# Cartography 101: Map-Making Tips to Engage Stakeholders

**Katie Gaul, MA**

Health Workforce Technical Assistance Center;
With additional support from the Program on Health Workforce Research & Policy and the North Carolina Rural Health Research Program at the Cecil G. Sheps Center for Health Services Research, UNC Chapel Hill

**Health Workforce Technical Assistance Center Webinar**

**April 26, 2017**



HWTAC
Health Workforce Technical Assistance Center

# What's on the agenda for today?

- Why are maps important?
- What's GIS? How can I learn more?
- Cartography 101:
  In order to make a good map, you need to know…
  - Your audience
  - Your data
  - What kind of map best shows your data
  - How to create appropriate legend categories
  - The best colors to use (or not to use)
  - A little bit about projections
- What more do you want to know?

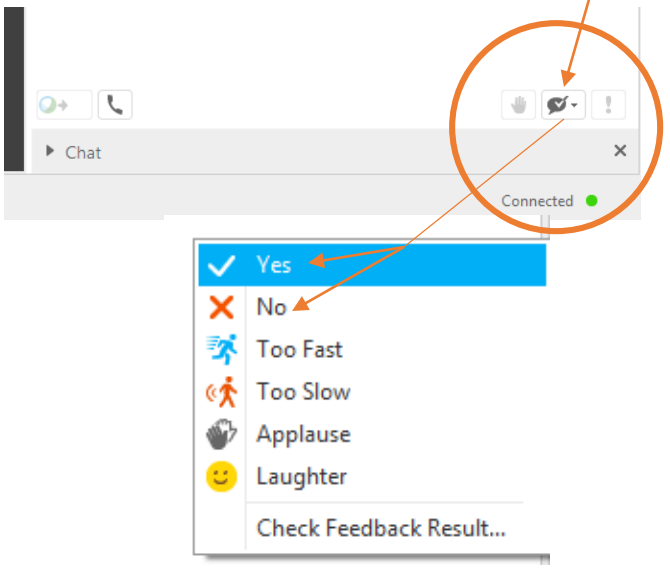
HWTAC
Health Workforce Technical Assistance Center

# But first … getting the lay of the land

**Show of "hands":**

- Who has ever made a map or has someone in your office that can map?
- What software do you/they use?
  - ArcGIS
  - MapInfo
  - QGIS
  - Other?

To participate in the poll, look for this symbol at the bottom right of your screen, or if you're in full-screen mode, look for the Participants button at the top center. Click Yes or No to answer each question as I ask.




Note: The post-webinar evaluation will have additional questions. Please take a few minutes at the end to tell us more about what you would like to learn. We need your input so we can make the webinars more useful and relevant to you.

# What's the big deal about maps?

# Maps can be simple, yet powerful

**Simply put,**

**A map takes your data from this…**

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 1 | fips | County | ResLivBirths2014 | DocsDeliveringBabies2014 | CNM2014 | DocsAndCNM2014 | BirthsPerProvider2014 |
| 2 | 37001 | Alamance | 1,766 | 9 | 7 | 16 | 110 |
| 3 | 37003 | Alexander | 351 | 0 | 1 | 1 | 351 |
| 4 | 37005 | Alleghany | 99 | 0 | 0 | 0 | -9 |
| 5 | 37007 | Anson | 237 | 0 | 0 | 0 | -9 |
| 6 | 37009 | Ashe | 223 | 2 | 0 | 2 | 112 |
| 7 | 37011 | Avery | 114 | 2 | 2 | 4 | 29 |
| 8 | 37013 | Beaufort | 447 | 2 | 0 | 2 | 224 |
| 9 | 37015 | Bertie | 164 | 0 | 0 | 0 | -9 |
| 10 | 37017 | Bladen | 363 | 2 | 0 | 2 | 182 |
| 11 | 37019 | Brunswick | 1,102 | 7 | 0 | 7 | 157 |
| 12 | 37021 | Buncombe | 2,576 | 60 | 11 | 71 | 36 |
| 13 | 37023 | Burke | 885 | 6 | 2 | 8 | 111 |
| 14 | 37025 | Cabarrus | 2,335 | 31 | 1 | 32 | 73 |
| 15 | 37027 | Caldwell | 828 | 3 | 1 | 4 | 207 |
| 16 | 37029 | Camden | 98 | 0 | 0 | 0 | -9 |
| 17 | 37031 | Carteret | 581 | 6 | 0 | 6 | 97 |
| 18 | 37033 | Caswell | 210 | 0 | 0 | 0 | -9 |
| 19 | 37035 | Catawba | 1,806 | 16 | 11 | 27 | 67 |
| 20 | 37037 | Chatham | 610 | 0 | 2 | 2 | 305 |
| 21 | 37039 | Cherokee | 210 | 2 | 0 | 2 | 105 |
| 22 | 37041 | Chowan | 124 | 2 | 1 | 3 | 41 |
| 23 | 37043 | Clay | 78 | 0 | 0 | 0 | -9 |
| 24 | 37045 | Cleveland | 1,055 | 7 | 3 | 10 | 106 |
| 25 | 37047 | Columbus | 608 | 3 | 2 | 5 | 122 |
| 26 | 37049 | Craven | 1,500 | 7 | 3 | 10 | 150 |
| 27 | 37051 | Cumberland | 5,700 | 31 | 16 | 47 | 121 |

**… to this**

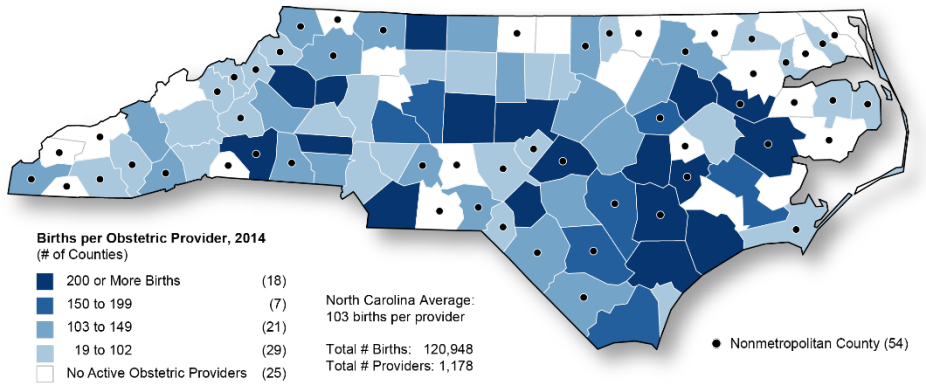



**Figure 2 -- Resident births per obstetric care provider*, North Carolina, 2014.**
Note: Data include active, instate Certified Nurse Midwives (CNMs) who were licensed in North Carolina as of October 31, 2014, and active, in-state, non-federal, non-resident-in-training physicians who were licensed in North Carolina as of October 31, 2014 and reported that they provide obstetric deliveries. Providers are assigned to counties based on self-reported primary practice location. Sources: Providers: North Carolina Health Professions Data System, with data derived from the North Carolina Board of Nursing and North Carolina Medical Board, 2014. Resident Live Births: Department of Health and Human Services, Vital Statistics, linc.state.nc.us, accessed 9/27/2016. Nonmetropolitan Counties: "Core Based Statistical Area" (CBSA) is the US Census Bureau and Office of management and Budget collective term for Metropolitan and Micropolitan Statistical Areas. Here, nonmetropolitan counties include micropolitan and counties outside of CBSAs, effective July 2015.

Fraher E. The Value of Workforce Data in Shaping Nursing Workforce Policy: A Case Study from North Carolina. *Nursing Outlook*. 2017; 65(2): 154-161.

## Why else?

- A picture is worth a thousand words
- Use maps and data to challenge anecdotal evidence
- Communicate with the tabularly challenged
- Maps grab people – "where's my county?"

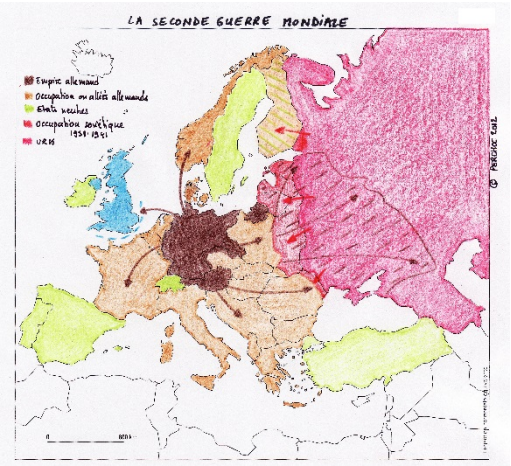
HWTAC Health Workforce Technical Assistance Center

# How do you make a map?

## Draw by hand

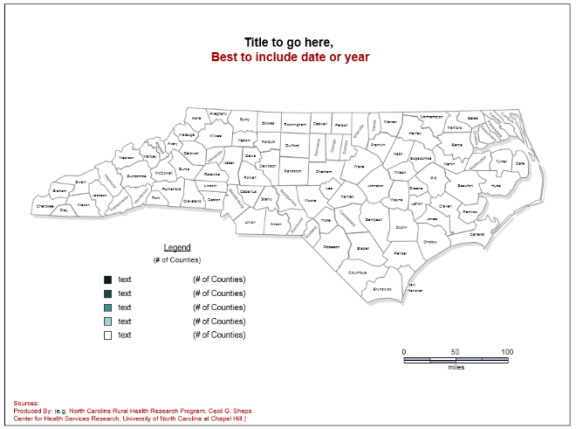

http://handmaps.org/mapsind.php?mapID=4

## Color by hand

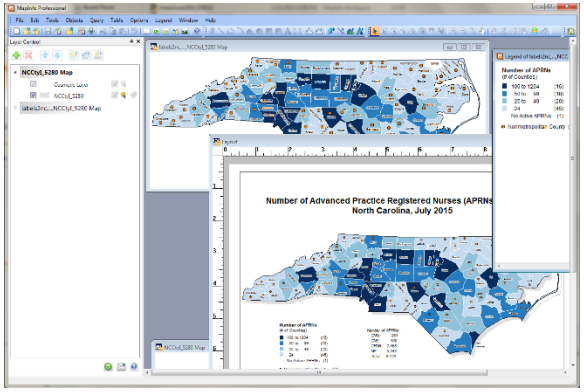



https://f.hypotheses.org/wp-content/blogs.dir/1064/files/2012/11/Carte_crayon_SGM3.jpg

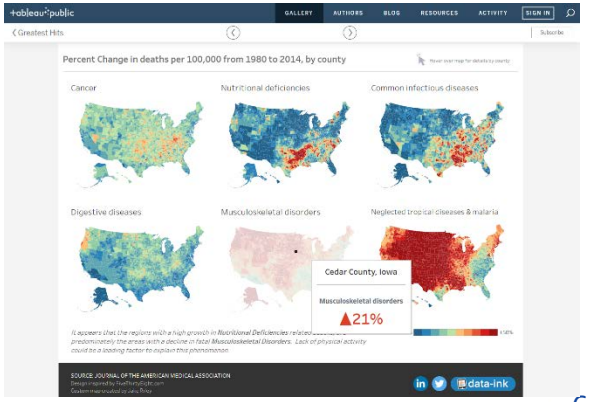
## Click and shade in PowerPoint




## Use GIS or cartographic software




## Use online tools




https://public.tableau.com/en-us/s/gallery/changing-diseases

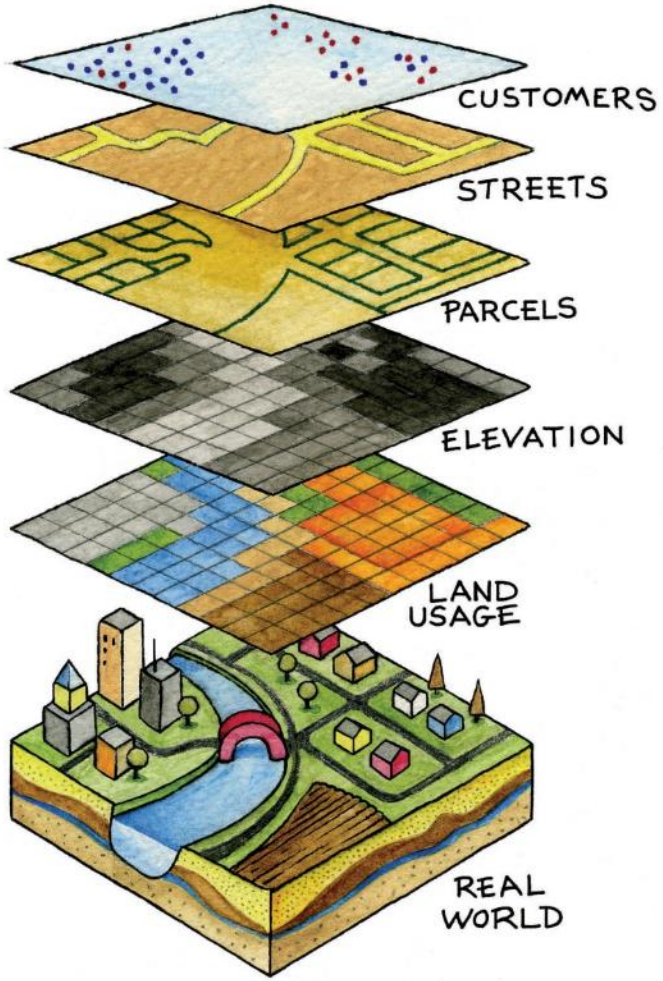
# What's GIS?

# What is a Geographic Information System?

- GIS integrates hardware, software, and data; this allows us to visualize, question, analyze, and interpret data to understand relationships, patterns, and trends.*
- Connects data to maps based on unique ID
- Allows you to layer different types of data to see and analyze
- Allows you to translate data into meaningful results
- *Vector*: points, lines, polygons
- *Raster*: images built on pixels

* Adapted from ESRI definitions, http://www.esri.com/what-is-gis

# GIS uses layers




## Your layers might be

- Counties, ZIP Codes, Rational Service Areas, Census areas
- Cities
- Road Networks
- Healthcare Providers
- Healthcare Facilities
- Educational Institutions
- Patients
- Transportation (bus routes…)
- Demographics
- Topography

Note: You might have to geocode certain data (e.g., street addresses) to use them in a map

http://guides.lib.byu.edu/c.php?g=246326&p=3440307

# Software - examples

- **GIS**
  ArcGIS (industry standard); MapInfo;
  QGIS (free, open-source); Cartographica (Mac)
- **Cartographic**
  Microsoft MapPoint; Tableau; CARTO
- **Design**
  Adobe Illustrator/MapPublisher;
  CorelDraw
- **Statistical**
  SAS; Stata
- **Web Development**
  Javascript, D3

*Note: It is helpful to have Excel or a statistical programming package (SAS, Stata, etc.) to manipulate data before mapping.*

# Online tools - examples

- **Tableau**
  http://www.tableausoftware.com/public/
- **CARTO (formerly CartoDB)**
  https://carto.com/
- **HRSA**
  http://datawarehouse.hrsa.gov/data/mapservices.aspx
- **Robert Graham Center**
  http://www.graham-center.org/online/graham/home/tools-resources.html

# Training

- Universities and community colleges
- ESRI Campus - campus.esri.com
- Lynda.com
- Webinars, workshops, conferences
- One-on-one training
- Books, self-directed

# Basics of Cartography

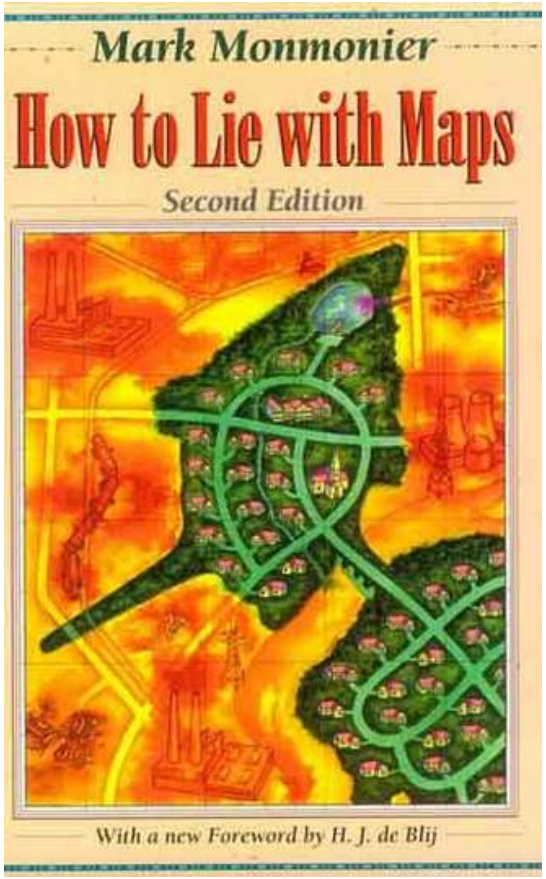
# First rule

**Know your audience.**

- Is your audience technical?
- Are they focused on policy? Research?
- Do they understand complex information?
- How will they use the maps/data?

# A word of caution

- The way that you determine the map type and legend breaks, use text and colors, and construct the layout will affect how the reader perceives the map.
- Beware of biasing the reader to promote your own purposes.



# Map elements

ESSENTIAL

1. Descriptive title
2. Well-labeled legend
3. Data source
4. Production info, date

OPTIONAL

5. Notes, as needed
6. Distance scale
7. North arrow
8. Neatline

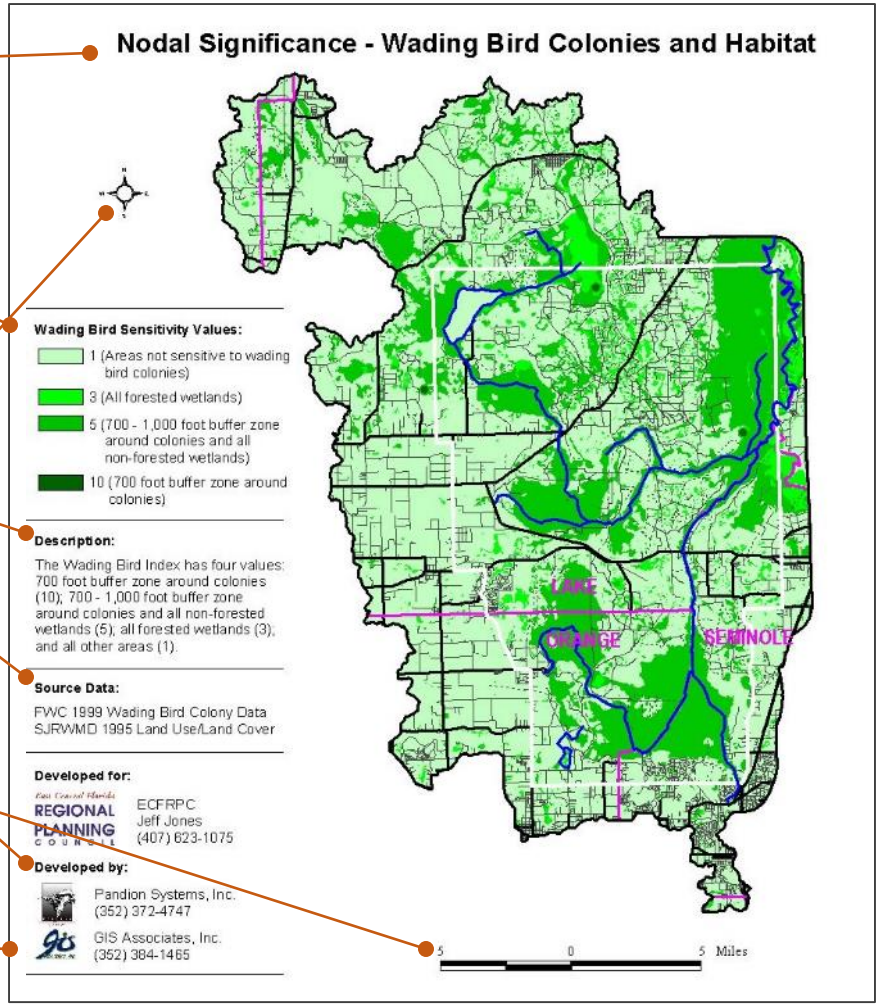
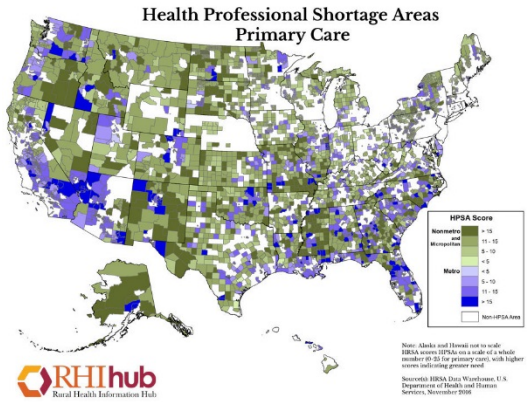



Image from http://www.gis-associates.com/images/17.jpg, accessed 4/25/17

HWTAC
Health Workforce Technical Assistance Center

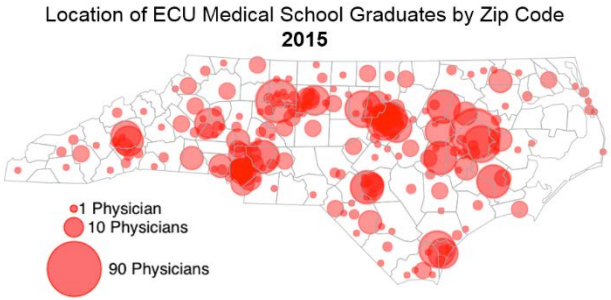
# What kinds of maps are there?

## *Choropleth*

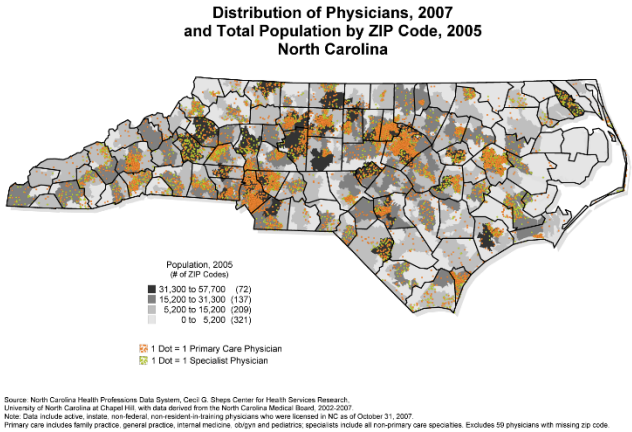



https://www.ruralhealthinfo.org/rural-maps/mapfiles/hpsa-primary-care.jpg

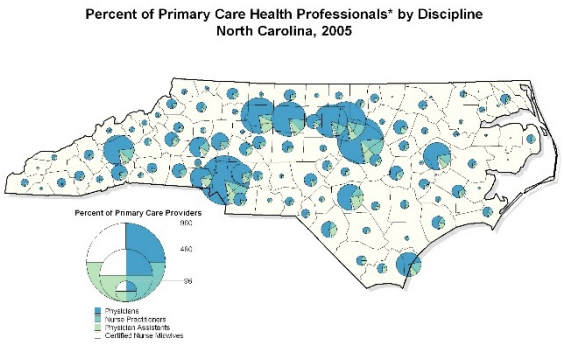
## *Graduated Symbol*



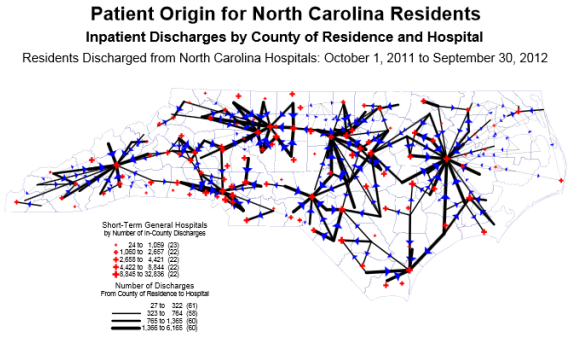

## *Dot Density*



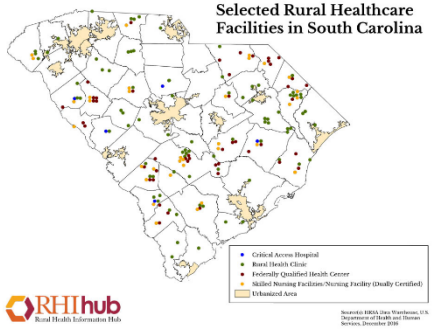

## *"Flying pies"*




## *Flow*




## *Plain Old Dots*




https://www.ruralhealthinfo.org/states/images/south-carolina-rural-health-facilities.jpg

And others…

# Different data types

- Point (*hospital*), line (*highway*), polygon (*county*)
- Data types:
  - Nominal – name or class only (*CBSA designations*)
  - Ordinal – rank only (*scale of 1-5*)
  - Interval – value on continuous arbitrary scale (*0.4 to 103.1*)
  - Ratio – value on continuous scale starting with absolute zero (*PCPs per 10K pop*)

*Examples in italics.*
See http://www.geog.ucsb.edu/~kclarke/Geography183/Lecture06.pdf as a nice summary of data types and classification

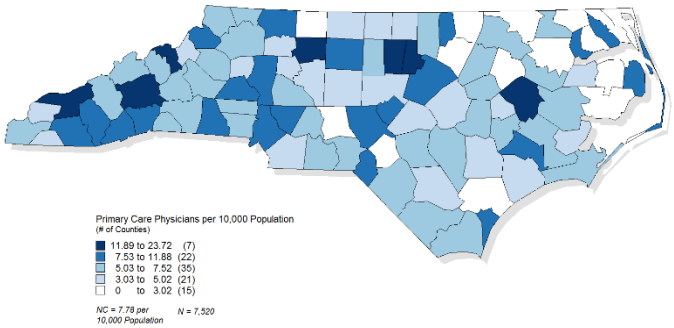
# Determining Legend Breaks

- Natural breaks
- Equal count
- Equal  interval
- Standard deviation
- Custom

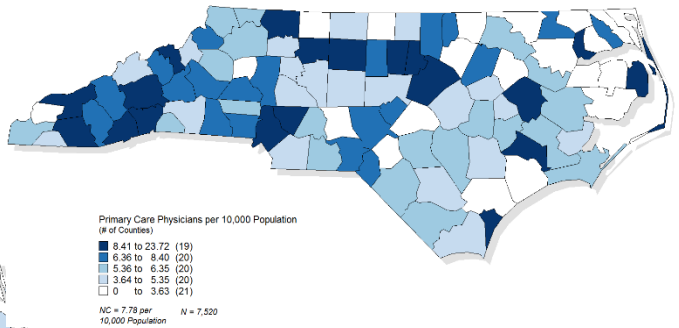
# Determining legend breaks

**Primary Care Physicians per 10,000 Population**
**North Carolina, 2011**

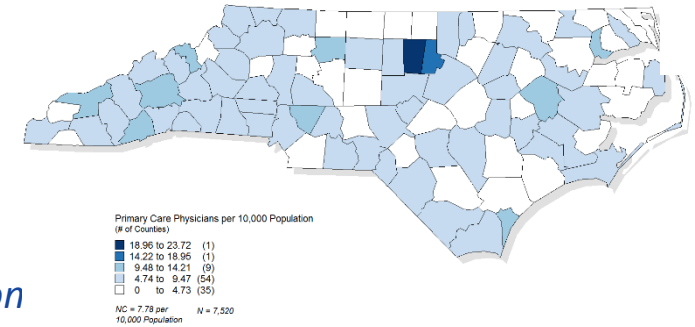
*Natural Breaks*



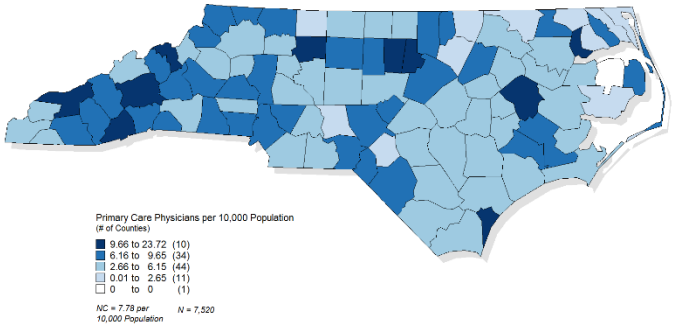

*Equal Count*



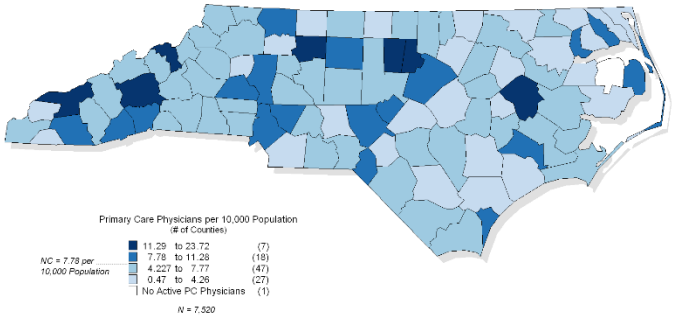

*Equal Interval*




*Standard Deviation*




*Custom*

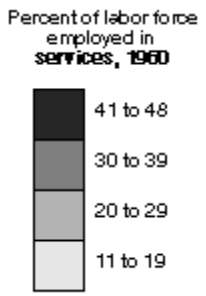



Note: Primary Care Physicians include active, instate, nonfederal, non-resident-in-training MDs and Dos licensed in NC as of October 31, 2011 who indicated a primary specialty of Family Practice, General Practice, Internal Medicine, Ob/Gyn or Pediatrics. Source: North Carolina Health Professions Data System, with data derived from the North Carolina Medical Board, 2011. Produced by: North Carolina Health Professions Data System, Cecil G. Sheps Center for Health Services Research, University of North Carolina at Chapel Hill.

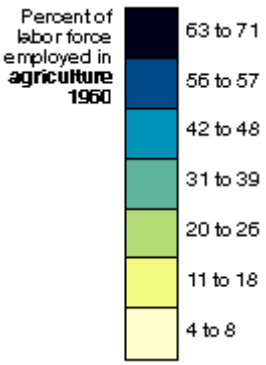
# Color options

- One shade or multi-hue, light to dark
- Diverging – e.g., orange values are negative, green values are positive values
- Qualitative – individual colors for individual values
- Two variable schemes – more complex, harder to interpret, but allows you to show "more" data

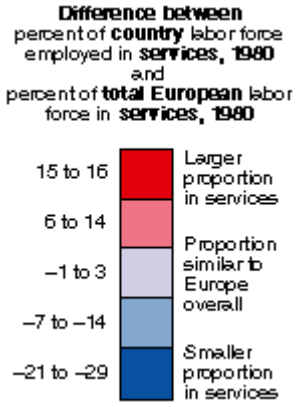
*One shade*




*Multi-hue*

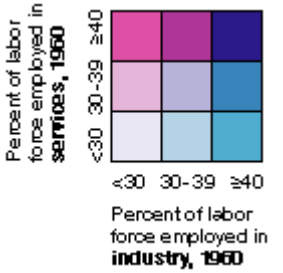



*Diverging*




*Qualitative*


*Two-variable*



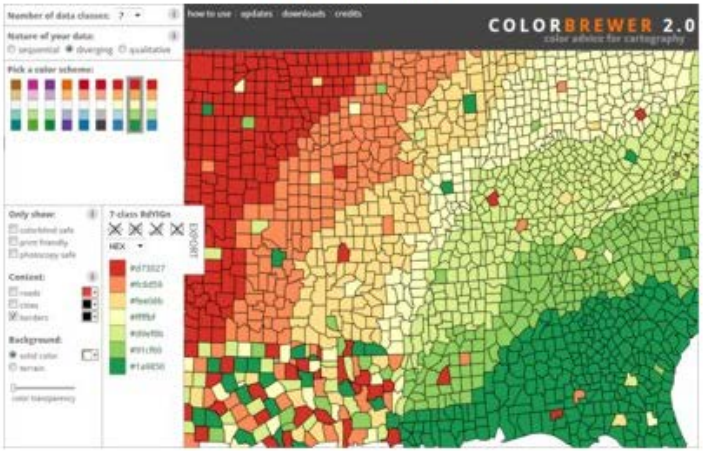

http://go.owu.edu/~jbkrygie/krygier_html/geog_353/geog_353_lo/geog_353_lo09.html, Originally accessed June 2014; as of April 2017, link was found to be defunct.

# Color pitfalls

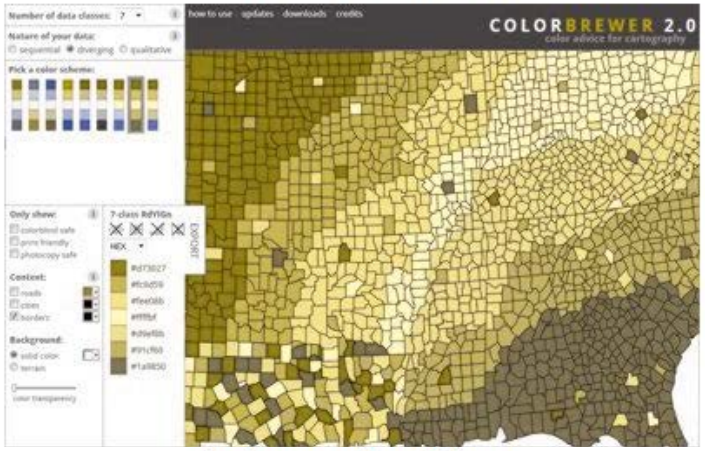
- Colors mean different things to different people
- Map format: print, PDF, projector, monitor, color vs. black and white?
- Example: diverging color ramps don't print well in b&w
- Contrast: ensure that color ranges are easily identifiable on the map. Too many ranges are difficult to interpret.
- Color blindness: avoid red/green combinations; blue and yellow less of a problem
- To see how color looks to those with color blindness: http://www.vischeck.com/vischeck/vischeckImage.php

# Vischeck example

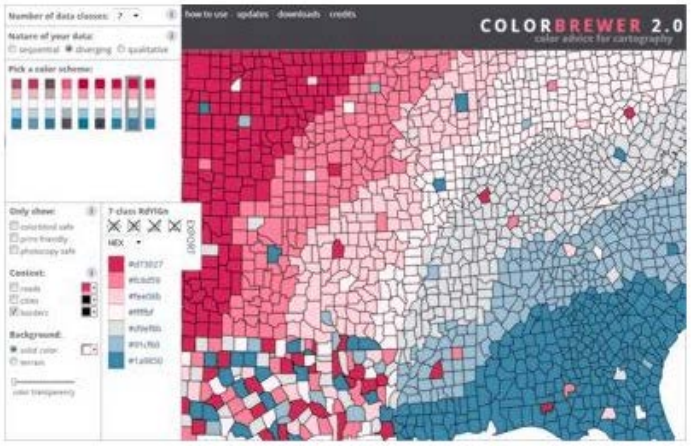
Original Image



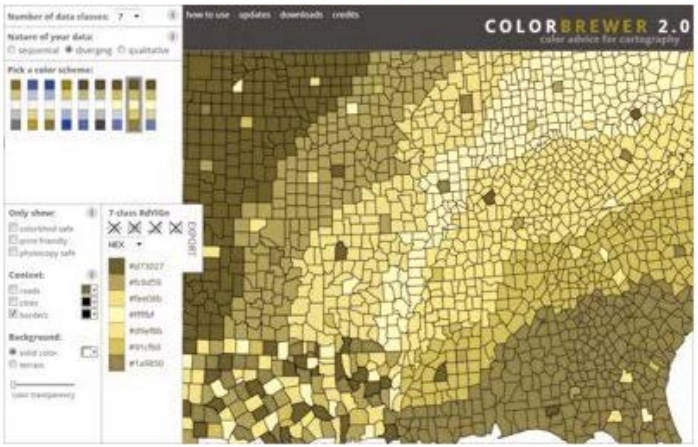

Deuteranope Simulation




Tritanope Simulation

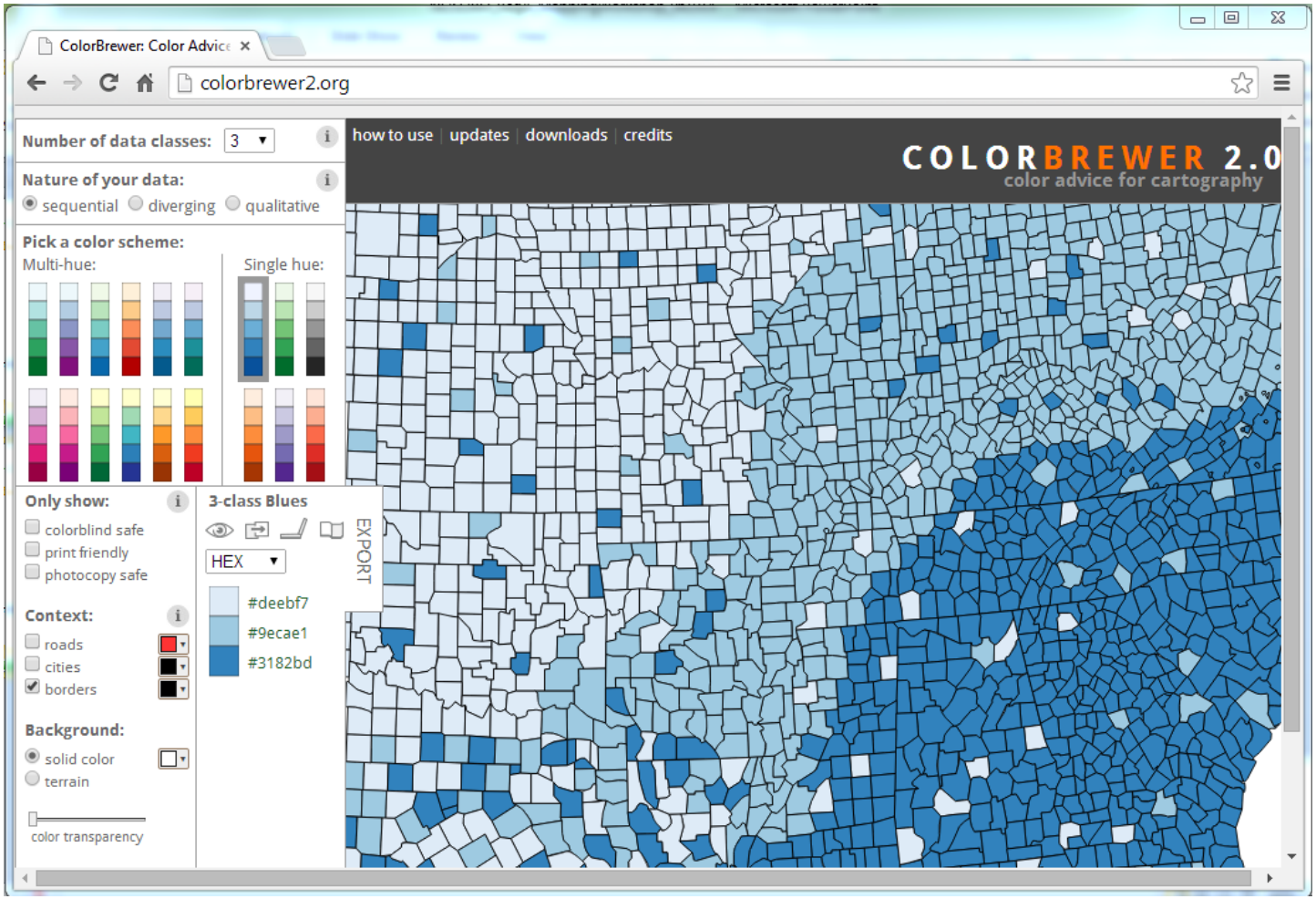



Protanope Simulation




HWTAC
Health Workforce Technical Assistance Center

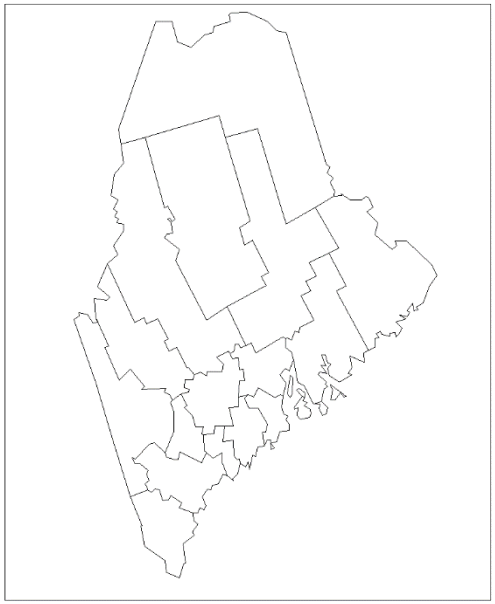
# Great color resource: http://colorbrewer2.org/



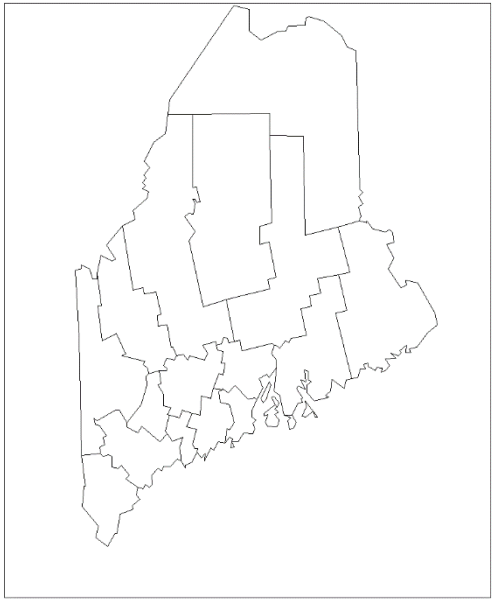
# Projections

- A projection is a way to transform the spherical earth to a flat piece of paper (or screen)
- There are many different types of projections
- Different types of projections preserve different characteristics, such as area, distance, shape
- When doing spatial analysis, including distance calculations, you'll need to choose the appropriate projection
- I prefer to use State Plane Coordinate System for state-level maps; this is personal preference

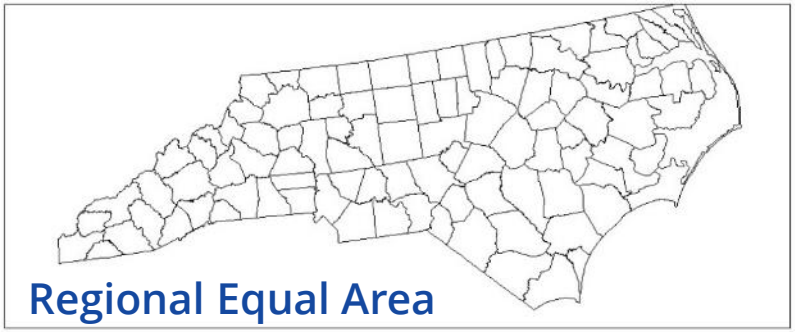
# Projections – State Plane Coordinate System

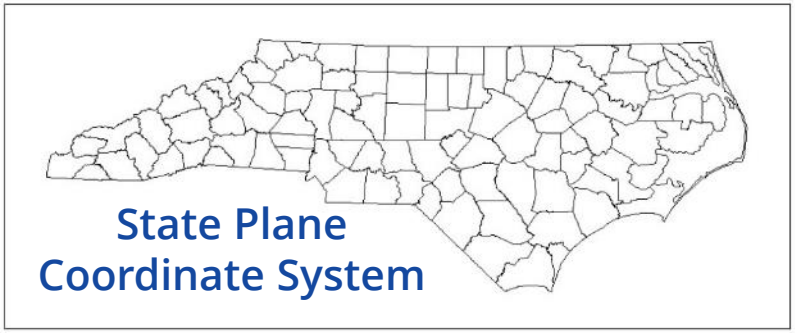


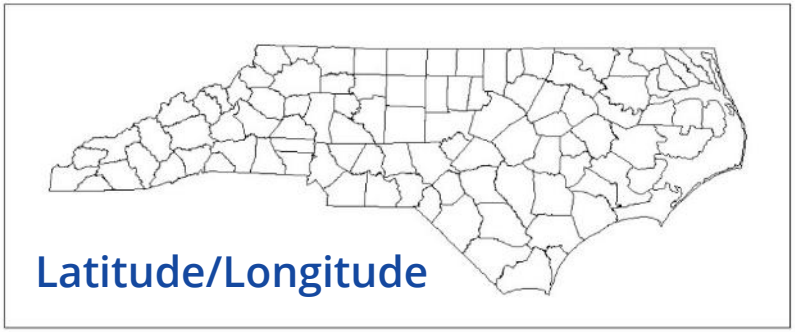
Regional Equal Area



State Plane
Coordinate System



# Dos and Don'ts

**Do:**

- Use clean fonts, no less than 6pt
- Use clear text – be succinct yet descriptive
- Use the appropriate map type, legend breaks and colors for your data and message
- Balance your whitespace
- Make sure your colors print in black and white
- Include your data source, give credit where credit is due

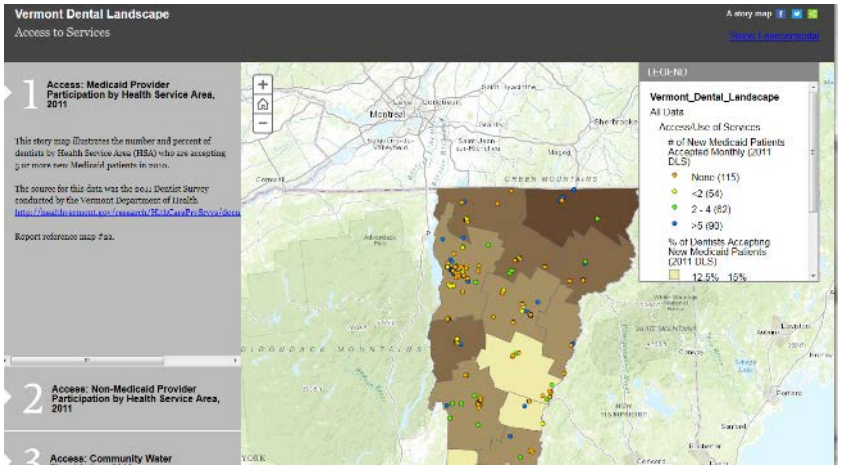
**Don't:**

- Clutter your map with unnecessary labels, text or features
- Try to load your map with too much information
- Use too many legend breaks
- Use hard-to-read fonts
- Use clashing colors
- Knowingly manipulate legend breaks and colors to influence your audience
- Plagiarize (*yes, it's a map thing too*)

HWTAC
Health Workforce Technical Assistance Center

# Engaging your stakeholders

- Well-designed maps will catch your audience's attention
- Maps are tweetable – use them to start a conversation on social media
- "Story Maps" – use the maps to tell a story and provide more context. They can add anecdotes that maps by themselves cannot convey.
  https://storymaps.arcgis.com/en/



http://vtdentalhealth.stone-env.net/Access/, accessed 4/26/17

HWTAC
Health Workforce Technical Assistance Center

# Contact info – I'd love to hear from you

**Katie Gaul**

k_gaul@unc.edu

(919) 966-6529

Health Workforce Technical Assistance Center
HealthWorkforceTA.org

UNC Program on Health Workforce Research and Policy
www.healthworkforce.unc.edu

North Carolina Rural Health Research Program
http://www.shepscenter.unc.edu/programs-projects/rural-health/