EXPLORATIONS

Activity 10

Water, Water

Concepts/Skills

- Multiplication
- Division
- Percent
- Ecology
- Problem-solving
- Prerequisite: median

Materials

- TI-15 calculators
- Paper, pencils
- Markers

Overview

Students will work in cooperative groups to solve a real-world problem involving water consumption. Each group's final product will be a chart showing the results of the group investigation, an oral presentation about the group's solution to the problem, and individual written explanations about the processes used by the group to reach a solution.

Focus

Discuss the use and need of water with the students. Have them make estimates/guesses as to the average amount of water one person uses each day. Have them make lists of the ways individuals use water: drinking, bathing, toilet flushing, washing clothes, watering yards, swimming pools, and so forth. Additional information on water consumption can be found at http://clarkpud.com/tips.htm.

Presenting the Problem

1. Review the four steps of problem solving with the students:
   - understanding the problem
   - making a plan
   - carrying out the plan
   - evaluating the solution

   Have the students read *The Problem* page and paraphrase the problem. Make sure the students are clear on what the problem asks.

2. *The Problem* page gives the students the necessary information to solve the problem. Have the students make a plan and carry it out. Help them evaluate their solution before they begin making their chart to show their results.
3. If groups have difficulty with the problem, use the *Things to Consider* page. This page provides guiding questions to help the students complete the problem-solving steps.
4. Have the students post their charts and present their plan to the rest of the students.

Evaluating the Results

1. After the charts are posted, have students examine the various solutions presented. Ask:
   - *How are the charts similar?*
   - *How are the charts different?*
2. Ask them to compare the numbers used.
   - *Did all groups use the same numbers?*
   - *Why do you think this is so?*
3. Ask them to determine the reasonableness of the results.
   - *Did each group answer the question?*
   - *Do the numbers used make sense?*
   - *Did all of the groups consider all of the variables?*
4. Ask them to consider how the calculator was used.
   - *Did all of the groups use the calculator in the same way?*
5. Ask them to extend their thinking.
   - *What would happen if the discharge of the Edwards aquifer decreased?*
   - *Would all of the towns survive?*

Extension

The problem calls for using the median discharge of the Edwards Aquifer in determining the water consumption of a new town. Students could also calculate the mean discharge and compare the numbers. A discussion about the similarities and differences between two measures could occur.

Additional Information

Additional information about the Edwards Aquifer can be found at this web site: http://www.edwardsaquifer.net. Permission for using the information from this site was given by Gregg A. Eckhardt.

Student Activity

Name ____________________

Date ____________________

Activity 10

Water, Water

The Problem: How much water will a new town use?

Your team has been asked to decide if the Edwards Aquifer can be used as the water source for a new town in the Hill Country of Texas. This town will have a beginning population of 5,000 people. Each year, 5,000 more people will live in the town until the population reaches 25,000 people. Your problem is to decide if there will be enough water from the aquifer for the town.

The Facts

- ♦ An aquifer is an underground water source. The Edwards Aquifer is in the central region of Texas.
- ♦ In the United States, each family of four uses about 350 gallons of water a day.
- ♦ Huge quantities of water are measured in acre feet. One acre foot of water is about 326,000 gallons.
- ♦ The discharge of the Edwards Aquifer includes springs, artesian wells, and water pumped from the aquifer. The amount of discharge changes each year. The chart below shows the annual discharge for the years 1983 – 1997.

Annual discharge for the Edwards Aquifer (in acre feet)*

Year	Discharge
1983	720,100
1984	702,300
1985	856,500
1986	817,300
1987	922,000
1988	909,700
1989	766,800
1990	730,000
1991	790,600
1992	1,130,200
1993	996,700
1994	814,800
1995	761,000
1996	705,600
1997	684,700

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- ♦ About 30% of the discharge of the Edwards Aquifer is used by municipalities, such as the new town, and the other 70% includes springflow, water for irrigation, and water for manufacturing plants.

- Many municipalities use the Edwards Aquifer. San Antonio, a city of about 959,000 people, uses the Edwards Aquifer as its primary water source.

The Task

1. Your team will create a chart showing the following information:
   - The number of people in the town each year
   - The amount of water they will use each year
   - The median discharge of the Edwards Aquifer in acre feet
   - The percentage of the median discharge the town will use each year
2. Each person on the team will write an explanation of the team's solution. This explanation will answer these questions:
   - How did you calculate the amount of water per person?
   - How did you calculate the amount of water the town will use each year?
   - How did you decide if there was enough water for the town?

Things to Consider

Understanding the Problem

Read the *Water, Water Problem* page, and then answer these questions.

- How much water does a family of four use each day? How much water does one person use each day? How much water does one person use in a year? How do you know?
- How many gallons of water are in one acre foot? How many people can live for a year on that number of gallons? How do you know?

Making a Plan

Before you make your plan, answer these questions.

- What is an estimate of the median discharge of the Edwards Aquifer?
- What percentage of the water was used by municipalities?
- How many acre feet of water were used by municipalities based on the median discharge?
- How many people could live on that much water for a year?
- How much water does San Antonio need for its population for a year?
- What percent of the water for municipalities does San Antonio use?
- How much water will the people in your town need each year?

Carrying Out the Plan

Before you begin your chart, answer these questions.

- What does your chart have to show? Do you have all of the necessary information? What other calculations do you need to make?
- What kind of chart would best represent this information?
- How will you display your information on the chart? What additional information will you show on your chart? Have you considered including the discharge of the Edwards Aquifer, the amount of water one person uses in a year, or the amount of water San Antonio uses each year? What other information do you know that might make your chart more informative?
- How can you make your chart clear and understandable to the class? Are the letters large enough? Are the colors dark? Is it easy to read?

Evaluating the Solution

- Did you answer the question? How do you know?
- Does your answer make sense? Is your population smaller than San Antonio? Is the amount of water you plan to use less than the amount used by San Antonio?
- Did everyone in the group write an explanation?

Using the Calculator

Name ______________________

Date ______________________

Water, Water: Rounding with the Fix keys

Try this problem with the calculator:

1. Harold went to the store to buy clothes. He bought a pair of jeans for $23, a pair of pants for $31, a shirt for $14, and a sweater for $26. About how much did Harold spend?

Press:	The display shows:
Fix 10. 23 + 31 + 14 + 26 Enter	

This gives the answer rounded to the nearest 10.

Press:	The display shows:
Fix 100. 23 + 31 + 18 + 26 Enter	
Fix ·	

The exact answer is now in the display.

How are the two rounded answers alike? How are they different? When you use Fix 10., to what place is the answer rounded? When you use Fix 100., to what place is the answer rounded? If you were going shopping, which answer would be more helpful?

2. In our school district, there are 4 elementary schools, 2 middle schools, and 1 high school. The enrollments at the elementary schools are 529, 476, 603, and 411. The enrollments at the middle schools are 496 and 541. The enrollment at the high school is 723. About how many students are in the school district?

Press:	The display shows:
Fix 100. 529 + 476 + 603 + 411 + 496 + 541 + 723 Enter	

How is the answer rounded?

Now calculate the answer to the nearest 10. What keys do you need to use for this calculation?

Now calculate the answer to the nearest 1000. What keys do you need to use for this calculation?

What is the exact answer to the problem? What keys do you need to use to find this answer?

3. The Dallas Stars and the Buffalo Sabres played in the 1999 Stanley Cup finals. They played 6 games. The attendance at each game was as follows:

Game	Attendance
Game 1	17,001
Game 2	17,001
Game 3	18,595
Game 4	18,595
Game 5	17,001
Game 6	18,595

About how many people attended the six games, rounded to the nearest 1000?

What is the exact answer to the problem? When would you need an exact answer? When would a rounded answer be more helpful?