



## Activity 4.2: Climate Change Impacts on Ecosystem Services

Grades 7 – 9

**Description:** Part 1: Global Impacts of Climate Change: Students will begin to make connections between their actions and climate change. Students will participate in a jigsaw to teach one another about the global impacts of climate change on humans and the natural world. In the next activity, students will research impacts of climate change in a specific area of the world.

Part 2: Regional Impacts of Climate Change: In this activity, students will research the impacts of climate change for a particular state, region, or country around the world. Students use their research to create a presentation, poster, newsletter, or letter to a government official. Students present their research to the class.

**Materials:**

**Part 1**

- “Effects of Climate Change” handout
- Computers with internet access
- Pens or pencils

**Part 2**

- “Effects of Climate Change” charts from Part 1
- Internet access
- Supplies to make posters, videos, or alternate presentations

**Time:** Three to four class periods, plus additional time outside of class (parts 1 and 2)

**National Science Education Standards:**

Content Standard F #2-4. Science in Personal and Social Perspectives – natural resources, environmental quality, natural and human-induced hazards, science and technology in local, national, and global challenges.

**AAAS Benchmarks:**

**4C/M7** Human activities, such as reducing the amount of forest cover, increasing the amount and variety of chemicals released into the atmosphere, and intensive farming, have changed the Earth's land, oceans, and atmosphere. Some of these changes have decreased the capacity of the environment to support some life forms.

**3C/H4** The human species has a major impact on other species in many ways: reducing the amount of the Earth's surface available to those other species, interfering with their food sources, changing the temperature and chemical composition of their habitats, introducing foreign species into their ecosystems, and altering organisms directly through selective breeding and genetic engineering.

**3C/H3** In deciding on proposals to introduce new technologies or curtail existing ones, some key questions arise concerning possible alternatives, who benefits and who suffers, financial and social costs, possible risks, resources used (human, material, or energy), and waste disposal.

**4B/H9** Although the Earth has a great capacity to absorb and recycle materials naturally, ecosystems have only a finite capacity to withstand change without experiencing major ecological alterations that may also have adverse effects on human activities.



**8C/H5** Decisions to slow the depletion of energy resources can be made at many levels, from personal to national, and they always involve trade-offs involving economic costs and social values.

**7D/M3** Trade-offs are not always between desirable possibilities. Sometimes social and personal trade-offs require accepting an unwanted outcome to avoid some other unwanted one.

### Guiding Questions

- What are the effects of climate change on ecosystems and ecosystem services?
- What are the impacts of climate change on different parts of the world?

### Assessments

- Regional Impacts of Climate Change – Research Checklist
- Student presentation on the impacts of climate change on their chosen country

## Part 1: Global Impacts of Climate Change

**Time:** One class period

### Procedure:

1. Ask students: *How do you think we contribute to climate change?*
2. Tell students: *Once, all climate changes occurred naturally. Before the Industrial Revolution, human activity released very few gases into the atmosphere, but now through burning fossil fuels and cutting down trees we are increasing the greenhouse gases in the atmosphere. Ask students to recall the lab activity from unit 2, with two cans, one can had a bag around it, representing greenhouse gases, and the other did not. The can with the bag had a higher temperature.*
3. Ask each student to think of something they do that releases greenhouse gases into the atmosphere, and ask them to explain the steps from that activity to releasing greenhouse gases (for example: If a student talks about using a hair dryer, you might ask them if there is gas coming out of the hair dryer. There isn't, but in order to generate electricity, coal is burned at a power plant, and the power plant releases greenhouse gases.)
4. Students will likely generate many examples on their own, but here are some additional examples you may wish to provide: When do you send greenhouse gases into the air?  
Whenever you...

|                    |                         |
|--------------------|-------------------------|
| Watch TV           | Use the air conditioner |
| Turn on a light    | Use a hair dryer        |
| Ride in a car      | Play a video game       |
| Listen to a stereo | Wash or dry clothes     |
| Microwave a meal   | Use a dishwasher        |



CHICAGO BOTANIC GARDEN

5. Ask students:
  - Why should people care about the environment?
  - Why should we work to prevent climate change?
6. Tell students that they will be learning and teaching one another about impacts of climate change. According to the Nature Conservancy, there are eight major impacts of climate change.
7. Hand out the sheet “The Effects of Climate Change.”
8. The students will learn and teach about the impacts through a jigsaw. Assign each impact to an “expert group” of three or four students (depending on the number of students in the class, you may also allow students to choose their impact). Students in each “expert” group can do their research together, or can research individually and come together to discuss and share what they have learned. Students can research their impact using the Nature Conservancy website, <http://www.nature.org/ourinitiatives/urgentissues/global-warming-climate-change/>, additional online sources, or the fact sheets provided. (Note: fact sheets have been revised to a 7- to 8<sup>th</sup>-grade reading level, from approximately a 12<sup>th</sup>-grade reading level on the website). Students can do additional research as needed to complete the three questions for each impact:
  - What does it mean?
  - How is this caused by climate change?
  - What are the consequences?
  - How does it affect ecosystem services?Encourage students to look up words or concepts they do not understand.
9. Next, place students into “jigsaw” groups of eight students, one student with each impact. The students will teach one another about the impacts of climate change and fill in the chart. Make sure that students are teaching one another, and not just copying from each others’ charts.
10. When students have completed the chart, ask the students to reflect in their journal:
  - Which impact of climate change will have the most impact on your life, and why?
  - What can you do to prevent this from occurring?
11. The chart can be collected as an assessment, and should be placed in the students’ portfolios. Now is a good time to return to Activity 2.4: Causes and Effects of Climate Change, which reviews causes (increased fossil fuel use, etc.) and effects (drought, species extinction) of climate change. Or the activity can serve as a review of concepts if you have not yet done the activity. The cause and effect graphic organizers from Activity 2.4 are included at the end of this activity.



**Additional resources:**

- Additional information about the economic effects of climate change in Illinois is available here: <http://www.cier.umd.edu/climateadaptation/Illinois%20Economic%20Impacts%20of%20Climate%20Change.pdf>
- Additional information about the jigsaw classroom technique is available here: <http://www.jigsaw.org/>
- Additional information on regional effects of climate change from the Union of Concerned Scientists: <http://www.climatehotmap.org/>

**Part 2: Regional Impacts of Climate Change**

**Time:** Two to three class periods, plus additional time outside of class

**Procedure:**

1. Introduce the activity by telling students: thus far in the unit, you have learned that that climate change affects people in different ways (“Faces of Climate Change”) and that climate change has many types of impacts (“Impacts of Climate Change”). For this activity, you will be using all three of these activities as background to research the effects of climate change in a particular state, country, or region around the world.

**Materials:**  
**Part 2**

- “Effects of Climate Change” charts from Part 1
- Internet access
- Supplies to make posters, videos, or alternate presentations

2. Students will work in groups to research the major impacts of climate change detailed in activity 3 (e.g.: economic losses, effects on wildlife, etc.) for a particular country or region. You may have students choose groups (two to four students in a group would be ideal) and regions/countries, or you may assign these. Some suggestions for regions/countries include:

|                            |                         |                            |
|----------------------------|-------------------------|----------------------------|
| <i>Australia</i>           | <i>Brazil</i>           | <i>Canada</i>              |
| <i>Central Africa</i>      | <i>China</i>            | <i>Greenland</i>           |
| <i>India</i>               | <i>Italy</i>            | <i>Middle East</i>         |
| <i>New Zealand</i>         | <i>South Africa</i>     | <i>U.S.A. – Alaska</i>     |
| <i>U.S.A. – Gulf coast</i> | <i>U.S.A. – Midwest</i> | <i>U.S.A. – West Coast</i> |

However, students may also choose a country to which they have particular ties, or in which they are particularly interested.

3. Tell students they will be researching the impacts of climate change in their particular region/county and presenting the information to their class in a creative manner. Hand out the



CHICAGO BOTANIC GARDEN

“Regional Impacts of Climate Change Research Checklist” so that students can keep track of the information they have found, and where the information comes from.

4. For the presentation, it is up to you how you’d like students to present their research. Some options include: a poster, a video they film themselves or prepare on the computer, a skit, a newspaper/newsletter, comic book, travel guide, website, etc. You may have each group choose how they’d like to present the information, or choose one format that all students should follow.

**Extensions:**

1. Groups can research a charity that is helping with climate change related issues in their region of the world. Students can work as groups or as a class to raise money for their selected charity.
2. Students can present their research to other classes in the school to educate them about regional impacts of climate change.

**Rubric: The impacts of climate change on (their chosen) country**

| Concept   | Low  | Medium  | High   |
|---|--|---|--|
| Overview of their country: geography, economy, political structure, economic focus, and climate                                       | Does not include all information in the description of their country, gives a cursory overview of their country                  | Presents the context in which consideration of climate impacts will be presented  | Covers all areas of their country in appropriate detail and explains which is most important in the context of climate change  |
| Identification of impacts and discussion of each as social, economic, political, environmental, or personal impacts of climate change | Includes incorrect or incomplete impacts for their country; does not discuss social, economic, political or personal impacts     | Includes correct impacts and discusses some of the ways they affect the country’s social, economic, political structures                            | Includes correct impacts and explains how each climate impact affects the relevant areas of the country’s social, economic, political structures   |
| Identification of the ways the country is trying (or not) to address these challenges   | Does not discuss the country’s approach to climate impacts   | Discusses either specific actions OR the country’s approach to climate impacts but not both   | Discusses both specific actions and the country’s approach to climate impacts  |
| Organization  | Presentation is disorganized, mixing up impacts of climate changes and how it affects different aspects of life in their country | The presentation is organized and the order of the discussion makes sense to the listener, though it may not be the same for each example or impact | There is an agenda, or described order of discussion; there is a consistent order followed in discussing each climate impact and its effects on different aspects of that country; students summarize their findings |
| Inclusion of appropriate citations and references   | No citations or references   | Citations and references not in correct format  | Correctly formatted citations and references   |



Name: \_\_\_\_\_ Date: \_\_\_\_\_ Room: \_\_\_\_\_

## Part 1: The Effects of Climate Change

Climate change has effects on animals, plants, and humans. In this activity you will become an expert on one of the effects of climate change, and teach your classmates about that effect. You will also learn about other effects of climate change from your classmates.

**Instructions:** Using the Internet (<http://www.nature.org/ourinitiatives/urgentissues/global-warming-climate-change/>) or the fact sheets provided, research one effect of climate change. You should understand how climate change causes the effect, and some of the consequences. *Make sure to use your own words!*

| Effect of climate change | What does it mean? | How is this caused by climate change? | What are the consequences? | How does it affect ecosystem services? |
|--------------------------|--------------------|---------------------------------------|----------------------------|--|
| Changing landscape       |                    |                                       |                            |  |
| Economic losses          |                    |                                       |                            |  |
| Temperature increase     |                    |                                       |                            |  |



CHICAGO BOTANIC GARDEN

| <b>Effect of climate change</b>                    | <b>What does it mean?</b> | <b>How is this caused by climate change?</b> | <b>What are the consequences?</b> | <b>How does it affect ecosystem services?</b> |
|--|---------------------------|--|-----------------------------------|---|
| <b>Increased risk of drought, fire, and floods</b> |                           |  |                                   |   |
| <b>More heat-related illness and disease</b>       |                           |  |                                   |   |
| <b>Rising seas</b>                                 |                           |  |                                   |   |
| <b>Stronger storms and increased storm damage</b>  |                           |  |                                   |   |
| <b>Wildlife at risk</b>                            |                           |  |                                   |   |



### Climate Change Impact Fact Sheet: Higher Temperatures

Power plants and automobiles release heat-trapping gases into the atmosphere. Deforestation and burning of rainforests also contribute to the warming of the planet. In fact, **the five hottest years on record have all occurred since 1997**. The ten hottest years on record have been since 1990. The warmest year on record to date was 2005. During the twentieth century, the Earth's average temperature rose one degree Fahrenheit to its highest level in the past four centuries. Scientists believe that this is the fastest rise in the Earth's temperature in 1,000 years.

Higher temperatures are to blame for an increase in heat-related deaths and illness. They cause increased melting of the ice caps, which contributes to rising sea levels. Warming seas cause an increase in storm intensity. They also cause the death of coral reefs. These are just a few of the serious results of climate change.

Scientists project that if we don't reduce heat-trapping carbon, the average surface temperature of Earth could increase by 3 to 10 degrees F. by the end of this century.

**Don't let average temperatures fool you:** A one-degree increase may occur in one place, while a 12-degree increase in another place. At the same time other areas may become much colder. Average does not mean equal all over the Earth.

*Text adapted from: The Nature Conservancy. Available:*  
<http://www.nature.org/ourinitiatives/urgentissues/global-warming-climate-change/>

### Climate Change Impact Fact Sheet: Changing Landscapes

As the Earth's temperature rises and rainfall and snowfall amounts change, the landscapes around us will also change. As the climate warms, trees and other plants around the world will move farther north toward Polar Regions and up mountain slopes.

These vegetation shifts will undo much of the work that we've done to conserve plants. They may alter the habitats of nature preserves and our national parks.

In the tundra, there is a layer of soil that is frozen all year long. This permafrost is thawing due to climate change. This will allow shrubs and trees to take root where they have not been able to grow before. In the Great Plains of the United States, the grasslands may become forests. New England's stunning fall foliage may eventually fade as maple and beech forests shift north toward cooler temperatures.

As plant communities try to adjust to the changing climate by moving toward cooler areas, the animals that depend on them will be forced to move as well. However, towns and cities and other human development may block the migration of both plants and animals.

Some species, such as polar bears, may be left without any remaining viable habitat, putting much of our treasured wildlife at risk of extinction.

*Text adapted from: The Nature Conservancy. Available:*  
<http://www.nature.org/ourinitiatives/urgentissues/global-warming-climate-change/>





### **Climate Change Impact Fact Sheet: Wildlife at risk**

Rising temperatures are changing the climate around the globe. As the climate changes, habitats change as well. Many animal species have to move to cooler areas to survive.

The climate is changing faster than many species can move or adjust. If the warming keeps up at its current speed, **experts predict that 1/4 of Earth's species will be close to extinction by 2050.**

Many species are already feeling the impact:

- In 1999, the last golden toad in Central America died. This was the first record of a species becoming extinct due to climate change.
- Polar bears may be gone from Earth in as little as 100 years, due to the melting of ice in the Arctic.
- In the tropics, warmer ocean temperatures are killing off coral reefs.
- Some U.S. states may lose their state birds. The Baltimore oriole may leave Maryland as it seeks a cooler climate. The same may happen to the black-capped chickadee of Massachusetts, and the American goldfinch of Iowa.

*Text adapted from: The Nature Conservancy.  
Available:*

<http://www.nature.org/ourinitiatives/urgentissues/global-warming-climate-change/>

### **Climate Change Impact Fact Sheet: Increased risk of drought, fire, and floods**

Climate change affects the rate of the water cycle on, above, and below the surface of the Earth. As a result, drought and floods are becoming more frequent, severe, and widespread.

Higher temperatures increase the amount of moisture that evaporates from land and water. This leads to drought in many areas. When rain does fall on lands that are affected by drought, flooding is more likely to occur.

As these droughts and floods become more frequent and more severe they will hurt agriculture, the water supply, and human health. This has already been observed in some parts of Asia and Africa, where droughts have become longer and more intense.

Hot temperatures and dry conditions also increase the risk of forest fires. The conifer forests of the western United States are experiencing earlier snowmelts and longer summers than they used to. Both spring and summer temperatures have risen recently. This has led to an increase in the number of forest fires by 400 percent. The amount of land that has burned since 1970 has increased by 650 percent.

*Text adapted from: The Nature Conservancy.  
Available:*

<http://www.nature.org/ourinitiatives/urgentissues/global-warming-climate-change/>



### Climate Change Impact Fact Sheet: Rising Seas

As the Earth's atmosphere heats up, the polar ice caps melt. Water from the glaciers enters the oceans causing sea levels to rise. Rising seas threaten to inundate low-lying areas and islands. This threatens coastal communities and causes damage to property. It also erodes shorelines and destroys ecosystems such as mangroves and wetlands that protect coasts from storms.

Sea levels have risen between four and eight inches in the past 100 years. Current projections suggest that **sea levels could continue to rise between 4 and 36 inches over the next 100 years.** A 36-inch increase in sea level would swamp *every* city on the East Coast of the United States, from Miami to Boston.

Worldwide, **approximately 100 million people live within three feet of sea level.** A sea level rise due to climate change could displace tens of millions of people who live in low-lying areas. This is especially true in developing countries. The residents of some small island countries that barely rest above the current sea level are already moving off of their islands. They are some of the world's first climate change refugees.

*Text adapted from: The Nature Conservancy.  
Available:  
<http://www.nature.org/ourinitiatives/urgentissues/global-warming-climate-change/>*

### Climate Change Impact Fact Sheet: Stronger Storms and Increased Storm Damage

Scientific research indicates that climate change will cause hurricanes and tropical storms to become more intense. These storms will last longer and have higher wind speeds. They will cause more damage to coastal ecosystems and communities.

Scientists feel that higher ocean temperatures are the main reason for this. Hurricanes and tropical storms get their energy from warm water. As the temperatures of the sea surface rise, developing storms will contain more energy.

At the same time, other factors will increase the damage caused by these storms. These factors include the rising sea levels, disappearing wetlands, and increased coastal development.

*Text adapted from: The Nature Conservancy.  
Available:  
<http://www.nature.org/ourinitiatives/urgentissues/global-warming-climate-change/>*



### **Climate Change Impact Fact Sheet: Heat-related Illness and Disease**

As the Earth's temperatures rise, so do the risks of heat-related illness and death. This is especially true for the poorest groups of people.

In 2003, extreme heat waves caused more than 20,000 deaths in Europe. They caused more than 1,500 deaths in India. Scientists have connected the deadly heat waves to climate change. They warn of more to come.

Climate change may also increase the spread of contagious diseases. This is due to the fact that warmer temperatures allow animals and bacteria that carry diseases to survive in areas that were once too cold for them. Diseases and pests that were once found only in the tropics may move into new areas that were once too cold for them to survive. Mosquitoes that carry malaria are one example of an insect that might expand its range.

The World Health Organization (WHO) estimates that climate change may have caused more than 150,000 deaths in the year 2000 alone. They predict that there will be an increase in deaths in the future.

*Text adapted from: The Nature Conservancy.  
Available:*

<http://www.nature.org/ourinitiatives/urgentissues/global-warming-climate-change/>

### **Climate Change Impact Fact Sheet: Economic Losses**

Climate change affects business and the economy around the world. If we don't take action to cut worldwide carbon emissions, it will hurt the world economy by as much as 20 percent. Local towns and businesses will feel these costs. For example:

In southern New England, lobster catches have dropped in recent years. This is due to rising sea temperatures. Warmer water is not good for lobster growth and health.

Ski resorts located in the lower Swiss Alps have trouble getting bank loans because they are getting less snow than before.

In Lake Erie, climate change may greatly *lower* lake levels. This would change shoreline habitats. People would also need to move ports and other lake structures, which would cost millions of dollars.

Globally, stronger hurricanes and rainstorms could cause billions of dollars in damage to property, transportation, and communication. Lower yields from crops due to long droughts and high temperatures could put hundreds of thousands of people at risk for starvation. This would be especially true in Africa.

High sea temperatures also threaten the survival of coral reefs. Coral reefs generate an estimated \$375 billion per year in goods and services.

*Text adapted from: The Nature Conservancy.  
Available:*

<http://www.nature.org/ourinitiatives/urgentissues/global-warming-climate-change/>



Name: \_\_\_\_\_ Date: \_\_\_\_\_ Room: \_\_\_\_\_

### Part 2: Regional Impacts of Climate Change – Research Checklist

1. Our region/country: \_\_\_\_\_

Directions: Research the “Effects of Climate Change” in your region or country. You will use this information to make a presentation to your teacher/class. If you need help with what the effects mean, refer back to your chart “The Effects of Climate Change” from activity 3.

| <b>Effect of climate change</b> | <b>How our country/region is affected by this impact of climate change</b> | <b>Where we found this information (cite)</b> |
|---------------------------------|--|---|
| <b>Changing landscape</b>       |  |   |
| <b>Economic losses</b>          |  |   |



CHICAGO BOTANIC GARDEN

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Room: \_\_\_\_\_

| <b>Effect of climate change</b>                    | <b>How our country/region is affected by this impact of climate change</b> | <b>Where we found this information (cite)</b> |
|--|--|---|
| <b>Higher temperature</b>                          |  |   |
| <b>Increased risk of drought, fire, and floods</b> |  |   |
| <b>More heat-related illness and disease</b>       |  |   |



CHICAGO BOTANIC GARDEN

| <b>Effect of climate change</b>                   | <b>How our country/region is affected by this impact of climate change</b> | <b>Where we found this information (cite)</b> |
|---|--|---|
| <b>Rising seas</b>                                |  |   |
| <b>Stronger storms and increased storm damage</b> |  |   |
| <b>Wildlife at risk</b>                           |  |   |



CHICAGO BOTANIC GARDEN

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Room: \_\_\_\_\_

2. List the primary impacts of climate change (at least three) in your region/country and describe how each has affected ecosystem services in that country.

| <b>Impact of climate change</b> | <b>Type of ecosystem service</b> | <b>How climate change has impacted that service</b> |
|---------------------------------|----------------------------------|---|
|                                 |                                  |   |
|                                 |                                  |   |
|                                 |                                  |   |
|                                 |                                  |   |
|                                 |                                  |   |
|                                 |                                  |   |
|                                 |                                  |   |



Name: \_\_\_\_\_ Date: \_\_\_\_\_ Room: \_\_\_\_\_

## Climate Change Causes and Effects Graphic Organizer

Under “causes,” write down what you think makes climate change occur. Under “effects,” write what you think happens because of climate change. In the “questions” box, note any questions you have, or things you would like to know about the causes and effects of climate change.

### Causes

|  |
|--|
|  |
|  |
|  |
|  |

### Effects

|  |
|--|
|  |
|  |
|  |
|  |

→  
**Climate  
Change**  
→

---

### Questions





Name: \_\_\_\_\_ Date: \_\_\_\_\_ Room: \_\_\_\_\_

## Climate Change Causes and Effects Graphic Organizer

Under “causes” write down what you think makes climate change occur. Under “effects” write what you think happens because of climate change. In the “questions” box, note questions you have, or what you’d like to know about the causes and effects of climate change.

### Causes

*Natural Causes*

*Human-Based Causes*

### Effects

*Effects on plants*

*Effects on animals*

*Effects on humans*



---

### Questions