Geographic Information Systems for Agriculture

PEIMS Code: N1300272
Abbreviation: GIS4AG
Grade Level(s): 10-12
Award of Credit: 1.0

Approved Innovative Course

- Districts must have local board approval to implement innovative courses.
- In accordance with Texas Administrative Code (TAC) §74.27, school districts must provide instruction in all essential knowledge and skills identified in this innovative course.
- Innovative courses may only satisfy elective credit toward graduation requirements.
- Please refer to TAC §74.13 for guidance on endorsements.

Course Description:

Geographic Information Systems (GIS) for Agriculture is a comprehensive overview of technology available for implementation in precision agriculture. Students will be introduced to basic terminology and concepts of GIS and Remote Sensing (RS) software programs and participate in applying those concepts and programs as they pertain to the agricultural industry. Students will learn Global Positioning Systems (GPS), remote sensors, satellite data, soil sampling, Unmanned Aerial Support (UAS) and yield monitoring for crop planning, chemical applications, and harvesting. Students will also use GIS/RS software to help mitigate challenges in economics/supply chains, natural resource management, and wildlife conservation using spatial analysis.

Essential Knowledge and Skills:

(a) General Requirements. This course is recommended for students in grades 10-12. Recommended prerequisites: Principles of Agriculture, Food, and Natural Resources. Students shall be awarded one credit for successful completion of this course.

(b) Introduction.

(1) Career and technical education instruction provide content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.

(2) The Agriculture, Food, and Natural Resources Career Cluster focuses on the production, processing, marketing, distribution, financing, and development of agricultural commodities and resources, including food, fiber, wood products, natural resources, horticulture, and other plant and animal products/resources.

(3) The Geographic Information System for Agriculture is a course designed to provide students with the academic and technical knowledge and skills that are required to

pursue a career as a Precision Agriculture Specialist, Crop Specialist, Independent Crop Consultant, Nutrient Management Specialist, Physical Scientist, Precision Agronomist, Precision Farming Coordinator, Research Agricultural Engineer and Soil Fertility Specialist. Students will learn to use computers to develop or analyze maps of remote sensing to compare physical topography with data on soils, fertilizer, pests, or weather.

(4) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(c) Knowledge and Skills.

(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:

(A) identify career development, education, and entrepreneurship opportunities in the field of agriculture, food, and natural resources;

(B) apply competencies related to resources, information, interpersonal skills, problem solving, critical thinking, and systems of operation in agriculture, food, and natural resources;

(C) demonstrate knowledge of personal and occupational safety, environmental regulations, and first-aid policy in the workplace;

(D) analyze employers' expectations, including appropriate work habits; ethical conduct, legal responsibilities, and good citizenship skills: and

(E) identify careers in agriculture, food, and natural resources with required aptitudes in science, technology, engineering, mathematics, language arts, and social studies.

(2) The student develops a supervised agriculture experience program. The student is expected to:

(A) plan, propose, conduct, document, and evaluate a supervised agriculture experience program as an experiential learning activity;

(B) apply proper record-keeping skills related to the supervised agriculture experience;

(C) participate in youth leadership opportunities to create a well-rounded experience program; and

(D) produce and participate in a local program of activities using a strategic planning process.

(3) The student explains the current applications of GIS in agriculture, food, and natural resources and identifies the future need for GIS in precision agriculture. The student is expected to:

(A) identify career development and entrepreneurship opportunities in the field of geographic information systems (GIS) for agriculture;

(B) discuss current and emerging careers related to GIS in agriculture and natural resource fields;

(C) define and explain precision agriculture and its applications;

(D) identify and analyze applications of GIS technologies in agriculture, food, and natural resources;

(E) interpret GIS data as it pertains to agriculture; and

(F) research and present on licensing, certification, and credentialing requirements.

(4) The student analyzes geographic information and spatial data types in agriculture, food, and natural resources. The student is expected to:

(A) describe of the history of GIS and terminology used in agriculture;

(B) identify GIS models and representations in precision agriculture;

(C) apply GIS representations of geographic phenomena in soil types, topography, and farming management;

(D) organize and manage spatial data in yield monitoring for crop planning; and

(E) evaluate ethics in utilizing GIS data sources in agriculture.

(5) The student knows and uses GIS tools used in agriculture, food, and natural resources. The student is expected to:

(A) identify hardware and software for agriculture data management and processing such as data recording devices, GPS receivers, UAS, soil monitoring instruments, yield monitoring systems and other remote sensors;

(B) demonstrate competencies related to spatial data capture, spatial data storage and maintenance;

(C) explain spatial data query and analysis;

(D) create spatial data presentations for agriculture; and

(E) explain the benefits and limitations of remote sensing tools and technologies, including Unmanned Aerial Support (UAS), Unmanned Aerial Vehicles (UAV), and Global Positioning System (GPS) used in precision farming such as satellite farming and site-specific crop management.

(6) The student integrates spatial referencing and global positioning techniques in agriculture, food, and natural resources. The student is expected to:

(A) identify the uses of spatial referencing and global positioning in modern farming;

(B) analyze and explain spatial referencing systems and projections for capturing and displaying agricultural data for the use of improving crop production; and

(C) explain agriculture uses for satellite-based positioning including monitoring farm equipment and fertilizer applications.

(7) The student analyzes the applications for spatial data entry and preparation for agricultural analysis. The student is expected to:

(A) identify different GIS platforms commonly used in agriculture such as ESRI's ArcGIS, or AGROMA;

(B) compare and contrast different spatial data entry systems regarding its application within agriculture;

(C) collect and input agricultural spatial data into the GIS platform for analysis; and

(D) apply concepts related to agriculture data accuracy and precision.

(8) The student performs agricultural spatial data analysis. The student is expected to:

(A) classify analytical GIS capabilities for maximum crop yields;

(B) compare vector and raster-based data for agricultural analysis; and

(C) research and present on concepts related to GIS analysis function and natural resource management.

(9) The student creates spatial data visualizations and cartographic models. The student is expected to:

(A) identify types of GIS maps used in agriculture;

(B) develop GIS maps for various types of agricultural data;

(C) explain cartographic symbols used in precision farming; and

(D) creates visual data for use in agricultural decision making.

Recommended Resources and Materials:

Esri. "Esri Schools Mapping Software Bundle." Accessed May 13, 2021. https://www.esri.com/en-us/industries/education/schools/schools-mapping-software-bundle.

Esri. "Learning ArcGIS: GIS for Agriculture CTE Programs." Accessed May 13, 2021. https://learn.arcgis.com/en/paths/gis-for-agriculture-cte/.

Hancock, J.P., Don Edgar, Michael Pate, Lori Dyer, and Brian Hoover. *Agricultural Mechanics and Technology Systems*. Tinley Park, IL: Goodheart-Wilcox Company, Inc., 2017.

Kar, Dinesh. *Sensing Agriculture from Space: Geospatial Technology Concepts and Solutions for Key Players in Agri Value Chain*. Happy Self-Publishing, 2020.

Krishna, K.R. *Push Button Agriculture: Robotics, Drones, Satellite-Guided Soil and Crop Management*. Ontario, Canada: Apple Academic Press, Inc., 2016.

Sabins, Floyd Jr. and James Ellis. *Remote Sensing: Principles, Interpretation, and Applications*. Long Grove, IL: Waveland Press, Inc., 2020.

Recommended Course Activities:

- Split the class into small groups. Have them answer the following question: We have seen that GIS has the capability of being a great management tool for the agriculture industry. What can you envision to be some of the applications of this technology in our area? Have a representative from each group write one application they found on the board.
- Have students identify and evaluate types of GIS maps used in agriculture.
- Interview industry stakeholders and/or entrepreneurs on the benefits and application of GIS maps in their career field.

- Team up with local GIS businesses to collect data and create a basic GIS map.
- Label GIS maps with correct cartographic symbols.
- Instruct students to independently compare vector and raster-based data for agricultural analysis. With Internet access, give the students 15 minutes to research and think independently about how they would answer the question. Allow an additional 10 minutes for class discussion and form an answer together.
- Students may shadow a professional in Agriculture GIS for some or all of a workday to observe not only job characteristics and responsibilities, but also what the job requires on a day-to-day basis. Students should write a summary of their shadowing experience.
- Invite a local GIS Professional to speak with students about GIS so that students can gain more in-depth look at GIS as a career.
- Have students learn the basics of field-based global position systems (GPS) and GIS data collection and management by using hand-held GPS devices in a scavenger hunt. Students use GPS receivers to find designated waypoints and report back on what they found. They compute distances between waypoints based on the latitude and longitude and compare with the distance the receiver finds.

Suggested methods for evaluating student outcomes:

- Response Cards: Whiteboards, note cards or other items are simultaneously held up by all students in class to indicate their response to a question or problem presented by the teacher.
- Think-pair-share: Students take a few minutes to think about the question or prompt. Next, they pair with a designated partner to compare thoughts before sharing with the whole class.
- 3-2-1: Students consider what they have learned by responding to the following prompt at the end of the lesson: (1) things they learned from your lesson, (2) things they want to know more about, and (3) questions they have.
- Quizzes: Short quiz given at the end of class to quickly check for understanding.
- Student Reflection: At the end of class, students will be able to reflect on the lesson and summarize on paper what they learned.
- Exit Ticket
- Traditional summative assessment
- End of year project

Teacher qualifications:

An assignment for Geographic Information Systems for Agriculture is allowed with one of the following certificates.

- Agriculture, Food, and Natural Resources: Grades 6-12.
- Agricultural Science and Technology: Grades 6-12.
- Any vocational agriculture certification.
- Trade and Industrial Education: Grades 6-12. This assignment requires appropriate work approval.

- Trade and Industrial Education: Grades 8-12. This assignment requires appropriate work approval.
- Vocational Trades and Industry. This assignment requires appropriate work approval.

Additional information: