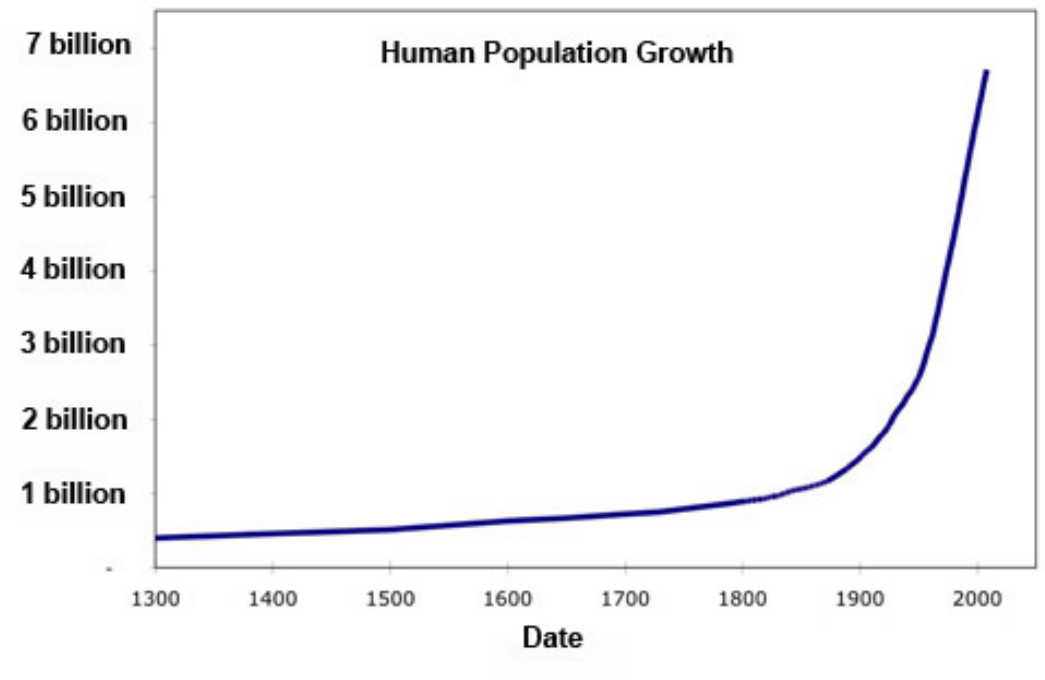
EOC Review

Human Population Growth

- Human population has been growing exponentially-will continue until ***carrying capacity*** is reached
  - More people means a higher need for energy, water, and nutrients
  - As we grow, developing new resources, conservation, and recycling will become increasingly important

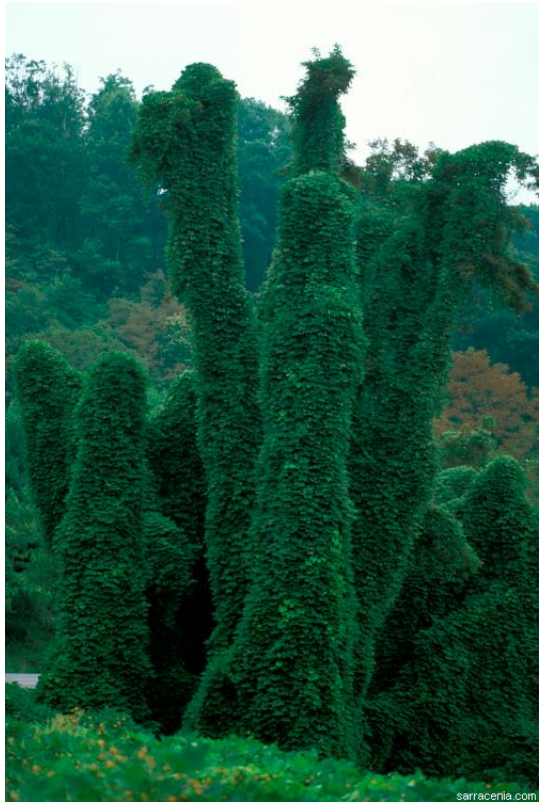


Human Activities that Impact the Environment

- Pollution
- Global Warming
- Burning Fossil Fuels
- Habitat Destruction

Human Activities that Impact the Environment

- **Nonnative Species** (Invasive Species)-Organism introduced into new environment
  - Impact: Often have no natural predators; can reproduce out of control and cause competition with native species

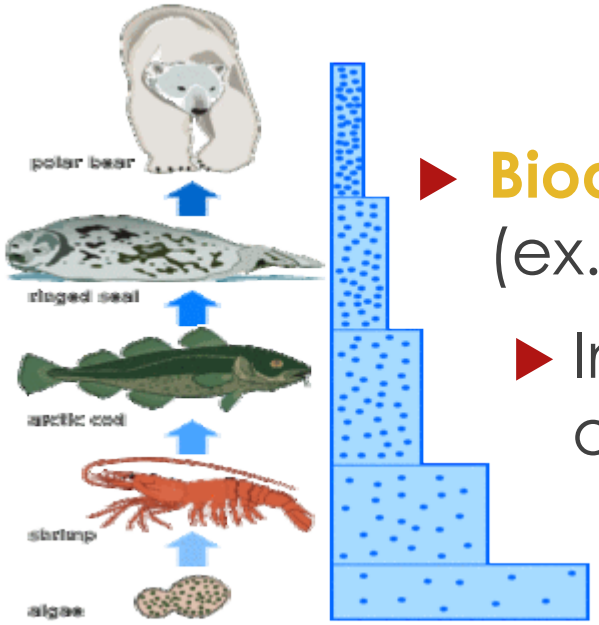


Impacts on North Carolina Ecosystems

- **Acid Rain**-Rain with a pH lower than 5.6
  - Impact: Damaging plants and animal that feed on them; affect and damage pH of aquatic habitats
- **Beach Erosion**-Sand is carried away from beaches
  - Impact: Homes in coastal areas vulnerable to damage, alters beach ecosystems
- **Urban Development**-Growth of cities
  - Impact: Land/habitats often cleared for use

Impacts on North Carolina Ecosystems

- **Waste Lagoons/Hog Farms**-Release sewage, fertilizer, and sediment into water (eutrophication)
  - Impact: Algal blooms that harm the ecosystem



- **Bioaccumulation**-An increase in the amount of a substance (ex. Pesticides) in the tissues of an organism
  - Impact: May directly impact the organism or their offspring; can end up in human consumed food as well

Impacts on Natural Resources

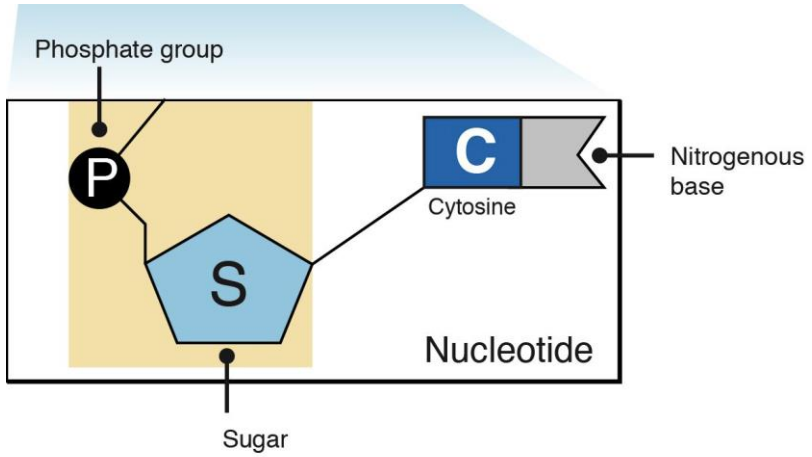
- **Resource Depletion**-Supply is limited on some, and humans often use more than they need
  - Impact: Resource acquisition often destroys land and habitats
- **Deforestation**-The removal of trees in an area
  - Impact: Destroys habitats, lowers biodiversity, adds CO_2
- **Pesticides**-Chemicals designed to kill pests, such as insects and rodent, in order to reduce disease and increase food production
  - Impact: Can sicken animals other than target pest (ex. bees); runoff can carry pesticides to nearby bodies of water

Conservation

- **Conservation**: The careful use and protection of resources
- **Sustainability**: The ability of a population or ecosystem to survive indefinitely
- How do we help?
  - Reduce use of fossil fuels
  - Reuse and recycle waste
  - Protecting endangered species
  - Habitat restoration

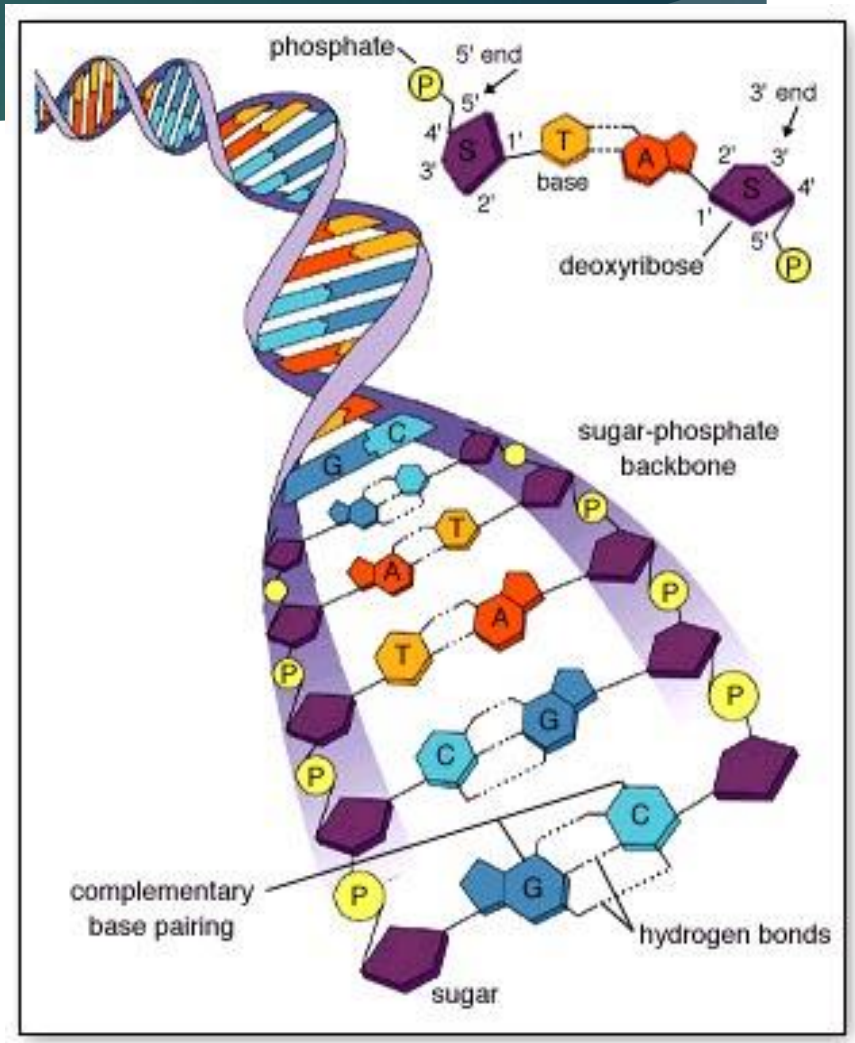
The Building Blocks of DNA

- **Nucleotides**: Composed of 1 phosphate, 1 sugar, and 1 nitrogenous base
  - The sugar is deoxyribose in DNA, and ribose in RNA
  - In DNA, bases are A (Adenine), T (Thymine), C (Cytosine), and G (Guanine)
- When joined together, the nucleotides form a **nucleic acid** (DNA or RNA)



DNA Structure

- DNA takes the shape of a **double helix** ("twisted ladder")
  - The "sides" of the ladder are alternating phosphate-sugar groups
  - The "rungs" of the ladder are complementary nitrogenous base pairs, held together by hydrogen bonds
- A always pairs with T, and C always pairs with G!

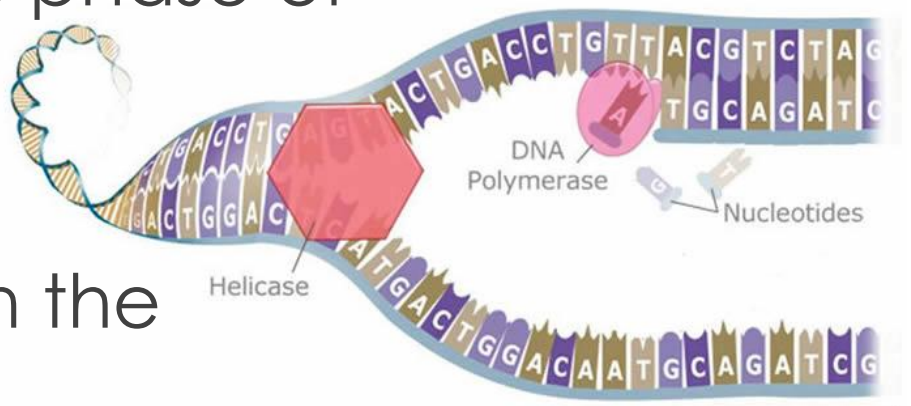


About DNA

- The sequences of nucleotides in DNA code for proteins-central to cell function and life
- Cells respond to their environments by producing different types and amounts of proteins
- All organisms DNA contains the same base pairs, ATGC
- All of the cells within an organism contain the same DNA-the expression of those genes differs to create traits

DNA Replication

- Recall that DNA is replicated during the S phase of the cell cycle, before the cell divides
- **Replicate**=To make a copy
- During replication, DNA is unzipped down the middle by the enzyme helicase.
  - Nucleotides separate, breaking strand into two halves
  - Each half is used to construct two identical DNA molecules



Standards 3.1.2 and 3.1.3

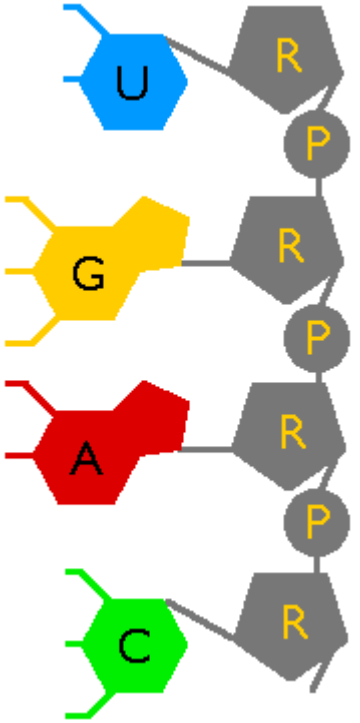
PROTEIN SYNTHESIS AND MUTATIONS

Proteins

- ***Proteins*** are large organic molecules that provide many functions
  - Structural support, like forming a part of cell materials (ex. Collagen that forms bones)
  - Functional support, like hormones, enzymes, and chemicals(ex. Hemoglobin transporting oxygen)
- The building blocks of proteins are called ***amino acids***. Amino acids link together to form a protein.
  - Some amino acids we make. Others, we must get from food (essential amino acids)

RNA

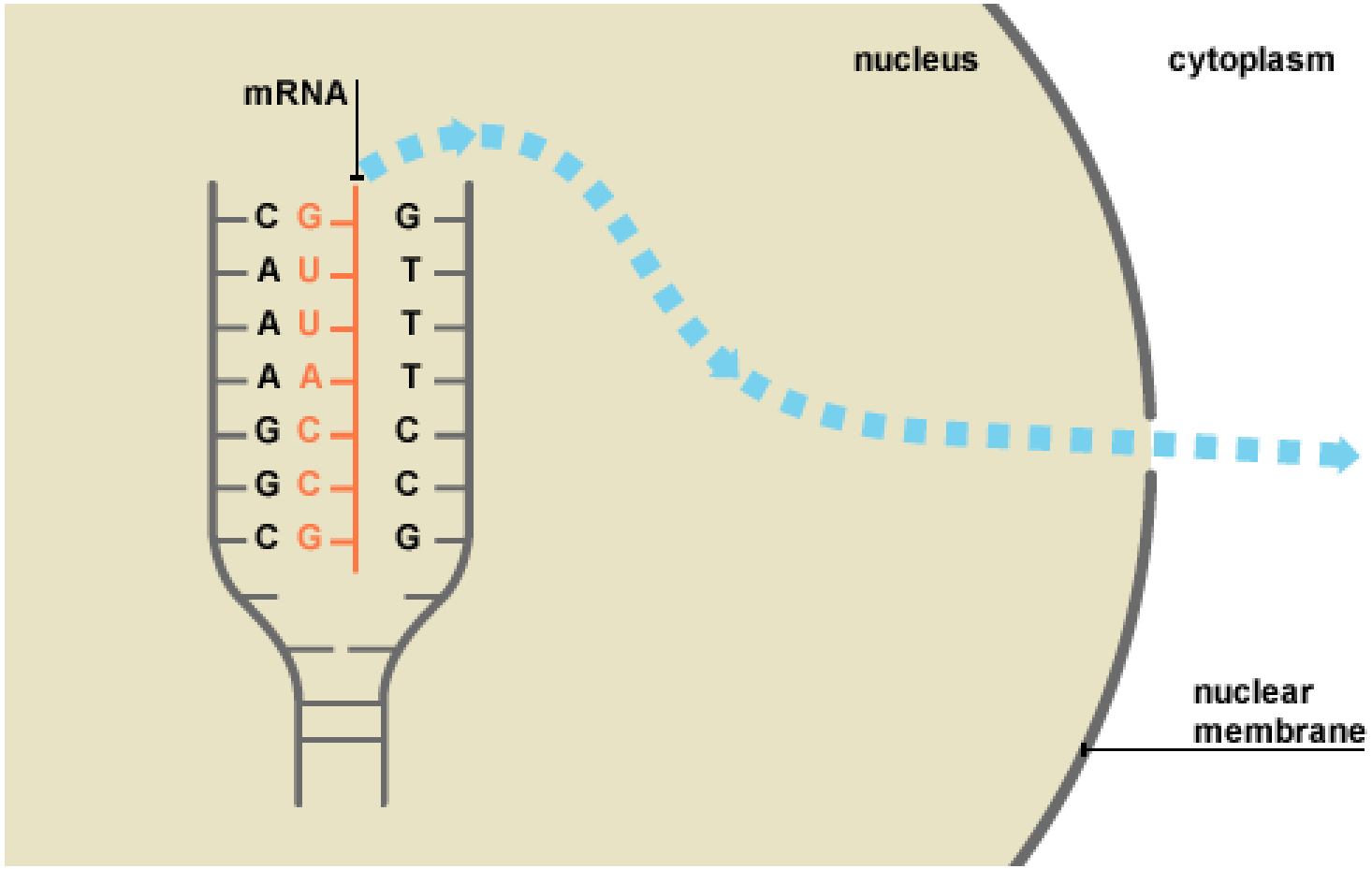
- The instructions for making proteins are found in DNA. ***RNA*** plays a role in delivering those instructions to the ribosome for production.
- RNA is a ***nucleic acid***. Like DNA, they are composed of nucleotides. Key differences in DNA and RNA are:
  - RNA has the sugar ribose
  - RNA is single stranded
  - RNA can leave the nucleus
  - RNA has the base U (uracil) instead of T (thymine)
- The three types of RNA involved in ***protein synthesis*** are mRNA, tRNA, and rRNA. All three play a role in helping proteins be made.



Protein Synthesis: Transcription

- ***Protein Synthesis***=the process in which cells make proteins. It is broken up into two main parts, transcription and translation.
- ***Translation:*** DNA → RNA
  - When a protein is needed, mRNA must be made to deliver the message to the ribosome. Remember, DNA cannot leave the nucleus.
  - To do this, the segment of DNA needed temporarily unzips. The DNA is used as a template to make an mRNA strand. Remember, uracil replaces thymine.
  - Once the mRNA strand is complete, it can leave the nucleus to travel to the ribosome for protein production.

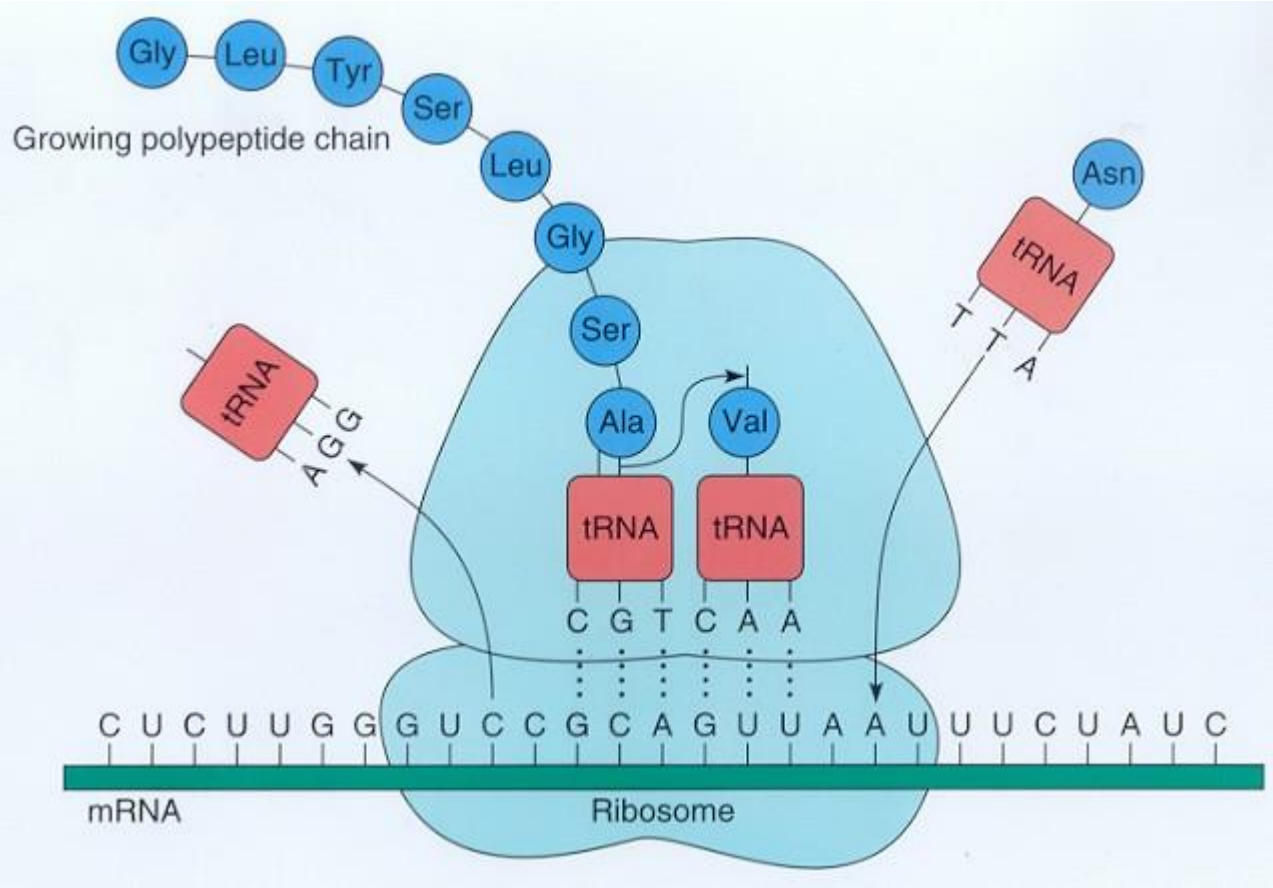
Transcription: A Closer Look



Protein Synthesis: Translation

- ***Translation***: RNA → Protein
  - Once the mRNA lands on the ribosome, the mRNA codons can be read and ***translated*** into amino acids
    - Every 3 letters on the mRNA is called a ***codon***. 1 codon codes for 1 amino acid.
  - As each codon is read, a tRNA molecule delivers the correct amino acid. The tRNA knows where to land because it has a complimentary anticodon that corresponds to the codon on the mRNA
  - As the amino acids are dropped off, they link together to form an amino acid chain. The chain will continue to grow until a stop codon is reached.
  - At this point, the protein is complete and ready to be used!

Translation: A Closer Look



Reading a Codon Chart

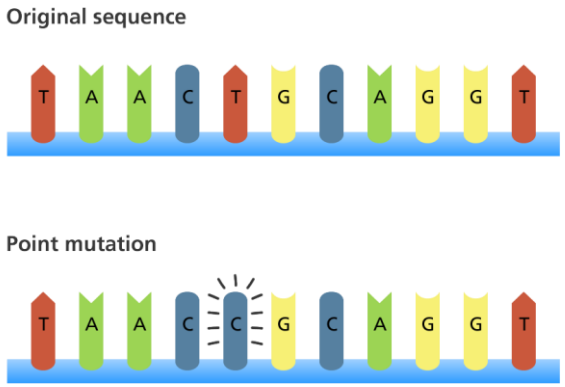
- Identify the amino acids:
  - AUG
  - CCC
  - GAC
  - UGA

Codons in mRNA

First Base	Second Base								Third Base
	U		C		A		G		
	UUU	Phenylalanine	UCU	Serine	UAU	Tyrosine	UGU	Cysteine	U
U	UUC	Phenylalanine	UCC	Serine	UAC	Tyrosine	UGC	Cysteine	C
	UUA	Leucine	UCA	Serine	UAA	Stop	UGA	Stop	A
	UUG	Leucine	UCG	Serine	UAG	Stop	UGG	Tryptophan	G
	CUU	Leucine	CCU	Proline	CAU	Histidine	CGU	Arginine	U
C	CUC	Leucine	CCC	Proline	CAC	Histidine	CGC	Arginine	C
	CUA	Leucine	CCA	Proline	CAA	Glutamine	CGA	Arginine	A
	CUG	Leucine	CCG	Proline	CAG	Glutamine	CGG	Arginine	G
	AUU	Isoleucine	ACU	Threonine	AAU	Asparagine	AGU	Serine	U
A	AUC	Isoleucine	ACC	Threonine	AAC	Asparagine	AGC	Serine	C
	AUA	Isoleucine	ACA	Threonine	AAA	Lysine	AGA	Arginine	A
	AUG	Methionine or start	ACG	Threonine	AAG	Lysine	AGG	Arginine	G
	GUU	Valine	GCU	Alanine	GAU	Aspartic Acid	GGU	Glycine	U
G	GUC	Valine	GCC	Alanine	GAC	Aspartic Acid	GGC	Glycine	C
	GUA	Valine	GCA	Alanine	GAA	Glutamic Acid	GGA	Glycine	A
	GUG	Valine	GCG	Alanine	GAG	Glutamic Acid	GGG	Glycine	G

Mutations

- ***Mutations*** are changes in a gene or chromosomes
  - May occur spontaneously (ex. Mistake during DNA replication)
  - May occur in response to environment (ex. UV radiation causing cancer)
  - May be harmful, exhibit no change, or introduce a new trait to a population



- Types of mutations in DNA:
  - ***Substitution***: One nucleotide replaces another (may or may not cause change in amino acid sequence)
  - ***Insertion/Deletion***: One base is added or removed (changes the entire amino acid sequence after the mutation)

Standard 3.2.1

MEIOSIS AND GENETIC DIVERSITY

Meiosis

- Recall that your body cells, or somatic cells, reproduce via mitosis for growth and repair
- In your reproductive cells, a different process occurs. This process is called ***Meiosis***.
- Meiosis is a form of ***sexual reproduction***. This means it requires the cells of two parents to create a new organism
  - The cells produced from this process are called ***gametes*** (sperm and egg cells)
  - When two gametes join at fertilization, the resulting cell is called a ***zygote***
  - Remember, gametes have half (n) the number of chromosomes. After fertilization, the resulting organism will have the correct number (2n).

Comparing Mitosis to Meiosis

	Mitosis	***Meiosis***
Type of Reproduction?	Asexual	Sexual
Number of Divisions	1	2
Number of Cells Produced	2	4
Haploid or Diploid	Diploid	Haploid
Number of Chromosomes (humans)	46	23

How Does Meiosis Lead to Diversity?

- ***Fertilization***: Homologous chromosomes from parents have matching genes but may have different alleles. Each gamete produced is different, so each organism inherits a different combination of alleles.
- ***Crossing-Over***: A process in which segments of homologous chromosomes break off and are exchanged. This increases genetic combinations.
- ***Independent Assortment***: When the cell divides, each daughter cell receives a mix of chromosomes that differs from the original cell, creating diversity.
- ***Gene Mutation***: Sometimes a mutation introduces a new trait into a population, increasing diversity of traits.

Benefits of Sexual Reproduction

- While sexual reproduction takes longer and produces less offspring than asexual reproduction, the offspring are genetically different. This is beneficial in a number of ways:
  - Offspring may be able to survive in more varied conditions (ex. Disease)
  - Undesirable alleles may be filtered out

Errors in Meiosis

- Sometimes, chromosomes do not separate properly during meiosis. This is called ***nondisjunction***, and can lead to an organism having an incorrect number of chromosomes.