Genetic Engineering
Biotechnology

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Biology
making changes in the DNA code of a living organism
selective breeding is also known as artificial selection
gene pool

- all the genes & all the alleles that can occur in a population of a particular species
main drawbacks...
-reduction in the size of the gene pool which will increase the chance of recessive alleles when bred together; (This is why we don't intermarry!)
Inbreeding

- breeding of individuals with similar characteristics
- increased chance of genetic defects
- commonly done with pure-bred animals to get desirable traits; but it still creates problems for the breed
Hybridization - crossing dissimilar organisms to bring out the best of both - hybrids are very hardsy - Luther Burbank - Shasta daisies - hybrids (ox-eye daisy x English field daisy)
Ways to increase variation...

- induce/increase mutations
- polyploidy - having many sets of chromosomes
Polyploid

- having many sets of chromosomes
- lethal for animals
- usually great for plants

Strawberries can be octoploid
- 8 sets of chromosomes; makes them redder, juicier, more resistant to cold, etc.
Cloning

...making an identical copy of another organism
What are the steps involved in cloning?

1. **Donor cell (somatic)**
   - Provides the somatic cell that will fuse with the egg cell.

2. **Egg cell (reproductive)**
   - Provides the egg cell from which the nucleus will be taken.

3. **Fuse**
   - The somatic cell and egg cell fuse to create an embryo.

4. **Embryo**
   - The fused cells develop into an embryo.

5. **Implanted in**
   - The embryo is implanted in the foster mother.

6. **Foster mother**
   - The foster mother gives birth to the cloned animal.

7. **Cloned animal**
   - The cloned animal is born.
Advantages...
- help save endangered species
- could enable a sterile woman to have a baby using any cell in her body

Disadvantages...
- suffer from genetic defects & health problems
- ethical & moral issues
Recombinant DNA
-produced by combining DNA from different sources
Recombinant DNA

Altering the genetic makeup of an organism by:

- adding new DNA to it, or,
- changing the DNA that is already there.
What are some applications of recombinant DNA technology?

- treat genetic disorders
- make insulin
- make HGH
- inactivate tumors
Transgenic Organisms - the one that gets the gene

Transgenic Plant Animation.flp
How do scientists create a transgenic organism?

-Genes from one organism are transplanted into the DNA of another.

Can you guess which chick is transgenic?
Applications of Transgenic Microorganisms...

**medically**
- can produce insulin
- can produce growth hormone
- can produce clotting factors for blood
- cheaply & in abundance

**industry**
- sweeteners for sodas

The sweetener in most diet sodas—phenylalanine—is transgenic bacteria. Transgenic bacteria also make important medicines.
Applications of Transgenic Plants...

medically
- bananas being used to give vaccines
- produce insulin
- produce HGH

agriculturally
- supply natural insecticides
- resistance to viruses & disease
- increases crop yields

Symptom expression in non-inoculated upper leaves of NlB transgenic tobacco plants resistant (left) and susceptible (right) to infection by PVY.
Applications of Transgenic Animals...

agriculturally
- disease resistance
- improve food supply

medically
- produce hormones
- produce insulin

A natural protein produced in the milk of GEM and other transgenic cows kills the bacteria that cause mastitis. (Photo by Stephen Ausmus)
GLOW in the DARK FUN!!!

South Korean scientists tinkering with fluorescence protein genes say they have bred white Turkish Angora cats to glow red under ultraviolet light.

The pair of cats cloned from a mother’s altered skin cell are nearly a year old. The researchers told the AFP that their work could help unravel mysteries of some 250 genetic diseases suffered by both humans and cats. The findings also could be used to clone endangered tigers, leopards, and other animals, the report said.

However, it's unlikely that such psychedelic-looking cats would come to pet stores anytime soon. Debates about the ethics and safety of concocting cloned and transgenic animals continue to rage.
Pigs - Taiwan (Jan 2006)
National Taiwan University cloned 3 pigs which are green inside out inclusive their internal organs.

Rabbit (named Alba) - French 2001
Fluorescent jellyfish called *Aequorea victoria* gene (EGFP - enhanced Green Fluorescent Protein) was zygote microinjection into fertilized rabbit eggs.

Zebrafish - Japan 1997
Gene Therapy
- replacing an absent or faulty gene by a working normal gene

What are some diseases that could be cured by gene therapy?
- bone marrow (leukemia)
- Parkinson's
- cystic fibrosis

Why is it so controversial right now?
- involves the use of embryonic stem cells
Gene Therapy

Transplants of genetically engineered cord blood have been successfully used to cure some forms of “bubble boy syndrome”, or SCID. Initially, the SCID results were touted as the first success story of gene therapy. Unfortunately, this clinical trial was halted in 2003 when two of the children subsequently developed leukemia. It is not clear at present if the leukemia was triggered by the gene insertion process, or if the SCID patients simply had a greater predilection towards leukemia than the population at large.
gene therapy

would you say you had a dominant or recessive character?
To get a DNA fingerprint, you need restriction enzymes.

- Cuts DNA at a specific sequence of nucleotides
- We use restriction enzymes to cut DNA from one organism and place it in another organism.
Gel Electrophoresis

1. cut DNA with restriction enzyme
2. place DNA fragments in gel
3. turn on power
4. DNA has a negative charge & will move towards the positive charge
5. shorter fragments move faster
What do the lines represent on a gel?
- DNA fragments

Are the smaller DNA fragments closer to the top or the bottom of the gel?
- bottom because the smaller the fragment, the faster & farther it moves toward the positive end

How might you describe a DNA fingerprint?
- each person's DNA is unique just as each person's fingerprint is unique
**Were Baby S & Baby J switched at birth?**

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**Baby J matches more with Mrs. Smith & Baby S matches more with Mrs. Jones**
Human Genome Project
-the effort to map the genetic sequences of human chromosomes

The project was completed in 2003
Value...

- understand disease
- understand genetic trait transmission
- develop new medicines & treatments
- develop gene therapies using transgenic organisms

MAPPING THE FUTURE—Francis Collins, M.D., Ph.D., head of the National Human Genome Research Institute at the National Institutes of Health, spoke in Houston Jan. 17 about the Human Genome Project’s implications for the future. The project was completed in 2003, and identified all genes in human DNA. (Photo by Steve Ueckert)
If only a small portion of DNA is made up of usable genes, then why might we have all of the extra DNA in our cells?

- evolutionary history
- junk DNA - repetitive sequences that make us unique
- epigenome - scientists now believe that "junk" DNA acts as gene regulators - turning genes "on" or "off" - like a light switch
If 99.9% of human DNA is the same, then what is the source of the variation that allows DNA fingerprinting to uniquely identify individuals?

Through gel electrophoresis techniques we can analyze DNA that has little or no known function but can vary widely from one person to another.
Amniocentesis

What is the basic procedure?
-place needle through abdominal wall into amniotic fluid & withdraw fluid
Why is an ultrasound necessary along with this procedure?
   - so the needle won't poke the baby

Why have this procedure done?
   - to analyze the baby's chromosomes (karyotype) or do a chemical analysis
Karyotype

-a picture of chromosomes in mitosis grouped in homologous pairs

What can be revealed using a karyotype?
-the sex of the baby & any chromosomal abnormalities
Down's Syndrome

47,XY,+21
Klinefelter's Syndrome

Taller than average height
Reduced facial hair
Reduced body hair
Breast development (gynaecomastia)
Osteoporosis
Feminine fat distribution
Small testes (testicular atrophy)
Trisomy 13
Ethics