

Engineering for Climate Change: A Severe Weather Design Challenge Learning Lab Teachers Guide (grades 6–12)

Preparing Before Your Upcoming Field Trip

Thank you for joining us for the “Engineering for Climate Change: A Severe Weather Design Challenge” field trip! Below are some resources to help prepare your students for our field trip together. This program will allow students to learn more about climate change, resilience, problem design, and the impacts of climate change.

Suggested Discussion Prompts for Before the Program

- What is climate change and what are some key factors contributing to its effects?
- How has the engineering design process helped us in our everyday lives?
- What does it mean for a community to be resilient?
- How does climate change affect your daily life and community? How do different people experience the effects of climate change and extreme weather locally and globally?
 - Special Note: If students are feeling distressed in any way, make a point to share that there are ways to take action. Climate mental health resources can be found in the “Climate Resources” section on the last page.

Optional Activity to Introduce Engineering Design to Students Before the Program

[Solving Everyday Problems Using the Engineering Design Cycle](#) (*TeachEngineering*)

Learning Objectives:

- Identify the engineering design process steps in a case study to build an example solution.
- Apply the engineering design cycle steps to future engineering assignments.

Resources to Introduce Climate Change Before the Program

- [The Climate System](#) (*UCAR Center for Science Education*)
- [Impacts of Climate Change](#) (*UCAR Center for Science Education*)
- [Future Climate: Explore the Possibilities](#) (*UCAR Center for Science Education*)
- [Adapting to Climate Change](#) (*UCAR Center for Science Education*)

Videos to Introduce Climate Change Before the Program

- [Earth Day 1970 – 2017: What’s Changed?](#) [4 min] (*American Museum of Natural History*)
- [Climate Change 101](#) [4 min] (*National Geographic*)
- [How Do Greenhouse Gases Actually Work?](#) [3 min] (*Minute Earth*)
- [Is the Weather Actually Becoming More Extreme?](#) [5 min] (*TED-Ed*)
- [How Can We Respond to Climate Change?](#) [14 min] (*Crash Course Climate and Energy*)
- [Adaptation and Mitigation](#) [3 min] (*Climate Wisconsin*)

Supplemental Activities and Resources

Dig Deeper and Keep Exploring After Your Field Trip!

Post-Program Activities

1. Urban Heat Island Effect

[Feeling the Heat](#) (*UCAR Center for Science Education*)

Time:

- Preparation: 20 minutes
- Class time: two class periods

Learning Objectives:

- Students investigate how trees, grass, asphalt, and other materials affect temperature.
- Based on their results, students hypothesize how concentrations of surfaces that absorb heat might affect the temperature in cities - the urban heat island effect.
- Students analyze data about the history of Los Angeles heat waves in a kinesthetic way, learning that the increase in the number of heat waves is due to urban growth and global warming.

Educational Standards:

- [MS-PS3-4](#) Energy
- [MS-ESS2.D](#) Weather and Climate
- [HS-PS3-4](#) Energy
- [HS-ESS3.C](#) Human Impacts and Earth Systems

2. Clean Water for Everyone

[Water Filtration Challenge](#) (*National Aeronautics and Space Administration*)

Time:

- Preparation: 20 minutes
- Class time: one to two hours

Learning Objectives:

- Students will understand and apply the engineering design process by designing, building, and improving a water filtration device.
- Students will learn to measure and analyze the effectiveness of their devices by testing, comparing, and identifying effective filters and pH levels.
- Students will explore the importance of water filtration and how groundwater cleanup projects contribute to sustainable water use and pollution reduction.

Educational Standards:

- [HS-ETS1-1](#) Engineering Design
 - [MS-ETS1-4](#) Engineering Design
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3. Reporting on Environmental Justice (*recommended for High School*)

[Reporting on Environmental Racism](#) (*Southern Poverty Law Center Learning for Justice*)

Time:

- Preparation: 20 minutes
- Class time: one to two class periods, depending on preference

Learning Objectives:

- Students explore the terms environmental racism and environmental justice.
- Students use print sources and fellow students' knowledge to collect information about environmental racism.
- Students utilize the news gathering questions Who?, What?, Where?, When?, Why?, and How? to record notes.
- Students make inferences and draw conclusions about environmental racism.

Educational Standards:

- [HS-ESS3-1](#) Earth and Human Activity
- [HS-ESS3-4](#) Earth and Human Activity
- [HS-ETS1-3](#) Engineering Design

4. Solving the Carbon Dioxide Problem (*recommended for High School*)

[Solving the Carbon Dioxide Problem](#) (*UCAR Center for Science Education*)

Time:

- Preparation: 20 minutes
- Class time: three 50-minute class periods for the activity (Parts I and II) and one 50-minute class period for presentations (Part III)

Learning Objectives:

- Students will analyze the sources and sinks of carbon dioxide in the atmosphere to determine the complexity and uncover questions.
- Students will investigate and evaluate current solutions for reducing the amount of carbon dioxide in the atmosphere
- Students will propose a plan to use viable mitigation strategies for meeting the demand of reducing atmospheric carbon dioxide and consider the challenges associated with each strategy
- Students will make a claim, supported by evidence and reasoning, about how their plan will remove enough carbon dioxide from the atmosphere to limit global warming to 1.5 °C.

Educational Standards:

- [HS-ESS2-6](#) Earth's Systems
 - [HS-ESS3-4](#) Earth and Human Activity
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Climate Resources

Resources for Teaching Climate Change

- [Climate Mental Health](#) (*Climate Literacy and Energy Awareness Network*)
- [Climate Misinformation on Social Media Is Undermining Climate Action](#) (*Natural Resources Defense Council*)
- [Guidance and Teaching about Climate and Energy](#) (*Climate Literacy and Energy Awareness Network*)
- [NOAA Climate Change Preliminary Reading Resources](#) (*National Oceanic and Atmospheric Administration*)
- [What is Climate Grief?](#) (*Climate and Mind*)
- [Your Guide to Talking With Kids About Climate Change](#) (*Natural Resources Defense Council*)
- [High School Weather and Atmospheric Science Projects](#) (*Science Buddies*)
- [Tackling Climate Change through Environmental Justice High School](#) (*National Oceanic and Atmospheric Administration*)

Online Resources

- [Why Does Climate Change?](#) (*UCAR Center for Science Education*)
- [The Water Cycle and Climate Change](#) (*UCAR Center for Science Education*)
- [Hurricanes and Climate](#) (*UCAR Center for Science Education*)
- [Warming Makes Droughts Extreme](#) (*National Aeronautics and Space Administration*)
- [Sea Level Rise Viewer](#) (*National Oceanic Atmospheric Administration, Coastal Management*)
- [Climate Change Impacts on the Built Environment](#) (*Environmental Protection Agency*)
- [An Introduction to Air Quality Research](#) (*TeachEngineering*)
 - Recommended for Upper High School Students
- [Tools for a Thriving Future](#) (*Climate Interactive*)
- [What is Geoengineering?](#) (*Massachusetts Institute of Technology*)
- [Greenhouse Gas Reduction Programs and Strategies](#) (*Environmental Protection Agency*)
- [Table of Climate Solutions](#) (*Project Drawdown*)
- [18 Simple Things You Can Do About Climate Change](#) (*University of California, Davis*)

Videos

- [Study Past Climate to Predict Future](#) [2 min] (*UCAR Center for Science Education*)
- [How to Make Sense of Extreme Weather](#) [12 min] (*TED Climate*)
- [What Makes Cities So Hot?](#) [1 min] (*UCAR Center for Science Education*)
- [The Adaptation Principles: 6 Ways to Build Resilience to Climate Change](#) [2 min] (*World Bank*)
- [The Science of Extreme Weather and How to Reduce the Harm](#) [6 min] (*TedTalk with Al Roker*)
- [The Engineering Challenges of Renewable Energy](#) [12 min] (*Crash Course Engineering*)

This Guide was developed by Zoe Caryl, a 2024 SciEd Intern from the Smithsonian Affiliations Leadership for Change Internship.
