ARIZONA STATE UNIVERSITY

GENERAL STUDIES PROGRAM COURSE PROPOSAL COVER FORM

Courses submitted to the GSC between 2/1 and 4/30 if approved, will be effective the following Spring.

Courses submitted between 5/1 and 1/31 if approved, will be effective the following Fall.

(SUBMISSION VIA ADOBE.PDF FILES IS PREFERRED)

DATE 03/01/2010

1. ACADEMIC UNIT: School of Geographical Sciences and Urban Planning

2. COURSE PROPOSED: GPH 371 Intro. to Cartography & Georepresentation 3
(prefix) (number) (title) (semester hours)

3. CONTACT PERSON: Name: Barbara Trapido-Lurie Phone: x5-7449

Mail Code: 5302 E-Mail: btl@asu.edu

4. ELIGIBILITY: New courses must be approved by the Tempe Campus Curriculum Subcommittee and must have a regular course number. For the rules governing approval of omnibus courses, contact the General Studies Program Office at 965–0739.

5. AREA(S) PROPOSED COURSE WILL SERVE. A single course may be proposed for more than one core or awareness area. A course may satisfy a core area requirement and more than one awareness area requirements concurrently, but may not satisfy requirements in two core areas simultaneously, even if approved for those areas. With departmental consent, an approved General Studies course may be counted toward both the General Studies requirement and the major program of study. **(Please submit one designation per proposal)**

Core Areas

Literacy and Critical Inquiry–L ☐
Mathematical Studies–MA ☐ CS ☒
Humanities, Fine Arts and Design–HU ☐
Social and Behavioral Sciences–SB ☐
Natural Sciences–SQ ☐ SG ☐

Awareness Areas

Global Awareness–G ☐
Historical Awareness–H ☐
Cultural Diversity in the United States–C ☐

6. DOCUMENTATION REQUIRED.
(1) Course Description
(2) Course Syllabus
(3) Criteria Checklist for the area
(4) Table of Contents from the textbook used, if available

7. ***In the space provided below (or on a separate sheet), please also provide a description of how the course meets the specific criteria in the area for which the course is being proposed.***

This mandatory review resubmission has extensive documentation. At a general level, the organizer table explains how the student work meets both the spirit and specifics of criteria #1 (Computer applications) in satisfying both critera 1a and 1b. The syllabus is annotated to indicate compliance. Specific exercises are also attached that exemplify compliance in both specifics and spirit.

CROSS-LISTED COURSES: ☒ No ☐ Yes; Please identify courses: _____

Is this amultisection course?: ☒ No ☐ Yes; Is it governed by a common syllabus? _____

ARIZONA STATE UNIVERSITY

LUC ANSELIN

Chair/Director (Print or Type)

Chair/Director (Signature)

Date: 3/3/2010

Rev. 1/94, 4/95, 7/98, 4/00, 1/02, 10/08

March 2010

General Studies Course Proposal Documentation

GPH 371 – Introduction to Cartography and Georepresentation

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6. **Lab 3: Projection fundamentals** **Appendix 2**

Course Description

Study and creation of maps. Fundamental mapping principles (projection, scale, generalization, symbolization) and computer-based cartographic production. Fee

Proposer: Please complete the following section and attach appropriate documentation.

ASU--[CS] CRITERIA			
A COMPUTER/STATISTICS/QUANTITATIVE APPLICATIONS [CS] COURSE MUST SATISFY ONE OF THE FOLLOWING CRITERIA: 1, 2, OR 3			
YES	**NO**		**Identify Documentation Submitted**
		1. Computer applications*: courses must satisfy both **a** and **b**:	
☒	☐	**a.** Course involves the use of computer programming languages or software programs for quantitative analysis, modeling, simulation, animation, or statistics.	The syllabus and the course schedule have been annotated in yellow to indicate where this criteria has been met
		b. Course requires students to analyze and implement procedures that are applicable to at least one of the following problem domains **(check those applicable)**:	
☐	☐	**i.** Spreadsheet analysis, systems analysis and design, and decision support systems.	
☒	☐	**ii.** Graphic/artistic design using computers.	Lab 2 is attached. Lab 2 exemplifies how this criteria is met.
☐	☐	**iii.** Music design using computer software.	
☒	☐	**iv.** Modeling, making extensive use of computer simulation.	Lab 3 is attached. Lab 2 exemplifies how this criteria is met.
☐	☐	**v.** Statistics studies stressing the use of computer software.	
*The **computer applications** requirement **cannot** be satisfied by a course, the content of which is restricted primarily to word processing or report preparation skills; learning a computer language or a computer software package; or the study of the social impact of computers. Courses that emphasize the use of a computer software package or the learning of a computer programming language are acceptable, provided that students are required to understand, at an appropriate level, **the theoretical principles embodied in the operation of the software and are required to construct, test, and implement procedures that use the software to accomplish tasks in the applicable problem domains.**			
		2. Statistical applications: courses must satisfy both **a** and **b**.	
☐	☐	**a.** Course has a minimum mathematical prerequisite of College Mathematics, College Algebra, or Precalculus**,** or a course already approved as satisfying the MA requirement.	

Course Prefix	Number	Title	Designation
GPH	371	Introduction to Cartography and Geographic Visualization	**CS**

Organizer to explain how the course meets CS Criteria.

Criteria (from checksheet)	How course meets spirit (contextualize specific examples in next column)	Please provide detailed evidence of how course meets criteria (i.e., where in syllabus)
1a. Course involves the use of computer programming languages or software programs for quantitative analysis, modeling, simulation, animation, or statistics.	Students in cartography use several different software programs that involve first quantitative analysis to analyze statistics. Then, the maps themselves represent a discrete type of spatial modeling that generalizes the analyzed data. Cartography is the art and science of communicating geographic information through maps. Maps frequently are tools for visualizing quantitative data that can't be directly viewed: demographic characteristics, earth structures, climate patterns, etc. In this second role, maps act as models that help us understand geographic phenomena.	In **syllabus**, course objective states: *Cartography is a fundamental tool of geography; it is also a science and art in its own right. Cartography uses principles of design, perception, statistics, and communication. A skilled cartographer draws on knowledge from all these areas, plus the critical element of his or her own creativity, to create maps that are compelling and accurate. By the end of the semester, you should be able to use principles, skills, and creativity to transform numerical or verbal data into effective, powerful maps. You will also learn how to use two software products, ESRI ArcGIS and Adobe Illustrator, as tools for effective cartographic representation.*
1b ii. Course requires students to analyze and implement procedures that are applicable to … Graphic/artistic design using computers.	Cartography draws from the field of graphic design as well as perceptual studies in psychology. Lectures introduce principles from both these fields as well as others developed through research by cartographers. Each major conceptual topic is accompanied by a lab in which students are asked to create a map applying the principles just introduced, using computer software to carry out the project. This hands-on approach allows students to develop problem-solving skills simultaneously in both the software tools and the subject domain of cartography.	**Labs 2, 3, 4, 6 and 7**. For example, the lab 2 introduction reads: *The primary objective of this project is for you to design a simple map from beginning to end; being conscious of your map's purpose and the design strategies you use to achieve that purpose. In addition, you'll practice the Illustrator techniques you learned in lab 1 – creating and modifying objects and text, organizing a file through the use of layers, etc.*

-- Continued on next page --

1b iv. Course requires students to analyze and implement procedures that are applicable to … **iv.** Modeling, making extensive use of computer simulation.	As described under 1a, cartography is a tool for modeling geographic phenomena; using maps as a tool for visualizing geographic data.	The following labs emphasize modeling: **Lab 3: Projections** – students learn to select an appropriate map projection, based on map purpose and area of the globe represented. students need to consider error associated with projecting the curved surface of the earth on a flat map. **Lab 5: Spatial data** – gives students practice in distinguishing data in terms of levels of measurement and spatial distribution represented. **Lab 6: Proportional symbols** – students deal with a problem of representing quantitative data using proportional symbols. **Lab 7: Choropleth maps** – students deal with issues of grouping quantitative data into classes, and representation of the classes on maps.

GPH 371: Introduction to Cartography and Georepresentation
Fall 2009
http://myasucourses.asu.edu

Instructor: Barbara Trapido-Lurie
Email: btl@asu.edu
Phone: (480) 965-7449
Office: Coor 5566

Office hours: TTh 12:30-1:30 pm, and by appointment

Class meets: TTh 10:30 – 11:45 am, CPCOM 107

Primary text: Krygier, John and Wood, Denis (2005). *Making Maps · A Visual Guide to Map Design for GIS*. Guilford Press

Alternative text: Slocum, Terry (2009). *Thematic Cartography and Geographic Visualization,* 3rd edition. Prentice-Hall.

Other resources:
- Purchase of a portable USB "Pin Drive" is highly recommended (start at ~$15)
- Labs require a number of black-and-white prints of digital files

Course objectives: Cartography is a fundamental tool of geography; it is also a science and art in its own right. Cartography uses principles of design, perception, statistics, and communication. A skilled cartographer draws on knowledge from all these areas, plus the critical element of his or her own creativity, to create maps that are compelling and accurate. By the end of the semester, you should be able to use principles, skills, and creativity to transform numerical or verbal data into effective, powerful maps. You will also learn how to use two software products, ESRI ArcGIS and Adobe Illustrator, as tools for effective cartographic representation.

Grading: Grading in the course will be based on the following point system:

Course component	points	%
Lab exercises*	190	35
Final project	100	19
Two midterms	150	28
Final exam	80	15
Class participation**	20	4
Total possible	**540**	

Course grade	Minimum percent	Minimum points
A	92 %	497
A-	90	486
B+	88	475
B	82	443
B-	80	432
C+	78	421
C	70	378
D	60	324
E	50	270

*** Tentative weighting of lab exercises:**

Lab 1 – Mapping & Illustrator basics	30	Lab 5 – Spatial data	10
Lab 2 – Map design intro	20	Lab 6 – Proportional symbols	35
Lab 3 – ArcGIS intro/ Map Projections	25	Lab 7 – Choropleth mapping	30
Lab 4 – ArcGIS to Illustrator/ Type design	40		

**** Class participation:** Class participation involves being in class, and actively participating in discussions and group exercises. Because cartography involves choices and decisions, and there is

never a single "correct" map, being able to talk about cartographic processes is an essential part of being a cartographer.

Lateness/make-up policies:

Labs are due ***at the beginning of class*** on the day listed. Projects handed in late will be graded but not critiqued. Late assignments will be marked off **5%** per complete weekday they are late, starting at the beginning of class on the day they are due *(e.g. if you turn in Lab 2 at 5:00pm on Tues., Sept 15, the most you could get on it is 19 points. If it's turned in at 5 pm on Thursday, Sept. 17, it's 15% off, or 17 points max).* Projects completed during lecture will be marked off **20%**. As an incentive to complete assignments, no assignment will be marked off more than 50%, if turned in before the last day of classes.

Midterms will be given during class time on days listed. Except in the case of serious illness, any conflict with listed exam times must be discussed at least one week in advance and an alternate time *before the listed exam time* will be arranged.

Critical dates:

Tues, Oct 6	**Midterm 1**
Tues, Nov 3	**Midterm 2**
Sun, Nov 8	**Last day for course withdrawal (through MyASU)**
Tues, Dec 15	**Final exam**

Course calendar

Appli-cable CS criteria	Date			Class Topic	Reading (in Krygier)	Assignment given	Due
1a	August	T	25	What is a map?		*1a: Illustrator basics*	
1a		Th	27	Looking at maps critically	pp. 3-19	*1b,c: Map basics & more Illustrator*	
	Sept	T	1	Scale and generalization	110-111, 162-169		*Lab 1a*
1b ii		Th	3	Map design fundamentals 1	25-43, 145-152	*2: Design intro*	
1b ii		T	8	Map design fundamentals 2			*Labs 1b, 1c*
1b iv		Th	10	Geographic coordinates, projections	112-114, 92-109	*3: Projections*	
1b iv		T	15	Map projections 2			*Lab 2*
1b iv		Th	17	Map projections 3			
		T	22	Reference maps	125-139	*4a: ArcGIS to Illustrator*	*Lab 3*
1b ii		Th	24	Type design 1	234-249		
1b ii		T	29	Type design 2		*4b: Type design*	
	Oct	Th	1	*Midterm review/ work day*			*Lab 4a*
		T	6	**Midterm 1**			
1b iv		Th	8	Spatial data	51-62	*5: Spatial data*	
1b ii		T	13	Color 1/*work day*	255-271		*Lab 4b*
1b ii		Th	15	Color 2.			*Lab 5*
1b iv		T	20	Proportional symbols 1	196-211, 214-215	*6: Proportional symbols*	
1b iv		Th	22	Proportional symbols 2.			
1b iv		T	27	Choropleth maps 1	212-213 170-189	*7: Choropleth maps*	
1b iv		Th	29	Choropleth maps 2			
	Nov	T	3	**Midterm 2**			
1b iv		Th	5	Multivariate maps / Final project	208-209, 216-217		*Lab 6*
		T	10	*Lab 7 work day, final project*			
1b iv		TH	12	Symbolizing surfaces	222-225		*Lab 7*
1b iv		T	17	Dot & dasymetric maps	220-221		*FP topic*
1b iv		Th	19	Innovative directions			
		T	24	*Lab work day*			
		Th	26	***No class - Thanksgiving!***			
	Dec	T	1	*Lab work day*			*FP Design Doc*
		Th	3	*Lab work day*			
		T	8	Critique final projects / *work day*		*Draft final project*	
		F	11				*Final project*

	T 15	**Final exam; 9:50-11:40 am**			

Table of Contents from Textbook:

Krygier, John and Wood, Denis (2005). *Making Maps · A Visual Guide to Map Design for GIS.* Guilford Press

Applicable CS Criteria:

It's a Map 3

What exactly is a map, and why are maps and map making so powerful?

Why Are You Making Your Map? 25

What are you trying to do with your map? Your intentions for your map shape the way you make it.

1b iv →

Mappable Data 51

Making maps requires data. Locating and processing data is a vital step in the map-making process.

1a →

Map-Making Tools 73

A diversity of map-making tools enables you to make a diversity of maps.

1b iv →

Geographic Framework 91

Key concepts that shape the geographic framework upon which your map will be constructed.

1b ii →

Map Layout 125

Arranging your map, its title, and other components.

Applicable CS criteria:

7 **Intellectual and Visual Hierarchies** *145*
Adding depth and order to your map by manipulating its visual elements.

8 **Map Generalization and Classification** *161*
Simplifying point, line, and area data for a more effective map.

9 **Map Symbolization** *195*
Matching visual marks to your data.

10 **Type on Maps** *233*
The effective use of type on maps.

11 **Color on Maps** *255*
The effective use of color on maps.

12 **Finishing Your Map** *277*
Evaluating your map to make it perfect.

Index *292*

Due: Tuesday, Sept. 15, 10:30 am

GPH 371 Lab 2: Giving directions with a map

Lab purpose

The primary objective of this map is for you to design a simple map from beginning to end; being conscious of your map's purpose and the design strategies you use to achieve that purpose.

In addition, you'll practice the Illustrator techniques you learned in lab 1 – creating and modifying objects and text, organizing a file through the use of layers, etc.

Problem:

You are to create a highly generalized map that shows someone **how to get from a well-known location in the Valley to a less well-known location that's at least a few miles away**. Some possibilities:

- How to get from ASU to your house
- How to get from somewhere in downtown Phoenix to a hiking trail in South Mountain
- How to get from Fiesta Mall to Pioneer Park, just east of downtown Mesa

The map will accompany of an invitation to a party, a special event, etc. (you decide the specifics for your map). Assume that the people receiving the invitation are newcomers – they know where the first location is, but don't know much else about the area.

Reproduction cost is an issue, so the map needs to be designed so that a black-and-white print looks good, and it should fit on a less than a half-sheet of letter paper (it should be no larger than **7" x 5"**).

The map doesn't need to be to scale, but the map should give some information about distances. **Your objective is clarity and simplicity. Think carefully about what information to include, and how to make the map as easy to use as possible.**

Use the design principles presented in class to help you focus your map's appearance. Be sure to give consideration to

- Generalization (especially selection – what geographic elements and supporting information to include)
- The map's visual and information hierarchy
- Figure-ground development
- Symbol design and visual contrast
- Legibility
- Visual balance and layout

What to turn in:

1. A **black-and-white print of your map**
2. Your **map plan**, typed (template is available on class website)

Procedure:

1. **Begin to plan and design your map:**
    a. Decide on the purpose of your map (party invitation, etc.) and the origin and destination that it will show.
    b. Come up with a tentative layout for your map – I suggest doing this initially with pencil and paper.
    c. As you work on the layout, think about what geographic features and supporting elements (legend, explanatory text, etc.) should be included. Also consider the map's "information hierarchy" -- what elements are most important? What elements give supporting information but are less critical?
    d. Based on the planning you've done, make some notes on the map's concept and design, using the "map plan" worksheet attached. (A digital version is available on the class web site, under "Lab Info". Your final map plan should be typed, using this template.)

2. **Construct the map in Illustrator.** I suggest the following steps:
    e. In a new, blank file, create at least two layers – one for text, and one for geographic elements. You may decide to create separate layers for roads, key locations, etc. Some people prefer more layers, some prefer fewer!
    f. Set up guides to help you visualize the maximum area of your map *(see next page for details)*.
    g. Begin to draw the geographic features you've decided to include, using the Pen tool and geometric shape tools, as you've learned to do in the previous exercises. Remember some basic symbol characteristics you can control …
        - Line width
        - Line and fill color *(see next section for suggestions on creating grey shades)*
    h. Add text, remembering that you can control ..
        - Type size
        - Font
        - Style (regular, bold or italic)
        - Rotation of text *(Next section gives instructions on manipulating these features)*

    Feel free to explore other features of Illustrator, if you like, as strategies to strengthen your map's design.

3. **Evaluate your map.** Re-read your map plan notes, and take a fresh look at the map; then revise either the map or the Map Plan, if you think either can be improved.

4. **Turn in your map and a final "Map Plan."** *(Don't turn in this instruction sheet.)*

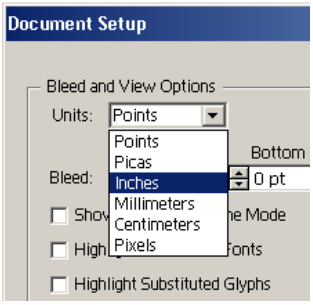
    Turn in either a **print** of the map or a **PDF file**. To create a PDF file in Illustrator, choose *File > Save As*, and under "*Save as type:*" choose *Adobe PDF*.

Grading

For this assignment, and all other assignments that involve designing a map, grading will be based on an evaluation checklist. The checklists are posted on the class website, in the lab folder under "**Lab Info**."

Some additional techniques for this map

A. Setting up guides to show map size limits



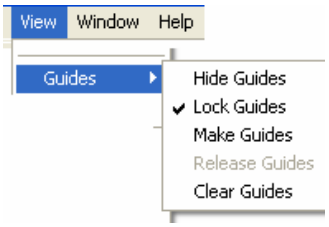
1. Go to "File > Document Setup", and check that your document will show measurements in inches *(as shown at right)*. If it's set to some other units, change the selection to "**Inches**".

2. **Draw a rectangle with dimensions of 7" x 5":** Select the rectangle-drawing tool ( ) that you used in previous labs. But this time, instead of dragging the shape of a rectangle on the canvas, click once anywhere on the canvas. A dialog box will appear, in which you can enter a width of 7" and height of 5" (**or the reverse**, depending on the shape of the map layout you've planned). Click "OK" and the rectangle will appear on your page.

3. Drag the rectangle to the approximate center of the document page.

4. **Convert the rectangle to a guide:** Right-click on the edge of the rectangle, and choose "Make guides". The rectangle's outline will become a bright blue color.

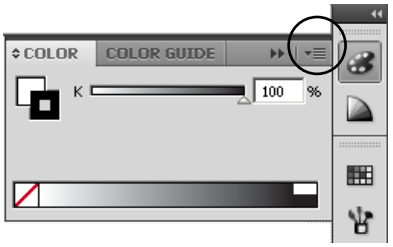
5. **Working with guides:** By default, the guide you've just created is "locked" – that is, you can't select or move it. It also won't print. However, there are a number of options for modifying guides and your view of them:



   a. From the top menu bar, choose View > Guides *(shown at right)*. If you'd like to move a guide or delete it, first click on "Lock Guides". To hide a guide (if you'd like to get a better idea of how the image will look when printed), choose "Hide Guides".

   b. Guides exist on the layer in which they were created. So, if you created your guide on your Text layer, when you hide the Text layer by clicking off its eye in the Layers palette, your guide will disappear. Some people like to create a layer just for guides, for better control of whether or not they're visible.

B. Creating shades of grey



1. Check that you can see the options on your Color palette; if not, choose "Show options" from the drop-down menu (which is available from the button circled at right).

2. From the same drop-down menu, choose "Grayscale". Your color palette should now look like the one shown at right.

3. To change a fill or stroke to a shade of grey, select the object you're working with, choose either the Fill Indicator or Stroke Indicator on the Color palette, and click on the grey that you'd like to use from the graduated bar across the bottom of the palette. Or – alternately – you can type in a value between 0 and 100 in the text box on the right side of the palette. (0% is white, 100% is black.)

4. Note: **If you'd like to change a text object to grey**, select it and change its **FILL color**. Text normally has ***no*** stroke color. Giving text a stroke color usually makes the text difficult to read!

C. Matching the appearance of several objects, using the eyedropper tool

Suppose you've drawn a line representing a road, and chosen a 37.5% gray color for its stroke, and 4- point line for its width. You'd like to give several other lines the same appearance.

Illustrator's Eyedropper tool gives a very easy way to do this! It's circled on the toolbar shown at right. To use it,

1. Select the object or objects whose appearance you'd like to change. Select the Eyedropper tool.
2. Using the Eyedropper tool, click on the object whose appearance you'd like to copy.
3. The selected objects will now match the one you "sampled" with the Eyedropper! This works for text, too – the font, size, color and style will be copied over.

D. Changing type characteristics

Character palette

You had a little experience in changing type characteristics in Lab 1a. For more options, it's convenient to use the Character palette, shown at right. If you don't see it, make it visible by selecting Window > Type > Character from the top menu bar.

The three drop-down menus labeled at right allow you to change basic type characteristics. A future lesson will explain more about the other options. You can change type characteristics either

- Before you add a new type element, or
- By changing a type element you've already created – just select it; then select new characteristics from the Character palette.

E. Rotating text (or any other object)

For this exercise, you might want to rotate text so it runs in the same direction as a road *(like the example at right, above)*. To do this, you can use the Rotate tool *(circled at right, below)*. (This tool can be used to rotate any other object also – lines, polygons, etc.) To use it,

1. Select the piece of text.
2. Select the Rotate tool, and move your cursor some distance away from the piece of text. Now, drag your cursor in a circular motion. The text will rotate, from its center, in the direction you drag.
3. Remember how the Shift key forces the Pen tool to draw lines only at 0°, 90°, or 45° angles? It has the same effect on the Rotate tool (and many other tools)! So, if you'd like your text to be vertical, hold down the Shift key as you drag with the Rotate tool, and the text will" snap" to the angle you want.

Map Plan – Exercise 2

Name _____

Map Title _____

Map purpose: Write a sentence describing the purpose of your map and the context in which it will appear – are you inviting people to a party, trail clean-up, political rally, or ?

Constraints:

1. Will be printed in black and white (shades of grey are fine).
2. Must be no larger than 5" x 7".

Geographic features and other information elements: (*Geographic features* might include elements such as roads, landmarks, etc. *Information elements* might include a title, legend, bar scale or note about distances, etc.) Here, explain in a few sentences or phrases why you decided to incude the items you did, and why you chose not to include other possible features or elements. Your reasons should follow from your map's purpose and the project constraints.

Information hierarchy: This is a ranking of the features you listed above, *in order of their importance to the purpose of the map*. It should follow logically from your map purpose. Also remember -- the visual hierarchy should match the information hierarchy, so items near the top of the list should appear more visually prominent on your map than items at the end of the list.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

Design comments:

This section is optional, but if you like, use it to explain the reasoning behind any of your design choices not explained elsewhere, such as

- Your information hierarchy
- The appearance of the geographic features and text
- Map layout and balance

GPH 371 Lab 3: Projection fundamentals (25 points)

Name:_____

Due: **Tuesday., September 22, 10:30 am**

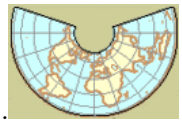
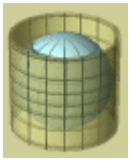
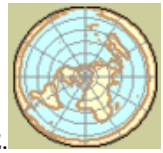
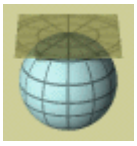
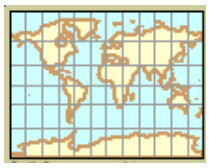
Lab purpose

In the three parts of this exercise, you'll …

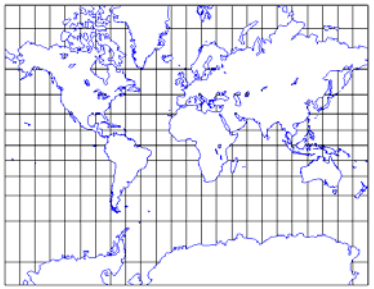
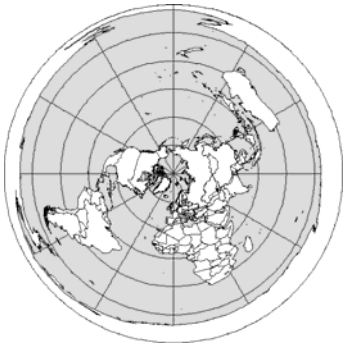
1. Review map projection terminology
2. Use a systematic method to choose map projections for several mapmaking projects
3. Learn how to use ESRI's ArcMap software to create customized projections. *Instructions for this part of the exercise will be handed out on Tuesday, September 15.*

Part 1. Projections reviewed *(8 points)*

1. **Projection surfaces:** Match the projection surface diagram with its name and a map projection that could result. *(1 pt)*

Projection surface diagrams		Map projections
a. 	_____ planar (azimuthal) _____	1. 
b. 	_____ cylindrical _____	2. 
c. 	_____ conic _____	3. 

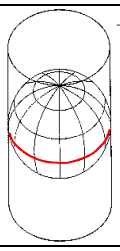
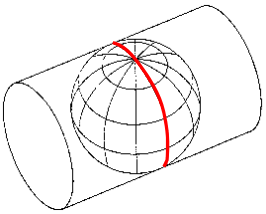
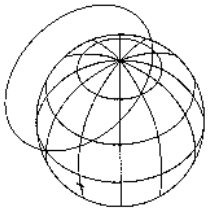
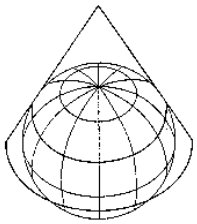
2. **Projection properties**: Fill in the blank cells in the table below. Use the **first projection lecture** for reference. *(3 points)*

				
Projection surface (choose from: planar, conic, cylindrical, pseudocylindrical)				
Specific projection name (e.g., Mollweide, Robinson, Azimuthal Equidistant)				
What **property(ies)** does this projection preserve? Or, is it a **compromise projection** (that doesn't preserve any properties)				
Give an example of a **map purpose** for which this projection is well-				

Added new row, to help students distinguish surfaces & projection names

suited (examples: "*thematic map*", "*ocean navigation*")				

3. **Choosing map projections: surface and aspect:** The table below shows sketches of 4 projection approaches. Fill in the blank cells in the table below, indicating each sketch's **surface (cylindric, conic or planar)** and its **aspect (equatorial, polar or oblique)**. Finally, think of a region (or a country or continent) for which each projection approach would be a good choice (You can use an atlas or map of the world for ideas). *(4 points)*

Projection sketches				
Projection **surface**				
Projection **aspect**				Normal
Example of a region *(for example, "Africa", France", "Arizona")* that you might map with this surface & aspect				

Part 2. Choose some projections *(9 points)*

For this part of the assignment, your job is to choose a projection for three maps. Similar to what we did in class, you'll work through a series of questions to logically arrive at some appropriate projections. Basically, the questions are:

1. What kind of accuracy is most important for this map (that is, what **properties** are critical?)
2. What **portion of the world** is being mapped?
3. Based on 1 and 2, what projections are suitable?
4. What projection **aspect** should be used? If an oblique aspect is chosen, where should the projection be centered?

Map A. Migration from the Philippines in the 20th Century

1. This map use arrows of various widths to show the number of immigrants from the Philippines, between 1900 and 2000, to countries all over the world. **This is a thematic map** – its purpose is to show the pattern of emigration. **Specific distances from the Philippines are secondary**. **What property or properties are most critical for this map?** To help determine your answer, recall our class discussion. Circle your choice(s) below.

   Equal-area (equivalence) Conformality Equidistance Azimuthality

   Briefly explain your choice:

2. This is an easy one – What portion of the world is being mapped?

   The world A hemisphere A continent or ocean A region or country

3. Now, choose two reasonable projections for this map. **Choose specific projections, not a surface or property.** Use the selection guide distributed in class, or its online version at http://www.public.asu.edu/~aoblt/371/projections-key.htm.

   1. _____ 2. _____

4. Where do you think the map's center should be? Why? *(Just describe a location – in Part 3 you'll find its latitude and longitude.)*

Map B. Population density map of Australia

1. Using data from Australia's most recent census, this map will show the variation in Australia's population density. What single projection property is most critical for this map?

   Equal-area (equivalence) Conformality Equidistance Azimuthality

   Briefly explain why you chose this property:

2. Again, identify what portion of the world is being mapped:

   The world A hemisphere A continent or ocean A region or country

3. Choose **two** appropriate projections for this map.

   1. _____ 2. _____

   Briefly explain why you chose these projections:

4. Where should the map projection be centered? Why? *(Again, just a verbal description is fine)*

Map C. A navigational map, to be used in plotting air flights from Miami to major cities of Europe

1. As in all air navigation, the goal is to find the **shortest route** from Miami to the European destinations – that is, the great circle routes. So this map should use a projection on which it's easy to plot great circle routes. The map should also show the **precise distance** between the two cities. What 2 properties are most important for this map?

   Equal-area (equivalence) Conformality Equidistance Azimuthality

2. What portion of the world is being mapped?

   The world A hemisphere A continent or ocean A region or country

3. Using the same references as for the previous map, choose **one** appropriate projection for this map.

   Projection chosen: _____

   Briefly explain why you chose this projection:

4. Where should this projection be centered?

Name:_____

Due: **Tuesday, September 22, 10:30 am**

GPH 371 Lab 3 - Part 3. Use ArcMap to make maps in your chosen projections *(8 points)*

In this section, you'll generate basemaps for the three map topics you worked on in the previous section. Each basemap will show a graticule and country outlines, and will be in a projection that you selected in Part 2.

If you were making finished maps, you could use either ArcMap or Illustrator to plot the flow arrows, population densities, and a great circle route. But that can wait for future exercises!

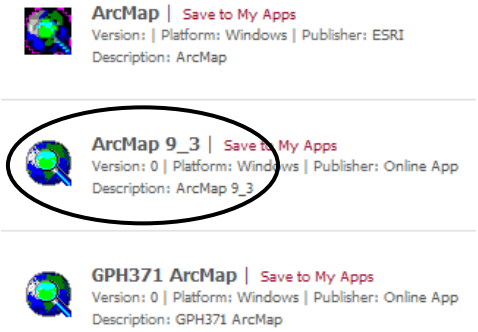
Here are instructions on getting started in ArcMap, and then plotting the basemaps:

Getting started with ArcMap

I. Get the files you'll need: The 2 files are on the class web site, in the **Lab 3** folder under **Lab Info**. Follow instructions on the web site, which explain where to save the files.

II. If you'll be working through My Apps:

1. Load My Apps, either from MyASU or http://myapps.asu.edu.
2. In the Search box, search for **ArcMap**.
3. Three options will appear. For this assignment, use the most recent version, ArcMap 9.3 *(circled at right)*.
4. Choose Save to My Apps , then Run App now .

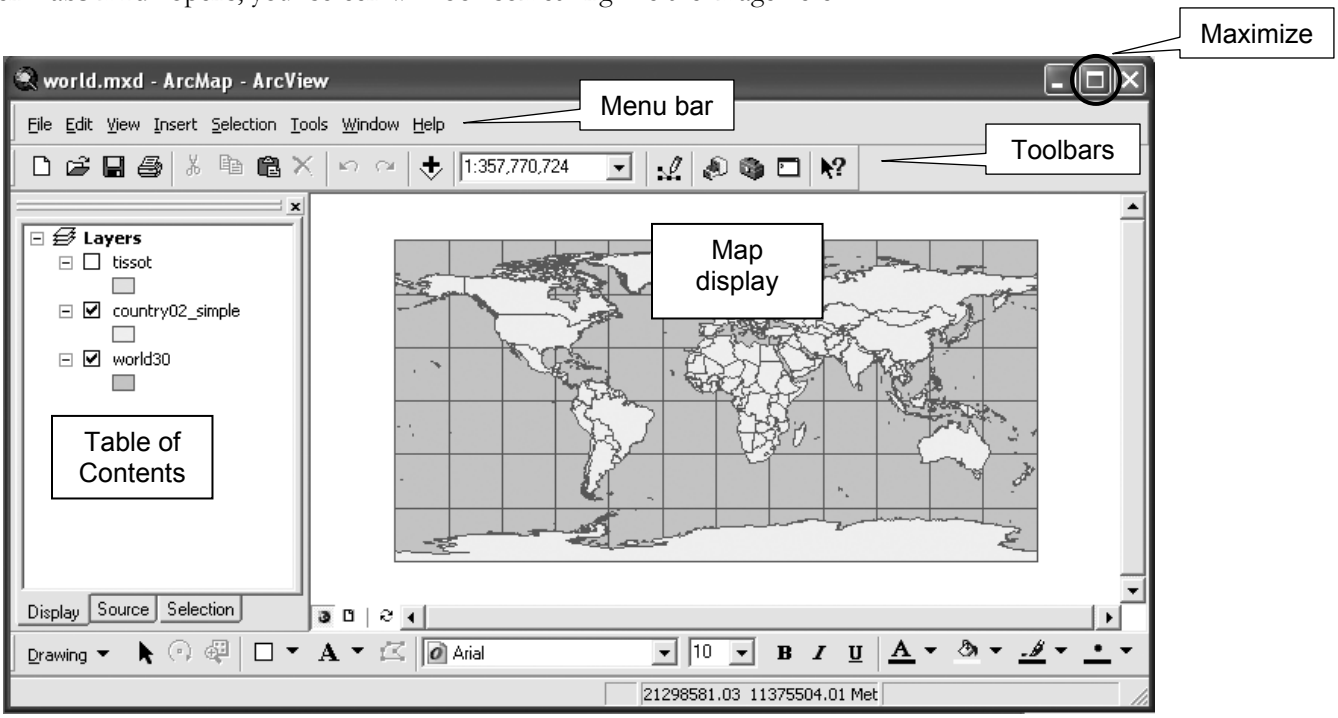


III. All students – whether working through MyApps or on a computer with ArcMap installed:

5. **Open the Lab 3 project file:** After ArcMap loads, you'll see a dialog that gives you some options for how to start. Choose An existing map: , then click "OK".
6. Navigate to your "projections" folder, and choose lab3.
7. You should see a list on the left, and a world map on the right. *(If you don't, check with me!)*
8. Proceed to next page of instructions.

IV. Get to know the ArcMap interface

When "lab3.mxd" opens, your screen will look something like the image here:



1. If the ArcMap window doesn't fill the computer screen, make it larger by clicking the maximize button in the upper right corner of the window.

2. If the map doesn't fill the space available on the map display, choose "View > Zoom Data > Zoom Full Extent" from the menu bar.

3. The map that you see is in what ArcMap calls a "geographic" projection. In this projection, both meridians and parallels have equal spacing all over the map. For what areas of the world does this spacing produce the most distortion?

_____ *(0.5 pt)*

Now you're ready to plot your 3 basemaps, as described on the following pages. If you're a newcomer to GIS, here's a little more information:

A very short introduction to GIS files and data:

GIS software requires 2 basic types of files:

- **Data files** -- store the shapes of geographic features, and can also store all kinds of descriptive information about the locations. (If you downloaded data from Blackboard, you saw two files called "World.ldb' and World.mdb. These two files store the country and ocean layers that you'll work with in this assignment.)

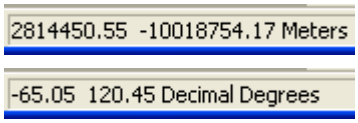
- **Project files** – store the appearance of the data files as you see them in ArcMap. lab3.mxd is a project file. It stores information about the color of the land and ocean, and the size of the image in the map display. Once you start customizing your map display by giving it a projection, if you'd like to save your work, you can save your own version of lab3.mxd. However – If you send me these files, I can't see your maps, because I don't have the data files. **That's why, to share your work in GIS, you'll usually create files in some other format, like JPEG or PDF.**

Creating the 3 basemaps

A. Create the Philippines migration basemap

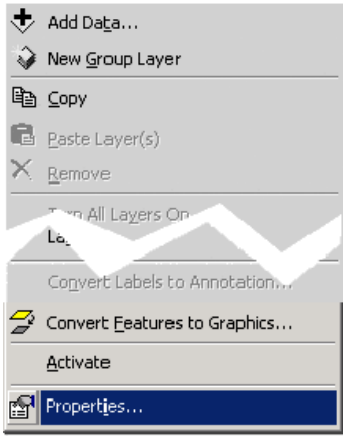
1. **Find the map's center:** If you plan to center your map somewhere other than at the Prime Meridian (like on the Philippines?), you'll need to know the longitude of your desired map center. Using ArcMap, you can find approximate latitude and longitude of a location as follows:

1a



   a. Move your cursor around over the map. As you move it, notice two sets of numbers in the lower-right corner of the ArcMap window that keep changing *(like 1a, above right)*. These numbers give the cursor's position on the earth's surface, either in meters or degrees latitude and longitude. **If your interface is showing meters rather than geographic coordinates**:

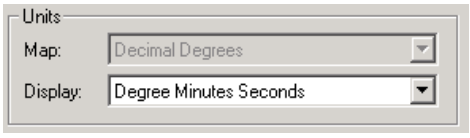
1a - i



      i. Right-click on Layers on the left-hand side. A menu will appear – from the very bottom of this menu, select "**Properties**" *(See 1a -i, at right)*. A large dialog box called "**Data Frame Properties**" will appear. If the "**General"** tab isn't in front, click it to the front.

      ii. Change the setting for "Display" units to "Degrees Minutes Seconds" or "Decimal Degrees" *(See 1a - ii, at right)*. Click on "OK".

1a - ii



   b. Notice that the coordinate display now gives the cursor's location in latitude and longitude coordinates. **The first coordinate gives longitude (meridian); the second coordinate gives latitude (parallel).** Set your cursor over the Philippines, and make a note here of an appropriate central meridian for this map (You might round off your reading to the nearest 5°):

      Central meridian: _____ *(0.5 pt.)*

2. **Plot the map projections you chose for this map in Part 2**. Turn to the general directions on **pages 11-12 of this handout**. They explain how to plot the two projections you selected for this map, and how to center each projection.

3. **After working through the directions on pages 11-12:**

   a. Choose your favorite projection, and make sure it's centered as you intended.

   b. Turn in an image of the projection -- either in printed form or as a JPEG file – whichever you prefer.

      - **To print the map**: Choose File > Print. **Label the printed map with the name of the projection you selected.**

      - **To save the map as a JPEG file**: Choose File > Export Map. For the option "Save as type", choose JPEG. Then, **name the file "3a"** (for the lab # and map #) **followed by the name of the projection you selected**. When you've completed all 3 maps, you can send them to me via email (btl@asu.edu), or upload them to the Digital Dropbox.

B. Create the Australia basemap

1. If it's not already open, open the project file "**lab3.mxd**".

2. Use the zoom tools, just as you used a similar tool in Illustrator, to zoom in to Australia. Using the "Zoom in" tool, you can drag from one corner of the area you'd like to include to the opposite corner.

3. As with the previous map, you'll need to find some key latitude and longitude values. Once again change the map's display to geographic coordinates, if it's showing meters. Then find the following coordinate values: *(1 point for all values)*

   Central longitude_____ central latitude_____

   If your projection is conic, determine a good location for the 2 standard parallels and note these locations below. (One standard parallel should be about halfway between the top and center of the region being mapped, and the other should be about halfway between the bottom and center of the region being mapped.)

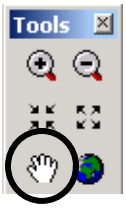
   Standard parallel 1 _____ Standard parallel 2 _____

4. **Select and center a map projection for Australia.** This will be similar to what you did for the Philippines map -- refer to the "General Procedures" pages for more details. Use the diagram of Projected Coordinate Systems folders on **page 11** to figure out where to find your chosen projection, then center the projection on Australia, as described on **page 12.**

   If your chosen projection is conic, here are some tips:

   a. Notice that the "Continental" folder doesn't include an "Australia" folder. So open a folder for any other region (they all contain the same projections), and customize the central meridian and standard parallels using the values you just found.

   b. Remember that latitudes in the southern hemisphere should be preceded by a minus (-) sign.



5. **Center Australia on the screen.** Adjust the zoom of the map, if you think it's needed. You can also center Australia within the map frame by dragging on the map with the pan tool *(see right)*.

6. **Print or create a JPEG file of the map.** Use the same procedure as for the Philippines map. If you create a JPEG file, name it "3b" plus the name of your projection. If you print it, label it with your chosen projection.

C. Create the air navigation map.

The process for constructing this map will be very similar to what you've done for the previous maps:

1. Open your **lab3.mxd** map project, if it's not open. Zoom and pan to the North Atlantic area.

2. Choose one of the two places you identified in Part 2 (p. 5, last step) as a correct place to center the projection. **Find the latitude and longitude** of that location, using the same procedure as for the last two maps:

   latitude_____ longitude_____ *(1 point)*

3. **Re-project the map to the map projection you chose in Part 2.** Use the diagram of Projected Coordinate Systems folders on **page 11** to figure out where to find your chosen projection**.**

   Be sure to adjust the map's center to the latitude and longitude you found above. Remember, to enter a **latitude in the Western hemisphere**, enter a "minus" before the latitude number.

4. If you feel it's needed, adjust the map's zoom and centering to focus on the route from Lisbon to Miami. Use the zoom and pan tools.

5. **Print or create a JPEG file of the map.** If you create a JPEG file, name it "3c" plus the name of your projection.

Grading of maps:

Each map is worth 2 points. Deductions will be as follows:

- Projection name is missing (it should be either written on your printout, or included in your JPEG file name) - *-1 point*
- Projection doesn't match the ones selected in Part 2 - *-0.5 pt*
- Not centered correctly - *-.5 point*

What to turn in:

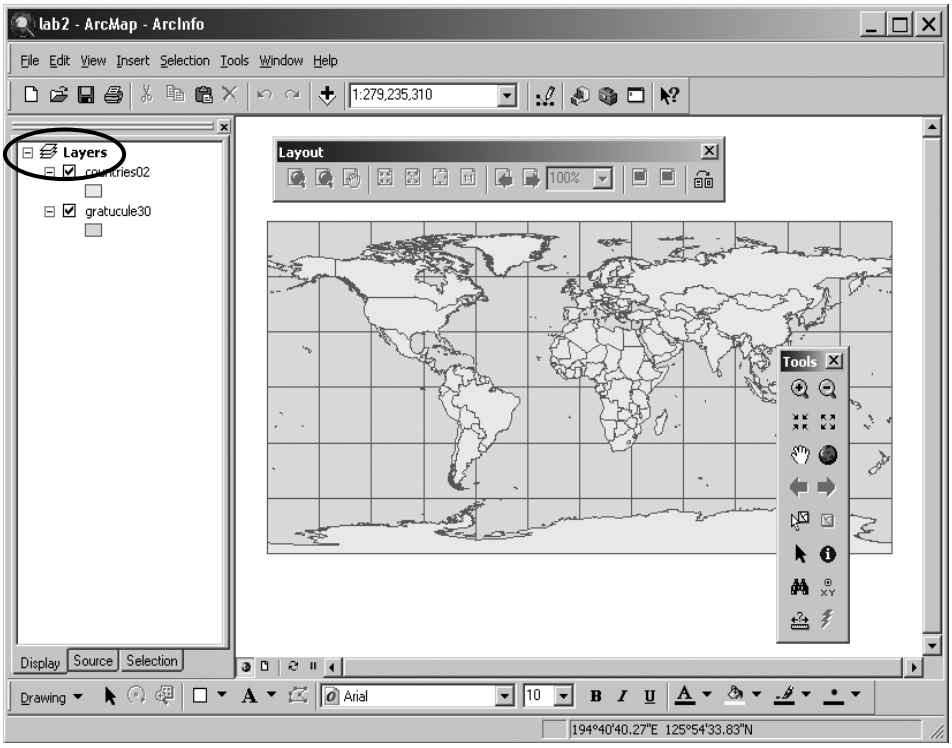
- **This assignment sheet**, or a Word document with the answers to all questions (labeled by question number)
- **If you printed your maps**: the three maps, labeled with the projections you chose.
- **If you saved your maps as JPEG files:** the 3 files, named with the projection used and the exercise (3a, 3b, or 3c), and sent to me via email (btl@asu.edu), or uploaded to the digital dropbox.

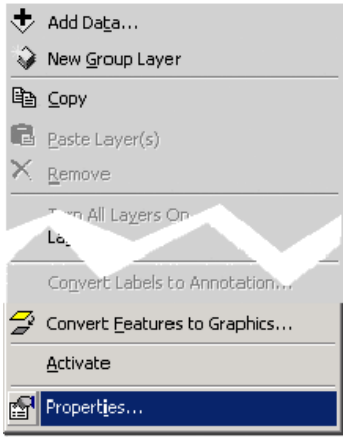
Turn in these items by **Tuesday, September 22, 10:30 am.**

General Procedures: Working with projections in ArcMap

A. Choose your projection.

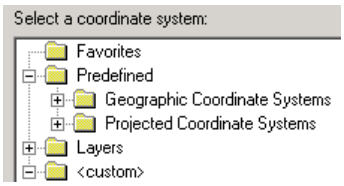
1. Right-click on Layers on the left-hand side of ArcMap *(See below.)* A context menu will appear – from the very bottom of this menu, select "**Properties**" *(See illustration at right.)*

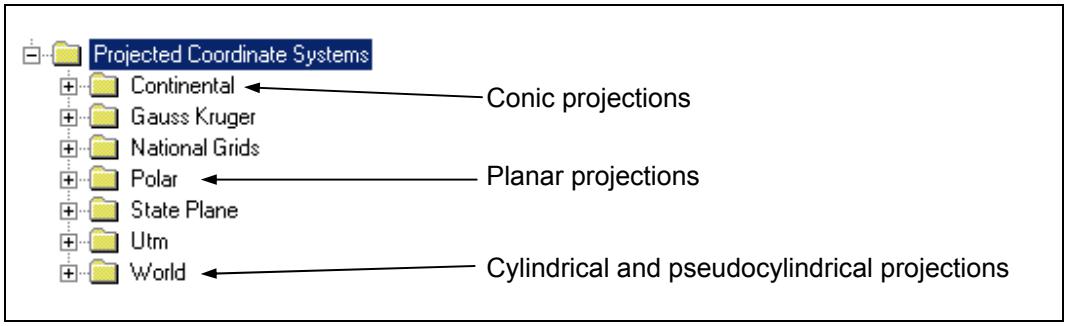




2. A large dialog box called "**Data Frame Properties**" will appear. Select the tab called "**Coordinate Systems**" – this is where projections are defined.

3. In the bottom left you'll see a series of folders *(something like the example at right).* Click on the folder called "Predefined", so that its two subfolders appear *(as they do at right).* Then open the Projected Coordinate Systems folder, so you can see its 7 subfolders. Projections for world and regional maps, like those you'll be making, are found in the 3 folders labeled in this diagram:





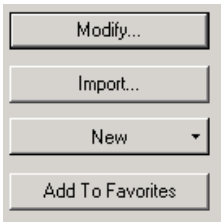
As you see, the ArcGIS developers have organized projections based on what's commonly used for various parts of the world. As a cartographer, you'll sometimes choose projections other than the "typical" ones, and customize them for your purpose.

As a new GIS user, use this diagram as a guide to where to find your chosen projections. (For example if your projection is a planar one, you'll find it in the folder called "Polar".)

4. Click on a projection name, then "Apply" to see the projection on the map. (You can drag the "**Data Frame Properties**" box out of the way, if it's blocking the map.)

5. When you find your favorite projection from the ones you chose in Part 2, click "**OK**" to close the data frame properties dialog box.

B. Is the projection centered on the correct geographic region for your map?



1. If the answer is "no", go into the Coordinate System dialog again *(see steps 1 & 2, above)*, and click on the "Modify" button *(see right)*.

2. In the window that appears, you'll be able to enter the parameters for where you'd like to center your map. The chart on the below gives some typical parameters for various types of projections. Use it as a guide to modify your map projections.

Parameter	Value	
False_Easting	0.000000000000000000	**Cylindrical and Pseudocylindrical projections:** Enter the desired central longitude of your map* in the **Central Meridian** field.
False_Northing	0.000000000000000000	
Central_Meridian	0.000000000000000000	

Parameter	Value	
False_Easting	0.000000000000000000	**Conic projections:** Enter the desired central longitude of your map* in the **Central Meridian** field. In the **Standard Parallel_1** field, enter a latitude** about halfway between the top and middle of the region you're mapping. In the **Standard Parallel_2** field, enter a latitude about halfway between the middle and bottom of the region you're mapping.
False_Northing	0.000000000000000000	
Central_Meridian	25.000000000000000000	
Standard_Parallel_1	20.000000000000000000	
Standard_Parallel_2	-23.000000000000000000	

Parameter	Value	
False_Easting	0.000000000000000000	**Planar projections:** Enter the desired central longitude* of your map in the **Central Meridian** field. In the **Latitude of Origin** field, enter the desired central latitude of your map.**
False_Northing	0.000000000000000000	
Central_Meridian	0.000000000000000000	
Latitude_Of_Origin	90.000000000000000000	

Important:

* **Longitudes in the Western hemisphere are stated as negative numbers** (so to indicate a Central Meridian of 112 W, type "-112").

** **Latitudes in the Southern Hemisphere are also stated as negative numbers** (so to indicate a Standard Parallel of 20 S, type "-20").

3. Once you've changed the value of the Central Meridian, Standard Parallels, and/or Latitude of Origin – as explained in the chart – click "OK" in the "Modify" window, and then "OK" in the Coordinate System Properties dialogue. You should be able to see the change on your map.

At this point, return to the instructions for the specific map you're working on.