Summary of Assessment Results
BS in Biological Sciences, Spring 2012

A. Changes to curriculum and assessment plants

1. The faculty developed and approved Intended Learning Outcomes during AY2011-2012 (see document at end of this report). Our assessment is directly related to the intended learning outcomes and this document is available on the B&W website. In addition we have a more detailed set of Core Concepts of Biology (see document at end).

2. The faculty is in the process of approving major changes to the curriculum. In addition to adding concentrations, this would include the addition of a capstone course (see document at end). If approved by the Faculty Senate this will be implemented in Fall 2013.

B. Results of assessments.

Note: with the exception of the some of the ETS results, most of these describe results for the BS + BA students. The vast majority of students are completing BS degrees.

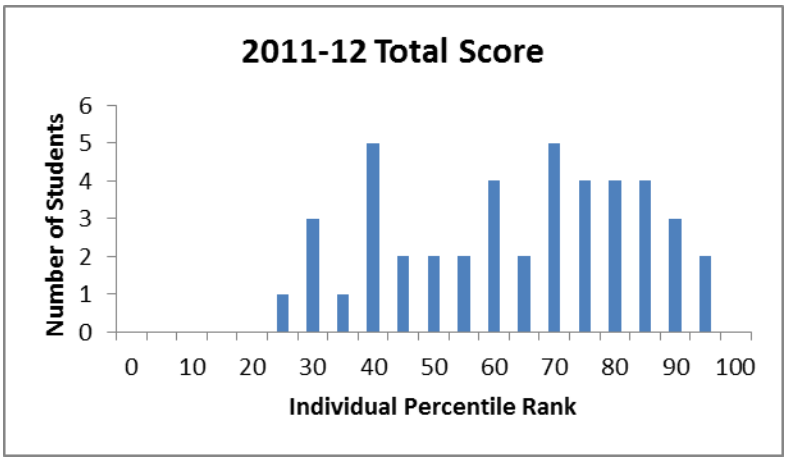
1. ETS Major Field Test: In fall of 2010 we initiated the use of the ETS Major Fields Test, so we now have data from two years. A total of 70 students (all in Biol. 481, a required course) took the test (26 in FY11, 44 in FY12). The test is subdivided into the areas of cellular biology, molecular biology and genetics, organismal biology, and Ecology and Evolutionary Biology. The results were as follows:

	Total	Cell	Mol/Gen	Organ	Ecol/Evol
mean F2010	164	65	62	61	63
instit percentile	92	96	91	84	94
mean S2011	156	54	53	55	58
instit percentile	50	41	39	50	76
mean F2011	164	62	62	60	65
instit percentile	92	91	91	80	97
mean S2012	159	57	57	55	63
instit percentile	76	71	70	54	94
mean F11&S12	161	59	60	57	64
instit percentile	84	79	87	66	95

Students are clearly meeting the target of 50th percentile on average: across the four semesters our students were in the 84th percentile, with the highest percentile in Ecology and Evolution (95th) and the lowest in Organismal Biology (66th). There is substantial variation between semesters, but this is likely a reflection of low sample size (N=16 for Call 201, 10 for Spring 2011, 20 for Fall 2011, and 27 for Spring 2012).

We looked at numbers of BS and BA degrees separately for AY2011-2012; the average for the BA was 161 and the average for the BS was 163. Thus there is no indication of a significant difference, but the sample size for the BA was very small (6 students).

Although on average students did well, a substantial fraction (36%) scored below the 50th percentile (see figure below).



Based on these results we conclude that students who complete the degree are, on average, well versed in basic biological concepts. However, there is room for improvement in training in organismal biology, and about a third of students are performing below expectations.

2. Application of the scientific method: independent research. In AY 2011-2012, 19 students completed independent projects in research through BIOL x97 designators. Additional students will have completed research projects through URSA courses; these students will be able to take Biol 493 (Research Experience in Biology, proposed spring 2012) in the future which will allow us to track them. The addition of the capstone requirement will bring this to 100% of our graduates.

3. Training in oral and written communication: A total of 68 students completed O courses and 20 students completed O/2 courses with a BIOL designator in AY2011-2012. This suggests that most students are now able to take their oral intensive courses within the discipline, thereby reducing the total number of courses they must take. A total of 40 students completed W courses with a BIOL designator. This suggests that more offerings of W courses would be welcome; with the addition of the capstone requirement we will be able to bring this to close to 100%.

Comments on results: Overall our students are meeting the learning goals as indicated by the performance on the ETS Major Field Test. There are still gaps in terms of providing students with a research experience and with written communication training within Biology, but the new curriculum and in particular the addition of the capstone course will narrow or close these gaps.

Assessment improvements to be made:

During this past year we did not conduct the exit survey of seniors, not did we track employment of our graduates. We will re-initiated the former in Fall 2012, but we still do not have an easy or

effective way to track employment past graduation. We will also consistently separate BS and BA degree students so we can track them separately.

Program and Course Changes

General: The curriculum has been greatly revised and those revisions will be submitted for Faculty Senate approval in Fall 2012. Changes in this past year were relatively minor.

Program Changes

1. The minimum number of credits required for the degree was reduced from 130 to 120. This brings us in line with other departments and will reduce time to completion for students.

Course Additions

1. Biol. 3xx, Principles of Epidemiology. This course is a very popular course, particularly for those in the health sciences, that had been run as a trial course previously.
2. Biol 488/688, Arctic Vegetation Ecology: Geobotany. This is part of a newly developed series in arctic vegetation that includes a summer field course.
3. Biol 457/657, Environmental Microbiology. This is a very popular course with interdisciplinary appeal that had been run as a trial course previously.

Course Modifications

1. Biol 425, Mammalogy: a W was added. This will increase the opportunities for completing W requirements within the major.

Course Deletions . These courses had not been taught in more than 5 years.

1. Biol 328-O, Biology of Marine Organisms
2. Biol 418-W, Development Biology
3. Biol 6453/653, Molecular Biology

I. Intended Learning Outcomes for the Biology Baccalaureate Degrees

1. Knowledge

Graduates should demonstrate broad knowledge of core biological concepts, including evolution, inheritance and the expression of genes, cellular and organismal structure and function, and biologically-relevant pathways and transformations of energy and matter. Graduates should demonstrate depth of knowledge in at least one sub-discipline of biology.

2. Competency

Communication: Biology graduates should communicate clearly and accurately about biological issues in both oral and written form. In particular, they should be able to argue cogently from evidence, write the findings of a simple biological study in the format of a scientific paper, and give an effective oral presentation on a biological issue.

Technical proficiency: Graduates should be able to apply the basic tools of the biologist. They should be competent in basic laboratory skills and techniques. They should be able to record and maintain accurate data records and to summarize, graph, and interpret data sets using computer tools. They should be able to use computer software to produce a technical report that includes graphs, tables, and references .

Information literacy: Biology graduates should recognize when information is needed and have the ability to locate, evaluate critically, and use effectively the needed information. They should be aware of, and be able to access, publically available biological databases. They should be able to access the technical literature in biology using online resources, and to distinguish between peer-reviewed scientific literature and less dependable sources of information. They should be able to correctly interpret the goal, approach, and basic findings of a biological journal article. Graduates should cite others' work responsibly and accurately.

Quantitative approaches: Graduates should be able to apply quantitative approaches to problem solving in biology. In particular, they should be competent to recognize bias in data collection and appreciate the role of stochasticity in biological processes. They should be able to distinguish discrete and continuous variation, summarize and analyze data using statistics, and create visual displays of information that effectively summarize data.

Collaboration: Graduates should be able to collaborate effectively with others on scientific projects, leading to a productive outcome.

3. Critical and creative thinking

Graduates should be able to apply their knowledge of the principles of biology, chemistry, physics, and mathematics to solve problems in biology. They should be able to critically evaluate biological claims, such as those they will encounter in the scientific literature and the media. They should be able to address the impact of modern biology on society. Graduates should be able to formulate hypotheses and predictions, design a study, interpret the results logically, and communicate the results effectively.

Core Concepts of Biology[1]

Evolution and biodiversity

- All living things have evolved from a common ancestor.
- The first life forms on earth existed approximately 3.8 billion years ago.
- Phenotype is a combination of genotype and environmental influences.
- Genes come in multiple variants (alleles) with slightly different DNA sequences. New alleles are generated by mutation, which provides genetic variation on which evolution can act. Not all mutations change the phenotype, and many mutations are neutral.
- Evolutionary change occurs when the frequency of heritable traits changes through time within populations, through the processes of natural selection, genetic drift, gene flow, and mutation.
- Diversity is expressed at multiple levels, from genes to ecosystems.
- Three fundamental domains of living organisms exist: Bacteria, Archaea, and Eukarya.
- Groups of organisms exist as species or other taxonomic units, which maintain their identity from other groups through time and over space, and which have their own unique evolutionary history and fate.
- Earth's atmospheric composition and climate have undergone vast changes over billions of years, driving the extinction of some taxa and evolutionary change in others.

Structure and function

- Cells are fundamental units of living systems.
- Although biological systems and organisms are extraordinarily diverse, fundamental molecular and cellular processes are conserved.
- Living systems are far from thermodynamic equilibrium. They utilize energy, largely derived from photosynthesis, which is stored in high-energy bonds or ionic concentration gradients. The release of this energy is coupled to thermodynamically unfavorable reactions to drive biological processes.
- DNA is the primary genetic material responsible for inheritance. Information encoded in DNA is organized into genes. These heritable units use RNA as informational intermediates to encode protein sequences.
- Proteins become functional upon folding into distinctive three-dimensional structures. Most biological processes are controlled by multiple proteins, which assemble into modular units to carry out and coordinate complex functions.
- Lipids assemble with proteins to form membranes. Membranes surround cells to separate them from their environment and also form distinct compartments within eukaryotic cells.
- Structural complexity and information content are built up by combining simpler subunits into multiple complex combinations.
- Biological systems maintain homeostasis by the action of complex regulatory systems. These are often networks of interconnecting, partially redundant systems to make them stable to internal or external changes.
- In multicellular organisms, cells divide and differentiate to form tissues, organs, and organ systems with distinct functions. These differences arise primarily from changes in gene expression.
- Communication networks within and between cells, and between organisms, enable multicellular organisms to coordinate development and function.

[1] Sources:
AAAS (2011) Vision and Change in Biology Undergraduate Education: a Call to Action (www.visionandchange.org)

National Research Council of the National Academies (2003) BIO2010: Transforming Undergraduate Education for Future Research Biologists (http://www.nap.edu/catalog.php?record_id=10497)

- Some diseases arise from disruption of cellular communication and coordination by infection, mutation, chemical insult, or trauma.
- Living organisms have behavior; individual behaviors may be altered by experience in some species.

Ecology

- Elements cycle constantly through non-living and living pools within ecosystems.
- Populations of species interact with one another and the environment to form interdependent ecosystems with flow of energy and materials between multiple levels.
- Interactions between organisms may be beneficial, negative or neutral to the organisms involved.
- Most infectious diseases are caused by interactions between host organisms and pathogenic bacteria, fungi or viruses.
- Populations are impacted by both stochastic and deterministic processes.
- Potential population growth rates typically exceed realized population growth rates. Population growth may be impacted by the density of the population, resource availability, interspecific interactions, and environmental conditions.
- Humans rely on resources and processes performed by other organisms within the ecosystem to provide a livable environment.
- By virtue of large population sizes and the use of technology, humans have the capacity to modify the ecosystems upon which they depend at a global scale.

Capstone Project in Biological Sciences [PROPOSED CHANGES TO BE SUBMITTED FALL 2013]

The intent of the Biological Sciences capstone project is to integrate a range of knowledge and skills learned in previous courses, including scientific knowledge, quantitative literacy, and communication skills, and to apply these products of the university education to a creative activity. For a biologist, a fundamental expression of applied knowledge, creativity, and critical reasoning is to engage in scientific inquiry.

The capstone project in Biological Sciences consists of mentored research project on a biological topic that is completed in the junior or senior year. The capstone project must be designed or chosen by the student in consultation with a faculty mentor. The faculty mentor must approve the project before work begins. The project must include both evaluation of data and communication of the study intent, methods, results, interpretation, and conclusion in the form of a written paper. The capstone project requirement may be met in two ways, detailed below.

First, the student may pass, with C grade or better, a designated capstone course in Biological Sciences or Wildlife Biology and Conservation. Capstone courses are offered across a range of sub-disciplines within biology. A list of capstone courses in Biological Sciences can be found in the UAF catalog. All capstone courses include the expectation that the student will complete a biological research project. Typically, the capstone course instructor will introduce one or several model study systems and methodologies that will form the basis for the student's project. The course instructor will assist the student to design a study and analyze the results. The student will communicate the results of the project in a in a written report. Some capstone courses may require that students communicate their research findings in additional ways, such as in an oral report or poster presentation. In order to receive a C (2.0) grade or better in a capstone class, the student must receive a C grade or better on the capstone project.

Second, the student may satisfy the capstone requirement by conducting a research project with a faculty mentor, typically a member of the UAF Biology & Wildlife faculty. A student may receive course credits for the research project by enrolling in independent study (BIOL 397 or 497) or undergraduate biology research (BIOL 488 or URSA 488); however, course credits are not necessary for completion of the capstone project requirements. A more informal arrangement, in which the student performs and communicates a project under the supervision of a member of the Biology & Wildlife faculty or completes research in the context of an internship, may satisfy the capstone requirements as well. In either case, to satisfy the capstone requirement using a research project conducted outside a designated capstone course, the student must file a petition with the Biology & Wildlife department chair. The petition must include a memo by the student's faculty mentor confirming that the work was completed and a copy of the mentor's written assessment of the final paper, showing that the work was of satisfactory quality.

All capstone projects will be assessed using a common set of expectations. The rubric used by mentors to grade capstone projects may be viewed here <link>. [SEE NEXT PAGE]

Final Evaluation of Capstone Project by Research Supervisor

To be completed by student

Student's name _____ Date _____

Capstone Project Title _____

To be completed by Research Supervisor

	Yes (excellent)	Somewhat (adequate)	No (inadequate)
1. Is the capstone project the product of data collection and/or analysis by the student?			
2. Does the capstone paper make a compelling argument for the significance of the student's research within the context of the current literature?			
3. Does the capstone paper clearly articulate the student's research goals?			
4. Are the methods appropriate given the student's research agenda?			
5. Is the data analysis appropriate and accurate?			
6. Does the author interpret the results skillfully and accurately?			
7. Are the tables and figures clear, effective and informative?			
8. Is there a compelling discussion of the implications of findings?			
9. Is the literature review appropriate and complete?			
10. Are the citations presented consistently and professionally throughout the text and in the list of works cited?			
11. Is the writing appropriate for the target audience?			
12. Is the paper clearly communicated and free of language errors?			

Major -- B.A. Degree [PROPOSED CHANGES TO BE SUBMITTED FALL 2013]

1. Complete the general university requirements. (See page XXX. As part of the core curriculum requirements, complete: CHEM F105X* and F106X*.)

2. Complete the B.A. degree requirements (See page XXX). As part of the B.A. degree requirements, complete STAT 200X*. As part of the humanities and social sciences requirement, take at least 9 credits of upper division coursework. As part of the minor, take at least 3 credits of upper division coursework.)

3. Complete the following program (major) requirements:*
   a. Complete the following courses:

   BIOL F115X--Fundamentals of Biology I--4 credits
   BIOL F116X--Fundamentals of Biology II--4 credit

   BIOL F2XX—Principles of Genetics—4 credits
   ~~BIOL F261--Introduction to Cell and Molecular Biology—3 credits~~
   ~~BIOL F271--Principles of Ecology--4 credits~~
   ~~BIOL F310--Animal Physiology (4)~~

   ~~or BIOL F334W--Structure and Function of Vascular Plants (4)~~
   ~~or BIOL F342--Microbiology (4)--4 - 8 credits~~

   ~~or BIOL F111X and F112X--Human Anatomy and Physiology I & II (8)~~

   BIOL F481--Principles of Evolution--4 credits

   PHYS F103X--College Physics--4 credits
   ~~STAT F200X--Elementary Probability and Statistics--3 credits~~

   ~~BIOL 303—Principles of Metabolism and Biochemistry (4)~~

   ~~or~~ CHEM F321--Organic Chemistry I (~~3~~4)

   ~~and CHEM F322—Organic Chemistry (3)~~

   b. Complete two of the following three biology breadth requirements**

   1. BIOL 3XX—Cell Biology (3)

   2. BIOL 3XX—Principles of Ecology (4)

   3. Physiology: complete one of the following:

   BIOL F310--Animal Physiology (4)

   or BIOL F334W--Structure and Function of Vascular Plants (4)
   or BIOL F342--Microbiology (4)--4 - 8 credits

   or BIOL F111X and F112X--Human Anatomy and Physiology I & II (8)

c. Complete three elective courses from lists A, B, C, or D, at least one of which is designated a W course***. If possible, satisfy all UAF core requirements for W and O courses and the biology capstone requirement with these elective courses.

d. Complete a biology capstone project (No credit requirement)
The capstone requirement can be met through petition, by completing a mentored research project with a faculty member (e.g. by taking BIOL 488, BIOL 497, or BIOL 498, or without course credits), or automatically by completing at least one of the following courses:

BIOL 334W – Plant Structure and Function (4)

BIOL 472W – Community Ecology (3)

BIOL 441W, O/2 – Animal Behavior (4)

BIOL 473W – Limnology (4)

BIOL 4XX – Research Techniques in Cell and Molecular Biology (3)

BIOL 4XX – *New physiology capstone course*

BIOL 4XX – *New ecology capstone course*

BIOL 303 – Metabolism -?

4. Minimum credits required—120 credits