

Geospatial Technology II

8424 36 weeks

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Course Description

Suggested Grade Level: 10 or 11 or 12

Prerequisites: 8423

Geospatial Technology II builds upon the study and use of Geospatial Technology I. Students further 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. Data is created, collected, and used to analyze spatial relationships. 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 such technologies. Students will also use network-based data management systems.

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	8424	Tasks/Competencies
Exploring Geospatial Technologies (GT)		
39	+	Explain uses of GT devices.
40	+	Explain ways the GPS revolutionized GT.
41	+	Describe careers in geographic information systems (GIS).
42	+	Analyze ethical, security, legal, policy, and privacy issues related to GT applications.
43	+	Perform a site survey.
Examining Geospatial Tools and Applications		
44	+	Evaluate GT.
45	+	Identify factors affecting the integrity of geospatial data.
Developing Cartographic Products		
46	+	Select a scale at which features will be displayed on a map.
47	+	Provide examples of symbology and cartographic standards.
48	+	Revise maps.
49	+	Create a template for a series of maps.
50	○	Produce a mapbook for a geographic area.
Building Geographic Databases		
51	+	Collect relevant datasets.

52	+	Determine the source, projection, scale, date, and accuracy of a dataset.
53	+	Change the projection of a raster file or vector file.
54	+	Develop a geodatabase.
55	+	Add spatial components to existing databases.
Manipulating Data in a GIS		
56	+	Combine several separate shapefiles and attribute tables into one file.
57	+	Create geographic subsets of shapefiles and attribute tables.
58	+	Create a definition query.
59	+	Modify vector shapefiles spatially to create, modify, and delete point, line, and polygon features.
60	+	Modify attribute tables to create, alter, delete, and append attribute values.
61	+	Develop spatial data using a three-dimensional (3D) viewer.
Working with Raster Data and RS		
62	+	Define <i>electromagnetic spectrum</i> .
63	+	Identify sources of RS data.
64	+	Use RS data to perform geospatial analysis.
65	+	Analyze geographic features using RS.
66	+	Define <i>photogrammetry</i> .
67	+	Define <i>orthorectification</i> .
68	+	Georeference a raster image.
69	+	Use images to analyze change.
70	+	Reclassify a raster to change values in the cells.
71	+	Create a digital elevation model (DEM) from a 3D data source.
72	+	Use DEM to represent terrain characteristics.

73	<input checked="" type="radio"/>	Describe the relevant parameters of RS.
74	<input type="radio"/>	Use multispectral imagery to identify spatial features.
75	<input type="radio"/>	Identify the electromagnetic signature for selected objects.
76	<input checked="" type="radio"/>	Define <i>supervised classifications</i> and <i>unsupervised classifications</i> .
Analyzing Geographic Data		
77	<input checked="" type="radio"/>	Create a process design using modeling.
78	<input type="radio"/>	Modify a script for custom processing.
79	<input checked="" type="radio"/>	Refine a process design.
80	<input checked="" type="radio"/>	Use multiple GIS tools and databases to conduct advanced spatial analysis.
81	<input checked="" type="radio"/>	Calculate lengths, distances, and areas in GIS.
82	<input checked="" type="radio"/>	Analyze statistics of a dataset using statistical geoprocessing tools.
83	<input checked="" type="radio"/>	Geocode a table of addresses.
Designing a Client-based Application		
84	<input checked="" type="radio"/>	Identify potential client-based applications.
85	<input checked="" type="radio"/>	Analyze project feasibility.
86	<input checked="" type="radio"/>	Recommend solutions.
87	<input type="radio"/>	Use mobile technology.
88	<input type="radio"/>	Design a mobile application.

Legend: Essential Non-essential Omitted

Curriculum Framework

Exploring Geospatial Technologies (GT)

Task Number 39

Explain uses of GT devices.

Definition

Explanation may include, but not be limited to,

- Global Positioning System (GPS) receivers and GPS-enabled devices
- satellites
- transmitters
- remote sensing equipment
 - light detection and ranging (LIDAR)
 - unmanned aerial systems (UAS)
 - mobile scanning.

Process/Skill Questions

- What are applications that would require GPS use?
- How has GT evolved?
- How has cell phone use of the GPS evolved?

ITEEA National Standards

14. Medical Technologies

15. Agricultural and Related Biotechnologies

16. Energy and Power Technologies

17. Information and Communication Technologies

18. Transportation Technologies

19. Manufacturing Technologies

20. Construction Technologies

TSA Competitive Events

Geospatial Technology (Virginia only)

Task Number 40

Explain ways the GPS revolutionized GT.

Definition

Explanation may include, but not be limited to,

- navigation
- surveying
- mapping.

Process/Skill Questions

- How did a navigator know the location of a ship before the GPS was created?
- What are some examples of locating points on the ground that may have been more difficult in the past?
- What part does surveying play in the GPS?

ITEEA National Standards

1. The Characteristics and Scope of Technology

Task Number 41

Describe careers in geographic information systems (GIS).

Definition

Description could include

- analysis
- logistics
- database management
- systems development.

Process/Skill Questions

- Why is database management an important aspect of GIS?
- What are the implications of GIS in systems development?
- What skill sets of GIS does an analyst need?

ITEEA National Standards

14. Medical Technologies

15. Agricultural and Related Biotechnologies

16. Energy and Power Technologies

17. Information and Communication Technologies

18. Transportation Technologies

19. Manufacturing Technologies

20. Construction Technologies

Task Number 42

Analyze ethical, security, legal, policy, and privacy issues related to GT applications.

Definition

Analysis should include 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

- Whose responsibility is it to maintain the security of collected data?
- What is the distinction between what is ethical and what is legal?
- What, if any, are acceptable reasons for the government to collect citizen data?
- What are the ethical and legal responsibilities of sharing and publishing geospatial data?

ITEEA National Standards

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

Task Number 43

Perform a site survey.

Definition

Performance should include

- surveying equipment
 - GPS
 - measuring tape
 - transits
 - leveling rods
- references
- field books.

Teacher resource:

[Virginia Association of Surveyors \(VAS\)](#)

Process/Skill Questions

- What is the purpose of surveying equipment?
 - What equipment is necessary for different surveys?
 - What is a boundary survey?
 - What is the connection between surveying and GIS?
 - How does one lay out a boundary? (e.g., soccer field, house, parking lot)
 - How does one survey the boundary of an existing structure or site?
 - What is a lot survey?
-
-

Examining Geospatial Tools and Applications

Task Number 44

Evaluate GT.

Definition

Evaluation should include

- GPS receivers and GPS-enabled devices
- desktop software
- cloud-based applications
- satellites
- transmitters
- remote sensing (RS) equipment.

Process/Skill Questions

- How can the differences between two models of the same brand hand-held device be determined?
- How can GT be assessed for various uses, such as use by hikers, sailors, truckers, emergency medical technicians, and law enforcement?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

13. Assess the Impact of Products and Systems

Task Number 45

Identify factors affecting the integrity of geospatial data.

Definition

Identification could include

- source
- quality
- quantity
- relevance.

Process/Skill Questions

- How is quality determined?

- How can the data be independently verified?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

TSA Competitive Events

Geospatial Technology (Virginia only)

Developing Cartographic Products

Task Number 46

Select a scale at which features will be displayed on a map.

Definition

Selection should allow for clear presentation of all map features.

Process/Skill Questions

- What determines the scale of features used for a map?
 - What are the implications of having too much information on a map?
-

Task Number 47

Provide examples of symbology and cartographic standards.

Definition

Provision should include professional standards for symbology and cartography.

Process/Skill Questions

- What is the purpose of symbology standards?
- What is the purpose of cartography standards?
- Who maintains the symbology and the cartography standards for various maps?

TSA Competitive Events

Geospatial Technology (Virginia only)

Task Number 48

Revise maps.

Definition

Revision should be according to symbology and cartographic standards and based on maps that the student has created or evaluated.

Process/Skill Questions

- When in the process should revisions be made?
- How does an evaluation of a published map contribute to understanding of symbology and cartographic standards?
- What copyright issues come into play when a published map is altered?

TSA Competitive Events

Geospatial Technology (Virginia only)

Task Number 49

Create a template for a series of maps.

Definition

Creation should follow standard design principles and include consistent use of cartographic symbols.

Process/Skill Questions

- What are the benefits of a template?
 - What might be the consequence of not using cartographic symbols consistently?
-

Task Number 50

Produce a mapbook for a geographic area.

Definition

Production should include following steps for the compilation of a set of detailed, related electronic and/or print media maps.

Process/Skill Questions

- What are different formats for creating a mapbook?
 - What is the purpose of a mapbook as opposed to multiple maps?
 - What are the steps in the production of a mapbook?
-
-

Building Geographic Databases

Task Number 51

Collect relevant datasets.

Definition

Collection must support a project, application, or a series of related applications.

Process/Skill Questions

- What are sources for obtaining datasets?
- How can the relevance of a dataset be determined before obtaining it?

TSA Competitive Events

Geospatial Technology (Virginia only)

Task Number 52

Determine the source, projection, scale, date, and accuracy of a dataset.

Definition

Determination should include

- examining related metadata
- datum map projection.

Process/Skill Questions

- How can metadata be accessed?
- How can metadata be used to determine the accuracy of a dataset?
- How is the projection type identified?
- What are commonly used data?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

Task Number 53

Change the projection of a raster file or vector file.

Definition

Change should be made with knowledge of the purpose associated with the chosen projection.

Process/Skill Questions

- How can projection be changed?
- What drives a change in projection?

Task Number 54

Develop a geodatabase.

Definition

Development should include extraction from a large database to a local storage device using a modern file structure used in GIS.

Process/Skill Questions

- What is the need for a geodatabase?
- How can data be extracted from a database?
- What is the difference between a file and a personal database?

TSA Competitive Events

Geospatial Technology (Virginia only)

Task Number 55

Add spatial components to existing databases.

Definition

Addition should include completion of incomplete or new data.

Process/Skill Questions

- What are the steps in editing databases?
 - What is the value of editing databases?
-
-

Manipulating Data in a GIS

Task Number 56

Combine several separate shapefiles and attribute tables into one file.

Definition

Combination should result in one file with appropriate content and filename.

Process/Skill Questions

- What is the need to combine separate shapefiles and attribute tables into one file?
 - What are the steps to combine separate shapefiles and attribute tables into one file?
-

Task Number 57

Create geographic subsets of shapefiles and attribute tables.

Definition

Creation should include

- using spatial selection tools
- querying by location or attribute
- using appropriate processing tools.

Process/Skill Questions

- How can selected locations be manipulated using available tools?
- How can spatial locations be selected using available tools?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

Task Number 58

Create a definition query.

Definition

Creation 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?
- How can spatial areas be selected by attribute(s)?
- Why would multiple attributes be needed to select a feature?

Task Number 59

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

Definition

Modification 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 60

Modify attribute tables to create, alter, delete, and append attribute values.

Definition

Modification 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 61

Develop spatial data using a three-dimensional (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?
-
-

Working with Raster Data and RS

Task Number 62

Define *electromagnetic spectrum*.

Definition

Definition should include

- frequency, wavelength, hertz, Planck's Constant, and speed of light
- the relationship between the electromagnetic spectrum and the methods for collecting RS data
- types of radiation, such as
 - visible light
 - ultraviolet light
 - infrared
 - radio
 - gamma
 - X-ray
 - microwaves.

Process/Skill Questions

- How do frequency and wavelength relate to RS?
- What devices use part of the electromagnetic spectrum in RS?

- What are the major sections of the electromagnetic spectrum?
 - What are the differences between active and passive sensors?
-

Task Number 63

Identify sources of RS data.

Definition

Identification should include

- road sensors
- stream gauges
- imagery
- satellites
- geophysical data
- supervisory control and data acquisition (SCADA) systems
- LIDAR.

Process/Skill Questions

- Where is RS data found?
 - What are different RS data sources?
 - What types of data are available through these data sources?
 - What are the limitations of acquiring RS data?
-

Task Number 64

Use RS data to perform geospatial analysis.

Definition

Use may include

- accessing spatial analysis and evaluation data
- reviewing task requirements
- choosing resolution
 - considering availability of imagery with the desired resolution
 - determining the level of detail required.

Process/Skill Questions

- What data will assist with the analysis?
 - What are the data availability constraints?
 - What data resolutions are needed to perform the analysis?
-

Task Number 65

Analyze geographic features using RS.

Definition

Analysis should compare features such as

- land and water
- types of vegetation
- soil moisture
- impervious surfaces.

Process/Skill Questions

- How does one determine whether areas of an image represent land or water?
 - How does one differentiate among types of vegetation?
 - How does one analyze soil to determine moisture content?
-

Task Number 66

Define *photogrammetry*.

Definition

Definition should include

- measuring and plotting data from aerial photographs
- making reliable measurements between physical objects
- producing planimetric, topographic, and contour maps.

Process/Skill Questions

- What is photogrammetry used for?

- How can an aerial photograph be adjusted to match map data?

Task Number 67

Define *orthorectification*.

Definition

Definition should include the process of removing the effects of image perspective (tilt) and relief (terrain) for the purpose of creating a planimetrically correct image.

Process/Skill Questions

- How does orthorectification use elevation data to correct terrain distortion in aerial or satellite imagery?
 - Why can an orthorectified image be used to measure true distances?
-

Task Number 68

Georeference a raster image.

Definition

Georeferencing should involve taking a raster image and aligning it to a known coordinate system.

Process/Skill Questions

- How can an image be georeferenced to align with a known dataset?
 - Why is it necessary to link the raster image to the map?
-

Task Number 69

Use images to analyze change.

Definition

Use should involve a series of aerial or satellite images of the same location to evaluate changes over time.

Process/Skill Questions

- How can images taken at different times (temporal scale) be used to detect changes in the environment?
- What are reasons to compare images of the same location taken at different times?
- How can this method be used to monitor urban development?

ITEEA National Standards

13. Assess the Impact of Products and Systems

Task Number 70

Reclassify a raster to change values in the cells.

Definition

Reclassification should allow the user to better analyze the data.

Process/Skill Questions

- Why would one reclassify the data?
 - How can a raster image be reclassified to detect nuances of change in the dataset?
 - What are examples where changing values improved evaluation?
-

Task Number 71

Create a digital elevation model (DEM) from a 3D data source.

Definition

Creation should result in usable raster files which represent

- continuous elevation values over a given area
- surface references
- common datum.

Process/Skill Questions

- What tools are needed to convert 3D data into a DEM?
- How does one interpret a DEM?
- What are common uses of DEM?

ITEEA National Standards

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

Task Number 72

Use DEM to represent terrain characteristics.

Definition

Use should result in models and terrain features that allow the user to analyze an area's geographical characteristics, such as

- elevation models
- contours
- hill shading
- slopes
- viewsheds.

Process/Skill Questions

- How can a DEM be used to create contour lines, hill shading of a dataset, characterizations of slope, or models of a viewshed?
- How can geographical characteristics be inferred from a DEM?

ITEEA National Standards

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

Task Number 73

Describe the relevant parameters of RS.

Definition

Description should include

- spatial resolution
- temporal resolution
- spectral response.

Process/Skill Questions

- Why is spatial resolution a parameter of RS?
- How is time a factor when gathering data from RS?

ITEEA National Standards

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

Task Number 74

Use multispectral imagery to identify spatial features.

Definition

Use may include identification of

- types of vegetation
- natural landscape features
- man-made structures.

Process/Skill Questions

- What is a multispectral signature?
- How can different types of terrain be identified using multispectral imagery?

ITEEA National Standards

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

Task Number 75

Identify the electromagnetic signature for selected objects.

Definition

Identification should include use of histograms for selected objects.

Process/Skill Questions

- How can the electromagnetic signature of objects allow identification using RS technologies?
- How is a histogram produced?

ITEEA National Standards

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

Task Number 76

Define *supervised classifications* and *unsupervised classifications*.

Definition

Definition should relate to the organization of the spatial data and include

- *supervised classifications*—human intervention or guidance
- *unsupervised classifications*—fully automated, based on rule sets.

Process/Skill Questions

- What is the difference between supervised and unsupervised classifications?
 - What tools can be used to run the different classifications?
-
-

Analyzing Geographic Data

Task Number 77

Create a process design using modeling.

Definition

Creation should include the use of analysis and geoprocessing tools to create a work flow for modeling purposes.

Process/Skill Questions

- What is process design?
- What is a model?
- What are the benefits of using a model?

Task Number 78

Modify a script for custom processing.

Definition

Modification should include use of an appropriate scripting language, such as Python, Visual Basic for Applications, and JavaScript.

Process/Skill Questions

- What are the benefits of customizing a script?
 - What scripting languages are available?
-

Task Number 79

Refine a process design.

Definition

Refining should include

- using prototypes and modeling
- defining the factors for each objective in the analysis
- documenting the analysis steps to be performed.

Process/Skill Questions

- When does a process design warrant modification?
- What is the importance of documenting the refinement process?

ITEEA National Standards

8. The Attributes of Design

9. Engineering Design

Task Number 80

Use multiple GIS tools and databases to conduct advanced spatial analysis.

Definition

Use should result in data such as

- distance
- density
- surface analysis
- predictive analysis
- contour
- 3D maps.

Process/Skill Questions

- What are reasons to conduct spatial analysis?
- What tools are available to conduct spatial analysis?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

TSA Competitive Events

Geospatial Technology (Virginia only)

Task Number 81

Calculate lengths, distances, and areas in 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

12. Use and Maintain Technological Products and Systems

TSA Competitive Events

Geospatial Technology (Virginia only)

Task Number 82

Analyze statistics of a dataset using statistical geoprocessing tools.

Definition

Analysis may include the number of records, the 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 should attribute table statistics be analyzed?
- What are spatial statistics?
- What tools are used to calculate spatial statistics?

Task Number 83

Geocode a table of addresses.

Definition

Geocoding may include

- assigning a street address to a location
- coding the location of an object, such as an address, a census tract, a postal code, or x, y coordinates
- converting x, y coordinates to spatial data.

Process/Skill Questions

- What are the methods of geocoding?
- What happens if an address does not geocode correctly?

Designing a Client-based Application

Task Number 84

Identify potential client-based applications.

Definition

Identification may include issues within the

- community
- region
- state
- country
- world
- special interests.

Process/Skill Questions

- How will the clients use the applications?
- What problems are the clients attempting to solve?

Task Number 85

Analyze project feasibility.

Definition

Analysis may include

- availability of data
- time constraints
- resources.

Process/Skill Questions

- What data sources are available?
- When are the products needed?
- What necessary tools and skills are available?
- How can the problem be subdivided into smaller questions?

ITEEA National Standards

11. Apply the Design Process

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

Task Number 86

Recommend solutions.

Definition

Recommendation should include

- products
- presentation
- follow-up.

Process/Skill Questions

- What is the deliverable?
- Where and when will draft products be presented to clients for critique?
- What updates and maintenance are needed to keep the application updated?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

13. Assess the Impact of Products and Systems

Task Number 87

Use mobile technology.

Definition

Use should include 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?
-

Task Number 88

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

SOL Correlation by Task

39	Explain uses of GT devices.	History and Social Science: WG.1, WG.2, WG.4
40	Explain ways the GPS revolutionized GT.	History and Social Science: WG.1, WG.2, WG.4

41	Describe careers in geographic information systems (GIS).	
42	Analyze ethical, security, legal, policy, and privacy issues related to GT applications.	History and Social Science: GOVT.1, GOVT.8, GOVT.9, GOVT.15
43	Perform a site survey.	
44	Evaluate GT.	History and Social Science: WG.1, WG.2, WG.4
45	Identify factors affecting the integrity of geospatial data.	
46	Select a scale at which features will be displayed on a map.	
47	Provide examples of symbology and cartographic standards.	
48	Revise maps.	
49	Create a template for a series of maps.	
50	Produce a mapbook for a geographic area.	
51	Collect relevant datasets.	History and Social Science: WG.1, WG.2, WG.4
52	Determine the source, projection, scale, date, and accuracy of a dataset.	Mathematics: COM.1
53	Change the projection of a raster file or vector file.	
54	Develop a geodatabase.	History and Social Science: WG.1, WG.2, WG.4 Mathematics: COM.13
55	Add spatial components to existing databases.	
56	Combine several separate shapefiles and attribute tables into one file.	
57	Create geographic subsets of shapefiles and attribute tables.	History and Social Science: WG.1, WG.2, WG.4
58	Create a definition query.	Mathematics: COM.8
59	Modify vector shapefiles spatially to create, modify, and delete point, line, and polygon features.	Mathematics: G.3, G.9
60	Modify attribute tables to create, alter, delete, and append attribute values.	History and Social Science: WG.1
61	Develop spatial data using a three-dimensional (3D) viewer.	History and Social Science: WG.1
62	Define <i>electromagnetic spectrum</i> .	
63	Identify sources of RS data.	
64	Use RS data to perform geospatial analysis.	
65	Analyze geographic features using RS.	
66	Define <i>photogrammetry</i> .	History and Social Science: WG.1, WG.2, WG.4

67	Define <i>orthorectification</i> .	
68	Georeference a raster image.	
69	Use images to analyze change.	History and Social Science: WG.1, WG.16, WG.17, WG.18 Science: ES.1
70	Reclassify a raster to change values in the cells.	
71	Create a digital elevation model (DEM) from a 3D data source.	
72	Use DEM to represent terrain characteristics.	
73	Describe the relevant parameters of RS.	
74	Use multispectral imagery to identify spatial features.	History and Social Science: WG.1 Science: BIO.8, ES.1, ES.6
75	Identify the electromagnetic signature for selected objects.	
76	Define <i>supervised classifications</i> and <i>unsupervised classifications</i> .	
77	Create a process design using modeling.	History and Social Science: WG.1
78	Modify a script for custom processing.	
79	Refine a process design.	
80	Use multiple GIS tools and databases to conduct advanced spatial analysis.	History and Social Science: WG.1, WG.2, WG.4
81	Calculate lengths, distances, and areas in GIS.	History and Social Science: WG.1
82	Analyze statistics of a dataset using statistical geoprocessing tools.	Mathematics: PS.2*
83	Geocode a table of addresses.	History and Social Science: WG.1
84	Identify potential client-based applications.	History and Social Science: WG.1, WG.2
85	Analyze project feasibility.	History and Social Science: WG.1
86	Recommend solutions.	History and Social Science: WG.1
87	Use mobile technology.	
88	Design a mobile application.	History and Social Science: WG.1 Mathematics: COM.2

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

- College and Work Readiness Assessment (CWRA+)
- National Career Readiness Certificate Assessment
- Spatial Projects and Community Exchange (SPACE) Examination
- Spatial Technology and Remote Sensing (STARS) Certification Examination
- 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 I (8423/36 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