**Preview Questions**

1. How do you determine what projected coordinate system (PCS) you data is using?
2. How do you identify the units of the projection?
3. What other PCSs should I check if the standard options do not align the data?

**Reading Summary**

* The state plane coordinate system (SPCS) was designed by the U.S. Coast and Geodetic Survey.
  + It provides a standard for map projections within the United States.
  + It has a mapping accuracy of 1:10,000 within each zone.
  + Originally the SPCS was based on the North American Datum (NAD) 1927 datum and the Clarke 1866 spheroid.
* The SPCS projection for one zone should not be used for data in another zone in the same or different state.
* The SPCS FIPS (Federal Information Processing Standard) zones are defined on NAD 1983, which is based on the Geodetic Reference System (GRS) 1980.
* Most zones using the Lambert conformal conic projection have larger Left and Right extend values than Top and Bottom values.
* Most zones using the transverse Mercator projection have larger Top and Bottom extend values than Left and Right values.
* Five standard datums available for use with the SPCS
  + NAD 1927
  + NAD 1983
  + NAD 1983 (CORS96)
  + NAD 1983 (HARN)
  + NAD 1983 (NSRS2007)
  + Additional datums supported for Hawaii, Guam, and other U.S. territories
* Three units of measure can be used with the SPCS
  + U.S. survey foot
  + International foot
  + Meter
* The UTM coordinate system divides the each into sixty zones each 6 degrees wide.
  + Designated by number followed by N (north of equator) or S (south of equator).
  + Based on the transverse Mercator projection.
* UTM coordinate system also includes band designations that run east-west and measure 6 or 8 degrees in the north-south direction.
* UTM coordinate system with units of meters
  + Top and Bottom coordinates are generally 7 digits to the left of the decimal
  + Left and Right coordinates are 6 digits to the left of the decimal
* UTM can be used in conjunction with nearly any geographic coordinate system (GCS).
* SPCS is the most commonly used PCS in the United States.
  + Test SPCS options first when trying to identify the coordinate system for data.
* Determining if units of selected projection are appropriate for unknown data
  + Data draws to the northeast of where it should🡪linear units are too big
  + Data draws to the southwest of where it should🡪linear units are too small
  + Data draws a long distance to the northeast of where it should and is about three times the proper size🡪data was created with units of feet but the selected projection has units of meters
  + Data draws a long distance to the southwest of where it should and is about one-third the proper size🡪data was created with units of meters but the selected projection has units of feet
* If the state plane options do not align the data, test for UTM.
* If there is a north-south shift of about 200 meters (650 feet) between datasets, the unknown data may be on NAD 1927 instead of NAD 1983.
* Minnesota and Wisconsin have developed specific county coordinates systems for each county.
* Some states have developed specific PCS to project data for the entire state.
* Some PCS are for continent-wide datasets.
* Increasing amounts of data are being distribute on the Internet in the web Mercator projection.

**Preview Questions**

1. How do you add x,y data to ArcMap and make the data line up with other data?
2. Why are buffers created with the ArcGIS for Desktop tools oval instead of round?

**Reading Summary**

* You can identify the type of coordinate systems used to create the data by examining the extent of the data in ArcMap.
* Parameters required for all coordinate systems:
  + Name
  + Units of measure
  + Datum
* The units are angles in geographic coordinate systems.
* The units are linear units in projected coordinate systems.
* Decimal degree units are used in ArcGIS for Desktop to define the following:
  + Central meridian or longitude of origin
  + Standard parallel 1
  + Standard parallel 2
  + Latitude of origin
  + Longitude of natural origin
  + Latitude of natural origin
  + Longitude of second point
  + Latitude of second point
  + Azimuth
  + Rotation angle
* False easting and false northing parameters are provided in linear units.
  + Values will be the same units and the coordinate system.
* Geographic coordinate systems (GCS) have four components
  + Spheroid (ellipsoid)
  + Datum
  + Prime meridian
  + Units of measure
* A spheroid is a 3D shape created from a 2D ellipse rotated around its minor axis.
* A datum is the collection of points of known accuracy used to georeferenced map data.
  + Can be horizontal or vertical
* A prime meridian is a line of longitude extending north to south form North Pole to South Pole where the x coordinate in a geographic coordinate system is zero.
  + Longitudes east are positive
  + Longitudes west are negative
* A projected coordinate system (PCS) is a 2D Cartesian system that simplifies calculations of geographic features.
* A PCS is used instead of a GCS because GCS units are angles which cannot tell you anything about distance on the ground.
* PCS have four components
  + Shape (conformal)
  + Equal area
  + Equidistant
  + True direction
* You cannot have a map projection that preserves both the shape of data and distance.
  + Select a conformal projection if preserving the shape of data is most important.
  + Select an equal area projection for the data if accurate area measurements are needed.
  + Select and equidistant projection for the data if accurate distance measurements are needed.
  + Select a true direction projection to plot a course for boating for flying.
* Local coordinate systems are often used when creating computer-aided design (CAD) files.
* You can perform coordinate conversion in ArcGIS