

## Climate Change and Sustainability Primer

### TABLE OF CONTENTS

UNIT SUMMARY	2
STUDENT LEARNING OUTCOMES	3
LESSON PLAN	3
LESSON 1: CLIMATE 101: EARTH AND CLIMATE CHANGE VOCABULARY	4
LESSON 2: DESIGN IT BRIGHT: ENVIRONMENTAL REGULATION AND CLIMATE PROTECTION POLICIES	7
LESSON 3: GROWING GREENER: THE IMPACT OF CLIMATE CHANGE ON OUR PLANET AND OUR COMMUNITY	14

## Climate Change and Sustainability Primer

### Unit Summary

This Primer is an introduction to the concept of climate change and sustainability, intended to pair with the green@school handbook and supporting units. This primer provides basic information about climate change covering a cross section of disciplines such as policy, science, ethics, economics, and humanities. All subsequent units studied as part of the green@school certification checklist relate ultimately to reducing greenhouse gas emissions to slow climate change and so this document provides the backbone for larger green@school instruction. Activities and information from this unit can be connected to your current curriculum or constructed to support any of the units in the green@school handbook. Students will be introduced to new ways to relate climate change to their daily lives and understand what sustainability means for current and future generations. As a way to realize the often abstract nature of climate change, students are asked to take a pledge to make small changes in their habits to collectively mitigate this global threat. This primer is also designed to help students discern fact from fiction and become climate change ambassadors, imparting this new science-based knowledge upon their friends, family, school, and community!

Beyond these climate-tied themes, students and instructors will learn about the concept of “sustainability.” Sustainability is an emerging term of significance and one that should be imparted across all ages of civil society. From corporate boardrooms, to community meetings, to school sites themselves, the use of the term “sustainability” awakens our understanding of the importance of and the intersections between the social, environmental and economic systems that drive, and are also impacted by, our daily activities and long-term decisions. The word sustainability is derived from the Latin *sustinere*, meaning to hold, but has also been interpreted to mean “maintain”, “support”, or “endure” applied to development projects as those that “meet the needs of the present without compromising the ability of future generations to meet their own needs,” via the United Nations (Wikipedia, 2014 <http://en.wikipedia.org/wiki/Sustainability>). Throughout the green@school program, students will learn that sustainability is the central theme behind the activities and lessons developed for their application. Education for Sustainability (EFS) empowers students to make decisions that balance the need to preserve healthy ecosystems with the need to promote vibrant economies and equitable social systems for all generations to come (Center for Green Schools, 2014 [www.centerforgreenschools.org](http://www.centerforgreenschools.org)). green@school gives students a platform to become active advocates for and practitioners of sustainability through an ongoing lifelong journey to leave behind ecologically sound, economically feasible, and socially responsible actions, habits, purchasing decisions, and built environment. The green@school program offers students a chance to flex their influence on their environment and quality of life, and leave a more sustainable community for not just incoming classmates, but for their children and grandchildren.

## Climate Change and Sustainability Primer

### Student Learning Outcomes

These learning outcomes are designed to impart students the knowledge required to ask questions, unravel climate change science, and develop their own personal roadmap to become part of the solution.

1. Correctly define terms that relate to climate change and sustainability.
2. Form an opinion about the severity of climate change based on science.
3. Learn what laws are in place to mitigate and adapt to climate change.
4. Debunk climate change myths.
5. Spotlight climate change in the news.
6. Relate how the green@school program, and so actions on their campus, is tied to climate change.
7. Learn what their city and neighboring cities are doing to mitigate and adapt to climate change.

### Lesson Plan

This unit provides students with the resources and guidance necessary to explore the concepts of climate change and sustainability. Through initial lessons, interactive activities, Do-It-Yourself campaigns and initiatives, students will be transformed into campus climate experts, understanding how the other units focused on energy, water, materials, pollution, stormwater and health & wellness are all interconnected and empowered with the tools to make changes that can have generational and global environmental benefits. The lessons that shape this primer, and your students' background on climate and sustainability, include the following:

LESSON 1: CLIMATE 101: EARTH AND CLIMATE CHANGE VOCABULARY

LESSON 2: DESIGN IT BRIGHT! ENVIRONMENTAL REGULATION AND CLIMATE CHANGE POLICIES

LESSON 3: GROWING GREENER: IMPACT OF CLIMATE CHANGE IN YOUR COMMUNITY

LESSON 4: GETTING GREEN DONE: YOU ARE PART OF THE SOLUTION

*A note to instructors:* the plug-and-play activities shared throughout all green@school units are framed for your students, with the hope that you can simply offer/print these activities for their direct use. No extra prep time required!

## Climate Change and Sustainability Primer

### Lesson 1: Climate 101: Earth and Climate Change Vocabulary

Before we dive into climate change science, let's first understand the important systems and functions of our pale blue dot (great launch to this lesson to ground the importance of our planet – checkout [Carl Sagan's video](#) on the subject:

<https://www.youtube.com/watch?v=XH7ZRF6zNoc>). Our earth protects and sustains life in the following ways:

1. Maintains gases in the atmosphere
2. Moderates weather and climate
3. Regulates hydrologic (water) cycle
4. Preserves fertile soils (arable land)
5. Disposes wastes and cycling of nutrients
6. Controls agricultural pests
7. Pollinates our crops
8. Provides us with forest products and food from the sea
9. Maintains an incredible genetic library

It further provides the following functions, without which our planet would be uninhabitable.



Figure 1: Our earth's many assets  
SOURCE: Ehrlich & Ehrlich, Healing the Earth, 1991.

## Climate Change and Sustainability Primer

- **Discussion Activity** | *What person, nation or corporation can provide the same resources as the Earth?*

Take a few minutes to discuss the various processes handled deftly by our planet, including its relationship with the sun and other elements (reference Figure 2 above). Develop a human-designed system or process that can adequately replace three of these activities without causing additional health or habitat problems.

- 1.
- 2.
- 3.

- **Online Activity** | *Climate Change 101 With Bill Nye the Science Guy*

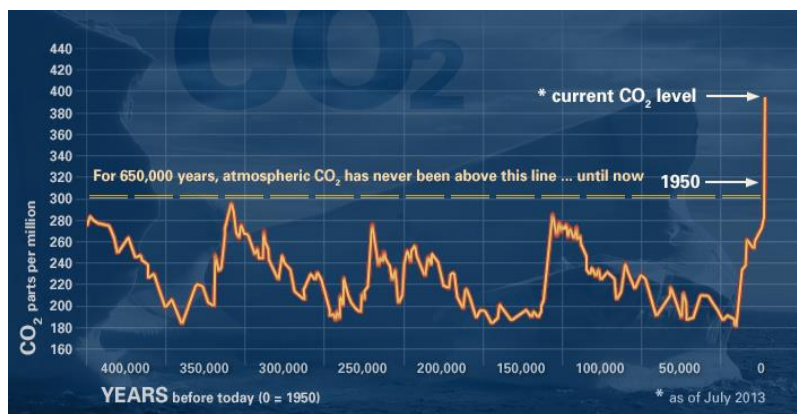
Who better to walk us through the science of climate change than Bill Nye the Science Guy? [Watch this video](http://www.smithsonianmag.com/videos/climate-change-101-with-bill-nye-the-science/?no-ist) (http://www.smithsonianmag.com/videos/climate-change-101-with-bill-nye-the-science/?no-ist) and answer the following questions listed below. Then, work in small groups to discuss your thoughts and present them to the class.

1. If the climate has changed on earth seven times over the last 650,000 years, how is the current state of our climate unique and why should we address climate change now?
2. How do we know our recent climatic changes are caused by humans?
3. If it is caused by humans, what can we do to reduce our personal and school's emissions and contribution to this changing climate?

### The Rise of CO<sub>2</sub>

Figure 1 compares atmospheric CO<sub>2</sub> captured in ice core samples over time. Data shows that atmospheric CO<sub>2</sub> never surpassed 300 parts per million (ppm) for 650,000 years. Evidence shows a warming trend beginning around the 1850's, toward the tail end of the industrial revolution, which correlates with the rapid increase in atmospheric CO<sub>2</sub>.

Figure 1: NASA and National Oceanic and Atmospheric Administration



## Climate Change and Sustainability Primer

### Terms Related to Climate Change:

Time to get down with some new vocab! Walk your students through the following terms to help build their climate expertise, which they'll apply further through the next series of lessons. It's likely they'll find that they're not alone in learning these new terms and concepts. Have them check in with friends, peers, other teachers and family members to gauge their climate knowledge and help your students to develop a personal definition and meaning to apply moving ahead.

**Climate:** Climate is a measure of the average pattern of variation in temperature, humidity, atmospheric pressure, wind, precipitation, atmospheric particle count and other meteorological variables in a given region over long periods of time. Simply put, a climate is the average weather conditions in a place over many years (usually at least 30). For instance, Cupertino's climate is generally warm with mild, with wet winters and hot, dry summers.<sup>1</sup>

**Weather:** Weather refers to the day-to-day condition of temperature and precipitation. Weather is a specific event or condition that happens over a period of hours or days. (i.e. today's temperature or yesterday's thunderstorm)<sup>2</sup>

**Climate change:** A significant and lasting change in the statistical distribution of weather patterns over periods ranging from decades to millions of years.

**Global warming:** Global warming refers to an unequivocal and continuing rise in the average temperature of Earth's climate system.

**Greenhouse gas (GHG):** Heat-trapping gases. The primary greenhouse gases in the Earth's atmosphere are water vapor, carbon dioxide, methane, nitrous oxide, and ozone.

**Greenhouse effect:** Greenhouse gases trap heat and warm the earth, which in turn can contribute to climate change. Natural changes, human activities (or both) can cause such warming. You can think of carbon dioxide produced by human activities as a "carbon blanket" that traps heat from escaping to the atmosphere.

*"Climate is what we expect, weather is what we get." – Mark Twain*

<sup>1</sup> A Student's Guide to Global Climate Change, accessed on 10/5/14 at <http://www.epa.gov/climatechange/kids/basics/concepts.html>

<sup>2</sup> A Student's Guide to Global Climate Change, accessed on 10/19/14 at <http://www.epa.gov/climatechange/kids/basics/concepts.html>

<sup>1</sup> Near-record Jump in Carbon Concentrations in Global Atmosphere Last Year, accessed on 10/22/14 at <http://news.mongabay.com/2013/0306-hance-atmospheric-carbon-2012.html>.

## Climate Change and Sustainability Primer

### Lesson 2: Design It Bright: Environmental Regulation and Climate Protection Policies

***A note to instructors:*** Introduce and share background information on the Industrial Revolution with students and ask them to surmise why these manufacturing and technology changes would result in climatic changes today.

Time to apply the climate and systems science concepts introduced in Lesson 1 to understand the causes of climate change more fully. Our climatic changes can be attributed to two primary activities that kicked into high gear at the end of the 19<sup>th</sup> century (during the [Industrial Revolution](http://www.history.com/topics/industrial-revolution) – <http://www.history.com/topics/industrial-revolution>), and continue through present day, all across our globe:

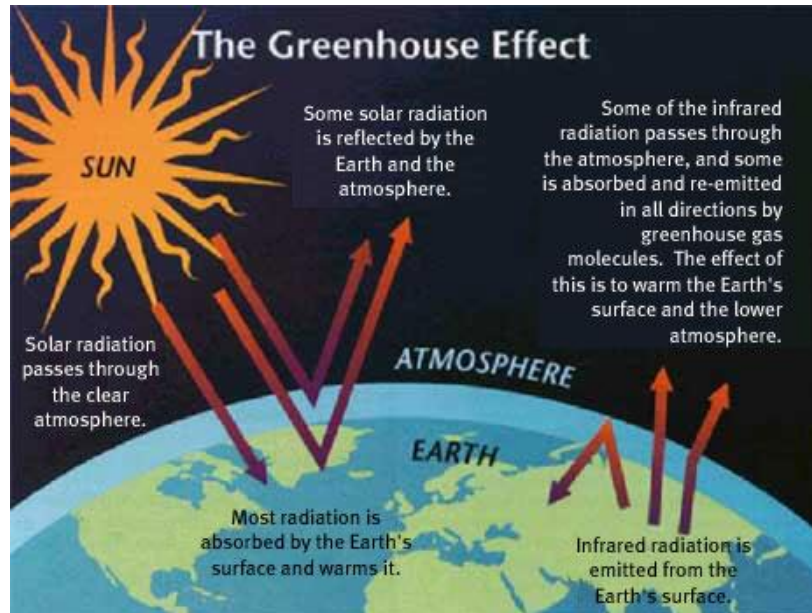
1. *Increased combustion of fossil fuels*—like coal, oil, and natural gas – to power a growing number of homes, factories, and vehicles. Today fossil fuels continue to be the dominant energy source all over the world, but burning these fossil fuels releases carbon dioxide into the atmosphere.
2. *Increased deforestation* - sold as fuel (sometimes in the form of charcoal or timber) or to open space for development. While cleared land was once used as pasture for livestock, plantations of commodities and settlements, these spaces are now home to manufacturing facilities, corporate headquarters, and housing developments surrounded by impervious surfaces that increases urban heat islands and land surface temperatures, exacerbating climate impacts.<sup>3</sup> (learn more about heat islands [here](http://www.epa.gov/heatisland) - <http://www.epa.gov/heatisland>). Trees are able to store carbon dioxide from the air for long periods of time through sequestration, providing oxygen for life on Earth.

***A note to instructors:*** Share additional background with students on the causes of climate change by accessing science-based information available on this NASA: <http://climate.nasa.gov/causes/> and EPA website: <http://www.epa.gov/climatechange/science/causes.html>

<sup>3</sup> IOP Science, accessed on 10/03/14 at [http://iopscience.iop.org/1755-1315/17/1/012163/pdf/1755-1315\\_17\\_1\\_012163.pdf](http://iopscience.iop.org/1755-1315/17/1/012163/pdf/1755-1315_17_1_012163.pdf).

## Climate Change and Sustainability Primer

Figure 4: Greenhouse Effect<sup>4</sup>



These activities contributed to the sharp increase in carbon dioxide in our global atmosphere, a greenhouse gas. Carbon dioxide traps heat to warm the Earth's surface via a process termed "the greenhouse effect." Although the greenhouse effect occurs naturally and is essential for our survival, human activities (like burning fossil fuels and clearing forests) produce more greenhouse gases than would naturally exist, thereby strengthening the greenhouse effect and warming our planet! Increases in greenhouse gases are a major contributing factor to current climate changes. The Earth's past climate changes were predominantly caused by changes in the sun's energy. In order to properly address the effects that these activities have had on the environment, many environmental regulation and climate protection policies have been put in place, we'll look at these through the next series of activities.

<sup>4</sup> Sustainable Energy Authority of Ireland, accessed on 11/1/14 at [http://www.seai.ie/images\\_upload/Schools/Secondary\\_Schools/Subjects/Geography\\_LC/Greenhouse\\_Effect\\_/greenhouseeffect.jpg](http://www.seai.ie/images_upload/Schools/Secondary_Schools/Subjects/Geography_LC/Greenhouse_Effect_/greenhouseeffect.jpg).



## Climate Change and Sustainability Primer

### ➤ **Research Activity** | *Get Your Math On! Calculate GHG Emissions*

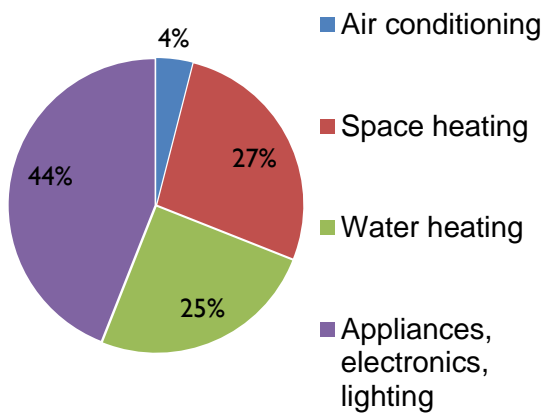
Time to build student’s climate analytic skills. Start by having them look up the following terms:

1. Climate Systems
2. Carbon Sequestration
3. Carbon pricing
4. Carbon tax

### How do I contribute?

Before introducing students to the sampling of direct climate actions each of us can take to support our shared environment, it’s important to learn which of our daily activities have associated greenhouse gas emissions, and so, have a climate impact. Any time we use electricity or fuel for an activity, we are creating greenhouse gases. Driving to work or school, watching TV, charging a cell phone, powering a refrigerator or air conditioner, or taking a hot shower, are

**Energy Consumption in California Homes (EIA, 2009)**

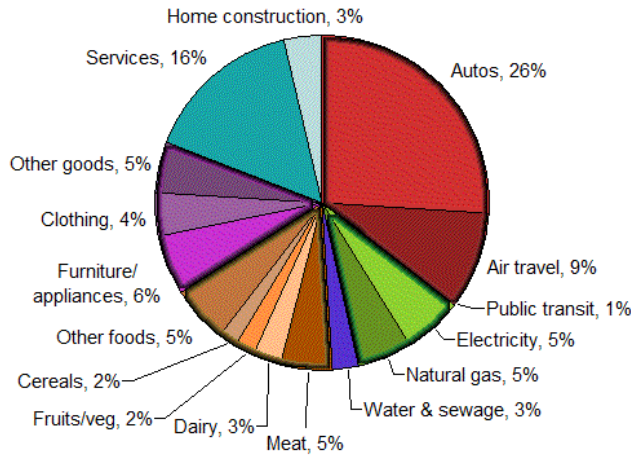


just a few of the countless things we do that support our lives, and all result in emissions. As green@school introduces in each of its units, we produce emissions indirectly as a result of waste disposal (through collection and landfill gas), water use (through pumping and treatment), and purchasing choices (through production, shipping, and disposal). We can reduce these emissions by thinking about how we get where we need to go, how well our homes and facilities function, and what kinds of goods and services we purchase.

For example, take a look at the typical household energy bill in California (left) – this can give us an idea of areas of opportunity to reduce energy consumption, and thus greenhouse gas emissions. (*Note: household energy use varies greatly by a number of factors, including geographic location, home size and age, number and habits of family members, etc.*).

## Climate Change and Sustainability Primer

### Average CA Household GHG



In California, we have a milder climate than in other

parts of the country, so we use less energy on heating and cooling than homes elsewhere in the US (*lucky us!*). So comparatively, the largest portion of our energy use goes toward electricity use for appliances, electronics, and lighting. This indicates that reducing plug load in our homes by installing efficient lighting, buying energy efficient appliances, turning off electronics and appliances when not in use, and other actions can especially reduce our home's emissions. This picture does not capture, however, energy use and emissions associated with personal transportation, waste

we create, and items we buy. The chart above seeks to shift the conversation to also include the impacts of our daily choices, activities and habits. To get a more complete estimation of personal emissions and see where the most important areas are for action, have students complete the [CoolCalifornia Carbon Footprint Calculator](http://www.coolcalifornia.org/calculator): <http://www.coolcalifornia.org/calculator> for their family or your school.

### Climate...it's serious business

Like analyzing personal emissions using a carbon calculator, such as that shared above, many organizations have started to gather inventories of their greenhouse gas emissions as a means of analyzing the environmental impacts of their operations, identifying opportunities for improvement, and evaluating the outcomes of these changes. Still unsure why any organization would assess its operational emissions? It's actually a regulatory requirement for certain businesses in California that comes with strict penalties for non-compliance. Chevron and Southwest Gas have been fined approximately \$1 million for violating California's mandatory greenhouse gas emissions reporting rule in 2011. This is the second time the California Air Resources Board (ARB), the regulating body, has issued fines for late or inaccurate reporting under the regulation, which mandates "electric power entities" (i.e., utilities and industrial facilities) emitting more than 10,000 metric tons of carbon dioxide to annually report their GHG emissions.<sup>5</sup> Learn more about this unique California Law at [ARB's website](http://www.arb.ca.gov/cc/reporting/ghg-rep/ghg-rep.htm): (<http://www.arb.ca.gov/cc/reporting/ghg-rep/ghg-rep.htm>).

<sup>5</sup> Environmental Leader, accessed on 09/22/14 at <http://www.environmentalleader.com/2014/01/28/chevron-southwest-gas-fined-1m-for-not-reporting-ghg-emissions/>

## Climate Change and Sustainability Primer

### ➤ Discussion Activity | Test Your Knowledge: Fact or Fiction

Based on the information students have reviewed to date, have them answer the following True or False questions to gauge their climate competency and share their answers with a partner.

- \_\_\_\_\_ 1. Sea levels are rising.
- \_\_\_\_\_ 2. The Earth's temperature is rising.
- \_\_\_\_\_ 3. The United States has the highest greenhouse gas emissions in the world.
- \_\_\_\_\_ 4. The United States consumes the most energy in the world.
- \_\_\_\_\_ 5. The Earth's climate is changing constantly.
- \_\_\_\_\_ 6. I can make changes that can affect our climate.
- \_\_\_\_\_ 7. I can reduce atmospheric carbon dioxide levels by planting a tree.
- \_\_\_\_\_ 8. Warmer weather is the only effect of global warming.
- \_\_\_\_\_ 9. I will not experience the effects of climate change in my lifetime.
- \_\_\_\_\_ 10. Greenhouse gases occur naturally in the atmosphere.
- \_\_\_\_\_ 11. Plants use carbon dioxide for photosynthesis.
- \_\_\_\_\_ 12. There is plenty of ice in Antarctica, so global warming clearly isn't problem.
- \_\_\_\_\_ 13. The winter temperatures on the east coast of the United States are really cold, therefore the East Coast is not experiencing global warming.
- \_\_\_\_\_ 14. Emissions generated in the United States from the combustion of fossil fuels have no effect on what happens to people in other parts of the world.
- \_\_\_\_\_ 15. Climate change is inevitable, so there is no need to take action.

**Instructor Answer Key:** 1. True, 2. True, 3. True, 4. True, 5. False, 6. True, 7. True, 8. False, 9. False, 10. True, 11. True, 12. False, 13. False, 14. False, 15. False.

## Climate Change and Sustainability Primer

### ➤ **Research Activity** | *Let's Get Political: What do climate-related policies and programs look like in California?*

Listed below are important environmental policies and commitments that seek to curb greenhouse gas emissions at the state, federal, and even international level. Have students spend time reviewing these, conducting research to find others, and work to identify local policies to address climate change, since we need to reduce emissions at the source! For example, the City of Cupertino is one of many localities across the nation working to develop its very own Climate Action Plan to ensure the City is doing its part to address climate change across its community and among its own municipal operations (see: [www.cupertino.org](http://www.cupertino.org)). Cupertino's plan defines Cupertino's path toward creating a healthy, livable, and vibrant place for its current and future residents to live, learn, work, and play. The strategies outlined in this CAP seek to not only reduce greenhouse gas emissions, but also provide energy, water, fuel, and cost savings for the City, its community members and businesses, further improving Cupertino's already high quality of life. The plan also represents another example of a successful partnership between engaged community members and City staff to jointly plan for Cupertino's sustainable future and continue to lead by example on important environmental issues.

Check out some of the following Cupertino city resources listed below or visit your local city's website, city hall or library to learn what your community is doing to address its climate impacts.

#### **City of Cupertino Resources:**

[Cupertino Sustainability](http://www.cupertino.org/index.aspx?page=768): <http://www.cupertino.org/index.aspx?page=768>

#### **International Commitments:**

[The Kyoto Protocol](http://unfccc.int/kyoto_protocol/items/2830.php): [http://unfccc.int/kyoto\\_protocol/items/2830.php](http://unfccc.int/kyoto_protocol/items/2830.php)

[The Copenhagen Accord](https://unfccc.int/meetings/copenhagen_dec_2009/items/5262.php): [https://unfccc.int/meetings/copenhagen\\_dec\\_2009/items/5262.php](https://unfccc.int/meetings/copenhagen_dec_2009/items/5262.php)

#### **Federal Laws:**

[Clean Air Act](http://www.epa.gov/air/caa/): <http://www.epa.gov/air/caa/>

[Clean Water Act](http://www2.epa.gov/laws-regulations/summary-clean-water-act): <http://www2.epa.gov/laws-regulations/summary-clean-water-act>

## Climate Change and Sustainability Primer

### State Laws:

[AB32](http://www.arb.ca.gov/cc/ab32/ab32.htm) – California Global Warming Solutions Act: <http://www.arb.ca.gov/cc/ab32/ab32.htm>

[SB375](http://www.arb.ca.gov/cc/sb375/sb375.htm) – Sustainable Communities and Climate Protection Act:

<http://www.arb.ca.gov/cc/sb375/sb375.htm>

[AB 1493](http://www.leginfo.ca.gov/pub/01-02/bill/asm/ab_1451-1500/ab_1493_bill_20020722_chaptered.pdf) - California Vehicle Global Warming Law: [http://www.leginfo.ca.gov/pub/01-02/bill/asm/ab\\_1451-1500/ab\\_1493\\_bill\\_20020722\\_chaptered.pdf](http://www.leginfo.ca.gov/pub/01-02/bill/asm/ab_1451-1500/ab_1493_bill_20020722_chaptered.pdf)

### Organizations:

[Intergovernmental Panel on Climate Change](http://www.ipcc.ch/): <http://www.ipcc.ch/>

[Federal Environmental Protection Agency](http://www.epa.gov/air/caa/): <http://www.epa.gov/air/caa/>

[California Environmental Protection Agency](http://www.calepa.ca.gov/): <http://www.calepa.ca.gov/>

[ICLEI Local Governments for Sustainability](http://www.icleiusa.org/): <http://www.icleiusa.org/>

[Environmental Defense Fund](http://www.edf.org/): <http://www.edf.org/>

[Joint Venture Silicon Valley Climate Task Force](http://www.jointventure.org/index.php?option=com_content&view=category&layout=blog&id=4&Itemid=35):

[http://www.jointventure.org/index.php?option=com\\_content&view=category&layout=blog&id=4&Itemid=35](http://www.jointventure.org/index.php?option=com_content&view=category&layout=blog&id=4&Itemid=35)

### Climate Action Plans

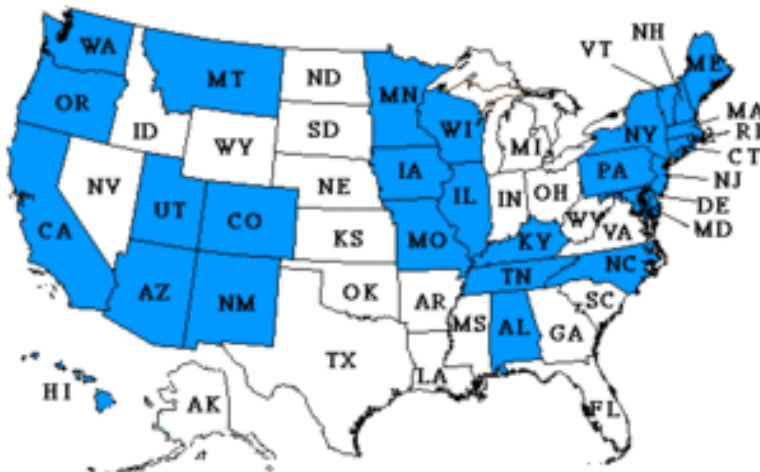


Figure 1: States in blue have declared GHG mitigation strategies or hold action plans.<sup>6</sup>

### [President Barack Obama’s Climate Action Plan](http://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf):

<http://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf>

### [EPA’s 2011-2015 Strategic Plans](http://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P1008YOS.PDF):

<http://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P1008YOS.PDF>

<sup>6</sup> Wikipedia, accessed on 10/2/14 at [http://en.wikipedia.org/wiki/Climate\\_change\\_policy\\_of\\_the\\_United\\_States](http://en.wikipedia.org/wiki/Climate_change_policy_of_the_United_States).

## Climate Change and Sustainability Primer

### Lesson 3: Growing Greener: The Impact of Climate Change on Our Planet and Our Community

Now that your students have background knowledge in global climate systems and the human activities that are contributing to changes in that system, we'll explore some of the ways the earth is responding. You can share the list on the following page with students as a handout or copy and paste it into a presentation to share with them (idea: build an animation where the image appears first and the text second, asking them to first guess what climate impact they perceive is shown via the image appearing on screen, next revealing a text description of the impact).

Climate change has already had observable effects on our state and region, and those impacts are forecasted to intensify in coming decades. Extreme heat days, temperatures and drought are on the rise, placing our community's water supply and residents' health at risk. Fire season has increased by 78 days per year and a 99.7% chance of a 6.7 or greater earthquake within the next 30 years is predicted by the Southern California Earthquake Center - reminding us that the atmosphere, our oceans and geosphere are inexorably intertwined and all are susceptible to these new climate-induced stresses and strains<sup>7</sup>.

Extreme weather events are not unfamiliar to Californians, who have historically combated wildfires, floods, droughts, mudslides, crop failures and other disasters that threatened our communities. Still today, these events take lives, destroy land and property, and cost residents and businesses billions of dollars. Informed by strong scientific research and consensus, communities are working to safeguard our collective future, economy, and civil society threatened by climate change-driven extreme weather events that are anticipated to increase in intensity and frequency.

Like many other communities, our backdrop in Cupertino threatened by the geological and climate instability that has become the new normal. Impacts from climate change currently experienced and forecasted to surge in California are abundant and are focused on the following environmental outcomes that will transform the way we live, work, learn and play:

<sup>7</sup> The Guardian, accessed on 11/6/14 at <http://www.theguardian.com/environment/2012/feb/26/why-climate-change-shake-earth>

## Climate Change and Sustainability Primer



### Sea level rise

Global sea level rose approximately 17 centimeters (6.7 inches) in the last century. The rate in the last decade, however, is nearly double that of the last century.



### Global temperature rise

All three major global surface temperature reconstructions show that Earth has warmed since 1880.<sup>5</sup> Most of this warming has occurred since the 1970s, with the 20 warmest years between 1981 to the present. The warmest years to date have occurred in the past 12 years.



### Warming oceans

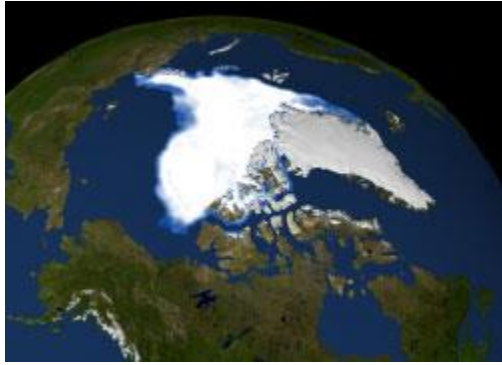
The oceans have absorbed much of this increased heat, with the top 700 meters (about 2,300 feet) of ocean warming 0.302 degrees Fahrenheit since 1969.



### Shrinking ice sheets

The Greenland and Antarctic ice sheets have decreased in mass. Data from NASA's Gravity Recovery and Climate Experiment show Greenland lost 150 to 250 cubic kilometers (36 to 60 cubic miles) of ice per year between 2002 and 2006, while Antarctica lost about 152 cubic kilometers (36 cubic miles) of ice between 2002 and 2005.

## Climate Change and Sustainability Primer



### Declining Arctic sea ice

Both the extent and thickness of Arctic sea ice has declined rapidly over the last several decades (and with it the beloved polar bears!).



### Glacial retreat

Glaciers are retreating almost everywhere around the world — including in the Alps, Himalayas, Andes, Rockies, Alaska and Africa.



### Extreme events

The number of record high temperature events in the United States has been increasing, while the number of record low temperature events has been decreasing, since 1950. The U.S. has also witnessed increasing numbers of intense rainfall events. Climatic change may increase the frequency of extreme weather events.



### Ocean acidification

Since the beginning of the Industrial Revolution, the acidity of surface ocean waters has increased by ~30 percent.<sup>12, 13</sup> This increase is the result of humans emitting more carbon dioxide into the atmosphere, therefore more being absorbed into the oceans. The amount of carbon dioxide absorbed by the upper layer of the oceans is increasing by 2 billion tons per year.

Learn more about the current and predicted effects of climate change by exploring NASA's Global Climate Change: Vital Signs of the Planet [website](#)



## Climate Change and Sustainability Primer

(<http://climate.nasa.gov/effects/>) and the Environmental Protection Agency (EPA)'s Climate Impacts & Adaptation [website](http://www.epa.gov/climatechange/impacts-adaptation/) (<http://www.epa.gov/climatechange/impacts-adaptation/>).

"There are risks and costs to a program of action. But they are far less than the long-range risks and costs of comfortable inaction."

– John F. Kennedy

As shared throughout this document, climate change poses great risks to both Cupertino and our entire globe. It jeopardizes extensive, and often costly, efforts to enable food access and security, protect public health and safety, promote economic development and stability, and safeguard natural resources upon which our prosperity depends. Local changes in precipitation and temperatures will awaken new vulnerabilities for our residents and businesses. To abate these anticipated climate risks, predicted to intensify in the coming decades, requires initiative, imagination and ingenuity. It requires confident leadership and common-sense, crowd-sourced solutions. Most importantly, it requires collective action. Shared here are a series of activities to encourage your students to learn more, get involved, and take direct action as newly appointed campus environmental leaders.

## Climate Change and Sustainability Primer

### ➤ **Action Activity** | *Climate Action on the Ground Floor: Comment on Your Community's Climate Action Plan*

We've all seen overwhelming videos of ice caps melting, polar bears going extinct, and icebergs collapsing...but what will climate change actually mean to you and your students? They will probably not witness an iceberg collapse in your city, though they are likely to experience many of the other effects of climate change in their own backyards, shared earlier in this primer. So how do we make climate change more relevant to students? Start by asking them to answer the following questions, allowing time for research, as a class, in small groups, or in teams:

- How is our community impacted by climate change?
- Has our city evaluated its community or municipal emissions (i.e. by conducting a greenhouse gas emissions inventory)?
- Has our City developed a plan to reduce its emissions? (i.e., by developing a Climate Action Plan)

*A note to instructors:* These are all public documents and so students have open access to them and are invited to participate in the development of these and other environmental policies.

As described above, the City of Cupertino is currently developing a Climate Action Plan (CAP), which defines climate change impacts relevant to our community, shares the city's path to reduce greenhouse gas emissions, and provides energy, water, fuel and cost savings for the City, its community members, businesses, and schools. The development of this document offers an opportunity for students to engage in the design of a climate agenda for their community, as these are public documents which are required by law (the California Environmental Quality Act - <http://resources.ca.gov/ceqa/>) to have a public process to engage and gather ideas and feedback from residents, businesses and other organizations. Students in Cupertino should access this draft document and share their ideas on ways to improve our environmental quality of life by visiting the City's Climate Action Plan website at [www.cupertino.org](http://www.cupertino.org). To facilitate their review, prompt them with the following questions:

- What are three things you learned about Cupertino's current environmental initiatives?
  1. \_\_\_\_\_
  2. \_\_\_\_\_
  3. \_\_\_\_\_
- List the primary sources of emissions in our city.
  1. \_\_\_\_\_
  2. \_\_\_\_\_
  3. \_\_\_\_\_
- Describe three unique ways Cupertino will reduce these emissions.

## Climate Change and Sustainability Primer

1. \_\_\_\_\_
  2. \_\_\_\_\_
  3. \_\_\_\_\_
- Share three ways you will take action to reduce your personal emissions.
    1. \_\_\_\_\_
    2. \_\_\_\_\_
    3. \_\_\_\_\_

Don't live in Cupertino? You can apply this exercise to any city anywhere. Check out your City's website to see if a Climate Action Plan was adopted or is in-progress. To find more information about how your local community's climate will be affected by climate change, access this tool [here](http://cal-adapt.org/tools/factsheet/): <http://cal-adapt.org/tools/factsheet/>.

### ➤ Discussion Activity | Be A Climate Scientist

Over the last 100 years, California has experienced sea level rise of about 7 inches. However, the State of California is projected to experience an additional 14-inch sea level rise, compared to 2000, by 2050. By 2100, sea level is expected to increase between 40 and 55 inches. That is approximately 4 ½ feet, or the average height of a 10-year-old! This increase in sea level would increase the risk of floods for approximately 270,000 Bay Area residents. Higher sea level would flood parts of Highway 101 and the Caltrain railroad, with the San Francisco International Airport (SFO) also at risk.

Reference the following figures to see where a 16-inch sea level rise would impact the entire San Francisco Bay Area and the South Bay in particular.



Share the images with students and ask them to discuss the following questions, again in pairs, small groups or as a class:

1. Do you ever visit any of the places or regions of the bay area expected to be underwater?
2. How do you think Cupertino will be impacted?
3. How can the Bay Area adapt to this sea level rise?

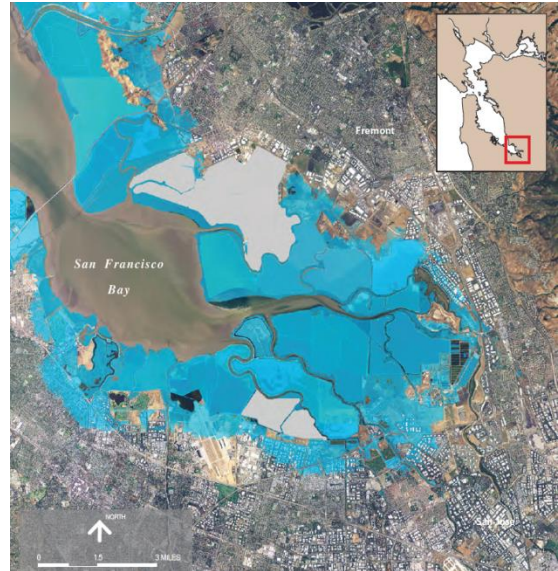
Figure 13: This is the 2014 view of San Francisco Bay. <sup>8</sup>

<sup>8</sup> San Francisco Bay Conservation and Development Commission, accessed on 11/18/14 at [http://www.bcdc.ca.gov/planning/climate\\_change/maps/regional16.pdf](http://www.bcdc.ca.gov/planning/climate_change/maps/regional16.pdf).

## Climate Change and Sustainability Primer

Figure 14: Inundated areas of the San Francisco bay area expected as a result of a 16 inch sea level rise by 2050.<sup>9</sup>

Visit the [San Francisco Bay Conservation and Development](http://www.bcdc.ca.gov/planning/climate_change/index_map.shtml) website ([http://www.bcdc.ca.gov/planning/climate\\_change/index\\_map.shtml](http://www.bcdc.ca.gov/planning/climate_change/index_map.shtml)) for more information on sea level rise impacts, such as maps of the 55 inch sea level projection and maps for other regions within the Bay Area.<sup>10</sup>



### ➤ Discussion Activity | *Extreme Weather Events*

Generally, California is expected to experience warmer and drier temperatures with a reduction of winter rain (and snow in the mountains). Average temperatures are expected to increase (about 1.5°C or 2.7°F) by 2050. Extreme weather events such as heat waves, wildfires, droughts and floods will likely be among the earliest impacts of climate change in California.<sup>11</sup> As a result of higher sea levels, the Pacific Coast and Bayshore will suffer from storm surges, more extensive inland flooding, and increased erosion.

It is likely that these extreme weather events will occur in our lifetime, and as shared previously in this primer, many of these changes are already in progress. One way to learn about these changes is to collect an oral history by asking students to interview older residents in your community (e.g. grandparents, teachers, neighbors, etc.) about the climate changes they have witnessed during their lifetime. Here students will gain valuable communications and research skills, while documenting the environmental transformation of their community based upon real-time feedback shared by those closest to them. Provided below are a few initial questions to support their inquiry process, but instructors should encourage students to develop their own expanded list before hosting these interviews:

<sup>9</sup> San Francisco Bay Conservation and Development Commission, accessed on 11/08/14 at [http://www.bcdc.ca.gov/planning/climate\\_change/maps/16/south\\_bay.pdf](http://www.bcdc.ca.gov/planning/climate_change/maps/16/south_bay.pdf).

<sup>10</sup> San Francisco Bay Conservation and Development Commission, accessed on 11/20/14 at [http://www.bcdc.ca.gov/planning/climate\\_change/index\\_map.shtml](http://www.bcdc.ca.gov/planning/climate_change/index_map.shtml).

<sup>11</sup> California Natural Resources Agency, accessed on 11/17/14 at <http://www.climatechange.ca.gov/adaptation/>.

## Climate Change and Sustainability Primer

### For student reflection before hosting interviews:

- How do you see your life and the lives of those around you change as a result of climate change?
- How does a change in climate affect others across the globe?
- How will our changing climate impact our nation's economics, travel, equity, natural resources, import and export of goods, meeting basic needs and more?

### Proposed interview questions:

- How long have you lived in the City, region, state?
- What changes have you seen to our local environment over this time?
- What changes have you seen to our climate over this time?
- What specific changes have you seen in our communities, to the Bay, to the foothills, our reservoirs, our natural landscape?
- What is your perspective on climate change?
- How does this perspective shape your prior answers?

### For student reflection, following the interviews:

- What climate-driven changes were noted by your interviewees?
- How did their perspective on climate change influence their response?
- Do you anticipate these changes to continue, to become intensified or weakened?
- Have you compared your interviewee response with any data or reports to validate their perspectives?

*A note to instructors:* share California's Climate Change portal with students in advance and ask them to ground-truth their findings: <http://www.climatechange.ca.gov/>.

## Climate Change and Sustainability Primer

### ➤ **Research Activity** | *Climate Change and Health*

An increase in natural disasters increases the need for emergency and public health services. Here students will explore the intersection between these climate change-connected natural disasters and human health, with your support.

Heat-related illness and deaths are projected to increase as a result of extreme temperatures, especially in vulnerable populations such as the elderly and infants. These warmer and drier conditions can also enhance the risk of wildfires, which pollute the air. Higher temperatures, extreme weather events, and drought will likely impact local agriculture as well, lessening production and impacting our food supply.

Residents in California are greatly affected by air quality. The California Air Resources Board estimates that unhealthy levels of ozone (smog) and particulate matter contribute to 19,000 premature deaths a year, and 280,000 asthma attacks and other respiratory symptoms.<sup>12</sup> Poor air quality and increased summer temperatures can greatly impact the public health of residents and workers.

Provide this context and invite students to research the relationship between hosts, parasites, and vectors for common vector-borne diseases and evaluate how climate change could affect the spread of disease. [Share WWF's Climate Change and Disease blog](#) so that students can dive deeper to explore how climate change affects public health:

<http://www.wwfblogs.org/climate/sites/default/files/WWFBinaryitem5967.pdf>.

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<sup>12</sup> American Lung Association. Land Use, Climate Change & Public Health Issue Brief: Improving Public Health and combating climate change through sustainable land use and transportation planning. Spring 2010.

## Climate Change and Sustainability Primer

### ➤ **Action Activity** | *Addressing Problems and Sourcing Solutions*

You can be part of the solution! This activity seeks to empower students as resident climate change experts by sharing resources that affect their local environment and introducing modest adjustments they can make in their daily lives to improve their quality of life and strengthen our shared future. These are organized by the green@school units, available for you to build into your current class curriculum or club agenda:

- **Energy:** Reduce energy use and conserve more. The energy we use is primarily generated from the burning of fossil fuels. Find out how much energy your school uses and find ways to reduce and/or conserve energy using the green@school checklist to conduct a campus assessment.
- **Water:** Save, share, sip. Help friends and teachers reduce the water they use on campus by developing a water savings campaign. Teach family members ways to reduce water use at home by conducting a home assessment, using the Do-It-Yourself toolkit available at the Cupertino Library.
- **Materials Management:** Provide new ways for students and staff to refuse, reduce, reuse, and recycle on campus. Teach family and friends about tactics to manage materials and effectively use Recology's suite of recycling and composting services.
- **Pollution Prevention:** Our current human activities dispose lots of chemicals and noxious gases into the air, water, and soil. This not only increases greenhouse gases, it affects our health and the health of generations to come. Find out what pollutants your school uses and suggest changes, informed by your green@school checklist.
- **Wastewater:** Keep pollution from entering major bodies of fresh and sea water. Help friends and school staff keep your campus clean and learn the tactics that your district uses to properly dispose of hazardous wastes. Find out how your science classes dispose of chemicals that are used in experiments by setting up a time to chat with the instructor.
- **Transportation:** Walk and bike frequently. Use public transportation and encourage family and friends to do the same. Transportation is a leading cause of greenhouse gas emissions in California. What can you do to reduce this impact?
- **Health and Wellness:** What you eat is vital to your health and today's dairy, meat, and packaged food manufacturers produce more greenhouse gases than you may

## Climate Change and Sustainability Primer

have thought. Research this further and respond with dietary changes that are good for your health and our planet!

Now that you're more familiar with these concepts, are you willing to take a stand to climate change? Start by pledging to our Earth!

### Pledge Allegiance to the Earth:

"I pledge allegiance to the Earth, and to the flora, fauna, and human life that it supports, one planet, indivisible, with safe air, water and soil, economic justice, equal rights and peace for all."

*Source: Women's Environment and Development Organization*



## Climate Change and Sustainability Primer

### Personal Climate Action Pledge

I,

\_\_\_\_\_  
pledge to save resources and preserve the earth's life support systems for me, my family, friends, kids, grandkids, and generations to come. I pledge that I will do my part because everyone and every resource counts and collectively, we can make a difference. I promise to:

*A note to instructors:* Share this pledge with your students before diving into the g@s units. This pledge will set the stage for topics ahead and help gauge student interests and passions beforehand.

- Turn off the lights in empty rooms at home, and ask my teachers to do the same at school.
- Turn off my iPod, iPhone, television, or other electronics when not in use.
- Ask my parents to buy florescent or LED light bulbs, or light bulbs that are labeled as energy efficient.
- Open the drapes and window shades on cold, sunny days to let in heat from the sun.
- Close drapes and window shades on summer days. This way, my air conditioner won't have to work double time!
- Make sure the heating and cooling vents in my house are not blocked or covered.
- Put on a sweater or put an extra blanket on my bed if I get chilly, instead of turning up the heat.
- Open windows and use fans instead of turning on the air conditioning on warm days.  
*Tip: opening windows that are across from each other will let a nice breeze into the house!*
- Ask my parents to make sure our house is properly insulated.
- Decide what I want to eat before I open the refrigerator door.
- Walk or ride my bike to friends' houses instead of asking my parents to drive me.
- Ask my parents to carpool when possible.

## Climate Change and Sustainability Primer

- Ask my parents to combine short car trips, such as running errands to avoid multiple, individual trips.
- Run dishwashers, washing machines, and clothes dryers only when they are full and off-peak\* if possible.
- Turn the water off when I brush my teeth.
- Look for leaky faucets and ask my parents to fix them.
- Ask my parents to install water-saving devices in our shower heads, faucets, and toilets.
- Take short showers instead of baths, and remember not to turn the water on too hot. It takes a lot of energy to heat water!
- Compost, reuse, reduce, and recycle at home and ask my teachers to start a composting, reuse, and recycling program at school.
- Avoid over-packaged products and buy products made from or packaged in recycled materials. It takes less energy to produce a recycled product than a new one.
- Keep my eyes and ears open for more ways to conserve energy and other resources to help the environment.

\_\_\_\_\_  
Signed

\_\_\_\_\_  
Date