

# SOIL and WATER SCIENCE





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Words that are defined in the glossary are in bold the first time they appear in the text.

Additional resources are available from Purdue Extension's Education Store, [www.edustore.purdue.edu](http://www.edustore.purdue.edu).

Support documents are attached to activities and designated by 



## How is your water treated if you live in the country?


### INTRODUCTION

Water is a critical natural resource. It is one of four essential needs, along with air, food, and shelter, and is necessary for life. Think of all the ways you use water in your home. Most businesses and industries depend on water to create products; agriculture depends on water for crops; and people enjoy water for recreation and its beauty.

When water is used, it often picks up **contaminants** that must be removed before it can be used again or returned to **surface water** and **groundwater** supplies so that these water sources remain clean and healthy. Wastewater is mainly treated in two ways. In most cities and towns, municipal water treatment plants treat wastewater from homes, businesses, and sewer systems. Most people who live in the country have private wastewater treatment systems called septic systems.

This activity will help you understand how an onsite (rural) wastewater treatment system works. The Municipal Wastewater Treatment activity will help you understand how a municipal (city) wastewater system works.

### TOOL KIT

- Pencil or pen
- Onsite Wastewater Treatment worksheet
- Operating and Maintaining an Onsite Sewage System, ID-142-W 



- Complete the Onsite Water Treatment worksheet.
- Answer the questions on the worksheet.
- Discuss the Chat questions with your adult helper.

### LIFE SKILLS

- Acquiring knowledge
- Conserving natural resources
- Managing resources



**Share What Happened:** Describe the steps involved in onsite wastewater disposal.

**Apply:** List five onsite wastewater care rules.

**Generalize to Your Life:** Why is it important for everyone to understand wastewater disposal?



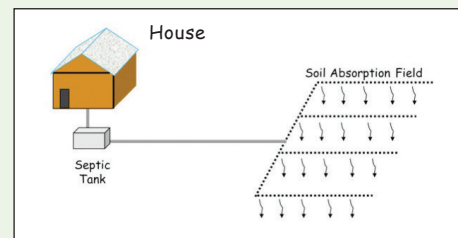
## ONSITE WASTEWATER TREATMENT WORKSHEET

People who live in the country are responsible for maintaining their own wastewater system. Because wastewater is treated and disposed of on the homeowner's property, these systems are called onsite wastewater disposal systems. Some people refer to them as septic systems, because the septic tank is an important component of the system. Nearly half the people in Indiana live in residences with septic systems. These onsite **sewage** systems can effectively treat sewage and protect you and the public from disease that human waste carries.

Onsite wastewater disposal systems work on the same principles as wastewater treatment facilities. Treatment involves three steps:

1. Separating the waste
2. Treating the waste with **anaerobic** and aerobic organisms
3. Disposing of the remaining products

The two main parts of an onsite wastewater disposal system are the septic tank, where **sludge** settles to the bottom, and the **absorption** field, where the liquids (**effluent**) are filtered through the soil. Pipes transport sewage from the house to the tank and the effluent from the tank to the absorption field. In a conventional onsite sewage system (Figure 1), sewage flows from the household into a watertight, underground septic tank. Sewage then flows from the septic tank to a distribution box (not shown) and then out to a soil absorption field for final treatment.



**FIGURE 1.**  
**Onsite Wastewater System**  
Source: Purdue University

### Questions

1. What are the three components of an onsite wastewater system?
2. Where does the wastewater that enters the septic tank come from?
3. Where does the wastewater go when it is in the absorption field?

## ONSITE WASTEWATER TREATMENT WORKSHEET continued

The septic tank (Figure 2) receives a wide range of waste from the building sewer. The waste in a typical septic tank includes pathogens, nutrients, and even heavy metals from makeup. In a properly functioning septic tank, the waste forms three distinct layers. Heavy solids settle to the bottom of the tank to form a sludge layer. Greases and fats float to the surface to form a scum layer. The middle and largest layer is liquid waste. Bacteria in the tank work to **decompose** the sewage.

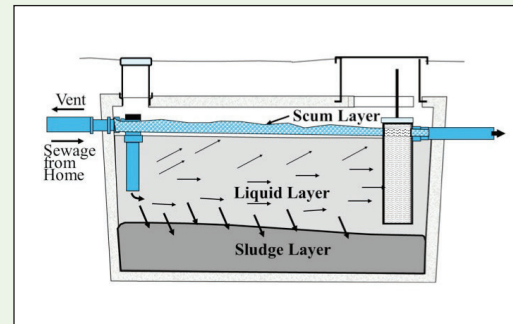
An inlet **baffle** to the septic tank (not shown) serves many important functions. First, the baffle slows the sewage as it enters the tank. If too much sewage enters, or it enters too fast, it will disturb the sludge and scum layers. An effluent filter on the outlet (right, in the figure) keeps the scum and sludge from leaving the septic tank. The effluent filter must be cleaned regularly so it does not become plugged.

If the sludge and scum layers are stirred up, some might exit the tank. This can plug up the absorption field, because scum and sludge might never degrade. An accumulation of scum and sludge can eventually cause the absorption field to fail.

The solids in both types of treatments must be removed, usually every three to five years, by tanker trucks. The solids are often mixed with soil to add nutrients to farm fields.

An absorption field consists of a series of trenches that begin after the distribution box. Each trench contains a distribution pipe that must be laid level to distribute effluent uniformly. The pipe is embedded in coarse gravel or something similar. The effluent trickles out through holes in the pipe, down through the gravel, and into the soil. Organic matter in the effluent forms a **biomat** on the bottom and sides of the absorption trench. The biomat filters out the remaining solids and allows the effluent to pass into the soil. In cases where there can be too much **organic matter** in the sewage, adding a secondary treatment system might be necessary to reduce the organic content of the effluent before it is discharged to the absorption field.

A well-designed absorption field in the proper soil that is correctly constructed and maintained should function trouble-free for a long time. However, many good agricultural soils are not well suited to conventional onsite wastewater disposal systems. The sequence of treatment described above will not work well in soil with slow permeability or a high water table, so more complex designs might be required. These might include lowering a high **water table** with perimeter drains, using elevated systems such as sand mounds, using shallow drip irrigation, or connecting to an existing central sewer or cluster system. However, the principle of all of onsite sewage systems is roughly the same: keep effluent in the septic tank for at least two days for anaerobic treatment, and make the effluent pass through at least 24 inches of **aerated** soil for final treatment. Water conservation methods that minimize the amount of water that must be treated can reduce problems and will help extend the life of any onsite system.



**FIGURE 2. Onsite Wastewater System**  
Source: Purdue University

## ONSITE WASTEWATER TREATMENT WORKSHEET *continued*

### Questions

4. What are the three layers in a septic tank?

5. Where do the liquids go when they leave the septic tank?

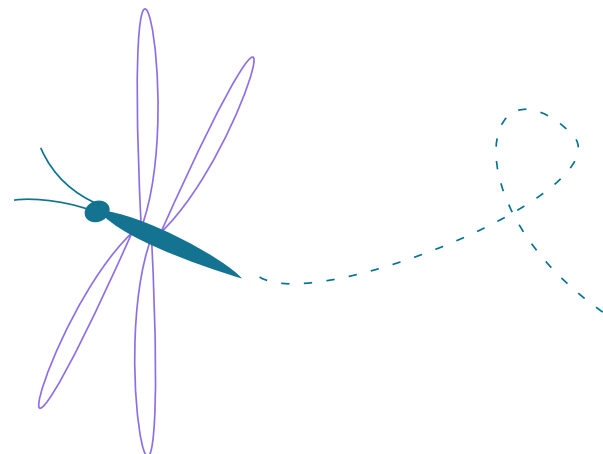
6. Figure 2 shows a filter near the outlet (right) side of the septic tank. What do you think the purpose of the filter is?

### Onsite wastewater system installation

Installing an onsite wastewater system requires five things:

- Accurate information about the soils on the site
- A proper design based on the soils information
- Construction that accurately follows the design plans
- Installation under favorable weather conditions
- Ongoing care and maintenance after installation

If one of these key components is missing, the system will likely fail before it should. The soils that support the absorption system are important. They determine the type of system that is installed — even if a conventional onsite wastewater system can be installed at all!



## ONSITE WASTEWATER TREATMENT WORKSHEET *continued*

### Onsite wastewater care and maintenance

A lack of ongoing care and maintenance is often the culprit in onsite wastewater system failures, so understanding some basic principles is important. Sewage that backs up in drains or in a seeping, smelly area of the yard is not just unpleasant; it could be a health hazard. People who have an onsite system should always conserve water, control what goes into the system, protect the absorption field, and perform regular inspections and maintenance.

### Questions

Answer or guess the answers to the following questions. Then, read *Operating and Maintaining an Onsite Sewage System (ID-142-W)* to check your answers.

7. List the five factors that are key to installing a new onsite wastewater disposal system.

8. How can you conserve water to protect your onsite wastewater disposal system?

9. What types of things should not be poured down the drain?

10. How can you protect the absorption field?

11. How often should onsite wastewater disposal system owners inspect their system?

