WHAT GOES IN, MUST COME OUT
Water Flow of Utah Lake
COMPARING FRACTIONS WITH DIFFERENT NUMERATORS AND DENOMINATORS

This lesson plan has been created as a resource for fourth grade teachers to teach the new core standards to their students. It integrates math and science standards in a meaningful and fun way. To see which specific standards are addressed, please refer to them below.

STANDARDS ADDRESSED:

4th Grade Math

4.NF.2 Number and Operations-Fractions Standard 2

Compare two fractions with different numerators and different denominators, e.g., by creating common denominators or numerators, or by comparing to a benchmark fraction such as 1/2. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with symbols >, =, or <, and justify the conclusions, e.g., by using a visual fraction model.

4.NF.3 Number and Operations-Fractions Standard 3

Understand a fraction *a*/*b* with *a* > 1 as a sum of fractions 1/*b*

4.MD.6 Measurement and Data Standard 6

Measure angles in whole-number degrees using a protractor. Sketch angles of the specified measures.

Science

Standard 1: Students will understand the physical characteristics of Utah's wetlands, forests, and deserts and identify common organisms for each environment.

Objective 2: Describe the water cycle.

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PART 1: SELECTING AND SETTING UP A MATHEMATICAL TASK	
What are your mathematical goals for the lesson? (i.e., what do you want students to know and understand about mathematics because of this lesson?)	Students will find sums using fractions with different numerators and denominators. Students will be able to understand the relationship Utah Lake has with the water cycle. They will learn about evaporation, precipitation, underground water, and springs.
• What are your expectations for students as they work on and complete this task? • What resources or tools will the students have to use in their work to give them entry into and reason through, the task? • How will the students work—independently, in small groups, or in pairs—to explore this task? • How will students record and report their work?	• Protractor, Ruler • Fraction Strips or Circles/or other fraction manipulatives • Graph • Notepaper
How will you introduce students to the activity to provide access to *all* students while maintaining the cognitive demands of the task?	They will participate in a hands-on activity. See below.

Matrix adapted from: Smith, Margaret Schwan, Victoria Bill, and Elizabeth K. Hughes. "Thinking Through a Lesson Protocol: Successfully Implementing High-Level Tasks."

Mathematics Teaching in the Middle School 14 (October 2008): 132-138.

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PART 2: SUPPORTING STUDENTS' EXPLORATION OF THE TASK	
As students work independently or in small groups, what questions will you ask to— · help a group get started or make progress on the task? · focus students' thinking on the key mathematical ideas in the task? · assess students' understanding of key mathematical ideas, problem-solving strategies, or the representations? · advance students' understanding of the mathematical ideas?	• What do you know already? • What is a numerator? • What is a denominator? • How can you compare two fractions? • Which one is bigger?
How will you ensure that students remain engaged in the task? · What assistance will you give or what questions will you ask a student (or group) who becomes quickly frustrated and requests more direction and guidance in solving the task? · What will you do if a student (or group) finishes the task almost immediately? How will you extend or expand the task to provide additional challenge?	• Give the students an equivalent fraction. • Ask, "How do you know that?" • Reinforce students that they are capable of solving the problem • Break the problem apart and look at little pieces of a time • What patterns do you see that could help to solve this problem • Have students make their own graph showing fractional parts. • Have students create a graph showing the same information, but missing a fractional part. Have them show that you can find unknown parts when other parts are known. (Relates to 4.MD.7)

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PART 3: SHARING AND DISCUSSING THE TASK	
How will you orchestrate the class discussion so that you accomplish your mathematical goals? · Which solution paths do you want to have shared during the class discussion? In what order will the solutions be presented? Why? · What specific questions will you ask so that students will -- 1. make sense of the mathematical ideas that you want them to learn? 2. expand on, debate, and question the solutions being shared? 3. make connections among the different strategies that are presented? 4. look for patterns? 5. begin to form generalizations? What will you see or hear that lets you know *all* students in the class understand the mathematical ideas you intended for them to learn?	• Have students show simple solutions. Then move to solutions that are more complex. • Allow student responses. • Walk around the room taking notes on what each group is doing and what order you want to share in. Every group will share their findings. • After everyone shares their answers, what were the common findings within the groups? How were they different? • Are there other ways to solve this problem that were not shared? • Did anyone come up with another way to solve the problem, after watching the other groups go? • Debrief the task with the class talking about the mathematical concepts that were taught.

TEACHER BACKGROUND:

Teach this lesson following lessons on the water cycle.

Outflow

Surface water outflow from Utah Lake occurs only to the Jordan River, located on the north end of the Lake and averages 428,200 acre-feet per year, which is 139 billion gallons, or enough water to fill 2.3 million classrooms with water (an acre is the volume of water that covers one acre to a depth of one foot. It is equal to 325,851 gallons). Evaporation averages 349,800 acre-feet per year, which is 115 billion gallons, or enough water to fill 2.0 million classrooms with water. The figure below summarizes the annual average outflow from Utah Lake.

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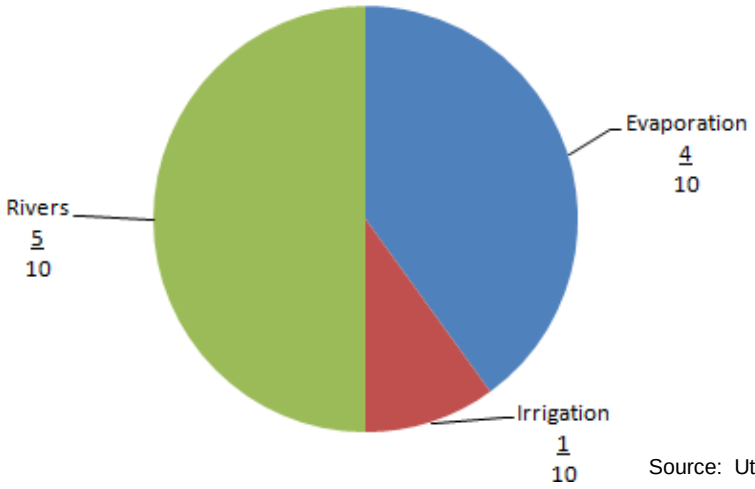
Figure 1: Outflow for Utah Lake between 1980-2003



Source: Utah Lake TMDL Study, 2007

Inflow

Utah Lake receives water from precipitation, rivers, streams, canals, and groundwater within the watershed. Water leaving Utah Lake flows out by way of the Jordan River, and into the Great Salt Lake.

The three largest tributaries of Utah Lake are the Provo River, Spanish Fork River, and Benjamin Slough. In addition to surface flows, groundwater is another significant source of inflow to Utah Lake. Groundwater enters the Lake via three types of flow: freshwater springs, diffuse fresh seeps, and mineralized springs. The table and figure below summarizes the annual average inflow to Utah Lake from major surface water sources.

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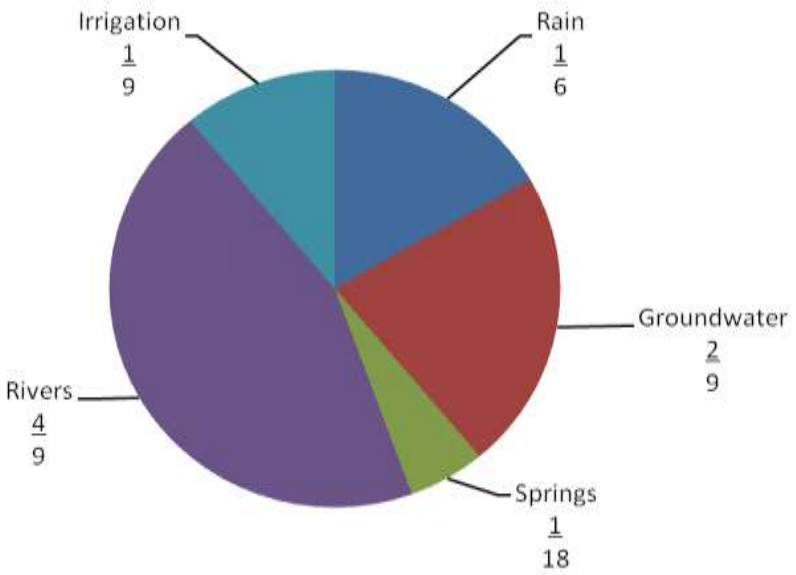
Table 1: Average Annual Inflow to Utah Lake (Streams/Tributaries)

Tributary	Average Annual Flow (acre feet/year)
Provo River	151,000
Spanish Fork River	99,700
Benjamin Slough	36,700
Mill Race Creek	33,500
Powell Slough	24,900
Hobble Creek	19,800
Mill Pond	12,100
Dry Creek (South of Provo Bay)	10,600
Spring Creek	8,800
White Lake Overflow to Goshen Bay	6,200
Big Dry Creek	6,000
American Fork River	5,900
Minnie Creek	3,900
Little Dry Creek	1,600
Dry Creek (Lehi)	900
TOTAL FLOW	**421,600**

Source: Utah Lake TMDL Study, 2007

Figure 2: Inflow for Utah Lake between 1980-2003



Source: Utah Lake TMDL Study, 2007

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TEACHER MATERIALS:

- Computer
- Circle Graph Generator (If you have internet access, you can use this circle graph generator).
- Other possible ideas for generating a circle graph in the classroom
    - Excel
    - Drawing Paper (keep in mind you will be changing the data).
    - Other websites
- Google Maps image of Utah Lake
- Clear glass of water

STUDENT MATERIALS:

- Colored Pencils/Crayons
- Protractor, Ruler
- Fractions Strips or Circles/or other fraction manipulatives

PROCEDURE:

Outflow of water from Utah Lake

1. Hold up an empty glass and ask students, “How could water have left this glass, or where did it go?”
    - Follow with questions to review what they know about the water cycle and other uses of water such as “When you dump a glass of water down the sink where does it go?” Review ground water, evaporation, and accumulation in rivers, streams, and lakes.
2. Show a picture or map of Utah Lake and ask this question “Where does the water in Utah Lake go?”
    - You may choose to make a T-Chart as a comparison between the glass and Utah Lake. Sources of output from Utah Lake should include evaporation, Jordan River, and irrigation (outflow).
3. Hand out fraction strips or fraction circle manipulatives to model the inflow. Have them make fractions represented on the graph that represent the entire graph. Allow students to explore.
    - Using info from the teacher background material, take the opportunity to discuss in-depth the outflow of water from Utah Lake.

4. Students need to add the fractional parts with similar denominators to show it equals one whole.

5. Pass out a copy of the graph. Have the students measure the angles of the graph using a protractor to the nearest whole number degrees.

Inflow of water from Utah Lake

1. Hold up a glass of water and ask students, "How did the water get into this glass?"
    - Follow with questions that will review what they know about the water cycle, such as "How does water get to the faucet?" "How did the water get to the reservoirs or wells?" Through questions, review ground water, precipitation, and accumulation in rivers and streams.

2. Show a picture or map of Utah Lake and ask the same questions that were just asked in the attention activity.
    - You may choose to make a T-Chart as a comparison between the glass and Utah Lake. Give the students the fractional parts that make up the inflow to Utah Lake. Sources of input into Utah Lake should include precipitation, rivers, groundwater, springs, and irrigation runoff.

3. Hand out or make fraction strips or fraction circle manipulatives to model the inflow. Have them create a graph using the manipulatives.
    - Using info from the teacher background material, take the opportunity to discuss in-depth the inflow of water to Utah Lake.

4. Students need to add the fractional parts with different numerators and denominators to show it equals one whole.

5. Pass out a copy of the graph. Have the students measure the angles of the graph using a protractor to the nearest whole number degrees.

ASSESSMENT:

- Student work.

EXTENTIONS:

- Have students make their own graph showing fractional parts.

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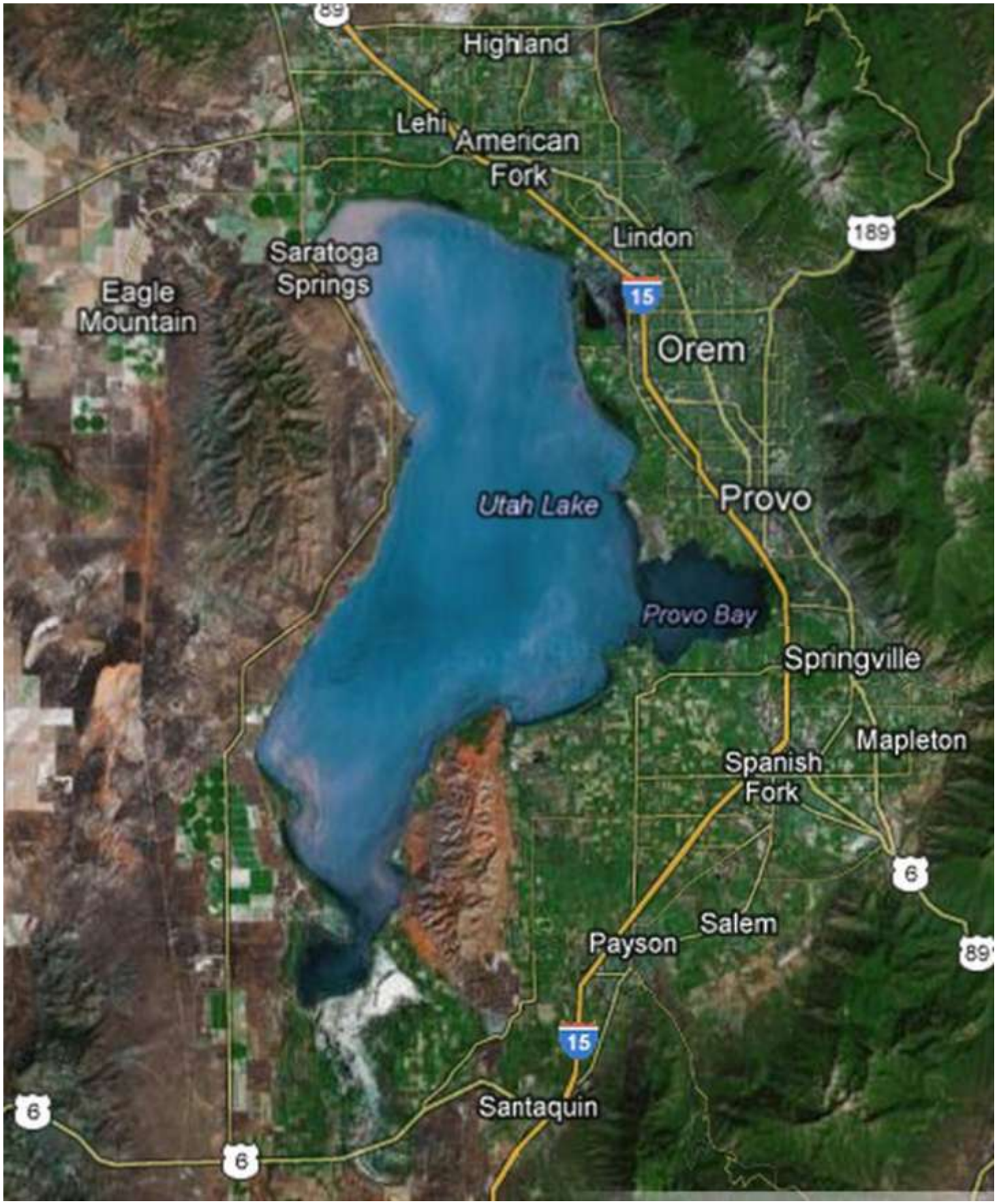
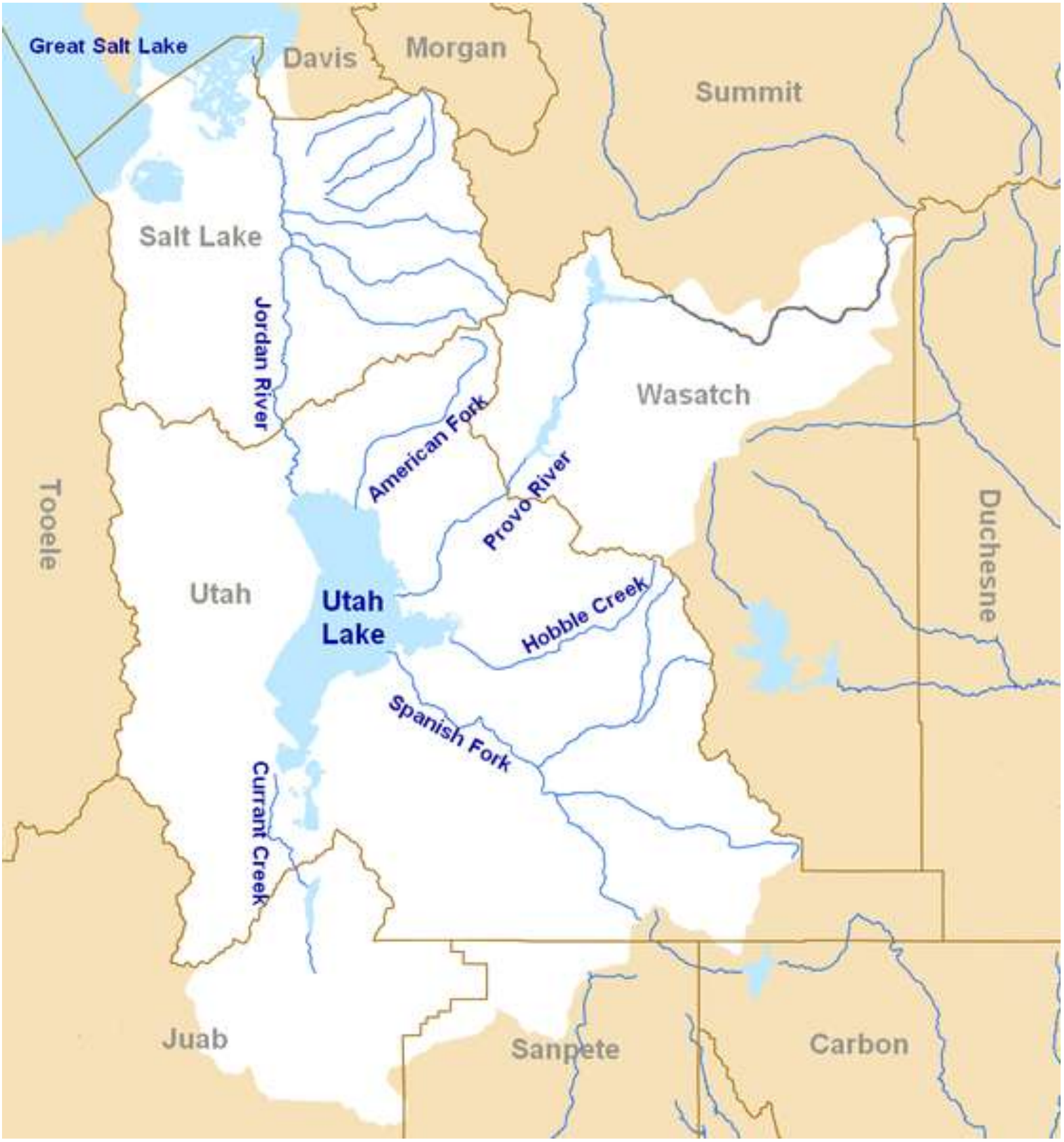
- Have students create a graph showing the same information, but missing a fractional part. Have them show that you can find unknown parts when other parts are known. (Relates to 4.MD Standard 7)

ADDITIONAL REFERENCES:

- Virtual Utah Website
- Utah Conservation Data Center Interactive Map

UTAH LAKE – GOOGLE MAP




Great Salt Lake
Davis
Morgan
Summit
Salt Lake
Jordan River
Wasatch
American Fork
Provo River
Tooele
Duchesne
Utah
Utah Lake
Hobble Creek
Spanish Fork
Currant Creek
Juab
Sanpete
Carbon