

# Riparian areas

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*"Most people camp too close to the creek to make good coffee."*

— Rube Long

The physical, chemical, and biological makeup of a stream relates to the surrounding physical features of the watershed and its geologic origin. Looking at these features helps us understand stream-watershed relationships and allows managers to predict the effects of human influences on different streams.

Think of the uplands of a watershed as the sides of a funnel, and the stream flowing from the mouth of the funnel. The **riparian area** is the sides of the spout surrounding the stream. The riparian area is the green zone of plants along the stream. Water, nutrients, and sediments from across the uplands move downhill to support this lush and productive area.

Streams and riparian areas develop together, each affecting the development of the other. Headwater streams are small, and the riparian areas that surround them are relatively narrow. Larger streams and rivers flood more often, and floodwaters carve out wide **floodplains**. The plant communities that develop along the edge of the stream are generally distinct from those that cover the broader, and somewhat drier floodplains.

Plants along the stream influence the entire stream ecosystem. Riparian areas (Figure 6) have several unique properties. A riparian area is linear, has a water transport

channel and floodplain, and is connected to upstream and downstream ecosystems.

Riparian habitat is a combination of three areas. Each is distinctive and contributes to the entire ecosystem.

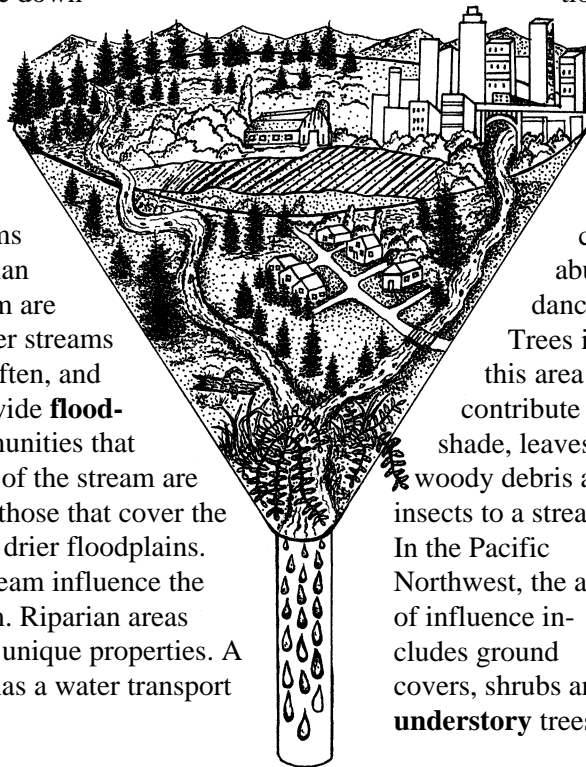
**Aquatic area:** The aquatic area of streams, lakes and wetlands is generally wet. During dry periods, aquatic areas have little or no water flow. Any side channels or oxbows containing freshwater ponds are included in this area.

**Riparian area:** The riparian area is a terrestrial zone where annual and intermittent water, a high water table, and wet soils influence vegetation and microclimate.

**Area of influence:** This is a transition area between a riparian area and upland cover. An area of influence has soil moisture and is characterized by a noticeable change in plant composition and

abundance.

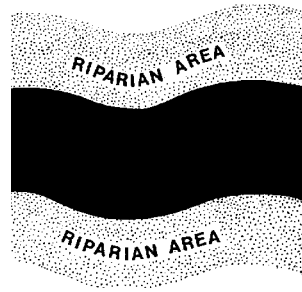
Trees in this area contribute shade, leaves, woody debris and insects to a stream. In the Pacific Northwest, the area of influence includes ground covers, shrubs and **understory trees**



## Vocabulary

aquatic area  
aquifer  
area of influence  
edge effect  
floodplains  
Oregon Forest  
Practices Act  
riparian area  
riparian management areas  
understory

(usually deciduous) on the floodplains, and canopy trees (usually coniferous) on hillsides. This stair-stepping of vegetation provides a variety of wildlife habitat.



Stream food chains depend on organic debris for nutrients. In small headwater streams, 99% of the energy for organisms comes from the vegetation along the stream, and only 1% from photosynthesis. The leaves, needles, cones, twigs, wood, and bark dropped into a stream are a storehouse of readily available organic material that is processed by aquatic organisms and returned to the system as nutrients and energy.

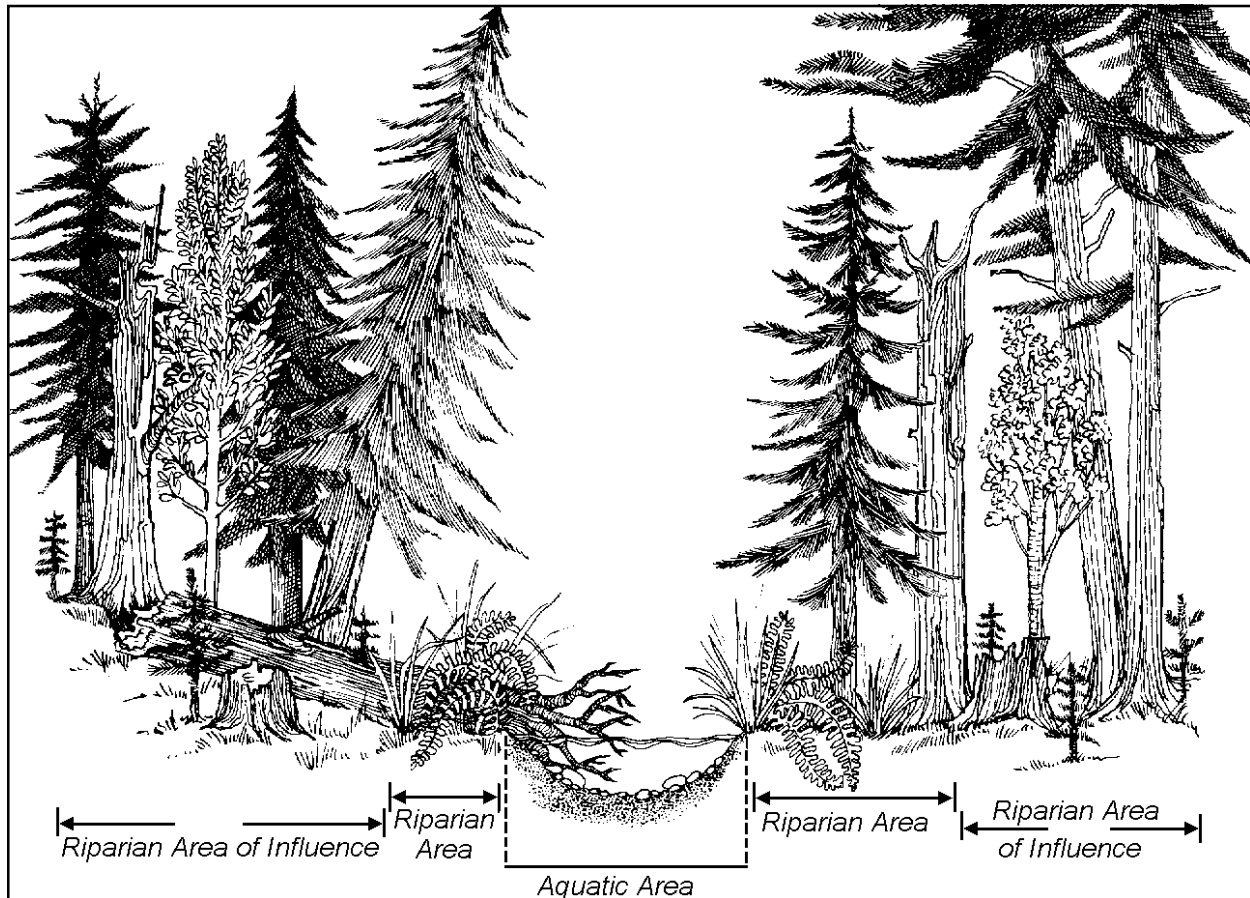
A diverse population of insects depends on this varied food base. Between 60% and 70% of the debris is retained and processed in the headwaters by bacteria, fungi, insects, and abrasion, with very little leaving the system until it has been at least partially processed.

Riparian areas have a high number of edges (habitat transitions) within a very small area. The large number of plant and animal species found in these areas reflects habitat diversity. Since they follow streams, riparian areas are linear,

## Role of riparian vegetation

Riparian plant communities (Table 1) provide cover for aquatic and terrestrial animals. Shade created by the riparian vegetation moderates water and air temperatures. This vegetation limits water contamination, slows water velocities and filters and collects large amounts of sediment and debris. Uncontrolled sediments can kill fish and destroy spawning areas.

**Figure 6. Riparian Habitat**



increasing the amount and importance of **edge effect**. Extensive edge and resulting habitat diversity yield an abundance of food and support a greater diversity of wildlife than nearly any other terrestrial habitat.

## Floodplains

Floodplains are an important part of a riparian area. Floodplain vegetation that shades or directly contributes material to a stream is considered part of the riparian area.

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*Flooding is critical to the exchange of nutrients and energy between stream and riparian area.*

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Stream channels rely on natural flooding patterns. Frequency of flooding and groundwater supply are the major factors controlling the growth of floodplain trees. Floodplains and

backwaters act as reservoirs to hold surplus runoff until peak floods are past. This controls and reduces downstream flooding. Floodplains also spread the impact of a flood over a larger area as vegetation helps collect debris and sediment.

Composition of riparian plant communities depends on the water pattern (fast or slow moving or dry or wet periods). Both wet and dry phases are necessary in this area to complete the stream's nutrient cycle and food chain. Flooding is critical to the exchange of nutrients and energy between the stream and the riparian area.

When healthy, vegetated banks in the riparian area act as natural sponges. They help maintain soil structure, allow increased infiltration, and reduce bank erosion.

Vegetated streambanks also contribute to aquifer (groundwater) recharge. Precipitation is filtered through the riparian soils and enters underground reservoirs called **aquifers**. Good cover slows the flow and increases percolation into underground aquifers. Stored water is then available during drier periods to maintain and improve minimum flow levels. A major benefit of this aquifer recharge is maintenance of year-round streamflow.

**Table 1. Functions of Riparian Vegetation As They Relate to Aquatic Ecosystems**

<b>Riparian Vegetation</b>		
<b>Site</b>	<b>Component</b>	<b>Function</b>
Above ground- above channel	Canopy and stems	<ul style="list-style-type: none"> <li>• Shade—controls temperature and instream photosynthetic productivity</li> <li>• Source of large and fine plant detritus</li> <li>• Source of terrestrial insects</li> </ul>
In channel	Large debris derived from riparian vegetation	<ul style="list-style-type: none"> <li>• Control routing of water and sediment</li> <li>• Shape habitat—pools, riffles, cover</li> <li>• Substrate for biological activity</li> </ul>
Streambanks	Roots	<ul style="list-style-type: none"> <li>• Increase bank stability</li> <li>• Create overhanging banks—cover</li> </ul>
Floodplain	Streams and low-lying canopy	<ul style="list-style-type: none"> <li>• Retard movement of sediment, water and floated organic debris in flood flows.</li> </ul>

Source: William Meehan et al., *Influences of Riparian Vegetation on Aquatic Ecosystems With Particular References to Salmonid Fishes and Their Food Supply*, 1977, p. 137.

Riparian vegetation uses large amounts of water in transpiration. Often, vegetation needs the most water during the period of lowest streamflow. At these times, vegetation may actually reduce streamflow.

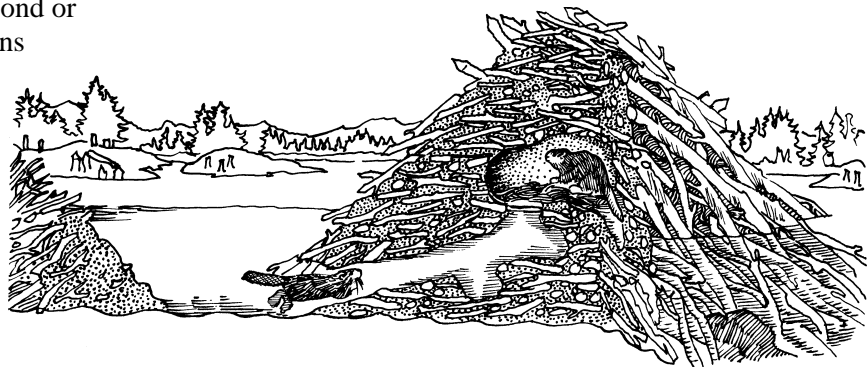
## Wildlife in riparian areas

Riparian ecosystems provide the essentials of wildlife habitat: food, water and cover. In general, the area within 200 yards of a stream is used most heavily by wildlife. In western Oregon, of 414 known species of wildlife, 359 use riparian ecosystems extensively and 29 species are tied exclusively to this area. While riparian areas cover less than 1% of the land in eastern Oregon, 280 of 379 species use this area extensively.

Riparian areas provide migration routes and corridors between habitats for many animals. Woody plant communities in the riparian area provide cover, roosting, nesting and feeding areas for birds; shelter and food for mammals; and increased humidity and shade (thermal cover) for all animals.

Birds are the most common and conspicuous form of wildlife in a riparian ecosystem. In this important breeding habitat, as many as 550 breeding pairs have been found per 100 acres. Bird density is just one indicator of the productivity of a riparian area.

Mammals of all sizes are found in riparian areas. Many rodents are parts of various food chains. Some, such as beaver, may modify riparian communities. The effects of beavers on a watershed can be both positive and negative. Their actions change watershed hydrology as well as damage cover. A beaver dam changes energy flow in its immediate area by turning part of a stream environment into a pond or swamp. If high beaver populations coincide with heavy livestock use, the results can be devastating to streams. On the other hand, their dams can be beneficial as sediment traps and fish habitat. Water held behind a beaver dam is released more slowly over a longer period.



Amphibians and reptiles are another indicator of riparian quality. Nearly all amphibians depend on aquatic habitats for reproduction and overwintering. Certain turtles, snakes, and lizards also prefer riparian ecosystems.

Animal populations in riparian areas are affected by the size and diversity of available

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habitat. Adjacent land-use activities may have a direct effect on wildlife population size within a riparian area.

Fish populations can be an indicator of watershed and riparian ecosystem health. Large woody materials, such as fallen trees and limbs, create pools and protective cover, which are necessary components of fish habitat. This woody debris also increases the diversity of invertebrates, which are a basic part of the food chain on which fish depend.

## People in riparian areas

Since the land along streambanks and floodplains is often fairly flat, riparian areas are attractive locations for roads. Roadbuilding may increase sedimentation, which can adversely affect aquatic life, especially fish. Runoff from roads can carry oil, antifreeze, and other contaminants

into the stream. Road construction can also damage valuable wildlife habitat. Traffic, a hazard in itself, may disturb or displace many wildlife species.

Roads probably have a greater and longer-lasting impact on riparian areas than any other human activity. Routes should be selected and designed with careful consideration of potential long-term effects.

Riparian vegetation is often cleared for farming purposes. This often weakens bank structure, making it more susceptible to erosion and a contributor to sediment deposition downstream. Landowners who convert riparian areas to farmland for short-term gains in agricultural production may lose in the long run. The loss of vegetation on stabilized banks could cause the stream to wash away that same valuable land during periods of high flow.

Livestock, like wildlife, are attracted to shade, water and forage in riparian areas. If mismanaged—allowing the area to be grazed excessively or at the wrong time—livestock can severely affect the riparian area's value. Livestock can compact the soil near the water, reducing its infiltration capabilities. When riparian vegetation is damaged—either by trampling or overgrazing—shading is reduced, erosion potential is increased as streambanks slough away, water tables are lowered, and water quality is affected. Animal wastes may also threaten water quality.



Livestock can be managed. The impact of livestock can be reduced by controlling access and grazing levels along streambanks.

Residential and commercial development has occurred near riparian areas throughout history. Development in these sites has generally degraded the value of the resources. Degradation

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has included filling and altering of stream channels, removing vegetation for building construction, and paving large amounts of land for roadways.

Some problems associated with development can be avoided by good planning and site design. Residential communities can be planned with riparian area values in mind. Construction sites can avoid steep slopes, wetlands, and sensitive biological sites. Areas that offer the amenities of a relatively healthy riparian area often have an increased real estate value.

Construction of campgrounds and recreation sites in riparian areas encourages use by anglers, birdwatchers, hikers, boaters, and others. This use, especially irresponsible acts like littering or erosion caused by improper use of off-road vehicles, may conflict with the welfare of wildlife and reduce water quality.

Streams and their riparian areas are the source of domestic water for many cities. High water quality is important for these uses. To maintain it, riparian areas must be carefully managed.

Mining in and near streams has severe impacts on riparian ecosystems. Mining

often increases sedimentation and disrupts spawning areas by moving large amounts of gravel, rock and soil. In addition, mining may introduce poisonous heavy metals into streams.

## Timber harvest in riparian areas

Timber harvest in riparian areas requires careful management and consideration for possible effects on fish and wildlife habitat. Prior to the Oregon Forest Practices Act in 1971, timber harvest was largely uncontrolled along streams, lakes, wetlands, or other waters. Clearcuts commonly extended to the edges of these waters, and most trees and understory brush were either removed or damaged. Removal of this vegetation eliminated future sources of large woody debris and reduced the shade that prevented increased water temperatures. Early logging practices also caused severe damage to stream habitat. For example, dragging and decking logs in stream channels and using splash dams to move logs down streams with man-made floods caused direct damage to spawning areas. Where and how early roads were built caused indirect damage by removing trees along the stream, increasing the amount of sediments in streams, and reducing the stream's ability to move across its floodplain.

Modern forest management requires the retention of vegetation within riparian areas along streams, lakes, wetlands, and other waters. **Riparian management areas (RMAs)** are required by the **Oregon Forest Practices Act** to protect resources such as fish habitat, water quality, and domestic water supplies. The Forest Practices Act is administered and enforced by the Oregon Department of Forestry. It applies to all

commercial forest management activities on state and private lands. On federal lands the management of these zones is guided by other regulations and management plans, but the requirements of the Oregon Forest Practices Act must always be met or exceeded.

The width of riparian management areas under the Forest Practices Act varies from 50 feet to 100 feet along fish-bearing waters de-

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pending on the size of the stream. These areas are established along both sides of streams. The actual width of a riparian management area varies according to the amount of trees and other vegetation that must be maintained. The width of RMAs can be varied to adapt to features of the terrain or to address other concerns or sensitive sites encountered at the timber harvest operation.

Within riparian management areas, landowners are required to maintain vegetation (including trees) to achieve desired amounts of shade and cover. Activities are controlled to minimize negative effects on fish habitat and water quality. On fish-bearing streams, vegetation is managed to achieve a mature forest over time. Along some non-fish bearing streams, vegetation is maintained to protect water quality. There are also a number of streams without fish where no vegetation retention is required.



Besides maintaining vegetation, there are a number of other requirements for the management of riparian areas along fish-bearing streams. For example, all downed trees in aquatic habitats and within the riparian management area must remain. This assures that large woody debris in streams or on the ground is available as habitat for fish and wildlife. All snags not considered a safety hazard must be left in the riparian area. These dead trees serve as a source of future downed wood and, for as long as they are standing, provide foraging and nesting sites for birds and other wildlife.

The current “water protection rules” of the Forest Practices Act also include incentives for landowners to actively enhance stream habitat. One major factor that currently limits fish pro-

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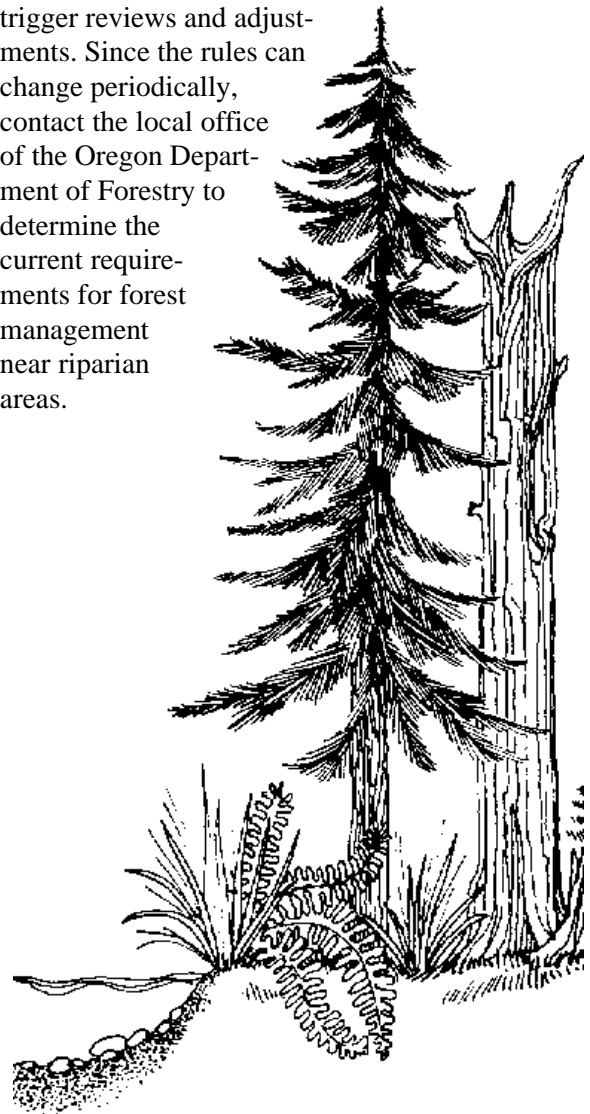
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areas along streams.*

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duction in Oregon streams is a lack of large woody debris in streams. This is a result of historic logging practices that failed to keep trees as a source of large wood along streams. Cleaning stream channels by removing large wood to make transporting logs and fish migration easier also contributed to the current lack of woody debris. It could take centuries for enough stream-side trees to fall into streams naturally to remedy this problem. To address the shortage of large woody debris in streams in a timely manner, the rules include an incentive for landowners to place large woody debris, or complete other needed restoration projects, in conjunction with nearby timber harvest operations. Landowners who complete enhancement projects to provide immediate benefits to fish habitat are allowed to remove a few additional trees from the riparian zone. The number of trees that can be removed is still limited, however, so a mature forest condition will eventually develop.

Other forest management activities are also regulated to protect resources such as riparian areas. Those activities include road building and maintenance, chemical use, and prescribed burning, among others. These activities must be planned and implemented carefully to prevent damage to waters and other forest resources.

The Oregon Forest Practices Act, and its associated rules, are continually reviewed and adjusted. The current rules for protection of Oregon waterways include a commitment by the Oregon Department of Forestry to conduct monitoring to evaluate the rules and to report findings to the Board of Forestry for appropriate rule changes. In addition, other processes, such as the recent Endangered Species Act listings of coho salmon and steelhead, often trigger reviews and adjustments. Since the rules can change periodically, contact the local office of the Oregon Department of Forestry to determine the current requirements for forest management near riparian areas.



# Extensions

1. “Riparian Retreat,” *Aquatic Project WILD*, pp. 118. Grades 6-12.
2. “The Edge of Home,” *Aquatic Project WILD*, pp. 75. Grades 4-12.
3. “Blue Ribbon Niche,” *Aquatic Project WILD*, pp. 52. Grades 5-12.
4. “Porosity and Permeability,” *Groundwater: A Vital Resource*, pp. 24-26. Grades 7-12.
5. “Farmers and Water Pollution,” *Groundwater: A Vital Resource*, pp. 47-48. Grades 9-12.
6. “Municipal Waste Contamination of Groundwater,” *Groundwater: A Vital Resource*, pp. 53-55. Grades 7-9.
7. “How Much Water Can Different Soils Hold?,” *Earth: The Water Planet*, pp. 17-22. Grades 4-8.
8. “Back to the Future,” *Project WET*, pp. 293-299. Grades 3-12.
9. “Get the Ground Water Picture,” *Project WET*, pp. 136-141. Grades 6-12.
10. “A Grave Mistake,” *Project WET*, pp. 311-314. Grades 6-12.
11. “Humpty Dumpty,” *Project WET*, pp. 316-321. Grades 3-8.
12. “Irrigation Interpretation,” *Project WET*, pp. 254-259. Grades K-8.
13. “Wish Book,” *Project WET*, pp. 460-464. Grades 6-12.
14. A relatively simple procedure can be used to assess a stream’s ability to hold the organic material it produces (retention).

Ginkgo leaves are excellent to use in this activity. They are bright yellow in autumn (making them easy to spot), similar in size to the leaves of common riparian trees, and they are not native to North America.

Collect ginkgo leaves (or any other bright yellow leaves, such as aspen, or readily available brightly colored autumn leaves). Dry them immediately after they fall in autumn and then store until needed. Soak the leaves for 12 hours before they are released. This creates neutral buoyancy to simulate natural distribution patterns.

Release about 3,000 leaves at the upstream end of a 50-yard section. Map leaf distribution about three hours after release. About 30% to 90% will be retained. Students should be aware that retention is affected by channel structure, flow patterns, substrate types, and leaf characteristics.

When the retained leaves are collected, make a record of what is causing the retention. To calculate the proportion of leaves retained by each type of feature, divide the number of leaves found at each structure type by the number of leaves released. Students can determine which structures are most effective in retention and the importance of leaves and other debris to aquatic food chains. Discussion can include collection of inorganic sediments, fine particulate organic matter, woody debris, or dissolved nutrients.

Doing the same activity in different riparian areas (for example, a freshly logged site, second-growth forest, or old-growth forest) would provide an opportunity for comparison. A stream’s ability to retain much of the energy base it produces is a primary function of riparian vegetation. (Speaker, Moore and Gregory, 1984.)

15. Riparian floodplain soils are a major reservoir of water depending on the degree of compaction. The following procedure can be used to determine how much void space (usually 30% to 50%)—space capable of being filled with water—exists in a soil.

Locate a fairly uniform soil, relatively free of rocks. Using bottomless cans prepared as described in the following activity, “A dirty subject,” tap a can down into the ground as far as possible. Leave the can in place while you dig around the sides. Con-



tinue to dig until you are able to slide a flat piece of metal under the bottom of the can. Do not disturb the plug of soil in the can. Seal the metal plate to the can with putty or a similar substance to make a watertight seal. Pour water into the can from a graduated cylinder, taking note of the amount of water used, until the soil is saturated.

Calculate the volume of the soil in the can ( $\pi r^2 \times H = \text{volume of soil}$ ) and compare it with the amount of water added to its void spaces. Compare soils from various compacted and non-compacted areas. (Contributed by Bruce Anderson, 1988.)

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# A dirty subject ... soil, vegetation and watersheds

**Activity Education Standards:** Note alignment with Oregon Academic Content Standards beginning on p. 483.

## Objectives

The student will (1) measure the rate of water infiltration in compacted and non-compacted soils, and (2) describe the relationships between soils, vegetation, runoff, and wildlife in riparian habitats.

## Method

The student will collect, compare, and interpret data on the rate of water infiltration (inches/minute) in sites with compacted and non-compacted soils.

### For younger students

1. Consult extension activities at the end of each chapter to address the needs of younger students.
2. Read activity background information aloud to younger students or modify for your students' reading level.
3. When doing Step 1 in the procedure, have students mark the 2-inch mark *before* taking off the can ends, to avoid students handling sharp edges as they mark.
4. Students need previous experience with reading rulers and determining measurements. Using each group's data, calculate the infiltration rate formula as a class. Rephrase some questions or answer as part of a group discussion.

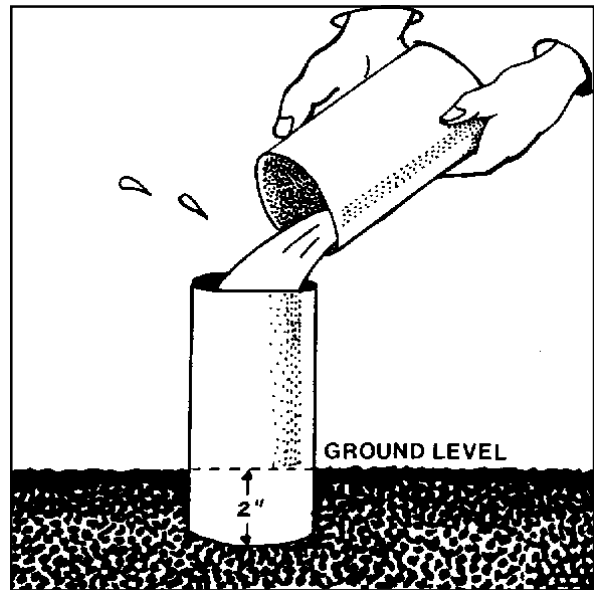
A Dirty Subject is adapted from *Conservation Activities for Girl Scouts*, U.S. Dept. of Agriculture, PA-1009, Natural Resources Conservation Service, 1972.

## Materials

- copies of student sheets (pp. 175-178)
- large fruit or vegetable juice cans of uniform size (two cans per team)
- 1, 12-inch ruler per team
- 1 board (approximately 12"×4"×2") per team
- 1 hammer
- 1 watch or clock with second hand
- 1 quart liquid measure
- water (amount will vary with site)

### Notes to the teacher

Select two cans of the same size and diameter for each team. Cut the bottoms out of each can just above the rim. This leaves a sharp edge that will drive easily into the ground. Cut out the other



## Vocabulary

organic materials  
infiltration rate

end of the can with a standard can opener, leaving the rim intact for added strength. Mark the outside of each can 2 inches from the sharp end. (See diagram below.)

Introduce the topics in the "Do you know..." section to set the stage for later discussion. Demonstrate the activity described below for your students. This activity is ideal for working in teams, with individuals taking measurements, making observations, and recording data.

Try to locate an area with compacted soil (a playground, trail or other heavy traffic zone) near non-compacted soil of the same type. (It can be difficult to drive cans into compacted soil without smashing them, so you may want to try out the sites first.) In each selected spot, students will place the sharp end of the can on the ground, place the board on top of the can and gently tap with the hammer until the 2-inch mark is reached. Older students can select their own sites and drive the cans themselves. You may want to drive in the cans ahead of time for younger students to avoid having students handle the sharp edges. (Option: If more than one soil type is available, you may want to conduct several trials in compacted and uncompacted spots within each soil type, allowing comparison between soils.)

By pouring a measured quantity of water in the cans (do a test run to determine the amount of water needed at the site), and measuring the time it takes for the water to infiltrate into the soil, students can obtain data relating soil compaction (or soil type, using the option mentioned above) to water storage and rate of runoff. The entire activity should be done on the same day so the soil moisture will be approximately the same at all test sites.

Compare the rates of water infiltration between student groups. Ask students what might account for these differences. What will happen to water that cannot penetrate the soil? (It will run off quickly to lakes and streams.) What will happen to water that infiltrates the soil easily? (It will soak into the ground.) How will this affect the nearest stream? (Fast runoff will cause the stream to flood, later drying up because no water was stored in the ground.) How might this affect wildlife? (Many answers are possible: relating

water storage to streamflow, allowing water to run longer, affecting water temperature, oxygen, fish, vegetation, land animals, and more.)

## Background

### *Do you know . . .*

Soils are much more than just dirt. Soils contain different amounts of minerals, and both decaying and living organic materials (those with carbon which are or once were part of a living thing). This means each soil is different in its ability to:

- provide nutrients for plants,
- absorb water, and
- store water.

Plants greatly affect soils. Their growing roots break up large soil particles into smaller ones. Their leaves, stems and flowers fall to the ground and decay, adding organic materials (nutrients) to the soil. Soils are protected from water and wind erosion by plants. Plants help soils store water temporarily by slowing down runoff.

Plants, in turn, are affected by the soils in which they grow. Soils with organic matter and the ability to store water support healthy plant communities. A watershed with both good cover (plants) and good soils (soils not compacted by vehicles, foot traffic, or animals) retain water and release it slowly, allowing streams to run all year.

Watersheds with compacted soils, little vegetation, or both, shed water rapidly, allowing little time for rainwater or melting snow to infiltrate into the ground. Such rapid runoff increases erosion, stripping away vegetation and soils that might otherwise store water.

Soils and vegetation in a watershed, in turn, have much influence over:

- what fish and wildlife live there (provide food and cover for both fish and wildlife),
- runoff and streamflow (determine how fast water runs off),
- amount of oxygen and sediments in watershed streams (plants hold sediments and

cool the stream so the water can carry more oxygen), and

- water temperature (plants provide shade for the stream).

Everything in a watershed is connected to everything else—soils, plants, fish, and wildlife. The amount of water slowed and stored by the soil and vegetation is a key element in the whole system. When one part of the system breaks down (e.g., loss of vegetation), the whole watershed is affected.

## Procedure

### *Now it's your turn . . .*

Just how much water can soil absorb? In this investigation you will measure the rate of water infiltration for soils in your area.

Using the materials provided, measure the rate of infiltration of water into soil at two different sites—one compacted, one not compacted.

1. Select two cans of the same size and diameter for each team. Cut the bottoms out of each can just above the rim. This leaves a sharp edge that will drive easily into the ground. Cut out the other end of the can with a standard can opener, leaving the rim intact for added strength. Mark the outside of each can 2 inches from the sharp end.
2. Try to locate an area with compacted soil (a playground, trail, or other heavy traffic zone)

near non-compacted soil on the same type. Place one can on the compacted site, and another on the uncompacted site.

3. In each spot selected, place the sharp end of the can on the ground. Place the board on the dull end of the can, and tap *gently* with the hammer until the two-inch mark on the can is reached. Avoid spots where rocks or sticks make it difficult to drive the can down. Do not disturb the plant material or organic matter in the can.
4. Pour a measured amount of water into the can all at once, and begin timing the rate of infiltration. Immediately measure the distance in inches from the top of the can to the water level and record your observations on the data table. (**Note:** If a retrieval is needed for some reason, move your can to a new spot. Once water has been poured into a can, the soil moisture has been changed, affecting the outcome. Do not attempt to do a retrieval in a “used” test location.)
5. Measure the amount of water that has moved downward at the end of each minute for the first 10 minutes.
6. Using your completed data table, determine the rate of infiltration in inches per minute (in/min). Share your rates of infiltration with other students, and get their figures. Combine your rate of infiltration with the rates found by other teams. Determine an average rate for the compacted and non-compacted sites.
7. Answer the questions provided.

## Data tables

- I. **Infiltration rate:** Record the rate of downward movement of water (inches) every minute for 10 minutes. Begin measurements immediately after pouring water into the can.

Minutes	0	1	2	3	4	5	6	7	8	9	10
Site I (inches) (compacted soils)											
Site II (inches) (non-compacted soils)											

$$\text{Infiltration rate (inches/minute)} = \frac{\text{Downward movement (inches)}}{\text{Time elapsed (minutes)}}$$

A. Total downward movement = \_\_\_\_\_

B. Total time (minutes) = \_\_\_\_\_

C. Infiltration (inches/min) = \_\_\_\_\_

D. Class averages = Site I: \_\_\_\_\_ Site II: \_\_\_\_\_  
(compacted soils) (non-compacted soils)

## II. Observations:

**Site I**  
(compacted soils)

**Site II**  
(non-compacted soils)

<b>A. Location description</b> (field, pasture, trail, etc.)		
<b>B. Description of soil</b> (loose, compact, sandy, etc.)		
<b>C. Organic materials</b> (leaves, sticks, other?)		
<b>D. Vegetation</b> (grass, shrub, tree, etc.)		

## Questions

- What might account for any difference in infiltration rates between test sites?  
***Different soil types are able to absorb water at different rates. Soils that are compacted have fewer spaces to fill with water.***
- What will happen to the water that cannot penetrate the soil?  
***It will run off quickly to lakes and streams.***
- What will happen to the water that penetrates the soil more easily?  
***It will soak into the ground and be temporarily stored.***
- How are streams affected by vegetation, soil, and rates of runoff?  
***Fast runoff will cause the stream to flood, later drying up because no water was stored in the ground.***
- In what ways might wildlife be affected by vegetation, soil, and runoff?  
***Many answers are possible relating to streamflow, allowing water to run longer, affecting water temperature, oxygen, fish, vegetation, land animals, and more.***

## Going further

- Redo the experiment with soils from at least six sites in the uplands and other areas in your watershed. Compare the water infiltration ability of these samples with the examples you tested in the previous experiment. Predict the results before beginning the second set of tests. What might account for the differences, if any? Based on your results, identify areas needing improvement. Then research and design a project to improve the water infiltration capability of compacted soils in those areas.

# ***A dirty subject ... soil, vegetation and watersheds***

## ***Do you know . . .***

Soils are much more than just dirt. Soils contain different amounts of minerals, and both decaying and living organic materials (those with carbon which are or once were part of a living thing). This means each soil is different in its ability to:

- provide nutrients for plants,
- absorb water, and
- store water.

Plants greatly affect soils. Their growing roots break up large soil particles into smaller ones. Their leaves, stems and flowers fall to the ground and decay, adding organic materials (nutrients) to the soil. Soils are protected from water and wind erosion by plants. Plants help soils store water temporarily by slowing down runoff.

Plants, in turn, are affected by the soils in which they grow. Soils with organic matter and the ability to store water support healthy plant communities. A watershed with both good cover (plants) and good soils (soils not compacted by vehicles, foot traffic, or animals) retain water and release it slowly, allowing streams to run all year.

Watersheds with compacted soils, little vegetation, or both, shed water rapidly, allowing little time for rainwater or melting snow to infiltrate into the ground. Such rapid runoff increases erosion, stripping away vegetation and soils that might otherwise store water.

Soils and vegetation in a watershed, in turn, have much influence over:

- what fish and wildlife live there (provide food and cover for both fish and wildlife),
- runoff and streamflow (determine how fast water runs off).
- amount of oxygen and sediments in watershed streams (plants hold sediments and cool the stream so the water can carry more oxygen), and
- water temperature (plants provide shade for the stream).

Everything in a watershed is connected to everything else—soils, plants, fish, and wildlife. The amount of water slowed and stored by the soil and vegetation is a key element in the whole system. When one part of the system breaks

A Dirty Subject is adapted from *Conservation Activities for Girl Scouts*, U.S. Dept. of Agriculture, PA-1009, Natural Resources Conservation Service, 1972.

## **Vocabulary**

organic materials  
infiltration rate

down (e.g., loss of vegetation), the whole watershed is affected.

## *Now it's your turn . . .*

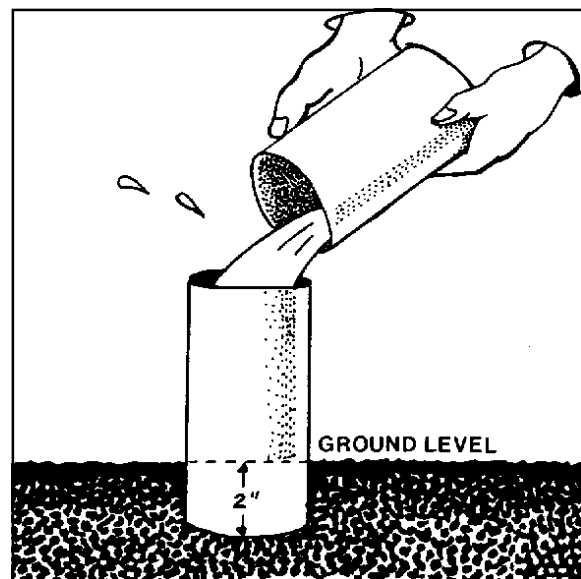
Just how much water can soil absorb? In this investigation you will measure the rate of water infiltration for soils in your area.

Using the materials provided, measure the rate of infiltration of water into soil at two different sites—one compacted, one not compacted.

1. Select two cans of the same size and diameter for each team. Cut the bottoms out of each can just above the rim. This leaves a sharp edge that will drive easily into the ground. Cut out the other end of the can with a standard can opener, leaving the rim intact for added strength. Mark the outside of each can 2 inches from the sharp end.
2. Try to locate an area with compacted soil (a playground, trail, or other heavy traffic zone) near non-compacted soil on the same type. Place one can on the compacted site, and another on the uncompacted site.
3. In each spot selected, place the sharp end of the can on the ground. Place the board on the dull end of the can, and tap *gently* with the hammer until the two-inch mark on the can is reached. Avoid spots where rocks or sticks make it difficult to drive the can down. Do not disturb the plant material or organic matter in the can.
4. Pour a measured amount of water into the can all at once, and begin timing the rate of infiltration. Immediately measure the distance in inches from the top of the can to the water level and record your observations on the data table. (**Note:** If a retrieval is needed for some reason, move your can to a new spot. Once water has been poured into a can,

the soil moisture has been changed, affecting the outcome. Do not attempt to do a retrieval in a “used” test location.)

5. Measure the amount of water that has moved downward at the end of each minute for the first 10 minutes.
6. Using your completed data table, determine the rate of infiltration in inches per minute (in/min). Share your rates of infiltration with other students, and get their figures. Combine your rate of infiltration with the rates found by other teams. Determine an average rate for the compacted and non-compacted sites.
7. Answer the questions provided.



### Student sheet



# Data tables

I. **Infiltration rate:** Record the rate of downward movement of water (inches) every minute for 10 minutes. Begin measurements immediately after pouring water into the can.

Minutes	0	1	2	3	4	5	6	7	8	9	10
Site I (inches) (compacted soils)											
Site II (inches) (non-compacted soils)											

$$\text{Infiltration rate (inches/minute)} = \frac{\text{Downward movement (inches)}}{\text{Time elapsed (minutes)}}$$

A. Total downward movement = \_\_\_\_\_

B. Total time (minutes) = \_\_\_\_\_

C. Infiltration (inches/min) = \_\_\_\_\_

D. Class averages = Site I: \_\_\_\_\_ Site II: \_\_\_\_\_  
(compacted soils) (non-compacted soils)

## II. Observations:

	Site I (compacted soils)	Site II (non-compacted soils)
<b>A. Location description</b> (field, pasture, trail, etc.)		
<b>B. Description of soil</b> (loose, compact, sandy, etc.)		
<b>C. Organic materials</b> (leaves, sticks, other?)		
<b>D. Vegetation</b> (grass, shrub, tree, etc.)		

# Questions

1. What might account for any difference in infiltration rates between test sites?
2. What will happen to the water that cannot penetrate the soil?
3. What will happen to the water that penetrates the soil more easily?
4. How are streams affected by vegetation, soil, and rates of runoff?
5. In what ways might wildlife be affected by vegetation, soil, and runoff?

# Made in the shade

**Activity Education Standards:** Note alignment with Oregon Academic Content Standards beginning on p. 483.

## Objectives

The student will (1) demonstrate the effect of solar radiation in heating water, (2) demonstrate how shade helps keep water cool by limiting solar radiation, and (3) describe the influence of riparian vegetation in keeping streams cool.

## Method

Students place two pans of water, one shaded and one unshaded, in a sunny location and record the changes in temperature over time.

### For younger students

1. Consult extension activities at the end of each chapter to address the needs of younger students.
2. Read activity background information aloud to younger students or modify for your students' reading level.

## Materials

- 2 pans of equal size and shape (for each team)
- water
- aluminum foil
- thermometer (one for each team)
- copies of student sheets (pp. 181-182)

## Background

### *Do you know . . .*

... that just as a hat shades your head and keeps it cooler on a hot summer day, shade provided by riparian plants helps keep a stream cooler in the summer. Cool water is important to the animals and plants that live in the stream. If water temperatures become too warm, they may become ill or die.

Riparian areas are important temperature regulators for streams. The plants in the riparian area shade and protect the stream and its banks from the heat of the sun. Warm air temperatures may still transfer some heat to the stream, but less total heat energy reaches the stream than if it was unshaded.

## Procedure

### *Now it's your turn . . .*

How much does shade affect water temperature? Try the following experiment to find out.

1. Add the same measured amount of water to each of the pans. Cover one pan with aluminum foil with the shiny side up. This represents a shaded stream while the uncovered pan represents an unshaded stream.
2. Place the pans side by side in a sunny place.
3. Check the temperature of each pan every 10 minutes.
4. Record the information you collect on the data sheet.

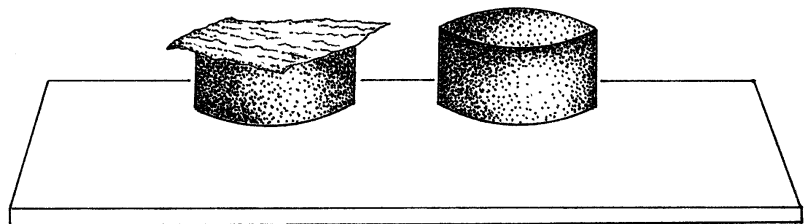
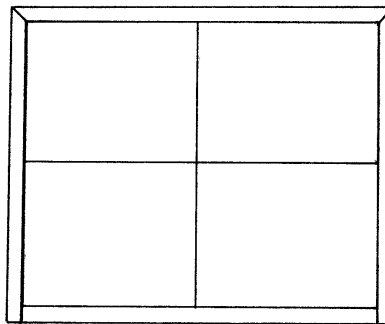
Time elapsed	0 min.	10 min.	20 min.	30 min.	40 min.	50 min.	60 min.
Unshaded temperature							
Shaded temperature							

# Questions

1. Which pan heated more quickly, the shaded or unshaded one?  
***The unshaded pan heated more quickly.***
2. Why are cool stream temperatures important?  
***Many aquatic organisms, such as salmon, trout and some other aquatic organisms, need cool water to live. Within this cooler range of temperatures, an organism's metabolism is more efficient and the species has a greater chance for success.***
3. Besides plants, what else can help shade a stream?  
***Answers will vary, but should include shade from adjacent hills or stream banks (topographic shading) as well as debris (logs, rocks, leaves) in the stream. A stream's orientation to the path of the sun can also affect the amount of solar radiation it gets, i.e. a stream that flows north-south does not receive as much solar radiation as a stream that flows east-west. A stream's valley form (broad valley versus narrow valley) also affects the amount of solar radiation it receives.***
4. In the northern hemisphere the summer sun is slightly to the south rather than directly overhead. If a stream in this part of the world runs east-west, which side of the stream needs the most protection from solar radiation? Along with a written description, sketch your interpretation of this answer.  
***Since the sun is slightly to the south, plants on the south bank will shade the stream more effectively than plants on the north bank.***

## Going further

1. Do different amounts and types of shade make a difference in the cooling effects of the shade?
2. Does a completely unshaded pan heat up twice as fast as a pan that is only half shaded?
3. Is debris (bark or leaves) floating on the top of the water effective in keeping water cooler?
4. Which heats more quickly, a pan tightly covered with foil or loosely covered with foil?
5. How does the amount of water (deep or shallow) affect the rate at which the water warms?
6. How does turbulence affect how quickly the water warms?
7. How does shade affect the water temperature once the water is warm?

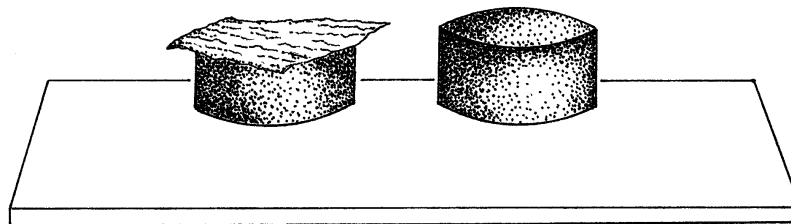
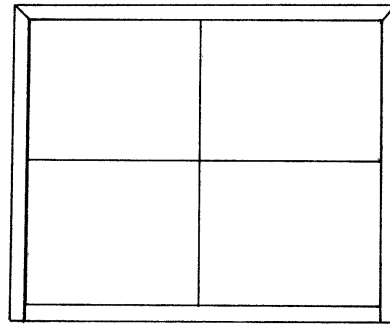


## Made in the shade

### Do you know . . .

... just as a hat shades your head and keeps it cooler on a hot summer day, shade provided by riparian plants helps keep a stream cooler in the summer. Cool water is important to the animals and plants that live in the stream. If water temperatures become too warm, they may become ill or die.

Riparian areas are important temperature regulators for streams. The plants in the riparian area shade and protect the stream and its banks from the heat of the sun. Warm air temperatures may still transfer some heat to the stream, but less total heat energy reaches the stream than if it was unshaded.



### Now it's your turn . . .

How much does shade affect water temperature? Try the following experiment to find out.

1. Add the same measured amount of water to each of the pans. Cover one pan with aluminum foil with the shiny side up. This represents a shaded stream while the uncovered pan represents an unshaded stream.
2. Place the pans side by side in a sunny place.
3. Check the temperature of each pan every 10 minutes.
4. Record the information you collect on the data sheet.

Time elapsed	0 min.	10 min.	20 min.	30 min.	40 min.	50 min.	60 min.
Unshaded temperature							
Shaded temperature							

**Student sheet**

# Questions

1. Which pan heated more quickly, the shaded or unshaded one?
2. Why are cool stream temperatures important?
3. Besides plants, what else can help shade a stream?
4. In the northern hemisphere the summer sun is slightly to the south rather than directly overhead. If a stream in this part of the world runs east-west, which side of the stream needs the most protection from solar radiation? Along with a written description, sketch your interpretation of this answer.

# Passin' through

**Activity Education Standards:** Note alignment with Oregon Academic Content Standards beginning on p. 483.

## Objectives

The student will (1) describe characteristics of substances considered as water pollutants, (2) describe how wetlands and riparian areas can filter water, and (3) discuss the negative effects of pollution on aquatic wildlife and habitats.

## Method

Students conduct an experiment by putting a variety of pollutants into water and attempting to filter the pollutants out with a model soil filter.

### For younger students

1. Use a sponge to demonstrate how a riparian area absorbs and filters substances before doing this activity.
2. Prepare the activity as a demonstration. Ask students to do the pH sampling.
3. Try “The Edge of Home,” *Aquatic Project WILD*, pp. 75. Grades 4-12.
4. Try “How Much Water Can Different Soils Hold?” *Earth: The Water Planet*, pp. 17-22. Grades 4-8.
5. Try “Back to the Future,” *Project WET*, pp. 293-299. Grades 3-12.
6. Try “Humpty Dumpty,” *Project WET*, pp. 316-321. Grades 3-8.
7. Try “Irrigation Interpretation,” *Project WET*, pp. 254-259. Grades K-8.

This activity is adapted from the draft “Invisible Travelers,” an activity originally written for *Aquatic Project WILD*, pilot version, 1996, Western Regional Environmental Education Council.

## Materials

- copies of student sheets (pp.187-190)

### For each set of stations:

- 4 used plastic 2-liter drink bottles
- 4, 3-inch squares of screen or mesh
- 4 rubber bands
- 4 sturdy cardboard boxes to support filter
- catch container large enough to hold one quart of solution
- filter materials—rich topsoil, subsoil, sand, gravel, pebbles
- test solution #1—one quart of water mixed with one half cup of vinegar
- test solution #2—one quart of water mixed with one half cup of crushed charcoal
- test solution #3— one quart of water mixed with one half cup of cooking oil
- test solution #4—one quart of water mixed with one half cup of lawn clippings or bark mulch
- pH paper or other pH testing materials

### Notes to the teacher

1. Use the diagram as a guide to set up the models. Make sure the hole cut in the bottom of the cardboard box is large enough to support the bottle. You may have to experiment to come up with the right diameter. Give students this information. It may prevent spills of dirt, water, and rocks.
2. If water is easily moving through the filters, it is not necessary to pour the entire quart of solution through the filters.
3. Students will explore pH in greater depth in Chapter 8, “Water Quality.”

## Vocabulary

riparian areas  
sediments  
wetlands

# Background

## *Do you know . . .*

... that water running over the land's surface can pick up many things, including pollutants, and carry them suspended in the water? Eventually these things are deposited somewhere. For example, in the spring—when high water erodes soil from river banks—clay, silt, and other soil particles are picked up and carried by rivers and streams. Normally these soil particles are carried for short distances, then settle out and are deposited when the current slows down. In small quantities this is not harmful. But large amounts of **sediment** from eroded agricultural or forest land, highway construction sites, and urban development are not a part of the normal cycle. Sediments can destroy fish spawning beds, suffocate filter feeding insects, and even damage fish gills.

The best solution for these problems is to prevent pollution. But eroded sediments or other pollutants carried by moving water can be filtered out by healthy **wetlands** or **riparian areas**. In a wetland or riparian area, the vegetation slows the speed of water moving over the land surface, letting some of the particles settle

out. Wetland and riparian soils also filter water that infiltrates, or passes through the soil, removing even more pollutants.

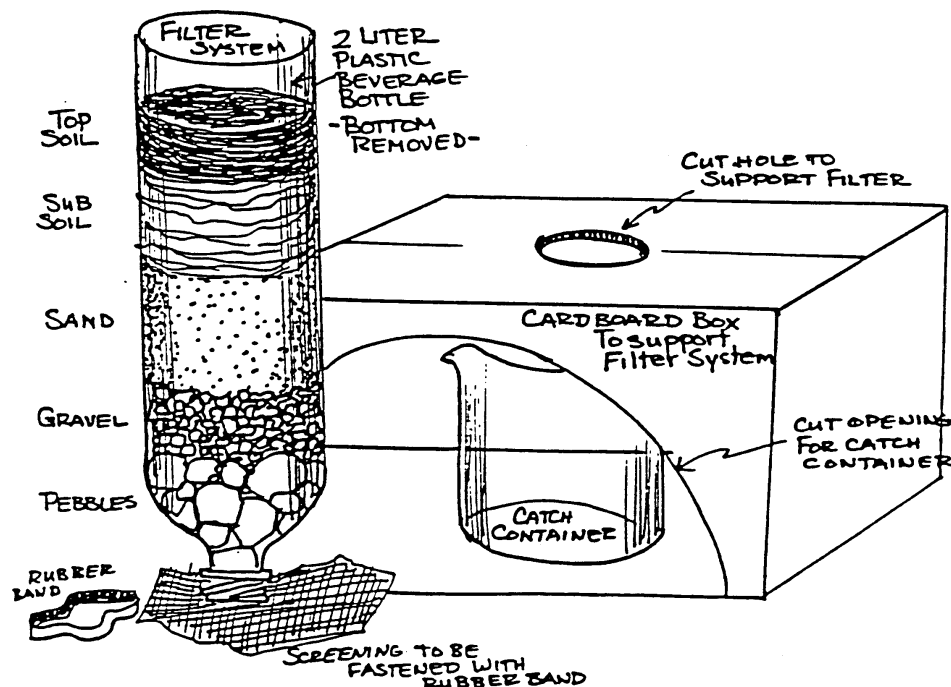
# Procedure

## *Now it's your turn . . .*

In this activity you will use a model to learn how riparian and wetland soils can filter pollutants from water. You will test the ability of soils to filter four different pollutants. At each test station follow the directions and write your observations on the data sheet. Then answer the questions that follow.

**Note: Do not taste the test solutions.**

Set up each of the four filter models as shown in the diagram. Label each filter, for example "Test Solution 1," "Test Solution 2," etc. Also label the test solution containers. Turn the cardboard box so the open end fits over the catch container. Cut a small hole in the bottom of the box to support the filter. To avoid spills, make sure the hole supports the filter before letting go of the bottle. Make sure the catch container is lined up below the hole in the bottom of the cardboard box and is large enough to catch the flow.





Station		Smell	Appearance (color, cloudy, or transparent)	pH
No. 1: Acid	Before filtering			
	After filtering			
No. 2: Charcoal	Before filtering			
	After filtering			
No. 3: Oil	Before filtering			
	After filtering			
No. 4: Organic debris	Before filtering			
	After filtering			

### At each filter:

1. Observe and describe the test solution before filtering. Consider smell, transparency, cloudiness, and pH. Record your observations on the data sheet.
2. Place the catch container under the filter. Slowly pour the solution through the filter system.
3. Observe and describe the test solution after filtering. Record your observations on the data sheet.
4. Answer the following questions.

## Questions

1. Which test solution's smell was most changed by passing through the filter?  
**Answers may vary, but the odor of vinegar will likely persist through the filtering, even if it is less noticeable.**
2. Which test solution's appearance was most changed by passing through the filter?  
**The charcoal and organic debris solutions should be the most changed because they most likely will not make it through the filter.**
3. Which test solution's pH was most changed by passing through the filter? How do you think the riparian filter changed the pH?  
**Answers will vary depending on the soils used in creating the filters. The vinegar solution will probably be changed the most. pH factors will vary depending on the composition of the soil used in the filter.**
4. For which solutions was the riparian filter most effective at removing pollutants? Why?  
**Answers will vary based on how students evaluate effectiveness.**

5. Riparian soils can only filter out a small amount of some pollutants before they lose their effectiveness. Which of the pollutants in the test solutions could riparian filters most likely filter indefinitely? Why?

***A riparian soil filter would have a nearly unlimited ability to filter charcoal and organic debris. Charcoal, organic debris, or other large materials are strained out and added to the top layers of riparian soils. But like a sponge, riparian soils can absorb only a limited amount of solutions they must "soak up."***

6. Which test solution pollutants would riparian filters have a limited ability to filter? Why?  
***Vinegar and oil. The soil's ability to buffer acid is limited. Oil will eventually coat so many soil particles that new additions will pass through unchanged.***

7. List several pollutants that might move to streams or wetlands with runoff or overland flow. Which of these will riparian and wetland soils most likely filter out? Which of these will likely pass through riparian and wetland soils without much filtering?

***Answers will vary, but one good example is runoff from parking lots and other impervious surfaces.***

---

## Going further

1. Design an experiment to test the limits of your "riparian soils" for filtering out the test solution pollutants.
2. Riparian filter strips are commonly used to filter soils carried as sediments. Try the experiment with several solutions containing various soil types (sand, loam, clay). Is the filter as effective for each of these solutions of muddy water? Which types of sediment particles are riparian soils most effective in filtering out of solution?

# Passin' through

## Do you know . . .

... that water running over the land's surface can pick up many things, including pollutants, and carry them suspended in the water? Eventually these things are deposited somewhere. For example, in the spring—when high water erodes soil from river banks—clay, silt, and other soil particles are picked up and carried by rivers and streams. Normally these soil particles are carried for short distances, then settle out and are deposited when the current slows down. In small quantities this is not harmful. But large amounts of **sediment** from eroded agricultural or forest land, highway construction sites, and urban development are not a part of the normal cycle. Sediments can destroy fish spawning beds, suffocate filter feeding insects, and even damage fish gills.

The best solution for these problems is to prevent pollution. But eroded sediments or other pollutants carried by moving water can be

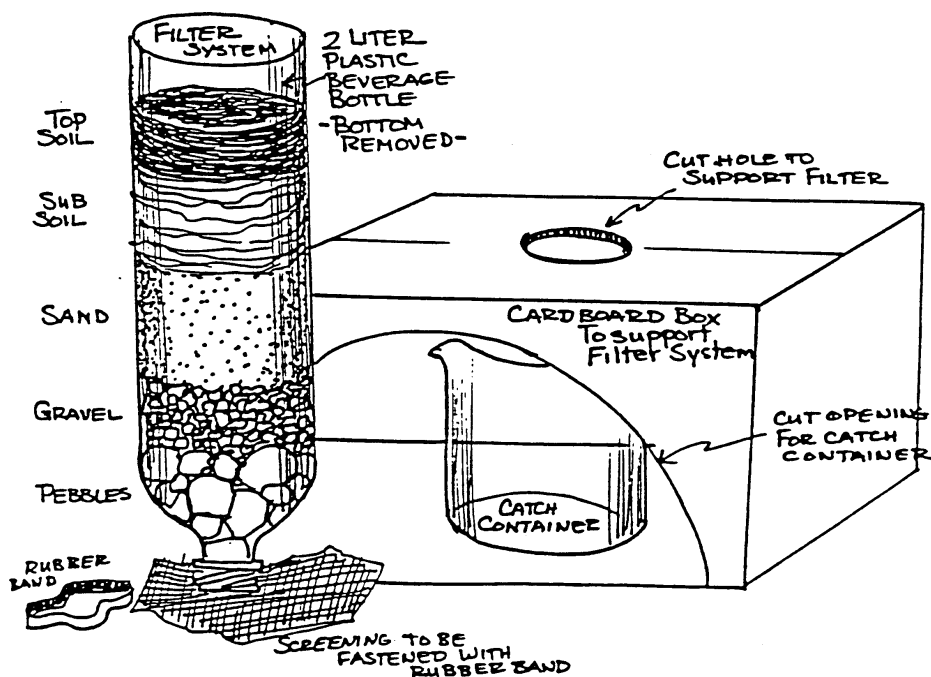
filtered out by healthy **wetlands** or **riparian areas**. In a wetland or riparian area, vegetation slows the speed of water moving over the land surface, letting some of the particles settle out. Wetland and riparian soils also filter water that infiltrates, or passes through the soil, removing even more pollutants.

## Now it's your turn . . .

In this activity you will use a model to learn how riparian and wetland soils can filter pollutants from water. You will test the ability of soils to filter four different pollutants. At each test station follow the directions and write your observations on the data sheet. Then answer the questions that follow.

**Note: Do not taste the test solutions.**

Set up each of the four filter models as shown in the diagram. Label each filter, for example "Test Solution 1," "Test Solution 2," etc. Also label the



## Vocabulary

riparian areas  
sediments  
wetlands

This activity is adapted from the draft "Invisible Travelers," an activity originally written for *Aquatic Project WILD*, pilot version, 1996, Western Regional Environmental Education Council.

## Student sheet

Station		Smell	Appearance (color, cloudy, or transparent)	pH
No. 1: Acid	Before filtering			
	After filtering			
No. 2: Charcoal	Before filtering			
	After filtering			
No. 3: Oil	Before filtering			
	After filtering			
No. 4: Organic debris	Before filtering			
	After filtering			

test solution containers. Turn the cardboard box so the open end fits over the catch container. Cut a small hole in the bottom of the box to support the filter. To avoid spills, make sure the hole supports the filter before letting go of the bottle. Make sure the catch container is lined up below the hole in the bottom of the cardboard box and is large enough to catch the flow.

**At each test station:**

1. Observe and describe the test solution before filtering. Consider smell, transparency, cloudiness, and pH. Record your observations on the data sheet.
2. Place the catch container under the filter. Slowly pour the solution through the filter system.
3. Observe and describe the test solution after filtering. Record your observations on the data sheet.
4. Answer the following questions.

**Student sheet**

# Questions

1. Which test solution's smell was most changed by passing through the filter?
2. Which test solution's appearance was most changed by passing through the filter?
3. Which test solution's pH was most changed by passing through the filter? How do you think the riparian filter changed the pH?
4. For which solutions was the riparian filter most effective at removing pollutants? Why?
5. Riparian soils can only filter out a small amount of some pollutants before they lose their effectiveness. Which of the pollutants in the test solutions could riparian filters most likely filter indefinitely? Why?
6. Which test solution pollutants would riparian filters have a limited ability to filter? Why?
7. List several pollutants that might move to streams or wetlands with runoff or overland flow. Which of these will riparian and wetland soils most likely filter out? Which of these will likely pass through riparian and wetland soils without much filtering?

**Student sheet**

# Things that go “bump” in the night

**Activity Education Standards:** Note alignment with Oregon Academic Content Standards beginning on p. 483.

## Objectives

Students will (1) describe how small mammal populations in a riparian area are sampled, and (2) calculate (as part of a simulation exercise) the estimated small mammal population in an area, using the Lincoln Index.

## Method

Students will learn how small mammals are captured to estimate their population size in a particular area. Students will then use a simulation activity to model the procedure for using the Lincoln Index in estimating population size.

### For younger students

1. Consult extension activities at the end of each chapter to address the needs of younger students.
2. Read activity background information aloud to younger students or modify for your students' reading level.

## Materials

- 200-300 poker chips or beans (to represent mice)
- plastic bag (to represent habitat where mice live)
- copies of student sheets (pp. 195-198)

Adapted from Hastie, Bill, “Things That Go ‘Bump’ In The Night” and “Figuring Wildlife Populations,” *Oregon Wildlife*, September 1983 and October 1983.

## Notes to the teacher

1. You may want to combine data from all teams to show the effect of a larger sample size.
2. Graphing the results of each team's data and subsequent trials provides a good opportunity for discussion of small mammal population dynamics. Subsequent trials can introduce factors such as mortality, immigration, emigration, or other factors affecting trapping success.

## Background

### *Do you know . . .*

. . . what those sounds are around you as you lie under a tree in a sleeping bag trying to go to sleep? Have you ever really listened and wondered what kind of “critter” was making those sounds? These sounds, like the trees around you, attempt to hide in the darkness. But they do not remain unnoticed.

Many of these sounds are made by small mammals that are most active at night and rest during the day. Such animals are said to be **nocturnal**.

Riparian areas provide the essentials of good wildlife habitat—food, water, and cover. If you are camping in the riparian area along a stream, the trees and shrubs under which you sleep also serve as cover, roosting, nesting, and feeding areas for birds; shelter and food for small mammals; and provide increased humidity and shade for all animals. Small rodents, such as mice, are

## Vocabulary

Lincoln Index  
nocturnal

population  
riparian area

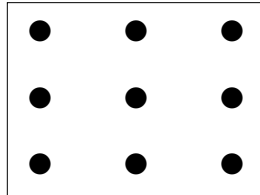
an important part of many riparian area food chains. It is likely these are the small rodents you hear as you are trying to sleep.

One way to find out which animals explore the area as you sleep is to trap the animals as they go about their nightly search for food. To find out what kind of small rodents inhabit an area and how many are present, biologists use live traps that do not injure the animal. They set and bait a number of traps and wait for darkness to come. Later that night, traps are checked, and captured animals are identified and immediately released back into the area. Biologists are very careful when handling these animals to avoid bites and scratches that may transmit animal diseases.

One of the common problems field biologists face is estimating the size of a **population** (group of individuals of a specific kind in a given area at a given time). A

census of the human population of the United States is taken every few years by counting all the people that live there. Because counting small nocturnal mammals (like mice) is very hard to do, biologists use other methods to estimate the size of such a population.

The **Lincoln Index** is a common method used by biologists to estimate the size of a small



animal population. Using traps similar to the one in the drawing, they trap and mark animals, release them, and then reset their traps. By noting the number of marked animals recaptured, the biologist can apply the Lincoln Index equation to estimate the population size.

Traps are baited with oatmeal, peanut butter or other grain or nut products and set out in a grid arrangement as shown, at least one yard apart. Because most small mammals are active at night, traps are set out one to two hours before dusk and checked every four hours. **Animals are not left in the traps overnight.**

## Procedure

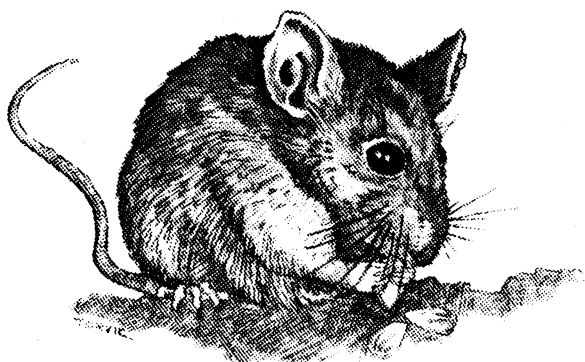
### *Now it's your turn . . .*

How can you find out what animals and how many live in the riparian area next to your stream? You could volunteer to work with a local wildlife biologist to run a small-mammal trapline in your area, see what you capture, and estimate the size of their population.

Biologists would normally handle trapped animals to identify, mark, and release them. Since small mammals sometimes carry diseases transferred to humans through a bite, **we do not recommend that you handle the animals.**

Instead, use the following activity as a model to simulate the results of a trapping program and use of the Lincoln Index.

- Place 200 to 300 poker chips (which represent members of a population of white-footed deer mice) in a plastic bag. The bag represents the area in which the mice live.





- “Capture” a handful of mice (poker chips) from the bag. Mark those captured with a piece of masking tape.
- Write down the number of mice captured and release them back into the area where they were caught (the bag). Mix them evenly with the mice not captured.
- Make another “handful” capture from the area. Record the total number captured and the number of these animals that were captured the first time (those marked with tape).

Total population (N)	Total No. individuals captured 1st catch (M)	Total No. individuals captured 2nd catch (n)	No. recaptured individuals 2nd catch (m)

- Now, using the data you have recorded, apply it to the following formula.

$$\frac{N}{M} = \frac{n}{m}$$

or

$$\frac{\text{Total population (N)}}{\text{Number of individuals captured, marked and counted the first time (M)}} = \frac{\text{Total of the second catch (marked and unmarked) (n)}}{\text{Number of individuals recaptured (marked) in the second catch (m)}}$$

**Example:**

Forty-two mice were captured the first time. On the second try, 36 mice were captured, 12 of which were also captured the first time (marked).

$$M = 42 \quad \text{Cross-multiplying to solve for N: } 12N = 42 \times 36 \text{ (or 1,512)}$$

$$n = 36 \quad \text{Dividing 12 into 1,512 = 126, so } N = 126$$

$$m = 12 \quad \text{Using the Lincoln Index we have found the population of mice for a given area to be 126.}$$

$$\frac{N}{42} = \frac{36}{12} \quad \text{Remember this is not an exact number. It is only an estimate. In this case, the actual number of individuals (poker chips) in the area we sampled (the bag) was known, so it is possible to see how accurate the Lincoln Index can be in estimating population size.}$$

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## Questions

1. Why is it necessary for biologists to use formulas like the Lincoln Index to estimate populations of animals which live in a riparian area or other habitat within a watershed?  
***It is nearly impossible to count small animals like mice because of their small size, secretive lifestyle, and nocturnal habits.***
2. How accurate was your population estimate (the population you calculated versus the actual number of mice (chips) in the bag)?  
***Answers will vary.***

3. What factors could influence or affect the population size estimate obtained by using this model?  
***The size of the sample (big hands versus small hands), accuracy of counting, and accuracy of calculation. Generally, the larger the sample size, the more accurate the estimate.***
  4. List as many factors as you can that could influence or affect the population size estimate in actual mark/recapture sampling procedures done in the field?  
***The size of the sample, mortality of marked or unmarked animals, weather factors which might affect the activity level of animals being trapped, immigration or emigration of animals to or from the study area, or "catchability" of the animals (some are "trap happy" or more easily caught than others).***
  5. Why are small mammals, like mice, important to a riparian area?  
***Small mammals are an important part of riparian area food chains.***
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## References

- Burt, William H., and Richard B. Grossenheider.  
*A Field Guide to Mammals* (Third Edition).  
Boston: Houghton Mifflin Co., 1978.
- Whitaker, John O. *The Audubon Society Field  
Guide to North American Mammals*. New  
York: Alfred A. Knopf, 1980.

## Going further

1. Design an experiment to compare small-animal populations within a riparian area and outside of a riparian area. Research how small animals contribute to the functioning of a healthy riparian area. Prepare a report and share the information with the class.

## Things that go “bump” in the night

### Do you know . . .

. . . what those sounds are around you as you lie under a tree in a sleeping bag trying to go to sleep? Have you ever really listened and wondered what kind of “critter” was making those sounds? These sounds, like the trees around you, attempt to hide in the darkness. But they do not remain unnoticed.

Many of these sounds are made by small mammals that are most active at night and rest during the day. Such animals are said to be **nocturnal**.

Riparian areas provide the essentials of good wildlife habitat—food, water, and cover. If you are camping in the riparian area along a stream, the trees and shrubs under which you sleep also serve as cover, roosting, nesting, and feeding areas for birds; shelter and food for small mammals; and provide increased humidity and shade for all animals. Small rodents, such as mice, are an important part of many riparian area food chains. It is likely these are the small rodents you hear as you are trying to sleep.

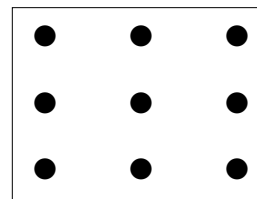
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Adapted from Hastie, Bill, “Things That Go ‘Bump’ In The Night” and “Figuring Wildlife Populations,” *Oregon Wildlife*, September 1983 and October 1983.

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### Vocabulary

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riparian area

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**Student sheet**

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**Student sheet**

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