, and community members who can provide hands-on experiences and real-world applications of scientific concepts.

Utilizing locally available resources in science education can help students: make real-world connections to scientific concepts, foster a sense of place-based learning, and promote environmental stewardship.

Improvisation is creating, inventing, making a shift of arrangements on materials to prepare equipment from simple, cheap and available materials by both teachers and students.

Two types of improvisation

Improvisation by substitution – where an already existing material is used in place of equipment that is not available.

Improvisation by construction – a student or a teacher construct a new material to teach a lesson when the required material or equipment is not available.

Steps

1. Making careful study of the conventional apparatus or experiment
2. Thinking of some low-cost substitutes that may be available in the market
3. Designing the improvised apparatus or experiment
4. Test the improvised apparatus.

5. Making further improvements on the improvised apparatus using the test results
6. Use the improvised apparatus in the laboratory in practice.

No	Standard equipment	Improvised equipment	Function
1	Hand lens	Electric bulb	For magnification
2	Bunsen burner	Kerosene stove	Source of heat
3	Funnel	Plastic bottle open at the base	For transferring liquid
4	Plant press	Wood/plywood, khaki cloth, shoe b uckles, belt	For drawing moisture or water away f rom plants
5	Round bottom flask	Electric bulbs	For measuring liquid volume
6	Measuring cylinder	Graduated feeding bottle	For measuring liquid volume
7	Indicators	Flower extract	As an indicator for acid and base
8	Catching net	Mosquito net, wooden ring/iron, thr ead, and needle	For collecting insects or catching inse cts
9	Test tube holder	Cloth hanger(peg)	For holding the test tube
10	Watch glass	Cover of Vaseline bottle	For stocking and putting specimens
11	Potometer	Graduated wood, cardboard, tube or biro cases, wood stands, wide-mouthed bottles, electronic packs, h ose	For measuring the rate or speed of pla nt transpiration
12	Clinostat	Can of Nido, plank wood, flat wood support, and handle	For demonstrating the direction of pla nt growth in response to light

Key Ideas

- In order to encourage deeper comprehension and knowledge retention, learner-centered approaches, active learning methods useful.
- Engaging students through interactive activities, discussions, and hands-on experiences help for meaningful learning.
- For effective learning, places students at the center of the learning process, giving them the freedom to investigate ideas and work with classmates.

Implications to teaching

- What new things did you learn from this session?
- How these methods of teaching and technology will help you to teach biology?

Takeaway resources

- Video link- https://www.youtube.com/watch?v=nkTIYjbiyN0, https://www.youtube.com/watch?v=xxVxgQJwV7w,
- reading materials on different active learning methods.

Session 1.3: Misconceptions in learning biology (30 minute)

Session Objectives

At the end of this session, trainees will be able to

1. Explain misconceptions.
2. Recognize sources of misconceptions.
3. Apply appropriate teaching strategies and technologies to minimizing misconceptions.

Activity

Fill the following columns (column 2 and 3) of the table with regards to what you know and what you want to know about misconceptions. Then, after reading the brief description of misconceptions in learning biology given below and fill the fourth column about what you have learned from your reading to check your progress.

1	2	3	4
Topic	**Whatyouknow**	**Whatyouwanttoknow**	**Whatyouhavelearned**
Misconceptions			

1.3.1 Misconceptions

Misconceptions refer to the concepts that have peculiar interpretations and meanings in students' perceptions that are not scientifically proven to be correct. Literature indicated that students come to school with their own knowledge, idea or concept about biology and learn new ideas by relating them to what they already know, and then transferring them into their long-term memory. However, the knowledge the student come with may not consistent with the knowledge that the scientific community agreed up on. If the knowledge is not consistent with this knowledge, it is considered as misconceptions.

These various ideas come from the immediate surroundings of the learners and are then introduced to formal education, beginning in primary school. Every person has a unique

perspective on science, regardless of age, culture, or educational background. Misconceptions that students hold stem from their early school years and beyond.

Misconceptions regarding the concepts of respiration, ecology, genetics, photosynthesis, circulatory system, energy flow, and classifications are frequently encountered in the field of biology (Tekkaya, 2002). Misconceptions held by students are frequently deep-rooted, barriers to learning, resistant to instruction and persist even after instruction.

Correcting misconceptions supports continued academic success, promotes long-term memory and recall and advances comprehensive scientific education. There are different source of misconceptions as indicated in the figure below.

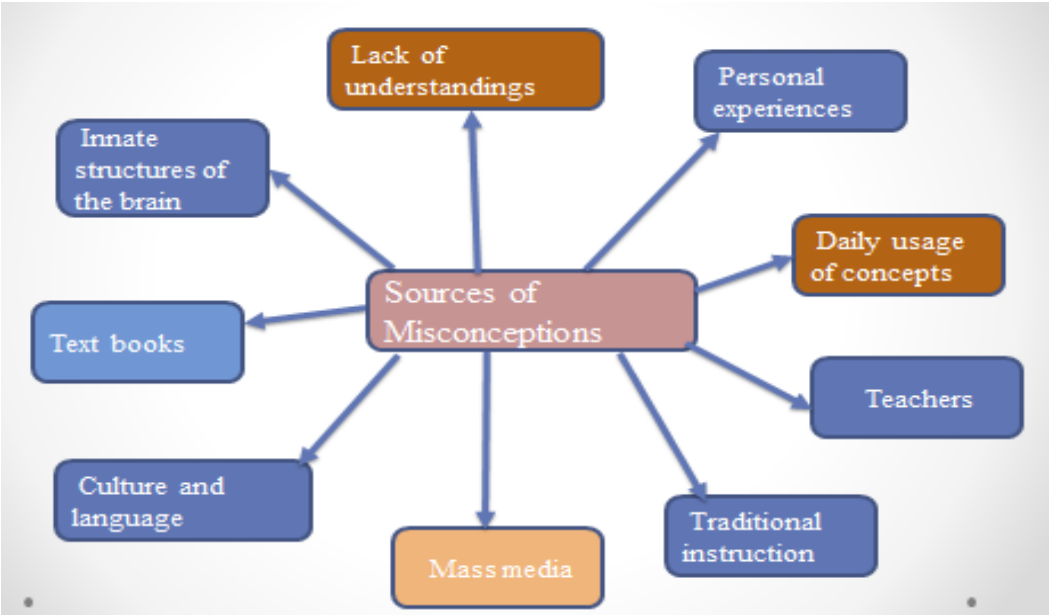


Figure 18.Source of Misconceptions

For effective learning, identifying and correcting misconception is mandatory. There are different misconceptions identification tools including two tier multiple choice diagnostic test (MCDT) as indicated in the figure below.

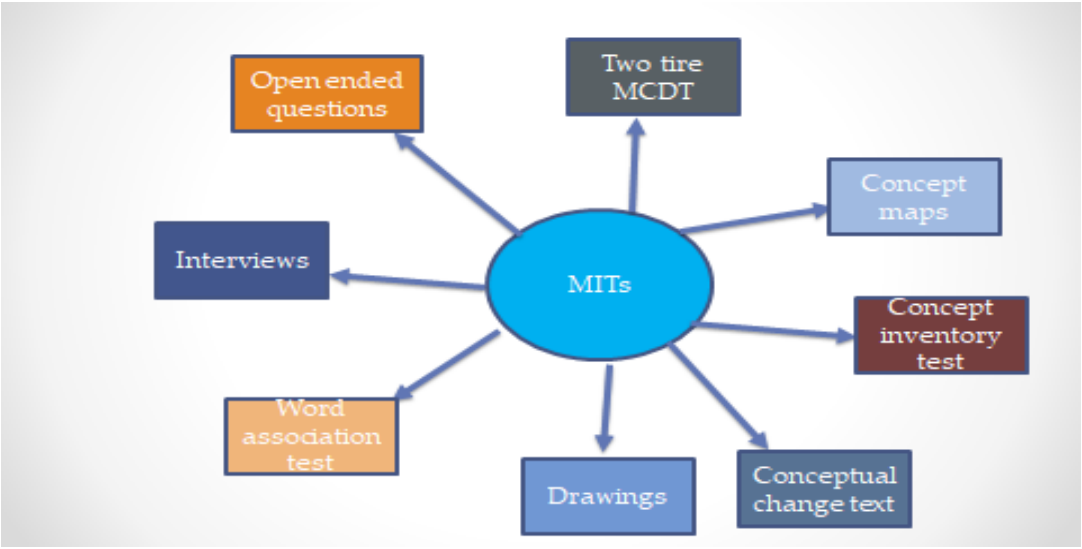


Figure 19. Misconception identification tools (MITs)

Examples of misconceptions in learning biology

A. Some common Misconceptions of Characteristics of Life

1. All living things move

2. All living things have brains and nervous systems

4. Viruses are living organisms

5. All living things need oxygen to survive

B**. Some common misconceptions of human health, nutrition, and disease**

1. Healthy eating is all about avoiding certain foods

2. All fats are unhealthy

3. Natural = Healthy

4. Illness is solely caused by germs

C. Some common misconceptions in enzymes

1. Enzymes only catalyze the breaking-down processes

2. The rate of enzymatic reaction decreases because enzyme molecules are used up

D. Some common misconceptions in genetics

1. Diploid (2n) cells are formed as a result of meiosis.

2. DNA replication takes place only in the meiosis process.

3. A dominant trait is the most likely to be found in the population.

4. If your dad is bald, you will be bald too.

E. Some common misconception of cells

1. All cells are microscopic

Key Ideas

- Biology misconceptions are frequently caused by past encounters, individual convictions, intuitive reasoning, a lack of comprehension of scientific ideas, oversimplified explanations, and cultural influences.
- Even after being exposed to accurate information, these preconceived conceptions may endure, making it difficult to properly understand and apply scientific principles.
- Targeted and deliberate approaches are needed to address misconceptions in order to encourage critical thinking, correct scientific understanding, conceptual change, and improved scientific comprehension among students.

Implications to teaching

- What new things did you learn from this session?
- How identifying misconceptions will help you to teach biology?

Takeaway resources

- Video link - https://www.youtube.com/watch?v=t5j25pDB_O4,
- Reading materials on different misconceptions

Unit Summary

- Teaching and learning process are integral part of education for achieving educational goals.
- Behaviorism is a learning theory that is based on the notion that all behaviors are learned through interactions with the environment, or conditioning. The view held by behaviorists is that only observable behavior should be investigated since environmental stimuli influence our behavior.
- Constructivism is a learning theory that places a strong emphasis on students actively creating their own knowledge and understanding. It implies that students can only create meaning by actively participating in the world and instead of being passively absorbed, knowledge is constructed.
- Connectivism is relatively new theory of learning proposes that students should use contemporary technology to integrate their ideas. It suggests that learning happens online through peer networks and acknowledges the importance of digital tools and the internet in education.
- There are varieties of learner-centered strategies that prioritize the needs, abilities, interests, and learning styles of students.

Unit 2: Teaching Characteristics and Classification of Organisms (3hrs)

Introduction

This unit aimed at equipping trainees with in-deep understanding of concept related to living things and the way of delivering these concepts using appropriate teaching strategies and technologies. This unit deals with the characteristics of living things, classification of living things, taxonomic hierarchies of living things and appropriate pedagogies and technologies used to teach these biological concepts. The pedagogical approach used in unit is learner centered approaches mainly using 7E instructional model and cooperative learning through group discussion. The Unit also tries to address some misconceptions in characteristics of living things, classification of living things and taxonomic hierarchies of living things.

Unit outcomes

At the end of this Unit, the trainee will be able to:

1. Explain characteristics of living things
2. Demonstrate classification and hierarchy of organisms
3. Identify specific teaching method and technologies resources to teach the concepts characteristics of living things and classification.
4. Design a lesson using appropriate teaching method and technology to teach the concept characteristics of living things and classification.
5. Apply specific teaching method and technologies to teach the concepts of life and characteristics of living things.
6. Identify misconceptions in learning characteristics of living things and classification

Session 2.1: Teaching Characteristics of Living Things (1:30hr)

Session Objectives

At the end of this session, the trainee will be able to:

1. Explain characteristics of living things.
2. Design a lesson using 7E instructional model and technologies to teach the concept of life and characteristics of living things.
3. Identify misconceptions in learning characteristics of living things.

Activities 1

NB- This activity is designed based on 7E instructional model developed by Arthur Eisenkraft (2003).

Practicing teaching of characteristics of living things by using 7E instructional model.

1. Elicit phase

In this phase you are expected to answer the following questions based on your experience to reflect what is in your mind.

1. What they knew about life and characteristics of living things?
2. How they taught these topics in your school so far?
3. What technologies they did apply in teaching these concepts?
4. What kind of misconception they identified?

2. **Engagement phase**

Think and answer the following question to focus your attention to the activity.

- When is something alive?
- A car moves, consumes oil, uses O_2 for combustion of fuel and release smokes (CO_2). Water and wind moves. Plants do not move freely. Do these processes signify life?
- see this video link https://www.youtube.com/watch?v=juxLuo-sH6M

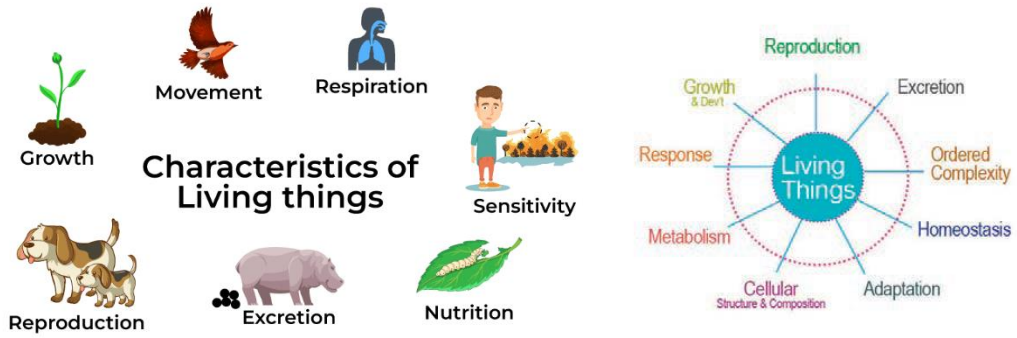
3. **Exploration phase**

Form three groups and investigate the following characteristics of living things based on your experience, textbook and the figures below and discuss.

Group 1- reproduction, metabolism, and ordered complexity.

Group 2- response (sensitivity), growth, cellular structure and composition.

Group 3 - adaptation, homeostasis, and excretion.



4. **Explanation phase**

after investigating and discussing the concept in your group,

- Present to the whole class what you discussed.
- Explain each characteristic with examples.

While presenting and explaining, try to

- identify misconception if present,
- evaluate your conceptual understanding.

5. **Elaboration phase**

In this phase, your trainer will

- create an opportunity for you to reflect on misconception and conceptual understandings
- correct if the misconceptions are persistent and problems in conceptual understanding

6. **Evaluation phase**

After correcting the misconceptions and fulfilling your conceptual understanding gaps: 1. conduct a self- assessment - assessment as learning.

- Answer questions given by your trainer on content, pedagogical and technological aspects related to the lesson assessment for learning.

7. **Extension phase**

after completing the session, apply your knowledge and relate to your day to day life by

- Observing and identifying things in your surroundings (home, school, university and village) and study characteristics of living things that distinguish from non-living things.
- Explaining the importance of studying characteristics of living things for your real life.

Activity 2

Be in group and design a lesson on taxonomic hierarchy of living things in the text book based on the above 7E instructional model.

Key Ideas

- Energy is needed by living things to perform vital functions like growth, reproduction, and movement.
- Living things use mechanisms of temperature regulation to keep their internal environments stable.
- Living things have the ability to change and evolve over time in response to their surroundings.
- Living organisms have the ability to reproduce and transmit genetic information to their progeny.
- Adaptations in the environment can be reflected in the behaviors or physiological processes of living things.
- The 7E instructional model is a student-centered teaching learning approach.
- Some common misconceptions about the characteristics of living things are:
  - All living things move.
  - Only complex organisms are alive.
  - All living things need oxygen to survive.
  - Viruses are truly alive. The truth is a debated topic. Viruses share some characteristics of living things, like reproduction, but they cannot carry out all life functions on their own and rely on a host cell to survive. Therefore, they are often not considered truly "alive" in the traditional sense.

Implications to teaching

- What new things did you learn from this session?
- How 7E instructional method of teaching and video links will help you to teach other biology topics?
- How can you help your students benefit from this lesson in your school?

Takeaway resources

Video link - https://www.youtube.com/watch?v=juxLuo-sH6M,

- Reading materials example model of instruction (7E).

Session 2.2: Teaching Classification of Organisms (1:30hr)

Session Objectives

At the end of this session, the trainee will be able to:

1. Explain how organisms are grouped based on shared characteristics.
2. Describe the concept of binomial nomenclature and its role in scientific classification.
3. Identify specific teaching method, technologies and locally available resources to classification of organisms.
4. Design a lesson using heuristic method and technology to teach the concept of classification of organisms.
5. Apply heuristic method and technology to teach the concept of classification of organisms
6. Identify common misconceptions about classification of organisms.

Activity 1

NB- This activity is sample lesson plan to teach classification of living things and taxonomic hierarchies using a heuristic method.

Practicing teaching of classification of organisms usingheuristic method as presented below through collaborative work.

1. Introduction

Provide brief introduction about the **diversity of life on Earth,** the importance of classifying living things for scientific understanding and communication, the concept of **taxonomy** and **taxonomic hierarchies and binomial nomenclature**.

2. Heuristic Classification

- Make small groups.
- Look at pictures or descriptions of different organisms (e.g., animals, plants, fungi etc).
- Classify the organisms into broad categories (e.g., animals vs. plants) based on observable characteristics (e.g., presence of chlorophyll, mobility).
- Discuss your reasons and share your classifications with the class.
- Conduct mini-lecture or you can use video on the topics of taxonomic hierarchies including the concept of **taxonomic hierarchies** (e.g., domain, kingdom, phylum, class, order, family, genus, and species), examples of how organisms are grouped into these hierarchical levels and discuss the **Linnaean system of classification** and its historical significance.

3. **Practicing in classifying unknown organisms using taxonomic key**
   - Use a picture or description of unknown organisms
   - Create a simple **taxonomic key** (dichotomous key) to identify and classify the organisms. Use the following sample.

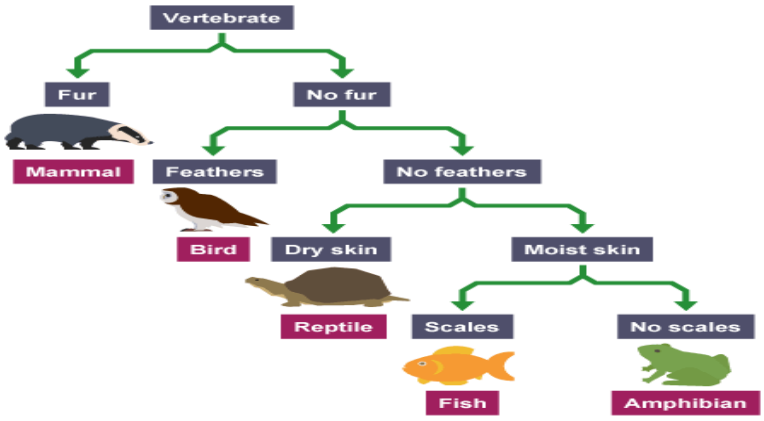


Figure - Example of dichotomous key

Emphasize the importance of using observable characteristics (e.g., presence of wings, number of legs) to guide the classification process.

4. **Conclusion**
   - Recap the main points discussed during the lesson.
   - Highlight the role of taxonomy in understanding biodiversity and evolutionary relationships.
   - Explore more about specific taxonomic groups (e.g., mammals, birds) on their own.
5. **Assessment**
   - Write a short paragraph about a specific taxonomic group (e.g., reptiles, flowering plants).
   - Show dichotomous key of different groups of animals and plants

Key Ideas

- This lesson plan utilizes a heuristic method by allowing students to discover the concept of classification and taxonomic hierarchy through a hands-on sorting activity.
- This approach fosters a deeper understanding and encourages students to think critically about how living things are organized in the natural world.

- It helps to encourage active learning and discovery, develop critical thinking and problem-solving skills, promote collaboration and communication among trainees/students and makes learning more engaging and memorable.
- Biological classification is like a giant filing cabinet for living things. It's a system for organizing organisms into groups based on their shared characteristics. This system helps us understand the relationships between different species and navigate the vastness of the natural world.
- All living things are divided into three domains based on genetic similarity: Archaea (archaebacteria): Very ancient prokaryotic microbes without a nucleus, Bacteria (eubacteria): More advanced prokaryotic microbes, and Eukarya (eukaryotes): Includes all life forms with eukaryotic cells (plants, animals, fungi). Eukaryotic cells have a nucleus.
- Binomial nomenclature is term for the two-part scientific naming system. Binomial nomenclature ensures clear communication among scientists worldwide, eliminating confusion caused by common names that can vary by region or language.
- Some common misconceptionabout taxonomic classification of organisms include:
    - Only physical features are used to classify organisms.
    - The classification of organisms does not change.
    - Amphibians and reptiles are not vertebrates.

Implications to teaching

- What new things did you learn from this session?
- How heuristic method of teaching and technology will help you to teach other biology topics?
- How can you help your students benefit from this lesson in your school?

Takeaway resources

- Video link
    - https://www.youtube.com/watch?v=nB6exRHHPrY&pp=yg
    - https://www.youtube.com/watch?v=sMg_3NY76UE&pp=yg
- reading materials Heuristic method of teaching

Summary

All living things**:**

- are made up of cells, which can be unicellular or multicellular.
- have structures and parts with specialized functions.
- reproduce, which can be sexual or asexual.
- grow and develop over time.
- adjust and respond to changes in their environment.

- **Living things are classified in to five kingdoms.**
- Living things are classified into a hierarchy from kingdom down to species.
- Given each species a two-part Latin name indicating its genus and speciesis**called Binomial Nomenclature.**
- **Dichotomous Keys** are used to identify organisms based on a series of choices that lead the user to the correct name of a given item.
- The **heuristic method** is a student-centered approach that actively encourages learners to explore and discover knowledge through problem-solving and inquiry-based learning.
- The **7E instructional model** is an inquiry-based instructional model rooted in the theory of constructivism

Unit 3: Teaching Human health, nutrition and disease (5hrs)

Introduction

This unit aimed at equipping trainees with in-deep understanding of concepts related to human health, nutrition, and disease and the way of delivering these concepts using appropriate teaching strategies and technologies. It deals with food, nutrition, nutrients, balanced diet, nutrients deficiencies,infectious and non-infectious diseases and appropriate pedagogies and technologies used to teach these biological concepts. The pedagogical approach used in this unit is learner centered approaches mainly using small group discussion and case studies. It also tries to address some common misconceptions in learning human health, nutrition, and disease.

Unit outcomes

At the end of this unit, the trainee will be able to:

1. Explain nutrition, balanced diet and nutrients deficiencies in human being.

2. Describe infectious and non-infectious diseases and treatment mechanisms.
3. Identify specific teaching method and technologies to teach the concepts of in human health, nutrition and diseases.
4. Design a lesson using appropriate teaching method and technology to teach the concept of in human health, nutrition and diseases.
5. Identify misconceptions in learning in human health, nutrition and diseases.

Session 3.1: Teaching Food, Nutrition and nutrients (1:30hr)

Session Objectives

At the end of this session, the trainee will be able to:

- Explain concepts of food, nutrition and nutrients.
- Design a lesson using small group discussion and specific technology to teach food, nutrition and nutrients.
- Apply small group discussion and specific technologies to teach secondary school biology.
- Identify misconceptions in learning food, nutrition and nutrients.

Activity

Make six small groups using your own creative ways of group formation and answer the following questions before discussing in groups.

- What do they know about food, nutrition, nutrients, and balanced diet and how you taught these concepts to your students before in your school?
- See video link -https://www.youtube.com/watch?v=SFE1DfAlipo,

Then, each group should take one of the following topics and discuss in details as indicated below. Select a group leader involving both male and female.

Group 1. Carbohydrates

Group 2. Proteins

Group 3. Lipids

Group 4. Vitamins

Group 5. Minerals

Group 6. Water

During discussion use the following guiding questions.

- What are these nutrients?

- What are their roles in our body?
- How does our body get them?

After discussion, each group is expected to present for the whole class and reflect on their presentation, identify misconceptions and provide feedback.

Assessment

- Conduct self- assessment - assessment as learning.
- Answer questions raised by trainer on food, nutrition and nutrients, small group discussion and technological aspects related to the lesson.

Key Ideas

- The three main macronutrients—fats, proteins, and carbohydrates—and how they support different physiological processes, aid in tissue growth and repair, and provide energy.
- Micronutrients, such as vitamins and minerals, emphasize the variety of nutrient sources for comprehensive nutrition by supporting immune function, metabolism, bone health, and general vitality.

Common Misconceptions

1. **Water is not nutrient.**
2. **Fat-free means healthy.**
3. **Supplements can replace a healthy die.**
4. **Sugar is bad for you.**
5. **Organic is healthier than non-organic.**

Implications to teaching

- What new things did you learn from this session?
- How small group method of teaching and technology will help you to teach other biology topics?
- How can you help your students benefit from this lesson in your school?

Takeaway resources

- Video link- https://www.youtube.com/watch?v=SFE1DfAlipo, https://www.youtube.com/watch?v=inEPlZZ_SfA
- Reading materials on different misconceptions.

Session 3.2: Teaching Balanced diet and Nutrients deficiencies (2hrs)

Session Objectives

At the end of this session, the trainee will be able to:

- Explain concepts of balanced diet and nutrients deficiencies.
- Design a lesson using case study method and specific technology to teach balanced diet and nutrients deficiencies.
- Apply case study method and specific technologies to teach balanced diet and nutrients deficiencies.
- Identify misconceptions in learning balanced diet and nutrients deficiencies.

Activity 1

Make five groups using your own creative ways of group formation and answer the following questions before discussing in groups.

- What do they know about balanced dies and effect of nutrient deficiencies on human health?
- How can we make healthier food choices when eating?
- What is your experience in choosing healthier food when eating?

Then, each group should take one of the following cases as indicated below and discuss in groups.

Group1.

Case 1- *Student X is a fourteen-year-old student who enjoys playing basketball and soccer. He comes from a low-income family where there aren't many nutrient-dense meals, which accounts for his lack of energy and emaciated appearance. His friends have noticed that over the past few months, he has become noticeably thinner with little muscle, old-looking face, exhausted all the time, and has had trouble focusing in class. His clothes seem baggy on him because he has lost weight.*

Discussion Points

- What type of deficiency does student X is suffering from?
- What do you think about the cause of this deficiency?
- How do you solve this problem?
- What do you recommend for his family or government?

Group2.

Case 2- *Thirteen-year-old student Y is a student who loves to dance and participate in school performances but her growth is limited in relation to age and has dry or flaky skin, swelling of leg and abdomen, and changes of the hair color, weakness and*

irritability. She lives in an area affected by drought. Because of food scarcity, her family's diet consists mostly of starchy foods like cassava and maize, and her health is deteriorating.

- What type of deficiency does student Y is suffering from?
- What do you think about the cause of this deficiency?
- How do you solve this problem?
- What do you recommend for his family or government?

Group 3.

Case 3*- Student A is a fifteen years old, and she follows a vegetarian diet. The student is a talented athlete and an enthusiastic swimmer. Her coach observes a decline in his athletic performance as a result of fatigue, and she looks pale and has much less energy than usual. She has been having severe exhaustion feeling weak and irritable, lightheadedness, and dyspnea during practice sessions. Finally, her sudden weakness makes it difficult for her to engage in sports.*

- What type of deficiency does disease student A is suffering from?
- What do you think about the cause of this deficiency??
- How do you solve this problem?
- What do you recommend for his family or government?

Group 4.

Case 4- A *three years old child frequently spends a lot of time in home. During a routine check-up, his doctor notices a slight bowing in his lower limbs, and he also reports leg pain and stiffness.*

- What type of deficiency disease does this child is suffering from?
- What do you think about the cause of this deficiency?
- How do you solve this problem?
- What do you recommend for his family or government?

Group 5.

Case 5*- Over the past week, student A, a 14-year-old outdoor enthusiast, has been camping and has primarily consumed meals without vegetables and fruits. While camping, she experiences bleeding and swollen gums, joint pain, and unrelated bruises on her skin.*

- What type of deficiency disease does this student is suffering from?
- What do you think about the cause of this deficiency?
- How do you solve this problem?
- What do you recommend for her family or government?

After discussion, each case study it is expected to present for the whole class, identify misconceptions and provide feedback.

Assessment

- Conduct self- assessment - assessment as learning.
- Answer questions raised by trainer on balanced diet and nutrients deficiencies.

Activity2

Make a group and design a case study for malnutrition (stunting and obesity).

NOTE

- **Marasmus** is caused by inadequate consumption of carbohydrate. Treatment options include gradually reintroducing food, such as nutrient-dense, high-protein, high-calorie foods, and supplementing with vitamins and minerals as needed **(case-1)**.
- **Kwashiorkor** is brought on by a diet low in protein. Treatment options include introducing foods high in protein gradually, maintaining a balanced diet, and, in extreme cases, seeking medical attention (**Case 2)**.
- **Anemia,** a disorder that lowers the blood's ability to carry oxygen because of the less hemoglobin in the body. It can be brought on by a lack of iron and vitamin B12. Depending on the underlying cause, treatment options may include iron or vitamin supplements, dietary modifications, or medical interventions **(Case 3)**.
- **Rickets disease** is a vitamin D deficiency. It is brought on by a diet low in vitamin D, calcium, phosphorus, or by not getting enough sunlight, which aids in the synthesis of vitamin D **(Case 4)**.
- **Scurvy** is a vitamin C deficiency**.** It results from a diet deficient in vitamin C from fruits and vegetables. The symptoms can be reversed by taking vitamin C supplements and eating foods high in vitamin C, such as broccoli, tomatoes, and citrus fruits **(Case 5)**.

Key Ideas

- Eating a balanced diet that includes a range of foods from various food categories can guarantee that you are getting the nutrients you need for good health and wellbeing.
- The absence of vital nutrients in the diet leads to deficiency illnesses.
- To avoid the onset of deficiency disorders and to preserve optimum health, eat a balanced diet full of vital nutrients.

- Deficiency diseases arise when a particular nutrient is absent in the quantities necessary for the body to operate and be in optimal health. It includes Marasmus, Kwashiorkor, Anemia, Rickets and Scurvy.

Common Misconceptions on balanced diet and nutrients deficiencies are:-

- Healthier food is without fat.
- Vegetarian diets are protein free.
- Only developing countries are affected by deficiency diseases.
- Supplements can fully prevent deficiency diseases.
- Deficiency diseases only affect certain age groups.
- Over weight is due to eating enough balanced diet.
- Exclusive eating meat regularly makes our body healthy and strong.

Implications to teaching

- What new things did you learn from this session?
- How case study method of teaching and technology will help you to teach other biology topics?
- How can you help your students benefit from this lesson in your school?

Takeaway resources

- Video link https://www.youtube.com/watch?v=NqV1Ig4_nfI, https://www.youtube.com/watch?v=gHXQm8QCPeY, https://www.youtube.com/watch?v=z0LAOQyk5hU, https://www.youtube.com/watch?v=wrDX3dNQSBg
- Sample case studies method of teaching.
- Reading materials on deficiency diseases.

Session 3.3:Teaching Infectious and Non-infectious diseases (1:30hr)

Session Objectives

At the end of this session, the trainee will be able to:

- Describe concepts of infectious and non-infectious diseases.
- Apply jigsaw method to teach infectious and non-infectious diseases.
- Practice specific technologies to teach the concepts of infectious and non-infectious diseases.

- Design a lesson using jigsaw method and specific technology to teach infectious and non-infectious diseases.
- Identify misconceptions in learning infectious and non-infectious diseases.

Activity 1

Based on your prior knowledge answer the following questions.

What do you know about infectious and non-infectious diseases?

Show the video link https://www.youtube.com/watch?v=9axOFtPqS0c

Using jigsaw method, make seven groups each having six members, called home groups. Then, give number for each member in the group starting from number 1 for each group (i.e. 1- 6 for each group).

Give each home group one of the infectious diseases as shown below and let you to discuss for.

Group 1. HIV,

Group 2. TB,

Group 3. Malaria,

Group 4. COVID-19,

Group 5. Amebiasis,

Group 6. Giardiasis

Group 7. Typhoid.

What do you know about each disease and your experience of this disease

Then, you can also go through the following guided questions which help to facilitate the discussions within each group.

1. What are the causes of the each infectious disease?
2. What are the symptoms of each infectious disease?
3. How do these infectious diseases spread from person to person?
4. What are the prevention and treatment mechanisms?

After you discussed the disease assigned to you, all members assigned with number 1 should sit together and follow the same procedure for number 2, 3, 4 , 5, 6 so that you can have 6 groups each having 7 individuals, 1 from each group(1- 7). These

are expert groups because they know everything about cause, symptom, transmission and treatment of the disease.

Each group members should share their discussion for the members of the group.

After all expert groups have shared their findings, you need to have a discussion with whole-class by emphasizing the following points:

- Compare and contrast the diseases.
- Discuss commonalities and differences in causes, transmission, and prevention.
- Address misconceptions and clarify doubts.

Assessment

- Conduct self- assessment - assessment as learning.
- Answer questions raised by trainer on infectious and don-infectious diseases, Jigsaw method and technological aspects related to the lesson.

Activity 2- Design a lesson for non-infectious diseases using Jigsaw method.

Key Ideas

- Pathogens such as bacteria, viruses, fungi, or parasites etc. cause infectious diseases and can spread from person to person through contaminated food, water, air, or vectors. Influenza, tuberculosis, HIV/AIDS, malaria, and COVID-19 are typical instances of infectious diseases.
- The symptoms of infectious diseases can differ greatly based on the particular pathogen, but fever, exhaustion, coughing, diarrhea, and rash are often among them.
- Vaccination, proper hygiene (hand washing, for example), and safe food and water practices are some ways to prevent infectious diseases.
- Depending on the kind of pathogen causing the infection, therapeutic interventions for infectious diseases may include the use of antibiotics, antivirals, antifungals, or anti-parasitic drugs.

Common misconceptions

- TB is a disease caused by cold weather.
- Vaccines are harmful.
- Vaccine is a medicine to cure infectious disease.
- Antibiotics can treat all infectious diseases

Implications to teaching

- What new things did you learn from this session?
- How Jigsaw method of teaching and technology will help you to teach other biology topics?
- How can you help your students benefit from this lesson in your school?

Takeaway resources

- Video link
  - https://www.youtube.com/watch?v=9axOFtPqS0c,
  - https://www.youtube.com/watch?v=2JWku3Kjpq0,
- Jigsaw method model
- reading materials on infectious diseases

Unit Summary

- Human health is profoundly influenced by nutrition, which plays a critical role in our overall well-being.
- Good nutrition is associated with numerous benefits but malnutrition poses significant threats to human health.
- Adequate nutrition is essential for optimal body function, and severe nutritional inadequacy can lead to disease and even death.
- Deficiency diseases are health issues that arise due to the lack of essential nutrients in one's diet over an extended period.
- Infectious diseases are disorders caused by organisms such as bacteria, viruses, fungi, or parasites.
- The case study method involves an in-depth, detailed examination of a subject (the case), as well as its related contextual conditions.
- The jigsaw method is a cooperative learning technique with a three-decade track record of successfully reducing racial conflict and increasing positive educational outcomes.
- Group discussion is a form of cooperative learning and collective problem-solving where participants engage in dialogue to reach a conclusion or to exchange ideas.

Unit 4: Teaching Biochemical molecules (3hrs)

Unit Introduction

This unit aims at helping trainees to establish understandings of what biological molecules are, and how would they teach these concepts for biology. The general classification of the biological molecules that are divided into two categories: inorganic and organic. It also talks

about how they affect cell structure and function.

Unit outcomes

After completing this unit, trainees will be able to:

- Conduct experiments to identify nutrients in different foodstuff.
- Classify nutrients in to inorganic and organic biochemical molecules.
- Explain the functions of inorganic and organic biochemical molecules.
- Appreciate why Ethiopians use malting seeds to make local drinks (Tella, Areke).
- Recognize specific teaching method, technologies and locally available resources to teach the concepts of biochemical molecules.
- Identify misconceptions in the concepts of biochemical molecules

Session 4.1: Teaching inorganic biochemical molecules (1hr)

Session Objectives

At the end of this session, the trainees will be able to:

1. Identify inorganic biochemical molecules.
2. Explain functions of inorganic biochemical molecules.
3. Design a lesson using **Flipped Classroom** approach and technologies to teach inorganic biochemical molecules.
4. Apply **Flipped Classroom** approach to teach the concepts of inorganic biochemical molecules.
5. Recognize misconceptions in the concepts of inorganic biochemical molecules.

Activity

This activity is designed based on the **Flipped Classroom** approach for teaching inorganic biochemical molecules. This method is particularly effective for complex topics like inorganic biochemical molecules.

The steps of the activities are as follows.

I. **Pre-Class Learning**

Use reading materials (textbooks), videos, and locally available resources about inorganic biochemical molecules before the class at your home. This allows you to familiarize yourselves with the topic at your own pace.

See the Video link https://youtu.be/q4tMUtMRgwM?t=493 before class.

II. **In - Class Activities**

Use class time for interactive activities. This could include discussions, problem-solving sessions, and group projects on nature and functions of inorganic biomolecules. For example, you could develop model of the structure of a molecule using physical or digital tools.

III. **Hands-On Experiments**

Simple lab experiments may be important in this topic. Try to observe the properties and reactions of inorganic biochemical molecules firsthand.

For example, capillary action – Observe the **capillary action** of water by placing two cups with water and a paper towel strip connecting them. The water will rise up the paper towel due to capillary forces. This is important to realize the characteristics of water and capillary action.

See the video linkhttps://www.youtube.com/watch?v=w_tc8tlEoBs

Assessment

- After the class, answer questions raised by your trainer such as identify inorganic compounds in your surroundings (home, school, university, village) and study their function and how they are different from organic biomolecules of life.
- You may be also asked the importance of studying water, inorganic ions and their characteristics to relate with your real life.
- Conduct self- assessment - assessment as learning.

Note: By flipping the traditional teaching model, you allow students to explore the topic independently and then apply their knowledge in a supportive, collaborative environment.

Key Ideas

- A flipped classroom is a setting in which what is traditionally, done in class is performed at home and vice versa. The students attend classes after they have watched their videos at home. They spend the class hour by discussing the concepts which are

difficult to understand with their teachers and other students. They are engaged in more activities which promote their understanding in a better manner. The availability of videos recorded is a vital factor in a flipped classroom and empowers teachers to facilitate engaging, student-centered learning experiences, especially when teaching complex topics like the inorganic biomolecules of life.

- Our body is made up of two types of biochemical molecules: organic and inorganic molecules.
- Biochemical molecules that do not contain both carbon and hydrogen are known as inorganic biochemical molecules. Many inorganic compounds, such as water (H_2O) and the hydrochloric acid (HCl) generated by your stomach, include hydrogen atoms. Only a few inorganic compounds, on the other hand, contain carbon atoms. One of such examples is carbon dioxide (CO2). Organic biological molecules are made up of both carbon and hydrogen atoms. Covalent bonds are used to make organic biochemical compounds in living creatures, including the human body. Carbon and hydrogen, respectively, are the second and third most abundant elements in your body. You will soon figure out how these two elements interact in the meals you eat, the compounds that make up your bodily structure, and the chemicals that keep you running.
- A common misconception is that all biomolecules are organic. However, inorganic biomolecules, including certain essential elements and minerals, also exist and are vital for life. Examples include water, oxygen, hydrogen, nitrogen, calcium, and phosphorus. Both organic and inorganic substances play crucial roles in biology.

Implications to teaching

- What new things did you learn from this session?
- How flipped classroom and hands-on activity method of teaching and technology will help you to teach other biology topics?
- How can you help your students to benefit from this lesson in your school?

Takeaway resources

- Video link (https://youtu.be/lC57cJzM8OA?t=15
- Model of instruction (flipped classroom).
- Reading materials include student text books, training module etc.

Section 4.2: Teaching organic biochemical molecules (2hrs)

Session Objectives

At the end of this session, the trainees will be able to:

1. Classify organic molecules based on their constituent elements and the monomers from which they are constructed.
2. Elaborate the functions of carbohydrates, proteins, lipids, and Nucleic acids to the body.
3. Conduct experiments to identify nutrients in different foodstuffs.
4. Design a lesson using 7E instructional model,technologies and locally available resources to teach the concepts of organic biochemical molecules.
5. Apply 7E instructional model andtechnologies to teach the concepts of organic biochemical molecules.
6. Identify misconceptions in the concepts of organic biochemical molecules

Activity

NB- This activity is designed based on 7E instructional model developed by Arthur Eisenkraft (2003)

You have to do the activities of teaching and learningby following the 7E instructional model as presented below through collaborative work.

1. Elicit phase

At the beginning of the training session (elicit phase), you should answer the following questions based on your previous knowledge.

- What do you know about organic biomolecules, their structure, composition, and function?
- How had you taught these topics in their school so far?
- Which technologies did you applied in teaching these concepts?
- What kind of misconception did you identified?

2. **Engagement phase**

Then in this phase, give answers for the following question to draw your attention to the activity:

Start with an engaging activity to make the lesson more interesting that stimulate the learner. This could be a short video or a real-life example that relates to organic biochemical molecules.

Or show the following video link and

https://youtu.be/QWf2jcznLsY?t=262

3. **Exploration phase**

During this phase:

- Make four groups and assign the following organic biomolecules to each group to explore based on your experience.

Group 1- carbohydrates-definition, monomers, type of covalent linkage, structure, classification, function etc .

Group 2- lipids – definition, monomers, type of covalent linkage, structure, classification, function etc.

Group 3 – proteins- definition, monomers, type of covalent linkage, structure, classification, function etc.

Group 4 – nucleic acids- definition, monomers, type of covalent linkage, structure, classification, function etc.

4. **Explanation phase**

After exploring and discussing the concept in a group,

- Each group should present what you discussed.
- Explain each organic biomolecules with examples, structure, function, classification etc.

While each group is presenting, try to

- Identify misconception if present.
- Evaluate your conceptual understanding.

5. **Elaboration phase**

In this phase, you are expected to

- Create an opportunity for individuals trainees to reflect on misconception and conceptual understandings.
- Correct if the misconceptions are persistent and problems in conceptual understanding.

6. **Evaluation phase**

After correcting the misconceptions and fulfilling conceptual gaps, conduct

- self- assessment - assessment as learning.

7. **Extension phase**

After completing the session, try to apply your knowledge and relate to your day to day life and answer the following concepts.

- Observe and identify the four organic biomolecules in your surroundings (home, school, university, and village) and study them.
- The importance of studying organic biomolecules for your real life.

Key Ideas

- Organic biochemical molecules are complex compounds that contain carbon atoms. They are found in all living organisms and play a vital role in the structure and function of cells. There are four main types of organic biochemical molecules: carbohydrates, lipids, proteins, and nucleic acids.
- **Carbohydrates** are energy-rich compounds made up of carbon, hydrogen, and oxygen. They include sugars, starches, and cellulose. **Lipids** are fats, oils, and waxes. They are used for long-term energy storage and insulation. **Proteins** are complex molecules made up of amino acids. They are essential for growth and repair in the body. **Nucleic Acids** are the molecules of inheritance – DNA and RNA. They carry the genetic information necessary for life.
- Macromolecules are formed by polymerization, a process that joins smaller units called monomers by covalent bonds. The process of forming polymers from monomers occurs in various ways, often through dehydration synthesis. Dehydration reactions join monomers and form polymers, while hydrolysis reactions break apart macromolecules into their components.
- Some common misconceptions related to organic biochemical molecules:

➢ All carbohydrates are sugars and they are only used as source of energy. While many carbohydrates are sugars (monosaccharaides and disaccharides) with a primary function of providing energy, there are other important types. Polysaccharides like cellulose (in plant cell walls) and chitin (in insect exoskeletons) provide structural support and some carbohydrates serve as recognition molecules in cell-cell interactions.

- All carbohydrates are sweet in taste.Not all carbohydrates are sweet in taste. Sweetness is a characteristic of specific types of carbohydrates (sugars), but not all carbohydrates are sweet.
- All fats (lipids) are harmful and should be avoided. However, lipids play essential roles in the body, such as energy storage, insulation, and cell membrane formation. It's important to understand that there are different types of fats, and while some can be harmful in excess (like saturated and trans fats), others are beneficial (like unsaturated fats).
- Proteins only build muscles. Proteins are truly crucial for muscle growth and repair, they serve many other functions in the body. They act as enzymes, hormones, and antibodies, and are involved in numerous biochemical reactions.

Implications to teaching

- What new things did you learn from this session?
- How 7E instructional model and technology will help you to teach other biology topics?
- How can you help your students benefit from this lesson in your school?

Takeaway resources

Video link (https://youtu.be/QWf2jcznLsY?t=262),

- Reading materials - model of instruction (7E).

Unit Summary

- Biochemical molecules, also known as biomolecules, are vital substances produced by cells and living organisms.
- Biomolecules are the most essential organic molecules, which are involved in the maintenance and metabolic processes of living organisms.
- There are four major classes of biological macromolecules (carbohydrates, lipids, proteins, and nucleic acids), and each is an important component of the cell and performs a wide array of functions.
- Each biomolecule plays a unique and indispensable role in maintaining life and facilitating the complex biochemical processes that occur within living organisms.
- **Flipped Classroom** is an educational strategy that reverses the traditional learning environment by delivering instructional content, often online, outside of the classroom.

- **7E Instructional Model** is basedon the theory of constructivism and includes seven stages: **Elicit, Engage, Explore, Explain, Elaborate, Evaluate,** and **Extend.**

Unit 5: Teaching of Cell Reproduction (3hrs)

Unit Introduction

This unit aims at helping trainees establish understandings of the cytological basses of inheritance i.e., the cell cycle and cell division, and what will happen if cell cycle is not controlled?. A cell cycle is a sequence of events that takes place in the parent cell as a means of distributing genetic materials thereby forming daughter cells. There are two main divisions of the cell cycle: Interphase and cell division. Cell division is a basic process in all living things where a parent or mother cell, divides into two daughter cells. An ordered series of events involving cell growth and cell division that produces two new daughter cells are termed the cell cycle.Uncontrolled cell division can lead to the formation of a mass of cells, or a tumor. It also aims at equipping trainees with specific pedagogies and technologies to teach cell reproduction.

Unit outcomes

After completing this unit, trainees will be able to:

- Identify the two types of cell division.
- Explain the importance of cell division.
- Outline the series of events taking place in the cell cycle.
- Compare and contrast Mitosis and Meiosis.
- Recognize the occurrence of cancer cells due to failure to control the cell cycle.
- Identify specific teaching method, technologies and locally available resources to teach the concepts of cell reproduction.
- Make out misconceptions in the concepts of cell cycle and cell division.

Session 5.1. Teaching the cell cycle (1hr)

Session Objectives

At the end of this session, the trainee will be able to:

1. Define cell cycle.
2. Outline the various stages of cell cycle.
3. Explain the key events occurring in each phase of the cell cycle.
4. Collect information on cancer.

5. Design a lesson using hands-on activities and technologies to teach the concepts of cell cycle.
6. Apply hands-on activities and technologies and locally available resources to teach the concepts of cell cycle.
7. Identify misconceptions in the concepts of cell cycle.

Activity

This lesson delivery uses a hands-on activity to teach the cell cycle phases. It is well-structured and should effectively teach the cell cycle to you. It includes an introduction, instructions for a hands-on activity, presentations and discussion, and a reflection period. The models and presentations will serve as an assessment of the trainees' understanding of the cell cycle. Additionally, a short quiz at the end of the lesson will further assess their knowledge. This activity not only aims to teach the cell cycle but also encourages active learning and creativity.

In this session a **hands-on activity** is selected to show the cell cycle to trainees and the materials needed for this activity includes craft paper, markers, scissors, glue, and labels.

Major Steps of the activity

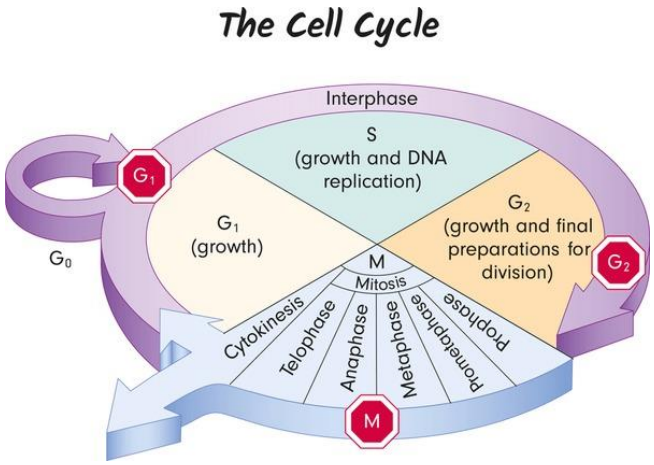
The first step is introduction which may take 10-15 minutes and begin the lesson training with a brief summary of the cell cycle and its stages from textbooks. Be aware that your activity will comprise creating a physical model of the cell cycle.

Next to the introduction step is instruction that may take 5 minutesin this stage you are expected to prepare and collect craft materials and you will be using these materials to create a model of the cell cycle and each of you should include all the stages of the cell cycle (Interphase, Prophase, Metaphase, Anaphase, Telophase, and Cytokinesis) in your model.

The third phase is a **hands-on activity** or**model creation that may proceed 30 - 40 minutes.In this step you** must use the craft materials to create your own cell cycle models that encourage your creativity and individual interpretation.

Note:*This is a guiding procedure on how you can create a model of the cell cycle using the materials.*

- *Collect your materials - craft paper, markers, scissors, glue, and labels.*
- *On the craft paper, draw a large circle. This will represent the full cell cycle.*
- *Divide the circle into different sections for each stage of the cell cycle: Interphase (further divided into G1, S, and G2 phases), Prophase, Metaphase, Anaphase, Telophase, and Cytokinesis.*
- *Use different colored markers to distinguish between the different stages.*
- *Write the name of each stage in its respective section using the labels.*
- *In each section, draw a smaller diagram that represents what happens in that stage. For example, in the 'Interphase' section, you can draw a cell with a clearly visible nucleus (as DNA is in its uncondensed form). In the 'Metaphase' section, draw chromosomes aligned at the metaphase plate. Draw arrows to show the progression of the cell cycle.*
- *The cell cycle typically moves clockwise, starting and ending with cytokinesis.*
- *Use glue to firmly attach the labels to the craft paper.*



In the fourth step once the models are complete, present your model to the class. You should explain each stage of the cell cycle as it appears in your model. This may take 20-30 minutes.

After all the presentations, there should be a class discussion including asking questions and sharing of your observations for about 15- 20 minutes regarding the concept of cell cycle.

Then finally, reflection is important that may take 5 - 10 minutes. You should conclude the lesson by emphasizing the importance of the cell cycle in biological processes like growth, development, and healing and write a short reflection on what you have learned from the activity.

Remember:

- For **assessment, t**he models and presentations will serve as an assessment for understanding of the cell cycle.
- The goal of this lesson is not only to teach the cell cycle but also to encourage active learning and creativity.

After completing the session, apply your knowledge and relate to your day to day life,

- to observe and identify the role of cell division.
- recognize the importance of studying cell cycle and how it is related to cancer.

Key Ideas

- This hands-on activity allows you to be active participants in the learning process. By physically moving through the phases and completing tasks, you gain a deeper understanding of the cell cycle and its importance. It incorporates movement, collaboration, and creativity to solidify understanding.
- This is a basic and simplified model and the cell cycle is a complex process. This model should help to visualize and understand the basic steps of the cell cycle. You will attend classes by doing a model and you will spend the class hours by discussing concepts you would find difficult to understand within the class.
- A cell cycle is a sequence of events that takes place in the parent cell as a means of distributing genetic materials thereby forming daughter cells.
- There are two main divisions of the cell cycle: Interphase and cell division.
- The interphase is a non-dividing but important preparatory phase and has three phases (G1, S and G2) respectively.
- The dividing or M (mitosis stage) has prophase, metaphase, anaphase and telophase in such sequence.
- Cell division is important for growth, repair, and reproduce and so on.
- Cancer can start when the controlling factors over cell division and cell growth fail.
- Cancer occurs in the absence of growth factors allowing a cell to divide continuously at very high density at the expense of other normal cells.
- Cancer cells can have a number of problems.
- A common misconception about cell cycle include:

- Interphase is not part of mitosis - although we often discuss interphase and mitosis together, it's essential to recognize that interphase is technically not part of mitosis. Interphase is the longest phase of the cell cycle, where the cell grows, synthesizes DNA, and prepares for mitosis. During mitosis, chromosomes align, separate, and move into new daughter cells.
- DNA replication occurs during interphase, not prophase- a common misconception is that DNA copies itself during prophase. However, this is not accurate. DNA replication takes place during interphase, specifically in the S phase, before the cell enters mitosis.
- Chromosome number remains the same in daughter cells- contrary to the misconception that chromosome numbers change during cell division; the chromosome number in the daughter cells remains the same as it was in the parent cell.

Implications to teaching

- What new things did you learn from this session?
- How hands-on method of teaching and technology will help you to teach other biology topics?
- How can you help your trainees benefit from this lesson in your school?

Takeaway resources

- Video link
- https://youtu.be/e6N9_RhD10Q?t=10
- https://youtu.be/5VyQNcH3ZL0?t=7
- model of instruction (hands on activity by making a model of cell cycle),
- reading materials

Session 5.2. Teaching Cell division (Mitosis and Meiosis) (2hr)

Session Objectives

At the end of this session, the trainee will be able to:

1. Recognize the two types of cell division.
2. Explain the cause and importance of cell division.
3. Compare and contrast mitosis and meiosis.
4. Apply specific teaching method, locally available materials and technologies to teach the concepts of mitotic and meiotic cell division.
5. Find misconceptions in the concepts of mitotic and meiotic cell division.

6. Explain the key events occurring in each phase of Mitosis and Meiosis (Meiosis I and II).

Activity

This lesson delivery uses combination of varieties of teaching methods such as interactive lecture method that is supported with visual aids, hands on activity, group work, quizzes and games to teach cell reproduction, cell division, mitosis and meiosis.

Here are some teaching activities and steps that you could use to learn and teach cell reproduction, cell division, mitosis, meiosis for the trainees.

Start with interactive lectures – select a representative/s to give a brief lecture on cell division using simple language and real-life examples. Here, you can practice diagrams and animations to explain the stages of cell division, mitosis, and meiosis.

Use visual aids – after brief introduction, you can use charts, models, and videos to help you to visualize the cell cycle and the processes of mitosis and meiosis. There are many online resources available with animations of these processes.

For instance, you can use the following video link;

- Video link
- (https://youtu.be/e6N9_RhD10Q?t=48,
- https://youtu.be/5VyQNcH3ZL0?t=39

Engage yourself on Hands-On Activities- create your own models of cells undergoing mitosis and meiosis using clay or other craft materials. This will help to understand the physical changes a cell undergoes.

Group work – form a group and each group can take each stages of mitosis or meiosis to present to the class. This encourages cooperative learning.

Applying quizzes and games - use quizzes and games to test your understanding and make learning fun. For example, you could have a race where have to put the stages of mitosis or meiosis in order.

Assignments - that involve practicing drawing diagrams of mitosis and meiosis or writing brief descriptions of each stage.

Identify and clarify misconceptions – regularly make a discussion and ask and answer questions so that this can simplify misconceptions and reinforce learning.

After completing the session, apply your knowledge and relate to your day to day life,

- How can you make the topic more relatable to everyday life.

Key Ideas

- The key is to make the lessons interactive and engaging, providing to different learning styles (visual, auditory, kinesthetic) to help trainees understand and retain the information better. It's also important to continuously assess understanding and provide feedback.
- Cell division is a basic process in all living things where a parent or mother cell, divides into two daughter cells. An ordered series of events involving cell growth and cell division that produces two new daughter cells are termed the cell cycle. Cells on the path to cell division proceed through a series of precisely timed and carefully regulated stages of growth, DNA replication, and nuclear and cytoplasmic division that ultimately produces two identical (clone) cells.
- Mitosis is a type of nuclear division where duplicated chromosomes of a single mother cell are distributed between two identical daughter cells, having the same number and kind of hereditary materials (chromosomes) as the parent nucleus. As a result, a diploid (2n) mother cell gives rise to two diploid (2n) identical daughter cells.
- Apart from cytokinesis (cytoplasmic division), mitosis as nuclear division (Karyokinesis) is divided into a series of phases namely; prophase, metaphase, anaphase, and telophase.
- Cytokinesis, also known as cytoplasmic division, will take place after the four stages of mitosis (nuclear division) are completed. However, its completion in animal cell is different from plant cell. As animal cell is surrounded only by cell membrane, cytokinesis enables the cytoplasm of the mother cell to pinch or constrict in the middle. As a result the two daughter cells entirely separate. However, as plant cell is surround by hard cell wall in addition to the cell membrane , the cytoplasm cannot simply pinch off and fully separate; instead a new wall will be laid down between the two daughter cells, Thus, the two adjacent cells remained joined together by the middle wall – called middle lamella.
- The process of meiosis is a characteristic feature of organisms that reproduce sexually. It occurs in reproductive organs such as ovaries of female animals, testes of male animals, anther and ovules of flowering plants. Meiosis involves two fissions of the nucleus giving rise to four gametes or sex cells, each possessing half the number of

chromosomes (n) present in the mother cell. Meiosis is called reduction division, as the final daughter cells are haploid (n) as compared to the diploid (2n) mother division.

- Meiosis is split into two phases: meiosis I and meiosis II. Each phase has four stages: prophase, metaphase, anaphase, and telophase. In meiosis I, these stages are known as prophase I, metaphase I, anaphase I, and telophase I. In meiosis II, they are known as prophase II, metaphase II, anaphase II, and telophase II.
- **Some common misconceptions** related to cell division, mitosis, and meiosis include:
  - Interphase is not part of meiosis - although a cell undergoes interphase before entering meiosis, technically, interphase is not considered part of meiosis. Interphase is the phase where the cell grows, copies its DNA, and prepares for division during the G1, S, and G2 phases. It occurs before both mitosis and meiosis.
  - Meiosis does not occur in all cells - while meiosis is crucial for sexual reproduction, it does not happen in all cells. Only specialized cells undergo meiosis to produce gametes (sperm and egg cells).
  - Crossing over occurs only during prophase I- crossing over is a crucial event that happens during prophase I of meiosis. It involves the exchange of genetic material between homologous chromosomes. This process allows for genetic diversity among offspring. Remember that crossing over does not occur during mitosis.
  - Meiosis does not occur in all cells - meiosis specifically takes place in reproductive cells (gametes). Its purpose is to create haploid gametes (sperm and eggs) that will be used in fertilization. Other cells in the body do not undergo meiosis.
  - Meiosis is important to, but not the same as, sexual reproduction - while meiosis is essential for sexual reproduction, it is not synonymous with the entire process. Meiosis results in the formation of gametes, which are necessary for sexual reproduction. However, sexual reproduction also involves fertilization (the fusion of gametes), which occurs separately from meiosis.

Implications to teaching

- What new things did you learn from this session?
- How this method of teaching and technologies will help you to teach other biology topics?
- How can you help your trainees benefit from this lesson in your school?

Takeaway resources

- Video link

- https://youtu.be/e6N9_RhD10Q?t=48 The Cell Cycle
- https://youtu.be/DwAFZb8juMQ?t=24*mitosis 3d animation | Phases of mitosis | cell cycle and cell division | mitosis and meiosis.*
- https://youtu.be/PGK2KFDLYRk?t=17*mitosis versus meiosis*
- https://youtu.be/16enC385R0w?t=27 Phases of Meiosis
- https://youtu.be/kQu6Yfrr6j0?t=82Phases of Meiosis I and II
- model of instruction (combination of varieties of teaching methods such as interactive lecture method that is supported with visual aids, hands on activity, group work, quizzes and games)
- reading materials

Unit Summary

- Cell reproduction is a fundamental process by which cells duplicate their contents and divide, resulting in two cells with similar, if not identical, contents. This process is essential for growth, development, and maintenance of life.
- Understanding cell reproduction is key to comprehending how life perpetuates and evolves, and it also provides insights into the mechanisms behind various diseases, including cancer, where the regulation of cell division is disrupted.
- Hands-on activities are educational experiences where students learn by actively engaging in an activity or project.
- This method of learning involves using their hands and bodies to understand and explore concepts.
- It's a practical approach that can include building models, conducting experiments, or creating projects

Unit 6: Teaching Nature, Biology and Technology (3hrs)

Introduction

This unit aimed at equipping trainees with in-deep understanding of concept related to nature, biology and technology and the way of delivering these concepts using appropriate teaching strategies and technologies. This unit deals with the learning from nature, biology and technology, impact of biology and technology on society, nature and ethical issuesand appropriate pedagogies and technologies used to teach these biological concepts. The

pedagogical approach used in unit is learner centered approaches mainly using field trip project method and debate method. The unit also tries to address some misconceptions in learning nature, biology and technology.

Unit outcomes

- Describe learning from nature, interconnection of biology and technology
- Explain impact of Biology and Technology on society, nature and Ethical issues
- Design a lesson specific teaching method and specific technology to teach the concepts in this unit.
- Apply specific teaching method and technology to teach the concepts in this Unit
- Identify misconceptions in learning, learning from nature, biology and technology.

Session 6.1: Learning from Nature, Biology and technology (2hr)

Session Objectives

At the end of this session, the trainee will be able to:

- Explain how we learn from nature.
- Mention technologies inspired/imitated from nature.
- Describe how these technologies are developed from nature
- Design a lesson using field trip and project methodand specific technology to teach learning from nature and biology and technology.
- Apply field trip and project methodand specific technology to teach learning from nature, biology and technology.
- Identify misconceptions in learning, learning from nature, biology and technology.

Activity

This activity is designed based on **field trip and project method**

First it is important to ask yourself and answer the following questions.

- What do you know about learning from nature?
- What are some of the technologies imitated from nature?

Let's begin with an overview of biomimicry which is the process of using natural processes and designs to solve problems of human beings.

Give examples of how naturalistic inventions have resulted in ground-breaking technologies in a variety of industries, including engineering, architecture, and medicine.

Show the video link- https://www.youtube.com/watch?v=coEwQRba_2o

You can also use the following as an example

- Gustave Eiffel was inspired by the spongy structure of human bones (particularly the femur) to design the lightweight and tall structure of the Eiffel Tower.

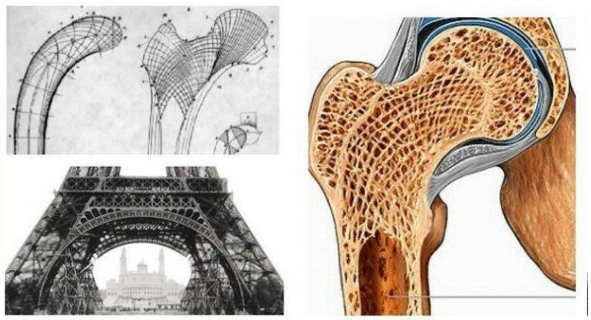


Figure 1. Gustave Eiffel Tower designed mimicking spongy structure of human bones

- George de Mestralcreated Velcro after seeing the burs attached to his dog's fur, discovered the most effective and used fasteners in the world.

Figure: 2.Velcro designedmimicking hooks on bur fruits

- Engineering involving whale tubercules to create improved machinery for travel or energy production.

Figure 3. Wind energy designed mimicking whale fins

- Entomologists and engineers created a water bottle with similar water-collecting and water-repelling bumps from beetles that can collect water on their backs in dry area.

Figure: 4. self-filling water bottles designed mimicking Beetles

- The noses (front) of bullet trains have been designed by engineers imitating the shape of the beaks of kingfishers when they dive into water.

Figure 5. Bullet train noses imitate the beak of a kingfisher

- Gherkin, London, designed mimicking Venus flower basket sponge – the flower structure.

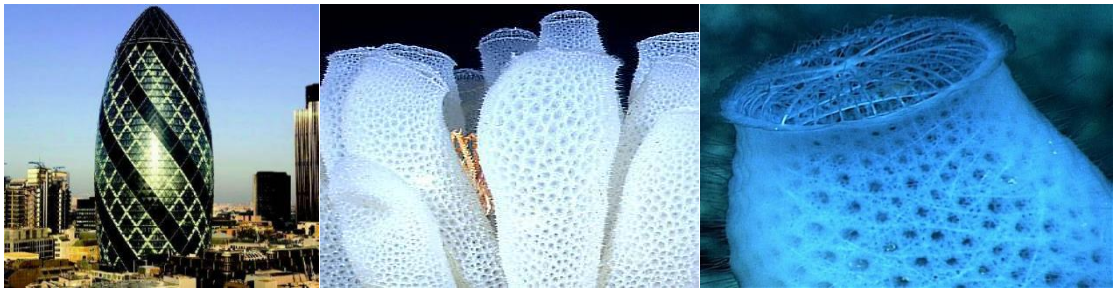


Figure 6 Gherkin, London - Venus flower basket sponge

- After discussing on the above examples, select your own project title for investigation, like for instance, 1) designing technology from critical observation of nature and 2) investigating the contribution of biology for innovation of technology and the contribution of technology to the advancement of biology.
- Set your own objectives, plan how to what andhowto do theinvestigation.
- Go outside and conduct research to observe and enjoy nature directly. In the field:
  - Tell what you learn from your observation.

- What type of technology could be mimicked from your observation of natural process?
- Design a technology or product based on natural structures.
- Create models that represent biological processes.

- Reflect on the project –discuss whether the objectives of the project have been achieved or not.

Assessment

- Conduct a self- assessment - assessment as learning
- Answer questions raised by your trainer in relation to nature, biology, technology field trip and project method

Key Ideas

- Architects, engineers, and material scientists are just a few of the fields where biomimicry can inspire design.
- More aesthetically pleasing and functional designs can be produced by fusing natural forms and principles with man-made ones.
- By examining how nature has addressed difficult issues and applying those ideas to technological and engineering problems, biomimicry can stimulate innovation.
- This strategy can promote sustainable development and result in breakthroughs across a range of industries.
- A wide range of naturally occurring structures, functions, and processes are available in biology, which can stimulate technological advancement.
- Through the study of biological systems, scientists and engineers can create new products and technologies that are inspired by or mimic.
- Biology contributes for invention of technologies and technology enables advancement in biological studies.

Common misconceptions

- Misconceptions: the main goal of researching nature for biological or technological advancement is primarily aesthetic.
- Correct conception - there are many useful solutions found in nature that can be used to address difficult problems facing people.
- The false beliefs that technology is independent of nature and that knowledge of biological systems has no bearing on technological advancements.

- Correct conceptions—a lot of technological progress has been influenced by biological concepts and natural solutions.
- Misconception: Traditional medicine and healthcare solely benefit from the application of biology.
- Correct conception: The fields of agriculture, environmental preservation, materials science, and energy production are just a few of the industries that will be greatly impacted by biology and biotechnology.
- Misconception: Biomimicry, or bioinspired design, is a straightforward approach that mimics nature's solutions.
- Misconception: Technology and biology are two distinct domains that do not overlap or enhance one another.
- Correct conception – ground breaking discoveries in fields like precision medicine, bioengineering, and environmental sustainability have resulted from the fusion of biological knowledge with technological progress.
- The misconception that, in the quickly evolving world of modern technology, studying from nature or biomimicry is outmoded or unnecessary.
- Correct conception – nature continues to serve as an inspiration for innovative research and development, providing ageless knowledge and long-lasting answers to contemporary problems.

Implications to teaching

- What new things did you learn from this session?
- How fieldtrip and project method of teaching and technology will help you to teach other biology topics?
- How can you help your students benefit from this lesson in your school?

Takeaway resources

- Video link https://www.youtube.com/watch?v=YT5TZY-emYM, https://www.youtube.com/watch?v=V2GvQXvjhLA, https://www.youtube.com/watch?v=coEwQRba_2o
- Field trip and project method
- reading materials on learning from nature, biology and technology

Session 6.2: Teaching the Impact of Biology and Technology on Society,

Nature and Ethical issues (1hr)

Session Objectives

At the end of this session, the trainee will be able to:

- Explain impact of Biology and Technology on society and the natural world and Ethical issues.
- Design a lesson debate method and specific technology to teach impact of Biology and Technology on society, nature and Ethical issues.
- Apply debate method to teach impact of Biology and Technology on society, nature and Ethical issues.
- Identify misconceptions in learning, impact of Biology and Technology on society, nature and Ethical issues.

Activity

This activity is based on debate method of teaching.

Think about the following questions:

- What do you know about the effect of advancement of Biology and Technology on society and the natural world and ethical issues considered in biological studies? How had you taught this topic?
- Show the link https://www.youtube.com/watch?v=-YyTU_k7t0M,
- By revising session 6.1, introduce what ethics mean and ethical issues in studying plants, animals, genetic engineering, animal testing and stem cell research.
- Then, conduct a debate being against or for the following topics.
- To conduct the debate, make two groups: For and Against. Then, choose your roles in the debate.
- Remember you need to be clear about the sources and kinds of evidence you want to use (e.g., a grade 11 biology textbook, articles, case studies, videos) to support your claims.

Debating topic 1 - advancement in Biology and Technology benefits the society and the natural world **VS** advancement in Biology and Technology has an effect of on society and the natural world.

- **You can weigh the benefits of life-saving medical interventions (such as gene therapy and vaccinations) against drawbacks such as worries about genetic alteration and unforeseen consequences.**
- **Benefits of higher crop yields and pest resistance versus drawbacks of GMO.**
- **After completing your debate on topic 1, conduct a debate on topic 2 below.**

Debating topic 2- considering ethical issues while conducting biological studies on plants and animals you no need to consider because they are created for us to use.

- **You can weigh the benefits of bioethics (such as organ transplantation and cloning) against potential drawbacks and ethical limits.**
- **Should human embryos be modified using gene editing technology for medical reasons? Is this a morally acceptable practice?**
- **Are there more morally acceptable alternatives to using animals in scientific and pharmaceutical research?**
- **At the end of each debate session, evaluate your group debate performance based on your group ability to communicate clearly, confidently, and cooperatively as well as ability to work as a team and the quality of their arguments, evidence, and content reasoning.**
- **At the end be convinced with scientific evidences.**

Assessment

- Conduct a self- assessment - assessment as learning
- Answer questions raised by your trainer in relation to debating issues and debate method of teaching.

Key Ideas

- Through improvements in disease prevention, diagnosis, and treatment, advances in biology and technology have completely changed the healthcare industry.
- Biology and technology are essential for fostering environmental sustainability and conservation in order to create eco-friendly substitutes like biofuels and biodegradable materials, and new technologies aid in monitoring.

- Increased crop yields, pest resistance, and nutrient-rich foods are the results of biotechnological advancements in agriculture.
- Issues like cloning and genetic testing privacy are raised by the nexus of biology and technology. These issues have an impact on society.
- There are some concerns, ethical issues, in relation to some activities products of advanced biology such as cloning and GMOs.

Implications to teaching

- What new things did you learn from this session?
- How debate method of teaching and technology will help you to teach other biology topics?
- How can you help your students benefit from this lesson in your school?

Takeaway resources

- Video link
  - https://www.youtube.com/watch?v=-YyTU_k7t0M,
  - https://www.youtube.com/watch?v=xIx-6392MiA,
  - https://www.youtube.com/watch?v=Oo_em56XPuk.
- debate method
- reading materials on debate method and impact of biology and technology

Unit Summary

- The concept of learning from nature to advance biology and technology is deeply rooted in the practice of **biomimicry**.
- This approach involves studying the structures, functions, and processes of biological entities and ecosystems to inspire the development of new technologies and solutions to human challenges.
- Learning from nature in biology and technology involves a philosophical and practical shift towards sustainability and innovation inspired by the natural world.
- This is a multidisciplinary endeavor that spans across fields such as biology, engineering, design, and environmental science, aiming to create a better future by following nature's lead.

- A field trip project is an educational activity that takes students out of the classroom to gain real-life experiences related to their course of study.
- Debate is a **formal discussion or argumentation between two or more individuals or teams on a specific topic or proposition**.
- It is a structured method of formal argumentation where two opposing teams present their viewpoints on a given topic.

Unit 7.Teaching of Enzymes (7 hrs)

Unit Introduction

This unit aims at helping trainees to explain enzymes; their properties, factors affecting their activities, functions, mechanisms of action, regulation, their industrial applications and kinetics. Demonstrate proteins and their structures. The pedagogical approach used in this unit is learner centered approaches, experiential learning model and a multi-method approach for teaching the concept of enzymes. This multi-method approach combines various strategies such as visual aids and models, interactive demonstrations, case studies and real-life examples, kinetics simulations,group discussions and debates to engage trainees effectively. The unit also tries to address some misconceptions in learning enzymes.

Unit outcomes

After completing this unit, trainees will be able to:

- Explain enzymes and their properties.
- Clarify structure of proteins and how it relates to enzyme function.
- Describe enzyme functions and factors affecting their activities.
- Identify mechanisms of action of enzymes and their regulation.
- Elucidate enzyme kinetics and their industrial applications.
- Design specific teaching method, technologies and locally available resources to teach the concepts of enzymes.
- Recognize misconceptions in the concepts of enzymes.

Session 7.1. Teaching enzymes; their properties, factors affecting their activities and functions (4hrs)

Session Objectives

At the end of this session, the trainee will be able to:

- Explain enzymes and their function as biological catalysts.
- Describe properties of enzymes.
- Describe the basic structure of proteins and how it relates to enzyme function.
- Differentiate between different types of enzymes.
- Identify factors that can affect enzyme activity.
- Design a lesson using experiential learning model and technologies to teach the concepts of enzymes.
- Apply experiential learning model, technologies and locally available resources to teach the concepts of enzymes; their properties, factors affecting their activities and functions.
- Identify misconceptions in the concepts of enzymes; their properties, factors affecting their activities and functions.

Activity

This lesson utilizes an experiential learning model to engage trainees in exploring enzymes, their properties, functions, and the factors affecting their activity.This model emphasizes the importance of experience and its role in the learning process. Developed by David Kolb and others, it provides a framework for understanding how individuals learn through their interactions with the world around them. Laboratory based activity or experiment in class room or in lab is very crucial to teach this lesson. Most of the activities are easy to perform in class room from locally available materials.

Materials required to carry out the lesson are:

- Ziplock bags
- potato for catalase demonstration
- Hydrogen peroxide solution (3%)
- Crackers
- Warm water
- Cold water
- Petri dishes or shallow trays
- Masking tape
- Labels for enzymes (amylase, lipase, catalase)-eg. dish soap -containing lipase

- Gloves (optional)
- Construction paper
- Pipe cleaners
- Beads (different colors)

Experiential learning is a powerful approach that actively engages learners through hands-on experiences. The following is a simple model to explore enzymes and their characteristics, functions etc. The followings are some steps to create an effective experiential learning experience.

I. Contextualization and Introduction (15 minutes)

Be familiarizing yourself with the idea of enzymes and discuss their significance and role in a variety of biological processes to start. Alternatively, you may begin with a lighthearted exercise where you sporadically run into each other in the classroom to simulate uncontrollable chemical reactions.

- Find out if there's a way to expedite and improve the speed of reactions.
- Explain the idea of catalysts and how they can accelerate reactions without depleting themselves.
- Describe how enzymes- which are composed of proteins- are biological catalysts. They are vital to all living things because they expedite necessary chemical reactions.
- Give instances from everyday life (such as digestion, metabolism, and DNA replication) where enzymes are essential.

II. Enzyme Exploration Stations/Activities (45–60 minute):

1. Enzyme Function and Protein Structure

- Make a small group and find materials such as pipe cleaners, construction paper, and various colored beads.
- Construct a model that resembles a protein molecule. The polypeptide backbone can be represented by pipe cleaners, and different colored beads can stand in for different amino acids.

  Then try to present the following points to your groups.

- Tell to your group about how a protein's specific structure and function are determined by the arrangement and folding of its amino acids.
- Describe how an enzyme's unique form results in an active site- a section that locks onto its target molecule, or substrate - like a lock and key.

2. Three Enzyme Action Stations that cycle every fifteen minutes:

Three stations should be set up, each representing a distinct kind of enzyme:

Station 1: Amylase (starch digestion)- In ziplock bags, combine crackers and warm water with a label for "amylase" (enzyme that breaks down starch). You observe the breakdown of crackers (starch) in warm water, representing digestion.

For this you can use a simple procedure for testing amylase activity using saliva and a piece of bread.

Rinse your mouth with water to remove any food particles and find a clean test tube or other locally available materials that substitute test tube such as small transparent small water bottle. Instruct the trainee to spit into the test tube until it is about half full with saliva. Place a small piece of bread (containing starch) into the saliva-filled test tube. Gently swirl the test tube to combine the bread and saliva. Observe the mixture for any changes (e.g., color, consistency) over a period of time (e.g.5-8 minutes). Jot down your observations and analyze the outcomes. If the bread becomes softer or dissolves, it indicates the presence of amylase (the enzyme that breaks down starch). If there is no change, it suggests insufficient amylase activity or other factors affecting digestion.

Station 2: Lipase (fat digestion): Add a drop of oil and warm water to petri dishes marked "lipase" (enzyme that breaks down fats) or you can use any locally available materials that can substitute petri dishes described above. You see no differences. After that, add a drop of lipase-containing dish soap and see how the oil breaks down.

Station 3: Catalase (hydrogen peroxide breakdown) - (requires liver if present or you can use fresh potato cubes). In Petri dishes labeled "catalase" (enzyme found in liver or fresh potato cubes that breaks down hydrogen peroxide), add a piece of raw liver or fresh potato cubes (wear gloves if handling) and hydrogen peroxide. You observe the bubbling reaction or oxygen gas production.

Note: In addition you can set up different stations or activities related to enzymes. Each station focuses on a specific aspect.

You are also expected to do the following simple actions based on the above activities and materials in class and observe the results accordingly.

A. **Enzyme Properties**: Try to get samples of enzymes such as amylase, catalase etc. and discuss their properties like pH sensitivity, temperature dependence.
B. **Enzyme Functions**: Create situations (e.g., breaking down starch, converting lactose) where participants can observe enzymes in action.

C. **Factors Affecting Activity**:

a) **Temperature**: Prepare enzyme solutions at different temperatures (e.g., room temperature, ice-cold, warm). Measure their activity using appropriate substrates.

b) **pH**: Set up buffers with varying pH levels. Test enzyme activity under acidic, neutral, and alkaline conditions.

c) **Substrate Concentration**: Vary substrate concentration (e.g., starch) and observe its impact on enzyme activity.

III. Explanation that may take 20 - 25 minutes:

1. Each group in class come together and discusses the observations from each station. Relate the breakdown of crackers/starch, oil, and hydrogen peroxide to the specific functions of amylase, lipase, and catalase, respectively. You should also introduce the concept of different types of enzymes with specific functions based on their active site shape.

2.Discuss how various factors can influence enzyme activity. You should demonstrate the effect of temperature by repeating the amylase cracker experiment in cold water. Explain how extreme pH can disrupt the enzyme's shape, delaying its function.

IV. Elaboration that may take 20 minutes:

In this phase you should to create or design a model in drawing or in figure depicting an enzyme, its interaction with a substrate and label the active site and the substrate.

V. Evaluation, Reflection and Discussion that may take 15- 20 minutes:

- After completing the activities, you can make reflective discussion by answering the following questions.
    - What did you observe during the experiments?
    - How did enzyme activity change under different conditions?
    - What factors influenced enzyme effectiveness?
    - How can this knowledge be applied in real-life contexts?

VI. Extension Activities:

- You can research the applications of enzymes in everyday life, such as in food processing, medicine, and biofuels.
- You can design an experiment to test the effect of different concentrations of an enzyme on reaction rate.

Key Ideas

- **Experiential learning** is a powerful approach that actively engages learners by allowing them to **experience, reflect,** and **apply** knowledge in real-world contexts.

- Kolb's model proposes a cycle of learning stages: **concrete experience, reflective observation, abstract conceptualization,** and **active experimentation.**
- Enzymes are remarkable biological molecules that play a crucial role in accelerating biochemical reactions within living organisms. Enzymes are biological polymers that catalyze various biochemical reactions. Most enzymes are proteins, although there's a class of RNA catalysts called ribozymes. Ribozymes are RNA molecules that catalyze reactions either within their own bonds or among other RNAs.
- Enzymes consist of linear chains of amino acids that fold into intricate three-dimensional structures. The specific sequence of amino acids determines the enzyme's structure and, consequently, its catalytic activity. The active site, where catalysis occurs, is a small region within the enzyme's structure.
- Enzymes are essential for metabolic processes and other chemical reactions in cells. They convert substrates (reactant molecules) into distinct products. Without enzymes, life processes would grind to a halt.
- Enzymes are classified based on the type of reaction they catalyze: Hydrolases: Involved in hydrolysis reactions (e.g., breaking down molecules with water). Oxidoreductases: Facilitate oxidation-reduction reactions (e.g., electron transfer). Lyases: Catalyze the addition or removal of groups from substrates. Transferases: Transfer functional groups between molecules. Ligases: Join two molecules together. Isomerases: Rearrange atoms within a molecule.
- Factors affecting enzyme activity: temperature: enzymes have an optimal temperature range for activity. Extreme heat or cold can denature them. pH: Enzymes function optimally within specific pH ranges. Substrate Concentration: As substrate concentration increases, enzyme activity also rises until saturation occurs. Cofactors and Coenzymes: Some enzymes require additional molecules (cofactors or coenzymes) for activity. Inhibitors: Certain molecules inhibit enzyme activity. Enzyme Regulation: Cells regulate enzyme activity to maintain homeostasis. Remember, enzymes are the unsung heroes behind countless biochemical reactions, ensuring our bodies function harmoniously.
- Properties of enzymes can be Physical or chemical properties. Physical properties include-Thermos-Labile: Enzymes are sensitive to temperature. Most enzymes are inactivated at temperatures above 60°C. However, some dried enzymes can withstand even higher temperatures, up to 100°C to 120°C.Optimal Temperature: Each enzyme

has an optimal temperature range for activity, typically between 25°C and 45°C. At 37°C, enzyme activity is strongest. Colloidal Nature: Enzymes act as colloids or high-molecular-weight compounds. Water Sensitivity: Enzymes are soluble in water but are unstable in dilute glycerol, NaCl, and dilute alcohol. The chemical property of enzymes consists of Catalytic Properties: Enzymes are biological catalysts. They accelerate reactions by converting large amounts of substrate into products. Importantly, enzymes remain unaffected by the reactions they catalyze. Enzyme Specificity: Each enzyme is highly specific, catalyzing a particular reaction. For instance, sucrase specifically hydrolyzes sucrose. pH Dependence: Enzyme activity varies with pH. Different enzymes have specific pH optima (e.g., pH 2 for pepsin and pH 8.5 for trypsin). Active Sites: Enzymes have active sites where substrates bind during biochemical reactions.

- General Properties of Enzymes: Biochemical Reaction Acceleration: Enzymes initiate and accelerate biochemical reactions. pH Sensitivity: Enzyme activity depends on the medium's acidity (pH). Bidirectional Catalysis: Enzymes can accelerate reactions in both forward and reverse directions. Stability: Enzymes are soluble in water and exhibit varying stability.
- A common misconceptions about enzymes include:
  - Enzymes die when heated - enzymes cannot be "killed" because they are not living entities. Instead, they denature when heated above a certain temperature.
  - Enzymes denature when it's cold- actually, the frequency of collisions between substrate and enzyme decreases at lower temperatures.
  - Enzymes only break down large molecules - enzymes can also speed up reactions that involve building large molecules from smaller ones (e.g., protein synthesis).

Implications to teaching

- What new things did you learn from this session?
- How experiential learning model of teaching and technology will help you to teach other biology topics?
- How can you help your students benefit from this lesson in your school?

Takeaway resources

- Video link
  - https://youtu.be/ozdO1mLXBQE?t=10
  - https://youtu.be/R23ZXqysTZc?t=64
  - https://youtu.be/UZtn043XJt4?t=3

- https://www.youtube.com/watch?v=JSIesdpFc9M
- model of instruction - **experiential learning** model
- Reading materials - text book.

Session 7.2. Teaching mechanisms of actions, kinetics, regulation and application of enzymes (3hrs)

Session Objectives

At the end of this session, the trainee will be able to:

1. Recognize the two types of enzyme-substrate models.
2. Explain enzyme regulation.
3. Describe enzyme kinetics.
4. Explain the key application of enzymes.
5. Design a lesson using a multi-method approach and technologies to teach the concepts of enzyme.
6. Apply specific teaching method, technologies and locally available resources to teach the concepts of enzyme-substrate models, enzyme regulation, enzyme kinetics and application of enzymes
7. Identify misconceptions in this lesson.

Activity

This session explores a multi-method approach for teaching the concept of mechanisms of actions, kinetics, regulation and application of enzymes. This approach combines various strategies such as visual aids and models, interactive demonstrations, case studies and real-life examples, kinetics simulations, group discussions and debates etc to engage trainees effectively.

1. **Visual Starters using Aids and Models**
   - Think about and introduce key concepts like the lock-and-key and induced fit models using visual aids.
   - Show diagrams or animations illustrating how enzymes (the “keys”) fit into specific substrates (the “locks”). Here, you can apply a key of your door to explain lock-and-key model.
   - Encourage trainees to imagine how enzymes interact with substrates.

2. **Hands-on Learning /Interactive Demonstrations**

- Prepare puzzle pieces representing enzymes and substrates to physically assemble, demonstrating enzyme specificity.
- Use moldable materials like clay or paper to model the shape changes of enzymes during the "induced fit" process.
- *Hint for this activity:Take a piece of clay (or construction paper) in a different color and mold it into a complementary shape. Imagine this as the substrate, the molecule the enzyme needs to work with. The substrate shape should not perfectly fit into the initial enzyme mold, but rather have some overlapping areas that suggest a potential fit. Use markers to label this as "Substrate" on the clay model or write it on the paper cutout. Gently press the substrate mold (or cutout) against the enzyme mold (or cutout). As you press, observe how the enzyme shape slightly changes to better accommodate the substrate. You can mold the enzyme slightly to create a more defined fit around the substrate. Once you achieve a good fit (enzyme substrate complex), carefully separate the enzyme and substrate models. Notice how the enzyme shape has been altered slightly due to the interaction with the substrate. This represents the "induced fit" phenomenon.*

3. Case Studies and Real-World Connections /Real-Life Examples

- Discuss real-life applications of enzymes, such as:
    - Digestion: How enzymes break down food in our bodies.
    - Industry: Enzyme use in processes like brewing, detergent production, and biofuel creation.
    - Medicine: Enzyme replacement therapy (e.g., insulin for diabetes).

4. Interactive Simulations

- Utilize computer simulations to show enzyme kinetics. Allow trainees to experiment with factors influencing enzyme activity, like substrate concentration. Briefly discuss the Michaelis-Menten equation's significance.
- https://youtu.be/y0NcxAIoTHE?t=103

5. **Group Discussions and Debates**

- Divide your class into groups and assign topics related to enzymes, like regulation mechanisms (allosteric and covalent regulation), inhibition types (competitive and non-

competitive), and applications (advantages and disadvantages). Encourage debate and critical thinking.

6. Expert Insights and Field Trips

- Invite professionals like biochemists or industry experts to share their experiences. Organize field trips to labs or biotech companies for you to see enzymes in action. So that you can connect theory to real-world practices.

7. Assessment and Reflection

- Evaluate your understanding through practicing with quizzes, short essays, or presentations. Reflect on the role of enzymes in daily life and explore related news or research articles.

Further Exploration: After the session, how you can make enzymes more relatable to your everyday life. Additionally, explore these questions:

- Documentary recommendations on enzymes?
- Methods to address common misconceptions about enzymes?
- Fun enzyme-related experiments for trainees?

Key Ideas

- This session explores a multi-method approach for teaching the concept of enzymes. This approach combines various strategies such as visual aids and models, interactive demonstrations, case studies and real-life examples, kinetics simulations, group discussions and debates etc to engage trainees effectively.
- Enzyme regulation is a control system for enzymatic activities in which enzymes are turned “on” or “off” depending on the organisms need. It is adapting enzymatic activities by other molecules or metabolic cells to either increase or decrease the activities.
- Regulatory enzymes are of two types, allosteric enzymes and covalently modulated enzymes.
- Enzyme inhibition is a decrease in enzyme activity by enzyme inhibitors. Enzyme inhibitors are molecule that binds to an enzyme and blocks its activity. There are two types. These are reversible inhibitors and irreversible inhibitors
- Enzyme kinetics describes the rates of chemical reactions that are catalyzed by enzymes and the binding affinities of substrates, inhibitors and the maximal catalytic rates

achieved. Enzyme kinetics explains that enzymes speed up reactions by lowering the activation energy of the reactants and turning them into products.

- One of the most known models of enzyme kinetics is the Michaelis-Menten formula that takes a form of equation describing the rate of enzymatic reaction by relating the reaction rate, rate of formation of product to the concentration of substrate.
- The application of enzymes are widely used in food, feed, textile, papermaking, leather and detergents, pharmaceutical and other industrial productions.
- Malting (sprouting) is a widely applied traditional technology. It is the process of steeping, germinating and drying grain to convert it into malt. There are three steps to modern malting, steeping, germinating and kilning
- Traditional malting is the process of sprouting barley grains for the production of enzymes (α-amylase and β-amylase) to process fermentation drinks such as Tella.
- **Here are common misconceptions related to this lesson topic.**
  - The lock-and-key model suggests that enzymes are rigid and static structures. But in reality, enzymes are flexible and can undergo conformational changes to accommodate substrates.
  - The lock-and-key model implies that enzymes only interact with one specific substrate. The fact is enzymes can interact with multiple substrates, although specificity is still crucial.
  - The induced fit model assumes that enzymes and substrates remain unchanged during binding. However, both the enzyme and substrate undergo conformational changes for optimal binding.
  - Induced fit only occurs during the initial binding of substrate to enzyme. But induced fit continues until the substrate is completely bound, affecting the final shape and charge.
  - Enzymes work best at a fixed temperature of 37°C. But the fact is that enzymes function across a wide range of temperatures, including extreme conditions.
  - Enzymes are always active and produce maximum output. But enzyme activity is carefully regulated based on cellular needs and conditions.
  - Enzymes alter the thermodynamics of a reaction. The fact is enzymes influence kinetics (rate), not thermodynamics (equilibrium).
  - The Michaelis-Menten model assumes irreversible binding. The truth is that it considers reversible binding and specific assumptions about initial conditions.

Implications to teaching

- What new things did you learn from this session?
- How multi-method approach of teaching and technology will help you to teach other biology topics?
- How can you help your trainees benefit from this lesson in your school?

Takeaway resources

- Video link
  - https://youtu.be/DmLOOq42fMc?t=29
  - https://www.youtube.com/watch?v=wopmynybDIA
  - https://www.youtube.com/watch?v=V8QRP2J4Q-s
- model of instruction (a multi-method approach)
- reading materials

Unit Summary

- Enzymes are protein molecules that act as biological catalysts (biocatalysts) and accelerate rate of chemical reactions by lowering activation energy. All enzymes are proteins except ribozymes made up of chains of amino acids linked together by peptide bonds. The general properties of enzymes are the nature of both their physical and chemical properties. The physical properties of enzymes include denaturation, solubility, colloids, biocatalysts, precipitation, molecular weight, and enzyme activity. Enzyme chemical properties are sensitivity, regulations, specificity, catalysis and reversibility reactions. Enzymes are proteins and proteins have different structures. Protein structure is a polymer of amino acids joined by peptide bonds with three-dimensional arrangements of atoms in amino acid chain molecules. The protein complex macromolecules have four structural levels: Primary structure, Secondary structure, tertiary structure and quaternary structure.
- There are two different of enzyme-substrate binding models: the lock and key model and the induced fit model. An enzymatic transition state is the reaction rates of elementary chemical reactions and assumes chemical equilibrium between reactants and activated transitions.Enzyme regulation is a control system for enzymatic activities in which enzymes are turned “on” or “off” depending on the organisms need. It is adapting enzymatic activities by other molecules or metabolic cells to either increase or decrease the activities. There are varieties of factors that affect the activity of enzymes: temperature, pH, inhibitors, activators, radiation, water, enzyme, substrate, and end-product concentrations
- Enzyme kinetics describes the rates of chemical reactions that are catalyzed by enzymes and the binding affinities of substrates, inhibitors and the maximal catalytic rates achieved.

Enzyme kinetics explains that enzymes speed up reactions by lowering the activation energy of the reactants and turning them into products. Hence, the concentration of enzyme and substrates determines the rate of the reactions or production volumes per unit time. Application of enzymes is the use of enzymatic biochemical reactions for chemical conversion process that are driving forces of great change for productivity of various industries. Enzyme protein catalytic activity is efficient enough (100s to 1000s) of times higher than that of inorganic catalyst. The application of enzymes is widely used in food, feed, textile, papermaking, leather and detergents, pharmaceutical and other industrial productions.

Unit 8: Teaching Genetics (24hrs)

Introduction

This unit aimed at equipping trainees with in-deep understanding of concept related to genetics and the way of delivering these concepts using appropriate teaching strategies and technologies. This unit deals with the genetic materials, protein synthesis**,**Mendelian inheritance, Mendel's laws and test cross, non-Mendelian inheritance, sex-linked inheritance and pedigree analysis in humans, genetic disorders and treatments and appropriate pedagogies and technologies used to teach these biological concepts. The pedagogical approach used in unit is learner centered approaches such as Think - Pair – Share' method, concept mapping, guided inquiry method, buzzgroupmethod, jigsaw method, case based problem based strategies and group discussion. The unit also tries to address some misconceptions in learning genetics.

Unit Outcomes

After completing this unit, trainees will be able to:

- Describe genetic materials.
- Explain protein synthesis.
- Mendelian inheritance and laws.
- Describe sex determination in human and other animals.
- Explain non-Mendelian inheritance.
- Describe sex-linked inheritance and pedigree analysis in humans.
- Explain genetic disorders and their treatment mechanisms.
- Apply specific teaching methods and technologies to teach the concepts of genetics.

- Design a lesson specific teaching method and specific technology to teach the concepts in this unit.
- Identify misconceptions in learning, learning from nature, biology and technology.

Session 8.1: Teaching the genetic materials (2hr)

Session Objectives

At the end of this session, the trainees will be able to:

- Describe DNA, RNA, genes and chromosomes
- Design a lesson using Think - Pair – Share' methodand specific technology to teach these topics
- Apply Think - Pair – Share' methodand specific technologies to teach genetic materials.
- Identify misconceptions in learning these topics.

Activity 1

This activity is designed based on 'Think - Pair – Share' method.

1. Think

In this stage, take a few minutes to individually think about what you already know about DNA, RNA, genes and chromosomes their structure and functions, as well as how you had taught. You should also write down any questions you may have.

See video link- https://www.youtube.com/watch?v=C98YgAzpleQ

2. Pair

In this stage, you should be in pairs, in four or in eight and share your thoughts, questions, and prior knowledge with your partner.

3. Share

In this stage, you should be together with entire class for a share-out session once you have had some time to talk with your partners. Invite some couples to discuss the main ideas that came up in your talks, any new information you learned, and any questions that you had. Be part of a discussion in the classroom to address frequently asked questions and misunderstandings.

Try to get materials (toothpicks, colored beads) and develop a model of DNA, RNA, gene and chromosome and describe their function. Work together in pairs or small groups to complete these activities and discuss your findings.

4. Assessment Reflection

Reflect on what you have learned during the activity using self-assessment.

Activity 2

Support your learning with laboratory activity

Design an activity to extract DNA from banana or onion cell.

The following video on how to extract DNA will help you to design the activity.

https://youtu.be/Zypk_v2o6Q8?t=23

Key Ideas

- An organism's characteristics and functions are determined by its genetic makeup, which is found in materials like DNA and RNA.
- These molecules' genetic code, which is essential to biological processes, gives instructions for the synthesis of proteins.
- Most living things have genetic material in the form of DNA (deoxyribonucleic acid), a double-stranded molecule made up of a series of nucleotides that code for genetic information.
- Single-stranded RNA, or ribonucleic acid, helps synthesise proteins by utilizing the genetic instructions found in DNA.

- Think-Pair-Share method is helpful in teaching students about genes, chromosomes, DNA, and RNA structure and function.
- It encourages involvement, teamwork, critical thinking, and a deeper comprehension of intricate biological ideas.

Misconceptions

- Misconception: the idea that a person's entire set of traits and behaviors is inherited.
- Correct conceptions: although genetic information greatly shapes traits, gene-environment interactions and environmental conditions also affect how genes are expressed.
- Misconception: The idea that all genetic information is encoded in DNA ignores the functions of RNA, epigenetic modifications, and other elements in the regulation and expression of genes.
- Correct conceptions: Recognizing how different molecular components interact is necessary to comprehend the complexity of genetic materials.
- Misconception - Genetic modification invariably leads to genetic improvement or enhancement.
- Correct conceptions- genetically modified organisms may have unanticipated effects and raise ethical questions, and the definition of enhancement vary according to context.

Implications to teaching

- What new things did you learn from this session?
- How Think-Pair-Share and laboratory method of teaching and technology will help you to teach other biology topics?
- How can you help your students benefit from this lesson in your school?

Takeaway resources

- Video lin- https://www.youtube.com/watch?v=_-4TKFInXwE, https://www.youtube.com/watch?v=hywRdDVR76A, https://www.youtube.com/watch?v=SeOrvA9ikW8&t=15s,
- Think-Pair-Share method material
- reading materials on genetic material

Session 8.2: Teaching Protein Synthesis (2hrs)

Session Objectives

At the end of this session, the trainees will be able to:

- Explain process of protein synthesis
- Differentiate between transcription and translation.
- Design a lesson using concept mapping method and specific technology to teach protein synthesis.
- Apply concept mapping method and specific technologies to teach the process protein synthesis.
- Identify misconceptions in learning protein synthesis.

Activity

This activity is designed based on concept mapping. First reflect on the following questions. What do you know about protein synthesis? How you taught these concepts in the schools. Reflect individually and share in group.

Then, revise your thought about basic process of protein synthesis, including transcription and translation, and the role of DNA, RNA, and ribosomes.

Reflect and refer unit one of this module about the concept of concept mapping and how it can help you visualize and organize information.

See the video link -https://www.youtube.com/watch?v=N_U5MUZNb7o

Then, draw/create a concept map of protein synthesis and create visual representations of the process protein synthesis and interpret it. You can create a basic concept map using a digital tool, one way of using technology.

At the end, refer the following concept mapping and compare your concept map.

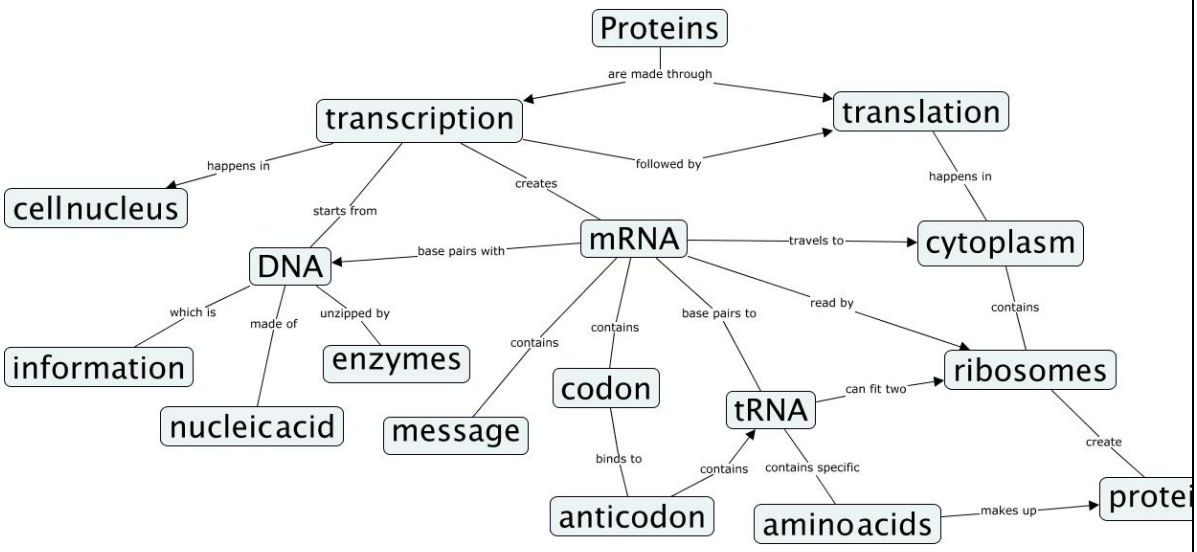


Figure 1. concept map of protein synthesis

After completing the concept map, review it as a class and discuss any questions or areas of confusions and misconceptions.

Assessment

Use the concept map as an assessment tool to practice assessment as learning and assessment for learning.

Key Ideas

- The basic biological process known as protein synthesis is the process by which the cell uses coded instructions to form polypeptide chains, which are made up of amino acids. These are the salient features: translation and transcription.
- A portion of DNA is copied during transcription to create messenger RNA (mRNA) in the cell nucleus. o This mRNA contains the genetic information required for protein synthesis in an organelle called the ribosome.
- The mRNA is transported to the ribosome, where it interacts with enzymes and ribosomal RNA (rRNA).
- Certain amino acids are delivered to the ribosome by transfer RNA (tRNA) molecules.

- Every codon, which is a group of three mRNA bases, represents a distinct amino acid.
- tRNA molecules identify these codons and provide the appropriate amino to build the polypeptide chain called **Proteins**.

Common Misconceptions

- Misconception: A few students believe that amino acids are produced by protein synthesis.
- Correct conception: The cell already contains amino acids; they are not created during the synthesis of proteins.
- DNA directly codes for proteins - DNA is the blueprint, but it doesn't directly interact with the protein building machinery. An intermediary molecule, called messenger RNA (mRNA), carries the instructions from DNA to the ribosomes where proteins are made.
- Protein synthesis happens only in the nucleus - Protein synthesis occurs in the ribosomes, which are found in the cytoplasm of cells (in eukaryotes) or throughout the cell in prokaryotes. The mRNA, which carries the code from DNA, travels from the nucleus to the ribosomes.
- Only animal protein is high-quality protein - Many plant-based foods can provide all the essential amino acids your body needs, especially if you eat a varied diet that includes different types of plant proteins.

Implications to teaching

- What new things did you learn from this session?
- How concept map method of teaching and technologies will help you to teach other biology topics?
- How can you help your students benefit from this lesson in your school?

Takeaway resources

- Video link https://www.youtube.com/watch?v=2zAGAmTkZNY https://www.youtube.com/watch?v=x5ZXQo-xeMo
- Concept map
- reading materials on protein synthesis

Session 8.3: Teaching Mendelian Inheritance (4hrs)

Session Objectives

At the end of this session, the trainee will be able to:

- Explain principles of Mendelian inheritance and how traits are passed down from parents to offspring.
- Predict and analyze the genotype and phenotype ratios in monohybrid crosses using Punnett squares.
- Explain monohybrid cross problem based and guided inquiry method to teach Mendelian inheritance.
- Design a lesson using problem based and guided inquiry methodand specific technology to teach Mendelian inheritance.
- Apply problem based and guided inquiry method and specific technologies to teach the concepts of Mendelian inheritance.
- Identify misconceptions in learning Mendelian inheritance.

Activity 1

This activity is designed based on guided inquiry method and problem solving strategies. The inquiry process has the following five steps (see unit one) and this lesson is designed following these steps.

1. Think of and answer the following questions

How are traits passed down from parents to offspring? Mono hybrid crosses? How do you predicting the outcomes of these crosseswhat are alleles, dominant and recessive traits, genotype and phenotype? How you taught these concepts in the schools. Reflect individually and share in group.

See video link- https://www.youtube.com/watch?v=J2J5v861CTI

2. Investigate

You need to draw background information on genetics, Punnett squares, and monohybrid crosses and materials to explore Mendel's pea plant experiment. Try to investigate the seven alternative contrasting traits Mendel studied and why he selected pea plant, homozygous, heterozygous, dominant, recessive traits individually using your textbook and internet.

3. Create

Make small groups and each group take a problem on specific genetic trait to investigate through a monohybrid cross. For instance, you can form six groups and do the following monohybrids crosses.

1. Assume that there are two types of pea plants - one with smooth seeds (dominant) and the other with wrinkled (recessive) seeds in a garden. A gardener decides to cross a smooth-seeded plant with a wrinkled-seeded plant to study how the seed texture trait is inherited.
2. Show the appearance of (a) F_1 and (b) F_2 progenies when a pure (homozygous) tall pea plant is crossed with a pure (homozygous) short pea plant.
3. A farmer crossed hornless and horned cattle. Hornless (H) in cattle is dominant over horned (h). A homozygous hornless bull is mated with a homozygous horned cow.
4. A farmer crossed red fruit and yellow fruit in tomatoes. Red fruit (R) is dominant over yellow fruit (r). A plant that is homozygous for red fruit is crossed with a plant that has yellow fruit.
5. Brown eyes in humans are dominant to blue eyes. A brown-eyed man, whose mother was blue-eyed, marries a brown-eyed woman whose father had blue eyes. Show the cross.
6. A pea plant that is pure for purple flowers mates with a pea plant that has white flowers. One of their offspring self-fertilizes and produces 100 offspring. How many would you predict turn out to have purple flowers and how many would you predict turn out to have white flowers? Show the cross.

While solving these problems, you should have to outline the following:

1. Create a punnett square.
2. List the phenotypes and genotypes of the parent plants being crossed.
3. Determine the genotype of the gametes (haploid cells resulting from meiotic division).
4. Find all possible combinations of gametes, as fertilization is a random process.
5. Determine parental, F1 and F2 generations.
6. Determine the phenotypic and genotypic ratios of the resulting offspring.

4. Discussion

Each of your group should discuss and share results of discusion. Try to compare and analyze the different outcomes, as well as identify patterns and trends in the inheritance of traits.

5. Reflect

Reflect on what you learn about monohybrid crosses? and what significance of Mendel's work has on our understanding of genetics?

Assessment

- Conduct self-assessment – assessment as learning
- Answer questions raised by the trainer in relation to monohybrid cross and guided inquiry method

Activity2

Be in group and design a lesson to teach Mendelian inheritance in dihybrid cross using problem solving strategies.

Key Ideas

- Genetic information is transferred between organisms across generations.
- A monohybrid cross examines a single set of alleles, or genes, that are responsible for a particular trait.
- Using parental genotypes as a basis, a Punnett square can be used to predict the genotypes and phenotypes of potential offspring.
- Using a dihybrid cross, two pairs of independent alleles (genes) for distinct traits are simultaneously examined.
- Guided inquiry method is an interactive and collaborative learning method that promotes student engagement, critical thinking, and a deeper understanding of genetic crosses.

Common Misconceptions

- Misconception - In populations, dominant traits are invariably more prevalent.
- Correct conceptions –A variety of factors, such as the environment and selective pressures, influence how frequently a trait occurs.
- Misconceptions - There are people who mistake co-dominance for dominance.
- Correct conceptions - In co-dominance, both alleles express themselves equally (AB blood type, for example), whereas in dominance, one allele obscures the expression of the other (brown eyes over blue eyes, for example).

Implications to teaching

- What new things did you learn from this session?
- How guided inquiry method and problem solving strategies of teaching and technology will help you to teach other biology topics?
- How can you help your students benefit from this lesson in your school?

Takeaway resources

- Video link
  - https://www.youtube.com/watch?v=I8uiiZgy5uI,

- https://www.youtube.com/watch?v=PyP_5EgQBmE,
- https://www.youtube.com/watch?v=B7VMXUk6TEg,
- https://www.youtube.com/watch?v=xTOMgXeGizU,
- https://www.youtube.com/watch?v=3f_eisNPpnc,

- Problem based and guided inquiry
- Reading materials about monohybrid and dihybrid cross.

Session 8.4: Teaching Mendel's Laws and Test cross (3hrs)

Session Objectives

At the end of this session, the trainee will be able to:

- Explain the concepts of the law of segregation and the law of independent assortment.
- Illustrate how test crosses can be used to determine the genotype of unknown individual.
- Design a lesson using Think-Pair-Share and case based problem solving strategies and specific technology to teach Mendel's laws and test cross.
- Apply Think-Pair-Share and case based problem solving strategies and specific technologies to teach Mendel's laws and test cross.
- Identify misconceptions in learning Mendel's laws and test cross.

Activity 1

This activity is designed based on Think-Pair-Share method and case based problem solving strategies. First, think of and answer the following questions.

What do you know about law of segregation, law of independent assortment and test cross? How you taught these concepts in the schools. Then reflect individually and share in group. See video link

- https://www.youtube.com/watch?v=6D17YJZo7kk,
- https://www.youtube.com/results?search_query=test+cross

Look at the following problem **cases:**

Case 1- *In a genetic study on flower color, purple (P) is dominant over white (p). A heterozygous purple flower is crossed with a homozygous white flower. Demonstrate Mendel's law of segregation.*

Case 2- *A farmer is breeding corn plants with two traits: kernel color (Y: yellow, y: green) and kernel shape (R: round, r: wrinkled). A heterozygous yellow green corn plant is crossed with a heterozygous round wrinkled corn plant. Examine how the law of independent assortment leads to new allele combinations*

Case 3- *Imagine a farmer who has a plant with purple flowers (dominant phenotype). The farmer wants to know whether the plant is homozygous (PP) or heterozygous (Pp) for flower color. Show how can he know whether the plant is homozygous or heterozygous?*

Think of these problems, do the following activities being in pair and share for the class.

- Solve the problem in the three cases and show using punnett square.
- Describe law of segregation and independent assortment from these cases.
- Apply the concept of test cross.
- Real-World Connections: apply your knowledge of test crosses and Mendel's laws to analyze genetic traits in different organisms or experimental scenarios.

Assessment

- Conduct self-assessment – assessment as learning
- Answer questions raised by the trainer in relation to law of independent assortment and law of segregation and case based problem based method

Key Ideas

- **Law of segregation: Mendel postulated that meiosis is the process by which the two alleles that each unique organism carries for a trait segregate. Because of this, a given trait has only one allele in each gamete (sperm or egg).**
- **Law of independent assortment: Mendel noted that various characteristics, like seed shape and flower color, segregate apart from one another. In other words, the inheritance of one characteristic does not affect the inheritance of another.**
- **A test cross: is a breeding experiment called used to find an individual with a dominant phenotype's genotype. It entails mating that person with a homozygous recessive person.**
- Case study problem based method is a learner centered approach that can help students visualize and understand the practical application of test crosses and Mendel's laws in genetic experimentation.

Implications to teaching

- What new things did you learn from this session?
- How Think-Pair-Sharemethod and case based problem solving strategy of teaching and technology will help you to teach other biology topics?
- How can you help your students benefit from this lesson in your school?

Takeaway resources

- Video link
  - https://www.youtube.com/watch?v=QkkDzKcynJQ,
  - https://www.youtube.com/watch?v=XOMpxfTCHnM,
  - https://www.youtube.com/watch?v=8y_SLtToUOA,
- Case study and problem solving strategies
- reading materials about Mendel's laws and Test cross

Session 8.5: Teaching Sex Determination (3hrs)

Session Objectives

At the end of this session, the trainee will be able to:

- Explain the mechanisms of sex determination in different organisms.
- Apply BuzzGroupMethod to teach sex determination.
- Use specific technologies to teach the concepts of sex determination.
- Design a lesson using BuzzGroupMethodand specific technology to teach sex determination.
- Identify misconceptions in learning sex determination.

Activity

This activity is designed based on buzz group discussion method. First, think of and answer the following questions.

What do you know about sex determination? How you taught these concepts in the schools.

See the video link - https://www.youtube.com/watch?v=f2oD9-_WBFE

Form small groups of 3-5 members each.

- Each group should work on the question how sex is determined in humans?
- You should discuss the question in each group.
- Discuss the questions with the whole class based on the group presentations.

Stop the discussion on the first question and each group should answer on the question how sex is determined in insects, birds, fish and reptiles?

- Discuss the question in each group.
- Discuss the questions with the whole class based on group presentations.

Reflect and summarize the key points covered during the session and clarify any remaining doubts/misconceptions.

Key Ideas

- The result of determining a person's sex—whether they develop into a male or female—is remarkably conserved.
- The fundamental processes, however, can differ greatly.
- Though other species use different mechanisms, humans are known to use their X and Y chromosomes.
- Certain species possess distinct sex chromosomes, like X0 in insects and ZW in birds.
- Sex determination can be influenced by temperature, social cues, and other environmental factors.

Implications to teaching

- What new things did you learn from this session?
- How buzz group discussion method of teaching and technology will help you to teach other biology topics?
- How can you help your students benefit from this lesson in your school?

Takeaway resources

- Video link- https://www.youtube.com/watch?v=f2oD9-_WBFE' https://www.youtube.com/watch?v=gDYRH08S-Z4
- Buzz group discussion method material
- Reading materials on sex determination

Session 8.6: Teaching Non-Mendelian inheritance (4hrs)

Session Objectives

At the end of this session, the trainee will be able to:

- Explain concepts of non-Mendelian inheritance with examples.
- Use Jigsaw method to teach non-Mendelian inheritance.

- Apply specific technologies to teach the concepts of non-Mendelian inheritance.
- Design a lesson using Jigsaw method and specific technology to teach non-Mendelian inheritance.
- Identify misconceptions in learning non-Mendelian inheritance.

Activity

This activity is designed based on Jigsaw method of teaching. First, think of and answer the following questions.

What do you know about Co-dominance, Incomplete dominance, Multiple alleles (ABO blood group inheritance) and Rh factor inheritance in humans and its medical importance and how you taught them in the school?

Make four groups each having 8 members, called home groups. Then, you are expected to assign number for each member in the group starting from number 1 for each group (i.e. 1- 8 for each group). In this case you can give number one for two individuals, number 2 for two individuals, number 3 for two individuals and number 4 for two individuals in each group. Therefore, the expert group will have 2 representatives from each group.

Each home group should be assigned to one of the topic as shown below and discuss.

Group 1. Co-dominance,

Group 2. Incomplete dominance,

Group 3. Multiple alleles (ABO blood group inheritance),

Group 4. Rh factor inheritance in humans and its medical importance,

After you discussed the topic, all members assigned with number 1 should come and sit together. Do the same for members assigned with number 2, 3 and 4 so that you can have 4 groups each having 8 individuals, 2 from each group(1- 4). These are expert groups because they know everything about Co-dominance, Incomplete dominance, Multiple alleles (ABO blood group inheritance) and Rh factor inheritance in humans and its medical importance and how you taught in the school.

Each group members of the group should share their discussion for the members in the expert group.

After all expert groups have shared their findings; make a whole-class discussion:

- Explain each concept.
- Address misconceptions and clarify doubts.

NB. You can make the member of each home group 12 and in this case you have to give the same number for three individuals in each group, for instance number 1 for 3 individuals in each group, number 2 for three individuals in each group, etc, so that you can have 12 individuals in the expert group.

Assessment

After correcting the misconceptions and fulfilling conceptual gaps,

- Conduct self- assessment - assessment as learning - reflect on what you learned.
- Answer questions your trainer asks on non-Mendelian inheritance, Jigsaw method and technological aspects related to the lesson.

Key Ideas

- Co-dominance occurs when an individual who is heterozygous expresses both alleles at the same time without one fully outweighing the other.
- A heterozygous organism's phenotype in incomplete dominance is a blend of its homozygous parents' phenotypes in an intermediate stage.
- A single gene has multiple alleles in the ABO blood group system.
- A, B, and O are the three main alleles.
- Another significant blood group system is the Rh factor (Rhesus factor), which is based on a single gene with two alleles: Rh+ (Rh antigen presence) and Rh- (Rh antigen absence).

Implications to teaching

- What new things did you learn from this session?
- How Jigsaw method of teaching and technology will help you to teach other biology topics?
- How can you help your students benefit from this lesson in your school?

Takeaway resources

- Video link- https://www.youtube.com/watch?v=OwD38Yrjh7g, https://www.youtube.com/watch?v=EqmrQQ4b7Kg, https://www.youtube.com/watch?v=sneVb3f8wx8,

- Jigsaw method
- reading materials

Session 8.7: Teaching Sex-linked Inheritance and Pedigree Analysis in Humans (3hrs)

Session Objectives

At the end of this session, the trainee will be able to:

- Explain sex-linked inheritance and.
- Analyze pedigree analysis in humans
- Design a lesson using case based problem based strategies with small group discussion method and specific technology to teach sex-linked inheritance and pedigree analysis in humans.
- Apply case based problem solving strategieswith small group discussion method to teach sex-linked inheritance and pedigree analysis in humans.
- Apply specific technologies to teach the concepts of sex-linked inheritance and pedigree analysis in humans.
- Identify misconceptions in learning sex-linked inheritance and pedigree analysis in humans.

Activity

This activity is based on case based problem solving strategies and small group discussion. Before you engaged in doing the activities, reflect on the questions below.

What do you know about sex-linked inheritance pedigree analysis and how you taught in the school?

Make 8 small groups and follow the instructions bellow

1. The firs 4 small groups will take case 1 and the rest 4 small groups should take case 2 and
2. Each group should discuss the cases on sex linked traits such as color blindness and hemophilia.
3. Compare the result of discussion between 4 for groups for each case.
4. Share discussion result of each case that each group agreed with to class.

For the first 4 small groups

Case 1- *Abebe's family has a history of color blindness, which is a sex-linked trait. Abebe is color blind, but his wife Alemitu is not. They have three children: two boys and one girl. One of the boys is color blind, while the other boy and the girl are not.*

Case Study Questions:

1. What is the probability that a son of Abebe and Alemitu will be color blind?
2. Why are more males affected by color blindness than females?
3. Creates a family tree (pedigree) showing Abebe and Alemitu's family.
4. How can you use a pedigree chart to show the inheritance of color blindness in the Abebe's family?
5. What caution should be taken?
6. What are the treatments?

Solve the following problems.

1. A mother with normal vision (carrier) and a color-blind father (XY) have children.
2. A color-blind father (XY) and normal vision (not carrier) mother have children.

Here, you are expected to:

1. Predict the genotypes and phenotypes of their offspring.
2. Use Punnett squares to calculate probabilities.
3. Use a pedigree chart to visually represent the inheritance of color blindness.

For the second 4 small groups

Case 2 – *Abebech's family has a history of hemophilia which is a sex linked trait. Abebech loves playing soccer and spending time with her friends. One day, while playing soccer with her friends, Abebech accidentally falls and scrapes her knee. She notices that the bleeding from the scrape doesn't stop as quickly as it should, and she starts to feel worried. Abebech got engaged to Bekele.*

Case Study Questions:

1. Is Abebech's problem related with hemophilic?
2. If so, what is the probability that a son of Abebech and Bekele will be hemophilic?
3. Why are more males affected by hemophilia than females?
4. Creates a family tree (pedigree) showing Abebech and Bekele's family.
5. How can you use a pedigree chart to show the inheritance of hemophilia in the Abebech and Bekele family?

6. What caution should be taken?
7. What are the treatments?

Solve the following problems.

1. A normal mother (carrier) and a hemophilic father (XY) have children.
2. A hemophilic father (XY) and normal mother (not carrier) have children.

You are also expected to:

1. Predict the genotypes and phenotypes of their offspring.
2. Use Punnett squares to calculate probabilities.
3. Use a pedigree chart to visually represent the inheritance of hemophilia.

Assessment

After correcting the misconceptions and fulfilling conceptual gaps,

- Conduct self- assessment - assessment as learning - reflect on what you learned.
- Answer questions your trainer asks on sex-linked inheritance and pedigree, case based problem solving strategies and small group discussion and technological aspects related to the lesson.

Key Ideas

- Two sex chromosomes—XX in females and XY in males—determine biological sex in humans.
- X or Y chromosome genes are thought to be associated with specific sex traits.
- While Y-linked genes are unique to males, X-linked genes are present in both males and females.
- With two X chromosomes, females can have either homozygous or heterozygous status for every sex-linked gene.
- Because men only have one X chromosome, they are more likely to suffer from X-linked disorders. They express the X-linked gene allele that they inherit.
- The blood clotting disorder hemophilia serves as an illustration.
- Family trees called pedigrees illustrate the patterns of inheritance for particular characteristics or genetic conditions.
- Pedigree analysis aids in identifying inheritance patterns, such as X-linked, autosomal recessive, and dominant.

Implications to teaching

- What new things did you learn from this session?
- How case based problem solving strategies and small group discussion of teaching and technology will help you to teach other biology topics?
- How can you help your students benefit from this lesson in your school?

Takeaway resources

- Video link https://www.youtube.com/watch?v=ygeuA3T9neM, https://www.youtube.com/watch?v=-Ztzi6pAh5M, https://www.youtube.com/watch?v=9blCsIQ6P9c, https://www.youtube.com/watch?v=yd5BEEbgkTU,
- Cases, problem solving strategies
- reading materials on sex linked trait and pedigree

Session 8.8: Teaching Genetic Disorders and Treatments (3hrs)

Session Objectives

At the end of this session, the trainee will be able to:

- Explain concepts of genetic disorders and their treatment mechanisms.
- Apply group discussion method and specific technologies to teach genetic disorders and their treatment.
- Design a lesson using group discussion method and specific technology to teach genetic disorders and their treatment.
- Identify misconceptions in learning genetic disorders and their treatment.

Activity

This activity is designed based on group discussion and presentation. Before you are engaged in group discussion, answer the following questions individually.

What do you know about genetic disorders, genetic testing and counseling and gene therapy?

Then, the trainer will introduce you about genetic disorder, genetic testing and counseling and gene therapy.

Use the following procedure

1. Make 4 groups and each group should take over a different genetic disorder to research as shown below.

Group 1- Cystic fibrosis

Group 2- Sickle cell anemia

Group 3- Down syndrome

Group 4 - Huntington's disease.

2. Introduce the topic of discussion to the group members.
3. Select a group leader and secretary of each group and starting discussion.
4. Discuss and explain the causes, symptoms and treatment mechanisms of the genetic disorder.
5. Present the result of discussion to the whole class.
6. Conduct over all reflection on presentations.

Assessment

After correcting the misconceptions and fulfilling conceptual gaps,

- Conduct self- assessment - assessment as learning - reflect on what you learned.
- Answer questions your trainer asks on genetic disorders and treatment, group discussion method and technological aspects related to the lesson.

Key Ideas

- **Mutations, or changes, in our genes or chromosomes, result in genetic disorders.**
- **Genetic disorders can present with a wide range of symptoms, from mild to severe. It includes** Cystic fibrosis**,** Sickle cell anemia**,** Down syndrome and Huntington's disease, etc
- **Inherited mutations, spontaneous mutations, and environmental variables are among the causes.**
- **Genetic testing aids in locating mutations linked to particular illnesses.**

Common Misconceptions

- **Misconception- All traits are determined solely by genes.**
- **Correct conception- a combination of hereditary and environmental factors determines most traits. Disease risk can also be influenced by lifestyle decisions.**
- **Misconception- There is only one gene that controls every trait.**
- **Correct conception- Multiple genes control a large number of polygenic traits. For instance, several genes are involved in height, skin tone, and eye color.**
- **Misconception- The most prevalent traits are always the dominant ones.**

- **Correct conception- prevalence is not determined by dominance. If carriers are common, recessive traits may be common.**
- **Misconception- Only a select group of individuals possesses "disease genes."**
- **Correct conception- Variations linked to disease risk are present in every individual.**

Implications to teaching

- What new things did you learn from this session?
- How group discussion method of teaching and technology will help you to teach other biology topics?
- How can you help your students benefit from this lesson in your school?

Takeaway resources

- Video link- https://www.youtube.com/watch?v=4gJM5T_xFpQ, https://www.youtube.com/watch?v=Qss-agfB0qk, https://www.youtube.com/watch?v=CvJNzxvPCzg,
- Role play and group discussion
- reading materials on genetic disorders

Unit Summary

- Genetics is the branch of biology that studies the inheritance of traits in living organisms. It is essential for understanding diseases, inheritance, and biological diversity.

- **Mendelian Inheritance:** Patterns of trait inheritance as discovered by Gregor Mendel through his pea plant experiments.
- Non-Mendelian inheritance refers to patterns of inheritance that do not follow Mendel's laws of genetics. These include multiple allele traits, codominance, incomplete dominance.

- Protein synthesis is the process by which cells construct proteins, which are crucial for the structure and function of all your cells and occurs though transcription and translation.

- Sex-linked traits are associated with genes found on sex chromosomes. In humans, these are the X and Y chromosomes. Because males have only one X chromosome, they are more likely to express sex-linked traits, especially if they are recessive, since

they lack a second X chromosome that could carry a dominant allele. An example is color blindness, which is more common in males.

- Genetic disorders are diseases caused by abnormalities in an individual's genome. It can be **single-gene disorders** are caused by mutations in a single gene, **chromosomal disorders** occur when there are missing or extra copies of chromosomes and **complex disorders** involve mutations in multiple genes, often coupled with environmental factors.

- Sex determination is the process by which an organism develops into a male or female. In humans, this is typically determined by the XY chromosome system, where the presence of a Y chromosome leads to male development. However, there are other systems in nature, such as the ZW system in birds or temperature-dependent sex determination in some reptiles. Environmental factors can also influence sex determination in some specie.
- **Think-Pair-Share** is a collaborative learning strategy where students first think about a question or topic individually, then pair up with a peer to discuss their thoughts, and finally share their ideas with the larger group or class.
- A concept map is a visual tool that represents the relationships among various concepts. It involves identifying and organizing key ideas, usually depicted in boxes or circles, and connecting them with lines or arrows that are labeled with words to explain how the concepts are related.
- **Case-Based Problem Solving** strategies involve presenting students with real-life or hypothetical cases to solve. It helps develop analytical thinking and reflective judgment.

Unit 9: Teaching Microorganisms (5hrs)

Unit Introduction

This unit aims at helping trainees to establish understandings of microorganisms, their classification, use, disease caused by microorganisms and prevention mechanisms. Microorganisms, tiny living beings invisible to the naked eye, encompass a diverse range of organisms from bacteria to fungi. Though some cause diseases like pneumonia and athlete's foot, others are beneficial, producing foods like yogurt and cheese, and even cleaning up oil spills. We can classify and understand these microbes to utilize their positive impacts and employ hygiene, vaccination, and antibiotics to combat the harmful ones. You will identify specific teaching method, technologies and locally available resources to teach the concepts of

microorganisms, their classification, use, disease caused by microorganisms and prevention mechanisms. You are also expected to identify common misconceptions related to microorganisms.

Unit outcomes

After completing this unit, trainees will be able to:

- Understand the concept of microorganisms.
- Classify different types of microorganisms (Eubacteria, Archaea, Fungi, Protozoa, and Viruses).
- Explore methods to control microorganisms.
- Identify specific teaching method, technologies and locally available resources to teach the concepts of microorganisms.
- Identify misconceptions in the concepts of microorganisms, their classification, use, disease caused by microorganisms and prevention mechanisms.

Session 9.1: Teaching Microorganisms and their Classification (2hrs)

Session Objectives

At the end of this session, the trainee will be able to:

- Explain concepts of microorganisms and their types.
- Apply Jigsaw method to teach microorganisms and their classification.
- Use specific technologies to teach the concepts of microorganisms and their classification.
- Design a lesson using Jigsaw method and specific technology to teach microorganisms and their classification.
- Identify misconceptions in learning microorganisms and their classification.

Activity

This activity is designed based on Jigsaw method of teaching. Before engaging yourself in the activity, answer the questions below.

What do you know about microorganisms and their types?

Divide the class into six groups each having six members, called home groups. Then assign number for each member in the group starting from number 1 for each group (i.e. 1- 6 for each group).

Assign each home group as shown below and let them to discuss for each of the following points.

Group 1. General overview of microorganisms,

Group 2. Eubacteria,

Group 3. Archaea,

Group 4. Fungi,

Group 5. Protozoa,

Group 6. Viruses,

What do you know about each type of microorganisms and your experience of these organisms?

Then you should do the following guided questions to help and facilitate the discussions within each group.

1. What are microorganisms and how they are different from other organisms?
2. What are the general characteristics of each type of microorganism?
3. How does each type of microorganism differ from each other?
4. How does viruses are unique from other microorganisms?

After you discussed each type of microorganism assigned to you, call all members assigned with number 1 and let them to sit together. Do the same for members assigned with number 2, 3, 4 , 5, 6 so that you can have 6 groups each having 6 individuals, 1 from each group(1- 6). These are expert groups because they know everything about microorganisms and their classification.

Each group members should share their discussion for the members of the group.

After all expert groups have shared their findings; make a whole-class discussion and complete the following concepts.

- Compare and contrast the various types of microorganisms.
- Address misconceptions and clarify doubts.

After correcting the misconceptions and fulfilling conceptual gaps, conduct

- assessment as learning - self- assessment–reflect on what you learned.
- assessment for learning – your trainer will ask questions on content, pedagogical and technological aspects related to the lesson and answer the following questions.

- How do bacteria differ from viruses?
- What role do fungi play in ecosystems?
- Why are protozoa important for human health?

Key Ideas

- The Jigsaw method is an engaging cooperative learning technique that can be effectively used to teach various topics, including microorganisms and their types.
- Microorganisms, also known as microbes, are tiny living organisms that are invisible to the naked eye. They play essential roles in various ecosystems and have both positive and negative impacts on our lives.
- Common types of microorganisms include bacteria, fungi, viruses, and protozoa.
- Despite their small size, microorganisms are incredibly diverse and have a significant impact on our planet.
- Microorganisms are classified into different taxonomic categories to facilitate research and communication.
- The most recent classification system includes five kingdoms. Bacteria: Single-celled prokaryotic organisms. Archaea: Another group of single-celled prokaryotes that thrive in extreme environments. Protoctista: Includes protozoa (single-celled eukaryotes) and algae (photosynthetic eukaryotes). Fungi: Eukaryotic organisms that include yeasts, molds, and mushrooms. Animalia: Multicellular eukaryotes.
- Each kingdom is further divided into phylum, class, order, family, genus, and species. For example, Escherichia coli (E. coli) belongs to the domain Bacteria, kingdom Eubacteria, phylum Proteobacteria, class Gamma proteobacteria, order Enterobacteriales, family Enterobacteriaceae, genus Escherichia, and species E. coli .
- Microorganisms have several beneficial uses. Bioremediation: Some bacteria and fungi can break down pollutants and clean up contaminated environments. Fermentation: Microorganisms are used in food and beverage production (e.g., yogurt, beer, bread). Medicine: Antibiotics (such as penicillin) are produced by certain bacteria and fungi. Biotechnology: Genetic engineering and production of enzymes. Wastewater treatment: Microorganisms help remove organic matter from sewage. Agriculture: Nitrogen-fixing bacteria enhance soil fertility.

- Some common misconceptions about microorganisms and their types
  - All microbes are bad. The vast majority of microorganisms are harmless or even beneficial.
  - Microbes are only single-celled but some microorganisms like protists and fungi can be multicellular.
  - Microbes are visible to the naked eye but most microorganisms are microscopic and require microscopes to be seen.
  - Microbes only live in dirty places but microbes exist everywhere, including clean environments like our skin and the air.
  - Antibiotics kill all microbes but antibiotics target specific bacteria and won't work against viruses or fungi. The overuse of antibiotics can also lead to the development of antibiotic resistance.
  - Bacteria are all bad but many bacteria are essential for human health. For instance, gut bacteria aid in digestion and nutrient absorption. Food spoilage and some diseases are caused by specific types of bacteria.
  - Viruses are living organisms but viruses are not technically alive. They are genetic material (DNA or RNA) enclosed in a protein coat. They reproduce by capturing the machinery of host cells.
  - Fungi are all molds but fungi encompass a diverse group, including molds, yeasts, and mushrooms. Some fungi cause diseases, while others are beneficial, like those used in bread production and cheese making.

Implications to teaching

- What new things did you learn from this session?
- How Jigsaw method of teaching and technology will help you to teach other biology topics?
- How can you help your students benefit from this lesson in your school?

Takeaway resources

- Video link
- https://youtu.be/iDVq2etiknU?t=5
- https://youtu.be/YSitT0oOoyc?t=4
- model of instruction (Jigsaw method),
- reading materials

Session 9.2: Teaching microorganisms, disease transmission, prevention,

and bacterial isolation techniques (3hrs)

Session Objectives

At the end of this session, the trainee will be able to:

- Define normal microbiota and its role in human health.
- Identify different modes of disease transmission.
- Explain ways to prevent the spread of disease.
- Describe beneficial uses of microorganisms.
- Explain methods to control unwanted microbial growth.
- Design an experiment to isolate bacteria.
- Design a lesson using inquiry method and specific technology to teach the lesson topic.
- Apply inquiry method and specific technologies to teach the lesson.
- Identify misconceptions related to this lesson topic.

Activity

To do this activity, the trainees may use the following materials while taking the training. The activity is designed based on inquiry based method of teaching.

- Whiteboard/Projector
- Markers/Pens
- Pictures of various body surfaces (skin, mouth, gut)
- Pictures of different diseases (common cold, flu, athlete's foot)
- Sample scenarios for disease transmission (coughing, sharing utensils)
- Images of beneficial microorganisms (yogurt, bread)
- Antiseptic wipes/soap (optional)
- Petri dishes (optional)
- Broth (nutrient-rich liquid for bacteria growth) (optional)
- Cotton swabs (optional)

Inquiry-Based Lesson Plan adopted from various sources.

Introduction (10 minutes)

Start your activity by brainstorming and reflecting on microorganisms and types of microorganisms. Briefly discuss their size and invisibility to the naked eye. Observe pictures

of different body surfaces (skin, mouth, gut). Do you think these areas have any microorganisms? Then explain the concept of normal microbiota that are trillions of bacteria that live on and inside us, playing a crucial role in digestion, immune function, and overall health.

Then, do the following tasks orderly.

1. Investigating Diseases, its transmission and prevention (30 minutes)

Form manageable groups of three or four students, give each group a picture of a different condition (flu, athlete's foot, common cold), and have a discussion about how these infections spread.

Proceed with your conversation on the various ways that diseases can spread (vector-borne, airborne, and through contact). Describe how a balanced, normal microbiota can aid in preventing the microbial pathogens that cause disease from settling in human bodies.

Additionally, you must talk about preventive strategies - that is, how to stop the spread of illness - such as washing your hands, concealing your cough, and practicing good hygiene.

2. Fascination with microorganisms (30 minutes)

Display images of some dangerous bacteria in addition to those of helpful microbes employed in the manufacture of food (yogurt, bread). Talk about the benefits and drawbacks of various microbes for humans.

Explain the idea of limiting unwelcome microbial development. Talk about practices such as using soap and water to wash your hands, sanitizing surfaces, and preserving food. If supplies are available, compare the cleanliness of trainees' hands before and after using soap and antiseptic wipes to illustrate the efficacy of hand cleaning.

3. **The Isolation Technique (30 minutes)**

- Make groups and challenge yourself to design an experiment to isolate bacteria from their environment (e.g., classroom desk, doorknob). Discuss the importance of aseptic technique to avoid contamination.
- If materials are available, briefly explain the use of petri dishes, broth, and cotton swabs for bacterial isolation.

- You should design your own experiment steps, outlining howyou would collect samples, transfer them to petri dishes, and incubate them.

4. **Summarizing (20 minutes)**
   - Each group shares their experiment designs and discusses the challenges of isolating and identifying bacteria.
   - Briefly discuss the importance of these techniques in medical fields and research so as to connect to the real world.
5. **Extension (20 minutes)**

You should to research specific beneficial or harmful microorganisms.

6. **Assessment**
   - Self-assessment - observe your own participation in discussions and activities.
   - Your trainer can use your designed experiments as formative assessment.
7. **Distinguishing**
   - Offer more assistance and scaffolding to those who find the concepts difficult.
   - Increase the difficulty level by assigning them to investigate particular illnesses or microbes.

Key Ideas

- This lesson uses inquiry-based learning by encouraging you to ask questions, make observations, design experiments, and draw conclusions. This approach fosters critical thinking, problem-solving skills, and a deeper understanding of the microscopic world within and around us.
- Microorganisms can cause various diseases in humans, animals, and plants. Examples include: Bacterial infections: Tuberculosis, strep throat, urinary tract infections. Viral infections: Influenza, common cold, HIV/AIDS. Fungal infections: Athlete's foot, ringworm. Protozoal infections: Malaria, amoebic dysentery. Parasitic infections: Malaria (caused by Plasmodium), intestinal worms.
- Prevention involves hygiene practices, vaccination, and antimicrobial treatments.
- Some common misconceptions about this lesson topics include:
  - All bacteria are bad for us but our normal microbiota plays a vital role in health. Disruption of this balance can lead to problems.
  - Only direct contact can spread disease but diseases can also spread through airborne droplets, contaminated surfaces, and vectors like mosquitos.

Implications to teaching

- What new things did you learn from this session?
- How inquiry based method of teaching and technology will help you to teach other biology topics?
- How can you help your students benefit from this lesson in your school?

Takeaway resources

- Video link
- https://www.youtube.com/watch?v=Y1vqtjA8I-k
- https://youtu.be/-ps_0InQBSk?t=18
- https://youtu.be/uPveNOnmQxI?t=13
- model of instruction (Inquiry base method),
- reading materials

Unit Summary

- Microorganisms are a diverse group of minute organisms that are too small to be seen with the naked eye that include bacteria, archaea, algae, fungi, protozoa, and viruses.
- Microorganisms are indispensable to life on Earth, influencing many aspects of our environment, health, industry, agriculture and economy.
- Microorganisms play a key role in nutrient cycling, breaking down dead matter and recycling nutrients that are essential for ecosystem functioning.
- Microorganisms play a key role in medicine including the development of antibiotics, vaccines, and the understanding of pathogenic mechanisms causing diseases.
- Microorganisms are used in a variety of industrial processes, such as the fermentation of beer, wine, and cheese, as well as the production of biofuels and pharmaceuticals.

Unit 10: Teaching Energy Transformation ((9hrs)

Introduction

This unit aimed at equipping trainees with in-deep understanding of concept related to energy transformation and the way of delivering these concepts using appropriate teaching strategies and technologies. This unit deals with photosynthesis (light dependent and light independent reactions) and cellular respiration (aerobic and anaerobic respiration) with appropriate pedagogies and technologies used to teach these biological concepts. The pedagogical

approach used in this unit is learner centered approaches mainly using 5E instructional model and experiential learning model.

Unit Outcomes

After completing this unit, trainees will be able to:

- Explain the process of photosynthesis
- Explain the process of cellular respiration
- Compare photosynthesis and cellular respiration
- Design a lesson using effective teaching method and specific technology to teach process photosynthesis and cellular respiration.
- Apply specific teaching strategies and technologies to teach process of photosynthesis and cellular respiration.
- Identify misconceptions in learning process photosynthesis and cellular respiration.

Session 10.1: Teaching Photosynthesis (4:30hrs)

Session Objectives

At the end of this session, the trainee will be able to:

- Explain concepts of photosynthesis.
- Compare light dependent and light independent reaction stage of photosynthesis
- Design a lesson using 5E instructional model, buzz group discusion and specific technology to teach process photosynthesis.
- Apply 5E instructional model, buzz group discussion and specific technologies to teach process photosynthesis.
- Identify misconceptions in learning process photosynthesis.

Activity

This activity is designed based on 5E instructional model.

1. Engagement phase

At this phase, answer the following questions to engage yourself in the lesson.

1. Have you ever wondered how a plant eats?
2. How do you think it gets its food?
3. How is the energy from sunlight used to build sugars?

4. Have you ever wondered how plants make their own food?
5. Why do plants need sunlight?
6. Why are plants green?

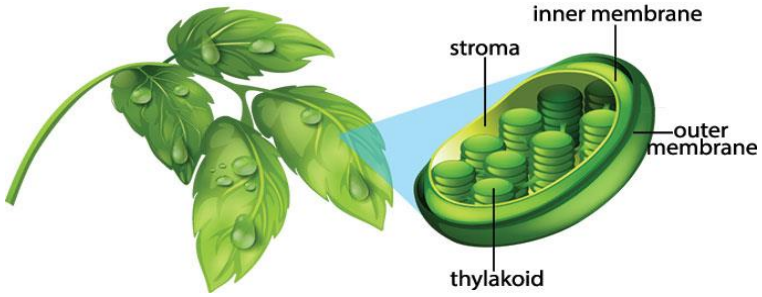
You can also show video of plants undergoing photosynthesis to spark curiosity and set the stage for learning such as https://www.youtube.com/watch?v=ArfEX-F7Xys, https://www.youtube.com/watch?v=QUjQC6TOE3k'.

2. Exploration phase

In this phase, make groups and explore based on your experience, notes on the textbook and the diagram and figure below. Work together to explore the process of photosynthesis and use buzz group discussion being in small groups.

Explore and discuss leaf structure and where photosynthesis takes place in the same buzz group. Use the following guiding questions.

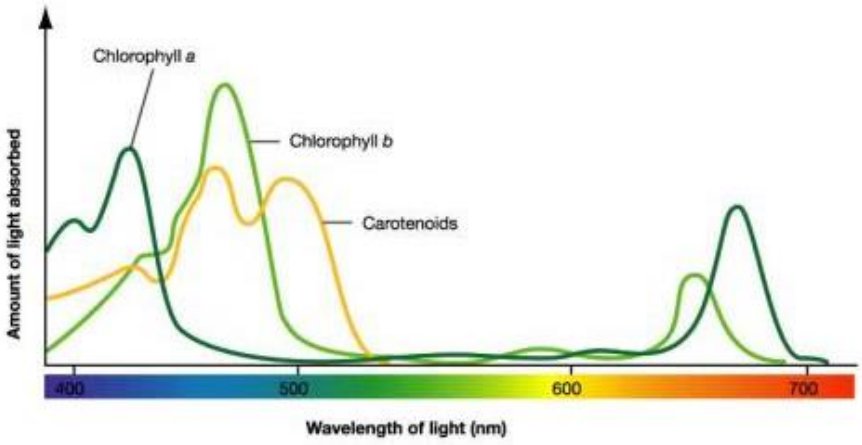
- What are the structures of a leaf?
- Where photosynthesis does takes place in the leaf of a plant?
- Why?



Chloroplast

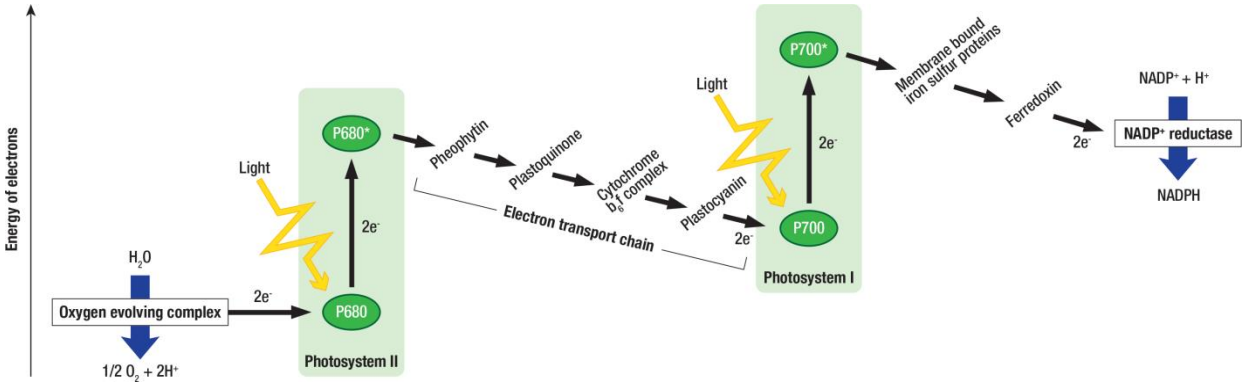
Stop the buzz group discussion on leaf structure and site of photosynthesis and discuss chlorophyll pigments and how they absorb light energy in the same buzz group and answer the following questions.

- What are chlorophyll pigments?
- How do they absorb light energy?
- Which wave length they absorb? Why?



Stop the buzz group discussion on Chlorophyll pigments and how they absorb light energy and continue discussion on light dependent reaction in photosynthesis (Photosystem I and II) in the same buzz group based on the following questions.

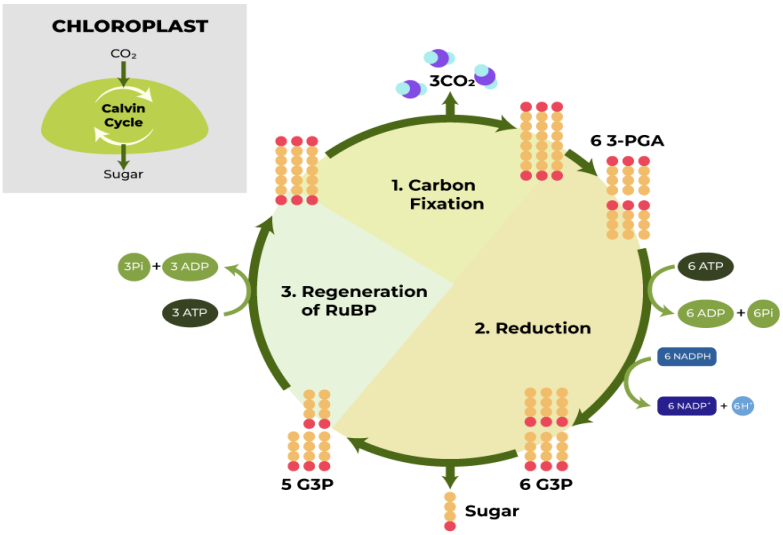
- What happens to chlorophyll pigments as they absorb light energy?
- What happens in photosystem I and II?
- What are the products of light dependent stage of photosynthesis?



https://www.youtube.com/watch?v=SnnmmKApT-c

Stop the buzz group discussion on light dependent reaction (photosynthesis I and II) and discuss light independent reaction in photosynthesis in the same buzz group. Use the following guiding questions.

- What happens in the light independent stage of photosynthesis?
- How the products of light dependent stage used for light independent stage?
- What are the products of light independent stage of photosynthesis?



https://www.youtube.com/watch?v=c2ZTumtpHrs

Show the overall reaction of photosynthesis indicated below

Photosynthesis Equation						
Carbon dioxide	+	Water	SUNLIGHT →	Sugar	+	Oxygen
$6CO_2$		$6H_2O$		$C_6H_{12}O_6$		$6O_2$

After completing your last buzz group discussion and learning theoretically, conduct laboratory activity on testing a leaf for starch, show that oxygen is produced during photosynthesis, and the need of light, chlorophyll and carbon dioxide in photosynthesis if there is laboratory in the training center, if not use the following video links/ virtual laboratory. NB. This is demonstration, may not replace practical activity.

Activity- Conduct a laboratory test for the presence of starch

https://www.youtube.com/watch?v=0s_xZqvwm_s

https://www.youtube.com/watch?v=E9CSyXS3pXc

https://www.youtube.com/watch?v=Uz7JnVUWCZQ

Activity- Oxygen production test

https://www.youtube.com/watch?v=cC49fbTCCDc

https://www.youtube.com/watch?v=3RBl3xqnCrc

Activity- Necessity of CO_2, light and chlorophyll for photosynthesis- Moll's half-leaf experiment

https://www.youtube.com/watch?v=tGXjUlg20jA

https://www.youtube.com/watch?v=R1YXMRdPOXw

https://www.youtube.com/watch?v=YtvyFOvbgu8

https://www.youtube.com/watch?v=sQK3Yr4Sc_k

Activity- Measuring rate of photosynthesis and drawing a graphunder different conditions with the help of Wilmott's bubbler

https://www.youtube.com/watch?v=epnwKqBDzGU

https://www.youtube.com/watch?v=W7t0p8ZLEjY

https://www.youtube.com/watch?v=3RBl3xqnCrc

https://www.youtube.com/watch?v=sMOn04HYRkE&t=5s

https://www.youtube.com/watch?v=id0aO_OdFwA

3. Explanation phase

After exploring, discussing and doing practical activities:

- each group should share what they discussed with respect to each stages of photosynthesis from light absorption to glucose/starch synthesis.
- During explanation phase, focus on the following points

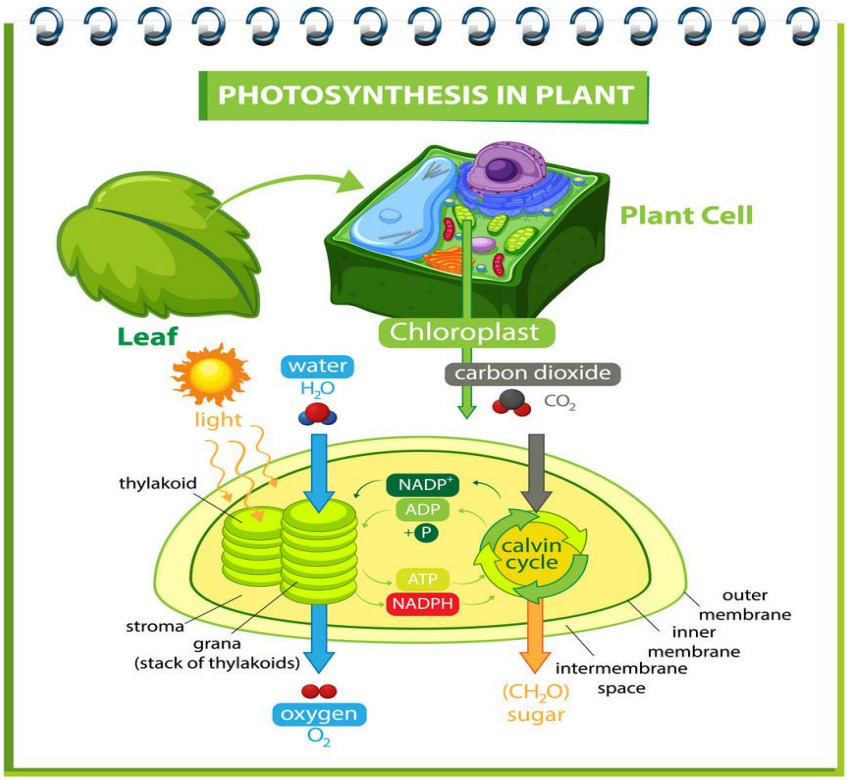
Light-dependent reactions

Goal	Convert light energy into chemical energy
Location	Chloroplasts—thylakoids
Input	Sunlight, H_2O, $NADP^+$, ADP
Output	NADPH, ATP, O_2

Light-independent reactions

Goal	Use stored chemical energy to "fix" CO_2 and create a product that can be converted into glucose
Location	Chloroplasts—stroma
Input	CO_2, NADPH, ATP
Output	$NADP^+$, ADP, G3P (Two G3P can be made into $C_6H_{12}O_6$)

Support your explanation with the figure below



While you are presenting and explaining, try to identify misconception if present.

4. Elaboration phase

In this phase, you are expected to

- reflect on misconception and conceptual understandings.
- Correct if the misconceptions are persistent and problems in conceptual understanding.
- apply you understanding of photosynthesis to real-life examples.
- analyze how environmental factors like light intensity or temperature can affect the rate of photosynthesis in plants.
- Create a 3D model of a chloroplast, chlorophyll and process of photosynthesis or draw diagrams illustrating both stages.
- Use online simulations to explore light-dependent and light-independent reactions.

5. Evaluation phase

After correcting the misconceptions and fulfilling conceptual gaps,

- Conduct a self- assessment- assessment as learning -–reflect on what they learned.
- Answer questions on photosynthesis, 5E instructional model, buzz group discussion and technological aspects related to the lesson.

Activity 2

Be in group and design a lesson on contributions of photosynthesis for continuity of life, O_2 and CO_2 balance and global warming based on the above example.

Key Ideas

- Green plants, algae, and certain bacteria use a process called photosynthesis to transform solar energy into chemical energy that is then stored as glucose (sugar).
- Sunlight is captured by chloroplasts' chlorophyll pigments.
- Plants absorb carbon dioxide from the atmosphere using microscopic openings known as stomata.
- The light-dependent reactions split water molecules into hydrogen ions (H^+) and oxygen (O_2).
- A sequence of enzyme-catalyzed steps fixes CO2 into glucose in the light-independent reactions.
- The byproduct is the release of oxygen.
- The overall mechanism of photosynthesis is the production of sugars that store chemical energy from carbon dioxide and water.
- Plant pigments known as chlorophyll absorb sunlight, and organelles known as chloroplasts are where photosynthesis occurs.
- During the light-dependent reactions, solar energy is captured and utilized to build sugars during the light-independent reactions.

Misconception

- Misconception: Photosynthesis is limited to daytime activities.
- True idea: in the absence of direct sunlight, the light-independent reactions (Calvin cycle) can take place.

Implications to teaching

- What new things did you learn from this session?
- How 5E instructional model and buzz group discussion method of teaching and technology will help you to teach other biology topics?
- How can you help your students benefit from this lesson in your school?

Takeaway resources

- Video link https://www.youtube.com/watch?v=RpTBm54pcvA,

https://www.youtube.com/watch?v=ArfEX-F7Xys

- model of instruction (5E) and lesson plan
- reading materials

Session 10.2: Teaching Cellular Respiration (4:30hrs)

Session Objectives

At the end of this session, the trainee will be able to:

- Explain concepts of cellular respiration.
- Compare glycolysis and Kreb's cycle stage of cellular respiration
- Compare aerobic and anaerobic cellular respiration
- Design a lesson using experiential learning model, buzz group discussionand specific technology to teach cellular respiration.
- Apply experiential learning modelandbuzz group discussionto teach process cellular respiration.
- Select and use specific technologies to teach the concepts of process cellular respiration.
- Identify misconceptions in learning process cellular respiration.

Activity

This activity is designed based on experimental learning model.

1. **Do**

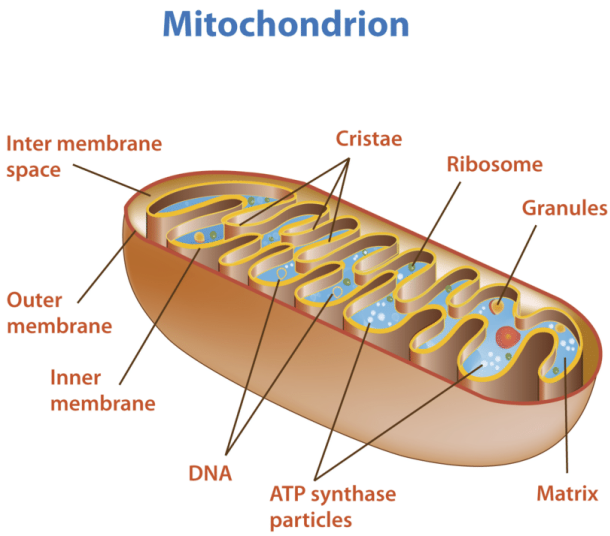
First think of and reflect on what you know about cellular respiration. Then, make small group and do the following using buzz group discussion.

1.1 Look at the following food items, discuss and answer the following questions.

- Why we eat?

- What is the importance of energy for living things?
- How organisms get energy?

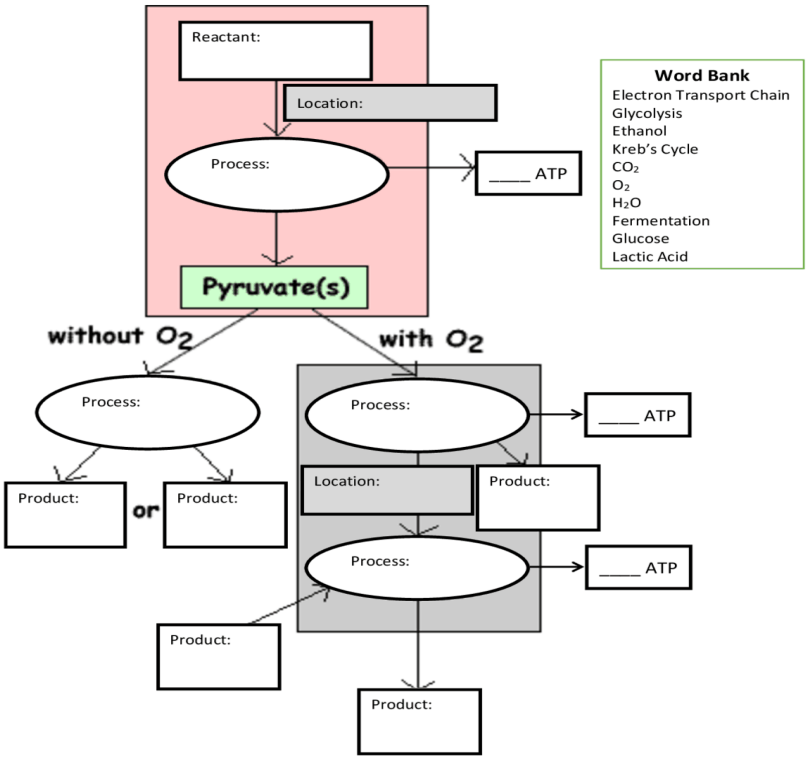
- What is the relation between photosynthesis and cellular respiration?
- Where cellular respiration does occur? Recall the structure of an animal cell.



Stop the first buzz group discussion and do the following in the same group.

1.2 Look at the following concept map and answer the questions.

- What are the stages of cellular respiration and what happens at each stage?
- What is the difference between aerobic anaerobic respirations?
- What is the role of mitochondria, glucose, ATP, NAD, FAD and Oxygen in aerobic and anaerobic respiration?
- Complete the following concept map using word bank and your experience in teaching cellular respiration.



Stop the buzz group discussion on concept map and show the following link video.

https://www.youtube.com/watch?v=q52qtdrvah8

https://www.youtube.com/watch?v=BDdIozBu3r8

2. Share

You should share what you did during your buzz group discussion focusing on why we eat food? What happens during glycolysis, Krebs cycle, electron transport chain? and the products of each stages in cellular respiration.

See animations of the glycolysis, Krebs cycle, electron transport chain, and ATP synthesis using the following links to support your understanding.

https://www.youtube.com/watch?v=BO0zL03CtDs

https://www.youtube.com/watch?v=zNpeuA4gtq0&list=PLI1XjFOSo4gOymAvlRs_8sSUH1BKKUiDA&index=4

https://www.youtube.com/watch?v=CSrtewCJbpg&list=PLI1XjFOSo4gOymAvlRs_8sSUH1BKKUiDA&index=5

https://www.youtube.com/watch?v=IlSFn0gRyC4&list=PLI1XjFOSo4gOymAvlRs_8sSUH1BKKUiDA&index=7

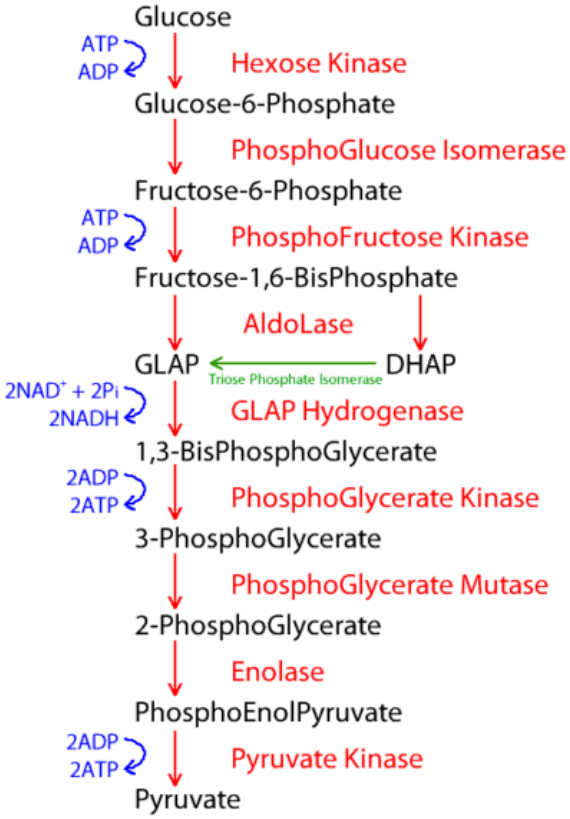
3. Process

Look at diagrams or models that illustrate the different steps of aerobic respiration and examine based on your experience, investigate and discuss in buzz group and explain the production of energy throughout the process of cellular respiration by doing the following activities.

- In a buzz group that you have used previously, do the following tasks on glycolysis, link reaction, Krebs cycle and electron transport chain.

3.1 Examining your experience and investigating glycolysis

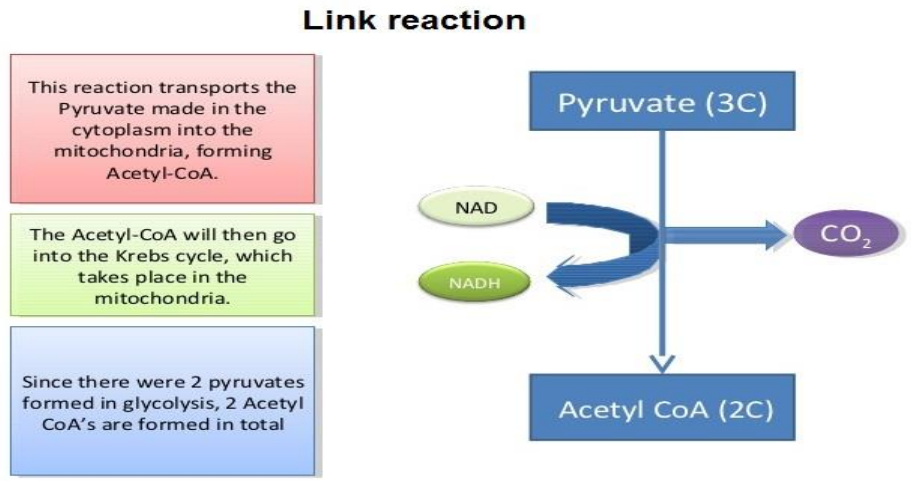
- Based on the following figure, explain what happens in the cytoplasm? What are involved in the reaction? Describe the role of all involved components. Identify input and output in the reaction.



- Stop the discussion on glycolysis and continue buzz group discussion on link reaction.

3.2 Examining your experience and investigating the link reaction

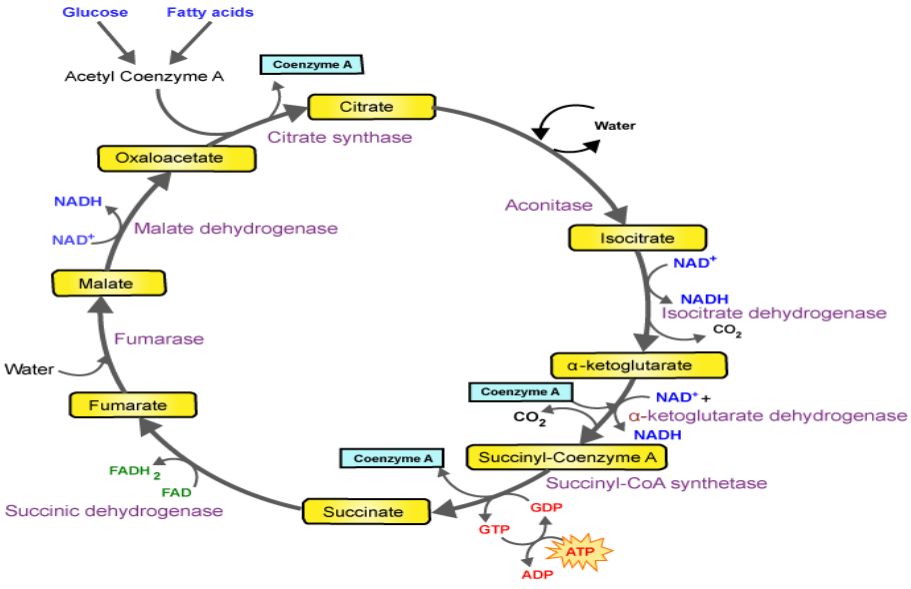
- Based on the following figure, explain what happens in the link reaction in mitochondria? What are involved in the reaction? Describe the role of all involved components. Identify input and output in the reaction.



- Stop the discussion on link reaction and continue buzz group discussion on Krebs cycle.

3.3 Examining their experience and investigating Krebs cycle

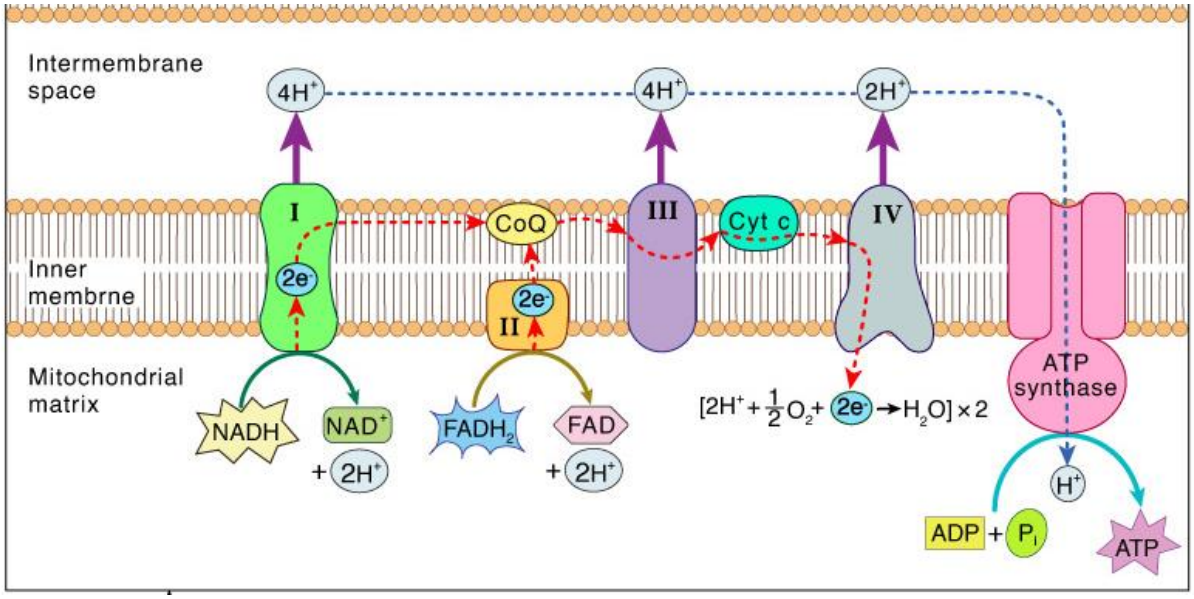
- Based on the following figure, explain what happens in the Krebs cycle in mitochondria? What are involved in the reaction? Describe the role of all involved components. Identify input and output in the reaction.



- Stop the discussion on Krebs cycle and continue buzz group discussion on electron transport chain.

3.4 Examining your experience and investigating electron transport chain

- Based on the following figure, explain what happens in the electron transport chain in mitochondria? What are involved in the reaction? Describe the role of all involved components. Identify input and output in the reaction.



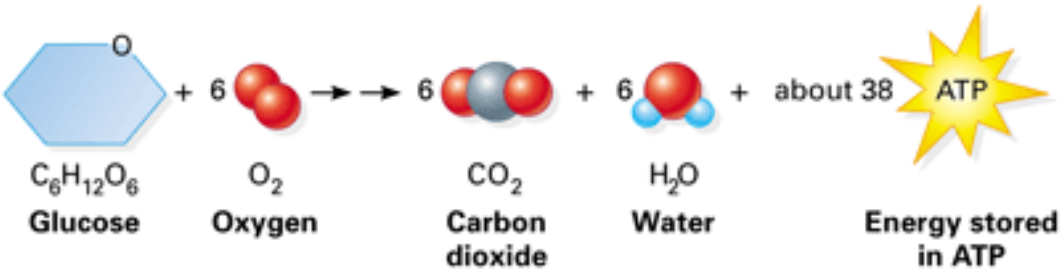
https://www.youtube.com/watch?v=we9CCApSPqg

4. Generalize

Summarize what you have discussed while doing the above tasks during buzz group discussion.

- Summarize overall process in whole class participation. Outline how **glucose** is broken down, how **ATP** is generated, and why **oxygen** is essential.

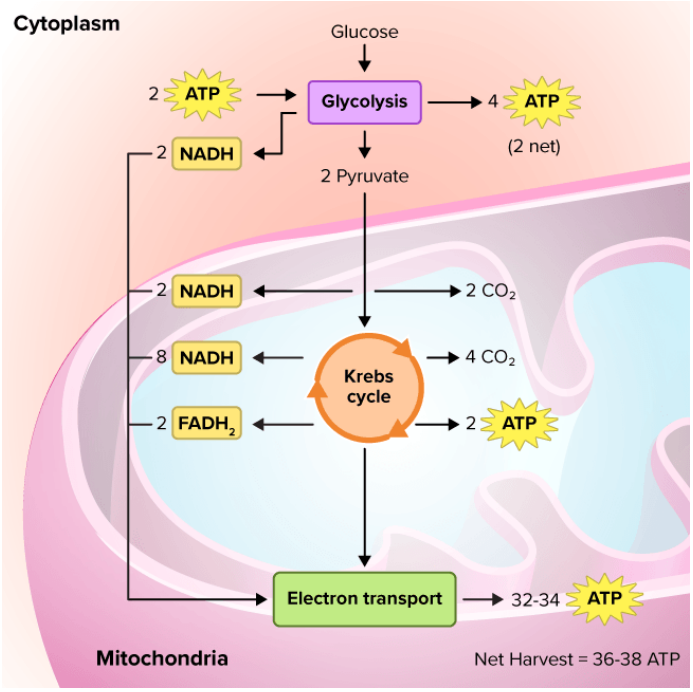
The overall reaction of aerobic cellular respiration is represented as follows.



- Note that ATP serves as energy currency for organisms.

- You can use **analogy method**. For instance - Energy stored in ATP is like money stored in your pocket as energy stored in lipid and protein is like money stored in commercial bank of Ethiopia.

You can use the following diagrams and table to summarize the whole lesson



Source	Carbon Flow	Substrate-Level Phosphorylation	Oxidative Phosphorylation	ATP Maximun Yield
Glycolysis	Glucose (6C) ↓ 2 Pyruvates (2C)	2 ATP	6 ATP from 2 NADH	8
Transition reaction	2 pyruvates (3C) ↓ 2 acetyl (2C)+2CO_2		6 ATP from 2 NADH	6
Krebs Cycle	2 acetyl (2C) ↓ 4 CO_2	2 ATP	18 ATP from 6 NADH 4 ATP from 2 $FADH_2$	24
Total	Glucose (6C) ↓ 6 CO_2	4 ATP	34 ATP from 12 NADH 2 $FADH_2$	38 ATP

5. Apply

Using the following scenariotoapply the knowledge gained in your day to day life.

Imagine you are a runner at the starting line, ready for a long-distance race. Your body is like a machine, and it needs energy to run. This energy comes from a molecule called ATP (adenosine triphosphate).

- How your body does prepare before race starts?
- What happens as you start running?
- What happens as you keep up running?
- What happens in the final stage of running?
- What is the role of cellular respiration in growth and metabolism?
- Why do you think your breathing rate increases during exercise?
- What might happen if your muscles run out of glycogen stores?
- How does the body deal with the lactic acid produced during intense exercise?
- What is the relation of cellular respiration with photosynthesis

Key Ideas

- The process by which cells convert glucose to adenosine triphosphate (ATP), the main source of energy for cellular functions, is known as cellular respiration.
- Glycolysis: A process that converts glucose to pyruvate that takes place in the cytoplasm.
- The Krebs cycle, also known as the citric acid cycle, occurs in the mitochondria and breaks down pyruvate even more.
- The electron transport chain, or ETC, is a component of the inner mitochondrial membrane that uses oxidative phosphorylation to produce ATP.
- The anaerobic process needs oxygen (O_2) in order to produce ATP efficiently.
- Our bodies use cellular respiration to transform glucose into ATP, which is required for muscle contraction during physical activity.
- Exercise intensity directly correlates with energy expenditure and the degree to which our cellular respiration processes must adapt.
- Cellular respiration is a basic process that keeps life going, not just a set of actions.

Misconception:

- A common misconception is the association between breathing and cellular respiration.
- Correct conception: Cellular respiration, which takes place inside cells and involves the breakdown of glucose, is different from breathing in that it supplies oxygen.

Implications to teaching

- What new things did you learn from this session?
- How experiential model and buzz group discussion method of teaching and technology will help you to teach other biology topics?
- How can you help your students benefit from this lesson in your school?

Takeaway resources

- Video link - https://www.youtube.com/watch?v=1RXk1NJpRDI, https://www.youtube.com/watch?v=j_3M70E9ciA, https://www.youtube.com/watch?v=JUmT24R8CyA, https://www.youtube.com/watch?v=hMK1-bgTAtQ,
- model of instruction (Experiential learning),
- reading materials cellular respiration

Unit Summary

- Energy transformation, also known as energy conversion, is the process of changing energy from one form to another. According to the **law of conservation of energy,** energy cannot be created or destroyed; it can only be transformed from one form to another.
- In everyday life, energy transformations are constantly occurring, such as when we eat food (chemical energy) and our bodies convert it into mechanical energy to move muscles and solar panels, which convert solar energy into electrical energy.
- **Photosynthesis** converts light energy from the sun into chemical energy stored in glucose in plants, algae, and some bacteria. It takes in carbon dioxide (CO_2) and water (H_2O), and produces glucose ($C_6H_{12}O_6$) and oxygen (O_2).
- **On the other hand, cellular respiration** converts chemical energy stored in glucose into usable energy in the form of ATP (adenosine triphosphate) in the cells of organisms of plants and animals. It uses oxygen (O_2) and glucose ($C_6H_{12}O_6$), and produces carbon dioxide (CO_2), water (H_2O), and energy (ATP).

- In short, photosynthesis stores energy by building glucose molecules, while cellular respiration releases energy by breaking down glucose molecules.
- Both processes are fundamental to the flow of energy through the biosphere.
- The 5E Instructional model is an active learning process, which consists of five phases: **Engagement, Exploration, Explanation, Elaboration,** and **Evaluation.** The model is designed to be student-centered, promoting inquiry-based learning and encouraging students to construct meaning while developing evidence-based explanations.
- The Buzz Group discussions method helps to engage participants actively to discuss specific problems or questions.
- The Experiential learning model is a dynamic process that emphasizes learning through action, reflection, and application, making it a powerful tool for deep and lasting learning.

Unit 11: Teaching Evolution (9hrs)

Introduction

This unit aimed at equipping trainees with in-deep understanding of concept related to evolution, theory of evolution and evidences. It deals with different theories of evolutions and available evidences and types of evolution and natural selection and appropriate pedagogies and technologies used to teach these biological concepts. The pedagogical approaches used in this unit are debate and group discussion with presentation.

Unit outcomes

After completing this unit, trainees will be able to:

- Explain concepts evolution.
- Describe theories of evolution.
- Analyze evidences of evolution.
- Design a lesson using appropriate teaching method and specific technology to teach evolution and related theories and evidences of evolution.
- Apply specific method and technologies to teach evolution and related theories and evidences of evolution.
- Identify misconceptions in evolution and related theories and evidences of evolution..

Session 11.1: Teaching Theories of Evolution (3hrs)

Session Objectives

At the end of this session, the trainee will be able to:

- Explain concepts evolution.
- Describe theories of evolution
- Design a lesson using debate method and specific technology to teach evolution and related theories.
- Apply debate method to teach evolution and related theories.
- Use specific technologies to teach the concepts of evolution and related theories
- Identify misconceptions in evolution and related theories.

Activity

This activity is designed based on debate method of teaching. Before engaging yourself in debate, answer the questions below.

- What do you know about evolution? How you had taught this topic?

After introduction on of evolution, make yourself ready to conduct a debate **For** or **Against** on the following topics.

Guide line to be followed

- Make two groups: one group representing the pro-evolution side and the other group representing the anti-evolution side (**For** and **Against**).
- Choose your roles in the debate.
- Be clear about the sources and kinds of evidence you want to use (e.g., a grade 12 text book, articles, case studies, videos) to support your claims.
- Actively participate in the debate, limit time on the debate's structure.
- Finally, all of you should comment on the topic and give vote to determine which side made the strongest argument with evidence.

Topics of debate could be

1. Evolution existed and organisms continue to evolve Vs evolution not existed and organisms continue to evolve

2. Creationism view Vs evolutionist view?

Assessment

Assessment will be based on your ability to communicate clearly, confidently, and cooperatively as well as your ability to work as a team and the quality of your arguments, evidence, and content reasoning.

Key Ideas

- Natural selection causes species to change over time, leading to the emergence of new species from pre-existing ones.
- There is only one common ancestor among all living things, and this origin accounts for the diversity of life.
- Better adapted characteristics increase an organism's chances of surviving, reproducing, and transferring their beneficial traits to offspring.
- There are different theories of evolution with their own evidences.

Implications to teaching

- What new things did you learn from this session?
- How debate method of teaching and technology will help you to teach other biology topics?
- How can you help your students benefit from this lesson in your school?

Takeaway resources

- Video link
  - https://www.youtube.com/watch?v=x73bsC7WIsE
  - https://www.youtube.com/watch?v=ccdXeaP1l_s
- Debate method sample
- reading materials evolution

Session 11.2: Evidence for Evolution (3hrs)

Session Objectives

At the end of this session, the trainee will be able to:

- Explain concepts of evidences of evolution.
- Distinguish between evidences of evolution

- Design a lesson using group discussion with presentation method and specific technology to teach evidences of evolution.
- Apply group discussion with presentation method to teach evidences of evolution.
- Use specific technologies to teach the concepts of evidences of evolution.
- Identify misconceptions in evidences of evolution.

Activity 1

This activity is designed based on group discussion and presentation. Before you are engaged in group discussion, answer the following questions individually.

What do you know about Evidence for Evolution?

Use the following procedure

1. Make 4 groups and each group should take over a different evidence of evolution to research as shown below.
   Group 1. Comparative anatomy
   Group 2. Embryology
   Group 3. Fossil record (Palaeontology)
   Group 4. Biochemistry
2. Introduce the topic of discussion to the group members.
3. Select a group leader and secretary of each group and starting discussion.
4. Discuss and explain the causes, symptoms and treatment mechanisms of the genetic disorder.
5. Present the result of discussion to the whole class.
6. Conduct over all reflection on presentations.

Use the following guided questions during discussions within each group.

1. How does these can be evidence for occurrence of evolution among organisms?

Assessment

After correcting the misconceptions and fulfilling conceptual gaps,

- Conduct self- assessment - assessment as learning - reflect on what you learned.
- Answer questions your trainer asks on evidence of evolution, group discussion method and technological aspects related to the lesson

Session 11.3 Teaching Types of Evolution (3hrs)

Session objectives

At the end of this session the trainees able to

- Define natural selection
- Explain types of evolution,
- Describe human evolution
- Differentiate between genetic drift and gene flow
- Use specific instructional strategies and technologies to teach the concepts of types of evolution
- Identify misconceptions in types of evolution

Activity

Be in group and design a lesson for teaching types of evolution, natural selection, human evolution, mutation, genetic drift and gene flow based on the above examples.

Key Ideas

- Fossils offer evidence of transitional forms and the gradual evolution of species.
- Common ancestry can be used to explain anatomical similarities between different species, such as the similarity in vertebrate bone structure.
- Strong evidence for shared descent and evolutionary relationships can be found in the genetic similarities and differences between species.
- The study of biochemical reactions and molecules, including DNA and proteins, has produced a wealth of data supporting evolution.
- Early developmental stages of several species' embryos have been found to share striking similarities, indicating a shared evolutionary ancestor.

Implications to teaching

- What new things did you learn from this session?
- How group discusion method of teaching and technology will help you to teach other biology topics?
- How can you help your students benefit from this lesson in your school?

Takeaway resources

- Video link - https://www.youtube.com/watch?v=CGFEJRjUh2g
- Group discussion with presentation
- reading materials evidences of evolution

Unit Summary

- **Evolution** is the process through which species of organisms change over time through successive generations. It is a cornerstone of modern biological theory.
- The **evidence for evolution** includes: **Fossil Records**, **Comparative Anatomy**, **Molecular Biology**, comparative embryology, **Biogeography and Observational Evidence**
- **The theory of evolution proposes that all species of organisms develop and change over time through a process called natural selection. There are different evolutionist theories and t**hese theories and evidences collectively explain the diversity of life on Earth and how species adapt and change over time.
- Debate Method involves a structured discussion between two opposing sides presenting arguments for or against a specific topic or proposition.
- Group Discussion involves a collaborative conversation among a group of individuals to exchange ideas, share perspectives, and reach consensus on a particular topic.
- Both the debate method and group discussion are valuable tools for engaging participants, exploring different viewpoints, and reaching informed decisions through effective communication and critical thinking.

Unit 12: TeachingHuman body systems (9hrs)

Unit Introduction

This unit aims at helping trainees to identify, design and use specific teaching method, technologies and locally available resources to teach the concepts of nervous system. The trainees are expected to define the nervous system and differentiate between the central nervous system (CNS) and peripheral nervous system (PNS), clarify the structure and function of neurons, the basic unit of the nervous system, describe the process of nerve impulse transmission, including the role of neurotransmitters, explain the concept of reflexes and their role in body functions and identify some misconceptions in these concepts of nervous system.

Unit outcomes

At the end of this unit trainees are able to:

- Explain the structure and functions of nervous system.
- Describe homeostasis.
- Explain the structures and function of endocrine system.
- Analyze the effects of drugs on functions of nervous system and endocrine system.

- Design a lesson using appropriate teaching method and specific technology to teach body systems.
- Apply specific method and technologies to teach human body system.
- Identify misconceptions in homeostasis, nervous system and endocrine system

Session 12.1: Teaching the nervous system (3hrs)

Session Objectives

At the end of this session, the trainee will be able to:

1. Define the nervous system and differentiate between the central nervous system (CNS) and peripheral nervous system (PNS).
2. Explain the structure and function of neurons, the basic unit of the nervous system.
3. Describe the process of nerve impulse transmission, including the role of neurotransmitters.
4. Explain the concept of reflexes and their role in body functions.
5. Design a lesson using appropriate teaching method, technology and locally available resources to teach the concepts of nervous system.
6. Identify misconceptions in these concepts of nervous system.

Activities

In this topic you should have to do the activities of teaching and learningby following Think-Pair-Share teaching method as presented below through collaborative work and use the following materials to make the teaching learning process more effective.

- Diagrams of the nervous system and neurons
- Videos or animations showing nerve impulse and transmission
- Reflex hammer for demonstration

1. Introduction

- Begin the lesson by group discussion on what the nervous system is and why it's important.

2. Think-Pair-Share Activity to teach types of the nervous system

Think: Think about the different types of the nervous system (central and peripheral) and their functions.

Pair: You should pair up to discuss your thoughts.

Share: Each pair has to share your discussion with the class.

Activity 1. Neurons and their functions

- **Think**: Think about what neurons are and their functions in the nervous system.
- **Pair**: Pair up to discuss your thoughts.
- **Share**: Each pair should share their discussion with the class.

Activity 2. Nerve impulse and transmission

- **Think**: Think about how nerve impulses are transmitted in the nervous system.
- **Pair**: Pair up to discuss your thoughts.
- **Share**: Each pair should share their discussion with the class.

Activity 3. Neurotransmitters

- **Think**: Think about what neurotransmitters are and their roles in the nervous system.
- **Pair**: Pair up to discuss your thoughts.
- **Share**: Each pair should share their discussion with the class.

Activity 4. Reflexes

- **Think**: Ask trainees to think about what reflexes are and how they work.
- **Pair**: Pair up to discuss your thoughts.
- **Share**: Each pair should share their discussion with the class.

3. Conclusion

- Summarize the main points of the lesson.
- Try to share one new thing you learned about the nervous system.
- You have to research a neurological disorder and prepare a short presentation on its cause, symptoms, and treatment methods.

After completing the session, apply your knowledge and relate to your day to day life,

- Observe and identify things in your surroundings (home, school, university, village) and study nervous system.
- The importance of studying nervous system.

Key Ideas

- The nervous system acts like your body's command center, sending messages throughout keeping everything in our system.
- Key parts: Brain & spinal cord (CNS): The processing center and information highway, receiving and interpreting signals. Nerves (PNS): The messengers, branching out to carry signals to and from the brain and body.
- Controls everything you do, from thinking and feeling to moving and sensing the world around you.
- The CNS and PNS work together. Sensory nerves bring information in, the brain processes it, and motor nerves send instructions back out.
- The nervous system allows for quick reflexes and responses to keep you safe and functioning.
- A reflex action is an automatic, rapid, and spontaneous response to a stimulus without conscious control.
- Some misconceptions of the nervous system
  - While it’s true that much of the brain appears gray, it’s not the whole story. The living brain in your skull is also white, black, and red. Gray matter exists throughout various brain parts, including neurons and other
  - Learning doesn’t directly cause new wrinkles in the brain. However, neural connections strengthen and adapt, leading to increased complexity and efficiency.
  - We only use 10% of our brains.but the fact is, while not every part of the brain is constantly firing, different areas are activated depending on the task at hand. We utilize far more than 10% of our brainpower for various functions.
  - The spinal cord only handles simple reflexes. But the spinal cord plays a crucial role in coordinating movement, relaying sensory information, and even some complex reflexes.
  - Intelligence is determined by brain size. While brain size does play a role, it's not the only factor. The structure, efficiency, and connectivity of neurons are more crucial for cognitive function.

- Left-brained people are logical; right-brained people are creative. While there is some lateralization of function (left hemisphere for language, right for spatial reasoning), both sides work together for most tasks.

Implications to teaching

- What new things did you learn from this session?
- How Think-Pair-Share method of teaching and technology will help you to teach other biology topics?
- How can you help your trainees benefit from this lesson in your school?

Takeaway resources

- Video link
- https://youtu.be/RNLceVI8jcc?t=13
- https://youtu.be/VAEmxt78bBI?t=5
- https://youtu.be/44B0ms3XPKU?t=12
- model of instruction (Think-Pair-Share teaching method),
- reading materials

Activity

Make four groups, each group take one topic from the following topics in your text book and design a lesson plan by using various appropriate teaching methods. Then discuss in groups, present it and share your knowledge to whole class.

1. Sense organs.
2. The endocrine system.
3. Homeostasis in the human body.
4. Substance and drug abuse and their side effects of on the normal functioning of nervous and endocrine systems.

Unit Summary

- The nervous system is a complex network of cells and tissues in our body.
- The nervous system plays a crucial role in controlling and coordinating bodily functions, responding to internal and external stimuli, and maintaining homeostasis.
- Functions of the nervous system involves:
    - Sensory input: Gathering information from sensory receptors and transmitting it to the CNS.
    - Integration: Processing and interpreting sensory information to make decisions.

- Motor output: Sending signals from the CNS to muscles and glands to produce a response.

- It is divided into two main parts: the central nervous system (CNS) and the peripheral nervous system (PNS).
  - Central Nervous System (CNS): Includes the brain and spinal cord, which serve as the control center for the body. The brain processes information received from the senses, initiates responses, and stores memories. The spinal cord carries messages between the brain and the rest of the body.
  - Peripheral Nervous System (PNS): Consists of nerves that connect the CNS to the rest of the body. It is further divided into the somatic nervous system (voluntary control of skeletal muscles) and the autonomic nervous system (involuntary control of internal organs).
- Neurons are the basic building blocks of the nervous system, transmitting electrical signals called action potentials. Glial cells provide support and protection for neurons.

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Part II – Educational Technology

Part II – Educational Technology

Introduction

This Educational Technology training manual is developed by EdTech Hub ET in collaboration with the Ministry of Education (MOE) to empower general education teachers to leverage technology effectively in their teaching and learning practices. Built upon the UNESCO ICT Competency Framework for Teachers (2018), MoE Digital Competency Framework and the TPACK model of technology integration as its conceptual framework, the manual provides practical guide on how to integrate technology in secondary school teachings. Further contextual factors have been considered, and several consultative workshops were conducted to develop the material.

This professional development resource aims at entrenching digital literacy in teaching and learning, equipping teachers, and learners with ICT skills, and enhancing their capacity to use technology in their day-to-day activities. Above all, it helps teachers to consider and use any locally available technologies for teaching and learning purposes.

The manual helps teachers and practitioners in secondary schools to practice creative use of technology in their classrooms. However, the material is not a comprehensive how-to guide, rather it provides initial possible strategies and practical exercises for schools to consider integrating technology in their lessons. Teachers are encouraged to further explore on EdTech subjects to have a detailed knowledge and skills in their efforts to leverage technology in their lessons through participating in continuous professional development activities.

The first unit of the material details educational technology related concepts, locally available digital resources and their practical implication at the school level. The second unit looks at the basic digital skills needed in our daily life which encompasses through navigating computer and smartphones, connecting to the internet, using the worldwide and web and google educational apps. The subsequent units' contents (units three through five) are intended to help teachers explore various digital tools and resources that will assist them in incorporating technology into their lessons. The emphasis has been on how to help teachers improve both subject knowledge and digital literacy simultaneously. Each unit's sessions feature practical suggestions for the classroom and out-of-school practices, as well as explorations of free web-based resources and activities for preparing. The final unit focuses on the safety and security procedures that should be implemented when using digital resources and working online to preserve teacher data and safety.

The module is suitable for both new and experienced general education teachers, offering comprehensive coverage of essential topics such as an introduction to educational technology, digital technology tools, open educational resources, and digital citizenship. To fully grasp the material, participants can expect to invest approximately two full days in face-to-face setting or two weeks of online teaching in completing the course.

Pedagogical Approach

The pedagogical approach employed in developing this module aligns with the experiential learning model**.** Learners actively engage with new information through a variety of interactive methods, including discussions, demonstrations, question-and-answer sessions, and other activities. These experiences serve as the foundation for their learning journey, providing concrete encounters that facilitate understanding.

After these initial experiences, learners enter a reflective phase. During this stage, they contemplate their encounters, draw connections to existing knowledge, and conceptualize the newly acquired concepts. Often, this reflective process leads to the understanding of the educational implication and development of novel ideas based on their experiences. Finally, learners are encouraged to engage in a self-assessment to measure and test their understanding and skills within their own context, reinforcing the learning process.

The sessions within this module are thoughtfully organized. They include a brief introduction to the topic, expected learning outcomes, specific activities, key ideas, implications for learning, and takeaways. Teachers are prompted to respond to key questions and note down activity points for future reference. Consider recording these insights in your portfolio using the provided handout. This structured approach serves as a quick reference for understanding digital literacy and its practical application in teaching and learning. The key ideas highlight essential information related to the topic, enabling educators to apply their learning effectively. Additionally, supplementary reading resources are provided for offline activities and further practice. Overall, this process reflects the experiential model of learning.

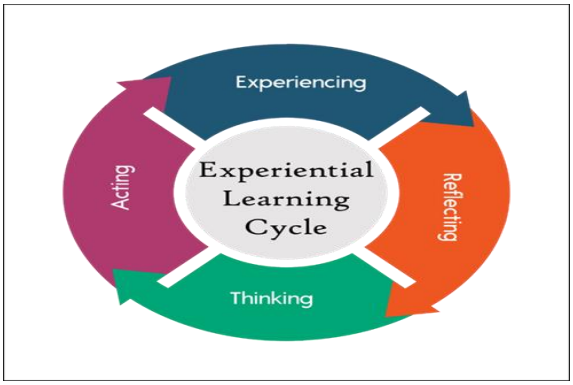


Figure 1: Experiential Learning Cycle; Source: Bing

Training Delivery Methods

In this digital skills training, we leverage a variety of online platforms to facilitate our sessions. Engaging in numerous activities across these platforms offers dual advantages. Firstly, it enhances the interactivity and user-friendliness of our training sessions. Secondly, it grants participants hands-on experience with diverse educational tools, which they can then seamlessly integrate into their teaching practices upon returning to their respective schools. Facilitators are advised to familiarize themselves with these digital tools in advance, ensuring a smooth guidance process for the participants. Facilitators are also required to complete the online EdTech course in advance as it enables them practice with different online training tools and the content of the training. A link to the online training is provided in unit five of this material.

Materials needed to during the Training

As a trainee, you'll require a copy of the trainees' guide (this document), a general lesson plan for each day and an accompanying PowerPoint slideshow to deliver this course. During the training, refer to the relevant slides in the manual. Many of the notes from the manual are also included directly in the slides. Ensure that participants have access to an internet connection for optimal course delivery. Some parts of the course will require participants to use a computer (PC or laptop) with a slideshow program and internet access. Encourage participants to bring tablets or smartphones. Ideally, all participants should have smartphones, but if not, at least one internet-connected tablet or smartphone should be available in each group setting, as practical exercises are an integral part of the course.

Before starting the course, create a working Telegram Group among participants. The group page will serve as our online dashboard for sharing documents and information. We strongly recommend utilizing all available digital resources during course delivery and minimizing paper use.

Learning Outcomes

After completing this module, you will be able to:

- Explain importance of educational technology and its applications their subjects.
- Design technology enhanced lesson plans that can address specific learning objectives.
- Take advantage of locally available digital tools to increase student engagement and active participation.

- Engage in different online and offline educational tools to enhance students' learning outcomes and professional development.
- Use digital resources safely and securely to ensure operational efficiency and data security.

Total Allotted Time to Each Unit (Face-to-Face)

S/N	Unit	Content	Number of Sessions	Allotted Time	Remark
1	One	Understanding Educational Technology	Two	1hr 5'	
2	Two	Basic Digital Skills	Two	1hr 10'	
3	Three	The use of social media for Education Purpose	One	1hr 25'	With practice
4	Four	Online Educational Tools	Three	3hr 20'	With practice
5	Five	Accessing and Creating Digital Content	Three	3hr 50'	With Practice
6	Six	Digital Citizenship	Two	1hr 10'	

UNIT ONE: UNDERSTANDING EDUCATIONAL TECHNOLOGY

Introduction

This unit provides you with a set of activities designed to explore the concept of educational technologies and digital literacy. It supports you to understand digital literacy in light of its implications for classroom teaching and learning. You will delve into the concept of educational technology and discuss its impact on how students learn and how you can teach. In addition, you will also explore any possible technologies available in their local areas. Further, it will enable you to explore the concept of Teaching and Larning Using Locally Available Resource (TALULAR) as a framework for identifying technology-based learning resources. This includes digital resources within your schools and towns, tech-savvy colleagues, and even relevant institutions. Think of this session as a springboard for seamlessly integrating technology into your learning environments.

Learning Objectives

At the end of this unit, you will be able to:

- Explore digital resources in your school and consider their use for teaching and learning activities.
- Explain the concept of educational technology and its application in teaching and learning practices.
- Identify key digital literacy skills and its implication for teaching and learning.

Key Topics

Session One: Locally available digital resources and their function

Session Two: The concept of educational technology and digital literacy

Session One: Locally available digital resources and their function.

Introduction

This session contains activities that are designed to provide you with an opportunity to explore any possible technologies available in your school and local areas. It will provide a useful starting point to think of using locally available digital resources in your classroom instruction and professional development. They will further explore the concept of TALULAR for technology-related learning resources. TALULAR is an acronym that stands for Teaching and

Learning Using Locally Available Resources. There are different technological resources available in your local context that can be used for teaching and learning. These resources might include any digital resource in your schools.

Activity 1.1. Individual Task (10 minutes)

Individually, list down all digital resources you might know and their possible uses in our daily lives. Consider how technologies are being used in your town, country, and the world at large.

NB: Use Slido/Menti.com to respond (your facilitator will give you a link to Slido.com or Menti.com). After all your peers share their answers on a link shared by your trainer a word cloud will be created as shown figure 1.

Facilitator Notes

Generate a link to https://www.slido.com/ or https://www.mentimeter.com/ and distribute it to participants. Then direct them to submit their responses via the chosen platform. They will also learn how to create word clouds and use the platforms by doing so. In the event of offline sessions or connectivity issues, provide participants with sticky notes to jot down their responses.

You can create a word cloud like the below one through different online tools like menti.com, kahoot.it, and other related apps. Step-by-step guidelines have been provided in the digital tools' session.

Figure 2: Word Cloud

Activity 1.2. Group Discussion on your digital experience (15 minutes)

In groups of four to six, share your experience of using digital content or resource in your classroom or elsewhere for teaching and learning purpose.

- What was the topic of your lesson?
- How you use digital content or digital resource?
- How do you prepare or from where did you get the content or the resource?

NB: Share your response to the wider team (whole class) through one of the interactive online tools or use a flipchart to share your group discussion.

Facilitator Notes

Provide participants with a link to an online collaboration dashboard, such as Padlet or Jamboard, and instruct them to post their group discussions on the platform. In cases of connectivity issues, participants may use a flipchart to present their discussions. However, they are encouraged to utilize digital platforms for their presentations to foster creativity. Emphasizing the educational benefits of technology, such as reducing paper usage, encourages participants to employ all available digital resources to disseminate their discussion outcomes. For instance, they could photograph their discussion and upload it to the Telegram group page. The facilitator can then display these images via a projector for the entire class to view.

Activity 1.3. Explore Digital Experience of a Teacher (15 minutes)

Case Story 1

At Sendafa Secondary School, Mr. Menberu, a dedicated physics teacher, sought to enhance student engagement through interactive learning. Despite resource constraints, his ambition to incorporate technology into his teaching led him to utilize locally available digital tools. Mr. Menberu identified several underused assets within the school, including desktop computers, plasma TVs, tablets, and his personal smartphone. Conversations with the school principal, Mr. Aman, and the ICT teacher, Mr. Naol, revealed that these tools could be effectively employed for educational purposes with minimal maintenance. Recognizing Mr. Menberu's enthusiasm, the school also provided him with complimentary Wi-Fi access to facilitate the use of online educational resources. To Mr. Menberu's surprise, he discovered that many students had access to smartphones and TVs at home. After assessing all available digital resources, he collaborated with Mr. Naol and his department colleagues to devise strategies for leveraging these technologies to make physics more engaging and understandable. Mr. Menberu's initiatives included:

- ✓ ***Establishing a Telegram group for his class to distribute educational content and maintain communication with students and parents.***
- ✓ ***Offering downloadable video lectures for students to view on any accessible device.***
- ✓ ***Encouraging students to engage with educational TV programs, providing them with specific channel recommendations.***
- ✓ ***Introducing students to physics simulations via the PhET app in the school's digital hub.***
- ✓ ***Utilizing the classroom's plasma TVs to display images and videos that complemented his lessons.***
- ✓ ***Creating PowerPoint presentations to further enrich his teaching materials.***

Mr. Menberu's Educational Technology use not only revitalized his physics lessons but also ignited a newfound appreciation for the subject among his students. The positive shift in student performance was evident, and his classroom soon became an exemplar for

fellow educators, inspiring them to harness the power of technology in their teaching practices.

Read case story 1 and reflect on the following questions based on Mr. Menberu's experiences:

- What did you learn from his approach to digital integration in his teaching?
- Identify the types of digital content/tools he discovered to aid his students' learning?
- What are the effects of Mr. Memberu's using of digital resources in his classroom?
- How can you apply his experience to your own teaching and learning context within your subject areas?

Session Two: The Concept of Educational Technology

Introduction

In this session, you will investigate various definitions of educational technology and interpret the concept through practices. You will also explore what does not constitute Educational Technology and address common misconceptions within the educational context. They will formulate their personalized definition of educational technology, having examined different concepts in the area. Finally, they will explore key concepts of digital literacy and their implication for teaching and learning.

Activity 2.1. Individual activity on myths about Educational Technology (10 minutes)

This activity helps trainees to identify and explore what is commonly referred to as digital literacy or educational technology but in actual teaching and learning, they are not. Post agree and disagree signs on the wall and read aloud the below sentences then ask participants whether they agree or not. Then, ask them why they agree or disagree.

Facilitator Notes

Read out the below statements one at a time and ask participants to agree or disagree giving reason for their choice. Alternatively, you can attach 'agree' and 'disagree' signs on the opposite walls and conduct the activity in groups. Participants need to have a clear understanding of the various concepts of educational technology particularly as they relate to teaching and learning practices.

Educational Technology

- Educational Technology is merely the ability to use digital technologies (disagree)

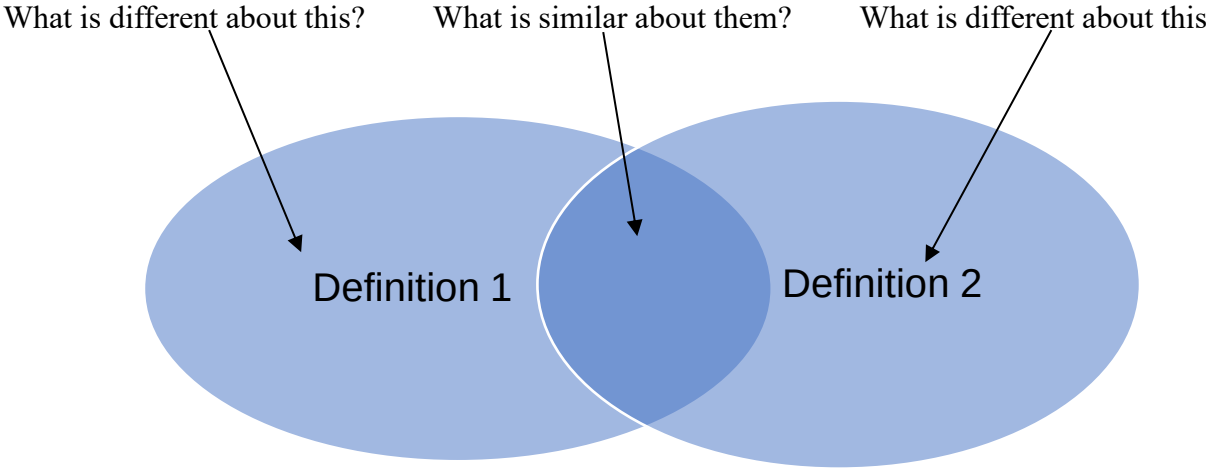
- Being able to understand how a tool works do not tell us how effect it is being used, or the value or purpose for which it is being used.

- Educational Technology is just a set of basic computer skills related to the use of hardware, software, and online resources (disagree). EdTech is the use of hardware, software, and online resources to improve students learning outcomes.
- Digital literacy includes the ability to use digital technology safely and securely (agree). But, while e-safety and security are essential aspects of digital literacy, this is far from the whole picture; it also encompasses the use of technology as methodology, assessment tools, classroom management and to access to digital contents.

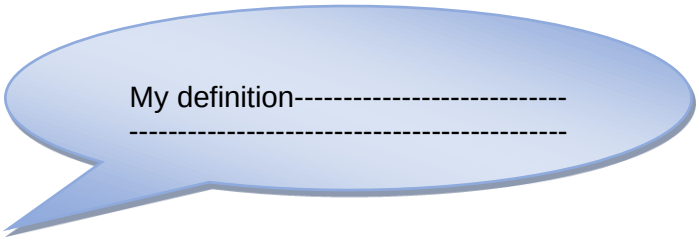
- The ultimate purpose of Educational Technology practices is to use different online and offline educational resources (disagree). The ultimate purpose of EdTech is to improve students' learning outcomes through using any available technology. We use technology not for the sake of using it, but only to improve learning outcomes.

Activity 2.2. Define Educational Technology (**Individual task 10 minutes)**

Individually go to the list of definitions in the 'key ideas' below, then choose two of the definitions provided, the one you are most drawn to and the one which you think is more related to teaching and learning. Then, compare the two definitions. Take the parts of each definition that make the most sense to you and write your definition of educational technology. Share your definition on https://jamboard.google.com/. A specific link to Jamboard will be provided by the facilitator. You might also share your definitions on Telegram group page.



Take the parts of each definition that make the most sense to you and write your own definition of educational technology.



Facilitator Notes

This activity provides practitioners with several definitions of educational technology and supports them to identify common futures among the definitions. They will review the definitions considering their usefulness in teaching and learning. Finally, they will develop their definition of digital literacy.

Key Ideas

In today's digital age, educators have access to a variety of resources, but it's essential to recognize that not all schools or educational settings have equal access to high-tech gadgets or sophisticated digital tools. In many cases, locally available resources play a crucial role in enhancing the teaching and learning experience. Traditional media such as television and radio remain relevant even in the digital era. For instance, Plazma TVs allow teachers to display visual content by project educational videos, animations, or slideshows to enhance explanations and engage students. Again, almost every teacher carries a smartphone these days, even including students. Teachers can use their phones to look up information on the spot, for capturing photos or videos during field trips or experiments and other activities as well. Besides, teachers might also consider using radios for audio-based learning and access to educational broadcast programmes. Similarly, teachers might consider using other digital resources to improve their teaching and learning practices. let's not overlook the value of familiar tools like TVs, radios, and mobile devices. By thoughtfully harnessing these resources, teachers can create dynamic and engaging learning environments that benefit all students.

Definitions of Educational Technologies

- Educational Technology is the use of technology in the instructional processes to enhance both teaching and learning.
- Educational Technology is the use of multimedia to create engaging, effective learning experiences.

- Educational technology is the use of available technological tools for pedagogical purposes and motivation.
- Educational technology is the l use of technology, such as computers, digital technology, and networked digital devices as well as theories for educational purpose in ethical way.
- Educational technology is the use of digital technology in teaching and learning as methodologies, classroom management, formative assessments, teachers' training, etc tools.

Implication to Teaching

Record your responses to the following questions as your key learning areas and future consideration on your handout.

- What did you learn about Educational Technology and how are you going to apply it in your practice?
- What digital resources are easily available in your school and how are you going to use them next year?
- What adjustment you would do to your practice to integrate technology into your lesson based on the above activities?

Self-Assessment (Unit One)

1. What is the acronym TALULAR and how does it relate to technology-based learning resources?
   A. Teaching And Learning Using Locally Available Resources; it helps identify technology-based learning resources
   B. Technology And Learning Using Local Applications; it focuses on digital literacy skills
   C. Teaching And Learning Using Advanced Resources; it emphasizes online educational resources
   D. Technology And Learning Using Global Tools; it highlights the use of international digital resources

2. What is the importance of digital literacy in navigating the digital landscape?
   A. It equips individuals to evaluate information critically
   B. It focuses on technical proficiency only
   C. It enhances personal and professional development
   D. It is a luxury rather than a necessity

3. How can teachers leverage digital literacy skills to enhance their teaching and learning activities?
   A. By accessing a vast library of online content

B. By collaborating with students on digital platforms
C. By sharing engaging resources
D. All of the above

4. What is the role of technology in our daily life?
   A. Technology is irrelevant in our daily routines
   B. Technology enhances connectivity and productivity
   C. We can live without technology
   D. Technology benefits only specific group of people

5. One of the following is very important to integrate technology into lesson?
   A. Level of advance of technology
   B. Availability of online resources
   C. Learning outcomes
   D. None of the above

Reference Materials

Type	Resources
Read	Making Teaching from Locally available resources
Read	We are Teachers online Resources
Read	Definition of Educational Technology
Watch	What is Digital Literacy?
Watch	Why Digital Literacy matters?

UNIT TWO: BASIC DIGITAL SKILLS

Introduction

This unit delves into basic digital skills such as basic organisation of computers, connecting to the intermate, using search engines, and email account creation. The sessions in this unit provides you an overview of the fundamental components of a computer followed by bridging the gap between your computer and the vast world of information. Mastering internet connectivity helps you to access a universe of resources at your fingertips. No exploration of the digital world is complete without harnessing the power of search engines. Here, you'll gain the expertise to navigate these powerful tools effectively, allowing you to locate information with precision and efficiency.

Finally, you will build the skills to create and manage email accounts, transforming them into valuable tools for communication with students, colleagues, and anyone in your professional network. You will also explore the role of email as a tool for teaching and learning.

Learning Objectives

At the end of this chapter, you will be able to:

- Identify different parts of computers and their functions.
- Use the Internet, the World Wide Web, and search engines.
- Create your own personal email account and start using it to improve your teaching and learning practices.
- Exercise using Google Educational Apps for classroom instruction.

Key Topics

Session One: Computers and Smartphones

Session two: Using Web Browser and Email

Session Three: Google Educational Apps

Session One: Computers and Smartphones

Both computers and smartphones are powerful tools that have revolutionized the way we live, work, and communicate. However, they have distinct differences in terms of functionality, portability, and

processing power. In this session, you will explore different parts of a computer and its function. Computers, including desktops and laptops, offer greater processing power and storage capacity compared to smartphones. They are ideal for demanding tasks like video editing, gaming, and running complex software.

Smartphones on the other hand, are small, portable devices that offer a wide range of features, including communication, entertainment, and productivity tools. They are powered by mobile operating systems like Android and iOS, and their processing power has significantly increased in recent years.

Activity 1. 1. Navigating Computer (Peer work – 15 minutes)

Take a moment to observe the computer or laptop you are currently using at school or plan to use in the future. Answer the following questions by discussing with your peer.

- What are the different parts of your computer/laptop/desktop? Categorize the hardware parts of the computer into input, process, and output devices.
- What do you do with your computer (Desktop or laptop) you bring with you or find at your schools?
- Are you using computers as teaching and learning tools in your teaching and learning? For what purpose did you use them in teaching and learning?

Activity 1.2. Navigating your phone (Think Pair Share – 10 minutes)

Mobile phones are emerging to be strong learning tools if used appropriately. Still, some educators believe that using cell phones might be a distraction in schools and classrooms as students might use them inappropriately. While still, this remains true, educators and teachers found that phones can be turned into learning tools by putting in place good school rules and policies. Phones have evolved over the years into powerful teaching aids that, when used appropriately, can improve learning outcomes.

Take a time to observe your phone's functions. Consider how you could use your cell phone to assist your students learn better in class. (Consider your local environment) What types of tasks can you complete with your phone as a teacher? Pair your answer with your peer sitting next to you, then share with the whole class what you both have discussed and matched.

Session Two: Using Web Browsers

In this session, you will explore the internet and its use to connect you with a global network which allows for communication and resource sharing across the world. World Wide Web, also known as the web, is a system which contains resources that are accessed through the internet.

The World Wide Web uses website sites to create virtual spaces on the internet where videos, files, images, and other digital resources are stored so that you can view, store and retrieve them.

Activity 2.1. Connecting to the Internet (Individual Practice – 5 minutes)

- How would you connect to the internet through your phone or computer?
- Using any digital device you have on your hand, please connect to the internet, and do something. And then show it to your friend or Facilitator?

Facilitator Note:

Conclude the discussion by mentioning that we can connect to the internet in different ways including through data on your phone, WIFI or cables. Wi-Fi is a wireless technology that enables electronic devices with wireless adapters such as laptops, mobile phones, TVs, and tablets to connect to the internet.

Activity 2.2. Using a Web Browser (Group discussion – 15 minutes)

In a group of four to six, engage in a discussion about the following questions:

Figure 3: Different Browsers

- What is a web browser?
- Which web browsers do you typically use?
- How have you utilized web browsers to enhance your teaching and learning processes?

NB: Share your response to the wider team (whole class) through one of the interactive online tools or use a flipchart to share your group discussion.

Activity 2.3. Use of Emails (Group Discussion – 10 minutes)

This activity introduces participants to email ultimately aiming at helping them use email as a communication tool.

Group Discussion (10 minutes)

In groups of four to six, discuss the following questions.

- What is email and how does it function?
- What are the benefits of using email in educational settings?

Figure 4:Email; Source@pixabay

- What are your current email habits and challenges? How often do you check your emails?
- With whom do you usually use emails and for what purposes?
- How can teachers use email for teaching and learning?

Activity 2.4. Create your email (Demonstration - 25 minutes)

Click on this (How to create a gmail account) and watch the video about email creation and then create your email. You can also follow the steps provided in the box below as you create your email. Once, you watch the demonstration, create at least two email accounts on Gmail and Outlook email platforms.

What to do:
To create gmail account follow the following steps.

- **Go to the Google Account sign in page.**
- **Click Create account.**
- **Enter your name.**
- **In the "Username" field, enter a username.**
- **Enter a secured password and confirm your password.**

What to do:
To create an Outlook email account, you need to follow these steps.

- Go to the Microsoft Outlook website and select Create free account.
- Click Get a new email address. You can choose between @outlook.com or @hotmail.com as your domain name.
- Choose a username that is unique and easy to remember. If your username is already taken, you will need to pick another one.
- Create a password that is strong and secure. You can use a combination of letters, numbers, and symbols.
- Enter your personal information, such as your name, birthdate, and country or region.

- Verify your account by entering the code that is sent to your phone number or alternate email address.

Activity 2.5. Send email messages (Individual Task - 15 minutes)

Now you have already created an email account, please send a message to at least five participants including your facilitator. Then in a group, reflect on the following questions:

- How do you find your experience? Was it difficult or easy?
- What are the common features you saw on the email page? List down all the features on the email page?

Facilitator Notes

Following participants reflection, please show them the main features on email page such as new email (compose new email), inbox, outbox, sent items, delete, etc.

Activity 2.6. Accessing and Navigating Google workspace

Google Workspace for Education provides free educational apps for students and educators. These tools cover various learning needs and include popular options like Google Docs, Sheets, and Slides for collaborative document creation; Google Classroom for managing online classes, Google Search for finding information, and Google Scholar for academic resources. In this activity, you'll learn how to access these tools easily. Later, we'll explore the use of some of these tools in more detail.

Figure 5: Google Apps

Open the Google Chrome website (Google website) and explore the page. Specifically, open the nine dots you see in the top right corner of the Google Chrome browser which represent the app launcher or app grid. When you click on these dots, it opens a menu that provides access to various Google apps. You can find shortcuts

to apps like Gmail, Google Drive, Google Form, and more. This is a convenient way to quickly access your favourite Google tools.

Demonstration- 20 Minutes

Use the following what to instruction and access different google apps using the app grid, Navigate the app, list different apps you accessed and state their function. Practice adding and removing different apps into the app launcher.

What to do:

Follow the below guide to access different Google apps either on your computer or phone.

- **Make sure you have a Google account: If you use Gmail, YouTube, or other Google services, you already have one.**
- **Open Chrome browser and go to a Google website.**
- **Log in to your Google account (if not already signed in)**
- **Look for the App Launcher icon: It's a grid of nine small squares, usually located in the top right corner of the webpage.**
- **Click on the App Launcher icon. This will display a list of various Google Apps you can access.**
- **Choose the Google App you want to use: Click on the icon for the desired app (like Docs, Sheets, Slides, Classroom, etc.) to launch it within the Chrome browser window.**

Facilitator Note (Optional): *Show participants a five-minute video taken from the reference section. Then ask participants to access google apps through app launcher or app grid on chrome/google website either through their phone or laptop. Give them some time (10 minutes) to do this.*

Key Ideas

Computers

Figure 6; Source @Google Image

A computer, typically positioned on a desk, is specifically crafted for individual use. It comprises various interconnected components, functioning as a cohesive unit. Computer hardware parts are categorised into three parts:

- Input Devices: These are the tools that allow you to interact with your computer. Think keyboards, mice, touchscreens, webcams, and microphones. How do you use these to provide instructions and information to your computer?
- Processing Unit: Imagine this as the brain of your computer. It receives your instructions from the input devices, processes them, and generates the desired results.
- Output Devices: These are the components that display the results of your computer's work. Monitors, printers, and speakers fall into this category. How do they translate the computer's calculations into a form you can understand and interact with?

Computers can be powerful tools that can revolutionize teaching and learning, offering a range of benefits for both students and educators. From providing access to information to fostering collaboration and developing digital skills, computers have become an integral part of the modern educational landscape.

Smartphones

Smartphones serve as powerful educational tools, providing a portable repository of information and interactive learning possibilities. Smartphones can be utilized both in the classroom and for personal learning for the following activities:

- Access to Information: Students and teachers can instantly tap into the vast internet resources for research, answering questions, and exploring new topics.
- Educational Apps: Numerous subject-specific apps cater to various age groups and learning styles. These apps offer interactive exercises, simulations, and engaging games.
- Collaboration Tools: Communication apps allow students to form study groups, collaborate on projects, and share ideas beyond the classroom.
- Creative Learning: Teachers can use smartphones to create educational videos, presentations, or podcasts, reinforcing their understanding and showcasing their learning.

World Wide Web and Browsers

The World Wide Web, commonly known as the web, is a vast system that houses resources accessible through the internet. Websites create virtual spaces on the web where videos, files, images, and other digital content are stored. As users, we can view, store, and retrieve these resources. Connecting to the internet via Wi-Fi, data, or cable allows our electronic devices such as laptops, mobile phones, TVs, and tablets to access this wealth of information.

As educators, the internet provides us access to information on nearly any subject matter. Whether you're researching, learning, or exploring, the web is a treasure trove of knowledge. Beyond information, the internet enhances our ability to communicate and collaborate with people worldwide.

Web Browsers

A web browser is application software that enables you to access resources and websites on the World Wide Web. Several popular browsers include Google Chrome, Mozilla Firefox, Apple Safari, and Microsoft Edge. These browsers operate similarly and share common controls. Once you master one browser, you'll find it easier to navigate others as well.

Email

Email (electronic mail) is the exchange of computer-stored messages from one user to one or more recipients via the internet. Emails are a fast, inexpensive and accessible way to communicate for business or personal use. Users can send emails from anywhere as long as they have an internet connection. Emails are a great way to communicate with colleagues, students, and parents, as well as to share information, resources, and feedback.

Besides communication, you need an email to access and use the majority of educational tools. Therefore, it is advisable for teachers to have two email accounts: one on Gmail and one on Microsoft. The Gmail account allows you to use Google's free products, while the Microsoft account enables you to access Microsoft's products.

Implication to Teaching

Please note down your reflections on the following prompts, which will serve as key takeaways and future action points:

- Reflect on the insights gained from the session, including any new abilities and knowledge acquired. How do you intend to integrate these into your teaching methods?

- Share your discoveries about the use of email. How do you foresee implementing email communication moving forward?
- List down at least five educational applications provided by Google.
- How would you intend to use different web browsers for educational purposes?

Self-Assessment

1. How does a monitor help you interact with your computer?
   A. It translates calculations into a visual form.
   B. It allows you to type instructions.
   C. It processes information.
   D. It stores data.
2. Smartphones can be used for educational purposes by:
   A. Restricting access to certain websites.
   B. Downloading social media apps.
   C. Providing access to educational apps and the internet.
   D. Making phone calls.

3. Web browsers allow you to access:
   A. Your computer's files
   B. Websites on the World Wide Web
   C. Only educational resources
   D. Video games

4. Which of the following is NOT a popular web browser in Ethiopia?
   A. Google Chrome
   B. Mozilla Firefox
   C. Microsoft Edge
   D. None of the above

5. Email is primarily used for:
   A. Storing documents online
   B. Sending messages electronically
   C. Playing games
   D. Watching videos

6. Why might a teacher need two email accounts (Gmail and Microsoft)?
    A. To separate personal and professional emails.
    B. To access specific educational tools.
    C. Because Gmail is free and Microsoft is not.
    D. There is no specific reason; one account is sufficient.

Reference Materials

Type	Resources
Watch	Components of Computer System
Watch	Usage of Smartphones
Read	Computer Organisation and Design Books
Read	Set up Google Workspace on an Android device - Google Workspace Learning Center
Read	Microsoft Support
Watch	What is Web Browser?
Watch	How to create email account on Outlook?
Watch	Google Workspace Beginner Guide

UNIT THREE: THE USE OF SOCIAL MEDIA FOR EDUCATIONAL PURPOSES

Introduction

In this unit, you will explore the possibility of leveraging social media platforms, specifically Telegram and Facebook, for educational purposes. These platforms offer a myriad of possibilities for enhancing teaching and learning experiences. By harnessing their features, educators can engage with students, foster collaborative learning environments, share resources, and facilitate discussions. Whether it's creating study groups, disseminating course materials, or encouraging peer interaction, these social media channels hold immense potential to enrich educational practices. Participants will explore strategies, best practices, and activities that demonstrate how these platforms can be effectively integrated into the teaching and learning process, ultimately contributing to improved learning outcomes.

Learning Objectives

At the end of this chapter, you will be able to:

- Explore the use of social media for educational purposes.
- Utilize social media platforms such as Telegram and Facebook to improve your teaching and learning practices.

Session One: Social Media for Educational Purpose

Introduction

In this session, we will explore the use of social media like Facebook and Telegram to facilitate communication between teachers, students, and parents. Using such platforms facilitate discussions, Q&A sessions, and announcements.

Social media can also liven up learning with interactive features like polls and quizzes, while sharing educational resources like videos and articles keeps students engaged. By integrating social media strategically in their teaching and learning, teachers can create a dynamic and engaging learning environment that fosters collaboration, critical thinking, and engagement

Activity 1.1. Using Telegram as Educational Tool (Group work – 10 minutes)

Figure 7;Source@Google Image

In group of four to six, discuss on the following questions.

- What are the benefits of using Telegram in educational settings?
- How can teachers use Telegram for teaching and learning?

Demonstration (20 minutes)

Use the following Instruction and create a Telegram group. Add your peers or contacts from you address book as a member. Please practice sharing questions, videos and create poll in your telegram group.

What to do:

Step 1: Create Telegram Account

- **Connect to the Internet/Turn on mobile phone data.**
- **Click on play store/App store.**
- **Download Telegram on your phone Step.**
- **Install Telegram application.**

Step 2: Form Telegram Group

- **Launch Telegram application.**
- **Select new group.**
- **Add your students by selecting from phone book.**
- **Name the group.**
- **Start posting learning materials in the form of images, documents or texts to the group.**

Facilitator Note

Create a group of four participants (group them by subject matter) and take them through the telegram app. Assist them to create group, post assignment, videos, create poll and complete other functionalities on the app.

Optional: Show them the five-minute video on the use of the Telegram app and then ask participants to create group, post assignment, videos, create poll and complete other functionalities on the app.

Activity 1.2. Using Facebook for educational purposes (Group Work - 10 minutes)

Facebook can be utilized for educational objectives in various ways, enhancing interaction, involvement, and a sense of community beyond the traditional classroom setting. By establishing private groups for your classes, you can encourage ongoing discussions, host question-and-answer sessions, and share educational materials outside of regular school hours.

Figure 8;Source Google Image

In groups of four to six discuss on the following questions:

- Do you have Facebook account? What is your experience of using Facebook?
- Have you used it for educational purposes? How Facebook will be used for educational purposes?

Demonstration (10 minutes)

Demonstrate how to create private groups on Facebook and then support your trainees to do the same in groups. Follow the below steps as you create closed group on Facebook.

Activity 1.3. Creating Group or Page on Facebook (Group Work - 30 minutes)

Use the following instruction and create a Facebook Group Page in your specific subject matter expertise and share relevant resources, initiate chat among your students, run live Facebook videos and complete other activities which you might think are relevant for your teaching and learning.

What to do:

- **Make sure you have a personal Facebook account.**
- **On your Facebook homepage, navigate to the "Groups" section if you want to open Facebook group or navigate to the “pages” section if you want to open Facebook page on the left-hand menu and click the ‘create group’ button on the page.**

- **Group Name: Choose a clear and appropriate name that reflects the class or subject.**

- **Privacy: Select "Closed" from the privacy options. This ensures only approved members can see the group's content.**

- **Description (Optional): Provide a brief description outlining the group's purpose and intended audience (e.g., students enrolled in Biology class).**

- **Start by inviting your students who have Facebook accounts (with parental permission if necessary). You can search for them by name or email address.**

- **As the group admin, you can approve membership requests, monitor discussions, pin important announcements, and manage content within the group.**

Key Ideas

Telegram

Telegram is a software used for communication and instant messaging and offers many possibilities such as sending various media files, in addition to making voice or video calls. The Telegram program can be used in education in many ways and means, some of which can be mentioned as follows:

- Send assignments, reading materials and tasks by students to the teacher.
- Create groups and channels for classroom.
- Create polls and quizzes
- Communicate with students from other school.
- Parents communicate with teachers to follow their children performance
- Provide e-content for the home side in the reverse learning strategy.
- Make video, audio and text announcement, lecture, and resources, etc.

Facebook

Teachers might also consider using Facebook for educational purposes in several ways, fostering communication, engagement, and community outside the classroom. You can create

private groups for your students to facilitate discussions, Q&A sessions, and sharing of resources beyond classroom hours. Through private group on Facebook, we will encourage the following activities among students.

- Collaborative Projects: Encourage students to work together on projects by using Facebook groups for brainstorming, sharing research findings, and coordinating tasks.
- Sharing Learning Resources: Post links to educational websites, articles, videos, or even create online document folders within the group for students to access relevant materials.
- Polls and Quizzes (informal): Conduct quick polls or quizzes (using third-party apps within Facebook) to gauge student understanding or gather feedback on topics.
- Announcements and Reminders: Share important updates, homework reminders, or upcoming events with the entire group or specific students through private messages.
- Virtual Field Trips and Events: Utilize Facebook Live or pre-recorded videos to share virtual tours of museums, historical sites, or connect with guest speakers remotely.
- Digital Citizenship Lessons: Facebook provides real-world context for teaching online etiquette, responsible content sharing, and critical thinking about information found online.

Important Considerations:

- Privacy is Key: Ensure groups are private and only accessible to students and parents/guardians with permission.

- Set Clear Guidelines: Establish ground rules for respectful communication and appropriate content sharing within the group.

- Parental Involvement: Keep parents informed about the group's purpose and encourage their involvement if necessary.

Additional Tips to create a Closed Facebook Group for educational purposes.

- Consider creating a separate Facebook account specifically for educational purposes, keeping it separate from your personal profile.

- Encourage students to add their full names for easier identification.

- Regularly post relevant resources and discussions to keep the group active and engaging.

Implication to Teaching

Please note down your reflections on the following prompts, which will serve as key takeaways and future action points:

- Reflect on the insights gained from the session, including any new abilities and knowledge acquired. How do you intend to integrate these into your teaching methods?
- Identify the features of Telegram that could be beneficial for educational activities?
- Outline your strategy for utilizing social media platforms like Facebook and Telegram to enhance educational experiences in the forthcoming period?

Self-Assessment

1. Telegram Group Engagement Task: Post a welcoming message on your previously created Telegram group page or channel. Here's a suggested greeting: "Welcome, students! This is our dedicated space for learning and growth. Let's embark on this educational journey together with enthusiasm and curiosity." Share the Telegram link with your facilitator and peers.
2. Facebook Interaction Task: Initiate a discussion on your Facebook page by posting a topic related to your subject discipline.

Reference Materials

Read	Social Media in Education
Watch	The Use of Telegram for Educational Purposes
Watch	The Use of Facebook for instruction
Watch	Social Media in Education

UNIT FOUR: ONLINE EDUCATIONAL TOOLS

Introduction

This chapter will empower teachers to leverage technology in their classrooms. You will explore a variety of online educational tools that are suited for diverse subjects and learners. The session in this unit will help you to develop the ability to select the most appropriate platforms and resources for specific learning objectives. Teachers practice how the tools might be used appropriately and incorporated into teaching and learning in a way that supports students in developing both subject knowledge and digital literacy. You will need internet access to practice these tools. But you are encouraged to critically analyse the tools in terms of developing critical thinking, problem-solving, analytical skills, etc among students. As you review each tool, please think about how possibly you apply them in your classrooms or outside all aims at improving learning outcomes.

Learning Objectives

By the end of this chapter, you will be able to:

- Identify different types of online educational technology tools that suits for teaching and learning.
- Select appropriate online tools and platforms for different purposes and audiences.
- Utilize communication, assessment and creative tools in their teaching and learning.
- Participate in online learning communities that foster digital skills among teachers, and other stakeholders.
- Utilize artificial intelligence tools during the preparation of lesson plans, assessments, and instructional materials.

Key Topics

Session One: Communication and Collaboration Tools

Session Two: Assessment Tools

Session Three. Creative Tools

Session One: Virtual Communication and Collaboration Tools

In this session, you will explore different communication and collaboration tools that help you facilitate online discussion and collaboration among students. These tools provide you with various functionalities such as live meetings, document sharing, collaborative works and many more tasks. In addition, you will explore possibilities of creating and managing your groups, and channels, share files and documents, and communicating with students.

Activity 1.1. Using Google Meet

Google Meet allows educators to easily connect and collaborate with students through links or codes, making it perfect for both planned lessons and quick discussions. This fosters remote learning by enabling online classes and virtual tutoring, regardless of location. Engagement is boosted through features like screen sharing and presentations. Google meet is accessible from both web browsers and mobile apps.

Figure 9. Google Meet; Source @Google Image

Question and Answer (5 Minute)

Could you share your experience and familiarity with Google Meet? Have you used it before or observed others using it? Have you participated in online meetings organized through the Google Meet platform? What was your experience?

Facilitator Notes:

Encourage participants to discuss their experiences with Google Meet. While it's not essential to pose every question listed previously, consider using them to guide the conversation and extract detailed insights regarding the participants' usage of Google Meet.

Demonstration (25 minutes)

Use the following instruction and demonstrate how to organize and schedule online meetings using Google Meet. Once you completed the demonstration, create your own instant meeting using Google Meet. Then allow share the meeting link with others/your peers and allow them to join the meeting and practice how you would potentially run an online meeting.

What to do: Starting a Google Meet Meeting:

There are two ways to start a Google Meet meeting:

1. **From the Google Meet website:**

- **Go to https://meet.google.com/.**
- **Click "New meeting."**
- **Choose an option:**
  - **Create a meeting for later: Get a meeting link to share and schedule the meeting for a specific time (optional).**
  - **Start an instant meeting: Join a meeting directly without needing a link beforehand.**
    - **You'll be the host of the meeting, and others can join using the meeting link or code.**

2. **From Google Calendar (if integrated):**

- **If Google Meet is integrated with your Google Calendar, you can schedule a meeting directly within Calendar.**
- **Create a new event or edit an existing one.**
- **Click "Add video conferencing" and choose "Google Meet."**
- **A meeting link will be automatically added to the event details.**
- **Invite participants to the event, and they can join the meeting using the link at the scheduled time.**

3. **Basic Controls During a Google Meet Meeting:**

- **Microphone: Mute or unmute your microphone by clicking the microphone icon.**
- **Camera: Turn your camera on or off by clicking the camera icon.**

- **Chat: Send text messages to other participants in the chat window.**
- **Screen share: Share your entire screen or a specific window with other participants.**
- **Presentation: Present content from your computer (slides, documents, etc.).**
- **Leave meeting: End the meeting for yourself (if you're the host) or leave the meeting as a participant.**

Additional Tips:

- **You can adjust your meeting settings (background blur, captions, etc.) by clicking on the three dots in the bottom right corner.**
- **Google Meet works on most web browsers and also has mobile apps for Android and iOS.**

Facilitator Notes

Please take few minutes to discuss about Google Meet and how to access the app with participants. While the trainees are trying to demonstrate and create an instance meeting or schedule using google meet please round about and assist them.

Activity 1.2. Group Discussion about your Google Meet Experiences (15 minutes)

Discuss the following questions with your group members.

- What are your thoughts on the app?
- In what ways do you intend to integrate Google Meet into your educational practices?
- Could you share your experiences with setting up and conducting an online session? Do you find Google Meet user-friendly?
- Would you be willing to take a lead in organizing concurrent online meetings via Google Meet within your department to facilitate the exchange of experiences and collaborative learning among your friends?

Activity 1.3. Exploring Padlet (Question and Answer - 10 minutes)

Padlet is a digital dashboard tool designed for online collaboration and information sharing. It works like a virtual wall where users can post various content, making it an asset in the educational landscape.

Figure 10;Padelt; Source @Google Image

- What is your experience of using Padlet as a teacher? Have you used the app before or seen others use the app for educational purposes?
- How can teachers use Padlet to foster collaborative and engaging learning experiences?
- What tasks are well-suited for an online tool like Padlet in educational settings or during instructional processes?

Facilitator Notes:

Encourage participants to discuss their experiences with Padlet. After the discussion, summarize the session with the below information about the use of Padlet for instructional purposes. Demonstrate how to set up a free padlet account and share the link with your trainees. Then ask each participant to write two personal goals on the link provided. Setting personal learning goals is an important way to guide your progress and set expectations for yourself throughout this course. write two personal goals you hope to achieve while taking this course. (Click on the + sign to write your personal goals)

Example of Personal Goals:

1. Learn about education technology and its use in classrooms

2. Practice different online educational tools

Activity 1.4. Practising using Padlet (Individual Task 15 minutes)

Using your mobile phone, create free Padlet account and use the Padlet as online presentation board to discuss a topic or assignment from your specific subject area (If your mobile phone is not functional; please work in pairs or groups).

What to do:

- **Go to https://padlet.com/ and create a free account with your email address or sign in if you already have one.**
- **Click on "Create a Padlet" button.**

- **Choose a layout for your Padlet (Wall, List, Stream, etc.) based on your content and purpose.**
- **Give your Padlet a title and description (optional).**
- **Click "Create Padlet."**
- **Click the "+" button on your Padlet to add content.**
- **Choose how you want to add content:**
  - **Text: Write directly on the Padlet.**
  - **File: Upload an image, document, or other file.**
  - **Link: Include a link to a website or resource.**
  - **Video/Audio: Embed a video or audio clip from YouTube, Vimeo, etc.**
- **Add a title and description to your content (optional).**
- **Click "Save" or press "Enter" to add the content to your Padlet board.**
- **Click the "Share" button in the top right corner.**
- **Choose a sharing method:**
  - **Copy Link: Share the link with anyone who has access.**
  - **Embed Code: Embed the Padlet on a website or learning management system.**
  - **Social Media: Share the Padlet on social media platforms.**
  - **Set privacy options for your Padlet (public, private, password-protected).**

Session Two: Assessment Tools

Introduction

In this session, we delve into a variety of online assessment tools designed to support teachers in the development of both formative and summative assessment questions for your classroom. Specifically, you will gain an understanding of diverse assessment tools and articulate their applications within an educational context. You'll also get hands-on practice with these tools, integrating them into your lesson planning. Additionally, you'll be guided through the process of creating accounts to access and utilize these various assessment tools effectively.

Activity 2.1. The use of Quizizz (Question and Answer - 5 minutes)

Figure 11;Source @Google Image

Quizizz is an online interactive tool to assign homework and provide feedback, present quizzes in the form of games and have a real-time understanding of students' academic progress.

- What is your experience of using QUIZIZZ as a teacher?
- Have you use the app before or seen others use the app for educational purpose or in a training setting?

Activity 2.2. Online live activity using QUIZIZZ (20 minutes)

How much do you know about Educational Technology? Run the below assessment using Quizizz platform (https://quizizz.com/admin/quiz/6403b3ddfe08dd001db7681d?source=quiz_share)

Facilitator Notes

During the session, ensure to comprehensively demonstrate the app's functionalities, including its ability to generate complete graded reports for each student and how to access and edit premade questions from Quizizz library. Additionally, acquaint participants with the various modes of conducting the session, such as the 'assignment' feature and the paper mode, to provide a thorough understanding of the app's functionality in different contexts.

Activity 2.3. Create your personal free QUIZIZZ account (Individual task - 15 minutes)

Use your mobile phone to create a free quizizz account and explore resources in your subject area (If your mobile phone is not functional; please work in pairs or groups). You can also download the app from Play Store or App Store for optimal use of the app.

What to do:

- **Go to https://quizizz.com and log in, or if you are a new user, click 'Get started' and create a new account by using your email address.**
- **To use an existing quiz, select the 'Search for quizzes' box and browse. If you want to create your own quiz, select 'Create a new quiz', enter a name for the quiz, and choose the relevant subjects. Choose a type of question and fill in the question, as well as answers.**
- **Add a title image if desired. Select the appropriate language and grade range and add tags to make it easier to search for.**

- **Either select 'Play live' or 'Assign HW' and choose the desired attributes. Then share the quiz with your students by sending them the link and 6-digit code.**
- **Students can go to https://quizizz.com/join, click 'Join a game', and type in the 6-digit code to participate in the live quiz or complete it at homework. Once the students are finished, the teacher can refresh the page to view the results.**
- **You can also access to several quizzes and assignments in the library. You just need to review the questions and use for yourself.**

Activity 2.4. Introducing Slido (Question and answer – 5 minutes)

Slido is the ultimate Q&A and polling platform for live and virtual meetings and events. It offers interactive Q&A, live polls and insights during your meetings/events. What is your experience in using slide for educational purpose or in any other setting?

Activity 2.5. Create free slido account (Demonstration - 15 minutes)

Using the following what to do instruction and create a free slido account and explore the different functionality of the app. Then, support trainees to create their accounts. After participants create their account ask them to design audience questions and provide answer links with their groups.

What to do:

- **To create slido account follow the below easy steps:**
- **Go to https://www.slido.com/Links to an external site.**
- **Sign up for free**
- **Start using slido**

Activity 2.6. Exploring Survey Collection Tools (Google Form)

From time to time, educators engage in research or action research to enhance their teaching methods and contribute to educational progress. Google Forms provides a convenient platform for creating online forms and surveys, complete with various question types. You can easily share these forms with your audience. Additionally, Google Forms facilitates result analysis, allowing you to gain insights from your audience's responses. Furthermore, it's a useful tool for preparing quizzes for your classroom.

Question and answer (5 minutes)

Have you used Google Form before? When did you use it and for what purpose? What was your experience in using Google Forms?

Create survey or quiz with Google Form (Demonstration - 20 minutes)

Follow what to do instruction given below and please demonstrate how to create a survey or quiz using Google Forms or you can show participants a demonstration video. Once you completed the demonstration, ask participants to do the following:

- work in pairs and prepare a quiz using Google Forms; share it with at least 10 participants and present the result of your survey with your group members.
- Prepare a short survey using Google Forms and share it with your facilitator and students, then present the result of the survey to whole class (As you prepare the survey refer your specific learning area or subject matter).

What to do:

- **Go to https://docs.google.com/forms in your web browser. You'll need a Google account to access it (same as Gmail or YouTube).**
- **Click the "+" button or choose "Blank form" to start from scratch.**
- **You can also choose a template for specific purposes like event registration or contact forms.**

- **Click on the "Untitled Question" box and type your question.**
- **Select the question type from the dropdown menu (multiple choice, short answer, checkbox, etc.).**
- **Customize the question further by adding answer choices, making it mandatory, or shuffling options.**
- **Drag and drop questions to rearrange their order.**
- **Add sections with titles to categorize related questions.**
- **Use images, videos, or descriptions to provide additional context.**
- **Click on the "Settings" tab to configure options like:**
  - **Who can access: Choose whether anyone can submit the form or require a Google account.**
  - **Collecting responses: Decide how to collect responses (one response per person or allow multiple submissions).**
  - **Quiz settings (if applicable): Set grading options, time limits, and feedback for quizzes.**
- **Click on the "Send" button to share your form. You can:**
  - **Copy and paste the link to share anywhere.**
  - **Embed the form directly on a website.**
  - **Send the form via email with a personalized message.**
- **All responses to your form are automatically collected in a Google Sheet.**
- **Access the sheet by clicking the "Responses" tab.**
- **You can view individual responses, analyze data with charts and graphs, and even export the data to other formats.**

Facilitator Notes

Support participants as they create their own survey/quiz. Encourage them also to share the form through varies platforms like Facebook and Telegram pages.

Activity 2.7. Practicing Using EvalBee Application

EvalBee apk.

1. Assume a mathematics teacher who teaches three sections of grade ten and two sections of grade eleven, for a total of five sections with an average of 45 students in each class. How long will it take the teacher to check a student answer sheet in an examination that encompasses 40 objective-type questions out of 50?

2.Using your smart phone download the Eval Bee android app from the Play Store, create account and Sign in. Then using the Instruction below practice using EvalBee Optical mark readers App.

What to do:

- **Go to google play or app store on your smartphone and download Evalbee apk or https://evalbee.com on web browser and create an account.**

Steps to create optical mark reader or recognition (omr)

- **Decide the roll number digits (Make it 2)**
- **Insert an exam set (exam codes).**
- **Decide Exam Sets (Codes) and**
- **The number of subjects Make it 1**
- **Write the subject name in the subject box**
- **Decide the number of types of items on the section box**
- **Insert type of the item in sections 1,2 and 3**

***Section 1* :- Replace it with I. True or False**

- **True or False items in section 1**
  - ✓ **Decide number of questions for True or False items**
  - ✓ **Decide possible options from question type box**
- **You can allow partial marks (if necessary)**

***Section 2* :- Replace it with II. Matching**

- **Decide number of matching items**
- **Decide possible options**
- **You can allow partial marks**

***Section 3*:- Replace it as III. Multiple Choice**

- **Decide number of matching items**
- **Decide possible options**

- **You can allow partial marks**
- **SAVE**
  - **Write class name e.g Grade 10**
  - **Exam Name:- Mathematics**
  - **Select Exam Date It is mandatory**
  - **Finally SAVE.**
  - **Once you set answer sheet click on exam**
  - **Go to Exam management**
  - **Click on Answer Key and set it**
  - **Finally Save it**
  - **Download and print the answer sheet**
  - **Administer the Exam**
  - **Scan each answer sheet**
  - **Go to report**
  - **Record the each student result**

Session Three: Creative Tools (Artificial Intelligence)

Introduction

Artificial Intelligence (AI) is a branch of computer science that deals with the creation of intelligent agents, which are systems that can reason, learn, and act autonomously. AI research has been highly successful in developing effective techniques for solving a wide range of problems, from game playing through enhancing services in varies sectors such as education, agriculture and health.

Activity 3.1. Understanding AI (Question and Answer -10 minutes)

- What is Artificial intelligence?
- Have you used it so far or seen while others use it for different purpose including teaching and learning?

Facilitator Notes

Show them AI videos on power point slides and provide highlight of the current development of AI globally. AI is bringing exciting possibilities to classrooms around the world. There are various AI tools available to help teachers with their tasks. We will explore some of the commonly used AIs in the below activity. As conclusion show the AI video on the power point.

Activity 3.2. Stream your task through AI (Gemini and Bing) Lecture – 5 minutes

Copilot/Bing and Bard/Gemini are the two popular apps easily accessible in Ethiopia for varies tasks. Copilot/Bing is developed by Microsoft and Bard is created by Google AI respectively. Both AIs focuses on generating text, translating languages, and answering questions in an informative way.

These AI tools can be a game-changer for teachers by:

- Simplifying lesson planning: Generate ideas, find relevant resources, and outline learning objectives with AI assistance.
- Crafting engaging assignments: Design interactive exercises, propose different question types, and personalize learning pathways for each student.
- Exploring innovative teaching methods: Discover new approaches to explain concepts, spark creativity in activities, and create a dynamic learning environment.
- Provide Educational resources such as images and videos for your lesson and other activities.

By harnessing the power of AI tools like Copilot and Bard, teachers can free up valuable time and focus their expertise on what matters most: guiding their students and fostering a love of learning.

Activity 3.3. Demonstrate how AI works for schools/teachers - 10 minutes

Demonstrate the use of Bing and Bard through performing the following activities:

- Prepare lesson plans, assessment questions and instructional resources for one of the subject matters using Bard?

- Prepare instructional resources for the above topic using Bing AI – ask the AI to provide you with pictures or simulation activities for the above topic?

Facilitator Notes

As you showcase the capabilities of AI, emphasize that it's incredibly user-friendly. Teachers can conveniently access the service via a mobile app, making it even more accessible. Encourage them to download the Bing app on their phones for future use.

Activity 3.4. Practicing the use of AI (Individual Activity - 20 minutes)

Go to Edge or Chrome browsers and use either Bing or Bard as you prepare your next week plan, please generate the following and share it with your group members.

- Lesson Plan for your next week classes.
- Assessment Questions for your next week classes.
- Ask Advise for Methodologies and Teaching aids you might use in your class.

Key Ideas

Communication and Collaboration Tools

Virtual classrooms can be transformed by online communication and collaboration tools, fostering richer educational experiences for students. Platforms like Google Meet, Microsoft Teams, and Zoom create virtual meeting spaces for live video sessions, real-time interaction, screen sharing, and even breakout rooms for focused group discussions.

These tools empower educators to conduct engaging lectures and discussions, address student queries, and facilitate collaborative projects where students can work together on assignments, share ideas, and develop teamwork skills. Additionally, inviting guest speakers from various fields becomes a possibility, enriching students' learning with diverse perspectives. Virtual field trips further broaden horizons, allowing students to explore museums, historical sites, or natural wonders from anywhere in the world. Assessment is also streamlined, with online quizzes, tests, and even oral exams conducted effectively.

Beyond video conferencing platforms, online tools like Padlet offer a dynamic digital canvas. Imagine a virtual bulletin board where students can brainstorm ideas, organize thoughts, create mind maps, share research findings, project summaries, and creative works. It's a space for

collaboration, visual presentations, and receiving peer feedback or reflecting on learning experiences.

Similarly, Jamboard, Google's interactive whiteboard tool, fosters a collaborative environment for drawing, writing, and brainstorming. Students can use it to visualize complex concepts, problem-solve across various subjects, dissect scientific phenomena through visual aids, or even create engaging storyboards. From brainstorming sessions to collaborative problem-solving and visual storytelling, these online tools unlock new possibilities for enriching virtual classrooms. Below are easy guide on how to use some of these tools.

Assessment Tools

Interactive tools like Quizizz gamify quizzes, transforming them into game shows with competition and immediate feedback. Google Forms offer versatility, allowing the creation of quizzes, surveys, polls, and even short-answer assessments, with easy data analysis for personalized learning. Slido and Mentimeter prioritize real-time participation. Students can submit questions, participate in polls, and contribute to word clouds, keeping them engaged in lectures and presentations. Finally, Kahoot! takes gamification a step further, turning assessments into fast-paced game shows where students compete for the top spot. These are just a few options that can create a more engaging and data-rich learning environment, fostering interactive assessment platforms.

Artificial Intelligence

The ultimate purpose of using AI in education should be to improve student learning outcomes. AI can be a powerful tool in this journey, but it's crucial to use it wisely. Here are some key points for teachers:

- **Supportive Partner, not a Substitute:** AI can assist with various tasks, from crafting lesson plans and designing exams to assessing student work and managing records. However, it shouldn't replace teacher expertise. Review and adapt AI-generated materials to fit your specific classroom context.

- **Combating Plagiarism:** Simply submitting student work generated by AI can lead to plagiarism. If you suspect AI use, consider using AI plagiarism detection tools to verify the originality of student responses.

- **Empowerment, not Automation:** AI is here to enhance, not replace, teachers. Be creative! Explore AI-powered apps to streamline grading and free up valuable time. This allows you to focus on what matters most: guiding your students and fostering a love of learning.

- **Strategic use of AI:** By using AI strategically and maintaining a critical eye, educators can leverage its potential to personalize learning, streamline processes, and ultimately, improve student outcomes.

- The Eval Bee application is designed to help teachers create and scan Optical Mark Recognition (OMR) answer sheets for objective types of examinations such as True or False, Matching, and Multiple Choice and generate result reports in real time by scanning the OMR sheet using their phone's camera. It is an Efficient App for Teachers that makes assessment Easy & Effective in No time. Creating answer sheet design in a few clicks, Scan answer sheets in real-time. Using Eval Bee allows the error-free scan and evaluation of printed OMR answer sheets through pre-trained AI and machine learning-based algorithms in real-time. This saves a lot of time and energy for teachers and makes it easy for students and parents to get quick evaluation results.

Implication for Teaching

Record your responses to the following questions as your key learning and future considerations on your handouts.

- What did you learn about communication and collaboration tools?
- What is your plan to communication and collaboration tools in your teaching and learning or any other related task in your school?
- What did you learn about online assessment tools?
- What did you learn about Artificial Intelligence?
- What is your plan to use AI like Bard and Bing in your teaching and learning or any other related task in your school?
- What new skills, experience, knowledge have you got?
- How would you like to apply the new skills in your subject teaching learning activities (consider also exploring anything you took as a learning apart from the platform)?

Self-Assessment

1. Which of the following is NOT a benefit of using online communication and collaboration tools in virtual classrooms?
   A. Streamlined assessment through online quizzes and tests
   B. Increased difficulty for students to brainstorm ideas
   C. Enhanced real-time interaction with teachers and classmates
   D. Broader learning experiences with virtual field trips
2. Platforms like Google Meet and Zoom primarily enable:
   A. Individual research and writing assignments
   B. Collaborative brainstorming and project work
   C. Accessing and reading online textbooks
   D. Taking timed multiple-choice quizzes
3. Jamboard, an interactive whiteboard tool, is most useful for:
   A. Conducting live video sessions with guest speakers
   B. Administering online polls and surveys
   C. Visualizing complex concepts and problem-solving collaboratively
   D. Providing individual feedback on written assignments

4. Which of the following statements accurately describes Quizizz?
   A. It's a tool for creating traditional written quizzes.
   B. It offers a game-show style format for assessments with immediate feedback.
   C. It's primarily used for conducting online surveys.
   D. It requires students to write code to answer questions.

5. Google Forms allows teachers to create all of the following EXCEPT:
   A. Multiple-choice quizzes
   B. Open-ended essay questions
   C. Live word cloud activities
   D. Short answer response assessments

6. The primary benefit of using tools like Slido and Mentimeter in the classroom is:
   A. To assign homework for students to complete independently.
   B. To facilitate real-time interaction and participation during lectures.
   C. To provide in-depth feedback on written assignments.
   D. To create static presentations for students to view at their own pace.

7. Which one of the following is true about Artificial Intelligence (AI) in education?
   A. AI will replace teachers altogether in the future classroom.
   B. AI tools like Gemini and Copilot will provide additional support to educators.
   C. AI is not currently relevant to the field of education.
   D. Students should be trained in AI development as the primary learning objective.

8. 8. Which one the following is not true about Eval Bee?
   A. It generates error free or 100% accurate reports
   B. Saves a lot of teachers time and Energy
   C. It has room for various fractional markings
   D. It has very limited contribution on avoid exam cheating

Reference Materials

Watch	Using Google Meet
Watch	Online Educational Communication Tools
Watch	The use of padlet for educational purposes
Watch	Online Assessment Tools for Teachers
Watch	The use of Quizziz for teaching and learning
Watch	AI for Educational Purposes
Watch	(690) HOW TO MAKE ANSWER SHEET IN EVALBEE - YouTube

UNIT FIVE: CREATE AND ACCESS TO DIGITAL CONTENTS

Introduction

In this chapter you will discuss on how to access, use, and create digital resources and contents for your teaching and learning. Digital contents can be accessed either online or through hard disks like CDs or flash cards. You will also cover different subject specific Open Educational Resources (OERs) and Ministry of Education digital library portals.

Learning Objectives

By the end of this chapter, you will be able to:

- Create engaging digital content using different platforms for your lesson.
- Explore basic Word and PowerPoint processers functions.
- Learn how to navigate the Ministry of Education's online library and find subject-specific digital resources that will enrich your teaching.
- Explore innovative ways to integrate digital content both for classroom and remote teaching.
- Access different subject specific Open Educational Resources (OERs) for their classes.

Key Topics

Session one: Create Digital Contents

Session Two: Access Digital Contents

Session Three: Ministry of Education Digital Libraries

Session Four: Open Educational Resources (OERs)

Session One: Digital Contents

In this session, you will comprehend about digital content and explore your digital content experience on how to access authenticated resources from online sources.

Activity 1.1. What is Digital Content? (Question and Answer - 10 minutes)

Discuss with the whole class on the following questions:

- What is digital content?
- Give examples of digital contents?

Facilitator Notes

Ask participants the above questions; the objective of this activity is to provide some general understanding of digital content among participants. Finally, conclude the session by mentioning that digital contents can be produced and accessed in various ways and it encompasses materials published, distributed, and stored in electronic formats, including text, voice recordings, video clips, photographs, and animations.

Activity 1.2. Exploring your digital content experience (Group discussion - 15 minutes)

In group of four to six, discuss the following questions:

- Share your experience of using digital content in your classroom?
- What was the topic of your lesson? How you used the digital content?
- Where did you get the content (source)?

Activity 1.3. A Teacher's Journey

Case Scenario 2: Enhancing Learning with Digital Content (20 minutes)

Scenario: Mrs. Almaz's Biology Class

Mrs. Almaz, an experienced biology teacher, is passionate about creating engaging and effective lessons for her students. She believes that integrating digital content can enhance learning experiences and foster student engagement. Here's how she approaches this:

Mrs. Almaz starts by identifying the learning objectives for her lesson. She considers why the topic is important for her students and how digital content can support those objectives. She selects digital materials that align with the curriculum and provide relevant information. For example, she might use interactive maps, videos, or online simulations to illustrate cell concepts from MoE digital Library or authenticated open educational resources such as Khan

Acadamy. Mrs. Almaz evaluates the quality and accuracy of the digital resources. She checks the credibility of the sources, ensuring that the information is up-to-date and reliable. Mrs. Almaz believes that active student participation is crucial. She chooses digital materials that encourage interaction, such as quizzes, polls, or virtual field trips.

She ensures that the chosen digital content is accessible to all students. She considers factors like internet connectivity, device compatibility, and any necessary accommodations. She provides alternative formats (e.g., transcripts for videos) to accommodate diverse learning needs. After the lesson, Mrs. Almaz seeks feedback from her students. Did the digital content enhance their understanding? Was it engaging?

In small group, discuss about the criteria Mrs. Almaz took into account when selecting digital contents for her lesson? List down all the consideration she has made.

Facilitator Notes:

During the discussion on factors to be considered during digital content selection, inform participants to refer to a similar exercise in Chapter one. As you conclude the discussion, emphasize that teachers need to assess digital content based on at least the following criteria:

- *Accessibility: Ensure that the content is accessible to all students.*
- *Relevance: Consider whether the content aligns with the learning objectives.*
- *Interactivity: Evaluate the level of engagement and interaction among students.*
- *Production Quality: Check for high-quality visuals, audio, and overall presentation.*
- *License Information: Be aware of the content's licensing terms.*

Session Two: Creating Digital Contents

Digital content can be considered as any type of media that exists in the form of digital data, including text, images, audio, video, and more. It can be accessed and distributed through electronic devices and online platforms. In this session you will learn different mechanism to create digital contents for your classroom instruction.

Activity 2.1. Preparing PowerPoint Slideshow

Slideshows are very good way to present information in a visually engaging way. They can be used for anything from showcasing visual display of teaching and learning materials to delivering a compelling presentation at work. In education, we don't use slideshow for only sake of presenting

information, rather the goal is to enhance the learning experience, not to overwhelm students with too much information or distract them with overly complex slides.

Questions and Answers (5 minutes)

What is your experience of using slides for teaching and learning? When did you use it? For what purpose? What was the challenge?

Lecture (10 minute)

Present the development of an educational slideshow (PPT). Creating a slideshow for teaching and learning purposes involves several key steps to ensure that the presentation is effective and engaging. Here's a guide to help you create an educational slideshow.

- Define the Objectives: Set clear learning goals for your presentation.
- Know the context: Understand the strengths, weaknesses, and needs of your students. Consider their age, language skills, accessibility and ability to interpret concepts.
- Plan Your Content: Think of what you want to put on your slide - tables, charts, diagrams, or timelines, etc.
- Design the Slides: Use a clean and simple design. Use your placeholder wisely.

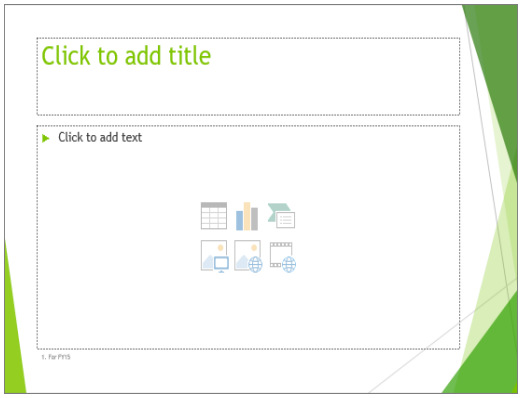


Figure 12. Placeholder

- Make It Interactive: Engage your students by incorporating questions, discussions, or problems to solve.
- Make it short: Don't overwhelm students with too much information or distract them with overly complex slides; use the general rule of 5/5/5. 5 words in each line, 5 lines in each slide, 5 text heavy slide on a subject.
- Practice and Delivery: Rehearse your presentation to ensure smooth delivery.

Demonstration (20 minute)

Demonstrate what you have explained. Open your slideshow, select a topic and create PowerPoint presentation; find an image and paste it as well. Add a caption to your image too. If you have time and think they are ready for it, you could show animation, design options and

other functionality for the power point at this point too. Design options on PowerPoint will suggest designs for your slide given what you have put on it already. Alternatively, you can also show participants a five-minute video.

Once you completed demonstration, ask participants to create their slideshow with text and images. They should make no more than 3-4 slides here. Give them some time (10 minutes) to do this. Additionally, please ask participants to **record** themselves while presenting the slideshow. After recording, they should share the recordings with their respective groups.

Activity 2.2. Using Google Slide to Create a Presentation (10 minutes)

If you don't have access to a laptop or desktop; you can create PowerPoint using Google Slides with your phone. Follow the following steps to download and create PowerPoint using Google slide.

Creating a PowerPoint presentation using Google Slides on your phone is a convenient option when you don't have access to a laptop or desktop. Here's a simple guide to get you started:

- Go to your phone's app store (Google Play Store for Android or App Store for iOS).
- Search for "Google Slides".
- Download and install the app.
- Open the Google Slides app.
- Sign in with your Google account. If you don't have one, you'll need to create it.
- Tap on the "+" icon, usually located at the bottom right of the screen.
- Select "New Presentation" to start creating your slides.
- Google Slides will offer you a variety of themes to choose from.
- Select one that suits the style and purpose of your presentation.
- Tap on the slide where you want to add content.
- Use the toolbar to insert text, images, shapes, and more.
- You can add new slides by tapping on the "+" icon near the slides preview.
- Your presentation will be automatically saved to your Google Drive.
- You can share it with others by tapping on the "Share" icon and entering their email addresses.

Activity 2.3: Using Word Processing (Question and Answer – 5 minutes)

Word processing software is a powerful tool used for creating, formatting, and editing various types of documents. Whether you're jotting down thoughts, taking meeting notes, drafting emails, or writing standard operating procedures word offer much more than the typewriters of old.

- How comfortable are you with word processing programs?
- How often do you use them?

Activity 2.4: Practice using Word (20 minutes)

Go to this link Basic Function of Word and explore how to create a text document. Then using a Microsoft word prepare a text document based on the guidance on the resource. Align your document with your subject discipline.

NB: As they create their worksheet, don't forget to practice using features like select, copy, paste, and other functions of the Word.

Activity 2.5: Using Google Docs to create a Word document (20 minutes)

Google Docs is an online word processor that lets you create and format documents and work with other people using Google Docs. On your computer or phone open Google Docs. You can access Google Docs through the nine dots on Chrome browser (Please refer accessing Google Apps in unit two).

Activity 2.3. Accessing Image for your instruction (Group Discussion - 10 minutes)

This activity focus on how to find and copy images from the internet to use in your teaching as a resource. This can be a valuable way to enhance your lessons and engage students. In group of four to six, discuss on the following questions:

- Where did we get images for our worksheets? Or when we need images for different instructional purpose?
- How do we copy images?
- Do we need to consider anything as we copied images?

Figure 13;Free Source of Images; Source @Google Image

Facilitator Notes:

Ask if participants have ever downloaded an image from the internet and where they sourced it from, with Google Images likely being a common response. Educate them on various platforms where teachers can access free and legal images, emphasizing the importance of looking for images with a

Creative Commons (CC) license. Mention that search engines like Google Images and Bing Images allow users to filter for CC images.

Highlight that platforms such as Pixabay and Unsplash specialize in providing free images. Additionally, introduce the Noun Project as a valuable resource offering free icons for various purposes, particularly beneficial for educators creating worksheets or presentations.

Guide participants on how to search for legally usable images on search engines like Google by navigating to the Usage Rights menu and selecting Creative Commons Licenses. This filter ensures that only images with the CC license are displayed.

Demonstration (15 minutes)

Do an example with Google Images, Unsplash, Pixabay and Noun Project. Take participants through the steps of copying images and use on a working document.

Group Work (15 minutes)

In group of four to six, ask participants to access images from one of the above sources for a lesson in their specific subject area. Let groups work on different source of image such as Bing AI image, Google Images, Unsplash, Pixabay and Noun Project at a time. Finally, allow them to present their result to the whole class. Ask them also to reflect on their experience.

Session Three: Open Educational Resources

Open Educational Resources (OERs) are teaching, learning and research materials in any medium that can be found in the public domain or have been released under an open license that permits no-cost access, use, adaptation, and redistribution by others with no or limited restrictions. Below are some educational resources for your consideration:

Subject specific open educational resources (OER) are learning materials that are tailored to a particular subject or discipline, such as mathematics, history, or engineering. They can include full courses, course materials, modules, textbooks, videos, tests, softwares, etc. Subject specific OER can help teachers and learners to find relevant and quality resources for their teaching and learning needs.

Some examples of platforms that offer subject specific OER are:

- https://oercommons.org/: A public digital library of OER that allows users to search and browse OER from various sources and subjects. Users can also create and publish their own OER using the Open Author tool.
- https://merlot.org/merlot/.A curated collection of free and open online teaching, learning, and faculty development services contributed and used by an international education community. Users can search for OER by discipline, material type, audience, language, and more.
- https://phet.colorado.edu/: Simulations and animations for STEM subjects.
- https://literacy.concordia.ca/en/: Resources for English Language.

Activity 3.1. How to Use OERs (Presentation/Lecture/ -10 minutes)

When we use resources from OERs, it is very important to ask ourselves the following questions:

- How does the content related to my learning outcomes?
- Who created the content? who is using the content?
- When was last updated?

It is also important to apply the 5R activities: retain, reuse, revise, remix, and redistribute as you plan to use contents from open educational resources.

- Retain a copy of an OER on your device or cloud storage for future use.
- Reuse an OER in its original form for your lesson, such as showing a video or assigning a reading.
- Revise an OER by modifying it to suit your needs, such as adding annotations, comments, questions, or feedback.
- Remix two or more OER by combining them to create a new resource, such as integrating a text with an image or a quiz.
- Redistribute an OER by sharing it with others, such as your students, colleagues, or online.

Group Discussion (20 minutes)

In small groups, review one of the examples of open educational resources provided in previous pages and explain on how to apply the 5R principles as you select content for your lesson.

Activity 3.1. Exploring Ministry of Education e-library Resources

Ministry of Education Ethiopia has established e-library for teachers and students to access relevant educational resources online through cloud technology. The e-library enable teaching and learning resources to be available online through computers and smart phones. Through this platform teachers and students will have access to approved resources for teaching and learning use.

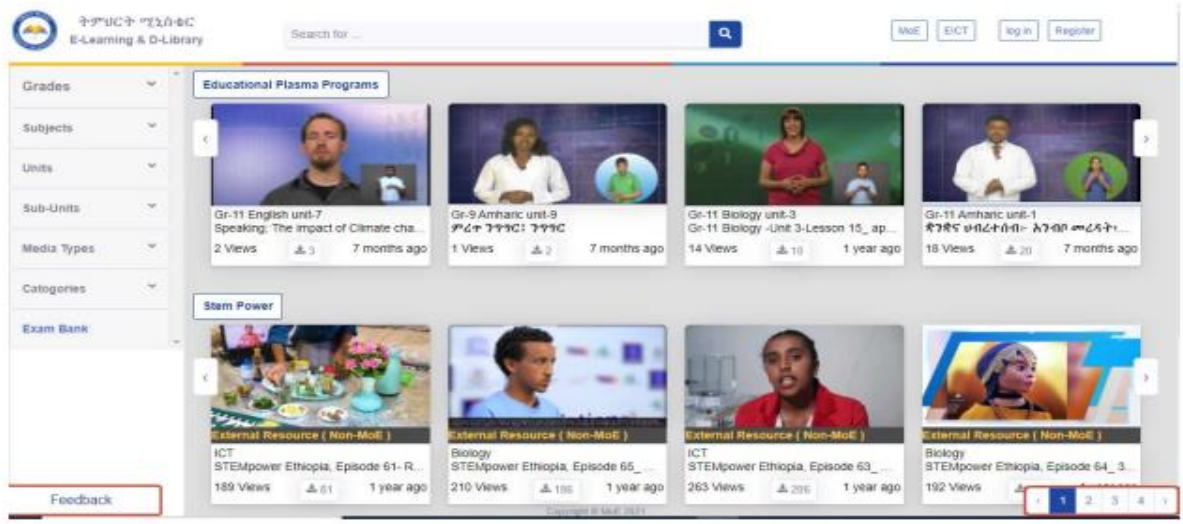


Figure 14. MoE Digital Library

Group Discussion (15 minutes)

In groups of four to six, discuss on the following questions:

- Have you ever utilized digital content from the MoE digital library portal?
- What specific topic or subject was covered in the lesson where you used digital content from the portal?
- Describe how you incorporated the digital content into your teaching.
- Was the content beneficial for enhancing your lesson?
- When selecting content from the portal, what criteria did you consider?

Demonstration (20 minutes)

Use the following what to do Instruction and Demonstrate how to access digital content from MoE Digital Library. Please select contents which are relevant to your subject matter area and describe to your colleagues on how you would use it in your lesson?

What to do:

Step 1: Go to: http://elearn.moe.gov.et.

Step 2: Select content of your choice based on grades, subjects, units, media types, and categories on the left side of the page.

Step 3: Use selected content for the work at hand.

Activity 3.3. MoE Learn English Platform (https://learn-english.moe.gov.et/)

MoE learn English platform is a free of charge or **zero rate** site for learning English language and skills. It offers various resources and activities for different levels of learners, from grade KG to grade 12. You can find videos, podcasts, and quizzes on topics such as grammar, vocabulary, pronunciation, listening, writing, and more. You can also create an account to access the site and track your progress. The site is developed by Ministry of Education Ethiopia in partnership with ethiotelecom. The site is updated regularly with new content and features.

Figure 15. MoE Learn English Website

Group Work – Review MoE Learn English Website (20 minutes)

In group of four to six, review MoE Learn English Website (https://learn-english.moe.gov.et/)

- What are your impressions of the site?
- Does it use zero rating or charge you for data usage?
- Are the contents useful and relevant for your teaching and learning?

Activity 3.4. Review Khan Academy Resources (https://www.khanacademy.org/)

Khan Academy is one of the examples of open educational resources that deliver high-quality educational content across multiple disciplines. This platform provides on its website, or on the Khan Academy's YouTube™ channel, an advanced learning analytics module with useful visualizations. The Khan Academy platform enables online courses in which lessons are produced in the form of videos, interactive activities, and challenges.

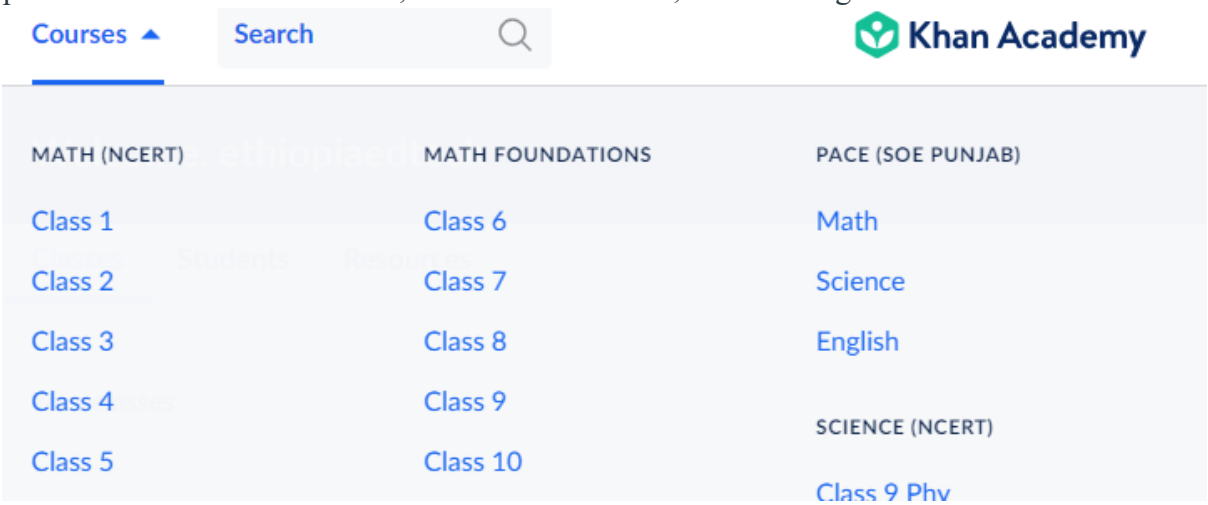


Figure 16. Khan Academy

Students can watch videos and solve supplementary practice exercises to understand various lessons and concepts more easily. Also, teachers can make use of Khan Academy to supplement the teaching process and provide extra content to learners to enhance learning.

Individual Task (15 minutes)

Go to https://www.khanacademy.org/ and identify content related to your subject area. Which content do you identified? How are you going to use the content to enhance learninig outcomes among students? How do you explain the whole experiences of accessing content from Khan Academy?

Activity 3.5. YouTube as Source of Educational Contents

YouTube is not open educational resources, but it can be a powerful tool for teachers to enhance their lessons and cater to different learning styles. Here are some ways teachers can leverage YouTube for educational purposes:

- Finding educational content: YouTube offers a vast library of educational videos on almost any subject imaginable. Teachers can find documentaries, lectures, experiments, simulations, and instructional videos created by educators or educational institutions.

- Visualizing complex concepts: Scientific phenomena, historical events, or abstract ideas can be brought to life through engaging and informative videos. This can be particularly helpful for students who learn better visually.

- Introducing new topics: A captivating and well-made video can spark students' curiosity and introduce a new topic in a stimulating way.

- Flipped classroom approach: Teachers can use YouTube videos for students to watch at home, freeing up classroom time for discussions, activities, and deeper exploration of concepts.

Additional tips for teachers using YouTube for Educational Purpose:

- Carefully curate content: Since not all YouTube content is created equal, teachers need to preview videos and choose those that are accurate, age-appropriate, and meet learning objectives.
- Consider copyright: Copyright laws apply to YouTube videos. Teachers should be familiar with fair use guidelines to ensure they are using content legally.
- Engage students with the video: Simply showing a video isn't enough. Teachers should prepare discussion questions or activities to help students process the information and connect it to the lesson.

Individual Task (15 minutes)

Go to YouTube and identify content in your subject matter for any topic you might think to explore further. Which content do you identified? How are you going to use the content to enhance learning outcomes among students? How do you explain the whole experience of accessing content from YouTube?

Activity 3.6. Exploring Digital Skills Training for Educators (EdTech 101 online course)

The EdTech 101 Course has been thoughtfully prepared as a complement to the face-to-face digital training. Its primary purpose is to allow educators (teachers, principals and supervisors)

to continue practising the use of digital tools and platforms once they return to school. In addition to the content covered during in-person sessions, this online course provides additional insights on how to seamlessly integrate digital technologies into teaching and learning practices.

The course is suitable for both new and experienced teachers, offering comprehensive coverage of essential topics. Participants will explore an introduction to educational technology, delve into various digital platforms, discover open educational resources (OER), and gain an understanding of digital citizenship. To fully grasp the material, participants can expect to invest approximately two weeks in completing the course. However, the flexibility of the course allows educators to take it at their own pace, anytime and anywhere that suits them. Based on their choice, teachers can also choose to focus on specific sections that interest them once they joined the course.

Join the training on Canvas with the following steps:

- **Open a Browser and Go to: https://canvas.instructure.com/enroll/CX4AC8**
- **Complete the Request Form**: Fill in the required information:
  - New user details (if applicable).
  - Full name.
  - Email address.
  - Agree to the terms of use.
  - If there's a Captcha form, complete it as well.
  - After submitting the form, you'll be directed to the course dashboard.
  - Here, you'll find information related to the training course.
- **Activate Your Account via Email**:
  - Check your email inbox for an activation email from Canvas.
  - Click the activation link provided in the email.
  - You'll be taken to a page where you can set your password.
- **Access the Course**:
  - Now that your account is activated, you can log in to Canvas using your email and the password you just set.
- **Mobile Access**:

- For convenience, you can also download the Canvas Student App from the App Store or Google Play Store on your phone.
- Use the app to attend the course on the go.

Individual task (45 minutes)

Get registered yourself on the course. Please follow the link provided to register for the course. Explore the course features, check your email, and activate your account using the activation email. Your facilitator will guide you through the registration process.

Key Ideas

Digital Content

Digital content can be a useful tool if teachers use it appropriately in improving learning outcomes among students. Digital tools might be employed in diverse ways to enhance learning experiences. One significant advantage of using digital content is its capacity to explain complex concepts in a more captivating manner. Teachers leverage interactive tools, simulations, and educational games to simplify the topic under discussion. Moreover, digital content facilitates differentiation, catering to students with varying learning styles and paces. Learners can revisit lessons and access supplementary resources online, fostering a self-directed learning environment. Additionally, digital content streamlines tasks for teachers—pre-made materials, online assessments, and grading software save valuable time, allowing personalized feedback to students.

Below are some of the factors we might consider as we select digital resources for our lesson.

- Learning outcomes: What knowledge, skills and attitudes do you want the learners to achieve? In fact, technology should not drive learning but rather the set learning outcomes.
- Age of learners: the technology tools to be used should consider learner development stage and their readiness to use it.
- Access to technology: What technology is available for use in the teaching and learning process.
- Learner centeredness: Does the technology chosen allow the learners to learn collaboratively on their own and can they be able to use it without depending on the teacher.
- Creativity and innovation: does the technology arouse creativity and innovation in the learners? Can the learners suggest other ways in which they can use the technology?
- Safety of learners: This should be a paramount importance especially when learners are expected to use online tools and resources.

- Teacher competence: How the teacher use the technology with confidence as he facilitates learning.
- Inclusiveness: technology instructional design should be accessible to all learners including those with special needs.

Images

Using visuals such as images play a crucial role in enhancing both teaching and learning. They capture students' attention, simplify complex ideas, and act as translators for abstract concepts. Thought-provoking images also stimulate discussions and critical thinking. For younger learners and those acquiring a new language, pictures bridge the gap between words and their meanings, reinforcing vocabulary acquisition. By incorporating a variety of visuals, teachers create an inclusive learning environment that fosters deeper understanding and a lifelong love of learning.

Power Points

Teachers and educators often utilize presentation tools like PowerPoint and Google Slides to create educational content for their students. These platforms allow them to save time and seamlessly incorporate various resources into their materials. Additionally, some educators choose to record their presentations using PowerPoint's recording feature, making it convenient to share with students for future reference.

Ministry of Education e-Library

Ministry of Education e-Library provides a wealth of educational content, most of them verified and approved. Access a variety of engaging formats to suit your learning style, including educational videos, audiobooks, and textbooks. Follow the below steps to access resources from MoE e-Library.

Open Educational Resources (OERs)

Open educational resources (OERs) are transforming classrooms by offering teachers a treasure of free and adaptable learning materials. These resources, which can include digital textbooks, interactive exercises, and multimedia content, empower teachers in several ways. Firstly, OERs tackle the issue of cost. By incorporating them, teachers can reduce the financial burden on students who might otherwise struggle to afford traditional textbooks. Secondly, OERs are incredibly flexible. Many come with open licenses, allowing teachers to modify and tailor them to their specific curriculum and student needs. This fosters a more personalized learning

experience. Additionally, OERs can tap into the power of collaboration. Teachers can share and adapt resources developed by colleagues around the world, promoting innovation and the exchange of best practices. Ultimately, OERs empower teachers to create dynamic and engaging lessons that cater to diverse learning styles, all while promoting a more equitable and accessible learning environment for all students.

Implication for teaching

Record your responses to the following questions as your key learning and future considerations on your handouts.

- What did you learn about digital content and how are you planning to use them in the future?

- What is your plan to use images from different sources for your teaching and learning or any other related task in your school?
- What is your plan to use slideshow presentations in your teaching and learning or any other related task in your school?
- What did you learn about MoE e-Libraries and Learn English platforms?
- What are Open Educational Resources and How are going to use them going forward?
- What is your plan to use MoE Digital Library and Learn English Platform for your teaching and learning or any other related task in your school?
- How are you going to encourage your students to access the MoE digital libraries and other OERs?
- What did you learn about Khan Academy and YouTube?
- How are you going to encourage your students to access digital content from YouTube and Khan Academy Sources?

Self-Assessment

1. What is one significant advantage of using digital content in education?

   A. It saves teachers time by automating grading.
   B. It fosters self-directed learning among students.
   C. It replaces traditional textbooks entirely.
   D. It simplifies complex ideas through interactive tools.

2. How do images enhance teaching and learning?

   A. By providing pre-made materials for teachers.
   B. By bridging the gap between words and meanings.

C. By automating assessments.

D. By replacing traditional textbooks.

3. Which presentation tools are commonly used by educators?

   A. Google Sheets and Excel

   B. PowerPoint and Google Slides

   C. Word and Notepad

   D. Prezi and Keynote

4. How can teachers create a PowerPoint presentation using Google Slides on their phones?

   A. By downloading the Google Slides app and signing in with their Google account.

   B. By using a laptop or desktop computer.

   C. By searching for "Google Slides" in the app store.

   D. By selecting a theme from a variety of options.

5. What does the Ministry of Education e-Library provide?

   A. Free laptops for students

   B. Educational videos, audiobooks, and textbooks

   C. Online assessments

   D. Grading software

Reference Materials

Read	Importance of Using PowerPoints and Word as a Teacher
Read	The Basics of Word
Read	The Basics of PowerPoints
Watch	How to use Google Docs and Slides
Watch	Creating Quality Digital Contents
Read	Best Practice for Teaching with Digital Content
Read	How to use image effectively in your lesson
Read	Why Should I use OERs?
Watch	Impactful use of OER
Read/Watch	http://elearn.moe.gov.et.
Watch	https://learn-english.moe.gov.et/
Read	How to join online course on Canvas

UNIT SIX: DIGITAL CITIZENSHIP

Introduction

In this chapter, you will discuss about safe use of technologies such as mobile phone, computers, tablet, and the internet. Specifically, you will discuss on risks in connection with internet use and safety measures.

Learning Objectives

By the end of this chapter, you will be able to:

- Explore safe and responsible behaviour in using internet and communication technologies.
- Explain the risks associated with using the internet and communication technologies.
- Contextualize e-safety rules and guidelines for their schools.

Key Topics

Session One: Internet Risks and e-Safety

Session Two: Computer and Smartphones Safety

Session One: Internet Risks and e-Safety

Activity 1.1: Exploring the concept of e-Safety. Think Pair Share (10 minutes)

What is e-Safety? With what concept or term does e-Safety connected?

e-Safety is often synonymous with online, or internet safety and it is concerned with being safe and appropriate use of technologies without compromising personal security and safety.

Activity 1.2: Unpacking Risks Associated with Internet

Group Discussion (15 minutes)

Students are often unaware of the potential danger in relation to internet and are susceptible to unsafe online behaviour. Now, in group of four to six, discuss on potential e-Safety risks. After you finish your discussion, share with your facilitator on any convenient platform for you.

Activity 1.3: Exploring e-safety risks.

Group Discussion (15 minutes)

In small groups, discuss on the following potential e-safety risks. (Each group might discuss at least on two of the risks mentioned below). Then, prepare online presentation using Google Slides or any convenient platform and present for the whole class.

1. Social Networking Risks
2. Age restrictions
3. Sharing Online profiles/Security risk
4. Publishing content
5. Uploading Photos and Videos
6. Cyberbullying
7. Copyright
8. Exposure to inappropriate online content
9. Excessive time online

Activity 1.4: Fake News

Being online exposes children to number of fake news and unverified information which put them and even others to risks of different kind.

Whole class discussion (5 minutes)

- What is fake news? what is news?
- Give examples of fake news on digital platforms?

Facilitator Notes

- ***News*** *is factual information about a recent event that is new to people and will be of interest to them.*
- ***Fake news*** *is lies and/or propaganda told for a political or commercial purpose and influence millions of people. It's often deploying through digital technology, social media, news networks to go viral and reach people very quickly.*

Activity 1.5: Fact, Opinion and Fake news

Whole class discussion (10 minutes)

- What is the difference between facts and opinion?
- Give some examples of facts, opinion and fake information on the similar topic?

- How can we help students to differentiate between facts, opinions, and fake information?

Example of Fact and Opinion

- **Fact:** Ethiopia is one of the Country in East Africa.
- **Opinion:** Ethiopia will soon become middle income Country.
- **Fact:** Abebech Gobena has provided education opportunity for many Ethiopians through her NGO.
- **Opinion:** Abebech Gobena is a well-remembered person in Ethiopian philanthropy work. Fact: Addis Ababa is the capital of Ethiopia.
- **Opinion:** Pollution is the main problem facing Addis Ababa.

Media Detection questions

Always encourage your students to ask themselves the following questions as they come across media contents.

Figure 17. Media detection questions

Activity 1.6: Adopting e-Safety rules for your school

Group Discussion (15 minutes)

Do you have e-safety rules at your school? In small group discuss on possible e-Safety rules for students and teachers in your school. Then, post your answers with your group name on top of it on one of interactive platforms.

Facilitator Notes: Basic e-safety rules

Social networking poses little risk if students follow basic e-safety 'rules' such as:

- *keeping personal information private*
- *respecting the rights and feelings of others*
- *Stick to the given assignment (importance of providing specific links)*
- *thinking about the long-term consequences of what you post online*
- *reading and adhering to the terms and conditions of use*

Session Two: Computer and Smartphone safety

Activity 2.1. Using Computer and smartphones safely (15 minutes)

Make a group of four to six members and discuss on the following issues.

1. How do you give care and protect your devices from malfunctioning and break?

2. What safety measures due you take to protect and secure your devices from an allowed users, virus and cyber-attacks?

Key Ideas

Internet Risks

The following are common internet risks that we should be aware of and also educate our students.

- ***Social Networking Risks:***
  - Social media platforms can expose users to cyberbullying, inappropriate content, and privacy breaches.
  - Discuss how to manage privacy settings, avoid sharing personal information publicly, and recognize fake profiles.
- ***Age Restrictions****:*
  - Many online services have age restrictions to protect children from inappropriate content.
  - Explore the importance of adhering to age limits and the risks associated with underage access.
- ***Sharing Online Profiles/Security Risk***:
  - Sharing personal information online can lead to identity theft, phishing attacks, and stalking.
  - Highlight the need for cautious profile sharing and strong passwords.
- ***Publishing Content****:*

- Posting content online (blogs, videos, etc.) can have unintended consequences.
- Discuss responsible content creation, copyright awareness, and avoiding harmful material.

- ***Uploading Photos and Videos****:*
  - Sharing images and videos can lead to privacy breaches or misuse.
  - Talk about consent, geotagging, and the impact of sharing visual content.
- ***Cyberbullying****:*
  - Online harassment affects mental health and well-being.
  - Address strategies to prevent and respond to cyberbullying.
- ***Copyright****:*
  - Using copyrighted material without permission can lead to legal issues.
  - Educate about fair use, Creative Commons licenses, and proper attribution.
- ***Exposure to Inappropriate Online Content****:*
  - Children may accidentally encounter harmful or explicit material.
  - Discuss safe browsing habits and parental controls.
- ***Excessive Time Online***
  - Spending too much time online can impact physical health, sleep, and social interactions.
  - Explore healthy screen time practices and digital balance.

Safe Use of Computers and Smartphone

Maintaining clean digital devices is crucial for both the longevity of the devices and our own well-being. Let's explore some reasons why it's essential to keep your electronic equipment clean:

1. **Device Performance and Longevity**:
- Regular cleaning helps prevent dust buildup and clogged fans, which can lead to overheating and damage to internal components.
- Clean devices run more smoothly, ensuring optimal performance and extending their lifespan.
2. **Improved Appearance**:
- A clean device looks better and is more pleasant to use.
- Considering how much time we spend interacting with our devices, an improved appearance positively impacts our daily experience.
3. **Health Protection**:
- Think about all the surfaces you touch throughout the day. Now imagine transferring that to your devices—keyboards, screens, and touchpads.
- If you don't clean your devices, they can harbour bacteria and germs, posing health risks when you touch your face or hands.
- Safe use of devices helps your eye from being damage due to inappropriate use.
4. **Avoiding Constant Replacements**:
- Regular cleaning reduces wear and tear, preventing premature device failure.
- Frequent replacements are inconvenient and costly, so maintaining your devices can save you time and money.

Implication for Teaching

Record your responses to the following questions as your takeaway and future consideration on your handouts.

- What did you learn e-safety?
- What are the potential risks in using digital technologies (internet)?
- What new skills, experience, knowledge have you got?

- How would you like to apply the new skills in your subject teaching learning activities?

Self Assessment

1. **What is the difference between facts and opinions?**

A. Facts are subjective statements, while opinions are objective.
B. Facts are based on evidence and can be verified, while opinions are personal beliefs.
C. Facts and opinions are interchangeable.
D. Opinions are always accurate, while facts can be misleading.

2. **Which of the following statements is an opinion?**

A. Ethiopia is one of the countries in East Africa.
B. Addis Ababa is the capital of Ethiopia."
C. Abebech Gobena has provided education opportunities for many Ethiopians through her NGO.
D. Ethiopia will soon become a middle-income country.

3. **What risks are associated with social networking platforms?**

A. Exposure to cyberbullying and inappropriate content
B. Increased privacy and security
C. Enhanced communication skills
D. Improved mental health

4. **Why is it important to keep digital devices clean and in good working order?**

A. To prevent identity theft
B. To avoid copyright infringement
C. For the health of the device and the user
D. To enhance internet speed

Reference Materials

Read	Smart Phone Use Safety Tips
Read	Parental Guide to Smartphone Safety
Read	How to secure your devices
Read	e-Safety Tips
Watch	Safe Online
Watch	Digital Footprint

Watch	Four Reasons to care about your digital footprint
Watch	How Fake News Spread
Watch	Fact vs Fake

Well done! You've made it to the end of the Module! We hope you've found it useful, and you'll join us Canvas Online Digital Skills Training.