See also this good and more extensive overview of cartographic design from the Harvard Graduate School of Design – Paul Cote’s Elements of Cartographic Style - http://www.gsd.harvard.edu/gis/manual/style/index.htm

Also, for help on making scale bars and legends in ArcGIS, see the tip sheet for Creating and Editing Scale Bars and Legends on the Tufts Tip Sheets wiki under the Mapping and Presentation section.

**Cartographic Requirements for Project Maps**

All maps must have the following (note: if some of these elements are the same for more than one map, they can be shared by those maps – e.g., one north arrow, one scale bar, source citation, your name as cartographer, map projection – as long as it is clear through placement or text that these elements apply to the multiple maps):

- A title
- A scale bar or scale text showing map units (e.g., miles, meters)
- A north arrow
- A legend (quickly understandable by viewer - real words, not file names (e.g., “water” or “lakes and rivers”, not Hydro_25k)!
- Source citations, including source agency or agencies, time period of content.
- Your name as cartographer
- Map projection used (e.g., Massachusetts State Plane Mainland, NAD 1983, meters)

Note that the spatial granularity of elements like census geography or parcels or county boundaries must also be clearly noted either in the title, subtitle, or legend (e.g., population density by census tract, land use by parcel)

**General principles**

Always keep your map viewer in mind! Lay out your maps, text and other material to help the viewer quickly understand what you want to show and to navigate through your narrative. Never make the viewer work too hard!

Provide both context and focus.

The context is “where are we” in terms of a regional or metropolitan perspective. This is usually accomplished by a map showing the study area in its larger geographic region. It may also be accomplished at a more local level by showing major roads and water in pale colors in the background.

The focus is where you want the viewer to concentrate. This can be accomplished in many ways – larger maps of the study area; the study area in fully saturated colors (e.g., clipping the land use focus area and showing that in full saturation but maintaining the wider land use context in the same colors but at lower saturation. Note: the only way I know of to lessen saturation of a layer is to increase its transparency.

Don’t include layers or information that are unnecessary for your main focus.
In maps showing ranges of numbers or categories, include as few classes as possible to convey your information. Viewers can only comprehend about 5-7 categories and color ranges.

In maps showing ranges of numeric values stick with one color ramp. If you are showing hot and cold, or above/below mean, you might use a bi-color ramp like blue to red but take great care with these kinds of color schemes.

Use white space effectively for map elements where appropriate.

Lower the clutter quotient! Don’t repeat things in the title, legend title, and legend classifications. Don’t have unnecessary decimals in your tables or legends. Don’t repeat units or % in your tables or legends. Use these elements effectively to get information across without repetition. E.g., a title might be “Transit Ridership in Boston” with a subtitle “By Census Tract (2000 Census)”. The legend title might be “Percent of Workers Using Transit”, and the legend classification could have <10, 10-30, 30-60, >60)

Use standard colors where appropriate (e.g., see the American Planning Association’s recommendations for standard land use colors at http://myapa.planning.org/lbcs/standards/colorcodes.htm)

**Setting the Data Frame’s Coordinate System**

If the data you are using is already projected (e.g., data from MassGIS is already projected into the Massachusetts State Plane NAD 83 coordinate system), you most likely will NOT want to change the coordinate system of your data frame. However, if the data is unprojected (in a geographic coordinate system – GCS), then you should project it for better map results. There are many national data sets that are unprojected, including the US data we have from ESRI. The example below shows how to project a map US data into an appropriate coordinate system.

To change the coordinate system of your map, e.g., from what you see on the left to what you see on the right (a much better way to show the US in a choropleth map):

1. **Choose View – Properties** (this takes you to the properties of the entire data frame)
2. **Click on the Coordinate System tab**
3. **Select Predefined – Projected Coordinate System** and the type of the coordinate system you want. In the case above we went to Continental – North
America – USA – Contiguous Albers Equal Area Conic USGS.

4. Click OK when done.

Map Tips

- Don't use fill patterns (hatching, dots, etc.) - they are usually very distracting and hard to distinguish - use them if you are forced to because you need to have a black and white map. There ARE a few other occasions where they come in useful, but be careful and sparing with them.
- Focus your viewer on what you want to show - include background / context data in paler colors (e.g., roads in gray, water in a pale blue)
- For choropleth maps, it is simplest to use a single color scheme (e.g., pale blue to dark blue, white-gray-black, pale red to dark red) - there are some other color schemes that work but the safest bet is a very simple color scheme.
- Use the Natural Breaks method of classification unless you think another method more effectively tells the story you want to tell and understand the reasons behind your choices. But do adjust the breaks to make more sense to a map viewer (e.g., 13.9% might be better set at 15%).
- When you are first starting with mapping in ArcGIS, stick with the graduated colors option, again unless you see a pressing need for something else. Other options like graduated symbols or dot density can sometimes be appropriate, but you should wait to use them until you have a better understanding of what impact they convey. Take a look at using charts, like pie charts (e.g., you can show in a pie chart the distribution of vacant, owner-occupied, and renter-occupied units), but again, unless you feel very confident of your design skills, hold off for now. These make good maps in very rare circumstances. Just because the computer can do it, doesn't mean you should use it!
- Manage your white space! The shape of your study area may offer some opportunities for map element placement. You might allow it to fill the whole page, for example, but still have room in corners for the legend, scale, title, etc., as in the map to the right (Travis County, Texas)
- For some layers, there are too many distinct features to show each one by a color (e.g., zoning or watersheds). For these it is often better to simply have the feature outline appear with no fill, and use the name or some other attribute to label each feature.
- Softer, pastel colors are more pleasing to the eye than bright colors (e.g., you can use a pale versions of the standard land use colors for a very effective land use map)
- For background on your different topic maps, you need to include orientation features like streets and rivers but in such a way that they don't distract from the main topic (e.g., land use) - you can color streets a light gray so that the viewer can see them but they are not so dark as to overwhelm the map. With major road and water, also be discrete.
- If your outline colors on some layers are getting in the way, turn them off with the symbology properties or work to adjust them so that they don't distract from the main idea of the map.
• The study area shape may be a challenge to show on paper. To get the most for your space on the actual map, make the data frame on the layout fit your study area, and then put the excess white space on the paper to good use for your other map elements.
• Make sure your scale is easily readable and makes sense - adjust the size so that it is reading whole miles - e.g., 2 miles, not 1.8 miles.
• Adjust the number of columns on the legend so that you can spread it across space if you need to
• Make a digital version of your map before printing on paper or a plotter – you will see how the various elements come out looking on the page size you specify – adjust as necessary
• Some additional resources
  o *The textbook – GIS for the Urban Environment* (Juliana Maantay and John Ziegler, ESRI Press, 2006), chapter 5 – Data Visualization and Map Design
  o Land Trust GIS - [http://www.landtrustgis.org/](http://www.landtrustgis.org/) - go to the GIS Technology link, Advanced Techniques – you will see several useful tip sheets, including “Design Map Layouts” and “Print Great GIS Maps”

**Layout Tips**

Set your page set-up in ArcMap BEFORE working on the map layout!

If you are putting maps into a poster or digital slide format, think about the size you need and set the Page Setup accordingly. E.g., if you want 10” by 10” map on your poster, set this in the Page Setup before doing the layout so that you have full control rather than relying on resizing an image later – see below (note Use Printer Settings is unchecked and custom dimensions are entered):
Always check your map layouts at 100% scale to see how they look. Things can look substantially different at the full scale. Orthophotos might be pixilated, or parcel boundaries that obscured the color in the map view might look fine in the 100% layout view.

Assuming you want to export to a graphic to put on a poster or in another digital format, Export to one of the following formats:

TIF – this is the highest quality format, but it can make a large and cumbersome file
GIF – this is compressed but is good for graphics that have text or categorical data/colors
JPG – this is compressed and will blur text, boundaries, etc. But it is good for imagery, orthophotos.

For printed material like posters, export to 300 dpi.

For digital materials like a powerpoint, you can export to 150 dpi

If you are putting more than one map on a page, some notes to help:

- You can put more than one map on a page by adding another data frame to your ArcMap session (Insert menu), and you can copy and paste (or drag) base map data layers from one data frame to another (e.g., streets and water bodies)
- To make all the data frame panes the same size, hold down the CTRL key and click on each pane in turn - this is the way to select multiple panes. Then with all the panes selected, right-click to get a menu for adjustments. One of the available functions is Distribute and under this you can use the Make Same Size option
- You will also see an Alignment function that will help you line up panes.
o Make sure all the data panes are showing the county at the same scale. You have to set the scale for each individual pane but you should do this towards the end of making all the adjustments to your layout, otherwise you might have to set scale all over again anyway. To set the scale for a data frame in Layout View, click on the data frame you are working on, then go to the scale area of the Standard Menu and type in the appropriate scale (I used 1:900,000 for my tabloid sheet with six maps):

**Useful functions**

To constrain a map to a certain area (e.g., town boundary, pedshed) enable “virtual clipping” by a shape file - Data frame properties – Data Frame Tab – Enable Clip to Shape. But use this sparingly – you are eliminating the context when you do this. It could be appropriate in the context of a poster where another map or maps clearly indicate context.

If you want to keep context, do a real clip (ArcToolbox – Analysis – Extract tools) the focus areas to show them in more saturated colors as discussed above.

The Data Frame toolbar has a tool that allows you to rotate the map and north arrow for a map of an area that does not fit well into your standard rectangle framework (e.g., Somerville). Again, use sparingly – people are used to map orientation where up is north, so it is easy to confuse folks where north is pointing to some other direction.

Get rid of outlines where appropriate – e.g., if outlines are getting in the way of you seeing the color differences between parcel land use or between census tract population density.

If you have a good coloring and classification set up for a layer, save it as a layer file. Then you can apply it to a clipped copy easily.

**Legend Tips**

Creating good legends in ArcGIS takes experience – don’t be afraid to experiment, then delete and try again!

<table>
<thead>
<tr>
<th>Bad legend</th>
<th>Better Legend</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Legend</strong></td>
<td><strong>% Renter Occupied</strong></td>
</tr>
<tr>
<td>RENTER_OCC / HSE_UNITS</td>
<td></td>
</tr>
<tr>
<td>0.02555 - 0.2070</td>
<td>&lt;20</td>
</tr>
<tr>
<td>0.2071 - 0.3718</td>
<td>20-35</td>
</tr>
<tr>
<td>0.3719 - 0.5322</td>
<td>35-50</td>
</tr>
<tr>
<td>0.5323 - 0.7426</td>
<td>50-75</td>
</tr>
<tr>
<td>0.7427 - 0.9639</td>
<td>&gt;75</td>
</tr>
</tbody>
</table>

How to get from here to there...

This is what I do with legends - you can also read up on them in ArcGIS Desktop Help.
• First, when creating the map in the first place, set intelligible breaks and labels for your data - you do both these things in the Layer Properties - Symbology tab, as in the example below (renter occupied normalized by total housing units to show percent renter-occupied) - here I have used the Natural Breaks method but I am in the midst of slightly adjusting the upper break points in each range and applying labels:

![Layer Properties window](image)

• Next create a legend in the layout view (Insert - Legend). I typically accept all of the defaults. This gives you the bad legend but you now have something to play with...

• In the lay-out, right-click on the legend and choose Properties.

• In the Legend tab, I type the legend I want to see on my map, e.g., % Renter-Occupied. Make sure that Show is checked.

  (Note: in your title or other text, you should be explaining what the map is in full, e.g., Percent of total housing units that are renter-occupied. With that done, your legend title can be very succinct)

• In the Items tab (still in Legend Properties), first make sure that any items (layers) you don't want in the legend are not showing by clicking on unwanted items under Legend Items and moving them back over to the left)

• Next right-click on the legend item of interest (or the one that is causing problems, in my example the item is the layer `census2000_tracts_sf1`) and select Properties
• In the Legend Item Properties box, click on the General tab, and uncheck Show Heading. This gets rid of the annoying RENTER_OCC/HSE_UNITS heading.
• Another route to modifying the legend is to click on the item as above, then click the Style... button, then click on the various style examples and check the little preview pane. I use the third style down - Horizontal Single Symbol Label Only for the census maps.
• You can adjust the number of columns in a legend by putting down how many columns it should have in the Legend Properties box. Also, if you click on a particular legend item, you can indicate that a new column should start with that item.
• You can adjust the order of the legend items in the Legend Properties box.