Biology 5.3
Mendelian genetics

”Behold, what manner of love the Father hath bestowed upon us, that we should be called the sons of God: therefore the world knoweth us not, because it knew him not.”

Inheritance of traits

1. Offspring inherit traits from their parents.
2. Diploid organisms receive one genome (set of genes) from each parent.
3. Parents transmit the genes received from their parents to their offspring—Grandparents to grandchildren.
4. Chromosomal segregation, independent assortment, gene swapping, and genetic changes during meiosis allows for unique individual traits.
5. Hybrid vigor or heterosis refers to enhanced qualities when offspring benefit from the combination of genetic information from parents.

Mendelian laws of inheritance

1. The Law of Segregation: Chromosomes and their associated genes are separated into individual gametes.
2. The Law of Independent assortment: Chromosomes and their associated genes are shuffled and distributed to individual gametes.
3. The Law of Dominance: A recessive gene will not manifest itself when paired with a dominant gene but can be passed on to offspring.

The father of genetics

1. Gregor Mendel was an Austrian student of philosophy and physics. He became a monk for the free education.
2. He spent eight years growing 29,000 pea plants for his research on inheritance.
3. His published findings in 1865 were ignored until 1900 because his conclusions were contrary to the thinking of the day.
4. Mendel compared seven characteristics of pea plants: height, pod shape and color, seed shape and color, flower location, and flower color.
5. Mendel’s first experiments involved self-pollination to establish a controlled conclusion to compare with.
6. Self-pollinated pea plants produce offspring (F1) with the same traits as the parents (P).
7. Cross pollination resulted in a combination of traits from both parents.
8. The occurrence of combined traits resulted in recurring and predictable mathematical ratios and probabilities.
9. He described the three occurrences of what is now referred to as Mendelian genetics.

Genetic expression in traits

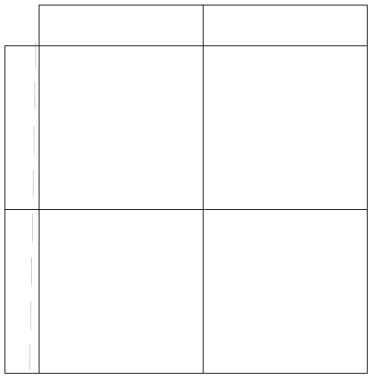
1. Genes express themselves in physical traits.
2. Genotype determines the phenotype.

Copyright © 2014 Patrick Briney

3. Genotype: The genetic identity of a trait.
4. Phenotype: The physically expressed trait.
5. Genotype is designated with letters such as DD, Dd, dd.
    - Upper case 'D' is the letter for a Dominant trait such as 'T = tall'.
    - Lower case 'd' is the letter for a recessive trait such as 't = not tall'.
    - Two letters combined show the diploid match of genes from each parent.
    - DD indicates homozygous two dominant genes.
    - tt indicates homozygous two recessive genes.
    - Dd indicates heterozygous genes with one dominant and one recessive.
    - Genes that code for the same trait (such as height or shape, or color) are called alleles.
    - Alleles can be homozygous or heterozygous.
6. Change in the genotype can change the phenotype.
7. Change in the phenotype will not change the genotype.

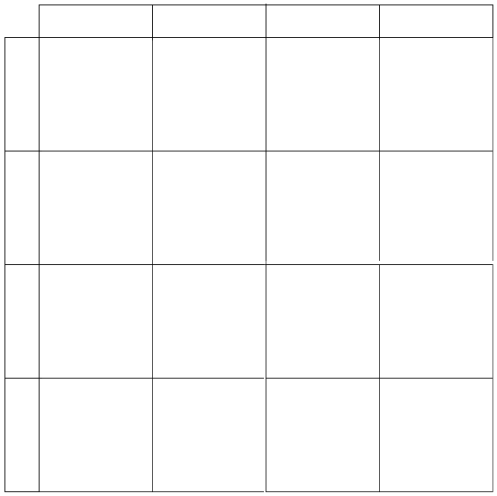
Punnett square

1. The shuffling of genes makes it possible to predict the probability of an offspring's genotype and phenotype.
2. Predicting the probabilities of phenotypes and genotypes is possible using the Punnett square, invented by a British geneticist named Reginald C. Punnett.
3. The Punnett square diagram shows how genes can be shuffled and combined.
4. The top row of the square shows the paternal assortment of genes.
5. The vertical row of the square shows the maternal assortment of genes.
6. The remaining squares show the possible gene combinations.
7. A cross comparison of one trait such as height only is called a monohybrid cross.
8. A cross comparison of two traits such as height and color is called a dihybrid cross.
9. Fill in the following monohybrid Punnett square for a paternal genotype of TT and a maternal genotype of Tt.

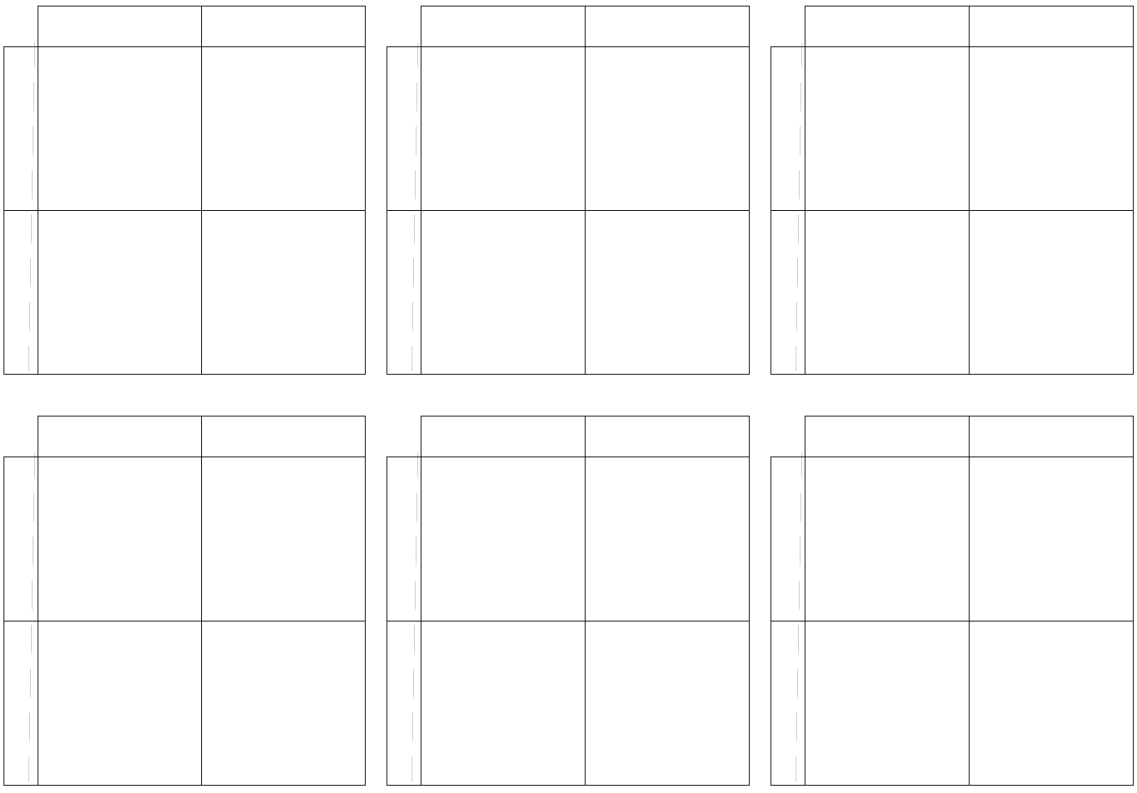


10. Based on the above Punnett square, what do you predict for the genotypes of the offspring?
11. Fill in the following Dihybrid Punnett square for a paternal genotype of TTRr and a maternal genotype of Ttrr.

Copyright © 2014 Patrick Briney



12. Show the probability of offspring for XX or XY with a Punnett square.
13. Compare the following monohybrid crosses: TT x TT, TT x tt, TT x Tt, Tt x Tt, tt x tt



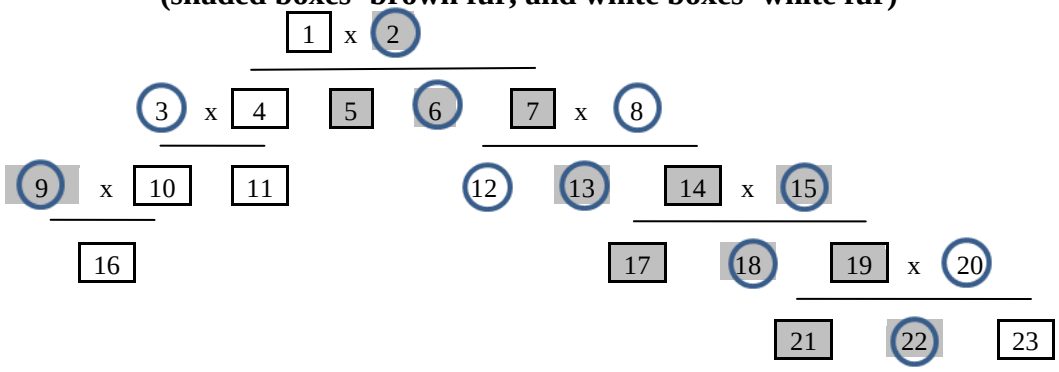
Pedigree chart

1. Chart depicting phenotypes of generations.
2. Used to determine genotypes of current and past generations from phenotypes.

Copyright © 2014 Patrick Briney

3. Circles (females) and squares (males)
4. Order of offspring left to right
5. Phenotypes are depicted by shading. The trait of interest is shaded.
6. Carriers do not manifest the trait of interest, but have the gene.
7. In the following chart, identify the phenotypes and genotypes.

(shaded boxes=brown fur, and white boxes=white fur)



List answers in next table

Organism #	Phenotype	Genotype	**Organism #**	Phenotype	Genotype
1			**13**		
2			**14**		
3			**15**		
4			**16**		
5			**17**		
6			**18**		
7			**19**		
8			**20**		
9			**21**		
10			**22**		
11			**23**		
12					

8. Draw a pedigree chart for your family with a trait of interest.

Copyright © 2014 Patrick Briney

Exercises

1. How to indicate homozygous genotype for dominant red feathers and recessive white feathers.
2. How to indicate heterozygous genotype for red feathers?
3. How to indicate heterozygous genotype for green peas? (Green is dominant, yellow is recessive)

4. If P1= Tt x Tt, then F1: _____

5. Draw a Punnett square for Zz x zz

6. What are the probabilities of genotypes and phenotypes for Zz x zz?

_____

7. If P1: Cc x Cc (C= cute and c= not cute)
   What are the possible genotypes for F1? _____

8. What are the possible phenotypes for the previous F1? _____

9. What are the probabilities of genotypes and phenotypes for cc x Cc? _____

   _____

10. If P1: AA x aa, and F1 x Aa,
    What are the possible genotypes for **F2**? _____

Copyright © 2014 Patrick Briney