Raindrops: Where Does Rain Fall in Arizona?

Students will examine the relationship between elevation and rainfall using maps and a scatter plot.

Overview
Arizona is often characterized as one large desert with little or no rainfall. Rainfall varies in different parts of the state, creating different landscapes and geographical areas.

Purpose
In this lesson students will gain a better understanding of the geographical regions of Arizona through an analysis of rainfall and elevation in a scatter plot.

Materials
- Handout #1: Arizona’s Cities map

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Grade Level
6 and 8

Duration
2 class periods

National Geography Standards
ELEMENT THREE: PHYSICAL SYSTEMS
7. The physical processes that shape the patterns of Earth's surface.

Arizona Geography Strand 4
CONCEPT 1
World in Spatial Terms
GRADE 6 and 8
PO 1 Construct maps, charts and graphs to display geographic information.

CONCEPT 2 Places and Regions
PO 1 Identify common characteristics of contemporary and historical regions on the basis of climate, landforms, ecosystems, and culture.

CONCEPT 3
Physical Systems
Science Strand 6
Concept 2
GRADE 6
Explain the water cycle and factors that affect climate.

Other Arizona Standards
Math Common Core Standards
Statistics and Probability (SP)
6.SP.4. Display numerical data in plots on a number line, including dot plots, histograms, and box plots.
8.SP.1. Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.

Standards for Mathematical Practice
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Objectives
The student will be able to:

1. Locate major geographical areas of Arizona.

2. Locate major cities on a map of Arizona, and describe the general climate of the cities.

3. Create, read, and analyze scatter plots.

4. Explain the correlation between elevation and precipitation in Arizona.

Procedures

Prerequisite Skills: Students should have experience in constructing and reading scatter plots. Use or display Handout #6 - Sample Scatter plots for review of interpreting scatter plots if necessary.

SESSION ONE

1. Ask students to describe the climate of Arizona. Make a list of words students use to describe the climate.

2. Distribute Handout #1 – Arizona’s Cities map. Ask students which cities they have visited. What is the climate like in those cities? How does the climate in those cities differ from our city?

3. Ask students to predict which cities get the least rainfall and which get the most rainfall. Pass out Handout #2 – Annual Average Precipitation and Elevation. Ask students to look at the fourth column, which gives average annual precipitation for each city. Compare students’ predictions with figures on chart.

4. Explain to students that they will be using the elevation and precipitation data to make a graph later in this lesson. Because some of the numbers are not very “friendly”, students will need to round them off for ease of use in making the scatter plot. Elevations should be rounded to the nearest hundred. Ask students to name multiples of 100: 100, 200, 300, etc. All of the numbers should end with one of these multiples.

For the first city, Ajo, 798 is closer to 800 than to 700 and will be rounded to 800. (See Answer Sheet for all rounding.)

5. Students should also round precipitation data to the nearest whole number. One way to explain this is to relate it to money. For example, Casa Grande has a precipitation of 8.45. Ask students if $8.45 is closer to $8.00 or closer to $9.00. The correct answer is 8.

6. Distribute colored pencils or markers. Have students color each city according to the amount of rainfall each gets. They will need five different colors to mark cities with the following amounts of rain:

   - Less than 5 inches
   - 5 – 9 inches
   - 10 – 14 inches
   - 15 – 19 inches
   - More than 20 inches

7. Ask students what conclusions they can draw from looking at the color patterns on the map. (All of the cities with less than 5 inches of rain are along the western border of the state. The only cities with more than 20 inches of rain are in the north central part of the state. Most of the cities receive between 5 and 14 inches of rain per year and most of those cities are in the southern part of the state.) Display Handout #4 -Arizona Landforms map (either as a transparency or as handouts). Ask students to pencil in the three regions on Handout #1 – Arizona Cities. Why do certain areas of the state get more rain than others? (Students should determine that some cities have higher elevations than others. They should notice that the driest places are at low
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elevations, and that the places with the most precipitation are at higher elevations.)

8. Students should verify that there is a relationship between the amount of rainfall in a city and its elevation by making a scatter plot of the two sets of data. Pass out Handout #3 - Graph Template and ask students to begin a scatter plot. The template already has the x and y axes labeled for students. (If students have experience making scatter plots, give them blank graph paper and let them determine the labels and scales for the axes.) The students should begin with the first city, Ajo. Since the elevation is 1800 feet, students should go between 1500 and 2000 on the x-axis, but a little closer to 2000. They should then continue up vertically and plot a point in the middle of 8 and 10 on the y-axis, as the precipitation for Ajo is 9 inches. See sample graph.

9. Students may need to finish the scatter plot for homework.

SESSION TWO

1. Ask students to direct their attention to the scatter plot that they completed for homework. What conclusions can they draw from analyzing the scatter plot? Is there a relationship between the elevation of a city in Arizona and the amount of rain it gets? In other words, do cities with higher elevations get more rainfall, and cities with lower elevations get less rainfall? The students should notice that the points on the graph generally follow a trend from the lower left corner of the graph towards the upper right corner. If students have difficulty seeing this, show them the first two examples of positive correlations in Handout #6.

2. Are there exceptions to the general positive trend in the Arizona scatter plot? Which cities are they? Why don’t they fit the trend? (Students might note the three points on the lower right side of the graph represent Page, St. Johns, and Winslow. These points are farthest from the other points and are all located in the northeast section of Arizona.)

Optional: Handout #6 – Scatter plot Samples give examples of positive and negative correlations. The teacher can use these examples to explain the concept of correlation to students if they are not familiar with it.

3. Again refer to Handout #4 - Arizona Landforms map (either as a transparency or as handouts). How do the shapes and locations of the landforms match their map of rainfall in Arizona cities? Why do Page, Winslow, and St. Johns get relatively little rainfall for their elevations? (These three cities are all located in the plateau region, a series of high plateaus with fairly level surfaces. Even though these cities are much higher than those in the desert region, they do not get significantly more rainfall. Flagstaff is also in this region. However, it is significantly higher than the other cities and close to high peaks, the San Francisco Peaks, which causes it to receive more rain.)

4. Pass out the quiz, Handout #5 – Rainfall and Elevation in Arizona. Students should work individually or in small groups to answer the questions.

Assessment

Students should be evaluated by their scores on the quiz. Questions 1, 3, 5, 7 and 10 can be used to evaluate the math skills. Questions 2, 4, 6, 8 and 9 can be used to evaluate the geography concepts. A score of 80% or more indicates mastery of the objectives.

Extensions

More information on the climate of Arizona can be found at the Western Regional Climate Center’s web site. There are many interesting
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Students may want to read the Climate Narrative of Arizona:
http://www.wrcc.dri.edu/narratives/ARIZONA.htm

They may also be interested in looking at the Climate Extremes by state:
http://www.wrcc.dri.edu/htmlfiles/state.extremes.html

Ideas for this lesson were adapted from Arizona Water Story, An Upper Elementary School Unit of Study. This educational packet can be found in the Central Arizona Project’s web site:
http://www.cap-az.com

Population Estimates For Arizona’s Counties and Incorporated Places, July 1997. (Used for question #10 in quiz.)
http://www.library.arizona.edu/users/kollen/july97az.html

Information and data for Sample Scatter plots were taken from the following sites:
NCTM Illuminations
http://illuminations.nctm.org/lessonplans/9-12/lineardata
Exploring Data
http://exploringdata.cqu.edu.au/sctrplot.htm

Sources
The precipitation data in the chart is from the following page in the Western Regional Climate Center’s web site:
http://www.wrcc.dri.edu/htmlfiles/az/az.ppt.ext.html

The elevation data in the chart was gathered from the Arizona Department of Commerce’s web page on Community Profiles:
http://www.commerce.state.az.us/Communities/community_profile_index.htm

http://www.wrcc.dri.edu/CLIMATEDATA.htm

http://www.wrcc.dri.edu/htmlfiles/az/az.ppt.ext.html

http://www.library.arizona.edu/users/kollen/july97az.html

http://illuminations.nctm.org/lessonplans/9-12/lineardata
http://exploringdata.cqu.edu.au/sctrplot.htm