

BIOLOGY NOTES

Genetics #1: Meiosis and Mendel

For additional support and information, read and reference Chapter 6 in your Interactive Reader or Chapter 12 in your Biology "Bee" Book.

• Section 1 – Chromosomes and Meiosis

○ Somatic Cells vs Germ cells

- Somatic = Are known as Body Cells.
 - They make up your body tissue & organs.
- Germ = Will become our Gametes.
 - Gametes are our sex cells.
 - They are found in
 - Female = Egg
 - Male = Sperm
 - The DNA in these cells

▪ Chromosome = A long continuous thread of DNA

- Each species has a characteristic number.
- Humans = 46 Chromosomes... 23 pair.
- Each pair = Homologous pair – b/c

They code for the same "type" of characteristics, but each one will contain info given from each parent.

- One comes from the mom and one from the dad.
- Similar shape & appearance.
- Code for the same type of traits

"Homo" = Means same

• Autosomes vs Sex Chromosomes

- Autosomes = Chromosome pairs # 1-22.
- Sex Chromosomes = 23rd pair of chromosomes. They control the development of sexual characteristics.

▪ X and Y

- X and Y are not Homologous
- When pairing
 - XX = Female
 - XY = Male

Sexual Reproduction
Provides genetic
Variation.

○ The Female can only donate an X

○ The Male can donate an X or a Y

○ Therefore, it is the male who is responsible for the gender of a child.

Sexual Reproduction

• Involves the fusion of two gametes that results in offspring.

← • Offspring are a mixture of BOTH parents.

○ They fuse and become one cell = Fertilization

Diploid vs Haploid

• Body cells = Have 46 chromosomes (in Humans).

○ These cells are diploid = Full set of chromosomes.

○ One from the mother and one from the father

○ Diploid cells are represented by $2n$.

▪ Diploid $2n$... (n) = # of chromosome.

▪ Di = 2 of each type of chromosome.

• Gametes = Our sex cells are Haploid.

○ Contains only a half set of chromosomes.
In humans = 23 chromosomes.

○ Represented by : (n)

▪ In humans = 22 autosomes + 1 sex chromosome

▪ $n = 23$

Section 1 Review Questions:

• Identify:

Which cell type makes up the brain? _____

• Summarize:

Are homologous chromosomes identical to each other? Explain

• Apply:

Why is it important that gametes are haploid cells?

Section 2:

○ Meiosis: Nuclear division

- 1 Diploid "Germ Cell" will become 4 Haploid Cells.
- Has two major parts:
 - Meiosis I
 - Meiosis II
- Each of these contains 4 steps:
- That means from start to finish there are 8 total steps.
 - Read and Study the Image on page 94 of your Interactive Reader.

▪ Homologous Chromosomes:

They are two separate chromosomes... one from your mom + one from your dad.

- Very similar in size and appearance.
- Carries the same genes on each.
 - One will have mom's info.
 - The other will have dad's info.

* They are divided by Meiosis I. *

▪ Chromatid:

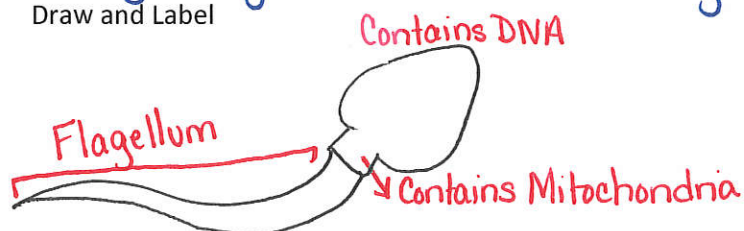
- Each half of a duplicated chromosome is called a = Chromatid
- Sister Chromatids = Refers to the duplicated chromosomes that remain attached by the centromere.

* Not divided until Meiosis II *

▪ Gametogenesis: The production of functional gametes.

- Sperm
 - Smaller than an egg.
 - Only gives DNA to the egg.
 - Movement = Flagellum
 - After gametogenesis = 4 functional male gametes.

Draw and Label



- Egg
 - Contains DNA, Organelles, + other molecular building blocks.
 - After gametogenesis = Only 1 egg is formed.
 - Polar Bodies
 - These are the other cells produced by meiosis in females. They do not become an egg.
 - They only contain a little DNA + are eventually absorbed by the body. = They serve no purpose.
- Instead of producing 4 gametes from one Germ Cell..... Females only produce 1 functional Egg (gamete) and some other cells called Polar Bodies
- The 1 Egg that is formed does NOT contain polar bodies.

Section 2 Review Questions:

- Contrast:

What is the major difference between metaphase I and metaphase II?

Metaphase I = Lines up Homologous Chromosomes.

Metaphase II = Lines up Sister Chromatids.

- Infer:

Explain why Mendel's choice of either-or characteristics aided his research?

The results had to be "this" or "that"... there was no mixing or diluting of the traits

Dops....
This question goes w/ section 3+4.

Section 3:

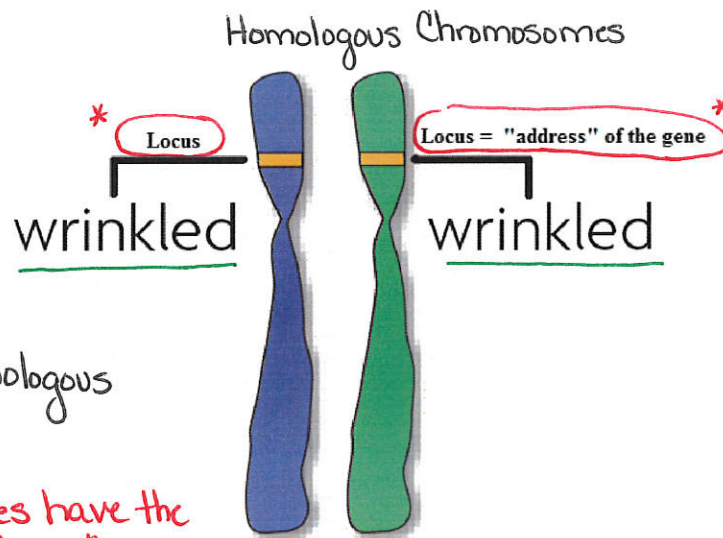
- **Traits:** Distinguishing characteristics that are inherited or passed from one generation to the next.
 - Examples: Eye Color, Leaf Shape, Tail Length
- **Genetics:**
The study of biological inheritance patterns + variation in organisms.
 - Father of Genetics: Gregor Mendel
 - He worked with pea plants because they reproduce quickly and he could control how they mate.
 - Each plant contains both male and female reproductive organs.
 - This means that in nature, the peas would typically self-pollinate. (plant mates with itself).
 - Over time when organisms self-pollinate they can develop a purebred species.
 - Purebred = Gene line that has become genetically uniform.
 - **Mendel's Three Key Choices:**
 - Control over breeding.
 - Use of purebred plants.
 - Studied "either-or" traits that appeared in only two alternate forms. } * Tall or Short
* Purple or White
* Round or Wrinkled Seeds
- **Cross =** In genetics, the mating of two organisms is called a "cross".
 - * ▪ Mendel demonstrated that traits are inherited as discrete units.
 - They are not blended or diluted.
- **Law of Segregation = Mendel's 1st Law**
 - Organisms **inherit** two copies of each gene, one from each parent.
 - Organisms **donate** only one copy of each gene in their gametes. Thus the two copies of each gene **segregate, or separate**, during gamete formation.

Section 4 - Traits, Genes and Alleles

- **Gene:**

- A piece of DNA that provides a set of instructions to make a certain protein.
- Discrete units of heredity.
- Most exist in many forms.
- Each gene has a specific position or Locus on a pair of homologous chromosomes.

* The locus is telling where pea-shape can be found on the Homologous chromosome



Both chromosomes have the "wrinkled" pea shape.

- **Allele:**

Any of the alternative forms of a gene that may occur at a specific locus.

- Your cells have two alleles for each gene because..... You get one allele from mom & one from dad.

- **Dominant:** allele is the allele that is expressed

- If you inherit this allele it will show up.
- Example: T in the Tall pea plants.

- **Recessive:** The allele that is expressed Only when two recessive alleles are inherited.

- Example

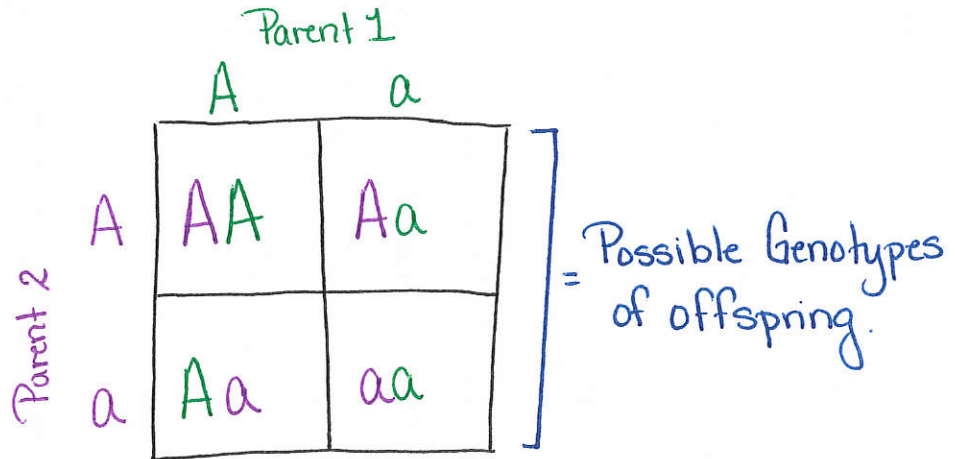
Short (t) = tt

- If the alleles are different we call them: **Heterozygous**
 - (Hetero) = different
 - Example : **Tt**
- If the alleles for the trait are the same we call them: **Homozygous TT**
- However, there are two ways that alleles can be homozygous:
 - **Homozygous Dominant = TT**
 - or
 - **Homozygous Recessive = tt**
- **Genome:** All of an organism's genetic material
- **Genotype:** Refers to the actual genetic makeup of a specific set of genes.
 Example = The Genotype for a short pea plant = **tt**
- **Phenotype:** The actual physical expression of a trait.
 Example : The Phenotype of a short pea plant = Short.
- If it is a trait that can be seen, then the phenotype is what you see!

Section 5– Traits and Probability

- **Punnett Square:**

- Grid system for predicting all possible genotypes resulting from a cross
- Remember that a cross is defined as: Mating of two organisms.
- Visual Vocab: Draw and Label the Punnett Square that is on page 183.



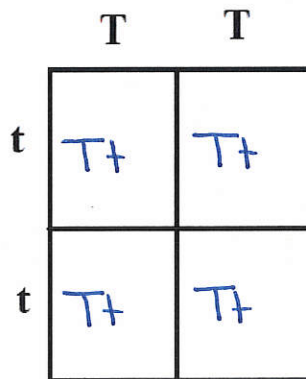
- **Monohybrid Crosses:**

- A cross that examines the inheritance of only ONE specific trait.
- Sample Problem: Let's Cross a Purebred Tall Plant with Purebred Short plant. To help you out on this problem, think back to what the term "Purebred" tells us.

* Purebreds are genetically uniform.

Purebred Tall = TT

Purebred short = tt



- How many of the offspring will be Homozygous dominant? None
- What is the phenotype of all of the offspring? Tall

- Use the following information and set up and work out the Punnett Square.

- In Mendel's Pea plants

- Purple flowers are dominant. (F)
- White flowers are recessive. (f)
- What would the outcome be if you crossed 2 plants that were both heterozygous for flower color?

	F	f
F	1. FF	2. Ff
f	3. Ff	4. ff

This means the alleles must be different.
 Parent #1 = Ff
 Parent #2 = Ff

* What is the chance of having offspring with Purple Flowers = 3 out of 4
 or 75%

* What would be the phenotype of the offspring in box 4? White

- Testcross:

A cross between an organism with an unknown genotype + an organism with the recessive phenotype.

(STOP) = Genetics #1 Test Stops Here...

- Dihybrid Crosses:

A cross that examines the inheritance of TWO different traits.

- Example = See colored handouts that have 16 boxes.

- Law of Independent Assortment:

States that allele pairs separate independently of each other during gamete formation (meiosis).

- Probability

$$\frac{\text{Number of ways a specific event can occur}}{\text{Number of total possible outcomes}}$$

Just because something CAN occur, doesn't mean it will.

Example = Flip a Quarter

We will have a quiz on this info.