Section 6: Biotechnology and Genetic Engineering - Notes

Objectives:

- Explain how genetic engineering has impacted the fields of medicine, forensics, and agriculture.
- Describe the processes of selective breeding, gene splicing, cloning, genetically modified organisms, and gene therapy.

Warm-up:

- Name one genetically modified organism (GMO) that you've heard of.

- Is this organism good or bad?

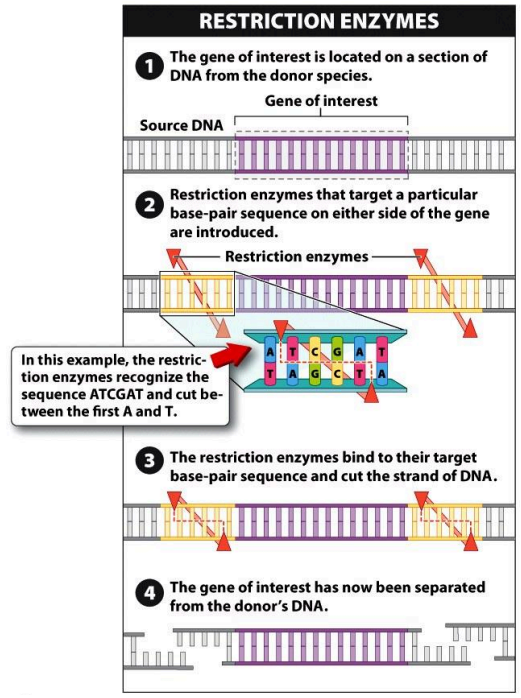
Biotechnology:

- **<u>Biotechnology:</u>** any procedure or method that uses biological systems or _____ _____ to develop or modify either _____ or _____for specific use.
    - Includes genetic engineering, gene splicing, _____, gene therapy, genetically modified organisms, and _____.

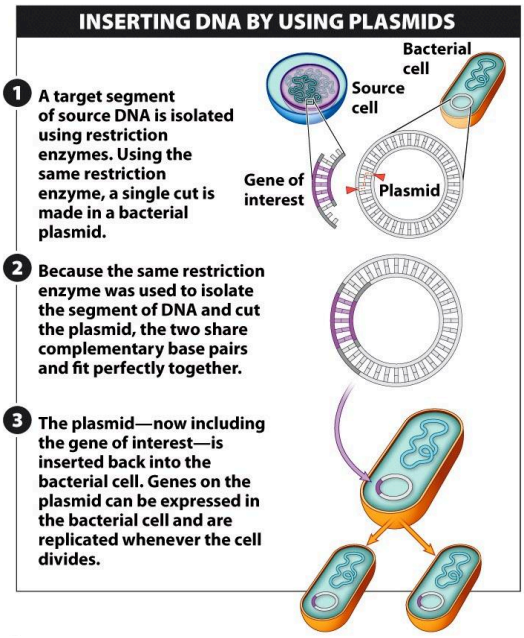
Genetic Engineering:

- **<u>Genetic Engineering:</u>** a technology that includes the process of _____ the genetic material of a cell resulting in _____ functions or outcomes that would not occur _____.

- Once a particular gene is located, _____ _____ are used to cut out and isolate that gene.
    - Restriction enzymes work by targeting a specific _____ sequence.
    - After binding to their target, the restriction enzyme _____ the strand of DNA and the gene of interest is _____ from the remaining DNA.

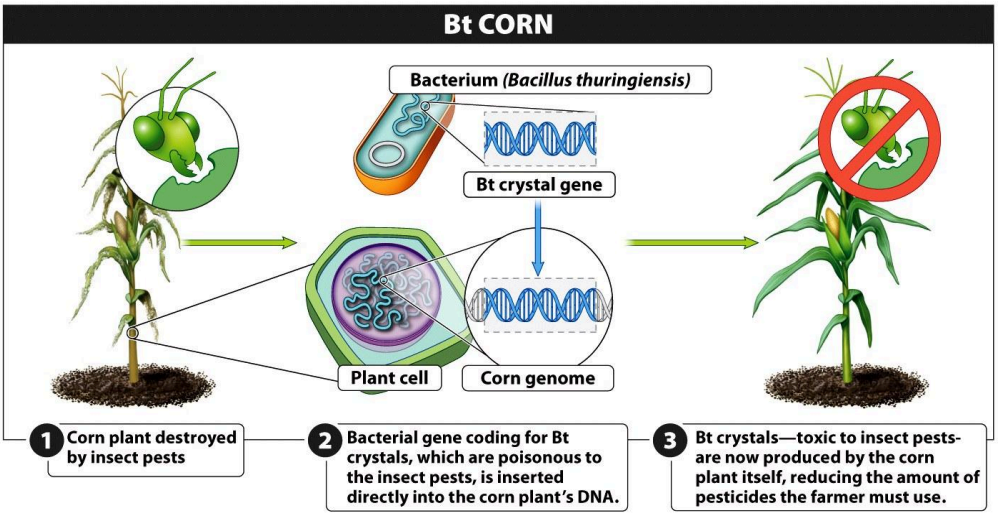


- Once the gene has been isolated, it is possible to make many _____ of the gene using a DNA _____ chain reaction (PCR).
    - This process can be repeated over and over until there are _____ of identical copies.
- The gene of interest can now be _____ into other strands of DNA to begin making _____.
    - **<u>Gene Splicing:</u>** a type of gene _____ in which the DNA is intentionally broken and recombined using laboratory techniques.
- The isolated gene can be placed into a bacterial cell's _____ where it can be _____ and expressed.
    - **<u>Plasmid:</u>** _____ DNA molecules that are separate from _____ DNA and can replicate independently.



Genetically Modified Organisms:

- The isolated gene can also be placed in other organisms to give them a _____ that they did not previously have.
    - Example: _____



- By transplanting a _____from one organism into another, a _____ organism is produced.

- **Transgenic Organisms:** organisms that have _____ genetic material from _____ organisms.
    - Examples: Suntory "_____" Rose, _____ that produce a rare protein in their milk to treat blood clotting disorders, _____ _____ that helps people with vitamin A deficiency, _____ that express a jellyfish protein that glows green under ultraviolet light

- Transgenic organisms are a type of _____ _____ (_____).
    - **Genetically Modified Organism:** an organism whose genetic material has been _____ through some genetic engineering technology or technique.
        - GMOs occur when the DNA has been altered in a way that wouldn't have happened _____ by mating or natural recombination.

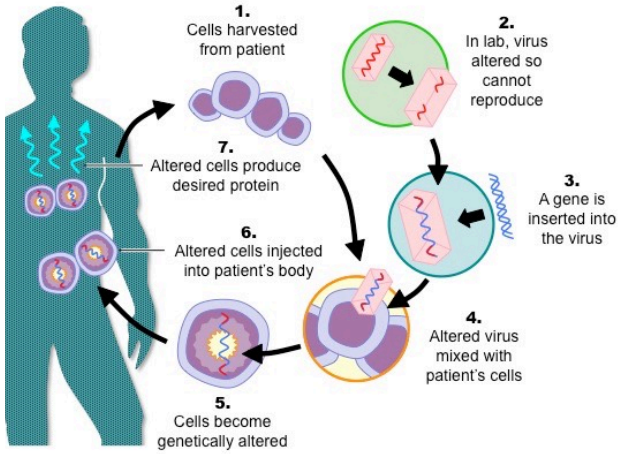
- Humans began genetically modifying organisms _____ of years ago (and continue to do so today) by using _____ _____ to select for desirable traits.

- Advantages of GMOs:
    - Used in biological and medical _____, _____ of pharmaceuticals, experimental medicine, and _____
    - GMOs may provide _____ food quality, higher _____ yields, foods with a greater shelf-life, and less need for _____

- Disadvantages of GMOs:
    - Desired traits may have _____ consequences.
    - Organisms may become _____ to genetically modified crops and may become harder to _____.
    - GMOs could _____ or _____ with wild organisms.
    - GMOs can reduce _____.

Gene Therapy:

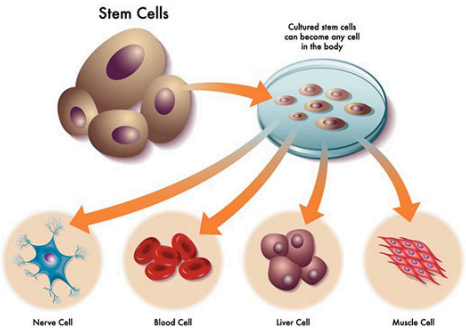
- **<u>Gene Therapy:</u>** the intentional _____, alteration, or _____ of genes within an individual's cells and tissues for the purpose of treating a _____.
    - In the future, this may allow doctors to use _____ to treat disease instead of _____ or surgery.
    - The new gene would allow the patient to begin making the _____ that they are missing or that is faulty.



- While a promising area of research, gene therapy has not been mastered and carries _____:
    - Unwanted _____ system reaction
    - The _____ may be targeted
    - The new gene may be inserted into the _____
        - This can lead to _____ or have other harmful effects

Stem Cells:

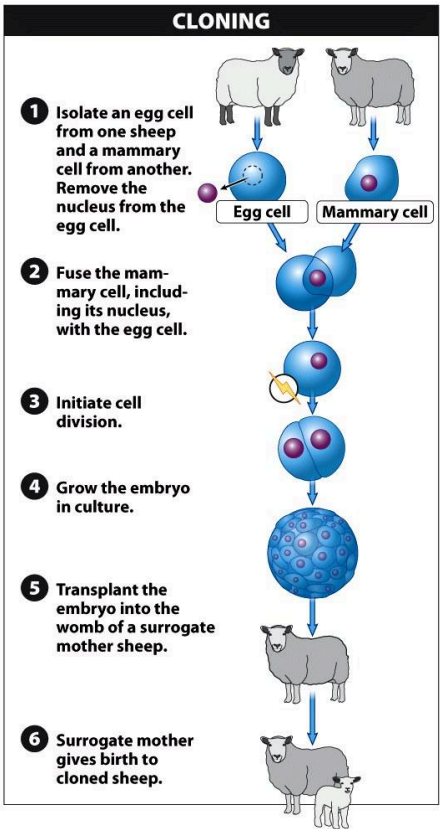
- **<u>Stem Cells:</u>** an _____ cell that can give rise to many different _____of cells.
- Stem cells are used in many areas of research to treat _____ and _____.



    - Bone Marrow Transplant - already _____ treatment of bone marrow disorders, blood disorders/cancers, etc.
        - Bone marrow stem cells produce _____.
    - Type 1 _____(replace destroyed cells in pancreas)
    - Treatment of _____, brain injury, or _____
    - _____, muscular dystrophy...etc

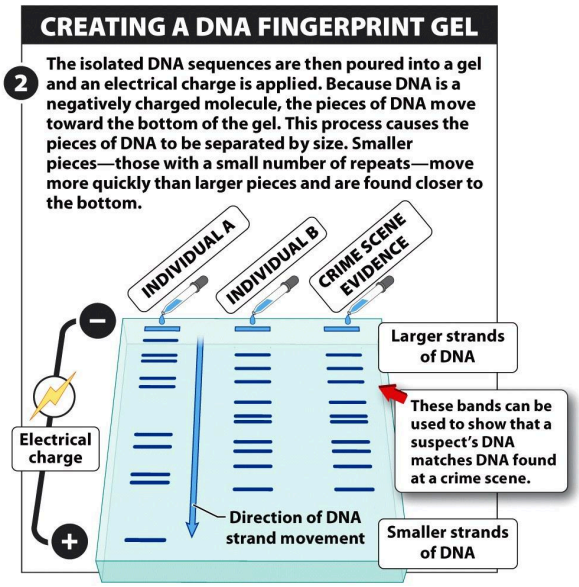
Cloning:

- **<u>Cloning:</u>** a process in which a cell, cell product, or organism is _____ from an original source
  - _____ cloning - the transfer of a DNA fragment from one organism to a self-replicating genetic element such as a bacterial _____.
  - _____ cloning - the process of taking undifferentiated embryonic cells (_____) for use in medical research
  - _____ cloning - the transfer of genetic material from the nucleus of a donor adult cell to an _____ cell that has had its nucleus removed for the purpose of creating an _____ that can produce an exact genetic copy of the donor organism.



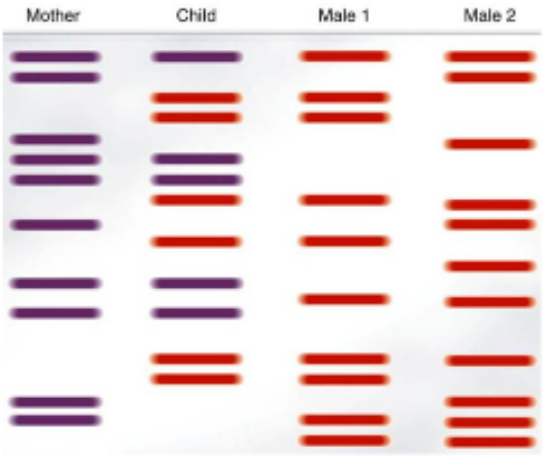
Forensic Science:

- **<u>Forensics:</u>** the science of tests and techniques used during the _____ of _____.
  - Includes many techniques and sub-categories, including _____
- **<u>DNA Fingerprint:</u>** a test to _____ and evaluate genetic information.
  - The DNA in question is _____ using restriction _____ into strips that have different _____.
  - The DNA strips are then run through a _____.
  - Longer strips move _____ through the gel and stay closer to the starting line.
  - Shorter strips move _____ and move further down the gel.
  - The banding patterns can then be _____ to show if the two samples of DNA are similar.



- DNA fingerprints cannot be used conclusively to prove someone _____ of a crime, but it can be used to prove someone _____.

- DNA fingerprints can also be used to establish family _____.



Human Genome:

- The _____ was a project to decode the 3,000,000,000 base pairs in the human genome and identify all the _____ present.
    - It started in _____ and was completed in _____.
    - Helps us understand _____, what causes them, and how to treat them
    - Led to advances in _____ science; _____ and other energy applications; _____, animal husbandry, bioprocessing; bioarcheology, anthropology and _____.