

Empowering Colleges:
Expanding the Geospatial Workforce

# Defining What The Geospatial Workforce Needs to Know

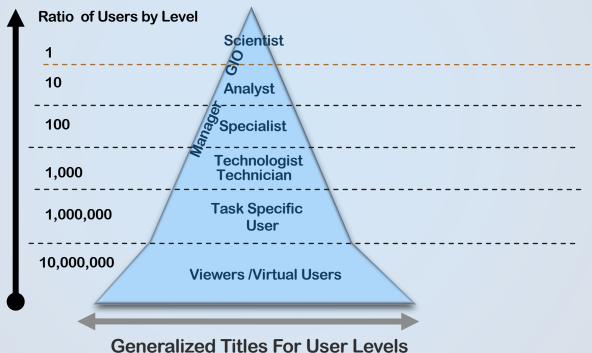
Focus on Diversity, Equity and Inclusion

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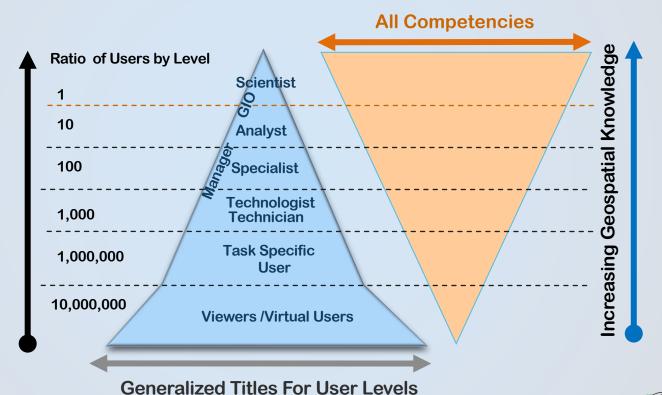


## **Geospatial Workforce and Users of the Technology**



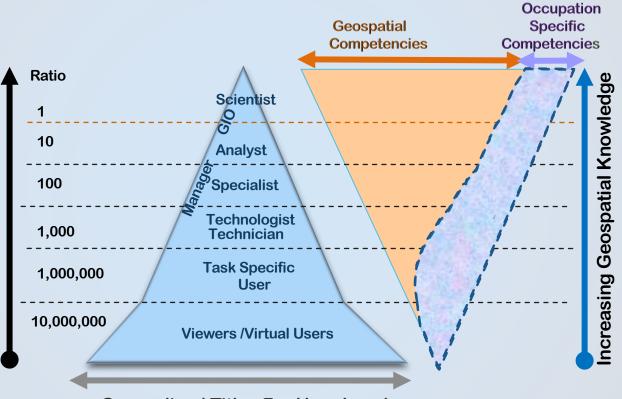


### **All Competencies For User Levels**



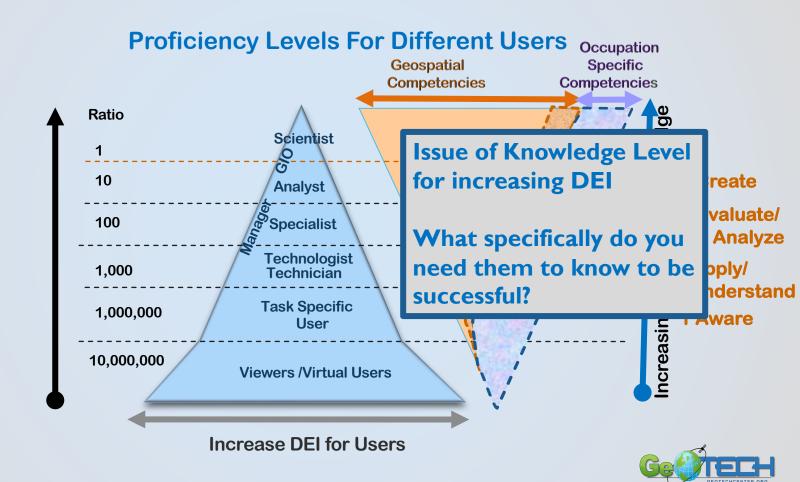


### **Geospatial and Occupation Specific Competencies**



**Generalized Titles For User Levels** 





### Filling the Geospatial Knowledge Bucket - Nine Competency Categories

- 1. Conceptual Foundations including Spatial and Critical Thinking
- 2. Geospatial Data Fundamentals
- 3. Data Acquisition
- 4. Database Design and Management
- 5. Geospatial Analysis
- 6. Cartography and Visualization
- 7. Application Development
- 8. Remote Sensing Fundamentals
- 9. Professional Practice

Note: acknowledge use of similar terms and language from GISCI, GTCM and UCGIS Body of Knowledge



# Focus on DEI - skill levels and competency requirements still depend on employee work assignment

# **Example from Category I – Conceptual Foundations**

- I: Aware of critical and spatial thinking related to spatial patterns in places and timeframes for applications but cannot apply them independently
- 2: Understand use of critical and spatial thinking related to spatial patterns in places and timeframes for applications and can apply them with signification guidance
- 3: **Ability to use** critical and spatial thinking to analyze and evaluate patterns in places and timeframes for applications with **minimal guidance**.
  - 4: **Ability to** use critical and spatial thinking related to spatial patterns in places and timeframes for different applications **without assistance** and **create** possible new methodology

# **List of Skills and Competencies**

- Personal Assessment Tool
  - Worker does a "Self Assessment"
- Matching skill levels based on needed knowledge
- Customize the list for specific workforce user level
- Use it to identify strengths and weaknesses

|    |   |   |   | ı        |   |
|----|---|---|---|----------|---|
| 2  | 0 | 0 | Unaware - No knolwedge of competency                                |          |   |
| 3  | • | 1 | Aware- Can explain basic facts about competency                     |          |   |
| 4  |   | 2 | Apply - Use competency with significiant guidance                   |          |   |
| 5  | • | 3 | Analyze - Use competency with some guidance                         |          |   |
| 6  |   | 4 | Evaluate - Use competency with little guidance                      |          |   |
| 7  |   | 5 | Create - Use competency with no guidance and extend application     |          |   |
| 8  |   |   |   |          |   |
| 9  |   |   | 1. Conceptual Foundations   |          |   |
|    |   |   | 1001 Conceptual foundations on which geographic information         |          |   |
| 10 |   |   | systems are based   |          | 1 |
|    |   |   | 1002 Spatial patterns and knowledge of how people and places are    |          |   |
| 11 |   |   | linked using spatial and critical thinking                          | •        | 1 |
|    |   |   | 1003 Geographic information relating to the Human-Environment       |          |   |
|    |   |   | Interaction, Regional Geography, Physical Geography, Cultural       |          |   |
| 12 |   |   | Geography   | •        | 1 |
| 13 |   |   | 1004 Principles of geography applied to geospatial projects         | •        | 1 |
|    |   |   | 1005 Problem statement outlining the problem and ways to solve it   | _        |   |
| 14 |   |   | using geospatial technology   |          | 1 |
|    |   |   | 1006 Tobler's First Law: "everything is related to everything else, |          |   |
| 15 |   |   | but near things are more related than distant things"               | •        | 1 |
|    |   |   | 1007 Geometric approximations of the Earth's shape such as          | •        |   |
| 16 |   |   | spheroids, ellipsoids, and geoids                                   | •        | 1 |
| 17 |   |   | 1007 Map scale  | •        | 1 |
| 18 |   |   | 1008 Map scale effect on collection or creation of data             | •        | 1 |
| 19 |   |   | 1009 Datums   | <u>O</u> | 1 |
| 20 |   |   | 1010 Vertical datums  |          | 1 |
| 21 |   |   | 1011 Horizontal datums  | •        | 1 |



# Resources Used to Create a List of Skills and Competencies

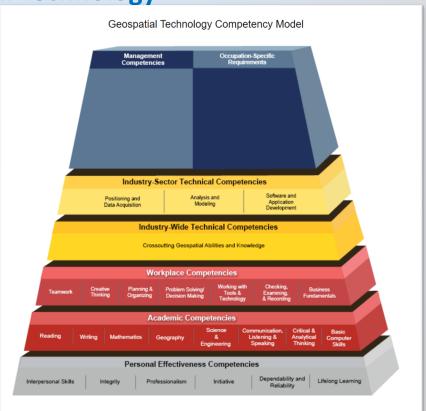


# USA Department Of Labor Geospatial Technology

**Competency Model - GTCM** 

- Interactive 3D Model
- GTCM Updated in 2022/23 with industry input
  - provides one source for defining the skills and competencies needed by the workforce
- Tier 4 and 5 lists specific geospatial skills and competencies
  - Tier 5 divided into 3 areas: Data Acquisition, Analysis, and software development

https://www.careeronestop.org/competencymodel/competency-models/geospatial-technology.aspx





# Another Source Of Industry Input - a DACUM "Developing a Curriculum"

| Meta-Knowledge<br>% of nanels & count      | Meta-Skills<br>% of panels & count       | Meta-Behaviors<br>% of panels & count | Meta-DACUM  | Job/Occupation Analysis  |
|--|--|---------------------------------------|---|--|
| Accuracy & precision 33% 4                 | Cartography 100% 17                      | Analytical, lorical 89% 11            |   |  |
| CAD, Engineering drawings 33% 3            | Communication 67% 6                      | Accept criticism 22% 2                | GIS   | & Remote Sensing   |
| Computer 78% 13                            | Conflict Revolution 22% 3                | Adaptable, flexible 67% 8             | (Tachnicians 2 Space  | rialists-5, Analysts-1 & Senior Analys   |
| Computer networks, servers 33% 4           | Cooperative, people skills 33% 6         | Common sense 44% 4                    | (Technicians-2, Spec  | anists-5, Analysts-1 & Semol Analys  |
| Coordinate systems, projections 89% 13     | Critical thinking 78% 8                  | Creative 56% 5                        |   |  |
| Current events 11% 1                       | Document interpretation 11% 2            | Dedicated, penistent 56% 11           | DACUM Panels  | Sponsored by:  |
| Database technology 56% 7                  | Equipment operation, maintenance 33% 3   | Detail orientated 100% 11             |   | 2500   |
| File formats, transfers, conversions 44% 9 | Follow procedures 33% 4                  | Diplomatic, discretion 33% 3          |   | + NSP  |
| Geography 44% 8                            | Keyboarding 33% 3                        | Dress, etiquette, bygiene 11% 1       |   | The National Science Foundation;   |
| Geoprocessing, modeling 22% 4              | Leadenhip 22% 2                          | Ethical, respectful 44% 4             | NOR, Northland Community & Technical College.<br>East Grand Forks, MN - Geospatial Intelligence | Advance Technology Education   |
| Geometry 11% 1                             | Map reading 44% 4                        | Focused 44% 6                         | Specialist - Suprember 11-12, 2018 -7 Specialists   | This material is based upon work supported by the National   |
| GIS 33% 4                                  | Multi-tasking 44% 4                      | Honesty, integrity 22% 4              | SLC, Sult Lake Community College, Sult Lake City.   | Foundation under Grant No. DUE ATE 1394591. Any coinic   |
| GPS, surveying, protagging 78% 14          | Organizational 78% 7                     | Inquisitive 11% 1                     | UT - GES Specialist - March 27-28, 2014 -<br>n Septidists                                       | findings, and conclusions or recommendations expressed in the  |
| Industry sector applications 33% 5         | Presentation, oral communication 67% 9   | Open minded 11% I                     | USG, U.S. Goospatial Intelligence Foundation, Harndon,  | material are those of the author(s) and do not necessarily refl  |
| Jargon, acronomo 22% 2                     | Problem Solving 100% 9                   | Patience 67% 6                        | VA - Geospatial Analyst - October 22-23, 2013 -   | views of the National Science Foundation.  |
| Legal descriptions 33% 6                   | Professional development 22% 2           | Positive utitude 50% 8                | 9 Analysis<br>DEN Meno State College, Descrip, CO., Remate                                      |  |
| Legal requirements 22% 3                   | Research 35% 4                           | Proactive, initiative 56% 8           | Sensing Specialist - September 14-15, 2011 -  |  |
| Mathematics, alaebra 89% 9                 | Soutial Thinking 44% 4                   | Professionalism 33% 3                 | 8 Specialists   | Produced by:   |
| Phonogrammetry, remote sensing 78% 25      | Team Player, interpersonal skills 78% 13 | Reliable, punctual 44% 4              | MIL, ASPES National Conference, Milwanitee, WI -<br>Bemote Sensing Specialist - May 1-2, 2011 - | Troubled by:   |
| Physics, Chemistry 33% 4                   | Time management 56% 5                    | Resourceful 56% 6                     | 6 Specialists   |  |
| Programming, societing 89% 17              | Troubleshooting 44% 4                    | Respectful 33% 3                      | SAC, Massion College, Santa Clara, CA - Remote  |  |
| Queries & analysis 67% 10                  | Visual interpretation 22% 3              | Self-motivated 89% 13                 | Sensing Specialist - August 20 - 21, 2009 -<br>5 Americkes                                      |  |
| Rester / Vector 22% 2                      | Web-design & development 11% 1           | Sense of humor 11% 1                  | ARC, American River College, Sacramento, CA   | GEOTECHCENTER OF   |
| Scale, resolution 44% 4                    | Writing 78% 12                           | Visionary 11% 2                       | Sonior GBS Analyst - June 4-5, 2009 -   | GEOTECHCENTER.O  |
| Software 50% 8                             |  | Williagness to Jeans 56% 8            | S Analysis<br>GSC, Gaineville State College, Arlanta, GA - GBS                                  |  |
| Standards (client, industry) 56% 11        |  | Work long bours 22% 2                 | Technician - January 16-17, 2009 -  |  |
| Statistics, probability 67% 33             |  | Work under Pressure 33% 5             | 12 Technicians  | TOTAL DISPLAYING   |
| Trigonometry, calculus 22% 3               |  |                                       | LLC, Lake Land College, Mattern, E GIS Technician<br>Necessity 19-20, 2001. 12 Technician       |  |
| Units of measurement, conservious 22% 3    |  |                                       |   |  |
|  |  |                                       | Created by John Johnson<br>Dahard by Budger Judger  | Name and Address of the Owner o |
|  | pripment & Supplies: % of panels & co    |                                       | GeoTech Conter  | 2006 W 2005  |
|  |  | Project management software 11% 2     |   |  |
|  |  | Scanner 56% 6                         |   |  |
|  |  | Security software 11% 1               |   |  |
|  |  | Sensors, photogrammetry/RS 11% 6      |   | According to the Control of the Cont |
|  |  | Server 22% 2                          |   | U.S. Department of Labor   |
|  |  | Sameoscopes 22% 2                     |   | Geospatial Technology Competency Model   |
|  |  | Espe: measuring, flagging 22% 4       |   |  |
|  |  | Tool box 11% 1                        |   | III  |
|  |  | Topographic maps 11% 1                |   | III  |
|  |  | Vehicle 44% 4                         |   | Date: October, 2019  |
|  | Notice 78% 7                             |                                       |   |  |
|  | Printer 44% 4                            |                                       |   | III  |
| PS receivers 28% 10                        | Programming software 11% 3               |                                       |   |  |

| Me  | eta-DACUM R<br>Meta-Duties                     | esearch Cl   | hart for G   | IS & Rem  | ote Sensir  | g (Technici  |   | its, Analysts &<br>: % of punels, # o                                       |   | lysts)  |  |   |   | October, 201   | *<br>—                                     |
|-----|--|--|--|---|---|--|---|---|---|---|--|---|---|--|--|
| ١.  | MANAGE DATA Al Define data requirements: 56% 6 |  | A2 Research<br>data sources:<br>78% 14                             | A3 Acquire<br>data: 89% 13  | A4 Connect<br>to data feeds:<br>33% 3   | AS Import &<br>export data:<br>67% 12  | A6 Order &<br>purchase data:<br>56% 5             | A7 Organize<br>data: 89% 15   | A8 Backup &<br>restore data:<br>78% 15                | A9 Convert /<br>reformat data:<br>89% 16  | A10 Join &<br>relate tables:<br>44% 5                | A11 Create & edit feature<br>behavior (topology, sabtypes,<br>domains): 33% 3 |   | A12 Design<br>& edit<br>databases:<br>67% 13             | A13 Assign<br>user<br>pennissions<br>44% 4 |
|     | MANAGE DATA                                    |  | A14 Research & implement<br>security protocols: 33% 5              |   | A15 Evaluate<br>data quality:<br>44% 5  | A16 Validate<br>data:100% 19   |   |   | A18 Create &<br>maintain data<br>dictionary:<br>11% 1 |   |  |   | work described i  | n performance to   | rms.                                       |
| 3   | GENERATE DATA                                  | B1 Collect<br>field attribute<br>data: 67% 6 G   | B2 Conduct<br>surveys &<br>questionnaire:<br>44% 5                 | B3 Capture<br>crowd-source<br>data: 11% 1                         | B4 Plan field<br>missions:<br>67% 26  | B5 Collect<br>ground<br>control points<br>33% 8                                | B6 Digitize<br>data: 78% 7                        | B7 Geocode<br>addresses:<br>67% 7   | BS Scan non-<br>digital data:<br>67% 6                | B9 Create /<br>edit vector<br>data: 78% 14  | B10 Create /<br>edit attribute<br>data: 56% 10       | B11 Create /<br>edit metadata:<br>100% 11                                     | B12 Create<br>photogramme<br>tric data: 11%<br>3        | B13 Create<br>LIDAR based<br>products:<br>44% 5          | B14 COGO<br>legal<br>descriptions<br>33% 3 |
| : [ | PROCESS DATA                                   | C1 Geo-<br>reference &<br>rectify data:<br>89% 9   | C2 Define<br>spatial<br>reference:<br>22% 2                        | C3 Reproject<br>& transform<br>data: 67% 7                        | C4 Conduct<br>image<br>classification:<br>44% 23  | classification: 37% 8 co-regist  |   | C6 Mosaic /<br>co-register<br>images: 44%<br>5                              | C7 Sample /<br>resample<br>image data:<br>33% 4       | radiometric calibration: 22% 4 in   |  | C9 Conduct<br>image<br>enhancement:<br>44% 6                                  | C10 Conduct v<br>interpretation of<br>3                 | nduct visual<br>nation of imagery: 33%<br>geope<br>: 78% |  |
|     | PROCESS DATA                                   |  | C12 Orthorecti<br>etric data: 33%                                  | fy photogram-<br>3  | C13 Process /<br>post-process<br>GPS data:<br>44% 4   | C14<br>Normalize<br>data structure:<br>22% 2                                   | definite begi                                     |   |   | ningful outcome; Results in a product, service or decision; Can be observed and measured; Has a<br>Requires specific knowledge, skills, behaviors, tools & equipment. |  |   |   |  |  |
| ,   | ANALYZE DATA                                   | DI Conduct<br>queries: 44%<br>5  | D2 Conduct<br>network<br>analysis: 67%<br>12                       | D3 Conduct<br>statistical<br>analysis: 78%<br>9                   | D4 Conduct<br>Proximity<br>analysis: 22%<br>2   | DS Conduct<br>spatial<br>analysis:44%<br>13                                    | D6 Conduct<br>quantitative<br>analysis: 44%<br>7  | D7 Conduct<br>change<br>detection:<br>33% 4                                 | D8 Conduct<br>view-shed<br>analysis: 22%<br>2         | D9 Perform fea<br>/ image segmen  | ge segmentation: 44% 7 scenario e<br>analysis: 33% m |   | DI ICreate &<br>execute<br>models: 56%<br>10            |  |  |
| z I | MANAGE<br>SOFTWARE &<br>HARDWARE               | E1 Install & upgrade software: 44% 5   | E2 Create<br>scripts &<br>custom tools:<br>67% 7                   | E3 Evaluate<br>software &<br>hardware:<br>33% 4                   | E4 Configure<br>& upgrade<br>servers: 33%<br>5  | E5 Optimize<br>database<br>performance:<br>22% 4                               | E6 Order<br>materials &<br>supplies: 22%<br>3     | E7 Maintain<br>equipment &<br>supplies: 44%<br>9                            | E8 Provide<br>technical<br>support: 44%<br>5          | E9 Create<br>help files &<br>user guides:<br>11% 1  | STEPS: Specifi                                       | TEPS: Specific elements or activities required to perform a TASK.             |   |  |  |
| ,   | MANAGE<br>PROJECTS                             | FI Coordinate F2 Clarify project scope goals & project deliverables: feasibility: 44% 5 78% 10 |  | F4 Develop project timeline & F5 Define project study area: 56% 6 |   | project study  | P6 Allocate<br>project<br>resources:<br>44% 6     | F7 Evaluate<br>project status:<br>67% 14                                    | F8 Develop policy, standards<br>& procedures: 56% 13  |   |  |   | F10 Prepare co<br>budgets: 44% 5                        | 10 Prepare cost estimates an<br>adgets: 44% 5            |  |
|     | MANAGE<br>PROJECTS<br>con'l                    | F11 Evaluate and supervise<br>project personnel: 33% 4   |  |   | F12 Prioritize & streamline<br>project workflows: 44% 6 strategic p                         |  | F13 Contribute<br>strategic plan:                 | Contribute to company<br>rgic plan: 22% 2 F14 Participate<br>personnel: 44% |   |   |  |   | F16 Create & implement<br>disaster recovery plan: 11% 2 |  |  |
| : 1 | GENERATE<br>PRODUCTS &<br>SERVICES             | CCTS & create maps: create web graphics: 22%   |  |   | Create animations, fly-<br>nights and videos: 56% 7   |  | G6 Create<br>tables, charts<br>& graphs:<br>56% 6 | G7 Develop<br>presentations:<br>56% 5                                       | G8 Conduct<br>oral<br>presentations:<br>56% 7         | G9 Prepare<br>documents &<br>data: 44% 10   | G10 Publish<br>digital<br>information:<br>89% 16     | G11 Integrate o   | lata: 33%   |  |  |
| 3   | GENERATE<br>PRODUCTS &<br>SERVICES con't       | G12 Develop software<br>applications & web services:<br>22% 4                                  |  |   | G13 Develop<br>and maintain<br>websites:<br>33% 4   | d suintain that expert workers perform; All tasks, in order to be perform      |   |   |   |   |  |   |   |  | be the tasks                               |
|     | PROFESSIONAL<br>DEVELOPMENT                    |  | H1 Interact & communicate<br>with co-workers:33% 7 Plan career:569 |   | lf-assessment &<br>L 9  | soessment & H3 Participate in conferences,<br>seminars & workshops: 100%<br>17 |   |   |   | H5 Develop training program & materials: 44% 4  |  | H6 Attend professional<br>training classes & workshops:<br>89% 11             |   | H7 Pursue advance degrees à<br>certificates: 56% 6       |  |
| 1   | PROFESSIONAL<br>DEVELOPMENT                    | FIONAL PMENT PROFESSIONAL Certification(s): 100% 10  |  |   | H9 Promote and represent the field of geospatial technology: & professional activities: 58% |  | outreach  |   |   | in mentoring<br>10  | H13 Publish<br>professional<br>articles: 44%         | H14 Network<br>professionally<br>: 56% 8                                      | H15<br>Participate on<br>committees:<br>13% 1           | H16 Resear<br>technology<br>trends: 44%                  |  |

New
DACUMs will
continue to
be carried out
and an
updated
MetaDACUM
published

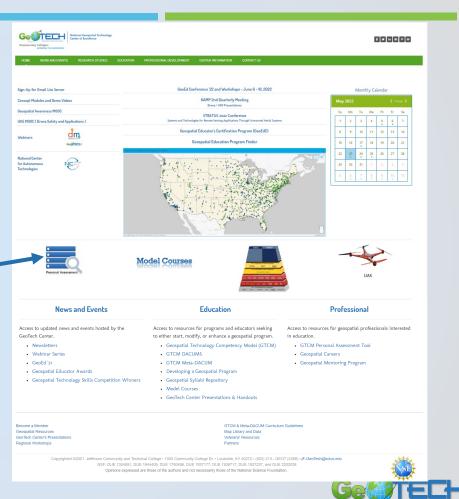
- Two-day intensive workshop where geospatial workers are asked to tell what they do and define what they need to know to do it
- Outcome is a DACUM chart
- Multiple DACUMS have been combined creating a MetaDACUM



# GeoTech Center Webpage geotechcenter.org

Resources to help fill in the knowledge gaps

Assessment Tool
10 Model Courses
Concept Module PPTs
Demonstration Videos
Learning Modules
MOOC 's





- Artificial Intelligence, Machine Learning, Deep Learning & Internet of Things
- Data Management and Metadata
- Data Visualization and MAUP, Colors
- Map Projections, Datums, Scale
- Ethics
- Excel and CSV tables hints and tips
- Mathematics and Statistics
- Geocoding
- **Programming**
- **Remote Sensing**
- Topology
- **US Census**

https://www.geotechcenter.org/concept-modules-anddemonstration-videos8203.html









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Back to Model Courses

# **Model Courses**

### **Certifica** te Model **Courses**



### **Elective** Model Courses



**Awarene** ss Model **Course** 



#### GST 101 - Introduction to Geospatial Technology

ourse Description: Introduction to the fundamentals of Geospatial Technology, including Geographic Information Systems (GIS), Global ositioning Systems (GPS), cartography, remote sensing, and spatial analysis through a series of hands-on computer-based exercises. articipants will learn how to utilize peospatial technology to address social and environmental issues. This course is designed to be used as and-alone course to complement other disciplines or as an entry level course into a geospatial program. Course content is based upon the nited States Department of Labor's Geospatial Technology Competency Model for entry level geospatial occupations including Geospatial o IS Technicians and Technologists

#### tudent Learning Outcomes (SLOs):

- 1. The student will describe the fundamental concepts of Geographic Information Science and Technology.
- 2. The student will demonstrate proficiency in the basic functions of geospatial software and hardware.
- 3. The student will demonstrate awareness of fundamental remote sensing and spatial analysis techniques

Course Materials

- 4. The student will demonstrate basic proficiency in map creation and design principles, including thematic map display, employment of map projections and cartographic design.
- 5. The student will demonstrate proficiency in the creation and acquisition of spatial data including the use of the Global Position System
- 6. The student will demonstrate how to access different sources of data, demonstrate the process of creating data, and discuss the fundamental concepts of data quality.







Unit 1- Introduction Overview



# **Thank You!**

- Please contact me if you need help finding a resource or if you have suggestions for a resource you would like the GeoTech Center to create or improve!
- Ann Johnson ann@baremt.com

