

INVESTIGATION

4



Project

Formation of Deserts

PURPOSE

- ▶ Explain factors in the existence and location of Earth's deserts
- ▶ Analyze atmospheric, geographic, and oceanographic data in relation to desert formation

BACKGROUND

Why are there deserts and why do they exist where they do? **Deserts** are geographic places that receive less than 25 cm, or 10 in., of rain each year. They usually are found in areas where moisture-laden air fails to come in contact with the land. Many deserts are hot in the daytime and cold at night. It is not uncommon for their temperature to change as much as 50°F from day to night. This is primarily because of their low humidity, between 10–20%. By contrast, deciduous forests in the eastern United States, with about 80% humidity during the day, absorb heat and hold much of it during the night. There the average temperature change in summer is only about 20°F from day to night. Water has a high **heat capacity**, as you learned in Investigation 3, and must lose a lot of energy for a small temperature change, whereas soils can change temperature quickly. For this reason water vapor is a very effective greenhouse gas.

Fig. 4-1

"The Mittens," Mesas on the Navajo Indian Reservation in Arizona's Monument Valley



While deserts cover 20% of the Earth's surface, they are not randomly distributed. And not all deserts are hot. They can exist in cold regions as well, provided they lack precipitation. Below are examples of how this phenomenon explains the existence of most of the world's deserts, which exist generally in four types of regions.

I. High-Pressure Areas Many people who watch TV weather reports know that low pressure generally means rainy, damp conditions while high pressure brings dry, clear weather. The same rules apply to geographic regions. Belts of high pressure around Earth, near the latitudes of 30°N and 30°S, seem to correspond to many of the world's hot deserts. High-pressure zones also occur at the poles, which are cold deserts.

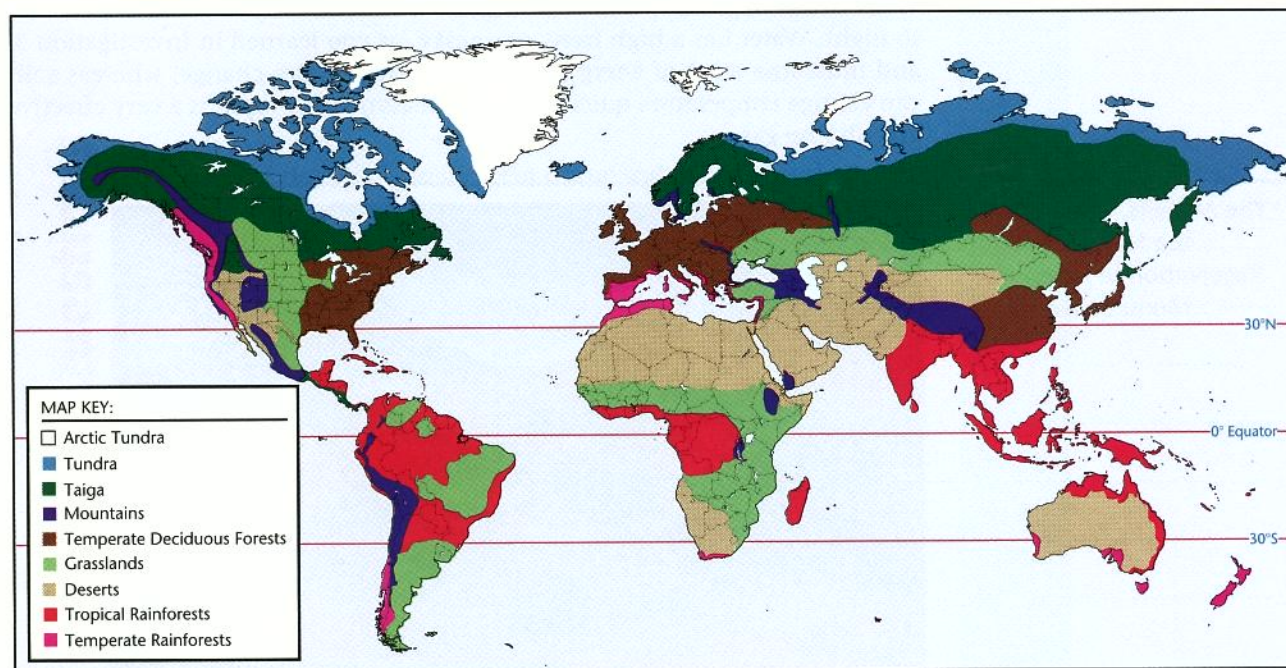
II. Mountain Areas Mountain ranges tend to remove water from the atmosphere as air masses rise to move across the range, from **windward** to **leeward**, leaving much drier air to descend on the other side. Deserts can form on the downwind, or leeward, side of the mountain range. These are sometimes called **rainshadow deserts**.

III. Coastal Areas Some deserts are coastal, a fact that might seem to contradict the lack of moisture rule for deserts. Atmospheric moisture comes from the sea—remember the **Hydrologic Cycle**. The air over the ocean may be nearly saturated with water, but the total amount of water depends on the water temperature. Cold coastal water does not evaporate easily and can even remove atmospheric moisture. Cold air holds less moisture. When this cold, low-humidity air moves onto land that is warmer than the ocean, the air warms and absorbs moisture from the land, making it drier than it would normally be.

IV. Inland Areas The interiors of large continental land masses are usually much drier than the coasts. Moist air from off-shore usually loses much of its water by the time it reaches the interior.

Fig. 4-2

Earth's Desert Regions



1. Explain why there are global high-pressure and low-pressure belts on Earth. In some detail, tell how the high-pressure belts give rise to many of the world's largest deserts.

2. For this question, use your text or other sources as needed. Then, on the drawing of the globe, **Fig. 4-3**, draw and label:

a. The major high- and low-pressure belts of Earth

b. The following wind belts, indicating with arrows the direction in which they blow:

- Doldrums
- Tropical Easterlies (tradewinds)
- Horse Latitudes
- Prevailing Westerlies
- Polar Easterlies

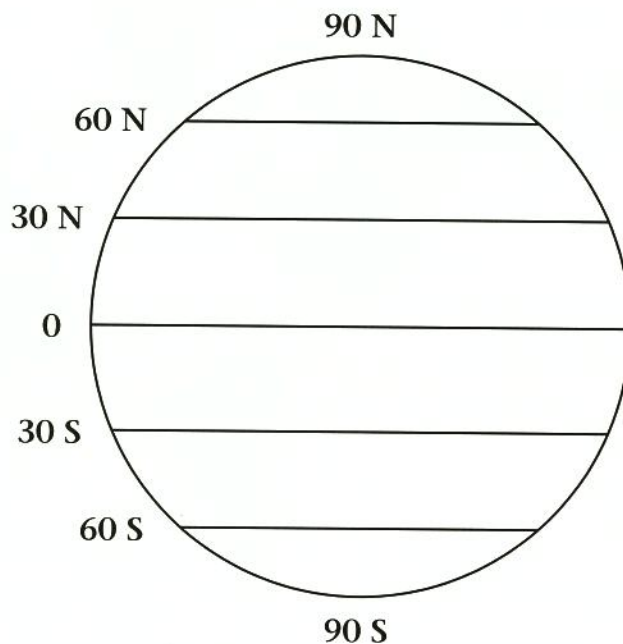


Fig. 4-3: Earth's Major Wind and Pressure Belts

Questions

3. Based on the information you drew on the map for Question 2 and your knowledge of the major mountain ranges of North and South America, explain the following:

a. the deserts of eastern Washington State and Oregon

b. the deserts of Nevada, Utah, and Arizona

c. Death Valley of California

d. the Atacama Desert of Chile on the western side of the Andes and the Monte Desert of Argentina on the eastern side of the Andes

Questions

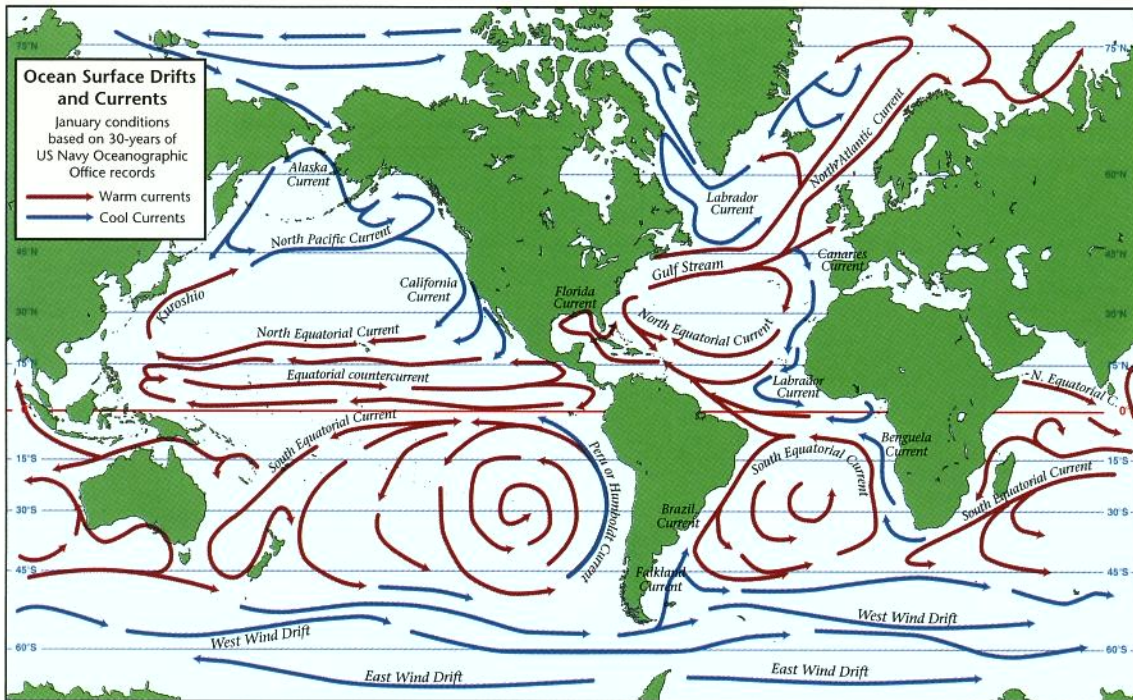


Fig. 4-4: Major Ocean Currents

4. Observe in **Fig. 4-4** the major surface currents of the Earth's oceans. The large circulations are called **gyres** by oceanographers. In the northern hemisphere the gyres move clockwise and in the southern oceans counterclockwise. Notice that some currents, such as the Peru current, move from the poles toward the Equator, bringing cold water along the coast. Others, like the Gulf Stream on the east coast of the United States, bring warm water from the tropics.

a. Should the east coast of South Africa be drier than the west coast of the country? Why or why not?

b. Explain how the cold California Current contributes to the dryness of southern California, Arizona, and New Mexico.

5. Why is there a large desert region in central Asia, while the central plains of the interior United States is not a desert? As part of your answer, describe the differences between the geography of central Asia, with its relation to the Indian Ocean, and the central plains of the United States, with its proximity to the Gulf of Mexico.

Questions

6. Briefly describe how rising and sinking air (high and low pressure) in the atmosphere can be the same explanation for:

a. clear and rainy days

b. deserts near 30° N and 30° S

c. rain shadows

d. the Monsoon of southern Asia and the southwestern United States

7. Describe three strategies or adaptations used by the following to survive in desert environments:

a. plants

b. vertebrate animals
