COURSE SYLLABUS – BIO 308 Plant Physiology

(Spring 2024)

The field of **plant physiology** includes the study of all the internal activities of plants—those chemical and physical processes associated with life as they occur in plants. This includes study at many levels of scale of size and time.

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Office & Hours: Any time by appointment.

Contents

The aim of this course is to learn the metabolic physiology of plants. It includes relations of water and plant cells, water balance of plants, mineral nutrition, solute transport, photosynthetic light and carbon reactions, translocation in the phloem (sugar transport), respiration and lipid metabolism, assimilation of mineral nutrients.

Learning Outcomes

Upon completion of this course students should be able to:

- Learn the main concepts of plant physiology.
- Examine detailed characteristics of plant cells, relations of water and plant cells, water balance, mineral nutrition and solute transport.
- Describe the most important plant metabolism process; photosynthesis: light reactions carbon reactions and its physiological and ecological considerations.
- Characterize translocation in the phloem, respiration and lipid metabolism, assimilation of mineral nutrients, secondary metabolites and plant defense, cell walls structure.
- Understand respiration and lipid metabolism in plants.

Course Materials

Instructor slides will be the main course material and will be available on SUcourse+ (restricted for redistribution, some parts may be subject to international copyrights).

Computer with camera and internet connection. Make sure your battery is charged and you have a smartphone hotspot connection ready as a backup to home internet to be able to participate in-session quizzes without interruption.

Grading Policy (% impact on final grade):

Lab Attendance (10%) –. Lab attendance is COMPULSORY to pass this course. Anyone missing 3 or more labs without a valid medical report shall be dropped from the course. Your lab quizzes will be marked as your attendance for each lab session.

Lab Reports (25%) Lab reports must contain details of your scientific experiment alongwith your

Attendance to lecture sessions will have an impact of 10% on final grade. Missing >15 min of a session will be regarded as absence

Midterm on week 6 (25%) – There will be four homework assignments throughout the term with 20% impact on final grade.

Student Presentations on weeks 12 and 13 (15%) – (see "Student Presentation Rules and Schedule" below) These can be taken in the lab sessions depending on the topic assigned. (Either theoretical topic or demonstration topic)

Final Exam (30%) – The final exam will be held online and will be composed of multiple choice, fill in the blanks and short essay questions.

Make-up Policy:

Missing homework due dates, presentation, or the final exam results in a zero grade for that specific grading item. No scheduled make-ups will be offered for a missed grading item. In case a student misses his/her presentation or the final exam due to an emergency with a **valid excuse** (*e.g.,* a written proof of doctor's report, accident report, etc.) the instructor and TA must be informed within the same week. In such a case, a separate exam will be given at a time and date determined by the instructor.

Policies on Attendance, Classroom Behavior and Cheating:

Attendance to all on-line live lecture sessions is essential for understanding and interpreting the course material and asking questions to the instructor. Attendance to lecture sessions will have an impact of 10% on final grade. Student presentation sessions have a separate attendance policy (see the "Student Presentation Rules and Schedule" below). In case of absence in lecture sessions, it is the student's responsibility to check the syllabus, retrieve the associated course materials from on-line resources (listed above) and discuss the missed sections with classmates. Students will be responsible from all course slides and any other material presented during lectures (excluding the parts out of context as declared by the instructor). Sabanci University's regulations on plagiarism and cheating will be strictly enforced on students who help, attempt, or conduct any form of cheating. The cheated component (exam, assignment,report etc) will result in a zero.

WEEKLY SCHEDULE OF COURSE ACTIVITIES & EXAMS

Week	*Activity/Chapter
1	Why study plants? Overview of Plant Structure, The Plant Cell, Plasmodesmata
2	Water and Plant cells: Water in Plant Life, The Structure and Properties of Water
3	Water Transport Processes Water Balance of Plants: Water Absorption by Roots, Water Transport through the Xylem, Water Movement from Leaf to the Atmosphere
4	Mineral Nutrition: Essential Nutrients, Deficiencies and Plant Disorders, Treating Nutritional Deficiencies, Soil, Roots and Microbes
5	Solute Transport: Passive and Active Transport, Transport of Ions Across A Membrane Barrier, Membrane Transport Processes, Membrane Transport Proteins, Ion Transport in Roots
6	Photosynthesis: The Light Reactions: Photosynthesis in Higher Plants, Organization of the Photosynthetic Apparatus, Organization of Light Absorbing Antenna Systems, Mechanisms of Electron Transport, Proton Transport and ATP Synthesis in the Chloroplast, Repair and Regulation of the Photosynthetic Machinery, Genetics, Assembly and Evolution of Photosynthetic Systems (**Mid-term Exam after 6th week, will be announced after April 10)**
7	Photosynthesis: Carbon Reactions: The Calvin Cycle, Regulation of the Calvin Cycle, The C2 Oxidative Photosynthetic Carbon Cycle, CO2 Concentrating Mechanisms I: Algal and Cyanobacterial Pumps, The C4 Carbon Cycle, Crassulacean Acid Metabolism, Synthesis of Starch and Sucrose
8	Photosynthesis: Physiological and Ecological Considerations: Light, Leaves and Photosynthesis, Photosynthetic Responses to Light by the Intact Leaf, Photosynthetic Responses to Carbon Dioxide, Photosynthetic Responses to Temperature.
9	Translocation in the Phloem: Pathways of Translocation, Patterns of Translocation: Source to Sink, Materials Translocated in the Phloem: Sucrose, Amino Acids, Hormones, and Some Inorganic Ions, Rates of Movement
10	The Mechanism of Translocation in the Phloem: The Pressure- Flow Model, Phloem Loading, Phloem Unloading, Photosynthate Allocation and Partitioning
11	Respiration and Lipid Metabolism: Glycolysis: A Cytosolic and Plastidic Process, The Citric Acid Cycle: A mitochondrial Matrix Process, Electron Transport and ATP Synthesis at the Inner Mitochondrial Membrane, Respiration in Intact Plants and Tissues, Lipid Metabolism
****12 & 13**	Topic group-1: Assimilation of Mineral Nutrients: Nitrate Assimilation, Ammonium Assimilation, Biological Nitrogen Fixation, Sulfur Assimilation, Phosphate Assimilation, Cation Assimilation, Oxygen Assimilation, The Energetics of Nutrient Assimilation Topic group-2: Secondary Metabolites and Plant Defense: Cutin, Waxes, Suberin, Secondary Metabolites, Terpenes, Phenolic Compounds, Nitrogen Containing Compounds, Plant Defense Against Pathogens

*****subject to change during the semester

******weeks of student presentation sessions, students may also choose their own topics

Student Presentation Rules and Schedule

1. During the student presentation sessions, full time attendance is required (missing >10 min of a session will be regarded as absence). You may miss only one student presentation without a penalty, however if you miss more than one, then your final grade will be reduced by one letter grade (i.e. A to A-). In case a student misses a presentation session due to an emergency with a valid excuse (e.g. a written proof of doctor's report, accident report, etc.) the instructor and TA must be informed within the same week.

2. Although your course slides and text book is the main source to build up your PowerPoint presentation, you are encouraged to research other resources from the IC (https://www.sabanciuniv.edu/bm/en) and the internet to design and enrich your presentation.

3. Students assigned to a chapter are responsible for sharing the chapter content (i.e. sub-topics in a chapter) among themselves.

4. Having learned your presentation chapter and shared the sub-topics with your presentation partner, you should then prepare your slides (e.g. 10-15 slides) that would cover a 25 min (± 5 min) presentation.

5. Your presentation will be evaluated according to the criteria below (in order of priority), and your presentation grade will have an impact of 15% on your final letter grade as stated in the syllabus published in SUcourse+.

   - A comprehensive coverage of the chapter sub-topics assigned
   - Use of scientific language, grammar, typeset, units of measurement
   - Visual quality of the presentation material (titles, bullets, tables, font size, figures, tables, photos, slide numbers, etc.)
   - Time management (25 ± 5 min)
   - **Voice modulation, use of open body language, audience engagement, eye contact, hand gestures, interactive strategies.**

6. Presentations must be uploaded to SUcourse+ as a single ".pptx" file before the presentation day.

7. Some precautions during the student presentation sessions:

   - Choose your major points carefully and illustrate them with examples (organisms etc).
   - Talk clearly and in well-modulated tones. Avoid speaking too rapidly, softly, or loudly..
   - Maintain eye contact. Use hand gestures naturally, gracefully, and to emphasize points. Use a laser pointer to circle in a half-moon shape or fully encircle the aspects you want to emphasize.
   - Bulletproof confidence comes from preparation. Embellish your presentation with interesting and relevant material supported by figures, flowcharts, bulletpoints, references, and organism examples.

- Avoid crowding your presentation with too many sentences. Stick to the topic and use a large font with fewer sentences.

Lab Syllabus

Read beforehand what the lab will entail.

All lab reports must contain scientifically accurate pictures taken by each student individually. Any student using another one's experimental photograph will lost points in the lab report.

Lab Experiments:

Lab. 1: Germination of bread wheat and durum wheat seeds under different abiotic stress conditions.

Aim of this experiment is to germinate bread wheat (*Triticum aestivum* cv.Adana 99) and durum wheat (*Triticum durum* cv.Sarıçanak) under salinity stress to observe and compare the results of these genotypes relatively to each other.

Lab. 2: Growing common bean under hydroponics culture with various nutrient deficiencies: K, Mg, P, N and Fe.

Aim of this experiment is to perform a hydroponics experiment with common bean (*Phaseolus vulgaris* cv. Göynük 98) under control and various nutrient deficiency conditions to observe the physiological symptoms of potassium, magnesium, phosphorus and iron deficiencies and their effects on the shoot-to-root ratio.

Lab. 3: Element Analysis of common bean plants from exp #2.

Aim of this experiment is to digest the ground shoot samples of common bean (*Phaseolus vulgaris* cv. Göynük 98) plants (from the experiment #2) with using acid digestion system and make their mineral element analysis with ICP-OES (inductively coupled plasma optical emission spectrometer).

Lab. 4: Tropism experiment

Aim of this experiment is to observe phototropism and gravitropism of differently oriented common bean (*Phaseolus vulgaris* cv. Göynük 98) seedlings under light and dark conditions.

Lab. 5: Measuring the carbohydrate partitioning in common bean plants which are grown under control and Mg deficiency conditions with shading and non-shading the leaf parts.

Aim of this experiment to observe and measure the carbohydrate partitioning of common bean plants (*Phaseolus vulgaris* cv. Göynük 98) which are subjected to photooxidative stress and Mg deficiency.

The following schedule will be performed for the practical lab classes. Instructions will be online and performance will be in person:

Weekly Lab Schedule

Date	Lab	BIO 308L - Plant Physiology - Lab.
Week 1	0	Syllabus & Lab Safety
Week 2	1	Wheat germination in abiotic stress setup
Week 3	1	Observation & Results
Week 4	2	Bean and maize nutrient deficiency experiment setup
Week 5	2	Bean and maize growth
Week 6	2	Observation under K, Mg, P, N and Fe deficiency
Week 7	3	Milling of maize and shoot samples and acid digestion
Week 8	3	Measurement (ICP-MS and ICP-OES)
Week 9	4	Phototropism and gravitropism of differently oriented common bean setup
Week 10	4	Observation & Results of seedlings under light and dark conditions
Week 11	5	Growth of common bean in control and Mg deficiency conditions
Week 12	5	Observation and measurement
Week 13	5	Analysis
Week 14		-