

**Title:** Unit II: Transmission Genetics

**Subject/Course:** Human Genetics

**Topic:** Inheritance Patterns, Sex & Genetics, Multifactorial Traits, Genes & Behavior

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

### Stage 1- Desired Results

#### Established Goals:

*Student knowledge & understanding of...*

- Processes of Mendelian and non-Mendelian inheritance patterns
- Impact of Mendelian and non-Mendelian inheritance patterns
- Role of sex chromosomes in gene expression
- Effect of the environment on gene expression
- Impact of genetics on human behaviors

#### PA Standards for Science & Technology:

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

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

**3.1.12.B1.** Explain gene inheritance and expression at the molecular level.

**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.** Analyze **gene expression** at the **molecular** level.

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

#### **3.1.B.B5.**

##### PATTERNS

Describe how Mendel's laws of segregation and independent assortment can be observed through patterns of inheritance.

Distinguish among observed inheritance patterns caused by several types of genetic traits (dominant, recessive, codominant, sex-linked, polygenic, incomplete dominance, multiple alleles)

##### CONSTANCY AND CHANGE

Explain how gene actions, patterns of heredity, and reproduction of cells and organisms account for the continuity of life.

**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

#### PA Keystone Anchors/Eligible Content:

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

**BIO.B.2.1** Compare Mendelian and non-Mendelian patterns of inheritance.

**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.

#### Transfer:

Students will be able to independently use their learning to...

- Apply Mendelian inheritance patterns to predict genetic outcomes

- Describe non-Mendelian patterns of inheritance, and influencing factors
- Explain how sex chromosomes determine gender, and how that gene expression can be affected both before and after birth
- Describe how the environment and personal lifestyle choices can affect gene expression in traits and illnesses, and ways in which personal decisions can influence genetic outcomes

**Meaning:**

**Understandings:**

*Students will understand that...*

- Gregor Mendel deduced the basis of inheritance patterns. His two laws brilliantly described how chromosomes behave in meiosis, which had not yet been discovered.
- Patterns of inheritance can be obscured when genes have many variants, interact with each other or the environment, are in mitochondria, or are linked on the same chromosome.
- Sex affects our lives in many ways. Which sex chromosomes we are dealt at conception sets the developmental program for maleness or femaleness, but gene expression before and after birth greatly influences how that program unfolds.
- Who we are and how we feel arises from an intricate interplay among our genes and environmental influences. Understanding genetic contributions to traits and illnesses can suggest how we can alter our environments.

**Essential Questions:**

1. How did Mendel’s work form the basis of modern genetics?
2. How do we track inheritance patterns?
3. How do non-Mendelian inheritance patterns (incomplete dominance, codominance, multiple alleles, pleiotropy) affect gene expression?
4. How do sex chromosomes (X, Y) affect our traits and identities?
5. Why is it important to understand the interplay between genes and the environment?
6. How do determine the effects of environment and genetics on polygenic and multifactorial traits?

**Acquisition:**

*Students will know...*

- Patterns of one gene inheritance
- Patterns of multiple gene inheritance
- Family inheritance patterns
- Non-Mendelian inheritance patterns
- Effect of-linkage on gene expression
- Role of sex chromosomes in specific gene expressions
- Traits associated with sex chromosomes
- Traits are greatly impacted by genes and environment
- Means of investigating multifactorial traits
- Implications of specific populations subsets on understanding of genetic and environmental influences

*Students will be skilled at ...*

1. Distinguishing Mendelian inheritance patterns (dominant/recessive, homozygous/heterozygous))
2. Applying the Punnett Square to predict genotypic and phenotypic outcomes
3. Explaining the law of segregation
4. Explaining the law of independent assortment
5. Determining inheritance patterns in familial generations
6. Describing non-Mendelian inheritance patterns (incomplete dominance, codominance, multiple alleles, pleiotropy) affect gene expression
7. Explaining the possible phenotypic outcomes of gene linkage
8. Distinguishing between X and Y chromosomes and their roles in gene expression
9. Explaining sex linkage, sex-limited, and sex-influenced traits
10. Explaining the effects of X inactivation
11. Distinguishing between single-gene, polygenic and multifactorial traits

- 12. Investigating multifactorial traits
- 13. Explaining the difference between empiric risk and Mendelian frequencies
- 14. Describing how wider studies (adoption, twins, genomes) can reveal about genetic and environmental influences

**Stage 2- Assessment Evidence**

**Unit-Based Project**

Inheritance and Influences of Genetic Disorders

Students will select a sex linked or behavioral disorder and research & present:

- Manifestations of disorder
- Genes involved
- Pattern of inheritance / genetic cause (mutation, non-disjunction, etc.)
- Genetic factors affecting expression
- Heritability
- Environmental influences on gene expression
- Pedigree or karyotype

Students will be evaluated on:

- Description of disorder
- Identification of genes involved
- Explanation of disorder inheritance or cause
- Description of genetic interplay
- Inclusion of pedigree/karyotype
- Identification of environmental factors affecting gene expression
- Depth, breadth and accuracy of genetic information
- Quality of project (neatness, organization, layout)
- Physical and oral presentation

**Other Evidence:**

Chapter quizzes:

- Ch4: Single Gene Inheritance
- Ch5: Beyond Mendel’s Laws
- Ch6: Matters of Sex
- Ch7: Multifactorial Traits
- Ch8: Genetics of Behavior

Unit test: Transmission Genetics

Laboratory Activities

Chapter Case Studies

**Stage 3- Learning Plan**

**Pre-Assessment**

## Learning Events

Vocabulary:

CH4: Single Gene Inheritance

*Law of segregation, homozygous, heterozygous, dominant, recessive, Punnett square, autosomal dominant, autosomal recessive, consanguinity, law of independent assortment, pedigree*

Vocabulary

Chapter topic scenario questions/discussion

- Chap 4: “A Tale of Two Families” p.69

Chapter outline

Lecture presentation/notes/discussion

Animations/videos

Exercises:

- Punnett Square practices: Mendelian inheritance

Chapter Review Questions

- Chap 4: pp.86-87

Online activities/webquests

- Chap 4 p.88

Chapter readings with 5 sentence synopsis

- Reading 4.1: “It’s All in the Genes” p.74
- Reading 4.2: “Cystic Fibrosis: Then & Now” p.77

Laboratory exercises (online & hands-on)

- Observing single gene peer traits and rate of occurrences
- PTC taste testing

Chapter Applied Questions

- Chap 4: pp.86-87

Bioethics reading and discussion questions

- Chap 4: “When Diagnosing a Fetus Also Diagnoses a Parent: Huntington Disease” p.76

Forensics Focus and/or Case Studies

- Chap 4: p.88

Guided reading/Review handouts

CH5: Beyond Mendel’s Laws

*Incompletely dominant, codominant, epistasis, penetrant, expressivity, pleiotropic, genetic heterogeneity, phenocopy, heteroplasmic, linked, recombinant, linkage maps, haplotype, genome wide association studies*

Vocabulary

Chapter topic scenario questions/discussion

- Chap 5: “A Gene Search to Explain a Child’s Blindness” p.89

Chapter outline

Lecture presentation/notes/discussion

Animations/videos

Exercises:

- Punnett Square practices: non-Mendelian inheritance
- Human characteristics & chromosomal expression activity
- Human gene expression of traits activity
- Human pedigrees practices

Chapter Review Questions

## Progress-Monitoring

- ✓ Do Nows
- ✓ 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

- Chap 5: pp.107-108

Online activities/webquests

- Chap 5 p.109

Chapter readings with 5 sentence synopsis

- Reading 5.1: “The Genetic Roots of Alzheimer Disease” p.97

Laboratory exercises (online & hands-on)

- Building chromosomes: gene linkage and recombination
- Blood typing lab

Chapter Applied Questions

- Chap 5: pp.107-108

Forensics Focus and/or Case Studies

- Chap 5: p.109

Guided reading/Review handouts

CH6: Matters of Sex

*Heterogametic sex, homogametic sex, sex ratio, hemizygous, sex-limited traits, sex-influenced traits, X inactivation, manifesting heterozygote, genomic imprinting*

Vocabulary

Chapter topic scenario questions/discussion

- Chap 6: “Stem Cell and Gene Therapies Save Boys’ Lives” p.111

Chapter outline

Lecture presentation/notes/discussion

Animations/videos

Exercises:

- Punnett square practice: Sex determination
- Punnett Square practice: sex-linked genes
- Pedigree practice: sex-linked genes
- Sex chromosome expression influencing factors chart

Chapter Review Questions

- Chap 6: pp.128-129

Online activities/webquests

- Chap 6 p.129

Chapter readings with 5 sentence synopsis

- Reading 6.1: “Colorblindness” p.118
- Reading 6.2: “Rett Syndrome: - A Curious Inheritance Pattern” p.125

Laboratory exercises (online & hands-on)

- Using the NCBI website, identify and describe a sex-linked disorder

Chapter Applied Questions

- Chap 6: pp.128-129

Forensics Focus and/or Case Studies

- Chap 6: pp.129-130

Guided reading/Review handouts

CH7:Multifactorial Traits

*Multifactorial traits, polygenic trait, empiric risk, heritability, concordance, genome-wide association studies, cohort study, case-control study*

Vocabulary

Chapter topic scenario questions/discussion

- Chap 7: “The Genetics of Athletics” p.131

Chapter outline

Lecture presentation/notes/discussion

Animations/videos

Exercises:

- Venn diagram: multifactorial traits vs. polygenic traits
- Genetics of race: skin color expression and inheritance patterns (pbs.org/race)

Chapter Review Questions

- Chap 7: pp.146-147

Online activities/webquests

- Chap 7 p.148

Chapter readings with 5 sentence synopsis

- Reading 7.1: “Many Genes Control Heart Health” p.133

Laboratory exercises (online & hands-on)

Genetics of race: skin color expressions and implications (pbs.org/race)

Chapter Applied Questions

- Chap 7: pp.146-147

Forensics Focus and/or Case Studies

- Chap 7: p.148

Guided reading/Review handouts

CH8:Genetics of Behavior

*Neurons, neuroglia, major depressive disorder, bipolar disorder, neurexins, neuroligins*

Vocabulary

Chapter topic scenario questions/discussion

- Chap 8: “Chronic Fatigue Syndrome” p.149

Chapter outline

Lecture presentation/notes/discussion

Animations/videos

Exercises:

- Behavior disorders chart: disorder, genes, influences

Chapter Review Questions

- Chap 8: pp.161-162

Online activities/webquests

- Chap 8 pp.162-163

Laboratory exercises (online & hands-on)

- Select a drug of abuse and create diagram of genetics involved, drug action/effect, environmental factors in play for addiction

Chapter Applied Questions

- Chap 8: pp.161-162

Forensics Focus and/or Case Studies

- Chap 8: p.163

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 4-8 = 4 weeks

Approx:

8 days: Chap 4 & 5 (quiz)

4 days : Chap 6 (quiz)

8 days: Chap 7-8 (quiz)

Review/reteach

Unit test / Unit Project due