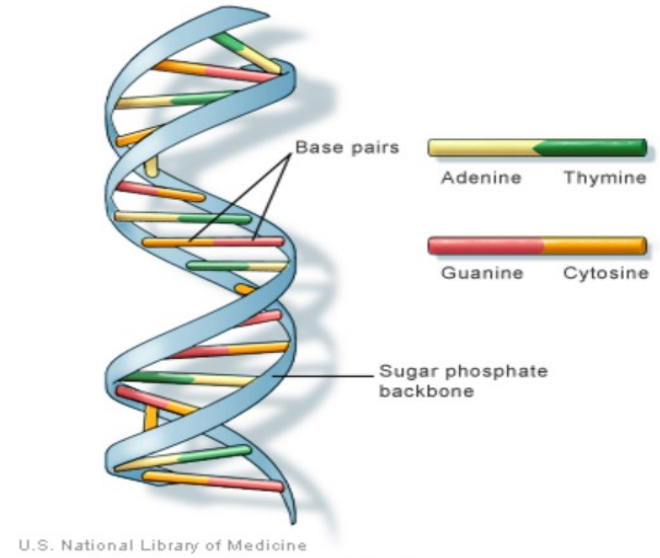
KINGSBOROUGH COMMUNITY COLLEGE
THE CITY UNIVERSITY OF NEW YORK



Credit: U.S. National Library of Medicine

Biology 3700
HUMAN GENETICS

Syllabus Fall 2023

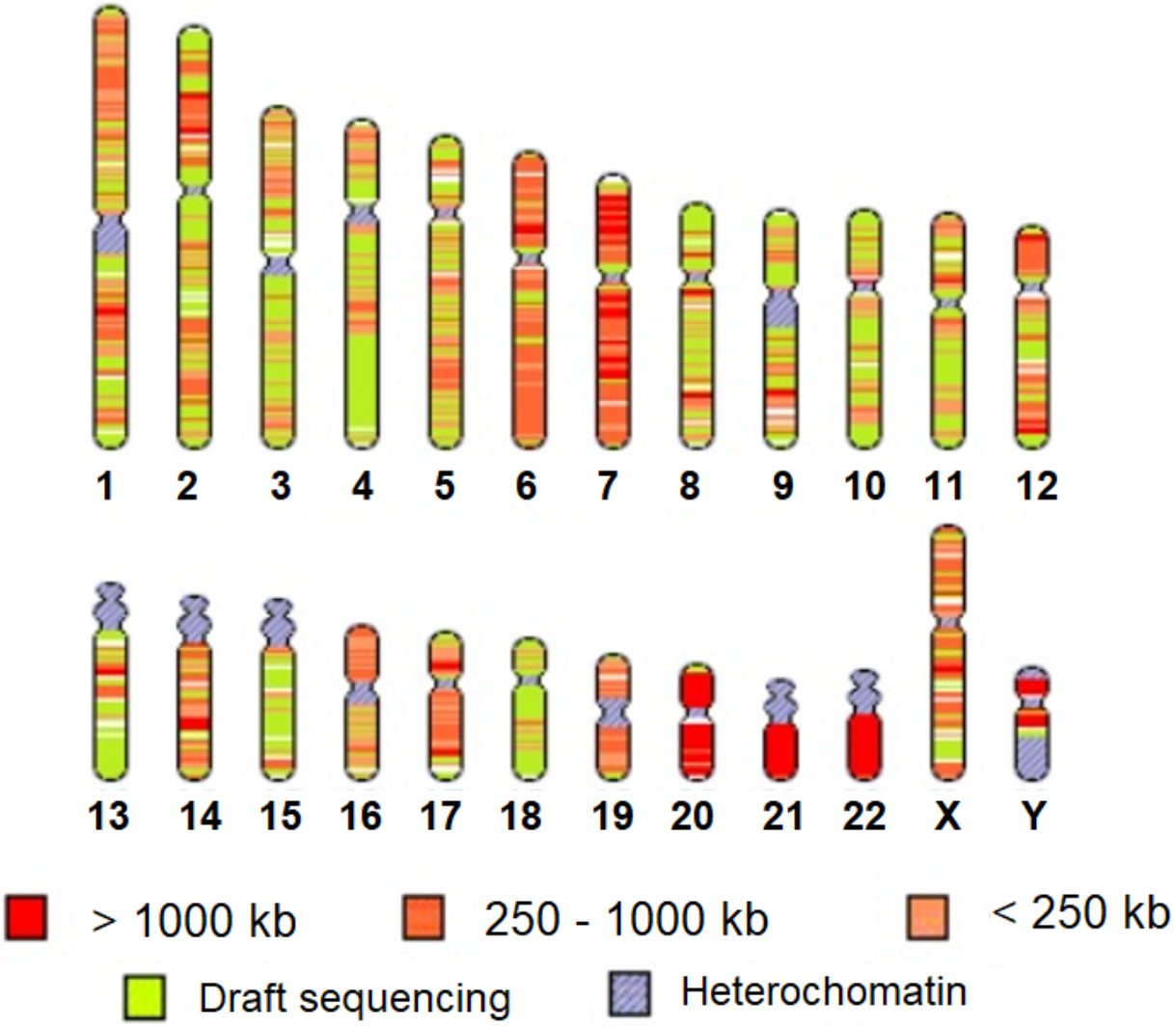
Professor ZMG Sarwar Jahangir
Ph.D. in Cellular Molecular and Developmental Biology
Department of Biological Sciences

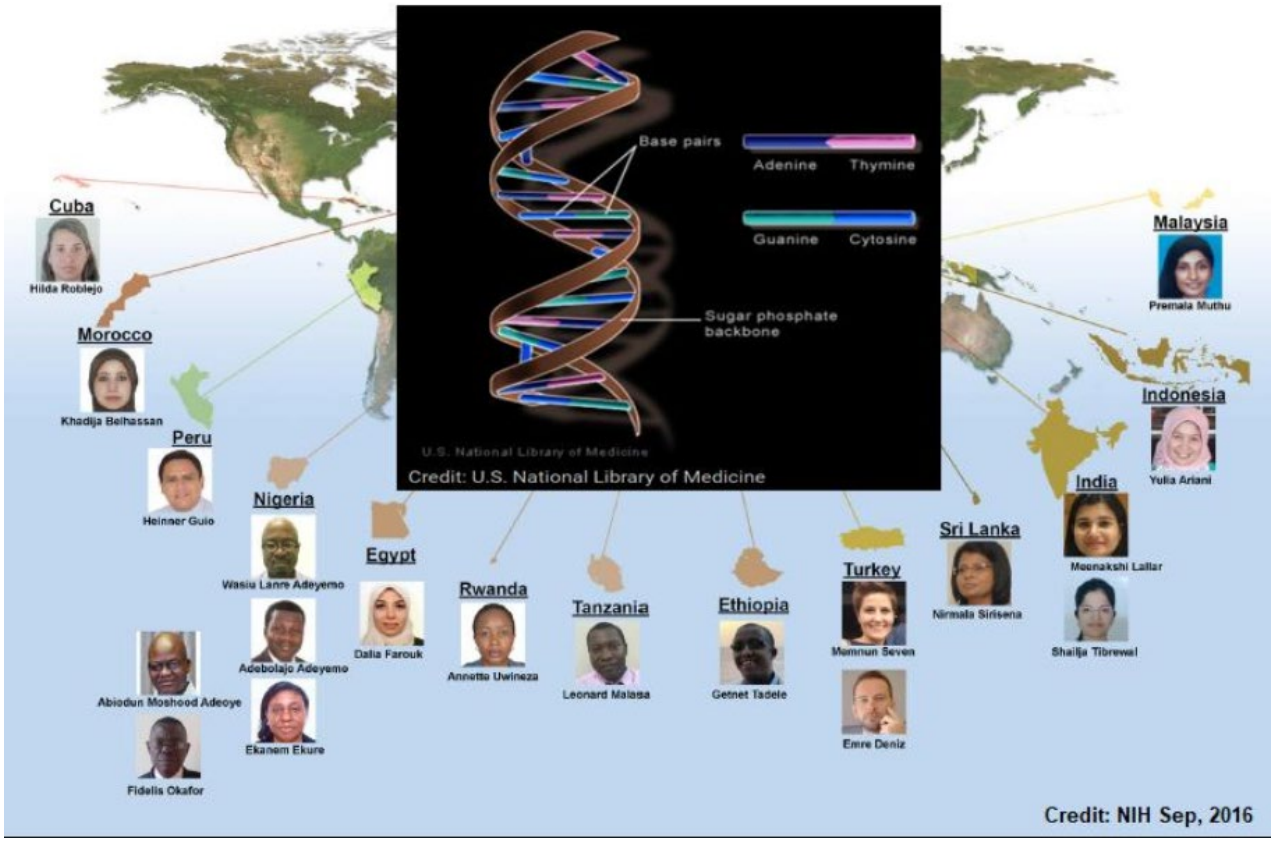
From NCBI

Human Chromosomes

22 autosomes + 2 sex chromosomes

DNA sequencing incomplete




Base pairs
Adenine
Thymine
Guanine
Cytosine
Sugar phosphate backbone
U.S. National Library of Medicine
Credit: U.S. National Library of Medicine
Cuba
Hilda Robiejo
Morocco
Khadija Belhassan
Peru
Heinner Guio
Nigeria
Wasiu Lanre Adeyemo
Adebolajo Adeyemo
Abiodun Moshood Adeoye
Ekanem Ekure
Fidelis Okafor
Egypt
Dalia Farouk
Rwanda
Annetta Uwineza
Tanzania
Leonard Malasa
Ethiopia
Getnet Tadele
Turkey
Memnun Seven
Emre Deniz
Sri Lanka
Nirmala Sirisena
India
Meenakshi Lallar
Shailja Tibrewal
Malaysia
Premala Muthu
Indonesia
Yulia Ariani
Credit: NIH Sep, 2016

KINGSBOROUGH
COMMUNITY COLLEGE

Access-Ability Services

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Access-Ability Services (AAS) serves as a liaison and resource to the KCC community regarding disability issues, promotes equal access to all KCC programs and activities, and makes every reasonable effort to provide appropriate accommodations and assistance to students with disabilities. Please contact this office if you require such accommodations and assistance. Your instructor will be glad to make the accommodations you need, but you must have documentation from the Access-Ability office for any accommodations.

Access-Ability Services is always looking to hire student aides/federal work study students to help provide certain services for our students with disabilities, if you are interested please stop by D205 to find out more.

Disability Related Services D205

Office Hours:

Monday	9am-5:00pm
Tuesday	9am-8:00pm
Wednesday	9am-8:00pm
Thursday	9am-5:00pm
Friday	9am-5:00pm

By email: AAS@kbcc.cuny.edu By phone: 718-368-5175

STUDENT RESPONSIBILITIES & ACADEMIC INTEGRITY

Absence Policy

Attendance is required to do will in the course. You are expected to attend all lectures, exams, and presentations. **Excessive absences will result in an F grade** regardless of the legitimacy of the absence. As defined by the University Policy for Attendance a student is considered excessively absent if they have missed more than 15% of the total instructional hours for a class. Therefore, if you miss more than 12 hours total, in any combination of lecture exams and presentations, an F grade is automatically assigned.

A student absent for <15% in total must take the initiative for completing the incomplete course work and is responsible for all covered material and assigned work. The student must discuss absences with the professor prior to an anticipated absence or immediately following a missed activity session for advice.

Cell Phones and Beepers

The use or ringing of cell phones and beepers in the classroom during class sessions is a disruption of class and a violation of the Henderson Rules. Violation of this policy may result in a disciplinary referral**.**

Written Assignments

You will prepare three case study reports as in the schedule. You will be completing case studies in person. In addition, two students jointly will be making a 10 minutes presentation during the last third of the semester, as scheduled. That will carry 10 points for the final grade. The presentation will be based on human genetics on current issues and future directions.

Plagiarism (Academic Integrity)

You may find the CUNY and KCC's **Academic Integrity** Policies are in:

- Kingsborough Community College Catalogue
- Kingsborough Community College Student Handbook
- www.kingsborough.edu/**Academic**_Integrity_Policy.pd

"Plagiarism **as a violation of academic integrity** is the intentional use of another's intellectual creation(s) without attribution. Determination and penalty—ranging from grade reduction to course failure—is at the sole discretion of the faculty member."

In addition, your instructor may inform you of his or her policy regarding academic integrity at the beginning of the semester.

Assessment

You will be given a 10-20 minutes assessment test at the last part of the semester in order to test the effectiveness of teaching and learning in this course. Your instructor will decide of the content of this test and may assign a credit value, if appropriate.

COURSE DESCRIPTION

It is a three-credit course meeting three hours per week.

This non-majors Biology offering encourages students to become more "science literate" by learning and relating how current topics are constantly molding and influencing our changing world, specifically in the field of genetics. We will read, examine and critique current newspaper articles as well as use the Internet for our studies. Lectures will be augmented by selected readings from the newspapers and/or primary literature, as applicable to the topic. Class discussions and case studies will extend our lecture topics of human heredity including gene therapy, somatic nuclear transfer and stem cells, thereby allowing an extensive and comprehensive treatment of them.

The end of term ethic debate requires students to utilize course material (textbook, class discussions, and literature sources) to formulate and present their view/opinion on a topic the class chooses. Your support or disagreement will be written, presented and (re)evaluated in the format of a class debate. The course grade calculation includes a portion for submission of Internet Assignments (samples attached) which will require you to either locate or access web sites utilized by students, researchers and teachers to procure specific genetic information then to answer specified questions.

The Big Picture … MAIN COURSE OBJECTIVES

- To enrich our understanding of human heredity through exploration of the many aspects involved [a survey through the molecular, cellular and organismal levels].
- To understand how normal and abnormal cellular processes affect humans at all these levels.
- To learn what current ideas, issues and trends involve human inheritance.
- To become aware of, and to be able to discuss ethical, legal and social issues in human genetics and the implications of these developments.

TEXTBOOK

Reading Assignments: **OER (Open Education Resources) online** – Blackboard.

- Biology OER- https://openlab.citytech.cuny.edu/bio-oer/gene-expression/
- Genetics Home reference - https://ghr.nlm.nih.gov/
- Help me understand genetics: https://ghr.nlm.nih.gov/primer
- Public domain – provided as PowerPoints.

ADDITIONAL MATERIALS

Optional reading: Human Genetics. Concepts and Applications. 11th Ed. 2015. Ricki Lewis ISBN 13: 978-1308-700946 McGraw-Hill Education, NY. Pp 498. Bio 37, Sarwar Jahangir, Kingsborough Community College, Biological Science.

COURSE GRADE CALCULATION

Written Examinations (20pts x 3)	= 60%
Internet Assignments and Case Reviews (4pts x 2.5)	= 10%
End-of Term Ethics Debate Presentation	= 10%
Final Examination	= 20%
Total	**= 100%**

Notes:

- There are no make-up examinations. A missed examination will be assigned a grade of zero. In accordance with KCC's Attendance Policy, excessive absences will result in course grade reduction.
- Two lateness's are equivalent to one absence.
- In accordance with the college's policies on academic integrity, any student identified participating in cheating; plagiarism, *etc*. will be subjected to disciplinary actions.
- An extra credit assignment worth 5 points may be available on request. Please see the instructor during the week of 9-10. The assignment will not be accepted after its due date.
- Utilization of mobile any mobile or electronic devices is prohibited during lecture and examinations.

Office Hours in person: Tu & Th 11:30 AM-12:30 PM

Department of Biological Sciences

Kingsborough Community College; *The City University of New York*

BIOLOGY 37-01, Human Genetics: Lecture *Fall 2023*

Tu &Th 9:15 AM – 11:45 AM Room M118

Assigned Reading - OER (Open Education Resources) free online;

Optional reading: Human Genetics. Concepts and Applications. 11th Ed. 2015. Ricki Lewis. ISBN 13: 978-1308-700946, McGraw-Hill Education, NY. Pp 498.

Instructor: ***Professor ZMG Sarwar Jahangir, Biological Sciences*.**

Date	Major Lecture Topics	Assigned Reading	Optional reading
Sep 12 Tu & 14 Th	Topic 1: Overview of Genetics; https://openlab.citytech.cuny.edu/bio-oer/gene-expression Topic 2: Cells; OER https://ghr.nlm.nih.gov/primer	**OER**	1-14 15-37
Sep 19 Tu & 21 Th	**Case Study 1. Assignment given on Sep 21.** Topic 3: Meiosis and Development; https://ghr.nlm.nih.gov/search?query=meiosis	**OER**	42-67
Sep 26 Tu & Oct 28 Th	**Case study 1 due on Sep 26.** Topic 4: Single-Gene Inheritance; https://ghr.nlm.nih.gov/search?query=inheritance&tab=all	**OER**	68-88
Oct 03 Tu & 05 Th	**1st Exam on Oct 03. Includes topics covered before.** Topic 5: Beyond Mendel's Laws; https://openlab.citytech.cuny.edu/bio-oer/genetics/co-dominance-and-multiple-alleles/	**OER**	89-109
Oct 12 Th & 17 Tu	**Case Study 2. Assignment given on Oct 12.** Topic 6: Matters of Sex; https://ghr.nlm.nih.gov/search?query=sex+linked+traits	**OER**	110-129
Oct 19 Th & 24 Tu	**Case study 2 due on Oct 19.** Topic 7 Multifactorial Traits; https://ghr.nlm.nih.gov/search?query=multifactorial+traits	**OER**	130-147
Oct 26 Th & 31 Tu	**2nd Exam on Oct 26. On topics covered after the 1st Exam.** **Case Study 3. Assignment given on Oct 26.** Topic 8: Genetics of Behavior; Topic 9: DNA Structure and Replication; https://ghr.nlm.nih.gov/search?query=Genetic+and+behavior https://ghr.nlm.nih.gov/search?query=DNA+structure	**OER**	148- 162
Nov 02 Th & 07 Tu	**Case study 3. Due on Nov 07.** Topic 10: Gene Action: From DNA to Protein; https://ghr.nlm.nih.gov/primer/howgeneswork/makingprotein	**OER**	163-179 180-198

Nov 09 Th & 014 Tu	Topic 11: Gene Expression and Epigenetics; https://ghr.nlm.nih.gov/primer/howgeneswork/epigenome Topic 12: Gene Mutation; https://ghr.nlm.nih.gov/search?query=mutation Topic13: Biotechnology; https://ghr.nlm.nih.gov/search?query=Biotechnology	**OER**	199-211 212-235 374-388
Nov 16 Th & 21 Tu	**3rd Exam on Nov 22. On topics covered after the 2nd Exam.** **Nov 29, Term End Student Presentation begins.**		
Nov 28 Tu & 30 Th	**Term End Student Presentation.**		
Dec 05 Tu & 07 Th	**Term End Student Presentation.**		
Dec 12 Tu	**Final Examination; Cumulative: 9:15 AM – 11:45 AM.**	Good luck!	

Grading: There will be three written exams each carrying 20% X 3 = 60% for the final grade. In addition, there will be three Case Studies each carrying3.33% x 3 = 10 % and a Term End Presentation carrying additional 10% for the final grade. The final exam will carry 20%. Thus, three lecture exams, three case studies, one term end presentation and the final exam will add to 100% for the final grade.

Grades and % scores (tentative): A^+ = 97-100; A, 94-96; A^-, 90-93; B^+ = 87-89; B, 84-86; B^-, 80-83; C^+ = 77-79; C, 74-76; C^-, 70-73; D^+ = 65-69; D, 60-64; F, ≤ 59

Excessive absences will result in an F grade regardless of the legitimacy of the absence. As defined by the University Policy for Attendance a student is considered excessively absent if they have missed more than 15% of the total instructional hours for a class. Therefore, if you miss more than 12 hours total, in any combination of lecture exams and presentations, an F grade is automatically assigned.

LECTURE TOPICAL OUTLINE

Week / Topic Objectives

Topics

1 Introduction: Overview of Genetics

Levels of genetics
What are genes and how do they work?
How are genes transmitted from parents to offspring?
How do scientists study genes?
Most genes do not function alone
Applications of genetics

https://openlab.citytech.cuny.edu/bio-oer/gene-expression

At the conclusion of this section's material students will:
Understand the historical and current (modern) applications and approaches used in the field of human genetics.
Understand how genetic studies and practices include ethical, legal and social issues.

2 Cells

Cell components
The cell cycle (cell division) and cell death (apoptosis)
Cell to cell interactions (signal transduction)
Mitosis is essential for growth and cell replacement
Stem cells and cell specialization

OER https://ghr.nlm.nih.gov/primer
https://ghr.nlm.nih.gov/search?query=mitosis

At the conclusion of this section's material students will:
Understand that cells are the fundamental unit of living organisms, and be able to describe how each cellular component functions.
Be able to describe mitotic cell division, and explain its role in cell replacement.
Be able to state what stem cells are, how they function, and where they exist

3 DNA and Chromosomes
DNA Structure and Replication
DNA carries genetic information
Discovery of the structure of DNA (Watson & Crick model)
DNA contains two polynucleotide chains
RNA is a single-stranded nucleic acid
From DNA molecules to chromosomes
DNA replication depends on complementary base pairing

https://ghr.nlm.nih.gov/search?query=DNA+structure

At the conclusion of this section's material students will:
Know and distinguish the relationship between DNA, chromatin and a chromosome.
Recognize and identify parts of the DNA double helix.
Deduce proper results of DNA replication when given an example segment.
Be a*ble to describe how genetic information is maintained*

4 Gene Action: From DNA to Protein
DNA, not protein is the hereditary molecule
The link between genes and proteins
Genetic instructions are stored in DNA
The genetic code: the key to life
Tracing the flow of genetic information from nucleus to cytoplasm
Transcription produces genetic messages
Translation requires the interaction of several components
Polypeptides fold into three-dimensional shapes to form proteins
Protein structure and function are related

https://ghr.nlm.nih.gov/primer/howgeneswork/makingprotein
https://ghr.nlm.nih.gov/primer/howgeneswork/epigenome
At the conclusion of this section's material students will:
Describe how the information encoded in DNA specifies protein products.
Be able to trace the flow of genetic information from the DNA in the nucleus to the protein product in the cytoplasm.
Distinguish between transcription and translation and describe similarities and differences.
Explain the steps entailed for final protein product formation.

5 Meiosis and Development

The reproductive system
Meiosis

Gamete Maturation (spermatogenesis and oogenesis)
Equalizing the expression of X chromosomes in males and females
Prenatal Development
How is sex determined?
Defining sex in stages: chromosomes, gonads, and hormones
Mutations can uncouple chromosomal sex from phenotypic sex
Sex-influenced and sex-limited traits
Birth Defects (teratogens)
Maturation and Aging (accelerated aging, longevity)

https://ghr.nlm.nih.gov/search?query=meiosis

At the conclusion of this section's material students will:
Be able to describe which parts of the human reproductive system are involved in sex determination and development.
Know the sequence of sex determination from conception to determination of genetic sex, then gonadal sex, then phenotypic sex.
Understand and describe dosage compensation, and the difference between sex-influenced and sex-limited inheritance.
Name and describe teratogens that influence development
Discuss accelerated aging and longevity

6 Reproductive Technologies

Fertility and Sub fertility
Male fertility, female fertility, infertility tests
Assisted reproductive technologies
Donated sperm, donated uterus, *in vitro* fertilization,
ICSI Oocyte banking
Pre-implantation genetic diagnosis
Potential therapies to correct many disorders (gene therapy) Genetic counseling assesses reproductive risks
Extra Embryos

https://ghr.nlm.nih.gov/search?query=Biotechnology

At the conclusion of this section's material students will:
Be able to define and describe male and female fertility and infertility test
Be able to describe various assisted reproductive technologies utilized as childbearing options.
Be able to describe and discuss ethical issues in reproductive technology
Discuss pre-implantation technologies and potential therapies
Describe how/why surplus embryos are made and utilized

7 Chromosomes

Portrait of a chromosome – chromosome parts
Karyotypes – constructing and analyzing karyotypes
Visualizing chromosome
Variations in chromosome number (polyploidy, aneuploidy)
What are the risks for autosomal trisomy?
Variations in chromosome structure
(deletions, duplications, translocations, inversions)
Other forms of chromosomal abnormalities

https://ghr.nlm.nih.gov/chromosome

At the conclusion of this section's material students will:
Be able to quantitatively and qualitatively describe the characteristic human chromosomal complement.
Name and describe sex chromosome aneuploidies and their consequences
Name and describe structural alternations within chromosomes
Identify and differentiate between normal and abnormal karyotypes and describe a condition to which they correspond.
Be able to describe several human syndromes based on the karyotype provided.

8 Single-Gene Inheritance

Following the inheritance of one gene – segregation
Mendel's experiments
Single-gene inheritance in humans
    Mendel's first law
Following the in heritance of two genes – independent assortment
    Mendel's second law
Pedigree analysis

https://ghr.nlm.nih.gov/search?query=inheritance&tab=all

Beyond Mendel's Laws

When gene expression appears to alter Mendelian ratios
    Multiple alleles, epistasis, pleiotropy, penetrance, expressivity
Maternal inheritance and mitochondrial genes
    Linkage

https://openlab.citytech.cuny.edu/bio-oer/genetics/co-dominance-and-multiple-alleles/
At the conclusion of this section's material students will:
Describe a method of how traits are inherited
Describe how many basic genetic concepts we know about genetics was first identified in pea plants.

Describe Gregor Mendel's experimental methodology utilizing pea plants to study one and more than one gene simultaneously
Explain how Gregor Mendel's experiments explain the separation and assortment of genes (alleles).
Explain how meiosis explains Gregor Mendel's experimental results.
Describe Mendelian inherence in humans
Be able to distinguish between autosomal dominant, autosomal recessive, and sex-linked dominant and recessive traits.
Explain holandric and maternal inheritance, illustrating with an example for each.
Explain how most human traits are controlled by more than one gene. Give several examples.
Provide a few examples of exceptions to Gregor Mendel's laws.
Know how to interpret and design a pedigree.

9 Multifactorial Traits

Genes and the environment mold most traits
Polygenic traits
Fingerprint patterns
Height, hair color, skin color
Heart health
Weight

https://ghr.nlm.nih.gov/search?query=multifactorial+traits

At the conclusion of this section's material students will:
Explain how most human traits are controlled by >1 gene and giving several examples.
Distinguish between polygenic and multifactorial traits.
Describe how height, hair and eye color are in inherited.
Relate gene expression to environmental influence (e.g.: heart health and weight).

10 Genetics of Immunity System

The importance of cell surfaces
The immune system – components and systems
Immune system responses: non-specific and specific defenses
Physical barriers, innate v. acquired immunity
Blood types, transplantation
Abnormal immunity – autoimmunity, allergies
Altering immune function – vaccines, transplants

https://ghr.nlm.nih.gov/search?query=Immune+genetics

At the conclusion of this section's material students will:
Be able to distinguish between antibodies and antigens.
Be able to discuss how the immune system defends the body against infection.
Distinguish between general and specific defenses against infection.
Be able to discuss how antibodies are manufactured in the body during infection.

Describe blood types and their importance in blood transfusions and immune reactions between mother and fetus.
Be able to describe immune system disorders such as allergies and autoimmune reactions.

11 Genetics of Cancer

Cancer is genetic not usually inherited
Characteristics of cancer cells
Origins of cancer cells - cancer begins in a single cell
Cancer is a disease of the cell cycle
Cancer genes
A series of genetic changes causes some cancers
Brain tumors, colon cancer
Chromosome changes, hybrid genes, and cancer
Environmental; causes of cancer (carcinogens, cancer-environmental links)
Evolving cancer diagnosis and treatment

https://ghr.nlm.nih.gov/search?query=mutation
https://ghr.nlm.nih.gov/search?query=cancer

At the conclusion of this section's material students will:
Be able to explain why cancer is considered a genetic disease.
List the steps that occur manifesting in cancer, from a single mutated cell to the disease.
Describe the mutations and steps in colon cancer.
Describe several common genetic changes which occur in cancer cells.
Distinguish between Inherited susceptibility and sporadic cancers
Name and describe potential contributing factors in cancer (e.g.: colon, lung)

12 Allele Frequencies

The importance of knowing allele frequencies (sec. 14.1)

DNA Profiling (sec 14.4)

Privacy (sec 14.5)

https://ghr.nlm.nih.gov/search?query=Alleles
At the conclusion of this section's material students will:
Be able to discuss the importance of knowing allele frequencies
Learn how DNA profiling is utilized in forensics and disasters
Discuss challenges to genetic privacy.

THEN….
And at the very end of the semester, many years later…
Be able to discuss human inheritance with confidence.