BIO 308 – Plant Physiology (Spring 2025) – Course Syllabus

Course Instructor: Prof. Devrim Coşkun

- E-mail: devrim.coskun@sabanciuniv.edu
- Office: FENS 1002

Course Schedule:

- **Start:** Week of February 10, 2025
- **End:** Week of May 19, 2025
- **Lectures:**
  - Tuesdays: 12:40 – 14:30 (FENS L030)
  - Fridays: 13:40 – 14:30 (FENS L067)
- **Labs:**
  - Fridays: 14:40 – 17:30 (FENS 2053)
- **Office Hours:**
  - Tuesdays: 14:40 – 15:30 (FENS 1002)

Teaching Assistants (TAs):

- Ezgi Güllü (ezgi.gullu@sabanciuniv.edu)
- Sarah Ashar (sarah.ashar@sabanciuniv.edu)

Course Description: This course will explore the fundamental processes of plant life from a physiological perspective. Students will engage with topics ranging from water and nutrient uptake to photosynthesis and growth regulation, understanding both the underlying mechanisms and their ecological significance. This syllabus aims to balance theoretical knowledge with practical application, preparing students for further studies or careers in plant sciences, agriculture, or environmental management.

Course Objectives:

- Understand basic plant functions at the cellular, tissue, and whole-plant levels.
- Analyze the physiological responses of plants to environmental stimuli.
- Develop skills in laboratory experimentation, data analysis, and interpretation.
- Develop skills in science communication and public speaking.

Make-up Policy: Missing any course assessment (see below) without valid/documented justification (e.g., doctor's note, police report) will automatically result in a zero grade. Given a valid excuse, a make-up assessment will be provided at the discretion of the professor.

Policies on Attendance, Classroom Behaviour, and Cheating: Attendance to lectures and laboratories is mandatory and essential for success in the course (see also Make-up Policy, above). In case of an absence, it is the student's responsibility to catch-up on any missed content. Sabancı University's regulations on plagiarism and cheating will be strictly enforced.

Course Structure:

Week 1 Lectures: Introduction to Plant Physiology (February 11 & 14)

- Overview of plant functions, cell structure, and organization.
- Introduction to major physiological processes.
- Readings:
    - Taiz & Zeiger (2015). Chapter 1. Plant and Cell Architecture.

Week 1 Lab: Introduction to Laboratory Research (February 14)

- Safety protocols in the lab.
- Basic lab equipment overview.
- Introduction to the scientific method, data recording, and basic statistics.

Week 2 Lectures: Water Relations (February 18 & 21)

- Water potential, osmosis, and water movement in plants.
- Stomatal function and transpiration.
- Readings:
    - Taiz & Zeiger (2015). Chapter 3. Water and Plant Cells.
    - Taiz & Zeiger (2015). Chapter 4. Water Balance of Plants.

Week 2 Lab: Water Potential and Osmosis (February 21)

- Experiment: Stomatal Response to Environmental Changes.
- Objectives: To observe and measure how stomatal conductance changes in response to different environmental conditions.

Week 3 Lectures: Mineral Nutrition (February 25 & 28)

- Essential (and beneficial) nutrients, their uptake, and transport.
- Deficiency symptoms and soil-plant relationships.
- Readings:
    - Taiz & Zeiger (2015). Chapter 5. Mineral Nutrition.
    - Taiz & Zeiger (2015). Chapter 6. Solute Transport.

Week 3 Lab: Nutrient Uptake in Plants (February 28)

- Experiment: Investigating Nutrient Deficiency in Hydroponically Grown Common Bean.
- Objectives: Identify nutrient deficiencies visually, measure growth rates and nutrient uptake, and discuss uptake mechanisms.

Week 4 Lectures: Photosynthesis I (March 4 & 7)

- Light reactions; mechanisms of light capture and energy conversion.
- Chloroplast structure and function.
- Readings:
    - Taiz & Zeiger (2015). Chapter 7. Photosynthesis: The Light Reactions.

Week 4 Lab: Photosynthesis I - Light Reactions (March 7)

- Experiment: Measuring Light Reactions with Chlorophyll Fluorescence.
- Objectives: Understand light harvesting and electron transport in photosynthesis.

Week 5 Lectures: Photosynthesis II (March 11 & 14)

- Calvin cycle, photosynthetic efficiency, and C3, C4, CAM pathways.
- Photorespiration and its implications.
- Readings:
    - Taiz & Zeiger (2015). Chapter 8. Photosynthesis: The Carbon Reactions.
    - Taiz & Zeiger (2015). Chapter 9. Photosynthesis: Physiological and Ecological Considerations.

Week 5 Lab: Photosynthesis II - Dark Reactions (March 14)

- Experiment: The Dark Reactions.

- Objectives: Observe CO_2 fixation and understand the Calvin cycle's role in biomass production.

Week 6 Lectures: Respiration (March 18 & 21)

- Glycolysis, TCA cycle, and electron transport chain.
- Energy balance in plant cells.
- Readings:
    - Taiz & Zeiger (2015). Chapter 12. Respiration and Lipid Metabolism.

Week 6 Lab: Respiration Rates (March 21)

- Experiment: Root Respiration in Response to Environmental Stimuli.
- Objectives: Learn about respiratory pathways and measure energy production.

Week 7 Lectures: Midterm Week (March 25 & 28)

- Tuesday lecture:
    - ***Student Presentations Group I***
    - Review session for midterm exam.
- Friday lecture: ***Midterm Exam***

Week 7 Lab: No lab!

Week 8 Lectures: Plant Growth and Development (April 8 & 11)

- Hormones in plant growth regulation (auxins, gibberellins, cytokinins, abscisic acid, ethylene).
- Photomorphogenesis and phytochrome system.
- Readings:
    - Taiz & Zeiger (2015). Chapter 15. Signals and Signal Transduction.
    - Taiz & Zeiger (2015). Chapter 16. Signals from Sunlight.
    - Taiz & Zeiger (2015). Chapter 18. Seed Dormancy, Germination, and Seedling Establishment.
    - Taiz & Zeiger (2015). Chapter 19. Vegetative Growth and Organogenesis.

Week 8 Lab: Hormonal Effects on Growth (April 11)

- Experiment: Gibberellin vs. abscisic acid effects on seed germination.
- Objectives: Investigate hormone roles in plant growth and dormancy.

Week 9 Lectures: Long-distance Transport (April 15 & 18)

- Phloem transport, sink-source relationships.
- Vascular systems and long-distance signaling.
- Readings:
    - Taiz & Zeiger (2015). Chapter 11. Translocation in the Phloem.

Week 9 Lab: Translocation and Vascular Transport (April 18)

- Experiment: Xylem and phloem transport using dyes in herbaceous plants.
- Objectives: Visualize and understand the movement of nutrients and sugars within the plant.

Week 10 Lectures: Stress Physiology (April 22 & 25)

- Responses to biotic (pathogens, herbivores) and abiotic stresses (drought, salinity, temperature extremes).
- Adaptation and acclimation strategies.
- Readings:
    - Taiz & Zeiger (2015). Chapter 23. Biotic Interactions.
    - Taiz & Zeiger (2015). Chapter 24. Abiotic Stress.

Week 10 Lab: Stress Responses (April 25)

- Experiment: Salinity stress on plant growth, form, and function.
- Objectives: Explore how plants adapt to environmental stress.

Week 11 Lectures: Plant Movement and Tropisms (April 29 & May 2)

- Mechanisms of tropisms (phototropism, gravitropism, halotropism).
- Nastic movements and their physiological basis.
- Readings:

- Taiz & Zeiger (2015). Chapter 18. Seed Dormancy, Germination, and Seedling Establishment.

Week 11 Lab: Plant Movement and Tropisms (May 2)

- Experiment: Measuring phototropism, gravitropism, and halotropism.
- Objectives: Understand the physiological basis of plant nastic movements and tropism.

Week 12 Lectures: Senescence and Abscission (May 6 & 9)

- Physiological changes during aging.
- Control of leaf and fruit drop.
- Readings:
  - Taiz & Zeiger (2015). Chapter 22. Plant Senescence and Cell Death

Week 12 Lab: Leaf Senescence (May 9)

- Experiment: Tracking changes in chlorophyll content and enzyme activity during leaf aging.
- Objectives: Study the physiological changes during senescence.

Week 13 Lectures: Reproduction (May 13 & 16)

- Flower development, pollination, fertilization.
- Seed formation and dormancy.
- Readings:
  - Taiz & Zeiger (2015). Chapter 18. Seed Dormancy, Germination, and Seedling Establishment.
  - Taiz & Zeiger (2015). Chapter 20. The Control of Flowering and Floral Development.
  - Taiz & Zeiger (2015). Chapter 21. Gametophytes, Pollination, Seeds, and Fruits.

Week 13 Lab: Flower anatomy and Plant Reproduction (May 16)

- To understand the structure and function of flowers in relation to plant reproduction.
- To identify and dissect different types of flowers to understand their reproductive components.

Week 14: Course Review & Final Exam Preparation (May 20 & 23)

- Tuesday lecture:
  - ***Student Presentations Group II***
  - Synthesis of course material, discussing interconnections between different physiological processes.
- Friday lecture:
  - Review session for final exam.

Week 14 Lab: No Lab!

Assessments:

- **Midterm Exam:** 30%
  - Covering all course material from Weeks 1 – 6
  - Format: Multiple choice, True/False, Short- and Long-form answers
  - Will take place during the ***Week 7 Friday lecture slot (March 28)***
- **Final Exam:** 35%
  - Covering all course material from Weeks 1 – 14
  - Format: Multiple choice, True/False, Short- and Long-form answers
  - Will take place during the designated final exam schedule.
- **Lab Notebook:** 20%
  - Students will produce weekly (in-class) lab reports based on each week's experiment.
  - See below for details.
- **Student Presentation:** 15%
  - Each student will give a 10–15-minute presentation on a (pre-approved) topic related to class.
  - Presentations will take place during the ***Tuesday lecture period of Weeks 7 and 14***.
  - See below for details.

Textbook:

- "Plant Physiology and Development, 6th/7th edition" by Lincoln Taiz, Eduardo Zeiger, Ian M. Møller, and Angus Murphy (Sinauer Assoc. Inc.)

Additional Resources:

- Journal articles selected from the primary literature.
- Online databases like *Google Scholar* and *ISI – Web of Science* for further reading.

Lab Component: Each week, students will participate in a lab session where they will conduct experiments related to the week's lecture topics, enhancing practical understanding of plant physiology concepts.

- See '***Lab Manual'*** for detailed description of each week's experiment.
- **Lab Notebook:** Each lab session will require a detailed report including:
    - Introduction (background, objectives, hypothesis)
    - Methods (detailed procedure)
    - Results (data description, with graphs and/or tables)
    - Discussion (interpretation of results, error analysis)
    - Conclusion (summary of main findings)
- **Lab Attendance and Participation:** Attendance and participation is mandatory.
- **Additional Details:**
    - Labs are conducted in groups to facilitate peer learning, but individual reports are required.
    - Each lab session will start with a brief discussion or demonstration of the day's experiment.
    - Students are encouraged to ask questions and engage in problem-solving during lab sessions.
    - Safety gear (lab coats, goggles) is mandatory where applicable.
    - Students are responsible for bringing their own notebook, which will be handed in to the TAs at the end of each session for marking.

Student Presentations:

- Each student will choose or be assigned a topic related to course material, diving deeper into the biological mechanisms, cutting-edge research, and societal impact.
- Presentations should last 10 – 15 minutes, followed by a 5-minute Q&A session.
- Grading will be based on content accuracy, clarity, organization, and engagement with the audience (incl. Q&A).
- Presentations will take place during the ***Tuesday lecture period of Weeks 7 (Group I) and 14 (Group II)***.