Name:__________________________________ Date:________________

Glacial Deposition and Groundwater

Focus on Dutchess County

Thousands of years ago an enormous ice sheet blanketed the Hudson Valley in what was called the Wisconsinan Glaciation. The ice reshaped the land in its southern advance and northern retreat, leaving scars and signs that can still be discerned today. We have these glaciers to thank for the landscape we enjoy so much today – from the beaches of long island, to the Hudson River and Catskills. The glaciers were involved in each of their formations.

Yet, the glaciers did more than just carve and create natural beauty. They left behind sediments that play an integral role in our everyday lives. These sediments are used in industrial, commercial, and residential ways that we often don't even realize. In this activity you will see how these glacial sediments were deposited and how they hold the groundwater that is so important for sustaining communities here in the Hudson Valley.

Preliminary Questions:

1. Look at the Glacial Deposits Map for Dutchess County. What are the three types of Deposits left behind by the last glacial advance?

   a.

   b.

   c.

2. Describe the physical characteristics of each of the three kinds of deposits listed in the previous question.

   a.

   b.

   c.

3. Look at the direction that the three types of sediment were laid down in, especially sand and gravel. In what general direction are the deposits distributed? How did the deposits come to lie this way and what does this tell you about the movement of the glaciers that once existed in NY?

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4. What is odd about the placement of Lacustrine deposits in Dutchess County?

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Activity:

Each group has in front of them one cup glacial till, one cup lacustrine deposit, and one cup sand and gravel. It is your job to determine the permeability of each of the three glacial deposit types found in Dutchess County. After completing this activity, you will discover which deposit is best for holding groundwater that in turn can be tapped for drinking.

1. Measure out 100 ml of water.
2. Add 2-3 drops of food coloring to the water and stir with a dropper
3. Your partner should be ready with the stopwatch. Pour the colored water on the glacial till all at once. As soon as the water hits the sediment, have your partner start the stopwatch. Stop the stopwatch when all of the water has permeated (gone into) the sediment.
4. Record your data in the table provided.
5. Repeat steps 1-3 for the lacustrine and sand and gravel cups.

Deposit Type	***Time for 100% Permeability***
Glacial Till	
Lacustrine	
Sand and Gravel	

In the space below, draw diagrams showing the sediment composition in each of the three cups, including the pore spaces or lack thereof in your picture. Be sure to label your diagrams and the different sediment types found within each sample.

Activity Questions:

1. Which sediment type has the highest rate of permeability? Which has the slowest?

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2. Explain why you got the results you listed in the previous question (Hint: Think sediment size).

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3. Which deposit type do you think would be the best to have under or near your house if you got your drinking water from a well? Why?

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4. If you had unlimited time and resources, how could you have improved this experiment?

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Predictions:

1. Refer back to the Glacial Deposit Map for Dutchess County. Name three townships that you think have groundwater as their main supplier of drinking water.
   a.
   b.
   c.

2. Name one town that may have to get its drinking water from a source other than the ground or may have to supplement with other water resource to meet its water demands.
   d.

3. Go on-line at home or in school and find the water source of the drinking water in each of the towns you listed in the previous two questions.
   a.
   b.
   c.
   d.

4. Now look at the Dutchess County Groundwater Occurrences Map. Do any of your predicted towns fall in the gray or dark blue areas? (Those are areas that contain at least some sand and gravel.) If so, which ones?

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5. Notice that limestone is also addressed on this map. Water that falls from the sky tends to be slightly acidic. In time, that water will percolate down through the ground to the limestone. What happens when you put acid on limestone? What kind of weathering is this?

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Consider how highly permeable sand, gravel, and limestone are—together, they possess a high capacity for groundwater storage!

6. In conclusion, write a paragraph (at least four complete sentences) describing how glaciers shaped the Hudson Valley's sediments and impacted the groundwater supply that we utilize today in Dutchess County.

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Excerpt from "The Hudson: A History" by Tom Lewis

From Chapter 1: The River and the Land

…The most recent rending of the land occurred about an hour ago in geologic time. Roughly 22 million years ago the earth's climate began to cool; by about 2 million years ago the path of the Hudson Valley lay under a thick sheet of ice that covered even the high peaks of the Adirondacks. At times the glacier advanced; at others it receded; and each time it left its mark upon the landscape. The last ice sheet, the Wisconsin, culminated about 20,000 years ago. It had the greatest impact on our present land, eliminating and reworking earlier glacial deposits. It was possibly 350 feet thick, exerting extraordinary pressure that actually flattened the land. The Atlantic Ocean was perhaps 400 feet lower than today, exposing about 100 miles of the continental shelf. The receding sheet eased the pressure on the land, allowing it to rise, with the result that the valley of the Hudson that had been created over a hundred million years earlier became both wider and deeper.

As the southern edge of the Wisconsin ice sheet receded, glacial ice also flowed south to create an immense terminal moraine of sand and gravel that we know as Long Island. Today the Hudson passes from the Upper to the Lower Bay through the Narrows, but this wasn't always the case. The moraine of Long Island once extended west, damming the waters from the glacier to create Glacial Lake Hudson. The lake very possibly extended northward to the Tappan Zee and spilled through the Sparkill Gap into New Jersey. Into this glacial lake streams and rivers often deposited layers of sand, gravel, and clay left by the glacier. Glacial Lake Hudson lasted for thousands of years before the force of the water finally cut a path through the Narrows to the ocean. Today we see unmistakable signs of this geologic event in the clays, sands, and sediments like those found at Croton Point, where the present-day Croton River meets the Hudson.

The narrow passage of the Hudson through the Highlands that we see today did not exist under the Wisconsin ice sheet. At that point a barrier of rock arose as the ice retreated to create another huge lake-Glacial Lake Albany-that extended from the Highlands northward to Glens Falls and westward into the region of the lower Mohawk valley. Again, streams and rivers that emptied into the lake marked their union with deposits of sediments. Like Glacial Lake Hudson to the south, Lake Albany scoured its way through the metamorphic rock barrier at the Highlands to complete the river's present course to the sea.

Scientists have found another, unseen, Hudson that takes an important place in the geological story. After the waters flow through the Narrows between Brooklyn and Staten Island, and southeast toward the Ambrose Light, the river seems to end. Twenty thousand years earlier, when the Wisconsin ice sheet was receding and the continent extended about 130 miles farther, to the rim of the continental shelf, the river could be seen flowing through a channel before dropping into a deep gorge. Since the waters from the receding ice sheet made the Atlantic Ocean about 400 feet deeper, the floor of this great submerged gorge geologists call it "Hudson Canyon"-lies between 9,000 and 15,000 feet beneath the ocean's surface. Other East Coast rivers, the Delaware and the Potomac, have similar canyons, but the Hudson Canyon is the greatest of them all.