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Water...A Priceless Resource

An Educational Package for Teachers and Other Adults

WATER--A PRICELESS RESOURCE

This educational package was prepared for teachers and other adults; it is also appropriate for high school use. The material was developed under a grant from the New Mexico Water Resources Research Institute, and the package was produced at New Mexico State University.

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After you have used the learning package, please return it in its original condition to the sender within one week. Your professional courtesy will allow others to use the materials as scheduled.

Chris Buethe
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WATER--A PRICELESS RESOURCE

OBJECTIVES

This package is designed to inform and to promote better understanding of the water problems of New Mexico and the Southwest in order to help us put one of our most valuable natural resources to its best use.

CONTENTS OF THE PACKAGE

This package contains a set of 225 slides to be shown in sequence, and a tape recording to accompany the slides. A copy of the tape script with designated slide changes marked is included for use in previewing and in properly advancing the sequentially numbered slides. Printed supplementary materials* based upon the mediated package are also provided.

*Teachers may wish to duplicate portions of the supplementary materials for use in reinforcing learning. Also, local, familiar slide scenes may be substituted in order to enhance the meaning of the materials.

WATER PROBLEMS

A: Water Quality

1. The three major sources of water pollution are:

   (1) domestic sewage;

   (2) industrial waste-water; and

   (3) sediment.

2. Man is the prime creator of water pollution.

3. Water can be polluted by human and animal wastes, vegetation contamination (excessive growth of algae), chemicals, oil wastes, heat, and silt.

4. In crowded residential areas that are not served by a sewer system, pollution from septic tanks can be recycled into local domestic wells.

5. Some water pollutants are concentrated in the food chain; these include certain pesticides, mercury, and some radioactive materials.

6. The natural self-purification system of some rivers and streams is being taxed far beyond its capacity; the results are depletion of oxygen in the stream, odors, discoloration, the excessive growth of slimes, and the manifestation of other forms of pollution.

7. Water that LOOKS clean and clear may not necessarily be free from contamination and may not be useable for a particular purpose. The physical appearance cannot be used as an absolute test of the purity of the water.

B: Water Quantity

1. In the Southwest the annual precipitation varies markedly from year to year, resulting in years of above average precipitation followed by more years of below average rainfall.

2. Because of the variable nature of precipitation supplied to states like New Mexico, surface water must often be stored in reservoirs for more than one year before use.

POSSIBLE SOLUTIONS TO WATER PROBLEMS

Technological research has helped resolve SOME water problems, but technology has not been able to solve ALL problems. Each individual must recognize that he shares the responsibility for protecting our water resources by helping to eliminate and reduce water pollution and waste.

A: Current Possible Solutions

1. Appropriate, enforced laws.

2. Close supervision of housing developments and trailer parks that use septic tanks can prevent ground water pollution.

3. Dams can be built to regulate the flow of rivers and streams. Water can be held in storage reservoirs for flood control purposes, irrigation, municipal and industrial water supply, hydro-electric power generation, recreational use, and navigational purposes.

4. Properly treated waste-waters can be used again for irrigation of golf courses, for some recreational purposes, and for domestic use if absolutely necessary. A few cities have recycled forty to fifty percent of their water supply during period of drought.

5. Better designed, lined, and maintained irrigation ditches can prevent excessive seepage losses.

6. Better irrigation methods, such as sprinkle and trickle irrigation, would conserve water.

7. Improvement of the lay-out of fields and the avoidance of over-irrigation would conserve water.

8. Water loss and erosion due to over-grazing of arid lands can be prevented by proper plant coverage.

B: Future Possible Solutions

1. Desalinization plants are a prospective means of using saline ground waters and sea water, but the processing is expensive. Additional research on improved technique will take time.

2. Cloud seeding has NOT proven to be sufficiently successful as a means of increasing the water supply of the Southwest because it is undependable and unpredictable.

- BE A PART OF THE SOLUTION -

WHAT THE INDIVIDUAL CAN DO TO PROTECT OUR WATER RESOURCES

A: To Avoid Waste

1. Run dishwashers only when full.
2. Wash only full loads of laundry.
3. Keep drinking water in the refrigerator instead of running the faucet until the water is cold.
4. Don't leave the water running when brushing your teeth, shaving, or when washing your face and hands.
5. Take quick showers instead of tub baths.
6. Fix leaky faucets: a dripping faucet can lose up to 15 gallons of water per day.
7. Keep all outside faucets completely closed when not in use.
8. Avoid unnecessary runoff of water when washing your car and watering your lawn.

B: To Avoid Pollution

1. Measure accurately soaps, detergents, bleaches, and other laundry aids.
2. Avoid throwing cigarette filters into toilets: they cause problems at sewage plants.
3. Pull or hoe weeds by hand rather than use herbicides.
4. Use poisonous chemicals only as advised by qualified experts.

For more information on water laws and water quality protection, contact the New Mexico State Engineer Office and the Environmental Improvement Agency in Santa Fe. (Most states have comparable information agencies.)

- BE A PART OF THE SOLUTION -

SUMMARY OF WATER-RELATED INFORMATION TO AUGMENT TAPE AND SLIDES

I - Water's Role in the Human Body

1. The three most important requirements to keep man alive are water, air, and food.
2. Water composes over 2/3 of the body weight.
3. Adult muscle is from 80% to 90% water.

II - The Water Cycle

Water changes its form and its geographic location as it proceeds through the hydrologic cycle. The energy to move water through this cycle comes from the sun. The process involved includes:

1. Cloud formation.
2. Precipitation.
3. a) Seepage of precipitation into the ground and temporary storage prior to its natural or artificial (pumped) discharge.
   b) Runoff.
   c) Evaporation.
4. Uptake in plant life (transpiration) and animal life.
5. Return of water vapor to the atmosphere.

III - Water Purity and Supply

A: General

1. Almost three-fourths of the earth is covered with water.
2. Ninety percent of the earth's water is too salty or saline to be useable, and two percent is frozen in glaciers and ice caps at the poles.

3. Less than one percent of all the earth's water is fresh enough for use.

4. Fresh water is potable or drinking water that contains very little dissolved salt.

5. All water has some dissolved minerals in it.

6. Rainwater is not "pure" because raindrops build on particles of dust or salt in the air.

7. Fresh water is not to be found in sufficient useable amounts anywhere one may choose to drill a well.

B: In the Arid Southwest

1. Ground water is the main source for industrial and municipal water use in New Mexico.

2. Our ground water supplies are recharged from precipitation that seeps into soils and percolates into the ground.

3. Relatively little NEW water is added each year to the Southwestern ground water supplies.

4. The water table is lowering in many areas of the Southwest.

IV - Water Use

A: General

1. As the standard of living in an area goes up, the quantity of water required for municipal and industrial purposes increases.

2. As the population increases, the value of every gallon of water increases because of an increase in demand for a fixed quantity of water available.

3. North Americans are removing water from our ground water reservoirs at a rate that is approximately twice as fast as the hydrologic cycle can replace it.

B: In the Arid Southwest

1. Because there is not enough water to meet all demands in New Mexico, the right to use the available water is legally assigned to those who were using it first.

2. Of the 25 most popular recreational activities in New Mexico, eight require water.

3. The use of water to produce electricity is not generally a practical method because of the limited water supply available.

V - Agricultural Useage of Water

A: General

1. Most crops require AT LEAST 20 inches of water per year.

2. The type of crop determines the amount of water required for successful growth in a given location.

3. Almost one-half of the water in the United States is used for irrigation purposes: over one-fourth of this is lost in its transportation before it reaches its target crops.

4. Most irrigation in the United States takes place in desert and semi-desert areas.

B: In the Arid Southwest

1. About one half of the water for irrigation in New Mexico comes from surface water: the other half comes from ground water supplies.

2. The irrigation water is carried in ditches. Poorly designed irrigation ditches and lack of maintenance on properly designed ditches often result in excessive seepage losses.

GLOSSARY OF WATER TERMS

ACRE-FOOT: The volume of water required to cover one acre of land with one foot of water, or 43,560 cubic feet.

ADVANCED WASTE TREATMENT: See *TREATMENT*.

AQUIFER: A geologic formation which contains water and has the ability to transmit it from one point to another in quantity to permit economic development.

ARID: Dry from lack of precipitation.

BACTERIA: Primitive plants, generally free of pigment, which reproduce by dividing in one, two, or three planes. They occur as single cells, groups, chains, or filaments, and do not require light for their life processes. They may be grown by special culturing out of their native habitat.

BENEFICIAL USE OF WATER: The use of water for any purpose from which benefits are derived, such as domestic, irrigation, or industrial supply, power development, or recreation.

BIOCHEMICAL OXYGEN DEMAND (B.O.D.): The quantity of oxygen utilized primarily in the biochemical oxidation of organic matter in a specified time and at a specified temperature. The time is usually five days and the temperature is usually 20°C.

BRACKISH WATER: Water containing dissolved minerals in excess of acceptable normal municipal, domestic, and irrigation standards, but less than the levels of sea water.

CESSPOOL: An underground pit into which raw household sewage or other untreated liquid waste is discharged and from which the liquid seeps into the surrounding soil or is otherwise removed. Also called Leaching Cesspool.

CHLORINATION: The application of chlorine to water, sewage, or industrial wastes, generally for the purpose of disinfection, but frequently for accomplishing other biological or chemical results.

CLOSED BASIN: A basin closed with respect to surface flow when its topography prevents the occurrence of visible outflow. It is closed hydrologically if neither surface nor underground outflow can occur.

CLOUD SEEDING: The process of attempting to induce rain by injecting clouds with silver iodide or dry ice.

CONCENTRATION: The quantity of dissolved materials in a unit volume or weight of water. Concentration is expressed in milligrams per liter, parts per million, equivalents per million, specific electrical conductance in micromohs per cm, and tons per acre-foot.

CONFINED AQUIFER: An aquifer which is bounded above and below by formations of impermeable or relatively impermeable material.

CONSUMPTIVE USE OF WATER: The sum of the quantity of water used by vegetative growth in transpiration or building of plant tissue and the quantity evaporated from adjacent soil or plant surfaces in a given specified time. Also referred to as Evapotranspiration.

DEEP PERCOLATION: In geology, the percolation downward of water by leakage through the geologic formation.
In hydrology, the percolation downward of water past the lower limits of the root zone.

DEGRADABLE: Capable of being decomposed, deteriorated, or decayed into simpler forms with characteristics different from the original. Also referred to as Biodegradable.

DEPLETION (GROUND-WATER): The withdrawal of water from a ground-water source at a rate greater than its rate of replenishment, usually over a period of several years.

DESALINIZATION: The process of removing salt from saline waters to make them more useable.

DISINFECTION: The killing of most (but not necessarily all) of the harmful and infectious microorganisms in or on a medium by means of chemicals, heat, ultraviolet light, etc.

DISSOLVED OXYGEN: The amount of free (not chemically combined) oxygen in water. Usually expressed in milligrams per liter.

DISTILLATION: The process of evaporating water and condensing it for the purpose of removing undesirable salts.

EFFLUENT:
(1) A liquid which flows out of a containing space.
(2) Sewage, water, or other liquid, partially or completely treated or in its natural state, flowing from any part of a reservoir, basin, or treatment plant.

EUTROPHICATION: The process of overfertilization of a body of water by nutrients which produces more organic matter than the self-purification process can overcome.

EVAPORATION: The natural process by which water is changed from a liquid to a gas or vapor state.

FILTRATION: The process of passing a liquid through a filtering medium (which may consist of granular material such as sand, magnetite, or diatomaceous earth, finely woven cloth, unglazed porcelain, or specially prepared paper) for the removal of suspended or colloidal matter, usually of a type that cannot be removed by sedimentation.

FLOOD: An unusually large flow of water covering land not normally covered by water.

FLOOD PLAIN: Land bordering a stream and which receives overbank flow.

GROUND WATER: Water beneath the earth's surface accumulating as a result of infiltration and deep percolation.

GROUND WATER BASIN: A ground water reservoir together with all the overlying land surface and the underlying aquifers that contribute water to the reservoir. (In some cases, the boundaries of successively deeper aquifers may differ in a way that creates difficulty in defining the limits of the basin.)

GROUND WATER RESERVOIR: An aquifer or aquifer system in which ground water is stored. The water may be placed in the aquifer by natural or artificial means.

HYDRO-ELECTRIC POWER: The electricity generated by the energy of falling water.

HYDROLOGIC CYCLE: See *WATER CYCLE*.

HYDROLOGY: The study of water in the air, on the surface of the earth, and underground.

INFILTRATION: The process whereby water passes through an interface, such as from air to soil or between two soil horizons.

IRRIGATION: Supplying land with water by ditches or artificial channels. Four types of irrigation are

- *TRICKLE:* slow movement of water by pipes or hoses to specific locations or plants in a field.
- *SUBSURFACE:* gravity flow through top soil layers in the down-slope direction.
- *SPRINKLE:* use of sprinklers to disperse water in a field.
- *FLOOD:* complete covering of a field with water; submersion.

NAVIGATION: Directing water along a course to a desired location.

PERCHED GROUND WATER: Ground water supported by a zone of material of low permeability and located above an underlying main body of ground water with which it is not hydrostatically connected.

PERCOLATION: The movement of water within a porous medium such as soil.

PESTICIDES: Chemical compounds used for the control of undesirable plants, animals, or insects. The term includes insecticides, weed killers, rodent poisons, nematode poisons, fungicides, and growth regulators.

POLLUTANTS: Substances that may become dissolved, suspended, absorbed, or otherwise contained in water and that impair its usefulness.

POLLUTION: The presence of any substance (organic, inorganic, biological, thermal, or radiological) in water at intensity levels which tend to impair, degrade, or adversely affect its quality or usefulness for a specific purpose.

POTABLE: Suitable for drinking.

PRECIPITATION: Moisture from the atmosphere in the form of rain, sleet, snow, hail, or dew.

RECYCLE: The process of making water reuseable.

RESERVOIR: A basin for collecting a supply of water.

RETURN FLOW: That part of a diverted stream flow which is not consumptively used and which returns to a source of supply (surface or underground).

SALINE WATER: Water containing dissolved salts. See also *BRACKISH WATER.*

SEDIMENT: Mineral material deposited or transported by water.

SEDIMENTATION: The process of subsidence and deposition by gravity of suspended matter carried by water, sewage, or other liquids. It is usually accomplished by reducing the velocity of the liquid below the point where it can transport the suspended material. Also called Settling.

SEWAGE: Largely the water supply of an Installation after it has been fouled by various uses. (From the standpoint of source it may be a combination of the liquid or water-carried wastes from residences, buildings, and industrial establishments, together with such ground water, surface water, and storm water as may be present.)

SEWER: A pipe or conduit, generally closed, but normally not flowing full, for carrying sewage and other waste liquids.

SOLVENT: Having the capability to dissolve other substances.

SURFACE WATER: Water above ground which can be seen.

TREATMENT:

BIOLOGICAL: Forms of sewage treatment in which bacterial or biochemical action is intensified to stabilize, oxidize, and nitrify the unstable organic matter present. Examples are: intermittent sand filters, contact beds, trickling filters, and activated sludge process.

SECONDARY: The treatment of sewage by biological methods after primary treatment by sedimentation.

ADVANCED WASTE TREATMENT: The additional treatment of sewage beyond that of secondary treatment in order to obtain a very high quality of effluent. Usually includes nutrient removal.

WATER CYCLE: The movement of water from the atmosphere to the earth and back to the atmosphere through various stages or processes including cloud formation, precipitation, interception, runoff, infiltration, percolation, storage, evaporation, and transpiration.

WATER TABLE: The top level of saturation where water is found in the ground.

TAPE SCRIPT

Advance Slide (1)

WATER, A PRICELESS RESOURCE

Advance Slide (2) (Pause)

[The following script is recorded on the tape that accompanies the sequentially numbered slides. Each number in parentheses indicates the point in the script at which that slide should be advanced into viewing position.]

(3) Most of the Earth is covered with water. In fact, if we were to look at the Earth from outer space, we would see that almost three-quarters of the Earth is covered with water. (4) Yet there is deep concern over water shortages and (5) water pollution in many parts of the world. Some countries are plagued (6) with flooding, while others are concerned (7) with drought. You may have heard the slogan: (8) "Save water: shower with a friend." Well, things haven't gotten quite that bad, but we do need to (9) take action in order to save our water.

Just what is meant by (10) a water shortage? Does it mean that it is raining less and less each year? Does it mean (11) that our growing cities are demanding more water? When we speak of a municipal water shortage, we mean that there is a shortage of useable water which is readily available to a city. (12) Towns can become completely vacated due to lack of sufficient "fresh" water.

(13) Why is it that there is such a shortage of water if most of the Earth is covered with it? (14) Almost all of the water covering the Earth has salt or other chemicals in it, (15) sometimes to such an extent that it is unsuitable for human consumption. On the other hand, water (16) containing very little salt or chemicals would taste flat. Have you ever tasted melted snow or distilled water? All water has some dissolved minerals in it, but as the salt concentration increases, the water becomes less useful and (17) finally useless for more and more purposes. Ocean water contains large amounts of salt; people have been known to die of thirst in an ocean, surrounded by water, because their bodies could not tolerate extremely salty water. (18) "Fresh" water is water with relatively little salt dissolved in it. (19) Contrary to what most people believe, rainfall is not pure water. After all, raindrops have to build upon little particles of dust or salt. (20) Raindrops start small and get larger, adding salt and dust particles as they grow and fall.

When we realize that a little less than one percent of all the Earth's water is fresh enough for us to use, we can better appreciate the value of this priceless resource. (21) Ninety-seven percent of our water is presently unuseable and two percent is frozen; this leaves (22) one percent for use by factories, farms and ranches, and for personal

use. (23) If this good water becomes dirty with such things as viruses, slime, bacteria, or too much salt, the amount of useable water is limited still further. (24) As the general population increases, the value of every gallon also increases. (25) In New Mexico and the Southwest, the tremendous lack of water has made it a valuable asset. (26) In fact, water is one of the most precious natural resources of the region. (27) Much of New Mexico is considered to be semi-arid or arid, (28) a condition that is associated with desert country.

One of the greatest problems with trying (29) to make productive agricultural lands out of very dry areas (30) is transporting water to them. Most of (31) New Mexico's Indians originally settled along river banks where they could raise crops (32) such as maize and squash. Later Indians, like the incoming Spanish settlers, also used water (33) to raise cattle, sheep, goats, and other livestock. The presence (34) of water indicates whether or not people can live successfully in an area. (35) Most large towns are built near an adequate source of water, although many of these towns (36) are "biting the hand that feeds them" by polluting their air and water.

(37) What difference does it make to us if there is a so-called water shortage? (38) How does it affect our lives? (Pause) (39) If the Earth's supply of water became exhausted, (40) all life on Earth would cease to exist. (41) All developed forms of life require water, even the seemingly self-sufficient cactus.

The three most important requirements (42) to keep man alive are water, (43) air, and food. (44) Man can live only two to three days without water, whereas he can live a much longer time without food. (45) Some animals can live three months or more without food, (46) but water is more vital to them.

Water plays an important part (47) in our bodies. It makes up over two-thirds of body weight. One of the most valuable properties of water is its solvency action in the body, or its power to dissolve a variety of substances. Both breathing and digesting food require water and its properties as a good solvent. There is no other liquid that acts as a solvent better than water, and for this reason it has been called the "universal solvent."

(48) Adult muscle is from 80 to 90 percent water. If we look at some of our muscles, they may appear to be all water! When we do not get enough water, the tissues don't receive the oxygen they need, and waste products begin to accumulate in the tissues. (49) If water is not obtained in time, the body stops working, and death results. To most of us, this doesn't seem like a very pleasant condition. (50) After seeing the important part that water plays in keeping us alive, we can understand why it is such a valuable and priceless resource. (51)

If you are from an arid section of the country, and you can still remember the last time (52) you got caught in the rain, you, no doubt,

got soaked. (53) Everywhere, things were saturated. (54) Suddenly, the sun came out, and there was little evidence of an abundance of water. (55) Where does the water come from, (56) and where does it go? (57)

The never-ending movement of water is called the water cycle, (Pause) This water cycle includes cloud formation, precipitation, run-off and evaporation. (58) Water cycles from the earth (59) to the atmosphere and (60) back to the earth again. It flows into the arroyos, (61) streams, rivers, and (62) finally to the sea. (63) Some seeps into the ground, and (64) is known as ground water. (65) Most ground water comes from rain and other precipitation, including hail, (66) dew, (67) snow, and sleet. (68) Water which soaks into the surface ground-layer can continue to move downward through the soil and into the underground structure. It then flows underground through soil and rock. (69) Some flows downward and laterally along bedrock until it reaches a river or the sea. (70)

Little new water is being added to the ground. In fact, we use much old water, some of which has been in the ground for thousands of years. (71) Ground water is now the main source of water (72) for municipal and industrial use in New Mexico. (73) About one-half of the water used for irrigation in the State comes from the ground. The other half of agricultural water comes from surface water, which is simply water that can be seen.

(74) The windmill was an early means of using cost-free power to draw ground water from the earth. Windmills have the extra advantage of being pollution-free, (75) and they consume none of our precious fuels. (76) Because of large-scale pumping for agricultural purposes, the water-table, where water is first found underground, is lowering in many areas.

Can you recall the water cycle from our discussion of it? (Pause) (77) Did you include cloud formation, precipitation, (78) ground-water, (79) surface water, run-off, (80) and evaporation?

Water from the earth, sea, and plants evaporates into the atmosphere. (81) Energy to move this water comes from the sun. (82) As the air is indirectly warmed by the sun, it can hold more moisture. This means that hot desert days rob the land of large amounts of water through evaporation. (83)

We often see moisture in the atmosphere in the form of clouds, which can produce precipitation. (84) Both surface and ground water come from this precipitation, and continue in the water cycle from earth to atmosphere and back again.

(85) Do you think it is possible to find fresh water anywhere if you are willing to dig a hole that is deep enough? (86) No! At least not in sufficient useable amounts. In most parts of New Mexico we do not really know how much water is available in the ground. In many places we could drill and drill, and never find water in useable quantities. (87) In some areas, if we do find water, it may be too saline, or salty to use.

(88) Water is used in enormous quantities for personal, (89) municipal, industrial, and (90) agricultural purposes. Stop to recall (91) some of the many uses of water in your home. A conventional washing machine uses from 12 to 20 gallons per load. (92) Automatic washers use from 25 to 34 gallons per load. (93) Washing dishes by hand for just one meal requires from six to thirteen gallons per load. (94) Extra luxuries in the home require additional amounts. A garbage disposal typically uses two gallons per minute. Evaporative coolers consume much water. (95) An average tub bath uses from 15 to 30 gallons. (96) A shower uses about three gallons of water per minute. Taking a quick shower or bathing in shallow tub water can save this resource. (97) Flushing a toilet requires about three gallons of water. (98) In a large New Mexico community, each person uses about 150 to 200 gallons of gallons of water per day, on the average. Much more water is needed during the summer months than during the winter. (99) This figure varies from 40 to 50 gallons per person per day in poorer areas (100) to more than 300 gallons per person per day in wealthy areas, where water can be "afforded." (101) Our expanding standard of living increases the demand for water for both domestic and industrial consumption. (102)

In order to provide all of this needed water, municipal water systems must be dependable, both in supply (103) and in purity. In addition to furnishing the required water for personal and home use, these public water supply organizations must cater to other water demands as well. (104) Fire fighting (105) and industrial use are but two of such demands.

(106) The source of most city water supplies is ground water. Modern municipal wells use electrical power to pump this water into a storage rank. Usually, water from deep wells needs only a minimum of treatment to protect against bacteria. (107) Such treatment normally involves chlorination--the process of adding chlorine to the water supply. Other disinfectants are sometimes used to kill the bacteria. (108) Additional common treatments used by municipal plants include settling with alum, which, when added to water, forms large, gelatin-like particles that trap impurities which stick to it and finally settle to the bottom. A second treatment process is filtering water through fine sand: the sand screens out the impurities. (109)

Sewage treatment is divided into two basic stages, primary and secondary. Primary treatment includes the use of a bar screen to remove rags and large objects, and a grit chamber to remove heavy mineral solids. (110) After flowing through a bar screen and grit chamber, it goes into a settling tank where solids in suspension settle. (111) The partially treated waste water is sometimes discharged into a stream, but more often it is sent to secondary treatment units. Biological treatment is used in the secondary units to achieve a higher degree of pollution reduction than is possible by the primary treatment. This principally achieves the (112) removal of very small organic particles that are in suspension and some of the organic matter in solution. If we did not have proper sewage treatment

carrying out the previously described processes, our water supply would not be safe for us to drink. The Environmental Protection Agency showed that by 1972 only 32 states had fully approved Water Quality Standards for their interstate streams. (113) More than a thousand communities dumped raw sewage into the water. (114)

In addition to that used in our homes, water is needed for recreational purposes. A recent study showed that out of 25 of New Mexico's favorite recreations, eight required water. (115) (Pause) Fishing, boating, (116) swimming, (117) water and snow skiing, and camping require water. (118)

It takes enormous quantities of water to meet the agricultural needs of plants and (119) animals, to irrigate fields, (120) to make a car, or to (121) produce electricity. (122) It has been calculated that U.S. industry uses 17 trillion gallons of water annually, and less than one-third of that is treated before being discharged. Can we throw polluted water away? Is there really an "away"? (123)

Agriculture is an important industry to New Mexico (124) and is the largest consumer of water. Most crops require at least 20 inches of water per year, and some parts of the State receive (125) under 10 inches of rain annually. A few areas have as much as 30 inches, (126) but most of the State receives far less than 20 inches per year. (127) And farms can't exist without water. (128) Most irrigation takes place in the desert and semi-arid areas of the Southwest. (129) The type of crop, of course, determines the number of acre-feet of water needed. An acre-foot is the amount of water required to cover an acre of land with one foot of water. (130) Crops such as cotton and corn (131) require less water than (132) lettuce and onions. Most farmers in New Mexico who irrigate crops are allowed to divert three acre-feet of water per acre cultivated, or 36 inches per acre.

Water is also used (133) to produce electricity. Electrical power plants burn coal and other fuels to turn water into steam. (134) This steam supplies the energy to run turbines, which in turn produce electricity. (135) Hydroelectric power is generated in the conversion of the potential energy (136) of a waterfall, or of stored water (137) behind a dam, into electrical energy. (138) However, this is not a practical method of power generation in New Mexico and most of the Southwest since running water is at a minimum.

(139) The Rio Grande, the principal river in New Mexico, (140) runs like a backbone down the middle of the State. (141) Other important rivers in New Mexico are the San Juan, Canadian, (142) and the Pecos. The State has (143) few natural lakes; the largest lakes are man-made, created to store irrigation waters. (144) The most important of these is Elephant Butte Reservoir, created by a dam on the Rio Grande. (145) Other large artificial lakes in the State include McMillan, Avalon, (146) Alamogordo, Navajo, El Vado, Caballo, and Conchas.

(147) Dams are built to hold back the flow of water from streams or rivers. (148) A dam can also hold back silt and mud, (149) making river or stream water much cleaner and clearer. (150) The water above a dam

forms an artificial lake or reservoir where water collects when rain falls. The accumulated water can then be stored and released when needed. (151) Water is held in storage dams for flood control, (152) irrigation, domestic supply, (153) hydroelectric power supply, (154) recreation, and navigation.

(155) Of all the animals that require water, man is the prime creator of pollution. Today we find ourselves with a shrinking supply (156) of clean, fresh water, mainly because we have not taken proper care of the precious liquid. (157) We produce as much pollution in New Mexico as some states with a larger population. (158) Water can be polluted (159) by silt or chemicals, (160) or contaminated by oil wastes or even by heat. In addition, many water pollutants are concentrated in the food chain. (161) For example, a poisonous chemical used to kill weeds can get into the water that is drunk by a cow. Some of that chemical stays in the cow's tissues. (162) Later, the human who eats beef from that cow may retain part of the same poison in his tissues. How serious this can be is difficult to assess because some of the chemicals involved haven't been in use long enough for a full evaluation. People can become ill from pollutants that have been passed along the food chain.

(163) Despite a water shortage in New Mexico, the population has continued to grow. (164) In many areas, this growth has accounted for pollution. (165) In crowded subdivisions and trailer parks, pollution from septic tanks can flow into domestic wells. (166) Inadequate design or operation of some municipal sewage plants allows some domestic wastes to go into (167) our rivers with little or no treatment. (168) Individuals and groups use our rivers and streams as dumping grounds. The Environmental Protection Agency notes that waste from (169) one big farm's feedlot can equal the pollution potential of a city's sewage. Runoff into streams can be serious; ammonia that is associated with cattle wastes can result in an overabundance of nitrogen in a lake. Feed lots for 1,000 or more animals must now get federal permits to operate.

(170) Until recently, the lakes and rivers had been forced to attempt to clean themselves, often with undesirable side-effects. With the increased population and (171) continued mismanagement of water, this self-purification system has been taxed far beyond its capability to function. For example, many detergents contain chemicals that accumulate in lakes and (172) rivers, promoting an overgrowth of algae. Once green algae die and decay, oxygen is consumed, often precluding (173) the existence of fish and in some cases causing a septic condition that prevents aerobic bacterial action that normally helps to clean up organic matter in lakes and rivers.

(174) Water which is clean and clear-looking is not necessarily useable water: (175) likewise, muddy and dirty-looking water can be useable. (176) An E.P.A. survey of 969 U.S. public water systems showed that over 40 percent delivered water of inferior quality, 36 percent contained bacteria exceeding the safe limits, and nine percent were potentially dangerous. Poorly treated water spreads disease and runs up an incalculable health bill, (177) especially for children and the aged. To find out how to have your water supplies checked for purity, contact the New Mexico

Environmental Improvement Agency, P.E.R.A. Building, Santa Fe, New Mexico, Phone 827-2373. Other states have similar agencies.

(178) The individual can be important in eliminating pollution. Using limited amounts of detergents can prevent pollution. It may not be necessary to run washing machines so frequently. Reusing water for such jobs as washing garbage pails is another way to save water. Dishwashers should only be operated when full. (179) Pulling weeds by hand instead of using a herbicide helps to keep these poisons out of the water. A dramatic example of the side-effects of herbicide water-pollutants is seen (180) when home owners spray strong, petroleum-based herbicides on weeds near trees and shrubs. Often, the poisons are taken into the roots, thereby killing valued plants. It is not unusual to find that residual poisons can affect plants grown on the same site years later. (181) Emptying ashtrays into the toilet can cause problems. Cigarette filters are almost indestructible, and can mean trouble at the sewage treatment plant.

(182) In a short summary, we have three major water pollution sources: [1] overcrowded living conditions producing sewage pollution; (183) [2] industries and agriculture polluting both surface and ground water; and (184) [3] sediment pollution of surface waters such as streams and rivers.

(185) Why do people continue to pollute the water when over and over they are told how valuable and scarce this resource is? (186) The main reason for pollution by some industries, farms, and housing developments is that it is often less expensive today to pollute than to stop polluting. Someone else pays the pollution bill. (187) Pollution control is difficult and expensive, but it is needed in the long run. It will take a five-year investment of at least 43 billion dollars to clean up the surface water of the United States. (188) This is not inexpensive. We must realize that pollution not only harms our local water sources, but also affects the ocean and its living things. (189)

Good laws, when enforced, can help solve water problems. (190) New Mexico is judged by many to have generally excellent water laws which are based upon a "prior use" principle. Water rights and laws help provide stability to agriculture, (191) cities, factories, (192) and recreation. Proper laws help to protect (193) the water rights we now have, allow large storage facilities to control flooding, and provide additional recreational facilities. For instance, (194) housing and trailer-park developments can be more carefully supervised and controlled to prevent ground water pollution from septic tanks. (195) In New Mexico we can contact the New Mexico State Engineer Office in Santa Fe to become better informed on water laws or to report the misuse of water. Most states have some comparable agency to write to for information. (196)

Significant amounts of water could be saved by improving a few situations. (197) Water is wasted when people fail to fix leaky faucets (198) or when they water their streets more than their lawns. (199) Remember earlier we mentioned that almost one-half of the water used in the

United States is used for irrigation purposes? (200) Over one-fourth of that water is lost needlessly before it reaches the crops! By using (201) better irrigation systems, sprinklers, (202) trickle irrigation, and subsurface irrigation, much water could be saved. Meters can caution when excessive irrigation is under way; they are used with wells in some river basins. (203) Overgrazing or desert vegetation causes water problems, while proper plant cover prevents soil erosion (204) and loss of water. Small, poorly designed irrigation ditches as well as (205) inadequate maintenance of those that are well constructed, result in excessive losses. (206) Lining ditches, improving field layout, (207) and avoiding over-irrigation all help.

Our water supplies here in the Southwest vary markedly from year to year. It is therefore unwise to use all available water in a given year. (208) Water must be budgeted by everyone--the home, the farm, and industry. (209)

Research is helping to resolve the water shortage problem, although technology has not been able to solve all the problems. (210) Recycled water, when properly treated, can be used for many purposes. For example, it can be partially treated for use on golf courses, or more fully treated for use in swimming pools or our city's domestic water systems. (211) A few cities recycle up to 50 percent of their water, so they consume less total water than other cities. Recycling could be a good way to avoid (212) extensive water rationing, which may otherwise become necessary in the future.

(213) The scientific process of cloud-seeding has been used in some areas to make rain. It has not proved practical in the Southwest because it is undependable and unpredictable. (214) Another prospective source of water is sea water that is processed in desalinization plants. (215) This process is expensive, however, and research on improved techniques takes time. Desalinated ocean and (216) sea water is already being used on a small scale to provide drinking water. (217) Desert farmlands could resort to oceans to derive a supply of water if the desalinization process is perfected to produce fresh water abundantly and at low cost. However, (218) the cost of transporting this desalinated water to needed areas is still high. Use of atomic power may lessen fuel costs and (219) lead to more research toward the use of salty water. Atomic power may also be used to melt icecaps for recycling. But, atomic power's use causes new kinds of pollution problems. We may learn better ways to use solar energy. However, we should not depend upon technological breakthroughs too heavily. (220) The solution is to conserve and utilize properly the water we already have.

(221) The quantity of industrial water required to meet the increasing demands of our expanding standard of living is tremendous. North Americans are (222) removing fresh water from underground sources twice as fast as the hydrologic cycle can replace it. (223) At the present rate that Americans are using water, they will need 700 billion gallons of underground water per year by 1980. There will only be 650 billion gallons available. With the world's population increasing at an alarming rate, the (224) production of sufficient food is becoming a grave problem that depends upon water for its solution. The cost of replacing our present water sources is tremendous. (225) To repeat, we must do a better job of using the water we already have. Fresh, useable water will always be a priceless resource.