

EARTH SCIENCES - TYPES OF MAPS TEACHER GUIDE

MATERIALS:

Electronic Reader - Maps
5 different types of maps (see lab)
inflatable globes
local topographical map

Objective: To understand the uses and importance of maps.

WHAT IS A MAP?

Teacher note

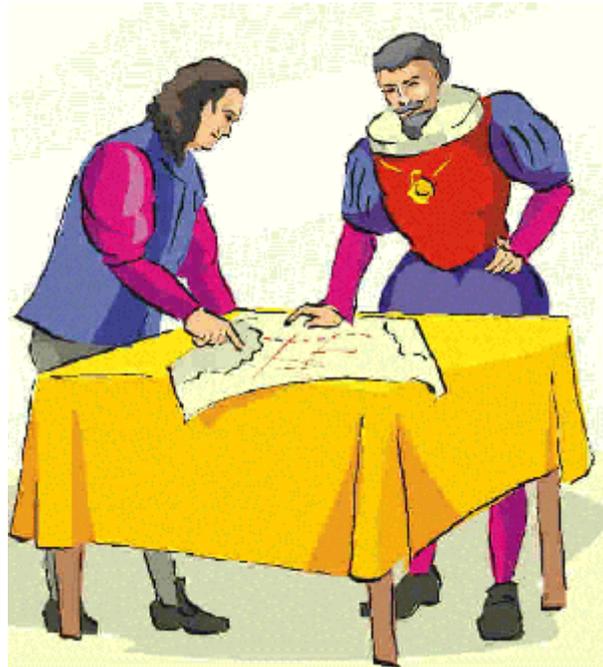
Maps are the focal point for understanding geography. There are many ways to teach map reading. Learning how to find north, read a legend, distances and location are standard skills that are taught in geography. However, you can teach map reading skills and science at the same time. Maps become exciting when you use them to make understanding science easy.

Ask students about what they think a map represents and write their responses down and discuss with class.

You may want to check out two websites with information on maps:

A **map** is a picture or representation of the Earth's surface, showing how things are related to each other by distance, direction, and size. Maps are a way of showing many things about a portion of the earth's surface on a flat piece of paper that can be carried and transported easily. A map is not a photograph of the Earth's surface. It can show many things that a picture cannot show, and as a result, a map looks different in many ways from a photograph of the Earth's surface.

Maps have been used for centuries. A person who creates map as a profession is called a **cartographer**.



USES OF MAPS

Teacher note

Brainstorm ways in which maps are used. List the students' ideas on the board.

Maps can be used in evaluating natural resources; in analyzing and forecasting weather conditions; in agriculture, fisheries, and general commerce; and in regional planning. Maps help in navigation and locating places by sea, air, and land.

Maps are important to scientists concerned with the causes and effects of the distributions of phenomena, in such disciplines as geology, oceanography, meteorology, climatology, animal and plant ecology, agronomy, economics and the social sciences, as well as geography itself.

Today maps are used by people to find places they have not seen. Let's say you are asked to find the nearest high school from your house. You could walk aimlessly from your house and hope you find a school.

However, if you were thinking, you would use a local map to help locate the nearest high school. The **scale** on the map can help you determine the distance and the **legend** reveals what **map symbol** is a high school. The **direction** in which you should walk can also be determined. However, you may need a **compass** to walk in the direction. Let's learn about other types of maps and their uses.



TOPOGRAPHIC MAPS

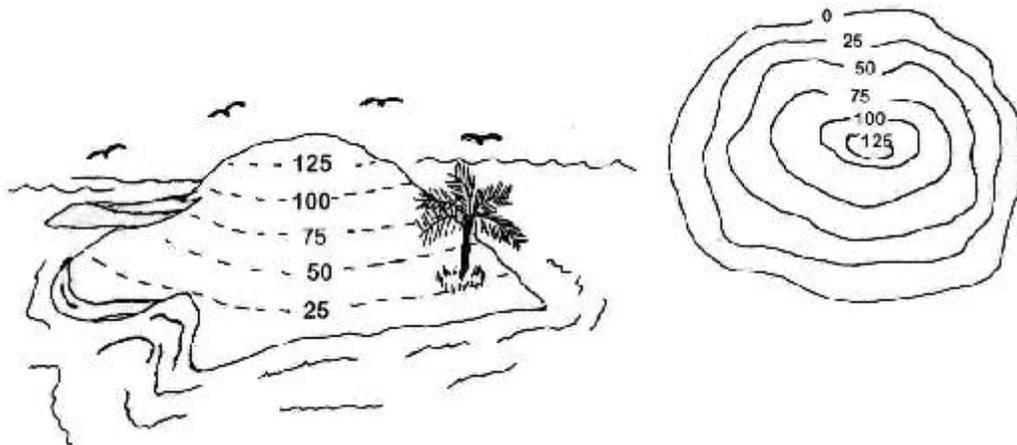
Teacher note

Students may be unfamiliar with topographical maps. Ask the students why a hiker would want to know the “lay of the land” before setting out on a hike? Try to help the student understand that by knowing how high and steep mountains and valleys are, a hiker can more easily plan a trail.

According to the U.S. Geological Survey: "A topographical map is a line and symbol representation of natural and selected man-made features of a part of the Earth's surface plotted to a definite scale. A distinguishing characteristic of a topographic map is the portrayal of the shape and elevation of the terrain by contour lines. Topographic maps show the location and shape of mountains, valleys, and plains; the networks of streams and rivers; and the principal works of man."



Topographic maps show a 3 dimensional world in 2 dimensions by using **contour lines**. Many people have trouble reading these maps, because they have mountains and valleys are represented with **concentric** circles and lines. Many hikers use topographic maps, especially in areas where there are no roads with signs. Geologists depend on topographic maps to record the types of rocks. Engineers use topographic maps when they are planning roads, buildings, or other human-made structures. Imagine designing a city without considering where hills and valleys are located!



GEOLOGIC MAPS

Teacher note

Geologic maps are difficult for students to understand because it shows the rocks that are on the surface of the Earth. However, a geologic map also provides ways in which you can tell how the rocks go into the Earth as shown in the figure below.

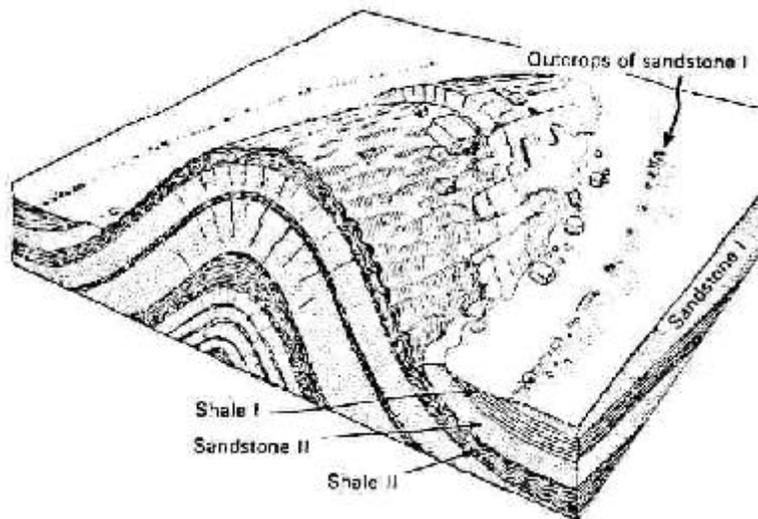
Students will learn about the different rocks in following units. They will also begin to understand how forces that cause earthquakes and volcanoes can move and deform rocks.

In the quick activity page, have students construct their own geologic map by coloring in like sediments. If you connect the sediments, a map will emerge. This is the basic principle of a geologic map.



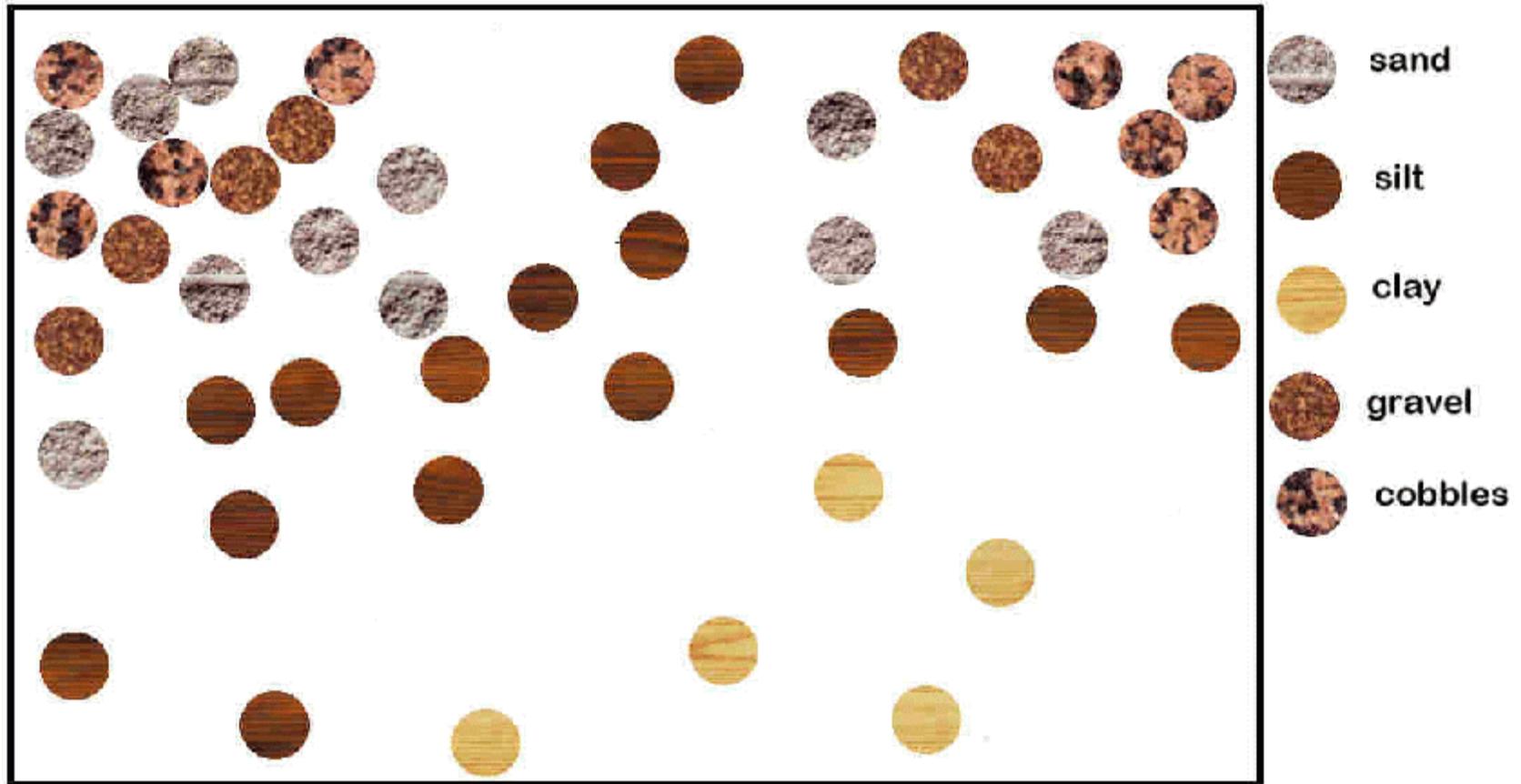
A geologic map is a map of the different types of rocks that are on the surface of the Earth. By mapping different rock types, geologists can determine the relationships between different rock formations which can then be used to find mineral resources, oil, and gravel deposits. Also, you want to know what type of rock you are building on or else you might have a Leaning Tower of Pisa or a pile of rubble after a strong earthquake.

Go to the activity and construct your own geologic map.



QUICK ACTIVITY - MAPS - GEOLOGIC MAPS

PROCEDURE: Connect like sediments to construct your own geologic map. Make sure you cover the entire area.

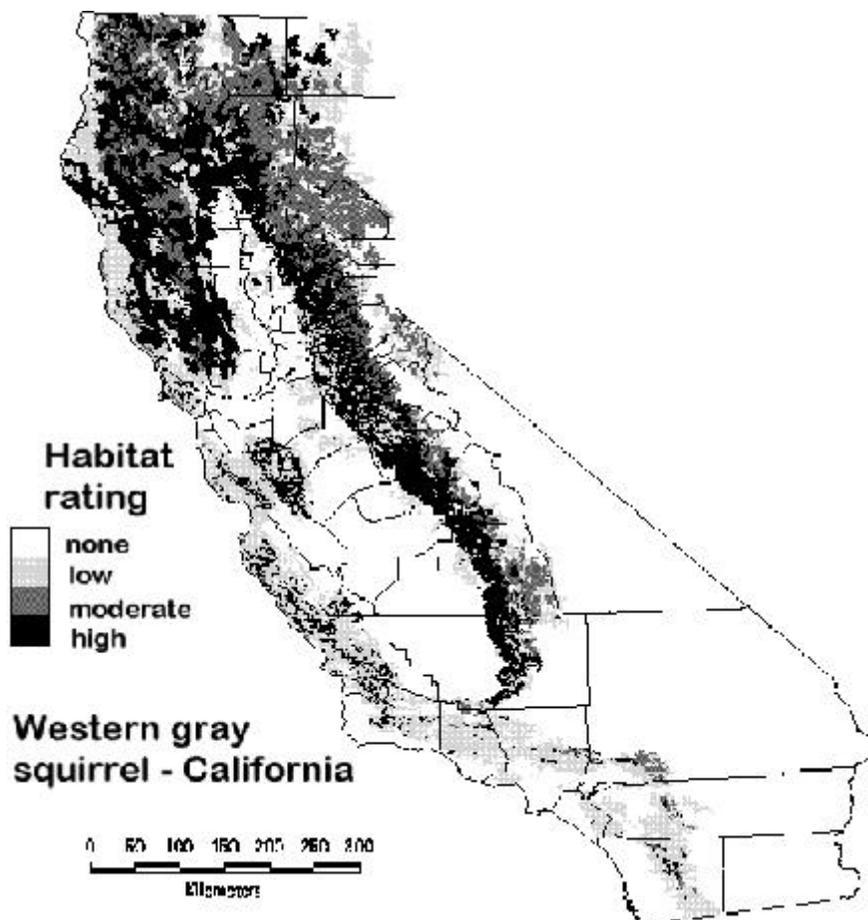


BIOGEOGRAPHIC MAPS

Teacher note

Ask: Why would people care about the migration patterns of animals? Possible answers include: People would want to know if industrialization might interfere with migration patterns, or People would want to know if the numbers of animals are increasing or decreasing.

Scientists involved in the study of animals, plants, and other living organisms use maps to illustrate where these groups live or migrate. It is important to many zoologists to know where the organisms that they study live and where they move to. People who **monitor** endangered species need to know if the ranges of **migration** have become larger or smaller through time.



ENVIRONMENTAL MAPS

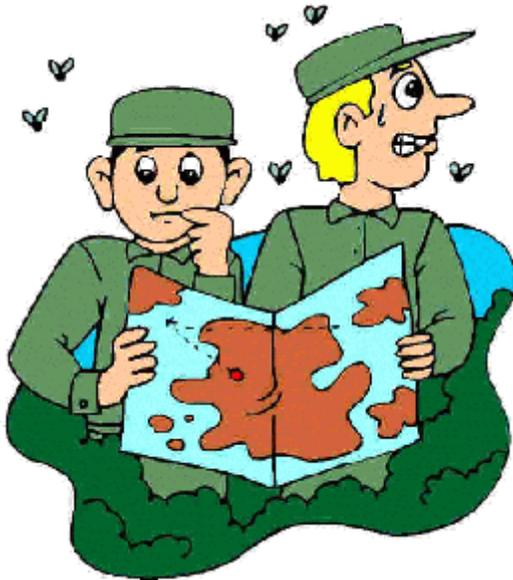
Teacher note

Ask the students if they have ever watched the weather on the television or seen a weather map in a newspaper. Explain that this is a meteorological map.

You may want to ask students to record how many times they look at a map in a week. Include bus maps, store maps, or any other places where a student may see a map.

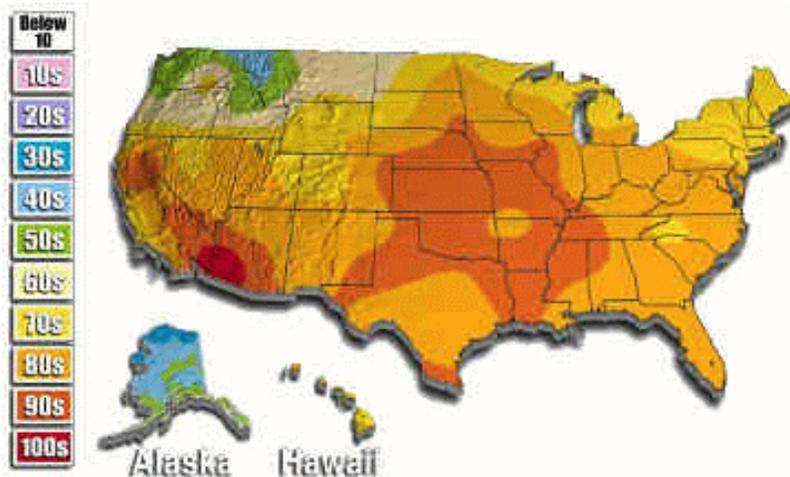
You might want students to look at the National Weather Service's website. This site has meteorological map finders for each state.

<http://www.nws.noaa.gov>



These types of maps include maps that look at human's activity in urban and metropolitan areas and the environment in which we all live. Maps that illustrate **physiographic** features such as forests, grassland, woodland, tundra, grazing land, ocean floors, and ocean sediments could be included in this large grouping.

Meteorological maps that show climate, weather and wind are types of environmental maps. Meteorologists, oceanographers, geographers, city planners, and many other professionals depend greatly on these maps to record and forecast their specific field.



DIFFERENT TYPES OF MAPS LAB

This lab can be customized to your location or to the maps available to you. The key point is for students to compare and contrast the different types of maps, by asking the same question for each map.

OVERVIEW OF LAB

Have the students answer the questions on the lab sheet using the maps that they are given. They will be asked to look at the maps and describe the detail and content of each map. This is a good time to teach geographic skills if your students are not very knowledgeable in this area. Students will be asked to read maps and locate various localities, names, and structures.

TIPS

Arrange the maps around the room in a station format. Allow the students to move about the stations with their worksheets to complete the lab. After completing the lab, review the results. Make sure you label the type of maps that you have. Remember if you don't have enough maps, ask students to bring in old maps that their parents may want to donate.

If you have computers for students to work on we have included a series of maps on the Salt Lake Region in Utah. These photographs and maps can help students investigate the difference by comparing and contrasting.



DIFFERENT TYPES OF MAPS



Have you ever seen anyone using a map to find their way around town? Maps are used extensively throughout society. Road maps provide information such as street names and landmarks. There are many different types of maps. Some maps are used for forecasting the weather, while others are used to plot the population in an area. Learning to recognize what a map has to offer is an important skill. In this lab you will look at a variety of maps and determine what you can learn from each type of map.

PROBLEM: How are maps useful in our society?

HYPOTHESIS:

MATERIALS: 5 types of different maps

PROCEDURE:

Describe the following maps by stating: 1. Type of map. 2. What area does each map cover? 3. What does each of the maps show? 4. What are the details of the map? 5. Is there anything that makes it different from the rest of the maps?

1.

2.

3.

4.

5

CONCLUSION: After viewing the maps, what map do you think is the most useful to take on a hiking trip? Explain.

DIFFERENT TYPES OF MAPS

PHYSIOGRAPHIC MAP OF WESTERN UNITED STATES

from U.S. Geological Survey



DIFFERENT TYPES OF MAPS

PHOTO OF SALT LAKE CITY

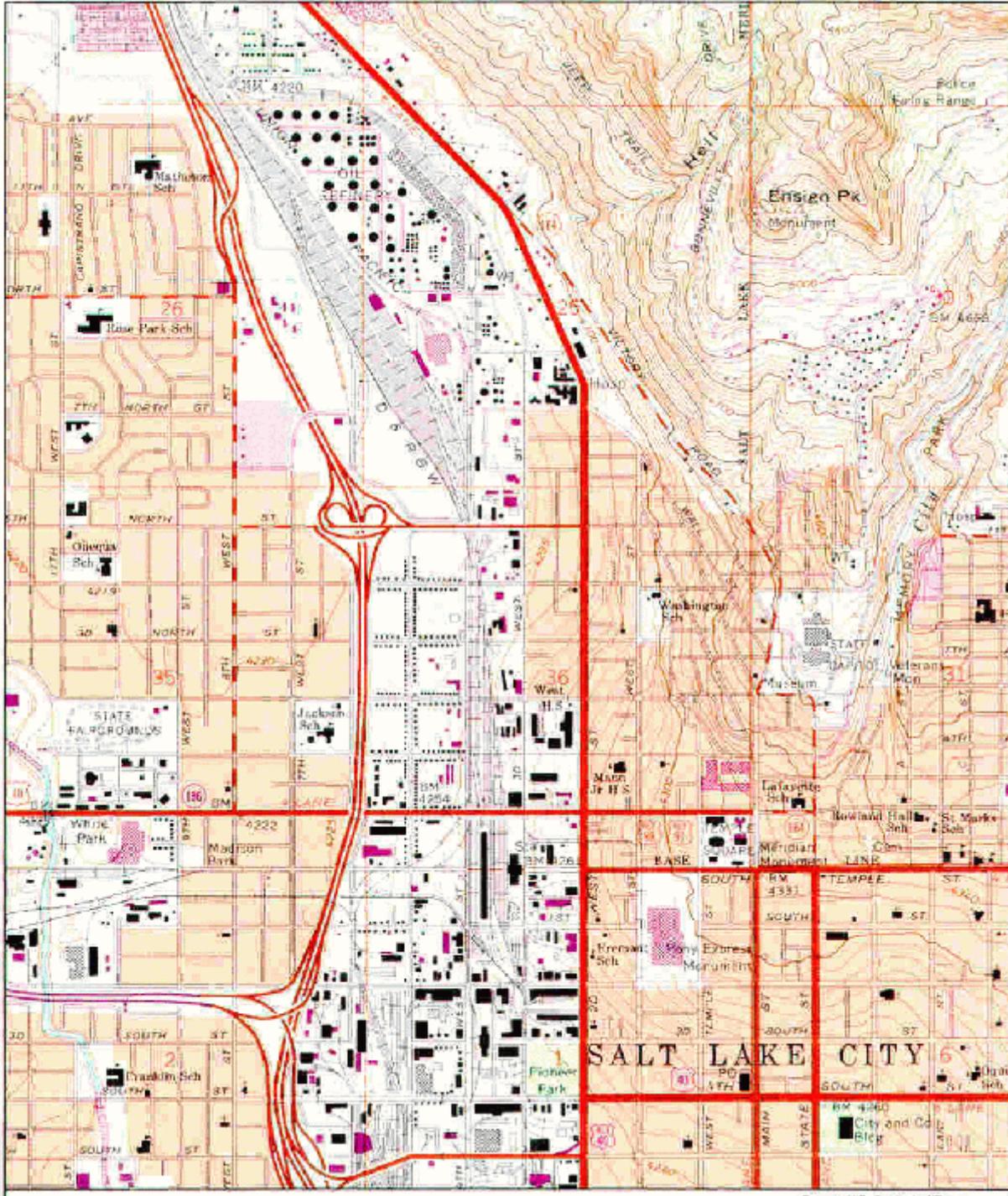
from U.S. Geological Survey



DIFFERENT TYPES OF MAPS

TOPOGRAPHIC MAP

from U.S. Geological Survey



DIFFERENT TYPES OF MAPS

SHADED RELIEF

from U.S. Geological Survey



READING A GLOBE LAB

Teacher note:

Latitude identifies locations or distances in degrees north or south of the equator. Also note that each of these lines is numbered in degrees. The equator is numbered 0° latitude. In the northern half of the globe or map, latitude is measured from 0° at the equator to 90° at the North Pole. The same is true for the southern half of the globe. Locations north of the equator are referred to by degrees north latitude.

Other lines on the globe or map pass through the poles. These lines are called meridians or lines of longitude. **Longitude** identifies locations or distances east or west of the prime meridian. They divide the Earth into 360° similar to a sphere. Unlike lines of latitude, meridians are not parallel. They are farthest apart at the equator. They get closer together as they reach the poles, where the meridians meet. The starting point of longitude is called the **prime meridian**, which represents 0° longitude. The east and west longitude lines meet at the 180° meridian. This line is called the **International Date Line**.

ANSWERS: 1. Reno; 2. Lisbon; 3. Vorkata; 4. Eureka; 5. Norfolk; 6. Santiago; 7. Winnipeg; 8. Oslo; 9. Buchara; 10. Sorang

We can identify locations as precise points on the Earth's surface by using a **grid** system of **latitude** and **longitude**. The use of giving a North and South direction (latitude) and an East and West direction (longitude) is used through the world. This system aids us in measuring distances and finding directions between and among places on the Earth's surface. The starting point is the prime meridian, which represents 0° longitude. The exact opposite position at 180° is called the International Date Line, which is where the date actually changes. So if you are going from Monday in California, and cross the International Date Line going to Japan. It would be Tuesday! You have to start the day somewhere.



READING MAPS LAB



PROBLEM: How can you locate different locations on the globe?

HYPOTHESIS:

MATERIALS: lab sheet, inflatable globe

PROCEDURE:

1. Find the city that is closest to the given latitude and longitude. Write its name in the blank spaces.
2. When you are finished, answer the questions in the conclusion.

1. 40°N, 120°W : _____

2. 40°N, 10°W : _____

3. 68°N, 65°E : _____

4. 41°N, 125°W : _____

5. 28°S, 165°E : _____

6. 20°N, 70°W : _____

7. 50°N, 100°W : _____

8. 59°N, 11°E : _____

9. 39°N, 69°E : _____

10. 2°S, 133°E : _____

CONCLUSION: Was it easy or difficult to use latitude and longitude to find the cities on the globe?

Why is knowing your latitude and longitude more important on the ocean than on the land?

TOPOGRAPHIC MAP OF LOCAL AREA LAB

Teacher note

For this exercise, the students will need to know various types of symbols used in topographic maps. Go over the different types of symbols (refer to U.S. Geological Survey publication on symbols.) Show them a real topographic map of the area. Give them a xerox of the area around the school and have them complete the lab sheet.

Show students a real U.S. Geological Survey map of the area. The students will answer the questions from a section of the map that you have prepared.

Ask: Why would people care about the migration patterns of animals? Possible answers might include: People would want to know if industrialization might interfere with migration patterns, or People would want to know if the numbers of animals are increasing or decreasing.

Go over the different symbols that are used on a topographic map. You can find the complete symbols on the U.S. Geological Survey site or use the ones listed below.

If you cannot find a local topographic map, you can go to the U.S. Geological Survey website that can help you locate the map that you would like.

<http://mcmcweb.er.usgs.gov/topomaps/>

ROADS AND RELATED FEATURES

Roads on Provisional edition maps are not classified as primary, secondary, or light duty. They are all symbolized as light duty roads.

Primary highway	
Secondary highway	
Light duty road	
Unimproved road	
Trail	
Dual highway	
Dual highway with median strip	
Road under construction	
Underpass; overpass	
Bridge	
Drawbridge	
Tunnel	

BUILDINGS AND RELATED FEATURES

Building	
School; church	
Built-up Area	
Racetrack	
Airport	
Landing strip	
Well (other than water); windmill	
Tanks	
Covered reservoir	
Gaging station	
Landmark object (feature as labeled)	
Campground; picnic area	
Cemetery: small; large	

MARINE SHORELINE

Topographic maps

Approximate mean high water

Indefinite or unsurveyed

Topographic-bathymetric maps

Mean high water

Apparent (edge of vegetation)

TOPOGRAPHIC MAP OF LOCAL AREA LAB

PROBLEM: How are topographic maps be used to find locations and features where you live?

HYPOTHESIS:

PROCEDURE:

Use the topographic map that your teacher gives you to answer the questions on the lab sheet.

MATERIALS: 7 1/2' quadrangle topographic map of local area, xerox copy of immediate school area

1. Orient your map by turning it so that the top is north.
2. Draw the following symbols:
 building: _____
 school: _____
 church: _____
 road: _____
3. What is the name of your map?

4. What year was your map first published?

What year was your map revised?

5. What is the contour interval of your map?

6. Find your school on the map and circle it on a xerox copy of the map. (If you do not have a copy follow your teachers instructions.)

7. Find your home on the map and circle it on a xerox copy of the map.

8. Using a colored pencil trace the route from your house to your school on a copy of the map.

9. What is the distance from your house to school?

10. Find and name the two largest roadways:

1. _____

2. _____

11. What is the elevation of your school?

12. What is the elevation of your house?

13. Who publishes this type of topographic map?

14. Are there any mistakes on this map? If so, list them.

Geographic Information Systems

The Story



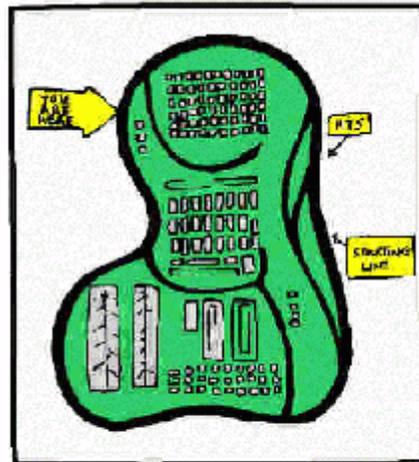
Teacher note

Geographic Information Systems (GIS) combines layers of information to fully understand an area.

There is a web site devoted in explaining GIS, (<http://www.gis.com>). You may want to use this site to further develop the idea of using computers in creating dynamic maps for research, planning, building, and much more.

Introduction

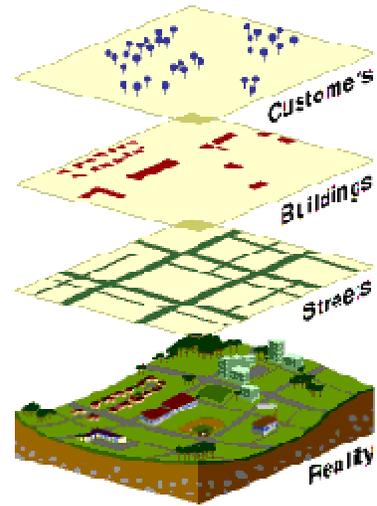
On a rainy weekend during the school year, you decide to visit the science museum that has just opened near your home. When you arrive, you discover that it is huge. There are more interesting things to see than you can possibly examine in an afternoon. How do you decide what to see? How do you find out where to go?



Luckily, inside the entrance of the museum, you see a row of computer stations. At each station, a screen displays a map of the museum. As you move the computer's mouse over the map, a window appears telling you what is displayed in each area. You want to see the museum's exhibit on gemstones. You notice that the computer screen has a search command. You enter the word "gemstones". The screen responds by highlighting the room on the map where gemstones are displayed. It also tells you how to get there from the museum entrance, as well as what gemstones are currently on display.

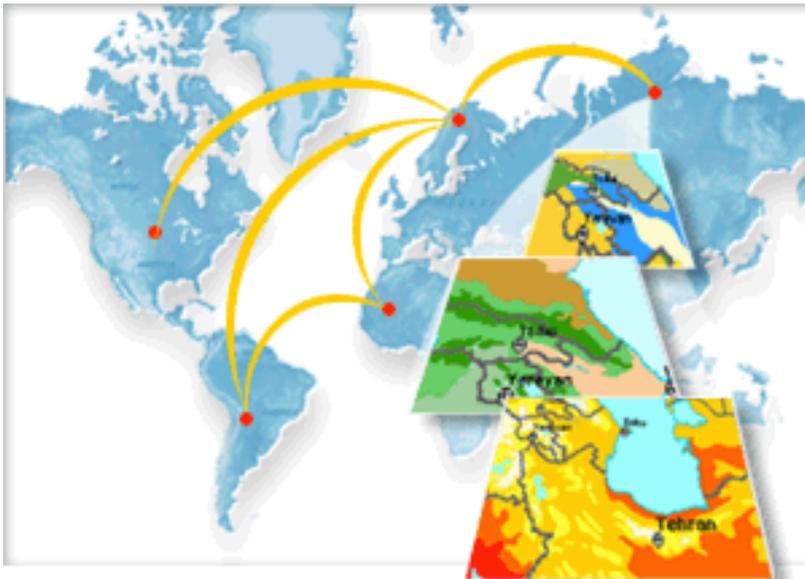
What is a Geographic Information System?

The program you used at the museum is an example of a geographic information system, or GIS. A GIS is a type of computer software. The basis for this software is a computerized map. Like a regular paper map, a GIS map shows where things are located. A GIS, however, is much more than a map. It also contains a database of information about the things on the map, such as what was displayed in each room of the museum. In addition, the GIS contains software that analyzes the database and map information to find connections between them. Searching for gemstone displays in the museum is an example of a GIS analysis. To answer your question, the software examined the database and map, and gave you the location of the gemstone exhibit. There is no fixed information to go with the map in a GIS. Some GIS show where power lines run, others show the roads, while others show schools.



GIS

GIS is important because of its ability to analyze information. Any information which is related to maps can be analyzed with a GIS. The types of maps and data in a GIS are also very flexible. A GIS map can cover very small to very large areas. A small GIS map might just



show a few blocks in a city. It might show details of where utilities such as telephone lines, sewers, and cables are located. A large GIS map could cover the entire Earth. It might show seasonal changes in plant growth. The information that a GIS map shows can be about anything.

A geographic information system (or GIS) is a way of representing information about the world in a computer in the same way a map shows the world on paper.

MAPS AND MAP READING TEACHER OUTLINE AND NOTES

I. What is a map?

A. Usually a flat representation of an area of the Earth (or Moon, etc). Contains information about an area.

B. How is a map similar to or different than a photograph of an area? A map uses symbols to highlight area and makes human created and natural features more distinct.

II. Type of maps. Show examples.

A. Road maps, topographic maps, geologic maps, historical maps, bus route maps, climate maps, population density maps, land use maps, and many more.

B. Use different maps for different purposes. You don't use your spelling book to learn about fractions, and you don't use your math book to learn about U.S. history. A topographic map helps show relief and a city map shows roads. You would not use a city map to determine the relief.

III. Maps are like books - we learn how to read them.

A. Maps are written in a language of symbols. We only need to learn the language. The letters and words in a book are a type symbols.

B. Parts of a book: Title page, table of contents, index, glossary. Maps have analogous parts. Instead of this information beginning on extra pages in the front and back of the book, maps have all this information printed in the margins.

C. The legend (or explanation, or key) on a map is like the glossary in a book.

IV. Directions (which way?)

A. North, east, south, west are the four cardinal directions.

B. How do we find directions in the real world? (without a map)

1. Compass
2. Sun and shadows
3. Stars

C. Directions on a map.

1. Look for north arrow
2. North is usually at the top of a map, especially if there is no arrow showing another direction

V. Distance and Scale

A. A scale is a relationship of sizes. Distances on the map to distances in the real world are expressed in a ratio.

B. Maps are usually smaller than the area they represent. Not very convenient to carry around the city map the same size as the city.

C. Three ways to express scale.

1. In words: 1 inch = 1 mile
2. A bar scale:
3. A ratio: 1:24,000. Although this is sometimes the most difficult one to understand, it can be the most useful. It tells us exactly how much all the measurements in the real world were “shrunk down,” to fit the map. It also has no units; it’s valid whether you are measuring in inches, miles, meters, or anything else.

VI. Map Projections

A. Earth is spherical, like a globe. Maps are flat. What problems arise in representing a round world on a flat piece of paper?

B. Imagine trying to get an orange peel (or even half of one) to lay flat on a table. It can’t be done without tearing or stretching parts of the peel. This is exactly what map makers do when depicting the Earth. There are various ways we can do this.

C. Examples of projections (just a few examples)

1. Mercator - Used for navigation or maps of equatorial regions. Distances are only true along Equator, but are reasonably correct within 15° of Equator. Distortion increases from north and south of the Equator.

2. Gnomonic - Used along with the Mercator by navigators to find the shortest path between two points. Considered to be the oldest projection. Ascribed to Thales, the father of abstract geometry who lived in the 6th century B.C.

3. Azimuthal Equidistant - Useful in showing airline distances from center point of projection. Distances and directions to all places true only from center point of projection.

4. Albers Equal Area Conic - Shows maps for the conterminous United States. All areas on the map are proportional to the same areas on the Earth.

5. Lambert Conformal Conic - Used by U.S. Geological Survey for many 7.5 minute topographic maps and for the State Base Map series. Distances true only along standard parallels.

D. We don't have as much of a problem with maps covering only a small area. (It's easy to get a small piece of the orange peel to lay flat. If an orange was a globe!)

E. Reconstructing different projections.

VII. Topography and Topographic (Topo) Maps

A. How do we show a 3 dimensional world on a 2 dimensional piece of paper? Show exact shape of land, elevation, etc.

B. Contour lines

1. "Connect the dots" of equal lines of elevation.
2. If you were walking and following the same path as a contour line, you would not be walking uphill, nor downhill, but perfectly level.
3. Bath tub ring analog. The water flows out in equal lines of elevation.
4. Old shore lines showing water levels as a lake dries up. Always horizontal.

C. How to read a topo map: What do steep cliffs, rolling hills, river valleys, flat lands, etc. Look like on the map?

Earth Science - TYPES OF MAPS - Unit Test

Part 1. Definitions Match the number of the term or concept in Column 1 with the letter of the correct definition in Column 2.

Column 1	Column 2
1. Geologic maps	a. map maker
2. legend	b. equal lines of elevation
3. GIS	c. mapping living organisms
4. contour lines	d. map of different rock types
5. weather map	e. Geographic Information System
6. Cartographer	f. interpretation of map symbols
7. Biogeographic maps	g. meteorological maps
8. International Date Line	h. representation of the Earth's surface
9. Contour lines with numbers	i. Date actually changes
10. map	j. shows elevation

Part 2. Multiple Choice Choose the best answer to complete each statement.

- Topographic maps do not show
 - elevation
 - water
 - bathymetry
 - cities
- A physiographic map looks at
 - land features
 - cities
 - human-made features
 - distribution of houses
- The difference between a photo and a map is
 - a map has pictures
 - a photo has a legend
 - a map has a legend
 - a photo has directional markers

4. A shaded relief map uses coloring effects to show
 - a. houses
 - b. elevation
 - c. distribution of trees
 - d. none of these

5. A road map does not show the following
 - a. relief
 - b. roads
 - c. cities
 - d. distances

6. Longitude is
 - a. a long line
 - b. parallel to the equator
 - c. east or west of the prime meridian
 - d. parallel to the prime meridian

7. Latitude is
 - a. a long line
 - b. parallel to the equator
 - c. east or west of the prime meridian
 - d. parallel to the prime meridian

8. Weather maps are a type of
 - a. environmental map
 - b. topographic map
 - c. road map
 - d. biogeographic map

9. Geographic Informational Systems (GIS) contains software that
 - a. makes a one layered map
 - b. creates a globe
 - c. analyzes data and maps information to find connections
 - d. none of the above

10. A cartographer
 - a. draws pictures of an area
 - b. interprets maps
 - c. arranges layers of maps
 - d. creates maps

ANSWERS:

PART I.

1. D
2. F
3. E
4. B
5. G
6. A
7. C
8. I
9. B
10. H

PART II.

1. C
2. A
3. C
4. B
5. A
6. C
7. B
8. A
9. C
10. D