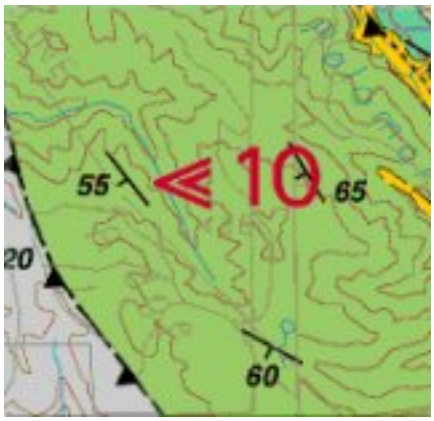
Name: _____

Dirt Maps



Do you think every place on Earth has the same type of soil or dirt? If you said no, then you are right. In fact, our planet has various types of features depending on the climate and location of the area. To keep track of these earth materials, scientists use **geologic maps** and **soil maps.**

Geologic maps show the location and types of geologic features in an area. With these maps, scientists can locate different types of rocks, faults, folds, and other geologic structures. These maps are different from topographic maps because they are made on top of **base maps.** Base maps include the actual land features of an area. Cartographers usually design base maps so they are printed in light colors or with gray lines. The purpose is to make sure the information on the geologic map can be read easily.

With every type of map, there are specific ways of measuring and labeling its features. On geologic maps, you have **geologic units.** Geologic units describe the rock type and the volume or amount of that rock within that area. To show differences in geologic units, cartographers use different colors. If the rocks are within the same age range, then they are given different shades of the same color. Each geologic or rock unit is assigned a letter code. The letter code has one capital letter and one or more lowercase letters. The capital letter stands for the age of the rock. The lowercase letters stand for the type of rock.

Geologic maps also have special symbols. **Contact lines** are used to show the point or **contact** where two geologic units meet. There are two common types of contacts called **faults** and **depositional contacts.** Faults appear where rocks move past one another. Depositional contacts appear where one layer of rock forms above another layer. **Strike** and **dip** symbols are used for rock beds. Strike symbols show the direction the rock beds run. Dip symbols show the angle of the rock beds. Who knew rocks were so complicated?

Soil maps are used to classify and map the different types of soil in an area. The **National Resources Conservation Service (NRCS)** is the government agency responsible for soil mapping. The NRCS is a part of the **United States Department of Agriculture (USDA).** When soil maps are made, they are usually made for a county within a state.

Scientists use field surveys to get information about an area's soil. On these surveys, scientists find out information about the properties of the soil. They write a **text** about the area's land features and climate. The scientists then design tables that list the types and amounts of soil in that area. Now, they are ready to map out the area. Similar to geologic maps, one part of the soil map shows the layout of the different types of soil in the area. The other part gives specific information about each type of soil.

There are different industries and people who use soil maps. Farmers, agricultural engineers, and land

management businesses use these maps to learn more about soil properties in an area. Knowing about soil properties helps these industries to conserve our soil and plan for responsible future use of the soil.

Dirt Maps

Questions

_____ 1. Geologic maps show _____ in an area.

A. Seismic activity
B. Soil properties
C. Geologic units
D. Aquatic units

2. What is the main idea of this article?

_____

_____

3. Why is it important for scientists to make geologic maps?

_____

_____

4. How are depositional contacts different from faults?

_____

_____

5. Farmers, agricultural engineers, and land management businesses use soil maps. Why would landscapers use soil maps?

_____

_____

6. Describe each section of a soil map.

_____

_____

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_____ 7. Strike symbols are used to show the _____.

A. Direction rock beds run in an area
B. Angle of tilt of rock beds in an area
C. Depth of a fault in an area
D. Height of a depositional contact in an area

8. What is the purpose of a base map?

_____

_____

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How many of these can you write about? Think! Write! Check all the ones you answered.

- ☐ Think about the soil in your backyard. Write a poem that describes the properties of your yard's soil. Be creative!
- ☐ There are many types of soil on our planet. Are certain types of soil found in different areas? Use the internet to locate a current soil map (visit the USDA website http://soils.usda.gov/) for your state. What types of soil are found in your state? Does the location of the soil depend on the area of the state? Write an essay that explains the types of soil and the properties of the soil found in your state.

Don't stop writing. Use a blank piece of paper to continue.

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The Flat Sphere



It sits on the counter by the window peering out into the world. It comes to life when the names of countries, explorers, and oceans are thrown around the room. It's your trusty classroom globe! Students throughout the years have seen a globe or two by their classroom windows. We take this colorful sphere for granted. However, have you ever wondered how scientists produce such an accurate model of our planet?

Cartographers are the earth scientists responsible for producing globes and maps of Earth. For centuries, scientists have made models and pictures of our planet. Today's cartographers use different methods for collecting information about the Earth's surface. Technology in the form of satellites and airplane computers has allowed scientists to collect images of Earth from space and high altitudes. This is done through **remote sensing.** By using remote sensing, scientists can take images of the Earth's surface from high above and analyze those images. In addition to remote sensing, cartographers also conduct **field surveys.** Field surveys allow scientists to measure specific areas on Earth that need to be mapped. They walk or drive through these areas, collecting measurements and plotting those measurements on maps. Surveyors then use these measurements to make measurement estimates for areas between the surveyed points. Once all of the information is collected, cartographers produce globes and maps of our planet.

Speaking of globes, can you imagine how hard it would be if that was the only representation of our planet we could use? It would be very hard to store globes in our cars as we travel. Well, cartographers have found ways to transfer the images from a globe to a flat map. Scientists accomplish this goal by using **map projections.** Imagine having a transparent globe with a flashlight inside. It would be very easy to wrap the globe with paper and trace its images onto the paper. As you may have guessed, it is not that simple. Cartographers use mathematical formulas to make map projections. Three basic map projections are used- **cylindrical, conic,** and **azimuthal.** A fourth projection, **interrupted,** is not used as often as the previous three. Each map projection has its advantages and disadvantages.

Cylindrical, or **Mercator** projections, have meridians that are straight and equally-spaced parallels. Mercator projections have a grid-like appearance which makes this type of map useful for navigation. Since meridians meet at the poles on globes, the distances and sizes of land masses are distorted at the poles on maps with Mercator projections. Sizes and distances at the equator, however, are accurate.

If you were to place a sheet of paper on our lighted globe so that it touched only one point of the sphere, you would produce a map with an azimuthal projection. Azimuthal projection maps have distorted shapes, areas, and distances as you move farther away from the contact point. The contact point is usually one of the poles; however, it may be at other points on the globe. If the point is at one of the poles, the Earth looks as if it is cut into even pie slices. If the point is any point other than the poles, the Earth looks like a stretched-out sphere. On this projection

there is not equal spacing between the parallels. This unequal spacing causes distortion in direction and distance. In spite of the distortion, navigators use this type of map because great circles appear as straight lines. If a straight line was drawn between any two points on an azimuthal projection map, you would actually have a great circle route.

On maps with conic projections, there is little distortion of shapes and areas along the contact point parallel. If you were to place a cone-shaped paper on the globe with its point lined up with the globe's pole, the cone would touch the globe along one parallel of latitude. The distances along the meridians and parallels are correct on this type of map. Cartographers can also combine conic projections of different neighboring areas on the globe. The cone would touch the globe at different latitudes. The result - a continuous map called a **polyconic projection** map. This map's small areas are almost the same relative size and shape as those areas on the globe. The final projection, interrupted projection, is produced by one of the other three projections. The map has the appearance of flattened orange peel slices. This projection is rarely used.

Even though cartographers have found methods for limiting distortion on two-dimensional maps, there is not any one projection that is a completely accurate model of Earth.

The Flat Sphere

Questions

_____ 1. Cartographers use _____ and _____ to map areas of the Earth.

A. remote sensing and field surveys
B. field surveys and expeditions
C. field surveys and historical models
D. remote sensing and excavation

2. What are the disadvantages of using map projections?

_____

_____

3. If I wanted to study equatorial regions, which map projection do you think I should use? Why?

_____

_____

4. Describe the four types of map projections.

_____

_____

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5. If you were an airline pilot, which map projection would you use? Why?

_____

_____

6. Why do you think maps with interrupted projections are rarely used in the classroom?

_____

_____

_____ 7. When a straight line is drawn between any two points on an azimuthal projection map, it produces a _____.

A. great circle route
B. fault line
C. contour line
D. parallel

8. Why are globes more useful for studying larger areas than maps?

_____

_____

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Name: _____

How many of these can you write about? Think! Write! Check all the ones you answered.

- ☐ You are an azimuthal projection map. Write a monologue that explains to the other map projections why you are valuable. Be creative!
- ☐ Humans have used maps for thousands of years. When did the first map appear on Earth? Use the internet and other research tools to find out about the history of maps. Design a time line that describes the origin of important maps throughout history and the people responsible for designing the maps.

Don't stop writing. Use a blank piece of paper to continue.

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It's the Great Circle, Columbus!



When explorers began sailing across the oceans in search of new lands, the need for a completely new science emerged. **Cartography,** or the science of designing maps, became extremely important to explorers and sailors who were seeking new lands. It's still important today because maps allow scientists to track changes to our planet's surface and allow people everywhere to locate specific places on Earth.

Since Earth is a sphere, scientists use the Earth's axis of rotation to determine reference points for directions. The geographic North and South Poles are the points where the Earth's axis of rotation intersects the surface of our planet. As you know, the equator lies halfway between the poles. This **parallel** separates our planet into the Northern and Southern Hemispheres. Parallels are the many circles that run east and west around the Earth (well at least on maps and globes). They are referred to as parallels because they are parallel to the equator. Parallels are labeled *N* for north of the equator and *S* for south of the equator. Cartographers measure the distance between these parallels in degrees of **latitude.**

Latitude is the distance north or south of the equator. The equator is 0 degrees latitude. Latitude is also referred to as an angular measurement. Since the distance from the equator to each of the poles is 1/4 of a circle (circle is 360 degrees), the latitude of each pole is 90 degrees. One degree of latitude equals 1/360th of the Earth's circumference. That is equal to 111 kilometers. For every degree of latitude, there are sixty minutes ('). Every minute of latitude equals 1.85 kilometers. Each minute of latitude is equal to sixty seconds ("). If we were to locate the city of Washington, D.C., its latitude would be 39 degrees N. If we wanted a more precise measurement, then Washington, D.C., is located at 38 degrees 53' 23" N latitude.

Another measurement cartographers use is **longitude.** Longitude shows the location of a specific place east or west of the **Prime Meridian. Meridians** are imaginary semi-circles that run north and south around the Earth through the poles. The Prime Meridian, 0 degrees, runs through Greenwich, England. Just like latitude, longitude is an angular measurement. However, the distance between each degree of longitude changes with the location of the longitude. All of the meridians meet at the poles. As you move away from the equator where one degree of longitude equals 111 kilometers, the distances decrease. In fact, at 80 degrees N latitude, one degree of longitude equals about 20 kilometers. All meridians west of the Prime Meridian are 0 degrees to 180 degrees W (west), and all meridians east of the Prime Meridian are 0 degrees to 180 degrees E (east). If we looked at Washington, D.C., again, its more precise measurement would be 38 degrees 53'23" N, 77 degrees 00'33"W. Now we move on to the **great circle.**

Great circles are very important in navigation. Pilots who fly long-distance aircraft use great circles to find the most direct route between two locations. Great circles are any circles that divide our planet in half or mark the

circumference of the globe. Simply put, two meridians that are across the Earth from each other form a great circle. The equator is the only line latitude that is a great circle. On a sphere, the shortest distance between two points is the route along a great circle. Airplanes and ocean-going vessels usually navigate using great circles.

Cartographers have found ways to use the Earth's magnetic force to help determine direction. Our planet has two **geomagnetic poles**- the Geomagnetic North Pole and the Geomagnetic South Pole. The geomagnetic poles and the geographic poles are located in two different places. The geomagnetic poles are along a line through the center of our planet. This line is at an angle to the Earth's axis of rotation. Since these poles exist, we can use magnetic compasses to find directions (north, south, east, and west) on Earth. The needles on magnetic compasses always point to our Geomagnetic North Pole. The horizontal angle between the true Geographic North Pole and the Geomagnetic North Pole is called **magnetic declination.** Since our planet's magnetic field constantly changes, maps that show the magnetic declinations of the Earth are updated regularly.

One final way that people find direction on Earth is by using **global positioning systems (GPS).** GPS was once only used by the military. However, now systems are readily available for consumer use. This system uses a global network of satellites. These satellites transmit radio waves to the Earth's surface. The first GPS system was NAVSTAR, which was started in 1978. Receivers on the Earth's surface pick up signals from three satellites in order to determine position. These satellites calculate the latitude, longitude, and altitude of the receiver and are accurate within several meters of the actual location.

All of these methods used by cartographers help us to find our way around our vast planet.

It's the Great Circle, Columbus!

Questions

_____ 1. Lines of longitude run _____.

A. North and south of the equator
B. East and west of the equator
C. East and west of the prime meridian
D. North and south of the prime meridian

2. Compare parallels with meridians.

_____

_____

_____ 3. Airline pilots and ocean-vessel pilots use _____ to travel the shortest distance between two points.

A. Great circles
B. Semi-circles
C. Compasses
D. None of the above

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4. Why is the distance between meridians not constant, but the distance between parallels is constant?

_____

_____

5. What is wrong with the following location: 125 degrees N, 195 degrees E?

_____

_____

_____ 6. The distance covered by a degree of latitude is _____.

A. 1/360th of the Earth's circumference
B. 1/180th of the Earth's circumference
C. 1/270th of the Earth's circumference
D. 1/90th of the Earth's circumference

7. How does GPS help people to find their location on Earth?

_____

_____

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Name: _____

How many of these can you write about? Think! Write! Check all the ones you answered.

- ☐ Write a title down paragraph to explain lines of parallel or lines of meridian. Use the letters in the word "latitude" or the word "longitude" to begin each sentence.
- ☐ Use the internet and other library resources to research the history of compasses on Earth. Have they changed the technology of compasses during the past few years? Make sure your essay discusses how compasses have evolved since they were first invented.

Don't stop writing. Use a blank piece of paper to continue.

Name: _____

The Best View of Earth?



A journey into the world of maps introduces you to globes, map symbols, legends, and directions. There are even different types of maps for different purposes. However, did you know that globes are the most accurate model of our planet? That's right; if you want the best view of Earth, globes are the way to go. Before you run out and fill your bedroom with globes, there is something you should know. In addition to being hard to carry in your pocket, globes do not show much of the surface detail. The tool that is best for that job is a flat map.

Cartographers produce flat maps of the Earth's curved surface by using **projections.** There are three main types of projections: **cylindrical, conical,** and **planar** or **azimuthal.** All of these projections distort the Earth's surface. Why? Imagine opening up a plastic globe from pole to pole along the prime meridian. Now imagine flattening the two halves on your desk at school. The continents would probably look odd. That's because the drawings of the land features were done to specific measurements based on a curved surface. To flatten them, the shapes would have to change. That is distortion.

Cylindrical projections, or **Mercator projections,** produce a map that looks like it was on a larger cylinder, wrapped around our planet. You will recognize this map because the latitude and longitude lines are straight. Together, these lines form a grid of rectangles. Maps with Mercator projections are used for sea and air navigation. Why? On these maps, the entire world is shown. The only areas not shown are the areas near the poles. Sailors and pilots can map their journey by drawing a straight line from point to point. One disadvantage about this map is that areas far away from the equator are distorted. These areas look larger than they are in real life. On a Mercator map, Greenland is greater in size than South America. In real life South America is almost eight times larger than Greenland.

Conical projection maps are produced as if a cone hat was placed on a globe at the North Pole. This would show that the paper hat only touches the globe on parallels halfway between the North Pole and the equator. A flattened map with this projection has curved latitude lines. Since the curving of the latitude lines mirrors our planet's curved surface, some of the land features are their true sizes and shapes. Cartographers may use this projection when mapping the United States. Since the United States is located in the middle latitudes and is a large area, there will be less distortion. However, the areas near the equator and the poles will have distortion.

The last projection, planar or azimuthal, looks like large sliced pizza pies but with land features. There is only one **contact point,** which is usually one of the poles. Imagine shining a light from the center of the globe towards one of the poles. That is the projection you get with planar maps. In fact, when a planar map shows a polar region, the longitude lines meet at the contact point in the center. There's your globe pizza pie. The land features that are farther away from the poles are distorted in size and shape. Navigators of airplanes and ships use planar maps to

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plot their trips. This is because they can draw a straight line between any two points and get a great circle route. Remember, the shortest distance between two points on a globe is the route along a great circle. Scientists also refer to these maps when studying the polar regions.

All map projections share the same goal - to show the Earth's curved surface on a flat map. However, each projection shows different parts of the world accurately (depending on the contact point) and other parts as distorted images.

The Best View of Earth?

Questions

_____ 1. The three major map projections are _____.

A. conical, cylindrical, and elliptical
B. cylindrical, azimuthal, and polygonal
C. conical, cylindrical, and azimuthal
D. cylindrical, planar, and hexagonal

2. Why do cartographers use map projections?

_____

_____

3. True or false? Globes are not the most accurate model of our planet. Give a reason for your answer.

_____

_____

_____ 4. Azimuthal or planar maps are used mostly by _____.

A. airline and ship pilots
B. astronomers and meteorologists
C. scientists studying polar regions
D. both A and C

5. Compare cylindrical projection maps with conical projection maps.

_____

_____

6. What is the one disadvantage to using Mercator map projections?

_____

_____

Name: _____ edHelper

_____ 7. When a straight line is drawn between any two points on an azimuthal projection map, it produces a _____.

A. great circle route
B. parallel
C. contour line
D. fault line

8. Based on what you have read, why do you think globes are more useful for studying larger areas than maps?

_____

_____

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Name: _____

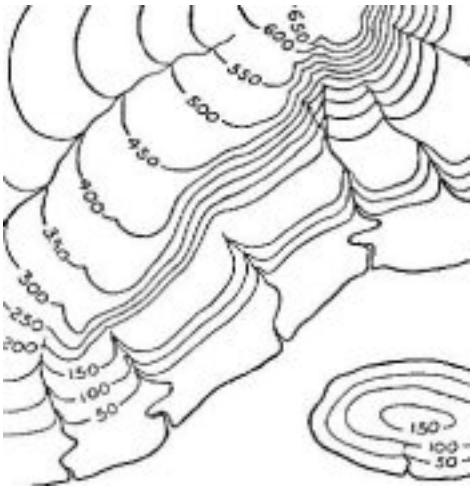
How many of these can you write about? Think! Write! Check all the ones you answered.

- ☐ You are a cylindrical or Mercator projection map. Write a speech that explains to the other map projections why you are valuable. Be creative!
- ☐ Create a panel discussion between a globe and the other three major map projections. The topic - "The Future of Mapmaking." Make sure you include a moderator (that could be you) and an audience (possibly the world's cartographers). Remember, every map deserves a voice! You can write your panel discussion as a script and have fellow classmates act out the discussion. Be creative!

Don't stop writing. Use a blank piece of paper to continue.

Name: _____

Language of Topography



Every map has its own special language. The road maps have lines for streets, routes, and highways. The political maps have boundary lines, capital stars, and major cities. For **topography maps,** the **contour lines** are the key to understanding this map's special language. Topography is the size and shape of natural and human-made land features. Map projections and globes do not give scientists detailed information about our planet's surface. This is why topographic maps are very useful.

Earth scientists, such as geographers and cartographers, want to know about the Earth's surface. They want to know about the shape, size, and **elevation** of its land features. Elevation is the height of a land feature above sea level. This is also referred to as the **mean sea level.** Elevation is calculated by choosing a point halfway between the highest and lowest ocean tide levels. At mean sea level the elevation of a land feature is zero.

Contour lines show changes in elevation. They are isograms because they connect points on the land surface that have the same elevation. These lines also show the shape of the land feature. Every fifth contour line is bolder than the other lines. This line is an **index contour.** Cartographers include the index contour to make the map easier to read. (This way you don't have a bunch of squiggly lines going on forever in front of your eyes.) The four lines above and below the index contour are not in bold. Index contours are also labeled with the elevation of that area. Contour lines never cross. If an exact elevation is available, an "X" will be added next to the number. If the contour lines are spaced widely apart, this means the elevation is changing gradually. The land in that area is basically level. Contour lines that are drawn close together mean a sharp change in elevation. Contour lines are used to show the **slope** or steepness of a land feature.

In addition to elevation, the direction of contour lines is used to show the shape of landforms. If you want to find a valley on a topographic map, just look for the V-shaped contour lines. The point of the V points upstream towards higher land. The width of the valley is shown by the width of the contour lines. Rivers will flow downstream or away from the point of the V. Mountaintops and hilltops are labeled with closed-loop contour lines. **Depressions** or sunken areas have special closed-loop contours. **Depression contours** contain short straight lines that are perpendicular to the inside loop.

If you want to know the difference in elevation between contour lines, you need to know the **contour intervals.** Contour intervals are the same for the entire map. If the difference between two lines is 20 feet, then the contour interval of the entire map is 20 feet. Contour intervals, however, are different from map to map. The **relief** is the difference between the elevation of the highest point and lowest point on the surface. Topographic maps with high reliefs usually have high contour intervals. Maps with low reliefs tend to have low contour intervals.

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The symbols used on topographic maps are very important. Cartographers who work for the **United States Geological Survey (USGS)** use different colored symbols to show land features. Bodies of water are usually colored blue. Forest and other plant areas are colored green. Buildings, roads, railroads, and boundaries are black. Contour lines are either black or brown. Cartographers will color areas that are still being researched purple. The USGS makes topographic maps for urban, rural, and suburban areas of the U.S. This agency also updates our maps. Stop by the USGS website http://www.usgs.gov/ to view their current topographic maps.

Language of Topography

Questions

1. If you were looking at a topographic map for an urban area, what symbols would you expect to see in the map legend?

_____

_____

2. Compare a depression contour and a contour line.

_____

_____

_____ 3. Contour intervals are the same for every topographic map.

A. False
B. True

4. If you were going on a hiking trip with your family to a national park for the first time, which map would be more appropriate to use- a geographic map or a topographic map? Why?

_____

_____

_____ 5. Contour lines that are widely spaced show _____.

A. areas with valleys
B. areas with depressions
C. gradually changing elevation
D. sharply changing elevation

_____ 6. The contour interval is the difference between _____.

A. contour lines
B. elevations
C. sea levels
D. parallel lines

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7. Explain the purpose of index contours.

_____

_____

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Name: _____

How many of these can you write about? Think! Write! Check all the ones you answered.

- ☐ Write a title down paragraph to explain topography. Use the letters in the word "topography" to begin each sentence.
- ☐ We know the USGS produces the majority of the topographic maps in the United States. However, do other countries have federal agencies that design and make topographic maps? Use the internet and other reference materials to research topographic maps of other countries. Write a comparison essay that compares the topographic map of one country with the maps made in the U.S. Make sure you include information about the agency that produces the maps for that country.

Don't stop writing. Use a blank piece of paper to continue.