Genetic Engineering and Selective Breeding

What happens when you take DNA from a jellyfish, and insert it into Mouse DNA?

Scientists used a bioluminescent gene from a jellyfish to create “glowing” green mice!

These are all baby mice, with no hair yet. The inserted gene makes the skin glow under ultraviolet (UV) light.

These 3 in the middle are normal baby mice.

What you need to Know

- Selective Breeding involves choosing two organisms of the same species and mating them with the hope of getting the best qualities of each parent to show up in the offspring.

- Genetic Engineering involves choosing certain genes and moving them from one organism to another – even to a different species or removing the gene entirely!

- Both activities are controversial.
What you need to Understand

• Genetic engineering is an ethical issue that needs to be regulated by the personal, cultural, and global conscience.

Genetic Engineering: Details

• Taking DNA from one organism and inserting it into another organism’s DNA sequence, to make the organism have a specific trait.

• It produces an organism that has a new trait that it would not have developed on its own.

Genetic Engineering Example A:

• Diabetic = a person whose pancreas cannot create the important hormone insulin.

1. Take the gene for making insulin from a healthy donor’s DNA
2. Add that gene to the DNA of pancreas cells from a diabetic
3. Let mitosis happen for a while (in a “test tube”) so you get LOTS of pancreas cells with the good gene.
4. Surgically implant the good cells back into the diabetic

Genetic Engineering Example B:

Problem: Butchers complain about the amount of time it takes to pluck the feathers off chickens.

Solution: Make chickens with no feathers.
Genetic Engineering Example C:
Problem: Bugs eat leafy green vegetables, limiting profits for farmers.
Solution: Cabbage plant + scorpion venom = bug-proof veggies

Genetic Engineering Example D:
Problem: Tomatoes only grow in warm weather. Tomatoes freeze in cold weather.
Solution: Give tomatoes the ability to make anti-freeze.

Genetic engineering involves the manipulation of genes!
### Advantages of Genetic Engineering

- Will get **improved** organisms
- Can create organisms with traits **not** previously thought possible
- Can **remove** “bad” genes
- Reduces the chance of getting “**undesirable**” organisms

### Disadvantages of Genetic Engineering

- **Costly**
- Must be performed in a **lab** with special **equipment**
- **Ethical** issues
- Long term **negative** affects
- Negative **environmental impacts**
  - Super-C apples (allergies!)
  - Superweeds!
  - Natural insecticides seep into soil & kill good insects!

---

### Genetic engineering has few limits - except our imagination, and our moral or ethical code.

### Selective Breeding: Details

- Selective breeding involves **mating** organisms with **different** “desirable” traits to get offspring with the **desirable traits of both parents**
  - **SAME SPECIES!**

- Selective breeding is used mostly for dogs, cats, other pets, cattle, and **crops**.
Selective Breeding: Example A

Tough wild boars mated with friendly meaty pigs give you robust & meaty pigs for your farm.

Tough Boar + meaty pig = Superpig

Selective Breeding: Example B

Brahman cattle:
Good resistance to heat, but poor beef.

English shorthorn cattle:
Good beef but poor heat resistance.

Santa Gertrudis cattle (cross of 2 breeds)
RESULT = good beef and resistant to heat!

hot weather cow + beefy cow = supercow

Selective Breeding: Example C

Choosing only the best corn plants for seeds results in better crops over a long time.

Ancient corn from Peru (~4000 yrs old)
Selective Breeding: Example D

\[ \text{little red tomato} + \text{big green} = \text{BIG RED TOMATO} \]

Remember!

• Selective breeding crosses organisms (mates) with desirable traits to produce offspring that have the traits from both parents!

Advantages of Selective Breeding

• Might get improved organisms
• Don’t need any special tools or lab
• Can be performed easily by farmers & breeders

Disadvantages of Selective Breeding

• Undesirable traits from both parents may appear in the offspring
• Disease can accumulate in the population
  – You may end up with deaf dalmatians, boxers with heart disease, labs with hip problems…
REVIEW

- Genetic Engineering
  - Relatively new process performed within labs
  - Manipulates or alters the genetic makeup of organisms
  - Results in organisms with new traits

- Selective Breeding
  - Process has been around for thousands of years
  - Combines the best traits of two organisms
  - Results in organisms that have the desirable traits of their parents

<table>
<thead>
<tr>
<th>Scientific Example or Fact</th>
<th>GE or SB?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmers removed the gene in chicken DNA to make them grow featherless.</td>
<td>GE</td>
</tr>
<tr>
<td>This process attempts to combines the best traits of 2 parents.</td>
<td>SB</td>
</tr>
<tr>
<td>Dog breeders wanted to breed a dog that would run fast but also be born with long, shiny fur, looking for the best characteristics from the parents.</td>
<td>SB</td>
</tr>
<tr>
<td>Scientists take out a gene for bioluminescence from a jellyfish and put that gene into a mouse’s DNA to see if it will have a glowing effect.</td>
<td>GE</td>
</tr>
<tr>
<td>This process is relatively new and done in science labs.</td>
<td>GE</td>
</tr>
<tr>
<td>Humans choose the desired traits in this process.</td>
<td>BOTH</td>
</tr>
<tr>
<td>This results in organisms with new combinations of traits that may never have existed before.</td>
<td>BOTH</td>
</tr>
<tr>
<td>English Shorthorn cattle, which produced good beef were bred with Brahman cattle from India to make the offspring both tasty and resistant to heat and humidity.</td>
<td>SB</td>
</tr>
<tr>
<td>This process has been around for thousands of years.</td>
<td>SB</td>
</tr>
<tr>
<td>Scientists removed a gene for fat in bison to make their meat leaner.</td>
<td>GE</td>
</tr>
<tr>
<td>This process can be done using organisms of 2 very different species.</td>
<td>GE</td>
</tr>
</tbody>
</table>