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# **Grade 9 Science: Biology Sustainable Ecosystems and Climate Change**

# **B1. Relating Science to Our Changing World**

**Overall Expectations:**

* Assess impacts of climate change on ecosystem sustainability and on various communities.
* Describe ways to mitigate these impacts.

### **Introduction**

Welcome to our exploration of how climate change affects the world around us. You might have heard about climate change in the news, seen its effects in your community, or even discussed it in other classes. But have you ever stopped to think about how these changes impact the delicate balance of our ecosystems and the communities that depend on them?

In this lesson, we'll dive into the science behind climate change, discover its impacts on ecosystems and communities, and learn about efforts to mitigate these effects. Get ready for an engaging journey that will help you understand the world in a new way.

## **Engage: The Changing World Around Us**

#### **Capturing Attention**

Let's start by thinking about what we already know about climate change. Have you noticed any unusual weather patterns lately? Maybe you’ve experienced a hotter summer, a milder winter, or more intense storms. These are all signs that our climate is changing. But why is this happening, and what does it mean for our planet?

#### **Stimulating Thinking**

Think about your local area. What plants and animals live there? How do the seasons affect them? Now imagine if the temperature rose by a few degrees, or if there was more or less rainfall. How might these changes affect the living things around you? Jot down your thoughts in a journal.

#### **Eliciting Prior Knowledge**

Before we dive into new concepts, let's activate what you already know. Take a few minutes to reflect on the following questions and write down your answers:

* What is climate change?
* How do you think climate change impacts the environment?
* Have you heard of any initiatives to combat climate change in your community?

## **Explore: Discovering Climate Change Impacts**

#### **Investigating Local Climate Change Effects**

Climate change can be observed in many ways right in your own community. This section will guide you through individual activities that will help you discover and understand these impacts firsthand.

#### **Activity 1: Observing Plant and Animal Life**

**Objective:** Identify and document changes in local plant and animal life that may be linked to climate change.

**Materials Needed:**

* Notebook or journal
* Pen or pencil
* Camera or smartphone (optional)

**Steps:**

1. Choose a nearby natural area to explore, such as a park, garden, or forest.
2. Spend at least 30 minutes observing the plants and animals in this area.
3. Take note of any unusual patterns, such as plants blooming earlier or later than usual, changes in the types of plants or animals present, or an increase in pest activity.
4. Take photos of any significant observations.
5. Reflect on how these changes might be connected to climate change. Write a brief summary of your findings in your journal.

#### **Activity 2: Monitoring Weather Patterns**

**Objective:** Track local weather patterns over a period of time to identify any unusual changes or trends.

**Materials Needed:**

* Notebook or journal
* Pen or pencil
* Access to a weather app or website

**Steps:**

1. Choose a period of two weeks to monitor local weather patterns.
2. Each day, record the temperature, precipitation, and any extreme weather events (e.g., storms, heatwaves).
3. Note any deviations from the expected weather patterns for that time of year.
4. At the end of the two weeks, analyze your data to identify any unusual trends or patterns.
5. Write a summary of your observations and how they might be related to climate change in your journal.

#### **Activity 3: Investigating Water Levels**

**Objective:** Observe and document changes in local water levels that could be linked to climate change.

**Materials Needed:**

* Notebook or journal
* Pen or pencil
* Camera or smartphone (optional)
* Access to a nearby body of water (e.g., river, lake, pond)

**Steps:**

1. Visit a nearby body of water.
2. Observe and note the current water level. Take photos if possible.
3. Return to the same location once a week for four weeks and document any changes in water levels.
4. Note any factors that might influence these changes, such as recent weather events.
5. Reflect on how these changes might be connected to climate change. Write a brief summary of your findings in your journal.

#### **Activity 4: Exploring Local Initiatives**

**Objective:** Identify and learn about local initiatives aimed at combatting climate change.

**Materials Needed:**

* Internet access
* Notebook or journal
* Pen or pencil

**Steps:**

1. Research online to find local initiatives that address climate change. These could include community gardens, renewable energy projects, or conservation programs.
2. Choose one initiative to investigate further.
3. Gather information on the goals, activities, and outcomes of the initiative.
4. Reflect on how this initiative helps mitigate the impacts of climate change in your community.
5. Write a summary of your findings and reflections in your journal.

By completing these activities, you will gain a deeper understanding of how climate change impacts your local environment and what steps can be taken to address these changes. Documenting your observations and reflections will help you connect theoretical knowledge with real-world experiences, enhancing your learning process.

## **Explain: Understanding the Science**

#### **B1.1 Impacts of Climate Change on Ecosystems**

**Objective:** Assess the impacts of climate change on the sustainability of local and global ecosystems.

**Discussion:**

##### **Local Ecosystems**

Climate change affects local ecosystems in various ways. For example, rising temperatures can lead to:

* **Shifts in Plant Populations:** Some plants may bloom earlier or later than usual, affecting the entire food chain. Warmer temperatures can also allow invasive species to thrive, outcompeting native plants.
* **Animal Migration:** Animals may change their migration patterns in response to temperature changes, seeking cooler habitats or following shifts in their food sources.
* **Pest Proliferation:** Warmer winters can enable pests like mosquitoes and ticks to survive in greater numbers, leading to more disease outbreaks.

**Example:** In Ontario, the warmer climate has allowed the range of the black-legged tick, which can carry Lyme disease, to expand northward.

##### **Global Ecosystems**

On a global scale, the effects of climate change are equally profound:

* **Coral Bleaching:** Higher sea temperatures cause corals to expel the algae (zooxanthellae) they rely on for food, leading to widespread coral bleaching and reef death.
* **Polar Ice Melt:** The Arctic and Antarctic ice caps are melting at alarming rates, contributing to rising sea levels and loss of habitat for species like polar bears and penguins.

**Example:** The Great Barrier Reef in Australia has experienced severe bleaching events, threatening its biodiversity and the livelihoods of communities dependent on it.

**Mitigation Efforts:**

Various initiatives aim to combat climate change. These include:

* **Green Roofs:** Urban areas can reduce heat islands by installing green roofs, which also help absorb rainwater and reduce runoff.
* **Renewable Energy:** Shifting from fossil fuels to renewable energy sources like solar and wind can significantly reduce greenhouse gas emissions.

**Example:** The city of Toronto has implemented a green roof bylaw, requiring new buildings to include green roofs to help mitigate urban heat and improve air quality.

#### **B1.2 Impacts on Canadian Communities**

**Objective:** Assess the impacts of climate change on communities in Canada, including First Nations, Métis, and Inuit communities.

**Discussion:**

##### **Indigenous Communities**

Climate change poses unique challenges for Indigenous communities in Canada. These communities often rely on the land and natural resources for their way of life, making them particularly vulnerable to environmental changes.

* **Thawing Permafrost:** In northern regions, permafrost is melting, which can destabilize buildings and roads.
* **Changing Ice Conditions:** For communities that depend on ice for transportation and hunting, thinner ice poses significant risks.

**Example:** The Inuvialuit community in the Northwest Territories has observed changes in ice thickness, affecting their traditional hunting practices.

##### **Urban and Rural Communities**

* **Urban Areas:** Cities might experience increased heatwaves, which can strain infrastructure and health services. Urban areas are also prone to flooding due to more intense rainfall and storm surges.
* **Rural Areas:** Agriculture in rural areas is affected by changes in precipitation and temperature, which can lead to crop failures or reduced yields.

**Example:** The 2018 heatwave in Quebec led to numerous heat-related illnesses and deaths, highlighting the need for better heat management strategies in urban areas.

#### **B1.3 Sustainable Practices and Ecosystem Equilibrium**

**Objective:** Investigate and explain how sustainable practices used by various communities, including First Nations, Métis, and Inuit communities, reflect an understanding of the importance of the dynamic equilibrium of ecosystems.

**Discussion:**

##### **Indigenous Practices**

First Nations, Métis, and Inuit communities have long practiced sustainable living, recognizing the importance of maintaining a balance within ecosystems.

* **Controlled Burns:** Some Indigenous communities use controlled burns to manage forest health and prevent larger, uncontrolled wildfires. These practices enhance biodiversity and reduce the risk of catastrophic fires.
* **Sustainable Harvesting:** Techniques such as rotational harvesting ensure that resources like fish, game, and plants are not depleted, allowing ecosystems to recover and maintain their productivity.

**Example:** The Haudenosaunee practice of the "Three Sisters" planting method (corn, beans, and squash grown together) exemplifies sustainable agriculture that enhances soil health and crop yields.

##### **Modern Sustainable Practices**

Modern approaches to sustainability also focus on maintaining ecosystem balance:

* **Renewable Energy Sources:** Using wind, solar, and hydroelectric power reduces reliance on fossil fuels, decreasing greenhouse gas emissions.
* **Conservation Efforts:** Protecting natural areas and restoring damaged ecosystems help maintain biodiversity and ecosystem services.

**Example:** The establishment of marine protected areas (MPAs) helps conserve marine ecosystems and support sustainable fisheries.

**Individual Activity:**

Reflect on how these sustainable practices can be applied in your own life or community. Write a brief essay discussing the importance of dynamic equilibrium in ecosystems and propose a sustainable practice that could help maintain this balance in your local area.

By thoroughly understanding these concepts, you will be better equipped to appreciate the complexity of climate change and its impacts on both ecosystems and human communities. This comprehensive understanding will also empower you to participate in and advocate for sustainable practices in your own life.

## **Elaborate: Applying Knowledge**

#### **Deepening Understanding Through Application**

In this section, we will extend your understanding by applying the knowledge you have gained about climate change and its impacts. These activities are designed for you to complete independently, allowing you to explore and connect the concepts to real-world situations.

#### **Activity 1: Personal Impact Assessment**

**Objective:** Assess the personal and local impacts of climate change.

**Materials Needed:**

* Notebook or journal
* Pen or pencil
* Internet access (optional)

**Steps:**

1. Reflect on the changes you have observed in your local environment over the past few years. Consider weather patterns, plant and animal life, and any other noticeable changes.
2. Write a detailed account of these observations in your journal.
3. Research online to find any scientific studies or reports about climate change impacts in your area.
4. Compare your observations with the findings from your research. Write a summary of how climate change is impacting your local environment and community.

**Example:** If you have noticed more frequent flooding in your area, find out if this has been linked to climate change in local studies.

#### **Activity 2: Designing a Climate Mitigation Plan**

**Objective:** Develop a plan to mitigate the effects of climate change in your community.

**Materials Needed:**

* Notebook or journal
* Pen or pencil
* Internet access

**Steps:**

1. Identify a specific climate change issue affecting your community (e.g., increased heatwaves, flooding, declining air quality).
2. Research existing solutions and initiatives that address this issue.
3. Design your own climate mitigation plan, incorporating elements from your research and adding your innovative ideas.
4. Outline the steps needed to implement your plan, including resources required, potential partners, and a timeline.
5. Write a detailed proposal for your plan, explaining how it will help mitigate the effects of climate change in your community.

**Example:** If you choose to address increased heatwaves, your plan might include planting more trees for shade, creating cooling centers, and promoting energy-efficient cooling technologies.

#### **Activity 3: Exploring Indigenous Sustainable Practices**

**Objective:** Learn about and reflect on sustainable practices used by Indigenous communities.

**Materials Needed:**

* Notebook or journal
* Pen or pencil
* Internet access

**Steps:**

1. Choose one Indigenous community in Canada (e.g., a First Nation, Métis, or Inuit community) to focus on.
2. Research their traditional and contemporary sustainable practices related to the environment.
3. Write a summary of these practices, explaining how they contribute to the dynamic equilibrium of ecosystems.
4. Reflect on how these practices could be adapted and applied in your own community or personal life.
5. Write an essay discussing the importance of Indigenous knowledge in the global effort to combat climate change.

**Example:** You might explore the Métis practice of sustainable fishing and how it ensures fish populations remain healthy and abundant.

#### **Activity 4: Creating a Visual Presentation**

**presentation**

**Objective:** Create a visual presentation to educate others about the impacts of climate change and sustainable practices.

**Materials Needed:**

* Computer or tablet with presentation software (e.g., PowerPoint, Google Slides)
* Internet access for research
* Notebook or journal for notes

**Steps:**

1. Choose a specific aspect of climate change impacts or sustainable practices to focus on for your presentation.
2. Research your chosen topic, gathering reliable information and data.
3. Create a visual presentation that includes:
   * An introduction to your topic
   * Detailed explanations of key points
   * Visual aids (e.g., images, graphs, videos) to enhance understanding
   * A conclusion summarizing the importance of your topic and suggesting actions people can take
4. Practice presenting your slides to ensure a smooth delivery.
5. If possible, share your presentation with family, friends, or classmates to spread awareness.

**Example:** You could create a presentation on the impacts of climate change on polar ecosystems, including the effects on polar bears and sea ice.

By engaging in these individualized activities, you will deepen your understanding of climate change and its impacts. These activities will help you make connections between scientific concepts and real-world applications, empowering you to take action in your community and contribute to global sustainability efforts.

## **Evaluate: Assessing Understanding**

#### **Evaluating Knowledge Through Quizzes and Reflection**

In this section, you will assess your understanding of the impacts of climate change on ecosystems and communities. This will include a multiple-choice quiz and a reflective activity to solidify your learning.

#### **Quiz: Climate Change and Ecosystems**

**Easy Questions:**

1. What is climate change?
   * A) A shift in weather patterns over a long period.
   * B) A temporary change in the weather.
   * C) A local weather event.
   * D) A change in the seasons.
2. Which of the following is an impact of climate change on local ecosystems?
   * A) Invasive species thrive.
   * B) Stable temperatures.
   * C) Decreased pest populations.
   * D) Constant rainfall.
3. What does coral bleaching result from?
   * A) Lower water temperatures.
   * B) Higher water temperatures.
   * C) Increased fish populations.
   * D) Decreased algae.
4. Which initiative can help mitigate urban heat islands?
   * A) Cutting down trees.
   * B) Planting green roofs.
   * C) Increasing fossil fuel use.
   * D) Removing parks.
5. What is a common effect of thawing permafrost on infrastructure?
   * A) Stability.
   * B) Strength.
   * C) Destabilization.
   * D) Improvement.
6. Why are polar bears affected by climate change?
   * A) Increased prey availability.
   * B) Loss of ice habitat.
   * C) Warmer water temperatures.
   * D) More hunting opportunities.
7. What is the purpose of controlled burns in Indigenous practices?
   * A) To start forest fires.
   * B) To manage forest health.
   * C) To destroy crops.
   * D) To increase pests.
8. What is one benefit of renewable energy sources?
   * A) Increase in greenhouse gas emissions.
   * B) Reduction of greenhouse gas emissions.
   * C) Decrease in biodiversity.
   * D) Increase in fossil fuel use.
9. What type of plant practice is used by the Haudenosaunee?
   * A) Monoculture.
   * B) "Three Sisters" planting.
   * C) Slash-and-burn.
   * D) Industrial agriculture.
10. How do marine protected areas help ecosystems?
    * A) By increasing pollution.
    * B) By conserving marine life.
    * C) By promoting overfishing.
    * D) By reducing biodiversity.

**Moderate Questions:**

1. How does climate change affect animal migration?
   * A) Animals stay in one place.
   * B) Animals change their migration patterns.
   * C) Animals stop migrating.
   * D) Animals move closer to cities.
2. Which community faces unique challenges due to melting permafrost?
   * A) Urban communities.
   * B) Coastal communities.
   * C) Indigenous communities.
   * D) Agricultural communities.
3. What are green roofs used for in urban areas?
   * A) To increase air conditioning.
   * B) To reduce urban heat islands.
   * C) To eliminate parks.
   * D) To increase concrete surfaces.
4. What is an example of a sustainable harvesting technique?
   * A) Overfishing.
   * B) Rotational harvesting.
   * C) Deforestation.
   * D) Monoculture farming.
5. How does the "Three Sisters" planting method benefit soil health?
   * A) It depletes the soil nutrients.
   * B) It enhances soil health and crop yields.
   * C) It removes all nutrients from the soil.
   * D) It prevents plant growth.
6. What is a primary goal of the Paris Agreement?
   * A) To increase greenhouse gas emissions.
   * B) To limit global warming.
   * C) To decrease renewable energy use.
   * D) To promote fossil fuels.
7. How does climate change impact First Nations hunting practices?
   * A) Increases hunting opportunities.
   * B) Changes ice conditions affecting hunting routes.
   * C) Reduces the need for hunting.
   * D) Increases prey availability.
8. What role do controlled burns play in forest management?
   * A) They destroy the forest.
   * B) They manage forest health and reduce fire risk.
   * C) They increase wildfire risks.
   * D) They remove all vegetation.
9. How can you assess the impact of climate change on your local area?
   * A) Ignore local changes.
   * B) Observe and document changes in weather, plant, and animal life.
   * C) Only rely on global data.
   * D) Avoid considering local impacts.
10. What does the term "dynamic equilibrium" in ecosystems refer to?
    * A) A static, unchanging state.
    * B) A balance that allows for natural fluctuations and resilience.
    * C) A state of constant change without balance.
    * D) An ecosystem without any fluctuations.

**Hard Questions:**

1. How do rising temperatures impact invasive species?
   * A) Decrease their populations.
   * B) Allow them to thrive and outcompete native species.
   * C) Have no effect on them.
   * D) Eliminate their presence.
2. Compare the effects of climate change on urban and rural communities.
   * A) Both experience the same impacts.
   * B) Urban areas face heatwaves, while rural areas face agricultural changes.
   * C) Rural areas experience increased heatwaves.
   * D) Urban areas see no change, rural areas face increased heatwaves.
3. How does renewable energy contribute to mitigating climate change?
   * A) By increasing greenhouse gas emissions.
   * B) By reducing greenhouse gas emissions.
   * C) By eliminating all other energy sources.
   * D) By promoting fossil fuel use.
4. What impact does coral bleaching have on marine ecosystems?
   * A) It enhances coral growth.
   * B) It leads to widespread reef death.
   * C) It has no significant impact.
   * D) It increases fish populations.
5. Explain the significance of the Great Barrier Reef's bleaching events.
   * A) They improve marine biodiversity.
   * B) They threaten the reef's biodiversity and local communities.
   * C) They are beneficial to coral health.
   * D) They have no long-term effects.
6. Why are marine protected areas important for sustainable fisheries?
   * A) They allow for overfishing.
   * B) They help conserve marine ecosystems and support sustainable fishing.
   * C) They reduce fish populations.
   * D) They increase marine pollution.
7. How do sustainable practices reflect an understanding of ecosystem equilibrium?
   * A) They disregard natural balance.
   * B) They aim to maintain balance and resilience in ecosystems.
   * C) They disrupt the equilibrium.
   * D) They focus only on short-term gains.
8. What is the impact of increased pest populations due to climate change?
   * A) Decreased disease outbreaks.
   * B) Increased disease outbreaks and agricultural damage.
   * C) Improved crop yields.
   * D) Reduced pest-related problems.
9. How do indigenous practices contribute to climate change mitigation?
   * A) By increasing greenhouse gas emissions.
   * B) By promoting sustainable and balanced resource use.
   * C) By focusing solely on industrial methods.
   * D) By ignoring environmental impacts.
10. Describe the process and benefits of green roofs.
    * A) They increase urban temperatures.
    * B) They reduce urban heat islands and improve air quality.
    * C) They eliminate vegetation.
    * D) They increase stormwater runoff.

#### **Reflection**

Write a short reflection (about 200 words) on how understanding the impacts of climate change can help you make more sustainable choices in your daily life. Consider what you have learned about local and global impacts, Indigenous practices, and modern sustainable initiatives.

### **Answer Key**

**Easy Questions:**

1. A
2. A
3. B
4. B
5. C
6. B
7. B
8. B
9. B
10. B

**Moderate Questions:**

1. B
2. C
3. B
4. B
5. B
6. B
7. B
8. B
9. B
10. B

**Hard Questions:**

1. B
2. B
3. B
4. B
5. B
6. B
7. B
8. B
9. B
10. B

By completing this evaluation section, you will be able to assess your understanding of climate change impacts and sustainable practices comprehensively. Reflecting on these questions and your answers will help solidify your knowledge and prepare you to apply these concepts in real-world scenarios.