

# Youth and Climate Change Action Topics and Resources: 3.0

|   |           |
|---|-----------|
| <b>Introduction</b>   | <b>2</b>  |
| <b>Section One: Background Information</b>                  | <b>3</b>  |
| 1.) Causes of Climate Change                                | 3         |
| 2.) Impacts of Climate Change                               | 4         |
| 3.) History of climate change and action in Lowell          | 4         |
| 4.) Mitigation vs. Adaptation                               | 6         |
| <b>Section Two: Factors to Consider</b>                     | <b>7</b>  |
| 5.) Electrification & Energy efficiency                     | 7         |
| 6.) Renewable energy  | 7         |
| 7.) Green Jobs  | 8         |
| 8.) Green Infrastructure vs Gray Infrastructure             | 9         |
| 9.) Alternative Transportation                              | 10        |
| 10.) Environmental Justice                                  | 11        |
| <b>Section three: Impacts/Events in Lowell</b>              | <b>12</b> |
| 11.) Urban Heat Island                                      | 12        |
| 12.) Urban Forestry   | 13        |
| 13.) Gas Leaks  | 13        |
| 14.) Flooding   | 14        |
| 15.) Combined Sewage Overflows                              | 15        |
| 16.) Personal decisions - Small acts by individuals add up! | 16        |

## Introduction

This document is a list of climate change topics written by the LEADS Youth and Climate Change team for use by students and teachers in the Lowell Public Schools to build a climate change curriculum. It gives an overview of each topic, a root cause when applicable, basics and local resources, related terms, and example projects.

# Section One: Background Information

## 1.) Causes of Climate Change

Groups like Merrimack River Watershed Council (MRWC) and UMass Lowell's Climate Change Initiative (CCI) are currently working on curriculum and educational programs for students in a similar age range. Both recommend giving students a basic understanding of climate science and the causes of climate change. The Lowell Parks & Conservation Trust (LP&CT) also offers environmental education programs in ten Lowell Public School (K-12) sites, in addition to offering programs for teens (TREES and EYTF). All programs have climate change content. Mass Audubon, a key partner in LP&CT's afterschool programs, hosts the Youth Climate Leadership Program, which Lowell students participate in.

**Root Cause:** Climate Change is a natural process that takes place over long periods of time. Many natural factors contribute to this process. However, when we talk about climate change in modern times, we are talking about changes to the climate that are happening at a far faster rate due to human behavior. Burning fossil fuels, which adds greenhouse gasses to the atmosphere, throws off the earth's processes that we depend on and speeds up global warming at a rate we have never seen before. Greenhouse gasses are emissions that are effective at absorbing the sun's light and warm the atmosphere. They come from burning fossil fuels which include coal, oil, and natural gas. Under the 2015 Paris Agreement, many nations agreed to hold warming to well below 2°C, or 3.6°F, globally, and preferably limit it to 1.5°C, or 2.7°F, compared to pre-industrial levels. In 2021 nations agreed to the Glasgow climate pact which involves cutting carbon emissions by 45 percent by 2030 to meet this 1.5°C goal.

### **Background Resources:**

[Nasa Climate Change Tools](#)

[Carbon Footprint Calculator](#)

[Climate Basics](#)

[National Geographic Carbon Dioxide](#)

### **Local Resources:**

[Climate Impacts and Solutions with En-ROADS](#), designed for high school educators

[Mass Audubon's Youth Climate Leadership Program](#)

**Related terms:** Emissions, Anthropocene, Deforestation, Greenhouse Gases, Atmosphere, Pollution

## 2.) Impacts of Climate Change

Impacts of climate change in Lowell will include flooding, droughts, extreme heat, and more. This will impact the lives of people living in Lowell. The City of Lowell has been awarded the Municipal Vulnerability Preparedness (MVP) grant and updated its hazard mitigation plan (HMP) to address some of these changes and plan ways to reduce their effects.

**Root Causes:** The way that climate change impacts different towns and people is dependent on a lot of factors. To determine how climate will impact an area, people often look at elevation, terrain, plant life, weather trends, existing infrastructure, and natural landmarks. Lowell's proximity to the Merrimack and the Concord river along with its history of flooding are two indicators of its likelihood to experience flooding as climate change progresses.

### Goals:

- Identify how Lowell's residences and infrastructure is going to be impacted by climate change
- Identify what steps can be taken now to reduce the impacts of climate change on the city
- Identify what steps can be taken to address what changes are guaranteed to occur.

### Background Resources:

<https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/climate-change-ma.pdf>

### Local Resources:

[Climate Impacts and Solutions with En-ROADS](#), designed for high school educators  
[MVP and HMP](#)

**Related terms:** Urban heat island, extreme weather events, hazard mitigation, mitigation, adaption

### **3.) History of climate change and action in Lowell**

From the mills and the industrial revolution to the current efforts of the city, the university, and other groups, Lowell's history and the history of climate change are visibly connected. Groups such as the UMass Lowell Office of Sustainability, the City of Lowell, the MRWC, Lowell Sustainability Council, and Mass350 have identified this history as an important tool for teaching the causes and impacts of climate change in the area and the work that can be done.

**Root Cause:** The Industrial Revolution is thought to be the starting point of major human-caused climate change. In the late 1800s, as factories opened up and began burning coal as a source of energy, we saw a spike in carbon emissions and an increase in temperatures. Now almost every part of the way we live is dependent on fossil fuels and is responsible for an increase in carbon in our atmosphere. The systems surrounding agriculture, transportation, and buildings are all major sources of carbon in our atmosphere and require changing to offset climate changes.

**Goals:**

- Residents understand the history of climate change and how it relates to the history of Lowell.

**Background Resources:**

[The Warming Effects of the Industrial Revolution](#)

[\(Video\) Humans Have caused Climate Change](#)

[Industrial Revolution to Climate change](#)

**Local Resources:**

[Lowell National Park](#)

[Tsongas Industrial History Center \(TIHC\)](#)

**Related terms:** Industrial Revolution

## 4.) Mitigation vs. Adaptation

Mitigation and adaptation are the two most common ways climate solutions are categorized. Mitigation refers to the steps that we take now to reduce the potential impacts of climate change. Common mitigation efforts include reducing emissions by changing to low-carbon energy sources and repairing carbon sinks like expanding forests. Adaptation is acting now to reduce the impact of changes that are guaranteed to occur later. Examples of climate adaptation include updating infrastructure to prepare for flooding and increases in temperatures. Lowell's MVP and HMP are examples of adaptation.

### **Background Resources:**

[Adaption VS Mitigation](#)

[The Difference Between Adaption and Mitigation](#)

[\(Video\) Adaption and Mitigation](#)

### **Local Resources:**

[MVP/HMP](#)

**Related terms:** mitigation, adaptation

# Section Two: Factors to Consider

## 5.) Electrification & Energy efficiency

Electrification refers to the process of changing systems that use fossil fuels to generate electricity to those which can be powered through renewable sources. Energy efficiency refers to using new technology to update systems so that they use less energy to perform the same task. The shift to electric systems is a change that often goes hand and hand with renewable energy. By switching to electric systems more people will use renewable energy and utilize less carbon-rich resources. For electrification to be successful and to save users money, energy efficiency needs to be improved simultaneously with electrification. The City of Lowell is focused on improving both and the Greater Lowell chapter of Mass350 is advocating for a position to be made in the city to share tools and resources with lower-income households who might not be able to afford to update their homes.

### Goals:

- Increase the number of systems that use electricity over carbon-based sources like natural gas and petroleum (fossil fuels).
- Find new ways to use less energy while accomplishing the same tasks.

### Background Resources:

[Electrification and Energy Demand](#)

[Benefits of Energy Efficiency](#)

### Local Resources:

[City of Lowell Resolution to Promote Clean Energy and Reduce Fossil Fuel Use](#)

Lowell Sustainability Council's Energy Efficiency Subcommittee

**Related terms:** electrification, energy efficiency

## 6.) Renewable energy

Switching to renewable energy is one of the most common steps that cities and states can take to reduce their contribution to climate change. Examples of renewable energy include wind, solar, geothermal, biomass, and hydropower. The City of Lowell, UMass Lowell, Mass350, and the UML Chapter of MassPIRG all have different goals surrounding renewable energy. The City of Lowell has a Community Choice Aggregation that is made up of 45% more renewable energy than is mandated by the state.

### Goals:

- Find new ways to replace traditional energy sources in our everyday lives with renewable sources.
- Increase education surrounding renewable energy and ensure more people know about the options available to them.

### Project Examples:

<https://greenschoolsnationalnetwork.org/student-driven-solar-how-west-bloomfield-high-school-students-powered-their-science-department-with-solar-electricity/>

### Background Resources:

<https://www.nrdc.org/stories/renewable-energy-clean-facts>

<https://www.energy.gov/clean-energy>

<https://www.eia.gov/energyexplained/renewable-sources/>

### Local Resources:

[Lowell's CCA](#)

[Mass Climate Action Network](#)

[City of Lowell Resolution to Promote Clean Energy and Reduce Fossil Fuel Use](#)

**Related terms:** Community Choice Aggregation, Renewable Energy Credits.

## 7.) Green Jobs

Green jobs include a wide range of industries and businesses and are defined as any job that produces goods or provides services that benefit the environment or conserve natural resources. Industries include conservation, advocacy, renewable energy, ecotourism, and much more. The City of Lowell and UMass Lowell's Green Community Partnership aims to increase the number of green jobs in Lowell. This is one of five projects funded through the Green Community Partnership.

### Goals:

- Increase the number of people entering fields with green jobs.
- Increase people's understanding of green employment fields and the work being done.

### Background Resources:

[Green Jobs and a Sustainable Economy](#)

[Green Related Jobs-](#)

### Local Resources:

[Green Community Partnership](#)

### Related terms:

## 8.) Green Infrastructure vs Gray Infrastructure

Green infrastructure refers to an approach to water management that protects, restores, or mimics the natural water cycle. This approach is considered better for cities like Lowell where flooding is more likely in the next few years due to climate change. These methods help to store and divert water in ways that traditional infrastructure doesn't. Examples include rain gardens, permeable concrete and pavements, and planting native plants. Gray infrastructure refers to traditional structures such as dams, seawalls, roads, pipes, or water treatment plants. Updating green infrastructure is a part of the City of Lowell's current plans. Some of these changes also work to reduce other impacts of climate change such as the urban heat island effect which refers to cities having a higher temperature than surrounding areas.

### Goals:

- Increase green infrastructure in the city to help with water management, increase recreation space, and/or improve air quality.



**Project examples:**

Rain garden- <https://lowelllandtrust.org/a-rain-garden-for-all/>

**Background Resources:**

[EPA on Green Infrastructure](#)

**Local Resources:**

[Decatur Way \(ACTION Project\)](#)

[Concord River Greenway Park \(Rain Garden\)](#)

## 9.) Alternative Transportation

According to the EPA, greenhouse gas emissions from transportation make up 29% of the United States total emissions, making it one of the largest single contributors to emissions in the United States. Ways to reduce this include improving public transportation, switching to electric vehicles, and updating infrastructure like roads and sidewalks to make commutes easier and more efficient for pedestrians, bikers, those using public transportation, and cars. One example of a project like this in Lowell is the LP&CT's current project, the Concord River Greenway, a multi-use recreational trail which when completed will connect major open spaces in the city to the center of the city and provide alternative transportation between Lowell's neighborhoods. Lowell Regional Transit system currently owns and operates five diesel/electric hybrid 35-foot buses, accounting for 11 percent of its fleet. In its regional transit plan update, from January 2021, LRTA wrote that it had identified the need to collaborate in a joint procurement with other RTAs for up to six hybrid-diesel and electric vehicles over the next five years. Other groups in Lowell that have a vested interest in this topic include UMass Lowell, 350ma, and the city of Lowell.

**Goals:**

- Encourage the use of multi-use recreational pathways and alternative transportation in Lowell.
- Find new ways to integrate alternative forms of transportation into Lowell.
- Make assessing alternative transportation easier in Lowell.

**Project examples:**

**Background Resources:**

[Transportation and Climate Change](#)

[National Geographic Transportation and Climate Change](#)

**Local Resources:**

Lowell's Trail network

[Pawtucket Greenway](#)

[LRTA page 30 section 4.5.1.1](#)

[Concord River Greenway Park](#)

**Related terms:** Hybrid vehicles, pedestrian, Transportation Alternatives programs

## 10.) Environmental Justice

Environmental injustice refers to how people of color, indigenous populations, low-income communities, and those with preexisting health conditions are put at greater risk due to changes in the environment. A critical part of environmental justice is understanding these problems do not start in the aftermath of a natural disaster, and they cannot be prevented by simply adapting and planning for the impacts of climate change. Environmental injustice is a systemic issue that builds up over years and is worsened by climate events. Even without a climate event, the impacts of these inequalities manifest in many different ways including food insecurity, health issues, access to safe housing, and much more. One example of this in Lowell is the Urban Heat Island Impact. Low-income households living in outdated homes and older residents are more likely to experience health complications as a result of the heat, as well as higher energy costs.

### Goals:

- Understand how social factors like race, nationality, economic statuses pertain to how individuals and communities are impacted by climate change and climate events.
- Find ways to help those who will be most impacted and mitigate that impact.

### Project examples:

### Background Resources:

[National Geographic environmental Refugees](#)

[Climate Crisis and People of Color](#)

[What We Mean When We Say Environmental Justice](#)

### Lowell Resources:

[Solidarity Lowell](#)

[LP&CT's Greening the Gateway Cities](#)

**Related terms:** At-risk populations, food deserts, environmental justice

# Section three: Impacts/Events in Lowell

## 11.) Urban Heat Island

The urban heat island effect refers to urban environments being 1-7°F warmer than rural areas due to an increased concentration of human activities and structures that trap heat. During periods of extreme heat, the urban heat island effect contributes to higher air pollution levels, heat-related deaths, respiratory difficulties, heat exhaustion, and heat strokes. Certain at-risk groups, like the elderly and the economically disadvantaged, are more likely to be negatively impacted. Lower-income households experience relatively higher costs of heating and cooling. 350Mass of Greater Lowell has prepared a report on the impacts of urban heat islands in Lowell. They recommended an implication of cool down areas and greening the built environment.

**Root Causes:** Multiple factors contribute to the urban heat island impact but the simplest explanation is that these urban environments are home to lots of dark surfaces that absorb the sun's incoming sunlight.

**Goals:**

- Educate more residents about the impacts and causes of heat islands
- Increase green infrastructure in the city

**Project Examples:**

<https://vtx.vt.edu/articles/2021/09/fralinlifesci-theo-lim-outreach.html>

**Background Resources:**

[National Geographic Urban Heat Island](#)

[Epa on Urban Heat Island](#)

**Local Resources:**

[Heat Island report](#)

[Greening the Gateway Cities](#)

**Related terms:** albedo, at-risk populations, heat exhaustion, heatstroke

## 12.) Urban Forestry

Urban forestry refers to the care, maintenance, and protection of trees in an urban area. A large focus of urban forestry is improving the urban environment. In a city like Lowell, trees play an important role far past their aesthetic beauty. They help to keep temperatures low, remove carbon and air pollution, and capture stormwater pollution. Urban forestry isn't just the trees you find in parks but the trees found on streets and in neighborhoods. In cities like Lowell where the urban heat island impact is a major concern, planting more trees is an important solution, but lower-income neighborhoods often have fewer trees on their streets meaning they are more likely to feel the impacts of the heat island impact. With fewer trees to remove pollutants, they are also more likely to develop respiratory diseases, like asthma. The Lowell Parks and Conservation Trust is one group in Lowell that works with urban forestry, teaching a wide range of students about environmental stewardship. The LP&CT has multiple projects that aim to expand Lowell's canopy and protect its existing trees.

### Goals:

- Increase tree canopy in Lowell
- Protect the ecosystems in the area.

### Project examples:

[Tree Planting](#)

### Background Resources:

[What is Urban Forestry](#)

### Local Resources:

[Greening the Gateway Cities](#)

[LP&CT Urban Forestry Program:](#)

[UMass Lowell Tree Campus](#)

**Related terms:** stewardship, conservation

## 13.) Gas Leaks

A gas leak occurs when the line or pipe is damaged and releases methane gas into the environment. These leaks kill trees and plants in the area, release greenhouse gasses, and can cause fires and explosions if left unaddressed. They can also make residents extremely sick. Gas companies have scales that they use to grade leaks and determine which ones to prioritize, but all leaks are dangerous. The Multi-town Gas Leak Initiative, a group of 28 municipalities advocating for the acceleration of gas leak repairs, says that 7% of all leaks are responsible for more than half of methane emissions, but companies are rewarded more for replacing entire pipes than for fixing leaks. The Initiative is advocating that this policy be changed and that companies should shift focus from replacing pipes to repairing existing leaks and looking for alternative sources of heat and energy that don't have the same emissions.

**Root Cause:** Gas leaks occur as pipes get old and begin to warp, bend and crack. Many of the pipes throughout Massachusetts are very old and the state is working to replace them, but the process takes a long time and is expensive.

### **Goals:**

- Increase education surrounding gas leaks and their impacts.
- Change how we approach the repairs of leaks
- Advocate for the replacement of natural gas with other forms of heating.

### **Project examples:**

#### **Background Resources:**

[Gas leaks Allies](#)

[Heet:](#)

[Fossil Fuel Free Future](#)

[Emission Cuts and Gas Pipelines](#)

[Emissions From Gas Leaks](#)

#### **Local Resources:**

[City of Salem website](#)

[Gas Leak Detective](#)

**Related terms:** Natural gas, Greenhouse gases,

## 14.) Flooding

One of the major impacts of climate change in Lowell will be flooding. Situated near the Merrimack and the Concord River, Lowell has a history of flooding. In 2006 the city experienced the Mother's Day flood during a storm which forced many to evacuate their homes and resulted in flooding of the Pawtucketville neighborhood. In addition, both Haverhill's and Lawrence's water treatment plants were flooded, resulting in bursting pipes in Haverhill and raw sewage being released into the Merrimack at both cities. As climate change continues, extreme weather events like this are likely to occur more often. The city has already begun planning for what this could mean for Lowell with its Municipal Vulnerability Preparedness (MVP) grant and updated its hazard mitigation plan (HMP). The City of Lowell is looking at its current gray infrastructure to see what needs to be updated and possibly replaced. It is also looking at what green infrastructure can be added to help with water management to reduce risks of flooding.

**Root Cause:** Due to its proximity to the two rivers, Lowell is naturally at risk of flooding. As climate change increases and more extreme weather events occur that risk will increase.

**Goals:**

- Build infrastructure and systems to prevent floods from spreading and to protect Lowell from floods.

**Project examples:**

Rain garden- <https://lowelllandtrust.org/a-rain-garden-for-all/>

**Resources:**

[Flooding and Climate Change](#)

**Local Resources:**

[Lowell MVP](#)

[Flood Factor](#)

[Flood Protection](#)

**Related Terms:** green infrastructure, grey infrastructure

## 15.) Combined Sewage Overflows

The Merrimack River is the source of drinking water for about 600,000 people. Each year roughly 550 million gallons of wastewater are discharged into the Merrimack in what is called Combined Sewage Overflow (CSO) events. These are spurred on by 50-70 rain events that are large enough to overwhelm our sewage and waste-water systems forcing water treatment facilities all along the river to release untreated sewage from homes and offices along with rainwater that brings in the trash and other pollutants all along our streets. Of those 550 million gallons, about 45% is generated by Manchester, NH, and 35% by Lowell. The remaining 20% comes from Nashua, Lawrence, and Haverhill. Due to limited research, the impacts of these events are not entirely understood, but we know that they impact the quality of our drinking water, prevent recreational activities on rivers following these events, and are harmful to the ecosystems in and around the river.

**Root Causes:** CSOs are the result of outdated infrastructure going back to the Industrial Revolution. Around the world, sewage systems were designed to get rid of sewage as quickly as possible. The same infrastructure is still used to this day in cities all along the Merrimack, including cities like Lowell and Lawrence. In this system water from storm drains and wastewater from buildings are all sent to one place to be treated and cleaned before being released. When an area with sewage systems like this experiences a lot of rain or precipitation all at once the facilities become overwhelmed with water and must release it without first treating it or risk flooding or raw sewage backing into homes. This could be avoided if wastewater from homes and buildings were sent to separate places than storm drains, but the cost to upgrade and fix these systems is enormous.

### **Goals:**

- Increase awareness of Combined Sewage Overflows when they occur.
- Begin to research how CSOs impact people and ecosystems near them.
- Find ways to mitigate the impact of CSOs.

**Project examples:** create rain garden

### **Resources:**

[EPA on CSOs](#)

### **Local Resources:**

[Merrimack River Watershed Council](#)



[Challenges for the Merrimack River](#)

[CSO Threatens Merrimack River](#)

**Related terms:** Watershed, Flooding, water treatment, pollution

## **16.) Personal decisions - Small acts by individuals add up!**

While individual actions do not significantly contribute to climate change as a whole, many of us have the power to change the systems that play major roles in climate change. There are many things individuals can do to join the conversation surrounding climate change and to create change in their communities. From small actions like recycling and planting trees to more organized actions like lobbying for legislation and advocating for changes in their community, all actions are important in helping people get involved and preventing them from becoming discouraged or overwhelmed by the size of the issue. Groups like the Lowell Sustainability Council, 350Ma of Greater Lowell, Lowell's Parks and Conservation Trust, UMass Lowell's CCI, and UMass Lowell's Masspirg chapter encourage people of all ages to learn about their work and contribute when possible. Carolyn McCarthy of the UML's CCI and a member of LSC also noted the importance of knowing the difference between sustainable actions and actions that help mitigate or adapt to climate change. Recycling is one example. While recycling is incredibly environmentally sustainable, it doesn't necessarily have a large impact on climate change.

### **Goals:**

- Empower people to take action and speak out about climate change in their community.

### **Resources:**

- [What You Can Do](#)
- [How You Can Help](#)

**Related Terms:** Recycling, Composting, Energy Conservation, Advocacy, Sustainability,