CONSERVATION CONNECTION

WATER IN SOUTHERN CALIFORNIA

Conservation Connection: Water in Southern California

Presented by:

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And

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Adapted from:

Conservation Connection: Water & Energy Use in Southern California

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WATER IN SOUTHERN CALIFORNIA

WATER IN SOUTHERN CALIFORNIA

	Water, Energy and You			Water Sources & Water Distribution			Water Use & Water Challenges			Water & the Future		
STANDARDS	6th	7th	8th	6th	7th	8th	6th	7th	8th	6th	7th	8th
COMMON CORE STANDARDS												
Reading for Informational Text:												
1-Cite textural evidence	•	•	•	•	•	•	•	•	•			
2-Determine a central idea												
4-Determine the meaning of words	•	•	•	•	•	•	•	•	•	•	•	•
5-Analyze how text structure contributes to the author's ideas							•	•	•	•	•	•
7-Integrate information presented										•		
8-Evaluate the argument and specific claims in a text										•	•	•
Writing:												
1-Write arguments to support claims	•	•	•	•	•	•	•	•	•	•	•	•
2- Write informative/explanatory texts										•	•	
3-Write narritives to develop real or imagined experiences										•	•	•
5- Develop & strengthen writing by planning, revising, editing										•	•	•
7- Conduct short research projects										•	•	•
8- Gather relevent information from multiple sources										•	•	•
Speaking and Listening:												
1-Engage in a range of collaborative discussions	•	•	•	•	•	•	•	•	•	•	•	•
4-Present claims and findings	•	•	•	•	•	•	•	•	•	•	•	•
Language:												
1-Demonstrate command of the conventions of English grammar and usage.	•	•	•	•	•	•	•	•	•	•	•	•
2- Demonstrate command of the conventions of English Punctuation												
3-Use knowlege of language when writing, speaking, reading or listening	•	•	•	•	•	•	•	•	•	•	•	•
NEXT GENERATION SCIENCE STANDARDS												
Earth and Human Activity:												
ESS2-4- Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity				•								
ESS3-3- Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.	•			•			•			•		
ESS3-Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.												•
ESS3-5- Ask questions to clarify evidence of the factors that have cause the rise in global temperatures over the past century.	•											
Engineering, Technology and Application of Science												
ETS1-4 Develop a model to generate data for interactive testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.										•		

Water, Energy, and You

Students will:

- be introduced to the importance of water and energy
- compare their use of water and energy to use in the past
- keep track of personal water and energy use

Vocabulary

• condensation • precipitation

• evaporation • renewable

• nonrenewable • transpiration

Materials and Preparation

- Copies of Conservation Connection pages 12-15 for each student

• Home Energy and Water Checklists

Approximate Time Requirement

- 1 class period

Procedures

I. Introduce the program

A. Distribute a copies of pages 12-15 to each student and explain that the class is going to be learning about water and energy in California, especially in southern California. Allow students a few moments to look through the material.

B. Divide students into groups and have them look at page 12—How Are Water and Energy Used? Read aloud the directions at the top of the page. Ask students to work with group members to list all the uses they can think of for water and for energy. Remind students that water and energy are used in places other than in the home, for example to fight fires, grow food, manufacture paper.

C. When students have completed their lists, ask each group to read what they've listed.

D. Point out that along with their direct uses, they are responsible for many "indirect" uses of water and energy in industry and agriculture.

II. Think About Water, Energy, & You

A. Ask students to turn to look at page 13—Water, Energy, &You.

Read aloud and have students discuss the questions under Think About It.... In the discussion of each question, allow students to share their ideas, but be sure to point out the following:

1. What would a day be like without water or energy? There would be no day as we know it without water and energy; we need the radiant heat and light from the sun; we need water to drink. Without water and energy, we could not live.

2. How have you personally used water and energy today? Some personal uses may not be so obvious, such as reading clocks, drinking milk that was kept cold in the refrigerator, talking on the phone, and flushing toilets.

3. How do you think your use of water and energy compares to people's use 100 years ago? A hundred years ago, people did not have such easy access to water and energy, and they did not have so many products that use water and energy. Edison did not invent the light bulb until 1879, and the first electric power station wasn't built until 1882; the electric vacuum cleaner and washing machine were invented in 1907; the Model T automobile was put into production in 1913; only about 60% of farms had flowing indoor water by 1936.

4. Is there enough water and energy to last forever? We do expect the sun to continue to shine and rain to continue to fall; thus, we expect there to always be water and energy. However, will we always have enough clean water and enough energy when and where it is needed for everyone?

Procedures (Continued)

III. Learn About Water, Energy, & You

A. Have students read the text under Learn About It... on page 13. Then use the questions below to briefly discuss what they read. Alternatively, write the questions on the chalkboard, divide students into groups, and have each group answer the questions using the information on page 13.

1. What is the water cycle? Water circulates constantly. Water that evaporates from the ground or that is released from plants through transpiration rises into the air as water vapor. In the air, it cools and condenses and eventually falls to the earth as precipitation (rain, snow, sleet, hail), where it again evaporates and rises into the air.

2. Can we increase our supply of water? No. We have a fixed supply of water. Varying amounts of water are available in different places and at different times depending on geography and weather, but only a limited amount of water exists on Earth.

3. How can you tell when energy is being used? Energy is being used any time there is heat, light, or motion.

4. What's the difference between renewable and nonrenewable energy sources? Renewable energy sources never get used up; they are constantly resupplied by natural processes. For example, sun, wind, and water are all renewable energy sources. Nonrenewable sources have only a limited amount. For example, once we've used up all the fossil fuels (oil, natural gas, coal), there will never be any more.

5. Why do we need to be concerned about our supply of water and energy? As our population grows and as we find more and more ways to use energy and water, we are using more water and energy all the time. In times of drought, our supply of water is sometimes not enough for everyone. And during periods of high energy demand, such as on hot summer days, we sometimes can't produce enough energy.

6. So how can we be sure we have enough water and energy for the future? Allow students to share their ideas.

IV. Track Personal Water and Energy Use

A. Have students look at copies of pages 14 and 15—Personal Water Use Log and Personal Energy Use Log. Explain that for 24 hours (starting either now or tomorrow morning), they are to keep track of every time they personally use water and energy. Review the examples.

B. Point out that on each page they are to fill in only the first two columns at this point, indicating what they used and for how long they used it. Explain that the last column—"Gallons Used" will be completed later (in Lessons 3).

V. **Introduce the Home Water & Energy Checklists**

A. Ask students if they think any water or energy is wasted in their homes.

B. Distribute Home Water & Energy Checklists to each student, copied from those provided by Times in Education and LADWP.

C. Read aloud and discuss the directions for completing the checklists. Emphasize that students should work with their families to answer the questions. Explain that some of the items are easy to answer, but some will take investigation. Tell students that some questions may require the assistance of an adult. Point out that next to some items is a box containing tips to help answer the question.

Extension Activities

• Prepare water and energy timelines. Research significant dates in our history of water (e.g., in 1888 Thomas Crapper perfected the valve system of the toilet; in 1913 the Los Angeles Aqueduct began delivering water; in 1914 the first drinking water standards were adopted) and energy (e.g., in 1879 Thomas Edison invented the light bulb; in 1903 the Wright Brothers flew the first airplane; first power pole set in the ciry of Los Angeles in 1915; Power Plant 1, located 12 miles north of Saugus in the Angeles National Forest, produced first commercially sold electricity by the City of Los Angeles and LADWP's predecessor water agency in 1917 (Before that, power was supplied to city Los Angeles customers by the City of Pasadena); in 1942 the first nuclear chain reaction was demonstrated) and make murals depicting the events throughout history.

• Compare water and energy use throughout history. Divide students into groups and assign each group to research a particular historical group of people—such as the first colonists, early Native Americans, settlers on the frontier, plantation owners during the Civil War, etc.—to determine their water and energy sources and uses.

Water Sources and Water Distribution

Students will:

• learn about surface water and groundwater

• learn how water is distributed—especially in southern California

Vocabulary

• acre-foot • overdraft

• aqueduct • reservoir

• aquifer • surface water

• groundwater

Materials and Preparation

• Copies of pages 16-17

• Topographical wall map of California

• Materials for demonstration (optional) - large glass jar or small aquarium - aquarium gravel - watering can - meat baster - water

Approximate Time Requirement

• 1 class period

Procedures

I. Think About Water Sources

A. Distribute copies of page 16, Water Sources.

B. Read aloud and discuss the questions under Think About It....

II. Learn About Water Sources

A. Display a topographical map of California. Have students note where most of the natural rivers and lakes are and where most of the cities are. Ask students why they think that is.

B. Have students read the information on page 16 about surface water and groundwater and use the following questions to generate a discussion.

1. What happens to all the rain that falls? About 1/3 of the rain that falls ends up in rivers, lakes, and streams. The rest is used by plants and animals, soaks into the ground, and evaporates.

2. What is surface water? Surface water is all the water we see on the surface of the Earth—water in creeks, streams, rivers, lakes, the ocean.

3. What is groundwater? Groundwater is water under the surface of the Earth that collects in aquifers, which are basins underground where water is stored in spaces between particles of sand, gravel, and rock.

4. How does water get into the ground? Water naturally soaks into the ground from rain, irrigation, river beds, ponds, or by engineered stormwater recharge projects.

5. How do we get the water out of the ground? Wells are drilled into the ground and the water is pumped up.

6. What does "overdraft" mean? "Overdraft" means that too much water has been pumped out of the ground, compared to that replenished usually by rainfall or snowfall. This can cause land to sink, compact and become unusable. As a result, plants depending on groundwater can die.

7. Why are most of California's rivers, streams, and lakes in northern California? About 75% of the precipitation in California falls in the north, creating rivers, streams, and lakes.

8. In California, how much of the water we use comes from surface water and how much from groundwater? Most years, about 2/3 of the water we use comes from surface water and about 1/3 comes from groundwater. In the city of Los Angeles, groundwater use is about 11% and is expected to increase to 24% in the future.

Procedures (Continued):

9. In southern California, do we use the same amounts of surface water and groundwater as in the entire state? No. Groundwater use in southern California is the same—about 1/3 or 33% of our total supply. But local surface water provides only about 2% of our supply. In the city of Los Angeles, groundwater use is about 11% (see guidebook "Water, Energy, the Environment and You")

10. So where does the rest of the water we use in southern California come from? Allow students to share their ideas.

III. (optional) Demonstrate Groundwater and Surface Water

A. Fill a jar or aquarium with gravel, building the ground up slightly higher on one side than the other. Sprinkle water from a watering can into the jar or aquarium to simulate rain. Saturate the ground but do not pour so much that water shows above ground. To simulate the drilling of a well, use the meat baster to pump up some groundwater.

B. Sprinkle more water until a "lake" forms at the low ground end. Have students experiment with "raining" more and "pumping" more to demonstrate the interaction between groundwater and surface water.

IV. Think About Water Distribution

A. Have students look at page 17

B. Read aloud and discuss the Think About It.... questions.

V. Learn About Water Distribution

A. Have students read the information on page 17 and use the following questions to generate a discussion.

1. What are aqueducts? Aqueducts are channels, pipelines, and tunnels through which water travels across land.

2. What are the three aqueducts bringing water into southern California? The Los Angeles Aqueduct, the Colorado River Aqueduct, and the California Aqueduct bring water into southern California.

3. How much of the water we use in southern California comes through these three aqueducts? About 66% of our water is imported through these three aqueducts. *

4. Where do we store the water until it is needed? We store water in reservoirs—which are either lakes or large tanks.

5. What other uses do reservoirs have? Reservoirs can provide recreation, flood control, and electricity if they have hydroelectric power plants.

6. Why do you think some reservoirs prohibit activities like swimming and water skiing? Limiting the amount of actual "body contact" in the water lowers the level of contamination, making water treatment less of a challenge.

VI. Continue Tracking Water Use

A. Remind students that they should be keeping track of all the water and energy that they are using today.

B. Check students' Personal Water & Energy Use Logs to be sure they are being filled in.

Extension Activities

• Research your city's water supply and water uses. Find out, either through Internet research or by calling your water agency, information about the supply and demand of water in your area.

• Investigate droughts in California. What defines a drought? When was the last one in California? What's the history of droughts in California? How long do they last? What effects do they have on people, on the environment, on the economy? Will there be fewer or more droughts in the future?

• Research major reservoirs. For each of the seven major reservoirs in southern California, identify their size, their water source, and the places their water is used. - Castaic Lake - Diamond Valley Lake - Lake Matthews - Lake Perris - Pyramid Lake - Lake Silverwood - Lake Skinner– Los Angeles Reservoir

* Aqueducts provide 87% of the current Los Angeles water supply provided by the Department of Water and Power.

Water Use and Water Challenges

Students will:

- determine how water is used in the state of California and in southern California (agriculture, environment, urban)
- discuss the problem of water supply meeting water demand
- analyze their personal water use

Vocabulary

- agriculture • environment
- urban

Materials and Preparation

- Copies of page 18– 20
- Students' water logs from "Water Energy, and You" (page 14)
- Topographical wall map of California

Approximate Time Requirement

- 1 to 2 class periods

Procedures

I. Think About Water Use

A. Have students look at page 18—Water Use.

B. Read aloud and discuss the questions under Think About It....

II. Learn About Water Use

A. Direct students' attention to the large pie graph on page 18. Point out the percentages indicating how much water is needed by each of the sectors in the state. Discuss how water is used within each sector.

B. Tell students to look at the small pie graph on page 18. Explain that this graph shows how water is used in southern California. Ask students:

1. What differences do you notice in the graphs? Almost all the water goes to urban use in southern California.

2. Why do you think water use in southern California is so different from the state as a whole? Southern California is almost all homes, industries, and businesses. We have very little agriculture, but we do have lawns that use a lot of water.

C. (optional) Divide students into four stakeholder groups: - agriculture - environment - industry and business - homes and public services

Have each group prepare a brief presentation as to how water is used by their group, why water is so important to their group, and how their group could conserve water.

D. Discuss California's water use by asking students:

1. In what category are most of your personal uses of water? Personal uses of water are in the urban category.

2. How does the use of water in each sector affect you? - We eat the food that is grown by agriculture; - we use the products that are made by industry; - we shop in the stores and use the services of businesses; - we depend on fire fighting, street cleaning, and other public services; - we depend on the wetlands and freshwater basins for clean water; - we eat fish from rivers, streams, and oceans; - we enjoy the beauty and other benefits of the environment.

3. How do you think water use differs from region to region throughout the State? Southern California has a high urban water use; central California has a high agricultural water use; northern California has a high environmental water use.

III. Calculate Personal Water Use

A. Ask students to look at 19 — How Much Water Do You Use? Point out to students that for each use two amounts are shown—a regular amount and a water conserving amount.

B. Have students use the figures shown on this page to fill in the amounts of water for each water use they listed on their Personal Water Use Log (page 14) and total the number of gallons they used for one day. (NOTE: Estimate the amount of water for any uses not shown.).

Procedures (Continued)

III. Calculate Personal Water Use (Continued)

C. Take a quick tally to see what water uses were most common among students and what used the most water. Tell students that: - indoors, each person in California uses from about 50 gallons to more than 100 gallons of water each day; - outdoors, on average, each person uses almost another 100 gallons of water each day; - a family of 5 needs about 326,000 gallons of water a year—that's an acre-foot of water, which is enough to fill a football field a foot deep. Ask students how their use compares to these figures. Discuss why there might be differences.

IV. Think About Water Challenges

A. Have students look at page 20 — Water Challenges.

B. Read aloud and discuss the Think About It.... question.

V. Learn About Water Challenges

A. Have students read the text under Learn About It.... Then use the following questions to generate a discussion.

1. Why is supplying water to everyone that needs it—especially in southern California—so expensive? We import much of our water in southern California, and it is expensive to build and maintain aqueducts, reservoirs, and pumping plants.

2. How does supplying water affect the environment? Water is pumped from rivers and streams where plants and animals live. And a lot of land is needed for aqueducts, reservoirs, and pumping plants.

3. What are the costs of supplying water? Costs include building and maintaining aqueducts and reservoirs and paying for a lot of electricity to pump water along the way, especially over huge mountains. The Los Angeles Aqueduct is gravity fed and doesn't have huge energy requirements.

4. How is the population of California changing and why is that a problem for water supply? The population grows every year, and all those people use water—directly and indirectly.

B. Direct students' attention to the bar graph on page 20 showing the population in southern California and the amount of water used. Ask students to look at the graph and determine: - how much water was used in 1990? - how much water was used in 2000? - what is the water supply in 2009?

C. Read aloud the text under the graph. Have students figure the amount of water that will be needed in 2020 for the projected population and fill in the graph. 213,000 (acre feet of water/one million people) x 21 (million people) = 4,473,000 acre feet of water

D. Point out to students that even though the amount used per person has decreased, we need to use water wisely because of weather variability and projected population increases.

Extension Activities

- Make pictographs showing the various uses of water in each sector. Locate pictures, or draw them, showing many different uses of water in agriculture, industry, business, homes, cities, the environment.
- Investigate indirect uses of water—that is, water that they do not use first-hand but that is needed to make products they use or to provide services they use. How much water is needed for such indirect water uses as: generating electricity, growing wheat to make bread, manufacturing a car, raising a cow, cleaning streets?
- Begin a water issues file. Look through newspapers, magazines, and the Internet for articles about water supply in California. Discuss the articles, especially if there are conflicting viewpoints.

Water and The Future

Students will:

- learn about ways to stretch our supply of water— recycling, desalination, conservation, groundwater and stormwater capture
- solve math problems related to water use

Vocabulary

- conservation • reclaimed water
- technology • desalination
- recycled water • water efficiency
- drought

Materials and Preparation

- Copies of page 21-23
- Pages 29-39 Part II local Water Supplies in "Water, Energy, the Environment and You" Teacher's Guide
- Materials for recycling demonstration - two clear gallon containers - a measuring cup - water (175 ounces, about 1½gallons)
- Materials for desalination demonstration - teakettle - cup of salt water - 2 teacups (enough salt added to water - hot plate to taste the salt) - oven mitt - straws

Approximate Time Requirement

- 1 to 2 class periods

<u>Procedures</u>

I. Think About Water & the Future

A. Have students look at page 21—Water and The Future.

B. Read aloud and discuss the questions under Think About It....

II. Learn About Recycling

A. Have students read the first paragraph on page 21 under Learn About It....

B. Display a clear gallon container and tell students that this container is going to represent the supply of water for homes in their community for a year. Have students fill and mark the container (with tape or marker) as follows:

- add 3 oz., mark the level, and label: DRINKING & COOKING - 3%
- add 5 oz., mark the level, and label: FAUCETS - 5%
- add 11 oz., mark the level, and label: LAUNDRY - 11%
- add 15 oz., mark the level, and label: BATHING - 15%
- add 19 oz., mark the level, and label: TOILETS - 19%
- add 47 oz., mark the level, and label: OUTDOOR USES - 47%

Explain that the percentages indicate the approximate amounts needed by homes in California for each particular use.

C. Ask students:

1. What needs the most water? Outdoor uses consume the most water.

2. What uses the most water in the house? Toilets use the most water.

3. For each use, what happens to the water?

   - For toilets, bathing, laundry, and faucet uses, the water goes down the drain, into the sewer, then to the wastewater treatment plant.
   - For drinking & cooking, the water is consumed by us.
   - For outdoor uses, the water soaks into the ground or evaporates or runs off onto pavement and into storm drains.

D. Show students the empty container and tell them that it represents the wastewater treatment plant. Have students "dispose" of the water in the first container appropriately—that is:

- use the water labeled OUTDOOR USES to water plants, or trees, or the lawn
- pour the water from FAUCETS, LAUNDRY, BATHING, and TOILETS into the empty container (signifying down the drain to the wastewater treatment plant)

Procedures (Continued)

- drink the water labeled DRINKING & COOKING (if you are sure that the water and the container are clean; otherwise, water a plant)

E. Tell students that there is a drought and that your community's total supply of water for household uses is now only 3/4 of what it was the year before. Refill the first container with 75 ounces of clean water. (NOTE: If instead of a drought, the population increased, the original supply might stay the same – 100 ounces – but the amount needed for each of the uses shown on the container would increase. The resulting effect would be the same.)

F. Ask students:

1. Is there enough water for all the uses? No.

2. How could the supply be extended to have enough? Water that went down the drain to the wastewater treatment facility could be recycled to water lawns (even perhaps for drinking with new technology). Better yet, lawns could be replaced with low water use gardens.

3. Would there be enough water if some of the water in the wastewater container were used? Yes, and some would even be left over.

4. Is water recycled? Yes. California has been recycling water to use for irrigation for many years.

G. Have students read the information about "Recycling" on the copies of page 21. Discuss:

- What can recycled water be used for?
- Why is recycled water sometimes more expensive?

III. Learn About Desalination

A. Ask students:

1. Where do you see the most surface water when you look at a world map or globe? Most surface water is in the ocean.

2. Why don't we use ocean water? It's too salty.

3. Is there any way to take the salt out of the water? Yes. Salt can be removed through desalination.

B. Set up the desalination demonstration:

1. Pour the cup of salt water into the teakettle.

2. Ask a student to use a straw to taste a little of the water and tell the rest of the class how it tastes.

3. Place the teakettle on the hot plate.

4. Heat the salt water until it boils and turns into steam.

5. Put on the oven mitt and hold one teacup upside down over the escaping steam from the teakettle so the water vapor collects in the cup.

6. Place the second teacup underneath so that as the vapor condenses, water will drip into the second cup.

7. When most of the water has boiled out of the teakettle, have students taste the water that has collected in the teacup. Explain that the water has been "distilled," which is one method (though not the one commonly used) to remove salt from water.

C. Have students read the information about "Desalination" on page 21. Discuss:

1. Where is desalination being used in California now? Desalination is being used in several places. Large plants are on Santa Catalina Island and in the Monterey Bay area. A research desalination facility has been built in Long Beach. There is a new plant serving San Diego County.

2. Why aren't we desalting more water? Currently, desalination is expensive. And it may upset the ecological balance of the marine environment.

- Desalinization plants are located at sea level. They use electricity to purify sea water, and almost all of the water from these plants has to be pumped. This is costly because it is energy intensive.

Procedures (Continued)

IV. Learn About Conservation

A. Have students read about "Conservation" on page 22 and ask:

1. Why is conservation a key way to stretch our water supply? Conservation would: - increase our supply at no extra cost - decrease our costs for distributing water - decrease our costs for cleaning wastewater - benefit the environment by taking less fresh water out of it and discharging less wastewater into it.

2. What are the two major methods of conserving water? We can conserve water with: - new technologies, such as toilets and washers that use less water - non-wasteful practices, such as taking shorter showers and planting low water-use plants.

3. Overall, is more water used indoors or outdoors? More water is used outdoors.

4. What are some ways to reduce outdoor water use? We can plant low-water use plants, turn sprinklers off in the rain, use a broom instead of a hose.

5. According to the pie graph, what are the top three uses of water indoors? Toilets, clothes washers, and showers are the top three water users indoors.

B. Have students brainstorm ways to conserve water. Tell them that when they analyze their Home Water & Energy Surveys they will learn more about ways to save water.

V. Solve Math Problems

A. Have students look at page 23— Water Math. Read the directions for Parts A and B aloud and have students work on the problems either: - individually - in pairs or groups - together as a class (especially #2 in Part B)

B. Correct the exercise with the class, working through the problems and discussing the answers. Answers available on page 24.

Extension Activities

- Research proposals to reduce water use. Find out about the Green New Deal. What legislation or other proposals have been presented to meet that order? What would you propose? For an example, see a recent announcement by Mayor Eric Garcetti that LA will recycle 100% of its wastewater by 2035, which will allow LADWP to reliably source a majority of its water sustainability and locally instead of depending significantly on imported water (see: plan.lamayor.org).
- Conduct a shower versus bath experiment Have all students who have bathtubs at home fill their tubs to take a bath, but tell them that before they get in the tub to measure the depth of water. Make a chart in class recording the various depths of water. Next, tell students to take a shower in the same bathtub, but before they begin they should close the bathtub drain so that the water will collect in the tub. Tell them to time their shower and to measure the depth of water that has collected in the tub when they are finished. Record the figures on the chart and compare.
- Research conservation products and report on water savings. Determine an average cost for various new water-saving products (e.g., Energy Star washing machine, Water Sense toilet, low-flow showerhead). Then, calculate how much water is saved and how long the product will take to "pay for itself"—that is, even though a new water-efficient product may be more expensive to buy, it costs less to operate, so how long will it take to make up the extra cost to purchase the product?
- Research and design a graywater reclamation system. Find out how various designs work for recycling water at home, what regulations must be followed, and what problems might exist? Have the class work in teams to research city regulations and design a system for a new home that is being built.
- Research the economics of recycling water. Compare using recycled water to using imported water. What are the differences in cost? What are the advantages and disadvantages of each?

How Are Water and Energy Used?

List all the ways you can think of that people use water and energy in homes, in businesses, in the community, on farms.

Water Uses	Energy Uses

Water, Energy, & You

CHECK THIS OUT:

Go online to

www.ladwp.com/waterconservation

www.ladwp.com/energyefficiency

Think About It...

- What would a day be like **without** water or energy?
- How have you personally used water and energy today?
- How do you think your use of water and energy compares to people's use 100 years ago?
- Is there enough water and energy to last forever?

Learn About It...

We need water and energy.

Water makes up about 65% of our bodies; we cannot live more than about a week without drinking water. And we need water to grow our food and make products that we use every day.

Energy is essential to life; we could not exist without the heat, light, and food that are created by the energy the sun provides. And, of course, we use energy in so many other ways, from cooking our food to running our cars.

We use **a lot** of water and energy every day. Is there a never ending supply? Well, yes...and no.

Water does fall from the sky, but it is not "new" water. The amount of water on Earth never increases or decreases. We have a fixed supply that moves from one place to another in different forms (i.e. snow, rain, surface water).

Heated by the sun, water on the ground in oceans, lakes, rivers, streams, and other areas *evaporates*; water vapor is also released from plants through *transpiration*. All this water vapor rises into the air, cools, and *condenses* into tiny droplets that gather and form clouds or fog. Finally, when the clouds meet cool air over land, *precipitation* in the form of rain, hail, sleet, or snow is triggered, and water returns to the land or sea. Thus, the water you use is the same water used by dinosaurs, early Native Americans, pilgrims, and your great grandparents.

Energy—which produces heat, light, or motion—comes from many sources, such as:

- fossil fuels (oil, natural gas, coal)
- the sun
- the wind
- the ocean

Some of our energy sources are *renewable*; they can keep on providing energy. For example, we expect the sun to keep shining and the wind to keep blowing. However, the energy sources that we depend on the most—oil, natural gas, and coal—are *non-renewable*. There is only a limited supply of these fossil fuels in the earth. Once they're gone, they're gone forever.

Our supply of water and energy meets our needs most of the time. But, in times of drought and during periods of high energy demand, we don't have enough water and energy. And as the population grows every day so does our demand for water and energy, yet our supply is decreasing as we find more ways to use these precious resources.

So how can we be sure we have enough for the future?

PERSONAL WATER USE LOG

For one day, keep track of everything you do that uses water and the number of minutes the water is running for each use. LATER, you will fill in the number of gallons used and then compare your daily water use to that of others.

Name:______________________________ Date:____________

Water Use	Number of Minutes Water Running	Gallons Used
Example: shower	12 minutes	

TOTAL _______ **gallons**

PERSONAL ENERGY USE LOG

For one day, keep track of everything you do that uses energy and the number of minutes or hours that you use that energy. LATER, you will fill in the number of kilowatt hours or BTU used and then compare your use to that of others.

Name:________________________ Date:____________

Energy Use	Number of Minutes or Hours Energy Used	Kilowatt Hours* OR	BTU Used**
Example: radio	25 minutes		

* One kilowatt-hour (kWh) is 1,000 watts of electricity use for one hour—e.g., a 1,000 watt hair dryer used for one hour, or a 100 watt light bulb burning for 10 hours.

** One BTU, which stands for British Thermal Units, signifies the quantity of heat needed to raise the temperature of one pound of water by one degree Fahrenheit; it is a very small unit.

TOTAL _______ **kWh** _______ **BTU**

Water Sources

Think About It...

- Where does the water you drink and use every day come from?
  - How much of the water from rain, and other precipitation, is available for us to actually use?

CHECK THIS OUT:
Go online to www.nationalatlas.gov/natlas/Natbsstart.asp for a map showing all aquifers and surface water in California.

Learn About It...

We get all the water we use from only two places – **on** the ground and **under** the ground.

Surface Water

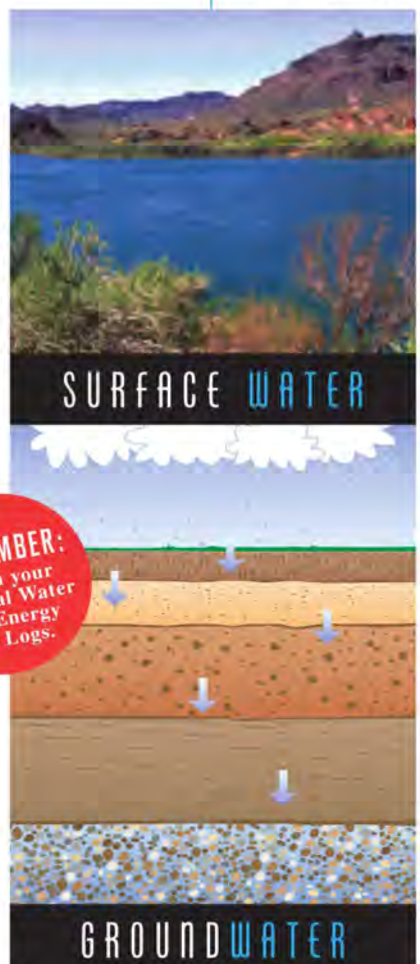
Water on top of the ground is called *surface water*. We can see this water in:

- lakes
- rivers
- streams
- oceans

How does the water get there? From rain, of course, and snow and sleet and hail. In California, about 200 million *acre-feet* of water falls from the sky every year; that's about the same as 200 million football fields each filled a foot deep with water. One acre-foot is about 326,000 gallons, so that's a lot of water. But only about ⅓ of that water actually ends up in rivers, lakes, and streams. The rest of it is either used by trees, plants, and animals or soaks into the ground or evaporates.

REMEMBER: Fill in your Personal Water and Energy Use Logs.

Most of California's rivers, streams, and lakes are in the north because that's where about 75% of the precipitation falls. Southern California has much less rain; therefore, southern California has few natural lakes and rivers.



Groundwater

Water that soaks into the ground collects in basins called *aquifers*. These aquifers are not like lakes above ground. They are more like sponges, holding water in spaces between particles of sand and gravel and in cracks in rocks.

Where does your city get its water? Go to www.bewaterwise.com to find your local agency.

California has about 500 aquifers. Some are just the size of small pools; others are miles long and hundreds of feet deep. Some are just a few feet underground; others are thousands of feet underground. In all of them, the water gets there by soaking into the ground from:

- rain
- irrigation of crops
- river and stream beds
- recharge ponds where water is purposely spread on the ground to refill the aquifer.

That's how water gets into the ground. How do we get it out? Wells are drilled into the ground and electric pumps push the water up to the surface. But even though a lot of water is stored underground, we can't pump it all up. Some of it is too deep and too expensive to reach, and some of it is too salty or too polluted.

Even if we could, we shouldn't pump out all the *groundwater* because that can cause *overdraft*, which causes problems, such as:

- The ground may compact and never be able to hold water again.
- Land may sink, causing buildings, roads, and pipelines to crack or break.
- Plants depending on the groundwater may die.

For the entire state of California, during most years—

- about ⅔ of the water we use comes from surface water
- about ⅓ of the water we use comes from groundwater.

The City of Los Angeles gets about 11% of its water from groundwater and 87% from surface water.

In southern California, like the rest of the state, about ⅓ of the water we use during most years comes from groundwater. However, local surface water supplies southern California with only about 2% of our water, not 60-70% like the entire state.

So where do you think the rest of the water we use in southern California comes from?

Water Distribution

Think About It...

- 75% of the people in California live in the central and southern part, but 75% of the rain and snow falls in the northern part of the State, so how does the water get to where it is needed?
- What do we do in drought years when less rain falls and less water is available to use?

Learn About It...

Throughout California—especially in southern California—more water is needed in some places than is locally available. So we move water to where it is needed.

Aqueducts

To carry water across land and over or through mountains in California, channels, pipelines, and tunnels have been built. This system of *aqueducts*—which literally means to lead water—moves more water farther than anywhere else in the world.

In southern California, about 66%* of the water we use is imported through three aqueducts:

- Los Angeles Aqueduct
- Colorado River Aqueduct
- California Aqueduct

Reservoirs

All along the aqueducts are *reservoirs* that are used to store the water until it is needed. These reservoirs might be large storage tanks or lakes formed by dams. In times of heavy rain, excess water can be stored in the reservoirs. The water can be saved for use in case of a severe drought or an emergency—such as an earthquake—or in times of high water demand—such as in hot summer months.

More than a thousand reservoirs store water throughout California. In southern California, seven major reservoirs—as well as many smaller ones—store water from the three aqueducts used to import water into the region.

Many reservoirs provide other benefits:

- *Recreation.* Like natural lakes, some reservoirs are used for fishing, swimming, boating, and water-skiing.
- *Flood control.* Reservoirs and the dams that create them can protect land from flooding by holding back water.
- *Clean, low-cost electricity.* Some reservoirs have hydroelectric power plants that produce electricity when water is released from dams to turn turbine-generators. This electricity contributes to the energy needed to pump water.

* In the city of Los Angeles, 87% are from the three aqueducts.

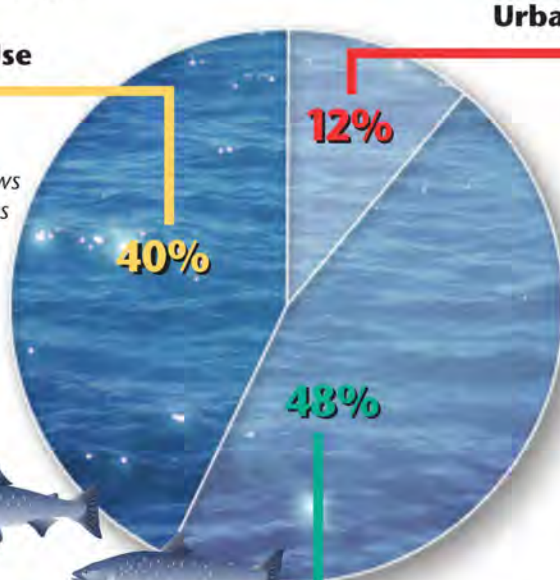
Water Use

Think About It...

- Besides personal uses, what else is water needed for?
  - What do you think the most water is used for in California?

Learn About It...

In California, we use all the water we have available to use. We even bring extra water into California from other states. Here's where the water goes:



Agricultural Water Use

- **Crops** *(for people—California grows half the fruit and vegetables eaten in America—and for animals, e.g., alfalfa and corn)*
- **Animals** *(for drinking, e.g., a cow can drink 35 gallons a day)*

Urban Water Use

- **Homes** *(toilets, faucets, hoses, etc.)*
- **Businesses** *(shops, office buildings, restaurants, hotels, car washes, etc.)*
- **Industry** *(to make products, to cool machinery, to produce food, etc.)*
- **Public services** *(street cleaning, fire fighting, park watering, etc.)*

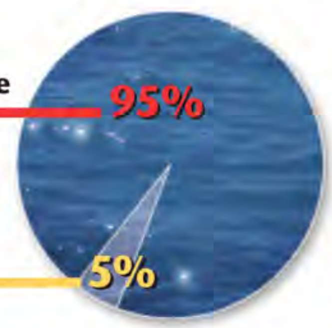
Environmental Water Use

- **Streams** *(to keep flowing)*
- **Plants and trees** *(to live)*
- **Wetlands** *(to stay healthy)*
- **Fish and other animals** *(for habitat and to drink)*
- **Coastal freshwater basins** *(to keep ocean water out)*

In southern California, water is divided up differently.

Urban Water Use

Agricultural Water Use



How is water used in your area? Go to www.bewaterwise.com to find your local agency.

Why is water use in southern California so different from the state as a whole?

How Much Water Do You Use?

- Use the figures below and your Personal Water Use Log to calculate how much water you used in one day.
- Is it more or less than the average?
- How can you reduce your total water usage?

Water Use	Estimated Regular Amount	Estimated Water Conserving Amount
Toilet Flush	1.6 gallons per flush	≤ 1.1 gallons per flush for high-eficiency toilets
Shower	2.5 gallons per minute	1.5 gallons per minute with low-flow showerhead
Brush Teeth	7.5 gallons water running for 3 minutes	0.1 gallons water running for 12 seconds and then turned off
Wash Hands	1.9 gallons water running for 45 seconds	0.2 gallons while turning off water when washing hands
Wash Dishes by Hand	30 gallons water running for 12 minutes	6 gallons with sink full of water
Automatic Dishwasher	10 gallons regular cycle	4 gallons cycle
Clothes Washer	35 gallons per load	13 gallons for water-efficient washer
Water Yard with Automatic Sprinkler	450 gallons for 30 minutes	225 gallons for 15 minutes
Faucet	2.5 gallons per minute	0.5 gallons per minute with aerators

Water Challenges

Think About It...

- We have water on the ground and under the ground; we move water to where we need it; we store water for when we need it; we use water over and over. So, what's the problem?

Learn About It...

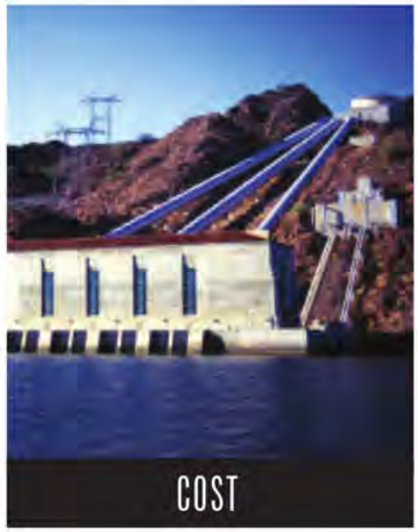
Providing water to all the people that need it is not a cheap and easy job. And the job is only getting tougher. Why?

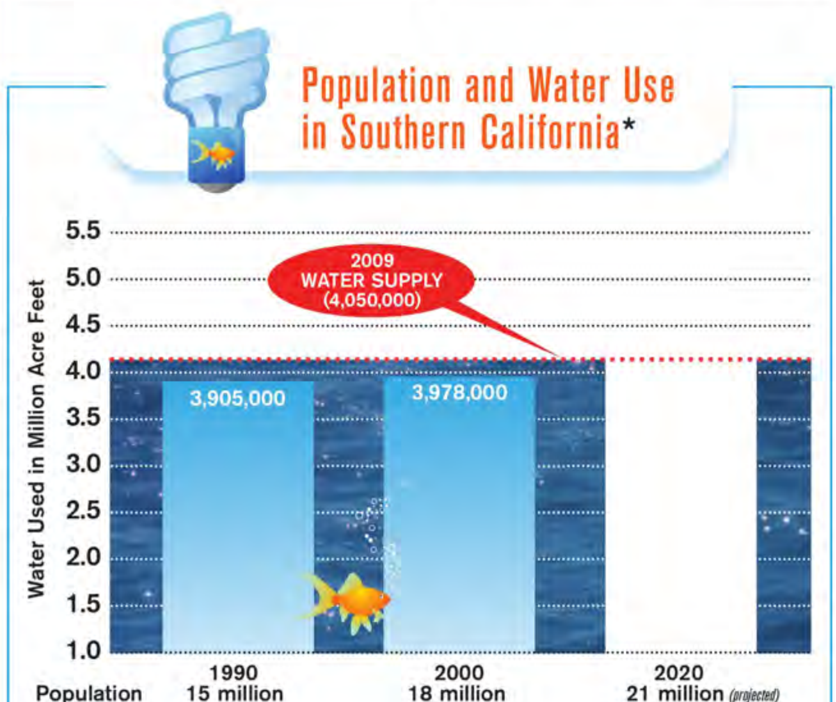
- **First, cost.**
  It is very expensive to build and maintain aqueducts and reservoirs. Water must be pumped along the way and lifted over huge mountains. Great amounts of electricity are used, which costs a lot of money.

- **Second, the environment.**
  Taking water out of rivers and streams can have negative impacts on the plants and animals that depend on them and on the people that enjoy them. Water companies try to affect the *environment* as little as possible. But even so, large amounts of land are taken up by aqueducts, pumping plants, dams, and reservoirs. And when dams are built to form reservoirs, land is flooded, which obviously affects the people, animals, and plants that live there.

- **Third, population.**
  More people are being born and more people are moving into California every year. According to California's Department of Finance, the state's population can increase by as much as 500,000 people a year. Thus, more water is needed every year, not just for personal uses but also to build more houses, to grow more food, to make more products, and to generate more electricity.

So where will we get more water?





The graph above shows the growth in population and water use in southern California. Currently, every 1 million people account for approximately **213,000 acre feet** of water a year for both direct and indirect uses (an acre-foot of water is about 326,000 gallons). If the population in 2020 reaches 21 million as expected, how much water will be needed? **Show your answer on the graph.**

**From Metropolitan Water District of Southern California*

Water & the Future

Think About It...

- If there's only a fixed supply of water, how can we get more?
  - Do you waste any water?

Is recycled water used in your area? For what purposes?

Learn About It...

We can't manufacture water. The surface water and groundwater that we have are all that we'll ever have. But we can stretch our supply.

Recycling

Water that goes down the drain ends up at a wastewater treatment facility. At these facilities, water goes through a series of cleanings and treatments. Some of this *"reclaimed"* water is put back into the environment—rivers, lakes, the ocean, the ground. But some of it, after even more cleaning, is *recycled*—that is, it is delivered to people to use.

California has been using reclaimed water for irrigation for about 70 years. Now recycled water can be used for all purposes, even drinking in some places. Most recycled water is used:

- to water school grounds, cemeteries, golf courses, nurseries, parks, greenbelts
- to irrigate crops and pastures
- to manufacture products and cool industrial machinery
- to make snow, fight fires, clean streets
- to flush toilets
- to recharge groundwater

In southern California, there are many water recycling facilities—some very small, some quite large. One facility in Irvine, part of Municipal Water District of Orange County, supplies recycled water to commercial high-rise buildings to flush toilets. But reclaiming water to recycle it is expensive. First, of course, money must be spent to clean the water. Then we must also build separate pipelines, pumps, and storage reservoirs for the recycled water. However, as more facilities are built and more recycled water is used, the cost of recycled water will decrease. Using more recycled water can help California maintain a reliable supply of fresh water.

WATER RECYCLING

DESALINATION

Desalination

Where is most of the surface water on the earth? In the ocean, of course. But ocean water is too salty to drink. We can, however, take the salt out of the water in a process called *desalination.*

California already has several desalination plants. One plant on Santa Catalina Island, off the coast of southern California, produces 25% of the island's drinking water. The desalination plant in the Monterey Bay area is the largest in the state.

Because California is next to the ocean, plenty of salt water is available. However, turning seawater into fresh water is much more expensive than other methods of supplying fresh water. Money must be spent not only to build and maintain the plants but also to pay for the huge amounts of energy it takes to remove the salt. Then the salt must be disposed of. It is often put back into the ocean, where it may upset the delicate ecological balance of the marine environment.

In Long Beach, part of Metropolitan Water District of Southern California, a desalination research and development facility has been built to study new technologies to reduce energy use and minimize environmental impact.

As technology improves and as we need more water to meet our growing demand, desalination may become a cost-effective reliable source of water.

Water & the Future

Continued....

CHECK THIS OUT:

Go online to **www.bewaterwise.com** for more water conservation tips.

Conservation

The best way to stretch our water supply is to conserve water. *Conservation* means not wasting water and using water efficiently, that is getting the same results using less water.

Californians are familiar with conservation. California, especially southern California, has always had *droughts*—long dry periods without much rain or snow. The longest drought in California lasted 60 years! During these times, people had no choice but to use less water. But if we used less water **every day**, we could:

- make our water supply go further
- reduce costs for distributing water
- benefit the environment by taking less fresh water out and putting less wastewater back in.

Water can be conserved in homes, on farms, at businesses, and in industries—through both improved technology and non-wasteful practices.

Improved Technologies

Advances in *technology* are helping us conserve water indoors and outdoors. Improvements in *water efficiency* include:

- faucets and showerheads that put out fewer gallons per minute
- toilets that use less water with every flush
- clothes washers and dishwashers that use 40% less water
- recycling systems for water used in car washes, laundromats, amusement parks, factories, power plants
- drip irrigation systems that put water only where it is needed
- evapotranspiration (ET) systems that monitor the evaporation from soil and the transpiration from plants to determine the exact amount of water lawns and plants need
- irrigation systems that return runoff from the bottom of a field to be used again.

Water-Saving Practices

In southern California, 95% of water use is in the urban sector. Therefore, reducing water use in our homes is especially important. For example, everyone can:

- turn water off when brushing teeth or washing dishes
- take shorter showers
- wash only full loads in clothes washers and dishwashers

Typical Household Water Use (Indoor)
From Metropolitan Water District of Southern California

Though very important, the amount of water used indoors is far less than the amount of water used outdoors in southern California—especially for landscape watering. Up to 70% of a household's water use can go outdoors. To help reduce that amount, people can:

- plant low-water use California Friendly® plants
- turn off sprinklers when it's raining
- use a broom instead of a hose to clean pavement.

Conservation—with both water-saving devices and practices—can save millions of gallons of water, as well as millions of dollars, every day.

How can you conserve water?

WATER MATH

Part A: Look at the sample water rates and water bill below to answer the following questions.

LA DWP Los Angeles Department of Water & Power

AUTO PAYMENT Aug 13, 2018

Page 6 of 11

Water Charges

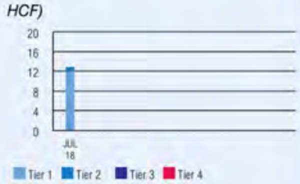
BILLING PERIOD 6/12/18 - 7/27/18 — **DAYS** 45

RATE SCHEDULE
Water Schedule A - Single-Dwelling Unit Residential

NEXT SCHEDULED READ DATE
9/26/18

ALLOTMENT		TEMP ZONE
Tier 1	12 HCF	LOW
Tier 2	16 HCF	
Tier 3	24 HCF	

USAGE HISTORY *(Total HCF)*



	Prev Yr	Jul 18
Total HCF used	0	13
Average daily gallons	0	216
Days in billing period	0	45
Your average daily cost of water		$1.86
Your average cost per gallon of water		$0.01

1 Hundred Cubic Feet (HCF) = 748 Gallons

METER NUMBER	CURRENT READ	–	PREVIOUS READ	=	TOTAL USED
00000000	1916		1903		13 HCF

Tier 1 Water	12 HCF x $6.26833/HCF	75.22
Tier 2 Water	1 HCF x $8.36/HCF	8.36
Subtotal Water Charges		**$83.58**
	Total Water Charges	**$ 83.58**

1. How many Units of Water (HCF) did this customer use during this billing period? ________

2. What is the total cost for water during this billing period?
$ ________

3. Use the chart at the bottom of the bill to fill in the blanks:
   a. _______ Number of HCF used in Tier 1
   x_______ Average cost per HCF in Tier 1
   =_______

   b. _______ Number of HCF used in Tier 2
   x_______ Average cost per HCF in Tier 2
   =_______

4. If 3 fewer HCF were used, approximately how much would the bill be? $ ________

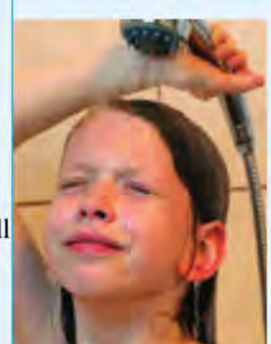
Part B: Use the figures from your "Personal Water Log" on page 14 To answer the following questions:

1. a. How many gallons of water would you use in a year?________
   b. How many gallons of water have you used in your life so far? ________
   c. How many would you use by the time you are 50?________

2. a. What is the range of daily water use in your class?
   From ________to ________
   b. What is the average use?________
   c. What is the median use?________

3. Estimate how much water would be used each day for personal uses. . .
   by your class?________
   by your entire school?________
   by your community?________
   by people in southern California (*population 19 million)*?
   ____
   by people in the entire state (*population 38 million)?*
   ____

4. How many fewer gallons would you have to use every day to reduce your water use
   a. by 10%?________
   b. by 20 %?________
   c. How would you do it?



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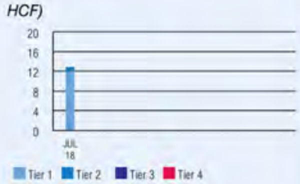

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2. What is the total cost for water during this billing period? $ __83.58__

3. Use the chart at the bottom of the bill to fill in the blanks:
   a. __12__ Number of HCF used in Tier 1
   x 6.26833 Average cost per HCF in Tier 1
   = 75.22

   b. __1__ Number of HCF used in Tier 2
   x 8.36 Average cost per HCF in Tier 2
   = 8.36

4. If 3 fewer HCF were used, approximately how much would the bill be? $ __62.68__

Part B: Use the figures from your "Personal Water Log" on page 14 To answer the following questions:

Variable Answers Below

1. a. How many gallons of water would you use in a year?________
   b. How many gallons of water have you used in your life so far? ________
   c. How many would you use by the time you are 50?________

2. a. What is the range of daily water use in your class?
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   c. What is the median use?________

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   by your entire school?________
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   by people in southern California (*population 19 million*)?
   ____
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   ____

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