



Mendel

Main Ideas:

- Genes are units of information that are inherited from parent to offspring.
- Offspring get half their genes from each parent - 23 chromosomes from mom and 23 chromosomes from dad. This unique combination of genes is what makes each person different.
- Mendel discovered the basic rules of inheritance - that traits are controlled by PAIRS of factors (alleles); and that dominant alleles can hide recessive alleles.
- Punnett Squares are a way to show all the possible outcomes of a genetic cross and determine the probability that an offspring will have a phenotype & genotype.
- Pedigrees are used to track inherited traits through several generations of a family and can be used to understand genetic diseases.

Check the textbook for more information:

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|--------------------------------|-----------|
| Chapter 14: Genetics | p.510-559 |
| Chapter 15: Modern Genetics | p.564-587 |



Genetics & Heredity Unit Review



Cells & Microscopes

A microscope is a tool with 1 or more lenses which magnifies an object and makes it appear larger.

Total magnification = Eyepiece Lens x Objective Lens



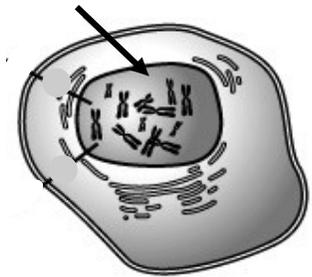
It allows us to see objects that are much too small to see with the unaided eye. The invention of the microscope was important for science because it allowed

scientists to discover **CELLS** - the smallest unit of life.

Basic microscope rules:

- always carry with 2 hands
- Begin viewing with the low power objective (shortest).
- Start focusing using the coarse adjustment knob (big one), then use the fine adjustment knob to sharpen the focus.
- DON'T use the coarse adjustment knob with the high power objective (longest lens). You can crack the lens & slide!

All living things are made of cells. In the center of a cell is a **NUCLEUS**, which is im-



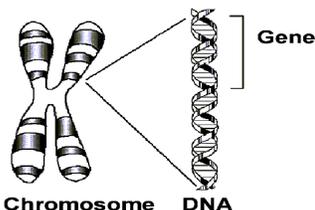
Cell

portant because it is the "brain" or control center of the cell. It directs everything the cell does and contains

DNA, Chromosomes, and Genes

All genetic material is found inside the nucleus of a cell. Your **GENES** are recipes for making proteins — and since you are made of proteins — your genes are the recipe for making you!

Each human cell has **23 pairs of chromosomes** (46 in all!).



Chromosomes—are made of tightly wound up DNA.

Genes—are recipes for proteins and are made of long sections of DNA located on a specific part of a chromosome.

DNA - is your genetic code.

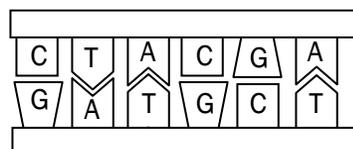
DNA - is short for the chemical name: *Deoxyribonucleic Acid*.

DNA is shaped like a twisted ladder called a *double helix*. It has 2 long strands (sugar-phosphate backbone) that are connected by millions of base pairs. These are combinations of 4 different chemicals (nitrogen bases). The nitrogen bases pair in a certain way:

Cytosine pairs with **Guanine**
Adenine pairs with **Thymine**

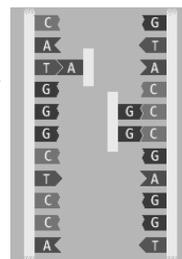
The **ORDER** of these base pairs is the recipe for making proteins and is your genetic code.

Everyone's genetic code is unique & different. Each person gets different combinations of genes from both parents.



DNA replication - is how

DNA creates a copy of itself. It unzips into 2 single strands. Those strands are used as templates to create 2 new copies.



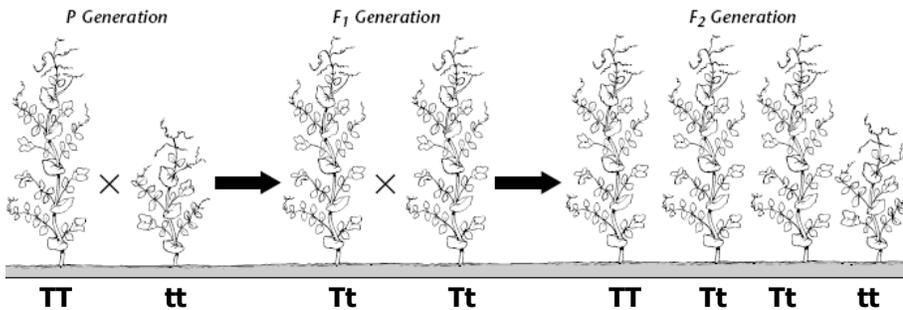
Protein Synthesis - is how DNA makes protein. A copy of DNA called **mRNA** is made in the nucleus. It then travels out in the cell to a **ribosome** where proteins are made by joining together long chains of amino acids.

Mutations - are mistakes that sometimes happen when DNA is copied. Mutations can happen if a section of DNA is *deleted, added or substituted*. Mutations can be **HARMFUL**, **HELFPUL** or they may make **NO DIFFERENCE AT ALL**.

Gregor Mendel's Experiments

GREGOR MENDEL - was an Austrian monk who lived in the 1800s and conducted thousands of experiments on pea plants. He is known as the "father of genetics" for figuring out the basic rules of how traits are passed from parents to offspring.

For example, he crossed a purebred tall plant (TT) with a purebred short plant (tt) and all the offspring were TALL(Tt).



The short trait was "lost" (because "t" was recessive, and the tall allele "T" was dominant). When he crossed the two hybrid tall plants (Tt), the short trait (tt) reappeared 25% of the time.

Phenotype - an organism's physical appearance (how does the trait look?)
Example: Tall stem or Short stem)

Genotype - an organism's genetic

make-up. (Which alleles does it have?)
Example: TT or Tt or tt)

Allele - one form of a gene. Each gene is controlled by 2 alleles.

Dominant allele - it is more "powerful" and can mask/hide a recessive allele.
Example: "Tall" stems are controlled by the dominant allele (shown with a capital "T").

Recessive allele - it is one that is hidden when the dominant allele is present.
Example: "Short" stems are controlled by the recessive allele (shown with a lower-case "t").

Homozygous (Purebred) - when both alleles for a gene are the same (TT or tt).

Heterozygous (Hybrid) - when there are 2 different alleles for a gene.

Probability & Punnett Squares

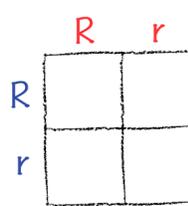
A Punnett Square - is a tool you can use to figure out all the possible offspring from a genetic cross.

If you know the genotypes of both the parents, a Punnett square can tell you the probability (% chance) that 2 parents will have an offspring with a certain phenotype & genotype.

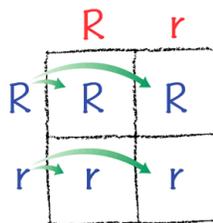
Example: If you cross 2 *heterozygous* (hybrid) plants with *ROUND* seeds, what are the possible phenotypes and genotypes of the offspring?

("R" for round seeds is dominant over "r" for wrinkled seeds).

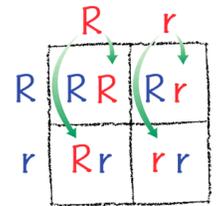
1) Begin by placing the genotype of one parent along the top of the square and the genotype of the other parent along the side.



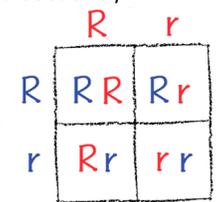
2) Then copy one parent's alleles to the right, across each pair of boxes in the square.



3) Next copy the other parent's alleles down, into each pair of boxes in the square below.



4) The completed square shows that 3/4 (75%) of the possible offspring will have *ROUND* seeds and 1/4 (25%) will have *wrinkled* seeds. 1/4 will be homozygous dominant (RR), 2/4 will be heterozygous (Rr), and 1/4 will be homozygous recessive (rr).



Human Genetics

Some human traits are controlled by **single genes** (with 2 or more alleles)- for example, widow's peak, tongue-rolling, hitchhiker's thumb, blood type.

Other human traits are controlled by **multiple genes** which act together as a group to produce a single trait—for example, height and skin color have many different phenotypes because

they are influenced by many genes. Human traits are influenced by **genes AND environment**.

One of the 23 pair of human chromosomes are called sex chromosomes because they determine gender— two X chromosomes result in a **female (XX)**, one X and one Y chromosome results in a **male (XY)**.

Genetic disorders are caused by **mutations** in the DNA of genes or chromosomes - Cystic Fibrosis, Sickle Cell Disease, and Down Syndrome are examples.

Some of these diseases are **recessive**, so it's possible for a person to be a **carrier**—they carry 1 copy of the mutated gene, but they don't have the disease, because they have a copy of the dominant normal gene which keeps them healthy. (Sickle cell is recessive— you need 2 copies of the gene to be sick).