Chapter 5

Latitude:
a geographic "big idea"
and some consequences in Africa

Latitude is important, because the amount of sunshine
that comes to a place depends on its latitude.

This fact has consequences that can be seen
when you look at many maps of Africa -
maps that show temperature, rainfall,
floods, wildfires, plants, animals,
land use, population, cities,
languages, trade, religions,
and diseases such as malaria.

Photo by Gray Tappan

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Tropical desert -
little rain,
few plants,
few animals,
few people

Savanna -
scattered trees
and grasses
in summer

and in winter

Equatorial rainforest -
lots of rain,
tall trees,
big rivers

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Malaria is a scary disease.

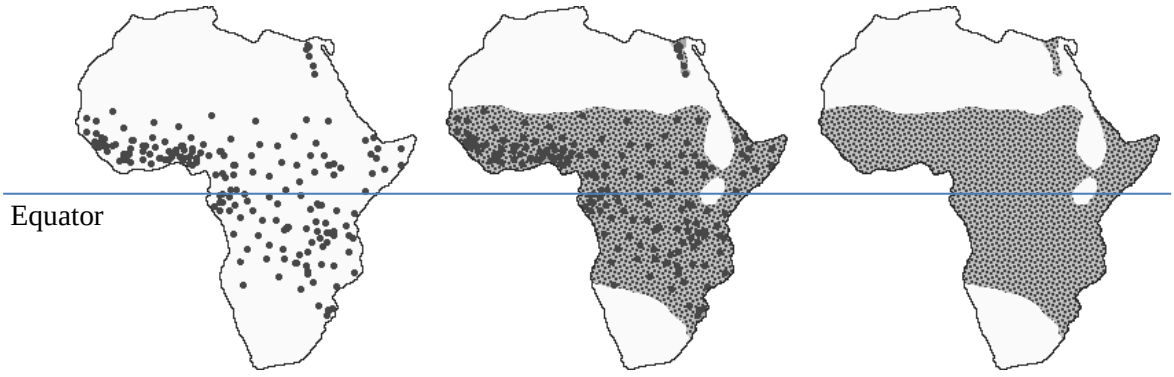
First you get a fever and a headache. It feels like a bad flu. Then you hurt all over. You may have internal bleeding or trouble breathing. Eventually, if not treated, malaria can kill you.

Unfortunately, malaria is hard to cure. It takes a lot of time and money to discover a drug that works. The disease germs, however, can develop resistance to a new drug in only a few years.

As we said, malaria is a scary disease. It kills more than a million people every year. You can do the math. That is about 115 people per hour. Stated another way, it is about one death somewhere in the world every half minute.

"One death every half minute" is a generalization. You know generalizations can sometimes be misleading. It is like saying a lake has an average depth of four feet. You can still drown in a deep spot if you try to wade across it. Like deep spots in a lake, malaria does not occur everywhere. This makes malaria an even bigger problem in the places where it does occur.

These maps show where malaria occurs in Africa.



Communities with cases of malaria line drawn around malaria area simplified map of malaria region

Why does malaria occur where it does? The answer involves a lot of connections between people, history, and environmental conditions. This chapter will explore some of these connections. One really obvious connection is with the basic geographic idea called latitude.

Definition: **latitude** is a measure of distance away from the Equator.

A real-world "laboratory" to investigate some consequences of latitude.

Africa is centered on the Equator. It extends about the same distance both north and south of the Equator. This makes Africa a good place to study the effects of latitude. Here's why:

IF something is influenced mainly by latitude,
THEN we should be able to observe it twice in Africa.

IF we see it a specific distance north of the Equator,
and IF it is caused in some way by latitude,
THEN we should also see it the same distance south of the Equator.

Malaria seems to be related to latitude. It occurs only at low latitudes (short distances from the equator). It is not common at higher latitudes (farther from the equator). Moreover, it seems to "stop" about the same distance south of the equator as it does north of the equator.

The science behind the big idea: It all starts with the sun.

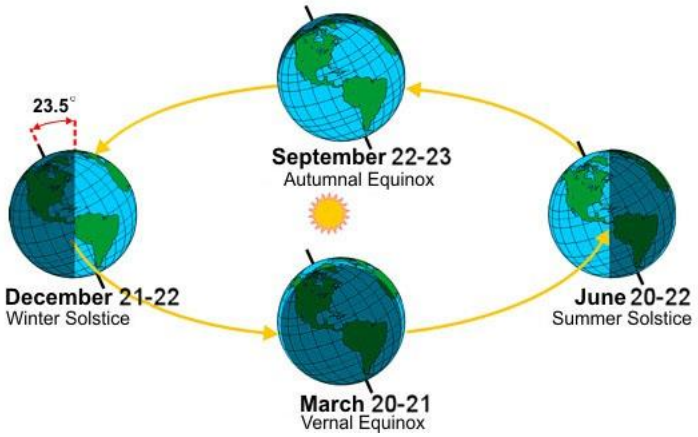
The sun is the source of energy for the major environmental systems on earth. Malaria occurs in a specific part of these global systems. To understand malaria, you have to understand the geography of sunshine. (You have to understand why the sun shines where it does.)

This page is a quick summary of the science of sunlight.

The earth moves around the sun. Its motion, however, is not a perfectly round circle. Moreover, the earth does not "stand" straight up and down. It tilts a little. We will leave it to an astronomy or geology class to explain all of the details. For a geography class, all you need to remember is this: *The changing angle of the sun's rays is the reason for the seasons.*

Typical diagram showing earth-sun relationships during the year
(Source: National Oceanic and Atmospheric Administration).

If you want to see different diagrams, including animations, do an internet search using these keywords: "earth sun relationships."



On March 21, people at the Equator see the sun at noon directly overhead ("straight up"). At every other place, the noon sun is "down" from overhead. Its angle depends on your latitude. If you are in Chicago, at 42°N latitude, the sun is 42 degrees down to the south.

By April 15, the noon sun is directly overhead about 700 miles north of the Equator. To people at the Equator, the noon sun is about ten degrees north from directly overhead.

On June 21, the noon sun shines directly down on the Tropic of Cancer. This line is 23.4 degrees of latitude north of the Equator. This is an important line, because it is as far north as the sun "goes." No place north of this line ever sees the sun directly overhead.

Survival tip: a sun directly overhead can cause sunburn in less than 15 minutes. Fortunately, you never see the sun that high in places like Chicago, London, or Tokyo, because those cities are farther from the Equator than the Tropic line.

On September 23, the noon sun is directly overhead at the Equator again.

On December 22, the noon sun shines directly down on the Tropic of Capricorn, 23.4°S. This Tropic line is exactly the same latitude south as the Tropic of Cancer is north. If that gives you the feeling that some really big forces are running this show, you are right!

On March 21, the sun has "moved" and shines directly down on the Equator again.

Question: Why is this important?
Answer: Because the sun drives the entire "weather machine" of the earth.

The sun provides the energy that makes wind blow. It provides the heat that evaporates water. It provides the warmth that makes air rise. Rain depends on wind, moisture, and rising air. Therefore, the sun is the real reason why rain and snow fall where they do. Through these effects, the sun makes it possible for certain plants and animals to grow in each place. This generalization includes trees, lions, monkeys, and camels. It even includes the insects that carry malaria.

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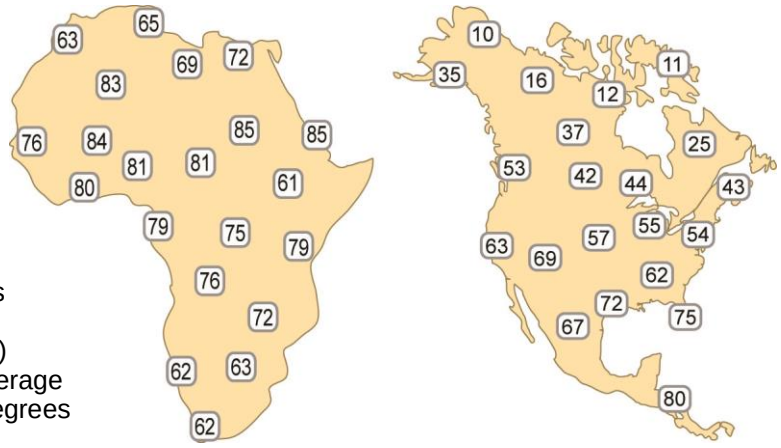
Consequence #1: Africa is the only continent that does not have a "cold end."

Every place on earth is affected by the seasonal "movement" of the sun. In this chapter, we will focus on the effects in Africa. Africa is unique in several ways. You already know that Africa is the only continent that is centered on the Equator. As a result, Africa does not have a distinct "warm end" and "cold end." People who live in the United States might think this is strange. North America is cold in its northern part and warm in the southern part.

Average annual temperatures at 21 weather stations in Africa and North America.



To make the patterns easier to see, color the places:

- **Dark Red**, if the average is above room temperature (more than 68 degrees)
- **Medium Orange**, if the average is between 50 and 68 degrees (good for food crops)
- **Yellow**, if the average is between 32 and 50 degrees (OK for evergreen trees)
- nearly **White**, if the average is below freezing (32 degrees)

These colors follow the general rule about mapmaking: *Darker colors mean more of the thing you are mapping.*

You probably have heard that it never freezes in Miami. Nearly all of Africa is closer to the Equator than Miami is. As a result, most parts of Africa never get cold enough to freeze.

Link to another chapter. There are some exceptions to this statement about freezing. High mountains, for example, "obey" the big idea of the chapter on South America:

Big idea: *Elevation is important, because air gets colder as you go higher.*

A few mountains in Africa are really high. These mountaintops are really cold on top. As a result, they can have snow on them, even though they are close to the Equator. The highlands of Ethiopia are not quite that high. Even so, they are still cooler and more comfortable than nearby lowlands. Like the Incas in South America, the Ethiopian people developed an early civilization in cool highlands close to the equator.

You might think it's good if it never freezes. This is not true. Here are three reasons why:

1. Freezing can kill disease germs, harmful insects, weeds, and poisonous plants.
2. Freezing can break hard soil clods apart. This helps rainwater to sink into the soil.
3. Freezing can help preserve food. (That's why we have freezers in our houses!)

In short, a place that has no frost can have many other conditions that are not ideal for humans. Diseases like malaria are one of those conditions. If you live in a place that gets really cold in winter, you do not have to worry much about malaria.

On the other hand, freezing can crack roads and building foundations. Like many things in nature, freezing is a tradeoff. That fact does not change the main point of this page:

Most of Africa is warmer than nearly all of North America, especially in winter.

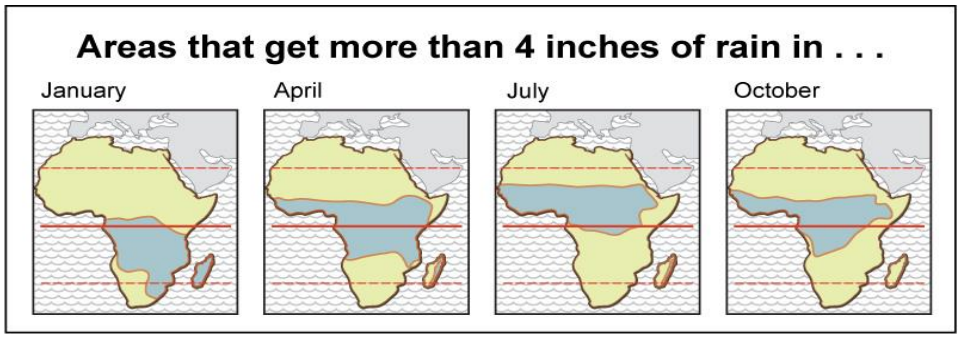
Consequence #2: Rainfall decreases as you go away from the equator in Africa.

A map of rainfall in Africa is more complicated than its temperature map. Some parts of Africa get more than fifteen feet of rain. That is four times as much as Boston or Chicago. At the same time, Africa has some very dry deserts. The two deserts are located about the same distance away from the equator. They are caused by something related to latitude!

Here is the key to understanding the climates of Africa. The hot sun at the equator creates a zone of rainy weather. Climatologists call it the ITCZ (InterTropical Convergence Zone). We will call it the Equatorial Rainy Belt. This name clearly tells us what it is and where it occurs:

The Equatorial Rainy Belt is a belt of rainy weather.
It "goes around the earth" near the Equator.

These maps show how the rainy belt moves north and south in different seasons.



Places near the equator get rain every month. Why? Because at least part of the rainy belt is over the equator at all times. All that rain helps the trees near the equator to grow tall.

Places near the Tropic lines, by contrast, tend to be dry all year. The rainy belt never gets that far away from the equator. In north Africa, where the continent is "wide," the dry area is called the Sahara. This is the largest desert on earth (don't say "Sahara Desert," because "Sahara" means desert!) Southern Africa is "narrower." It has a smaller desert, called the Namibian desert, or the Kalahari.

Places halfway between the Equatorial rainforest and the Tropical deserts get about half as much rain as the equator. They do NOT get half as much rain in every month. They get just as much rain, when it rains. The rain comes when the sun is closest to directly overhead. When the sun is overhead in the other hemisphere, these places are dry.

If you really understand this general pattern of rainfall, it can help you understand a large number of other facts about Africa. For example, you can see why certain animals live where they do. You can understand how people make a living in different places. You can see why diseases such as malaria occur where they do. You can understand why empires grew where they did. You can see why slave trading happened where it did. This knowledge can even help you predict how animals, diseases, and countries might react to global climate change.

For now, all you have to remember is this simple statement: there is an Equatorial Rainy Belt, and it "follows the sun". It moves a few hundred miles north in summer. It moves south in winter. As a result, the most important environmental question for any place in Africa is:

Question: *How long is the rainy season?*
Answer: The rainy season is 12 months long near the equator.
It gradually decreases as you go away from the equator.
There is no rainy season near the Tropic of Cancer and the Tropic of Capricorn.

Consequence #3: Particular kinds of plants and animals tend to live at specific latitudes.

The Rainy Belt makes trees grow tall. The result is the rainforests that occur near the equator in Africa, South America, or any island that is close to the equator. (Borneo is an example.)

In the chapter on South America, you learn the "bumper sticker" of a rainforest plant.

Grow tall, or else find a way to live in the shade!

The "marching orders" for animals are also simple. "Learn how to live high in the trees, or be satisfied with a diet of dead things that fall out of trees." If you don't like the idea of eating wrinkled old leaves, rotten fruit, and dead animals, then learn how to live high in the trees. That is where the sunlight makes tender green leaves. It's as simple as that.

Meanwhile, in the Tropical deserts, the "rule of life" is different but just as simple: *learn how to live without much water*. Plants can do this in a number ways. For example:

- Some plants make long roots that can reach underground water.
- Some plants complete their entire life cycle in a few weeks after a rare rainstorm.
- Some plants collect water after a rain and store it inside. If they do this, they have to keep animals from stealing it. One way is to use thorns or chemicals to discourage animals.
- Some plants absorb sunlight directly into their stems, so they don't need leaves.
- Some plants make chemicals that poison other plants that might take some of the water.

Desert animals use similar strategies. Some burrow underground, where it is cooler and more humid. Some store water (like camels). Some go into the desert only during favorable times (e.g., in the short rainy season at places about 20 degrees of latitude away from the Equator).

What happens if the rainy season is longer than a few weeks? A few more plants can survive. More animals can live there. The total amount of biological production is a bit greater.

If the rainy season is two months long, you get grasses and the animals that eat them. Another two months of rain can provide enough water for small shrubs and trees. A mixture of grass and trees is the perfect environment for large ground animals – giraffes and zebras and lions and tigers. These large animals cannot live in dry places, because dry places do not provide enough to eat. And they do not live in wet places, because they can't climb tall trees!

Hidden inside that paragraph is a really important point. *Different animals and plants like to live in different places in the geographic transition from wet rainforest to dry desert.*

Definition: a **geographic transition** is the change in conditions as you go from one place to another. Transitions can be abrupt, gradual, irregular, etc.

Ecoregion	Latitude Range	Rainy Season	Plant Cover	Typical Animals	Typical Soil
Rainforest	0-5	more than 10 months	Tall trees, vines, fungi	Birds, monkeys, insects, snakes	Leached, infertile
Savanna	5-15	5-9 months	Short trees and grasses	Zebra, giraffe, lion, cheetah	Iron-rich, often hard
Grassland	15-20	2-4 months	Grasses	Impala, cheetah	dark, fertile
Desert (middle of desert)	20-30	1 month (less)	Shrubs, cactus (nothing)	Camels, lizards (none)	thin, salty

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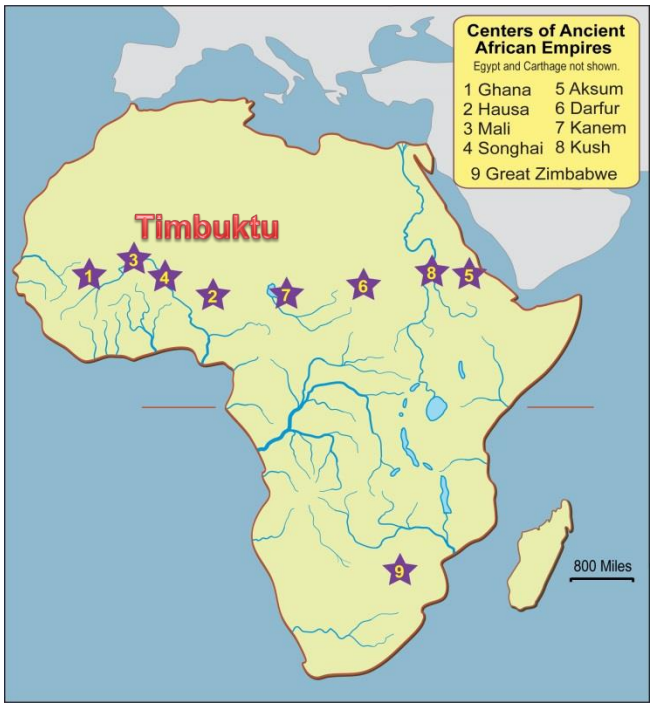
Consequence #4: Long ago, people built cities in the transition from rainforest to desert

In the old days, Africa had some great trading cities. Nearly all, from Aksum to Zimbabwe, were located in the same kind of place.



We will look at just one example – the ancient city of Timbuktu (it's number 3 on the map).

This historically important city is located about 15 degrees of latitude north of the Equator. In other words, it is more than halfway from the Equatorial rainforest to the Tropical desert. Therefore, its rainy season is less than half the year.

This rainy season is just about right for people. It is long enough to make plenty of grass to feed cows. It is also long enough to grow some kinds of grain to feed people.

At the same time, the dry season is long enough to kill many diseases that are common in rainier places.

In this favorable location, Timbuktu became an important city more than a thousand years ago. It had a major role in world trade, religion, and education. People built one of the first great universities there. For a few hundred years, Timbuktu was one of the main cities in some large empires. These empires stretched across thousands of square miles.

Time for a quick comparison: In <u>space</u>, the West African empires were about as big as all the states from Virginia to Florida and west to Texas. In <u>time</u>, the empires lasted much longer than the United States has, so far.

You can look in a history book or website for more details about the West African empires. As geographers, we want to figure out why people chose to live in places like Timbuktu. We are also interested in their connections to other parts of the world.

We have already noted the *conditions* that made this a good place for people to live.

It had enough rain to grow food.

BUT

It did not have enough water to grow a lot of malaria mosquitoes (or other diseases).

Timbuktu also had good *connections*. The most important connection was along a river. Timbuktu is located next to the Niger River, the longest one in West Africa. This river starts in some mountains near the coast. All by itself, that fact is not very important. But look at what happens when we add one more fact: *the West African mountains have gold in them*.

People discovered the gold thousands of years ago. The gold was a major reason for trade. People could travel along the Niger River and carry gold to trading centers like Timbuktu. Camel caravans could then take the gold across the desert to Egypt and Mesopotamia. From there, African gold went all the way to Europe, India, and China. In return, silk, weapons, glass, and other valuable things could come to West Africa from all over the known world.

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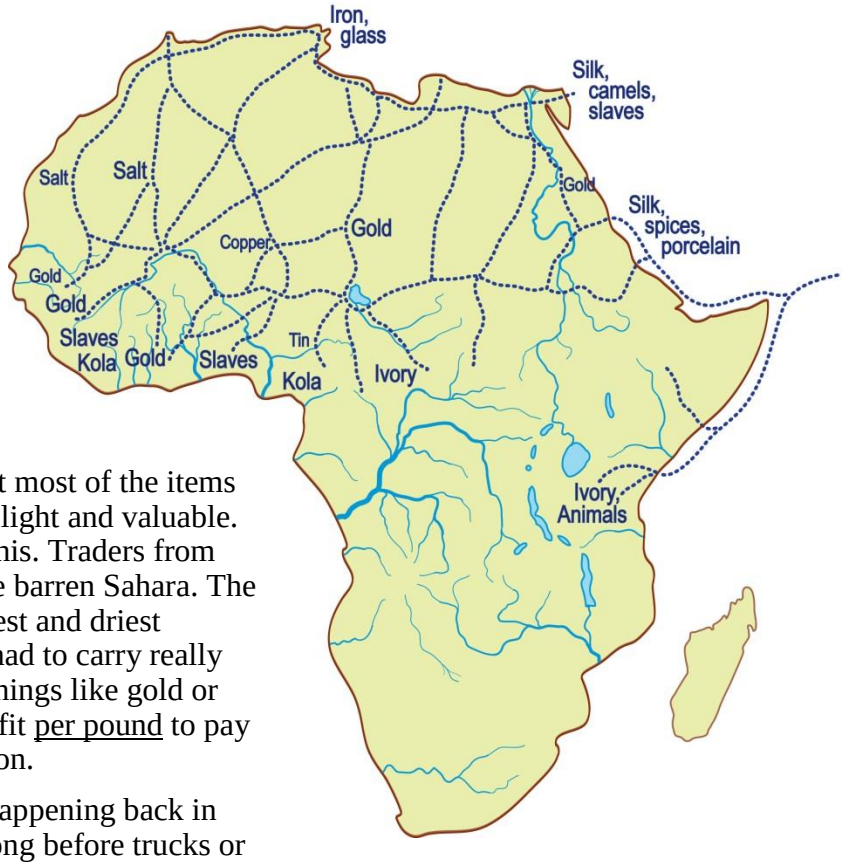
Trade caravan routes crossed the desert by going from one oasis to another.
(An oasis is a place that has water.)



You might have noticed that most of the items listed on this map are fairly light and valuable. There is a good reason for this. Traders from West Africa had to cross the barren Sahara. The Sahara is one of the largest and driest deserts in the world. You had to carry really light and valuable things. Things like gold or silk could make enough profit per pound to pay the high cost of transportation.

Remember, this was happening back in the 1300s. That was long before trucks or trains were invented. In fact, the high point of Timbuktu history was more than 100 years before Columbus sailed to America.

Unfortunately, the West African traders sold something else – human slaves. The trade in slaves was important at that time for three reasons.

1) Slaves were especially valuable before people invented gasoline engines and electric motors. Slaves were a source of power as well as labor.

2) Slaves were self-transporting. They could be forced to walk along with a trading caravan.

3) Slaves could carry other things, like gold or silk, as they went with the caravans.

In fact, the slave trade actually had many parts. West African slaves were traded to people in Egypt and Arabia. Arab slaves were traded to people in West Africa. African slaves were traded northward across the desert to ports on the Mediterranean Sea. The Vikings even traded slaves between England and other countries!

Then European explorers arrived in West Africa in the 1400s. They turned a small but steady slave trade into a really big and ugly business.

Before we look at European colonialism in Africa, we should check out a few more consequences of the big idea about latitude.

Can you think of another effect of the seasonal movement of the sun and the Equatorial Rainy Belt?

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Consequence #5: Rivers flood at predictable times in places that have rainy seasons.

The savanna empires of western and southern Africa were not the first civilizations in Africa. That honor goes to Egypt. Egypt is a totally different kind of place. It does not have a rainy season like in Timbuktu. In fact, Egypt has almost no rain, because it is located right on the Tropic of Cancer.

How could people live in such a dry place?

You can get an answer by looking at the rivers in Africa.

Most rivers start in high, rainy places. Then they flow downhill to the ocean.

That is usually the end of the story.

But Africa has several rivers that have more complicated stories. You already know that the Niger River starts in rainy mountains near the coast in West Africa. It then flows northeast, away from the ocean. The river goes into grasslands near Timbuktu. Then it makes a big curve and heads southeast, back toward the ocean.

The Nile River is an even more famous exception. It also starts near the Equator, in the high mountains of East Africa. Then the Nile River flows northward. It goes right through the Tropical desert.

COMMENT: Rivers that flow through deserts, like the Nile, are called **exotic rivers**. The world actually has several exotic rivers. Here are some of the most famous:

1) the Colorado River in the United States,
2) the Tigris and Euphrates Rivers in modern Syria and Iraq,
3) the Indus River in Pakistan,
4) the Huang He of northern China,
5) and a lot of smaller rivers like the Jordan River in Israel or the Rio Grande between Texas and Mexico.

Exotic rivers were important in human history, because they are sources of water in a desert. Moreover, nearly every exotic river is the subject of a major dispute over water today. Some people even suggest that water will be the main reason for wars in the late 21st century. Do you think that's possible?

The Nile River has several traits that made it more than just a source of water in a dry place. Most of the creeks that join to form the Nile River start in places that get rain only in summer. For that reason, the Nile River gets really big in late summer. Then it nearly dries up in late winter. (At least, that is what the river did before people built giant structures like the Aswan Dam to control its flow.)

Floods like this are also common on the Indus, the Tigris, the Huang He, and most of the other exotic rivers of the world. Floods from these rivers have killed hundreds of millions of people.

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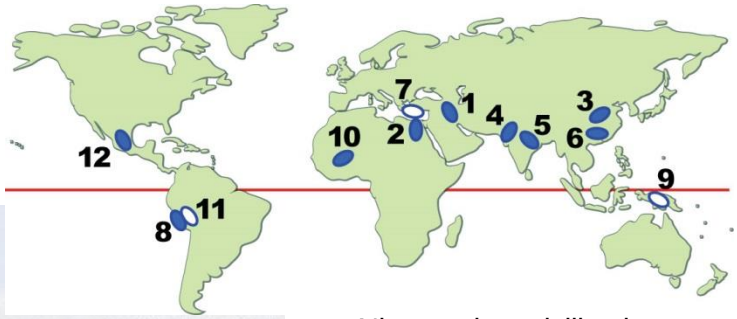
Floods are not all bad, however. In fact, they have several effects that are good for humans:

1) Floodwater is usually muddy. When muddy water sinks into the soil or evaporates, the mud is left on top of the ground. This makes the soil more productive. In ancient times, people were willing to put up with floods in order to have more to eat.
   (That tradeoff is not as important now that we have refrigerators and supermarkets!)
2) Floodwater can kill weeds and some harmful animals, such as snakes or insect pests.
3) Floodwater helps refill groundwater. People can use wells to get water in dry months.
4) Floodwater can remove salt from the soil as the water seeps downward into the ground.
5) Floodwater softens the ground so that it is easy to plow.
   This simple fact was a really big deal before tractors were invented!

Definition: a **floodplain** is the flat, muddy, swampy land next to a river that floods.

Irrigated field on a floodplain near the Niger River in West Africa. (US Dept. of Agriculture)



Nine ancient civilizations that relied on flooding rivers:
1. Mesopotamia
2. Egypt 3. Huang
4. Indus 5. Ganges
6. Yangtze 8. Peru coast
10. Niger 12. Aztec

Three that did not:
7. Minoan 11. Inca
9. New Guinea highlands

In short, the flooding of the Nile River helped make Egypt a great place to start a civilization, thousands of years ago. Way back then, the surrounding desert was actually an advantage. Enemies from other places would have to cross the desert in order to attack the Egyptians.

Important note: we did not say that the Nile River made people build pyramids near it. We did say that the flooding Nile made this valley a good place for people to grow a lot of food. That helped them build a civilization at a particular time in history.

Unfortunately, the Nile civilization had a geographic problem: it could not grow larger than its floodplain. People could not grow food in the surrounding desert. This limit on population proved to be a problem later. Other powers such as Persia or Rome could get big enough to conquer Egypt. But that's another story – look it up on the web, or ask your history teacher.

Here, let's just repeat one fact: *places with distinct rainy seasons often have rivers that flood.*

A flooding river was a good thing at a particular time in history, when people were just learning how to grow food.

(You can take a virtual field trip across the Nile floodplain. Do an internet map search for the Luxor Museum. Then zoom to a wider view, and head west to the desert.)

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Consequence #6: Fires often occur where rainy seasons are short and dry seasons long.

Fires and floods are like opposite sides of the same coin.

Floods happen after rainy seasons. **Fires** occur after dry seasons.

Floods and fires are alike in one way. TV announcers usually describe them as bad. For example, they interview people whose houses are burning. Then they might show a picture of a tired firefighter. Or maybe they show a helicopter dropping water on the fire.

Images like that may be exciting to watch on TV, but they are not a complete picture. We don't have room for all the details, but here is the bottom line: many of the most productive environments in Africa, from a human point of view, are places with fires every few years.

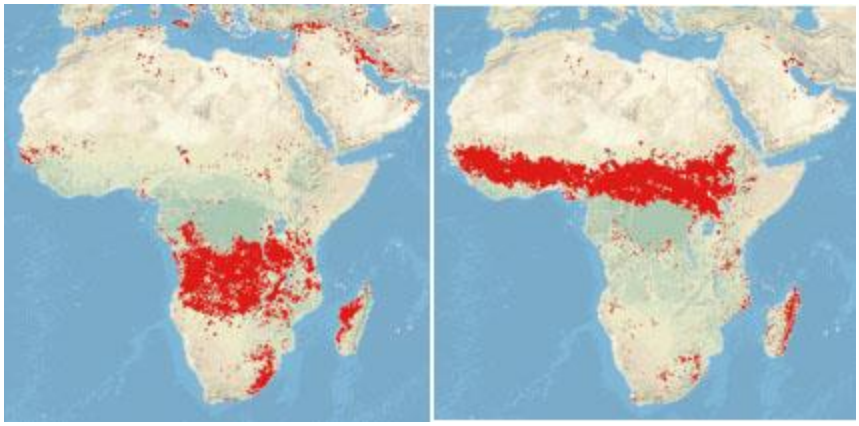
Here are some good things that fires do in a natural environment:

1) Fires burn old, dry, uneaten grasses and shrubs.
2) Fires recycle nutrients into the soil.
3) Fires kill some dangerous animals.
4) Fires force other animals to migrate from one place to another.

In short, frequent fires help maintain an environment where young, new plants can grow.

Given a choice, animals like zebras or antelope prefer to eat the green plants that grow after fires. In fact, two of the most important food crops in the world – corn and sorghum – were actually discovered after fires. They were like "natural popcorn" – easy to gather and eat.

Fires must be allowed to burn in a natural way in order to have these good effects. In the United States, people tried to stop forest fires for more than a century. This allowed dead plants to accumulate. The extra fuel, in turn, makes new fires hotter than normal. The result is what you see on TV: helicopters, firefighters, people crying near burning houses, and so forth.



These two maps were made from NASA satellite images. They show fires during June (left) and December (right) in a typical year. Most of the fires occur when and where you expect:

In June, the rainy belt is north of the equator, and most fires are in the southern hemisphere.

In December, the Rainy Belt has moved south. When that happens, plants in the north are dying and drying out, and fires break out north of the equator.

In Africa, animal migrations are associated with natural fires. Both of these natural processes are complicated by artificial borders that people made between countries and around wild areas. Before we look at how those borders were made, and who made them, we should consider one more consequence of seasonal rain.

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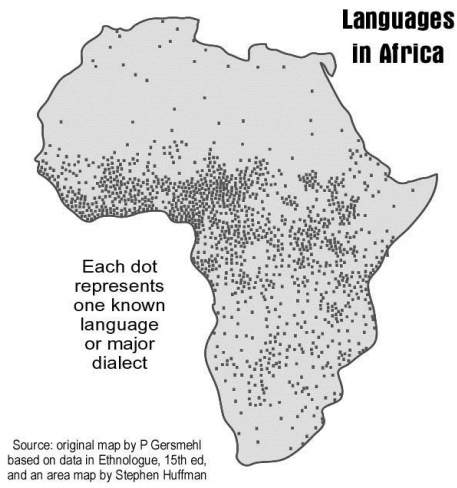
Consequence #7: the map of human languages resembles the map of seasonal rain.

At first glance, you might think that language and rain have nothing in common. Let's compare a map of languages with a satellite image of Africa. What do you see?



The bright yellow area in the northern part of the satellite image is dry land. It does not have many plants. Throughout history, only a few people lived there. Many of them moved from one place to another. They were looking for places that got at least some rain. Other people lived as traders. They carried gold and spices across the desert to trade for silk, pottery, tools, and weapons. Both kinds of people – herders and traders – were used to travelling long distances. Fortunately, travel was fairly easy, because people could ride horses and camels.

One consequence of all that travel is an important fact: People had a trading they could use all the way across North Africa, from the Atlantic Ocean to Asia.

Now look at the dark green areas on the satellite image. These are rainforests. In these forests, people did not have to move far. They could always find something to eat nearby, because there was plenty of rain for plants in every month of the year. At the same time, travel was difficult. Large animals like horses and camels were rare, for at least three reasons.

1) Large animals could not move easily through a dense forest.
2) Large animals could not find much to eat near the ground.
3) Large animals could get diseases that were carried by insects.

In short, people in the rainforests had little reason to travel, AND travel was difficult.

As a result, rainforest people tended to stay close to home. People who stay in one place are not likely to speak with many other people. In time, their languages slowly changed. People invented new words or began to use old words in new ways. Over time, rainforest people developed hundreds of different languages. Even a fairly small area near the coast had dozens of different languages when European explorers and slave traders arrived in the 1400s.

Thought question: Where would it be easier to capture people as slaves?

- Would it be easier in an area filled with many small groups of people who stayed close to home and spoke many different languages?

- Would it be easier in an area where people had horses and camels, could travel fast, and could communicate with a single language over a large area?

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Consequence #8: Colonial borders usually went straight inland, because European slave traders paid little attention to patterns of rainfall and language.

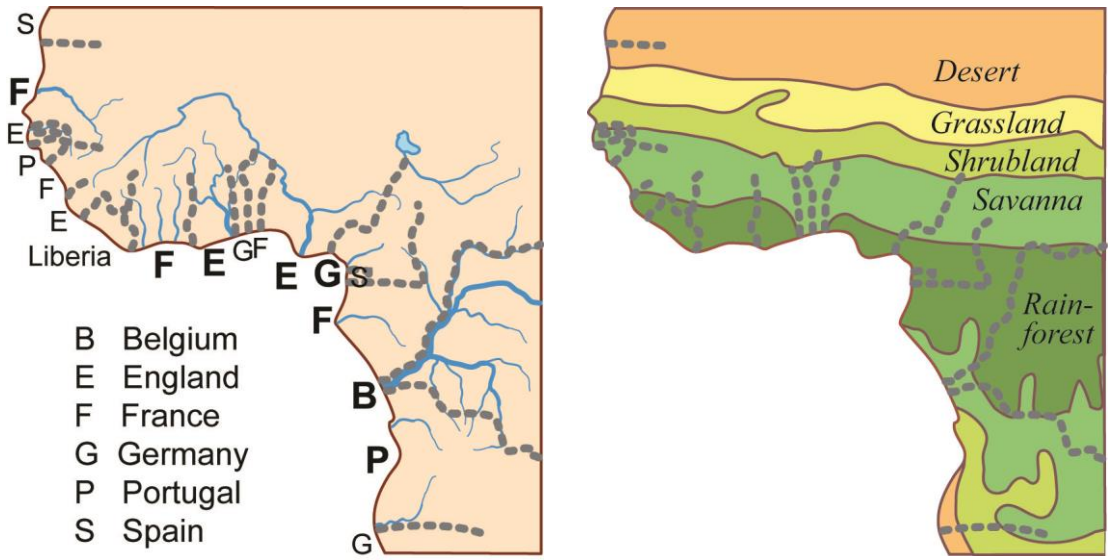
European sailors came to Africa for several reasons. The first attraction was gold. Remember the mountains where the Niger River starts? Europeans called that area "the Gold Coast."

Later, they came to buy or steal slaves.

Unfortunately, the Europeans did not know much about the geography of Africa. They did not understand the patterns of rainfall, plants, animals, and land use.

They soon learned that travel was hard through the dense forests near the Equator. As a result, they tended to go on rivers. They built boat landings and forts near the rivers. Then, they drew borders between them. The result was a set of colony borders that went directly inland from the coast. The map shows how the borders between colonies ran north-south in West Africa.

Definition: a **border** is the boundary line between two countries, states, or colonies.



In other words, the borders cut right across the natural environments in West Africa. You already know that these environmental boundaries run generally east-west, for two reasons.

1) The pattern of plants and animals depends on the amount of rain.

2) The rainy season gets shorter as you go farther away from the Equator.

As African countries gained independence, they usually kept the old colonial borders. As a result, each country in West Africa is a kind of mixture. It has an area of rainforest near the coast. People live in small villages and speak many languages there. Farther north, each country has natural savannas and grasslands. People in those drier areas make a living by raising cattle. Many move around a lot. They speak the same language over a large area.

People also have different religions in different places. People who live in the forest areas of are often Christian or animist. Most of the people in the grassland areas follow Islam.

As a result, West African countries like Nigeria, Benin, Ghana, or Cote d'Ivoire are split inside. They have different regions of religion as well as language and land use.

Those divisions within each country are a problem for governments. They make it more difficult to deal with issues like education, poverty, terrorism, . . . and diseases like malaria.

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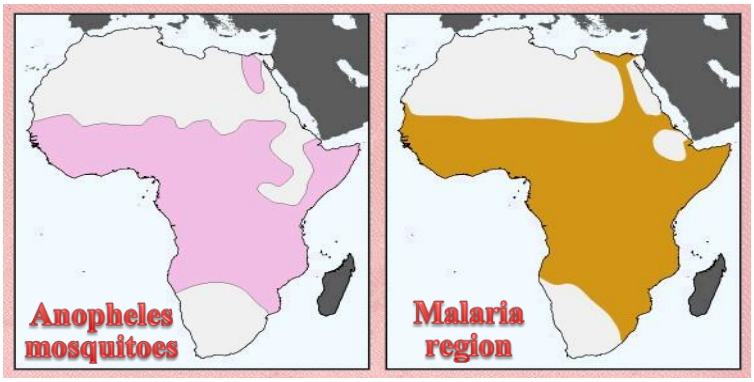
Consequence #9. Mosquitoes live (and carry malaria) in places with long rainy seasons.

In this chapter, we have explored how the Equatorial Rainy Belt moves south in winter and north in summer. We have looked at its effects on plants, animals, rivers, fires, farmers, traders, and languages. We can now go back to the first topic– a disease called malaria.

At first, the cause of malaria was a mystery. People seemed to catch it in hot, humid places. The word "mal-aria" actually means "bad air." People used that name because they thought you got the disease by breathing hot and humid air. Unfortunately, they did not know why hot and humid air was bad.

Fast forward a hundred years. People have made maps showing where different kinds of plants, animals, and insects live. They noticed that the places where people get malaria also have a mosquito called Anopheles (uh-NAH-fuh-leez). They also made a big discovery.

If you can get rid of the mosquitoes in an area, people stop getting malaria.



These maps show the natural *ranges* of malaria and anopheles mosquitoes.

Definition: a **range** is the area where a specific kind of plant or animal can live.

That might lead someone to think that getting rid of mosquitoes would be an easy cure for malaria. But you know better. You know that the mosquitoes live in places that have long rainy seasons. You also know that these places have dense forests, full of insects and small animals. You know it is hard to travel there. You know that people speak many different languages there. You know these places have a long history of being raided for slaves. You also know that the borders between these countries were marked by the slave traders. As a result, the borders do not fit the environment, the languages, or the religions of the people.

In short, you know that long rainy seasons have many effects. These effects can combine to make the job of a malaria doctor harder. Think about it: How easy is it to run a clinic in a place where travel is hard, there is no electricity, and people speak different languages?

This brings us to a really important conclusion:

A disease such as malaria does not exist in isolation (all by itself).

It exists as part of a complex system of causes and effects. People must understand these relationships in order to come up with good ways to fight the disease.

On the other hand, places in Africa have resources that can become more valuable as the world runs out of petroleum. For example, the deserts near the Tropic lines have plenty of solar energy. (You know why – it hardly ever rains there!) The rainforests near the equator have a wide variety of plants and animals. Many of these can be used for food, chemicals, and medicines. Still other parts of Africa have important mineral resources. In short, the same forces that made the map of environments can also provide solutions to problems. People just need to understand these patterns!

Conclusion – what does the big idea of latitude help us understand about Africa?

Ultimate cause: the noon sun "moves" with the seasons. It moves north and shines down on the Tropic of Cancer in June. It shines directly down on the Equator in March and September. And it moves south to shine down on the Tropic of Capricorn in December.

Big idea: Latitude is important, because the angle of the sun depends on the date and the latitude, and in turn has a strong influence on climate.

Study area: Africa is a good place to study the effects of latitude, because Africa is the only continent that is centered on the Equator. If a feature or process is related to latitude, therefore, you should see it both north and south of the equator.

Consequence #1: Africa is the only continent that does not have a "cold end."

Consequence #2: Rainfall decreases as you go north or south from the equator in Africa.

Consequence #3: Different plants and animals live at different distances from the equator, because each kind of plant or animal seems to grow best in places that get a specific amount of rain.

Consequence #4: People built trading cities and empires in places with about 4-6 months of rain. These cities are in the *transition area* between the Equatorial rainforest and the Tropical deserts.

Consequence #5: Places with distinct rainy seasons tend to have rivers that flood.
That is not necessarily a bad thing (especially before tractors were invented).

Consequence #6: Places with long dry seasons tend to have fires.
That is not necessarily a bad thing (especially before fertilizers were invented).

Consequence #7: The map of human languages resembles the map of seasonal rainfall, because people tended to develop different local languages in places where they did not travel much, and they did not travel much in the rainforest.

Consequence #8: Country borders in Africa are left over from colonial times. These borders are a problem today, because slave traders and colonists paid little attention to the geography of rainfall, land use, and language.

Consequence #9. Mosquitoes live (and carry malaria) in places with a long rainy season.

Putting it all together: it is hard to fight malaria (or Ebola, or terrorism, or . . .) in Africa, because of the complex interactions between sunshine, rainfall, natural vegetation, land use, language, slave traders, and political borders.

The processes related to latitude, however, also give Africa a wide range of natural environments, from rainforests to deserts. These environments have different resources that can help people address the issues that face them in the 21st century.

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Extra Science Reading:

Lags in the System

This simple idea of a rainy belt that follows the annual movement of the sun has one big complication: there are delays built into the system. Some of these delays occur because it takes the ground awhile to warm up when the sun is shining.

Here is a simple example of the delay effect: we all know that noon is not the warmest time of the day. It is usually warmer at 2 or 3 in the afternoon. It takes awhile for the ground to warm up when the sun is shining.

Likewise, June is not the warmest month of the year in the northern hemisphere. The sun is farthest north in June, but July is usually warmer than June, because it takes the earth awhile to warm up after the time of maximum solar energy.

Because of the temperature delay, the rainy belt also lags at least a month behind the sun. The sun reaches its northernmost position in late June; the Rainy Belt doesn't reach its northernmost position until late July or early August.

Logical chain, to help you connect several chapters of this book together:

1. The Equatorial Rainy Belt makes hurricanes when it gets far from the Equator. This happens in July and August – months after the time of maximum solar energy.

2. The hurricanes then take another month or two to move across the ocean. This is why September and October are the peak months for hurricanes in Florida.

It is also important to note that hurricanes are a very good example of something that is "caused" in one part of the world at one time of the year and then has "effects" in some other places several months later.

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