

## DNA Biotechnology

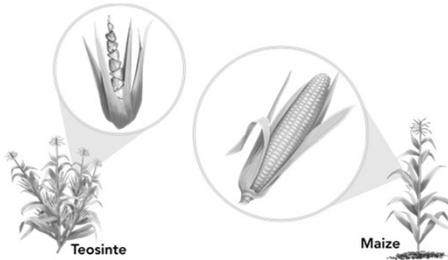
Take your Biotechnology notes out

### Selective Breeding

- Humans breed organisms with desired traits.
- Takes advantage of naturally occurring genetic variation.



### Selective Breeding in Plants



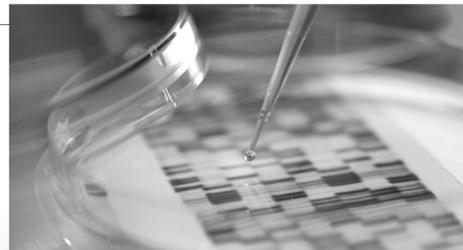
## DNA Biotechnology

- The manipulation of organisms or their parts for human use.

## DNA Analysis

- Using DNA sequences to identify people
- Compares DNA samples in certain areas of chromosomes that differ
- Useful for determining paternity, evidence in crime scenes, & identifying human remains
- Many different techniques to identify DNA

### The Process of Genetic Engineering



### Learning Targets

- I can explain how scientists copy the DNA of living organisms.
- I can explain how recombinant DNA is used.
- I can describe how transgenic organisms are produced.

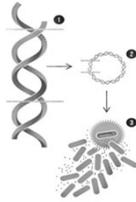
### Genetic Engineering

- Production of organisms with new genetic traits



### Uses of Genetic Engineering

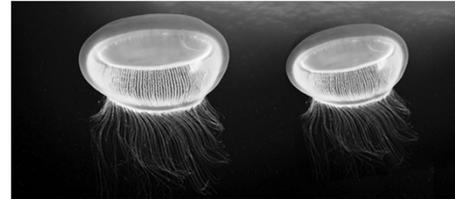
- Used to make insulin, better crops (pest and disease resistance), and better animals (selective breeding).



### DNA Analysis

Finding a Gene

- Predict mRNA sequence
- Screen a genetic library to find a match



### DNA Extraction

- Removing DNA samples from an organism to use for comparison

### PCR: Copying DNA

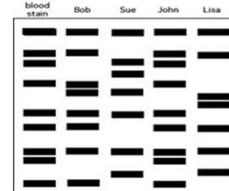
- Technique that quickly produces many copies of a DNA fragment.

### Restriction Enzymes

- Act as "molecular scissors"
- Come from bacteria
- Used to cut long DNA molecules into shorter pieces
- Cuts at specific locations
- Allows scientists to more easily study & manipulate genes

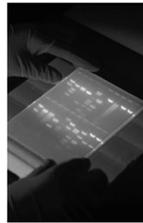
### Gel Electrophoresis: Sorting DNA by size

- Separates DNA or proteins by size and charge using an electric current to pull fragments through a gel
- Compares DNA from different individuals or organisms



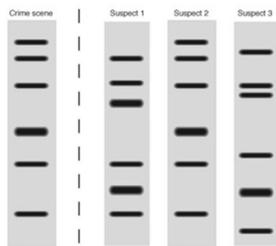
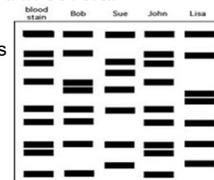
### Gel electrophoresis

- Smaller fragments move faster and travel farther than larger fragments.
- Fragments of different sizes appear as bands on the gel.

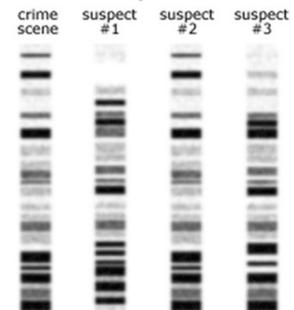


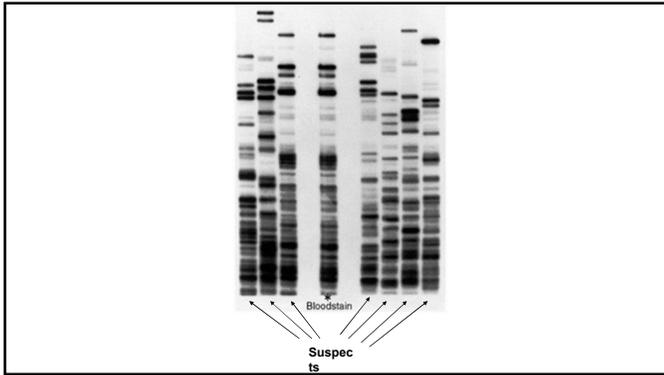
### DNA fingerprinting

- Creates a pattern of bands known as a **DNA Fingerprint**
- DNA fingerprinting is used in several ways.
  - evidence in criminal cases
  - paternity tests
  - studying biodiversity



### DNA samples from:





### Plasmids

- Ring of DNA from bacteria.
- This DNA is separate from bacterial DNA and usually contains survival information like antibiotic resistance.

Bacterial DNA

Plasmids

### Recombinant DNA

- Cutting out a segment of DNA from one organism & placing it in a new organism
- Results in a combination of DNA from both organisms

foreign DNA

plasmid (bacterial DNA)

### Transgenic Organism

- has one or more genes from another organism inserted into its genome.

foreign DNA

restriction site

gene

sticky ends

Plasmid

### Transgenic Animals

### Transgenic Plants

Agrobacterium tumefaciens

Plasmid

Gene to be transferred

Recombinant plasmid

Desired gene

Agrobacterium tumefaciens

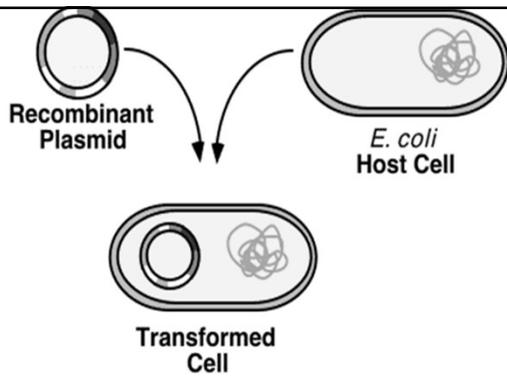
Transferred gene

Plant cell colonies

- Transgenic bacteria can be used to produce human proteins, such as insulin
  - gene inserted into plasmid
  - plasmid inserted into bacteria
  - bacteria express the gene
- Transgenic plants are common in agriculture.
  - transgenic bacteria infect a plant
  - many crops are now genetically modified (GM)



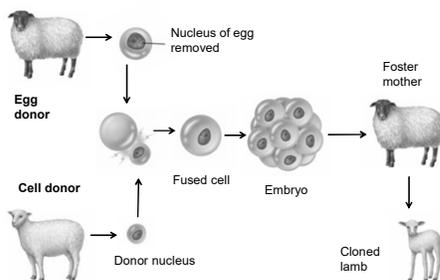
- Scientists have concerns about some uses of genetic engineering.
  - possible long-term health effects of eating GM foods
  - possible effects of GM plants on ecosystems and biodiversity



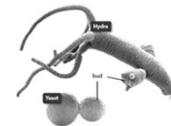
### Cloning

- Producing genetically identical individuals from a single cell

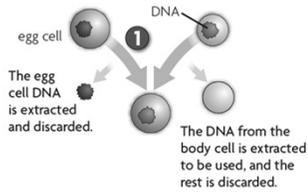
### Cloning



- Cloning occurs in nature.
  - bacteria (binary fission)
  - some plants (from roots)
  - some simple animals (budding, regeneration)



- Mammals can be cloned through a process called nuclear transfer.
  - nucleus is removed from an egg cell
  - nucleus of a cell from the animal to be cloned is implanted in the egg



- Cloning has potential benefits.
  - organs for transplant into humans
  - save endangered species
- Cloning raises concerns.
  - low success rate
  - decreased biodiversity

### Applications of Biotechnology

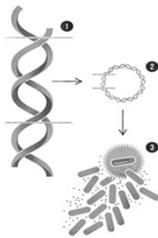


### Learning Targets

- I can explain how genetic engineering can benefit agriculture and industry.
- I can explain how biotechnology can improve human health.
- I can explain how DNA is used to identify individuals.

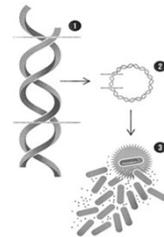
### Real-world Applications of Genetic Engineering

- Medical Applications
- Agricultural Applications
- Forensics (personal identification)



### Medical Applications

- Gene Therapy
- Insulin production
- Vaccines
- Cloning



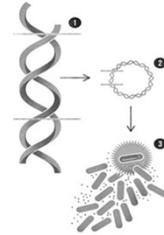
### Health and Medicine

- Genetic Testing
- Medical Research
- Preventing and Treating Disease
  - Golden Rice
  - Human Proteins
  - Gene Therapy
  - GM Mosquitos



### Agricultural Applications

- Increasing better yields of crops & improving nutrition
- Pest/Disease resistance
- Improving animals



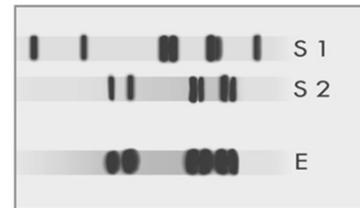
### Agriculture and Industry

Ideally, genetic modification will lead to better, less expensive, and more nutritious food as well as less harmful manufacturing processes.

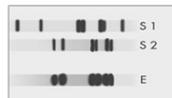
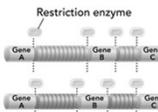
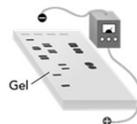
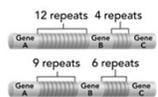
- GM crops
- GM animals



### Forensic Science



### Personal Identification



- The **Human Genome Project** has sequenced all of the DNA base pairs of human chromosomes.

- analyzed DNA from a few people
- still working to identify and map human genes



### Applications of Genetic Engineering Review

- Explain how genetic engineering can benefit agriculture and industry.
- Explain how biotechnology can improve human health.
- Explain how DNA is used to identify individuals.

### Biotech Videos

- <https://www.youtube.com/watch?v=YX-NrhCfK7I>
- <https://www.youtube.com/watch?v=nfC689EIUVk>

### Ethics and Impacts of Biotechnology



### Learning Objectives

- Explain what privacy issues biotechnology raises.
- Describe some of the pros and cons of transgenic organisms.
- Explain what some of the ethical issues are around new biotechnology.

### Profits and Privacy

#### Patenting Life

- Molecules and biotechnology procedures can be patented.
- Genes found in nature cannot be patented.

#### Genetic Privacy

- DNA can reveal private information, including ethnic heritage, the chances of developing certain diseases, and evidence for criminal cases.
- Who owns the information stored in your DNA?
- How should genetic information be used?

### Arguments for GM Foods

Produce higher yields	Lower food costs
Reduce land use	Reduce chemical usage
Reduce energy consumption	After more than two decades, no evidence of harm has been found.



### Arguments against GM Foods

No long-term studies

Insect resistance genes may threaten beneficial insects.

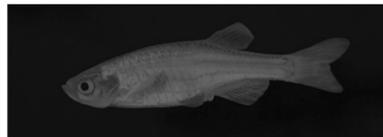
Herbicide resistance genes may lead to overuse of herbicides.

Patents may prove too costly for small farmers.



### Ethics of the New Biology

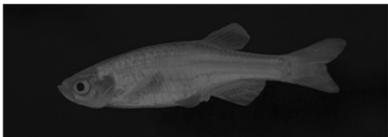
• Just because we have the technology to modify an organism's characteristics, are we justified in doing so?



### Review Ethics and Impacts of Biotechnology

• In your opinion, what is the single most important ethical issue related to biotechnology?

• Why does this issue need to be resolved?



### Just Because We Can, Does it Mean We Should?

