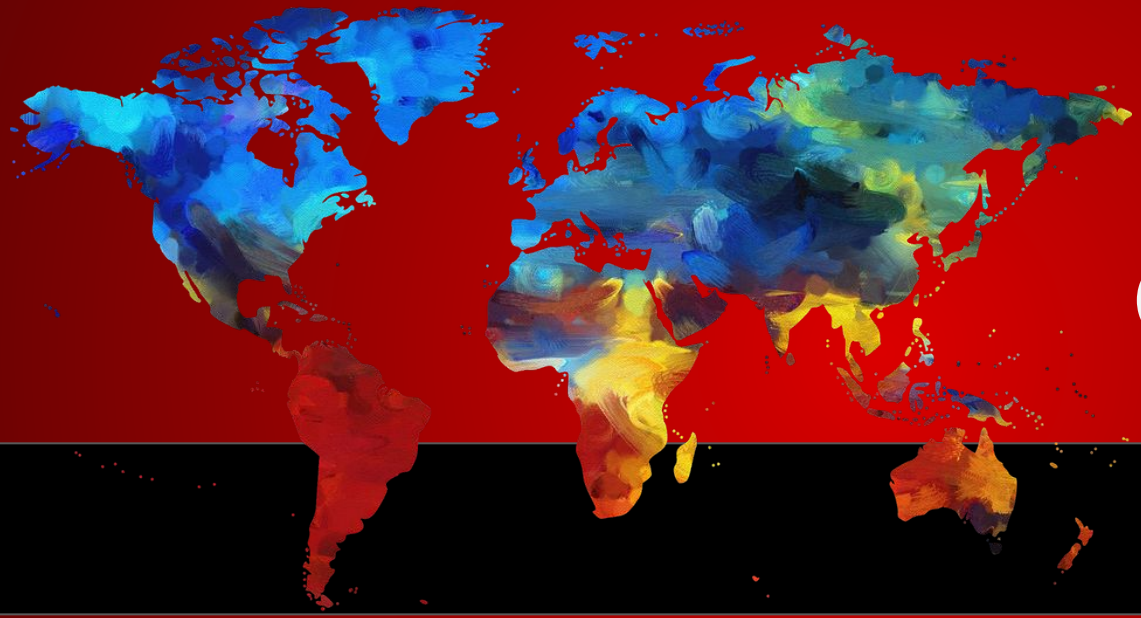


Climate Change

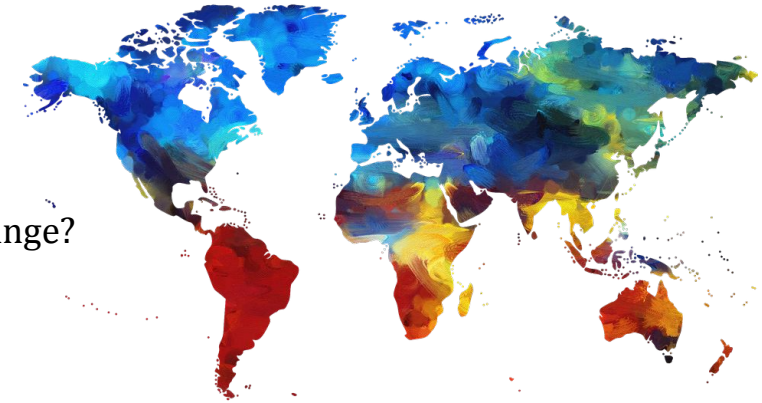
...a hot topic

Created by Angela Trent

Goals

- Students will understand the causes and effects of climate change.
- They will understand the difference between mitigation and adaptation strategies for climate change.
- They will be able to apply adaptation strategies to real-world climate change scenarios.

Objectives



1. **Key topic - Climate Change**
2. **Essential Questions**
   - **a.** What are the effects of rising global temperatures?
   - **b.** What should humans do in response to climate change?
3. **Students Will Be Able To**
   - a. Evaluate real-world effects of climate change.
   - b. Identify and explain adaptation strategies in different regions.
4. **Long Term Application**

   Students will have the background knowledge required to understand future discussions, articles, news reports, etc. about climate change.

Standards

National Geography Standards *Geography for Life*:

Environment and Society - Geography Standards 14-16

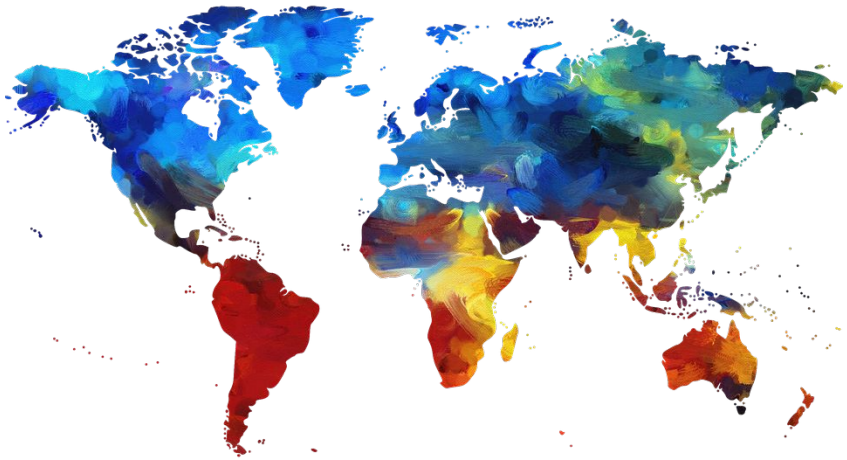
Oklahoma Academic Standards for the Social Studies:

<u>Grades 6 and 7 World Geography</u>

- Content Standard 4.2 - Explain how climate change is affecting environments and human populations
- Content Standard 4.6 - Describe the role of citizens as responsible stewards of natural resources

Geographic Themes and Essential Elements:

Human-Environment Interaction



Procedures

Engage - Students record background knowledge and questions on TQD.

Explore - Students read one Climate Change Evidence card (slides 7-10) with partner or small group and hypothesize how this change might affect humans, animals, and land in different regions. Have groups share thoughts with the class.

Explain - Show video clip, Potential Impacts, and Adaptation and Mitigation slides.

Elaborate - Partners or small groups read one Case Study card and identify adaptation strategies. Share with the whole class.

Evaluate - Identify adaptation and mitigation strategies on Exit Ticket case study.
Then record discoveries about climate change on TQD.

Engage:

Fill out the T and Q boxes of your TQD graphic organizer.

T - What do you THINK you already know about climate change?

Q - What questions do you have about climate change?

Think. Question. Discover.

Topic of Study Climate Change

T	Q
Things you THINK you already know	QUESTIONS you want to research

D

DISCOVERIES made after studying the topic

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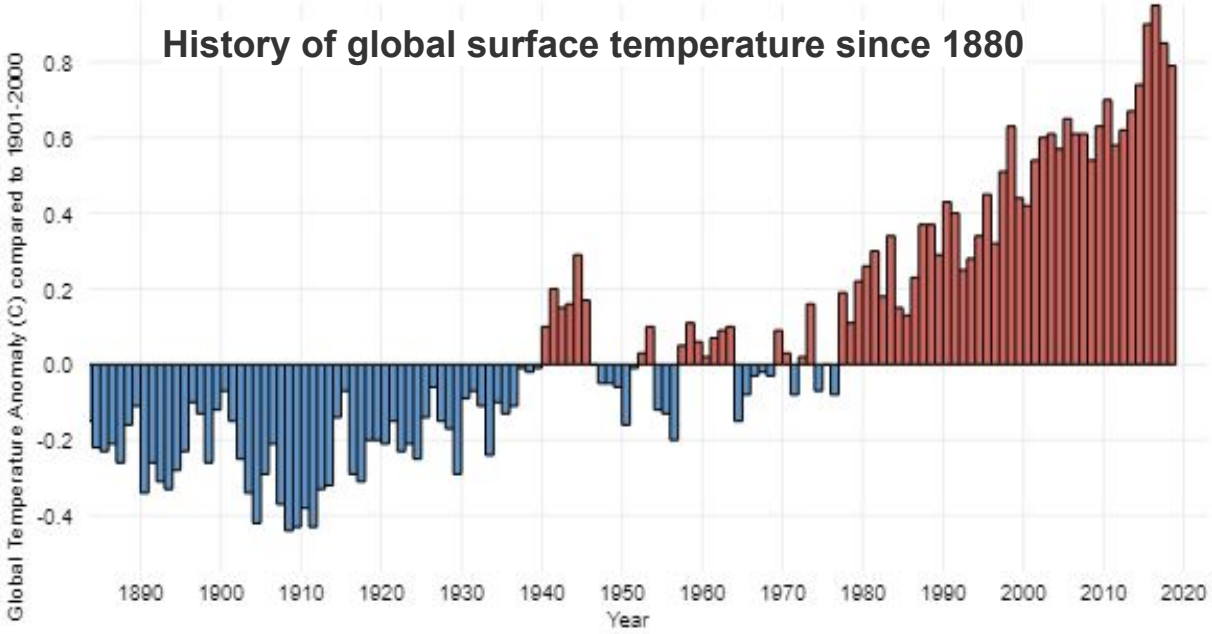
What makes us think the climate is changing?

Evidence Card 1

Historic temperature records show a consistent **rise in global temperature averages** for the past 100 years.



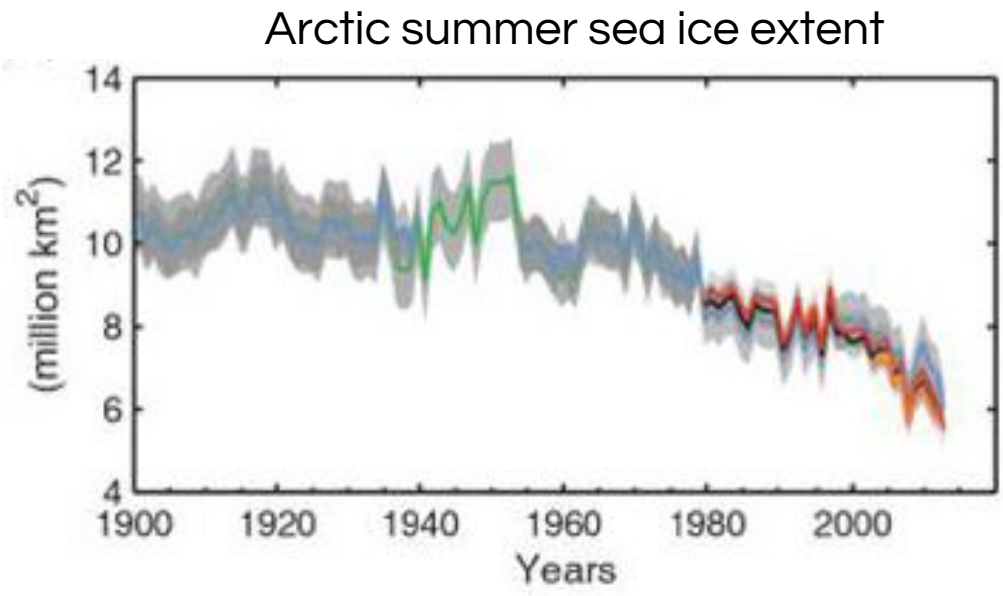
Warmest year on record: 2016

Source: NOAA Climate.gov

What makes us think the climate is changing?

Evidence Card 2

Polar ice, glaciers, and other **land and sea ice masses are in decline**, or getting smaller.



Source: [IPCC AR5, Summary for Policymakers (WG1), Fig. SPM.3]

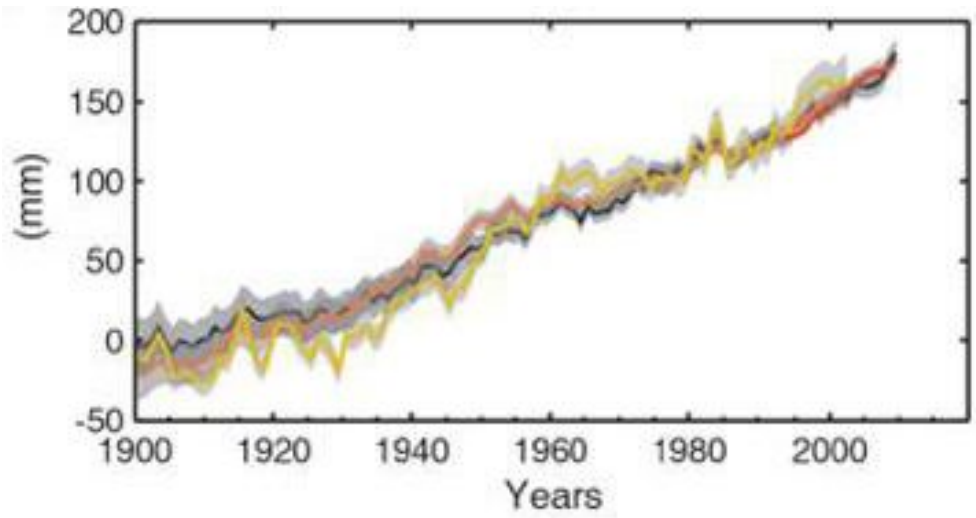
What makes us think the climate is changing?

Evidence Card 3

Sea levels are consistently rising as ice caps, permafrost, and land ice melts, and as the warmer ocean water expands.

Source: [IPCC AR5, Summary for Policymakers (WG1), Fig. SPM.3]

Global Average Sea Level



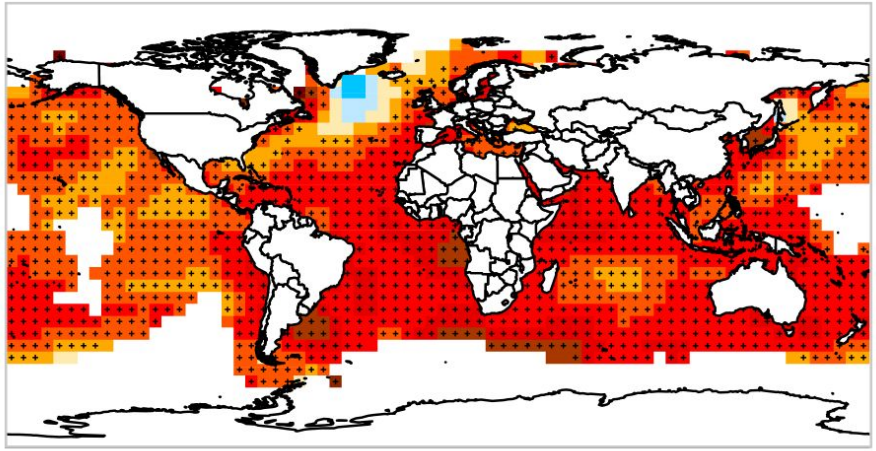
What makes us think the climate is changing?

Evidence Card 4

Ocean temperatures are consistently rising.

Source: [IPCC AR5, Summary for Policymakers (WG1), Fig. SPM.3]

Change in Sea Surface Temperature 1901-2015



Data sources:

- IPCC (Intergovernmental Panel on Climate Change). 2013. Climate change 2013: The physical science basis. Working Group I contribution to the IPCC Fifth Assessment Report. Cambridge, United Kingdom: Cambridge University Press. www.ipcc.ch/report/ar5/wg1.
- NOAA (National Oceanic and Atmospheric Administration). 2016. NOAA Merged Land Ocean Global Surface Temperature Analysis (NOAAGlobalTemp): Global gridded 5° x 5° data. National Centers for Environmental Information. Accessed June 2016. www.ncdc.noaa.gov/data-access/marineocean-data/noaa-global-surface-temperature-noaaglobaltemp.

For more information, visit U.S. EPA's "Climate Change Indicators in the United States" at www.epa.gov/climate-indicators.

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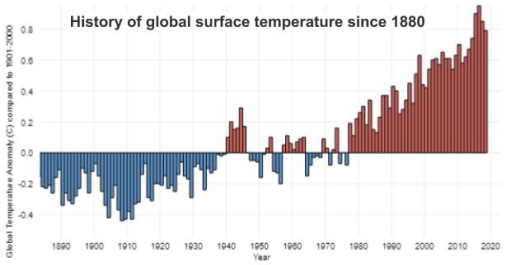

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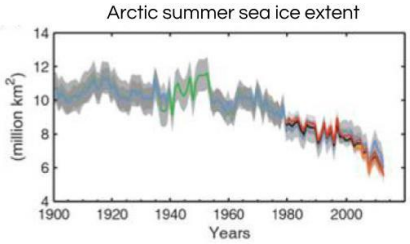

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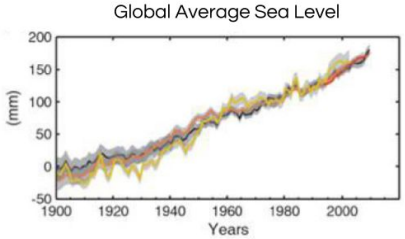

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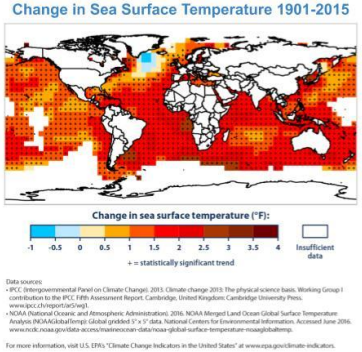
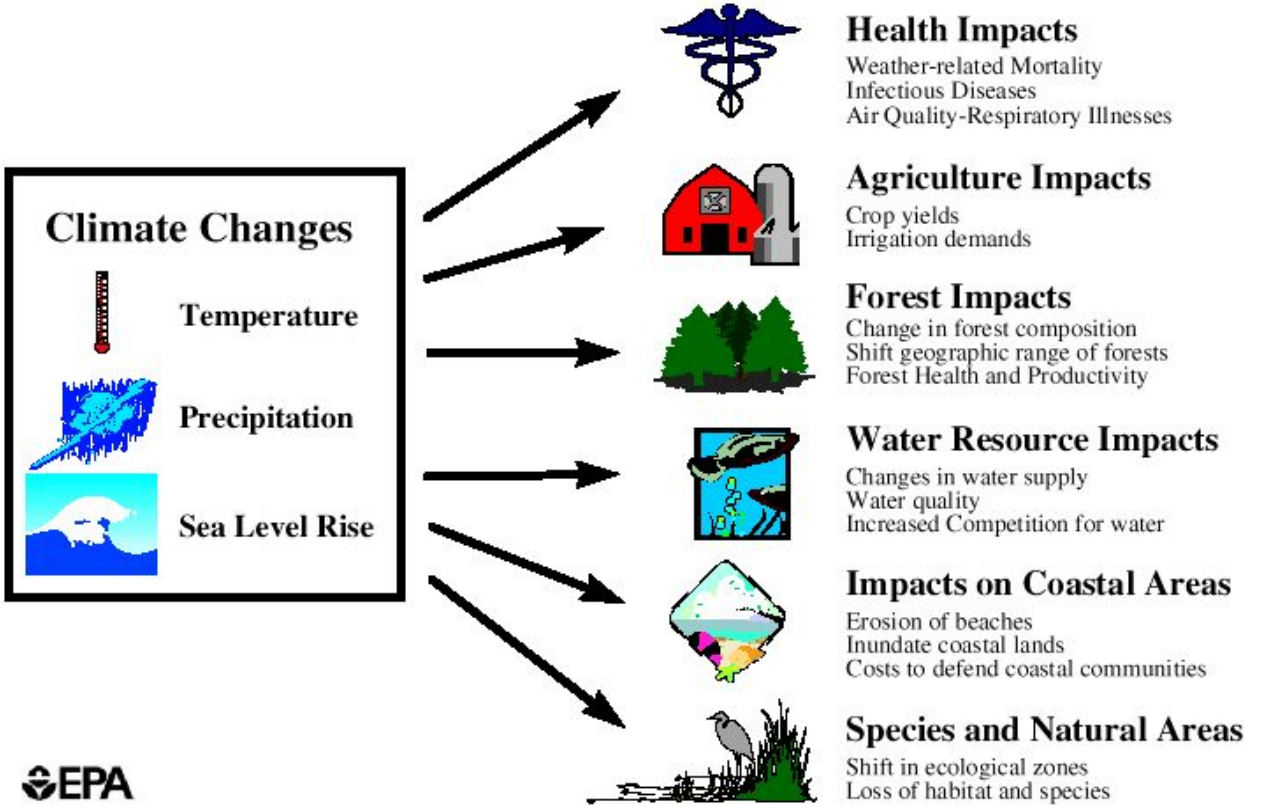


Source: IPCC AR5, Summary for Policymakers (WG1), Fig. SPM.3

Potential Climate Change Impacts



EPA

United States Environmental Protection Agency

What do we do now?

ADAPTATION

Adapting to life in a changing climate

- Move towns away from endangered coasts
- Build flood defenses and plan for water storage
- Develop resilient crops and adapt to longer or shorter growing seasons

MITIGATION

Reducing Climate Change

- Reduce sources of greenhouse gases
- Burn less fossil fuels by replacing them with cleaner energy (wind, solar, etc.)
- Increase forests and soil that absorb and store greenhouse gasses

Source: Climate.nasa.gov

Climate Change Adaptation and Mitigation
Video: PBS Learning Media

Case Study 1: Kiribati - Pacific Island Nation

Kiribati is a nation of islands in the Pacific Ocean. Rising sea levels and storm surges threaten many of their villages, eroding away land along the coast. Finding fresh water has been a challenge because storm surges flood the water wells with salty sea water. The World Bank has built coastal sea walls and installed solar powered water pumps to help.

“In villages like Nabeina in Kiribati, sea-level rise not only threatens their shorelines but also the wells where they source fresh water for drinking, cooking, and washing. By installing a solar pump in the village, villagers were able to adapt to the challenge of saltwater intrusion and build resilience.”

The government of Kiribati also purchased 6,000 acres of land on the nearby island of Fiji because of its higher elevation and more stable coastline. Citizens may have to relocate if conditions worsen as predicted.

Source: World Bank and New York Times

Case Study 2: Gansu Province, China

Farmers across China's Gansu Province, one of the country's driest regions, are already struggling to cope with the effects of climate change, as droughts and arid land contribute to the region's vast poverty.

The World Bank and the Chinese government are funding a $313.14 million project to improve irrigation systems and boost climate-smart agricultural practices. They've also helped farmers stay informed about the weather with new meteorology stations so they can know when to plant and harvest as the climate changes.

Some traditional crops won't thrive in Gansu's new climate environment, so the project has introduced new varieties of crops that are better adapted to extreme weather like droughts or floods.

Source: World Bank

Case Study 3: Cape Town, South Africa

One result of climate change is an increase in droughts around the world. Cape Town had a severe water crisis in 2018 that was partially caused by one of these droughts. The city came dangerously close to “Day Zero”, the day they would have to turn off the water supply.

To prepare for Day Zero, the city prepped 200 emergency water stations outside grocery stores and other gathering spots. Each would have to serve almost 20,000 residents. Cape Town officials made plans to store emergency water at military installations. They also drilled new water wells and built desalination plants to take the salt out of seawater.

Cape Town is no longer in crisis, but residents still do what they can to conserve water, and the government continues to prepare for the next drought that is likely to occur as temperatures rise.

Source: National Geographic

Case Study 4: Alaskan Villages

According to a national climate report, Alaska is warming twice as fast as the rest of the country. Rural and Alaska Native communities are the first to feel those impacts. Warren Jones is from the village of Quinhagak, which sits close to the Kuskokwim Bay. Just last week, he went fishing for trout. That's not a normal activity for November because the river should have already been frozen.

The community is trying to save artifacts from an ancient village nearby because they feared their heritage would wash out to the sea from erosion, caused by climate change. About 87 percent of Alaska Native communities are experiencing erosion. Many residents rely on rivers freezing over so they can travel to other villages by snow machine or car. And so they can hunt and fish safely in the winter.

Some villages are also facing relocation in order to survive. Newtok is the village that's closest to being able to relocate, and it will cost them millions of dollars to move.

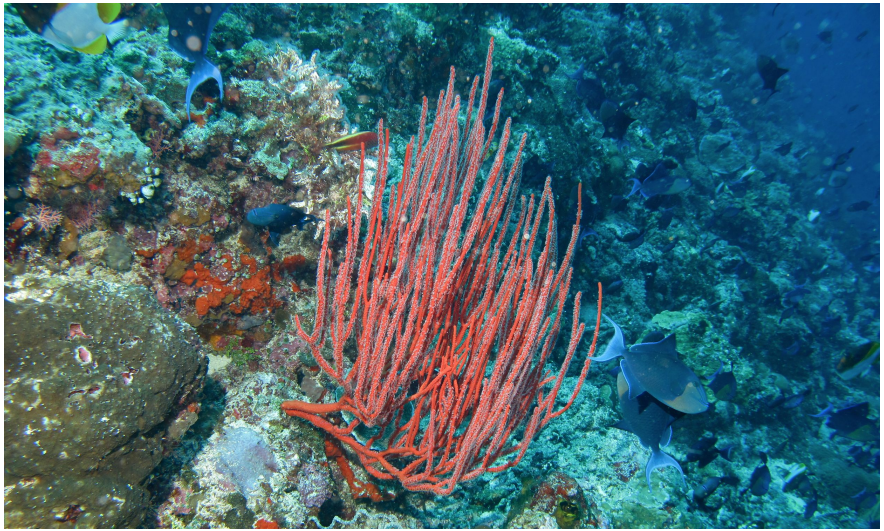
Source: Alaska Public Media and Smithsonian

Exit Ticket Case Study: Belize Barrier Reef

Coral reefs all over the world are threatened by climate change. Even a small increase in average temperature can cause coral bleaching and the destruction of these diverse ecosystems. The Belize Barrier Reef is one of these endangered areas. It's the second largest reef in the world, but it was put on the UNESCO danger list in 2009.

In response, The Caribbean Community Climate Change Centre has partnered with the World Wildlife Fund to farm stony corals and transplant them to damaged reefs. Farming corals that may be resilient to climate change will help it remain healthy and provide important shoreline protection during tropical storms.

WWF helps preserve the mangroves, the trees and shrubs that grow along the coast and protect coral reefs. They also support the Coral Watch program that measures the impacts of climate change on the coral reef. This information will help Belize and world aid groups know how to protect the reef as the climate continues to change.



Source: EcoMar Belize and National Geographic

Extension Activity

1. Read an EPA fact sheet about the effects of climate change for ONE state. Click this link to find the list of state fact sheets.
2. Make a list of the top 3 ways climate change is likely to impact that particular state.
3. Use your knowledge of adaptation strategies to write a climate change plan to address these effects.

EPA United States Environmental Protection Agency

August 2016
EPA 430-F-16-038

What Climate Change Means for Oklahoma

In the coming decades, **Oklahoma** will become warmer, and both floods and droughts may be more severe. Most of Oklahoma did not become warmer during the last 50 to 100 years. But soils have become drier, annual rainfall has increased, and more rain arrives in heavy downpours. In the coming decades, summers are likely to be increasingly hot and dry, which would reduce the productivity of farms and ranches, change parts of the landscape, and possibly harm human health.

Our climate is changing because the earth is warming. People have increased the amount of carbon dioxide in the air by 40 percent since the late 1700s. Other heat-trapping greenhouse gases are also increasing. These gases have warmed the surface and lower atmosphere of our planet about one degree during the last 50 years. Evaporation increases as the atmosphere warms, which increases humidity, average rainfall, and the frequency of heavy rainstorms in many places—but contributes to drought in others.

While most of the earth warmed during the last century, natural cycles and sulfates in the air cooled eastern Oklahoma. Sulfates are air pollutants that reflect sunlight back into space. Now sulfate emissions are declining, and the factors that once prevented parts of the state from warming are unlikely to persist.

Temperature change (°F):
-1 -0.5 0 0.5 1 1.5 2 2.5 3 3.5

Changing temperatures in the last century. While most of the nation has warmed, eastern Oklahoma has cooled. Source: EPA, Climate Change Indicators in the United States.

Precipitation and Water Resources

Changing the climate is likely to increase the demand for water but make it less available. As rising temperatures increase evaporation and water use by plants, soils are likely to become even drier. Average rainfall is likely to decrease during spring and summer. Seventy years from now, the longest period without rain each year is likely to be at least three days longer than it is today. Increased evaporation and decreased rainfall are likely to reduce the average flow of rivers and streams.

Drier soils will increase the need for farmers to irrigate their crops, but sufficient water might not be available. Approximately 16 percent of Oklahoma's farmland is irrigated. In the Panhandle, most irrigation water is ground water from the High Plains Aquifer System. As a result, this aquifer is becoming depleted. Since the 1950s, the amount of water stored in the aquifer has declined by more than 25 percent in parts of the Panhandle. (See map on back page.)

Decreased river flows can create problems for navigation, recreation, public water supplies, and electric power generation. Commercial navigation can be suspended during droughts when there is too little water to keep channels deep enough for barge traffic. Decreased river flows can also lower the water level in lakes and reservoirs, which may limit municipal water supplies; impair swimming, fishing, and other recreational activities; and reduce hydroelectric power generation. Conventional power plants also need adequate water for cooling. Compounding the challenges for electric utilities, rising temperatures are expected to increase the demand for electricity for air conditioning.

Agriculture

Increasing droughts and higher temperatures are likely to interfere with Oklahoma's farms and cattle ranches. Hot weather causes cows to eat less and grow more slowly, and it can threaten their health. Reduced water availability would create challenges for ranchers, as well as farmers who irrigate crops such as wheat. Yields are likely to decline by about 50 percent in fields that can no longer be irrigated. The early flowering of winter wheat could have negative repercussions on livestock farmers who depend on it for feed.

A dry cornfield in Canadian County during the 2011 drought. Credit: Ron Hays, Oklahoma Farm Report.

Resources

Websites:

Environment and Climate Change Canada
NOAA Climate.gov
IPCC AR5, Summary for Policymakers

Video Clips:
PBS - Climate Change Adaptation and Mitigation
World Bank - Kiribati