Choosing how to represent your data on a map may be the most important mapmaking decision you make. How you represent your data determines what your map communicates.

On some maps, you might simply want to show where things are. The easiest way to do this is to draw all the features in a layer with the same symbol. On other maps, you might draw features based on an attribute value or characteristic that identifies them. For example, you could map roads by type to get a better sense of traffic patterns or map the wildlife habitat suitability of a particular bird species, ranked from least to most suitable.

In general, you can draw map features as follows:

- With a single symbol
- To show a category such as a name (unique values maps)
- To represent a quantity such as population (graduated color, graduated symbol, and dot density maps)
- To show multiple attributes that are related (multivariate and chart maps)

You can also draw these other data types:

- Images and rasters (see Chapter 14, ‘Working with rasters’)
- TINs representing a three-dimensional surface
- CAD drawing files

Browse the map gallery on the next few pages to see the various ways you can symbolize your data.
A map gallery

Single symbol map

Drawing your data with just a single symbol gives you a sense of how features are distributed—whether they’re clustered or dispersed—and may reveal hidden patterns.

In the map above, you can easily see where people live and conclude that some areas are more densely populated based on the number of cities clustered together.

Unique values map

On a unique values map, you draw features based on an attribute value, or characteristic, that identifies them. In the map above, each land use type is drawn with a specific color. Typically, each unique value is symbolized with a different color. Drawing features based on unique attribute values shows the following:

- How similar features are distributed—whether they’re grouped or dispersed
- How different feature types are located in relation to each other
- How much of one category there is compared to other categories
When you need to map quantities or amounts of things, you might choose to use a graduated color map. Graduated color maps have a series of symbols whose colors change according to the values of the particular attribute. Graduated color maps are most useful for showing data that is ranked (for example, 1 to 10, low to high) or has some kind of numerical progression (for example, measurements, rates, percentages).

The map above uses different shades of color—in a graduated color ramp—to represent different amounts of people. Here, darker shades indicate a greater number of people.

Another way to represent amounts of things is to vary the size of the symbol a feature is drawn with. The graduated symbol map above uses a larger symbol to show earthquakes with a larger magnitude. Like graduated color maps, graduated symbol maps are most useful for showing rank or progression of values. However, instead of using color to represent the differences in values, the size of the symbol varies.

When making a graduated symbol map, it is important to choose the range of symbol sizes carefully. The largest symbols need to be small enough that neighboring symbols don’t completely cover one another. At the same time, the range in size from the smallest to the largest needs to be great enough that the symbol for each class is distinct.
The maps on the previous pages display one attribute, or characteristic, of the data—for example, a name or an amount. Multivariate maps display two or more attributes at the same time. The map above illustrates the level of human impact on the natural landscape of Australia. Major habitat types are shown with unique colors, and the level of disturbance for each habitat is shown with a graduated symbol. The larger the symbol, the higher the human impact is on the particular habitat.

Chart maps allow you to symbolize multiple attributes on one map as well as communicate the relationship among different attributes. Chart maps display charts—bar and pie charts—over features. The map above shows you the volume and type of goods distributed by an exporter throughout Asia.

Pie charts show relationships between parts and the whole and are particularly useful for showing proportions and ratios. Bar charts compare amounts of related values and are well suited to showing trends over time. Stacked bar charts can show both the relative relationship between data as well as allowing for absolute comparisons.
Mapping the density of features lets you see the patterns of where things are concentrated. This helps you find areas that require action or meet some criteria. For example, the map above shows where the highest concentration of crimes occurs in a city. Using this map, the city may choose to increase the number of police patrols in the areas of high density.

One way to map density is with a dot density map. This type of map symbolizes features using dots drawn inside polygons to represent a quantity. Each dot represents a specific value. For example, on the crime map, each dot might represent five incidents of crime. When creating a dot density map, you specify how many features each dot represents and how big the dots are. You may need to try several combinations of amount and size to see which one best shows the pattern.

Much of the most readily available geographic data is in the form of rasters. A raster can represent almost any geographic features, though most rasters you’ll work with in ArcMap will probably be scanned maps or photographs of the earth’s surface. You might add an aerial photograph to your map to provide a realistic background to your other data, or you might use satellite imagery to add up-to-the-minute information about weather conditions or flood levels. You can even update your other data by using a raster as a guide for editing.

For more information on displaying raster data, see Chapter 14, ‘Working with rasters’.
One of the ways you can represent a continuous surface, such as terrain elevation or temperature gradient, is to display the surface as a color-shaded relief map. This type of map displays elevation ranges in graduated colors and shades ridges, valleys, and hillsides using a simulated light source. The shading adds a realistic effect that makes the surface look as though you are viewing it from high above. The combined use of color for elevation and shading for surface morphology results in a highly informative, yet easy to interpret, view of your surface.

You can integrate CAD drawings onto your maps seamlessly, without having to convert these files into other GIS formats. This is particularly useful if your organization has existing CAD data resources. For example, some departments in your organization may be using a CAD package to help manage facilities and other infrastructure. You can let ArcMap draw these layers as they appear in the CAD package, or you can precisely control how to draw them.
Drawing all features with one symbol

Often, seeing where something is—and where it isn’t—can tell you exactly what you need to know. Mapping the location of features reveals patterns and trends that can help you make better decisions. For example, a business owner might map where his customers live. Seeing where they live can help him decide where to target his advertising.

The easiest way to see where features are is to draw them using a single symbol. You can draw any type of data this way. When you create a new layer, ArcMap by default draws it with a single symbol.

Tip
Changing the symbol
To quickly change the symbol features are drawn with, click the symbol in the table of contents to display the Symbol Selector.

Tip
Changing the color
To quickly change the color of a symbol, right-click the symbol in the table of contents to display the Color Selector.

Drawing a layer using a single symbol

1. In the table of contents, right-click the layer you want to draw with a single symbol and click Properties.
2. Click the Symbology tab.
3. Click Features.
   Because Single symbol is the only option, ArcMap automatically selects it.
4. Click the Symbol button to change the symbol.
5. In the Symbol Selector dialog box, click a new symbol or change specific properties of the symbol.
6. Click OK on the Symbol Selector dialog box.
7. Type a Label for the feature.
   The label appears next to the symbol in the table of contents.
8. Click OK.
Drawing features to show categories like names or types

A category describes a set of features with the same attribute value. For example, given parcel data with an attribute describing land use—for example, residential, commercial, and public areas—you can use a different symbol to represent each unique land use type. Drawing features this way allows you to see where features are and what category they belong to. This can be useful if you’re targeting a specific type of feature for some action or policy. For instance, a city planner might use the land use map to target areas for redevelopment.

In general, look for these kinds of attributes when mapping by category, or unique value:

- Attributes describing the name, type, or condition of a feature.
- Attributes containing measurements or quantities that are already grouped, for example, “0–99”, “100–199”.
- Attributes that uniquely identify features, for example, a county name attribute could be used to draw each county with a unique color.

Drawing a layer showing unique values

1. In the table of contents, right-click the layer you want to draw showing unique values and click Properties.
2. Click the Symbology tab.
3. Click Categories.
4. Click the Value Field dropdown arrow and click the field that contains the values you want to map.
5. Click the Color Scheme dropdown arrow and click a color scheme.
6. Click Add All Values. This adds all unique values to the list. Alternatively, click the Add Values button to choose which unique values to display.
7. If you want to have more descriptive labels, click a label in the Label column and type a new one.
8. Click OK.
You can let ArcMap assign a symbol to each unique value based on a color scheme you choose or explicitly assign a specific symbol to a specific attribute value.

To draw features with specific symbols, you need to create a style beforehand that contains symbols named after the attribute value they represent. For example, if you have a dataset that categorizes roads as either major or minor, then you would need to have line symbols within that style named “major” and “minor”. ArcMap will match the attribute value to the line symbol name to draw the feature. Features that don’t have a matching line symbol won’t be drawn. This way of drawing features is especially useful if you want to draw your data the same way on different maps.

**See Also**

For more information on creating styles, see Chapter 9, ‘Working with styles and symbols’.

**Drawing features by referencing specific symbols in a style**

1. In the table of contents, right-click the layer you want to draw showing unique values and click Properties.
2. Click the Symbology tab.
3. Click Categories.
4. Click Match to symbols in a style.
5. Click the Value Field dropdown arrow and click the field that contains the values you want to map.
6. Click the Match to symbols in Style dropdown arrow and click the style that contains symbol names that match attribute values.
   
   If the style is not loaded, click the Browse button to browse for it on disk.

7. Click Match Symbols.
   
   This adds all unique values that have a matching symbol in the style. Alternatively, click the Add Values button to choose which unique values to display.

8. If you want to have more descriptive labels, click a label in the Label column and type a new one.

9. Click OK.
Tip

Ordering unique value headings

You can also arrange the headings for unique values. Just select a heading and use the arrow keys to move it.

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Sorting unique values

1. In the table of contents, right-click the layer whose unique values you want to sort and click Properties.
2. Click the Symbology tab.
3. Click the Value column to show a context menu.
4. Click Reverse Sorting.
5. Click OK.

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Ordering unique values

1. In the table of contents, right-click the layer whose unique values you want to reorder and click Properties.
2. Click the Symbology tab.
3. Click the value you want to move up or down in the list.
4. Use the up and down arrows to either promote or demote the value in the list.
   The arrow buttons only move values within a heading.
5. Click OK.
Managing categories

If you're drawing features by category, the number of categories you display will affect what patterns are revealed on the map. Most people can easily discern up to seven categories for a given layer. The more technical the audience, the more categories they will be able to identify and the more easily they will be able to interpret complex patterns. Conversely, a less technical audience may benefit more from a map with fewer categories.

When displaying your data, you can control how you organize and display categories for a layer. If you want to display fewer categories, you can combine similar categories into one category—for example, combine two detailed land use categories into a more general one. Combining categories in this manner can make the patterns more apparent. However, the trade-off is that some information may be lost.

Instead of reducing the number of categories, you might organize individual categories into groups that you define. This allows you to work with and view them as a group. Additionally, a map reader will see the groups listed in the table of contents.

Combining two or more categories into one

1. In the table of contents, right-click the layer drawn with unique values for which you want to combine categories and click Properties.
2. Click the Symbology tab.
   You should already see categories in the scrolling list. If you don't, follow the steps for ‘Drawing a layer showing unique values’ in this chapter.
3. Click the first value you want to combine. Hold down the Shift or Ctrl key and click the additional values that you want to combine.
4. Right-click over the values and click Group Values.
   The selected values will now be combined into one category.
5. Click OK.

Splitting up combined categories

1. Right-click a combined category.
2. Click Ungroup Values.
Organizing categories in groups

1. In the table of contents, right-click the layer drawn with unique values for which you want to organize categories and click Properties.

2. Click the Symbology tab. You should already see categories in the scrolling list. If you don’t, follow the steps for ‘Drawing a layer showing unique values’ in this chapter.

3. Click the first value you want to group together. Hold down the Shift or Ctrl key and click the additional values that you want to group.

4. Right-click a selected value, point to Move to Heading, and click New Heading.

5. Type a name for the new heading.

6. Click OK.

7. Click OK on the Layer Properties dialog box.

Tip

Deleting groups
ArcMap will automatically delete groups that contain no attribute values in them.

Tip

Renaming groups
Click the group heading in the table of contents and type a new name.

A new heading now appears in the table of contents with values grouped in it.
Ways to map quantitative data

Quantitative data is data that describes features in terms of a quantitative value measuring some magnitude of the feature. Unlike categorical data, where features are described by a unique attribute value such as a name, quantitative data generally describes counts or amounts, ratios, or ranked values. For example, data representing precipitation, population, and habitat suitability can all be mapped quantitatively.

Which quantitative value should you map?

Knowing what type of data you have and what you want to show will help you determine what quantitative value to map. In general, you can follow these guidelines:

- Map counts or amounts if you want to see actual measured values as well as relative magnitude. Use care when mapping counts as the values may be influenced by other factors and could yield a misleading map. For example, when making a map showing the total sales figures of a product by state, the total sales figure is likely to reflect the differences in population among the states.
- Map ratios if you want to minimize differences based on the size of areas or numbers of features in each area. Ratios are created by dividing two data values and are also referred to as normalizing the data. For example, dividing the 18- to 30-year-old population by the total population yields the percentage of people aged 18–30. Similarly, dividing a value by the area of the feature yields a value per unit area, or density.
- Map ranks if you’re interested in relative measures and actual values are not important. For example, you may know a feature with a rank of “3” is higher than one ranked “2” and lower than a “4”, but you can’t tell how much higher or lower.

Should you map individual values or group them in classes?

When you map quantitative data, you can either assign each value its own symbol or group values into classes using a different symbol for each class.

If you’re only mapping a few values (less than 10), you can assign a unique symbol to each value. This may present a more accurate picture of the data, since you’re not predetermining which features are grouped together. More likely, your data values will be too numerous to map individually and you’ll want to group them in classes, or classify the data. A good example of classified data is a temperature map you might find in a newspaper. Instead of displaying individual temperatures, these maps show temperature bands, where each band represents a given range in temperature.

Ways to classify your data

How you define the class ranges and breaks—the high and low values that bracket each class—will determine which features fall into each class and thus what the map will look like. By changing the classes you can create very different-looking maps. Generally, the goal is to make sure features with similar values are in the same class.

Two key factors for classifying your data are the classification scheme you use and the number of classes you create. If you know your data well, you can manually define your own classes. Alternatively, you can let ArcMap classify your data using standard classification schemes. The four most common schemes are natural breaks, quantile, equal interval, and standard deviation. These are described on the following pages.
Standard classification schemes

**Natural breaks (Jenks)**

Classes are based on natural groupings of data values. ArcMap identifies break points by looking for groupings and patterns inherent in the data. The features are divided into classes whose boundaries are set where there are relatively big jumps in the data values.

**Quantile**

Each class contains an equal number of features. A quantile classification is well suited to linearly distributed data. Because features are grouped by the number in each class, the resulting map can be misleading. Similar features can be placed in adjacent classes, or features with widely different values can be put in the same class. You can minimize this distortion by increasing the number of classes.
Equal interval

This classification scheme divides the range of attribute values into equal-sized subranges. For example, if features have attribute values ranging from 0 to 300 and you have three classes, each class represents a range of 100 with class ranges of 0–100, 101–200, and 201–300. This method emphasizes the amount of an attribute value relative to other values, for example, to show that a store is part of the group of stores that made up the top one-third of all sales. It’s best applied to familiar data ranges such as percentages and temperature.

Standard deviation

This classification scheme shows you the amount a feature’s attribute value varies from the mean. ArcMap calculates the mean value and then generates class breaks by successively adding to it or subtracting from it the standard deviation. A two-color ramp helps emphasize values above (shown in blue) and below (shown in red) the mean.
Drawing features to show quantities like counts or amounts

When you want your map to communicate how much of something there is, you need to draw features using a quantitative measure. This measure might be a count; a ratio such as a percentage; or a rank such as high, medium, and low.

You can represent quantities on a map by varying the color or symbol size you use to draw features. For example, you might use increasingly darker shades of blue to represent increasingly higher rainfall amounts or larger circles to represent cities with larger populations.

Generally, you’ll need to classify your data when you display it. Classifying data groups features with similar values into discrete classes and displays them with the same symbol. You can either manually define classes or apply one of the standard classification schemes to do so automatically—just specify the number of classes you want to show. Once you’ve defined the classes, you can add more classes, delete classes, or redefine class ranges.

Representing quantity with color

1. In the table of contents, right-click the layer you want to draw showing a quantitative value and click Properties.
2. Click the Symbology tab.
3. Click Quantities. ArcMap automatically selects Graduated colors.
4. Click the Value dropdown arrow and click the field that contains the quantitative value you want to map.
5. To normalize the data, click the Normalization dropdown arrow and click a field. ArcMap divides this field into the Value to create a ratio.
6. Click the Color Ramp dropdown arrow and click a ramp to display data with.
7. Click the Classes dropdown arrow and click the number of classes you want.
8. Click Classify.
9. In the Classification dialog box, click the Method dropdown arrow and click the classification method you want.
10. Click OK on the Classification dialog box.
11. Click OK on the Layer Properties dialog box.

Right-click over a class to see additional options such as sorting and number formatting.
It’s always a good idea to examine your data before you map it. For instance, you may find that you have a few extremely high or low values or null values where no data is available. These values can skew a classification and thus the patterns on the map. Fortunately, you can choose to exclude these values before you classify your data.

You may also want to normalize your data before you map it. When you normalize data, you divide it by another attribute to come up with a ratio. Often, ratios are easier to understand than the raw data values. For example, dividing total population by area yields the number of people per unit area, or a density. Dividing a store’s sales figure by the total sales for all stores yields a percentage of sales at that store.

See Also
For more information on creating and managing styles, see Chapter 9, “Working with styles and symbols.”

Creating your own color ramp for a layer

1. In the table of contents, right-click the layer that shows a quantitative value and click Properties.
2. Click the Symbology tab.
3. Click Quantities.
4. Double-click the top symbol in the list and set the start color for the ramp.
5. Double-click the bottom symbol and set the end color.
6. Optionally, double-click any middle symbol to set its color.

This lets you create a multicolor ramp.
7. Click all the middle symbols you’ve set the color of.

By selecting one or more middle symbols, the color of those symbols is included in the new ramp. Otherwise, ArcMap only uses the top and bottom symbols.
8. Right-click a symbol and click Ramp Colors.
9. Optionally, right-click the Color Ramp dropdown and click Save to save your new ramp to your default style.

You only need to save the ramp if you want to use it again on another layer.
10. Click OK.
Representing quantity with graduated symbols

1. In the table of contents, right-click the layer you want to draw showing a quantitative value and click Properties.
2. Click the Symbology tab.
3. Click Quantities and click Graduated symbols.
4. Click the Value dropdown arrow and click the field that contains the quantitative value you want to map.
5. To normalize the data, click the Normalization dropdown arrow and click a field. ArcMap divides this field into the Value to create a ratio.
6. Type the minimum and maximum symbol sizes.
7. Click the Classes dropdown arrow and click the number of classes you want.
8. Click Classify.
9. Click the Method dropdown arrow and click the classification method you want.
10. Optionally, click Exclusion to remove unwanted values from the classification (e.g., null values).
11. Click OK on the Classification dialog box.
12. Click OK on the Layer Properties dialog box.

Tip

Why don’t the symbols get bigger when I zoom in?
As you zoom in on the map, the graduated symbols will not get bigger. If you want them to get bigger, you need to set a reference scale. Right-click the data frame and click Set Reference Scale. Now when you zoom in, all the symbols in the data frame will become larger.

Tip

With how many digits do you want to display your labels?
You can set the number of significant digits for labels by clicking the Label column heading. This reveals a menu that lets you format the labels.
Representing quantity with proportional symbols

1. In the table of contents, right-click the layer you want to draw showing a quantitative value and click Properties.
2. Click the Symbology tab.
3. Click Quantities and click Proportional symbols.
4. Click the Value dropdown arrow and click the field that contains the quantitative value you want to map.
5. To normalize the data, click the Normalization dropdown arrow and click a field. ArcMap divides this field into the Value to create a ratio.
6. If the Value represents a measurement on the map—an area or distance—click the Unit dropdown arrow and click a unit. Otherwise, skip to step 9.
7. Click Square or Circle as the symbol.
8. Click Radius or Area. For example, click Radius if your data represents the distance an earthquake was felt from its epicenter. Click Area if the value represents an area.
9. Click OK.

Tip

What’s the difference between graduated symbols and proportional symbols?
When you draw features with graduated symbols, the quantitative values are grouped into classes. Within a class, all features are drawn with the same symbol. Thus, you can’t discern the value of individual features; you can only tell that its value is within a certain range.

Proportional symbols represent data values more precisely. The size of a proportional symbol reflects the actual data value. For example, you might map earthquakes using proportional circles, where the radius of the circle is based on the magnitude of the quake. The difficulty with proportional symbols arises when you have too many values; the symbols may become indistinguishable. Also, the symbols for high values can become so large as to obscure each other.

Tip

The maximum value symbol is too large
If the symbol for the maximum value fills the space on the dialog box, it will probably be too big on the map. Try reducing the symbol size for the minimum value, normalizing the data, or excluding some values. If it’s still too large, use graduated symbols instead.
Representing quantity with a dot density map

1. In the table of contents, right-click the layer you want to draw showing a quantitative value and click Properties.
2. Click the Symbology tab.
3. Click Quantities and click Dot density.
4. Click one or more fields under Field Selection that contain the quantitative values that you want to map.
5. Click the arrow button to add fields to the field list.
6. Double-click on a dot symbol in the field list to change its properties.
7. Type the dot size or click the slider to adjust the size.
8. Type the dot value or click the slider to adjust the value.
9. Check Maintain Density to preserve the dot density. When checked, as you zoom in, the dot size will increase so that a given area will visually appear as dense. Otherwise, the dot size will remain constant.
10. Optionally, click Properties to set the dot placement options.
11. Click OK.

Tip
How big should the dots be?
When creating a dot density map, you specify how many features each dot represents and how big the dots are. You may need to try several combinations of amount and size to see which one best shows the pattern. In general, you should select values that ensure the dots are not so close as to form solid areas that obscure the patterns, or so far apart as to make the variations in density hard to see.
Symbolizing your Data

Setting a classification

When you classify your data, you can either use one of the standard classification schemes ArcMap provides or create custom classes based on class ranges you specify. If you choose to let ArcMap classify the data, simply choose the classification scheme you want and set the number of classes. If you want to define your own classes, you can manually add class breaks and set class ranges that are appropriate for your data. Alternatively, you can start with one of the standard classifications and make adjustments as needed.

Why set class ranges manually? There may already be certain standards or guidelines for mapping your data. For example, temperature maps are often displayed with 10 degree temperature bands. Or you might want to emphasize features with particular values, for example, those above or below a threshold value that determines whether some action will occur. Whatever your reason, make sure you clearly specify what the classes mean on the map.

Setting a standard classification method

1. In the table of contents, right-click the layer that shows a quantitative value for which you want to change the classification.
2. Click the Symbology tab.
3. Click Quantities.
   You should see the current classification.
4. Click Classify.
5. Click the Method dropdown arrow and click the classification method you want.
6. Click the Classes dropdown arrow and click the number of classes you want to display.
7. Click OK on the Classification dialog box.
8. Click OK on the Layer Properties dialog box.
Inserting your own class break and setting a range

1. In the table of contents, right-click the layer you want to set class breaks for. You should see the current classification.
2. Click the Range you want to edit. Make sure to click the Range, not the Label.
3. Type a new value. This sets the upper value of the range.
4. Click OK.

Deleting a class break

1. Click Classify from the Symbology tab of the Layer Properties dialog.
2. Click on the class break you want to delete. The selected break is highlighted.
3. Right-click over the histogram and click Delete Break.

Tip

Seeing more data values plotted on the histogram
Increase the number of columns shown to see more data values in the histogram.
Excluding features from the classification

1. Click Classify from the Symbology tab of the Layer Properties dialog.
2. Click Exclusion.
3. Double-click the field you’re using to draw the layer.
4. Double-click an operator.
5. Double-click the value you want to exclude.
   If you don’t see the value in the list, click the Complete List button.
6. Click OK to execute the expression and exclude values.

See Also
For more information on building query expressions, see Chapter 13, ‘Querying maps’. 
Drawing features to show multiple attributes

Geographic data usually has a number of different attributes that describe the features it contains. While you’ll commonly use one of the attributes to symbolize the data—for example, show categories or quantities—you may sometimes want to use more than one. For example, you might display a road network using two attributes: one representing the type of road and the other representing the traffic volume along it. In this case, you could use different line colors to represent the different types of roads and also vary the line width to indicate traffic volume along each road.

When you symbolize your data using more than one attribute, you create a multivariate display. Symbolizing your data this way can effectively display more information about the data; however, it can also make your map more difficult to interpret. Sometimes it might be better to create two separate displays than to try to display the information together.

Drawing a layer to show both categories and quantities

1. In the table of contents, right-click the layer you want to draw showing multiple attributes and click Properties.
2. Click the Symbology tab.
3. Click Multiple Attributes. ArcMap automatically selects the Quantity by category option.
4. Click the first Value Fields dropdown arrow and click the field that contains the values you want to map.
5. Click the Color Scheme dropdown arrow and click a color scheme.
6. Click Add All Values.
7. Click Symbol Size or Color Ramp, depending on how you want to symbolize the quantitative value. This example shows Symbol Size.
8. Click the Value dropdown arrow and click the quantitative value you want to map.
   Set other options as described in ‘Drawing features to show quantities like counts or amounts’.
9. Click OK.
10. Click OK.
Drawing features with charts

Pie charts, bar charts, and stacked bar charts can present large amounts of quantitative data in an eye-catching fashion. For example, if you’re mapping population by county, you can use a pie chart to show the percentage of the population by ethnic group for each county.

Generally, you’ll draw a layer with charts when your layer has a number of related numeric attributes that you wish to compare. Use pie charts if you want to show how much of the total amount each category takes up. Use bar charts to show relative amounts, rather than a proportion of a total.

1. In the table of contents, right-click the layer you want to draw showing quantitative values and click Properties.
2. Click the Symbology tab.
3. Click Charts and click Pie.
4. Click one or more fields under Field Selection that contain the quantitative values that you want to map.
5. Click the arrow button to add fields to the field list.
6. Click the Color Scheme dropdown arrow and click the colors you want to use.
7. Check the box to prevent the charts from overlapping.
8. Click Size.
9. Click the Variation Type you want.
10. Type in a size or click the arrows to set the size.
11. Click OK.
12. Click OK.

Tip

Charting negative values
Avoid using pie or stacked bar charts with data containing negative values.

Symbolizing your data 157
Drawing bar and column charts

1. In the table of contents, right-click the layer you want to draw showing quantitative values and click Properties.
2. Click the Symbology tab.
3. Click Charts and click Bar/Column.
4. Click one or more fields under Field Selection that contain the quantitative values that you want to map.
5. Click the arrow button to add fields to the field list.
6. Click the Color Scheme dropdown arrow and click the colors you want to use.
You can double-click an individual symbol in the list to change its properties.
7. Check the box to prevent the charts from overlapping.
8. Click Size.
9. Type in a maximum length or click the arrows to set the length.
10. Click OK.
11. Click OK.
Drawing stacked charts

1. In the table of contents, right-click the layer you want to draw showing quantitative values and click Properties.
2. Click the Symbology tab.
3. Click Charts and click Stacked.
4. Click one or more fields under Field Selection that contain the quantitative values that you want to map.
5. Click the arrow button to add fields to the field list.
6. Click the Color Scheme dropdown arrow and click the colors you want to use.
   You can double-click an individual symbol in the list to change its properties.
7. Check the box to prevent the charts from overlapping.
8. Click Size.
9. Type in a maximum length or click the arrows to set the length.
10. Click OK.
11. Click OK.

Click Properties to switch between bars and columns.
Drawing TINs as surfaces

TINs represent continuous surfaces such as terrain elevation or temperature gradient. Typically, you display a TIN using color-shaded relief. This lets you easily see the ridges, valleys, and hillsides and their respective heights. Seeing the data this way can help explain why other map features are where they are.

You can display any one of three surface characteristics—slope, aspect, and elevation—on your map and even simulate shaded relief.

Geographic features that cross the surface—such as a river, road, or shoreline—can be explicitly represented in a TIN with a breakline. These features form the edges of triangles and therefore influence the surface at their location. Since the underlying triangulation defines the surface, you might want to take a closer look at it. You can also display the internal structure of a TIN—for example, nodes and breaklines—independently or on top of the shaded relief display.

Drawing a color-shaded relief surface

1. In the table of contents, right-click the TIN layer that you want to draw and click Properties.
2. Click the Symbology tab.
   By default, ArcMap displays the face elevation and breakline edges of the TIN.
3. Click an entry in the list to see its symbolization properties.
4. Modify the symbolization properties as necessary. For example, set a new color ramp or change the number of classes.
5. Click the Add button to draw additional elements of the TIN—for example, nodes.
6. Click the renderer that represents the TIN feature you want to draw.
7. Click Add.
8. Click Dismiss when you are finished adding renderers.

The list will update to show what you want to draw.
9. Click an element in the list.
10. Click the Up or Down arrow to change its draw order.
   The TIN features at the top of the list will draw on top of those below them.
11. Click OK.

**Tip**

**How are slope and aspect measured?**

Slope values range between 0 and 90 degrees, where 0 indicates no slope. Aspect is also measured in degrees. North is 0 degrees, east is 90 degrees, south is 180 degrees, and west is 270 degrees.
Drawing CAD layers

You can display CAD drawings on your map just like other data types. You can decide which CAD layers to draw and how to draw the entities on the layer.

Depending on how you added the CAD data to your map, you have two display options:

- If you added the CAD drawing file for display only, you can only choose which CAD layers to show or hide. ArcMap draws all entities according to the colors specified in the drawing file. You can’t override this drawing behavior.
- If you added the CAD drawing as features—point, line, or polygon—because you are interested in using the data for geographic analysis, you have access to all the symbolization options as other feature layers. For example, you can draw the polygon entities with a single symbol or classified by a unique value.

Displaying a CAD drawing file

1. In the table of contents, right-click the CAD drawing layer and click Properties.
2. Click the Display tab.
3. Click and drag the sliders to adjust the CAD display.
4. Click the Drawing Layers tab.
5. Check the CAD layers that you want to display.
6. Click OK.
Drawing CAD features as points, lines, or polygons

1. In the table of contents, right-click the CAD dataset and click Properties.
2. Click the Symbology tab.
   The drawing options available to you are the same as other feature layers.
3. Modify the drawing properties as necessary.
   See the previous topics in this chapter for more detailed instructions.
4. Click the Drawing Layers tab.
5. Check the CAD layers that you want to display.
6. Click OK.

See Also
For more information on symbolizing the features in a CAD dataset, see ‘Drawing features to show categories like names or types’ in this chapter.

Tip
Adjusting transparency
You can also use the Effects toolbar to adjust the transparency of CAD layers.
### Advanced symbolization

ArcMap provides a few other tools that let you control how layers draw. You can:

- Draw layers transparently.
- Set a reference scale for symbols so they’ll, for example, get larger as you zoom in on the map.
- Order the drawing sequence of multilevel road networks with complex symbology.

Transparency is especially useful for drawing raster layers over other layers on your map, allowing you to see the raster layer while still viewing underlying features.

When you set a reference scale, symbols and text will appear larger as you zoom in on your data frame and smaller as you zoom out on your data frame. So for example, text labels will get larger if you zoom in to a scale that is larger than the reference scale.

The current scale of the data frame is used as the reference scale to which all symbols and text in the data frame will be made relative. Setting a reference scale is like “freezing” the symbol and text sizes used in your data frame so that the way

## Drawing a layer transparently

1. Click the View menu, point to Toolbars, and click Effects. The Effects toolbar appears.
2. Click the Layer dropdown arrow and click the layer you want to adjust.
3. Click Adjust Transparency.
4. Drag the slider bar to adjust the transparency.

Fire station layer before (left) and after adjusting transparency.
they look at the reference scale is maintained at all scales.

One reason to set a reference scale is if you want the detail in your data frame to look the same onscreen in Data view as it will when you print it out. Let’s say you are creating a map for publication that will be printed out at a scale of 1:25,000. If you set your data frame’s scale to be 1:25,000 and then choose Set Reference Scale, the symbols and text sizes in your data frame will appear on-screen at the same size in relation to each other that they will have in your printed map.

When a reference scale is set, all layers (except for raster layers) in the current data frame will have their symbols scaled relative to the reference scale. However, you can disable scaling for individual layers: double-click the layer, go to the Display tab, and uncheck “Scale symbols when a reference scale is set.”

### Setting a reference scale for symbols

1. Set the scale of the data frame to the scale you want to use as the reference scale.
2. Right-click the data frame in the table of contents and click Set Reference Scale.

### Clearing a reference scale

1. Right-click the data frame in the table of contents and click Clear Reference Scale.
Arranging the drawing order of complex symbols and features

1. In the table of contents, right-click a data frame and click Advanced Drawing Options.
2. Check Draw using advanced drawing options.
3. Click each symbol and set the appropriate properties.
   Use the pictures to help you decide how you want the symbols to interact as they draw.
4. Click Apply to view your changes.
5. Click OK.

Tip
What does Advanced Drawing Options provide?
Use the Advanced Drawing Options to order the drawing sequence of multilevel road networks with complex symbology. You can drag and reorder the drawing sequence, join features drawn with the same multilayered symbol, and merge features drawn with a variety of multilayered symbols.

Tip
Symbolizing your data
Symbolizing by unique values will help when drawing layers with complex intersecting features.