Designing for Change

Grades 9-12

Lesson developed by the Center for Climate Protection for use in the ECO_2school Youth Leadership Program.

Time: One class period 45-50 minutes

Summary:
Designing for Change is a social and historical framework for climate change. Learn about the interdependence of people and climate with this overview of social, economic, and political trends. It provides a social and historical perspective to help students deepen their understanding of how changing attitudes toward the climate have impacted our current behavior and addresses the problem in positive and impactful ways.

Standards:
CA HSS Analysis Skills (9-12)
Historical Research, Evidence, and Point of View

1. Students distinguish valid arguments from fallacious arguments in historical interpretations.
2. Students identify bias and prejudice in historical interpretations.

Historical Interpretation

1. Students show the connections, causal and otherwise, between particular historical events and larger social, economic, and political trends and developments.
5. Students analyze human modifications of landscapes and examine the resulting environmental policy issues.

CCSS.ELA-LITERACY.RH.9-10.3
Analyze in detail a series of events described in a text; determine whether earlier events caused later ones or simply preceded them.
CCSS.ELA-LITERACY.RH.11-12.3
Evaluate various explanations for actions or events and determine which explanation best accords with textual evidence, acknowledging where the text leaves matters uncertain.

Materials:

- **Computer, projector and speakers to view the PowerPoint**
- **Copy of the Designing for Change PowerPoint**
- **Laser pointer**
- **Pencils or other small prizes**
- **Teacher activity packet**
  - **Literature Review**
  - **Current event articles**
  - **Essay: Students are Making a Difference**
  - **Presenter Evaluation**

Background for Facilitator and Assumed Prior Student Knowledge:
It will be helpful to have an understanding of basic climate science prior to giving this presentation. Review Climate Literacy, The Essential Principles of Climate Sciences A Guide for Individuals and Communities published by the National Oceanic and Atmospheric Association (NOAA) and the American Association for the Advancement of Science (AAAS)
The information in this unit can also be found in the notes of the PowerPoint. When using presentation mode on your computer the notes will be visible to you as a presenter. However, is it preferable to have a deep familiarity with the material so you are not reading off the slides.

Preparation:
Plan on arriving a half hour before your first presentation. Check in at the office and confirm school visitor procedures.
Set up and test all AV equipment in advance. If you are not using your own computer, check to see that it has the appropriate software to run a PowerPoint and embedded videos. There are two swear words in the first video. Check with the teacher prior to showing the video.
Be prepared to ask students questions to facilitate the understanding of key concepts.

Introduction and Overview *Slides 1-3*

Facilitators note: Introduce yourself to the students. What is your name? What organization are you with? Why are you here? What inspires you to do this work?

By the end of this presentation students should have an increased understanding of the different systems affecting our climate, historical framework of our changing climate, and the ability to identify ways we can help contribute to solutions to the problem.

Facilitators note: Vocabulary from the Climate Literacy Vocabulary List are bolded in the text.

Climate is the area's average weather conditions and extent those conditions vary over long time intervals. When you think about climate it has been relatively stable for the last 10,000 years. Climate is about the ways three systems- air, water and land - interact with each other over long periods of time.

Weather on the other hand is what you see when you look out the window. C*omment on the weather outside the window.* It is about relatively short periods of time and specific geographic areas. It can be about a day a week or a season and can refer to an area as small as *your town* or as large as the state of CA. Weather and climate are interconnect but different. Climate influences weather and weather is an indicator of what is happening with climate.

Facilitators note: When introducing the concepts of climate and weather this is a good opportunity to evaluate student levels of pre-knowledge. Ask the students the questions "what is climate" and "what is weather" and incorporate their knowledge and understanding into your definition.

Gallery Walk *Slide 4*
One hundred and fifty years of climate history in fifty pictures. This visual history helps students identify trends and key moments in the history of climate scientific discovery and make connections to the social and political influence and impacts.

Facilitators note: Hang the slides on the wall (before the presentation begins) and ask students to bring back any of the slides that are interesting to them for a group discussion. Make sure to call on a few students, hopefully with slides from different time periods to provide the widest possible breadth of key historical moments in climate history.

Brief History of Climate Science *Slides 5-9*
In the past 2.6 million years the planet has gone through repeated cycles of warm periods and cool periods. It is kind of like a top. As it spins you can see that it does not spin in a perfect circle. Similarly, the earth is not a perfect circle. It too wobbles. A man named Milankovitch discovered these wobbles about one hundred years ago. These wobbles cause variation in temperature over long periods of time. Remember when we talk about climate we are talking about big systems, the entire planet, over long periods of time, tens of thousands of years. This accounts for things like the ice age

and temperature variation over long periods of time. This is called the Milankovitch cycle or more commonly **Ice Age Cycles**. With information from these studies scientists are able to predict that the next ice age is not scheduled to come for about 30,000 years. So, we can all take a big sigh of relief.

Land: CO_2 is on the move. For millions of years massive amounts of CO_2 have been stored deep in the earth. In the forms of oil, coal and natural gas. With industrialization, we have been removing and burning it at a rapid rate. Trees also sequester or hold CO_2. Massive de-forestation is upsetting the carbon cycle. So where is all that CO_2 going?

Air: About sixty years in 1958 ago a chemist named Charles Keeling figured out a way to measure carbon dioxide in the air. He measured CO_2 levels for years and discovered two important things:

- The amount of CO_2 in our atmosphere varies based on seasons and the carbon cycle
- The amount of CO_2 in our atmosphere is increasing over time.

We call this the Keeling Principal. It is also known as the Mauna Loa Curve.

Facilitators note: Ask the question "If these changes are seasonal what is the big thing that happens in the fall that would cause an increase in CO_2?" Answer: Leaves fall from the tress and decompose. Trees are releasing CO_2. Ask the question "What then happens in the spring that would cause CO_2 levels to drop?" Answer: Trees put out new growth and new leaves. Increasing their ability to store CO_2.

Water: Knowing that Air, Water and Land are interconnected and being naturally curious people, meteorologists wondered if CO_2 is rising in our air, what is happening in the water?
They went to **Oceanographers** or scientists that study our oceans. What do you think they found?

Facilitators note: Check for understanding. Ask the students what they think the correct answer is before continuing.

They noticed a trend that the amount of CO_2 in our oceans is also increasing. Furthermore, they discovered that the increased CO_2 is causing something called **Ocean Acidification.** When carbon dioxide enters the ocean it combines with seawater to produce carbonic acid. This increases the acidity of the water and lowers its pH. Now scientists are really curious. They are seeing an increase in CO_2 in the air and an increase in CO2 in the water. Remember our three-interconnected systems air, water and land? What do you think is happening to the CO_2 in the land?

Facilitators note: Check for understanding. Ask the students what they think is the correct answer. Ask for a show of hands as to how many people think that the amount of CO_2 in our land is also increasing? How many people think the amount of CO_2 in our land is decreasing? You can also ask students to do a thumbs up for increasing, a thumbs down for decreasing or a flat hand for unsure.

It turns out the amount of CO_2 in our land is decreasing. Humans are removing the CO_2 that has been sequestered deep in the earth in the form of coal, oil and natural gas at an alarming rate. And the CO_2 that is being released into the air and water is having a visible impact on those systems. We mentioned plants sequestering CO2 when we looked at the Keeling Curve.

Who knows what the Greenhouse effect is? Who can explain it to us?

Facilitators note: Ask 1-3 students, depending on the quality of their answers, what the Greenhouse effect is. Once you hear a good answer reiterate it for the class to make sure everyone has heard it.

The **Greenhouse effect** is an important part of earth's ability to sustain life. The earth gets its warmth from the sun. The **atmosphere** is the mixture of gases that surround the earth in layers. It both holds and protects us from the suns heat. **Solar radiation** or the energy we get from the sun passes through the atmosphere to warm the planet. Some of that heat escapes back into space and some of it stays on the surface. **Carbon Dioxide** and other atmospheric gases trap heat. If it weren't for these gases the earth would be a very cold and inhospitable place. CO_2 and Oxygen are both key elements of our atmosphere. When the amount of CO_2 rises, more solar energy becomes trapped., thus raising the temperature. It is like putting extra blankets on your bed. You might want one to keep you warm at night but if you add too many it gets too hot to be comfortable. The increase in CO2 is causing global temperature rises and it is getting too hot to be comfortable.

Current Thinking Summed Up *Slides 10-12*
The Earth is warming.
Climate change refers to the rapid rise in global temperature caused by human influenced imbalance in the carbon cycle and the subsequent greenhouse effect. During the 20^{th} century the Earth's global average surface temperature rose by about $1.08^{o.}$ Since 2000 an additional warming of 0.25^{o} has been measured. While this may seem small it is an extraordinarily rapid rise compared to the changes in the last 10,000 years. Over the 21^{st} century, climate scientists expect the Earth's temperature to continue to rise even more than it did in the 20^{th} century.

Scientists study the past to understand what has happened and they use that information to help make predictions about what will happen. The past 100 years of observations, experiments and theory are used to construct and refine computer models that represent the climate system and make predictions about its future behavior. Results from these models lead to better understanding of the linkage between the earths systems and climate conditions. Current climate change projections are reliable enough to help humans evaluate potential decisions and actions in response to climate change.

What are scientists saying? Tens of thousands of scientists all over the world working on their individual projects, coordinating efforts and sharing results and there is 98% agreement, a scientific consensus around human caused climate change. But don't just take my word for it. Let's hear what Michel Jarraud, one of the world's leading climatologists has to say. He is a representative of the IPCC, the International Panel on Climate Change, commissioned by the UN to study the issue.

Humans are causing it.
Humans are causing it. The **fossil fuels -** oil, coal and natural gas - we use to run our cars, supply our energy and run our factories emit CO_2 when burned. That CO_2 is going up into the atmosphere and causing **global warming** or an increase in the earth's average temperature based on changes to our climate. Cutting down trees and clear cutting our forests that sequester CO_2 are also contributing to the problem.

Some of the results we are seeing today are increased frequency and intensity of heat waves, droughts and floods. Melting ice sheets and glaciers are causing a rise in global sea level and are putting entire island nations at risk and increasing the damage to homes, buildings and communities during storms.

Facilitators note: As you say" This is where Healdsburg and Cloverdale get their water." point or use the laser pointer to identify the photo of Lake Sonoma.

Here in California we are feeling the impact of a multi-year drought. The Sierra snowpack supplies water to 1.7 million people across the greater Bay Area. More precipitation is happening as rain instead of snow and spring run-off is happening sooner. This means less water going into aquifers, and rivers. This impacts us.

Facilitators note: Ask students to identify some of the impacts they have felt. Students will respond with comments like taking shorter showers, not watering the lawn or not washing their cars.

For eco-systems, the Eel River is drying up, salmon cannot get upstream to spawn or salmonids cannot get to the ocean and grow to maturity. Agriculturally, fruit trees that rely largely on ground water are dying or need to be irrigated.

The hotter weather is not bad for everything; ticks and mosquitos have a longer breeding season and are increasing in number. As a result, infectious diseases like malaria and Lyme Disease are expected to increase.

Facilitators note: Ask students, how many people know someone who has had Lyme Disease?

This is another impact we are feeling in our home community. Drought, the famine that results from it, disease and poor air quality are affecting human health and mortality rates all over the world. People in the developing world feel the greatest impacts.

Humans are not the only species impacted by climate change. The rate of extinction is happening 1,000 times faster. The International Union for Conservation now has more than 20,000 species of plants and animals on their list.

Incidents of extreme weather are projected to increase as a result of climate change, including heat waves and severe cold. Precipitation is expected to be less frequent but more intense and droughts will be more frequent and more severe. Hurricanes Katrina and Sandy are both examples of this.

We don't know the upcoming costs of the impacts of climate change but we do know that the number is going up. In 2011 We spent $21.3 billion in disaster relief in the US, in 2012 it went up to $34.4 billion. The cost of super storm Sandy in 2013 was $75 billion. We pay off these debts over time, 20-30 years. That means you will be paying not just for these disasters but for increases into the future.

What's Going On Globally and Locally *Slides 13-20*
Looking at the three tiers of health: global, community, and personal.

Right now, the world is emitting more greenhouse gases than our planet can handle. It is estimated that we would need more than 1.5 Earths to sustain the amount of emissions we are releasing. The US is consistently among the highest emitters of greenhouse gases per capita (meaning per person). Combine this with the estimate that if everyone else used resources the way we do in the US we would need 5 planets to keep up with our consumption habits. All economic sectors need to make the shift to more sustainable, renewable, and efficient means of operation.

In the Bay Area, our transportation habits account for the largest amount of emissions at almost 65% when combining vehicle emissions with emissions from refineries that mainly supply oil for our automobiles.

As for our personal habits, once again it's transportation that dominates the greenhouse gas emissions at 33% of our household GHG footprints.

Both California and Sonoma County have taken major steps in combating global warming. Recently released data by the California Air Resources Board show that the state achieved its goal of reducing greenhouse gas emissions below 1990 levels. We have the carbon-neutral Sonoma County Water Agency and Sonoma Clean Power which offers energy from renewable sources of power.

Facilitators note: Play the video: **Our Future- What's Possible** (4 mins film)*. (Slide 21)*

Solutions *(Slides 22-30)*
<u>Individual Solutions</u>
All of us, today, need to start changing our personal behavior and living in ways that are healthier for ourselves and the planet. Over 70% of students live 3 miles or less from school. 60% of the trips we take are in walk and bike distance (under 3 miles) but only 12% if then are walked or biked. By walking or riding your bike just one day a week you can save an average of 100 Lbs. of CO2 from being emitted a year.
<u>Community Solutions</u>
Engage in your community. We need to start building the infrastructure that makes our personal changes not just possible but easy, efficient and cost effective. Talk to the people you live with, go to school with and hang out with. Join organizations you agree with. Connect to elected and the public organizations.

- There are a multitude of ways to design our cities to make them more walkable, bikeable and livable.
- Army core of engineers is looking at ways to redesign our water capture systems to keep up with less snow, more rain and fewer but larger storms.
- Sonoma Clean power brings geo-thermal and other clean energy solutions into our homes every time we flip a switch
- Scientists and engineers are being paid to think up new and better solutions. The Bay Area has an entire government agency who is planning how to address sea level rise in the Bay Area.

Dream Big

We need the next generation of innovators, problem solvers and creative thinkers applying themselves to the issue of climate change and doing things in new and different ways.

To bring it back to the elephant in the room, the transportation sector:

Dreaming big can mean expanded and more efficient public transportation systems. Electric and driverless cars. Mixed-use/bicycle/pedestrian/transit-oriented development to smart roads and carbon taxes, there are many avenues that will help make our transportation systems less polluting and more sustainable.

Innovate

The internal combustion engine (the one in most of our cars) is out dated and out moded. It is inefficient and wastes a tremendous amount of energy. Just think of all the heat that comes off an internal combustion engine. That is all wasted energy, energy that is not being used to power the vehicle. Now think of all the additional energy we spend trying to cool those engines down. Electric vehicles reduce the need for fossil fuel consumption and do not emit CO2.

Invent

We have only begun to image what we can do with solar voltaics. Smart roads with computers can track the number of cars on the road which will help us understand traffic patterns and provide drivers and engineers with detailed data. These roads can even be powered by solar panels! The opportunities are endless. What are some of your ideas?

Engage

These are students like you who are working to mitigate the impacts of climate change. Here are a few of your Youth Advisory Board members who have been working here in Sonoma County and the greater Bay Area to have a positive impact. Jasmine won the Breathe CA award as a Freshman at Windsor for her work with Spare the Air Youth organizing the Youth for Environment and Sustainability Conference.

Patrick Schiller worked with Supervisor Shirlee Zane on a Gold Resolution and addressed the County Board of Supervisors when he was a junior at Maria Carrillo.

Shivani Shumar came with us to the NAAEE conference and helped facilitate a discussion youth leadership and engagement with people from all over the United States.

What are you going to do to address the problem of climate change?

Digging deeper in to our question:

Are we asking the right question?

What do we know?

What do we need to know?

What do we want to know?

Where do we go to get answers?