Annual Program Report
2022-2023

The report(s) should be inclusive of all levels, degrees (i.e. certificates, bachelor's and master's), modalities and locations.

Department: Biology in the Biology and Chemistry Department

Department Chair: Michael Nosek (chair)

Department Assessment Committee Contact: John Ludlam

This document is to be kept in the department and an electronic file is due to the AVP of Institutional Research and Planning by June 1, 2023.

Section I: Program Assessment (please complete this section for each program in your department)

Program: Biology

A. Program Learning Outcomes (PLOs) (Educational Objectives)

I. List of PLOs and the timeline for assessment

PLO #	PLO – Stated in assessable terms	Where are the learning outcomes for this level/program published? (please specify) Include URLs where appropriate.	Timing of assessment (annual, semester, bi-annual, etc.)	When was the last assessment of the PLO completed?
1.	Demonstrate content knowledge of the AAAS BioCore, with topics in: ● Evolution ● Transformations of Energy and Matter ● Information Flow, Exchange and Storage	Program assessment plan	Annual	AY21/22 Capstone Courses

	● Structure and Function ● Systems			
2.	Conduct original biological research. ● Clearly articulate testable questions and hypotheses ● Design and execute experiments ● Analyze data using appropriate statistical methods ● Summarize data concisely with graphs, tables or images ● Draw appropriate conclusions ● Demonstrate safe practices in laboratory and field	Program assessment plan	At least once in a five-year period	AY21/22 Capstone Courses
3.	Communicate science orally and in writing. ● Present information in a clear and organized manner ● Write well-organized and concise reports in a scientifically appropriate style ● Use relevant technology in communications. ● Communicate to a general audience	Program assessment plan	At least once in a five-year period	AY21/22 Capstone Courses
4.	Use scientific literature. ● Retrieve information efficiently and effectively by searching the biological literature ● Cite sources appropriately	Program assessment plan	At least once in a five-year period	Fall 2022 Capstone Assessment

II. **PLO Assessment** (Please report on the PLOs assessed and/or reviewed this year. Programs should be assessing at least one each year.)

Using the table below, list and briefly describe the **direct method(s)** used to collect information assessing whether students are learning the core sets of knowledge (K), skills (S) and attitudes (A) identified as essential.

PLO # (from above)	**Assessment description (exam, observation, national standardized exam, oral presentation with rubric, etc.)**	**When assessment was administered in student program (internship, 4th year, 1st year, etc.)**	**To which students were assessments administered (all, only a sample, etc.)**	**What is the target set for the PLO? (criteria for success)**	**Reflection on the results: How was the "loop closed"?**
4	Presentations made by students in Cancer Genomics course	Capstone course (3rd or 4th year)	All	Two-thirds (>66%) of our students will score as sufficient or proficient in each of the elements defined by our scoring rubric for PLO4: (1) retrieve information, (2) evaluate scientific articles, (3) cite sources.	Summary results are included below in Table 1. Results exceeded target for retrieving information and citing sources. Successful target was not achieved for evaluating scientific articles. The data was reported at department retreat and strategies were discussed (see comments below).

You may use this comment box to provide any additional information, if applicable:

The topic of evaluating scientific literature was discussed at our department retreat in January of 2023. The capstone assessment results were discussed to provide a prompt for a broader discussion. Faculty members shared assignments and strategies employed in their courses that involve using scientific literature. It was decided that we would revise the language in our 5 year assessment plan from "evaluate" scientific literature to "use" scientific literature. The rationale for the change is that evaluating scientific literature is a graduate level skill and therefore not a reasonable expectation for undergraduate students.

Summary of Findings: Briefly summarize the results of the PLO assessments reported in Section II above combined with other relevant evidence gathered and show how these are being reviewed/discussed. How are you "closing the loop"?

Reflection Prompt	Narrative Response
Other than GPA, what data/ evidence is used to determine that graduates have achieved the stated outcomes for the degree? (e.g., capstone course, portfolio review, licensure examination)	PLO-1 is assessed from our pre-post assessment test of BioCore content knowledge. This was last assessed in AY 2021-22 and revealed a few areas of weakness, including physiology (structure/function, surface area/volume ratios, negative feedbacks), and a few specific concepts about evolution and energy flow. Students show strengths and significant improvement across many areas of Biology, including cell biology, genetics, phylogeny and ecology. We are in the process of moving the questions to an online format and reevaluating the strength of the test questions. PLOs 2-4 are capstone skills. PLO 4 was assessed using a Capstone Skills rubric to assess presentation in capstone courses. In fall 2022, Cancer Genomics student presentations were assessed. The skills that were assessed were (1) retrieving information, (2) evaluating scientific articles, and (3) citing sources.
Who interprets the evidence? **What is the process? (e.g. annually by the curriculum committee)**	PLO-1 is a test that is analyzed by members of the Assessment Committee Typically, PLOs 2-4 are evaluated by members of the Assessment Committee. Committee members attend student presentations in the capstone course and use a rubric developed with the input of the faculty member teaching the course. However, we have found that the presentations are difficult to assess by outside observers (given the technical nature of the assignments). Therefore, in fall 2022 the faculty instructor used the capstone rubric to assess student presentations. We believe that this method provided more accurate data on the ability of the students to use scientific literature.

What changes have been made as a result of using the data/evidence? (close the loop)	The topic of evaluating scientific literature (PLO 4) was discussed at our department retreat in January of 2023. The capstone assessment results (Table 1 below) were discussed to provide a prompt for a broader discussion. Then we reflected on a survey the faculty filled out, asking 1) which skills they expect students to already know; 2) which skills are most problematic to students; and 3) specific strategies faculty use to teach those skills. Faculty members shared assignments and strategies employed in their courses that involve using scientific literature. It was decided that we would revise the language in our 5 year assessment plan from "evaluate" scientific literature to "use" scientific literature. The rationale for the change is that evaluating scientific literature is a graduate level skill and therefore not a reasonable expectation for undergraduate students. The discussion from this retreat topic is summarized below as Appendix 4.

Table 1. Summary of the results for Cancer Genomics capstone presentations in Fall 2022. Score categories were 3 = proficient, 2 = sufficient, 1 = deficient, 0 = no attempt. Average scores and percentage of students achieving sufficiency or proficiency are reported.

	Retrieve Information	Evaluate Scientific Articles	Cite Sources
Average	2.63	1.93	2.70
Percent Scoring Sufficient or Proficient	93.33	53.33	86.67

B. Assessment Plan for Program/Department

I. Insert the program or department Assessment Plan (This is an independent plan from what is reported in this document). Assessment Plan included in Appendix 3.

II. Explain any changes in the assessment plan including new or revised PLOs, new assessments that the program/department plans to implement and new targets or goals set for student success.

The Assessment Committee submitted the Biology Plan in June of 2020. The consensus from the discussion at the departmental retreat was that it is not realistic for undergraduate students to really "Evaluate scientific articles critically." Yet that is how one of sub-categories of this LO was titled. That sub-category could be reworded more simply to something like "Using scientific literature". That name better fits the current description of this sub-category that asks students to "Skillfully relate results to recently published literature. Synthesize in-depth information from a thorough range of relevant sources."

III. If you do not have a plan, would you like help in developing one? We have a Biology Assessment Plan

C. Program Review Action Plan or External action Letter/Report

Annual Reflection/Follow-up on Action Plan from last Program Review or external accreditation (only complete the table that is appropriate for your program

I. **Programs that fall under Program Review:**

i. Date of most recent Review: **2018 (Biology)**

ii. Insert the Action Plan table from your last Program Review and give any progress towards completing the tasks or achieving targets set forth in the plan.

Specific area where improvement is needed	**Person(s) responsible for implementing the change**	**Timeline for implement ation**	**Resources needed/** ***(Copied from Action Plan Table in Program Review)***	**Progress Made this Year**

Clarifying expectations and assessment in capstone courses.	Curriculum and Assessment	“AY21”	Assessment Committee along with Profs will generate expectations and assessments. The Curriculum committee will review and bring to department.	A rubric has been created and is being used as a guide to assess PLOs 2-4 and assessment results have been analyzed by the assessment committee and discussed at department retreats.
Clarify the objectives and outcomes of Independent Studies.	Curriculum	“AY19”	None needed.	Independent Studies are now listed on the seats list and formal syllabi with objectives and outcomes are required.
Reassess the need for additional courses offered at 2000 or above.	Department Chair in association with Curriculum Committee	AY23		Additional courses have already been added to the curriculum. The department will reassess the need for additional courses as the number of students in our program changes.
Consider a physiology cluster requirement for majors.	Assessment	“AY20”		Two courses were created to fulfill this need: Human A&P I & II. They are not a requirement of the major but are a requirement of our largest concentration: health sciences. We will continue assessing this content area to determine if these courses are having an impact.
Considering making statistics a requirement.	Department	Finished		Resolved in 2019. The diverse needs of our students make the implementation of this requirement problematic. Since

				Applied Statistics has been a recommended course for many years it was felt that the students are best served by advisor recommendation rather than making it a requirement.
Continue to address challenges in our assessment plans.	Assessment	Finished	The committee will develop an action plan to address specific deficiencies within the assessment plan. This plan should include a timeline and required resources. Resources may include funding for summer working groups.	Biology Assessment Plan was completed at the end of AY20. In Spring 2023, we modified PLO4 after a discussion during our department retreat.
Improve the coordination and marketing of internships with the addition of an internship coordinator.	Department Chair	"Ongoing beginning AY20."	Coordinate with the dean. Possibility of summer stipend in addition to course release.	Dr. Awasibisah was supported by an Academic Innovation Fund grant in Fall 2022 to work on internship coordination. In AY21 the Student Affairs Committee held virtual workshops on resumes and finding jobs. Seminars for Intro to Health Science Professions were open to all students. Lindsay from Career Center gave a workshop on internships for students in Genetics class, and she organized a career panel.

Addition of release time for the health professions advising.	Department Chair	AY19	Coordinate with the dean.	The addition of 1 course release for health profession advising began in 2021.
Document active-learning and guided inquiry in courses.	Curriculum	Ongoing	The department will develop a system of documenting the use of different course delivery mechanisms and STEM best practices	While interrupted by the pandemic and Gen Ed proposals, the department informally and frequently shares teaching strategies, especially for engaging online students. Biology and Chemistry faculty members have also been active participants in the formation of a General Education learning community focused on the STEM related learning outcomes of Quantitative Reasoning and Procedural and Logical Thinking. In upcoming years this community will be documenting best-practices to support students in developing these learning outcomes including active-learning and guided inquiry models and assignments.
Continue to participate in campus-wide initiatives to retain diverse students.	Student Affairs	Ongoing	Utilization of SSC, embedded tutors, additional faculty training, participation on campus-wide committees aimed towards student success.	Chris C collaborated with faculty from Computer Science, Engineering Technology and Mathematics to develop and submit an S-STEM NSF grant proposal to support recruitment and retention of academically talented low income students

				from underrepresented populations. The Biology & Chemistry was awarded a Moderna Foundation's grant to create a research fellows program that is targeted towards "high-risk" undergraduate populations. L. Grimm and R. Krieser discussed their DEI work at our Jan. 2023 department retreat, including responses that minority and first-generation students compiled regarding challenges they face at Fitchburg State.
Develop a consistent rotation of graduate courses.	Graduate Committee	NA	The long delay has to do with recognition that many programs are being revamped. Once GCE has stabilized then a course rotation will be developed that meets the needs of students in the new programs.	Discontinued because we no longer have a viable graduate program in our department.
Search for a full-time, tenure-track faculty member to teach A&P with a specialty in vertebrate biology.	Search Committee	Finished		Completed previously.

Develop an equipment maintenance and replacement plan.	Equipment and Facilities	AY20	The equipment and supply budget may have to increase depending on the equipment needed. Plan developed AY2019. Implementation begins in AY2020. This action item needs to include technical staff.	This is ongoing. In addition, the department applied for a $750K Mass Life Science grant in Spring 2023 to update and modernize our equipment
Review the new self-study guidelines AUC 176 from AY2018 and reconfigure the department committee structure and work distribution.	Department-wide	AY19		Not yet addressed.
Analyze the ever-increasing burden on the department for non-major's courses and summer programs.	Chair in association with an ad-hoc committee	AY21		Ongoing.

iii. If you do not have an action plan, would you like help in developing one based on your last program review and needs of the program? NA

II. Programs with external Accreditation: NA

i. Professional, specialized, State, or programmatic accreditations currently held by the program/department.
ii. Date of most recent accreditation action by each listed agency.
Iii. Date and nature of next review and type of review.

List key issues for continuing accreditation identified in accreditation action letter or report.	Key performance indicators as required by agency or selected by program (licensure, board or bar pass rates; employment rates, etc.) (If required.)	Update on fulfilling the action letter/report or on meeting the key performance indicators.

Section II - Departmental Outcomes

A. Departmental Strategic Initiatives

Accomplished Initiatives AY22-23 Add more rows as needed	Corresponding Strategic Plan Goal & Strategy Goal # followed by Strategy # ex: 1.3	Indicate (X) if a Diversity, Equity and Inclusiveness (DEI) Goal
Work with MassLife Sciences (focused on life sciences workforce development) to create internship pipelines, upgrade laboratory equipment, and coordinate curriculum to fulfill demand for industry competencies. (ongoing)	1.2 - Forge innovative paths to career readiness	
Secured funding for research fellows program (Moderna Foundation Grant). The program is a scholarship program that targets underserved populations to increase retention (through faculty mentored research). (ongoing)	1.2 Forge innovative paths to career readiness 2.1 Narrow achievement gap 6.4 Increase philanthropic support for university	X
Formation of Biotechnology Advisory Board (ongoing)	1.4 Forge deeper connections between our curriculum and community needs.	

MassBioEd networking event- 17 biotechnology industry career professionals attended a networking event on our campus in Spring 2023. Well attended by students. (ongoing)	1.2 Forge innovative paths to career readiness	
Applied for Mass Life Sciences foundation grant to upgrade and modernize equipment.	6.4 Increase philanthropic support for university	
Applied Learning: undergraduate research. Especially reaching out to minority students (Ongoing)	2.1 - Student-ready university - cultural shift for underrepresented students	X
Reverse declining enrollment. Faculty outreach to accepted students; Virtual Open Houses, etc. (Ongoing). Early enrollment data for Fall 2023 shows improvement. Held MassBioEd Teacher Workshop on campus. Created a document, "Talking Points for Admissions" and shared with Admissions Staff and departmental faculty as a Google Doc. (ongoing)	5.6 - Marketing	
Creation of a Biology & Chemistry Alumni LinkedIn page to strengthen connections with alumni	5.6- Marketing	
Open Educational Resources: now adopted in both intro Bio classes, some upper level electives, and some non-majors classes. A list of courses and faculty using OERs in our department can be found here. (ongoing initiative)	5.7-Affordability	

Planned Initiatives for AY 23-24 Add more rows as needed	**Associated Strategic Plan Goal & Strategy** Goal # followed by Strategy # ex: 1.3	**Indicate (X) if a Diversity, Equity and Inclusiveness (DEI) Goal**
The department received a CTL Teaching, Learning and Innovation Grant to create an online guide to graphing and statistics. The idea arose from discussions in our Assessment Committee: It may help students to have more consistent approaches to teaching these skills across different courses. We will create a guide with embedded videos to teach basic skills, with the hopes that the skills will feel more familiar to students when they have the same resources.	1.7 Leverage institutional expertise in online education to reinforce the University's commitment to access.	
Creation of a research fellows program with moderna grant funding	1.2 Forge innovative paths to career readiness 2.1 Narrow achievement gap 6.4 Increase philanthropic support for university	X
Focus more on enrollment strategies. Improve 4-year plans with career competencies and Alumni stories. Check our website: how inviting is it? Consider another video with a tour?	5.6 - Marketing	
See all "Ongoing" initiatives above for AY'23.		

B. Departmental Accomplishments and Reflection:

Take this section to reflect on:

1. *22-23 Accomplishments not captured above*
2. *Initiatives that you may be considering for 23-24 academic year that you did not already capture above*
3. *Any other thoughts or information that you would like to share*

Over the past year, we applied for a number of grants to strengthen our program and modernize our equipment. The Moderna Foundation Grant funds 12 student salaries for faculty mentored research programs. Students will also receive academic credit for their work. The program targets “high risk” students with the aim of improving retention and academic performance. The program is funded for 1 year, but we plan to apply for additional funding. In addition we collaborated with faculty from Computer Science, Engineering Technology and Mathematics to develop and submit an S-STEM NSF grant proposal to support recruitment and retention of academically talented low income students from underrepresented populations.

The Mass Life Science grant is a $750K equipment grant that would modernize and upgrade our equipment. The grant has a biotechnology focus and required our department to perform outreach with local biotechnology companies. We received support from MassBioEd and Bristol Myers Squibb. We are continuing to reach out to Charles River Laboratories, Abbvie, and Biosynth. We also worked with MassBioEd to host a networking event. 17 career professionals and 52 students attended the event. Many of the career professionals were FSU alumni. We are planning to make this an annual event.

In addition we hosted a MassBioEd workshop for local high school and middle school teachers. The teachers received professional development credits and learned some biotechnology laboratory techniques that they could apply in their classroom. As part of this program, MassBioEd funded an equipment lending program which allows teachers to borrow biotechnology equipment that we store on our campus. We plan to make this workshop an annual event.

Also please refer to section II.A above.

Appendices

1. PLO 1: Assessment test
2. PLO 2 - 4: Capstone presentation assessment rubric
3. Assessment Plan June 2020
4. Summary of retreat discussion around PLO4: Using Scientific Literature

Appendix 1: PLO 1: Assessment test

Biology Program Assessment Test

This test is a way to measure how much biological knowledge students have when they start at Fitchburg State, and how much they learned when they are done. We do NOT expect you to know most of the answers when you arrive!

- Please enter all answers on a bubble sheet. Choose only one answer unless indicated otherwise.
- Please do NOT write on this test, so we can reuse this paper.

1. Are you a Biology Major? A. Yes B. No

2. Please select any courses you have already completed at Fitchburg State. You can select any number of answers, or none.
   - A. General Biology I (or equivalent)
   - B. General Biology II (or equivalent)
   - C. Genetics
   - D. Ecology

3. Please select any courses you have already completed at another college. You can select any number of answers, or none.
   - A. General Biology I (or equivalent)
   - B. General Biology II (or equivalent)
   - C. Genetics
   - D. Ecology

4. Which of the following are a source of energy used by plants? Choose ANY that are correct; there can be more than one.
   - A. Carbon dioxide (CO_2)
   - B. Phosphate (PO_4^-)
   - C. Sunlight
   - D. Water (H_2O)
   - E. ATP

5. A tropical rainforest is an example of an ecosystem. Which of the following statements about matter and energy in a tropical rainforest is the most accurate?
   - A. Energy is recycled back into the ecosystem, but most matter is released and not re-used.
   - B. Most matter is recycled back into the ecosystem, but most energy is eventually respired away and not re-used.
   - C. Both matter and energy are mostly recycled back into the ecosystem.
   - D. Both matter and energy are eventually respired away and not re-used.

6. The organisms at the top of a food web:
   - A. Accumulate all of the energy that existed in the consumed organisms that were lower in the food web.
   - B. Have less available energy than trophic levels below it.
   - C. Have the same amount of accumulated energy as each of the trophic levels below it.

D. Have available to it all of the energy of the food web.

7. If an organism has a greater evolutionary fitness than other individuals of the same population, then the organism _____. [*Choose only the ONE best answer.*]

A. Lives longer than others
B. Competes for resources more successfully than others
C. Mates more frequently than others
D. Utilizes resources more efficiently than others
E. Leaves more offspring than others

8. In an imaginary insect species, the dominant allele G codes for dark green color and the recessive allele g codes for light green color. Suppose a population of these insects moves into a habitat with light-colored leaves, such as a grassland. The lighter insects are better camouflaged and can escape predators. What changes would you expect in subsequent generations?

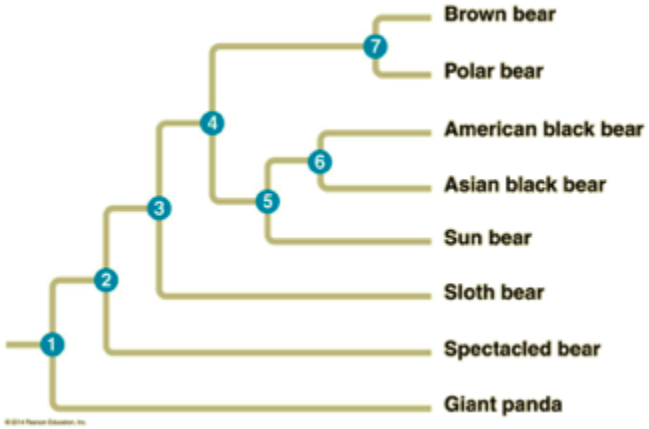
A. No change in frequencies of alleles or phenotypes.
B. Increase of the recessive allele frequency, but no change of phenotype because that allele is recessive
C. Increase of the frequency of the dominant allele and the dark color
D. Increase of the frequency of the recessive allele and light color
E. Increase of the recessive allele and eventually genetic co-dominance

The process of 9._____ generates new genetic variation, while 10._____ can act on this variation to produce adaptations to the environment.

A. Natural selection
B. Mutation
C. Genetic drift
D. Gene flow

11. This is a phylogenetic tree of the bear family, the Ursidae. Of the following pairs of species, which should have the most similar DNA to each other?

A. Giant panda and spectacled bears
B. Sun bears and black bears
C. Brown bears and polar bears
D. Brown bears and Giant panda bears
E. The answer cannot be inferred from an evolutionary tree like this.



12. Consider the following three species of mammals that are trying to stay warm.

	Species A	Species B	Species C
Surface Area =	10,200 cm^2	1728 cm^2	2400 cm^2
Volume =	63,000 cm^3	4320 cm^3	3000 cm^3
Surface Area/Volume =	0.16 cm^2/cm^3	0.4 cm^2/cm^3	0.8 cm^2/cm^3

Write the letter (A, B or C on your bubble sheet) of the species that would cool down the fastest, or have the most trouble trying to stay warm.

13. If the body is too warm, glands in the skin secrete sweat to cool the body, and then the body stops sweating. This is an example of: *[Choose ANY correct answers.]*

A. Homeostasis using negative feedback
B. Homeostasis using positive feedback
C. Thermoregulation using negative feedback
D. Thermoregulation using positive feedback

14. What does it mean for a gene to be "expressed"?

A. It is mutated to a different form
B. It is inserted into a bacterial plasmid
C. It is inactivated using methyl groups
D. It is transcribed to RNA and then translated into a protein
E. It is quickly replicated during cell division

15. A main source of energy for immediate use inside a cell is:

A. DNA
B. ATP
C. RNA
D. Ribosome
E. CO_2

16. Choose the process that requires an input of energy

A. Active transport
B. Osmosis (diffusion of water) through a plasma membrane
C. Facilitated diffusion of glucose across a plasma membrane down a concentration gradient
D. Diffusion of oxygen across the plasma membrane

17. Your bone cells, muscle cells, and skin cells look different because

A. They contain different numbers of genes
B. Each cell contains different kinds of genes
C. Each cell has a different mutation
D. Different genes are active in each kind of cell

18-20. You want to measure the effect of light waves on plant photosynthesis. You design an experiment that exposes corn plants to light at 4 different wavelengths and measure O_2 production as an indicator of photosynthesis. In this experiment…

18. What is the independent variable?
A. The control
B. Corn
C. Wavelength of light
D. Amount of light
E. O_2 production

19. What is the dependent variable?
A. The control
B. Corn
C. Wavelength of light
D. Amount of light
E. O_2 production

20. Which of the statements below best describe the hypothesis being tested in the experiment described above?
A. There is a relationship between O2 production and the variety of corn.
B. There is a relationship between the growth of corn plants and the amount of O2 they produce.
C. There is a relationship between the growth of corn plants and the amount of light to which they are exposed.
D. There is a relationship between the amount of O2 produced by corn plants and the wavelength of light to which they are exposed.
E. There is no relationship between photosynthesis and production of O2 in corn plants.

If the forests around Fitchburg State <u>are not</u> affected by a significant disturbance over the next century, then the tree community is likely to become 21._____ diverse due to 22._____.

21.
A. More
B. Less

22.
A. Dispersal of seeds
B. Co-evolution with herbivores
C. Stress from herbivores
D. Some species out-competing others
E. Differentiation of tree niches

23. Muscle cells have the ability to change shape in response to external stimuli. Which of the following properties allows muscle cells to perform this specialized function? *Choose ANY that apply.*

A. the cytoskeletal proteins within the cell
B. the organelles within the cell
C. the receptor proteins present on the cell's membrane
D. the shape of the cell
E. the high abundance of mitochondria in each cell

24. Which of the following is an example in which structure determines function? Choose ANY that apply.

A. Neurons have receptor proteins on their membranes that respond to external stimuli
B. Herbivores have flat teeth to grind fibrous plant materials
C. Plant leaves are coated with a waxy layer perforated by tiny holes
D. Enzymes have binding pockets that are specific for their substrates

25. A young man, due to his exposure to the sun, acquired a mutation in his skin cell DNA that increases his future risk of developing skin cancer. Should he be concerned that he will pass this mutation on to his future children? Choose the BEST answer.

A. Yes because his children will inherit all of his DNA.
B. Yes but only if he develops skin cancer in his lifetime.
C. Yes, because his children will inherit half of his DNA.
D. No because only mutations present in gametes (egg, sperm) are passed to children.
E. No because his children will inherit only half of his DNA.

26. Have you have already taken this assessment in another course this year?

A. No
B. Yes

Appendix 2: PLO 2 - 4: Capstone presentation assessment rubric

LO2 Conduct original biological research.				
	Proficient =3	**Sufficient** =2	**Deficient** =1	**No attempt =0**
2A. Clearly articulate testable questions and hypotheses	Identifies a creative, focused, and manageable topic that addresses potentially significant yet previously less-explored aspects of the topic.	Identifies a focused and manageable/doable topic that addresses some relevant aspects of the topic.	Identifies a topic that is far too general and wide-ranging as to be manageable and doable.	
2B. Design and execute experiments	All elements of the methodology are skillfully developed and described. Experimental treatments address the question without confounding factors. Sample size is appropriate.	Critical elements of the methodology are appropriately developed and described, however, more subtle elements are ignored or unaccounted for (e.g., too few samples).	Description of design demonstrates a misunderstanding of the methodology and/or the basic question addressed.	
2C-1. Summarize results concisely with graphs, tables or images	Skillfully converts relevant information into an insightful portrayal that contributes to a further or deeper understanding.	Portrayal is only partially appropriate or accurate. For example, a graph might be missing units, or the relevance of an image may be unclear.	Portrayal is mostly inappropriate as a way to summarize results.	
2C-2. Analyze data using appropriate statistical methods	Skillfully uses statistical summaries or tests for an insightful portrayal that contributes to a further or deeper understanding.	Statistical summary or test is only partially appropriate or accurate.	Portrayal or test is inappropriate or inaccurate.	

2C-3 Describe results: Explain patterns from observations or data	Provides thorough and accurate descriptions of patterns or trends in data. Skillfully incorporates statistics into writing. For example, differences in means are quantified, with units. Or the slope of a line is used to describe a pattern in a graph. Or P-values are included appropriately.	Provides simple and mostly accurate descriptions of patterns or trends in data. A simple description would be qualitative but not quantitative. Or there are occasional, minor errors in computations, units, etc.	Draws fundamentally incorrect interpretations about what the data mean.	
2D. Draw appropriate conclusions	Uses the results as the basis for thoughtful judgments, drawing insightful, carefully qualified conclusions from this work. Connects and expands on results from different sources, and formulates a coherent argument about a topic. Relates results to appropriate mechanisms (causes). AND/OR Relates appropriate applications or implications from the study.	Uses the results for basic judgments that are correct but lack inspiration or nuance. No attempts to qualify the conclusions, nor to elaborate on mechanisms, nor to consider implications outside this study. OR Minor errors exist in the conclusions.	Conclusions are not appropriate or are clearly incorrect for the results.	May restate a pattern in data/observations, but no attempt is made to draw any conclusions or judgments.
2E. Demonstrate safe practices in laboratory and field	**???**	**???**	**???**	
LO3 **Communicate science orally and in writing.**				

	Proficient =3	**Sufficient** =2	**Deficient** =1	**No attempt =0**
3A. Write well-organized and concise reports in a scientifically appropriate style	Writing is consistently well-organized, concise, professional, and coherent. Written work follows a publishable format.	Writing is mostly (but not completely) organized, professional, and coherent.	Writing lacks organization or is often not coherent. At least one section of a report is poor: e.g., an Introduction that lacks hypotheses, a Methods written like a recipe, or a missing Results description.	
3B. Present information in a clear and organized manner (Oral presentation or Poster)	Presentation is consistently well-organized, professional, and coherent. Images and text are clearly readable by the audience.	Delivery is mostly (but not completely) organized, professional, and coherent. Images and text are mostly readable.	Presentation lacks organization or is often not coherent. Images and text are often difficult for an audience to read or understand.	
3C. Use relevant technology in communications.	Effectively uses technology to present supporting text and images to the audience.	Uses technology to present supporting text and images to the audience.	Unable to use technology to present supporting text and images to the audience.	
3D. Communicate to a general audience	Poster or presentation could be easily understood by non-experts.	Poster or presentation could be understood by most Biology majors, but non-science majors would struggle to understand the main ideas.	The main ideas of the Poster or presentation could not be understood by people outside of that course.	

LO4 **Use scientific literature**

	Proficient =3	**Sufficient** =2	**Deficient** =1	**No attempt =0**
4A. Retrieve information efficiently and effectively by searching the literature	Retrieves appropriate, focused sources from primary literature. Scholarly review papers are acceptable.	Presents information from relevant sources, but including some less-scholarly sources, or representing limited points of view/approaches.	Presents information from mostly irrelevant sources.	No resources provided when they were expected in the assignment

~~4B. Evaluate scientific articles critically~~	~~Skillfully relates results to recently published literature. Synthesizes in-depth information from a thorough range of relevant sources.~~	~~Relates results to published literature, but only enough to fulfill the requirements of the assignment, or some areas of the literature were not considered.~~	~~Results or concepts from different sources are included, but there is no (or a very weak) connection to the focus of this study.~~	
4C. Cite sources appropriately.	All sources are cited in a professional, publishable manner.	Most sources are cited in a professional, publishable manner. A rare mistake might include missing page numbers, for example, or including author initials in the in-text citations.	Most sources are not cited in a professional, publishable manner. For example, commonly missing Journal, volume, or pages. Or omitting author or year in most in-text citations.	

Appendix 3.

Programmatic Assessment Plan

Program Name: ___Biology_____ Created By: ____Assessment Committee_____ Date: ___5/12/20_____

School of Health and Natural Sciences Mission

The mission of the School of Health and Natural Sciences is to help students develop the skills and habits of mind necessary for scientific inquiry and analysis in their professional, personal and civic lives. Faculty experts and engaged staff in the fields of biology, chemistry, earth and geographic sciences, exercise and sports science, mathematics, physics, psychological science, and nursing support students via foundational learning in the general education curriculum and mastery of content in a variety of majors. Our faculty offer classroom, laboratory, and clinical instruction as well as research opportunities in the sciences and health professions. Faculty and staff collaborate across the University and beyond to offer interdisciplinary learning opportunities.

Department of Biology and Chemistry Mission

The Biology and Chemistry Department believes that every student deserves a first-class education. We are educators at Fitchburg State because our personal values align with the campus values of equity and excellence. We strive to ensure that our students have the best of what we can offer them as they gain an in-depth knowledge of science that is part of a larger interdisciplinary, multicultural liberal arts and sciences education.

In order to achieve our mission, we undertake to:

- Produce students who are well prepared for diverse careers or advanced study in the biological and chemical sciences or related disciplines as well as gain the skills necessary to successfully adapt to future changes within their disciplines.
- Build lasting relationships with students that will advance their professional growth by recognizing the unique needs of each individual and reflecting our passion for engagement in authentic learning experiences.
- Maintain a high level of scholarly activity in a variety of fields associated with biology, chemistry and science education.

- Serve the needs of the university and specific academic departments through our curricular offerings and involvement in the university community.
- Endeavor to demonstrate leadership as stewards of the environment.
- Provide state of the art pedagogical approaches as well as utilize appropriate equipment, technology, and resources for teaching, learning and research in the sciences and science education.
- Work to support the University's mission of providing leadership and support for the economic, environmental, social, and cultural needs of North Central Massachusetts and the Commonwealth.

Part I: Student Learning Outcomes

University Level

ILP Code	Institutional Learning Priorities (ILPs)
ILP 1	**Graduates have a deep understanding of the world.** ***Accomplished through:*** **ILP 1A. Foundational Skills and Disciplinary Breadth** – Students will demonstrate attainment of the Learning Outcomes of the Liberal Arts and Sciences program. **ILP 1B. Mastery in a Defined Body of Knowledge** – Students will attain the specialized academic objectives of their major or program. **ILP 1C. Engagement with Campus and Community** – Students will develop personal and professional skills, goals, and ethical standards of behavior though co-curricular experiences.
ILP 2	**Graduates know how to learn and how to apply their knowledge.** ***Accomplished through:*** **ILP 2A. Creative and Critical Thinking** – Students will use evidence and context to increase knowledge, reason ethically, assess the quality of information, solve problems, and innovate in imaginative ways. **ILP 2B. Effective Communication** – Students will carefully consider and clearly articulate ideas for a range of audiences and purposes in written, spoken, technology-mediated, visual, or other forms of communication. **ILP 2C. Integrative Learning** – Students will apply their breadth and depth of knowledge, skills, and experience to address complex issues.
ILP 3	**Graduates are engaged citizens who demonstrate integrity and continuous personal growth.** ***Accomplished though:***

	ILP 3A. Respect for People and Cultures – Students will appreciate the contributions and needs of diverse individuals and groups and understand themselves in solidarity with others locally, nationally, and globally. **ILP 3B. Civic Participation in Wider Communities** – Students will demonstrate their ability to work within and across communities, to apply their knowledge in the service of others, and to promote social justice. **ILP 3C. Continuous Learning and Personal Growth** – Students will approach the world with confidence and curiosity, appreciate the complex identities of themselves and others, and reflect critically on their experiences throughout life to make informed choices that advance their own well-being and that of the larger community.

Division Learning Outcomes (DLOs) *

LO Code	Division Student Learning Outcomes	Alignment to LA&S LOs or ELOs
DIV 1	Develop the skills and habits of mind necessary for scientific inquiry and analysis in professional, personal and civic lives.	
DIV 2	Support students via foundational learning in the general education curriculum and mastery of content in a variety of majors.	
DIV 3	Offer classroom, laboratory, and research opportunities in the sciences and health professions.	
DIV 4	Offer interdisciplinary learning opportunities.	

*** These divisional learning outcomes are unofficial. To our knowledge, the school of health and natural sciences has yet to create officially stated learning outcomes. These divisional learning outcomes are derived from the school's mission statement.**

Department Learning Outcomes

LO Code	(Biology) Learning Outcomes (LOs)	Alignment to Division/LA&S LOs or ELOs
PLO 1	*Demonstrate content knowledge of the AAAS BioCore, with topics in:* ● *Evolution* ● *Transformations of Energy and Matter*	DIV 1, DIV 2,

	• *Information Flow, Exchange and Storage* • *Structure and Function* • *Systems*	
PLO 2	***Conduct original biological research***. · *Clearly articulate testable questions and hypotheses* · *Design and execute experiments* · *Analyze data using appropriate statistical methods* · *Summarize data concisely with graphs, tables or images* · *Draw appropriate conclusions* · *Demonstrate safe practices in laboratory and field*	DIV 1, DIV 3
PLO 3	***Communicate science orally and in writing.*** · *Present information in a clear and organized manner* · *Write well-organized and concise reports in a scientifically appropriate style* · *Use relevant technology in communications.* · *Communicate to a general audience*	DIV 2
PLO 4	***Use scientific literature.*** · *Retrieve information efficiently and effectively by searching the biological literature* · *Cite sources appropriately*	DIV 1

Part II: Curriculum Mapping

COMMON (Program Name) CORE

	PLO 1	PLO 2	PLO 3	PLO4
General Biology I	1A	1	1	1
General Biology 2	1-2	1	1	1
Ecology	1-2	2	2	2
Genetics	2	2	2	2

Capstone Course	2-3A	3A	3A	3A

0	1	2	3	A
Not Addressed	Introducing	Broadening	Fulfilling	Assessed for Program

Key

PLO = Program Learning Outcome
Not Addressed = PLO is not addressed within the specific course
Introducing = PLO is covered at an introductory level within the specific course
Broadening = PLO is covered in the course so as to reinforce the students' learning of it within the specific course
Fulfilling = Demonstration of proficiency of the PLO occurs within the specific course
Assessed for Program = There will be a Direct Assessment activity to be used in Program Level Assessment in all sections of this course.

Part III: Assessment Measures, Timelines and Targets

Direct Assessment

PLO #	Assessment description (written project, oral presentation with rubric, etc.)	Timing of Assessment	When assessment is to be administered in student program	To which students will assessments administered	What is the target set for the PLO? (criteria for success)
1	Students take a quiz with questions that are mapped to the AAAS BioCore content areas (Evolution, Transformations of Energy and Matter, Information Flow, Exchange and Storage, Structure and Function Systems)	Annual	General Biology I (1st year) & Capstone Course (3rd or 4th year)	A subset of students will be tested. Students enrolled in General Biology I and students enrolled in a subset of capstone courses (e.g	For each test question and content area, we measure the % correct answers and the % change from introductory students to capstone students. Our aspirational, "Proficient" target is to see scores of at least 75% correct on every post-test question, OR at least 50% correct with improvement of at least 25% from the pre-test. Because some questions are designed to be challenging and address common misconceptions, we can accept "Sufficient" scores of

				Developmental Biology).	50-75% provided there was improvement (5-25%) compared to the pre-test. "Deficient" areas that require discussion at our annual retreat are questions that score <50% in the post-test, OR areas that score 50-75% without any improvement.
2-4	Students complete a poster, oral presentation, or a lab report. Members of the Assessment Committee will evaluate criteria based on a rubric adopted by the department in 2020. The generic rubric will be adapted for each assignment with the help of the course instructor, to guide the Assessment Committee in scoring.	Annual	Capstone Course (3rd or 4th year)	A subset of students enrolled in capstone courses (e.g. Developmental Biology)	A majority of students (>66%) demonstrate sufficiency in one or more of the following areas: A) conducting original research; B) reporting results orally and in writing; and C) using scientific literature effectively.

Indirect Assessment

- Anonymous Student Survey- The Student Affairs Committee will administer an anonymous student survey bi-anually. The Assessment along with the Student Affairs Committees will compile the results and report the findings to the department. Past surveys have not explicitly asked about student perceptions of their skills in our learning outcomes, but we should consider adding that in the future. Identification of strengths and challenges of the Biology program will be discussed at an annual retreat held before the start of the academic year.

- Other indirect methods the committee is considering for the future are (1) measures from SSC and Dashboard data around retention and completion, especially among minority students, (2) survey data from local employers for skills they seek in our majors, and (3) placement data of our graduating students with employment and graduate school.

Part IV: Assessment Cycle Timeline

Explanation:

- Programmatic student learning outcomes are assessed on a five-year cycle, which means each one is to be FULLY analyzed at least once in a five-year period.

Five-Year Assessment Plan

Program Learning Outcome	Year 1	Year 2	Year 3	Year 4	Year 5
Demonstrate content knowledge of the AAAS BioCore, with topics in: ● *Evolution* ● *Transformations of Energy and Matter* ● *Information Flow, Exchange and Storage* ● *Structure and Function* ● *Systems*	X				X
Conduct original biological research.				X	
Communicate science orally and in writing.			X		
Use scientific literature.					X

Part V: Intended Analysis, Responsibility, and Communication

The AY 2019-2020 departmental assessment committee developed this assessment plan. The data created from the assessments described above will be analyzed and evaluated by future members of the assessment committee. The chair (and other members) of the assessment committee will communicate these results at an annual retreat held before the start of the academic year. Feedback from the department at these retreats will be compiled by the assessment committee into an action plan.

Appendix 4.
Summary of retreat discussion around PLO4: Using Scientific Literature.
Faculty filled out three survey questions. Here is a summary of their responses and our discussion at the retreat.

Question 1. What specific literature skills do you expect students to already know, if any, when they enter your upper-level classes? (We are not asking what you teach, but only your assumptions as they enter your course.)
Most faculty expected students to be able to distinguish scholarly literature, and to understand appropriate citation. Students should have some experience with search techniques, and in pulling out key ideas from articles, but these skills take time to develop.

Question 2. What are specific challenges you see in students with regards to finding, evaluating, or citing sources?
Common challenges are:

- Finding the most **appropriate sources** for a scientific topic. That can include misunderstanding how scholarly sources differ from other sources, or how to focus only on sources that are really focused on the topic.
- Reading skills.
- Professional citation techniques.
- Understanding the "purpose" of citation
- The consensus from our discussion was that it is not realistic for undergraduate students to really "Evaluate scientific articles critically." Yet that is how we titled one of sub-categories of this LO. That sub-category could be reworded more simply to something like "Using scientific literature". That name better fits the current description of this sub-category, to "Skillfully relate results to recently published literature. Synthesize in-depth information from a thorough range of relevant sources."

Question 3.
Please describe how you teach each learning outcome below (if applicable) in your courses. Do not include non-majors courses like A&P or Life Science for this evaluation. We are trying to evaluate where in the curriculum these learning outcomes are covered and if they are appropriate for our curriculum. Briefly describe (in one or two sentences) an assignment in your class that meets the outcomes below.

PLO 4A. Retrieve information efficiently and effectively by searching the literature
Retrieves appropriate, focused sources from primary literature. Scholarly review papers are acceptable.

- First year courses do not have time to teach this skill. Upper level electives typically have a librarian come teach search strategies. Most faculty use Google Scholar in classes, or the library search box.

- The retreat was useful to hear from FYE faculty in how they teach this skill, along with the other skills listed below, albeit in a different context (not a lab research project, but as skills in finding and evaluating literature).
- We should consider adding to the description "Distinguishes primary and secondary scholarly sources from less useful sources for scientific writing."

PLO 4B. Evaluate scientific articles critically

Skillfully relates results to recently published literature. Synthesizes in-depth information from a thorough range of relevant sources.

Most courses have projects in which students use literature. It seems only a few courses explicitly teach **how** to use research papers in student writing. It was helpful to hear how this skill is approached in FYE.

PLO 4C. Cite sources appropriately.

All sources are cited in a professional, publishable manner.

- Expectations for citation increase in the courses > 2000 level.
- Some classes take time to demonstrate or scaffold proper citation, rather than expect students to know how. A few electives also include an annotated bibliography, which may help with the skill in 3B, relating literature to student writing.
- Google Scholar has a citation tool that provides a correct citation for each paper. But students often do not take advantage of it.