Part 1 Earth's Water

Name:
Due:

Part 1 Lesson 1

The six ways _____ use water

- Survival / _____
- Household
- R_____
- Industrial
- T_____
- Agricultural

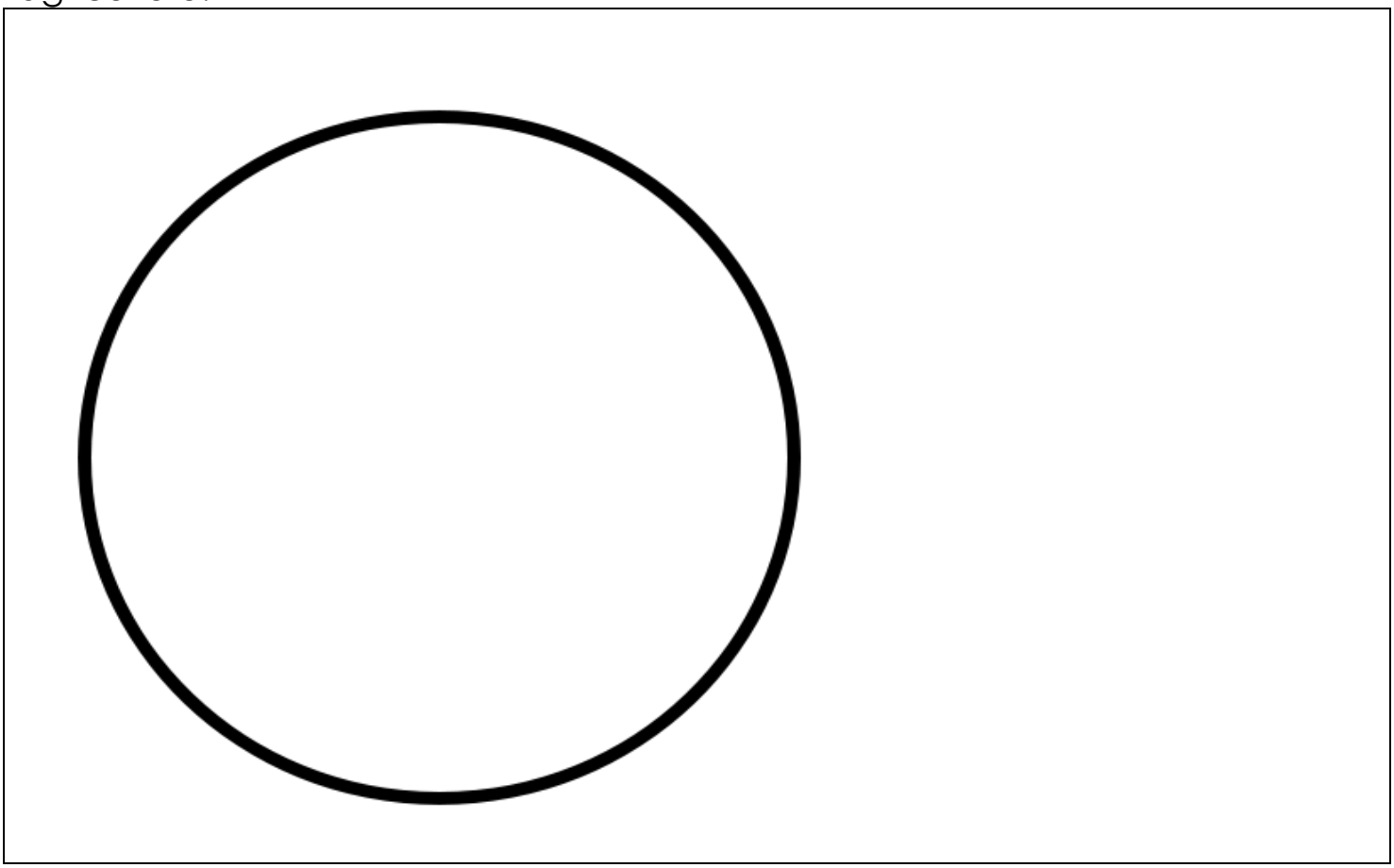
Please provide examples of ways human use water in the boxes below.

Earth's Water Supply

- Oceans _____% - Salt (Cannot _____ or use for Agriculture)
- Ice Caps _____% (Locked)
- Groundwater 0.5% (Most is too Deep)
- Soil M_____ 0.005% (Can't Obtain)
- Atmosphere 0.001% (Can't Obtain)
- Inland _____ 0.018% (Available)
- Rivers 0.000096% (Available)

Warning! 4 part question, check diamond when accomplished.

◊ Complete a pie graph below showing the locations of earth's water.
◊ Make sure that your graph includes all the places water is located on earth.
◊ Include % in the margin and
◊ provide a brief statement about whether humans can use it for drinking and agriculture.



Part 1 Lesson 2 Water the Resource

Please answer 3 of the 7 questions below about the War Over the Well.

1) Where is all this fighting occurring? What are they fighting over?
2) What happened at the well near Rabadore?
3) How many people are being affected by the drought in Somalia? What is happening to them?
4) Does Somalia have a government that can help? Explain?
5) What is a warlord? Are they good or bad? What do they do?
6) Describe one person from the article. What is their life like?
7) How would your life be different if we did not have any water or food?

Dying for Water in Somalia's Drought

Friday, April 14, 2006

RABDORE, Somalia -- Villagers call it the "War of the Well," a battle that erupted between two clans over control of a watering hole in this dusty, drought-stricken trading town.

By the time it ended two years later, 250 men were dead. Now there are well widows, well warlords and well warriors.

"We call them the 'warlords of water,' " Fatuma Ali Mahmood, 35, said in a raspy voice about the armed men who control access to water sources.

One day last year, Mahmood's husband went out in search of water. Two days later, he was found dead, she said as an infant on her back cried and nine other children tugged at her torn dress. He was shot when an angry crowd began fighting over the well, she said.

"His body was bloodied, swollen and just lying there with the other dead by the well, left in disgrace. The shame. We'd never seen conflict at this level of violence," she explained, shielding her eyes from a dust storm that was swirling in the heat under a blue sky. "Thirst forces men to this horror of war."

In Somalia, a well is as precious as a town bank, controlled by warlords and guarded with weapons. During the region's relentless three-year drought, water has become a resource worth fighting and dying over.

The drought has affected an estimated 11 million people across East Africa and killed large numbers of livestock, leaving carcasses of cows, goats and even hearty camels rotting in the sun. The governments of Kenya and Ethiopia have mediated dozens of conflicts over water in their countries, even sending in police and the army to quell disputes around wells.

The effects of the drought are most pronounced in Somalia, which has lacked an effective government and central planning, including irrigation projects, since the government of Mohamed Siad Barre collapsed in 1991. Since then, a hodgepodge of warlords and their armies have taken control of informal taxation systems, crops, markets and access to water.

Amid the anarchy and water scarcity, most of the country's almost 9 million people scratch out a living.

The U.N. World Food Program hires heavily armed men to help protect villagers as they pick up water, cooking oil and sorghum. Still, gunmen sometimes force women to give up their water or food as they walk back to their villages.

"Even when local people are good and plan out water catchment systems, warlords just take it over. That's why we have so many people drinking horrible water with worms and dirt and getting very ill," said Abdul Rashid, a Somali nurse in Rabdore who works with the International Medical Corps, a nonprofit relief group. "It's like the start of the water wars right here in Somalia."

"Before I go anywhere in Somalia, I pray. If someone is thirsty, they can shoot you for a glass of water. There's no police to come and no government to say anything," said Sheik Ibrahim Khail, 53, who operates a transport company for the World Food Program. "In other places they may just want to rob the driver or take the food and sell it. But here they want the water, too."

Long-term solutions to fighting drought include collecting what little rainwater that does fall, building modern irrigation systems and using new water exploration techniques, water experts said. But that kind of effort typically requires the coordination and enforcement of a central government, said Zlatan Milisic, the World Food Program's country director for Somalia.

"Somalia at heart is a water crisis that has turned into a food crisis," Milisic said. "The effects here are worse than anywhere else because there's no government, there's no stability. To me, this is the most unstable place in the world that is currently suffering a drought."

Fights over water break out even in places with a healthy supply.

In one such place, the town of Wajid, a 36-year-old man was executed after he killed a man in a fight over a well last month, according to town authorities.

Somalis who fled the drought and are living in makeshift shelters on the edge of town said the story of the death terrified them. They had come to Wajid to find water and hoped they could do so without being subjected to violence.

Isha Aden Hussein, 38, whose husband was killed in the War of the Well in Rabdore, walked more than 100 miles to reach this town. She and her husband once had a farm and spacious huts for their 10 children. Now she lives in a shelter made of thin, oily kitchen rags.

She described her life as "miserable" and said she just hoped to survive the drought. In the slightly cooler mornings and evenings, she collects firewood and tries to sell it. But the temperature rises to 115 degrees during the day, so she spends most of her time in her shelter.

"I just sit in there. I pray to God and wait for my paradise to come. In paradise, I'll be shading under a thick mango tree. I will be fat. My children will be dressed in smart uniforms for school. They will be reading me very nice stories," she said. "The most important is that they won't have thirst. Our mouths will always be wet. We'll drink in peace. "

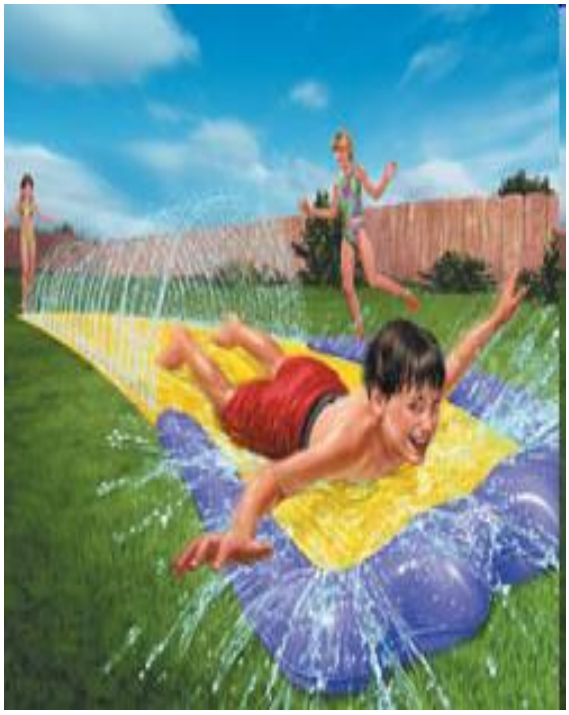
Please answer 3 of the 7 questions below.

1) **Where is all this fighting occurring? What are they fighting over?**
2) **What happened at the well near Rabadore?**
3) **How many people are being affected by the drought in Somalia? What is happening to them?**
4) **Does Somalia have a government that can help? Explain?**
5) **What is a warlord? Are they good or bad? What do they do?**
6) **Describe one person from the article. What is their life like?**
7) **How would your life be different if we didn't have any water or food?**

___.)_____

__.)_____

__.)_____

What does the photo on the right mean to you now that you have studied drought and famine in Somalia?	

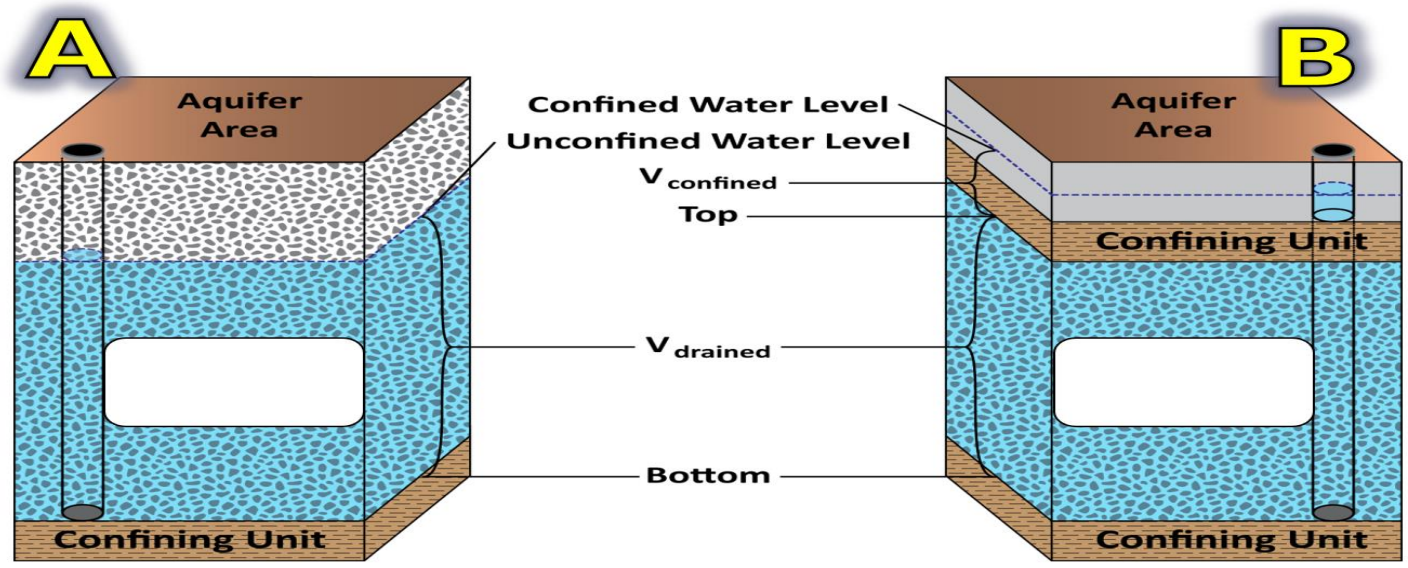
Part 1 Lesson 3 Groundwater and Water Conservation

Groundwater: Water stored in the _____

Aquifer: An underground layer of water-bearing p_____ rock.

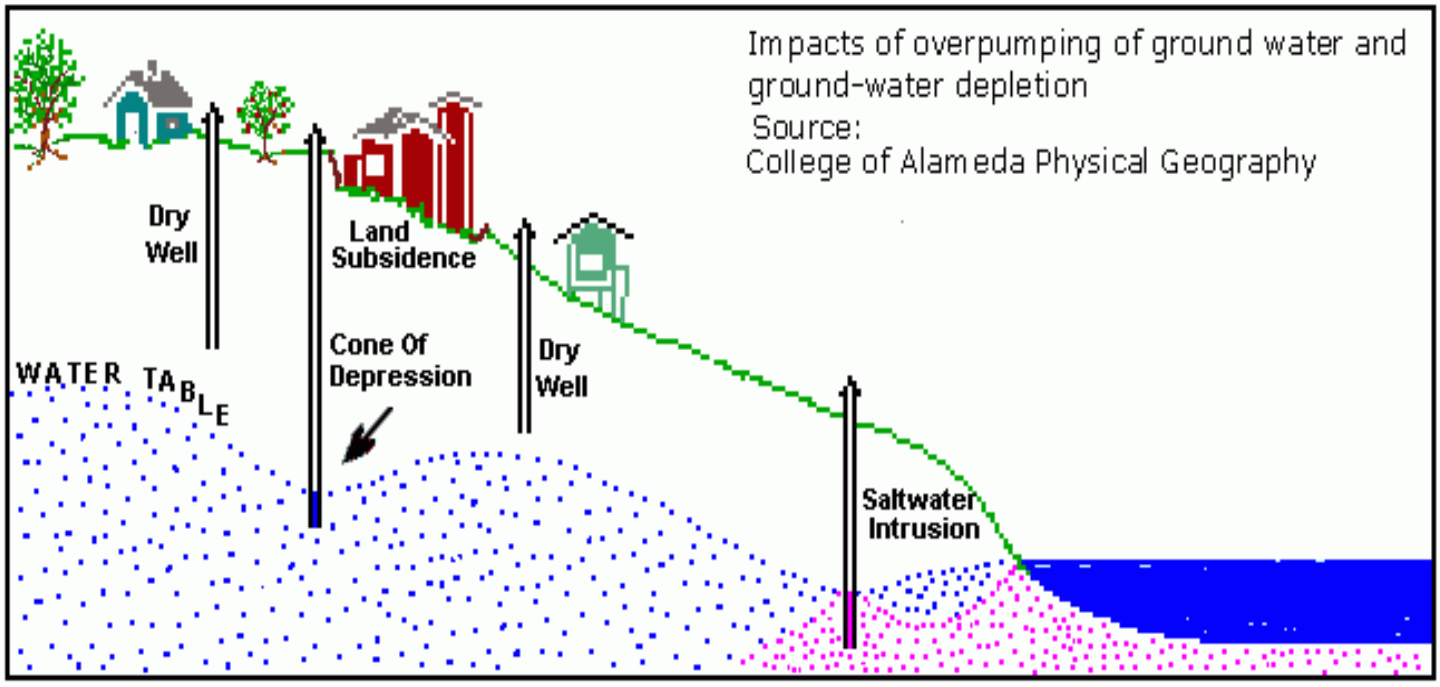
Which letter is a confined aquifer, and which is an unconfined aquifer?

A=	B=



Use the boxes below to describe some ways at home you can conserve water. Visit the internet if you are struggling.

Part 1 Lesson 4 Groundwater



Start with… $4,000	2nd Month	3rd Month	4th Month	End with…

Groundwater: Recharge and Discharge. How much money did you end up with?_____

What eventually happened to the groundwater over time?_____

_____

_____

_____

What happens when recharge occurs slower than discharge?_____

_____

_____

_____

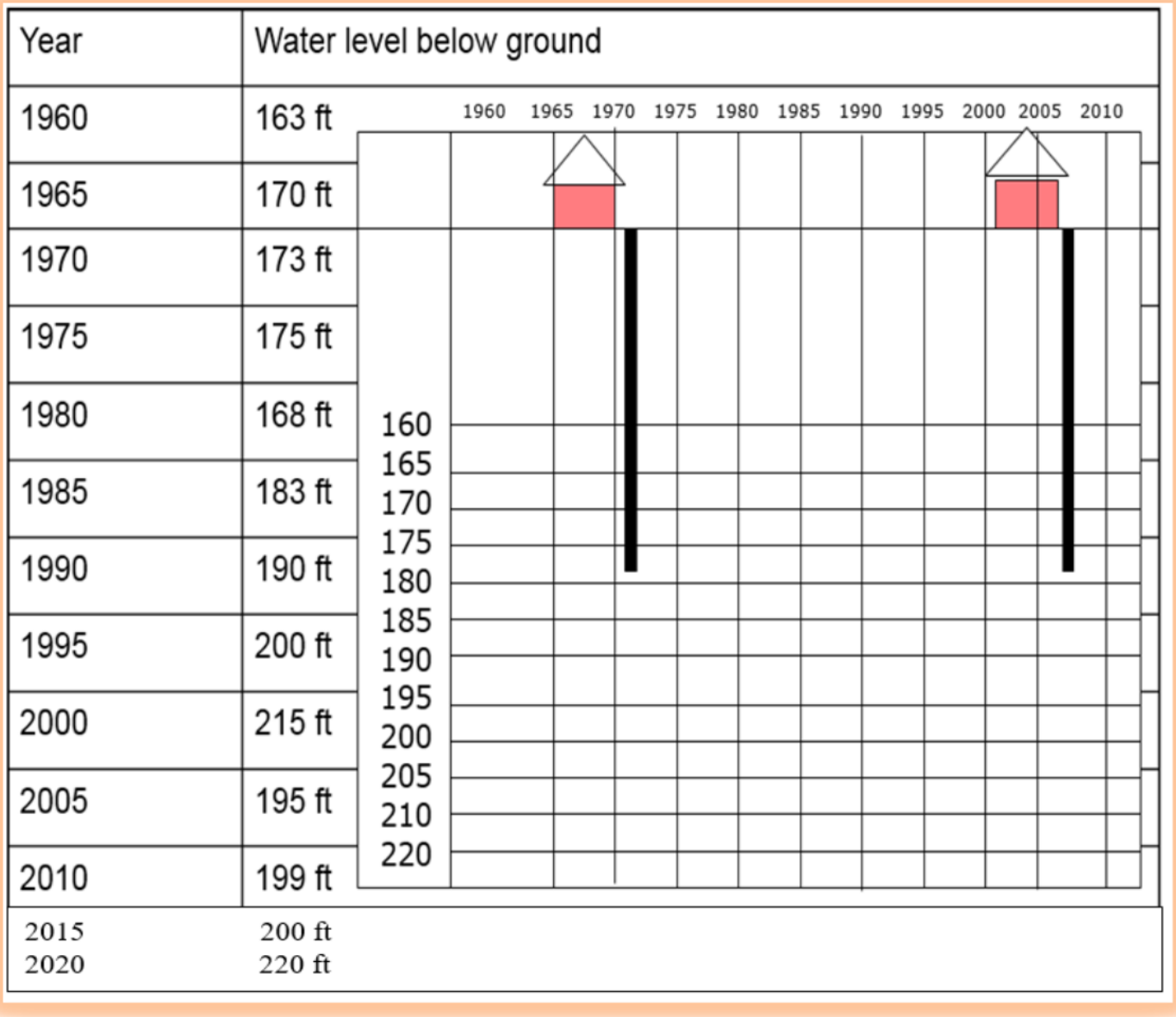
_____

_____

Graphing Groundwater Usage

Groundwater Depletion in Cook County, Georgia.

Year	Water Level Below Ground (Water Table)
1960	163 ft Deep
1965	170 ft Deep
1970	173 ft Deep
1975	175 ft Deep
1980	168 ft Deep
1985	183 ft Deep
1990	190 ft Deep
1995	200 ft Deep
2000	215 ft Deep
2005	195 ft Deep
2010	199 ft Deep
2015	200 ft Deep
2020	220 ft Deep



What happened to the depth of the groundwater over time?_____

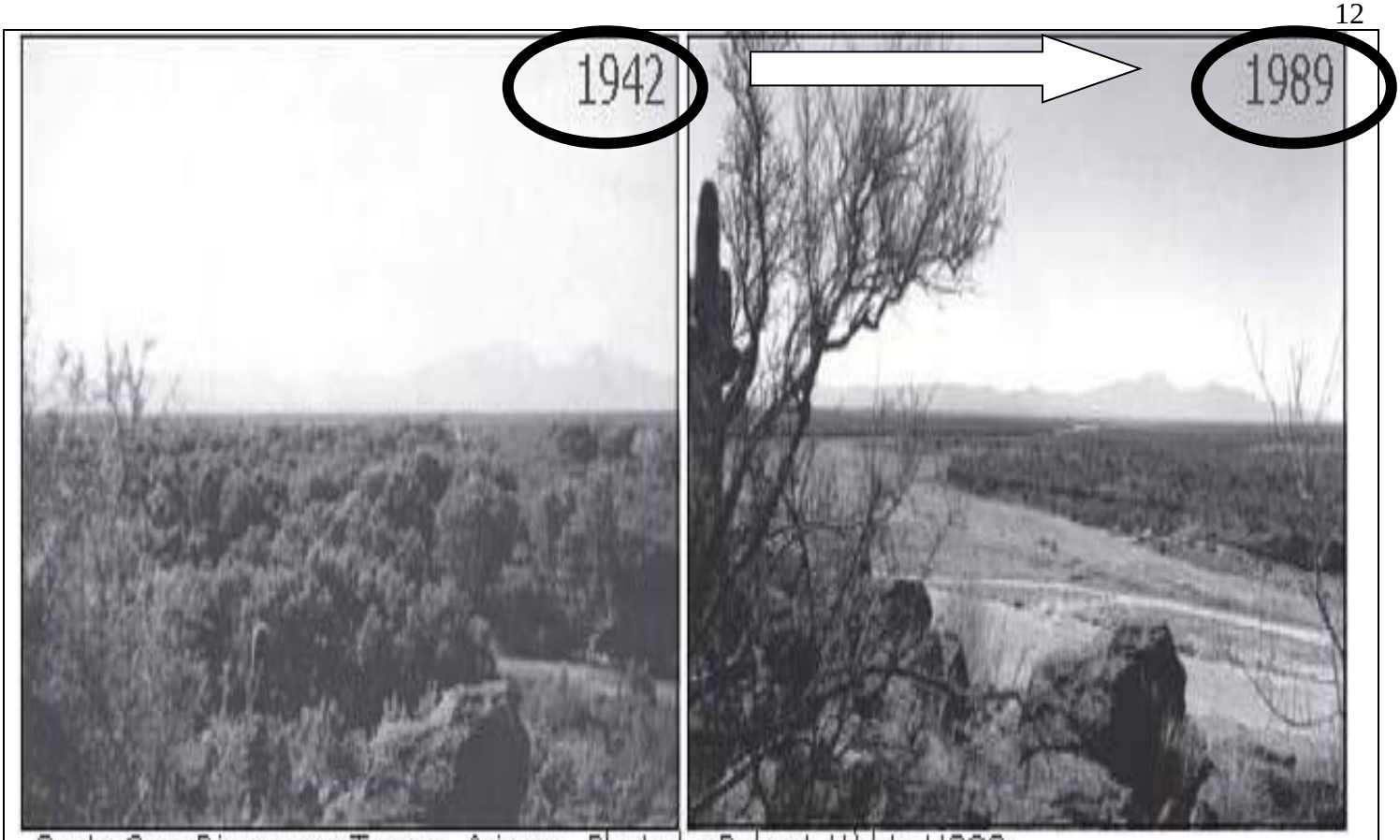
What period of time saw the most ground water depletion?_____

What years saw the most recharge to the water table?_____

Part 1 Lesson 5 Groundwater Depletion

Negative _____ of Groundwater Depletion

- Drying up of _____
- R_____ of water in streams and lakes
- Deterioration of _____quality
- Increased _____ costs
- Land use decreases in _____



Santa Cruz River near Tucson, Arizona. Photo by Robert Webb, USGS

Please use your knowledge of groundwater and groundwater depletion to discuss the photos taken above. Why is this concerning?

Part 1 Lesson 6 Groundwater Contamination

Groundwater Contamination: The act of contaminating or _____ the groundwater.

Please label a few sources of groundwater contamination

The Love Canal Tragedy EPA Journal 1979

Quite simply, Love Canal is one of the most appalling environmental tragedies in American history.

But that's not the most disturbing fact.

What is worse is that it cannot be regarded as an isolated event. It could happen again--anywhere in this country--unless we move expeditiously to prevent it. It is a cruel irony that Love Canal was originally meant to be a dream community. That vision belonged to the man for whom the three-block tract of land on the eastern edge of Niagara Falls, New York, was named--William T. Love. Love felt that by digging a short canal between the upper and lower Niagara Rivers, power could be generated cheaply to fuel the industry and homes of his would-be model city.

But despite considerable backing, Love's project was unable to endure the one-two punch of fluctuations in the economy and Nikola Tesla's discovery of how to economically transmit electricity over great distances by means of an alternating current.

By 1910, the dream was shattered. All that was left to commemorate Love's hope was a partial ditch where construction of the canal had begun. In the 1920s the seeds of a genuine nightmare were planted. The canal was turned into a municipal and industrial chemical dumpsite. Landfills can of course be an environmentally acceptable method of hazardous waste disposal, assuming they are properly sited, managed, and regulated. Love Canal will always remain a perfect historical example of how not to run such an operation.

In 1953, the Hooker Chemical Company, then the owners and operators of the property, covered the canal with earth and sold it to the city for one dollar. It was a bad buy. In the late '50s, about 100 homes and a school were built at the site. Perhaps it wasn't William T. Love's model city, but it was a solid, working-class community. For a while.

On the first day of August, 1978, the lead paragraph of a front-page story in the New York Times read: NIAGARA FALLS, N.Y.--Twenty five years after the Hooker Chemical Company stopped using the Love Canal here as an industrial dump, 82 different compounds, 11 of them suspected carcinogens, have been percolating upward through the soil, their drum containers rotting and leaching their contents into the backyards and basements of 100 homes and a public school built on the banks of the canal.

In an article prepared for the February, 1978 *EPA Journal*, I wrote, regarding chemical dumpsites in general, that "even though some of these landfills have been closed down, they may stand like ticking time bombs." Just months later, Love Canal exploded.

The explosion was triggered by a record amount of rainfall. Shortly thereafter, the leaching began. I visited the canal area at that time. Corroding waste-disposal drums could be seen breaking up through the grounds of backyards. Trees and gardens were turning black and dying. One entire swimming pool had been popped up from its foundation, afloat now on a small sea of chemicals. Puddles of noxious substances were pointed out to me by the residents. Some of these puddles were in their yards, some were in their basements, others yet were on the school grounds. Everywhere the air had a faint, choking smell. Children returned from play with burns on their hands and faces. And then there were the birth defects. The New York State Health Department is continuing an investigation into a disturbingly high rate of miscarriages, along with five birth-defect cases detected thus far in the area.

I recall talking with the father of one the children with birth defects. "I heard someone from the press saying that there were *only* five cases of birth defects here," he told me. "When you go back to your people at EPA, please don't use the phrase '*only* five cases.' People must realize that this is a tiny community. Five birth defect cases here is terrifying." A large percentage of people in Love Canal are also being closely observed because of detected high white-blood-cell counts, a possible precursor of leukemia. When the citizens of Love Canal were finally evacuated from their homes and their neighborhood, pregnant women and infants were deliberately among the first to be taken out.

"We knew they put chemicals into the canal and filled it over," said one woman, a long-time resident of the Canal area., "but we had no idea the chemicals would invade our homes. We're worried sick about the grandchildren and their children."

Two of this woman's four grandchildren have birth defects. The children were born and raised in the Love Canal community. A granddaughter was born deaf with a cleft palate, an extra row of teeth, and slight retardation. A grandson was born with an eye defect.

Of the chemicals which comprise the brew seeping through the ground and into homes at Love Canal, one of the most prevalent is benzene -- a known human carcinogen, and one detected in high concentrations. But the residents characterize things more simply. "I've got this slop everywhere," said another man who lives at Love Canal. His daughter also suffers from a congenital defect.

On August 7, New York Governor Hugh Carey announced to the residents of the Canal that the State Government would purchase the homes affected by chemicals. By the month's end, 98 families had already been evacuated. Another 46 had found temporary housing. Soon after, all families would be gone from the most contaminated areas -- a total of 221 families have moved or agreed to be moved.

State figures show more than 200 purchase offers for homes have been made, totaling nearly $7 million. A plan is being set in motion now to implement technical procedures designed to meet the seemingly impossible job of detoxifying the Canal area. The plan calls for a trench system to drain chemicals from the Canal. It is a difficult procedure, and we are keeping our fingers crossed that it will yield some degree of success.

I have been pleased with the high degree of cooperation in this case among local, State, and Federal governments, and with the swiftness by which the Congress and the President have acted to make funds available. But this is not really where the story ends.

We suspect that there are hundreds of such chemical dumpsites across this Nation. Unlike Love Canal, few are situated so close to human settlements. But without a doubt, many of these old dumpsites are time bombs with burning fuses -- their contents slowly leaching out. And the next victim could be a water supply, or a sensitive wetland near you.

Questions: Please answer 3 of the 8 questions in your journal.

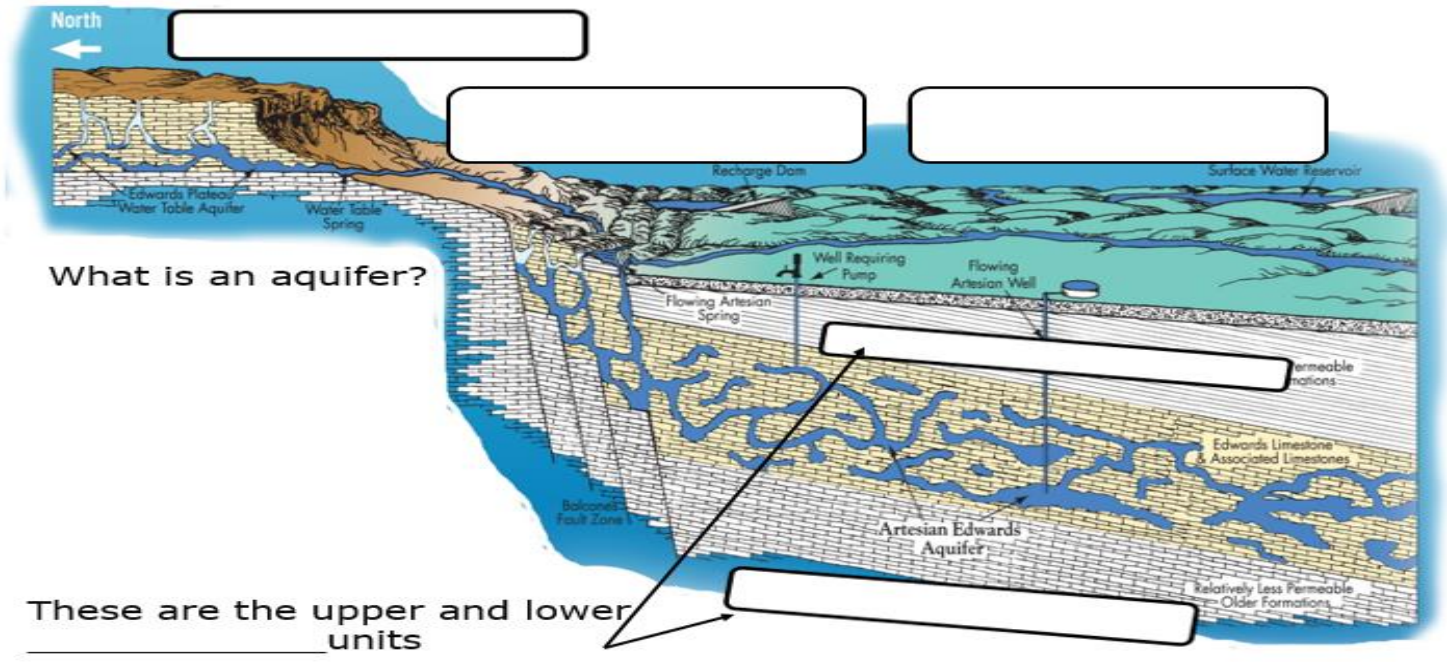
1) Summarize the Love Canal Tragedy in four sentences.
2) Would you move to Love Canal if given the chance back in the 1950's? Keep in mind that it looks like a great place to live.
3) Whose fault was this tragedy?
4) What health effects were caused by the pollutants buried under Love Canal?
5) What was done for the people who lived above Love Canal, and what is being done in the area now?
6) Why was buying the land above Love Canal a bad buy for only one dollar?
7) React to the fact that an elementary school was built right on top of chemical waste.
8) You are in charge of bringing justice to this mess. What would you do?

__.)_____

__.)_____

_.)_____

Please view the video and record some information about the Edwards Aquifer.
https://www.youtube.com/watch?v=guqinVOHTqc



DANGER UNDER THE SAND

Over the last several decades, millions of gallons of fuel, solvents, and other toxic chemicals were dumped or spilled on Massachusetts Cape Cod. Leaky underground storage tanks, sewage systems, and other sources of contamination throughout the Cape also released hazardous chemicals into the ground.

These chemicals have now seeped underground into the aquifer, from which cities towns, and individuals on the Cape draw their water. Cape Cod rests on hundreds of feet of sand left after the last Ice Age. Far below the surface, this sand holds rainwater that has seeped down through the sand. Once in the aquifer, the water travels toward the sea, following underground contours.

Unfortunately for the people of Cape Cod, the underground pollution has reached the aquifer and is on its way to the ocean. This means that municipal and private wells throughout the Cape are becoming contaminated. Scientists estimate that it may take 100 years for the toxic materials to work their way through the Cape Cod Aquifer.

In this activity – Please examine the map below and determine the source of the ground water contamination based on water testing of wells. Try and trace the numbers to **pin point** the source of the ground water contamination

The hand written numbers represent pollutants in parts per a million.

Low levels -	.001 – 1	(Color Yellow)
Medium levels -	1 – 10	(Color Orange)
High levels	10 – 200	(Color Red)

Look at the map below and quickly take an educated guess. Then break up into groups of four and figure it out together. Your group needs to agree on one location.

Hypothesis (guess) _____

_____

_____

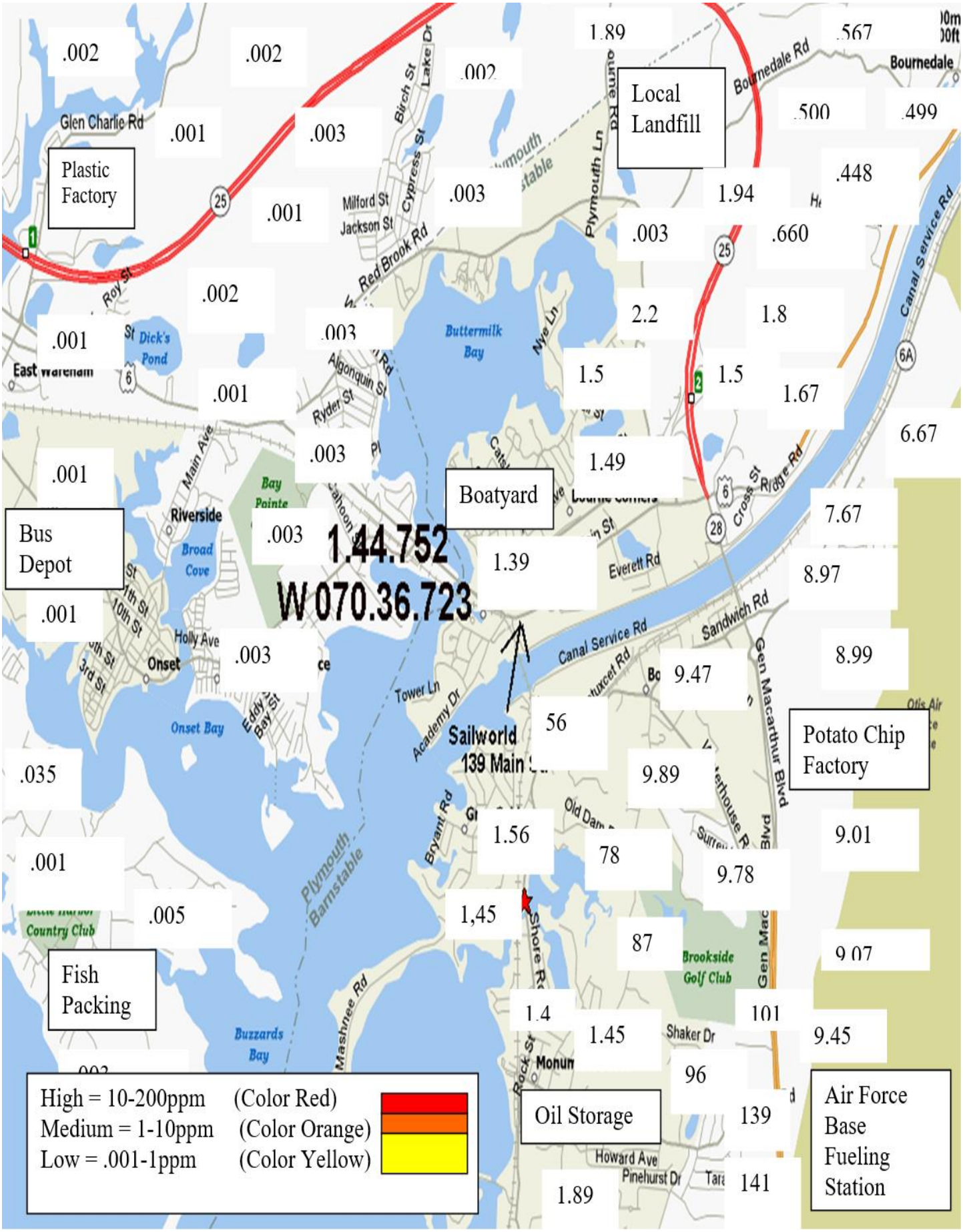
_____

_____

What is the source of the groundwater contamination? Why do you think that?

_____

_____


Local Landfill
Plastic Factory
Boatyard
Bus Depot
Potato Chip Factory
Fish Packing
Oil Storage
Air Force Base Fueling Station
1.44.752
W 070.36.723
High = 10-200ppm (Color Red)
Medium = 1-10ppm (Color Orange)
Low = .001-1ppm (Color Yellow)
Sailworld
139 Main
Bournedale
Buttermilk Bay
Onset Bay
Plymouth Barnstable
Buzzards Bay
Brookside Golf Club
Country Club
Riverside
Onset
East Wareham
Bay Pointe
Broad Cove
Dick's Pond
Canal Service Rd
Sandwich Rd
Gen Macarthur Blvd
Everett Rd
Howard Ave
Pinehurst Dr
Shaker Dr
Old Dam
Tower Ln
Academy Dr
Bryant Rd
Mashnee Rd
Shore Rd
Rock St
Red Brook Rd
Glen Charlie Rd
Milford St
Jackson St
Cypress St
Birch St
Lake Dr
Plymouth Ln
Bournedale Rd
Canal Service Rd
Cross St
Ridge Rd
Main Ave
Holly Ave
Ryder St
Algonquin St
Nye Ln
Roy St
.002
.001
.003
.035
.005
1.89
.567
.500
.499
.448
1.94
.660
2.2
1.8
1.5
1.67
6.67
1.49
7.67
1.39
8.97
9.47
8.99
56
9.89
1.56
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9.01
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87
9 07
1.4
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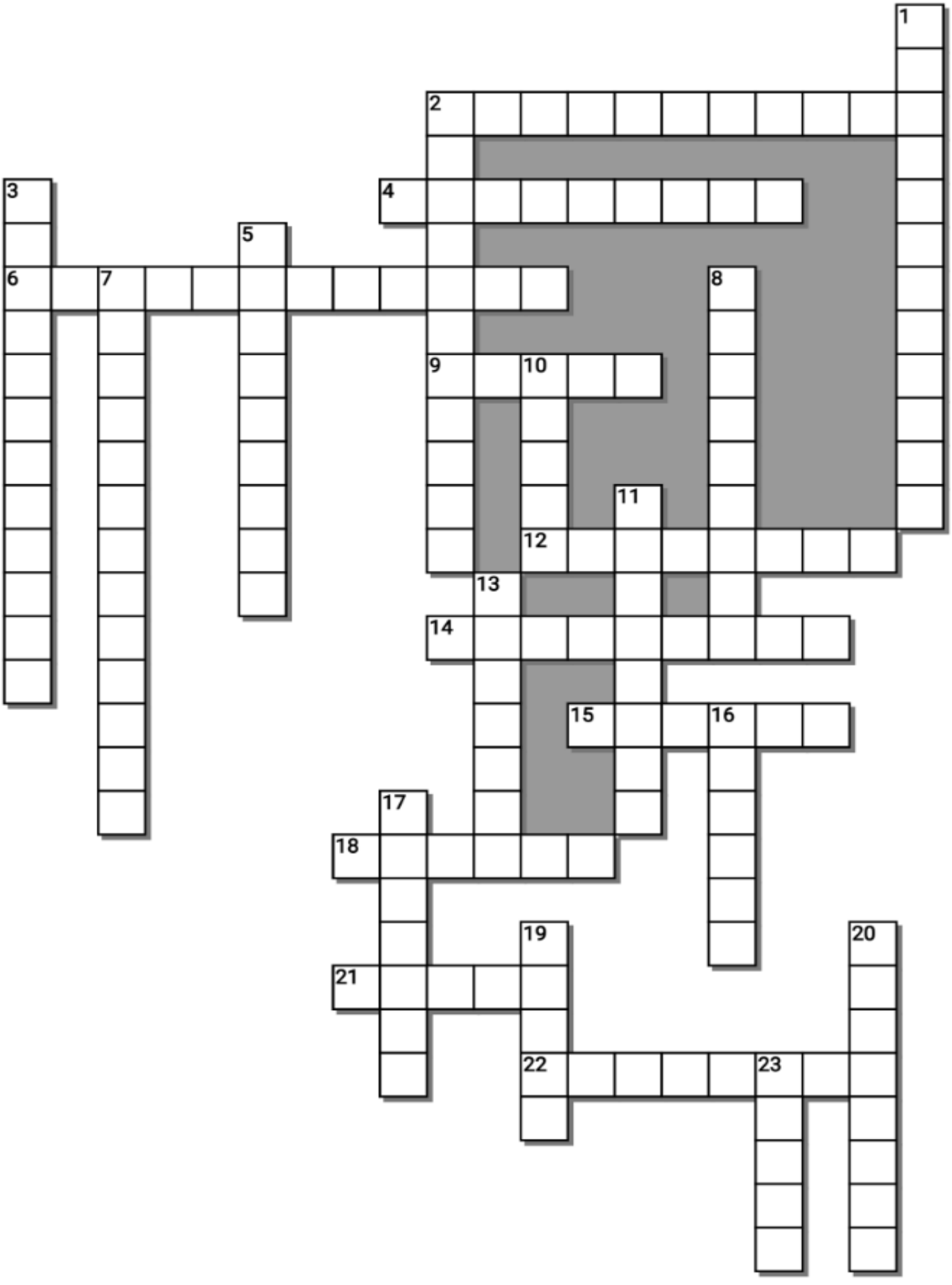
101
9.45
96
139
141
1.89


1
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23

Across

2. .5% of earth's water supply is found in g_____ (most is too deep to get)
4. When you wash dishes this is a _____ use of water
6. When you go water skiing this is a _____ use of water
9. One negative of groundwater depletion is the drying up of w___
12. An important use of water S_____/ health
14. L____C___: A disaster site in Western New York from groundwater pollution
15. R_____ 0.000096% (Available) of the water supply
18. 97% of earth's water can be found in the _____
21. Earth is knows as the _____ planet
22. This is the name for an underground layer of water bearing permeable rock

Down

1. When you water plants, this is a A_____ use of water
2. This is the name for water stored in the ground
3. A_____ run-Off, When pesticides and fertilizers wash off farms in the rain
5. Leakey L_____ When the waste in garbage seeps into the waterways
7. Groundwater C_____. The act of contaminating the groundwater
8. This is what happens when too much discharge occurs with groundwater. Groundwater D_____
10. Inland _____ 0.018% (Available) is this freshwater supply
11. Slang term for a method called hydraulic facturing which can pollute the groundwater
13. This country known as the horn of Africa has experienced several droughts and famine
16. 3/4 of planet E_____ is water
17. The largest supply of freshwater on earth is in the I__C__
19. U___ Run-Off, When rainwater washes pollution into the streams and rivers and gorund
20. Groundwater Depletion can cause land use to d_____
23. True or False? you can drink seawater for survival

Possible Answers

AGRICULTURAL, AGRICULTURAL, CONTAMINATION, DECREASE, DEPLETION, EAERTH, FALSE, FRACKING, HOUSEHOLD, ICECAPS, LAKES, LANDFILLS, LOVECANAL, OCEANS, RECREATIONAL, RIVERS, SOMALIA, SURVIVAL, URBAN, WATER, WELLS, ACQUIFER, GROUNDWATER, GROUNDWATER

Earths Waters Part 1 Lesson 8

Name:

1-10 = 10 pts * = Bonus + 1 pt,
(Secretly write owl in correct space +1 pt)
Final Question = 5 pt wager

Due: Today
Score ____ / 100

WATER USE	EVERY DROP	MUDDY WATERS	DRINK IT?	NAME THAT H_2O Bonus round 1 pt each
1)	6)	11)	16)	*21)
2)	7)	12)	17)	*22)
3)	8)	13)	18)	*23)
4)	9)	14)	19)	*24)
5)	10)	15)	20)	*25)

Final Question Wager ___ /5 Answer: _____

Part 1 Earth's Water

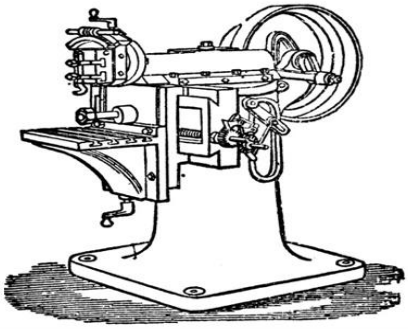
Name:
Due:

Part 1 Lesson 1

The six ways humans use water

- Survival / health
- Household
- Recreational
- Industrial
- Transportation
- Agricultural

Please provide examples of ways human use water in the boxes below.

Agriculture	Transportation	Recreation
		
Survival / Health	**Household**	**Industrial**
		

Earth's Water Supply

- Oceans 97.3% - Salt (Cannot drink or use for Agriculture)
- Ice Caps 2.91% (Locked)
- Groundwater 0.5% (Most is too Deep)
- Soil Moisture 0.005% (Can't Obtain)
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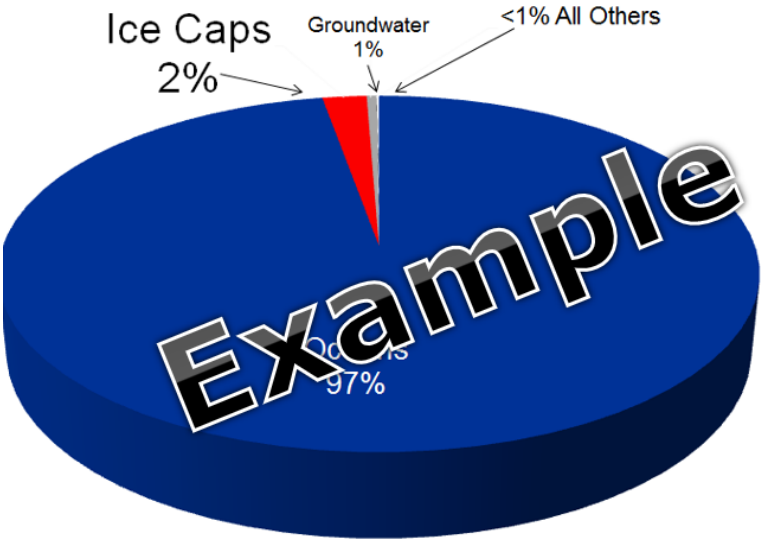
Warning! 4 part question, check diamond when accomplished.

◊ Complete a pie graph below showing the locations of earth's water.

◊ Make sure that your graph includes all the places water is located on earth.
◊ Include % in the margin and
◊ provide a brief statement about whether humans can use it for drinking and agriculture.



The oceans are a huge reservoir of water but its salty. Humans cannot use it for drinking or agriculture. It also kills livestock and contaminates the soil.

The ice caps are unfortunately a locked away source of freshwater. They are too far away to use for drinking and agriculture.

Groundwater is a great source of freshwater but most is too deep / costly to get.

Lakes and Rivers are a nice source of freshwater but are a small source.

Earth's Water Supply

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Part 1 Lesson 2 Water the Resource

Dying for Water in Somalia's Drought

Friday, April 14, 2006

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By the time it ended two years later, 250 men were dead. Now there are well widows, well warlords and well warriors.

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"His body was bloodied, swollen and just lying there with the other dead by the well, left in disgrace. The shame. We'd never seen conflict at this level of violence," she explained, shielding her eyes from a dust storm that was swirling in the heat under a blue sky. "Thirst forces men to this horror of war."

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Amid the anarchy and water scarcity, most of the country's almost 9 million people scratch out a living.

The U.N. World Food Program hires heavily armed men to help protect villagers as they pick up water, cooking oil and sorghum. Still, gunmen sometimes force women to give up their water or food as they walk back to their villages.

"Even when local people are good and plan out water catchment systems, warlords just take it over. That's why we have so many people drinking horrible water with worms and dirt and getting very ill," said Abdul Rashid, a Somali nurse in Rabdore who works with the International Medical Corps, a nonprofit relief group. "It's like the start of the water wars right here in Somalia."

"Before I go anywhere in Somalia, I pray. If someone is thirsty, they can shoot you for a glass of water. There's no police to come and no government to say anything," said Sheik Ibrahim Khail, 53, who operates a transport company for the World Food Program. "In other places they may just want to rob the driver or take the food and sell it. But here they want the water, too."

Long-term solutions to fighting drought include collecting what little rainwater that does fall, building modern irrigation systems and using new water exploration techniques, water experts said. But that kind of effort typically requires the coordination and enforcement of a central government, said Zlatan Milisic, the World Food Program's country director for Somalia.

"Somalia at heart is a water crisis that has turned into a food crisis," Milisic said. "The effects here are worse than anywhere else because there's no government, there's no stability. To me, this is the most unstable place in the world that is currently suffering a drought."

Fights over water break out even in places with a healthy supply.

In one such place, the town of Wajid, a 36-year-old man was executed after he killed a man in a fight over a well last month, according to town authorities.

Somalis who fled the drought and are living in makeshift shelters on the edge of town said the story of the death terrified them. They had come to Wajid to find water and hoped they could do so without being subjected to violence.

Isha Aden Hussein, 38, whose husband was killed in the War of the Well in Rabdore, walked more than 100 miles to reach this town. She and her husband once had a farm and spacious huts for their 10 children. Now she lives in a shelter made of thin, oily kitchen rags.

She described her life as "miserable" and said she just hoped to survive the drought. In the slightly cooler mornings and evenings, she collects firewood and tries to sell it. But the temperature rises to 115 degrees during the day, so she spends most of her time in her shelter.

"I just sit in there. I pray to God and wait for my paradise to come. In paradise, I'll be shading under a thick mango tree. I will be fat. My children will be dressed in smart uniforms for school. They will be reading me very nice stories," she said.

"The most important is that they won't have thirst. Our mouths will always be wet. We'll drink in peace. "

Please answer 3 of the 7 questions below.

8) **Where is all this fighting occurring? What are they fighting over?**
9) **What happened at the well near Rabadore?**
10) **How many people are being affected by the drought in Somalia? What is happening to them?**
11) **Does Somalia have a government that can help? Explain?**
12) **What is a warlord? Are they good or bad? What do they do?**
13) **Describe one person from the article. What is their life like?**
14) **How would your life be different if we didn't have any water or food?**

8) Where is all this fighting occurring? What are they fighting over?

Answer – This article is written about a county in East Africa called Somalia. This country has been suffering from a drought and people are fighting over control of a well.

9) What happened at the well near Rabadore?

Answer- Warlords took control of a well and 250 people have died fighting over water.

10) How many people are being affected by the drought in Somalia? What is happening to them?

Answer -11 million people have been affected by the drought in Somalia. They are thirsty and the lack of water has made it difficult to grow food.

11) Does Somalia have a government that can help? Explain?

Answer – Somalia doesn't have an effective central government. There's lots of fighting and violence.

12) What is a warlord? Are they good or bad? What do they do?

Answer – A warlord is a person who controls people or resources with violence. They can tax people and kill them. They are bad for the Somalia people.

13) Describe one person from the article. What is their life like?

Answer- Fatuma Ali Mahmood, a 35 year old woman whose husband was killed looking for water. She has 9 children. Isha Aden Hussein, 38 is another woman whose husband was killed. She has 10 children and lives in a tent of trash bags and prays for a day when the rains come.

14) How would your life be different if we didn't have any water or food?

Answers will vary but everyone's life would be different in a negative way.

Dying for Water in Somalia's Drought

Friday, April 14, 2006

What does the photo on the right mean to you now that you have studied drought and famine in Somalia? We are extremely lucky to live in a place that has an abundance of water. Our life would be much different if finding water was difficult. We should not waste water and try to conserve it.	

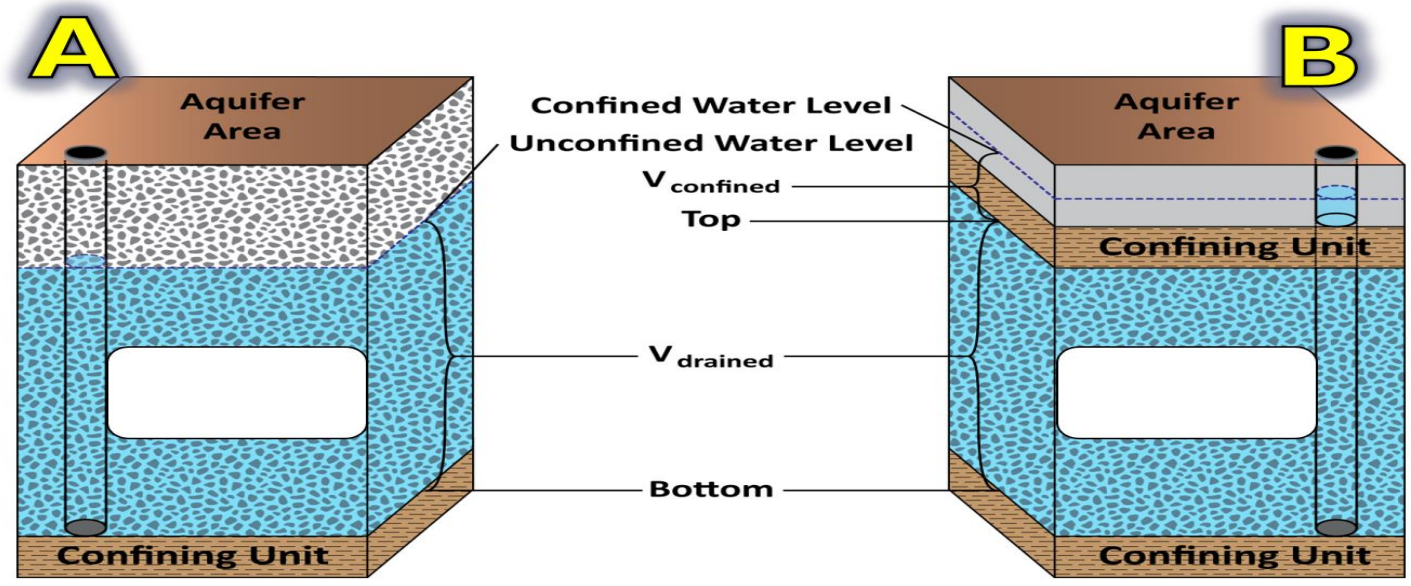
Part 1 Lesson 3 Groundwater and Water Conservation

Groundwater: Water stored in the ground

Aquifer: An underground layer of water-bearing permeable rock.

Which letter is a confined aquifer, and which is an unconfined aquifer?

A= Unconfined	B= Confined Aquifer / A confined aquifer is an aquifer below the land surface that is saturated with water. Layers of impermeable material are both above and below the aquifer, causing it to be under pressure so that when the aquifer is penetrated by a well, the water will rise above the top of the aquifer.



Use the boxes below to describe some ways at home you can conserve water. Visit the internet if you are struggling.

There are a number of ways to save water, and they all start with you. When washing dishes by hand, don't let the water run while rinsing. Fill one sink with wash water and the other with rinse water. Some refrigerators, air conditioners and ice-makers are cooled with wasted flows of water. Consider upgrading with air-cooled appliances for significant water savings. Adjust sprinklers so only your lawn is watered and not the house, sidewalk, or street.	Use the garbage disposal sparingly. Compost vegetable food waste instead and save gallons every time Plant in the fall when conditions are cooler and rainfall is more plentiful. For cold drinks keep a pitcher of water in the refrigerator instead of running the tap. This way, every drop goes down you and not the drain.	Run your clothes washer and dishwasher only when they are full. You can save up to 1,000 gallons a month. Choose shrubs and groundcovers instead of turf for hard-to-water areas such as steep slopes and isolated strips. Install covers on pools and spas and check for leaks around your pumps

Part 1 Lesson 4 Groundwater

Start with… $4,000	2nd Month $700.00 USD	3rd Month $-2,350.00 USD	4th Month $-2,750.00 USD	End with… $-1,450.00 USD

Groundwater: Recharge and Discharge. How much money did you end up with?_____

What eventually happened to the groundwater over time?
When you spend more than you make / withdraw more money than you deposit, you will eventually become bankrupt. This is the same that happens with groundwater.

What happens when recharge occurs slower than discharge?
If you use more water (discharge) than recharges, the groundwater will deplete overtime.

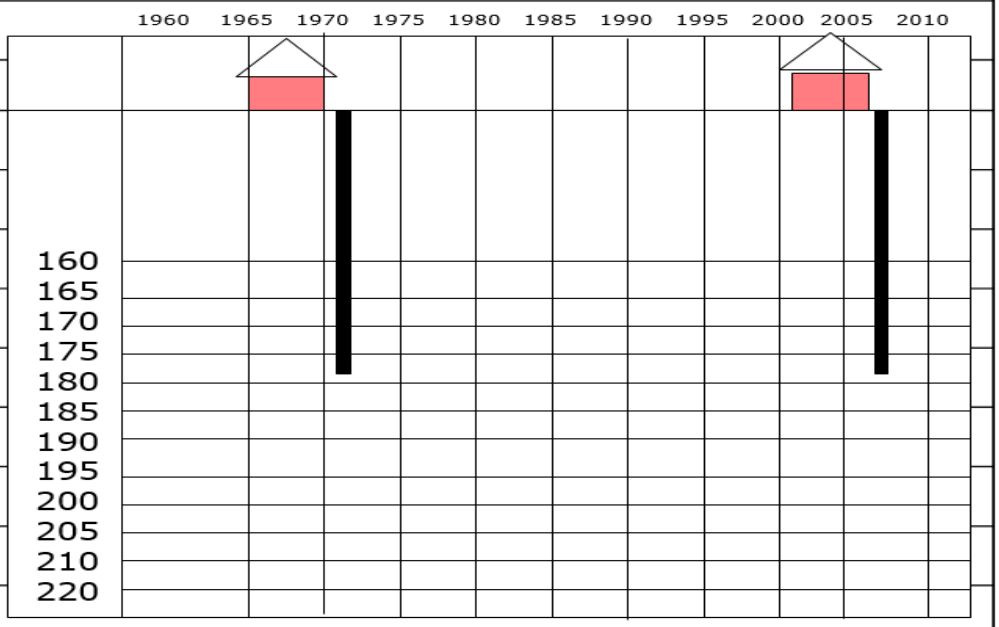
Graphing Groundwater Usage

Groundwater Depletion in Cook County, Georgia.

Year	Water Level Below Ground (Water Table)
1960	163 ft Deep
1965	170 ft Deep
1970	173 ft Deep
1975	175 ft Deep
1980	168 ft Deep

1985	183 ft Deep
1990	190 ft Deep
1995	200 ft Deep
2000	215 ft Deep
2005	195 ft Deep
2010	199 ft Deep
2015	200 ft Deep

Year	Water level below ground
1960	163 ft
1965	170 ft
1970	173 ft
1975	175 ft
1980	168 ft
1985	183 ft
1990	190 ft
1995	200 ft
2000	215 ft
2005	195 ft
2010	199 ft



What happened to the depth of the groundwater over time?
The groundwater became depleted over time. Although there were some years that saw a recharge, the trend was a decreases in available groundwater over a 55 year period.

What period of time saw the most ground water depletion?
Groundwater depleted about 40 feet from 1960-2010

2015	200 ft

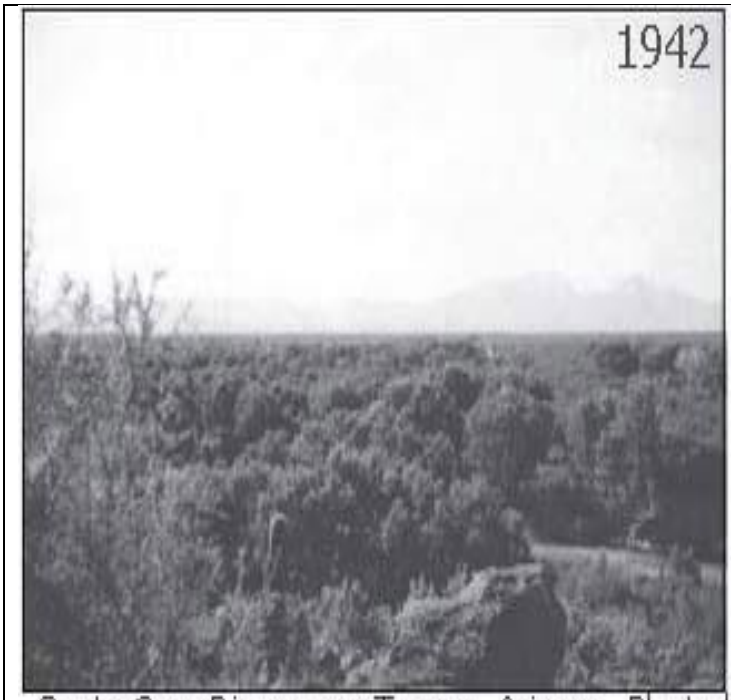
What years saw the most recharge to the water table?
Aquifer recharge occurred from 1970-1980 and from 2000 to 2005.

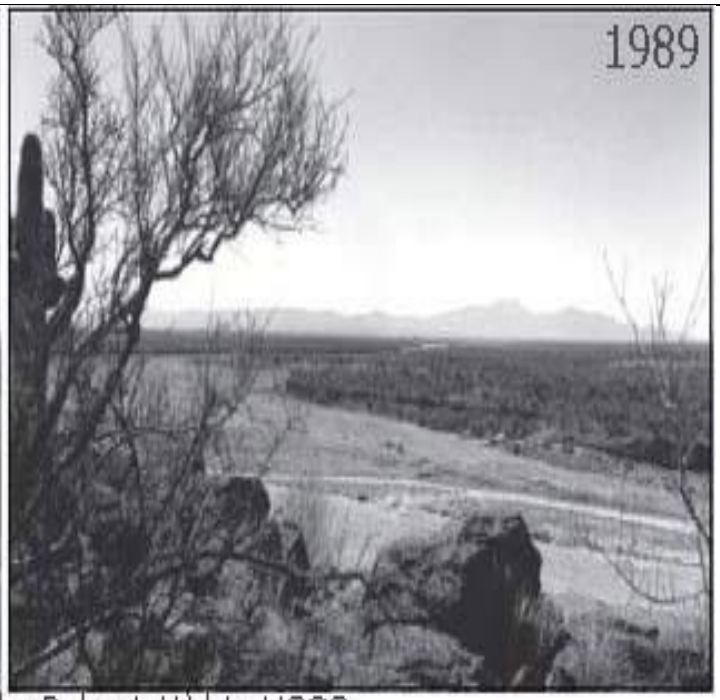
Part 1 Lesson 5 Groundwater Depletion

Negative Impacts of Groundwater Depletion

- Drying up of Wells
- Reduction of water in streams and lakes
- Deterioration of water quality
- Increased pumping costs

- Land use decreases in quality





Santa Cruz River near Tucson, Arizona. Photo by Robert Webb, USGS

Please use you knowledge of groundwater and groundwater depletion to discuss the photos taken above. Why is this concerning?
The 1942 Picture shows mesquite and cottonwood trees along the river. The same area 47 years later shows that the trees have disappeared. Water data from local wells indicate that the groundwater levels have declined more than 100 feet due to pumping. The use of groundwater / pumping appears to be the reason for the loss of trees.

The Santa Cruz River looks much different in 1942. The water table must have been much higher as the area near the river had lots of trees. The river in 1989 looks like a desert, and all of the trees are gone.

Negative Effects of Groundwater Depletion→

- Drying up of wells
- Reduction of water in streams and lakes
- Deterioration of water quality
- Increased pumping costs
- Land use decreases in quality

Part 1 Lesson 6 Groundwater Contamination

Groundwater Contamination: The act of contaminating or polluting the groundwater.

Please label a few sources of groundwater contamination

Part 3B Lesson 7 Water Pollution

The Love Canal Tragedy EPA Journal 1979

Quite simply, Love Canal is one of the most appalling environmental tragedies in American history.

But that's not the most disturbing fact.

What is worse is that it cannot be regarded as an isolated event. It could happen again--anywhere in this country--unless we move expeditiously to prevent it. It is a cruel irony that Love Canal was originally meant to be a dream community. That vision belonged to the man for whom the three-block tract of land on the eastern edge of Niagara Falls, New York, was named--William T. Love. Love felt that by digging a short canal between the upper and lower Niagara Rivers, power could be generated cheaply to fuel the industry and homes of his would-be model city.

But despite considerable backing, Love's project was unable to endure the one-two punch of fluctuations in the economy and Nikola Tesla's discovery of how to economically transmit electricity over great distances by means of an alternating current.

By 1910, the dream was shattered. All that was left to commemorate Love's hope was a partial ditch where construction of the canal had begun. In the 1920s the seeds of a genuine nightmare were planted. The canal was turned into a municipal and industrial chemical dumpsite. Landfills can of course be an environmentally

acceptable method of hazardous waste disposal, assuming they are properly sited, managed, and regulated. Love Canal will always remain a perfect historical example of how not to run such an operation.

In 1953, the Hooker Chemical Company, then the owners and operators of the property, covered the canal with earth and sold it to the city for one dollar. It was a bad buy. In the late '50s, about 100 homes and a school were built at the site. Perhaps it wasn't William T. Love's model city, but it was a solid, working-class community. For a while.

On the first day of August, 1978, the lead paragraph of a front-page story in the New York Times read: NIAGARA FALLS, N.Y.--Twenty five years after the Hooker Chemical Company stopped using the Love Canal here as an industrial dump, 82 different compounds, 11 of them suspected carcinogens, have been percolating upward through the soil, their drum containers rotting and leaching their contents into the backyards and basements of 100 homes and a public school built on the banks of the canal.

In an article prepared for the February, 1978 *EPA Journal*, I wrote, regarding chemical dumpsites in general, that "even though some of these landfills have been closed down, they may stand like ticking time bombs." Just months later, Love Canal exploded.

The explosion was triggered by a record amount of rainfall. Shortly thereafter, the leaching began. I visited the canal area at that time. Corroding waste-disposal drums could be seen breaking up through the grounds of backyards. Trees and gardens were turning black and dying. One entire swimming pool had been popped up from its foundation, afloat now on a small sea of chemicals. Puddles of noxious substances were pointed out to me by the residents. Some of these puddles were in their yards, some were in their basements, others yet were on the school grounds. Everywhere the air had a faint, choking smell. Children returned from play with burns on their hands and faces. And then there were the birth defects. The New York State Health Department is continuing an investigation into a disturbingly high rate of miscarriages, along with five birth-defect cases detected thus far in the area.

I recall talking with the father of one the children with birth defects. "I heard someone from the press saying that there were *only* five cases of birth defects here," he told me. "When you go back to your people at EPA, please don't use the phrase '*only* five cases.' People must realize that this is a tiny community. Five birth defect cases here is terrifying." A large percentage of people in Love Canal are also being closely observed because of detected high white-blood-cell counts, a possible precursor of leukemia. When the citizens of Love Canal were finally evacuated from their homes and their neighborhood, pregnant women and infants were deliberately among the first to be taken out.

"We knew they put chemicals into the canal and filled it over," said one woman, a long-time resident of the Canal area., "but we had no idea the chemicals would invade our homes. We're worried sick about the grandchildren and their children."

Two of this woman's four grandchildren have birth defects. The children were born and raised in the Love Canal community. A granddaughter was born deaf with a cleft palate, an extra row of teeth, and slight retardation. A grandson was born with an eye defect.

Of the chemicals which comprise the brew seeping through the ground and into homes at Love Canal, one of the most prevalent is benzene -- a known human carcinogen, and one detected in high concentrations. But the residents characterize things more simply. "I've got this slop everywhere," said another man who lives at Love Canal. His daughter also suffers from a congenital defect.

On August 7, New York Governor Hugh Carey announced to the residents of the Canal that the State Government would purchase the homes affected by chemicals. By the month's end, 98 families had already

been evacuated. Another 46 had found temporary housing. Soon after, all families would be gone from the most contaminated areas -- a total of 221 families have moved or agreed to be moved.

State figures show more than 200 purchase offers for homes have been made, totaling nearly $7 million. A plan is being set in motion now to implement technical procedures designed to meet the seemingly impossible job of detoxifying the Canal area. The plan calls for a trench system to drain chemicals from the Canal. It is a difficult procedure, and we are keeping our fingers crossed that it will yield some degree of success.

I have been pleased with the high degree of cooperation in this case among local, State, and Federal governments, and with the swiftness by which the Congress and the President have acted to make funds available. But this is not really where the story ends.

We suspect that there are hundreds of such chemical dumpsites across this Nation. Unlike Love Canal, few are situated so close to human settlements. But without a doubt, many of these old dumpsites are time bombs with burning fuses -- their contents slowly leaching out. And the next victim could be a water supply, or a sensitive wetland near you.

Questions: Please answer 3 of the 8 questions in your journal.

9) Summarize the Love Canal Tragedy in four sentences.
10) Would you move to Love Canal if given the chance back in the 1950's? Keep in mind that it looks like a great place to live.
11) Whose fault was this tragedy?
12) What health effects were caused by the pollutants buried under Love Canal?
13) What was done for the people who lived above Love Canal, and what is being done in the area now?
14) Why was buying the land above Love Canal a bad buy for only one dollar?
15) React to the fact that an elementary school was built right on top of chemical waste.
16) You are in charge of bringing justice to this mess. What would you do?

Questions: Please answer 4 of the 8 questions in your journal.

1) Summarize the Love Canal Tragedy in four sentences.

The Love Canal Tragedy was an environmental disaster that occurred when a town was built upon a chemical waste dump. People in the town began getting sick and some children were born with birth defects. The town had to be abandoned because it was so unhealthy. This is one example of why we need laws for hazardous waste disposal and urban planning.

2) Would you move to Love Canal if given the chance back in the 1950's?

Maybe, at the time, Love Canal seemed like a great place to live. The people were unaware of the hazards buried beneath them. If the people knew what lay beneath them they would have never moved to Love Canal.

3) Whose fault was this tragedy?

The Hooker Chemical Company dumped toxic chemicals for years in the canal and then covered the area with dirt and sold it to the town. Later, a community was build on top of the toxic waste. The politics associated with the sales and profit from Love Canal are where the fault lies.

4) What health effects were caused by the pollutants buried under Love Canal?

A large percentage of people in Love Canal are also being closely observed because of detected high white-blood-cell counts, a possible precursor of leukemia.

Two of this woman's four grandchildren have birth defects. The children were born and raised in the Love Canal community. A granddaughter was born deaf with a cleft palate, an extra row of teeth, and slight retardation. A grandson was born with an eye defect.

Of the chemicals which comprise the brew seeping through the ground and into homes at Love Canal, one of the most prevalent is benzene -- a known human carcinogen, and one detected in high concentrations. But the residents characterize things more simply.

5) What was done for the people who lived above Love Canal, and what is being done in the area now?

The people have been evacuated and relocated. Many of their homes were bought by the state and federal government. The area is being cleaned as the toxins are slowly being drained away from the canal.

6) Why was buying the land above Love Canal a bad buy for only one dollar?

The overall costs associated with the relocations and clean up of Love Canal is millions and millions of dollars. This is much more than the so called deal of 1 dollar by the Hooker Chemical Company.

7) React to the fact that an elementary school was built right on top of a pile of chemical waste.

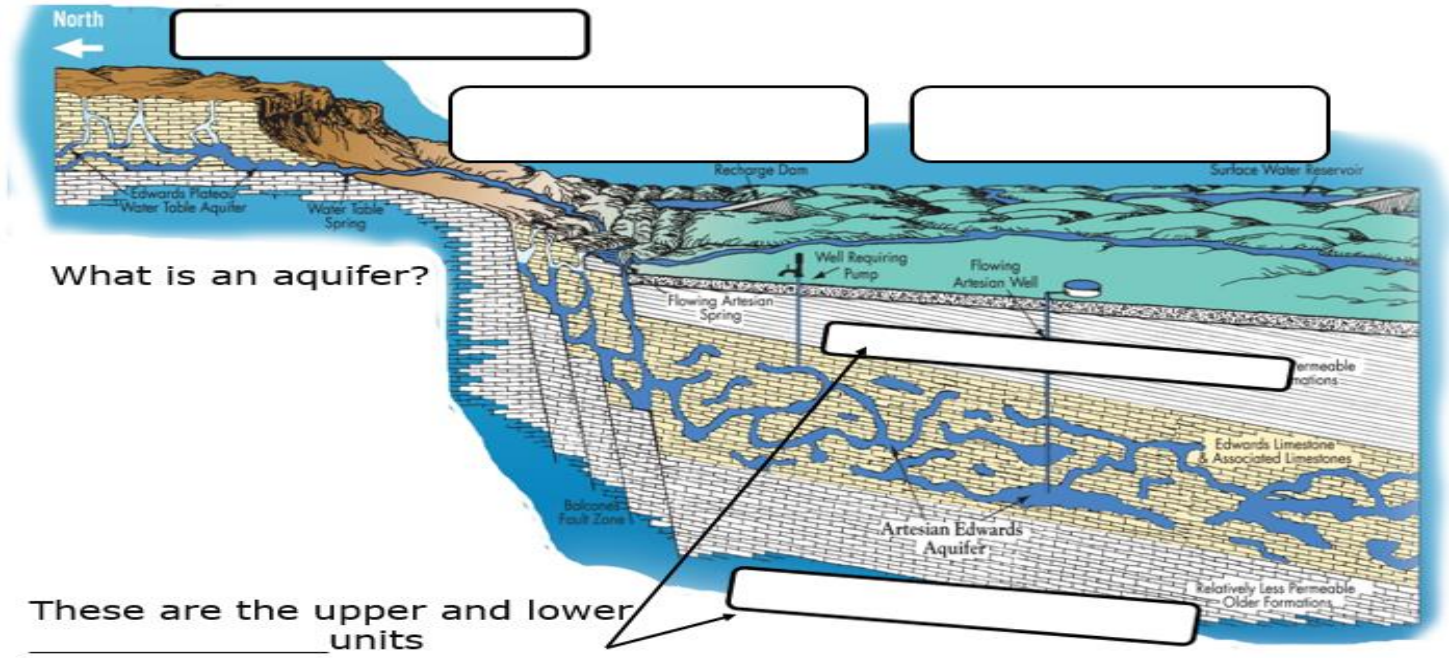
Someone must have known that the community and school was built on top of chemicals. For some reason, they did not speak up and warn everyone. This makes me disappointed in the people who allowed it.

8) You are in charge of bringing justice to this mess. What would you do?

I would assign a task force to investigate the incident and bring all of the people responsible to justice. I would also put laws into place so this type of disaster would not occur again.

Please view the video and record some information about the Edwards Aquifer.
https://www.youtube.com/watch?v=guqinVOHTqc

The Edwards Aquifer is one of the most prolific artesian aquifers in the world. Located on the eastern edge of the Edwards Plateau in the U.S. state of Texas, it is the source of drinking water for two million people, and is the primary water supply for agriculture and industry in the aquifer's region



DANGER UNDER THE SAND

Over the last several decades, millions of gallons of fuel, solvents, and other toxic chemicals were dumped or spilled on Massachusetts Cape Cod. Leaky underground storage tanks, sewage systems, and other sources of contamination throughout the Cape also released hazardous chemicals into the ground.

These chemicals have now seeped underground into the aquifer, from which cities towns, and individuals on the Cape draw their water. Cape Cod rests on hundreds of feet of sand left after the last Ice Age. Far below the surface, this sand holds rainwater that has seeped down through the sand. Once in the aquifer, the water travels toward the sea, following underground contours.

Unfortunately for the people of Cape Cod, the underground pollution has reached the aquifer and is on its way to the ocean. This means that municipal and private wells throughout the Cape are becoming contaminated. Scientists estimate that it may take 100 years for the toxic materials to work their way through the Cape Cod Aquifer.

In this activity – Please examine the map below and determine the source of the ground water contamination based on water testing of wells. Try and trace the numbers to **pin point** the source of the ground water contamination

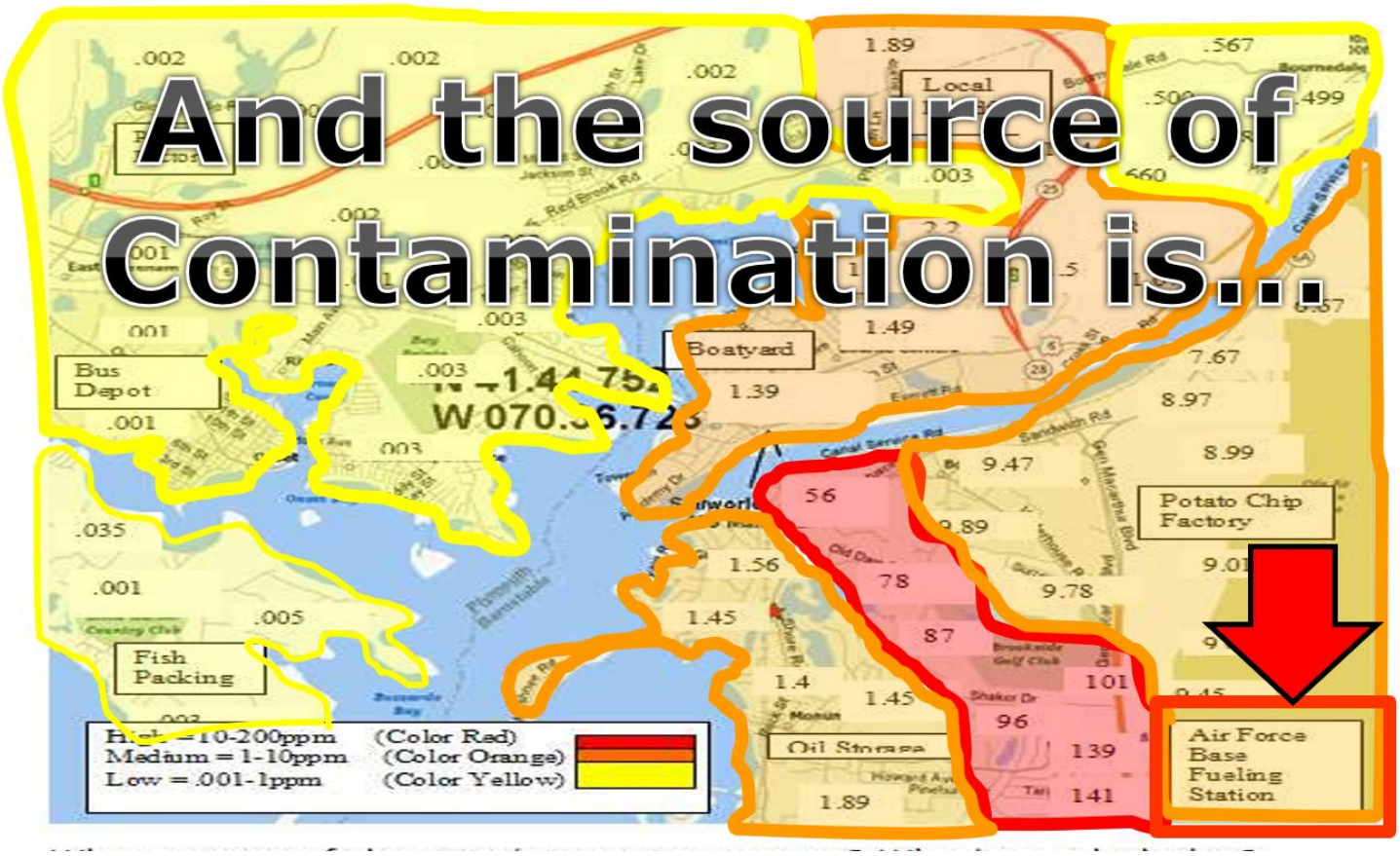
The hand written numbers represent pollutants in parts per a million.

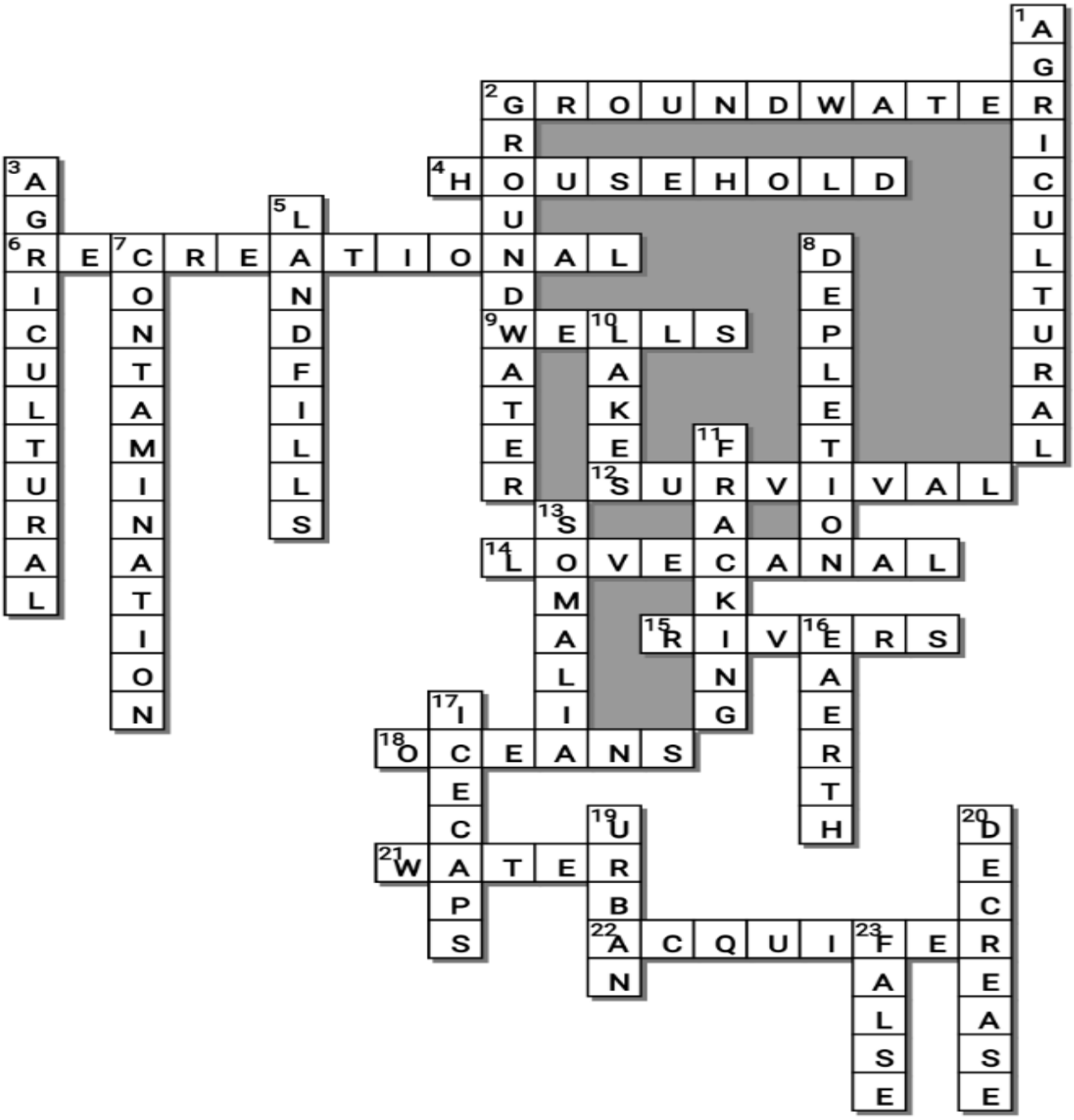
Low levels -	.001 – 1	(Color Yellow)
Medium levels -	1 – 10	(Color Orange)
High levels	10 – 200	(Color Red)

Look at the map below and quickly take an educated guess. Then break up into groups of four and figure it out together. Your group needs to agree on one location.

Hypothesis (guess) Any educated guess will work

What is the source of the groundwater contamination? Why do you think that?
The Air Force Base was the source of the contamination




1 AGRICULTURAL
2 GROUNDWATER
3 AGRICULTURAL
4 HOUSEHOLD
5 LANDFILLS
6 RECREATIONAL
7 CONTAMINATION
8 DEPLETED
9 WATER
10 LAKES
11 FRESH
12 SURVIVAL
13 SALMON
14 LOVECANAL
15 RIVERS
16 EARTH
17 ICE
18 OCEANS
19 URBAN
20 DECREASE
21 WATERS
22 ACQUIFER
23 FALSE

Across

2. .5% of earth's water supply is found in g_____ (most is too deep to get)
4. When you wash dishes this is a _____ use of water
6. When you go water skiing this is a _____ use of water
9. One negative of groundwater depletion is the drying up of w___
12. An important use of water S_____/ health
14. L____C___: A disaster site in Western New York from groundwater pollution
15. R_____ 0.000096% (Available) of the water supply
18. 97% of earth's water can be found in the _____
21. Earth is knows as the _____ planet
22. This is the name for an underground layer of water bearing permeable rock

Down

1. When you water plants, this is a A_____ use of water
2. This is the name for water stored in the ground
3. A_____ run-Off, When pesticides and fertilizers wash off farms in the rain
5. Leakey L_____ When the waste in garbage seeps into the waterways
7. Groundwater C_____. The act of contaminating the groundwater
8. This is what happens when too much discharge occurs with groundwater. Groundwater D_____
10. Inland _____ 0.018% (Available) is this freshwater supply
11. Slang term for a method called hydraulic facturing which can pollute the groundwater
13. This country known as the horn of Africa has experienced several droughts and famine
16. 3/4 of planet E_____ is water
17. The largest supply of freshwater on earth is in the I__C__
19. U___ Run-Off, When rainwater washes pollution into the streams and rivers and gorund
20. Groundwater Depletion can cause land use to d_____
23. True or False? you can drink seawater for survival

Possible Answers

AGRICULTURAL, AGRICULTURAL, CONTAMINATION, DECREASE, DEPLETION, EAERTH, FALSE, FRACKING, HOUSEHOLD, ICECAPS, LAKES, LANDFILLS, LOVECANAL, OCEANS, RECREATIONAL, RIVERS, SOMALIA, SURVIVAL, URBAN, WATER, WELLS, ACQUIFER, GROUNDWATER, GROUNDWATER

Earths Waters Part 1 Lesson 8

Name:

1-10 = 10 pts * = Bonus + 1 pt,
(Secretly write owl in correct space +1 pt)
Final Question = 5 pt wager

Due: Today
Score ____ / 100

WATER USE	EVERY DROP	MUDDY WATERS	DRINK IT?	NAME THAT H_2O Bonus round 1 pt each
1) THE BLUE PLANET	6) Letter D.) 97%	11) Letter A & C 1960-1970 and 1980-2000	16) Fracking	*21) DASANI
2) Survival / Health	7) Rivers, Inland Lakes, Groundwater	12) E.) Land use increases in quality	17) Any Water Conservation Measure	*22) AQUIFINA
3) Recreational (Owl +1pt)	8) Aquifer	13) THE ARAL SEA	18) The Great Lakes	*23) FIJI
4) Agricultural	9) Letter B Confined Aquifer	14) Urban-Run Off Agricultural Run Off, Leaky Landfill, Fracking More	19) The Water Fountain	*24) EVIAN
5) Transportation	10) A=Discharge B=Recharge	15) LOVE CANAL	20) Letter D 71%	*25) VITAMIN WATER

- Final Question Wager ___/5 Answer: Which are the only two below that are obtainable Freshwater? RIVERS and LAKES