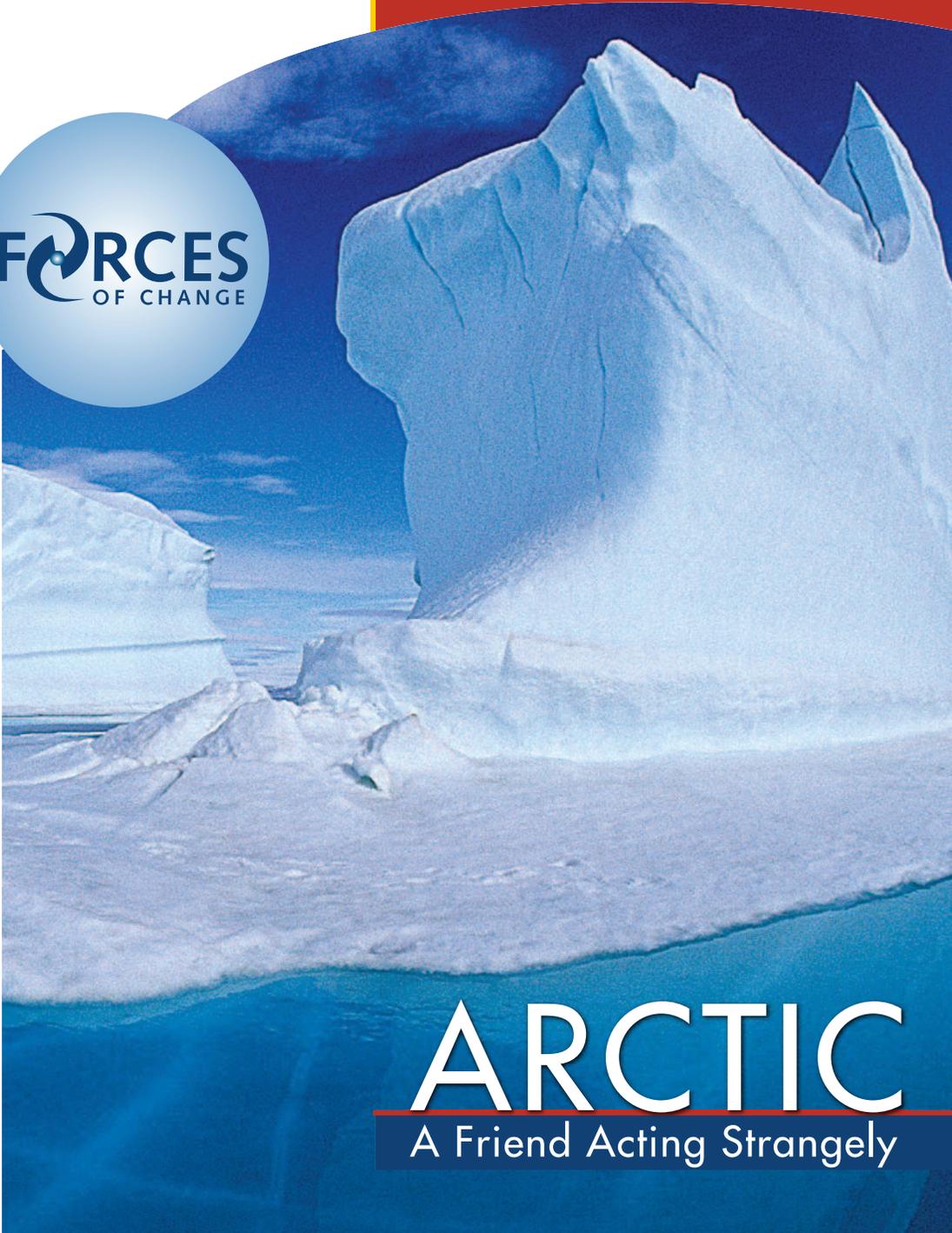


**Activity 3**  
Arctic Heat Wave?



# ARCTIC

A Friend Acting Strangely



Smithsonian  
*National Museum of Natural History*

## ACTIVITY 3

# ARCTIC HEAT WAVE?

## THE RATE OF CLIMATE CHANGE

### Are Ice Caps Melting Faster?

From 1979 to 2002, seasonal melting of the Greenland Ice Sheet has increased on average by 16%—an area about the size of Sweden. These images show the melt zone in 1992 and 2002. Satellites measure extent of melting. Airborne altimeters measure the ice cap's thickness.

© Konrad Steffen and Russell Huff, University of Colorado, CIRES



### OVERVIEW

Students interpret graphs of global temperature records and Arctic temperature records for the past 100 years to determine differences in the rates of change between the two records.

### SUGGESTED GRADE LEVEL

6 – 8

### ALIGNMENT WITH NATIONAL STANDARDS

*National Science Education Standards*

- Abilities necessary to do scientific inquiry
- Earth's history
- Understandings about science and technology
- Science and technology in society
- Nature of science

### ESTIMATED TIME

One 45-50 minute class period

### MATERIALS

- Overhead projector
- Transparencies of Fig. 3.1, 3.2 and 3.3
- Graph paper
- Access to the Internet
- Activity Sheet E

## ACTIVITY 3

### OBJECTIVES

Students will be able to:

- 1 > Define the concept of a temperature anomaly.
- 2 > Read a temperature graph.
- 3 > Identify trends in temperatures over time spans of years.
- 4 > Make comparisons between different parts of the graph.



#### Who's at Risk?

Ringed seals (*Pusa hispida*) are tied to sea ice for everything they do—rest, hunt, give birth, and nurse their young. It's uncertain how they will fare if sea ice continues to retreat.

Photo © Brendan P. Kelly

**Teacher note:** Figs. 3.1, 3.2 and 3.3 can be found in the *Teacher References at the end of this document.*

### BACKGROUND

As is true globally, temperatures in most of the Arctic region have increased during the past century. But are these changes unusual or just part of natural variation? To help answer that question scientists compare recent changes with records of those of the past.

They have determined that Arctic temperatures:

- Have been unusually warm, particularly in the past few decades.
- Have warmed roughly twice the rate of the rest of the world.
- Represent the highest levels in 400 years.
- Were particularly warm during the 1930s and 1940s as well, but the rate of warming has been more rapid in recent decades.

### About the temperature record graphs (figs. 3.1, 3.2 and 3.3)

- 1 > **What is a temperature anomaly?** The Y-axis on these graphs shows increases and decreases in average temperature “anomalies.” An anomaly is a deviation, or variation, from a “normal” temperature. Here “normal,” is the average annual temperature for the period 1961-1990. That 30-year average is the comparison point represented by the horizontal line at 0°. For example, the year 1900 was 0.2° C cooler than the 1961-1990 average. The warmest year in this record was 1998, nearly 0.6° C warmer than the 1961-1990 average.

## ACTIVITY 3

**2 > Why are the values different on the Y-axis of each of the graphs?** The Arctic temperature anomalies range have had a much greater range than those globally.

**3 > Why a 30-year record?** To calculate the long-term “normal” climate, scientists compile temperature records for at least a 30-year period. The data to compile these records came from many instruments on land, ships, buoys, and satellites.

### PROCEDURE

#### STEP 1 >

Using an overhead projector, show the class the transparency you made of (fig. 3.1) “400-year Arctic temperature Record” to explain the following:

- a. Each yellow bar represents a single year. (X-axis)
- b. Temperature values are in C° (Y-axis).
- c. The temperature values represent the number of degrees of increase or decrease from a long-term average. (The 30-year period 1961-1990)

#### STEP 2 >

On the transparency, highlight the portion of the graph that represents 1900 to 2004. Ask students to compare the average annual temperatures for the past 100 years to those for the preceding 300 years. Has the trend changed? (They should be able to see that most of the average annual temperatures prior to 1900 were usually colder than “normal” (the 1961-1990 average). Since 1900, most average annual temperatures have been warmer than “normal.” The trend has become decidedly warmer.)

#### STEP 3 >

Distribute **Activity Sheet E**.

#### STEP 4 >

Allow students about 20 minutes to complete **Activity Sheet E**.

### ASSESSMENT IDEAS

**1 >** Use results of **Activity Sheet E** as an assessment.

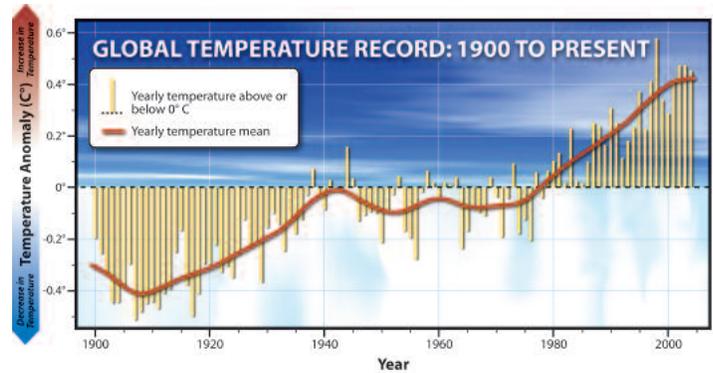
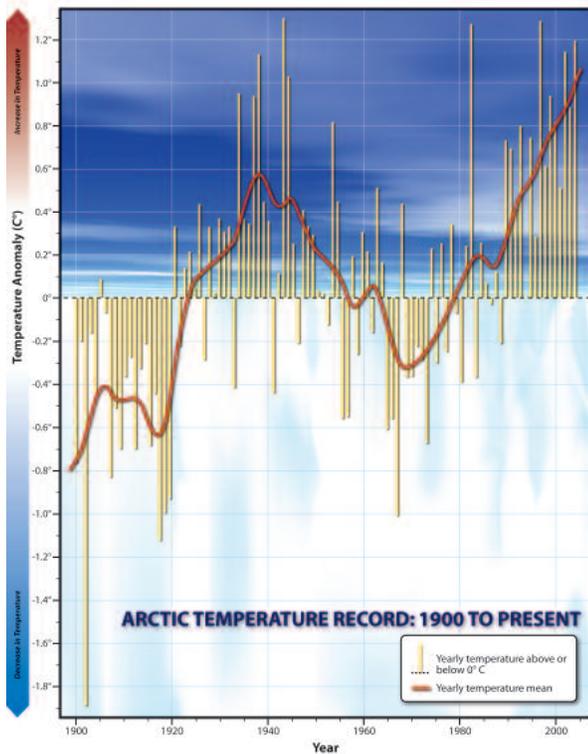
**2 >** Ask students to repeat the activity for a different graph that you provide.

### RESOURCES

<http://forces.si.edu/arctic>

# ACTIVITY 3 > ARCTIC HEAT WAVE? > ACTIVITY SHEET E

Student Name \_\_\_\_\_



The temperature record for each year is represented by a yellow bar. It shows the number of degrees that each year was above or below normal. Normal is the 0° line. The heavy red line can help you visualize the temperature trend between 1900 and 2004.

1 > On both graphs, highlight the most recent 30 years (1975-2004). Use the graph to find out about the temperature trend.

- Have global temperatures been warming or cooling? (circle one)
- Have Arctic temperatures been warming or cooling? (circle one)

2 > On both graphs, draw a circle around the most recent ten years (1995-2004). Use the graph to find out about the rate of change in temperatures for the globe and the Arctic.

- What was the warmest global year since 1995? \_\_\_\_\_
- How many degrees warmer was it than normal. (Look at the yellow bar in relation to the 0° line. That line represents "normal.") \_\_\_\_\_°C
- What was the warmest Arctic year? \_\_\_\_\_
- How many degrees warmer was it than normal. (Look at the yellow bar in relation to the 0° line. That line represents "normal.") \_\_\_\_\_°C
- Look at your data in "b" and "d" above: Were global or Arctic temperatures warmer? \_\_\_\_\_  
By how many degrees warmer? \_\_\_\_\_°C  
Show the difference in degrees warmer as a percentage: The temperature was \_\_\_\_\_% warmer.

3 > Would you agree or disagree with the following statement:

"During the past 30 years, temperatures in the Arctic have changed more from "normal" than those for the rest of the globe." Why do you agree or disagree?

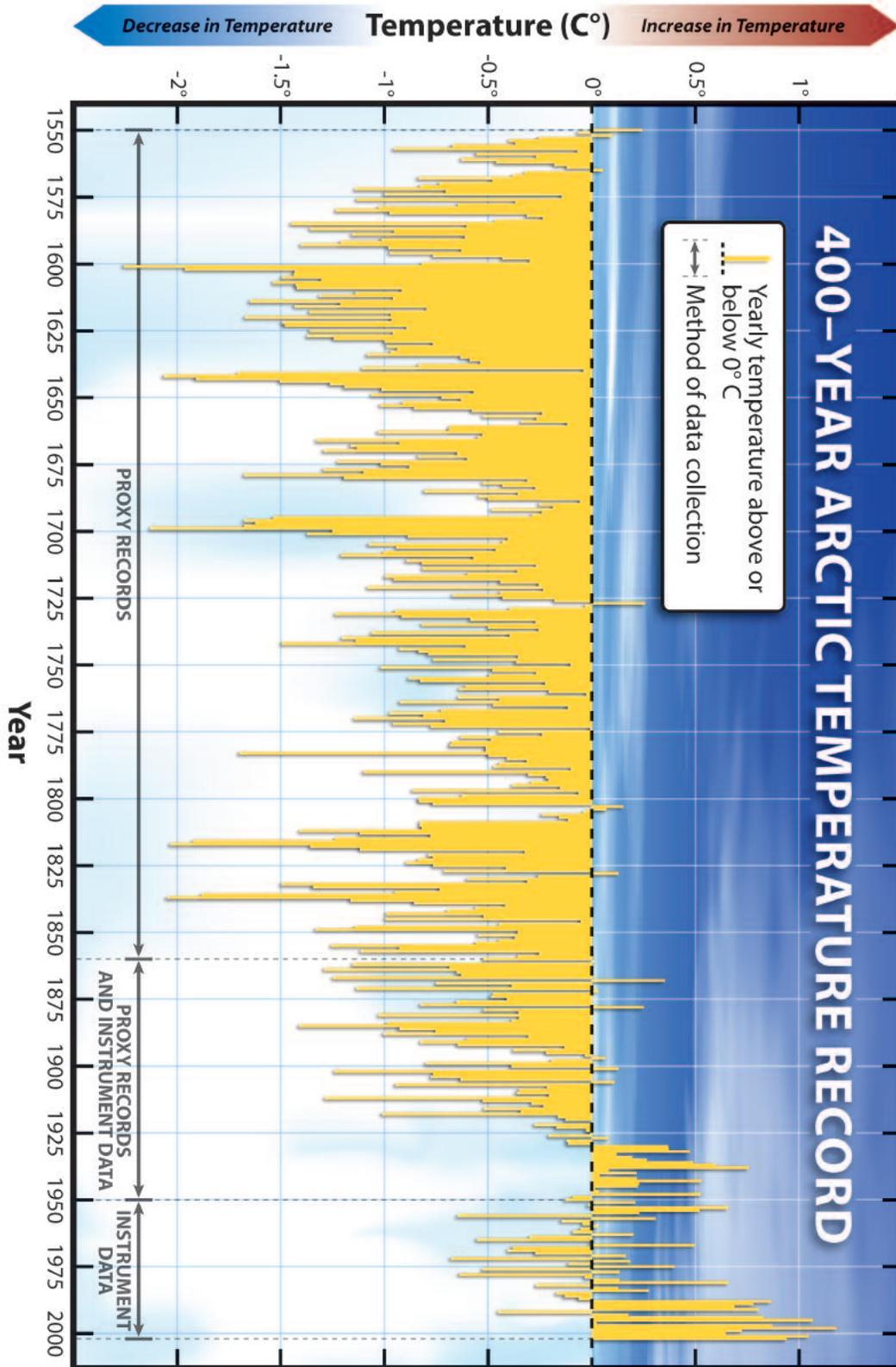
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## ACTIVITY 3 > TEACHER REFERENCES

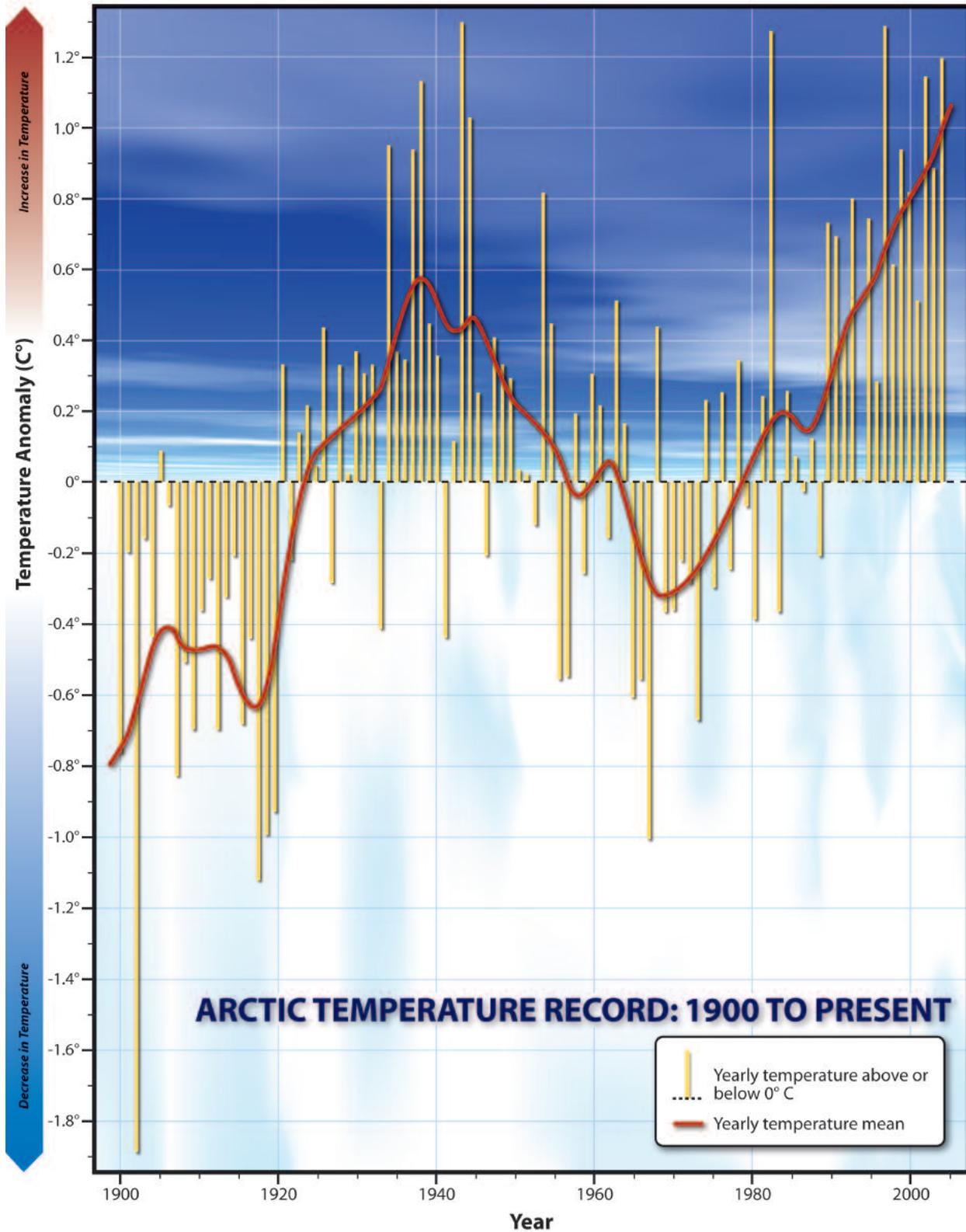
Teacher Reference #1: Fig. 3.1 (400-year Arctic Temperature Record)



Graph by The M Factory © Smithsonian Institution

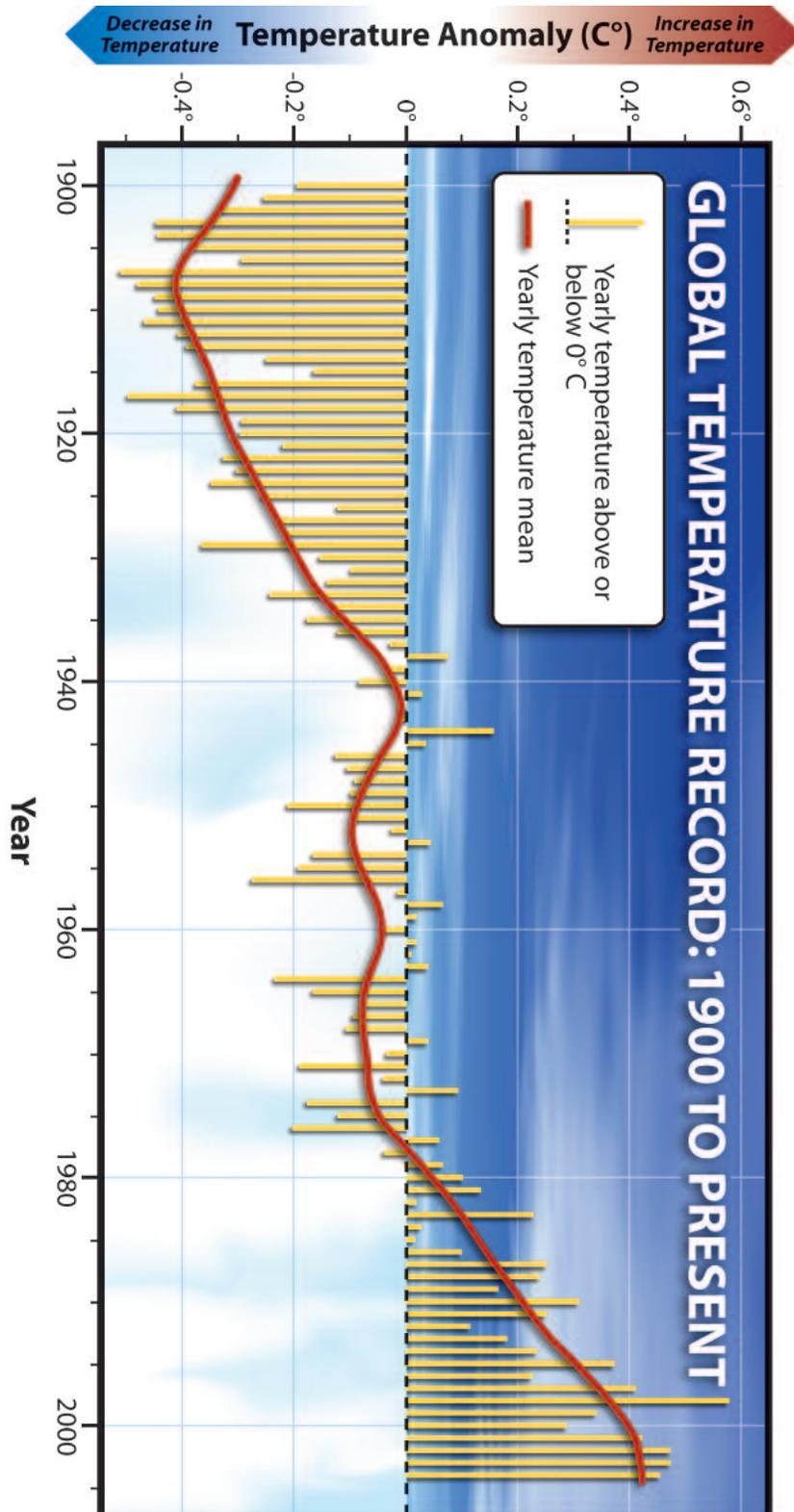
## ACTIVITY 3 > TEACHER REFERENCES

Teacher Reference #2: Fig. 3.2 (Arctic Temperature Record 1900 to Present)



## ACTIVITY 3 > TEACHER REFERENCES

Teacher Reference #3: Fig. 3.3 (Global Temperature Record 1900 to Present)



Graph by The M Factory © Smithsonian Institution