Genetics in *Harry Potter*'s World
Lesson 1

- Phenotypes & Genotypes
- Dominant & Recessive Traits
- Punnett Square

Genetics in *Harry Potter*?

- What types of inherited genetic traits are described in the *Harry Potter* series?

Inherited Physical Traits
in *Harry Potter*

"All the Weasleys have red hair, freckles, and more children than they can afford."
-- Draco Malfoy (*Sorcerers Stone*, Ch.6)

He was almost twice as tall as a normal man and at least five times as wide. (*Sorcerer's Stone*, Ch.1)

Harry had a thin face, knobby knees, black hair, and bright green eyes. (*Sorcerer's Stone*, Ch.1)

A pale boy with a pointed face and white-blond hair, Draco greatly resembled his father. His mother was blonde too... (*Goblet of Fire*, Ch.8)

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Applying Genetics to the *Harry Potter* Characters

- What are some **phenotypes** (observable traits) described in the four excerpts from the *Harry Potter* books?

Applying Genetics to the *Harry Potter* Characters

- What are some **phenotypes** (observable traits) described in the four excerpts from the *Harry Potter* books?
  - Freckles
  - Hair color
  - Eye color
  - Height

Applying Genetics to the *Harry Potter* Characters

- A genetic trait can be described in two ways:

    - **Phenotypes** are observable traits resulting from how one's genes are expressed. Ex., hair color, a talent, sickle cell disease, etc.

    - A **Genotype** consists of two letters that represent a gene's allele pair that results in a phenotype.

Example: Freckles

- Two possible **phenotypes** for freckles are:
  - **Has Freckles** (observable)
  - **No freckles** (observable)
- A **genotype** for freckles is indicated by two alleles in one of the genes that causes freckles. The possible alleles using the first letter of the trait "f" are:
  - **F** (dominant) = **Has Freckles**
  - **f** (recessive) = **No freckles**

Question: Using **F** and **f**, what are possible **genotypes** of the allele pair for freckles?

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Freckles: Genotypes & Phenotypes

Question: Using **F** and **f**, what are possible **genotypes** of the allele pair for freckles?

Genotype		Phenotype
(alleles inherited from parents)		(physical appearance)
F F	======	has freckles
F f	======	has freckles
f f	======	no freckles

One dominant allele (**F**) is sufficient for its trait (has freckles) to be observable, but both alleles have to be recessive (**f**) for the recessive trait (no freckles) to be observable.

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Example: Red Hair

- In one of the genes that determines hair color, red hair is **recessive** to brown hair. One way to describe these hair color alleles are:
    - Red hair = **r** (notes recessive red color)
    - Brown hair = **R** (notes dominant brown color)

Question: Using **r** (red hair) and **R** (brown hair) alleles, what possible **genotypes** of the allele pair are there?

Genotype (allele pair)   **Phenotype** (appearance)

Example: Red Hair

Question: Using **R** (brown hair) and **r** (red hair) alleles, what possible **genotypes** of the allele pair are there?

Genotype (allele pair)		**Phenotype** (appearance)
RR	======	brown hair
Rr	======	brown hair
rr	======	red hair

Punnett Square:
Heredity Prediction Diagram

Punnett Square: Freckles Case 1

Mom has freckles and dad has none. And each parent has a homozygous genotype (the two alleles in the gene are the same).

Their **genotypes** are:

Mom = _____

Dad = _____

Punnett Square: Freckles Case 1

The parents' homozygous genotypes are:

Mom = __F F__

Dad   = __f f__

Punnett Square

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Punnett Square: Freckles Case 1

The parents' homozygous genotypes are:

Mom = _**F F**_

Dad = _**f f**_

Using the parents' genotypes, each inner square is filled with a possible genotype for their child.

F   **F**

f

f

Punnett Square: Freckles Case 1

The parents' homozygous genotypes are:

Mom = __F F__

Dad   = __f f__

All possible genotypes of their children have a freckle-dominant allele, predicting a 100% chance of their children having freckles.

	F	**F**
f	**Ff**	**Ff**
f	**Ff**	**Ff**

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Punnett Square: Freckles Case 2

What happens if both mom and dad have freckles, and their genotypes are heterozygous (the two alleles in the gene are different)?

Their **genotypes** are:

Mom = _____

Dad   = _____

Punnett Square: Freckles Case 2

The parents' heterozygous genotypes are:

Mom =   **F f**

Dad   =   **F f**

Punnett Square

Punnett Square: Freckles Case 2

The parents' heterozygous genotypes are:

Mom = **F f**

Dad = **F f**

Using the parents' genotypes, each inner square is filled with a possible genotype for their child.

	F	**f**
F		
f		

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Punnett Square: Freckles Case 2

The parents' heterozygous genotypes are:

Mom = __F f__

Dad = __F f__

There is a 75% probability that their child will have freckles, or a 25% chance of a child with no freckles.

	F	**f**
F	**FF**	**Ff**
f	**Ff**	**ff**

Punnett Square: Weasley Family

All Weasley children have **<u>freckles</u>** and **<u>red hair</u>**. Use a Punnett Square to predict the most likely genotypes of their parents, Molly and Arthur Weasley, for the two traits.

Use the following allele possibilities that we identified previously:

- **r** (notes recessive red color) = Red hair
- **R** (notes dominant brown color) = Brown hair
- **F** (dominant) = Has Freckles
- **f** (recessive) = No freckles

Punnett Square: Weasley Family

All Weasley children have freckles and red hair—100% probability. Possible genotypes for their red hair (recessive trait) and freckles (dominant trait) are: **rr** only for red hair and **Ff** or **FF** for freckles. The Punnett Squares show the following genotypes for the children:

rr	**rr**
rr	**rr**

Ff/FF	**Ff/FF**
Ff/FF	**Ff/FF**

Both parents have rr.

At least one parent has **FF**.

.

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Punnett Square: The Potters

Question 1: Harry has dark/brown hair like his father, but his mom had red hair. Using the genotypes of **rr**, **Rr**, and **RR**, what possible genotypes does each of the Potters have?

Questions 2: Harry marries Ginny who has red hair. What are possible genotypes of their children's hair colors?

Use a Punnett Square to demonstrate how you arrived at your answers.

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Punnett Square: The Potters

Question 1: Harry has dark/brown hair like his father, but his mom had red hair. Using the genotypes of **rr**, **Rr**, and **RR**, what possible genotypes does each of the Potters have?

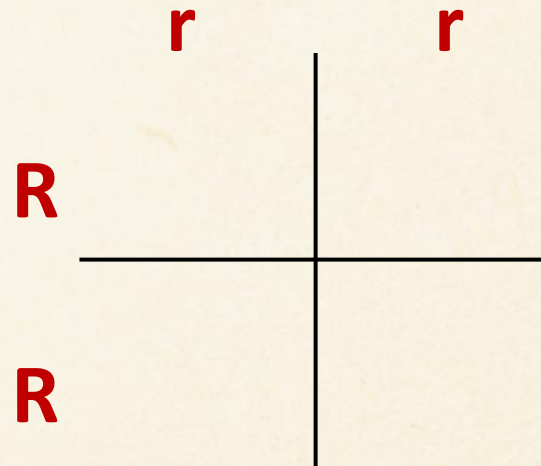The phenotypes of the Potters are:

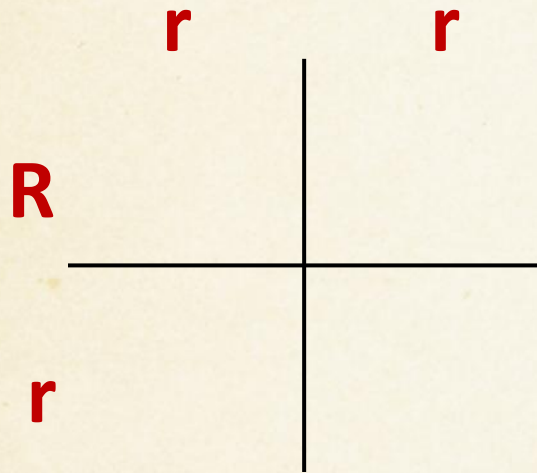James Potter (dad)—dark/brown hair

Lily Potter (mom)—red hair

Harry Potter—dark/brown hair

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Punnett Square: The Potters

Using the genotypes of **rr**, **Rr**, and **RR**, what are possible genotypes for Harry's parents?

– Mom-Lily (red hair) = **rr**

– Dad-James (dark hair) = **Rr or RR**

The parents' genotypes lead to 2 Punnett squares.

Punnett Square: The Potters

Given Harry's parents' possible genotypes, the two Punnett Squares can be completed as follows:

	r	**r**
R	**Rr**	**Rr**
r	**rr**	**rr**

	r	**r**
R	**Rr**	**Rr**
R	**Rr**	**Rr**

In this situation, the **only possible** genotype for Harry's dark hair is **Rr**.

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Punnett Square: The Potters

Questions 2: Harry marries Ginny who has red hair. What are possible genotypes of their children's hair colors?

Punnett Square: Harry & Ginny

Harry marries Ginny who has red hair. What are the possible genotypes of their children's hair colors?

First, what are the genotypes for Harry's and Ginny's hair colors?

Harry's genotype = **Rr**

Ginny's genotype = **rr**

Punnett Square: Harry & Ginny

Harry marries Ginny who has red hair. What are possible genotypes of their children's hair colors?

Given Harry and Ginny's genotypes, **Rr** and **rr**, we can fill in the Punnett Square for their children's genotypes.

Their children have a 50% chance of being either red- or dark-haired.

	r	**r**
R	**Rr**	**Rr**
r	**rr**	**rr**

Human Mendelian Trait Examples

- **Achoo Syndrome-** People with this sneeze as a reflex when they see sunlight, after having been in a dark room. It's a dominant trait.

- **Ear wax (wet/dry)-** Wet ear wax, or ear wax that is brown and sticky, is the dominant trait. Dry ear wax, or ear wax that is flaky, dry, and grayish-brown, is recessive.

- **Advanced Sleep Phase Syndrome-** People with this go to bed and wake up unusually early. It's a dominant trait.