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 know as an individuals 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 individuals 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

	A	a

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

	A	a
A		
a		

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 dominate over the a

	A	a
A	AA	Aa
a	Aa	aa

Punnett Squares, 4

- From this example 25% of offspring will be Homozygous Dominate (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

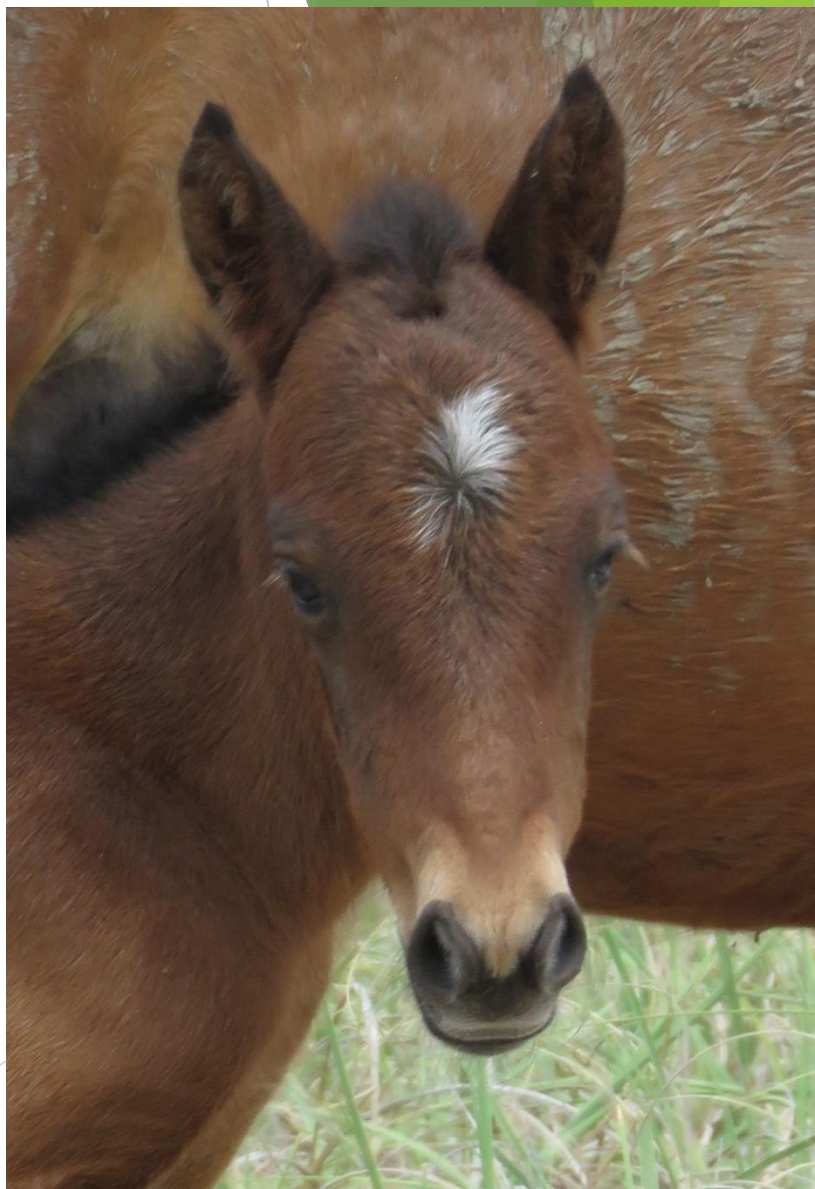
- A Shackleford stallion is Heterozygous for a Brown eyes. A mare is Homozygous Recessive for Blue eyes. What are the alleles for each horse and the possible offspring

Punnett Squares: Example 1 Answer

- Male- Bb
- Female- bb

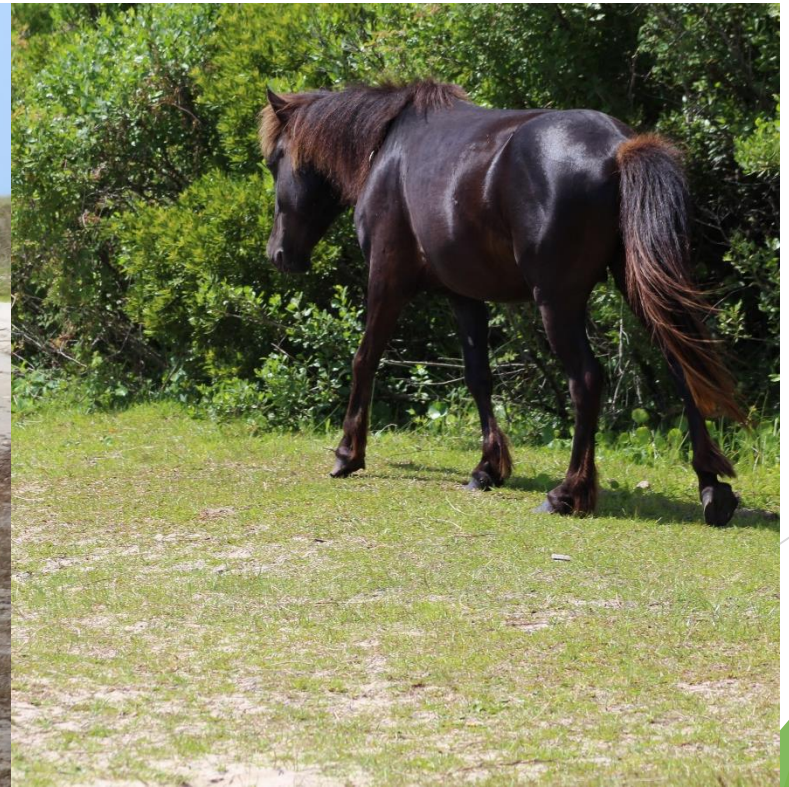
	B	b
b	Bb	bb
b	Bb	bb

- 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