Schoolyard Surfaces

Investigative Question: How does water move over different surfaces?

Goal: Students investigate surfaces that are found on the landscape, specifically permeable and impermeable surfaces, and consider how water flows downhill to collect into bigger bodies of water.

Objectives:

Knowledge- Students determine and indicate the direction of water flow at their school grounds, predicting where the water will pool and collect. Students understand that water flows quickly across hard (impermeable) surfaces and slows down or soaks into soft (permeable) surfaces.
Skills- Students compare observations, maps, and aerial images to understand a landscape. They compare areas first by predicting, then by using fractions and estimation to calculate permeable and impermeable.
Values- The ways people use the land changes how water flows, for good or for bad.

Grade: 4th

Special Safety: Scan schoolyard grounds for any potential hazards that might cause students to trip as they walk. Remind students to stay with their classroom group when outside.

VA Standards addressed: Science 4.1, 4.9; VS.1i, Math 4.2, 4.3 (extension activity), 4.13, 4.14

Materials:

- Large aerial photos (One of the garden area of the school; One of the larger region)
- Topo Map or map showing water in the area (use Google Earth to create an aerial with water on)
- Dry Erase markers
- Large dry erase board
- Student datasheets, includes line map (1/student pair)
- Clipboards (1/student pair)
- Markers (sets of blue and brown) and colored pencils (sets of red and green)
- Pencils
- Marbles and simple levels (capped u-line tubes with a marble inside)

Setup:

- Ask teacher to pair students (groups of 2)
- Bring all supplies to the schoolyard site

Procedure/ Instructional Strategy (This investigation is designed to take place outside.):

1. Inquiry Part 1: HOOK:
   a. Show students a raincoat and a sweater. *Ask*:
      i. Which one is better to wear in the rain, why?
      ii. Can water soak into the raincoat? No. The word we use for this is **impermeable** (like waterproof; water cannot move through).
      iii. English tie-in: How can we change the word to mean that water CAN move through, like the sweater? (**Permeable**)
      iv. Can sweaters get so full of water that no more can soak in? What happens when the water runs off?

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b. Use student responses to "Describe what water does when it falls as rain." Guide students toward considering how water moves over different surfaces and what direction it flows. (They may try to describe the water cycle instead.) The goal is for students to recognize and describe that water flows downhill. On impermeable/raincoat surfaces (like a parking lot) water stays on the surface while on permeable/sweater surfaces (like fields and forests) it soaks into the ground. Connect to prior learning: other activities of the day, the soil curriculum from 3rd grade (water moves though different sized soil particles at different rates).

c. Ask students to list/describe some of the different surfaces around the school. On the dry erase board, keep a T-chart of responses, listing "sweater" surfaces on one side, and "raincoat" surfaces on the other.

2. <u>Student Observations:</u>
   a. As suggestions wane, display the large aerial image of the school's schoolyard area and ask students to estimate what fraction of the property's surface is impermeable (surface that water cannot go through) vs. permeable (surface that can soak up water).
      Inquire: Look around. Where do you predict the water will flow if it falls on the parking lot? On the grass? Be sure to discuss the major surfaces listed by students.
   b. Students work in pairs to identify and record on their maps pervious and impervious surfaces and direction of water flow.
      i. Provide each group with a data sheet and red and green colored pencils, and blue and brown markers.
      ii. Help students decode the datasheet by investigating the key, reading the directions, and looking at the questions. Unlock the map by finding and labeling a few key features as a group. Encourage students to label more features to help them match the map to the landscape.
      iii. Instruct students to color all impervious surfaces red and all pervious surfaces green onto the student datasheets.
      iv. Instruct students to draw blue arrows to show where water goes. If they see a drain, draw an arrow towards the drain. If they see a slope, draw an arrow pointing downhill. On permeable/sweater surfaces the water can soak in or flow. Use blue to draw arrows to show the water flow direction and brown to make dots where water can soak in.
      v. Show students how to determine the direction of the slope using marbles or the simple level (Marbles roll down smooth surfaces, much like water. The level can be used on uneven surfaces.).
   c. As groups finish designating water flow and permeable/impermeable surfaces, instruct students to count how many squares are impermeable (raincoat) surfaces and how many are permeable (sweater) surfaces.
   d. If they wish, they may label features on the map and add additional symbols to the key.

3. <u>Conclusion</u>:
   a. Bring class back together to estimate the fraction of the schoolyard surfaces and compare student findings to their T-chart. Which surfaces did they see? Are there any surfaces that were missed? Look together at an aerial photo and large map that show nearby waterways. Based on their observations, where do they think the water at their school goes? Then where?
   b. If time remains, explore other parts of the immediate area – focusing on how water moves in that area, and how human beings try to control it. If time is short, reflect in place.
   c. Water moves quickly over impermeable (raincoat) or sloped surfaces, and slowly over permeable (sweater) or flat surfaces. Thinking about the fraction of the surface that is impermeable or sloped, and makes water move fast, versus the fraction that is permeable or flat and slows water down, how might rainfall at school affect nearby waterways after a big rain?

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(Does it speed up, cause erosion, or flooding? Does it pool in place and cause puddles?) If the movement of rain over the ground causes any of these problems, do students have any suggestions to help alleviate the issues?

Bad Weather Plan: Use visuals (projector and Google Earth are ideal, otherwise the large and small scale aerials and local maps) indoors instead of active exploring.

Substitute the following materials: projector, internet connected computer with Google Earth already installed, with the USGS topo map layer included (optional watershed layer – at CB scale), and zoomed in to the appropriate location, OR the same aerials and maps that would be used in the outdoor activity.

Extensions:

Mathematics SOL 4.3: Students determine the decimal equivalents for the fraction of permeable and impermeable surfaces and write these on their data sheets

School yard Surfaces Change over Time: Use aerial photos from different years. Students can compare how the ground surfaces have changed overtime. What do they predict those changes could do to their watershed? Some specific questions to explore:

- Has the route of water flow changed over time?
- Do you think the rate of water flow (how much and how fast water moves) has changed? What evidence supports their hypothesis?
- Has the quantity and type of run-off changed? In what ways and why?
- Do you see any evidence of erosion? Why is it there? How could it affect the watershed (land and water)?

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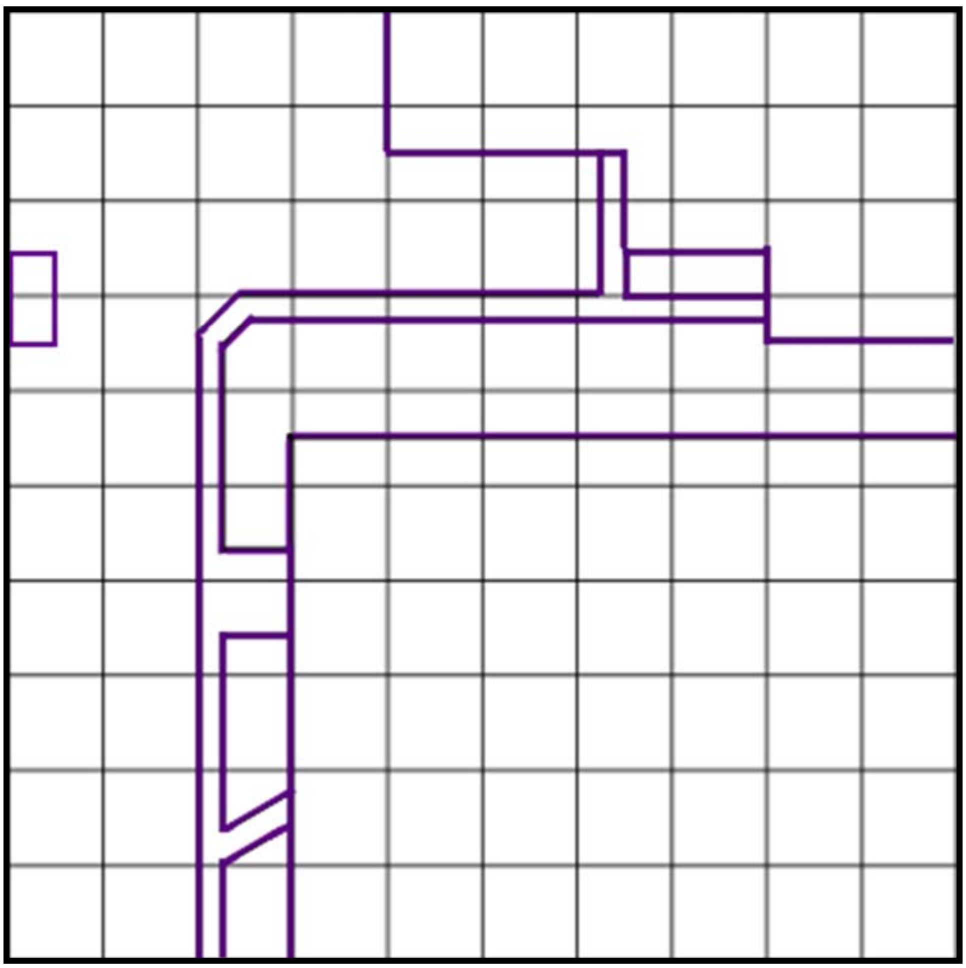
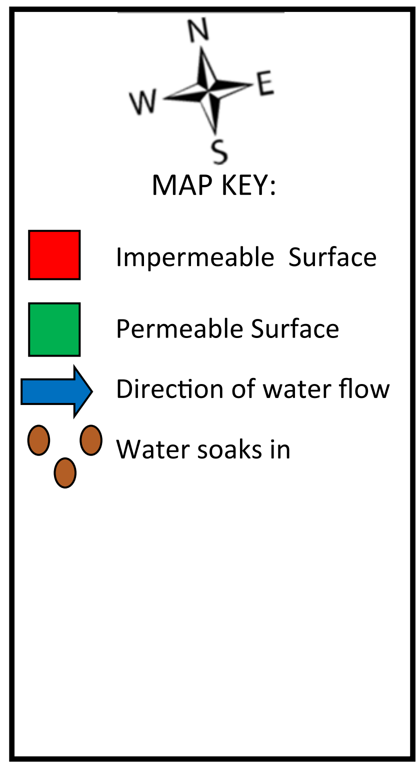
Cooley Schoolyard Surfaces

1. Color all surfaces on the map that **water doesn't soak into** (impermeable) RED.
2. Color all surfaces on the map that **water can soak into** (permeable) GREEN.
3. Draw arrows on the map showing **which way water flows** in BLUE. If it's hard to tell which way the land tilts, use a marble tool
4. Draw BROWN dots on the map showing **where water soaks into the ground**.





Total number of squares on the map =

A. Find the number of impermeable squares. ______ Round to the nearest whole number ______

B. Find the number of permeable squares. ______ Round to the nearest whole number ______

What fraction of the total surface is impermeable? _________

What fraction of the total surface is permeable? _________

EXAMPLE OF STUDENT WORK

Cooley Schoolyard Surfaces

- Color all surfaces on the map that **water doesn't soak into** (impermeable) RED.
- Color all surfaces on the map that **water can soak into** (permeable) GREEN.
- Draw arrows on the map showing **which way water flows** in BLUE. If it's hard to tell which way the land tilts, use a marble tool
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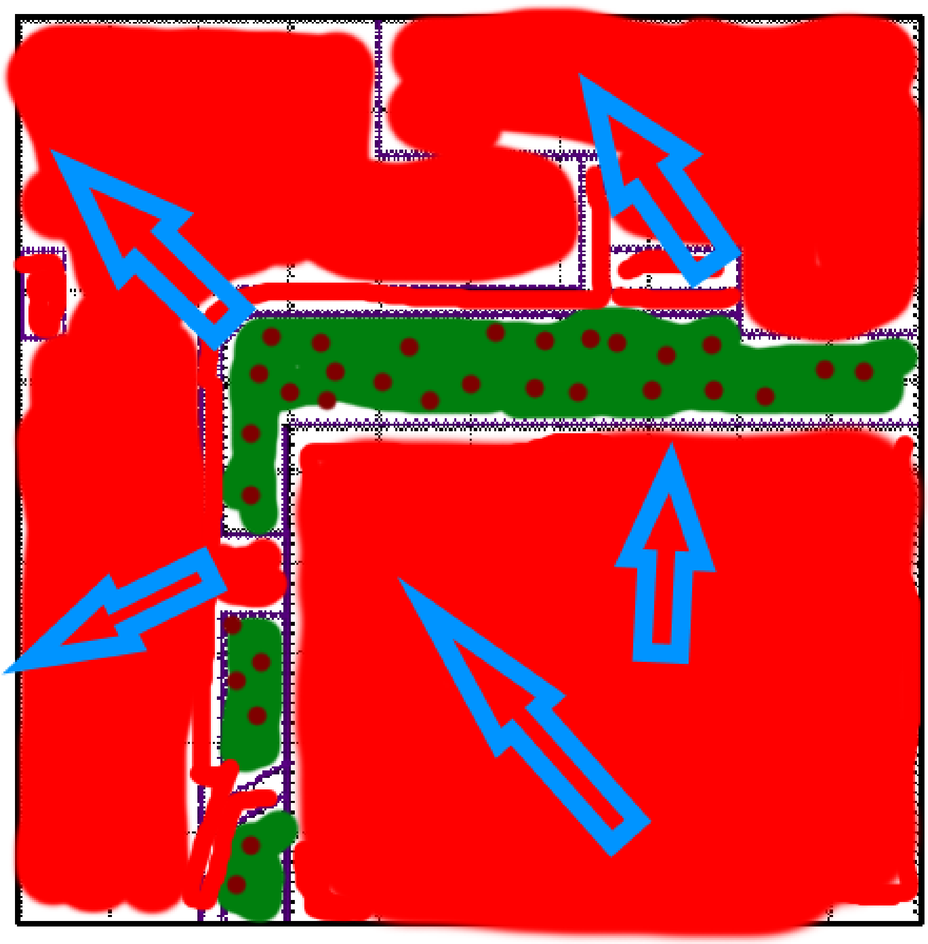

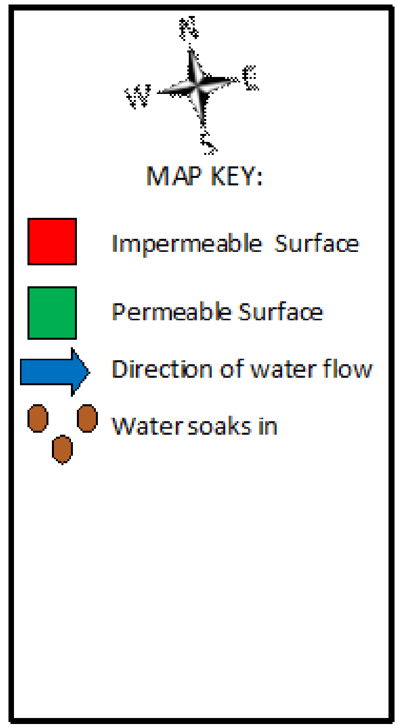

Total number of squares on the map =

A. Find the number of impermeable squares. 84 Round to the nearest whole number ______

B. Find the number of permeable squares. 16 Round to the nearest whole number ______

What fraction of the total surface is impermeable? 21/25

What fraction of the total surface is permeable? 4/25