# Kickoff: Read the following and comment.

2010-04-29 | permalink Cyprus is a country in Europe.

## Friends of the Earth Cyprus join campaign against spread of GMO crops

CYPRUS' Friends of the Earth have joined Greenpeace and Save our Souls (SOS) in a pan-European campaign against Genetically Modified Organism cultivation within Europe. [...] The US Embassy reportedly sent a warning letter shortly after the bill [for segregation of products with GMO content on supermarket shelves] was proposed, stating that approval could hurt US-Cyprus relations by "stigmatizing" GM products. The bill is currently still under consideration.

The Cyprus Mail, Cyprus: Cyprus joins campaign against spread of GMO crops

2011-05-18 | permalink

## Celebrate a safer life in Cyprus with new GMO law

AFTER 10 years of campaigning, the Cyprus Greens emerged victorious before the Parliament closed its doors prior to elections. A law regarding Genetically Modified Organism products wa passed stipulating that any product containing GMOs must be placed on separate shelving in supermarkets. This is a European first and the Cyprus Greens aspire to more. We hope this w mean the banning of GMO crops in Cyprus, the Mediterranean and Europe.

Cyprus Mail, Cyprus: Celebrate a safer life with new GMO law

# 9.1 Manipulating DNA

## KEY CONCEPT

**Biotechnology relies on cutting DNA at specific places.**

# 9.1 Manipulating DNA

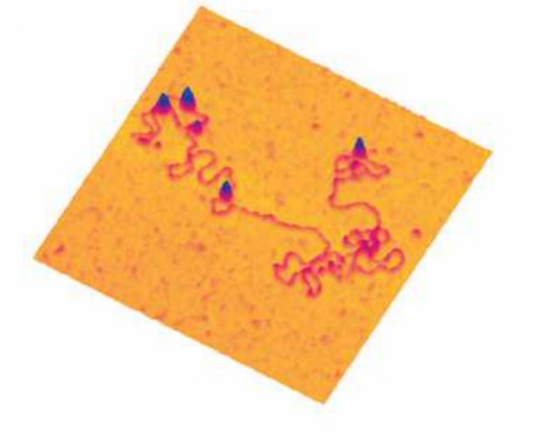
## Scientists use several techniques to manipulate DNA.

- Chemicals, computers, and bacteria are used to work with DNA.
- Scientists use these tools in genetics research and biotechnology.

# 9.1 Manipulating DNA

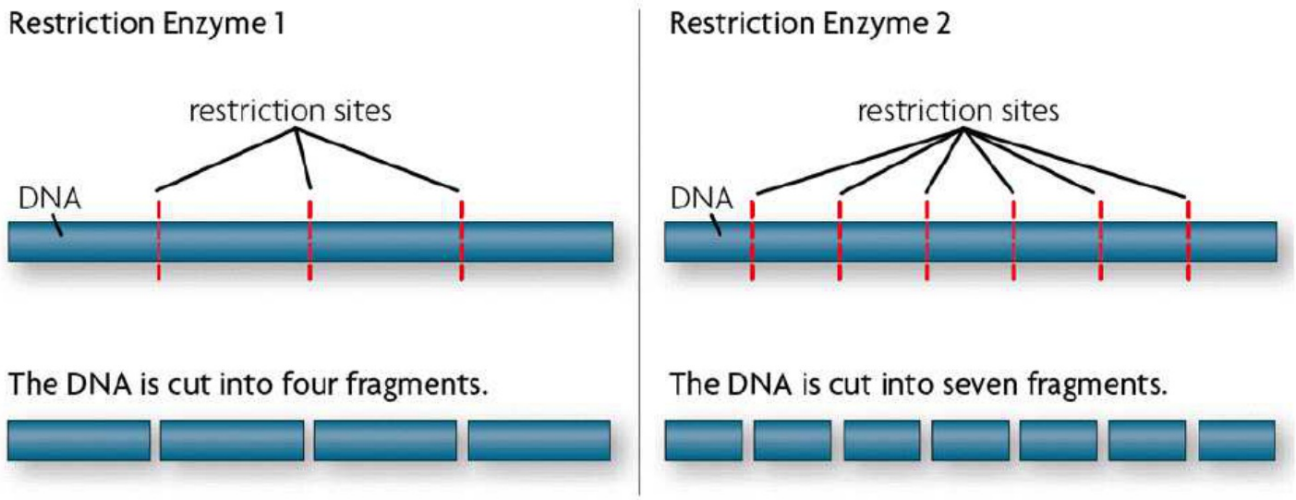
## Restriction enzymes cut DNA.

- Restriction enzymes act as “molecular scissors.”
  - come from various types of bacteria
  - allow scientists to more easily study and manipulate genes
  - cut DNA at a specific nucleotide sequence called a restriction site



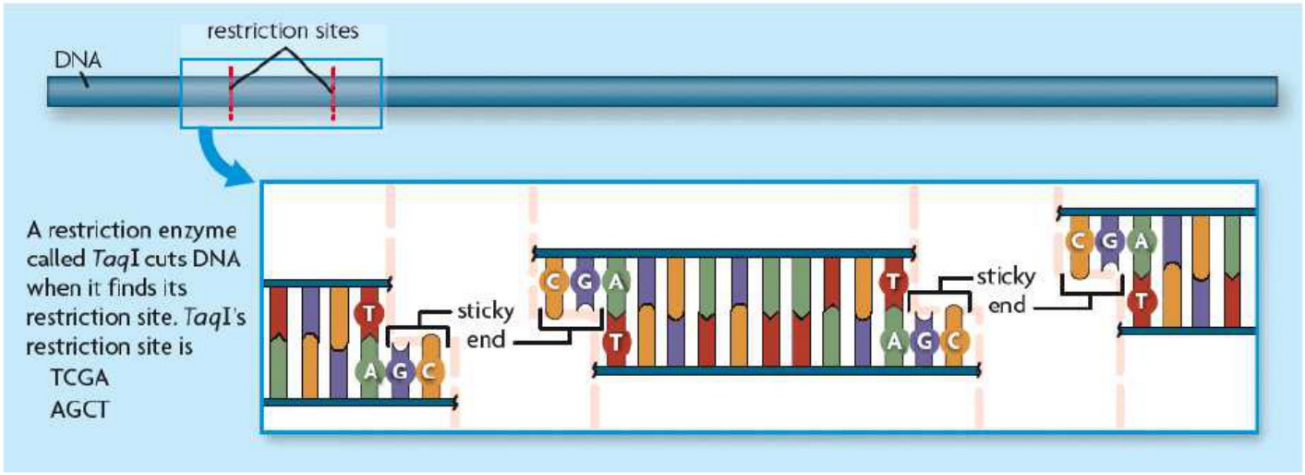
# 9.1 Manipulating DNA

- Different restriction enzymes cut DNA in different ways.
  - each enzyme has a different restriction site



# 9.1 Manipulating DNA

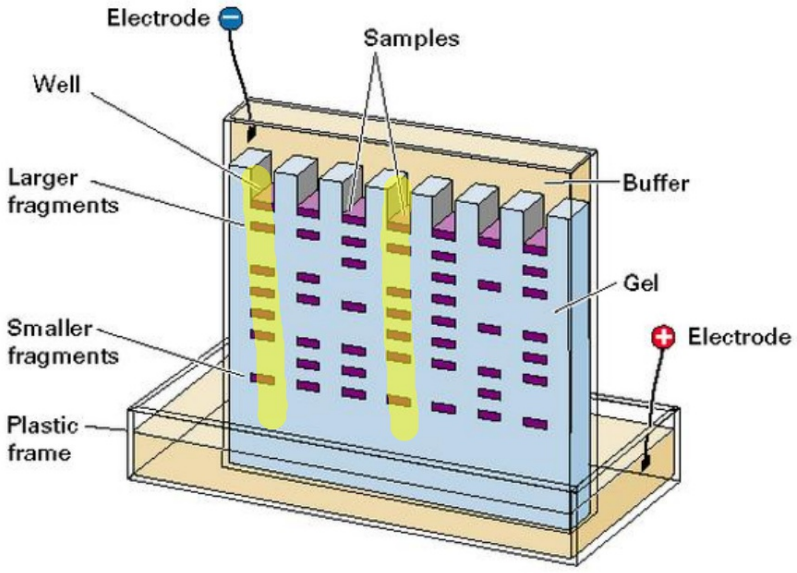
- some cut straight across and leave “blunt ends”
- some make staggered cuts and leave “sticky ends”



# 9.1 Manipulating DNA

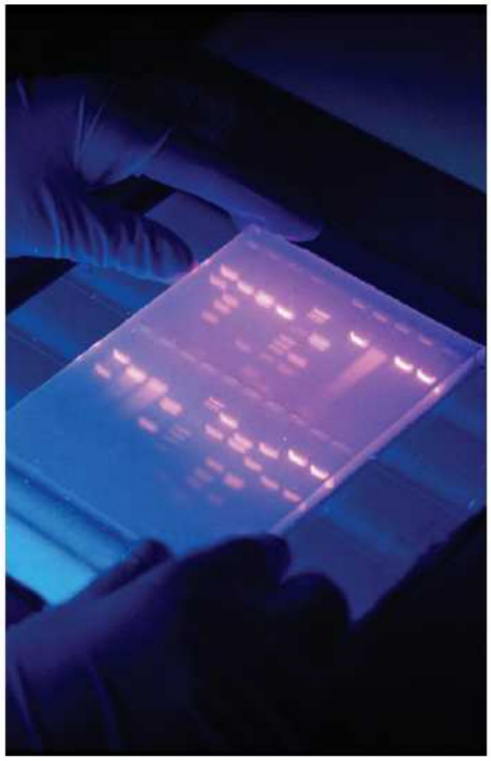
## Restriction maps show the lengths of DNA fragments.

- Gel electrophoresis is used to separate DNA fragments by size.
  - A DNA sample is cut with restriction enzymes.
  - Electrical current pulls DNA fragments through a gel.



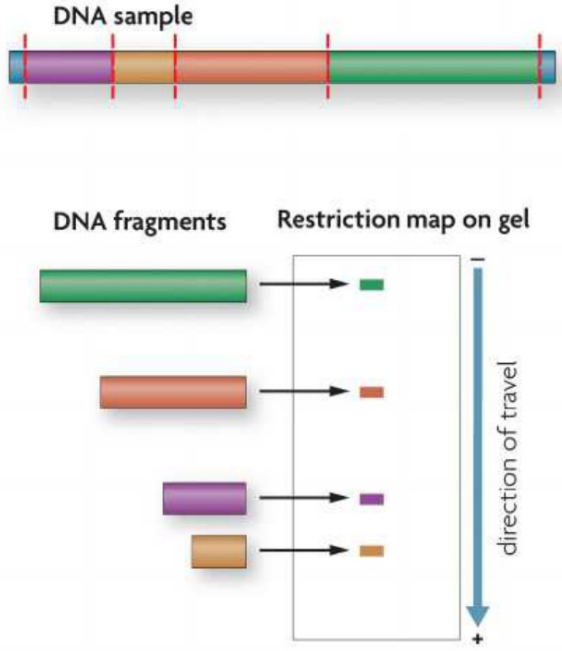
## 9.1 Manipulating DNA

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



# 9.1 Manipulating DNA

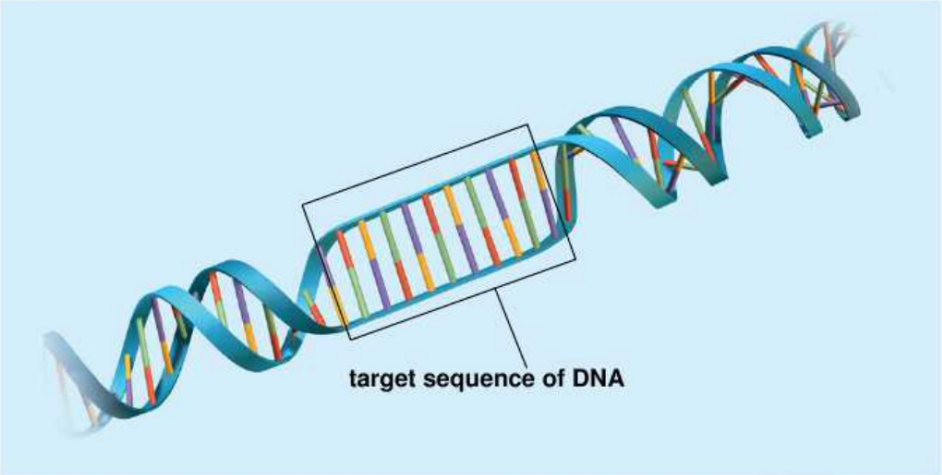
- A restriction map shows the lengths of DNA fragments between restriction sites.
  - only indicate size, not DNA sequence
  - useful in genetic engineering
  - used to study mutations



# 9.2 Copying DNA

## PCR uses polymerases to copy DNA segments.

- PCR makes many copies of a specific DNA sequence in a few hours.

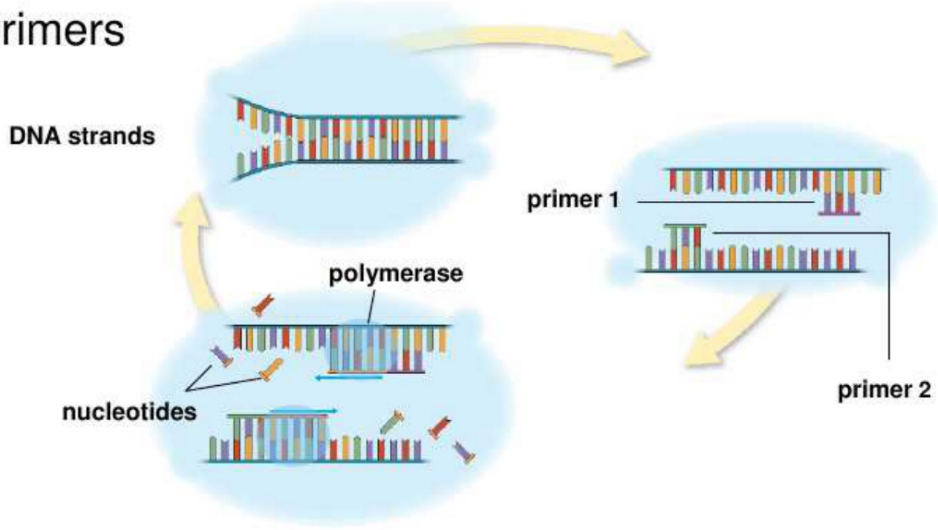



- PCR amplifies DNA samples.
- PCR is similar to DNA replication.

# 9.2 Copying DNA

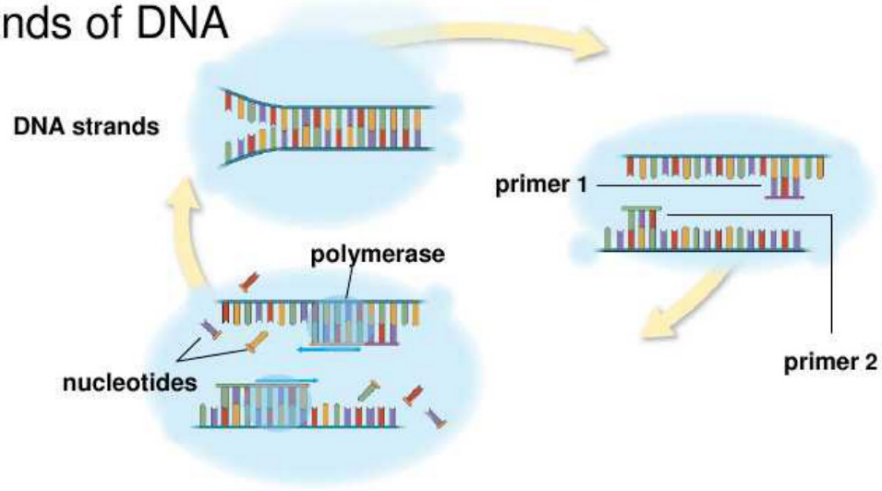
## PCR is a three-step process.

- PCR uses four materials.
  - DNA to be copied
  - DNA polymerase
  - A, T, C, and G nucleotides
  - two primers



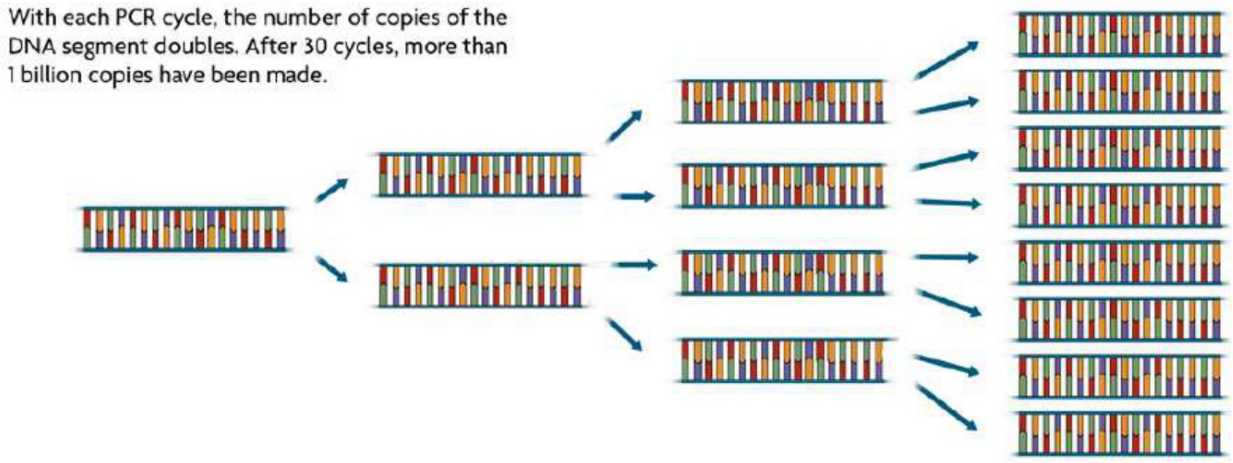
# 9.2 Copying DNA

- The three steps of PCR occur in a cycle.
  - heat is used to separate double-stranded DNA molecules
  - primers bind to each DNA strand on opposite ends of the segment to be copied
  - DNA polymerase binds nucleotides together to form new strands of DNA



# 9.2 Copying DNA

- Each PCR cycle doubles the number of DNA molecules.



# 9.3 DNA Fingerprinting

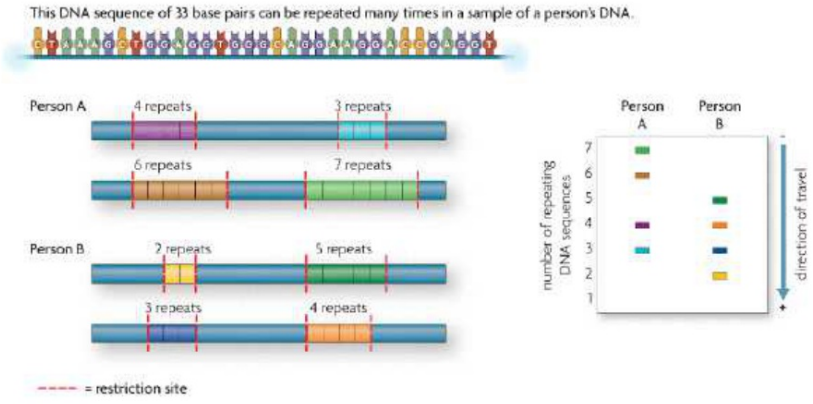
## KEY CONCEPT

**DNA fingerprints identify people at the molecular level.**

# 9.3 DNA Fingerprinting

## A DNA fingerprint is a type of restriction map.

- DNA fingerprints are based on parts of an individual's DNA that can by used for identification.
  - based on noncoding regions of DNA
  - noncoding regions have repeating DNA sequences
  - number of repeats differs between people
  - banding pattern on a gel is a DNA fingerprint



# 9.3 DNA Fingerprinting

## DNA fingerprinting is used for identification.

- DNA fingerprinting depends on the probability of a match.
  - Many people have the same number of repeats in a certain region of DNA.
  - The probability that two people share identical numbers of repeats in several locations is very small.

## 9.3 DNA Fingerprinting

– Individual probabilities are multiplied to find the overall probability of two DNA fingerprints randomly matching.

$$\frac{1}{500} \times \frac{1}{90} \times \frac{1}{120} = \frac{1}{5{,}400{,}000} = \textbf{1 chance in 5.4 million people}$$

– Several regions of DNA are used to make DNA fingerprints.

# 9.3 DNA Fingerprinting

- DNA fingerprinting is used in several ways.
  - evidence in criminal cases
  - paternity tests
  - immigration requests
  - studying biodiversity
  - tracking genetically modified crops

# 9.4 Genetic Engineering

## KEY CONCEPT

**DNA sequences of organisms can be changed.**

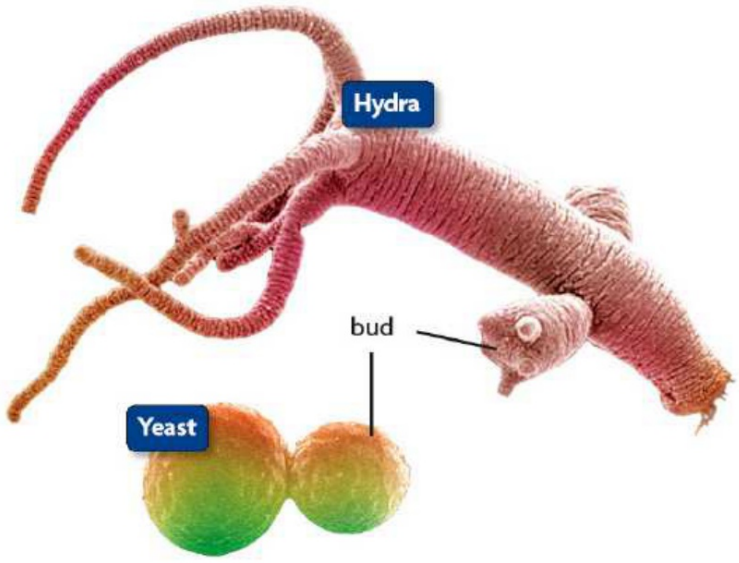
# 9.4 Genetic Engineering

## Entire organisms can be cloned.

- A clone is a genetically identical copy of a gene or of an organism.

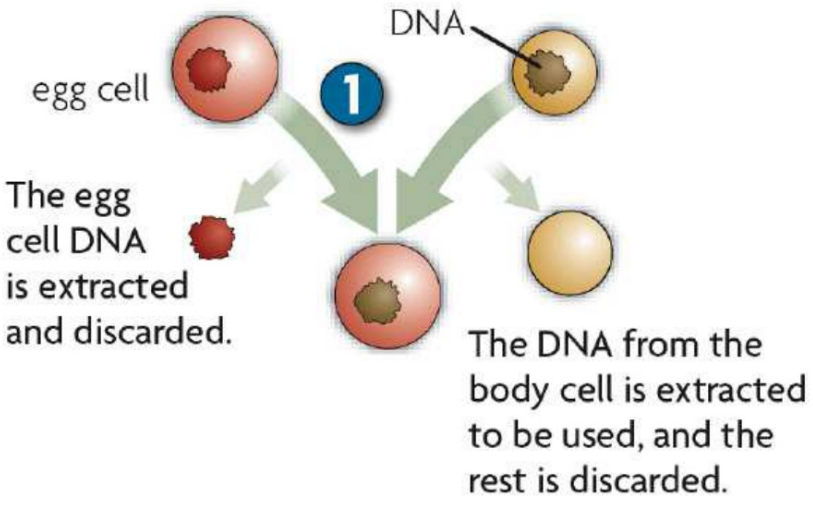
# 9.4 Genetic Engineering

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



# 9.4 Genetic Engineering

- 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



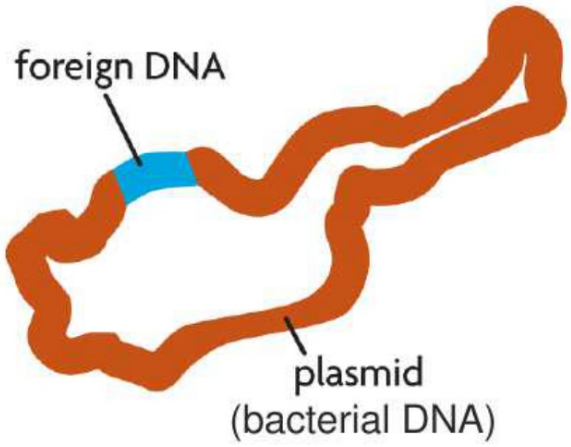
## 9.4 Genetic Engineering

- Cloning has potential benefits.
  - organs for transplant into humans
  - save endangered species
- Cloning raises concerns.
  - low success rate
  - clones “imperfect” and less healthy than original animal
  - decreased biodiversity

# 9.4 Genetic Engineering

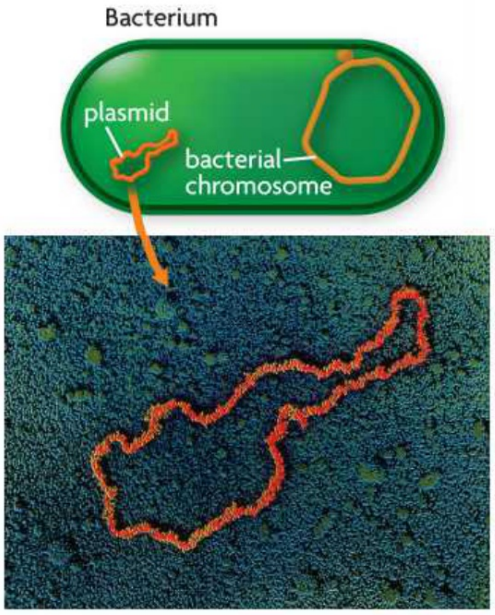
## New genes can be added to an organism's DNA.

- Genetic engineering involves changing an organism's DNA to give it new traits.
- Genetic engineering is based on the use of recombinant DNA.
- Recombinant DNA contains genes from more than one organism.



# 9.4 Genetic Engineering

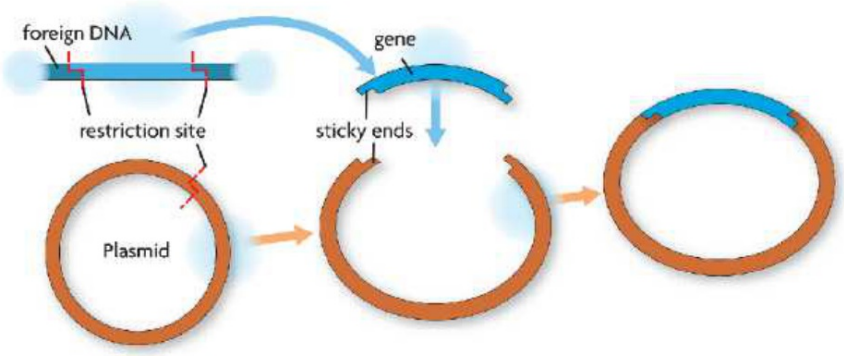
- Bacterial plasmids are often used to make recombinant DNA.
  - plasmids are loops of DNA in bacteria
  - restriction enzymes cut plasmid and foreign DNA
  - foreign gene inserted into plasmid

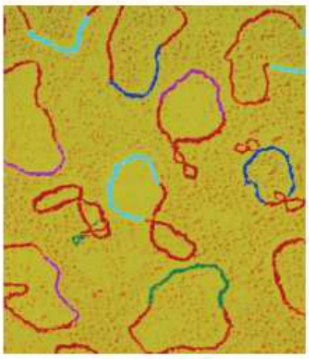


# 9.4 Genetic Engineering

## Genetic engineering produces organisms with new traits.

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



# 9.4 Genetic Engineering

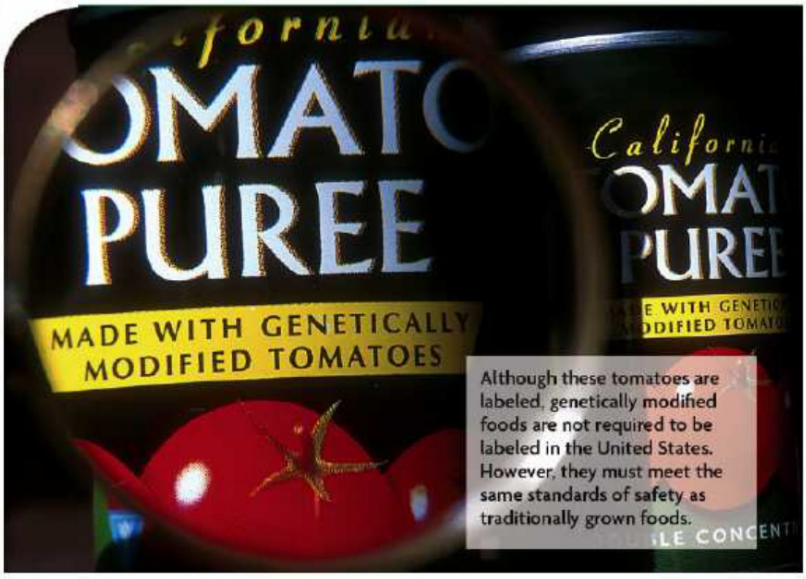
- Transgenic bacteria can be used to produce human proteins.
  - gene inserted into plasmid
  - plasmid inserted into bacteria
  - bacteria express the gene
- Transgenic plants are common in agriculture.
  - transgenic bacteria infect a plant
  - plant expresses foreign gene
  - many crops are now genetically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

## 9.4 Genetic Engineering

- Transgenic animals are used to study diseases and gene functions.
  - transgenic mice used to study development and disease
  - gene knockout mice used to study gene function

# 9.4 Genetic Engineering

- 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



# 9.5 Genomics and Bioinformatics

## KEY CONCEPT

**Entire genomes are sequenced, studied, and compared.**

## 9.5 Genomics and Bioinformatics

- **Genomics involves the study of genes, gene functions, and entire genomes.**
  - Genomics is the study of genomes.
    - can include the sequencing of the genome
    - comparisons of genomes within and across species

# 9.5 Genomics and Bioinformatics

- Gene sequencing is determining the order of DNA nucleotides in genes or in genomes.
- The genomes of several different organisms have been sequenced.

**FIGURE 9.13 COMPARING GENOME SIZES**

| Organism | Approximate Total DNA (millions of bases) |
|---|---|
| *E. coli* | 4.6 |
| Fruit fly | 165 |
| Yeast | 12.1 |
| Banana | 873 |
| Chicken | 1200 |
| Humans | 3000 |
| Vanilla | 7672 |
| Crested newt | 18,600 |
| Lungfish | 139,000 |

## 9.5 Genomics and Bioinformatics

- 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

# 9.5 Genomics and Bioinformatics

- **Technology allows the study and comparison of both genes and proteins.**
  - Bioinformatics is the use of computer databases to organize and analyze biological data.
  - DNA microarrays are used to study the expression of many genes at once.

- Proteomics is the study and comparison of proteins.

# 9.6 Genetic Screening and Gene Therapy

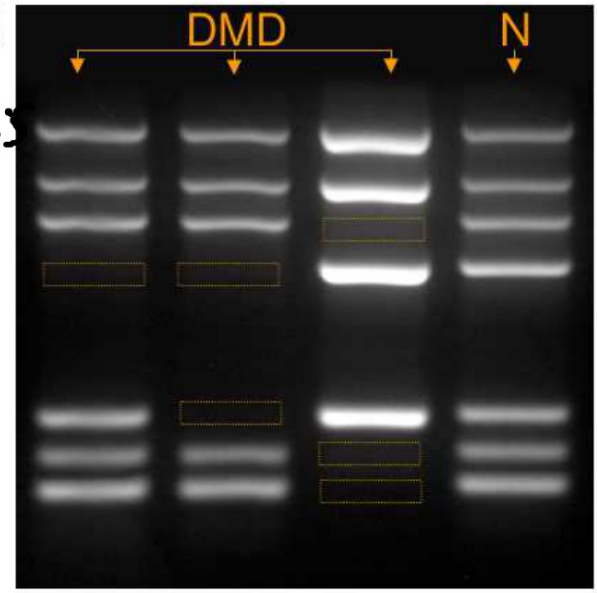
## KEY CONCEPT

**Genetics provides a basis for new medical treatments.**

# 9.6 Genetic Screening and Gene Therapy

## Genetic screening can detect genetic disorders.

- Genetic screening involves the testing of DNA.
  - determines risk of having or passing on a genetic disorder amniocentesis
  - used to detect specific genes or proteins
  - can detect some genes related to an increased risk of cancer
  - can detect some genes known to cause genetic disorders



# 9.6 Genetic Screening and Gene Therapy

## Gene therapy is the replacement of faulty genes.

- Gene therapy replaces defective or missing genes, or adds new genes, to treat a disease.

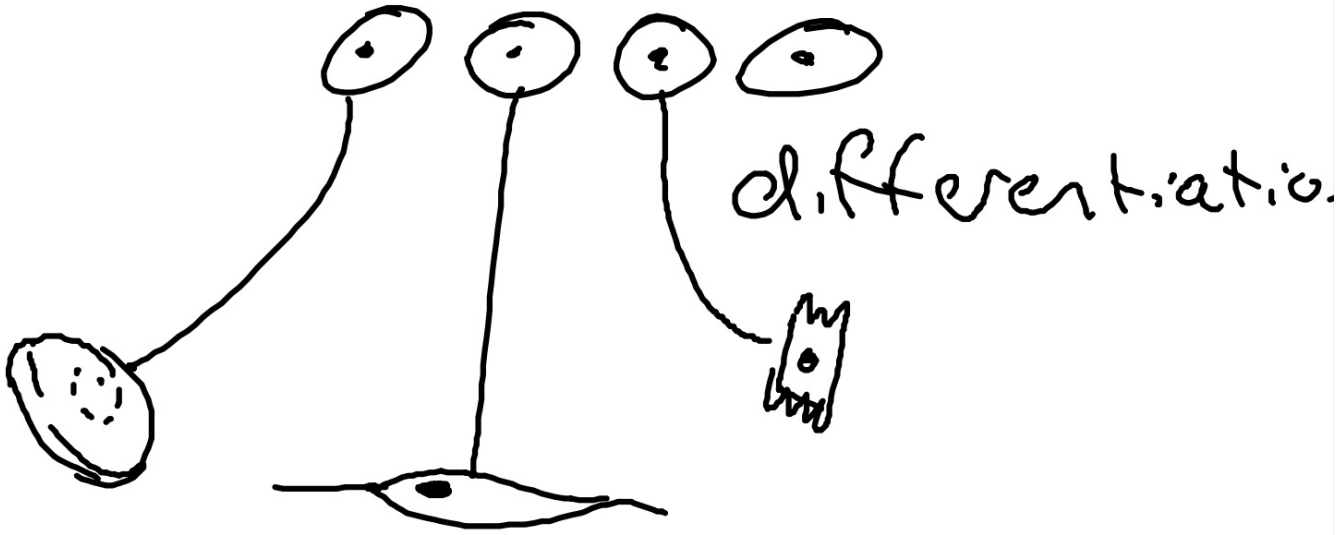
## 9.6 Genetic Screening and Gene Therapy

- Several experimental techniques are used for gene therapy.
  - genetically engineered viruses used to “infect” a patient’s cells
  - insert gene to stimulate immune system to attack cancer cells
  - insert “suicide” genes into cancer cells that activate a drug

## 9.6 Genetic Screening and Gene Therapy

- Gene therapy has many technical challenges.
  - inserting gene into correct cells
  - controlling gene expression
  - determining effect on other genes

Stem cells are undifferentiated.



Cheat Sheet for human karyotypes

1. Clip out one homologous pair at a time
2. Locate and cut out/paste sex chromosome first
3. Locate and cut out/paste the longest chromosomes so that chromosomes get progressively smaller
4. DO NOT lose chromosomes
5. Clean up your mess!
6. Make sure you and your partner have your name on every sheet.