Department of Education | College, Career and Technical Education

May 2024

Introduction to Geographic Information Systems (GIS)

Primary Career Cluster:	Agriculture, Food, and Natural Resources
Course Contact:	CTE.Standards@tn.gov
Course Code(s):	C18H39
Prerequisite(s):	*Algebra I* (G02X02, G02H00) and *Geometry* (G02H11, G02X03)
Credit:	1
Grade Level:	11-12
Elective Focus Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources, *Architecture & Construction, IT, or STEM,* courses.
POS Concentrator:	This course satisfies one out of two required courses to meet the Perkins V concentrator definition, when taken in sequence in the approved special program of study.
Programs of Study and Sequence:	This is an optional elective to support multiple special programs of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org SkillsUSA: http://www.skillsusatn.org/ Technology Student Association (TSA): http://www.tntsa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html.
Promoted Tennessee Student Industry Credentials:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html
Teacher Endorsement(s):	013, 014, 015, 016, 017, 018, 022, 047, 048, 070, 078, 081, 125, 126, 127, 128, 129, 131, 150, 151, 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, 950, 951, 982
Required Teacher Certifications/Training:	Teachers who have never taught this course MUST attend GIS training approved by Department of Education or successfully complete Esri Technical certification.
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html Best for All Central https://bestforall.tnedu.gov/

Course at a Glance

CTE courses provide students with an opportunity to develop specific academic, technical, and 21st century skills necessary to be successful in career and in life. In pursuit of ensuring every student in Tennessee achieves this level of success, we begin with rigorous course standards which feed into intentionally designed programs of study.

Students engage in industry relevant content through general education integration and experiences such as career and technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry standard content and technology, solve industry-based problems, meaningfully interact with industry professionals and use/produce industry specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for your students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course, note this is not an exhaustive list.

- Participate in CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry specific skills that involve teamwork and project management.
- Participate in CTSO events that align with this course including Agriscience Fair, Agricultural Issues, Employment Skills, and Geospatial Technology.

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-1.3** | Tour the city's emergency management command center and have the manager discuss the different careers needing this type of experience.
- **Standard 2.1-4.6** | Have the students work on projects that are supervised or evaluated by a geographic information systems (GIS) technician.

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; capture, store, validate, integrate, analyze, and display data related to locations on Earth; and 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.

Course Standards

1. Geographic Information Systems Overview

1.1 Elevation: 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.

1.2 Careers: Explore several **occupations related to the GIS and geospatial technologies fields** (e.g., GIS analyst, GIS technician, cartographer, geospatial information scientist, geospatial information technologist, geographer, engineer, and 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.

1.3 Occupational Requirements: 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.

2. Geography

2.1 Mapping Systems: 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.

2.2 Coordinate Systems: 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.

2.3 Vector Data: 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.

3. Database Management

3.1 Database Systems: 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.

3.2 Data Management: Apply data entry **techniques to enter and manipulate text and data** using various software applications (e.g., 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.

3.3 Filing Systems: 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.

4. Software Applications and GIS Analysis

4.1 Geospatial Database: 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.

4.2 Data analysis: 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.

4.3 Summary Reports and Illustrations: Analyze spatially based data to **create reports and construct graphic illustrations** (e.g., 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 (e.g., mean, median, mode, and range), and discuss how the results could be used as decision-making

tools in various fields (e.g., agriculture, health care, community planning, engineering, banking and financial services, transportation, or public safety).

4.4 Map Development: Plan and implement a multistep **procedure to layout and print maps**, including the 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 (e.g., title, author, data sources, legend, north arrow, and scale bar), and creating digital archives of maps.

4.5 Identifying Trends: Develop a research question that will guide an **examination and analysis of a geographic trend or phenomenon occurring in society**. Research findings and represent data in maps and other graphic illustrations (e.g., bar graphs, scatter plots, histograms). For example, investigate how industrial development affects the population of various animals in a specified area.

4.6 Project: 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, engage 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.