



...promoting the natural heritage of North Texas...

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An Introduction to Geographic Analysis and Mapping for North Texas: Educational Lesson Plans

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An Introduction to Geographic Analysis and Mapping for North Texas: Educational Lesson Plans

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Introduction

These lesson plans are the first six of an introductory series on geographic analysis. They can be adapted for a variety of age groups, depending upon the teacher's objectives and available resources. The lesson plans can be adapted to the LLELA area with aerial photos and maps available at the LLELA maps web page (<http://www.ias.unt.edu/llela/maps.htm>). Assistance adapting these plans specifically to LLELA, possibly in conjunction with a field trip, can be obtained by contacting the LLELA Education Director. Future lesson plans are in development to extend these concepts into the use of computer-based Geographic Information Systems (GIS) for learning and applying geographic analysis to ecological topics and watershed issues in north Texas.

Some useful websites that can assist in the planning or presentation of these lessons:

Web site	Address
LLELA	http://www.ias.unt.edu/llela
Dallas / Fort Worth Info	http://www.dfwinfo.com/index.asp
Texas Atlas	http://www.lib.utexas.edu/maps/atlas_texas
Texas Natural Resource Information Service	http://www.tnris.state.tx.us
US Geological Survey	http://www.usgs.gov
US Census	http://quickfacts.census.gov/qfd
About.com	http://geography.about.com
ESRI	http://www.esri.com
Terraserver	http://terraserver.homeadvisor.msn.com/default.asp

Please suggest new links or report any outdated links to LLELA.

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Lesson 1: Plan Views and Ground Views

Overview

Students will compare aerial photos of their school with their ground-based observations. They will create a poster of the school and its neighborhood that shows the relationship between ground views and aerial views of the same features.

Aerial photos are some of the most useful maps for small-scale planning and environmental science projects. Because they are taken from above, these images are not what we are used to seeing from the ground. It takes some practice to be able to look at an aerial photo and know what each shape represents when seen from our normal perspective (i.e., the ground). Students need both practice and imagination to learn to visualize buildings, forests, and city parks from the images in an aerial photo. This lesson takes students on a mini field trip around the school grounds and the school's immediate neighborhood, which allows students to compare an aerial photo of their school and its neighborhood with their own views from the ground.

Central Question

How can an aerial photo represent objects we see on the ground?

Key Teaching Points

An aerial photo is a bird's-eye view (often called a "plan view") of the world. Using an aerial photo can give students a start at understanding mapping and provide them with a clear understanding of the physical and manmade characteristics of a location.

Aerial photos have a variety of uses, from planning the best route for a hike to determining a location for a school or an airport. Aerial (and satellite) photos (both also called "remote sensing data") often serve as the basis from which many different types of maps—especially topographic maps (see Lesson A2)—are created.

Materials

?? An aerial photo of the school and its neighborhood.

Aerial photos can be acquired from a variety of sources, including the National Aerial Photography Program (their photo finder can be found at http://edc.usgs.gov/Webglis/glisbin/finder_main.pl?dataset_name=NAPP), as digital orthophoto images (DOQQs) from the Texas Natural Resource Information Service (<http://www.tnris.state.tx.us/digital.htm>) or the North Central Texas Council of Governments (<http://gis.dfwinfo.com/geodata/index.asp?menu1=off&menu2=off&menu3=on&menu4=&thegroup=1000&cats=none&Focus=Aerial&Image=97NTGISCO>), or as computer images from the North Central Texas Council of Governments (<http://map.dfwinfo.com/scripts/esrimap.dll?Name=MapBook&Cmd=Map>) and from Microsoft's TerraServer (<http://terraserver.homeadvisor.msn.com/default.asp>). Data for LLELA

can be found on LLELA's maps site (<http://www.ias.unt.edu/llela/maps.htm>). Local governmental agencies, such as the farm service agency, the county or city GIS department, or the city planning department, may loan out printed aerial photos for educational purposes.

If possible, make or copy the image for each student.

?? Aerial photos of other area locations with interesting or unique features.

Features such as stadiums, parks, forest lands, agricultural fields, and water bodies are interesting to view from above. Golf courses, wastewater treatment plants, and cemeteries can be especially difficult to visualize from their images in aerial photos, and are also useful features to show to students.

?? A camera

A camera can be used to take ground-based pictures of objects in the aerial photo. These pictures can subsequently be used in the classroom to create a poster of the school and its neighborhood that shows the relationship between ground views and aerial views of the same features. Digital cameras, if available, might make the creation of a poster easier.

Procedures

1. Have the students discuss the differences that might be seen at a location by someone on the ground and by a bird or someone in an airplane and looking down at the same place. Then show or distribute the aerial photo of the school and its neighborhood. Discuss the photo's viewpoint with the class.
2. Walk around the school grounds (and immediate neighborhood, if possible) with the students. Have them try to match their photos with what they can see from the ground. Take pictures of the ground views of the features in the aerial photo.
3. Upon return to the classroom, have the students discuss what they saw in comparison to what their aerial photos show. Show students other aerial photos of locations in the area that have features not found in the school's neighborhood, such as stadiums, golf courses, cemeteries, etc., and have them try to guess what the aerial photos are showing.
4. Have the class create a poster or set of posters that shows the relationships between aerial photos and how we see these features from our ground-based viewpoint.

Lesson 2: Topography and Elevation

Overview

Students will look at a topographic map of their school and its neighborhood and create a 3-D elevation model of the area using cardboard. Then they will look at a DEM and compare the three models.

Understanding topography and its representation on topographic maps is an important part of environmental science education. Topographic maps represent topography, or changes in elevation across an area, with contour lines. These lines connect places on the map that have the same elevation. Learning to use a topographic map is a difficult skill, because it requires students to visualize a three-dimensional surface from a flat piece of paper. Students need both practice and imagination to learn to visualize hills and valleys from the contour lines on a topographic map. Beginning students at any level do not easily grasp the concept of contour lines, so this lesson utilizes a hands-on activity to compare a three-dimensional topographic map (a relief model) with commonly used two-dimensional topographic representations (contour maps and digital elevation models).

Central Question

How can a two-dimensional map represent three dimensions of space?

Key Teaching Points

A topographic map is a representation of a three-dimensional surface on a flat piece of paper. Contour lines join points of equal elevation. The closer together the contour lines appear on a topographic map, the steeper the slope. Using a topographic map can give students a clear understanding of the physical and manmade characteristics of a location. The topographic map especially allows for a clear understanding of such physical features as mountains and canyons.

Topographic maps have a variety of uses, from planning the best route for a hike to determining a location for a school or an airport. Using the topographic map, students can see why some things are where they are. They can see how people have adapted to the physical characteristics of a particular location. Students can begin to understand how the topography of a location influences the transportation and communication within that area and with the rest of the world.

Materials

?? A USGS Topographic Quadrangle map of the area of interest (i.e., your school and its neighborhood).

These maps can be found and ordered through the USGS's Map Finder (http://edc.usgs.gov/Webglis/glisbin/finder_main.pl?dataset_name=MAPS_LARGE), or can be found on the internet at no charge. Teachers with access to GIS software can acquire topographic maps as digital line graphs (DLGs) from the Texas Natural Resource Information Service

(<http://www.tnris.state.tx.us/digital.htm>). Other sources of topographic maps on the web include Topozone (<http://www.topozone.com/>) and Microsoft's TerraServer (<http://terraserver.homeadvisor.msn.com/default.asp>). Data for LLELA can be found on LLELA's maps site (<http://www.ias.unt.edu/llela/maps.htm>). Local dealers (for paper maps) can be found on the web (http://mapping.usgs.gov/esic/map_dealers/tx.html).

Make an enlarged photocopy of the area of interest from the map. A good working size is at a scale at which 500 feet on the original map equals at least one inch on the copy. Several enlargements may be needed, depending on the size of the area of interest and the size of the model the students will build (see below). The map can be traced using tracing paper (use different line thicknesses to differentiate contours lines, roads, and streams); this simplifies the map if it is not necessary for the class to evaluate everything (such as different symbols) on the original map.

Each student will need two copies of the final map. One will be used as a template when the cardboard is being cut, and the second will be used as a reference for comparison with the finished relief model.

?? A USGS Digital Elevation Model map of the same area.

Teachers with access to GIS software can acquire digital elevation models (DEMs) from the Texas Natural Resource Information Service (<http://www.tnris.state.tx.us/digital.htm>). The area of interest can be clipped out and printed. If possible, print out a flat and a 3-D version of the same area for comparison. If you do not have GIS software, statewide elevation models can be seen at NOAA's website (<http://www.ngdc.noaa.gov/seg/topo/state.shtml>) or at Johns Hopkins University (<http://fermi.jhuapl.edu/states/maps1/tx.gif> or http://fermi.jhuapl.edu/states/tx_0.html). For other locations anywhere in the world, a selectable worldview relief map can be seen at (<http://www.ngdc.noaa.gov/mgg/image/2minrelief.html>).

?? Thick cardboard (corrugated cardboard boxes are a good size), cut to manageable size (approximately 11x17" or 8½x11" are both good sizes).

Each student should have one sheet for each elevation contour. Thus, if there are 10 contours in the area you want to represent, each student will need 10 sheets.

?? Scissors and glue.

For cutting cardboard and gluing the cardboard sheets together.

Procedures

1. Introduce and discuss the following vocabulary words and discuss their meanings with the class:

?? Sea level: the average height of the ocean

?? Elevation: the height of the ground above sea level

- ?? Three-dimensional: having three dimensions (height, width, and length)
- ?? Relief map: a map that depicts land shapes and elevations (usually in three dimensions). Relief is the difference in elevation between any two points. Where relief is low, the area appears to be relatively flat, such as in large river valleys or broad, flat uplands. When relief is high, the area is steep, such as in mountains and canyons. Relief determines the contour interval, which is the difference in elevation between adjacent contour lines (see below).
- ?? Topographic map: a map that represents a three-dimensional surface on a flat piece of paper. (“Topographic” is derived from two Greek words—”topo,” meaning “place,” and “graphos,” meaning “drawn or written.” Ask students if they can use that information to figure out what “topographic” might mean. Then ask a student to look up the word in the dictionary to see whether the guess was correct.)
- ?? Contour lines: lines that join points of equal elevation. (If it helps, a contour line can be thought of as an imaginary line on the ground that takes any path necessary to maintain constant elevation.) Where contour lines are close together, the ground is steep; where they are far apart, the terrain is flatter.

2. Give the students one copy of the map (the reference map). Ask such questions as

- ?? What area on this map has the highest elevation?
- ?? How do you know?
- ?? What area has the lowest elevation? (How do you know?)
- ?? Is this area basically flat or mountainous?
- ?? Are there places on the map where the terrain slowly changes?
- ?? Are there places where it drastically changes?

3. Once the students can interpret the meanings of the map’s contour lines, explain the model-building process to the students. They will begin by tracing the outlines created by individual contour lines, starting with the lowest elevation. Using the traced shape as a template, students will then cut out cardboard to match the shape. Students will trace each subsequent (and higher) contour, reproduce the shape in cardboard, and stack it on top of the last cardboard shape. Students should glue each piece in place. They will need to refer to the reference map to see how to place each layer of cardboard.

4. Once they have built the models, have the students compare the topographic map to their model. Comparing the model to the map will help students see that when the topography is steep, the contour lines are close together. When the topography is relatively flat, the contour lines are far apart. Ask students if the model surprises them in any way.

5. Present the digital elevation model data to the students, and have them compare it with their models and maps. What are the similarities and differences?

6. Ask students a variety of questions that will help them interact with their model. Compare their results with the aerial photos of the area from Lesson 1. Have them draw or place markers on the map to represent their school, local roads, etc.

7. This lesson can be extended to an analysis of large-scale terrain and its influence on (for example) Texas settlement. (For example, the White Rock Escarpment, a raised landform that stretches from San Antonio to north of Dallas, played a major role in Texas settlement.)

Lesson 3: Mapping Your Neighborhood

Overview

Students will create a personal map of their neighborhood using maps, remote sensing data, community information, and “local knowledge.”

Maps are powerful and widespread images, common everywhere from the nightly news, to the planning offices of any city, to every environmental scientist who works outside. Mapping is an essential activity in nearly any walk of life. Students can begin to understand this importance by creating a map of intrinsic interest to themselves—a personal map of their neighborhood. This map will include community knowledge, features, and data sources with which they are already familiar (aerial photos and topographic maps), as well as “local knowledge,” information that they know about their neighborhood that outsiders would not.

Central Question

If you are visiting someone who is not from your hometown, and they asked you: “what is it like where you live?” what would you say?

Key Teaching Points

Maps can be created from a variety of sources; two of the most useful sources are aerial photographs and topographic maps.

The concept of neighborhood is tightly bound up in perceptions of home and its connections to neighbors, public spaces (like parks and stores), and the physical and biological environment. Combining mapping concepts with personal information is a powerful way to explore and integrate concepts of community, environmental science, and mapping.

Materials

?? An aerial photo of each student’s neighborhood

Aerial photos can be acquired from a variety of sources, including the National Aerial Photography Program (their photo finder can be found at http://edc.usgs.gov/Webglis/glisbin/finder_main.pl?dataset_name=NAPP), as digital orthophoto images (DOQQs) from the Texas Natural Resource Information Service (<http://www.tnris.state.tx.us/digital.htm>) or the North Central Texas Council of Governments (<http://gis.dfwinfo.com/geodata/index.asp?menu1=off&menu2=off&menu3=on&menu4=&thegroup=1000&cats=none&Focus=Aerial&Image=97NTGISCO>), or as computer images from the North Central Texas Council of Governments (<http://map.dfwinfo.com/scripts/esrimap.dll?Name=MapBook&Cmd=Map>) and from Microsoft’s TerraServer (<http://terraserver.homeadvisor.msn.com/default.asp>). Data for LLELA can be found on LLELA’s maps site (<http://www.ias.unt.edu/llela/maps.htm>). Local

governmental agencies, such as the farm service agency, the county or city GIS department, or the city planning department, may loan out printed aerial photos for educational purposes.

Each student will need a copy for his or her neighborhood.

?? A topographic map of each student's neighborhood

These maps can be found and ordered through the USGS's Map Finder (http://edc.usgs.gov/Webglis/glisbin/finder_main.pl?dataset_name=MAPS_LARGE), or can be found on the internet at no charge. Teachers with access to GIS software can acquire topographic maps as digital line graphs (DLGs) from the Texas Natural Resource Information Service (<http://www.tnris.state.tx.us/digital.htm>). Other sources of topographic maps on the web include Topozone (<http://www.topozone.com/>) and Microsoft's TerraServer (<http://terraserver.homeadvisor.msn.com/default.asp>). Data for LLELA can be found on LLELA's maps site (<http://www.ias.unt.edu/llela/maps.htm>). Local dealers (for paper maps) can be found on the web (http://mapping.usgs.gov/esic/map_dealers/tx.html).

?? Sources of community information

Cities often have ecological, zoning, and demographic information about areas within their city. Sometimes there are organizations, such as the North Central Texas Council of Governments (<http://www.dfwinfo.com/index.asp>), that also can be a good source of community and regional information. Check with your local government agencies (city information and contacts can be found at <http://www.dfwinfo.com/almanac/citylist.html>) or chambers of commerce (<http://www.dfwinfo.com/almanac/cc.asp>) for appropriate sources of information.

Procedures

1. Introduce students to the geographic concept of "neighborhood." Discuss how the concept can mean different things to different people, and how different people can have different neighborhood "boundaries" even when they live in the same area.
2. Have the students write an essay about their neighborhood. Have them creatively describe their neighborhood for someone who has never been there. For example, they could answer the question: If you are visiting someone who is not from your hometown, and they asked you: "what is it like where you live?" what would you tell them? Other questions might be: Where are the boundaries of your neighborhood? Why did you choose those boundaries? What are your favorite or most visited parts of your neighborhood? Are there public places, such as parks or stores, in your neighborhood? Etc.
3. Have each student acquire a topographic map and aerial photo of their neighborhood. Help them find community information about their neighborhood or town. Using this information as well as "local knowledge," have each student create a map of his or her neighborhood. A successful map should show the boundaries of the neighborhood, personally important sites and features, community sites and features (roads, parks, public spaces, etc.) and the student's house.

3. Have each student describe his or her neighborhood to the class. Have the students answer questions such as those listed in question 2, using their maps as visual aids.

Lesson 4: Where do you live in north Texas?

Overview

Students will obtain basic geographic information about their county and explore changes in demographics and landscapes over time.

Demographic information is probably the most important form of information to local, state, and federal governments. This information is primarily used for planning and policy, though it has a very wide range of uses. It can be readily displayed in map format, which aids in quickly assessing patterns of growth and development across an area. Students can present demographic information in map format in order to answer questions about where they live and how their county is similar and different from other counties in north Texas. They will also learn how these patterns can be used in land use planning.

Central Question

What are demographics and how can that information be displayed visually?

Key Teaching Points

Maps use coordinate systems to help locate specific places. The three most common systems used in North America are the latitude/longitude system (which uses degrees, minutes, and seconds), the township and range system (which is based on square miles), and the Universal Transverse Mercator (UTM) system (which uses meters). The township and range system helped define the current boundaries of many of the counties of north Texas, but is falling into disuse. The UTM system is becoming more popular worldwide, where it is gradually replacing the latitude/longitude system. (More information on geographic coordinate systems can be found at <http://www.colorado.edu/geography/gcraft/notes/coordsys/coordsys.html>).

The demographics of a county are important factors in policy making and planning. Demographics change over time, which can lead to changes in policy and planning in local, state, and federal governments. Demographic information is often displayed in map format for ease of viewing and assessment of population patterns. Such maps can also be used to compare local areas with others across the state or nation.

Materials

?? A state map with county boundaries and a marked coordinate system.

A good map can be found at the University of Texas (<http://www.lib.utexas.edu/maps/states/texas3.gif>).

The University of Colorado also has a map of Texas with latitude and longitude coordinates (<http://www.colorado.edu/geography/gcraft/notes/mapproj/gif/txlccus.gif>).

TNRCC has a map of Texas and its UTM grids (<http://www.tnrcc.state.tx.us/gis/ourmaps.html>) in encapsulated postscript format.

?? A USGS Topographic Quadrangle map of the school and its neighborhood.

These maps can be found and ordered through the USGS's Map Finder (http://edc.usgs.gov/Webglis/glisbin/finder_main.pl?dataset_name=MAPS_LARGE), or can be found on the internet at no charge. Teachers with access to GIS software can acquire topographic maps as digital line graphs (DLGs) from the Texas Natural Resource Information Service (<http://www.tnris.state.tx.us/digital.htm>). Other sources of topographic maps on the web include Topozone (<http://www.topozone.com/>) and Microsoft's TerraServer (<http://terraserver.homeadvisor.msn.com/default.asp>). Data for LLELA can be found on LLELA's maps site (<http://www.ias.unt.edu/llela/maps.htm>). Local dealers (for paper maps) can be found on the web (http://mapping.usgs.gov/esic/map_dealers/tx.html).

?? Data from the U.S. Census Bureau.

The U.S. Census Bureau (<http://quickfacts.census.gov/qfd/>) maintains an extensive database of demographic information in tabular and map formats. Other possible sources of information are Texas A&M University (<http://txsdc.tamu.edu/census/maps/thematic/>), the North Central Texas Council of Governments (<http://www.dfwinfo.com/ris/topics.html>), and north Texas census data at the North Central Texas Council of Governments (<http://census.dfwinfo.com/>).

Procedures

1. Introduce students to the different ways maps use coordinate systems. Using a state map, have students try to guess the coordinates of their county and their school. County coordinates can be found through the Census Bureau (<http://quickfacts.census.gov/qfd/> and select Texas, the county of choice, and then "Browse more data sets for ... county"). USGS topographic maps usually contain both latitude/longitude and UTM coordinates along their margins. See how close the students came to the correct coordinates.
2. Find out how much the students know about their county's and their city's population by allowing them to estimate the number of people living within the borders. Then have them decide if the population has increased, decreased, or remained the same over the past 10 years.
3. Discuss the concept of demographics. Use the Census Bureau website to explore the demographics of the county, and discuss how this information can be displayed visually (<http://quickfacts.census.gov/qfd/> and select Texas, the county of choice, and then "Browse more data sets for ... county", select "Browse Tiger map of area"). Are there any patterns that arise from looking at the demographic information and maps? Based upon economic data, what are some good job choices for people who live in the county? What types of skills/training would be needed to support the county's main economic activities?
4. Do the same analysis for a nearby urban and a nearby rural county. How are these counties similar, and how are they different?

5. Have the students create maps of these three counties showing changes in demographics over the last 10 years. Have them choose 3-5 categories of analysis that highlight the largest differences and closest similarities between the three counties. Make sure the maps are clearly labeled and have good legends that indicate the patterns that they are meant to display. (Some examples of population change maps, for example, can be found at http://www.lib.utexas.edu/maps/atlas_texas/pop_change_counties_tx.jpg or <http://txsdc.tamu.edu/census/maps/thematic/stmap1.gif>)
6. Have the students discuss possible reasons for changes in the demographics of their home county, using the information they have acquired from all three counties. Have them decide upon a theory for why the changes in their home county have occurred, and have them cite several examples and or/comparisons with other counties to support their beliefs. Have them use graphs, charts, and maps to support their theory.
7. Using the information from their home county, discuss how changes in demographics can lead to changes in government policy and activities. For example, areas of high population growth may require more infrastructure (such as roads); maps are an excellent way to visualize the location where these needs may occur. The student-created maps should be used for this exercise.
8. A “Jeopardy” style game can be used to review and reinforce the information.

Lesson 5: Land Use and Land Cover

Overview

Students will explore the classification of landscapes and understand how places can be represented in different ways on a map.

Combined with aerial photos, topographic maps, and demographic information, land use and land cover maps are commonly used to help find appropriate sites for new development, such as businesses, landfills, or subdivisions. Environmental scientists use them to explore the relationships between wildlife and their habitats, as well as to help them manage wildlands for conservation purposes. Students who are familiar with other sources of map data (i.e., Lessons A1-A4) will have no trouble assessing different types of land use / land cover maps, and can use these maps to round out their understanding of land use assessment and planning in science, policy, and economics.

Central Question

How can different types of land uses or land covers be displayed on a map?

Key Teaching Points

Land use and land cover maps are used extensively in environmental science, as well as in governmental and business planning. They are often created from satellite photos, though at smaller scales they can be created from aerial photos.

“Land use” and “land cover” are phrases often applied to the same sort of maps, though they mean different things. Land use refers to how humans use particular areas of the landscape, for things such as growing crops, family dwellings, or industrial manufacturing. Land cover refers to what is located on particular areas of the landscape, such as urban development, forests, or large lakes. Since these maps are not photos, they require clear and unambiguous legends in order to properly interpret them. (Details and further information on the land use / land cover maps and their codes can be found at the USGS (http://edc.usgs.gov/glis/hyper/guide/1_250_lulc.)

Materials

?? An aerial photo of the school and its neighborhood.

Aerial photos can be acquired from a variety of sources, including the National Aerial Photography Program (their photo finder can be found at http://edc.usgs.gov/Webglis/glisbin/finder_main.pl?dataset_name=NAPP), as digital orthophoto images (DOQQs) from the Texas Natural Resource Information Service (<http://www.tnris.state.tx.us/digital.htm>) or the North Central Texas Council of Governments (<http://gis.dfwinfo.com/geodata/index.asp?menu1=off&menu2=off&menu3=on&menu4=&thegr oup=1000&cats=none&Focus=Aerial&Image=97NTGISCO>), or as computer images from the North Central Texas Council of Governments

(<http://map.dfwinfo.com/scripts/esrimap.dll?Name=MapBook&Cmd=Map>) and from Microsoft's TerraServer (<http://terraserver.homeadvisor.msn.com/default.asp>). Data for LLELA can be found on LLELA's maps site (<http://www.ias.unt.edu/llela/maps.htm>). Local governmental agencies, such as the farm service agency, the county or city GIS department, or the city planning department, may loan out printed aerial photos for educational purposes.

If possible, make or copy the image for each student.

?? A satellite photo of the same area and the surrounding area

Satellite photos can be ordered from the USGS (<http://edc.usgs.gov/products/satellite.html>), and some of the Dallas area can be found online at the USGS (<http://edcwww.cr.usgs.gov/earthshots/slow/Dallas/Dallas>) or at Johns Hopkins University (http://fermi.jhuapl.edu/states/avhrr/TX_213.n14.96jan24_1955.html). A satellite images of portions of north Texas can be found at the LLELA website (<http://www.ias.unt.edu/llela/maps.htm>).

?? A land use / land cover map of the same area and the surrounding area

Land use / land cover maps can be ordered through the USGS (<http://edc.usgs.gov/products/landcover.html>). Teachers with access to GIS software can download digital versions of these same maps at no charge (<http://edcwww.cr.usgs.gov/programs/lccp/mrlcreg.html>). Data for LLELA can be found on LLELA's maps site (<http://www.ias.unt.edu/llela/maps.htm>).

?? Tracing paper and colored pencils or overhead transparencies and colored marking pens.

For creating their own land use / land cover map.

Procedures

1. Discuss the concept of "cover type" in land use and land cover mapping. Discuss the differences and similarities of "land use" and "land cover" mapping approaches. Discuss how changes in definitions of cover types can lead to different maps. Show the students a satellite photo and the land use / land cover map of the same area. Have the students compare and contrast the satellite photo and the land use / land cover map.
2. Have the students classify the cover types shown in an aerial photo of the school and its neighborhood. Have them individually decide on cover type definitions and write them down. Then have them overlay their photo with tracing paper or an overhead transparency and draw boundaries on their photos that represent different cover types. Have them decide on a color scheme for their definitions and color their different cover types in a distinct way.
3. Upon completion of their maps, have the students compare and contrast their different definitions using their cover type maps as a visual aid. Have them discuss why their personal definitions may have led to maps that are different from other's maps. Make sure that they know

that their maps are not “wrong” for being different, and reinforce the idea that a clear legend is essential for any good map.

4. Again show the students the satellite photo and the land use / land cover map of the same area. Have the students compare and contrast their maps with the satellite photo and the land use / land cover map. What are the similarities and differences between them? Discuss the idea that map makers often use standardized cover type classification systems to make their maps, so that readers will have little trouble understanding the patterns on a variety of land use and land cover maps that come from either similar or different sources.

Lesson 6: An Introduction to Geographic Analysis

Overview

Regions are the basic analysis units of geography. Regional classifications and analyses organize and help us understand geographic information. An area like north Texas can be part of many different types of regions. Knowing how to analyze regional data by exploring it in layers can help us see the complexity of regional characteristics and relationships. Students will explore some of the physical and economic characteristics of the state of Texas through the use of a low-tech version of a Geographic Information System (GIS) overlay analysis. Students can use these maps to form conclusions about possible human influences on the state's environment, and how analyses (and maps) like theirs can be used to aid in conservation.

Central Question

How are geographic regions defined and analyzed?

Key Teaching Points

At the completion of this lesson, students should understand how multiple criteria can be used to define a region, the ways in which environmental and human regional systems are interrelated, and how to use regions to analyze geographic issues.

Materials

?? Transparency sheets (six for each group) and transparency markers

For creating their own geographic analysis maps.

?? Maps of various geographic regions of Texas (precipitation, vegetation zones, natural landscape zones, population densities, landuses, population origins, climate, etc.)

These types of maps can be acquired from a variety of sources, for both Texas and North America, at the University of Texas at Austin's Texas Atlas site (http://www.lib.utexas.edu/maps/atlas_texas/), at the ESRI data site (<http://www.esri.com/data/online/esri/wothphysic.html>), and at several other sites, such as :
<http://soilphysics.okstate.edu/S257/tx/landuse.htm>
<http://soilphysics.okstate.edu/S257/tx/rain.htm>
<http://www.tpwd.state.tx.us/expltx/eft/images/precip.gif>
<http://www.tpwd.state.tx.us/images/tx-eco95.gif>
<http://www.ocs.orst.edu/pub/maps/Precipitation/Total/States/TX/tx.gif>
http://fermi.jhuapl.edu/states/tx_0.html
<http://geography.about.com/library/maps/blustx.htm>

?? Blank Texas outline map

A blank Texas outline map can be found at About.com's geography site (<http://geography.about.com/library/blank/blxustx.htm>), or one can be created by tracing the state outline from any of the geographic regions maps acquired for this lesson (above).

Procedures

1. Divide the class into groups of four to five students. Distribute two transparency sheets and a marker to each group. Have students use the printed outline map of Texas to trace the outline on each of the two transparency sheets, or have the Texas outline map copied onto the transparencies prior to class. Then have them draw in freehand the climate regions, using the appropriate geographic map as a guide. Do the same on the other transparency for the landform region map.

2. Ask the groups to make lists of the characteristics of each map, possibly including the following:

- ?? number of regions on the map,
- ?? description of the size and distribution of the regions, and
- ?? possible relationships among regions.

Discuss the groups' findings and write them on a chalkboard.

3. Have each group place one transparency map atop the other and then put a blank transparency sheet over those two. On it, have students draw the state outline and draw and label the new regions formed by layering the two maps.

4. Briefly discuss what types of physical settings are more conducive to agricultural and urban development. Distribute another blank transparency. Ask the groups to draw agricultural regions on it, based on their perceptions of the landforms and climate. Distribute a third blank transparency, and have the groups complete an urban region map.

5. Have each group display and explain its maps. The discussions should eventually focus on the groups' reasons establishing their agricultural and urban boundaries. Further discussion could center on similarities and differences among the groups' maps and the spatial distribution of the groups' agricultural and urban maps. Do the different developments occupy the same areas? Why or why not?

6. Distribute a fourth transparency sheet to each group. Ask the groups to develop a new map that shows both agricultural and urban areas on one map and then locate and label the possible transportation routes for their development. As they make their regional boundary decisions, students should factor in the effects of climate and landform by laying their new maps over the original climate and landform maps.

7. Have each group display its new maps. Discuss the relationships found among the groups' agricultural, urban, and transportation regional maps, including the reasons for boundary decisions.