Central Washington University  
Assessment of Student Learning  
Department and Program Report

Please enter the appropriate information concerning your student learning assessment activities for this year.

Academic Year of Report: **2012-2013** College: **COTS**  
Department: **Biology** Program: **B.A., B.S. and M.S.**

As I did last year I will step outside the box and not use the standard format for this report. Instead I will describe our continuing departmental initiative to build a coherent and valuable assessment mechanism that we can all support and utilize.

We have continued to design our assessment and implementation this year. I am proud of what we have accomplished, led by our assessment committee. This committee, in conjunction with the departmental faculty, have produced several documents to guide our self-assessment.

Our Approach:
We have divided all of biological study into four Curricular Areas and within each of these areas we selected Assessment Topics (the Areas and Topics are briefly listed here and see Appendix I):

1) **Evolution**: microevolution, phylogeny, speciation, adaptation
2) **Cell and Molecular**: regulation/mechanism of gene expression, cell communication, transformation and use of energy
3) **Structure/Function**: homeostasis, adaptation, organ systems
4) **Ecology**: abiotic/biotic constraints, energy flow and nutrient cycles, population growth

Within each of these Topics we further subdivided them into two to four concepts and then we produced some question frameworks. In the current phase of this work we have begun linking these topics to specific courses in our curriculum.

Our next steps are to have our colleagues continue building and collecting exam questions that align to the topics, pool them together, and develop a common question set we can deploy to the core and upper division courses, as appropriate.

Two members of our departmental assessment committee (Ian Quitadamo and Lucinda Carnell) attended the national meeting **Vision and Change** this summer and learned a lot about what is happening nationally with reforming biology education. A key group associated with Vision and Change is PULSE (Partnership for Undergraduate Life Sciences Education), which is co-funded by NSF, NIH, and HHMI. PULSE just released a series of rubrics that we are now considering as
metrics for us to use to determine how well we are doing as a department. These rubrics cover a variety of topics, including 1) implementation of Vision and Change recommendations, 2) curriculum alignment, 3) assessment across the curriculum, 4) faculty practice and support, 5) infrastructure, and 6) climate for change - essentially all the parameters we need to consider as we move forward with our internal changes.

Of potential interest to our department, and a current topic of our discussion, is a national push toward departmental Vision and Change Certification, which would be something akin to ACS certification currently used by Chemistry. This could provide external validation for our department and attract more high-quality students to our program. Certification is being piloted by a few departments across the U.S.

The PULSE rubrics are listed in the spreadsheet tab “Vision and Change” (Biol_learning Outcomes_2013.xlsx). We are going to mesh our plans with these ideas so that we can be aligned with national standards. Ultimately we will use these rubrics to more systematically identify where we need to go next in our design of assessment and curriculum.

In our Learning Outcomes document we have divided outcomes into three categories: Knowledge, Skills, and Dispositions. We have begun working to sort the Knowledge and Skill outcomes according to the Vision and Change recommendations (in red bold in the spreadsheet Biol_learning Outcomes_2013.xlsx). Essentially we just need to realign what we have to the topics from Vision and Change.

I have pushed hard to get some real data so that we can feel we have done something. This is the bugaboo of any departmental initiative, if a project goes on too long without recognizable progress people will quit working on it. To that end we have agreed to the implementation of a Learning Disposition survey. We will implement this in the winter beginning with BIOL 181 and BIOL 499S. These two courses are bookends to our undergraduate program and we hope to eventually have a measure of how student dispositions change over the course of their time here. I am attaching the link to our disposition survey here.
https://cwu.qualtrics.com/SE/?SID=SV_9KLEmYwJyLvmDtz

These are exciting times for the Department of Biological Sciences: we have a department wide appreciation that assessment is a valuable goal and we are united in our approach. This alone moves us far beyond where we were just one year ago. We have assembled the pieces of the assessment framework and this winter we will actually begin collecting data that will begin to inform our teaching. The assessment tool might even be amenable to sample questions such as retention by tracking student dispositions and learning more about the normal attrition that occurs from our introductory series to the end of our program. We believe that some of this attrition is expected, and in fact good: students are discovering what they want to do, that’s a good thing. But potentially we can identify “pinch points” and through the use of our disposition surveys begin to understand what students think at certain way-points in our curriculum and if there is something we can do to increase student success in our programs.
Appendix I. Four Curricular Areas and Their Assessment Topics

Evolution Concepts

Microevolution

1) Changes in allele frequencies and genotype frequencies
   a) Give them observed data (counts of phenotypes) and test for Hardy-Weinberg equilibrium.
   b) Identify genotype and allele frequencies-based story problems.

2) Populations and Hardy-Weinburg equilibrium
   a) Identify the a null hypothesis from a Hardy-Weinberg Equilibrium problem.
   b) Match allele and genotype frequencies to Hardy-Weinberg equation.

3) 5 microevolutionary forces that affect evolution
   a) Infer microevolutionary forces that cause deviation from Hardy-Weinberg Equilibrium based on data.

Phylogeny

4) Choose appropriate methodologies to construct phylogenies
   a) Cladistics, maximum likelihood:
      i) Match type of method to description.
      ii) Construct a tree from data.

5) Interpret a tree
   a) Identify monophyletic groups/para/polyphyly, sister taxa.
   b) Distinguish among homology/homoplasy.

6) Reconstruct characters
   a) Place character changes on a tree from a story problem.
   b) Identify synapomorphies, symplesiomorphies, etc from a tree.

Speciation

7) Species Concepts
   a) Apply species concepts to written examples.

8) Mechanisms
   a) Apply mechanisms of speciation to examples or scenarios.

Adaptation

9) Tests
   a) Design an experiment to test for adaptation (select the best design and/or find the flaw in an experiment).

10) Sexual Selection, Natural Selection
    a) Distinguish among examples of adaptations arising from sexual selection, natural selection, random genetic drift etc.

Evolution Course Alignment

in progress
Cell/Molecular Concepts

Regulation/mecanism of the gene expression (prokaryotes and eukaryotes)

1) Mechanism of transcription and translation
   a) Questions
      i) BIOL 182
         (1) Transcribe and translation protein from gene sequence (translation question)
         (2) Transregulation- Lac Operon; Arbinose promoter; eukaryotes regulation
      ii) BIOL 422, BIOL 430
         (1) B cell and T cell alternative splicing and rearrangement of VD and J
         (2) XP gene alternative splicing
         (3) RNAi interference question

Cell Communication

1) Intracellular pathway:
   a) cAMP
   b) Ca++/IP3
   c) Tyrosine kinase
   d) Steroid receptors
   e) Membrane Transporter and channel
   f) Questions
      i) BIOL 182
         (1) Analyzing components of key pathway
         (2) Growth factor (tyrosine kinase pathway) expression cyclin and cell proliferation
      ii) BIOL 422 and BIOL 430
         (1) CD4 T cells IL2 receptor (tyrosine receptor) proliferation of CD8 T cells
         (2) Dopamine receptors in gene expression in addiction.

How Cells Transform and Use Energy

1) Glycolysis, Krebs, Oxidative phosphorylation (aerobic respiration)
2) Anaerobic respiration
3) Photosynthesis
4) Beta-oxidation
   a) Questions
      i) BIOL 182
         (1) Question: role of oxygen in cellular respiration.
         (2) Role of chemical gradient in producing ATP.
         (3) Redox reactions
      ii) BIOL 323
         (1) Anoxygenic photosynthesis
         (2) Chemolethotrophs (inorganic electron sources)
      iii) BIOL 430
         (1) Consequence of dysfunction of mitochondria under energy output.
         (2) DNP and uncoupling of mitochondria and consequence
Structure/Function Concepts

Homeostasis
1) How do organisms maintain proper water balance?
2) How do organisms maintain proper temperature?

Adaptation
3) How do organisms move in order to acquire energy, nutrients, mates, etc.?
4) What are adaptations for feeding?

Organ Systems
5) Discuss the methods that gases and nutrients are transported within an organism?
6) Discuss the production and distribution of gametes in terms of structures and physiological processes that are involved.

Structure/Function Course Alignment
These questions would be developed and initially asked of students in BIOL 183. The questions would again be included in a variety of courses in the Structure/Function Bin (primarily in 343, 353, 355, 356, 441, 455).

Ecology Concepts

Abiotic and Biotic Constraints on Organisms
1) Global patterns of atmospheric circulation
2) Niche Concept
3) Habitat Partitioning
4) Character Displacement
5) Biotic Interactions (competition, mutualism, predation)
   a) Question 1: What abiotic factors influence the distribution of organisms across an elevation gradient?
   b) Question 2: Explain the relationship between niche, competition, and character displacement?
   c) Question 3: How would global climate change influence the patterns of organismal distribution?

Energy Flow and Nutrient Cycles
1) Primary Production
2) Trophic levels
3) 2nd law of thermodynamics
4) Food Webs
   a) Question 1: Figure interpretation question asking students to interpret a top-down vs. a bottom up effect in a food web
   b) Question 2: What limits the number of trophic levels in an ecosystem?
   c) Question 3: Draw energy flow through a food web and indicate primary producers, primary and secondary consumers, and decomposers.
   d) Question 4: Diagram an elemental cycle
Population Growth

1) Exponential growth
2) Logistic Growth/Carrying Capacity
3) Life History Strategies
4) Density dependent/independent factors
   a) Question 1: How does population age structure indicate past, present, and future population trends?
   b) Question 2: How does changing r and K influence the shape of population growth curves?
   c) Question 3: Describe the life-history strategies of r and K selected species

Ecology Course Alignment

in progress