

	Global Climate Change	Estimated Duration
		18
<b>Unit Rationale</b>	Global climate change and its impacts on people and resources pose serious societal challenges. The actions we take today will influence the path of future greenhouse gas emissions and the magnitude of warming; they will also affect our ability to respond and adapt to changes, and to reduce vulnerability of people and places to possible harm. Educating future generations about the causes and effects of global climate change is imperative since implementing solutions depends on an informed public.	
<b>Unit Goals</b>	<ol style="list-style-type: none"> <li>1. Students will be able to explain the elements of climate and analyze the earth's energy balance that affects climate change.</li> <li>2. Students will be able to identify various sources of evidence used to chart climate and apply the evidence to determine the proximate and ultimate causes.</li> <li>3. Students will be able to analyze the impact of climate change on environmental, biological and social systems.</li> <li>4. Students will be able to compare climate change mitigation and adaptations strategies (macro and micro) in light of environmental, economic, political, and ethical impact.</li> <li>5. Students will use data and evidence to justify claims relating to climate, climate change, and mitigation.</li> </ol>	
<b>Prior Knowledge</b>	Students will be familiar with different aspects of weather and climate, but may not be able to differentiate the two terms. Students will also have heard the terms climate change and global warming, but may not understand the science behind these terms. Students will likely confuse other environmental issues like acid rain and holes in the ozone layer with climate change.	
<b>Summative Unit Assessment(s)</b>	<ol style="list-style-type: none"> <li>1. Traditional Test</li> <li>2. Mitigation Performance Assessment</li> </ol>	

Lesson #	estimated # of days	Lesson Objective Lesson Assessment	Science Standards
LP1	1	<b>Objective:</b> Students will be able to identify the relevance of studying climate change and differentiate between elements of weather and climate. <b>Assessment:</b> Quiz 1: Questions in quiz on LP1 & LP2	Ed6.a, Ed6.b
LP2	2	<b>Objective:</b> Students will be able to apply the concepts of energy and light to create an input/output model of energy budget for the Earth. <b>Assessment:</b>	P3.a, P3.b, P4.a, P4.e, P7.a; ES4.a, ES4.b, ES4.c, ES4.d, ES6.a, ES8.a; I1.d, I1.g
LP3	3	<b>Objective:</b> Students will be able to identify greenhouse gases and their sources and apply the properties of these gases and radiative forcing to model Earth's energy budget. <b>Assessment:</b>	P3.a, P4.a, P4.e, P7.a, ES4.b, ES4.c, ES4.d, ES6.a, ES7.b, ES8.b, I1.a, I1.b, I1.c, I1.d, I1.k
LP4	2	<b>Objective:</b> Students will analyze the sources for climate data and will analyze this data to identify the impact of climate change on physical systems. <b>Assessment:</b> Quiz over using data to make conclusions & mitigation strategies	ES1.c, ES4.a, ES4.b, ES4.c, ES6.a, ES6.c, ES8.b, I1.a, I1.d, I1.m
LP5	3	<b>Objective:</b> Students will analyze data to determine the consequences of climate change on environmental, biological, human, and social systems and identify adaptation strategies for these consequences. <b>Assessment:</b>	B6.b, B6.g, ES6.b, I1.a, I1.d, I1.m
LP6	2	<b>Objective:</b> Students will be able to identify elements of scientific consensus making and analyze debates about the validity of global warming claims. <b>Assessment:</b>	I1.i, I1.m
LP7	4	<b>Objective:</b> Students will be able to compare and contrast climate change mitigation strategies (macro and micro) in light of environmental, economic, political, and ethical impact. <b>Assessment:</b> Mitigation Performance Assessment: Group & Individual Products	Ed6.a, Ed6.b
LP8	1	<b>Objective:</b> Traditional Test <b>Assessment:</b> Traditional Test	

# LP 1

# Introduction to Climate Change

# of Days	1		
Prior Knowledge	Students will likely know about different weather phenomena, but may confuse weather and climate.	California English-Language Arts Content Standards	Reading 2.3, 2.4, 2.5, 2.8 (Article Analysis) Writing 2.3.c (Concept Map) Listening & Speaking 1.2 (Article Analysis)
Lesson Objective	Students will be able to identify the relevance of studying climate change and differentiate between elements of weather and climate.	Language Goals/Demands	Students will be able use different terms to relate components of the climate system and weather to each other. Demands: Definitions - Students must be able to recognize keywords that identify definitions; Concept Map - Students must know the difference between and be able to use nouns and verbs.
Lesson Assessment	Quiz 1: Questions in quiz on LP1 & LP2	Changes for Next Time	
California State Science Standard	Earth Science 6.a and 6.b		
Materials Needed	Student handouts, powerpoint slides, computer, projector, internet connection	What Worked Well	
Time	Learning Task or Activity	Method & Notes	
<b>Day 1</b>			
17 min	<p>Lesson Hook</p> <ul style="list-style-type: none"> <li>- Tell students that they are about to start a three week unit on climate change.</li> <li>- Climate change is a big issue in the news, but why is it such a big deal?</li> <li>- You will read a one-page article from Reuters about the impact of climate change on students their age. (The article is about sea level rise in a foreign country.)</li> <li>- Students will read in small groups and then discuss the article using the provided questions.</li> <li>- Make sure you have students think about whether this will impact them or not.</li> <li>- At the end of the activity, have students report to the entire class their headline for the sea level rise issue in the Bay Area</li> </ul>	<p>GROUP WORK</p> <p>See 1.1.1 for Article</p> <p>See Slide 1.1.2 for Article Vocabulary</p> <p>See 1.1.3 for Discussion Questions</p>	

8 min	<p>Sea Level Impact in the Bay Area</p> <ul style="list-style-type: none"> <li>- Here is a map of the sea level rise that could take place here in the Bay Area. (Show Google Map Image of Sea Level Rise)</li> <li>- Show students the current sea level and then have them make predictions about how much rise it will take to flood certain areas close to their school</li> </ul>	<p>WEB DEMO</p> <p>Google Maps Sea Level Rise  <a href="http://flood.firetree.net/?ll=43.3251,-101.6015&amp;z=13&amp;m=7">http://flood.firetree.net/?ll=43.3251,-101.6015&amp;z=13&amp;m=7</a>  (Find the North America Map and Zoom in on your coastal area. Start with 0 meters sea level rise so that students have a baseline and then increase in increments of your choice).</p>
10 min	<p>Defining Weather and the Climate System</p> <ul style="list-style-type: none"> <li>- Tell students that over the next three weeks you will learn more about how climate is changing and the impacts of this change.</li> <li>- But first, we have to make sure we understand exactly what weather and climate are</li> <li>- Go through Slides</li> </ul>	<p>LECTURE WITH SLIDES</p> <p>See Slides 1.1.4</p> <p>You may find it helpful to post 1.1.5 - "Keywords to identify definitions" for the remainder of the unit</p>
5 min	<p>Weather/Climate Confusion</p> <ul style="list-style-type: none"> <li>- Have students watch the Stephen Colbert Video that addresses the common misconception of climate and weather.</li> <li>- While watching the video, have students think about the proper use of weather, climate, and climate systems</li> </ul>	<p>WATCH VIDEO</p> <p><a href="http://www.huffingtonpost.com/2010/02/11/colbert-rips-fox-news-for_n_458075.html">http://www.huffingtonpost.com/2010/02/11/colbert-rips-fox-news-for_n_458075.html</a></p>
5 min	<p>Video Discussion</p> <ul style="list-style-type: none"> <li>- Discuss the ways in which people use the terms weather and climate and climate system improperly</li> <li>- Discuss the main evidence for support of climate change despite the heavy snowfall.</li> </ul>	<p>DISCUSSION</p>
5 min	<p>Concept Map Introduction</p> <ul style="list-style-type: none"> <li>- Handout Concept Map Instructions</li> <li>- Explain that students will be making a concept map throughout the unit.</li> <li>- Make sure students write in pencil</li> <li>- Finish by explaining students' homework for the night</li> </ul>	<p>LECTURE</p> <p>See 1.1.6 Concept Map Instructions (Student Handout)</p>
HW	<p>Homework: Start your concept map with the following terms: Climate System and Weather. Also, add two or three factors to your map that you think will affect the climate system.</p>	

# LP 2

# Energy Budget

# of Days	2		
Prior Knowledge	Students will have conceptions about the orientation of the Earth to the Sun. They will know that the Earth has a tilt. Many will probably think that the seasons are due to the distance from the sun. Finally, students will have a basic understanding that the Sun provides both light and heat for the Earth.	California English-Language Arts Content Standards	Writing 2.3 (homework) Listening and Speaking 1.1
Lesson Objective	Students will be able to apply the concepts of energy and light to create an input/output model of energy budget for the Earth.	Language Goals/Demands	
Lesson Assessment		Changes for Next Time	
California State Science Standard	Physics 3.a,3.b, 4.a, 4.e, 7.a; Earth Science 4.b, 4.c, 4.d, 6.a, 8.a; Investigation 1.d, 1.g		
Materials Needed	Styrofoam balls and lights for Sun-Earth Model Activity Rope for wavelength demonstration, Bottles, buckets, etc for Dynamic Balance Activity	What Worked Well	
Time	Learning Task or Activity	Method & Notes	
<b>Day 1</b>			
3 min	BW: Why does someone in Brazil experience different climate than you do in the Bay Area?	INDIVIDUAL SEAT WORK OR PAIR WORK	
4 min	Discuss BW and HW: Concept Map - Students share answers	DISCUSSION on concept map challenges and BW See 2.1.1 Bell Work Teacher Guide	
4 min	Energy Budget Introduction - Discuss the terms energy, budget, and equilibrium.	LECTURE/PRESENTATION See 2.0.1 Definitions See 2.1.3 Energy Budget Slides #2-5 Use 2.1.4 Student Notes	
7 min	Sun-Earth Model Activity Introduction - Where does the Earth get its energy? - How much energy reaches the Earth? Give students directions about the activity. Since they know the Sun is responsible for the Earth's energy, how do we know how much energy reaches the Earth from the Sun?	Q&A/ACTIVITY INSTRUCTIONS See 2.1.2 Sun-Earth Modeling Activity This activity could be shown as a whole class demonstration or in small groups.	

12 min	<p>Sun-Earth Model Activity</p> <ul style="list-style-type: none"> <li>- Student pairs use a light source and styrofoam balls to model the energy input from the Sun.</li> </ul>	<p>PAIR WORK/HANDS-ON ACTIVITY or CLASS DEMONSTRATION</p>
5 min	<p>Sun-Earth Model Activity Debrief</p> <ul style="list-style-type: none"> <li>- Teacher asks students for ideas about quantifying the solar output.</li> <li>- Discuss variables that are important: Size of planets, distance from each other, tilt of the planets</li> <li>- Discuss the impact of changing each of these variables of the input</li> </ul>	<p>DISCUSSION</p> <p>See 2.1.2 for Debrief Question Prompts</p>
17 min	<p>Develop the conceptual Energy Budget Model</p> <ul style="list-style-type: none"> <li>- Step through the incoming energy and the reflected energy</li> <li>- What are reasons why all of the Sun's energy is not warming the Earth? Talk about reflective surfaces and albedo.</li> <li>- Wavelength Demonstration</li> <li>- Optional albedo research video and additional slides</li> </ul>	<p>LECTURE/PRESENTATION</p> <p>See 2.1.3 Energy Budget Slides #6-17</p> <p>Use 2.1.4 Student Notes</p> <p>one 5' long rope or shorter ropes for group work</p> <p>optional video -</p> <p><a href="http://www.youtube.com/watch?v=9UJKVa2CICU&amp;feature=related">http://www.youtube.com/watch?v=9UJKVa2CICU&amp;feature=related</a></p>
5 min	<p>Concept Map Additions: Sun, Earth, Energy Budget, Albedo</p> <ul style="list-style-type: none"> <li>- Have students work in pairs to discuss how to add the additional words to their concept maps</li> </ul>	<p>INDIVIDUAL SEAT WORK OR PAIR WORK</p> <p>See 2.1.3 Energy Budget Slides #20</p>
HW	<p>Conceptual Questions on Energy Budget</p> <ul style="list-style-type: none"> <li>- Select a few problems for students to complete on their own.</li> </ul>	<p>See 2.1.5 Conceptual Problems</p>

Day 2		
3 min	BW: We know that if the Sun kept inputting energy and it didn't go anywhere, then we would eventually be fried. What do you think happens to this energy? Why don't we all burn up?	INDIVIDUAL SEAT WORK See 2.2.1 Energy Budget Slides #2
4 min	Review energy budget and variables	DISCUSSION/PRESENTATION See 2.2.1 Energy Budget Slides #3-5 See 2.2.2 Student Notes
20 min	Energy Output Model - Building understanding of outgoing radiation - Temperature – What did you observe? - Sun and Earth outgoing wavelengths - Atmosphere and Greenhouse gases	DISCUSSION/PRESENTATION See 2.2.1 Energy Budget Slides #6-17 See 2.2.2 Student Notes rope for wave length demonstration
25 min	Dynamic Energy Balance - This can be an activity or demonstration. - This provides direct experience of how changes to a system can alter the existing dynamic balance. - Refer to Bell Work. Talk about losing energy and ask for examples of analogies of this.	ACTIVITY/DEMONSTRATION See 2.2.2 for Dynamic Balance Activity
3 min	Concept Map Additions: Longwave radiation, short wave radiation	INDIVIDUAL WORK See 2.2.1 Energy Budget Slides #21
HW	Write 2 paragraphs describing what happens to the flow of energy into the Earth system. Use given image as a guide.	Homework 2.2.4

# LP 3

# Greenhouse Gases

# of Days	3		
Prior Knowledge	Students will have heard of greenhouse gases. They probably will know very little about energy balance.	California English-Language Arts Content Standards	Reading 2.5 Listening and Speaking 1.1, 2.2 (b,c)
Lesson Objective	Students will be able to identify greenhouse gases and their sources and apply the properties of these gases and radiative forcing to model Earth's energy budget.	Language Goals/Demands	
Lesson Assessment	Concept map on days 2-3, formative - connection of sources and sinks, Lab activity	Changes for Next Time	
California State Science Standards	Earth Science 4.c, 4.d, 6.a, 7.b, 8.b; Investigation 1 a, b, c, d, and k		
Materials Needed	Powerpoint, Materials for greenhouse gas effect activity; Resonance models with tennis balls, etc.; Gas Files Activity	What Worked Well	
Time	Learning Task or Activity	Method & Notes	
<b>Day 1</b>			
3 min	BW: Study for the Quiz over LP 1 & 2 - Check HW problems on the overhead	INDIVIDUAL SEAT WORK	
15 min	Quiz	INDIVIDUAL SEAT WORK 3.1.2 QUIZ	
7 minutes	What do you already know? What are the greenhouse gases? Where do they come from? How do they work?	KWL Chart See 3.1.3 Greenhouse Gases Slides #2 Activating prior knowledge. Before naming the greenhouse gases ask what students already know.	
10 minutes	Greenhouse Gas Presentation - If the amount of energy that comes in is the same amount of energy that goes out, how can our planet stay warm? - The answer is greenhouse gases. - Show pictures of a greenhouse and describe their properties. OR show this 6 minute video that is quite entertaining <a href="http://www.youtube.com/watch?v=AIBk0pGV_BQ">http://www.youtube.com/watch?v=AIBk0pGV_BQ</a>	LECTURE/DISCUSSION See 3.1.3 Greenhouse Gases Slides #3-5 Use 3.1.4 Student Notes Handout Students should use the notetaking page 3.1.4 to record notes during the lecture. There are also a few questions on the back to use during the resonance model activity or demonstration.	

17 min	<p>Resonance Model Demonstration</p> <ul style="list-style-type: none"> <li>- Show students different models of gas compounds and how they resonate. Have students connect the different wavelengths with resonance. What would happen without greenhouse gases? Goldilocks slide.</li> <li>Use this website to show different resonance patterns of vibrations <a href="http://chemtube3d.com/vibrationsCO2.htm">http://chemtube3d.com/vibrationsCO2.htm</a></li> </ul>	<p>LECTURE/DEMONSTRATION</p> <p>See 3.1.3 Greenhouse Gases Slides #6-9</p> <p>Show the types of gases in our atmosphere and what the temperature of the earth would be without GHGs.</p> <p>DEMONSTRATION - Follow notes on 3.1.4 Collect data with different groups on the board or any way you want. 3.1.4a Task Card for student investigation</p> <p>3.1.5 RESONANCE MODEL MAKING (Optional) students make their own models- will take an entire class period</p> <p>3.1.6 GOLDILOCKS ACTIVITY (Optional) Creation of atmospheric bean models to compare Earth, Mars and Venus</p>
3 min + HW	<p>Preparation for Greenhouse Gas Lab Activity</p> <ul style="list-style-type: none"> <li>- Students will think about and prepare for the lab activity</li> </ul>	3.1.7 HOMEWORK
<b>Day 2</b>		
3 min	<p>BW: What would happen if there were no greenhouse gases? Review your lab set up for today's lab.</p>	INDIVIDUAL SEAT WORK
35 min	<p>The Greenhouse Gas Effect Activity</p> <ul style="list-style-type: none"> <li>-Either students test their experimental design (inquiry-based) or they all follow the same procedures (written directions).</li> <li>-Students should work in groups to set up their labs. They might have different set ups and results if doing their own design. If they are successful at trapping CO<sub>2</sub> they should see a change in temperature between the two bottles.</li> </ul>	<p>HANDS-ON LAB</p> <p>See 3.2.1a Greenhouse Gas Lab – Inquiry, self guided</p> <p>OR 3.2.1b Greenhouse Gas Lab – specific directions</p> <p>Students will need some time to discuss their experimental set up and to decide on a plan as groups. They will need about 20 minutes to collect data.</p>
7 min	<p>Debrief Lab and Discussion</p> <ul style="list-style-type: none"> <li>- Debrief the lab, discuss the greenhouse effect and how the gas in the atmosphere does cause an increase in temperature.</li> </ul>	<p>DISCUSSION/LECTURE/Q&amp;A</p> <p>See 3.1.3 Greenhouse Gases Slides #10-11</p>
5 min	<p>Energy Balance Diagram or Review of Resonance</p> <ul style="list-style-type: none"> <li>- Teachers and students will step through the different parts of the energy balance diagrams with students providing explanations for each of the arrows</li> </ul>	<p>DISCUSSION/LECTURE/Q&amp;A</p> <p>See 3.1.3 Greenhouse Gases Slides #12 or 13</p> <p>Either review resonance or review the more complicated energy balance as a wrap up for the lab. This is a complicated model of the greenhouse gases and the energy balance. Use it to step through the process and</p>

5 min	<p>Concept Map</p> <ul style="list-style-type: none"> <li>- Students will add to the concept map they started on the first day. Hand out the new words to be added.</li> </ul>	<p>INDIVIDUAL SEAT WORK</p> <p>Use 3.2.2 Concept Map Homework</p>
HW	Work on concept map	
<b>Day 3</b>		
3 min	<p>BW: What do you think are the sources of greenhouse gases?</p>	INDIVIDUAL SEAT WORK, Check Concept Map
7 min	<p>Introduction to today's activity: Sources and Sinks - Thought question about bathtub.</p> <ul style="list-style-type: none"> <li>- Refer back to the Dynamic Balance Model in LP2, yet the water is represents carbon here, rather than energy in the Energy Budget unit.</li> </ul>	<p>THINK/PAIR/SHARE</p> <p>Use 3.3.1 Bathtub Thoughts Handout</p> <p>WHOLE CLASS DISCUSSION</p>
25 min	<p>Gas Files Activity</p> <ul style="list-style-type: none"> <li>- Students look at data and graphs to determine the quantities and sources of the different greenhouse gases</li> <li>- Examples will deal with CO<sub>2</sub>, methane, nitrous oxide, and water vapor</li> </ul>	<p>GROUP WORK</p> <p>Use 3.3.2 Gas Files Activity</p>
15 min	<p>Mitigation Strategies</p> <ul style="list-style-type: none"> <li>- Students now need to start to make the connection between carbon dioxide and reducing carbon emissions (mitigation)</li> <li>- Show the wedge diagram that will be used with the final assessment showing increases in carbon dioxide</li> <li>- Talk about three or four wedges - ways to mitigate more carbon emissions</li> </ul>	<p>LECTURE</p> <p>See 3.3.3 Mitigation Strategies Slides</p> <p>See 3.3.5 Pictures of Power Plants - OPTIONAL</p>
HW	<p>Concept Map</p> <ul style="list-style-type: none"> <li>- Students will add to the concept map they started on the first day. Hand out the new words they should add to their maps.</li> </ul>	<p>HOMEWORK</p> <p>Use 3.3.4 Concept Map Homework</p>

# LP 4

# Impacts of Climate Change on Physical Systems

# of Days	2		
Prior Knowledge	Depending on students' backgrounds they may or may not be able to identify dependent and independent variables. If students struggle with reading easy graphs, they may need more scaffolding prior to the Stations activity.	California English-Language Arts Content Standards	Reading 2.5 Writing 2.3.b, c Listening and Speaking 1.1, 2.0.b, c
Lesson Objective	Students will analyze the sources for climate data and will analyze this data to identify the impact of climate change on physical systems.	Language Goals/Demands	Students will be able to describe the impacts of climate change on the physical system and justify claims with evidence.
Lesson Assessment	Quiz over using data to make conclusions & mitigation strategies	Changes for Next Time	
California State Science Standard	Earth Science 1.c, 4.a, 4.b, 4.c, 6.a, 6.c, 6.d, 8.b; Investigation 1.a, 1.d, 1.m		
Materials Needed	Graphs and Questions for each station; Graphs for Causes; Powerpoint slides for Ice Core Explanations, Mitigation Powerpoint	What Worked Well	
Time	Learning Task or Activity	Method & Notes	
<b>Day 1</b>			
3 min	BW: Some scientists collect data from tens of thousands of years ago. How do you think scientists can know what happened so far in the past? Discuss your ideas with a partner	Pair Work	
20 min	Data Collection Instrumentation - Show students slide #2 pointing out that the data goes back 100,000 years. - Ask for student input about how data is collected especially from periods long ago. (Talk about thermometers, satellites, etc. and introduce ice cores if students don't suggest this) - Pass out Student Guide for use during this segment	<b>WHOLE CLASS DISCUSSION/ANALYSIS</b> See Slides 4.1.1 for Ice Core Slides See 4.1.1 for Ice Core Slides and Notes See 4.1.2 for Ice Core Guiding Questions  If you have access to streaming video, you may replace the slide show and data analysis with the KQED video (20 minutes) on ice cores found at: <a href="http://www.kqed.org/quest/television/web-extra-at-the-core-of-climate-change">http://www.kqed.org/quest/television/web-extra-at-the-core-of-climate-change</a>	

7 min	<p>Mitigation Introduction</p> <ul style="list-style-type: none"> <li>- We have talked about the presence of GHG's and how we detect them, how do you think we can limit them? We will be talking about this at different points over the next few lessons.</li> <li>- Have the chalkboard divided into four parts. Assign student pairs to one sector and have them discuss for four or five minutes how we might be able to decrease or "mitigate" GHG emission in these sectors. Have students write ideas on the board under the proper heading</li> </ul> <p>Possible Sectors: Transportation, Heating &amp; Cooling Buildings, Industry emissions, Electricity Use</p>	<p>PAIR WORK</p> <p>See Slides 4.1.3, # 1-3 to introduce the activity</p>
12 min	<p>Mitigation Presentation</p> <ul style="list-style-type: none"> <li>- Present slides on four or five of the wedge strategies that students will use for the summative assessment</li> </ul>	<p>LECTURE/SLIDES</p> <p>See Slides 4.1.3 for Mitigation Strategies</p> <p>See Teacher Guide 4.1.3 for copies of mitigation strategies and notes</p>
HW	<p>Concept Maps - Add the following terms and relationships to your Concept Map:</p> <p>Sea Level Rise, Glacial Cover, Ice Cores</p>	<p>HOMEWORK SLIDE</p> <p>See 4.1.3 #8 for homework slide</p>
<b>Day 2</b>		
3 min	<p>BW: What parts of Earth's systems do you think are changing due to increased greenhouse gases? Try and think of two or three possibilities.</p>	<p>INDIVIDUAL SEAT WORK</p>
5 min	<p>Introduction to Stations</p> <ul style="list-style-type: none"> <li>- Humans are responsible for significant increased carbon emissions that have an impact on physical and biological systems. Today we are going to look at evidence to make claims about the impact of increased emissions on the <u>physical world</u>. You will be divided into groups and rotate through four stations. Each station has the instructions and task cards. You will record your answers on the student handout.</li> <li>- Divide up students into four groups</li> </ul>	<p>TEACHER-LED INSTRUCTIONS</p> <p>See 4.2.1 for Station Resource Cards</p> <p>See 4.2.2 for Station Task Cards</p> <p>See 4.2.3 for Student Prompts for the Station Activity</p>

8 min	Station 1: Long-term Temperature Graphs Station 2: Long-term Sea Level Rise Graphs Station 3: Long-term Snow Cover Graphs Station 4: Severe Weather Frequency Graphs	GROUP WORK
8 min	Station 2:	GROUP WORK
8 min	Station 3:	GROUP WORK
8 min	Station 4:	GROUP WORK
10 min	Group Processing/Station Debrief - What claims can be made about climate change? - What is the evidence that climate is changing? What is the impact on physical systems? (Remind students to support their statements with data from the previous day's stations). - Is this evidence convincing?	TEACHER-LED DISCUSSION See 4.2.4 for Discussion Slides
HW	Write a paragraph summarizing the impact of climate change on the physical system. You should mention how confident you feel in the data that supports these claims.	

**LP 5****Consequences on Biological Systems & Adaptation**

# of Days	3		
Prior Knowledge		California English-Language Arts Content Standards	Reading 2.0, 2.5 Listening and Speaking 1.3, 2.5
Lesson Objective	Students will analyze data to determine the consequences of climate change on environmental, biological, human, and social systems and identify adaptation strategies for these consequences.	Language Goals/Demands	Make sure students understand meaning of adaptation, system, biological, environmental, and social, density, displacement
Lesson Assessment	Students will generate and share adaptation strategies for dealing with the impact of climate change on biological systems	Changes for Next Time	
California State Science Standard	Biology 6.b, 6.g; Earth Science 6.b.; Investigation 1.a, 1.d, 1.m		
Materials Needed	LP 4 Quiz; Materials for sea level activity - clear containers, cubes of ice, clay, rulers; materials (data and graphs) for stations	What Worked Well	
Time	Learning Task or Activity	Method & Notes	
<b>Day 1</b>			
3 min	BW: Make a list of positive and negative impacts of climate change	INDIVIDUAL SEAT WORK (5.1.1)	
5 min	Discuss Bellwork - Ask students to share different consequences for humans or the environment - End by talking about sea level rise as an important consequence for coastal areas like the Bay Area. - Also remind students of ALBEDO: different materials/surfaces have different level of reflectivity.	LECTURE/DISCUSSION See 5.1.1 Consequences Slides	
10 min	Begin Sea Level Activity - Students will set up Sea Level Activity (in small groups) and record initial observation of water level (outside if possible)	HANDS-ON ACTIVITY See 5.1.4 Sea Level Activity Instructions and Datasheet Students set up activity using task card.	

15 min	Quiz over LP 4	INDIVIDUAL SEAT WORK Use 5.1.2 LP4 Quiz and Key Make second observation of ice after quiz
20 min	Sea Level Activity Continued - Have students make 2 more observations (at 20 and 30 min) -Teacher lead discussion (based on preliminary observations). What has occurred? What is different? What is the same between the two conditions? What are the scientific principles behind this phenomena? - Students make final observations (measure water level)	HANDS-ON ACTIVITY CONTINUED See 5.1.3 Ice Activity Instructions and Datasheet.doc Students check every 10 minutes, recording results on table. Have students work with groups to discuss and answer questions. Conclude with a whole group discussion.
HW	Homework What are some of the factors that contribute to sea level rise? What areas will be most affected?	
<b>Day 2</b>		
2 min	BW: We recently looked at graphs of sea level rise. If this pattern continues, what parts of the Bay Area will be affected?	INDIVIDUAL SEATWORK
5 min	Introduction to idea of Adaptation: We've looked at some of the impacts of climate change, one example is sea level rise. What are some things we can do to prevent more damage from climate change? The changes and adjustments we make are "adaptations".	DISCUSSION Review mitigation (introduced in earlier lessons). Introduce idea of adaptation. Create a KWL (what we KNOW, what we WANT to know, and what we LEARNED (this column is filled in later)) about adaptation.
10 min	We've talked about Physical systems (past lessons, now we're going to look at the IMPACT OF CLIMATE CHANGE ON BIOLOGICAL SYSTEMS) Station 1: Ecosystems Station 2: Agriculture Station 3: Fire on Wildlands Station 4: Global Health and Disease	GROUP WORK Students will rotate between 4 stations. Each station will have data, pictures, and graphs showing the consequences of climate change on each topic. Students have a list of questions about adaptations. Use 5.2.1 Sample Evidence Claim Use 5.2.2 Station Task Cards Use 5.2.3 Student Questions Use 5.2.4 Station Graphs Biological Systems
10 min	Station 2	GROUP WORK
10 min	Station 3	GROUP WORK
10 min	Station 4	GROUP WORK

4 min	Closure Question: What do you think will be the easiest consequence to deal with? What do you think will be the most difficult consequence to adapt to as an individual? As a society?	DISCUSSION
HW	Based on what we've learned so far, what are some ways that climate change might affect the community where you live?	
<b>Day 3</b>		
2 min	BW: List one way that climate change impacts a) agriculture b) ecosystems and c) weather and d) health and disease	INDIVIDUAL SEATWORK
10 min	Differences between mitigation and adaptation - Review definition - Students discuss in pairs - Fill in KWL chart	GROUP DISCUSSION See 5.3.1 Adaptation Resources See 5.3.2 Mitigation and Adaptation Slides
15 min	The Great Discussion Prep: Students will work in groups, pulling together the various activities, data, and information they have learned over the course of the Climate Change Unit. Due to resources only ONE area of impact can be addressed. You will be assigned one of the four topics from the stations. Why should your topic be the one area addressed? Give examples and evidence to support your position. (including feasible and practical mitigations and adaptations)	GROUP WORK Teacher will assign each group an area of impact: ecosystem, agriculture, severe weather, or health.
25 min	The Great Discussion Presentations	STUDENT GROUP PRESENTATION Discussion format: teacher's choice

# LP 6

# Science Consensus and the Climate Change Debate

# of Days	2		
Prior Knowledge	Students will have attained a basic level of the science behind global warming. Students will also likely have been exposed to elements of the global warming debate through various media sources.	California English-Language Arts Content Standards	Reading 2.8 Listening and Speaking 1.11, 1.12, 1.13
Lesson Objective	Students will be able to identify elements of scientific consensus making and analyze debates about the validity of global warming claims.	Language Goals/Demands	Teachers must be prepared to moderate discussions and arguments that may have deep seeded values based on political, religious, or social identities
Lesson Assessment		Changes for Next Time	
California State Science Standard	Investigation 1.I, 1.m		
Materials Needed	Video Projector, Laptop or Computer with Connection to Internet	What Worked Well	
Time	Student Learning Task or Activity	Teacher METHOD or Activity	
<b>Day 1</b>			
25 minutes	Preponderance of Evidence Activity - Students should be divided into groups. There are 10 different cards. Students will review the cards for their group, discuss the evidence, and then listen/give presentations and take notes on all the other evidence.	GROUPWORK 6.1.1 Preponderance of Evidence.ppt (to use as resource cards) 6.1.2 Preponderance of Evidence Activity Card 6.1.3 Preponderance of Evidence Graphic Organizer Pkia Video at <a href="http://www.youtube.com/watch?v=QVJuRgil0wQ">http://www.youtube.com/watch?v=QVJuRgil0wQ</a> or search for dam cute pika	
15 minutes	A Process of Science - Teacher presents and discusses the process of science, scientific consensus, science in policy, and political interference in science.	PRESENTATION 6.1.4 Process Science Slides	
5 minutes	Video of Commercial on Carbon Dioxide - Teacher plays video without much of an introduction. After viewing the video, the teacher asks for initial impressions.	VIDEO Play 6.1.5 Video clip for RealPlayer <a href="http://www.factcheck.org/article395.html">http://www.factcheck.org/article395.html</a> has the video as a download <a href="http://www.youtube.com/watch?v=7sGKvDNdJNA&amp;feature=player_embedded">http://www.youtube.com/watch?v=7sGKvDNdJNA&amp;feature=player_</a> dded	

10 minutes	Students work in groups to analyze the commercial using the transcript and questions on task card.	GROUP WORK See 6.1.6 Transcript of commercial Use 6.1.7 Task card for student analysis
<b>Day 2</b>		
3 min	Bellwork: Perhaps you have heard debates about global warming. Write down different arguments that you have heard in the media about global warming.	INDIVIDUAL SEAT WORK
5 min	Teacher-led Discussion What are some of the major debates over global warming that you wrote down for bellwork? - Have students share what they have heard and where they have heard it. Write some of these ideas on the board and note the sources - Tell students that they will be watching segments from a video called "The Global Warming Swindle". On their handout, they will be asked to write down some of the major arguments that the video makes. They can also write notes about what they think about the argument to the side as they will be talking about these in groups after the video.	TEACHER-LED DISCUSSION
20 min	Watch Global Warming Swindle Parts 1 & 2 - Use the note guide to write down the major arguments that the movie makes	WATCH VIDEO Student Handout 6.2.1: Video Guide Part 1 Link: <a href="http://www.youtube.com/watch?v=6TqqWJugXzs">http://www.youtube.com/watch?v=6TqqWJugXzs</a> Part 2 Link: <a href="http://www.youtube.com/watch?v=L5rGpDMN8lw&amp;NR=1">http://www.youtube.com/watch?v=L5rGpDMN8lw&amp;NR=1</a>
8 min	Teacher-led Discussion - Based on your note guide, what are some of the major arguments that the film makes? - What are their sources of evidence? - What is your response to these claims?	TEACHER-LED DISCUSSION
14 min	Watch the Global Warming Debate Rebuttal	WATCH VIDEO Part 1 Link: <a href="http://www.youtube.com/watch?v=lljGynF4qkE&amp;feature=related">http://www.youtube.com/watch?v=lljGynF4qkE&amp;feature=related</a> Part 2 Link (only need to watch first few minutes): <a href="http://www.youtube.com/watch?v=goDsc9laSQ8&amp;feature=related">http://www.youtube.com/watch?v=goDsc9laSQ8&amp;feature=related</a>

6 min	Class Discussion How did both of the films use evidence? What kind of experts can you trust? What must you think about when viewing media critically about climate change?	TEACHER-LED DISCUSSION
HW	Read strategy wedge table to prepare for mitigation wedge activity	7.1.4 Wedge Strategies Table

# LP 7

# Climate Change Mitigation

# of Days	4		
Prior Knowledge		California English-Language Arts Content Standards	Reading 2.4 Writing 1.2, 1.4
Lesson Objective	Students will be able to compare and contrast climate change mitigation strategies (macro and micro) in light of environmental, economic, political, and ethical impact.	Language Goals/Demands	Some expert groups may receive more than 3 wedge strategies or some home groups may have more than one individual from an expert group.
Lesson Assessment	Mitigation Performance Assessment: Group & Individual Products	Changes for Next Time	
California State Science Standard			
Materials Needed	Mitigation Diagram, Wedge Activity Packets including task cards, resource cards, and graphic organizers. Individual assessment prompt	What Worked Well	
Time	Learning Task or Activity	Method & Notes	
<b>Day 1</b>			
15 min	Mitigation Strategies Introduction - Define & illustrate mitigation wedges using diagrams - Introduce the activity goals and procedures	LECTURE See in 7.1.0 Mitigation Wedge Images	
35 min	Expert Group Jigsaw - Students analyze 3-4 strategies to take back to their groups.	GROUP WORK Use 7.1.1 Expert Groups Task Card #1 Use 7.1.2 Graphic Organizer Use 7.1.3 Resource Cards Use 7.1.4 Wedge Strategies Table	
HW	Students review their organize to present to their home groups tomorrow		
<b>Day 2</b>			
25 min	Home Group Sharing - Experts divide into their home groups and give an overview from their graphic organizer about their particular strategies	GROUP WORK	

25 min	Home Group Discussion - Home groups choose 10 strategies based on the given parameters. - Students discuss the rationale of picking specific strategies.	GROUP WORK Use 7.2.1 Home Group Assignment (Task Card #2) Use 7.2.2Band 7.2.2A Mitigation Wedge Pieces Use 7.2.3 Mitigation Plan Worksheet
<b>Day 3</b>		
15 min	Home Group Wedges Finalization - Groups label the wedge strategies on their workseet that will be turned in and check over their group summary sheet	GROUP WORK - Have extra worksheets available in case students need a blank sheet
35 min	Mitigation Plan Analysis - Teacher models how to analyze the perspective of a 'teacher' with the transportation conservation strategy. (Use 7.3.2) - Students analyze their choices in light of two different perspectives on the Mitigation Plan Group Analysis.	GROUP WORK Use 7.3.1 Mitigation Plan Group Analysis See 7.3.2 Mitigation Plan Answers - Groups should turn in a consensus analysis of their plan by the end of the period.
<b>Day 4</b>		
20 min	Class Discussion of Plans - Ask different groups to talk about how one wedge they chose affected one of the perspectives in each of the categories.	TEACHER-LED DISCUSSION
30 min	Individual Assessment - Given a standard mitigation plan, students will analyze the plan's consequences from two perspectives.	SUMMATIVE ASSESSMENT Use 7.4 Mitigation Plan Individual Analysis