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.

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**Isoline Maps**

**SAMPLE LESSON PLAN**

**CURRICULUM AREA**

Geography, Science

**SPATIAL THINKING SKILL**

Transition

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**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

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**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 representing annual patterns of rainfall in Africa. Review the map and worksheet instructions. Students will create isolines for 0, 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 40 inches north of 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. 

**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

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**AFRICA: ANNUAL PRECIPITATION**

**LEGEND**

<table>
<thead>
<tr>
<th>Interval</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 40 inches</td>
<td>0</td>
</tr>
<tr>
<td>41 - 80 inches</td>
<td>1</td>
</tr>
<tr>
<td>81 - 120 inches</td>
<td>2</td>
</tr>
<tr>
<td>121 - 160 inches</td>
<td>3</td>
</tr>
<tr>
<td>greater than 160 inches</td>
<td>4</td>
</tr>
</tbody>
</table>

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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.
**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.

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**Materials:**
* Student Worksheet
* Transparency of Worksheet
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**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:

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- 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.

**Key Terms:**
* Isoline: A line connecting points of equal value (e.g., temperature, elevation)
* Interpolation: Estimating a data point between two known points (values)

**Isoline Maps**

**Isolines have a parallel trend.**

**Isolines never cross (this would mean one point had two different values, e.g., two different temperatures).**

**Isolines are always closed curves, so the line must extend to both coastlines.**

**Isolines which are close together reflect a steep gradient or transition. Therefore the area with the steepest transition is Southern West Africa.**

**Isolines which are far apart reflect a gradual transition.**

**Isolines are used to map data ranging from barometric pressure to population density.**

**Isolines are gentle sloping lines (no sharp angles).**

**Isolines connect points of equal value.**

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

**Wrapping Up:**
Discuss the following questions:

* Which regions of Africa have the most, least annual rainfall?
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**Extensions:**
* Use elevation, temperature, or bathymetric data to create more isoline maps
* Ask students to find other examples of isoline maps

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

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