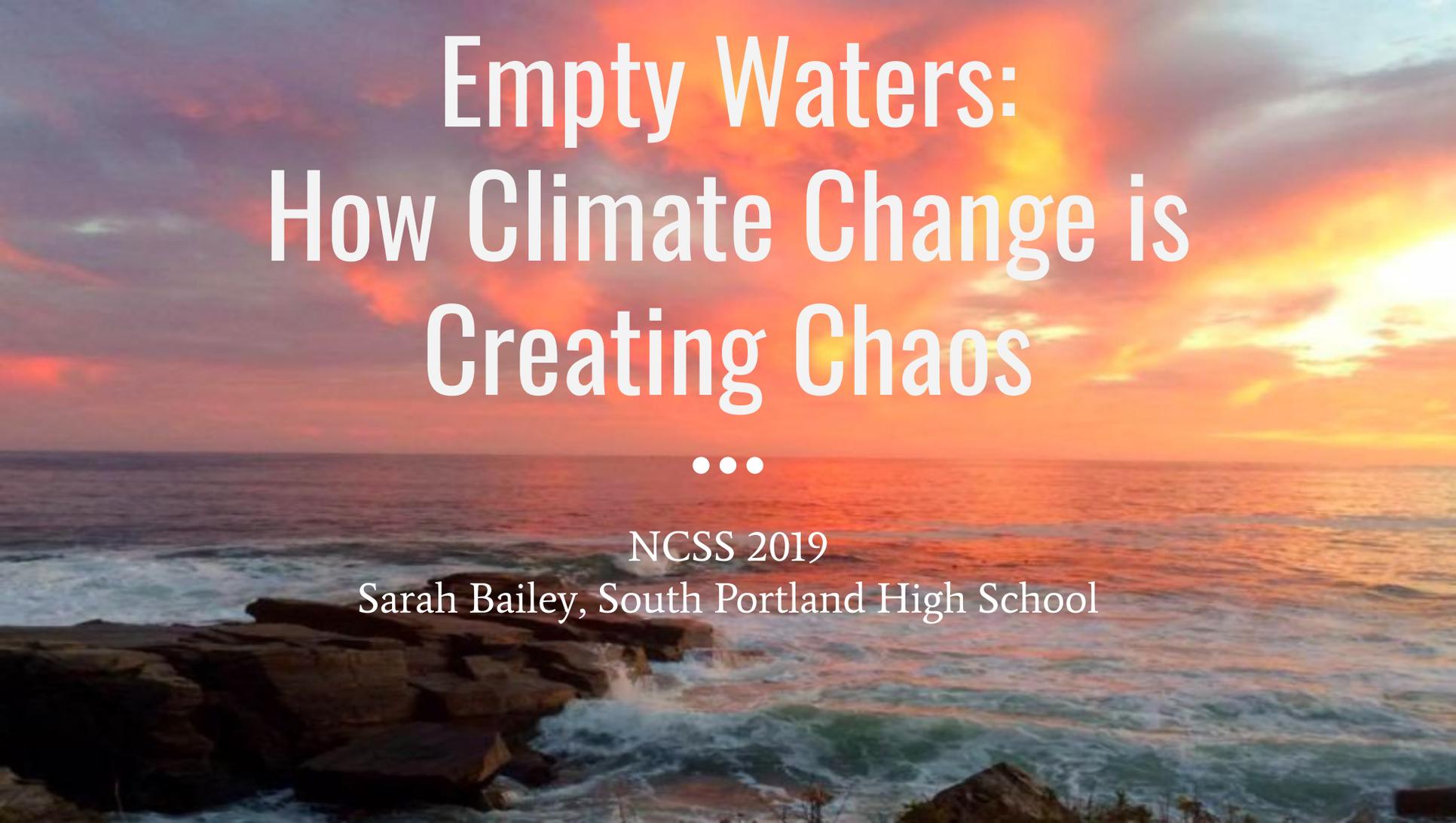


# WELCOME

While we are waiting to get started, please take a moment to think about which of the following statements is true:

- A. A warming ocean temperature leads to an increase in the amount of water vapor over the oceans, in turn leading to the risk of heavy rain and snow
- B. A warming ocean temperature causes sea levels to rise
- C. A warming ocean temperature will change the circulatory patterns of ocean currents.



A dramatic sunset over the ocean with waves crashing against rocks in the foreground. The sky is filled with vibrant orange, red, and yellow hues, with the sun low on the horizon. The water is dark blue with white foam from the waves. The rocks in the foreground are dark and jagged.

# Empty Waters: How Climate Change is Creating Chaos

...

NCSS 2019

Sarah Bailey, South Portland High School

- Why teach about climate change
- Impact that climate change is having on our community
- Background-Gulf of Maine
- Affected populations
- Change in water quality
- Lesson plans

# Question time

- What is climate change?
- Why is it happening?
- How does it fit into the social studies curriculum?

# Water is everything

70% of our Earth is covered in oceans

The oceans absorb the sun's heat, helping to regulate temperatures on land

The oceans are home to millions of plants and animals

2018 was the oceans' hottest year on record

Warming ocean waters means changes to reef systems, rising sea levels, larger storms, and changes to ocean currents

# Topic ideas

- Geography
- Culture
- Human Geography
- Early Civilizations

# Background to the problem

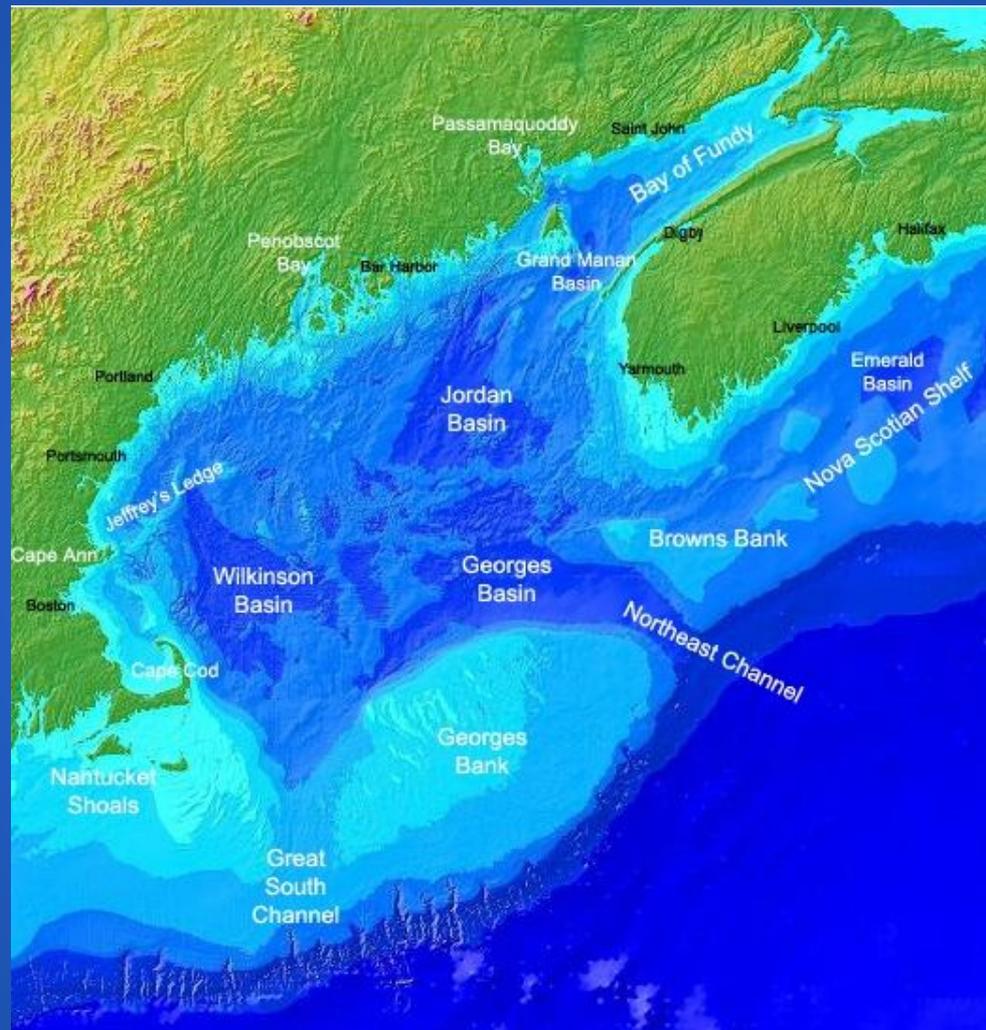
The Gulf of Maine stretches from Cape Cod to Nova Scotia

It is the intersection between cold water masses from the Arctic and warm water masses from the Gulf Stream.

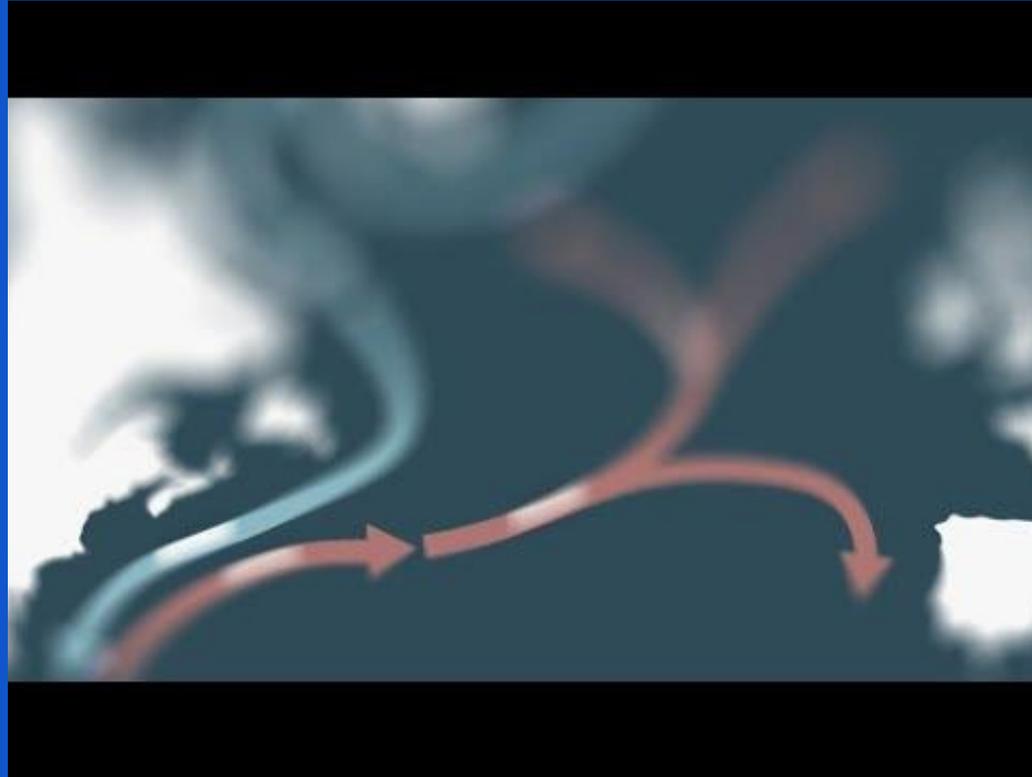
There are two current issues:

- Overall warming of the global ocean as air temperatures and greenhouse gases rise
- Melting of ice in Greenland and the Arctic Ocean, which provides some fresh water is altering ocean circulation patterns in the region.

“Warmer atmospheric temperatures heat up the water directly, but they also disrupt a



# Let's inform you



[Gulf of Maine, Explained: The Warming Gulf of Maine](#)

# FACTS

- Maine has the longest coastline in the United States
- The Gulf of Maine is warming 99% faster than the rest of the world's oceans
- A 2017 report from NOAA predicts at least a six inch increase in sea level by 2050

# How does this affect me?

What is the closest waterway to you?

What are the current concerns with it?

What is being done to help?

# Let's Lesson Plan

- Making it fit
  - Geography
  - Economics
  - World History

# Science and History collide

## Climate Change Inquiry: Sea Ice and Temperature

developed by the  
**Global Precipitation Measurement Mission**  
GPM NASA.GOV / EDUCATION    TWITTER.COM / NASA\_RAIN    FACEBOOK.COM / NASA\_RAIN

Name: Joshua    Date: 11/13/19    Period: 6/2

### Climate Change Inquiry Labs: Sea Ice and Temperature

#### Lab Instructions

Even though sea ice occurs primarily in the polar regions, it influences our global climate. Sea ice has a bright surface, so much of the sunlight that strikes it is reflected back into space. As a result, areas covered by sea ice don't absorb much solar energy, so temperatures in the polar regions remain relatively cool. If gradually warming temperatures melt sea ice over time, fewer bright surfaces are available to reflect sunlight back into space, more solar energy is absorbed at the surface, and temperatures rise further. This chain of events starts a cycle of warming and melting. This cycle is temporarily halted when the dark days of the polar winter return, but it starts again in the following spring. Even a small increase in temperature can lead to greater warming over time, making the polar regions the most sensitive areas to climate change on Earth.

Text excerpted from: <http://nsidc.org/cryosphere/seaice/>

**Objective:** Students will investigate the effect of the simulated reduction of arctic sea ice on ocean temperatures.

**Hypothesis:** I think that a container simulating less arctic sea ice will have a water temperature higher compared to a container with more simulated sea ice.  
(higher, lower or the same)

I think the difference between the temperatures will be 7 degrees.

**Materials**

- flat containers (two) - plastic bins, cut open cardboard cartons, or something similar
- thermometers or temperature probes (2)    • tape    • towels for insulation (optional, but helpful)
- heat lamp and bulb    • graduated cylinder or measuring cup and water
- aluminum foil (to represent sea ice)

**Procedure**

1. Set up the experiment as shown in the diagram at right. Make sure you use the same amount of water in each container, and that you place the lamp equally between the two containers.
2. Record the starting temperatures for the two containers. Turn on the heat lamp. NOTE: The bulb and lampshade may get quite hot, so use caution.
3. Record the temperature of the water in each container after about 30 minutes.

→ While you're waiting, complete the questions on the back of the paper.

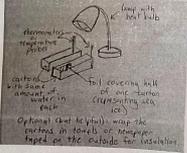


Diagram labels: thermometer, lamp with heat bulb, flat covering half of one container (representing sea ice), container with same amount of water in each, Optional: (and be sure) wrap the outside in towels or newspaper. Be sure to also include the insulation.

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	Starting temperature	After 30 minutes	Change in temperature
No sea ice	73.7°	84.7°	+11.0°
Half sea ice (simulated by aluminum foil)	73.7°	79.8°	+6.1°

After the experiment: Was your hypothesis supported by the data? Yes, not a little off

Explain why this might be the case. As expected the ice (aluminum) reflected the sunlight so the water stayed cool but the non ice one was a lot warmer just in general

→ While you're waiting, visit <http://nsidc.org/cryosphere/seaice/index.html> to learn more about sea ice.

How is sea ice different from other types of ice? Name some of those other forms of ice. Sea ice forms in only salt water not fresh like glaciers etc. Also normal ice floats on top while sea ice sinks to the bottom b/c it's so cold and dense.

How does sea ice affect the movement of ocean waters? Sea ice blocks out b/c of their reflective nature. Maybe it pushes cold water down to the bottom and pushes it to the equator when it puts warm water from the equator toward it. Circle

How does the salt in ocean water affect the way it freezes? The fresher freezing point of salt is lower than fresh water so it has to be colder for it to turn ice with less sea ice the salt can form ice.

Can you drink melted sea ice? Why or why not? Yes and no. New ice holds concentrated brine so it wouldn't be good to drink. Although multi-year ice has nearly no brine so it's fresh enough to drink.

→ Continue reading about the characteristics and formation of sea ice from the National Snow and Ice Data Center, or visit the links below until the experiment is complete.

**Life at the Edge:** An interactive map showing the extent of sea ice in the Arctic Ocean in 2000, and its predicted extent in 2050 and 2100. Also has snapshots of the animals that are affected as the ice melts. <http://ngm.nationalgeographic.com/2007/06/vanishing-sea-ice/sea-ice-interactive>

**Inuit siku (sea ice) Atlas:** Learn what the native people of Canada call different parts of the sea ice, and what they know about the importance of sea ice and the changes that are occurring. [http://sikuatlas.ca/sea\\_ice.html](http://sikuatlas.ca/sea_ice.html)

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# EXPERIMENT TIME



# Creating Inquiry

Student Inquiry Lab: Empty Waters

# Data Collection

## Lobster Catch on the East Coast

Now that you've had a chance to explore how temperatures are changing along our coastline, let's take a look at what's happening with animal populations.

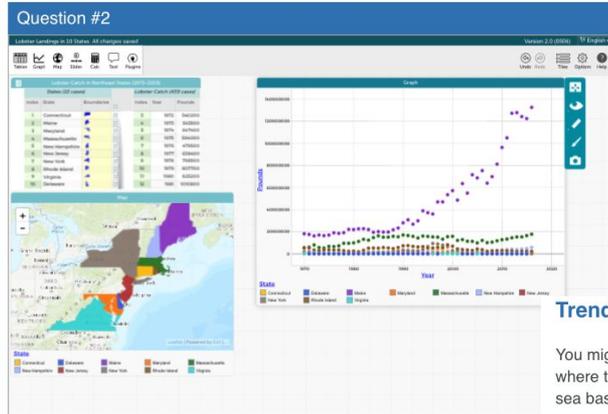
### Explore the Data

Let's start by looking at how lobster catch is changing along the east coast.

#### Make a Time Series Graph

- Drag **Year** to the x-axis and **Pounds** to the y-axis.
- Drag **State** to the middle of the graph to color the data points by state.
- Click on **Maine** in the legend at the bottom of the graph.

**What do you notice about Maine's lobster catch compared to the other states?**



## Trends in Black Sea Bass Catch

You might remember from LabVenture that black sea bass are starting to show up in fishermen's traps in the Gulf of Maine, where they've never been seen before. They are typically found further south. In this lesson, you'll look at recent trends in black sea bass catch and use a model to think about what black sea bass populations might look like in the future.

### Explore the Data

Like we did with lobster, let's look at how black sea bass catch is changing along the East Coast.

#### Make a Graph

- Drag **Year** to the x-axis and **Pounds** to the y-axis.
- Drag **State** to the middle of the graph.
- Starting in **North Carolina** and moving north, click on each state in the map.
- **What do you notice in the graph?**

### Question #4



# WARMING UP

## The Gulf of Maine

### WHY YOU SHOULD CARE

A large gulf on the Atlantic Coast  
Stretches from Cape Cod to Nova Scotia  
36,000 sq. miles  
Home to 3,000 marine species and birds

**99%**

Warming faster  
than the rest of  
the world's  
oceans

**68.9**

Average  
temperature of  
the Gulf in  
summer of 2018

**40%**

Lobster landings  
decline

### CLIMATE CHANGE DOES MATTER

SEA ICE MELTING OCEANS WARMING SPECIES LEAVING

### LOBSTER ARE MIGRATING NORTH EMPTY WATER



### MARINE ECOSYSTEMS ARE THREATENED

Shrimp  
Cod  
North Atlantic Right Whales  
Seals

### Moving In

There are a large number of invasive species moving in due to the warming of the Gulf of Maine

BLACK SEA BASS GREEN CRABS

# Infographics

## GULF OF MAINE CHAOS



The Gulf of Maine is rising faster than 99% of the world's oceans

### 1 CLIMATE CHANGE

There are three contributing factors to the change in the Gulf of Maine:

1. Man-made global warming
2. Melting ice in the Arctic
3. Changing ocean currents



### 2 CHANGING HEART BEAT

The currents around the Gulf of Maine are changing. By 55% in fact! The Labrador Current should be bringing in cold water into the Gulf but because the water is becoming slower it is causing the Gulf Stream to move in faster. This is making us ill!



### 3 HEAT WAVES

The Gulf of Maine hit some record temps in 2018, 68.9°F for more than five consecutive days.

### 4 MOVIN' OUT

The waters of Maine may not seem colder by 2050, these coastal sea areas are picking up heat to warm the water temperature. Now the waters is what it's all!



### 5 DECLINE OF THE LOBSTER



\*Data only goes up to 2018

### 6 TIPPING THE ECO SCALE

Invasive species such as green sturgeon and black sea bass are making their way into Maine. Black sea bass are preying off of baby lobster. Other invasive species include sea urchin and butterfish.



### 7 BABYING THE SHELLFISH

The changes in the Gulf of Maine are causing a term called acidification. It is not only you alone developing shells of oyster and other species.



### 8 WHERE'S THE WHALES?

Changes in water temperature for the Gulf of Maine also means a loss of food. This is why the food web means we have lost whales and makes it worse for the 400 Right Whales left on earth.

# Drawing Connections

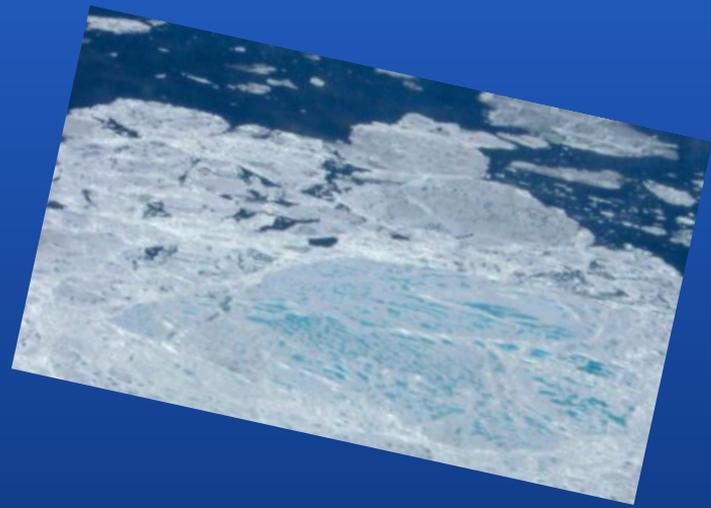
Do modern civilizations still treat their waterways as living gods?

How have populations impacted waterways today?

Brainstorm ways in which waterways are becoming "sick"



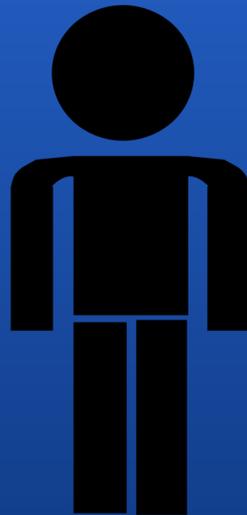
# PICTURE PROMPT

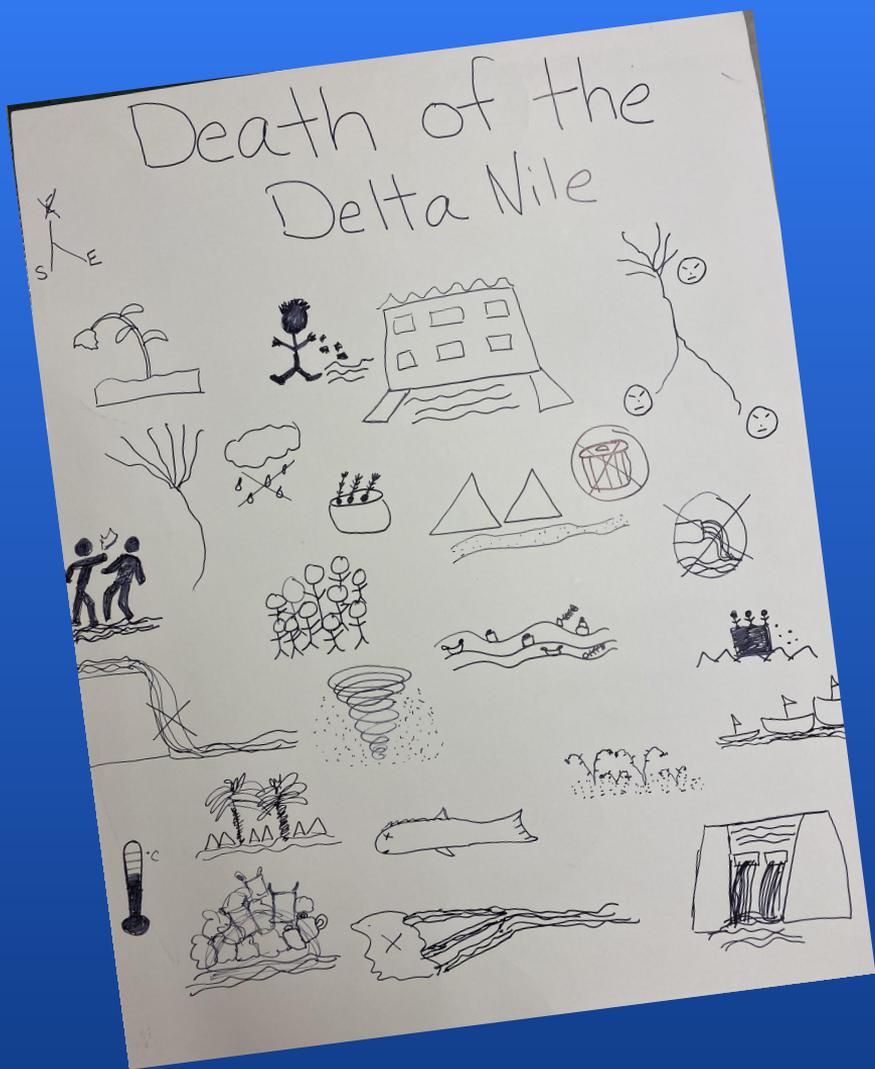




# Death of the Nile

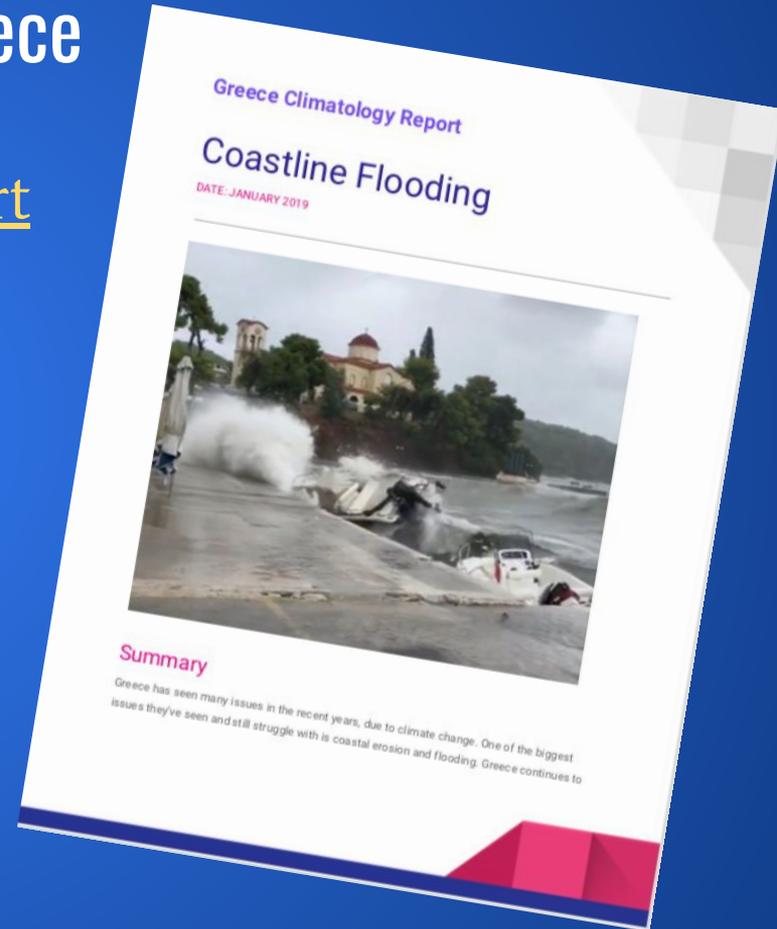
## Death of the Nile





# Drought in Greece

## Sample Greece Climate Change report



**Thank you**

