

Academic Assessment Report
BEST PRACTICES IN STUDENT LEARNING OUTCOMES
(B.S. DEGREE / CROP SCIENCE)
(MAY 2016)

Contact

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CSES Mission

The mission of the Department of Crop, Soil, and Environmental Sciences is to provide superior education programs at the undergraduate and graduate levels, conduct innovative research and extension programs in the crop, soil, and environmental sciences and provide superior service for citizens of Arkansas and the nation.

Program Goals

(Program goals are broad general statements of what the program intends to accomplish and describes what a student will be able to do after completing the program. The program goals are linked to the mission of the university and college.)

1. Graduates have the discipline-specific knowledge in crop sciences required to perform successfully in private, government, or academic entry-level positions.
2. Graduates are able to critically analyze, synthesize, and evaluate new information to make informed decisions.
3. Graduates have the ability to solve complex, multidisciplinary problems.
4. Graduates are able to prepare and synthesize information to effectively communicate, both orally and in writing.

Student Learning Outcomes

(Student Learning Outcomes are defined in terms of the knowledge, skills, and abilities that students will know and be able to do as a result of completing a program. These student learning outcomes are directly linked to the accomplishment of the program goals.)

1. Students will demonstrate the discipline specific knowledge required to function as crop science professionals.
2. Students will demonstrate the ability to critically evaluate situations or scenarios to arrive at well thought out and supported decisions and outcomes.
3. Students will demonstrate the ability to work through and solve complex, multidisciplinary problems.
4. Communication skills
 - a. Students will demonstrate the skills required to effectively communicate technical/scientific information in oral platforms.
 - b. Students will demonstrate the ability to integrate, organize, and effectively present written reports of technical/scientific information.

Assessment Measure for Outcome 1

- Achievement will be measured using **pre- and post-assessments**.
- This is a **direct** measure of student learning.
- Learning will be measured by generating an assessment of 25 test questions from the CPSC faculty to cover crop science/physiology, weed science/pest management, crop production, and soil fertility/plant nutrition. These areas represent essential concepts for discipline-specific knowledge of students completing a crop science degree.
- The initial assessment was generated by CPSC faculty during the spring 2016. The CPSC teaching faculty submitted questions to the CSES Assessment to cover essential concepts. The assessment was not piloted during the spring 2016 semester, and will begin in the fall 2016 semester. See below for courses during which the pre- and post-assessments will be administered.
Target populations are at least half of the (incoming) spring sophomore and half of the fall graduating CPSC class.
- Scores will be calculated for each assessment with the range, average, and median calculated for the pre and post-assessments to calculate the change in scores from pre- to post-assessment.

Acceptable and Ideal Targets (not required for indirect measures)

- The use of pre- and post-assessments are a new initiative for CSES; therefore, we are unsure of how “incoming” students in particular will perform on the pre-assessment.
- Acceptable: We are initially targeting a 50% increase in the mean and/or median test scores between the two populations (incoming and graduating students).
- Ideal: We are initially targeting an 80% increase in the mean and/or median test scores between the two populations (incoming and graduating students).

Key Personnel (who is responsible for the assessment of this measure).

- CSES 2103 Crop Science (SP), required course for all CPSC student, is the target course for the pre-assessment.
- CSES 4013 Advanced Crop Science (FA), required course for all CPSC students, is the target course for the post-assessment.

Summary of Findings

- The initial assessment tool was generated by CPSC faculty during the spring 2016. Data generation will begin during the fall 2016 semester.

Recommendations

- There are no recommendations at this time as there has not been any data collected.

Assessment Measure for Outcome 2

- Achievement will be measured using a critical thinking scenario (administered during class, potentially included on the post-assessment for learner outcome #1) and assessed using a **critical thinking rubric**.
- This is a **direct** measure of student learning.
- Assessment scenarios will be generated to cover application of critical thinking in crop science contexts.

Acceptable and Ideal Targets (not required for indirect measures)

- Acceptable: 50% of seniors assessed will score proficient or greater.
- Ideal: 90% of seniors assessed will score proficient or greater.

Key Personnel (who is responsible for the assessment of this measure)

- CSES 4013 Advanced Crop Science (FA), required course for all CPSC students, is the target course for the assessment.

Summary of Findings

- The target class to implement assessment of critical thinking is CSES 4013 Advanced Crop Science which is a fall course.

Recommendations

- Recommendations will be forthcoming with the generation of data in the upcoming academic year.

Assessment Measure for Outcome 3

- Achievement will be measured using a problem based scenario (administered during class, potentially included on the post-assessment for learner outcome #1) and scored using a **problem solving rubric**.
- This is a **direct** measure of student learning.
- Assessment scenarios will be generated to cover application of problem solving in crop science contexts.

Acceptable and Ideal Targets (not required for indirect measures)

- Acceptable: 50% of seniors assessed will score proficient or greater.
- Ideal: 90% of seniors assessed will score proficient or greater.

Key Personnel (who is responsible for the assessment of this measure)

- CSES 4013 Advanced Crop Science (FA), required course for all CPSC students, is the target course for the problem solving assessment.

Summary of Findings

- The target class to implement assessment of critical thinking is CSES 4013 Advanced Crop Science which is a fall course.

Recommendations

- Initial experience with the problem solving question in the ESWs program assessment has shown the importance of considering the rubric while generating the problem solving question for assessment, and not just utilizing the rubric during the assessment stage of program review.

Assessment Measure for Outcome 4a

- Achievement will be assessed using an **oral communication rubric** during oral presentations where the student has compiled and evaluated the scientific literature as part of a class project and/or completed an independent research project as part of a special problems, research project or internship class.
- This is a **direct** measure of student learning.

Acceptable and Ideal Targets (not required for indirect measures).

- Acceptable: 70% of seniors assessed will score proficient or greater.
- Ideal: 90% of seniors assessed will score proficient or greater.

Key Personnel (who is responsible for the assessment of this measure).

- CSES 3023 CSES Colloquium (FA), an upper division, professional development, communication-intensive course that should capture at least half of the senior population, is the target course for the assessment.
- CSES 462V Internship, Special Problems, and Honors thesis defenses provide opportunities where students present their experiences to an audience and the oral communication rubric can be used to evaluate communication skills.

Summary of Findings

- CSES Colloquium is a fall course and most internships occur during the summer with presentations given during the fall semester, so oral communication skills have not been assessed yet.

Recommendations

- Data will be collected during the 2106-2017 academic year to assess performance in oral communication.

Assessment Measure for Outcome 4b

- Achievement will be assessed using a **written communication rubric** for laboratory reports and technical/scientific proposals where the student has analyzed, synthesized and evaluated information from independent sources as part of a class project and/or completed an independent research project as part of a special problems, research project or internship class.
- This is a **direct** measure of student learning.

Acceptable and Ideal Targets (not required for indirect measures).

- Acceptable: 70% of seniors assessed will score proficient or greater.
- Ideal: 90% of seniors assessed will score proficient or greater.

Key Personnel (who is responsible for the assessment of this measure).

- CSES 462V Internship, Special Problems, and Honors thesis research provide opportunities where students have completed independent research projects. Students have to write papers in which they organize data and information they have analyzed, synthesized and evaluated to clearly and fluently convey a message.

Summary of Findings

- Most internships and many research experiences occur during the summer with presentations given during the fall semester, so written communication skills have not been assessed yet.

Recommendations

- Data will be collected during the 2106-2017 academic year to assess performance in written communication.

Overall Recommendations

- Currently, there are no changes recommended for the CPSC Assessment Plan, rather a full implementation is needed. It is imperative that the new procedures being developed for assessment become ingrained as part of the academic culture of faculty such that implementation is seamless and an integrated component of faculty's teaching. If it is a chore to be remembered, then implementation of program assessment components are not likely to succeed.

Action Plan

- During the summer, the Department Head and CSES Assessment Committee will make sure that teaching faculty have necessary rubrics and are prepared to use them in fall and spring courses.
- The pre-assessment needs to be given during class in the spring, while the post-assessment will be administered during class in the fall semester.
- Assessment implementation and progress will be a topic at most faculty meetings during the 2016-2017 academic year.
- Data generated during the 2016-2017 academic year will be used to determine if action is needed to alter assessment, student learner outcomes, and/or curriculum.

Supporting Attachments

- Pre-/post-assessment for CPSC
- Problem solving rubric adapted from Association of American Colleges and Universities
- Critical thinking rubric adapted from Association of American Colleges and Universities
- Oral communication skills rubric adapted from Association of American Colleges and Universities
- Written communication skills rubric adapted from Association of American Colleges and Universities

ORAL COMMUNICATION VALUE RUBRIC

for more information, please contact value@aacu.org



Definition

Oral communication is a prepared, purposeful presentation designed to increase knowledge, to foster understanding, or to promote change in the listeners' attitudes, values, beliefs, or behaviors.

Evaluators are encouraged to assign a zero to any work sample or collection of work that does not meet benchmark (cell one) level performance.

	Capstone Exemplary	Milestones		Benchmark Developing
		Proficient	Basic	
Organization	Organizational pattern (specific introduction and conclusion, sequenced material within the body, and transitions) is clearly and consistently observable and is skillful and makes the content of the presentation cohesive.	Organizational pattern (specific introduction and conclusion, sequenced material within the body, and transitions) is clearly and consistently observable within the presentation.	Organizational pattern (specific introduction and conclusion, sequenced material within the body, and transitions) is intermittently observable within the presentation.	Organizational pattern (specific introduction and conclusion, sequenced material within the body, and transitions) is not observable within the presentation.
Language	Language choices are imaginative, memorable, and compelling, and enhance the effectiveness of the presentation. Language in presentation is appropriate to audience.	Language choices are thoughtful and generally support the effectiveness of the presentation. Language in presentation is appropriate to audience.	Language choices are mundane and commonplace and partially support the effectiveness of the presentation. Language in presentation is appropriate to audience.	Language choices are unclear and minimally support the effectiveness of the presentation. Language in presentation is not appropriate to audience.
Delivery	Delivery techniques (posture, gesture, eye contact, and vocal expressiveness) make the presentation compelling, and speaker appears polished and confident.	Delivery techniques (posture, gesture, eye contact, and vocal expressiveness) make the presentation interesting, and speaker appears comfortable.	Delivery techniques (posture, gesture, eye contact, and vocal expressiveness) make the presentation understandable, and speaker appears tentative.	Delivery techniques (posture, gesture, eye contact, and vocal expressiveness) detract from the understandability of the presentation, and speaker appears uncomfortable.
Supporting Material	A variety of types of supporting materials (explanations, examples, illustrations, statistics, analogies, quotations from relevant authorities) make appropriate reference to information or analysis that significantly supports the presentation or establishes the presenter's credibility/authority on the topic.	Supporting materials (explanations, examples, illustrations, statistics, analogies, quotations from relevant authorities) make appropriate reference to information or analysis that generally supports the presentation or establishes the presenter's credibility/authority on the topic.	Supporting materials (explanations, examples, illustrations, statistics, analogies, quotations from relevant authorities) make appropriate reference to information or analysis that partially supports the presentation or establishes the presenter's credibility/authority on the topic.	Insufficient supporting materials (explanations, examples, illustrations, statistics, analogies, quotations from relevant authorities) make reference to information or analysis that minimally supports the presentation or establishes the presenter's credibility/authority on the topic.
Central Message	Central message is compelling (precisely stated, appropriately repeated, memorable, and strongly supported.)	Central message is clear and consistent with the supporting material.	Central message is basically understandable but is not often repeated and is not memorable.	Central message can be deduced, but is not explicitly stated in the presentation.

**Crop, Soil, and Environmental Sciences
Oral Communication Performance
Assessment Rubric**

Student _____

Degree ESWS CPSC

Course _____

Assignment _____

Date _____

Student Learning Outcomes	Score using Rubric
1. Organization	_____
2. Language	_____
3. Delivery	_____
4. Supporting Material	_____
5. Central Message	_____

CRITICAL THINKING VALUE RUBRIC

for more information, please contact value@aacu.org



Definition

Critical thinking is a habit of mind characterized by the comprehensive exploration of issues, ideas, artifacts, and events before accepting or formulating an opinion or conclusion, and can be demonstrated in assignments that require students to complete analyses of text, data, or issues..

Evaluators are encouraged to assign a zero to any work sample or collection of work that does not meet benchmark (cell one) level performance.

	Capstone Exemplary	Milestones		Benchmark Developing
		Proficient	Basic	
Explanation of issues	Issue/problem to be considered critically is stated clearly and described comprehensively, delivering all relevant information necessary for full understanding.	Issue/problem to be considered critically is stated, described, and clarified so that understanding is not seriously impeded by omissions.	Issue/problem to be considered critically is stated but description leaves some terms undefined, ambiguities unexplored, boundaries undetermined, and/or backgrounds unknown.	Issue/problem to be considered critically is stated without clarification or description.
Evidence <i>Selecting and using information to investigate a point of view or conclusion</i>	Information is taken from source(s) with enough interpretation/evaluation to develop a comprehensive analysis or synthesis. Viewpoints of experts are questioned thoroughly.	Information is taken from source(s) with enough interpretation/evaluation to develop a coherent analysis or synthesis. Viewpoints of experts are subject to questioning.	Information is taken from source(s) with some interpretation/evaluation, but not enough to develop a coherent analysis or synthesis. Viewpoints of experts are taken as mostly fact, with little questioning.	Information is taken from source(s) without any interpretation/evaluation. Viewpoints of experts are taken as fact, without question.
Influence of context and assumptions	Thoroughly (systematically and methodically) analyzes own and others' assumptions and carefully evaluates the relevance of contexts when presenting a position.	Identifies own and others' assumptions and several relevant contexts when presenting a position.	Questions some assumptions. Identifies several relevant contexts when presenting a position. May be more aware of others' assumptions than one's own (or vice versa).	Shows an emerging awareness of present assumptions (sometimes labels assertions as assumptions). Begins to identify some contexts when presenting a position.
Student's position (perspective, thesis/hypothesis)	Specific position (perspective, thesis/hypothesis) is imaginative, taking into account the complexities of an issue. Limits of position (perspective, thesis/hypothesis) are acknowledged. Others' points of view are synthesized within position (perspective, thesis/hypothesis).	Specific position (perspective, thesis/hypothesis) takes into account the complexities of an issue. Others' points of view are acknowledged within position (perspective, thesis/hypothesis).	Specific position (perspective, thesis/hypothesis) acknowledges different sides of an issue.	Specific position (perspective, thesis/hypothesis) is stated, but is simplistic and obvious.
Conclusions and related outcomes (implications and consequences)	Conclusions and related outcomes (consequences and implications) are logical and reflect student's informed evaluation and ability to place evidence and perspectives discussed in priority order.	Conclusion is logically tied to a range of information, including opposing viewpoints; related outcomes (consequences and implications) are identified clearly.	Conclusion is logically tied to information (because information is chosen to fit the desired conclusion); some related outcomes (consequences and implications) are identified clearly.	Conclusion is inconsistently tied to some of the information discussed; related outcomes (consequences and implications) are oversimplified.

PROBLEM SOLVING VALUE RUBRIC

for more information, please contact value@aacu.org



Definition

Problem solving is the **process** of designing, evaluating, and implementing a strategy to answer an open-ended question or achieve a desired goal, involving problems that range from well-defined to ambiguous in a simulated or laboratory context, or in real-world settings..

Evaluators are encouraged to assign a zero to any work sample or collection of work that does not meet benchmark (cell one) level performance.

	Capstone Exemplary	Milestones		Benchmark Developing
		Proficient	Basic	
Define Problem	Demonstrates the ability to construct a clear and insightful problem statement with evidence of all relevant contextual factors.	Demonstrates the ability to construct a problem statement with evidence of most relevant contextual factors, and problem statement is adequately detailed.	Begins to demonstrate the ability to construct a problem statement with evidence of most relevant contextual factors, but problem statement is superficial.	Demonstrates a limited ability in identifying a problem statement or related contextual factors.
Identify Strategies	Identifies multiple approaches for solving the problem that apply within a specific context.	Identifies multiple approaches for solving the problem, only some of which apply within a specific context.	Identifies only a single approach for solving the problem that does apply within a specific context.	Identifies one or more approaches for solving the problem that do not apply within a specific context.
Propose Solutions/Hypotheses	Proposes one or more solutions/hypotheses that indicates a deep comprehension of the problem. Solution/hypotheses are sensitive to contextual factors as well as all of the following: ethical, logical, and cultural dimensions of the problem.	Proposes one or more solutions/hypotheses that indicates comprehension of the problem. Solutions/hypotheses are sensitive to contextual factors as well as the one of the following: ethical, logical, or cultural dimensions of the problem.	Proposes one solution/hypothesis that is “off the shelf” rather than individually designed to address the specific contextual factors of the problem.	Proposes a solution/hypothesis that is difficult to evaluate because it is vague or only indirectly addresses the problem statement.
Evaluate Potential Solutions	Evaluation of solutions is deep and elegant (for example, contains thorough and insightful explanation) and includes, deeply and thoroughly, all of the following: considers history of problem, reviews logic/reasoning, examines feasibility of solution, and weighs impacts of solution.	Evaluation of solutions is adequate (for example, contains thorough explanation) and includes the following: considers history of problem, reviews logic/reasoning, examines feasibility of solution, and weighs impacts of solution.	Evaluation of solutions is brief (for example, explanation lacks depth) and includes the following: considers history of problem, reviews logic/reasoning, examines feasibility of solution, and weighs impacts of solution.	Evaluation of solutions is superficial (for example, contains cursory, surface level explanation) and includes the following: considers history of problem, reviews logic/reasoning, examines feasibility of solution, and weighs impacts of solution.
Implement Solution	Implements the solution in a manner that addresses thoroughly and deeply multiple contextual factors of the problem.	Implements the solution in a manner that addresses multiple contextual factors of the problem in a surface manner.	Implements the solution in a manner that addresses the problem statement but ignores relevant contextual factors.	Implements the solution in a manner that does not directly address the problem statement.
Evaluate Outcomes	Reviews results relative to the problem defined with thorough, specific considerations of need for further work.	Reviews results relative to the problem defined with some consideration of need for further work.	Reviews results in terms of the problem defined with little, if any, consideration of need for further work.	Reviews results superficially in terms of the problem defined with no consideration of need for further work

**Crop, Soil, and Environmental Sciences
Problem Solving Performance
Assessment Rubric**

Student	_____	
Degree	ESWS	CPSC
Course	_____	
Assignment	_____	
Date	_____	

Student Learning Outcomes	Score using Rubric
1. Define Problem	_____
2. Identifying Strategies	_____
3. Propose Solutions/Hypotheses	_____
4. Evaluate Potential Solutions	_____
5. Implement Solution	_____
6. Evaluate Outcomes	_____

WRITTEN COMMUNICATION VALUE RUBRIC

for more information, please contact value@aacu.org



Definition

Written communication is the development and expression of ideas in writing. Written communication involves learning to work in many genres and styles. It can involve working with many different writing technologies, and mixing texts, data, and images. Written communication abilities develop through iterative experiences across the curriculum.

Evaluators are encouraged to assign a zero to any work sample or collection of work that does not meet benchmark (cell one) level performance.

	Capstone Exemplary	Milestones		Benchmark Developing
		Proficient	Basic	
Context of and Purpose for Writing <i>Includes considerations of audience, purpose, and the circumstances surrounding the writing task(s).</i>	Demonstrates a thorough understanding of context, audience, and purpose that is responsive to the assigned task(s) and focuses all elements of the work.	Demonstrates adequate consideration of context, audience, and purpose and a clear focus on the assigned task(s) (e.g., the task aligns with audience, purpose, and context).	Demonstrates awareness of context, audience, purpose, and to the assigned tasks(s) (e.g., begins to show awareness of audience's perceptions and assumptions).	Demonstrates minimal attention to context, audience, purpose, and to the assigned tasks(s) (e.g., expectation of instructor or self as audience).
Content Development	Uses appropriate, relevant, and compelling content to illustrate mastery of the subject, conveying the writer's understanding, and shaping the whole work.	Uses appropriate, relevant, and compelling content to explore ideas within the context of the discipline and shape the whole work.	Uses appropriate and relevant content to develop and explore ideas through most of the work.	Uses appropriate and relevant content to develop simple ideas in some parts of the work.
Genre and Disciplinary Conventions <i>Formal and informal rules inherent in the expectations for writing in particular forms and/or academic fields (please see glossary).</i>	Demonstrates detailed attention to and successful execution of a wide range of conventions particular to a specific discipline and/or writing task (s) including organization, content, presentation, formatting, and stylistic choices	Demonstrates consistent use of important conventions particular to a specific discipline and/or writing task(s), including organization, content, presentation, and stylistic choices	Follows expectations appropriate to a specific discipline and/or writing task(s) for basic organization, content, and presentation	Attempts to use a consistent system for basic organization and presentation.
Sources and Evidence	Demonstrates skillful use of high-quality, credible, relevant sources to develop ideas that are appropriate for the discipline and genre of the writing	Demonstrates consistent use of credible, relevant sources to support ideas that are situated within the discipline and genre of the writing.	Demonstrates an attempt to use credible and/or relevant sources to support ideas that are appropriate for the discipline and genre of the writing.	Demonstrates an attempt to use sources to support ideas in the writing.
Control of Syntax and Mechanics	Uses graceful language that skillfully communicates meaning to readers with clarity and fluency, and is virtually error-free.	Uses straightforward language that generally conveys meaning to readers. The language in the portfolio has few errors.	Uses language that generally conveys meaning to readers with clarity, although writing may include some errors.	Uses language that sometimes impedes meaning because of errors in usage.

**Crop, Soil, and Environmental Sciences
Written Communication Performance
Assessment Rubric**

Student	_____	
Degree	ESWS	CPSC
Course	_____	
Assignment	_____	
Date	_____	

Student Learning Outcomes

Score using Rubric

- | | | |
|----|------------------------------------|-------|
| 1. | Context of and Purpose for Writing | _____ |
| 2. | Content Development | _____ |
| 3. | Genre and Disciplinary Conventions | _____ |
| 4. | Sources and Evidence | _____ |
| 5. | Control of Syntax and Mechanics | _____ |

Environmental, Soil, and Water Science
Pre- and Post- Curriculum Knowledge Assessment

Name _____

Date _____

Semester and Year entered ESWS _____

PRE

POST

1. The dissolved oxygen in a BOD sample at 1:20 dilution is initially $11.4 \text{ mg liter}^{-1}$. After 5 days at 20°C the dissolved oxygen was $3.6 \text{ mg liter}^{-1}$. The BOD_5 of the sample is
 - a) $7.8 \text{ mg liter}^{-1}$
 - b) $31.2 \text{ mg liter}^{-1}$
 - c) 72 mg liter^{-1}
 - d) $156 \text{ mg liter}^{-1}$

2. Which of the following is/are true regarding water pollution?
 - a) water pollution occurs naturally
 - b) water pollution can be accelerated by human activity
 - c) water is considered polluted when it is unusable for a particular purpose
 - d) all of the above

3. Diversity is
 - a) highest at intermediate levels of disturbance
 - b) calculated with the following equation $dN/dt = rN(1-N/K)$
 - c) the number of different species in a community
 - d) calculated with the following equation $N_t = N_o e^{rt}$

4. The H^+ concentration in moles L^{-1} of an aqueous sample with a pH of 6.8 is
 - a) 6.8
 - b) 6.8×10^5
 - c) 1.5845×10^{-7}
 - d) $10^{6.8}$

5. Twenty dry tons of poultry litter compost (40% C, $\text{C/N} = 9$) was applied to an acre in March. How much net mineralization would occur in 137 days if its first order rate constant for N mineralization was $0.0001/\text{d}$?
 - a) 0.56 tons
 - b) 0.11 tons
 - c) 0.54 tons
 - d) 12.66 tons

6. Computer-based mapping, analysis, and location-based data management that can be used to solve problems is
 - a) Geographic Information System (GIS)
 - b) Global Positioning System (GPS)
 - c) Raster Imaging
 - d) Remote Sensing

7. Which of the following are considered the five soil-forming factors?
 - a) climate, relief, time, organisms, and plants
 - b) color, relief, time, organisms, and rocks
 - c) country, topography, temperature, animals, and rocks
 - d) parent material, relief, time, organisms, and climate

8. The fine-earth fraction of soil has what upper-limit of physical dimension?
 - a) 2 microns
 - b) 2 mm
 - c) 0.2 mm
 - d) 0.02 m

9. What precursor air pollutants emitted from industrial and mobile sources result in ozone formation?
 - a) VOC and NO_x
 - b) NO_x and SO_x
 - c) CO₂ and H₂O
 - d) CO and NO_x

10. Which of the following is not an ecological consequence of acid deposition?
 - a) decreased aquatic diversity and increased risk of harmful algal blooms
 - b) eutrophication
 - c) leaching of basic cations from soil and aluminum toxicity to plants
 - d) weathering from acid inputs that increases buffering capacity of soils

11. The problem that we currently face in global climate change is not that the earth has never been so warm, but the rapid changes in climate. Current models estimate that the average global temperature may rise between 2 and 6°C during the next century leading to which of the following consequences?
 - a) a consistent increase in temperature across the globe
 - b) inconsistent rates of change across species and locations altering ecology
 - c) rapid adaptation of plants and animals to new phenology and abiotic conditions
 - d) warmer climatic with unchanged precipitation patterns

12. Which of the following soil microorganisms are generally most numerous in a typical agricultural soil?
 - a) bacteria
 - b) fungi
 - c) nematodes
 - d) protozoa

13. Sulfate is extracted in 50 mL extract solution from 22 g of moist soil, reacted chemically to form a precipitate, and absorbance of light in the solution is measured in a spectrophotometer. The dry weight of a 10-g soil sample at equivalent moisture content was 8.1 g. The calibration curve for absorbance data based on standard solutions is shown below. The regression of the calibration curve gave an $R^2 = 0.997$, with a slope = 0.018, and the y-intercept = 0.002.

<u>Std. ($\mu\text{g S/mL}$)</u>	<u>abs</u>
0	0.002
12.5	0.205
25	0.478
50	0.883

The extraction solution absorbance of the soil sample is 0.381. Given these data, what is the concentration of $\text{SO}_4^{2-}\text{-S}$ ($\mu\text{g S/g}$) in the soil?

- a) 0.06
b) 2.6
c) 21.1
d) 58.8
14. During an analysis for soil test phosphorus of Mehlich-III soil extract analyzed by inductively coupled plasma- atomic emission spectroscopy, the laboratory technician extracts and analyzes a laboratory duplicate to check the precision of the method. This is an example of
- a) quality assurance
b) quality control
c) field duplicate
d) MDL
15. Ammonium sulfate $(\text{NH}_4)_2\text{SO}_4$ is broadcast onto to a silty clay soil which is at a temperature of 25 °C and a moisture content of 0.3 g g^{-1} . What would be the immediate loss mechanism of concern for N?
- a) denitrification
b) nitrification
c) volatilization
d) leaching
16. Estimate the CEC of a Mollisol at pH = 7, with 16% 2:1 smectite clay (average CEC of 80 cmol_c/kg), 3% kaolinite clay (average CEC of 8 cmol_c/kg), and 3.5% OM (average CEC of 200 cmol_c/kg).
- a) 288
b) 35.83
c) 22.5
d) 20.04

17. A soil core 10 cm long and 2.5 cm in diameter is collected from a moist field. The moist soil weight in the core is 132 g. The empty core weight is 35 g. The dry soil weight is 78 g. What is the volumetric moisture content of the soil?
- a) 0.20
 - b) 0.24
 - c) 0.30
 - d) 0.41
18. Stream A supplies Town X's drinking water. Should one be concerned about the quality of Town X's drinking water?
- | | |
|----------------|-----------|
| nitrate | 5 ppm |
| phosphate | 10 ppb |
| oxygen | 8.5 ppm |
| <i>E. coli</i> | 25/100 mL |
- a) fecal contamination and possible presence of pathogens
 - b) excessive nitrate
 - c) excessive phosphate
 - d) low dissolved oxygen
19. Which of the following best describes the three key characteristics of a wetland?
- a) hydrophobic vegetation, hydrology, and organic soil
 - b) hydrophobic vegetation, continuous ponded water, and hydric soil
 - c) hydrophilic vegetation, continuous ponded water, and hydric soil
 - d) hydrophytes, hydrology, and hydric soil
20. Which of the following water characteristics represents a eutrophic lake?
- a) low dissolved P concentration
 - b) low light absorbance reading
 - c) long Secchi disk reading
 - d) low chlorophyll-a reading