





# Waiting for the Rains: The Effects of Monsoons in South Asia

## 27.1 Introduction

Every June, all of India looks to the sky. When the rains come late, people begin to worry. Indian astrologers call this time *rohini*. It is a time when hot, dry winds swirl dust across the parched plains. Women might walk for miles in 115°F heat to the nearest water source. Sometimes they collapse from heat exhaustion.

As one hot day follows another, farmers pray for help from the Hindu rain god Indra. In one region, people catch frogs to bring rain. They hope that the frogs' loud croaking will call down clouds from the sky. Even the giant crocodiles of northern India wait eagerly for the rains. Without flooded, moist riverbanks, they have nowhere to lay their eggs.

When the skies finally darken, a sense of expectation builds. The **monsoons** have arrived. These seasonal winds blow in from the ocean each summer. They are strong and violent, bringing with them clouds heavy with moisture. Almost all of the rain South Asia gets each year comes from these summer storms. All of India celebrates as sheets of rain pound the dry, thirsty land below.

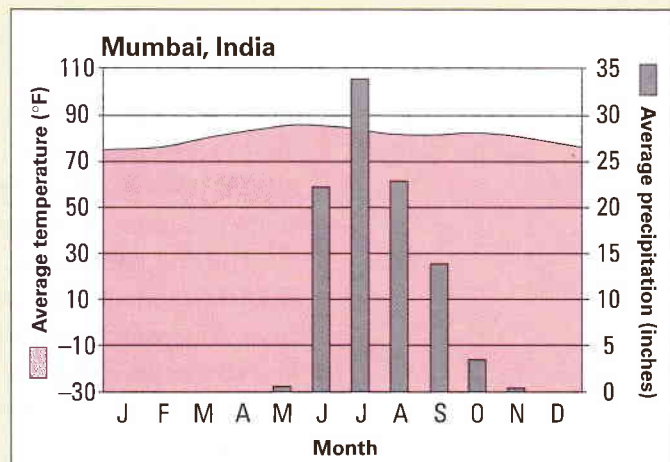
In this chapter, you will find out why the monsoons blow across South Asia each year. You will explore how monsoons affect the **climate** of four cities in this region. And finally, you will discover how the people in these cities adapt to a lifetime spent waiting for the rains.

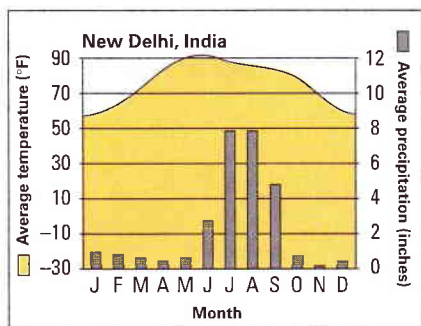
### Essential Question

**How does climate influence human activity in a region?**

This climagraph shows average monthly temperatures and precipitation in the city of Mumbai, India. Notice the bars. They show the average precipitation for each month. Also notice the line. It shows average monthly temperatures for this city. Keep this climagraph in mind as you try to answer the Essential Question.

### Graphic Organizer





### New Delhi's Monsoon Climate

Monsoon winds affect the climate of New Delhi, the capital of India. The city sits on the edge of the Thar Desert in northern India. From October to May, it stays mostly cold and dry. But during the summer monsoon months, rain can drench the city.

## 27.2 The Geographic Setting

South Asia juts out into the Indian Ocean like a giant triangle. This very large **peninsula** is also known as the Indian subcontinent. The Himalaya mountain range cuts the subcontinent off from the rest of Central Asia. One out of every five people on Earth lives in South Asia. Most are farmers who both look forward to and fear the coming of the monsoons.

**Changes in Atmospheric Pressure Create Monsoons** Have you ever heard a weather forecaster talk about an area of high or low pressure? What this means is high or low **atmospheric pressure**. This is the weight of the **atmosphere** pressing down on the surface of Earth. Falling cool air creates areas of high pressure. Rising warm air creates areas of low pressure.

In a high-pressure area, cool air from the upper atmosphere presses down toward Earth's surface. As it does so, atmospheric pressure increases. With all of this downward pressure, very little surface air can rise into the upper atmosphere to form clouds. High pressure generally means sunny days and no rain. The opposite happens in a low-pressure area. Warm surface air moves easily into the upper atmosphere. If this air is moist, it forms clouds that bring rain.

Air from high-pressure areas naturally flows into low-pressure areas. This movement of air creates wind. In the spring and summer, the air over South Asia warms up faster than the air over the Indian Ocean. As this hot air rises, it creates a low-pressure area. Cool, moist air from the Indian Ocean flows into the area of low pressure. This movement of air creates the summer monsoons.

In the fall and winter, however, the air over South Asia cools down. The cooler air sinks and forms an area of high pressure. This high pressure keeps the moist air that blew in with the summer monsoons far out to sea. Little rain falls in South Asia from October to March. During this long dry period, South Asians must deal with dusty fields and dwindling water sources.

**Mountain Ranges Create Rain Shadows** Mountains affect where summer storms drop their moisture. A mountain slope facing **upwind**, or against the monsoon winds, generally gets a lot of rain. A slope facing **downwind**, or in the same direction the wind is blowing, gets far less rain. Geographers call the impact that mountains have on rainfall patterns the **orographic effect**.

The orographic effect works this way. When clouds blow up against mountains, the moist air rises up the slopes. As the air rises, it cools. The cooling air cannot hold as much moisture as it did before. And so the clouds release their moisture as rain or snow.

By the time the clouds cross over the mountains, they have little moisture left. As a result, people living on the downwind side get very little rainfall. This dry area is called a **rain shadow**. People living in a rain shadow have to adapt to life with little rain.

## ► Geoterms

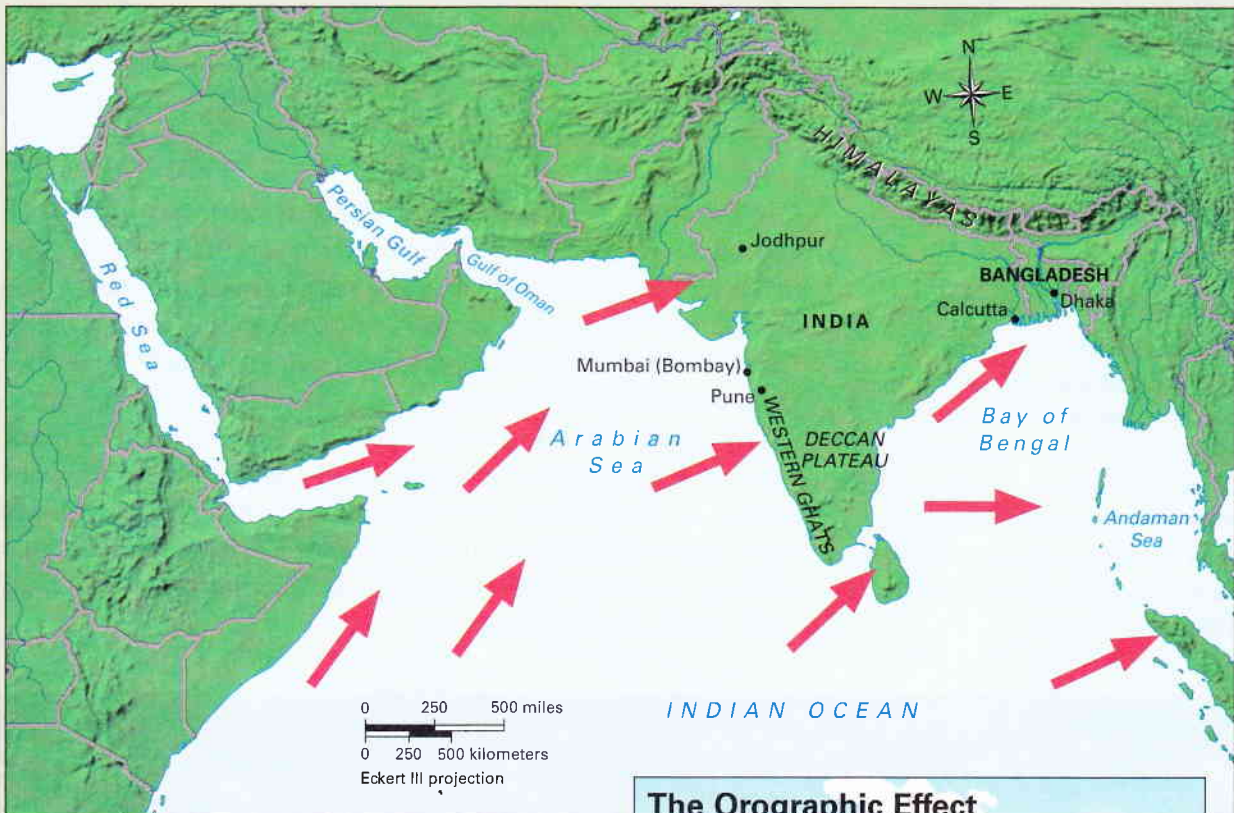
**atmospheric pressure** the weight of the atmosphere pressing down on any point of the surface of Earth. Air sinks in high-pressure areas, and few clouds form. Air rises in low-pressure areas to form clouds that produce rain.

**monsoon** a seasonal wind. Summer monsoon winds in South Asia usually bring rain to that region.

**orographic effect** the precipitation that occurs when moist air rises up the side of a mountain. As the air rises, it cools down and releases most of its moisture as rain or snow.

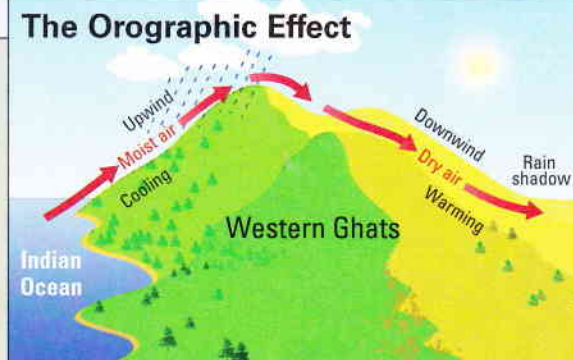
**rain shadow** a dry area on the downwind side of a mountain

### South Asia's Summer Monsoons



#### Monsoons and Mountains

Summer monsoon winds carry moist air from the Indian Ocean. These winds strike the Western Ghat mountain range in western India. As air rises, it cools and drops its moisture as rain. Cities on the upwind side of the mountains receive plenty of rainfall. Cities on the downwind side, in the rain shadow, receive relatively little.





## 27.3 The Wet Months in Dhaka, Bangladesh

Ten million people live in Dhaka, the **capital city** of Bangladesh. For them, July can be a difficult month. In July 1996, the homes of 3 million people were flooded. Two years later, 1,500 people died in July floods. Their deaths were blamed on everything from drowning to disease. In July 2004, rains left much of Dhaka under water.

**One of the World's Wettest Capitals** Most of Bangladesh lies on a river **delta** that seldom rises more than 30 feet above sea level. Rice, a crop that grows best in warm, shallow water, thrives here. In July, monsoon rains often raise rivers to dangerous levels. When the rivers flood, even rice finds it hard to survive.

Dhaka sits in the center of Bangladesh. The city has one of the wettest climates on Earth. Up to 80 inches of rain falls there each year. Most of this rain comes in the summer months. From November to April, the weather is dry.

Flooding is not Dhaka's only problem. Bangladesh is often hit by **tropical cyclones**. Tropical cyclone is another name for hurricane. Because Dhaka sits at sea level, it is often lashed by high winds and waves during these violent storms.

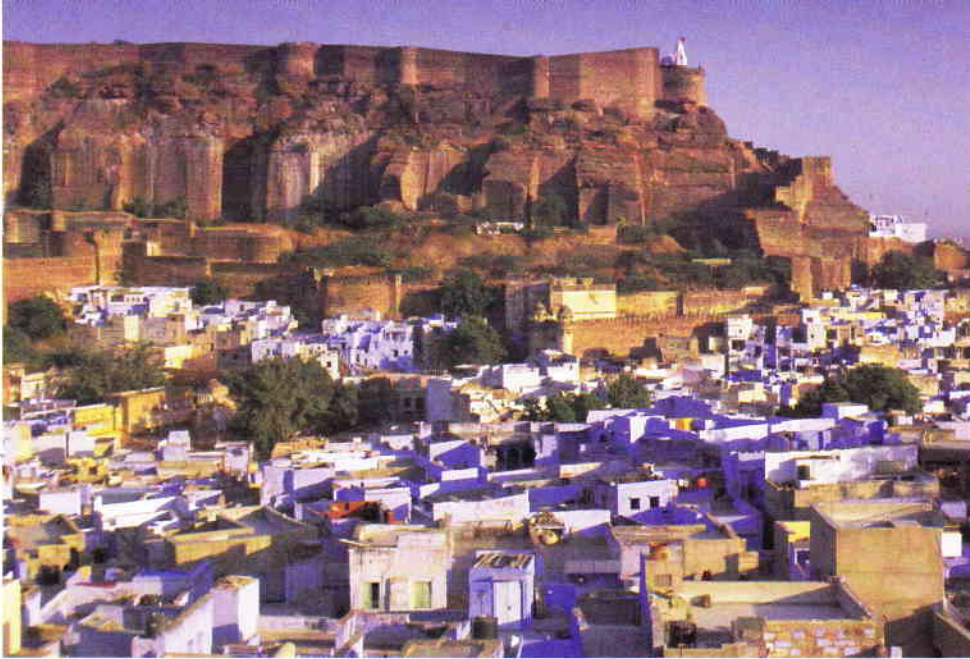
**Life Depends on the Rains** Bangladesh's economy depends on agriculture. Nearly three out of every five people farm the country's rich delta soil. They rely on monsoon rains to water their fields. When the summer rains are late, crops like rice, sugarcane, tea, and tobacco suffer. When monsoons bring too much rain too quickly, fields flood. Deep water then makes planting and harvesting impossible.

Dhaka also suffers from too much rain. When city streets flood, car and bus traffic comes to a halt. Schools and businesses close down because no one can get to work. Floodwaters pollute the city's drinking water supply. Under these conditions, disease spreads rapidly. Children growing up in Dhaka learn early that the rains that bring life to local fields can also end life in the city.

### Preparing for the Rain

The people of Dhaka have come to expect flooding when the summer rains arrive. One way they have adapted is to raise their homes up on stilts. A raised home is not convenient most of the year, when everything has to be carried up and down stairs or ladders. In times of flood, however, it can be a lifesaver.





### The Blue City Beneath the Fort

The Mehrangarh Fort was built in 1459. It sits on a tall hill overlooking Jodhpur. Because the buildings of this city are painted blue, Jodhpur has earned the nickname the Blue City.

## 27.4 The Dry Months of Jodhpur, India

The Mehrangarh Fort rises out of the **desert** like a towering giant. The fort looks down on the “Blue City” of Jodhpur, India. In the old city, most of the houses are painted blue. Some say this is to keep away mosquitoes. In July 2002, nearly half of Jodhpur’s crops could not be planted. The summer monsoons were late. The worst **drought** in more than 40 years had begun.

**A City on the Edge of a Desert** Jodhpur sits at the eastern edge of the Thar Desert in northern India. This region is a leading producer of cattle, spices, and grains. It has a typical **semiarid** climate. For most of the year, the weather is hot and dry.

The people living in and around Jodhpur are used to their semiarid climate. In most years, the city receives about 14 inches of rain. Average temperatures do not drop below 60°F, even in the winter. Summer monsoons bring much-needed rains from June to September.

**Water Is a Critical Resource** Eighty percent of the people living around Jodhpur are farmers. But farming is difficult in this dry region. The desert soil needs a great deal of water to produce crops. Farmers depend on the monsoons for that water. How much rain will come and when will it arrive are questions people here ask every year.

The rains come late in some years. Or too little rain falls. When that happens, crops fail. Drinking water vanishes. Families that run out of food sometimes survive by eating *samas*, a wild grass. As people grow weak from hunger, disease spreads more easily.

The people of Jodhpur have learned to adapt to their semiarid climate. Many raise livestock as well as crops. The animals can survive on native plants when crops fail. Some farmers have begun to use drip irrigation to conserve water. This method drips water directly on a plant’s roots. Little water is wasted as **runoff** or to **evaporation**. This careful use of water makes sense in Jodhpur, where every drop counts.



### The Dry Plains Near Jodhpur

Water is a luxury in the area around Jodhpur. Women must sometimes walk miles in scorching heat to fetch drinking water for their families. Wind can pick up the thin dust on the arid plains. These dust storms are common before the summer monsoons.



### Life Continues Despite Floods

Monsoon rains often fill the streets of Calcutta. Buses and cars can't drive through flooded streets. But rickshaws can. A rickshaw is a small cart with two or three wheels. It is pulled by someone who walks or bicycles in front of it. Rickshaw drivers are highly valued during the summer monsoon season.



### 27.5 Waiting for the Rains in Calcutta, India

Calcutta is a city of contrasts. It has been called both the “City of Joy” and the “Dying City.” Its modern skyscrapers tower over the muddy Hooghly River, a branch of the Ganges River. When the monsoons come in June, the river floods. After a rain shower or two, Calcutta finds itself knee-deep, or even neck-deep, in water.

**Wet Summers and Dry Winters** Around 15 million people call Calcutta home. About a third of them live in **slums**.

The city's winters are dry and pleasant. Moderate winds blow in from the north. From June to September, the winds shift directions. Moist monsoon air blows in from the Indian Ocean. Monsoons can dump nearly 50 inches of rain on the city in only four months. Temperatures can soar to 100°F. The summer rains present a great challenge to Calcutta.

**Monsoon Rains Begin and End Life** Calcutta floods easily. The city's old canals overflow quickly when rain fills the streets. Buses and taxis can't drive on flooded roads. Children wade to school through waist-high water and spend the day in wet clothing. Still, the monsoon rains are welcome. Farmers need the rain to water their crops. The rains also provide relief from the sticky summer heat.

Calcutta has had to find ways to deal with summer floods. In the past, a system of canals drained floodwater out of the city. Later this system was abandoned for modern streets and sewers. But when too much rain falls, garbage clogs the old canals. Standing water in flooded streets breeds mosquitoes. Diseases spread by mosquitoes, such as malaria, spread quickly. People sicken and die.

Today Calcutta officials are looking at rebuilding the city's old canals to help with flooding. Meanwhile, sewer lines are being repaired so that they can carry more water during storms. The city is also working to keep the river clear of debris so that more water can drain downstream during heavy rains.

## 27.6 Living in the Rain Shadow: Pune, India

Pune is located on the Deccan Plateau in western India. It is only 115 miles from Mumbai—a short two-hour drive. Yet Mumbai receives over 70 inches of rain during the summer monsoons. In contrast, Pune’s rainfall totals only 29 inches for the entire year.

**A Year-Round Dry Climate** Between Mumbai and Pune lies a mountain range known as the Western Ghats. As monsoon winds rise up its slopes, the air cools and releases its moisture. By the time the winds reach the downwind side, little moisture is left.

Pune sits in a rain shadow on the opposite side of the Western Ghats from Mumbai. While the coastal city must brace for heavy rain, Pune is spared from flooding. For most of the year, the air is dry and pleasant. The monsoons bring welcome rains from June to September.

**Limited Rainfall Makes Water Precious** The people of Pune have learned to get by with little water. In the past, farmers here raised sugarcane, a crop that requires a lot of water. Today they plant crops that are more drought resistant, such as sugar beets.

Pune has also tried to increase its rainfall with **cloud seeding**. This process involves scattering chemicals into clouds to bring about rain. Rain falls when the water vapor in clouds condenses into droplets. These droplets form around tiny specks of ice in the air. Under the right conditions, clouds can be seeded to help condensation to occur. Usually this is done by spraying them from the air with tiny bits of silver iodide or dry ice. The hope is that water droplets will form around these “seeds.”

It is hard to tell just how effective cloud seeding is in Pune. The reason is that no one knows how much rain might have fallen without seeding. But for people living in a rain shadow, the chance of more rain makes seeding seem worth the cost.



### Living in a Rain Shadow

Pune lies in a rain shadow. Farmers in the area can grow crops like rice only if monsoon rains are plentiful.

## 27.7 Beginning to Think Globally

In this chapter, you learned how monsoons affect climate in South Asia. Differences in atmospheric pressure between the land and sea cause the summer monsoons. These winds bring both welcome rain and deadly floods to coastal cities. The orographic effect also shapes the climate of this region. Cities on the downwind sides of mountains often lie in a rain shadow. Unlike their coastal cousins, the people in these cities must adapt to limited rainfall.

Other regions also have monsoons. From November to April, northern Australia braces for its monsoon season. Monsoons hit the West African coast from May to July. In Arizona, monsoon rains arrive in the middle of summer, as moist air from the Gulf of Mexico blows inland.

Wherever people live, climate affects their activities. Think about this as you look at climates around the world in the next section.



## 27.8 Global Connections

The map shows climate zones around the world. The three climagraphs show average monthly temperatures and precipitation in three cities.

### How might climate affect the type of housing people build?

In hot and humid tropical climates, people build homes that let in the breeze. In dry desert climates, they make windows small to keep out the sun. In very wet climates, people build houses raised on stilts. A raised house stays dry when the land below it floods. In **tundra** climates, houses are also raised off the ground. This is to allow cold air to flow under the building. Otherwise, the warmth of a house could melt the **permafrost**, or permanently frozen ground, below. If this happened, the house could sink into the mud.

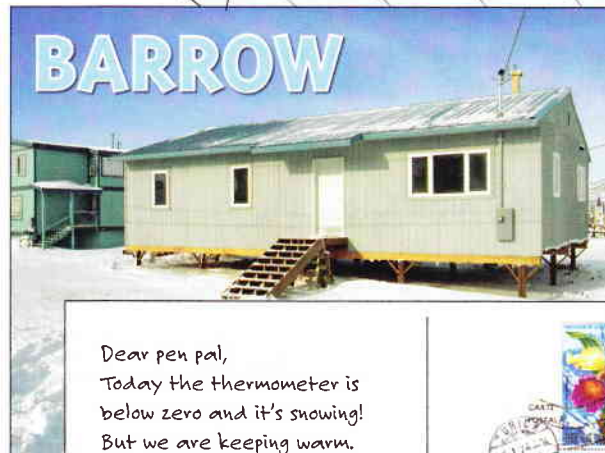
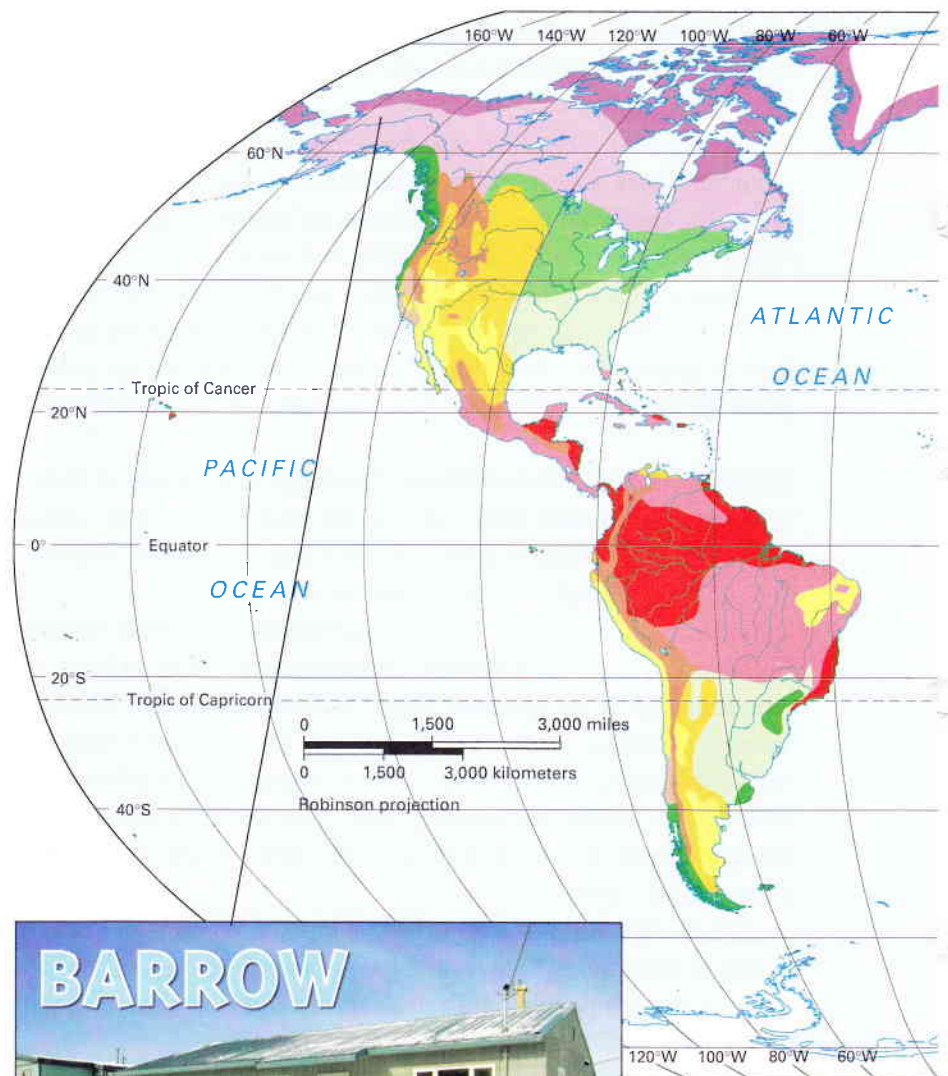
### How might climate affect the type of clothing people wear?

People who live in arid climates often wear loose-fitting, flowing clothes. They want to cover up most of their skin to avoid being too exposed to the sun. People who live in more temperate places like London have come to expect daily downpours. They keep umbrellas and raincoats handy.

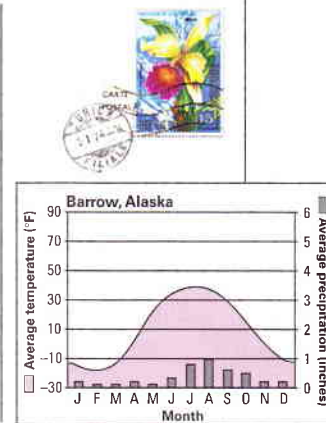
### How might climate affect what people do for fun?

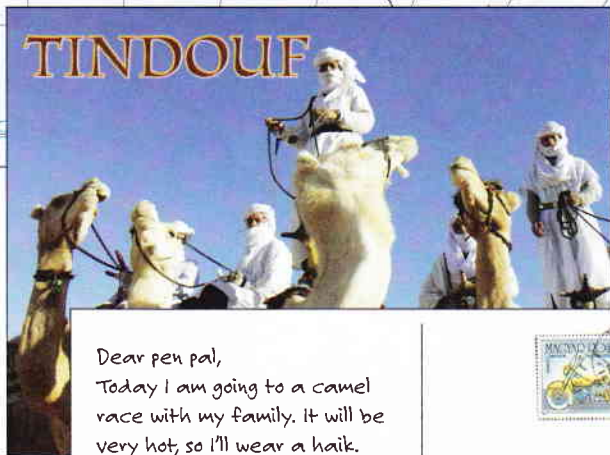
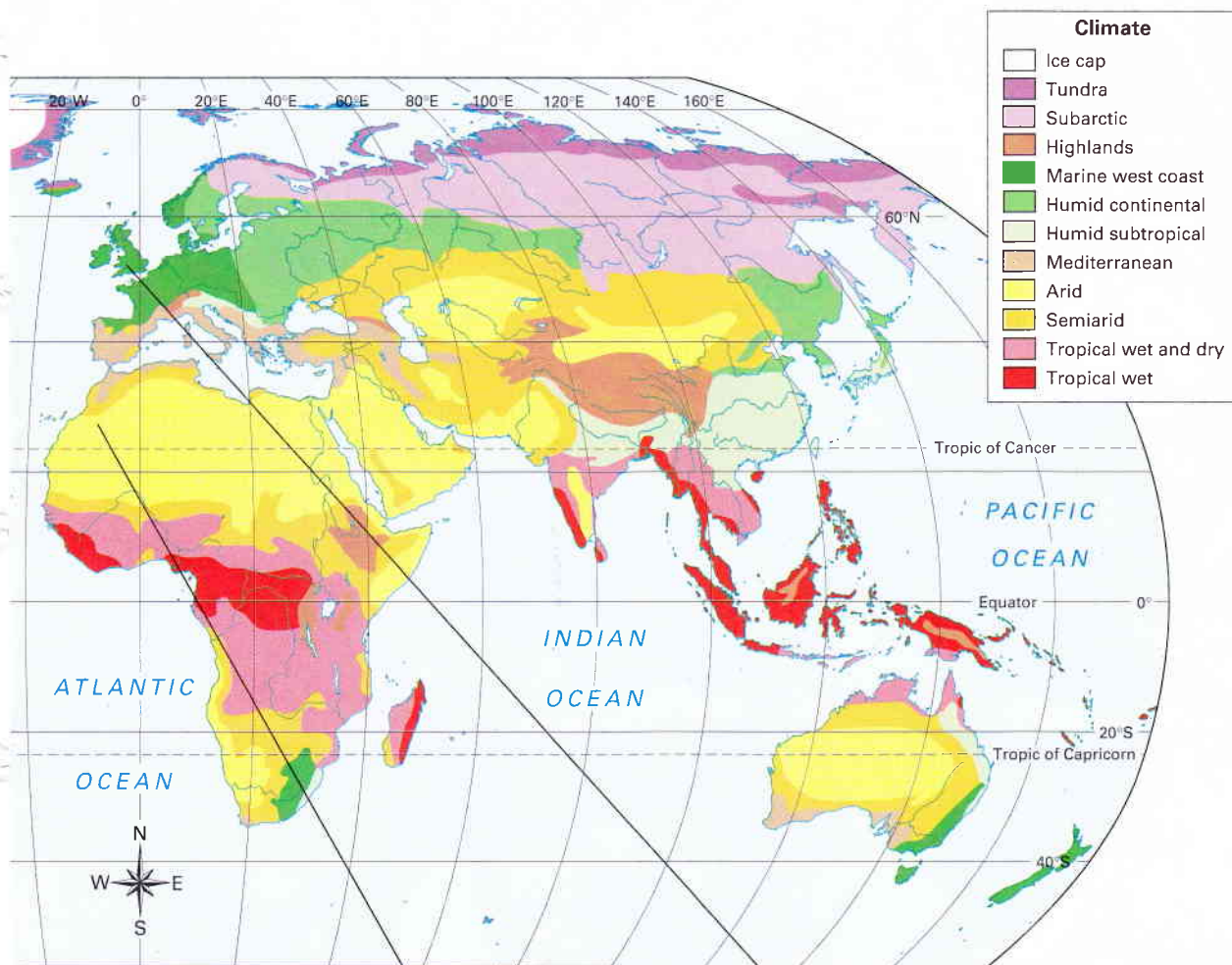
In Alaska, dog sledding and ice fishing are common cold-climate sports. Surfing is popular in Hawaii. North Africans enjoy camel racing. In Namibia, people gather at the dunes in the Namib Desert to sand-board. Much like snowboarding, sandboarding involves sliding down a slippery slope of sand on a wooden board.

## Climate Zones Around the World



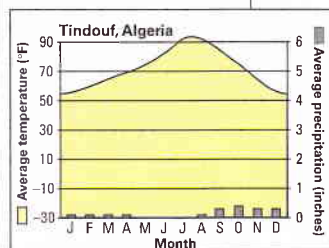
Dear pen pal,  
Today the thermometer is below zero and it's snowing! But we are keeping warm. Luckily, our home is well-insulated from the cold. It is also raised up on pilings. If we didn't do this, our house would melt the frozen ground below. Then we would sink into the mud!  
Write soon,  
Leah





## TINDOUF

Dear pen pal,  
Today I am going to a camel race with my family. It will be very hot, so I'll wear a haik. That's a loose-fitting garment that I wrap around me to keep me as cool as possible. Camel racing is popular here, along with camel dancing. The riders make their camels move to the beat of the music.  
Your friend,  
Ezina



## LONDON

Dear pen pal,  
It's raining again today, but I played soccer anyway. Luckily for us, it doesn't get that cold here despite all the rain. But my mum is always reminding me to take my umbrella and wear my wellies, or what you call rainboots.

Sincerely yours,  
William

