CYA | Syllabus

BIOL 351 | Genetics in Practice; Decoding the Language of chromosomes
Spring 2025
NCSR "Demokritos"

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Course Description

- Have you ever wondered how genetic material in the form of DNA or chromosomes constitutes the language of life?
- Have you ever considered why genetic tests have become increasingly important in recent years in the diagnosis of certain hereditary diseases or other multifactorial diseases?
- Have you ever wanted to be an expert in crime investigation or explore your ancestry?
- Have you ever tried to find how environmental genotoxic exposure induces DNA damage and genetic diseases?

In this course we will address these and many other questions. The current course focuses on human Genetics and its applications in human life. We will cover a variety of genetic applications from medicine to social life. Genetic material in the form of DNA or chromosomes constitutes the language of life. Genetic tests have become increasingly important in recent years in the diagnosis of certain hereditary diseases or other multifactorial diseases contributing to prevention, early diagnosis and/or treatment selection of patients (e.g. personalized medical treatment, gene therapies). This course is relevant to wider social contexts as people's genetic information is increasingly being used for a wide range of non-clinical purposes, such as crime investigations, determining paternity and exploring one's ancestry.

The aim of the course is students to familiarize themselves with Genetics and its applications to human life, especially in current medical practice and research but also in society. Moreover, to understand how genetic variations influences brain function, social behavior, educational attainment and our health. The course is adapted to be understandable to all the students regardless the field of their studies. It is relevant to any academic and social context. Non previous knowledge is required and the class work will be sufficient for their exams. In the frame of this course, lectures and laboratory practice of students will take place at NCSR 'Demokritos".

Course approach

This course will be held at the campus of National Centre of Scientific Research (NCSR) "Demokritos", which is the largest research center in Greece. Course topics will be explored mainly by lectures, presentations and reading, questions and emerging issues by class discussions while relevant methodologies by laboratory experiments.
All lectures will be tailored to the students and include digital learning resources such as video, audio, animations and images concerning biological phenomena and procedures. Key topics will be extensively discussed in classroom in such a way that students can understand them in depth. Classroom work is expected to largely cover the final exams.

A different case report paper (1-2 pages) easily to be understand will be given to each student to read, in order to write an abstract (250-500 words) including aim, methodology and conclusions giving the opportunity to students to work individually and develop skills relevant to analysis and interpretation of sources.

Moreover, in the classroom, interesting genetic topics will be analyzed and through this analysis students in small groups or as a class will be able to improve scientific skills such as research methodology, analysis and interpretation of the results. As part of the course, 2 debates between small groups with selected contemporary topics will be organized so that the students improve public speaking and research skills. Debates also will allow them to think about aspects and perspectives they may not have considered, encourage them to speak strategically and learn how to create a persuasive argument.

Learning Objectives

The course structure consists of a combination of lectures, discussions and lab experience. Students will learn:

- The basic genetic terminology of human Genetics such as DNA, chromosomes and genes
- The methods and theory of this research area
- Chromosome and gene analysis applications in human life and more specifically how genetic analysis contribute to:
  -prenatal diagnosis, genetic syndromes and infertility
  -prevention, early diagnosis and treatment selection of patients with cancer or hematological malignancies (e.g. personalized treatment).

- How Genetics is being used for a wide range of non-clinical purposes, such as crime investigation, determining paternity and exploring one's ancestry.
- Research design in Genetics

By the end of the course, students will be able to:

- Understand Genetics applications to human life, especially in current medical practice and research but also in society
- Recognize the difference between cytogenetic and molecular tests, when we perform them and what we can identify from each test
- Identify a chromosome abnormality in a karyotype
- Understand how genetic variation influences brain function, social behavior, educational attainment and our health.
- Informed firsthand what it takes to become an expert in Genetics.
- Read and critically analyze primary literature
- Evaluate the ethical dilemmas facing clinicians, researchers, and the public pertaining to the use of genetic information
- Explore how their role as researchers and/or citizens will influence and be influenced by genetic information.

Course Requirements

The course will include 12 lectures, group projects, 2 debates, 5 laboratories and 1 tour at the NCSR "Demokritos" campus in order the students to meet the facilities of the Center and to be informed about the current research projects. The course requirement includes:

- Arriving on time. If unable to attend class, you have to inform me beforehand by sending an email.
- Class contribution is a very important factor in determining your grade for the semester. It includes physical and mental presence in the classroom and active participation in class discussions. Students are expected to ask questions and express their opinions during class. If students are extremely uncomfortable speaking in front of an audience, they may send their opinions or afterthoughts via email.
- Reading the corresponding course material from lectures which will be distributed to students in PowerPoint or PDF file formats and is sufficient for student final exams. Lectures will include briefly and essentially state-of-the-art knowledge in the subjects of Genetics in a manner understandable to the participants.
- Group projects and Presentations: Group projects based on a given literature (analysis of a case study) or on a given subject will be conducted, and results will be presented by the students in power point (lasted no longer than 10 minutes).

Evaluation and Grading

Your grade for this course will be based on the following distribution:
Class contribution: 30%
Student effort in Laboratory experiments: 10%
Group projects and Presentations: 30%
Final exam: 30%

Evaluation Criteria - Course Assignments

- 5-10 pages reading a week
- Group projects and Presentations
- Written Assignment –For homework, one case report paper easily to be understand will be given to each student to read, in order to write an abstract (250-500 words) including aim, methodology and conclusions.

CYA Regulations and Accommodations

Attendance Policy

CYA regards attendance in class and on-site (in Athens or during field study trips) as essential. Absences are recorded and have consequences.

ePolicy on Original Work

Unless otherwise specified, all submitted work must be your own original work. Any ideas taken from the work of others must be clearly identified as quotations, paraphrases, summaries, figures etc., and accurate internal citations and/or captions (for visuals) as well as an accompanying bibliography must be provided.

Use of Laptops

In-class or onsite use of laptops and other devices is permitted if this facilitates course-related activities such as note-taking, looking up references, etc. Laptop or other device privileges will be suspended if devices are not used for class-related work.

Class Schedule

Class Day	Day/Date/Place (if applicable)	Topic / Readings / Assignments Due
1	Tue Jan 28	Welcoming New Students Tour at the NCSR "Demokritos" campus in order students to meet the facilities of the Center and to be informed about the current research projects.
2	Thu Jan 30	Lecture 1: History of Genetics
3	Tue Feb 4	Lecture 2: Basic genetic terminology: DNA, chromosomes, genes
4	Thu Feb 6	Lecture 3: Types of chromosome aberrations and cytogenetic methods / Required Bibliography 1 / Reading
5	Tue Feb 11	Lab 1: Human cells culturing and monitoring, chromosome fixation and slides preparation for karyotypic analysis
6	Thu Feb 13	Lecture 4: Applications of chromosome analysis in prenatal diagnosis and genetic syndromes / Required Bibliography 3 / Group project and Presentations
7	Tue Feb 25	Lecture 5: Applications of chromosome analysis in hematological malignancies / Required Bibliography 6/ Reading
8	Thu Feb 27	Lab 2: Karyotyping, chromosome analysis and detection of chromosome abnormalities in genetic syndromes and hematological malignancies cases / Required Bibliography 5 / Group project and Presentation
9	Tue Mar 4	Lecture 6 and lab: Applications of chromosome analysis in infertility and case studies / Required Bibliography 4 / Reading
10	Thu Mar 6	Lab 3: "Search for literature sources"
11	Tue Mar 11	Projects: analysis of a case report in each group
12	Thu Mar 13	Projects: analysis of a case report in each group
13	Thu Mar 27	Lab 4: Fluorescence in situ hybridization (FISH), a Molecular Cytogenetic method used especially for detection of submicroscopic aberrations and FISH analysis in hematological malignancies cases
14	Tue Apr 1	Lecture 7: Types of gene mutations and molecular methods
15	Thu Apr 3	Lecture 8: From chromosomes to genes: searching for pathogenetic molecular pathways / Required Bibliography 2 / Group project and Presentations
16	Tue Apr 8	Lecture 9: Applications of gene analysis in the predisposition of Alzheimer's disease and mental diseases
17	Thu Apr 10	Lecture 10: How environmental genotoxic exposure induces DNA damage and genetic diseases.
18	Tue Apr 22	Lab 5: Extraction DNA and electrophoresis

19	Thu Apr 24	Lecture 11: Applications of gene analysis in crime investigation, determining paternity and exploring one's ancestry / Required Bibliography 7 / Reading
20	Tue Apr 29	Lecture 12: Bioethics in the clinical applications of chromosome and gene analysis
21	Tue May 6	1st debate in Genetics
22	Thu May 8	2nd debate in Genetics
23	Tue May 13	Projects: analysis of a case report in each group
24	Thu May 15	Exams / Lecture materials (PowerPoint slides)

N.B.: The course schedule, in terms of subjects and readings, may be subject to change to benefit student learning and to keep up to date with current research.

COURSE BIBLIOGRAPHY

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