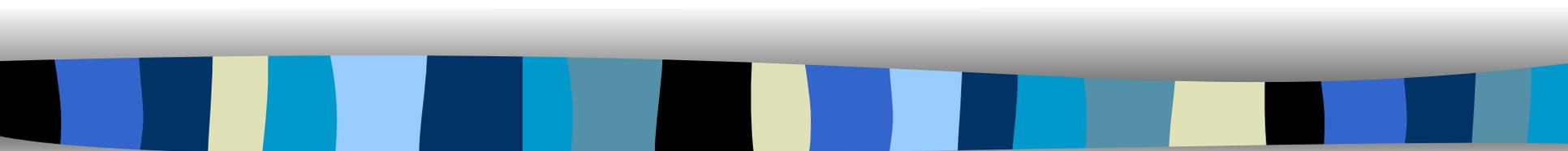
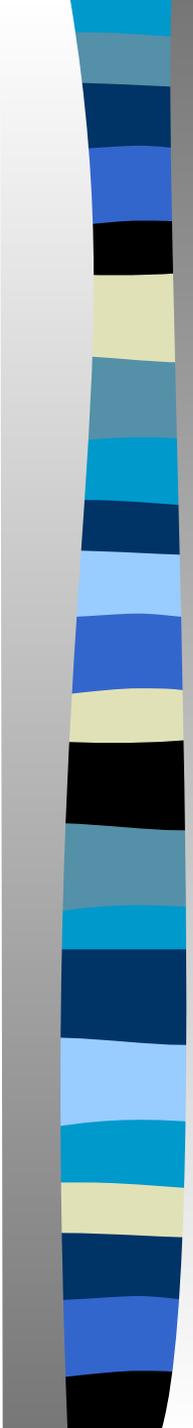


Chapter 13 & 14



The Human Genome & Genetic Engineering

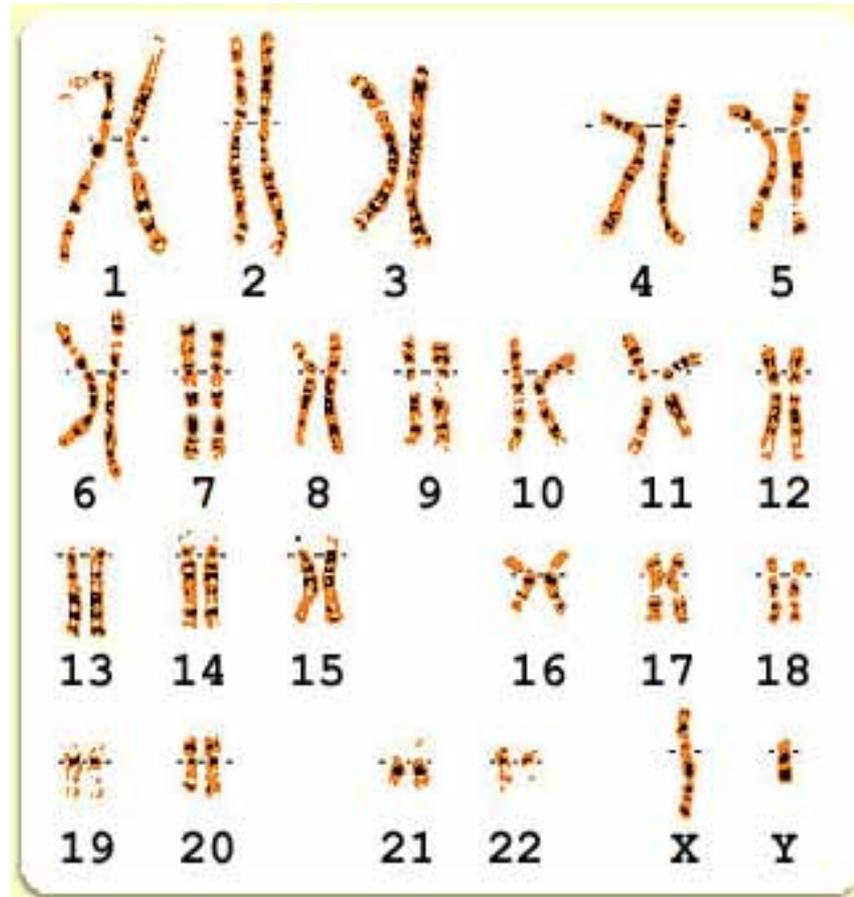


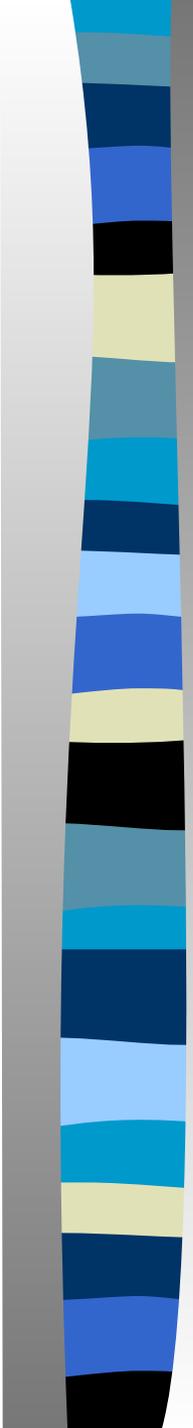
The Human Genome

- Our complete set of genetic info
- Tens of thousands of genes

Human Heredity

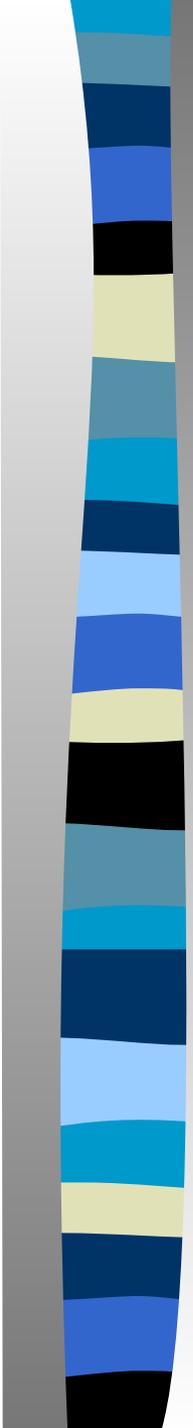
- **# of chromosomes:**
46 total or 23 pairs
(44 autosomes & 2 sex chromosomes)
- **Karyotype:** picture of chromosomes arranged in homologous pairs





Sex Chromosomes & Gametes

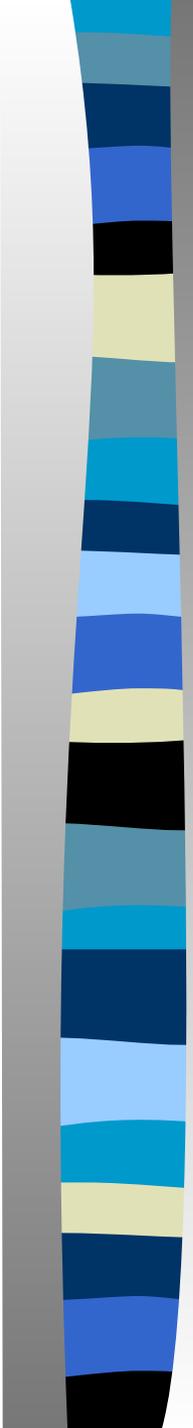
- Females have 2 X chromosomes (XX)
- Males have 1 X and 1 Y chromosome
- X chromosome is bigger than Y (XY)



**What are the chances of getting a boy
or a girl?**

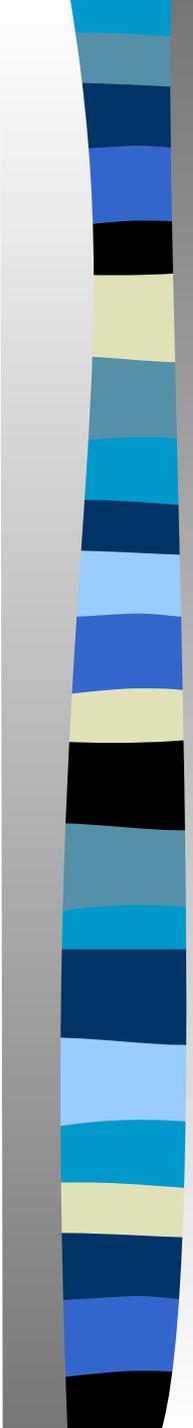
	X	Y
X	XX	XY
X	XX	XY

**50/50
Chance**



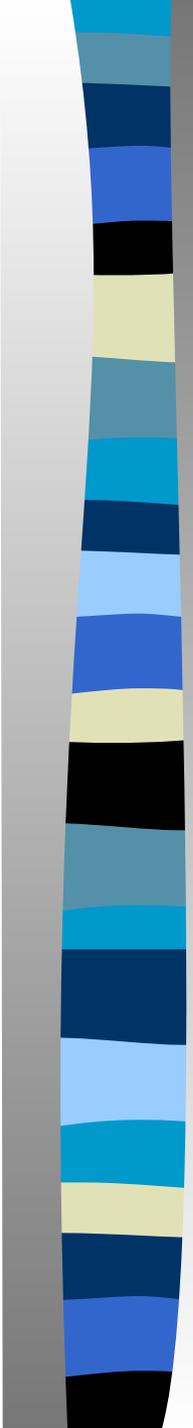
Sex Linked Genes

- Genes that are located on the X and Y chromosome
- X chromosome contains many genes- over 100 genetic disorders have been mapped to the X chromosome
- Y chromosome contains only a few genes



Sex Linked Traits

- All X linked alleles are expressed in males because they only have 1 X chromosome
- Females that have one X linked allele are called carriers and do not express the trait
- Females that have both X linked alleles express the trait



Colorblindness

- Recessive allele that is linked the X chromosome (X^c)
- Females must have both recessive alleles to be colorblind (X^cX^c)
- All males who have the recessive allele will be colorblind (X^cY)
- 1/10 males red-green colorblind
- 1/100 females red-green colorblind

X^C

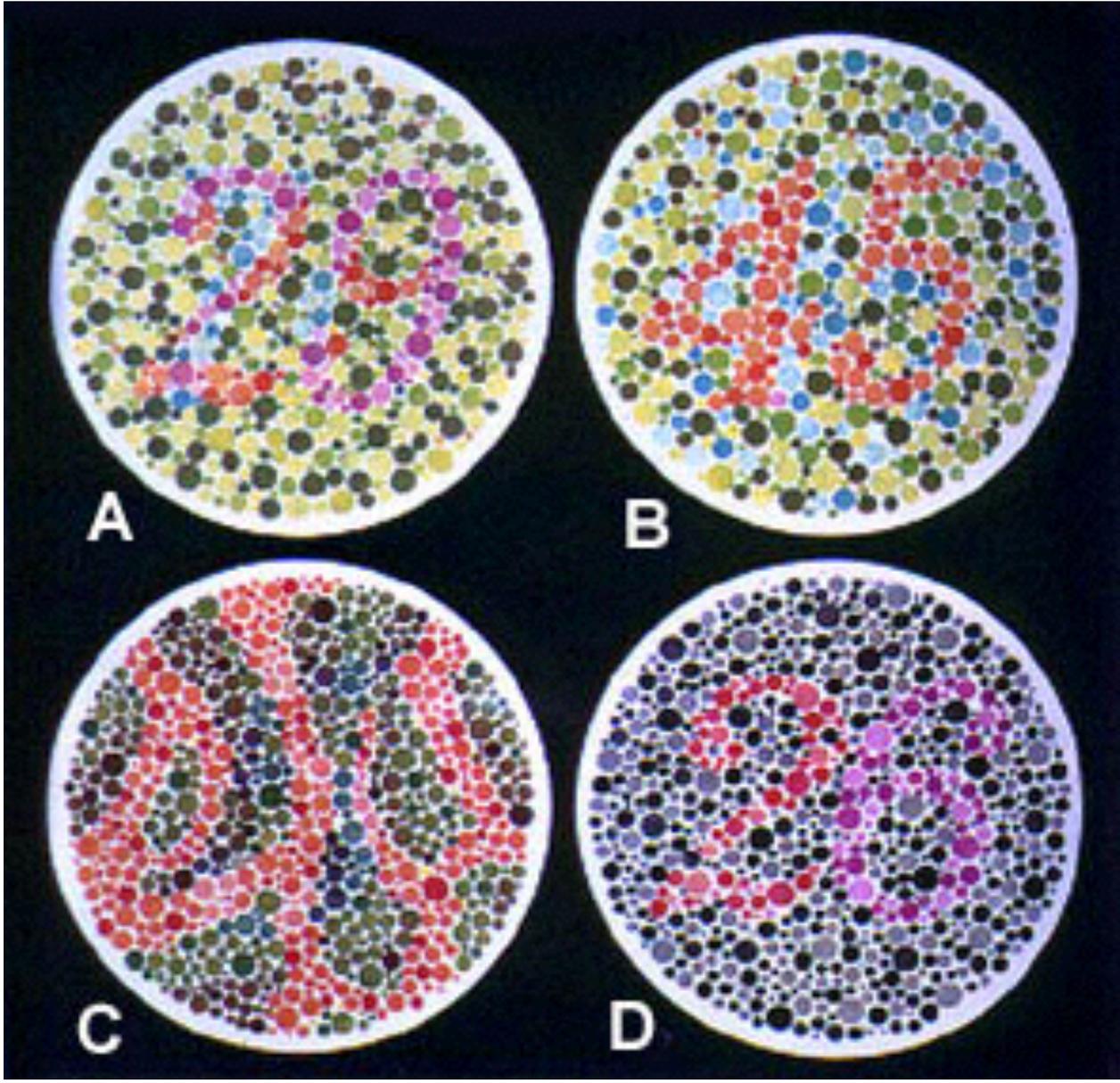
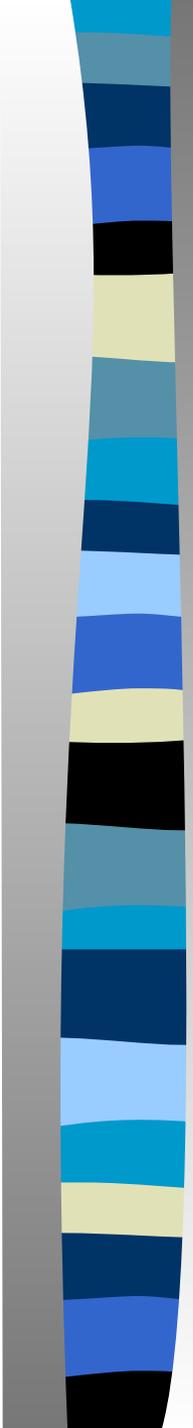
Y

X^C

X^c

Carrier mother: $X^C X^c$

Normal Father: $X^C Y$

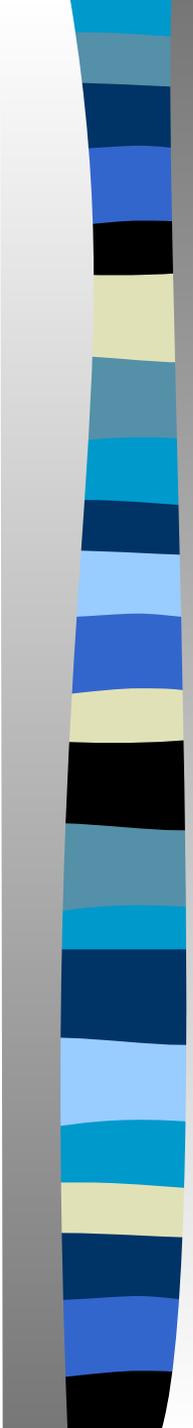


A

B

C

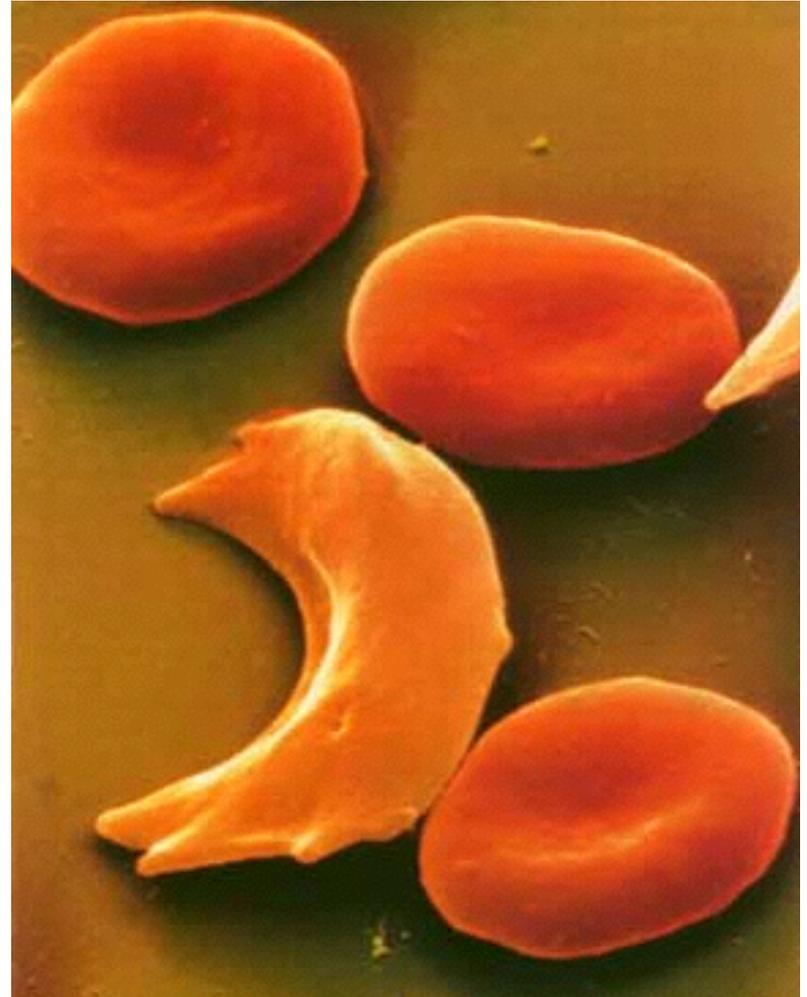
D

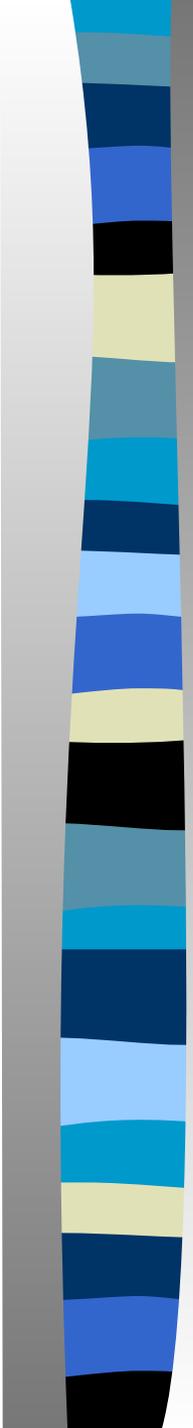


Review: Gene Mutations

- Change in the sequence of DNA of a single gene can cause serious disorders
- Sickle cell disease results from the change of one base in the sequence of DNA

Red Blood Cells:





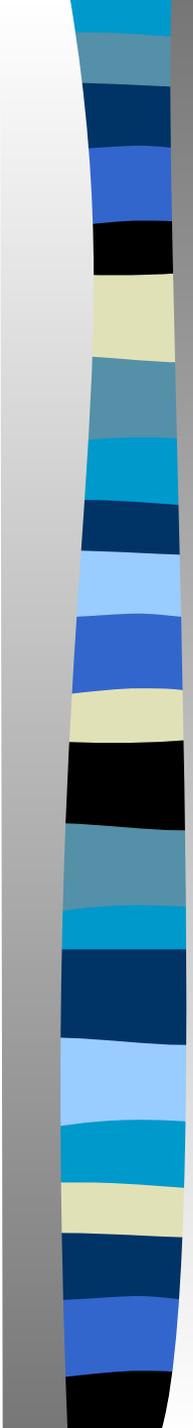
Chromosomal Disorders

- Mostly due to homologous chromosomes failing to separate during meiosis
- Results in abnormal # of chromosomes in gametes
- Can occur with autosomes (#1-22) and sex chromosomes (#23)

Down Syndrome

- Result of 3 copies of chromosome #21
- Mild to moderate mental retardation and more susceptible to diseases





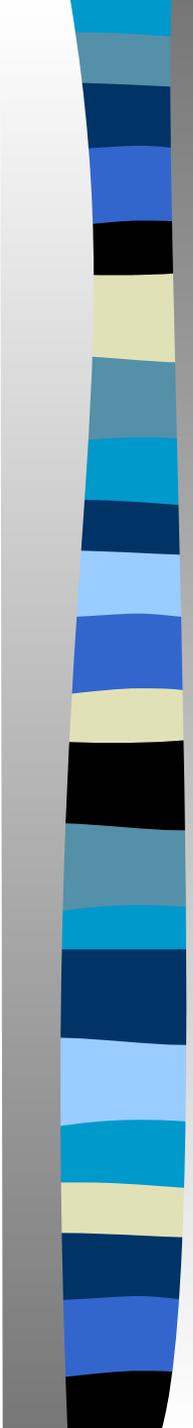
Sex Chromosome Disorders

Turner's Syndrome:

- only 1 X chromosomes
- Females are sterile because sex organs do not develop at puberty

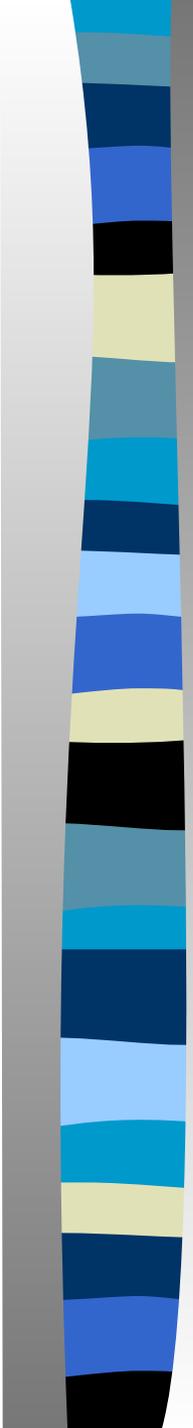
Klinefelter's Syndrome:

- Males receive an extra X chromosome
- Interferes with meiosis and usually prevents males from reproducing



DNA Analysis

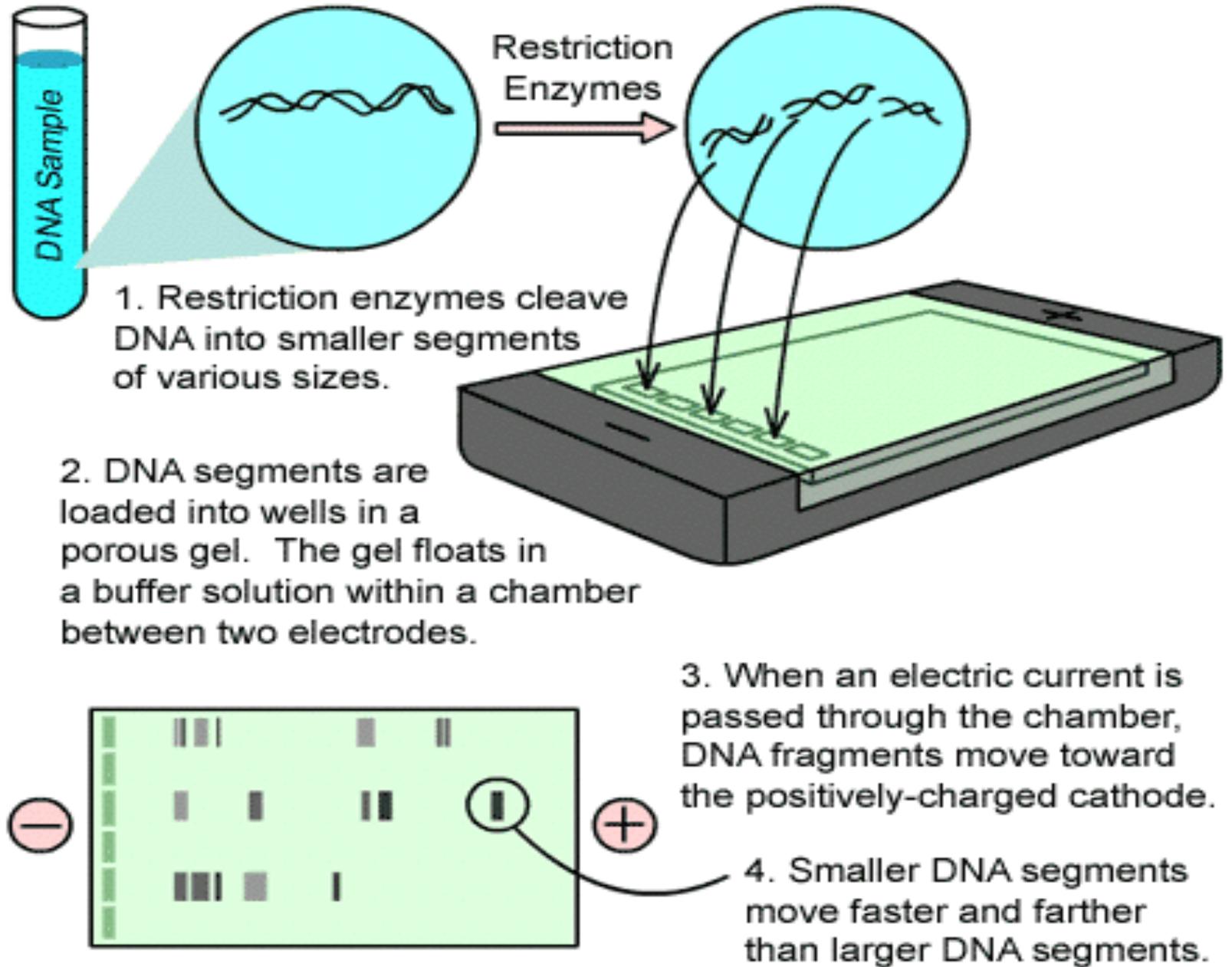
- **Gel Electrophoresis:** used to separate and analyze DNA
- **Process:**
 1. restriction enzymes cut DNA into fragments
 2. DNA mixture is placed in one end of a porous gel



Process cont.

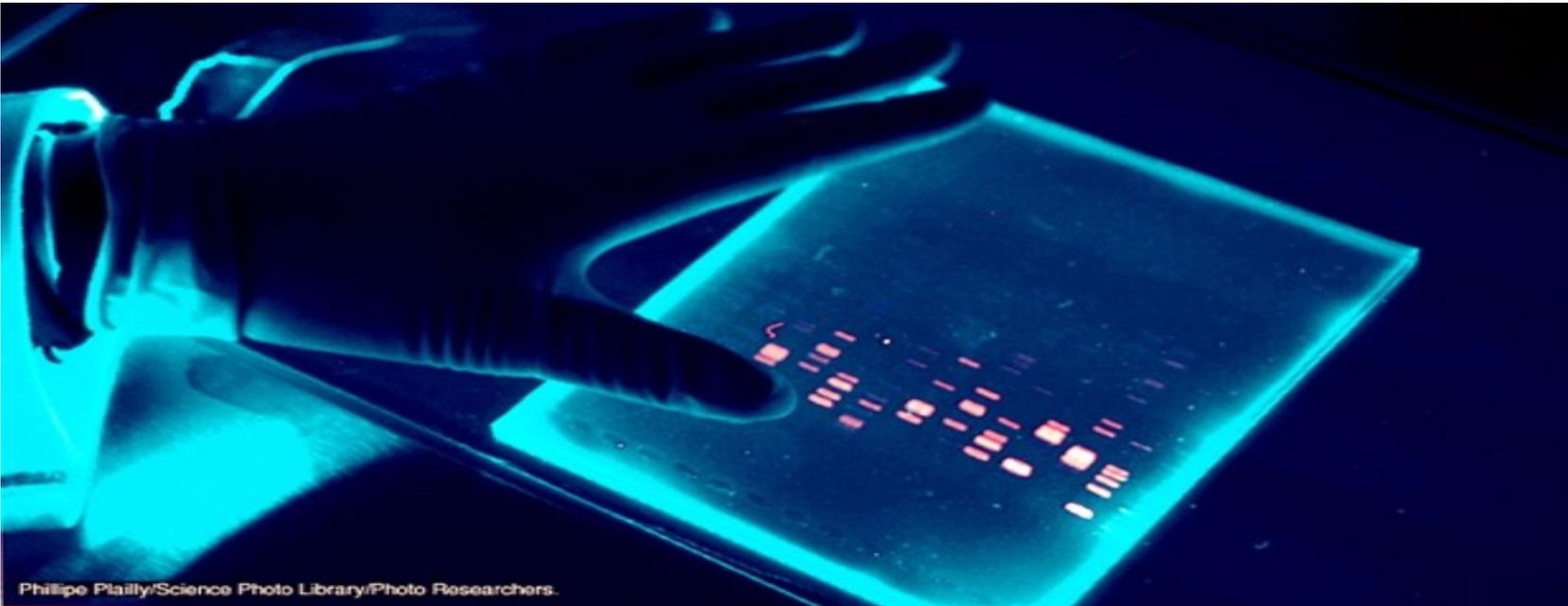
3. Electricity is applied to gel causing DNA (-) to move toward (+) end of the gel (**shorter fragments move faster & travel farther in the gel**)
4. Fragments are labeled using a radioactive probe producing the DNA fingerprint

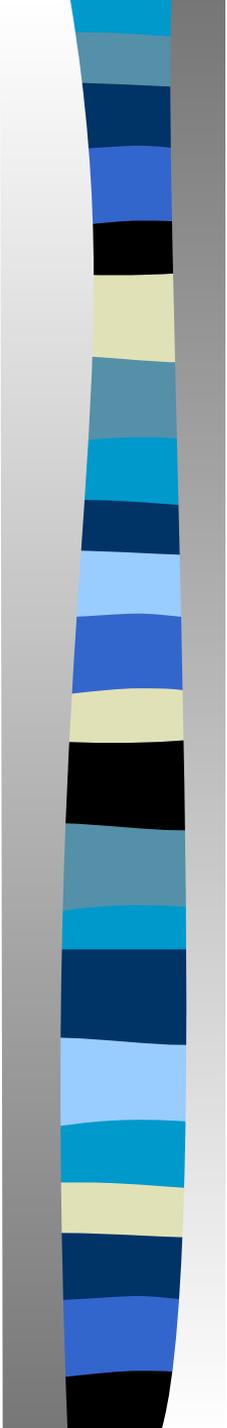
Figure S-2: Gel Electrophoresis

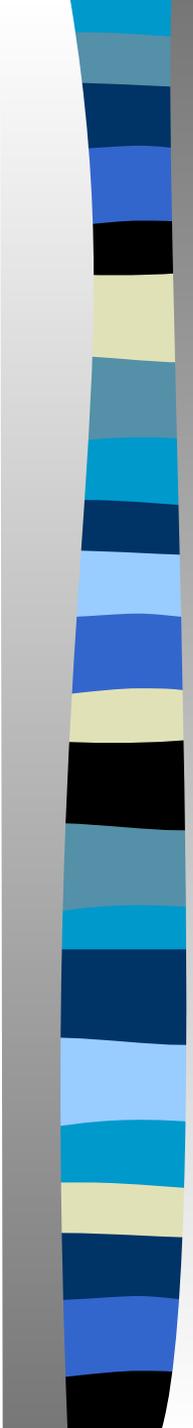


DNA Fingerprint

- Unique to each person
- Used to compare DNA of different people & different organisms
- Can be used to identify a single gene







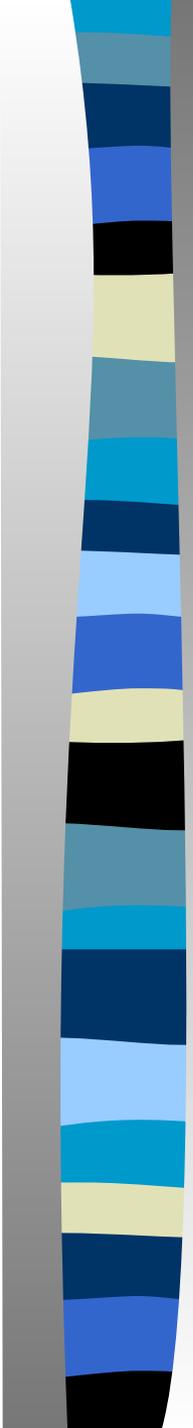
Genetic Engineering

- Making changes to the DNA code

Selective Breeding: choosing animals with desired traits & breeding them to pass those traits on to the offspring

Examples in plants: crop plants

Examples in animals: horses, dogs, cats, farm animals



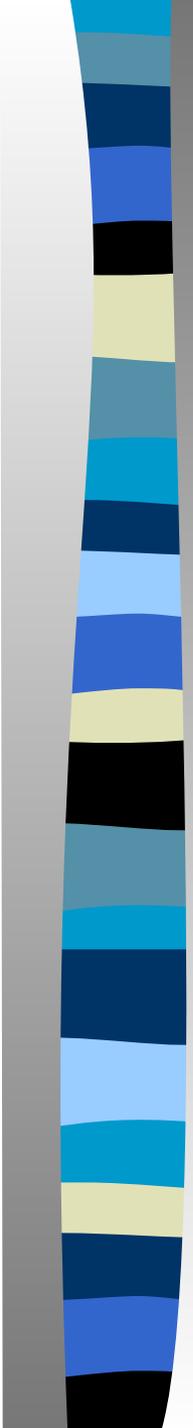
Selective Breeding cont.

Effects of Selective Breeding on Gene

Pool: decreases it, which increases the chance of genetic defects

Inbreeding: continued breeding of individuals with similar characteristics

- Produces organisms with a greater amount of genetic defects

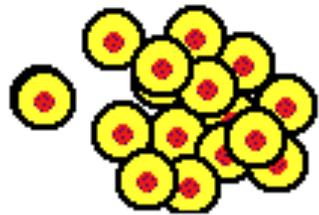


Cloning

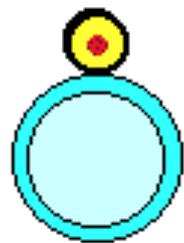
- Producing a genetically identical organism from a single cell
- **Whole Organisms:** Dolly was the first clone of an adult mammal (1997)
- **Effects of Cloning on Gene Pool:** decreases it because genetic variation decreases



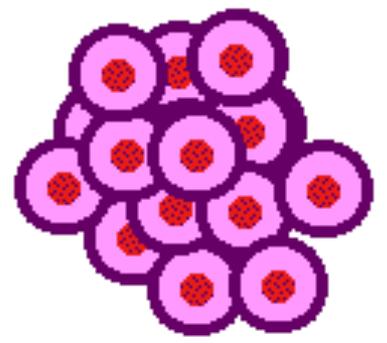
Organism to be cloned



Developed differentiated cells taken from the organism. They have been starved of nutrients so that they don't begin to copy their chromosomes. They copy their chromosomes right before the cells reproduce themselves. Two copies of chromosomes can cause defects in the organism.



Egg cell and cell to be cloned, are fused together



Begins to develop as an embryo

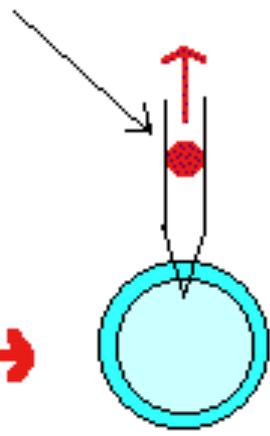


Implanted into a ewe



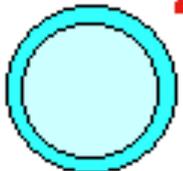
Clone is born

A glass pipette smaller in diameter than hair



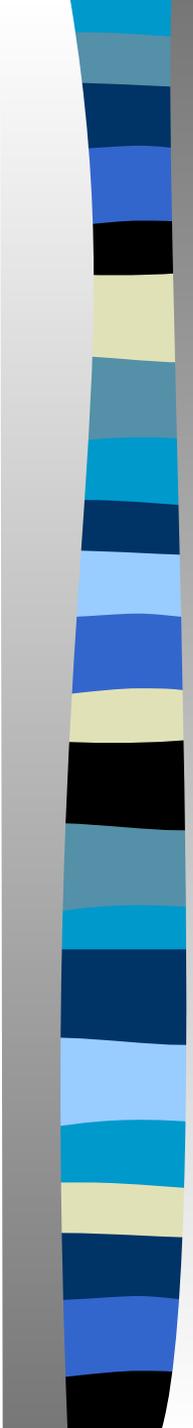
Unfertilized Egg Cell

Nucleus removed from egg cell



Egg Cell with no Nucleus





Using Bacteria in Genetic Engineering

- **Transformation:** a cell takes in external DNA and it becomes part of the cell's DNA
- **Recombinant DNA Technology:** taking genetic material from one organism & placing it in another organism

Recombinant DNA Technology

Process:

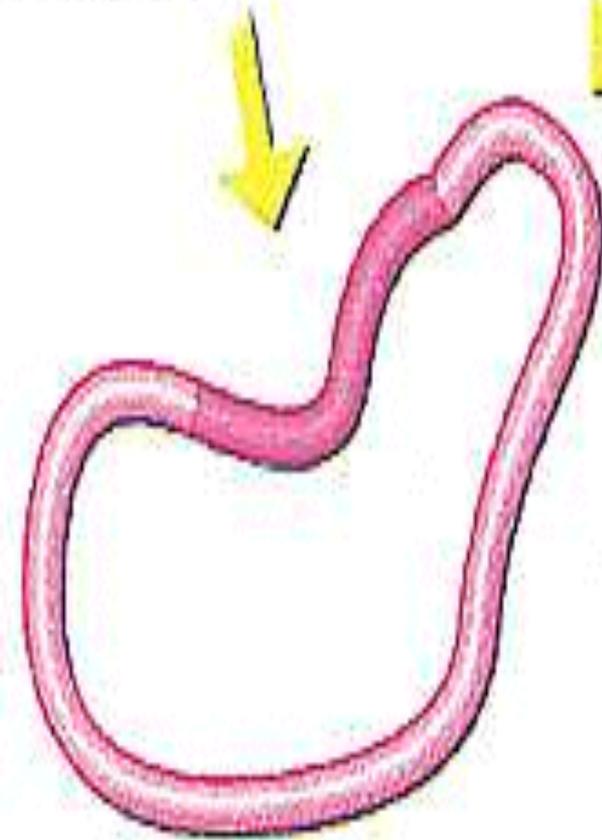
1. Remove plasmid DNA from a bacterium & cut it with a restriction enzyme
2. Isolate the desired gene from human DNA using the same restriction enzyme
3. Insert desired gene into the plasmid DNA
4. Insert “new” plasmid into a specific bacterium
5. As the bacterium reproduces, so does the plasmid with the desired gene
6. Soon there will be millions of bacteria able to produce the desired protein

Example:

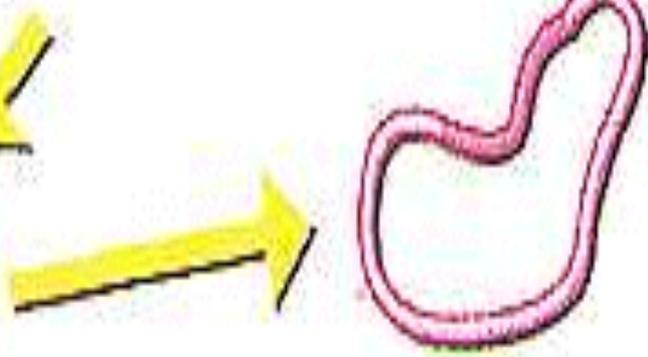
Production of human insulin for diabetics

Production of Human Insulin

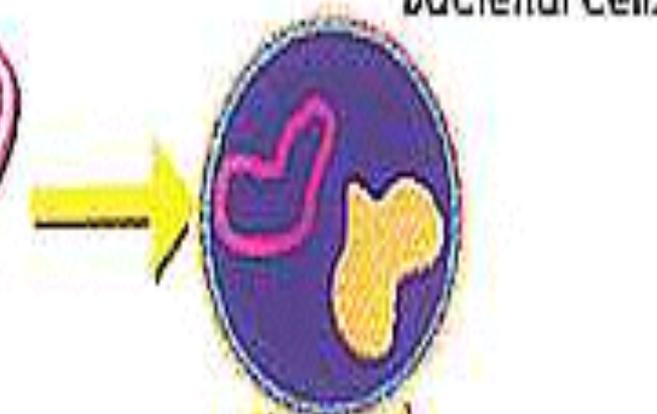
Synthetic gene fragment, coding for insulin.



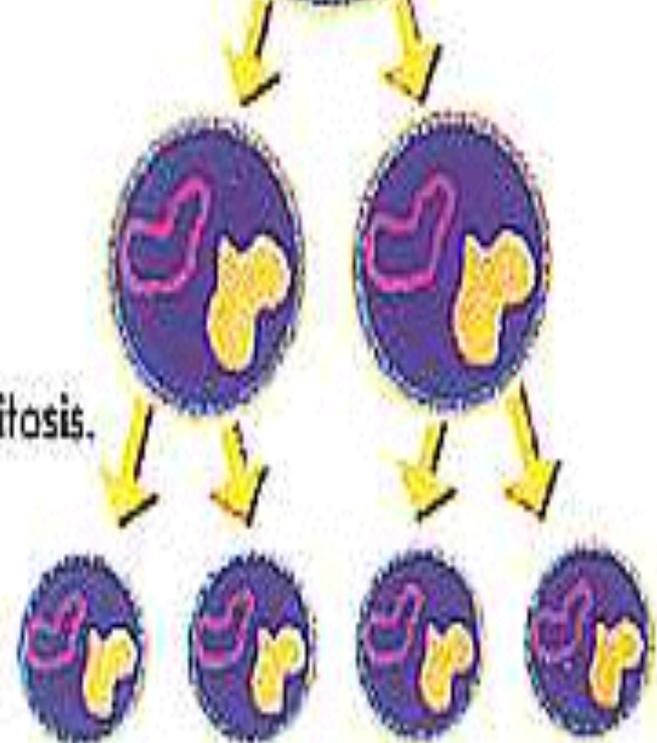
Recombinant plasmid.

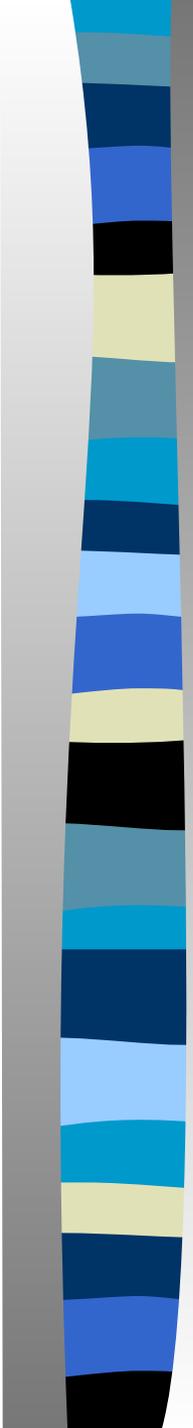


Bacterial cell.



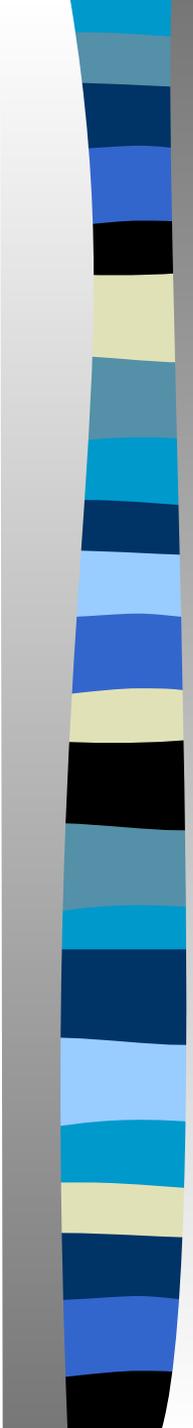
Mitosis.





Genetically Engineered Organisms & The Gene Pool

- **Bacteria**: produce important substances for health & industry
- **Examples**: insulin, and growth hormone
- **Animals**: used to study genes & improve food supply
- **Example**: cows grown with extra growth hormone



Genetically Engineered Organisms

- **Plants:** soybean & corn now contain genes to produce natural insecticide
- **How does genetic engineering the gene pool?**
- It decreases it, due to a decrease in genetic variation among organisms of the same species