# Chapter 5. Evolution

# Evolution of Evolutionary thinking (Pre-Darwinian)

**Jean-Baptiste Lamarck** (1744-1829) – a French naturalist, proposed a theory that organisms would change to adapt to their environment. He believed that certain traits which were beneficial could be passed on to the offspring.

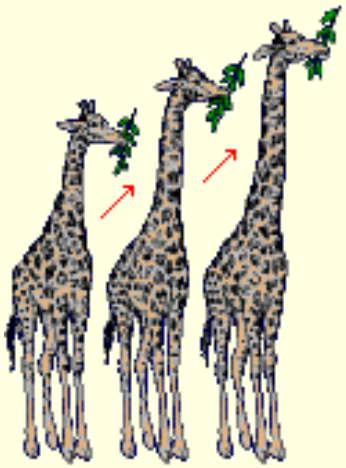
# Lamarckism

Lamarck based his theory on two observations thought to be true in his day:

1. “Use it or lose it” - Individuals lose characteristics they do not require and develop those which are useful.
2. Inheritance of acquired traits - Individuals inherit the acquired traits of their ancestors.

# Lamarckism

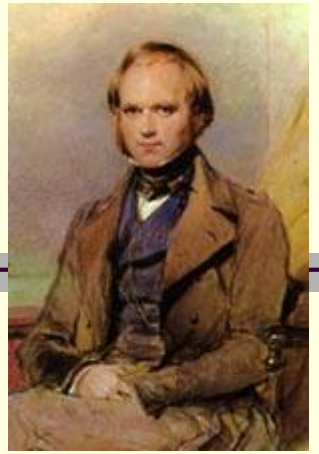
- Examples include: the stretching by giraffes to reach leaves leads to offspring with longer necks;



- Strengthening of muscles in a blacksmith's arm leads to sons with like muscular development.

This theory was later disproved!

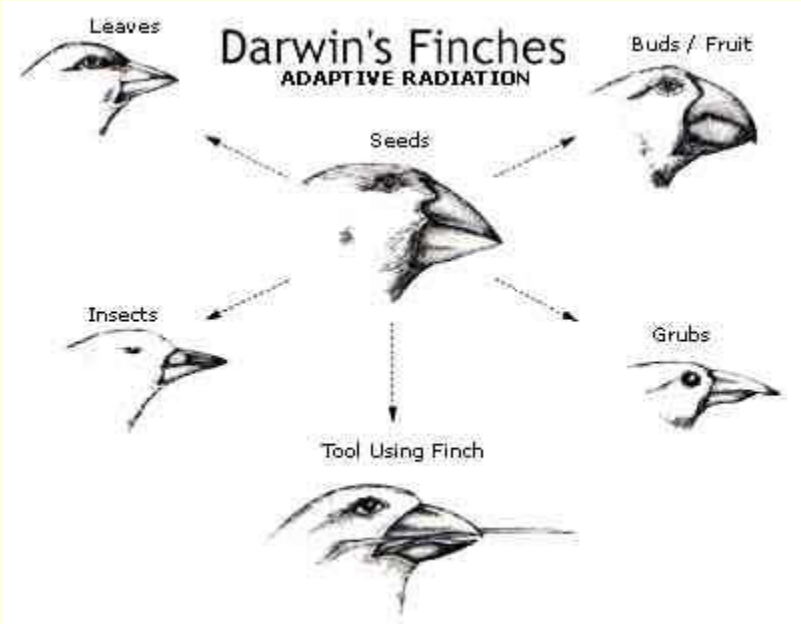
# Darwin's Voyage



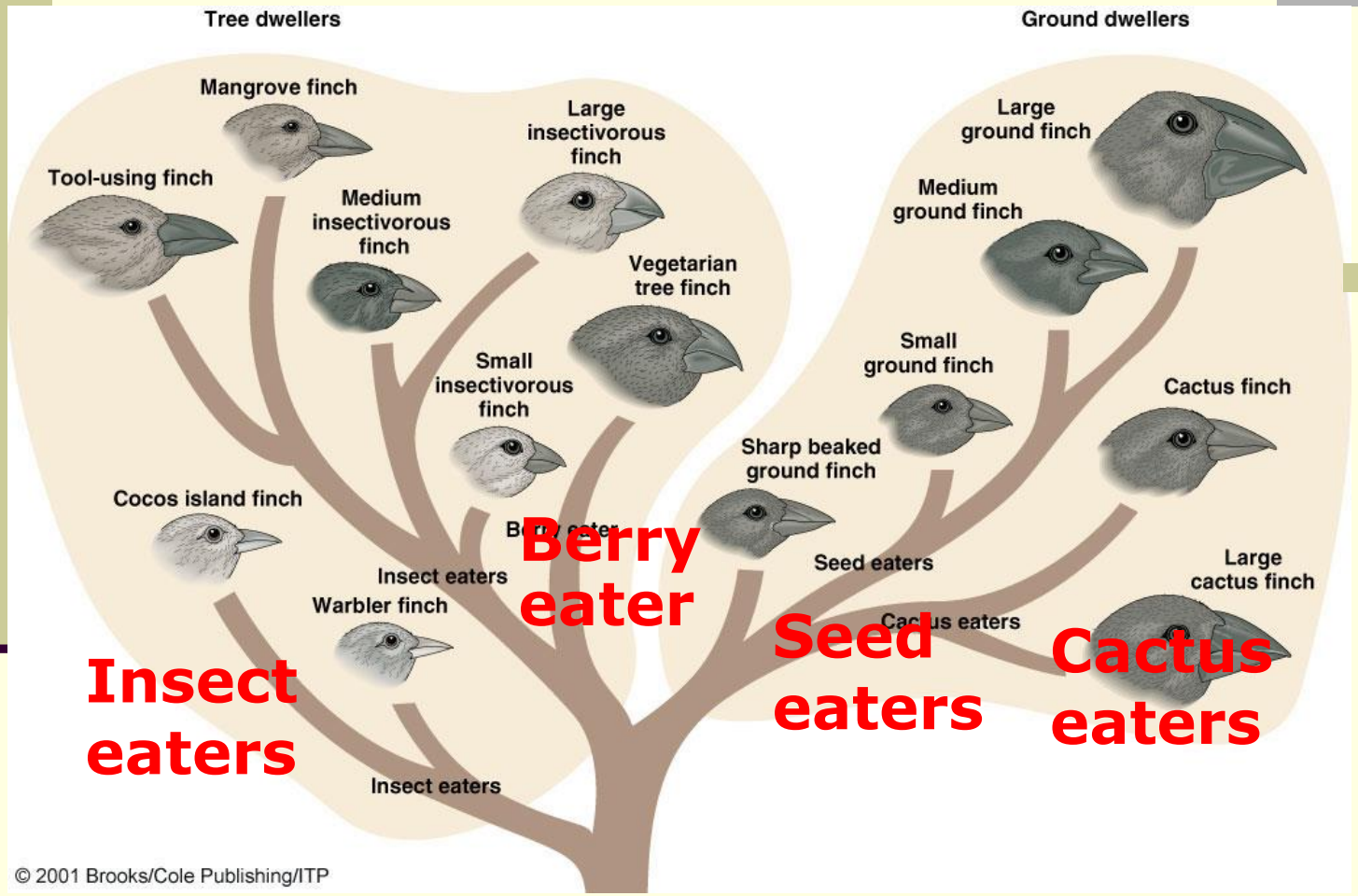
- Charles Darwin
  - Set sail on the HMS Beagle in 1831
  - Became the ship's naturalist
  - Arrived in the Galapagos Islands in 1835
  - Observed that the animals on the islands were similar to those on the mainland

# Darwin's Voyage

- Galapagos Animals
  - The Galapagos animals, while similar, were also different from island to island as well as to the mainland
  - Most obvious difference were the sizes and shapes of the finches' (small birds) beaks
  - Sizes and shapes of the beaks were adapted to what the birds ate



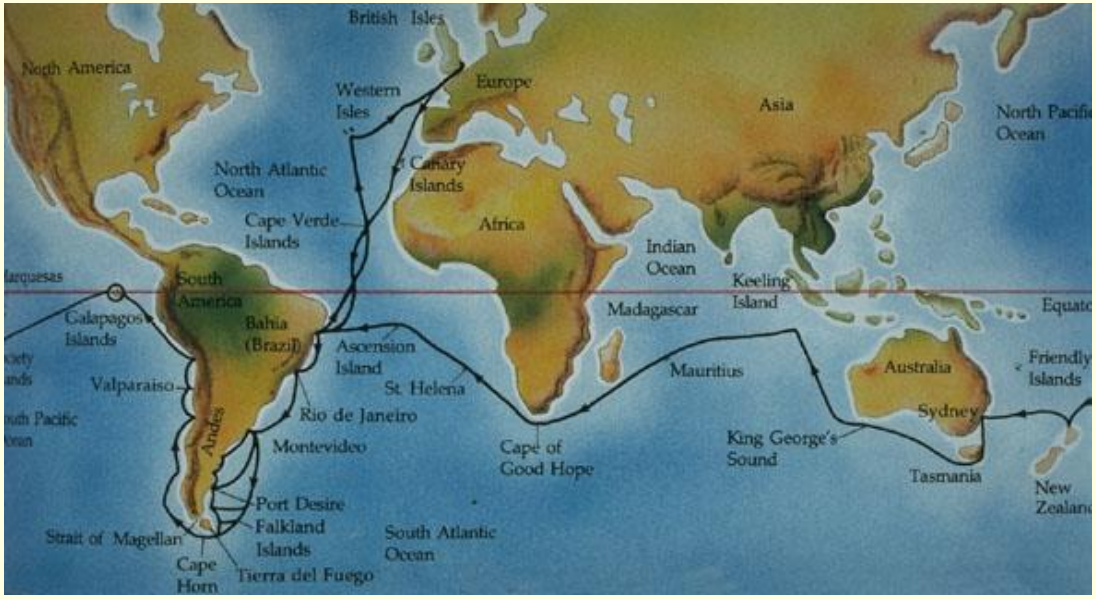
# Galápagos Finches




- Beak shape varies depending on diet

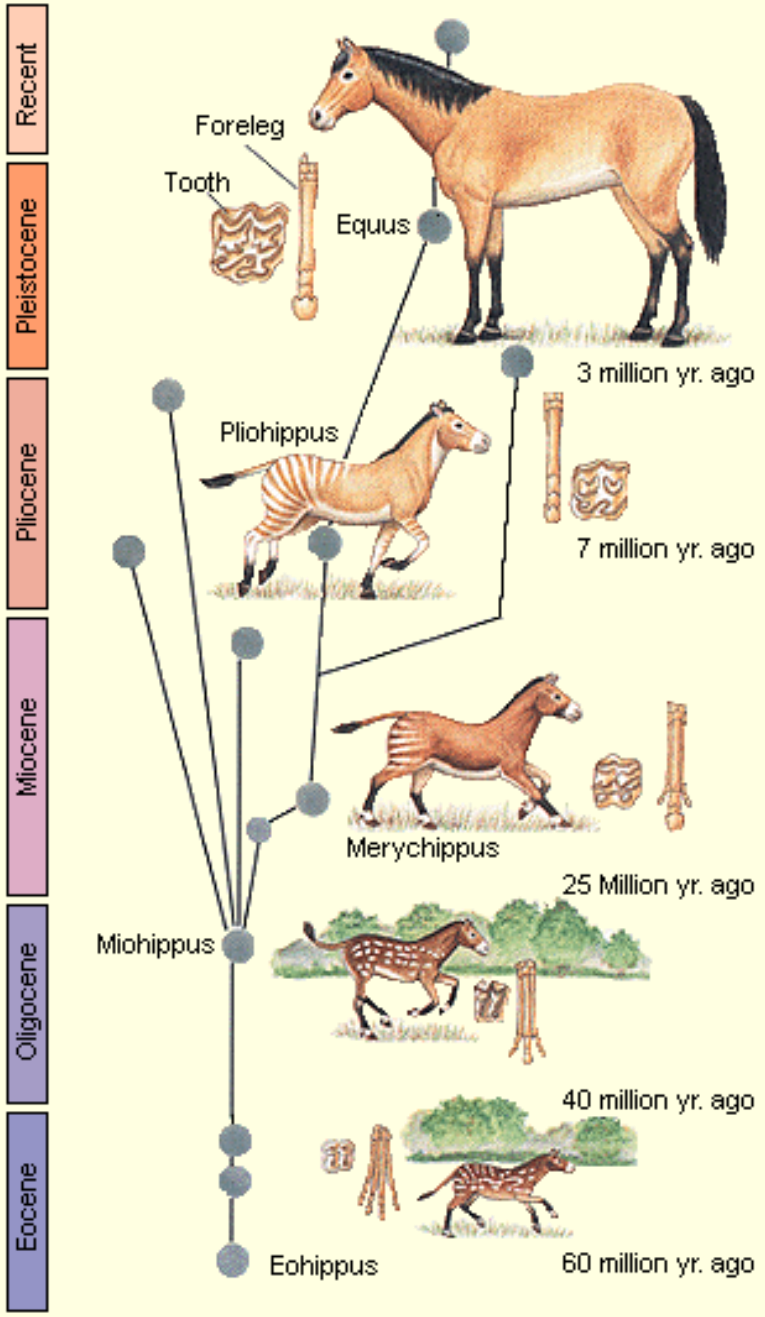
# Darwin's Voyage

- On the Origin of Species (Darwin's book)
  - For the 20 years that followed his return to England Darwin studied plants, animals and adaptations
  - Darwin wrote about how species can change gradually over many, many generations and become better adapted to new environmental conditions.



# Evolution

- The gradual change in a species over time.

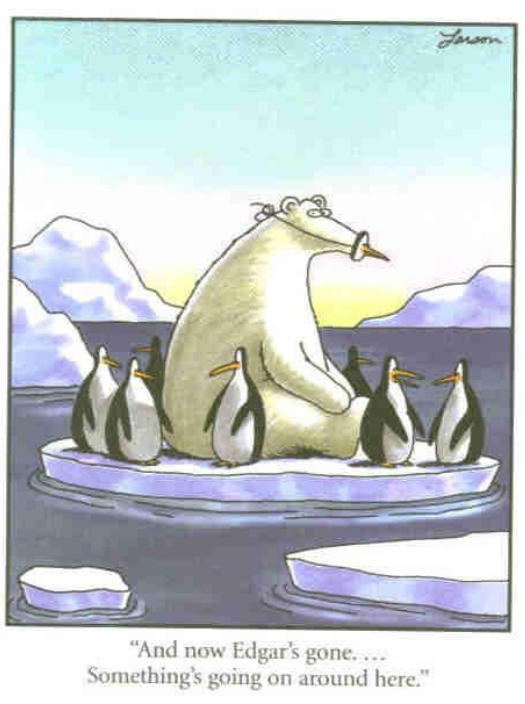


# Natural Selection

Organisms that are better **adapted** to an environment are more likely to survive and reproduce than organisms that are less well adapted.

# Adaptations

Katydids have camouflage to look like leaves.


"And now Edgar's gone. …
Something's going on around here."

Non-poisonous king snakes mimic poisonous coral snakes.

# Factors that affect Natural Selection:

**a) Overpopulation:** most species produce far more offspring than will/can survive

Hence the remaining offspring will eventually die leaving a limited number of offspring to survive

# Factors that affect Natural Selection:

**b) Competition:** since food and resources are limited, the offspring have to compete to survive

Darwin called it: “Struggle for existence”

# Factors that affect Natural Selection:

**c) Survival of the fittest:** Only those individuals that are better suited to the environment will survive and reproduce ("Survival of the fittest").

Fit individuals pass on to a portion of their offspring the advantageous characteristics.

# Factors that affect Natural Selection

**d) Artificial Selection:** Selective breeding as practiced by humans on domesticated plants and animals….For example: Dogs

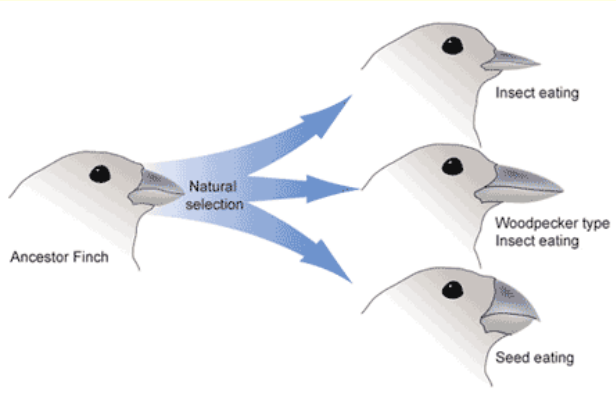
# Factors that affect Natural Selection:

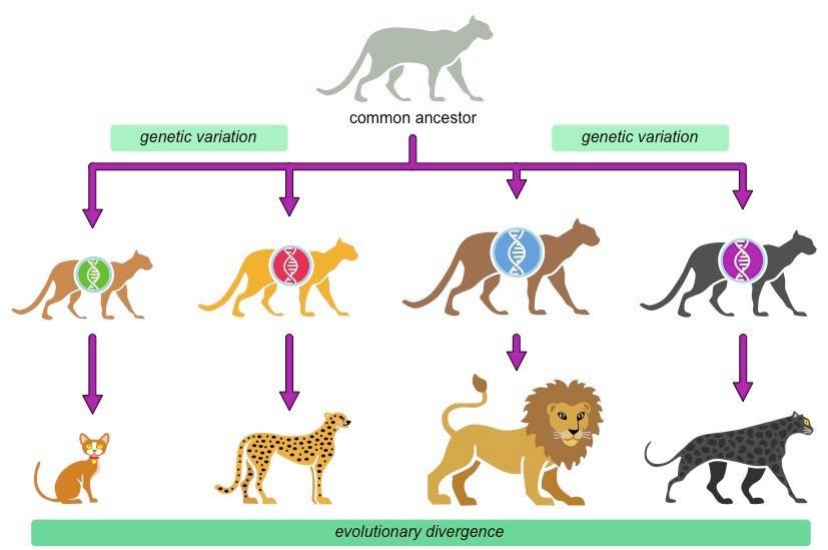
**e) Variation:** Members within a species exhibit individual differences – these differences must be inheritable

Natural selection won't work in a population of clones! Remember that a key to variation is sexual reproduction.

# Factors that affect Natural Selection

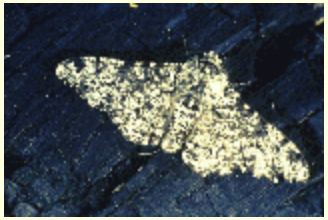
**f) Speciation:** The development of a new species, or speciation, occurs as variations or adaptations accumulate in the population over many generations.



# Moths

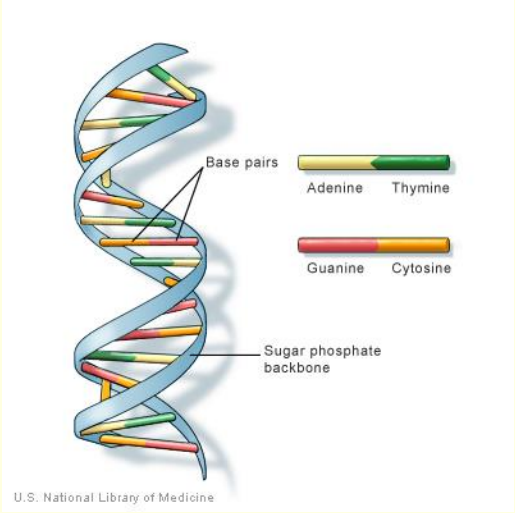
Originally, the pepper moth was white, which was good because it could blend in.



Then, trains were invented and the soot they produced covered the trees. Making the trees black. The moths that were black could now survive better.

# Genetic Engineering

- Genetic engineering, sometimes called genetic modification, is the process of altering the DNA in an organism's genes.
- This may mean changing one base pair, deleting a whole region of DNA, or introducing an additional copy of a gene.
- It may also mean extracting DNA from another organism's genome and combining it with the DNA of that individual.



# Genetic Engineering

- Genetic engineering is used by scientists to enhance or modify the characteristics of an individual organism.
- Genetic engineering can be applied to any organism, from a virus to a sheep.
- For example, genetic engineering can be used to produce plants that have a higher nutritional value or can tolerate exposure to herbicides.

# Benefits of Genetic Engineering

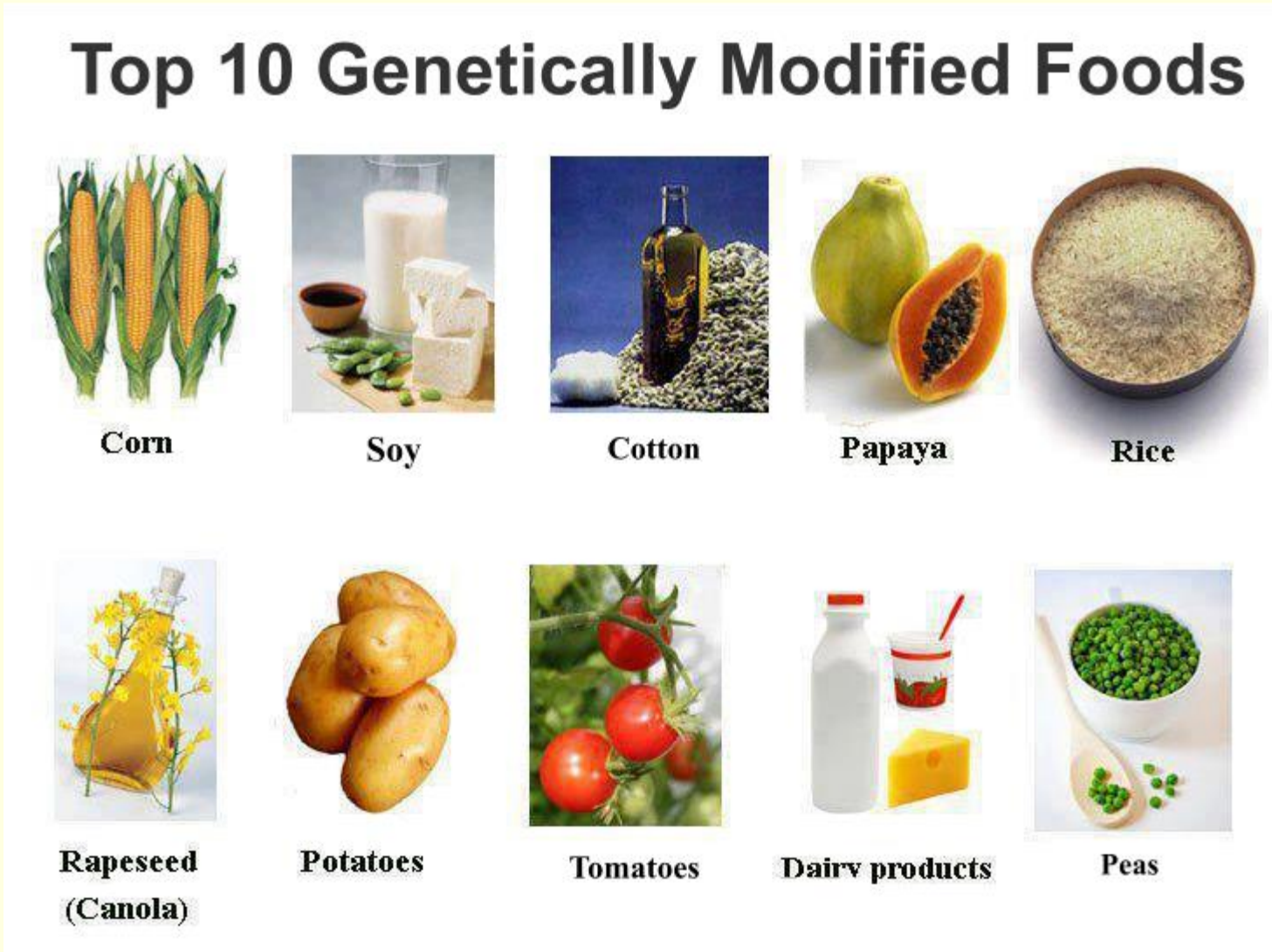
## Benefits of genetic engineering to society

| **Applications of genetic engineering** | **Benefits to society** |
|---|---|
| Development of<br>• crops that produce toxins that kill insect pests; and<br>• pesticide-resistant crops | Use of costly pesticides that may damage the environment is reduced<br>e.g. the Bt gene from a certain bacterium can be inserted into plants to produce a toxin that kills certain insect pests |
| Development of foods designed to meet specific nutritional goals | Improved quality of foods<br>e.g. 2 genes of daffodil and one gene from the bacterium *Erwinia uredarora* inserted into rice plants produce 'Golden Rice' rich in vit. A |

# Ethical issues with Genetic Engineering

- Are we playing god?
- Religion beliefs
- Creates new viruses
- Designing babies?
- Cloning

# Successfully Genetically Engineered Foods



# Cross breeding organisms

Zebroid

Liger

Wholphin

Pizzly

Beefalo

Savannah Cat

Zonkey

Llama

Tigon

Hinny

Dzo

# The End (?)