


**EXTRA CREDIT**

**Extra Credit Atlas Exercise for Exam I is available on the course home page. Submit answers to me using the blue Scantron sheet by Feb. 19, 2019.**



**Once you have completed the exercise, transfer your answers to the blue Scantron sheet using a #2 pencil. Completely erase all mistakes and stray marks. LATE answer sheets will NOT be accepted.**

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**6**

**Geographers' Tools**

**Maps and their Parts**

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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.

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**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.

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## MAP PROJECTIONS

❖ 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

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?**

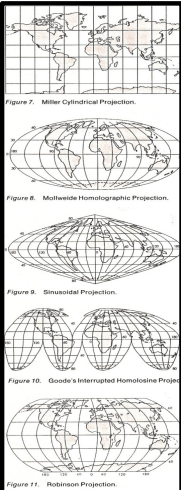
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## MAP PROJECTIONS

❖ 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.**



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## 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=pZ1z4W8f\\_E](https://www.youtube.com/watch?v=pZ1z4W8f_E) 1 min intro to map projections

<https://www.youtube.com/watch?v=kII05FD2JQ> 6 min illustration why all world maps have inaccuracies.

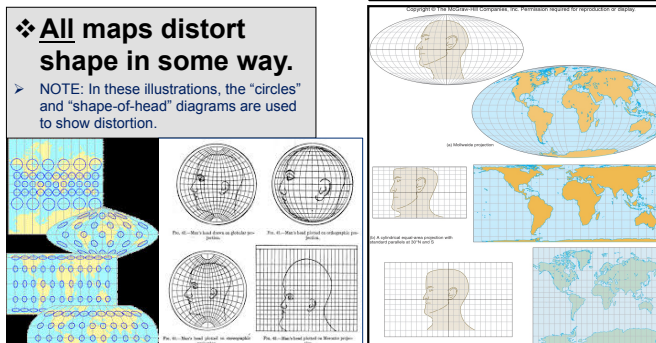
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## MAP DISTORTION

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

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

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

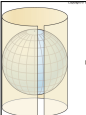


Distortion occurs because of the way lines of latitude and longitude are spaced in the different projections.

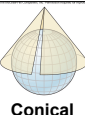
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## Geometrical Map Projections

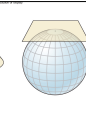
Cylindrical



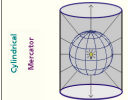
Conical




Planar




**Cylindrical**



**Conical**



**Planar**

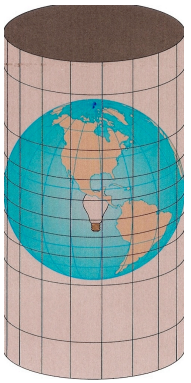



Projection Concepts Perspective Examples

- 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.

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## CYLINDRICAL PROJECTION





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

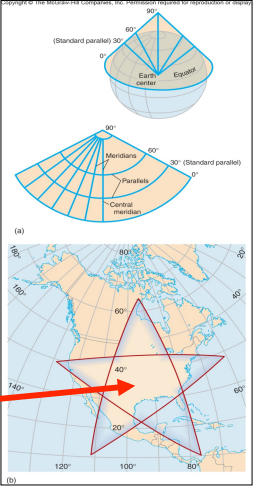
- **Cannot** show the polar regions.
- Star illustrates areas of distortion.
- Notice the unusual scale on the map.

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## 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**

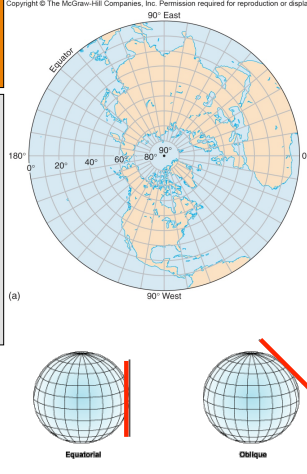


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## PLANAR PROJECTION

**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.**




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<https://www.usertf.com/resources/the-globe-of>

## 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.

3-D Earth



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<https://www.usertf.com/resources/the-globe-of>

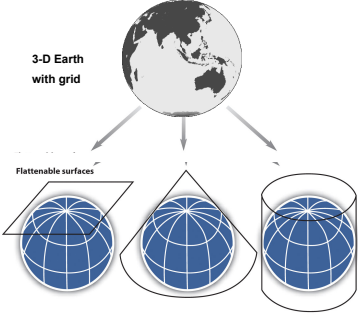
## Comparing Projections

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 surfaces



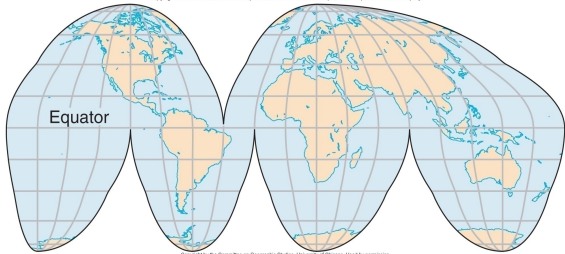
Flat maps



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## Goode's Homolosine Projection

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Equator

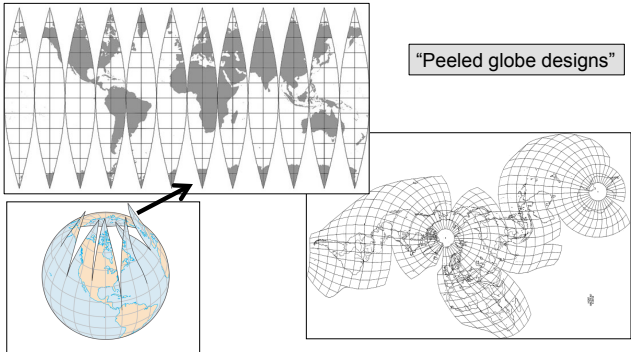
Copyright by the Committee on Geographic Statistics, University of Chicago. Used by permission.

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

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## Other Interrupted Projections

"Peeled globe designs"

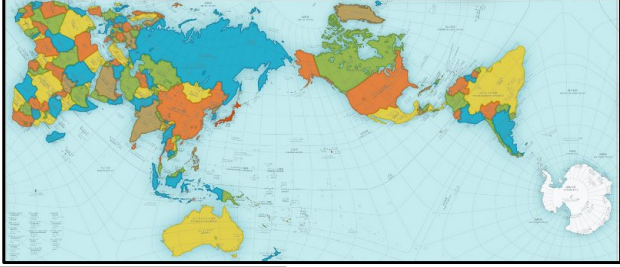


<https://www.youtube.com/watch?v=b1xT1InFCc> 1.3 min video map projection (no sound)

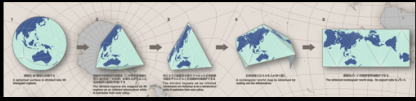
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### AuthaGraph Projection

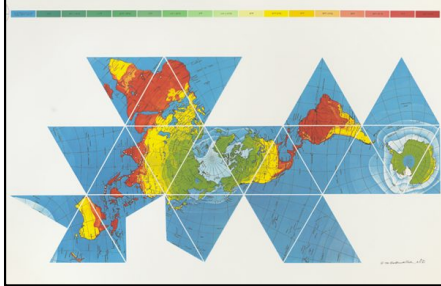


Attempts to accurately show the **size** of land areas in relation to each other by using 96 triangles placed on the sides of a 3-D pyramid and then converting it into a 2-D rectangle.



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### 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.

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## 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.

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### Showing Scale

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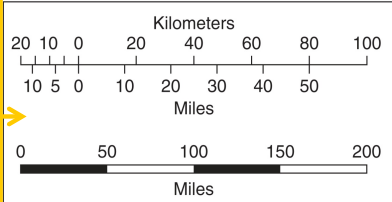
"1 inch to 1 mile"  
"1 centimeter to 5 kilometers"

(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**

$\frac{1}{62,500}$       1:62,500

(c) **Representative fraction scale**

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## 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


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## Effect of Scale on DETAIL

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

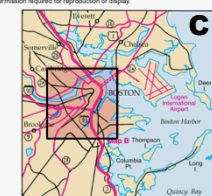
✓ Note that each shaded box (a, b, c, d) fits into the next one.

**A**




(a) 1:25,000

**C**




(c) 1:250,000

**B**



(b) 1:100,000

**D**



(d) 1:1,000,000

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## SYMBOLIZATION

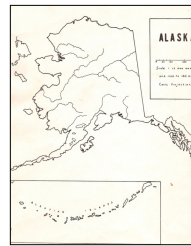
❖ Symbolization is the portrayal of information.

✓ Ideal maps should have the following seven elements:

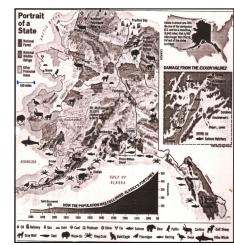
1. Title
2. Date
3. Grid
4. Direction
5. Scale
6. Projection used
7. Legend or key

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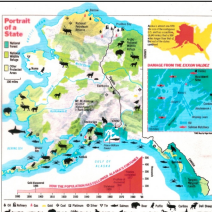
## Maps and Symbolization



ALASKA



Portrait of a State



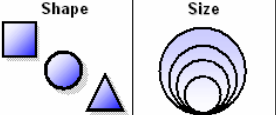
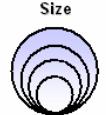

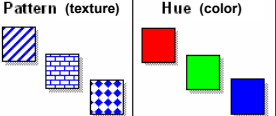
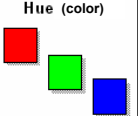

Portrait of a State

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## Map Symbols: with a legend or key

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

**Visual Variables**

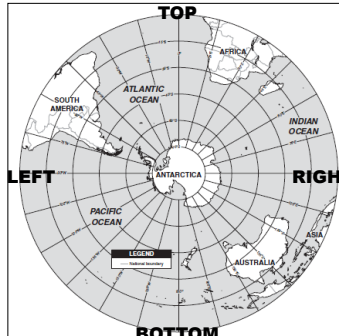
<b>Shape</b> 	<b>Size</b> 	<b>Orientation</b> 
<b>Pattern (texture)</b> 	<b>Hue (color)</b> 	<b>Hue (shade)</b> 

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.

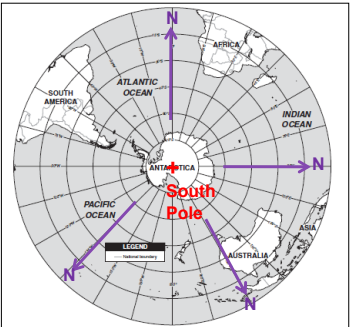


Where is north on this map?


## 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.

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### Representing the World

**What is wrong with this world map?**

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

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### World Map

**What is wrong with this map?**

It's a World Map Centered on Australia.

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### 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.

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## 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 arrow-heads 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.

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## 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.

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## Graduated Circles Format

### Where 50,000 Guns Found in Chicago Came From

Gun shops are outlawed in Chicago, but more than 15,000 guns were traced to neighboring towns inside Cook County.

Circle sizes represent the number of guns traced to that county.

More than 4,000 guns came from Mississippi, the third most of any state.

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. 1/30/13 THE NEW YORK TIMES

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## Types of Maps: Isoline

Uses lines to connect points of equal value.

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### Types of Maps - Flow Line

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

[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)

Flow of smuggled guns

### 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

### Types of Maps: Choropleth (quantitative)

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

Reporting Density of Africa

Motor Vehicle Theft Rate per 100,000 Population

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

### 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.

Change 1990 to 2000

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

States Where Insurance Renewal Plans Before Change by Obama

Squares are sized according to the number of policies which state's individual insurance market in 2002



## Portraying Data

Based on the patterns can you guess what data is 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

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## Summary: TYPES of MAPS

- Point: dot distribution
- Point: graduated symbol
- Flow Line
- Isoline
- Choropleth: qualitative
- Choropleth: quantitative
- Cartogram

**Dot distribution maps** use points to show the location or distribution of a feature. Some charts quantify the density of a value in each point. The visual impression in such maps is of some areas with dense concentrations of dots and other areas with very few. Such mapping is the typical distribution of the phenomenon. For example, Figure 1-2 shows the location of earthquakes worldwide. Figure 1-3 shows the location of major cities in the world.

**Graduated symbol maps** use different sizes of symbols to show differences in quantity across locations. A large symbol shows the location of large quantities, while a small symbol shows the location of smaller quantities. For example, Figure 1-4 uses dots to show the location and proportional quantity of major cities in the world.

**Flow maps** use different line thicknesses to show different quantities moving across an area. Figure 1-5 shows the movement of international immigrants.

**Isoline maps** connect points of equal value to show variation across an area. The pattern of the lines conveys the pattern of the data. A topographic map is an isoline map where the lines show equal elevations. Figure 1-6 is an isoline map showing the location of equal barometric pressure.

**Qualitative maps** identify a characteristic of a place that has qualitative rather than quantitative meaning. Such as the value of a grade, using different area symbol maps in which color or shading emphasize differences between areas. A map showing countries or U.S. states is of this type. Figure 1-14 shows different soil regions.

**Choropleth maps** use color or shading to show quantities of different areas, usually with specific shades indicating larger quantities. For example, Figure 1-7 color-coded states of the same color to represent rates of population growth. Choropleth maps often have different values into a smaller number of groups or classes, each class is then assigned a different shade.

**Cartograms** Sometimes we find it useful to convey an idea by deliberately distorting features on the earth's surface to indicate some characteristics of those features. Cartograms display different quantities by intentionally adjusting features, usually areas. Figure 1-2 shows the world map of different countries in proportion with each country's population.

**This diagram is from your textbook (1.27).**

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# NEXT

## Gathering Information

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## FIRST EXAM

❖ **Tuesday, February 26, 2019.**

- Combination of multiple choice questions and map interpretation.
- Bring a #2 pencil with eraser.
- Based on class lectures supplementing **Chapter 1**. Review lectures 1-8 on home page.

➤ **If you miss this exam, a written-response make up test consisting of definitions, concepts and explanations, plus the place name maps will be given.**

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