

Biotechnology

Understanding the Application

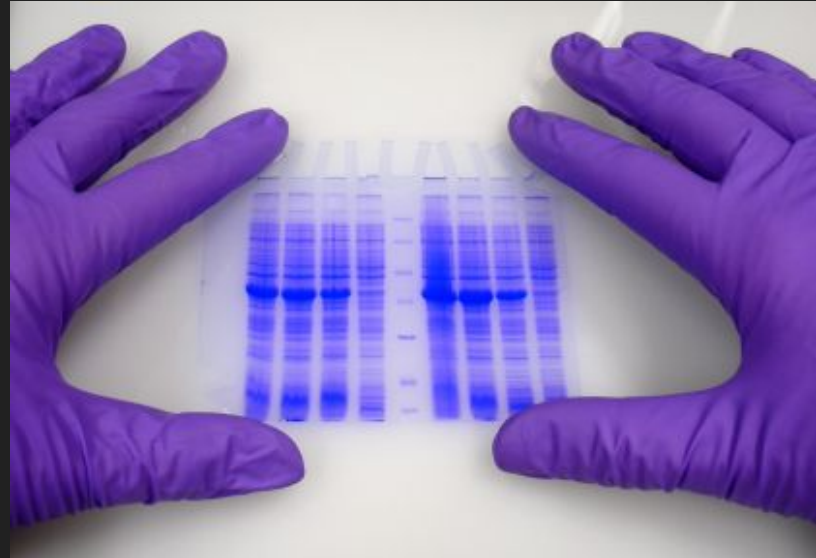
Genetic Engineering

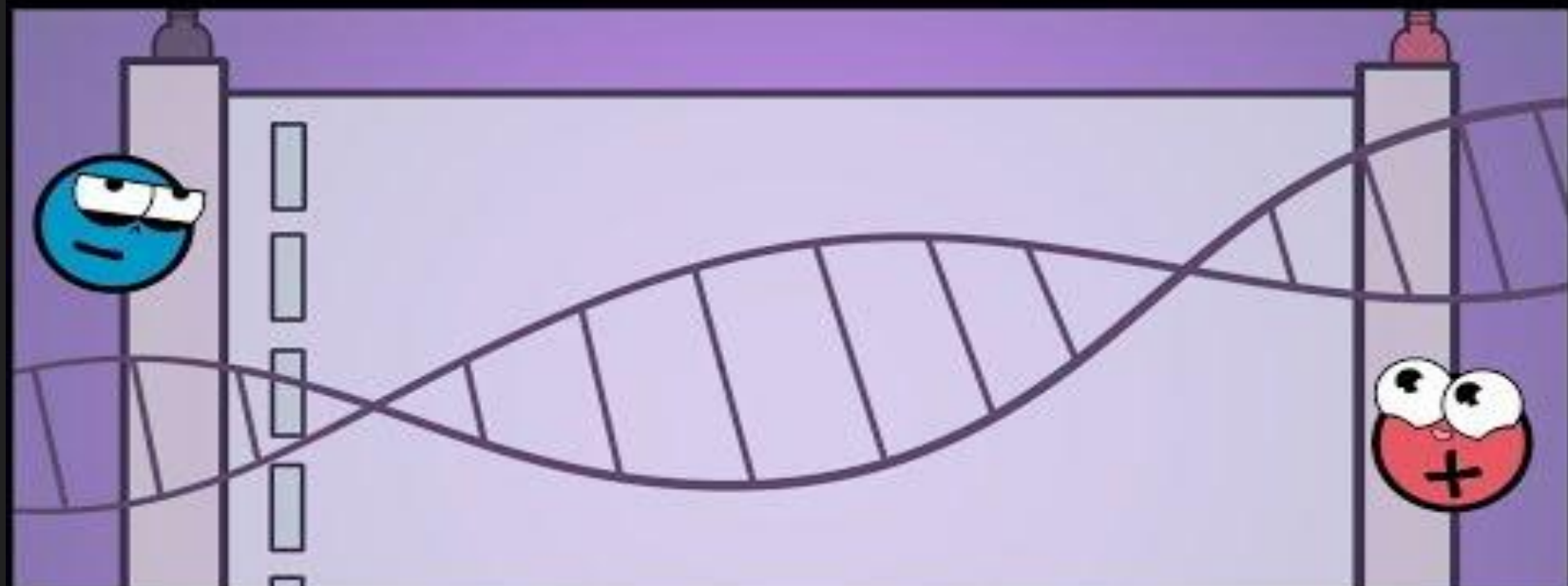
- Genetic engineering refers to any process in which man alters an organism's DNA
 - Examples - cloning, genetically modified organisms (GMO)
- In this unit, we will be exploring different types of genetic engineering and the ethical issues that arise within the field!



Gel Electrophoresis

- Gel Electrophoresis is the process of separating molecules (DNA, RNA and proteins) based on size
 - This process of comparing DNA is used in a number of things, including
 - identifying individuals through fingerprinting
 - parental ID
 - Evolutionary Relationships



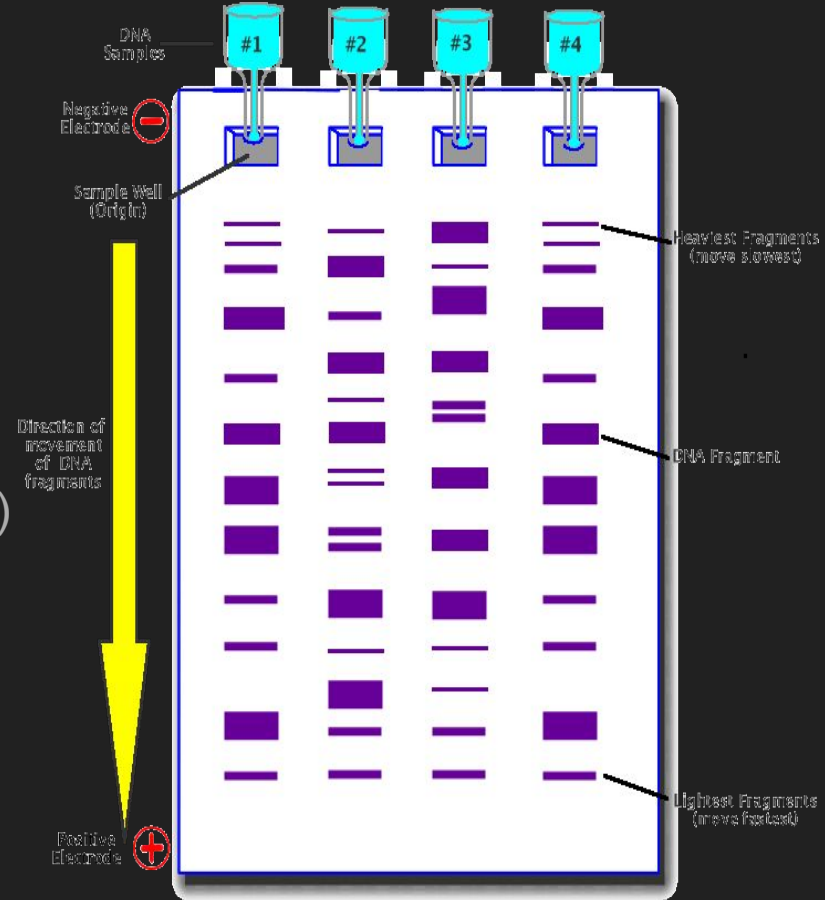


Gel Electrophoresis

with the Amoeba Sisters

Steps in Gel Electrophoresis

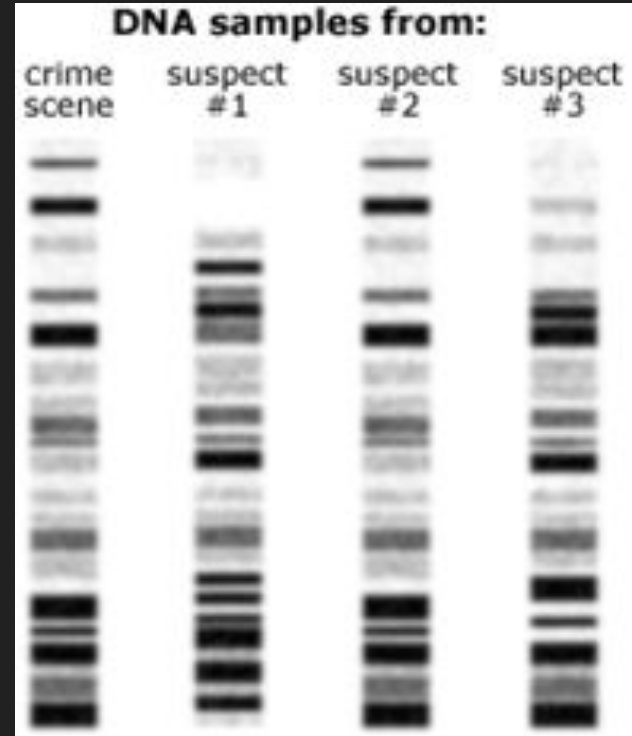
- A. DNA samples are cut into different sized fragments using *restriction enzymes*
- B. Fragments are run on gels through an electric current.
- C. Longer fragments move slowly (not as far), while smaller pieces will move faster (farther)
- D. These movements will create bands on the gel that can be read under UV lights or through staining
- E. The different bands can be compared to other DNA segments for genetic similarities



Gel Electrophoresis
(Creating a DNA Profile)

Using Gels: Identifying Individuals

- DNA Fingerprints are different for every person (EXCEPT - Identical Twins)
- Can be used to identify suspects, where the suspect's gel matches the crime scene information?



Using Gels: Paternity

- Parental gels can help determine the father
 - Gels are read with half the bands coming from mom and half from dad
- In this gel, is the father shown 1, 2, 3 or 4?

DNA Fingerprinting Experiment

Daughter Horse	Mother Horse	Possible Fathers			
		1	2	3	4
				■	■
■	■	■	■		
	■		■	■	■
	■				
■		■		■	
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Using Gels: Endangered Species

- Species can be identified using gel electrophoresis
 - Used in identifying and cataloging (categorize) species

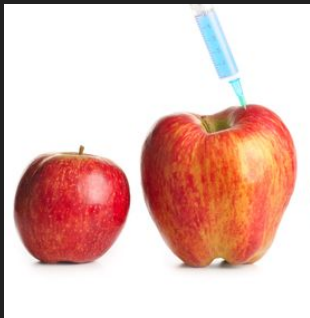


Transgenic Organisms

GMO - Genetically Modified Organism

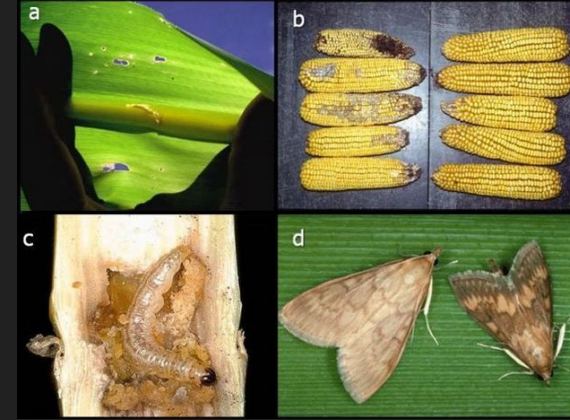
What is a Transgenic Organism?

- A transgenic organism is any organism that has a gene from another organism within it
 - inserting a foreign piece of DNA into a cell
 - Transgenic organisms come about when humans would like the trait of one organism to be present in another!
- Transgenic organisms are commonly used in agriculture and industries like pharmaceutical companies and pesticide companies



Transgenic Organisms: Agriculture

- Sometimes, transgenic organisms are grown in agriculture in order to keep crops healthy, resist pests, produce higher yield and last longer.
 - Examples Include:
 - BT Corn - pesticide resistant corn that incorporates a gene poisonous to insects (found in bacteria); which prevents insects from eating it
 - Frost Resistant strawberries - a gene inserted from an arctic fish allows strawberries to grow in colder seasons
- Sometimes, they are grown in agriculture to appeal to human tastes
 - Examples:
 - Grapples (combination of an apple and grape)



Transgenic Organisms: Industry

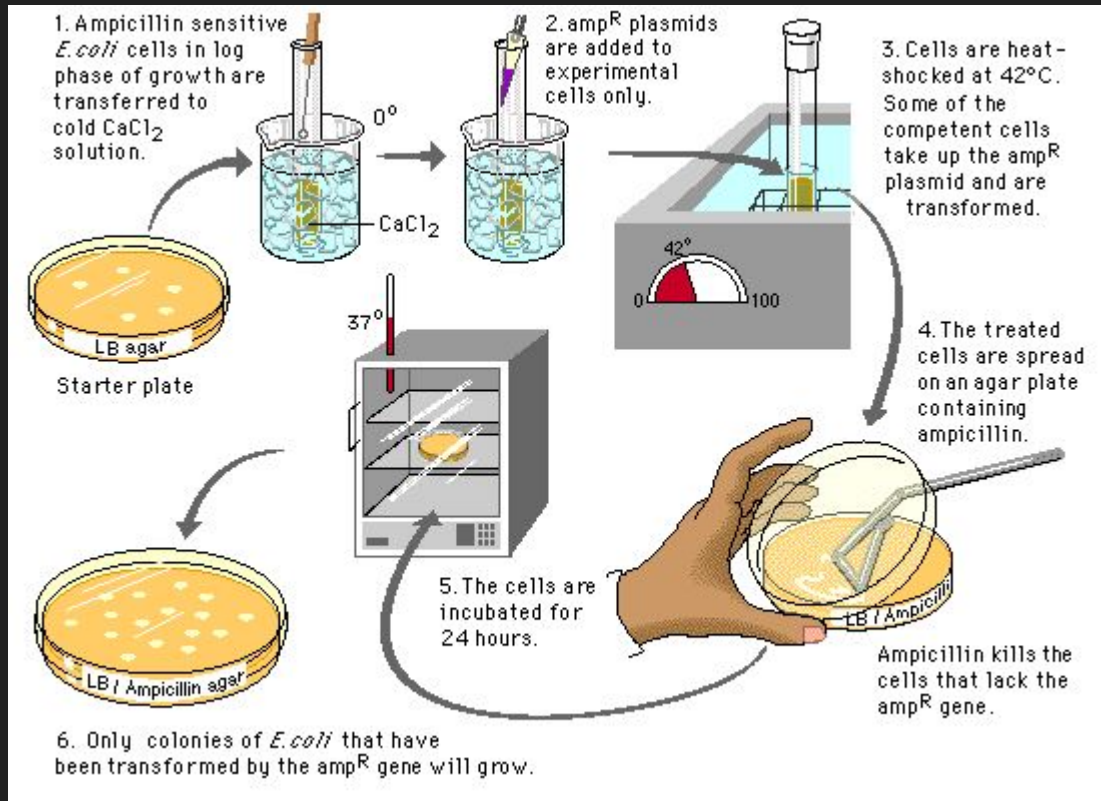
- Transgenic organisms have allowed for the production of things previously unavailable to us
 - Example: The production of Human Insulin
 - Type I Diabetics (Insulin Dependent) - must inject insulin because their pancreas does not produce or use it normally
 - Thanks to genetic engineering, scientists have found a way to create synthetic insulin produced by bacteria or yeast
- Things like this are done through a process called bacterial transformation



Steps of Bacterial Transformation

1. First, you must isolate the gene of interest
2. Insertion of foreign DNA gene into bacterial plasmid. This is done using Restriction Enzymes and DNA Ligase.
 - a. A plasmid is a genetic structure in a cell that can be separated from the chromosomal DNA and replicate independently; typically used in a lab manipulation of genes.
3. Getting bacteria to take in the plasmid; Recombinant DNA is inserted into the bacteria.
4. Selecting the successfully transformed bacteria
5. Producing the product
 - a. The bacteria has now been modified to produce the product based on the genes that were selected and inserted (ex. insulin in bacteria)

Bacterial Transformation



Recombinant DNA Technology

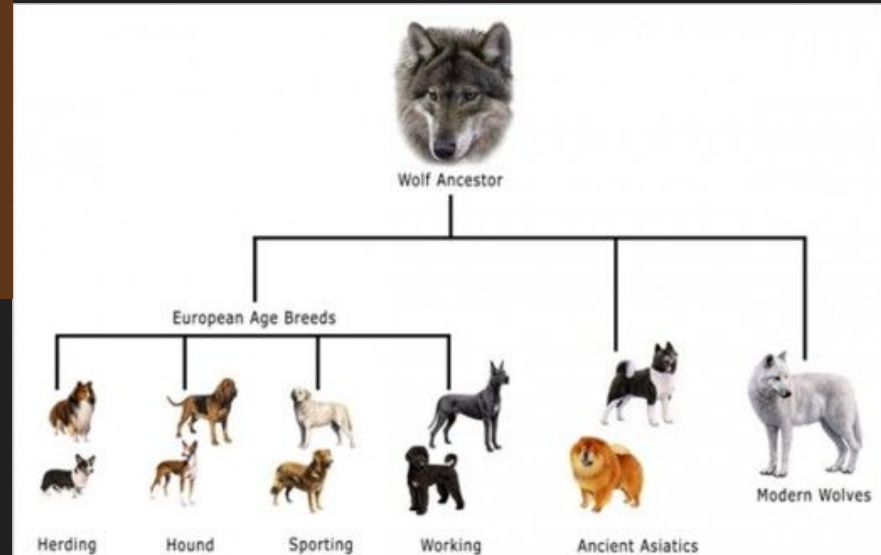
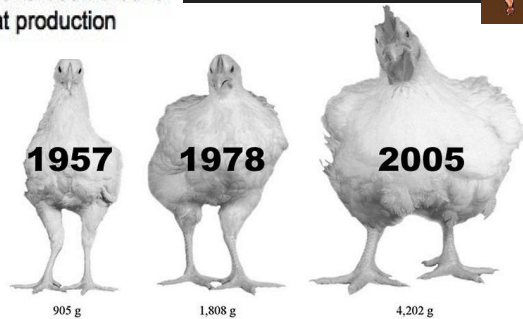


Selective Breeding

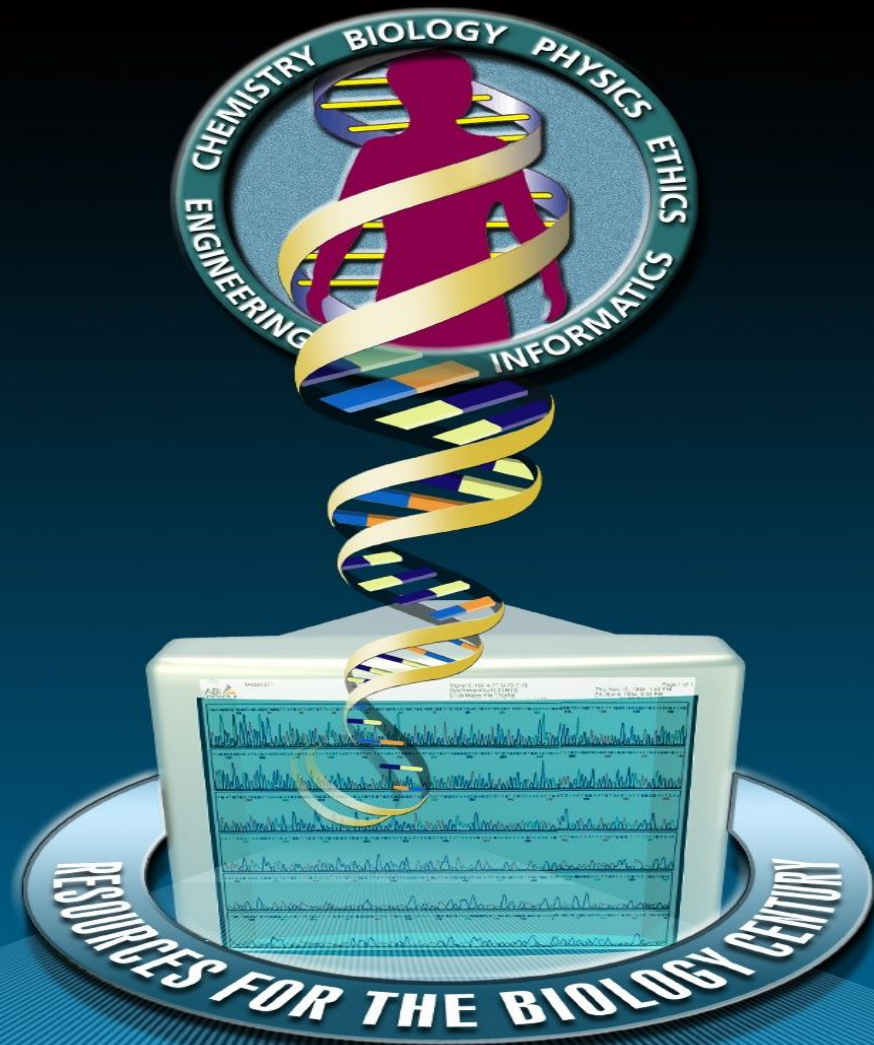
- When man chooses specific organisms to breed to get desired offspring
 - Examples: Dogs, Livestock and Foods



Belgian Blue cattle have been bred for increased meat production



Human Genome Project



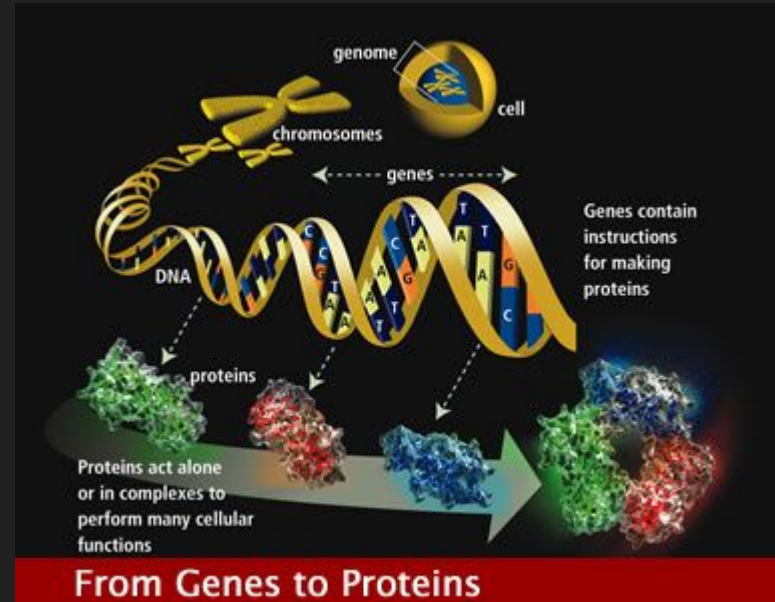
Human Genome Project

- Stated in 1990, the Human Genome Project was started with the goal of determining the sequence of chemical base pairs to make up human DNA
 - Scientists wanted to identify and map all of the genes of the human genome!



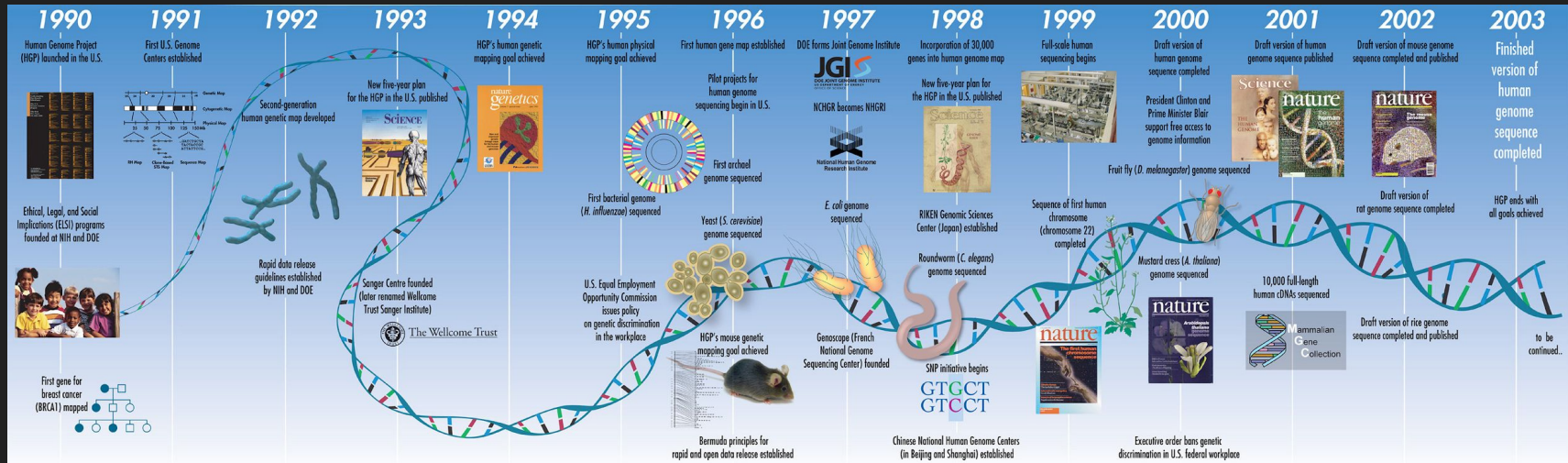
Why the Human Genome Project?

- The Human Genome Project was established with the hope of knowing the human genome....
 - would allow them not only to identify genes that cause genetic conditions
 - Such as, diabetes, heart disease and cancer
 - BUT - also allow them to better treat or prevent those diseases!



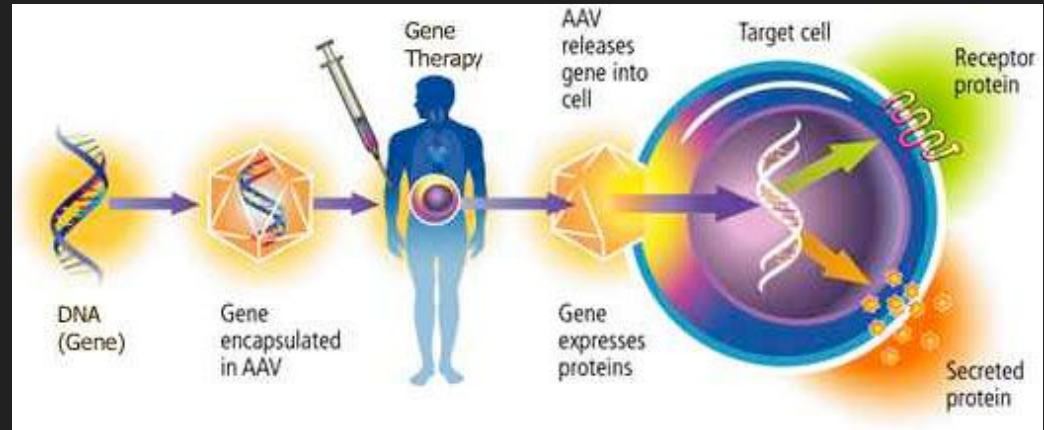
The Human Genome Project

- The Human Genome Project became a successful part of science in April of 2003!
 - Scientists were able to read the genetic blueprint of a human being
- Just as scientists predicted, the project has been useful in determining carrying genes and developing gene therapy



Gene Therapy

- Gene Therapy is a method of using genes to treat or prevent diseases
 - Nucleic acids polymers inserted into cells as a drug are used to express proteins or interfere with expressions
 - Remember: DNA codes for proteins that determine traits!
- Uses include:
 - Immunodeficiency -- an immunodeficiency disease in one in which disorders prevent the body from fighting infections and diseases they way it should
 - Cystic Fibrosis



Ethical Issues

In Genomics and Biotechnology

Genetically Modified Organisms

- Genetically modified organisms (or GMO's) are often a big debate - especially since many are consumed by us!
 - Example:
 - Disease Resistant Plants
 - They are produced for numerous reasons in order to benefit consumers, including increasing crop production, lowering prices
 - There is debate; however, on whether this is always safe for human consumption since the modifications do not occur naturally
 - Allergies, gene transfer to cells of the body



WHAT DO YOU THINK?

The Debate over Biotechnology

- When talking about this topic, the largest issue is always the ethical implications of such methods
- What do you think?
 - Should science improve humans?
 - Should science improve other organisms?
 - What consequences might there be on this technology?



Transgenic Organisms

- Example: Transgenic Mice (hair gene removal)
- Used to help burn patients and others by making human facial features (ears, nose, lips, etc)



Cloning

- Making an identical copy of an organism
 - Steps:
 - Take unfertilized egg from a female of the same species, remove the nucleus
 - Retrieve nucleus of somatic (body) cell of individual you wish to clone
 - Insert the somatic nucleus into the egg cell
 - Providing growth factors needed
- First animal to be cloned was Dolly the sheep, in 1996



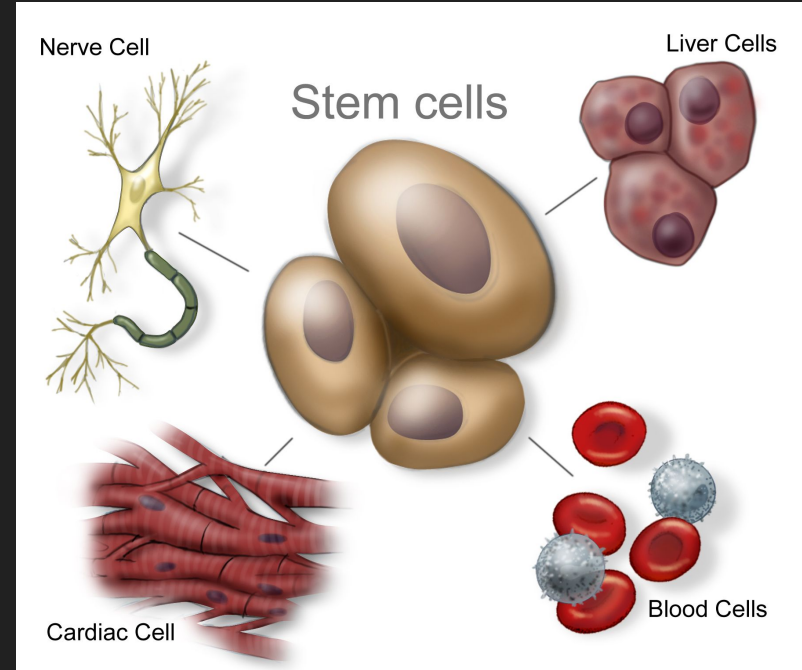
Gene Therapy

- Recall that gene therapy uses the alteration of a person's genes to treat genetic conditions
- Ethical issues surrounding this include:
 - Who decides which traits are normal/faulty?
 - Will this only be available to wealthy individuals?
 - Should it be used to enhance other traits, like height, intelligence or athletic ability?



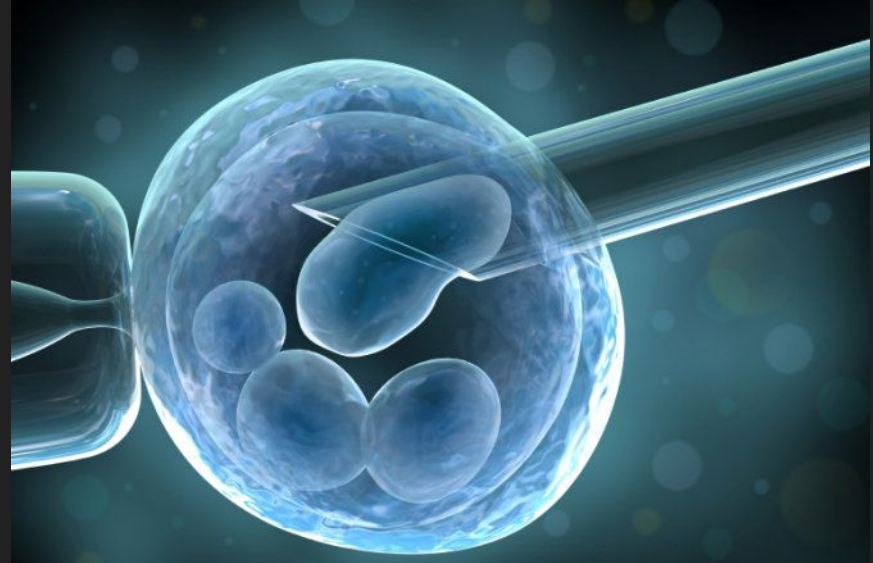
Stem Cells

- Stem cells are undifferentiated cells that can become any type of cells
 - Recall that differentiation takes place as a zygote develops, undifferentiated cells become complex systems of tissues and cell types
- Embryonic Stem Cells - Can become all cell types in the human body
- Adult Stem Cells - thought to be limited to differentiating into only those cell types of their tissue of origin (brain, heart, blood, etc)



Stem Cell Research

- Stem cells are used in research with the potential to treat diseases and aid in research
- However, ethical issues cause debate since stem cells are derived from zygotes - In order to use them, human embryos must be destroyed
 - Debate is still ongoing. but new research about stimulating a patient's cells to behave like stem cells may open new possibilities



What do you think?

