New Course Request Form

1. Date: September 19, 2013  Department: Biology

2. Purpose and Nature of Course (include relevant assessment data to support this proposal):
   With the introduction of several new sequencing techniques, genomes are being sequenced at an astonishing rate. For about $1000, you can get the genome of your favorite microbe sequenced in a couple weeks. Compare that to the first couple genomes (just in the 1990s) that took a couple years to complete! With the ease, speed, and low cost of sequencing, genomic analysis is becoming commonplace in areas of biology from human medicine to evolution to ecology. An introductory course in Genomics will prepare our students to utilize this powerful tool which has become a standard route of investigation in Biology. Additionally, this course will be added to the group of courses which fulfill the BI3390-3999 block (Synthesis of Biology Concepts). Currently, there are only two courses regularly offered in this block (Biostatistics and Evolution). Adding Genomics will round out the course offerings in this block.

3. Prefix: BI  Number: ___3393______  CIP:__________________

4. Course Title: ___Introduction to Genomics________________________
   Abbreviated Title (for Master Schedule), Maximum 20 spaces
   INTRO GENOMICS

5. Credits (Place number of credits beside appropriate types)
   Credit(s) ___3__ Undergraduate
   Credit(s) _____ Graduate
   For variable credits, list Minimum Credit _____: Maximum Credits _____

6. Clock Hours:
   Lecture ___3__  Recitation _____  Lab _____
   Contract Hours:  Lecture ___3__  Recitation _____  Lab _____

7. To repeat for additional credit (not repeat of previously earned grade), list maximum hours of credit that may be earned over multiple Semesters ______ semester hours.

8. Course Description for Catalog (limit to four sentences):
   An introduction to the field of Genomics, including genome structure, sequencing technologies, sequence analysis, and applications of genome analysis. Genomes across all domains of life as well as viruses will be explored. Questions in the fields of medicine, ecology, evolution, and cell biology will be addressed using the tools of genomic analysis.
9. Prerequisites: (Courses which MUST be completed prior to taking this course) BI 3370

10. Co-requisites: (Courses which must be taken prior to or simultaneously with)

11. If taught dual-level or cross-listed with another department, list:
   Prefix _____ Number _____ Support Signature ________________________________
   If dual-level, attach a document that indicates content, assignments and assessments for
   graduate and undergraduate courses.

12. List Student Learning Outcomes and describe evaluation techniques for this course in an
    attached syllabus:

13. Courses to be eliminated: (Course deletion form must be completed):
   Prefix _____ Number _____
   If none: How will increased offerings be staffed?

14. New faculty resources needed? _____Yes __x__ No

15. Requested initial date of offering (Must meet new catalog deadline of March 1)

16. Estimated Frequency of Offering: ______every other Fall__________

17. New Library Resources Needed? _____Yes __x__ No If yes:
   Signature of appropriate librarian indicating needs can be met:
   ______________________________

18. New Technology Resources Needed? _____Yes __x__ No, if yes:
   Signature of Director of Information Technology indicating needs can be met:
   ______________________________

19. New Equipment resources needed? _____Yes __x__ No, if yes:
   Describe Equipment: ________________________________
   Source of funding: ________________________________

20. List 1 – 3 sample textbooks for this course:
   _____Introduction to Genomics (Arthur M. Lesk, Oxford University Press)_____

21. Describe any student enrollment restrictions (limited to majors in program XXX,
    restricted from majors in program XXX, etc.)

21. Request that Course be considered for General Education Credit. Please check
    applicable boxes.
    a. _____ Satisfy Foundation of Knowledge Requirement
i. _____ Written Communication
ii. _____ Oral Communication

b. _____ Satisfy Approaches of Knowledge Requirement
   i. _____ Humanities
   ii. _____ Mathematics
   iii. _____ Natural Sciences
   iv. _____ Social and Behavioral Sciences

c. _____ Satisfy Unity and Diversity of Humanity
   i. ______ Language other than English
   ii. ______ Western and Non Western Global Cultures
   iii. ______ Strand 1 Ethics and Civic Responsibility
   iv. ______ Strand 2 Environmental, Economic, Social, and Personal Sustainability
   v. ______ Strand 3 Arts and Human Experience

You must submit a separate application for General Education Credit.

22. Does this course impact any Education Programs? _____ Yes   ___x___ No
    If Yes: Signature of Chair of TEC must appear below.

23. Special Needs, if any:

    Recommendation Dates and Signatures:   Signature   Date
    Department:   _____________________________
                   _________________
    TEC (if any education program):   _____________________________
                   _________________
    Gen’l Education Subcomm. (If necessary):   _____________________________
                   _________________
Graduate Council (If necessary): __________________________

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Academic Affairs Committee: __________________________

___________

University Senate: __________________________

___________

President: __________________________

___________

MU Form A41N – Effective 4/1/01
Introduction to Genomics

Biology 3393
Mansfield University
Fall Semester 20XX

General Information
Credit hours: 3
Meets: T Th 2:00 -3:15 Grant 122
Computer Exercises (most Th)
will be in Grant computer lab
Instructor: Dr. Jeanne Kagle

Instructor Availability
Phone: (570) 662-4549
Email: jkagle@mansfield.edu
Office: 405 Pinecrest/169 Grant
Office Hours: MW 10:00 – 12:00
Th 3:30 – 4:30

Course Description
An introduction to the field of Genomics, including genome structure, sequencing technologies, sequence analysis, and applications of genome analysis. Genomes across all domains of life as well as viruses will be explored. Questions in the fields of medicine, ecology, evolution, and cell biology will be addressed using the tools of genomic analysis.

Introduction

With the introduction of several new sequencing techniques, genomes are being sequenced at an astonishing rate. For about $1000, you can get the genome of your favorite microbe sequenced in a couple weeks. Compare that to the first couple genomes (just in the 1990s) that took a couple years to complete! With the ease, speed, and low cost of sequencing, genomic analysis is becoming commonplace in areas of biology from human medicine to evolution to ecology. This course will prepare you to utilize this powerful tool which has become a standard route of investigation in Biology.

Course Objectives
My goals for Introduction to Genomics (BI 4455) are to contribute substantially to your:
1. understanding of the structures of eukaryotic, bacterial, archaean, and viral genomes.
2. ability to explain various methods of DNA sequencing.
3. ability to assemble and analyze genome sequence data.
4. confidence in using genomic analysis to answer a wide array of biological questions.

Course Text
Required:
Introduction to Genomics (2nd edition, Arthur M. Lesk)
Course Overview

This course will be comprised of several in-class components, assignments, and laboratory:

In class:

➢ During Tuesday class time there will be lecture, but there will also be discussions, problem sets, and learning activities.

➢ Thursday class time will consist mostly of learning and using the computer tools used in genomic analysis (primarily for prokaryotes). You will need a working knowledge of these tools to complete your independent projects.

➢ There will be three exams on the material covered in this course. Exams will include both concepts and ability to use computer tools.

➢ Each student will propose and complete an independent research project using the genomics analysis tools introduced in the course. Project results will be presented orally during the allotted final exam time for the course (see schedule).

Out of class:

➢ I expect that you will have done the assigned reading for each class in preparation for class.

➢ Several times there will be short assignments addressing the topics being covered in class. These are designed to give you practice working with the concepts and problems for which you will be responsible on exams.

➢ This course has a Desire2Learn site. I will communicate with you using this site. I will post the lecture slides, the class syllabus, some required reading, important and interesting web links and other documents.

➢ Part of your grade will be based on a project involving using genomics to answer a research question of your choice.
Grading

Grades are based on the three unit exams, a final comprised of a unit exam and cumulative material, in-class and homework assignments, and extra credit. Grades will not be curved and letter grades will be assigned as shown below.

<table>
<thead>
<tr>
<th>Approximate points distribution:</th>
<th>Project (including proposal and presentation)</th>
<th>30%</th>
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<tr>
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<td>Computer Exercises, Assignments, etc.</td>
<td>30%</td>
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<td>Exams</td>
<td>40%</td>
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Grading scale:

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Final grade</th>
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<tr>
<td>93-100 %</td>
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<td>90-92</td>
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<td>60-62</td>
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<tr>
<td>&lt; 60</td>
<td>Fail</td>
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Policies

Attendance:

Attendance is critical if you wish to succeed in this class. We will cover a lot of material during each class period, and we will build on the material we have covered in previous lectures. Please be on time to class. It is distracting and disrespectful to other students and me to enter class late. If you must enter after class has begun, do so quietly.

Attendance for exams is MANDATORY. No make-up exams will be given except for in the case of documented absences. Sanctioned University events will be considered an excused absence so long as complete documentation is provided (see below). If you must miss an exam for a Mansfield University school-sanctioned event, you must notify the instructor 48 hours BEFORE the exam to schedule a make-up exam.

If you must miss an exam due to documented illness or other excusable reason, you must:

- prior to the absence if possible, but no later than the first class period after the excused absence (if school-sanctioned event 48 hours prior as noted above) inform the current instructor (preferably via email) that a written excuse is coming from a physician, coach or other authority.

- within a week of absence, provide the instructor with an official absence form (available from the instructor or on the course website) along with a copy of the signed excuse. The original must be available for review.
prior to the absence if possible, but no later than the first class period after
the excused absence (if school-sanctioned event 48 hours prior as noted above),
arrange to make up missed exam. In order to avoid prolonged delay of make-up of the
work, the instructor may give the make-up work and hold it for grading until after the
written excuse is received.

Academic Integrity:

The integrity of all scholarly work is at the foundation of an academic community.
Although you are encouraged to work and study together, students are expected to submit original
work. Dishonesty in academic work, including cheating, academic misconduct, fabrication, or
plagiarism is unacceptable. When you use information from a book or any other source, that
source MUST be credited appropriately. Any form of cheating will result in no credit on the
assignment or exam and the incident will be reported to the Provost. See the policy and
procedure listed at http://www2.mansfield.edu/academic-affairs/faculty-resources/forms-and-
procedures.cfm under “Academic Integrity Policy.”

The University fully supports the Copyright Laws of the United States. Respect for
intellectual labor and creativity is vital to academic discourse and enterprise. This principle
applies to any original work in any tangible medium of expression. Images displayable on
computer screens, computer software, music, books, magazines, journals, photographs, and
articles are among items subject to copyright. A work need not be explicitly labeled with a
copyright notice to be afforded copyright protection. For more information on Copyright please
consult the Mansfield University Copyright Information website:
http://mansfield.libguides.com/copyright.

Students Requesting Academic and/or Access Accommodations:

Students with documented learning disabilities, physical challenges, or other significant
medical conditions that may affect their learning in this course should meet with the University’s
Disability Advisor in the Department of Academic and Human Development (141 South Hall,
Phone: 662-4436) as soon as possible. The Disability Advisor will arrange to provide your
professors with an appropriate letter so that we may serve your particular needs more effectively.
If you have a disability that requires classroom or testing accommodations, the advisor will also
clarify appropriate arrangements.

Student Consumer Rights and Responsibilities:

The Higher Education Opportunity Act (Public Law 110-315) (HEOA) was enacted on
August 14, 2008, and reauthorizes the Higher Education Act of 1965, as amended (the HEA). The
HEOA (2008) requires colleges and universities to provide students with information necessary to
make informed decisions concerning their educational experiences. Mansfield University strives
to serve its students fairly and equitably. The following MU website provides an inclusive list
by topic of student consumer rights and responsibilities:
http://mansfield.edu/HEA/
Graded Items

Exams (40% of Final Grade):

There will be three exams on the course material. Exams will be administered through D2L, but in class. These exams may include multiple-choice questions, matching, short answer, and essay questions. There will also be questions that ask you to use the computer tools which have been introduced in the course. Expect to see questions based on short readings or data presented within the exam itself. These readings and data will be similar to what you have seen in class, but not identical.

Computer Exercises and Homework Assignments (30% of Final Grade):

Each of these assignments will be graded based on criteria appropriate to the assignment. These are meant more for you to practice working with the material presented in class as opposed to evaluation of your progress.

Project (30% of Final Grade):

Each student will choose a research question which can be addressed using tools of genomics. You will analyze sequence data using what we have learned in class to answer your question and present your results to the class orally during the allotted final exam time. More details for this assignment will be available in the first couple weeks of the semester.
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<th>Wk.</th>
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<th>Topic</th>
<th>Text Reading</th>
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<tr>
<td>1</td>
<td>T</td>
<td>Genome Structure &amp; Central Dogma</td>
<td>1-16; 41-48; 115-133</td>
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<td>Th</td>
<td>Intro to NCBI &amp; Other Databases</td>
<td>24-25;104-109</td>
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<td>2</td>
<td>T</td>
<td>DNA Mapping &amp; Sequencing</td>
<td>17-18; 79-104</td>
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<td>Intro to Assembly</td>
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<td>3</td>
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<td>Basic Tools of Sequence Analysis</td>
<td>30-32; 133-143; 161-181</td>
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<td>Intro to Sequence Analysis</td>
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<td>Intro to RAST and DNA Subway</td>
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<td>Functional Genomics</td>
<td>191-208</td>
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<td>Metabolic Pathway Analysis</td>
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<td>Comparative Genomics</td>
<td>143-146</td>
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<td>Comparative Genomics in RAST</td>
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<td>SNPs and Personalized Medicine</td>
<td>20-24; 52-66; 237-241</td>
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<td>SNP Analysis</td>
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<td>Genomics and Evolution</td>
<td>176-186; 215-229; 241-250</td>
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<td>Phylogenetic Analysis with Mega</td>
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<td>Paleosequencing &amp; Anthropology</td>
<td>229-234; 250-258</td>
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<td>Metagenomics</td>
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<td>Intro to MG-RAST</td>
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<td>Genomics in Ecology</td>
<td>Journal Article TBD</td>
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<td>MG-RAST Continued</td>
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<td>Expression Analysis</td>
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<td>Microarray and RNA-seq Analysis</td>
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<td>Present ideas for independent projects</td>
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<td>Exam 3</td>
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<td>Independent Projects</td>
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Final: Oral Presentations of Independent Projects
Departmental Learning Goals Addressed

Knowledge of Biology (Assessed through Computer Exercises, Exams, and Independent Projects)
1.2 hierarchical organization of living systems
1.3 structure and function of cells
1.4 energy transformations of living systems
1.5 patterns of growth, reproduction, and development in living systems
1.6 structural and functional features that allow organisms to carry out fundamental life processes (e.g., resource acquisition, gas exchange, transport of materials,
1.7 molecular genetics
1.8 ecological interactions among organisms and between organisms and their environments
1.9 evolutionary history and mechanisms of evolutionary change in populations
1.10 biological diversity

Research Skills and Understanding of the Scientific Process (assessed through Independent Project proposal and oral presentation)
Students will:
2.2 Collect, organize, and analyze relevant background information
2.3 Generate and state testable hypotheses or goals
2.4 Design experiments to test hypotheses
2.7 Interpret and analyze data

Critical, analytical, and integrative thinking (Assessed through Computer Exercises, Exams, and Independent Project)
Students Will:
3.1 Have the ability to approach novel problems with flexibility, creativity, and confidence
3.2 Make connections between concentration areas within biology.
3.3 Apply theoretical perspectives to personal experiences and current events/problems.
3.5 Draw conclusions and evaluate their relative quality
3.8 Analyze scientific information, and apply these skills to the decision making process.
3.9 Be able to read and interpret biological literature.

Writing and other communication skills (Assessed through Independent Project proposal and oral presentation)
Students Will:
4.1 Writing skills which involve integration of personal knowledge of biological content
4.2 Ability to communicate ideas and arguments effectively both orally and in writing

Concentration-Specific Learning Outcomes:
In addition to the core Student Learning Outcomes for the Biology program, students in the Cell and Molecular Concentration are expected to be able to apply:

5.3 A. Mastery of Student-Learning Outcomes 1.3, 1.6, and 1.7.
Specific Student Learning Outcomes for Genomics
(Related Departmental Learning Goals follow in parentheses)

Assessed through Exams
Exam 1:
- Describe and compare the structure of genomes in bacteria, archaea, eukaryotes, and viruses. (1.7, 1.10)
- Explain the process of gene expression. (1.7)
- Explain and compare various methods of DNA mapping and sequencing. (1.7) Be able to select reasonable methods for specified purposes. (3.8)
- Describe the major steps of genomic analysis from sequencing to annotation. (1.7, 1.9)
- Explain the theory behind computer applications for DNA sequence analysis such as assembly, alignments, similarity searches, ORF determination, and automated annotation.

Exam 2:
- Explain and provide examples of how genomic analysis can be used to determine the structure and function of organisms (prokaryotes in particular). (1.3, 1.2, 1.4, 1.9, 1.10)
- Explain and provide examples of how comparisons between organisms’ genomes can provide insight into organisms’ unique characteristics. (1.3, 1.2, 1.4, 1.9, 1.10)
- Explain what SNPs are and how SNP analysis can be used in personalized medicine. (1.7, 1.10, 1.9, 3.3)
- Explain and provide examples of how genomic analysis allows scientists to investigate evolution. (1.9)

Exam 3:
- Describe paleosequencing and how it could be applied to evolutionary studies, anthropology, and de-extinction. (1.7, 1.9, 1.10, 3.3)
- Explain and provide examples of metagenomics and how studying the metagenome of an environment can reveal ecological interactions. (1.7, 1.8)
- Distinguish among the genome, transcriptome, and proteome and explain the biological information contained in each. (1.2, 1.7)
- Describe the two primary methods of investigating the transcriptome. (1.7)

Assessed through Exams, Computer Exercises, and Independent Project
- Navigate the NCBI website, select proper databases, and extract necessary information in the correct format. (2.2)
- Utilize the Staden software package to assemble shotgun sequences into contigs.
- Determine ORFs in DNA sequence both manually and using ORF Finder or similar program. (1.7)
- Perform sequence searches in BLAST using appropriate parameters; properly interpret BLAST search reports.
- Use sequence annotation programs such as RAST and DNA Subway to analyze gene structure, synteny, and assign gene functions. (1.7)
- Use RAST to determine whether or not specific metabolic pathways are present in an organism. (1.7, 1.4, 3.2)
- Use RAST to compare the genomes of organisms, including presence/absence of genes or functions, genome size, and synteny. (1.9, 1.10, 3.2)
- Perform simple SNP analysis using appropriate tools. (1.7, 1.10)
- Create and interpret phylogenetic trees of multiple DNA or protein sequences using Mega. (1.9)
- Use MG-RAST to analyze the characteristics of a microbial ecosystem through metagenomics. (1.8)
- Perform expression analysis using both microarray and RNA-seq techniques. (1.7, 1.5, 1.3)
- Select appropriate analytical tools to answer a particular problem. (3.1, 3.8, 3.2)

Assessed through Independent Project
- Utilize the tools of genomics to address an independently selected biological question. (3.1, 3.2, 3.3, 3.4, 3.5, 3.8, 3.9, 4.1)
- Orally present genomics research to peers and faculty in a clear and accurate fashion. (3.2, 4.2)