Lab 9: Genetics & Inheritance

BIOL-8

Name: _____ **Date:** _____

Objectives

By the end of this lab, you will be able to:

- Define key genetics terms: gene, allele, genotype, phenotype, dominant, recessive
- Use Punnett squares to predict offspring genotypes and phenotypes
- Identify dominant and recessive traits in yourself
- Analyze a family pedigree to trace inheritance of a trait

Part 1: Key Concepts

Read each term and definition carefully. You will use these throughout the entire lab.

Term	Definition
Gene	A segment of DNA that codes for a specific trait
Allele	A version of a gene (e.g., brown-eye allele vs. blue-eye allele)
Genotype	The alleles an organism carries, written with letters (e.g., *Aa*)
Phenotype	The physical trait you can observe (e.g., "brown eyes")
Homozygous	Two identical alleles (*AA* or *aa*)
Heterozygous	Two different alleles (*Aa*) — also called a **carrier** if the trait is recessive
Dominant	The allele expressed when at least one copy is present (capital letter, e.g., **A**)
Recessive	The allele expressed only when two copies are present (lowercase letter, e.g., **a**)
Punnett Square	A grid used to predict the offspring of a genetic cross

Check Your Understanding

1. If someone has the genotype *Bb*, are they homozygous or heterozygous?

2. An organism with genotype *aa* shows the recessive trait. What genotype(s) would show the dominant trait?

3. What is the difference between a genotype and a phenotype?

4. Why is a person with genotype *Aa* called a "carrier" for a recessive condition?

Part 2: Coin Toss — Modeling Allele Segregation

> ***Learning Goal:*** *See how random chance determines which allele a parent passes on.*

When a parent with genotype **Aa** makes sperm or egg cells, each cell randomly gets either the **A** or the **a**. This is like flipping a coin.

Procedure

1. Get **two coins**. One = Father (Aa). One = Mother (Aa).
2. Flip both coins **10 times**. Record each result below.
3. **Heads** = Dominant allele (**A**)
4. **Tails** = Recessive allele (**a**)
5. Both Heads = **AA** · One of each = **Aa** · Both Tails = **aa**

Data

Genotype Tally (10 Tosses)

#	Genotype	Tally	Count	Percentage
1				
2				
3				
4				

Questions

1. The expected ratio for Aa × Aa is 25% AA, 50% Aa, 25% aa. How close were your results?

2. Would your results be closer to the expected ratio if you flipped 100 times? Why?

Part 3: Punnett Squares — Albinism

Learning Goal: *Use Punnett squares to predict offspring for a real human trait.*

Albinism is a recessive condition where the body produces little or no melanin pigment.

- **A** = Normal pigmentation (dominant)
- **a** = Albinism (recessive)

Cross 1: AA × aa

A man with normal pigmentation (**AA**) has children with a woman who has albinism (**aa**).

Draw the Punnett square in the box below:

```
          Mother
        ___a___  ___a___
       |        |        |
  A    |        |        |
F      |________|________|
a      |        |        |
t   A  |        |        |
h      |________|________|
e
r
```

Genotype of all offspring:

Phenotype of all offspring:

Can any child from this cross have albinism? Why or why not?

Cross 2: Aa × Aa

Two people who are both **carriers** (Aa) have children together.

Draw the Punnett square in the box below:

```
          Mother
        ___A___  ___a___
       |        |        |
  A    |        |        |
```

```
F     |________|________|
a     |        |        |
t   a |        |        |
h     |________|________|
e
r
```

Expected genotypic ratio:

- AA: _____%
- Aa: _____%
- aa: _____%

What fraction of their children could have albinism?

_____

What fraction would be carriers (Aa) but look normal?

_____

Part 4: Punnett Squares — Sickle Cell Trait

Learning Goal: *Apply Punnett squares to another real human genetic condition.*

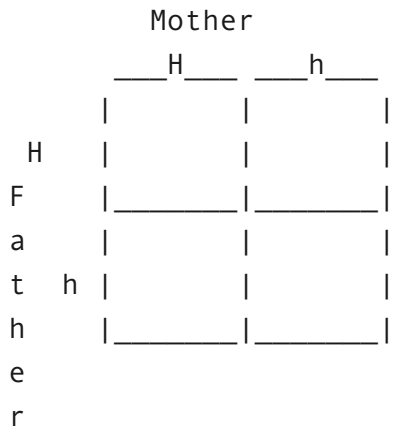
Sickle cell disease is an autosomal recessive condition affecting hemoglobin in red blood cells.

- **H** = Normal hemoglobin (dominant)
- **h** = Sickle cell hemoglobin (recessive)
- **HH** = Unaffected
- **Hh** = Carrier (sickle cell *trait* — usually healthy)
- **hh** = Sickle cell *disease*

Cross: Hh × Hh

Both parents are carriers for sickle cell trait.

Draw the Punnett square in the box below:



1. What is the probability their child will have sickle cell disease (hh)?

2. What is the probability their child will be a carrier (Hh)?

3. What is the probability their child will be completely unaffected (HH)?

4. If this couple has 4 children, how many would you *expect* to be carriers? (This is a prediction, not a guarantee.)

Part 5: My Traits — Dominant vs. Recessive

Learning Goal: *Identify real dominant and recessive traits in yourself.*

Check yourself for each trait below. If you show the dominant phenotype, your genotype could be homozygous dominant *or* heterozygous — write it with an underscore (e.g., **T_**).

My Genetic Profile

#	Trait	Dominant	Recessive	My Phenotype	My Possible Genotype
1					
2					
3					
4					
5					

1. For any trait where you show the recessive phenotype, what must your genotype be? Why?

2. Why can't you know your exact genotype if you show the dominant phenotype?

Part 6: Family Pedigree — Tracing a Trait Through Generations

Learning Goal: *Read and draw a pedigree chart to trace how a trait is inherited in a real family.*

A **pedigree** is a diagram that shows how a trait passes through a family. Here are the standard symbols:

Symbol	Meaning
□	Male
○	Female
■ / ●	Affected (has the trait)
□─○	Mated pair
Vertical line down	Their children

Scenario: Cystic Fibrosis

Cystic fibrosis (CF) is an **autosomal recessive** condition (genotype **ff**).

- **F** = Normal (dominant)
- **f** = Cystic fibrosis (recessive)

Read the family description, then draw the pedigree in the box below.

Generation I (Grandparents): Frank (unaffected) and Gina (unaffected) have three children.

Generation II (Their children):

- **Maria** (unaffected) — marries **Tom** (unaffected). They have 2 children.
- **Carlos** — has cystic fibrosis.
- **Anna** (unaffected) — no children yet.

Generation III (Grandchildren):

- Maria and Tom's daughter **Lily** (unaffected)
- Maria and Tom's son **Sam** (unaffected)

Draw the Pedigree

Use the standard symbols above. Use squares for males, circles for females. Shade in anyone who is affected.

```
Draw your pedigree here. Use three rows:

  Generation I:     □——○
                      |
                ____________________
               |         |          |
  Generation II:   ○——□      ■        ○

  Generation III:  ○    □
```

(Fill in names, shade affected individuals)

Pedigree Analysis

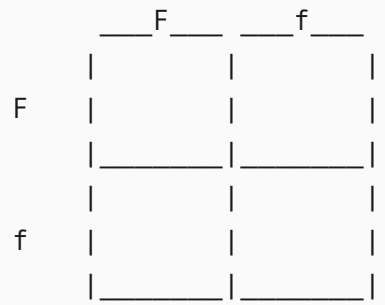
1. Carlos has cystic fibrosis (ff). He got one *f* allele from Frank and one from Gina. What must Frank and Gina's genotypes be?

2. Frank and Gina appear healthy but each carry one recessive allele. What is the term for this?

3. What are Maria's possible genotypes? (There are two options.)

4. If Maria is a carrier (Ff) and Tom is also a carrier (Ff), what is the probability that their child would have cystic fibrosis?

5. Draw the Punnett square for Ff × Ff in the box below to support your answer.



6. Looking at your pedigree, could you tell just by looking at appearances that Frank and Gina were carriers? Why is this important for genetic counseling?

Conclusion

1. In your own words, explain why two healthy parents can have a child with a recessive genetic condition like albinism, sickle cell disease, or cystic fibrosis.

2. What is one thing you learned in this lab that surprised you about how traits are inherited?

Lab created for BIOL-8: Human Biology