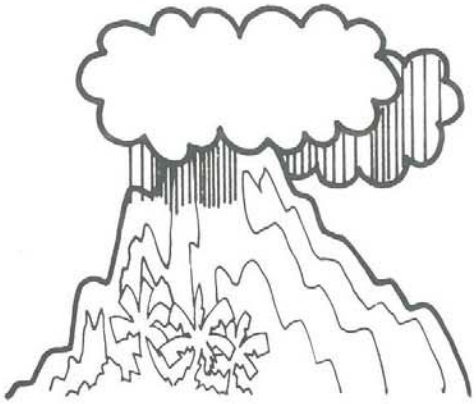
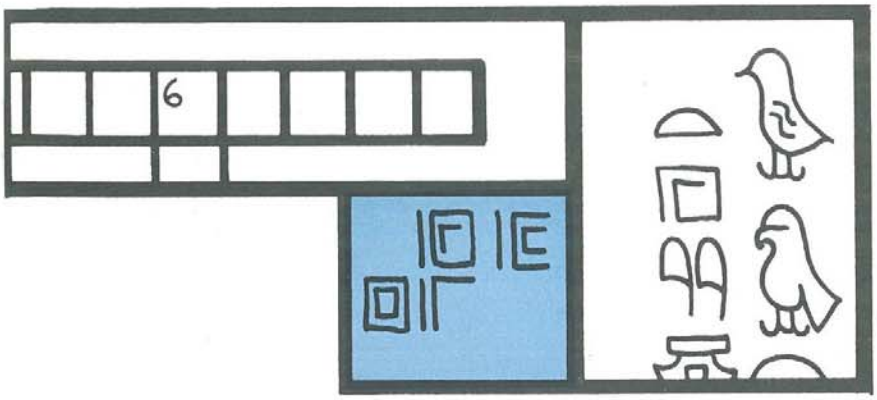
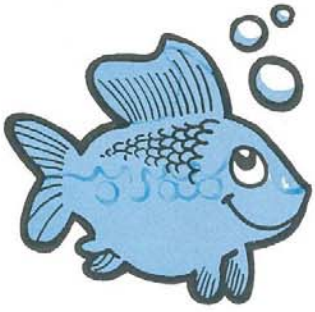




AN ACTIVITY BOOK

BY THE HONOLULU

BOARD OF WATER SUPPLY



M	H	B
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H	T	G
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T	E	M
E	R	E
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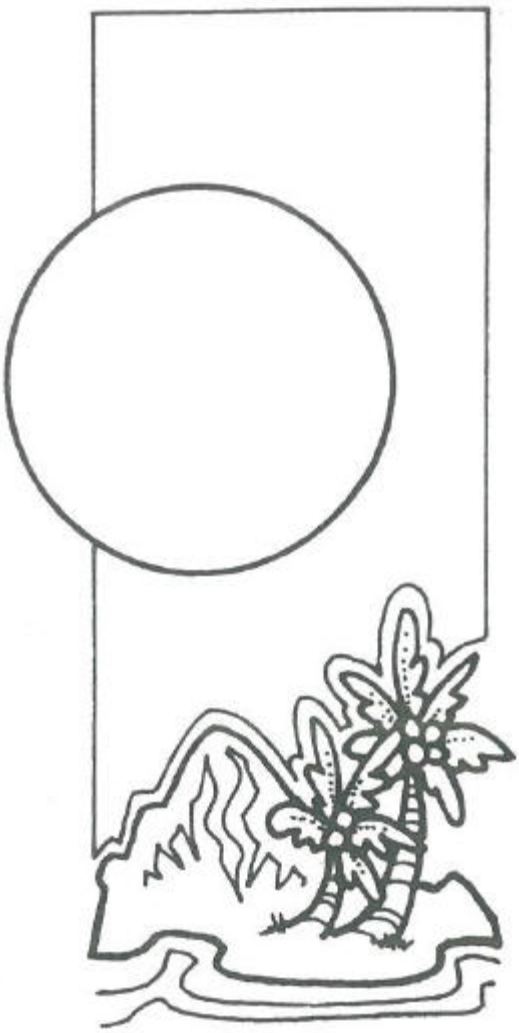
Welcome to Water for Life…Ka Wai Ola.



This book was created to provide an activity-oriented medium for students to learn more about water and water conservation.

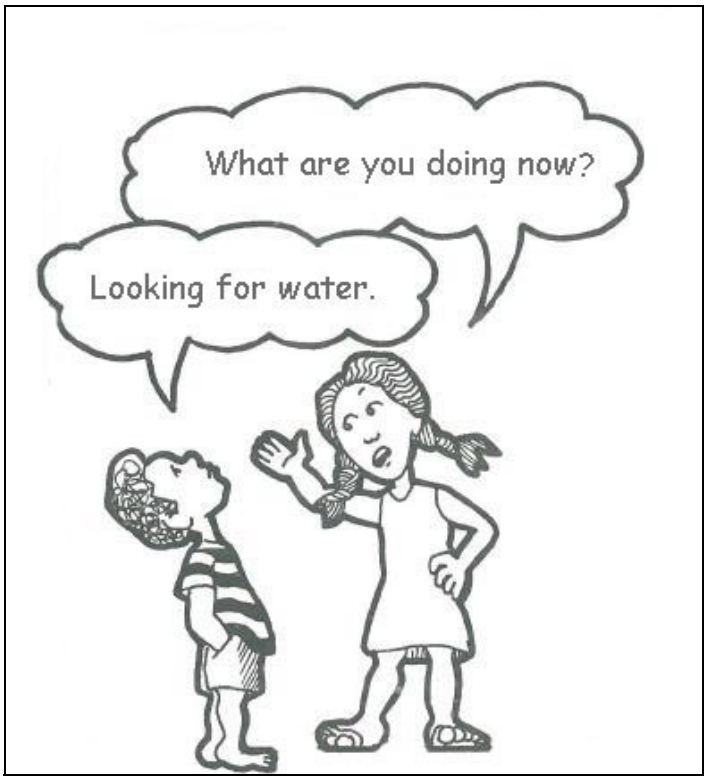
The Honolulu Board of Water Supply works hard to preserve and protect our most essential resource – our water. We are blessed with many gifts here in Hawai'i, and a plentiful supply of the best water in the world is at the top of that list. We have also been blessed with a community that has worked with us when we have asked for conservation.

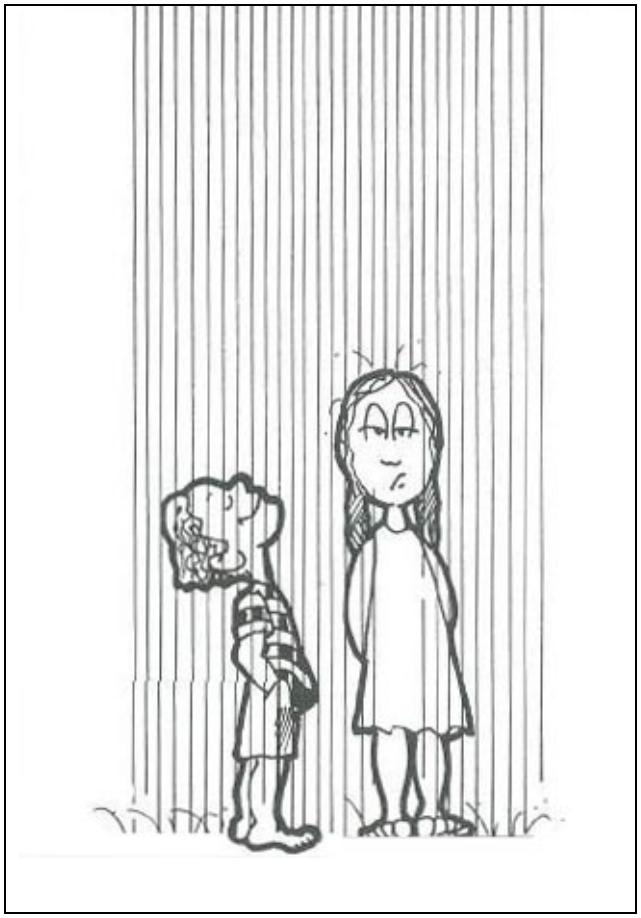
Our educational and outreach programs have provided thousands of students and residents with information and knowledge to better understand everyone's role as a steward of our water resources.

Credits are due to **Donald L. Buchholz**, author and illustrator of much of this publication, and the staff of the BWS Communications Office for their contributions to this booklet's update and publication.

Honolulu Board of Water Supply
630 South Beretania St
Honolulu, HI 96843
www.boardofwatersupply.com

Where Does Water Come From?

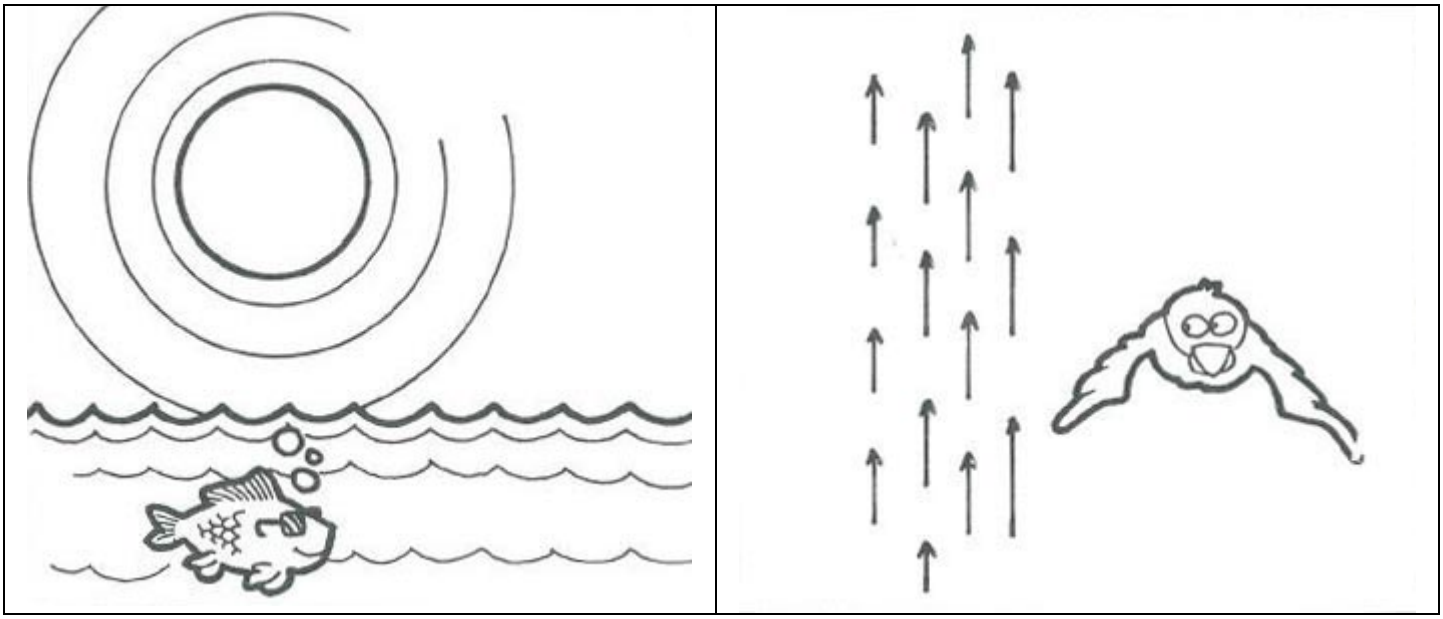




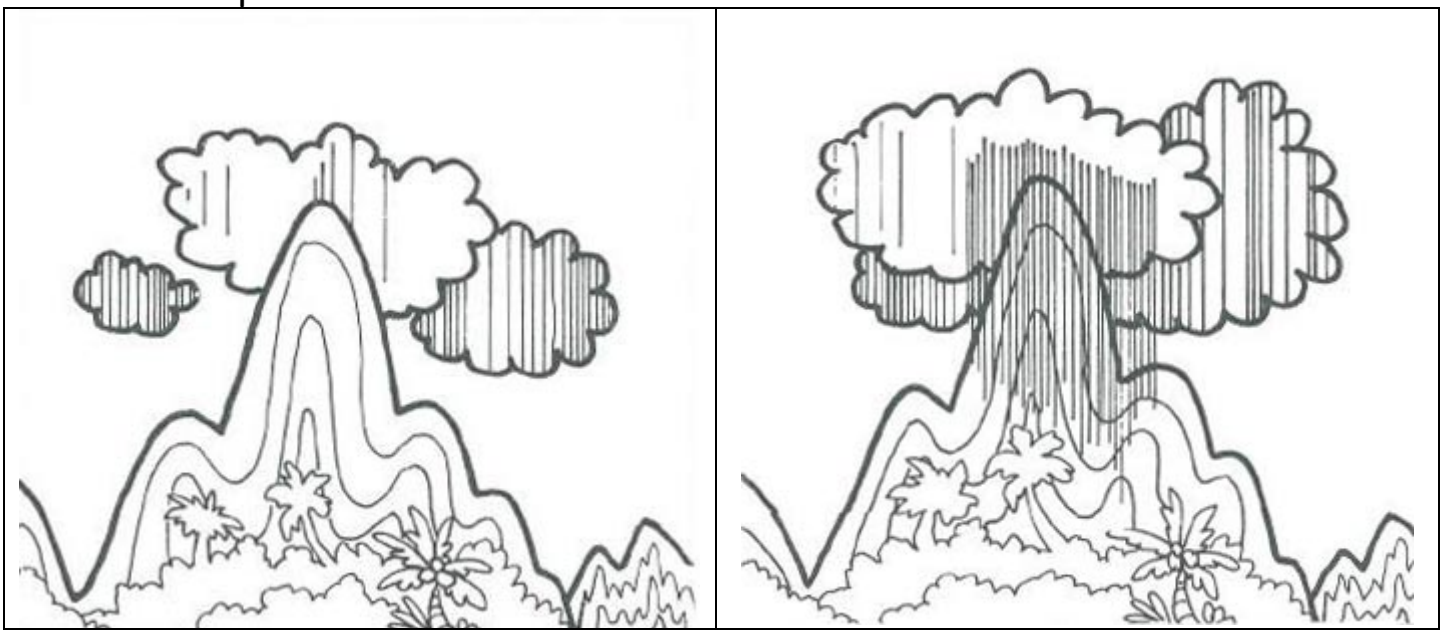
How an Island Makes Water

The water cycle on an island is in constant motion that starts with:

Evaporation – The sun shines on the ocean. Soon water heats up and turns into steam or water vapor and rises into the air.



Condensation – Clouds of water vapor get together up where the air is cool and the water vapor turns back into water.



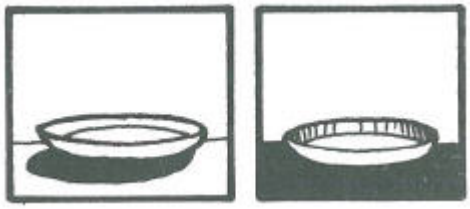
And then, **Precipitation** – It rains!

OBSERVING

1. Evaporation

Measure two equal amounts of water (i.e. one cup) and place in two dishes or pans.

Put one dish in the sun



and the other in the shade.
Wait two hours.

What happens?

2. Condensation

Take a glass of ice water and set it on the table.

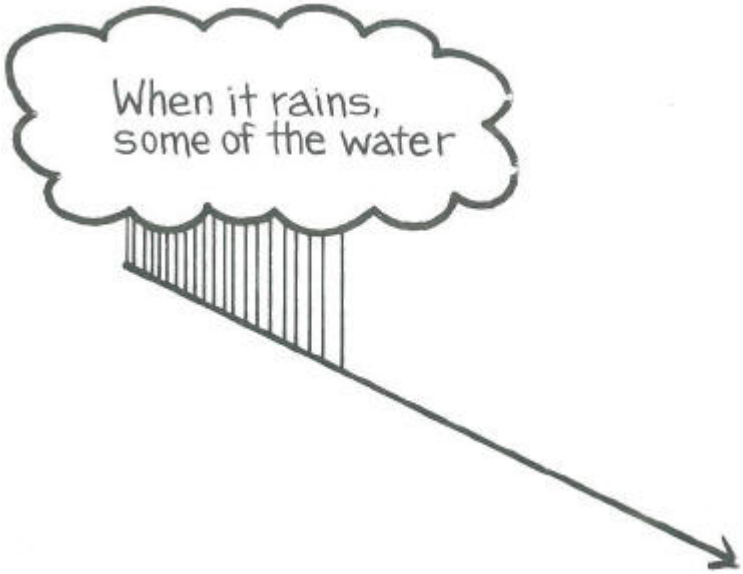
Wait a few minutes.

What happens?

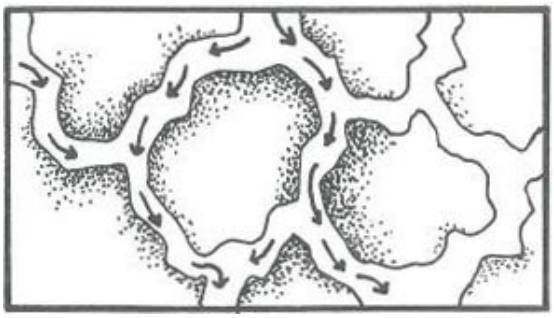
What Happens to Water When It Rains

Research shows that billions of gallons of rain can fall each day.

An important factor in the water cycle is an area called the watershed. The trees and plants that grow on mountains or valleys help to catch and collect rainwater.



Some of the rainwater runs off the mountain and heads back to the ocean. This water makes river and streams and is called surface run-off.



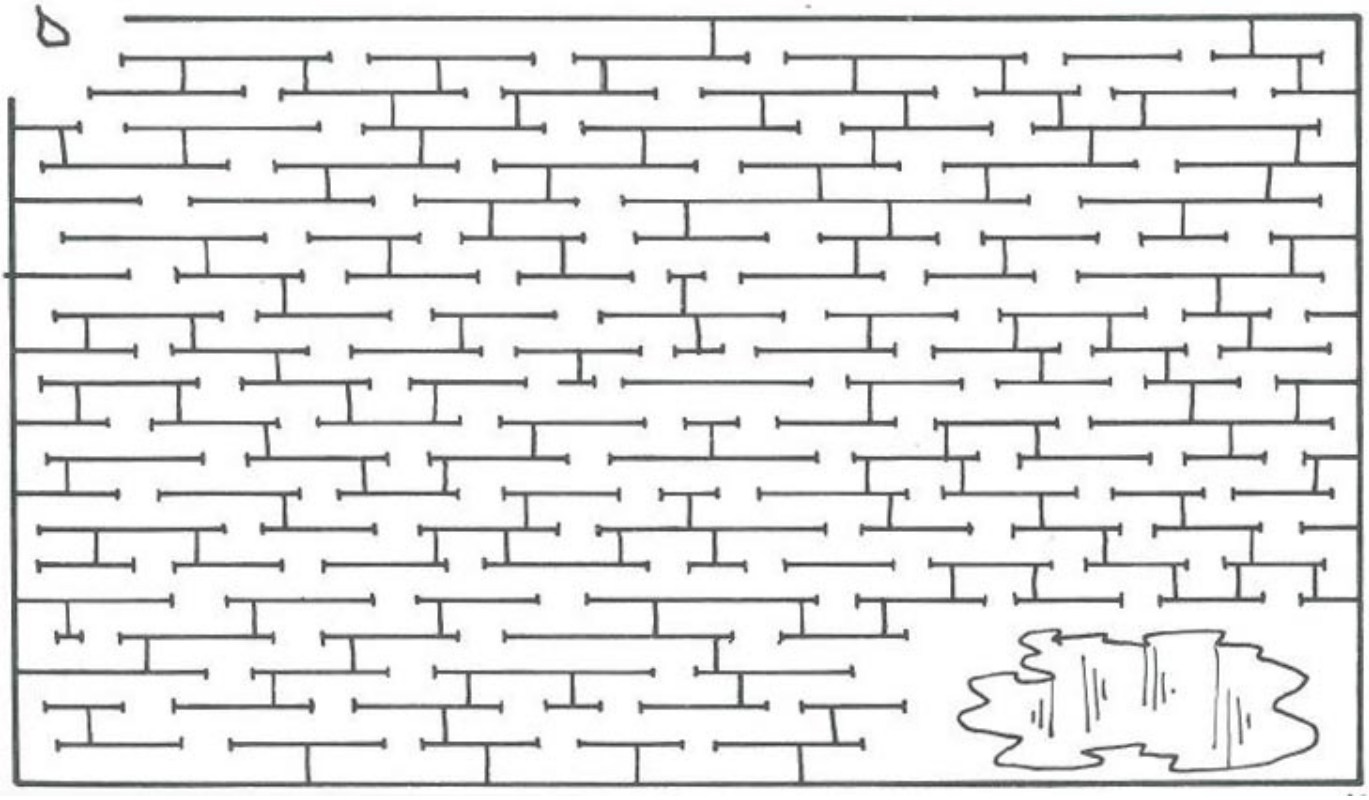
The rainwater that is not surface run-off is very important because it goes into the ground! This water runs through spaces and cracks in the **porous*** volcanic rock and travels deep into the island to an aquifer.

***porous** means it has holes in it

Sometimes the fresh water ends up in underground, watertight pockets called **dike compartments**.

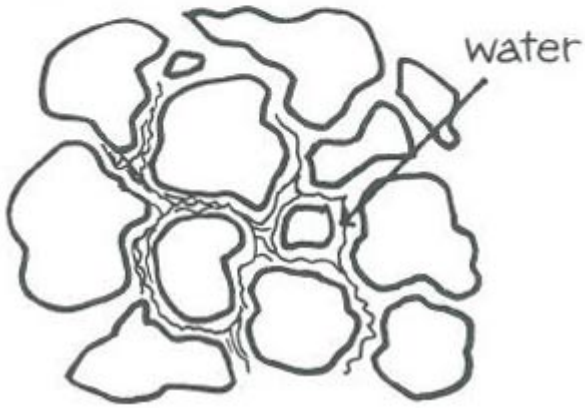
This underground fresh water is our most important source of water!

Find a patch for water to go underground.



Don't forget that lava rock is 10-30% porous – that's where the water is : in the cracks and holes in the lava rock and between the rocks.

The other 70-90 % of this area is **solid rock.**



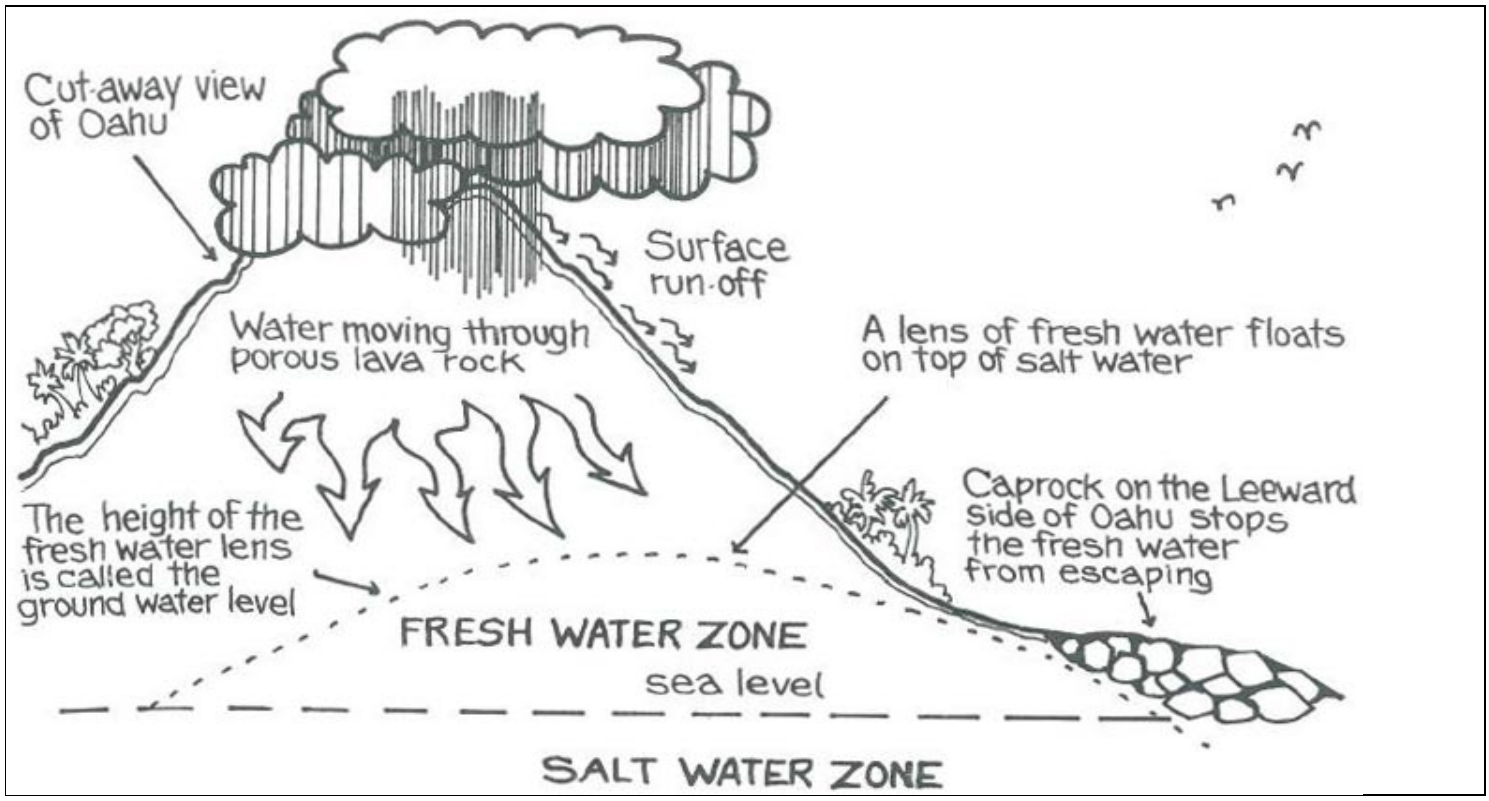
Did you know

that our water is so pure from being filtered through the lava rock that we don't need to add any chemicals or anything to make it taste good or make it safe.

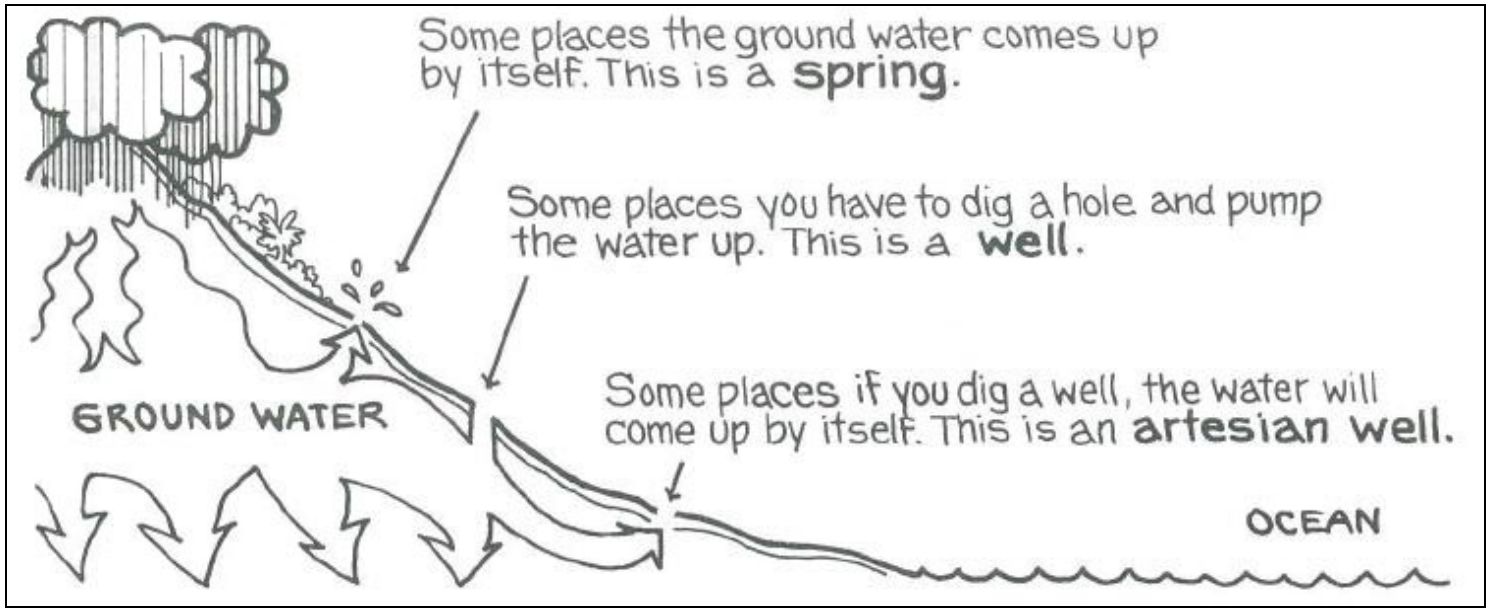
It already is.

How Groundwater Works

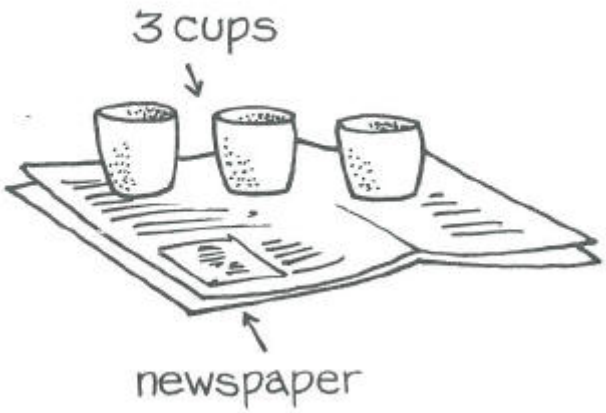
Cut away view of O'ahu.



There are a number of ways to get to this underground water.



OBSERVING



Get 3 paper or Styrofoam cups. Poke 4 small holes in the bottom of each cup with a pencil.

Fill each cup half full using

Carefully fill the cups with water. Observe what happens. Which took the shortest time for the water to leak out? Which took the longest time?

Ancient Hawaiians Lived in Harmony With Water

In ancient times as now, fresh water was the key to life and prosperity. Early Hawaiians settled near streams and springs where water was plentiful. They developed extensive systems to grow crops and raise fish.

Did you know

that in ancient Hawaiian days it was **kapu** to bathe or wash clothes upstream– bathing and washing were only permitted at the mouth of the stream.

Do you know why?

Strict rules or ***kapu*** were followed on the use of fresh water. One rule did not allow bathing or washing upstream. This was only permitted at the mouth of the stream. Do you know why?

Early Hawaiians were punished if water was wasted or misused. People who lived in upland areas needed to be sure streams were clean and available for those who lived at the lower areas of the **ahupua'a** (a land division generally from mountain to sea). Can you think of any **kapu** about water and using water that might be a good idea today?

A WATER CROSSWORD PUZZLE

Across

1. A glass of ice water will get wet on the outside as it stands. This is because of _____.

3. We have a lot of ground water here on Oahu because lava is _____.

5. Our water supply comes from _____.

7. _____ creates rivers and streams.

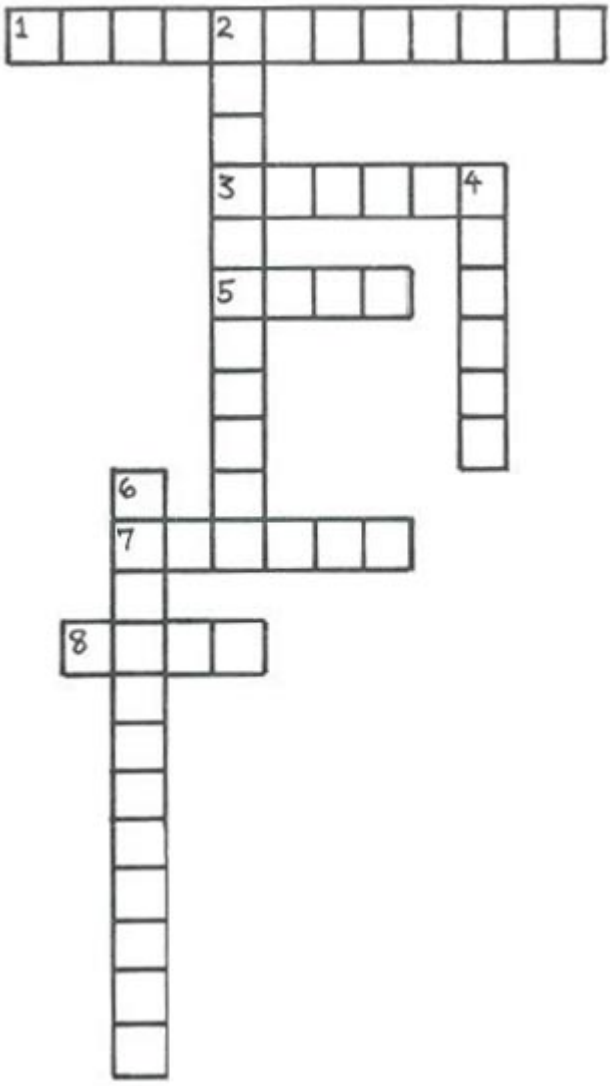
8. If you have to dig a hole and pump water out of the ground, this is called a _____.

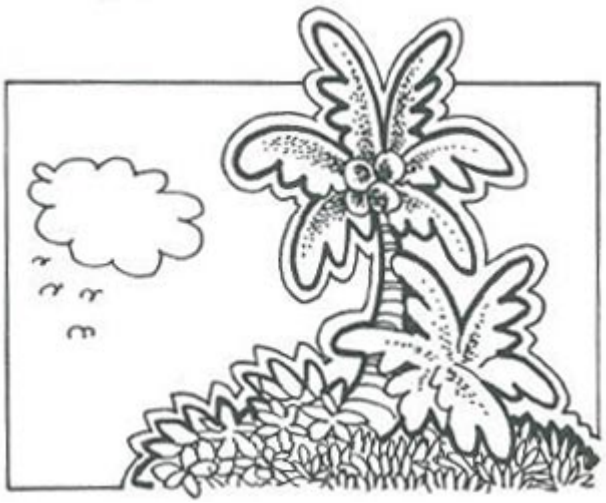
Down

2. If you put a dish of water outside in the sun, the water will soon disappear. This is called _____.

4. When ground water comes to the surface by itself, this is called a _____.

6. If you dig a well and the water comes up without the need of a pump, that is called an _____.





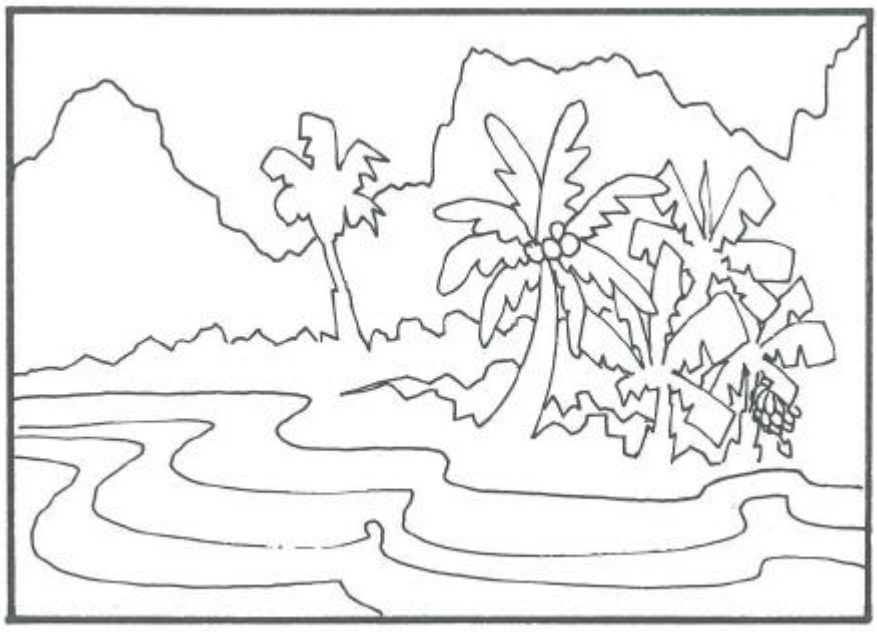
The ancient Hawaiians

considered fresh water (wai)
to be of great importance -
water was life itself.

We can see how the early Hawaiians felt about water by looking at some Hawaiian words:

wai · fresh water
wai · wai wealthy, or fulfilled (do you know the song **Kanaka Waiwai?**)
kanawai · laws (**kana** · belonging to or equally sharing + **wai** · fresh water)

Westerners talk about the law of the land;
Hawaiians talk about the law of the water.



The early Hawaiians got their drinking water from rivers, streams and springs.

Hawaiian Place Names

If you look at a map of Oahu – and other islands in the Hawaiian group, you will see a lot of place names that have the word **wai** in it:

Wai·pahu – water + bursting – the Hawaiian name for a spring on the leeward side of Oahu which later became a plantation town.

Dictionary Time

How many place names can you find that have **wai** as part of the name? What does the other part of the word mean? Can you tell why that place got its name?

Place name	**Meaning**
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

The Egyptians,

like the early Hawaiians, knew the importance of water – read their message below:

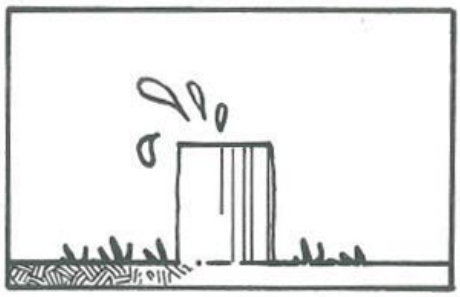
The Egyptians also had an alphabet. Use their alphabet to read their message.

Write messages to your friends

When there weren't very many people in Honolulu, the traditional Hawaiian water sources – streams, rivers and springs – were enough for everybody.

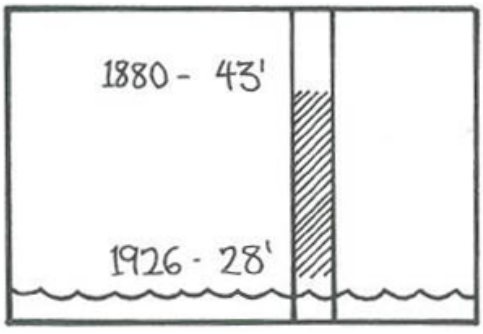
But as Honolulu grew in population, so did the need for water. Surface water began to dry up…but there was all that ground water – and only a small amount of it emerging in natural springs…

so in 1879 James Campbell dug an artesian well.



This was such a good idea that by 1920 there were 410 wells on Oahu!

And the wells worked so well that the ground water level dropped by 1/3



Does this mean that the more water used – the less we have?

Read on

Unscramble the words to fill in the blanks.

Our _____ supply depends on _____.
(wrate) (nair)

_____ _____ about _____ _____ _____
(yerev) (yad) (wot) (nillibo) (nallogs)

of _____ falls in the mountains of Oahu.
(nari)

About 650 million _____ of this _____
(llanogs) (arni)

ends up _____.
(dugerdrounn)

When it doesn't _____ for a _____ _____,
(anir) (nolg) (mite)

this is called a _____.
(throdug)

It is during _____ that we
(gurthods)

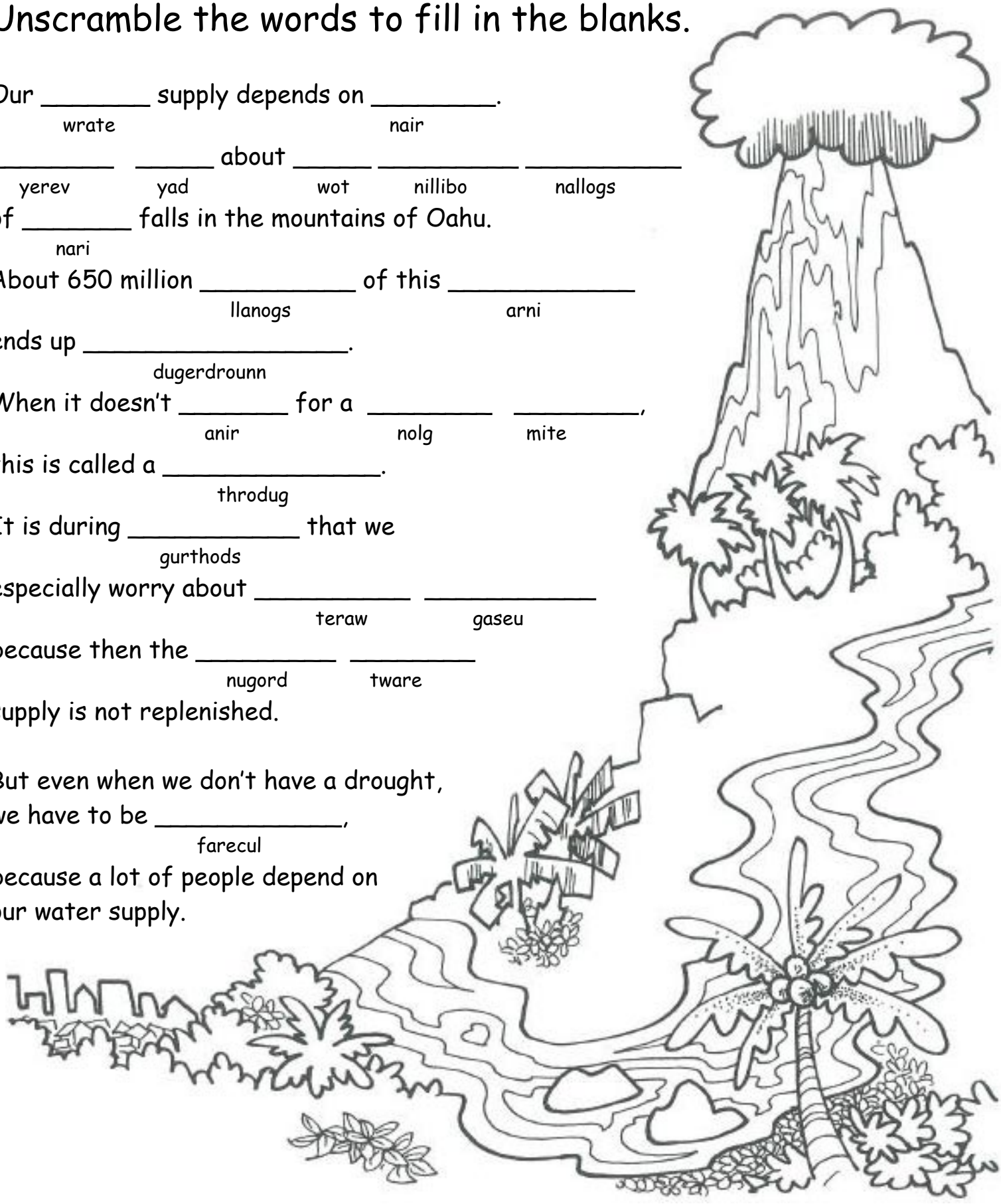
especially worry about _____ _____
(teraw) (gaseu)

because then the _____ _____
(nugord) (tware)

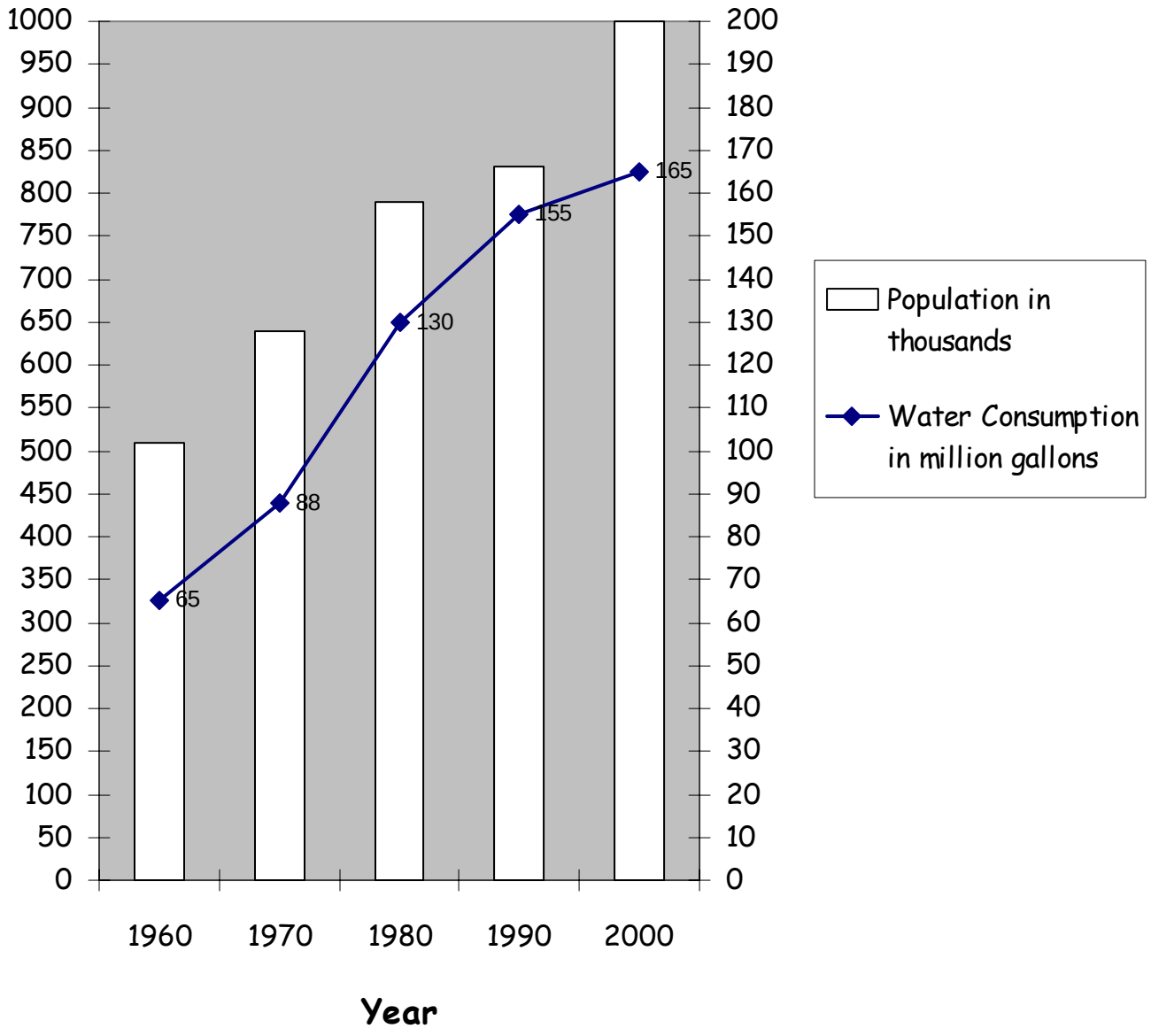
supply is not replenished.

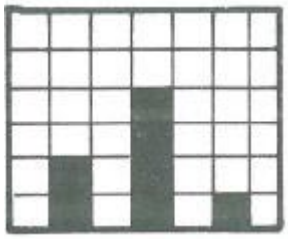
But even when we don't have a drought,
we have to be _____,
(farecul)

because a lot of people depend on
our water supply.



Population Growth of Honolulu
1960 - 2000





Graph Reading Practice

1. When was population growth the largest? _____
   a. 1900-1920 c. 1960-1980
   b. 1940-1960 d. 1980-2000

2. When did the population become more than 50,000? _____

3. How much was the population growth from 1960 – 1980? _____

4. More people needed water in 1960 than in _____
   a. 2004 c. 1980
   b. 2000 d. 1940

5. Less people needed water in 1940 than in _____
   a. 1960 c. 1900
   b. 1920 d. 1980

6. How many people in Honolulu depended on clean, good tasting, safe water in 1960? _____

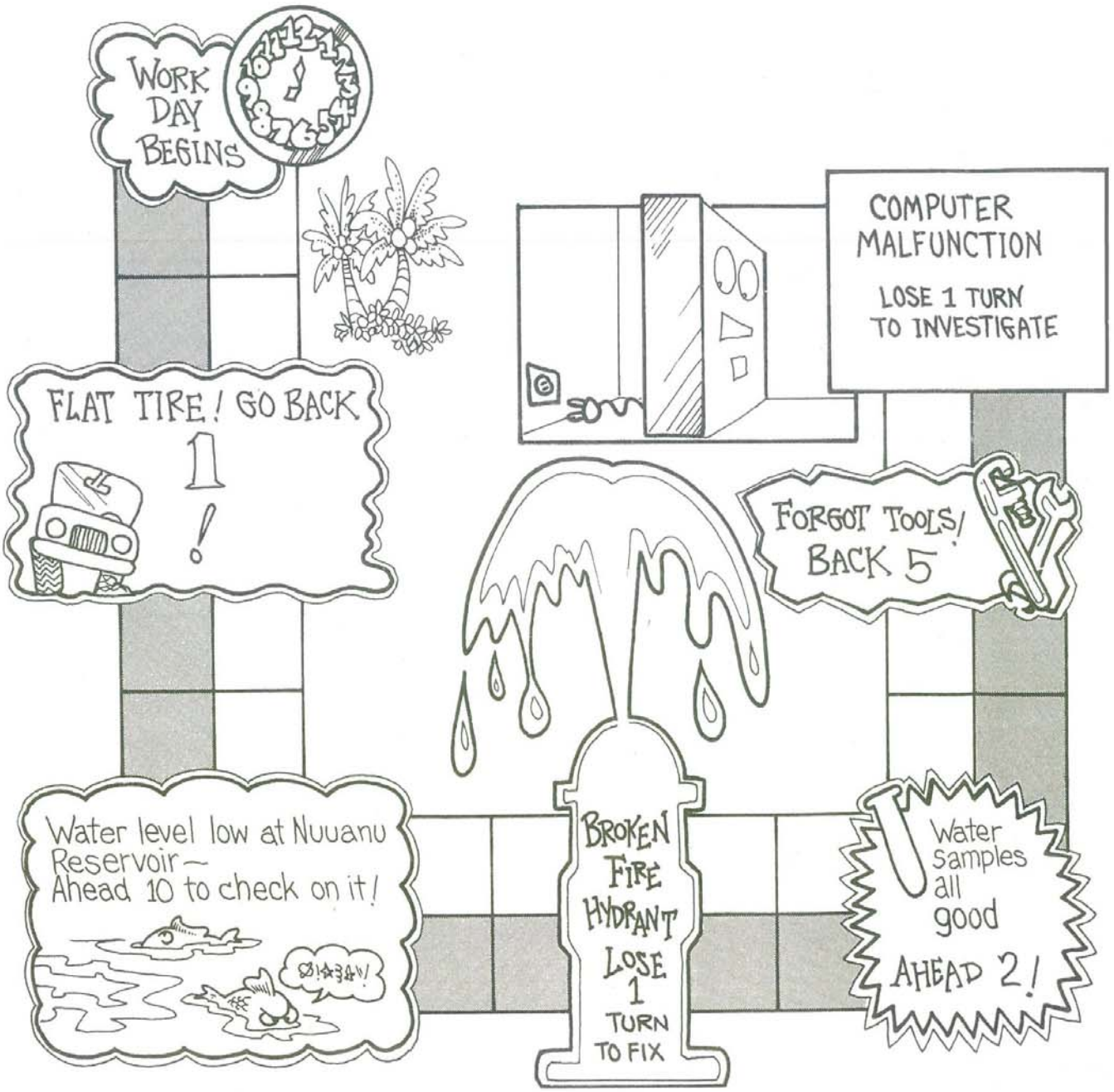
7. How many people in Honolulu needed water in 1900? _____

8. How many people in Honolulu depended on water to be clean, safe, good tasting and readily available in 1980? _____

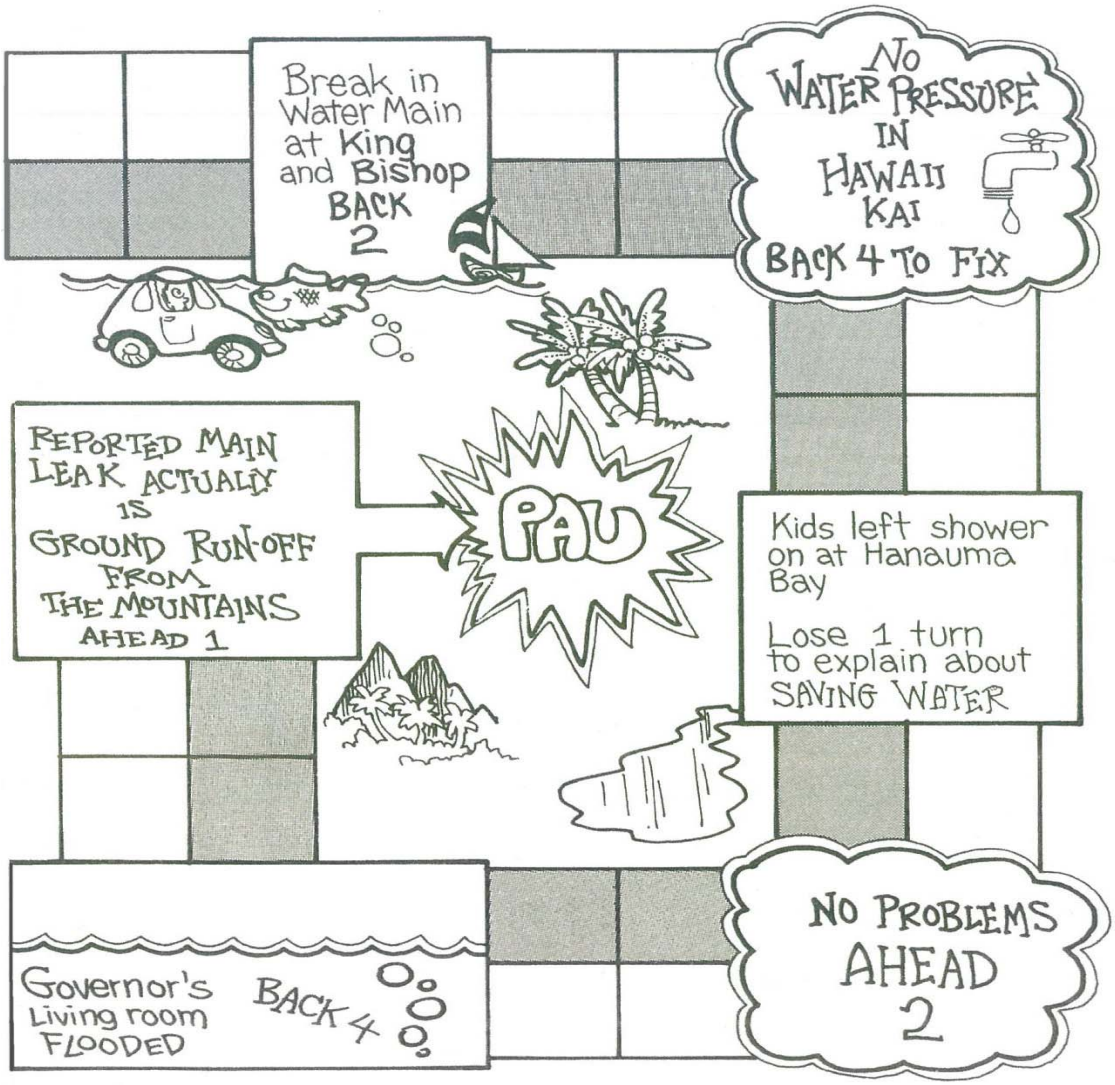
9. How many people lived in Honolulu in 1920? _____
   a. less than 100,000
   b. less than 70,000
   c. less than 150,000
   d. less than 50,000

ALL IN A DAY'S WORK AT

Two people play. First one finished is the winner. You can use a nickel and two pennies. Use the pennies as markers and flip the nickel. If the nickel comes up **tails**, advance 1. If the nickel comes up **heads**, advance 2. Have fun.



THE BOARD OF WATER SUPPLY



The Board of Water Supply

After the big drought in the 1920s, people began to worry about water. So the **Board of Water Supply** was formed in 1929.

It is the responsibility of the **Board of Water Supply** to keep people supplied with water.

The **Board of Water Supply** tests water to make sure it is safe and clean. They also fix breaks in lines, do construction and maintenance work and look for new ways to bring more water up from the underground water system.

More than 600 people work for the **Board of Water Supply**. There are always people working – they watch water levels in the reservoirs and make sure that everything is working properly.

There is an **Emergency Number** to call anytime if there is a water emergency. Do you know where to find that number? Do you know your **Emergency Numbers** for the **Police**? The **Fire Department**?

The number to call for the Police, Fire Department and Ambulance is:

The emergency number for the Board of Water Supply is:

People who help to get your water to you have many kinds of jobs.

Here are some Greek words to help you understand the meaning of some job words:

hydro ·	water	·The study of weather
geo·	earth	·Someone who studies the weather
meteor ·	weather	·Someone who studies water
-ology	study of	·The study of the earth
-ologist	someone who studies	·Someone who studies the earth
		·The study of water

Now make some words

meteor + *ology* _____

meteor + *ologist* _____

_____ + _____

_____ + _____

_____ + _____

_____ + _____

A lot of different people work in a lot of different jobs at the Board of Water Supply. How many different jobs can you find in the puzzle that might be found at the Board of Water Supply?

C	O	M	P	U	T	E	R	P	R	O	G	R	A	M	M	E	R
C	H	E	M	I	S	T	U	O	W	I	S	E	E	E	N	N	C
U	Y	K	T	O	G	A	R	D	E	N	E	R	S	T	A	G	A
O	D	E	D	I	L	O	R	E	P	A	I	R	M	E	N	I	S
T	R	U	C	K	D	R	I	V	E	R	N	C	I	R	M	N	H
Z	O	C	B	K	L	D	S	E	C	R	E	T	A	R	Y	E	I
R	L	M	I	W	E	L	D	E	R	N	K	E	H	E	W	E	E
B	O	O	K	K	E	E	P	E	R	S	O	Y	T	A	H	R	R
E	G	E	O	L	O	G	I	S	T	C	A	A	C	D	N	S	S
E	I	P	I	P	E	F	I	T	T	E	R	S	L	E	U	E	I
R	S	M	E	C	H	A	N	I	C	S	D	O	E	R	O	N	M
C	T	I	N	V	E	S	T	I	G	A	T	O	R	S	H	M	M
A	S	A	C	C	O	U	N	T	A	N	T	S	T	T	T	Y	U
G	R	O	U	N	D	S	K	E	E	P	E	R	S	E	V	O	T

_____

_____

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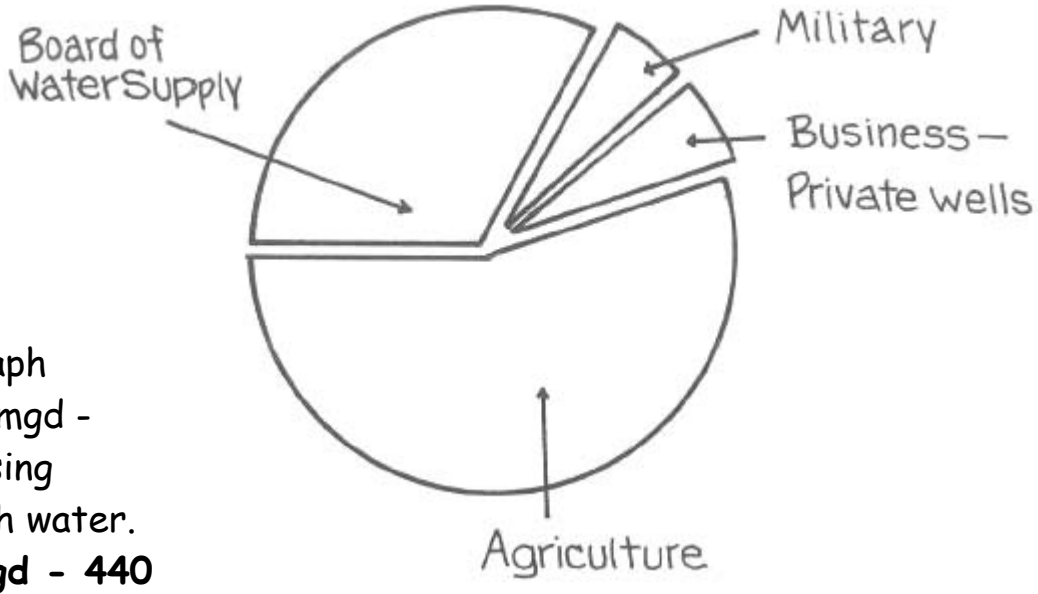
Millions of Gallons!



A pie graph showing mgd - who is using how much water.
Total mgd - 440

Water use is talked about in millions of gallons per day, (mgd)

1. Who uses the most water?

   _____

2. Who uses the least water?

   _____

3. Agriculture uses 230 mgd. What percentage of total mgd is used by Agriculture?

   a. 52 % c. 03%
   b. 25 % d. 72%

   _____

4. Military usage is 40 mgd. What percentage of total mgd is used by the Military?

   _____

Water Mathematics

Fact: the average household in Honolulu today uses 440 gallons of water per day.

1. How much water does the average family use in a month? _____

2. Look at your family's latest water bill. It represents your family's water usage for **two months**. How much water did your family use in each month?

   per month A. _____ per day _____
   per month B. _____ per day _____
   What is your average monthly usage? _____
   What is your average daily usage? _____

3. Water charges are figured by the amount per 1000 gallons. Can you compute your cost? (monthly usage / 1000/ your **monthly** cost) _____

4. In 1929 the cost per 1000 gallons was $0.09. What do you think a water bill was per month in 1929? Did a family in 1929 use as much water as we do today?

   _____
   _____

5. What about a family in 1829? Explain. _____
   _____
   _____
   _____

Appliances and Gadgets in Daily Water Use

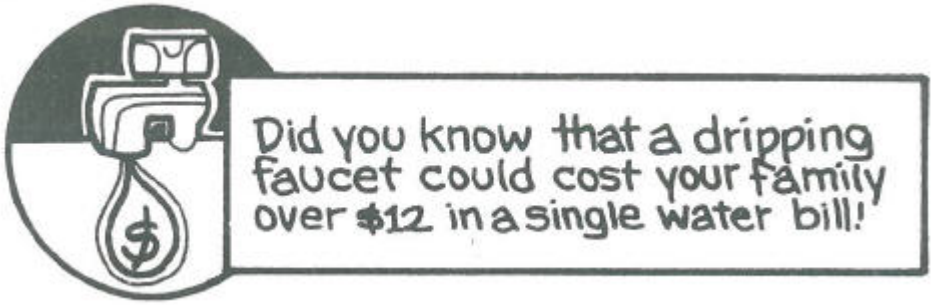
Find 10 things that use water
in the puzzle below

S	T	E	R	E	O	E	A	R	P	H	S	N	R
I	S	U	R	F	B	O	A	R	D	A	P	R	A
D	I	S	H	W	A	S	H	E	R	W	R	Y	T
W	T	S	D	A	U	T	O	M	O	B	I	L	E
L	M	Y	M	T	O	I	L	E	T	U	N	O	R
I	R	I	C	E	C	O	O	K	E	R	K	L	B
K	N	L	I	R	A	L	L	B	E	R	L	E	E
O	M	G	S	H	O	W	E	R	Y	U	E	Y	D
C	O	F	F	E	E	M	A	K	E	R	R	U	L
S	O	C	W	A	S	H	M	A	C	H	I	N	E
U	K	L	S	T	E	A	M	I	R	O	N	U	D
C	C	E	I	E	W	A	T	E	R	B	E	D	M
H	O	F	I	R	E	H	Y	D	R	A	N	T	F

How many of these
do you think
were used in 1929?

How many of these
do you think
were used in 1829?

Looking for Leaks



Look for leaks – faucets, showers, the bathtub, in the laundry room, the outside faucets…

Use this chart to help your family know about leaks and get them fixed.

Date	Location of Leak	Date Fixed

Codes

sometimes use the alphabet, numbers, and different combinations. A simple code might just use the next letter in the alphabet

MJLF UIJT

A more difficult code might use a combination of both numbers and letters:

A is the first, you see,
B can make a _____
C can rhyme the number _____
…the rest is up to you.

Now solve the poem to get the clues – and read the code

3 15 14 19 5 18 22 5
___ ___ ___ ___ ___ ___ ___ ___

23 1 20 5 18
___ ___ ___ ___ ___

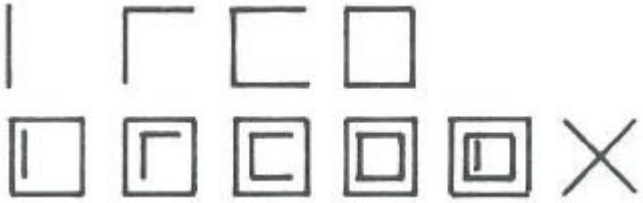
Make up your own codes using any combinations you can think of…or us a different alphabet…or…

...or a code could

use totally different symbols...

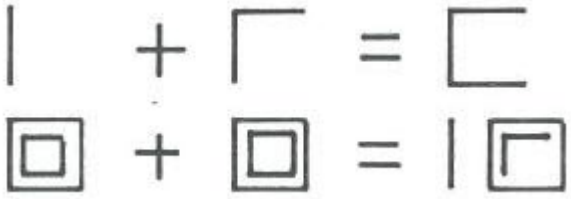
(don't let strange or new symbols bother you. Just figure them out.)

Look at the symbols in a different arrangement - like this:

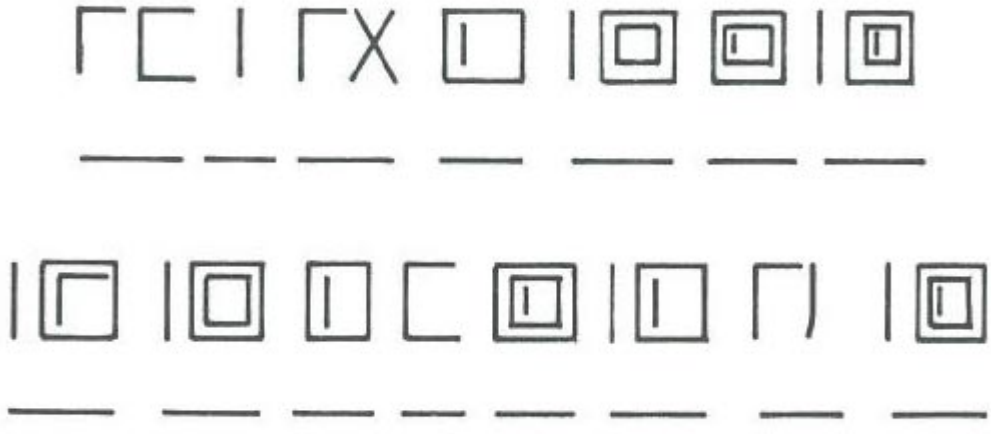


Notice anything? Right! The pattern repeats itself. Why would it do that?

One more clue:



Now, can you read this message? Don't forget how the code on page 24 worked – just do the same thing!

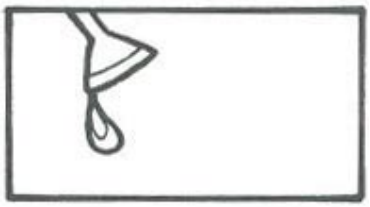


Conserving Water

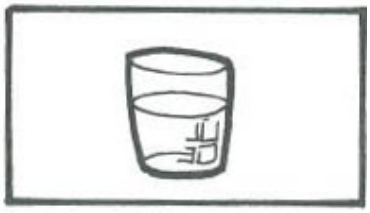
There are a lot of ways you can help conserve water in your home every day.

Family Water Saving Tips

You can save up to 10 gallons of water if you turn off the water when you brush your teeth.



Take showers instead of tub baths, and shut off the water when you soap yourself – then turn it back on to rinse. You could save 20 gallons of water.



Keep drinking water in the refrigerator instead of running the faucet until the water is cold.

Use a stopper in the sink when you do the dishes instead of letting the water run – you could save up to 30 gallons of water per meal.

Use a broom or a rake to clean your sidewalks or driveway – you could save up to 50 gallons of water.

Use a bucket to wash the car – you could save up to 100 gallons of water every time you wash the car.

Wait until you have a full load of wash before you do the laundry – you could save up to 30 gallons of water.

Keep a record

of your efforts to save water. Write down your family's water usage total from your last water bill.

Date of use	Amount of water used	Total cost

Make a chart like this one to record your weekly efforts to save water. Make a small x every time you use one of the tips from page 26.

shut off faucet	
take shower	
use stopper/ dishwashing	
sweep sidewalks	
doing laundry	
other	

Keep your weekly records until the next bill comes – then check your family's water usage.

Date of use	Amount of water used	Total cost

Subtract the new totals from the old.

Amount of water saved	Money saved

Writing about Water

Page 1 of this book is a cartoon strip about water; there is a Hawaiian legend about Kane and Kanaloa and water; a lot of stories, poems and even songs have been written about water.

You could write a poem using Japanese **Haiku** – an unrhymed verse form that has 5 syllables in the first line, 7 syllables in the second line and 5 syllables in the last line.

Water is our friend; _____
Without it we could not live. _____
Let's help conserve it! _____

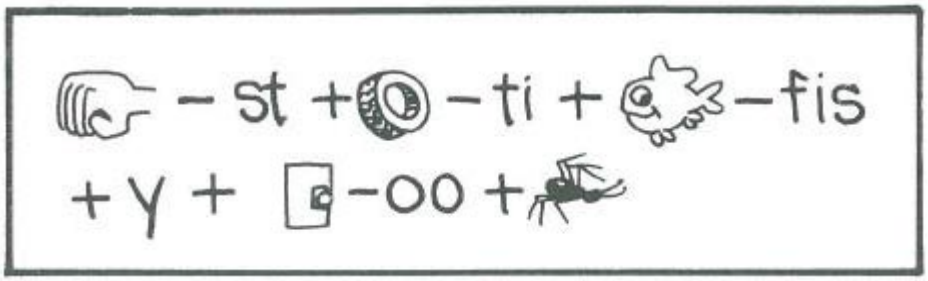
Or you could make a cartoon strip:

Or you could write your own story, poem or even song.

Making a Water Rebus

I'm short and squat
and could easily be used for a seat;
I'm easy to spot
every 350 feet.

What am I?



A _____ _____

Make your own water-related rebus. Try it out with your friends. Can you solve theirs?

OBSERVING

How Water acts

Put a drop of water on


the back of your hand


a piece of folder paper


a piece of cloth

What happened?

_____

_____

Can you tell why? _____

_____

How things act with water

Get 3 paper cups. Fill them with water.
In the first cup, put a drop of cooking oil –
In the second cup, put a drop of milk –
In the third cup, put a drop of soy sauce –
What happened? _____

_____

Can you tell why? _____

_____

Get 3 paper cups. Fill them with water.

Put a spoonful of **sugar**
in the first cup

Put a spoonful of **flour**
in the second cup

Put a small amount of **pepper**
in the third cup

What happened? _____

_____

Can you tell why? _____

_____

A Recipe For a Tasty Treat

Get an ice tray.

Fill it **half full** with orange juice.
Cover the ice tray with aluminum
foil and stick a toothpick in
each square.

The next day, carefully remove the aluminum foil
so you don't break or loosen the toothpicks.

Fill up the ice tray the rest of the way
with grape juice. Refreeze.

Enjoy the treats with your friends!

Even though

there are more people on Oahu than ever before, we have the water we need – this is because of **The Board of Water Supply**. They maintain our water system and constantly look for new sources of water.

To help **The Board of Water Supply** find some new sources of water, use a mirror and take out the extra letter.

CLEFAFNUFFWAFSTFEFWATFEFR

_____

DEFSAFLIFNAFTEFOFCEFAFFNWAFTFERF

_____

And in the future we can be assured of a continuing supply of water if we just remember

DOFNOFTWAFSFTEFWAFFTEFRF

_____

Answers _____

p. 4 to keep the rivers and streams clean

p. 8 ACROSS – 1. condensation, 3. porous, 5. rain, 7. run-off.
DOWN – 2. evaporation, 4. spring, 6. artesian well.

p. 11 Water - the gift of life.

p. 13 water, rain, every day,
one million gallons, rain, gallons,
rain, underground.
rain, long time, drought.
droughts, water usage, ground water.
careful.

p. 15 1. d, 2. 1880, 3. 80,000
4. d, 5. a, 6. almost 300,000
7. almost 40,000
8. about 365, 000
9. d.

p. 18 911
748-5000

p. 19 hydrology, hydrologist
geology, geologist

computer programmer
chemist · gardener
repairmen · truck driver
secretary · welder
bookkeeper · geologist
investigator · engineer
accountant · cashier
groundskeeper
pipefitters · mechanics

p. 20 1. Agriculture
2. Military
3. d.
4. less than 10%

p. 21 1. 13,200 gallons per month

p. 22 dishwasher
automobile
rice cooker
coffee maker
wash machine
steam iron
water bed
fire hydrant
toilet
shower
sprinkler

p. 24 conserve water

p. 25 water is precious

p. 29 fire hydrant

p. 32 clean up waste water
desalinate ocean water
do not waste water