



# Genetics: Mendel and Punnett Squares



# Gregor Mendel

- ▶ Father of Modern Genetics
- ▶ Completed experiments on pea plants in his monastery's garden
- ▶ Studied seven independent traits in pea plants
- ▶ In the experiments he showed a basis for heredity and inheritance
- ▶ Mendel focused on Sexual reproduction, however that is not the only type of reproduction



Picture courtesy of the Smithsonian

# Asexual vs Sexual Reproduction

## ▶ Asexual reproduction

- ▶ Asexual reproduction is when offspring are created from only one parent. Offspring are exact copies of that parent
- ▶ Examples include bacteria and some plants

## ▶ Sexual Reproduction

- ▶ Sexual Reproduction is combining the genetic information of two individuals to create a new individual.
- ▶ Examples include Humans and Horses

# Alleles

- ▶ Mendel found that each offspring gets half of its genetic makeup from each parent
- ▶ These halves are presented as individual Alleles
  - ▶ Alleles can be named a, b, c, d and e
- ▶ Every individual has two Alleles for each trait
- ▶ With sexual reproduction each parent gives one Allele to the offspring



# Alleles cont.

- ▶ Alleles can be Dominant or Recessive
  - ▶ Dominant alleles can be capital letters, like E for brown eye color
  - ▶ Recessive alleles can be small letters, like e for blue eye color
  - ▶ Dominant alleles are expressed (shown) in the offspring
  - ▶ Recessive alleles are present but not expressed (shown) in the offspring
- ▶ For example, the offspring might get an E from one parent and an e from the other. What color eyes will it have?



# Genotype vs Phenotype

- ▶ These Alleles are known as an individual's Genotype.
- ▶ Genotype determines Phenotype
  - ▶ Genotype is the genetic makeup of an individual organism
  - ▶ Phenotype is a set of observable characteristics of an individual
- ▶ As in the previous example the offspring might get an E from one parent and an e from the other.
  - ▶ Ee is this individual's Genotype and Brown eyes is its Phenotype



# Punnett Squares

- ▶ Punnett Squares are used to determine the probability offspring will express a certain genotype
- ▶ The Punnett Square takes the given genotype of the parents and shows the possible offspring genotype



# Punnett Squares, 1

- ▶ You take the alleles of the sire **Aa** and place them at the top of the Punnett Square

	<b>A</b>	<b>a</b>

- ▶ Then you take the alleles of the Dam **Aa** and place them on the side of the Punnett Square

	<b>A</b>	<b>a</b>
<b>A</b>		
<b>a</b>		

# Punnett Squares, 2

- ▶ After that you fill in the square
- ▶ Each set of alleles is designated as
  - ▶ Homozygous Dominate (AA),
  - ▶ Homozygous Recessive (aa), or
  - ▶ Heterozygous (Aa)

	A	a
A	AA	Aa
a	Aa	aa

# Punnett Squares, 3

- ▶ Homozygous is a pair of alleles that are the same, they can be either both dominant (Homozygous Dominant) or both recessive (Homozygous Recessive)
  - ▶ **AA** or **aa**
- ▶ Heterozygous is a pair of alleles where one is dominant and one is recessive
  - ▶ **Aa**
- ▶ The Heterozygous will be the same as the Homozygous Dominant because the **A** is dominant over the **a**

	<b>A</b>	<b>a</b>
<b>A</b>	<b>AA</b>	<b>Aa</b>
<b>a</b>	<b>Aa</b>	<b>aa</b>

# Punnett Squares, 4

- ▶ From this example 25% of offspring will be Homozygous Dominant (AA), 25% will be Homozygous Recessive (aa), and 50% will be Heterozygous (Aa)
- ▶ To get the heterozygote you add the two Aa squares
- ▶ The possible offspring should always equal 100%
  - ▶  $25\%AA + 25\%aa + (25\%Aa + 25\%Aa) = 100\%$

	A	a
A	AA 25%	Aa 25%
a	Aa 25%	aa 25%

# Punnett Squares: Example 1

- ▶ A Shackleford stallion is Heterozygous for a Brown eyes. A mare is Homozygous Recessive for Blue eyes. What are the alleles for each horse and the possible offspring

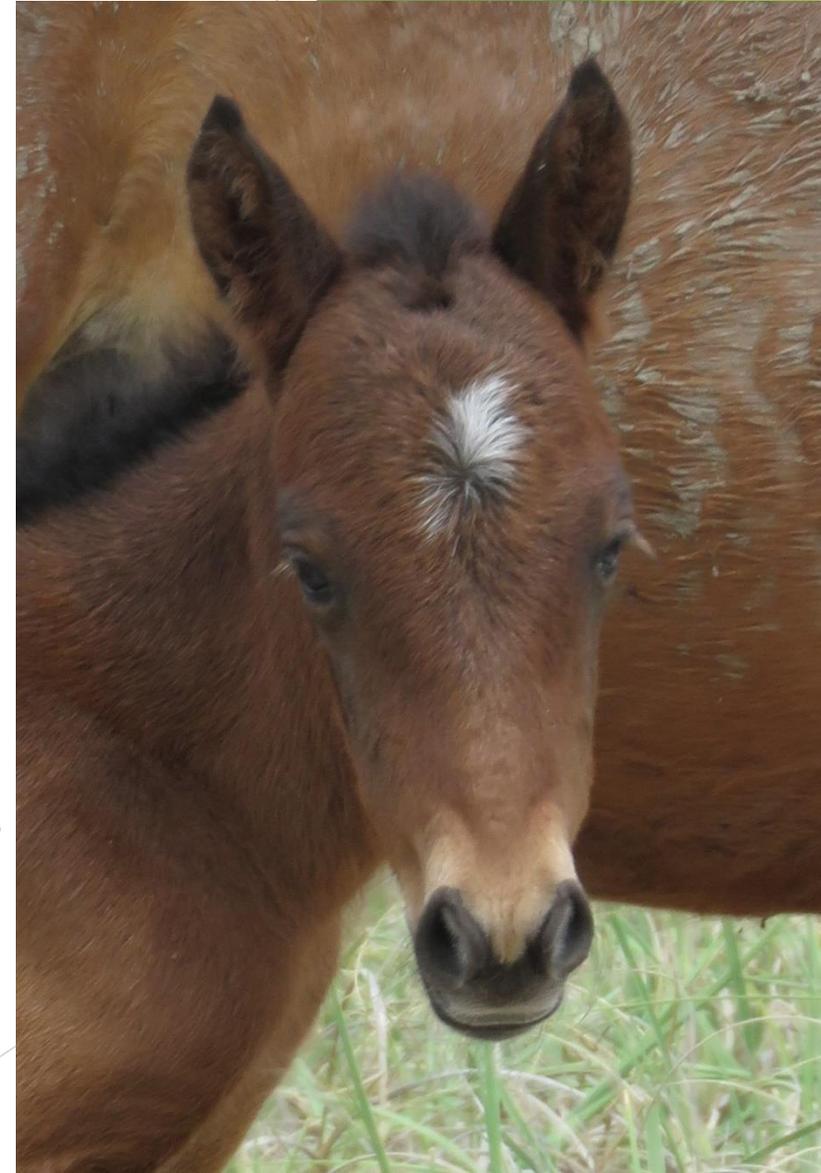


# Punnett Squares: Example 1 Answer

- ▶ Male- Bb
- ▶ Female- bb

	B	b
b	Bb	bb
b	Bb	bb

- ▶ 50% of the offspring will have Brown eyes and 50% will have Blue eyes



# Punnett Squares: Example 2

- ▶ Black hair is dominant in the population of horses on Shackleford Banks. If a heterozygous black stallion breeds a heterozygous black mare, what is the probability that the foal produced will have black hair?



# Punnett Squares: Example 2 Answer

- ▶ There is a 75% chance that the foal produced will be black.
- ▶  $25\%BB + 50\%Bb = 75\%$

	B	b
B	BB	Bb
b	Bb	bb

