



Maps are graphic representations of places that use point, line, and area symbols, as well as color, to show how selected human and physical features are located, arranged, distributed, and related to one another. No single map can show everything, so the features portrayed on each map are selected to fit a particular purpose. It is impossible to accurately depict the spherical Earth on a flat surface without distorting shape, area, distance, or direction (try peeling an orange and flattening it out!), so *cartographers* use different *projections* to preserve selected properties (shape, size, distance, direction), while others get distorted.



**Map:** A graphic representation of selected characteristics of a place, usually drawn to *scale* on a flat surface.

**Cartographer:** A person who makes maps.

**Map projection:** The process of transferring information from a three-dimensional (spherical) surface to a two-dimensional (flat) surface. Every map has some distortion, either in shape, size (area), distance, or direction. Learn more about map projections by visiting the National Geographic feature "Round Earth, Flat Maps"

(<http://www.nationalgeographic.com/2000/projections>)

## Key Map Elements

A good map should tell you what it is about (title), which direction north is (orientation), when the map was made or updated (date), who made the map (author), what the symbols mean (legend or key), how distances on the map relate to distances on the ground (scale), where to find selected places on the map (index), how to find places on the map (grid), and where the map's information comes from (sources or credits).

However, not every map will identify all of this information. The more information provided, the better you will be able to evaluate its content, credibility, and appropriateness for a given purpose or audience.

The acronym **DOGSTAILS** makes it easy to remember the important parts of a map:

<b>Date</b>	<b>D</b> When the map was made
<b>Orientation</b>	<b>O</b> Directions (north arrow)
<b>Grid</b>	<b>G</b> Locates places on the map
<b>Scale</b>	<b>S</b> What the map distance is
<b>Title</b>	<b>T</b> What, where, and when
<b>Author</b>	<b>A</b> Who made the map
<b>Index</b>	<b>I</b> Map address of places
<b>Legend</b>	<b>L</b> What the symbols mean
<b>Sources</b>	<b>S</b> Basis for map information

You may also have heard the acronym **TODALSIGs**, which lists the map elements in order of importance.

**Title:** Text explaining what the map is supposed to portray: what is happening, where, and when.



**Orientation:** In most cases, the direction "north" is assumed to be at the top of a map. A **north arrow** is a symbol indicating the direction in which north lies; a **compass rose** is a symbol indicating the cardinal directions (N, S, E, W) and sometimes intermediate directions (NE, NW, SE, SW).



**Date:** Text identifying when the map was made and/or updated.

**Author:** Text identifying the cartographer or organization responsible for making the map.

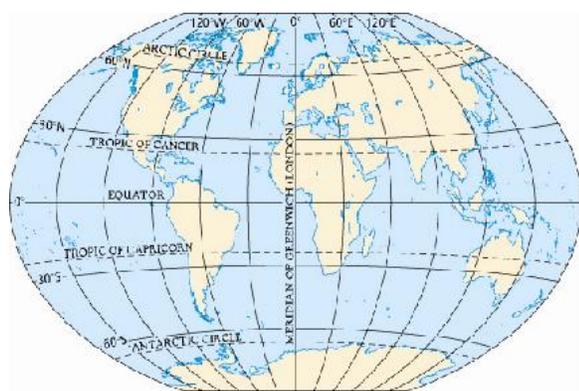
**Legend or Key:** A guide identifying what the map's symbols and colors represent.

**Scale:** The relationship between distance on a map and actual distance on the earth. Scale may be represented by words (e.g., "one inch equals one mile"), a ratio or fraction (e.g., 1:63,360), or a divided bar. Bar scale is best to use when enlarging or reducing the size of a map, since the scale size will change with the map size. A map showing a small area in detail (such as a street map of a neighborhood) is a **"large scale"** map, while a map showing a large area without much detail (such as the world or a continent) is a **"small scale"** map (think about fractions here!).

### Types of Scale

Verbal	words	one inch equals one mile
Number	ratio or fraction	1:63,360
Graphic	divided bar or line (like a ruler), usually showing miles or kilometers	

**Index:** A listing of the places on the map and where to find them using *grid* coordinates—either *latitude-longitude* (77°53'W, 38°02'N) or letter-number (B4).



**Grid:** Intersecting lines (called a "coordinate system") drawn on a map to pinpoint location. The grid can be a simple set of intersecting perpendicular lines identifying rows and columns with letters and numbers (often used on a street map) or a set of intersecting lines identifying selected *latitudes* and *longitudes* (often used on topographic or world maps).

**Latitude** and **longitude** are imaginary lines encircling the globe, intersecting each other to form a grid that helps us pinpoint location—our "global address." They are measured in terms of the 360 degrees of a circle, sub-divided into minutes and seconds. For example, the White House in Washington, DC is located at 38°53'51"N, 77°02'11"W—that means it is 38 degrees, 53 minutes, 77 seconds north of the equator, and 77 degrees, 2 minutes, 11 seconds west of the Prime Meridian.

**Latitude lines** (also called "parallels") run east-west, parallel to the Equator and measure distance north and south, from 0 degrees at the Equator to 90 degrees at the North and South Poles.

**Longitude lines** (also called "meridians") run north-south and meet at the poles, measuring distance east and west of the Prime Meridian, from 0 degrees at the Prime Meridian running through Greenwich, England, to 180 degrees at the International Date Line (mostly in the Pacific Ocean).

**Sources:** Text identifying where the map's information comes from (like a bibliography for the map).

## Additional Map Elements

The following features may or may not be present on a given map:

**Neat line:** A box drawn around the map to give a "neat," or tidy, appearance to the product.

**Insets:** Additional, smaller maps set within the larger main map.

**Graphs:** Pictorial representations of numeric data, often used as an additional method of displaying the data represented on the map. Line graphs, bar graphs, and pie charts are common types.

**Timelines:** Text and graphics arranged sequentially along a line to give information about when events or phenomena occurred. Timelines are sometimes used on maps to give a better idea of how time relates to the data or theme represented.

**Explanatory Text:** Text that is not part of the map's title, legend, or credits, used to give the map reader a deeper understanding of the map, its data, and/or its theme.

**Credits:** Text that may include sources, author, photographers, individuals, or organizations involved in creating the map or its contents.

## Basic Issues in Map Design

### 1. Considering the purpose of and audience for the map:

One of a cartographer's first steps is to identify the purpose and audience of the map. The purpose and audience determine how data are displayed, what map elements are included, and the general layout and format of the entire map. A map designed to be a teaching tool for third graders will obviously look different than a map designed to be included in a report for senators.

### 2. Choosing a map type:

Once cartographers know what they want to show on a map, they must decide which map type (reference or thematic) will be most effective in communicating the map's purpose to its readers. The type of data, audience, and geographic area represented are some of the factors that affect this decision. See section on "Types of Maps" below for more information.

### 3. Selecting a title that represents what is shown

Choosing a title for a map is an important part of the cartographic process. The title of the map should tell map readers, in a few words, what is important about the map. Some map titles simply state the information portrayed (e.g., "Percentages of Global Indigenous Languages"), while other titles engage map readers with a broader, catchier phrase (e.g., "Voices of the World").

### 4. Selecting and placing text

Placing text on a map is a particularly difficult challenge to the cartographer. Text must be placed so that it is readable and easily located but also must not interfere with the map's data or design. Different font types, styles, sizes, and colors can be used to establish clear association between text and map features.

### 5. Designing an overall layout for easy understanding

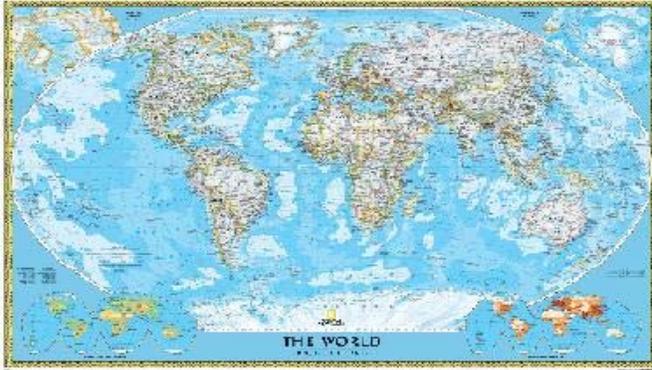
As in any form of graphic art, cartographers have to consider the layout of all map elements to create a final product that is informative, accurate, and aesthetically pleasing. Visual balance is always an important consideration for design.

## Types of Maps

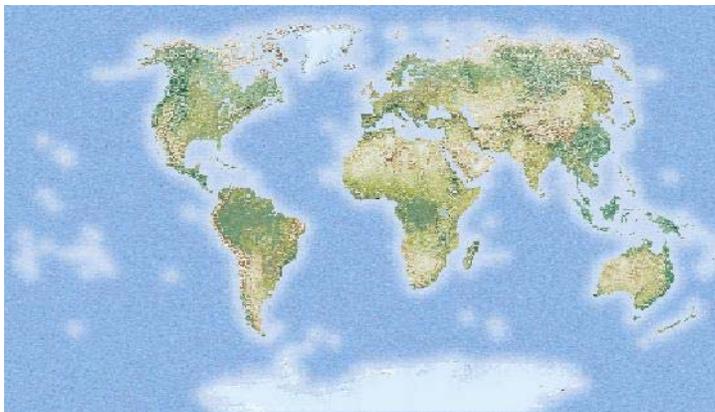
There are two main types of maps, based on their design purpose. **Reference** (or **general purpose**) **maps** depict selected details of the physical and human-made environment as accurately as possible. **Thematic** (or **special purpose**) **maps** depict the general spatial pattern of selected features or data.

## Reference (General Purpose) Maps

**Reference** (also called **general purpose**) **maps** depict selected features of the physical and human-made environment. Reference maps use symbols to locate and identify important landmarks and geographic features. Examples include road maps, classroom wall maps, political maps, physical maps, and topographic maps.



**Political maps** are reference maps that show names and boundaries of political geographic units (states, countries, etc.) and only very important physical or human features (e.g., rivers, highways, etc.)



**Physical maps** use shaded or painted relief to illustrate the major landforms (natural features) of a region, country, or world. Mountain ranges and rivers usually are prominent features on such maps; other features would include deserts, glaciers, lakes, and valleys. The colors on physical maps often include brown or green for land and blue for water.

**Topographic maps** are general reference maps showing coastlines, cities, and rivers that use contour lines to show elevation differences. Such maps are helpful to hikers because they can show elevation changes along a trail. Government agencies like the U.S. Geological Survey (USGS) produce these maps that are often based on satellite data or aerial photography.

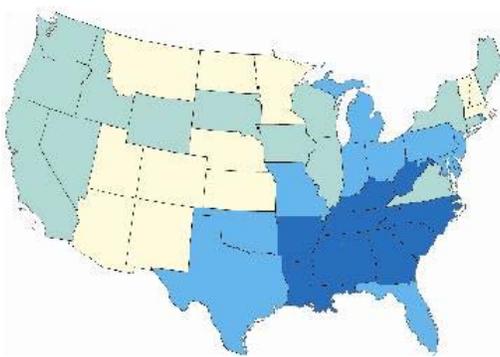


**Satellite maps** are produced from data recorded by satellite sensors and transmitted to Earth where computers process the data into images. Satellites can provide map images of formerly inaccessible parts of our world and of distant worlds—like Mars or the Moon.

## Thematic (Special Purpose) Maps

**Thematic** (also called **special purpose**) **maps**: Display distributions—or patterns—over Earth's surface. Thematic maps emphasize some particular feature or set of data (such as rainfall or locations of crops), using color, shading, or symbols to represent differences. For example, **census maps** focus on population distribution as well as data on such items as age, ethnicity, and income; these maps help governments provide services to its citizens and plan for the future.

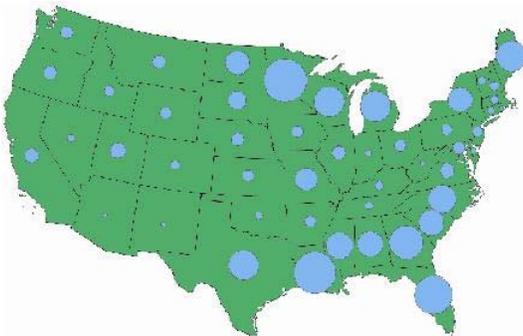
Thematic maps can portray data using shaded areas (choropleth), dots (dot-density), symbols of different sizes (graduated symbol), lines of equal measurement (isoline), or proportional size of area (cartogram).



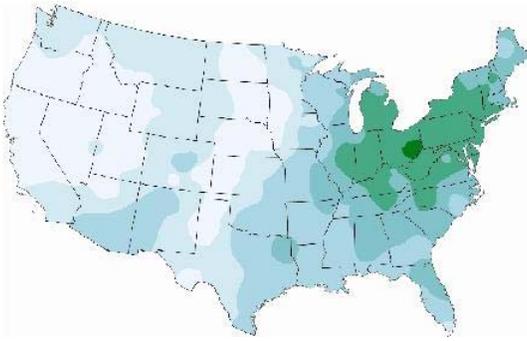
**Choropleth Maps** use color shading to represent different quantities or values. Darker colors usually represent greater quantities or values, while lighter colors usually represent smaller quantities or values.



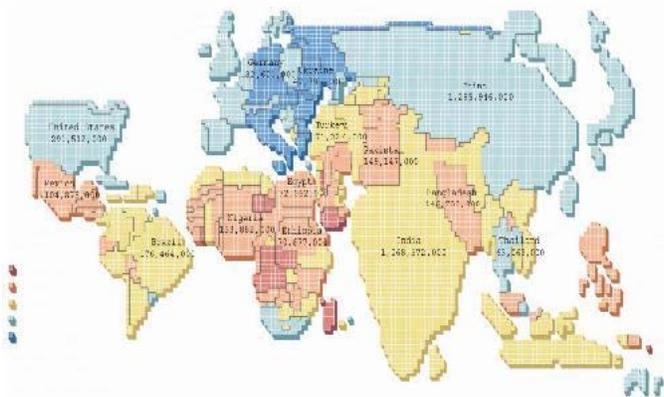
**Dot-density** (also called **dot**) **maps** place individual points on a map to correspond with occurrences of a particular feature or data. Clusters of dots show where the features or data are concentrated.



**Graduated symbol maps** use symbols of different sizes placed within an area to show the value or quantity associated with it. The symbol is often a circle, but it may be one that relates to the map's theme (such as figures of people to represent population data).



**Isoline** (also called **isopleth**) **maps** use lines to connect points of equal value, such as temperature, rainfall, or elevation. Lines of equal temperature are called **isotherms**, lines of equal rainfall are called **isohyets**, and lines of equal elevation are called **contours**. Contour lines are often used on topographic maps.



**Cartograms** distort the size and shape of map areas to show statistical data. For example, a cartogram of world population shows land area as proportional to population size—although the United States and China have similar land areas (the U.S. is slightly larger), a population cartogram would show China as much larger than the U.S. because its population is much larger.

Read *Maps Can Tell a Migration Story: An Interview with National Geographic Cartographers* (<http://www.nationalgeographic.com/xpeditions/activities/09/gamapinterview.pdf>) to find out about considerations cartographers make.

## Suggested Resources

National Geographic: Round Earth, Flat Maps

<http://www.nationalgeographic.com/2000/projections/>

National Geographic: MapMachine—View and Customize (click "What is a Satellite [or other type, from drop-down box] Map" for pop-up box with definitions)

<http://mapmachine.nationalgeographic.com/mapmachine/viewandcustomize.html>

University of Texas Bureau of Economic Geology: Scale Calculator

<http://www.beg.utexas.edu/GIS/tools/scale2.htm>

National Geographic: Geography Standard 1—How to Use Maps and Other Geographic Representations, Tools, and Technologies to Acquire, Process, and Report Information From a Spatial Perspective

<http://www.nationalgeographic.com/xpeditions/standards/01/index.html>

National Geographic: Xpedition Hall—Globe Projector

<http://www.nationalgeographic.com/xpeditions/hall/index.html?node=20>

National Geographic: A World Distorted by AIDS (cartogram)

<http://www7.nationalgeographic.com/ngm/0509/feature4/map.html>

National Geographic: Xpeditions Activity—Crack the Code

<http://www.nationalgeographic.com/xpeditions/activities/01/crackcode.html>

National Geographic: Xpeditions Lesson Plan—Contour Maps With DOGSTAILS

<http://www.nationalgeographic.com/xpeditions/lessons/01/g68/dogstails.html>

National Geographic: Xpeditions Lesson Plan—Latitude, Longitude, and Mapmaking

<http://www.nationalgeographic.com/xpeditions/lessons/01/g68/mapmaking.html>

National Geographic: Xpeditions Lesson Plan—Mapping Mars

<http://www.nationalgeographic.com/xpeditions/lessons/01/g68/marsmap.html>

National Geographic: Xpeditions Lesson Plan—Map Projections

<http://www.nationalgeographic.com/xpeditions/lessons/01/g912/projections.html>

National Geographic: Xpeditions Lesson Plan—A Look at the Population Density of the United States

<http://www.nationalgeographic.com/xpeditions/lessons/01/g912/density.html>