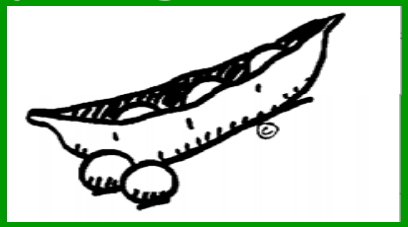
MENDEL AND MEIOSIS

Gregor Mendel – father of heredity

MENDEL'S LAWS OF HEREDITY

- Heredity – branch of genetics dealing with the passing on of traits from parents to offspring
- Pea Plants
  - Easy maintenance & large #s of offspring
  - Allele – genetic factor that controls the expression of a gene
    - Ex. Green & Yellow are the 2 alleles in pea plants that code for seed color
    - More than one allele can control a trait
    - Mendelian Inheritance – inheriting traits that are controlled by one pair of alleles



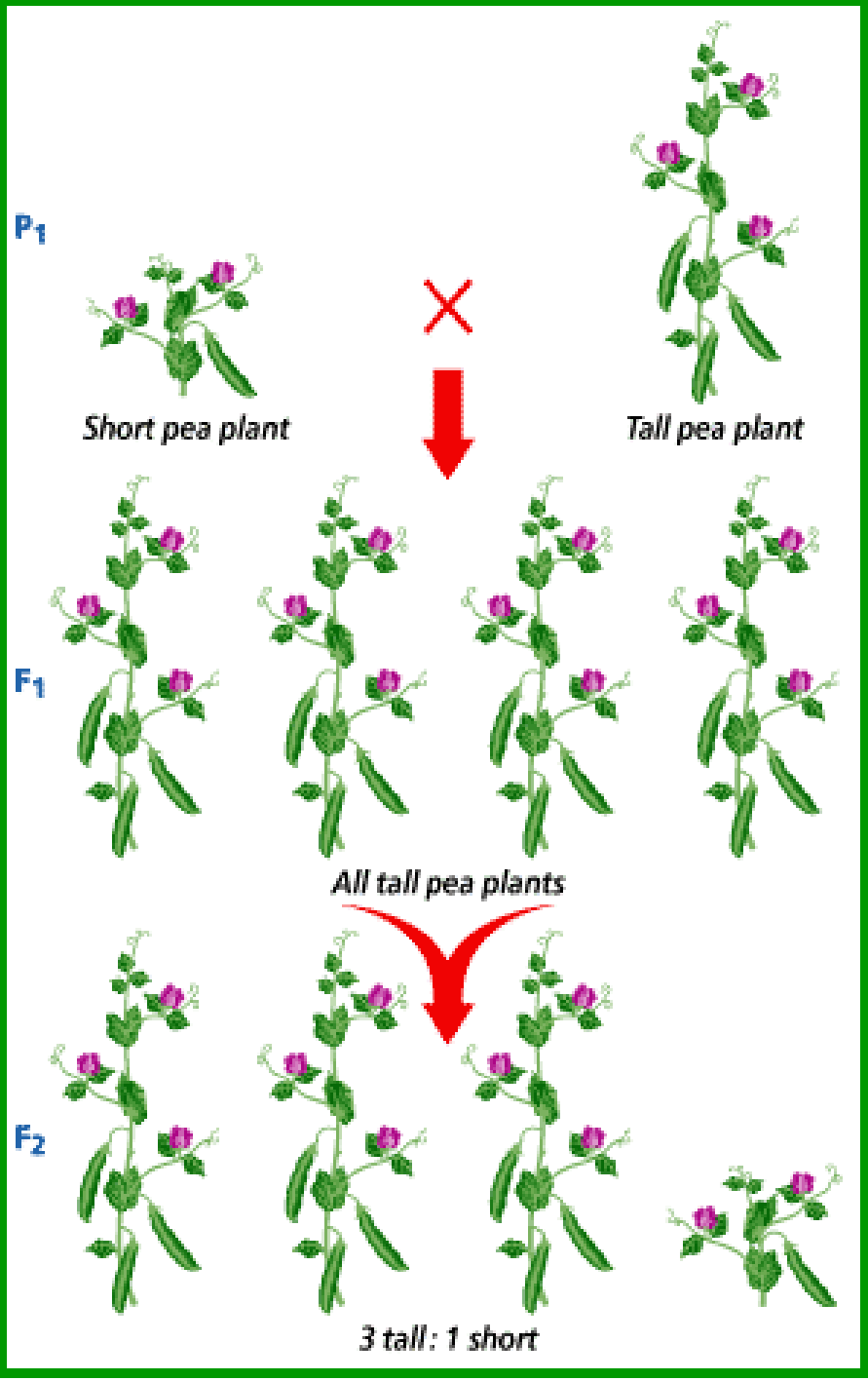
LAWS OF DOMINANCE & SEGREGATION

- History/Method of determining the laws
  - Mendel chose plants that were similar to the parents in all of the generations/offspring
    - Gametes – sex cells i.e. sperm & egg
    - Inbreeding – fertilization of gametes that are from the same parent or closely related parents
      - Results in a "pure line" of traits i.e. dog breeds
    - Outbreeding – fertilization of gametes by unrelated parents
      - Results in variety ex: Tall pea plants with short pea plants

GENERATIONS

- F1 Generation
  - 1ST set of offspring that come from 2 non-related parents (short plant & tall plant)
  - Only 1 of the traits was noticed in the F1 offspring
    - Ex. Tall X Short always gave Tall offspring
- F2 Generation
  - Bred members of F1 together (inbreeding)
  - The trait that was hidden in the F1, showed up sometimes in the F2

MENDEL'S PEA PLANTS



LAWS

- Law of Dominance
  - Dominant Trait - the observable trait in the F1 generation. Represented by a capital letter (T=tall)
  - Recessive Trait – the trait that's hidden in the F1 generation, but reappears in the F2. Represented by a lowercase letter (t = short)
- Law of Segregation
  - Each trait is controlled by a pair of factors (alleles) that separate during gamete formation & randomly unite during fertilization

THE PRINCESS & THE WRINKLED PEA

BLANK CROSSES

http://biologica.concord.org/webtest1/web_labs_mendels_peas.htm

ALLELES & GENOTYPE

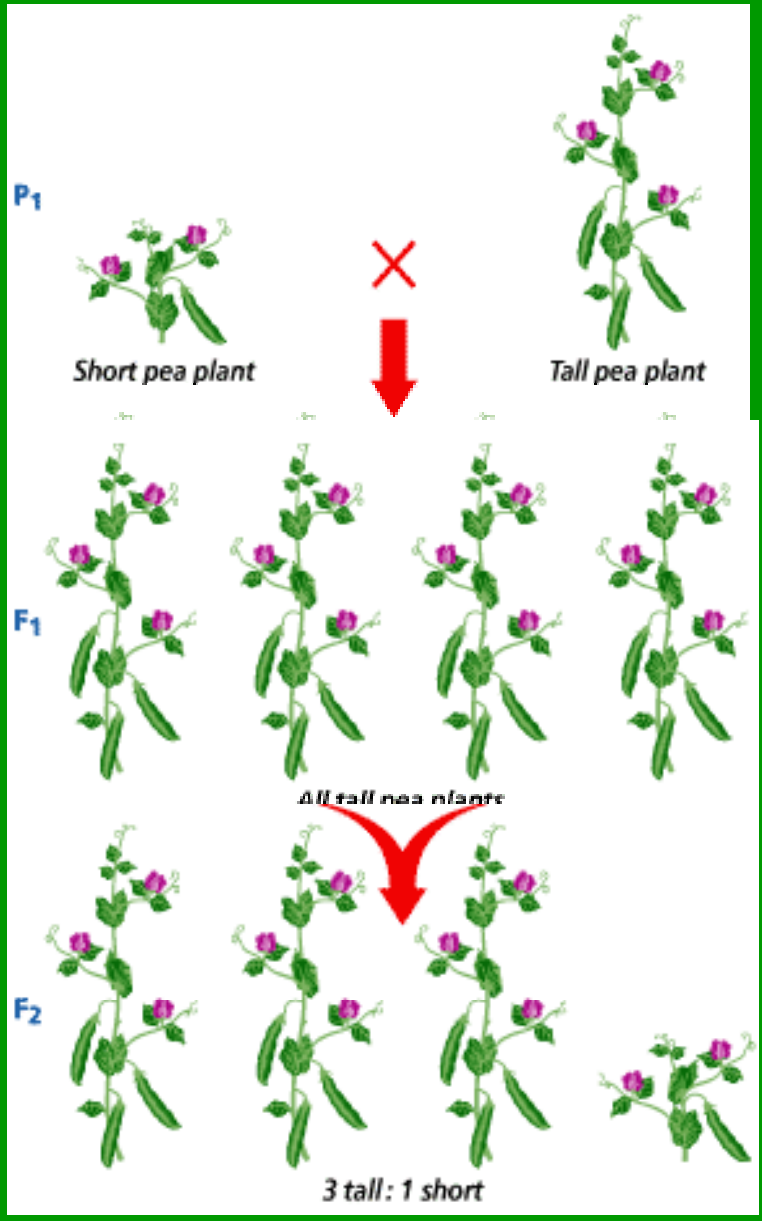
- Haploid = possessing ½ of the total number of chromosomes
- Diploid = possessing all of the total number of chromosomes
  - Humans have 46 chromosomes…
    what is the human haploid number?
    What is the human diploid number?
- Zygote = single diploid (2N) cell that is formed when 2 gametes fuse during fertilization
- Genotype = the genetic makeup or combination of alleles of the offspring
- Phenotype = the physical appearance of the allele of the offspring
  - Different combinations of alleles cause different phenotypes
- Homozygous = both alleles on the chromosome for a certain trait are the same
- Heterozygous = the alleles on the chromosome for a certain trait are different (dominant allele is shown)

CROSSES (punnet squares)

- Monohybrid
  - Experiment where 2 parents differ by only 1 trait
  - Mendel tested these traits in Pea Plants:
    - 1. seed shape = ROUND or wrinkled
    - 2. seed color = YELLOW or green
    - 3. flower color = PURPLE or white
    - 4. flower position = AXIAL (side) or terminal (tip)
    - 5. pod color = GREEN or yellow
    - 6. pod shape = INFLATED or constricted
    - 7. height = TALL or short
  - All of the plants Mendel started with were true-breeding (pure bred) for these characteristics

What were Mendel's results?

- F1 Generation
  - All tall
  - 4 tall: 0 short
  - 4:0 ratio of tall to short
- F2 Generation
  - ¾ tall to ¼ short
  - 3 tall: 1 short
  - 3:1 ratio of tall to short



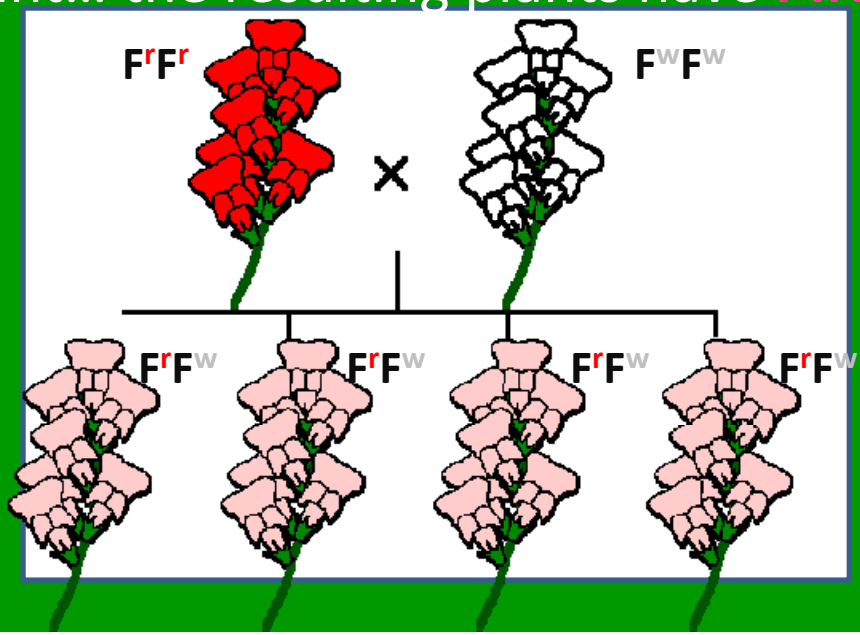
- Parent A is heterozygous for seed color (use the letter G), Parent B is homozygous recessive for seed color. Determine the monohybrid cross and phenotype ratios for these two parents.

DIFFERENT TYPES OF INHERITANCE

- All traits do not follow simple Mendelian Inheritance
  - In some organisms, there are traits in which the phenotypes are different from EITHER parent
  - In other cases, more than one allele is responsible for the inheritance of traits
  - Some traits can also be controlled by a single allele!

INCOMPLETE DOMINANCE

- Incomplete dominance occurs when 2 alleles produce three phenotypes
  - Ex. Flower color in some plants
    - If you cross a **red**-flowered plant with a **white**-flowered plant… the resulting plants have **PINK FLOWERS**!



CODOMINANCE

- When 2 alleles are expressed equally in the offspring
  - Ex. Certain varieties of chickens
    - If you cross a **red** flower with a **white** flower, the resulting offspring have both **red** & white **petals** (checkered appearance)

MULTIPLE ALLELES

- Some traits are controlled by more than one pair of alleles
  - Ex. Fur color in rabbits and human blood types
    - Multiple alleles can only be studied in populations since one individual will not be able to show all possible appearances
    - There are 3 alleles for blood type in humans, but each person will only have 2 alleles for the gene… which gives the 4 different blood types

BLOOD TYPES

TYPE (phenotype)	ALLELE	PATTERN
Type A	I^AI^A or I^Ai	Simple/Mendelian
Type B	I^BI^B or I^Bi	Simple/Mendelian
Type O	ii	Simple/Mendelian
Type AB	I^AI^B	CoDominance

What's common?

Information from www.redcrossblood.org

	Caucasian	African American	Hispanic	Asian
O +	37%	47%	53%	39%
O -	8%	4%	4%	1%
A +	33%	24%	29%	27%
A -	7%	2%	2%	0.5%
B +	9%	18%	9%	25%
B -	2%	1%	1%	0.4%
AB +	3%	4%	2%	7%
AB -	1%	0.3%	0.2%	0.1%

SEX-LINKED INHERITANCE

- Autosomes = in humans, 22 matching pairs of chromosomes
- Sex chromosomes = 23RD pair of chromosomes differ in male & female
- Sex chromosomes determine the sex/gender
  - Female = XX
  - Male = XY

- sex-linked genes = genes located on the sex chromosome that don't determine gender
- Traits controlled by sex-linked genes are usually associated with 1 particular sex & are inherited with sex chromosomes
  - Ex. Eye color in fruit flies, hemophilia (human blood-clotting disorder), red-green colorblindness
    - Hemophilia & RG are carried on the X-chromosome & are recessive
    - Both men & women can have the disease, but men have a greater chance than women because they only have 1 X-chromosome

POLYGENIC INHERITANCE

- The inheritance of a trait that is controlled by 2 or more genes
  - Ex. Hand width, skin color,
  - ENVIRONMENTAL INFLUENCES
    - The genetic makeup only determines potential for dev.
    - Actual growth & development is influenced by environmental factors, too

ENVIRONMENTAL FACTORS

- Internal Environment
  - Affected by factors such as age & hormones
    - Ex. Male & female birds differ greatly in their plumage
    - Ex. Horns on rams are much heavier than ewes
- External Environment
  - Temperature, nutrition, light, chemical, and infectious agents can all affect gene expression
    - Coat color in rabbits can be affected by temp.
    - Leaf size can be affected by light