

**Title:** Unit IV: Population Genetics

**Subject/Course:** Human Genetics

**Topic:** Allele Frequencies  
(Constant & Changing), Human  
Ancestry

**Grade:** 11/12 **Designer(s):** Erin Gallagher

### Stage 1- Desired Results

#### Established Goals:

*Student knowledge & understanding of...*

- Explanation of inheritance patterns
- Role of sexual reproduction in genetic variation
- Effect of environmental factors on genetic variation
- Explanation of gene pool changes (alleles) within human populations
- Description of human evolution and genetic changes over time

#### PA Standards for Science & Technology:

**3.1.10.B1.** Describe how **genetic** information is inherited and expressed.

**3.1.B.B2.** Illustrate that the sorting and recombining of genes in sexual reproduction results in a great variety of possible gene combinations in offspring.

**3.1.12.B2.** Evaluate the process of **sexual reproduction** in influencing genetic variability in a population

**3.1.12.B3.** Explain the impact of environmental factors on gene **expression**.

**3.1.B.C1.** Describe species as reproductively distinct groups of organisms.

Analyze the role that geographic isolation can play in speciation.

Explain how evolution through natural selection can result in changes in biodiversity through the increase or decrease of genetic diversity within a population.

Describe how the degree of kinship between species can be inferred from the similarity in their **DNA** sequences.

**3.1.12.C1.** Analyze how natural **selection** leads to **speciation**.

**3.1.12.C2.** Analyze how **genotypic** and **phenotypic** variation can result in **adaptations** that influence an **organism's** success in an environment

**3.1.B.C2.** Describe how mutations in sex cells may be passed on to successive generations and that the resulting **phenotype** may help, harm, or have little or no effect on the offspring's success in its environment.

Describe the relationship between environmental changes and changes in the gene pool of a population.

**3.1.B.C3.**

**PATTERNS**

Discuss the implications of a universal genetic code for evolution.

#### PA Keystone Anchors/Eligible Content:

**BIO.B.1.2** Explain how genetic information is inherited.

**BIO.B.2.3** Explain how genetic information is expressed.

**BIO.B.2.4** Apply scientific thinking, processes, tools, and technologies in the study of genetics.

**BIO.B.3.1** Explain the mechanisms of evolution.

**Transfer:**

Students will be able to independently use their learning to...  
 Relate genome changes and consistencies to allele frequencies in a population, as well as to the distinguishing characteristics of an individual  
 Describe the forces that affect populations and drive evolution  
 Apply understandings of the human genomic evolution to the path of human evolution until modern day

**Meaning:**

**Understandings:**

*Students will understand that...*

- Human genetics at the population level considers allele frequencies. Parts of the genome that have changed over time enable us to trace our origins, migrations and relationships. Parts of the genome that do not change provide a way to distinguish individuals.
- Nonrandom mating, migration, genetic drift, mutation and natural selection are the forces that mold populations and drive evolution.
- Our genes and genome are informational molecules, and their sequences hold clues to our deep past as well as our present diversity.

**Essential Questions:**

1. How does population genetics impact evolution?
2. How do we determine and predict constant allele frequencies?
3. What are some of the processes that impact changes in allele frequencies?
4. How does natural selection affect allele frequencies?
5. How did modern humans evolve?
6. Why is DNA information so crucial in investigating human evolution?

**Acquisition:**

*Students will know...*

- Effect of population genetics on evolution
- Impact of microevolutionary and macroevolutionary changes
- Determination of constant allele frequencies (application of the Hardy Weinberg principle)
- Processes which change allele frequencies in populations (nonrandom mating, migration, genetic drift, mutations)
- Effect of natural selection on population allele frequencies
- Process of human evolution
- Role of DNA in tracing human origins
- Genes important in human evolution
- Evolutionary trends revealed by chromosomes and proteins
- Role of mitochondrial DNA in tracking human population migration and expansion

*Students will be skilled at ...*

1. Describing a gene pool
2. Identifying the five processes that cause microevolutionary change
3. Describing the impact of macroevolutionary change
4. Applying the Hardy Weinberg principle to determine and predict constant allele frequencies
5. Explaining how nonrandom mating changes allele frequencies in populations
6. Explaining how nonrandom mating changes allele frequencies in populations
7. Explaining how migration changes allele frequencies in populations
8. Explaining how genetic drift changes allele frequencies in populations
9. Explaining how mutations changes allele frequencies in populations
10. Describing the effect of natural selection on population genetics
11. Distinguishing among the stages of human evolution
12. Explaining how DNA evidence provides insight on human evolution
13. Identifying genes vital in human evolution
14. Describing evolutionary trends by chromosome patterns and protein encoding
15. Applying knowledge of mitochondrial DNA in

tracking human origins  
 Explaining what mitochondrial EVE represents  
 Describing the pattern of human migration and expansion

**Stage 2- Assessment Evidence**

**Unit-Based Project**

Human Evolution

Students will select a modern day human geographic group (e.g. Southeast Asia islanders, Ashkenazi Jews, Scandinavians, sub-Saharan Africans, Native Americans, Mongolians, etc) and trace the human ancestry and evolutionary path, complete with and evaluated on:

- timeline
- cladogram
- genetic change sources (mutations, interbreeding, allelic change forces, etc.)
- environmental influences
- modern traits descriptors.

Additional evaluations:

- Project quality (neatness, layout, organization)
- Explanation, accuracy and quality of information
- Diagrams & charts
- Bibliography

**Other Evidence:**

Chapter quizzes:

- Ch14: Constant Allele Frequencies
- Ch15: Changing Allele frequencies
- Ch16: Human Ancestry

Unit test: Population Genetics

Laboratory Activities

Chapter Case Studies

**Stage 3- Learning Plan**

**Pre-Assessment**

## Learning Events

Vocabulary:

CH14: Constant Allele Frequencies

*Population, population genetics, gene pool, Hardy-Weinberg equilibrium, DNA profiling, variable number of tandem repeats (VNTRs), short tandem repeats (STRs)*

Vocabulary

Chapter topic scenario questions/discussion

- Chap 14: “Post-conviction DNA Testing” p.260

Chapter outline

Lecture/ notes/ discussion

Animations/videos

- PBS Evolution series

Exercises

- Venn diagram: microevolution vs. macroevolution
- Hardy Weinberg equilibrium practice applications
- Applying & Interpreting DNA profiles

Chapter Review Questions

- Chap 14: pp.275-276

Online activities/webquests

- Chap 14 p.276

Chapter readings with 5 sentence synopsis

- Reading 14.1: “DNA Profiling: Molecular genetics Meets Population Genetics” p.267

Laboratory exercises (online & hands-on)

- DNA profiling - (pbs video) and gel electrophoresis
- DNA profiling in forensics lab (gel electrophoresis)

Chapter Applied Questions

- Chap 14: pp.275-276

Bioethics reading and discussion questions

- Chap 14: “Population Biobanks” p.273

Forensics Focus and/or Case Studies

- Chap 14: pp.276-277

Guided reading/Review handouts

CH15: Changing Allele Frequencies

*Cline, genetic drift, founder effect, population bottleneck, genetic load, natural selection, balanced polymorphism, eugenics*

Vocabulary

Chapter topic scenario questions/discussion

- Chap 15: “The Evolution of Lactose Tolerance” p.278

Chapter outline

Lecture/ notes/ discussion

Animations/videos

- PBS evolution series

Exercises:

- Allelic change forces chart (nonrandom mating, migration, genetic drift, mutation & natural selection)

## Progress-Monitoring

- ✓ Do Now
- ✓ Vocabulary quizzes
- ✓ Outlines check
- ✓ Online activities completion and accuracy check with discussion on results
- ✓ Accuracy of review and applied questions, guided reading handouts, chapter reading synopses
- ✓ Bioethics scenarios discussion
- ✓ Forensic focus/case studies analyses
- ✓ Lab exercises execution & data analyses
- ✓ Unit project progression monitoring

## Chapter Review Questions

- Chap 15: pp.298-299

## Online activities/webquests

- Chap 15 p.300

## Chapter readings with 5 sentence synopsis

- Reading 15.1: “Antibiotic Resistance: The Rise of MRSA” p.289

## Laboratory exercises (online & hands-on)

Modeling allelic change forces: 4 part activity on nonrandom mating, migration, genetic drift, and mutation & natural selection

## Chapter Applied Questions

- Chap 15: pp.298-299

## Bioethics reading and discussion questions

- Chap 15: “Two Views of Neural Tube Defects” p.295

## Forensics Focus and/or Case Studies

- Chap 15: p.300

## Guided reading/Review handouts

## CH16: Human Ancestry

*Hominoids, hominins, synteny, homeobox (HOX gene), haplogroups,*

## Vocabulary

## Chapter topic scenario questions/discussion

- Chap 16: “The Hobbits” p.301

## Chapter outline

## Lecture/ notes/ discussion

## Animations/videos

- Walking with Cavemen
- Eve

## Exercises:

- Human evolution cladogram/diagrams
- Human evolution characteristics chart comparison
- Human evolution timeline (dates, geography, characteristics)

## Chapter Review Questions

- Chap 16: pp.322-323

## Online activities/webquests

- Chap 16 p.323

## Chapter readings with 5 sentence synopsis

- Reading 16.1: “What makes Us Human?” pp.312-313

## Laboratory exercises (online & hands-on)

- See web activities

## Chapter Applied Questions

- Chap 16: pp.322-323

## Bioethics reading and discussion questions

- Chap 16: “The Havasupai Indians: New Uses for Old DNA Samples” pp.309-310

## Forensics Focus and/or Case Studies

- Chap 16: pp.323-324

## Guided reading/Review handouts

**Technology**

- Laptops and Internet for online activities and project research
- Powerpoint/LCD projector for lecture/discussion
- Laboratory equipment & materials for lab exercises
- McGraw-Hill Connect Genetics (teacher): online assignments, quizzes, tests, online activities, questions, presentations, animations, student performance tracking
- McGraw Hill ConnectPlus Genetics (student): eBook, assignments, quizzes, tests, questions, activities, vocab flashcards, animations
- Text companion website: [www.glencoe.com/lewis10](http://www.glencoe.com/lewis10) or [www.mhhe.com/lewisgenetics10](http://www.mhhe.com/lewisgenetics10)
- Discovery Streaming videos

**Pacing Guide**

Chapters 14-16 = 2 weeks

Approx:

6 days: Chap 14-15 (quiz)

4 days: Chap 16 (quiz)

Review/reteach

Unit test / Unit Project due