SeaWorld/Busch Gardens
Splash of Math
4-8 Classroom Activities

SeaWorld Water Systems

OBJECTIVE

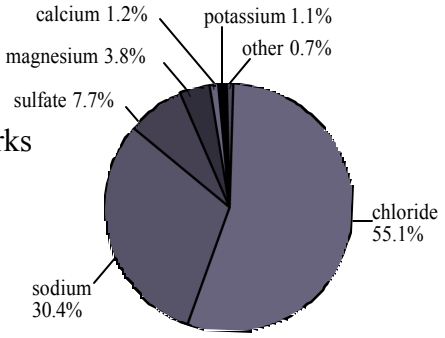
The student will decide how to solve a complex problem, breaking it down into simpler parts. He or she will practice communicating mathematical ideas.

ACTION

1. Distribute a copy of the *SeaWorld Water Systems* funsheet to each student and ask students to work through the real-life problems. (For problem #5, display the "Sea Water Constituents" overhead transparency.)
2. Once their work is complete, ask students to describe their problem-solving logic and methodology. Did all students do each problem the same way?

ANSWERS

1. 5,000,000 gallons ÷ 27,000 gallons per minute = 185.2 minutes
   185.2 minutes ÷ 60 minutes per hour = 3.1 hours
2. A filtration system that cycles 80 gallons per minute would take:
   5,000,000 gallons ÷ 80 gallons per minute = 62,500 minutes
   62,500 minutes ÷ 60 minutes per hour = 1,041.7 hours
   The filtration system at Shamu stadium has to be much faster to filter 5 million gallons of water.
3. Penguin Encounter: chill the water year-round to lower the temperature
   Shark Encounter: heat the water year-round to raise the temperature
   Dolphin Bay: monitor the temperature year-round, heat in winter and chill in summer to meet temperature requirements
   Shamu Stadium: monitor the water temperature year-round, chill most of the time
4. No, the Shark Encounter holds 15.96 billion drops of water. You would need 15.96 drops of blood for the sharks to be able to detect it. (280,000 gallons x 3.8 liters per gallon x 1,000 milliliters per liter x 15 drops per milliliter = 15.96 billion drops)
5. composition of sea water:



BACKGROUND INFORMATION

Marine animals require clean water to stay healthy. At SeaWorld, the water is constantly filtered to remove animal wastes and harmful materials. The SeaWorld Water Quality department monitors the water in SeaWorld animal habitats several times a day. Technicians test the water for temperature, turbidity (water clarity), salinity (salt concentration), bacteria, pH (acidity), and chlorine. (A minimal amount of chlorine is added to the water in some mammal exhibits to destroy harmful bacteria.)

At SeaWorld San Diego, the sea water comes from Mission Bay. It is filtered several times; it can then be heated or chilled for various animal exhibits. At SeaWorld parks in Orlando and San Antonio, sea water is manufactured by adding salts to regular tap water. Throughout the world, ocean water is relatively constant in regard to the major salt constituents. The constituents listed below comprise more than 99% of sea salt. Other elements in sea salt add up to less than 1%.

In this activity, students assume the role of new employees in the Water Quality department. Once they are able to answer the following questions correctly, they will be allowed to scuba dive in the pools to do any necessary repair work.

MATERIALS

For each student:
- copies of *SeaWorld Water Systems* funsheet on page 6
- pencil and paper
- calculators

For class:
- overhead transparency of sea water constituents table (below, enlarge 200%)

SEA WATER CONSTITUENTS

chloride	55.1%
sodium	30.4%
sulfate	7.7%
magnesium	3.8%
calcium	1.2%
potassium	1.1%
other elements	<1.0%

Water filters at Shamu Stadium run continuously to keep the water clean.

SeaWorld Water Systems

1. Shamu Stadium contains more than five million gallons of filtered sea water. If the water is filtered at a rate of 27,000 gallons per minute, how long will it take for the water to completely turn over?
2. An average home swimming pool cycles 80 gallons per minute. Compare this to the filter cycle at Shamu Stadium. Why do you think the system at Shamu Stadium has to be so much faster?
3. The sea water used in SeaWorld San Diego animal habitats comes from Mission Bay. It is filtered several times; it can then be heated or chilled for various animal exhibits. Mission Bay water temperatures can range from about 55°F to 70°F, depending on the season and ocean conditions. Describe in numbers and words what you will need to do to maintain water temperature at the desired ranges for the following exhibits.

Penguin Encounter	42–45° F
Shark Encounter	76° F
Dolphin Bay	63–67° F
Shamu Stadium	52–55° F

4. Sharks are able to detect certain amino acids (such as those found in blood proteins) in concentrations as low as one part per billion. The Shark Encounter holds 280,000 gallons of water. Could a shark smell a drop of blood in this aquarium? (Hint: Determine how many drops are in a gallon. Fifteen drops of water equal 1 ml.)
5. Make a pie chart in the space below illustrating the composition of salt in sea water. Use a percentage for each constituent of sea salt.