FAIRMONT STATE UNIVERSITY™

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MEMORANDUM

TO: Faculty Senate

FROM: Dr. Susan Ross

DATE: February 4, 2019

SUBJECT: Curriculum Proposal #18-19-03 REV #1
Science and Technology/Natural Science/Biology

I recommend approval of the attached Curriculum Proposal #18-19-03 REV #1. This proposal adds a new elective (Cell Biology, BIOL 3395) to the Biology major. It supports students following pre-professional and graduate school tracks.

cc: Richard Harvey
Steve Roof
Phil Yeager
Laura Ransom
Cheri Gonzalez
Lori Schoonmaker

CURRICULUM PROPOSAL (Submit one hard copy and an electronic copy to the Associate Provost by the second Tuesday of the month.)

Proposal Number: _____

School/Department/Program: Science and Technology, Natural Science, Biology

Preparer/Contact Person: Phil Yeager

Telephone Extension: 4168

Date Originally Submitted: 17 Sep 18

Revision (Indicate date and label it Revision #1, #2, etc.): Revision #1, 13 Nov 18

Implementation Date Requested: Fall 2019

I. **PROPOSAL**. Write a brief abstract, not exceeding 100 words, which describes the overall content of the proposal.
   a. **This proposal adds a new elective (Cell Biology, BIOL 3395) to the Biology major. It supports students following pre-professional and graduate school tracks**

II. **DESCRIPTION OF THE PROPOSAL**. Provide a response for each letter, A-H, and for each Roman Numeral II–V. If any section does not apply to your proposal, reply N/A.

A. Deletion of course(s) or credit(s) from program(s)
   a. N/A

Total hours 0 deleted.

B. Addition of course(s) or credit(s) from program(s)
   a. Cell Biology, Elective

Total hours 0 added.

C. Provision for interchangeable use of course(s) with program(s)
    a. N/A

D. Revision of course content. Include, as an appendix, a revised course description, written in complete sentences, suitable for use in the university catalog.
    a. N/A

E. Other changes to existing courses such as changes to title, course number, and elective or required status.
    a. N/A

F. Creation of new course(s). For each new course

1. Designate the course number, title, units of credit, prerequisites (if any), ownership (FSU or shared) and specify its status as an elective or required course. If you are creating a shared course, attach a memo from the Deans of the affected Schools explaining the rationale for the course being shared.
    1. BIOL 3395 (See Registrar's approval Appendix E)
       Cell Biology
       4 credit hrs
       Prerequisites: BIOL 1106, CHEM 2200
       Ownership FSU
       Elective

2. Include, as an appendix, a course description, written in complete sentences, suitable for use in the college catalog.
   Appendix B

3. Include, as an appendix, a detailed course outline consisting of at least two levels.
   Appendix C

4. In order to meet the requirements as outlined in Goal One of the Strategic Plan, please include Outcome Competencies and Methods of Assessment as an appendix. Examples are available upon request from the Chair of the Curriculum Committee.
   Appendix D

G. Attach an itemized summary of the present program(s) affected, if any, and of the proposed change(s).
   a. Biology program (major and minor) will have one more elective.
   Describe how this proposal affects the hours needed to complete this program. Specifically, what is the net gain or loss in hours? Use the format for Current and Proposed Programs in Appendix A.
      a. There is no effect of the course addition.

RATIONALE FOR THE PROPOSAL.

A. **Quantitative Assessment**: Indicate the types of assessment data, i.e., surveys, interviews, capstone courses, projects, licensure exams, nationally-normed tests, locally developed measurements, accreditation reports, etc., that were collected and analyzed to determine that curricular changes were warranted. Quantitative data is preferred.
   a. **ETS, Biology scores in Cell Biology in 2017 averaged 52.7, with 4 students above the national average and 9 students, or 69%, below the national average. Similar findingS are seen over the past 10 years. The need for the Cell Biology course is seen in the 2017 student exit survey (our first). In this survey 6 out of 10 responses noted the need for a Cell Biology course. Currently students needing this course must take it through another university.**

      Approximately 80% of students in the current freshman class indicate they are pre-professional majors, and this trend has been true over the past 10, or more, years. Of the students we have tracked over the past 5 years, 34% indicate they have been enrolled in either graduate or pre-professional schools. In the 2017 exit survey of Biology students 50% indicated they were going to graduate school.

B. **Qualitative Assessment**: Based upon the assessment data above, indicate why a curricular change is justified. Indicate the expected results of the change. Be sure to include an estimate of the increased cost, or reduction in cost of implementation. FOR EXAMPLE: Will new faculty, facilities, equipment, or library materials be required?

a. **As seen from the above data, standardized test scores and student demand both indicate the need for the proposed course. The Cell Biology will not increase costs to the Biology program as it is an elective in rotation and instructors are already in place to teach the course. Activities developed for this course are in-house using free materials.**

III. Should this proposal affect any course or program in another school, a memo must be sent to the Dean of each school impacted and a copy of the memo(s) must be included with this proposal. In addition, the Deans of the affected schools must sign below to indicate their notification of this proposal.

a. N/A

By signing here, you are indicating your college's/school's notification of this proposal.

College/School	Dean	Signature

IV. Should this proposal affect any course to be added or deleted from the general studies requirements, a memo from the chair of the General Studies Committee indicating approval of the change must be included with this proposal.
N/A

V. ADDITIONAL COMMENTS.

APPENDIX A
B.S. Degree in Biology
Current Program

Required Major Courses			HRS
BIOL	1105	BIOLOGICAL PRINCIPLES I	4
BIOL	1106	BIOLOGICAL PRINCIPLES I	4
BIOL	2202	GENERAL BOTANY	4
BIOL	2203	GENERAL ZOOLOGY	4
BIOL	3306	FUNDAMENTALS OF ECOLOGY	4
BIOL	3368	ANIMAL PHYSIOLOGY **OR**	4

BIOL	3370	PLANT PHYSIOLOGY	4
BIOL	3380	GENETICS	4
BIOL	3390	MOLECULAR BIOTECHNOLOGY	4
BIOL	4485	SENIOR SEMINAR	2
CHEM	1105	CHEMICAL PRINCIPLES	5
CHEM	2200	FOUNDATIONS IN BIOCHEMISTRY	4
CHEM	2201	ORGANIC CHEMISTRY I	4
CHEM	2202	ORGANIC CHEMISTRY II	4
			4
TOTAL Required Major Courses			51
Major Electives			12
BIOL	2224	MICROBIOLOGY	
BIOL	3312	ADVANCED BOTANY	
BIOL	3315	INVERTEBRATE BIOLOGY	
BIOL	3316	VERTEBRATE BIOLOGY	
BIOL	3330	AQUATIC ECOLOGY	
BIOL	3331	TERRESTRIAL ECOLOGY	
BIOL	3360	BIOCHEMISTRY	
BIOL	4420	DEVELOPMENTAL BIOLOGY	
Minor Requirements/Electives (if minor is required)			
TOTAL HOURS FOR MAJOR (and minor if required)			**63**

Required General Studies Courses		
Attribute IA – Critical Analysis		3
	ENGL 2220	
Attribute IB – Quantitative Literacy		3
	MATH 1185 or MATH 2501 (PR for BIOL 3390)	
Attribute IC – Written Communication		
	ENGL 1101	3
Attribute ID - Teamwork		
	COMM 2200	
Attribute IE – Information Literacy		X
	ENGL 1102	
Attribute IF – Technology Literacy		3
	TECH 1100	
Attribute IG – Oral Communication		3
	COMM 2200	
Attribute III - Citizenship		3
	POLI 1100	
Attribute IV - Ethics		3
	ENGL 2220	
Attribute V - Health		3

	PHED 1100	
Attribute VI - Interdisciplinary		3
	POLI 1100	
Attribute VIIA - Arts		X
	INTR 1120	
Attribute VIIB - Humanities		3
	INTR 1120	
Attribute VIIC – Social Sciences		X
	GEOG 2210	
Attribute VIID - Natural Science		X
	CHEM 1105	
Attribute VIII – Cultural Awareness		3
	GEOG 2210	
TOTAL GENERAL STUDIES HOURS		**30**
TOTAL FREE ELECTIVES		**27**
TOTAL HOURS		**120**

APPENDIX A
B.S. Degree in Biology
Proposed Program

Required Major Courses			**HRS**	
BIOL	1105	BIOLOGICAL PRINCIPLES I	4	
BIOL	1106	BIOLOGICAL PRINCIPLES I	4	
BIOL	2208	GENERAL BOTANY	4	
BIOL	2203	GENERAL ZOOLOGY	4	
BIOL	3306	FUNDAMENTALS OF ECOLOGY	4	
BIOL	3368	ANIMAL PHYSIOLOGY **OR**	4	
BIOL	3370	PLANT PHYSIOLOGY	4	
BIOL	3380	GENETICS	4	
BIOL	3390	MOLECULAR BIOTECHNOLOGY	4	
BIOL	4485	SENIOR SEMINAR	2	
CHEM	1105	CHEMICAL PRINCIPLES I	5	
CHEM	2200	FOUNDATIONS IN BIOCHEMISTRY	4	
CHEM	2201	ORGANIC CHEMISTRY I	4	
CHEM	2202	ORGANIC CHEMISTRY II	4	
TOTAL Required Major Courses				51
Major Electives				12
BIOL	2224	MICROBIOLOGY	4	
BIOL	3312	ADVANCED BOTANY	4	
BIOL	3315	INVERTEBRATE BIOLOGY	4	
BIOL	3316	VERTEBRATE BIOLOGY	4	
BIOL	3330	AQUATIC ECOLOGY	4	
BIOL	3331	TERRESTRIAL ECOLOGY	4	
BIOL	3360	BIOCHEMISTRY	4	
BIOL	4420	Cell Biology	4	
BIOL	3395	DEVELOPMENTAL BIOLOGY	4	
Minor Requirements/Electives (if minor is required)				
TOTAL HOURS FOR MAJOR (and minor if required)				**63**

Required General Studies Courses		
Attribute IA – Critical Analysis		3
	ENGL 2220	
Attribute IB – Quantitative Literacy		3
	MATH 1185 or MATH 2501 (PR for BIOL 3390)	
Attribute IC – Written Communication		
	ENGL 1101	

Attribute ID - Teamwork	
COMM 2200	
Attribute IE – Information Literacy	X
ENGL 1102	
Attribute IF – Technology Literacy	3
TECH 1100	
Attribute IG – Oral Communication	3
COMM 2200	
Attribute III - Citizenship	3
POLI 1100	
Attribute IV - Ethics	3
ENGL 2220	
Attribute V - Health	3
PHED 1100	
Attribute VI - Interdisciplinary	3
POLI 1100	
Attribute VIIA - Arts	X
INTR 1120	
Attribute VIIB - Humanities	3
INTR 1120	
Attribute VIIC – Social Sciences	X
GEOG 2210	
Attribute VIID - Natural Science	X
CHEM 1105	
Attribute VIII – Cultural Awareness	3
GEOG 2210	
TOTAL GENERAL STUDIES HOURS	**30**
TOTAL FREE ELECTIVES	**27**
TOTAL HOURS	**120**

APPENDIX B

Cell Biology course description

Cell Biology is an upper level biology course designed for students in pre-professional and graduate school tracks. This course focuses on the biology of eukaryotic cells: structure, function, bioenergetics, enzymes, cell membranes and organelles; transport across membranes, chemotrophic energy metabolism, receptors, and the endomembrane system. It consists of three one-hour lectures and one single activity per week. Prerequisites: BIOL 1106 and CHEM 2200.

APPENDIX C
Course Outline

001 Preview of Cell Biology
- a) Chapter Objectives
  - i) Explain the cell theory and how the modern field of cell biology emerged from this theory.
  - ii) Investigate the experimental techniques and model organisms used to study cell biology.
  - iii) Apply metric system
  - iv) Recognize the difference between resolution and magnification
  - v) Apply the scientific method to areas of scientific inquiry.
- b) Assessment
  - i) Clicker questions
  - ii) Written Exam

004 Cells and Organelles
- a) Chapter Objectives
  - i) Recount the general properties common to all cells, how these properties likely evolved from primitive cells, and the properties that distinguish eukaryotes, prokaryotes, and archea from each other.
  - ii) Explain the basic structure and function of the major organelles within a typical eukaryotic cell.
- b) Assessment
  - i) Clicker questions
  - ii) Activity, Surface to Volume
  - iii) Written exam

005 Bioenergetics: The Flow of Energy in the Cell
- a) Chapter Objectives
  - i) Describe the importance of energy to the cell and how the energy flows through the biosphere.
  - ii) Use the laws of thermodynamics to calculate different bioenergetic values relevant to cell biology (i.e. entropy, enthalpy, free energy, and the equilibrium constant).
- b) Assessment
  - i) Clicker questions
  - ii) Activity, Photosynthesis lab 2 and problem set
  - iii) Written exam

006 Enzymes the Catalysts of Life
- a) Chapter Objectives
  - i) Summarize the relationship of activation energy to cellular chemistry, and how enzymes (including ribozymes) are able to catalyze chemical reactions.
  - ii) Calculate the important parameters of enzyme kinetics (i.e. Vmax and Km) using the principles of the Michaelis-Menten equation.
  - iii) Distinguish the diverse ways that enzymatic activity is regulated.
- b) Assessment
  - i) Clicker questions

ii) Activity, Bioenergetics Problem set
iii) Written exam

007 Membranes: Structure, Function, and Chemistry

a) Chapter Objectives
   i) Differentiate the five functional roles that biologic membranes play in the biology of the cell.
   ii) Investigate how the fluid mosaic model provides the basis for the structure of cellular membranes.
   iii) Draw the structure of a lipid and explain how the structure allows a lipid bilayer to spontaneously assemble in an aqueous environment
   iv) Explain the importance of membrane lipid and protein component structural asymmetries in membrane function.
   v) Describe the process by which membranes grow, are turned over, or are absorbed
b) Assessment
   i) Clicker Questions
   ii) Activity, Enzyme lab and problem set
   iii) Written exam

008 Transport Across Membranes: Overcoming the Permeability Barrier

a) Chapter Objectives
   i) Compare and contrast the three transport processes used by the cell to move solutes across membranes- simple diffusion, facilitated diffusion, and active transport.
   ii) Calculate the change in free energy (delta G) for the transport of uncharged or charged solutes across membranes.
   iii) Given a set of molecules of differing solubility in water, predict their relative rates of diffusion across a membrane bilayer.
b) Assessment
   i) Clicker questions
   ii) Activity, Diffusion, Osmosis and Active Transport, Concord Consortium
   iii) Written exam

009 Chemotrophic Energy Metabolism: Glycolysis and Fermentation

a) Chapter Objectives
   i) Use the laws of thermodynamics to calculate different bioenergetic values relevant to cell biology (i.e. entropy, enthalpy, free energy, and the equilibrium constant).
   ii) Classify metabolic pathways as either anabolic (i.e. gluconeogenesis) or catabolic (i.e. chemotrophic energy metabolism).
   iii) Investigate the structure and function of ATP as a universal energy coupler.
   iv) Analyze the role of glycolytic enzymes in the process and regulation of glycolysis (using both classical and alternative substrates), fermentation, and other novel roles.
b) Assessment
   i) Clicker questions
   ii) Activity, Diffusion, Osmosis and Active Transport, Concord Consortium
   iii) Written exam

010 Chemotrophic Energy Metabolism: Aerobic Respiration

a) Chapter Objectives

i) Dissect the process of aerobic respiration in mitochondria through the steps of glycolysis, pyruvate oxidation, the TCA cycle, electron transport, proton pumping, and ATP synthesis.
ii) List the types of energy used by cells and give examples of when / in what cells / situations the different energy sources are used
iii) Explain why energy transformations are necessary in the cell
iv) Explain how cyanide, an electron transport chain inhibitor, impacts oxygen consumption within animal cells

b) Assessment
i) Clicker questions
ii) Activity, Chicago Murders: A Case Study in Cellular Respiration
iii) Written exam

012 The Endomembrane System

a) Chapter Objectives
i) Describe the structure and function of each component of the endomembrane system including the endoplasmic reticulum, the Golgi complex, endosomes, lysosomes, and vacuoles (in plant cells).
ii) Examine the role of peroxisomes in eukaryotic cell function.

b) Assessment
i) Clicker Questions
ii) Activity, Structure and function of cell organelles
iii) Written exam

013 Cytoskeletal System

a) Chapter Objectives
i) Distinguish the properties and activities of the three major cytoskeletal components- microtubules, microfilaments, and intermediate filaments.
ii) Differentiate intracellular microtubule-based movement via motor proteins (kinesin and dynein) from microtubule-based motility via cellular appendages (cilia and flagella)

b) Assessment
i) Clicker questions
ii) Structure and function of cell organelles (continued)
iii) Written exam

014 Cellular Movement: Motility and Contractility

a) Chapter Objectives
i) Differentiate intracellular microtubule-based movement via motor proteins (kinesin and dynein) from microtubule-based motility via cellular appendages (cilia and flagella)
ii) Interrogate the role of myosin in actin-based cell movement in both muscle and non-muscle cells.

b) Assessment
i) Clicker questions
ii) Cell Movement
iii) Written exam

015 Beyond the Cell: Cell Adhesions, Cell Junctions, and Extracellular Structures

a) Chapter Objectives

i) Specify the mechanisms whereby cells associate with each other through cell adhesion and cell-cell junctions.
ii) Compare the composition and function of the extracellular matrix of the animal cell to the plant cell surface.

b) Assessment
i) Clicker questions
ii) Activity, I-cell-MATRIX
iii) Written exam

022 Signal Transduction Mechanisms: I, Electrical and Synaptic Signaling in Neurons

a) Chapter Objectives
i) Calculate membrane potential based on ion concentrations using either the Nernst or Goldman equations.
ii) Describe the structure of the neuron and how it is able to transmit the action potential in response to stimuli.
iii) Explain the mechanism used by nerve cells to communicate with each other and deliver signals via synapses (either electrical or chemical).

b) Assessment
i) Clicker Questions
ii) Activity, Signal Transduction in cells
iii) Written exam

023 Signal Transduction Mechanisms: II. Messengers and Receptors

a) Chapter Objectives
i) Summarize the general flow of information used in cell signaling pathways.
ii) Compare and contrast the three main types of receptor-mediated signal transduction pathways used in intercellular communication- G protein-linked receptors, protein kinase-associated receptors, and hormone receptors.
iii) Investigate the role of calcium in cell signaling processes.

b) Assessment
i) Clicker Questions
ii) Activity, Signal Transduction in cells (continued)
iii) Written exam

024 The Cell Cycle and Mitosis

a) Chapter Objectives
i) List the phases of the cell cycle, what occurs in each phase, and how each is regulated.
ii) Investigate the signals that control cell fate (cell proliferation versus apoptosis).
iii) Compare different methods used to coordinate cell division in different cell types.

b) Assessment
i) Clicker questions
ii) Activity, Cell Cycle
iii) Written exam

Appendix D
Outcome Competencies and Methods of Assessment

1) Outcome: Discuss the structure and function of a eukaryotic cell.
   a) Details/Description:
      i) Satisfactory Performance Standard: 70% of participants receive a 70% or better
      ii) Ideal Target: 100% of participants receive 70% or better
      iii) Implementation Plan: TBD
      iv) Key/Responsible Personnel: Phil Yeager
      v) Supporting Attachments:
         (1) Surface area to volume ratio and its importance in cell.
         (2) Photosynthesis lab and problem set
         (3) Bioenergetics problem set
         (4) Cell movement

2) Outcome: Demonstrate the ability to think critically and employ critical thinking skills.
   a) Details/Description:
      i) Satisfactory Performance Standard: 70% of participants receive a 70% or better
      ii) Ideal Target: 100% of participants receive 70% or better
      iii) Implementation Plan: TBD
      iv) Key/Responsible Personnel: Phil Yeager
      v) Supporting Attachments:
         (1) Who would win a “cage match” between the following, and why? “Scorpion vs. Mouse: A Tale of Venom and Action Potentials”
         (2) *“*Caught Red-Handed: Hemoglobin, Carbon Monoxide, and a Butcher’s Knife”
         (3) “How to Make ATP: Three Classic Experiments in Biology

3) Outcome: Evaluate and analyze figures and data.
   a) Details/Description:
      i) Satisfactory Performance Standard: 70% of participants receive a 70% or better
      ii) Ideal Target: 100% of participants receive 70% or better
      iii) Implementation Plan: TBD
      iv) Key/Responsible Personnel: Phil Yeager
      v) Supporting Attachments:
         (1) Enzyme Lab and Problem Set
         (2) Cellular Respiration
         (3) Surface area to volume ratio and its importance in cell

4) Outcome: Illustrate connections between cell biology and concepts across scientific disciplines.
   a) Details/Description:
      i) Satisfactory Performance Standard: 70% of participants receive a 70% or better
      ii) Ideal Target: 100% of participants receive 70% or better
      iii) Implementation Plan: TBD

iv) Key/Responsible Personnel: Phil Yeager
v) Supporting Attachments:
   (1) Chicago Cyanide Murders: A Case Study in Cellular Respiration
   (2) Diffusion, Osmosis and Active Transport
   (3) The Campus Coffee Shop
   (4) Caffeine Conundrums

Appendix E
Course Number Approval

From: Gonzalez, Cheri
To: Yeager, Phillip
Cc: Roof, Steven; Flood, Mark
Subject: RE: Request for conformation of Course Number availability
Date: Wednesday, September 12, 2018 1:57:09 PM

I apologize for my delayed response. BIOL 3395 is approved to be used.
Thank you
Cheri

Cheri L. Gonzalez
University Registrar
Fairmont State University
304-367-4112
Cheri.Gonzalez@fairmontstate.edu