

**COURSE DATA****DATA SUBJECT****Code:** 33052**Name:** Plant physiology**Cycle:** Undergraduate Studies**ECTS Credits:** 10**Academic year:** 2025-26**STUDY (S)**

Degree	Center	Acad. year	Period
1100 - Degree in Biology	Facultat de Ciències Biològiques	3	Annual

**SUBJECT-MATTER**

Degree	Subject-matter	Character
1100 - Degree in Biology	Plant biology	COMPULSORY

**COORDINATION**

RENAU MORATA BEGOÑA

**SUMMARY**

**DUE TO THE IMPLEMENTATION OF THE NEW CURRICULUM FOR THE BACHELOR'S DEGREE IN BIOLOGY, THIS SUBJECT IS BEING DISCONTINUED FROM THE OLD CURRICULUM AND IS THEREFORE OFFERED EXCLUSIVELY AS A NON-TEACHING (ND) COURSE IN THAT CURRICULUM. THIS MEANS THAT IT WILL NOT HAVE ANY FACE-TO-FACE TEACHING ACTIVITIES ASSOCIATED WITH IT AND THAT THE SUBJECT WILL BE ASSESSED SOLELY THROUGH A THEORETICAL AND PRACTICAL EXAM.**

**STUDENTS WHO DO NOT PASS THIS COURSE IN ANY OF THE 2025-26 OR 2026-27 ACADEMIC YEARS WILL BE REQUIRED TO ADAPT TO THE NEW CURRICULUM TO CONTINUE THEIR BACHELOR'S DEGREE IN BIOLOGY.**

Plant Physiology is a subject of the third year of the Degree in Biology which forms part of the Plant Biology area, together with Botany, taught in the second year.

Plant Physiology is intended to provide basic knowledge of how plants function and of processes that occur in them as living beings, also integrating the knowledge acquired in other subjects such as Cell Biology, Botany, Biochemistry and Soil Science.



To acquire basic knowledge of Plant Physiology, students will learn water relations of the plants (absorption, transport and loss of water), mineral nutrition and transport of photoassimilates, as well as photosynthetic metabolism, which allows the reduction and assimilation of the main bioelements, and respiratory processes, participants also in the energy metabolism of the plant. There will be an approach to secondary metabolism, through which compounds of fundamental importance are produced. In addition to the basic physiological processes of plants it is important to understand the mechanisms involved in their growth and development, as well as their interactions with the environment. Therefore, along this course the students will learn from the plant hormones to the photoreceptors, through the movement of plants, different life cycle processes and the integration of all these processes in space and time, and the adaptation mechanisms to possible adverse environmental conditions.

In short, the goal of this course is that at the end of it the students have learned how plants function at different levels of organization and how they adapt functionally to the environment in which they develop.

Plant Physiology is a subject with an important experimental content and additionally to the theoretical training, laboratory experiments will be conducted that will help to allow the acquisition of the knowledge, concepts and techniques of this scientific discipline.

## PREVIOUS KNOWLEDGE

## RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

## OTHER REQUIREMENTS

## COMPETENCES / LEARNING OUTCOMES

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Adquisición de conciencia social y profesional sobre la problemática ambiental y la importancia de la biotecnología vegetal y sus implicaciones éticas.

Capacidad de análisis y síntesis de la información relativa a la materia.

Capacidad de comunicar ideas e información a nivel escrito y oral.

Capacidad de diseñar y llevar a cabo experimentos, así como de analizar e interpretar datos.

Capacidad de interactuar tanto con el profesorado como con los compañeros.

Capacidad para trabajar en grupo.

Comprender e interpretar trabajos científicos relacionados con los vegetales.

Comprender y manejar la terminología científica básica relacionada con la materia.



Conocer cómo las plantas reconocen, integran y responden a las señales endógenas y ambientales que les llegan, permitiendo que se adapten a situaciones fluctuantes.

Conocer cómo las plantas son capaces de obtener sus nutrientes esenciales y cómo son capaces de convertir la energía solar en alimento.

Conocer el funcionamiento de aparatos y técnicas elementales relacionadas con la asignatura.

Conocer los ensayos prácticos que se pueden realizar para demostrar las distintas hipótesis relacionadas con la Fisiología vegetal.

Conocer los principios básicos del funcionamiento de las plantas.

Habilidad para argumentar desde criterios racionales, diferenciando claramente lo que es opinable de lo que son hechos o evidencias científicas aceptadas.

Saber buscar la información bibliográfica adecuada para, en un momento dado, poder actualizar y profundizar en sus conocimientos sobre un tema específico.

## DESCRIPTION OF CONTENTS

### 1. Introduction to Plant Physiology.

Introduction to Plant Physiology.- Concept and scope of Plant Physiology. Relation with other sciences. Plant Physiology programme. Bibliographic sources. Assessment.

The plant cell. Organelles characteristic of the plant cell. The cell wall: structure, composition and function. Transformations of the cell wall and areas of communication.

Lab session 1.- Membrane permeability. Factors which alter membrane permeability

### 2. Water balance.

Water in plants .- Importance of water. The structure and properties of water. Water potential: concept and components. Water balance in cells and tissues.

Absorption and transport of water in the plant .- Water movement in the soil-plant-atmosphere continuum. Water absorption by the root. The root as an osmometer: Root pressure and guttation. Transport of water in the plant. Composition of the xylem sap. Mechanism of ascent of water.

Transpiration .- Concept, importance and magnitude. Transpiration rates. Transpiration through the stomata. Mechanisms for opening and closing of stomata. Factors affecting transpiration.

Lab session 2.- Measurement of water and osmotic potentials in plant tissues.

Lab session 3.- Measurement of transpiration with the potometer.



### **3. Mineral nutrition.**

Nutrient uptake by plants .- The root as an organ of absorption. Nutrient uptake at the cellular level. Radial transport in roots. Longitudinal transport.

Mineral nutrition of plants.- Plant mineral composition. Essential mineral elements. Functions of mineral elements in the plant. Mineral deficiencies: Causes and symptoms.

Lab session 4.- Mineral Nutrition

### **4. Plant metabolism (1)**

Photosynthesis. Photosynthesis: concept, general equation and processes included. Types of photosynthesis. The photosynthetic apparatus in plants: chloroplast, structure and chemical composition. Photosynthetic pigments: chlorophylls, carotenoids and phycobilins.

Absorption of light energy. Absorption of light and forms of energy dissipation. Photosynthetic unit, reaction centers and harvesting antennae. Thylakoid ultrastructure, composition and distribution of photosynthetic complexes.

Photosynthetic electron transport and photophosphorylation. The electron transport: cyclic, noncyclic and pseudocyclic. The water splitting complex. Photophosphorylation. Mechanism of coupling between electron transport and photophosphorylation.

Photosynthetic carbon dioxide fixation. Carbon dioxide assimilation in plants: the Calvin-Benson cycle. Cycle regulation. Synthesis of sucrose and starch. Photorespiration. Biochemical route and physiological significance.

Adaptive pathways of prior accumulation of carbon dioxide. Pathways and adaptive significance. C4 photosynthetic metabolism. CAM photosynthetic metabolism. Accumulation in algae. Photorespiration in C4 and CAM plants. Water use efficiency (WUE).

Transport of photoassimilates. The phloem structure and function. Substances transported through the phloem. Concepts of source and sink. Loading and unloading mechanisms. Mechanism of phloem transport.

Lab session 5.- Photosynthesis in isolated thylakoid vesicles. Hill reaction.

### **5. Plant metabolism (2)**

Respiration in plants. Overview of the respiratory process. Peculiarities of the respiratory chain in plants: the alternative oxidase.

Metabolism of nitrogen and sulfur. Forms of nitrogen absorbed by the plant. Nitrogen fixation in symbiotic associations. Assimilatory reduction of nitrate and ammonium. Assimilation of sulfur.

Secondary metabolism. Major groups and important synthesis routes. Alkaloids. Terpenoids. Phenolic compounds.



Lab session 6.- Measurement of gas exchange in different species.

Lab session 7.- Experimental results in Plant Physiology. Problems and questions.

## **6. Plant Development (1)**

Plant growth. Plant growth and development: terminology and cellular bases. Organization and activity of apical meristems of the stem and root. Quantification and kinetics of growth.

Plant growth regulators. Phytohormone concept. Perception and hormonal signal transduction. Main groups of hormones: auxins, gibberellins, cytokinins, ethylene, abscisic acid. Other plant hormones, polyamines, brassinolide, jasmonates, salicylates, oligopeptides, oligosaccharines.

Lab session 8.- Plant hormones: auxins.

Lab session 9.- Plant hormones: gibberellins.

Lab session 10.- Plant hormones: cytokinins.

## **7. Plant Development (2)**

Photomorphogenesis. Concept. Photoreceptors in photomorphogenesis. The phytochrome system: chemical characteristics, types of phytochrome, photostationary state, metabolism. Mechanism of action. Phototropins and cryptochromes.

Rhythms and movement in plants. The biological clock. Types of movements in plants. Nutations. Nastic movements: nictinastia and tigmonastia. Tropisms: phototropism and gravitropism.

Physiology of flowering. Definition and control of flowering. Endogenous control. Environmental control: the photoperiod and low temperatures (vernalization). Floral transition: transduction pathways. Flower development.

Fruit physiology. Fruit formation. Parthenocarpy. Fruit growth. Fruit ripening: associated physical and biochemical changes. Climacteric and non-climacteric fruit: characteristics.

Seed physiology. Development and structure of the seed. Germination: factors that affect it. Metabolism of germination. Dormancy: concept. Seed dormancy: causes. Environmental factors that cause the outbreak of dormancy. Hormonal control of dormancy in seeds. Dormancy in buds.

Senescence and abscission. Senescence in plants: types. Abscission: control and hormonal regulation.

Plant physiology in adverse conditions. Stress in plants: definition and types. Plant responses to adverse conditions. Abiotic stress. Biotic stress.

Lab session 11.- Germination. Effect of different factors.

## **WORKLOAD**

**PRESENCIAL ACTIVITIES**

Activity	Hours
Tutorials	10,00
Theory	60,00
Laboratory	30,00
<b>Total hours</b>	<b>100,00</b>

**NON PRESENCIAL ACTIVITIES**

Activity	Hours
Attendance at other activities	0,00
Individual or group project	20,00
Independent study and work	60,00
Preparation of lessons	70,00
Preparation for assessment activities	0,00
Resolution of case studies	0,00
<b>Total hours</b>	<b>150,00</b>

**TEACHING METHODOLOGY****NOT APPLICABLE DUE TO THE IMPLEMENTATION OF THE NEW STUDY PLAN**

The course has the student as the main protagonist of their own learning, and is structured around four axes:

¿ **Lectures.** Teachers will explain and emphasize key concepts that help in understanding the different parts of the programme and indicate the recommended resources for further preparation of the subject in depth. In some classes, a more participatory model will be used, focusing on communication between students and between them and the teacher.

¿ **Lab classes.** During these classes the students will learn skills in plant physiology in a practical and direct manner. They will acquire the skills and abilities needed for effective work in the laboratory.

¿ **Tutorials.** The tutorials will be held in small groups. In them, the teacher will guide the student on all the elements that make up the learning process, both in terms of general approaches and specific issues of the themes already developed. They will include guiding for seminar preparation.

**Seminars.** In the seminars, students, organised in groups of 2 - 5 students, will give a presentation on one of the possibilities proposed: a) experimental work developed by themselves, b) a quality scientific article or other proposals indicated by the lecturers of the subject, and c) theoretical seminars previously proposed by the lecturers. In the seminars, the ability to schematise and summarise will be exercised, as well as oral and/or written expression. As mentioned above, the seminars will be carried out in teams, and all members of the group must participate in the oral presentation. After each presentation, there will be a debate on the topic of the seminar, in which the main role will be played by the students.

**EVALUATION**



## NOT APPLICABLE DUE TO THE IMPLEMENTATION OF THE NEW STUDY PLAN

In order to pass the course, a minimum score of 5 out of 10 must be achieved. The following items will be assessed:

- **Knowledge:** assessed by means of an on-site written exam, this represents up to 80% of the final mark. This exam may include questions directly related to knowledge acquired in lab sessions. A minimum of 4.5 out of 10 must be achieved in the exam, to be added to the marks for the rest of the course activities, in the proportions 80% knowledge, 20% other activities. A partial on-site exam may be taken which, in order to eliminate subject matter, must achieve a mark equal to or higher than 4.5 out of 10.

- **Other activities:** The other activities carried out throughout the course including seminars, assignments, tutorial related activities, etc. will account for up to 20% of the final mark. At least 8% of the evaluation of these activities will be related to the practicals. **In order to obtain the maximum mark in the subject, it is necessary to complete all the tasks indicated in this section.**

- *Attendance at lab sessions, tutorials, and seminar presentations* is **compulsory**. Absences may have a negative impact on the final course grade.

- Students who do not pass the course in the exam of the 1st call will keep the grade obtained in the other activities until the 2nd call.

- Attendance at laboratory practices will be kept at least until the second session of the academic year following its completion, provided there is no variation in the practical teaching program

## REFERENCES

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VNIVERSITAT D VALÈNCIA

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