

**NETA PowerPoint® Slides**

to accompany

prepared by  
Ian Dawe

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**Chapter 5****Evolution and Biodiversity**

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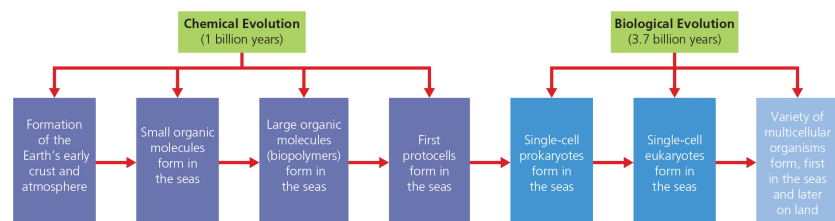
## Key Concepts

Origins of life  
 Evolution and adaptation  
 Ecological niches and adaptation  
 Speciation, extinction, and biodiversity  
 Future of evolution and artificial gene selection

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## Origins of Life



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## What Is Evolution?

### Evolution

- Change in a population's genetic makeup through successive generations
- **Macroevolution**
  - Long-term, large-scale changes that form new species or genera
- **Microevolution**
  - Small genetic changes occurring in the population that do not give rise to new species

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## How Does Microevolution Work?

*Genes mutate, individuals are selected,  
populations evolve.*

### Gene Pool

- Available different **alleles** in the population (diversity)

### Mutations: The Source of Diversity

- Random changes in DNA sequence
- Due to radioactivity or mistakes in copying

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## What Role Does Natural Selection Play in Microevolution?

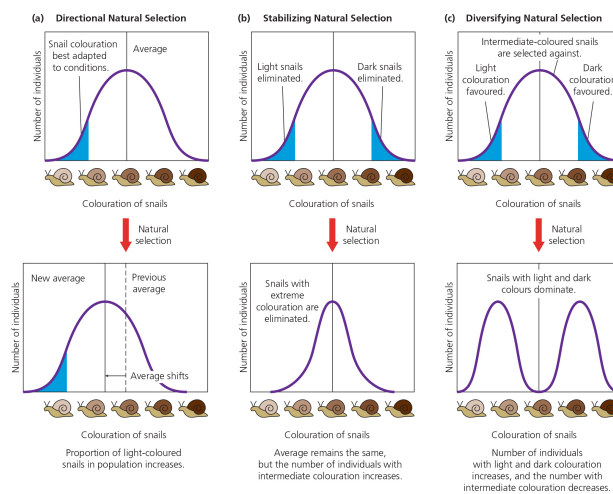
When variability in a **heritable trait** leads to **differential reproduction**

**Adaptive traits** enable better survival and reproduction.

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## Types of Natural Selection



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## What Is Coevolution?

Related genetic changes in interacting species  
Indicates close ecological relationship between species

– *For example, bats vs. moths*

- Moths develop countermeasure against sonar
- Some bats evolved to use different frequency

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## What Is an Ecological Niche?

### **Ecological Niche**

- A species' functional role or way of life

### **Habitat**

- Physical location where a species lives

### **Fundamental Niche**

- Full theoretical potential niche

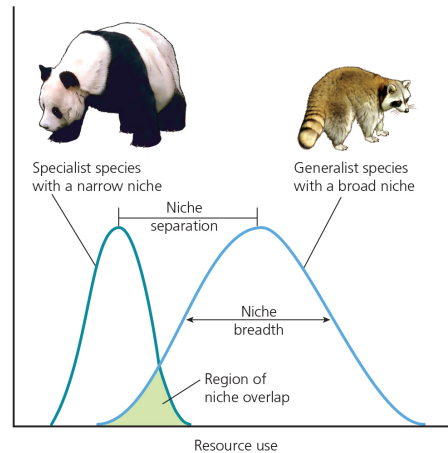
### **Realized Niche**

- The part of fundamental niche actually occupied

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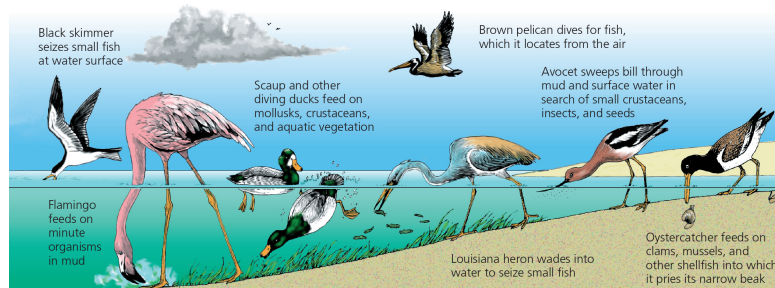
## What Are Generalist and Specialist Species?



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## Specialized Feeding Niches

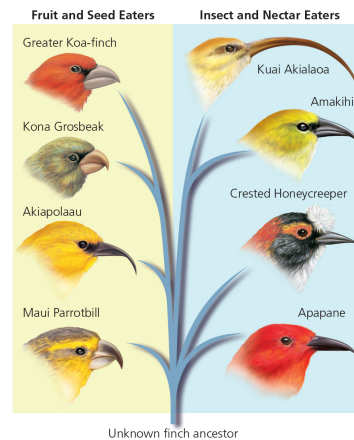


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## Divergent Evolution

- One species diverges into a variety of similar species with specialized niches



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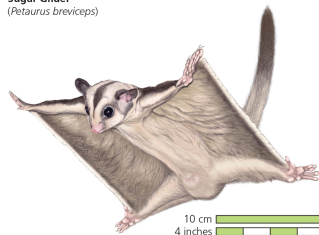
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## Convergent Evolution

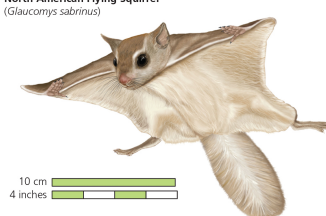
Distantly related species develop similarities due to similar environmental constraints or opportunities

Same problem = Same solution

**Sugar Glider**  
(*Petaurus breviceps*)



**North American Flying Squirrel**  
(*Glaucomys sabrinus*)



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## Commonly Misunderstood Aspects of Evolution

### Effects of use or disuse

- Traits acquired during an organism's lifetime *cannot be passed on*.
- Selection relies on differential reproductive success of traits *already encoded* in genes.

### Survival of the fittest

- *Not* survival of the “strongest”
- Fitness measures **reproductive** success.

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## How Do New Species Evolve?

### Allopatric Speciation

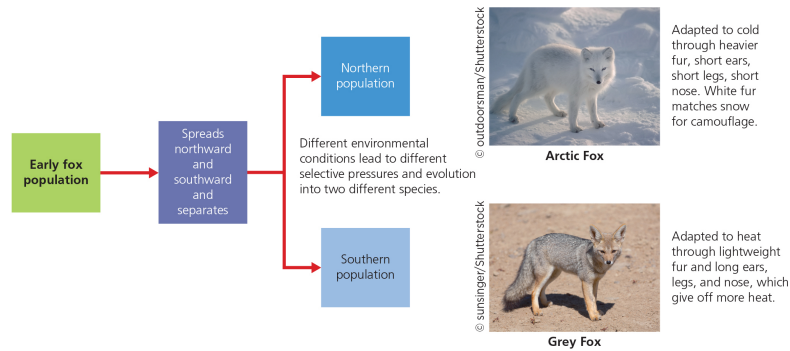
1. Geographic isolation
2. Reproductive isolation
  - Natural selection operates independently on separate populations.

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## Example of Allopatric Speciation



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## How Do New Species Evolve?

### Sympatric Speciation

- Portions of a single population become unable to interbreed due to
  - Mutations
  - Behavioural changes

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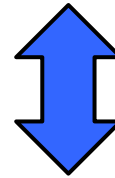
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## What Is Extinction?

Occurs when a species is unable to adapt to a changing environment

- **Background extinction**
- **Mass depletion**
- **Mass extinction**

Low extinction rate



High extinction rate  
(25–70% of species)

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## Human Impacts on Species

**Biodiversity = Speciation – Extinction**

Background extinction rate

- 1–5 species per million

20<sup>th</sup>-century extinction rate

- 100–1000 species per million
- Human influence
  - Population growth
  - Resource consumption

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## What Is the Future of Evolution?

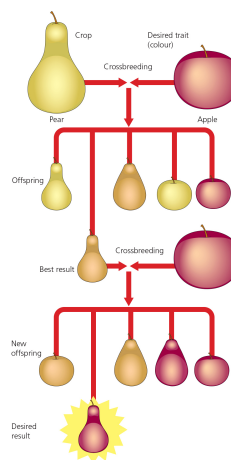
Artificial selection  
Genetic engineering  
Biopharming

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## What Is Artificial Selection?

Selective breeding  
Slow process  
Can only combine  
traits from similar  
species



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## What Is Genetic Engineering?

Transplanting genes between species by **gene splicing**

Genetically modified organisms (GMOs)

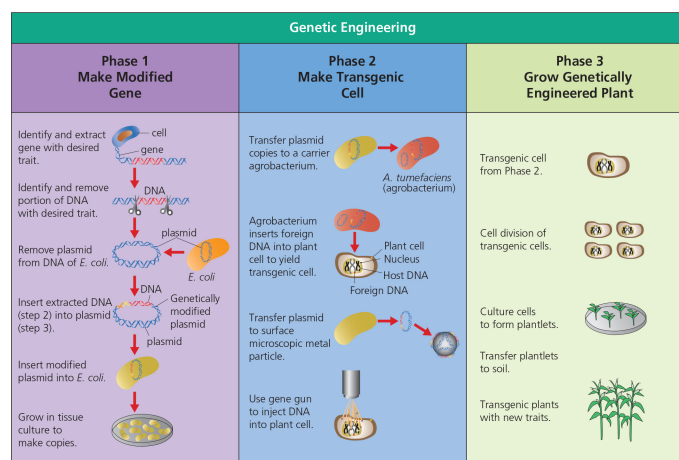
Less time and cost than crossbreeding

Engineer animals to incubate or produce  
utilitarian compounds = **Biopharming**

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## Genetically Engineering a Plant



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## **What Are Some Concerns About the Genetic Revolution?**

Unpredictability

Ethical, legal, and privacy concerns

Cautionary labelling of GMOs

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## **Conclusion**

Evolution is the process of selecting a subset of biodiversity generated through mutation that is best suited for reproduction in a given environment.

Evolution happens to populations occupying an ecological niche.

Artificial selection is important for the future.

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