

## BIOTECHNOLOGY



## What Is Biotechnology?

- Using scientific methods with organisms to produce new products or new forms of organisms
- Any technique that uses living organisms (or their substance) to
  - make or modify a product
  - to improve plants or animals
  - to develop microorganisms for specific uses



## What Are the Benefits of Biotechnology?

- Medicine
  - Human
  - Veterinary
  - Biopharming
- Environment
- Agriculture
- Food products
- Industry and manufacturing



## What Are Genetic Engineering Organisms?

- Genetic engineering- artificially changing the genetic information in the cells of organisms
- Transgenic- an organism that has been genetically modified
- GMO- a genetically modified organism
- GEO- a genetically enhanced organism



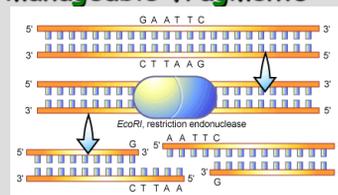
## DNA Extraction

- **Chemical treatments** cause cells and nuclei to burst
- The DNA is inherently **sticky**, and can be pulled out of the mixture
- This is called **"spooling"** DNA



## Cutting DNA

- **Restriction enzymes** cut DNA at specific sequences
- Useful to divide DNA into **manageable fragments**



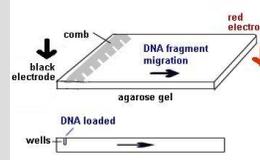
## Electrophoresis

- DNA can be separated based on **size and charge**
- The **phosphate groups** are **negatively charged** (therefore DNA is slightly negative)
- DNA is placed in a **gel** and electricity is run through

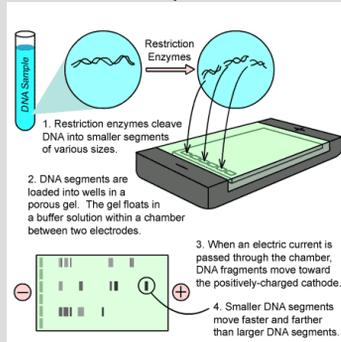


## Electrophoresis

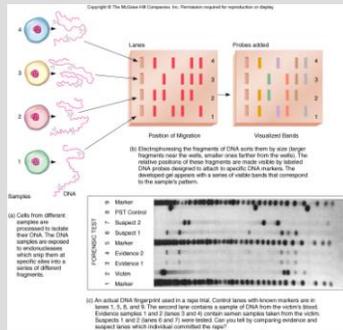
- **Negative DNA** moves toward the positive end
- **Smaller** fragments move farther and faster



## Electrophoresis

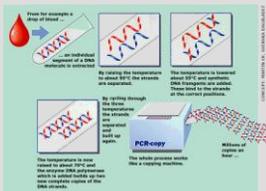


## DNA Fingerprinting: Forensics

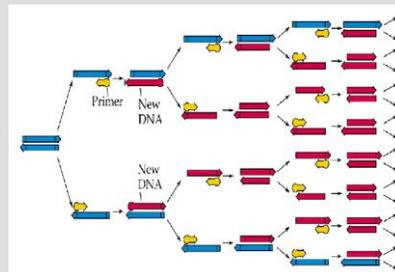


## Copying DNA

- **Polymerase Chain Reaction**
- Also called PCR
- A method of making many copies of a piece of DNA



## PCR

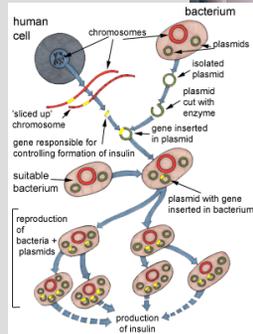


Large amounts of DNA can be made from a small starting sample

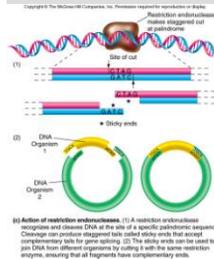


## Recombinant DNA

- Combining DNA from two different organisms



## Useful Properties of DNA



- Restriction endonucleases can cut DNA at specific sites, leaving sticky ends for insertion of new DNA

## Human Genome Project

## Human Genome Project

- Started in 1990
- Research effort to sequence all of our DNA (46 chromosomes)
- Over 3.3 billion nucleotides
- Mapping every gene location (loci)
- Conducted by scientists around the world

## HGP Insights

- Only 2% of human genome codes for proteins (exons)
- Other 98% (introns) are non-coding
- Proteome - organism's complete set of proteins

## Benefits of Genetic Engineering

## Biotechnology Breakthroughs

- **Insulin (1982)**
  - First commercial biotech product
  - Reliable, inexpensive source of insulin
- **Rice**
  - Enriched with beta-carotene and iron
- **Bananas**
  - Containing edible hepatitis vaccine

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## Biotechnology Breakthroughs

- **Potatoes** with higher solid content
- **Garlic** that lowers cholesterol
- **Fruits and vegetables** that reduce risks of cancer and heart disease

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## Environmental Benefits

- **Reduced pesticide use**
- **Lower energy requirements**
- **Cleaner water**
- **Less soil erosion**

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## Difficulties in Genetically Engineering Humans

- Inserting gene in correct cells
- Inserting gene so it is expressed correctly
  - Orientation
  - Regulation
- Controlling virus vector
- Ethical issues



## Other Issues

- How will genetically engineered organisms affect environment?
- Spread of genes to other organisms?
- Who will decide?

