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Puddle Pushers

Topic
Evaporation

Key Question
After it rains, what happens to the water in a puddle?

Focus
Students will observe that water in a puddle disappears (evaporates) after a period of time.

Guiding Documents
Project 2061 Benchmarks
- *The sun warms the land, air, and water.*
- *When liquid water disappears, it turns into a gas (vapor) in the air and can reappear as a liquid when cooled, or as a solid if cooled below the freezing point of water.*
- *Numbers and shapes—and operations on them—help to describe and predict things about the world around us.*
- *Length can be thought of as unit lengths joined together, area as a collection of unit squares, and volume as a set of unit cubes.*
- *Areas of irregular shapes can be found by dividing them into squares and triangles.*

NRC Standard
- *Materials can exist in different states—solid, liquid, and gas. Some common materials, such as water, can be changed from one state to another by heating or cooling.*

*NCTM Standards 2000**
- *Understand such attributes as length, area, weight, volume, and size of angle and select the appropriate type of unit for measuring each attribute*
- *Develop strategies for estimating the perimeters, areas, and volumes of irregular shapes*
- *Collect data using observations, surveys, and experiments*

Math
Measurement
- length
- area
- time

Estimation

Science
Physical science
- states of matter

Earth science
- meteorology
  - water cycle

Integrated Processes
Observing
Predicting
Collecting and recording data
Comparing and contrasting
Interpreting data
Generalizing
Applying

Materials
String
White glue
Water
Small plastic cups
Chalk
Metric tapes
Centimeter grid paper

Background Information
We live on a water planet—70% is covered with oceans and seas, and of the rest, a high percentage is covered by lakes, ponds, rivers, streams, etc. Considering the entire planet, there is plenty of water on Earth; we will never run short. As a matter of fact, there is as much water on our planet today as there was 100 years ago, even 1000 years ago, 5000 years ago, etc. Because water moves through a cycle (evaporation, condensation, precipitation, accumulation), the amount of water remains constant.

The ocean is ultimately the source of most of the precipitation that falls on the land. Air masses moving over the water pick up large quantities that have *evaporated*. When these air masses move over the continents, much of this water falls out of the clouds (*condensation*) as *precipitation*. On land the water can infiltrate the ground, or evaporate into the air, or run off into rivers, lakes, and eventually the ocean (*accumulation*).

In this activity students will observe the disappearance of puddles (evaporation) after precipitation has occurred. They will determine the perimeter and surface area of the puddles at established time intervals.

Management
1. This activity needs to be done on concrete or asphalt so the water does not infiltrate the surface. Because the weather in some areas may not cooperate with your agenda, you may have to make your own puddles.

2. The area selected for puddle observations needs to be secured during the observation period so the puddles can remain undisturbed. You may want to post signs or rope off the area so that others will know not to tamper with the site.
3. To determine the time intervals between the observations, consider the existing conditions which will influence the evaporation rate (Is it cloudy or sunny? Is there a breeze? What is the temperature? …the humidity?).
4. Students should work in groups of four or five.
5. White glue and water should be mixed prior to the activity. Use a ratio of 1:1. Pour about 50 mL of this mixture into one plastic cup per group. This mixture will be used to preserve the "perimeter" measures of each puddle ring.
6. Use string (not yarn) for making measurements. If colored string is available, use a different color for each puddle measure. The students could then color code their data.
7. Cut three or four lengths of string for each group. The lengths will depend on the sizes of the puddles. Students can trim the strings as they measure.

Procedure

1. After a rain (real or artificial), give each group a piece of chalk and take them outside to the concrete/asphalt surface that has been selected.
2. Have groups select a puddle and write their group's name beside it so they can use the same puddle for each observation.
3. Direct the students to use their chalk to draw around the perimeter of the puddle—make a "puddle ring"—and mark the time of day next to it.
4. Return to the classroom. Have students record the time of the observation on their activity sheet. Ask students to predict what will happen to their puddles after ___ minutes.
5. Wait the determined time interval and repeat this procedure at least three more times.
6. At the end of the observation period, tell students that they will now meaure their puddle rings.
7. Give each group as many strings as observations were made. Tell them that they will wrap the first string over the first chalk-drawn puddle ring. Direct them to cut the string to that length. Have them measure and record the length on their activity sheet. They should do this for all puddle rings.
8. Distribute plastic cups with the white glue and water. Instruct the students to immerse their strings, one at a time, in this mixture.
9. The soaked strings should be positioned around the puddle rings and be left to dry. (The drying process may take two hours or more depending upon weather conditions.) All puddle rings should be done this way.
10. When the strings are dry and stiff, have students gently lift them from the surface and take them back to the classroom.
11. Ask students to estimate the area covered by the puddle from the first measurement. Solicit ideas of how they could determine the area.
12. Let students explore various strategies, then if not already suggested, distribute the grid paper and inform students that they can count the square centimeters that fall within the stiffened strings.
13. Have students record their area measurements.

Discussion

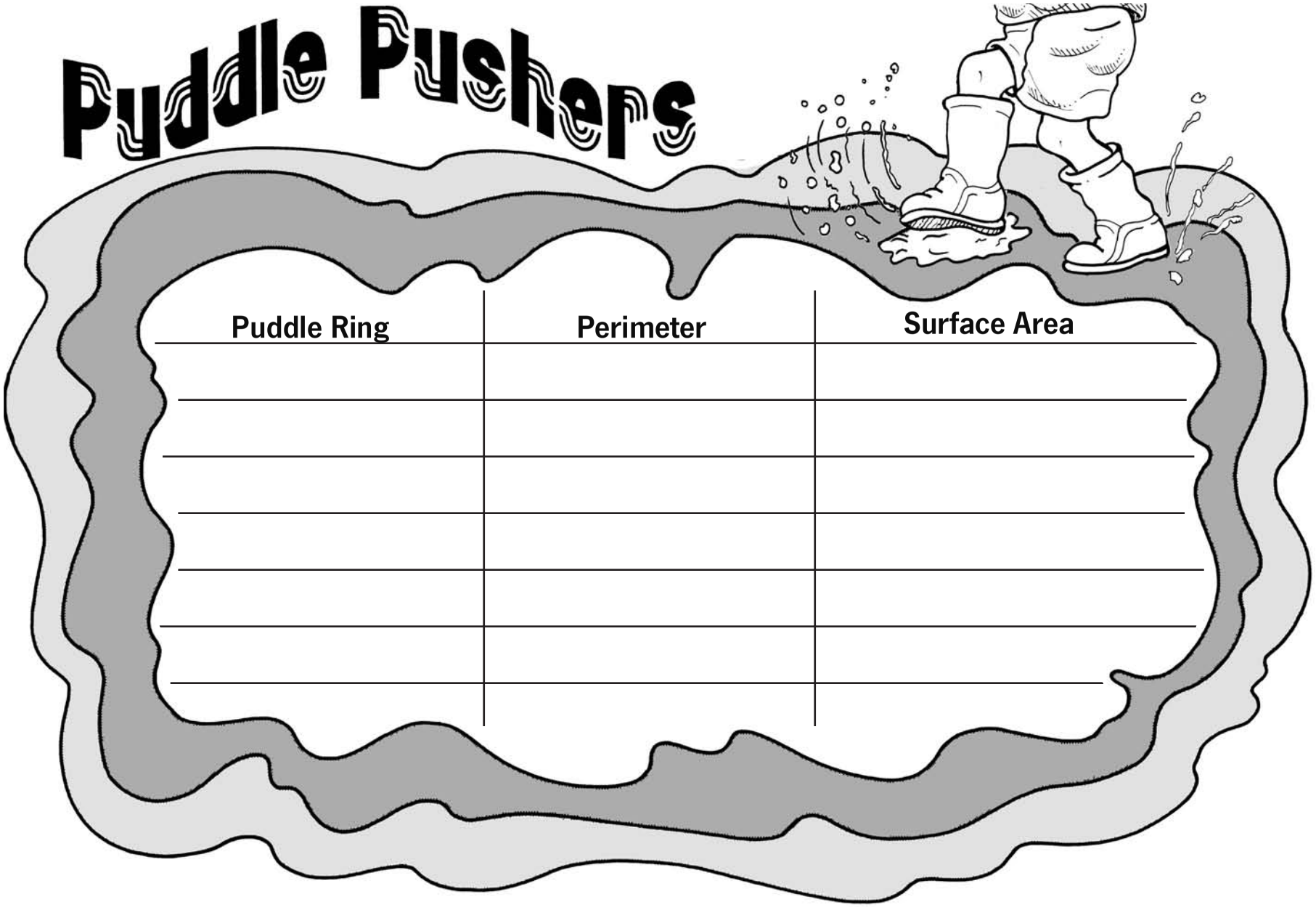
1. What did you notice about the puddle rings during your observations? [They got smaller (unless it rained).] Why did this happen? [The water evaporated.]
2. What happened to the perimeters of the puddle rings during your observations? [They decreased.]
3. Did they decrease consistently? [not necessarily] How could you tell? [by looking at the data table]
4. How did you determine the areas of the puddles?
5. If you used the grid paper, were there any problems with this strategy? [what to do with squares that weren't completely within the puddle ring]
6. How could you solve these problems?
7. How did your puddle's size compare with another group's?
8. Did all the water in your puddle disappear? Was it the same for everyone? What could be some reasons for the differences?
9. What did you learn from this activity? [The water in the puddle evaporated. We were able to experience three of the four parts of the water cycle: precipitation, accumulation, and evaporation. The water changed from a liquid into a gas.]

Journal Prompt: Tell the story of a rain puddle. Be sure to include how and where it forms and how it disappears.

Connections

The sun's heat energy warms the Earth, causing some water molecules to quicken and break free into the atmosphere as invisible water vapor. Heat energy puts the water cycle into motion. Observing and measuring a shrinking puddle provides evidence of evaporation. Would the same puddle evaporate in the same amount of time on another day? Does the rate of evaporation change? If so, what affects it? Those questions will be explored in the next activity, *Going, Going, Gone!*

Puddle Pushers



Puddle Ring	Perimeter	Surface Area

On a large piece of chart paper, write a story about your puddle using pictures, words, and numbers.

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