INTRODUCING SPATIAL THINKING SKILLS ACROSS THE CURRICULUM

Spatial Thinking Skills are an important set of competencies for examining the world around us. These skills enable the geographer to visualize and analyze spatial relationships between objects, such as location, distance, direction, shape, and pattern. Any issue or event can be viewed spatially: the spread of disease, earthquake activity, trade, immigration, and so forth. Geography's unique spatial perspective makes it an ideal starting point for interdisciplinary instruction. If we want to foster problem-solving and analytical skills in our classrooms, then we must infuse our curricula with content and activities that support the development of Spatial Thinking Skills. Eight fundamental Spatial Thinking Skills are listed below.

SKILL	DEFINITION	EXAMPLE
COMPARISON	Comparing one place with another…	e.g., rainfall, income, satellite images, maps, graphs
AURA	Describing the influence that a place can have on neighboring locations...	e.g., smoke from a factory, noise from a highway, property value near a park
REGION	Drawing a line around all places that have similar characteristics or are linked together in some way...	e.g., Corn Belt, Ozark Highlands, Polish neighborhood, Tornado Alley
TRANSITION	Describing what happens between two places with known conditions...	e.g., Do features change gradually or abruptly from one place to another?
ANALOGY	Finding places on other continents (or in other cities, mountains, etc.) that have similar positions and therefore have similar conditions...	e.g., Mediterranean climate, subduction zones, inner ring suburbs
HIERARCHY	Identifying a spatial hierarchy, or how 'nested' features relate to one another...	e.g., river networks, distribution hierarchies, political hierarchies (town, county, state, country)
PATTERN	Describing the arrangement of features or conditions in an area...	e.g., evenly or unevenly spaced, clusters, donuts, strings
ASSOCIATION	Identifying the extent to which features have the same map pattern...	e.g., malls and freeway exits, malaria and anopheles mosquitoes

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Spatial Thinking - Science

DRAWING ISOLINES

Lesson Overview:

Isolines are used to map data ranging from barometric pressure to population density. The pattern of isolines reveals whether the "transition" from one location to another is abrupt or gradual. The ability to create and interpret isoline maps is an essential skill for understanding transitions over space. In this lesson, students will use recorded rainfall data to create and interpret an isoline map of annual precipitation patterns in Africa.

Objectives:

* Students will plot isolines of annual precipitation in Africa using recorded precipitation point data.
* Students will explain the effect of data intervals and color schemes on the interpretation of isoline maps.
* Students will use an isoline map to identify areas of abrupt and gradual change in patterns of annual precipitation within Africa.

Geography Standard 1: Use maps and other geographic representations, tools, and technologies to acquire, process, and report information from a spatial perspective.

Science Standard A, Science as Inquiry: Use appropriate tools and techniques to gather, analyze, and interpret data.

Materials:

* Student Worksheet AFRICA: Annual Precipitation
* Transparency of Worksheet
* Graphite pencils and assorted colored pencils

Key Terms:

Isoline: A line connecting points of equal value (e.g., temperature, elevation)

Interpolation: Estimating a data point between two known points (values)

Getting Started:

Show students three maps which employ isolines such as a topographic map, a population density map, and a weather map. You can find online examples by searching the Internet for "isolines," "isobars," or "isotherms." Challenge students to identify the common strategy that all three maps use to display data (isolines). Explain that isoline maps use lines or bands of color to enable people to visualize patterns of data that would, otherwise, be impossible to see. Review these basic "rules" of isolines:

* Isolines connect points of equal value
* Isolines are gentle sloping lines (no sharp angles)
* Isolines are always closed curves even though the map might only show part of it
* Isolines never cross (this would mean one point had two different values, e.g., two different temperatures)
* Isolines have a parallel trend.

Explain that in today's lesson they will create and interpret an isoline map of yearly rainfall in Africa.

Using the Student Worksheet:

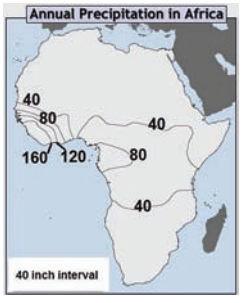
Distribute a worksheet to each student and display a transparency of the worksheet in front of the class. Explain that students will use data on the worksheet to create isolines reflecting annual patterns of rainfall in Africa. Review the map and worksheet instructions. Students will create isolines for 40, 80, 120, and 160 inches of rainfall.

On the transparency, model the process of plotting points for the 40 inch isoline. Do this by interpolation—create a set of dots located between data points above and below 40 inches of annual rainfall. Start at the point between 2 inches and 52 inches near the west coast of southern Africa. Place a dot (closer to 52 than to 2) to estimate the 40 inch point. Then place a second dot between the 18 and 41 inch points (just below the 41). Continue in this way across the continent and connect the dots to complete the isoline. Remind students that isolines are continuous curves, so the line must extend to both coastlines. Give students time to complete the remaining isolines and color their maps. Finished maps will look like the one at the end of this lesson. **Note:** The 120 inch isoline must be interpolated from the 80 inch isoline.

Wrapping Up:

Discuss the following questions:

* Which regions of Africa have the most, least annual rainfall?
  Most: southern West Africa and Central Africa
  Least: northern and southern Africa
* Do you think 40" is an appropriate interval for answering the previous question? Why or Why not?
  Answers will vary. Smaller intervals reveal more detail about data patterns. In this case, a smaller interval would reveal more information about the large 0—40 inch zones. The map maker must decide how much detail is appropriate.
* How would you describe the "transition" from areas of low to high annual rainfall in different parts of Africa?
  Isolines which are close together reflect a steep gradient or transition. Therefore the area with the steepest transition gradient is southern West Africa.
* How did you decide the color scheme for your map?
  Answers will vary. A good color scheme communicates information clearly without introducing distractions.

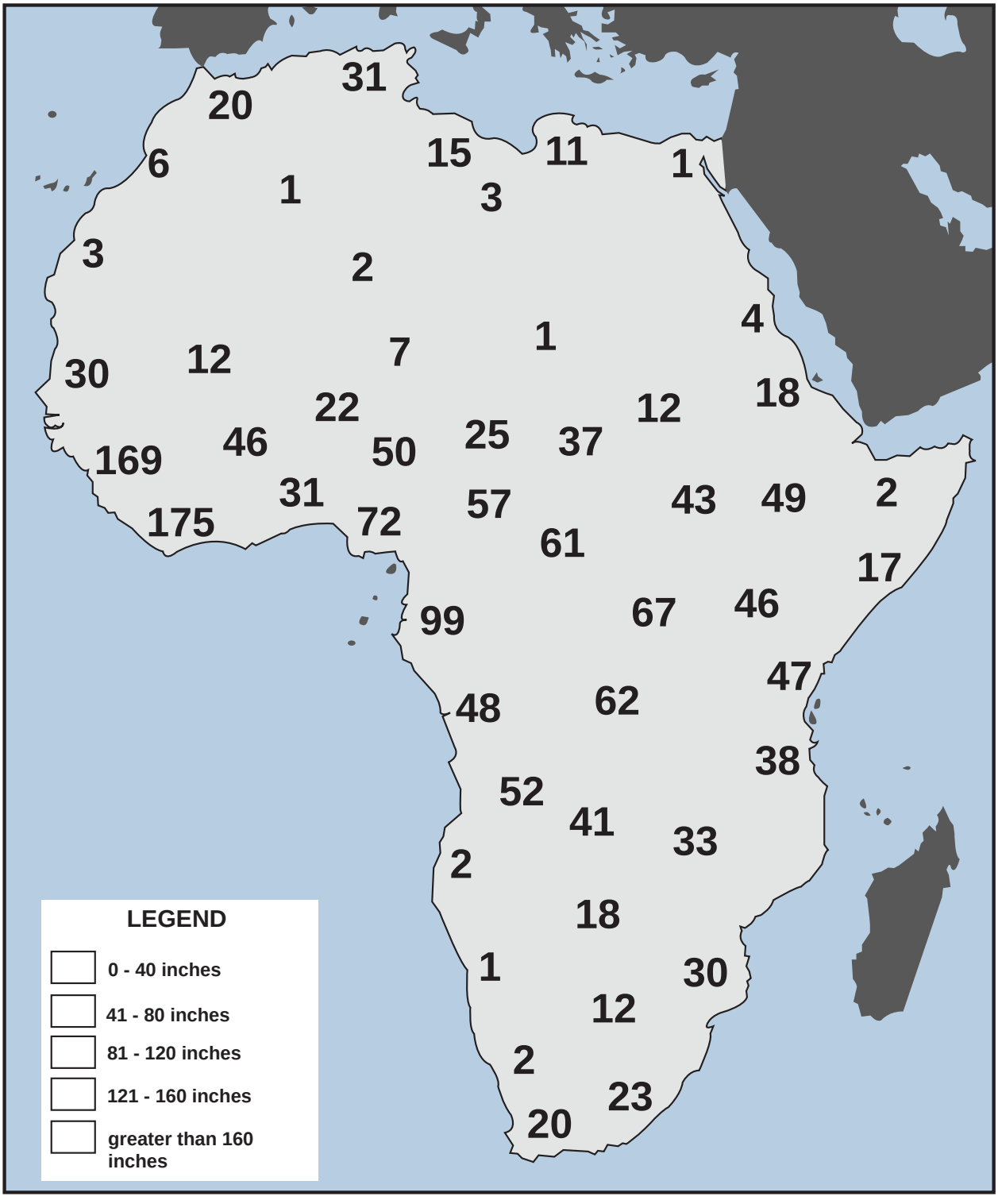


Extensions:

* Use elevation, temperature, or bathymetric data to create more isoline maps
* Ask students to find other examples of isoline maps

Name_____

AFRICA: ANNUAL PRECIPITATION



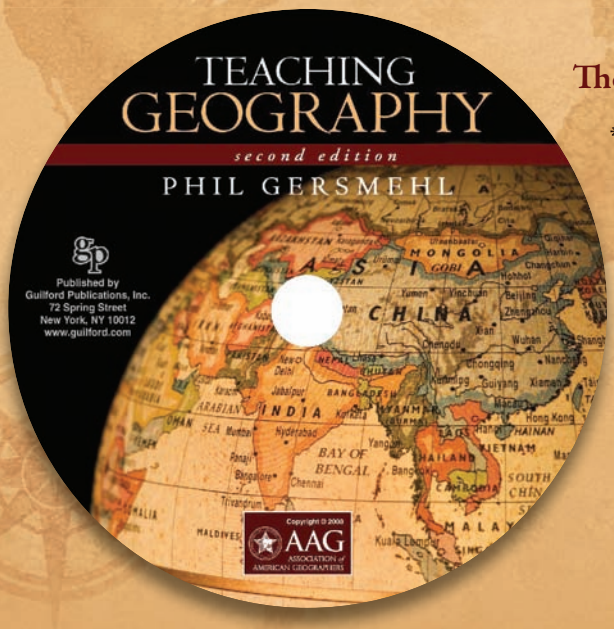
Each number on this map represents the recorded yearly precipitation at that point.

Directions:

- Calculate and draw precipitation isolines on this map using an interval of 40 inches.
- Complete the map legend and color your map.

FOSTERING SPATIAL THINKING SKILLS IN THE CLASSROOM

The *Teaching Geography* CD-ROM can help you design lessons and activities that promote spatial thinking. This interactive CD accompanies Phil Gersmehl's *Teaching Geography*, but it is a fully independent, stand alone resource as well. It includes lessons that are cross referenced by World Regions, Maps and Tools, and Spatial Thinking categories. The CD's lessons introduce, explain, and demonstrate each of the aspects of spatial thinking: comparison, aura, region, transition, analogy, hierarchy, pattern, and association. The CD also introduces three related skills for spatio-temporal thinking: change, movement, and diffusion.



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Teaching Geography CD-ROM	$ 25.00
Teaching Geography CD-ROM, Lab pack (10 copies)	$200.00

This product was developed in partnership with the National Council for Geographic Education (NCGE) with funding from the FIPSE program in the U.S. Department of Education. For more information about the CD and related resources, visit the AAG's Teacher's Guide to Modern Geography website at www.aag.org/tgmg.