# Plant Growth and Development

Code: 44786
ECTS Credits: 6

2025/2026

| Degree | Type | Year |
|---|---|---|
| Plant Biology, Genomics and Biotechnology | OP | 1 |

## Contact

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## Teachers

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## Teaching groups languages

You can view this information at the end of this document.

## Prerequisites

Basic knowledge of Plant Physiology, Genetics and Molecular Biology.

## Objectives and Contextualisation

This course focuses on the mechanisms at the molecular, cellular and organism level that regulate the different stages of plant development which include: gametogenesis and embryogenesis, germination, vegetative growth and reproductive growth (development of flowers, seeds and fruits). The course also covers light perception and signal transduction, and the role of plant hormones in growth and development.

## Learning Outcomes

1. CA15 (Competence) Apply the knowledge acquired from the functional mechanisms of plants, in universally accessible environments, within broader (or multidisciplinary) contexts related to your area of study or based on the needs and demands of society.
2. CA16 (Competence) Possess the learning skills that will enable you to continue studying in a way that will be largely self-directed or autonomous.
3. KA13 (Knowledge) Describe the functional mechanisms of plants at different organisational levels and characterise processes of growth and development.
4. KA14 (Knowledge) Select study methodologies and case studies in the field of plant growth and development and characterise the impact of light.
5. SA24 (Skill) Manage bibliographic information and computer resources in the field of plant growth and development.
6. SA25 (Skill) Critically discuss plant growth and development processes under different environmental conditions.
7. SA26 (Skill) Apply the most appropriate methodology for the genetic and molecular study of the different processes of plant development, as well as signalling routes and hormonal interaction.
8. SA27 (Skill) Apply bioinformatic tools in the genetic, evolutionary and functional study of plants and dissect the genetic networks that regulate plant development and the interaction between them.

## Content

1. GENERAL CONCEPTS

1.1. Course introduction. Developmental differences between animals and plants. Tropisms.

1.2. Plant signalling. Hormonal signalling pathways. Overview and aspects of different hormones.

1.3. Epigenetics in development. General concepts. Chromatin and nuclear organization. Epigenetic marks.

1.4. Small RNA-mediated gene regulation. Types of non-coding RNAs. Mechanism of action and biological roles.

1.5. Cell biology. Regulation of cell division, elongation and polarity. Concepts and techniques on microscopy.

2. PLANT LIFE CYCLE

2.1. Evolutionary perspective of plant life cycle. Gametogenesis and embryogenesis in Cryptogams, Gymnosperms and Angiosperms.

2.2. Germination and Dormancy. Functional structures in the seed. Dormancy. Germination. Role of phytohormones.

2.3. Vegetative development

2.3.1. Root development. Organization and maintenance of root apical meristem. Radial patterning during vascular development. Root branching. Lateral root development.

2.3.2. Shoot development. Organization and maintenance of shoot apical meristem. Organogenesis and organ polarity. Cell-to-cell communication during development.

2.3.3. Senescence. Senescence in development and aging. Lifespan. Cellular implications.

2.4. Reproductive development

2.4.1 Floral induction. Photoperiod and circadian clock . Gibberellins pathway. Vernalization and ambient temperature. Young-adult transition, age dependent pathway. Endogenous pathway controlling flowering. Integration of pathways, florigen.

2.4.2. Flower development. Floral meristem. Floral mutants: floral organ specification, floral organ identity genes. ABCE model of flower development. Floral quartets. Ovule and fruit development. Fruit dehiscence.

2.4.3. Fruit development. Regulation of fruit ripening. Role of ethylene.

3. LIGHT INFLUENCE ON GROWTH

3.1. Light-regulated development and signaling cascades. Transcriptional regulation of seedling de-etiolation, shade avoidance responses and photoperiodic growth.

3.2. Post-transcriptional regulatory mechanisms influencing light responses.

## Activities and Methodology

| Title | Hours | ECTS | Learning Outcomes |
|---|---|---|---|
| Type: Directed | | | |
| Lectures | 30 | 1.2 | CA15, KA13, SA25, SA26, SA27, CA15 |
| Seminaries | 6 | 0.24 | CA16, KA14, SA24, CA16 |
| Type: Supervised | | | |
| Mentoring | 9 | 0.36 | CA15, CA16, KA13, KA14, SA25, SA26, SA27, CA15 |
| Type: Autonomous | | | |
| Personal study | 90 | 3.6 | CA15, CA16, KA13, KA14, SA24, SA26, SA27, CA15 |
| Seminar/Report preparation | 12 | 0.48 | CA15, CA16, KA13, KA14, SA24, SA25, SA26, SA27, CA15 |

Theoretical lectures: lectures represent the main activity to be performed in the classroom. The objective is the acquisition of knowledge on the mechanisms that control development during the life cycle of the plant. Lectures will be complemented with presentations provided by the professors, thus the methodology is mainly based on verbal communication, accompanied by visual schemes. Teacher's direct questions to students during the class are indicative of the student's degree of follow-up.

Seminaries: the objective of the seminars is to promote the ability to analyze and synthesize, the critical reasoning and the ability to solve problems. The seminaries are involved in various activities, such as, for example, analysis and discussion of case studies and problems with the public presentation of work, resolution of questions related to the tract topics, etc.

Preparation of seminars/reports: the students will prepare autonomously (with supervised help if necessary) a work about one of the topics of the program.

Mentoring: In groups or individually, the professors will be available to help the students to solve their doubts about the concepts of the subject and guide them in their studies.

Personal study: Knowledge acquired will be complemented with bibliographical references and other sources of information given to foster self-study.

Use of AI
For this course, the use of Artificial Intelligence (AI) technologies is permitted exclusively for support tasks, such as bibliographic or information searches, text correction, or translations. For seminar/case study

submissions, students must clearly identify which parts were generated using AI technology, specify the tools used, and include a critical reflection on how these tools influenced both the process and the final outcome of the activity. Lack of transparency regarding AI use in this assessed activity will be considered academic dishonesty and may result in partial or full penalties to the grade, or more serious sanctions in severe cases.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

## Assessment

## Continous Assessment Activities

| Title | Weighting | Hours | ECTS | Learning Outcomes |
|---|---|---|---|---|
| Assistance and participation | 10% | 0 | 0 | CA15, KA13, KA14, SA25, SA26, SA27 |
| Continuous in-class assessment | 40% | 1.5 | 0.06 | CA15, KA13, KA14, SA25, SA26, SA27 |
| Report | 30% | 0 | 0 | CA15, CA16, KA13, KA14, SA24, SA26, SA27 |
| Seminar | 20% | 1.5 | 0.06 | CA16, KA13, KA14, SA24 |

The evaluation is based on the following items:

Continuous in-class assessments: During the development of the classes, various exercises will be performed in the classroom to evaluate the knowledge acquired. These assignments will account for 40% of the final grade.

Report: The student will defend one of the program topics through a report. The weight of this work will be 30% of the final grade.

Seminar: The quality of the preparation and presentation of works or public exhibitions will be evaluated, including the answers to the questions and problems proposed. Overall, the evaluation of the seminars will weigh 20% of the final grade. The seminars/problems are obligatory assistance activities and are not recoverable.

Assistance, attitude and participation will be valued by a 10% maximum.

This subject does not include the single assessment system.

## Bibliography

Plant hormones: physiology, biochemistry and molecular biology (book)

Davies, P. 2013. Springer Science & Business Media. ISBN 9401104735, 9789401104739. doi:

10.1007/978-94-011-0473-9

Hormonal Interactions in the Regulation of Plant Development.

Vanstraelen and Benkov. 2012. *ANNU. REV. CELL DEV. BIOL.* 28:463-87

Seed Dormancy and Germination

Bentsink L. and Koornneef M. 2008 *THE ARABIDOPSIS BOOK 6*: e0119. https://doi.org/10.1199/tab.0119

Two Faces of One Seed: Hormonal Regulation of Dormancy and Germination.

Shu et al. 2016. *MOL. PLANT*. 9, 34-45.

PIFs: systems integrators in plant development

Leivar and Monte. 2014. *PLANT CELL*, 26: 56-78

Molecular Control of Grass Inflorescence Development

Zhang and Yuan. 2014. *ANNU. REV. PLANT BIOL.* 65:553-78

Leaf Development

Tsukaya. 2013. *THE ARABIDOPSIS BOOK 11*: e0163. https://doi.org/10.1199/tab.0163

Photomorphogenesis

Arsovski et al. 2012 *THE ARABIDOPSIS BOOK 10*: e0147.. https://doi.org/10.1199/tab.0147

Shade Avoidance

Casal, J. 2012 *THE ARABIDOPSIS BOOK 10*: e0157. https://doi.org/10.1199/tab.0157

Flower Development

Alvarez-Buylla, LR et al. 2010. *THE ARABIDOPSIS BOOK 8:* e0127. https://doi.org/10.1199/tab.0127

## Software

Not applicable.

## Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

| Name | Group | Language | Semester | Turn |
|---|---|---|---|---|
| (PAULm) Classroom practices (master) | 1 | English | second semester | morning-mixed |
| (TEm) Theory (master) | 1 | English | second semester | morning-mixed |