Module 3: Climate Change and Ecosystems

Climate Change Overview

Climate change refers to long-term changes in temperature, precipitation, and other climate patterns. Current changes are primarily driven by human activities.

Greenhouse Effect

Natural Greenhouse Effect

- Essential for life on Earth
- Greenhouse gases trap heat
- Maintains Earth's temperature

Enhanced Greenhouse Effect

- Increased greenhouse gas concentrations
- Primarily from human activities
- Leading to global warming

Major Greenhouse Gases

- **Carbon Dioxide (CO2)**: From burning fossil fuels
- **Methane (CH4)**: From agriculture and waste
- **Nitrous Oxide (N2O)**: From agriculture and industry
- **Water Vapor**: Natural but amplified by warming

Evidence of Climate Change

Temperature Records

- Global average temperature increasing
- More frequent heat waves

- Warmer winters
- Shifting temperature patterns

Ice and Snow

- Melting glaciers
- Reduced Arctic sea ice
- Permafrost thawing
- Earlier snowmelt

Sea Level Rise

- Thermal expansion of seawater
- Melting ice sheets
- Coastal flooding
- Saltwater intrusion

Extreme Weather

- More intense storms
- Changing precipitation patterns
- Increased drought
- More frequent wildfires

Impacts on Ecosystems

Terrestrial Ecosystems

- Shifting species ranges
- Changes in phenology (timing of events)
- Altered growing seasons
- Forest dieback
- Desertification

Marine Ecosystems

- Ocean acidification
- Coral bleaching
- Shifting fish distributions
- Sea level rise impacts
- Changes in ocean currents

Freshwater Ecosystems

- Altered stream flows
- Warmer water temperatures
- Changes in species composition
- Reduced water availability
- Increased evaporation

Adaptation and Mitigation

Mitigation Strategies

- Reduce greenhouse gas emissions
- Transition to renewable energy
- Increase energy efficiency
- Carbon capture and storage
- Reforestation

Adaptation Strategies

- Protect vulnerable ecosystems
- Restore degraded habitats
- Assist species migration
- Develop climate-resilient practices
- Plan for sea level rise

Future Projections

Climate Models

- Predict future climate scenarios
- Based on emission scenarios
- Show range of possible outcomes
- Help guide policy decisions

Potential Impacts

- Continued temperature increase
- More extreme weather events
- Significant ecosystem changes
- Economic and social impacts
- Need for urgent action