**Preview Questions**

1. How do you open and save a map document?
2. What are map layers?
3. How do you navigate in a map document?
4. How do you measure distances?
5. What are feature attributes?
6. How do you select features?
7. How do you change selection options?
8. What are attribute tables?
9. How do you label features?

**Reading Summary**

* Layers comprise spatial vector features consisting of points, lines, and polygons.
* Each geographic feature has a corresponding data record.
* ArcMap is the primary mapping component of ArcGIS for Desktop.
* Use Customize > Toolbars option to show or hide tool icons.
* Map layers are references to vector data sources such as points, lines, polygons, raster images, etc.
* The map document does NOT contain copies of the map layers.
* Map layers files are external to the map document.
* Add map layers to the Table of Contents from their storage locations.
* When connecting folders browse to the root drive only; you can then browse to any subfolder.
* ArcMap stores a path in the map document when you add a layer.
* Relative paths do not contain drive letter names and are preferred.
* Relative paths option is found in File > Map Document Properties.
* The Catalog window is where you select GIS data for the map.
* The full extent is the view of the entire map.
* The current extent is the current view of the map.
* The Overview window shows were you are on the full map.
* Use spatial bookmarks to save a map extent for easy access.
* Map objects have coordinates which enables you to measure distances along chosen paths.
* Graphic features are connected to their data records.
* You can find features on a map using feature attributes.
* You can select one or more features in a map layer to create a subset.
* You can change the selection symbol for the entire map or for individual layers.
* Setting selectable layers avoids selecting multiple features from different layers.
* The attribute table displays the attributes of a map layer.
* The Statistics function in the attribute table provides descriptive statistics.
* Labels are derived from one or more feature attributes.
* ArcMap places labels dynamically.
* You can convert labels to graphics to edit them individually.
* Once labels are converted to graphics you can move, scale, and change them individually.

**Preview Questions**

1. What are point and polygon maps?
2. What are qualitative attributes?
3. What are quantitation attributes?
4. What are custom classes used for?
5. How do you customize colors?
6. How do you create normalized and density maps?
7. What is a dot density map?
8. What is a fishnet map?
9. What are group layers and layer packages?

**Reading Summary**

* ArcMap uses attribute values to automate drawing.
* Tabular data is classified using attributes with codes that have mutually exclusive and mutually exhaustive qualitative values.
* The first layer of a map is a reference layer.
* Use a definition query to select a subset of feature classes to display on a map.
* The human eye cannot make distinctions unless there are relatively large changes in graphical elements.
* Divide a numeric attribute into classes.
* Break values are maximum values for classes.
* A choropleth map uses color fill in polygons to represent numeric attribute values.
* Increasing color value (i.e., darkness) represents increasing or decreasing values.
* Point maps show locations of date or events using point markers.
* The point is the center of the marker.
* You can create custom classifications.
* Always type from the bottom up (e.g., right to left in an exponential long-tailed to the right frequency distribution) when typing break values for manual classification.
* You can save symbolization of a layer as a layer file (.lyr) to reuse with new data.
* ArcMap provides preselected color ramps but you can change them manually.
* The human eye can differentiate light colors more easily than dark colors.
* Normalizing data is dividing by some attribute.
* Obtain density by dividing attribute by the area of polygons.
* Dot density maps fill each polygon with randomly placed points based on the value of an attribute.
* A fishnet map overlays uniform, square polygons (i.e., cells) over the map.
  + Identically sized and shaped polygons limit perception of variation to color value only.
* Create group layers to enable or disable multiple layers at the same time.
* A layer package is one file with all data sources and symbolization included which can be shared with others.

**Preview Questions**

1. What types of output can ArcGIS produce?
2. How do you build each type of map output?
3. How can you share your maps and access shared maps?

**Reading Summary**

* Visible scale ranges for map layers enable viewing of different layers depending on how far zoomed in our out you are so that you can control the level of detail that is visible.
* Map layers do not display when zoomed out farther than the minimum scale range.
* Map layers do not display when you are zoomed in farther than the maximum scale range.
* To set the scale range, right click on the map layer.
* Turn off attributes that are not relevant to the analysis.
* Attributes should have plain English names.
* Map tips are attributes that display in a small window when you hover over a feature.
* Turn map features into hyperlinks by turning on the attribute with the URL website address or entering the URL address manually.
* Save a layer file to allow easy reuse of numeric scales.
* Turn on snap elements such as guides and grids by right clicking outside the layout to access the Layout View tab.
* Create guidelines by using the vertical and horizontal rulers.
* Reuse a custom map layout to save time and achieve consistency across maps.
* Turn labeling off to speed up processing when working in Layout View.
* Use the Insert menu option to add certain map elements such as legends, titles, subtitles, etc.
* To create a map with the same layout, copy and paste the dataframe.
* To modify a legend created in ArcGIS, convert it to a graphic.
* To create graphics for a map layout, use the Create Graph Wizard by going to View > Graphs > Create Graphs.
* To build a map animation:
  + Set time properties of the layer.
  + View using the Time Slider window to play a simple video.
  + Add a new date column to create a display a moving window of data.
  + Set the advanced time properties of the layer.
* You can store, share, obtain, and use map layers at ArcGIS Online ([www.arcgis.com](http://www.arcgis.com)).
  + Free public accounts with 2 GB of free storage
  + Integrate maps you create with Esri-supplied and user-supplied map layers
* Two formats for vector map layers
  + Compressed (zipped) shapefile for any kind of vector map layer
  + Comma, semicolon, or TAB separated text files for points that include latitude and longitude coordinates
* Files making up the shapefile must be at the root of the compressed file and not in a folder.
* In Windows Explorer
  + select the files making the shapefile
  + right-click the selection
  + click Sent To
  + select compressed (zipped) file
* ArcGIS.com is also a repository of spatial data.
  + Maps from partners’ sources
  + Maps from the GIS community at large
* Join groups or create your own groups to share maps on ArcGIS.com.
* Free ArcGIS maps are available from Google Play, etc.

**Preview Questions**

1. How do you build file geodatabases?
2. What are ArcCatalog utilities?
3. How do you modify attribute tables?
4. How do you join tables?
5. How do you aggregate data?

**Reading Summary**

Building a File Geodatabase

* ArcGIS can directly use or import most GIS file fomats.
* The file geodatabase (.gdb) is the recommended native file format for ArcGIS.
* A file geodatabase is a collection of files in a file folder.
  + Provides structure and organization for spatial data.
* ArcCatalog is a special utility program that is required to build file geodatabases.
* The Catalog window in ArcMap allows you to do most utility work while in ArcMap.
* Feature classes are map layers stored in a geodatabase.
* You can import shapefiles into a file geodatabase.

Using ArcCatalog Utilities

* Use Preview first to get an overview of a feature layer or table.
* Must use ArcCatalog for file management, including renaming and copying items.

Modifying an Attribute Table

* Most of what gets displayed in a GIS depends on attribute table values.
* Delete attributes that are unnecessary from the user’s point of view.
* It’s often necessary to join two tables into a single combined table.
* Text data is left-aligned and numeric data is right-aligned.
* When joining data, create a numeric version of the text data being used as the identifier.
* Use selection to avoid unwanted data, particularly when creating new variables (i.e., columns).

**Preview Questions**

1. Where do you obtain certain data for creating geodatabases?
2. How do you download the data?
3. How do you clean the data?
4. How do you join data from multiple tables?
5. What are the limitations of ArcCatalog?

**Reading Summary**

Downloading and processing Census SF 1 data tables

* The American FactFinder website ([www.factfinder.census.gov](http://www.factfinder.census.gov)) maintained by the U.S. Census Bureau provides tabular census data with geocodes for joining to census boundary maps.
* Summary File 1 (SF 1) data provides basic data on populations, housing units, and households.
* SF 1 is available for all census levels.

*Process data in Microsoft Excel*

* Use Microsoft Excel to clean up the census data before using it in your GIS.
* Text fields are left-aligned.
* Numeric fields are right-aligned.
* To join data sets you might need to convert the field used as the identifier in one of the tables from number to text.

*Import files into a file geodatabase*

* Import features and tables to the geodatabase before adding or editing attributes.
* You cannot directly edict Excel spreadsheet attributes in ArcMap.
* ArcMap cannot accept column names with imbedded blank spaces.

Downloading and processing American Community Survey Census data

* To obtain more detailed data on various attributes such as education, income, transportation, etc., download estimates from the American Community Survey (ACS) compiled by the U.S. Census Bureau.

*Process data in Microsoft Excel*

* Again, use Microsoft Excel to clean up the census data before using it in your GIS.
* Delete unnecessary data columns.

**Preview Questions**

1. How do you join tables?
2. How do you create centroid coordinates in a table?
3. How do you aggregate data?

**Reading Summary**

* Joining table data to a feature class uses the same steps for shapefile map layers and other map layer formats.
* Right-click the layer > Joins and Relates > Join
* The centroid of a polygon is the point at which the polygon would balance on a pencil point if it were cut out of cardboard.
* Use centroid to display two attributes of the same map layer in the same map.
* When you export joined tables as a table you get all the attributes of the joined table stored as one table permanently.
* Basic workflow for aggregating data:
  + Join a code table to all points.
  + Apply a definition query.
  + Use a spatial join to count items.
  + Use the results to create a choropleth map.
* A spatial join of a polygon layer with a point layer produces statistics by polygon for the points.

**Preview Questions**

1. What is metadata?
2. What are world projections?
3. What are US projections?
4. What do systems of projections do?

**Reading Summary**

* Metadata is documentation of spatial data to facilitate its interpretation and proper use.
* ArcGIS metadata is described in a metadata file that can be accessed with ArcCatalog.
  + Customize > ArcCatalog Options > Metadata tab
* Two types of coordinate systems:
  + Geographic coordinate system
  + Projected coordinate system
* Geographic coordinate systems use longitude and latitude coordinates for locations.
* Projected coordinate systems use a mathematical transformation to locate places on a sphere to on a flat surface using rectangular coordinates.
* Geographic coordinate systems may use decimal degrees which are angles of rotation of the Earth’s radius from the prime meridian at the equator.
* Geographic coordinate systems create large distortions when viewed on a flat surface.
* For most GIS applications you should use an equal-area projection of a large area.
  + Produces accurate areas of polygons
  + Enables calculations and produces accurate population densities
* There are collections of projections for medium and large-scale maps that have localized projections tailored to a specific study area, which have little or no discernable distortion.
* State Plane Coordinate System is NOT a projection; it divides the U.S. into more than 124 numbered zones each with its own tailored projection.
* The first map layer added to a map document sets the coordinate system and projection for the data frame as a default.
* ArcMap re-projects all map layers to the data frame projection on the fly.
* You can change the data frames projected coordinate system:
  + Right click the data frame > Properties > Coordinate System tab
* All GIS layers should have a coordinate system and projection defined; however, this is not always the case and you made need to assign this information.
* In a shapefile , .prj file contains the coordinate system and projection information.

**Preview Questions**

1. How do you use attribute and spatial queries to extract features?
2. How do you clip features?
3. What does it mean to dissolve features?
4. How do you merge features?
5. What are intersecting layers?
6. What are union layers?
7. What does ModelBuilder do?

**Reading Summary**

* Use ArcMap geoprocessing tools to study one specific area in detail.
* Two methods for creating study area features on one specific region:
  + Select by attributes
  + Select by location
* Use the Clip geoprocessing tool to cleanly “cut off” a specific region for a study area.
  + Use for display purposes only.
* Use the Dissolve tool to create administrative or other types of boundaries.

**Preview Questions**

1. How do you merge two or more separate but adjacent layers into a single layer?
2. How do you create a new feature class combining all the features and attributes of two input, overlaying feature classes?
3. How do you create a new feature class that combines the geometry and attributes of two input polygon layers to generate a new output polygon layer?

**Reading Summary**

* Use Geoprocessing > Merge function to merge several feature layers into one feature class.
* Use Geoprocessing > Intersect function to create a new feature class combining all the features and attributes of two input, overlaying feature classes.
* Use Geoprocessing > Union function to create a new feature class that combines the geometry and attributes of two input polygon layers to generate a new output polygon layer.

**Preview Questions**

1. How do you digitize polygon, line, and point features?
2. How do you add attribute data for vector features?
3. What are editing tools?
4. How do you spatially adjust features?

**Reading Summary**

* Digitizing a polygon feature means creating a new polygon class and then adding features.
* Process entails:
  + Creating a new polygon feature class in a geodatabase
  + Editing with the Editor toolbar
* You can move a polygon.
* You can delete a polygon.
* You can edit a polygon vertex points:
  + Add vertex points
  + Move vertex points
  + Delete vertex points
* You can digitize zones.
* You can edit feature attribute of digitized zones.
* You can label a digitized zone.
* Digitizing line features entails using existing line features as a base layer.
* Setting endpoint and vertex snapping makes digitizing line features easier.
* You can digitize point features.
* You may need to run off snapping when digitizing point features.
* Advanced editing tools affect the shape of digitized polygons and include Trace, Cut Polygons, Smooth, Generalize, and Rotate.
* Trace is a quick way to create new segments that follow the shape of other features.
* Cut Polygon creates two polygons from one original polygon.
* Smooth eliminates sharp angles in polygon outlines.
* Generalize creates features at small scales with less detail but preserves basic shapes.
* You can digitize features by specifying an exact length and angle.
* Spatially adjusting features allows you to transform, rubber sheet, and edge match features.
* Use the transformation tool to align a feature.

**Preview Questions**

1. What is geocoding?
2. How do you geocode by ZIP code?
3. How do you geocode by street address?
4. How do you correct address data interactively?
5. How can street map layers improve geocoding?
6. What is an alias table?

**Reading Summary**

Geocoding data by ZIP Code

* Geocoding is plotting address data as points on a map.
* Geocoding by ZIP Code is common because the data is often available.
* ZIP Code areas lack underlying design principle which often makes interpretation of results limited.
* Process
  + Create an address locator
  + Geocoding function is accessed through the path Customize > Toolbars > Geocoding
  + Count geocoded records by ZIP code to get a better understanding of the output
  + Fix and rematch ZIP codes

Geocoding data by street address

* Incorporate ZIP codes because some addresses may have the same house number and street name but be located in different ZIP codes, which frequently happens in study areas that cover multiple municipalities.
* Process
  + Create an address locator for streets with a zone
  + Test locator with the Find tool to locate individual addresses
  + Geocode address data to streets

Correcting source addresses using interactive rematch

* Some addresses may not match because of spelling errors, omissions, etc.
* Making corrections depends on your knowledge of the local streets and addresses
* Process
  + You can correct input addresses by using the Geocoding > Review/Rematch Addresses
  + You can correct addresses by pointing on a map

Correcting street reference layer addresses

* Find and fix incorrect addresses in a reference street layer used for geocoding.
* Process
  + Create an address locator for the layer
  + Geocode addresses to the layer
  + Use Review/Rematch Addresses to identify problem street segment records
  + Edit the street record
  + Rebuild the address locater
  + Rematch interactively using edited street segment

Using an alias table

* Alias tables are used to geocode records that are identified by their landmark name rather than their street address (e.g., “White House” vs. “1600 Pennsylvania Avenue NW, Washington, D.C. 20500”)
* Use the Add Data button to add the table to the geodatabase with the address locator
* Link the alias table to the address locator through the Properties panel of the address locator