How Septic Systems Work

Learning Objectives: Students will: (1) construct a model of a septic system, (2) examine and describe how the components of a septic system work and (3) discuss the location of a septic system as a potential threat to groundwater and surface water with someone who has a septic system.

Subjects: Environmental Education, Science, Health Education and Social Studies

WMASs: EE: A.8.3, A.8.5

SC: A.8.6

HE: A.8.2

SS: A.8.10, D.8.11

Grades: 6–9

Materials:

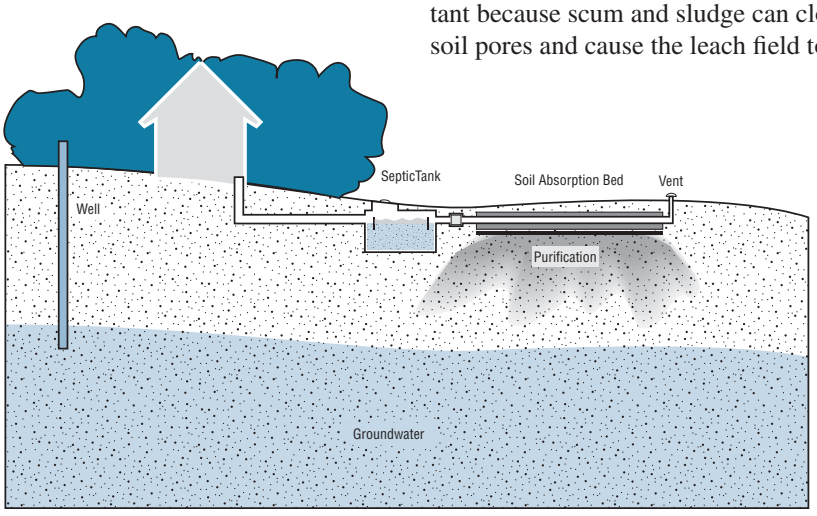
- How Septic Systems Work activity sheet
- 6 Steps to a Successful Septic Tank System overhead*
- The Septic Tank at Work overheads*
- for each group of 2–4 students:
  - one small (6–8 oz. (ounce)) glass jar or beaker
  - one large (12 oz.) glass jar or beaker
  - sand
  - paper towel
  - potting soil
  - 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. Septic systems are a type of onsite wastewater treatment device used to treat domestic wastes where there is no public wastewater treatment system available. The Wisconsin Department of Commerce uses the term "private onsite wastewater treatment system" (or POWTS) to identify these systems. The Department of Commerce allows a number of different designs for new or replacement installation. This exercise focuses on septic systems since the vast majority of onsite wastewater treatment systems in use today are septic systems.

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 10 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 ¾ 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. Using part B of the worksheet, 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:

Investigate and compare different types of onsite wastewater treatment systems. Visit **wra.org/pdf/government/landuse/onsite_system_descriptions.pdf** for a copy of General Descriptions of Common Types of Onsite Sewage Systems. Invite the county onsite waste disposal specialist to speak to your class. Ask him/her to bring diagrams of conventional and mound septic systems. Under what circumstances should a mound system be built? Are there other onsite wastewater treatment system designs? When are they used?

Adapted from: *GREAT: Groundwater Resources and Educational Activities for Teaching,* 1989, Iowa Department of Natural Resources, Wallace Building, Des Moines, IA 50319.