TN Department of Education | College, Career and Technical Education

Introduction to Geographic Information Systems (GIS)

Primary Career Cluster:	Science, Technology, Engineering, and Mathematics (STEM)
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code(s):	6142
Prerequisite(s):	*Algebra I* (0842, 3102) and *Geometry* (0843, 3108)
Credit:	1
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other STEM, IT, Architecture & Construction, or Agriculture courses.
Programs of Study and Sequence:	This is an optional elective to support multiple programs of study.
Aligned Student Organization(s):	SkillsUSA: http://www.tnskillsusa.com Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov Technology Student Association (TSA): http://www.tntsa.org Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to your local postsecondary institution.
Teacher Endorsement(s):	013, 014, 015, 016, 017, 018, 047, 048, 070, 078, 081, 125, 126, 127, 128, 129, 131, 157, 210, 211, 212, 213, 214, 230, 232, 233, 413, 414, 415, 416, 417, 418, 422, 448, 470, 477, 519, 531, 595, 596, 700, 740, 760
Required Teacher Certifications/Training:	Teachers who have never taught this course MUST attend the training provided by Department of Education or successfully complete Esri Technical certification.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-stem

Course Description

Introduction to Geographic Information Systems is an applied course for students who have already mastered basic computer skills and wish to apply those skills in novel contexts with the use of geographic information systems (GIS) and geospatial technologies. Upon completion of this course, proficient students will develop the ability to reason spatially and analyze relationships among

concepts; to capture, store, validate, integrate, analyze, and display data related to locations on the Earth; and to create, query, maintain, and modify geospatial datasets. They will learn how GIS is used as a decision-making and data management tool to solve problems in various industries and fields. Furthermore, students will use GIS software to create a spatially accurate map with data retrieved from online or locally available resources.

Program of Study Application

This is an optional elective credit for students interested in the subject area as a support for their program of study in Architecture & Construction, Agriculture, STEM, or Information Technology. For more information on the benefits and requirements of implementing these programs in full, please visit the career cluster websites:

- Agriculture, Food, & Natural Resources: https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources
- Information Technology: https://tn.gov/education/article/cte-cluster-information-technology
- Science, Technology, Engineering & Mathematics (STEM): https://tn.gov/education/article/cte-cluster-stem
- Architecture & Construction: http://www.tn.gov/education/article/cte-cluster-architecture-construction

Course Standards

Geographic Information Systems Overview

1) Research the history of mapping, geographic information systems (GIS), global positioning systems (GPS), remote sensing, and other geospatial technologies. Examine how these technologies have evolved, concentrating on their recent migration towards online platforms, and evaluate their influence on present-day society, citing specific textual evidence from news articles and scholarly journals.

2) Explore several occupations related to the GIS and geospatial technologies fields (such as GIS analyst, GIS technician, cartographer, geospatial information scientist, geospatial information technologist, geographer, engineer, urban and regional planner) and describe the many sources and types of information, such as government, private, and open source data, that these occupations use. Determine how various industries employ different kinds of data to meet their needs.

3) Investigate an assortment of skills and education required for GIS and geospatial technology professionals. Write an informative text that identifies the typical educational and certification requirements, working environments, and career opportunities for these occupations. For example, participate in an information-gathering tour of a local organization that uses GIS technology, and report on the roles and responsibilities of GIS professionals on staff, including the kinds of software and equipment they use.

Geography

4) Distinguish among the characteristics of various types of maps, including but not limited to topographic maps, physical maps, choropleth maps, and heat maps. Explain how they are used to conduct different types of GIS analysis, as well as what types of information they communicate. For example, look at how census data can be displayed as choropleth maps representing various data fields (e.g., average household income, household size, etc.). Identify key elements of a map, demonstrate how to read a topographic map, and explain how maps can be derived from aerial photography.

5) Identify locations within various coordinate systems such as the Geographic Coordinate System, Universal Transverse Mercator (UTM), and the State Plane Coordinate System. Explain the difference between a Cartesian and a geographic coordinate system. Demonstrate the ability to convert latitude and longitude information between degree-minute-second (DMS) and decimal-degree (DD) forms.

6) Distinguish among the characteristics of various types of data such as vector data (i.e. points, lines, polygons) and raster data, and explain how they are used to conduct GIS research and analysis. For example, using GIS software, demonstrate how to select layers to create various views of a location or create buffers around vector data features.

Database Management

7) Find common data sources that can be used to conduct geospatial analysis. Compare and contrast government versus open-source databases for retrieving a range of geospatial data. For example, compare the validity of data retrieved from OpenStreetMap (OSM) with data retrieved from the Census Bureau.

8) Apply data entry techniques to enter and manipulate text and data using various software applications (such as spreadsheets, presentations, word processing, and database management systems). For example, create a spreadsheet with coordinate data and upload the data to a GIS. Review and evaluate the input for accuracy, quality, and completeness of documentation. Report the evaluation of the data and justify the conclusions.

9) Understand and demonstrate the effective use of file and folder management techniques for either Windows or Mac environments. For example, demonstrate knowledge of the interoperability between Microsoft Office and Esri products or the use of cloud computing and a GIS.

Software Applications and GIS Analysis

10) Perform a multistep procedure that a GIS technician would follow to build a geospatial database and manipulate the data within a GIS software package. For example, implement a workflow to use GPS equipment to collect data and transfer that data to a GIS. Use the GIS to measure distance, calculate area, edit feature data, and display features and map elements.

11) Demonstrate how to symbolize, edit, sort, and query data in GIS software, and how to effectively use zooming, identifying, selecting, and panning tools. Practice communicating the procedures to others in a mock-workplace scenario, such as a situation when a geospatial technologist must provide technical support to a telecommunications client.

12) Analyze spatially-based data to create reports and construct graphic illustrations (such as bar graphs, scatter plots, histograms, and maps) for a technical or lay audience using GIS software and other technologies. Interpret the information assembled in the form of summary and descriptive statistics (such as mean, median, mode, and range), and discuss how the results could be used as decision-making tools in various fields (such as agriculture, health care, community planning, engineering, banking and financial services, transportation, or public safety).

13) Simulate the work of a team of GIS technicians charged with producing data layers and maps. Plan and implement a multistep procedure to layout and print maps, including development of map templates. This procedure should include, but is not limited to: defining page margins and parameters for printing a specific size, effectively using required map elements (such as title, author, data sources, legend, north arrow, and scale bar), and creating digital archives of maps.

14) Develop a research question that will guide an examination and analysis of a geographic trend or phenomenon occurring in society. Write a report to discuss the research findings and represent data in maps and other graphic illustrations (such as bar graphs, scatter plots, histograms). For example, investigate how industrial development affects the population of various animals in a specified area. Develop and strengthen writing through planning, revising, editing, and rewriting the research essay over time.

15) Research an issue affecting the community that can be analyzed using GIS. Define the scope of the problem and develop a research question that will guide a service learning project to address the problem. Using public data such as the American Community Survey, conduct an original analysis of the problem, engaging community members and affected populations, and deliver the results in the form of a poster or multimedia presentation. The presentation should be of academic competition quality and should discuss the problem statement/research question, descriptive information on the community, the methodology used to explore the problem, and a recommended solution justified by GIS analysis.

Standards Alignment Notes

*References to other standards include:

- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.