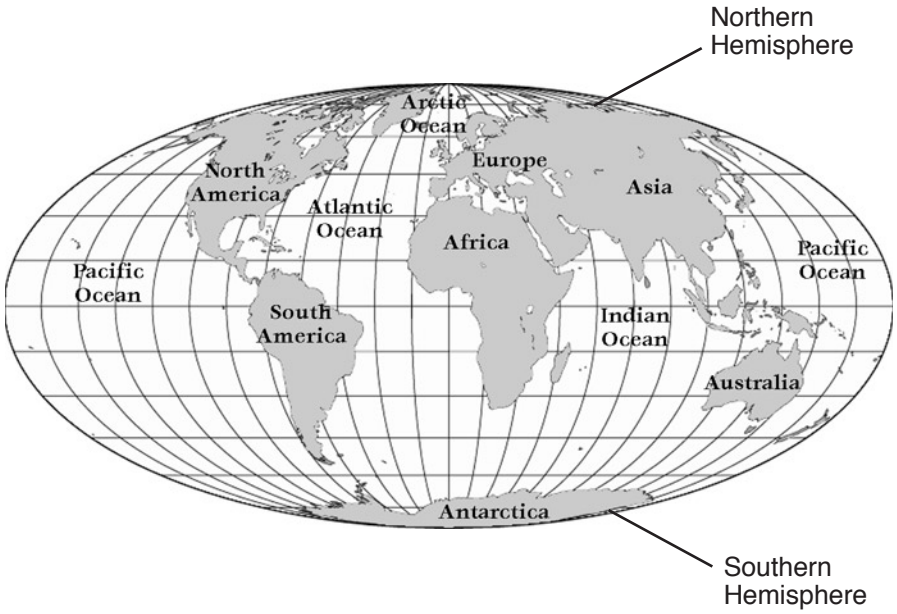
Understanding Maps of Earth

The Surface of Earth

Astronauts in the International Space Station looking down on Earth see it as a beautiful planet covered with land and water. Only about 30% of Earth's surface is land! The remaining 70% of the surface is covered with water.

The land on the surface of Earth is divided into seven major pieces called continents: Asia, Europe, Antarctica, Australia, Africa, North America, and South America.

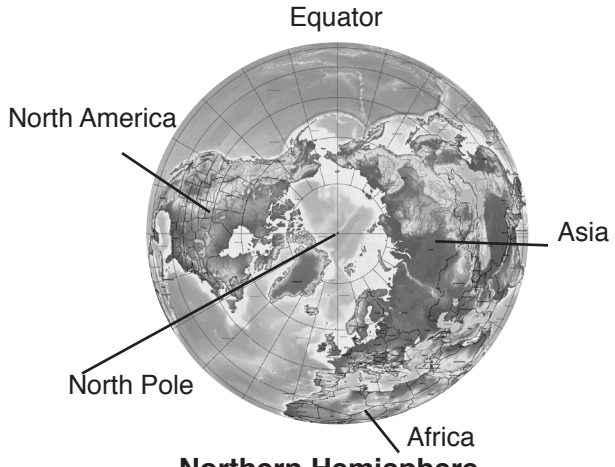
The largest bodies of water are the oceans. The four major oceans, from largest to smallest, are the Pacific Ocean, Atlantic Ocean, Indian Ocean, and Arctic Ocean. There are many bodies of water smaller than oceans called seas.



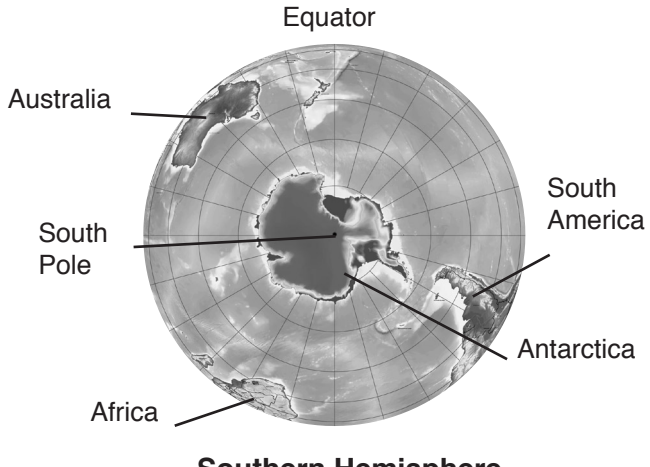
Hemispheres

Earth is approximately spherical with an average radius of 4000 miles. This spherical Earth can be divided into equal halves called hemispheres. If we separate Earth half way between the North and South poles (at the equator), we get the Northern Hemisphere (centered around the North Pole), and the Southern Hemisphere (centered around the South Pole).

Notice that the Northern Hemisphere is 39% land and 61% ocean, while the Southern Hemisphere is 19% land and 81% ocean.



Northern Hemisphere



Southern Hemisphere

Latitude and Longitude

Maps and globes usually have lines on them to help locate places on Earth. These lines are called latitude and longitude lines. These lines are not actually on the planet, but are imaginary lines used to help us find our way around the curved surface of Earth. The imaginary lines circling the globe in an east-west direction are called the lines of latitude (or parallels, as they are parallel to the equator). They are used to measure distances north and south of the equator. The lines circling the globe in a north-south direction are called lines of longitude (or meridians). They are used to measure distances east and west. Lines of latitude and longitude crisscross to form a grid. The location of any point on the surface of Earth can be described by two coordinates: its latitude and its longitude.

Latitude

Latitude measures how far north or south a point lies from the equator. The equator is at 0 degrees (0°) latitude, and it divides Earth into its northern and southern hemispheres. It is the starting point for measuring distances in degrees north or south of the equator. Values for latitude range from 0° to 90° North for locations north of the equator, and from 0° to 90° South for locations south of the equator.

Notice on the figure that the lines of latitude run in the east-west direction and are parallel to the equator. Any other location directly east or west of you lies at the same latitude that you do.

ISS EARTHKAM COORDINATES

ISS EarthKAM measures latitude and longitude using decimal degrees and N, S, E, W notation. For example, 39.2º N and 120.7º W.

Other formats for reporting latitude and longitude that you may see include:

39º 12' 00'' and 120º 42' 00'' (degrees, minutes, and seconds)

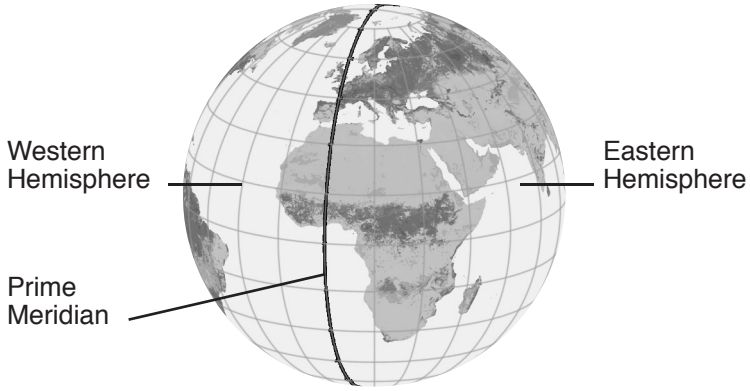
39.2º and -120.7º (south and west are negative)

ONE DEGREE OF LATITUDE

One degree of latitude is equal to about 111 kilometers at any place on the globe. If you know that two cities, at the same longitude, are 10 degrees of latitude apart, then you know they lie about 1110 kilometers (10 degrees x 111 km/degree) from each other.

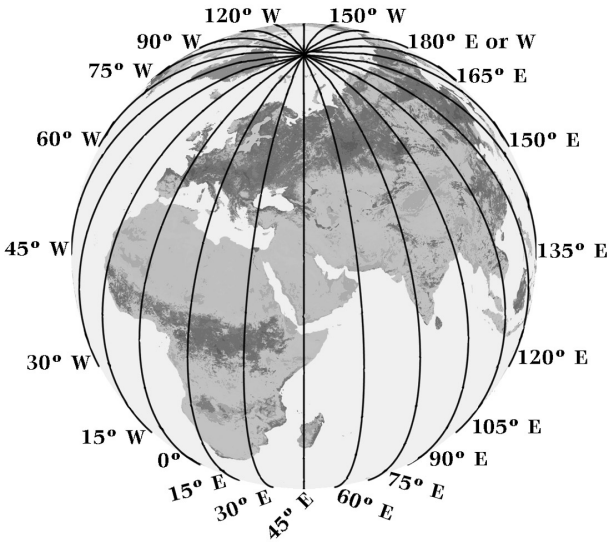
Longitude

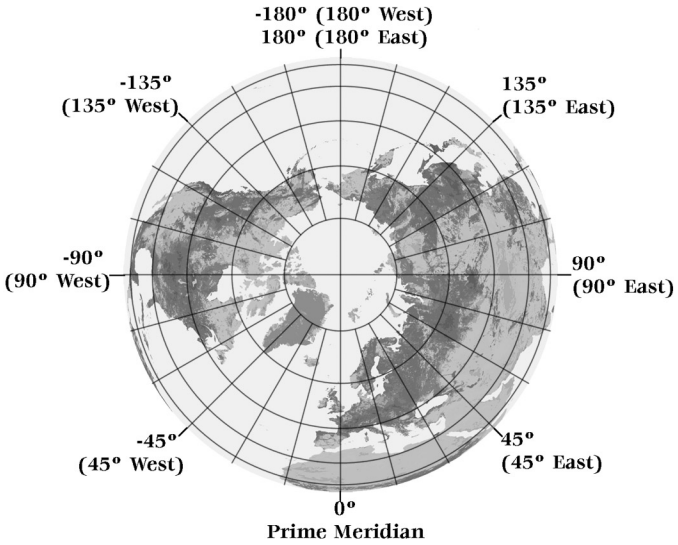
The lines circling the globe in a north-south direction are called lines of longitude (or meridians). Greenwich, England (near London) was selected to be zero degrees longitude in 1884 because it was the home of the most advanced observatory at that time. The “Prime Meridian” runs from the North Pole to the South Pole through Greenwich and is the starting point for measuring east and west longitudes. Locations with 0º longitude lie exactly on the Prime Meridian.



ONE DEGREE OF LONGITUDE

As you go further north or south of the equator, the distance between the two lines of longitude becomes smaller, because all longitude lines intersect at the poles. At the equator (0° latitude), 1° of longitude corresponds to approximately 110 kilometers. At 30° N or S, 1° of longitude corresponds to approximately 96.5 km, and at 60° N or S, 1° of longitude corresponds to approximately 56 km.

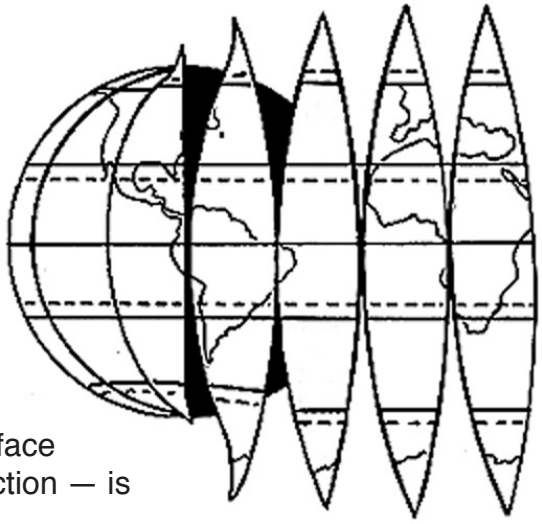




Longitude measures how far east or west a point lies from the Prime Meridian. Values for longitude range from 0º to 180º E for locations east of the Prime Meridian and 0º to 180º W for locations west of the Prime Meridian. 180º E and 180º W are the same longitude line.

Globes

The best representation of Earth is a globe. Globes do not distort the geometry of Earth (except, of course, its size!). Since globes are hard to carry around and you can't see the entire surface of Earth all at once, map makers produce flat maps of Earth. This is not an easy thing since the surface of Earth is curved.



Flat Maps of Earth

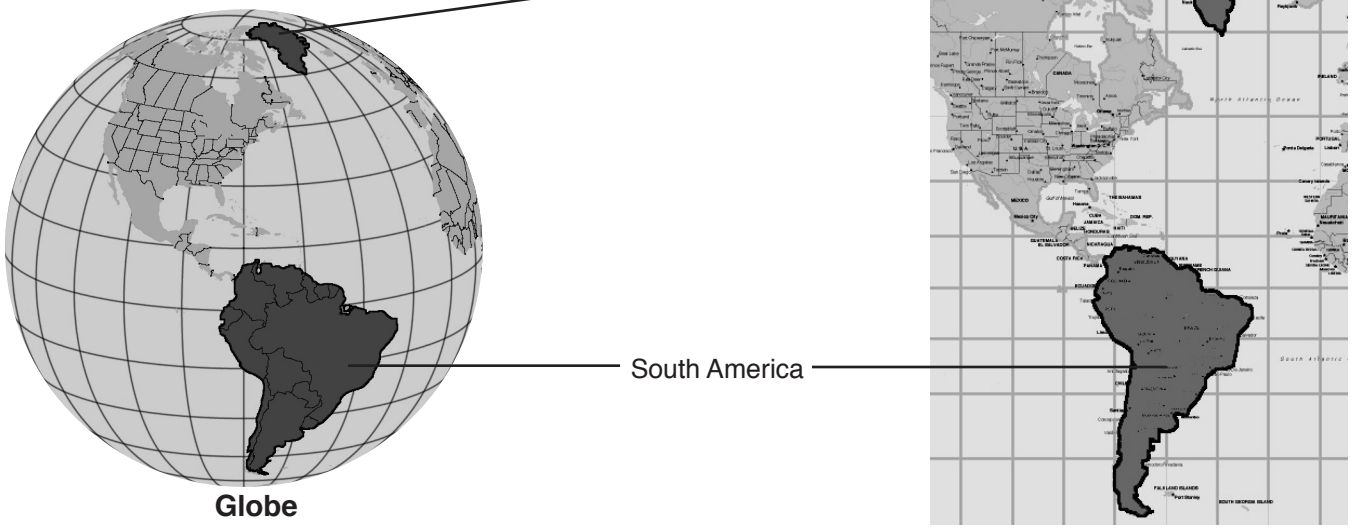
One way to get a flat map of the curved Earth is to cut the outer layer of the globe from top to bottom in equal sections. These long sections (called gores) are pointed on both ends.

Mercator Maps

There are numerous mathematical methods — called projections — used to transfer information about Earth's curved surface to a flat, rectangular map. One method — the Mercator projection — is the type used for the ISS EarthKAM Slider Map.

Mercator maps give true directions, but they exaggerate the size of the land that lies far from the Equator.

Compare the two figures: the globe and the Mercator map. They show the same regions of Earth, but the details of the regions look different. Greenland is much smaller than South America on the globe, but appears to be longer than South America on the Mercator projection map. Also notice how the longitude and latitude lines are curved on the globe but straight on the Mercator projection map.

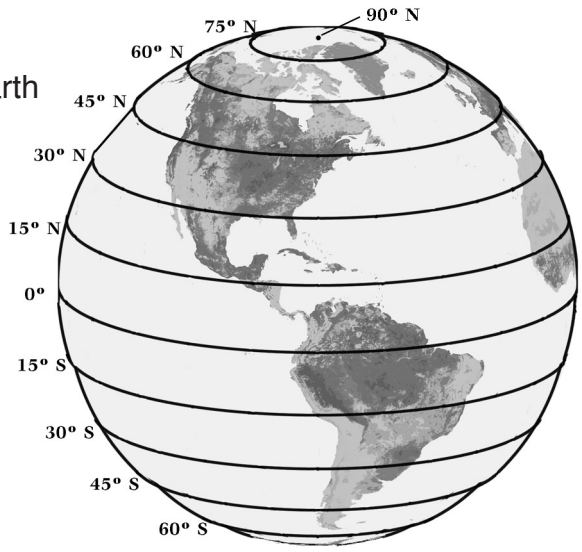


Globe **Mercator Map**

Important Facts about Latitude and Longitude

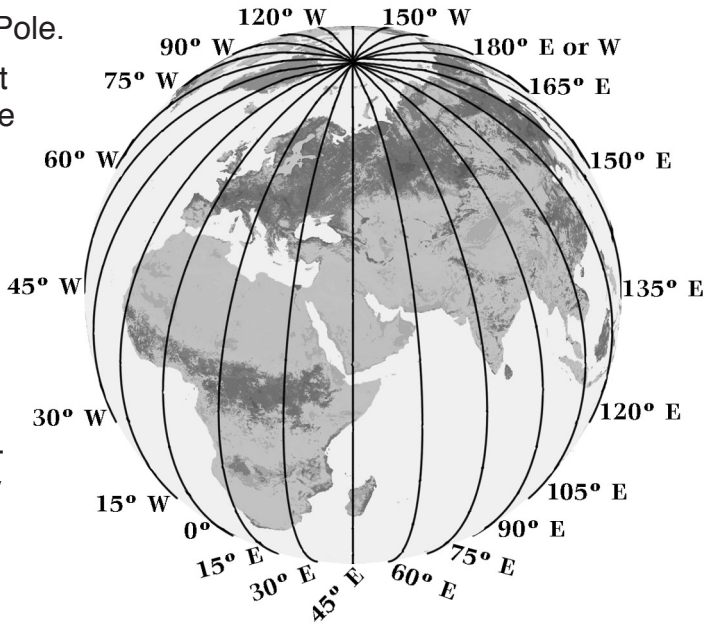
Latitude

- Latitude lines circle the globe in an east-west direction.
- Latitude measures how far north or south a point on Earth lies from the equator. (Latitude lines are also called parallels, as they are parallel to the equator.)
- The equator is at 0° latitude and separates Earth into Northern and Southern hemispheres.
- Locations north of the equator have latitudes between 0° (the equator) and 90° N (the North Pole).
- Locations south of the equator have latitudes between 0° (the equator) and 90° S (the South Pole).



Longitude

- Longitude lines run from the North to the South Pole.
- Longitude measures how far east or west a point on Earth lies from the Prime Meridian. (Longitude lines are also called meridians.)
- The Prime Meridian, the line of longitude which passes through Greenwich, England, is the 0° longitude line.
- Longitude values to the east of the Prime Meridian can be specified by either 0° to 180° E or by positive values 0 to +180°
- Longitude values to the west of the Prime Meridian can be specified by either 0° to 180° W or by negative values 0 to -180°.



Understanding Latitude and Longitude

Have your students read Understanding Maps of Earth and Important Facts about Latitude and Longitude, provide them with atlases, and then have them complete the Understanding Latitude and Longitude worksheet.

1. Which latitude and longitude values place you in the middle of the Salton Sea? (Find a map of California which shows latitude and longitude.) **b. 33º N, 116º W**
2. What places do the other pairs of latitude and longitude values identify?

   a. 40º N, 124º W **Piercy (Northern California)**

   c. 39º N, 120º W **Northern Edge of Lake Tahoe**

   d. 36º N, 122º W **Pacific Ocean, off Monterey**

   e. 38º N, 120º W **Yosemite National Park**
3. How far are you from your parents if you are at 36º N latitude and 116º W longitude and they are at 34º N latitude and 116º W longitude? And what state are you in?

   222 kilometers. Barely in California, near the Nevada border.

   (The Understanding Maps of Earth reading tells students that one degree of latitude always equals 111 kilometers.)
4. Where are you if you are at 34° S latitude and 18ºE longitude?

   Cape Town, South Africa
5. What is the approximate latitude and longitude of Rome, Italy?

   42º N, 12.5º E
6. What is the approximate latitude and longitude of Cairo, Egypt?

   29º N, 31º E
7. What is the approximate latitude and longitude of the Falkland Islands (Islas Malvinas)? **52º S, 60º W**
8. What is the approximate latitude and longitude of Mt. Everest (Chomolungma)? **28º N, 87º E**
9. What is the approximate latitude and longitude of the Torres Strait (separating New Guinea and Australia)? **10º S 142º E**

Encourage your students to continue practicing identifying locations and their latitudes and longitudes. For example, what is the latitude and longitude of your school?

Geography — Worksheet

Understanding Latitude and Longitude

Using an atlas and the readings Understanding Maps of Earth and Important Facts about Latitude and Longitude, answer the following questions. It is important that you understand both how to identify the latitude and longitude of a specific location and how to find a location given a specific latitude and longitude. These skills will be important while working with ISS EarthKAM images.

1. Which latitude and longitude values place you in the middle of the Salton Sea? (Find a map of California which shows latitude and longitude.)
   a. 40º N, 124º W
   b. 33º N, 116º W
   c. 39º N, 120º W
   d. 36º N, 122º W
   e. 38º N, 120º W

2. What places do the other pairs of latitude and longitude values identify?
   a. 40º N, 124º W_____
   b. 39º N, 120º W_____
   c. 36º N, 122º W_____
   d. 38º N, 120º W_____

3. How far are you from your parents if you are at 36º N latitude and 116º W longitude and they are at 34º N latitude and 116º W longitude? And what state are you in?

4. Where are you if you are at 34º S latitude and 18ºE longitude?

Geography — Worksheet (cont.)

5. What is the approximate latitude and longitude of Rome, Italy?

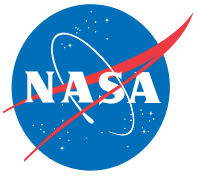
6. What is the approximate latitude and longitude of Cairo, Egypt?

7. What is the approximate latitude and longitude of the Falkland Islands (Islas Malvinas)?

8. What is the approximate latitude and longitude of Mt. Everest (Chomolungma)?

9. What is the approximate latitude and longitude of the Torres Strait (separating New Guinea and Australia)?

10. What locations interest you? What are their latitudes and longitudes?



Identifying Continents and Oceans

The students will learn about world geography. They will learn to identify the four major oceans (Pacific, Atlantic, Indian, and Arctic) and the seven continents (Asia, Europe, Africa, Antarctica, Australia, North America, and South America).

Materials/Resources:

- Student Handouts 1 and 2: Labeled and Unlabeled World Maps

Time: 1 (50 minute) period

Level: Easy

Recommended Procedures:

Challenge the students with remembering the locations of the major features on the map.

1. Have all the students look at the Labeled World Map provided.
   - Ask them to identify the seven continents and four major oceans.
   - Have them locate the prime meridian (0º longitude) and the Equator (0º latitude) and notice which oceans and continents these lines pass through.
2. After they have studied the map and are sure they can identify these major world features, have them test themselves and each other by labeling as many continents and oceans as they can on the Unlabeled World Map.
   - Remind them to label the prime meridian and the Equator.
3. Have the students use the compass on the maps to describe the relative locations of the continents and oceans.
   - What major ocean is west of North America? **Pacific Ocean**
   - What continent is east of Europe? **Asia**
   - What ocean is south of Asia? **The Indian Ocean**
   - What continent is north of Africa? **Europe**

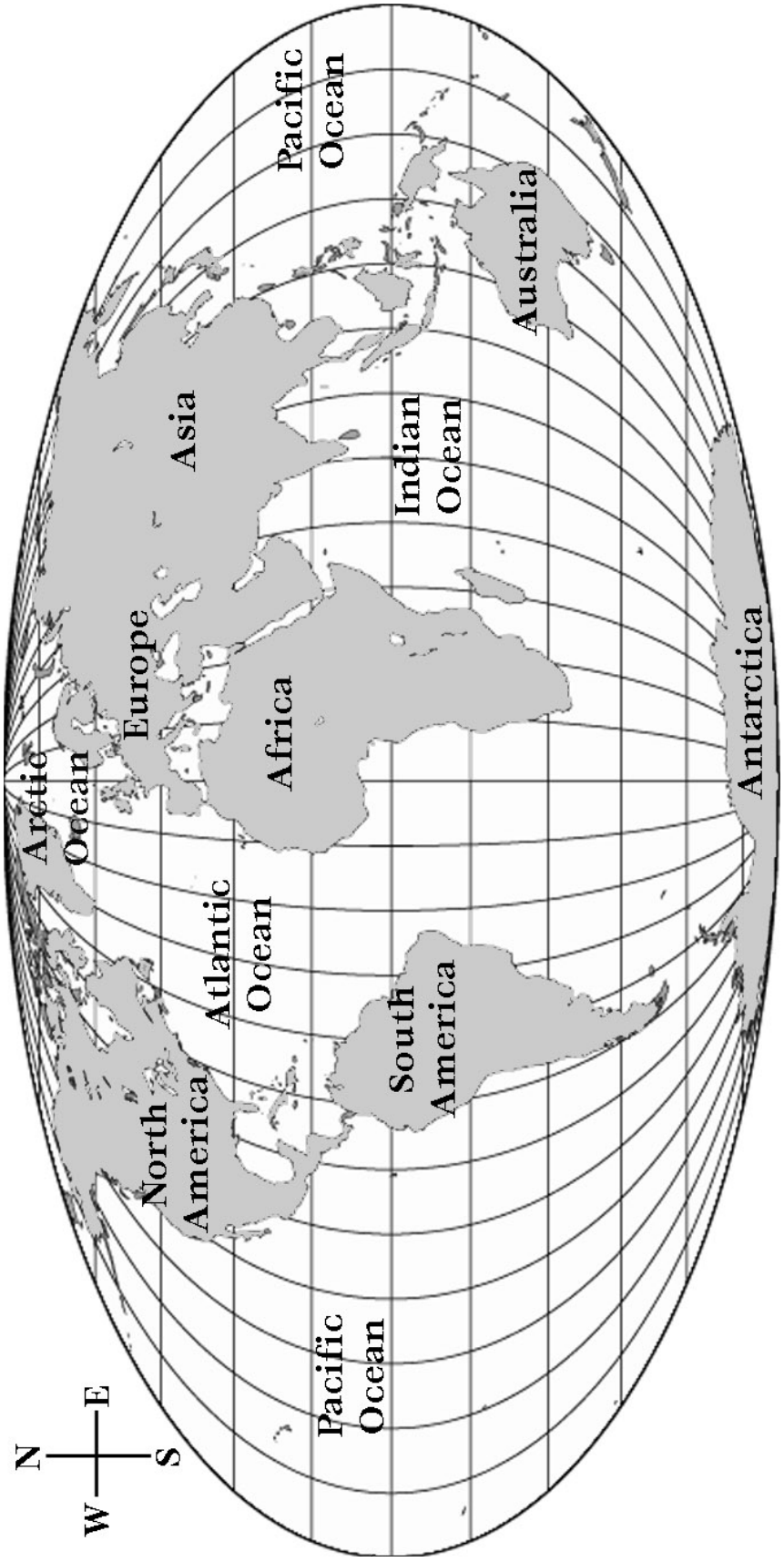
STANDARDS

Geography

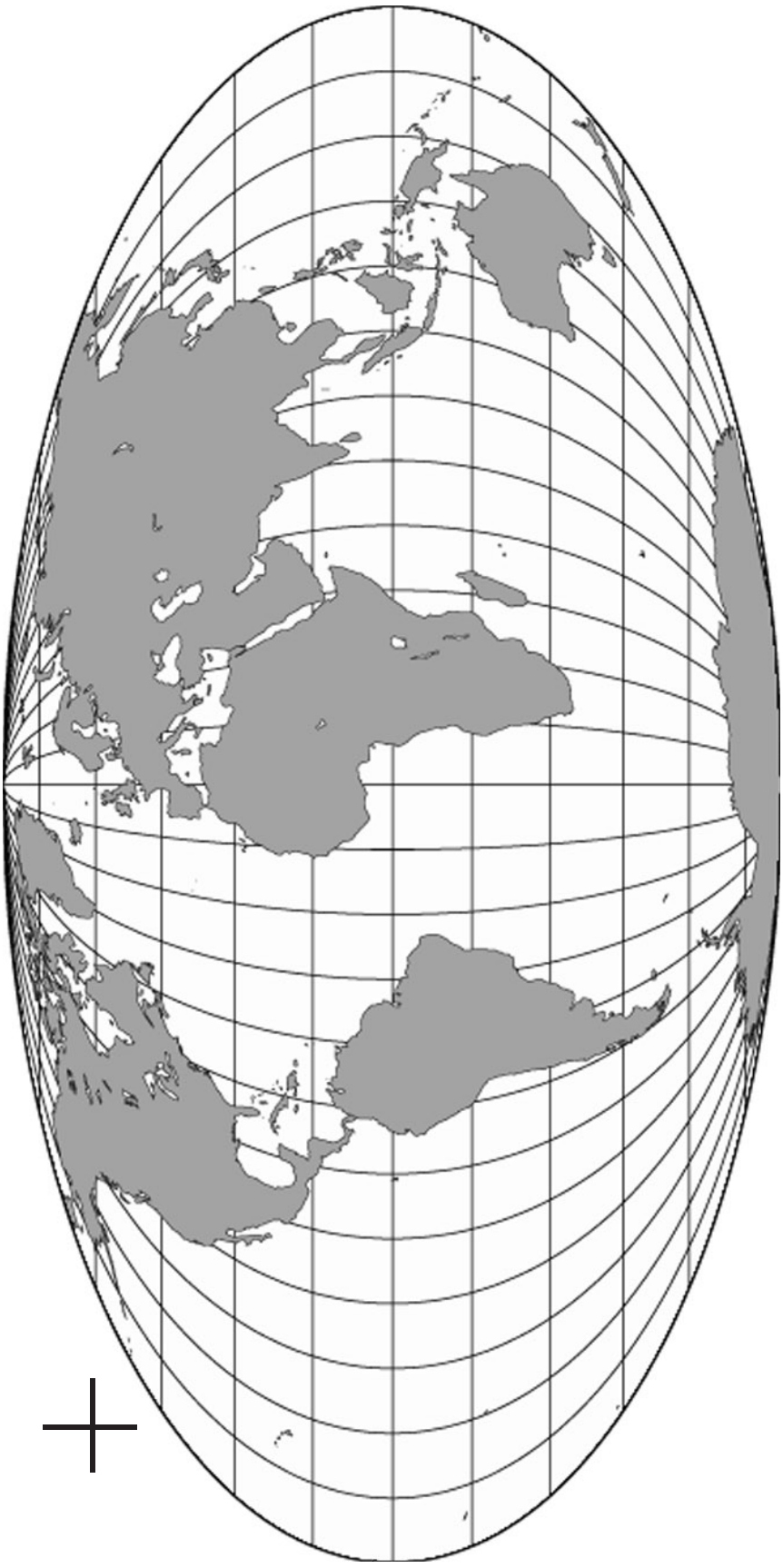
The World in Spatial Terms

• Standard 1: How to use maps and other geographic representations, tools, and techniques to acquire, process, and report information from a spatial perspective.

Labeled World Map



Unlabeled World Map



Create a Tennis Ball Globe

Students create a Tennis Ball Globe, seeing how a spherical Earth can be shown in one type of flat map.

Materials/Resources:

- Make copies of Student Handouts 1 and 2: Create a Tennis Ball Globe and Map Cut-out.

  Material Warning: The Map Cut-out is appropriately sized for wrapping around a tennis ball; however, photocopy machines sometimes cause changes in scale. Check that your copies are of the appropriate size before making enough for your class(es).
- Gather the necessary materials: Scissors, Tape, Two-sided tape (if available), Tennis balls (1 per team), Tape measures, and a Globe (optional).

Time: 1 (50 minute) period

Level: Easy

Recommended Procedures:

1. Have the students assemble their tennis ball globes.
2. Have students measure the circumference (in inches) of the tennis ball globe. Then have them determine the scale of their globe, using the fact that the actual circumference of Earth is approximately 25,000 miles. How many miles equal one inch? (If the tennis ball had a circumference of 10 inches, then 1 inch on the tennis ball would be equal to 2500 miles on Earth's surface.)

STANDARDS

Geography

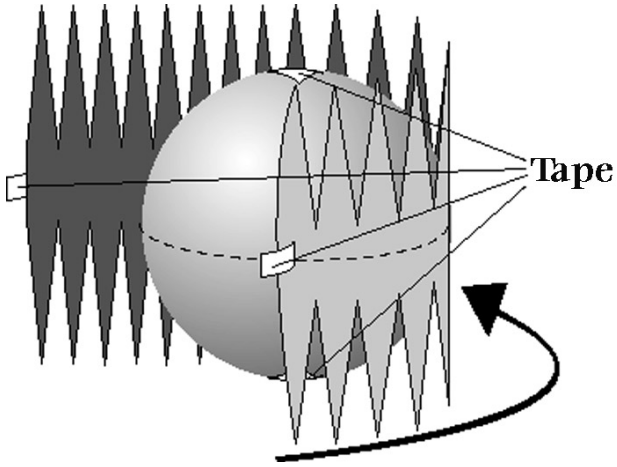
The World in Spatial Terms

• Standard 1: How to use maps and other geographic representations, tools, and techniques to acquire, process, and report information from a spatial perspective.

Create a Tennis Ball Globe

You will create a model of Earth using a flat map of Earth and a tennis ball.

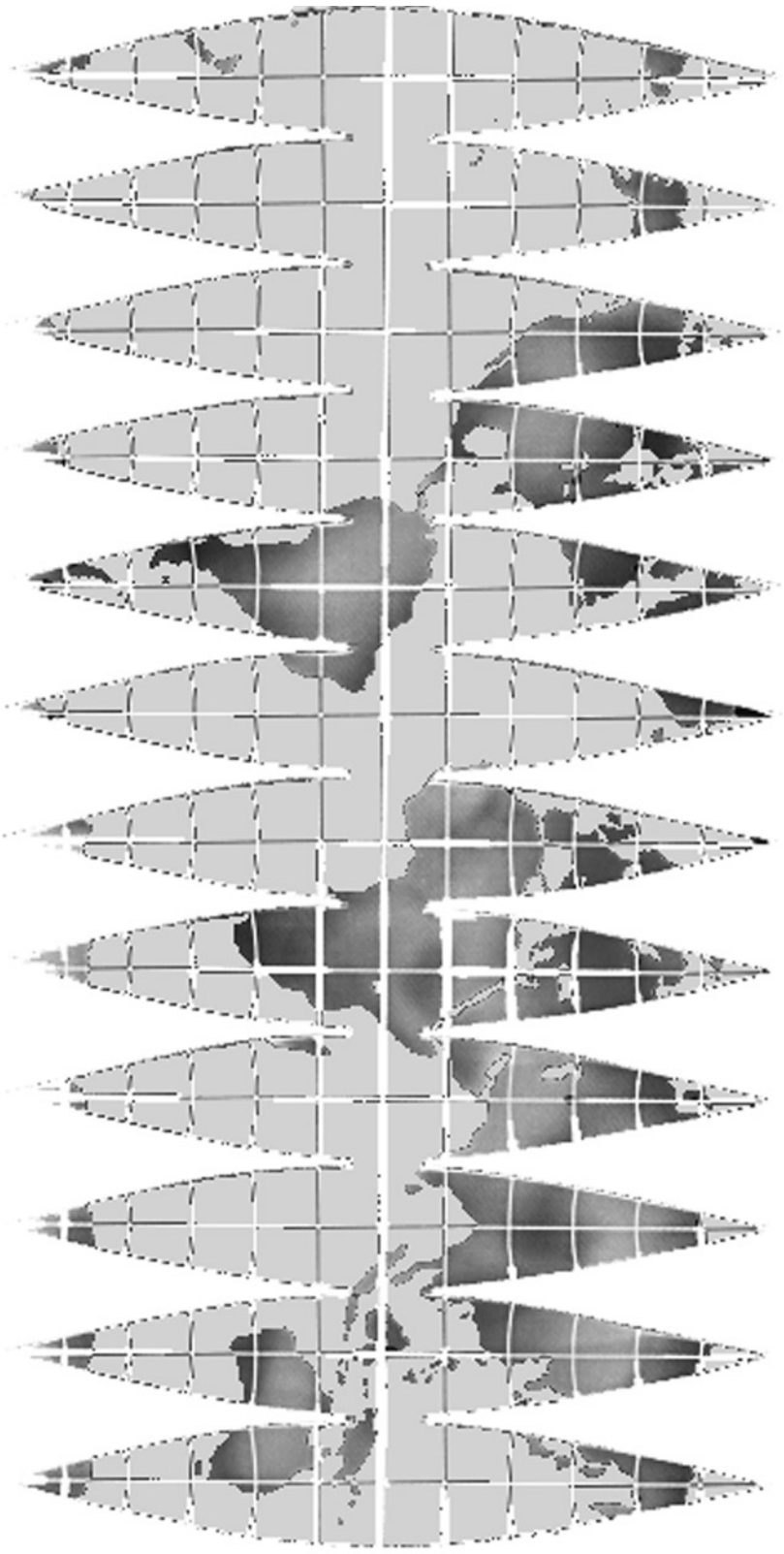
1. Carefully cut out the Map Cut-out.
2. Wrap the cut-out around the tennis ball so the Equator goes around the middle of the ball.



3. Tape the map together at the Equator.
4. Put a piece of two-sided or folded-over tape at each of the poles—the top and bottom of the ball.
5. Bring the points of the map together by pressing them onto the tape one by one.
6. Once all of the points are together, put a piece of tape on top of the poles to hold them in place.

You now have a spherical map of Earth on your tennis ball—a tennis ball globe!

Map Cut-out

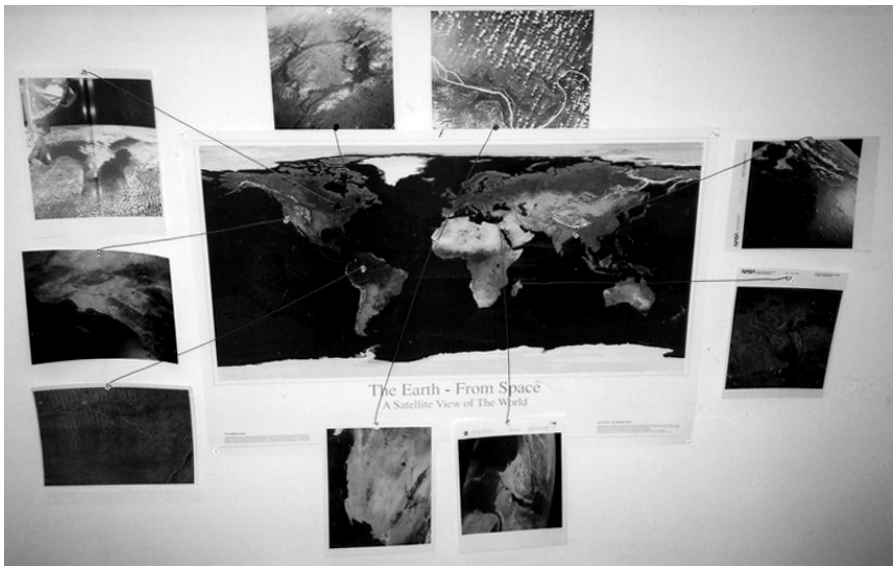


1 inch square

Photocopy machines sometimes cause changes in scale. If the square above is 1 inch on each side, the Map Cut-out should fit your tennis ball.

What Can Be Seen in Maps and Images

Students consider what can and cannot be seen because of size in ISS EarthKAM images. They consider what can be seen on a wall map of the world and then compare this to what can be seen in ISS EarthKAM images, and possibly other images of Earth from space.



Materials/Resources:

- Print out several ISS EarthKAM images and their Metadata. Optional: Print out other images of Earth from space.
- Gather the necessary materials: a wall map of Earth, push pins, string or yarn, and atlases.
- Attach the map to the wall in a place where you can use push pins to mount the images and mark locations.

Time: 1-2 (50 minute) periods

Level: Easy

Recommended Procedures:

1. Show your students the wall map and ask them to name and describe the places and features they see. These may include continents, oceans, deserts, rivers, mountains, and rain forests. Also have them identify specific countries and states.

STANDARDS

Geography

The World in Spatial Terms

• Standard 1: How to use maps and other geographic representations, tools, and techniques to acquire, process, and report information from a spatial perspective.

2. Ask your students to list several features too small to be seen on the map, such as houses, small cities, and ponds. Then ask them what is the smallest feature that they can see on the map. For example, can they see the Hawaiian Islands?
3. With your students, examine one of the images you gathered.
   a. Have them find the location of the image on the world map, using the atlases and the Metadata.
   b. Have them compare the size of the features in the image with the size of the features at that location on the wall map. They will see that more details are visible and that everything appears much larger in the image.
   c. Have them attach the image to a clear space on the wall, and use push pins and string to link the image to its corresponding location on the map.
4. Repeat step 3 with the other images you gathered. Each time, have a discussion identifying what they can see in the image that is too small to see in the map.
5. Ask your students to list:
   a. Ten things that are too small to be seen in the images, such as a person or house.
   b. Ten things that can be seen in the images, such as a city or river.
   c. Ten things that are too large to be seen, such as an entire continent.
6. Now discuss all their lists. What can and cannot be seen in the images?
   a. What human-made features can be seen? Cannot be seen?
   b. What natural features can be seen? Cannot be seen?
   c. Are any features that can be seen in an image of a size that cannot be seen in other images? (The scales of the different ISS EarthKAM images can differ, and if you are using non-ISS EarthKAM images of Earth, then the range of scales may be even broader.

Encourage your students to ask questions for which they, and even you, may not know the answers. The ISS EarthKAM images are a tremendously rich resource of thought-provoking topics for scientific and geographic investigations.