The following is a draft scope and sequence for spatial learning across disciplines. GIS elements are included where appropriate, and references came directly out of national standards in geography, mathematics, science, and social studies. Categories are subject to change, but are based upon ESRI's Process Sequence for GIS in Education from: Applications of GIS in the K-12 Science Classroom.

(K-1)

Representation

Understand maps as representations (geography, social studies)

Understand globes as models of Earth (geography, social studies)

Introduction to attribute layers (geography)

Understand relative scale and relative space (geography, math)

Introduction to symbolization - connecting representation to reality (geography, math)

Exploration

Introduction to attribute layers (geography)

Changing representation by adding/subtracting layers (geography, math)

Position/motion of objects (science)

Perspective (math)

List and describe shapes in the environment (math)

Introduction to attributes of measurement: length, volume, weight, area, time (math)

List and describe attribute layers in the environment (GIS)

Analysis

Describe **more/less** relationships (geography, math)

Describe **near/far** relationships (geography, math)

Describe how/why to use representations of reality (GIS)

Visualization

Changing representation by adding/subtracting layers (geography, math)

Describe attributes/parts of 2/3-D shapes (math)

Create mental images of geometric shapes using spatial memory and visualization (math)

Representation

Understand satellite images as representations (geography, social studies)

Introduction to generalization (geography)

Symbolization - points, lines, and areas (geography, math)

Construct and use mental maps that demonstrate understanding of relative direction, location, size, and shape (social studies)

Interpret different representations of data: concrete, graphic, photographic (math)

Exploration

Differences among and between phenomena (geography, science, math)

Relative distribution (geography)

Relative distance (geography)

Human patterns on the landscape (geography, but also science and math)

Describe problems in which GIS tools can be used (technology)

Natural versus manmade objects (science)

Tools of measurement: virtual and otherwise (math)

Analysis

Identify local landmarks in aerial photos, on maps, and through cognitive mapping - school, home, police station, park, grocery (geography)

Use attribute layers to differentiate among physical and human characteristics (GIS)

Compare data from different places (geography)

Compare and order objects/data within and among attributes: length, area, time (geography, technology, math)

Describe change over time - places, environments, earth and sky - (geography, science)

Visualization

Changing representation by adding/subtracting layers (geography, math)

Asking spatial questions

Symbolization

Generalization

(4-5)

Representation

Understand different representations in physical, temporal, human, and psychological space (geography, social studies)

Symbolization/labeling major physical/human elements (geography)

Earth system models (geography, science)

Inclusion/exclusion of attribute layers (GIS)

Figure/ground (GIS)

Understand the classification of shapes according to their properties (math)

Exploration

History in/across space (geography)

Types of natural resources (geography)

Spatiality of earth/life systems dynamics - local/regional scales (geography, science)

Explore and utilize coordinate systems in order to find absolute location and determine path direction (geography, math)

Use appropriate data sources/tools to generate, manipulate, and interpret information: atlas, data bases, grid systems, charts, graphs, maps (social studies)

Identify and describe examples in which science and technology have led to changes in the physical environment: dam/levee building, oil drilling, medicine from the rain forest, deforestation, etc. (social studies)

Identify and use various sources for reconstructing the past: documents, photos, maps, etc. (social studies)

Objects in the sky (science)

The effects of scale (math)

Linking data tables to graphics layers (GIS)

Explore attribute hierarchy based upon perceived importance of attributes (GIS)

Analysis

Understand characteristics and changes in populations (geography, science)

Investigate phenomena and various methods of collecting data (geography, science, math)

Describe and speculate about physical systems changes: seasons, weather and climate, and water cycles (social studies)

Demonstrate an understanding that people in different times and places view the world differently (social studies)

Estimate distance and calculate scale (social studies, math)

Analyze and compare perception, representation, and reality (GIS)

Visualization

Asking spatial questions

Symbolization

Generalization

(6-8)

Representation

Geographic scale (geography, GIS)

Explain how information and experiences may be interpreted by people from diverse cultural perspectives and frames of reference (social studies)

Compare and relate different forms of representation (math)

Representations of the structure of the Earth system (science)

Representing Earth in the solar system (science)

Map projections: appropriateness/requirements (GIS)

Purpose/audience (GIS)

Figure/ground (GIS)

Exploration

Motions and forces (science)

Natural hazards (science)

Science and technology in society (science)

Understand and find absolute location using a coordinate system (math, GIS)

Examine issues using a query builder (GIS)

Explore the effects of buffering for a phenomenon (GIS)

Analysis

Accuracy in measurement, documentation, representation (geography)

Examine relationships between and among phenomena through place/space (geography)

Examine influences of space in uniting/dividing (geography)

Spatial modeling of Earth/life/human systems dynamics at the global scale: diffusion, distance decay, spatial interaction of multiple phenomena (geography)

Identify and use key concepts to explain, analyze, and show connections among patterns of historical change and continuity: chronology, causality, change, conflict, and complexity (social studies)

Give and explain examples of ways that economic systems structure choices about how goods and services are to be produced and distributed (social studies)

Scientific inquiry (science)

Structures/functions of living systems (science)

Populations and ecosystems (science)

Populations, resources and the environment (science)

Analyze the nature of changes in linearly quantifiable data (math, GIS)

Create a data table linked to graphics in order to solve a real-world problem (community problem-solving with GPS/GIS)

Visualization

Effects of altering visual displays of data

Symbolization/generalization

Asking spatial questions

Interpreting data for relevance, accuracy, bias, comprehensiveness

Purpose/audience

(9-12)

Representation

Appropriateness of scale

Figure/ground

Presentation

Visual hierarchy

Perception

Map projections (appropriateness/requirements)

Symbolization/generalization

Exploration

Natural resources (science)

Matter, energy, and organization of living systems (science)

Science and technology in local, national, and global challenges (science)

Origin and evolution of the universe (science)

Origin and evolution of the Earth system (science)

Interdependence of organisms (science)

Biological evolution (science)

Interactions of energy and matter (science)

Analysis

Spatially analyze systems/processes: motions and forces (science), energy in the Earth system (science), personal/community health (science), population growth (geography; science), environmental quality (geography; science), natural/human induced hazards (geography; science)

Capabilities/limitations for presenting GIS output (technology)

Appropriate uses of tools for spatial analysis (technology)

Compute, analyze, and visually display statistical information for spatial phenomena (math, GIS)

Gather data for a real-world problem - spatial interrelationships, interactions, divisions, etc. (GIS)

Process/analyze data to solve real-world problems using GIS tools (GIS)

Visualization

Effects of altering visual displays of data

Symbolization/generalization

Asking spatial questions

Interpreting data for relevance, accuracy, bias, comprehensiveness

Purpose/audience

Possible Capstone Projects (social studies)

Apply key concepts (time, chronology, causality, change, conflict, and complexity) to explain, analyze, show connections among patterns of historical change and continuity

Investigate, interpret, and analyze multiple historical and contemporary viewpoints within and across cultures related to important events, recurring dilemmas, and persistent issues, while employing empathy, skepticism, and critical judgment

Analyze group and institutional influences on people, events, and elements of culture in both historical and contemporary settings

Compare and analyze the ways nations and organizations respond to conflicts between forces of unity and forces of diversity

Analyze the role of specialization and exchange through spatial economic and transportation models

Apply knowledge of production, distribution, and consumption in the spatial analysis of a public issue such as allocation of health care or the consumption of energy, and devise a plan for accomplishing a socially desirable outcome related to that issue

Spatially analyze the relationships and tensions between national sovereignty and global interests, in such matters as territory, economic development, nuclear and other weapons, use of natural resources, and human rights concerns

Locate, access, analyze, organize, synthesize, evaluate and apply information about selected public issues—identifying, describing, and evaluating multiple points of view