Course Information

IB 364: Human Genome and Bioinformatics

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Course Description

Highlights advances in understanding the human genome, utilizing the latest techniques in bioinformatics; i.e., acquiring, analyzing, storing, and displaying the information from the entire genome and protein sequences. Explores the latest laboratory techniques, as well as the use of extensive online databases and software. Students explore the significance of sequencing the human genome, applying bioinformatics to the genome, and realizing its potential to understand human health, disease, and the place of humans in the large ecosystem. Finally, students become an expert on a chosen genomic disease/disorder and successfully relay this information to the general public.

Course Goals and Objectives

Upon completing this course, students will be able to:

- Be fluent in terms related to genomics, DNA sequencing and annotation, and bioinformatics sites;
- Explain the different technologies used to sequence and interpret DNA and proteins;
- Navigate common bioinformatics databases and find information within;

- Understand what information bioinformaticians and researchers are looking for once a sequence of DNA or protein is obtained;
- Become proficient at searching primary literature for answers to questions about genomic diseases/disorders;
- Compare multiple sequences and explain why this information is useful for researchers;
- Evaluate the methods used for studying your chosen disease/disorder;
- Apply the gained knowledge to explain the complicated science of genomics and how relates to the chosen disease/disorder to members of the general public in an engaging and clear manner.

Course Structure

This is a **3–credit hour** course. The course is **8 weeks** long and consists of 7 content modules and a final project week. Please be aware that this course is accelerated in nature; 16 weeks' worth of content will be covered in a 8-week time span. You should dedicate approximately **10-15 hours** per week to working on the course itself, but actual time commitments will vary depending on your input, needs, and personal study habits. You are required to log on to the course website a minimum of **4 days per week.**
This course is designed with the principles of collaborative learning, constructivism, and active participation in mind. You are encouraged to share your thoughts and engage in problem-solving. The course has a consistent and predictable structure, organized around the weekly modules, with a course website that is straightforward and easy to navigate. Instructions and due dates for activities and assignments are clearly articulated so that you know what is expected of you and will be able to easily stay on track. We realize that you have a life beyond the scope of this course. However, if you are unable to complete an assignment because of professional obligations, you should notify the instructor or, better yet, prepare the assignment ahead of time and post it early. This will give your classmates a head start in reading and responding to

your work. Most assignments are due by 11:55 PM of their respective due dates as listed on the course calendar, giving you and your classmates time to read and comment on each other's work before the next module begins.

Readings should be read and submitted during the module for which they are assigned in order to get the most benefit from the course and to stay on schedule for their final project. At the end of each content module, participants will have an opportunity to make sure that they have completed all the required activities and assignments.

Textbooks

There is one book required for the course: Genome: An Autobiography of a Species in 23 Chapters by Matt Ridley. In addition, please refer to the optional books of interest, websites, and e-Reserve information listed below and in the overview of each weekly module.

Before delving into Genome, you might also want to read this review of the book by a slightly cranky Jerry Coyne from February of 2000. This is just fair warning that the book is not a completely scholarly review of the topic of genomics, but rather an interesting popular take on the genetics beforehand. This is why we are "re-writing" the book in this course.

(full review)

Genome is among the first of what will certainly become a flood of books explaining human genetics to the public. Because much of the 'autobiography' is still in test tubes, however, Ridley spends less time showcasing the genome project than recounting the last decade of research in human genetics. His stories are at once instructive and infuriating. For each nugget of science, Ridley also includes an error or misrepresentation. Some of these derive from poor scholarship: others from his political agenda. Ridley's genetic determinism is so implacable that he admits virtually no environmental influence on our human make-up, and his right-wing politics lead him to slant the implications of the research he discusses and to deliver annoying homilies against big government

and environmentalism. In the end, *Genome* is more soapbox than synopsis.

Optional Books of Interest

- Here Is a Human Being by Misha Angrist
- Drawing the Map of Life: Inside the Human Genome Project by Victor McElheney
- My Beautiful Genome by Lone Frank
- The $1,000 Genome by Kevin Davies
- A Life Decoded: My Genome: My Life by J. Craig Venter
- The Language of Life: DNA and the Revolution in Personalized Medicine by Francis Collins
- The Human Genome: Book of Essential Knowledge by John Quackenbush

Websites and Other References of Interest

- Scitable: Learn Science at Nature—We will have many readings from this site. It is a useful tool for teachers in general.
- Genome.gov—Home page for the National Human Genome Research

Articles and e-Reserves

Other reading materials and e-reserves will be listed in the weekly Module Overview pages within the course website.

Course Outline

Week 1: Basic Molecular Biology Review, Introduction to Genomics and Bioinformatics, Introduction to Common Bioinformatics Databases

In this module, students will review and refresh their knowledge of the basic tenets of molecular biology and be introduced to the fields of genomics and bioinformatics.This will also be an introduction to the major bioinformatics databases. Students will take a tour of the sites and get a feel for navigating them.

Week 2: Genome Sequencing Techniques and Annotation and Interpretation

This week's module will be an overview of the tools and techniques commonly used to sequence genomes and will look at information most commonly looked for once a researcher has a sequence of DNA.

Week 3: Non-human Genome Projects, including model organisms and The Human Genome Project

This module will allow students to explore the significance of genome sequencing and the vast potential of the information obtained by sequencing the human genome. The history of the human genome project is an important look at how science unfold through advances in technologies and interpersonal drama.

Week 4: Genomic Variation and Genomic Medicine

This week's module will consider the nature and distribution of variation of the genome within a species; students will be introduced to the role of Direct-to-Consumer sequencing services in personal genomics.

Week 5: Comparative Genomics in Evolution and Medicine, Similarity Searches, Phylogenetics

In Week 5, students will consider the nature and distribution of variation of the genome between species and will receive an introduction to analyzing multiple sequence alignments. Using multiple online bioinformatics tools, students will analyze sequence alignments and understand the theory behind best alignments and will be introduced to creating phylogenetic trees using bioinformatics databases.

Week 6: Gene Expression, the Transcriptome, and Epigenetics

In this module, students will be introduced to the importance of documenting gene expression on a genome-wide scale and the technologies developed for parallel analysis of the expression of thousands of genes.

Week 7: Proteomics and Functional Genomics

Students will explore protein sequences, function, structure and the acquisition of information related to proteins.

Week 8: Final Project

This week, students will present or post their final project early in the week. Fellow students will be assigned a peer's project to evaluate before the end of the week. Students will earn points from evaluating the project but the projects will be graded solely by the instructors.

Course Activities

Grading Scale

Grade	Points	Percent
A+	594–625	95.00–100.00
A	563–593	90.00–94.99
B+	532–562	85.00–89.99
B	500–531	80.00–84.99
C+	469–499	75.00–79.99
C	438–468	70.00–74.99
D+	407–437	65.00–69.99
D	313–406	50.00–64.99
F	0–312	0.00–49.99

View the Graduate College Handbook for Students, Faculty and Staff Chapter III: Academic Record Grading System page for more information.

Assignments, Weights, and Deliverables

You can access your scores by clicking the **Grades** link from the left column of the course home page.

All interim and final deliverables have due dates. Failure to meet deadlines results in a reduction of the assignment points. For the due dates of each assignment, please see the course calendar.

Point Distributions

Assignments	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Total points per assignment
Synchronous Session Participation*	0*	0*	0*	0*	0*	0*	0*	0*	0
Coursewide Glossary	10	10	10	10	10	10	10		70
Bioinformatics Site Visit	15	15	15	15	15	15	15		105
Book Questions	10	10	10	10	10	10	20		80
Self-Assessment Quiz	10	10	10	10	10	10	10	10	80
Milestone for final project	20	20	20	20	20	20	20		140
Final Project								100	100
Evaluation of Peer's Final Project								50	50
Total points	65	65	65	65	65	65	75	160	625

***Note about synchronous session participation**: Though there will be a weekly synchronous session and while you are

encouraged to attend every session, they are not required. You can, however, earn extra credit for attending or somewhat less extra credit for viewing a recording of the session and writing a brief summary. See details below.

Module Overview

Each module will begin with the module overview, explain what the module is about, what learning goals you are expected to achieve, how long the module will take, and in what activities you will participate. Each module is designed with the same structure and activities unless otherwise specified. The module activities are explained in greater detail below. You can find the due dates of specific assignments in the course calendar.

Synchronous Sessions

Weekly: Each week there will be an optional synchronous session in which all students and instructors may join together online at the same time to talk. These sessions will use *Blackboard Collaborate* (formerly known as *Elluminate Live!*) to join all participants together in a session where you can text chat, voice chat, and see the computer desktop of the instructor. This is where the instructor will attempt to answer your "muddiest point" questions. Attending these sessions will allow you to earn extra credit , though you may write a summary of the recorded session if you are not able to attend for slightly less credit.

Muddiest Point

Weekly**:** After viewing the lecture, reading the assigned readings, and watching associated videos and podcasts, students will briefly reflect upon what was most confusing or "muddy" aspects of the readings and turn that in before the optional synchronous session where the instructor and other students will attempt to make the topic clearer.

Coursewide Glossary

Weekly: Each student will choose the assigned number of vocabulary words from the weekly list, define them, and provide one or two valid/salient/meaningful links for each to assist in

creating a coursewide glossary about the human genome and bioinformatics.

Bioinformatics Site Visits

Students will follow guided instructions to visit multiple sites nearly weekly (except weeks 1 and 3) in order to familiarize themselves with common bioinformatics databases and explore what tools are available to researchers and the general public to assist in the analysis of DNA and protein sequences.

Guided Book Questions

Weekly: Students will have the opportunity to learn more about their chosen genomic disease/disorder by finding answers to questions based on the book chapters they are reading in Genome: An Autobiography of a Species in 23 Chapters.

Milestone for Final Project

Weekly: This course will guide you step by step toward the completion of your final project.

Each week you will have milestones and book questions to complete related to the information learned during the week and turn this in to "impress your professors". Any information you provide must be backed up by a primary literature source (or sources) and you will cite these in the format suggested by Nature. All of these milestones will work together to help finish your final project for this class.

Self-Assessment Quiz

Weekly: At the end of each module, students will take a self-paced 10-question quiz to evaluate new knowledge obtained. This will be a mixture of multiple choice, true/false, matching, and short answer questions.

Final Project

One time: By the end of this course, you will become an expert on one disease/disorder that has been genomically elucidated. You may begin with a disease that has a long genetic history, but it must be one that has been further studied using the new techniques involved in genomics.

Your final project will be describing the disease to the general public (think your mom or cousin, for instance). You will have a lot of flexibility in HOW you present the disease for the final

project. You may want to write a book chapter, a newspaper or magazine article, start a blog, or make a video or a podcast, or even write a comic book. Whatever method you choose is fine, but the information about the disease must be accessible to the general public.

A note about sources of information: It is highly recommend that you only consult the following sources of information in studying for this class. Use of another source (such as Internet sites found via Google) may provide information that is unreliable.

- Suggested books and required readings
- Supplemental information posted on course website
- Internet links provided in class or on course website

Technical Support

Students who experience technical difficulties should get help from the following resources:

- For course content, activities, grades, etc., consider posting your question to the **Course Q & A** forum; otherwise, contact your instructor.
- Course website problems
- Other technical problems