

Connecting GIS to AP Human Geography

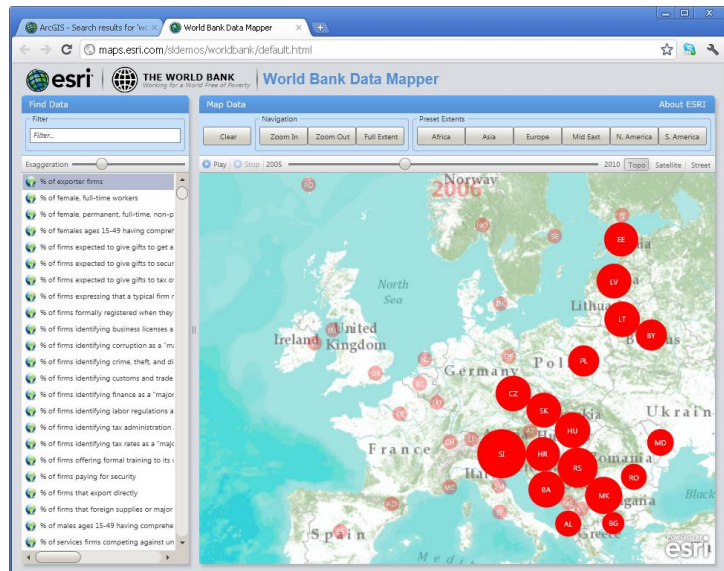
Introduction

GIS allows students to view, understand, question, interpret, and visualize data in many ways that reveal relationships, patterns, and trends in the form of maps, globes, reports, and charts. Advance Placement Human Geography (APHG) is a subject that requires students to think spatially, to gain a rich content knowledge in such topics as population, agriculture, and human-environment interaction, and to develop skills analyzing geographic data. A GIS helps students answer questions and solve problems by enabling them to look at their data in a way that is quickly understood and easily shared.

13 Linkages Between GIS and AP Human Geography

How can AP Human Geography be more effectively taught and learned using GIS? Let's explore 13 ways.

First, GIS is a versatile, powerful, yet easy-to-use toolkit that fits in well with nearly every AP subject. The reason is twofold. The goal of AP courses is to provide students with a rigorous immersion in discipline-specific content knowledge **and** analytical skills, so that they will be prepared to succeed at the university level. Using GIS requires students to engage in this same rich body of content knowledge **and** these same higher-level thinking skills. GIS does not provide the content knowledge—in AP History, AP Biology, AP Environmental Studies, AP Human Geography, or any other subject. Rather, deep inquiry with GIS allows students to build that content knowledge because through GIS, students are examining real places, relationships, and data. In terms of the analytical skills that AP encourages, GIS provides an inquiry-driven, problem-solving environment to evaluate, synthesize, test hypotheses, and make decisions—skills important in college success, and beyond.



Analyzing the spatial and temporal pattern of exporter firms using a GIS. The above map is one of hundreds of maps that use data from the World Bank is can be easily created and analyzed using ArcGIS Online (www.arcgis.com).

Asking questions is the first part of geographic inquiry: It forms the basis for knowing what types of social data to collect, what data to analyze, and what decisions to make. The GIS does not ask the questions. Rather, it is the student that has a firm foundation in understanding such APHG topics as energy production and cultural patterns, who asks the questions. Systems such as watersheds and biomes have shaped human behavior and interaction, and conversely, humans have profoundly affected these natural systems. Understanding these interactions is fundamental to asking questions and solving problems with GIS.

Second, using GIS is aligned with the purpose of the AP Human Geography course. The purpose of the AP Human Geography course (The College Board 2011) is to “introduce students to the systematic study of patterns and processes that have shaped human understanding, use, and alteration of the Earth’s surface.” GIS was created to examine patterns and processes in a systematic way. In APHG, “students employ spatial concepts and landscape analysis to examine human social organization and its environmental consequences.” Students can use GIS to examine the temporal and spatial components of concepts from migration to urbanization, from land use change to the organization of cities. In APHG, students “also learn about the methods and tools geographers use in their science and practice.” A key advantage of using GIS is that it is a professional tool created in part by professional geographers and used by professional geographers, wildlife biologists, city planners, epidemiologists, and by those in hundreds of other job descriptions on a daily basis to solve problems.

Third, using GIS adheres to each of the five major goals of APHG. The first of these is “to use and think about maps and spatial data.” In the 21st Century workplace, maps and spatial data are used on a daily basis, but they are not used as paper map sheets in a drawer or those that can be pulled down from a roller on a wall. Today’s maps can be created in seconds, modified, saved, shared, and applied in many different ways, in many different locations, and at many different scales. These are digital maps and images found in a GIS environment. Students using GIS cannot *help* but think about spatial data, because each map in a GIS is tied to a geographic database. That database can be queried, sorted, and modified as the problem dictates.

The second goal is “to understand and interpret the implications of associations among phenomena.” GIS was created to enable people to understand associations, such as between political systems and resulting land use, between urbanization and impervious surface, water quality, and runoff, and many other topics core to APHG. The third goal is “to recognize and interpret at different scales the relationships among patterns and processes.” Paper maps limit the user to a specific scale, specific symbols, and specific themes, but in a GIS, all of these may be modified, so that patterns can be detected. Considerations of scale—from the accuracy of spatial data to the proper scale suitable to solve a problem—are central to being effective with GIS. Using a GIS, students can determine how events and processes at different scales influence one another.

The fourth goal is to “define regions and evaluate the regionalization process.” Students using GIS can draw boundaries around regions of specific ethnicities, histories, or environments, assess whether these

areas qualify as a “region” based on APHG definitions, modify them, and re-evaluate. The fifth goal is to “characterize and analyze changing interconnections among place.” GIS allows neighborhoods, cities, regions, and countries to be examined over time, through asking questions spatially or by attribute, or to enable time animations.

The fourth connection between APHG and GIS is rigor. GIS is a professional set of quantitative analytical tools. Students using GIS engage the discipline of geography in a rigorous way, from building models to testing whether a specific map projection is more suitable for a certain problem, to symbolizing demographic maps as quantile versus equal interval. In short, students using GIS are developing and applying skills, abilities, and content knowledge for college, which is the fundamental goal of AP.

Fifth, the fact that each school develops its own curriculum for APHG also makes GIS an appealing technology to use. GIS is not a one-size fits all type of technology. It can be used in many ways—online or as desktop computer software, with step-by-step or open ended lessons, grappling with local issues or global problems, or analyzing watersheds or suburbanization. GIS can also ingest information from a wide variety of sources—anything from student-collected data on businesses in their local community, to population data from the US Census Bureau, to economic data from the World Bank. GIS can output information as maps, graphs, tables, movies, animations, in map-based presentations, and in standard reports.

Sixth, GIS can be effectively used to study each of the seven main topics in APHG. The first of these, “Geography: Its nature and perspectives” can be effectively taught with GIS, as we have seen because of the importance that geography and GIS place on spatial organization. These include geographic concepts such as location, space, place, scale, pattern, regionalization, and globalization. Settlement patterns, especially urbanization, can be studied by examining satellite images over time or contrasting zoning in different cities. The first topic includes that “students learn how to use and interpret maps, apply mathematical formulas, models, and qualitative data to geographical concepts,” which, as we have seen, is enabled by GIS. GIS allows students to more rapidly move from the data gathering stage to the data analysis stage. Through spatial analysis and making decisions in a GIS environment, students become keenly aware of the “relevance of academic geography to everyday life and decision making.”

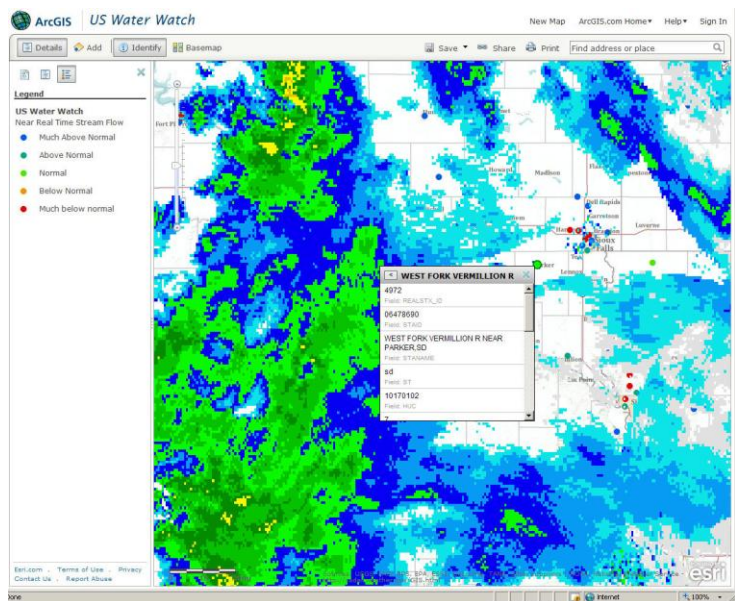
The second APHG topic, “Population,” can also be taught effectively with GIS. Through analyzing data spatially with maps and databases, students make sense of cultural, political, economic, and urban systems. They can examine trade balances around the world or median income by neighborhood in their own city. They can understand fertility, mortality, and migration by, for example, making maps and contrasting median age and fertility rates around the world. GIS can also enhance teaching and learning about the third APHG topic, “Cultural patterns and processes” through examining the concept of culture. For example, they can assess the spatial and place dimensions of cultural groups as defined by language, religion, race, ethnicity, and gender, in the present as well as in the past. Through the maps they make and the patterns that they uncover, they will understand diffusion across time and

space. Through examining land use patterns or tourism impacts, they will understand the way culture shapes human-environmental relationships.

The fourth APHG topic, “Political organization of space” can also be taught effectively with GIS. Students can examine boundaries and problems that so easily cross them, such as water quality and urban growth. The fifth APHG topic, “Agriculture and rural land use” can also be analyzed spatially within a GIS framework. Students can use GIS to help them understand how agricultural regions function, and the impact of agricultural change on the quality of life and the environment. For example, they can examine the distribution of Earth’s major crop production regions. They can also examine land survey systems such as metes-and-bounds, the public land survey system in the USA, and the French long lot system using maps and satellite images. They can assess how these land survey systems both impact and reflect environmental conditions and cultural values. Using GIS can address the sixth APHG topic, “Industrialization and economic development” in similar ways, because economic activity has a spatial character influenced by the interaction of such factors as natural resources, culture, politics, and history. Economic inequality can be examined at an individual community level or on a global level.

Finally, GIS can help students understand the seventh APHG topic, “Cities and urban land use.” Students using GIS can study systems of cities, discover where cities are located, and analyze why they are there—both their site and situation, and also from the global perspective. The current and historical distribution of cities, for example, can be studied by examining the 10 most populous cities over the past 2,500 years in a GIS. The economic and cultural functions of cities, reasons for their differential growth, and the types of transportation and communication linkages can all be studied with maps, images, and databases showing land use, transportation routes, zoning, and demography. Comparing the form, structure, and landscapes of cities past and present can be accomplished with historical and current maps in a GIS, in a qualitative and quantitative way.

The seventh link between GIS and APHG is that AP courses emphasize systems thinking. The “S” in GIS stands for “system”, so systems thinking is embedded in spatial analysis. The mapped layers may or may not be related in theme, scale, proximity, and process to each other. For example, soil in an area is influenced by the bedrock geology, local weathering, and regional climate, and in turn influences the local land use, vegetation, and animals supported, influencing the ecoregion and



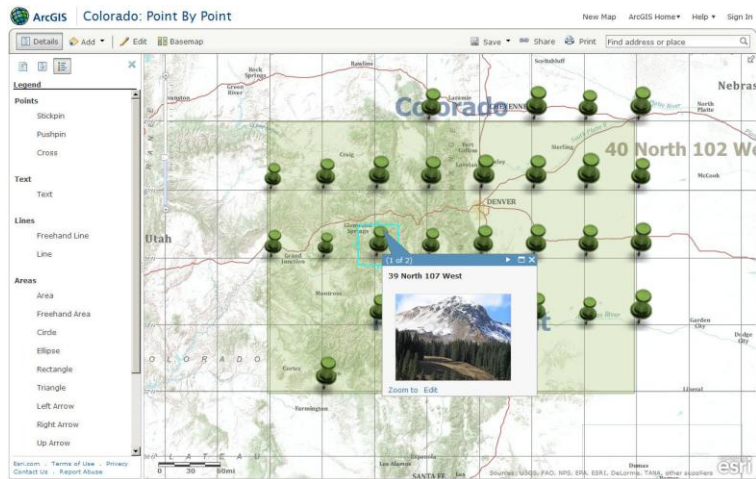
the threats to that ecoregion. By being able to ask questions of multiple data sets, students can analyze concepts and processes in a holistic fashion. Let's consider the impact of cities on watersheds as one example.

Using ArcGIS Online, students can examine current weather, compare rainfall to current streamflow, consider the drainage area of the watershed, and assess how the impervious surface of cities impact streamflow.

Eighth, GIS is well-connected to the critical thinking emphasis of APHG because students using GIS need to continually question the accuracy, validity, source, purpose, and appropriateness of the data they are using. Maps, like other data, are useful, but contain inaccuracies, distortions, and missing data. Error needs to be understood and managed. Finally, GIS is not a closed system, but rather, an open one that can be customized and shared.

Ninth, each of the key issues of APHG, from the impact of cities on the environment, to migration, to land use decisions, and more, occurs somewhere, and typically occurs in multiple locations and at a variety of scales. Each arose somewhere, diffused somehow, and each changes over space and time. Each affects the ways that other phenomena interact. The geographic perspective is therefore important in understanding scientific issues, and GIS provides a rich toolset in which to use the geographic perspective. GIS allows for the multiple variables necessary in scientific analysis in two dimensions, three dimensions, and even four dimensions (including time). For example, population can be mapped as hills and valleys on a map of a region, with specific places hyperlinked to student photographs or photographs from the web that illustrate the population density and ethnicity of that region.

Tenth, investigating APHG topics with GIS lends relevancy and real-world contexts to the topics. The central themes that geographers have studied for decades have recently become topics on daily newscasts. These include the loss of life and property from natural hazards, long-term climate change, how water availability and water politics impacts agriculture, how migration affects culture, and other topics. These have raised awareness to the need for studying these issues not in isolation but rather through the context provided by APHG.



Eleventh, as the 21st Century makes abundantly clear, we live on a dynamic planet, ever changing on a variety of scales. All of the APHG topics incorporate the concept of change. Conditions may change quickly or slowly, and may come from natural or human processes. One way GIS enables change to be examined is through satellite images, assigning different colors to different combinations of wavelengths to enable particular patterns to be seen, showing changes in land use from urbanization or agriculture. GIS also offers a rich array of animation and other time-enabled functions to visualize and understand change.

Twelfth, students who are well grounded in the spatial perspective through GIS are better able to, during school and after graduation, use data at a variety of scales, in a variety of contexts, think systematically and holistically, use quantitative and qualitative approaches to solve problems. In short, these graduates are better decision makers. Students engaged in GIS and AP make heavy use of the inquiry process. This involves asking questions, acquiring resources, analyzing data, assessing and making decisions from resulting information, and acting on that information. This often leads to additional questions, and the cycle continues. Much of APHG has an applied nature—it leads to action. As issues such as water quality and availability and population pressure transcend cultures and regions and become increasingly complex, an integrative decision-making tool such as GIS is critically needed. Students using these tools can make the kind of decisions that will positively impact people and the planet.

Thirteenth, given the widespread concerns faced by the modern world, it is imperative that students study and understand APHG not only to equip them for life in the 21st Century, but to ensure that we emerge at the end of the 21st Century in a sustainable way. How can we expect decision-makers to care about the planet and its people unless they have learned about the planet and its people as students? And how can they learn about our world unless they engage in geography and use GIS as students?

Resources Connecting GIS to APHG Education

Esri develops and connects educators to resources that enable the effective use of GIS in APHG education. Many of these resources, such as lessons, data sets, and tools, can be accessed via the Esri Education Community (<http://edcommunity.esri.com>). Let's explore just a few of these resources.

EdCommunity Blog

Every few days, the Esri education staff writes a column in the EdCommunity blog (<http://edcommunity.esri.com/blog>) about the application of GIS to education, and frequently these columns focus on geography education. Topics include examining the resource needs of a world of 7 billion people, mapping natural hazards, examining human health variables, and much more.

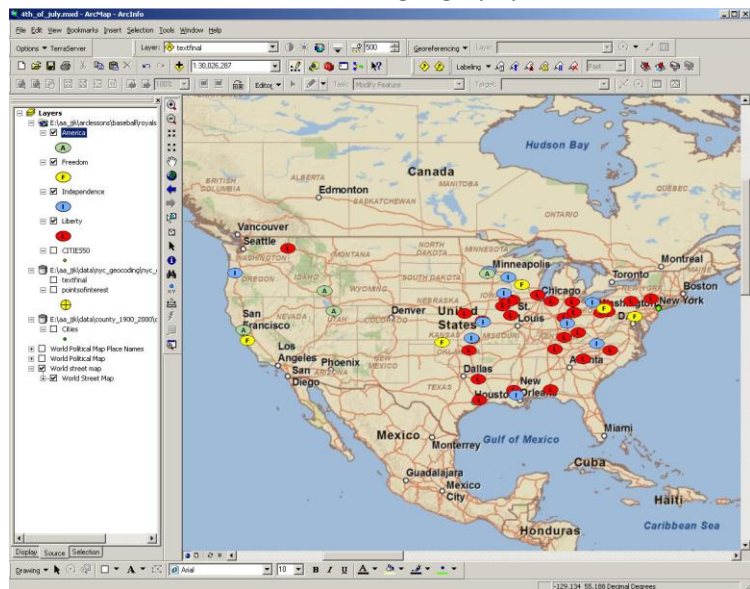
ArcGIS Online

ArcGIS Online (<http://www.arcgis.com>) offers a free, powerful, and easy-to-use web-based toolkit where students and educators can construct, save, and share their own customized maps on an infinite variety of topics and scales. These maps can be compared in a variety of ways and panels, all using a standard web browser (see lesson <http://edcommunity.esri.com/arclessons/lesson.cfm?id=641>). The content is rich, ranging from population, demographics, natural hazards, land use, agriculture, food expenditures (see lesson <http://edcommunity.esri.com/arclessons/lesson.cfm?id=563>) to unusual imagery around the world (<http://edcommunity.esri.com/arclessons/lesson.cfm?id=558>), and much more. Data can be compared in many ways, such as in side-by-side maps, through altering the transparency or symbology of specific variables, and through analyzing the attributes. For more rigorous analysis with additional tools, ArcGIS Desktop (<http://www.esri.com/arcgis>) offers further capabilities.

Lessons

Numerous lessons on the ArcLessons library, (<http://edcommunity.esri.com/arclessons>) can be used in APHG education. Educators can use these activities to encourage spatial thinking, to teach and learn APHG content, and to foster GIS skills. For example, building an analytical story (<http://edcommunity.esri.com/arclessons/lesson.cfm?id=650>) shows how to use ArcGIS online to create, analyze, and present a map-based story about an issue.

A series of videos on the Esri Education Team's [YouTube Channel](#) and on [a geography channel](#) describes the process of gathering field data with GPS and mapping and analyzing it with GIS in educational contexts. The videos feature explanations and demonstrations not only on the technical procedures involved with gathering data on locations and characteristics of data and then analyzing its spatial patterns, but also the pedagogical advantages to using these technologies within the context of spatial thinking in instruction. In short, they focus not only the “hows”, but also the “whys”. Embedded throughout the series are issues of data and project management, scale, accuracy, precision, metadata, and appropriateness.



Case Studies

Numerous examples exist showing how geography educators are helping expand their students' futures with GIS on <http://edcommunity.esri.com>. For example, in Maine, [a geography teacher uses GIS to emphasize geospatial thinking](#). GIS provides [real job skills for students](#). GIS helps focus on [why geography education matters](#). These studies show the ease and power with which GIS can be incorporated into geography education. It is imperative that we engage 21st Century issues with 21st Century perspectives and 21st Century tools such as GIS.

References

The College Board. 2011. Human Geography Course Description.

