Introduction to GIS

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University of Kentucky Libraries

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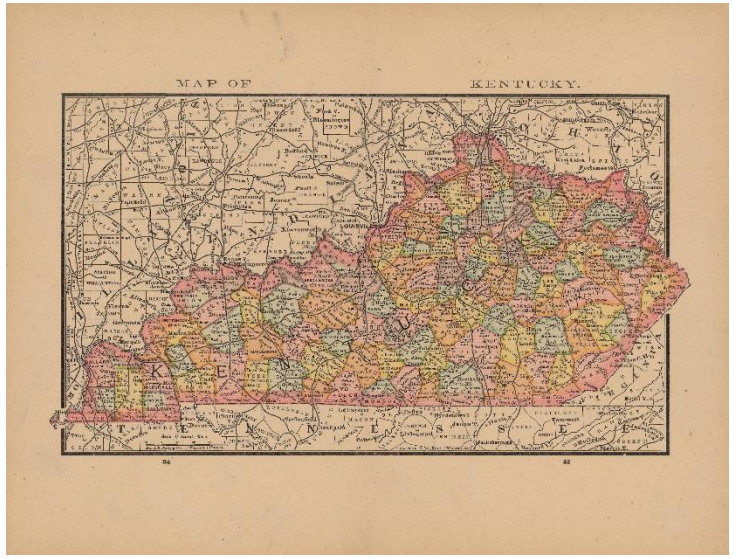
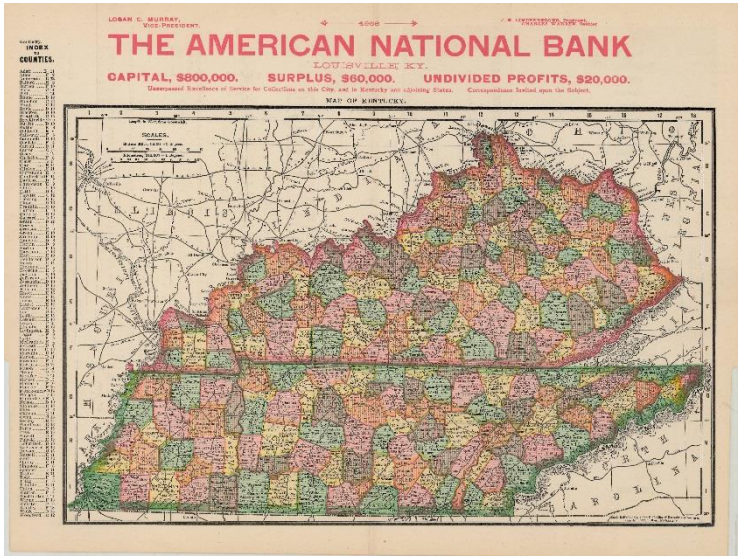


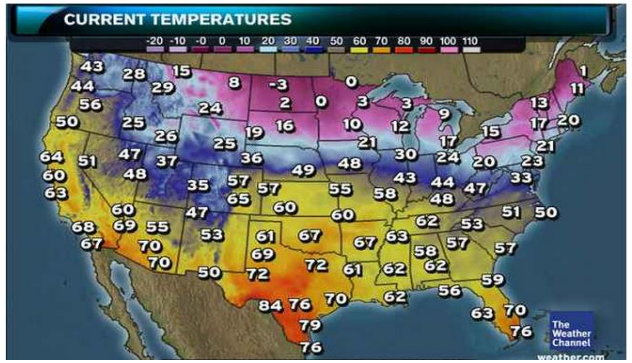


Outline

- Overview of various terms
- Quick overview of ArcGIS and QGIS
- Geocoding Activity
- Considering Map Design
- ArcGIS Online

What is a Map?

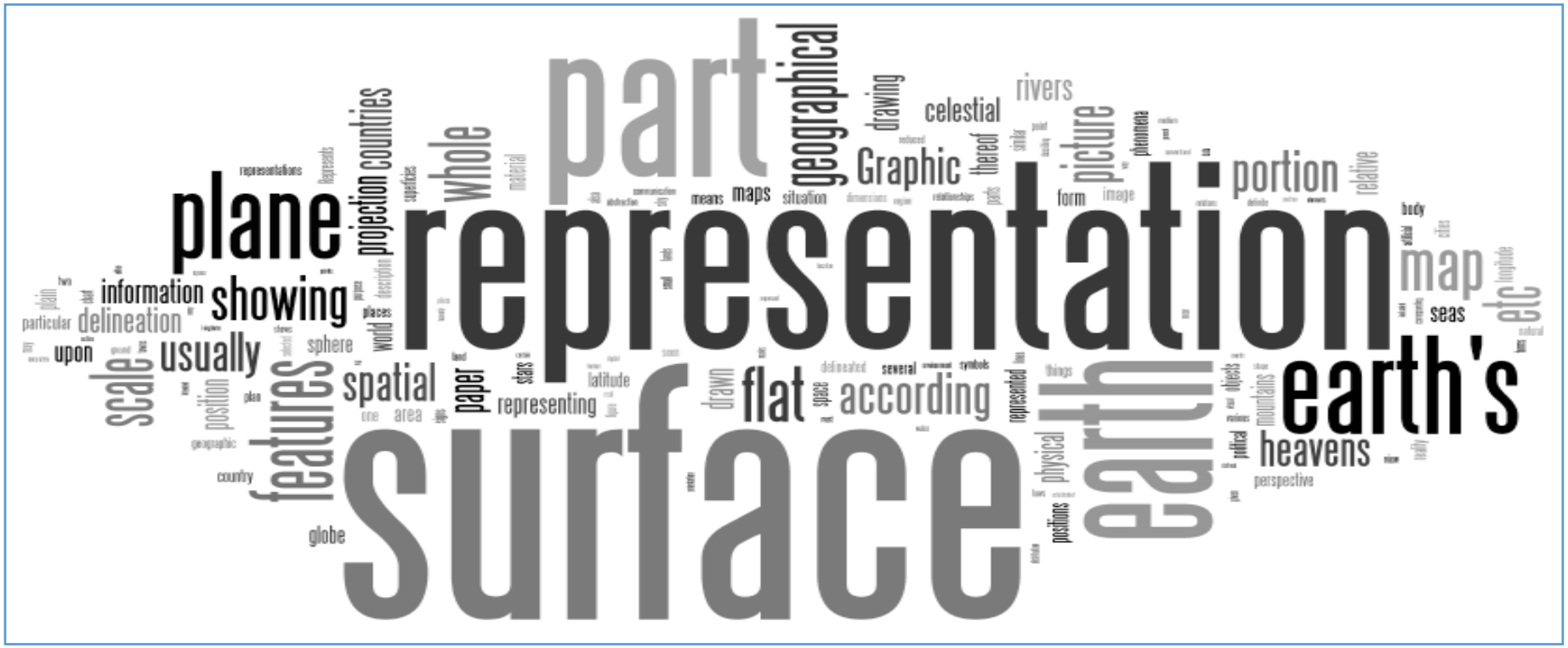
- Simple Definition: A spatial representation of reality
- Why are maps useful?
  - Maps can simplify & make “reality” easier to understand
    - Less is Sometimes More
  - Maps can help us see new realities
  - Maps can show us what we cannot easily see with our eyes



In 1996, J.H. Andrews compiled 321 definitions of “map” (“What Was a Map?” Cartographica 33:4, pp. 1-11).

After editing out all the source information/miscellaneous stuff, you have a bunch of words that can be pumped into a word cloud generator

The word cloud visualization does help to make some sense out of the 8106 words in the 321 definitions….



What is a Map?

- The map has a narrative
  - Elements and information are framed for the viewer
    - Consider how they depict cause and effect

- Maps **actively** construct new knowledges and serve as interventions into our understandings of the world

Requires mapmakers and map readers to consider:

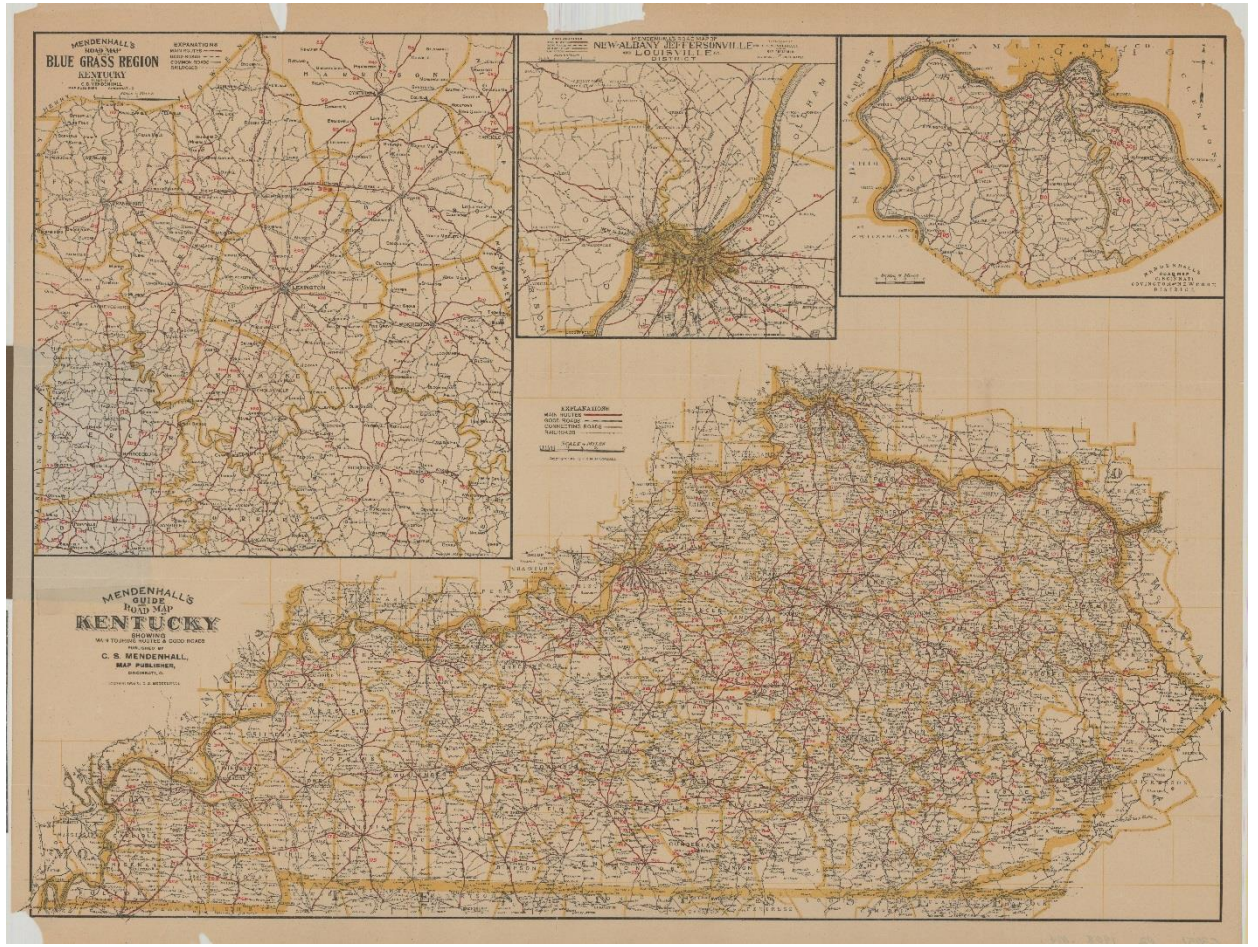
- What counts as data?
- The role of images/symbols and design in effectively depicting

What is GIS?

- Geographic Information System (GIS) is “A set of tools that captures, stores, analyzes, manages, and presents data that are linked to a location”

- Spatial or Data Analysis: “Study of the spatial visualization of patterns, properties, and relationships. Examples of variables that are often analyzed include population demographics, quality of life indexes, illness distributions, and business sales (Camera et al. 2001)

What Features Appear on Maps?

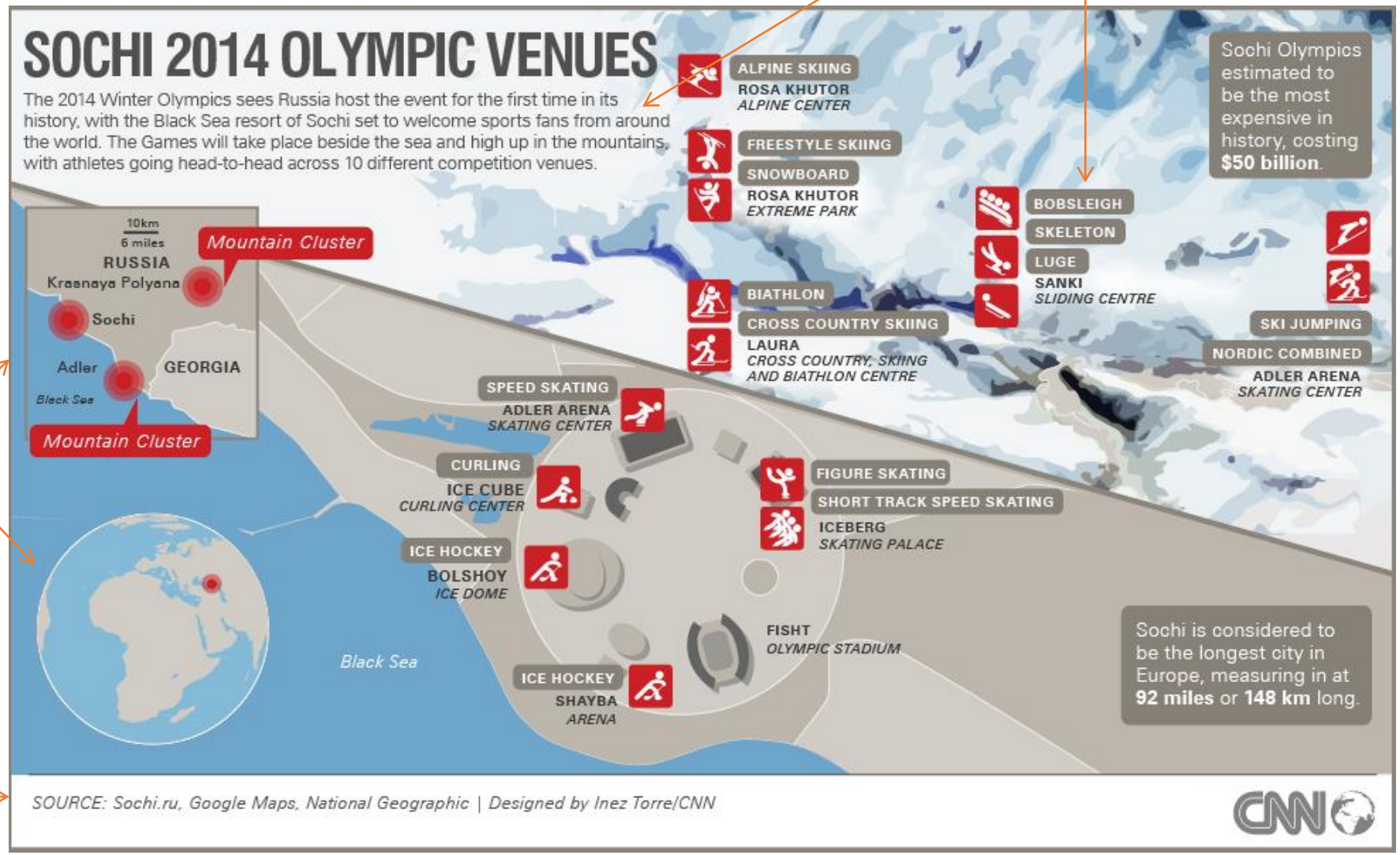


Map Features

- Title – Is there a label describing what the map shows?
- Scale – Is there a scale to read distances?
- Explanatory Text – Text blocks to communicate information (map content, goals, etc.)
- Legend – Is there a legend (key) to aid readers?
  - Necessary in helping readers “unlock” the map symbols
- Orientation – Which way is North?
- Border – Helps to draw/unite all the information
- Date – Is there a date?
- Sources, Credits, Etc. – date, author, map series, organization
- Inserts and Locator Maps

Explanatory text

Title



Locator Map

Source

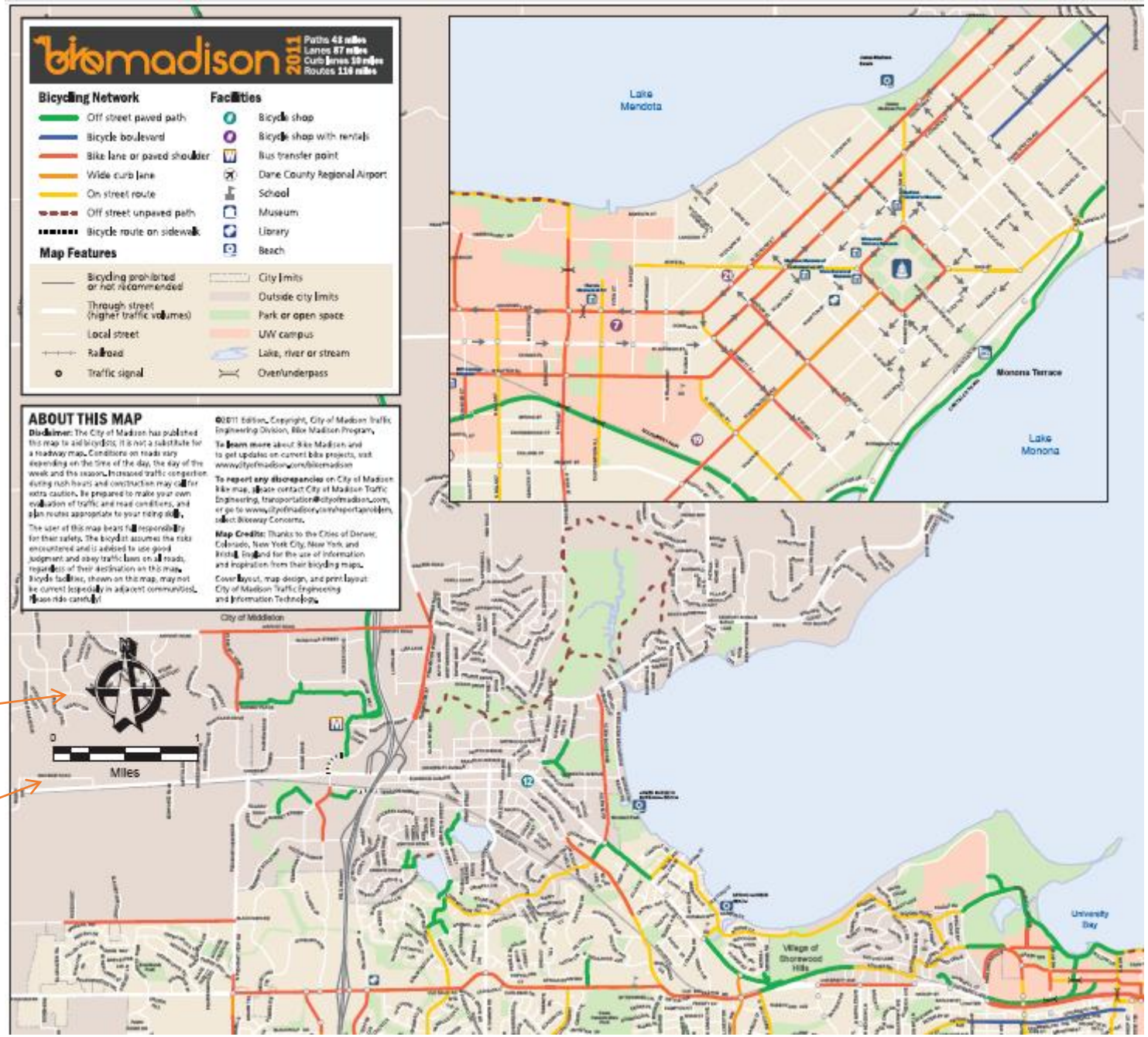
Title

Legend

Explanatory Text

Directional Indicator

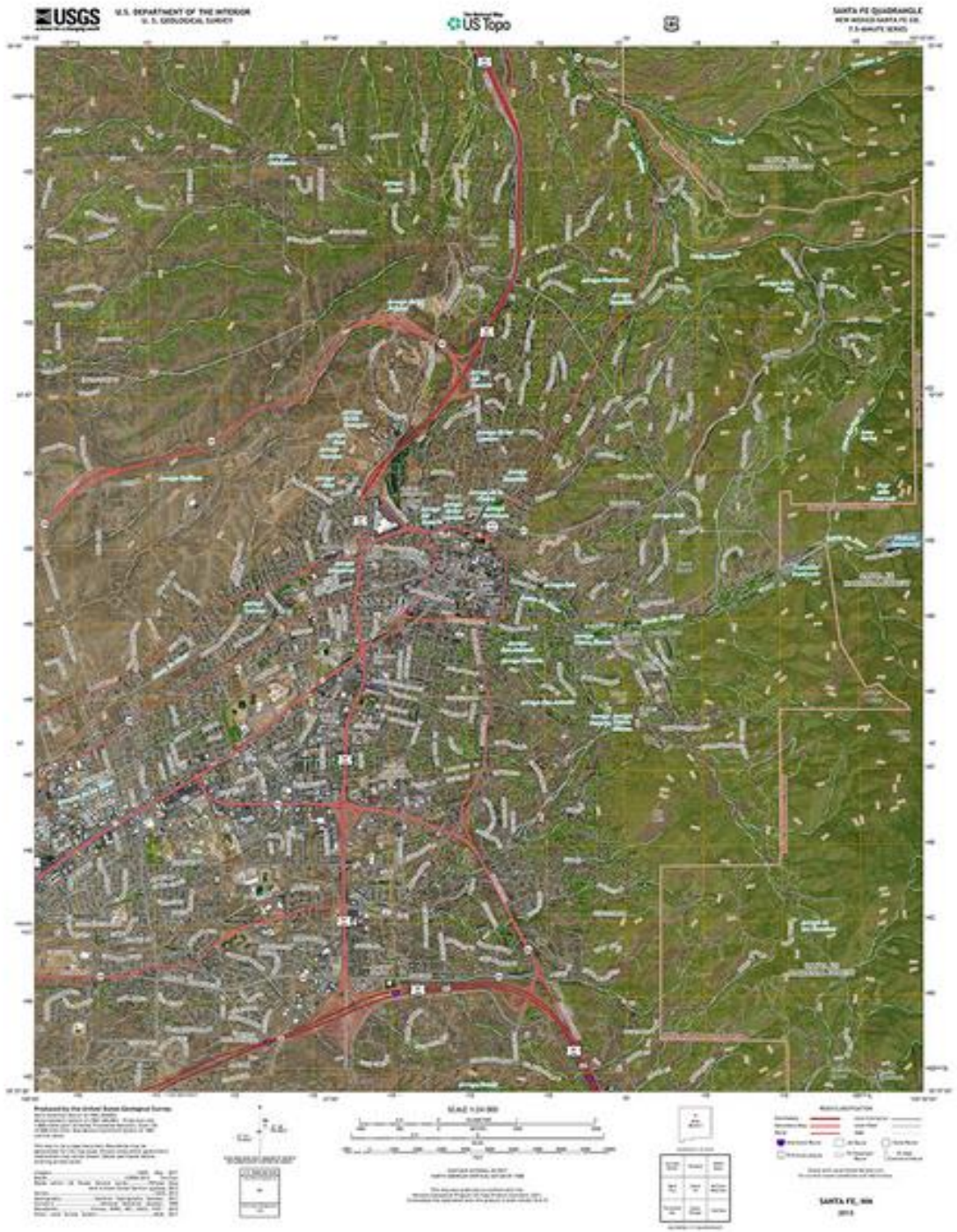
Scale bar



Inset

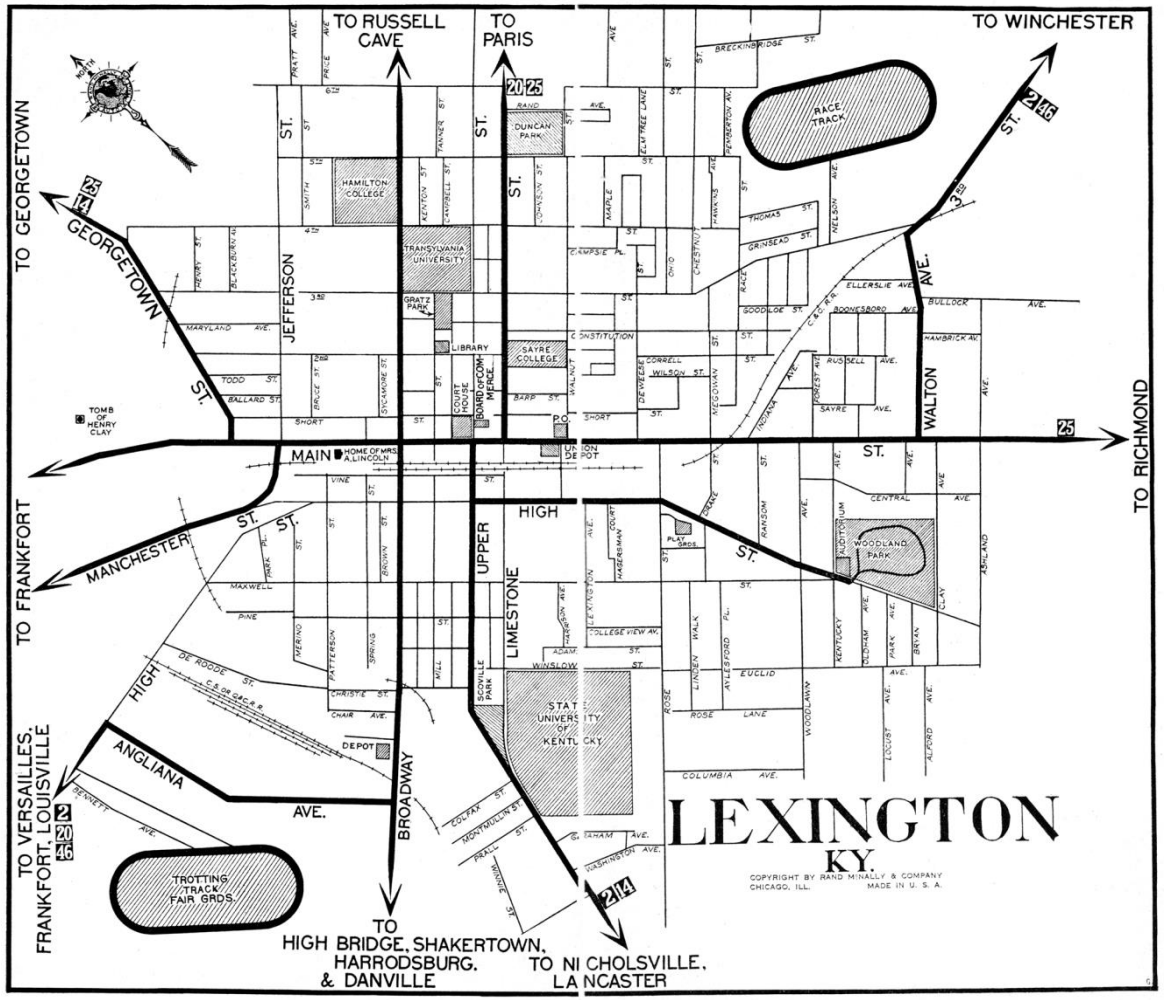
Map Features

If you have to know the rules, before you can break them!

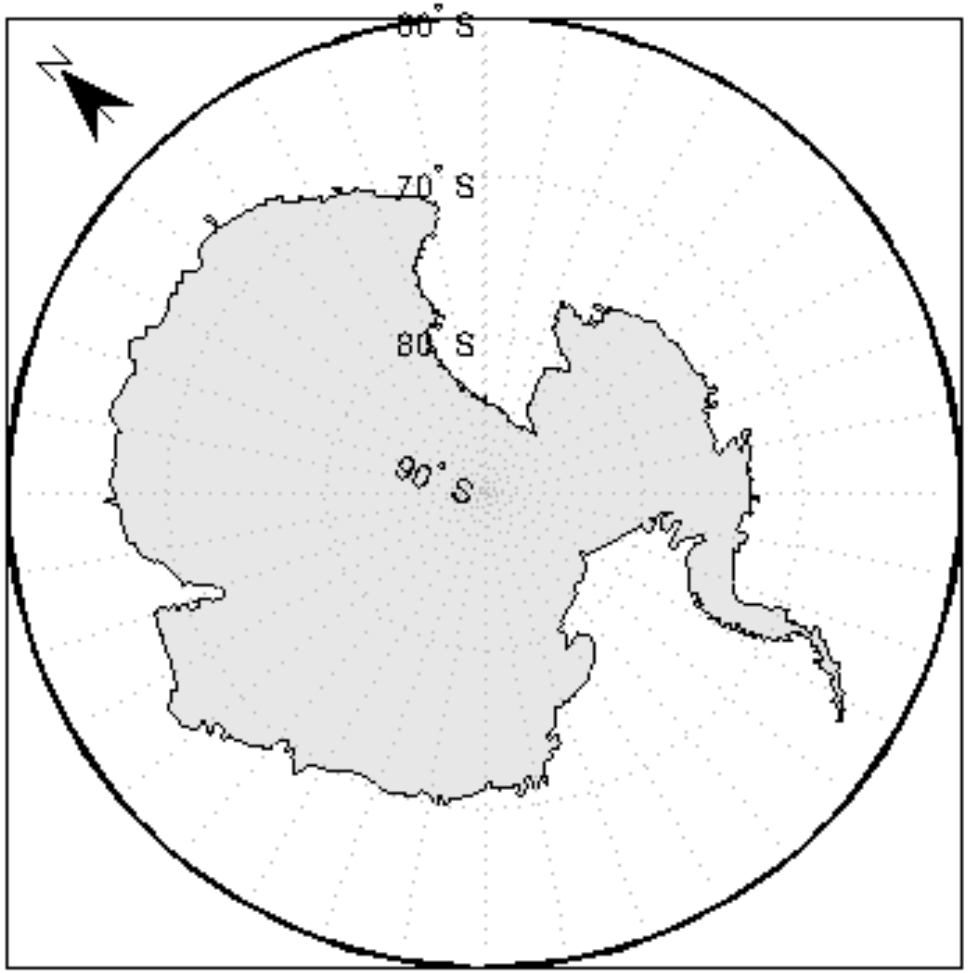


Santa Fe

The convention of orienting maps with North at the top is so widespread, that maps often lack a directional indicator (aka “North Arrow”) unless it is oriented differently.



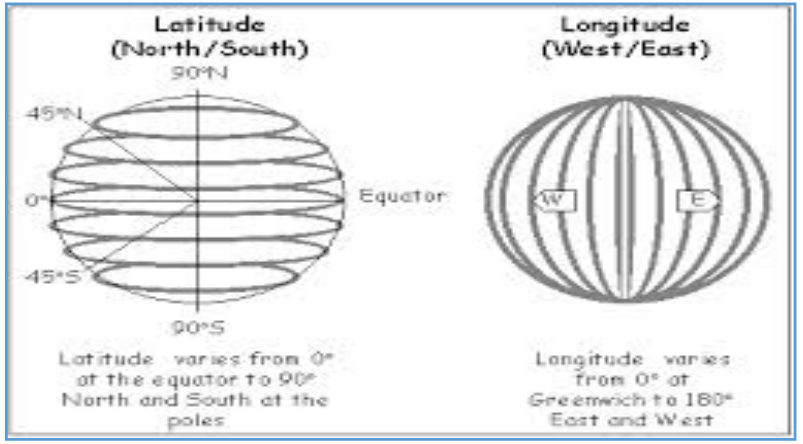
www.americanroads.us



www.mathworks.com

Map Features: Latitude & longitude

Latitude and longitude are imaginary lines encircling the globe, intersecting each other to form a grid that helps us pinpoint location—our "global address."



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

Map Features: Scale

The scale of a map shows how much you would have to enlarge your map to get the actual size of the piece of land you are looking at.

Typically, represented in one of three ways on a map:

- Verbal - scale is expressed in words: 1 inch = 1000 mi
- Visual – bar line that graphically depicts the relationship between map distance and ground distance

Representative Fraction:

- Ratio – 1:1,200,000

- First number of the scale is always one. It's your unit of measurement, usually an inch.
- The second number is the ground distance.
  - For example, if your U.S. Geological Survey (USGS) map has a scale of 1:24,000, it means that one inch on the map is equal to 24,000 inches (2000 feet or 609.6 meters) in the real world

Map Features: Scale

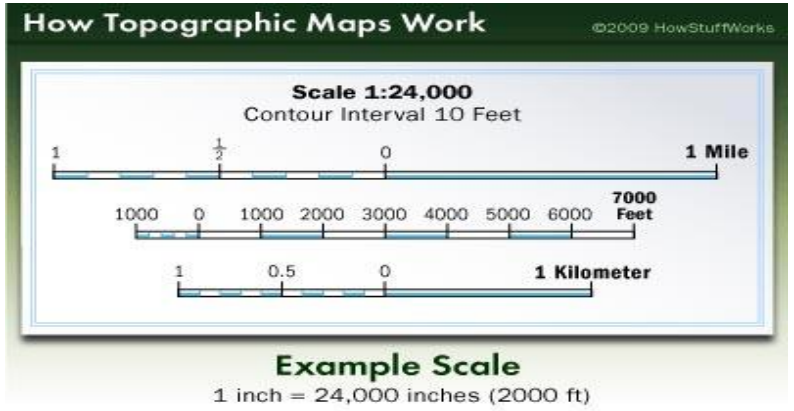
The terms 'large scale' and 'small scale' are used to describe different scales. However, they can be confusing :

Large scale maps have low number in the scale, such as 1: 1250.

- **The features are shown are large or are “zoomed in”**

Small scale maps have a high number in the scale, such as 1: 250 000.

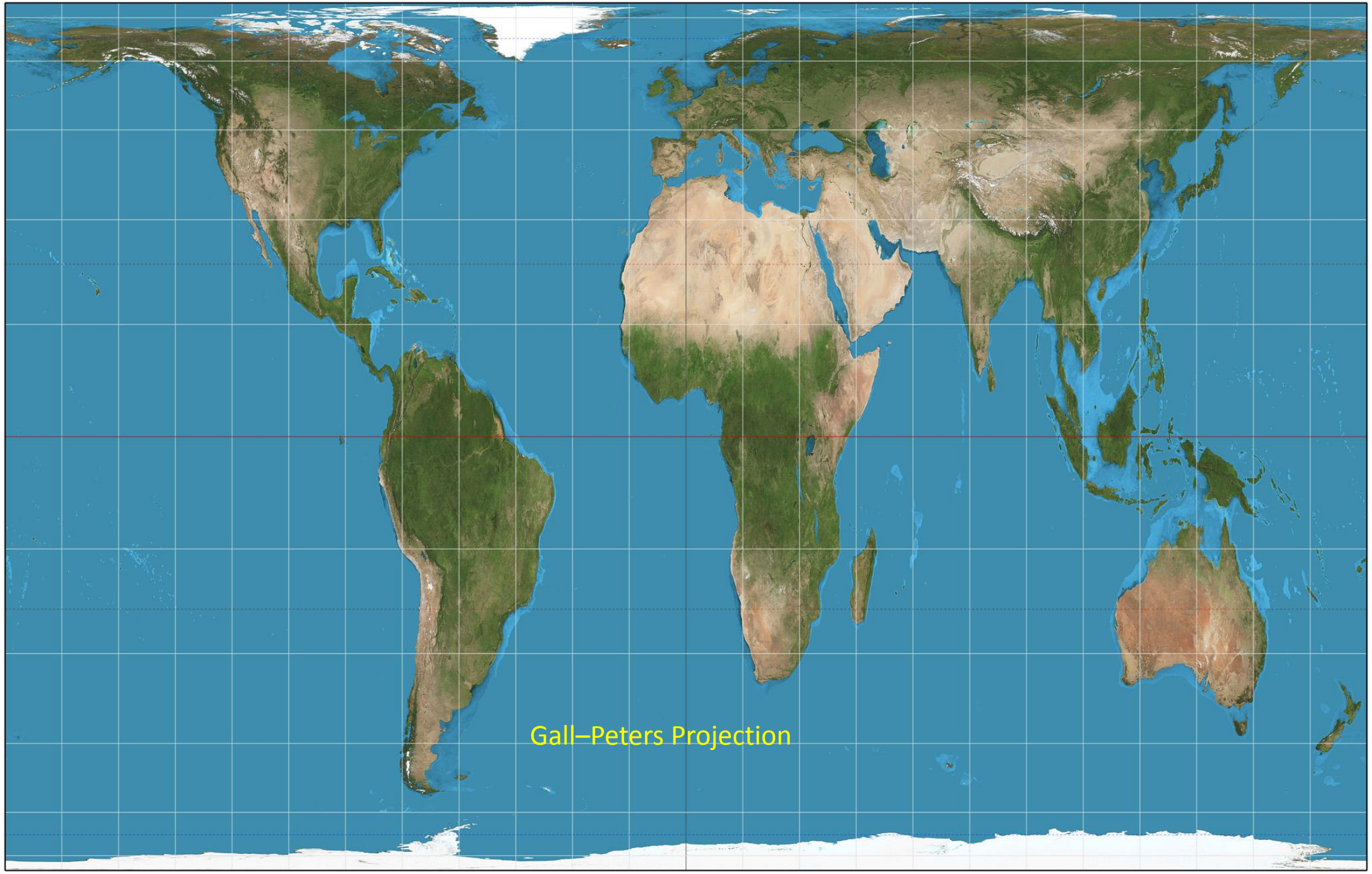
- **Individual features shown are small or are “zoomed out”**

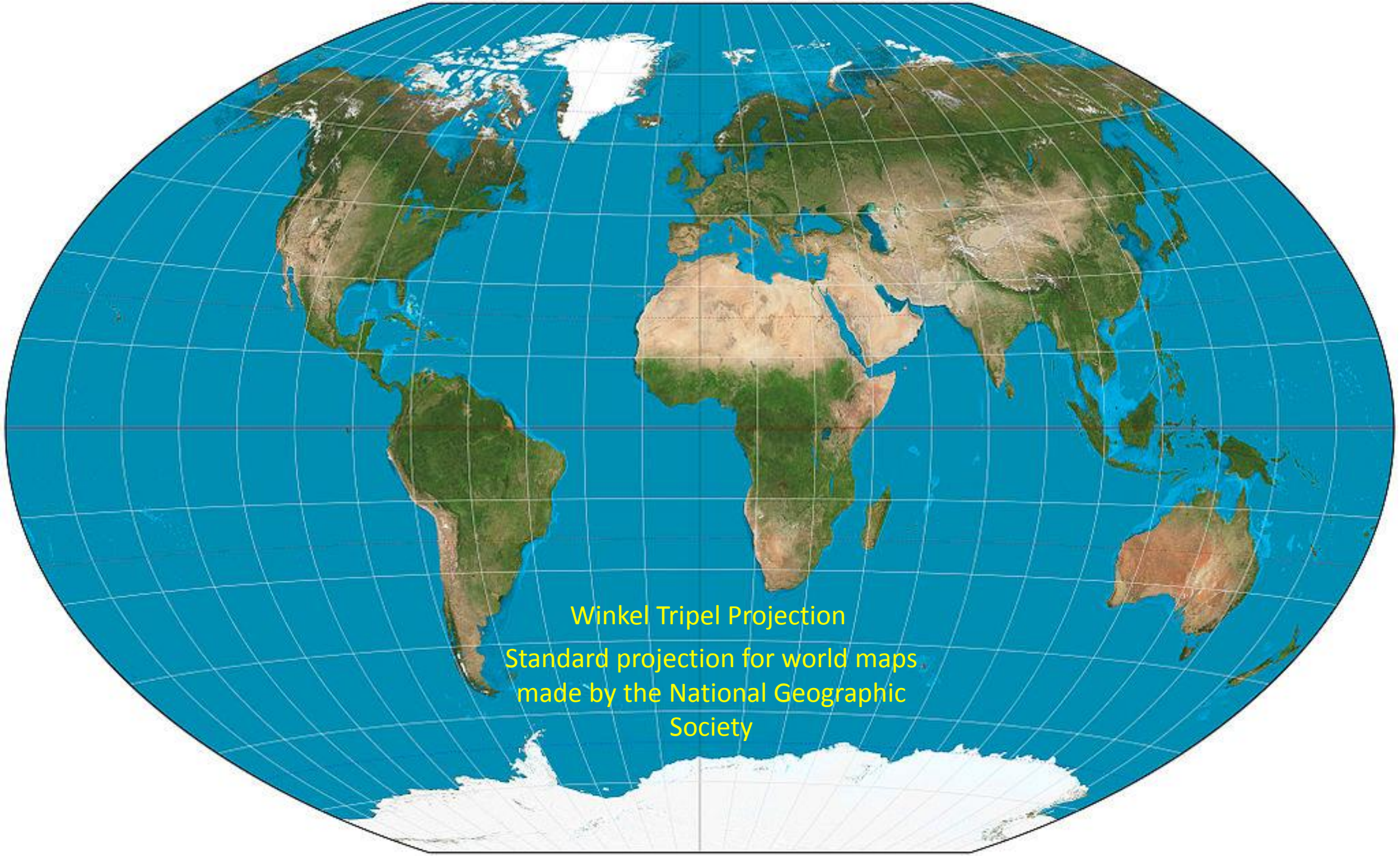


Map Features: Projections

- A map projection is:
  - The systematic transformation of the latitudes and longitudes of locations on the surface of a sphere or an ellipsoid into locations on a plane.
  - Map projections are necessary for creating maps.
  - All map projections distort the surface in some fashion.


Mercator Projection

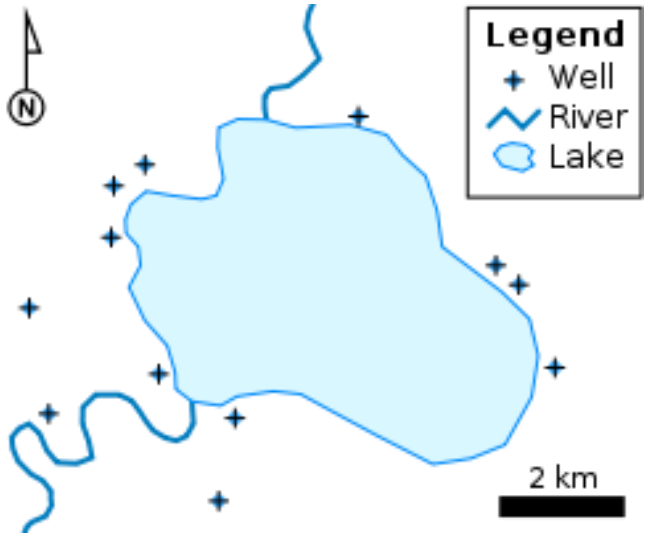

Gall–Peters Projection


Winkel Tripel Projection
Standard projection for world maps made by the National Geographic Society

Types of GIS File Formats

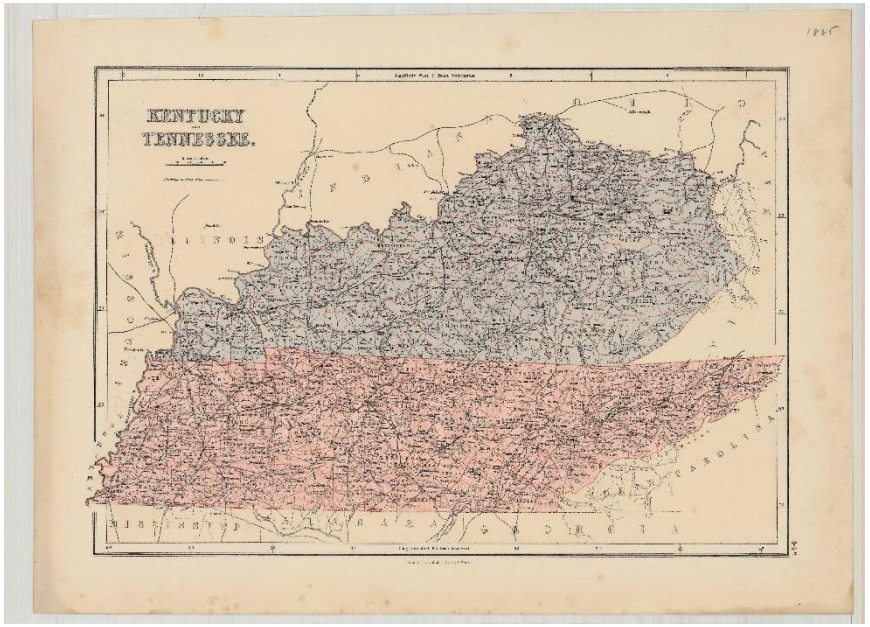
- Vector - geographical features are often expressed as vectors
  - Points
  - Lines
  - Polygons
- Popular File Formats
  - Shapefile – Very Common, developed by Esri
  - Tiger – Topologically Integrated Geographic Encoding and Referencing

KML – Keyhole Markup Language – XML based open standard



Types of GIS File Formats

- Raster – Pixels. Can be digital aerial photographs, digital pictures, scanned maps
- Popular GIS file formats
  - GeoTiff – Tiff variant enriched with GIS relevant metadata
  - JPEG2000
  - Digital raster graphic (DRG)



Map Data

- Discrete:

Data only found at fixed locations or when the data represent only specific values.

Buildings and roads are features that have distinct boundaries

Can be shown as a point, line, or a polygon.

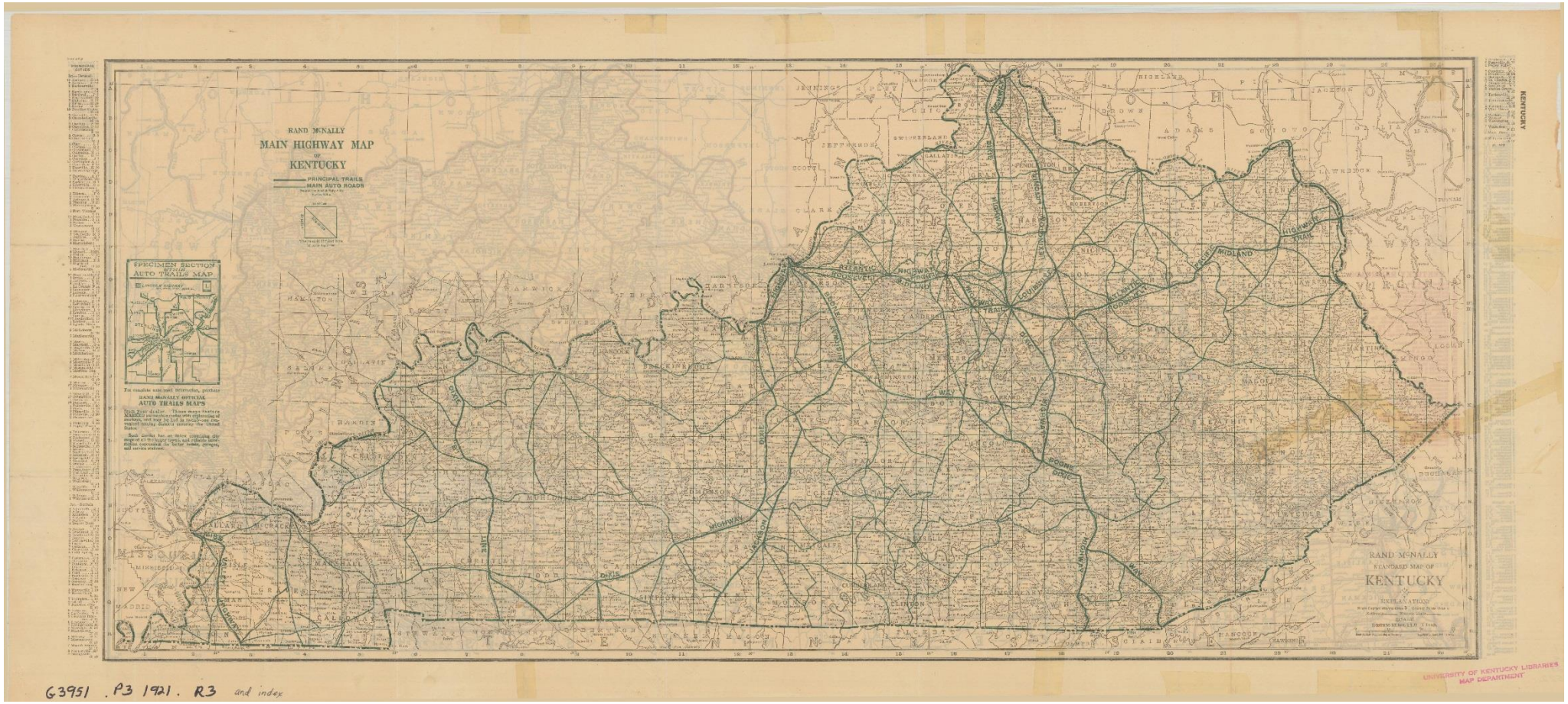
- Points could be cities
- Lines could be roads
- Polygons could be provinces in a country

Map Data

Continuous data – does not have well-defined boundaries and sometimes has no boundaries.

- It is typically seen throughout the mapped area and smoothly transitions from one value to another.
  - Temperature measurements
  - Atmospheric pressure
  - Elevation

Thinking about Making Maps



Don’t reinvent the wheel

- https://www.census.gov/geo/maps-data/
- https://datamapper.geo.census.gov/

Esri (ArcGIS Products) & QGIS

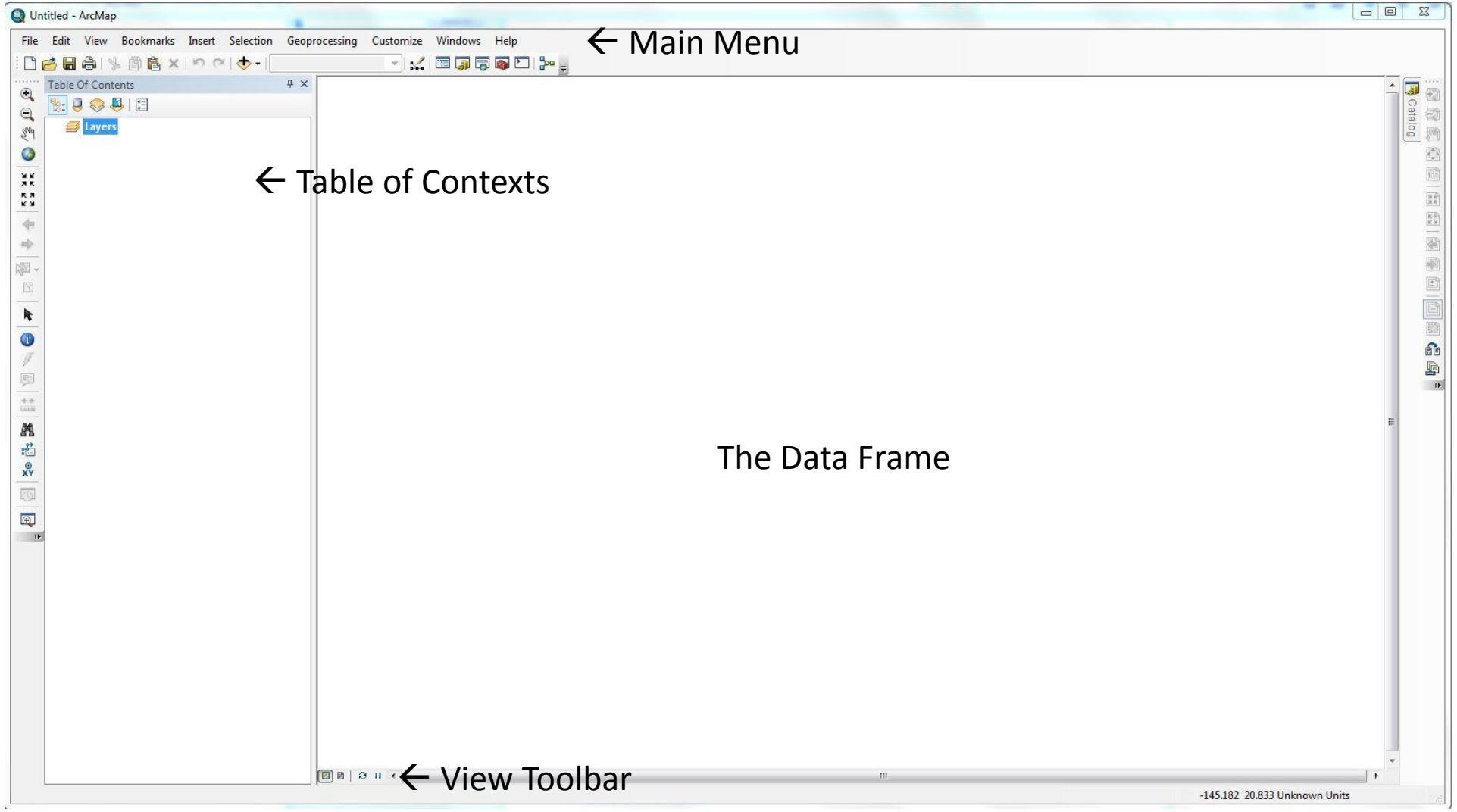
- ArcGIS Online – cloud based mapping platform.
- ArcMap – Desktop application (does not work with Macs)

- Consult UKY GIS Campus Support for access information

QGIS

- Free and Open Source GIS Platform
- Works with Windows, Mac, and Linux

ArcMap Interface



Geocoding

- The conversion of addresses into geographic coordinates
- “GeoSearch” → When converting one address
- “Batch Geocoding” → When converting many
- BatchGEO (http://www.batchgeo.com) a free online tool that geocodes addresses, maps them and creates a KML file

- Reverse Geocoding → Take coordinates and change into address
  - http://noc.to/geodecode
- Your Address → Standardization → Coordinates → Points on a Map

Map Communication/Design

Map Communication oftentimes deals with the fusion of:

- **Intellectual Hierarchy** – what are the different elements around the map, and what are their relative importance to the overall communication
- **Visual hierarchy** – choose your visual hierarchy that reflects the intellectual hierarchy

Map Communication is shaped by how the map features, visual arrangements, and symbolization interact with one another

Good design enhances map communication

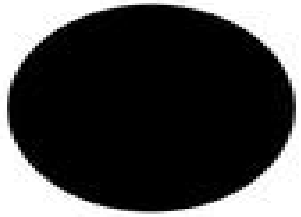
Poor design inhibits communication

Important to remember that communication is linked to the audience:

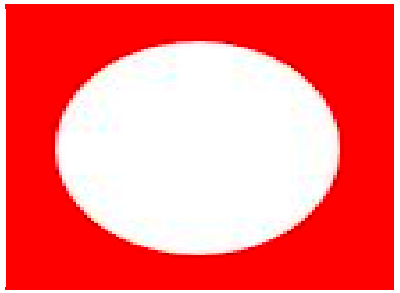
- Know who you are talking to
  - Experts or Novices
- How will maps be displayed:
  - Printed or Web
  - Size
  - Color or B/W

Visual Hierarchy (figure-ground)

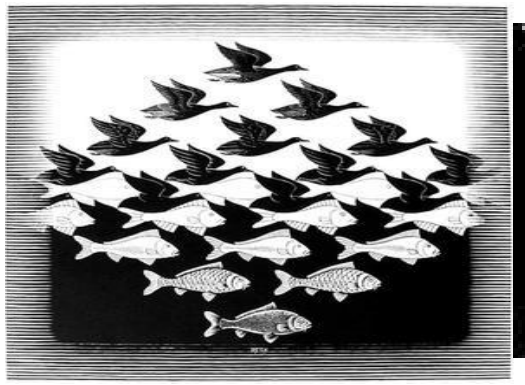
- Figure-ground effect:
  - Figures on maps are seen as separate from the rest of the map
    - Can be used to emphasize what is important in the map
    - The main focus of the composition (positive space)
    - Ground: The secondary portion of the composition (negative space)
- Elements of Foreground and Background

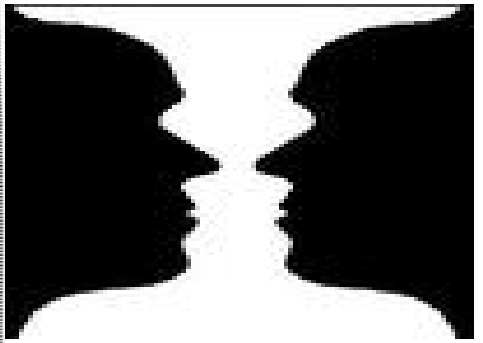


Figure



Ground

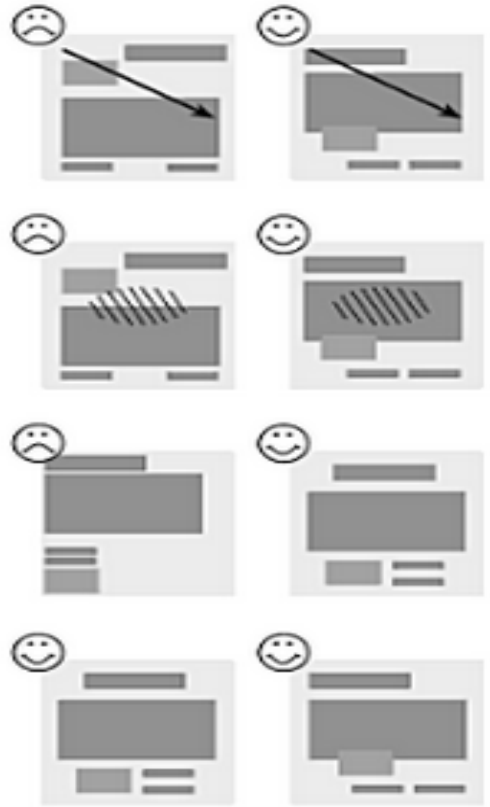


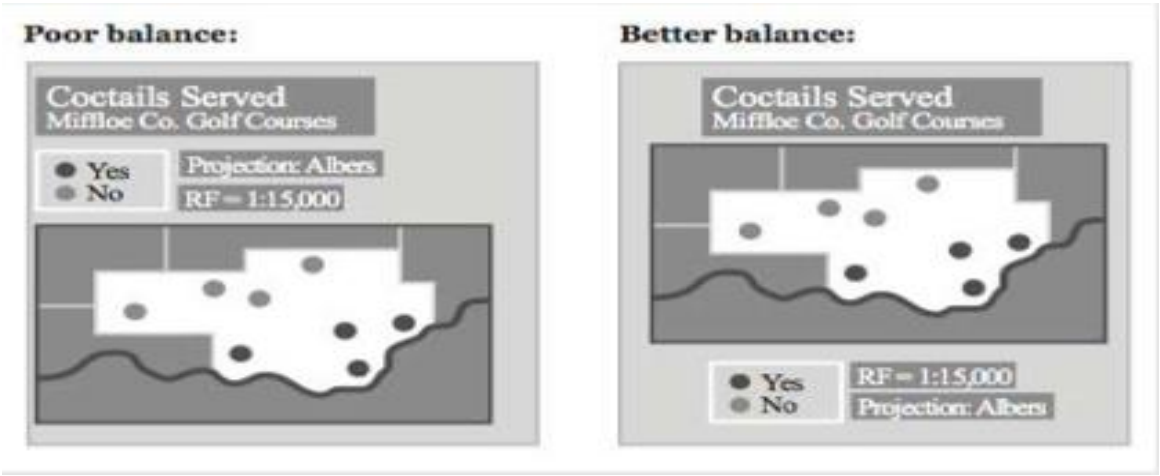


Visual Arrangement

Key Elements

- Visual Center – slightly above the actual center
- Balance – some map pieces are ‘heavier’ than others so you want to move pieces around to keep the visual balanced
- Symmetry – balance around a central vertical axis





Map Symbolization

- Everything on a map is a symbol
- Symbol - A thing representing something else because of relationship, association, convention, or resemblance
  - Map symbols are tied to data and concepts
  - Choose symbols that best match your data

Oftentimes:

- Symbolize by shape/unique symbol or color hue for qualitative data
- Symbolize by size or color value for quantitative data

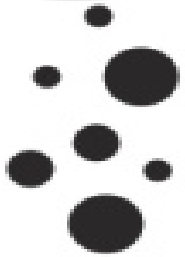
symbol by resemblance

Other map symbols *look* like particular data or concepts.

A map showing the location of airports uses an airplane symbol for airports: the symbol *looks* like an airplane, and is associated with an airport.

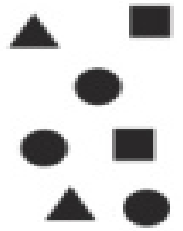
Maps in a war atlas use red symbols to show the location of battles: the symbol *looks* like an explosion, and is associated with a battle. People often associate red with danger or conflict.

symbol by relationship



Some map symbols *intuitively* suggest general kinds of data.

A map showing the population of different cities uses circle sizes from small to large: sizes vary in *amount*, as do the data.



A map showing restaurants, antique stores, and museums in a town uses different shapes: shapes vary in *kind*, as do the data.

symbol by convention

Some symbols "make sense" even though they may not entirely make sense.

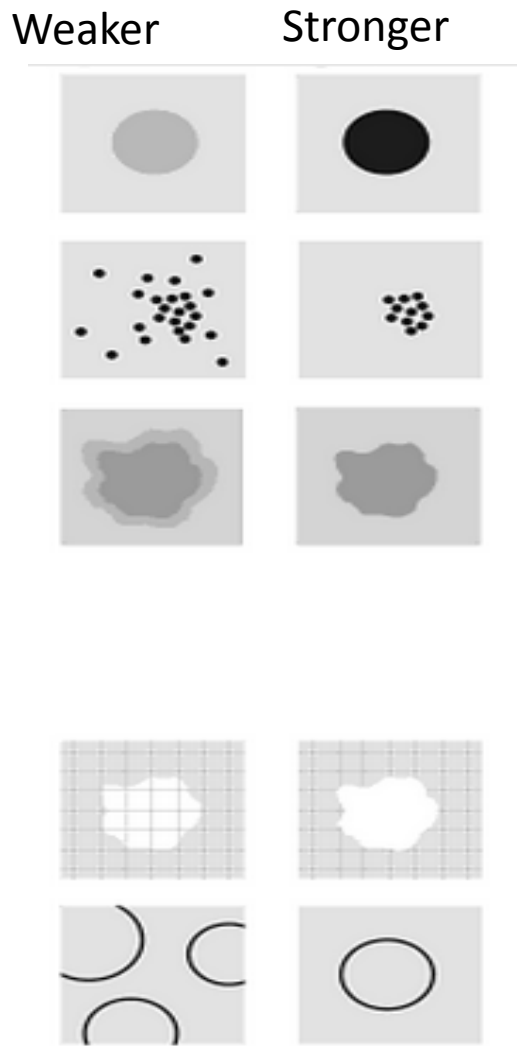
The U.S. Geological Survey uses the Christian cross to symbolize all places of worship - church, mosque, synagogue. We know what they mean, though it's not very politically correct.

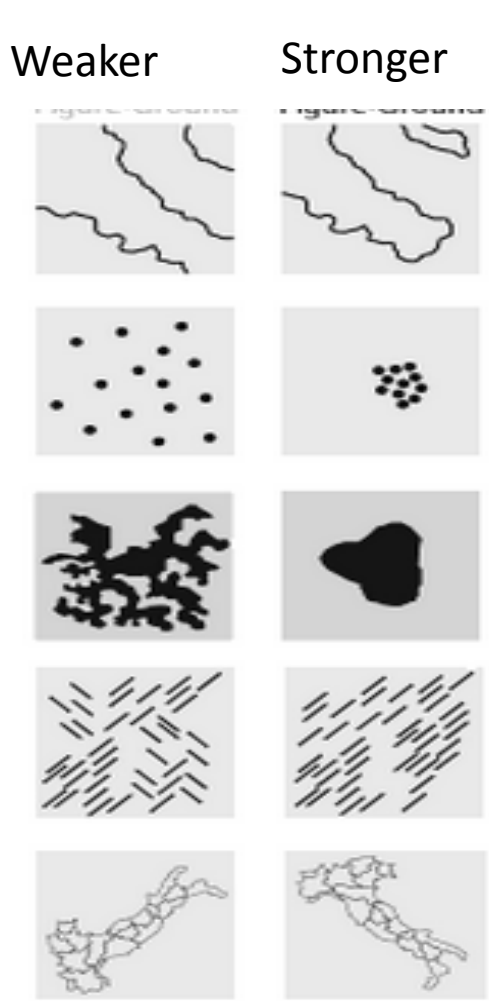
A map showing the earth's oceans uses blue for water. But is water out in the real world blue? Not usually. Blue on a map, however, suggests water - it's a *convention*. If you depart from conventions (color your oceans their actual color) you could confuse your map's readers.

Enhancing Visual Difference

Overview Visual Difference Detail

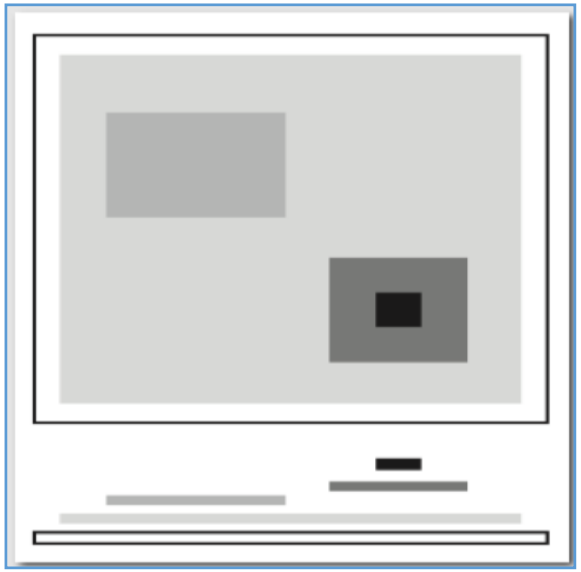
- Edges
- Texture
- Layering
- Shape & Size
- Closure
- Proximity
- Simplicity
- Direction
- Familiarity
- Color



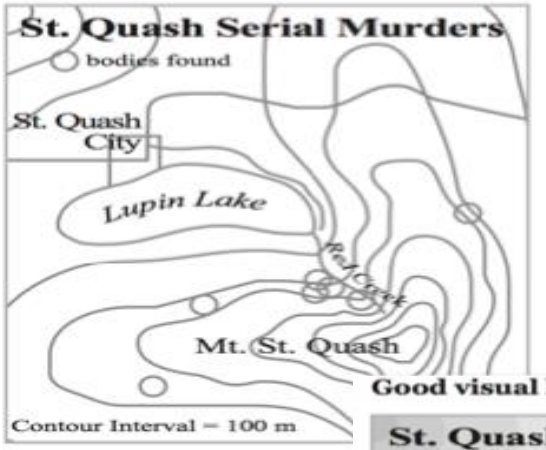


Visual Hierarchy

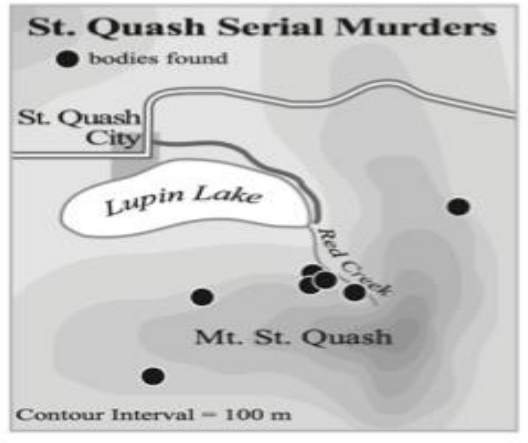
- Design choices effect visual order
- Separate and layer information in rough proportion to their relevance
  - Important information sits on top of the visual hierarchy
  - Push supporting elements to the back
  - Discard what is not relevant
  - Style and layering set visual order



Poor visual hierarchy:

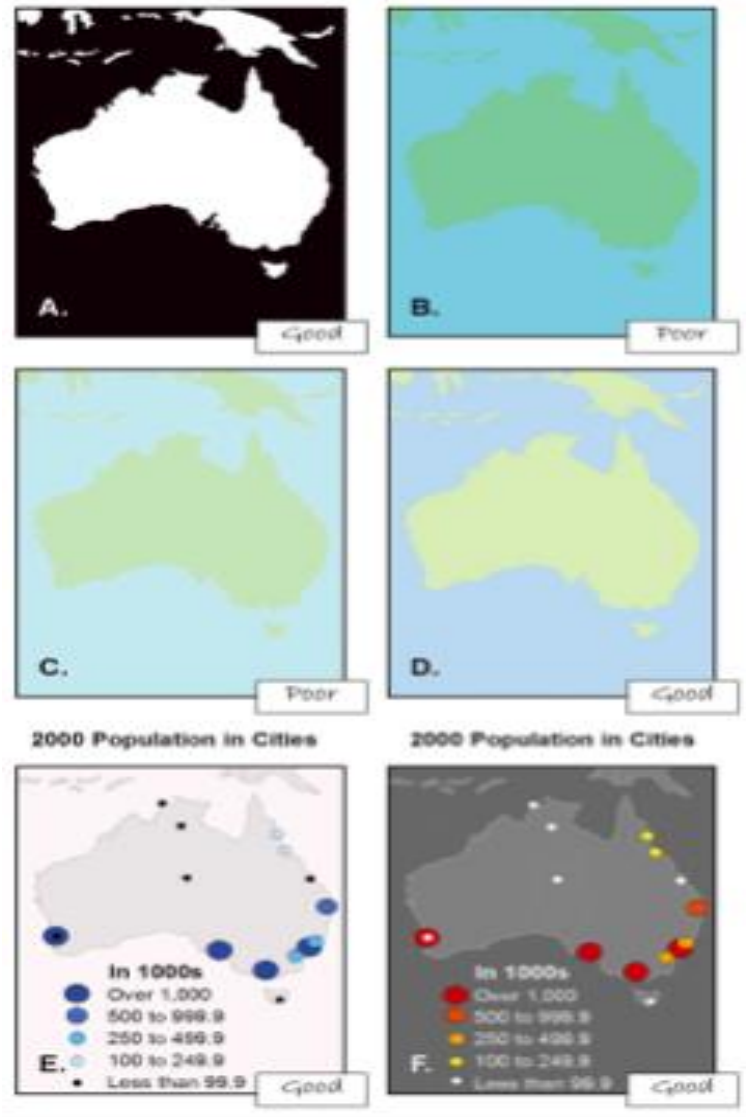


Good visual hierarchy:



Visual Hierarchy (visual difference)

- Visual contrast emphasizes figure-ground relationship
- Darker or brighter features stand out
- Features with less contrast appear to belong together



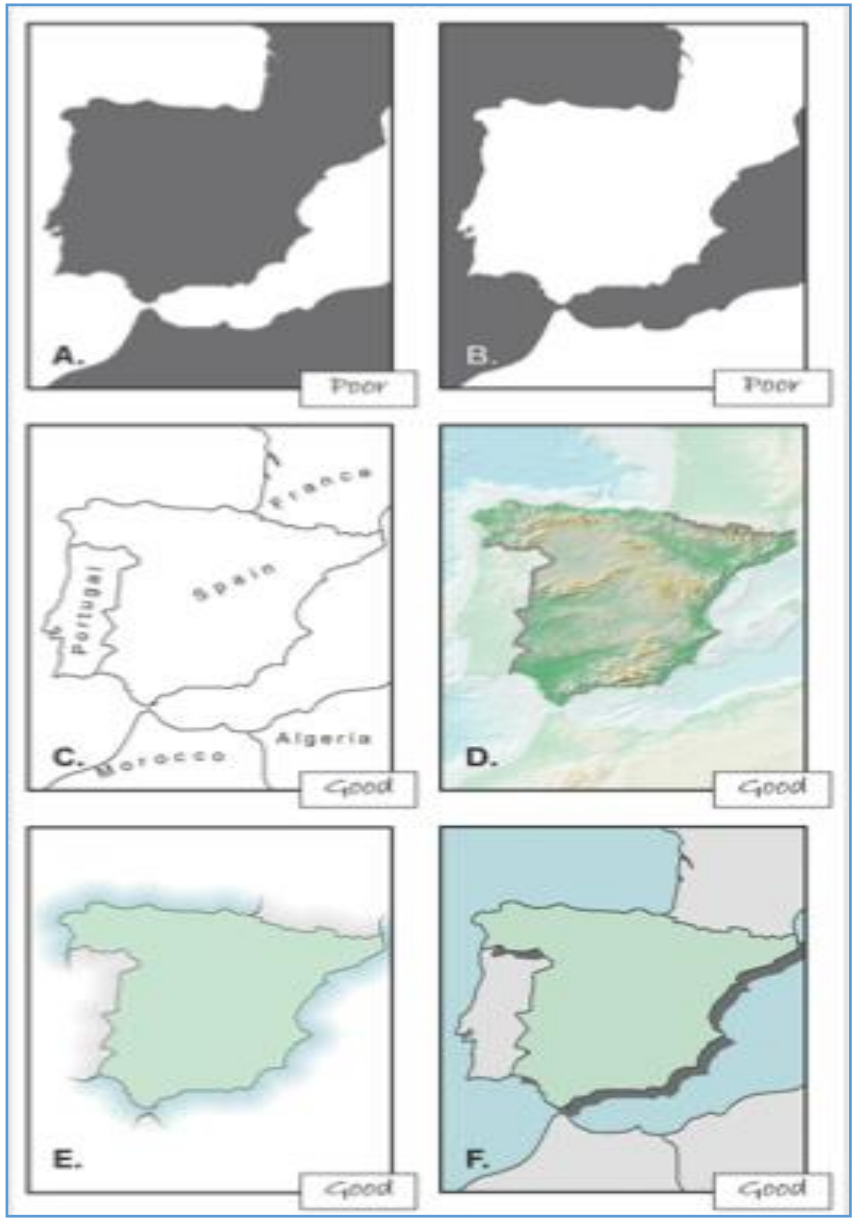
Poor Figure Ground

OK Figure Ground

Good Figure Ground

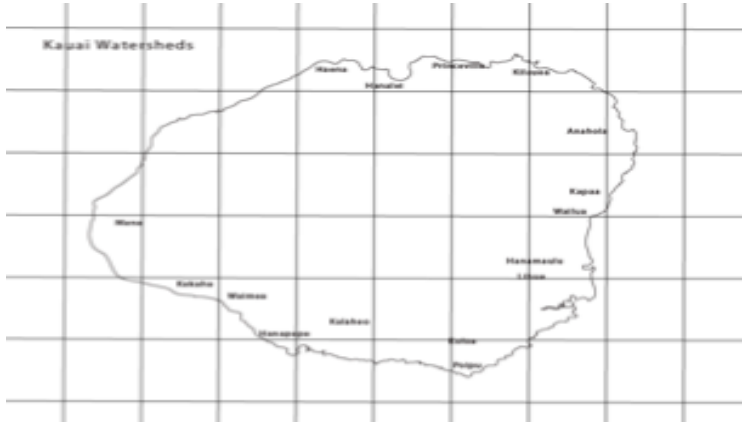
Visual Hierarchy (Separation)

- Defined edges between features
- Deemphasized backgrounds



Visual Hierarchy (layering)

- Proper layering enhances visual order
- Continue Ground behind Figure



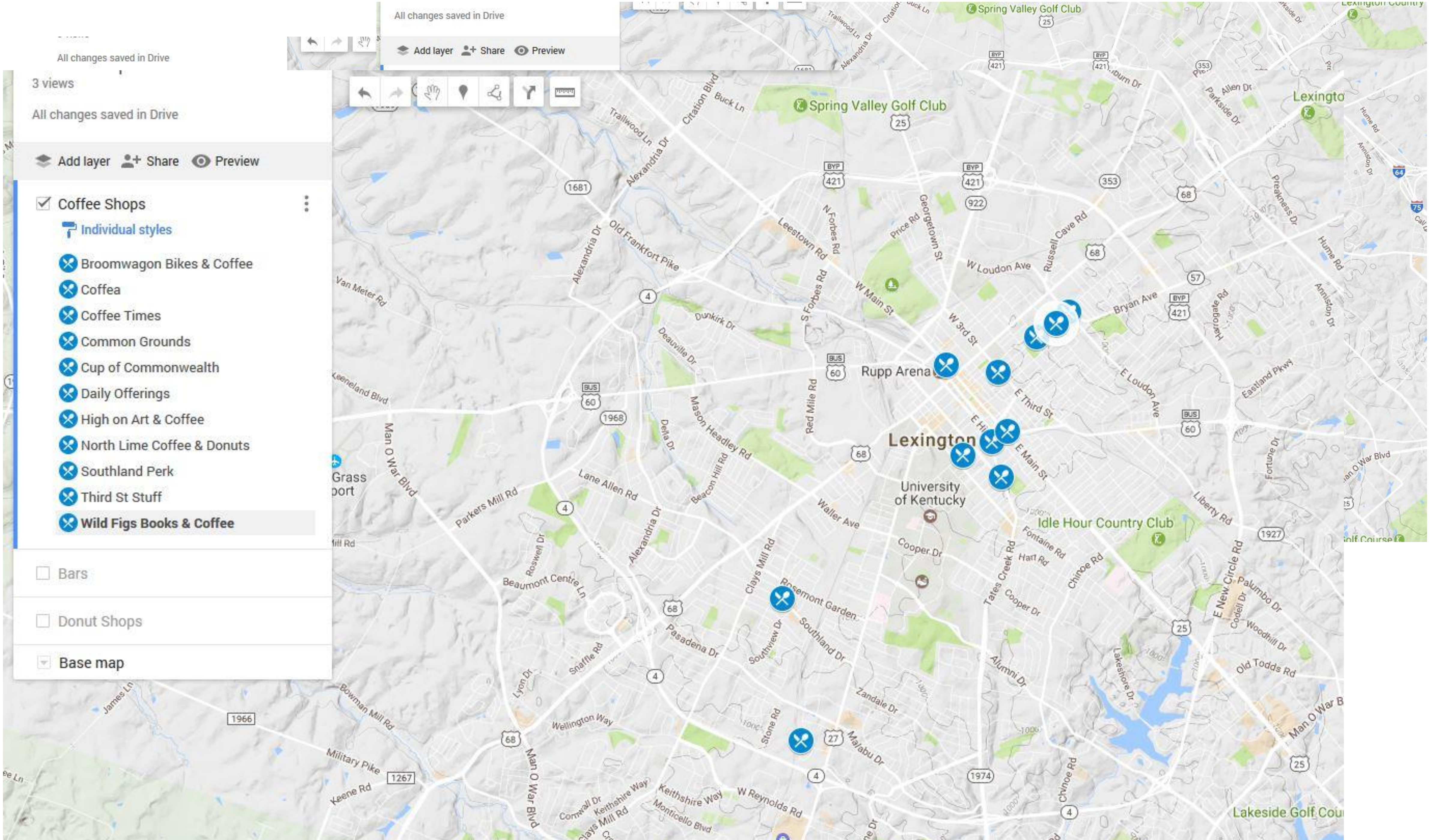
Color on Maps

- Does your map need to be in color?
- Gray scale maps can be very effective
  - Avoid cultural associations
  - Best for b&w reproductions
- Color
  - Use color sparingly
  - Spot colors on muted field emphasize data
  - Color on muted background draws the eye to your data
  - Connect color choice to your data

Common Colors

- Blue - lakes, rivers, streams, oceans, reservoirs, highways, local borders

  - major highways, roads, urban areas, airports, special interest sites, military sites, place names, buildings, borders
- Yellow - built-up or urban areas
- Green - parks, golf courses, reservations, forest, orchards, highways


All changes saved in Drive
Add layer
Share
Preview
3 views
All changes saved in Drive
Add layer
Share
Preview
Coffee Shops
Individual styles
Broomwagon Bikes & Coffee
Coffea
Coffee Times
Common Grounds
Cup of Commonwealth
Daily Offerings
High on Art & Coffee
North Lime Coffee & Donuts
Southland Perk
Third St Stuff
Wild Figs Books & Coffee
Bars
Donut Shops
Base map
Spring Valley Golf Club
Rupp Arena
Lexington
University of Kentucky
Idle Hour Country Club
Lakeside Golf Cou
W Loudon Ave
Bryan Ave
Russell Cave Rd
Georgetown St
Leestown Rd
W Main St
W 3rd St
E Third St
E Main St
E Loudon Ave
Old Frankfort Pike
Alexandria Dr
Citation Blvd
Trailwood Ln
Buck Ln
Price Rd
N Forbes Rd
S Forbes Rd
Dunkirk Dr
Deauville Dr
Mason Headley Rd
Red Mile Rd
Lane Allen Rd
Beacon Hill Rd
Waller Ave
Cooper Dr
Parkers Mill Rd
Beaumont Centre Ln
Clays Mill Rd
Rosemont Garden
Southland Dr
Southview Dr
Pasadena Dr
Shaffer Rd
Wellington Way
Military Pike
Keene Rd
Bowman Mill Rd
Man O War Blvd
Keithshire Way
W Reynolds Rd
Monticello Blvd
Stone Rd
Malabu Dr
Zandale Dr
Alumni Dr
Tates Creek Rd
Fontaine Rd
Chinoe Rd
Liberty Rd
E New Circle Rd
Palumbo Dr
Woodhill Dr
Old Todds Rd
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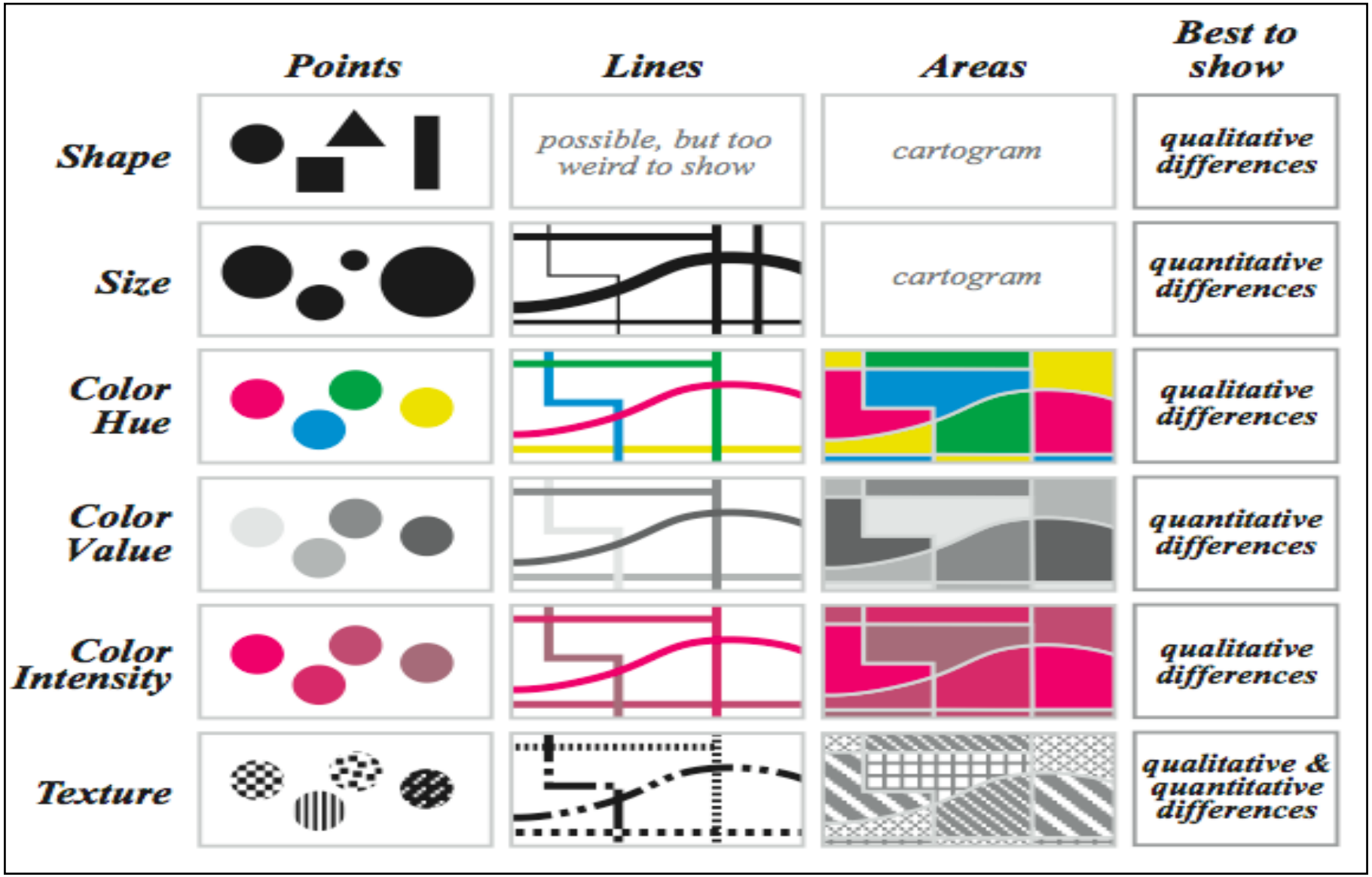
Representing Data



Different visual variables are more effective for showing qualitative or quantitative differences

Some Questions to ask Yourself:

- Map Title – is it brief and directly related to the map?
- Map scale – is it correct?
- Do legend symbols match the map?
- Does your map include source(s) and author information?
- Does it reproduce ok in b&w?
- Will the map fit the page or screen?

Additional Resources

Great Site to Search for Answers:

http://gis.stackexchange.com/

Google!!!

Or me!

Feel free to talk with me about any project.