CENTRAL OREGON COMMUNITY COLLEGE

Associate Degree Geographic Information Systems Program Outcome Guide (POG)

Program Outcome Guide

Themes, Concepts, Issues	Process Skills	Program Assessment Tasks	Performance Indicators	Intended Outcomes
As a provider of GIS data: *Themes*: Demonstrate knowledge and apply skills essential to the discipline. *Concepts*: Position and Data Acquisition. *Issues*: Expertise in unique geometric and thematic properties of geospatial data, factors that affect data quality, knowledge of various data production technologies and deployment to meet project requirements.	1. Work with GIS tools and technology. 2. Provide effective GIS data. 3. Meet individual user needs. 4. Use critical thinking skills in making decisions. 5. Perform as team member. 6. Maintain accountability and integrity in GIS practice. 7. Grow professionally. 8. Communicate effectively. 9. Make decisions based on established legal, ethical and professional standards.	Pass theory exams at ≥ 70%. Meet, or exceed, outcome criteria for projects and assignments. Meet, or exceed, outcomes for a Co-operative education experience. Meet or exceed outcome criteria for individual and group presentations. Meet or exceed outcome criteria for a capstone project.	**Graduates will:** Report satisfaction with educational experience in achieving intended student learning outcomes as measured by graduate survey. Benchmark 70% *Achieve success points six to twelve months following completion of a degree or certificate as measured by graduate survey. Bench mark ___%* **Employers will:** Report satisfaction with the educational preparation of graduates (Degree or Certificate) as measured by employer survey. Benchmark 70% *Report evidence of graduates (Degree or Certificate) achieving CTE SLO's in the professional setting within six to twelve months of employment as measured by employer survey. Benchmark _____%* **CTE Program will:** *Achieve targeted student completion rate as measured by graduation/course*	**As a provider of GIS data:** Demonstrate knowledge and apply skills essential to the discipline. Apply GIS skills necessary to provide geospatial and thematic data. **As a manager of GIS data:** Demonstrate knowledge and apply skills essential to the discipline. Apply critical thinking and problem solving skill that reflect best practice. Coordinate and manage the delivery of reliable, valid, GIS data including analysis and specialized user needs products. **As a communicator:** Communicate effectively and appropriately within a professional setting in both written and oral form. Utilize professional communication skills to achieve project outcomes in collaboration with GIS users across disciplines. **As a Resource:** Apply critical thinking and problem solving skill that reflect best practice.
As a manager of GIS Data: *Themes*: Demonstrate knowledge and apply skills essential to the discipline. Apply critical thinking and problem-solving skills that reflect best practice. *Concepts*: Analysis and Modeling, Software and Application Development *Issues*: Professional end-user of geospatial data and software, knowledge of when to employ analytical functions and tools to render valid and reliable information, development of software products to targeted needs of the user community.				
As a communicator: *Themes*: Communicate effectively and appropriately within a professional setting in both written and oral form. Research, interpret and apply data/information in the professional setting. *Concepts*: Listening, speaking, and providing, in oral and written form, work related presentations. *Issues*: Receive, interpret, understand and respond to verbal messages and other cues, give attention to and understand what people are saying, speak clearly using common English conventions taking into account the audience, influence others through thoughts and ideas persuasively, gain commitment and support for proposed ideas. Create documents and presentations in logical, organized, coherent and persuasive manner.				
As a resource: *Themes*: Apply critical thinking and problem-solving skills that reflect best practice. Research, interpret and apply data/information in the professional setting. *Concepts*: Recognizing, exploring and using a broad range of ideas and practices. Apply critical-thinking skills to solve problems by generating, evaluating and implementing solutions. *Issues*: Employ unique analysis, see "what can be", integrate information. Identify problems, generate alternatives, choose and implement a solution.				

As a team member: *Themes*: Perform as a team member exemplifying professional practices and behavior. *Concepts*: Work cooperatively with others to complete projects. *Issues*: Accept team membership and identify with its goals, determine when to be a leader, identify member roles, use teamwork skills to achieve goals, solve problems and manage conflict, give and receive feedback constructively, be open to new ways of doing things.			*completion rate. Benchmark ____%* *Achieve targeted pass rates on required licensing or certification exam for each graduating cohort, or students completing, during a defined period of time. Benchmark ____%* Deliver CTE curricula that meet current industry standards as measured by Advisory board member curriculum analysis. Benchmark ____%	Research, interpret and apply data/information in the professional setting. Develop and implement GIS services for users who may or may not be GIS knowledgeable. **As team member:** Perform as a team member exemplifying professional practices and behavior. Work in groups modeling behaviors, and values of the GIS professional.

Additional Notes:

The GIS AAS and Certificate programs at COCC, through work with a DACUM funded by the National Science Foundation, an active Advisory Committee and the CareerOneStop competency model clearinghouse, Geospatial Technology

(http://www.careeronestop.org/competencymodel/blockModel.aspx?tier_id=4&block_id=708&GEO=Y)

have identified "Critical Work Functions" that geospatial professionals will be expected to perform during their careers. A list of the work functions is provided following.

Critical work functions are listed in the "Issues" section of each Course Outcome Guide. Each function listed under the "Issues" section of the respective course will have a level of competency expected at the completion of the course for the listed functions.

For each function, there are specific skills needed to perform that function. COCC GIS has identified, three levels of competency for each skill:
Level 1: Be familiar with by having been presented as a topical area in lecture. The student would need "hands-on" instruction prior to performing the skill in the workplace. Identified in purple color.
Level 2: Having performed in an exercise in the course. The student would need "oversight verification", but would be able to perform the skill with some direction. Identified in blue color.
Level 3: Has a working/journeyman knowledge, having performed multiple exercises and/or projects. The student could be expected to perform the skill with little to no direction needed. Identified in green color.

Critical Work Functions

- **Earth Geometry and Geodesy**

- Discuss the roles of several geometric approximations of the earth's shape, such as geoids, ellipsoids, and spheres 265
- Describe characteristics and appropriate uses of common geospatial coordinate systems, such as geographic (latitude and longitude), UTM and State Plane Coordinates 265, 273
- Explain the relationship of horizontal datums, such as North America Datum of 1983 (NAD 83) or the World Geodetic System of 1984 (WGS 84), to coordinate system grids and geometric approximations of the earth's shape 265, 266, 273, 285
- Describe characteristics and appropriate uses of common map projections, such as Transverse Mercator, Lambert Conformal Conic, Albers Conic Equal Area, Azimuthal Equidistant, and Polar Stereographic 265

- **Data Quality**
  - Discuss the elements of geospatial data quality, including geometric accuracy, thematic accuracy, resolution, precision, and fitness for use 273, 275, 285
  - In the context of a given geospatial project, explain the difference between quality control and quality assurance 285
  - Identify data quality and integration problems likely to be associated with geospatial and attribute data acquired with legacy systems and processes 275, 285
  - Calculate and interpret statistical measures of the accuracy of a digital data set, such as Root Mean Square Error (RMSE) 286, 287

- **Satellite Positioning and Other Measurement Systems**
  - Describe the basic components and operations of the Global Navigation Satellite System (GNSS), including the Global Positioning System and similar systems 273, FOR230A
  - Explain the distinction between GNSS data post-processing (such as U.S. National Geodetic Survey's Online Positioning User Service) and real time processing (such as Real-Time Kinematic) 273, FOR230A
  - Collect and integrate GNSS/GPS positions and associated attribute data with other geospatial data sets 273, 275, FOR230A
  - Compare differential GNSS and autonomous GNSS 273, FOR230A
  - Plan a GNSS data acquisition mission that optimizes efficiency and data quality 273
  - Identify and describe characteristics of inertial measurement systems and other geospatial measurement systems 286, FOR220A, FOR230A, FOR230B

- **Remote Sensing and Photogrammetry**
  - Use the concept of the "electromagnetic spectrum" to explain the difference between optical sensors, microwave sensors, multispectral and hyperspectral sensors 286
  - Differentiate the several types of resolution that characterize remotely-sensed imagery, including spatial, spectral, radiometric, temporal, and extent 286
  - Explain the difference between active and passive remote sensing, citing examples of each 286
  - Acquire information needed to compare the capabilities and limitations of various sensor types in the context of project requirements 286
  - Explain the use of sampling ground truth data for quality assurance in remote sensing 286
  - Define "orthoimagery" in terms of terrain correction and georeferencing 286

- **Cartography**
  - Employ cartographic design principles to create and edit visual representations of geospatial data, including maps, graphs, and diagrams 211, 275
  - Demonstrate how the selection of data classification and/or symbolization techniques affects the message of the thematic map 211, 265, 275, 287
  - Critique the design of a given map in light of its intended audience and purpose 211, 275

- **Geographic Information Systems**
  - Demonstrate understanding of the conceptual foundations on which geographic information systems (GIS) are based, including the problem of representing change over time and the imprecision and uncertainty that characterizes all geographic information all
  - Use geospatial hardware and software tools to digitize and georeference a paper map or plat 265, 266, 275, 285
  - Acquire and integrate a variety of field data, image data, vector data, and attribute data to create, update, and maintain GIS databases all
  - Specify uses of standard non-spatial data models, specifically the relational data model and its extensions 265, 285, CIS135DB
  - Compare advantages and disadvantages of standard spatial data models, including the nature of vector, raster, and object-oriented models, in the context of spatial data used in the workplace 265, 284, 285, 287
  - Describe examples of geospatial data analysis in which spatial relationships such as distance, direction, and topologic relationships (e.g. adjacency, connectivity, and overlap) are particularly relevant 267, 285, 287
  - Use geospatial software tools to perform basic GIS analysis functions, including spatial measurement, data query and retrieval, vector overlay, and raster map algebra all
  - Demonstrate a working knowledge of GIS hardware and software capabilities, including real time GPS/GIS mapping systems all

- **Programming, application development, and geospatial information technology**
  - Demonstrate understanding of common geospatial algorithms, such as geocoding or drive time analysis, by writing or interpreting pseudo code 267, 284
  - Recognize GIS tasks that are amenable to automation, such as route generation, incident response, and land use change analysis 265, 266, 267, 275, 285
  - Identify alternatives for customization and automation, such as APIs, SDKs, scripting languages 284
  - Identify the information technology components of a GIS, such as databases, software programs, application servers, data servers, SAN Devices, workstations, switches, routers, and firewalls 265, 266
  - Compare benefits and shortcomings of desktop, server, enterprise, and hosted (cloud) software applications 266, 267
  - Discuss trends in geospatial technology and applications 265, 286
  - Compare the capabilities and limitations of different types of geospatial software, such as CAD, GIS, image processing 265, 285, 286
  - Recognize opportunities to leverage positioning technology to create mobile end-user applications 275

- **Professionalism**
  - Identify allied fields that rely on geospatial technology and that employ geospatial professionals 265, 273, 275
  - Participate in scientific and professional organizations and coordinating organizations GIS/RS club activities
  - Demonstrate familiarity with codes of professional ethics and rules of conduct for geospatial professionals 273, 275
  - Identify legal, ethical, and business considerations that affect an organization's decision to share geospatial data 265, 273

Technical Content Areas: Headings correspond to select knowledge areas identified in the first edition of the *GIS&T Body of Knowledge* (UCGIS 2006).

- **Conceptual Foundations**
  - Spatial and topological relationships 265, 266, 267, 273, 275, 285, 287

- **Geospatial Data**
  - Earth geometry and its approximations, including geoids, ellipsoids, and spheres 265
  - Georeferencing systems, including coordinate systems and land partitioning systems 265, 273, 275, FOR230A,
  - Datums, horizontal and vertical 265, 273, 275, FOR230A,

- Map projections 265, 266, 273, 275, 285, FOR220A, FOR220B
- Data quality, including geometric accuracy, thematic accuracy, resolution and precision 273, 275, 285,
- Surveying, including numerical methods such as coordinate geometry, least-squares adjustment, and network adjustments FOR230A, FOR230B
- Global Navigation Satellite System, including GPS, GLONASS, Galileo, Beidou (a.k.a. Compass), QZSS, and navigation applications 273, 275, FOR230A
- Data input, including field data collection, digitizing, scanning, and data conversion 273, 275, 285, FOR220A, FOR220B, FOR230A
- Terrain modeling and representation 287
- Photogrammetry FOR220A
- Remote Sensing, including aerial imaging, image interpretation, image processing, multispectral and hyperspectral remote sensing, and full-motion video 286
- Metadata, standards and infrastructure 275, 285
- Alternative positioning technologies, such as wifi, TV, cell, and RFID 284

- **Data Modeling**
  - Database Management Systems, including relational, object-oriented, and extensions of the relational model 284, CIS153DB
  - Data Models, including grid, raster, TIN, hierarchical, topological, vector, network, and object-oriented 265, 266, 267, 285, 287
  - Geospatial data compression methods Not Covered
  - Data archiving and retrieval 285, 287

- **Design Aspects**
  - Conceptual Models Raster/Vector 265, 266, 285, 286, 287

- **Analytical Methods**
  - Geometric Measures 273, 285, 287
  - Overlay Analysis 265, 267, 275, 285, 287
  - Viewshed Analysis 287
  - Network Analysis 265, 267

- **Cartography and Visualization**
  - Principles of Map Design, including symbolization, color use, and typography 211
  - Graphic Representation Techniques, including thematic mapping, multivariate displays, and web mapping 211
  - Data Considerations for Mapping, including source materials, data abstraction (classification, selection and generalization), and map projections 211, 265, 273, 275, 285, 287
  - Map Production 211, 265, 275, 285, 287

- **GIS&T and Society**
  - Legal issues, including property rights, liability, and public access to geospatial information 273, 275
  - Ethical issues, including privacy, geographic profiling, and inequities due to the "digital divide" 273, 275, 285
  - Codes of ethics for geospatial professionals 273, 275

- **Organizational and Institutional Aspects**

- Professional, scientific and trade organizations, such as AAG, ACSM, ASPRS, GITA, MAPPS, NSGIC, and URISA 265, 273, 286
- Professional certification and licensing bodies, including GISCI, ASPRS and NCEES 265, 273, 286
- Federal agencies, such as U.S. Geological Survey, U.S. Census Bureau, National Geospatial-Intelligence Agency 265, 285, 286
- International organizations, such as GSDI, ISPRS, and ICA Not Covered
- Publications, including scholarly journals, trade magazines, and blogs 265, 286
- State and regional coordinating bodies, such as NSGIC and state Geographic Information Offices 265, 275, 285
- Standards organizations, such as FGDC and OGC 285