



# Understanding and Combating Climate Change

## Teacher Manual: Lesson 1

### Essential Question

How does climate change affect my life and community, and how can I actively participate in its solution?

**Learning objectives.** Students will be able to

1. Identify and explain the consequences of climate change
2. Identify at least three ways their community can address climate change
3. Discuss how they can help combat climate change today and in the future.

### Lesson Summary

The lesson is intended to connect students with the real-world impact of climate change and encourage them to think critically about its relevance to their lives. They will learn about greenhouse gas emissions contributing to climate change and how that results in changes to our weather, oceans, and ecosystems.

### Technology referenced in this lesson:

- Building retrofits: better insulation, modern windows, and energy-efficient lighting
- Community solar
- Electric vehicles
- Improved public transportation
- Waste diversion
- Tree planting

**Careers referenced in this lesson:** None

Agenda	Timing	PPT Slide	Pre- lesson
<u>Opening Activity</u>	5 minutes	4	
<b>Present agenda and learning objectives</b>	5 minutes	5–6	
<u>Direct Instruction</u> Video Technology introduced Careers introduced	20 minutes	7–16	
<u>Primary Learning Activity</u> Partner or small group work Reinforce what was learned	20 minutes	17–18	
<u>Closing</u> Review learning objectives Closing activity Reflection	5 minutes	19–22	
<u>Extension</u>			
<u>Handouts</u>			
<b>TOTAL TIME</b>	<b>55 minutes</b>		

**preparation:**

- Read Student Presentation Deck (PPT).
- Watch the video(s) included in Student Presentation Deck (Most are available on the [MassCEC YouTube channel](#)).
- Print the worksheets and handouts prior to the class.
- Verify that the computer hosting the presentation deck is connected to the internet for video and hyperlink viewing.
- Check any links in the slide deck to make sure they work as intended, and then review the content below.

**Where to learn more about the lesson’s content**

If additional preparation time is available, these resources will provide additional background on the topics covered in this lesson:

- If you are curious about the feelings that may be brought up by discussions of climate change, consider visiting this resource: An Educator's Guide to Climate Emotions to Help Young People Navigate These Sometimes Difficult Emotions.  
<https://www.climatepsychology.us/educators-guide-climate-emotions>

## Overview and Opening Activity (10 mins)

### Materials and resources:

- Slide deck

**Opening activity:** Get students thinking and talking right away.

**Activity objective:** Get students thinking about the impact climate change has on us based on recent headlines about climate-related crises.

- **Present the slide of headlines.** Direct students to form pairs with someone nearby.
  - Pair and Share: Partners share a climate change-related news story they've heard recently. If they can't think of one, they can discuss one of the headlines on the slide.
  - Partners discuss what they notice about climate in the headlines and how it makes them think about the future of clean energy.
  - Bring the class back together and ask: *"How do you think climate change could affect your community or future?"*
- After a few students share, transition: *"Today, we're going to learn how climate change impacts all of us and how we can be part of the solution."*
- **Present the agenda.** Students should be gaining familiarity with the format:
  - After the opening activity, they will learn new information. The main activity helps the students learn about strategies to make communities more resilient. The closing activity helps them synthesize what they learned and helps with knowledge transfer.
- **Present the big question and lesson objectives:**
  - How does climate change affect their life and community, and how can they actively participate in its solution?
  - Identify and explain the consequences of climate change.
  - Identify at least three ways their community can address climate change.
  - Discuss how they can help combat climate change today and in the future.

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## Direct Instruction (20 mins)

Provide information to help the students achieve the learning objectives and prepare them to actively engage with the activity.

- Use inquiry-based learning strategies to engage learners where possible.
- Highlight careers related to the technologies.
- Help the learners to relate the learning to themselves and their communities.

**Show the video** (3–5 minutes) and follow it with a brief check-in to hear what students took away.

The video sets the stage to inspire the student to be part of the solution to climate change. The students are living in a time where climate change has already happened through no actions of theirs. But they have the power to slow and stop the changes to our planet. Through their actions, they can improve air quality; the environment around them; the buildings they live, work, and go to school in; and how they move around the world. Pursuing a career in clean energy is one way students can help combat climate change.

**Video debrief:**

- What interested you most in the video?
- How do you see yourself being part of the solution?

**What Causes Climate Change?**

**Discussion guidance:**

- Use the image or infographic to explain the greenhouse effect and trapped heat as a primary explanation and cause of climate change. Climate change is driven by human activities such as burning fossil fuels.

**Possible student questions:** *“Can natural processes cause climate change, too?”*

- Yes, but the current changes and the rate of climate change we’re experiencing are mainly due to human activities.

**The Greenhouse Gas Effect**—two-minute video from EPA

- Before the video, tell the students this will help explain how the greenhouse effect warms the planet.

**Key points to emphasize:**

- Human actions, such as burning fossil fuels, lead to more greenhouse gases in the atmosphere, which trap heat and warm the planet.
- The greenhouse effect leads to extreme weather, rising sea levels, and ecosystem changes, affecting our lives.

**Types of Greenhouse Gases**

Most relevant is that carbon dioxide is the most prevalent greenhouse gas contributor to climate change.

**Possible student questions:** *What is an example of each type of greenhouse gas?*

- **Carbon dioxide** is the primary greenhouse gas contributing to recent climate change. It enters the atmosphere through burning fossil fuels, solid waste, trees, and other biological materials and as a result of certain chemical reactions, such as cement manufacturing. Carbon dioxide is absorbed and emitted naturally as part of the carbon

cycle through plant and animal respiration, volcanic eruptions, and ocean-atmosphere exchange.

- Both natural and human activities produce **methane**. Natural wetlands, agricultural activities, and fossil-fuel extraction and transport all emit methane.
- **Nitrous oxide** is mainly produced through agricultural activities and natural biological processes. Fossil fuel burning and industrial processes also create nitrous oxide.
- **Chlorofluorocarbons, hydrochlorofluorocarbons, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride, together called F-gases**, are often used in coolants, foaming agents, fire extinguishers, solvents, pesticides, and aerosol propellants.

### Consequences of Climate Change

Health risks:

- Extreme heat and poor air quality
- Rising sea levels

### Discussion guidance: Extreme heat and poor air quality

- Extreme heat causes more deaths than any other weather-related hazard—more than hurricanes, tornadoes, or flooding. In addition, thousands of people exposed to extreme heat seek medical treatment each year.
- Over 65,000 Americans visit an emergency room each summer for acute heat illness. This shows why addressing climate change is urgent.
- Climate change can also impact human health by worsening air and water quality, increasing the spread of certain diseases, and altering the frequency or intensity of extreme weather events.

**Key point to emphasize:** Rising temperatures are inconvenient and dangerous, especially for vulnerable populations.

### Sources:

- U.S. Global Change Research Program. “The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment.” Last modified 2016. <https://health2016.globalchange.gov>
- Graph showing total number of fatalities by hazard. Source: NOAA National Weather Service, 2016.
- EPA Guidebook Extreme Heat. <https://www.epa.gov/sites/default/files/2016-10/documents/extreme-heat-guidebook.pdf>
- <https://www.epa.gov/emergencies-iaq/emergency-events-can-impact-your-indoor-air-quality-infographic>

**Discussion guidance: Rising sea levels**

- This map shows the estimated sea-level rise around Boston.
- How would you feel if your favorite beach was underwater due to rising sea levels? What about where you went fishing or where you used to go swimming or ice skating?
- Ask students if anyone has an example of an area where they've seen a difference in the waterline or coastline in their lifetime.

**Key points:**

- Changes in rainfall can result in more floods, droughts, or intense rain. Heavy rainfall and overwhelmed drainage systems can also damage inland buildings.
- In the bigger picture, rising sea levels threaten coastal communities and ecosystems, communities along rivers, and eventually communities near lakes and ponds or any community near water.

**Source:**

Interactive tools can be linked from: Massachusetts Sea Level Rise and Coastal Flooding Viewer. <https://experience.arcgis.com/experience/23d861b79aed450eb8972013dd28579b/page/Sea-Level-Rise/>

“This interactive map shows the National Oceanic and Atmospheric Administration (NOAA) ‘bathtub’ modeling of coastal flooding above Mean Higher High Water (MHHW, the average height of daily highest tides) with six scenarios showing increasing levels of sea level rise (one-foot increments up to six feet). This static ‘bathtub’ model does not account for storm surge, waves, erosion, and other dynamic factors.”

**Two-Minute Video**

Here is another look at a community hit by a recent storm surge.

WCBV Channel 5 Boston. “Storm Surge, Flooding Cause Major Home Damage in North Shore Town.” Posted January 13, 2024. YouTube, 1:58.

<https://youtu.be/KaxrEI4Miyk?si=76TartjfU2aj2Fy9>

Ask students to consider the impact of the recent climate-related event shown in the video.

1. What are some of the ways the flooding impacted individuals?
2. What impact did it have on the community?
3. Consider the image of potential sea-level rise in Boston. What impact will changes like that have on communities there?

**Key point to emphasize:**

- Climate change impacts us all, no matter where we live.

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## Primary Learning Activity (20 mins)

### Materials:

- Worksheets
- Source: [Climate Ready Boston Executive Summary](#)

**Activity objective:** Students will learn about several of Boston’s Climate Action Plan strategies to reduce emissions and improve climate resilience. This activity will foster collaboration, deepen understanding of real-world climate strategies, and show how local action contributes to climate goals.

### Instructions:

- Divide students into groups based on three categories. Depending on class size, you may choose to have more than one group focusing on each of the categories below:
  - Buildings
  - Transportation
  - Everything else (energy efficiency, waste reduction, green spaces)
- Direct students to their worksheet, which they will use to complete this activity. On the worksheets, each category lists three to four strategies from Boston’s Climate Action Plan.
- Each group should
  - Choose one or two strategies from their category to focus on; they should choose the strategy or strategies they find most exciting or believe will be the most impactful
  - Discuss how their chosen strategy will help Boston now and in the future
  - Answer the questions in their worksheets.
- Groups will present to the rest of the class. Each group should take about one minute to summarize the main points:
  - Their chosen strategy and its benefits for Boston’s communities
  - How it contributes to climate resilience

### Debrief discussion: *Which strategies surprised you as being used to combat climate change?*

- Encourage discussion on how these strategies connect to one another and to broader systems across the state and region.
- The city is promoting transit-oriented development (TOD) to reduce the climate impact of new growth and development, especially in highly populated areas.
  - Transitioning to the use of net-zero carbon methods and materials for new construction

- Adoption of zero-emission vehicles making our energy supply cleaner and more resilient
- Climate action plans in the northeast are increasingly including nature-based solutions, such as planting urban trees and building green infrastructure for slowing and holding stormwater runoff.

**Key concept to highlight:** Climate resilience is essential; holistic approaches in cities such as Boston can serve as models for other communities.

**Potential student question:** *“Why are we looking at Boston’s climate plan and not other towns?”*

- The Climate Ready Boston Initiative is an example that is more fully developed than in many other cities and towns. This initiative was intended to produce a systemic and comprehensive framework. This framework was developed by working with local climate scientists, engineers, planners, and designers to identify vulnerable locations and engage in changes to promote resilience.

**Summarize key takeaways:**

1. Climate change is a long-term shift in global or regional climate patterns, primarily caused by humans.
2. Greenhouse gasses in the atmosphere trap heat, making the planet warmer.
3. Climate change can lead to health risks from extreme heat and worsening air quality, extreme weather, and sea-level rise.
4. I can take action to slow climate change.

### Differentiations and Adaptations: Learning Activity

**For students who need something visual, tactile, or kinesthetic: Use a visual mapping exercise.**

- Provide the students with a large printed map of Boston or an interactive digital map.
- Allow the students to physically mark locations where climate action strategies (e.g., renewable energy projects, green infrastructure, or transportation improvements) could be implemented.
- Incorporate manipulatives such as color-coded sticky notes or markers for each strategy, helping students visualize the connections between actions and their impacts on different parts of the city.



**For students who would benefit from additional structured guidance: Provide step-by-step prompts.**

- Provide clearly defined sub-prompts for each strategy (e.g., “Identify a Problem,” “Propose a Solution,” “Explain the Benefits”).
- Include sentence starters and additional prompts for students who need extra support with organizing their thoughts (e.g., “One way Boston can reduce emissions is by...”).
- Allow students to work in smaller groups or pairs with specific roles (e.g., researcher, note-taker, presenter) so that every student can contribute according to their strengths.

### **Closing Activity** (5 mins)

**Materials:**

- Presentation/Slide deck, slides
- Reflection journal/worksheet

**Activity objective:** Encourage students to reflect on key takeaways and identify areas of curiosity for further exploration.

- What is one change you can make immediately that will slow climate change?
- Imagine the future. What will happen if more people like you make just one change?

Check individual understanding of Learning Objectives.

Write a sentence or two to share your thoughts about the following questions.

1. What are two consequences of climate change?
  2. In what way does climate change affect your life?
  3. How does (or how can) your community address climate change?
  4. What is one way you will help combat climate change?
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**Extensions—if learners are loving this topic and want more . . .**

### **Research Local Climate Initiatives**

**Prompt:** Research a specific climate initiative in your town or a nearby city that aligns with Boston’s Climate Action Plan (e.g., renewable energy projects, bike-sharing programs, urban tree planting). Write a short summary or create a poster explaining the initiative, its goals, and its impact on the community.

**Goal:** Encourage students to connect what they’ve learned to their own community and explore real-world applications of climate strategies.

### **Create a Personal Climate Action Plan**

**Prompt:** Imagine you are designing a climate action plan for your neighborhood or school. Identify two or three strategies to reduce emissions or increase resilience to climate change (e.g., installing solar panels or starting a recycling program). Explain why these strategies would work and how you would implement them.

**Goal:** Empower students to think creatively and take ownership of climate solutions at a local level.

**Handouts: Group Activity (below). Worksheets can be printed from this guide or from separately accessed PDF files.**

# Boston's Climate Resilience

## Instructions

Boston's Climate Action Plan is divided into three main categories: buildings, transportation, and everything else.

Choose one strategy from your assigned category below. Discuss and answer the questions on the following page using the prompts to guide your discussion. Prepare to present your strategy and its benefits for climate resilience to the class.

## Category Strategies

### Group A: Buildings

1. **Energy retrofits:** Upgrading older buildings to improve energy efficiency (e.g., better insulation, modern windows, energy-efficient lighting)
2. **Green building standards:** Building new structures using eco-friendly designs and materials to reduce pollution
3. **Electrification:** Switching from gas or oil heating to electric systems using clean, renewable energy sources

### Group B: Transportation

1. **Expanding public transit:** Improving and expanding bus and train networks to reduce the use of individual cars
2. **Promoting electric vehicles (EVs):** Providing incentives, charging stations, and public awareness to make buying and driving EVs easier
3. **Bike lane infrastructure:** Building more bike lanes and safe routes for cyclists to promote zero-emission commuting

### Group C: Everything Else

1. **Community solar programs:** Allowing multiple homes and businesses to share solar energy from one main solar setup, even if they can't put panels on their buildings
2. **Waste diversion:** Reducing trash by recycling, composting, and finding ways to create less waste
3. **Tree planting for urban cooling:** Planting more trees in cities to cool the air and improve the air quality

## Discussion Prompts

What is climate resilience? Using the prompts below, explore how your chosen strategy can benefit Boston's communities now and in the future.

**What is your strategy?**

**Describe the strategy in your own words:**

**How does this strategy help cut down on pollution?**

**What are the benefits for Boston's communities?**

**What challenges could make this strategy hard to implement?**

**How can people help support this strategy?**

**Based on what you've explored in this lesson, how do you define climate resilience?**

**Notes:**