Revised: September 06, 2017 (this version supersedes all prior versions)

Ray P. Authement College of Sciences
Assessment Plan for General Education in Natural Sciences

A. Goals

Natural Sciences: Students should be able to understand the nature of scientific knowledge and have a sufficient knowledge base to be familiar with the power and limitations of science as related to contemporary topics.

B. Objectives/Outcomes

Students should be able to:

B.1. Apply key processes and scientific reasoning to draw reasonable conclusions within the natural sciences.

B.2. Use critical and logical thinking, knowledge of accepted scientific methods, and appropriate sources to evaluate the credibility of information with scientific content.

Objectives/Outcomes Restated to Show They Belong to EVALUATE LAYER on Bloom's Taxonomy

R-B.1. **Draw reasonable conclusions** within the natural sciences by applying key processes and scientific reasoning (Note: this is EVALUATE on Bloom's Taxonomy in section C.4.).

R-B.2. **Evaluate credibility of information** with scientific content by using critical and logical thinking, knowledge of accepted scientific methods, and appropriate sources
(Note: this is EVALUATE on Bloom's Taxonomy in section C.4).

C. Instruments/Measures of Evaluation

C.1. General education courses to be assessed

Refer to UL's Core General Education Requirement document at the following URL for general education courses recommended:

http://academicaffairs.louisiana.edu/sites/academicaffairs/files/Core%20Curriculum%20Table%20FA2013%20Final_0.pdf

Courses that will be assessed are shown in Table 1 next along with their semester for assessment.

Table 1. Plan for Course Assessment			
Natural Sciences	**Courses Assessed**	**Assessed in Fall (starting Fall 2017)**	**Assessed in Spring (starting Spring 2018)**
BIOL	121, 122	121	122
CHEM	101, 102	101	102
ENVS	100, 150	150	100
GEOL	105, 106	105	106
PHYS	160, 170	160	170

C.2. Rubric for evaluation (Updated)

The rubrics for the two outcomes are shown in Table 2.

Table 2. Rubrics for Evaluation of Outcomes				
	Undeveloped	**Developing**	**Developed**	**Exemplary**
Apply key processes and scientific reasoning to draw reasonable conclusions within the natural sciences (B.1.)	Cannot adequately apply appropriate scientific methodology and reasoning to draw reasonable conclusions (typical score on relevant questions is in the range of 0%-59%)	Provides a limited or basic application of scientific methodology and reasoning to draw reasonable conclusions (typical score on relevant questions is in the range of 60%-69%)	Provides a satisfactory application of scientific methodology and reasoning to draw reasonable conclusions (typical score on relevant questions is in the range of 70%-89%)	Provides a thorough application of scientific methodology and reasoning to draw reasonable conclusions (typical score on relevant questions is in the range of 90%-100%)
Use critical and logical thinking, knowledge of accepted scientific methods, and appropriate sources to evaluate the credibility of information with scientific content (B.2.)	Does not adequately evaluate the validity and credibility of information with scientific content (typical score on relevant questions is in the range of 0%-59%)	Provides a limited evaluation of validity and credibility of information with scientific content by using critical and logical thinking as well as knowledge of scientific methods (typical score on relevant questions is in the range of 60%-69%)	Provides a satisfactory evaluation of validity and credibility of information with scientific content by using critical and logical thinking as well as knowledge of scientific methods (typical score on relevant questions is in the range of 70%-89%)	Provides a thorough evaluation of validity and credibility of information with scientific content by using critical and logical thinking as well as knowledge of scientific methods (typical score on relevant questions is in the range of 90%-100%)

C.3. Details of education and evaluation (homework, final exam)

Each unit in Natural Sciences will develop and use its own set of questions to educate and test students for outcomes B.1 and B.2. Students will get exposure to training in applying their knowledge of scientific processes with reasoning and critical thinking through at least one homework. Students will be tested on their final exam with questions specifically aimed at evaluating outcomes B.1 and B.2.

The units will follow a common guideline for developing questions (e.g., questions on graph interpretations and other forms of scientific representation that test outcomes B.1 and B.2) which is expected to make comparison on student performances across disciplines easier. Such guideline has been agreed upon by the college level committee on general education comprising a representative from each unit and an Associate Dean. Note that the term common guideline does not mean that units will have a common pool of questions, rather it means each unit will develop its own sets of questions while adhering to a general set of rules. Only questions that are concerned with evaluation or appraisal related to outcome B.1. and B.2. will be used to assess those outcomes. Keywords listed in C.5. will be used to craft questions assessed to ensure adherence to Bloom's taxonomy.

C.4. Bloom's Taxonomy
(source: https://commons.wikimedia.org/wiki/File:Bloom_taxonomy.jpg)

C.5. Suggested Keywords to be Used in the Questions Assessing Outcomes B.1. and B.2.
(source: https://www.cte.cornell.edu/documents/Assessment%20-%20Blooms%20Taxonomy%20Action%20Verbs.pdf)

Evaluate, appraise, judge, reframe, criticize, order, support, compare, decide, discriminate, recommend, summarize, assess, choose, convince, defend, estimate, find errors, grade, measure, predict, rank, score, select, test, argue, conclude, consider, critique, debate, distinguish, editorialize, justify, persuade, rate, weigh.

D. Criterion of Success

Course embedded evaluation of student work, as described in section C.3. of this document, will be done by the academic units using their own rubric. Outcomes B.1 and B.2 will be considered successful or achieved if at least 50% of students meet or exceed *Developing* performance on rubric.

E. Process of Assessment

The following three points explain the process of assessment further.

E.1. Frequency of assessment

The frequency of assessment for courses is shown in Table 1 as to whether a course is assessed in Fall or Spring.

E.2. Sample size of assessment

All students in all sections of all courses listed in Table 1 will be assessed.

E.3. Closing the loop / Continual improvement

Each unit in natural sciences will form a departmental level general education committee that will effect and oversee the implementation of assessment and evaluation. This is proposed to be under the supervision of respective department heads. The department heads can make recommendations for further improvement based on such committee's findings.

The college wide council on general education, described in section F., will meet every year to go over the evaluation statistics from each unit to assess whether units were too hard or too easy and to take corrective actions at the college level.

Assessment and evaluation along with steps for closing the loop will be reported via Live Text to Alise Hagan.

F. Council for General Education in the Ray P. Authement College of Sciences

The Ray P. Authement College's structure for assessment consists of the following.

College Level (under the supervision of Dean Ackleh): Ashok Kumar (Associate Dean), Phyllis Griffard (BIOL), Febee Louka (CHEM), Gabriela Petculescu (PHYS), Durga Poudel (ENVS and GEOL)

Charges: Implement assessment; recommend measures to effect assessment-data-driven changes across the college; meet as needed; report the College's findings annually to the Dean as well as the University Council on General Education.

BIOL (under the supervision of Pegge Alciatore and Paul Leberg): Phyllis Griffard (coordinator for general education), Heather Birdsong, Suzanne Fredericq, Lewis Deaton, and Daniel Povinelli.

Charges: Implement assessment; recommend measures to effect assessment-data-driven changes for the courses assessed; meet as needed; report the findings annually to the College Level Committee.

CHEM (under the supervision of August Gallo and Thomas Junk): Febee Louka (coordinator for general education), Jennifer De Guzman ,and Elizabeth Owuor.

Charges: Implement assessment; recommend measures to effect assessment-data-driven changes for the courses assessed; meet as needed; report the findings annually to the College Level Committee.

ENVS and GEOL (under the supervision of Durga Poudel): Durga Poudel (coordinator for general education), Aubrey Hillman, Jenneke Visser, Jim Foret, Gary Kinsland, Brian Schubert, and Jennifer Hargrave.

Charges: Implement assessment; recommend measures to effect assessment-data-driven changes for the courses assessed; meet as needed; report the findings annually to the College Level Committee.

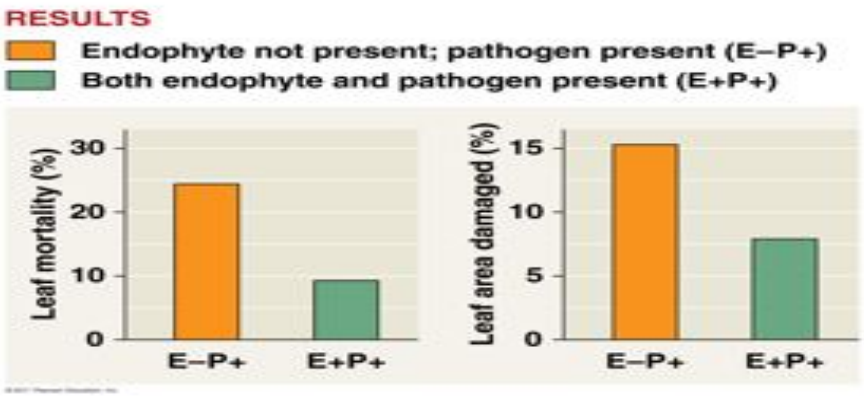
PHYS (under the supervision of Natalia Sidorovskaia): Gabriela Petculescu (coordinator for general education), Gina Sorci, and Andy Hollerman

Charges: Implement assessment; recommend measures to effect assessment-data-driven changes for the courses assessed; meet as needed; report the findings annually to the College Level Committee.

G. Sample Questions (for general guidance only; not binding on any unit)

Four examples are provided next from BIOL so as to provide a glimpse into actual questioning on homework and final exam. These are meant to be of helpful nature and not binding on a unit.

Example 1 (courtesy, Dr. Phyllis Griffard, BIOL)



56. Most plants are hosts to symbiotic organisms called endophytes. Researchers studied the endophytes of the cacao tree (the fruit of which are used to make chocolate) and reported the results shown here. What was the research question?
    a. Can endophytes protect cacao plant from a pathogen?
    b. Do endophytes damage cacao leaves?
    c. Which is harmed more by the pathogen, leaf mortality or leaf area?
    d. Are endophytes pathogenic?
    e. Are endophytes as harmful as the cacao pathogen?

57. What claim can be made based on the results?
    a. This pathogen kills the beneficial endophytes as well as the host plant
    b. When endophytes and pathogens are both added to the plant, the plant loses more leaves than if neither is added
    c. Pathogens kill more leaves than endophytes do
    d. Endophytes kill more leaves than the pathogen does
    e. Endophytes protect the host plant from damage by the pathogen

Example 2. (courtesy, Dr. Phyllis Griffard, BIOL)

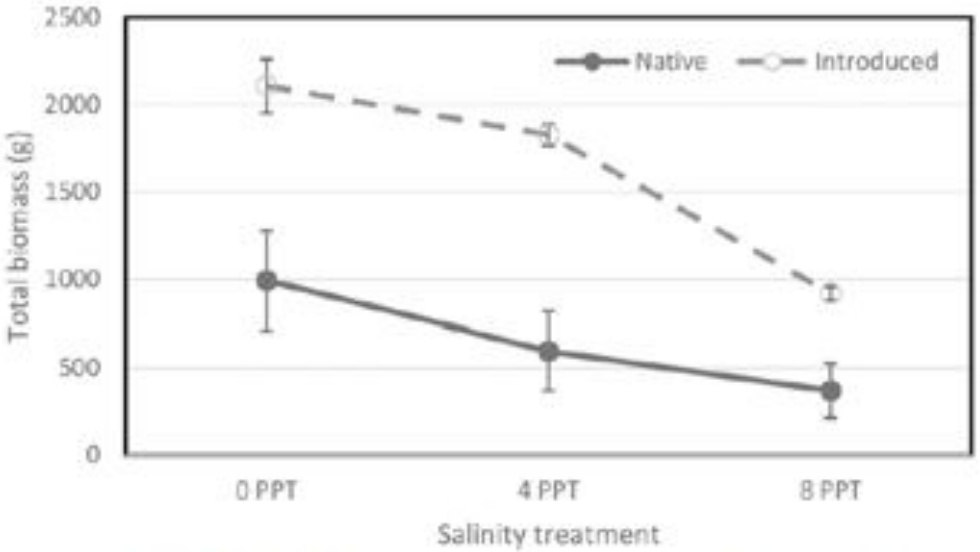
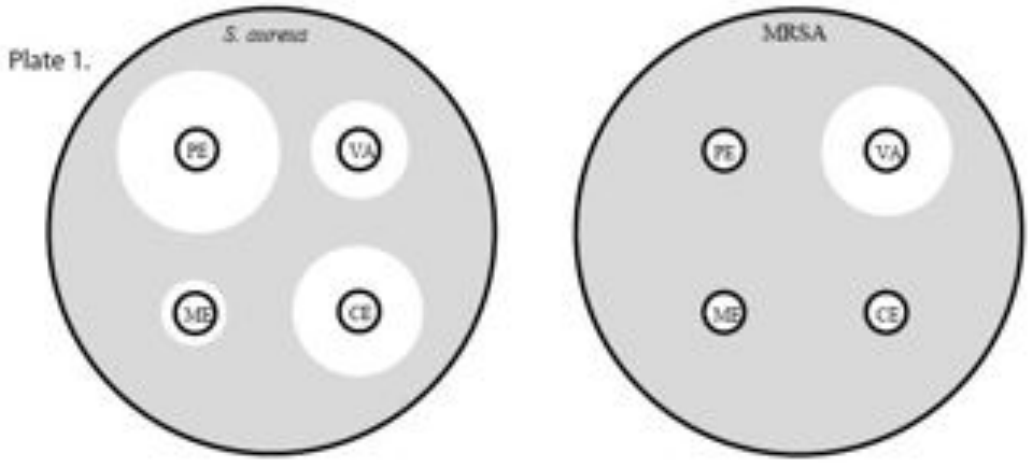


FIGURE 4 The effects of species and salinity on total biomass. Both species and salinity had significant effects on total biomass but the species × salinity effect was not significant. Means ± SE are displayed in an interaction plot to better illustrate the main effects and their interactions (SAS, Linear Models, Plots).

60. Which statement is a valid claim based on the data shown here about Introduced and Native irises?
    a. Introduced irises produced more biomass than native irises regardless of whether salt was present
    b. Introduced irises will outcompete native irises in the wild
    c. Introduced irises are invasive and natives are not
    d. Native irises attract more pollinators than introduced irises

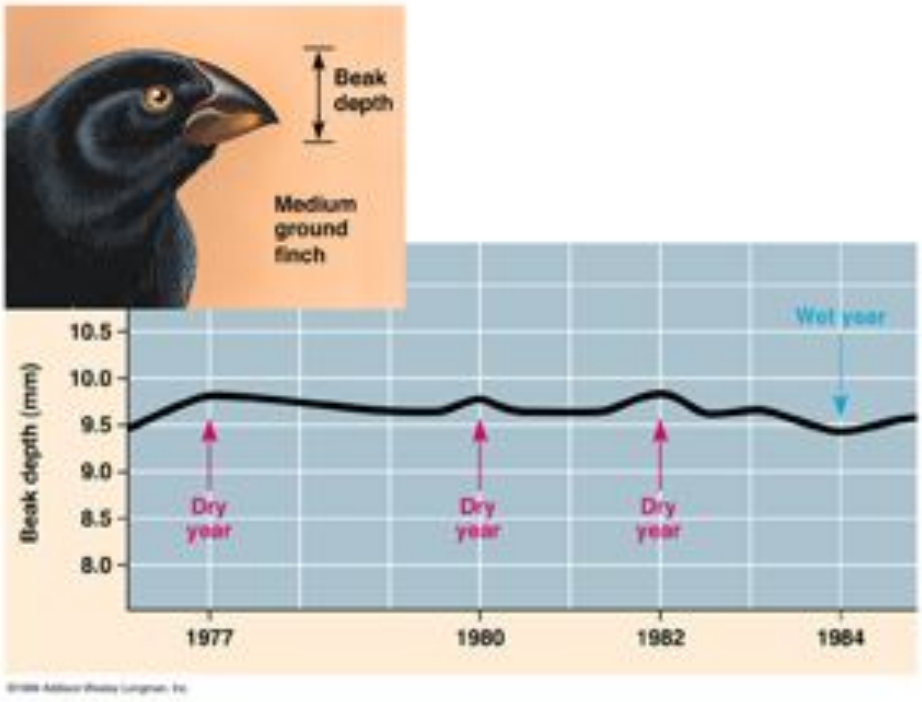
Example 3. (courtesy, Dr. Phyllis Griffard, BIOL)



19. *S. aureus* and MRSA were grown on agar with 4 antibiotics using the Kirby-Bauer Disk Diffusion technique. Which statement is TRUE based only on these two plates?
    a. MRSA is resistant to all 4 antibiotics
    b. *S. aureus* is more sensitive to VA (vancomycin) than MRSA is
    c. *S. aureus* infection could be successfully treated with penicillin but MRSA could not
    d. Antibiotics caused mutations to occur that led to resistance

Example 4. (courtesy, Dr. Phyllis Griffard, BIOL)

islands.



15. The graph here summarizes one finding of Peter and Rosemary Grant's research on the Galapagos Islands. Which statement about the beak size of finches on the island of Daphne Major during prolonged drought is true?
    a. All the birds with smaller beak depth starved since their preferred food was unavailable during the drought.
    b. Each bird evolved a deeper, stronger beak as the drought persisted.
    c. Each bird that survived the drought produced only offspring with deeper, stronger beaks than seen in the previous generation.
    d. The percentage (frequency) of birds with the strong-beak alleles increased in the population as each drought persisted.