UMass Amherst's Educational Effectiveness Plan (EEP) provides departments with an ongoing structure for conducting systematic inquiry into the effectiveness of their efforts to support student success. Departments initially developed and submitted their EEP inquiry plans and evidence gathering strategies in spring 2018 and are asked to provide updates on their progress on a regular basis. EEP activity is also incorporated into the University's strategic planning process – with departments including their EEP progress and findings into their 2021 Strategic Planning Refresh. What follows is the department's most current reporting, as synthesized by the Office of Academic Planning and Assessment (OAPA).

Microbiology EEP

Identify the evidence you currently use (beyond GPA) to determine that your undergraduates have achieved the objectives you have for them.

Information provided by the UMass Amherst Office of Institutional Research; information provided by the University Senior Survey; noting anecdotal observations from working with undergraduates in experiential situations such as research labs, teaching assistantships, etc.

Please describe the focus of your inquiry and explain why this inquiry is important to your department right now.

Line of Inquiry 2018: Our inquiry is focused on measuring the extent to which our curriculum design and mode of instruction meet departmental learning objectives. In addition, we want to measure how successful our graduates are in meeting career goals. The department would like to have appropriate and relevant data to make informed decisions concerning curriculum priorities and alterations (especially in response to potential enrollment increases and changing training needs of our undergrads). Our inquiry will be based on four steps: 1) develop a plan to inform faculty and students of our learning objectives, 2) map our learning objectives to our curriculum, 3) examine class outcomes using grades and instructor assessments, and 4) develop postgraduate success metrics.

Progress your department has made toward addressing your line of inquiry, and the types of evidence that you have collected to inform your inquiry.

Our inquiry is focused on measuring the extent to which our curriculum design and mode of instruction meet departmental learning objectives. In addition, we want to measure how successful our graduates are in meeting career goals. The department would like to have appropriate and relevant data to make informed decisions concerning curriculum priorities and alterations (especially in response to potential enrollment increases and changing training needs of our undergrads). Our inquiry will be based on four steps: 1) develop a plan to inform

faculty and students our learning objectives, 2) map our learning objectives to our curriculum, 3) examine class outcomes using grades and instructor assessments, and 4) develop postgraduate success metrics. We have completed step number 2. Step 1 is partially completed. Faculty have been informed of our student learning objectives and have given feedback. However, the SLOs have not been made available to students yet. Now that the SLOs are complete and have been reviewed by the faculty, the SLOs will be posted to the Microbiology Department website and will be made available to Microbiology undergraduate peer advisors and will be posted in the peer advising office.

What are your department's next steps regarding your continuing and/or upcoming EEP line of inquiry?

We will continue to work on step 3. We will no longer work on step 4 of our inquiry. The CNS academic dean suggested that we not pursue this line of inquiry because the CNS Center for Career and Professional Development will be gathering this data. We will be able to use their data, once it is collected, but will not have to collate the information ourselves. Our original inquiry is rather large and encompassing. We expect to take several years to determine how we can best measure the extent to which are students meet curricular SLOs. We are also trying to better understand the intention of lines of inquiry and hope to develop future questions that are tangible and have more assessable outcomes. Simply investigating what data is most appropriate for how SLOs are being met may be the most natural extension of our current inquiry. In Spring 2020, we will work on having all our faculty add the overall departmental SLOs to their syllabi to show students how their particular classes fit into their Microbiology education. In Fall 2020 and Spring 2021, we will be formulating questions to begin to answer step three of our inquiry.

What are the Student Learning Objectives for your department or program(s)?

Microbiology, B.S.

Evolution

- Mutations, horizontal gene transfer, and selection pressure help drive evolution
- Phylogenetic trees are a tool to show evolutionary relationships
- Eukaryotes evolved from prokaryotes
- Evolution is an ongoing, dynamic process
- Systematics and nomenclature

Cell structure and function

- Structure of microorganisms (cell wall, outer membrane, porins, etc.)
- How these structures allow microorganisms to function
- Specialized structures (endospores, flagella, pili, antibiotic production, etc.) are found in some microorganisms and can confer particular advantages

- Structural components can be targets for antibiotics, immunity, and viral infection

Metabolic pathways

- How well a microorganism lives/grows in an environment depends on its metabolic characteristics
- Bacteria and archaea have unique and wide-ranging metabolic diversity
- Catabolism and energy generation
- Anabolism and biosynthesis of macromolecules
- Bacterial cell division and the microbial growth cycle
- Growth of microorganisms is influenced and can be controlled by numerous physical and chemical characteristics such as temperature or pH

Information flow and genetics

- Central dogma and how it differs between bacteria, archaea, and eukaryotes
- How genetic variation in microorganisms occurs (mutations, gene transfer, etc.) and DNA repair
- Regulation of gene expression
- Bacterial protein synthesis, secretion, and degradation
- Biotechnology and manipulation of genomes as tools to understand microorganisms

Viruses

- Structure of viruses
- Viral replication, lytic and temperate life cycles
- Viral diversity and viral hosts

Microbial systems

- Microorganisms are everywhere
- Biofilms, communities, and ecosystems, and how these systems can be both beneficial and harmful to humans
- Impact of perturbation on microorganism ecosystems
- Microbial communication
- Nutrient cycles

Immunology

- Cells and organs of the human immune system
- Innate immunity: macrophages, neutrophils, complement, inflammation
- Adaptive immunity: T cells, B cells, antigen presentation, cytokines, antibodies

- Similarities and differences in how the immune system responds to pathogenic viruses, bacteria, protozoan parasites, fungi and yeast, and worms
- Immune diseases and deficiencies
- Immunizations and artificial immunity

Pathogenesis

- Infection vs disease, and the role the both microorganisms and the health of the host play in infection and disease
- Virulence factors of bacteria and pathogenesis
- Lytic vs temperate life cycles of viruses and how these cause disease
- The importance of Koch's Postulates and the Germ Theory of Disease
- Epidemiology and the spread of disease (transmission, reservoir, etc.)
- Diversity of infective microorganisms

Human use of microorganisms

- Microorganisms are used as research models that give us fundamental scientific knowledge
- Humans utilize microorganisms for many reasons, such the production of food, medicine, or chemical products
- Because the true diversity of microbes is largely unknown, its effects and benefits have not been fully explored

Scientific thinking

- Formulate hypotheses and design experiments
- Understand scientific method
- Analyze and interpret results and data using quantitative reasoning
- Communicate in written and oral formats
- Identify credible sources
- Identify and discuss ethical issues in microbiology

Lab Safety

- Describe the importance of lab safety
- Demonstrate the ability to safely work with BSL-2 organisms and recombinant DNA products
- Use personal protective equipment appropriately
- Operate all lab equipment (centrifuges, microscopes, power packs, etc.) in a safe and appropriate manner
- Demonstrate the ability to safely work with chemicals and Bunsen burners

Introductory Laboratory Skills

- Properly prepare (both stained and wet mount) and view organisms with a microscope
- Use sterile technique to grow microorganisms in a pure culture
- Demonstrate the ability to isolate and cultivate bacteria by using streak plate or spread plate methods
- Utilize the correct methods to cultivate filamentous fungi and yeast
- Utilize the correct methods to cultivate viruses
- Underline the importance of selective and differential media in isolating and identifying bacteria
- Properly use pipet aids and pipetmen to properly measure and dispense liquids

Lab Math

- Demonstrate the ability to calculate serial dilutions
- Use the correct formulas to calculate the number of cells in a population (CFU/ml, hemacytometer counts, etc.)
- Utilize C1V1=C2V2 and other basic math formulas to determine dilutions and concentrations
- Analyze data: statistics, growth rates, enzyme rates, etc.

Advanced Lab Skills

- Calculate the amount of protein in a sample using a spectrophotometer or chemical assay
- Calculate the amount of DNA or RNA in a sample using a spectrophotometer or NanoDrop
- Utilize PCR to amplify genetic material
- Utilize cloning techniques to alter microorganisms
- Show how DNA/RNA can be visualized through the use of agarose gels
- Use of molecular biology techniques for taxonomic and phylogenetic analysis of a population
- Demonstrate how proteins are visualized on an SDS-PAGE gel
- Use Western blotting and antibodies to visualize specific proteins in a protein gel
- Demonstrate how proteins can be separated from each other by chromatography
- Utilize ELISAs to determine the amount of a particular macromolecule
- Prepare and use fluorescence microscopy to visualize cells or cellular components
- Utilize whole cell assays (attachment assay, feeding assay, etc.) to show how cells interact with each other and their surroundings
- Use a biosafety cabinet and appropriate techniques to grow eukaryotic cell cultures