

IMPERVIOUS VS. PERVIOUS SURFACES

OBJECTIVES

- Define what runoff is and learn how it can affect the water level in a river or stream
- Discuss how different land uses in a watershed can affect surface runoff amounts

TOPICS

- Water runoff
- Impervious surface
- Land use

TEKS ALIGNMENT

Grade 7 Science:

1A, 2A, 2B, 2C, 2D,
2E, 3B, 3C, 4A, 8C

Grade 8 Science:

1B, 5D, 11B, 11C

BACKGROUND MATERIAL

Did you ever wonder why water levels rise in a stream or river after a rain, or why some rains cause flooding and other rains do not? To understand the connections between rainfall and water levels in rivers, it is important to understand the concept of runoff.

Runoff occurs when rain falls onto the land and then flows off the surface or through the soil and enters a stream that is at a lower elevation. Runoff also occurs when more rain falls during a particular period of time than can be absorbed by into the soil. Thus, the amount of runoff depends on the amount of rainfall, the type of soil, the amount and type of land cover, the land slope, and the amount of water that is already in the soil because of recent rains.

Different types of land uses affect the amount and quality of runoff. Land uses include urban (cities and towns), farming, livestock grazing, transportation, and natural uses. Urban uses can result in increased surface runoff from impervious cover, such as concrete, asphalt and rooftops. Livestock grazing can result in increased runoff from overgrazed pastures because shorter grass and bare ground hold back less rain than longer grass. Urban and rural transportation uses, like roads, can disrupt the natural flow patterns of water and can result in increased runoff from impervious cover. Making drainage ditches out of streams by lining them with concrete can also increase runoff.

KEY TERMS

Impervious cover is a material on the land surface through which water cannot infiltrate. Impervious surfaces include material like concrete, asphalt, metal or brick

Permeable cover is a material that water can

infiltrate into or percolate through

Runoff is water that flows over the surface of the land when rainfall is not able to infiltrate into the soil, either because the soil is already saturated with water, because the land surface is

impermeable, or because the rate of rainfall exceeds the rate of water infiltration into the ground

Urbanization is the process of creating and enlarging cities and towns

PROCEDURES

- A. Start by asking the students what happens to streets and low water crossings during storms. Ask them what happens to water levels in streams and rivers when it rains.
- B. Prepare for this activity by cutting a large opening in the smaller edge of the three aluminum foil broiling pans for the water to drain out. Then, place sponges in the bottom of two of the broiling pans – you may have to cut the sponges to get them to fit tightly and flush with the bottom of the pan
- C. Ask the students to place the tile on top of one of the pans with sponges, place one carpet tile on the other pan with sponges, and place the other carpet tile on the broiling pan without sponges
- D. Instruct the students to place the three broiling pans at an angle inside the larger aluminum baking pan so that each broiling pan drains into the baking pan
- E. Have them pour 500 mL or another specified amount of water onto highest end of the pan containing the carpet and sponges. They should record the initial amount on the table in Student Sheet 1.

MATERIALS

- Three 500 mL beakers or a glass measuring cup with small increments
- Three 11.75"x 8.56"x1" aluminum foil broiling pans
- Three 13.5"x9.625"x2.94" aluminum foil baking pans
- One floor tile cut to fit the broiling pan
- Two carpet tiles cut to fit the broiling pan (make sure that the back of the carpeting does not have rubber or plastic – water should be able to get through it)
- Eight 6"x3" dry sponges
- Student sheets

- F. Instruct the students to allow the water on the carpet and sponges to drain into the drain pan for 10 seconds
- G. Have the students pour the contents of the drain pan (baking pan) into an empty graduated beaker or glass measuring cup and record the amount of water that is recovered
- H. Instruct the students to subtract the amount of water recovered in the drain pan from the amount of water applied initially to obtain the amount of water retained by the carpet and sponges. They should record this amount in the table
- I. Have the students repeat steps 5-8 for the pan containing the now wet sponges and carpet
- J. Have the students repeat the steps 5-8 for the pan containing the carpet with no sponges
- K. Have the students repeat steps 5-8 for the pan containing the now wet carpet with no sponges
- L. Have the students repeat steps 5-8 for the pan containing the tile and sponges
- M. Ask the students to construct a graph showing the amount of runoff vs. the types of land surfaces
- N. Have the students observe the aerial photographs of a site in northern Bexar County found on Student Sheet 2, and lead a discussion based on the observed differences in impervious vs. pervious surfaces.

GUIDING QUESTIONS

- What type of ground cover does the carpet represent?
- What type of ground cover does the tile represent?
- What do the sponges represent?
- What could the pan with the carpet without sponges represent?
- What do the large aluminum baking pans represent?
- How did the different surfaces affect runoff into the pans?
- What happened to the sponges that were under the carpet after you poured water onto the pan? How about sponges under the tile?
- What effect do streets, houses and parking lots have on the amount of surface runoff that is produced by a storm?
- Where does this runoff go?
- If the river cannot hold all the runoff, what happens to the extra water?
- Which do you think produces less runoff and flooding, an area covered by a lot of concrete, or an area covered by a lot of grass and soil?
- If it has recently rained and the soil is wet, what effect will it have on runoff if it rains again?

EVALUATION

Start by having the students relate the observations that they made with their models to the area around their home or school. What type of land do they observe? Is it flat or hilly? Is the ground covered with grass and other plants or is there concrete and asphalt? Do they see any bare soil that could erode because of rainfall? Where do they think rainfall would infiltrate into the ground and where do they think it would run off? Then, ask the students to write a short paper about runoff and pollution in their town or area. Have them describe the geography and types of land uses that they observe in the area where they live. As their city or town grows and more homes, streets and parking lots are built, have them describe what might happen with runoff and how this might affect flooding.

STUDENT SHEET 1

Ground Cover	Dry carpet and sponges	Wet carpet and sponges	Dry carpet	Wet carpet	Tile and sponges
Volume of water applied (mL)					
Volume of water caught as runoff (mL)					
Volume of water retained (mL)					

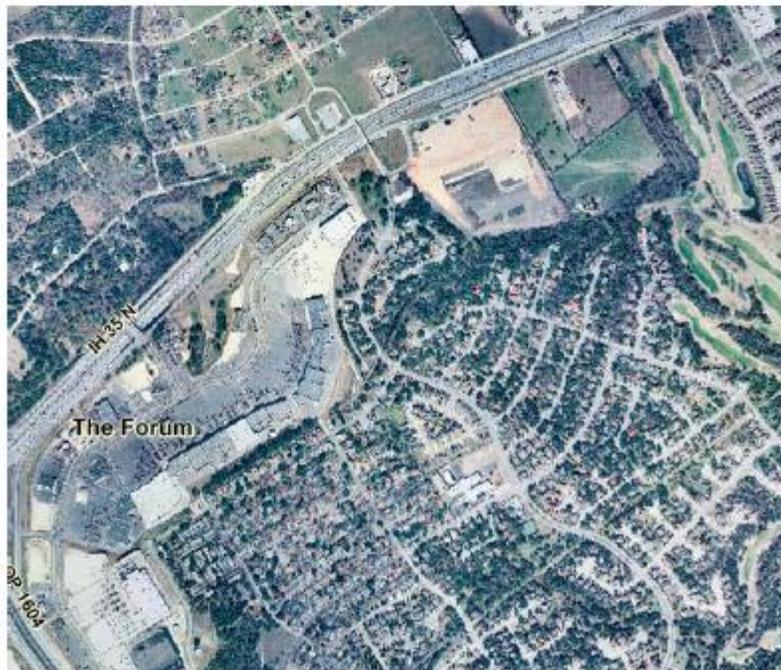
STUDENT SHEET 2

These aerial photographs show an area in north-east Bexar County that recently has undergone development. Notice the increase in impervious cover in the second photograph.

1995
The Forum
Site



2003
The Forum
Site



REFERENCES

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