LONG SIGNATURE SHEET

UNC CHARLOTTE

Proposal Number: BINF 2-25-11

Proposal Title Graduate and Undergraduate Course Additions for the Department of Bioinformatics and Genomics

Originating Department Department of Bioinformatics and Genomics

TYPE OF PROPOSAL: UNDERGRADUATE_____ GRADUATE_____ UNDERGRADUATE & GRADUATE ✓
(Separate proposals sent to UCCC and Grad. Council)

DATE RECEIVED	DATE CONSIDERED	DATE FORWARDED	ACTION	SIGNATURES
2/25/11	2/25/11	3/3/11	Approved	DEPARTMENT CHAIR [print name here]
3/3/11	3/4/11	3/5/11	Approved	COLLEGE CURRICULUM COMMITTEE CHAIR Print name:
3/5/11	3/15/11	3/15/11	Approved	COLLEGE FACULTY CHAIR Print name:
3/15/11	3/15/11	3/15/11	Approved	COLLEGE DEAN Print name here if signing on behalf of Dean:
3/17/2011 ~~2/25/11~~	3/18/2011 ~~2/25/11~~	3/18/2011 ~~3/15/11~~	Approved ~~Approved~~ [undergrad courses only]	UNDERGRADUATE COURSE & CURRICULUM COMMITTEE CHAIR (for undergraduate courses) Janet E. Levy
3-24-11	4-5-11	4-6-11	Approved	GRADUATE COUNCIL CHAIR (for graduate courses) Rob Roy McGregor
			Approved	FACULTY GOVERNANCE SECRETARY (noting Faculty Council approval on Consent Calendar)
				FACULTY EXECUTIVE COMMITTEE (if decision is appealed)

COPY MADE Grad School 4-6-11 ap

Revised 10/20/10
OAA/cag

University of North Carolina at Charlotte BINF 2-25-11

Revised Undergraduate and Graduate Curriculum

Course and Curriculum Proposal from: Department of Bioinformatics and Genomics.

"Graduate and Undergraduate Course Additions for the Department of Bioinformatics and Genomics"

A. PROPOSAL SUMMARY AND CATALOG COPY.

1. SUMMARY. The Department of Bioinformatics and Genomics within the College of Computing and Informatics seeks to update its graduate curriculum. Technology in the fields of bioinformatics and genomics is rapidly changing the state-of-the art of our science. These changes to the graduate curriculum are required to ensure that our students receive up-to-date training. These changes also reflect the addition of our new Bioinformatics and Computational Biology PhD program that was approved by General Administration in January 2011. In conjunction with updating the BCB PhD curriculum, we propose to also update the elective courses for the PSM degree and undergraduate students.

We propose to create the following classes:

BINF 4171/5171 – Business of Biotechnology

BINF 4191/5191 –Biotechnology and the Law

BINF 7999 – Master's Degree Graduate Residency

BINF 8991 – Doctoral Dissertation

BINF 9999 – Doctoral Degree Graduate Residency

2. PROPOSED CATALOG COPY. (Starts on the following page)

BIOINFORMATICS

Department of Bioinformatics and Genomics
Bioinformatics Building, Room 309
704-687-8541
http://bioinformatics.uncc.edu/

Degrees
Professional Science Masters in Bioinformatics
Ph.D. in Bioinformatics and Computational Biology

Program Chair
Dr. Lawrence Mays

Program Directors
Dr. Dennis Livesay (PhD program)
Dr. Cynthia Gibas (PSM program)

Graduate Faculty
Cory Brouwer, Associate Professor
Xiuxia Du, Assistant Professor
Anthony Fodor, Assistant Professor
Cynthia Gibas, Associate Professor
Jun-tao Guo, Assistant Professor
Dennis Livesay, Associate Professor
Ann Loraine, Associate Professor
Lawrence Mays, Professor
Jessica Schlueter, Assistant Professor
Shannon Schlueter, Assistant Professor
Susan Sell, Professor
ZhengChang Su, Assistant Professor
Jennifer Weller, Associate Professor

Adjunct Faculty
Marjorie Benbow

Ph.D. in BIOINFORMATICS and COMPUTATIONAL BIOLOGY

The Ph.D. in Bioinformatics and Computational Biology (BCB) is granted for planning, execution and defense of original research resulting in significant contributions to the discipline's body of knowledge. To that end, the BCB Ph.D. program also requires didactic coursework to prepare the student for research success. Student progress is primarily assessed by: (a) satisfactory coursework performance, (b) the Qualifying Examination, (c) the Dissertation Proposal and (d) the Dissertation Defense. Courses and the Qualifying Examination are used to ensure that the student has sufficient breadth of knowledge. The Dissertation Proposal is used to ensure that the scope of dissertation research is important, that the plan is well thought out and that the student has sufficient skills and thoughtfulness needed for success. The Dissertation Defense is used to assess the outcomes of the dissertation research, and whether or not the plan agreed upon by the Dissertation Committee has been appropriately adhered to.

Didactic Curriculum

In consultation with their Academic Advisor and/or Program Director, students must take an appropriate selection of the following Gateway Courses. For example, an incoming student with a Computer Science background would be expected to take 8100 and 8101, but not 8111 and 8112. All students must complete the Core Courses prior to taking the Qualifying Examination. Each Ph.D. student must complete two Research Rotations in the first year. Each Research Rotation provides a semester of faculty supervised research experience to supplement regular course offerings. Graduate Research Seminar is taken every semester until the semester following advancement to candidacy. Finally, many additional Elective Courses are available, but are not explicitly required.

Gateway Courses:
- BINF 8100 Biological Basis of Bioinformatics
- BINF 8101 Energy and Interaction in Biological Modeling
- BINF 8111 Bioinformatics Programming I
- BINF 8112 Bioinformatics Programming II

Core Courses:
- BINF 8200 Statistics for Bioinformatics
- BINF 8201 Molecular Sequence Analysis
- BINF 8202 Computational Structural Biology

Research Rotations:

- BINF 8911 Research Rotation I
- BINF 8912 Research Rotation II

Graduate Research Seminar:

- BINF 8600 Seminar

Qualifying Examination

Prior to defining a research topic, students are required to pass a Qualifying Examination to demonstrate proficiency in bioinformatics and computational biology, as well as competence in fundamentals common to the field. The Qualifying Examination must be passed prior to the fifth semester of residence. It is composed of both written and oral components that emphasize material covered in the Core Courses listed above.

Dissertation Proposal

Each student must present and defend a Ph.D. Dissertation Research Proposal after passing the Qualifying Examination and within ten semesters of entering the Program. The Dissertation Proposal will be conducted by the student's Dissertation Committee, and will be open to faculty and students. The proposal must address a significant, original and substantive piece of research. The proposal must include sufficient preliminary data and a timeline such that the Dissertation Committee can assess its feasibility.

Dissertation

Each student must complete a well-designed original research contribution, as agreed upon by the student and Dissertation Committee at the Dissertation Proposal. The Ph.D. Dissertation is a written document describing the research and its results, and their context in the sub-discipline. The Dissertation Defense is a public presentation of the findings of the research, with any novel methods that may have been developed to support the conclusions. The student must present the Dissertation and defend its findings publicly, and in a private session with the Dissertation Committee immediately thereafter.

PROFESSIONAL SCIENCE MASTER'S IN BIOINFORMATICS

Additional Admission Requirements

In addition to the general requirements for admission to the Graduate School, the following are required for admission to the Professional Science Master's (PSM) in Bioinformatics:

Under most circumstances, students admitted to the program will have:

1) A baccalaureate degree from an accredited college or university in Biology, Biochemistry, Chemistry, Physics, Mathematics, Statistics, Computer Science, or another related field that provides a sound background in life sciences, computing, or both.

2) A minimum undergraduate GPA of 3.0 (4.0 scale) and 3.0 in the major.

3) A minimum combined score of 1000 on the verbal and quantitative portions of the GRE, and acceptable scores on the analytical and discipline-specific sections of the GRE.

4) A combined TOEFL score of 220 (computer-based), 557 (paper-based), or 83 (internet-based) is required if the previous degree was from a country where English is not the common language.

5) Positive letters of recommendation.

Degree Requirements

The Professional Science Masters (PSM) in Bioinformatics degree requires a minimum of 37 graduate credit hours, and a minimum of 33 credit hours of formal course work. A minimum of 24 credit hours presented toward a PSM in Bioinformatics must be numbered 6000 or higher. A maximum of 6 hours of graduate credit may be transferred from other institutions.

1. Total hours required. The program requires 37 post baccalaureate credit hours. Because of the interdisciplinary nature of this program, which is designed to provide students with a common graduate experience during their professional preparation for the PSM in Bioinformatics degree, all students will be required to take a general curriculum that includes a two-year sequence of courses as described below:

2. Core Requirements.

a. Fundamentals Courses

The **Fundamentals** course sequences are intensive graduate-level courses designed to provide accelerated training in a second discipline that complements the student's undergraduate training. Students entering the program are expected to have achieved proficiency in either Biological Sciences or Computing, and to require at most two of the

Fundamentals courses.

Fundamental Biology track: This course sequence is designed for students entering with a degree in Computer Science or another quantitative science discipline. The Fundamental Biology course sequence provides accelerated training in Genetics, Cell and Molecular Biology, and Biochemistry. BINF 6100 (Biological Basis of Bioinformatics), 6101 (Energy and Interaction in Biological Modeling).

Fundamental Computing track: The Fundamental Computing track is designed for students entering with a degree in a life science discipline. The Fundamental Computing course sequence provides accelerated training in programming and data structures. BINF 6111, 6112 (Bioinformatics Programming I and II).

b. Core Bioinformatics Courses

Fundamentals courses prepare students for the required **Core** courses. All students must take BINF 6200, Statistics for Bioinformatics. In addition, students must take 6 additional credit hours of **Core Genomics** courses from among BINF 6201 (Molecular Sequence Analysis), BINF 6203 (Genomics), BINF 6205 (Computational Molecular Evolution) and BINF 6350 (Biotechnology and Genomics Laboratory) and 6 credit hours from the **Core Computational** courses from among 6202 (Computational Structural Biology), BINF 6204 (Mathematical Systems Biology), BINF 6210 (Numerical Methods and Machine Learning for Bioinformatics) and BINF 6310 (Advanced Statistics for Genomics).

c. Professional Preparation Requirement

Students are required to take at least 3 credit hours of electives designed to prepare them to function effectively and ethically in a professional environment. Some recommended electives in this category include BINF 5171, Business of Biotechnology, BINF 5191, Biotechnology and the Law, BINF 6151, Professional Communications, PHIL 6050, Research Ethics, and ITIS 6362, Information Technology Ethics, Policy, and Security. Additional elective choices that may fulfill this requirement can be identified by the student and the student's Advisory Committee.

d. The remaining credit hours of formal course work can be completed in additional **Core Bioinformatics** courses and/or other recommended program electives.

The student's Advisory Committee will review the student's plan of study each semester.

Bioinformatics Electives: Any courses with BINF numbers, with the exception of **Fundamentals** courses, which require approval, are open to PSM students seeking to complete their coursework requirements.

Recommended Electives offered by other units: A wide range of courses in Biology, Chemistry, Computer Science, Software and Information Systems, and other departments may be appropriate electives for PSM in Bioinformatics students. As course offerings change frequently, the Bioinformatics Program maintains a list of current recommended electives, which can be found online at bioinformatics.uncc.edu.

e. Other requirements

• *Bioinformatics Seminar.* In addition to 33 hours of formal coursework, students are required to enroll in the Bioinformatics Program seminar (BINF 6600) for at least one semester (1 credit hour) and to enroll in either an approved internal or external internship (BINF 6400) or a faculty-supervised original research project leading to a thesis (BINF 6900).

• *Grades required.* An accumulation of three C grades will result in suspension of the student's enrollment in the graduate program. If a student makes a grade of U in any course, enrollment in the program will be suspended.

• *Amount of transfer credit accepted.* A maximum of 6 credit hours of coursework from other institutions will count toward the PSM in Bioinformatics degree requirements. Only courses with grades of A or B from accredited institutions are eligible for transfer credit.

COURSES IN BIOINFORMATICS

BINF 4171. **Business of Biotechnology. (3)** Prerequisite: Junior or senior status in a scientific/technical course of study or if in a non-biological/technical or scientific program, special permission of the instructor. This course introduces students to the field of biotechnology and how biotech businesses are created and managed. The students should be able to define biotechnology and understand the difference between a biotech company and a pharmaceutical company. Additional concepts covered will include platform technology, biotechnology's history, biotechnology products and development processes, current technologies used by biotech companies today, biotechnology business fundamentals, research and development within biotech companies, exit strategies, and careers in the biotech field. (Spring)

BINF 5171. **Business of Biotechnology. (3)**
Prerequisite: Admission to a graduate program. This course introduces students to the field of biotechnology and how biotech businesses are created and managed. The students should be able to define biotechnology and understand the difference between a biotech company and a pharmaceutical company. Additional concepts covered will include platform technology, biotechnology's history, biotechnology products and development processes, current technologies used by biotech companies today, biotechnology business fundamentals, research and development within biotech companies, exit strategies, and careers in the biotech field. (Spring)

BINF 4191. Biotechnology and the Law (3)
Prerequisite: Junior or senior status in a scientific/technical course of study or if in a non-biological/technical or scientific program, special permission of the instructor. At the intersection of biotechnology and the law, an intricate body of law is forming based on constitutional, case, regulatory and administrative law. This body of legal knowledge is interwoven with ethics, policy and public opinion. Because biotechnology impacts everything in our lives, the course will provide an overview of salient legal biotechnology topics, including but not limited to: intellectual property, innovation and approvals in agriculture, drug and diagnostic discovery, the use of human and animal subjects, criminal law and the courtroom, agriculture (from farm to fork), patient care, bioethics, and privacy. The body of law is quite complex and it is inundated with a deluge of acronyms. The course will provide a foundation to law and a resource to help students decipher laws and regulation when they are brought up in the workplace. (Fall)

BINF 5191. Biotechnology and the Law (3)
Prerequisite: Admission to a graduate program. At the intersection of biotechnology and the law, an intricate body of law is forming based on constitutional, case, regulatory and administrative law. This body of legal knowledge is interwoven with ethics, policy and public opinion. Because biotechnology impacts everything in our lives, the course will provide an overview of salient legal biotechnology topics, including but not limited to: intellectual property, innovation and approvals in agriculture, drug and diagnostic discovery, the use of human and animal subjects, criminal law and the courtroom, agriculture (from farm to fork), patient care, bioethics, and privacy. The body of law is quite complex and it is inundated with a deluge of acronyms. The course will provide a foundation to law and a resource to help students decipher laws and regulation when they are brought up in the workplace. (Fall)

BINF 6100. Biological Basis of Bioinformatics. (3)
Prerequisites: Admission to graduate standing in Bioinformatics and undergraduate training in Computer Science or other non-biological discipline. This course provides a foundation in molecular genetics and cell biology focusing on foundation topics for graduate training in bioinformatics and genomics. (Fall)

BINF 6101. Energy and Interaction in Biological Modeling. (3)
Prerequisites: Admission to graduate standing in Bioinformatics. This course covers: (i.) the major organic and inorganic chemical features of biological macromolecules; (ii.) the physical forces that shape biological molecules, assemblies and cells; (iii.) the chemical driving forces that govern living systems; (iv.) the molecular roles of biological macromolecules and common metabolites; (v.) and the pathways of energy generation and storage. Each section of the course builds upon the relevant principles in biology and chemistry to explain the most common mathematical and physical abstractions used in modeling in the relevant context. (Spring)

BINF 6111. Bioinformatics Programming I. (3)
Prerequisites: Admission to graduate standing in Bioinformatics. This course introduces fundamentals of programming for bioinformatics using a high-level object-oriented language such as python. The first weeks cover core data types, syntax, and functional programming, focusing on construction of programs from small, testable parts. Students will learn productive use of the Unix environment, focusing on Unix utilities that are particularly useful in

bioinformatics. The course will cover object-oriented programming, introduce analysis of algorithms and sequence alignment methods, and introduce computational environments that are particularly useful in bioinformatics analyses such as R, BioPython, and Web services in bioinformatics. By the end of the class, students will have gained the ability to analyze data within the python interpreter (for example) and write well-documented, well-organized programs. (Fall)

BINF 6112. Bioinformatics Programming II. (3)
Prerequisite: BINF 6111. This course is the second semester of Introduction to Bioinformatics Programming I. In this semester, students will practice and refine skills learned in the first semester. New topics introduced will include: programming as part of a team, using sequence analysis algorithms in realistic settings; writing maintainable and re-usable code; Web programming; and graphical user interface development. At the end of the semester, students will be able to evaluate and deploy computer languages, tools, and software engineering techniques in bioinformatics research. (Spring)

BINF 6151/GRAD 6151. Professional Communications. (1) This course covers: Principles and useful techniques for effective oral presentations, poster presentations, scientific writing, use of references and avoiding plagiarism. Students in the class will critique and help revise each other's presentations and learn how to avoid common pitfalls. In addition, students will learn how to properly organize and run a meeting. Students will prepare a CV, job application letter and job talk. (Fall).

BINF 6200. Statistics for Bioinformatics. (3)
This course aims to introduce students to statistical methods commonly used in bioinformatics. Basic concepts from probability, stochastic processes, information theory, and other statistical methods will be introduced and illustrated by examples from molecular biology, genomics and population genetics with an outline of algorithms and software. R is introduced as the programming language for homework. (Fall)

BINF 6201. Molecular Sequence Analysis. (3)
Prerequisite: BINF 6100 or equivalent. Introduction to bioinformatics methods that apply to molecular sequences. Introduction to biological databases online includeing sequence databases, molecular sequence data formats, sequence data preparation and database submission; local and global sequence alignment, multiple alignment, alignment scoring and alignment algorithms for protein and nucleic acids, gene finding and feature finding in sequences, models of molecular evolution, phylogenetic analysis, and comparative modeling. (Fall)

BINF 6202. Computational Structural Biology. (3)
Prerequisite: BINF 6101, 6201 or equivalents. This course covers: **(a)** the fundamental concepts of structural biology (chemical building blocks, structure, superstructure, folding, etc.); **(b)** structural databases and software for structure visualization; **(c)** structure determination and quality assessment; **(d)** protein structure comparison and the hierarchical nature of biomacromolecular structure classification; **(e)** protein structure prediction and assessment; and **(f)** sequence- and structure-based functional site prediction. (Fall)

BINF 6203. Genomics. (3)
Prerequisite: BINF 6100 or equivalent. This course surveys the application of high-throughput molecular biology and analytical biochemistry methods and data interpretation for those kinds of high volume biological data most commonly encountered by bioinformaticians. The relationship between significant biological questions, modern genomics technology methods, and the bioinformatics solutions that enable interpretation of complex data is emphasized. Topics include: Genome sequencing and assembly, annotation, and comparison; genome evolution and individual variation; function prediction; gene ontologies; transcription assay design, data acquisition, and data analysis; proteomics methods; methods for identification of molecular interactions; and metabolic databases, pathways and models. (Spring)

BINF 6204. Mathematical Systems Biology. (3)

Prerequisites: BINF 6200 and 6210 or equivalents. This course introduces basic concepts, principles and common methods used in systems biology. The class emphasizes molecular networks, models and applications, and covers the following topics: the structure of molecular networks; network motifs, their system properties and the roles they play in biological processes; complexity and robustness of molecular networks; hierarchy and modularity of molecular interaction networks; kinetic proofreading; optimal gene circuit design; the rules for gene regulation. (Spring)

BINF 6205. Computational Molecular Evolution. (3)

Prerequisites: BINF 6201 (Molecular Sequence Analysis) and BINF 6200 Statistics for Bioinformatics (or permission of the instructor). This course covers major aspects of molecular evolution and phylogenetics with an emphasis on the modeling and computational aspects of the fields. Topics will include: models of nucleotide substitution, models of amino acid and codon substitution, phylogenetic reconstruction, maximum likelihood methods, Bayesian methods, comparison of phylogenetic methods and tests on trees, neutral and adaptive evolution and simulating molecular evolution. Students will obtain an in-depth knowledge of the various models of evolutionary processes, a conceptual understanding of the methods associated with phylogenetic reconstruction and testing of those methods and develop an ability to take a data-set and address fundamental questions with respect to genome evolution. *(On demand)*

BINF 6210. Numerical Methods and Machine Learning in Bioinformatics. (3)

Prerequisites: Ability to program in a high-level language (Perl, Java, C#, Python, Ruby, C/C++), Calculus. This course focuses on commonly used numerical methods and machine learning techniques. Topics will include: solutions to linear systems, curve fitting, numerical differentiation and integration, PCA, SVD, ICA, SVM, PLS. Time permitting, Hidden Markov Chains and Monte Carlo simulations will be covered as well. Students will learn both the underlying theory and how to apply the theory to solve problems. (Fall)

BINF 6211. Design and Implementation of Bioinformatics Databases. (3)

In this course students learn the necessary skills to access and utilize public biomedical data repositories, and will be expected to design, instantiate, populate, query and maintain a personal database to support research in an assigned domain of bioinformatics. The course content includes common data models and representation styles, use of open-source relational DBMS, and basic and advanced SQL. The course focuses on how data integration is achieved, including the use of standardized schemas, exchange formats and ontologies. We examine large public biomedical data repositories such as GenBank and PDB, learn how to locate and assess the quality of data in Web-accessible databases, and look at representation, standards and access methods for such databases. (Spring)

BINF 6310. Advanced Statistics for Genomics. (3)

Prerequisite: BINF 6200 or equivalent. The first half of this course emphasizes canonical linear statistics (t-test, ANOVA, PCA) and their non-parametric equivalents. The second half of the course emphasizes Bayesian statistics and the application of Hidden Markov Models to problems in bioinformatics. Students should have fluency in a high-level programming language (PERL, Java, C# or equivalent) and will be expected, in assignments, to manipulate and analyze large public data sets. The course will utilize the R statistical package with the bioconductor extension. (Spring)

BINF 6311. Biophysical Modeling. (3)

This course covers: **(a)** an overview of mechanical force fields; **(b)** energy minimization; **(c)** dynamics simulations (molecular and coarse-grained); **(d)** Monte-Carlo methods; **(e)** systematic conformational analysis (grid searches); **(f)** classical representations of electrostatics (Poisson-Boltzmann, Generalized Born and Coulombic); **(g)** free energy decomposition schemes; and **(h)** hybrid quantum/classical (QM/MM) methods. *(On demand)*

BINF 6312. Computational Comparative Genomics. (3)

Prerequisite: BINF 6201 or equivalent. This course introduces computational methods for comparative

genomics analyses. The course covers the following topics: the architecture of prokaryotic and eukaryotic genomes; the evolutionary concept in genomics; databases and resources for comparative genomics; principles and methods for sequence analysis; evolution of genomes; comparative gene function annotation; evolution of the central metabolic pathways and regulatory networks; genomes and the protein universe; *cis*-regulatory binding site prediction; operon and regulon predictions in prokaryotes; regulatory network mapping and prediction. *(On demand)*

BINF 6313. Structure, Function, and Modeling of Nucleic Acids. (3)
Prerequisite: BINF 6100-6101 or equivalent. This course covers the following topics: atomic structure, macromolecular structure-forming tendencies and dynamics of nucleic acids; identification of genes which code for functional nucleic acid molecules; cellular roles and metabolism of nucleic acids; 2D and 3D abstractions of nucleic acid macromolecules and methods for structural modeling and prediction; modeling of hybridization kinetics and equilibria; hybridization-based molecular biology protocols, detection methods and molecular genetics methods; and the role of modeling in designing these experiments and predicting their outcome. *(On demand)*

BINF 6350. **Biotechnology and Genomics Laboratory. (3)** Prerequisite: none. This course teaches basic wet-lab techniques commonly used in biotechnology to generate genomics data. Lectures will cover methods for sample isolation, cell disruption, nucleic acid and protein purification, nucleic acid amplification, protein isolation and characterization, molecular labeling methods and commonly used platforms for characterizing genome-wide molecular profiles. In particular we will discuss and learn to perform: tissue culture and LCM isolation of cells, DNA sequencing methods, DNA fingerprinting methods, RT-qPCR and microarrays of cDNA, 1D and 2D gels for protein separation, protein activity assays, and proteomics platforms. Lectures will describe emerging methodologies and platforms, and will discuss the ways in which the wet-lab techniques inform the design and use of bioinformatics tools, and how the tools carry out the processing and filtering that leads to reliable data. The course will also discuss the commercial products beginning to emerge from genomics platforms. (Spring)

BINF 6380. Programming III. (3)
Prerequisite: BINF 6112 or equivalent.
This course emphasizes implementation of bioinformatics algorithms in the context of parallel processing. Topics covered depend on instructor expertise and student interest but may include development of multi-threaded applications, developing for multi-core processors and utilization of large clusters and "cloud" supercomputers. Students will be expected to complete a significant independent project (Fall).

BINF 6400. Internship Project. (1-3)
Prerequisite: Admission to graduate standing in Bioinformatics. Project is chosen and completed under the guidance of an industry partner, and will result in an acceptable technical report. (Fall, Spring)

BINF 6600. Seminar. (1)
Prerequisite: Admission to graduate standing in Bioinformatics. Departmental seminar. Weekly seminars will be given by bioinformatics researchers from within the University and across the world. (Fall, Spring)

BINF 6601. Journal Club. (1)
Prerequisites: Admission to graduate standing in Bioinformatics. Each week, a student in the class is assigned to choose and present a paper from the primary bioinformatics literature. (Fall, Spring)

BINF 6900. Masters' Thesis. (1-3)
Prerequisites: Twelve graduate credits and permission of instructor. Project is chosen and completed under the guidance of a graduate faculty member, and will result in an acceptable master's thesis and oral defense. *(On demand)*

BINF 6880. Independent Study. (1-3) Faculty supervised research experience to supplement regular course offerings.

BINF 7999. Master's Degree Graduate Residency Credit. (1)

(Fall, Spring, Summer)

BINF 8100. Biological Basis of Bioinformatics. (3)
Prerequisites: Admission to graduate standing in Bioinformatics and undergraduate training in Computer Science or other non-biological discipline. This course provides a foundation in molecular genetics and cell biology focusing on foundation topics for graduate training in bioinformatics and genomics. (Fall)

BINF 8101. Energy and Interaction in Biological Modeling. (3)
Prerequisites: Admission to graduate standing in Bioinformatics. This course covers: (i.) the major organic and inorganic chemical features of biological macromolecules; (ii.) the physical forces that shape biological molecules, assemblies and cells; (iii.) the chemical driving forces that govern living systems; (iv.) the molecular roles of biological macromolecules and common metabolites; (v.) and the pathways of energy generation and storage. Each section of the course builds upon the relevant principles in biology and chemistry to explain the most common mathematical and physical abstractions used in modeling in the relevant context. (Spring)

BINF 8111. Bioinformatics Programming I. (3)
Prerequisite: Admission to graduate standing in Bioinformatics. This course introduces fundamentals of programming for bioinformatics using a high-level object-oriented language such as python. The first weeks cover core data types, syntax, and functional programming, focusing on construction of programs from small, testable parts. Students will learn productive use of the Unix environment, focusing on Unix utilities that are particularly useful in bioinformatics. The course will cover object-oriented programming, introduce analysis of algorithms and sequence alignment methods, and introduce computational environments that are particularly useful in bioinformatics analyses such as R, BioPython, and Web services in bioinformatics. By the end of the class, students will have gained the ability to analyze data within the python interpreter (for example) and write well-documented, well-organized programs. (Fall)

BINF 8112. Bioinformatics Programming II. (3)
Prerequisite: BINF 8111. This is a continuation of Bioinformatics Programming I (BINF 8111). This course is the second semester of Introduction to Bioinformatics Programming I. In this semester, students will practice and refine skills learned in the first semester. New topics introduced will include: programming as part of a team, using sequence analysis algorithms in realistic settings; writing maintainable and re-usable code; Web programming; and graphical user interface development. At the end of the semester, students will be able to evaluate and deploy computer languages, tools, and software engineering techniques in bioinformatics research. (Spring)

BINF 8151/GRAD 8151. Professional Communications. (1) This course covers: Principles and useful techniques for effective oral presentations, poster presentations, scientific writing, use of references and avoiding plagiarism. Students in the class will critique and help revise each other's presentations and learn how to avoid common pitfalls. In addition, students will learn how to properly organize and run a meeting. Students will prepare a CV, job application letter and job talk. (Fall).

BINF 8200. Statistics for Bioinformatics. (3)
This course aims to introduce statistical methods commonly used in bioinformatics. Basic concepts from probability, stochastic processes, information theory, and other statistical methods will be introduced and illustrated by examples from molecular biology, genomics and population genetics with an outline of algorithms and software. R is introduced as the programming language for homework. (Fall)

BINF 8201. Molecular Sequence Analysis. (3)
Prerequisite: BINF 8100 or equivalent. BINF 8100 or equivalent. Introduction to bioinformatics methods that apply to molecular sequences. Introduction to biological databases online includeing sequence databases, molecular sequence data formats, sequence data preparation and database submission; local and global sequence alignment,

multiple alignment, alignment scoring and alignment algorithms for protein and nucleic acids, gene finding and feature finding in sequences, models of molecular evolution, phylogenetic analysis, and comparative modeling. (Fall)

BINF 8202. Computational Structural Biology. (3)
Prerequisite: BINF 8101, 8201 or equivalents. This course covers: **(a)** the fundamental concepts of structural biology (chemical building blocks, structure, superstructure, folding, etc.); **(b)** structural databases and software for structure visualization; **(c)** structure determination and quality assessment; **(d)** protein structure comparison and the hierarchical nature of biomacromolecular structure classification; **(e)** protein structure prediction and assessment; and **(f)** sequence- and structure-based functional site prediction. (Fall)

BINF 8203. Genomics. (3)
Prerequisite: BINF 8100 or equivalent. This course surveys the application of high-throughput molecular biology and analytical biochemistry methods and data interpretation for those kinds of high volume biological data most commonly encountered by bioinformaticians. The relationship between significant biological questions, modern genomics technology methods, and the bioinformatics solutions that enable interpretation of complex data is emphasized. Topics include: Genome sequencing and assembly, annotation, and comparison; genome evolution and individual variation; function prediction; gene ontologies; transcription assay design, data acquisition, and data analysis; proteomics methods; methods for identification of molecular interactions; and metabolic databases, pathways and models. (Spring)

BINF 8204. Mathematical Systems Biology. (3)
Prerequisites: BINF 8200 and 8210 or equivalents. This course introduces basic concepts, principles and common methods used in systems biology. The class emphasizes molecular networks, models and applications, and covers the following topics: the structure of molecular networks; network motifs, their system properties and the roles they play in biological processes; complexity and robustness of molecular networks; hierarchy and modularity of molecular interaction networks; kinetic proofreading; optimal gene circuit design; the rules for gene regulation. (Spring)

BINF 8205. Computational Molecular Evolution. (3)
Pre-requisites: BINF 8201 (Molecular Sequence Analysis) and BINF 8200 (Statistics for Bioinformatics) or permission of the instructor. This course will cover major aspects of molecular evolution and phylogenetics with an emphasis on the modeling and computational aspects of the fields. Topics will include: models of nucleotide substitution, models of amino acid and codon substitution, phylogenetic reconstruction, maximum likelihood methods, Bayesian methods, comparison of phylogenetic methods and tests on trees, neutral and adaptive evolution and simulating molecular evolution. Students will obtain an in-depth knowledge of the various models of evolutionary processes, a conceptual understanding of the methods associated with phylogenetic reconstruction and testing of those methods and develop an ability to take a data-set and address fundamental questions with respect to genome evolution. *(On demand)*

BINF 8210. Numerical Methods and Machine Learning in Bioinformatics. (3)
Prerequisites: Ability to program in a high-level language (Perl, Java, C#, Python, Ruby, C/C++), Calculus. This course focuses on commonly used numerical methods and machine learning techniques. Topics will include: solutions to linear systems, curve fitting, numerical differentiation and integration, PCA, SVD, ICA, SVM, PLS. Time permitting, Hidden Markov Chains and Monte Carlo simulations will be covered as well. Students will learn both the underlying theory and how to apply the theory to solve problems. (Fall)

BINF 8211. Design and Implementation of Bioinformatics Databases. (3)
In this course students will acquire skills needed to access and utilize public biomedical data repositories, and will be expected to design, instantiate, populate, query and maintain a personal database to support research in an assigned domain of bioinformatics. The course content includes common data models and representation styles, use of open-source relational DBMS, and basic and advanced SQL. The

course focuses on how data integration is achieved, including the use of standardized schemas, exchange formats and ontologies. We will examine large public biomedical data repositories such as GenBank and PDB, learn how to locate and assess the quality of data in Web-accessible databases, and look at representation, standards and access methods for such databases. (Spring)

BINF 8310. Advanced Statistics for Genomics. (3)
Prerequisite: BINF 8200 or equivalent. The first half of this course emphasizes canonical linear statistics (t-test, ANOVA, PCA) and their non-parametric equivalents. The second half of the course emphasizes Bayesian statistics and the application of Hidden Markov Models to problems in bioinformatics. Students should have fluency in a high-level programming language (PERL, Java, C# or equivalent) and will be expected, in assignments, to manipulate and analyze large public data sets. The course will utilize the R statistical package with the Bioconductor extension. (Spring)

BINF 8311. Biophysical Modeling. (3)
This course covers: **(a)** an overview of mechanical force fields; **(b)** energy minimization; **(c)** dynamics simulations (molecular and coarse-grained); **(d)** Monte-Carlo methods; **(e)** systematic conformational analysis (grid searches); **(f)** classical representations of electrostatics (Poisson-Boltzmann, Generalized Born and Coulombic); **(g)** free energy decomposition schemes; and **(h)** hybrid quantum/classical (QM/MM) methods. *(On demand)*

BINF 8312. Computational Comparative Genomics. (3)
Prerequisite: BINF 8201 or equivalent. This course introduces computational methods for comparative genomics analyses. The course covers the following topics: the architecture of prokaryotic and eukaryotic genomes; the evolutionary concept in genomics; databases and resources for comparative genomics; principles and methods for sequence analysis; evolution of genomes; comparative gene function annotation; evolution of the central metabolic pathways and regulatory networks; genomes and the protein universe; *cis*-regulatory binding site prediction; operon and regulon predictions in prokaryotes; and regulatory network mapping and prediction. *(On demand)*

BINF 8313. Structure, Function, and Modeling of Nucleic Acids. (3)
Prerequisite: BINF 8100-8101 or equivalent. The course covers the following topics: atomic structure, macromolecular structure-forming tendencies and dynamics of nucleic acids; identification of genes which code for functional nucleic acid molecules, cellular roles and metabolism of nucleic acids; 2D and 3D abstractions of nucleic acid macromolecules and methods for structural modeling and prediction; modeling of hybridization kinetics and equilibria; hybridization-based molecular biology protocols, detection methods and molecular genetics methods, and the role of modeling in designing these experiments and predicting their outcome. *(On demand)*

BINF 8350. Biotechnology and Genomics Laboratory. (3) Prerequisite: none. This course teaches basic wet-lab techniques commonly used in biotechnology to generate genomics data. Lectures will cover methods for sample isolation, cell disruption, nucleic acid and protein purification, nucleic acid amplification, protein isolation and characterization, molecular labeling methods and commonly used platforms for characterizing genome-wide molecular profiles. In particular we will discuss and learn to perform: tissue culture and LCM isolation of cells, DNA sequencing methods, DNA fingerprinting methods, RT-qPCR and microarrays of cDNA, 1D and 2D gels for protein separation, protein activity assays, and proteomics platforms. Lectures will describe emerging methodologies and platforms, and will discuss the ways in which the wet-lab techniques inform the design and use of bioinformatics tools, and how the tools carry out the processing and filtering that leads to reliable data. The course will also discuss the commercial products beginning to emerge from genomics platforms. (Spring)

BINF 8380. Programming III. (3)
Prerequisite: BINF 8112 or equivalent. This course emphasizes implementation of bioinformatics algorithms in the context of parallel processing. Topics covered depend on instructor expertise and

student interest but may include development of multi-threaded applications, developing for multi-core processors and utilization of large clusters and "cloud" supercomputers. Students will be expected to complete a significant independent project (Fall).

BINF 8600. Seminar. (1)
Prerequisites: Admission to graduate standing in Bioinformatics. Departmental seminar. Weekly seminars will be given by bioinformatics researchers from within the university and across the world. (Fall, Spring)

BINF 8601. Journal Club. (1)
Prerequisites: Admission to graduate standing in Bioinformatics. Each week, a student in the class is assigned to choose and present a paper from the primary bioinformatics literature. (Fall, Spring)

BINF 8911 Research Rotation I (2), BINF 8912 Research Rotation II (2).
Faculty supervised research experience in bioinformatics to supplement regular course offerings. (Fall, Spring, Summer)

BINF 8991 Doctoral Dissertation Research (1-9).
Individual investigation culminating in the preparation and presentation of a doctoral dissertation. (Fall, Spring, Summer)

BINF 9999. Doctoral Degree Graduate Residency Credit. (1)
(Fall, Spring, Summer)

B. JUSTIFICATION.

1. Need for proposed courses.
   The field of Bioinformatics and Genomics continues to change rapidly. These proposed modifications to the course curriculum are required to keep our curriculum focused on the most recently developed technology.

   As our department has continued to grow in terms of both faculty and students, we have gained more experience with our classes and some of the changes we propose reflect this experience. Many of our students will pursue careers in the biotechnology industry and we have therefore proposed to add BINF 4191/5191 (Biotechnology and the Law) and BINF 4171/5191 (Business of Biotechnology). Our PhD students must pursue independent research projects over the course of a semester, and we therefore propose to create mechanisms BINF 8991 to capture this activity. Some students in their final semester need the 1-credit BINF 7999 Master's Degree Residency or BINF 9999 Doctoral Degree Graduate Residency.

2. Prerequisites and corequisites.
   All of the new classes require good standing within our PSM or Ph.D. program or permission of the instructor. These requirements are reasonable given the course content.

3. Justification of course numbering scheme.
   The Biotechnology and the Law and the Business of Biotechnology courses will be offered with dual 4000/5000 numbers with second digits following the guidelines for course numbers described in the 2005-2007 Graduate Catalog. In addition, we have followed the numbering scheme laid out in the original bioinformatics curriculum proposal in which fundamental courses have a second digit of "1", core bioinformatics courses have a second digit of "2" and electives have a second digit of "3" or higher.

4. Improvements to the scope and quality of instruction.

As outlined above, the changes to these courses will make our curriculum more relevant to recent changes in the biotechnology industry, will better reflect the skills and research interests of our growing department and will incorporate our experiences in teaching these courses to our growing graduate student population over the last several years.

C. IMPACT.

1. Students served.

We currently have 22 Ph.D. students, 18 PSM students, and 6 graduate certificate students enrolled in our program. We are currently offering Bioinformatics undergraduate elective courses that have 5 students enrolled. We anticipate another 5 Ph.D., 10 PSM, and 5 undergraduate students to enroll in the 2011-2012 academic year. Most of the students taking our classes are drawn from students in our degree programs, although we have also had significant enrollment from students in other undergraduate and graduate programs (including biology and Computer Science) as well as post-baccalaureate students.

2. Impact on other courses.

The proposed changes are new courses taught by our newly-hired faculty.

a. When and how often the added courses will be taught
The additional courses will be taught at least once every academic year.

b. How the content and/or frequency will affect other courses
Offerings of other courses will be unaffected.

c. Anticipated enrollments.
We anticipate between 7 and 20 students enrolling in these courses in the near term. However, with the continued growth of our Ph.D., PSM, and undergraduate programs, we expect eventual enrollment to be 15-20 students in the BINF 4191/5191, 4171/5171 and 8991 courses.

d. Effect of enrollment in other courses.
The courses offered by our department have little overlap with the efforts of other departments on campus and as such will not affect the enrollment of the courses of other programs.

e. Experience offering these courses as special topics.
The courses have not been offered as special topics. The BINF 8991 Doctoral Dissertation Research will replace the ITSC 8991 requirement for the Bioinformatics and Computational Biology PhD students. The BINF 4171/5171 Business of Biotechnology will replace BINF 6171/8171.

f. Impact on catalog copy.
We have drafted catalog copy (see above) that should be inserted into the College of Computing and Informatics section of the catalog.

D. RESOURCES REQUIRED TO SUPPORT PROPOSAL.

1. Personnel

a. Specify requirements for new faculty, part-time teaching, student assistant and/or increased load on present faculty.

As described above, we have 13 active faculty within our department and plans to recruit at least 1 additional faculty over the next year. We are adequately staffed to teach the newly proposed courses.

b. List by name qualified faculty members interested in teaching the courses.
We here list faculty interested in teaching the **new** classes:

BINF 4171/5171 – Business of Biotechnology (Cory Brouwer)

BINF 4191/5191 –Biotechnology and the Law (Marjorie Benbow)

BINF 7999 – Master's Degree Graduate Residency (Cynthia Gibas)

BINF 8991 – Doctoral Dissertation Research (Dennis Livesay)

BINF 9999 – Doctoral Degree Graduate Residency (Dennis Livesay)

2. Physical Facility. Our recently constructed Bioinformatics building has state of the art classroom facilities and student computer workrooms. All classes will be taught in this building.

3. Equipment and Supplies. No new equipment.

4. Computer. No new computer equipment is required beyond what is already in the Bioinformatics building.

5. Audio-Visual. No new audio-visual equipment is requested beyond the state-of-the-art presentation facilities in the Bioinformatics building.

6. Other Resources. No other new resources are required for the teaching of these courses.

E. CONSULTATION WITH THE LIBRARY AND OTHER DEPARTMENTS OR UNITS.

1. Library consultation: See Appendix materials

2. Letters from chairs. See Appendix materials

F. INITIATION AND CONSIDERATION OF THE PROPOSAL

1. Originating Unit.
This proposal was originated by the department of Bioinformatics and Genomics on February 25, 2011.

2. Other Considering Units.

The proposal was considered by the College of Computing and Informatics at the March 15, 2011 faculty meeting.

G. ATTACHMENTS:

1. Proposal for BINF 4171/5171 – Business of Biotechnology
2. Proposal for BINF 4191/5191 – Biotechnology and the Law
3. Proposal for BINF 7999 – Master's Degree Graduate Residency
4. Proposal for BINF 8991 – Doctoral Dissertation Research
5. Proposal for BINF 9999 – Doctoral Degree Graduate Residency

BIOTECHNOLOGY AND THE LAW
BINF 4191
SYLLABUS – FALL 2011

Instructor: Marjorie Benbow, JD, MBA, MSPH
Office: 205 Bioinformatics
Office Phone: (704) 687-8563
Office Hours: Monday 4:00 – 5:00 pm and by appointment
Class Hours: Monday 5:00 – 7:45
Email: not assigned yet

A. COURSE DESCRIPTION

Biotechnology and the Law: At the intersection of biotechnology and the law, an intricate body of law is forming based on constitutional, case, regulatory and administrative law. This body of legal knowledge is interwoven with ethics, policy and public opinion. Because biotechnology impacts everything in our lives, the course will provide an overview of salient legal biotechnology topics, including but not limited to intellectual property, innovation and approvals in agriculture, drug and diagnostic discovery , the use of human and animal subjects, criminal law and the courtroom, agriculture (from farm to fork), patient care, bioethics and privacy.

The body of law is quite complex and it is inundated with acronyms (FDCA, FDA, ICH, NDA, EPA, OPP, USDA, GMO, JCAHO, HIPAA, IRB, IACUC, CMS, IP, USPTO, EPO, MOU, LOI, CBER, CFSAN OSHA, BSL, CLIA, GMP, GLP, GAP, not to mention DNA, mRNA and RNA). The pedagogical approach is project based and instructor- and classmate-interactive. The course will provide a foundation to law and a resource to help students decipher laws and regulation when they brought up in the workplace.

(3 credit hours)

The course meets in 217 Bioinformatics Bldg on Mondays from 5:00 to 7:45

B. PRE- OR CO-REQUISITES

Prerequisite: Junior or senior status in a scientific/technical course of study or if in a non-biological/technical or scientific program, special permission of the instructor.

C. OBJECTIVES OF THE COURSE

Upon completion of Biotechnology and the Law, students will be able to:

- Articulate the broad societal ramifications of breaking the DNA code
- Gain knowledge of selected laws governing biotechnology
- Become familiar with intellectual property rights
- Deploy survey tools to understand issues of biotechnology, public awareness, ethics and the law
- Be exposed to case law and the litigation process
- Execute proper lab notebook hygiene
- Develop critical thinking skills and communication skills necessary to convey positions on issues
- Compare and contrast agreements
- Develop an appreciation to the challenges of policymaking / legislative agendas around biotechnology

D. INSTRUCTIONAL METHOD

The course integrates lectures, debates, presentations, discussions and class projects.

E. MEANS OF STUDENT EVALUATION

40% Quizzes, Requirements and Class Assignments (including electronic and class participation)
30% TWO (2) Midterms (15% each)
30% Final

The syllabus includes REQUIREMENTS and ASSIGNMENTS. All students must complete requirements. Students registered for BINF 4191 are required to complete **three (3).** Students may select which assignments they would like to complete. To improve a grade, a student may substitute additional assignments, and the highest three assignments will be used to determine that grade. It is recommended that students try to complete assignments early in the semester given the number of project deadlines occurring toward the end of the semester.

All materials submitted as part of course requirements become the property of the instructor. Students desiring to retain copies of their work should make such copies before turning in their materials.

F. SPECIFY POLICIES THAT APPLY TO THIS COURSE:

The following policies apply to students in BINF 4191

1. UNIVERSITY INTEGRITY

All students are required to read and abide by the Code of Student Academic Integrity. Violations of the Code of Student Academic Integrity, including plagiarism, will result in disciplinary action as provided in the Code. Definitions and examples of plagiarism are set forth in the Code. The Code is available from the Dean of Students Office or online at: http://www.legal.uncc.edu/policies/ps-105.html. A set of links to various resources on plagiarism and how to avoid it is available at the UNCC Library website: http://library.uncc.edu/display/?dept=instruction&format=open&page=920.

2. ATTENDANCE

Class attendance is required, although exceptions will be made for reasons such as illness or family emergency.
If the instructor is late, students are required to wait 20 minutes after the start of class before leaving to avoid being counted absent. If written instructions are left, they are to be followed.

3. GRADING POLICY

Grades will be assigned on the following scale:
A=90-100%
B=80-89%
C=70-79%
D=60-69%
F=<60%

4. ADDITIONAL POLICIES.

Students seeking accommodations for disabilities must first consult with the Office of Disability Services (ODS) and follow the instructions of that office for obtaining accommodations. Reasonable and appropriate accommodations will be provided to students presenting a memo from ODS.

The use of cell phones, pagers, PDAs, or other communication devices is disruptive and thus is prohibited during class. Individuals using such devices, unless for class activities or an emergency, are to leave the class, and will receive an unexcused absence. Students are permitted to use computers during class for note-taking and other class-related work only, at the discretion of the instructor.

G. TEXTBOOK

No formal textbook. A collection of current readings and chapters will be assigned.

H. SCHEDULE OF TOPICS (SUBJECT TO CHANGE)

8/22 Societal Impact of Breaking the DNA Code
Intellectual Property (Copyrights, Trademarks, Patents and Trade Secrets)
Requirement: 8/24 COB
Submit a personal statement on what you think is the largest impact of breaking the DNA code and why. (~1000 words) Your original statement should be approximately five paragraphs (introduction, supporting paragraphs and conclusion).

8/29 Intellectual Property (Copyrights, Trademarks, Patents and Trade Secrets) – continued
Exploring the Pros and Cons of Open and Closed Source
Requirement: 8/31 COB
Notebook hygiene - Correct a lab notebook
Requirement: 9/1 COB
Create a draft of a tool that you would like to use to gain insight into how the 'public' reaction or levels of public knowledge about a biotechnology topic (GMOs, food definitions (natural, organic), etc.
Assignment: 8/31 COB
In teams of two, submit a trademark for state and federal approval.

9/5 No Class
Assignment: 9/7 COB
Write a position statement on open vs. closed source (~1000 words).

9/12 Plant Varieties, Their Patents and Approval of GMOs
From Farm to Fork (GAP)
Assignment: 9/16 COB
Write a plant patent.

9/19 A Case Study: The Approval of
Guilt, Innocence and Evidentiary Protocol
How to Be a Good Expert Witness
Requirement: 9/21 COB
Does DNA prove guilt? (~1000 words)

9/26 Midterm 1
Requirement: 9/26 during class
Trial: Who's Your Daddy? – A moot court competition
Assignment: 9/29 COB
Critique the validity of a crime scene / forensic episode.

10/3 Consent and Privacy
Assignment: 10/5 COB

Compare and contrast the consent forms used for clinical trials, the personalized genomic project, the human Genographic project (National Geographic, project lead Dr. Spencer Wells), a standard medical visit and a student supplied consent form.
Write a position paper on your reaction to what you learned about the protection of your privacy or the personal genomic project. (~1000 words)

10/10 No Class

10/ 17 From Bench to Bedside:
Technology Transfer and Licensing Agreements
MTAs
Requirement: 10/17 COB
Finalize your tool and topic for understanding public opinion or public knowledge/awareness of a biotechnology topic. Include how you will deploy this tool to provide insight about this biotechnology topic.

10/ 24 Clinical Trials
Animal and Human Subject Welfare Protocols (IRB and IACUC)

10/31 Advertising, Promotion and Labeling
Food or Drug?
Assignment: 10/19 COB
What do you see wrong on this label? Why? How would you correct it?

11/7 Midterm #2
Topics for 11/21 to be distributed or proposed by students.

11/14 Contract Law (MOUs, LOIs, SLAs, etc)

11/21 Stem Cells and BioBanking
Assignment: 11/23 COB
Write a position paper on either StemCells or Biobanking. (~1000 words)

11/28 Classroom Activity: Debate
Requirement: 11/30 by the beginning of class
Submit a position paper on your topic or debate (~1000 words)

12/5 Present Survey Findings to your class
Requirement: 12/5 in class presentation
Using a visual aid, present to your findings. (10 minutes, and be prepared for up to five minute Q&A session)

12/X Final Exam

BIOTECHNOLOGY AND THE LAW
BINF 5191
SYLLABUS – FALL 2011

Instructor: Marjorie Benbow, JD, MBA, MSPH
Office: 205 Bioinformatics
Office Phone: (704) 687-8563
Office Hours: Monday 4:00 – 5:00 pm and by appointment
Class Hours: Monday 5:00 – 7:45
Email: not assigned yet

I. COURSE DESCRIPTION

Biotechnology and the Law: At the intersection of biotechnology and the law, an intricate body of law is forming based on constitutional, case, regulatory and administrative law. This body of legal knowledge is interwoven with ethics, policy and public opinion. Because biotechnology impacts everything in our lives, the course will provide an overview of salient legal biotechnology topics, including but not limited to intellectual property, innovation and approvals in agriculture, drug and diagnostic discovery , the use of human and animal subjects, criminal law and the courtroom, agriculture (from farm to fork), patient care, bioethics and privacy.

The body of law is quite complex and it is inundated with acronyms (FDCA, FDA, ICH, NDA, EPA, OPP, USDA, GMO, JCAHO, HIPAA, IRB, IACUC, CMS, IP, USPTO, EPO, MOU, LOI, CBER, CFSAN OSHA, BSL, CLIA, GMP, GLP, GAP, not to mention DNA, mRNA and RNA). The pedagogical approach is project based and instructor- and classmate-interactive. The course will provide a foundation to law and a resource to help students decipher laws and regulation when they brought up in the workplace.

(3 credit hours)

The course meets in 217 Bioinformatics Bldg on Mondays from 5:00 to 7:45

J. PRE- OR CO-REQUISITES

Prerequisite: Admission to a graduate program.

K. OBJECTIVES OF THE COURSE

Upon completion of Biotechnology and the Law, students will be able to:

- Articulate the broad societal ramifications of breaking the DNA code
- Gain knowledge of selected laws governing biotechnology
- Become familiar with intellectual property rights
- Deploy survey tools to understand issues of biotechnology, public awareness, ethics and the law
- Be exposed to case law and the litigation process
- Execute proper lab notebook hygiene
- Develop critical thinking skills and communication skills necessary to convey positions on issues
- Compare and contrast agreements
- Develop an appreciation to the challenges of policymaking / legislative agendas around biotechnology

L. INSTRUCTIONAL METHOD

The course integrates lectures, debates, presentations, discussions and class projects.

M. MEANS OF STUDENT EVALUATION

40% Quizzes, Requirements and Class Assignments (including electronic and class participation)
30% TWO (2) Midterms (15% each)
30% Final

The syllabus includes REQUIREMENTS and ASSIGNMENTS. All students must complete requirements. Students registered for BINF 5191 are required to complete **five (5)** assignments. Students may select which assignments they would like to complete. To improve a grade, a student may substitute additional assignments, and the highest five assignments will be used to determine that grade. It is recommended that students try to complete assignments early in the semester given the number of project deadlines occurring toward the end of the semester.

All materials submitted as part of course requirements become the property of the instructor. Students desiring to retain copies of their work should make such copies before turning in their materials.

N. SPECIFY POLICIES THAT APPLY TO THIS COURSE:

The following policies apply to students in BINF 5191

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B=80-89%
C=65-79%
U=0-64%

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O. TEXTBOOK

No formal textbook. A collection of current readings and chapters will be assigned.

P. SCHEDULE OF TOPICS (SUBJECT TO CHANGE)

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In teams of two, submit a trademark for state and federal approval.

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Requirement: 11/30 by the beginning of class
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12/5 Present Survey Findings to your class
Requirement: 12/5 in class presentation
Using a visual aid, present to your findings. (10 minutes, and be prepared for up to five minute Q&A session)

12/X Final Exam

BINF 4171 Business of Biotechnology

Syllabus

Dr. Cory R. Brouwer Email: Cory.Brouwer@uncc.edu Phone: (704) 250-5764 Office Hours: ½ hour before and after class or by appointment	Times: M 9:30 – 12:15 Location: Bioinformatics 205 Website: http://moodle.uncc.edu

Course Description:

The purpose of "The Business of Biotechnology" course is to introduce students to the field of biotechnology and how biotech businesses are created and managed. The students should be able to define biochemistry and understand the difference between a biotech company and a pharmaceutical company. Additional concepts covered will include platform technology, biotechnology's history, biotechnology products and development processes, current technologies used by biotech companies today, biotechnology business fundamentals, research and development within biotech companies, exit strategies, and careers in the biotech field.

Prerequisite:

Junior or senior status in a scientific/technical course of study or if in a non-biological/technical or scientific program, special permission of the instructor.

Tentative Course Outline

Date	Subject	Chapter
1/10	Introduction, syllabus, expectations; Biotechnology as an Industry Overview	1, 2
1/24	Molecular Biology	3
1/31	Drug Development	4
2/7	Tools and Techniques	5
2/14	Applications	6
2/21	Exam 1	
2/28	Finance; Biotech Formation Fundamentals	10, 11
3/14	Biotech Formation Fundamentals (cont); R&D	10, 12
3/21	Marketing	13
3/28	Managing Biotechnology	15
4/4	Intellectual Property	7
4/11	Exam 2	
4/18	Regulation; Politics and Ethics	8, 9
4/25	Licensing, Alliances, Mergers	14
5/2	Putting it all together-building biotech companies; Career Opportunities	17,19
5/9	Exam 3	

Required Material

- Yali Friedman. *Building Biotechnology* (Logos Press, 2008) ISBN: 9780973467666
- Additional material will be provided on the course website. We will likely update this list as we proceed throughout the semester. You are responsible for getting up-to-date information on the current readings.

Grading Plan:

Students will be evaluated based on their mastery of the concepts and theories taught in the class, and the ability to use them for solving practical problems. The grade is determined as follows:

Exam #1	15%
Exam #2	15%
Exam #3	10%
Project	50%
Attendance	5%
Class Participation	5%
Quickie Quizzes	Extra points

Attendance and Participation

Students are expected to punctually attend all scheduled sessions and are responsible for completing work from all class sessions. No make-ups will be provided for missed classroom activities. Enrolled students will receive a grade of zero on days missed. Students who miss a class are expected to consult with students who attended to understand testable materials, activities, or assignments for that day. Students will take multiple exams during the course that will account for the examination component of the student's course grade. Exams may feature a combination of essay/short answer style questions, as well as multiple choice and labeling problems. Class material, class notes and assigned readings will be very important in providing suitable responses. The participation of all students in classroom discussion of relevant materials is expected as it contributes in a meaningful way to understanding the subject matter.

If you experience difficulty in meeting course expectations, please seek assistance. Some possible sources of assistance include: peers, your professor, and/or other appropriate University academic resources as listed on the University's advising website:

www.advising.uncc.edu/AcademicSupportServices.pdf.

Since much of our learning occurs as a result of classroom activities, classroom participation, defined in terms of students' contributions to a positive learning environment, will constitute a portion of the students' final grades. Students contribute to a positive learning environment by applying the following behaviors:

- Being an active participant, but not a dominating one.
- Being a good listener and demonstrating respect for others' opinions, even if you disagree.
- Making thoughtful, insightful comments, and not speaking just to be heard.
- Building on others' comments.
- Asking questions, not just giving answers.

- Identifying key assumptions underlying discussion points and arguments.
- Providing constructive and positive comments.

Course Expectations

Classroom expectations. Please read the entire syllabus carefully before continuing in this course. These policies and expectations are intended to create a productive learning atmosphere for all students.

Respectful discussions of ideas. Each of us brings a unique viewpoint and insights to the classroom. You are expected to listen to someone else's comments and respond to them in a respectful manner. You don't have to agree, but you do need to moderate responses to promote civil discourse.

Grades are on a 10 point scale, where A=90 to 100; B=80-89; C=70-79; D=60-69, F=<60 There is no curve. The award of a grade of "I" will strictly adhere to The University's catalog guidelines. Grade penalties may be assessed on late assignments. UNC Charlotte's grading policies may be viewed at http://provost.uncc.edu/catalogs/2009-2010/degreereqs&acadregs.htm

C**ommunication skills**. Students are expected to demonstrate correct and effective oral and written communication skills including good spelling, grammar and punctuation. Students whose communication and writing skills are deemed by the instructor as inadequate may be required to successfully complete tutoring sessions at the Writing Resources Center in the Department of English. Information on the Writing Resources Center may be found online at http://www.uncc.edu/writing/wrc.html.

Academic integrity. All students are required to read and abide by the Code of Student Academic Integrity which governs student behavior relating to academic work. The Code is available from the Dean of Students Office or online at: http://www.legal.uncc.edu/policies/ps-105.html. A set of links to various resources on plagiarism and how to avoid it is available at the UNCC Library website: http://library.uncc.edu/display/?dept=instruction&format=open&page=920.

Materials. All materials submitted as part of course requirements become the property of the instructor. Students desiring to retain copies of their work should make such copies before turning in their materials.

Disability accommodations. Students in this course seeking accommodations for disabilities must first consult with the Office of Disability Services and follow the instructions of that office for obtaining accommodations. Reasonable and appropriate accommodations will be provided to students presenting a memo from the Office of Disability Services (ODS).

Faculty absence or tardiness. If the instructor is late in arriving to class, you must wait a full 20 minutes after the start of class before you may leave without being counted absent, or you must follow any written instructions prepared in anticipation of that tardiness.

Sexual harassment. All students are required to abide by the UNC Charlotte Sexual Harassment Policy (http://www.legal.uncc.edu/policies/ps-61.html) and the policy on Responsible Use of University Computing and Electronic Communication Resources (http://www.legal.uncc.edu/policies/ps-66.html). Sexual harassment, as defined in the UNC Charlotte Sexual Harassment Policy, is prohibited, even when carried out through computers or other electronic communications systems, including course-based chat rooms or message boards.

Communication devices in classroom. The use of cell phones, beepers, or other communication devices is disruptive, and is therefore prohibited during class.

Computers in the classroom. Students are permitted to use computers during class for class-related work only, at the discretion of the instructor, who may required that notes be taken by hand.

Diversity. The College of Computing and Informatics strives to create an inclusive academic climate in which the dignity of all individuals is respected and maintained. Therefore, we celebrate diversity that includes, but is not limited to, ability/disability, age, culture, ethnicity, gender, language, race, religion, sexual orientation, and socio-economic status.

BINF BINF 5171 Business of Biotechnology

Syllabus

Dr. Cory R. Brouwer Email: Cory.Brouwer@uncc.edu Phone: (704) 250-5764 Office Hours: ½ hour before and after class or by appointment	Times: M 9:30 – 12:15 Location: Bioinformatics 205 Website: http://moodle.uncc.edu

Course Description:

The purpose of "The Business of Biotechnology" course is to introduce students to the field of biotechnology and how biotech businesses are created and managed. The students should be able to define biochemistry and understand the difference between a biotech company and a pharmaceutical company. Additional concepts covered will include platform technology, biotechnology's history, biotechnology products and development processes, current technologies used by biotech companies today, biotechnology business fundamentals, research and development within biotech companies, exit strategies, and careers in the biotech field.

Prerequisite:

Admission to a graduate program.

Tentative Course Outline

Date	Subject	Chapter
1/10	Introduction, syllabus, expectations; Biotechnology as an Industry Overview	1, 2
1/24	Molecular Biology	3
1/31	Drug Development	4
2/7	Tools and Techniques	5
2/14	Applications	6
2/21	Exam 1	
2/28	Finance; Biotech Formation Fundamentals	10, 11
3/14	Biotech Formation Fundamentals (cont); R&D	10, 12
3/21	Marketing	13
3/28	Managing Biotechnology	15
4/4	Intellectual Property	7
4/11	Exam 2	
4/18	Regulation; Politics and Ethics	8, 9
4/25	Licensing, Alliances, Mergers	14
5/2	Putting it all together-building biotech companies; Career Opportunities	17,19
5/9	Exam 3	

Required Material

- Yali Friedman. *Building Biotechnology* (Logos Press, 2008) ISBN: 9780973467666
- Additional material will be provided on the course website. We will likely update this list as we proceed throughout the semester. You are responsible for getting up-to-date information on the current readings.

Grading Plan:

Students will be evaluated based on their mastery of the concepts and theories taught in the class, and the ability to use them for solving practical problems. In addition to the required work, students registered for BINF 5191 will present a group project. The grade is determined as follows:

Exam #1	15%
Exam #2	15%
Exam #3	10%
Project	50%
Attendance	5%
Class Participation	5%
Quickie Quizzes	Extra points

Attendance and Participation

Students are expected to punctually attend all scheduled sessions and are responsible for completing work from all class sessions. No make-ups will be provided for missed classroom activities. Enrolled students will receive a grade of zero on days missed. Students who miss a class are expected to consult with students who attended to understand testable materials, activities, or assignments for that day. Students will take multiple exams during the course that will account for the examination component of the student's course grade. Exams may feature a combination of essay/short answer style questions, as well as multiple choice and labeling problems. Class material, class notes and assigned readings will be very important in providing suitable responses. The participation of all students in classroom discussion of relevant materials is expected as it contributes in a meaningful way to understanding the subject matter.

If you experience difficulty in meeting course expectations, please seek assistance. Some possible sources of assistance include: peers, your professor, and/or other appropriate University academic resources as listed on the University's advising website:

www.advising.uncc.edu/AcademicSupportServices.pdf.

Since much of our learning occurs as a result of classroom activities, classroom participation, defined in terms of students' contributions to a positive learning environment, will constitute a portion of the students' final grades. Students contribute to a positive learning environment by applying the following behaviors:

- Being an active participant, but not a dominating one.
- Being a good listener and demonstrating respect for others' opinions, even if you disagree.
- Making thoughtful, insightful comments, and not speaking just to be heard.
- Building on others' comments.

- Asking questions, not just giving answers.
- Identifying key assumptions underlying discussion points and arguments.
- Providing constructive and positive comments.

Course Expectations

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New graduate course proposal

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1. **Course number / title:** BINF 7999 / Master's Degree Graduate Residency

2. **Course description:** A semester of residency in bioinformatics to supplement regular course offerings.

3. **Pre- or co-requisites:** Permission of the instructor

4. **Objectives of the course:** Individual graduate residency.

5. **Instructional method:** The course is presented in an independent format.

6. **Means of student evaluation:** Students will not be graded.

7. **Specify policies that apply to this course:**

    a. *University integrity:* All students are required to read and abide by the Code of Student Academic Integrity. Violations of the Code of Student Academic Integrity, including plagiarism, will result in disciplinary action as provided in the Code. Definitions and examples of plagiarism are set forth in the Code. The Code is available from the Dean of Students Office or online.[1] A set of links to various resources on plagiarism and how to avoid it is available at the UNCC Library website.[2]

    b. *Attendance:* Attendance is required at instructor's discretion, although exceptions will be made for reasons such as illness or family emergency. Excessive absences will result in a reduced classroom participation score at the instructor's discretion, and will negatively impact the overall course grade.

    c. *Grading policy:* Grades will be assigned on the following scale: N

    d. *Additional requirements:* Not applicable.

8. **Probable textbooks or resources:** Will vary according to the subject area – discretion of mentor.

9. **Topical outline of course content:** Will vary according to specific topic – discretion of mentor.

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[1] http://www.legal.uncc.edu/policies/ps-105.html
[2] http://library.uncc.edu/display/?dept=instruction&format=open&page=920

New graduate course proposal

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1. **Course number / title:** BINF 8991 / Doctoral Dissertation Research

2. **Course description:** A semester of faculty supervised dissertation research in bioinformatics to supplement regular course offerings.

3. **Pre- or co-requisites:** Permission of the instructor

4. **Objectives of the course:** Individual investigation culminating in the preparation and presentation of a doctoral dissertation.

5. **Instructional method:** The course is presented in a one-on-one mentor/mentee format.

6. **Means of student evaluation:** Students will be evaluated on their ability to prepare and present the doctoral dissertation.

7. **Specify policies that apply to this course:**

    a. *University integrity:* All students are required to read and abide by the Code of Student Academic Integrity. Violations of the Code of Student Academic Integrity, including plagiarism, will result in disciplinary action as provided in the Code. Definitions and examples of plagiarism are set forth in the Code. The Code is available from the Dean of Students Office or online.[3] A set of links to various resources on plagiarism and how to avoid it is available at the UNCC Library website.[4]

    b. *Attendance:* Attendance is required at instructor's discretion, although exceptions will be made for reasons such as illness or family emergency. Excessive absences will result in a reduced classroom participation score at the instructor's discretion, and will negatively impact the overall course grade.

    c. *Grading policy:* Grades will be assigned on the following scale: A=90-100%, B=80-90%, C=65-80%, and U=0-65%.

    d. *Additional requirements:* Not applicable.

8. **Probable textbooks or resources:** Will vary according to the subject area – discretion of mentor.

9. **Topical outline of course content:** Will vary according to specific topic – discretion of mentor.

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[3] http://www.legal.uncc.edu/policies/ps-105.html
[4] http://library.uncc.edu/display/?dept=instruction&format=open&page=920

New graduate course proposal

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1. **Course number / title:** BINF 9999 / Doctoral Degree Graduate Residency

2. **Course description:** A semester of residency in bioinformatics to supplement regular course offerings.

3. **Pre- or co-requisites:** Permission of the instructor

4. **Objectives of the course:** Individual graduate residency.

5. **Instructional method:** The course is presented in an independent format.

6. **Means of student evaluation:** Students will not be graded.

7. **Specify policies that apply to this course:**

    a. *University integrity:* All students are required to read and abide by the Code of Student Academic Integrity. Violations of the Code of Student Academic Integrity, including plagiarism, will result in disciplinary action as provided in the Code. Definitions and examples of plagiarism are set forth in the Code. The Code is available from the Dean of Students Office or online.[5] A set of links to various resources on plagiarism and how to avoid it is available at the UNCC Library website.[6]

    b. *Attendance:* Attendance is required at instructor's discretion, although exceptions will be made for reasons such as illness or family emergency. Excessive absences will result in a reduced classroom participation score at the instructor's discretion, and will negatively impact the overall course grade.

    c. *Grading policy:* Grades will be assigned on the following scale: N

    d. *Additional requirements:* Not applicable.

8. **Probable textbooks or resources:** Will vary according to the subject area – discretion of mentor.

9. **Topical outline of course content:** Will vary according to specific topic – discretion of mentor.

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[5] http://www.legal.uncc.edu/policies/ps-105.html
[6] http://library.uncc.edu/display/?dept=instruction&format=open&page=920