

Chapter 12



Genetics Notes

Mendel and The Gene Idea



- Gregor Mendel was a monk who experimented with pea plants and was also a scientist
- He is known as the “Father of Genetics.”
- Genetics = the study of how traits are passed to offspring and the variation of inherited characteristics

Traits of the Pea Plants

- Plant height
- Flower position on stem
- Pod color
- Pod appearance
- Seed texture
- Seed color
- Flower color



Controlled Experiment



- Mendel took all the stamen off one plant and then moved the pollen himself from one plant to the other
- Self-pollination = allowing plants to mate without interference
- Cross-pollination = manually moving the pollen from one plant to the next

Experiment



- Mating of 2 true-breeding varieties – self pollination
P generation (parental) – cross pollination



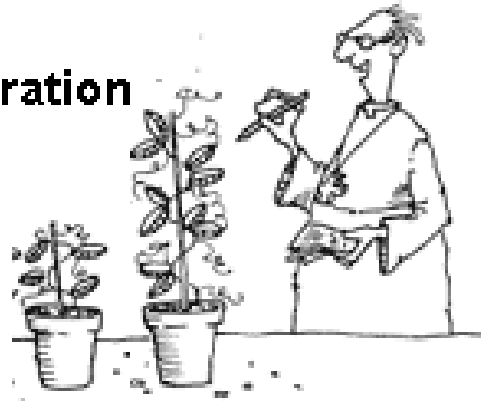
F₁ generation (1st filial) – self pollination
Results: 100% dominant trait (100% purple flowers)



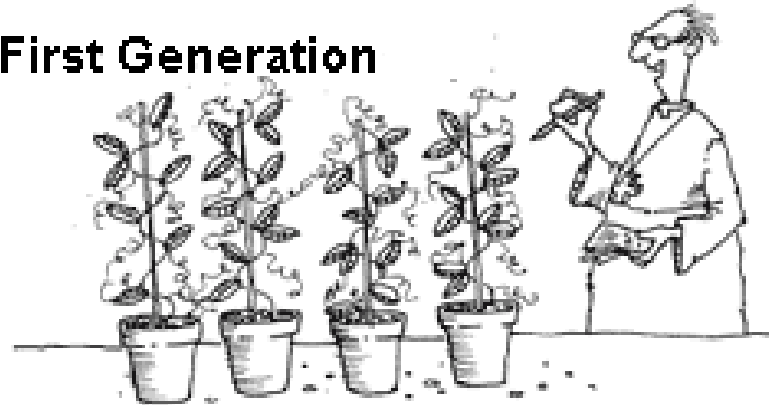
F₂ generation (2nd filial)
Results: 75% dominant and 25% recessive (3:1)

Visualizing Mendel's Experiments

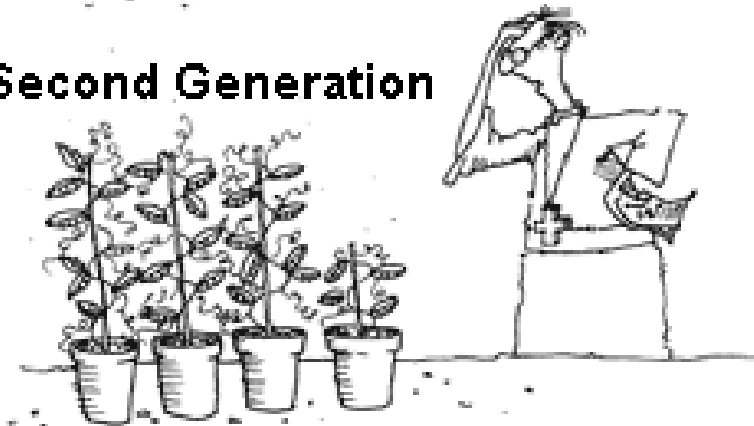
Parent Generation



First Generation



Second Generation



Review Question



- Mendel carefully removed the anther from one flower and placed the pollen on the pistil of another flower. What is this type of pollination called?
 - A. Self-pollination
 - B. Cross-pollination
 - C. True-pollination

Some Useful Genetic Vocabulary

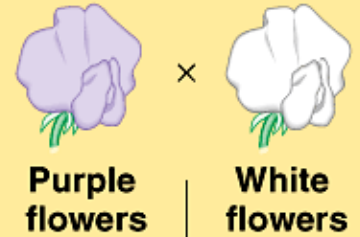


- *Dominant* – masks or dominates another factor (trait)
- *Recessive* – gets masked or dominated by another factor (trait)
- Mendel called the different varieties of traits factors
- Scientist now refer to them as alleles

Alleles – different versions of a gene

- accounts for variations in inherited characters

P Generation
(true-breeding parents)

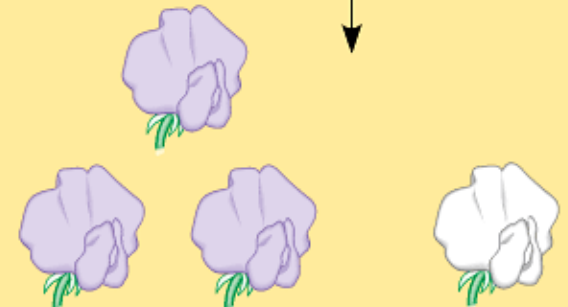


F₁ Generation
(hybrids)



All plants had purple flowers

F₂ Generation
Ratio 3:1



Some Useful Genetic Vocabulary



- *Homozygous* – an organism having a pair of identical alleles for a gene (PP or pp)
- *Heterozygous* – an organism having two different alleles for a gene (Pp)
- *Phenotype* – an organism's traits or physical appearance (purple or white flowers)
- *Genotype* – an organism's genetic makeup (PP, pp, or Pp)

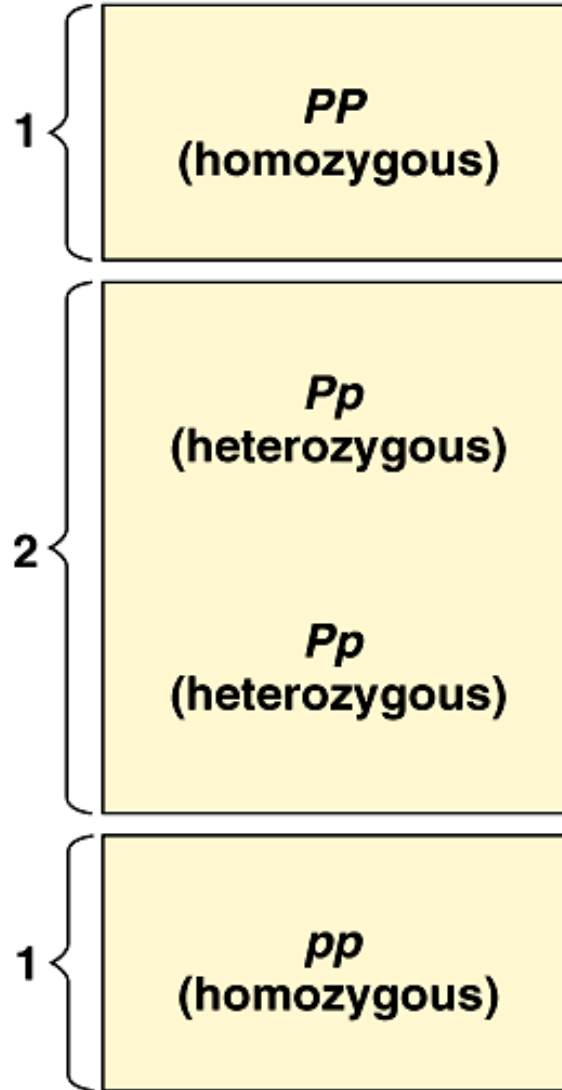
Mendel's Conclusion



- Something within the plant controlled the characteristics
- Determined that “factors” were inherited from the parents
- Mendel knew that the white trait did not disappear in the F_1 generation
- Now know there are dominant and recessive traits

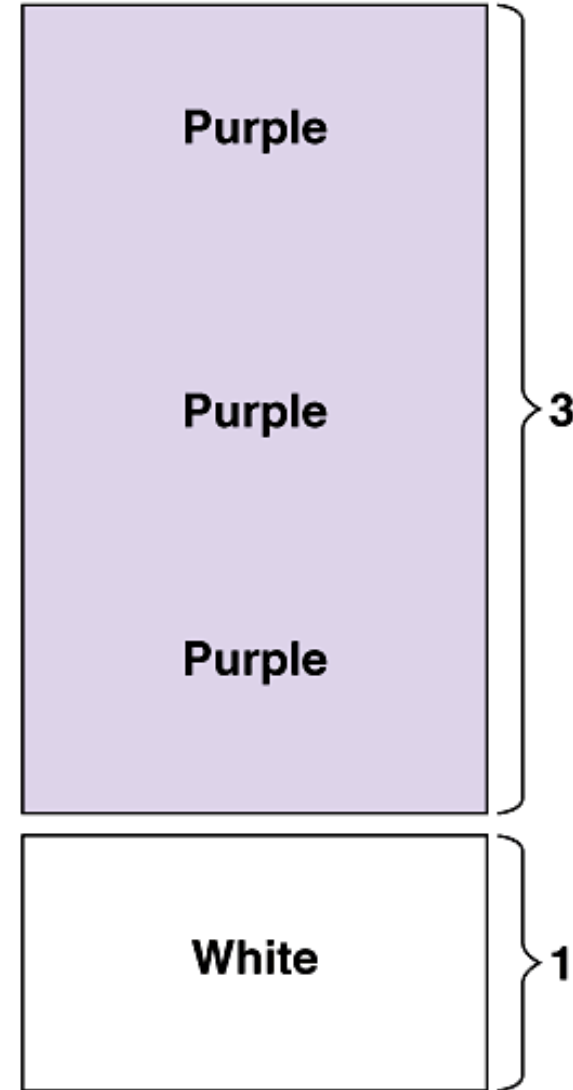
Genotype vs. Phenotype

Genotype



Ratio 1:2:1

Phenotype



Ratio 3:1

Review Question



- What is the term that describes an organisms combination of genetic material?
 - A. Dominant
 - B. Recessive
 - C. Genotype
 - D. Phenotype

Review Question

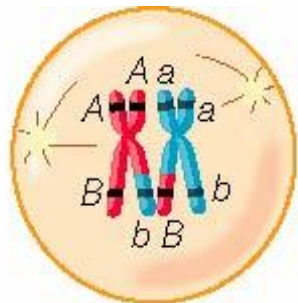
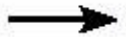
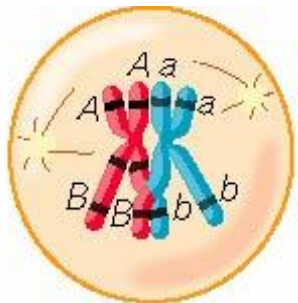
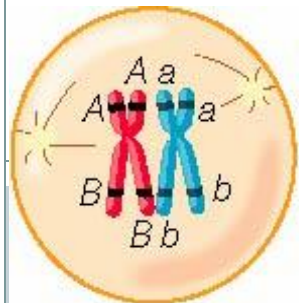


- What term is used to describe the allele that is not expressed when another allele is present?
 - A. Dominant
 - B. Recessive
 - C. Genotype
 - D. Phenotype

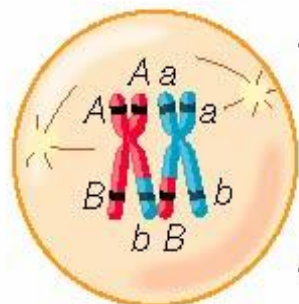
Law of Segregation



- States: During the formation of either the egg and sperm cell (Meiosis), the two alleles for a character (trait) separate
- When the sperm and egg cell come together, an organism will inherit the two alleles - one from each parent

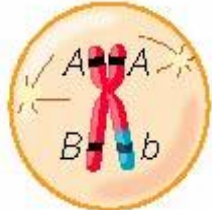


(a) Crossing over

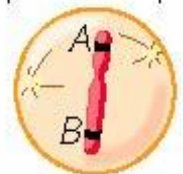


First meiotic division

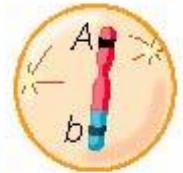
Second meiotic division



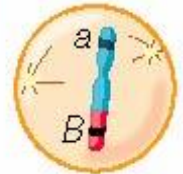
Four possible gametes



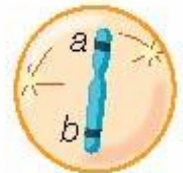
Parental genotype



Recombinant genotype



Recombinant genotype



Parental genotype

Law of Independent Assortment



- States: Each pair of alleles during gamete formation line up independently of each other
- In pea plants, flower color is independent of seed color, is independent of seed-shape, etc.
- *Monohybrid* – cross involving one trait
- *Dihybrid* – cross involving two traits

Probability



- Probability = # of times an event is expected to happen / # of opportunities for an event to happen (total)
- Ex: Coin Flip
 - Probability of getting heads = 1 time expected / 2 opportunities
 - Heads = .5 or 50% chance

Punnett Square



- Punnett Square = chart used to predict the probability that certain traits will be inherited in the offspring
- Parent alleles located in egg or sperm cells are placed along the side and top of the square

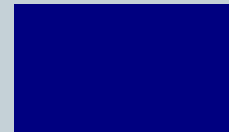
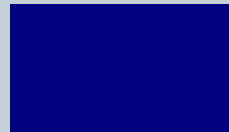
Cross: Homozygous Dominant X Homozygous Recessive



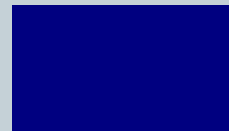
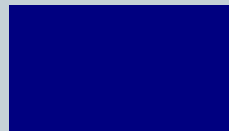
b

b

B



B



Answers:



Other Types of Dominance



- Complete dominance
- Incomplete dominance
- Co-dominance
- Multiple Alleles
- Sex-linked genes
- Polygenic inheritance

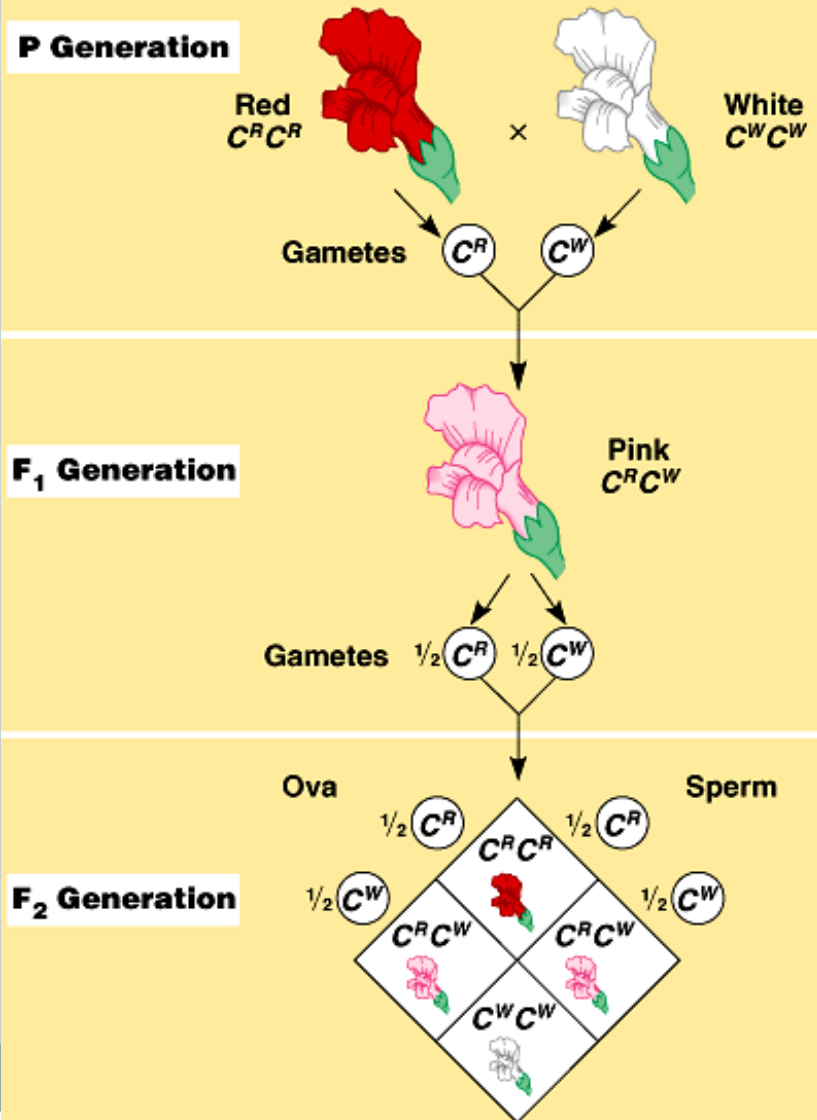
Complete Dominance



- One allele hides the expression of another allele

Incomplete Dominance

- The F_1 hybrids have an appearance somewhere in between the phenotypes of the two parental varieties (blending of traits)
- Example: Snapdragons, 4 o'clock flowers





Co-dominance



- Both alleles for a gene are expressed in the offspring
- Ex: strips on a zebra or spots on a leopard
- Ex: Blue Roan Horse
 - Horse has a mixture of black and white hair, giving the horse a bluish appearance, rather than a gray color.



Multiple Alleles



- Genes that exist in populations in more than two allelic forms
- ABO blood groups in humans
 - Blood types can be A, B, AB, or O
 - The letters refer to two carbohydrates that are found on the surface of red blood cells
 - Blood cells may have one substance or the other (type A or B), both (type AB), or none (type O)

Blood Types



- Type A phenotype = AA or AO genotype
- Type B phenotype = BB or BO genotype
- Type AB phenotype = AB genotype
- Type O phenotype = OO genotype

Blood Type Problem



- Find the genotypic and phenotypic ratios for each of the crosses

Cross AA and AB: G = 2:2 AA:AB P = 2:2 A:AB

Cross AO and BO: G = 1:1:1:1 P = 1:1:1:1

Cross BB and AO: G = 2:2 AB:BO P = 2:2 AB:B

Cross OO and AB: G = 2:2 AO:BO P = 2:2 A:B

Sex-linked or Linked Genes



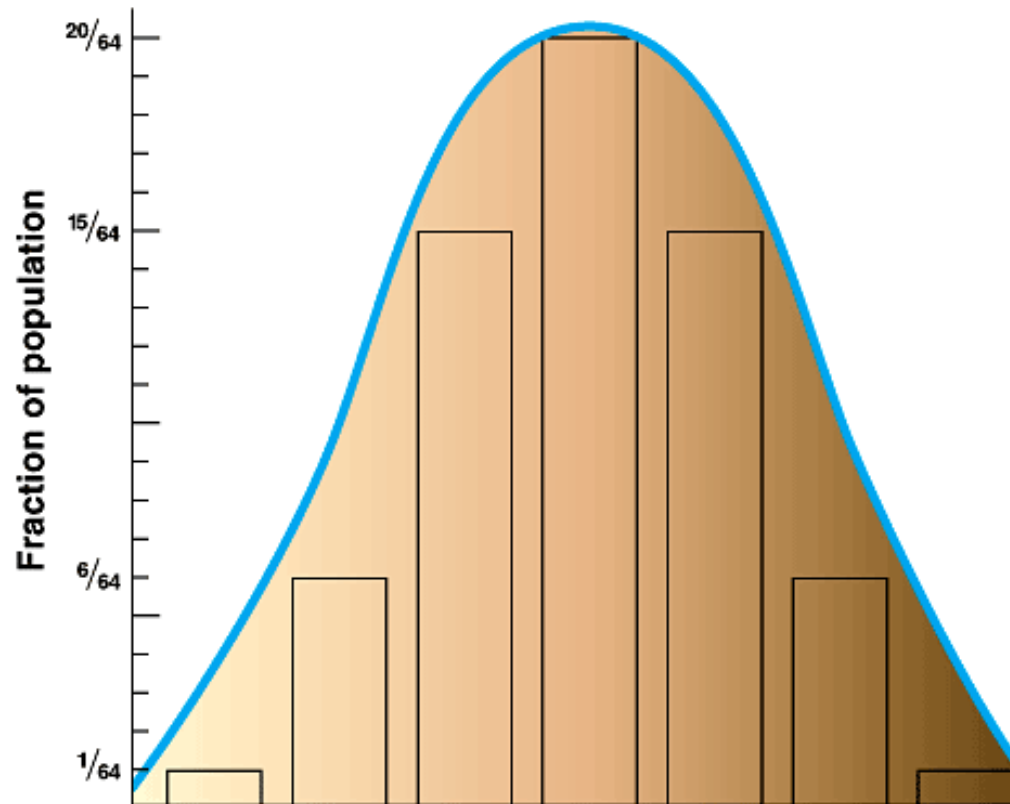
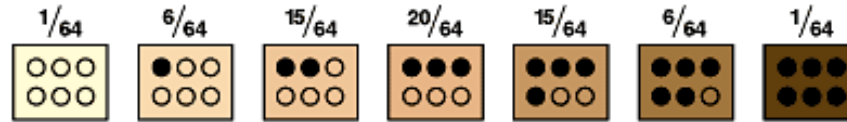
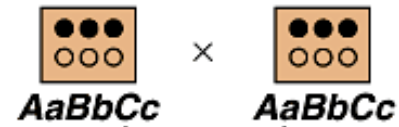
- Sex-linked = genes on the X or Y chromosome
 - Ex: colorblindness, male patterned baldness, hemophilia
- Linked genes = genes are so close together on a chromosome that will cross over together during Meiosis

Polygenic Inheritance



- Two or more genes influence the expression of a single phenotypic character.
- Varies in a population along a continuum.
- Ex: eye color, human skin color and height
 - Human skin color has at least 3 separately inherited genes

Polygenic Inheritance

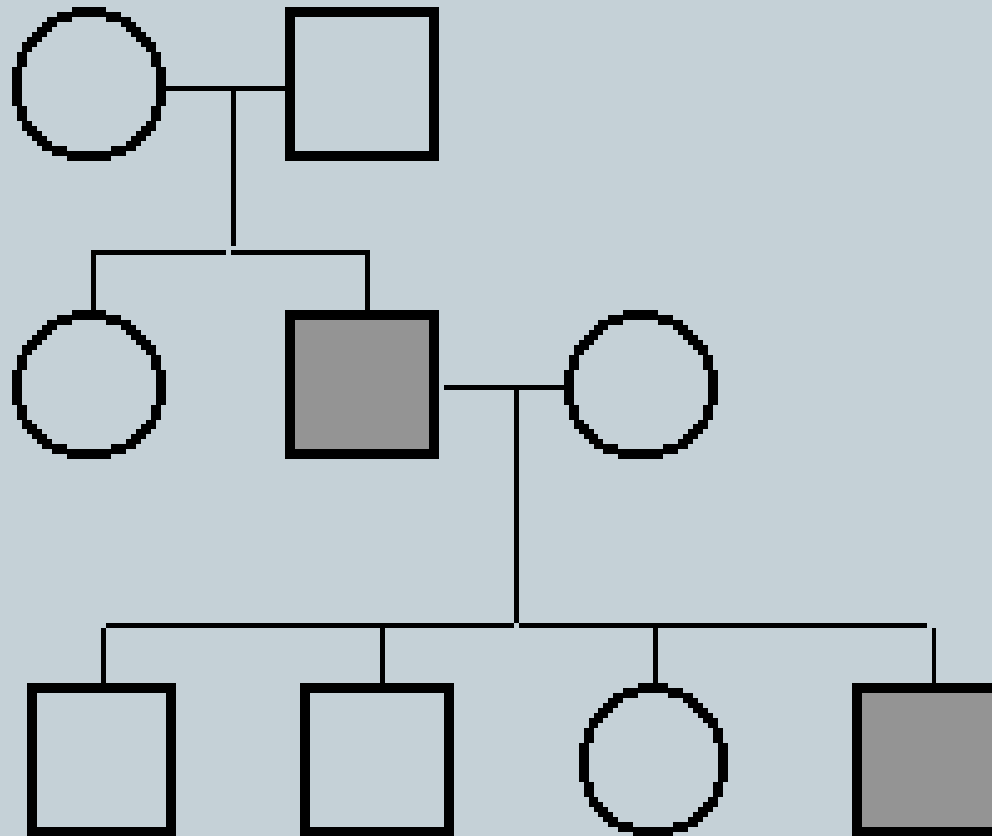


Pedigree Analysis

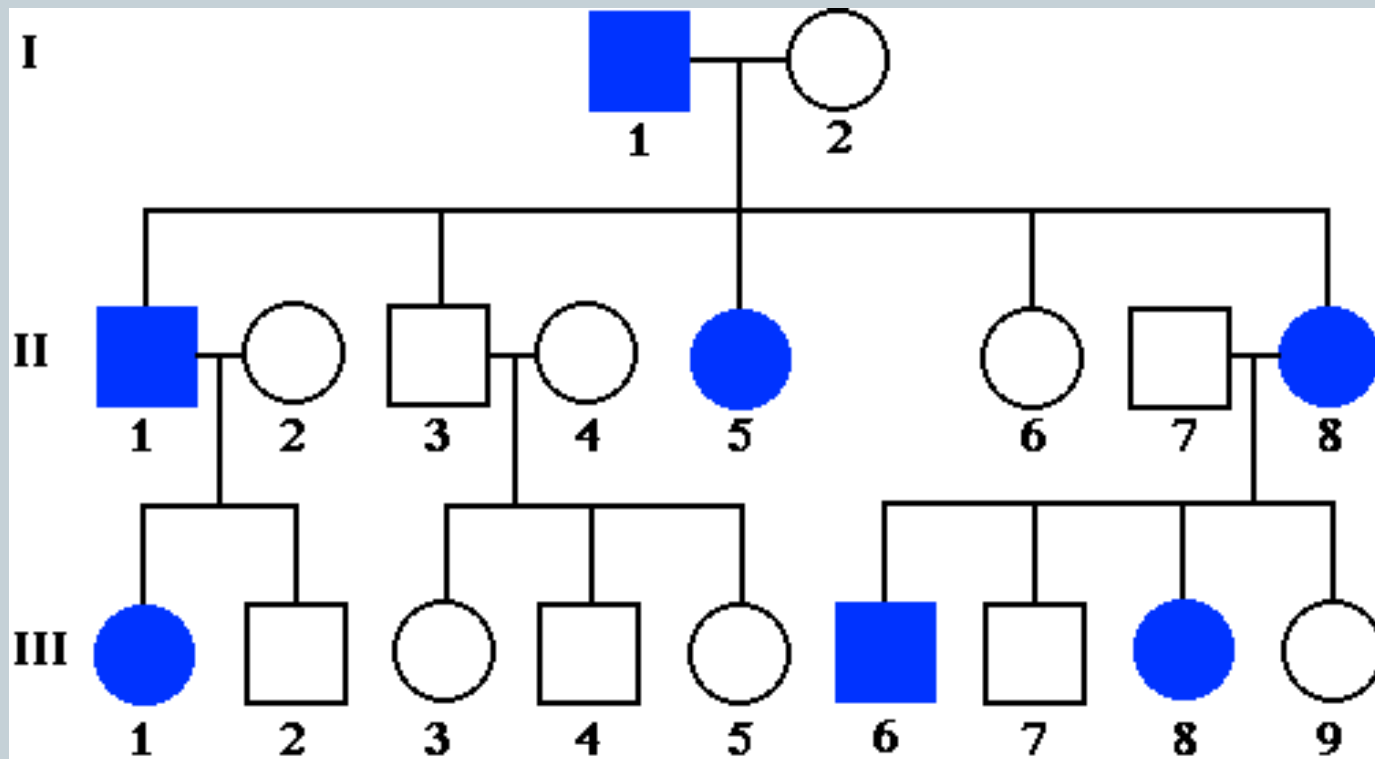


- A family history that shows how a trait is inherited over several generations
 - Circle = female
 - Square = male
 - Shaded = has the trait

Pedigree Analysis



Pedigree Analysis



Pedigree 1. An idealized pedigree of a family with hypercholesterolemia, an autosomal dominant disease where the heterozygote has a reduced number of functional low density lipoprotein receptors.

Genetic Disorders



- Sickle cell anemia
 - Autosomal recessive
 - Poor blood circulation and decreased ability of your blood to hold oxygen

- Cystic fibrosis
 - Autosomal recessive
 - Mucus buildup in the lungs making breathing difficult; short lifespan

Genetic Disorders



- Hemophilia
 - Sex-linked recessive
 - Failure of blood to clot

- Huntington disease
 - Autosomal dominant
 - Gradual deterioration of the brain