SECTION 2

The Geographer's Tools

BEFORE YOU READ

Reach Into Your Background

Skulls-and-crossbones. Ships with black sails. Cannons. Swords. Treasure maps. That's right, MAPS. These things are all tools in great pirate tales. Maps are also one of the most important tools geographers use. Geographers and movie pirates aren't the only ones who use them. You do too!

Questions to Explore

1. What are some of the different ways of showing the Earth's surface and why do geographers use them?
2. What are the advantages and disadvantages of different kinds of maps and globes?

Key Terms

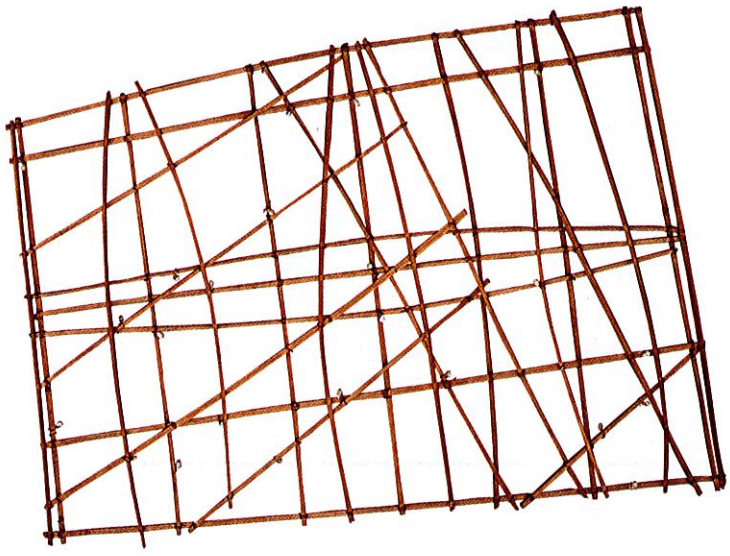
globe
scale
distortion
projection
compass rose
cardinal direction
key

Key People

Gerardus Mercator
Arthur Robinson

You might expect a map to be printed on a piece of paper. But hundreds of years ago, people made maps out of whatever was available. The Inuit (IN oo it) people carved detailed, accurate maps on pieces of wood. The Inuits were once called Eskimos. These Native Americans have lived in northern regions of the world for centuries. They needed maps that were portable, durable, and waterproof. Carved maps remind us that making maps is not just an exercise in school. People rely on maps, sometimes for their very survival.

▼ The Marshall Islanders made wood maps of the southwest Pacific Ocean. Curved palm sticks show ocean currents and shells show islands.



Globes and Maps

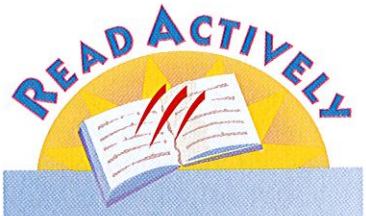
Hundreds of years ago, people knew very little about the land and water beyond their own homes. Their maps showed only the areas they traveled. Other places either were left out or were only an empty space on their maps. Sometimes they filled the empty spaces with drawings of lands, creatures, and people from myths and stories.

As people explored the Earth, they collected information about the shapes and sizes of islands,

continents, and bodies of water. Mapmakers wanted to present this information accurately. The best way was to put it on a **globe,** a round ball like the Earth itself. By using the same shape, mapmakers could show the continents and oceans of the Earth much as they really are. The only difference would be the **scale,** or size.

But there is a problem with globes. Try putting a globe in your pocket every morning. Try making a globe large enough to show the details of your state or community. A globe just cannot be complete enough to be useful and at the same time be small enough to be convenient. People, therefore, invented flat maps.

Flat maps, however, present another problem. The Earth is round. A map is flat. Can you flatten an orange peel without tearing it? There will be wrinkled and folded sections. The same thing happens when mapmakers create flat maps. It is impossible to show the Earth on a flat surface without some **distortion,** or change in the accuracy of its shapes and distances. Something is going to look larger or smaller than it is.



Predict Why do you think it would be hard to make an accurate map of the world on a flat sheet of paper?

An Orange Peel Map

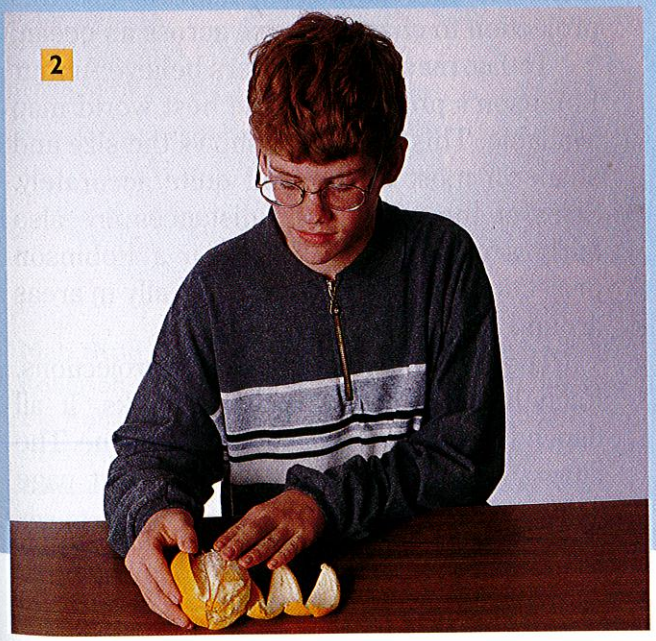
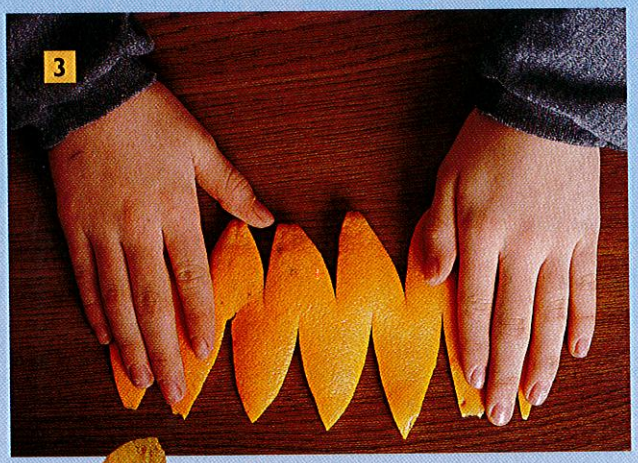


Chart Study It is almost impossible to flatten an orange peel. The peel tears, wrinkles, and stretches. Mapmakers can make a flat map of an orange—or of the Earth—by using mathematics. But even a map laid out to look like this flattened orange peel is not accurate. **Critical Thinking** Look carefully at the photographs. As the orange peel is flattened, what distortions do you think might occur?



Getting It All on the Map

In 1569, a geographer named Gerardus Mercator (juh RAHR duhs muhr KAYT uhr) created a flat map to help sailors navigate long journeys around the globe. To make his map flat, Mercator expanded the area between the longitudes near the poles. Mercator's map was very useful to sailors. They made careful notes about the distortions they found on their journeys. More than 400 years after he made it, those notes and the Mercator **projection,** or method of putting a map of the Earth onto a flat piece of paper, is used by nearly all deep-sea navigators.

When Mercator made his map, he had to make some decisions. He made sure that the shape of the landmasses and ocean areas was similar to the shapes on a globe. But he had to stretch the spaces between the longitudes. This distorted the sizes of some of the land on his map. Land near the Equator was about right, but land near the poles became much larger than it should be. For example, on Mercator's map Greenland looks bigger than South America. Greenland is actually only one eighth as large as South America.

Ask Questions What would you like to ask Gerardus Mercator about the map he made in 1569?

The World: A Mercator Projection

Map Study Mercator maps make areas near the poles look bigger than they are. This is because on a globe, the lines of longitude meet at the poles, but on a flat Mercator map, they are parallel. However, Mercator maps are useful to navigators because the longitude and latitude lines appear straight. Navigators can use these lines and a compass to plot a ship's route. **Place** Here Greenland looks bigger than it really is. It actually is about the size of Mexico. What other areas do you think might look larger than they should? Why?

Geographers call a Mercator projection a conformal map. It shows correct shapes but not true distances or sizes. Other mapmakers used other techniques to try to draw an accurate map. For instance, an equal area map shows the correct size of landmasses but their shapes are altered. The Peters projection on the next page is an equal area map.

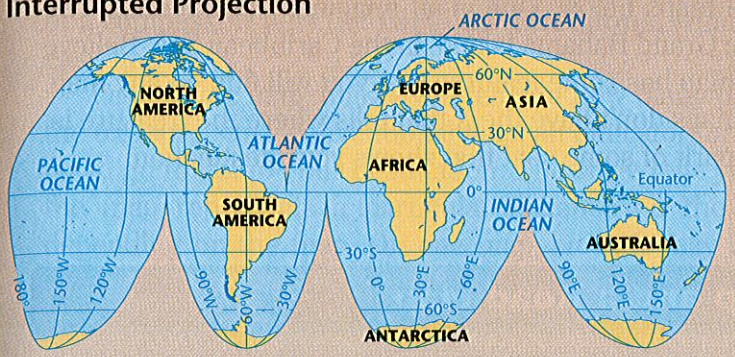
Mapmakers have tried other techniques. The interrupted projection (see next page) is like the ripped peel of an orange. By creating gaps in the picture of the world, mapmakers showed the size and shape of land accurately. The gaps make it impossible to figure distances correctly. You could not use this projection to chart a course across an ocean.

Today, many geographers believe Arthur Robinson's projection is the best world map available. This projection shows the size and shape of most of the land quite accurately. Sizes of the oceans and distances are also fairly accurate. However, even a Robinson projection has distortions, especially in areas around the edges of the map.

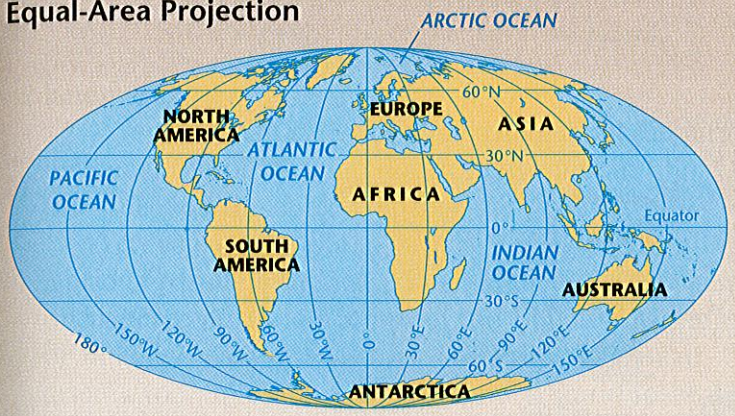
There are many other types of projections. Each has advantages and drawbacks. It all depends on how you want to use each one. The illustrations on this page and the next page show several projections.

The World: Interrupted, Equal Area, and Peters Projections

Interrupted Projection

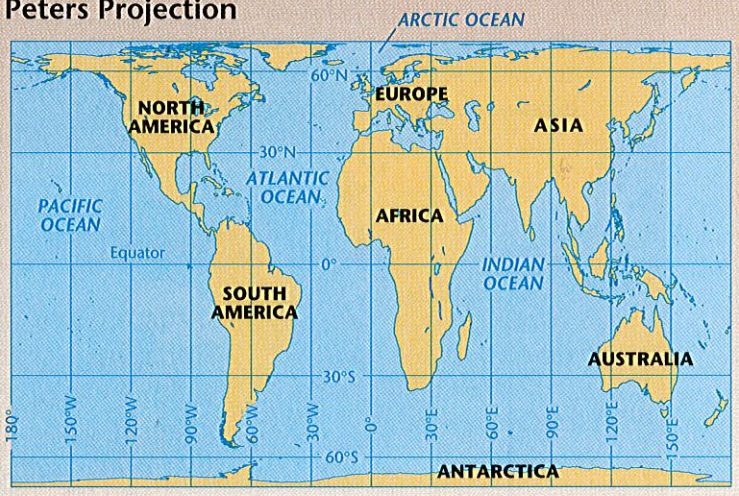


Equal-Area Projection

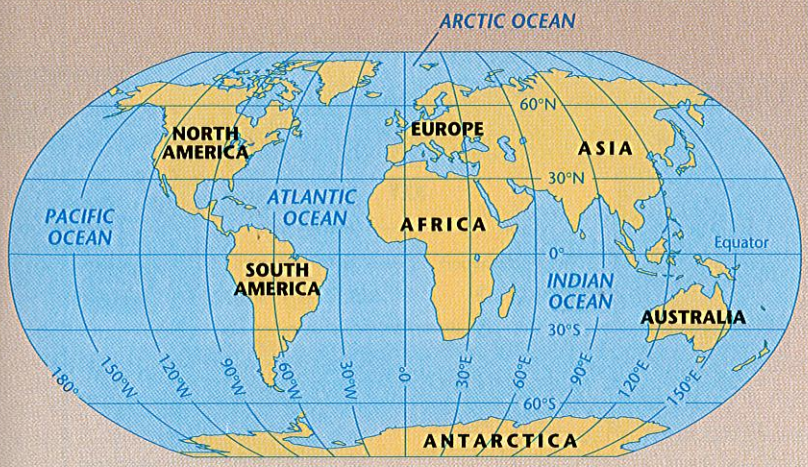


Map Study There are many ways to show a globe on a flat map. The interrupted projection map, on the left, shows the real sizes and shapes of continents. The equal area map, below left, shows size accurately. The Peters projection, below, shows land and ocean areas and correct directions accurately. **Location** Compare each projection with the more accurate Robinson projection below. What do each of these three projections distort?

Peters Projection



The World: A Robinson Projection



Map Study In 1988, the National Geographic Society adopted the Robinson projection as its official projection for world maps. While the Robinson projection does distort the globe a little, it shows the sizes and shapes of countries most accurately. **Movement** Do you think the Robinson projection would be as useful to a navigator as the Mercator projection? Why or why not?

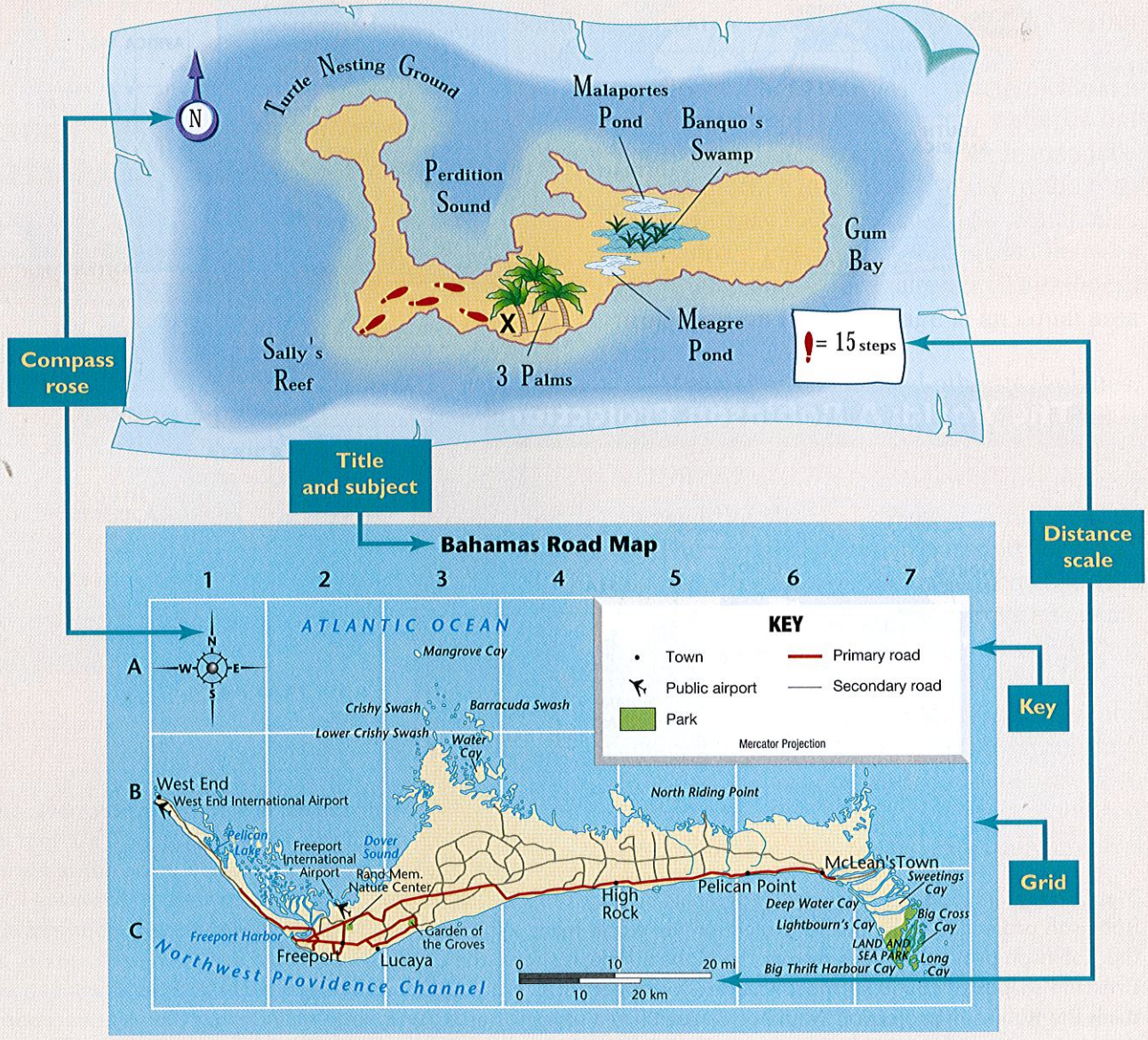
The Parts of a Map

Look at the two maps below. One is an imaginary pirate map. The other is a map of the Grand Bahama Island, in the Caribbean Sea. Believe it or not, the pirate map has some features that you will find on any map. Of course, regular maps don't have the X that tells where the treasure is, but you will find a mark of some sort that shows your destination.

A Pirate Map and a Road Map

Map Study Almost all maps have some things in common. A compass rose shows direction. A key explains special symbols. A grid often shows longitude and latitude. The road map below has a grid of numbers and letters to help locate places.

Location What airport is located at B-1?



The pirate map has an arrow pointing north. On the regular map, you will find what geographers call a **compass rose,** which is a model of a compass. It tells the **cardinal directions,** which are north, south, east, and west.

On a pirate map, marks will tell you how many paces to walk to find the treasure. On a conventional map, an indicator for scale tells you how far to go to get to your destination. The scale tells you that one inch on the map represents a particular distance on the land. Scales vary, depending on the map. On one map, an inch may equal one mile. On another map, an inch may equal 100 miles.

On the pirate map, special symbols indicate landmarks such as small ponds, a swamp, or a distinct group of trees. Regular maps also have symbols. They are explained in the section of the map called the **key,** or legend. It may include symbols for features such as national and state parks, various types of roads, sizes of towns and cities, or important landmarks.

A regular map includes some things that the pirate map doesn't. For instance, the pirate map doesn't have a map title. On a regular map, a title tells you the subject of the map.

A treasure map does not have a grid, either. Some regular maps use a grid of parallels and meridians. Remember that parallels show latitude, or distance north and south of the Equator. Meridians show longitude, or distance east and west of the Prime Meridian. On some maps, the area is too small for longitude and latitude to be helpful. These maps usually have a grid of letters and numbers to help people find things.

Every part of a map has a very simple purpose. That is to make sure that people who use maps have accurate information they need. The more you know about maps, the easier it will be for you to use them well—even if you're hunting for buried treasure!

Connect What parts of a map do you think are most helpful to you?

SECTION 2 REVIEW

1. Define (a) globe, (b) scale, (c) distortion, (d) projection, (e) compass rose, (f) cardinal direction, (g) key.

2. Identify (a) Gerardus Mercator, (b) Arthur Robinson.

3. What are some advantages and disadvantages of using a globe to show the Earth's surface?

4. Why are there so many different types of map projections?

5. How can knowing the parts of a map help you?

Critical Thinking

6. Making Comparisons You are planning a hiking trip with your family to a nearby state park. Your family uses two maps: a road map and a map of the park. What advantages does each map have?

Activity

7. Writing to Learn Think of a place that you like to visit. How would you tell a friend to get there? Make some notes about directions and landmarks you could include in a map. Then make a map that shows your friend how to get there.