Genetic Engineering ~ Biotechnology

- Transfer of a gene from one cell to another
- Transfer of gene from one species to another
- Cure genetic diseases (e.g. sickle cell anemia)
- Cloning (humans?)
Somatostatin (human hormone) produced by genetic engineering in 1978.

Two gallon container of bacteria makes 5 milligrams of Somatostatin.

Before gene engineering, 500,000 sheep brains makes 5 milligrams of Somatostatin.
Plasmid is extra piece of bacterial chromosome used in genetic engineering.
Bacterium with plasmid

Plasmid cut open by restriction enzyme

Human insulin gene

Bacterium now has a human gene for synthesizing insulin (a protein)
Gene therapy using viruses

Virus infects bad cell with bad gene

Good gene turns bad cell into good cell

Virus

Good gene from good Human cell

Good gene + viral genes
Gene Therapy is treating cystic fibrosis (thick mucus blocks the narrow airways of the lungs)
Adenovirus (infects respiratory system) is used to add normal gene to abnormal cells with “bad” gene.

Blocked and inflamed lung air passage because of fluid buildup from Cystic Fibrosis – results from one “bad” gene.
SCID – Severe Combined Immunodeficiency Syndrome; non functional immune system and susceptible to all infections. Children live in plastic bubble = “bubble baby.”
Gene Therapy is treating Severe Combined Immunodeficiency Disease (SCID) – No immune system
Genetically Engineered Cotton Production in US in 2003 = 70%

% of acreage growing engineered cotton
Cotton genetically engineered to be resistant to insect pests

Cotton control w/o genetic engineering
Here’s what happened when they discovered that genetically engineered cotton was planted in 1998.
Does human cloning have an “evil” side?
Clone – cell or organism that is genetically identical to the parent cell or organism
Early experiment whereby frogs were cloned
Cloning Dolly:

Nucleus removed from somatic (body) cell in Sheep #1

Nucleus placed into enucleated oocyte (egg) from Sheep #2

Oocyte placed into Sheep #3

Oocyte develops into Dolly = clone of Sheep #1
Somatic cells

Enucleation of oocyte (egg)

Oocyte from Sheep #2 with nucleus from Sheep #1

Oocyte implanted into Sheep #3 (black faced sheep)

Dolly, clone of #1
Cloning Dolly:

The Nucleus was removed from a somatic cell in Sheep #1

The nucleus is placed into an enucleated oocyte from Sheep #2

The oocyte is placed into Sheep #3

Oocyte develops into Dolly = a clone of Sheep #1
Dolly, Clone of Sheep #1
Surrogate mother, sheep #3
1997

Dolly the clone
Dolly, Clone of Sheep #1
Sheep #1
Egg donated by mixed breed female

DNA from skin cell

DNA put into egg

Egg put into mother

Mother gives birth to Snoopy the clone

Mother gives birth to Snoopy the clone
2003 – cloned mule

Mules are sterile crosses between horses and donkeys.
Clone (Prometea) is genetically identical to mother = asexual reproduction

Adult horse donates the nucleus, also donates the egg, and served as surrogate mother
Prometea all grown up with mother
Should cloning be used to save species on the brink of extinction such as the Spanish Mountain Goat or Panda
How far will human cloning go?
Cloning and Stem Cell Technology

1. Removal of nucleus from Skin cell
2. Egg cell now has nucleus from skin cell
3. Egg cell exposed to growth factors and forms a blastula
4. Cells from blastula are removed and are now called stem cells
5. Stem cells are given specific chemicals to encourage growth (in vitro) into specific cells

Egg, Nucleus, Removal of nucleus from Skin cell, Egg cell now has nucleus from skin cell, Cells from blastula are removed and are now called stem cells, Stem cells are given specific chemicals to encourage growth (in vitro) into specific cells