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 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.

The Teaching Geography CD-ROM contains:

* 80 interactive, stand-alone lessons
* Notes and model learning activities for each lesson
* A set of transparency masters
* Multimedia presentations with diagrams, maps, and other graphics
* Suggested "Content Clusters" to create units
* Options for integrating spatial thinking skills in Math…Science…Social Studies

"Whether you're a novice or veteran teacher, the Teaching Geography CD is an amazing collection of exciting units, lessons, and ideas for bringing the language and perspective of geography to your classroom. I use it with both my secondary students and pre-service teachers with great success!"

Rik Katz
Washington Middle School
Seattle, Washington

Skilled thinking is a 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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**EXPLORING RELATIONSHIPS WITH CORRELATION GRAPHS**

**Lesson Overview:**
Correlation graphs, or scatterplots as they are also called, enable us to explore the relationship (“association”) between variables. A positive relationship implies that as one variable increases, the other one does as well. A negative relationship is the opposite: as one variable increases in value, the other one decreases. In this lesson, students will plot the relationship between Income (GNP per Capita) and Life Expectancy to see if there is an “association” between these two variables.

**Objectives:**
* Students will plot GNP per Capita and Life Expectancy data points on a Cartesian coordinate system to create a scatterplot.
* Students will describe and interpret a scatterplot to determine if GNP per Capita and Life Expectancy are “associated.”

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

**Math Standard, Data Analysis and Probability:** Discuss and understand the correspondence between data sets and their graphical representations, especially histograms, stem-and-leaf plots, box plots, and scatterplots.

**Math Standard, Data Analysis and Probability:**

**Materials:**
* Student Worksheet: INCOME & HEALTH: IS THERE A CONNECTION?
* Transparency of worksheet

**Getting Started:**
Tell students that they are going to learn about a strategy for determining the relationship between two variables. Write the words income and health on the board and ask the class to think of ways these two things might be related. For example, income may affect factors that influence health, such as a person’s diet or their ability to pay for health care. On the other hand, poor health may reduce a person’s ability to earn income. Explain that students will use income and health data to investigate whether there is a relationship between these two variables. Distribute the Income & Health worksheet to students.

**Using the Student Worksheet:**
Be sure students understand the definitions of the two variables: GNP per Capita and Life Expectancy. (NOTE: They will use GNP per Capita as a surrogate for personal income, but it is important that they realize these statistics are not synonymous.) Ask students to suggest and write a specific hypothesis about a possible relationship between GNP per Capita and Life Expectancy. For example, places with the highest GNP per Capita will have the lowest Life Expectancy.

Have students create a scatterplot to make it easier to test their hypothesis. Point out that on this graph, the independent variable (GNP per Capita) is on the x-axis and the dependent variable (Life Expectancy) is on the y-axis. Model the process of plotting points on the graph using the data for Northern Africa, then provide time for students to plot the remaining points. The finished scatterplot will look like the one on the right.

**Key Terms:**
GNP per Capita: the dollar value of a country’s final output of goods and services (Gross National Product) in a year, divided by its population. GNP per Capita is used to compare economic standards of living between countries.

Hypothesis: an “educated guess” or thoughtful attempt to explain why things might be related.

Life Expectancy: an estimate of the number of years a newborn will live based on current conditions.

**Wrapping Up:**
Use the questions on the worksheet to discuss the interpretation of the scatterplot. The discussion should include:
* Regions with higher GNP per Capita tend to have higher Life Expectancy than the regions with lower GNP per Capita.
* Among regions with low GNP per Capita, even a small difference in GNP is reflected in a significant difference in Life Expectancy. For the regions with high GNP per Capita, the differences in Life Expectancy are relatively small.
* Southern Africa is an example of an outlier: its Life Expectancy is much lower than that of other regions with similar GNP per Capita. A per Capita rate does not take distribution of wealth into account. In Southern Africa, a small percent of the population controls most of the wealth, while the majority of people do not enjoy the benefits of the region’s overall economic well-being.
* The graph shows that Life Expectancy and GNP per Capita are “positively” related—as one goes up, so does the other. Another way of saying this is that high GNP per Capita is “associated” with high Life Expectancy. This does not necessarily mean that higher income causes good health. This is an important distinction.

**Extensions:**
* Create a scatterplot of GNP per Capita and Infant Mortality to see an example of “negatively” related variables.
* Use a graphing calculator to identify the equation that best suits the data.

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**SAMPLE LESSON PLAN**

**CURRICULUM AREA**
Geography, Math

**SPATIAL THINKING SKILL**
Association

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**INCOME AND HEALTH: IS THERE A CONNECTION?**

Use the numbers in the two columns from the data table to locate points on the graph below.

When you have completed your scatterplot, use it to answer the questions below.

1. What is the general pattern shown on the graph?
2. How does the pattern differ between regions with a GNP Per Capita under $10,000 and a GNP Per Capita of over $20,000?
3. How does Southern Africa differ from other regions? Can you think of a possible explanation?
4. Does this graph prove that high income causes good health? Why or why not?

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**Data Table**

<table>
<thead>
<tr>
<th>Region</th>
<th>GNP per Capita (in dollars)</th>
<th>Life Expectancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern Africa</td>
<td>3680</td>
<td>67</td>
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**Graph**

**Life Expectancy**

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<th>50</th>
</tr>
</thead>
<tbody>
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<td>40</td>
<td>30</td>
<td>20</td>
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</tr>
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**GNP per Capita (1000 $US)**

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<th>50</th>
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<tr>
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**Getting Started:** Tell students that they are going to learn about a strategy for determining the relationship between two variables. Write the words income and health on the board and ask the class to think of ways these two things might be related. For example, income may affect factors that influence health, such as a person's diet or their ability to pay for health care. On the other hand, poor health may reduce a person's ability to earn income. Explain that students will use income and health data to investigate whether there is a relationship between these two variables. Distribute the Income & Health worksheet to students.

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**Key Terms:**
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* Hypothesis: an "educated guess" or thoughtful attempt to explain why things might be related.
* Life Expectancy: an estimate of the number of years a newborn will live based on current conditions.

**Wrapping Up:** Use the questions on the worksheet to discuss the interpretation of the scatterplot. The discussion should include:
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**Extensions:**
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* Use a graphing calculator to identify the equation that best fits the data.

**Correlation Graphs**

**SAMPLE LESSON PLAN**
**Curriculum Area:** Geography, Math
**Spatial Thinking Skill:** Association

**Income and Health:** IS THERE A CONNECTION?

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**Life Expectancy**

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**GNP per Capita (1000 SUS)**

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INTRODUCING SPATIAL THINKING SKILLS ACROSS THE CURRICULUM

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Spatial Thinking - Math

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