

Geospatial Technology I

8423 36 weeks

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Virginia Department of Education

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Course Description

Suggested Grade Level: 9 or 10 or 11 or 12

The geospatial technology program provides experiences pertaining to the study and use of geographic information systems (GIS), global positioning systems (GPS), remote sensing (RS), and mobile technologies. Fundamentally, these technologies allow students to explore and analyze the natural and human-made world, locally, globally, and beyond. Students use tools, processes, and techniques to create, store, access, manipulate, and revise data to solve human challenges. These experiences employ real-world spatial analysis models and guidelines for integrating, interpreting, analyzing, and synthesizing data, with a focus on both the implications and the limitations of geospatial technologies.

Task Essentials Table

- Tasks/competencies designated by plus icons (⊕) in the left-hand column(s) are essential
- Tasks/competencies designated by empty-circle icons (○) are optional
- Tasks/competencies designated by minus icons (⊖) are omitted
- Tasks marked with an asterisk (*) are sensitive.

Task Number	8423	Tasks/Competencies
Examining Past, Present, and Future Geospatial Technologies (GT)		
39	⊕	Describe the evolution of GT.
40	⊕	Identify geospatial applications in jobs/careers.
41	⊕	Identify geospatial opportunities at the postsecondary level.
42	⊕	Describe ethical, security, legal, policy, and privacy issues in GT applications.
43	⊕	Describe platforms of mobile technology implementation.
44	⊕	Examine the applications of mobile technologies.
Creating and Using Maps		
45	⊕	Identify map components for a layout.
46	⊕	Identify types of maps.
47	⊕	Create maps to solve problems.
48	⊕	Explain the concept of projections.
49	⊕	Explain ways maps can distort reality.
50	⊕	Research sources of map data.
51	⊕	Acquire geospatial data.
52	⊕	Evaluate metadata.
53	○	Use mobile technology.
54	○	Design a mobile application.

Using GPS		
55	<input checked="" type="radio"/>	Explain how a GPS functions.
56	<input type="radio"/>	Explain the scientific and mathematical components of a GPS.
57	<input checked="" type="radio"/>	Mark a data point using a handheld GPS receiver or GPS-enabled device.
58	<input checked="" type="radio"/>	Upload GPS points into a mapping system.
59	<input checked="" type="radio"/>	Navigate to an object in a given location using a handheld GPS receiver or GPS-enabled device.
60	<input checked="" type="radio"/>	Record attributes of a data point or event.
61	<input checked="" type="radio"/>	Explain geodetic markers.
62	<input checked="" type="radio"/>	Describe geodetic concepts.
Manipulating GIS Data		
63	<input checked="" type="radio"/>	Use standard conventions for naming files.
64	<input checked="" type="radio"/>	Apply standard conventions for managing files and file structures.
65	<input checked="" type="radio"/>	Manage data in a GIS.
66	<input checked="" type="radio"/>	Add geographic data to a GIS.
67	<input checked="" type="radio"/>	Create a GIS map using raster and vector data sets.
68	<input checked="" type="radio"/>	Analyze the relationship of spatial components.
69	<input checked="" type="radio"/>	Calculate lengths, distances, and areas in a GIS.
70	<input checked="" type="radio"/>	Use classification schemes to display numerical attributes.
71	<input checked="" type="radio"/>	Explain a definition query.
72	<input checked="" type="radio"/>	Use a query to select data.
73	<input checked="" type="radio"/>	Use a query to select data by location.
74	<input checked="" type="radio"/>	Analyze statistics of a dataset.
75	<input checked="" type="radio"/>	Create GIS data sets using geoprocessing tools.

76	⊕	Define <i>georeferencing</i> .
77	⊕	Define <i>geocoding</i> .
78	⊕	Edit vector shapefiles spatially to create, modify, and delete point, line, and polygon features.
79	⊕	Edit attribute tables to create, modify, delete, and append attribute values.
80	○	Develop spatial data using a 3D viewer.
Managing Geospatial Projects		
81	⊕	Define a design problem.
82	⊕	Identify design problem constraints.
83	⊕	Identify data requirements.
84	⊕	Collect geospatial data.
85	⊕	Compose a technical document that includes a presentation analysis map.
86	⊕	Develop a product that shows spatial reasoning.
87	⊕	Evaluate final solutions.
88	⊕	Present final project results.

Legend: ⊕ Essential ○ Non-essential ⊖ Omitted

Curriculum Framework

Examining Past, Present, and Future Geospatial Technologies (GT)

Task Number 39

Describe the evolution of GT.

Definition

Description should include the definition and application of the following technologies:

- Surveying technology
- Geographic information systems (GIS)
- Global positioning systems (GPS)
- Remote sensing (RS)
- Light detection and ranging (LIDAR)
- Cloud/web-based technologies
- Automated machine guidance (AMG)

Process/Skill Questions

- When was the first GPS created?
- Why was GIS created?
- What would a timeline of GIS, GPS, and RS technological development since 1950 look like?
- What are applications for AMG?

ITEEA National Standards

1. The Characteristics and Scope of Technology

17. Information and Communication Technologies

18. Transportation Technologies

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

4. The Cultural, Social, Economic, and Political Effects of Technology

5. The Effects of Technology on the Environment

6. The Role of Society in the Development and Use of Technology

7. The Influence of Technology on History

TSA Competitive Events

Technology Bowl

Task Number 002

Identify geospatial applications in jobs/careers.

Definition

Identification could include industries which require knowledge of GT, such as

- public utilities
- science
- agriculture
- financial management
- health services
- social services
- law enforcement
- engineering
- architecture
- planning
- transportation
- manufacturing
- energy and power
- construction
- business and marketing
- research
- aerospace
- land surveying
- photogrammetry.

Process/Skill Questions

- What GT skills are needed in local industry?
- What industries within 25 miles need workers with GT skill sets?
- What will a search for jobs/careers that require GIS, GPS, RS, and use of geographic data yield?
- What academic credentials make a candidate better qualified for jobs in GT?

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Task Number 003

Identify geospatial opportunities at the postsecondary level.

Definition

Identification should include

- degree and certificate programs
- educational institutions.

Process/Skill Questions

- What opportunities are available?
- What is the difference between a degree and a certificate program?
- What institutions provide postsecondary programs in GT?

Task Number 004

Describe ethical, security, legal, policy, and privacy issues in GT applications.

Definition

Description should identify moral imperatives and areas of concern related to

- data collection
- presentation of graphics

- transparent biases of data
- property rights
- copyright issues
- privacy issues
- data theft
- plagiarism.

Process/Skill Questions

- What is the distinction between ethical and legal?
- What are the acceptable situations for the government to collect citizen data?
- How can cartography misrepresent data?
- How have GTs changed law enforcement practices?
- How can GTs be used to gain unfair market advantages?
- What are the ethical and legal responsibilities of sharing and publishing geospatial data?

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TSA Competitive Events

Essays on Technology

Extemporaneous Speech

Task Number 005

Describe platforms of mobile technology implementation.

Definition

Description should include, but not be limited to,

- smart phones
- tablets
- in-vehicle devices
- handheld data loggers
- mobile applications.

Process/Skill Questions

- What are the advantages and limitations of mobile technology?
- What are ethical and legal implications of using mobile technology?
- How has mobile technology evolved to meet the needs of society?

ITEEA National Standards

1. The Characteristics and Scope of Technology

4. The Cultural, Social, Economic, and Political Effects of Technology

Task Number 006

Examine the applications of mobile technologies.

Definition

Examination should include

- location-based services
- data-collection services.

Process/Skill Questions

- What are specific examples of location-based services and data-collection services?
- How have mobile technologies influenced the way data is collected?

ITEEA National Standards

4. The Cultural, Social, Economic, and Political Effects of Technology

Creating and Using Maps

Task Number 007

Identify map components for a layout.

Definition

Identification should include

- map feature symbology for qualitative and quantitative data
- north arrow
- scale
- creation or revision date
- color scheme
- boundary lines
- data sources
- legend
- professional liability
- base map (e.g., aerial, satellite, topography).

Process/Skill Questions

- How are different geographic and/or political elements displayed?
- How can map colors affect map interpretation?
- What elements on a map help with interpretation?
- Who is legally responsible for the accuracy of a map?

ITEEA National Standards

13. Assess the Impact of Products and Systems

5. The Effects of Technology on the Environment

6. The Role of Society in the Development and Use of Technology

TSA Competitive Events

Geospatial Technology (Virginia only)

Task Number 008

Identify types of maps.

Definition

Identification should include examples from the following categories:

- Topographic
- Thematic
- Political
- Demographic

Process/Skill Questions

- Where are topographical maps used?
- What is an example of a thematic map?
- How do policy analysts use political maps?
- What types of maps do city planners use?

TSA Competitive Events

Geospatial Technology (Virginia only)

Task Number 009

Create maps to solve problems.

Definition

Creation should include

- area of geographic focus
- brainstorming
- notes
- acceptance or rejection of probable solutions
- process summary.

Process/Skill Questions

- What are the criteria for accepting or rejecting probable solutions?
- What is the purpose of brainstorming, and how will it be used to solve a given problem?
- Who are the stakeholders for the maps?
- How do the maps solve the original problem?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

11. Apply the Design Process

TSA Competitive Events

Geospatial Technology (Virginia only)

Technology Problem Solving

Task Number 010

Explain the concept of projections.

Definition

Explanation should include

- types of projections
- selection of projection
- changing projections.

Process/Skill Questions

- What is a map projection?
- What is the difference between a geographic coordinate system and a projected coordinate system?
- Why is it important to have an appropriately projected map?

Task Number 011

Explain ways maps can distort reality.

Definition

Explanation should include

- misrepresentation by the map's creator
- projections
- graphic techniques
- data used or not used and an explanation of each.

Process/Skill Questions

- How can a graphic misrepresent information on a map?
- Why might an organization choose not to use all of the available data when creating a map?

Task Number 012

Research sources of map data.

Definition

Research should include private and public entities, such as

- U.S. Geological Survey (USGS)
- U.S. Census Bureau
- Virginia Geographic Information Network (VGIN)
- National Oceanic and Atmospheric Administration (NOAA)
- Virginia Department of Transportation (VDOT)
- Environmental Systems Research Institute (ESRI).

Process/Skill Questions

- What information is collected in the U.S. census?
- Where could one find a map of a piece of property in the local community?
- What types of maps are available for download?
- What map data is needed for a given project?

ITEEA National Standards

13. Assess the Impact of Products and Systems

17. Information and Communication Technologies

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Task Number 013

Acquire geospatial data.

Definition

Acquisition should include

- GPS receivers
- GPS-enabled devices
- web services
- data downloads
- physical media.

Process/Skill Questions

- What are readily available sources of data?
- What are the constraints of a network in terms of downloading capabilities?
- What data formats are able to be input into GIS software?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

12. Use and Maintain Technological Products and Systems

13. Assess the Impact of Products and Systems

TSA Competitive Events

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Task Number 014

Evaluate metadata.

Definition

Evaluation should include items such as

- time created
- source
- relevance
- attribute descriptions
- spatial coordinate system.

Process/Skill Questions

- What is metadata, and what is its purpose?
- How does one access metadata?
- How does one analyze the integrity of imported data?

TSA Competitive Events

Geospatial Technology (Virginia only)

Task Number 015

Use mobile technology.

Definition

Use should include various mobile devices to collect or track data.

Process/Skill Questions

- What mobile devices can be used for data collection?
- What mobile devices are available?
- What are examples of tracking applications on mobile devices?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

Task Number 016

Design a mobile application.

Definition

Design should include differentiation of the platforms and tools for mobile applications. Design may include implementation.

Process/Skill Questions

- What are the different platforms for mobile applications?
- What are the software development tools to implement mobile applications?

ITEEA National Standards

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

Using GPS

Task Number 017

Explain how a GPS functions.

Definition

Explanation should include

- geosynchronous orbit
- satellites
- multiple systems
- triangulation
- receivers

- mobile devices
- land-based corrections
- coordinate systems.

Process/Skill Questions

- How does a GPS function?
- What situations can result in faulty GPS information?

ITEEA National Standards

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

Task Number 018

Explain the scientific and mathematical components of a GPS.

Definition

Explanation should include various applications of the formula

$$d = vt$$

where v (velocity) is the speed of light and t (time) is the difference between signal sent and signal received.

Explanation should also include

- wavelength properties within the electromagnetic spectrum
- land-based corrections for errors.

Process/Skill Questions

- How are the properties of light applicable to the use of a GPS?
- How many signals from satellites must a GPS receiver/enabled device receive in order to specify a location?
- How has science advanced GPS technologies?

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 - 7. The Influence of Technology on History**
-

Task Number 019

Mark a data point using a handheld GPS receiver or GPS-enabled device.

Definition

Marking a point should include

- acquiring latitude and longitude or coordinates
- using the handheld GPS receiver or GPS-enabled device to mark a waypoint.

Process/Skill Questions

- How do the satellites locate someone's position?
- What can interfere with marking the waypoint?
- How accurate is the GPS unit?
- How does one interpret GPS data to correctly indicate position?

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Geospatial Technology (Virginia only)

Task Number 020

Upload GPS points into a mapping system.

Definition

Upload should include

- transferring data from the handheld GPS receiver or GPS-enabled device to the computer
- displaying data on a GIS map.

Process/Skill Questions

- What are the appropriate interfaces for transferring GPS data to a mapping system?
- How does one determine the appropriate interface?
- What format is used to display data?
- How does one ensure that the latitude and longitude are properly identified and entered correctly into the mapping system?

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Geospatial Technology (Virginia only)

Task Number 021

Navigate to an object in a given location using a handheld GPS receiver or GPS-enabled device.

Definition

Navigating to an object should include

- inputting the destination latitude and longitude into a handheld GPS receiver or GPS-enabled device
- plotting a route to the destination as prompted by the receiver
- identifying physical barriers and dangers in the path to the object.

Process/Skill Questions

- What is geocaching?
- What are some practical applications of using a GPS receiver or GPS-enabled device for navigation?
- What industries are using this technology?
- What is the orientation of the map?

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-

Task Number 022

Record attributes of a data point or event.

Definition

Recording should include

- understanding what qualifies as an event vs. a data point
- inputting data about a specific point
- managing and storing data appropriately
- sorting data by different attributes.

Process/Skill Questions

- What data is relevant to an event?
- How can the information collected be organized into a usable format?
- How can the data be used to make a conclusion?

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Geospatial Technology (Virginia only)

Task Number 023

Explain geodetic markers.

Definition

Explanation should include

- outlining the history of the geodetic markers, including the role of the National Geodetic Survey (NGS)
- locating markers in the immediate vicinity.

Process/Skill Questions

- What is a geodetic marker?
- When were the geodetic markers constructed?
- Have new geodetic markers been placed in the area recently?
- How are geodetic markers used today?

ITEEA National Standards

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Task Number 024

Describe geodetic concepts.

Definition

Description should include

- defining
 - *latitude*
 - *longitude*
 - *prime meridian*
 - *international dateline (IDL)*
 - *north pole*
 - *south pole*
 - *equator*
 - *true north*
 - *Cartesian mapping system*
 - *Mercator mapping system*
- locating
 - prime meridian
 - international dateline
 - equator
 - specific points on an existing map
- identifying the Earth's rotational axis.

Process/Skill Questions

- What information does the prime meridian provide?
- What information does the equator provide?
- How do the prime meridian and equator establish benchmarks for the interpretation of GPS data?

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Manipulating GIS Data

Task Number 025

Use standard conventions for naming files.

Definition

Use should include

- describing the theme of the dataset(s) being named and the proper extension for the file type
- naming a file for ease of identification/location using parameters dictated by GIS.

Process/Skill Questions

- How can files be named to describe their content?
- What do the extensions to file names tell about the files?

ITEEA National Standards

17. Information and Communication Technologies

Task Number 026

Apply standard conventions for managing files and file structures.

Definition

Application should include

- creating a file structure
- using naming conventions.

Process/Skill Questions

- What is the importance of using standard conventions?
- What would happen if link files were not included in the map files when shared?

ITEEA National Standards

17. Information and Communication Technologies

Task Number 027

Manage data in a GIS.

Definition

Management could include importing, exporting, converting, and packaging data in file types, such as

- drawing (DGN/DWG)
- graphic database (GDB)
- keyhole markup language (KML)
- extensible markup language (XML)
- shapefile (SHP)
- Excel spreadsheet (XLS)
- comma separated values (CSV).

Process/Skill Questions

- How are files imported?
- Why is there a need to import files?
- What alternative resources are available to import the file?
- What data formats can the mapping program support?

Task Number 028

Add geographic data to a GIS.

Definition

Adding should result in creation of maps and other graphic representations of people, places, and environments.

Process/Skill Questions

- What type of data represents information about places and the environment?
- What type of data is descriptive of the Earth's surface and ecosystems?
- What is a geographic theme?

ITEEA National Standards

17. Information and Communication Technologies

Task Number 029

Create a GIS map using raster and vector data sets.

Definition

Creation should include

- definition of *raster*
 - resolution
 - image processing
- definition of *vector*
 - points
 - lines
 - polygons.

Process/Skill Questions

- What is raster data? What is vector data?
- What are the limitations of raster data, and what are the limitations of vector data?
- What effect does vector data have on resolution? What effect does raster data have on resolution?
- How does data type affect hardware capabilities?
- What are shapefiles?
- What type of data can be represented by a point, an A line, and a polygon?

- What type of data can be displayed using a raster image?

ITEEA National Standards

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

Task Number 030

Analyze the relationship of spatial components.

Definition

Analysis should consider connections among spatial components and their attributes, such as

- size
- location
- density
- type
- capacity
- cost.

Process/Skill Questions

- What type of data is needed to represent population density in city neighborhoods?
- What is an attribute?
- What data fields are necessary to locate a building in a city?
- What role can database structure play in creating maps and objects?

ITEEA National Standards

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Task Number 031

Calculate lengths, distances, and areas in a GIS.

Definition

Calculation may include road segments, acreage, and distance between locations.

Process/Skill Questions

- How can the area of a polygon be calculated?
- How can the length of a line be calculated?

ITEEA National Standards

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

Task Number 032

Use classification schemes to display numerical attributes.

Definition

Use of classification schemes could include

- standard deviation
- interval

- quantile
- natural breaks.

Process/Skill Questions

- What are classification schemes?
- What factors drive the choice for meaningful classification schemes?
- What classification scheme would describe where people live?

Task Number 033

Explain a definition query.

Definition

Explanation should include filtering data to perform analysis.

Process/Skill Questions

- How does one conduct a definition query?
- What are the benefits of performing a definition query?

Task Number 034

Use a query to select data.

Definition

Use should be based on desired attributes.

Process/Skill Questions

- What is a query, and how can it be conducted?
- How can queries help filter data?

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Task Number 035

Use a query to select data by location.

Definition

Use should yield identification of data sets based on references to other data, such as physical location or proximity to a point, line, or polygon.

Process/Skill Questions

- How does one select data based on a specified geographic constraint?
- How does one manage the selected data?
- What options are available for querying by location?

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Task Number 036

Analyze statistics of a dataset.

Definition

Analysis should include using statistical geoprocessing tools to determine the number of records, minimum and maximum values for an attribute, standard deviation, mean, and sum values.

Process/Skill Questions

- How can statistics for an attribute table be obtained?
- Why analyze attribute table statistics?
- What are spatial statistics?
- What tools are used to calculate spatial statistics?

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TSA Competitive Events

Geospatial Technology (Virginia only)

Task Number 037

Create GIS data sets using geoprocessing tools.

Definition

Creation should generate spatial data sets that assist in analysis using tools and/or functions, such as

- clip
- buffer
- intersect
- merge
- dissolve
- union.

Process/Skill Questions

- How would one select the appropriate geoprocessing tools for the specified task?
- How are geoprocessing outcomes managed?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

Task Number 038

Define *georeferencing*.

Definition

Definition may involve

- shifting
- rotating
- scaling
- skewing
- warping
- orthorectifying.

Process/Skill Questions

- When would information need to be georeferenced?
- How is accuracy compromised when files are georeferenced?

Task Number 039

Define *geocoding*.

Definition

Definition should explain a GIS operation for converting street addresses into spatial data that can be displayed as features on a map.

Process/Skill Questions

- Why is geocoding used?
- What are some examples of geocoding?
- What ethical and legal issues should be considered before geocoding?

Task Number 040

Edit vector shapefiles spatially to create, modify, and delete point, line, and polygon features.

Definition

Edit should result in a more relevant shapefile.

Process/Skill Questions

- What would occur if more vertices were used to create the polyline?
- When is it feasible to delete a feature as opposed to modifying it?

Task Number 041

Edit attribute tables to create, modify, delete, and append attribute values.

Definition

Edit should result in a more relevant table.

Process/Skill Questions

- Why are misspelled attributes problematic?
- When is it important to modify attribute tables to add data?

Task Number 042

Develop spatial data using a 3D viewer.

Definition

Development should exhibit a stereographic picture of a map, city, or geographical formation.

Process/Skill Questions

- What is the function of a z component?
- What remotely sensed data is available for z data?

ITEEA National Standards

1. The Characteristics and Scope of Technology

17. Information and Communication Technologies

18. Transportation Technologies

20. Construction Technologies

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

4. The Cultural, Social, Economic, and Political Effects of Technology

5. The Effects of Technology on the Environment

6. The Role of Society in the Development and Use of Technology

7. The Influence of Technology on History



Managing Geospatial Projects

Task Number 043

Define a design problem.

Definition

The design problem should include

- a clearly stated objective
- the problem
- the method of assessment.

Process/Skill Questions

- How will the design problem demonstrate knowledge of GIS procedures?
- What resources will be needed to solve the design problem?

ITEEA National Standards

1. The Characteristics and Scope of Technology

12. Use and Maintain Technological Products and Systems

13. Assess the Impact of Products and Systems

2. The Core Concepts of Technology

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

9. Engineering Design

TSA Competitive Events

Engineering Design

Geospatial Technology (Virginia only)

Task Number 044

Identify design problem constraints.

Definition

Identification should include the limitations of available resources (e.g., time, available tools).

Process/Skill Questions

- What restrictions are there in the available technologies?
- What public policies and community issues could create design constraints?
- What resources are necessary to solve the design problem?

ITEEA National Standards

1. The Characteristics and Scope of Technology

12. Use and Maintain Technological Products and Systems

13. Assess the Impact of Products and Systems

2. The Core Concepts of Technology

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

9. Engineering Design

TSA Competitive Events

Geospatial Technology (Virginia only)

System Control Technology

Technology Problem Solving

Task Number 045

Identify data requirements.

Definition

Identification should include the following:

- Data must be current and accurate.
- Data must be relevant to the design problem.
- Data must be collected from multiple sources.
- The degree of precision must be clearly stated.

Process/Skill Questions

- How can the accuracy of the data be verified?
- What sources were used for the data?
- What is the value of collecting data from multiple sources?

ITEEA National Standards

1. The Characteristics and Scope of Technology

12. Use and Maintain Technological Products and Systems

13. Assess the Impact of Products and Systems

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

9. Engineering Design

TSA Competitive Events

Geospatial Technology (Virginia only)

Task Number 046

Collect geospatial data.

Definition

Collecting data should include

- various methods of data collection
- consideration of restrictions on data collection
- assessment of problems encountered during data collection
- accurate readings and measurements.

Process/Skill Questions

- What is the primary device used to collect data?
- What attributes were identified?

ITEEA National Standards

1. The Characteristics and Scope of Technology

12. Use and Maintain Technological Products and Systems

13. Assess the Impact of Products and Systems

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

9. Engineering Design

TSA Competitive Events

Geospatial Technology (Virginia only)

Task Number 047

Compose a technical document that includes a presentation analysis map.

Definition

Composition should include final reports that reflect the use of generally accepted principles of technical writing. The writing must be factual, clear, concise, and include terminology common to the customer's industry. It should also adhere to the standard rules for grammar and punctuation.

Process/Skill Questions

- Why is it important that the project report contain terminology that is clear to the reader?
- What illustrations or graphics can be used to enhance the writing?
- How can one ensure the project report is formatted to meet the technical communication needs of the customer?
- What format is needed to present the analysis to the targeted audience?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

4. The Cultural, Social, Economic, and Political Effects of Technology

8. The Attributes of Design

9. Engineering Design

TSA Competitive Events

Essays on Technology

Task Number 048

Develop a product that shows spatial reasoning.

Definition

Development should include the production of a map that shows spatial reasoning and reflects project results. The map should have color schemes that show that the producer followed the project guidelines.

Process/Skill Questions

- What legend items will be included in the final map to best show the reasoning?
- What layers will be included in the final map to best show the reasoning?
- How should the colors be used to best represent the data on the map?

ITEEA National Standards

13. Assess the Impact of Products and Systems

9. Engineering Design

TSA Competitive Events

Engineering Design

Geospatial Technology (Virginia only)

Task Number 049

Evaluate final solutions.

Definition

Evaluation should include

- a written summary
- maps
- a presentation of final project to audience(s)
- a legacy file documenting research, data, and metadata.

Process/Skill Questions

- Who is the audience?
- What resources and materials are necessary to communicate with the audience?
- Why would one want to duplicate the project, and could it be done?

ITEEA National Standards

1. The Characteristics and Scope of Technology

12. Use and Maintain Technological Products and Systems

13. Assess the Impact of Products and Systems

TSA Competitive Events

Engineering Design

Geospatial Technology (Virginia only)

Task Number 050

Present final project results.

Definition

Presentation must include the use of technical writing and either a slide presentation or written speech that may be distributed upon request. The presentation should be a minimum of five minutes and include all team members.

Process/Skill Questions

- What different presentation technologies are available?
- What is the best method of dividing the work among team members?
- What are the professional standards to use for the presentation?
- What practice methods should be used before the final presentation?

ITEEA National Standards

17. Information and Communication Technologies

TSA Competitive Events

Engineering Design

Geospatial Technology (Virginia only)

SOL Correlation by Task

39	Describe the evolution of GT.	English: 9.5, 10.5, 11.5, 12.5 History and Social Science: VUS.14, WG.1, WG.2, WG.3, WG.4, WG.5, WHII.14 Science: ES.1
40	Identify geospatial applications in jobs/careers.	English: 9.5, 9.8, 10.5, 10.8, 11.5, 11.8, 12.5, 12.8

41	Identify geospatial opportunities at the postsecondary level.	English: 9.5, 9.8, 10.5, 10.8, 11.5, 11.8, 12.5, 12.8
42	Describe ethical, security, legal, policy, and privacy issues in GT applications.	English: 9.5, 10.5, 11.5, 12.5 History and Social Science: GOVT.1, GOVT.9, GOVT.10, VUS.14, WG.1, WG.17, WG.18, WHIL.14
43	Describe platforms of mobile technology implementation.	English: 9.5, 10.5, 11.5, 12.5 History and Social Science: VUS.14, WHIL.14
44	Examine the applications of mobile technologies.	
45	Identify map components for a layout.	History and Social Science: WG.1, WG.2, WG.3, WG.4, WHI.1 Science: ES.1
46	Identify types of maps.	History and Social Science: WG.1, WG.3, WHI.1 Science: ES.1
47	Create maps to solve problems.	English: 9.5, 9.6, 10.5, 10.6, 11.5, 11.6, 12.5, 12.6 History and Social Science: WG.1, WG.3, WHI.1 Mathematics: G.3, G.14 Science: ES.1
48	Explain the concept of projections.	English: 9.5, 10.5, 11.5, 12.5 History and Social Science: WHI.1 Mathematics: G.14 Science: ES.1
49	Explain ways maps can distort reality.	English: 9.5, 10.5, 11.5, 12.5 History and Social Science: WHI.1 Mathematics: G.14 Science: ES.1
50	Research sources of map data.	English: 9.8, 10.8, 11.8, 12.8

		History and Social Science: GOVT.1, GOVT.8, GOVT.9, GOVT.15, VUS.14 Science: ES.1
51	Acquire geospatial data.	History and Social Science: VUS.14, WG.1, WG.2, WG.3, WG.17, WG.18, WHII.14
52	Evaluate metadata.	
53	Use mobile technology.	History and Social Science: VUS.14, WHII.14
54	Design a mobile application.	English: 9.5, 10.5, 11.5, 12.5
55	Explain how a GPS functions.	History and Social Science: VUS.14, WHII.14 Mathematics: G.5, G.8, T.8, MA.8
56	Explain the scientific and mathematical components of a GPS.	Mathematics: A.4, G.3, G.14, T.3, MA.14
57	Mark a data point using a handheld GPS receiver or GPS-enabled device.	History and Social Science: WG.1
58	Upload GPS points into a mapping system.	History and Social Science: WG.1
59	Navigate to an object in a given location using a handheld GPS receiver or GPS-enabled device.	English: 9.5, 10.5, 11.5, 12.5 History and Social Science: WG.1 Mathematics: A.7, G.3, G.14
60	Record attributes of a data point or event.	English: 9.5, 10.5, 11.5, 12.5 History and Social Science: WG.1 Mathematics: COM.1
61	Explain geodetic markers.	English: 9.5, 10.5, 11.5, 12.5 History and Social Science: WG.1
62	Describe geodetic concepts.	English: 9.3, 9.5, 10.3, 10.5, 11.3, 11.5, 12.3, 12.5 History and Social Science: WG.1, WHI.1 Mathematics: G.3, G.14, MA.14 Science: ES.1
63	Use standard conventions for naming files.	English: 9.5, 10.5, 11.5, 12.5
64	Apply standard conventions for managing files and file structures.	

65	Manage data in a GIS.	History and Social Science: WG.1, WG.2, WG.4 Mathematics: COM.14, COM.16
66	Add geographic data to a GIS.	History and Social Science: WG.1, WG.2, WG.4 Mathematics: COM.10
67	Create a GIS map using raster and vector data sets.	English: 9.3, 9.5, 10.3, 10.5, 11.3, 11.5, 12.3, 12.5 History and Social Science: WG.1 Mathematics: G.3, G.4, G.9, G.13, G.14, COM.1, MA.7
68	Analyze the relationship of spatial components.	English: 9.5, 10.5, 11.5, 12.5 History and Social Science: WG.1, WG.2, WG.4 Mathematics: G.2, G.3, G.4, G.13, G.14, COM.1, COM.3, PS.1*, PS.3*
69	Calculate lengths, distances, and areas in a GIS.	Mathematics: A.7, G.3, G.8, MA.8
70	Use classification schemes to display numerical attributes.	Mathematics: PS.1*, PS.2*
71	Explain a definition query.	English: 9.3, 9.5, 10.3, 10.5, 11.3, 11.5, 12.3, 12.5 Mathematics: COM.7
72	Use a query to select data.	History and Social Science: WG.1, WG.4
73	Use a query to select data by location.	History and Social Science: WG.1, WG.4 Mathematics: G.1
74	Analyze statistics of a dataset.	English: 9.5, 10.5, 11.5, 12.5 History and Social Science: WG.1, WG.4 Mathematics: COM.1, COM.3
75	Create GIS data sets using geoprocessing tools.	
76	Define <i>georeferencing</i> .	English: 9.3, 9.5, 10.3, 10.5, 11.3, 11.5, 12.3, 12.5
77	Define <i>geocoding</i> .	English: 9.3, 9.5, 10.3, 10.5, 11.3, 11.5, 12.3, 12.5

		History and Social Science: WG.1, WG.2, WG.4
78	Edit vector shapefiles spatially to create, modify, and delete point, line, and polygon features.	English: 9.6, 9.7, 10.6, 10.7, 11.6, 11.7, 12.6, 12.7 Mathematics: G.3, G.9
79	Edit attribute tables to create, modify, delete, and append attribute values.	English: 9.6, 9.7, 10.6, 10.7, 11.6, 11.7, 12.6, 12.7
80	Develop spatial data using a 3D viewer.	English: 9.6, 9.7, 10.6, 10.7, 11.6, 11.7, 12.6, 12.7 History and Social Science: WG.1, WG.2, WG.4 Mathematics: G.3, COM.1, COM.3
81	Define a design problem.	English: 9.5, 10.5, 11.5, 12.5 History and Social Science: WG.1, WG.2, WG.4 Mathematics: COM.1, COM.4, COM.5, COM.10 Science: ES.1, ES.2
82	Identify design problem constraints.	History and Social Science: WG.1, WG.2, WG.4 Mathematics: COM.3, COM.10
83	Identify data requirements.	Mathematics: COM.15, PS.7*, PS.8* Science: ES.1
84	Collect geospatial data.	English: 9.8, 10.8, 11.8, 12.8 History and Social Science: WG.1, WG.2, WG.4 Mathematics: COM.15, PS.8*
85	Compose a technical document that includes a presentation analysis map.	English: 9.1, 9.6, 9.7, 10.1, 10.6, 10.7, 11.1, 11.6, 11.7, 12.1, 12.6, 12.7
86	Develop a product that shows spatial reasoning.	Mathematics: G.3, G.14, MA.14
87	Evaluate final solutions.	English: 9.6, 9.7, 10.6, 10.7, 11.6, 11.7, 12.6, 12.7
88	Present final project results.	English: 9.1, 9.6, 9.7, 10.1, 10.6, 10.7, 11.1, 11.6, 11.7, 12.1, 12.6, 12.7

Teacher Resources

Design Brief: Build a New High School (advanced)

Context

Your high school is overcrowded, and projected enrollment statistics show that the class sizes will continue to increase by 10 percent a year for several years. Therefore, the county has decided to build a new high school and reconfigure the boundaries of the school district.

Challenge

Your job is to conduct a preliminary study to find the best location within your county for the new high school. Using the data set that is provided, design the high school and the layout of the property, indicating the site of the high school.

Factors to consider in choosing the location:

- Size, location, and cost of land proposed for new site
- Proximity of the new site to your high school and other schools in the area
- Access to existing streets and the potential for locating connecting roads
- Zoning requirements and restrictions for the site

Factors to consider when developing the layout:

- The new school should accommodate 70 percent of the students currently enrolled in your school.
- There should be room for 40 percent expansion.
- Demographics of the county should be examined to identify areas with highest population of high school students.
- All sports facilities should be included on the site plan.
- The parking facility should be incorporated into the site plan.
- Buffer zones to adjacent residential areas should be planned for sound and lighting.

Objectives

- Identify the location and perform a site layout using GIS resources.
- Identify the zoning requirements for your site.
- Plan connecting roads by using a GIS.
- Plan excavating for the facilities and examine drainage and runoff issues. Indicate your findings by showing contour topography.
- Design a scale model for the high school including:
 1. houses/facilities in the buffer zone
 2. utilities/landscaping and their impact on the neighborhood

Material

- Computer lab equipment
- GIS software
- Data set
- CAD software
- Modeling materials, such as balsa wood or foam core, glue, X-Acto knives, plywood base

References

- GIS Internet resources showing roads, rivers, topography, land use, zoning
- Virginia View database

Evaluation

- Did you save and document your GIS project?
- Did you develop a slide presentation portfolio based on the five objectives?
- Did you justify your final site selection including zoning criteria?
- Did you incorporate the five objectives into your presentation?
- Did you prepare a one-page technical paper concerning drainage and runoff issues and solutions?
- Did your model support your GIS research?
- How accurate is the data?
- Do you have the appropriate data to support your recommendations?
- How would your recommendations affect the community?

Primary Area

Geospatial Technology

Applications

- Communications
- Construction

Grade Levels

10-12

Correlation to Geospatial Technology Tasks/Competencies

011, 021, 022, 023, 042, 043, 044, 045, 046, 047, 048, 049

Design Brief: Community Fire Hydrant

Context

Due to growth in the community during the past 20 years with more homes, businesses, and schools, the local fire support plan must be reviewed and updated.

Challenge

To begin, import a drawing of a school building to use as a spatial reference for the fire safety

study. Analyze data to identify existing fire hydrant locations and proposed locations for new fire hydrants. The proposed locations for new fire hydrants must be within the area of service for the existing fire station. Your job is to create a map that shows the relationship between the local high school and fire protection resources. You must also recommend locations for additional fire hydrants where needed. Use geospatial reference data, and then import a CAD drawing into ArcMap. Finally, plot the map with the following elements:

- Existing roads and streets
- Traffic lights
- Stop signs
- Individual properties with existing structures (residential/commercial/governmental)
- Location of the community high school
- Location of the community fire station (option: collect with GPS)
- Location of existing fire hydrants and area of service

Objectives

- Create a map that contains the elements listed in the challenge.
- Import a given CAD drawing that will align with your shape files and aerial photo.
- Identify proposed locations for new fire hydrants.
- Create additional drawings to support your analysis.

Materials

- GIS software
- Existing shape files for the community
- Aerial photos of the community
- CAD drawing of community high school
- GPS units

References

County GIS data: Street maps to include the area served by the community fire station

Evaluation

- Do your drawings align with existing shape files?
- Does your analysis of the drawings identify the need for new fire hydrants?
- Does the analysis develop any recommendations for new fire hydrant locations?
- Are the recommendations illustrated on the drawings?
- How accurate is the data?
- Do you have the appropriate data to support your recommendations?
- How would your recommendations affect the community?

Primary Area

Geospatial Technology

Applications

Construction
Communication

Grade Levels

9-12

Correlation to Geospatial Technology Tasks/Competencies

014, 015, 016, 017, 018, 019, 021, 022, 023, 024, 025, 026 ,030, 041, 042,043, 044, 045, 046, 047, 048, 049, 050

Design Brief: Designing a New Biotechnology Lab with Site Selection

Context

In order to add biotechnology to the curriculum at your school, it will be necessary to add additional space to the current campus plan.

Challenge

Your school will be adding biotechnology to its curriculum, and your task is to find a location for the new lab. This lab will include an adjoining greenhouse that will enable study of the effect of biotechnology on agriculture. Create a site layout that includes the new lab and greenhouse. The biotechnology facility may be separate or attached to the existing school building.

Objectives

- Using GPS and GIS technologies, develop a map and plan of the school, including the property lines, location of buildings, athletic fields, utilities, and parking facilities.
Consider the following:
 1. Location of trees and utilities
 2. Problems of sun blockage
 3. Levelness of ground
- Identify characteristics for the new lab's site location.
- Use GIS information to determine the geographic location of the site.
- Update the original map to show the proposed location of the new lab and greenhouse.
- Present results of the project, with supporting data, in the form of a visual GIS display.

Materials

- GPS unit with interface
- GIS software
- GPS download software
- Internet access

References

- An introductory manual to GIS
- Local and state government terrain-related data, road data, and local orthophotography

Evaluation

- Did you create an original site layout of the school campus?
- Did you select a suitable location for the lab?
- Have you updated the site layout to include the new lab's location?
- Have you prepared the results of the project, with supporting data, in the form of a visual GIS display?
- How accurate is the data?
- Do you have the appropriate data to support your recommendations?
- How would your recommendations affect the community?

Primary Area

Geospatial Technology

Applications

Biotechnology

Biology

Environmental Science

Grade Levels

9-12

Correlation to Geospatial Technology Tasks/Competencies

014, 015, 016, 017, 018, 020, 023, 026, 033, 042, 043, 044, 045, 046, 048, 049, 050

Design Brief: Tackling Bucks

Context

NFL teams are businesses, and their owners want to maximize profits. To boost the bottom line, they need to think about a variety of revenue sources including attendance, merchandise, and concessions. Some team owners may not be developing their attendance to the maximum possible levels.

Challenge

Your group has been asked to create a ranking for potential revenue earnings of all 32 NFL teams.

Factors to consider include:

- Identify the population count within a 30-mile radius of the team's stadium. Depending on the available statistics, you may alternatively use population in the metropolitan areas of each team's stadium or population in the county and adjoining counties of the stadium.
- Identify the median income within this radius.

- For purposes of this study, all teams should be located within the contiguous 48 states.

Note: This project could be applied to Major League Baseball teams, to NBA teams, or to other major sports teams.

Objectives

- Identify the location of each NFL stadium by latitude and longitude.
- Enter the latitude and longitude coordinate data into ArcMap.
- Identify a 100-mile-radius buffer zone around each stadium.
- Obtain U.S. census data for the year 2000 and for the most current year available. Determine total population, median income, and the growth rate of population for each of your stadium areas. Additional information, such as total attendance figures for the past season(s) at each of your stadiums and ticket prices can also be added to enhance your study.
- From the above, plus any other factors you may wish to consider, rank the NFL teams in terms of their potential revenue.
- Find an alternate U.S. location outside a 60-mile radius of another team's stadium that would produce a better result.

Materials

- GIS software (ArcGIS)
- U.S. census data
- NFL stadium data

References

All of your data may be obtained from the Internet. Good sources for U.S. census data and NFL data include:

<http://www.esri.com/tiger>

<http://www.census.gov/>

Evaluation

- Can you defend your ranking?
- What are your results?
- How do your statistics support your results?
- Does the map that you have created support your analysis?

Primary Area

Geospatial Technology

Applications

Planning
Construction

Grade Levels

9-12

Correlation to Geospatial Technology Tasks/Competencies

014, 023, 026, 033, 041, 042, 043, 044, 045

Design Brief: Homeland Security

Context

Because homeland security is a priority in the United States, a special commission has been established in each state with the specific task of providing localities with a plan in case of a natural disaster or terrorist act.

Challenge

Working in groups, students must develop a plan to react to a disaster, natural or otherwise.

- Identify vulnerable assets (fire stations, government buildings, water sources, or other infrastructure).
- Rank the assets based on their vulnerability/importance to the community.
- Determine which hospitals and large public buildings can handle (1) casualties in large numbers and (2) emergency shelter.
- Determine the main evacuation routes and alternate routes for traffic flow for major events (hurricanes, floods).
- Access a local government site such as the City of Norfolk's "Interactive Mapper" <https://norfolk.gov/1596/Geographic-Information-Systems>. Review the available information presented through layers, data, and search tools created and assembled by software like AutoCAD Map and ESRI ArcMAP or, as in this example, an Arc IMS server (an online GIS).

Objectives

- Interpret aerial photography.
- Develop a comprehensive community inventory of potential homeland security targets.
- Interpret GIS data.
- Analyze GIS data and draw conclusions.

Materials

- GIS software
- Computer lab

References

- GIS textbook
- County-provided GIS data themes

Potential Data Needs

Roads, infrastructure, hospitals, military bases, water supplies, historically significant landmarks, government buildings, public shelters

Evaluation

- Does the group's plan provide a critical analysis of its research?
- Does the group's plan address each of the items listed in the Challenge above?
- Are the results of the group's plan clearly communicated using the GIS?

Primary Area

Geospatial Technology

Applications

Transportation

Planning

Communication

Grade Levels

9-12

Correlation to Geospatial Technology Tasks/Competencies

030, 035, 040, 041, 043, 044, 045, 049

Design Brief: Housing Development Site Suitability

Context

In planning a new housing development, developers must investigate many sources of information and meet various criteria before deciding whether building the development is possible, and if so, where to build it.

Challenge

Your work team must find a site for a new housing development in your area.

The following criteria for the site selection must be met:

- The land must be undeveloped.
- The area should be between 10 and 30 acres.

It will be up to your team to set the criteria for distances from schools, businesses, and utilities. Use GIS data from ArcMap, the Internet, and local sources. Once a site is found, use GPS units to ground truth your site. Document all attributes that might affect your selection. These attributes include, but are not limited to, landforms, boulders, animals, trees, and bodies of water.

Create a map of the site with the GPS waypoints and attributes. Incorporate all data into an interactive map for a presentation. During the presentation, either try to persuade the class that this would be a reasonable place for a new development or present arguments that demonstrate the unsuitability of the site even though it meets the criteria. Factors to consider:

- Impact on the watershed
- Impact on wildlife
- State and local zoning requirements
- Impact on transportation infrastructure

Other suggested criteria may include:

- The development should be on relatively flat land.
- The development should be located within 1,000 feet of an existing road.
- The development should be located at least 3 miles from an airport.
- No structures should be built within an existing stream, river, or pond.
- Soils should be classified as dry and perkable.

Objectives

- Use GIS software to locate a site that meets the criteria.
- Use GPS data to create a map in GIS.
- Work cooperatively to create a project.
- Use public speaking skills to present persuasive arguments.
- Produce an interactive map.
- Use GIS data to interpret spatial relationships.

Materials

- GPS units
- GIS software
- Computer equipment
- Internet access

References

- GIS instructional resources showing
 1. roads
 2. water (above and below ground level)
 3. land use and local orthography.
- Local information on zoning and utilities

Evaluation

- Did the selected site meet the criteria?
- Was responsible decision-making demonstrated during the presentation?

- Were the presentations and conclusions supported by data?
- What are the potential impacts on the local community?

Primary Area

Geospatial Technology

Applications

Transportation
Environmental
Planning

Grade Levels

9-12

Correlation to Geospatial Technology Tasks/Competencies

014, 015, 017, 018, 033, 034, 035, 042, 044, 045, 047, 049

Design Brief: We Must Get to Work!

Context

Weather conditions often cause environmental problems for communities. These problems need to be analyzed and anticipated. Transportation issues arise that necessitate the development of alternative plans to keep traffic flowing.

Challenge

Over the weekend, Hurricane Elvira struck, causing major flood and road damage in the coastal area of Virginia's Hampton Roads. The Midtown tunnel was flooded, and officials determined that it would be unusable for the next 30 days. Residents must find alternative routes to work. Your work location is the Norfolk Naval Station, which is located at the northern end of Hampton Boulevard. Your carpool meets at the intersection of College Drive and Townpoint Road.

You have been hired as a GIS consultant to find an alternate route for your carpool.

Objectives

- Identify/select the Midtown tunnel that flooded.
- Determine the route taken using the tunnel.
- Develop two alternate ways to work.
- Calculate distance, costs, and times for each route.
- Calculate the differences from your normal route.
- Prepare a map showing all routes.
- Prepare a visual presentation representing the differences between routes.

Materials

- GIS software
- Presentation materials
- Data dictionary
- Data files for counties.shp and streets.shp
- Internet access

References

GIS software manual

Evaluation

- Did you produce a GIS map that displays routes as layers?
- Did you identify alternate routes?
- What is the best route, and how did you determine it?
- Have you prepared a visual presentation explaining differences between routes?
- How accurate is the data?
- Do you have the appropriate data to support your recommendations?
- How would your recommendations affect the community?

Primary Area

Geospatial Technology

Applications

Transportation

Grade Levels

9-12

Correlation to Geospatial Technology Tasks/Competencies

023, 033, 034, 041, 042, 043, 044, 045, 048, 049, 050

Design Brief: Why Not a Fast-Food Restaurant?

Context

In the fast-food restaurant industry, opening additional franchises is the key to growth. The three critical elements in siting a new restaurant are: location, location, location.

Challenge

As a member of a site research team, you must determine the requirements for building a fast-food restaurant and compare it with other restaurants in your locality.

Objectives

- Browse a well-known fast food restaurant's web page to determine the extent of its franchises.

- Determine the requirements for ownership of a restaurant, costs to construct the building, and the number and types of jobs that would be created by opening a restaurant.
- Use GIS data to determine the commercially zoned parcels in the county.
- Determine the assessed values of these properties.
- Use GIS to determine the best location for a restaurant with consideration of the environmental impact.
- Plot actual locations of parcels, and coordinate these to maps.
- Plan, construct, and organize a presentation of your results for the board of supervisors.

Materials

- GIS software
- LCD projector
- Laptop computer with slide presentation software
- Internet access

References

- GIS software manual
- Local state and government road files
- Local orthophotography
- Zoning information
- Demographic data by census tract or census block

Evaluation

- Have you listed the requirements for the construction of a restaurant (franchise requirements, county requirements)?
- Have you identified the costs to construct the building?
- Have you identified the number and types of jobs that would be created?
- Does your GIS data determine the commercially zoned parcels in the locality?
- Did you identify environmental impacts for your location and how they influenced your decision?
- Are you prepared to present your results to the board of supervisors?
- Do you have the appropriate data to support your recommendations?
- How would your recommendations affect the community?

Primary Area

Geospatial Technology

Applications

Construction

Communications

Grade Levels

9-12

Correlation to Geospatial Technology Tasks/Competencies

011, 022, 023, 026, 030, 033, 034, 036, 043, 044, 045, 048, 049, 050

Entrepreneurship Infusion Units

Entrepreneurship Infusion Units may be used to help students achieve additional, focused competencies and enhance the validated tasks/competencies related to identifying and starting a new business venture. Because the unit is a complement to certain designated courses and is not mandatory, all tasks/competencies are marked “optional.”

Appendix: Credentials, Course Sequences, and Career Cluster Information

Industry Credentials: Only apply to 36-week courses

- ArcGIS Desktop Entry Certification Examination
- College and Work Readiness Assessment (CWRA+)
- National Career Readiness Certificate Assessment
- Workplace Readiness Skills for the Commonwealth Examination

Concentration sequences: *A combination of this course and those below, equivalent to two 36-week courses, is a concentration sequence. Students wishing to complete a specialization may take additional courses based on their career pathways. A program completer is a student who has met the requirements for a CTE concentration sequence and all other requirements for high school graduation or an approved alternative education program.*

- Geospatial Technology II (8424/36 weeks)
- Modeling and Simulation Technology (8460/36 weeks)

Career Cluster: Agriculture, Food and Natural Resources	
Pathway	Occupations
Agribusiness Systems	Agricultural Economist Farm, Ranch Manager Farmer/Rancher
Environmental Service Systems	Environmental Compliance Inspector Environmental Sampling and Analysis Technician Water Conservationist
Natural Resources Systems	Ecologist Fish and Game Officer Forest Manager, Forester Forest Technician Geological Technician Outdoor Recreation Guide Park Manager Park Technician Range Technician Wildlife Manager

Career Cluster: Agriculture, Food and Natural Resources	
Pathway	Occupations
Plant Systems	Certified Crop Advisor Crop Grower Farm, Ranch Manager Farmer/Rancher Soil and Plant Scientist

Career Cluster: Architecture and Construction	
Pathway	Occupations
Design/Pre-Construction	Civil Engineer Survey Technician Surveyor

Career Cluster: Government and Public Administration	
Pathway	Occupations
National Security	Combat Specialty Officer Military Enlisted Personnel Military Intelligence Specialist Military Officer Special Forces Personnel
Planning	Actuarial Analyst Economic Development Coordinator Economist Urban and Regional Planner
Public Management and Administration	Eligibility Specialist Government Accountant/Auditor Mail Carrier Postal Service Clerk Postmaster/Mail Superintendent
Regulation	Aviation Inspector Compliance Officer Environmental Compliance Inspector Financial Analyst Financial Manager Private Detective, Investigator Transit Vehicle Inspector
Revenue and Taxation	Compliance Officer Financial Analyst Real Estate Appraiser Revenue Agent

Career Cluster: Information Technology	
Pathway	Occupations
Information Support and Services	Data Entry Specialist Data Modeler Database Administrator Database Analyst Geographic Information Systems (GIS) Technician
Network Systems	Database Analyst Network and Computer Systems Administrator
Programming and Software Development	Applications Integrator Computer Software Engineer Programmer
Web and Digital Communications	Applications Integrator

Career Cluster: Law, Public Safety, Corrections and Security	
Pathway	Occupations
Emergency and Fire Management Services	Emergency Medical Technician, Paramedic Firefighter
Law Enforcement Services	Police Officer Private Detective, Investigator

Career Cluster: Science, Technology, Engineering and Mathematics	
Pathway	Occupations
Engineering and Technology	Agricultural Engineer Civil Engineer Civil Engineering Technician Computer Software Engineer Engineering Manager Environmental Engineer Industrial Engineer Petroleum Engineer Power Systems Engineer Telecommunications Specialist
Science and Mathematics	Botanist Ecologist Economist Environmental Scientist Geodetic Surveyor Geoscientist Hydrologist

Career Cluster: Transportation, Distribution and Logistics	
Pathway	Occupations
Health, Safety and Environmental Management	Health, Safety, and Environment Manager
Logistics Planning and Management Services	Logistics Analyst Logistics Engineer Logistics Manager
Transportation Operations	Pilot Transportation Manager
Transportation Systems/Infrastructure Planning, Management and Regulation	Civil Engineer Civil Engineering Technician Traffic Engineer Traffic Technician Urban, Regional Planner
Warehousing and Distribution Center Operations	Transportation Manager