Table of Contents

MINISTRY OF HIGHER EDUCATION, SCIENCE, AND TECHNOLOGY
UNIVERSITY OF LAMPUNG
FACULTY OF TEACHER TRAINING AND EDUCATION
Jalan Prof. Dr. Sumantri Brojonegoro No.1 Gedong Meneng - Bandar Lampung 35145
Telp./Fax: (0721) 704624 *e-mail*: fkip@unila.ac.id,
laman: http://fkip.unila.ac.id

Module Handbook

MODULE DESCRIPTION

Module name	Plant Physiology
Module level, if applicable	Bachelor of Biology
Code, if applicable	KBO619212
Subtitle, if applicable	Fisiologi Tumbuhan
Semester(s) in which the module is taught	IV
Person responsible for the module	Lecturer of Courses
Lecturer	Prof. Dr. Neni Hasnunidah, S.Pd., M.Si. Rochmah Agustrina, M.Si., Ph.D.
Language	Bilingual (Bahasa and English)
Relation to Curriculum	This course is a compulsory course taken in semester 4
Type of teaching, contact hours	Contact hours: 16 weeks x 150 minutes Structured learning: 16 weeks x 180 minutes Independent study: 16 weeks x 180 minutes Practicum sessions: 16 weeks x 255 minutes
Teaching methods	Lectures (150 minutes), Practicum sessions (255 minutes) Learning Methods SGD, RPS, DL, SDL, CoL, CbL, CtL, PjBL, PBL.
Workload	Contact hours: 16 weeks x 150 minutes
Credit points	3 sks = 3.84 ECTS
Requirements according to the examination regulations	Students must meet a minimum of 80% attendance
Recommended prerequisites	Plant Structure and Development
Module objectives/intended learning outcomes	1. Be pious to God Almighty and be able to demonstrate a religious attitude. 2. Internalize scientific values, norms, and ethics and be able to develop them through Plant Physiology lectures. 3. Collaborate and demonstrate a responsible attitude in the field of Plant Physiology studies. 4. Internalize the spirit of independence and fighting spirit and be able to develop it through Plant Physiology lectures. 5. Applying logical, critical, systematic, and innovative thinking in the context of developing or implementing science and technology that pays attention to and applies humanities values that are appropriate to the field of Plant Physiology.

	6. Demonstrate independent, quality, and measurable performance through learning Plant Physiology. 7. Examine the implications of the development or implementation of science and technology that pay attention to and apply humanities values in accordance with the field of Plant Physiology based on scientific rules, procedures and ethics in order to produce solutions, ideas and designs. 8. Prepare scientific descriptions of the results of Plant Physiology studies in the form of investigation reports. 9. Making appropriate decisions based on analysis of information and data in the context of solving problems in the field of Plant Physiology. 10. Maintain and develop networks with lecturers and colleagues both inside and outside the classroom; Be responsible for the achievement of group work results and carry out self-evaluation processes for work groups under his/her responsibility. 11. Documenting, storing, securing, and retrieving the results of his work in the form of a portfolio to ensure authenticity and prevent plagiarism. 12. Mastering facts, concepts, principles, laws, theories, and procedures in the field of Plant Physiology in depth and their application. 13. Have sensitivity in finding problems regarding Plant Physiology. 14. Applying logical, critical, systematic and innovative thinking in the context of solving Plant Physiology problems. Communicate recommendations on problem solving in the context of Plant Physiology based on application and research.
Content	1. Introduction to Plant Physiology 2. Plants and Water 3. Plant Nutrition 4. Photosynthesis 5. Respiration 6. Nitrogen and Sulfur Metabolism 7. Growth and Development 8. Plant Hormones 9. Plant Responses to the Environment.
Forms of Assessment	The assessment is carried out based on examination writing, assessment/evaluation of the learning process and performance with the following components: Structured assignments: 30%; Quiz : 10%; Middle Test: 15%; Final Test: 15%; Practicum 30%; Activity : 10%.
Study and examination requirements and forms of examination	1. Study and exam requirements: 2. Students wear shoes. 3. Students dress modestly. 4. Male students don't have long hair. 5. Attendance more than or equal to 80% 6. 15 minute delay tolerance 7. It is permissible to take follow-up exams for those who are sick (with a doctor's certificate) 8. Students have manners. 9. Students write their name and NPM on each assignment and exam. 10. Students who will complain about grades must promise not to cheat and be willing to be corrected again.

Media employed	Youtube, Journal, PPT, Learning Videos, V-Class
Reading list APA 2018	Primary: 1. Hasnunidah, N. & Suwandi, T. 2016. *Plant Physiology* . Yogyakarta: Innosains. 2. Taiz, L., Møller, I. M., Murphy, A., & Zeiger, E. 2022. *Plant Physiology and Development* (7th ed.). Oxford University Press. 3. Pessarakli, M. (Ed.). 2021. *Handbook of Plant and Crop Physiology* (4th ed.). CRC Press. 4. Salisbury, FB and CW Ross. 1995. *Plant Physiology* . Volume 1. Translated by Dr. Lukman and Sumaryono. Bandung: ITB Publisher. 5. _____. 1995. *Plant Physiology* . Volume 2. Translated by Dr. Lukman and Sumaryono. Bandung: ITB Publisher. 6. _____. 1995. *Plant Physiology* . Volume 3. Translated by Dr. Lukman and Sumaryono. Bandung: ITB Publisher. Supporters: 1. Evert, RF and SE Eichhorn. 2013. *Raven Biology of Plants:* Eighth Edition. New York: WH Freeman and Company Publishers. 2. Hopkins, WG & Huner NPA 2009. *Introduction to Plant Physiology*. New Jersey: John Wiley & Sons 3. Jones, C. and J. Jacobsen. 2001. *Plant Nutrition and Soil Fertility*. Bozeman: Montana State University Extension Service. 4. Koning, R.E. 1994. Solute Movement. *Plant Physiology Information Website*. Online: http://plantphys.info/plant_physiology/solutes.shtml, diakses pada 11 Agustus 2016. 5. Lambers, H., F.S. Chapin III, and T.L. Pons. 2008. *Plant Physiological Ecology*: Second Edition. New York: Springer Science + Business Media. 6. Marschner, H. 2003. *Mineral Nutrition of Higher Plants*: Second Edition. London and California: Academic Press. 7. Nelson, D.L. and M.M. Cox. 2013. *Lehninger Principles of Biochemistry*: Sixth Edition. New York: W. H. Freeman and Company. 8. Reece, J.B., L.A. Urry, M.I. Cain, S.A. Wasserman, P.V. Minorsky, R.B. Jackson. 2005. *Campbell Biology*: Ninth Edition. San Francisco: Pearson Education, Inc. 9. Santosa. 1990. *Fisiologi Tumbuhan*. Proyek Pelatihan tenaga Kependidikan. Yogyakarta: Fakultas Biologi Universitas Gadjah Mada. 10. Taiz, L. and Z. Eduardo. 2002. *Plant Physiology*: Third Edition. Sunderland: Sinauer Associates Inc. 11. Weed Science Society of America. 2013. *Corn and Soybean Herbicide Chart. Purdue University College of Agriculture.* Online: https://ag.purdue.edu /btny/weedscience/Documents/Herbicide_MOA_CornSoy_12_2012%5B1%5D.pdf, accessed 15 August 2016. 12. Workforce Compensation and Performance Services. 2002. *Plant Physiology Series*, GS-0435. Washington DC: Cumming Publishing Company

MINISTRY OF HIGHER EDUCATION, SCIENCE, AND TECHNOLOGY
UNIVERSITY OF LAMPUNG
FACULTY OF TEACHER TRAINING AND EDUCATION
Jalan Prof. Dr. Sumantri Brojonegoro No.1 Gedong Meneng - Bandar Lampung 35145
Telp./Fax: (0721) 704624 *e-mail*: fkip@unila.ac.id,
laman: http://fkip.unila.ac.id

Course Program

COURSE CONTRACT

Course Title	Plant Physiology
Course Code	KB0620212
Semester	IV
Credits	3 SKS (≈ 3.84 ECTS)
Status	Compulsory
Prerequisites	Plant Structure and Development
Study Program	Undergraduate Program of Biology Education
Lecturer	1. Prof. Dr. Neni Hasnunidah, S.Pd., M.Si. 2. Rochmah Agustrina, M.Si., Ph.D.
Course Description	The Plant Physiology course discusses the processes and life activities of plants, including: plant physiology as a science; the relationship of plants with water and soil; the events of diffusion, osmosis, transpiration, transportation, translocation of nutrients and minerals in plants; metabolism that occurs in plants (photosynthesis, respiration, chemosynthesis, lipid and nitrogen metabolism); the relationship of plants with the environment (growth, differentiation, and development, plant hormones, plant responses to the environment).
Course Learning Outcomes (CLOs)	1. Be pious to God Almighty and be able to demonstrate a religious attitude. 2. Internalize scientific values, norms, and ethics and be able to develop them through Plant Physiology lectures. 3. Collaborate and demonstrate a responsible attitude in the field of Plant Physiology studies. 4. Internalize the spirit of independence and fighting spirit and be able to develop it through Plant Physiology lectures. 5. Applying logical, critical, systematic, and innovative thinking in the context of developing or implementing science and technology that pays attention to and applies humanities values that are appropriate to the field of Plant Physiology. 6. Demonstrate independent, quality, and measurable performance through learning Plant Physiology. 7. Examine the implications of the development or implementation of science and technology that pay attention to and apply humanities values in accordance with the field of Plant Physiology based on scientific rules, procedures and ethics in order to produce solutions, ideas and designs. 8. Prepare scientific descriptions of the results of Plant Physiology studies in the form of investigation reports. 9. Making appropriate decisions based on analysis of information and data in the context of solving problems in the field of Plant Physiology. 10. Maintain and develop networks with lecturers and colleagues both inside and outside the classroom; Be responsible for the achievement of group work results

	and carry out self-evaluation processes for work groups under his/her responsibility. 11. Documenting, storing, securing, and retrieving the results of his work in the form of a portfolio to ensure authenticity and prevent plagiarism. 12. Mastering facts, concepts, principles, laws, theories, and procedures in the field of Plant Physiology in depth and their application. 13. Have sensitivity in finding problems regarding Plant Physiology. 14. Applying logical, critical, systematic and innovative thinking in the context of solving Plant Physiology problems. 15. Communicate recommendations on problem solving in the context of Plant Physiology based on application and research.
Teaching and Learning Strategies	● Lectures (100 minutes), Practicum sessions (170 minutes) ● Learning Methods SGD, RPS, DL, SDL, CoL, CbL, CtL, PjBL, PBL.
Assessment and Evaluation	**Assessment Components:** ● Structured assignments: 30% ● Quiz : 10% ● Middle Test: 15% ● Final Test: 15% ● Practicum 30% ● Activity : 10%.
Weekly Course Schedule	1. Introduction to Plant Physiology 2. Plants and Water 3. Plant Nutrition 4. Photosynthesis 5. Respiration 6. Nitrogen and Sulfur Metabolism 7. Growth and Development 8. Plant Hormones 9. Plant Responses to the Environment.
Learning Media	Youtube, Journal, PPT, Learning Videos, V-class
References	Primary 1. Hasnunidah, N. & Suwandi, T. 2016. *Plant Physiology* . Yogyakarta: Innosains. 2. Taiz, L., Møller, I. M., Murphy, A., & Zeiger, E. 2022. *Plant Physiology and Development* (7th ed.). Oxford University Press. 3. Pessarakli, M. (Ed.). 2021. *Handbook of Plant and Crop Physiology* (4th ed.). CRC Press. 4. Salisbury, FB and CW Ross. 1995. *Plant Physiology* . Volume 1. Translated by Dr. Lukman and Sumaryono. Bandung: ITB Publisher. 5. _____. 1995. *Plant Physiology* . Volume 2. Translated by Dr. Lukman and Sumaryono. Bandung: ITB Publisher. 6. _____. 1995. *Plant Physiology* . Volume 3. Translated by Dr. Lukman and Sumaryono. Bandung: ITB Publisher. Supporters

1. Evert, RF and SE Eichhorn. 2013. *Raven Biology of Plants*: Eighth Edition. New York: WH Freeman and Company Publishers.
2. Hopkins, WG & Huner NPA 2009. *Introduction to Plant Physiology*. New Jersey: John Wiley & Sons
3. Jones, C. and J. Jacobsen. 2001. *Plant Nutrition and Soil Fertility.* Bozeman: Montana State University Extension Service.
4. Koning, R.E. 1994. *Solute Movement. Plant Physiology Information Website*. Online: http://plantphys.info/plant_physiology/solutes.shtml, diakses pada 11 Agustus 2016.
5. Lambers, H., F.S. Chapin III, and T.L. Pons. 2008. *Plant Physiological Ecology*: Second Edition. New York: Springer Science + Business Media.
6. Marschner, H. 2003. *Mineral Nutrition of Higher Plants:* Second Edition. London and California: Academic Press.
7. Nelson, D.L. and M.M. Cox. 2013. *Lehninger Principles of Biochemistry*: Sixth Edition. New York: W. H. Freeman and Company.
8. Reece, J.B., L.A. Urry, M.I. Cain, S.A. Wasserman, P.V. Minorsky, R.B. Jackson. 2005. *Campbell Biology*: Ninth Edition. San Francisco: Pearson Education, Inc.
9. Santosa. 1990. *Fisiologi Tumbuhan*. Proyek Pelatihan tenaga Kependidikan. Yogyakarta: Fakultas Biologi Universitas Gadjah Mada.
10. Taiz, L. and Z. Eduardo. 2002. *Plant Physiology*: Third Edition. Sunderland: Sinauer Associates Inc.
11. Weed Science Society of America. 2013. *Corn and Soybean Herbicide Chart.* Purdue University College of Agriculture. Online: https://ag.purdue.edu /btny/weedscience/Documents/Herbicide_MOA_CornSoy_12_2012%5B1%5D.pdf, accessed 15 August 2016.
12. Workforce Compensation and Performance Services. 2002. *Plant Physiology Series*, GS-0435. Washington DC: Cumming Publishing Company

	UNIVERSITY OF LAMPUNG FACULTY OF TEACHER TRAINING AND EDUCATION DEPARTMENT OF MATHEMATICS AND NATURAL SCIENCES BIOLOGY EDUCATION STUDY PROGRAM	Code Document

SEMESTER LEARNING PLAN

COURSES (MK)	CODE	MK Cluster	WEIGHT (credits)		SEMESTER	Date Compilation
PLANT PHYSIOLOGY	KBO619212	BIOLOGY EDUCATION	3 credits	Studying	IV	02/05/2024

AN AUTHORIZATION	RPS Development Coordinator	Expertise Coordinator	Head of Study Program
	Prof. Dr. Neni Hasnunidah, S.Pd., M.Si. Rochmah Agustrina, M.Si., Ph.D.	Prof. Dr. Neni Hasnunidah, S.Pd., M.Si.	Rini Rita T. Marpaung, M.Pd.

Achievements Learning (CP)	CPL-Prodi charged to MK	
	CPL1(S1)	Have faith in God Almighty and be able to show a religious attitude;
	CPL2(S6)	Cooperate and have social sensitivity and concern for society and the environment;
	CPL3(S8)	Internalizing academic values, norms, and ethics;
	CPL4(S9)	Demonstrate a responsible attitude towards work in his/her field of expertise independently;
	CPL5(S10)	Internalize the spirit of independence, struggle and entrepreneurship;
	CPL6(K1)	Able to apply logical, critical, systematic and innovative thinking in the context of developing or implementing science and technology that pays attention to and applies humanities values in accordance with his/her field of expertise.
	CPL7(K2)	Able to demonstrate independent, quality and measurable work;
	CPL8(P1)	Mastering the theoretical concepts of education in general and the theoretical concepts of biology education in depth, and being able to formulate solutions to procedural problems, especially in the field of biology education.
	CPL9(P2)	Able to solve problems in science education and learning, especially biology;
	CPL10(P3)	Master the concepts in depth of work skills and laboratory management in the field of biology;
	CPL11(KU1)	Able to apply logical, critical, systematic, and innovative thinking in the context of the development or implementation of science and technology by paying attention to and applying humanities values in biology learning;
	CPL12(KU2)	Demonstrate independent, quality, and measurable performance;
	CPL13(KU3)	Able to examine the implications of the development or implementation of science and technology that pay attention to and apply humanities values in accordance with their expertise based on scientific rules, procedures and ethics in order to produce solutions, ideas, designs or art criticism;
	CPL14(KU4)	Able to compile a scientific description of the results of the above study in the form of a thesis or final assignment report and upload it to the university website;
	CPL15(KU5)	Able to make appropriate decisions in the context of solving problems in his/her field of expertise, based on the results of information and data analysis;
	CPL16(KU6)	Able to maintain and develop networks with lecturers and colleagues both inside and outs examide the classroom;
	CPL17(KU7)	

	CPL18(KU9) CPL19(KK4	Able to be responsible for the achievement of group work results and carry out a self-evaluation process for the work groups under his/her responsibility. Documenting, storing, securing, and retrieving the results of his work in the form of a portfolio to ensure authenticity and prevent plagiarism. Able to publish ideas and research results;
	Course Learning Outcomes (CPMK)	
	CPMK1	Be pious to God Almighty and be able to demonstrate a religious attitude.
	CPMK2 CPMK3	Internalize scientific values, norms, and ethics and be able to develop them through Plant Physiology lectures.
	CPMK4 CPMK5	Collaborate and demonstrate a responsible attitude in the field of Plant Physiology studies.
	CPMK6	Internalize the spirit of independence and fighting spirit and be able to develop it through Plant Physiology lectures.
	CPMK7 CPMK8	Applying logical, critical, systematic, and innovative thinking in the context of developing or implementing science and technology that pays attention to and applies humanities values that are appropriate to the field of Plant Physiology.
	CPMK9 CPMK10	Demonstrate independent, quality, and measurable performance through learning Plant Physiology.
	CPMK11 CPMK12 CPMK13 CPMK14	Examine the implications of the development or implementation of science and technology that pay attention to and apply humanities values in accordance with the field of Plant Physiology based on scientific rules, procedures and ethics in order to produce solutions, ideas and designs.
	CPMK15 CPMK16	Prepare scientific descriptions of the results of Plant Physiology studies in the form of investigation reports.
		Making appropriate decisions based on analysis of information and data in the context of solving problems in the field of Plant Physiology.
		Maintain and develop networks with lecturers and colleagues both inside and outs examide the classroom; Be responsible for the achievement of group work results and carry out self-evaluation processes for work groups under his/her responsibility.
		Documenting, storing, securing, and retrieving the results of his work in the form of a portfolio to ensure authenticity and prevent plagiarism.
		Mastering facts, concepts, principles, laws, theories, and procedures in the field of Plant Physiology in depth and their application.
		Have sensitivity in finding problems regarding Plant Physiology.
		Applying logical, critical, systematic and innovative thinking in the context of solving Plant Physiology problems.
		Communicate recommendations on problem solving in the context of Plant Physiology based on application and research.
Course Short Description	The Plant Physiology course discusses the processes and life activities of plants, including: plant physiology as a science; the relationship of plants with water and soil; the events of diffusion, osmosis, transpiration, transportation, translocation of nutrients and minerals in plants; metabolism that occurs in plants (photosynthesis, respiration, chemosynthesis, lipid and nitrogen metabolism);	

	the relationship of plants with the environment (growth, differentiation, and development, plant hormones, plant responses to the environment).
Study Materials / Material Learning	1. Introduction to Plant Physiology 2. Plants and Water 3. Plant Nutrition 4. Photosynthesis 5. Respiration 6. Nitrogen and Sulfur Metabolism 7. Growth and Development 8. Plant Hormones 9. Plant Response to the Environment
Library	**Main :**
	1. Hasnunidah, N. & Suwandi, T. 2016. *Plant Physiology* . Yogyakarta: Innosains. 2. Taiz, L., Møller, I. M., Murphy, A., & Zeiger, E. (2022). *Plant Physiology and Development* (7th ed.). Oxford University Press. 3. Pessarakli, M. (Ed.). (2021). *Handbook of Plant and Crop Physiology* (4th ed.). CRC Press. 4. Salisbury, FB and CW Ross. 1995. *Plant Physiology* . Volume 1. Translated by Dr. Lukman and Sumaryono. Bandung: ITB Publisher. 5. _____. 1995. *Plant Physiology* . Volume 2. Translated by Dr. Lukman and Sumaryono. Bandung: ITB Publisher. 6. _____. 1995. *Plant Physiology* . Volume 3. Translated by Dr. Lukman and Sumaryono. Bandung: ITB Publisher.
	Supporters:

Week	Sub-CPMK (Final ability of each learning stage)	Evaluation		Learning Assistance, Learning methods, Student Assignments, [Estimated Time]		Sources and Media Learning	Weight Evaluation (%)
		Indicator	Form & Criteria	Offline	Online		
1	• Demonstrate an attitude of accepting the college contract agreement properly and responsibly. • Describes briefly and systematically the meaning and scope of the study of plant physiology.	1. Explain the aspects and scope of the study of Plant Physiology. 2. Explain the benefits of studying Plant Physiology.	1. Written test: Mid-term and Final Exam Scoring Guidelines 2. Non-test: a. Individual structured assignments: Practice questions, Learning Journal, Portfolio, b. Group activities: Presentation of material, Argumentation. Mid-term and final exams and assignment collection using tools Virtual Activities Unila Class	**Based on the Decree of the Chancellor of Unila,** learning in this semester follows the New Normal rules and SOPs by using full... learning (100% offline) Lecture-discussion Exercise **Based on Permendikti No. 3 of 2020** , 1 credit unit = 50 minutes of face-to-face lectures, so 2 credit units = 100 minutes of face-to-face lectures consisting of: 1) 80 minutes of group discussion 2) 20 minutes of independent quizzes	Using Vclas on the link: https://vclass.unila.ac.id/course/view.php?id=27654 ; *https://vclass.unila.ac.id/course/view.php?id=27655; https://vclass.unila.ac.id/course/view.php?id=27658* Learning Methods SGD, RPS, DL, SDL, CoL, CbL, CtL, PjBL, PBL. • Read the material and watch the learning videos • Group discussions using forums or other media • Doing the quiz Supporting References • Youtube • Slide • Journal	• Contract Lectures • References 5, 13, 16, 19.	5

Week	Sub-CPMK (Final ability of each learning stage)	Evaluation		Learning Assistance, Learning methods, Student Assignments, [Estimated Time]		Sources and Media Learning	Weight Evaluation (%)
		Indicator	Form & Criteria	Offline	Online		
2	Analyze the effect of temperature and solution concentration on the rate of diffusion osmosis.	1. Describe the relationship between the properties and important functions of water for plants. 2. Differentiate between diffusion and osmosis in plants. 3. Skilled in measuring factors that influence the rate of diffusion-osmosis. 4. Skilled at arguing with a clear structure, consisting of: *claims, evidence/data, warrants* and *backing* regarding factors that influence the rate of diffusion-osmosis 5. Presenting data on the effect of temperature and solution concentration on the rate of diffusion and osmosis in the form of a written report.	1. Written test: Mid-term and Final Exam, Scoring Guidelines 2. Non-test: a. Individual structured assignments: Practice questions, Learning Journal, Portfolio, b. Group activities: Presentation of material, Argumentation. Midterm exam and final exam and assignment collection using tools Virtual Activities Unila Class	**Lectures, Discussions** ***Flipped Classroom*** Students study and prepare presentation materials on the relationship between the properties and important functions of water for plants, diffusion and osmosis in plants from required books and other reading sources. Then, students make presentations on the material, present them in class and discuss them. **PjBL (*Project Based) Learning*) Argumentative** Students collaboratively demonstrate creativity in preparing presentations. Conduct laboratory investigations on factors that influence the rate of diffusion and osmosis. Conduct argumentative discussions to state *claims, evidence/data, warrants* and *backing* regarding factors that influence the rate of diffusion/osmosis.	Using Vclas on the link: https://vclass.unila.ac.id/course/view.php?id=27654 ; *https://vclass.unila.ac.id/course/view.php?id=27655; https://vclass.unila.ac.id/course/view.php?id=27658* Learning Methods SGD, RPS, DL, SDL, CoL, CbL, CtL, PjBL, PBL. • Read the material and watch the learning videos • Group discussions using forums or other media • Doing the quiz Supporting References • Youtube • Slide • Journal **Based on Permendikti No. 3 of 2020** , 1 credit unit = 50 minutes of face-to-face lectures, so 2 credit units = 100 minutes of face-to-face lectures consisting of: 1) 80 minutes of group discussion 2) 20 minutes of independent quizzes	• Contract • Lectures • References 2, 5, 11, 13, 14, 15, 16. • PPT Lecture Contract • Worksheet Student (LKM-01)	5

Week	Sub-CPMK (Final ability of each learning stage)	Evaluation		Learning Assistance, Learning methods, Student Assignments, [Estimated Time]		Sources and Media Learning	Weight Evaluation (%)
		Indicator	Form & Criteria	Offline	Online		
3	Analyze the symptoms of plasmolysis and deplasmolysis and the relationship between plasmolysis and the osmotic potential status between cell fluid and the solution in its environment.	1. Describe the processes of plasmolysis and deplasmolysis. 2. Skilled in measuring factors that influence plasmolysis and deplasmolysis 3. Skilled at arguing with a clear structure, consisting of: claims, evidence/data, warrants and backing regarding factors that influence plasmolysis and deplasmolysis. 4. Presenting data on the symptoms of plasmolysis and deplasmolysis and the relationship between plasmolysis and the osmotic potential status between cell fluid and the solution in its environment in the form of a written report.	1. Written test: Mid-term and Final Exam Scoring Guidelines 2. Non-test: a. Individual structured assignments: Practice questions, Learning Journal, Portfolio, b. Group activities: Presentation of material, Argumentation. Midterm exam and final exam and assignment collection using tools Virtual Activities Unila Class	**Lectures, Discussions** ***Flipped Classroom*** Students study and prepare presentation materials on the relationship between the properties and important functions of water for plants, diffusion and osmosis in plants from required books and other reading sources. Then, students make presentations on the material, present them in class and discuss them. **PjBL (*Project Based) Learning*) Argumentative** Students collaboratively demonstrate creativity in preparing presentations. Conduct laboratory investigations on factors that influence the rate of diffusion and osmosis. Conducting argumentative discussions to state *claims, evidence/data, warrants* and *backing* regarding the symptoms of plasmolysis and deplasmolysis as well as the relationship between plasmolysis and the osmotic potential status between cell fluid and the solution in its environment.	Using Vclas on the link: https://vclass.unila.ac.id/course/view.php?id=27654 ; *https://vclass.unila.ac.id/course/view.php?id=27655; https://vclass.unila.ac.id/course/view.php?id=27658* Learning Methods SGD, RPS, DL, SDL, CoL, CbL, CtL, PjBL, PBL. • Read the material and watch the learning videos • Group discussions using forums or other media • Doing the quiz Supporting References • Youtube • Slide • Journal **Based on Permendikti No. 3 of 2020** , 1 credit unit = 50 minutes of face-to-face lectures, so 2 credit units = 100 minutes of face-to-face lectures consisting of: 1) 80 minutes of group discussion 2) 20 minutes of independent quizzes	● References 2, 5 11, 13, 14, 15, 16. ● PPT Plasmolysis ● Worksheet Student (LKM-02)	5

Week	Sub-CPMK (Final ability of each learning stage)	Evaluation		Learning Assistance, Learning methods, Student Assignments, [Estimated Time]		Sources and Media Learning	Weight Evaluation (%)
		Indicator	Form & Criteria	Offline	Online		
4	Analyzing water potential, osmotic potential, and fluid pressure potential of cells in plant tissue	1. Describe the relationship between water potential, osmotic potential, and cell fluid pressure potential. 2. Skilled in determining the water potential and osmotic potential of cell fluids in plant tissues based on incipient plasmolysis, the constant volume method, and the Chardakov method. 3. Skilled in arguing with a clear structure, consisting of: *claims, evidence/data, warrants* and *backing* regarding water potential and osmotic potential of cell fluids in plant tissue based on incipient plasmolysis, constant volume method, and Chardakov method. 4. Presenting data on water potential and osmotic potential of cell fluids in plant tissue in the form of a written report.	1. Written test: Mid-term and Final Exam, Scoring Guidelines 2. Non-test: a. Individual structured assignments: Practice questions, Learning Journal, Portfolio, b. Group activities: Presentation of material, Argumentation. Midterm exam and final exam and assignment collection using tools Virtual Activities Unila Class	**Lectures, Discussions** ***Flipped Classroom*** Students study and prepare presentation materials on the relationship between the properties and important functions of water for plants, diffusion and osmosis in plants from required books and other reading sources. Then, students make presentations on the material, present them in class and discuss them. **PjBL (*Project Based) Learning*) Argumentative** Students collaboratively demonstrate creativity in preparing presentations; Conduct laboratory investigations on water potential and osmotic potential of cell fluids in plant tissues based on incipient plasmolysis, constant volume method, and Chardakov method; and Conduct argumentative discussions to state *claims, evidence/data, warrants* and *backing* on water potential, osmotic potential, and pressure potential of cell fluids in plant tissues.	Using Vclas on the link: https://vclass.unila.ac.id/course/view.php?id=27654 ; *https://vclass.unila.ac.id/course/view.php?id=27655; https://vclass.unila.ac.id/course/view.php?id=27658* Learning Methods SGD, RPS, DL, SDL, CoL, CbL, CtL, PjBL, PBL. • Read the material and watch the learning videos • Group discussions using forums or other media • Doing the quiz Supporting References • Youtube • Slide • Journal **Based on Permendikti No. 3 of 2020** , 1 credit unit = 50 minutes of face-to-face lectures, so 2 credit units = 100 minutes of face-to-face lectures consisting of: 1) 80 minutes of group discussion 2) 20 minutes of independent quizzes	● References 2, 5, 11, 13, 14, 15, 16. ● Potential PPT Osmotic Cell Fluid ● Worksheet Students (LKM-03)	

Week	Sub-CPMK (Final ability of each learning stage)	Evaluation		Learning Assistance, Learning methods, Student Assignments, [Estimated Time]		Sources and Media Learning	Weight Evaluation (%)
		Indicator	Form & Criteria	Offline	Online		
5	Analyze the factors that influence transpiration	1. Describe the differences between transpiration, guttation, evaporation. 2. Describe the relationship between stomatal movement and the mechanism of respiration 3. Skilled in measuring factors that influence transpiration. 4. Skilled at arguing with a clear structure, consisting of: *claims, evidence/data, warrants* and *backing* regarding factors that influence transpiration. 5. Present data on factors that influence transpiration in the form of a written report.	1. Written test: Mid-term and Final Exam, Scoring Guidelines 2. Non-test: a. Individual structured assignments: Practice questions, Learning Journal, Portfolio, b. Group activities: Presentation of material, Argumentation. Midterm exam and final exam and assignment collection using tools Virtual Activities Unila Class	**Lectures, Discussions** ***Flipped Classroom*** Students study and prepare presentation materials on the relationship between the properties and important functions of water for plants, diffusion and osmosis in plants from required books and other reading sources. Then, students make presentations on the material, present them in class and discuss them. **PjBL (*Project Based) Learning*) Argumentative** Students collaboratively demonstrate creativity in preparing presentations. Conducting investigations in the laboratory on the factors that... influence transpiration Conduct argumentative discussions to state *claims, evidence/data, warrants* and *backing* regarding factors that influence transpiration	Using Vclas on the link: https://vclass.unila.ac.id/course/view.php?id=27654 ; *https://vclass.unila.ac.id/course/view.php?id=27655; https://vclass.unila.ac.id/course/view.php?id=27658* Learning Methods SGD, RPS, DL, SDL, CoL, CbL, CtL, PjBL, PBL. • Read the material and watch the learning videos • Group discussions using forums or other media • Doing the quiz Supporting References • Youtube • Slide • Journal **Based on Permendikti No. 3 of 2020** , 1 credit unit = 50 minutes of face-to-face lectures so that 2 credit units = 100 minutes of face-to-face lectures consisting of: 1) 80 minutes of group discussion 2) 20 minutes of independent quizzes	• References 2, 5, 11, 13, 14, 15, 16. • Transpiration PPT • Student Worksheet (LKM-04)	5

Week	Sub-CPMK (Final ability of each learning stage)	Evaluation		Learning Assistance, Learning methods, Student Assignments, [Estimated Time]		Sources and Media Learning	Weight Evaluation (%)
		Indicator	Form & Criteria	Offline	Online		
6	Analyze the ability of soil to hold water and capillary movement of water in several soil textures.	1. Describes soil properties (structure, texture, and soil colloids) in relation to the role of soil as a source of nutrients. 2. Skilled in determining the relationship between soil texture and the speed of water propagation and the soil's ability to bind water. 3. Skilled at arguing with a clear structure, consisting of: claims, evidence/data, warrants and backing regarding the relationship between soil texture and the speed of water propagation and the soil's ability to bind water. 4. Presenting data on the relationship between soil texture and the soil's ability to bind water and the capillary movement of water in the form of a written report.	1. Written test: Mid-term and Final Exam, Scoring Guidelines 2. Non-test: a. Individual structured assignments: Practice questions, Learning Journal, Portfolio, b. Group activities: Presentation of material, Argumentation. Midterm exam and final exam and assignment collection using tools Virtual Activities Unila Class	**Lectures, Discussions *Flipped Classroom*** Students study and prepare presentation materials on the relationship between the properties and important functions of water for plants, diffusion and osmosis in plants from required books and other reading sources. Then, students make presentations on the material, present them in class and discuss them. **PjBL (*Project Based) Learning*) Argumentative** Students collaboratively demonstrate creativity in preparing presentations. Conduct laboratory investigations on the relationship between soil texture and the speed of water propagation and the soil's ability to bind water. Conduct argumentative discussions to state *claims, evidence/data, warrants* and *backing* regarding the relationship between soil texture and the speed of water propagation and the soil's ability to bind water.	Using Vclas on the link: https://vclass.unila.ac.id/course/view.php?id=27654 ; *https://vclass.unila.ac.id/course/view.php?id=27655; https://vclass.unila.ac.id/course/view.php?id=27658* Learning Methods SGD, RPS, DL, SDL, CoL, CbL, CtL, PjBL, PBL. • Read the material and watch the learning videos • Group discussions using forums or other media • Doing the quiz Supporting References • Youtube • Slide • Journal **Based on Permendikti No. 3 of 2020** , 1 credit unit = 50 minutes of face-to-face lectures so that 2 credit units = 100 minutes of face-to-face lectures consisting of: 1) 80 minutes of group discussion 2) 20 minutes of independent quizzes	• References 2, 5, 6, 7, 9. 11, 13, 14, 15, 16 • PPT Relationship Land with Plants • Worksheet Students (LKM-05)	5

Week	Sub-CPMK (Final ability of each learning stage)	Evaluation		Learning Assistance, Learning methods, Student Assignments, [Estimated Time]		Sources and Media Learning	Weight Evaluation (%)
		Indicator	Form & Criteria	Offline	Online		
7	Analyzing the symptoms of failure (deficiency) of nutrients in plant	1. Describe the types and functions of mineral nutrients required by plants. 2. Skilled in determining symptoms of nutrient deficiency in plants. 3. Skilled at arguing with a clear structure, consisting of: *claims, evidence/data, warrants* and *backing* regarding symptoms of nutrient deficiency in plants. 4. Presenting data on nutrient deficiency symptoms in plants in the form of a written report.	1. Written tests: Mid-term and Final Exams. Scoring Guidelines 2. Non-test: a. Individual structured assignments: Practice questions, Learning Journal, Portfolio, b. Group activities: Presentation of material, Argumentation. Midterm exam and final exam and assignment collection using tools Virtual Activities Unila Class	**Lectures, Discussions** ***Flipped Classroom*** Students study and prepare presentation materials on the relationship between the properties and important functions of water for plants, diffusion and osmosis in plants from required books and other reading sources. Then, students make presentations on the material, present them in class and discuss them. **PjBL (*Project Based) Learning*) Argumentative** Students collaboratively demonstrate creativity in preparing presentations. Conduct laboratory investigations on symptoms of nutrient deficiency in plants. Conduct argumentative discussions to state *claims, evidence/data, warrants* , and *backing* regarding symptoms of nutrient deficiency in plants.	Using Vclas on the link: https://vclass.unila.ac.id/course/view.php?id=27654 ; *https://vclass.unila.ac.id/course/view.php?id=27655; https://vclass.unila.ac.id/course/view.php?id=27658* Learning Methods SGD, RPS, DL, SDL, CoL, CbL, CtL, PjBL, PBL. • Read the material and watch the learning videos • Group discussions using forums or other media • Doing the quiz Supporting References • Youtube • Slide • Journal	• References 2, 5, 6, 7, 9, 11, 13, 14, 15, 16 • PPT Relationship between Soil and Plants • Student Worksheet (LKM-06)	5
8	**MIDTERM EXAM**			100 minutes face-to-face online video conference using Vclass at the link: https://vclass.unila.ac.id/course/view.php?id=27654 ; *https://vclass.unila.ac.id/course/view.php?id=27655 ; https://vclass.unila.ac.id/course/view.php?id=27658*			

Week	Sub-CPMK (Final ability of each learning stage)	Evaluation		Learning Assistance, Learning methods, Student Assignments, [Estimated Time]		Sources and Media Learning	Weight Evaluation (%)
		Indicator	Form & Criteria	Offline	Online		
9	Analyze the factors that influence photosynthesis in plants.	1. Describe the role of light energy in relation to the process of photosynthesis. Describe the mechanism of photophosphorylation. 2. Differentiate the anatomical structure of C3, C4, and CAM plants in relation to CO2 fixation. Explain the biosynthesis of starch and sucrose as a result of photosynthesis. 3. Skilled in measuring factors that influence photosynthesis. 4. Skilled at arguing with a clear structure, consisting of: *claims, evidence/data, warrants* and *backing* regarding factors that influence photosynthesis. 5. Presenting data on influencing factors photosynthesis in the form of a written report. 6. 7.	1. Written test: Mid-term and Final Exam Scoring Guidelines 2. Non-test: a. Individual structured assignments: Practice questions, Learning Journal, Portfolio, b. Group activities: Presentation of material, Argumentation. Midterm exam and final exam and assignment collection using tools Virtual Activities Unila Class	**Lectures, Discussions *Flipped Classroom*** Students study and prepare presentation materials on the relationship between the properties and important functions of water for plants, diffusion and osmosis in plants from required books and other reading sources. Then, students make presentations on the material, present them in class and discuss them. **PjBL (*Project Based) Learning*) Argumentative** Students collaboratively demonstrate creativity in preparing presentations. Conduct laboratory investigations on factors that influence photosynthesis in plants. Conduct argumentative discussions to state *claims, evidence/data, warrants* , and *backing* regarding factors that influence photosynthesis in plants.	Using Vclas on the link: https://vclass.unila.ac.id/course/view.php?id=27654 ; *https://vclass.unila.ac.id/course/view.php?id=27655; https://vclass.unila.ac.id/course/view.php?id=27658* Learning Methods SGD, RPS, DL, SDL, CoL, CbL, CtL, PjBL, PBL. • Read the material and watch the learning videos • Group discussions using forums or other media • Doing the quiz Supporting References • Youtube • Slide • Journal **Based on Permendikti No. 3 of 2020** , 1 credit unit = 50 minutes of face-to-face lectures so that 2 credit units = 100 minutes of face-to-face lectures consisting of: 1) 80 minutes of group discussion 2) 20 minutes of independent quizzes	• References 1, 5, 6, 8, 9, 10, 12 • PPT Photosynthesis • Student Worksheet (LKM-07)	5

Week	Sub-CPMK (Final ability of each learning stage)	Evaluation		Learning Assistance, Learning methods, Student Assignments, [Estimated Time]		Sources and Media Learning	Weight Evaluation (%)
		Indicator	Form & Criteria	Offline	Online		
10	Analyze the factors that influence cellular respiration in plants.	1. Skilled in measuring factors that influence cellular respiration in plants. 2. Skilled at arguing with a clear structure, consisting of: *claims, evidence/data, warrants* and *backing* regarding factors that influence cellular respiration in plants. 3. Presenting data on factors that influence cellular respiration in the form of a written report. 4. Describe the function and alternative pathway of hexose oxidation via the pentose phosphate pathway.	1. Written test: Mid-term and Final Exam Scoring Guidelines 2. Non-test: a. Individual structured assignments: Practice questions, Learning Journal, Portfolio, b. Group activities: Presentation of material, Argumentation. Midterm exam and final exam and assignment collection using tools Virtual Activities Unila Class	**Lectures, Discussions** ***Flipped Classroom*** Students study and prepare presentation materials on the relationship between the properties and important functions of water for plants, diffusion and osmosis in plants from required books and other reading sources. Then, students make presentations on the material, present them in class and discuss them. **PjBL (*Project Based) Learning*) Argumentative** Students collaboratively demonstrate creativity in preparing presentations. Conduct laboratory investigations on factors that influence cellular respiration in plants. Conduct argumentative discussions to state *claims, evidence/data, warrants* , and *backing* regarding factors that influence cellular respiration in plants.	Using Vclas on the link: https://vclass.unila.ac.id/course/view.php?id=27654 ; *https://vclass.unila.ac.id/course/view.php?id=27655; https://vclass.unila.ac.id/course/view.php?id=27658* Learning Methods SGD, RPS, DL, SDL, CoL, CbL, CtL, PjBL, PBL. • Read the material and watch the learning videos • Group discussions using forums or other media • Doing the quiz Supporting References • Youtube • Slide • Journal **Based on Permendikti No. 3 of 2020** , 1 credit unit = 50 minutes of face-to-face lectures so that 2 credit units = 100 minutes of face-to-face lectures consisting of: 1) 80 minutes of group discussion 2) 20 minutes of independent quizzes	• References 1, 5, 10, 13, 14, 15, 16. • PPT • Student Worksheet (LKM-08)	5

Week	Sub-CPMK (Final ability of each learning stage)	Evaluation		Learning Assistance, Learning methods, Student Assignments, [Estimated Time]		Sources and Media Learning	Weight Evaluation (%)
		Indicator	Form & Criteria	Offline	Online		
11	Analyzing the mechanisms of nitrogen and sulfur metabolism	1. Briefly describe the nitrogen cycle and its role in plants. 2. Describe the mechanism of nitrogen fixation. 3. Explain the conversion of ammonia to organic nitrogen. 4. Describe the mechanism of conversion of ammonium and nitrate into protein. 5. Explain the mechanism of sulfur assimilation in plants	1. Written test: Mid-term and Final Exam Scoring Guidelines 2. Non-test: a. Individual structured assignments: Practice questions, Learning Journal, Portfolio, b. Group activities: Presentation of material, Argumentation. Midterm exam and final exam and assignment collection using tools Virtual Activities Unila Class	**Lectures, Discussions** ***Flipped Classroom*** Students study and prepare presentation materials on the relationship between the properties and important functions of water for plants, diffusion and osmosis in plants from required books and other reading sources. Then, students make presentations on the material, present them in class and discuss them. **PjBL (*Project Based) Learning*) Argumentative** Students collaboratively demonstrate creativity in preparing presentations. Conduct laboratory investigations on the mechanisms of nitrogen and sulfur metabolism. Conduct argumentative discussions to state *claims, evidence/data, warrants* , and *backing* regarding the mechanisms of nitrogen and sulfur metabolism.	Using Vclas on the link: https://vclass.unila.ac.id/course/view.php?id=27654 ; *https://vclass.unila.ac.id/course/view.php?id=27655; https://vclass.unila.ac.id/course/view.php?id=27658* Learning Methods SGD, RPS, DL, SDL, CoL, CbL, CtL, PjBL, PBL. • Read the material and watch the learning videos • Group discussions using forums or other media • Doing the quiz Supporting References • Youtube • Slide • Journal **Based on Permendikti No. 3 of 2020** , 1 credit unit = 50 minutes of face-to-face lectures so that 2 credit units = 100 minutes of face-to-face lectures consisting of: 1) 80 minutes of group discussion 2) 20 minutes of independent quizzes	• References 2, 5, 13, 14, 15, 16 • PPT Nitrogen and Sulfate Metabolism	5

Week	Sub-CPMK (Final ability of each learning stage)	Evaluation		Learning Assistance, Learning methods, Student Assignments, [Estimated Time]		Sources and Media Learning	Weight Evaluation (%)
		Indicator	Form & Criteria	Offline	Online		
12	Analyze the factors that influence growth and development in plants.	1. Distinguish the definitions of growth, differentiation, and development in plants. 2. Skilled in measuring factors that influence growth and development. 3. Skilled at arguing with a clear structure, consisting of: claims, evidence/data, warrants and backing regarding factors that influence growth and development. 4. Presenting data on factors that influence growth and development in the form of a written report. 5. Describes development patterns in plants.	1. Written test: Mid-term and Final Exam Scoring Guidelines 2. Non-test: a. Individual structured assignments: Practice questions, Learning Journal, Portfolio, b. Group activities: Presentation of material, Argumentation. Midterm exam and final exam and assignment collection using tools Virtual Activities Unila Class	**Lectures, Discussions** ***Flipped Classroom*** Students study and prepare presentation materials on the relationship between the properties and important functions of water for plants, diffusion and osmosis in plants from required books and other reading sources. Then, students make presentations on the material, present them in class and discuss them. **PjBL (*Project Based) Learning*) Argumentative** Students collaboratively demonstrate creativity in preparing presentations. Conduct laboratory investigations on factors that influence growth and development. Conduct argumentative discussions to state *claims, evidence/data, warrants* , and *backing* regarding factors that influence growth and development.	Using Vclas on the link: https://vclass.unila.ac.id/course/view.php?id=27654 ; *https://vclass.unila.ac.id/course/view.php?id=27655; https://vclass.unila.ac.id/course/view.php?id=27658* Learning Methods SGD, RPS, DL, SDL, CoL, CbL, CtL, PjBL, PBL. • Read the material and watch the learning videos • Group discussions using forums or other media • Doing the quiz Supporting References • Youtube • Slide • Journal **Based on Permendikti No. 3 of 2020** , 1 credit unit = 50 minutes of face-to-face lectures so that 2 credit units = 100 minutes of face-to-face lectures consisting of: 1) 80 minutes of group discussion 2) 20 minutes of independent quizzes	• Reference 2.5, 11, 13, 15, 16 • PPT Growth and Development • Worksheet Students (LKM-09)	

Week	Sub-CPMK (Final ability of each learning stage)	Evaluation		Learning Assistance, Learning methods, Student Assignments, [Estimated Time]		Sources and Media Learning	Weight Evaluation (%)
		Indicator	Form & Criteria	Offline	Online		
13	Analyze the relationship between hormones and growth and development in plants.	1. Describes the concept of hormones in plants and its relationship to the mechanisms of perception, signal transduction, and action in the process of plant development. 2. Skilled in demonstrating the influence of hormonal factors on growth and development. 3. Skilled at arguing with a clear structure, consisting of: claims, evidence/data, warrants and backing regarding the relationship between hormones and growth and development. 4. Presenting data on the influence of hormones on growth and development in the form of a written report. 5. Analyze the relationship between types of hormones and their functions in controlling plant growth and development.	1. Written test: Mid-term and Final Exam Scoring Guidelines 2. Non-test: a. Individual structured assignments: Practice questions, Learning Journal, Portfolio, b. Group activities: Presentation of material, Argumentation. Midterm exam and final exam and assignment collection using tools Virtual Activities Unila Class	**Lectures, Discussions** ***Flipped Classroom*** Students study and prepare presentation materials on the relationship between the properties and important functions of water for plants, diffusion and osmosis in plants from required books and other reading sources. Then, students make presentations on the material, present them in class and discuss them. **PjBL (*Project Based) Learning*) Argumentative** Students collaboratively demonstrate creativity in preparing presentations. Conduct laboratory investigations on the effects of hormones on plant growth and development. Conduct argumentative discussions to state *claims, evidence/data, warrants* , and *backing* regarding hormones on plant growth and development.	Using Vclas on the link: https://vclass.unila.ac.id/course/view.php?id=27654 ; *https://vclass.unila.ac.id/course/view.php?id=27655; https://vclass.unila.ac.id/course/view.php?id=27658* Learning Methods SGD, RPS, DL, SDL, CoL, CbL, CtL, PjBL, PBL. • Read the material and watch the learning videos • Group discussions using forums or other media • Doing the quiz Supporting References • Youtube • Slide • Journal **Based on Permendikti No. 3 of 2020** , 1 credit unit = 50 minutes of face-to-face lectures so that 2 credit units = 100 minutes of face-to-face lectures consisting of: 1) 80 minutes of group discussion 2) 20 minutes of independent quizzes	● References 2, 5, 11, 13, 14, 15, 16, 17. ● Plant Hormone PPT ● Worksheet Student (LKM-10)	5

Week	Sub-CPMK (Final ability of each learning stage)	Evaluation		Learning Assistance, Learning methods, Student Assignments, [Estimated Time]		Sources and Media Learning	Weight Evaluation (%)
		Indicator	Form & Criteria	Offline	Online		
14	Analyze the influence of factors that influence the occurrence of movement in plants	1. Skilled in measuring factors that influence the occurrence of movement in plants. 2. Skilled at arguing with a clear structure, consisting of: claim, evidence/data, warrant and backing regarding factors that influence plant movement with a clear structure, consisting of: claim/counterclaim, evidence/data, warrant and backing. 3. Presenting data on factors that influence the occurrence of movement in plants in the form of a written report. 4. Describe the mechanisms of several tropic and nastic movements	1. Written test: Mid-term and Final Exam Scoring Guidelines 2. Non-test: a. Individual structured assignments: Practice questions, Learning Journal, Portfolio, b. Group activities: Presentation of material, Argumentation. Midterm exam and final exam and assignment collection using tools Virtual Activities Unila Class	**Lectures, Discussions** ***Flipped Classroom*** Students study and prepare presentation materials on the relationship between the properties and important functions of water for plants, diffusion and osmosis in plants from required books and other reading sources. Then, students make presentations on the material, present them in class and discuss them. **PjBL (*Project Based) Learning*) Argumentative** Students collaboratively demonstrate creativity in preparing presentations. Conduct laboratory investigations on factors that influence the occurrence of movement in plants. Conduct argumentative discussions to state *claims, evidence/data, warrants* and *backing* on factors that influence the occurrence of movement in plants.	Using Vclas on the link: https://vclass.unila.ac.id/course/view.php?id=27654 ; *https://vclass.unila.ac.id/course/view.php?id=27655; https://vclass.unila.ac.id/course/view.php?id=27658* Learning Methods SGD, RPS, DL, SDL, CoL, CbL, CtL, PjBL, PBL. • Read the material and watch the learning videos • Group discussions using forums or other media • Doing the quiz Supporting References • Youtube • Slide • Journal **Based on Permendikti No. 3 of 2020** , 1 credit unit = 50 minutes of face-to-face lectures so that 2 credit units = 100 minutes of face-to-face lectures consisting of: 1) 80 minutes of group discussion 2) 20 minutes of independent quizzes	• References 2, 5, 11, 13, 15, 16 • Plant Movement PPT • Student Worksheet (LKM-11)	

Sunday To-	Sub-CPMK (Final ability of each learning stage)	Evaluation		Learning Assistance, Learning methods, Student Assignments, [Estimated Time]		Sources and Media Learning	Weight Evaluation (%)
		Indicator	Form & Criteria	Offline	Online		
15	Analyzing factors that influence dormancy in plants	1. Describe the concept of dormancy in plants. 2. Skilled in measuring factors that influence dormancy. 3. Skilled at arguing about factors that influence dormancy with a clear structure, consisting of: claim/counterclaim, evidence/data, warrant and backing. 4. Presenting data on factors that influence dormancy in the form of a written report.	• Written test: Mid-term and Final Exam Scoring Guidelines • Non-test: a. Individual structured assignments: Practice questions, Learning Journal, Portfolio, b. Group activities: Presentation of material, Argumentation. Midterm exam and final exam and assignment collection using tools Virtual Activities Unila Class	**Lectures, Discussions** ***Flipped Classroom*** Students study and prepare presentation materials on the relationship between the properties and important functions of water for plants, diffusion and osmosis in plants from required books and other reading sources. Then, students make presentations on the material, present them in class and discuss them. **PjBL (*Project Based) Learning*) Argumentative** Students collaboratively demonstrate creativity in preparing presentations. Conduct laboratory investigations on factors that influence plant dormancy. Conduct argumentative discussions to state *claims, evidence/data, warrants* , and *backing* regarding factors that influence plant dormancy.	Using Vclas on the link: https://vclass.unila.ac.id/course/view.php?id=27654 ; *https://vclass.unila.ac.id/course/view.php?id=27655; https://vclass.unila.ac.id/course/view.php?id=27658* Learning Methods SGD, RPS, DL, SDL, CoL, CbL, CtL, PjBL, PBL. • Read the material and watch the learning videos • Group discussions using forums or other media • Doing the quiz Supporting References • Youtube • Slide • Journal **Based on Permendikti No. 3 of 2020** , 1 credit unit = 50 minutes of face-to-face lectures so that 2 credit units = 100 minutes of face-to-face lectures consisting of: 1) 80 minutes of group discussion 2) 20 minutes of independent quizzes	• References 3, 4, 5, 12, 13, 15. • Plant Movement PPT • Student Worksheet (LKM-12)	5

Sunday To-	Sub-CPMK (Final ability of each learning stage)	Evaluation		Learning Assistance, Learning methods, Student Assignments, [Estimated Time]		Sources and Media Learning	Weight Evaluation (%)
		Indicator	Form & Criteria	Offline	Online		
16	Analyze the factors that influence photoperiodism and vernalization in plants.	1. Distinguishing plant groups based on photoperiodism. 2. Explain the role of light as a regulator in the photoperiodism process. 3. Explaining the biological clock and circadian rhythm in plants. 4. Describe the mechanisms of flowering control. 5. Describe the mechanisms of vernalization and chilling.	1. Written test: Mid-term and Final Exam Scoring Guidelines 2. Non-test: a. Individual structured assignments: Practice questions, Learning Journal, Portfolio, b. Group activities: Presentation of material, Argumentation. Midterm exam and final exam and assignment collection using tools Virtual Activities Unila Class	**Lectures, Discussions** ***Flipped Classroom*** Students study and prepare presentation materials on the relationship between the properties and important functions of water for plants, diffusion and osmosis in plants from required books and other reading sources. Then, students make presentations on the material, present them in class and discuss them. **PjBL (*Project Based) Learning*) Argumentative** Students collaboratively demonstrate creativity in preparing presentations. Conducting investigations in the laboratory about Factors that influence photoperiodism and vernalization Conduct argumentative discussions to state *claims, evidence/data, warrants* and *backing* regarding photoperiodism and vernalization	Using Vclas on the link: https://vclass.unila.ac.id/course/view.php?id=27654 ; *https://vclass.unila.ac.id/course/view.php?id=27655; https://vclass.unila.ac.id/course/view.php?id=27658* Learning Methods SGD, RPS, DL, SDL, CoL, CbL, CtL, PjBL, PBL. • Read the material and watch the learning videos • Group discussions using forums or other media • Doing the quiz Supporting References • Youtube • Slide • Journal 80 minutes of group discussion 20 minutes of independent quizzes	References 3, 4, 5, 12, 13, 15. PPT Photo of periodicity and Vernalization Student Worksheet (LKM-12)	
16	**Final Semester Evaluation / Final Semester Exam**			100 minutes face-to-face online video conference using Vclass at the link: https://vclass.unila.ac.id/course/view.php?id=27654 ; *https://vclass.unila.ac.id/course/view.php?id=27655 ; https://vclass.unila.ac.id/course/view.php?id=27658*			30

Notes :

1. This RPS is made based on NEW NORMAL conditions and follows the rules and decisions of the UNILA Chancellor's Decree regarding learning carried out at Unila University in a Full Learning manner (100% online).
2. **DEPARTMENT Graduate Learning Outcomes (CPL-Jurusan)** are the abilities possessed by each Department graduate which are the internalization of attitudes, mastery of knowledge and skills according to the study program level obtained through the learning process.
3. **The CPL charged to a course** is a number of learning outcomes of study program graduates (CPL-Department) which are used to form/develop a course consisting of aspects of attitude, general skills, specific skills and knowledge.
4. **Course CP (CPMK)** is a capability that is specifically described from the CPL that is assigned to the course, and is specific to the study material or learning material of the course.
5. **Sub-CP Course (Sub-CPMK)** is a capability that is specifically described from CPMK that can be measured or observed and is the final capability planned at each stage of learning, and is specific to the learning material of the course.
6. **Indicators for assessing** abilities in the process and results of student learning are specific and measurable statements that identify the abilities or performance of student learning outcomes accompanied by evidence.
7. **Assessment criteria** are benchmarks used to measure or measure learning achievement in assessments based on established indicators. Assessment criteria serve as guidelines for assessors to ensure consistent and unbiased assessments.
8. Criteria can be quantitative or qualitative.
9. **Forms of assessment:** test and non-test.
10. **Forms of learning:** Lectures, Responses, Tutorials, Seminars or equivalent, Practicals, Studio Practicals, Workshop Practicals, Field Practicals, Research, Community Service and/or other equivalent forms of learning.
11. **Learning Methods:** Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning, and other equivalent methods.
12. **Learning materials** are details or descriptions of study materials that can be presented in the form of several main and sub-main topics.
13. **The assessment weight** is the percentage of the assessment for each sub-CPMK achievement, the amount of which is proportional to the level of difficulty of achieving the sub-CPMK, and the total is 100%.
14. TM=Face to Face, PT=Structured Assignment, BM=Independent Learning.

Assessment Rubric

Task

No.	Task		Time	Assignment Results and Assessment Criteria
1.	Independent	Studying Plant Physiology textbooks and other learning resources. Exercises	2 x 100	Practice Question Answers, Accuracy of Learning Journal Question Answers
2	Structured	Prepare presentations for discussion materials in ppt form that are true, clear, and creative according to the material assigned in groups Conduct research to solve a problem related to plant physiology Conduct argumentative discussions in presenting research results	2x100	Creativity, Accuracy of material, Presentation, Activeness in discussion, how to convey opinions in discussion. Having character as a researcher in doing internships, written research reports Argumentation Scheme

Rating

No.	Indicator	Rating		
		Type	**Shape**	**Criteria**
1.	Mastering the concept theoretical	Written Test Practice Questions	Test Rubric	Correct and complete answer = 4 Correct and incomplete answers = 3 Correct and incomplete answers = 2 Correct and very incomplete answer = 1 Wrong/no answer = 0
2	Skilled in conducting investigations.	Observation of researcher's character behavior	Sheet Observation	Honest = 18%, discipline = 24%, responsible = 12%, creative = 29%, and caring = 18% with criteria according to the attached rubric.
3	Skilled at arguing with a clear structure, consisting of: *claim/ counterclaim, evidence/data, warrant and backing ng .*	Performance observation	Argumentation Framework	Score / Descriptor 4 — Students are individually able to guarantee *claims* with available data and cite sufficient data to support *claims,* are able to write a logical explanation of a phenomenon and combine appropriate references when developing data. 3 — Students are individually able to guarantee *claims* with available data and cite sufficient data to support *claims,* are able to write a logical explanation of a phenomenon but are less able to unify appropriate references when developing data.
No.	**Indicator**	**Evaluation**		

		Type	Form	Criteria	
				2	Students are individually able to support *claims* with available data and cite sufficient data to support *claims,* but less able to write a logical explanation of a phenomenon and combine appropriate references when developing data.
				1	Students individually are only able to guarantee *claims* with available data and cite sufficient data to support *the claim.*
4	Compile a written investigation report.	Product report	Review of Investigation Report	Objective Session = 25%, Argument Session = 50%, and Writing Session = 25% with the following criteria: Not good = 4; Less good = 3; Good = 2; Very good = 1	
5	All indicators	Product	Study journal	Identity = 9%, with the following criteria: None = 1, Incomplete = 2; Complete = 3; Introduction = 27%, Lecture notes = 9%, Problem identification = 9%, Lecturer review notes = 9%, and Reflection = 36%, with the following criteria: None = 1; Less logical = 2; Logical = 3.	

In determining the final value, the following weighting will be used:

No.	Assessment Elements	Percentage value
1	Task Mandiri: Learning Journal Structured: Presentation, Discussion	20
2	Midterm exam	10
3	Final exams	10
4	Exercises	10
5	Practicum with PJBL-Argumentative consists of the following components:	50
	a. Investigation activities	20
	b. Argumentation activities	10
	c. Report	10
	d. Exam	10

Question Sheet for Mid Term Course Examination

Mid-Semester Examination – Plant Physiology

Type: Essay Questions (HOTS)
Time Allocation: 90 minutes
Total Score: 100 points

Instructions for Students

1. Answer all questions clearly and systematically.
2. Write your answers in academic English.
3. Each answer should be 250–400 words.
4. Support your answers with scientific concepts, diagrams, or case studies when necessary.
5. Plagiarism or irrelevant answers will reduce your score.

Essay Questions

1. Analyze how water potential components (osmotic potential, pressure potential, matric potential) regulate water movement in plant cells. Give examples of how this mechanism supports plant survival under drought conditions. (20 points)
2. Explain the role of membrane transport proteins in mineral uptake. Evaluate how nutrient deficiencies (e.g., nitrogen, phosphorus, potassium) affect plant physiology and growth. (20 points)
3. Describe the mechanism of light-dependent reactions in photosynthesis. Assess how environmental factors (light intensity, wavelength, temperature) influence photosynthetic efficiency. (20 points)
4. Compare the Calvin Cycle in C3, C4, and CAM plants. Analyze how these different pathways provide adaptive advantages in specific ecosystems. (20 points)
5. Discuss the stages of cellular respiration in plants. Evaluate the relationship between photosynthesis and respiration in maintaining energy balance in plant cells. (20 points)

Question sheet for Final Course Examination

Final Examination – Plant Physiology

Type: Essay Questions (HOTS)
Time Allocation: 120 minutes
Total Score: 100 points

Instructions for Students

1. Answer all questions in essay form (300–500 words each).
2. Use academic English and scientific terminology.
3. Support your answers with concepts, diagrams, or case studies when appropriate.
4. Plagiarism or irrelevant answers will reduce your score.

Essay Questions

1. *Analyze* the physiological factors that regulate plant growth and development. Discuss the role of environmental cues in modifying these processes.*(20 points)*

2. Explain the role of auxins, gibberellins, cytokinins, abscisic acid, and ethylene in plant physiology. *Evaluate* how signal transduction pathways integrate hormonal and environmental signals to regulate plant responses. *(20 points)*

3. *Critically evaluate* the ecological and physiological roles of secondary metabolites (e.g., alkaloids, terpenoids, phenolics) in plant defense mechanisms. Provide at least two examples. *(20 points)*

4. Describe how plants respond physiologically to abiotic stresses such as drought, salinity, and extreme temperatures. *Assess* adaptive strategies that enable plants to survive in challenging environments. *(20 points)*

5. *Analyze* the physiological basis of plant–microbe interactions, such as symbiotic nitrogen fixation and mycorrhizal associations. Discuss their significance for plant productivity and ecosystem sustainability. *(20 points)*

Answer Key & Rubric – Final Examination Plant Physiology

No.	Comprehensive Answer Key	Rubric (20 points each)
1	Factors regulating growth & development: plant hormones (auxins, gibberellins, cytokinins, ABA, ethylene), light, temperature, nutrients, water availability. Environmental cues: photoperiod, temperature (vernalization), stress conditions modify hormone activity. Integration: internal (endogenous hormones) + external (light/temperature) regulate growth stages (germination, elongation, flowering).	- Explanation of physiological factors (7 pts) - Role of environmental cues (7 pts) - Integration and analysis (6 pts)
2	Auxin: cell elongation, apical dominance, root initiation. Gibberellins: stem elongation, seed germination, flowering. Cytokinins: cell division, delay of senescence. Abscisic Acid (ABA): stomatal closure, stress response. Ethylene: fruit ripening, leaf abscission. Signal Transduction: receptors detect signals → transduction cascades (protein kinases, secondary messengers) → gene expression changes → physiological responses. Integration: environmental factors (light, stress) modify hormonal effects.	- Clear roles of 5 hormones (10 pts) - Explanation of signal transduction (5 pts) - Integration with environment (5 pts)
3	Secondary metabolites: - Alkaloids (nicotine, caffeine): toxic defense against herbivores. - Terpenoids (essential oils, latex): antimicrobial & anti-herbivory. - Phenolics (flavonoids, tannins): UV protection, pathogen resistance. Ecological roles: chemical defense, allelopathy, symbiosis attraction. Examples: Nicotine in tobacco; Tannins in oak leaves.	- Identification of classes (6 pts) - Explanation of roles (8 pts) - At least 2 clear examples (6 pts)
4	Abiotic stress responses: - Drought: stomatal closure (ABA), osmotic adjustment, deeper roots. - Salinity: ion exclusion, compartmentalization of Na+, synthesis of osmoprotectants. - Extreme temperature: heat shock proteins, membrane lipid changes, antifreeze proteins. Adaptive strategies: xerophyte adaptations, CAM photosynthesis, salt glands, seasonal growth cycles.	- Description of stress responses (10 pts) - Examples of adaptations (7 pts) - Analysis of survival strategies (3 pts)
5	Symbiotic nitrogen fixation: Rhizobium–legume symbiosis, nodule formation, nitrogenase enzyme converts $N_2 \rightarrow NH_3$. Mycorrhizae: fungi increase water & mineral uptake, exchange nutrients with plants. Significance: enhances productivity, soil fertility, ecosystem sustainability. Examples: Soybean–Rhizobium; Mycorrhizal associations in forest trees.	- Explanation of N-fixation (7 pts) - Explanation of mycorrhizae (7 pts) - Significance + examples (6 pts)

Sample Answer of Final Examination

Name	**:** Nabila Ramadani	Class	: A
NPM	**:** 2313024011	Course	: **Plant Physiology**

1. Plants grow and develop because inside they have hormone system and also external factors. Auxin make elongation, gibberellin push stem to grow tall, cytokinin make cell division. But without environment, it cannot run well. Light give signal for photoperiod, like flowering in short or long day plants. Temperature also important, like vernalization in wheat that need cold first before flowering. Water and nutrient give resource for energy and structure. So, plant growth is like combination of what plant already have inside (genetic and hormone) with signal from outside. When stress condition happen like drought, hormone like ABA become active to close stomata. So always integration between environment and physiology.

2. Auxin help in apical dominance, making root and elongation. Gibberellin push seed to germinate and stem elongation. Cytokinin make division, so in tissue culture if ratio high it can make shoot. ABA is stress hormone, close stomata during drought and keep seed dormant. Ethylene make fruit ripening, leaf fall, and also response stress. Signal transduction happen when hormone meet receptor, then make cascade like protein kinase and calcium signal, then change gene expression. Example is ABA close stomata, using ion channel regulation. Environment also join, like drought trigger ABA, light also interact with auxin distribution.

3. Plant also produce many compound not for growth but to protect. Alkaloid like nicotine is poison for insect. Terpenoid like essential oil make plant smell strong, sometimes to keep herbivores away. Phenolic like tannin make leaf taste bitter, so herbivores not eat too much. For example, tobacco with nicotine is strong defense. Oak leaves with tannin also protect from animal. In ecology, these compound also help plant to survive in environment, sometimes also in allelopathy.

4. Drought: plant close stomata using ABA, also make deeper root. Salinity: exclude Na+ or store in vacuole, sometimes produce proline. Cold stress: membrane become stiff, plant produce sugar to protect. Heat stress: plant produce heat shock protein. Adaptation example: cactus use CAM to save water. Halophyte like mangrove can remove salt with salt gland. So each stress plant have special way to survive. But if stress is too strong, still can die.

5. Rhizobium and legume is very famous example. Bacteria go inside root, make nodule, and fix nitrogen gas to ammonium. Plant get nitrogen, bacteria get carbohydrate. That is why soybean can grow good without fertilizer. Mycorrhiza also give benefit. Fungi hyphae go to soil, so water and phosphorus uptake better. Plant give sugar for fungi. In forest, this make trees more strong and also help ecosystem balance. This interaction very important for agriculture and nature because reduce fertilizer, keep soil fertile, and keep sustainable.