Seal Rock: Water, Water Everywhere?

Key Concepts

1. Water is necessary for life as we know it.
2. The areas of Seal Rock Campground are shaped by water; the plants and animals that live in those areas are dependent upon water, and water serves as the link between them.
3. Very little of the Earth's water is available for use by plants and animals, including humans.

Water is the source of life as we know it and the connecting thread which runs through the activities in this Seal Rock Marine Trail Curriculum Guide. In "Seal Rock: Water, Water Everywhere?" students perform a serial subtraction activity to visualize where water is found on Earth and as a way to recall the importance of water in sustaining life.

Materials

For class:

- photograph of the Earth from space

For each group of 3-4 students

- 3 liter jars
- 5 small plastic cups
- stick-on, removable labels (one for each jar and cup)
- a 50 ml graduated cylinder
- a 10 ml pipette and bulb
- a calculator
- pen or pencil
- piece of paper

Teaching Hints

Beginning with 1000 ml of water representing all of the water on earth, students make a series of predictions, subtractions, and comparisons to help them visualize the relative abundance of different water types and sources.

While this activity may be performed as a demonstration, there is much to be gained by having groups of students do the manipulations. Either way, the questions found in the text of the activity provide the material for a discussion of the topic.

If you have not already done so, take a few minutes to look ahead to the field trip that is at the core of this curriculum. Be sure to check the tide tables prior to scheduling your trip. Plan to arrange the order of the field activities to make best use of the tides. Schedule the beach activities for the period of low water.

Essential Academic Learning Requirements in Science

1. The student understands and uses scientific concepts and principles. (1.3)
2. The student knows and applies the skills and processes of science and technology. (2.1, 2.2)

Answer Key

Activity 1: Where's All the Water

1. No, all of the earth's water is not usable by humans for drinking and agriculture because most of it is either saltwater or tied up as snow and ice at the poles. While the answer to this question is obvious, it is included to get students to begin thinking about earth's water.

2. Answers will vary but should include lakes, rivers, and streams. Some students may mention freshwater in the form of ice and snow.

3. a. Polar ice and glaciers =
   6,980,000 cu. mi./ 326,000,000 cu. mi. x 100 = 2.14 % of the earth's total water

   b. 1000 ml x 2.14 % /100 = 21.4 ml ice in the "Earth Model."

   an alternative way of expressing this is:

   b. (1000 ml) x (% of earth's water which is ice) /100 = 21.4 ml ice in the "Earth Model"

4. a. the percentage of the earth's water which is stored as ground water = 2,000,000 cu. mi./326,000,000 cu. mi. x 100 = .61 %

   b. (1000 ml) x (% of earth's water which is ground water) /100 = 6.1 ml ground water in the "Earth Model"

5. a. Answers will vary regarding nearby lakes such as Lake Crescent, Lake Cushman and Lake Ozette.

   b. The biggest lake in the United States is Lake Superior, although part of it is in Canada. The biggest lake entirely in the United States is Lake Michigan.

6. a. the percentage of the earth's water held in lakes =
   30,000 cu. mi./326,000,000 cu. mi. x 100 = .0092 %

   b. (1000 ml) x (% of earth's water which is held in lakes) /100 = .092 ml

7. a. the percentage of the earth's water held in the atmosphere =

3,100 cu. mi./326,000,000 cu. mi. x 100 = .001 %

b. (1000 ml) x (% of earth's water which is held in the atmosphere) / 100 = .01 ml

8. a. the percentage of the earth's water found in rivers =

300 cu. mi./326,000,000 cu. mi. x 100 = .0001 %

b. (1000 ml) x (% of earth's water which is held in the atmosphere) / 100 = .001 ml

9. Answers will vary depending upon student predictions.

10. Answers will vary but are likely to include some of the following: drinking water, bathing, swimming, protection, travel, food processing, car wash, manufacturing, radiators, sidewalk cleaning, frozen juice bars, ice, transpiration. The object of this question is to get students to think about the ways in which we use water while taking it for granted.

11. Answers will vary but are likely to include some of the following: drinking water, bathing, swimming, protection, and travel.

12. Answers will vary.

13. Since most living things rely on fresh water, life would change dramatically if it disappeared or became polluted.

Activity 2: The Water Within

1. - 4. Answers depend on the body weight.

5. Water in our bodies comes primarily from water that we drink and water which is a component of the foods we eat.

6. To calculate the number of gallons in the adult harbor seal's body, the following procedure may be used:

   a. Weight of harbor seal = 300 pounds

   b. Multiply weight by 2 = 600 pounds

   c. Answer divided by 3 = 200 pounds (The approximate number of pounds of water in the seal's body.)

   d. A gallon of water weights about 8 pounds, so 200 pounds divided by 8 equals the number of gallons of water in the seal's body = 25 gallons.

   Note: This question assumes that adult harbor seals have the same percentage of water in their tissues as humans, a reasonable assumption for this level of precision.

7. To calculate the number of pounds of water in the female black tailed deer, the same procedure employed above may be used:

   a. Weight of black tailed deer = 160 pounds

   b. Multiply weight by 2 = 320 pounds

   c. Answer divided by 3 = 106 pounds (The approximate number of pounds of water in the black tailed deer's body.)

   Note: As with the harbor seal in question 6., this question assumes that black tailed deer have the same percentage of water in their tissues as humans.

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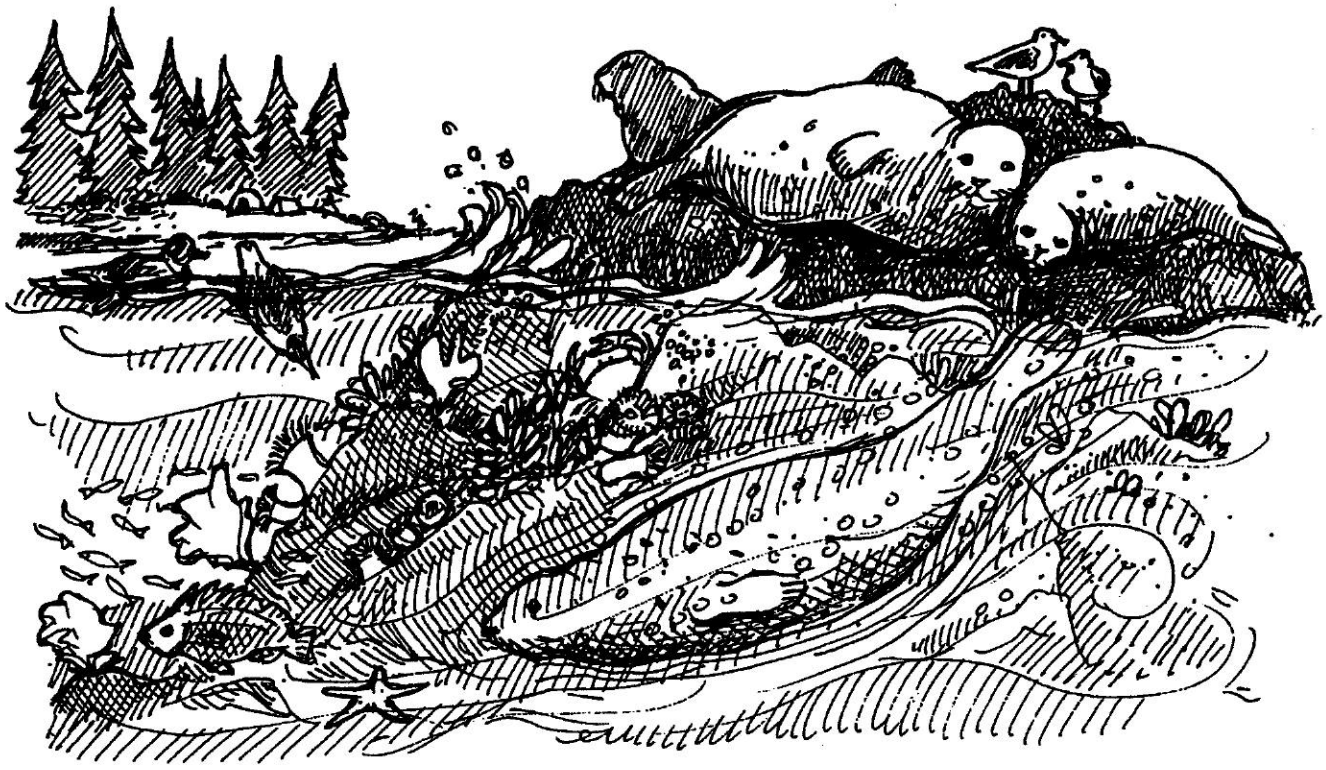


Seal Rock...what an enchanting name. Think of seals swimming in the open water of Hood Canal. Think of seals sunning themselves on the rocks. Think of the deep forest looming behind the rocky beach. All of these things and lots more are what you'll find at Seal Rock Campground. What do all of these things have in common? Water! The areas are shaped by water, the plants and animals that live here are dependent upon water, and water serves as the link between them. Let's begin by looking at this water.

Look at the photograph of your home planet. Only a few decades ago we had never seen a view like this of the earth. Pictures of our planet taken from spacecraft have changed our image of the earth, and we now give it names like "The Blue Planet" or the "Water Planet." If the earth had been named by a race of beings who first saw it from space, perhaps it would have been given such a name.

Scientists estimate that the total water on the planet equals 326,000,000 cubic miles. About 3/4ths of the earth's surface is covered with water. That's a lot of water! Seems like it ought to be enough for all the areas of Seal Rock Campground, for all of nature, and for human needs, too.

Yet even in the Pacific Northwest, an area famous for rain, people are arguing about water. There just doesn't seem to be enough water anymore for all the things we want to do with it. If the "Blue Planet" has so much water on it, why are we having these problems?

To find out one reason these problems are with us, try making a model of the earth's water supply. Imagine an earth only 4 feet in diameter. In this "Earth Model" all the water on the planet would equal just one liter! (That's just slightly more than one quart.)

Activity 1: Where's All the Water?

Measure 1000 milliliters (one liter) of water from your sink into one of the two tall jars. (Put it on a table or counter which will not be damaged by possible spills.) This container represents all the earth's water, possibly its most precious resource.

1. Is all the earth's water usable by humans for drinking and agriculture? Explain.

Of course it's fresh water we're most dependent on. But how much fresh water is there really?

Make a prediction by pouring from the container holding "the earth's total water" the amount of water that you think would represent the earth's fresh water supply into the second liter container. Label this container "Fresh Water Prediction." Set it aside for later.

Once again, fill the first container to the liter mark to represent all the water on earth.

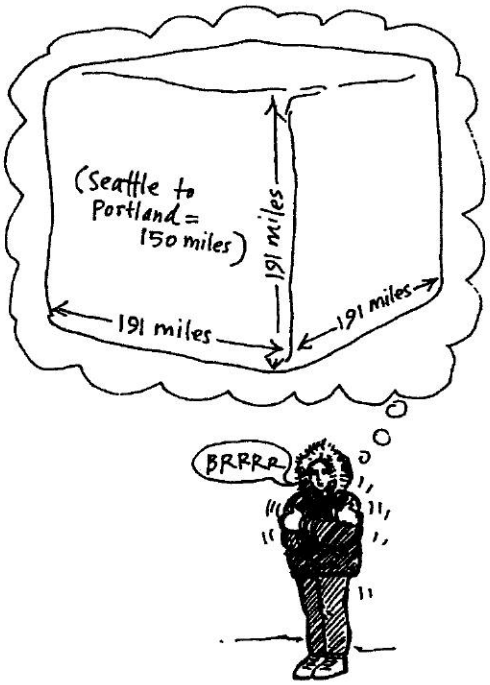
2. What are some places on earth that you would look for fresh water?

Here's a place you might not think to look, but there's actually more fresh water here than any other place. It's the polar ice caps and alpine glaciers.

Ice caps and glaciers contain water that fell as snow tens or even hundreds of thousand of years ago! Scientists believe the water stored in glaciers such as those in the Olympic Mountains is likely to be held there 10,000 years or more.

Just how much of our planet's fresh water is locked up in these ancient, frozen reservoirs? Scientists estimate they hold about 6,980,000 cubic miles of water.

To picture a cubic mile, imagine an ice cube one square mile on each side. Now try picturing 6,980,000 cubic miles of ice!



To find out what percentage of the earth's water is frozen, divide 6,980,000 cubic miles by the earth's total water and multiply by 100:

6,980,000 cu. mi./ 326,000,000 cu. mi. x 100 = ___%

Do that calculation now. Record and label your answer:

3. a. Polar ice and glaciers = ____% of the earth's total water

Putting this quantity into a percentage makes it easy to find out how much water would be ice in the "Earth Model." Here's what you do. Simply multiply the total water in the "Earth Model" (1000 ml) by the percentage of the earth's water which is ice, then divide by 100. Use the percentage you found in 3 a. above to find the answer:

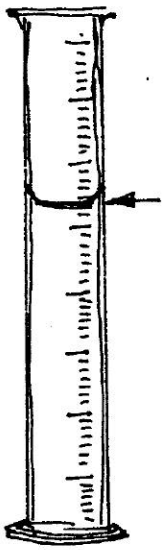
b. 1000 ml x ____% /100 = ____ml ice in the "Earth Model."

an alternative way of expressing this is:

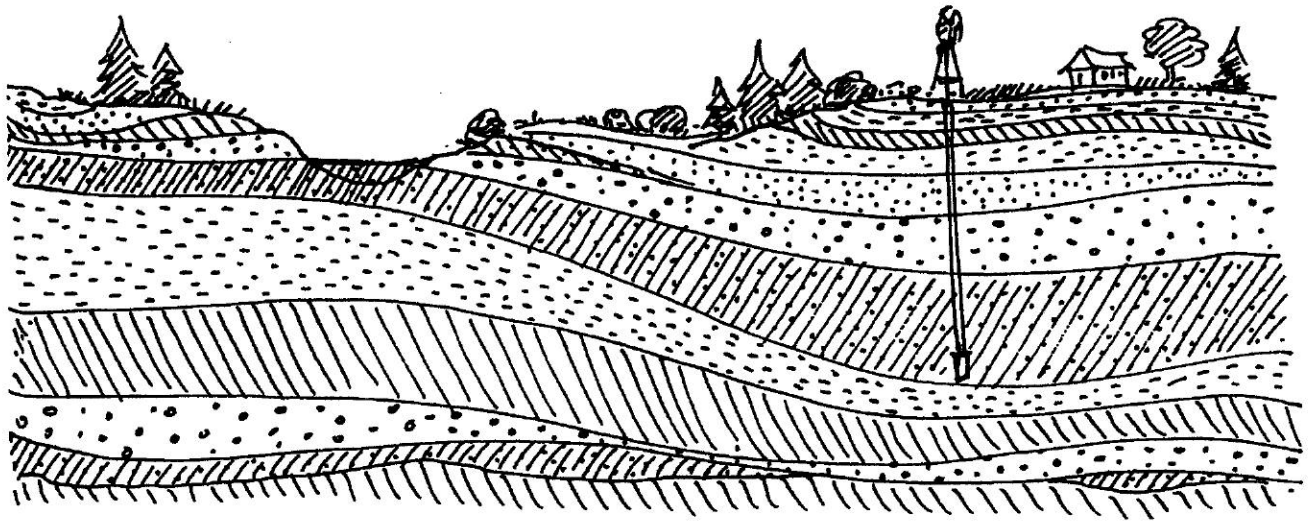
b. (1000 ml) x (% of earth's water which is ice) /100 = ____ml ice in the "Earth Model"

From the full liter container, measure this amount using a graduated cylinder. Pour it into a small cup and label the cup "Polar Ice Caps and Glaciers."

If using a graduated cylinder is new for you, here are some tips. The scale on the side shows its volume, divided into milliliters (mls.). When using a graduated cylinder to measure volume, always line up the lower edge of the water's curve (called the meniscus) with the line you're measuring against, as shown.



Where else would fresh water be found? If you dug a hole deep into the earth, in most parts of the world you would find water. This water is called "ground water." Ground water moves very slowly through deep soils and rock, so slowly in fact that it may have taken as many as 10,000 years to get there!



How much of our planet's fresh water is locked up in these deep underground reservoirs? Scientists estimate that 2,000,000 cubic miles of water are contained in the earth's ground water.

To find out what percentage of the earth's water is stored deep in the ground, divide 2,000,000 by the earth's total water and multiply by 100:

2,000,000 cu. mi./326,000,000 cu. mi. x 100 = % of water stored as ground water

Does this calculation look familiar? It should. You can use the same process to calculate all percentages.

4. Follow the same procedure you used earlier to calculate:

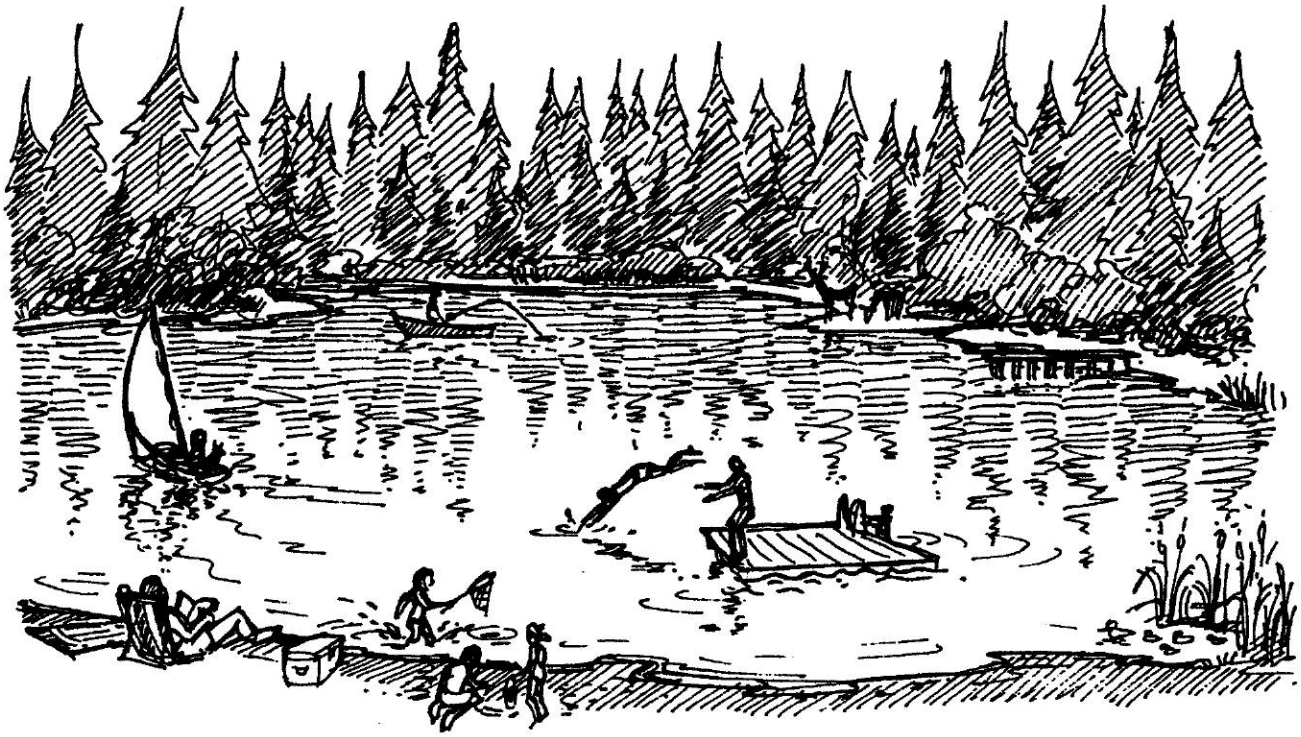
   a. the percentage of the earth's water which is stored as ground water: ____%

   b. the quantity of water which represents ground water in the "Earth Model": ____ml

Use the pipette to transfer this amount of water from the earth's total container to a small cup. Label this cup "Ground Water."

If using a pipette is new for you, you might like to spend a few minutes practicing using one. Draw water into the pipette by squeezing the pipette bulb, then empty it. What are the units on the pipette's scale? To measure a specific quantity, draw the water past unit to which you are measuring, and slowly release the extra water until the water level lines up with the unit you want. Finally, empty the pipette into the desired container. Don't worry about the small amount of water left in the tip of the pipette.

What about lakes? Chances are you were quick to think of lakes when asked to name sources of fresh water on the planet.



5. a. What is the name of a lake near where you live?

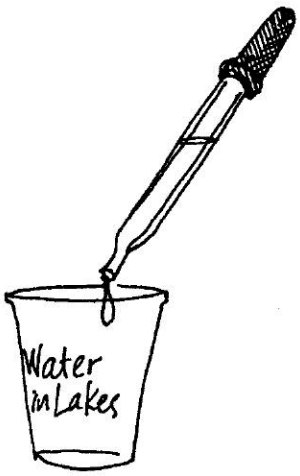
b. What is the name of the biggest lake in the United States?

Lakes are places where most of us can see large amounts of fresh water, yet all the lakes on earth combined hold only 30,000 cubic miles of water.

6. Follow the procedure you used earlier to calculate:

a. the percentage of the earth's water held in lakes: ____%

b. the quantity of water which represents lake water in the "Earth Model": ____ml



You may have difficulty measuring this amount of water even with the pipette! For the purposes of this exercise, you may use one drop of water to represent all the water found in the earth's lakes. Put this drop in a cup and label it "Water in Lakes."

Some of the earth's water is high above our heads. The atmosphere contains water vapor (the gas form of water) which is the source of rain, snow and clouds. We can't see, smell or taste water vapor, but we recognize it as water as soon as it condenses (reforms into liquid water) as rain or snow.

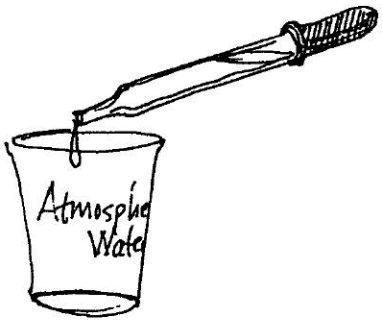
The atmosphere holds an estimated 3,100 cubic miles of water.

7. Calculate:

   a. the percentage of the earth's water which is held in the atmosphere ____%

   b. the quantity of water representing atmospheric water in the "Earth Model": ____ml

Once again you will need to represent the atmospheric water in the "Earth Model" with a small drop. Put this drop into a cup labeled "Atmospheric Water."



Where else do we find water? In rivers and streams, of course. To understand just how important rivers and streams are to our way of life, try imagining a world without them. Yet all the rivers and streams on the earth contain just 300 cubic miles of water!

8. Calculate:

   a. the percentage of the earth's water found in rivers: ____%

   b. the quantity of water representing rivers in the "Earth Model": ____ml

Use a wet finger to lightly streak the bottom of a cup. Label this cup "Water in Rivers."

The cups now represent where all the fresh and salt water on the planet is found.

9. How does the total fresh water in the "Earth Model" compare with the prediction you made at the beginning of this activity? (To find out, pour all your freshwater cups into the third liter container, which you can label "the earth's Fresh Water". Put it next to your jar labeled "Fresh Water Prediction.")

   a. Which jar has more water in it?

   b. How many times greater or less was your prediction than the actual amount of fresh water in the "Earth Model?"

10. Water is important to people and wildlife in many ways, some of which are in conflict. How many uses of water can you think of?

   a.
   b.
   c.
   d.
   e.
   f.
   g.
   h.
   i.
   j.

Can you think of 5 more?

k.

l.

m.

n.

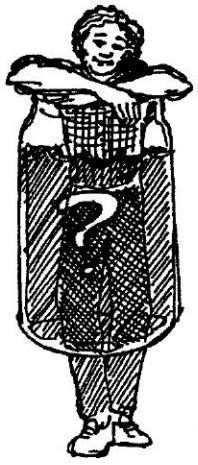
o.

11. What are some ways wildlife uses water?

12. How many of the 15 uses you listed depend on fresh water? Make a star by each use which does.

13. What would happen to life on earth if the fresh water disappeared or became polluted?

Activity 2: The Water Within



Not only does water shape the environment and determine what can live there, it makes up a large part of most plants and animals.

How many gallons of water are there in you? How many are in the animals of Seal Rock Campground? To find out, follow these steps, writing down what you get for each step.

1. Weigh yourself: ____ pounds

2. Multiply your weight by 2. ____

3. Divide your answer by 3. ____ (The answer is the approximate number of pounds of water in your body.)

4. A gallon of water weights about 8 pounds, so divide your answer by 8. This is the number of gallons of water in your body: _____.

5. Where does the water in your body come from?

6. Harbor seals are one of the larger mammals which visit Seal Rock Campground. An adult harbor seal may weigh 300 pounds.

   How many gallons of water are in such a seal?

7. Columbian black tailed deer also visit the forest and shoreline of Seal Rock Campground. A female mule deer may weigh 160 pounds. How many pounds of water are in such a deer?