I. Goal

Use the digital data collected at Finny to create a geologic map and interpret lithologic unit boundaries and faults.

Display your digital data in a 3D context.

II. Create a Geologic Map

Add Pertinent Data

1. Double-click on the data frame title in the table of contents and change the name to "Finny" (Figure 1). Right-click and choose properties. In the data frame properties box choose the coordinate system tab (Figure 2). Set the coordinate system. Under 'select a coordinate system:' browse to the Irish National Grid (Predefined _ Projected Coordinate System _ National Grid _ Irish National Grid). Click OK.

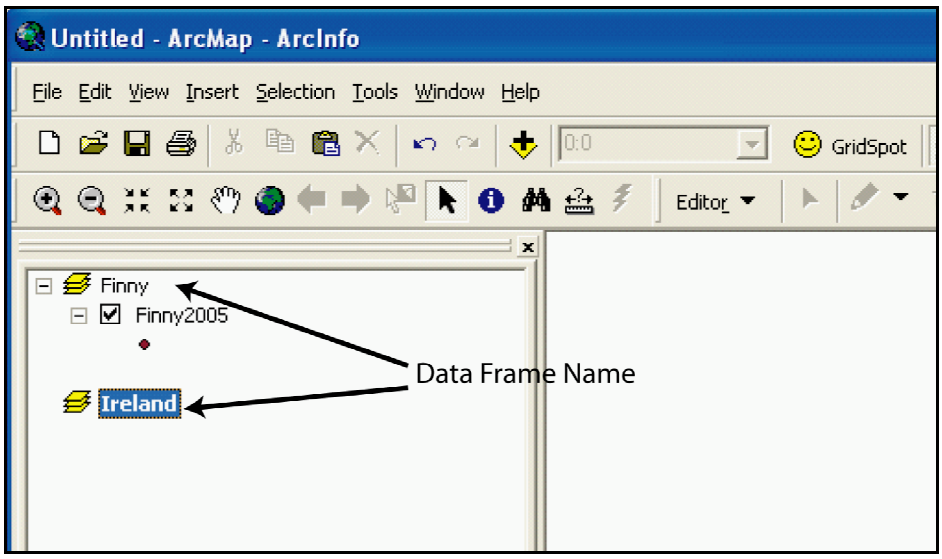

Figure 1. ArcMap Data Frame

2. To this data frame add your data, finny<group>.shp. Use the '+' button to add the data.

3. Add some background data to place your data in its regional context. You can add Finnyfence, Finny map.jpg, and/or Finnyairphoto, which are the fence map, topo map, and the satellite photo respectively. You may also want to add the GSI map that you worked with yesterday.

4. Add a second data frame. Go to insert _ data frame. Double-click on the name of the new data frame in the table of contents and rename it "Ireland." Only one data frame will be active at a time. To switch between data frames highlight the frame you want to work with, right-click and then scroll down to activate. The title of the active data frame will be displayed in bold face type. The Ireland data frame will provide a locus map for your layout. Remember to set the coordinate system for the second data frame. Use the Irish National Grid again.

5. Add Coastlines.shp to the Ireland data frame

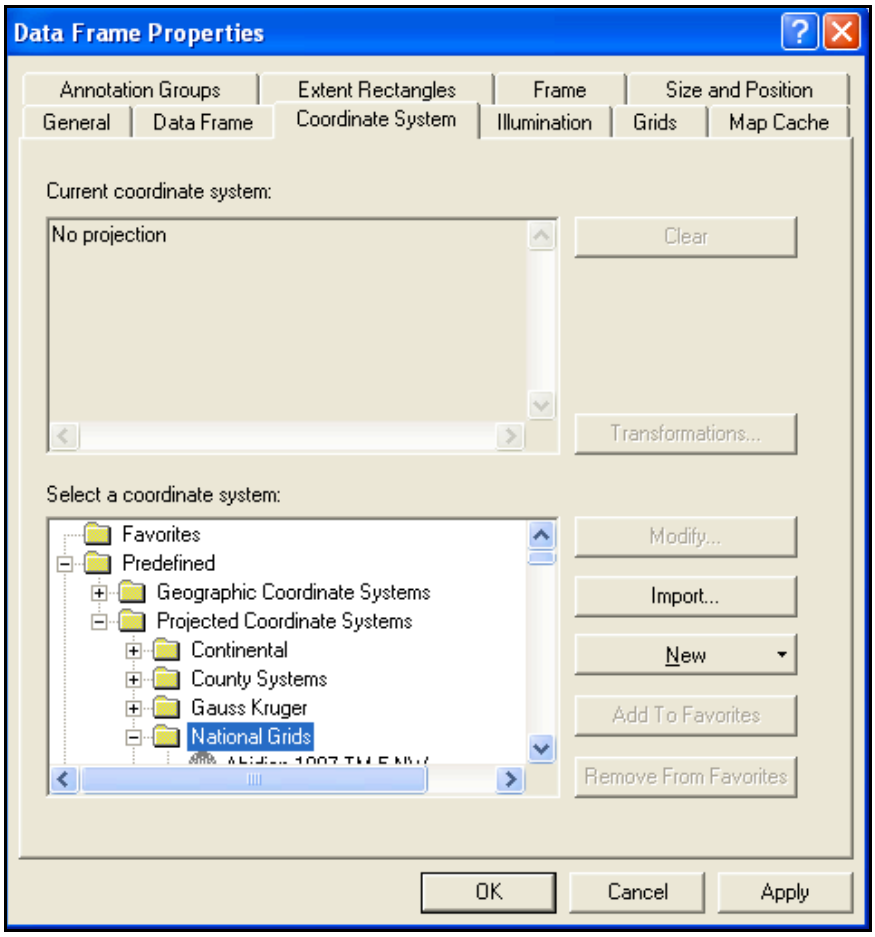

Figure 2. Data Frame Properties

Symbolize Data

Symbolizing features means assigning them colors, markers, sizes, widths, etc. It is important to make these choices carefully so that your map is legible and useful.

1. First, choose an outline color for the map of Ireland. Remember to activate the Ireland data frame. In the table of contents, double-click on the line symbol for the coastlines to open the symbol selector. From this interface you can define the color and line width of the coastline or choose one of the predefined styles. Choose a style and then return to the Finny data frame.

2. The Finny shapefile will be more complicated to symbolize because we'd like to use a strike and dip symbol but some of the data points have no strike or dip value. To work around this we'll copy the Finny shapefile so there are two Finny layers and then symbolize one with strike/dip and one without strike.

3. Highlight the Finny layer in the table of contents, right click, and copy the layer.

4. Select the Finny data frame and paste the layer into the data frame by right-clicking and choosing paste.

5. First symbolize the layer without strike/dip. Double-click on the Finny layer to call up the layer properties. Select the Define Query tab. Here we will select only the data points without strike. Click the query builder button (Figure 3). Reselect all the data points with a strike equal to zero. Double-click on the field name (STRIKE), single-click on the logical operator (=) and then type a zero. Your string should look like this "STRIKE" =0. Click OK. Now this layer will display only data points without a strike.

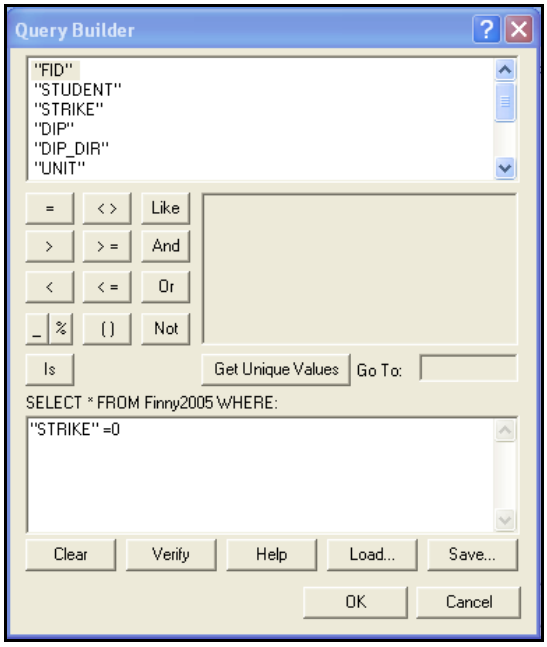

Figure 3. Query Builder

6. In the layer properties box tab over to symbology. On the left-hand side under the heading 'show' choose categories and then unique value. Under value field choose unit. Add your unit classes by clicking 'add all values' on the bottom of the dialogue. Now you should see your units listed. Click off the top symbol <all other values>. To set the symbol for each unit double-click on the symbol next to each field value. Choose a point, color, and point size for each unit. When you are done, click OK.

HINT: While bright colors look nice you might be printing in black and white. Try to choose shades that will look nice in black and white or color. You might also choose bold colors now to help with the analysis in the next section and then revert to grays and black before you print. You might also try different shapes for each unit.

7. Now symbolize the other Finny layer. Follow step five but this time select those data points with a strike greater than zero.

8. Tab over to the symbology page. Again, select unique value and set the value field to be unit. Turn off (unclick) the <all other values> class. Double-click on the symbol next to your first unit. Instead of a point we will use a symbol that looks like the strike-dip symbol. Go to properties (Figure 4). Property type should be character marker symbol. Under font scroll down to ESRI Geology USGS 95-525. Go to the symbol in the eighth row and third column. It should look like a strike/dip symbol. Set the angle to -90. The unicode for the symbol is 111. Choose the color that correlates to the color you chose for

the same unit without a strike. Click OK to get out of the symbol properties box and the symbol selector. Repeat these steps for each unit.

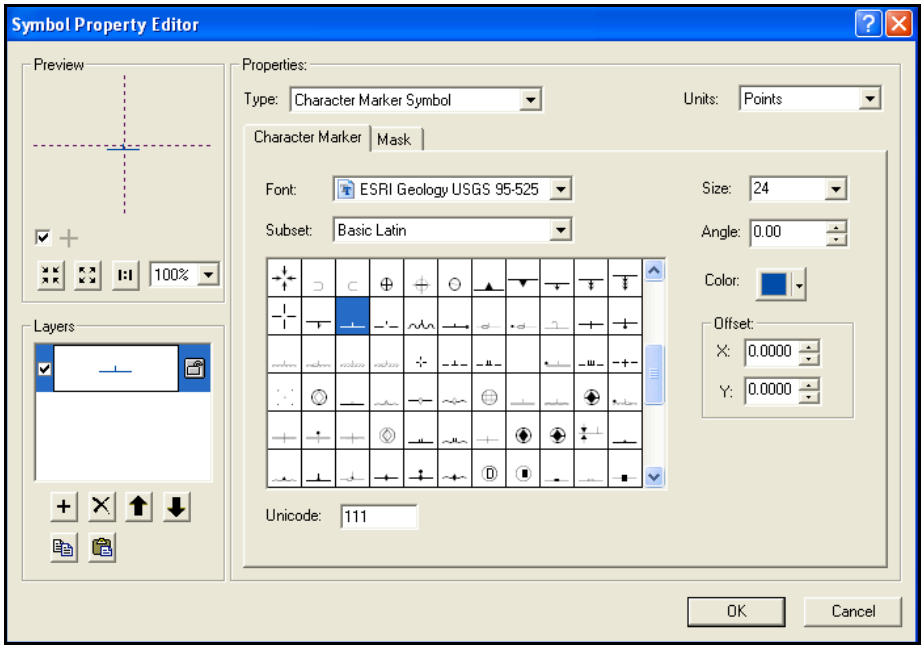

Figure 4. Symbol Property Editor

9. Click the advanced button, on the bottom right, to choose a rotation angle for the symbol. This allows you to rotate that symbol by a value in the attribute table. Use the strike field to rotate the symbol. Rotation style should be geographic.

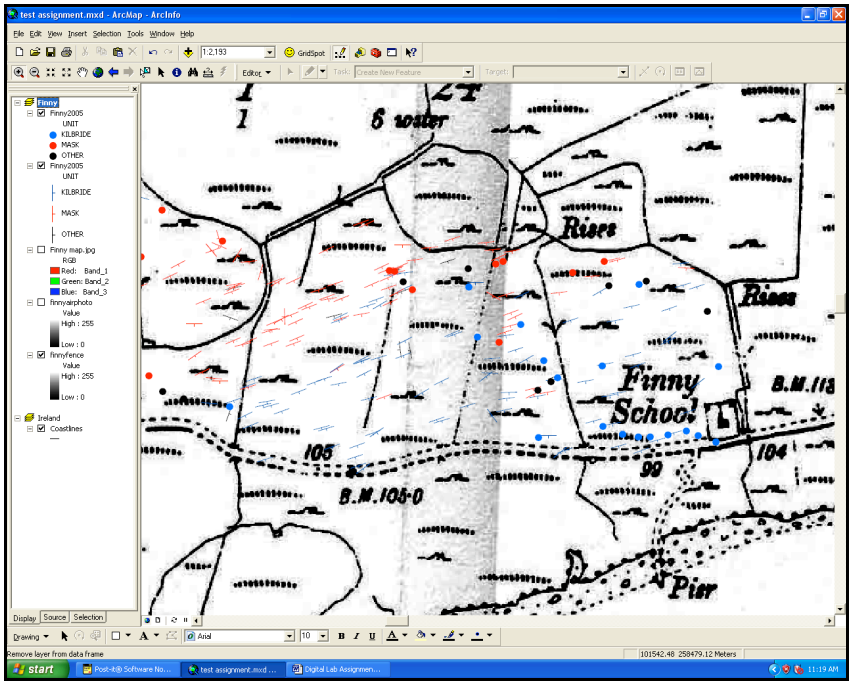

Figure 5. Your map should look similar to this before moving on. Expect some variation because this map is based on last year's data.

Add Faults and Contacts

Now that you have symbolized your data coherently it is time to analyze it. The goal of this analysis is to interpret the location of lithologic boundaries and faults. The boundaries and faults should be illustrated on your map as graphic lines (as apposed to a feature). These lines can be draw using the drawing tools. These tools are found on the bottom of your screen and function similar to those in other Microsoft products (Figure 6). Choose a line type for the faults and boundaries that is similar to those found on a USGS map. To change the line type double-click on the line, then click change symbol, in the symbol selector dialog choose more symbols and select Geology 24K. The new line symbols will be displayed after the default symbols.

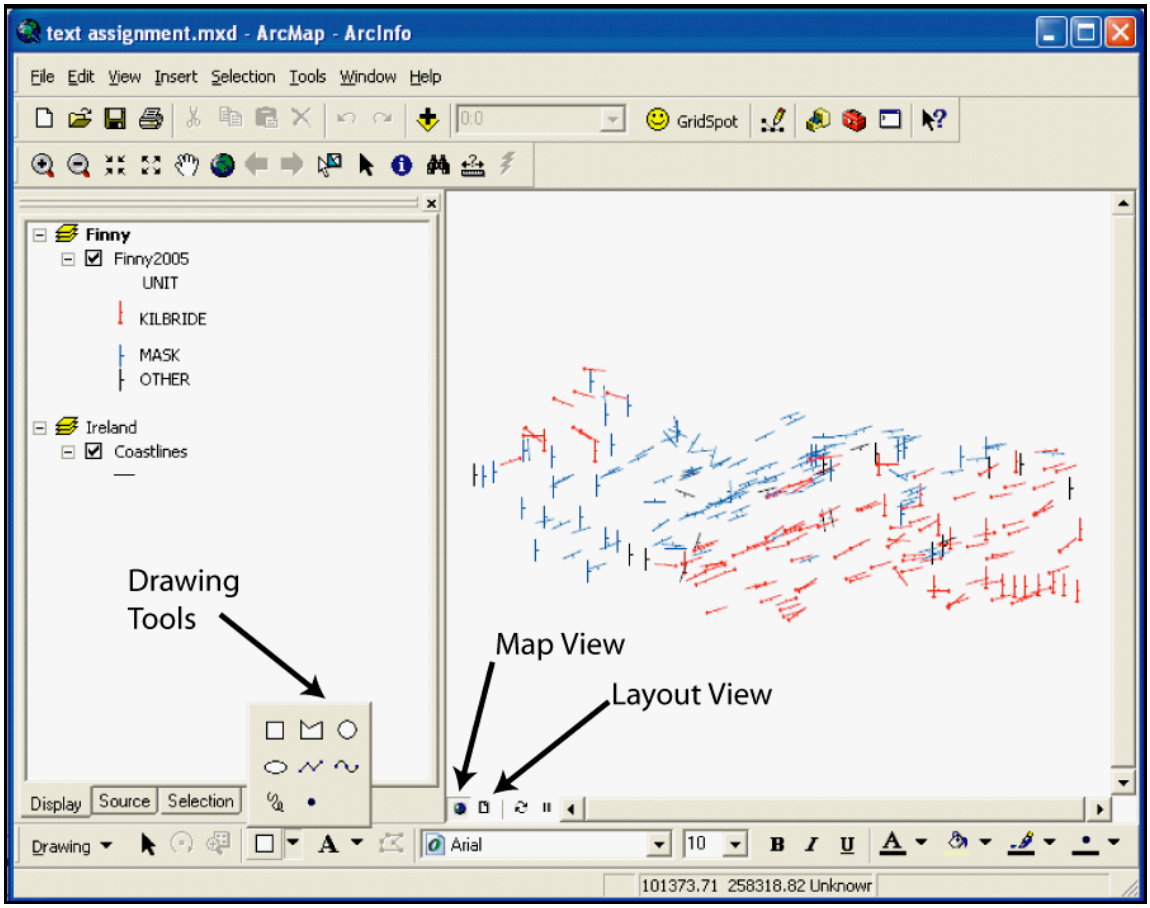

Figure 6. Drawing Tools

Create a Professional Looking Layout

Thus far you have been working in data view. ArcMap has two views, data view and layout view. Data (or map) view is where you work with your geographic data and layout (or paper) view is where you create a layout (i.e. - design a paper map). You can change the view by toggling between the globe and paper button on the bottom of the screen (Figure 6).

1. Switch to the layout view and you should see the two data frames on the paper. They will likely be overlapping. Use your mouse to resize and position the data frames. If you

would like to position the data frames precisely select the object, right-click, choose properties, select the size and position tab and then you can edit those properties exactly.

2. To each data frame you will need to add a scale bar and north arrow. Both can be added by selecting the desired data frame and then go to the insert menu and select north arrow/scale bar. By double-clicking on either object you can adjust its properties. To create a scale bar with units you must have the units set for the data frame properties

3. The map extent displayed in the layout may need to be adjusted. To do so use the zoom tools that you used while working in the map view. The zoom tools on the layout toolbar are used to move the layout, the paper (Figure 7).

Figure 7. Layout Toolbar

4. There are two data frames on your layout, one frame displays the data you collected at Finny and the other is the boundary of Ireland. It would be useful to locate Finny on the country map. Select the Irish map, right-click, choose properties, and then select the 'extent rectangles' tab. Here you will see the Finny data frame listed on the left. Select the data frame and then click the right-arrows (>) to move the data frame to the right under the heading 'show extent rectangles for these maps.' On the far right you can choose to locate Finny with a frame or a leader. Choose which ever looks best with your layout. Since the Finny map extent is so small it is difficult to see on the national map. Use some graphics to make it clear where Finny is.

5. Finally, you must add a legend. Select the Finny data frame and the click the insert menu and select legend to open the legend dialogue. By default the legend includes all layers from the map. To remove a layer select it and click the left-arrow (<). Proceed through the wizard to set up the legend. The headings and labels in the legend can be edited in the table of contents. At this point the legend is linked to your data frame so if you change anything in the data frame, i.e. the symbology, it will be reflected in the legend.

6. The faults and boundaries do not appear in the legend because they are graphics not features. To add these items to the legend we will convert the legend to a graphic feature and add the faults and boundaries. Do not do this until you are satisfied with your symbology because once the legend is converted to a graphic feature it will not be linked to the layer symbology and will not automatically update if you change something. To convert the legend to a graphic select the legend, right-click, and select convert to graphic. To edit the object, ungroup the graphic first. Select graphic, right-click and select ungroup. Now use the graphic tools to edit the legend and add in the faults and boundaries.

Does your map display the information you would like it to? If not, think about what else you'd like to edit to make it clear. Ask the instructors for help or suggestions. When you are satisfied with your map print it out. This will need to be handed in.

III. Explore your Data in 3D

Thus far you have worked been working in 2D. Now, let's explore your data in 3D with ArcScene.

1. First, make a 3D surface. Add 1024_c.shp to your Finny data frame. This shapefile contains points with elevation values. Right click on 1024_c and open the attribute table, notice that the columns are x, y, and z. These fields are your easting, northing, and elevation, respectively. The elevation is meters above msl. You need the 3D Analyst toolbar to make a TIN (Figure 8). If you do not see this toolbar, right-click on a gray area on the top of the screen and choose the 3D toolbar.

Figure 8. 3D Analyst Toolbar

2. Open the pull down menu under 3D analyst (Figure 9). Chose 'Create/Modify TIN' and then 'Create TIN from Features.'

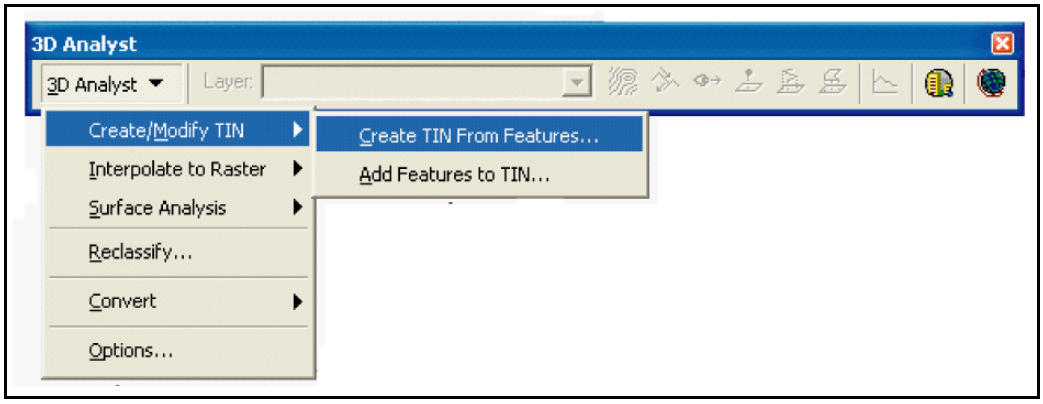

Figure 9. 3D Analyst Pull Down Menu

3. Under layers check 1024_c.shp. On the right-hand side, the height source: z, triangulate as: mass points, and tag value field: <none>. At the bottom chose a folder and name for the newly created TIN. Hit OK.

4. Edit the symbology of the TIN if you would like and then save the TIN as a layer file. Highlight the TIN, right-click and chose save as layer file. This saves the symbology so that it can be imported into ArcScene. If you do not save the TIN as a layer file the TIN will be one solid color in ArcScene. Since the display in ArcScene is 3D you will see relief as shadows even if the TIN is one color.

5. Open ArcGlobe, Start_All Programs_ArcGIS_ArcScene.

6. Add your Finny data and the TIN to ArcScene. Be sure to add the TIN layer file (*.lyr) not the actual TIN. The TIN is imported with relief because it is a 3D feature.

7. The height value for your Finny shapefile has to be set. Select the Finny shapefile, right-click and chose properties. Select the 'Base Heights' tab. Under the height section, choose 'obtain heights for layer from surface.' The TIN should be the chosen surface.

At the bottom of the dialogue choose a small offset for the data points. This will assure that the points are drawn on top of the TIN, not just below it where they will not be seen. One meter would be a good offset. Click OK.

8. The scene can be vertically exaggerated to enhance the relief. Highlight the data frame, right-click, choose scene properties, and navigate to the general tab. Here you can automatically calculate the vertical exaggeration or set it yourself.

9. The symbology of the Finny shapefile can be edited through the layer properties, the same way as in ArcMap. The strike/dip symbol can not be used in ArcScene because it is a 2D symbol not a 3D symbol. Choose from the symbol sets that are 3D.

10. To navigate around the scene use the navigation tools. The navigations tool () can be used to pan/rotate with the left mouse button, zoom in/out with the right mouse button.

IV. Assignment

Each group should hand in the following:

1. Lithologic description

2. **Both** geologic maps that you produce in the Galway GIS lab

3. Memoir: Provide a geologic explanation for the evolution of the Finny region. Explanation should be no longer than 1 page. Please use references if appropriate.