TENNESSEE DEPARTMENT OF EDUCATION
FIRST TO THE TOP

Introduction to Geographic Information Systems (GIS)

Primary Career Cluster:	Science, Technology, Engineering, and Mathematics (STEM)
Consultant:	Bethany King Wilkes, (615) 532-2844, Bethany.Wilkes@tn.gov
Course Code(s):	TBD
Prerequisite(s):	Algebra I (6109/3102) and Geometry (6111/3108)
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 or IT courses.
Programs of Study and Sequence:	This is an optional third or fourth course in both the *Engineering* and *Programming* and *Software Development* programs of study.
Necessary Equipment:	Computer laboratory
Aligned Student Organization(s):	Skills USA: www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov Technology Student Association (TSA): www.tntsa.org Amanda Hodges, (615) 532-6270, Amanda.Hodges@tn.gov
Coordinating Work-Based Learning:	If a teacher has completed work-based learning training, appropriate student placement can be offered. To learn more, visit http://tennessee.gov/education/cte/wb/.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	TBD
Required Teacher Certifications/Training:	TBD
Teacher Resources:	www.tn.gov/education/cte/ScienceTechnologyEngineeringMathematics.shtml www.tennessee.gov/education/cte/InformationTechnology.shtml

Course Description

Introduction to Geographic Information Systems is an applied course for students in the STEM and IT clusters 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. Students in this course 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. Standards in this course are aligned with the Tennessee Common Core State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee Common Core State Standards in Mathematics.*

Program of Study Application

This course is an optional third or fourth course in both the *Engineering* and *Programming & Software Development* programs of study. For more information on the benefits and requirements of implementing these programs in full, please see the program of study description documents found on the Science, Technology, Engineering, and Mathematics (STEM) and Information Technology websites listed below:

- www.tn.gov/education/cte/ScienceTechnologyEngineeringMathematics.shtml
- www.tennessee.gov/education/cte/InformationTechnology.shtml

Course Standards

Geographic Information Systems Overview

1) Research the history of mapping, geographic information systems (GIS), global positioning systems (GPS), other geospatial technologies, and remote sensing. Examine how these technologies have evolved, and evaluate their influence on present-day society, citing specific textual evidence from news articles and scholarly journals. (TN CCSS Reading 1, 2; TN CCSS Writing 2)

2) Explore several occupations within 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 metadata, that these occupations use. Determine how various industries employ different kinds of data to meet their needs. (TN CCSS Reading 4, 6, 9)

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. (TN CCSS Reading 2; TN CCSS Writing 2)

Geography

4) Distinguish among the characteristics of various types of maps, including but not limited to topographic maps, choropleth maps, and climate maps, and explain how they are used to conduct GIS research. 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 are derived from aerial photography. (TN CCSS Reading 4, 9; TN CCSS Writing 1; TN CCSS Math N-Q)

5) Interpret locations within various coordinate systems such as the Geographic Coordinate System, Universe Transverse Mercator (UTM), and the State Plane Coordinate System. Demonstrate the ability to convert latitude and longitude information between degree-minute-second (DMS) and decimal-degree (DD) forms. (TN CCSS Reading 4, 7; TN CCSS Math N-Q, A-CED)

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. For example, using GIS software, demonstrate how to select layers to create various views of a location or create buffers around vector data features. (TN CCSS Reading 4, 9; TN CCSS Writing 1; TN CCSS Math N-Q, N-VM)

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. (TN CCSS Reading 6, 9; TN CCSS Writing 4)

8) Apply keyboarding techniques to enter and manipulate text and data using various software applications (such as spreadsheets, presentations, and word processing). Simulate the work of a GIS technician to review and evaluate the input for accuracy, quality, and completeness of documentation. Report the evaluation of the data and justify the conclusions. (TN CCSS Reading 4)

Software Applications and GIS Analysis

9) Perform a multistep procedure that a GIS technician would follow to build a geodatabase and manipulate the data within a GIS software package. For example, use GPS equipment to collect data, measure distance, and calculate area, or demonstrate the use of mapping software to measure distance and area, edit feature data, display features and map elements. (TN CCSS Reading 3, 4; TN CCSS Writing 6, 7, 9; TN CCSS Math N-Q, G-GMD, G-MG)

10) Demonstrate how to symbolize, edit, sort, and query data in GIS software, and justify when it is appropriate to 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 information technologist must provide technical support to a telecommunications client. (TN CCSS Reading 1, 3; TN CCSS Writing 2; TN CCSS Math N-Q, G-CO)

11) Analyze spatially-based data to create reports and construct graphic illustrations (such as bar graphs, scatter plots, histograms) 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). (TN CCSS Reading 1, 4, 7; TN CCSS Writing 6, 8; TN CCSS Math S-ID)

12) 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, legend, north arrow scale bar), and creating digital archives of maps. (TN CCSS Reading 3; TN CCSS Writing 4, 6; TN CCSS Math N-Q, G-CO)

13) 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. (TN CCSS Reading, 1, 7, 9; TN CCSS Writing 2, 5, 6, 8, 9)

14) Research an issue affecting the community that can be analyzed using geographic information systems and geospatial technologies. 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. (TN CCSS Reading, 1, 4, 7; TN CCSS Writing 1, 7; TN CCSS Math N-Q, A-CED)

Standards Alignment Notes

*References to other standards include:

- TN CCSS Reading: Tennessee Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
    - Note: While not directly aligned to one specific standard, students that are engaging in activities outlined above should be able to also demonstrate fluency in Standards 5, 8, and 10 at the conclusion of the course.
- TN CCSS Writing: Tennessee Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in

History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
    - Note: While not directly aligned to one specific standard, students that are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- TN CCSS Math: Tennessee Common Core State Standards for Mathematics: Math Standards for High School: Number and Quantity, Geometry, Algebra, Statistics and Probability (pages 58-83).
    - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students that are engaging in activities listed above should be able to demonstrate quantitative, geometric, algebraic, and statistical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.
- 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.