THE GRASS IS ALWAYS CLEANER

OBJECTIVES

The students will do the following:

1. Explain the relationship between land use practices and erosion.
2. Explain how sediments enter surface water runoff from different land use practices.
3. Explain the importance and need for agricultural, construction, mining, and forestry BMPs.
4. Simulate erosion and erosion control methods (BMPs) in classroom demonstrations.

SUBJECTS:
General Science, Earth Science, Life Science, Physical Science, Ecology, Biology, Chemistry, Physics

TIME:
2 class periods

MATERIALS:
sod or grass seed (annual rye grass sprouts quickly)
soil (30-40 pounds or 13.5-18 kg)
8 boxes about 16" (40 cm) long, 12" (30 cm) wide, and 4" (10 cm) deep
8 plastic garbage bags
old garden hose or similar size tubing
mist bottle
8 half-gallon (2 l) sprinkling cans
8 half-gallon (2 l) mason jars, wide-mouth jars or plastic containers
8 blocks of wood 14" x 1" x 1" (35 x 2.5 x 2.5 cm)
2 pieces of wood 16" x 1/2" x 1/4" (40 x 1.25 x .63 cm)
measuring cup or graduated cylinder
gravel
tar paper
gauze
toothpicks
large knife or shovel to cut grass
meter or yardstick
box preparation diagram (included)
"The Grass is Always Cleaner" Quiz (optional, included)

BACKGROUND INFORMATION

Erosion is the gradual weathering of the earth's sufrace. It is a natural process which results in soil being washed into water bodies. Human activities, however, can greatly increase the rate of erosion by removing vegetative cover and exposing bare soil to winds and rain. Heavy rains can wash a variety of suspended materials into water bodies. Soil stripped of its protective vegetation can easily be washed into nearby surface waters. Many other pollutants such as bacteria, nutrients, and harmful chemicals can be transported on sediment. Sediment can interfere with aquatic life, commerical and recreational activities, and hydroelectric power generation. When sediment settles out of the water, it can gradually fill in lakes and streams. This can reduce flood storage capacity and hydroelectric generating potential. It can also create navigation problems.

The best way to solve nonpoint source pollution problems caused by sediment is to prevent sediment from reaching waterways. Using best management practices (BMPs) for agriculture, construction, mining, and forestry can prevent or reduce soil erosion. One agricultural BMP for sloped land is to plant crops on a contour instead of planting vertical row crops. Mining and forestry BMPs include designing haul roads in a zig-zag pattern, gravelling them, and bordering the edge of the roads with timber. Construction BMPs include using silt screens around disturbed areas and planting some sort of ground cover such as grass, as soon as possible to stabilize soil and trap sediment. Diversion ditches and grass filter strips are two other BMPs used in agriculture, forestry, and construction to trap sediment and prevent soil erosion

ADVANCED PREPARATION

A. Grow eight boxes of grass for activity or prepare boxes of soil for the sod. (CAUTION: If you use sod, keep it moist. Don't let it dry out!)

1. Either make the boxes yourself or divide the class into eight equal teams and have each team make one.

2. Give each team a box, garbage bag, and soil.

a. Have the teams line the box with a garbage bag.

b. Fill the box halfway with soil.

c. Cut a hole in the middle of one end of the box level with the soil.

d. Cut a six inch (15 cm) length of hose or similar tubing and insert it in the hole. This is your spout.

e. If planting your own grass, sprinkle the soil evenly with grass seed. (See recommendations on package for seeds per inch.) If preparing the box of soil for sod, set the boxes aside for the activity. (NOTE: Purchase sod a day or two before activity.)

f. If growing grass, water the seed using a mist bottle, cover the box with clear plastic, and place in a sunny location. It will take 5-10 days to grow grass. Use the mist bottle to keep the soil moist until the seeds sprout. If purchasing sod, use a spray bottle to keep sod moist.

B. Obtain the wood, gravel, tar paper, gauze, and toothpicks.

PROCEDURE

I. Setting the Stage

A. Explain that soil stripped of its vegetative cover can easily be washed into nearby water bodies in surface water runoff. This is called erosion. The material transported is called sediment.

B. Note that sediment is the largest single contributor to nonpoint source pollution and results mainly from improper agricultural, construction, logging, and mining practices.

C. Point out that other pollutants, such as nutrients, bacteria, and toxics, can attach to sediment particles and be carried into water bodies.

D. Best Management Practices (BMPs) are management practices which prevent or reduce water pollution.

II. Activity

A. Prepare the demonstration. (See illustration provided.)

1. Pass out instructions on how to prepare each box and go over the directions.

2. Have the students get a box and prepare it according to the directions. (NOTE: If sod is used, have them press firmly down on the sod to merge it with the soil. Gravel, plastic, and tar paper should also be pressed firmly to the soil or they will wash off during the demonstration.)

   Box A — Either cut a piece of sod that will completely fill the entire box and place on top of the soil or do nothing if planted with grass.

   Box B — Either cut the sod into strips two inches (5 cm) wide by the length of the box and place the strips on the top of the soil two inches (5 cm) apart running lengthwise in the box or remove grass according to the diagram. This box will represent traditional row cropping.

   Box C — Either cut the sod into strips two inches wide (5 cm) and the width of the box and place the strips on the top of the soil two inches (5 cm) apart running crosswise in the box or remove grass according to the diagram. This will represent contour planting.

   Box D — Either cut a piece of sod that will fill the entire box and place it on top of the soil and cut a lengthwise strip of sod that is four inches (10 cm) wide from the middle of this piece of sod and remove it or remove grass according to diagram. The bare soil will represent a dirt road.

   Box E — Repeat the same procedure for Box D and place two 1/4 inch (0.63 cm) thick strips of plywood parallel to each other across the road at a 45 degree angle downward. This is called a diversion ditch.

   Box F — Repeat same procedure for Box D and line the road with gravel.

   Box G — Either cut a piece of sod to fit half the box lengthwise or remove grass according to the diagram. Measure a four inch (10 cm) wide road and cut plastic or tar paper strip this size and place it down to represent a road.

   Box H — Either cut a piece of sod to fit half the box lengthwise or remove grass according to the diagram. Measure a four inch (10 cm) road and cut a piece of plastic or tar paper strip this size and place down to represent an asphalt road. Then cut a strip of gauze the length of the road. Weave toothpicks through the gauze at two inch (5 cm) intervals and stretch the gauze along the edge of either side of the side of the road and push toothpicks into the soil to secure. This is a silt screen.

3. Then place the boxes on a table so that the spouts will extend over the edge of the table.

4. Put one inch (2.5 cm) blocks under the opposite end of the boxes to create a slope.

5. Place a stool or chair under each spout and a mason jar, plastic container, or measuring container (3-4 cups) under it to catch the runoff.

6. Put one pint (500 ml) of water in each sprinkling can. Pour the water on all eight boxes at the same time. Pour at as steady a rate as possible with the sprinkling cans at the same height from the boxes at approximately one foot (0.3 m). (NOTE: More water maybe required, up to 1/2 gallon (2 l) depending upon whether sod or grass was used.)

B. Observe the results.

1. The students should record their observations and measurements (if appropriate) made for each of the boxes in a data chart they make. (NOTE: You may want to measure the volume of runoff produced in each jar for comparison.)

   a. Which box had the most soil erosion?

   b. Which box produced the muddiest runoff water?

2. Allow the sediment in the collection jars to settle out.

   a. Rank the jars with respect to the amount of sediment in each jar.

   b. Compare the erosion produced from all eight boxes.

   c. Also, compare the amount of erosion produced from vertical planting (Box B) to that from contour planting (Box C).

   d. Compare the erosion of the bare road (Box D) to the road with diversion (Box E) and the road with riprap (Box F).

   e. Compare the erosion of the bare construction site (Box G) to the one using a silt screen (Box H).

C. Discuss the results. As you go through each box, discuss how the demonstration simulated a real land use practice and explain how sediment would enter a water body if a BMP was not used.

1. The water that flows from the Box A should be relatively clear. [NOTE: The water may be absorbed completely (not flow into the jar) or it may take a long time to get any runoff.]

2. In Box B, the students should note a more rapid flow of water with more soil in the water.

3. Box C should show some soil in the water, but there should be less soil and a slower flow of water than Box B.

4. For boxes D, E, F, G, and H, the students should observe the difference between water flow (speed) and soil content in the water.

5. What was the relationship between land use and erosion in each box?

6. Note that ground cover reduces erosion the most and the contour planting (illustrated in box C) reduces erosion more than traditional row cropping (illustrated in Box B).

7. Boxes E and F illustrate procedures to be used with logging or mining roads to lessen the problem of soil in runoff waters.

8. Box H illustrates construction practices to reduce erosion.

9. Ask the students to think of examples of erosion control practices being used in their community. How do they work?

10. Discuss why BMPs are needed.

III. Follow-Up

A. Give the students the quiz (included) and go over the results.

B. Label and display the boxes in an exhibit to share with other students and parents.

C. You may want to perform more quantitative measures on the results of this activity. For example, if the amount of water that was poured into each box is known, your students could calculate and compare the percent of water that became surface runoff. Also, the amount of sediment and percent sediment load of the runoff from each box could be determined. (See the activity "It's Sedimentary, My Dear Watson.") Have students analyze the results using the same set of comparisons as previously discussed.

IV. Extension

A. Get land owner/contractor permission to have a group of students survey a construction site for evidence of erosion and other potential sources of nonpoint source pollution. What preventive measures used for nonpoint source pollution are they employing? They might take photographs of the site and share their findings with the class. Have them research state and federal laws regarding proper practices at construction sites. Is this land owner/contractor complying with the law? What other things could the land owner/contractor be doing to control nonpoint source pollution?

B. Invite a local contractor or an agent from the U.S. Soil Conservation Service or Canadian equivalent to speak to your class.

RESOURCES

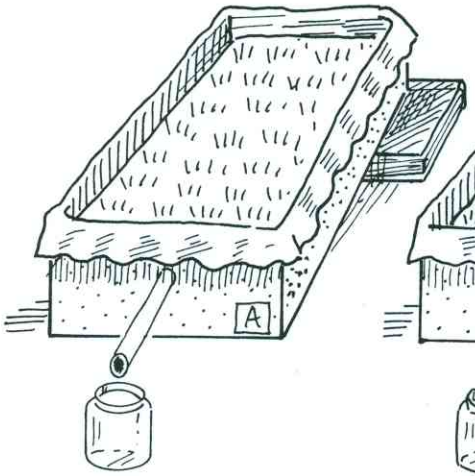
Best Management Practices for Silvicultural and Other Forest Activities in Tennessee, Tennessee Department of Conservation, Division of Forestry, Nashville, Tennessee, 1985.

Forests Protect Water Quality, U.S. Environmental Protection Agency, Region IV, and U.S. Department of Agriculture-Forest Service, Southeastern Area, Atlanta, Georgia, 1979.

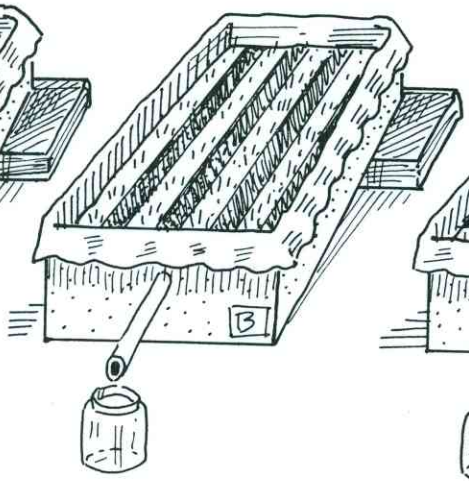
Turk, Jonathan and Amos Turk, Environmental Science, Saunders Publishers Company, Philadelphia, Pennsylvannia, 1988.

Weigle, Weldon K., Designing Coal Haul Roads for Good Drainage, Central States Forest Experiment Station, U.S. Department of Agriculture, Forest Service, Columbus, Ohio, 1965.

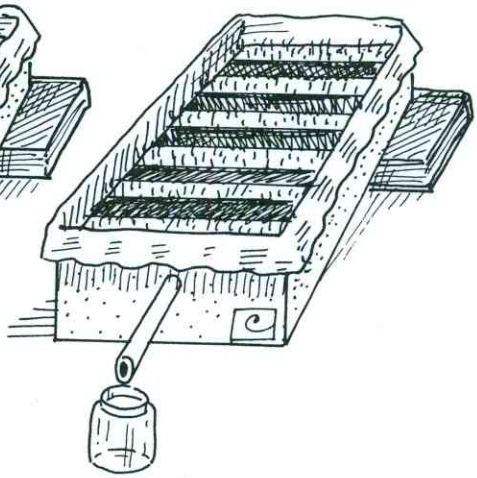
A. HOME LAWN



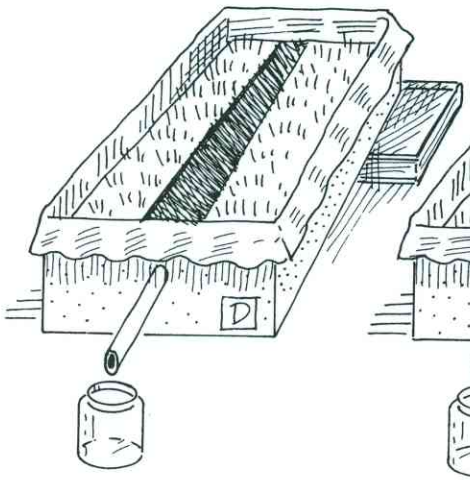
B. ROW CROPPING



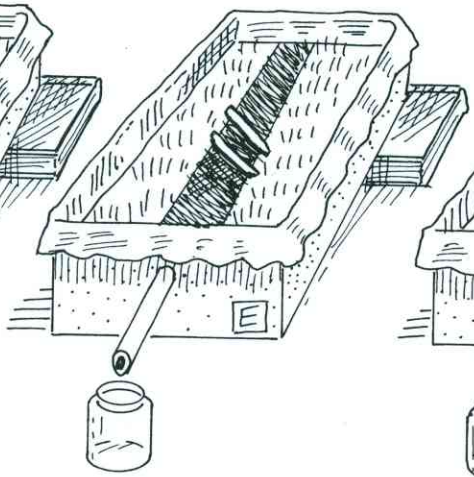
C. CONTOUR PLANTING



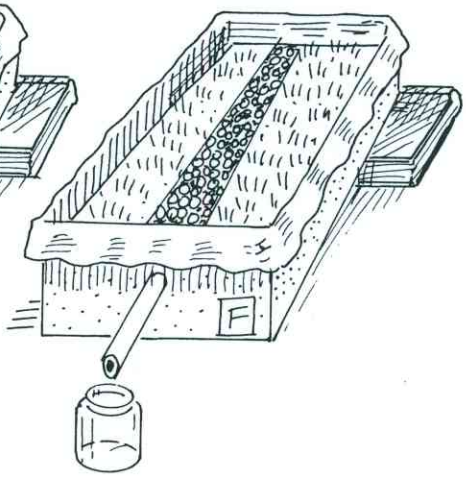
D. DIRT ROAD



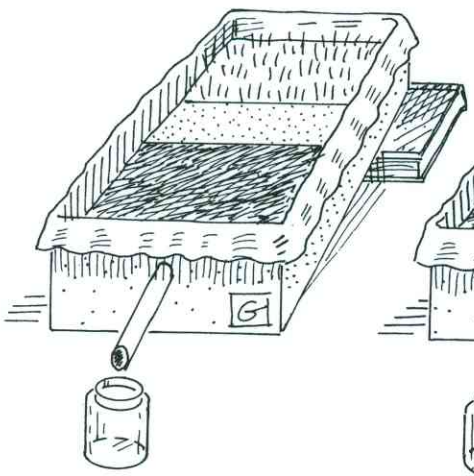
E. DIVERSION DITCH



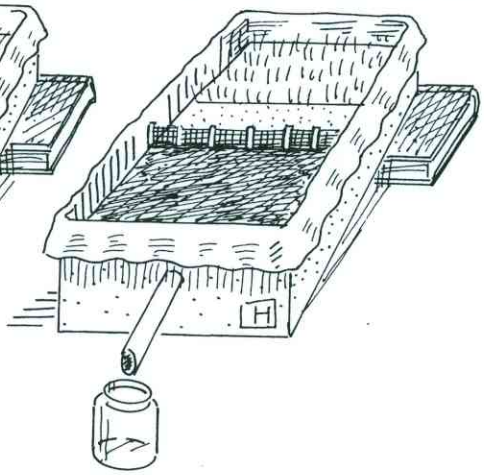
F. GRAVEL ROAD

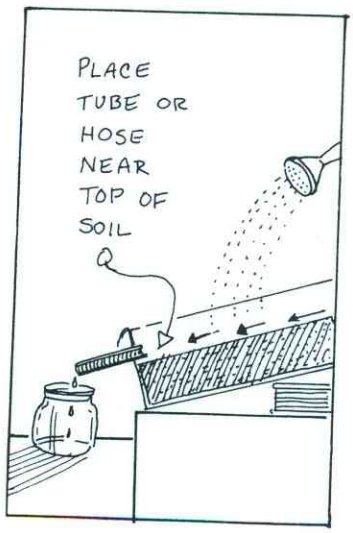


G. CONSTRUCTION BY ASPHALT ROAD



H. CONSTRUCTION BMP BY ASPHALT ROAD





Name _____ Date _____

THE GRASS IS ALWAYS CLEANER QUIZ

1. Soil stripped of its vegetation can easily be washed into nearby bodies of water. (True/False)

2. What is the single largest contributor to nonpoint source pollution? _____

3. What does BMP stand for? _____

4-6. List 3 types of land use which can cause erosion.

(1) _____

(2) _____

(3) _____

7-9. List 3 problems caused by sediment in bodies of water.

(1) _____

(2) _____

(3) _____

Use the data below to answer the following questions:

Box	Runoff	% Runoff
A - Home lawn	402 gal (1524 l)	13.4
B - Row cropping, highly erodable soils	939 gal (3559 l)	31.3
C - Contour planting	138 gal (523 l)	4.6
D - Dirt Road	471 gal (1785 l)	15.7
E - Diversion Ditch	318 gal (1205 l)	10.6
F - Gravel Road	441 gal (1671 l)	14.7
G - Construction by gravel road	981 gal (3718 l)	32.7
H - Construction by gravel road with silt screen	26 gal (98 l)	0.86

THE GRASS IS ALWAYS CLEANER QUIZ
(continued)

10. Based upon the data table, is contour planting or row cropping a better management plan?

_____

11. Does the silt screen reduce erosion when used on a construction site near an asphalt road?

_____

12. Which is a better management plan, a gravel road or a dirt road? _____

13.-15. Construct a bar graph with boxes A-H represented on the horizontal axis and % runoff on the vertical axis.

THE GRASS IS ALWAYS CLEANER QUIZ
(continued)

16-18. Construct a bar graph with boxes A-H represented on the horizontal axis and gallons (liters) runoff on the vertical axis.

19-20. Calculate % runoff if 2500 gal (9475 l) of rainfall produces 600 gal (2274 l) of runoff.

THE GRASS IS ALWAYS CLEANER
TEACHER KEY

1. Soil stripped of its vegetation can easily be washed into nearby bodies of water. (True/False)

2. What is the single largest contributor to nonpoint source pollution? sediment

3. What does BMP stand for? Best Management Practice

4-6. List 3 types of land use which can cause erosion.

(1) agriculture (4) construction

(2) logging

(3) mining

7-9. List 3 problems caused by sediment in bodies of water.

(1) excess nutrients

(2) toxic substances

(3) bacteria

Use the data below to answer the following questions:

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THE GRASS IS ALWAYS CLEANER
TEACHER KEY
(continued)

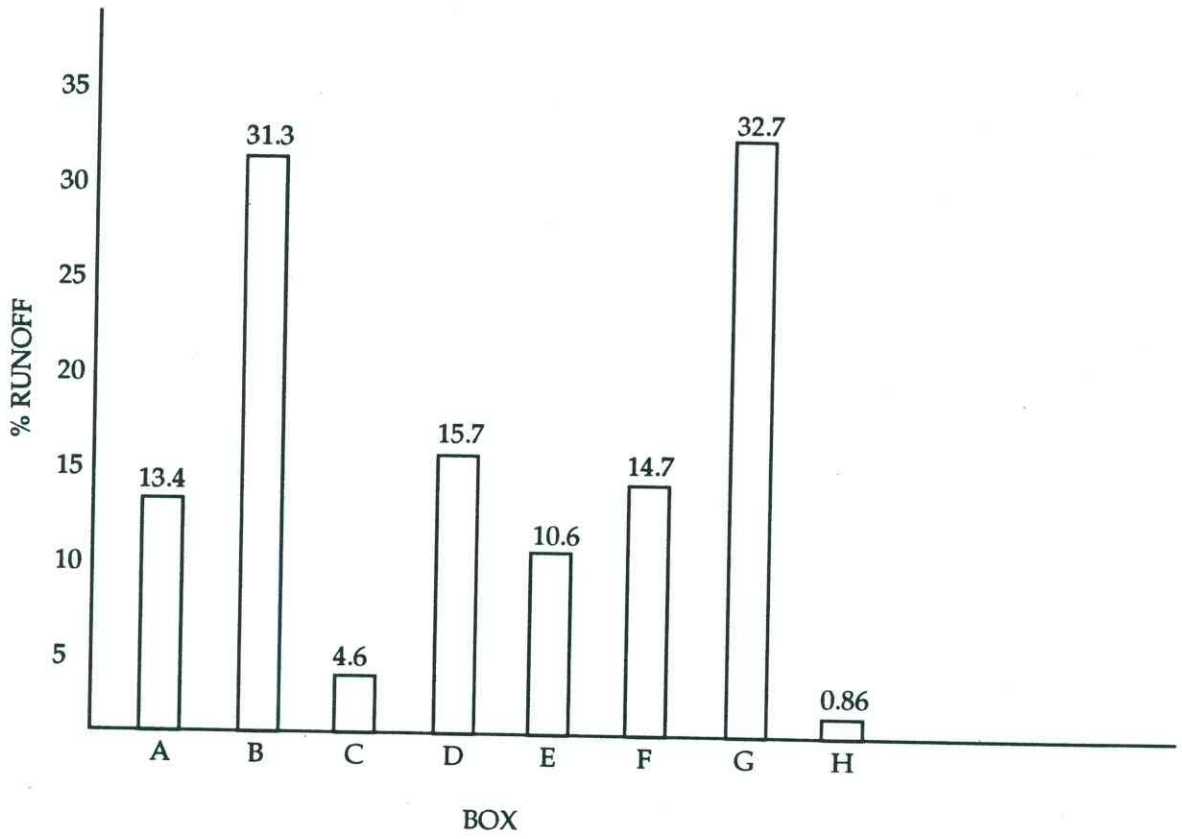
10. Based upon the data table, is contour planting or row cropping a better management plan?

contour planting

11. Does the silt screen reduce erosion when used on a construction site near an asphalt road? yes

12. Which is a better management plan, a gravel road or a dirt road? gravel road

13.- 15. Construct a bar graph with boxes A-H represented on the horizontal axis and % runoff on the vertical axis.



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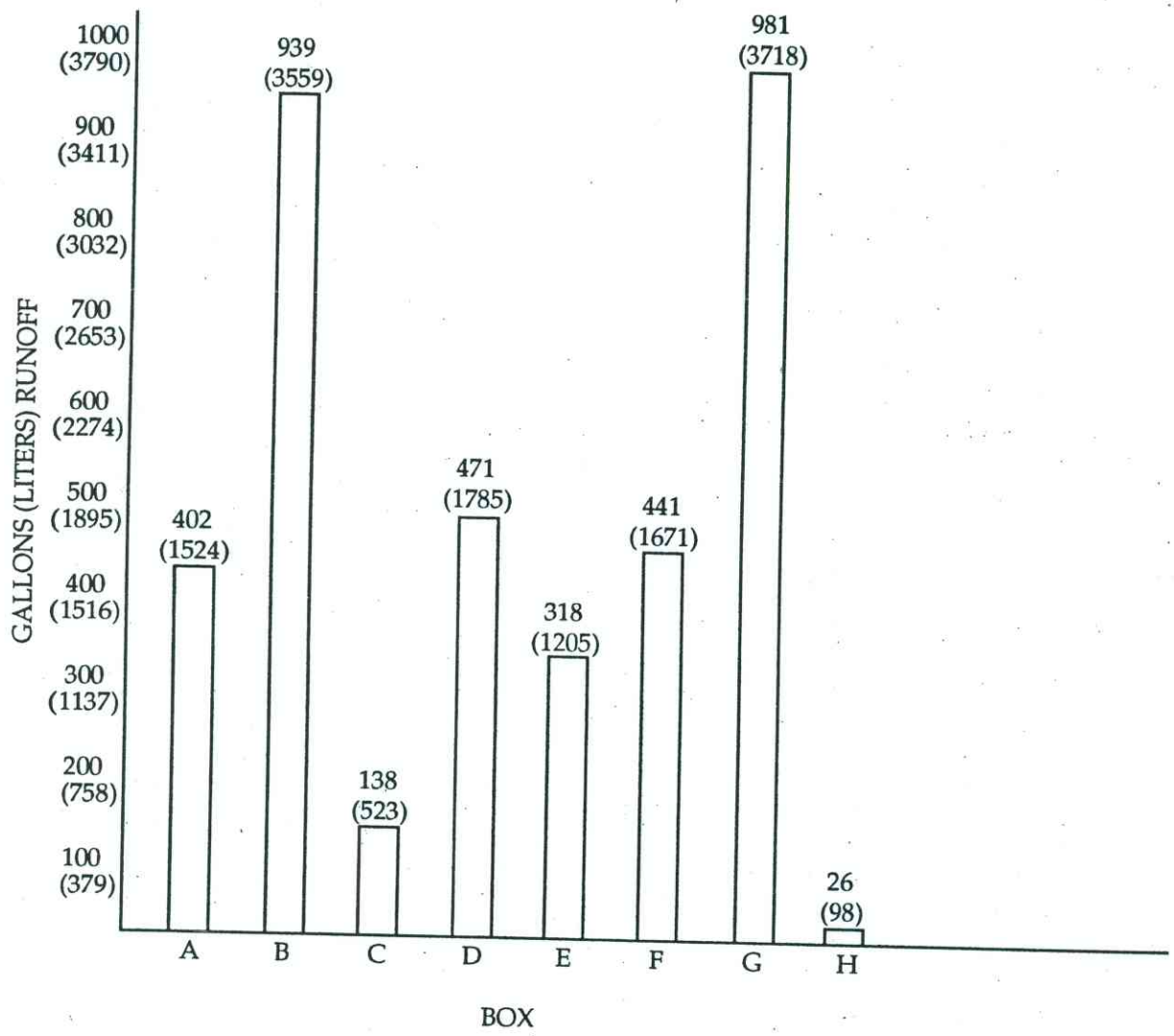

19-20. Calculate % runoff if 2500 gal (9475 l) of rainfall produces 600 gal (2274 l) of runoff.

$$\frac{600 \text{ gal } (2274 \text{ l})}{2500 \text{ gal } (9475 \text{ l})} \times 100 \% = 24.0\%$$