Predicting offspring of Heterozygous cross

What do these words mean (ch. 6.4)?

• Allele
• Heterozygous vs homozygous
• Dominant allele vs. recessive allele
• Genotype vs. phenotype
Based on this, what are your roots?

1. Egyptian
2. Roman
3. Greek
4. Germanic
5. Celtic
Penny Lab: Predicting offspring of Heterozygous cross

<table>
<thead>
<tr>
<th>Genotype (gene sequence represented by letters)</th>
<th>Phenotype (physical appearance - genes that are expressed)</th>
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</thead>
<tbody>
<tr>
<td>TT</td>
<td>Short Big Toe</td>
</tr>
<tr>
<td>Homozygous Dominant</td>
<td></td>
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<tr>
<td>Tt</td>
<td>Short Big Toe</td>
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<tr>
<td>Heterozygous</td>
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<tr>
<td>tt</td>
<td>Long Big Toe</td>
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<tr>
<td>Homozygous recessive</td>
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</table>
Mendel laid the groundwork for genetics.

- Traits are distinguishing characteristics that are inherited.
- Genetics is the study of biological inheritance patterns and variation.
- Gregor Mendel showed that traits are inherited as discrete units.
- Many in Mendel’s day thought traits were blended.
• **Gregor Mendel (1860s)**

• He used the garden pea plants to study how traits were passed from one generation to another.

• He started with pure breeding pea plants. He called this the P1 (parental generation).
Why use pea plants?

• Make a prediction? Why would pea plants be a good choice?
• Be prepared to share.
Why use pea plants?

• Male and female parts of flower = self fertilization
• Distinctive traits (either-or)
• Rapid reproduction
Mendel selectively bred the plants

- Removed male flower parts (anthers-produce pollen)
- Fertilized flowers with pollen from a plant that had the other trait.
DNA-RNA-PROTEIN

- Genes are sections of DNA that code for proteins which determine the development of traits.

(the phenotype of hair color and structure are controlled by a combination of genes, including a keratin gene for keratin and melanin protein production)
An allele is any alternative form of a gene occurring at a specific locus on a chromosome.

If an organism has two different alleles for a trait, only one is expressed or visible.

The same gene can have many versions.
Genes

• All of an organism’s genetic material is called the genome.
• A genotype refers to the makeup of a specific set of genes represented by letters/alleles.
• All individuals in a species have the same set of genes or genome, but they get their unique traits from the combinations of allele variations for each gene.
• **Dominant allele**: form of a gene that is fully expressed when two different alleles are present. Capital Letter (example: P)

• **Recessive allele**: form of a gene that is not expressed when paired with a dominant allele. Lower case letter (example: p)
Describing allele combinations

- Each parent donates one allele for every gene in each gamete.

- **Homozygous** (a.k.a. purebred) two alleles that are the same at a specific locus (location on chromosome). Represented by the same case either two upper case dominant or two lower case recessive.

- **Heterozygous** (a.k.a. hybrid) describes two alleles that are different at a specific locus on chromosome. Represented by upper and lower case letters.
A phenotype is the physical functional expression and appearance of a trait. Phenotype always *shows* the dominant trait when present (PP (purple) and Pp (also purple). Phenotype only shows recessive traits when homozygous (pp-white).
This created the second generation

- **F1 = First filial**
- All of the plants in this generation showed 1 trait.
- He then allowed the F1 generation to self fertilized and create the F2 (second filial) generation.
In reference to your own family, tell a partner who would be the P, F1 and F2 generations.

- **P**: Purebred white and purple plants were crossed to create F1.
- **F1**: Offspring were allowed to self-pollinate to create F2.
- **F2**: White flowers reappear in some offspring.
<table>
<thead>
<tr>
<th>F&lt;sub&gt;2&lt;/sub&gt; Traits</th>
<th>Dominant</th>
<th>Recessive</th>
<th>Ratio</th>
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</thead>
<tbody>
<tr>
<td>Pea shape</td>
<td>5474 round</td>
<td>1850 wrinkled</td>
<td>2.96:1</td>
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<tr>
<td>Pea color</td>
<td>6022 yellow</td>
<td>2001 green</td>
<td>3.01:1</td>
</tr>
<tr>
<td>Flower color</td>
<td>705 purple</td>
<td>224 white</td>
<td>3.15:1</td>
</tr>
<tr>
<td>Pod shape</td>
<td>882 smooth</td>
<td>299 constricted</td>
<td>2.95:1</td>
</tr>
<tr>
<td>Pod color</td>
<td>428 green</td>
<td>152 yellow</td>
<td>2.82:1</td>
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<tr>
<td>Flower position</td>
<td>651 axial</td>
<td>207 terminal</td>
<td>3.14:1</td>
</tr>
<tr>
<td>Plant height</td>
<td>787 tall</td>
<td>277 short</td>
<td>2.84:1</td>
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</table>
Round or wrinkled ripe seeds
Yellow or green seed interiors
Purple or white petals
Green or yellow unripe pods
Inflated or pinched ripe pods
Axial or terminal flowers
Long or short stems
Mendel’s Conclusions

- Traits are inherited as discrete units.
- Organisms inherit one version of each gene from each homologous pair—one from each parent.
- Homologous (2) copies segregate/separate during gamete formation during meiosis II.

![Diagram of Mendel's Conclusions](image-url)
Mendel’s Laws

• Basic rules of inheritance are referred to as Mendel’s Laws
• He created these by looking at all of the data he collected from crossing the pea plants.
• Not the only method of inheritance, there are many other ways that genes are passed down.
1) The law of segregation

- States that each pair of genes segregates, or separates during meiosis II.
- Because of segregation, each of an organism's gametes contain one gene from a matching homologous pair.
2) **The law of dominance**

- States that if two alleles in a gene pair are different or heterozygous, then the dominant/capital allele can control the trait and the recessive/lower case can be hidden.
- The dominant allele is the only version “expressed” or shown. (Example: Short big toe “T” will mask recessive Long toe “t”)

![Image of a foot](image_url)
Predicting monohybrid cross ratios

• A monohybrid cross shows the inheritance of one trait

• How do we determine the ratio of offspring that will be a certain genotype or the ratio for the phenotypes?
Letters vs. Features

**Phenotype**
- Purple
- Purple
- Purple

**Genotype**
1. PP (homozygous)
2. Pp (heterozygous)
3. pp (homozygous)

**Ratio**
- Phenotype: 3:1
- Genotype: 1:2:1
Predicting monohybrid cross ratios

• Using P and p for the color of pea flowers, show a cross between two plants heterozygous for flower color.

• Ratios represent how many of the offspring out of four will show specific traits:

  • Phenotypic ratio: 3:1  3 out of every four offspring are predicted to be purple.

  • Genotypic ratio: 1:2:1  One out of every four will have genotype PP (homozygous dominant), 2 will be heterozygous (Pp), and 1 will be homozygous recessive (pp).
Cross two pea plants that are both heterozygous for pod color. Determine the genotypic ratio and phenotypic ratio of the offspring.
Cross a pea plant is homozygous for round peas, and a plant that homozygous for wrinkled peas. Determine the genotypic ratio and phenotypic ratio of the offspring.

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Cross a pea plant that has yellow peas, with a plant that has green peas. What is this type of cross called?