NATIONAL GEOGRAPHIC

STATE GIANT MAPS

LESSON HANDBOOK

INTRODUCTION

Whether you are a new teacher seeking support on how to use maps in the classroom or an experienced educator searching for fresh ideas and methods, you'll find that this *State Giant Map Handbook* contains a valuable collection of classroom tools—from lessons, to extension activities, to educator background information.

WHAT'S IN THE HANDBOOK?

This handbook includes an overview of spatial thinking research regarding elementary students and lessons for use with the State Giant Map (designed for 3rd and 4th grade students).

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WHAT IS SPATIAL THINKING?

Photo by Mark Thiessen/National Geographic

Spatial thinking is arguably one of the most important ways of thinking for a child's development as he or she grows. All individuals, to greater or lesser extents, use this type of thinking as they interact with the world around them. It is a unique way of thinking *about* the world and interacting *within* the world.

The National Research Council (2006) describes spatial thinking as an amalgam of three components: concepts of space, tools for representation, and process for reasoning:

> To think spatially entails knowing about (1) space--for example, the relationship among units of measure (e.g., kilometers versus miles), different ways of calculating distance (e.g., miles, travel time, travel cost), the basis of coordinate systems (e.g., Cartesian versus polar coordinates), the nature of spaces (e.g., number of dimensions [two- versus three-dimensional]); (2) representation — for example, the relationships among views (e.g., plans versus elevations of buildings, or orthogonal versus perspective maps), the effect of projections (e.g., Mercator versus equal-area map projections), the principles of graphic design (e.g., the roles of legibility, visual contrast, and figure-ground organization in the readability of graphs and maps); and (3) reasoning —for example, the different ways of thinking about shortest distances (e.g., as the crow flies versus route distance in a rectangular street grid), the ability to extrapolate and interpolate (e.g., projecting a functional relationship on a graph into the future or estimating the slope of a hillside from a map of contour lines), and making decisions (e.g., given traffic reports on a radio, selecting an alternative detour) (p. 12-13).

Spatial thinking involves visualizing, interpreting, and reasoning using location, distance, direction, relationships, movement, and change in space. A student who has acquired robust spatial thinking skills is at an advantage in our increasingly global and technological society.

Providing quality instructional resources and activities for learning how to think spatially during the formative school years is critical. It is even more important that such resources and activities are not simply flashy software or fun and games, but instead are learning experiences designed with research on spatial concept development at their core.

WHAT DOES RESEARCH TELL US?

The National Geographic Society commissioned a research project, *Spatial Thinking About Maps: Development of Concepts and Skills Across the Early Years* by Audrey & Lindsey Mohan, regarding best practices and implications for the classroom. The project consisted of a meta-analysis of over 80 articles, book chapters and books from the most prominent researchers in spatial thinking in geography and earth science, especially those focused on the development of mapping concepts and skills.

A student who has acquired robust spatial thinking skills is at an advantage in our increasingly global and technological society. Spatial thinking is also positively correlated with success in math and science (see Battersby, Golledge, & Marsh, 2006). Thus, providing quality instructional resources for learning how to think spatially during the formative school years is critical. It is even more important

that such resources are not simply "flashy" software programs or fun and games, but instead are learning experiences designed with research on spatial concept development in mind.

The report is broken down into five sections and includes a separate annotated bibliography document. To read the entire report go to http://nationalgeographic.org/media/spatial-thinking-about-maps/. Included below is an executive summary of the findings by grade bands.

GRADES PRE-K THROUGH 1 (AGES 3 TO 6)

The research shows that young children (ages 3 to 6) appear to naturally acquire the ability to understand topological concepts such as on, in, inside, in the middle, between, around, and beside, regardless of cultural group or background experience with maps. However, even
if these spatial concepts are acquired at a young age, there are still some children who struggle with them. Topological concepts are the easiest to learn; thus, children in the early years only have access to these concepts when reasoning about maps.

A set of instructional resources at PK-1 would do well to focus on topological concepts, hands-on activities, and an introduction of basic projective concepts. During play, use blocks, toys, or puzzle maps that naturally lead to more use of spatial language. Students this age should work with maps of familiar places (such as the schoolyard) that are large in size and small in scale. Symbols should be realistic representations and easily interpreted. Complex or visually busy atlas pages using small font and
abstract symbols should be avoided. Preschool children learn more when there is social interaction or real-world action involved in spatial activities. Include activities in which children create and then analyze their own self-made maps of familiar places before they engage with activities in which they are using maps developed by other people.

Photo by Mark Theissen/National Geographic

Grades Pre-K through 1 (Ages 3 to 6)

Spatial Concepts	Conceptual Understanding	Possible Misconceptions	Curricular Implications
	Students:	*Students:*	*Materials:*
Identity and Location	Identify places on maps, landscape features on maps and aerial photographs, and locate familiar places on maps	Can identify places on maps, but may be limited by vocabulary development in their ability to describe the place or location	• Provide sensory experiences and tactile, hands-on, active mapping activities and puzzle maps • Provide opportunities to practice with maps of familiar places (e.g. classrooms, homes, schools, neighborhoods) and to make maps, both real and imaginary • Tap into students' interest in learning about extremes such as the largest continent and the smallest country • Provide simple maps large in size (tabletop or larger), as opposed to an atlas, to allow children to explore with their whole bodies • Provide pictorial and panoramic views, which are common ways that children represent their views of the world and connect to it
	Use landmarks as a way to identify where places or items are located on a map	Can confuse locations on maps if the map is not well aligned to their real world	
Magnitude	Understand magnitude of objects and associated vocabulary (e.g., bigger, smaller)	May confuse the scale of an object with the number of objects (numerosity)	
Relative Distance and Direction	Understand relative distance, such as near, far and next to, and begin using relative direction on maps, such as for navigating mazes	Struggle with knowing which way to "hold a map" and get easily confused if it is not aligned to the real world	
Symbols	Understand concrete symbols that represent an object or place in the real world	May not understand abstract, unrelated symbols, large numbers of symbols, or complexity of symbols (e.g., a map with U.S. represented as a pink country might be seen by some students to literally be a pink country)	

GRADES 2 THROUGH 4 (AGES 7 TO 9)

Prior to age 7 or 8 years, most children have limited mapping abilities because they have only mastered topological concepts and not projective concepts. Projective concepts begin to emerge in early elementary; however, children may not be proficient until upper elementary (around 9 years old). Educators need to incorporate additional spatial terms beyond relative terms such as near, far, and beside, and geographic terms should be introduced.

Resources for grades 2-4 should continue with topological concepts, but move forward to focus on helping students make progress on basic projective concepts. Students should construct maps collaboratively and use discussion to reason about their decision-making when choosing certain elements on the maps, such as scale, grid systems, and symbols. Activities should use different types of maps of the same area so that students can discuss the similarities and differences of each type of map (political vs. topographical vs. aerial) and their strengths and weaknesses. Students should observe their environment with adults asking questions about what they see; unique physical characteristics of the environment should be pointed out. Students begin to place themselves on the map and make spatial connections. Because they are making the transition between realistic and abstract symbols, students may make mistakes when interpreting maps, so educators must explicitly model how to read maps and show how symbols are developed and used.

Photograph by Winn Brewer/National Geographic

Grades 2 through 4 (Ages 7 to 9)

Spatial Concepts	Conceptual Understanding	Possible Misconceptions	Curricular Implications
	Students:	*Students:*	*Materials:*
Identity and Location	Accurately locate places and landscape features on a map, but perform better with familiar locales rather than foreign locales	Inconsistently use landmarks to verify locations	• Expose students to a broader world beyond the familiar. Begin including birds'-eye views of maps, but a combination of pictorial and panoramic views • Encourage students to explore the world but at the continent and country level • Include maps that use grid systems with limited amounts of information • Provide active and hands-on activities that allow children to manipulate maps when possible • Introduce more complex spatial concepts but provide explicit support in doing so as many concepts are not yet learned • Encourage students to produce their own maps and use maps and models that allow active exploration (e.g., 3-D topo maps, landscape models, "layers" found on a map)
	Demonstrate improvement with map alignment issues		
Distance and Direction	Transition from topological concepts of distance to metric measurements and scale	Still need guidance to transition to metric measurements	
	Readily use metric distances and scale by the end of Grade 4 Use landmarks and relative direction, but are ready to learn cardinal directions		
Symbols	Transition from iconic real-world symbols to abstract symbols	Still may make errors and need explicit guidance on what symbols mean Inconsistently use landmarks to verify locations	
Reference Frames	Can begin to understand grid systems (the coordinate system) and absolute location	Still need guidance with map features; they may become distracted by features that are not useful and may neglect useful features on maps	
Hierarchies	Do not yet have a well established concept of hierarchy (or nesting)	Should be introduced to the concept of hierarchy with close guidance	

GRADES 5 THROUGH 6 AND BEYOND (AGES 10 AND OLDER)

At this stage, elementary-age and preadolescent children are developing the ability to reason logically and make concrete connections to their world. They are able to solve realistic problems, classify objects by a variety of characteristics, and use maps with different symbol systems. The symbol systems may include color and abstractions, different projections, and different themes. During this time, students become less egocentric, are able to understand others' perspectives, and are inquisitive about people and places around the world.

Resources in grades 5-6 should begin by reviewing basic topological and projective concepts, but focus mostly on advancing a student's understanding of projective space. Students should complete activities in which they compare two different representations or maps and explain their own understanding of the relationship between the two. However, teachers should not make assumptions about students' spatial reasoning and understanding of spatial representations. For example, students may not necessarily use map scales and cardinal directions without prompting; therefore, explicit instructions and support will be needed. Teachers should anticipate substantial student-to-student variation in accuracy and complexity of reasoning.

Photograph by Mark Thiessen/National Geographic

Grades 5 through 6 and Beyond (Ages 10 and Older)

Spatial Concepts	Conceptual Understanding	Possible Misconceptions	Curricular Implications
	Students:	*Students:*	*Materials:*
Identity, Location, Distance and Directions	Need to be primed to use all the resources available to determine locations. They should be encouraged to explain decisions in order to prompt their thinking about landmarks, distances, and directions	May not readily use map scales, metric distances, and cardinal directions to help determine locations, but are able to do so with some guidance	• Explore and compare different projections and viewing angles • Use measured distances, cardinal directions and abstract symbols with support including the introduction of longitude and latitude • Use multiple map formats (e.g., reference maps, thematic maps, digital maps) at multiple scales • Introduce more complex spatial concepts, such as projection and overlay • Allow students to begin to confidently navigate the world
Symbols	Use abstract symbols and understand symbols do not always "look like" the referent		
Overlay and Complex Spatial Concepts	May incidentally understand the concept of overlay without formal instruction (about half of all Grade 6 students do so)	May not understand "layers" without direct instruction, support, and guidance	
	Can move on to complex spatial concepts such as distribution, patterns, overlays, and projection with support if mastery of the basic spatial concepts of location, distance, direction, boundaries, and regions is achieved		

MODEL ACTIVITIES

The activities in this handbook have been tested in the classroom. Taken together, they address multiple content area standards. Serving a variety of needs, these activities include a wide range of teaching strategies. Each activity includes the time needed, materials, any necessary preparations, directions, step-by-step description of the activity, tips, standards connections, and vocabulary.

You may want to do and/or read through the activities by yourself to become more familiar with them prior to having students on the map. Or you may enjoy involving your colleagues--the activities are especially effective with a group of teachers in an inservice or as a team of classrooms on the map. The activities are arranged in a natural progression of skills and knowledge, but may be used in any order depending on the level of the students.

Photograph by Winn Brewer/National Geographic

ADDITIONAL RESOURCES

National Geographic has additional information regarding teaching mapping in the elementary classroom that can be found at **https://www.nationalgeographic.org/education/map-skills-elementary-students/**

State focused activities may be available from your state Alliance. Please go to **https://www.nationalgeographic.org/education/programs/geography-alliances/** to navigate to your Alliance's home page and then to their resource/materials page.

The full research on spatial thinking is available at **http://nationalgeographic.org/media/spatial-thinking-about-maps/**

LESSON 1

WHAT? WHY? WONDER!

Guiding Question:

What do you see on the map?

EDUCATOR BACKGROUND INFORMATION

The Two Perspectives in Geography
Every discipline looks at the world from a particular point of view or perspective. For example, a historical perspective emphasizes change over time, and an economic perspective focuses on how people produce and exchange goods and services. As an integrative discipline, geography combines the physical and human realms. Geography is a way of looking at and thinking about the world, using both a spatial and an ecological perspective.

Spatial Perspective: Space and place are the keys to a spatial perspective. When we consider space on Earth's surface, we look at questions of area, scale, distance, direction, and location. Space on Earth's surface is the fundamental underpinning of geography. Places on Earth can be identified by their unique locations, physical features, and human characteristics. Although every place is unique, a study of geography enables us to understand how places are similar and then to link them into regions. Geographers describe, analyze, and seek to understand the spatial arrangement of things and people on Earth's surface. Ask yourself and your students to explore whether it matters:

- Where a playground or shopping mall is located;
- Where toxic waste is dumped;
- That the Rocky Mountains are located west of the Great Plains;
- That 20 percent of the world's population is located in China.

Ecological Perspective: Living and nonliving elements on Earth interact in complex webs of ecological relationships. Humans are one among many species that constitute the living Earth. Human actions modify physical environments and affect the viability of ecosystems on local and global scales. People who regularly inquire about connections and relationships among life forms, ecosystems, and human societies possess an ecological perspective.

Human Systems: People are central to geography because human activities may shape the Earth's surface; human settlements and structures are part of Earth's surface; and humans compete for control of Earth's surface. Earth's roughly seven and a half billion people are not evenly distributed upon the planet's surface. Geographers ask: Where? And Why?

Environment and Society: The physical environment is modified by human activities, largely because of the ways human societies value and use Earth's natural resources; and human activities are influenced by Earth's physical features and processes. It is difficult to name a place on Earth that has not been modified or regulated by human activity.

RECOMMENDED GRADES: 3, 4

TIME NEEDED: 15 - 20 MINUTES

(Note: You may wish to use this lesson as a warm-up activity before other lessons rather than as a stand-alone activity.)

Objectives

- Students will become familiar with the State Giant Map
- Students will reflect on things they wonder about after spending some time just taking in the map

Materials

None

Preparation

If you wish to play music while students walk around on the map, have your music source set up and ready prior to the activity.

Rules

Have students remove shoes before walking on the map.

No writing utensils. on the map.

DIRECTIONS

1. Invite students to take off their shoes and walk around on the map. Give students plenty of time to explore and ask questions, if they have any.
2. Tell students you want them to find, as they walk, a place on the map that they are interested in. Give them several minutes for this walk.
   NOTE: You might want to play music while they walk. Stop the music after a few minutes and ask them to go to "their spot."
3. Ask the following questions, allowing time for each student to respond to each question before moving on to the next question—while still standing on their spots:

   - *What do you see on your spot?*
   - *Why did you choose this spot? Why did you find this spot interesting?*
   - *What do you wonder about this spot on the map? What would you like to learn more about it?*

EXTENDING THE LEARNING

- You might wish to extend this simple activity by having students form small groups based on similar types of selected spots—cities, parks, rivers, etc. Then have them do some research on their "wonder" questions from above.

Tips

- Let students visit with one another quietly while they move around the map looking for their spots. If you think visiting might get distracting, use the option to play soft music during this time and ask students to focus on finding their spots.
- If your state is small, you may wish to have students work in pairs or small groups.

Standards

National Geography Standards

Geography Standard 1: How to use maps and other geographic representations, geospatial technologies, and spatial thinking to understand and communicate information (4th grade).

National Social Studies Standards

People, Places, and Environments (Early grades): Learners will understand concepts such as: location, direction, distance, and scale.

The College, Career & Civic Life (C3) Framework for Social Studies State Standards

Geographic Representations: Spatial Views of the World: D2.Geo.3.3-5
Use maps of different scales to describe the locations of cultural and environmental characteristics.

LESSON 2

GRIDS

Guiding Question:

How do you find your way around?

EDUCATOR BACKGROUND INFORMATION

This activity was developed to introduce students to how to find locations or places on a map through the use of a grid. A grid organizes the information on a map into smaller and more accessible segments. Using a grid, students are taking the first steps in finding a location or place. As they develop spatial thinking skills and become more refined in their use, longitude and latitude are taught. Instruction on this concept should begin in upper elementary for a majority of students. Students should be able to relate map grids to grids they use in math and to reading information on charts. A grid is used in mathematics, geography, and many other disciplines.

Location

Location is more than just pinpointing an activity, pattern, place, or event in space. It is broader in nature—concerned with more complex spatial relationships. Geographers answer these types of questions: Why is that city located where it is? Is there a pattern to the location of towns? What is the distribution of coal deposits in the United States? Answering each question correctly requires knowing location in both absolute (i.e., specific site) and relative terms (i.e., grids). But it also requires looking at the factors that lead to particular spatial patterns.

Place

Together, human and physical characteristics define a place. Place is space endowed with meaning. Places are created by physical and human action. Physical systems produce the climate, landforms, vegetation, and resources characteristic of a location. Human systems yield the people, language, religion, patterns of land use, architecture, and recreation that give locations character—what some call a sense of place. The meaning each individual takes from a place is influenced by perception. Since places change with time, people's perceptions of places change, too.

RECOMMENDED GRADES: 3, 4

TIME NEEDED: 30 - 50 MINUTES

Objectives

- Students will understand how to read grid lines on the State Giant Map
- Students will recognize the value of using grid lines to locate places on a map

Materials

Activity 1

- Cards (index cards work well for this) with grid locations written on them – one per student. (See Preparation)

Activity 2

- Basket or something similar to put cards into
- Index cards or other paper

Activity 3

- Sticky notes (4 colors) - provided
- Index cards or other paper

Preparation

Activity 1

Write grid "coordinates," such as B2, D5, etc., on index cards so that you have one for each student.

Rules

Have students remove shoes before walking on the map.

No writing utensils. on the map.

DIRECTIONS

This activity is written with one introductory activity (Activity 1) and two optional—use dependent on student readiness and available time—for a follow-up activity (Activity 2a or Activity 2b).

ACTIVITY 1: Introduction to Grids

1. Point out the numbers along the sides of the map and the letters along the top and bottom of the map.
2. Introduce the grid system for locating places on a map: *Grids help you locate places on maps. A grid uses lines to make rows and columns on a map. The rows go from side to side. On this map the rows have a number to their left and right. The columns go from top to bottom. They have a letter at the top and bottom. Every place on the map can be located in a row and column.*

3. Ask for a volunteer to find where column B, row 2 (B2) is on the map. Ask: *What cities, towns, or other features are located in B2?*
4. Ask for a volunteer to find where D5 is on the map. Ask: *What cities, towns, or other features are located in D5?*
5. Hand out cards with the grid locations printed—one per student. Ask students to stand on the location printed on their card.

ACTIVITY 2a: Simple Game

1. Have students create "find the spot" cards by writing down the grid coordinates of several places on the map. (Make sure students find their grid locations first and then come back to their desks or a table to write them on their cards. Don't let students take writing instruments onto the map. Rather than having students prepare the location cards, you may wish to prepare these cards with city names ahead of time in order to save time and avoid possible duplication of locations.)
2. Put the cards into a basket.
3. Have each student pull a card from the basket and walk to that location on the map.
4. Have students find the approximate distance from their location to the state capital using the mileage scale on the map.

OR

ACTIVITY 2b: Grid Relay

1. Give each student four index cards. Have students—while standing off the map—write down one city and its grid location on each card. (Remember not to allow writing utensils on the map. Rather than having students prepare the location cards, you may wish to prepare these cards with city names ahead of time in order to save time and avoid possible duplication of locations.)
2. Collect the cards and put them into a basket.
3. Divide the class into four teams: red, blue, green, and yellow. Have each team line up on the corresponding colored dot ("Base Camp") located on the map corners. Give each team a stack of sticky notes—a different color for each team.
4. Have one person from each team pull a card from the basket, in turns by team—without looking at the card—and place the card into a provided envelope. Repeat this until all the cards are gone.
5. Have the first person from each team pull a card from the envelope, read the card, take a colored sticky note from the stack, locate on the map the spot (grid location) that is written on the card, and place a sticky note there. Then, that student returns to the Base Camp and tags the next student. (Teammates can help, but only from the yellow border near their Base Camp!)
6. The tagged team member should pull another card from the envelope, take a sticky note, and set off to find their location—leaving the sticky note on the map and returning to Base Camp to tag the next player.
7. Continue the "relay" until all of the cards are gone and a trail of sticky notes shows the "journey" each team took. As each team finishes finding their locations and placing their sticky notes, the entire team sits down at Base Camp. This helps identify which teams finish first, second, third, and fourth.
8. Add another element by having students find the distance from their final location to the state capital, the highest point in the state, or another location. OR have them measure the distance of their entire "journey" around the map.

Tips

- Prior to beginning these activities, practice using grids by mapping a grid in the classroom and placing bean bags or other soft toys in each grid.
- Show students how to measure distances that are not straight lines by curling the string along the feature.
- Point out the scale bar in each corner of the map. Split the class in small groups and have them examine a scale in each corner.

Standards

National Geography Standard

Geography Standard 1: How to use maps and other geographic representations, geospatial technologies, and spatial thinking to understand and communicate information (4th grade).

Common Core State Standards: Math

Grade 4 » Measurement & Data
CCSS.MATH.CONTENT.4.MD.A.2: Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.

NCTM Principles and Standards for School Mathematics

Algebra (3-5) Standard 3: Use mathematical models to represent and understand quantitative relationships.

NCTM Principles and Standards for School Mathematics

Geometry (3-5) Standard 2: Specify locations and describe spatial relationships using coordinate geometry and other representational systems.

Next Generation Science Standards

Crosscutting Concept 3: Scale, proportion, and quantity.

VOCABULARY

Map grid: horizontal and vertical lines used to locate objects in relation to one another on a map

LESSON 3

PHYSICAL FEATURES SCAVENGER HUNT

Guiding Questions:

What are the different parts of a map?
What is the purpose of each of the parts of a map?
What are the physical features of your state?

EDUCATOR BACKGROUND INFORMATION

The Two Perspectives in Geography
Every discipline looks at the world from a particular point of view, or perspective. For example, a historical perspective emphasizes change over time, and an economic perspective focuses on how people produce and exchange goods and services. As an integrative discipline, geography combines the physical and human realms. Geography is a way of looking at and thinking about the world, using both spatial and ecological perspectives.

Physical Systems: Physical processes shape Earth's surface and interact with plant and animal life in such a way as to create, sustain, and modify ecosystems. Physical processes include aspects of climate and weather, plant and animal life, the water cycle, soil formation, landform development, and natural resources. Knowing about these processes is essential to answering questions about why things are located in particular places, distributed in particular patterns, or have the characteristics they do. For example, how can we plan for disaster relief if we do not understand the locations and processes of potential natural hazards?

Ecological Perspective: Both living and nonliving elements on Earth interact in complex webs of ecological relationships. Humans are one among many species that constitute the living Earth. Human actions modify physical environments and affect the viability of ecosystems on both local and global scales. People who regularly inquire about connections and relationships among life forms, ecosystems, and human societies possess an ecological perspective.

PHYSICAL FEATURES SCAVENGER HUNT

RECOMMENDED GRADES: 3, 4

TIME NEEDED: 45 MINUTES

Objectives

- Students will use map keys to locate features on your state map
- Students will name physical features found in your state

Materials

(written for class of 30 students; adjust accordingly; note that all materials are provided):

- Large poster size Physical Features Scavenger Hunt Card (4)
- Small size Physical Features Scavenger Hunt Card (5) 1 provided for each group and then 1 for teacher. Consider making copies so that each student has their own.
- Bingo chips
- Sticky notes (color-coded to match colors on map corner "base camps")
- Colored lanyards

Preparation

None

Rules

Have students remove shoes before walking on the map.

No writing utensils. on the map.

DIRECTIONS

In this activity, students complete a scavenger hunt to find physical features located in your state.

ACTIVITY - Part 1: Map key

1. Have students walk around the map and locate features such as rivers, lakes, national parks, mountains, marshes, and state borders.
2. Point out the map key that goes along with the map.
3. Hold up the map key and have volunteers read aloud the names of each of the items on the key. Explain that the images seen on the key represent features that are found in your state.

4. Tell students that some states have features that are not found on your state map. Some states have lava fields, some have Indian reservations, and others have international boundaries.
5. Give students time to wander around your state map and ask them to locate some of the features found on the key.
6. Tell students to ask questions about any features they are not sure of.

ACTIVITY - Part 2: Physical features scavenger hunt

1. Arrange students in 4 groups and pass out the colored lanyards so that all students in a group are wearing the same color lanyard. Have the students in each group number off—they will be taking turns finding the physical features on the giant map. (Some students may need to pair up, depending on class size.) Give each student a small Physical Features Scavenger Hunt Card. Give each group a stack of sticky notes of one color, 20 bingo chips, and a poster size copy of the scavenger hunt card. Explain that the small cards are for them to use as they walk on the map and the large cards are to be put on the side of the map in a place that is easily accessible.
2. Tell students that they are going to go on a scavenger hunt to find some of the features on your state map. Explain that they will be placing sticky notes (make sure they match their lanyard colors) on the giant map and bingo chips on their large scavenger hunt card. Tell students that not all of the features on their cards will be found on your state map. Tell students that they will be walking over the map searching for one feature from their scavenger hunt card and that once they find that feature they should place a sticky note on that location on the map. After they place their sticky note they must return to the team card and place a bingo chip on the same feature on their large card.
3. Tell students that if they are unable to find a feature on the map, or the feature they are looking for is not on the map, they must place 2 bingo chips in the "not on map" box on their large card.
4. When all students have finished, review the features the students were able to find and those they were not able to find. If some groups are unable to find some features that are on the map, show them where they are, or have other students point out the features.

EXTENDING THE LEARNING

- Discuss why some features are not found in your state (for example, lava does not exist in most states). Ask students which states might have some of those features.

Modifications

- Have students find as many examples of features as they can, placing a bingo chip on their team card for each example they find on the map. Students can compete to see which group is able to find the largest number of examples.
- Have students compete in a relay to see which team can complete this activity the fastest.

Standards

National Geography Standard

Geography Standard 1: How to use maps and other geographic representations, geospatial technologies, and spatial thinking to understand and communicate information (4th grade).

The College, Career & Civic Life (C3) Framework for Social Studies State Standards

Geographic Representations: Spatial Views of the World: D2.Geo.3.3-5
Use maps of different scales to describe the locations of cultural and environmental characteristics.

VOCABULARY:

Physical features: Naturally occurring geographic characteristics

Map key: An explanation of symbols and abbreviations used on a map, also known as a legend

LESSON 4

CARDINAL DIRECTIONS

Guiding Questions:

How do you orient yourself on a map?

EDUCATOR BACKGROUND INFORMATION

To know where places are in relation to one another, people use a system for telling direction. Cardinal directions are one set of directions that people around the world use. The four cardinal directions are north, south, east and west. These directions use the rising and setting of the sun as reference points. Because the Earth rotates from west to east, the sun appears to rise in the east and set in the west. The Poles, North and South, also provide directional reference points.

RECOMMENDED GRADES: 3, 4

TIME NEEDED: 45 MINUTES

Objectives

- Students will understand cardinal directions: north, south, east, and west; be able to orient themselves to each one on the map
- Students will use cardinal directions to locate places within their state

Materials

- Cardinal Direction Clues (see instructions in Preparation below)
- Cones
- Copy of Compass Rose (provided)
- Lanyards (4 colors to correspond to the 4 colors of the corner Base Camps)

Preparation

- Place the Compass Rose copy in the appropriate place/direction on your State Giant Map (do not tape the sheet to the map). You may wish to use the image on your state's tabletop map, located at http://education.nationalgeographic.org/topics/state-mapmaker-kits/ to determine how best to place the Compass Rose.
- Create 32 Cardinal Directions Clues for the game. Use index cards or other similar paper for these clue cards. In advance of the activity, select 32 locations on the giant map and put the name of one on each of the 32 clue cards.
- Divide the Cardinal Directions Clues into four stacks—one clue per player—and place the stacks face down next to the each of the Base Camps (colored circles in the corners of the map).

Rules

Have students remove shoes before walking on the map.

No writing utensils. on the map.

DIRECTIONS

Students learn the cardinal directions and play a fun relay game! "Navigators" give directional clues to "Explorers" to help them find locations on your state map. The winning team is the first to correctly mark each of its locations with a cone.

ACTIVITY

1. Introduce or review cardinal directions with students. Tell students that these are the four principal directions—north, south, east, and west—on the compass rose you have placed on the map.
2. Have the entire class spread out on the map. Lead them in taking two steps north, then two steps south, east, or west as you command and lead.
3. Divide the class into four teams—red, yellow, green, and blue—and instruct each team to line up along the yellow border behind their "Base Camp" (the colored circles in the corners of the map). Give each team their colored lanyards—all members of a team should have lanyards of the same color. As the game is a relay race, each team should have the same number of players. If a team is short a player, one player on that team will play twice. The first student in line is the first Navigator. The second student in line is the first Explorer. (Roles will rotate during game play.)
4. When the game begins, each Base Camp's Navigator must draw one Cardinal Directions Clue from the stack you have placed on the Base Camp. Give the Navigator time to find the location on the map—silently and without going onto the map (or the Navigator will give away the location!). The Navigator may not show the card to the Explorer. Using only cardinal directions and the team color, the Navigator must guide the Explorer to the location indicated on the card. The Explorer may only take one step per instruction. For example, Yellow Team draws "Denver." The Navigator calls out, "Yellow, north." The Explorer takes one step north. The Navigator calls "Yellow, east," and the Explorer takes one step east.
5. The Navigator continues to direct the Explorer one step at a time until he or she steps on the Denver location. The Navigator then confirms that he has successfully directed the Explorer by calling out, "Have you reached Denver?" The Explorer responds, "Yes, I have reached Denver!" The Explorer places his or her cone on the location and returns to Base Camp.
6. When the Explorer returns to Base Camp, he or she tags the Navigator and rejoins his or her teammates at the end of the line on the yellow border. When tagged, the Navigator steps onto the team's circle and becomes the Explorer. The next team member in line on the yellow border steps forward to become the Navigator.
7. Explorers may not touch each other while on the map. Explorers who touch each other must return to their Base Camp and begin again. The teacher referees the activity on the map.
8. Each player has an opportunity to be a Navigator and an Explorer. The winning team is the first to correctly mark each of its locations with a cone and return to Base Camp.

Tips

This game may be a little more difficult for the Yellow and Blue Teams, as their Base Camps are at the north end of the map. It may help to advise Explorers on these teams to face north before they begin taking steps, so that their orientation—north is forward, south is backward—is the same as that of the Green and Red Teams.

Standards

National Geography Standard

Geography Standard 1: How to use maps and other geographic representations, geospatial technologies, and spatial thinking to understand and communicate information (4th grade).

NCTM Principles and Standards for School Mathematics

Algebra (3-5) Standard 2: Specify locations and describe spatial relationships using coordinate geometry and other representational systems.

National Social Studies Standard

People, Places, and Environments (Early grades): Learners will understand concepts such as: location, direction, distance, and scale.

VOCABULARY

Cardinal directions: One of the four main points of a compass: north, east, south, west

Compass rose: Symbol indicating the cardinal directions (N, S, E, W)

LESSON 5

MAP SCALE AND MEASURING DISTANCE

Guiding Questions:

How do we know the size of or distance between locations?
How do we determine how far apart locations are from one another?

EDUCATOR BACKGROUND INFORMATION

Scale
Geographers study things at local scales (for example, microclimates of cities) and at global scales (for example, changes in world climate). As one well-known geographer has said, "Awareness of scale is of great importance, for in geographic work, concepts, relationships, and understandings that are found to have meaning at one scale may not be applicable when the same problem is examined at another scale." (Jerome Fellmann)

RECOMMENDED GRADES: 3, 4

TIME NEEDED: 45 MINUTES

Objectives

- Students will use two maps with different scales to compare equal distances
- Students will use a scale bar to measure features found in their state

Materials

- Map Measurement Table (one per student)
- State one-page maps (one per student or small group; see Preparation below)
- String (provided) – *or* use another way (feet, hands, objects) to measure distance on the map

Preparation

- Print copies of the one-page map of your state for each student. Access the one-page maps at http://education.nationalgeographic.org/mapping/outline-map?map=USA and select your state from the STATE dropdown menu. To print, click Download This Map in the lower right corner of the map box, download, and print.
- Print copies of the Map Measurement Table (last page in this lesson).
- Select and write down several locations (towns, cities, features) that are included on both the one-page map and the Giant State Map. You will use this in the activity below. You may want to write the names of these locations on flip chart or poster paper so that everyone will be able to see them when you do the activity.

Rules

Have students remove shoes before walking on the map.

No writing utensils. on the map.

DIRECTIONS

ACTIVITY - Part 1: Maps of different sizes

1. Give each student a copy of the state one-page map. Ask students if they have seen other maps of your state. (Students might say they have seen the state map in an atlas or as a foldable road map.)
2. Point out the scale bars on the one-page map. Explain: *Scales help you determine actual land distances for places that have been reduced to fit on a smaller area.* Demonstrate how the scale bars work. Tell students that they are going to use scale to help them determine actual distances of features in their state. Explain that the scale bar includes both miles and kilometers and that 1 mile is 1.6 times larger than 1 kilometer.
3. Ask students to find one of the locations you preselected on their one-page maps. Then have them find another of your preselected locations on their maps. Ask students to use a measurement tool (ex.-pieces of paper, rulers, fingers) and the map scale to determine the distance between these two points. Depending on your students' familiarity with map scale, you may need to demonstrate how to do this for the first set of locations. After you and the students have found the distance, repeat for several other sets of locations.
4. Now, introduce students to the State Giant Map. Point out that this map is both the same as and different from the one-page maps in several ways. Have students spend some time walking around the giant map, comparing it to the one-page map. Then ask:

    - *In what ways are the maps the same?* (Students might say that the state has the same shape and many of the same features, including some of the same towns and cities.)
    - *In what ways are the maps different?* (Students might say that one map has more towns and cities than the other. They might also realize that one map has certain features, such as a state park, that the other doesn't have. Ask for as many examples as you have time for.) Tell students that different maps show things differently for many reasons, including the size of the map or the purpose of the map.

5. Point out the map scale bars on the giant map. Ask students how this scale is different from the scale bars on the one-page map. Tell students that, although the scales are different, they will measure distances the same—they will find this out soon!
6. Tell students they will be working together to prove that the distances between points on the giant map are the same as the distances between those points on the small map. Remind them that they used tools to measure distances on the small map and ask them what sorts of tools they think they will need to use on the giant map. Let them know that they won't be able to use regular measuring tools like yardsticks or tape measures in this activity, and that they can't have utensils of any kind (such as pencils) on the giant map. Provide long pieces of string as one possible tool for this activity, but encourage students to use non-traditional measurement methods such as feet or hands.
7. Have students form small groups and have the groups take turns finding the pairs of the locations they worked with in step 3 above—this time on the giant map. Have them use the map scale on the giant map to measure the distances. When the groups have finished their measurements, ask: *How do these distances on this map compare with the distances you measured on the one-page map? Are they the same? Are they different?*

ACTIVITY - Part 2: Extending the Learning

1. Have students work in pairs or small groups to measure and record on the Map Measurement Table various distances on the map. (Use these or modify to add your own.)
    - Distance from their current location to the state capital
    - Distance of any river
    - Length of border to the east
    - Length of border to the south
    - Length of border to the west
    - Length of border to the north
2. (Remind students that because they are not allowed to use writing utensils on the map, they must complete their tables off the map.)
3. Have one group of students take a journey through your state. Tell them to write down the cities they would pass. Explain that they will need to lay down their piece of string to outline this journey. Once their string is in place, have the students determine the distance they would travel. As an extension, tell students to calculate the time it would take to complete their journey if they were traveling at 60 miles per hour for the entire trip. Another option would be to have students follow the course of a river that flows through your state, measuring the distance using string to outline the course.

Tips

- Show students how to measure distances that are not straight lines by curling the string along the feature.
- Point out the scale bar in each corner of the giant map. Break the class into small groups and have them examine a scale in each corner.
- Have students work individually or in small groups, depending on time available and the size of the class.

Modifications

- For small group work or another example of scale, use the State Tabletop Map for your state. Find yours at http://education.nationalgeographic.org/topics/state-mapmaker-kits/.
- Have students also record in centimeters or inches the distances they measured.
- Have students decide on other distances to measure.
- Have students create a circle around your city or town by giving them a particular distance as their radius and having them use the scale bar to measure this in all directions.

Standards

National Geography Standard

Geography Standard 1: How to use maps and other geographic representations, geospatial technologies, and spatial thinking to understand and communicate information (4th grade).

Common Core State Standards: Math

Grade 4 » Measurement & Data
CCSS.MATH.CONTENT.4.MD.A.2: Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.

NCTM Principles and Standards for School Mathematics

Algebra (3-5) Standard 3: Use mathematical models to represent and understand quantitative relationships.
Geometry (3-5) Standard 2: Specify locations and describe spatial relationships using coordinate geometry and other representational systems.

Next Generation Science Standards

Crosscutting Concept 3: Scale, proportion, and quantity.

National Social Studies Standard

People, Places, and Environments (Early grades): Learners will understand concepts such as: location, direction, distance, and scale.

The College, Career & Civic Life (C3) Framework for Social Studies State Standards

Geographic Representations: Spatial Views of the World: D2.Geo.3.3-5
Use maps of different scales to describe the locations of cultural and environmental characteristics.

VOCABULARY

Map scale: relationship between distance on a map and distance on the ground.

Measurement: process of determining length, width, mass (weight), volume, distance or some other quality or size.

MAP MEASUREMENT TABLE

Feature	Distance (miles)	Distance (kilometers)
Distance from your current location to the state capital		
Distance of any river		
Length of north state border		
Length of south state border		
Length of east state border		
Length of west state border		

LESSON 6

INTRODUCTION TO GIS

Guiding Question:

How do mapmakers display multiple pieces of information on a map?

EDUCATOR BACKGROUND INFORMATION

All maps consist of layers of information (data) to provide the map reader with important details and make using the map easier. In the past, cartographers—the people who make maps—decided what went on a map. Today, we can all do this through GIS, which stands for Geographic Information Systems. The S/system of GIS allows us to store and manipulate data we want to put on a map. This lesson is designed to introduce the concepts and vocabulary associated with GIS.

Patterns
Geographers seek patterns in distributions of things across space and time. Using geographic tools and skills, they investigate at a variety of scales to observe patterns, from the most local to the most global. They also discern reasons for a lack of patterns.

Systems
It is convenient to think of complex interlocking relationships as systems. Systems are collections of things that influence one another and appear to form a unified whole. The water cycle is a system, and the connections between and among cities form a system. Conceptualizing a collection of things as a system reveals how the elements are essential, how the elements interact, and how the system as a whole relates to other systems, both human and physical. Systems occur at a variety of geographic scales and are used to organize and model complex associations: Thinking in terms of systems is useful in studying the connection between humans and the environment and in thinking about interacting physical systems (ecosystems).

RECOMMENDED GRADES: 3, 4

TIME NEEDED: 45 MINUTES

Objectives

- Students will develop a simple definition of Geographic Information System (GIS)
- Students will understand how information from GIS is used in maps
- Students will discover how GIS is used in daily life

Materials

- Colored chain
- Map layer "transparencies" (provided)

Preparation

None

Rules

Have students remove shoes before walking on the map.

No writing utensils. on the map.

DIRECTIONS

ACTIVITY 1

1. Have students gather around a table (not on the map) and position the first transparent layer so that all can see it. Tell students that this is a simple map of an imaginary neighborhood with only one feature. Ask students what they see on the layer (roads). Then ask them what they would like to know more about what they see on this very simple layer.
2. Next, place the second layer on top of the first. This layer shows some public park areas. Ask:

    - *Why would you want to include this information on a map?*
    - *What else would you want to include on a map of this neighborhood?*

3. Add the third layer—more roads, buildings, and a small bridge over the Public Garden pond. Again, ask students what they see and why this information is important to know about this neighborhood.
4. Let students know that mapmakers often get the information they need to add important features to maps by using Geographic Information Systems – commonly called GIS. GIS might be thought of as a filing cabinet of information (data) that map makers can add to a map. Ask students to think about the layers (transparencies) you just added to the community:

    - *Did you learn more about the community with more layers? What sorts of information did you learn?*
    - *Could a map have too many layers—too much information? Why or why not?*

5. Identify ways GIS helps us in our everyday lives. Explain to students that many different industries use GIS. For example, GIS is used to help plan efficient routes for medical emergency vehicles to travel between emergency sites and medical care facilities such as hospitals. Businesses use GIS to decide where to build new stores, how to plan the best delivery routes, and where to open new restaurants—looking at where people live, where traffic patterns will be likely to bring customers, or where needed services might be, for example. And towns and cities use GIS to decide on transportation routes and where to build parks and schools.

ACTIVITY 2

1. Tell students that they are going to do an activity on the Giant State Map that will help them understand how GIS works.
2. Ask each student or pair of students to stand on a location they would like to visit. (It's OK if several students pick the same location.) Tell students that when they stand on a place they want to visit, they are creating points. Points show specific locations on a map and a set of points is another layer on a map.
3. Ask:

    - *What are some other points you could have created on this map?* (Students might say a national park, the state capital, the highest point in the state, etc.)
    - *On a map of a city or town, what other points might you create?* (The important idea here is for students to realize that places like a school, grocery story, or other building is a point on a map.)

4. Have one group of students use the plastic chain to create a line on the state map. You might suggest that they create a line that connects your town to the state capital or a national park.
5. Then, have another group of students create a line that follows a river on the map, again using the colored chain. Tell students that when they used the chain to follow the river, they created a line. Ask: *What are some other lines you could have created?* (Possible responses: roads, trails.) Tell students that lines are used in GIS to connect locations, boundaries, contours, and other features on the map. Often, lines connect points. Remind students that this is another type of layer—another set of information that adds details to the map. Ask students what other layers of points or lines might be made on a map.
6. Working together, the class has now simulated a simple, low-tech GIS!

ACTIVITY 3: Off the Map

1. Have students—individually or in small groups—create a simple map of your classroom. Ask them to begin by drawing the room boundaries—the outside walls of the room, locating any windows and doors.
2. Ask students what information they think should be added to the map—what layer(s) they should add. (Students might suggest adding the rows in between desks, the desks themselves, tables, bookcases, etc.) Have students add one or two additional layers of information—of their choice—to their maps.
3. Have students stand and share their maps with the rest of the class.

EXTENDING THE LEARNING

- Clarify the difference between GIS and GPS (Global Positioning System). This might be necessary to make sure students don't confuse the two terms during this activity. Tell students that GIS isn't the same as GPS. Ask students if they have ever heard of the term GPS. And ask: *When have you used GPS?* Encourage students to share descriptions of using car-mounted GPS devices, GPS on a smartphone for driving directions, or any other hand-held GPS devices. Explain that GPS technology uses satellites to pinpoint position on Earth with the aid of a GPS device or unit. This technology has become a part of many people's daily lives. Then ask: *Have you ever used a smartphone app that allowed you to use maps to explore information?* Invite volunteers to share the names and details of relevant apps. Explain to students that many apps today include GPS technology, as well as elements of a GIS, which they'll learn about in this activity. (See the vocabulary entries below and the links to more information about GIS and GPS.)

Standards

National Geography Standard

Geography Standard 1: How to use maps and other geographic representations, geospatial technologies, and spatial thinking to understand and communicate information (4th grade).

ISTE Standards for Students

Standard 6: Technology Operations and Concepts

The College, Career & Civic Life (C3) Framework for Social Studies State Standards

Geographic Representations: Spatial Views of the World: D2.Geo.3.3-5
Use maps of different scales to describe the locations of cultural and environmental characteristics.

VOCABULARY

Geographic Information Systems (GIS): A geographic information systems or geographical information system (GIS). See an encyclopedia entry on GIS at http://education.nationalgeographic.org/encyclopedia/geographic-information-system-gis/

Global Positioning System (GPS): System of satellites and receiving devices used to determine the location of something on Earth. See encyclopedic entry on GPS at http://education.nationalgeographic.org/encyclopedia/gps/.

Contours: A contour line (often just called a "contour") joins points of equal elevation (height) above a given level, such as mean sea level.