Department of Biology

College of Science

University of Salahaddin

Subject: Plant Physiology

Course Book: Fourth Class

Semester: 2nd Course

Lecturer's name: Assist. Prof. Dr Badr Qader Surchi

Academic Year: 2022/2023

Coursebook

1. Course name	Plant Physiology
2. Lecturer in charge	Dr. Badr Qader Surchi (Theory) Mahdi H. Ibrahim (Practical)
3. Department/ College	Biology/Science
4. Contact	e-mail: badr.surchi@su.edu.krd Mob. (07504564589) mahdi.ibrahim@su.edu.krd
5. Time (in hours) per week	Theory 2hr. and Practical 2hr,/week
6. Office hours	To be returned to the schedule on the office door
7. Course code	
8. Teacher's academic profile	**Dr. Badr Qader Surchi CV:** • Date of Birth: 1 July 1973 • Place of Birth: Erbil • Nationality: Iraqi • Marital status: Married • Sex: Male **Education:** • Completed a B.Sc. in Biology from the College of Science (1997-1998) at the University of Salahaddin in the Kurdistan Region of Iraq. • In 2006, I graduated from the University of Salahaddin, Kurdistan Region, Iraq with an M.Sc in Plant Biology from the Biology Department at the College of Science. • Completed a PhD in Medicinal Plant (2018) from Kahramanmaraş Sütçü İmam University (Turkey) within the Bioengineering and Sciences Department at the Natural and Applied Sciences Institute. **My work** has been featured in 15 prominent scholarly journals. Furthermore, I actively attended various professional gatherings. Currently, I hold the position of lecturer at Salahaddin University-Erbil . **Regarding my teaching background**, I have extensive experience instructing various wet-lab courses such as Plant Physiology, Botany, Introductory Biology, Ecophysiology, Ecology, and Medicinal and Aromatic Plants. Additionally, I have also taught a freshmen English Language Course.
	Mahdi H. Ibrahim CV: **Education** 1- Department of Biology, College of Science, Salahaddin University-Erbil, Erbil, Iraq. MSc in Biology/Plant Physiology 2003-2006 Thesis project: Effects of foliar application of Zinc, GA3 and their interaction on growth and development of pepper plants. 2- Department of Biology, College of Science, Salahaddin University-Erbil, Erbil, Iraq. B.Sc. in Biology 1992-1996 Research project: Effects of light spectra on photosynthesis.

	Professional Experiences 1- Assistant Lecturer, College of Science, Salahaddin University-Erbil, Erbil, Iraq. 2006- 2022. 2- Biology Assistant, College of Science, Salahaddin University-Erbil, Erbil, Iraq. Feb. 1997 - March 2003 **Teaching Experiences** 1- Practical Mycology 2- Practical Algae and Archegoniate 3- Practical Plant Physiology 4- Practical General Botany 5- Plant Physiology and Plant growth development (Tishk university)
9. Keywords	Photosynthesis, Respiration, Transpiration, Chloroplasts, Chlorophyll, Water uptake, Hormones, Plant growth regulators, Germination, Seed development, Plant metabolism, Nitrogen fixation, Reactive oxygen species (ROS), Secondary metabolites, Allelopathy and Nutrient cycling in plants.

10. Course overview:

Students in this course will engage in a thorough investigation of the physiological phenomena that manifest in plants. Plant physiology holds great importance for biologists, ecologists, and agronomists because of its direct impact on agricultural yields, intricate industrial processes, and carbon sequestration. It covers the fundamental principles that govern the growth, development, and functioning of plants across cellular, tissue, and whole-plant levels. Included in the discussion are the molecular mechanisms of photosynthesis, respiration, transpiration, nutrient uptake, and signal transduction. Moreover, the course explores the mechanisms by which plants adapt to environmental cues and stresses.

11. Course objective:

Introducing you to botany through the lens of plant physiology is highly effective. During this entire year, our attention will be devoted to an extensive array of subjects centred on plants. Our study seeks to examine the plant's growth progression, tracing its development from the initial seed stage to complete maturation. The learning process will encompass various reactions in plant biology, biochemistry, proteins, hormones, and enzymes. This includes understanding plant structure, nutrient and water acquisition and transportation, as well as plant reproduction. The Course encompasses a wide range of topics in plant physiology, including plant-water relation, photosynthesis, respiration, dormancy, water translocation, plant movement, photoperiodism, plant hormones, seed germination, and more.

12. Student's obligation

Students who are present in university lectures are required to follow certain obligations to establish an environment that is conducive to learning. These obligations include:

- Timeliness: It is important to arrive on schedule for lectures to minimize interruptions and ensure a seamless beginning to the session. Attendance: Students are strongly encouraged to attend class regularly.
- Actively take part in the learning process by engaging in discussions, posing inquiries, and making positive contributions to the class environment.

- It is expected that individuals conduct themselves professionally by avoiding disruptive behaviour, engaging in side conversations, or partaking in any actions that could have a detrimental effect on the learning process.
- To prepare for lectures, it is essential to review relevant materials or assignments beforehand. This promotes a greater efficacy in comprehending the content of the lecture.
- To minimize distractions and create a focused atmosphere during the lecture, it is important to either turn off or silence electronic devices.
- Attempt to actively take notes during the lecture to enhance understanding and retention of key concepts.
- Observance of University Policies: It is imperative to adhere to university policies regarding academic conduct, attendance, and any specific guidelines provided by the course or lecturer.
- According to the examination policy, students are required to complete two exams throughout the duration of the course. Absent students will not be granted make-up exams unless they provide a medical report.

Through fulfilling these obligations, students actively contribute to the establishment of a positive and productive learning environment, which ultimately benefits all individuals present within the lecture hall.

13. Forms of teaching

Teaching undergraduate students effectively involves using a variety of instructional methods to address diverse learning styles and promote engagement. These are common teaching methods that work well for undergraduates:

• The lecture presentation by the lecturer incorporates both brainstorming and group discussion activities.
• Questions specifically for students in a classroom setting.
• Integrating relevant images and educational films.
• Lecture slides will be available in either PowerPoint/PDF format for printing or as a Word document.
• Each week, all students will receive a digital copy of the lecture before the lecture day to get their hard copy. PowerPoint presentations will present all the covered topics.
• In traditional classroom lectures, they present content in a structured way, introducing key concepts, theories, and information.
• Organize small group discussions to foster active participation and critical thinking, allowing students to share ideas, ask questions, and engage in dialogue.
• Enhance theoretical knowledge through interactive workshops that include practical activities, problem-solving exercises, or collaborative projects.
• Laboratory sessions provide students with opportunities to apply theory, experiment, and develop practical skills.
• By examining real-world scenarios or case studies, theoretical knowledge can apply to practical situations, promoting critical thinking and problem-solving abilities.
• Students can learn at their own pace through online learning modules that use multimedia, quizzes, and interactive elements.
• Encourage teamwork, research skills, and the application of knowledge of group projects.
• Encourage student engagement by incorporating role-playing exercises that apply course concepts to real-life scenarios.
• Promote peer-to-peer learning through student-led presentations and discussions on specific topics.
• Guest lectures offer students real-world insights and diverse perspectives by inviting experts or professionals in the field.
• Arrange visits to applicable sites, such as industries, clinics, and natural habitats, in order to provide hands-on experience and foster deeper understanding.

• Authentic problems or scenarios are presented to students in Problem-Based Learning, and they are guided through researching, analyzing, and proposing solutions.
• Implement online forums or discussion platforms to facilitate asynchronous discussions, allowing students to collaborate and communicate beyond the confines of scheduled classes.
• Require students to maintain reflective journals, providing an opportunity to document their thoughts, insights, and personal reflections on the course content and learning experiences.
• Organize Socratic seminars to facilitate thoughtful discussions and encourage critical thinking.
• Have students show their knowledge and communication skills through class presentations for assessment.
• Introduce a flipped classroom model where students review lecture materials on their own before class, and take part in discussions, problem-solving, and interactive activities during class time.
• Foster a sense of social responsibility by incorporating service-learning projects that allow students to apply their knowledge and skills towards addressing community needs.

14. Assessment scheme:
The grade scheme is as follows:
Midterm: %50
Midterm Theory Exam(s): %15
Midterm Exam %10
Activities (Quizzes, Seminars, Reports, Assignments) %5

Midterm Practical Exam 35%
Activities (Seminars, Labs, or Fields) %6
Weekly reports (Results, Discussion, References) %8
Quizzes %6
Mid-term exams %15
Throughout the course, you can engage in quizzes, seminar presentations, daily attendance, active participation, reports, and posters.
Expect the first Midterm exam to be scheduled for the 4th or 5th week.
After the course, final semester exams will take place.
Final examination (Theory Exam) 50%

15. Student learning outcome:

- Several learning outcomes are expected to be accomplished by students upon the completion of a plant physiology lecture at the undergraduate level. The potential results may encompass:
- Develop a comprehensive understanding of plant structure and function, delving into the complexities of plant anatomy, morphology, and the diverse functions performed by different plant organs and tissues.
- Enhance your knowledge regarding plant developmental processes, including the complete life cycle ranging from seed germination to maturity, and delve into the multitude of factors that influence plant growth and development.
- Adeptness in Key Physiological Processes: Acquire a profound knowledge of vital physiological processes in plants, including photosynthesis, respiration, transpiration, and nutrient assimilation.
- The study focuses on the appreciation of environmental interactions, specifically examining how plants respond to various external stimuli, such as light, water, temperature, and more. Comprehend the modifications that facilitate the flourishing of plants in diverse ecological niches.

- Enhance your understanding of plant hormones and their functions in regulating diverse physiological processes, encompassing growth, development, and reactions to environmental cues.
- Expanding Understanding of Plant-Microbe Interactions: Acquire comprehensive comprehension of the symbiotic and pathogenic connections between plants and microorganisms encompassing bacteria and fungi.
- Develop a comprehensive understanding of experimental data analysis by actively engaging in the design, execution, and analysis of experiments centered on plant physiology. Acquire knowledge about the scientific method and how it is applied in research pertaining to plant science.
- Development of Critical Thinking and Problem-Solving Skills: Foster the capacity to engage in critical analysis of plant physiological phenomena, identify challenges, and formulate solutions grounded in acquired knowledge and scientific rationale.
- Discover the practical applications of plant physiology in the realms of agriculture, horticulture, and biotechnology through this exploration. Explore the relationship between plant physiology principles and their role in driving crop enhancement and fostering sustainable agriculture.
- Mastery of Plant Physiology Concepts Communication: Acquire the skill to effectively convey intricate plant physiology concepts through clear and concise written and oral communication.
- Emphasize the interdisciplinary elements of plant physiology through integrating concepts from biology, biochemistry, chemistry, and environmental science.
- Develop an understanding of the ethical considerations associated with plant research, agricultural practices, and biotechnological applications.
- These learning outcomes provide undergraduate students with a comprehensive understanding of plant physiology, thus preparing them for future pursuits in research, further education, or professions within areas such as plant biology, agriculture, environmental science, and biotechnology.

16. Course Reading List and References:

- George A. Agrios. (2005). Plant Physiology. 5th Ed. Academic Press.
- William G. Hopkins, Norman P. A. Hüner. (2008). Introduction to Plant Physiology. Wiley Publisher.
- Philip Stewart, Sabine Globig. (2012). Plant physiology. Apple Academic Press.
- Maria Duca. (2015). Plant Physiology. Springer International Publishing.
- Taiz L, Zeiger E, Moller I, Murphy A, 2015. Plant Physiology and Development. 6th ed. Sinauer Associates, Inc., Sunderland

17. The Topics	The Topics: (Theory part) 2 hrs./week
Week One	Introduction to Plant Physiology Definition of plant physiology Historical perspectives Importance of plant physiology in agriculture and environmental science
Week Two	Plant water relations Water uptake and transport in plants Transpiration and its regulation
Week Three	Mineral Nutrition Essential nutrients for plant growth Nutrient uptake and transport Nutrient deficiencies and toxicities
Week Four	Photosynthesis: Light Reactions Absorption of light by pigments Electron transport chain and photophosphorylation Calvin cycle and carbon fixation Factors affecting the rate of photosynthesis
Week Five	Photosynthesis: Dark Reactions C3, C4, and CAM photosynthesis Photorespiration and its significance Adaptations of plants to different photosynthetic pathways
Week Six	Respiration: Glycolysis and Citric Acid Cycle Glycolysis and its regulation Citric acid cycle and the production of NADH and FADH2 Electron Transport Chain and ATP Synthesis Electron transport chain and oxidative phosphorylation
Week Seven	Primary metabolites, such as carbohydrates, proteins, and lipids Essential roles in basic cellular processes Secondary metabolites, for plant survival and adaptation to environmental challenges. phytochemicals such as alkaloids, phenolics, and terpenoids.
Week Eight	Introduction to Plant Growth and Development Overview of plant hormones Structure and biosynthesis of auxins and gibberellins Physiological roles of auxins in plant growth and development Functions of gibberellins in stem elongation, seed germination, and flowering
Week Nine	Structure and biosynthesis of cytokinins and Abscisic Acid (ABA) Roles of cytokinins in cell division, shoot and root development

	Physiological roles of Abscisic Acid (ABA) seed dormancy, germination, and stress response
Week Ten	Structure and biosynthesis of ethylene and Other Plant Hormones Functions of ethylene in fruit ripening, senescence, and abscission Other Plant Hormones: Brassinosteroids, Jasmonic acid, Salicylic acid and Strigolactones
Week Eleven	Seed Importance of seed germination in plant life cycle Seed formation and maturation processes Seed Dormancy Physical (hardheadedness) and Physiological dormancy
Week Twelve	Tropisms in Plants Phototropism and mechanisms of light perception Geotropism and gravity sensing Thigmotropism and other less-known tropisms Molecular basis of tropic responses
Week Thirteen	Environmental Stress and Plant Development Response to abiotic stress (drought, salinity, temperature) Response to biotic stress (pathogens, herbivores) Hormonal and genetic regulation of stress responses
18. Lab.	The Plant Growth and Development Laboratory is designed to complement the theoretical knowledge gained in the Plant Growth and Development course. Students will engage in practical exercises to observe, analyze, and experiment with various aspects of plant growth, development, and responses to environmental stimuli. The laboratory sessions will include hands-on activities, microscopy, and data analysis, fostering a deeper understanding of the principles discussed in the lecture component.
Lab. 1	**The Practical Topics**
Lab. 2	Introduction of plant physiology.
Lab. 3	Plant-water relationship (Diffusion)
Lab. 4	Plant-water relationship (osmosis).
Lab. 5	Plant-water relationship (permeability)
Lab. 6	Seed and seed germination
Lab. 7	Photosynthesis I estimation of pigments
Lab. 8	Photosynthesis II oxygen production
Lab. 9	Respiration
Lab. 10	Transpiration
Lab. 11	Study of the plant hormone
Lab. 12	Study of Developmental and physiological mechanisms against the environment (mineral nutrition) Study of Developmental and physiological mechanisms against the environment (tropism)

	Assessment: Lab reports Laboratory notebooks Group projects Lab quizzes Participation in lab activities
	Exam questions for an undergraduate plant physiology course involve testing students' understanding of key concepts, their ability to apply knowledge, and critical thinking skills. Here are some important questions that cover various aspects of plant physiology: • What is the reason for the high significance of plants for humanity? Please provide a list of ten items of importance . • As part of the fourth quarter, please delineate five dissimilarities between light and dark reactions in photosynthesis. • Explain the process of photosynthesis, highlighting the key molecules involved and the factors influencing this vital plant function. • Discuss how plants adapt to limited water availability. Include a discussion of structural and physiological adaptations. • Describe the stages of plant growth from seed germination to flowering, emphasizing the role of hormones in each stage. • Explain the mechanisms of nutrient uptake by plant roots and the transport of nutrients through the plant. Discuss the importance of macronutrients and micronutrients. • Compare and contrast photosynthesis and cellular respiration in plants. Discuss their interdependence and the products of each process. • Describe the functions of auxins, gibberellins, and abscisic acid in plant growth and development. Provide examples of how these hormones are used in agriculture. • Explain the process of transpiration and its role in water movement within a plant. Discuss the factors influencing transpiration rates. • Discuss how plants respond to environmental stimuli such as light and gravity. Include examples of tropisms and photoperiodism. • Explore the symbiotic relationships between plants and mycorrhizal fungi. Discuss how these interactions benefit both the plant and the fungus. • Explain the concept of dormancy in plants and how seasonal changes influence plant physiology. Provide examples of plants exhibiting dormancy.

- Discuss a biotechnological application of plant physiology, such as genetic modification for enhanced crop yield or stress resistance. Evaluate the ethical implications of such applications.

- Analyze a hypothetical scenario where a plant is not growing well. Identify possible physiological issues and propose solutions based on plant physiology principles.

- Explore the interdisciplinary nature of plant physiology by discussing how concepts from chemistry, biology, and environmental science contribute to the understanding of plant processes.

- Define the following scientific words briefly:
  - Anaerobic respiration
  - Digestion
  - Field capacity
  - Active Transport
  - Plasmolysis
  - Plant Physiology
  - Uniport
  - Pigments
  - Chlorophyll
  - Photorespiration

- Write 5 importance of Functions of Chloroplast:
- Define Secondary Metabolites with 4 functions.
- Write 5 differences between photosynthesis and respiration.

- **Fill in the following blanks with these scientific words below:**

1- The formation of ATP in the presence of sunlight is called ----------It is of two types----------

2- Molecules moving from a region of higher concentration to a region of lower concentration are said to be moving along a ----------, while molecules going in the opposite direction are said to be moving.----------

3- Plants have 3 Types of Transpiration Stomatal, ----------, and ---------- Transpiration .

4- Assimilation: Sugars produced through photosynthesis may undergo many transformations. Some sugars are used ----------, but others not needed for that purpose may be transformed into----------

5- Chloroplast is an organelle containing ---------- that captures sunlight and converts it into useful energy, releasing ---------- . Chloroplasts are found in all green plants and algae .

6- Unlike plants, certain bacteria that perform photosynthesis do not produce ---------- as the by-product of photosynthesis. Such bacteria are called.----------

7- Biomolecules are any organic molecules in a living cell, including carbohydrates, proteins, fats, etc. Each biomolecule is essential for ---------- and----------

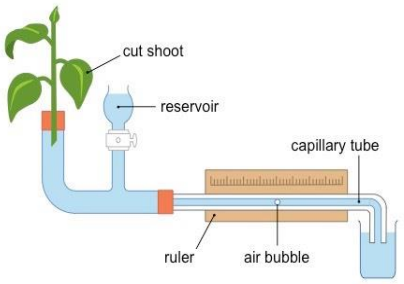
8- ---------- is a green pigment in the plant cell's chloroplasts and the cyanobacteria's mesosomes. This green colour pigment plays a vital role in ---------- by permitting plants to absorb energy from sunlight.

9- The metabolism is the total of all the biochemical activities carried out by an organism. Metabolites can be defined as the ---------- and ---------- of metabolism.

10- ---------- are "natural products." All plants produce ---------- specific to an individual species or genus during specific environmental conditions, making their extraction and purification difficult.

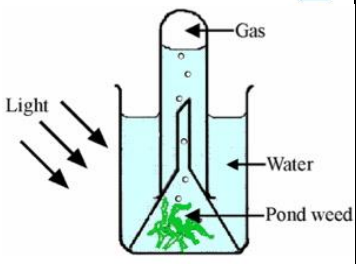
Practical Questions

Q1/ depending on the diagram, answer the following questions:



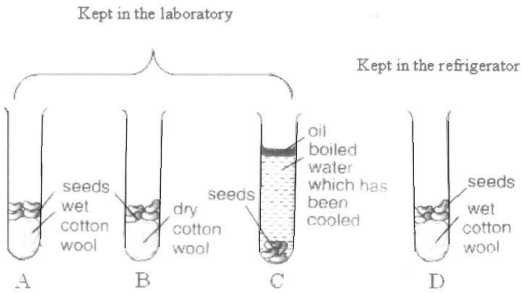
1- Write the name of the apparatus.
2- Explain why the plant shoot must be cut underwater?
3- What are the disa.vantages of this experiment? **(only two)**

Q2/ look at the diagram and answer the following questions:



1- Write the name of the gas?
2- Why did we put soda in the water during this experiment?
3- What are the advantages of this experiment? **(only two)**

Q3/ look at the diagram and answer the following questions:



1- Write the name of this experiment?
2- Why do we put oil in tube **C**?

Q4/ look at the picture and answer the following questions:

1- Write the name of the instrument?
2- In which experiments do we use it?
3- What are the differences between the methods of experiments? **(only one)**

Q5/ look at the picture and answer the following questions:

1- Write the name of the apparatus s?
2- What is the purpose of using this apparatus?
3- Why put **NaCl** solution in a side tube?
4- If the result is less than one, what does it mean?

Q6/ Count the following:

1- Phases of aerobic cellular respiration.
2- Types of transpiration.
3- The main complex of the thylakoid membrane.

	Q7/ Answer the following: 1- What is **chemiosmosis**? 2- Define **Coleorhiza**? Q8/ Write only **on** the difference between the following: 1- Transpiration and Guttation. 2- Leaf structure of C3 and C4 plants. 3- NAD & FAD. 4- Epigeous & Hypogeous germination.

20. Extra notes:

21. Peer review پێداچوونەوەی هاوەڵ

This course book must be reviewed and signed by a peer. The peer approves the contents of your course book by writing few sentences in this section.

A peer is person who has enough knowledge about the subject you are teaching, he/she must be a professor, assistant professor, a lecturer or an expert in the field of your subject.

ئەم کۆرسبووکە دەبێت لەلایەن هاوەڵێکی ئەکادیمیەوە سەیر بکرێت و ناوەرۆکی بابەتەکانی کۆرسەکە پەسەند بکات و جەند ووشەیەک بنووسێت لەسەر شیاوی ناوەرۆکی کۆرسەکە و واژووی لەسەر بکات.

هاوەڵ ئەو کەسەیە کە زانیاری هەبێت لەسەر کۆرسەکە و دەبیت پلەی زانستی لە مامۆستا کەمتر نەبێت.

Peer reviewed by:
Mr. Muhammed Ali Saleem
Head of Biology Department