

Teacher's Guide For California's Climate Change Impacts

For grade 7 - College

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MATERIALS IN THE PROGRAM

Teacher's Guide -This Teacher's Guide has been prepared to aid the teacher in utilizing materials contained within the *California's Climate Change Impacts* program. In addition to this introductory material, the guide contains the following for each program:

- *Suggested Instructional Notes*
- *Student Learning Goals*
- *Blackline Masters Quiz for duplication and handout to students*
- *Timeline of Events for California*
- *Timeline of Events for Climate Change*
- *Maps & Graphics*

INSTRUCTIONAL NOTES

It is suggested that you preview the individual program or programs that you will be teaching and read the Student Goals and Teacher Points. By doing so, you will become familiar with the materials and be better prepared to adapt the program to the needs of your class. Please note that *California's Climate Change Impacts* is set up to be played continuously and you will probably find it best to follow the program in the order in which it is presented, but this is not necessary. The program can be divided into chapters accessed through the DVD's Menu Screen under Chapter Selects. In this way each of the program's chapters can be played and studied separately. A proposed Lesson Plan based on chapter headings accessed through the DVD menu screen can be found with the program presented in this Teacher's Guide. It is also suggested that the program presentation take place before the entire class and under your direction. As you review the instructional program outlined in the Teacher's Guide, you may find it necessary to make some changes, deletions, or additions to fit the specific needs of your students. After viewing each program, you may wish to copy the **Blackline Master Quiz** and distribute it to your class to measure students' comprehension of the events.

LINKS TO CURRICULUM STANDARDS

The design for *California's Climate Change Impacts* was guided by the National Science Educations Standards, Content Standard D – Structure of the Earth system, Earth's history, Earth in the solar system; and the McRel K-12 Science Standards and Benchmarks, Grades 5-8) and 9-12).

INTRODUCTION AND SUMMARY OF CALIFORNIA'S CLIMATE CHANGE IMPACTS

California's Climate Change Impacts is a new approach to presenting the impact of climate change on California. The program is designed to present *California's Climate*

Change Impacts in a way that promotes successful student learning. The program begins with an overview of global warming and how global warming affects California's Mediterranean climate as well as its terrestrial and oceanic ecosystems. The program then investigates the impact of climate change and sea level rise on California's coastal cities and infrastructure; how climate change will affect the availability of fresh water for California's agriculture, industry and people; the impact of climate change on fires in California's forest and chaparral ecosystems; and finally, the program ends with the plans California has to mitigate the impact of climate change in the future.

Student learning Goals - In this *California's Climate Change Impacts* students will learn:

- California's 37 million people are running out of water
- Californians are running out of water because with global warming there is less fresh water stored in the state's mountain reservoirs for use by Californians
- The direct impact climate change is having on California's water supply
- What Climate change, or global warming is and what is causing it
- The impact of global warming on California's terrestrial and oceanic ecosystems
- How sea level rise caused by global warming will affect California's coastal cities
- How global warming will affect the supply of fresh water for people, agriculture, industry and wildlife
- With less water the impact of fires will be greater
- What California is doing to mitigate the impact of global warming

SUGGESTED LESSON PLAN

California's Climate Change Impacts is laid out so that the program can be viewed in its entirety, or by selecting the DVD Menu Screen, Chapter Selects, individual chapters can be viewed separately to create a lesson plan. Each chapter presents an in depth look at climate change and its impact on California.

Below is a list of the program's chapters. Using these chapters, teachers can create a lesson plan to cover the specific issues, themes and the historical figures mentioned.

California's Climate Change Impacts

- Open
- Introduction to Climate Change
- California's Terrestrial Ecosystems and Climate Change
- California's Oceanic Ecosystems and Climate Change
- Sea Level Rise
- California's Fresh Water Problems
- Fire
- The Future

Chapter One: Open

Student Goals - In this *California's Climate Change Impacts* chapter the students will learn:

- The people of California are running out of water
- Water is used for drinking, farming, industry and city services
- California's water comes from the Sierra Nevada Mountains and the Rocky Mountains
- Climate change is causing California's water shortage
- California is leading the way on the climate change issue
- California is at the front line for the problems caused by climate change
- California's snow packs are more vulnerable than most in the country to climate change problems

Chapter Two: Introduction to Climate Change

Student Goals - In this *California's Climate Change Impacts* chapter the students will learn:

- In the 1980s climate scientists began noticing that the world was warming up
 - Humans were causing the average global temperature to rise
 - In the 19th century, people in Europe and North America found new cheap sources of energy in coal and oil
 - This cheap source of energy unleashed the industrial age, which in turn created a global economy with 6.7 billion people dependent on cheap fossil fuels
- The unintended consequence of burning all these fossil fuels put huge amounts of the greenhouse gas carbon dioxide into the atmosphere
- CO₂ keeps the Earth from freezing and makes life possible
- However, too much CO₂ from burning all those fossil fuels is warming the planet near the surface and will continue to do so for many centuries
- The most dramatic effect of this general warming is a change in weather extremes
 - Some areas are experiencing longer and more intense droughts
 - For other areas winter is shrinking
 - Other regions feel the effects of more intense storms
 - California is having longer and more frequent heat waves
- Because of its Mediterranean climate, California's climate change impacts and adaptation strategies are unique

Chapter Three: California's Terrestrial Ecosystems and Climate Change

Student Goals - In this *California's Climate Change Impacts* chapter the students will learn:

- Of all the climate types in the world, the rarest is the Mediterranean climate
- California is one of the regions that has a Mediterranean climate
- A climate is defined as long-term patterns of temperature and precipitation over the four seasons
- Ecosystems are adapted to climates
- California's redwood forests are uniquely adapted to its coastal Mediterranean climate

- A climate that can be described as hot and dry in the summer, with very little rainfall and cool and wet in the winter
- California's Mediterranean climate has changed
 - A gradual rise in temperature with small changes in overall precipitation, but with wild precipitation changes from year to year
- California is at a border between the northern areas that get the Pacific Northwest storms and Mexico, which gets kind of tropical storms
- California will get a lot more variation in weather
 - Some years will see northern storms with intense cold and lots of rain
 - Some years will have warmer southern storms
- These changes are predicted to have dramatic impacts on the state's unique, geographically isolated ecosystems, called pocket ecosystems
 - One of the more interesting results of global warming in California's Mediterranean climate is taking place in the redwood forests
 - The redwood trees have been growing faster in the last couple decades than they have in their history
 - Some of California's unique pocket ecosystems will probably disappear as the climate continues to warm
- This continual warming is not only being felt on land, but it is also occurring in California's coastal waters

Chapter Four: California's Oceanic Ecosystems and Climate Change

Student Goals - In this *California's Climate Change Impacts* chapter the students will learn:

- The warming of the ocean has been hard to track because of periodic oceanic phenomena like el Nino and Pacific Decadal Oscillation, which sees temperature shifts over tens of years
- California's coastal waters are slowly warming, causing changes
 - There are now more warm water fishes up here
 - In 2005, not one of a half a million Cassins auklets on the Farallon Islands off San Francisco raised a chick
- As the oceanic waters continue to warm, California's fisheries might collapse
- What will happen to California's oceanic and intertidal ecosystem is a great unknown
- What is needed is more research and better climate impact models
- Another factor that is already having an effect on those coastal ecosystems is sea level rise
 - Sea level rise is a direct result of global warming

Chapter Five: Sea Level Rise

Student Goals - In this *California's Climate Change Impacts* chapter the students will learn:

- Currently the Antarctic ice sheet and the Greenland Ice Sheet contain the world's reservoir of frozen water
- These great ice sheets are rapidly melting and dumping fresh water into the ocean
- The result is that sea level rises across the planet
- For California, with 1300 miles of coastline, impacts of sea level rise will be dangerous because most of its 37 million people live along its coastline
- Already the sea level rise is affecting the wetlands along the coast
- From Humboldt Bay down all the way to the Mexican border, there has been documented a gradual and significant sea level rising
- In the San Diego and Los Angeles basin areas, sea level rise is predicted to have dramatic effects
- More areas are going to be uninhabitable
- Storm surges in the San Francisco Bay present the possibility of a hurricane Katrina type disaster
- The biggest challenge confronting Californians with global warming is the state's diminishing freshwater supply

Chapter Six: California's Fresh Water Problems

Student Goals - In this *California's Climate Change Impacts* chapter the students will learn:

- California's need for fresh water is enormous
 - The state uses it for irrigation in Northern, Central and southern areas of the state
 - People also need fresh water for drinking and municipal services for homes and industry
- This water come from the snow packs of the Cascade Mountains in the north and the Sierra Nevada Mountains to the east
- These mountains accumulate snow in the wet winter season and, as the snow melts, slowly release water into the Sacramento and San Joaquin River systems
- Along the course of these rivers are reservoirs that store water to be released and used during California's long dry summers
- As winter shrinks, as a result of global warming, so does the snowpack so there is less water stored for use
 - For about a 1 ½ degree Celsius warming, on average of the air temperature, California loses about a third of its total snow pack
- Climate change causes great fluctuations in the amount of precipitation from year to year with great impacts in the north of the state
- More of the precipitation is falling as rain as opposed to water falling as snow, which sticks up in the mountains
 - The mountains act like a freezer or refrigerator storing that water throughout the winter and then melting it off in the late spring/early summer, when California needs that water the most
 - New strategies are needed for controlling the water flow from the mountains to the crops and people downstream

- The overall effect is less water for the competing needs of agriculture, people and wildlife
- Competition for water is even more intense to the south
 - The Los Angeles urban center gets half of its water from the Sierras, and the other half comes via canal from the Colorado River
 - Agriculture in the Imperial Valley depends exclusively on water from the Colorado River
- Reservoirs along the Colorado River are running dry
- More water is drawn off every year than is replenished
- The replenishment will only diminish as the snowpack in the Rockies declines
- The people of California will have to figure out how to divide up less water or take drastic measures affecting agriculture and populations

Chapter Seven: Fire

Student Goals - In this *California's Climate Change Impacts* chapter the students will learn:

- Fire frequency and size of fires are expected to increase in California as its climate warms
- The first reason for this change is that across the state the fire season is lengthening
- The forest ecosystems were managed for total fire prevention and this has led to a great accumulation of dry undergrowth
- The consequences are more intense and faster fires that are harder to contain
- The second change in fire events occurs in California's scrub chaparral ecosystems
- The pattern of wet years followed by drought years produces tinderbox conditions during the dry years
- Small fires driven by the powerful Santa Ana winds lead to explosive fire events
- California is leading the way in planning for climate

Chapter Eight: The Future

Student Goals - In this *California's Climate Change Impacts* chapter the students will learn:

- California is setting the standard for dealing with climate change in reducing the state's carbon footprint
- It's promoting the idea of cap and trade for CO₂ emissions and reductions
- It has enacted laws forcing carmakers to make more fuel-efficient cars
- It is creating renewable energy sources
- The future of the United States is going to depend a lot on what role California plays in the development and implementation of this new technology

Answers to Blackline Master 1A Quiz

1 – a, b, c; 2 – a; 3 – c; 4 – a; 5 – b; 6 – a; 7 – b; 8 – d; 9 – a; 10 – c; 11 – a; 12 - b