

Biomes

What Is Biodiversity and Why Is It Important?

Essential Understanding: *The biodiversity found in genes, species, ecosystems, and ecosystem processes is vital to sustaining life on earth.*

Biodiversity

- **Species diversity**
- A set of individuals that can mate and produce fertile offspring
- 8-100 million species total; likely 10-14 million
- 2 million species identified
- ~50% in endangered tropical rainforests

Biodiversity

- **Genetic diversity**
- **Ecosystem diversity**
 - **Biomes**
 - **Distinct climate**
 - **Certain species, especially vegetation**
- **Functional diversity**

Insects

- Around for ~400 million years
- Bad reputation
- Useful to humans and ecosystems
- Vital roles in sustaining life
 - Pollinators
 - Natural pest control
 - Renewing soils

How Does the Earth's Life Change over Time?

Essential Understanding: *The scientific theory of evolution explains how life on earth changes over time through changes in the genes of populations.*

Essential Understanding: *Populations evolve when genes mutate and give some individuals genetic traits that enhance their abilities to survive and to produce offspring with these traits (natural selection).*

Population Changes over Time

- Populations evolve by becoming genetically different over time
- Genetic variability – **mutations**
 - Random changes in DNA molecules in genes
 - Can occur spontaneously
 - External agents: radiation
 - Can create a heritable trait

Natural Selection

- **Adaptive traits** - genetically favorable traits that increase the probability to survive and reproduce
- Trait – heritable and lead to differential reproduction
- Faced with environmental change
 - Adapt through evolution
 - Migrate
 - Become extinct

Evolution through Natural Selection Summarized

- Genes mutate, individuals are selected, and populations evolve such that they are better adapted to survive and reproduce under existing environmental conditions.

Adaptation through Natural Selection Has Limits

- Humans unlikely to evolve and have skin that's not harmed by UV radiation
 1. Desired trait must already be in the gene pool.
 2. Must have high reproductive capacity so adaptive traits can be spread rapidly

How Do Geological Processes and Climate Changes Affect Evolution?

Essential Understanding: *Tectonic plate movements, volcanic eruptions, earthquakes, and climate change have shifted wildlife habitats, wiped out large numbers of species, and created opportunities for the evolution of new species.*

Plate Tectonics

- Locations of continents and oceans determine earth's climate
- Movement of continents allow species to move and adapt
- Earthquakes and volcanoes affect biological evolution by separating populations of a species and allowing new species to develop

Earth's Long-Term Climate Changes

- Cooling and warming periods – affect evolution and extinction of species
 - Change ocean levels and area
 - Glaciers expanding and contracting
 - Climate changes
- Opportunities for the evolution of new species
- Many species go extinct

Earth is Just Right for Life to Thrive

- Life needs a temperature range that results in liquid water
- Earth's orbit: right distance from sun
- Earth's optimal gravity: keeps atmosphere
- Favorable temperature range over earth history has promoted evolution and biodiversity
- Favorable oxygen level in atmosphere

How Do Speciation, Extinction, and Human Activities Affect Biodiversity?

Essential Understanding: *Human activities decrease the earth's biodiversity by causing the premature extinction of species and by destroying or degrading habitats needed for the development of new species.*

Speciation

- **Speciation**
 - One species splits into two or more species that can no longer breed and produce fertile offspring
- **Geographic isolation**
- **Reproductive isolation**

Extinction

- **Biological extinction**
 - Entire species gone
- **Local extinction**
 - All members of a species in a specific area gone
- **Endemic species** vulnerable to extinction
- **Background extinction**
- Speciation generally more rapid than extinction

Extinction

- **Mass extinction**
 - Earth took millions of years to recover from previous mass extinctions
- Balance between speciation and extinction determines biodiversity of earth
- Humans cause premature extinction of species

What Is Species Diversity and Why Is It Important?

Essential Understanding: *Species diversity is a major component of biodiversity and tends to increase the sustainability of some ecosystems.*

Species Diversity

- **Species richness**
- **Species evenness**
- Varies with geographic location
- Species richness declines towards poles

Richness and Sustainability

- Hypothesis
 - Does a community with high species richness have greater sustainability and productivity?
- Research suggests “yes”

What Roles Do Species Play in an Ecosystem?

Essential Understanding: Each species plays a specific ecological role called its niche.

Ecological Niche (1)

- Species occupy unique niches and play specific roles in an ecosystem
- Includes everything required for survival and reproduction
 - Water
 - Sunlight
 - Space
 - Temperatures
 - Food requirements

Ecological Niche

- **Generalist species**
- **Specialist species**
- **Native species**
- **Nonnative species**
 - Spread in new, suitable niches

Cockroaches

- Existed for 350 million years – 3,500 known species
- Highly adapted, rapidly producing generalists
 - Consume almost anything
 - Endure food shortage
 - Survive everywhere except polar regions
 - Avoid predation
- Carry human diseases

Indicator Species

- Early warning system
- Fish
- Birds
- Butterflies
- Amphibians

Keystone Species

- Significant role in their food web:
large affect on types and abundances
of other species in an ecosystem
- Elimination may alter structure and/or
function of ecosystem
- Pollinators
- Top predators

Foundation Species

- Create habitats and ecosystems
- Beavers
- Elephants
- Seed dispersers

American Alligator

- Highly adaptable
- Only natural predator is humans
- 1967 – endangered species list
- Successful environmental comeback
- Keystone species

Why Should We Protect Sharks?

- Remove injured, sick animals
- Many are gentle giants
- Provide potential insight into cures for human diseases such as cancer
- Keystone species
- Hunted and killed by humans