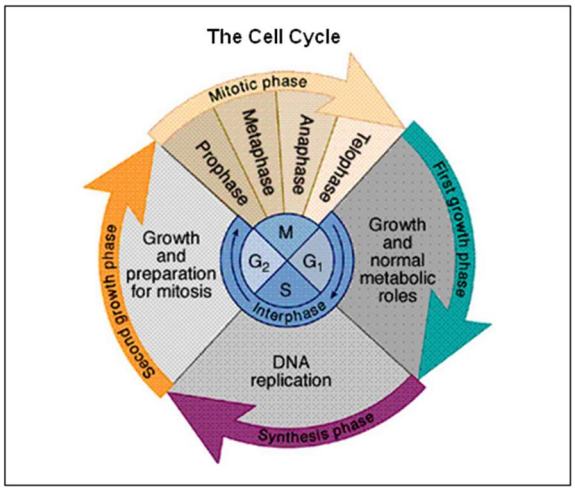
Biology EOC Review Session #3 June 1, 2017



Cell Cycle

The cell cycle is the phases in the life of a cell

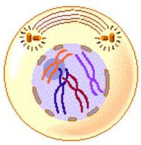
M phase: Mitosis (cell division) occurs
G1 phase: Cell grows
S phase: DNA synthesis (chromosomes are copied)
G2 phase: Cell checks and make sure replication was successful, preparations for division
M phase begins again

Chromosomes must be copied before mitosis so that new cells receive the same information as found in the parent cell-
Mitosis produces genetically identical cells

Mitosis Asexual reproduction in somatic cells

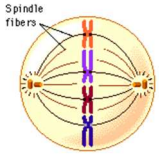
Division of a cell into 2 identical cells

Before mitosis: Chromosomes have copied themselves
Sister chromatids: original chromosome and its exact copy are attached to each other



Prophase

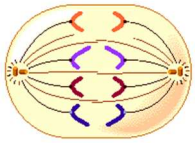
1. Prophase: Nuclear membrane disappears and spindle fibers start to form
   Centrioles move to opposite
2. Metaphase: Sister chromatids line up along the middle of the spindle fibers attach at the centromere.



Metaphase

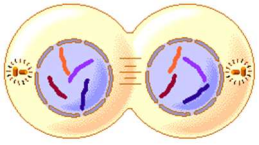
3. Anaphase: Sister chromatids separate and move to opposite ends of the cell.

4. Telophase: Spindle fibers break down and new nuclear membrane forms around each set of chromosomes



Anaphase

Cytokinesis occurs when the cytoplasm actually divides, forming two new cells. (not part of mitosis)



Telophase

Genetics and Meiosis

Chromosomes

DNA strands in the nucleus that contain the directions on how to make and keep an organism alive
Made up of genes, which are traits of an organism
Cells will die if their DNA is damaged or removed

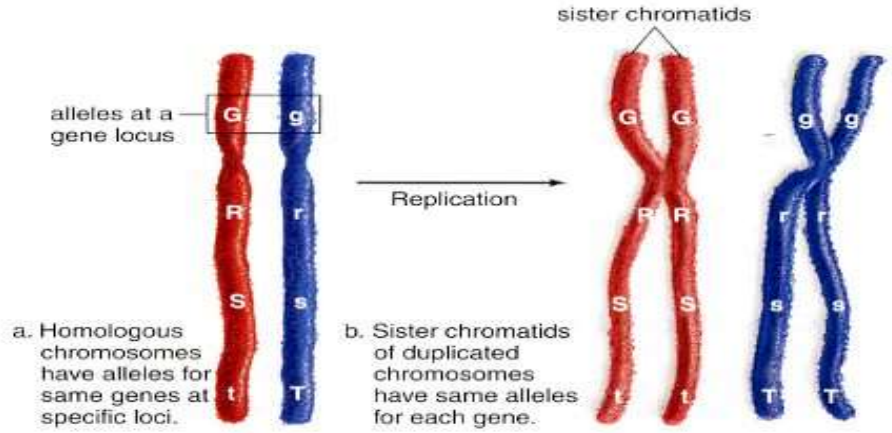
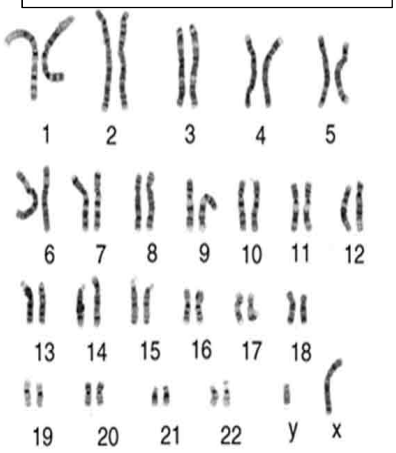


FIGURE 11.4 **Classical view of homologous chromosomes.**

a. The letters represent alleles; that is, alternate forms of a gene. Each allelic pair, such as *Gg* or *Tt*, is located on homologous chromosomes at a particular gene locus. **b.** Sister chromatids carry the same alleles in the same order.

Karyotype Example



Humans have mostly diploid cells, which means that we have 2 of each type of chromosome
Homologous chromosomes are 2 of the same type of chromosome
We have 23 (pairs) types of chromosomes but…
We have 46 chromosomes in all,

23 chromosomes from mom + 23 chromosomes from dad

Human gametes (sperm and egg cells) are haploid cells, which means that they have 1 of each type of chromosome
Sperm and egg cells have 23 chromosomes in all- Together they will make a complete set 46

Autosomes: chromosomes that are 1-22 not sex chromosome #23

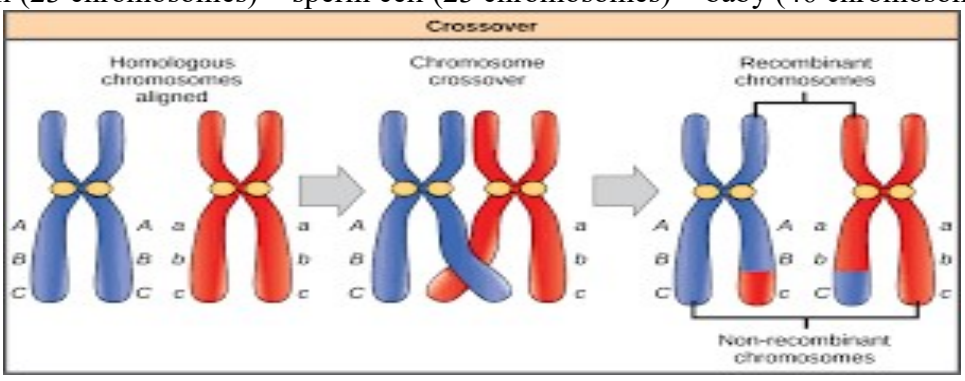
Sex chromosomes: Chromosomes that determine gender
Girls are XX, Boys are XY

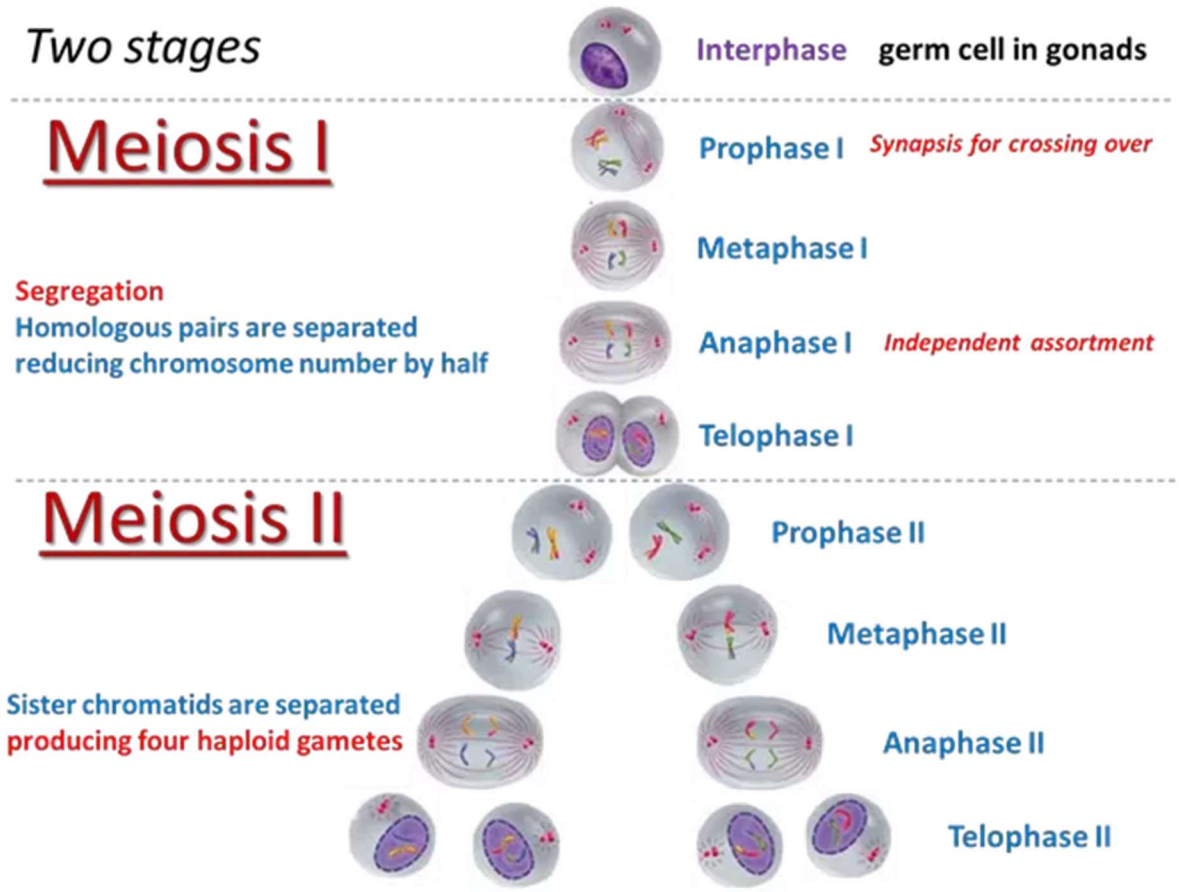
Karyotype: ordered picture of an organism's chromosomes
Healthy individuals have 2 of each type of chromosome
Individuals with Down syndrome have three #21 chromosomes

Cell division that produces gametes (sex cells), such as sperm and egg cells

Fertilization: Process of an egg and a sperm cell combining to produce a zygote

Zygote: Baby that is only 1 cell big
Egg cell (23 chromosomes) + sperm cell (23 chromosomes) = baby (46 chromosomes)





Meiosis- Synthesizing sex cells (egg and sperm)

Before meiosis/ Interphase

2 Each chromosome doubles, (of the same type) come together to make a chromosome pair. This gives 4 chromosomes stuck together- **Tetrad**

Meiosis I: Chromosome pairs separate into two new cells

Meiosis II: Each chromosome separates from its copy into 4 new cells

In meiosis, one cell becomes four cells but in mitosis, one cell becomes two cells

Meiosis

Mendelian Genetics

Gregor Mendel is an Austrian monk credited with beginning the study of genetics

Genetics is the study of heredity

Humans have **2 alleles** for every trait/ gene

Alleles: Different forms of a single trait, like blue and brown are **two eye color alleles**

Dominant gene: "Stronger" of 2 genes and shows up in the organism
Represented by a capital letter
B is the dominant gene for brown eyes

Recessive gene: "Weaker" of 2 genes and only shows up when there is no dominant gene present
Represented by a lowercase letter
b is the recessive gene for blue eyes

Homozygous (purebred): When 2 genes are alike for a trait
BB is homozygous for brown eyes, bb is homozygous for blue eyes

Heterozygous (hybrid): When 2 genes are different for a trait
Bb is heterozygous

Mendel's law of segregation states that the 2 genes we have for each trait get separated from one another when we make egg and sperm cells

Mendel's law of independent assortment states that the gene for one trait is inherited independently of the genes for other traits

(Only true when the genes are on different chromosomes)

Punnett Squares

Punnett squares are charts that are used to show the possible traits of offspring in a cross between 2 organisms

Let's say that B is the dominant gene for brown eyes and b is the recessive gene for blue eyes*

Genotype: The genes of an organism (Bb)

Phenotype: The physical appearance of an organism (Brown eyes)

Cross a male that is heterozygous with a female that has blue eyes. What will be the possibility that their children will have blue eyes?

Non-Mendelian Genetics

Human Genetics

Multiple alleles are three or more alleles that exist for a **single gene**

For example, A, B, and O are the multiple alleles for blood type

The possible blood types are A, B, AB, and O

You can be A+ or A-, B+ or B-, AB+ or AB-, O+ or O- depending on whether your blood cells have a special Rh protein

Codominance occurs when 2 dominant genes are expressed and both genes are seen in the organism

AB blood is codominant, a cat with black and white spots is codominant

Incomplete dominance occurs when 2 dominant genes are expressed and blended together in the organism

If the red flower color gene (R) is mixed with the white flower color gene (W) then the offspring will be pink (RW)

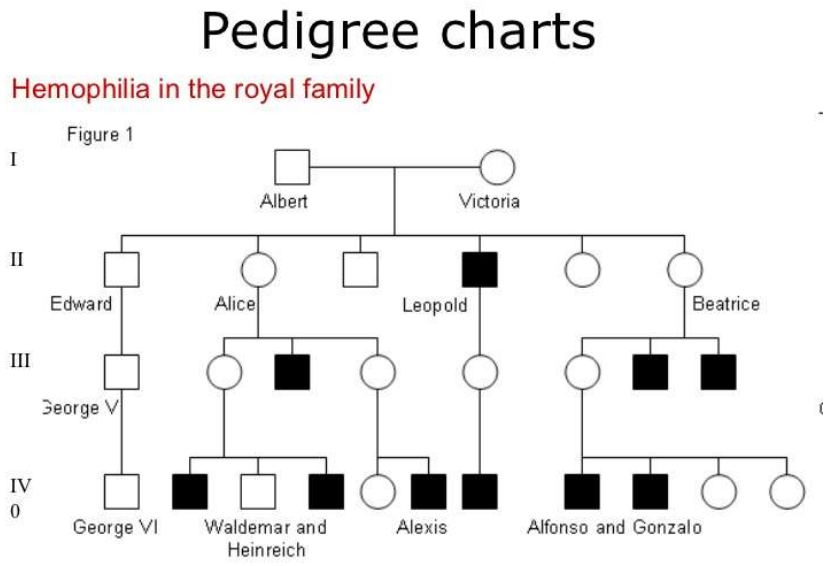
A polygenic trait is a trait that is controlled by more than one pair of genes, like skin color

A sex-linked trait is a trait that is found on the X chromosome, such as colorblindness

Females are XX so have 2 copies of sex-linked traits

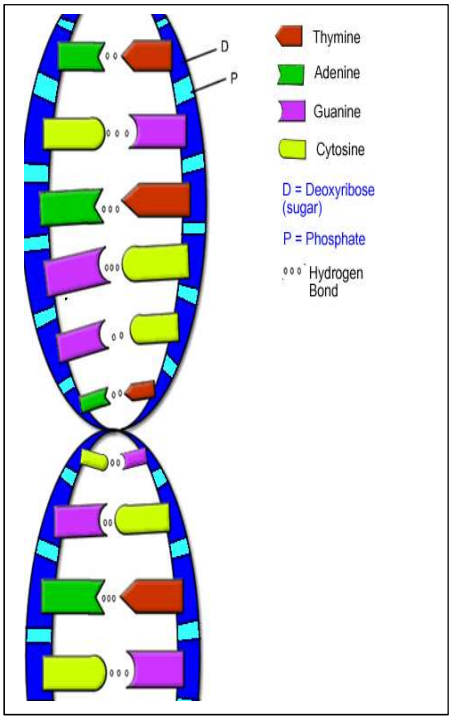
Males are XY so have 1 copy of sex-linked traits

A pedigree is a pictorial version of a family tree and how a specific trait shows up in family members



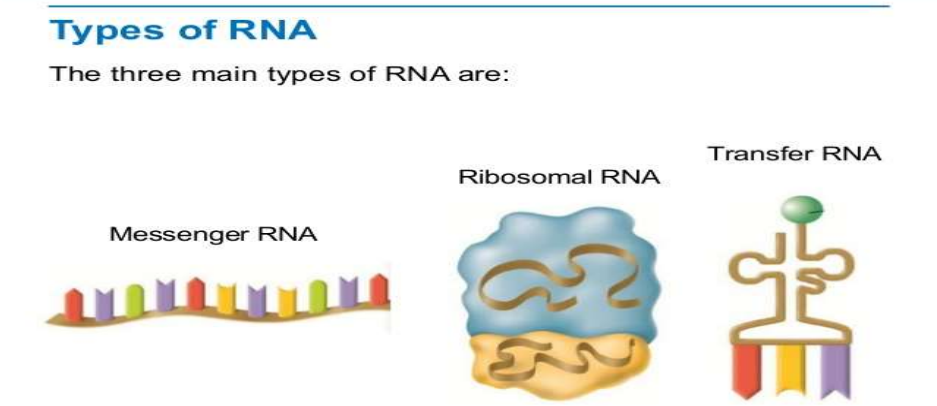
DNA

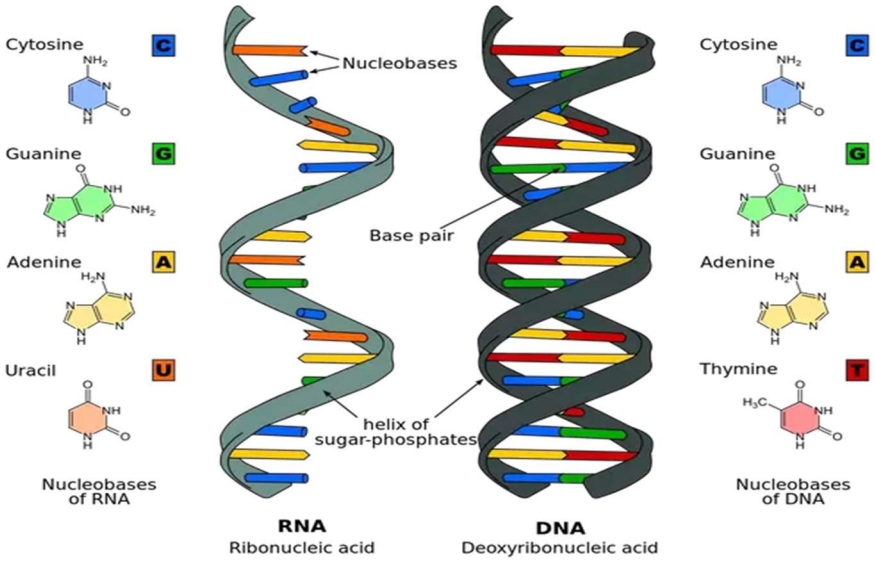
DNA = Deoxyribonucleic acid
Makes up the chromosomes in the nucleus and never leaves the nucleus
A chromosome is a chain of different genes
DNA has a double helix shape
Has four types of bases: **adenine (A), guanine (G),**
cytosine (C), thymine (T),
A binds T and G binds C
DNA is complementary, which means that the bases on one strand match up to the bases on the other strand
For example: Strand 1: ATG CCT GAC
Strand 2: **TAC GGA CTG**
Semi conservative replication is the process by which DNA copies itself and each new piece of DNA is made up of 1 old strand and 1 new strand



RNA

Ribonucleic acid
RNA is a copy of DNA that goes out into the cytoplasm to tell the cell what to do in order to stay alive.





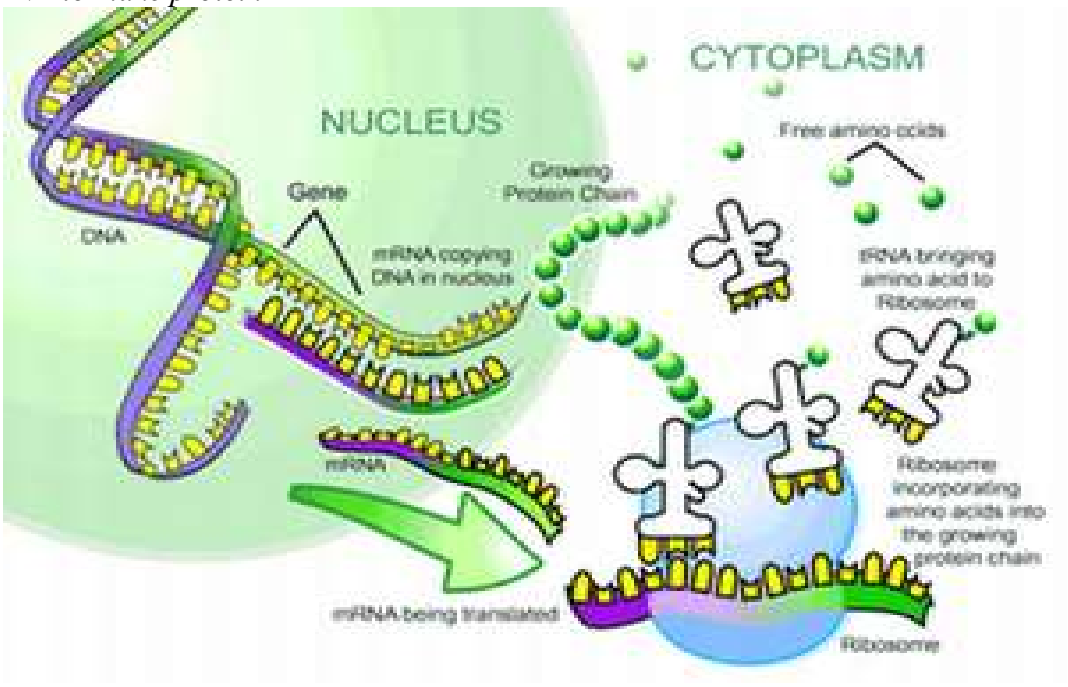
RNA is single stranded and has uracil (U) rather than thymine (T)

U binds A and G binds C

If the DNA is **ATG CCA AAG**

Then the RNA will be UAC GGU UUC

Using DNA to make protein



Protein Synthesis

1. Transcription: DNA in the nucleus is used to make messenger RNA (mRNA)
2. DNA has all the directions the cell needs to live, make proteins, ect..
   mRNA-(messenger RNA) moves out into the cytoplasm
3. RNA carries the directions to other to the rough ER and locates the ribosome-(the protein manufacturer)
4. Translation: The RNA attaches to a ribosome-(aka rRNA) and directs the production of a protein
5. Proteins do a lot of the work in the cell, and are very important in chemical reactions
6. Every 3 bases in mRNA is called a **codon** and codes for 1 amino acid

Mutations- *protein synthesis or DNA replication gone wrong……☹*

A mutation is a change in a gene or chromosome
If the mutation happens in a body cell, it only affects the organism that carries it
If the mutation happens in a sex cell, it can be passed on to offspring
Mutations can be
- **harmful** if they reduce an organism's chances for reproduction or survival
- **helpful** if they improve an organism's chances for survival
- **neutral** if they do not produce an obvious changes in an organism
- **lethal** if they result in the immediate death of an organism

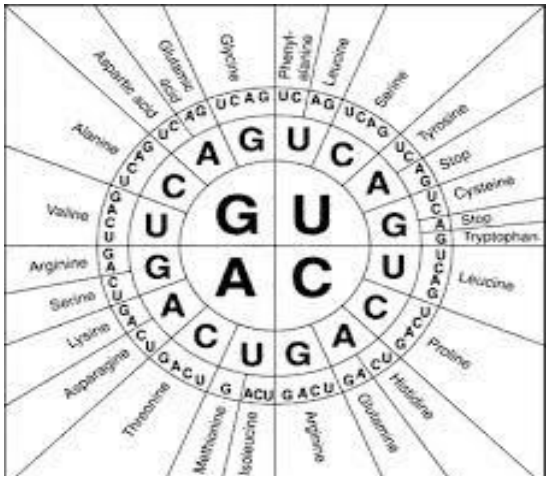
Mutations can occur spontaneously or be caused by a mutagen, which is a factor in the environment like UV and chemicals

There are three ways that DNA can be altered when a mutation(change in DNA sequence) occurs.

1. Substitution –one base-pairs is replaced by another:
Example: G to C or A to G

2. Insertion –one or more base pairs is added to a sequence:
Example: CGATGG ⟶ CGA**A**TGG

3. Deletion –one or more base pairs is lost from a sequence:
Example: C**G**ATGG ⟶ CATGG



There are five possible results of a mutation.

1. **Silent mutation**: When a base pair is substituted but the change still codes for the same amino acid in the sequence:
Example: TCT and TCC both code for the amino acid **Serine**

2. **Substitution:** When a base pair is substituted and the new codon codes for a different amino acid:
Example: **TCT codes for Serine** and **CCT codes for Proline**

3. **Premature Stop**: When a substitution results in the formation of a STOP codon before all of the codons have been read and translated by the ribosome.

Example: GTG	GTC	CGA	AAC	ACC ⟶	GTG	GTC	**TGA**	AAC	ACC
	Val-	Val-	Pro-	Asn-	Thr		Val-	Val-	STOP	------	-----

4. **Codon Deletion and Insertion:** A whole new amino acid is added, or one is missing from the mutant proton:

Example: GTG	GTC	CGA	AAC	ACC ⟶	GTG	GTC	**TGC**	CGA	AAC	ACC
	Val-	Val-	Pro-	Asn-	Thr		Val-	Val-	Cys-	Pro-	Asn-	Thr

5**. Frame Shift:** When a deletion or insertion results in a different base pair being the beginning of the next codon, changing the whole sequence of amino acids

Example: GTG	GTC	**C**GA	AAC	ACC	T	GTG	GTC	GAA	ACA	CCT
	Val-	Val	Pro	-Asn-	Thr		Val-	Val-	Glu-	Thr-	Pro