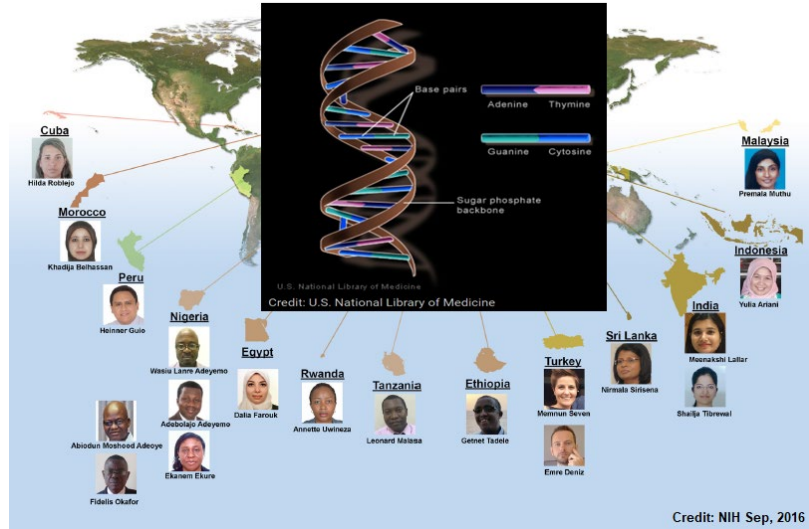


# KINGSBOROUGH COMMUNITY COLLEGE



# HUMAN GENETICS

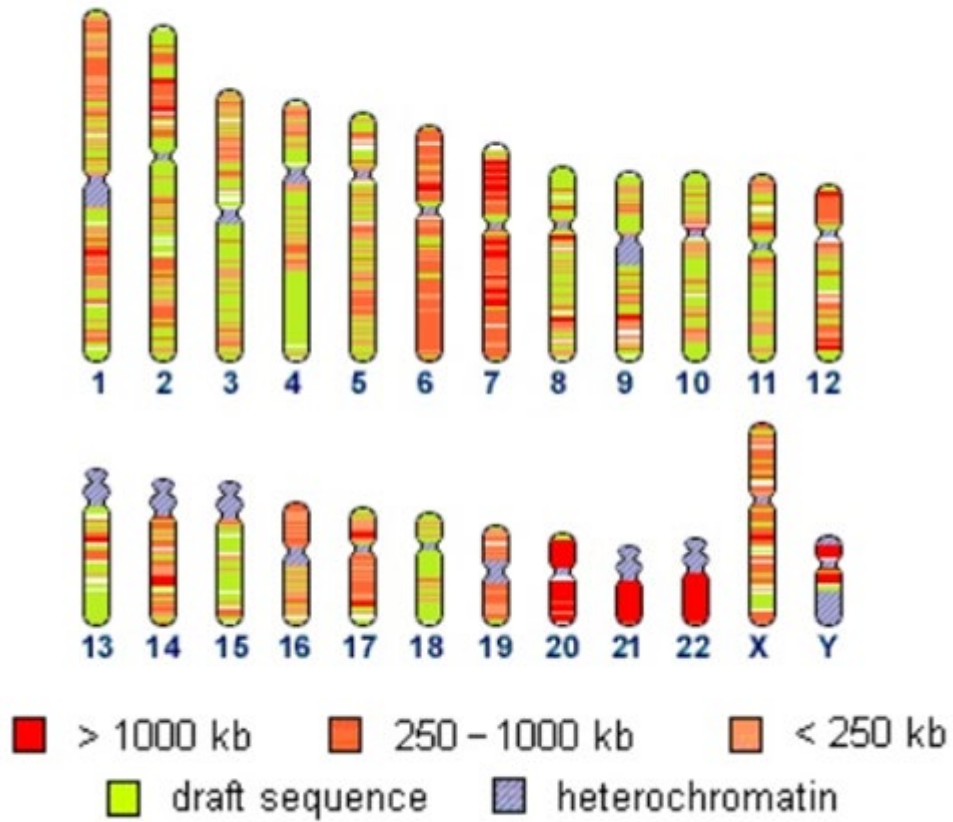
Biology 3700 (D01D – Code 20509)

Syllabus Fall 2019

*Modified and Taught by:*

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

# Human Chromosomes



*Source: NCBI*



## Access-Ability Services

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](mailto:AAS@kbcc.cuny.edu) By phone: 718-368-5175 \_\_\_\_\_

## **STUDENT RESPONSIBILITIES & ACADEMIC INTEGRITY**

**Any up-to-date KCC/CUNY policy will supersede any of the following**

### **Absence Policy**

A student who has been absent 15% of the total number of instructional hours in BIOLOGY 37 is deemed to be excessively absent. Each time late will be counted as ½ hour of absence. Excessive absences may result in the instructor assigning either a lower grade or continuous absences may result into a “WU” grade for this course.

The absent student must take the initiative for remaining up to date in the course and is responsible for all covered material and assigned work. The student must discuss absences with his or her professor. This should be done prior to an anticipated absence or immediately following a missed activity session.

### **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.pdf](http://www.kingsborough.edu/Academic_Integrity_Policy.pdf)

“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**

**No textbook is required. Assigned online readings only through OER (Open Education Resources) on 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%
<b>Total</b>	<b>= 100%</b>

### 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.
-

DRAFT

Prof. Sarwar Jahangir, Ph.D.

Office S 206; Tel: 718-368-5743; Office Hours: M T & W 4:10 PM-5:10 PM  
Department of Biological Sciences

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

## BIOLOGY 37-01 Lecture *Fall 2019*

M, T & Th 12:40 PM – 1:40 PM; Room TBA



**No textbook is required. Assigned online readings through Blackboard.**

**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.

Date	Major Lecture Topics	Assigned Reading	Optional reading
Sep 10,12 & 16	Topic 1: Overview of Genetics; <a href="https://openlab.citytech.cuny.edu/bio-oer/gene-expression">https://openlab.citytech.cuny.edu/bio-oer/gene-expression</a> Topic 2: Cells; OER <a href="https://ghr.nlm.nih.gov/primer">https://ghr.nlm.nih.gov/primer</a>	OER	1-14 15-37
Sep 17, 19 & 23	<b>Case Study 1. Assignment given on Sep 17</b> Topic 3: Meiosis and Development; <a href="https://ghr.nlm.nih.gov/search?query=meiosis">https://ghr.nlm.nih.gov/search?query=meiosis</a>	OER	42-67
Sep 24 & 26 & Oct 03	<b>Case study 1 due on Sep 24</b> Topic 4: Single-Gene Inheritance; <a href="https://ghr.nlm.nih.gov/search?query=inheritance&amp;tab=all">https://ghr.nlm.nih.gov/search?query=inheritance&amp;tab=all</a>	OER	68-88
Oct 07, 10 & 15	<b>1<sup>st</sup> Exam on Oct 07 Includes topics covered before.</b> Topic 5: Beyond Mendel's Laws; <a href="https://openlab.citytech.cuny.edu/bio-oer/genetics/co-dominance-and-multiple-alleles/">https://openlab.citytech.cuny.edu/bio-oer/genetics/co-dominance-and-multiple-alleles/</a>	OER	89-109
Oct 16, 17 & 21	<b>Case Study 2. Assignment given on Oct 16</b> Topic 6: Matters of Sex; <a href="https://ghr.nlm.nih.gov/search?query=sex+linked+traits">https://ghr.nlm.nih.gov/search?query=sex+linked+traits</a>	OER	110-129
Oct 22, 24 & 28	<b>Case study 2 due on Oct 22.</b> Topic 7 Multifactorial Traits; <a href="https://ghr.nlm.nih.gov/search?query=multifactorial+traits">https://ghr.nlm.nih.gov/search?query=multifactorial+traits</a>	OER	130-147
Oct 29, 31 & Nov 04	<b>2<sup>nd</sup> Exam on Oct 29. On topics covered after the 1<sup>st</sup> Exam.</b> Topic 8: Genetics of Behavior; <a href="https://ghr.nlm.nih.gov/search?query=Genetic+and+behavior">https://ghr.nlm.nih.gov/search?query=Genetic+and+behavior</a>	OER	148- 162
Nov 05, 07 & 11	<b>Case Study 3. Assignment given on Nov 05</b> Topic 9: DNA Structure and Replication; <a href="https://ghr.nlm.nih.gov/search?query=DNA+structure">https://ghr.nlm.nih.gov/search?query=DNA+structure</a>	OER	163-179
Nov 12, 14 & 18	<b>Case study 3. Due on Nov 12.</b> Topic 10: Gene Action: From DNA to Protein; <a href="https://ghr.nlm.nih.gov/primer/howgeneswork/makingprotein">https://ghr.nlm.nih.gov/primer/howgeneswork/makingprotein</a>	OER	180-198

Nov 19, 21 & 25	<b>3<sup>rd</sup> Exam on Nov 19. On topics covered after the 2<sup>nd</sup> Exam.</b> Topic 11: Gene Expression and Epigenetics; <a href="https://ghr.nlm.nih.gov/primer/howgeneswork/epigenome">https://ghr.nlm.nih.gov/primer/howgeneswork/epigenome</a> Topic 12: Gene Mutation; <a href="https://ghr.nlm.nih.gov/search?query=mutation">https://ghr.nlm.nih.gov/search?query=mutation</a>	OER	199-211 212-235
Nov 26 & Dec 02 & 03	Topic13: Biotechnology; <a href="https://ghr.nlm.nih.gov/search?query=Biotechnology">https://ghr.nlm.nih.gov/search?query=Biotechnology</a> <b>Nov 26, Term End Student Presentation begins.</b>	OER	374-388
Dec 05, 09 & 10	<b>Term End Student Presentation.</b>		
TBA	<b>Final Examination; Cumulative</b>	<b>A+ &amp; Good luck!</b>	

**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 carrying 3.33% 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<sup>+</sup> = 97-100; A, 94-96; A<sup>-</sup>, 90-93; B<sup>+</sup> = 87-89; B, 84-86; B<sup>-</sup>, 80-83; C<sup>+</sup> = 77-79; C, 74-76; C<sup>-</sup>, 70-73; D<sup>+</sup> = 65-69; D, 60-64; F, ≤ 59. A student who stopped coming to a class completely without a withdrawal and got a failing grade will get WU; Any student passing the class but missed a significant assignment, like the final exam, will get "INC". An already failing student and missed the final exam will get an F too.*



## 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 able 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 inheritance 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 inheritance 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 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.*

