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ABSTRACT

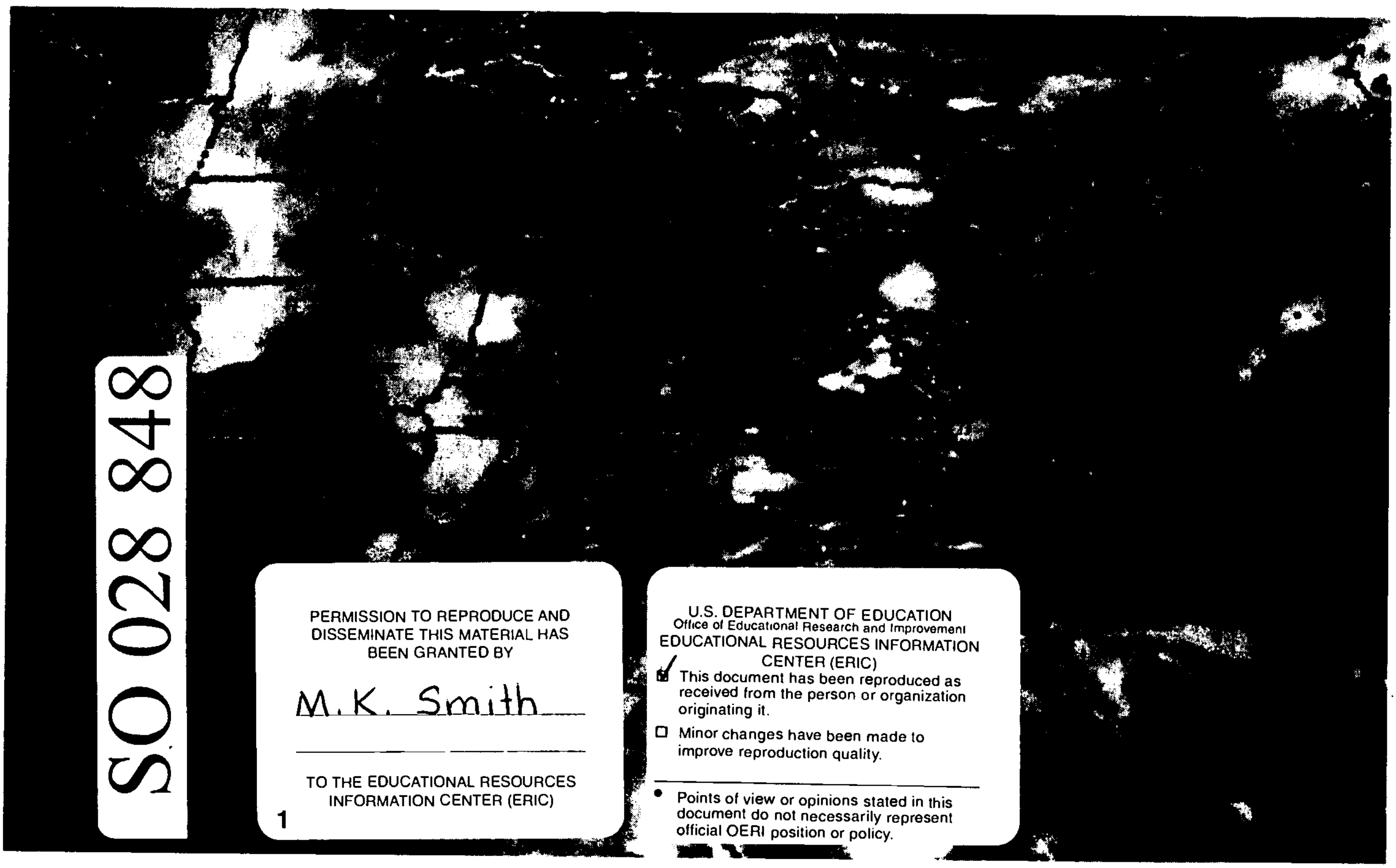
This issue of "Art to Zoo" focuses on weather and climate and is tied to the traveling exhibition Ocean Planet from the Smithsonian's National Museum of Natural History. The lessons encourage students to think about the profound influence the oceans have on planetary climate and life on earth. Sections of the lesson plan include: (1) "Ocean Currents - Going with the Flow"; (2) "Coastal Climates, Inland Climates"; (3) "Getting There - Ocean Currents and Navigation"; and (4) "El Nino - An Ocean Child." Worksheets, and a resources list conclude the unit. Lessons are designed for grades 4-8 and address science, geography, and social studies. (EH)

ART to ZOO

TEACHING WITH THE POWER OF OBJECTS

Smithsonian Institution

September/October 1995



TOMORROW'S FORECAST: Oceans and Weather

Inside

Lesson Plan

Take-Home Page in English/Spanish

Subjects

Science

Social Studies

Geography

Grades

4–9

Publication of *Art to Zoo* is made possible through the generous support of the Pacific Mutual Foundation.

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Art to Zoo's purpose is to help teachers bring into their classrooms the educational power of museums and other community resources.

Art to Zoo draws on the Smithsonian's hundreds of exhibitions and programs—from art, history, and science to aviation and folklife—to create classroom-ready materials for grades four through eight.

Each of the four annual issues explores a single topic through an interdisciplinary, multicultural approach.

The Smithsonian invites teachers to duplicate *Art to Zoo* materials for educational use.

Cover photo:
Satellite photography reveals the movement of massive weather systems across the continental United States.

TOMORROW'S FORECAST: Oceans and Weather

Whether you live on the gentle rolling plains of the Midwest or the glittering desert sands of the Southwest—no matter where in the world you are—your life is intimately tied to our planet's oceans. Even if you've never gone to a beach to watch a sunrise or sunset or to ride the waves, the oceans probably affected you as recently as this morning—when you may have checked the weather and decided what to wear.

The oceans influence the world's climate by storing vast amounts of solar energy and distributing that energy around the planet through currents and accompanying atmospheric winds. Dramatic weather events like hurricanes originate at sea, and the oceans also influence long-term conditions such as average daily temperature and rainfall. These factors in turn affect the variety and volume of crops that can be grown and the number of fish that can be caught. In fact, the oceans affect *all* life on our planet.

The world's oceans and their integral role in *weather* and *climate* are the focus of this issue of *Art to Zoo* and one of the many fascinating issues explored in *Ocean Planet*, a thought-provoking traveling exhibition inaugurated at the Smithsonian's National Museum of Natural History. As with the exhibition, we encourage you and your students to think about the profound influence the oceans have on our planetary climate and life on Earth.

AN OCEAN OF DIFFERENCE

In the complex recipe of Earth's climate and weather, no ingredient is more important than the Sun. Without its intense energy, life on our planet would be impossible. At an average distance of 93 million miles (150 million kilometers), only 1/2 billionth of the Sun's energy reaches Earth. Yet even that fraction of the Sun's power is massive—totaling some 1.8 x 10^{14} kilowatts, or more than 300,000 times the electrical generating capacity of the United States!

Not all of that solar radiation reaches the surface of Earth. Some energy is scattered by the atmosphere on its way to the surface or is reflected back by the clouds, leaving about 45 percent to complete the journey. This solar radiation is absorbed (as heat) in differing amounts by the various surfaces on Earth. Land areas heat up quickly during the day and cool rapidly at night, radiating much of their energy back to space. Luckily, atmospheric gases such as carbon dioxide and water vapor retain certain types of radiation that warm the atmosphere. Scientists have termed this phenomenon the *greenhouse effect.*

As compared with the continents, the world's oceans absorb much more of the incoming solar radiation and reflect much less back to space. That is because water has a higher *heat capacity* (holds more heat per unit volume) than land or air. Not surprisingly, the oceans' higher heat capacity directly affects the climate of our planet. The insulating effect of water gives coastal areas a more moderate range of temperatures than inland areas have at the same latitude.

The energy from the Sun (in the form of heat) fuels the circulation of Earth's atmosphere. Regions near the equator receive more heat than those near the poles. Warmer, lighter air rises at the equator while cooler, denser air sinks at the poles. This sets up a pole-to-equator movement of air at the surface and an equator-to-pole movement of air aloft, although actual atmospheric circulation is somewhat more complex. Because of Earth's rotation, atmospheric winds appear to be deflected to the right in the Northern Hemisphere and to the left in the Southern Hemisphere.

Ocean Currents—Going with the Flow

The circulation of the world's oceans generally mirrors the movements of the atmosphere. Surface currents driven by atmospheric winds move warm equatorial waters to the poles and cold polar waters toward the equator—setting up nearly circular patterns of movement known as *gyres.* Before steam-powered ships were introduced in the nineteenth century, sailors used these winds and currents to cross vast stretches of ocean. Many of the routes they took, such as those between Europe and America, were physically longer than the trade routes used today. Rather than setting out directly west from Europe, sailors moved parallel to the west coasts of Europe and North Africa until they reached the "trade winds" that carried them westward across the Atlantic to the Caribbean.

Today scientists recognize that ocean currents are more than natural highways of commerce. These massive movements of ocean water play a pivotal role in determining the climate of Earth, although their behavior is not entirely understood. And, of the myriad currents flowing through the open ocean and along the edges of continents, the Gulf Stream may have the greatest influence on climate.

This swift-moving current transports more than 100 times the outflow of all the world's rivers as it moves northeastward from Cuba to Newfoundland. Caribbean heat continues eastward (in the form of the North Atlantic Drift), greatly moderating the coastal European climate. Much of Britain, the southern parts of which lie north of the U.S.–Canadian border, experiences winters as mild as those of northern Florida, Georgia, and South Carolina, which are fifteen to twenty degrees in latitude further south!

The counterpart to the Gulf Stream in the Pacific is the Kuroshio (or Japan) Current, which moves from the Philippines northward past Taiwan and Japan. Overall, the climatic effects of the Kuroshio Current are less extensive than those of the Gulf Stream. Towering mountain ranges along the west coast of North America confine the effects of the current's waters to relatively small areas.

Other, similar currents affect climate on the rest of the planet. The relatively cold California, Peru, Benguela, and Canary Currents flow around the west coasts of the Americas, Africa, and Europe, creating cool, moist surface air with frequent fog and overcast skies.

El Niño—An Ocean Child

Not all ocean waters have a moderating effect on weather and climate. A massive ocean-atmosphere interaction in the tropical Pacific known as El Niño has brought about climatic devastation worldwide. The term *El Niño* (Spanish for "the Christ Child") was coined more than a century ago by Peruvian and Ecuadorian fishermen who noted that in some years a warm ocean current appeared during the Christmas season and lasted for several months.

The fishermen noticed because when the warm waters were present, fish were less abundant, threatening their livelihood. Even worse, they encountered heavy rains and flooding.

Scientists now understand that these fishermen were observing part of El Niño. The strongest El Niño event of this century occurred from 1982 to 1983 and has been blamed for $8 billion in damage worldwide. Climatic effects of this El Niño included drought and brush fires in Australia, Indonesia, southern India, and parts of Africa and Brazil. In contrast, heavy rains fell along the equator, in Southern California, and the southeastern United States, while winter temperatures soared far above normal in the interior of Canada.

While scientists do not entirely understand the causes of El Niño, they believe that it is linked to dramatic atmospheric changes that typically occur over the North Pacific every 2 to 7 years. In normal years, prevailing winds blowing from the east help to push Earth's warmest ocean water into the western Pacific. For reasons that aren't clear, occasionally the prevailing winds weaken and the warm water begins to move eastward across the Pacific toward South America—starting El Niño.

El Niño's effects extend far beyond the South American coast. Storm systems that would normally have been kept farther west by the prevailing winds move into the central equatorial Pacific, bringing heavy rain to typically dry islands. These heavy storm systems further disrupt the normal flow of the *jet streams* across the Northern Hemisphere.

In any El Niño year the polar jet stream shifts northward over western North America, resulting in mild winters over western Canada and the north central United States. At the same time the subtropical jet stream is more vigorous than normal, bringing heavy rainfall to the southern United States.

Tomorrow's Forecast...

Every day scientists gather vast amounts of data about the world's oceans from Earth-orbiting satellites, ocean-traversing research vessels, and drifting buoys. Advanced computer models process this raw data, helping scientists to forecast not only the probability of common weather systems but also the dramatic effects of El Niño. These efforts have been so successful that individuals, corporations, and governments alike have come to depend on weather and climate forecasts to make critical choices. Whether it's a decision to plant more or less of a crop, to import or export a product, or to invest in a developing technology, the ocean is an important factor.

Yet there is still much to be learned about the complex interactions between the ocean and atmosphere in determining our planet's weather. The ocean and atmosphere are so intertwined that it is often unclear which is driving the other at any given time. However, whatever the process, the ocean will always play an important role in tomorrow's weather.

GLOSSARY OF KEY TERMS

Weather
The immediate atmospheric conditions: temperature, humidity, precipitation

Climate
The long-term weather conditions in a specific geographic area

Greenhouse effect
The process by which Earth's surface is warmed by comparatively short-wavelength solar radiation and its atmosphere is warmed by relatively long-wavelength radiation reflected from its surface

Heat capacity
The amount of energy required to raise the temperature of a substance by a given amount

Gyres
Circular or spiral forms of water movement in an open ocean basin

Jet streams
Belts of strong winds in the upper atmosphere that separate warm and cold regions at Earth's surface

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LESSON PLAN
Step 1

OCEAN CURRENTS— GOING WITH THE FLOW

Objectives

■ Locate the continents and oceans of Earth.
■ Identify the basic circulation patterns of the oceans.
■ Evaluate the relation between ocean currents and trade routes of the past.

Materials

■ Copies of Worksheet 1, page 7.
■ Pencils or pens.
■ World maps or globes (you might also use the atlas section of your social studies book).
■ National Geographic ocean map of currents and speeds (if available).

Subjects

■ Science, geography, social studies

Procedure

1. Using the Introduction as a guide, tell your students that the oceans play a major role in determining the climate of our planet. Be sure to mention the oceans' ability to store vast amounts of solar energy (in the form of heat) and capacity to distribute that energy around the planet through currents and accompanying atmospheric winds.

2. Give each student a copy of Worksheet 1. (*Make sure each student has access to a map or globe with the continents and oceans clearly labeled.*) Ask your students to label the continents and oceans on both worksheet maps. You may wish to have students venture answers before consulting map sources, especially if your school lies within a coastal area or if you have recently completed a geography unit.

3. Direct your students to the map of ocean currents on Worksheet 1. Tell them that the map shows the relative temperatures of the currents—some are warmer than the waters surrounding them, others are cooler. Ask students to evaluate what relation exists between the temperature of the currents and their direction of flow. (*Students should conclude that warmer currents flow from the equator to higher latitudes, while colder currents flow from the polar regions toward the equator.*) This evaluation may be difficult for some students. You may wish to take a representative warm and cold current and ask students to identify whether the water in each flows toward or away from the equator. Apply the same questions to other currents to establish an understanding of the general pattern of current flow.

4. Tell your students that today scientists understand how ocean currents affect global climate. Remind them that the oceans are tremendous reservoirs of solar energy (in the form of heat) and that ocean currents move this energy around the globe. For an example, you may wish to describe the effects of the Gulf Stream on the climate of coastal Europe and North America (*this information can be found in the Introduction*).

5. To conclude the activity, direct your students to the map of ocean trade and travel routes on Worksheet 1. Tell your students that well before there was much scientific understanding of ocean currents sailors used currents to navigate. Ask students to consider how ocean-going vessels may have been powered before the advent of steam engines or any other mechanical power. They will probably say that vessels were mostly powered by the winds. Next, direct students to examine closely the trade and travel routes shown on Worksheet 1. Ask them to compare these routes to the flow of ocean currents on the top part of the worksheet. (*Students should conclude that trade and travel routes largely followed the flow of atmospheric winds and ocean currents.*)

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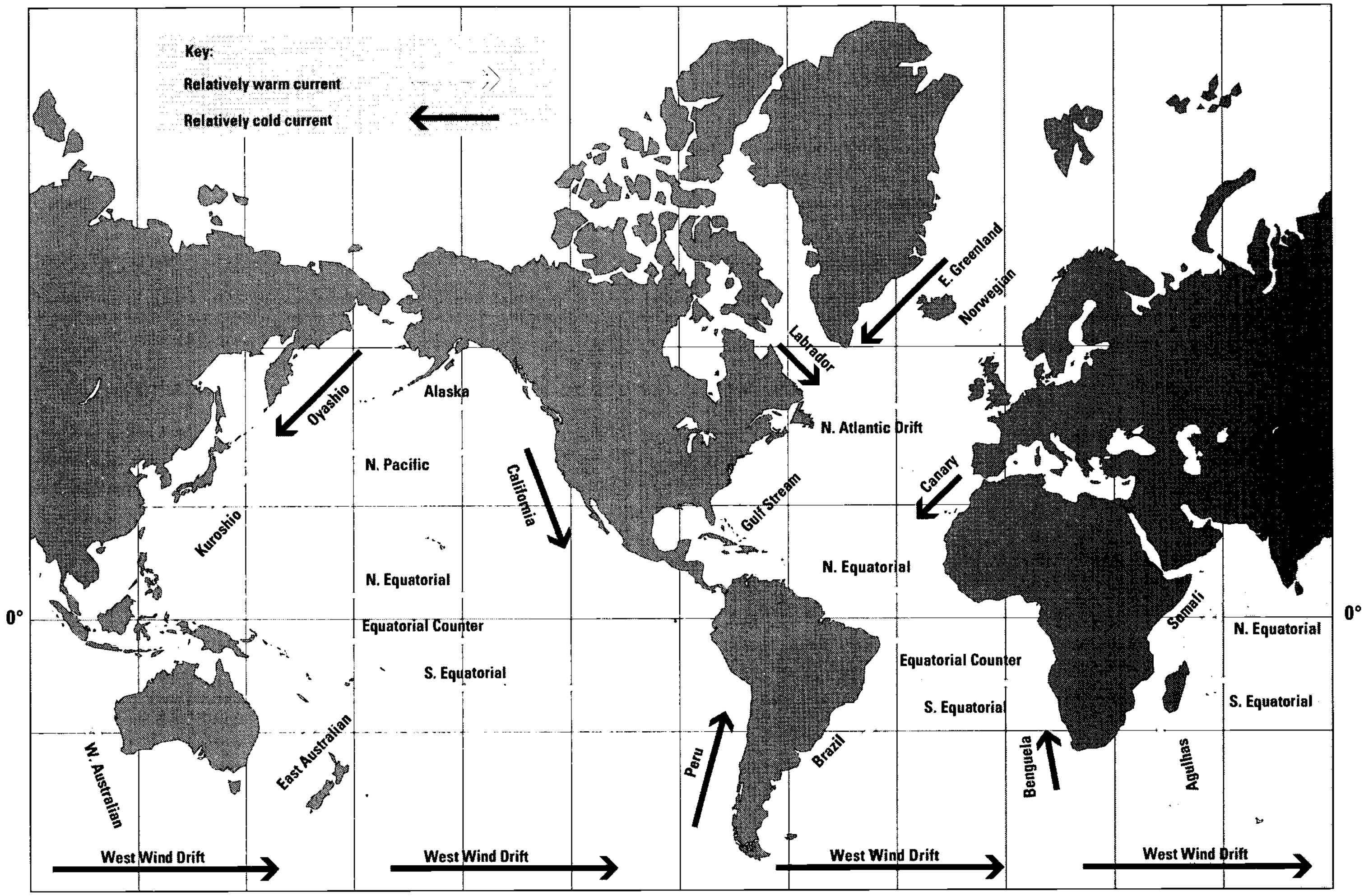
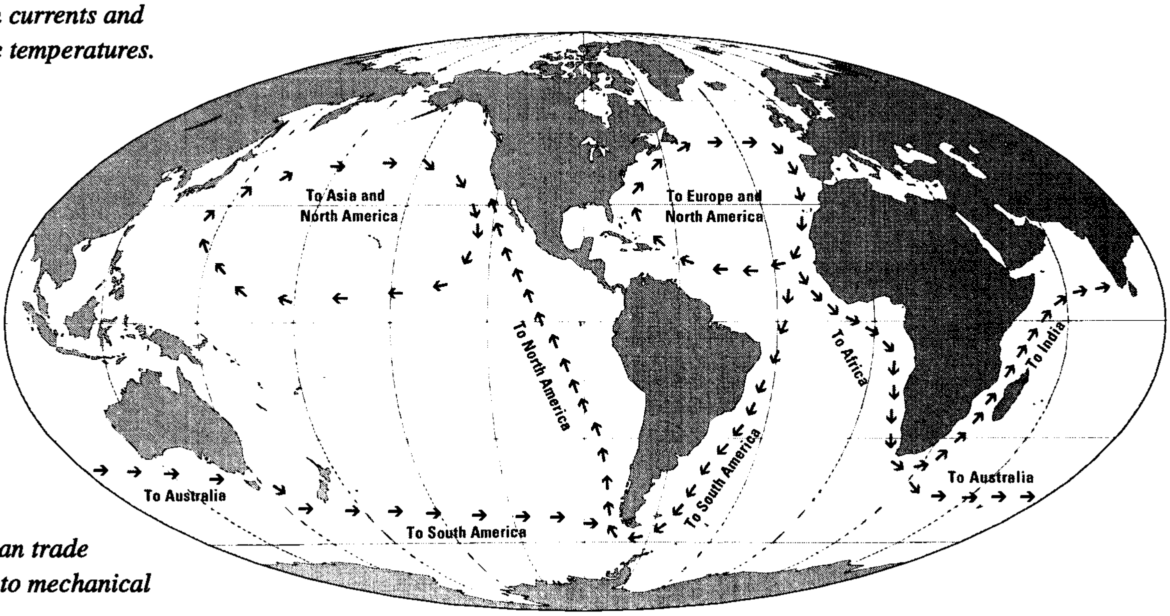
WORKSHEET 1
Ocean Currents



Major ocean currents and their relative temperatures.



Selected ocean trade ; prior to mechanical lsion.

LESSON PLAN
Step 2

COASTAL CLIMATES, INLAND CLIMATES

Objectives

- Evaluate climatic data from coastal and inland regions.
- Conduct an experiment on the differing heat capacities of water and air.
- Analyze data from an experiment.

Materials

- Copies of Worksheet 2, page 9.
- Four thermometers, four small jars of equal size, water.
- Pens or pencils.
- Chalkboard, chalk.

Subjects

- Science, math, geography

Procedure

1. Tell your students that they'll now be studying how ocean waters make the climate (in glossary) of coastal areas different from the climate of inland areas. Emphasize that first they will be examining data gathered by scientists across the world and then analyzing data from an experiment of their own.

2. (*You may wish to review the concept of latitude before proceeding with this activity.*) Give each student a copy of Worksheet 2. Direct students to examine the temperature data from the representative cities. Ask them if they notice any patterns. *Answers may vary, but students should note that the ranges of temperature are far more moderate in coastal areas.* Make sure to emphasize (if your students did not) that cities of nearly identical latitude have widely varying temperature ranges. Explain that because it takes far more energy to change the temperature of water than that of air or land, water warms up and cools off much more slowly than either. As a result, the temperatures of inland areas tend to change more than the temperatures of coastal areas that are "insulated" by water. (Note that factors other than proximity to water also affect climate. The cities in this exercise were selected only to illustrate general differences between coastal and inland climates.)

To extend the activity, you may wish to have students track two coastal and non-coastal areas at similar latitudes over a period of months. Temperature information can be found in many local newspapers.

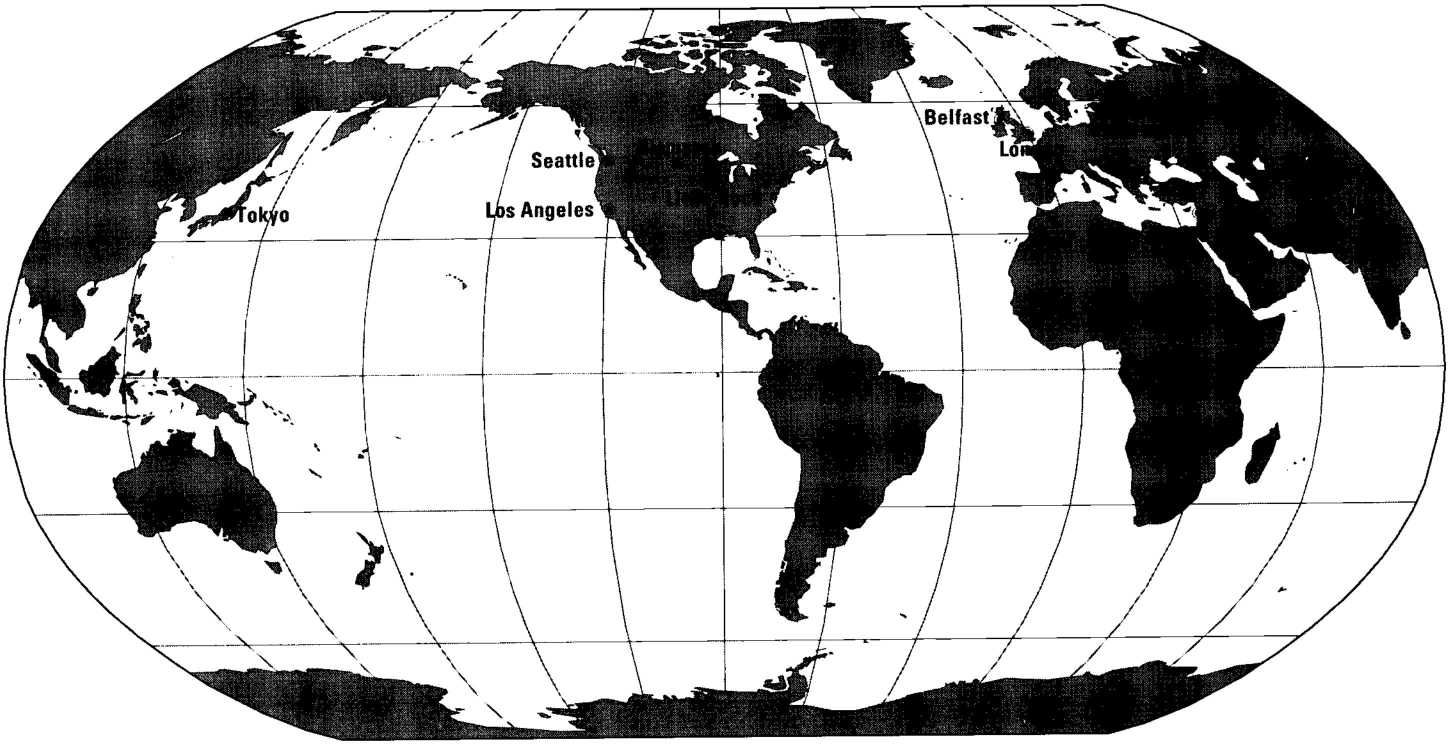
3. Explain that the following experiment tests how water and air differ in their capacity to hold heat. (*This would be a good time to review or present some basic information on the scientific method.*) Fill two small jars with equal amounts of water at room temperature (you may wish to appoint two students to do this) while leaving two other small jars "empty" with air. Divide the class into four groups of equal size and give a thermometer to each group. (*For greater safety, you may substitute alcohol-based thermometers for mercury-based units.*) Direct one group to place a jar of water in a cool, shaded spot. Have another group place a jar of water in direct sunlight. At the same time follow this procedure for the two remaining air-filled jars—have one group place a jar in a cool, shaded area and the other group place a jar in direct sunlight.

Next, tell students to place their thermometers in the jars and record the initial temperature on the worksheet. If possible, have your students take temperature readings after 15, 30, 60, and 90 minutes, recording their results on the worksheet.

To conclude the experiment, ask a representative from each group to write its temperature results on the chalkboard. Then graph the results on the chalkboard, with temperature on the vertical axis and time on the horizontal. This exercise will allow you to compare the temperature of water to the temperature of air in both shade and sunlight (*you will need to make two graphs*). The graphs will demonstrate that water cools and warms at a slower rate than air. (*If your students have already learned some graphing skills, you might want them to graph the data on the chalkboard.*)

4. Conclude the activity by asking your students if they have already observed that water and air cool and warm at different rates. Answers may vary, but many students will likely note that they have observed this phenomenon at a beach, in a pool, or in a bathtub.

WORKSHEET 2
Coastal Climates, Inland Climates



Selected inland and coastal cities.

HIGHS AND LOWS, COASTAL vs. INLAND

City	January (low)	July (high)	Latitude (°N)
Los Angeles	64°F (18°C)	81°F (27°C)	34.0°
Little Rock	50°F (10°C)	90°F (32°C)	34.5°
Seattle	41°F (5°C)	72°F (22°C)	47.5°
Bismarck	18°F (-8°C)	82°F (28°C)	47.0°
London	45°F (7°C)	73°F (23°C)	51.5°
Warsaw	32°F (0°C)	75°F (24°C)	52.5°
Belfast	43°F (6°C)	64°F (18°C)	54.0°
Moscow	16°F (-9°C)	73°F (23°C)	56.0°
Tokyo	46°F (8°C)	82°F (28°C)	35.0°
Kabul	36°F (2°C)	88°F (31°C)	35.0°
[illegible]	63°F (17°C)	90°F (32°C)	34.0°

LOG OF EXPERIMENT RESULTS

Jar of ☐ **air** ☐ **water** **(check one)**

Time (minutes)	Temperature

LESSON PLAN
Step 3

GETTING THERE— OCEAN CURRENTS AND NAVIGATION

Objectives

- Locate major port cities of the world.
- Identify ocean currents as potential travel routes.
- Analyze information from reference sources.

Materials

- Copies of the Take-Home Page, page 11.
- Copies of Worksheet 1, page 7.
- Encyclopedias, atlases.
- Pens or pencils.

Subjects

- Science, geography, social studies

Procedure

1. Begin the lesson by reminding students that the flow of ocean currents and atmospheric winds helped shape worldwide trade and travel routes before the advent of steam-powered ships. Tell them to imagine that they are captains of sailing ships during the 1800s who have been given an important mission by their ship owners: find the best travel routes between four pairs of cities. However, because of poor weather during a long ocean journey, only part of the owners' orders have arrived. The names of the cities have been lost and only a few clues to the cities' identities have survived!

2. Give each student a copy of the Take-Home Page. Tell them that they need to do two things to complete their mission successfully. First, use the "City Clues" to determine both cities in each of the pairs. Second, determine which ocean currents can help them to complete each of the four trips.

3. (*Depending on time and resource availability, you may complete the lesson as either a take-home or in-class activity.*) Tell students that to identify the pairs of cities, they will need to consult reference sources such as maps, encyclopedias, or geography books. (*If you assign this as a take-home activity, refer students to the public library.*) To find the ocean currents that would help complete the journey between each pair of cities, refer students to Worksheet 1.

4. Tell students that they will need to put the names of the cities on the Take-Home Page's world map and then trace a route between the city pairs. Be sure to mention that they also need to place the names of the ocean currents that assist in the journey on the same world map.

5. Once the students have completed the activity, review the results in class. Ask your students what reference sources they used to learn the identity of the cities. You may also ask what other interesting facts they may have learned in the course of their research.

TEACHER ANSWER KEY:

Journey 1:
Lagos
Rio de Janerio
Possible currents:
(Atlantic) South Equatorial, Brazil, West Wind Drift, Benguela

Journey 2:
Boston
Lisbon
Possible currents:
Gulf Stream, North Atlantic Drift, Canary, (Atlantic) North Equatorial

Journey 3:
Tokyo
San Francisco
Possible currents:
Kuroshio, North Pacific, California, (Pacific) North Equatorial

Journey 4:
Mombossa
Perth
Possible currents:
Agulhas, West Wind Drift, West Australian, (Pacific) South Equatorial

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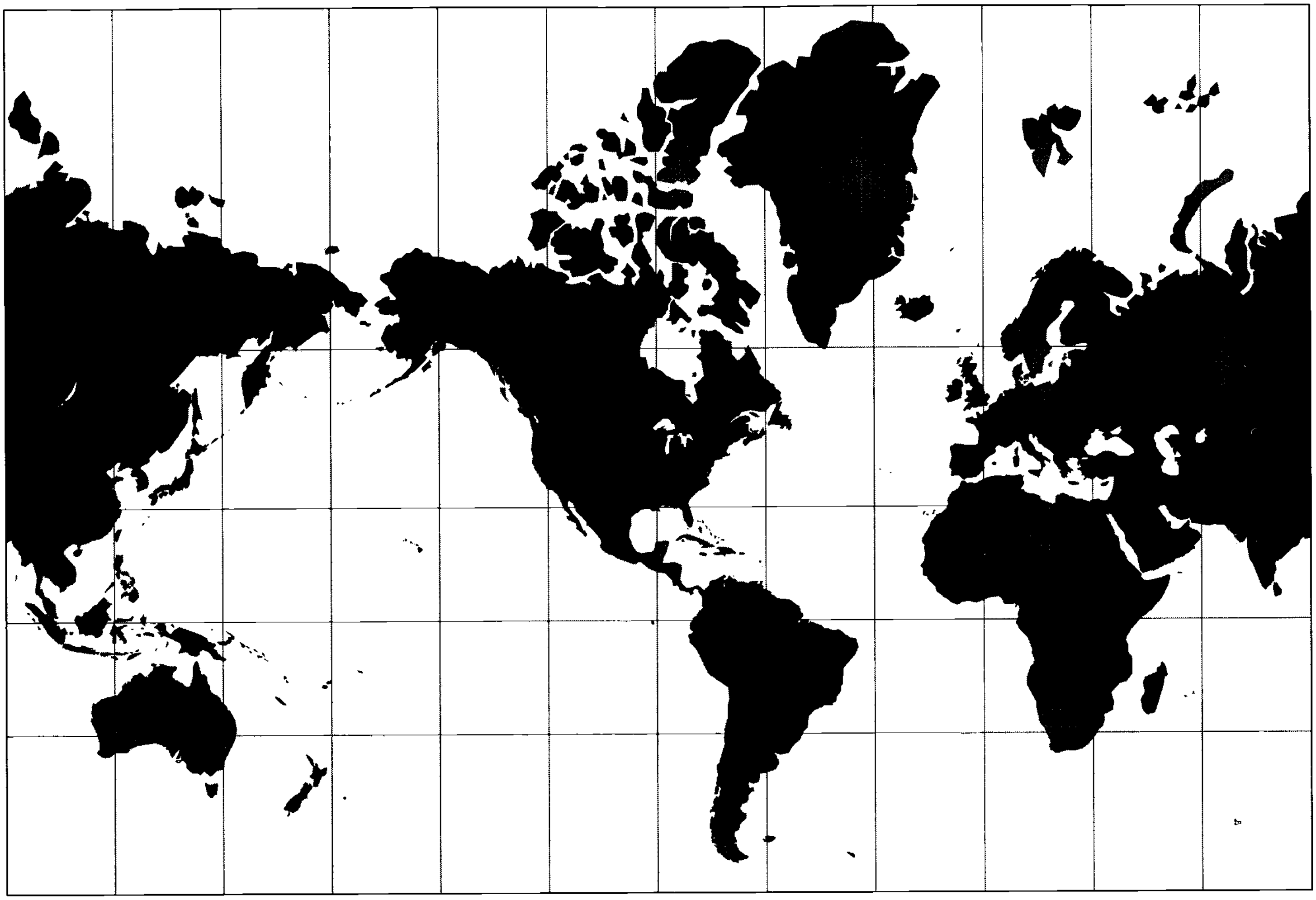
TAKE-HOME PAGE

To the teacher
■ Duplicate this page for students.
■ Use with Lesson Plan Step 3.

Publication of *Art to Zoo* is made possible through the generous support of the Pacific Mutual Foundation.



CITY CLUES—GETTING THERE

Directions:
Follow your teacher's instructions to locate the pairs of cities on the map. Be sure to also draw in the ocean currents that could be used to journey between the cities.

Journey 1

The major seaport of Nigeria.

Largest seaport in Brazil. Lies near the Tropic of Capricorn.

Journey 2

Largest city in New England and capital city of Massachusetts.

Capital city of Portugal.

Journey 3

Capital city of Japan and major world seaport.

Large seaport city in northern California located on a huge bay.

Journey 4

Major seaport of Kenya.

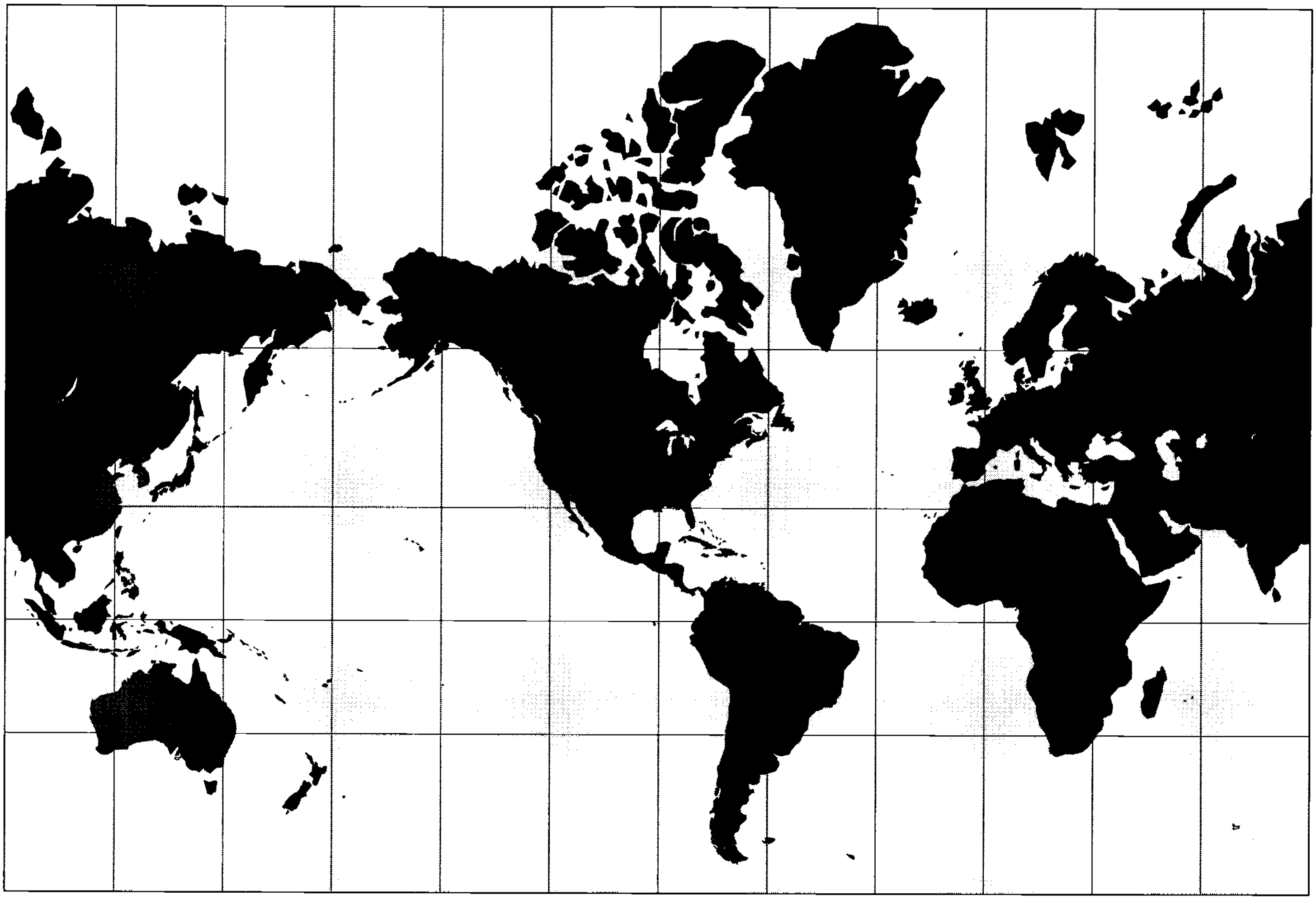
Capital city of Western Australia.

TRABAJO PARA HACER EN FAMILIA

Al Profesor

- Copie esta página para los alumnos.
- Usela con el tercero paso del plan de la lección.

Esta publicacíon ha sido posible gracias al aporte generoso de la Pacific Mutual Foundation.



SEÑAKES PARA LAS CIUDADES—CÓMO LLEGAR

Instrucciones:
Siga las direcciones de su profesor(a) para localizar los pares de ciudades en el mapa. Asegúrese de trazar una corriente oceanica que podría ser utilizada para viajar entre las dos ciudades.

Viaje 1

El puerto mayor de Nigeria.

El mayor puerto en Brazil. Se encuentra cerca del Trópico de Capricornio.

Viaje 2

La ciudad más grande de New England y las ciudad capital de Massachusetts.

La ciudad capital de Portugal.

Viaje 3

La ciudad capital de Japón y el puerto principal mundial.

Grand cudad porteña en el norte de California localizada en una bahía immensa.

Viaje 4

Puerto mayor en Kenya.

Ciudad capital de Australia Occidental.

LESSON PLAN
Step 4

EL NIÑO—
AN OCEAN CHILD

Objectives

■ Analyze satellite-based data for evidence of El Niño.
■ Evaluate weather reports for evidence of El Niño.

Materials

■ Copies of Worksheet 4, page 14.
■ Pens or pencils.
■ Crayons, markers, or colored pencils.

Subjects

■ Science, geography, social studies

Procedure

1. Begin the activity by telling your students that the climatic effects of the ocean are not always moderating or favorable. Using the Introduction as a guide, explain the devastating effects of the 1982–83 El Niño—the most intense El Niño event of the century. Be sure also to provide your students with an understanding of the causes of El Niño and its relation to ocean waters in the North Pacific. Stress that El Niño can divert the normal flow of the jet streams over North America, leading to milder winters over the north central United States and torrential rain over the southern United States.

2. Give each student a copy of Worksheet 4. Tell them that satellites enable scientists to collect vast amounts of weather information that would take decades to gather with ocean-going research vessels. Stress that scientists can use satellites to observe El Niño and can predict this event one season in advance.

Tell students that the two sea-surface temperature maps, Part A on Worksheet 4, are based on satellite data gathered during two different years. The data on one map represent an El Niño year, while the data on the other represent a non–El Niño year. Ask students to complete the maps by coloring in the ocean temperature bands according to the key provided. After the students have finished coloring the two maps, ask them to decide which represents an El Niño year. (Key: Year 1 is the El Niño year.) This may be difficult for some students. Suggest that they look to the coast of South America. Warm waters offshore are a sure indication of an El Niño year.

3. Tell your students to imagine the following scenario: They are scientists in the future interested in determining whether El Niño occurred during a 2-year period. Unfortunately, the satellite weather data they requested are missing. All they have to determine whether an El Niño event occurred are two reports of January weather events.

4. Direct your students to Part B on Worksheet 4. Ask them to read the items carefully, using them to determine which year was an El Niño year. (Key: Year 2 is the El Niño year.) Make sure your students justify their answers with concrete examples of atypical weather events. This may be difficult for some students. Suggest that they look for weather conditions similar to the ones you mentioned in your description of the 1982–83 El Niño event.

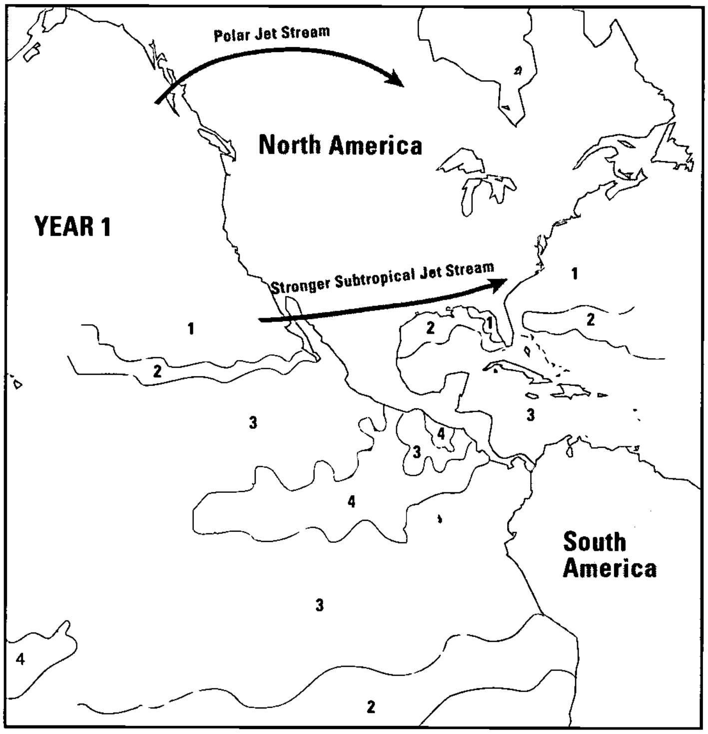
5. Conclude the activity by asking students whether they think there is presently an El Niño condition. Ask them to provide specific weather examples that may have resulted from an El Niño event. (*Check current climate information before proceeding.*)

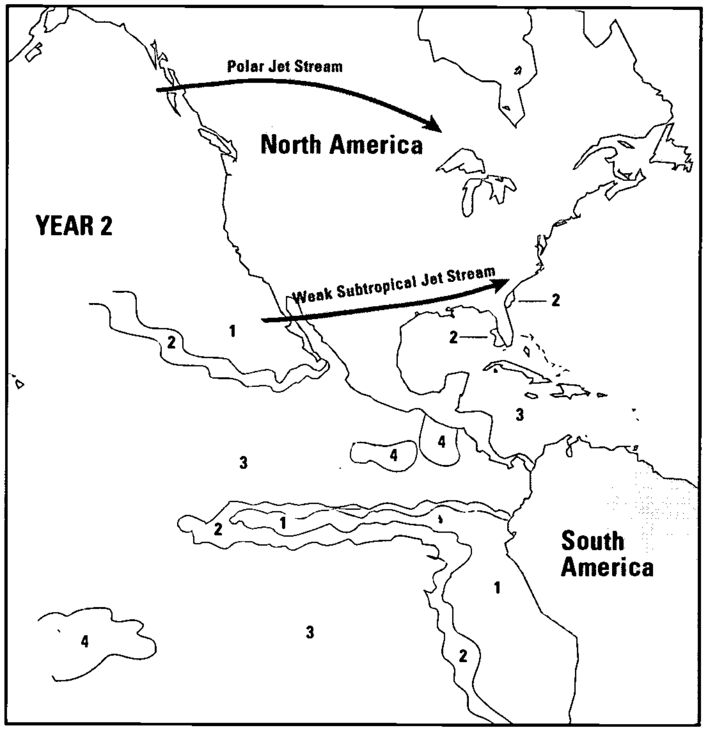
WORKSHEET 4
Find El Niño

Key
1=Green ↑ Colder
2=Yellow
3=Orange
4=Red ↓ Warmer

PART A: SEA-SURFACE TEMPERATURES AND JET STREAMS BASED ON SATELLITE IMAGES

Directions: Color the numbered areas according to the key. Which is the El Niño year?





PART B: JANUARY WORLD WEATHER ROUNDUP

Directions: Interpret these weather clues. Which is the El Niño year?

YEAR 1

Northeastern United States
High temperatures ranging from 25° to 30°F (-4° to -1°C)

Southeastern United States
High temperatures from 45° to 50°F (8° to 10°C)

Western United States (coastal)
Mild, rainy

South America
Mild, cool waters offshore

India
Periods of rain with intermittent sunshine

Southern Africa
Periods of rain with intermittent sunshine

YEAR 2

Northeastern United States
High temperatures ranging from 45° to 50°F (8° to 10°C)

Southeastern United States
Heavy rains and flooding

Western United States (coastal)
Severe storms

South America
Heavy rain and flooding in Peru and Ecuador

India
Dry, drought conditions

Southern Africa
Dry, drought conditions

RESOURCES

BOOKS, REPORTS, AND MAPS

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Franck, Irene M. G. *To the Ends of the Earth: The Great Travel and Trade Routes of Human History.* New York: Facts on File, 1984.

Ganeri, Anita. *The Oceans Atlas.* New York: Dorling Kindersley, 1994.

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University Corporation for Atmospheric Research. "Reports to the Nation on Our Changing Planet: El Niño and Climate Prediction." Boulder, Colorado: University Corporation for Atmospheric Research, Spring 1994.

ELECTRONIC RESOURCES

An interactive online version of the *Ocean Planet* exhibition is available through the Internet via the World Wide Web at **http://seawifs.gsfc.nasa.gov/ocean_planet.html.** This "virtual exhibition" features sound, video, and graphics that enhance understanding of the many themes of *Ocean Planet.*

Detailed information on El Niño is also available through the Internet via the World Wide Web at **http://columbia.wrc.noaa.gov/toga-tao/el-nino-story.html.** This site features animations and graphics that explain the complex interaction between the ocean and atmosphere in the making of El Niño.

A good site for teachers to begin exploring weather resources on the Internet is the University of Michigan's gopher site at **gopher://groundhog.sprl.umich.edu.** Here you can download the latest version of Blue Skies, an interactive weather display system that provides current weather data, satellite photographs, and weather maps. This application is available for Macintosh and Power Macintosh computers.

Note: Because of the rapidly evolving nature of the Internet, the uniform resource locators (URLs) above listed may have changed since publication.

CURRICULUM MATERIALS

Weather, a hands-on earth science unit for primary grades developed by the National Science Resources Center, introduces students to the components of weather and a variety of tools that help them learn more about temperature, wind, rainfall, and cloud formations. The complete kit is $369.95; the teacher's guide ($14.95) and activity books ($2.00 each) are available separately. These materials are offered through Carolina Biological Supply Company, 2700 York Road, Burlington, North Carolina 27215. Call (800) 227-1150 for more information.

EXHIBITION TOUR

The Smithsonian Institution Traveling Exhibition Service has scheduled the exhibition *Ocean Planet* to tour through a number of U.S. cities from March 1996 to November 1999. The following tour itinerary does not include five sites that are unannounced at the time of this publication.

- The Presidio of San Francisco, California
March 30–June 23, 1996
- Christopher Columbus Center, Baltimore, Maryland
July 27–October 20, 1996
- American Museum of Natural History, New York, New York
November 23, 1996–February 16, 1997
- Bishop Museum, Honolulu, Hawaii
July 12–October 5, 1997
- Chicago Museum of Science and Industry, Illinois
May 23–August 15, 1998
- Museum of Science, Boston, Massachusetts
September 19–December 13, 1998

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