Basic Principles of Cartographic Design

This session introduces the basic principles of map design to those with no formal cartographic training. Learn how to create maps with meaningful symbology that is easily deciphered and quickly captures the eye. The session will stress the communication channel between the map designer and the map reader, andwhat you should and shouldn't do in map design for both paper and digital media. Some cartography issues will be discussed, but the main objective is to teach you how to create better maps.

http://video.esri.com/watch/77/basic-principles-of-cartographic-design

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Video Transcription

00:01 My name is Makram Murad-al-shaikh and I will be presenting this workshop for you on cartography.

00:12 Can you change that to the presentation until they [unintelligible].

00:18 [inaudible]

00:21 The one that the …

00:22 [inaudible]

00:25 No, not this one. This one, yeah, this one, yeah.

00:32 I studied engineering way back when I was studying my bachelor's degree, and I kind of liked maps all the time...

00:42 ...so when time came and I was still in Baghdad teaching in the higher education system...

00:49 ...I decided to change course.

00:51 So, I went to the University in Wisconsin and did my master's degree in cartography and science in Wisconsin...

01:01 ...and I studied under all these big names of cartography, like Morrison and Robinson, if you have...

01:09 ...heard of the Robinson projection.

01:11 I met the guy and I invited him for dinner, Iraqi dinner, at home.

01:16 My wife was with me, this is why I could invite people.

01:20 And then they asked me what do I want to do in lieu of a thesis, if you want to do non-thesis options...

01:30 ...and I said, well, I want to do it in remote sensing, so I did that.

01:34 And while I was there in 1982, I was two years old, and this is when they...there was a course called...

01:42 ...Problems in Cartography, and they would change the topic each year.

01:46 And this year, that year was in GIS.

01:49 And I thought, well, let's take it, because I have to take it anyway.

01:53 So, I took that course and I thought, that is what I want to do, maybe in the future.

01:58 Unfortunately, I was forced to go back to Iraq to enjoy two more wars.

02:06 The end of the war of Iran and the Gulf War, and after that I left the country and in 1992...

02:13 ...I came to the United States and in 1993 I was employed by Esri.

02:19 Not ESRI, Esri.

02:21 Now I have to get used to it. And I've been teaching since then, all different courses.

02:27 I don't teach only cartography, but I wrote the cartography course, the original cartography course.

02:33 And I also teach GIS cartography courses in local colleges and universities since 1996.

02:42 Let me...Jorge, would you like to speak, something, just a few words.

02:48 He has been an instructor too.

02:51 Just in case something happens to me, at least you know that he has credentials, too.

02:59 Okay. I don't have a microphone.

03:03 They're going to...Yeah, just shout!

03:05 I don't need a microphone.

03:08 Only the cartographer needs a microphone. I'm a geographer. [inaudible] ....I'm just here helping Makram...

03:19 and we work together and we love maps, and I hope we can have a good time through this presentation and [inaudible]...

03:31 ...for many years following the path of teaching GIS and making maps...

03:39 ...and trying to make the best maps that we can use to communicate, and useful maps with GIS, not...

03:47 ...beautiful maps for your walls...at...home and use it as...oh, look at this!

03:56 I've spent thousands of dollars to build this beautiful map.

04:01 We want to use maps in the field and anywhere.

04:05 You'll see. We have been principled to tell you...Okay.

04:09 Thank you, Jorge. This is another guy with an accent, like me.

04:13 I studied under the American Jesuits from New England in Baghdad, nine years with them, high school and university.

04:19 Anyway, so this is what we're going to tell you today.

04:23 Since we have two screens and I can only point to one, anyone can tell me if they can see the red dot if I don't shake it.

04:36 And so sometimes I will be entertaining you, and sometimes I will be entertaining you guys.

04:43 So this is what I'm going to tell you about, we will define cartography for you and thank you for...

04:48 ...coming all of you, for this session.

04:51 Cutting yourself from software and coming to learn about cartography which has nothing to do with the software.

04:57 Well, yes it does.

04:58 I will point to some things that are related to the software and since I hope there will be no meetings in this room...

05:07 ...I can extend it as I please, and if you like to stay.

05:11 There's nothing else to do after that, I guess.

05:14 So, I will define cartography, talk about the communication channel, and why maps fail.

05:22 And talk about the objectives and limitations that are affecting the design, and talk about cartographic design issues...

05:31 ...and how you would abuse GIS cartography.

05:36 Not to abuse, I mean.

05:38 So, what is cartography?

05:40 Different resources would define it differently.

05:44 In the International Cartographic Association, they would define it as the art, science, and technology of making maps.

05:55 And notice the word "art" is not in red, which means it's okay to have beautiful maps but it is not the main objective...

06:03 ...of why you should create a map, because you can always be an artist and do whatever you want but whether...

06:09 ...the art will be useful or not, it's a different issue, and that's what I am trying to preach in

this entire workshop here.

06:21 Some would define it as making maps and some of them would define it as presentation, but my main...

06:27 ...word here is "use."

06:29 It is about use. It is not about you creating the map, it is how the 10,000 people who are going to read your map...

06:38 ...whether they are going to make use of that map or not, and this is what you should be always having in mind...

06:44 ...when you're creating any map.

06:47 So I am here to sitting somewhere on my desk.

06:52 I am a cartographer, I am a map specialist, I am a GIS specialist, I am not that fat!

07:04 I could be a CAD specialist, and I would be compiling data from different sources in reality.

07:11 It could be images from space, it could be images from, or photos from low altitude, high altitude...

07:20 ...photography, could be from maps that I have collected, and I could also have lived in the place.

07:26 And sit down here, and based on the objective of why am I creating the map, I would recognize...

07:35 ...that objective and recognize all that data, and select from it what is relevant to my objective...

07:46 ...and then classify, simplify my selection, and then finally put some symbols on it, or representing it...

07:56 ...on a piece of paper or maybe on the screen, and give it to my users who are sitting or standing there...

08:03 ...with a map and reading, analyzing, and interpreting what I have placed.

08:09 So , this is similar to when I give you directions to my house.

08:13 I will say, okay, you exit on this highway, you exit on exit 16, turn right on this street...

08:23 ...turn left after the second traffic light, turn left and turn right and so on, until I get you to the place.

08:33 However, I selectively did not tell you, after each one of these rights and lefts, what do you see on the right...

08:40 ...and what do you see on the left?

08:42 I selectively did not.

08:44 I did not tell you that there's a red building on the corner where you're going to turn right on.

08:51 So this is the same thing we're doing with our maps; we're actually looking at all that data that we have collected...

08:57 ...and we only select what we think it is relevant to the objective of the map, and then put it on that piece of paper.

09:05 And these people are going to look at my two-dimensional symbols, and they would extrude a vertical height...

09:17 ...or elevation of these buildings or these, whatever symbols, a tree that I put for them.

09:22 And it depends on their conception of reality whether they are going to...they would put their...

09:30 ...own windows and doors on these buildings, and also they will change it maybe to not only a rectangular one...

09:38 ...but how the architect would like it to be with all these crooked inside, in and out of the edges of the buildings.

09:47 So they can do whatever they want.

09:48 It's not under my control anymore.

09:51 I gave them the map, that's it.

09:53 And they are going to create a mental image of that reality.

09:59 Same thing as we are trying to create the mental image of the reality as I am trying to describe to you...

10:06 ...where...how to come to my place.

10:10 So whatever I give you, or I give that map reader in my map, is going to affect how this person is...

10:22 ...going to reconstruct that image of reality in their minds...

10:26 ...and how useful would that map would be to them.

10:31 So what is cartographic design?

10:33 It is a complex task.

10:35 On your screen display, you have three light guns.

10:40 One for the green, one for the blue, and one for the red.

10:44 Each one has 256 different shades.

10:46 If you multiply this by simple math, this is like 16.7 million colors that you have to choose from.

10:57 That's a lot to choose.

10:58 It's like you're finishing high school in the United States and you don't know what to do.

11:03 You're going to school.

11:04 You want to go to study.

11:06 You've got millions of different disciplines that you can go to and apply to.

11:11 It's very confusing.

11:13 Same thing as with maps.

11:15 There's so many symbols that you can create.

11:18 Each line can be a full line, can be a dashed line, can be a dotted line, can be a dash and a dot, a dash and a circle...

11:25 ...and a dash and a plus.

11:27 Millions of combinations and you have to choose from what to choose from.

11:30 So, it's a complex task.

11:33 It's a highly creative mental activity.

11:35 You have a specialization. You're a geologist, you're a geomorphologist, you're a hydrologist, you're a city planner.

11:43 You're an environmentalist and you have your own discipline.

11:45 You have all the specialty that you need to work in.

11:50 And then you have collected all this data, and then you came to my presentation here, and you've learned all that...

11:57 ...thing, and you're going to collect all this kind of information and put it in your map.

12:03 So, it is a complex type of a task, and it is highly creative.

12:08 You're thinking about how you place things in the map and what to put and how to color it, and so on.

12:14 You're using concepts of communication.

12:17 You're communicating with your graphics.

12:19 You're actually thinking in visual terms.

12:22 You're trying to create some hierarchy in your symbology, like larger symbols for more important type of information...

12:29 ...quantitatively, and less important would be a smaller size, and so on.

12:35 And all this, all these four things, are pointing towards creating a useful map.

12:42 You want the end person who is going to use it, is going to make use of it.

12:48 What are, then, cartographic objectives?

12:52 There are two types - one is called the map objectives, and the other one is design objectives.

12:57 The map objectives, why am I creating the map in the first place?

13:01 I have to ask myself, well, I could be highlighting some spatial relationships; I could be illustrating some analysis...

13:09 ...results that I have worked for two weeks on and now I am trying to present it; I want to convey some information...

13:17 ...and, finally, I want to have some easier comprehension of this complex type of events that are happening around us...

13:25 ...and I am presenting it with this piece of paper or this display.

13:30 Now, how do you do that, is what the design objectives are.

13:34 So I am going to take what I have, what I want to create and assign some meaningful symbology to whatever...

13:45 ...I want to create, and basically I am trying to fulfill these map objectives and ensure some truthful...

13:54 ...depiction of reality. A meandering rivers should be meandering no matter what scale of map you're using...

14:02 ...if it's a large scale or small scale, so it continues to be meandering.

14:05 So it's a truthful representation of reality.

14:09 And you want to fulfill some communication objective.

14:13 Communication objective is actually, what are you trying to create?

14:18 Which type of maps?

14:20 And one of them would be a general map, and a second one would be a thematic map.

14:24 A general map meaning that you have no bias toward any discipline, like topographic map is being created...

14:33 ...for many different disciplines.

14:35 You do not want to be biased to any discipline, and therefore your symbology will have a variety of information...

14:42 ...but your symbology will be of equal importance.

14:46 And therefore, your symbology should be subtle, which means no dark colors, no large objects...

14:54 ...so that you do not attract attention to something that you do not want to attract attention to...

15:00 ...because basically you're not biased.

15:04 But, in thematic maps, you are actually focusing your design on specific things.

15:13 Like, for instance, you want to create, in terms of qualitative thematic maps, you want to create a soil map...

15:21 ...so you are biased towards the soil society or discipline.

15:26 And it is qualitative because, what you are trying to do is to just identify which soils they are.

15:34 You are not saying that this soil is more important than the others.

15:38 So, basically, all your soils are equally important, and therefore your symbology should also reflect that.

15:45 You should not use dark or light in that kind of map.

15:50 All of them should be of subtle type of symbology.

15:54 In terms of quantitative, yes, I want to make some large and some small, because I am depicting quantity.

16:02 So there are some places where there are more population and there are more places that are less population...

16:08 ...and therefore my large or small symbol would indicate that.

16:13 The size would be the type of quality or property that you want to establish in this map.

16:23 You can turn a soil map from qualitative to quantitative by saying, okay, I want to accentuate this map...

16:32 ...by some color, indicating that this soil is more fertile for corn production.

16:39 In this case you are being biased now toward the other soil types that are nonproductive for the corn...

16:48 ...and so you want to make it darker or maybe you want to show it in a different color.

16:56 Like, for instance, red, which comes to your eyes in a higher visual level than green or than blue...

17:04 ...because of the wavelength, and how our eyes and retina would react to the longer wavelength first...

17:12 ...which is red, and the shorter wavelength next.

17:18 So, next thing you want to think about, which projection should I use?

17:24 Well, I am licensed to say that there is no projection on earth that is correct.

17:30 And for those of you who have been attending the previous session, you already discovered that.

17:35 There are some distortions, and these distortions can be either in shape or area or distance or direction.

17:45 You cannot maintain all these four properties in one map.

17:51 You can maintain it on the earth's surface, and you can do nothing about it, because this is how it is.

17:57 But when you turn it into a two-dimensional piece of paper, this is when projection is going to be used...

18:04 ...and this is when you have to do away with at least one or even two or even three of these properties, and just keep one.

18:14 For instance, you maintain only, you preserve only area.

18:19 This is what is called an equal area projection.

18:22 This is what you should be using maybe in a population density map, where you want to compare data...

18:29 ...based on density; in this case, it has to be an equal area projection.

18:37 And there are three different types of projections, by geometry, it's cylindrical, conical and azimuthal.

18:46 These are the developing surface that you would be actually using to project all the earth's surface - the different objects...

18:58 ...on the earth's surface into the inside and to the underside of these different developing shapes...

19:03 ...and then you would cut it open and then you flatten it, then this is what is called a projection.

19:11 This is basically a very simple way of explaining projections, but it is more involved because...

19:19 ...it has a lot of mathematics.

19:21 In the good old days when I was studying cartography, I had to sit down and calculate by a calculator - yeah, there...

19:33 ...was some calculators in my age. At that time, I was studying.

19:37 So I had to calculate every coordinate and then grow it myself.

19:43 Now you have a push of a button to pick up a projection.

19:47 You are more lucky than I was when I was studying projections.

19:54 Now, how much detail should I include in my map?

19:58 Well, it depends on what scale are you using.

20:02 If you are creating a large-scale map for the city where you want to have every tree should be taken care of...

20:12 ...in the map, this is a very large-scale map.

20:15 Normally the engineers would love that.

20:22 And it is important because they are going to run the pipes, and they want to know not only the location of the trees...

20:30 ...but what type of roots.

20:33 Do they grow downward, or they spread horizontally, and you want to be away from the roots when they...

20:40 ...grow horizontally, so that you lay the pipe and you don't have a lot of maintenance to do on your pipes...

20:46 ...so you need a large-scale map.

20:48 But if you're trying to develop, you're a city developer, and you'd like to see how the city is expanding in the year...

20:59 ...maybe, 2020 and 2030, then you don't care about the individual trees anymore.

21:07 You are now looking at a smaller-scale map where you are going to get rid of a lot of details...

21:14 ...and this is what generalization is all about, and then you are going to look at the general picture of the larger extent.

21:22 This is why you go from a large scale to a small scale, because you're not interested in local details...

21:29 ...you're more interested in larger extent.

21:32 So, you would be using generalization, and these are the different types of generalizations...

21:38 ...or things that you could do, so you could omit.

21:44 Omitting, meaning there are these four different larger rectangles and there are some small ones.

21:53 You keep the larger rectangles and you get rid of the smaller ones.

21:57 Of course, engineers and surveyors will hate you for that, but this is life.

22:02 You are looking at a smaller scale.

22:04 So you're not interested in that detail; this is okay.

22:07 Don't give your map at a small scale to the engineer or to the surveyor, basically.

22:13 So, in terms of the river systems, also all these different smaller tributaries...

22:21 ...can be just deleted.

22:24 You can aggregate, so you have several different locations of points, and instead of representing them as points...

22:32 ...say, they are trees, instead of showing them as point features, you can create a polygon aggregating...

22:39 ...them into a zone of trees, which is called a forest.

22:44 And then you would specify in your database a polygon instead of a point.

22:51 You can also collapse.

22:53 You are looking...this generalization is happening into two types of...most of the generalization is happening...

23:02 ...when you are going from large scale to small scale, but also you can do it at the same scale...

23:08 ...but for another purpose, you do not want too much detail and you can get rid of things.

23:13 But, most of the things are happening at a small scale.

23:15 So at a small scale, a thin river, which is presented as a polygon here, can be collapsed into a line, which you can.

23:27 You don't need the polygons, you will go into a line.

23:30 At the larger scale, you have digitized all your streets as polygons.

23:37 But what if you wanted to do network analysis?

23:41 You cannot do network analysis with polygons.

23:44 You have to collapse them into lines, centerlines, and then do the analysis on the lines, instead.

23:50 And so we have simplified it.

23:52 There's a lot of vertices here in the lines, and also there are many different pieces of information for the buildings.

24:00 I can generalize it, I simplify it with lesser, maybe lesser meandering here - still meandering...

24:05 But if you're not, then this is image flattening that you...

24:07 ...but lesser meandering than what it was.

24:09 And also in terms of the buildings.

24:11 I can also displace - displace, that means I can move a feature away from its position.

24:19 Don't tell your surveyors you did that.

24:23 You can do that because you are trying to create an easier-to-read map.

24:30 There are two lines that are very close, and you want to show them as they are separate.

24:36 As you go to a smaller scale, these two lines are going to really combine and become one.

24:42 So what you have, you have the cartographic license to spread them apart.

24:50 Now here's the deal.

24:51 Instead of telling the surveyors I did that, you tell them, I'm going to use cartographic representation and then...

25:00 ...I'm going to graphically move these apart, but the geometry range is the same.

25:06 This way, everybody's happy.

25:08 But you have to learn cartographic representation.

25:11 This is why you need to go to a cartography course.

25:14 Or maybe ask downstairs tomorrow about cartographic representation.

25:19 You could typify.

25:21 So I've got these two, four, six buildings in here.

25:24 I typify it with three buildings.

25:27 I want to show there are buildings, but I don't want to show every single building.

25:30 I am going to a small scale. This will be too crowded, so I just typify it with three.

25:34 I should also refine.

25:36 So instead of having this particular jagged line, which happens to be somebody who has done very crooked...

25:45 ...or maybe very fast digitizing, I could refine it by maybe curving those lines a little bit.

25:53 But what I'm doing actually, I'm deceiving the map reader.

25:56 Anytime you make changes like these, please don't tell them Makram told me this.

26:00 You have three different types of clay soils at the larger scale.

26:03 Tell them, with a small line underneath, that I have moved things away from location for clarity.

26:13 Be frank so that people will actually always believe you, that you're not cheating.

26:19 You can tell them that you have also added some vertices to these to make it nicer, look nicer.

26:25 So tell them this. Not too tiny, like the advertising in the credit cards.

26:33 They show too-tiny text.

26:36 Legible enough to read, but not too overwhelming on the map.

26:42 Classifying.

26:47 At the smaller scale, you just want to tell them that this is clay.

26:50 You don't care about montmorillonite or illite or calamite for those guys and the geologists...

26:59 ...that are sitting here in the audience.

27:01 You just tell them, I want this area to be named as plate...

27:05 ...and that's enough for me at the smaller scale.

27:07 I'm not interested in details.

27:09 An exaggeration.

27:10 This is when you are increasing the thickness of the line beyond what the scale allows you to.

27:16 So I want a 10-meter-wide road at a scale of 1 to a million would be .01 millimeter.

27:28 There's no such pen in the industry that can grow .01.

27:32 The smallest is the .1, which is equivalent to the triple-zero [unintelligible] pens.

27:39 And that's the smallest it can go.

27:40 Well, the microfilming industry can go to .08.

27:46 But you still, this is .01.

27:48 But .01 is a very thin line.

27:50 But you want to make sure that it looks, people would find it.

27:55 Remember, it's all about the user, it's all about the map reader.

27:58 You want to make it a little bit thicker, so you exaggerate the thickness of the line so they can see it when...and...

28:07 ...they can discover it when they are reading the map.

28:10 But, when you do so, please have that statement at the bottom, telling them that you exaggerated the thickness...

28:17 ...of the line for clarity purposes.

28:21 What symbol should I use?

28:22 Okay, I am now at the point I'm trying to decide on a qualitative map against a quantitative map.

28:28 Which one?

28:29 Well, a qualitative map, that means I can change differences in color, I can change differences in shape...

28:37 ...I can change differences in...or use differences in texture or pattern.

28:43 This I can use.

28:45 I cannot use size, or graytone value - how dark or light it is, that's graytone value.

28:55 This is for quantitative symbology to use.

29:00 What colors should I use?

29:02 Okay, so I'm thinking of red.

29:04 How many are thinking of the same red?

29:07 And remember I can change my mind.

29:11 We cannot communicate red just by telling you I am thinking of red.

29:17 I could be...there is at least four different reds in here.

29:21 So, I need to give you more details.

29:24 This is why we came up with these dimensions, like hue, and value, and saturation, so I have to give you...

29:31 ...which color hue it is, so I'm telling you it's red or green.

29:36 And let's stick with green so my other examples are green.

29:42 And the second dimension I have to tell you is value, which means how dark or light is that green.

29:50 And then, saturation is how bright or dim is that green.

29:57 And so this is three different important dimensions that I have to give you.

30:03 This is the hue, saturation, and value, one of many different types of color models that ArcGIS and ArcMap can support.

30:13 We have the RGB, which is the red, green, and blue, and then we have the cyan, magenta, and yellow.

30:22 The red, green, and blue is for your screens.

30:26 Any map you create for your screens, you can use the RGB, because is our default in ArcMap.

30:31 See, I told you, I'm going to talk a little bit about software.

30:34 And the cyan, magenta, and yellow, you think about it when you are going to send the map to a printer.

30:40 So you change your settings inside ArcMap to go into cyan, magenta, and yellow, and design your map accordingly...

30:48 ...because this is easier to translate when it goes to print on your printer.

30:53 And hue, saturation, and values is another one and there's other different types like the CIE color model, and so on.

31:03 Colors have connotations.

31:08 Colors have conventions.

31:09 Connotations like, for instance, red for higher temperatures.

31:15 Blue for lower temperatures.

31:17 Conventions. Some are, there are some...like the geological society.

31:26 Internationally, they have sat down and decided what colors they would use for their different types of...

31:36 ...rocks. So metamorphic, and all that.

31:41 And there are some color preferences.

31:43 I prefer green; how many of you sitting in the audience like green?

31:49 See? Not all of you like green.

31:51 So you should not force your green color onto somebody else.

31:58 This is why you need to do some research on your society on what colors they would prefer...

32:05 ...so that you can sit down and view use for your type of organizations or your type of state or sometimes...

32:16 ...in different countries - like, for instance, I know about Iraq.

32:19 In northern part of Iraq, they just like bright colors.

32:23 So, if you choose not to create maps with bright colors, this is offensive to them, maybe.

32:31 So, it's especially true for you guys in the United States who take some contracts for working for other countries

32:39 ...you need to study what type of color they'd like in those other countries, so that you can design accordingly.

32:48 Excuse me.

32:53 And also for maps that you create on your screen, you use some colors, they will not go and be printed the same way...

33:04 ...as you think they would, because you have 16.7 million colors that are going to translate to...

33:10 ...something like 256 different colors on your printer.

33:15 This is why we always tell you to print the - what is it called again? - that MXD that we have in the software?

33:26 I always forget it.

33:34 I will remember; it will come.

33:37 So there is this MXD file that has, it is a color model in which you can print it on every printer that you have calibrate.mxd.

33:48 Search that under the program files, ArcGIS, search for calibrate.mxd.

33:56 And then send it to print to your printer that you are going to use to create your maps with...

34:03 ...then select the colors that are from that chart so that you can make sure that whatever you select...

34:13 ...on your screen actually be printed, the same color that you want.

34:21 Now this is for you guys.

34:24 A lot of GIS people do not know that the human eye cannot decipher, cannot, notice the word "not"...

34:35 ...cannot decipher more than 12 colors on one map.

34:44 I will repeat it. They cannot decipher more than 12 colors on one map.

34:50 If you put more than 12, it's going to be a nice-looking map.

34:56 But not...starts with a "u"...not useful.

35:02 Which means they cannot decipher the colors.

35:04 Like, for instance, if you look at these colors, this one in here, this one in here, to me on my screen at least...

35:10 ...over there because this, just by way, went to the projector, and so the optics did their play on it, dissipated...

35:20 ...some of the light, and also my screen here did some defractions on it.

35:24 So they're not the same colors as on my screen anyway.

35:27 This is just to remind you of the printers, also. They do the same thing.

35:32 So, these two colors are the same.

35:36 These two colors to me are the same.

35:39 These three, they are very close.

35:42 These are, when you try to create a map and let the software decide for you, to ArcMap, to the computer...

35:52 ...this is at 253 of red and 254.

35:59 It knows it's different, but to my eye, it's not.

36:03 So you need to think about the user.

36:06 Also, in terms of the maximum shades of the same color, the human eye cannot decipher more than...

36:15 ...seven or, maximum, eight.

36:17 In fact, in our teaching now at Esri in the courses, we say six to seven, even.

36:25 And these should be distinct shades from the 0 to 255 continuum of the shades of the same color.

36:34 You have to pick one from here, one from here, one from here, one from here.

36:37 So it has to be distinct.

36:40 This is when you are trying to use quantitative type of mapping, when you're classifying your data.

36:48 The default is 5, by the way, in ArcMap.

36:52 But you can go to 100, if you want.

36:55 You can choose 100.

36:56 But, whether that's going to be a useful map or not, is not going to be useful.

37:01 Now you have to think sometimes about the color impaired.

37:04 I tried my best to bring this to the same colors that I think it was from research.

37:11 This is how people with deficiency in red would see.

37:16 The colors that normal eyes would see.

37:19 So there's no red. The deficiency in green, they would see like this.

37:23 Those who are blue defective would see this.

37:27 And those who are blue defective, by the way, are very rare.

37:32 And by the way, the women actually have better, they are better than men in terms of color

deficiency.

37:44 There are some 5 to 8 percent of the male population who are color deficient.

37:50 And the women, is only .5. This is because of the XX and XY chromosomes, if you learned your biology...

37:57 ...way back in high school.

37:59 So you need to avoid for these people when you're asked, try to avoid pure green or pure red.

38:06 Instead use for them shapes, different shapes and different textures.

38:10 And also what you could do is you can use changes in brightness instead.

38:16 Brightness, contrast instead of changing or adding more colors.

38:24 Now, this is what you should not use.

38:30 It is called optical illusions.

38:35 Any time you use a checker box like this where you use symbol component of black is alternating...

38:42 ...with an equal size of white, it will vibrate.

38:47 And the way to discover that is just move your head slightly this way or that way and I won't tell you're doing that.

38:58 Just move like this and you'll see it vibrating.

39:01 Do it the same way with this one.

39:05 Also there's something else that happens.

39:07 The human eye was created in such a way that we actually see illusions like these.

39:15 So, these are five rectangles that have been shaded progressively.

39:24 Each rectangle was uniformly shaded in the same color, but the next one has a darker shade of red.

39:36 There was no outline added, but when I put it together, it looks as if this area here is darker than this area here...

39:45 ...as it meets the darker red on the right-hand side.

39:51 Can't do anything about it; this is how our eyes are created.

39:54 So, that's optical illusion.

39:56 There is another example.

39:57 These two rectangles are the same.

40:03 I was pointing at these rectangles; this one and here, for you guys.

40:07 These are uniformly shaded.

40:10 But as I have placed this shade, behind it was a gradual shade of gray, the left part looked lighter than the right part.

40:27 What does that tell you?

40:31 You are going to place symbols, right, that are of the same color, and they are falling on different shades of gray...

40:41 ...or shades of blue.

40:43 So basically what I'm telling you here is that it will not look the same.

40:49 Now, if you are fortunate in your design, that you used one color and one circle like...

40:57 ...for instance, a red circle that you're placing on that background, on that variable background...

41:04 ...and there's one red circle in your legend, then you have no problem.

41:09 But if you have two reds that you have chosen, one is a little bit darker than the other one, and you're placing it...

41:16 ...on different background of shades, and remember what you do in map reading; you are looking at a symbol...

41:24 ...in the map body, taking your eyes to the side, to the legend, and then you are trying to find an association...

41:35 ...while you are remembering what you saw.

41:38 And that distance is related to time and we are growing old.

41:46 And if we cannot find the association fast, we have to go back and read again.

41:55 These trips back and forth, the longer it takes and the more number of trips you make, you will not use that map again.

42:05 So your map, if this has these qualities, you are going to have wasted your time because the map reader...

42:14 ...is not going to use your map.

42:17 And there are these last maps too, in which when you are using slanted lines or vertical lines, these lead the eye to...

42:28 ...as you are reading and you see a line, or a bunch of lines, your eyes tend to go in that direction.

42:34 This is how these guys in movies try to trick people to look at where they like you to look...

42:41 ...so that you won't see the effects that they have done.

42:45 And they do it fast sometimes in these movies that, what do they call them?

42:52 The adventure movies and all these like fast movies like the one from space and all that.

43:00 So there are a lot of things that they do small and they enlarge it on the screen and they trick you into looking here...

43:07 ...rather than there, so they don't see the cables or they don't see the Starbucks on a film that was done in the...

43:15 ...whatever, the 200 A.D. year, or something.

43:19 Things like that.

43:25 When do I use patterns?

43:27 You use it only for areas because when you use patterns in TIN symbology like a dot with a pattern in it...

43:35 ...or a line with a pattern, you cannot tell the difference.

43:40 So only use it in areas.

43:42 And this is only for qualitative symbology.

43:45 And also consider the effects of production, especially when you right-click on your data frame...

43:52 ...or you right-click on the legend and convert to graphics.

43:58 Once you convert to graphics, that item is not going to be linked to the data frame any more.

44:06 So as you reduce it in size and enlarge it, it's not going to be the same...

44:14 ...excuse me. Don't drink coffee when you're teaching...

44:21 ...especially this colored water outside.

44:24 So...Turkish coffee is better.

44:27 So the problem is that when you convert to graphics, what happens is that the item that you have converted...

44:38 ...to graphics will lose the link to the data frame.

44:42 So as you reduce it or enlarge it, it will not have any effect on the other one.

44:48 So the data frame will not change.

44:50 If you change the data frame, the legend is not anymore connected, and so it remains the same.

44:55 So if you have converted to graphics, then what happens you use patterns, the patterns...

45:01 ...will not look the same, especially if one is reduced or enlarged, so they will not be the same.

45:07 And this is what you want to, you want to have your legend very similar to your map body so that people...

45:15 ...will be benefiting from reading the legend.

45:21 How legible are my symbols?

45:23 Well, it depends on the size of symbols and how far are you from the map.

45:33 So this is what happens.

45:35 When you put your map in the Map Gallery, there are people there who are going to judge it...

45:41 ...especially if you say I want it to be in this category and I want to win an award?

45:46 Well, next year you are going to win an award because you are here.

45:50 So, what we need to do is, if the map is going to be placed on a wall, it means that I'm going to read it...

46:01 ...something like three to five feet away, or maybe a meter or so away.

46:05 I need to design my symbols and my text to be legible at that distance.

46:13 If it's being hand held, it's okay. Most of the time you can read it.

46:19 But if it is placed it on a wall, you have to design it as such.

46:24 Your smallest text and smallest symbol must be legible at the distance that was designed for it...

46:32 ...which is, in the Map Gallery, it should be at least three to four feet away, or five feet away, or maybe one meter...

46:38 ...to those who are metric, one meter to one meter and a half away.

46:42 So, the United States should has gone metric [in] 1984.

46:51 So, in the elements of cartography and part of my presentation which you are going to get by the way on the DVD...

46:59 ...after the conference, there will be a bunch of references.

47:04 One of them is the Elements of Cartography.

47:06 In one of these places in the book, there is a graph in which you can enter with how far is the distance of viewing...

47:16 ...and you'll end up how many point sizes your minimum size of points that you...

47:23 ...of the symbols, the smallest symbol that you could be using in your map.

47:27 That's a very useful one.

47:30 I have just given you an example.

47:32 And notice that not all people have perfect vision.

47:35 Remember that we test our eyes only at 20/20, and maybe every other year.

47:43 So if you're looking at a map after one and a half years after you tested your eyes and got glasses, it might not work.

47:52 Especially if you are after 30 years, like me. I'm 31.

47:56 Oh, I'm sorry, I'm 30.

47:59 Are there any specifications?

48:01 Well, yes, there are.

48:02 In the International Cartographic Association, there are three perceptions, thresholds, there are three thresholds.

48:10 One of them is called the perception threshold, which is the legibility of the smallest detail.

48:17 So the smallest detail will be if lines should not be less than .1 millimeter.

48:23 For those of who are not, they don't know what millimeters are, you have to divide by 25.4 to get it in inches.

48:31 ...and then you have to multiply by 16, all that thing that is not easy to use.

48:39 And then the points, the points should be, if it is a full point, meaning that it is all colored in, if it's a square...

48:51 ...it should be .5 millimeter - the minimum, .4 millimeter if it's round.

48:56 If it's hollow, it should be minimum .5 millimeters, for both the square and the circle.

49:04 The threshold of separation, this is the distinction between adjacent details, so I have two lines.

49:11 How far they should be at that scale.

49:15 It should be more than .2 millimeters.

49:20 And the differentiation, they didn't put any numbers in there, they said the smallest difference...

49:27 ...between nearly same-size symbols.

49:31 So, if you're going in graduated circles in which the circles are graduated based on the, how much is the population...

49:43 ...so in this case, if we have 100,000 people and 100,400, this will be a very small difference...

49:53 ...so your circles will be very close in size.

49:56 So in this case you have the cartographic license to increase one of these circles to be a little bit larger...

50:04 ...so it can actually be identified.

50:14 Creating visual contrast and hierarchy.

50:17 Visual contract is actually why we can see, because there is contrast.

50:26 So there's, in terms of differentiation, if I did not do any contrast in my symbology, like the example in here...

50:36 ...I just drew these two, and I know that I'm drawing for my maps land and some sea, but I did not identify them.

50:45 However, I could gray the land, or I could gray the sea.

50:52 In this case I have increased the contrast between the land and the water.

51:01 I could also create some relative importance by adding some signs, in this case, symbology...

51:09 ...with larger circles and smaller circles, or lines with thinner and thicker lines.

51:15 Or, I might be using variation in color value, how dark or light it is, so I am increasing the contrast between my symbology.

51:33 So how do I represent names on maps?

51:37 Well, I can use some qualitative symbology in my name placement.

51:46 So change colors, I can change styles, I can change form, the form meaning upper/lower case...

51:53 ...or upper case only, or upper/lower case with a slant.

51:58 My advice is never use upper case only.

52:01 If I give you a book to read which is all upper case, unless you are a United States policeman or lawyer...

52:11 ...you will take 1.25 to 1.5 times to read it.

52:17 Because we have imprints in our minds of upper/lower-case words, we don't read letters anymore, we read words.

52:26 Actually, our kids, they learn how to read words more than letters, and it is easier for us - we don't, when we read...

52:33 ...we don't read the "T-H-E" as, oh, that's a T, an H, an E; oh, that's "the." No, we know that's...

52:40 ...a "the" in here, so it is easier for us.

52:45 Also, reading a book is different than reading a map, because reading a book is sequential.

52:55 Sometimes a word comes into a paragraph and we don't know what it is.

52:59 How many know what serendipity is?

53:02 It should be 10 percent only.

53:04 Always doesn't fail.

53:07 Serendipity, by the way, it's also about the Indians. This is a good thing about the British.

53:16 The British took a guide named Serendip with them as a guide, and this guide discovered something...

53:23 ...that the British were not looking for.

53:25 That's what serendipity is, by the way.

53:27 So now you've learned one more word for your Scrabble game, if you will.

53:33 So if you are reading this word in a paragraph and you didn't know what it is and you still understood...

53:39 ...what the paragraph is all about, you're in the airplane, it's okay; you went and you continued reading.

53:45 In a map, you are looking for that word that you want to know where to go to.

53:52 Like for instance I was given directions to go to La Jolla, to exit on La Jolla Village Drive.

53:59 That was my first month in California.

54:06 So I was driving and went there, invited to a friend's house.

54:11 And I went around, around, around.

54:13 I couldn't find La Jolla Village Drive because the guy gave me the directions on the phone.

54:19 And so I stepped out of the car and called him and I said, "Where are you?

54:26 I have just exited a La Jolla Village Drive."

54:30 Yeah, yeah, yeah! Same thing.

54:32 No, it is not the same thing!

54:33 I am reading the thing, and you are telling me La Jolla.

54:36 It's two different things.

54:38 So you don't, you're going to a foreign country in which you do not know the spelling of and the pronunciation of these names.

54:46 A lot of our troops went to Iraq, for instance, and they were given a map that has "Dijla" on it, or "Tigris" on it.

54:56 Well, if you ask the locals, Where is the Tigris River, they won't tell you where it is because they don't know...

55:02 ...they're sitting next to it.

55:04 They know what Dijla is, but not Tigris.

55:06 This is why the United States went in 1980s, they started using local names like Beijing instead of Peking...

55:14 ...and Mumbai instead of Bombay, and so on.

55:19 So, these are important if you do not know Spanish.

55:26 Yes, so this was important to tell you because I have seen a lot of maps that are all upper case...

55:34 ...thinking that this is an important place.

55:37 Well guess what, I cannot read.

55:41 It's like Jack Dangermond when he said in the Plenary Session, I'm not going even to...

55:47 ...attempt to read that city in Iceland where they had the eruption.

55:53 Remember? I wouldn't attempt to.

55:57 So, quantitative. I can also use place-names in quantitative type of situations where I could use...

56:05 ...like for instance, San Diego, larger and Redlands is smaller, because San Diego is larger than Redlands.

56:15 And in terms of form I can use different types of form, upper case, lower case, or...

56:23 ...change the different form of the text to make quantitative type, like for instance, I would use upper case only...

56:33 ...which I don't like but it happens in a lot of specifications now that they use upper case only...

56:39 ...and then use lower case or upper/lower case combination.

56:42 That's the second thing that you could use.

56:45 By the way, when you see this arrow, it means use this first, then this, then that, then that.

56:52 Color value, differences in color value, you can use it also for quantitative types, but it is the weaker...

57:01 ...the third weaker, compared to the one on the left.

57:05 And then color, differences in color, like for instance, based on the electromagnetic wavelength...

57:14 ...which is the red first, then green, then blue.

57:17 You can use that one, but this is the weakest choice for quantitative differences.

57:25 There are some legibility issues, like the text color versus background color.

57:31 So I am drawing a dark line, a dark...

57:53 Can you hear me?

57:55 It worked.

58:00 I did electrical engineering, one course in Home Depot.

58:13 So, I'm drawing a dark blue line on a black background.

58:22 No matter how long I draw it to make it more distinct, it will not be distinct.

58:30 So that was an "I."

58:33 So any test that we are placing is going to be placed on several background colors.

58:36 ...several different color backgrounds.

58:39 You see, one color text for all the names that you're going to place, but they're going to be placed on...

58:49 You have to think about which color to use that will have enough contrast with these backgrounds. Very important.

58:57 And I talked about upper case/lower case, and no fancy...I love Old English style.

59:02 In fact, I learned 60 different lettering styles way back when I was one year old, in the '60s, and the one that I loved most...

59:13 ...is the Old English, and I did all my Christmas cards with it, but I will never use it in my maps...

59:19 ...because not everyone knows how to read Old English, and of course I do all these intricate kinds of calligraphy.

59:28 But, don't use it in my maps.

59:32 Here is my family.

59:35 Jack and Laura are my friends.

59:39 Jackville and Lauraville.

59:40 This is my name, and this is my daughter's name, my son's name, my sister's name.

59:48 There are only three Shirleys in Baghdad, by the way.

59:51 One of them was my sister and Shirley Temple was in the United States.

59:55 So readability issues. In the United States, this is what they use, normally.

1:00:02 Your first choice of placing the name relative to a point is in the upper right position.

1:00:09 If there is no space, then you go to the lower right.

1:00:16 If there's no space there, see how crowded it is, then you use the upper left.

1:00:22 If there is no space then you go to the lower left.

1:00:26 And then, if all fails, then you go above, then below.

1:00:31 Never put the name on the same line, because it can add an "o" to the beginning or the end of...

1:00:39 ...and it can mean different meanings in other languages.

1:00:46 Placing names along lines.

1:00:48 Notice the Mississippi here is placed at an ambiguous location, because I don't know if the...

1:00:55 ...Mississippi is going to flow this way or that way. I don't know.

1:00:59 So in that case I would move the Mississippi at the intersection so that I would not have any ambiguity.

1:01:08 There is an article which has 25 pages in the American Cartographer about place-names.

1:01:19 Don't be frightened about 25 pages, they're all graphics, about where to place, where not to place.

1:01:26 This is done by Professor Imhof, who is a Swiss cartographer. They are best cartographers in the world.

1:01:35 And so he has done all these do's and don't's, and you can read it, and it is part of my presentation...

1:01:44 ...as well in the, listed at the end of my presentation.

1:01:54 Now, in terms of contours, the software, what it does, it will pick up the midpoint of the contour line...

1:02:04 ...and then place the text in that direction, how it was digitized.

1:02:09 Whether it was digitized that way or that way, it will place it.

1:02:12 So you will get something like this.

1:02:15 What you should be using, actually, is a virtual line that will be perpendicular to a bunch of lines...

1:02:23 ...and this is where you place your labels for the contours.

1:02:29 In Maplex...how many of you have Maplex?

1:02:32 How many of you have ArcInfo and don't know they have Maplex? You have it. By default you have it.

1:02:39 If you haven't used it, it has 140 different rules that you can set.

1:02:44 It will at least give you a solution for maybe 60 percent of your headaches of labeling.

1:02:52 And then you turn everything into annotation later on, and then you fix the remainder that you want to fix...

1:02:59 ...to make it a very legible map, a useful map.

1:03:04 I am holding a map and I am reading an English map, or map in the English language, not necessarily English. Could be American.

1:03:16 So, the way I place my text for easy reading, I need to look at all the text that are, especially vertical.

1:03:25 The ones that are horizontal should always be read easily horizontally.

1:03:28 But the ones that are on the left should be read from bottom up.

1:03:34 Anything on the right should be from top to bottom.

1:03:38 Anyone who speaks Arabic here?

1:03:41 You should change the direction, okay?

1:03:46 And the description is not backwards.

1:03:50 Backwards is a relative term.

1:03:52 So, what map elements do I use?

1:03:56 Oops, bad statement. I did not put "use" at the end.

1:04:06 It's not my fault. It's actually the fault of giving us a new template in which everything is scrambled.

1:04:12 You think that you can move things, it doesn't work.

1:04:15 You can fix it; yes, thank you.

1:04:19 While he is fixing it, these are the different types of elements that you can put.

1:04:25 I'm not saying that every map should have it.

1:04:30 Notice, if you are creating a map that is population density, and what did I say population density earlier...

1:04:40 ...what kind of projection you would use?

1:04:43 Equal area.

1:04:45 Now, is the equal area projection, does it have the scale correct everywhere on the map?

1:04:55 I am assuming it's a small-scale map, so it's a larger extent.

1:05:01 And the answer starts with "n." No, it's not the same everywhere.

1:05:06 So, basically if you are creating a map that is of this type, which is an equal area projection...

1:05:15 ...which is a population density map, there's no need to put a scale bar in it...

1:05:20 ...because it is not correct everywhere.

1:05:23 There's no need to put it.

1:05:25 Do you have to put north arrow on every map?

1:05:31 No, but if you are going to get fired, then I would place a small one, gray, not black, which means...

1:05:41 ...that you don't put a high contrast on it, and put it discreetly because how many times...

1:05:46 ...you would use the north arrow on a map?

1:05:49 Starts with an "o." Once.

1:05:52 Once you orientate yourself, you don't use it anymore, so it's a secondary thing.

1:05:57 The main thing is your map body.

1:06:00 This is where you should be attracting attention to.

1:06:03 This leads us to visual balance.

1:06:07 They gave thousands of people maps and they looked at their eyes, where they fall the first 10 seconds.

1:06:16 And guess what? It falls on a place which is about 5 percent above the geometric center of the map...

1:06:26 ...the 5 percent of the height of the map, and the geometric center is the intersection of the corners.

1:06:34 If you draw lines at the intersection of the corners, you get the geometric center.

1:06:39 They discover that they would look at a point which is 5 percent above it.

1:06:44 What does this tell you?

1:06:51 Put the main map here! Exactly! Unless you are in Florida...

1:06:57 ...where the panhandle pushes to the right, pushes the mainland to the right, but what can we do?

1:07:05 They can split that portion and give it to somebody else.

1:07:11 So, what visual balance means is that I have to place my map body there and then there are some...

1:07:18 ...other graphic elements that are going to the place, which we call them cartographic elements...

1:07:21 ...or map elements or map objects...whatever the case. What's in a name.

1:07:26 So, we are going to place all these items and we are going to move them around and each one of these items...

1:07:35 ...will have a visual weight.

1:07:37 This visual weight depends on the size of the item; the value, which is how dark or light it is; and the brilliance...

1:07:45 ...how bright it is; and how close it is to the edge.

1:07:49 Of course, all map readers in the English language would start from the top right, and then - or...

1:07:55 ...top left, sorry - and then they move their eyes this way.

1:08:00 So, by default, they would do the same in map reading and whatever you put in the right-hand side will have more weight.

1:08:11 They will get attracted very fast because we will get into your map with your eyes on the upper left within a...

1:08:18 ...fraction of seconds, and then you'd concentrate here, and then anything that attracts you here...

1:08:25 ...you will immediately move your eye to that location.

1:08:29 So, you should not put visually heavy objects here.

1:08:34 No dark things, no large things on the right-hand side, especially in the lower right.

1:08:42 And what about gaps?

1:08:45 People are just afraid of a gap in a map.

1:08:46 So, what they do, they throw in a north arrow, throw in a scale bar, throw in a ship...

1:08:54 ...and enlarge those because there's the gap!

1:08:57 Well guess what? You don't need to be afraid of the gap.

1:09:02 But keep the gaps at the top of the map rather than at the bottom.

1:09:04 With this in mind there's a test for you.

1:09:06 You think you don't have tests in this?

1:09:09 It's not leisure anymore.

1:09:11 This is not a complete map; this is my disclosure.

1:09:16 And, you are not allowed to add anything to it, and no one of these maps are correct, or is correct.

1:09:25 So, which one is the most visually balanced, based on what I just said a few minutes ago?

1:09:34 Please be brave!

1:09:38 2-C.

1:09:40 How 2-C? You didn't listen well, you ate too much at dinner, at lunchtime.

1:09:47 I said, no gaps at the bottom.

1:09:50 1-B, 1-B. What did you eat?

1:09:59 [inaudible audience response]

1:10:02 This actually rotates to the left.

1:10:05 This rotates to the right.

1:10:07 This rotates to the right, to the left.

1:10:10 This one here is more close to the visual center which is why you guys said, but you forgot about the other part.

1:10:22 So this one here is further away from the visual center, but remember I said no one of them is right.

1:10:31 But I also said you should not put gaps at the bottom.

1:10:34 So this one would be the one that you should have chosen.

1:10:37 Now this is another map, more complicated.

1:10:41 The one on the left is my teenage boy's room, and this is my room.

1:10:48 This one on the left is my artistic part of me, and the one on the right is my engineering, dull part of me.

1:10:58 Which one is more visually balanced, based on what I've told you?

1:11:03 Notice the main map is at the visual center.

1:11:08 You should choose...How many choose B? Be brave.

1:11:13 Yes, yes, good, excellent.

1:11:17 You're A?

1:11:21 You're fired.

1:11:28 Okay, now don't think yourself as an American when you're looking at this map, or British for all that matter.

1:11:37 Which one is more visually balanced, whether it is A or B?

1:11:45 How many would say B?

1:11:47 I just told you, don't think like an American, because you always think that the scale, the legend...

1:11:55 ...should be on the right-hand side.

1:11:57 This is why you chose B.

1:11:58 You forgot about that this thing here is very far away from the visual center, compared to this one which is very close...

1:12:06 ...and you forgot the gap in here which is lost between the visuals that are in here.

1:12:13 This is why on the left-hand side is more visually balanced, but we are used to the legend on the right...

1:12:22 ...which can be fixed, right?

1:12:24 All you need to do is push this to the right, pick this spot here, and put it up there, done.

1:12:32 So, this is how you should be thinking about balancing your different objects and you try...

1:12:37 ...to attract attention to the main map body.

1:12:41 This is why we are talking about this visual balance.

1:12:44 Now, there are several factors that control our design.

1:12:48 In two minutes my presentation should have finished, but I am entertaining you as much as I want...

1:12:57 ...because I told the Map Gallery I am coming back at 5:00.

1:13:01 So I have half an hour for you guys.

1:13:03 [audience question] I was fired, right?

1:13:04 Yes, you were.

1:13:09 So for those of you who are going to leave, there are some evaluation sheets that the administration here...

1:13:16 ...wants you to fill it up for us so that we know whether we're going to have this next year or not. Same jokes.

1:13:25 This is, by the way, my 18th year of presenting this.

1:13:28 Can you imagine?

1:13:30 An 18th year, I have people here who are enjoying this. Thank you very much.

1:13:36 So, what factor's controlling my design?

1:13:40 Well, there are several that would.

1:13:42 One of them is the objective.

1:13:44 Map form - is it portrait? Is it landscape?

1:13:51 Is it folded?

1:13:52 Am I going...is it going to be centerfolded?

1:13:57 And all these different things - is it going to be round, or square, or rectangle, or whatever the case may be?

1:14:03 So this would actually control how I would design.

1:14:07 Second one, my audience.

1:14:09 If I am going to design a map for the highly technical committee in which they want to know...

1:14:17 ...whether...they want to know whether to place the landfill on a montmorillonite clay...

1:14:37 ...with a slope of less than 15 percent or with a certain type of zoning and a certain type of land use and away...

1:14:46 ...from local streets within half a mile distance, then what kind of design would I be creating for them?

1:14:59 I should be placing all these different...The polygon that I will be selecting would have to fit all those...

1:15:10 ...and I have to show in that map for the highly technical committee that it is actually fulfilled.

1:15:19 However, if I am passing this to the general public to vote on where to place the landfill, what does the...

1:15:26 ...general public need from, in the map?

1:15:30 How far are they away?

1:15:33 So basically the polygon and probably the street centerlines of the main ones only.

1:15:39 So my map for them would be much simpler than for the highly technical committee.

1:15:44 Reality and authenticity. Well, I told you about the meandering river, the crooked coastline of Norway...

1:15:52 ...should remain crooked when you actually create the map for them.

1:15:58 Generalization and skill. They are both working together to create...they control the quantity...

1:16:04 ...of information that you can place in the map.

1:16:07 Also the technical limits which will dictate the quality of your map.

1:16:14 Remember I talked about the 16.7 million colors and 256 that you have on the printer, so you're limited.

1:16:23 And conditions of hues.

1:16:26 Is it going to be in a dark place or in the light?

1:16:29 Like, for instance when you're picking up your car from the car rental, you will be generously given a map.

1:16:37 This map is useless.

1:16:39 Most of the time it's useless, because you're driving at 9 p.m., it's dark, and they gave you this tiny text and...

1:16:48 ...with very little contrast between the text and the background, and they're expecting us to dash...

1:16:53 ...at 65 miles an hour and read it.

1:16:56 I normally sit down there and for 10 minutes and I'm sure Jorge does that the same, but he's fired anyway.

1:17:03 So...and redraw it so that I can make use of it.

1:17:08 North is not true everywhere on a map; depends on the projection.

1:17:15 So this is Mollweide projection.

1:17:16 Notice this is only correct at the line that goes through Greenwich, that's it.

1:17:24 Elsewhere, it's curved.

1:17:26 In the United States we use the conical projection so much, so the north arrow...

1:17:31 ...is not correct anywhere in the map anytime you use conical projection.

1:17:36 And this is where I was teaching in Florida one time.

1:17:39 Anyone from Florida? They're nice people.

1:17:43 They gave me this map to look at and I said, oh, are these doghouses?

1:17:47 And they said, no, no, no, this is a map that we give to our policemen to divide themselves on the different beats...

1:17:58 ...where, like different neighborhoods.

1:18:00 And I said, no, not according to scale. Oh my God.

1:18:06 And then I realized, and this wasn't their fault, it was a bug in the ArcView 2 software that we had.

1:18:12 We go from beta view to layout view, then you decide, oh, I want to make changes, so we go to data view.

1:18:20 It uses the projection. I don't know why, but they fixed it, anyway.

1:18:24 So, but they didn't realize that this was happening, and so from then on, I gave my students...

1:18:33 ...I teach at university...the meanest scale, 5,137,603, and I would like them to manually draw a scale bar...

1:18:45 ...with easy-to-use divisions, and then I would tell them to, when you're done, go to your computers and create the map...

1:18:56 ...of the United States and just bring it in and bring your...go to layout view and insert your scale bar...

1:19:05 ...and make a scale bar with the same divisions and the same intervals, and check yours against it.

1:19:13 This is how you check the software that we are creating is correct.

1:19:18 You have to do the same thing, by the way.

1:19:20 Don't believe in the software all the time.

1:19:23 And, is it easy to use?

1:19:25 Well, how do you read these scale bars?

1:19:33 Well, I am in the outside in the open.

1:19:40 I have my shoestring.

1:19:42 I can take it and measure a distance on that map and then take it, and I'm not going to embarrass anyone in the crowd...

1:19:49 ...here as why there's something on the left-hand side from the zero in the other direction.

1:19:55 So, I would go from the zero and try to read here.

1:19:59 Then I say okay, this is 700; this one, 1,400. That's not easy to, I have to use a calculator...

1:20:02 No, no, no, nothing to do with metric here.

1:20:05 ...but I have this on the left so what I do is I move that here and that's what this is for.

1:20:12 This is 700 and this is what I need to pick up from this subdivision in there.

1:20:18 Well, guess what? How many of you can find out in the field, without a calculator, and if you're not my age...

1:20:32 ...30 years old, how to divide 7 by 5?

1:20:41 Right? My kids will definitely go to their cell phones and try to do that.

1:20:48 So this is not an easy-to-use scale bar.

1:20:51 What you should have done is what, anyone? Volunteer.

1:20:56 By now you should know me.

1:20:58 It's an easy-to-use...

1:21:04 It so happens, it's in meters, but it doesn't matter.

1:21:10 Have seven subdivisions on the left.

1:21:12 Or better, make your main divisions up to five.

1:21:19 So, you go to 500, 1,000 instead of 7,000, 700, 1,400.

1:21:25 If you don't know how to do it, go downstairs and somebody will show you how.

1:21:29 And if they, if you don't see anybody, come to the map...

1:21:39 ...wireless.

1:21:41 So, come to the Map Critique Station and I'll show you.

1:21:45 The other thing is, I am now creating this kind of a map, which is a classification map.

1:21:53 I'm classifying my data into five categories.

1:21:55 Each category is a range of data.

1:22:00 The minute I do that, what am I doing?

1:22:03 Starts with "g" and has a "z" at the end somewhere.

1:22:09 It has an "n," an "r." Generalization. I am doing generalization.

1:22:14 And if I'm doing a generalization, what are these decimal places doing in my generalization?

1:22:20 No need, really, there is no need for generalization in this case.

1:22:26 But, because the software does it, you keep it.

1:22:30 You should not keep it.

1:22:32 And there is a way, and if they don't show you downstairs, come and I'll show you.

1:22:37 And maps for screen displays.

1:22:40 This is where, this is my saddest slide because anything that I teach in the software that you need to do...

1:22:49 ...which is advanced drawing options, using multiple layer symbols, using picture symbols, using...

1:22:55 ...dashed lines and patterns, dot density, halos, and complex statements, SQL statements for text.

1:23:02 All this that I like to do, I have to avoid because of performance, because you are putting your map and people...

1:23:11 ...who want to look at your map, they need to look at it fast, and they cannot do it because they have to wait...

1:23:18 ...for all these things to calculate and grow.

1:23:21 Well, guess what?

1:23:23 I finally discovered that you could do something else.

1:23:27 Not really finally; it was two years ago.

1:23:30 That you could do what is called image flattening.

1:23:37 What is image flattening?

1:23:38 Meaning that all these things that have been placed on the screen with all these things, what you could do is...

1:23:45 ...you could save that to an image instead.

1:23:50 And when you save it to an image, all the things that you have, that has been calculated...

1:23:56 ...is now captured in a raster format and now we have got one image.

1:24:00 Unless you are trying to serve layers; that's a different issue.

1:24:09 ...could use, and therefore you can have, now we have one layer to serve instead of several different things...

1:24:15 ...happening and wait forever to display.

1:24:19 Finally, think of your user when you are creating your map.

1:24:23 And this is available for you, the presentation's available for you, and this is the different references I have placed for you...

1:24:36 ...and if people would like to stay, we could critique a map together.

1:24:41 I'm here! Anyone would like to stay.

1:24:46 There is a bad map that we created.

1:24:49 I'll give you 30 seconds to look at it, and then you can tell me what's wrong with it.

1:25:02 I'll help you.

1:25:04 When you looked at the map, what attracted you most?

1:25:08 [inaudible audience response]

1:25:09 Maine. Maine, right?

1:25:14 And what is the theme of the map?

1:25:18 It's about the Gulf of St. Lawrence, right?

1:25:23 But you look at Maine first.

1:25:27 Isn't that sad?

1:25:29 That's one of the things that, one of the problems.

1:25:33 And you mentioned, the province names are in upper case.

1:25:38 And what else?

1:25:41 The expressway, what about it?

1:25:43 [inaudible audience response]

1:25:45 It's too thick, and it's in red, and it attracts you most.

1:25:50 And was that the Gulf of St. Lawrence?

1:25:53 No? What else?

1:25:58 Two scale bars.

1:26:00 I am not against two scale bars, but look at the scale bars, what about them?

1:26:10 What is it?

1:26:11 [inaudible audience response]

1:26:15 These are different units, yes.

1:26:16 So, people, because remember these are Canadians, they need metric, and we are the United States, we need the miles.

1:26:24 So...

1:26:29 Look at my hands.

1:26:32 Align the zeroes so you can compare things.

1:26:36 Okay, now what else?

1:26:40 North arrow, what about it?

1:26:43 [inaudible audience response]

1:26:45 It's the second thing after, yeah, that's right, the second thing that can attract you.

1:26:49 First of all, it has a border.

1:26:53 Here's a clue for you that I didn't talk about, because this is what we teach in the longer course.

1:27:03 Do not put hurdles, graphic hurdles, in the eye of the reader who's trying to get somewhere to read.

1:27:09 Any border you put on any secondary element is a hurdle.

1:27:14 So, your legend should not have a hurdle.

1:27:17 It should not have a hurdle: that means no border for the legend.

1:27:20 Should not have the word "legend" in it!

1:27:24 I mean, the word "legend" is only for engineers and surveyors.

1:27:29 I happen to be an engineer, I know that.

1:27:32 So, you don't need the word "legend."

1:27:36 And you do not need the words "map of."

1:27:40 It's already a map, we know that.

1:27:42 Why do we need a "map of" by the top?

1:27:46 What about the logo?

1:27:49 [inaudible audience response]

1:27:51 Logo. No, they changed it. You're fired. They changed it, even.

1:28:04 For one thing, if I want to draw that logo I would draw it, first of all, starts with the letter "s." Smaller.

1:28:12 Second, has to do with... well, outside the map would be where outside the map?

1:28:20 I wouldn't put it at the top because it's not that important.

1:28:23 [inaudible audience response]

1:28:25 No Esri people here, so it's okay.

1:28:29 It should be somewhere discreet, unless you are advertising yourself.

1:28:33 Some of you guys would be advertising yourself in here, because you want some business or something...

1:28:38 ...you would enlarge the logo.

1:28:39 That's fine. It's business type.

1:28:42 But there's no need to make it large.

1:28:45 And third is, even if you want to keep it there, at least the background should be the same background as the land, not two...

1:28:57 I don't need to look at two colors there because it's attracting too much attention there. So...

1:29:08 And also the land does not have a wet coast, so there should be a line that is dark blue for the coastline.

1:29:20 There's no coastline, just land and sea.

1:29:25 The coastline is inundated, remember.

1:29:28 You should symbolize it as such, so you should have a dark blue coastline.

1:29:34 So this is an example of one of the attempts to fix the problem.

1:29:39 I still don't like what I see up here, but this is one of the attempts.

1:29:47 This is a second attempt in which we focus on...notice in the previous one, we did not focus on the...

1:29:55 ...Gulf of St. Lawrence; there's a lot of things, there's a lot of land involved.

1:30:00 Here, I focused on, I enlarged it, and notice this is now my center.

1:30:08 So these are different techniques of...and notice, no border.

1:30:15 You still can read it. So...

1:30:16 And no red!

1:30:22 Unfortunately we cannot delete it, because it's theirs, unless they give it to the Canadians. Then we...

1:30:29 ...don't have a problem, but that's a political issue, we don't discuss that.

1:30:33 But it has to be there because it's theirs, and it is subdued; it's not like as it used to be.

1:30:42 So, here it's in green, they would think that the United States is greener than ...

1:30:50 ...but you can look at the difference.

1:30:55 Well, thank you so much for your attention and for staying for a longer period of time.