Chapter 15 Genetic Engineering

Section 15.1 Selective Breeding
1. Selective Breeding

- To select/improve living org for human benefit
- Uses naturally occurring variations w/in species
- Breed indiv w/desired nat’l variation
- Corn/dogs: domesticated more than 6000 TYA
  - Teosinte (wild grass) to corn: selectively bred by Natv Americas
  - Animals w/wanted trait reproduce

![Diagram showing the evolutionary process from a common wild mustard to modern corn and the classification of dogs into different breeds.](image)
Selective Breeding consists of:

- Inbreeding, which crosses similar organisms for example:
  - Organism breed A which retains desired characteristics

- Hybridization, which crosses dissimilar organisms for example:
  - Organism breed A which combines desired characteristics
  - Organism breed B
A. **Hybridization**: Cross dissimilar organisms w/desired traits

1. Luther Burbank: Amer. botanist-greatest selective breeder
   - Developed hundreds of plant varieties
   - Combined disease resistance w/food producing capacity
B. **Inbreeding**: cross similar individual preserving unique traits

1. ↑ risk of combining recessive alleles for genetic disorders
II. Increasing Variation

- **Biotechnology**: manipulating genetic makeup
- **Mutations**: ultimate source of biologic diversity
A. Bacterial Mutations:
1. Heritable changes in DNA
2. Use radiatn/chemicals to induce change (some helpful)
3. Can expose millions quickly ↑ chance of beneficial change
4. Oil-digesting bacteria (now working on radioactive/metal digesting bacteria)
B. Polyplloid Plants

1) Cells w/↑ # chromosomes (drugs prevent separatn)
2) Plant survive (larger/stronger)-fatal in animals
3) Many crops/fruits (bananas) produced this way
16.2 Ideas that Shaped Darwin’s Thinking

I. Geological data uncovered an ancient, changing Earth

A. Hutton - Geologic Change
1. Earth processes operate very slowly (mountain building)
2. Concluded earth millions of years old (named deep time - difficult for humans to imagine)
B. Lyell’s Principles of Geology

1. **Uniformitarianism**: Laws of nature constant = past processes changing Earth same as present (rivers carving canyons)

2. **Darwin** studied Lyell’s work on Beagle
   a) Saw earthquake lift beach several ft => could build mountains w/ enough time
   b) Observed marine animal fossils in mountains
   c) If earth changed, so could life
II. Lamarck’s Evolutionary Hypotheses

A. Lamarck’s ideas
1. All org tend toward complexity/perfection
2. Alter size/shape based on use/disuse
3. Thought **acquired traits** inheritable -- Incorrect!

B. Evaluating Lamarck’s Hypotheses
1. Explained evolution scientifically
2. Suggested species not fixed-linked btw env/body structure
3. Work paved way for Darwin
III. Malthus & Population Growth

A. Humans: more born than die -> insufficient space/food

B. Natural Factors ↓ growth: war, famine, disease

C. Darwin noted same patterns for plants/animals = wondered which org. survived/Why?
IV. Artificial Selection

A. Nature provides variation/humans select for usefulness

B. Darwin studied changes by breeders
   - Nature provides raw materials for evolution

Reproductive Ability
(Tendency for geometric increase in number)
+ Environmental Restrictions
(Limited resources)

Struggle for Existence
(Competition)
+ Heritable Variations

Columbine Flower Species

Natural Selection
(Persistence of adaptive traits)
+ Environmental Changes

Evolution
(Change in a trait)
16.3 Darwin Presents Case

I. Evolution by Natural Selection

A. Struggle for existence
   1. Species compete for food/life/space (*Malthus*)

B. *Variations* occur naturally
   1. Some variants better suited
   2. *Adaptation*: Inherited characteristic ↑ chance of survival

C. Survival of the fittest (Key Factor)
   1. *Fitness*: ability to survive & repro in env’t
   2. Lo fitness: die w/out repro.
gradual increase in fitness of population over time

natural selection
competition
changes in gene pool

selective survival

results from

has definition

occurs at site

produced by

describes

changes in population structure

population

adaptation

TIL
D. Natural Selection
1. Mechanism for evolution
2. Environment influences fitness
3. Over time change in inherited characteristics of populations.
II. **Common Descent with modification**

- Living species descended with change from other species over time
- With deep time: All species (living/extinct) descended from common ancestor—single tree of life
Descent with modification. Darwin proposed that organisms are related by being descendants of a common ancestor, with modification among the descendants. Based mainly on fossil evidence, this evolutionary tree reveals that manatees and hyraxes are the elephants' closest living relatives.
16.4 Evidence of Evolution

I. Biogeography

A. Use distribution pattern of modern compared to fossil species

1. Closely related species differentiated w/diff climates (Galapagos island=variations between islands tortoises)

2. Distant species similar w/similar climates(similar selection pressures=develop similar adaptations)
II. Age of Earth and Fossils

A. Age

1. Radioactive dating
   - Enough time for evolution by Nat. Selctn ~ 4.5 Bil Yrs Old

2. Fossils
   - Fossil Records: remains of ancient life
   - Many recent fossil intermediates
     - Trace evolution from modern to extinct ancestors

Pakicetus
III. Comparing Anatomy and Embryology

A. Homologous Structures: similar structures w/different purposes from decent w/mod from com ancestor

1. Analogous Structures: common functn not structure
2. **Vestigial Structures**: inherited structures w/lost functn
- Fitness not affected so not eliminated w/Nat. Selctn
B. Embryology

- Similar embryo development evidence of common ancestor with vertebrates.
IV. Genetics and Molecular Biology

A. Genetic Code: All cells use DNA/RNA to pass info to next gen. & for protein synth.

B. Homologous Molecules:
- Most life proteins chem/struct similar (Cytochrome C for cell resp.
- Hox genes: determine head->tail dev. in multicelld animals