EvolutionHQ Activity: Introduction to Mendelian Genetics

Names: _____

Date: _____

Period: _____

Learning Objectives

- Understand the relationship between genes, alleles, genotype, and phenotype
- Use Punnett squares to predict offspring genotypes and phenotypes
- Calculate phenotypic and genotypic ratios from monohybrid crosses
- Distinguish between dominant and recessive traits

🔗 **Required Tool:** Open this link in a new tab

EvolutionHQ.org - Explore Punnett Squares

Part 1: Understanding Basic Terminology

Model 1: Genes and Alleles

Gregor Mendel studied pea plants and discovered patterns of inheritance. He focused on traits that came in two distinct forms. For example:

- **Seed shape:** Round or Wrinkled
- **Seed color:** Yellow or Green
- **Plant height:** Tall or Short

Each trait is controlled by a **gene**. Different versions of a gene are called **alleles**.

Term	Definition	Example
Gene	A unit of heredity that controls a trait	Gene for seed shape
Allele	Different forms of a gene	R (round) or r (wrinkled)
Dominant	Allele that is expressed when present	R (round) - capital letter
Recessive	Allele only expressed when two copies present	r (wrinkled) - lowercase letter

Critical Thinking Questions

1. In the example above, what gene is being studied?

2. How many different alleles are shown for this gene?

3. Why do you think the dominant allele is represented with a capital letter and the recessive with lowercase?

Part 2: Genotype and Phenotype

Model 2: Genotype vs. Phenotype

Organisms inherit two alleles for each gene, one from each parent.

Genotype (genetic makeup)	Description	Phenotype (physical appearance)
RR	Homozygous dominant (two same dominant alleles)	Round seeds
Rr	Heterozygous (two different alleles)	Round seeds
rr	Homozygous recessive (two same recessive alleles)	Wrinkled seeds

Critical Thinking Questions

4. How many copies of each gene does an organism have?

5. Can two organisms with different genotypes have the same phenotype? Use evidence from Model 2 to support your answer.

6. What must be true about an organism's genotype for it to display a recessive trait?

Key Question: Why is it important to distinguish between genotype and phenotype when studying inheritance?

Part 3: Monohybrid Crosses and Punnett Squares

🌐 **Navigate to the Monohybrid Cross section on EvolutionHQ.org**

Use the interactive tool to explore the following scenarios

Model 3: Using Punnett Squares

A Punnett square is a tool that helps predict the possible genotypes of offspring from a cross between two parents.

Scenario: Cross a heterozygous round-seeded plant (Rr) with another heterozygous round-seeded plant (Rr)

Use the EvolutionHQ.org Punnett Square tool to set up this cross and observe the results.

Critical Thinking Questions

7. Using the interactive tool, set up the cross described above (Rr × Rr). List all possible offspring genotypes and how many of each appear:

8. What is the genotypic ratio (the ratio of different genotypes) from this cross?

9. How many offspring show the round phenotype? How many show the wrinkled phenotype?

10. What is the phenotypic ratio from this cross?

Key Question: If round seeds are dominant, why do some offspring from two round-seeded parents show the wrinkled phenotype?

Part 4: Practice with Different Crosses

Application Problems

Use the EvolutionHQ.org Punnett Square tool to complete the following crosses. For each, determine the genotypic and phenotypic ratios.

Cross 1: Homozygous dominant (RR) × Homozygous recessive (rr)

Offspring genotypes: _____

Genotypic ratio: _____

Phenotypic ratio: _____

Cross 2: Heterozygous (Rr) × Homozygous recessive (rr)

Offspring genotypes: _____

Genotypic ratio: _____

Phenotypic ratio: _____

11. Compare the three crosses you've completed (Rr × Rr, RR × rr, and Rr × rr). Which cross produced offspring with only one phenotype? Why?

12. In which cross(es) could you produce offspring with the recessive phenotype?

Part 5: Introduction to Dihybrid Crosses

🌐 **Navigate to the Dihybrid Cross section on EvolutionHQ.org**

Model 4: Two Traits at Once

A **dihybrid cross** examines the inheritance of two different traits simultaneously.

Example: Consider seed shape AND seed color in pea plants:

- R = round (dominant), r = wrinkled (recessive)
- Y = yellow (dominant), y = green (recessive)

A plant could have genotype RrYy (heterozygous for both traits)

Critical Thinking Questions

13. How many genes are being studied in a dihybrid cross?

14. How many total alleles (letters) are needed to write the genotype for both traits?

15. Use the EvolutionHQ.org dihybrid cross tool to set up a cross between two plants that are heterozygous for both traits (RrYy × RrYy). How many boxes are in this Punnett square compared to a monohybrid cross?

16. Using the interactive tool, determine how many offspring show:
- Round and yellow seeds: _____
- Round and green seeds: _____
- Wrinkled and yellow seeds: _____
- Wrinkled and green seeds: _____

17. Express your answer from question 16 as a phenotypic ratio:

Key Question: How does studying two traits together differ from studying one trait at a time? What makes dihybrid crosses more complex?

Reflection and Summary

18. In your own words, explain how Punnett squares help predict the inheritance of traits from parents to offspring.

19. A farmer notices that when he crosses two purple-flowered plants, some of the offspring have white flowers. What does this tell you about the genotype of the parent plants?

20. Why are tools like the Punnett square interactive on EvolutionHQ.org useful for understanding genetics?