### National Geography Standards

**ELEMENT FIVE: ENVIRONMENT AND SOCIETY**
16. The changes that occur in the meaning, use, distribution, and importance of resources.

**ELEMENT SIX: THE USES OF GEOGRAPHY**
18. How to apply geography to interpret the present and plan for the future.

### Arizona Geography Strand

**Concept 3: Physical Systems**

- **Grade 6**
- **Science Strand 6 Concept 1** Describe the composition of and interactions between bodies of water and the atmosphere.
- **Science Strand 6 Concept 2** Explain the water cycle and factors that affect climate.

**Grade High School**

**Science Strand 3 Concept 2**

- **PO 3.** Analyze how earth's internal changes (e.g., earthquakes, volcanic activity, folding, faulting) and external changes (e.g., geochemical, water and carbon cycles, erosion, deposition) influence the character of places.

**CONCEPT 5 Environment and Society**

- **Grade 6**
- **PO 3** Explain how changes in the natural environment can increase or diminish its capacity to support human activities.

- **Grade 7**
- **PO 2** Describe the consequences of natural hazards (e.g., Dust Bowl hurricanes, droughts, earthquakes).

### Other Arizona Standards

**Strand 2 World History**

**Concept 9 Contemporary World**

- **Grade 7**
- **PO 3.** Analyze how world events of the late 20th century and early 21st century (e.g., terrorism, globalization, conflicts, interdependence, natural disasters, advancements in science and technology, environmental issues) affected, and continue to affect, the social, political, geographic, and economic climate of the world.

**Grade High School**

- **PO 4.** Examine environmental issues from a global perspective (e.g., pollution, population pressures, global warming, scarcity of resources).

### Mathematics Common Core Standards

**The Number System (NS)**

- **6.NS.C.9.** Convert between expressions for positive rational numbers, including fractions, decimals, and percents.

**Geometry**

- **6.G.A.1.** Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.

- **7.G.B.6.** Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

### Standards for Mathematical Practice

- **6.MP.1.** and **7.MP.1.** Make sense of problems and persevere in solving them.

- **6.MP.2.** and **7.MP.2.** Reason abstractly and quantitatively.

- **6.MP.4.** and **7.MP.4.** Model with mathematics.
Where Did the Lake Go? The Drying Up of Lake Chad

PO 4. Analyze the environmental effects of human use of technology (e.g., irrigation, deforestation, overgrazing, global warming, atmospheric and climate changes, energy production costs and benefits, water management) on the environment.

Overview
All living things depend on fresh water to survive and lakes provide much of that fresh water. When a lake dries up the impact on the environment is tremendous.

Purpose
In this lesson students will become aware of the significance a lake can have on an area and how a change in the lake can directly affect the lives of humans and other living things. Students will explore the rate of change in area of Lake Chad in Africa over the years.

Materials
- Lake Chad’s Location in the World map
- Africa map
- Lake Chad’s Location in Africa map (with country names)
- Didn’t There Used to be a Lake Here? The Drying Up of Lake Chad 1963-1997 (4 maps)
- Water Cycle Diagram (labeled and unlabeled) (optional)
- Handout #1 Vocabulary
- Handout #2 Diagram of the water cycle or use plain paper (optional)
- Handout #3 Data on Lake Chad
- Handout #4 Student Worksheet or use notebook paper
- Handout #5 Student Worksheet or plain paper
- Handout #6 Student Worksheet or plain paper
- Readings entitled Lake Chad and Africa’s Lake Chad Shrinks by 20 Times Due to Irrigation Demands (optional)
- Colored pencils
- Handout #7 Math practice and Answer Key
- Calculators (optional)
- Handout #8 Map of Lake Chad and surrounding river systems
- Document camera or overhead projector
- Computer lab to create PowerPoint (optional)
- Poster board or notebook (optional)

Objectives
The student will be able to:

1. Locate Africa on a world map.
2. Locate Lake Chad and surrounding countries on a map of Africa.
3. Describe the water cycle and the importance of fresh water to living things.
4. Practice changing numbers from fractions to decimals to percentages.
5. Compare the change of areas of Lake Chad over time by accurately completing grids.
6. Describe the various causes for changes in the area and volume of a lake.

Procedures
SESSION ONE
1. Discuss the hydrosphere, the moisture surrounding earth and all of the water on earth.

2. Project the Water Cycle diagram. Introduce the vocabulary involving the water cycle and the
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math terms such as area. (Handout #1). Have students complete the unlabeled Water Cycle Diagram or Handout #2.

3. Discuss sources for fresh water. (For example, springs, mountain snow, run-off from rains, underground storage areas, lakes, rivers, etc.)

4. Have students list uses for fresh water individually then in pairs, then record ideas as a group. Discuss as a group.

7. Define "lake", describe how a lake is formed, and how people use lakes.

SESSION TWO

1. Assign student worksheet #4 or use notebook paper. Students will list lakes they know or have visited and what they observed there.

2. Assign student worksheet #5 or use plain paper. Students are to write information about how people, animals, and plants use lake water.

3. Have students do worksheet #6 or use plain paper. On this paper, students are to write information about how people, animals, and plants would be affected by a decrease in the size of a lake. Another option would be to assign a "quick write" using the following prompt: "If a lake depends on rainfall how would a drought affect a lake? How would this decreasing size affect people and animals?"

4. Pass out Africa maps to students. Place a transparency of the Lake Chad’s Location in Africa (with country names) map on the overhead or place the map under the document camera.

5. Have the students label Lake Chad and surrounding countries. Have the class read the data on Lake Chad. (Handout #3) or readings entitled Lake Chad and Africa’s Lake Chad Shrinks by 20 Times Due to Irrigation Demands.

SESSION THREE

6. Show the satellite images and photos of Lake Chad.

7. Have students create a notebook, PowerPoint presentation, or poster board by attaching maps and written descriptions of what has been occurring at Lake Chad and the effects on the surrounding areas.

8. Assign math practice involving rate of change (Handout #7).

9. Have students determine the difference in area in square kilometers between the dates.

Assessment

Geography Assessment: On the poster board or notebook assignment, students will correctly label Lake Chad and surrounding countries on a map of Africa. (25 points) Students will cite 5 ways that people, animals, and plants would be affected by a decrease in the size of a lake. (75 points) If a PowerPoint presentation is created then the map of Africa will be a graphic from the Internet. Students will still cite 5 ways that people, animals, and plants would be affected by a decrease in the size of a lake. Mastery is considered 80% or higher.

Math Assessment: Students will determine the difference in area of Lake Chad from one date to another. Students will calculate the rate of change from fractions to decimals to percentages. Mastery is considered 80% or higher.

Extensions

- Students can research other lakes and report on changes in area over time.
- Students can research the Great Lakes and report on changes over time.
- Students can research and describe how specific lakes have uses that vary from other lakes.
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- Students can research the development of man-made lakes and their uses.
- Students can research dry lakebeds and determine how the lakes dried up.
- Students can create a "hands-on" demonstration to demonstrate a lake drying up using:
  - shallow pie pan or cookie sheet
  - sand
  - water
  - heat lamp

  Spread sand in shallow pie pan or cookie sheet. Add water. Place a heat lamp over the pan. Place a fan to blow over the water. Explain that this demonstrates evaporation. Sprinkling water over the dish can show rain. Straws could be used to illustrate irrigation. A funnel could represent a river feeding the lake.