SEPTIC

Septic Educational Program
To Instill Conservation

Michigan 4-H Youth Conservation Council
4-H Youth Development
Michigan State University Extension

Acknowledgments

This set of activities was developed in April 2005 by the members of the 2004–05 Michigan 4-H Youth Conservation Council:

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Introduction

About M4-HYCC

Every year, between 25 and 30 young people aged 13 to 19 from across Michigan are selected to be part of the Michigan 4-H Youth Conservation Council (M4-HYCC). One of their first tasks is to meet as a group to choose an environmental issue that affects the whole state that they will focus on during their term. Then they spend about three months working as a group and in five regional teams to research the issue. Finally they develop a presentation on the topic that they deliver before a committee of the Michigan legislature.

About SEPTIC

In 2004–05 the M4-HYCC members chose to study the impact of septic systems on the environment. Members of the team from southwest Michigan researched the youth education aspect of the issue. This set of activities, called “SEPTIC: Septic Educational Program to Instill Conservation” is the result of their research and study. The SEPTIC educational materials include activities created by the young people and information developed by several states in the Cooperative State Education, Extension and Research system.

The materials are meant to be a supplement to the teacher’s packet produced by the Michigan Department of Environmental Quality. They are designed to help young people learn about what septic systems are and how they function, why septic systems fail and how periodic maintenance can prevent such failures, and about the effect of septic systems on groundwater.

SEPTIC was developed by young people working in partnership with teachers and environmental professionals. As they worked to develop the activities, team members used what they know about what and how young people want to learn to create fun activities to help others learn about this important environmental issue.

We hope you and the young people with whom you work find the SEPTIC educational materials useful in your study of the impact of septic systems on the environment.

In addition to having your group complete the SEPTIC activities, you may also want to consider the Michigan 4-H Youth Conservation Council and SEPTIC as models for your group. Encourage them to choose an environmental issue that affects your community, research the issue and create their own educational activities to help other young people (and adults!) learn about the issue.

United States Environmental Protection Agency | Office of Water (4606) | EPA 816-F-01-021 July 2001

Source Water Protection Practices Bulletin

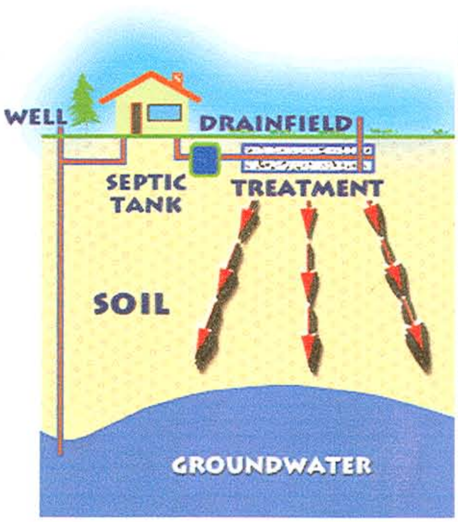
Managing Septic Systems to Prevent Contamination of Drinking Water

Septic systems (also known as onsite wastewater disposal systems) are used to treat and dispose of sanitary waste. When properly sited, designed, constructed, and operated, they pose a relatively minor threat to drinking water sources. On the other hand, improperly used or operated septic systems can be a significant source of ground water contamination that can lead to waterborne disease outbreaks and other adverse health effects.

This fact sheet discusses ways to prevent septic systems from contaminating sources of drinking water. Septic systems that receive non-sanitary wastes (e.g., industrial process wastewater) are considered industrial injection wells, and are not the primary focus of this fact sheet. Other fact sheets in this series address prevention measures for contamination sources such as fertilizers, pesticides, animal feeding operations, and vehicle washing.

SOURCES OF SEPTIC SYSTEM EFFLUENT

About 25 percent of U.S. households rely on septic systems to treat and dispose of sanitary waste that includes wastewater from kitchens, clothes washing machines, and bathrooms. Septic systems are primarily located in rural areas not served by sanitary sewers.



A typical household septic system consists of a septic tank, a distribution box, and a drain field. The septic tank is a rectangular or cylindrical container made of concrete, fiberglass, or polyethylene. Wastewater flows into the tank, where it is held for a period of time to allow suspended solids to separate out. The heavier solids collect in the bottom of the tank and are partially decomposed by microbial activity. Grease, oil, and fat, along with some digested solids, float to the surface to form a scum layer. (Note: Some septic tanks have a second compartment for additional effluent clarification.)

The partially clarified wastewater that remains between the layers of scum and sludge flows to the distribution box, which distributes it evenly through the drain field. The drain field is a network of perforated pipes laid in gravel-filled trenches or beds. Wastewater flows out of the pipes, through the gravel, and into the surrounding soil. As the wastewater effluent percolates down through the soil, chemical and biological processes remove some of the contaminants before they reach ground water.

Large capacity septic systems are essentially larger versions (with larger capacities and flow rates) of single family residential septic systems, but they may have more than one septic tank or drain field for additional treatment capacity. In some cases, an effluent filter may be added at the outlet of the large capacity septic tank to achieve further removal of solids. Many large systems rely on pumps rather than gravity to provide an even flow distribution into the drain field.

WHY IS IT IMPORTANT TO MANAGE SEPTIC SYSTEMS NEAR THE SOURCES OF YOUR DRINKING WATER?

Septic systems are a significant source of ground water contamination leading to waterborne disease outbreaks and other adverse health effects. The bacteria, protozoa, and viruses found in sanitary wastewater can cause numerous diseases, including gastrointestinal illness, cholera, hepatitis A, and typhoid.

Nitrogen, primarily from urine, feces, food waste, and cleaning compounds, is present in sanitary wastewater. Consumption of nitrates can cause methemoglobinemia (blue baby syndrome) in infants, which reduces the ability of the blood to carry oxygen. If left untreated, methemoglobinemia can be fatal for affected infants. Due to this health risk, a drinking water maximum contaminant level (MCL) of 10 milligrams per liter (mg/l) or parts per million (ppm) has been set for nitrate measured as nitrogen. Even properly functioning conventional septic systems, however, may not remove enough nitrogen to attain this standard in their effluent.

AVAILABLE PREVENTION MEASURES TO ADDRESS SEPTIC SYSTEMS

Septic systems can contribute to source water contamination for various reasons, including improper siting, poor design, faulty construction, and incorrect operation and maintenance. Most States and localities regulate siting, design, and construction of septic systems and only regulate operation and maintenance for large capacity septic systems. Some of the more widely used prevention measures are described below. Your local health department should be able to advise you on specific requirements for your community.

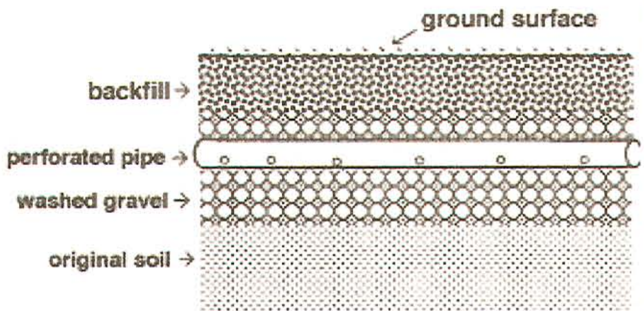
Please keep in mind that individual prevention measures may or may not be adequate to prevent contamination of source waters. Most likely, individual measures should be combined in an overall prevention approach that considers the nature of the potential source of contamination, the purpose, cost, operational, and maintenance requirements of the measures, the vulnerability of the source water, the public's acceptance of the measures, and the community's desired degree of risk reduction

Siting

Most jurisdictions have adopted, for septic systems, ***minimum horizontal setback distances*** from features such as buildings and drinking water wells and ***minimum vertical setback distances*** from impermeable soil layers and the water table. Septic systems should be located a safe distance from drinking water sources to avoid potential contamination. Areas with high water tables and shallow impermeable layers should be avoided because there is insufficient unsaturated soil thickness to ensure sufficient treatment. ***Soil permeability must be adequate*** to ensure proper treatment of septic system effluent. If permeability is too low, the drain field may not be able to handle wastewater flows, and surface ponding (thus contributing to the contamination of surface water through runoff) or plumbing back-ups may result. If permeability is too high, the effluent may reach ground water before it is adequately treated. As a result, alternative systems may be necessary in karst areas. Well-drained loamy soils are generally the most desirable for proper septic system operation. In making siting decisions, local health officials should also evaluate whether soils and receiving waters can absorb the combined effluent loadings from all of the septic systems in the area.

Design and Construction

Septic tanks and ***drain fields should be of adequate size*** to handle anticipated wastewater flows. In addition, soil characteristics and topography should be taken into account in designing the drain field. Generally speaking, the lower the soil permeability, the larger the drain field required for adequate treatment. Drain fields should be located in relatively flat areas to ensure uniform effluent flow.



Septic drain field

Effluent containing excessive amounts of grease, fats, and oils may clog the septic tank or drain field and lead to premature failure. The installation of ***grease interceptors*** is recommended for restaurants and other facilities with similar wastewater characteristics.

Construction should be performed by a ***licensed septic system installer*** to ensure compliance with applicable regulations. The infiltration capacity of the soil may be reduced if the soil is overly compacted. Care should be taken not to drive heavy vehicles over the drain field area during construction or afterward. Construction equipment should operate from upslope of the drain field area. Construction should not be performed when the soil is wet, or excessive soil smearing and soil compaction may result.

Operation and Maintenance

Proper operation and maintenance of septic systems is perhaps the most crucial prevention measure to preventing contamination. Inadequate septic system operation and maintenance can lead to failure even when systems are designed and constructed according to regulation. Homeowners associations and tenant associations can play an important role in educating their members about their septic systems. In commercial establishments such as strip malls, management companies can serve a similar role. Septic system owners should continuously monitor the drain field area for signs of failure, including odors, surfacing sewage, and lush vegetation. The septic tank should be ***inspected annually*** to ensure that the internal structures are in good working order and to monitor the scum level.

Many septic systems fail due to hydraulic overloading that leads to surface ponding. Reducing wastewater volumes through ***water conservation*** is important to extend the life of the drain field. Conservation measures include using water-saving devices, repairing leaky plumbing fixtures, taking shorter showers, and washing only full loads of dishes and laundry. Wastewater from basement sump pumps and water softeners should not be discharged into the septic system to minimize hydraulic load. In addition, surface runoff from driveways, roofs, and patios should be directed away from the drain field.

If an excessive amount of sludge is allowed to collect in the bottom of the septic tank, wastewater will not spend a sufficient time in the tank before flowing into the drain field. The increased concentration of solids entering the drain field can reduce soil permeability and cause the drain field to fail. Septic tanks should be pumped out every two to five years, depending on the tank size, wastewater volume, and types of solids entering the system. Garbage disposals increase the volume of solids entering the septic tank, requiring them to be pumped more often.

Household chemicals such as solvents, drain cleaners, oils, paint, pharmaceuticals, and pesticides can interfere with the proper operation of the septic system and cause ground water contamination. Homeowners should take advantage of ***local hazardous waste collection programs*** to dispose of these wastes whenever possible. Grease, cooking fats, coffee grounds, sanitary napkins, and cigarettes do not easily decompose, and contribute to the build-up of solids in the tank. The use of additives containing yeast, bacteria, enzymes, and solvents has not been proven to improve the performance of septic systems, and may interfere with their normal operation. Bacterial "starters" are not necessary because a wide range of bacteria are normally present in sewage entering the tank. Additives containing solvents or petrochemicals can cause ground water contamination.

Vehicles and heavy equipment should be kept off the drain field area to prevent soil compaction and damage to pipes. Trees should not be planted over the drain field because the roots can enter the perforated piping and lead to back-ups. Last, any type of construction over the drain field should be avoided. Impervious cover can reduce soil evaporation from the drain field, reducing its capacity to handle wastewater.

FOR ADDITIONAL INFORMATION

For information on septic system regulations in your community, contact your state or local health department. The information sources below contain information on measures to prevent septic system failures. All of the documents listed are available free of charge on the Internet.

Numerous documents on septic systems are available for download from U.S. Department of Agriculture Cooperative State Research, Education, and Extension Service State Partners. Links to the various State Partners can be found at http://www.reeusda.gov/1700/statepartners/usa.htm. Several examples of these documents are presented below:

Bicki, T.J. and D.G. Peterson. "Septic Systems: Operation and Maintenance of On-site Sewage Disposal Systems." *Land and Water: Conserving Natural Resources in Illinois*, Number 15, Cooperative Extension Service, University of Illinois at Urbana-Champaign. Retrieved February 26, 2001 from the World Wide Web: http://web.aces.uiuc.edu/vista/pdf_pubs/SEPTIC.PDF.

Hiller, Joe and Andrea Lewis. (October 1994). *Septic System Failure: What To Do.* University of Wyoming Cooperative Extension Service. B-1007. Retrieved February 27, 2001 from the World Wide Web: http://www.uwyo.edu/ag/ces/PUBS/Wy1007.pdf.

Hiller, Joe and Andrea Lewis. (October 1994). *Septic System Maintenance.* University of Wyoming Cooperative Extension Service. B-1008. Retrieved February 26, 2001 from the World Wide Web: http://www.uwyo.edu/ag/ces/PUBS/Wy1008.pdf.

Porter, E., R. Rynk, K. Babin, and B.N. Burnell. *Care and Maintenance of Your Home Septic System.* University of Idaho College of Agriculture, Cooperative Extension System. CIS 1027. Retrieved February 27, 2001 from the World Wide Web: http://info.ag.uidaho.edu/Resources/PDFs/CIS1027.pdf.

Powell, G. Morgan. (March 1996). *Get to Know Your Septic System.* Kansas Cooperative Extension Service, Kansas State University. MF-2179. Retrieved February 26, 2001 from the World Wide Web: http://www.oznet.ksu.edu/library/H20QL2/MF883.PDF.

Powell, G. Morgan. (July 1992). *Septic Tank – Soil Adsorption System.* Kansas Cooperative Extension Service, Kansas State University. MF-944. Retrieved February 27, 2001 from the World Wide Web: http://www.oznet.ksu.edu/library/H20QL2/MF944.PDF.

Powell, G. Morgan, Barbara L. Dallemand, Judith M. Willingham. (August 1998). *Septic Tank Maintenance: A Key to Longer Septic System Life.* Kansas Cooperative Extension Service, Kansas State University. MF-947. Retrieved February 28, 2001 from the World Wide Web: http://www.oznet.ksu.edu/library/H20QL2/MF947.PDF.

Powell, G. Morgan, Barbara L. Dallemand, Judith M. Willingham. (December 1998). *Why Do Septic Systems Fail?* Kansas Cooperative Extension Service, Kansas State University. MF-946. Retrieved February 27, 2001 from the World Wide Web: http://www.oznet.ksu.edu/library/H20QL2/MF946.PDF.

Runyan, R. Craig, *Septic Tank Maintenance.* Cooperative Extension Service, College of Agriculture and Home Economics, New Mexico State University, Guide M-113.

Washington State University Cooperative Extension and U.S. Department of Agriculture. (Reprinted January 1998). *Properly Managing Your Septic Tank System.* EB1671. Retrieved February 26, 2001 from the World Wide Web: http://cru.cahe.wsu.edu/CEPublications/eb1671/eb1671.html.

The National Small Flows Clearinghouse has developed a series of brochures on septic systems. They can be found at http://www.estd.wvu.edu/nsfc/NSFC_septic_news.html.

North Carolina State University Water Quality Group. *Septic Systems.* Retrieved February 27, 2001 from the World Wide Web: http://h2osparc.wq.ncsu.edu/estuary/rec/septic.html.

Septic Information Website: Inspecting, Designing, & Maintaining Residential Septic Systems. Retrieved February 28, 2001 from the World Wide Web: http://www.inspect-ny.com/septbook.htm.

Stormwater Manager's Resource Center. *Non-Stormwater Fact Sheet: Septic Systems.* Retrieved February 26, 2001 from the World Wide Web: http://www.stormwatercenter.net/Assorted%20Fact%20Sheets/Tool7-Non_Stormwater/SepticSystems.htm.

U.S. Environmental Protection Agency. (September 1999). *The Class V Underground Injection Control Study, Volume 5: Large Capacity Septic Systems.* Retrieved February 27, 2001 from the World Wide Web: http://www.epa.gov/safewater/uic/classv/volume5.pdf.

U.S. Environmental Protection Agency. *Decentralized Onsite Management for Treatment of Domestic Wastes.* Retrieved May 1, 2001 from the World Wide Web: http://www.epa.gov/seahome/decent.html.

U.S. Environmental Protection Agency. *Principles and Design of Onsite Waste Disposal with Septic Systems.* Retrieved May 1, 2001 from the World Wide Web: http://www.epa.gov/seahome/onsite.html.

Environment, Health & Safety

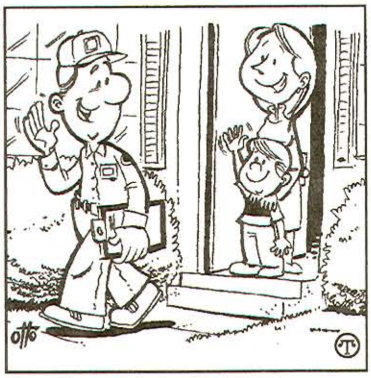
Your Septic Tank: Properly Maintained?

(NAPS)—If your septic tank failed, or you know someone whose did, you are not alone. The U.S. Bureau of Census reported that at least 10 percent of septic systems failed in the previous year. Some communities report failure rates as high as 70 percent.

Septic systems serve approximately 25 percent of U.S. households, and one in every three new homes built today uses these systems.

Here are ten simple steps you can take to keep your septic system working properly.

1. Locate your septic tank and drainfield. Keep a drawing of these locations in your records.
2. Have your septic system inspected at least every three years.
3. Pump your septic tank as needed (generally every three to five years).
4. Don't dispose of household hazardous wastes in sinks or toilets.
5. Keep other household items, such as dental floss, feminine hygiene products, condoms, diapers, and cat litter out of your system.
6. Use water efficiently.
7. Plant only grass over and near your septic system. Roots from nearby trees or shrubs might clog and damage the system.
8. Keep vehicles off your septic system. The weight can damage the pipes and tank, and your system may not drain properly under compacted soil.



The EPA suggests you have your septic system inspected at least every three years.

9. Keep gutters and basement sump pumps from draining into or near your septic system.
10. Check with your local health department before using additives. Commercial septic tank additives do not eliminate the need for periodic pumping and can be harmful to your system.

"Proper septic system maintenance is a commonly overlooked responsibility. Failing systems are a significant threat to our health and our water quality. Homeowners can make a real difference by following a few simple guidelines," says U.S. Environmental Protection Agency Assistant Administrator, G. Tracy Mehan.

For more information on septic system maintenance, visit www.epa.gov/owm/septic

Managing Your Septic System

WQ-39
Reprinted September 2005

MICHIGAN STATE UNIVERSITY EXTENSION

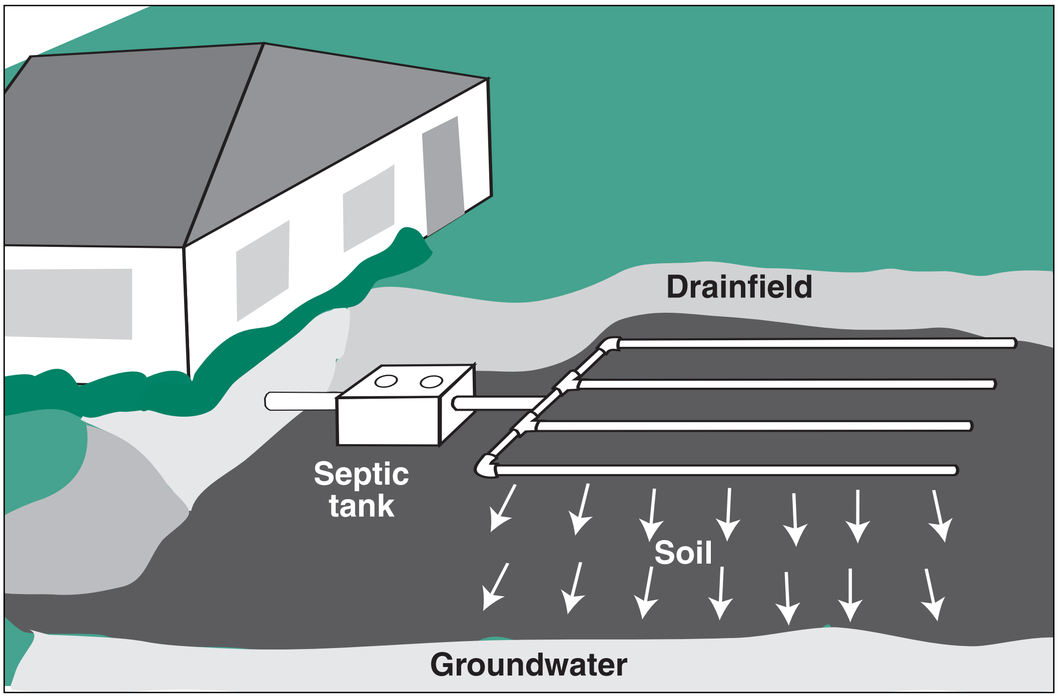
Prepared by Eckhart Dersch, Extension specialist in water management (retired), Department of Resource Development, Michigan State University

Households that are not served by public sewers usually depend on septic systems to treat and dispose of wastewater.

When Your Septic System is correctly located, adequately designed, carefully installed and properly managed, you will have a waste disposal system that is simple, economical, effective, safe and long-lasting. A failing system may result in property damage, odor, surface and possibly groundwater pollution, disease potential, and costly repairs or replacement.

MANAGEMENT IS THE KEY TO A LASTING WASTEWATER DISPOSAL SYSTEM.

This file contains information that will help you manage your septic system. It also provides a place to record and store vital information about your system. It should be kept with other documents about your home and property.



Septic System Components

A septic system has two basic parts: a **septic tank** designed to intercept, hold and partially treat solids contained in wastewater coming from the home, and a soil absorption field or **drainfield** to facilitate treatment and dispersal of clarified wastewater after it leaves the septic tank, as illustrated at left.

Helpful Sources of Assistance and Additional Information

Questions and concerns about your septic system can be directed to the sanitarian in your county or regional health office, to a septic system contractor or to your local Michigan State University Extension office. Additional information can be found in:

On-site Domestic Sewage Disposal Handbook, MWPS-24, Midwest Plan Services; request from Department of Agricultural Engineering, Michigan State University, $6.

Septic Tank Systems: A Homeowner's Guide, Michigan Environmental Health Association, <www.meha.net>.

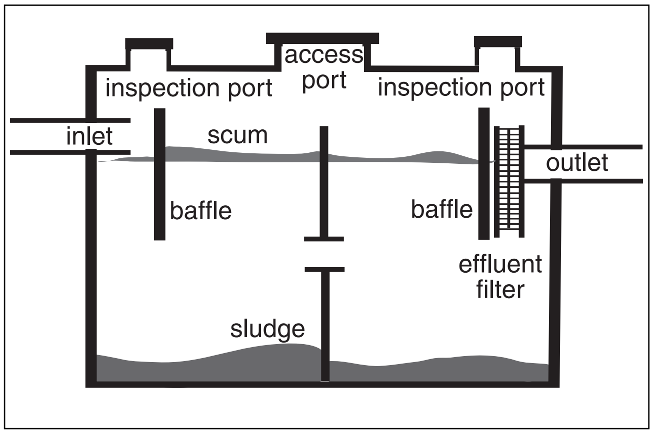
So...now you own a septic system; *Groundwater protection and your septic system,* and several additional on-site waste disposal publications, National Small Flows Clearinghouse, <www.nsfc.wvu.edu>.

Onsite Works! An Introduction to Decentralized Wastewater Treatment Systems, Housing Education and Research Center (HERC) at Michigan State University, <www.canr.msu.edu/cm/herc/onsite/index.html>.

Several bulletins on septic systems are available in Michigan State University Extension's WQ (water quality) bulletin series, including: *Home*A*Syst (WQ-51); Managing Shorelines to Protect Water Quality (WQ-52); What to Do if Your Septic System Fails (WQ-14); Buying or Selling a Home? What To Find Out About Your Water* and *Septic Systems (WQ-15);* and *How to Conserve Water in Your Home and Yard (WQ-16).* Contact your local MSUE office or the MSU Bulletin Office, 117 Central Services Bldg., MSU, East Lansing, MI 48824-1001, or <www.msue.msu.edu/waterqual/wq-mats.html>.

How the Septic Tank Functions

The typical septic tank is a large, buried, rectangular or cylindrical container made of concrete, fiberglass or polyethylene usually located 10 or more feet from the point where the sanitary drain leaves the house. Wastewater from your bathroom, kitchen and laundry flows into the septic tank. There, heavy solids settle to the bottom where bacterial action partially decomposes the solids into sludge and gases. The lighter solids, such as fats and greases, rise to the top and form a scum layer. The partially treated effluent then leaves the septic tank and flows to the drainfield. Septic tanks have one or two compartments specifically designed to capture the solids and prevent them



Cross-section of a two-compartment septic tank

from entering the drainfield. Two-compartment tanks do a better job of capturing the solids and may be required in new installations. Tees and baffles are essential parts of the septic tank. Some tanks are equipped with an inlet tee or baffle to slow incoming waste and direct it downward. The outlet tee or baffle prevents floating solids or scum from leaving the tank and then clogging the drainfield. Some tanks are also equipped with an effluent filter to further prevent the movement of solids into the drainfield. All septic tanks should have accessible covers for checking the condition of the baffles and for pumping out the accumulated sludge and scum mat. **If accumulated solids are not regularly removed from the septic tank, they will overflow into the drainfield and cause premature failure of the drainfield resulting in costly repairs or replacement.**

Servicing the Septic Tank

Regular servicing of the septic tank is the single most important maintenance requirement of a septic system. Required frequency of service depends on septic tank size, the number of persons in the household and whether occupants are minimizing the release of unnecessary solids into the wastewater. **Most septic tanks should be pumped every three to five years.**

How do I determine when to pump?

Most homeowners prefer to give this responsibility to a reputable septic tank pumping firm. Its representative will periodically check your system to determine the rate of solids accumulation and design a pumping schedule tailored to your situation. As a general rule, the tank will require pumping when any of the following occurs: the top of the sludge deposit is within 12 inches of the **bottom** of the outlet baffle; the **bottom** of the floating scum mat is within 6 inches of the bottom of the outlet baffle; the top of the floating scum mat is within 1 inch of the **top** of the outlet baffle or; the floating scum mat is more than 12 inches thick.

Should I use special products to enhance the operation of my septic tank?

No. Though many products are claimed to improve septic tank performance or reduce the need for routine pumping, they have not been found to make a significant difference. Some of these products can actually cause solids to be carried into the drainfield and lead to premature clogging. Other products containing organic solvents can contribute to groundwater contamination.

Where is my septic tank located?

The tank is usually located about 10 to 15 feet from the point where the sanitary drain leaves the house. It can be found by gently inserting a steel rod (soil probe) into the ground where the tank is most likely to be or by waiting for a light snowfall and observing where the snow first melts.

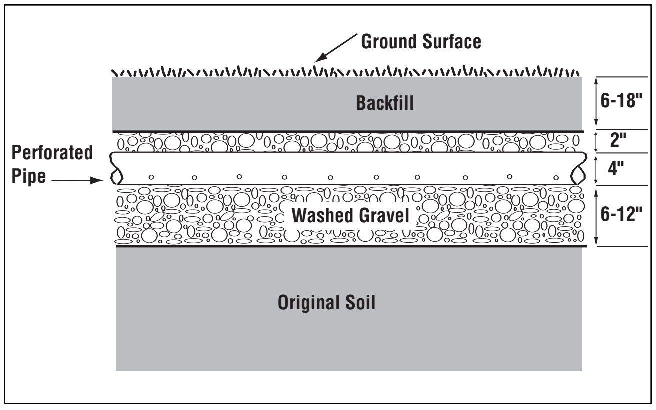
Safety Considerations

Certain features of the septic tank can cause serious injury or death, so the tank should be treated with extreme caution.

- **Never enter the septic tank.** It contains life-threatening gases and little oxygen.
- **Explosion or electrical shock** can occur when lights, appliances or tools are used in or near the septic tank. Smoking can also trigger an explosion.
- **Infectious diseases** can be acquired from contact with liquids and solids in the septic tank.
- **Secure exposed manhole covers and inspection ports** to prevent tampering or entry by children.
- **If sewer gas odors are detected in the home**, immediately call your plumber or a septic system maintenance firm. Evacuate the building if the odor is strong.
- **Keep children and spectators away** when septic system is being maintained or excavated.

How the Drainfield Functions

The drainfield receives partially treated effluent from the septic tank. It consists of a network of perforated pipes laid in gravel-filled trenches about 2 or 3 feet wide or in beds that are over 3 feet wide and 6 to 18 inches (or more) deep. The size and type of drainfield are determined by the estimated daily wastewater flow and local soil conditions. Wastewater trickles out of the perforated pipes, through the gravel layer and into the soil.



Physical and biological purification processes take place as the effluent percolates down toward groundwater. These processes work best where the soil is somewhat dry and permeable and contains plenty of oxygen for several feet below the drainfield. Some systems include a dosing chamber or distribution box in the pipe leading from the septic tank to the drainfield for regulating the release of wastewater into the drainfield. This promotes optimal treatment and dispersal of the water and prolongs the life of the drainfield. The lifespan of a well-maintained system can be 20 to 30 years or more.

Signs of system failure

- Odors, surfacing sewage, wet spots or lush vegetation on or near the drainfield.
- Plumbing or septic tank backups.
- Slow-draining fixtures.
- Gurgling sounds in the plumbing system.

If you notice any of these signs or if you suspect any other problems with your septic system, contact the sanitarian at your county or regional health office or your septic system contractor for assistance.

Alternative systems

In some situations, it may be possible or necessary to treat and disperse effluent from the septic tank using something other than only a drainfield. Alternative systems in use today include sand filters, mounds, wetlands, gravelless drainfields, pressure dosing and aerobic units. Servicing requirements for these systems vary and should be obtained from your local sanitarian or septic system contractor.

Recommendations

These suggestions will help you prolong the life of your septic system.

- **Minimize the amount of water entering the septic system.** Practice water conservation by installing water-saving fixtures in your home, using the least amount of water to get the job done, and repairing leaky faucets and toilets. When possible, keep water softener backwash out of the septic system.
- **Avoid using a garbage disposal unit.** Make compost out of vegetable wastes, coffee grounds, eggshells and other compostable kitchen wastes.
- **Eliminate release of non-degradable materials** such as fats, paper towels, hair, tampons, sanitary napkins and disposable diapers.
- **Never release toxic chemicals** such as solvents, disinfectants, oils, paints, paint thinner and pesticides. Use boiling water and a drain snake to open clogged drains instead of caustic drain openers. Use commercial bathroom cleaners in moderation. Use mild detergent or baking soda when possible.
- **Pump septic tank regularly**, usually once every three to five years, and never allow solids or scum to leave the septic tank and enter the drainfield.
- **Keep surface of drainfield properly drained** by slightly mounding the soil over the drainfield, redirecting downspouts and sump pump outflow, and not stockpiling snow over the area.
- **Do not install automatic sprinklers** over the tank and drainfield.
- **Landscape over septic system** with dense grass cover and other **shallow-rooted** plants.
- **Avoid impermeable or compacted surfaces over the drainfield** such as concrete, asphalt, plastic or compacted soil from vehicular traffic.
- **Save fertilizer** by not fertilizing over the drainfield.
- **Stay away from additives.** Their benefits have not been demonstrated, and some may actually harm your system and contaminate groundwater.
- **If there are observation ports in your drainfield,** look in them during wet (spring) and dry weather and determine depth of ponded water, if any. Records over time will help you forecast and solve any develping problems.

Septic System Layout

If you do not have a sketch showing where your septic system is located on you property, locate them using a soil probe and use the grid provided to show the location of your septic system components in relation to your house.

Preventative Maintenance Record

Keeping a record of your septic system maintenance will help you anticipate when the next cleaning may be needed.

Date	Work done	Firm	Cost

Septic System Contractor/Installer

Name ______________________

Address ______________________

Date Installed ______________________

Phone ______________________

Septic System Pumper

Name ______________________

Address ______________________

____

Phone ______________________

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A SEPTIC ACTIVITY:
Matching Game

Use what you've learned about septic systems and groundwater in the SEPTIC learning materials to complete this matching game. Fill in the blank in front of the words or phrases in column 1 with the number of the matching definition in column 2.

Column 1

_____ a. Septic tank

_____ b. Groundwater

_____ c. Water

_____ d. Every 3 to 5 years

_____ e. Biomat

_____ f. Pipes

_____ g. 120,000,000 gallons

_____ h. Septage

_____ i. Septic system

_____ j. Soil

_____ k. 20 percent

_____ l. Aquifer

_____ m. Drainfield

_____ n. Alternative systems

_____ o. 1,200,000

_____ p. Sewer

_____ q. Surface water

_____ r. Toilet

Column 2

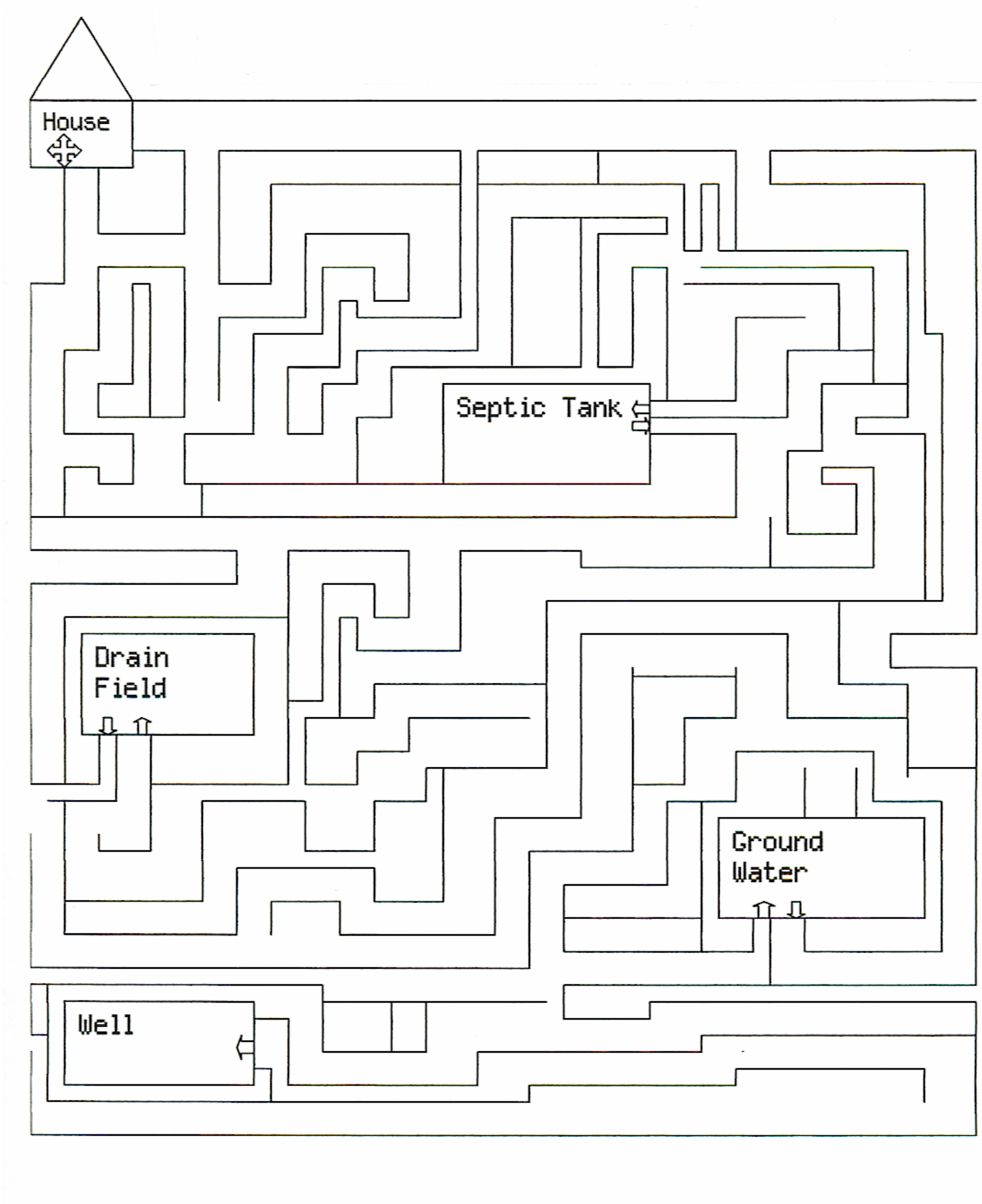
1. How often you should have your septic system pumped.
2. This includes water from dishwashers, washing machines and garbage disposals, and bodily wastes and other sources of water.
3. Human waste goes into the ground through this.
4. Rain, snow and ice are all forms of this.
5. This helps filter septage after it leaves the septic system.
6. The approximate number of septic tanks in Michigan.
7. The approximate amount of septage pumped each year in Michigan.
8. Systems (other than a septic system) that are designed to process and return septage to the environment; may use sand filters or air (aerobic).
9. Place where your poop settles.
10. The percentage of the world's surface water that is in the Great Lakes.
11. Where bodily waste begins the journey to the septic tank.
12. Includes all of the water under ground.
13. Your home is probably connected to one of these if you live in town.
14. Your septage gets to your septic tank through these.
15. Your bodily waste probably goes into one of these if you live outside of a city or town.
16. Water in the ground.
17. Mat that is created under a septic system's drainfield and can be good or bad.
18. Water above the ground.

A SEPTIC ACTIVITY
Matching Game Solution

a. Septic tank	9. Place where your poop settles.
b. Groundwater	16. Water in the ground.
c. Water	4. Rain, snow and ice are all forms of this.
d. Every 3 to 5 years	1. How often you should have your septic system pumped.
e. Biomat	17. Mat that is created under a septic system’s drainfield and can be good or bad.
f. Pipes	14. Your septage gets to your septic tank through these.
g. 120,000,000 gallons	7. The approximate amount of septage pumped each year in Michigan.
h. Septage	2. This includes water from dishwashers, washing machines, garbage disposals, bodily wastes and other sources of water.
i. Septic system	15. Your bodily waste probably goes into one of these if you live outside of a city or town.
j. Soil	5. This helps filter septage after it leaves the septic system.
k. 20 Percent	10. The percentage of the world's surface water that is in the Great Lakes.
l. Aquifer	12. Underground, includes all of the water there.
m. Drainfield	3. Hman waste goes into the ground through this.
n. Alternative systems	8. Systems (other than a septic system) that are designed to process and return septage to the environment; may use sand filters or air (aerobic).
o. 1,200,000	6. The approximate number of septic tanks in Michigan.
p. Sewer	13. Your home is probably connected to one of these if you live in town.
q. Surface water	18. Water above the ground.
r. Toilet	11. Where your bodily waste begins the journey to the septic tank.

A SEPTIC MAZE:
Where Does It Go After You Flush?

Follow the route that sewage takes from a house to a septic system to find your way through this maze. Here are a few hints to get you started: After you flush, the sewage flows through a maze of pipes out to a septic tank. The tank is where the "stuff" in the water separates into three layers: scum, liquids and solids. The solids sink to the bottom of the tank, the scum (usually substances such as grease and soap suds) floats on the top and the wastewater flows into the drainfield. When the liquid reaches the drainfield it seeps through holes in the drainfield and is purified on its way down to the groundwater.



A SEPTIC ACTIVITY:
Aquifer Flurries*

** Adapted from activities created by the Michigan Rural Water Association, the Groundwater Foundation and other sources.*

OBJECTIVE:
The participants will gain an understanding of how an aquifer works and how one can be contaminated.

LIFE AND LEARNING SKILLS:
- Using resources wisely
- Critical thinking

MATERIALS:
- ❑ "Aquifer Flurries Glossary" handout (one per person)
- ❑ "Make an Aquifer" handout (one per person)
- ❑ Chocolate sandwich cookies such as Oreos or Hydrox (2 packages)
- ❑ Rolling pin
- ❑ Clear plastic 12-ounce cups (one per person)
- ❑ 1 24-ounce bottle strawberry-flavored syrup
- ❑ 1 to 2 gallons vanilla ice cream or ice milk
- ❑ Ice cream scoop
- ❑ 2 to 3 gallons no- or low-fat white milk
- ❑ 1 small package green sprinkles
- ❑ Drinking straws (one per person)
- ❑ Disposable spoons (one per person; optional)
- ❑ Newsprint or other large paper (optional)
- ❑ Markers (optional)
- ❑ Masking tape (optional)
- ❑ Running water, soap and paper towels, or disposable cleaning wipes

PROCEDURE:
(Helper's Note: Check for food allergies among your group members before conducting this activity. You could substitute soy milk for cow milk, and use sugar-free products in place of several of the other ingredients if necessary.)
Before the meeting:
1. Gather the supplies and ingredients you will need for the activity. The quantities for the various ingredients in the aquifer flurries are calculated based on a group of 25 participants. You may need to adjust the quantities for your group size.
2. Use the rolling pin to crush the cookies.
3. Set bowls of crushed cookies around the work space so the participants can reach them easily.
4. You may want to reproduce the "Make an Aquifer" handout on newsprint and display it where everyone can see it easily.

During the meeting:

1. Tell the group that they're going to make and eat their own "aquifer flurries." In the process, they'll see how an aquifer functions and how it can be contaminated. They'll also learn how a water well works as they consume their aquifer flurries.
2. Have the group wash their hands with soap and warm water for 20 seconds before beginning to prepare their aquifer flurries. Be sure that all work surfaces are clean.
3. Distribute the "Make an Aquifer" and "Aquifer Flurries Glossary" handouts, plastic cups, drinking straws and disposable spoons.
4. Discuss with the group the terms on the "Aquifer Flurries Glossary" handout, and answer any questions they may have.
5. Lead them through the process of creating their own ice cream aquifer flurries by adding one ingredient at a time and discussing with them what each ingredient represents in a real aquifer as you add it to the ice cream aquifer. Refer them to the "Make an Aquifer" handout as you go. From the bottom up on the diagram:
   - Crushed cookies = Gravels and soils
   - Milk = Water
   - Vanilla ice cream = Confining layer
   - Sprinkles = Sand and top soil in the porous top layer of soil
   - Strawberry syrup = Contamination
   - Drinking straw = Water well
6. Fill a clear plastic cup one-third full with crushed chocolate sandwich cookies to represent gravel and soil.
7. Add enough white milk to just cover the cookies. This represents groundwater.
8. Add a layer of ice cream to serve as a confining layer over the water-filled aquifer.
9. Add more crushed cookies on top of the confining layer.
10. Scatter colored sprinkles over the top layer of crushed cookies to represent the soils in a porous top layer.
11. Pour strawberry syrup on top of the aquifer to represent contamination.
12. As the participants watch the white milk infiltrate the "confining layer" of their ice cream aquifers, discuss how contaminants move through an aquifer and how aquifers are vulnerable to spills on the earth's surface.
13. Next have the students use their drinking straws to "drill wells" into their ice cream aquifers. As they "pump water from their wells" (suck milk and ice cream through their straws), explain that they're lowering the water tables in their ice cream aquifers. Mention that as they consume their ice cream aquifers, they may be sucking contaminants (strawberry syrup) through the confining layer (ice cream) into the well area that will end up in the groundwater.
14. Demonstrate that an aquifer can be recharged with "rain" (add more milk to the glass) and recontaminated (add more strawberry syrup).
15. Encourage the participants to enjoy their aquifer flurries!

TALKING IT OVER:

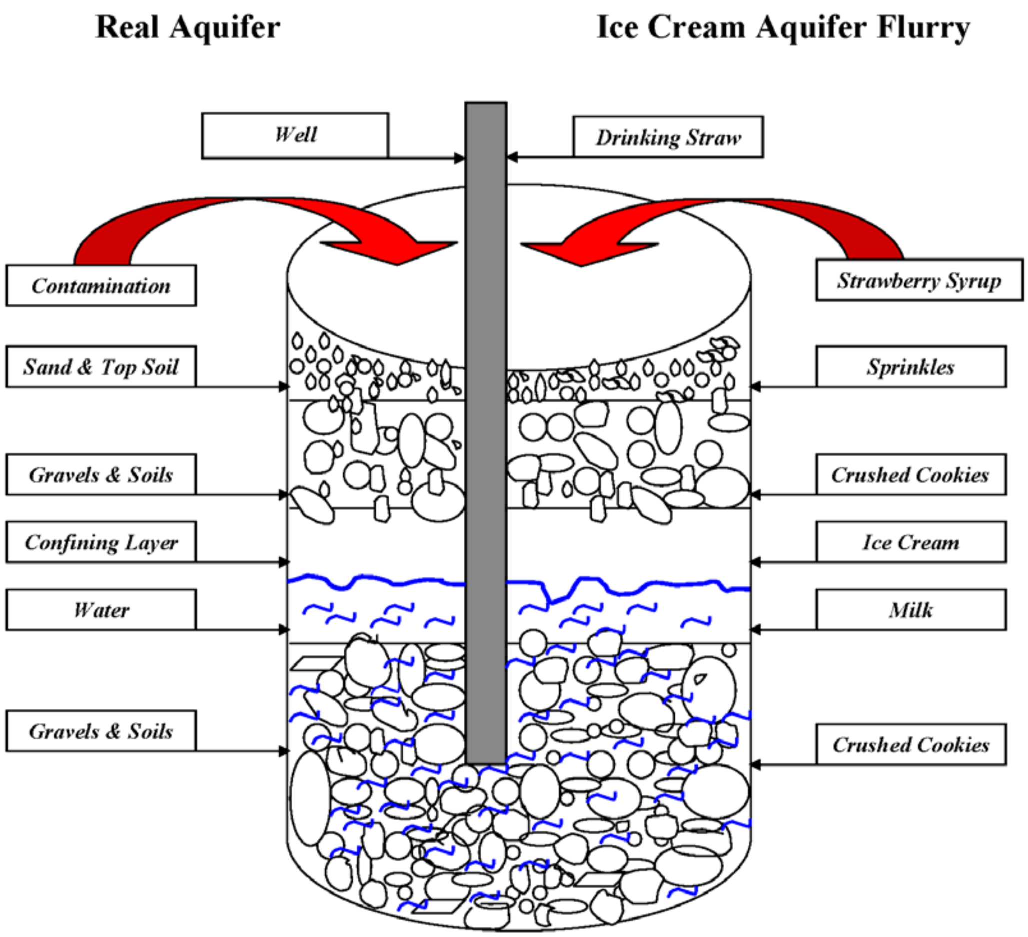
As they're finishing their aquifer flurries (or after the cleanup is finished), ask the group the following questions:

- How did the strawberry syrup affect your ice cream aquifer? *(it acted as a contaminant)*

- How might the contamination of an aquifer affect humans? *(make the water unpleasant or unsafe to drink, make people and animals sick)*
- What can humans do to prevent the contamination of aquifers? *(use less fertilizer on their lawns; don't pour contaminants such as motor oil, solvents and paint down household drains or into storm sewers; design, build and maintain septic systems properly)*
- What would you tell your family members about what you learned about aquifers from this activity?

AQUIFER FLURRIES HANDOUT:
Make an Aquifer

This diagram illustrates how the ingredients in an Aquifer Flurry represent the makeup of a real aquifer.



AQUIFER FLURRIES HANDOUT:
Glossary

- **Aquifer –** The area in which groundwater is stored; groundwater moves slowly through layers of sand, soil and rocks in an aquifer

- **Confined aquifer –** An aquifer in which the groundwater is bounded between layers of impermeable substances such clay or dense rock; confining layers are barriers to surface pollutants

- **Depletion –** The loss of water from surface water reservoirs or from groundwater aquifers at a rate greater than it can recharge

- **Groundwater –** Water that is found underground in cracks and spaces in the soil, sand and rocks

- **Groundwater contamination –** Groundwater into which human-made products such as gasoline, oil, road salts and chemicals infiltrate; contaminants often cause groundwater to become unsafe and unfit for human use

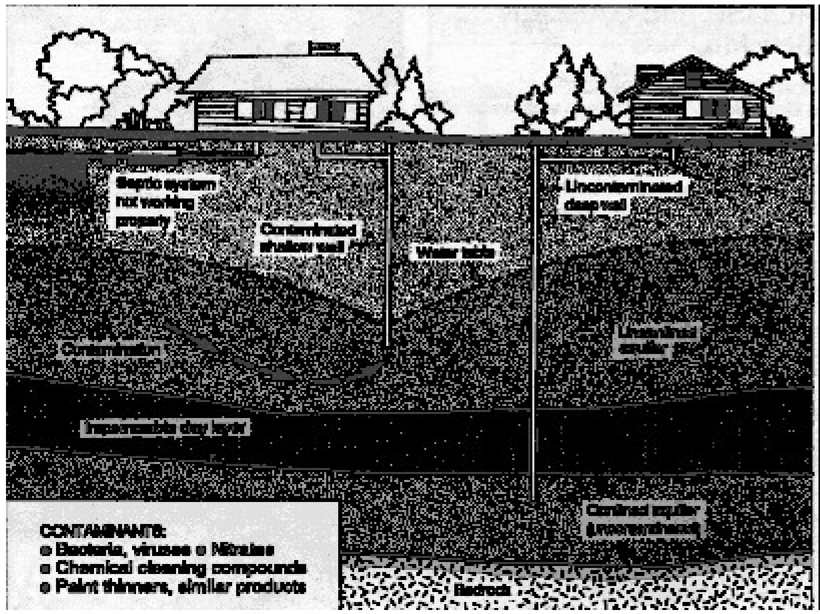
- **Recharge –** The process of replenishing groundwater supplies (such as by rain and melting snow)

- **Water cycle –** The continuous movement of water throughout the planet and atmosphere; infiltration occurs where water falls and seeps into the ground

- **Water table –** The top of an unconfined aquifer; indicates the level below which soil and rock are saturated with water

- **Well –** a hole that is drilled into an aquifer to extract water from it; after the well is drilled, pipes and a pump are installed and used to pull water out of the ground and screens filter out unwanted particles that may otherwise clog the pipe

Some Information and a Quick Quiz: Septic Systems and Groundwater



In many rural areas – and some older communities – the wastewater and sewage from homes and businesses are handled by individual septic systems rather than by municipal wastewater treatment plants.

If they're not properly designed, built and maintained, septic systems can have negative effects on groundwater. If a septic tank leaks or fails all together, the sewage that was supposed to have been treated by the septic system will infiltrate and contaminate the surrounding soil and groundwater. If the contamination reaches the aquifer, it may travel hundreds of feet over time and pollute nearby water wells and other sources of drinking water. Often the well that is contaminated first by a leaking or failing septic system is the well that serves the building the septic system serves.

Septic systems typically consist of the pipes running from the drains and plumbing fixtures in the house out to the septic tank and from there to the drainfield.

The drainfield is where the wastewater is distributed to infiltrate into the soil. A layer of clay should line the bottom of the drainfield to keep contaminants from escaping from the drainfield. But some drainfields are built without this impermeable layer, so they let contaminants escape into nearby soil layers and the groundwater.

Contaminated drinking water damages the environment and can make people and animals sick, which is why it's so important for homeowners to take care of their septic systems and for everyone to learn how serious this problem really is.

The diagram shows a house with a water well that has been contaminated by a septic system. The system's drainfield has been overloaded with wastewater discharged by the septic tank.

Quick Quiz

Use what you've learned from the short article and diagram above to answer these questions:

1. How can a malfunctioning septic system affect an area?

____

____

____

2. What function does a layer of clay perform in the subsurface of a septic system's drainfield?

____

____

____

3. If contamination from a septic system moves through ______________________ and into the ________________, it can move up ___________________ and pollute your drinking water.

Some Information and A Quick Quiz Answer Sheet: Septic Systems and Groundwater

1. A malfunctioning septic system can contaminate nearby wells and groundwater.

2. A layer of clay in the subsurface of a drainfield works as a barrier to keep contaminants from moving downward.

3. If contamination from a septic system moves through **the ground** and into the **aquifer,** it can move up **wells** and pollute your drinking water.

Excuse Me, Is this the Way to the Drainpipe?

Grades K - 6

➤ Objectives

- Explain where drinking water comes from and where wastewater goes once it leaves the home.
- Explain how the water we use fits into the water cycle.

➤ Interdisciplinary Skills

Reading, Art, Science.

➤ Estimated Time

- K-3: 45+ minutes to read, discuss, and color story
- 4-6: 10 minutes to read story; 45 minutes to create water travel book

➤ Materials

- ☐ Copies of the activity story
- ☐ Crayons (grades K-3)
- ☐ Paper and art supplies to make travel book (grades 4-6)

Background Information

We seldom think about where the water we use in our homes or businesses comes from or where it goes once it disappears down the drain. The water we use everyday is very much a part of the earth's water cycle and is continually recycled. When we use water we are, essentially, detouring it from its natural cycle and then, in short order, returning it back to the environment.

Water can dissolve, suspend, and transport many substances. Therefore, the quality of the water we drink has a lot to do with where it has been and what has been in contact with it. For this reason, our water supply sources are not always drinkable and may need treatment to remove natural or manmade contaminants. All drinking water must meet federal and state standards that were put in place to ensure that the water is safe to drink. Needless to say, protecting our water from harmful contaminants to begin with, is important.

Our ***drinking water*** comes from either ground water (e.g., wells, springs) or surface water (e.g., rivers, lakes, manmade reservoirs). Ground water supplies are usually extracted by a pump, treated and disinfected when necessary, and delivered to homes and businesses through a network of pipes called a ***distribution system***. Many people who live in rural areas have individual, on-site ground water wells with very simple piping systems; many other people who depend on ground water, but live in more populated areas, receive their water from large water supply wells with more complicated distribution systems.

Surface water supplies are withdrawn from rivers, lakes, and reservoirs through large intake structures. The water is disinfected and often treated at a ***water treatment facility*** to remove impurities before entering the distribution system. Surface water supplies often travel through many miles of underground pipes before reaching the faucets of people's homes and businesses.

Clean drinking water comes into our homes through one set of pipes and leaves our homes as ***wastewater*** through another set of pipes. The dirty wastewater that is flushed down the drain from our homes and businesses must be treated so that it can be safely and effectively recycled back to nature.

NOTES

In rural areas, wastewater pipes are hooked up to small on-site sewage treatment and disposal systems, or ***septic systems***, that are buried in the ground. In these systems, wastewater generally flows by gravity through a pipeline that runs from the home to a septic ***tank***, where wastewater is partially treated before it flows onward to a ***leaching system***. As wastewater passes through the leaching system (a buried network of pipes with holes through which the water passes) it is further filtered and treated by the soil and the microorganisms in the soil. Eventually, the treated water seeps into the ground water.

In more populated areas, wastewater in conveyed from the home into a network of sewer lines which lead to a ***wastewater treatment plant***. Here, wastewater is cleaned by mechanical, biological, and chemical processes before it is discharged into ground water or surface water. Water that is discharged from wastewater treatment facilities must meet stringent federal and state standards.

Both septic systems and large wastewater treatment systems rely on small, ***microscopic organisms*** (e.g., bacteria) to help clean up water. These organisms, nature's own built-in water purifiers, devour and digest organic waste material in the wastewater. The more efficiently the organic solids are digested, the cleaner the water. This is a big reason why it is important not to flush harmful substances, such as household hazardous wastes, paints, paint thinners, and drain cleaners, down the drain. These substances can kill natually-occurring bacteria, especially in septic systems, and cause the systems to function poorly.

Teaching Strategy: Grades K-3

1. Hand out copies of the story. For classes with pre-readers or early readers, read the story to the students. Discuss the story, ask questions, and show the students the pictures as you go along. (The art activity in the "Follow Those Pipes" activity can help students visualize what this story is describing.) Have older students read the story themselves and then have a discussion.
2. Discussion questions: Ask the students whether they think their water comes from a well by their home or whether it is piped in from somewhere else. If their water comes from somewhere

NOTES

else, do they know from where? Does their wastewater go to a septic tank or a wastewater treatment plant? Does Martha live in the city or the country? Ask the smaller children what parts of the story they think couldn't happen and what parts are true.

3. Have the students color the pictures in the story and take it home to share with their families.

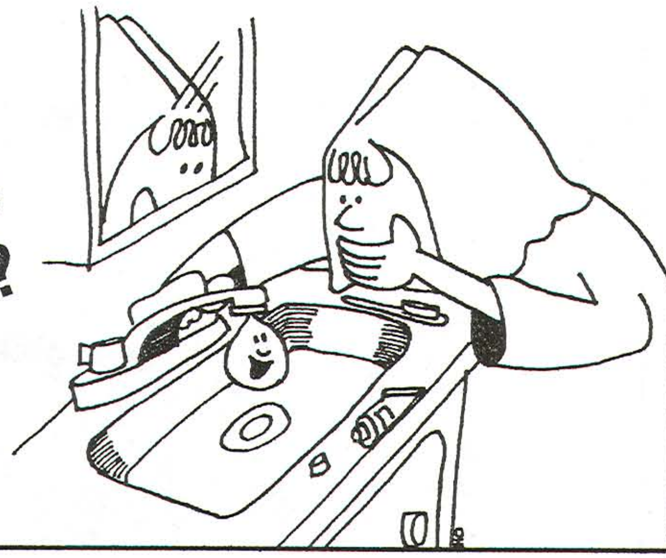
Teaching Strategy: Grades 4-6

1. Distribute copies of the story.
2. Have students read the story on their own. (The art activity in the "Follow Those Pipes" activity can help students visualize what this story is describing.)
3. Discuss the story. Ask the students whether they think their water comes from a well by their home or whether it is piped in from somewhere else. If their water comes from somewhere else, do they know from where? Does their wastewater go to a septic tank or a wastewater treatment plant? Does Martha live in the city or the country? In the city, where is the water cleaned to make sure it is safe enough to drink? In the city, where does the water go after people have used it?
4. Have the students create a "Willy Wetsworth Travel Book" that shows their own ideas about what a good travel adventure for a water drop might be. Make sure students show how the water gets from one place to another and in which phases (liquid, gas, solid).

Supplementary Activities

- Take the class on a field trip to a water and/or wastewater treatment plant.
- Invite a member of your local water or wastewater department or a plumbing contractor to be a guest and explain how water comes into and leaves homes and businesses.

Excuse Me, Is This The Way To The Drainpipe?



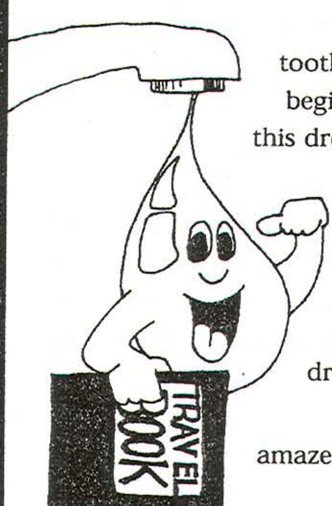
by Ellen Frye

illustrations by Hank Aho

Martha Merriweather forgot to brush her teeth. She'd already said goodnight to her mom and dad, to Benji, her brother, and Lulu, her parakeet. She was all snug under her red polka dot blanket. In fact, she was pretty near asleep when she remembered about her teeth.

It had been one of those days—one of those forgetting days. She forgot her lunch and had to borrow lunch money from Mrs. Johnson in the school office. She forgot her homework assignment and had to call her friend Terry to find out what it was. She'd even forgotten to feed Lulu until her mother reminded her.

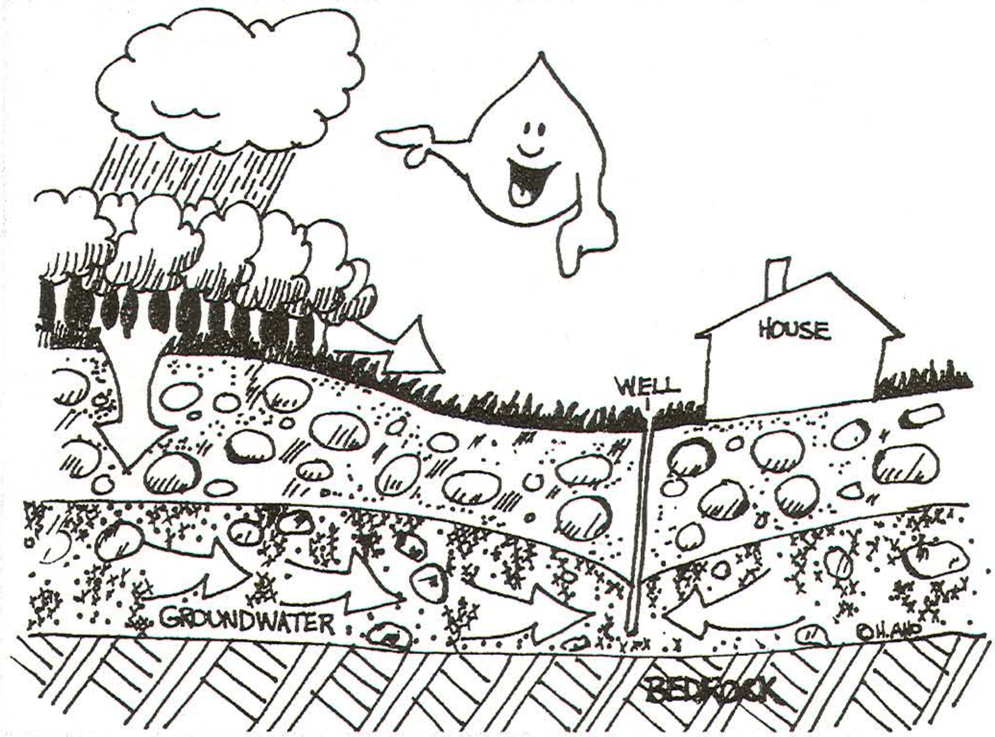
But Martha Merriweather did finally remember to brush her teeth. So she got out of bed, headed to the bathroom, turned on the light, picked up the toothbrush, picked up the toothpaste, put the toothpaste on the toothbrush...



But, just as Martha was bringing the toothbrush with the toothpaste to her teeth, she noticed a drop of water that was just beginning to drip from the faucet—which isn't so very unusual. But this drop didn't drip and it didn't drop; instead, it seemed to get bigger...and bigger. Furthermore, it seemed to be waving to her. Yes, it was waving to her. In fact, it seemed to be speaking to her. Yes...yes, it was speaking to her. In fact, it was asking her a question.

"Excuse me, is this the way to the drainpipe?," the drop was asking as it pointed to the drain in the sink.

"Yes it is," answered Martha, her eyes wide open with amazement. "But...but....you're talking!"



"Yes," said the drop, "I often talk when I have a question, and, if you recall, I did have a question! You see," he said, "my travel book says that I should flow from the Merriweathers' ground water well, continue on up through the Merriweathers' water pipes, until I get to the Merriweathers' bathroom faucet. At that point, my travel book says, I should dive downward to the Merriweathers' drainpipe."

"Merriweather?," cried Martha, "Merriweather? That's my name—Martha Merriweather."

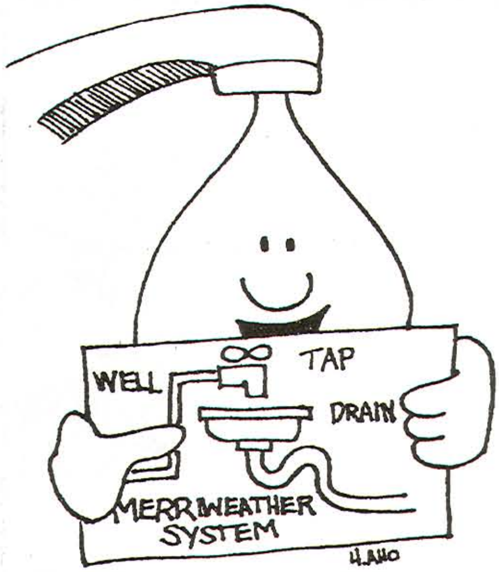
"And my name is Willy Wetsworth, a traveler and adventurer," said the drop. "Pleased to meet you."

"A traveler and adventurer?," whispered Martha gleefully.

"Yep," said Willy Wetsworth, "I spend my life traveling—in the clouds, in the sky, in the rivers, oceans, and streams, along the roadways, through the woodlands and grasslands, down in the soil, and between the rocks. Today, I'm traveling through water pipes—your water pipes. I was just pumped up into your house from the well in your backyard. It was a fun-foodling ride. Up, up, up, up, from the ground, then through this pipe and that pipe, until...well....here I am."

"Wow!," said Martha, trying to imagine what it would be like to travel in water pipes. She thought it might be "fun-foodling" if she were wearing a snorkel and flippers. She thought it might be like zooming through a water slide at the amusement park.

"Do you mean to say," she asked, "that any time people brush their teeth, or wash their hands, or take a shower, or wash the dishes, or do the laundry, or flush the toilet, or water the flowers...that all that water has just had an exciting ride through the pipes?"



"Yep," replied Willy.

"Do you mean to say that all the water that people use comes right from a well in their own backyard?," asked Martha.

"Well...sometimes yes, and sometimes no," replied Willy. "It says here in my travel book that some people, like the Merriweathers, live in the country where there are more trees than people, and where houses are spread apart. So when people who live in the country need water, they can usually get it from the water deep in the ground in their own backyard. But it's different in the city—the city's where there are more people than trees, and buildings are closer together. City water is usually piped in from a big well, or a lake, or a stream, or a reservoir that might be right near by or it might be many miles away. I have a friend who actually made the trip through city water pipes."

"Really?," asked Martha

"Yes," said Willy, "he started out at a big reservoir. From there he went through a big pipe to a water treatment plant."

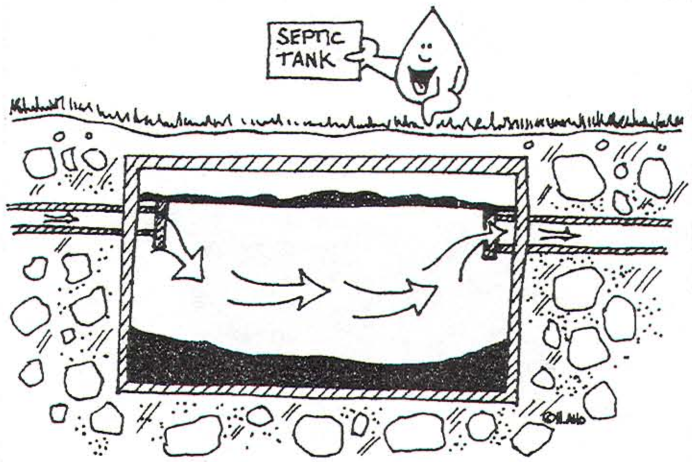
"A water treatment plant?," asked Martha. "What's that?"

"According to my friend," said Willy, "it's a place where water is cleaned so it's safe enough for people to drink."

"You mean your friend isn't safe to drink?" asked Martha.

"Well he probably is," said the drop. "But, in our travels, we water drops never know what we're gonna run into—or what's going to run into us. Let's face it, every living plant and animal on this earth needs us and uses us—people boil us, drink us, mix other stuff with us, throw their scumdiddle glunk in us. There are so many ways we can get dirty. Most days, mother nature can clean us up without anybody's help. But sometimes mother nature can use some help and a water treatment plant does just that—it's kind of like mother nature's little helper. My friend said it was really weird going through the treatment plant, but he felt good as new by the time he got out of there. But then...," continued the drop.

"But then what?," asked Martha, who by now was trying to decide whether or not she would like it if *she* were a water drop.



"Then he took a wondrous, long, rip-snoodling ride through some great big pipes, and then some medium-sized pipes, and then some smallish pipes, right into an apartment house," said Willy. "Other water drops went to other places like office buildings and stores and museums and libraries. And then..."

"And then what?," gasped Martha, thinking that, indeed, it might be fun to be a water drop.

"Then," said Willy Wetsworth, "the people who live and work in those buildings turned on their faucets and used their water for something or other—like brushing their teeth."

"Oh," said Martha, looking at the toothbrush and toothpaste she was still holding. "I was just about to brush my teeth when I met you."

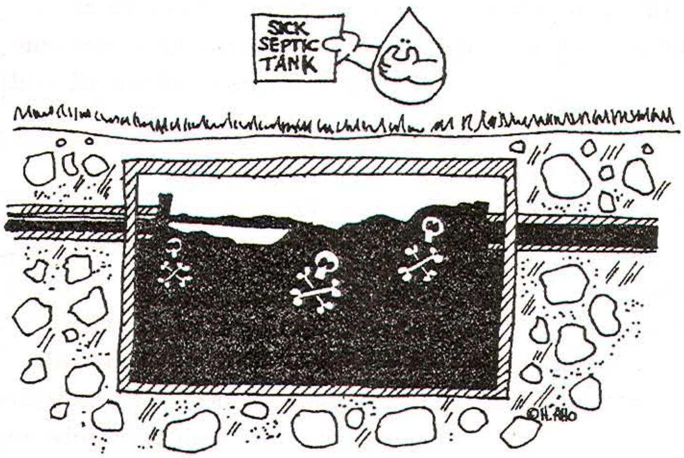
"And I was just heading for the drain," said Willy.

"But you mustn't," blurted Martha, who had already grown rather fond of the drop. "I mean...down the drain? What on earth will happen to you?"

"Well, it says right here in my travel book that I'll wash down another set of pipes and end up in a septic tank that's buried in the Merriweathers' backyard."

"A septic tank?," exclaimed Martha. "I've heard of that. A man came to clean our septic tank a little while ago, and when I asked my mother what a septic tank was she told me that it was a big box that holds our dirty water after it goes down the drain. She said it helps make the water clean again. The dirty water stays in the septic tank for awhile and then goes into another pipe and then it goes into the ground."

Martha thought for a moment and then asked Willy, "Are you sure you really want to go down the drain to a septic tank? It sounds yucky!"



"It's not so bad," said Willy. "My travel book says the Merriweathers take good care of their septic system, so it does a good job of cleaning us up. My book also says the Merriweathers don't throw all kinds of nasty scumdiddle glunk down the drain that might make my friends down in the septic tank sick."

"You have friends in the septic tank?," asked Martha.

"Yep," said Willy. "heaps and gobs of eency, beency, plump, and jolly bacteria—mother nature's little cleaner uppers. They live in the septic tank and love to eat the waste in your wastewater."

"Ick," thought Martha.

"They eat it and digest it and eat it and digest it," said the drop, "and, like magic, they change it from harm*ful* waste to harm*less* waste."

"Wow!," exclaimed Martha.

"But like I said," said the drop, "my bacteria buddies get sick when people throw nasty scumdiddle glunk down the drain."

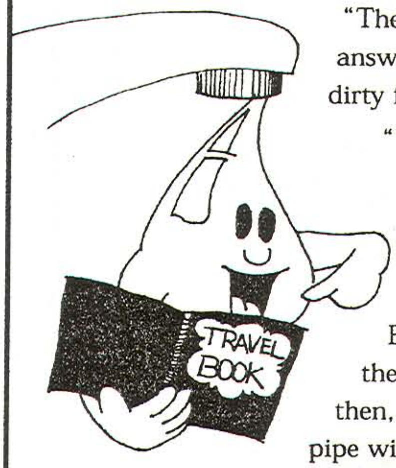
"What kind of scumdiddle glunk?," asked Martha.

"Oh, like paint thinner or plastics or oils or pesticides," said the drop.

"Oh," said Martha, who was beginning to think that being a water drop might not be as much fun as she thought. "I can't say that I've ever thrown any glunk down my drain, and I know now—for certain—that I never will!"

"Hooray for you, Martha Merriweather!," shouted the drop. "As you know, I thrive on adventure, but I've heard there are some septic systems that even I wouldn't want to visit. Some people just don't take care of them and, after awhile, they clog up and bog down and then my bacteria friends are anything but jolly. And then, of course..." said Willy, his smiling face giving way to a deep, dark frown.

"And then, of course what?," asked Martha, almost afraid to hear the answer.



"Then, of course, we water drops stay dirty, dirty, dirty," he answered with a shudder, "too dirty for anyone to drink...too dirty for brushing anyone's teeth."

"Oh," sighed Martha.

"But I'm going down that drain Martha Merriweather," Willy laughed and pointed to the drain. His face was once again lit up like the Fourth of July. "And if I get a little dirty and smelly in the septic tank, so what? Everybody gets dirty and smelly sometime. Down there in the septic tank, I'll hang out with my friends for a while and then, like you said, I'll float out of the tank and into a pipe—a pipe with holes in it," he said.

"It says right here in my travel book," Willy began reading from his book, "You will float out of one of the holes in the pipe and sink down into a big gravely place. From there, just relax and enjoy your journey into the soil below. Here in the soil you will find yourself getting cleaner and cleaner and cleaner and cleaner. In time, you will find yourself back in the ground water, not far from where your little adventure began." Willy smiled a big, wide smile and closed his book.

Martha asked Willy if his friend in the city had gone into a septic tank when he went down the drain.

"Oh no," replied Willy. "There's no room for septic systems in cities. Your septic tank is only a short trip from your house, but in the city, all the dirty water that goes down the drains of all the apartment houses and businesses travels through oodles upon oodles of pipes—smaller-sized, then middle-sized, then bigger-sized pipes that are buried under the streets. All that dirty water ends up at a flumongous, magrungous wastewater treatment plant."

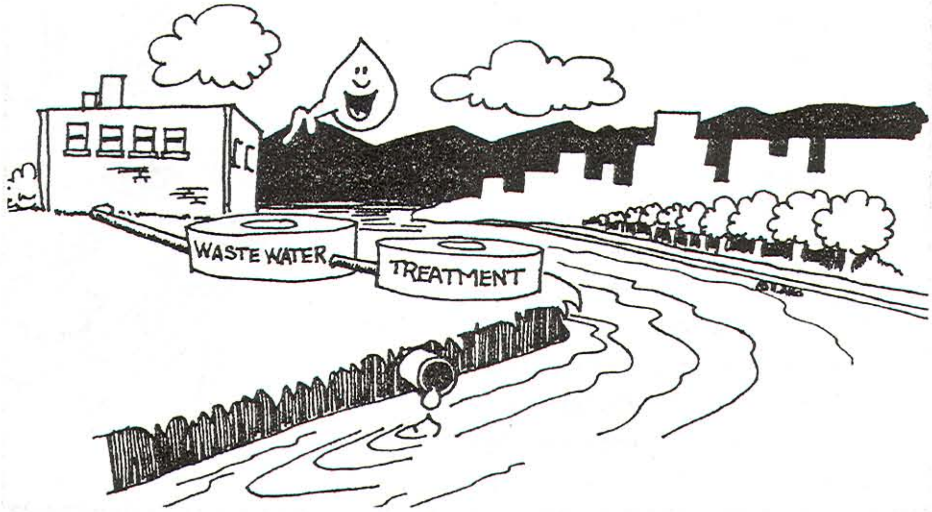
"Another treatment plant?," asked Martha.

"Another treatment plant," replied the drop, "but this one is called a wastewater treatment plant. A wastewater treatment plant is a place where dirty water that's flushed down drains and toilets gets cleaned up so that it's clean enough to go back into a nearby river, lake, stream, or ocean. Yep, my friend flowed into the wastewater treatment plant. He flowed from one big, flumongous tank to another getting cleaner and cleaner."

"Were there heaps and gobs of eency, beency, plump, jolly bacteria to help him get clean?," asked Martha.

"As a matter of fact, there were, Martha Merriweather, jillions and scillions and gadrillions of them. They were eating and digesting and eating and digesting...they ate so much," laughed Willy, "that after awhile they just sank to the bottom of the tank and took a nap."

"Took an nap?," giggled Martha.



"Yep," laughed the drop. "And, guess what they did next?"

"What?..What?," cackled Martha. "What did they do next?"

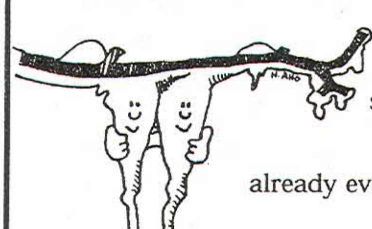
"They woke up and started eating and digesting all over again," roared the drop, swinging gleefully from the faucet. Martha was laughing gleefully too—she couldn't help it—although she wasn't sure which was funnier, the thought of jillions and scillions of plump and jolly bacteria having a giant feast or seeing a drop of water named Willy laughing himself silly.

"And what happened to your friend?" asked Martha, trying to calm her giggles down.

"Then," said the drop, trying to calm his giggles down, "then he splashed out of the treatment plant and into the Witchywatchy River. That's where I met him—in the Witchywatchy River. We spent one cold January as icicles on the bank of the Witchywatchy River."

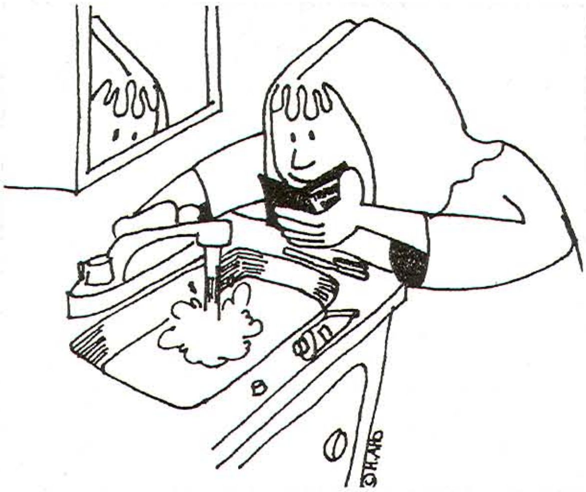
"Icicles?," shivered Martha. "Weren't you cold?"

"Nah," answered the drop. "We're water. Sometimes we float and flow as a liquid, sometimes we freeze into ice, and sometimes the heat makes us evaporate into the air as a vapor. It's fun-foodling Martha Merriweather...fun-foodling. But now," checking his waterproof watch, "I really must be moving on down the drain, and I think you must be brushing your teeth." He noticed a big, wet tear well up in Martha's eye and slide slowly down her face.



"Hey, hey, Martha Merriweather, I see a friend of mine sliding down your face—Tina Teardrop's her name. When I see Tina Teardrop I know somebody's sad. Are you sad?"

Martha felt her cheek for Tina Teardrop, but Tina had already evaporated into the air. "Must you go?," she asked. "I could



keep you with me in a special, special little jar..." But Martha knew that a jar would be a very bad place for a traveler and adventurer. "Will I ever see you again?," asked Martha.

"Of course you will," smiled Willy. "Whenever you turn on your faucet, or catch a snowflake in your hand, or see the frost on your windowpane, or watch the mist rise from your spaghetti water, or swim in a swimming pool, or watch a flower grow—I'll be there. I'm always here, Martha Merriweather. But if I were to become too dirty, even you wouldn't want to have me around. So make sure you let your friends and family know that we water drops need to stay clean—for the sake of all the people and animals and flowers and trees in the whole wide world. So, S.Y.L., Martha Merriweather."

"S.Y.L.?," puzzled Martha.

"See Ya Later," laughed Willy. "See Ya Later, Martha Merriweather," he waved and winked.

"S.Y.L., Willy Wetsworth," whispered Martha.

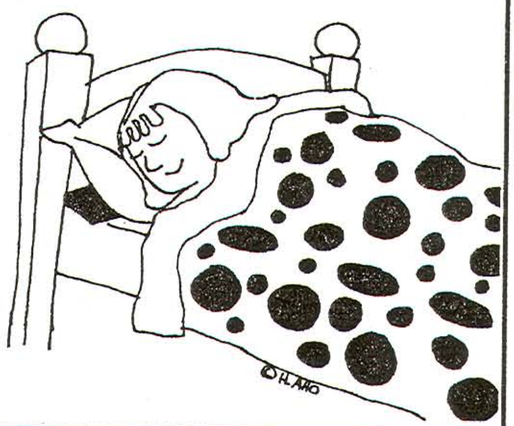
And, before her very eyes—right before her eyes—Willy got smaller and smaller until he was simply and purely a drop at the faucet. But, he'd left something behind. And what do you think it was?

He left his travel book with all the pictures of pipes and wells and ground water and ponds and lakes and oceans and glaciers and raindrops and snow flakes and...

Martha picked up the little book and opened it to the first page. And what do you think she saw?

She saw a little message. It said, "To my friend Martha Merriweather. From your friend, Willy Wetsworth." That's what it said.

As Martha brushed her teeth, she watched the foamy water wash down the drain, knowing that Willy was on his way to another adventure. She turned the water off, put her toothbrush away, and returned to bed. She crawled under her polka dot blanket, then she took the travel book and tucked it carefully under her pillow. It had been quite a night...a FUN-FOODLING NIGHT!



How Septic Systems Work

Goals: To have students understand how a septic system works. To help students realize how septic systems, if improperly cared for or placed in an unsuitable location can pollute groundwater.

Subjects: Science, Health, Home Economics

DPI Objectives: SC: A1-A3, D1, D2

EH: A1-A3, B1, B3, B4, C1, C3, C4

SS: A1, B1-B3, C1, C3

Grades: 6-9

Materials:

- 6 Steps to a Successful Septic Tank System overhead*
- The Septic Tank at Work overhead*
- How Septic Systems Work activity sheet
- for each group of 2-4 students:
  - one small (6-8 oz.) glass jar or beaker
  - one large (12 oz.) glass jar or beaker
  - sand
  - paper towel
  - potting soil
  - green food coloring
  - flexible straws
  - small pieces of white paper (e.g. holes from paper punch)

* masters provided

Background: Many rural homes use septic tank systems for disposal of wastewater from sinks, bathtubs and toilets. There are two parts to a septic system: a settling/storage container (septic tank) and a filtering area (soil absorption or leaching field). Both parts of this system are essential for proper wastewater disposal.

The main purpose of the settling tank is to protect the soil absorption field. Inside the settling tank, solids settle and form a sludge layer on the bottom and floating materials accumulate in a scum layer at the water surface. Clarified wastewater leaves the settling tank through a submerged outlet. The scum and sludge are left behind. This is important because scum and sludge can clog soil pores and cause the leach field to fail.

Bacteria in the septic tank helps to break down the scum and sludge that remains. Decomposition of these layers is slow, so scum and sludge gradually build up and must be removed periodically. Using kitchen garbage disposals increases the amount of solids in wastewater and speeds up sludge accumulation. (Composting vegetable matter instead of putting it down the garbage disposal keeps extra solids out of septic systems and also provides good fertilizer for flowerbeds and gardens.)

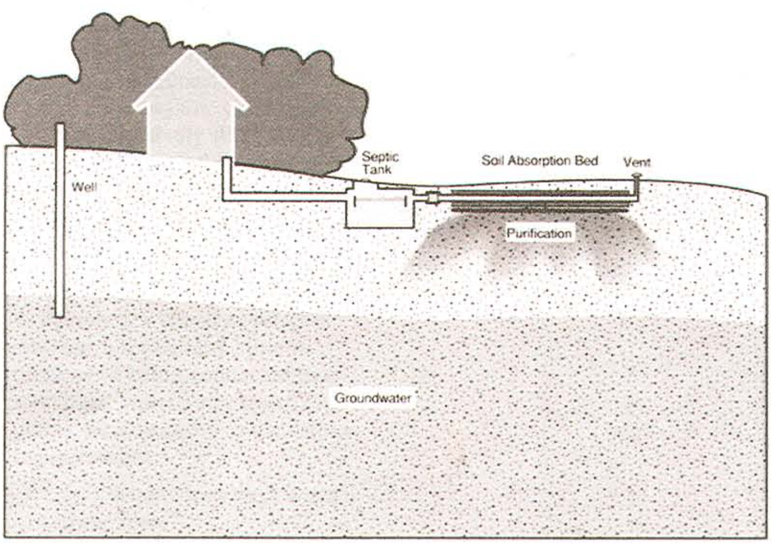
The soil absorption or leaching field does two things. It slowly disposes of wastewater below the surface of the ground, and it filters out harmful bacteria and many chemical contaminants before they reach groundwater.

Watertight pipes transport wastewater from the septic tank to the absorption field. In the absorption field, the water is divided among several trenches. Perforated, rigid plastic pipe or agricultural drain tile distributes the water throughout the trenches. A gravel bed below the distribution pipes temporarily stores the wastewater until it is absorbed by soil surrounding the trench.

Septic systems can pollute groundwater if the capacity of the surrounding soil to filter the wastewater is exceeded or if the underlying soils are very permeable, allowing contaminants to move rapidly to the water table before filtering is complete. Groundwater may also become contaminated if chemicals that are not decomposed by soil bacteria are dumped down sinks or toilets.

Adequate spacing of homes and proper planning, design, construction and maintenance of septic systems is the best insurance against groundwater contamination by household wastewater. Planners must consider the location of buildings, water supplies and soil characteristics. They must also decide how large a septic tank and absorption field is needed.

Proper maintenance of the system includes periodic pumping of sludge from the septic tank. Depending on the size of the tank and the number of persons in the household, cleaning may be needed as often as every two years or as seldom as every ten years, but tanks should be checked yearly.



Procedure:

A) Explanation.

1. Using the overheads, briefly discuss where wastewater goes in rural areas. Explain how a septic system works.

B) Investigation.

1. Work in small groups. Prepare a "wastewater" sample—water, sand, bits of paper and 2-3 drops of green food coloring.

2. Construct a model septic tank system:

a) Label small jar or beaker "septic tank."

b) Pour a well-stirred sample of wastewater into the septic tank until it is about 3/4 full.

c) Allow the sample to settle. Make observations.

d) Prepare a "leach field" as follows: Add alternating layers of sand and potting soil, separated by paper towels to the large jar or beaker. Wet the leach field.

e) Set the septic tank on a book or other riser. Place the leach field directly below the septic tank. Bend the flexible straw and fill it with water. Place fingers over both ends to keep the water in. After the wastewater has settled, connect the septic tank with the leach field as shown. Keep fingers over the ends of the straw until it is placed in the wastewater. This should create a siphon, allowing wastewater to flow onto the leach field. (It may be helpful to demonstrate this step for your students.) Observe the action of wastewater on the leach field.

3. Discuss your results:

- What settled to the bottom of the septic tank? What stayed on the surface?
- What was filtered out of the wastewater as it passed through the leach field? What was not? As in your septic system model, some components of wastewater (such as bacteria) are usually filtered out by soil. Other components (such as chloride, nitrates and volatile organic chemicals) are not effectively filtered and may be carried into groundwater.
- How did the green dye change as it passed through the leach field soil layers? Why?

4. Interview a friend or relative who has a septic tank system (instead of being connected to a municipal wastewater treatment plant). Find answers to the following questions:

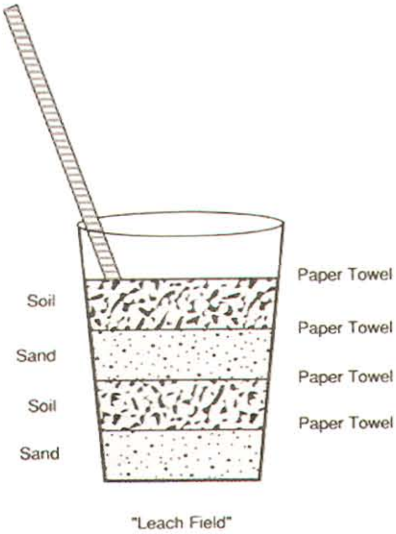
- Where does their water come from?
- If their water is from a private well, how far is the septic tank from their well?
- How far is the absorption field from their well?
- How far is their house from the septic tank?
- How far is their house from the leach field?
- Refer to the table on the worksheet. Is there anything closer to the septic tank or absorption field than the recommended minimum separation distance? If so, circle the unit and record next to the table how close it is.
- What is one other factor (besides separation distance) to consider when planning a septic system?

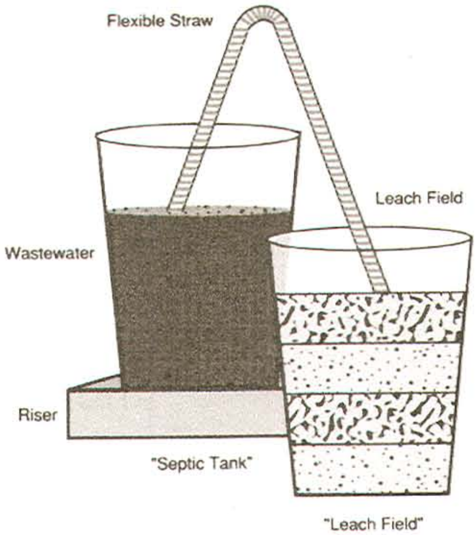
Students may find that many people don't know the answers to these questions. Should they? Why is this important? Discuss.

Going Beyond:

1. Investigate and compare different types of septic systems. Invite the county on-site waste disposal specialist to speak to your class. Ask him/her to bring diagrams of conventional and mound systems. Under what circumstances should a mound system be built? Are there other septic tank designs? When are they used?

Adapted from: ***Groundwater Resources and Educational Activities for Teaching****. 1989. Iowa Department of Natural Resources.*





How Septic Systems Work
activity sheet

Part A: Simulation

1. Prepare a "wastewater" sample—water, sand, small bits of paper and 2-3 drops of green food coloring.

2. Construct a model septic tank system:

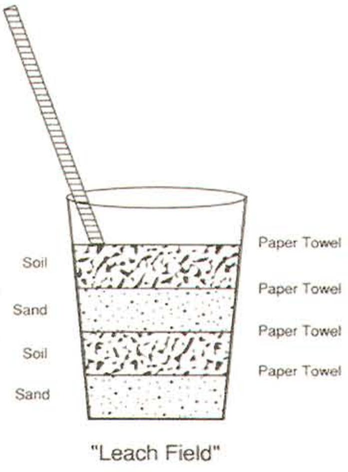
   a) Label small beaker or jar "septic tank."

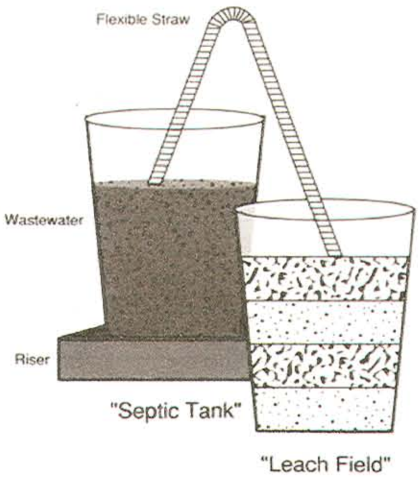
   b) Pour a well-stirred sample of wastewater into the septic tank until it is about 3/4 full.

   c) Allow sample to settle and observe. Record your observations.

   d) Prepare a "leach field" as follows: To large beaker or jar add alternating layers of sand and potting soil, separated by paper towels (as shown). Wet the "leach field" with water.

   e) Set the septic tank on a book or other riser. Place the leach field directly below the septic tank. Bend the flexible straw and fill it with water. Place fingers over both ends to keep the water in. After the wastewater has settled, connect the septic tank with the leach field as shown. Keep fingers over the ends of the straw until it is placed in the wastewater. This should create a siphon, allowing the wastewater to flow onto the leach field. (If wastewater doesn't flow through the siphon, try again!) Observe the action of wastewater on the leach field.





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Part B: Survey

Interview a friend or relative who has a septic tank system (instead of being connected to a municipal wastewater treatment plant). Find answers to the following questions:

1. Where does their water come from?

____

____

2. If their water is from a private well, how far is their septic tank from the well?

____

3. How far is the leach field from their well?

____

4. How far is their house from the septic tank?

____

5. How far is their house from the leach field?

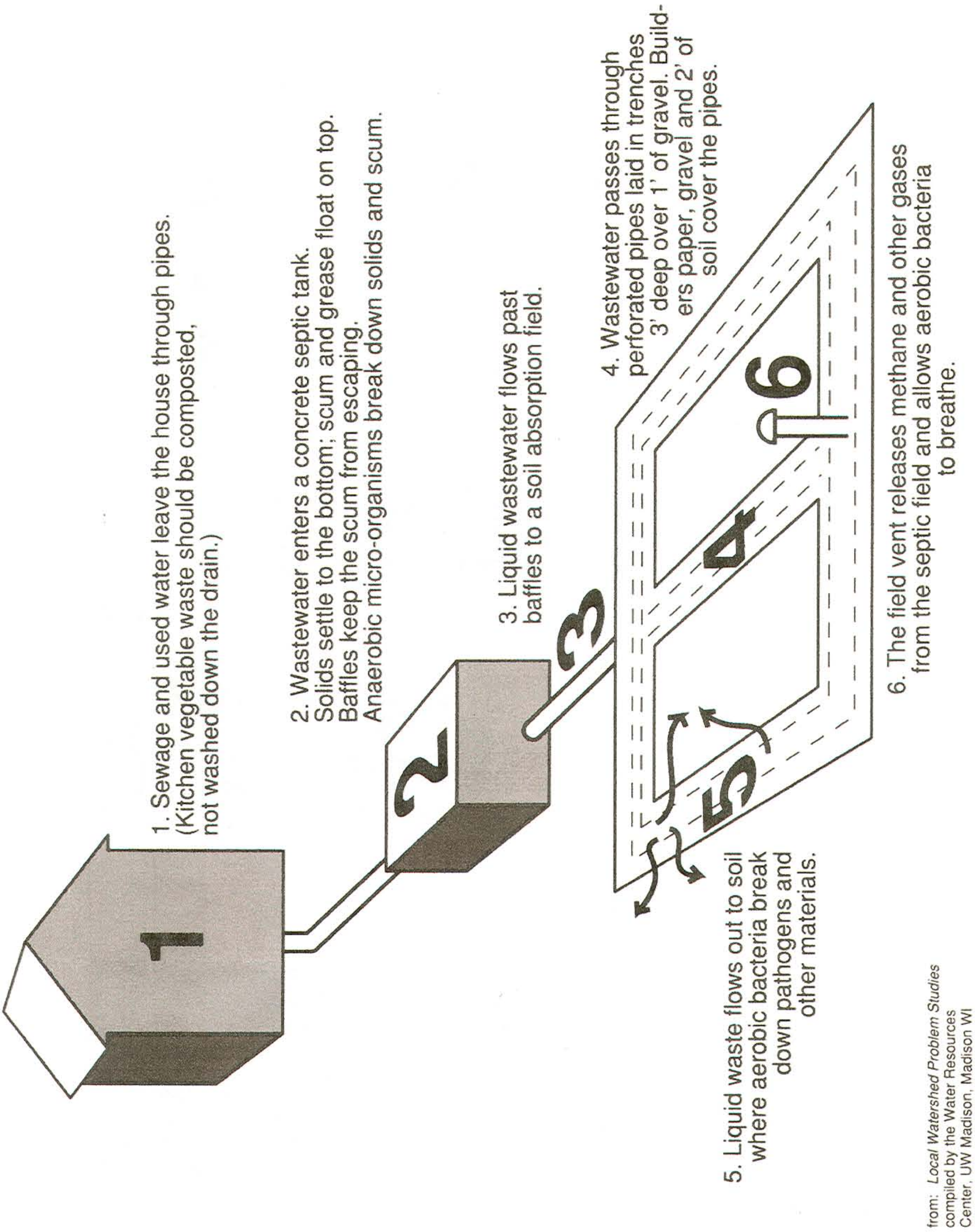
____

6. Refer to the table below. Is there anything closer to the septic tank or leach field than the recommended minimum separation distance? If so, circle the unit and record next to the table how close it is.

7. What is one other factor (besides separation distance) to consider when planning a septic system?

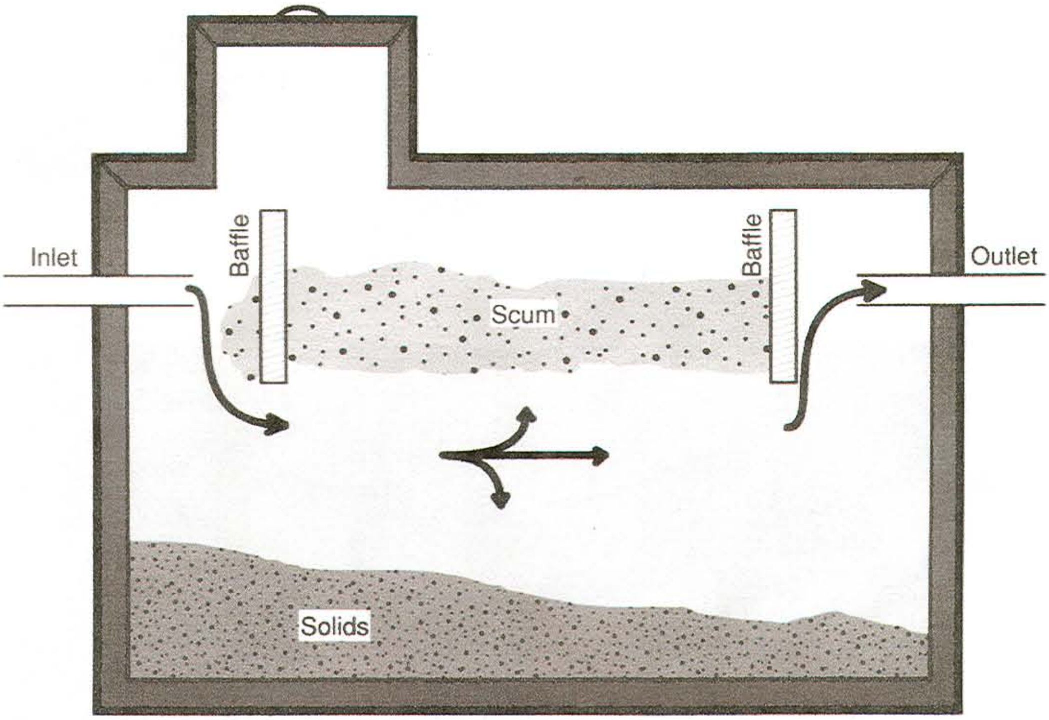
____

Unit	Septic Tank	Absorption Field
Private well	50	100
Public well	200	400
Lake or reservoir	50	100
Stream or ditch	25	25
House or other building	10	10

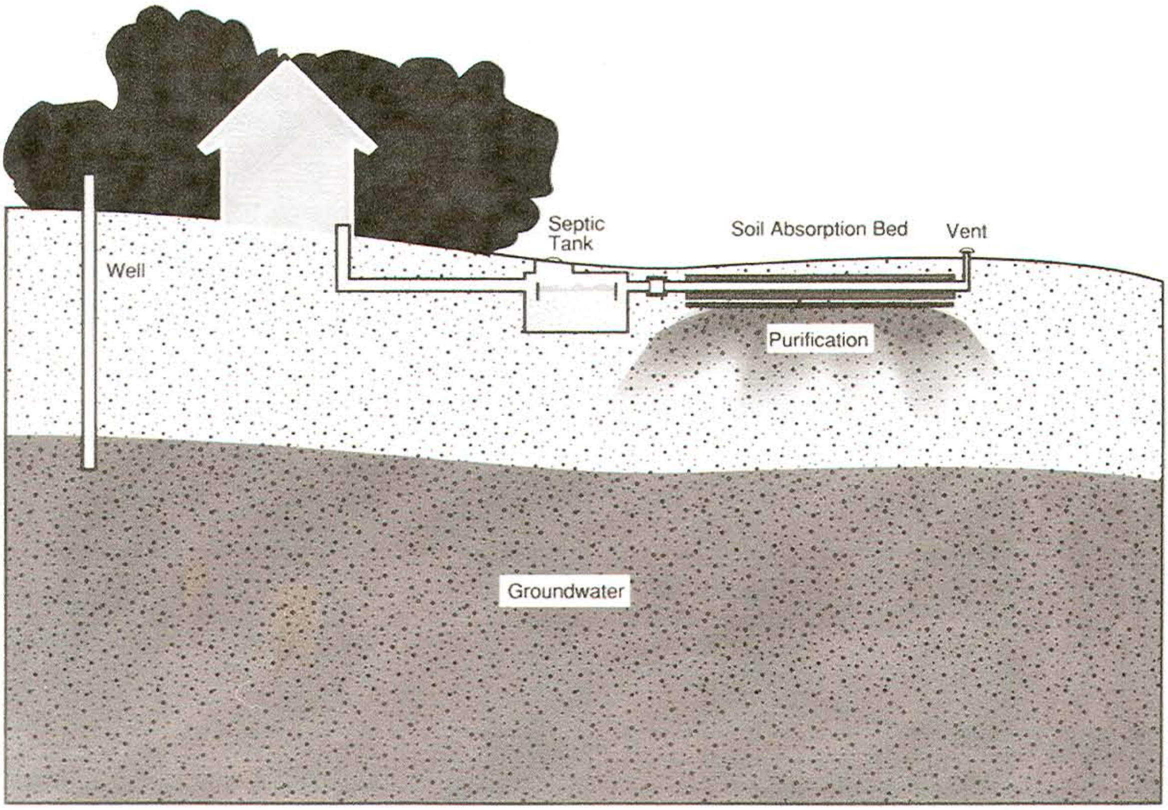


Overhead Master

The Septic Tank at Work



Filtering bacteria

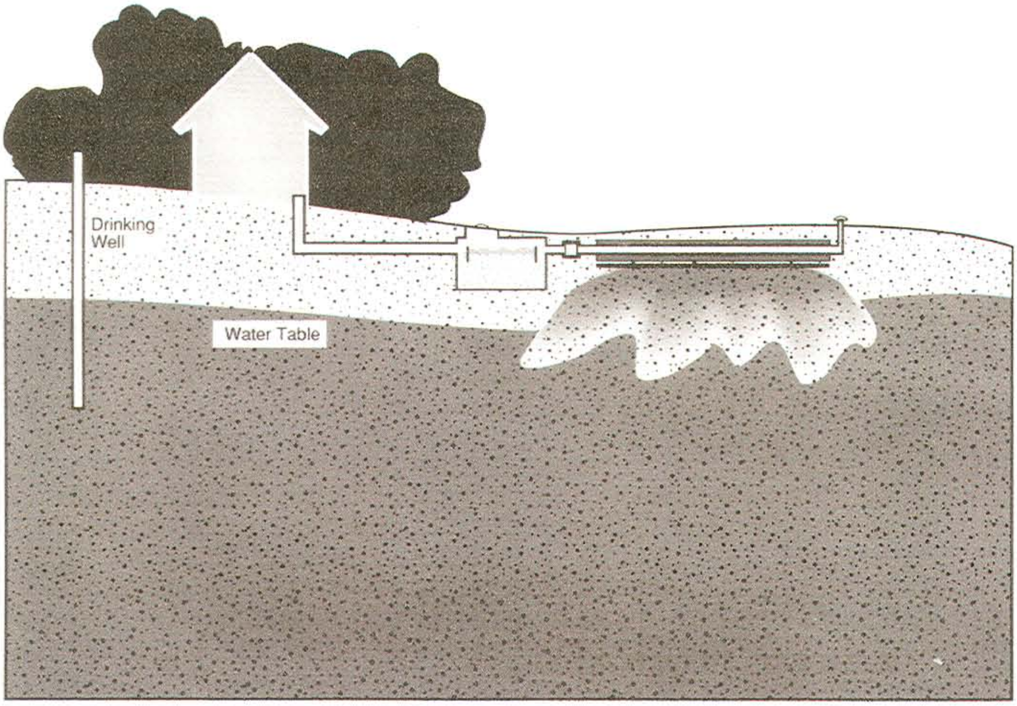


Overhead Master

7-4

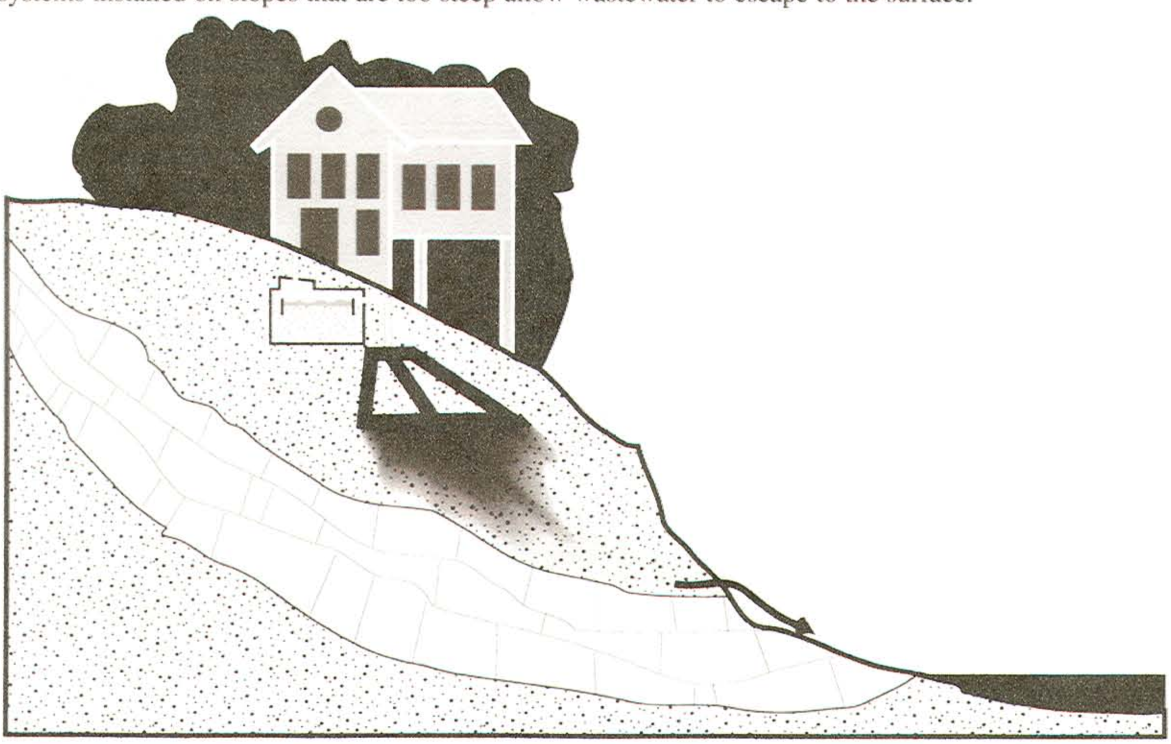
Saturated soil

Saturated soil conditions may allow wastewater to reach the surface or to contaminate groundwater.



Septic system on a slope

Septic systems installed on slopes that are too steep allow wastewater to escape to the surface.

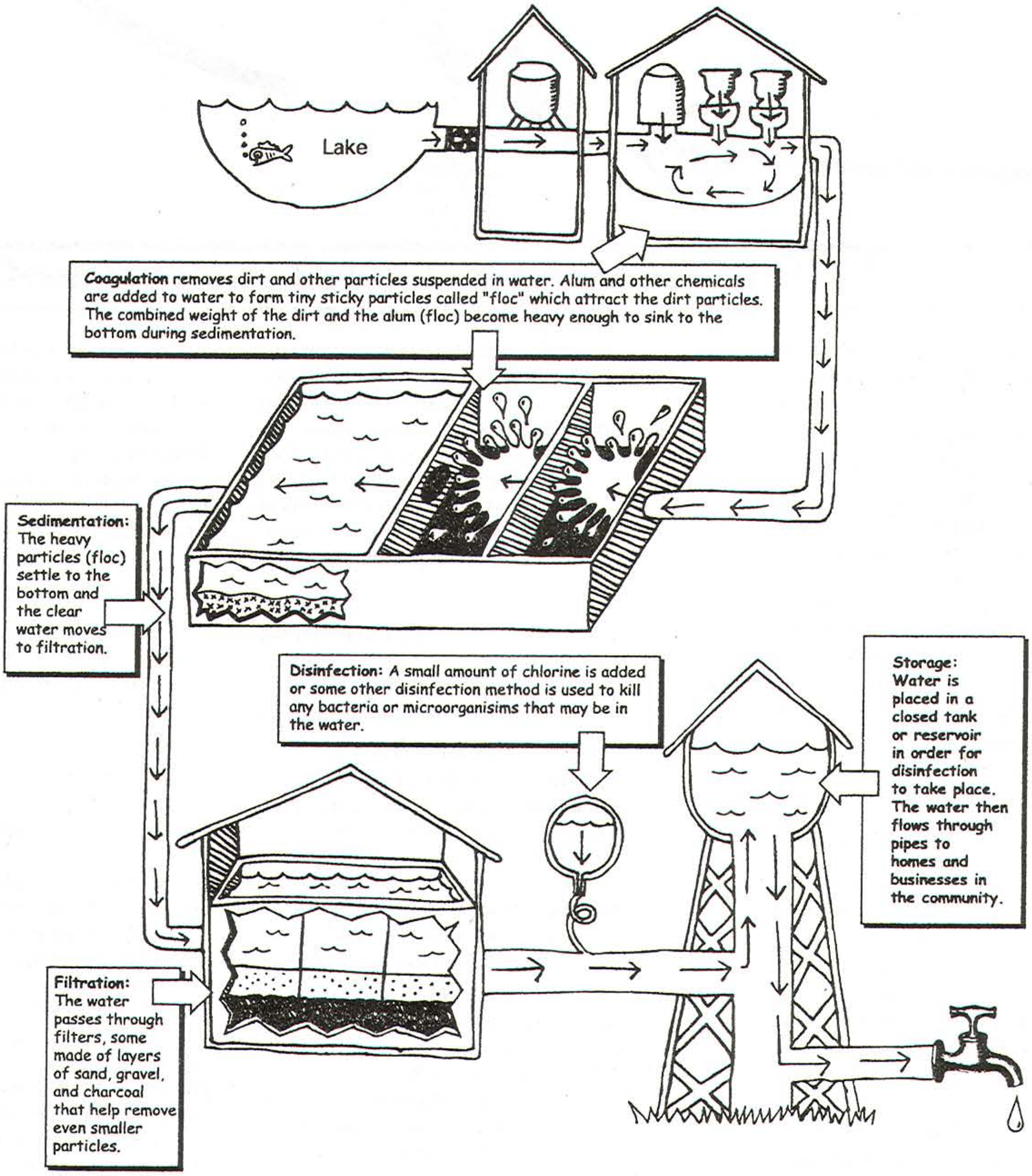


Overhead Master

7-5

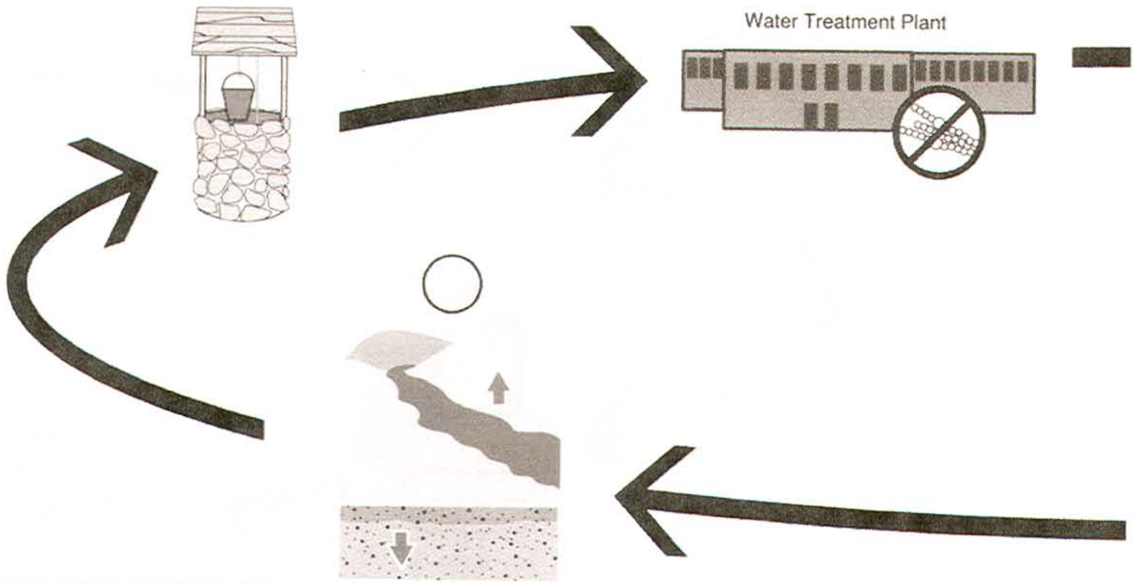
Blue Thumb Water Treatment Plant

Follow a drop of water from the source through the treatment process. Water may be treated differently in different communities depending on the quality of the water which enters the plant. Groundwater is located underground and typically requires less treatment than water from lakes, rivers, and streams.



Content Objectives:
3. Groundwater, filtration
4. Pollution, sewage, polluted water

Household Water



Where Does it Come From?...Where Does it Go?

Goals: To help students become aware of where their community's water comes from, how it is obtained and how it is treated before use by investigating the operation of a local water treatment facility. To help students understand where wastewater goes and how it must be treated by visiting a local wastewater treatment facility.

Subjects: Science, Health, Home Economics

DPI Objectives: SC: D1-D4

EH: A2, A3, B1-B4, C1-C4, C6

SS: B1-B3

Grades: 6-9

Materials:

- pencils and paper

Background: Have you ever wondered where the water comes from when you turn on your tap or where it goes after it drains from your bathtub? Water for most urban and suburban areas in Wisconsin comes from city or town wells that tap an underlying aquifer. *Groundwater* from these wells passes through a water treatment facility on the way to our homes and through a wastewater treatment facility after draining from our sinks, bathtubs and toilets.

The following field trips (or guest speakers) can help students understand the workings of these facilities and encourage them to think about where their water comes from, how it is changed as it passes through their homes and how it must be treated before it is allowed to return to the groundwater supply.

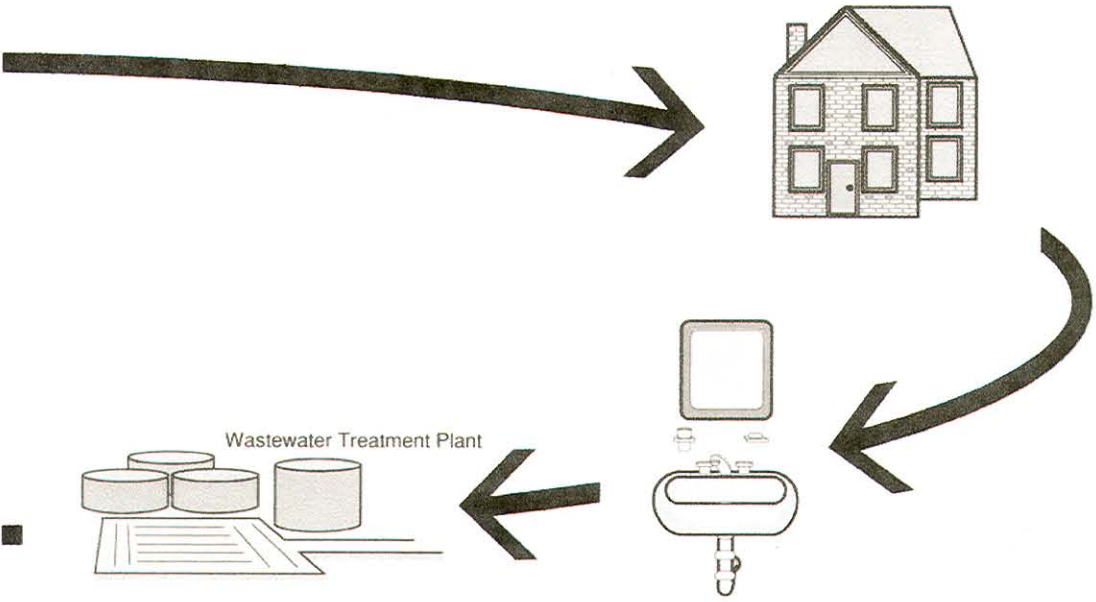
Procedure:

A) Investigate a water treatment facility.

1. Contact your municipal water treatment facility and obtain permission to visit it. Arrange with the manager or other resource person to guide your trip and be available to answer questions. If a field trip is not possible, arrange for a water treatment specialist to speak to your class.

2. Before visiting the water treatment plant or having a guest speaker, develop a list of questions you would like answered. Send the list to the guide or guest speaker in advance so he/she can prepare responses. Questions to consider include:

- From what aquifer(s) does your school or municipality get its water?
- What is the extent (area), boundaries and depth of the aquifer?
- What geological materials make up the aquifer?
- How many wells does your school or community use? Where are they ? How deep are they? How much water can they pump per minute/hour/day? When were they installed?
- What is a "cone of depression?" What is the extent of the cone of depression surrounding the well(s)? How does the cone of depression affect groundwater movement in the area?
- What time of the day, year, does the system pump the most water? Why?
- What is the natural chemical composition of the water before it is treated? How does the natural chemical composition compare with other wells around the state?
- How is water transported from the treatment plant to homes and businesses?
- Does the municipality have an adequate water supply for future needs?



❖ Are there any present or potential sources of contamination to the well(s)?

❖ What does the treatment plant do to insure that the water is safe to drink? What treatment methods are used?

❖ Is your community planning to drill new wells in the near future? If so, how much will it cost? Who will pay?

❖ How are local households charged for the water they use? (Do all local homes have water meters?)

❖ Does the price per gallon of water increase, decrease or stay the same as the amount used goes up? Does this pricing system encourage conservation?

❖ Does your community encourage water conservation in any other way?

3. Ask students to draw a diagram of a water treatment plant (including wells and aquifers) and describe how the facility works.

B) Investigate a wastewater treatment facility.

1. Arrange field trip or guest speaker as outlined in part A.

2. Prepare and send a list of questions you would like answered to the field trip guide or guest speaker so he/she can prepare responses. Questions to consider include:

❖ What household water passes through a wastewater treatment plant?

❖ Are all the homes in the community connected to a wastewater treatment facility?

❖ How does a wastewater treatment facility work?

❖ What is "grey-water?"

❖ What is "sludge?" Is it solid or hazardous waste? Why?

❖ What is done with sludge from the treatment plant?

❖ How much wastewater is processed each day?

❖ What training does the operator have?

❖ What happened to wastewater before the treatment plant was built?

❖ How might wastewater affect groundwater?

❖ What household materials should not be washed down the drain? Why?

❖ Can household chemicals affect bacteria at the wastewater treatment facility?

❖ How might sludge affect groundwater?

❖ What is the difference between a septic system and a wastewater treatment plant?

❖ How might a septic system affect groundwater?

3. Ask students to draw a diagram of a wastewater treatment plant and describe how the facility works.

Adapted from: ***Groundwater Study Guide****. 1984. Wisconsin Department of Natural Resources, Bureau of Information and Education.*

A Plume of Contamination

Goals: To have students understand how contaminants can enter and move with groundwater and what is meant by "plume of contamination." To help students realize why it is often difficult to determine the source of groundwater contamination.

Subjects: Science, Health, Home Economics, Environmental Science

DPI Objectives: SC: A1-A3, B3

EH: B4, C4

Grades: 6-9

Materials:

- A Plume of Contamination activity sheet
- clear plastic shoe boxes* or large plastic deli boxes—one for demonstration and one for each group of 3-4 students.
- sand
- powdered grape drink mix (do not add water)
- powdered lemonade mix (do not add water)
- for each group of 3-4 students:
  - watering cans or spray bottles
  - plastic straw, cut in half
  - pH paper
  - tape
- plastic shoe box lids or pencil erasers for props

* available at discount stores

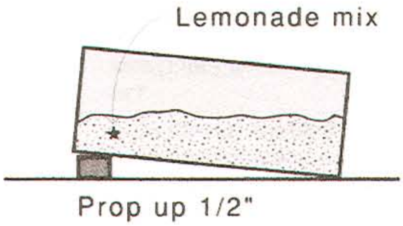
Background: Contaminants on the surface of the ground can move slowly through soils and reach groundwater. Contaminants spread outward from the point of origin, forming a plume which "points" to the source of contamination. A small amount of some contaminants can ruin a large quantity of groundwater.

Some chemical contaminants are easily detected by changes in color, odor, or taste of groundwater. However, most contaminants are "invisible" and require chemical testing for detection. Testing of many wells in an area may be required to determine the source of contamination.

Procedure:

A) Preparation.

1. Before class, fill one clear plastic shoe box for each group of 3-4 students with 1 inch of sand. Wet the sand with water and smooth off the surface. Station boxes around classroom.



2. Prop up one end of each box about 1/2 inch.

3. Make a small depression in the sand and add 1/2 teaspoon of dry lemonade mix at the elevated end. Cover the lemonade with sand. Vary the location of the lemonade contaminant in each box and keep a record of the contaminant location. After the demonstration, students will use pH paper to find the source of contamination.

B) Demonstration.

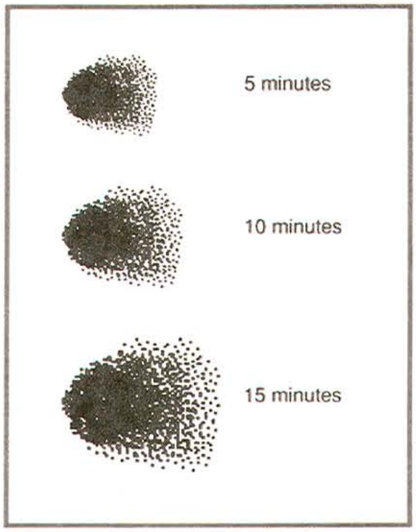
1. Prepare a plastic box as above, but don't add lemonade.

2. Make a small depression on the elevated side of the box. Place about 1/4 teaspoon of powdered grape drink mix in the depression. This represents a chemical contaminant.

3. "Rain" water on the contaminant, using the spray bottle or watering can. The "rain" should be light so the food coloring is diluted and seeps into the sand rather than running off the surface. If sand erodes badly, try again, using lighter "rain" or spread a layer of pea gravel on top to hold the sand in place.

4. Every 2-3 minutes check the bottom of the box for evidence of color. After about five minutes, a plume of color should begin to appear. Draw the shape of this plume, to scale, on the chalkboard.

5. Check the size and shape of the plume after 1/2 hour and draw the new plume, to scale, on the chalkboard. Discuss the results. The plume should be broad and fanlike, pointing to the source of contamination. Notice that the red and blue dye components of the grape drink mix separate. Why do you think this happens?



C) Investigation.

1. Tell students they will now have to use a chemical test to find the source of an invisible contaminant. Point out the boxes in which you've placed the lemonade mix. Explain that a lemonade "contaminant" has been put in a different location in each box and they will be using pH paper to find the plume of contamination. Lemonade is acidic and will lower the pH of water it encounters. It may be helpful to review the meaning of pH and the use of pH paper. Remind students that as acidity increases, pH decreases.

2. Work in small groups at the lemonade contaminant stations.

3. Lay a 6 inch strip of pH paper on a dry desk or counter. You may need to secure the paper to the desk or counter by placing a piece of tape at each end. Put a small drop of water on one end of the pH paper, note the color and record the

pH of the water on your activity sheet.

4. With a watering can, "rain" lightly on the upper end of each box so there's no runoff. Keep watering lightly for about 5 minutes. Wait 15 to 20 minutes.

5. Using a piece of plastic straw, remove a plug of sand (and water) from one of the locations indicated on the activity sheet diagram. Drop the wet sand on the pH paper. Note the color of the pH paper and determine the pH of the sample. If the sample is more acidic (has a lower pH) than tap water, place a "+" on that location on your activity sheet. If the acidity is the same or lower (pH same or higher), place a "-" at that location on your activity sheet. Rinse the straw.

7. Take a total of 12 "test well" samples from the locations shown on the diagram, rinsing the straw after each sample. Determine the pH of each sample and record a "+" or "-" on your activity sheet at each location.

8. Complete the activity sheet and discuss your results.

- ❖ What makes a contaminant move from where it is buried?
- ❖ What is a "plume of contamination?"
- ❖ What are some real contaminants that could be seen, smelled or tasted if they got into groundwater?
- ❖ What are some real contaminants that could not be seen if they got into groundwater?
- ❖ In the real world, what factors underground might influence the movement of contaminants?

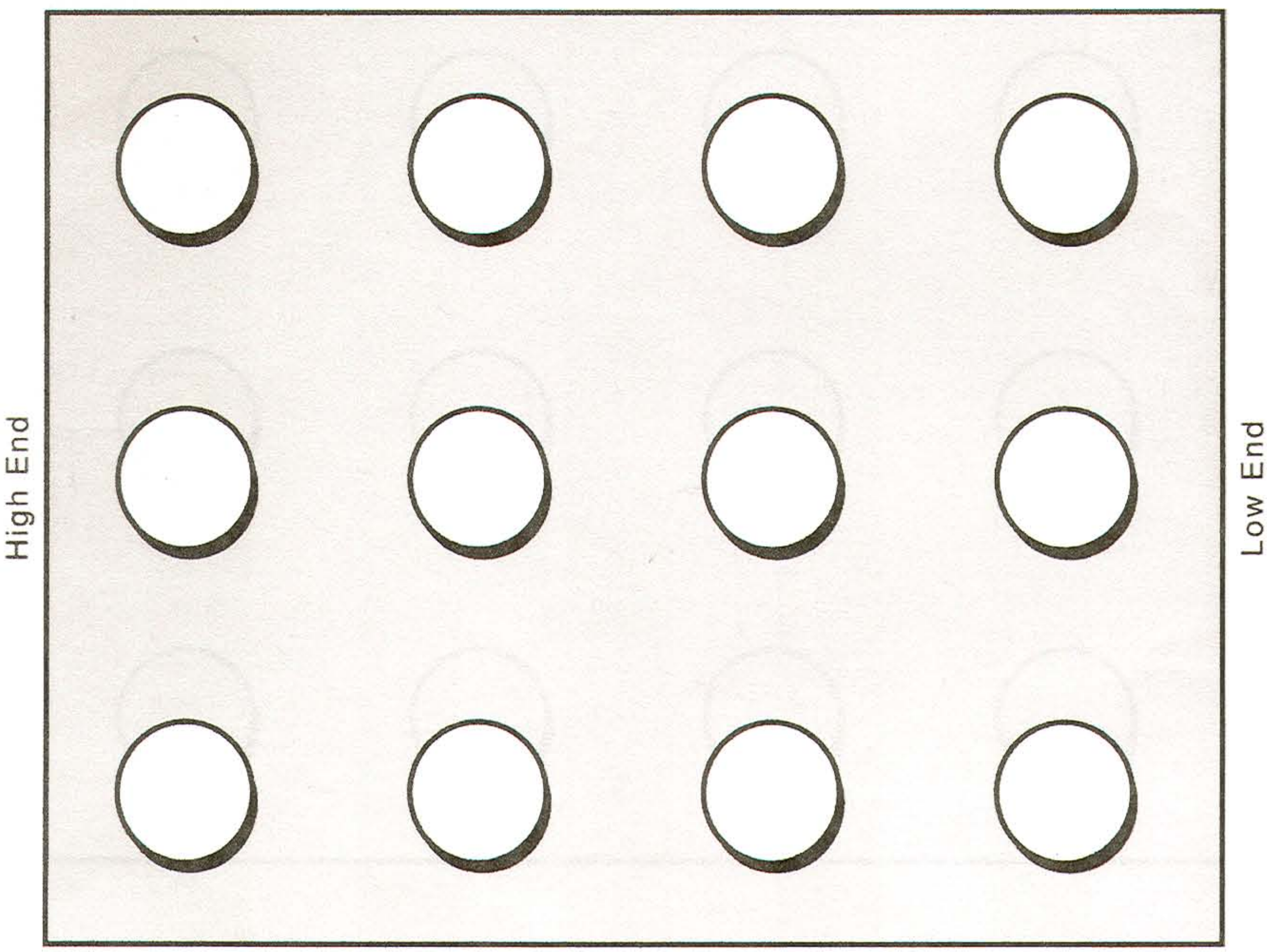
Going beyond:

1. Research and report on the types and effects of groundwater contamination from various sources in your area (e.g. private homes, schools, farms, landfills, gasoline stations, mine sites, septic tanks, industries, businesses, salt stockpiles, etc.).

2. Research and report on the effects contaminated groundwater may have on human health. Have a physician or public health official visit and discuss the topic.

3. Investigate bottled drinking water. Where does it come from? How much does it cost? What does the company do to insure that it is safe for human consumption? What regulations govern the quality of bottled water?

Adapted from: ***Groundwater Quality Protection in Oakland County****. 1984. The East Michigan Environmental Action Council.*



A Plume of Contamination activity sheet

Instructions:

1. Using pH paper, determine the pH of tap water.

pH of tap water ___________

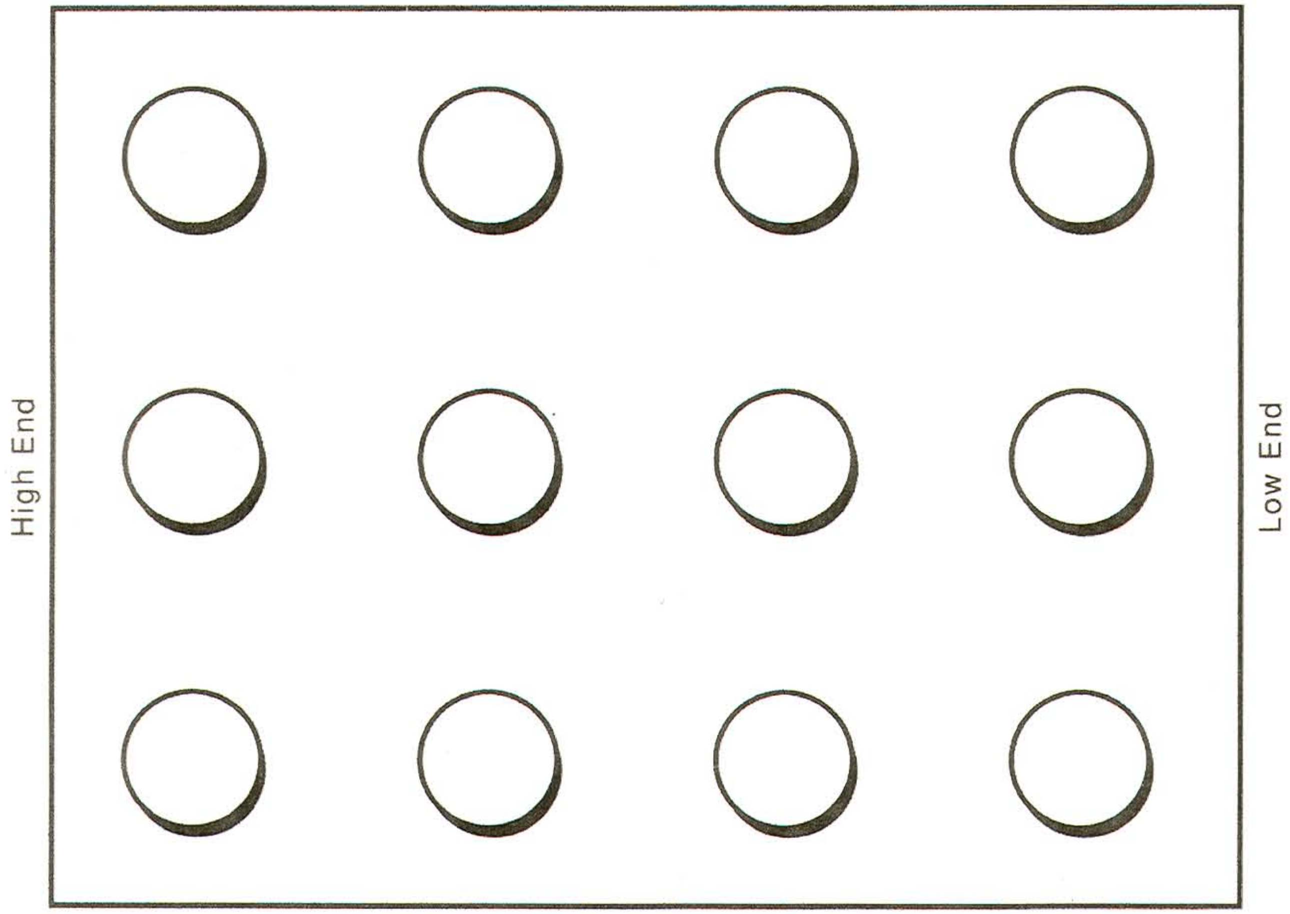
2. Take a sample of sand and "groundwater" from each test well location indicated. Test the groundwater at each location for contamination by placing the sand sample on a strip of pH paper. Rinse the straw after each sample.

3. Record your results for each location on the table below:

+ = contamination found (pH of sample < water)

- = no contamination (pH of sample = water)

Record the results directly on each test well location.



4. Based on the results of your tests, sketch the shape of the plume of contamination.

5. Are there enough "test wells" to determine the source of contamination? ______________________

6. If you were to select three additional "test well" locations, where would they be? Indicate your proposed locations with the letter "T" on the activity sheet.

7. Rinse the straws with tap water and test the groundwater at each new test well location. Record your results. If the results show contamination, mark the well with a T+. If the results show no contamination, label the well T-.

8. Are more test wells needed to show the extent of the plume of contamination? ______________________