



Universitas Negeri Surabaya
Faculty of Mathematics and Natural Sciences
Bachelor of Science Education Study Program

Document Code

SEMESTER LEARNING PLAN

Courses	CODE	Course Family	Credit Weight	SEMESTER	Compilation Date
Plant Anatomy and Physiology	8420103162		T=2 P=1 ECTS=4.77	0	July 19, 2024
AUTHORIZATION	SP Developer		Course Cluster Coordinator	Study Program Coordinator	
	Prof. Dr. Erman, M.Pd.	

Learning model	Project Based Learning
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Program Learning Outcomes (PLO)	PLO study program that is charged to the course																																																																																																																				
	PLO-11	Design and conduct research about learning of integrated science, and acquire, analyze, and interpret the research data																																																																																																																			
	PLO-13	Demonstrate knowledge of integrated science (physics, chemistry, and biology)																																																																																																																			
	Program Objectives (PO)																																																																																																																				
	PO - 1	Explaining phenomena and processes in plant anatomy and physiology using biology and chemistry concepts.																																																																																																																			
	PO - 2	Apply principles/laws/theories to various phenomena in plant anatomy and physiology.																																																																																																																			
	PO - 3	Apply substantive concepts (principles/laws/theories) in the field of plant anatomy and physiology in analyzing relevant cases.																																																																																																																			
	PO - 4	Design and conduct research about plant anatomy and physiology.																																																																																																																			
	PLO-PO Matrix																																																																																																																				
		<table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">P.O</th> <th style="width: 15%;">PLO-11</th> <th style="width: 15%;">PLO-13</th> </tr> </thead> <tbody> <tr><td>PO-1</td><td></td><td></td></tr> <tr><td>PO-2</td><td></td><td></td></tr> <tr><td>PO-3</td><td></td><td></td></tr> <tr><td>PO-4</td><td></td><td></td></tr> </tbody> </table>		P.O	PLO-11	PLO-13	PO-1			PO-2			PO-3			PO-4																																																																																																					
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PO Matrix at the end of each learning stage (Sub-PO)																																																																																																																					
	<table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <thead> <tr> <th rowspan="2" style="width: 10%;">P.O</th> <th colspan="16">Week</th> </tr> <tr> <th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>13</th><th>14</th><th>15</th><th>16</th> </tr> </thead> <tbody> <tr><td>PO-1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>PO-2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>PO-3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>PO-4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table>																P.O	Week																1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PO-1																	PO-2																	PO-3																	PO-4																
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Short Course Description	Study of the structure, function and development of higher plant organs in terms of their morphological and anatomical characteristics. The study includes the structure and function in and development of plant cells, comparison with animal cells, the development of meristems to mature tissue, various tissues (structure, function and development), structure, function and development of organs in vascular plants including the structure of stem development, roots , leaves, fruit and seeds as well as anomalies that occur in each organ.
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References	Main :	
		<ol style="list-style-type: none"> 1. Beck, Charles B. 2010. An Introduction to Plant Structure and Development: Plant Anatomy for the Twenty-First Century. 2 Edition Book. New York: Cambridge University Press. 2. Adam, Jennifer W. Mac, 2008. Structure and Function of Plants. New Delhi: Willey Blackwell. 3. Taiz, L. and Zeiger E. 2010. Plant Physiology. Fifth Edition. Sinauer Associates. California: Sunderland. 4. Tjitrosoepomo, Gembong. 2013. Morfologi Tumbuhan. Yogyakarta: Gadjah Mada University Press.
	Supporters:	

Supporting lecturer		Dr. Rinie Pratiwi Puspitawati, M.Si. Dr. Dyah Astriani, S.Pd., M.Pd. Enny Susiyawati, S.Si., M.Sc., M.Pd., Ph.D. Dhita Ayu Permata Sari, S.Pd., M.Pd. Aris Rudi Purnomo, S.Si., M.Pd., M.Sc. Wahyu Budi Sabtiawan, S.Si., M.Pd.,M.Sc.					
Week-	Final abilities of each learning stage (Sub-PO)	Evaluation		Help Learning, Learning methods, Student Assignments, [Estimated time]		Learning materials [References]	Assessment Weight (%)
		Indicator	Criteria & Form	Offline (offline)	Online (online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Explain the basic concepts of root anatomy and physiology.	1. Identifying anatomical structure of a root. 2. Explaining the function of a root. 3. Describing biological processes in a root.	Criteria: Quantitative (Scoring Guide) Form of Assessment : Participatory Activities, Tests	Presentation, discussion, and observation 2 X 50 3 X 60	Flipped Learning using Virtual Learning Unesa, Vinesa or Google Classroom 3 x 60	Material: Root Anatomy Bibliography: <i>Beck, Charles B. 2010. An Introduction to Plant Structure and Development: Plant Anatomy for the Twenty-First Century. 2 Edition Book. New York: Cambridge University Press.</i> Material: Root Anatomy Bibliography: <i>Adam, Jennifer W. Mac, 2008. Structure and Function of Plants. New Delhi: Willey Blackwell.</i> Material: Physiology of Root References: <i>Taiz, L. and Zeiger E. 2010. Plant Physiology. Fifth Edition. Sinauer Associates. California: Sunderland.</i> Material: Root Morphology Library: <i>Tjitrosoepomo, Gembong. 2013. Plant Morphology. Yogyakarta: Gadjah Mada University Press.</i>	5%

2	Explaining basic concepts about anatomy and physiology of stem.	<ol style="list-style-type: none"> 1. Identifying anatomical structure of a stem. 2. Explaining the function of a stem. 3. Describing biological processes in a stem. 	<p>Criteria: Quantitative (Scoring Guide)</p> <p>Form of Assessment : Participatory Activities, Tests</p>	Presentation, discussion, and observation 2 X 50 3 X 60	Flipped Learning using Virtual Learning Unesa, Vinesa or Google Classroom 3 x 60	<p>Material: Stem Anatomy Bibliography: <i>Beck, Charles B. 2010. An Introduction to Plant Structure and Development: Plant Anatomy for the Twenty-First Century. 2 Edition Book. New York: Cambridge University Press.</i></p> <hr/> <p>Material: Stem Anatomy References: <i>Adam, Jennifer W. Mac, 2008. Structure and Function of Plants. New Delhi: Willey Blackwell.</i></p> <hr/> <p>Material: Stem Physiology References: <i>Taiz, L. and Zeiger E. 2010. Plant Physiology. Fifth Edition. Sinauer Associates. California: Sunderland.</i></p> <hr/> <p>Material: Stem Morphology Library: <i>Tjitrosoepomo, Gembong. 2013. Plant Morphology. Yogyakarta: Gadjah Mada University Press.</i></p>	5%
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3	Explaining basic concepts about anatomy and physiology of leaves.	<ol style="list-style-type: none"> 1. Identifying anatomical structure of a leaf. 2. Explaining the function of a leaf. 3. Describing biological processes in a leaf. 	<p>Criteria: Quantitative (Scoring Guide)</p> <p>Form of Assessment : Participatory Activities, Tests</p>	Presentation, discussion, and observation 2 X 50 3 X 60	Flipped Learning using Virtual Learning Unesa, Vinesa or Google Classroom 3 x 60	<p>Material: Leaf Anatomy Bibliography: <i>Beck, Charles B. 2010. An Introduction to Plant Structure and Development: Plant Anatomy for the Twenty-First Century. 2 Edition Book. New York: Cambridge University Press.</i></p> <hr/> <p>Material: Leaf Anatomy Bibliography: <i>Adam, Jennifer W. Mac, 2008. Structure and Function of Plants. New Delhi: Willey Blackwell.</i></p> <hr/> <p>Material: Leaf Physiology References: <i>Taiz, L. and Zeiger E. 2010. Plant Physiology. Fifth Edition. Sinauer Associates. California: Sunderland.</i></p> <hr/> <p>Material: Leaf Morphology Library: <i>Tjitrosoepomo, Gembong. 2013. Plant Morphology. Yogyakarta: Gadjah Mada University Press.</i></p>	5%
4	Describing phenomena of water transportation in plants.	<ol style="list-style-type: none"> 1. Explaining the phenomena of diffusion and osmosis in plants. 2. Describing the process of plant water transportation. 3. Explaining the process of plant translocation. 	<p>Criteria: Quantitative (Scoring Guide)</p> <p>Forms of Assessment : Participatory Activities, Practical Assessment, Tests</p>	Presentation, discussion, and observation 2 X 50 3 X 60	Flipped Learning using Virtual Learning Unesa, Vinesa or Google Classroom 3 x 60	<p>Material: Diffusion and osmosis in plants, Plant water transportation, Plant translocation. References: <i>Adam, Jennifer W. Mac, 2008. Structure and Function of Plants. New Delhi: Willey Blackwell.</i></p> <hr/> <p>Material: Diffusion and osmosis in plants, Plant water transportation, Plant translocation. References: <i>Taiz, L. and Zeiger E. 2010. Plant Physiology. Fifth Edition. Sinauer Associates. California: Sunderland.</i></p>	10%

5	Explaining photosynthesis processes using biology and chemistry concepts.	<ol style="list-style-type: none"> 1.Explaining the processes of photosynthesis. 2.Describing chemical reactions during the process of photosynthesis. 3.Explain the transition from root to stem anatomical structures 	<p>Criteria: Quantitative (Scoring Guide)</p> <p>Forms of Assessment : Participatory Activities, Practical Assessment, Tests</p>	Presentation, discussion, and observation 2 X 50 3 X 60	Flipped Learning using Virtual Learning Unesa, Vinesa or Google Classroom 3 x 60	<p>Material: Photosynthesis and Chemical reactions in photosynthesis.</p> <p>References: <i>Adam, Jennifer W. Mac, 2008. Structure and Function of Plants. New Delhi: Willey Blackwell.</i></p> <hr/> <p>Material: Photosynthesis and Chemical reactions in photosynthesis.</p> <p>References: <i>Taiz, L. and Zeiger E. 2010. Plant Physiology. Fifth Edition. Sinauer Associates. California: Sunderland.</i></p>	10%
6	Interpreting diagrams of respiration processes in plants.	<ol style="list-style-type: none"> 1.Describing the stages of plant respiration. 2.Explaining a diagram of the process of plant respiration. 3.Describing chemical reactions during the process of plant respiration. 	<p>Criteria: Quantitative (Scoring Guide)</p> <p>Form of Assessment : Participatory Activities</p>	Presentation, discussion, and observation 2 X 50	Flipped Learning using Virtual Learning Unesa, Vinesa or Google Classroom 3 x 60	<p>Material: Plant respiration and Chemical reactions in plant respiration.</p> <p>References: <i>Adam, Jennifer W. Mac, 2008. Structure and Function of Plants. New Delhi: Willey Blackwell.</i></p> <hr/> <p>Material: Plant respiration and Chemical reactions in plant respiration.</p> <p>References: <i>Taiz, L. and Zeiger E. 2010. Plant Physiology. Fifth Edition. Sinauer Associates. California: Sunderland.</i></p>	5%
7	Explaining phenomena in plants in relation to plant hormones.	<ol style="list-style-type: none"> 1.Describing the phenomenon of tip bending to the light. 2.Explaining chemical reaction in relation to auxin. 	<p>Criteria: Quantitative (Scoring Guide)</p> <p>Forms of Assessment : Participatory Activities, Practical Assessment, Tests</p>	Presentation, discussion, and observation. 2 X 50 3 X 60	Flipped Learning using Virtual Learning Unesa, Vinesa or Google Classroom 3 X 60	<p>Material: Plant hormones</p> <p>Reference: <i>Adam, Jennifer W. Mac, 2008. Structure and Function of Plants. New Delhi: Willey Blackwell.</i></p> <hr/> <p>Material: Plant hormones</p> <p>References: <i>Taiz, L. and Zeiger E. 2010. Plant Physiology. Fifth Edition. Sinauer Associates. California: Sunderland.</i></p>	10%

8	-	<ol style="list-style-type: none"> 1.Explaining basic concepts about anatomy and physiology of roots. 2.Explaining basic concepts about anatomy and physiology of stem. 3.Explaining basic concepts about anatomy and physiology of leaves. 4.Describing phenomena of water transportation in plants. 5.Explaining photosynthesis processes using biology and chemistry concepts. 6.Interpreting diagrams of respiration processes in plants. 7.Explaining phenomena in plants in relation to plant hormones. 	<p>Criteria: Quantitative (Scoring Guide)</p> <p>Form of Assessment : Test</p>	<p>Test (Midterm Test) 2 X 50</p>		<p>Material: Plant Anatomy Bibliography: <i>Beck, Charles B. 2010. An Introduction to Plant Structure and Development: Plant Anatomy for the Twenty-First Century. 2 Edition Book. New York: Cambridge University Press.</i></p> <hr/> <p>Material: Plant Anatomy and Function References: <i>Adam, Jennifer W. Mac, 2008. Structure and Function of Plants. New Delhi: Willey Blackwell.</i></p> <hr/> <p>Material: Plant Physiology References: <i>Taiz, L. and Zeiger E. 2010. Plant Physiology. Fifth Edition. Sinauer Associates. California: Sunderland.</i></p> <hr/> <p>Material: Plant Morphology Library: <i>Tjitrosoepomo, Gembong. 2013. Plant Morphology. Yogyakarta: Gadjah Mada University Press.</i></p>	0%
9	Designing a research about leaf anatomy and physiology.	Providing a research design about leaf anatomy and physiology.	<p>Criteria: Qualitative (Rubric)</p> <p>Form of Assessment : Participatory Activities</p>	<p>Discussion 2 X 50</p>	<p>Flipped Learning using Virtual Learning Unesa, Vinesa or Google Classroom</p>	<p>Material: Effect of temperature on leaf anatomy and physiology References: <i>Djanaguiraman, M., Prasad, PV, Boyle, D., & Schapaugh, W. (2011). High-temperature stress and soybean leaves: leaf anatomy and photosynthesis. Crop Science, 51(5), 2125-2131</i></p> <hr/> <p>Material: Effects of pollution on leaf structure Reference: <i>Gostin, IN (2009). Air pollution effects on the leaf structure of some Fabaceae species. Notulae Botanicae Horti Agrobotanici Cluj-Napoca, 37(2), 57-63.</i></p>	10%

10	Conducting a research about leaf anatomy and physiology.	Conducting a research about leaf anatomy and physiology.	Criteria: Qualitative (Rubric) Form of Assessment : Participatory Activities, Practice/Performance	Research and discussion 2 X 50 3 X 60		Material: Effect of temperature on leaf anatomy and physiology References: <i>Djanaguiraman, M., Prasad, PV, Boyle, D., & Schapaugh, W. (2011). High-temperature stress and soybean leaves: leaf anatomy and photosynthesis. Crop Science, 51(5), 2125-2131</i> <hr/> Material: Effects of pollution on leaf structure Reference: <i>Gostin, IN (2009). Air pollution effects on the leaf structure of some Fabaceae species. Notulae Botanicae Horti Agrobotanici Cluj-Napoca, 37(2), 57-63.</i>	5%
11	-	Conducting a research about leaf anatomy and physiology.	Criteria: Qualitative (Rubric) Form of Assessment : Participatory Activities, Practice/Performance	Research and discussion 2 X 50 3 X 60		Material: Effect of temperature on leaf anatomy and physiology References: <i>Djanaguiraman, M., Prasad, PV, Boyle, D., & Schapaugh, W. (2011). High-temperature stress and soybean leaves: leaf anatomy and photosynthesis. Crop Science, 51(5), 2125-2131</i> <hr/> Material: Effects of pollution on leaf structure Reference: <i>Gostin, IN (2009). Air pollution effects on the leaf structure of some Fabaceae species. Notulae Botanicae Horti Agrobotanici Cluj-Napoca, 37(2), 57-63.</i>	5%

12	Creating a research article about leaf anatomy and physiology.	Providing a research article about leaf anatomy and physiology.	<p>Criteria: Qualitative (Rubric)</p> <p>Form of Assessment : Participatory Activities, Project Results Assessment / Product Assessment</p>	Research and discussion 3 X 50	Online Learning using Virtual Learning Unesa, Vinesa or Google Classroom 3 X 60	<p>Material: Effect of temperature on leaf anatomy and physiology</p> <p>References: <i>Djanaguiraman, M., Prasad, PV, Boyle, D., & Schapaugh, W. (2011). High-temperature stress and soybean leaves: leaf anatomy and photosynthesis. Crop Science, 51(5), 2125-2131</i></p> <hr/> <p>Material: Effects of pollution on leaf structure</p> <p>Reference: <i>Gostin, IN (2009). Air pollution effects on the leaf structure of some Fabaceae species. Notulae Botanicae Horti Agrobotanici Cluj-Napoca, 37(2), 57-63.</i></p>	10%
13	-	Providing a research article about leaf anatomy and physiology.	<p>Criteria: Qualitative (Rubric)</p> <p>Form of Assessment : Participatory Activities, Project Results Assessment / Product Assessment</p>	Research and discussion 3 X 50	Online Learning using Virtual Learning Unesa, Vinesa or Google Classroom 3 X 60	<p>Material: Effect of temperature on leaf anatomy and physiology</p> <p>References: <i>Djanaguiraman, M., Prasad, PV, Boyle, D., & Schapaugh, W. (2011). High-temperature stress and soybean leaves: leaf anatomy and photosynthesis. Crop Science, 51(5), 2125-2131</i></p> <hr/> <p>Material: Effects of pollution on leaf structure</p> <p>Reference: <i>Gostin, IN (2009). Air pollution effects on the leaf structure of some Fabaceae species. Notulae Botanicae Horti Agrobotanici Cluj-Napoca, 37(2), 57-63.</i></p>	5%

14	Communicating research findings about leaf anatomy and physiology orally.	Communicating research findings about leaf anatomy and physiology orally.	Criteria: Qualitative (Rubric) Forms of Assessment : Participatory Activities, Project Results Assessment / Product Assessment, Practices / Performance	Discussion 3 X 50	Online Learning using Virtual Learning Unesa, Vinesa or Google Classroom 3 X 60	Material: Effect of temperature on leaf anatomy and physiology References: <i>Djanaguiraman, M., Prasad, PV, Boyle, D., & Schapaugh, W. (2011). High-temperature stress and soybean leaves: leaf anatomy and photosynthesis. Crop Science, 51(5), 2125-2131</i> <hr/> Material: Effects of pollution on leaf structure Reference: <i>Gostin, IN (2009). Air pollution effects on the leaf structure of some Fabaceae species. Notulae Botanicae Horti Agrobotanici Cluj-Napoca, 37(2), 57-63.</i>	10%
15	-	Communicating research findings about leaf anatomy and physiology orally.	Criteria: Qualitative (Rubric) Form of Assessment : Participatory Activities, Practice/Performance	Discussion 3 X 50	Online Learning using Virtual Learning Unesa, Vinesa or Google Classroom 3 X 60	Material: Effect of temperature on leaf anatomy and physiology References: <i>Djanaguiraman, M., Prasad, PV, Boyle, D., & Schapaugh, W. (2011). High-temperature stress and soybean leaves: leaf anatomy and photosynthesis. Crop Science, 51(5), 2125-2131</i> <hr/> Material: Effects of pollution on leaf structure Reference: <i>Gostin, IN (2009). Air pollution effects on the leaf structure of some Fabaceae species. Notulae Botanicae Horti Agrobotanici Cluj-Napoca, 37(2), 57-63.</i>	5%

16	-	<ol style="list-style-type: none"> 1.Designing a research about leaf anatomy and physiology. 2.Conducting a research about leaf anatomy and physiology. 3.Creating a research article about leaf anatomy and physiology. 4. Communicating research findings about leaf anatomy and physiology orally. 	Criteria: Qualitative (Rubric) Forms of Assessment : Participatory Activities, Project Results Assessment / Product Assessment, Practices / Performance	Final Test 3 X 50		Material: Effect of temperature on leaf anatomy and physiology References: <i>Djanaguiraman, M., Prasad, PV, Boyle, D., & Schapaugh, W. (2011). High-temperature stress and soybean leaves: leaf anatomy and photosynthesis. Crop Science, 51(5), 2125-2131</i> <hr/> Material: Effects of pollution on leaf structure Reference: <i>Gostin, IN (2009). Air pollution effects on the leaf structure of some Fabaceae species. Notulae Botanicae Horti Agrobotanici Cluj-Napoca, 37(2), 57-63.</i>	0%
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Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Participatory Activities	50.82%
2.	Project Results Assessment / Product Assessment	10.83%
3.	Practical Assessment	9.99%
4.	Practice / Performance	10.83%
5.	Test	17.49%
		99.96%

Notes

1. **Learning Outcomes of Study Program Graduates (PLO - Study Program)** are the abilities possessed by each Study Program graduate which are the internalization of attitudes, mastery of knowledge and skills according to the level of their study program obtained through the learning process.
2. **The PLO imposed on courses** are several learning outcomes of study program graduates (CPL-Study Program) which are used for the formation/development of a course consisting of aspects of attitude, general skills, special skills and knowledge.
3. **Program Objectives (PO)** are abilities that are specifically described from the PLO assigned to a course, and are specific to the study material or learning materials for that course.
4. **Subject Sub-PO (Sub-PO)** is a capability that is specifically described from the PO that can be measured or observed and is the final ability that is planned at each learning stage, and is specific to the learning material of the course.
5. **Indicators for assessing** ability in the process and student learning outcomes are specific and measurable statements that identify the ability or performance of student learning outcomes accompanied by evidence.
6. **Assessment Criteria** are benchmarks used as a measure or measure of learning achievement in assessments based on predetermined indicators. Assessment criteria are guidelines for assessors so that assessments are consistent and unbiased. Criteria can be quantitative or qualitative.
7. **Forms of assessment:** test and non-test.
8. **Forms of learning:** Lecture, Response, Tutorial, Seminar or equivalent, Practicum, Studio Practice, Workshop Practice, Field Practice, Research, Community Service and/or other equivalent forms of learning.
9. **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.
10. **Learning materials** are details or descriptions of study materials which can be presented in the form of several main points and sub-topics.
11. **The assessment weight** is the percentage of assessment of each sub-PO achievement whose size is proportional to the level of difficulty of achieving that sub-PO, and the total is 100%.
12. TM=Face to face, PT=Structured assignments, BM=Independent study.