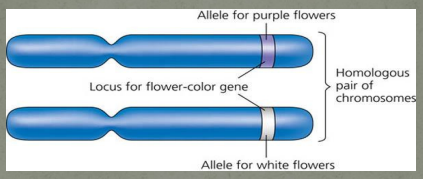
Genetics:

Punnett Squares

What is a Gene?

- A specific region of DNA that codes for a particular protein



- Alleles are different versions of the same gene
  - Ex. Purple flowers and white flowers

Every organism has 2 alleles for each trait: one from mom and one from dad.

- Dominant Alleles
  - use a capital letter to represent them
- Recessive Alleles
  - use a lower case letter to represent them

Example: Brown is dominant = B
Blue is recessive = b

Dominant trait is expressed unless both alleles are recessive

Genotype vs. Phenotype

- Genotype
  - genetic makeup for a specific set of genes
  - represented by 2 letters: BB, Bb, bb
- Phenotype
  - physical characteristics or traits
  - what it looks like: Brown or blue eyes

Example: Bb (genotype) carries one allele for brown and one for blue eyes, however they will have brown eyes (phenotype)

Homozygous vs. Heterozygous

- Homozygous: purebred
  - Two of the same alleles for one trait
  - Will have two of same letters: BB or bb
- Heterozygous: hybrid
  - Two different alleles for one trait
  - Will have two different letters: Bb

Genotype	Phenotype
BB	Brown eyes
Bb	Brown eyes
bb	Blue eyes

If brown hair is dominant over blond, which genotype would be blond?

A) BB

B) Bb

C) bb

Which is an example of a phenotype?

A) Bb

B) Brown hair

Which genotype is heterozygous brown?

- A) BB
- B) Bb
- C) bb

Which genotype is homozygous recessive?

A) BB

B) Bb

C) bb

Probability

- The likelihood that an event will occur
- Probability = $\frac{\text{\# of one kind of possible outcome}}{\text{total \# of all possible outcomes}}$ = %

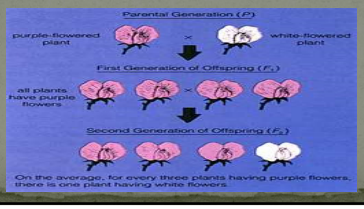
When the word or is used you add the odds
1/6 + 1/6 = 2/6

When the word and is used you multiply the odds
1/6 x 1/6 = 1/36

- What is the probability of rolling a 6 on a die?
  - 1/6
- What is the probability of rolling a 6 or a 5 on a dice cube?
  - 1/6 + 1/6 = 2/6
- What is the probability of rolling a 6 and a 5?
  - 1/6 x 1/6 = 1/36

Punnett Square

- Predicts all possible genotypes resulting from a cross
- Mendel's Generations:
  - P = parents
  - F1 = offspring (1st generation)
  - F2 = offspring of F1 (2nd generation)



6 Steps to Completing a Punnett Square Problem

1. Identify the dominant and recessive traits
2. Identify the phenotype of each parent
3. Identify the genotype of each parent
4. Fill in the Punnett Square
5. Write the phenotype ratio
6. Write the genotype ratio

Example: suppose you cross a plant that is heterozygous for purple flower with a plant that is homozygous recessive for white flowers

Step 1: identify the dominant and recessive traits

Purple is dominant (P)

White is recessive (p)

Step 2: identify the phenotype of each parent

Purple flower X white flower

Step 3: identify the genotype of each parent

Pp X pp

Example: suppose you cross a plant that is heterozygous for purple flower with a plant that is homozygous recessive for white flowers

Step 3: identify the genotype of each parent

Pp X pp

Step 4: fill in Punnett Square

	p	p
P	**Pp**	**Pp**
p	**pp**	**pp**

Example: suppose you cross a plant that is heterozygous for purple flower with a plant that is homozygous recessive for white flowers

	p	p
P	**Pp**	**Pp**
p	**pp**	**pp**

Step 5: Write the genotype ratio

50% Pp 50% pp

Step 6: Write the phenotype ratio

50% purple 50% white

Law of Segregation

- Organisms inherit 2 copies of each gene, one from each parent
- During gamete formation genes separate and only one version makes it into the gamete (egg or sperm)

Law of Independent Assortment

- allele pairs separate independently of each other during meiosis (gamete formation)
  - More likely to be separated:
    * if on different chromosomes
    * the further apart on a chromosome

Law of Dominance

- Traits have two alleles (one from the female and one from the male)
  - Some alleles are dominant (A) and some are recessive (a)

Genetics

Dihybrid Crosses

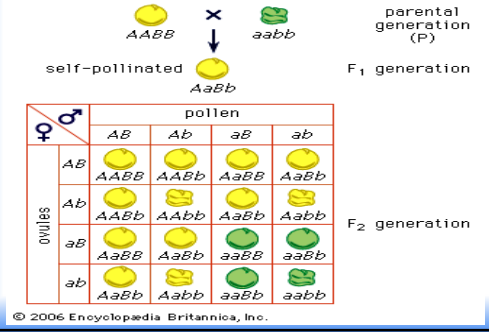
Mendel's Experiments

- Conducted experiments that examined the inheritance of 2 different traits:
  - Ex: flower color and pea shape
- Wondered if traits would be passed on together or separately
- Using purebred plants, he conducted many experiments using a variety of trait combinations
  - Ex: flower color and pea shape
  - pea shape and pod color

Mendel's Results

- The F1 generation of crossing 2 purebred plants would result in heterozygous plants:
  - The plants all expressed the dominant gene but carried the gene for the recessive trait *(how did he know that?)*
- When Mendel crossed the F1 generation which was heterozygous for both traits, he discovered that the F2 generation expressed all combinations of the 2 traits

Cross 2 purebred plants



Mendel's Conclusion

Law of Independent Assortment

- Allele pairs, one from mom and one from dad, separate independently of each other during meiosis.

Dihybrid Crosses are used to show how alleles independently sort

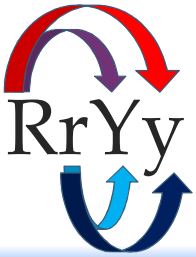
- Process (steps) are just like monohybrid crosses (single trait) with one extra step

Process for doing dihybrid problems

Step 1: Identify dominant and recessive traits
Step 2: Identify the phenotypes of each parent
Step 3: Identify the genotypes of each parent
Step 4: Determine possible allele combinations using FOIL method
Step 5: Complete Punnett Square
Step 6: Write out phenotypes and ratios
Step 7: Write out genotypes and ratios

Step 4: Use F.O.I.L. to identify all possible allele combinations:

RY, Ry, rY, ry



Use combinations to fill in Punnett Square: RY, Ry, rY, ry