

**Table 1. Required courses in the BIOLOGY track.**

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6
Course	explain basic concepts, methods & theories of the natural sciences	Describe and explain biologic concepts; describe and apply scientific methods in biology	independently undertake laboratory investigations; explain & follow safety protocols for teaching laboratories	demonstrate observational and experimental skills	apply scientific concepts, methods, and theories to problems of societal relevance	communicate scientific knowledge, orally and in writing, to a variety of audiences.
<b>Required all tracks</b>						
BIOL 171-172	I	I	I		I	
CHEM 161-162	I		I		I	
PHYS 170-272 or PHYS 151-152	I		I		I	
GEOL 111-112	I		I		I	
BIOL 171L-272L, CHEM 161L-162L, PHYS labs, GEOL 111L-112L	I		I, D, M	I, D, M		I, D
MATH 121 or BIOL 280	I					
MATH 125 or MATH 241	I					
NSCI 476		M			M	M
<b>Required in biology track</b>						
BIOL 125 or 270		I				
BIOL 275-275L		D	D		D	
BIOL 281		D				
BIOL 357		D				
UD BIOL elective		D,M				
UD BIOL elective		D,M				

**Table 2. Required courses in the CHEMISTRY track.**

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 5
Course	explain basic concepts, methods & theories of the natural sciences	Describe and explain chemical concepts; describe and apply scientific methods in chemistry	independently undertake laboratory investigations; explain & follow safety protocols for teaching laboratories	demonstrate observational and experimental skills	apply scientific concepts, methods, and theories to problems of societal relevance	communicate scientific knowledge, orally and in writing, to a variety of audiences.
<b>Required all tracks</b>						
BIOL 171-172	I	I			I	
CHEM 161-162	I	I	I		I	
PHYS 170-272 or PHYS 151-152	I	I			I	
GEOL 111-112	I	I			I	
BIOL 171L-272L, CHEM 161L-162L, PHYS labs, GEOL 111L-112L	I	I	I, D, M	I, D, M		I, D
MATH 121 or BIOL 280	I	I				
MATH 125 or MATH 241	I	I				
NSCI 476			M		M	M
<b>Required in chemistry track</b>						
CHEM 141		I			I	
CHEM 360		D			D	
CHEM 320		D				
CHEM 274-274L		D	D	D		
BIOL 125 or CHEM 241		I				
AQUA 425 or ENSC 301 or CHEM 431-431L		D,M	M (CHEM 431L)	M (CHEM 431L)	D (ENSC 301) M (AQUA 425)	

**Table 3. Required courses in the EARTH SCIENCE track.**

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6
Course	explain basic concepts, methods & theories of the natural sciences	Describe and explain earth science concepts; describe and apply scientific methods in earth science	independently undertake laboratory investigations; explain & follow safety protocols for teaching laboratories	demonstrate observational and experimental skills	apply scientific concepts, methods, and theories to problems of societal relevance	communicate scientific knowledge, orally and in writing, to a variety of audiences.
<b>Required all tracks</b>						
BIOL 171-172	I		I		I	
CHEM 161-162	I		I		I	
PHYS 170-272 or PHYS 151-152	I		I		I	
GEOL 111-112	I	I	I		I	
BIOL 171L-272L, CHEM 161L-162L, PHYS labs, GEOL 111L-112L	I		I, D, M	I, D, M		I, D
MATH 121 or BIOL 280	I					
MATH 125 or MATH 241	I					
NSCI 476		M			M	M
<b>Required in earth science track</b>						
ASTR 180-181		I				
ASTR 110L				I, D		
GEOG 300		D			D	
GEOL 205		I				
GEOL 300		D			D	D
MARE 201-201L		I	I, D	I, D		
UD elective		D				

**Table 4. Required courses in the PHYSICS track.**

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6
Course	explain basic concepts, methods & theories of the natural sciences	Describe and explain physics concepts; describe and apply scientific methods in physics	independently undertake laboratory investigations; explain & follow safety protocols for teaching laboratories	demonstrate observational and experimental skills	apply scientific concepts, methods, and theories to problems of societal relevance	communicate scientific knowledge, orally and in writing, to a variety of audiences.
<b>Required all tracks</b>						
BIOL 171-172	I		I		I	
CHEM 161-162	I		I		I	
PHYS 170-272 or PHYS 151-152	I	I	I		I	
GEOL 111-112	I		I		I	
BIOL 171L-272L, CHEM 161L-162L, PHYS labs, GEOL 111L-112L	I		I, D, M	I, D, M		I, D
MATH 121 or BIOL 280	I					
MATH 125 or MATH 241	I					
NSCI 476		M			M	M
<b>Required in physics track</b>						
MATH 242	I					
MATH 243	I					
MATH 300	D					
PHYS 274		D				
PHYS 371		D				
PHYS 211 or PHYS 230		D	D	D		
UD elective		D, M				

**Table 5. Elective courses in the allied sciences (PLO 1, 2b, 3, 4, 5).**  
 Students select three courses (two in the physics track).

Course	PLO 3: laboratory investigations	PLO 4: observa- tional & experi- mental skills	PLO 5: societal relevance	PLO 6: Communicate knowledge	
AG 304			D	A few courses will address communication with a broad audience.	
AG 375			D		
ANTH 481		D			
ANTH 484		D			
AQUA 425			M		
BIOL 357					
BIOL 371					
BIOL 381			D		
BIOL 443					
BIOL 445					
BIOL 455					
BIOL 457					
BIOL 460					
BIOL 467					
BIOL 477					
CHEM 274-2	M	M			
CHEM 360			D		
CHEM 431-4	M	M			
CHEM 487			M		
ENSC 301			D		
ENTO 304					
GEOG 300			D		
GEOL 300			D		
GEOL 342					
GEOL 431					
GEOL 432					
GEOL 445					
GEOL 450					
GEOL 460			M		
GEOL 472					
PHYS 330					
PHYS 331					
PHYS 341					
PHYS 360					
PPTH 404			M		
SOIL 304			D		
ED 310			D		D
ED 350			D		D
PHIL 329			D		D
PHIL 412			M		D
PHIL 416			M		D

**Table 6. Elective courses in the allied sciences (PLO 2)**

Students select three courses (two in the physics track).

Course	Biology track	Chemistry track	Earth Science Track	Physics track
	Describe, explain, and apply biology concepts & methods	Describe, explain, and apply chemistry concepts & methods	Describe, explain, and apply earth science concepts & methods	Describe, explain, and apply physics concepts & methods
AG 304	D			
AG 375	D			
ANTH 481			D	
ANTH 484			D	
AQUA 425		M		
BIOL 357	D			
BIOL 371	D			
BIOL 381	D			
BIOL 443	M			
BIOL 445	M			
BIOL 455	M			
BIOL 457	M			
BIOL 460	M			
BIOL 467	M			
BIOL 477	M			
GEO 432			M	
CHEM 274-274L		D	D	M
CHEM 360		D	D	
CHEM 431-431L		M	M	
CHEM 487		M		
ENSC 301			D	D
ENTO 304	D			
GEOG 300			D	D
GEO 300			D	
GEO 342			D	
GEO 431			M	
GEO 445			M	
GEO 450			M	
GEO 460			M	
GEO 472			M	
PHYS 330				D
PHYS 331				D
PHYS 341				D
PHYS 360				D
PPTH 404	M			
SOIL 304			D	
ED 310				
ED 350				
PHIL 329				
PHIL 412				
PHIL 416				

SCALE	Program Learning Outcome 1: <b>Student can describe and explain<sup>1</sup> basic concepts, methods, and theories of the natural sciences</b>
4—Exceptional	Same as “competent” except that student can define and explain <i>most</i> of the scientific terms and concepts in introductory textbooks. Explanations are always clear.
3—Competent	Can accurately define and explain many of the scientific terms and concepts found in introductory textbooks. Appropriate use of scientific terminology in written and oral communication. Most of the time can clearly explain the meaning of scientific terminology in plain English. Distinguishes between valid observations, hypotheses, theories, and laws, hypothesis testing, and hypothesis generation. Describes important theories and the evidence for them and explains how these theories were developed.
2—Emerging	Can accurately define and explain some of the scientific terms and concepts found in introductory textbooks. Distinguishes between hypotheses and theories. Describes important theories and can cite some of the evidence for them.
1--Beginning	Attempts to define and explain scientific terms and concepts found in introductory textbooks ae met with < 50% success rate. Explanations lack detail and clarity.

SCALE	Program Learning Outcome 2: <b>Student can describe and explain scientific concepts in one of the following fields: biology, chemistry, physics, or earth science; Student can describe and apply scientific methods in one of the following fields: biology, chemistry, physics, or earth science.<sup>2</sup></b>
4—Exceptional	Written observations and sketches are accurate, insightful, very detailed, and very comprehensive. Observations are kept separate from interpretations. Sketches are accurate, detailed, neat, and informative.
3—Competent	Written observations and sketches are accurate, relevant, detailed, and comprehensive. Observations are kept separate from interpretations. Sketches are accurate, detailed, and informative.
2—Emerging	Written observations lack detail and there are many relevant facts that student does not mention. Sketches fail to illustrate all the main features of a landscape, sample, or process. Student attempts to distinguish between facts and Interpretations, but is not always successful.
1--Beginning	Written observations lack detail and there are many relevant facts that student does not mention. Sketches fail to illustrate the main features of a landscape, sample, or process. Interpretations are confused with facts.

<sup>1</sup> The original wording is “articulate”, however, “describe and explain” is a more assessable objective.

<sup>2</sup> The original wording is “Articulate a detailed understanding of scientific concepts and methods in either biology, chemistry, physics, or earth/space science.” This has been rephrased to be more assessable and occupy a higher position on Bloom’s taxonomy.

<p>SCALE</p>	<p>Program Learning Outcome 3:  <b>Students can successfully undertake laboratory investigations<sup>3</sup>; students can explain &amp; follow safety protocols for teaching laboratories</b></p>
<p>4—Exceptional</p>	<p>In addition to criteria listed under “competent”, students can use their own knowledge to write safety guidelines for laboratories and field trips. Student knows which regulatory agency promulgates rules and guidance for laboratory safety. Student can write clear and complete instructions for a laboratory investigation that will be executed by others.</p>
<p>3—Competent</p>	<p>Students who meet expectations for laboratory safety will ...</p> <ul style="list-style-type: none"> <li>• consistently follow safety rules for laboratories and field trips.</li> <li>• explain the rationale behind each safety rule and the potential consequences of safety breaches.</li> <li>• watch others to identify and correct breaches of safety rules.</li> </ul> <p>Students who are competent at laboratory investigations can ...</p> <ul style="list-style-type: none"> <li>• independently execute an experiment from instructions.</li> <li>• identify appropriate methods of measuring mass and volume, and competently execute measurements.</li> <li>• identify appropriate methods of handling solid and liquid materials, and competently handle materials.</li> <li>• use compound and dissecting microscopes.</li> <li>• distinguish between accuracy and precision.</li> <li>• recognize and communicate measurement uncertainty.</li> <li>• report measurement units correctly and use significant figures correctly.</li> <li>• use simple classification schemes to identify common species, rock and mineral specimens, and well-preserved fossils.</li> <li>• read and interpret topographic and geologic maps.</li> </ul>
<p>2—Emerging</p>	<p>Students whose skills are emerging cannot explain the rationale behind safety rules and will sometimes ...</p> <ul style="list-style-type: none"> <li>• fail to follow safety rules.</li> <li>• need assistance in executing an experiment from instructions.</li> <li>• be inconsistent in executing measurements or making observations of biological or geological specimens.</li> <li>• write reports that are not clear on what the student did and what he or she found.</li> <li>• report units incorrectly or fail to use significant figures when needed.</li> <li>• make frequent errors when identifying geologic specimens or reading maps.</li> </ul>
<p>1--Beginning</p>	<p>Student does not consistently follow safety rules. Student needs considerable help in executing an experiment or makes errors that compromise the validity of results.</p>

<sup>3</sup> The original wording is “independently undertake laboratory investigations”, but “successfully undertake laboratory investigations” is a better objective.



SCALE	<p>Program Learning Outcome 4:</p> <p><b>Demonstrate observational and experimental skills.</b></p>
4—Exceptional	<p>In addition to accomplishments listed below under “competent”, students will independently design and execute an experiment that has the potential to produce new knowledge.</p>
3—Competent	<p>Competent students can ...</p> <ul style="list-style-type: none"> <li>• make observations that are unbiased, detailed, and informed.</li> <li>• distinguish between observations, interpretations, hypotheses, or suppositions.</li> <li>• accurately and clearly document observations, methods and results in a way that can be understood by others that were not there and had no prior knowledge of what the student did.</li> <li>• clearly explain the purpose and significance of an experiment.</li> <li>• carefully analyze experimental results to reach unbiased conclusions.</li> <li>• convert units to facilitate comparisons.</li> <li>• recognize and acknowledges problems that limit the validity of an experiment.</li> </ul>
2—Emerging	<p>Students whose skills are emerging may ...</p> <ul style="list-style-type: none"> <li>• confuse observations and interpretations.</li> <li>• make observations that are missing relevant details.</li> <li>• write reports that are not completely clear.</li> <li>• fail to analyze results carefully.</li> </ul>
1--Beginning	<ul style="list-style-type: none"> <li>• Student fakes data or allows others to copy their own data.</li> <li>• Observations made by student are cursory or inaccurate.</li> <li>• Reports are incomplete and unclear.</li> </ul>





continued from previous page

SCALE	Program Learning Outcome 6:
	<b>Students will communicate their knowledge, orally and in writing, to a variety of audiences.</b>
2—Emerging	<p>Writing partly addresses the needs of the audience and the purpose of the assignment, Addresses some--but not all--of the information that should be conveyed and contains irrelevant information. In places it is not clear what the writer or speaker is trying to say.</p> <p>Writing is not concise and could be improved by stronger organization. Prose contains grammatical errors and documents do not follow all the conventions for formatting, citation, and reference list.</p> <p>Speaker uses vocabulary or concepts that the audience is unfamiliar with. Background information is missing or the speaker devotes too much time to what the audience already knows. Poor organization makes it is difficult for the audience to follow the speaker’s ideas. Some of the slides are not legible and/or do not use illustrations effectively. There is no attempt to acknowledge sources. Amount of eye contact is inadequate, and time is too short or too long.</p>
1--Beginning	<p>There is no effort to identify the needs of the audience and the final product does not adhere to all the requirements of the assignment. Length is too short with skimpy content or too long due to rambling or unnecessary repetition. It is not always clear what the author or speaker is trying to say.</p> <p>Prose contains frequent grammatical errors and documents make no effort to follow conventions for formatting, citation, and reference list.</p> <p>For the oral presentation, many slides are not legible, and text has been used when illustrations would be more effective. The speaker does not look at the audience and reads from the slides or a prepared script.</p>