Niagara Whirlpool

Subject: Science
Grade 7-12

New York State Learning Standards

New York State Learning Standards for Mathematics, Science and Technology

Standard 1: Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seeks answers, and develop solutions.

1.1 Scientific Inquiry

1.11 The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing, creative process

1.12 Beyond the use of reasoning and consensus, scientific inquiry involves the testing of proposed explanations involving the use of conventional techniques and procedures and usually requiring considerable ingenuity

Standard 2: Students will access, generate, process, and transfer information using appropriate technologies

2.11 Information technology is used to retrieve, process, and communicate information and as a tool to enhance learning.

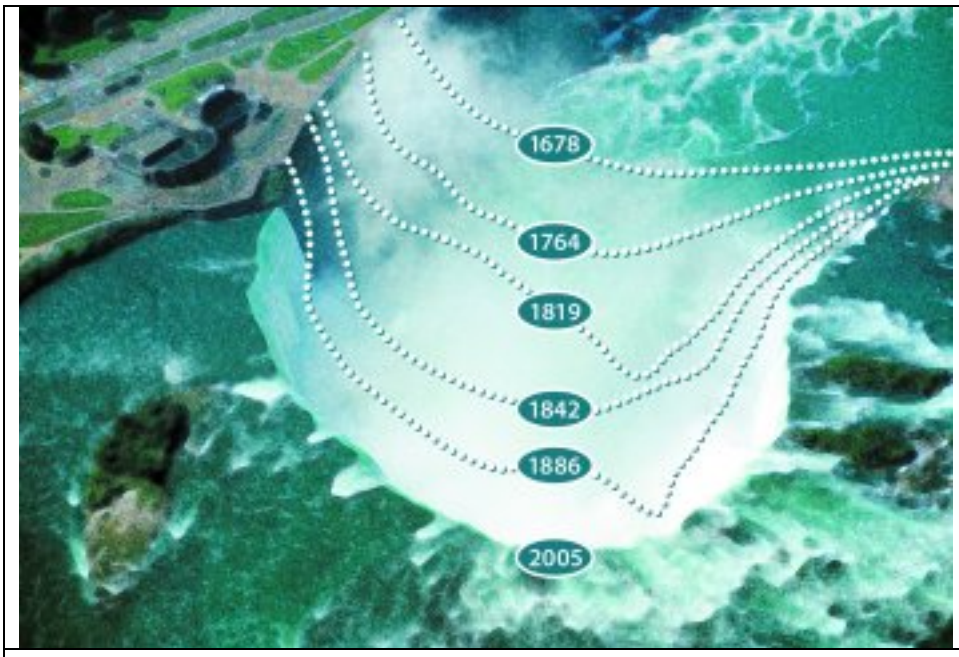
Overview

The Niagara Whirlpool is a natural whirlpool along the Niagara River. It is a basin measuring 1,700 feet long and 1,200 feet wide. Located on the United States-Canadian border, it is downstream from Niagara Falls in the Niagara Gorge. After rushing from the fall, the enormous volume of water is crushed into the narrow Great Gorge. This torrent of water created the Whirlpool Rapids that stretch for one mile. Here, the water surface plunges fifty feet. The speed of the rushing water often reaches as high as fifty miles per hour. Located where the Niagara River makes a sharp right angled turn, the greatest depth of the Niagara Whirlpool measures 25 feet. .

The Niagara Whirlpool is an example of “reversal phenomenon." When the Niagara River is at full flow, the waters plummet over the rapids and enter the pool. They then travel counter-clockwise around the pool past the natural outlet. When the water tries to cut across itself to reach the outlet, pressure builds. The resulting pressure forces the water under the incoming stream. The swirling waters create a vortex, or whirlpool, and then continue their journey to Lake Ontario.

When the flow of water is normal, the whirlpool spins in a counter clockwise motion. When the water flow is low, the whirlpool spins in a clockwise motion because the reversal does not occur. Usually, the cause of a low water flow is the diversion of water after 10PM each night for hydroelectric purposes. When the water flow is low, the water merely moves clockwise through the pool and passes to the outlet.

The whirlpool formed approximately 4,200 years ago by the upstream erosion of the Niagara Escarpment by the Niagara River. Niagara Falls is located along the boundary of the Niagara Escarpment. Since its formation, Niagara Falls has been retreating upstream.



Niagara Falls has been slowly retreating upstream over the years. The location of the Niagara Falls at different times is indicated on the picture to the left.

Source: "Niagara Falls Geology Facts & Figures" at http://www.niagaraparks.com/media/geology-facts-figures.html

During the slow retreat, the falls intersected with an ancient pre-glacial river bed inside Saint David's Buried Gorge. During the retreat of ice from the Wisconsinan glaciation of the last glacial period, the gorge filled with loose sediment and rock. As Niagara Falls intersected with this buried gorge, the river quickly washed away the filled-in silt and rock. The sharp and abrupt change in direction of water flow caused the water to swirl. . Also, the rapid flow of water exiting the Niagara Gorge, often a speeds as high as 30 feet per second, contributed to the swirling of the water. With the further erosion of the harder rock, a rounded basin developed. This basin extends just to the side of the actual course of the Niagara River. Whirlpool State Park is located along the Niagara Gorge.

The Niagara River whirlpool basin in Niagara Gorge

Source: "Niagara Whirlpool" at http://en.wikipedia.org/wiki/Niagara_Whirlpool

Activity

Students will use Wikipedia, the free encyclopedia to match terms associated with the Niagara Whirlpool to definitions.

	Term	Answer		Definition
1	Wisconsinan Glaciation		A	River that has continuous flow in parts of its stream bed all year round during years of normal rainfall
2.	Silt		B	Process by which soil and rock are removed from the Earth's surface by exogenetic processes such as wind or water flow, and then transported and deposited in other locations
3	Perennial River		C	Any whirlpool that has a downdraft
4	Gorge		D	Most recent major advance of the North American Laurentide ice sheet that occurred approximately 85,000 to 10,000 years ago
5	Erosion		E	A swirling body of water produced by the meeting of opposing currents
6	Rapid		F	The cliff over which the Niagara River plunges at Niagara Falls
7	Basin		G	Granular material of a size somewhere between sand and clay whose mineral origin is quartz and feldspar.
8	Vortex		H	Sections of a river where the river bed has a relatively steep gradient causing an increase in water velocity and turbulence
9	Whirlpool		I	A geological depressions:
10.	Niagara		J	A deep ravine between cliffs often carved from the

	Escarpment			landscape by a rive

Extension Activity

Students will conduct a science project that demonstrates how whirlpools are formed

Materials Needed

Two clean, empty 2 liter bottles
Water
Duct tape
Food coloring

Instructions

1. Remove the tops from both bottles.
2. Fill the first bottle three quarters full of water.
3. Add a few drops of food coloring.
4. Hold the second bottle above the first so the bottle openings fit together.
5. Use the duct tape to join the two bottles together tightly
6. . Tip the bottles so the water flows over the joined section to determine that there is no water leak.
7. Add more duct tape if there is a leak to prevent any additional water leaks.
8. Create a vortex by turn the connected bottles vertically so that the bottle with the water is above the empty bottle.
9. Swirl the bottles in a circular motion as rapidly as possible.
10. A whirlpool will form in the top bottle as it drains into the bottom bottle.

References

Marcotte, Dawn (2013) *How to Make a Whirlpool Science Project* at http://www.ehow.com/how_6346142_make-whirlpool-science-project.html
Niagara Gorge at http://en.wikipedia.org/wiki/Niagara_Gorge
Niagara Falls Geology Facts & Figures at http://www.niagaraparks.com/media/geology-facts-figures.html