	Universitas Negeri Surabaya Fakultas Matematika dan Ilmu Pengetahuan Alam Program Studi S1 Pendidikan Biologi	Kode Dokumen

RENCANA PEMBELAJARAN SEMESTER

MATA KULIAH (MK)	KODE	Rumpun MK	BOBOT (sks)			SEMESTER	Tgl Penyusunan
Fisiologi Tumbuhan	8420504102	Mata Kuliah Wajib Program Studi	T=4	P=0	ECTS=6.36	3	27 April 2023

OTORISASI	Pengembang RPS	Koordinator RMK	Koordinator Program Studi
	Dr. sc. agr. Yuni Sri Rahayu, M. Si.	Dr. sc. agr. Yuni Sri Rahayu, M. Si.	RINIE PRATIWI PUSPITAWATI

Model Pembelajaran	**Project Based Learning**

Capaian Pembelajaran (CP)

CPL-PRODI yang dibebankan pada MK	
CPL-2	Menunjukkan karakter tangguh, kolaboratif, adaptif, inovatif, inklusif, belajar sepanjang hayat, dan berjiwa kewirausahaan
CPL-6	Mampu membuat keputusan berdasarkan data/informasi dalam rangka menyelesaikan tugas sebagai bagian dari tanggungjawabnya dalam pekerjaan yang telah dilakukan.
CPL-9	Mampu mendemonstrasikan pengetahuan pedagogik tentang merancang, melaksanakan, dan mengevaluasi pembelajaran biologi.
Capaian Pembelajaran Mata Kuliah (CPMK)	
CPMK - 1	Creating an independent and honest character in carrying out tasks related to Plant Physiology.
CPMK - 2	Able to make right decisions based on analysis of information and data, and be able to provide guidance in choosing various alternative solutions independently and in groups in the field of plant physiology
CPMK - 3	Mastering theoretical concepts about the concept of plant physiology and its application
CPMK - 4	Able to apply Plant Physiology concepts or theories that have been mastered in solving various procedural problems according to their field of knowledge.
CPMK - 5	Having skills to apply the concepts and principles of Plant Physiology responsibly in a safe day-to-day.
CPMK - 6	Having an entrepreneurial spirit (ecopreneurship), researcher or quality control related to Plant Physiology material that can be developed and applied

Matrik CPL - CPMK

CPMK	CPL-2	CPL-6	CPL-9
CPMK-1	✔		
CPMK-2	✔		
CPMK-3	✔		
CPMK-4	✔		
CPMK-5	✔		
CPMK-6	✔		

Matrik CPMK pada Kemampuan akhir tiap tahapan belajar (Sub-CPMK)

CPMK	Minggu Ke															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
CPMK-1	✔		✔						✔							
CPMK-2				✔						✔		✔				
CPMK-3		✔			✔	✔	✔				✔		✔	✔		
CPMK-4								✔								
CPMK-5																✔
CPMK-6															✔	

Deskripsi Singkat MK	This course outlines three basic concepts and their applications, namely plants and their environment; plant metabolism; and plant growth and development. Plants and the environment study the relationship between plants and water, mineral nutrients, and transport processes in plants, including the factors that influence them, such as the opening and closing of stomata and transpiration. Metabolism includes respiration, photosynthesis, enzymes, nitrogen and fat metabolism in plants. Growth and development discusses the control of genes on growth and development, hormones, movement, morphogenesis, photoperiodism, vernalization, dormancy and senescence and the factors that influence them. Plant Physiology studies are accompanied by various process skills (minds on activity and hands on activity) that will be used to solve problems in the field of plant physiology and their applications to support the growth of the spirit of ecopreunership, researchers and quality control in the field of plant physiology. Learning is packaged with a student-certified learning approach using various methods according to the characteristics of the material such as presentations, discussions, and practicums or other learning strategies such as finding concepts, making resumes, etc.
Pustaka	**Utama :**

1. Salisbury, F.B. dan Ross, C.W. 1995. Plant Physiologi . NewYork: John Wiley & Sons
2. Hopkins, W.G.1995. Introduction to Plant Physiology . New York: John Wiley & Sons.
3. Jakarta: Gramedia.Loveless, A.R. 1989. Prinsip-prinsip Biologi Tumbuhan untuk Daerah Tropik .
4. Mohr, H. dan Schopfer, P. 1995. Plant Physiology . Berlin: Springer
5. Sastamihardja, Darjat dan Arbayah. 1994. Fisiologi Tumbuhan . Bandung: ITB Press
6. Yuliani.2017. Metabolisme Tumbuhan . Surabaya: Unesa Press.
7. Taiz, L. dan Zeiger, E. 2010. Plant Physiology. California: The Benjamin/Cummings Publishing Company, Inc.
8. Yuni Sri Rahayu. 2018. Hara Tanaman dan Asimilasinya. Surabaya: Unesa Press.

Pendukung :	

Dosen Pengampu	Prof.Dr. Yuni Sri Rahayu, M.Si. Prof. Dr. Yuliani, M.Si. Sari Kusuma Dewi, S.Si., M.Si.

Mg Ke-	**Kemampuan akhir tiap tahapan belajar (Sub-CPMK)**	**Penilaian**		**Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu]**		**Materi Pembelajaran [Pustaka]**	**Bobot Penilaian (%)**
		Indikator	**Kriteria & Bentuk**	**Luring (*offline*)**	**Daring (*online*)**		
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
1	Understand the structure and function of organelles in plant cells independently and honestly	1.a.Describe the scope and role of plant physiology 2.b.Identifying the structure of organelles in plant cells 3.c.Comparing the structure and function of organelles of plant and animal cells 4.d.Menunjukkan sikap jujur dan mandiri selama proses pembelajaran berdasarkan lembar observasi	**Kriteria:** 1.30% of Reports and practicum products are rated as TASKS 2.20% Midterms 3.20% of Student activities and responses during learning activities, especially practicum, are assessed as participation 4.30% Final Exams 5.Essay questions and multiple choice are accessed jointly at the Midterms and Final Exams 6.Performance questions are integrated during learning **Bentuk Penilaian** : Aktifitas Partisipasif	Lecturers facilitate student-centered learning through group discussions and are responsible for finding concepts (based on literature reviews) regarding plant physiology and processes in plant life activities based on the function of plant cell organelles and presenting the results of their group work. Lectures: 3x50 minutes Self Learning: 3x60 minute Read and underline important concepts of processes in plant cells based on the structure of the organelle function of plant cells and their differences from animal cells. Structural Task: 3x60 minutes Make a resume of the processes in plant cells based on the structure of the organelle function of plant cells and their differences with animal cells. 4 X 50	Lecturers facilitate student-centered learning through group discussions and are responsible for finding concepts (based on literature reviews) regarding plant physiology and processes in plant life activities based on the function of plant cell organelles and presenting the results of their group work. Read and underline important concepts of processes in plant cells based on the structure of the organelle function of plant cells and their differences from animal cells. Make a resume of the processes in plant cells based on the structure of the organelle function of plant cells and their differences with animal cells.	**Materi:** Function structure of plant organelles a. The concept of plant physiology and the processes in plant life activities b. The scope of plant physiology c. The Role of Plant Physiology d. Structure and function of organelles in plant cells **Pustaka:** *Salisbury, F.B. dan Ross, C.W. 1995. Plant Physiologi . NewYork: John Wiley & Sons* **Materi:** Function structure of plant organelles a. The concept of plant physiology and the processes in plant life activities b. The scope of plant physiology c. The Role of Plant Physiology d. Structure and function of organelles in plant cells **Pustaka:** *Hopkins, W.G.1995. Introduction to Plant Physiology . New York: John Wiley & Sons.* **Materi:** Function structure of plant organelles a. The concept of plant physiology and the processes in plant life activities b. The scope of plant physiology c. The Role of Plant Physiology d. Structure and function of organelles in plant cells **Pustaka:** *Taiz, L. dan Zeiger, E. 2010. Plant Physiology. California: The Benjamin/Cummings Publishing Company, Inc.*	5%

2	Understand the concept of water and its role in plants	1.a. Explain the concept of water potential, oscostic potential, turgor potential. 2.b. Skilled to do experiments on water potential and osmosis potential 3.c. Calculate PO and PA values based on experimental results 4.d. Summarize the concepts of water potential, oscostic potential, turgor potential, and related concepts based on experimental results. 5.e. Communicating the experimental results of water potential and osmotic potential 6.f. Make a report on the results of the experiment about water potential and osmosis potential 7.g. Show an honest and independent attitude during the learning process based on the observation sheet	**Kriteria:** 1.30% of Reports and practicum products are rated as TASKS 2.20% Midterms 3.20% of Student activities and responses during learning activities, especially practicum, are assessed as participation 4.30% Final Exam 5.Essay questions and multiple choice are accessed jointly at the Midterms and Final Exams 6.Performance questions are integrated during learning **Bentuk Penilaian** : Praktik / Unjuk Kerja	Lecturers facilitate student- centered case study through active discussions of students about the implementation of concepts of PT, PO, TO, PA, osmosis, diffusion in daily life based on pictures of various everyday phenomena. Based on the results of group discussions, representative students presented the results of discussions for solving problems of case study in daily life which were given based on the concepts of PA, PO, PT Lectures: 3x50 minutes Self Learning: 3x60 minutes Discussion on solving daily problems (case study) related to the concepts of CL, PO, PT and reporting the written results in groups. Practical Course: 3x60 minutes Structural Task: 3x60 minutes Make a practicum report 4 X 50	Lecturers facilitate student- centered case study through active discussions of students about the implementation of concepts of PT, PO, TO, PA, osmosis, diffusion in daily life based on pictures of various everyday phenomena. Based on the results of group discussions, representative students presented the results of discussions for solving problems of case study in daily life which were given based on the concepts of PA, PO, PT Lectures: 3x50 minutes Self Learning: 3x60 minutes Discussion on solving daily problems (case study) related to the concepts of CL, PO, PT and reporting the written results in groups. Structural Task: 3x60 minutes Make a virtual practicum report	**Materi:** 2. Plants and their Environment. a. The structure and properties of water b. Diffusion, osmosis, imbibition c. Osmosis Pressure, Turgor Pressure, Water Potential, Osmosis Potential **Pustaka:** *Salisbury, F.B. dan Ross, C.W. 1995. Plant Physiologi . NewYork: John Wiley & Sons* **Materi:** 2. Plants and their Environment. a. The structure and properties of water b. Diffusion, osmosis, imbibition c. Osmosis Pressure, Turgor Pressure, Water Potential, Osmosis Potential **Pustaka:** *Taiz, L. dan Zeiger, E. 2010. Plant Physiology. California: The Benjamin/Cummings Publishing Company, Inc.*	6%
3	Analyzing the absorption, transportation and nutrient requirements of plants	1.a. Determine the components of the soil 2.b. Distinguishing macro and micro nutrients in terms of function, deficiency, and absorption form (ions, compounds, etc.) 3.c. Distinguish passive and active transport	**Kriteria:** 1.30% of Reports and practicum products are rated as TASKS 2.20% Midterms 3.20% of Student activities and responses during learning activities, especially practicum, are assessed as participation 4.30% Final Exams 5.Essay questions and multiple choice are accessed jointly at the Midterms and Final Exams 6.Performance questions are integrated during learning **Bentuk Penilaian** : Aktifitas Partisipasif	Lecturers facilitate students using guided discovery by using LKM in groups, discussing, to find concepts (components of soil, macro and micro nutrients in terms of function, deficiency, absorption form, various kinds of passive and active transport) and presented the results of the group's work Lectures: 3x50 minutes Self Learning: 3x60 Minutes Read and rediscover the concept of soil components, macro nutrients, micro nutrients, nutrient function, deficiency, passive and active transport Structural Task: 3x60 minutes 4 X 50		**Materi:** 3. Soil and plant nutrition: a. Soil: structure, texture, minerals, organic matter b. Essential nutrients: macro and micro nutrients, function, deficiency. c. Absorption and transport of mineral salts **Pustaka:** *Yuni Sri Rahayu. 2018. Hara Tanaman dan Asimilasinya. Surabaya: Unesa Press.* **Materi:** 3. Soil and plant nutrition: a. Soil: structure, texture, minerals, organic matter b. Essential nutrients: macro and micro nutrients, function, deficiency. c. Absorption and transport of mineral salts **Pustaka:** *Taiz, L. dan Zeiger, E. 2010. Plant Physiology. California: The Benjamin/Cummings Publishing Company, Inc.*	5%
4	Linking the mechanism of water absorption and photosynthesis, as well as water circulation, to plant growth	1.a. Identify the function of water in plants 2.b. Distinguishing types and functions of groundwater 3.c. Distinguish intra and extra cellular transport 4.d. Describe the internal and external factors that affect water absorption in plants 5.e. Describe the mechanism of water circulation in plants 6.f. Describe the mechanism of transport through the	**Kriteria:** 1.30% of Reports and practicum products are rated as TASKS 2.20% Midterms 3.20% of Student activities and responses during learning activities, especially practicum, are assessed as participation 4.30% Final Exams 5.Essay questions and multiple choice are accessed jointly at the	Lecturers facilitate student-centered learning through case study using: 1. Animated water and mineral transport, transport through the phloem, opening the stomata 2. Figure nutrient transport, the mechanism for opening stomata Using the guided discovery model, students are guided in an active discussion to discover the concepts of water transport, nutrient	Lecturers facilitate student-centered learning through case study using: 1. Animated water and mineral transport, transport through the phloem, opening the stomata 2. Figure nutrient transport, the mechanism for opening stomata Using the guided discovery model, students are guided in an active discussion to discover the concepts of	**Materi:** Transport Mechanisms and Influencing Factors: a. The structure and properties of water b. Groundwater c. Water in plant cells d. Absorption of water by plant roots e. Apoplast and simplas f. Transport of water through the trachea and xylem g. Factors affecting water transport h.Transpiration concept i. The mechanism of opening and closing the stomata j.	5%

		phloem and the factors affecting it 7.g. Identify the part of the leaf that plays a role in the transpiration process 8.h. Distinguish various concepts about the opening and closing of stomata in plants 9.i. Skilled doing experiments showing the process of transpiration 10.j. Calculates the transpiration rate in plants 11.k. Explain the importance of the transpiration process for plants 12.l. Describe the factors that affect transpiration 13.m. Create a report on the results of the experiment 14.n. Show an honest and independent attitude during	Midterms and Final Exams 6.Performance questions are integrated during learning **Bentuk Penilaian** : Aktifitas Partisipasif	transport, transport through the phloem, opening the stomata and its influence. The results of the discussion are presented. Lectures: 3x50 minutes Self Learning: 3x60 minutes As a group, writing a resume of the concepts found includes: 1. Water transport mechanism 2. Nutrient transport mechanism 3. Phloem transport mechanism 4. Stomata opening mechanism 5. Transpiration and influencing factors. Practical course: 3x60 minutes Structural Task: 3x60 minutes Make a practicum report 4 X 50	water transport, nutrient transport, transport through the phloem, opening the stomata and its influence. The results of the discussion are presented. Lectures: 3x50 minutes Self Learning: 3x60 minutes As a group, writing a resume of the concepts found includes: 1. Water transport mechanism 2. Nutrient transport mechanism 3. Phloem transport mechanism 4. Stomata opening mechanism 5. Transpiration and influencing factors. Practical course: 3x60 minutes Structural Task: 3x60 minutes Make a practicum report	Transpiration rate calculation k. Factors affecting transpiration l. Transport through the phloem and the factors affecting it **Pustaka:** *Taiz, L. dan Zeiger, E. 2010. Plant Physiology. California: The Benjamin/Cummings Publishing Company, Inc.* **Materi:** Transport Mechanisms and Influencing Factors: a. The structure and properties of water b. Groundwater c. Water in plant cells d. Absorption of water by plant roots e. Apoplast and simplas f. Transport of water through the trachea and xylem g. Factors affecting water transport h.Transpiration concept i. The mechanism of opening and closing the stomata j. Transpiration rate calculation k. Factors affecting transpiration l. Transport through the phloem and the factors affecting it **Pustaka:** *Yuni Sri Rahayu. 2018. Hara Tanaman dan Asimilasinya. Surabaya: Unesa Press.* **Materi:** Transport Mechanisms and Influencing Factors: a. The structure and properties of water b. Groundwater c. Water in plant cells d. Absorption of water by plant roots e. Apoplast and simplas f. Transport of water through the trachea and xylem g. Factors affecting water transport h.Transpiration concept i. The mechanism of opening and closing the stomata j. Transpiration rate calculation k. Factors affecting transpiration l. Transport through the phloem and the factors affecting it **Pustaka:** *Salisbury, F.B. dan Ross, C.W. 1995. Plant Physiologi . NewYork: John Wiley & Sons*	

5	Communicates an understanding of enzymes and the factors that influence their activity	1. a. Distinguishing primary metabolism and secondary metabolism 2. b. Explain the basic concepts and properties of enzymes 3. c. Describe the mechanism of action of enzymes 4. d. Group enzymes based on their structure and naming 5. e. Describe the distribution of enzymes within cells	**Kriteria:** 1. 30% of Reports and practicum products are rated as TASKS 2. 20% Midterms 3. 20% of Student activities and responses during learning activities, especially practicum, are assessed as participation 4. 30% Final Exams 5. Essay questions and multiple choice are accessed jointly at the Midterms and Final Exams 6. Performance questions are integrated during learningUSS/UTS bobot 20% **Bentuk Penilaian** : Penilaian Praktikum, Praktik / Unjuk Kerja	Lecturers facilitate student- centered learning, guiding active discussions to discover the concept of enzyme properties and enzyme action mechanisms based on related images. Lectures: 3x50 menit Self Learning: 3x60 minutes Read and as a group, write the results of a review of factors that affect the mechanism of action of the enzyme in the practicum report Practical course: 3x60 minutes Structural task: 3x60 minutes Make a practicum report 4 X 50	Lecturers facilitate student- centered learning, guiding active discussions to discover the concept of enzyme properties and enzyme action mechanisms based on related images. Lectures: 3x50 menit Self Learning: 3x60 minutes Read and as a group, write the results of a review of factors that affect the mechanism of action of the enzyme in the practicum report Practical course: 3x60 minutes Structural task: 3x60 minutes Make a practicum report	**Materi:** Enzymes: a. Basic concepts b. Enzyme properties c. Mechanism of action of enzymes c. Structure, naming and grouping of enzymes d. Distribution of enzymes within cells e. Factors affecting enzyme activity f. Metabolic regulation via enzymes **Pustaka:** *Yuliani.2017. Metabolisme Tumbuhan . Surabaya: Unesa Press.* **Materi:** Enzymes: a. Basic concepts b. Enzyme properties c. Mechanism of action of enzymes c. Structure, naming and grouping of enzymes d. Distribution of enzymes within cells e. Factors affecting enzyme activity f. Metabolic regulation via enzymes **Pustaka:** *Taiz, L. dan Zeiger, E. 2010. Plant Physiology. California: The Benjamin/Cummings Publishing Company, Inc.*	6%

6	Understand the concept of photosynthesis and apply the role of photosynthesis to other organisms	1.a. Describe photosynthesis 2.b. Determine the parts of the chloroplast and determine the function of thylakoids and stroma 3.c. Determine the components of photosynthesis 4.d. Describes photosystem, inductive resonance and emerson effect 5.e. Distinguishing photosystem I and II 6.f. Distinguishing cyclic and non-cyclic photophosphorilation 7.g. Describe the carbohydrate synthesis reaction / dark reaction 8.h. Distinguish light reactions and dark reactions based on substrates and products 9.i. Distinguishes the mechanism of the C2, C3, C4, and CAM lines 10.j. Describe the mechanism and function of the Pentose Phosphate pathway 11.k. Describe the mechanism and function of the glycosylate pathway 12.l. Describe the factors that influence photosynthesis 13.m. Skilled doing experiments on chlorophyll content at various ages of leaves 14.n. Skilled using a spectrophotometer 15.o. Create a report on the results of the experiment 16.p. Show an honest and independent attitude during the learning process based on the observation sheet	**Kriteria:** 1.30% of Reports and practicum products are rated as TASKS 2.20% Midterms 3.20% of Student activities and responses during learning activities, especially practicum, are assessed as participation 4.30% Final Exams 5.Essay questions and multiple choice are accessed jointly at the Midterms and Final Exams 6.Performance questions are integrated during learning **Bentuk Penilaian** : Aktifitas Partisipasif, Penilaian Praktikum, Praktik / Unjuk Kerja	Lecturers facilitate student-centered learning, through pictures guiding active discussions to find concepts related to photosynthesis and its mechanisms. Using a case study to find out the plant mechanism to solve the water limitation based the photosyntesis type of the plant. Using guided discovery to find the concept of chlorophyll levels in plants through practicum. Lectures: 3x50 minutes Self Learning: 3x60 minutes Read and as a group write the results of a review about the differences in the mechanisms of the C2, C3, C4, and CAM pathways Practical course: 3x60 minutes Structural task: 3x60 minutes Make a practicum report 4 X 50	Lecturers facilitate student-centered learning, through pictures guiding active discussions to find concepts related to photosynthesis and its mechanisms. Using a case study to find out the plant mechanism to solve the water limitation based the photosyntesis type of the plant. Using guided discovery to find the concept of chlorophyll levels in plants through practicum. Lectures: 3x50 minutes Self Learning: 3x60 minutes Read and as a group write the results of a review about the differences in the mechanisms of the C2, C3, C4, and CAM pathways Practical course: 3x60 minutes Structural task: 3x60 minutes Make a practicum report	**Materi:** Photosynthesis Concept a. Chloroplast: structure, process of formation b. Absorption of light by chlorophyll and transfer of energy c. Photosystem d. Cyclic and non-cyclic photophosphor ylation e. Light reaction and dark reaction f. Differences in the mechanism of the C3, C4, CAM and C2 lines g. Pentose Phosphate Pathway h. Glycosylate Pathway i. Factors affecting photosynthesis **Pustaka:** *Yuliani.2017. Metabolisme Tumbuhan . Surabaya: Unesa Press.* **Materi:** Photosynthesis Concept a. Chloroplast: structure, process of formation b. Absorption of light by chlorophyll and transfer of energy c. Photosystem d. Cyclic and non-cyclic photophosphor ylation e. Light reaction and dark reaction f. Differences in the mechanism of the C3, C4, CAM and C2 lines g. Pentose Phosphate Pathway h. Glycosylate Pathway i. Factors affecting photosynthesis **Pustaka:** *Taiz, L. dan Zeiger, E. 2010. Plant Physiology. California: The Benjamin/Cummings Publishing Company, Inc.*	6%

7	Understand the concept of respiration and associate respiration with carbon balance in nature (linkage between respiration and photosynthesis)	1. a. Describes the concept of respiration 2. b. Determine the portions of the mitochondria 3. c. Distinguish the stages of the respiratory mechanism 4. d. Determine the location of the respiration stage 5. e. Describe the various hypotheses related to oxidative phosphorylation 6. f. Calculates the amount of energy obtained from the breakdown of 1 glucose molecule 7. g. Carry out a sprout respiration experiment 8. h. Summing up the factors affecting respiration 9. i. Create a report on the results of the experiment 10. j. Show an honest and independent attitude during the learning process based on the observation sheet	**Kriteria:** 1. 30% of Reports and practicum products are rated as TASKS 2. 20% Midterms 3. 20% of Student activities and responses during learning activities, especially practicum, are assessed as participation 4. 30% Final Exams 5. Essay questions and multiple choice are accessed jointly at the Midterms and Final Exams 6. Performance questions are integrated during learning **Bentuk Penilaian** : Aktifitas Partisipasif, Penilaian Praktikum, Praktik / Unjuk Kerja	Lecturers facilitate student-centered learning, through pictures guiding active discussions to find concepts related to respiration and its mechanisms. Facilitating students through practicum to find the concept of the effect of temperature on the respiration process. Lectures: 3x50 minutes Self Learning: 3x60 minutes Read and as a group, write the results of a review about the effect of temperature on the respiration process to be written in the practicum report section Practical course: 3x60 minutes Structural task: 3x60 minutes Make a practicum report 4 X 50	Lecturers facilitate student-centered learning, through pictures guiding active discussions to find concepts related to respiration and its mechanisms. Facilitating students through practicum to find the concept of the effect of temperature on the respiration process. Lectures: 3x50 minutes Self Learning: 3x60 minutes Read and as a group, write the results of a review about the effect of temperature on the respiration process to be written in the practicum report section Practical course: 3x60 minutes Structural task: 3x60 minutes Make a practicum report	**Materi:** a. the portions of the mitochondria b. the stages of the respiratory mechanism c. the location of the respiration stage d. the various hypotheses related to oxidative phosphorylation e. the amount of energy obtained from the breakdown of 1 glucose molecule f. a sprout respiration experiment g. the factors affecting respiration **Pustaka:** *Yuliani.2017. Metabolisme Tumbuhan . Surabaya: Unesa Press.* **Materi:** a. the portions of the mitochondria b. the stages of the respiratory mechanism c. the location of the respiration stage d. the various hypotheses related to oxidative phosphorylation e. the amount of energy obtained from the breakdown of 1 glucose molecule f. a sprout respiration experiment g. the factors affecting respiration **Pustaka:** *Taiz, L. dan Zeiger, E. 2010. Plant Physiology. California: The Benjamin/Cummings Publishing Company, Inc.*	5%

8	Midterm	1. Menyimpulkan konsep potensial air, potensial osmostik, potensial turgor, dan konsep-konsep terkait berdasarkan hasil percobaan 2. Membedakan unsur hara makro dan mikro dari segi esensialnya, fungsi, defisiensi, dan bentuk penyerapan (ion, senyawa dll) 3. Membedakan berbagai konsep tentang membuka menutupnya stomata pada tumbuhan 4. Membedakan transport intra dan ekstra seluler 5. Membedakan metabolisme primer dan metabolisme sekunder 6. Menjelaskan pentingnya enzim bagi pengaturan metabolisme tumbuhan 7. Membedakan fotosistem I dan II 8. Membedakan fotofosforolasi siklik dan non siklik 9. Membedakan reaksi terang dan reaksi gelap berdasarkan substrat dan produk 10. Membedakan mekanisme jalur C2, C3, C4, dan CAM 11. Membedakan tahap-tahap mekanisme respirasi 12. Menghitung besarnya energi yang diperoleh dari pemecahan 1 molekul glukosa 13. Menjelaskan mekanisme dan fungsi dari jalur Pentosa Phosphat 14. Menjelaskan berbagai hipotesis terkait dengan fosforilasi oksidatif	**Kriteria:** 20% Midterms **Bentuk Penilaian** : Tes	- 2 X 50		**Materi:** Transport dan mekanisme transport pada tumbuhan, Hara tanaman, defisiensi dan asimilasinya, Transpirasi Tanaman dan faktor yang mempengaruhinya **Pustaka:** *Yuni Sri Rahayu. 2018. Hara Tanaman dan Asimilasinya. Surabaya: Unesa Press.* **Materi:** Enzim, respirasi, **Pustaka:** *Yuliani.2017. Metabolisme Tumbuhan . Surabaya: Unesa Press.*	10%

9	Understand the concept of nitrogen metabolism and the link between photosynthesis, respiration and fat metabolism	1.a. Explain the fixation of nitrogen by plants through pictures 2.b. Describe the reduction mechanisms of nitrates, nitrites and the formation of amino acids 3.c. Describe the stages in which root nodules form 4.d. Describe the role of respiration and photosynthesis	**Kriteria:** 1.30% of Reports and practicum products are rated as TASKS 2.20% Midterms 3.20% of Student activities and responses during learning activities, especially practicum, are assessed as participation 4.30% Final Exams 5.Essay questions and multiple choice are accessed jointly at the Midterms and Final 6.Exams Performance questions are integrated during learning **Bentuk Penilaian** : Aktifitas Partisipasif	Lecturers facilitate students in groups and discuss, to find concepts based on a case study in Metabolism of N and its relation to photosynthesis and respiration. At the end of teaching learning process the students will present the results and formulate the solution/recommendation base on the academic review. Lectures: 3x50 minutes Self Learning: 3x60 minutes Reviewing the literature to find the concept of differences in the mechanism of N metabolism in legume and non-legume plants 4 X 50	Lecturers facilitate students in groups and discuss, to find concepts based on a case study in Metabolism of N and its relation to photosynthesis and respiration. At the end of teaching learning process the students will present the results and formulate the solution/recommendation base on the academic review. Lectures: 3x50 minutes Self Learning: 3x60 minutes Reviewing the literature to find the concept of differences in the mechanism of N metabolism in legume and non-legume plants	**Materi:** Nitrogen Metabolism: a. Nitrogen Cycle, b. nitrogen fixing, c. nitrogen source, d. reduction of nitrates, nitrites, ammonium, and the formation of amino acids, e. formation of nodules and rhizobium associations, f. the role of respiration and photosynthesis **Pustaka:** *Yuliani.2017. Metabolisme Tumbuhan . Surabaya: Unesa Press.* **Materi:** Nitrogen Metabolism: a. Nitrogen Cycle, b. nitrogen fixing, c. nitrogen source, d. reduction of nitrates, nitrites, ammonium, and the formation of amino acids, e. formation of nodules and rhizobium associations, f. the role of respiration and photosynthesis **Pustaka:** *Taiz, L. dan Zeiger, E. 2010. Plant Physiology. California: The Benjamin/Cummings Publishing Company, Inc.*	5%
10	Describe the stages of fat metabolism in plants	1.a. Identify the presence of fat in plants 2.b. Describes fat formation and fat degradation 3.c. Describe the steps in the glyoxylate cycle	**Kriteria:** 1.30% of Reports and practicum products are rated as TASKS 2.20% Midterms 3.20% of Student activities and responses during learning activities, especially practicum, are assessed as participation 4.30% Final Exams 5.Essay questions and multiple choice are accessed jointly at the Midterms and Final Exams 6.Performance questions are integrated during learning **Bentuk Penilaian** : Aktifitas Partisipasif	Lecturers facilitate students in groups and discuss, to find concepts Metabolism of fat in plants base on case study in plant related on daily life. Lectures: 3x50 minutes Self Learning: 3x60 minutes Reviewing the literature on types of fat metabolism in plants to solve the problem formulated before based on case study. Structural task: 3x60 minutes Make a report on the results of a literature review on the types of fat metabolism in plants and formulate the solution/recommendation base on the academic review. 4 X 50	Lecturers facilitate students in groups and discuss, to find concepts Metabolism of fat in plants base on case study in plant related on daily life. Lectures: 3x50 minutes Self Learning: 3x60 minutes Reviewing the literature on types of fat metabolism in plants to solve the problem formulated before based on case study. Structural task: 3x60 minutes Make a report on the results of a literature review on the types of fat metabolism in plants and formulate the solution/recommendation base on the academic review.	**Materi:** Sintesis lemak a. Asam lemak dan gliserol, b. Katabolisme lemak c. Daur glioksilat **Pustaka:** *Yuliani.2017. Metabolisme Tumbuhan . Surabaya: Unesa Press.* **Materi:** Sintesis lemak a. Asam lemak dan gliserol, b. Katabolisme lemak c. Daur glioksilat **Pustaka:** *Taiz, L. dan Zeiger, E. 2010. Plant Physiology. California: The Benjamin/Cummings Publishing Company, Inc.*	5%

11	Understand the various basic concepts of growth and development	1.a. Distinguish the concepts of growth and development 2.b. Describe growth kinetics 3.c. Describe the kinds of controls in development 4.d. Linking the concept of specialization in growth and development 5.e. Explains the concept of totipotency in plant cells 6.f. Skilled performs an experiment that shows the germination of seeds 7.g. Communicate the results of the seed germination experiment 8.h. Determine the factors that affect seed germination 9.i. Create a report on the results of the experiment 10.j. Show an honest and independent attitude during the learning process based on the observation sheet	**Kriteria:** 1.30% of Reports and practicum products are rated as TASKS 2.20% Midterms 3.20% of Student activities and responses during learning activities, especially practicum, are assessed as participation 4.30% Final Exams 5.Essay questions and multiple choice are accessed jointly at the Midterms and Final Exams 6.Performance questions are integrated during learning **Bentuk Penilaian** : Aktifitas Partisipasif, Penilaian Praktikum, Praktik / Unjuk Kerja	Lecturers facilitate student-centered learning, through pictures and guiding active discussions to discover concepts related to growth and development based on case study in daily life of the plant. At the end, the representative student present the result to find out the solution base on the case study before. Facilitating students through practicum using a guided discovery model to find the concept of the effect of immersion time on seed germination. Lectures: 3x50 minutes Self Learning: 3x60 minutes Read and as a group, write the results of a review about the effect of immersion time on germination speed to be written in the lab report section Practical course: 3x60 minutes Structural task: 3x60 minutes Make a practicum report 4 X 50	Lecturers facilitate student-centered learning, through pictures and guiding active discussions to discover concepts related to growth and development based on case study in daily life of the plant. At the end, the representative student present the result to find out the solution base on the case study before. Facilitating students through practicum using a guided discovery model to find the concept of the effect of immersion time on seed germination. Lectures: 3x50 minutes Self Learning: 3x60 minutes Read and as a group, write the results of a review about the effect of immersion time on germination speed to be written in the lab report section Practical course: 3x60 minutes Structural task: 3x60 minutes Make a practicum report	**Materi:** Plant morphogenesis: a. Basic growth and development b. Gene control of growth and development c. Specialization, totipotency, germination and factors that influence germination **Pustaka:** *Taiz, L. dan Zeiger, E. 2010. Plant Physiology. California: The Benjamin/Cummings Publishing Company, Inc.* **Materi:** Plant morphogenesis: a. Basic growth and development b. Gene control of growth and development c. Specialization, totipotency, germination and factors that influence germination **Pustaka:** *Hopkins, W.G.1995. Introduction to Plant Physiology . New York: John Wiley & Sons.* **Materi:** Plant morphogenesis: a. Basic growth and development b. Gene control of growth and development c. Specialization, totipotency, germination and factors that influence germination **Pustaka:** *Mohr, H. dan Schopfer, P. 1995. Plant Physiology . Berlin: Springer*	5%
12	Distinguishing various hormones and related to the function of each plant hormone	1.a. Distinguishing 2 groups of plant hormones, namely auxins, cytokinins, based on synthesis, activity, transport in plants and function of growth 2.b. Conduct experiments on the effect of various hormones on tissue growth 3.c. Create a report on the results of the experiment 4.d. Associated experimental results with the function of hormones in plant cells 5.e. Show an honest and independent attitude during the learning process based on the observation sheet	**Kriteria:** 1.30% of Reports and practicum products are rated as TASKS 2.20% Midterms 3.20% of Student activities and responses during learning activities, especially practicum, are assessed as participation 4.30% Final Exams 5. Essay questions and multiple choice are accessed jointly at the Midterms and Final Exams 6.Performance questions are integrated during learning **Bentuk Penilaian** : Aktifitas Partisipasif	Presentasi, diskusi, dan praktikum (kerja praktik) 4 X 50		**Materi:** Plant hormones: a. The function of hormones for plants, auxins, cytokinins b. Use of growing substances to regulate growth and development **Pustaka:** *Taiz, L. dan Zeiger, E. 2010. Plant Physiology. California: The Benjamin/Cummings Publishing Company, Inc.* **Materi:** Plant hormones: a. The function of hormones for plants, auxins, cytokinins b. Use of growing substances to regulate growth and development **Pustaka:** *Salisbury, F.B. dan Ross, C.W. 1995. Plant Physiologi . NewYork: John Wiley & Sons*	6%

13	Distinguish the various hormones and the function of each plant hormone	1.a. Distinguish 3 groups of plant hormones, namely gibberellin, ethylene and abscisic acid based on synthesis, activity, transport in plants and function of growth 2.b. Conducting experiments on the effect of the hormone auxin on the leaf abrasion process 3.c. Make a practicum report 4.d. Associated experimental results with the function of hormones in plant cells 5.e. Show an honest and independent attitude during the learning process based on the observation sheet	**Kriteria:** 1.30% of Reports and practicum products are rated as TASKS 2.20% Midterms 3.20% of Student activities and responses during learning activities, especially practicum, are assessed as participation 4. 30% Final Exams 5.Essay questions and multiple choice are accessed jointly at the Midterms and Final Exams **Bentuk Penilaian** : Penilaian Praktikum, Praktik / Unjuk Kerja	Continuing the Project from 12th meeting by presenting the report of the project. The 5th and 6th steps of project conducted in 12th meeting will be assessed and evaluated to measured the PJBL achievement. Lecturers facilitate student-centered learning, through pictures and guide active discussions to discover concepts related to the nature, synthesis mechanisms and the influence of the hormones gibberellin, ABA, and ethylene on growth and development. Facilitating students through practicum to discover the concept of the effect of the hormone auxin on leaf abscission. Lectures: 3x50 minutes Self Learning: 3x60 minutes Read and as a group and write the results of a review about the effect of the hormone auxin on leaf abrasion to be written in the practicum report section Practical course: 3x60 minutes Structural task: 3x60 minutes Make a practicum report 4 X 50	Continuing the Project from 12th meeting by presenting the report of the project. The 5th and 6th steps of project conducted in 12th meeting will be assessed and evaluated to measured the PJBL achievement. Lecturers facilitate student-centered learning, through pictures and guide active discussions to discover concepts related to the nature, synthesis mechanisms and the influence of the hormones gibberellin, ABA, and ethylene on growth and development. Facilitating students through practicum to discover the concept of the effect of the hormone auxin on leaf abscission. Lectures: 3x50 minutes Self Learning: 3x60 minutes Read and as a group and write the results of a review about the effect of the hormone auxin on leaf abrasion to be written in the practicum report section Practical course: 3x60 minutes Structural task: 3x60 minutes Make a practicum report	**Materi:** Plant hormones: a. The function of the hormones gibberellin, ABA, ethylene for plants b. Use of growing substances to regulate growth **Pustaka:** *Taiz, L. dan Zeiger, E. 2010. Plant Physiology. California: The Benjamin/Cummings Publishing Company, Inc.* **Materi:** Plant hormones: a. The function of the hormones gibberellin, ABA, ethylene for plants b. Use of growing substances to regulate growth **Pustaka:** *Mohr, H. dan Schopfer, P. 1995. Plant Physiology . Berlin: Springer*	6%
14	Describe the mechanisms of various plant responses (plant motion, photoperiod, vernalization and phytochromes) based on observations and experiments	1.a. Describes the concept of motion, photoperiodism, vernalization, phytochromes and biological work hours 2.b. Relate the concepts in part a to plant growth and development	**Kriteria:** 1.30% of Reports and practicum products are rated as TASKS 2. 20% Midterms 3.20% of Student activities and responses during learning activities, especially practicum, are assessed as participation 4.30% Final Exams 5.Essay questions and multiple choice are accessed jointly at the Midterms and Final Exams 6.Performance questions are integrated during learning **Bentuk Penilaian** : Penilaian Praktikum, Praktik / Unjuk Kerja	Lecturers facilitate students in groups and discuss, to find photoperiodic, vernalization and phytochromic concepts for Plants based on case study of plant growth and development in daily life. At the end of teaching learning process, the representative student present the solution base on case study formulated before. Lectures: 3x50 minutes Self Learning: 3x60 minutes Review the literature on photoperiodic, vernalization and phytochromic events that occur in resume form Structural task: 3x60 minutes Making material for presentations on plant motion and doing presentations on plant motion 4 X 50	Lecturers facilitate students in groups and discuss, to find photoperiodic, vernalization and phytochromic concepts for Plants based on case study of plant growth and development in daily life. At the end of teaching learning process, the representative student present the solution base on case study formulated before. Lectures: 3x50 minutes Self Learning: 3x60 minutes Review the literature on photoperiodic, vernalization and phytochromic events that occur in resume form Structural task: 3x60 minutes Making material for presentations on plant motion and doing presentations on plant motion	**Materi:** Plant response to stimuli: a. Movement of plants b. Photoperiod c. Vernalization d. Phytochrome **Pustaka:** *Taiz, L. dan Zeiger, E. 2010. Plant Physiology. California: The Benjamin/Cummings Publishing Company, Inc.* **Materi:** Plant response to stimuli: a. Movement of plants b. Photoperiod c. Vernalization d. Phytochrome **Pustaka:** *Sastamihardja, Darjat dan Arbayah. 1994. Fisiologi Tumbuhan . Bandung: ITB Press*	5%

15	Describe various plant responses (Dormancy) to environmental conditions	1.a. Comparing the effect of gibberellin and ABA on dormancy 2.b. Describe environmental factors that influence the breakdown of dormancy 3.c. Conduct experiments on seed dormancy 4.d. Summing up the concepts of dormancy and abscission based on the experimental results 5.e. Linking the concepts of dormancy and abscission with the response of plants to the environment 6.f. Create a report on the results of the experiment 7.g. Show an honest and independent attitude during the learning process based on the observation sheet	**Kriteria:** 1.30% of Reports and practicum products are rated as TASKS 2. 20% Midterms 3.20% of Student activities and responses during learning activities, especially practicum, are assessed as participation 4.30% Final Exams 5.Essay questions and multiple choice are accessed jointly at the Midterms and Final Exams 6.Performance questions are integrated during learning **Bentuk Penilaian** : Penilaian Hasil Project / Penilaian Produk	Lecturers facilitate student-centered learning, through pictures and guide active discussions to discover the concept of the role of the hormones gibberellin and ABA in seed dormancy Facilitating students through practicum to find the concept of the influence of environmental factors on breaking seed dormancy. Lectures: 3x50 minutes Self Learning: 3x60 minutes Read and in groups and write the results of a review about the influence of environmental factors on the breakdown of seed dormancy to be written in the literature review section of the practicum report Practical course: 3x60 minutes Structural task: 3x60 minutes Make a practicum report 4 X 50	Lecturers facilitate student-centered learning, through pictures and guide active discussions to discover the concept of the role of the hormones gibberellin and ABA in seed dormancy Facilitating students through practicum to find the concept of the influence of environmental factors on breaking seed dormancy. Lectures: 3x50 minutes Self Learning: 3x60 minutes Read and in groups and write the results of a review about the influence of environmental factors on the breakdown of seed dormancy to be written in the literature review section of the practicum report Practical course: 3x60 minutes Structural task: 3x60 minutes Make a practicum report	**Materi:** Plant response to stimuli: a. Dormancy b. Absence c. Senescence **Pustaka:** *Taiz, L. dan Zeiger, E. 2010. Plant Physiology. California: The Benjamin/Cummings Publishing Company, Inc.* **Materi:** Plant response to stimuli: a. Dormancy b. Absence c. Senescence **Pustaka:** *Salisbury, F.B. dan Ross, C.W. 1995. Plant Physiologi . NewYork: John Wiley & Sons*	5%
16	Final Test	1.Memahami konsep fotosintesis, respirasi dan metabolisme nitrogen (N) 2.Mengkaitkan konsep respirasi dan fotosintesis dengan asimilasi nitrat 3.Menjelaskan pembentukan lemak dan degradasi lemak 4.Mengkomunikasikan hasil percobaan perkecambahan biji dan faktor Zat Pengatur Tumbuh yang mempengaruhi proses perkecambahan biji 5.Mengkaitkan konsep dormansi dengan respon tumbuhan terhadap lingkungan 6.Mampu mengkaitkan hasil percobaan dengan fungsi hormon di dalam sel tumbuhan 7.Menjelaskan tentang konsep gerak, fotoperiodisme, vernalisasi, fitokrom dan jam kerja biologi 8.Mengkaitkan konsep diatas dengan pertumbuhan dan perkembangan tumbuhan	**Kriteria:** UAS 30% **Bentuk Penilaian** : Tes	-	-	**Materi:** Fotosintesis, respirasi, metabolisme Nitrogen, Metabolisme Lemak **Pustaka:** *Yuliani.2017. Metabolisme Tumbuhan . Surabaya: Unesa Press.* **Materi:** Perkecambahan, Pertumbuhan dan Perkembangan, Hormon tanaman, konsep gerak, fotoperiodisme, vernalisasi, fitokrom dan jam kerja biologi **Pustaka:** *Taiz, L. dan Zeiger, E. 2010. Plant Physiology. California: The Benjamin/Cummings Publishing Company, Inc.*	15%

Rekap Persentase Evaluasi : Project Based Learning

No	Evaluasi	Persentase
1.	Aktifitas Partisipasif	36.34%
2.	Penilaian Hasil Project / Penilaian Produk	5%
3.	Penilaian Praktikum	13.84%
4.	Praktik / Unjuk Kerja	19.84%
5.	Tes	25%
		100%

Catatan

1. **Capaian Pembelajaran Lulusan Prodi (CPL - Prodi)** adalah kemampuan yang dimiliki oleh setiap lulusan prodi yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.
2. **CPL yang dibebankan pada mata kuliah** adalah beberapa capaian pembelajaran lulusan program studi (CPL-Prodi) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, ketrampulan umum, ketrampilan khusus dan pengetahuan.

3. **CP Mata kuliah (CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.
4. **Sub-CPMK Mata kuliah (Sub-CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.
5. **Indikator penilaian** kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.
6. **Kreteria Penilaian** adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kreteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kreteria dapat berupa kuantitatif ataupun kualitatif.
7. **Bentuk penilaian:** tes dan non-tes.
8. **Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.
9. **Metode Pembelajaran:** Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning, dan metode lainnya yg setara.
10. **Materi Pembelajaran** adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.
11. **Bobot penilaian** adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.
12. TM=Tatap Muka, PT=Penugasan terstruktur, BM=Belajar mandiri.

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