

# 6 Geographers' Tools: Maps and their Parts

Prof. Anthony Grande  
Hunter College Geography

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## MAP MAKING QUANDRY

*How do we transfer information from a large 3-D spheroid (Planet Earth) onto a smaller 2-D object (flat sheet) without distorting that information?*

**With difficulty!**

The mapmaker must deal with **3 obstacles**:

1. **Conversion** of a sphere (*curved surface*) to a plane (*flat surface*).
2. **Shrinking** of the earth's surface to fit the smaller flat object.
3. **Portrayal** of information to make it understandable to the viewer.

## MAP MAKING

The mapmaker confronts the problem by using:

1. **PROJECTION** to **convert** a sphere to a flat surface.
2. **SCALE** to **shrink** the earth's surface proportionally to fit the object.
3. **SYMBOLIZATION** to **portray** information and make it understandable.

## GLOBES

Any flat map will sacrifice 1 or 2 or 3 or all 4 advantages of a globe.

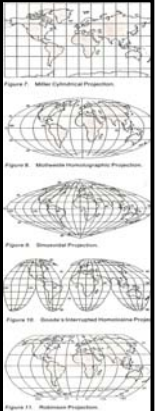
➤ **A map cannot show more than three advantages at any one time!**

**But which 3?**

- ❖ Only a **globe** can portray the earth's surface **without distortion**.
- Only a globe can show:
  - ✓ true **shape**
  - ✓ true **relative area**
  - ✓ true **distance**
  - ✓ true **direction**

## MAP PROJECTIONS

❖ A map projection is a representation of the 3-D earth's grid on a **flat surface**.



Each of these projections has a combination of unique characteristics to show shape, relative area, distance and direction.

**Read the section on maps and map projections in any thematic atlas.**

## MAP PROJECTIONS

❖ The basic concept behind a map "projection" is having a light source **within** the globe and having that light source project the earth's grid on to a flat object.

➤ However, today most map projections are **mathematically derived** and cannot be "projected."

[https://www.youtube.com/watch?v=eZ1z4W8f\\_E](https://www.youtube.com/watch?v=eZ1z4W8f_E) 1 min intro to map projections

<https://www.youtube.com/watch?v=N4DSFD2JQ> 6 min illustration why all world maps have inaccuracies.

## MAP DISTORTION

Based on the spacing of lines of latitude and longitude (as illustrated by "heads"), the continents have different appearances.

❖ **All maps distort shape in some way.**

➢ NOTE: In these illustrations, the "circles" and "shape-of-head" diagrams are used to show distortion.

Distortion occurs because of the way lines of latitude and longitude are spaced in the different projections.

## Geometrical Map Projections

Cylindrical

Conical

Planar

- If the globe is wrapped in a **cylinder**, a "cylindrical" projection is created.
- A **cone** creates a "conical" projection.
- A **plane (flat sheet)** creates a "planar" projection.

## CYLINDRICAL PROJECTION

In this projection the lines of **longitude** are **parallel!**

- **Cannot** show the polar regions.
- Star illustrates areas of distortion.
- Notice the unusual scale on the map.

## CONICAL PROJECTION

In this projection:

- Lines of longitude are **too close** nearing the **poles**.
- Lines of longitude are **too far apart** at the **equator**.
- Least distortion in the mid-latitudes

## PLANAR PROJECTION

In this projection, a plane (flat sheet) is placed **tangent to the globe** and the earth's grid is transferred to the plane.

➢ **Least distortion in the center of the map** but perimeter areas are stretched.

✓ Used mainly for polar areas.

## Comparing Projections

So depending on the map maker's choice of projection, the resulting flat map will have a unique appearance with a unique set of distortions.

Looks 3-D but is really an unrolled series of 2-D maps!

### Comparing Projections

So depending on the map maker's choice of projection, the resulting flat map will have a unique appearance with a unique set of distortions. And then there are the numerous interrupted projections and mathematically derived projections!

3-D Earth with grid

Flattenable surface

Flat maps

13

### Goode's Homolosine Projection

Equator

A mathematically derived projection providing the illusion of a "peeled orange". Its classification is "interrupted projection".

14

### Other Interrupted Projections

"Peeled globe designs"

<https://www.youtube.com/watch?v=b1xXTU1nFCQ> 1.3 min video map projection (no sound)

15

### AuthaGraph Projection

Attempts to accurately show the size of land areas in relation to each other by using 96 triangles placed on the sides of a 3-D pyramid and then converting it into a 2-D rectangle.

16

### R. Buckminster Fuller Map Projection

This map illustrates the "world island" nature of the earth's landmasses without an unnatural interruption. It can be used to illustrate diffusion (spread), including the migration of early humans and the recent movements of plants and animals.

✓ There is only a maximum distortion of 2% at any one place, thereby maintaining relative (true) **shape** and **size**.  
 ➤ **However:** true **direction** and **distance** are sacrificed.

17

### Happy Valentine's Day

Earth Day Wall Art designed by Blue Jay Ray

18

## SCALE

❖ **Scale is a RATIO.**

It is the **relationship between distance:** the distance on the map to the equivalent distance on the earth's surface (**map to earth**).

- Scale is a means of **measurement**.
- Scale influences **detail** (symbolization).
- There are **3 ways** to show scale.

19

## Showing Scale

“1 inch to 1 mile”  
“1 centimeter to 5 kilometers”

(a) **Verbal scale**

a) **VERBAL/Written:** in words

b) **GRAPHIC/Bar:** as a line or bar

c) **FRACTION/Ratio:** as a mathematical equation

(b) **Graphic scale**

(c) **Representative fraction scale**

20

## SCALE

Scale can be designated **large** or **small**.

**Large scale:**  
Shows **greater detail** but less of an area.

**Small scale:**  
Shows **greater area** but in less detail.  
(A globe is a **very, very small** scale map.)

**Small scale**  
Large area, little detail

**Large scale**  
Small area, great detail

21

## Effect of Scale on DETAIL

Same size squares but each square shows **different total surface area** and **different detail**.

✓ Note that each shaded box (a, b, c, d) fits into the next one.

22

## SYMBOLIZATION

❖ **Symbolization is the portrayal of information.**

✓ Ideal maps should have the following seven elements:

1. Title
2. Date
3. Grid
4. Direction
5. Scale
6. Projection used
7. Legend or key

23




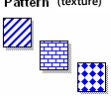


## Maps and Symbolization

24

## Map Symbols: with a legend or key

**The reader must know what the shapes, colors, patterns and sizes mean.**

**Visual Variables**

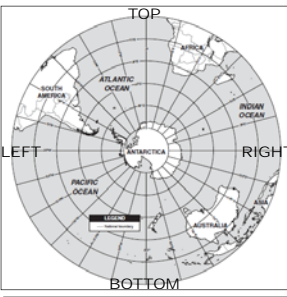
<p><b>Shape</b></p> 	<p><b>Size</b></p> 	<p><b>Orientation</b></p> 
<p><b>Pattern (texture)</b></p> 	<p><b>Hue (color)</b></p> 	<p><b>Hue (shade)</b></p> 

Therefore a **LEGEND** or **KEY** is needed. Without it, what is presented are just meaningless shapes and colors.

## DIRECTION

**Every map needs to have an indication of major compass points: north, south, east and west.**

This can be done with a compass arrow, marking of lines of latitude and longitude and/or indication of quadrant.

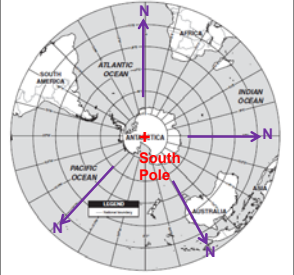


**Where is north on this map?** Is it top, bottom, left or right?


## Southern Hemisphere

**Which way is north?**


✓ **By following the meridians of longitude away from the South Pole, you will eventually end at the North Pole.**



## Which arrows point North?



## This way is North!!



Must always follow lines of latitude and longitude to ascertain direction.

Arrows B, C and E point to the North Pole.

## Representing the World

What is wrong with this world map?



Nothing. It's a Pacific Ocean-centered world map

## World Map

What is wrong with this map?

It's a World Map Centered on Australia.

31

## Formats for Presenting Mapped Information

**Mapped data can be presented in various formats.**

There are 5 general categories of maps.

1. Point
2. Flow line
3. Isoline
4. Choropleth
5. Cartogram

See Fig. 1.27 in your textbook.

The five can be sub-divided into seven groups which present mapped information differently.

32

## Map Formats

1. **Point Symbol:**
  - a. **Dot** - Uses dots to indicate values at a location; shows distribution and density.
  - b. **Graduated symbol** - Uses proportionally-sized circles or symbols to indicate quantities present.
2. **Isoline:** Uses lines to connect points of equal value.

3. **Flow Line:** Uses lines of varying widths with arrowheads to portray amount of movement.
4. **Choropleth:** Uses colors or shading to convey information
  - a. **Qualitative** = characteristics
  - b. **Quantitative** = amounts
5. **Cartogram:** Uses data other than land area to portray the size of a unit.

33

## Types of Maps: Point Symbols

Both maps portray the population distribution of California.

1. **Dot:** Uses dots to indicate point values at a location.
 

Shows distribution and density well.
2. **Graduated:** Uses proportionally-sized circles or other symbols to indicate quantities present at a location.
 

Good for comparing areas although the map may become visually cluttered.

1. Shows distribution and density well. 2. Good for comparing areas although the map may become visually cluttered.

34

## Graduated Circles Format

Where 50,000 Guns Found in Chicago Came From

The Chicago police traced the origin of about 50,000 guns recovered since 2001. While most originated near Chicago, the guns came from all 50 states and from more than 60 percent of the nation's counties. Mississippi accounted for about 9 percent of the total.

Source: Chicago Police Department. Note: Buybacks and turn-ins are not included in this analysis. 1/3/13 THE NEW YORK TIMES

35

## World Cocoa Production shown using Graduated Circles

Africa Dominates

Top 12 cocoa crop estimates for 2018-19, in tons

75K Dominican Republic	60K Colombia	2.2M Ivory Coast	250K Nigeria
310K Ecuador	120K Peru	830K Ghana	270K Cameroon
	200K Brazil		35K Uganda
			220K Indonesia
			40K Papua New Guinea

Source: International Cocoa Organization. Note: August estimates. Bloomberg

### Types of Maps: Isoline

Uses lines to connect points of equal value.

Average Annual Temperatures for the United States

Summer

Winter

37

### Types of Maps - Flow Line

Uses lines of varying widths (representing amounts) with arrowheads (indicating direction) to portray linear movement.

Migrants (in Thousands)

Flow of smuggled guns

[http://www.nytimes.com/interactive/2015/11/12/us/gun-traffickers-smuggling-state-gun-laws.html?\\_r=0](http://www.nytimes.com/interactive/2015/11/12/us/gun-traffickers-smuggling-state-gun-laws.html?_r=0)

### Types of Maps: Choropleth (qualitative)

Uses colors, shading and symbols to convey an area's characteristics (qualitative) without regard for man-made borders.

EPA Tracked Sites with Non-Grid Connected Wind Energy Generation Potential

39

### Types of Maps: Choropleth (quantitative)

Uses colors and shading to convey amounts by unit area (quantitative).

Motor Vehicle Theft Rate per 100,000 Population

Better for general use. Problem here is that this method does not differentiate values within an area.

40

### Types of Maps: Cartogram

Uses data other than land area to portray the size of an area. It is based on the unit value of the topic portrayed, not land area.

States are sized by population. 1 box = 100,000 people.

States are shaded according to the number of people who have signed up for Obama's health care plan.

41

### Portraying Data

Based on the patterns can you guess the type of information being shown?

Presentation of same data in 4 formats:

- Graduated Circle map
- Dot map
- Choropleth map
- Isoline map

Four ways to portray AIDS cases in Pennsylvania

42

