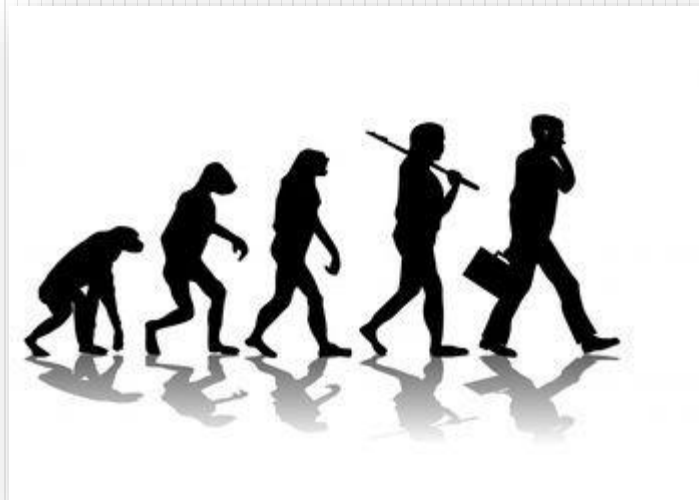


Biological Change Over Time

Introduction to Evolution



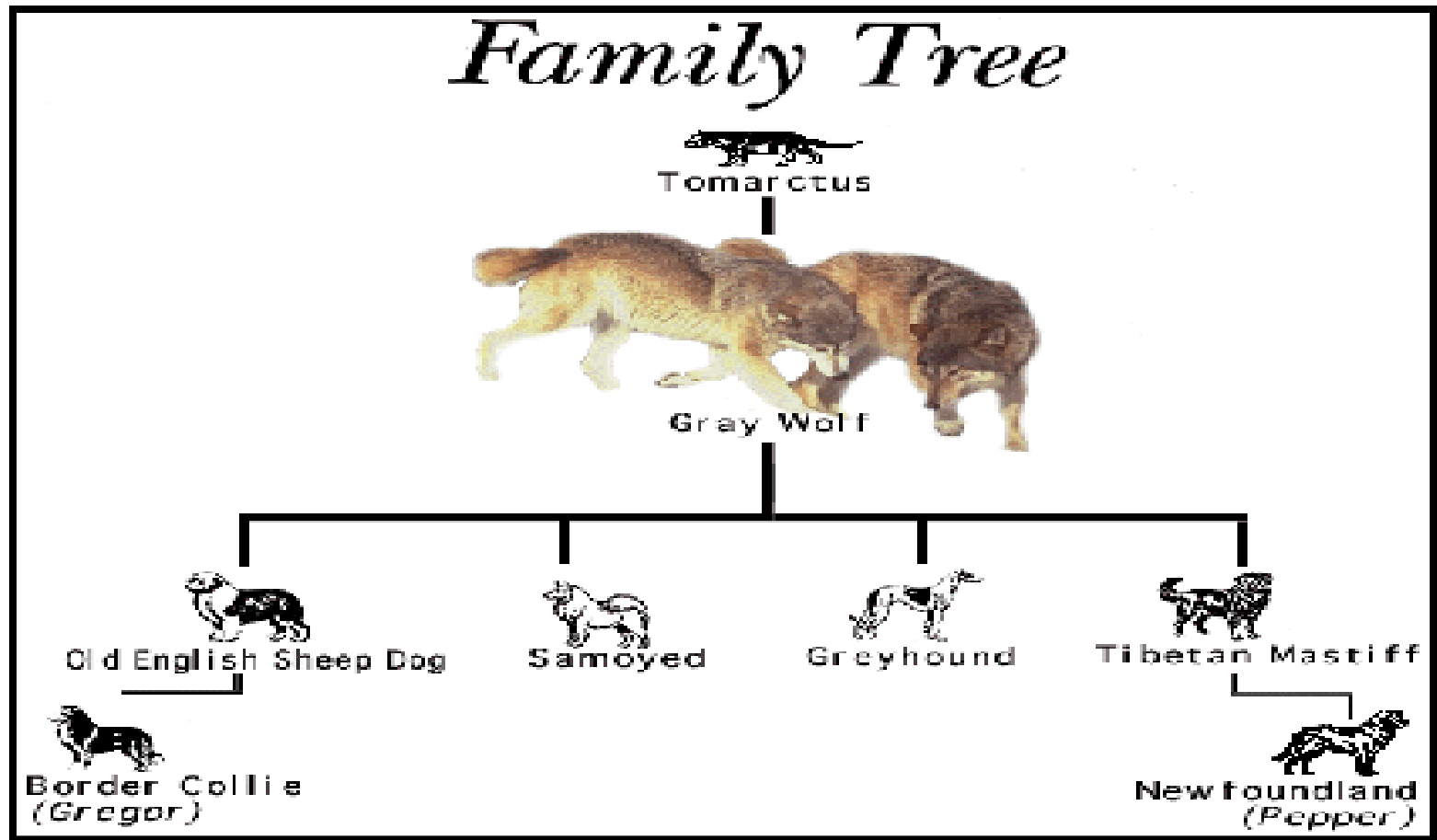
Evolution terms

- **Evolution** -is the change in biological species over time and many generations
- **Evolutionary change**- is a change that occurs in an entire population, usually over a long period of time
- **Evolutionary fitness**-when a specific trait allows individuals better survival and reproductive success
- **Selective advantage**- when nature selects for a particular trait allowing those individuals to have better survival and reproductive success

Where is change?

- We see change all around us. Some changes are rapid while others are slow and methodical. Some so slow that they are not seen on a day to day basis
- The snowshoe hare's white coat, broad feet and thick fur has been selected for over many generations as a result of better survival in colder weather with these traits
- Dogs and wolves look similar, but have many difference as a result of changes over time

Evolution of the Dog



How does change happen?

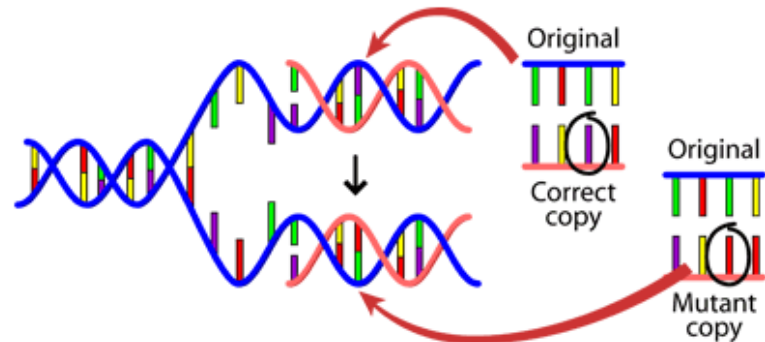
- individuals of all species exhibit some genetic variation
- The original source of change in a species is

Genetic mutation + Selective Pressure

- Mutation: A RANDOM change in the DNA of an organism (deletion, insertion, translocation and inversion)
- Sexual Reproduction: Creates new combination of genetic material
- Gene Flow: is any movement of genes from one population to another and is an important source of genetic variation.

- **DNA fails to copy accurately**

- Most of the mutations that we think matter to evolution are "naturally-occurring." For example, when a cell divides, it makes a copy of its DNA — and sometimes the copy is not quite perfect. That small difference from the original DNA sequence is a mutation.



- **External influences can create mutations**

- Mutations can also be caused by exposure to specific chemicals or radiation.

Different types of mutation...

- Neutral mutation: a mutation that does not result in any selective advantage
 - Ex. When the longer neck of the giraffe provide no benefit, when foliage is plentiful
- Harmful mutation: any mutation that decreases the reproductive success of the individual and are therefore selected against. Harmful mutations don't usually accumulate over time
 - Ex. When the longer neck decreases survival because it slows down the individuals ability to get away from the overpopulated lion predators in the area

Different types of mutation...

- Beneficial mutation: any mutation that increase the reproductive and are therefore selected for. Accumulate over time
 - Ex. The longer neck increases survival in times of foliage shortage.
- Whether a mutation is beneficial or harmful depends on the perspective we look at it from (EX. Antibiotic resistance in bacteria is beneficial for the bacteria, but not for humans)

Artificial Selection....

- Directed breeding in which individuals that exhibit a particular trait are chosen as parents of the next generation
- Used to produce plants or animals with desirable qualities
- Occurs in captivity
- Ex. Humans have been selectively breeding wolves over many generations to create the ideal dog. In other words the wolf is the ancestral species of all modern dog species.
- Ex. Humans have selectively bred the wild sea cabbage over many generations to create different varieties of cabbage, cauliflower, broccoli, kale, brussels sprout and kohlrabi



Broccoli - suppression of flower development



Cabbage - suppression of internode length



Kale - enlargement of leaves



Cauliflower - sterility of flowers



Wild mustard



Kohlrabi - enhancement of lateral meristems

How does artificial selection work...

- Within every species there is some pre-existing variety.
 - For example a wild tomato or strawberry provide small fruits, but some larger individuals within that population might be naturally occurring
- The bigger fruiting plants would then be repeatedly selected artificially by humans (their seeds were kept) to be allowed to reproduce. Creating larger and larger fruits over time.



The 100 year experiment...

- Longest running experiment in artificial selection by the Illinois agricultural experiment station
- Began in 1896
- Test the effects of artificial selection on the oil content of corn seeds
- Group A selected for high oil content and Group B was selected for low oil content.
- After 76 years Group A increased from 5% oil to more than 18% and group B decreased to less than 1% oil content
- Supports the effects of artificial selection

Limitations of artificial Selection

- **Cannot create traits that don't already exist in the population**
 - Breeders must work within the genetic variability that already exists in the population in order to alter it
 - Mutations are the only source of new genetic information
- **Some desirable mutations may be accompanied by undesirable ones**
 - For example an attempt was made to make strawberries that were tolerant of colder weather, but the hardy gene for strawberries was accompanied by a strange white colour. Thus this venture was discontinued .

Implications for natural populations

- Appearance and structure of organisms can change drastically through artificial and natural selection
- Can reduce genetic variability within a population
 - This loss of variation could present problems
 - For example: plants bred for sweeter fruits are favoured by humans but also by insects and therefore crops are more susceptible to infestation by pests
 - can be more prone to certain genetic illnesses including cancers because the alleles for these diseases are linked to the favoured alleles and therefore also inherited