ARCVIEW SUPPLEMENT
_____

SECTION 1
What is ArcView?

ArcView is a vector based GIS software package, with raster viewing capabilities, distributed by ESRI (Environmental Systems Research Institute) in Redlands, California. It is a desktop display and query tool that has some spatial analysis capabilities. Data cannot be created in ArcView, but rather in ESRI's original software, Arc/Info.

Lecture has taught you that in GIS there are two common ways to model the world, **raster** and **vector**. The previous labs have dealt with the raster model and the following labs will deal with the vector (or object) based model. Vector GIS stores the geometric description of an object (point, line, or polygon) and its location separately from a table of its attributes. The table of attributes contains fields (-#, -id, etc...) which are pointers to other tables that contain the description and location of an object (or feature). The rest of the columns in the table contain tabular data (demographics, soil type, flow rates, date, etc...) pertaining to each feature.

With ArcView a user can perform the following tasks:
- Display spatial data, Arc/Info data and other data formats
- Display tabular data on a view
- Use SQL (Standard Query Language) to retrieve records from a database
- Geocode tables containing addresses and display them
- Find attributes of any feature on a view
- Classify features with different symbols
- Select features according to their attributes
- Create charts showing the attributes of features
- Summarize the attributes of features
- Select features based on their proximity to other features
- Find places where certain features coincide
- Layout a map and print it.

SECTION 2
Data that can be used in ArcView

Data that describes the Earth's surface or the features found on it are called geographic data. This includes not only cartographic and scientific data, but also business data, land records, photographs, customer databases, travel guides, legal documents etc. Geographic data from a variety of sources can be used in ArcView.

Spatial Data stores the geometric characteristics and location of geographic features. Attribute information related to the geographic features describe what these features represent.   Spatial data are called **themes** in ArcView and coverages in Arc/INFO. Some examples are lakes, cities, vegetation zones, roads, rivers, fire hydrants etc.

Image Data includes satellite images, (aerial) photographs and other remotely sensed or scanned data stored in raster format. In ArcView you can access image

data by selecting **Image Data Source** in the **Add Theme** dialog box.

Tabular Data can include almost any data set whether or not it includes geographic data. Some tables can be viewed from a theme directly and others may contain additional attributes that can be **joined** to your existing data through common fields.

SECTION 3
ArcView:
Terminology &
User Interface

In ArcView you work with **view, tables, charts, and layouts**. They are all stored in one file called a **project**, you work with one project at a time and there are different windows within a project.

**To make anything *active* (view, tables, chart, layout, theme, etc..) just click on the window in which it is displayed. NOTE: The available menu items and tools change according to what type of window is active, only one window can be active at a time.

Terminology and Basic Descriptions

Project

A project can be thought of as a collection of documents, where a document is a view, table, chart, layout or script that you create. In reality it is a file that ArcView creates so that the users can organize their work about a single topic. Projects always have **.APR** extensions. The **project window** allows the user to manage and list the documents in the current project. To access the project menu and tools, the project window must be active. To open an existing project, make sure the project window is active and select **File/Open Project.** To start a new project select **File/New Project.** Projects contain any number of the following:

View

A view appears in a view window as an interactive digital map for display, query and analysis. The window must be active if you wish to use the view menu and tools. A view is a collection of **themes.** The view legend defines how the themes will be displayed and organized. The user can **zoom** in to a certain area by selecting the zoom tool and drawing a box around the desired extent of the zoom. Individual objects of a theme can be selected and identified on the view by using appropriate tools. A view has **view properties** (title, projection, map/distance units) which can be altered by selecting the **View/Properties** box.
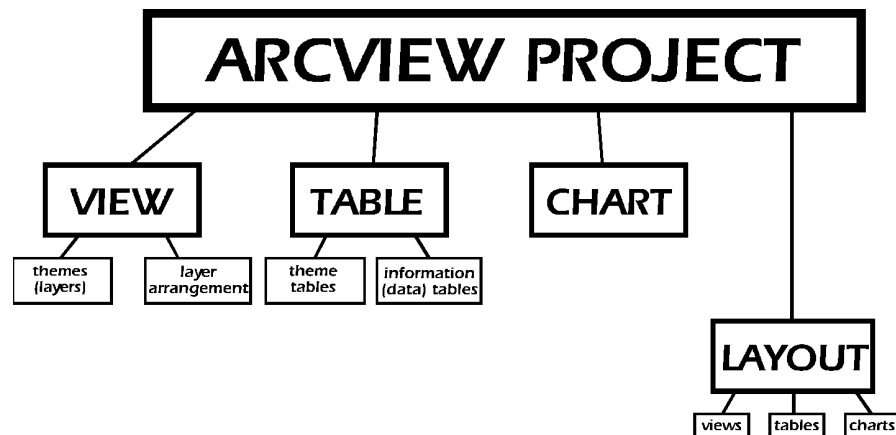
Theme

Themes are thematically related sets of a single type of spatial element (e.g. points representing wells, lines representing roads, polygons representing census tracts). Themes are added to an active view by selecting **add theme** in the button bar. The display of themes can be turned off/on by clicking on the ✔check mark box in the theme box. The user can add, delete, copy, paste or create new themes in

the view window. The display sequence of themes can be changed by clicking and dragging themes up and down in the view legend. The theme at the top of the legend will be drawn last so that it is on top of the others. Graphic display attributes for a theme can be customized by *double-clicking on the theme* and using the **legend editor** and **color palette** to create the desired look. Themes have **tables** which can be displayed in a **table window** by clicking on the **show table** button when the desired theme is active (shown by a highlighted box in the theme legend).

Tables

Tables of data pertaining to themes are displayed in tables windows and can be accessed once a theme is added to a view. In order to access the table menu and tools, the window of the desired table must be active. Tables store tabular data which can be displayed, queried and analyzed. Each record (row) corresponds to a single feature in the theme. The **fields** (columns) along the top of a table are the **attributes** (e.g. population growth, birth rate, etc.). There are two types of tables used in ArcView. The first type is a *theme table* which is directly related to the geographic features displayed in the view. The second type is a *data table*. This table contains additional data from any tabular data source and has no direct geographic expression. The functions of **link** and **join** are performed on tables. A *data table* can be **joined** to a *theme table* to increase the number of attributes for a theme. Selected features can be highlighted in both tables and views.

ARCVIEW PROJECT

VIEW	TABLE	CHART

themes (layers)	layer arrangement	theme tables	information (data) tables

LAYOUT

views	tables	charts

Charts

Charts display tabular information graphically in chart format (pie charts, scatterplots, bar graphs, etc.). Charts reflect the current status of the data in the table, if the source data changes it is automatically reflected in the chart. In order for a user to access the chart menu and tools, the desired chart window must be active.

Scripts (not used in these labs)

A script is a program written in Avenue, the ArcView programming language. Avenue allows a user to customize the GUI (graphical user interface) and

otherwise alter and enhance the functionality of ArcView.

Layouts

Layouts allow you to organize, display, and print any combination of the above documents in one window so as to produce a final product within your project. The user can add a title, scale bar, legend and north arrow to a layout. The layout window is where you will organize a layout for **printing.** To access the layout menu and tools, the desired layout window must be active.

Menu, Button, Tool & Status Bars

The **menu** bar at the top of the application window provides command choices and contains pull-down menus (**File, Edit, View, Layout** etc.).

The **button** bar is directly underneath the menu bar and provides shortcuts for commands contained in the menu bar.

The **tool** bar is underneath the button bar. The tool bar icons let you modify the action of the cursor.

The **status** bar is the bottom of the application window. If you pass (without clicking) the mouse over a button or tool you will see a description of the button or tool operation here.

Lab 5: EXPLORING VECTOR GIS WITH ARCVIEW

SECTION 1
Introduction

THE GEOGRAPHIC THEME

Exploring geographic data as an aid in decision-making.

THE DATA

The data you will be exploring covers the lower 48 United States. Themes include city and state demographics, interstate routes and state boundaries. The demographic themes include information from the 1990 census such as population, percent male and female, median rent and so on. The project contains one view, the Conterminous United States and four themes: Cities (over 100,000 population), Interstates, Lakes, and States.

LEARNING OBJECTIVES

After completing this lab you should be able to:

- Display data (maps and tables) and do some simple querying
- Manipulate the ArcView windows environment
- Understand the terminology used by ArcView
- Use the online Help
- Select information about a record

APPLICATION AREA

Real-time political campaign planning, routing

SECTION 2
Vector GIS

INTRODUCTION TO WINDOWS & VECTOR GIS

*Open **ArcView** by clicking on the ArcView box in the **program manager**. Then click on the **ArcView 2** icon to open an application window.*

*In the **menu bar** go to **FILE/OPEN PROJECT** and locate your data*

YOUR DATA IS LOCATED: Path: _____

TIP: to save re-drawing time, you may want to turn off themes you are not using

When the project opens, all the themes in the **view** will be turned off. Find out what is available by turning on each theme as described below.

*To make a **theme** in the **view** visible or invisible, click on the*

box or ✓ check mark in the theme you want to turn on / off.

✓ Tract
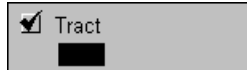
The view clearly needs to be manipulated in order to make the map look more presentable. Follow the instructions below.

---

1. Display

TIP: from the menu bar, choose **HELP/CONTENTS/HELP/ ALWAYS ON TOP** and use Search for Help on ... for full explanations. Click on the down arrow button on the title bar of Help to reduce the help window to an icon. To recall Help, click on the icon.

Theme Order

To move the polygon themes (lakes and state) so they appear underneath the point and arc themes, hold down left mouse button while pointing with the cursor at *the theme **state**. Drag the box to the bottom of the list of themes. Do the same to* **lakes.**

*Turn off the display of **cities** and **interstates** using the check box.*

Active Theme

Themes must be made **active** in order that they are responsive to analysis using the tool, menu and button bar commands.

To make one of the themes **active** *place the cursor over the name of the theme and click mouse once.*

*Make the **state** theme active. A gray box should appear around the **state** theme.*

View Properties

The view's appearance, or properties, can be changed. For example, the projection of the US can be changed.

NOTE: changing the meridian and parallel information will change the centerpoint of the projection. Notice that the latitude and longitude selected are within the United States.

*Go to **VIEW/PROPERTIES/PROJECTION**. Click on* **standard**. *From the **category** box scroll down to and choose "Projections of the United States". Since this view is of the conterminous US, in the **type** box click on the down arrow and choose **Lambert Conformal Conic (conterminous US)**. Hit **OK**.*

You will notice that **map units** have already been set as **projected meters**. The map units are determined during data creation.

Now you need to set the **distance units** so that measurements on the view can be made. *Click on the down arrow of distance units and choose **miles**. Hit **OK**.*

Color of Themes

To change the colors, *with the cursor on the **state** theme double click the mouse. This brings up the **legend editor dialog box**. Double click on the colored rectangle under the symbol heading, which brings up the **fill palette**. Click on the **paintbrush** to get the **color palette**. Click on a color, then hit **apply** in the legend editor dialog box.*

*To close the dialog boxes (or any window), double click on the top left hand corner of the **title bar**. To make a window fill the screen click once with cursor on the up arrow on the right hand side of the title bar.* (The down arrow creates an icon in the lower left corner of the application window. The window can be re-opened by clicking once on the icon.)

HINT: as you pass the cursor over the buttons, their function appears on the status bar at the bottom of the application window.

Object Identification

To identify an object of the active theme in a view, *click on the **information about a feature** tool* *from the toolbar.*

*Place the cursor on the map and click once on California. The **identify results** dialog box shows the details stored about the state.*

Q! 1 & 2

Now identify the lake in Florida.

Q! 3

HINT: the button and tool functions apply to the active theme only.

You can obtain information about any active theme. More than one theme can be made active by holding down the **shift key** and clicking with the cursor over a second, third etc., theme.

Experiment a little with variations on this function.

Close the identify results window.

TIP: read the Help on **scale**   **Scale**

A view's scale is shown on the right hand side of the tool bar. A view's scale is displayed as a representative fraction, and is thus true for whatever units in which the fraction is expressed. There are a few different ways to zoom in and out of a view, here is one way.

Click on the ⬚ *zoom out center tool.*

Q! 4

Now use the ⬚ *button to zoom to the extent of all themes.*

Q! 5

In ArcView you can't generalize the spatial data itself, but you can set the range of map scales at which a theme is drawn on the view by defining a **scale-dependent display property**.

Turn on the **cities** *theme using the check box.*

Q! 6 - 8

To set the scale-dependent display property of the cities theme, *make* **cities** *the* **active** *theme. Go to* **THEME/PROPERTIES/DISPLAY**. *In the* **maximum scale** *box type in* **10000000**. *Hit* **OK**.

Now cities do not appear on the view at the current scale. To see the cities now, *change the scale in the tool bar by clicking with the cursor inside the box and typing in a number less than* **10000000**. *Hit* **Enter** *on the keyboard.*

The view will now be zoomed into the center of the map. To move the map around the view at this scale, c*lick on the* **drags the display** *... tool* ⬚ *and place this cursor in the view. Hold down the mouse button and drag the cursor to move the map.*

When you have finished, *with* **state** *theme active zoom back to the extent of the* **state** *theme*

Q! 9

From your answer to question 9, *use the* **zooms in on a rectangle you drag** *tool* ⬚ *to select a box from the view that will be of a scale large enough to show the cities.*

Q! 10

2. Attributes

Vector GISs represent features in the real world as spatial objects (e.g. cities as points, roads as lines and urban areas as polygons). Features have characteristics called attributes (e.g. the area of a city). ArcView accesses the data source it displays, but does not contain the data itself. That is, the tables you see in ArcView are a dynamic reflection of data stored in external databases (such as Arc/Info coverages or dBASE files). Every table you see in ArcView has basic fields (ID and # fields) that are necessary for ArcView to reference the data in the database. Hidden tables store information used to define the shape, type (point, line and polygon) and placement (geographic location) of the object.

The ID field references both rows in the themes attribute table and the file containing the geometry and location of features.

Q! 11

3. Selecting Features

Relating tables to the spatial themes enables spatial searches to be performed using the attributes of features, which, in ArcView, are represented as spatial objects in the view.

*To bring up a theme's table, make the **view** the active window by clicking with the cursor on the **title bar**, which will become highlighted. Make **state** the **active** theme. To bring up the **attribute table** for **state** theme, click with the cursor on the **opens table** button in the button bar* ▣.

You can also open table windows by clicking with the cursor on the word **tables** in the **project window.**

Tables   Then double-click with the cursor on the required table name.

*In addition to **Attributes of State**, open the tables for **Attributes of Cities** and **Attributes of Interstates**. Familiarize yourself with the fields of the tables you have brought up on the screen.*

Q! 12

Selecting Features from a View

TIP: hold down the shift key and click with the cursor on other

*Make sure the **state** theme is active. Choose the **selects features in the visible, active themes** tool* ▣. *Click on a few*

features in order to select more than one feature.

states in the view. You should see the states highlighted and the corresponding records in the attribute table also highlighted.

*To see several highlighted states together in the table, make the table **active**. Use the **promotes selected rows to the top** button in the button bar* 🔲. *To **unselect** features, click on the **unselect** button in the button bar* 🔲.

Selecting Features from a Table

HINT: in order to highlight objects in a theme by selecting features from a table, that table's theme must be active in the view

The same process can be done in reverse. *Click on a record in the **Attributes of State** table. The object linked to that record will become highlighted in the view window.*

Box Selecting

*Using the **selects features** ... tool again, draw a box on the view by clicking the mouse and dragging the cursor diagonally. All the states within and intersecting the box will be highlighted.*

Modifying the Appearance of a Table

TIP: To make the table easier to read, unwanted fields can be turned off. *Go to **TABLE/ PROPERTIES** and in the **visible** column, click off the check marks to the first 5 fields. Hit **OK**.*

You may wish to see the state name field in the table next to another field (rather than scrolling through the table). You can move the fields by clicking on and dragging the field name horizontally to the desired position.

To change the width of columns, place the cursor between two field headings until you see double arrowheads, click and hold the mouse button while dragging horizontally to enlarge/shrink.

Finding a Feature

*Another type of query is finding the location of a feature. Click on the **finds features** ... button* 🔍. *In the dialog box, search for a state of interest to you using the State's name.*

Q! 13

SECTION 3 - Problem
Exploring & Querying

Exploring & Querying the Data

You are working for a potential presidential candidate who lives in California and it is nearing election time. The campaign manager has asked you to prepare a plan for a visit

to the first few states the candidate will visit by road before the election. The candidate's campaign is based on family values, so the manager wants to begin by rallying support in states which have a large proportion of two parent families. The candidate is sitting beside you and starts by asking:

"Which states have at least 30% of all households with both parents?"

TIP: ArcView specifically requires certain parentheses in the query box, but by clicking with the cursor on the fields and icons, these are inserted automatically. Search Help on **query builder**.

*To perform a query on a table, bring up the **Attributes of State** table. Choose the **query builder** button. To build a query on states which have >= 30% married households with children (**P_Marhhchd**), double-click on **P_Marhhchd**. (You will need to scroll to see the field.)*

*Now click once on >= and then type **30**. Click on **new set**. Close the query builder dialog box, use the **promote** button to list the selected set at the top of the table. Look at the far left of the tool bar to see how many records have been selected.*

"There seems to be some pattern there!"

Q! 14 & 15

"What additional states have at least 30% of all households with childless married couples?"

*Perform a second query on the table asking for **P_Marhhnoc** >= **30**. Click on **add to set**.*

Q! 16 - 18

TIP: browse through Q 19-23 to be aware of what is required from the following dialog.

"Hmm, let's be sure to remember which were the first states that we selected, since they are the most important ones that I should visit."

TIP: you may want to turn off the state theme momentarily to locate the start and end cities (which will also be highlighted in the same color)

"Now, let's find a route which goes through all these states. I want to start in Portland, Oregon and end in San Antonio, Texas".

"I think 8 stops total will be enough. Let's see which major cities I should go to so I can stop in each state at least once."

TIP: you may want to change the

Use zoom tools and information tool to find suitable cities.

scale dependent display property
of cities so they are shown when
the display is at a smaller scale

*"Hmm, there's a gap.   What additional states
should I visit? Let's choose the best ones."*

*You could use the label tool to label the Interstates as you
plan the route. First you will need to make sure the label will
be an Interstate number: go to THEME/PROPERTIES/TEXT
LABELS then in the box next to label field scroll down and
click on Route. Click OK. Now you can click on the label tool
and then on the Interstates in the view to see a label
appear.*

*"OK, let's plan the route. Where shall I go and how
long is the route?"*

Q! **19 - 22**

QUESTION & ANSWER SHEET

1. What is the population of California in 1990?

2. What was the population of North Dakota in 1990?

3. What is the name of the lake?

4. What happens to the scale as you zoom out?   (Remember to think of the scale as a ratio or representative fraction, such as 1:24,000 or 1/100,000)

5. What does the scale ratio represent?

6. Describe the spatial pattern of cities across the US. Where does there appear to be grouping?

7. What problem does this display present?

8. Why might you use the scale-dependent display property with the cities theme?

9. There are several other ways to zoom besides zooming to the extent of the active theme. What are these ways? (Hint: see Help)

10. What is the smallest scale ratio at which the cities theme will appear?

11. What are advantages or disadvantages to using a related table with ID numbers?

12. What are the necessary fields for a point, line and polygon table. The necessary fields are usually within the first few fields of the table.

Point Table: (hint, there are 4)

Line Table: (hint, there are 7)

Polygon Table: (hint, there are 4)

13. List the state you have chosen, 5 demographic fields and their values.

14. How many records are selected?

15. What is the spatial pattern in the selected set?

16. How many states are selected?

17. What is the difference between **add to set** and **new set**? (Hint: check Help and search for help on ... add to/new set.)

18. What does **select from set** mean?

FOR QUESTIONS 19 - 21 THERE ARE NO SPECIFIC <u>CORRECT</u> ANSWERS.

19. List the 8 cities and their states. (The first city is Portland, Oregon and the last is San Antonio, Texas.)

20. Which Interstates should the candidate take via the cities to minimize travel time?

21. Approximately how many miles is the tour of the states from question 19? (Hint: use **distance** tool in toolbar .)

22. Explain how you used ArcView to make your decision (i.e. which tools etc.).