Department of Botany
Course Structure (w.e.f. 2021)
Semester –I

Part	Components	Course Code	Course Title	Hrs/ Week	Credits	Max. Marks		
						CIA	ESE	Total
I	Tamil / French	21ULTA11 / 21ULFA11	பொதுத்தமிழ் தாள் - 1 இக்கால இலக்கியம் (செய்யுள், இலக்கணம், இலக்கிய வரலாறு, உரைநடை, சிறுகதை) Introductory French Course	6	3	40	60	100
II	General English	21UGEN11	Poetry, Prose, Extensive Reading and Communicative English-I	6	3	40	60	100
III	Core I	21UBOC11	Plant Diversity I (Algae, Bryophytes, Fungi and Lichens)	6	6	40	60	100
	Core Practical I	21UBOCR1	Plant Diversity I (Algae, Bryophyte Fungi and Lichens)	2	1	40	60	100
	Allied I	21UZOA11	Invertebrate & Chordate Zoology	4	3	40	60	100
	Allied Practical I	21UZOAR1	Invertebrate & Chordate Zoology	2		40	60	100
IV	Skill Enhancement Course - I	21UBOPE1	Professional English for Botany – I	2	2	20	30	50
	Ability Enhancement Course – I	21UAVE11	Value Education	2	2	20	30	50
Total				**30**	**20**			

Semester II

Part	Components	Course Code	Course Title	Hrs/ Week	Credits	Max. Marks		
						CIA	ESE	Total
I	Tamil /	21ULTA21 /	பொதுத்தமிழ் தாள் 2 சமய இலக்கியங்களும் நீதி இலக்கியங்களும் (செய்யுள், இலக்கணம், இலக்கிய வரலாறு, உரைநடை, வாழ்க்கை வரலாறு)	6	3	40	60	100
	French	21ULFA21	Intermediate French Course					
II	General English	21UGEN21	Poetry, Prose, Extensive Reading and Communicative English –II	6	3	40	60	100
III	Core II	21UBOC21	Anatomy, Embryology and Microtechniques	6	6	40	60	100
	Core Practical II	21UBOCR2	Anatomy, Embryology and Microtechniques	2	1	40	60	100
	Allied II	21UZOA21	Genetics, Physiology and Developmental Zoology	4	3	40	60	100
	Allied Practical I	21UZOAR1	Invertebrate & Chordate Zoology, Genetics, Physiology and Developmental Zoology	2	2	40	60	100
IV	Skill Enhancement Course - II	21UBOPE2	Professional English for Botany – II	2	2	20	30	50
	Ability Enhancement Course – II	21UAEV21	Environmental Studies	2	2	20	30	50
Total				**30**	**22**			

Semester III

Part	Components	Course Code	Course Title	Hrs/ Week	Credits	Max.Marks		
						CIA	ESE	Total
I	Tamil /	21ULTA31/	பொதுத்தமிழ் தாள் 3 : காப்பியங்களும் சிற்றிலக்கியங்களும் (செய்யுள், இலக்கணம், இலக்கிய வரலாறு, உரைநடை, புதினம்)	6	4	40	60	100
	French	21ULFA31	Advanced French Language					
II	General English	21UGEN31	Poetry, Prose, Extensive Reading and Communicative English-III	6	4	40	60	100
III	Core III	21UBOC31	Plant Diversity II (Pteridophytes, Gymnosperms and Paleobotany)	4	4	40	60	100
	Core Practical III	21UBOCR3	Plant Diversity II (Pteridophytes, Gymnosperms and Paleobotany)	2	2	40	60	100
	Allied III	21UCHA31	Allied Chemistry – I	4	3	40	60	100
	Allied Practical II	21UCHAR2	Allied Chemistry – I	2		40	60	100
	Skill Based Elective	21UBOS31/ 21UBOS32	1.Horticulture 2.Gardening and Nursery Management	2	2	20	30	50
	NME I	21UBON31	Plant Resource Utilization	2	2	20	30	50
IV	Ability Enhancement Course - III	21UAWS31	Women's Synergy	2	2	20	30	50
	Self Study/ MOOC / Internship (Compulsory)	21UBOSS1	Ethnobotany		2		50	50
Total				**30**	**25**			

Semester IV

Part	Components	Course Code	Course Title	Hrs/ Week	Credits	Max.Marks		
						CIA	ESE	Total
I	Tamil / French	21ULTA41 / 21ULFA41	பொதுத்தமிழ் தாள் 4: சங்க இலக்கியம்: (செய்யுள், இலக்கணம்,இலக்கிய வரலாறு, உரைநடை, நாடகம்) French Course and Literature	6	4	40	60	100
II	General English	21UGEN41	Poetry, Prose, Extensive Reading and Communicative English – IV	6	4	40	60	100
III	Core IV	21UBOC41	Taxonomy of Angiosperms and Economic Botany	4	4	40	60	100
	Core Practical IV	21UBOCR4	Taxonomy of Angiospermsand Economic Botany	2	2	40	60	100
	Allied IV	21UCHA41	Allied Chemistry – II	4	3	40	60	100
	Allied Practical II	21UCHAR2	Allied Chemistry – I Allied Chemistry – II	2	2	40	60	100
	Skill Based Elective	21UBOS41/ 21UBOS42	1.Organic Farming and Biofertilizer 2.Weed Science	2	2	20	30	50
	NME II	21UBON41	Food Technology	2	2	20	30	50
IV	Ability Enhancement Course - IV	21UAYM41	Yoga & Meditation	2	2	20	30	50
	Self Study / Online course / Internship (Optional)	21UBOSS2	Preservation of fruits and vegetables		+2		50	50
V	NCC, NSS &Sports Extension Activities/CDP/				1 +1			
Total				**30**	**26+3**			

Semester V

Part	Components	Course Code	Course Title	Hrs/ Week	Credits	Max.Marks		
						CIA	ESE	Total
	Core V (Common Core)	21UBCC51	Biotechnology	4	3	40	60	100
III	Core VI	21UBOC51	Biochemistry	4	4	40	60	100
	Core VII	21UBOC52	Ecology and Phytogeography	4	4	40	60	100
	Core VIII	21UBOC53	Biostatistics and Bioinformatics	4	4	40	60	100
	Core Practical V	21UBOCR5	Biochemistry Ecology and Phytogeography Biostatistics and Bioinformatics	6	3	40	60	100
	Common Core Practical VI	21UBCCR1	Biotechnology	2	1	40	60	100
	Core Elective	21UBOE51/ 21UBOE52	Genetics and Evolution / Pharmacognosy	4	3	40	60	100
IV	Common Skill Based Course	21UCSB51	Computer for Digital Era and Soft Skills	2	2	20	30	50
	Self Study/ Online course / Internship (Optional)	21UBOSS3	Seed Biology	--	+2		50	50
Total				**30**	**24+2**			

Semester VI

Part	Components	Course Code	Course Title	Hrs/ Week	Credits	Max.Marks		
						CIA	ESE	Total
III	Core IX	21UBOC61	Plant Physiology	4	4	40	60	100
	Core X	21UBOC62	Microbiology and Plant Pathology	4	4	40	60	100
	Core XI	21UBOC63	Cell and Molecular Biology	4	4	40	60	100
	Core XII	21UBOC64	Marine Biology	4	4	40	60	100
	Core Practical VII	21UBOCR6	21UBOC61, 21UBOC62	4	2	40	60	100
	Core Practical VIII	21UBOCR7	21UBOC63, 21UBCC64	4	2	40	60	100
IV	Project (Group)	21UBOP61		6	3	40	60	100
Total				**30**	**23**			
Total				**180**	**140+5**			

Semester	Hours	Credits	Extra Credits
I	30	20	---
II	30	22	---
III	30	25	---
IV	30	26	3
V	30	24	2
VI	30	23	--
Total	**180**	**140**	**5**

Courses	Number of Courses	Hours / week	Credits	Extra Credits
Tamil	4	24	14	--
English	4	24	14	--
Core	12T+8P	52T+24P	50T+14P	--
Skill Based Elective	2	4	4	--
Core Elective	1	4	4	--
Group Project	1	6	3	--
Allied	4T+2P	16T+8P	12T+4P	--
NME	2	4	4	--
Skill Enhancement Course	2	4	4	--
Ability Enhancement Course	4	8	8	--
Common Skill Based Course	1	2	2	--
NCC, NSS & Sports		--	1	
Extension Activities		--		1
Self Study Papers (Optional)	2	--		4
Self Study Papers (Compulsory)	1	--	2	--
Total		**180**	**140**	**5**

LESSON PLAN

Objective Oriented Learning Process RBT

Programme	B.Sc. Botany
Semester	I
Subject Title	Plant Diversity I (Algae, Bryophytes, Fungi and Lichen)
Code	21UBOC11
Hours	6
Total Hours	90
Credits	6
Max Marks	100
Unit & Title	Unit: 1 – Range of thallus organization in algae
Name of the Faculty	Dr.S. B.Maria Sumathi
T-L tools	Lecture method, **Visual aid**: PPT, Picture showing the various forms of algal thalli
Lecture Duration	60 minutes

Micro-planning

Prerequisite Knowledge: Quick Brainstorm: (2 min)

The teacher encouraged the students to reflect on the vast structural diversity in algae, stimulating their prior knowledge and connecting it to the evolutionary and ecological importance of thallus organization.

1.Topic for Learning through evocation (3 min)

The teacher asked the students about the names of commonly found algae and their colours and locations where they can be found.

2.Lesson Outline: Range of thallus organization in algae

2.1.Learning Objectives (5 min)

By the end of the lesson, students will be able to:

1. **Remember** the various types of thallus organization in algae.

2. **Understand** the structural differences between the types of thalli.
3. **Apply** the knowledge to classify algae based on their thallus organization.
4. **Analyze** the evolutionary and ecological significance of thallus diversity.
5. **Evaluate** the advantages and limitations of different thallus organizations in algae.
6. **Create** a visual model or diagram demonstrating the range of thallus organization.

2.2. Introduction to the topic (5 min)

1. Begin with a quick question: *"What comes to mind when you hear the term algae? Can you name some types?"*
2. Present an image/video of various algae (e.g., Chlamydomonas, Spirogyra, Ulva, and Kelp).
3. Briefly discuss what "thallus" means (definition: a simple plant body that is undifferentiated into roots, stems, or leaves)

Bloom's Taxonomy Level: Remember

2.3.Core Content Delivery: (20 min)

Teach the range of thallus organization in algae in detail.

a. Use a presentation or whiteboard to explain the types of thallus organization, emphasizing examples:

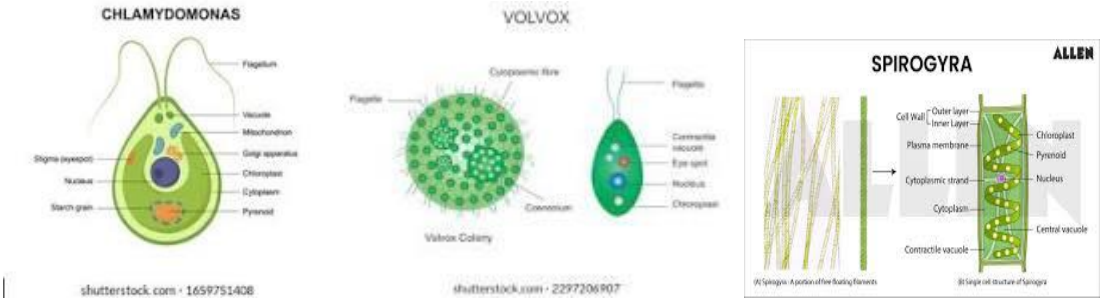
- **Unicellular (e.g., Chlamydomonas)**
- **Colonial (e.g., Volvox)**
- **Filamentous (e.g., Spirogyra)**
- **Membranous (e.g., Ulva)**
- **Siphonous/Coenocytic (e.g., Caulerpa)**
- **Parenchymatous (e.g., Laminaria)**

b. Highlight evolutionary trends from simple to complex forms.
c. Students group themselves into pairs and classify images of algae into the correct thallus types.

Bloom's Taxonomy Levels: Understand, Apply

2.4.Key Terms: Briefly introduce key terms like unicellular forms, colonial forms, filamentous forms, heterotrichous forms siphonous Forms, advanced types of thalli

2.5.Key Diagrams



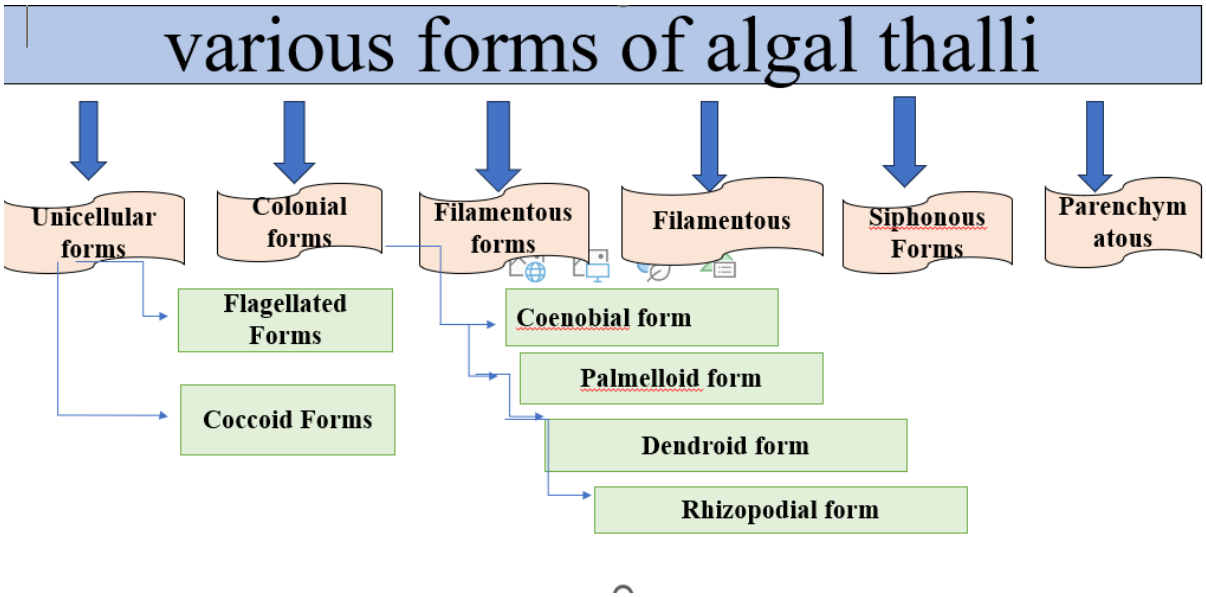
3. Discussion/ interactive Activity (8 min)

Engage the students to analyze and evaluate the significance of thallus diversity.

a. How does thallus organization affect survival and reproduction?
b. What might be the ecological advantages of filamentous vs. parenchymatous forms?
c. Discuss how the environment influences thallus structure (e.g., habitat depth, light availability).
d. Present hypothetical scenarios (e.g., algae in deep vs. shallow waters) and ask students to predict which thallus type would thrive and why.

Bloom's Taxonomy Levels: Analyze, Evaluate

4. Mind Map (3 min)



5. Summary and Conclution (6 min)

Ask students to individually create a diagram or chart summarizing the types of thallus organization, incorporating examples and evolutionary significance. Encourage creative representation, such as a flowchart or infographic

Bloom's Taxonomy Levels: Create

6. Assessment (8 min)

Formative Assessment:

1. Observe students' participation during group classification and discussions.
2. Provide real-time feedback on their diagrams and charts.

Summative Assessment:

A short quiz with questions such as:

- Define the term "thallus."
- Match algae examples with their thallus types.
- Explain why Caulerpa is considered siphonous/coenocytic.
- Compare the ecological advantages of filamentous and membranous algae

7. Questions

Name the unicellular non-flagellated forms

(a) coccoid forms (b) dendroid forms (c) rhizopodial forms (d)None of the above

Name the algae that have branched filamentous thallus

(a)Cladophora (b) Ulva (c) Volvox (d) Chlamydomonas

Find the type of thallus sttucture seen in *Vaucheria*

(a) filamentous forms (b) siphonous form (c) palmelloid form (d) dendroid form

8. References

1. Fritsch F.E. The Structure and Reproduction of Algae. London: Vol.I all II. Cambridge Univeristy Press, 1972. 2. Kamat N.D. Topics in Algae. Aurangabad: Sai Kraipa 2.
2. Vashishta B.R, Sinha A.K. and Singh V.P. Algae. New Delhi: S. Chand and Co. Ltd. 2007.
3. Pandey S.N. and Trivedi. P.S. A Text Book of Botany Vol. I and II. New Delhi: Vikas Publishing House Pvt. Ltd., 2006.

B. Mario Sundar

Verified by Subject Expert

M. Glory

Approved by HOD

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LESSON PLAN

Objective Oriented Learning Process RBT

Programme	B.Sc. Botany
Semester	I
Course Title	Skill Enhancement Course - I Professional English for Botany – I
Code	21UBOPE1
Hours	2
Total Hours	30
Credits	2
Maximum Marks	50
Unit & Title	Unit I - Listening to instructions and following – Instructions to use microscope
Name of the Faculty	Dr. Mary Santhi. R
T-L tools	Mind maps, video, microscope, think-pair- share
Lecture Duration	60 minutes

Micro-planning

Prerequisite knowledge: Quick brainstorm: Ask students to recall their previous experiences with microscopes, if any. Collect the responses.

1. Topic for Learning through evocation

Listening to instructions and following instructions to use microscope.

In this lesson, students will develop their ability to listen attentively, follow precise instructions and use the microscope effectively.

2. Lesson outline

2.1. Learning objectives

By the end of this lesson, students will be able to:

Remember the steps involved in using a microscope and the parts of the microscope.
Understand the purpose of each part of the microscope and its function.
Apply the microscope to view specimens.
Analyze the clarity and effectiveness of the instructions given for using the microscope.
Evaluate the success of the activity in terms of following instructions.
Create a step-by-step guide to using the microscope based on their understanding and analysis.

2.2. Introduction to the topic

1. Introduce the importance of following instructions in scientific work and the role of active listening.
2. Engage students with a video / animation: Show a short 2-3 minutes video or animation illustrating working of microscope.

Bloom's Taxonomy Level: Remember & Understand

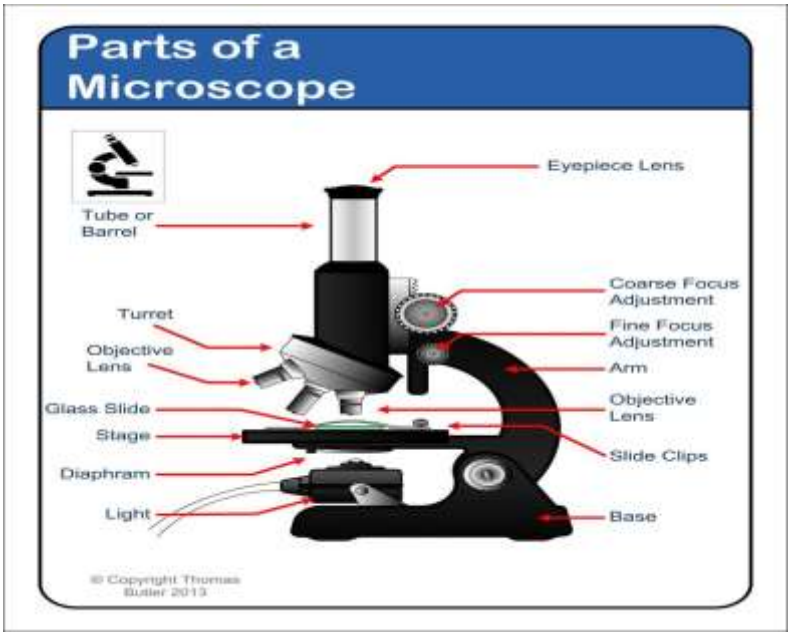
2.3. Core Content Delivery

Step-by-step demonstration of microscope usage, including adjusting the focus, changing objectives, and using the light source.
Explanation of each step and its importance.
Clarification of potential challenges students may face, such as incorrect focusing or misplacement of slides.
Encourage questions to ensure understanding.

Bloom's Taxonomy Level: Understand & Apply

2.4. Key Terms: Microscope, eyepiece, objective lenses, focus knob, stage clip, slide, light source, resolution, magnification

2.5. Key Diagrams



3. Discussion / Interactive Activity
Group Activity:

In small groups, students will be given written instructions on how to use a microscope. They will work together to follow the instructions, using microscopes to examine a sample slide. The activity will focus on active listening and collaboration.

Steps:

- Each group receives a set of instructions.
- One student reads the instructions aloud while the others follow the steps.
- The group discusses any challenges they face and corrects each other's techniques.
- At the end of the activity, each group will share their experiences and discuss any mistakes or difficulties encountered.

Bloom's Taxonomy Level: **Apply & Analyze**

4. Mind Map
Help students visualize and organize the steps and concepts related to using a microscope.

Create a mind map on the board to show how different parts of the microscope are related to the overall process of preparing and examining slides. Students can also contribute to the mind map by adding any additional steps they find important.

5. Summary and Conclusion

Recap the key points of the lesson, evaluate the students' performance in the activity, and provide closure.

- Recall the steps involved in using the microscope.
- Explain the importance of listening carefully and following instructions precisely.
- Evaluate understanding and performance, using a few guided questions:
- Identify the difficulties in following the instructions?

Bloom's Taxonomy Level: **Evaluate**

6. Assessment

- A short quiz with multiple-choice and short-answer questions on the parts of the microscope, their functions, and the correct steps for usage.
- A practical assessment where students individually use the microscope to view a sample slide and answer questions on the process.
- Observation of students during the group activity to assess their ability to work collaboratively and follow the instructions accurately.

7. Questions

- What was the most challenging part of following the instructions for using the microscope?
- Why is it important to use the correct focus when viewing a sample under the microscope?
- How can you ensure that the instructions you give to someone else about using a microscope are clear and easy to follow?

8. References

1. Pandey, SN and Trivedi, PS. (2006). A Text Book of Botany, Vol. I and II. New Delhi: VIKAS Publishing House Pvt. Ltd.
2. Sharma, OP. (2006). Text Book of Algae. New Delhi: Tata Mc. Graw-Hall Publications.

9. Extension Activities

- Assign students to write a detailed step-by-step guide for new students on how to use a microscope.
- Organize a mini-project where students research different types of microscopes (electron microscope, compound microscope, etc.) and present their findings.
- Pair students with a partner and have them take turns explaining and demonstrating how to use a microscope, focusing on the clarity of their instructions.

R. Mary Santhi

Verified by Subject Expert

M. Glory

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LESSON PLAN

Objective Oriented Learning Process RBT

Programme	B.Sc. Botany
Semester	II
Subject Title	Anatomy, Embryology and Microtechniques
Code	21UBOC21
Hours	6
Total Hours	90
Credits	6
Max Marks	100
Unit & Title	Unit: IV – Types of Endosperm
Name of the Faculty	Dr.S. B.Maria Sumathi
T-L tools	Lecture method, **Visual aid**: PPT, Picture showing the various types of endosperm
Lecture Duration	60 minutes

Micro-planning

Prerequisite Knowledge: Quick Brainstorm: **(2 min)**
Ask students what they already know about endosperm and its functions

1.Topic for Learning through evocation (3 min)

The teacher asked the students about the different types of endosperm . The teacher brought different types of endosperm to the class and showed them to the students to cheer them up

2.Lesson Outline: Types of Endosperm

2.1.Learning Objectives (5 min)

By the end of this lesson, students will be able to:

1. **Remember** the definition and role of endosperm in seeds.
2. **Understand** the types of endosperm and their developmental mechanisms.
3. **Apply** knowledge to classify examples of plants based on endosperm type.
4. **Analyze** the evolutionary and functional significance of different types of endosperm.
5. **Evaluate** the importance of endosperm for seed development and human nutrition.
6. **Create** a diagram or flowchart representing the classification of endosperm types

2.2. Introduction to the topic (5 min)

1. Start with a question: *"What do you think is the main source of nutrients for a developing seedling?"*
2. Present an image of seeds (e.g., coconut, maize) and highlight the role of the endosperm as a storage tissue.
3. Define endosperm and briefly mention its significance in seed development and human consumption (e.g., cereals).

Bloom's Taxonomy Level: Remember

2.3.Core Content Delivery: (20 min)

1. Use diagrams and explanations to describe the three types:

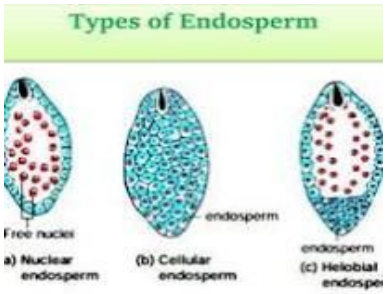
   - **Nuclear Endosperm:**
     - Free-nuclear division occurs, followed by cell wall formation (e.g., coconut water, maize).
   - **Cellular Endosperm:**
     - Division is immediately followed by cell wall formation (e.g., Datura, balsam Magnolia.).
   - **Helobial Endosperm:**
     - First division is asymmetrical, forming two regions—one cellular and one free-nuclear (e.g., monocots like Asphodelus).

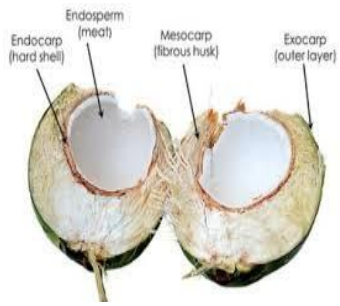
2. Provide students with labeled diagrams of the three types and ask them to identify the process illustrated in each.

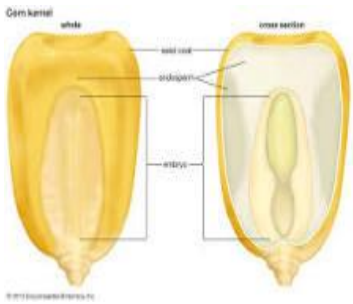
Bloom's Taxonomy Levels: Understand, Apply

2.4.Key Terms: Briefly introduce key terms like Nuclear Endosperm, Cellular Endosperm, Helobial Endosperm

2.5.Key Diagrams







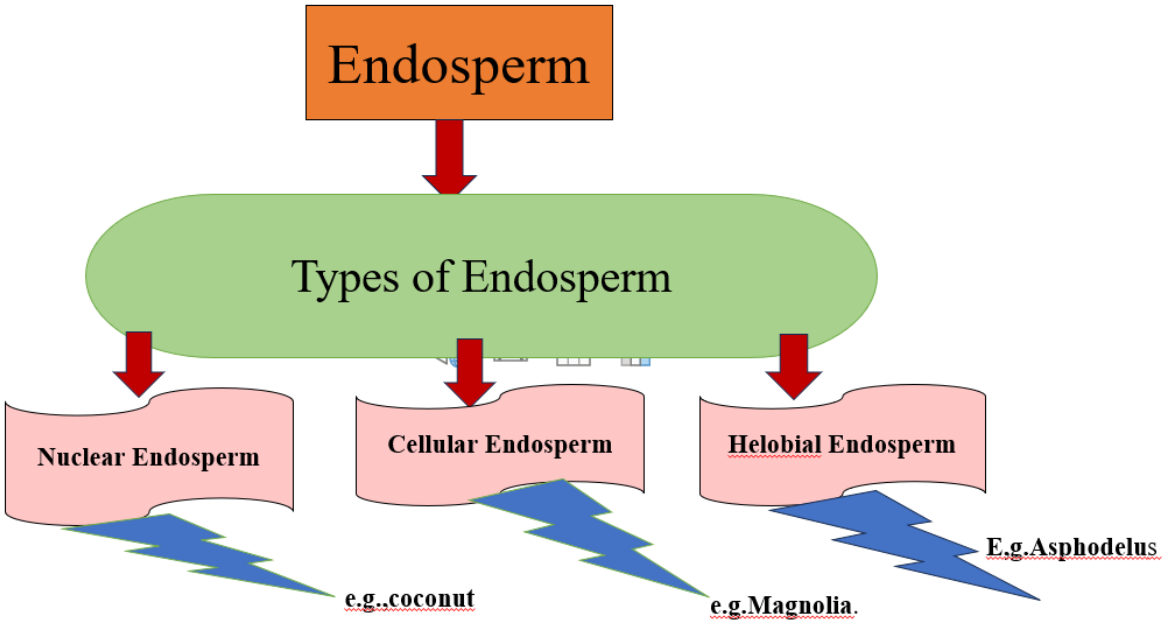
3. Discussion/ interactive Activity (8 min)

Engage the students to analyze and evaluate the structure and functions of endosperm.

1) How do different types of endosperm benefit the seed in terms of nutrient storage and distribution?
2) Why do monocots often show nuclear or helobial endosperm types?
3) Compare the significance of endosperm in monocots (e.g., cereals) and dicots (e.g., legumes).

Bloom's Taxonomy Levels: Analyze, Evaluate

4. Mind Map (3 min)



5. Summary and Conclution (6 min)

Ask students work individually or in small groups to create a flowchart or infographic categorizing the three types of endosperm, with labeled examples and key features.Encourage them to add evolutionary or ecological notes to their diagrams.

Bloom's Taxonomy Levels: Create

6. Assessment (8 min)

Formative Assessment:

1. Observe student participation during discussions and group work.
2. Provide feedback on their diagrams for clarity and correctness.

Summative Assessment:

A short quiz with questions such as:

- Define endosperm and list its functions.
- Differentiate between nuclear and cellular endosperm with examples.
- Explain the significance of helobial endosperm in monocots.
- Analyze the role of endosperm in human nutrition (e.g., rice, wheat).

7. Questions

Find out the family which lack of endosperm
(a)Orchidaceae b) Poaceae c) graminae d) Acanthaceae
Identify the type of endosperm restricted to monocot plant
(a)Helobial b) Cellular c) Nuclear d) Ruminate
Tell the type of endosperm seen in Asphodelus
(a) cellular (b) nuclear (c) helobial (d) both cellular helobial

8. References

1. Bhojwani S.S. and Bhatnagar S.P. The embryology of Angiosperms. Uttar Pradesh: Vikas Publishing house PVT. Ltd., 2007.
2. Maheswari, P. Introduction to embryology of angiosperm. India: Tata Mc Graw Hill publications and Co. 1971.

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LESSON PLAN

Objective Oriented Learning Process RBT

Programme	B.Sc. Botany
Semester	II
Course Title	Skill Enhancement Course - II Professional English for Botany – II
Code	21UBOPE2
Hours	2
Total Hours	30
Credits	2
Maximum Marks	50
Unit & Title	Unit I - Listening to audio text and answering questions: Primary Tissues in plants
Name of the Faculty	Dr. Mary Santhi. R
T-L tools	Mind maps, video, think-pair-share
Lecture Duration	60 minutes

Micro-planning

Prerequisite knowledge: Quick brainstorm: Ask students to recall their previous knowledge on plant tissues in basic sentences. Collect the responses.

1. Topic for Learning through evocation

Listening to Audio Text and Answering Questions on Primary Tissues in Plants.

In this topic, students will develop their English listening comprehension skills, with a focus on understanding scientific concepts related to plant biology.

2. Lesson outline

2.1. Learning objectives

By the end of this lesson, students will be able to:

Remember the key concepts related to primary tissues in plants.

Understand the role of primary tissues in plants.

Apply listening strategies to answer questions about the audio text.

Analyze the information provided in the audio and identify key details.

Evaluate the clarity of the audio text and its effectiveness in conveying information.

Create a summary or response based on the information from the audio.

2.2. Introduction to the topic

Introduce the concept of primary tissues in plants and the importance of listening comprehension in academic settings.

- A brief overview of primary tissues in plants: epidermis, ground tissue, vascular tissue and meristematic tissue.
- The significance of listening skills in understanding and processing scientific information, especially through audio materials.
- Review of key vocabulary related to primary tissues (e.g., parenchyma, xylem, phloem, cambium).

Bloom's Taxonomy Level: **Remember & Understand**

2.3. Core content delivery

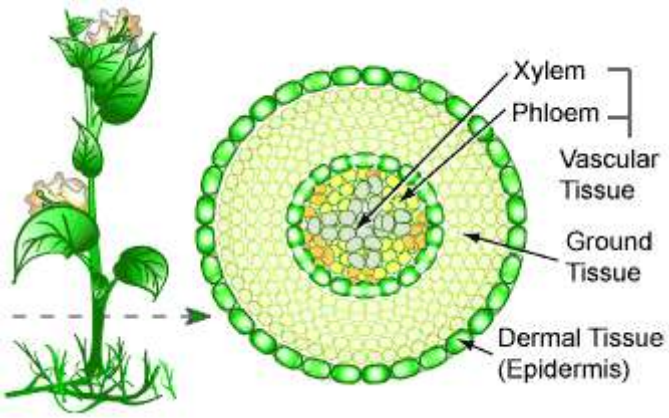
Present an audio recording that explains the primary tissues in plants, followed by guided listening activities.

- Play the audio recording that explains the primary tissues in plants.
- Ensure the recording is clear, with a moderate pace, and includes definitions and examples of the primary tissues (epidermal, ground, vascular, and meristematic tissues).
- Students listen actively to the audio, taking notes on key points.
- After the first listening, pause and explain any unclear concepts or terms that students may not have fully understood.
- Play the audio a second time for students to refine their understanding and take more detailed notes.

Bloom's Taxonomy Level: **Understand & Apply**

2.4. Key Terms: Discuss the different terms of plant tissues like primary tissues, epidermis, parenchyma, xylem, phloem, cambium, meristem, vascular tissue and ground tissue.

2.5. Key Diagrams



3. Discussion / Interactive Activity
Group Activity:

After listening to the audio, students will work in small groups to discuss and answer a set of comprehension questions related to the primary tissues in plants. They will analyze the audio text and share their findings with the class.

Steps:

1. Provide each group with a list of questions based on the audio.

Example questions:

- What are the primary tissues in plants, and what role does each tissue play?
- How do xylem and phloem differ in their function within the plant?
- What is the function of the meristematic tissue?

2. Allow students to discuss and formulate answers based on their notes from the audio.
3. Ask each group to present their answers to the class.
4. As a class, review and clarify any misunderstood concepts.

Bloom's Taxonomy Level: **Apply & Analyze**

4. Mind Map

Help students visualize the relationships between different primary tissues in plants and their functions.

Create a mind map on the board to show how each primary tissue contributes to the overall function of the plant. For example:

- Central node: "Primary Tissues in Plants"
- Branches for epidermis, ground tissue, vascular tissue, meristematic tissue, with sub-branches describing their functions and types of cells involved.

5. Summary and Conclusion

Summarize the key points learned during the lesson and evaluate the students' understanding.

- Review the main functions of the primary tissues in plants: epidermis (protective barrier), ground tissue (storage, support, photosynthesis), vascular tissue (transport of water, nutrients) and meristematic tissue (growth).
- Encourage students to evaluate their listening and comprehension skills by reflecting on the accuracy of their notes and answers.
- Prompt students to think critically about how they can improve their listening skills in future academic settings.

Bloom's Taxonomy Level: **Evaluate**

6. Assessment

Assess students' listening comprehension and understanding of primary tissues in plants.

- **Listening Comprehension Quiz**: After the group activity, students will individually complete a quiz with multiple-choice and short-answer questions based on the audio. This will test their understanding of the primary tissues in plants.
- **Discussion Participation**: Assess students' ability to analyze and discuss the content based on their listening notes.

7. Questions

Recall by understanding and stimulate critical thinking.

1. Discuss the characteristics of parenchyma cells, and where are they typically found in the plant?
2. Analyze how does the structure of the xylem facilitate its role in water transport?
3. Compare and contrast differences between simple and complex tissues in plants?
4. Prove that the information you've learned about plant tissues be applied to other fields of study, such as agriculture or biotechnology?

8. References

1. Verma, P.S and Agarwal, V.K. (2007). Cell biology, Genetics, Molecular

Biology, Evolution and Ecology. New Delhi, S. Chand and Co.
2. Bhojwani, S.S and Bhatnagar, S.P. (2007). The embryology of Angiosperms. New Delhi: Vikas Publishing house PVT. Ltd.

9. Extension Activities

- **Research Assignment**: Ask students to research how different types of plant tissues are adapted to specific environments (e.g., desert plants vs. tropical plants).
- **Micro-Lecture**: Students can create a short podcast or video explaining one of the primary tissues in plants, integrating both scientific content and clear language for English development.
- **Peer Review**: Students exchange their notes and provide feedback on the accuracy and clarity of each other's written summaries about primary tissues.

R. Mary Santhi

Verified by Subject Expert

m. Glory

Approved by HOD

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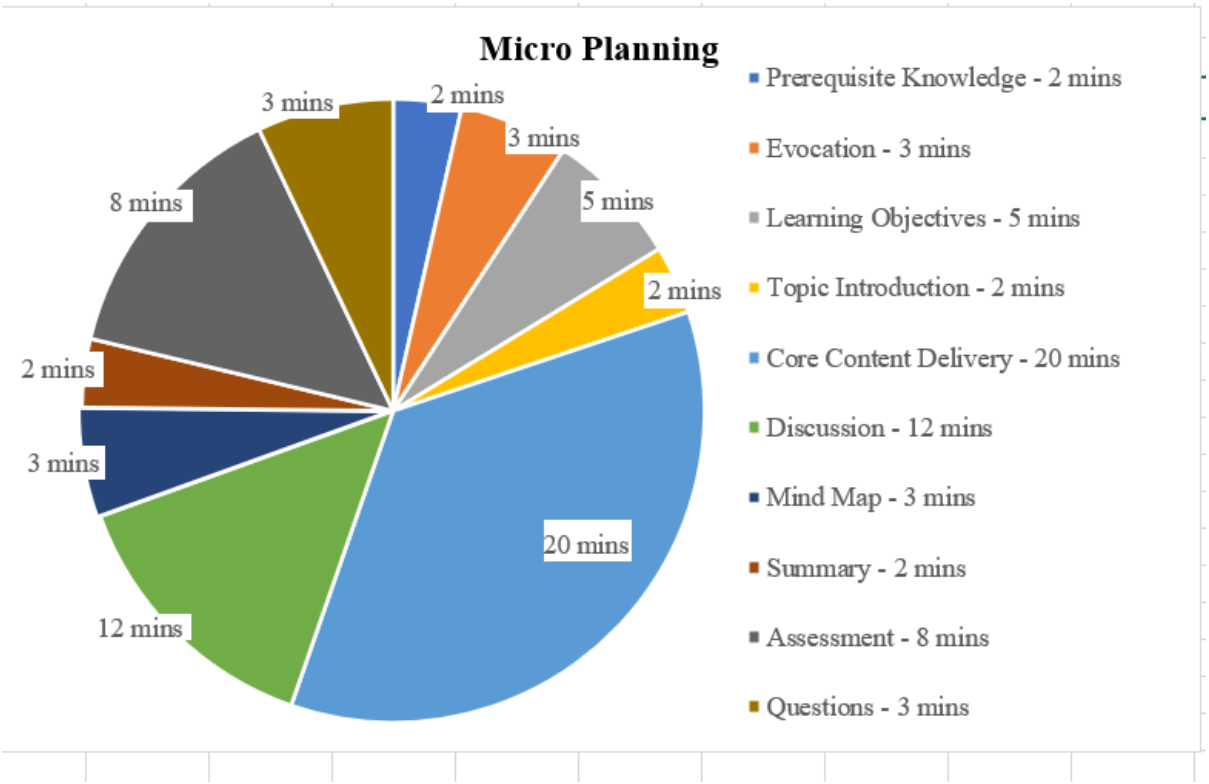
LESSON PLAN

Objective Oriented Learning Process RBT

Programme	B.Sc. Botany
Semester	III
Subject Title	Core: Plant Diversity II (Pteridophytes, Gymnosperms and Paleobotany)
Code	21UBOC31
Hours	4
Total Hours	60
Credits	4
Max Marks	100
Unit & Title	Unit: V – Fossils and its types
Name of the Faculty	Ms. S. Pauline Jenifer
T-L tools	Lecture method, **Visual aid**: PPT, Picture showing the types of fossils

Micro -planning



Prerequisite Knowledge:

The teacher will ask the students some basic questions about fossils to know the level of their knowledge about fossils.

1. Topic for Learning through evocation

The teacher will evocate the class by asking basic question like Have you seen Jurrasic Park movie? What do you know about dinosaurs? Why have they become extinct? Have you name some extinct species? These questions will stimulate the students to know the topic of today's class and to know about the process and types behind it.

2. Lesson Outline

2.1.Learning Objectives

By the end of the lesson, students will be able to:

1. **Remember**: Define fossils and their significance.
2. **Understand**: Explain how fossils form and identify different types of fossils.
3. **Apply**: Classify fossils into different categories based on their formation.
4. **Analyze**: Compare and contrast the different types of fossils.
5. **Evaluate**: Assess the importance of fossils in understanding Earth's history.

2.2.Topic Introduction

1. Engage students and activate prior knowledge.
2. Begin with an open question: *"Why are fossils considered Earth's time capsules?"*
3. Show an image or video of a famous fossil (e.g., a dinosaur fossil or a trilobite).

Bloom's Level: Remember

2.3.Core Content Delivery

1. Provide students with foundational knowledge about fossils.
2. **Definition**: Fossils as preserved remains, impressions, or traces of ancient organisms.
3. **How Fossils Form**: Conditions for fossilization (e.g., rapid burial, lack of oxygen).
4. **Types of Fossils**:
    i. Body Fossils: Actual parts of the organism (bones, teeth).
    ii. Trace Fossils: Evidence of activity (footprints, burrows).
    iii. Molds and Casts: Impressions (molds) and their filled replicas (casts).
    iv. Petrified Fossils: Organic material replaced by minerals.
    v. Amber Fossils: Organisms trapped in resin.
    vi. Carbon Films: Thin carbon layers of organisms.
5. **Significance of Fossils**: Evolutionary evidence, dating rocks, reconstructing past environments.

Bloom's Level: Remember, Understand

2.4.Key words:

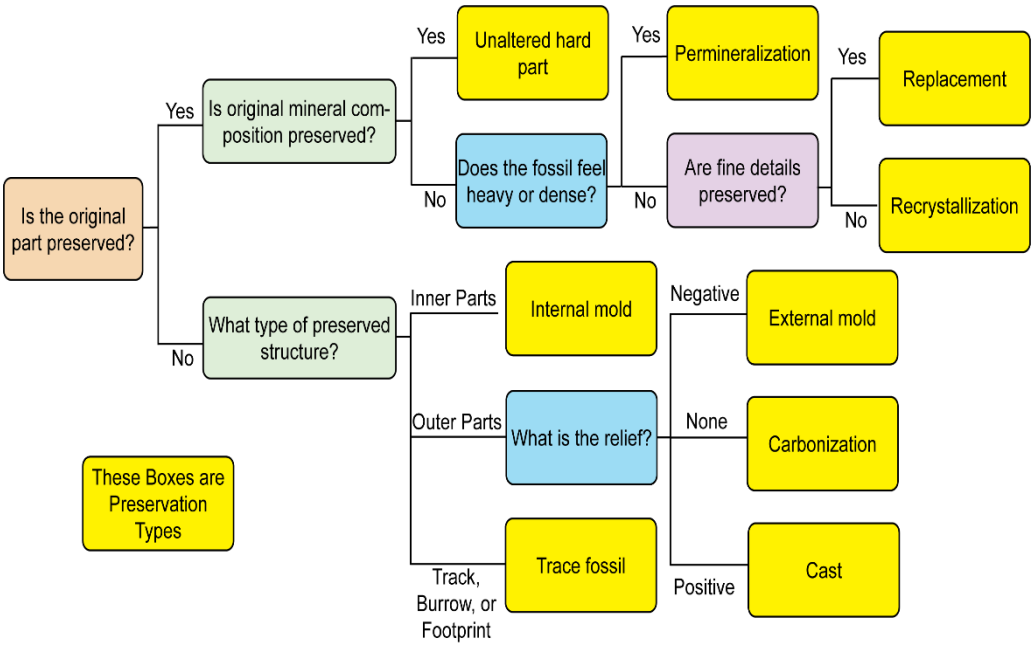
Fossils, Body fossils, trace fossils, petrified fossils, evolution

2.5. Key diagrams (if any):

3. Discussion/Interactive activity

1. Encourage application and analysis of knowledge.
2. Provide students with images or descriptions of various fossils (real or hypothetical).
3. Students work in pairs to classify fossils into their types.
4. Discuss why they classified fossils a certain way.
5. **Bloom's Level**: Apply, Analyze

4. Mind Map:



5. **Summary:**

Students will be asked to identify how evolution takes place in the types of fossils studied by using the mind map..

6. **Assessment through Stimulating questions/Analogy/New ideas and Concepts:**

Formative: Participation in fossil classification activity and discussion.

Summative: Quick quiz to test understanding of key concepts.

7. **Questions:**

Recall: Paleobotany deals with the study of

(a) living plants (b) **fossil plants** (c) hill plants (d) water plants

Identify the type of fossil preserves the actual remains of an organism

(a) Trace fossil (b) Mold fossil (c) Cast fossil (d) True-form fossil

Name the type of fossil created when an organism leaves an imprint in soft sediment that hardens over time

(a) Trace fossil (b) Mold fossil (c) Petrified fossil (d) Carbon film fossil

Find out an example of a trace fossil

(a) A petrified tree (b) A dinosaur footprint (c) A preserved insect in amber (d) A fish skeleton in rock

Mention what happens in the process of petrification

(a) The organism is frozen in ice (b) Minerals replace the organic material in the organism

(c) The organism is trapped in resin or amber (d) The organism is decomposed entirely

8. **References**

1. Vashishta, B. R., Sinha, A. K., & Kumar, A. (2022). Botany for Degree Students: Pteridophytes. New Delhi: S. Chand Publishing.
2. Shukla A.C. and Misra S.P. *Essentials of Paleobotany*. New Delhi: Vikas Publishing House Pvt. Ltd., 1982.

Verified by Subject Expert

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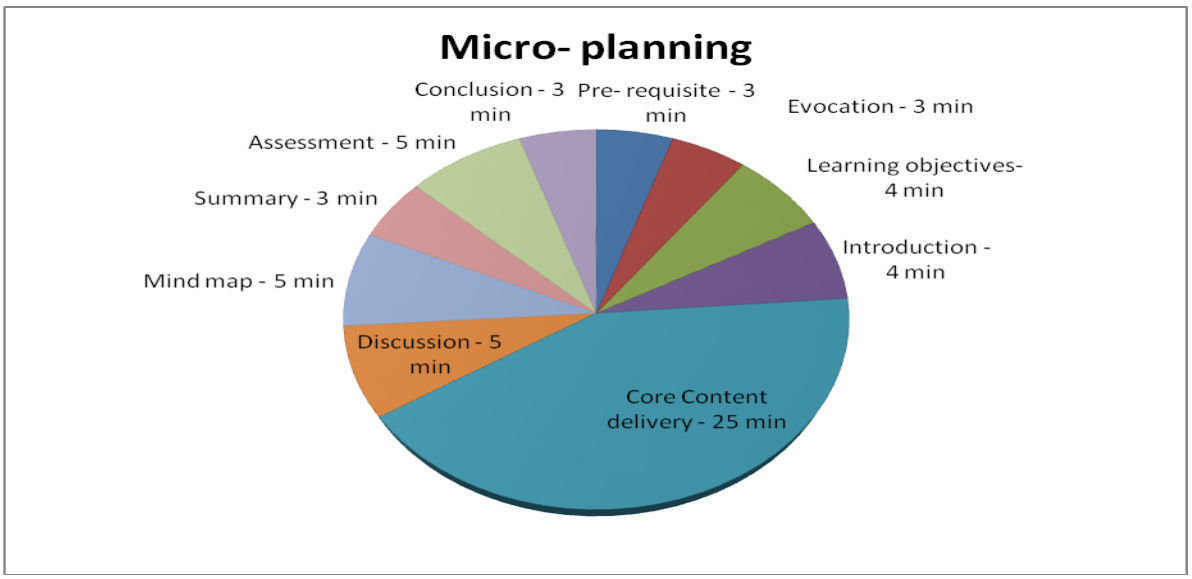
LESSON PLAN

Objective Oriented Learning Process RBT

Programme	II Allied (Zoology)
Semester	III
Course Title	Allied – Plant Diversity
Code	21UBOA31
Hours	4
Total Hours	60
Credits	3
Maximum Marks	100
Unit &Title	Unit: I – Classification of algae by F. E. Fritsch.
Name of the Faculty	Dr. F. Dayana Lobo
T-L tools	Lecture method, Visual aid: PPT, Videos
Lecture Duration	60 minutes

Micro-planning



Prerequisite Knowledge: Quick Brain storm: Start with a question to gauge prior knowledge, such as, "What do you think are the different types of algae, and where do you find them?"

1. Topic for Learning through evocation

Allow students to share their ideas and experiences with algae, including their roles in ecosystems. Show images or samples of various types of algae (e.g., green, brown, and red algae).
Introduce Fritsch's classification system, highlighting the main groups:
Chlorophyta (Green Algae)
Phaeophyta (Brown Algae)
Rhodophyta (Red Algae)

Cyanophyta (Blue-green Algae)
Chrysophyta (Golden-brown Algae)
Bacillariophyta (Diatoms)

Structure: Algae can be unicellular or multicellular, with various forms like filamentous, thallus, and differentiated structures like holdfasts, stipes, and blades.

Pigmentation: Algae contain different types of chlorophyll (a, b, c) and other pigments (carotenoids, phycobilins), which determine their color and photosynthetic abilities.

Reproduction: Algae reproduce both asexually (e.g., fragmentation, spores) and sexually (e.g., oogamy, anisogamy, isogamy), with diversity in reproductive strategies.

Habitat: Algae thrive in diverse environments, including freshwater, marine, and terrestrial ecosystems.

Nutrition: Most algae are autotrophic, performing photosynthesis, but some are heterotrophic and can engage in symbiotic relationships with other organisms.

2. Lesson Outline

2.1. Learning Objectives

By the end of this lesson, students will be able to:

1. **Remember** the characteristics of major algal groups
2. **Understand** the role of algae in photosynthesis
3. **Apply** dichotomous key for the classification of unknown algae.
4. **Analyze** the environmental factors affecting algal distribution and growth.
5. **Evaluate** the ecological impact of algal blooms in aquatic environments
6. **Create** a classification scheme for a new species of algae based on observed characters

2.2. Introduction to the topic

1. Introduce the topic and use prior knowledge.
2. Ask students to identify the different types of algae.
3. Discuss the Fritsch classification based on the structure and morphology of algae

Bloom's Taxonomy Level: Remember &Understand

2.3. Core Content Delivery

Teach the Fritsch classification of algae based on pigmentation, cellular structure, reserve food material, habitat and Reproduction

Fritsch divided algae into 11 classes

Divisions Based on Pigmentation:

Algae are classified primarily by their pigments, which determine their color and influence their habitat:

- **Chlorophyta (Green Algae)**: Contain chlorophyll a and b; generally found in freshwater and moist environments.
- **Phaeophyta (Brown Algae)**: Contain chlorophyll a and c, along with fucoxanthin; typically marine.
- **Rhodophyta (Red Algae)**: Contain chlorophyll a and phycobilins; proficient in absorbing light in deeper waters.

Cellular Structure:

Classification also considers cellular characteristics:

- **Unicellular Forms**: Single-celled organisms, such as in some Green and Cyanophyta.
- **Multicellular Forms**: Filamentous or branched forms, like Brown and Red Algae.

Reproductive Strategies:

Fritsch recognizes the reproductive modes, which can vary widely among different groups:

- Asexual reproduction (e.g., through fragmentation or spore formation).
- Sexual reproduction involving gametes.

Habitat and Ecology:

The ecological niches occupied by various algae:

- Freshwater, marine, and terrestrial habitats, as well as their roles in food webs (primary producers).

Additional Groupings:

Cyanophyta (Blue-green Algae): Though prokaryotic, included due to their aquatic photosynthetic nature.

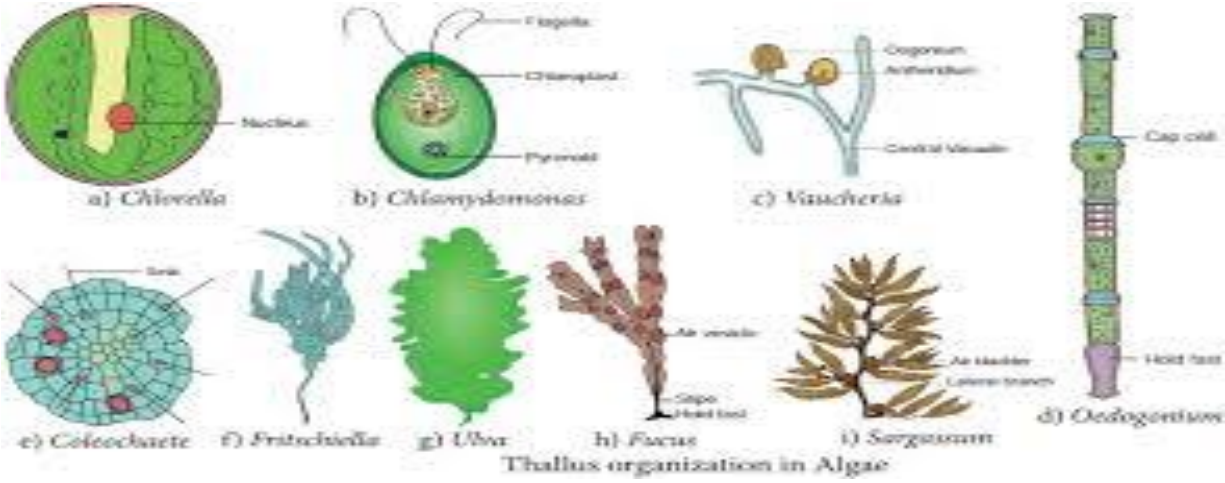
Chrysophyta (Golden-brown Algae) and **Bacillariophyta (Diatoms)** are also accounted for due to their ecological significance.

Bloom's Taxonomy Level: **Understand &Apply**

2.4. Key Terms:

Briefly introduce key terms like algae, pigments, cellular structure, habitat, reproduction, 11 classes

2.5. Key Diagrams



3. Discussion / Interactive Activity

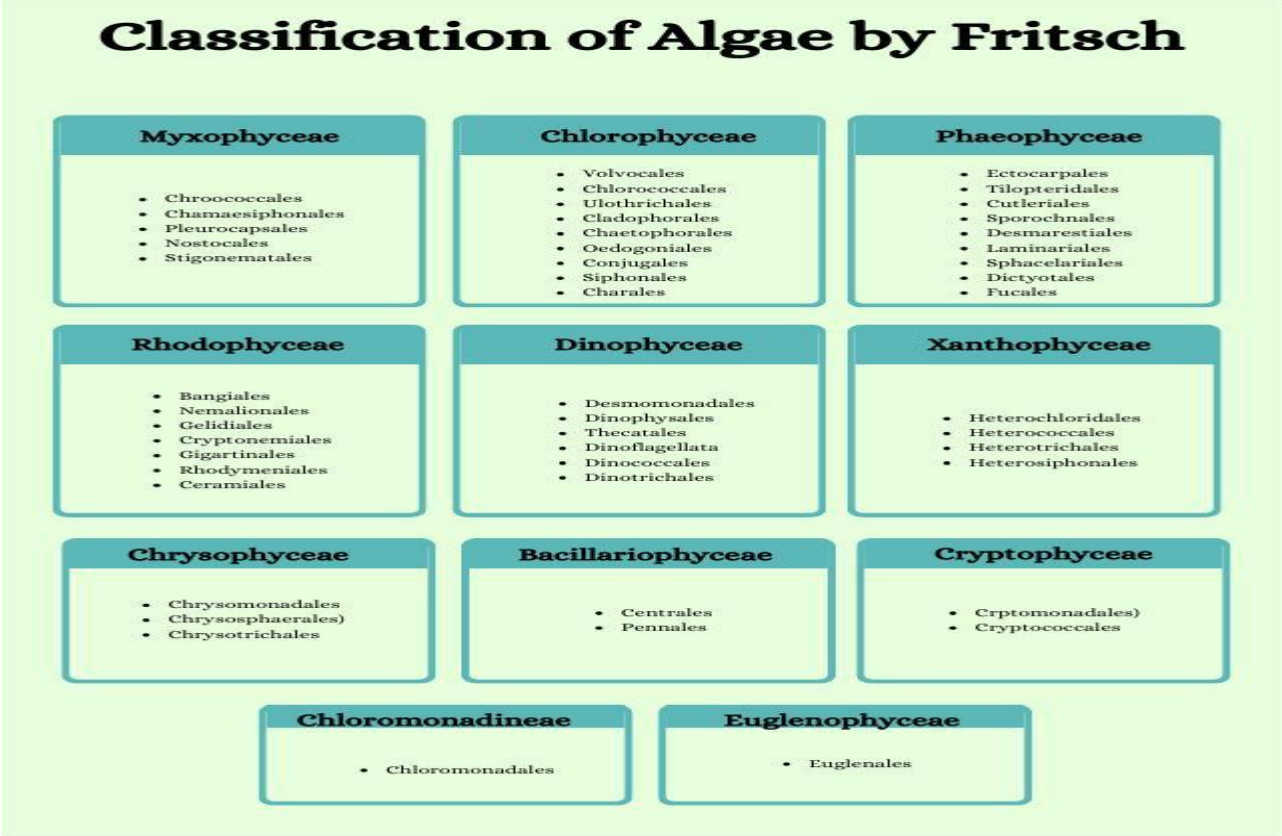
Engaging students to collect samples from local water bodies to identify and classify algae.

Group Work: Algae Identification: Organize a field trip to identify the different types of algae in Gulf of mannar

To discuss the ecological roles of different algae and their classification based on Fritsch system

Bloom's Taxonomy Level: **Apply & Analyze**

4. Mind Map:



5. Summary and Conclusion

Fritsch's classification system provides a detailed framework for understanding the diversity of algae based on pigment composition, cellular structure, reproductive strategies, ecological roles, and habitat preferences. This classification aids in the study and identification of algal species and their functions within aquatic ecosystems.

Bloom's Taxonomy Level: **Evaluate**

6. Assessment

Formative: Participation in group activities, diagrams, and discussions.
Summative:

1. A short quiz on Fritsch Classification

7. Questions

Identify in which group of algae includes diatoms?
(a) Chlorophyceae (b)Phaeophyceae (c) Rhodophyceae (d) Bacillariophyceae

Show that which characteristic is not typically used in Fritsch's classification of algae?
(a) Pigmentation (b) Cellular structure (c) Nutritional mode (d) Size of organism

Discuss the classification of algae by Fritsch

8. References:

1. Pandey S.N., Trivedi P.S. and Misra S.P. (2006). *A text Book of Botany. Vol. I and II.* Vikas Publishing House Pvt. Ltd. New Delhi.

2. Sharma O.P. (2006). *Text Book of Algae.* Tata Mc. Graw - Hall Publications. New Delhi.

3. Singh V. Pandey P.C. and Jain D.K. (2002). *A Text Book of Botany.* Rastogi Publication. Meerut.

9. Extension Activities:

Research task: Investigate how different algal groups are utilized in biofuels, food products, pharmaceuticals, and wastewater treatment.

Advanced task: Design a field study to collect samples from different habitats (e.g., freshwater ponds, coastal waters). Use GPS tools to map location and environmental conditions. Use microscopy and molecular techniques (e.g., PCR, sequencing) to identify algal species and assess biodiversity in collected samples. Compare field data with existing classification systems and analyze discrepancies.

Verified by Subject Expert

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LESSON PLAN

Objective Oriented Learning Process RBT

Programme	B.A., B.Com., B.Sc.
Semester	III
Course Title	NME I Plant Resource Utilization
Code	21UBON31
Hours	2
Total Hours	30
Credits	2
Maximum Marks	50
Unit & Title	Unit I – Botanical description, distribution, cultivation, harvesting and economic and nutritional values of rice
Name of the Faculty	Dr. Daffodil D Almeida. E
T-L tools	Mind maps, PPT, think-pair- share
Lecture Duration	60 minutes

Micro-planning

Prerequisite Knowledge: Quick Brainstorming: Ask students what they know about the paddy field, whether they have experienced the visit to paddy field. Write the answers on the board.

1. Topic for Learning through Evocation

Topic: Botanical description, distribution, cultivation, harvesting and economic and nutritional values of rice

2. Lesson Outline

2.1. Learning Objectives

By the end of this topic, students will be able to:

1. Remember the key information about rice's botanical classification, growth requirements and its economic and nutritional importance.
2. Understand the stages of rice cultivation and how environmental factors influence distribution and yield.
3. Apply the knowledge of rice cultivation to real-world agricultural practices.
4. Analyze the factors affecting rice production and its role in global food security.
5. Evaluate the importance of rice as a staple food crop and its economic significance.
6. Create solutions for improving rice cultivation and distribution in regions with food insecurity.

2.2. Introduction to the Topic

1. What is Rice? Begin with a general introduction to rice as a staple crop.
2. Botanical Classification
3. Historical Significance
4. Why is rice so important in feeding the global population?
5. How is rice cultivated and why is it so dependent on specific climatic conditions?

Bloom's Taxonomy Level: Remember & Understand

2.3 Core Content Delivery

Botanical Description of Rice:

Family: Poaceae (grass family)
Genus: *Oryza*
Plant Structure: Rice is an annual grass with a fibrous root system, erect stems and narrow leaves.
Flowers: Small and grouped in panicles (flowering clusters).

Distribution of Rice:

Geographical Range: Rice is grown in tropical and subtropical regions, particularly in Asia, Africa, and Latin America.
Major Producers: China, India, Indonesia, Bangladesh, and Vietnam.
Climate Requirements: Rice requires warm temperatures, abundant water (often grown in flooded fields, known as paddy fields), and long growing seasons.

Cultivation of Rice:

Land Preparation: Fields are flooded and leveled to create paddy fields.

Planting: Rice can be grown from seeds or seedlings, typically planted in early spring.
Growth Stages: Germination, vegetative growth, flowering, and ripening.
Irrigation: Essential for most rice cultivation, ensuring rice fields remain flooded for most of the growing season.

Harvesting:

Maturity: Rice is harvested when the grains are fully mature but not overripe.
Methods: Can be done manually (by hand) or using machines (combine harvesters).
Post-Harvest: Grains are dried, hulled, and processed.

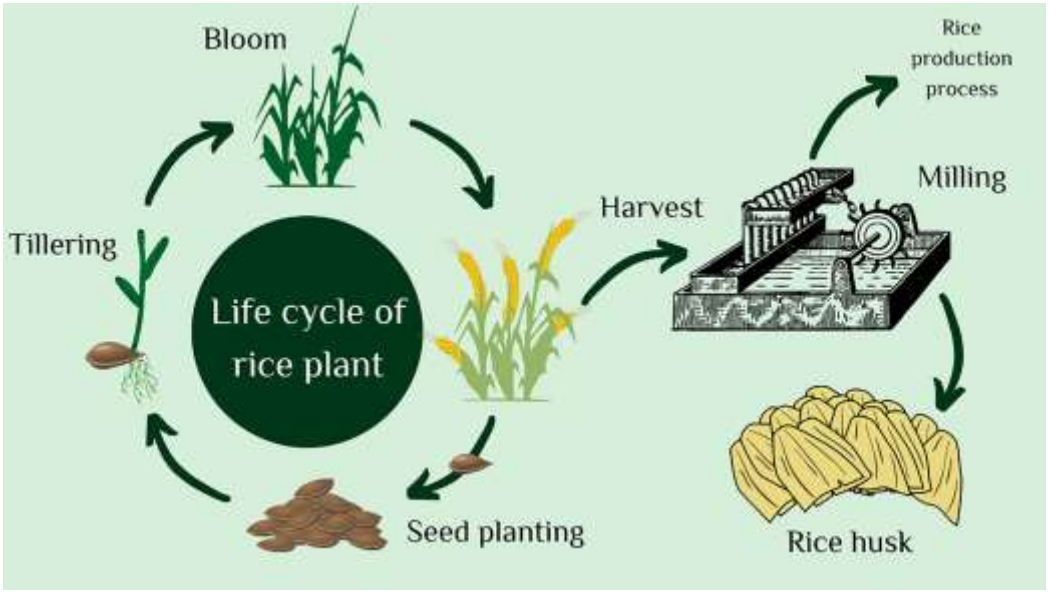
Economic and Nutritional Values of Rice:

Economic Value: Rice is a major staple crop in many countries, providing livelihood to millions of farmers. It is integral to global trade and food security.
Nutritional Value: Rich in carbohydrates, a good source of energy. White rice is a primary source of calories in many countries, although brown rice has more fiber and nutrients.
By-products: Rice husks and straw are used as animal feed, fuel, and in construction.

Bloom's Taxonomy Level: Understand & Apply

2.4. Key terms: Rice, Oryza sativa, Paddy Fields, Irrigation, Cultivation Stages, Economic Value, Nutritional Value.

2.5 Key Diagrams



3. Discussion / Interactive Activity

Engage students in applying and analyzing the process. Encourage creativity and deeper understanding.

Objective: Students will discuss how different climatic conditions affect rice production in different parts of the world.

Task: Divide students into small groups, each representing a different rice-growing region (e.g., Southeast Asia, Sub-Saharan Africa, South America).
Discussion Points:

- Identify the environmental factors critical for rice cultivation in each region?
- Analyse how do these regions handle challenges like water scarcity or extreme weather events?
- Discuss the methods for improving rice yields or expanding rice cultivation in these regions.

4. Mind Map

- **Rice** in the center.
- Branch out to: Botanical Description, Distribution, Cultivation, Harvesting, Economic Importance, Nutritional Value, Environmental Factors.
- Encourage students to fill out the mind map as the lesson progresses, helping them organize the material.

5. Summary and Conclusion

Summary: Review the key points about rice's botanical features, its distribution, cultivation practices and both its economic and nutritional importance.

- Emphasize rice's global significance as both a food crop and a driver of economies in several countries.

Evaluation: Ask students to evaluate how rice contributes to food security in their own country or a region of their choice. Have them suggest strategies to enhance rice production or sustainability.

Bloom's Taxonomy Level: Evaluate

6. Assessment

Multiple Choice Quiz: Include questions like:

1. What family does rice belong to?
2. Which of the following regions is not a major rice-producing area?
3. Describe the role of irrigation in rice cultivation.

Short Answer: Discuss the benefits of rice as a staple food crop in terms of its economic and nutritional value.

Group Presentation: Have groups present their ideas on improving rice cultivation in regions with water scarcity.

7. Questions

Encourage open questions from students regarding the topics.

1. Engage in a discussion about rice's role in their countries and how it might change in the future with evolving agricultural practices or climate change.

8. References

1. Pandey, BP. (1999). Economic Botany. New Delhi: S. Chand.
2. Sharma, OP. (1996). Hills Economic Botany. New Delhi: Tata Mc Graw Hill. Co. Ltd.

9. Extension Activities

- Field Visit: Visit to a local rice farm (if applicable) to observe rice cultivation firsthand.
- Research Assignment: Research the history of rice domestication and write a report on how rice has impacted global economies.
- Case Study: Examine a region facing challenges in rice production (e.g., water shortages, pests) and propose solutions for overcoming these challenges.

Verified by Subject Expert

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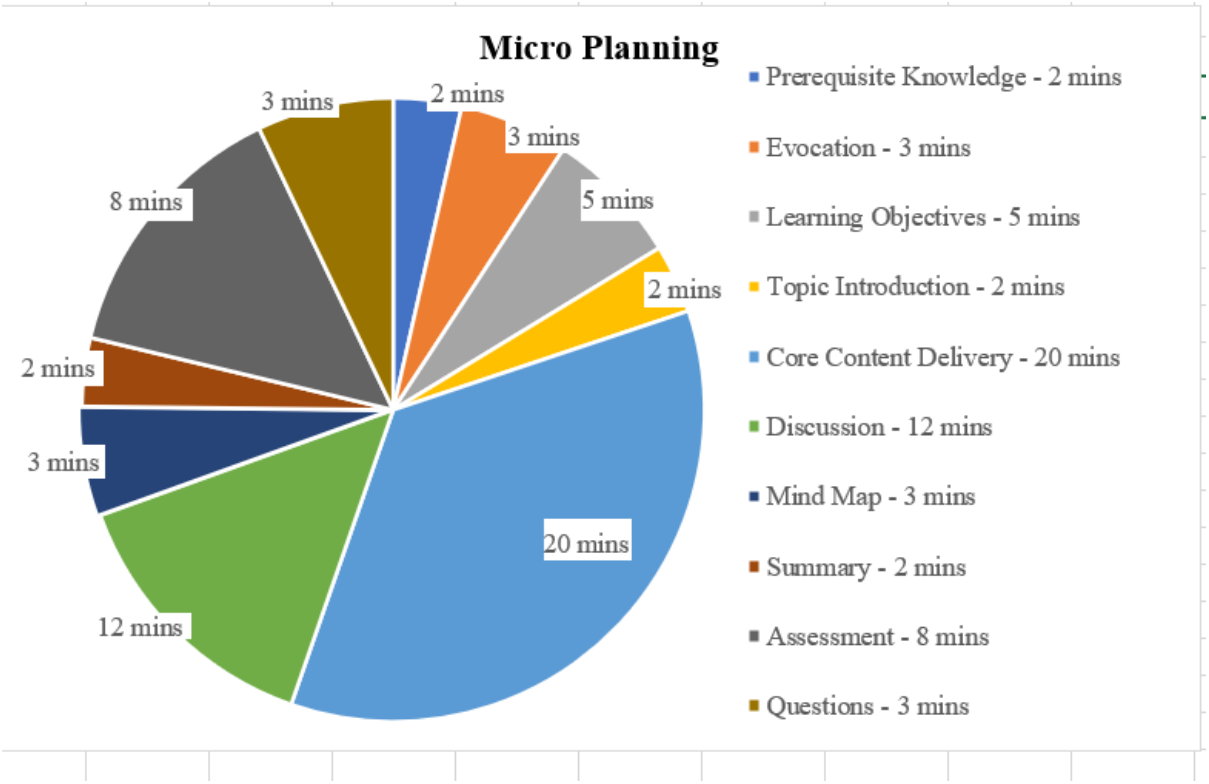
LESSON PLAN

Objective Oriented Learning Process RBT

Programme	B.Sc. Botany
Semester	IV
Subject Title	Core: Taxonomy of Angiosperms and Economic Botany
Code	21UBOC41
Hours	4
Total Hours	60
Credits	4
Max Marks	100
Unit & Title	Unit: I – Stipules and its types
Name of the Faculty	Ms. S. Pauline Jenifer
T-L tools	Lecture method, **Visual aid**: PPT, Picture showing the types of inflorescences

Micro -planning



Prerequisite Knowledge:

The teacher will ask the students some basic questions about parts of a leaf to know the level of their knowledge about leaves

1. Topic for Learning through evocation

The teacher will evocate the class by asking basic question like Have you noticed the variation in leaves? Have you noticed a prickling feel when you touch the leaf base? Have you

seen how pea plant attach on the neighbouring plants for support? Can you name that part?

2. Lesson Outline

2.1.Learning Objectives

By the end of the lesson, students will be able to:

1. **Remember**: Define stipules and list their functions.
2. **Understand**: Explain the significance and structural variations of stipules.
3. **Apply**: Identify and classify stipules in various plants.
4. **Analyze**: Compare the types of stipules and their adaptive significance.
5. **Evaluate**: Assess the ecological and evolutionary significance of stipules in plant morphology

2.2. Topic Introduction

1. Engage students and activate prior knowledge.
2. Start with a question: *"Have you noticed small leaf-like structures at the base of a leaf stalk? What could be their role?"*
3. Show a real plant or image highlighting stipules.

Bloom's Level: Remember

2.3.Core Content Delivery

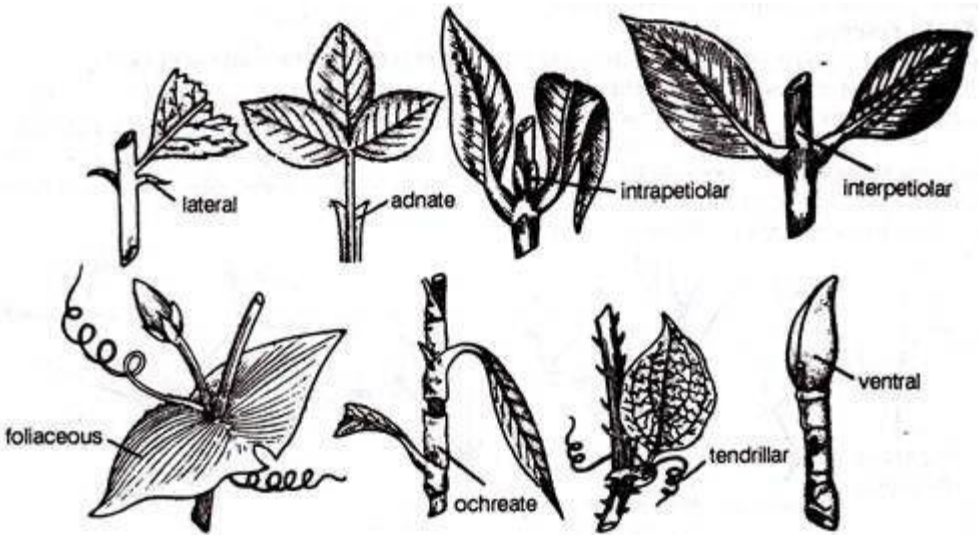
1. Provide students with foundational knowledge about fossils.
2. **Definition**: Outgrowths at the base of a petiole or leaf stalk.
3. **Functions of Stipules:** Protection of leaf buds, photosynthesis (in some cases), and support.
4. **Types of Stipules**:
    a) **Free Lateral Stipules**: Separate, lateral structures (e.g., Hibiscus).
    b) **Adnate Stipules**: Fused to the petiole (e.g., Rose).
    c) **Intrapetiolar Stipules**: Between the petiole and stem (e.g., Ixora).
    d) **Interpetiolar Stipules**: Between petioles of opposite leaves (e.g., Rubiaceae family).
    e) **Ochreate Stipules**: Tubular structures encircling the stem (e.g., Polygonum).
    f) **Tendrillar Stipules**: Modified as tendrils for climbing (e.g., Smilax).
    g) **Spiny Stipules**: Modified as spines for protection (e.g., Acacia).
5. Use diagrams and real-life examples to explain each type.

Bloom's Level: Remember, Understand

2.4.Key words:

Stipules, tendril, spines, adnate stipule, free lateral stipule

2.5. Key diagrams (if any):

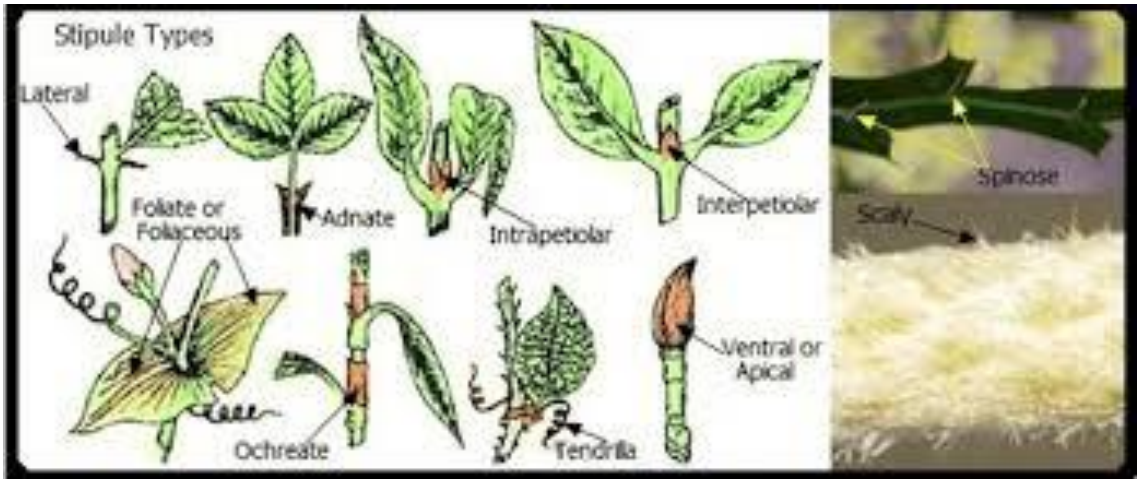


3. Discussion/Interactive activity

1. Foster critical thinking and assess understanding.
2. Discussion question: Why do some plants have stipules while others don't?
3. How do stipules contribute to the survival of plants in different environments?
4. Summarize key points using a chart or flow diagram of stipule types and examples.

Bloom's Level: Analyze, Evaluate

4. Mind Map:



5. **Summary:**

Students will be asked to identify the types of stipules by using the mind map..

6. **Assessment through Stimulating questions/Analogy/New ideas and Concepts:**

Formative: Participation in the plant observation exercise and group discussion.

Summative: Quick quiz to test understanding of key concepts.

7. **Questions:**

Identify the type of stipules surrounds the stem like a sheath

(a) Foliaceous stipules (b) Ochreate stipules (c) Tendrillar stipules (d) Spiny stipules

Find out the primary function of stipules

(a)Photosynthesis (b) Protection of young leaves or buds (c) Absorption of nutrients (d) Reproduction

Mention the type of stipules which are modified into spines

(a) Foliaceous stipules (b) Ochreate stipules (c) Tendrillar stipules (d) Spiny stipules

Identify in which type of stipules they resemble small leaves

(a) Foliaceous stipules (b) Ochreate stipules (c) Tendrillar stipules (d) Spiny stipules

8. **References**

1. Pandey B.P. *Taxonomy of Angiosperms*. New Delhi: S.Chand & Company Ltd., 2005
2. Shukla P. and Misra S.P. *An introduction to Taxonomy of angiosperms*. New Delhi: Vikas Pub. House Ltd., 1997.
3. Vashista P.C. *Taxonomy of Angiosperms*. New Delhi: Vikas Publications, 1985.

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M- Glory

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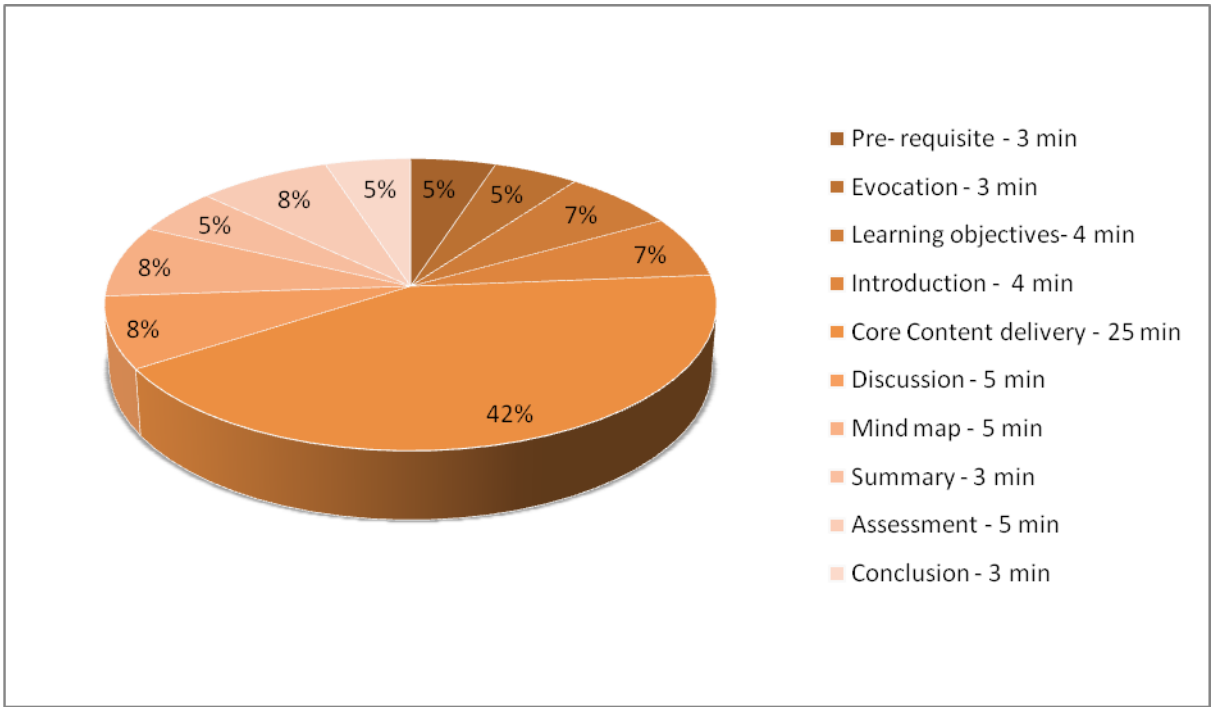
LESSON PLAN

Objective Oriented Learning Process RBT

Programme	II Allied (Zoology)
Semester	IV
Course Title	Allied: Taxonomy of Angiosperms and Plant Physiology
Code	21UBOA41
Hours	4
TotalHours	60
Credits	4
MaximumMarks	100
Unit&Title	Unit: I – Parts of a flower
Name of the Faculty	Dr. F. Dayana Lobo
T-L tools	Lecture method, **Visual aid**: PPT, Videos
Lecture Duration	60 minutes

Micro-planning



Prerequisite Knowledge: Quick Brain storm: Ask students what they already know about the flower and its parts

1. Topic for Learning through evocation

Flowers are complex structures made up of several key parts, each with specific functions. Here are the
main components:

Petals: These are often colorful parts that attract pollinators. They can vary in shape, size, and arrangement.

Sepals: These are the green, leaf-like structures that protect the developing flower bud. They are usually located beneath the petals.

Stamen: This is the male reproductive part of the flower, consisting of:

Anther: The part that produces pollen.

Filament: The stalk that supports the anther.

Pistil: This is the female reproductive part, which consists of:

Stigma: The top part that receives pollen.

Style: The slender tube connecting the stigma and the ovary.

Ovary: The structure that contains the ovules (which develop into seeds after fertilization).

Ovule: The structure within the ovary that develops into a seed after fertilization.

Receptacle: The thickened part of the stem where the flower parts are attached.

Peduncle: The stalk that supports the flower.

2. Lesson Outline

2.1. Learning Objectives

By the end of this lesson, students will be able to:

1. **Remember** the parts of a flower (Calyx, Corolla, Androecium and Gynoecium)
2. **Understand** the functions of each part of a flower. For example, petals attract pollinators, and the ovary contains ovules that develop into seeds.
3. **Apply :** Illustrate or label a diagram of a flower, correctly identifying each part and its function.
4. **Analyze** : Compare and contrast the reproductive structures of different types of flowers (e.g., angiosperms vs. gymnosperms)
5. **Evaluate** the importance of flower parts in the process of pollination and reproduction.
6. **Create** a unique flower by combining characteristics of various flowers, explaining how the parts of your flower contribute to its reproductive success.

2.2. Introduction to the topic

1. Introduce the topic and use prior knowledge.
2. Ask students to identify the parts of a flower
3. Discuss the parts of flower

Bloom's Taxonomy Level: Remember &Understand

2.3. Core Content Delivery

1. Calyx

The calyx is the collective term for the outermost whorl of flower parts, which are typically green and leaf-like structures called **sepals**. Sepals free – polysepalous, united – gamosepalous. The primary function of the calyx is to protect the developing flower bud before it opens and, in some cases, to support the flower once it blooms.

2. Corolla

The corolla is the second whorl of flower parts, comprised of **petals**. The corolla is often colorful and attractive, serving to attract pollinators like bees, butterflies, and birds. The arrangement and shape of the petals can vary greatly between species and are essential for the reproductive success of the plant.

3. Androecium

The androecium refers to the male part of the flower, which consists of the **stamens**. Each stamen typically includes an **anther** (where pollen is produced) and a **filament** (the stalk that supports the anther). The androecium plays a crucial role in reproduction by facilitating the production and release of pollen.

4. Gynoecium

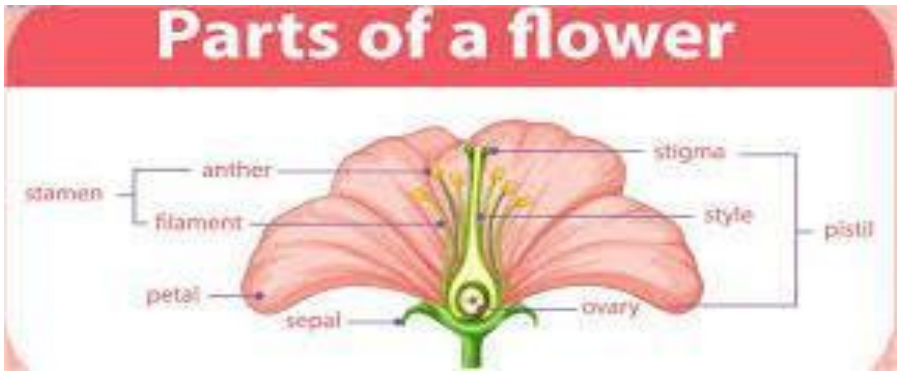
The gynoecium is the female part of the flower and includes the **carpels** (or pistils). Each gynoecium can consist of one or multiple carpels, which include the **ovary** (containing ovules, where seeds develop), **style** (the stalk that connects the ovary to the stigma), and **stigma** (the receptive tip where pollen lands). The gynoecium is essential for seed production.

Bloom's Taxonomy Level: **Understand &Apply**

2.4. Key Terms:

Briefly introduce key terms like sepal. Petal, androecium, gynoecium, anther, filament, ovary, style, stigma, aestivation, placentation, gamosepalous, polypetalous

2.5. Key Diagrams



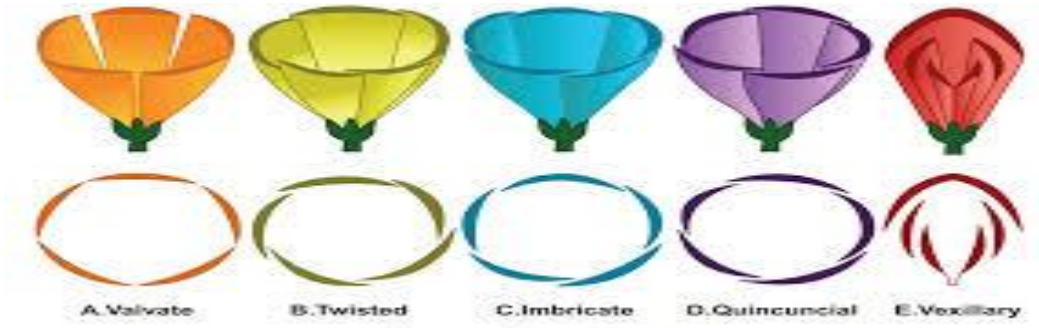
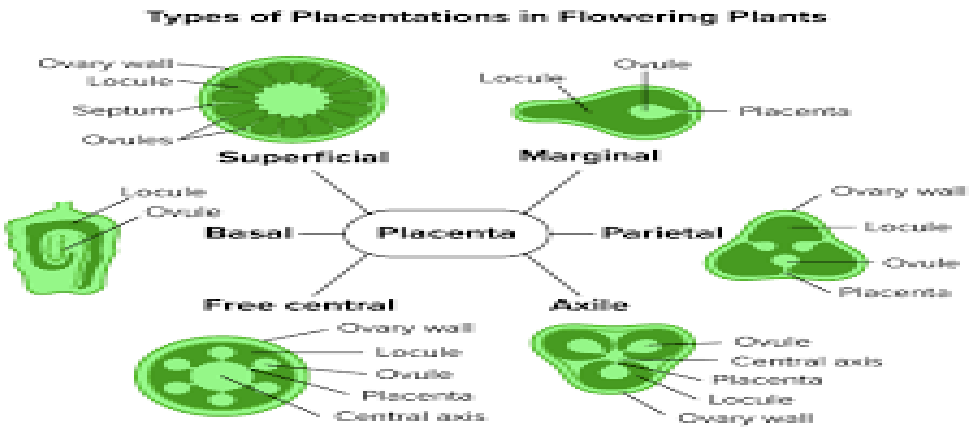


Figure 4.22: Aestivation



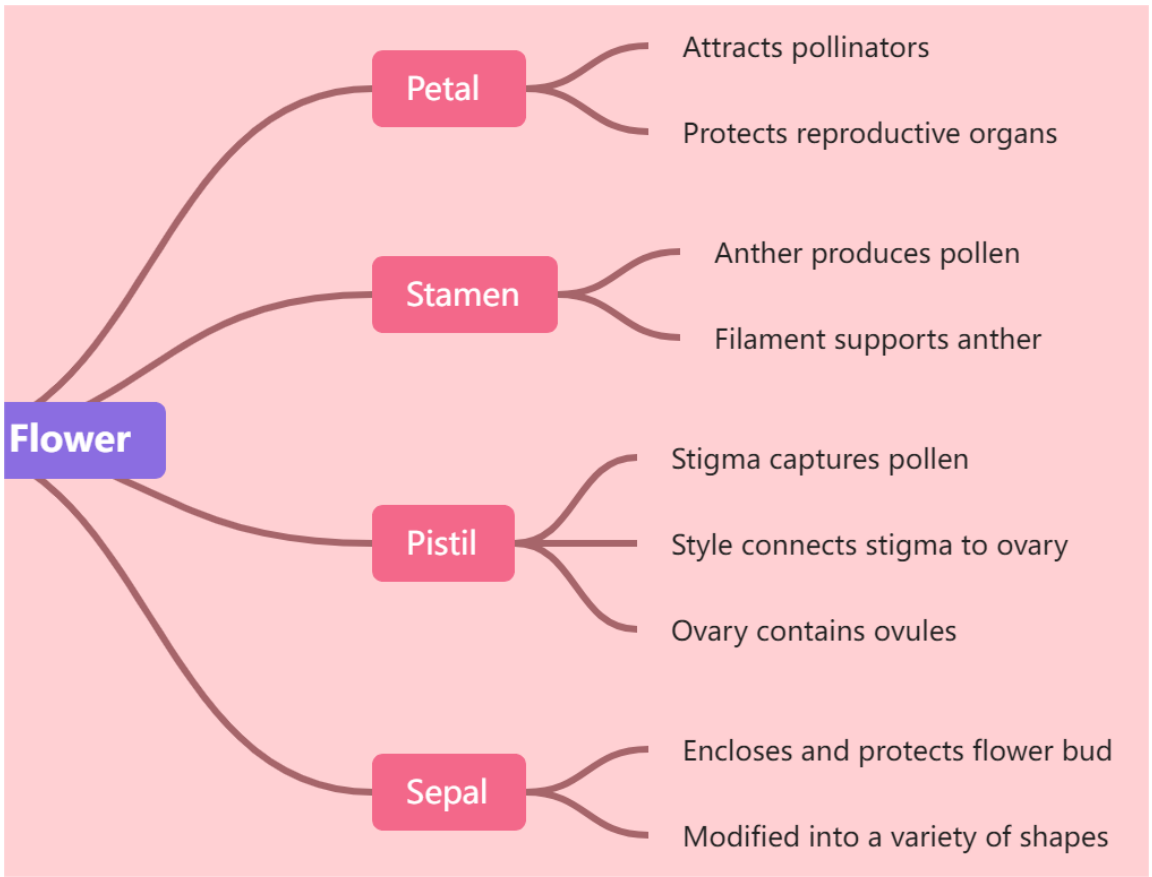
3. Discussion / Interactive Activity

Engaging students to identify the Parts of a flower, aestivation , placentation

Group Work: Plant Identification: Organize a field trip to identify the different types of flower

Bloom's Taxonomy Level: **Apply & Analyze**

4. Mind Map:



5. Summary and Conclusion

Together, these structures constitute the essential reproductive parts of a flower. The way these components interact is critical for the process of fertilization and ultimately for the development of fruits and seeds.

Encourage students to study more about different types of flowers and their characters

Bloom's Taxonomy Level: **Evaluate**

6. Assessment

Formative: Participation in group activities, diagrams, and discussions.
Summative:

1. A short quiz on parts of flower

7. Questions

Find the male reproductive part of a flower
(a) Stigma (b) Anther (c) Pistil (d) Stamen
Identify the structure connects the stigma to the ovary
(a) Style (b) Anther (c) Corolla (d) Peduncle
Recall the collective term of all the petals of a flower
(b) Style (b) Anther (c) Corolla (d) Peduncle
Describe the parts of flower

8. References:

1. Gurcharan Singh. (2012). *Plant Systematics*. New Delhi: Oxford & IBH Publishing Company, 2012.
2. Sharma, O.P. (1993). *Plant Taxonomy*. New Delhi: Tata Mc Graw Hill Publishing Co .Ltd
3. Pandey, S.N. and Misra S.P. (2008).*Taxonomy of Angiosperms*. New Delhi: Ane Books. India.

9. Extension Activities:

Research task: Investigate the different types of flower
Advanced task: How flowers interact with their pollinators

Verified by Subject Expert

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LESSON PLAN

Objective Oriented Learning Process RBT

Programme	B.Sc. Botany
Semester	IV
Subject Title	Food Technology
Code	21UBON41
Hours	2
Total Hours	30
Credits	2
Max Marks	100
Unit & Title	Unit: I – spoilage of vegetables
Name of the Faculty	Dr.S. B.Maria Sumathi
T-L tools	Lecture method, **Visual aid**: PPT, Picture showing spoiled vegetables
Lecture Duration	60 minutes

Micro-planning

Prerequisite Knowledge: Quick Brainstorm: **(2 min)**
The teacher asked the students to answer the question "what are the various causes of spoilage of vegetables'?

1.Topic for Learning through evocation (3 min)

The teacher asked the students about the disadvandages of spoilage of vegetable and its health issues

2.Lesson Outline: spoilage of vegetables

2.1.Learning Objectives (5 min)

By the end of this lesson, students will be able to:

1. **Remember** the concept of vegetable spoilage and its causes.
2. **Understand** the processes and factors contributing to vegetable spoilage.
3. **Apply** knowledge to identify spoilage symptoms in different vegetables.
4. **Analyze** the role of microorganisms and environmental factors in vegetable spoilage.
5. **Evaluate** strategies to prevent or reduce spoilage in vegetables.
6. **Create** a flowchart or diagram illustrating the spoilage process and prevention methods.

2.2. Introduction to the topic (5 min)

1) Begin with a question: *"What happens when vegetables are left outside the refrigerator for several days?"*
2) Show spoiled vegetables (images or physical samples) and ask students to identify visible signs of spoilage (e.g., discoloration, softening, mold).
3) Define vegetable spoilage and highlight its economic and health impacts.

Bloom's Taxonomy Level: Remember

2.3.Core Content Delivery: (20 min)

1. Teach the factors and mechanisms behind spoilage of vegetables in detail.

- **Biological Factors:**
  - Microorganisms (bacteria, fungi) causing decay.
  - Enzymatic actions leading to tissue breakdown.
- **Environmental Factors:**
  - Temperature, humidity, oxygen availability.
- **Physical Factors:**
  - Bruising or mechanical damage during handling and storage.

2. Effects of Spoilage

- Nutritional loss (reduction in vitamins, minerals).
- Formation of harmful by-products (e.g., toxins from fungal contamination).
- Economic loss in food supply chains.

3. Prevention and Control of Spoilage

- **Storage Practices:**
  - Refrigeration, humidity control, proper ventilation.
- **Handling Techniques:**
  - Gentle handling, avoiding bruising.
- **Preservation Methods:**
  - Use of natural preservatives (e.g., vinegar, salt).
  - Packaging techniques (e.g., vacuum sealing).

Bloom's Taxonomy Levels: Understand, Apply

2.4.Key Terms: Briefly introduce key terms like Biological Factors, Environmental Factors, Physical Factors

2.5.Key Diagrams

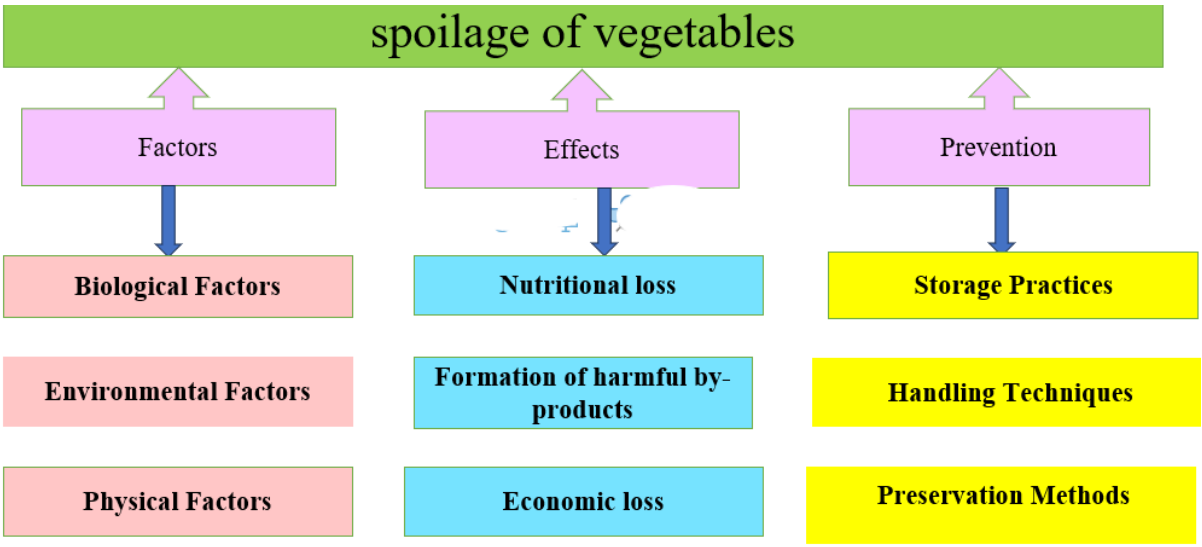


3. Discussion/ interactive Activity (8 min)

1. Discuss real-life examples (e.g., moldy tomatoes, slimy spinach) and identify the primary cause of spoilage in each case.
2. Present a case study on spoilage in a specific vegetable (e.g., potatoes affected by *Phytophthora infestans*) and discuss its implications.
3. Group task: Propose a storage and handling plan for a specific vegetable (e.g., leafy greens, tomatoes).
4. Encourage students to include practical solutions like packaging innovations.

Bloom's Taxonomy Levels: Analyze, Evaluate

4. Mind Map (3 min)



5. Summary and Conclution (6 min)

- Ask students to create a flowchart or infographic showing:
  - Causes of vegetable spoilage.
  - Effects on quality and health.
  - Prevention and control methods.
- Use markers and chart paper or digital tools for creativity.

Bloom's Taxonomy Levels: Create

6. Assessment (8 min)

Formative Assessment:

1) Monitor student engagement during discussions and group tasks.
2) Provide feedback on their flowcharts or infographics for accuracy and clarity.

Summative Assessment:

- A short quiz with questions such as:
  - Define vegetable spoilage and its causes.
  - Identify three microorganisms responsible for spoilage.
  - Explain the role of temperature in spoilage prevention.
  - Evaluate the effectiveness of vacuum packaging for spoilage control.

7. Questions

Name the toxic material produced by the fungus

(a) Mycotoxin (b) Zymase (c) riboflavin (d) glucosinolate

Find the main cause of wilting in fresh vegetables

(a) Loss of moisture (b) Incorrect temperature (c) Careful handling (d) Incorrect storage

8. References

1. Kulshrestha S.K. Food preservation. New Delhi: Vikas publishing House. 1994.
2. Srivastava R. P. Preservation of fruits and vegetable products. Dehra Dun: Bishen Singh Mahendra Pal Singh, 1982. 5. Srivastava R. P. and Kumar
3. Fruit and Vegetable Preservation: Principles and Practices. Lucknow: International Book Distributing Co., 2002.

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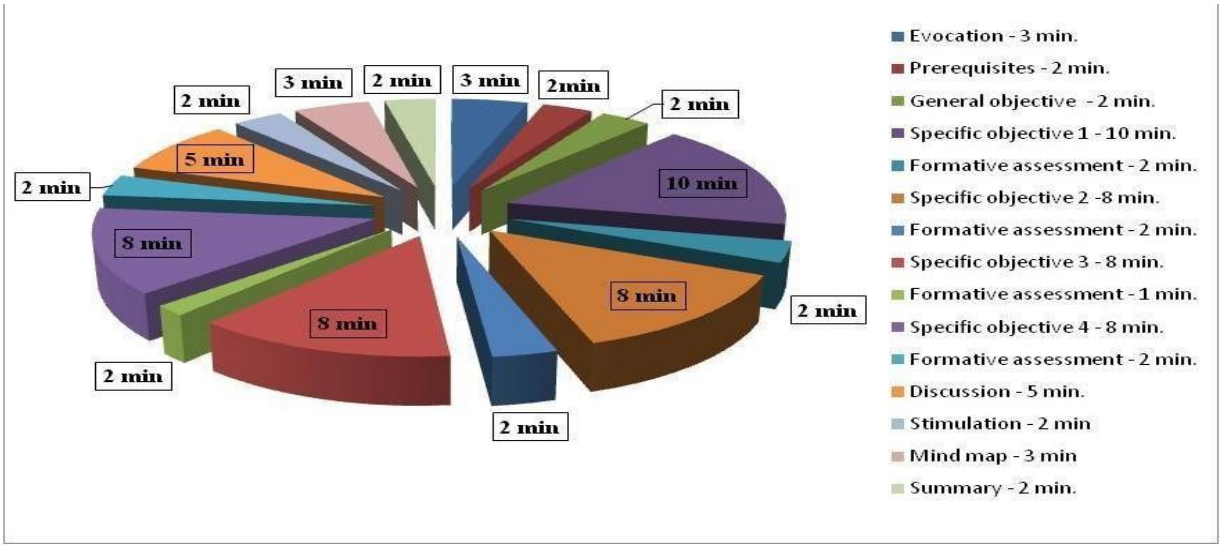
LESSON PLAN

Objective Oriented Learning Process RBT

Programme	B.Sc. Botany
Semester	V
Subject Title	Biotechnology
Code	21UBCC51
Hours	4
Total Hours	60
Credits	3
Max Marks	100
Unit & Title	Unit I - plant viral vector - CaMV
Name of the Faculty	Dr. S. Beulah Jerlin
T-L tools	Lecture method, Audio Visual aid-video

Prerequisite Knowledge: Structure and Function of CaMV

Microplanning : 60 Minutes



1. **Topic for Learning through evocation**

   "Have you ever wondered how scientists create genetically modified crops like pest-resistant cotton or vitamin-enriched rice?" The tools like *plant viral vectors*—biological "vehicles" used to deliver specific genes into plants. "One of the most important tools for this is the Cauliflower Mosaic Virus (CaMV), a plant virus that's been turned into a helper for genetic engineering." Today we are going to learn about CaMV.

2. Topic Introduction

Plant viruses are viruses that affect plants. Like all other viruses, plant viruses are obligate intracellular parasites that do not have the molecular machinery to replicate without a host. Plant viruses are pathogenic to higher plants. Cauliflower mosaic virus (CaMV) is a plant virus that infects brassica plants like cauliflower and turnips. Cauliflower mosaic virus (CaMV) is a member of the genus *Caulimovirus*, one of the six genera in the family *Caulimoviridae.*

3.1. General Objective

1. Understand the role of plant viral vectors in genetic engineering.
2. Study the structure, replication, and utility of Cauliflower Mosaic Virus (CaMV) as a plant viral vector.
3. Discuss the applications and limitations of CaMV in plant biotechnology.

3.2. Specific Objectives:

Enables the students to describe the

General characteristics: Double-stranded DNA virus, circular genome.

Natural host: Cruciferous plants like cauliflower, cabbage, and broccoli.

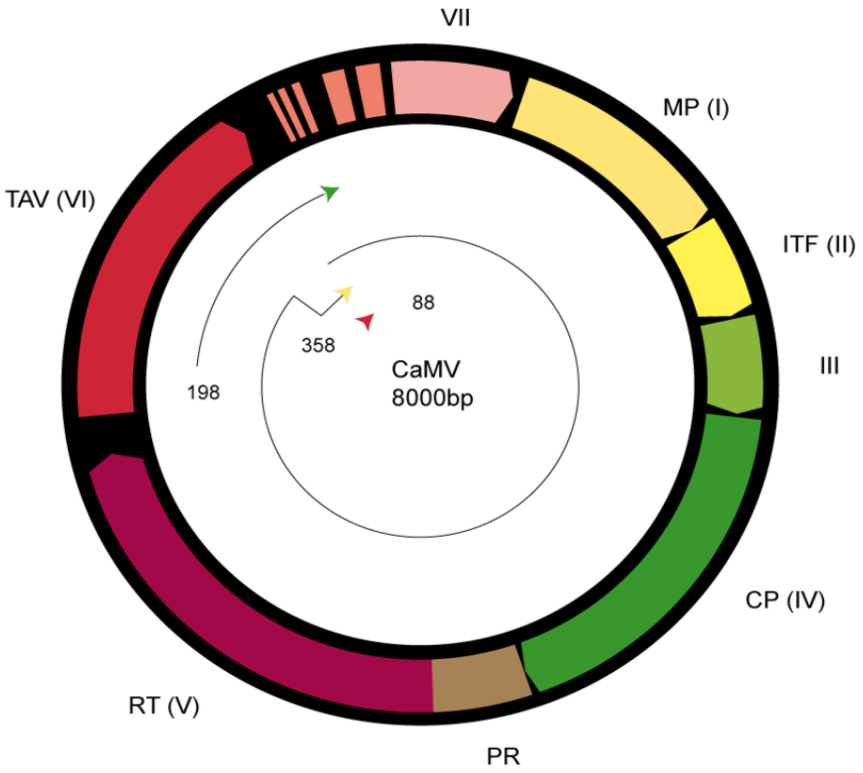
Importance: Widely used as a vector for gene delivery in plants.

3.3: Taxonomy of objectives

Taxonomy of Objectives						
Knowledge Dimension	**The Cognitive Process Dimension**					
	Remember	**Understand**	**Apply**	**Analyse**	**Evaluate**	**Create**
A. Factual Knowledge	1					
B. Conceptual Knowledge		1 & 2				
C. Procedural Knowledge				3,4		
D. Meta Cognitive Knowledge					2,3,4	

3.4 Key Word: Plant Virus, CaMV, Plant Viral Vector**,** Caulimo Virus, Cauliflower Mosaic Virus.

3.5 Key Diagrams:



s:

Structure and Genome Organization of CaMV

Examine the structural and genomic features of CaMV.

- **Structure:**
  - Icosahedral capsid.
  - Diameter ~50 nm.
- **Genome organization:**
  - Size: ~8 kb circular double-stranded DNA.
  - Key genes:
    - **P1-P6 proteins:** Functions in replication, encapsidation, and systemic infection.
    - **Promoter regions:** Use of the **35S promoter** in plant biotechnology.

Symptoms

CaMV can affect plant development, especially in early infections, and the production of flowers can be blocked

. • Low seed yields have also been reported from plants with CaMV infection.

• The virus can induce a range of systemic symptoms, such as:– chlorosis (loss of green leaf color),– mosaic(patches of light and dark green on leaves),– vein clearing (abnormal clear or translucent color of veins), and/or– stunting

• CaMV survives in Brassicaceae crop and weed hosts, including wild radish, turnip weed, canola, mustard, cauliflower, broccoli and cabbage, and weed hosts are known reservoirs for the virus outside the growing season.

• It has recently been shown that water stress can influence CaMV virulence and transmission:– under well-watered conditions, viral load, virulence, and transmission rate increased,– whereasunder water deficit, transmission rate, and virulence decreased.

Management

• The best way to minimize CaMV infection is to inhibit aphid contact with seedlings, which are very susceptible to virus infection.

• Seed beds can be isolated from aphids with a barrier of cereals or by growing the seedlings under insect-proof mesh.

• A barrier of cereals may act as a sink for the viruses and/or as a physical barrier, such that aphids will be more likely to land on the tall cereals first and lose their virus contents while probing.

• Pesticides are usually not an effective solution because aphids can transmit viruses before the pesticide has an effect.

• CaMV can also be transmitted mechanically by sap inoculation using contaminated hands and pruning tools.

• It has been shown that CaMV can stay for hours on surfaces such as doors, phones, and gloves, and can be exchanged by hand-shaking, so disinfecting tools, equipment, and anything that contacts plants will reduce infection.

CaMV as a Plant Viral Vector

Explain the role of CaMV in genetic engineering and plant biotechnology.

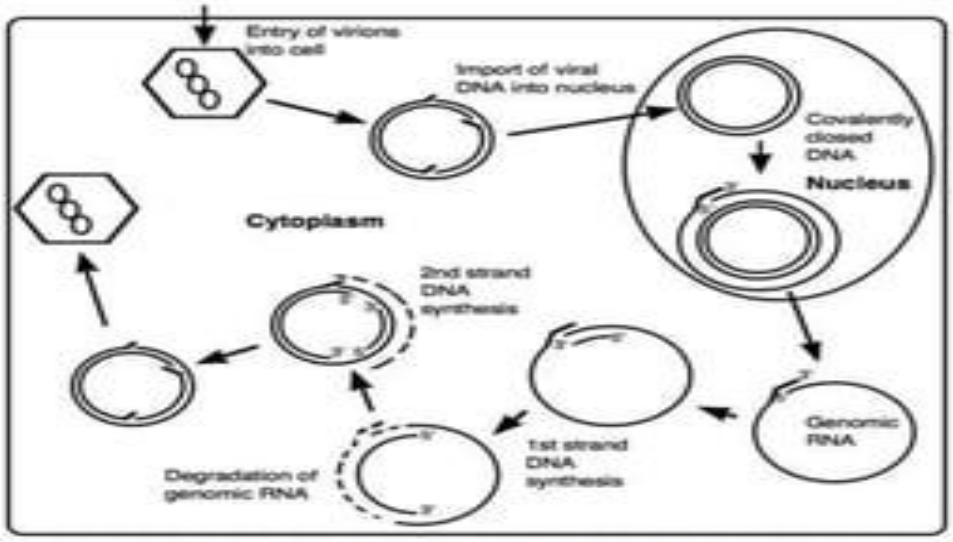
- **Key Features for Vector Use:**
    - Strong 35S promoter: Drives high-level expression of transgenes in plants.
    - Ability to infect a broad range of dicot plants.
- **Applications in Biotechnology:**
    - Expression of transgenes in plant systems.
    - Study of gene function and regulation.

- Production of genetically modified crops (e.g., pest resistance, improved yield).

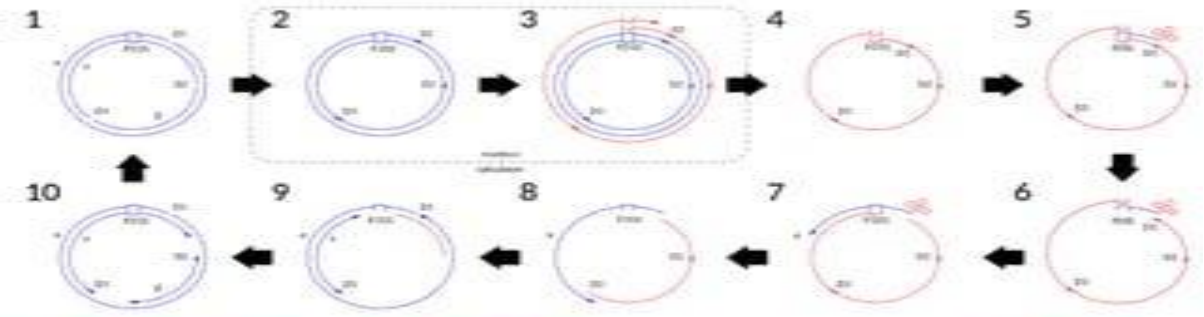
- **Methodology:**
  - Steps in using CaMV as a vector: Cloning, transformation, and expression.
  - Delivery methods: Agroinfiltration, particle bombardment.

Video Link: https://youtu.be/KKShbyZH5N8

4. **Mind Map**



Life cycle of Cauliflower Mosaic Virus



Replication of CaMV by reverse transcription

5.Summary and Discussion:

6. Assessment through Stimulating questions/Analogy/New ideas and Concepts

- How does the CaMV 35S promoter influence the success of transgenic plants?
- What measures can be taken to minimize risks associated with CaMV usage?
- Can you propose alternative plant viral vectors for research?

7. FAQ's

1. Identify the genetic material does CaMV Contains.

   (a) RNA (b)DNA (c)ds DNA (d) ss DNA

2. Find the genome size of CaMV

   (a) 8 Kilobases (b)10 Kilobases (c) 6 Kilobases (d) 4 Kilobases

3. name the substance presents on the surface of plant viruses.

   (a) Protein (b)Calcium (c) Nucleic Acid (d) Nickel

8. References

1. Sathyanarayana U. Biotechnology. Kolkata: Books And Allied (p) Limited, 2017.
2. Kumaresan, V. Biotechnology. Nagercoil:Saras Publication, 2010.

Verified by Subject Expert

Arockia Jeseelus Alphonse

Approved by HoD

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LESSON PLAN

Objective Oriented Learning Process RBT

Programme	B.Sc. Botany
Semester	V
Subject Title	Biochemistry
Code	21UBOC51
Hours	4
Total Hours	60
Credits	4
Max Marks	100
Unit & Title	Unit: V – classification of lipids
Name of the Faculty	Dr.S. B.Maria Sumathi
T-L tools	Lecture method, **Visual aid**: PPT, Picture showing the different structure of lipids
Lecture Duration	60 minutes

Micro-planning

Prerequisite Knowledge: Quick Brainstorm: **(2 min)**
Ask students what they already know about lipids and its functions

1.Topic for Learning through evocation (3 min)

The teacher asked the students about the different types of lipids . The teacher Asked simple question like 'What is lipid'?

2.Lesson Outline: classification of lipids

2.1.Learning Objectives (5 min)

By the end of this lesson, students will be able to:

1. **Remember** the definition, basic structure, and functions of lipids.

2. **Understand** the criteria for lipid classification based on chemical structure and function.
3. **Apply** the classification system to identify examples of lipids.
4. **Analyze** the structural diversity and functional significance of lipid classes.
5. **Evaluate** the importance of specific lipids in biological systems and health.
6. **Create** a diagram or flowchart to represent lipid classification visually.

2.2. Introduction to the topic (5 min)

1) Begin with a question: *"What do you know about lipids, and why are they essential for living organisms?"*
2) Show examples of lipids (fats, oils, phospholipids, cholesterol) to engage students.
3) Briefly discuss the role of lipids in energy storage, cell membranes, and signaling.

Bloom's Taxonomy Level: Remember

2.3.Core Content Delivery: (20 min)

1.Explain the main classes of lipids:

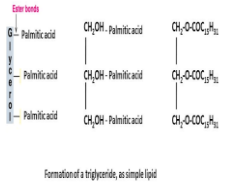
- **Simple Lipids:**
  - Esters of fatty acids with alcohols.
  - Examples: Fats (triglycerides) and oils, waxes.
- **Compound Lipids:**
  - Contain additional functional groups.
  - Examples: Phospholipids, glycolipids, lipoproteins.
- **Derived Lipids:**
  - Derived from hydrolysis of simple and compound lipids.
  - Examples: Steroids (cholesterol), carotenoids, fat-soluble vitamins.

2. Highlight the structural differences and functional significance of each type.
3. Use diagrams or a flowchart to explain the hierarchical classification of lipids.
4. Provide examples and ask students to classify them in real-time.

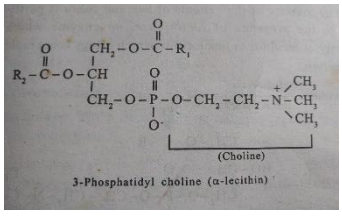
Bloom's Taxonomy Levels: Understand, Apply

2.4.Key Terms: Briefly introduce key terms like Simple Lipids, Compound Lipids, Derived Lipids

2.5.Key Diagrams



Formation of a triglyceride, as simple lipid



3-Phosphatidyl choline (α-lecithin)

Cholesterol

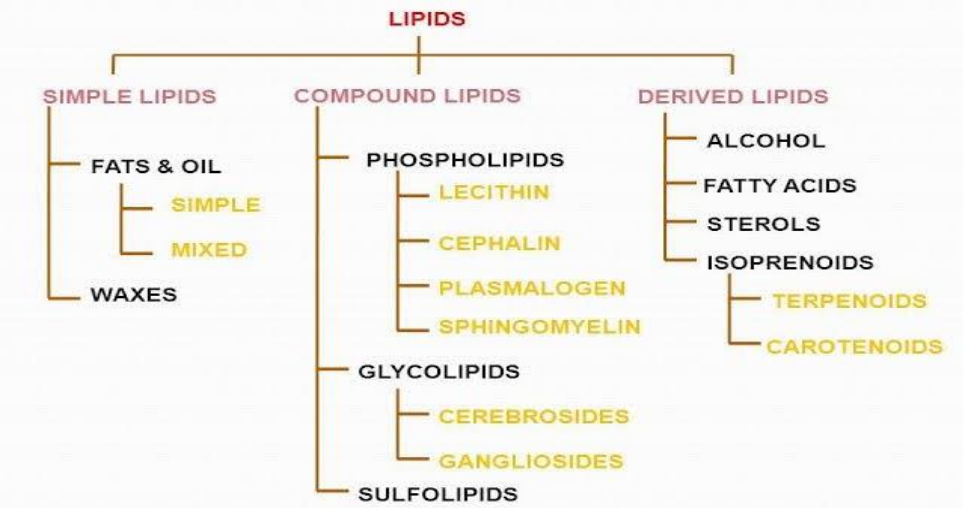
3. Discussion/ interactive Activity (8 min)

Engage the students to analyze and evaluate the structure and functions of lipids

1. How do the structures of fats, phospholipids, and steroids relate to their functions in cells?
2. Why are some lipids solid at room temperature (fats) while others are liquid (oils)?
3. Discuss the role of cholesterol in cell membranes and as a precursor for hormones.

Bloom's Taxonomy Levels: Analyze, Evaluate

4. Mind Map (3 min)



5. Summary and Conclution (6 min)

Ask the students to work individually or in small groups to create a diagram or infographic representing the classification of lipids. Encourage them to include examples and structures for each class and describe their biological significance.

Bloom's Taxonomy Levels: Create

6. Assessment (8 min)

Formative Assessment:

1) Monitor student participation during discussions and activities.
2) Review their diagrams for clarity, accuracy, and creativity.

Summative Assessment:

A short quiz with questions such as:

- Define lipids and list their primary functions.
- Differentiate between simple, compound, and derived lipids.
- Explain the role of phospholipids in cell membranes.
- Analyze the structural differences between fats and oils

7. Questions

Identify the composition of simple fat.

(a) a glycerol and three fatty acids (b) glycerol and two fatty acids

(c) glycerol and single fatty acids (d) one fatty acid and 3 glycerols.

Identify an example for simple lipids

(a) lecithin (b) wax (c) cephalins (d) none of the above

Find out glycolipid from the following

(a)cerebrosides (b) sphingomyelins (c) phenanthrene(d) lecithin

8. References

1. Jain J.L. Fundamentals of Biochemistry. New Delhi: S. Chand & Co., 2005.
2. Conn, E.I. and Stumpf P.K. Outlines of Biochemistry. Bombay: Wiley Eastern Ltd., 1996.
3. Lehninger A.L. Biochemistry. New Delhi: CBS Publishers, 1987.
4. Philip W., Kuchel and Ralston G.B. Biochemistry. New Delhi: Tata McGraw – Hill publishing company Ltd., 2003.

B. Maria Sundari

Verified by Subject Expert

Arockia Jeseelus Alphonse

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HOD of Botany
Mary's College (Autonomous)
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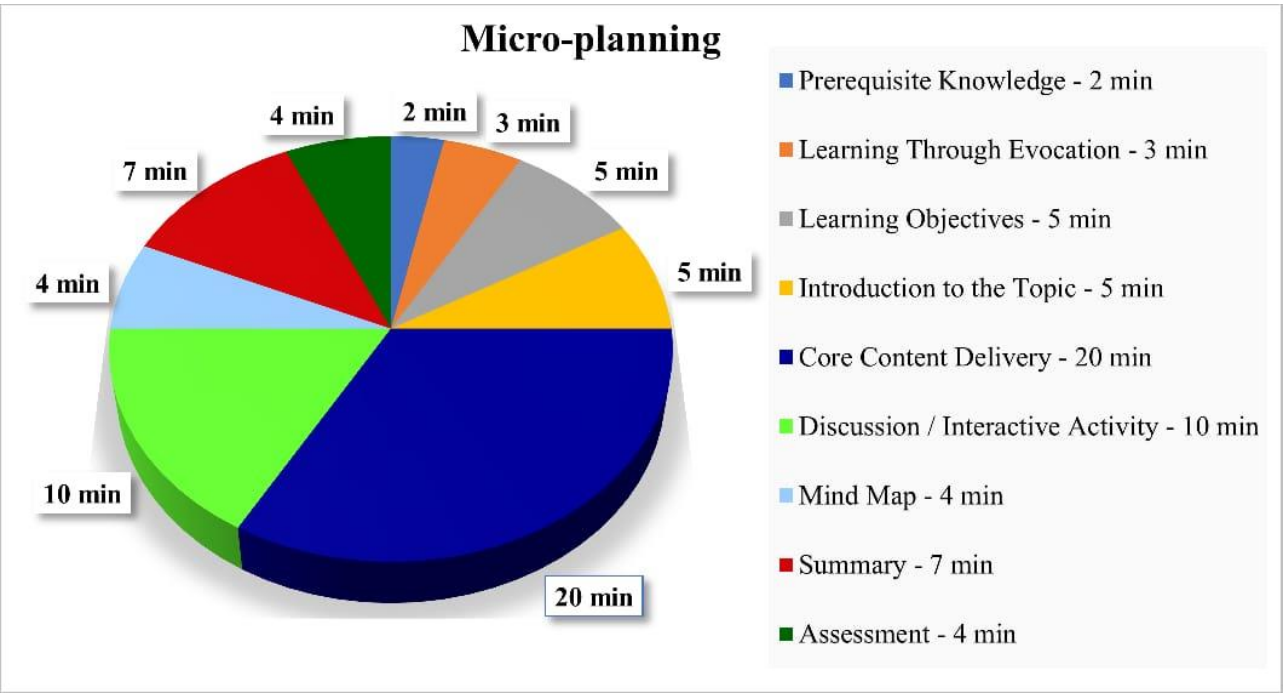
LESSON PLAN

Objective Oriented Learning Process RBT

Programme	B.Sc. Botany
Semester	V
Course Title	Core Ecology and Phytogeography
Code	21UBOC52
Hours	4
Total Hours	60
Credits	4
Maximum Marks	100
Unit & Title	Unit: II – Hydrophytes and its adaptation
Name of the Faculty	Dr. A. Jacintha Tamil Malar
T-L tools	Lecture method,PPT, Videos
Lecture Duration	60 minutes

Micro-planning



Prerequisite Knowledge: Quick Brainstorm: Ask students whether they have seen plants in water and tell the names of water plants.

1. Topic for Learning through evocation

Begin the lesson by asking an open-ended question:

"Have you ever wondered how plants like lotus or water hyacinth survive while floating on water or being completely submerged?"

Show images or videos of common hydrophytes (e.g., lotus, water lily, hydrilla).

Provide live specimens or pictures of hydrophytes. Let students observe key features like broad leaves, thin stems, and air spaces in leaves/stems

2. Lesson Outline

2.1. Learning Objectives

By the end of this lesson, students will be able to:

1. Remember: Define hydrophytes and list examples.
2. Understand: Explain the key adaptations of hydrophytes to survive in aquatic environments.
3. Apply: Identify adaptations in specific examples of hydrophytes.
4. Analyze: Differentiate between adaptations of hydrophytes, mesophytes, and xerophytes.
5. Evaluate: Assess the ecological significance of hydrophytes in aquatic ecosystems.
6. Create: Design a simple model or presentation showcasing hydrophyte adaptations.

2.2. Introduction to the topic

Start with a brainstorming question: "What kinds of plants can live in water, and how do they survive?"

Show images of different aquatic plants like water lily, lotus, and hydrilla.

Define hydrophytes and provide examples.

Bloom's Taxonomy Level: **Remember & Understand**

2.3. Core Content Delivery

Explain key features of hydrophytes:

1. **Floating leaves (e.g., water lilies).**
   Adaptation: Broad and flat leaves that float on the water surface.
   Maximizes surface area for sunlight absorption.
   Enhances photosynthesis in aquatic environments.
   Waxy coating on the leaf surface prevents waterlogging**.**
2. **Reduced or absent cuticle.**
   Example: Submerged plants like Hydrilla and Vallisneria.
   Adaptation: Thin or no protective waxy cuticle layer on the surface.
   Water availability is not a limitation, so there's no need for water conservation

3. **Aerenchyma for buoyancy.**
   Example: Water hyacinth, lotus.

   Adaptation: Spongy tissue in stems and leaves containing large air spaces.

   Provides buoyancy, allowing the plant to float or remain submerged without sinking.

   Facilitates gas exchange even in low-oxygen aquatic environments**.**

4. **Stomata on the upper surface of leaves.**
   Example: Water lilies.

   Adaptation: Stomata are located on the upper (exposed) surface of floating leaves.

   prevents stomata from being submerged, enabling effective gas exchange.

   Supports photosynthesis and respiration.

Bloom's Taxonomy Level: **Understand & Apply**

2.4. Key Terms: Briefly introduce key terms light, exchange og gas, buoyancy, stomata, floating, submerged and rooted.

2,5. Key Diagrams

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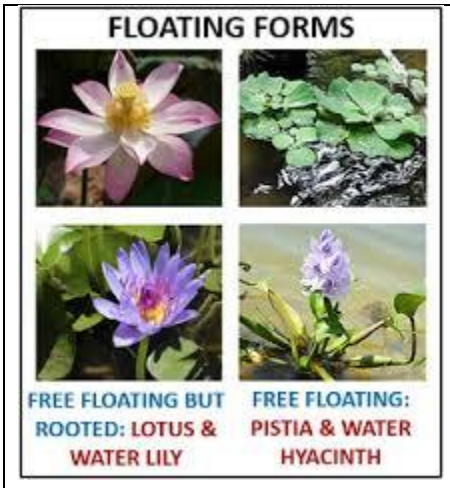
<td> 
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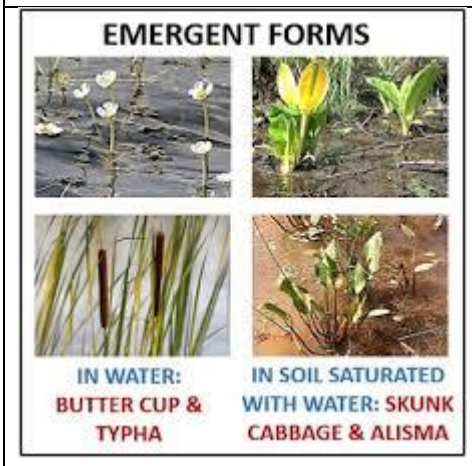
<td> 
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3. Discussion / Interactive Activity

Show diagrams of hydrophyte features (e.g., cross-section of aerenchyma, stomata placement on leaves).

Distribute a worksheet with the following:

- A table of plant features and their potential purposes.
- Students match the features to the correct hydrophyte adaptation.

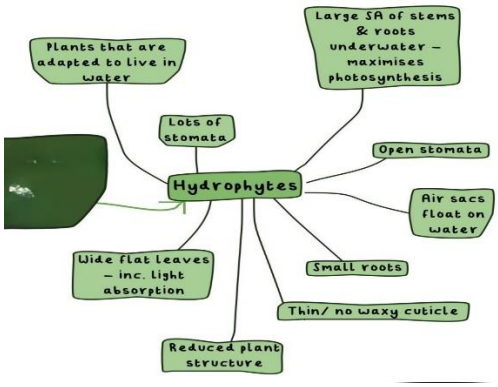
Ask questions like:

- "Why do you think submerged hydrophytes don't need a thick cuticle?"
- "How do air spaces in stems help water hyacinths float?"

Facilitate a short discussion to encourage participation.

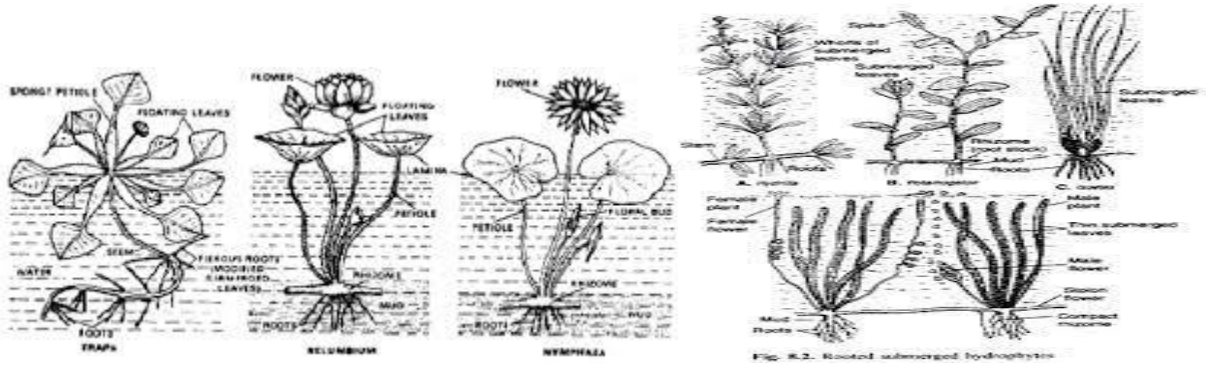
Bloom's Taxonomy Level: **Apply & Analyze**

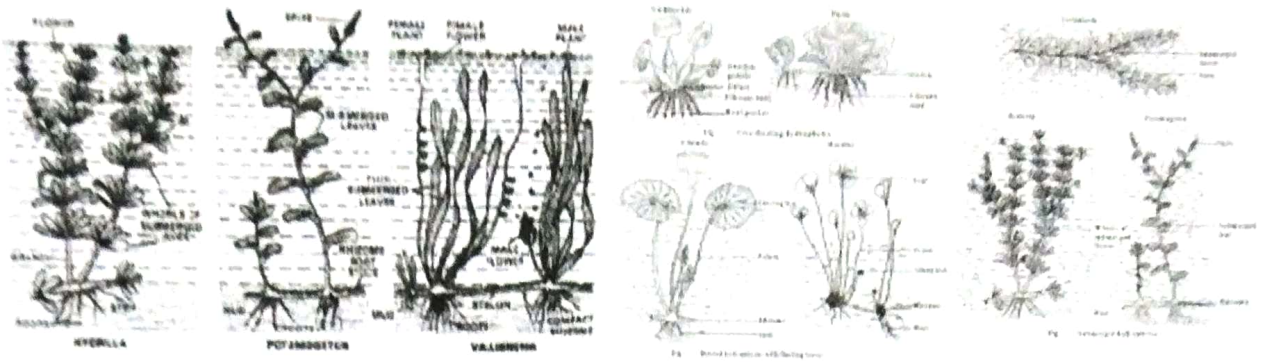
4. Mind Map



5. Summary and Conclusion

Summarize learning and evaluate understanding





Facilitate a discussion comparing adaptations of hydrophytes, mesophytes, and xerophytes.

Pose higher-order thinking questions like:

"Why are hydrophytes important for maintaining aquatic ecosystems?"

"What would happen to aquatic ecosystems if hydrophytes were removed?"

Bloom's Taxonomy Level: **Evaluate**

6. Assessment

Formative:

- Participation in brainstorming and group discussions.
- Accuracy of worksheet answers.

Summative:

- Quality and creativity of the final poster/model/presentation.

7. Questions

1, Identify which of the following is an example of a free-floating hydrophyte.

a) Lotus b) Hydrilla c) Duckweed d) Vallisneria

2. Find out the primary function of aerenchyma tissue in hydrophytes

a) Photosynthesis b) Water absorption c) Buoyancy and gas exchange
d) Nutrient storage

8. References

1. Sharma,P.D..Elements of ecology.Meerut:RastogiPublications,1999
2. Shukla,R.S.and Chandal,S.S.PlantEcology. NewDelhi: S.ChandandCo., 1991.

Extension Activities

- **Research task**: Observe a pond document the list of plants
- **Advanced task**: Draw the habit of the plants

Verified by Subject Expert

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LESSON PLAN

Objective Oriented Learning Process RBT

Programme	B.Sc. Botany
Semester	V
Course Title	Core VIII – Biostatistics and Bioinformatics
Code	21UBOC53
Hours	4
Total Hours	60
Credits	4
Maximum Marks	100
Unit & Title	Unit IV – Nucleic acid databases (NCBI, DDBJ and EMBL)
Name of the Faculty	Dr. Mary Santhi. R
T-L tools	Mind maps, PPT, video, think-pair- share
Lecture Duration	60 minutes

Micro-planning

Prerequisite Knowledge: Quick Brainstorming: Ask students what they know about databases specifically nucleic acid databases. Write the answers on the board.

1. Topic for Learning through Evocation

Topic: Nucleic Acid Databases (NCBI, DDBJ and EMBL)

2. Lesson Outline

2.1. Learning Objectives

By the end of this lesson, students will be able to:

1. **Remember** the key details about major nucleic acid databases (NCBI, DDBJ, and EMBL).
2. **Understand** the importance and functionalities of these databases.
3. **Apply** how to search for and retrieve nucleotide sequences from these databases.
4. **Analyze** the features of NCBI, DDBJ, and EMBL.
5. **Evaluate** the usefulness of each database for different research needs.
6. **Create** a simple bioinformatics workflow using the databases to retrieve relevant data.

2.2. Introduction to the Topic

1. Introduce the concept of nucleic acid databases and their role in modern molecular biology and bioinformatics.
2. Discuss the importance of databases in storing, organizing and sharing genetic information.
3. Briefly introduce the three major databases: NCBI (National Center for Biotechnology Information), DDBJ (DNA Data Bank of Japan) and EMBL (European Molecular Biology Laboratory).

Bloom's Taxonomy Level: Remember & Understand

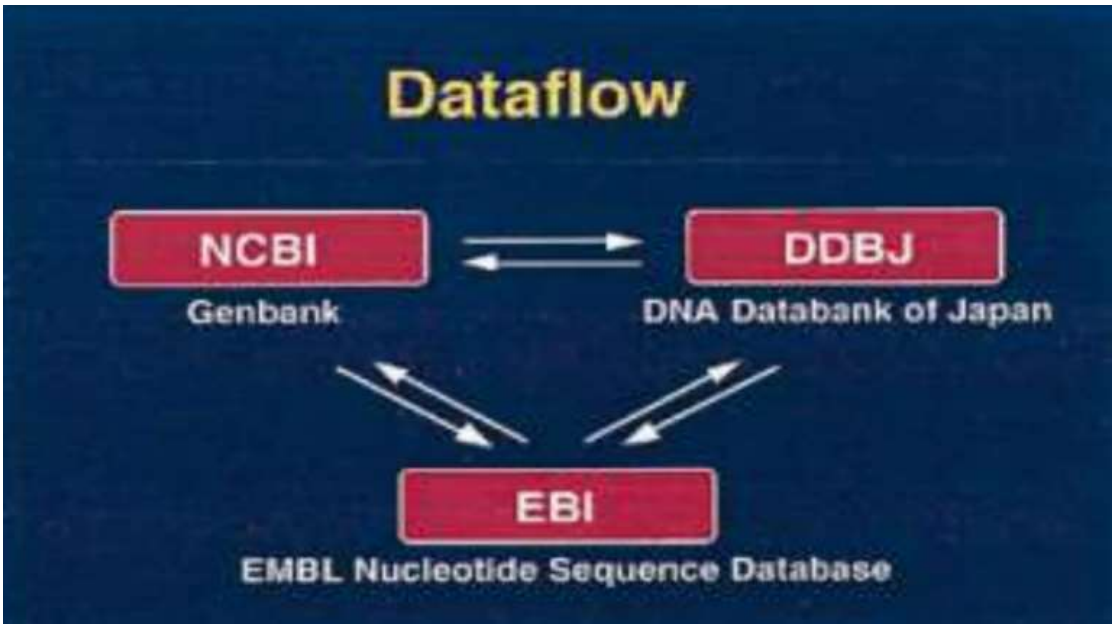
2.3 Core Content Delivery

- Detailed overview of each database's structure and function.
- Comparison of the three databases in terms of data types, submission processes, and access mechanisms.
- Discuss the types of nucleotide sequences available (e.g., mRNA, genomic DNA, expressed sequence tags).
- Explain how data is curated, maintained and updated in these databases.

Bloom's Taxonomy Level: Understand & Apply

2.4. Key terms: GenBank, EMBL, DDBJ, nucleotide sequences, sequence alignment, BLAST, Genomes, Bioinformatics tools.

2.5 Key Diagrams



3. Discussion / Interactive Activity

Engage students in applying and analyzing the process. Encourage creativity and deeper understanding.

1. Group Activity:

- Divide students into small groups.
- Each group will be given a task to search for a specific nucleotide sequence (e.g., gene of interest) using one of the three databases: NCBI, DDBJ, or EMBL.
- After searching, groups will answer questions related to their search results (e.g., how to refine a search, what filters to use, etc.).
- Encourage students to analyze and compare the different interfaces and data quality/quantity from each database.

4. Mind Map

- Create a mind map on the board or use a digital tool to visualize how NCBI, DDBJ, and EMBL relate to one another, highlighting common features, distinct features, and the type of data available.
- Include keywords such as 'Data Submission,' 'Search Tool,' 'Sequence Data,' and 'Collaboration’.

5. Summary and Conclusion

Summarize learning and evaluate understanding

- Recap key points discussed during the lesson.
- Encourage students to reflect on which database they might prefer using in their future research and why.
- Reinforce the importance of these databases for global collaboration in genomics and bioinformatics.

Bloom's Taxonomy Level: Evaluate

6. Assessment

Quiz with multiple-choice and short-answer questions to test understanding of the key differences between the databases, types of data available and search functionalities.

Example questions:

1. Identify the database in collaboration between Japan, the US and Europe?
2. Recall the type of nucleotide sequence data can be found in GenBank?
3. Analyze how would you use BLAST to compare sequences retrieved from EMBL?

7. Questions

Encourage open questions from students regarding the topics.

Example discussion prompts:

1. Recall what challenges might arise when retrieving sequence data from different databases?"
2. Identify how can databases like NCBI, DDBJ and EMBL be used in genomics research?

8. References

1. Gurumani, N. (2005). An Introduction to Biostatistics. Chennai: M.J.P. Publishers, Second edition.

2. Attwood, TK and Parry-Smith DJ. (2014) Introduction to bioinformatics. New York: Pearson Education Publishers.

9. Extension Activities

- Assign a project where students have to retrieve data on a specific gene from all three databases and compare the data quality, format and availability of additional annotations.
- Explore the integration of other bioinformatics tools like BLAST, primer design, or sequence alignment with the data from NCBI, DDBJ and EMBL.

R. Mary Santhi

Verified by Subject Expert

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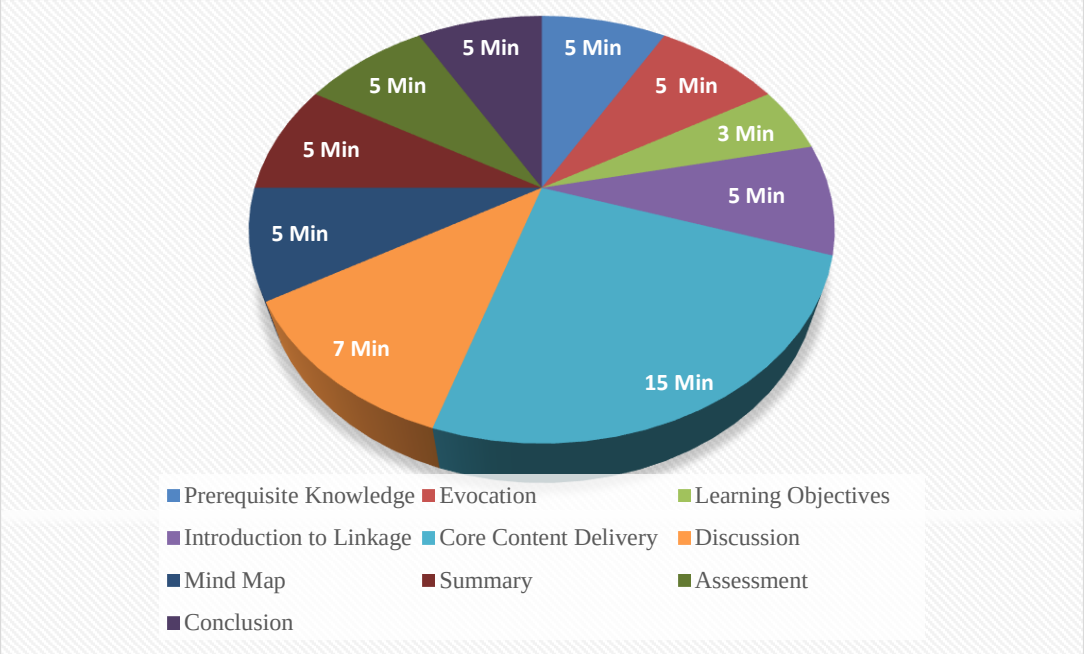
LESSON PLAN

Objective Oriented Learning Process RBT

Programme	B.Sc. Botany
Semester	V
Course Title	Core Elective - Genetics and Evolution
Code	21UBOE51
Hours	4
Total Hours	60
Credits	3
Maximum Marks	100
Unit & Title	Unit III: Linkage
Name of the Faculty	Dr. G. Flora
T-L tools	Lecture method, **Visual aid**: PPT, Videos
Lecture Duration	60 minutes

Micro-planning



Prerequisite Knowledge:
Activate prior knowledge relevant to the topic of linkage and ensure students have the foundational understanding needed for the lesson.
Activity:
Ask students to recall basic concepts related to genetics, such as:

- "What do you understand by genes and alleles?"
- "What is Mendel's law of inheritance?"
- "How do traits get passed from one generation to the next?"

1. Topic for Learning through evocation

Engage students and get them thinking about the concept of linkage in genetics through a relatable scenario or question.

Activity:

- Present a **thought-provoking question** like:
- "What happens if two genes are located close together on the same chromosome? Do they behave independently or dependently in inheritance?"
- Show a real-world example, such as **genetic diseases** that are influenced by linked genes, or reference something from popular culture or current events involving genetics.
- Encourage students to discuss how they think genes interact and what might happen when genes are inherited together.

2. Lesson Outline

2.1. Learning Objectives

By the end of this lesson, students will be able to:

a) **Remember** the definition of genetic linkage and the role of recombination in gene inheritance
b) **Understand** how linked genes behave differently from unlinked genes during inheritance.
c) **Apply** the recombination frequency data to predict the genotypes and phenotypes of offspring in a genetic cross involving linked genes, considering the distances between the genes on a chromosome.
d) **Analyze** a genetic cross involving linked genes to determine if genes are likely to be linked or independently assorted
e) **Evaluate** the impact of recombination frequency on the genetic map and discuss its accuracy.
f) **Create** an experiment to determine the genetic distance between two linked genes using recombination frequency data.

2.2. Introduction to the topic

a) Activate prior knowledge and introduce the topic.
b) Provide a brief **definition of linkage**:
c) Explain the connection to **Mendelian inheritance**, mentioning how independent assortment doesn't apply to genes that are linked.
d) Introduce the idea of **recombination** (crossing over during meiosis) and how it can affect linkage patterns.
e) Provide a **visual diagram** to show linked genes on a chromosome and how they segregate together during gamete formation.
Understand level of Bloom's Taxonomy, as the goal is to help students grasp the fundamental idea that genes located close to each other on the same chromosome are inherited together

2.3. Core Content Delivery

Present detailed content on genetic linkage, including key concepts, real-life examples, and theoretical applications.

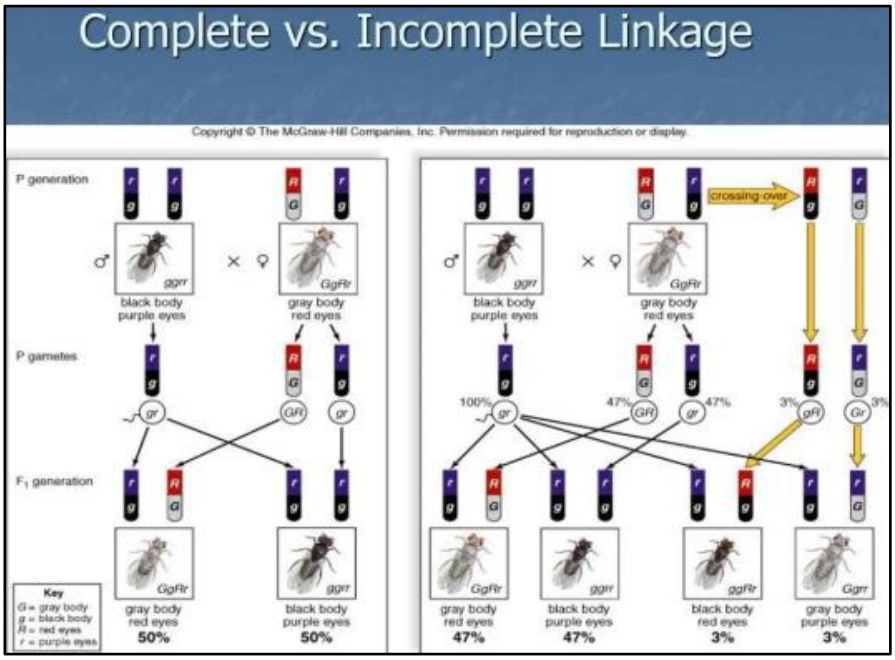
Presentation: Use a **PowerPoint or visual aids** to explain:

- The **basic principle of linkage** and how it contrasts with Mendel's Law of Independent Assortment.
- The role of **crossing over** and **recombination** in the inheritance of linked genes.
- **Example Problem**: Show how to solve genetic linkage problems using **punnett squares** for linked genes (e.g., predicting offspring genotypes based on linked alleles).
- Explain the concepts of **linkage maps** and how the frequency of recombination helps scientists map genes on chromosomes.
- Use **interactive activities** where students follow along to calculate recombination frequencies or predict genotypes.

Bloom's Taxonomy Level: **Linkage** mostly involves the **"Understand"** and **"Apply"** levels in Bloom's Taxonomy, as students need to comprehend the concept of linked genes and then apply this knowledge in practical examples (e.g., predicting genotypes and analyzing inheritance patterns).

2.4.Key Terms: Genetic Linkage, Linked Genes, Chromosome, Recombination, Crossing Over, Recombination Frequency, Linkage Disequilibrium, Genetic Map, Centimorgan (cM), Independent Assortment, Parental Types, Recombinant Types.

2.5. Key Diagrams



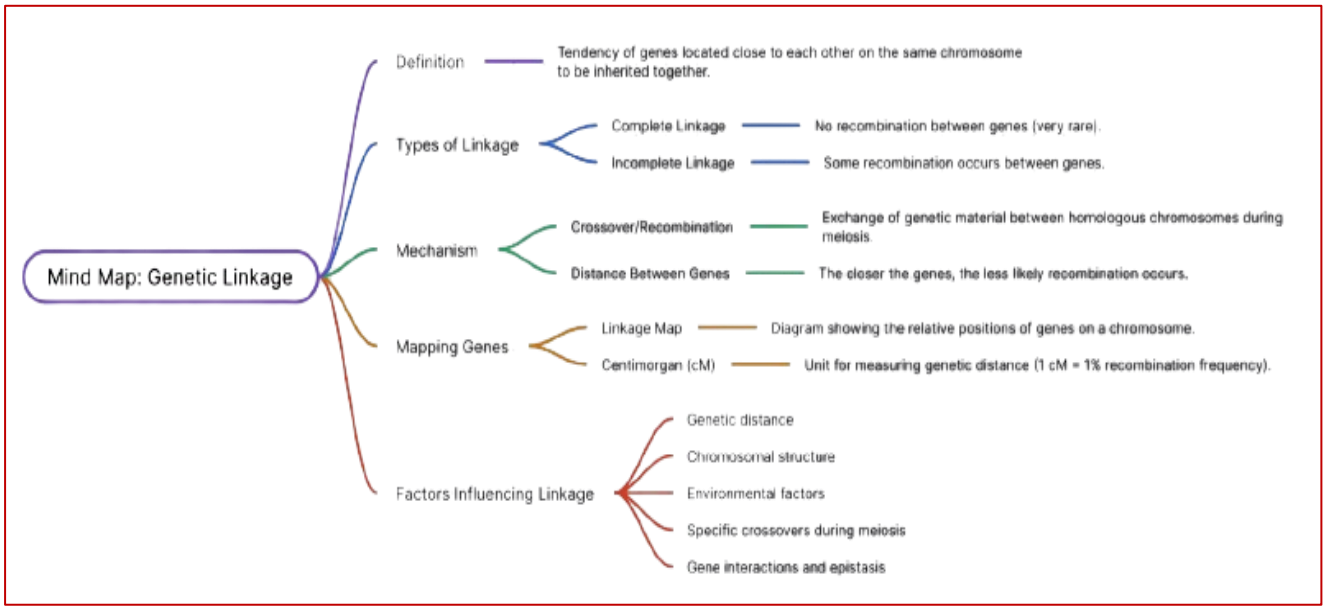
3. Discussion / Interactive Activity

Encourage critical thinking and student engagement with the content.

Facilitate a **class discussion** on the implications of linkage:

i. "How would linked genes affect the inheritance of traits in future generations?"
ii. "Why is it important for geneticists to understand linkage when creating genetic maps?"
iii. "Can genetic linkage have any advantages or disadvantages for evolution?"
iv. Encourage students to ask questions and discuss real-life implications of genetic linkage, such as its role in inheritance patterns of genetic disorders.

4. Mind Map



5. **Summary and Conclusion**

Summarize the key concepts covered in the lesson and reinforce learning.

- **Recap** the main points of the lesson using the mind map.
- "Linkage occurs when genes are close together on the same chromosome. These genes are inherited together unless crossing over happens. The frequency of recombination helps us map genes."
- Ask a few quick review questions to gauge student understanding:
- "What is the difference between linked genes and independently assorted genes?"
- "How can we use recombination frequencies to create genetic maps?"

6. **Assessment**

Formative: Participation in group activities, diagrams, and discussions.

Summative:

a) Give a **short quiz** with 2-3 multiple-choice or short-answer questions on linkage and recombination.

b) A short-answer question on calculating recombination frequency and interpreting linkage maps.

7. **Questions**

- What is genetic linkage?
  (a) Genes located on different chromosomes are inherited together
  (b) Genes located close to each other on the same chromosome are inherited together
  (c) Genes located far apart on the same chromosome never recombine
  (d) All of the above
- Which of the following is used to measure the genetic distance between two linked genes?
  (a) Kilobase pairs (kb) (b) Centimorgan (cM) (c) Base pairs (bp) (d) Mitochondrial DNA
- What does a recombination frequency of 50% indicate?
  (a) Complete linkage between the genes (b) No linkage between the genes
  (c) Genes are located on different chromosomes or are far apart on the same chromosome (d) Perfect gene inheritance

8. **References**

- Verma P.S. Agarwal V.K. Genetics. New Delhi: S. Chand and Company Ltd., 1994.
- P.S. Verma and Agarwal V.K. Cell biology, Molecular biology, Evolution and Ecology, Edition. New Delhi: S. Chand Publication, 2004.

9. **Extension Activities**

- **Gene Mapping Software Simulation** (In-Class or Homework):
  Allow students to use online tools like MapMaker or GeneMapper to practice creating linkage maps using sample genetic data.
- **Investigating Genetic Disorders** (Homework/Research Project):
  Ask students to choose a genetic disorder that has been mapped using genetic linkage and prepare a short report on the disorder and how genetic linkage analysis was used to identify the associated gene.

G.M

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LESSON PLAN

Objective Oriented Learning Process RBT

Programme	B.Sc. Botany
Semester	VI
Course Title	Core IX – Plant Physiology
Code	21UBOC61
Hours	4
Total Hours	60
Credits	4
Maximum Marks	100
Unit & Title	Unit I – Diffusion
Name of the Faculty	Dr. Mary Santhi. R
T-L tools	Mind maps, PPT, think-pair- share
Lecture Duration	60 minutes

Micro-planning

Prerequisite Knowledge: Quick Brainstorming: Ask students what they know about diffusion, whether they have experienced in their daily life. Write the answers on the board.

1. Topic for Learning through Evocation

Topic: Diffusion

2. Lesson Outline

2.1. Learning Objectives

By the end of this lesson, students will be able to:

1. **Remember** the definition of diffusion and the key factors influencing it.
2. **Understand** the concept of diffusion and the factors that affect the rate of diffusion.
3. **Apply** to real-life processes and biological systems.
4. **Analyze** the impact of different environmental factors on the rate of diffusion.
5. **Evaluate** the importance of diffusion in biological systems.
6. **Create** methods to model diffusion experimentally.

2.2. Introduction to the Topic

1. **What is Diffusion?** Begin with a simple definition and real-world examples (e.g., perfume spreading in a room, food coloring in water).
2. Discuss how diffusion is a passive process that doesn't require energy.
3. **Objective**: Introduce the students to the core idea that diffusion happens due to concentration gradients.

Bloom's Taxonomy Level: Remember & Understand

2.3 Core Content Delivery

Types of Diffusion:

- Simple Diffusion
- Facilitated Diffusion (through membrane proteins)
- Osmosis (special type of diffusion for water)

Factors Influencing Diffusion:

- **Concentration Gradient**: The steeper the gradient, the faster the diffusion.
- **Temperature**: Higher temperatures increase the kinetic energy of molecules, speeding up diffusion.
- **Molecular Size**: Smaller molecules diffuse faster than larger ones.
- **Medium**: Diffusion occurs more quickly in gases than in liquids or solids.

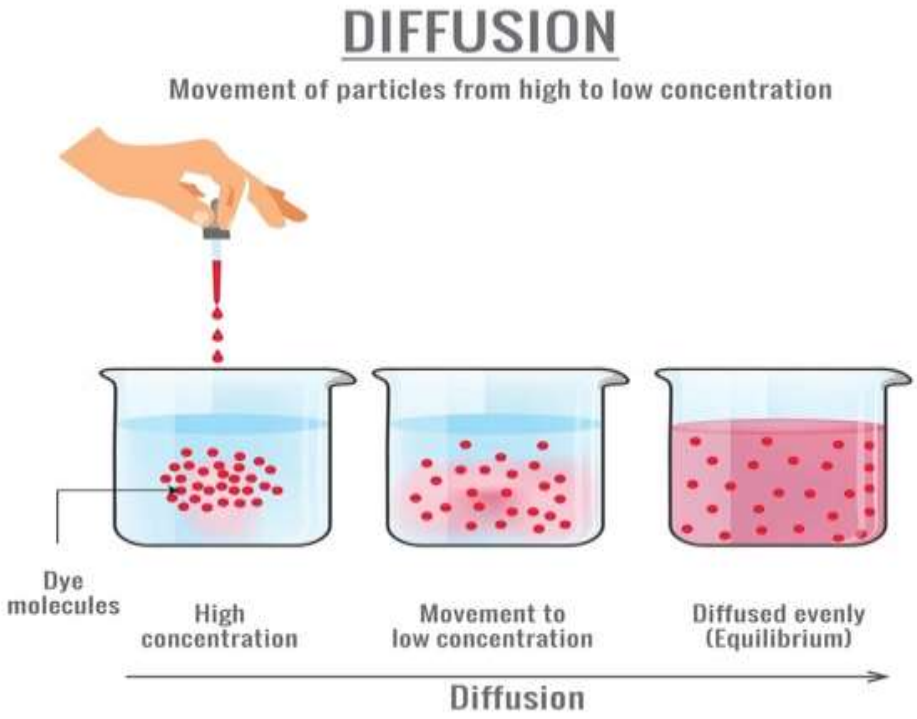
Real-life Applications of Diffusion:

- In humans: Gas exchange in the lungs (Oxygen and Carbon Dioxide).
- In plants: Water movement through roots (osmosis).
- In medicine: Delivery of drugs through cell membranes.

Bloom's Taxonomy Level: Understand & Apply

2.4. Key terms: Diffusion, concentration gradient, osmosis, facilitated diffusion, kinetic energy.

2.5 Key Diagrams



3. Discussion / Interactive Activity

Engage students in applying and analyzing the process. Encourage creativity and deeper understanding.

Objective: To investigate how temperature affects the rate of diffusion.
Materials: Water, food coloring, two containers, one with hot water and one with cold water.
Activity Steps:

- Place the same amount of food coloring into each container.
- Observe and record the rate at which the color spreads in each container.
- Discuss the effect of temperature on the rate of diffusion. (Students will conclude that higher temperature increases the rate of diffusion).

Follow-up Questions:

- Analyze what happens when we change the temperature?
- Examine how would diffusion work in living cells if they were exposed to varying temperatures?

4. Mind Map

Diffusion in the center.

- Branch out to: types of diffusion, factors affecting diffusion, applications of diffusion, rate of diffusion and real-life examples.

- Students can draw and label the mind map in their notes, allowing them to visualize and organize the information effectively.

5. Summary and Conclusion

- Summarize the core concepts covered in the topic.
- Diffusion is a vital process in living organisms.
- Factors like concentration gradients, temperature, and molecular size affect the rate of diffusion.
- **Assessment**: Ask students to evaluate why diffusion is critical for biological systems and how it relates to various physiological functions.
- Emphasize the significance of diffusion in cell biology, such as in gas exchange and nutrient absorption.

Bloom's Taxonomy Level: Evaluate

6. Assessment

Quiz: Include questions like:

1. Recall what is diffusion?
2. Show how does temperature affect the rate of diffusion?
3. Discuss the difference between simple diffusion and facilitated diffusion.

7. Questions

Encourage open questions from students regarding the topics.

Example discussion prompts:

1. Encourage students to relate diffusion to other biological processes they have studied, such as osmosis or active transport.

8. References

1. Jain, VK. (2004). Fundamentals of Plant Physiology. New Delhi: S. Chand & Ltd.

2. Salisbury, FB and Ross, CW. (2007). Plant physiology. Singapore: Thompson. Asia. Pvt. Ltd.

9. Extension Activities

- Experiment: Set up a lab where students can investigate diffusion in agar blocks using a dye.

R. Mary Santhi

Verified by Subject Expert

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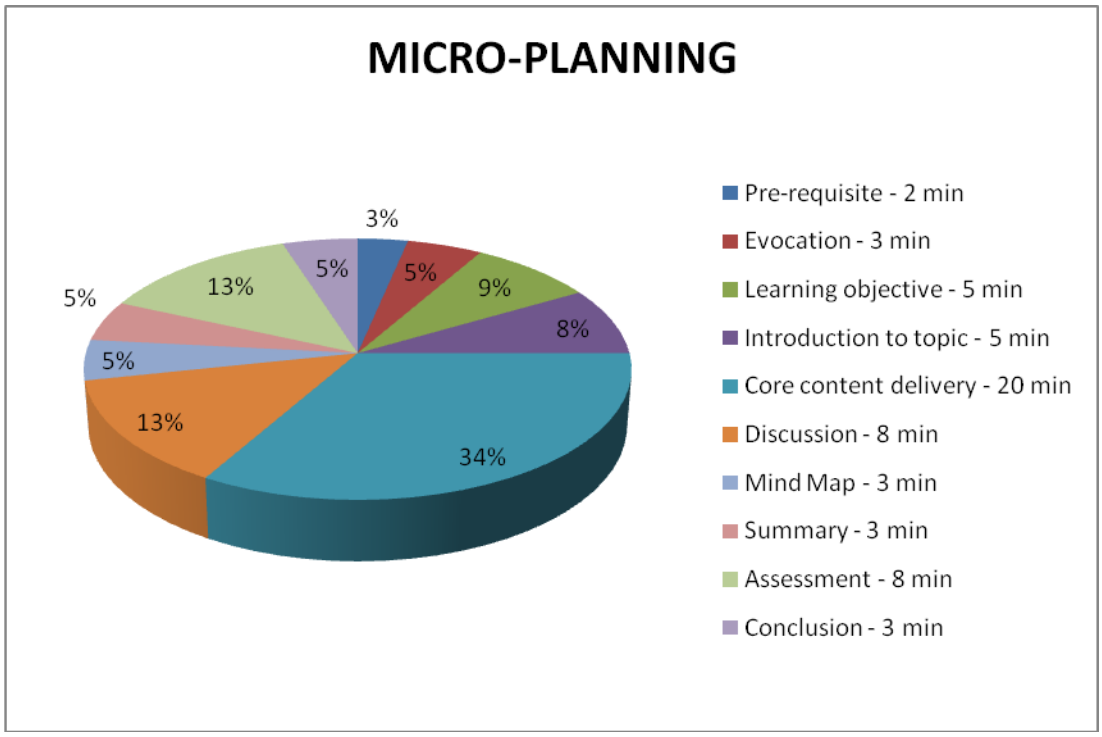
Lesson Plan

Objective Oriented Learning Process RBT

Programme	B. Sc. Botany
Semester	VI
Subject Title	Core: Microbiology and Plant Pathology
Code	21UBOC62
Hours	4
Total Hours	60
Credits	4
Max Marks	100
Unit & Title	Unit:IV – Types of food spoilage
Name of the Faculty	Dr. A. Antony Selvi
T-L tools	Lecture method, **Visual aid**: PPT, Presentation slides with visuals of spoiled food.

Micro-planning



Lesson Duration: 60 minutes

Prerequisite Knowledge:

The teacher will ask the students some basic questions about the food spoilage to know the level of their knowledge.

1. **Topic for Learning through evocation**

   The teacher will evocate the class by asking basic question like Have you noticed spoiled food at home or outside? Did you see the color change or smelt the spoilt food? Can you name few spoiled food you have viewed?

2. **Lesson Outline**

   2.1 Learning Objectives:

   By the end of the lesson, students will be able to:

1. **Remember:** Identify types of food spoilage and their causes.
2. **Understand:** Explain the mechanisms behind different spoilage types.
3. **Apply:** Relate knowledge to assess spoilage in real-life scenarios.
4. **Analyze:** Identify the contributing factors to spoilage in various conditions.
5. **Evaluate:** Assess prevention methods for food spoilage and design strategies to minimize spoilage in specific contexts.

2.2 Introduction (5 minutes)

1. Set the stage for learning and introduce the topic.
2. Begin with a question: "What do you think happens to food when it spoils?"
3. Present the importance of understanding food spoilage in food safety and industry.

Bloom's Level: Remember

2.3 Core Content Delivery

1. Recall prior knowledge and basic facts about food spoilage.
2. Define food spoilage
3. Types of food spoilage
   a) **Microbial Spoilage**: Spoilage caused by the growth and metabolic activities of microorganisms such as bacteria, yeasts, and molds.
   b) **Enzymatic Spoilage:** Spoilage caused by the action of natural enzymes present in food, leading to undesirable changes in texture, color, and flavor.

c) **Physical Spoilage:** Spoilage resulting from physical damage or improper handling of food, often leading to contamination or loss of quality.
d) **Chemical Spoilage:** Spoilage caused by chemical reactions in food, such as oxidation or contamination by external chemicals.

4. Use real life images to explain each type of spoilage.

Bloom's Level: Remember, Understand

2.4. Key words:

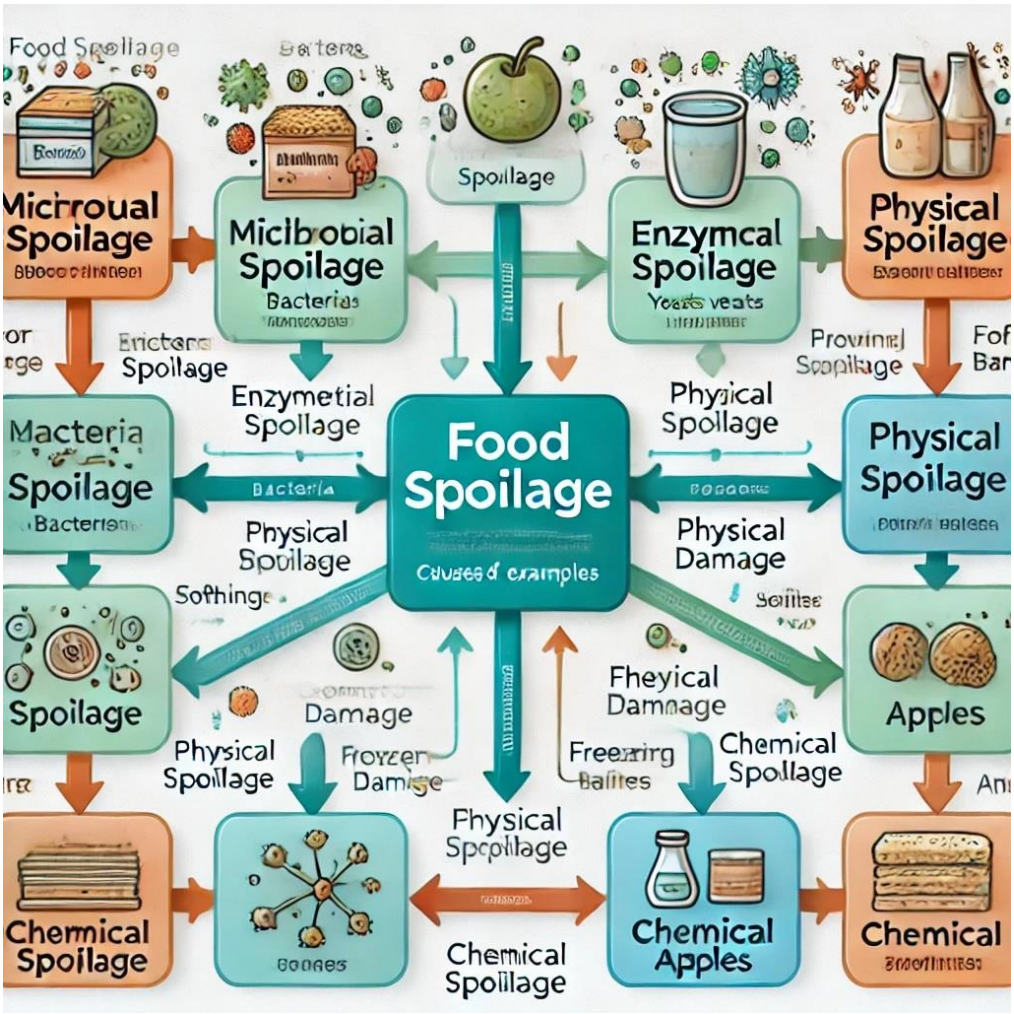
Food spoilage, microbes, physical spoilage, chemical spoilage

2.5. Key diagrams (if any):

3. **Discussion/Interactive activity**
    a) Foster critical thinking and assess understanding.
    b) Discussion question: Ask students to identify the type of spoilage and explain how it likely occurred.
    c) Discuss real-life implications, such as shelf life and food safety
    d) Analyze conditions and factors contributing to food spoilage.
    e) Summarize the key points

    Bloom's Level: Analyze, Evaluate

4. **Mind Map:**



5. **Summary:**

    Students are asked to evaluate the types of food spoilage by using the mind map.

6. **Assessment through Stimulating question/analogy/new ideas and concepts:**

- **Formative**: Participation in quizzes, discussions, and activities.

- **Summative**: Short reflective essay: "How would you use your knowledge of food spoilage to improve food safety?" Group project: Create a poster explaining one type of spoilage and prevention methods.

7. **Questions:**

What is food spoilage?
What are the signs of food spoilage?
Which bacteria cause food spoilage?
What to do after eating spoiled food?

8. **References**

1. Dubey R.C. and Maheswari D.K. A textbook of Microbiology. New Delhi: S. Chand Company Ltd., 2003.
2. Sharma P.D. Plant Pathology. Meerut: Rastogi Publications, 2013-14.

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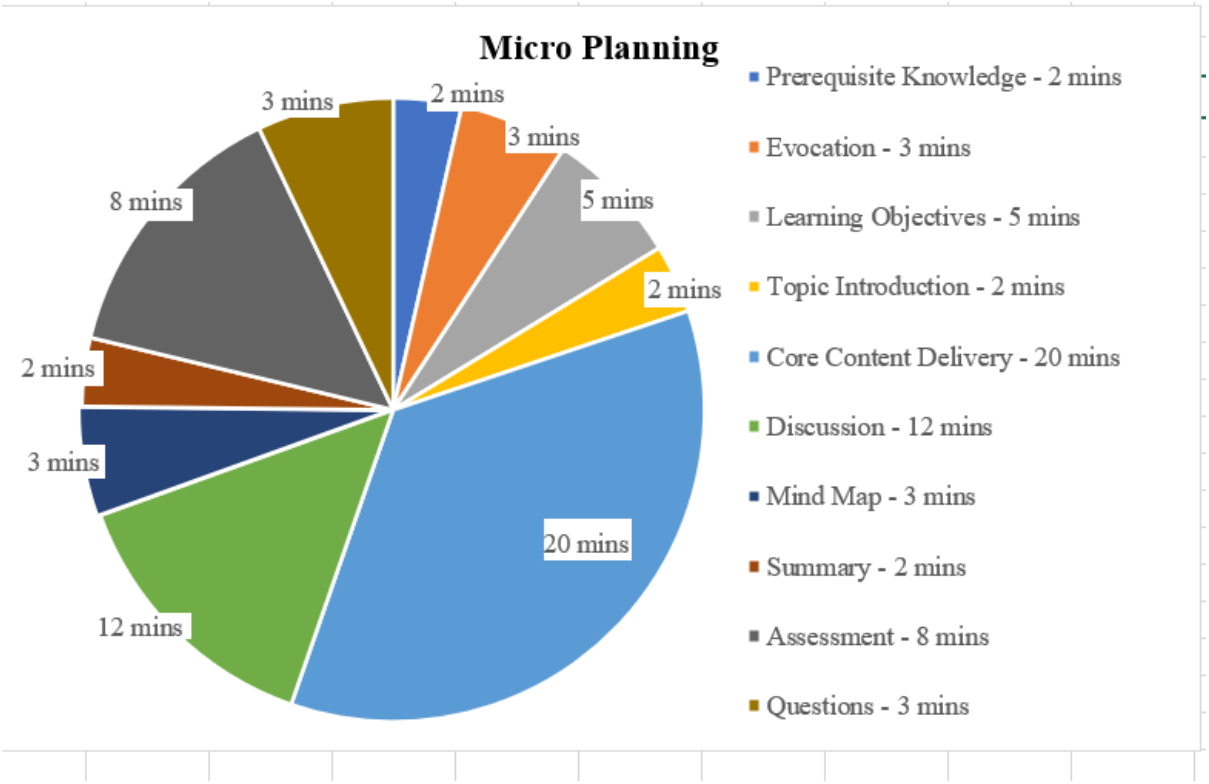
LESSON PLAN

Objective Oriented Learning Process RBT

Programme	B.Sc. Botany
Semester	VI
Subject Title	Core: Cell and Molecular Biology
Code	21UBOC63
Hours	4
Total Hours	60
Credits	4
Max Marks	100
Unit & Title	Unit: IV Mechanism of transcription in prokaryotes
Name of the Faculty	Ms. S. Pauline Jenifer
T-L tools	Lecture method, **Visual aid**: PPT, Picture showing the types of inflorescences

Micro -planning



Prerequisite Knowledge:

The teacher will ask the students some basic questions about the structure of DNA and function of some enzymes used in the process to know the level of their knowledge about leaves.

1. Topic for Learning through evocation

The teacher will evocate the class by asking basic question like How do we grow? Why is

our skin colours differ from each other? Why do we resemble our parents so much? How does our characters express? What is central dogma of life?

2. Lesson Outline

2.1.Learning Objectives

By the end of the lesson, students will be able to:

1. **Remember**: Define transcription and list the key components involved in prokaryotic transcription.
2. **Understand**: Explain the three main stages of transcription (Initiation, Elongation, and Termination).
3. **Apply**: Identify and label the transcriptional components in a DNA sequence diagram.
4. **Analyze**: Compare transcription in prokaryotes and eukaryotes, highlighting differences.
5. **Evaluate**: Discuss the importance of transcription regulation in gene expression.

2.2. Topic Introduction

1. Engage students and activate prior knowledge.
2. Start with a question: *"How does genetic information in DNA get converted into functional proteins?"*
3. Briefly recall the central dogma: DNA → RNA → Protein.
4. Show an animated diagram or a short video clip of transcription.

Bloom's Level: Remember

2.3.Core Content Delivery

1. Explain the molecular mechanism of DNA transcription in prokaryotes.
2. **Definition of Transcription**: Process of RNA synthesis from a DNA template.
3. **Key Components**:
    - DNA Template
    - RNA Polymerase (Holoenzyme with sigma factor)
    - Promoter (–10 Pribnow box and –35 region)
    - Terminator sequences (Rho-dependent & Rho-independent)
4. **Stages of Transcription:**
    - **Initiation:**
        - RNA polymerase binds to the promoter.
        - Sigma factor helps in recognition.
        - DNA unwinding occurs.

- **Elongation:**
  - RNA polymerase synthesizes mRNA in the 5’ to 3’ direction.
  - Nucleotides are added complementary to the DNA template strand.
- **Termination:**
  - Rho-independent termination: Formation of a hairpin loop in mRNA followed by poly-U tail.
  - Rho-dependent termination: Rho protein binds to the transcript and causes dissociation.

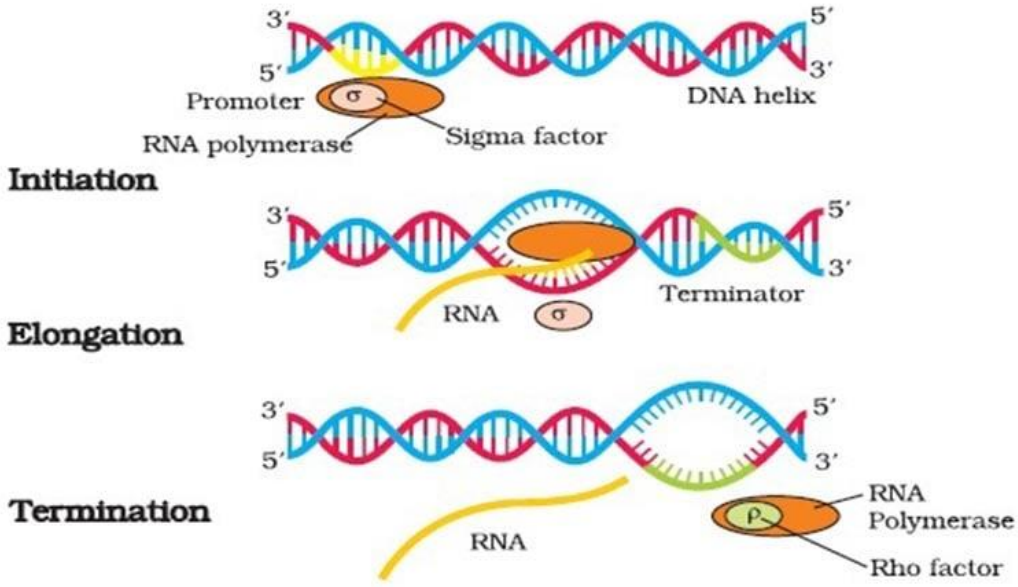
5. Use animations and diagrams to illustrate each stage.

Bloom’s Level: Understand

4.1.Key words:

Initiation, elongation, termination, Rho dependent

4.2.Key diagrams (if any):



5. Discussion/Interactive activity

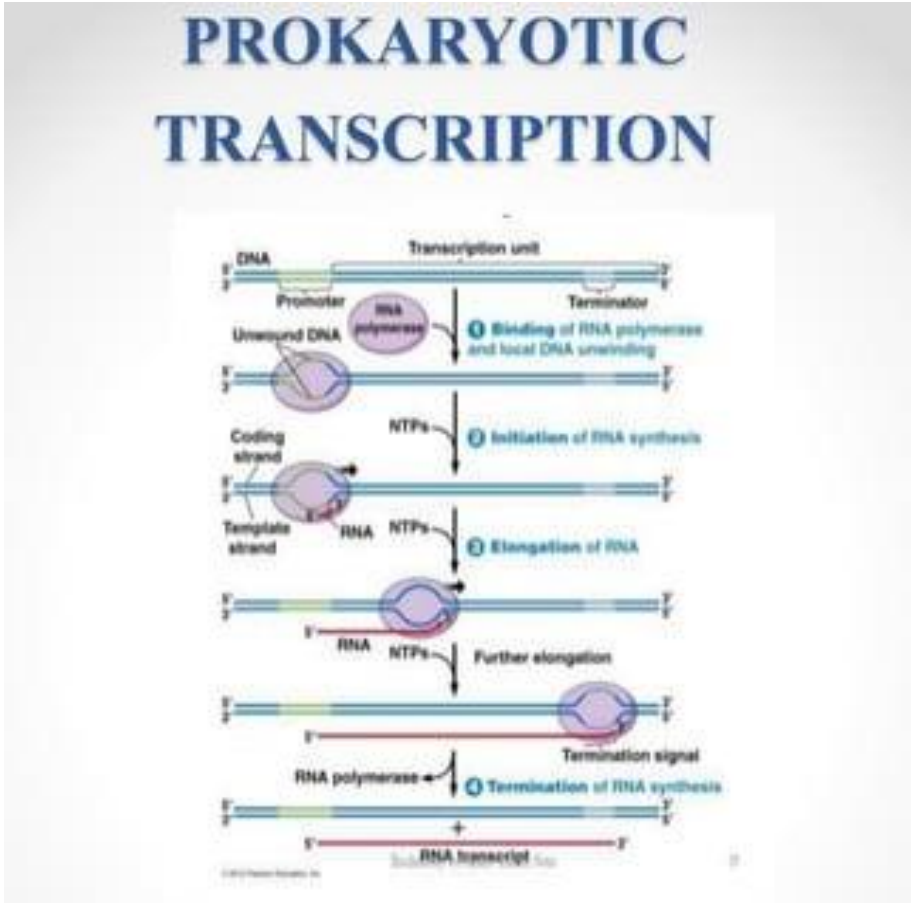
1. Foster critical thinking and assess understanding.
2. **Group Activity**:

   Provide students with a short DNA sequence.

3. **Ask them to:**
   1. Identify the promoter region.
   2. Predict the mRNA sequence transcribed from the given DNA.
   3. Determine whether termination would be Rho-dependent or Rho-independent.
4. **Discussion**: Compare transcription mechanisms in prokaryotes and eukaryotes.

- **Bloom's Level**: Apply, Analyze

5. **Mind Map:**



6. **Summary:**

Students will be asked to identify the process of transcription by using the mind map..

7. **Assessment through Stimulating questions/Analogy/New ideas and Concepts:**

Formative: Participation in group activity and discussion.

Summative: Quick quiz to test understanding of key concepts.

8. **Questions:**

Find out the function of a promoter in DNA

(a) Initiate transcription (b)Regulate termination (c) Encodes translation (d) Transcribe repressor

Identify the enzyme is involved in transcription.

(a) DNA Polymerase (b) **RNA Polymerase** (c) Amino acyl tRNA transferase (d) both (b) and (c)

Name the process involved in the RNA formation on the DNA template.

(a) Translation (b) transduction (c) **transcription** (d) transformation

Identify the process that lies between replication and translation?

(a) transition (b) transversion (c) **transcription** (d) transduction

Upstream in the transcription unit refers to

(a) **sequence before the start point** (b) sequence below the start point (c) sequence at the palindrome site (d) sequence in the elongation site

9. References

1. Veer Bala Rastogi. *Fundamentals of Molecular Biology*. India: MEDTECH. 2016
2. Verma P.S and Agarwal. V.K. *Cytology*. India: S. Chand & Company. 2006

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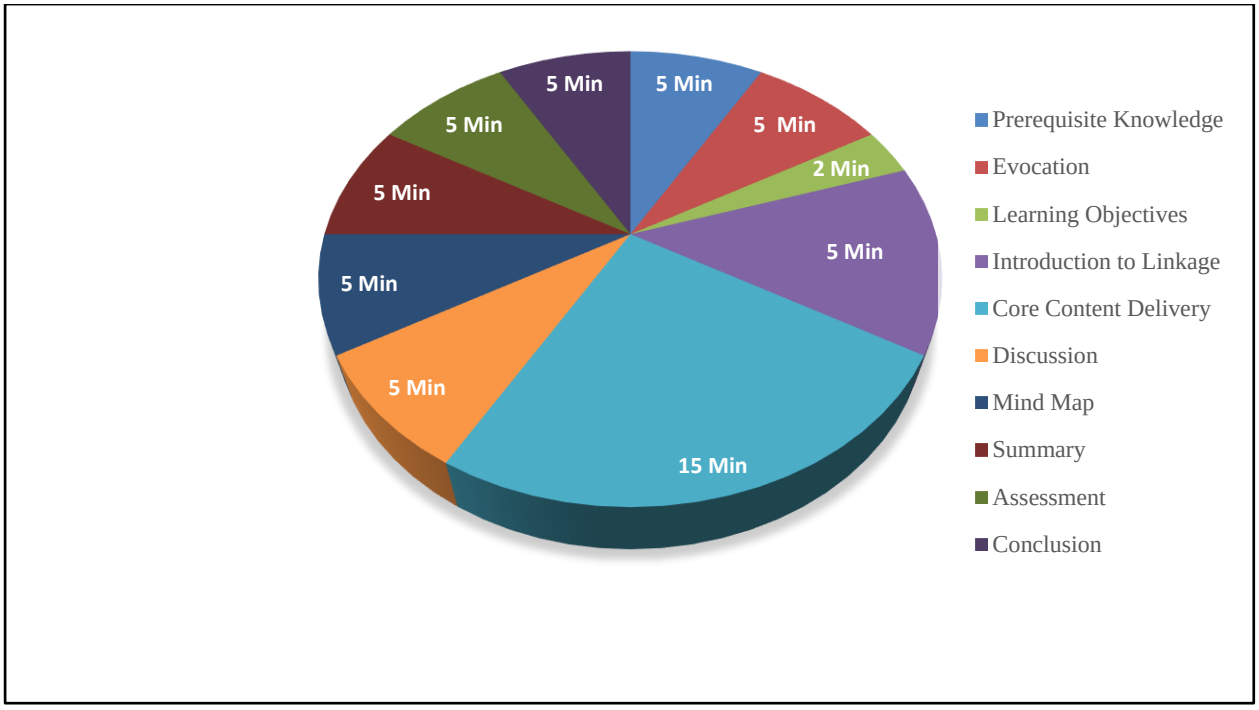
LESSON PLAN

Objective Oriented Learning Process RBT

Programme	B.Sc. Botany
Semester	VI
Course Title	Core XII Marine Biology
Code	21UBOC64
Hours	4
Total Hours	60
Credits	3
Maximum Marks	100
Unit & Title	Unit II: Biology, adaptation and ecology of phytoplankton
Name of the Faculty	Dr. G. Flora
T-L tools	Lecture method, **Visual aid**: PPT, Videos
Lecture Duration	60 minutes

Micro-planning



Prerequisite Knowledge:
Activity: Concept Mapping

- Activate prior knowledge about plankton, marine ecosystems, and basic biology concepts
- **Instructions:** Have students create a concept map on the board or on paper, linking key ideas like "plankton," "photosynthesis," "food chains," "marine ecosystems," and "producers." This will help assess their foundational understanding of the subject and prepare them for the upcoming lesson.

1. **Topic for Learning through evocation**

Engage and Spark Curiosity:

Start by showing a captivating image or short video clip of vibrant marine life, ocean scenes, and underwater ecosystems. The clip should include scenes with marine organisms and ideally showcase phytoplankton (e.g., colorful blooms or microscopic organisms).

Initial Questioning (Think-Pair-Share):

Ask the class the following questions:

- "What do you think are the smallest organisms in the ocean?"
- "Why do you think they are important for the survival of larger animals?"
- "Can you guess how these tiny organisms impact the environment?"

Think: Have students think individually for a minute.

Pair: Let them discuss their ideas in pairs.

Share: Ask pairs to share their thoughts with the class.

2. **Lesson Outline**

2.1. Learning Objectives

By the end of this lesson, students will be able to:

- **Remembering:** Recall types of phytoplankton and their basic characteristics.
- **Understanding:** Explain the adaptations of phytoplankton and their ecological roles.
- **Applying:** Discuss how environmental factors affect phytoplankton populations.
- **Analyzing:** Compare different types of phytoplankton and their adaptations.
- **Creating:** Develop a diagram or model illustrating the interaction of phytoplankton in the ecosystem.

2.2. Introduction to the topic

Introduce the topic by explaining the importance of **phytoplankton** as primary producers in marine food chains.

Link phytoplankton to concepts like **food webs**, **energy flow**, and **biogeochemical cycles**.

Explain how adaptations enable phytoplankton to survive in various environmental conditions, like different light intensities, nutrient availability, and water temperature.

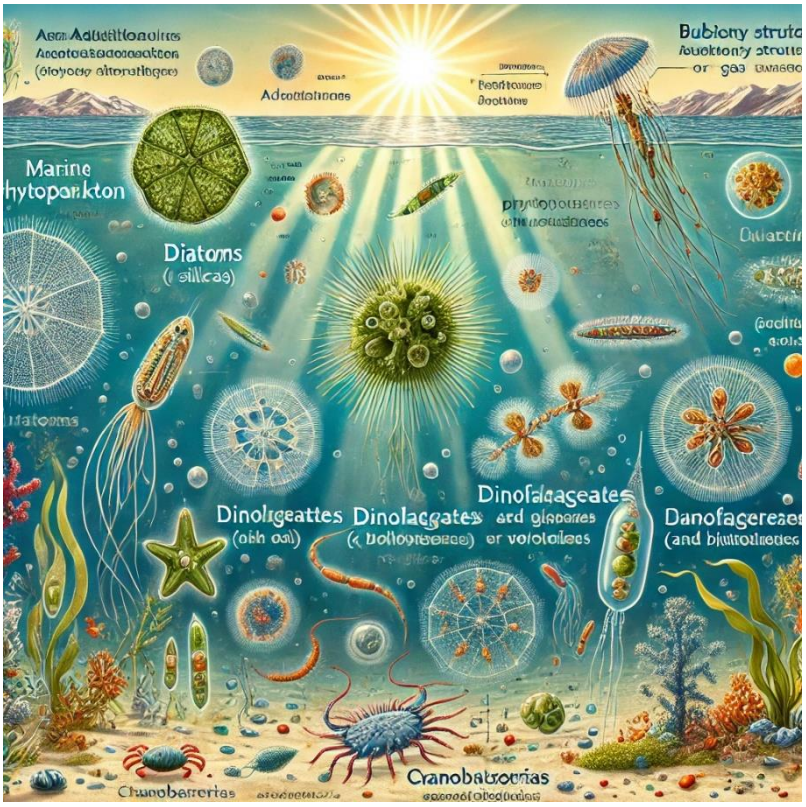
2.3. Core Content Delivery

- **What are Phytoplankton?**
  - Phytoplankton are microscopic organisms that live in aquatic environments and carry out photosynthesis.
  - They form the base of the aquatic food chain, supporting a variety of marine life.
  - Types: **Diatoms**, **Dinoflagellates**, **Cyanobacteria**.
- **Adaptations of Phytoplankton:**
  - **Size and Shape**: Small size for efficient nutrient uptake and large surface-area-to-volume ratio for light absorption.
  - **Buoyancy**: Many phytoplankton have adaptations like gas vacuoles or specialized shapes (e.g., flattened or spiny forms) that help them stay near the water's surface to access light.
  - **Pigmentation**: Various pigments (e.g., chlorophyll, carotenoids) help them absorb light at different wavelengths, allowing them to thrive in different depths of water.
  - **Reproduction**: Phytoplankton reproduce rapidly through binary fission or other methods, allowing them to respond quickly to environmental changes.
- **Ecology of Phytoplankton:**
  - Role as **primary producers** in aquatic ecosystems: Form the base of the food chain.
  - **Nutrient cycling**: Phytoplankton absorb carbon dioxide and release oxygen, playing a key role in global carbon cycles.
  - Influence of environmental factors such as **light**, **temperature**, and **nutrient availability** on phytoplankton growth.

Bloom's Taxonomy Level: During the Core Content Delivery, students are engaging with **higher-order cognitive skills** (especially **application** and **analysis**) as they move from recalling basic information to analyzing and applying concepts to understand the complex interactions in ecosystems. This range of Bloom's Taxonomy levels ensures students not only learn the facts but also grasp the deeper ecological connections and applications of their knowledge.

2.4.Key Terms: Phytoplankton, Photosynthesis, Primary Producers, Diatoms, Dinoflagellates, Cyanobacteria, Adaptations, Buoyancy, Pigmentation, Harmful Algal Bloom (HAB), Trophic Levels, Eutrophication, Global Carbon Cycle, Marine Food Web, Nutrient Cycling, Carbon Sequestration, Ecosystem Services.

2.5. Key Diagrams



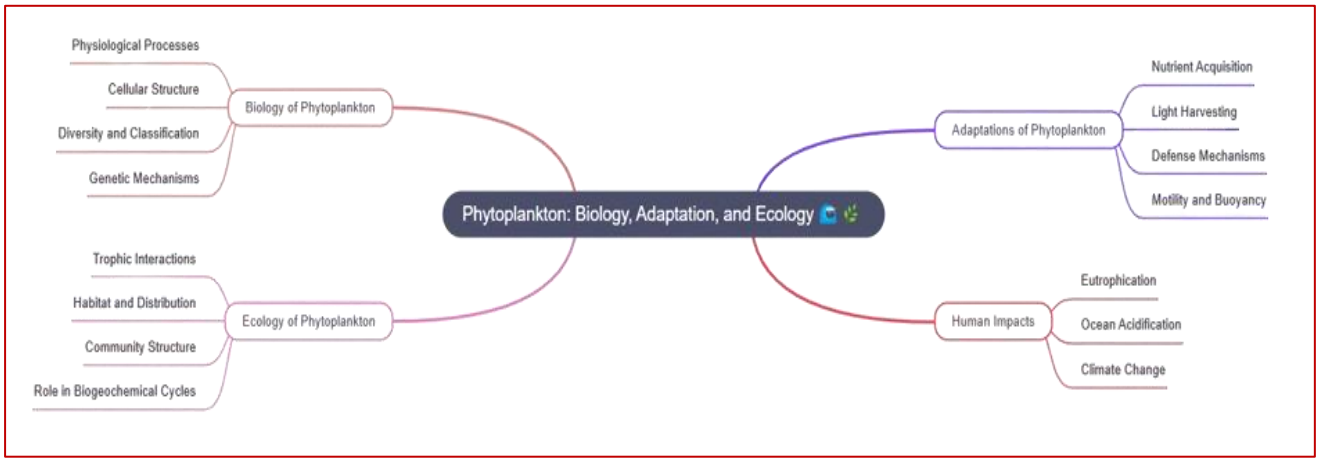
3. Discussion / Interactive Activity

Activity: Fishbowl Discussion

Encourage critical thinking and facilitate group discussion about the role of phytoplankton in ecosystems.

- Instructions: Set up a fishbowl discussion where a few students sit in the "inner circle" and discuss a topic while the others observe.
    - Topic: "How do environmental changes (e.g., climate change, pollution) affect phytoplankton populations and, in turn, marine ecosystems?"
    - After the discussion, the outer circle students can ask questions or comment on the discussion, encouraging critical analysis and deeper understanding of the topic.

4. Mind Map



5. Summary and Conclusion

Marine phytoplankton play a vital role in sustaining life in the ocean and maintaining Earth's oxygen balance. Their ability to adapt to various marine conditions ensures their survival and contribution to global ecosystems. By protecting marine environments, we help preserve these essential organisms and the life they support.

Activity

a) **Marine Food Chain Model**: Create a food chain with phytoplankton at the base, showing how they support marine life like zooplankton, small fish, and larger predators.

b) **Adaptation Discussion**: Have students draw or describe adaptations of phytoplankton, like shapes that help them float, or discuss why phytoplankton are more abundant near the ocean's surface.

6. Assessment

Formative: Quick Quiz: Use true/false questions to check understanding, e.g.:

- Phytoplankton are found at the bottom of the ocean. (True/False)
- Phytoplankton produce oxygen. (True/False)

Creative Task: Ask students to draw or describe a phytoplankton, including its adaptations for survival.

Summative:

Give a **short quiz** with 2-3 multiple-choice or short-answer questions

7. Questions

Which process do phytoplankton use to produce energy?

(a) Respiration (b) Photosynthesis (c) Fermentation (d) Chemosynthesis

What is the primary ecological role of phytoplankton?

(a) Breaking down dead matter (b) Producing oxygen and forming the base of the food chain (c) Consuming smaller organisms (d) Regulating ocean temperature

What adaptation helps phytoplankton stay near the ocean's surface?

(a) Heavy shells (b) Photosynthetic pigments (c) Buoyancy structures or oil droplets (d) Fast swimming abilities

8. References

- Boaden P.J.S. and R. Seed An Introduction to coastal ecology. New Delhi: Thomas Press Limited,1985.
- Newell and Newell. Marine Plankton a practicalguide. Hutchinson and Co. Ltd., 1977.

9. **Extension Activities**

Microscope Investigation

Provide water samples from ponds, lakes, or the ocean, and let students observe real phytoplankton under a microscope. Have them identify different shapes and structures and discuss their adaptations.

Phytoplankton Carbon Cycle Connection

Have students create a diagram or presentation to show how phytoplankton contribute to the global carbon cycle by capturing CO_2 during photosynthesis and storing it in the ocean.

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