**Week 3: Nuts and Bolts of Mapping**

**Segue: Describing Conceptual Models, Evaluating and Transforming Data:**

**Transforming Geometry and Attributes to Graphics**: In the first lecture we discussed the problem of using geographic data and GIS in decision-making situations. In the first assignment you practiced describing a decision-making context and Evaluating data that represent specific, limited, elements of the decision-making situation.

Learning how to frame and re-frame a question very clearly in terms of specific elements and very-clearly described relationships is the key to understanding whether a GIS project is useful or not. Once you learn to do this, it becomes easy to develop a question that can be inveastigated productively with GIS and Geographic Data.

For the second exercise, you learned about how vector GIS feature-classes use geometry and attributes to encode and exchange observations related to things and conditions. We have gained some control over he ways that ArcGIS uses layers to transform data to graphical symbols.

This is tricky, and again very critical to understand, not merely the step-by-step technical description of how to deal with data, styling and maps, but actually HOW AND WHY it works, form a conceptual design perspective. Students who try to skip this step end up having tore-build projects at the most inconvenient times.

One more word about the **distinction between data-sets (like shape files) and layers.** The big take-away from last week is that data-Sets are dumb. Metadata is what allows us to make sense of the data – and to evaluate it for a purpose. By examining the metadata and then setting up layer properties like: Line color, Line Weight, Polygon Fills, Point symbols and labels, we add intelligence to the data. Layers are another sort of metadata. Intelligent portrayal of the data makes the data and attributes meaningful to us and to others.

**Cycle of Evaluation and Refinement:** Ironically, describing a question is most difficult aspect of the course, does not involve software. It is usually a cyclical process:

1. Describe decision-making situation, conceptually.
2. Discover a data-set that relates to one aspect of that situation. Evaluate it in terms of geometry and attributes and other concerns.
3. Explore the data-set on maps to evaluate what might be learned from it, and what its limitations may be. This understanding involves looking at specific areas that you feel may be exemplary in light of your decision-making context and exploring how the data relate to other aspects of the place (represented with other data.)
4. Refine the conceptual model to better fit the data.

**QA on Last Week's Data Wrangling Exercise Here is a sample portable GIS Project.**

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**On to Coordinate Referencing Systems!**

One bit of our framework for spatial analysis that we have not spent much time on yet is the idea of referencing systems – which are an essential aspect of how people encode observations about things and conditions. Last week, we did encounter the attribute, GRADE, uses several integer values to express the various ways that a feature from the MBTA Transit Lines layer relates to the terrain surface. This is a very simple categorical referencing system. Referencing systems are what allow us to encode observations so that we can logically associate one observation with another. In Exercise 2 we used referencing systems to transform data into graphics according to rules (layer files) carefully crafted by MassGIS. These rules use the referencing systems encoded as attributes to transform data into graphics that make meaningful associations and distinctions that people can understand just by looking.

Today we are going to carry the idea of referencing systems and graphical communication a little further. First, we are going to have to explore one of the most important types of referencing systems in geography, referencing systems for location: Latitude, Longitude, Earth Models, and Projected Coordinate Systems. These systematic 3-D referencing systems are what let us logically associate observations or ideas according to their spatial relationships with other observations. A little-appreciated but crucially important aspect of using GIS is understanding the necessity of transforming coordinate systems, so that ideas as simple as **Circle** and **Square**, **Nearer and Farther** can be expressed and communicated with predictable results.

In the second half of this meeting we are going to take control over graphical transformations – and harness them to influence the way that people understand / conceive situations. This ability to insert our ideas into someone-else's mind is a make-or-break issue in practically any social endeavor. This is going to lead us into the Elements of Cartographic Style. We will learn a simple framework for evaluating how well maps communicate – and we will learn how to fulfill these ideals using ArcMap.

1. **Coordinate Systems are the Glue in Spatially-Referenced Observations**. Transforming Coordinate Systems is Essential for making maps that can be used to compare things with regard to their sizes shapes and distance between them
    a. Different agencies encode their observations with different coordinate systems. See MassGIS Oliver Download Page
    b. Plain geographic coordinate systems (GCS) are inappropriate for making maps that have scale-bars! TO make maps responsibly, the cartographer must always deliberately choose an appropriate projection. The software wil usually make the wrong choice.
    c. ArcMap and other GIS programs will transform the spatial references of datasets to an appropriate coordinate system for the part of the world that we are concerned with.
2. The technical details of this are discussed in more detail Geographic Coordinate Systems and Projections: The Glue in GIS Data and Maps.

**Break**

- **Discuss this week's assignment: Describing a Spatial Mechaism in Context:**
- An example of this week's Project Thanks to Alex Caskey!
    - Setting the stage for a decision-making situation: think of yourself as the playwrite or narrator: Introduce the characters and their relationships. (conceptual model)
- Elements of Cartographic Style: a primer on how to evaluate and refine maps.
    - Graphical Hierarchy
    - Elements that every map should have
- Work through techniques used in this week's exercise: Nuts and Bolts of Cartography with ArcMap.