

Lesson Five: Waterfalls

Factsheet

Purpose of Lesson

In this lesson pupils will learn how waterfalls are formed and their key characteristics. Four different waterfalls will then be located and investigated: Niagara Falls on the American/Canadian border in North America; Angel Falls in Venezuela, South America and High Force and Gaping Gill in Yorkshire, England.

Vocabulary

This lesson includes the following geographical terms. These should be used and explained to pupils as the lesson is taught.

Upper course	The first stage of river, often located on high ground
Middle course	The second stage of a river, where the land is flatter and the river wider
Lower course	The land is flat and the river is at its widest
Channel	The river bed and banks in which water flows
Erosion	Material is cut away from the river beds and banks by the water
Transportation	When eroded material is taken downstream
Deposition	Material is 'dropped' or deposited when the river no longer has the capacity to carry it
Strata	A layer of rock
Overhang	The hard rock strata that protrudes over the soft rock strata beneath on the outer ridge of the waterfall
Plunge pool	A deep pool created at the base of the waterfall, due to the erosive effect of turbulent water and swirling rocks
Retreat	The waterfall moves backwards upstream, or retreats, as the overhang collapses
Gorge	A steep-sided ravine, left as the waterfall retreats upstream

Annie Edson Taylor (1838-1921)

On October 24th 1901, Annie Edson Taylor, a 63 year old school teacher, was the first person ever to ride down Niagara Falls in a barrel. The *Waterfalls* PowerPoint presentation (see downloadable resources) includes an image of Annie Edson Taylor and the barrel. Her motive was to garner fame and fortune; her husband had died many years previously and she struggled financially. She chose the Horseshoe Falls, Canada, for her stunt, hiring a manager to promote it and several thousand people came to watch.

The large oak barrel she used was heavily padded and weighted down at the bottom with a blacksmith's anvil to keep the barrel floating up right. The lid of the barrel was screwed on with ordinary wood screws and air was pumped into the barrel using a bicycle pump. Rather than doing the feat alone, some reports of the event state that Annie took her pet kitten with her.

The barrel rode through the upper rapids, before plunging over the Horseshoe Falls and disappearing into the swirling water below. It was several minutes before the barrel bobbed to the surface and 20 minutes more before it floated near enough to the Canadian shore for rescuers to reach it.

According to reports of on the event, Annie's first words were, "I prayed every second I was in the barrel except for a few seconds after the fall when I went unconscious.....Nobody ought ever to do that again." It was ten years before another person did.

Unfortunately, she did not make her fortune from the event; her manager embezzled much of her money.

Other Niagara daredevils: Since Annie Edson Taylor's barrel stunt, 14 people have gone over the falls in, or on a device: while some have survived, others have been severely injured or have drowned. It is now illegal, on both sides of the border, to attempt to go over the falls.

In 2012, Nik Wallenda, a high wire artist became the first person to walk across the falls in 116 years, having received special permission from both governments. His tightrope was 550m long. He carried his passport on his trip and was required to present it upon arrival on the Canadian side of the Falls.

In January 2015, Will Gadd became the first person to climb up Niagara Falls. He climbed a frozen section of the Horseshoe Falls. There are many clips available on line of Gadd's feat. To see a short report, go to the BBC website <http://www.bbc.co.uk/newsround/31060065>

The Niagara Falls

Location: The Niagara Falls are located on the Niagara River, which drains Lake Erie (USA) into Lake Ontario (Canada). The Niagara River is 58km in length.

The Niagara Falls is comprises three waterfalls that mark the border between the United States of America and Canada. The largest, at 670 metres wide is the Horseshoe Falls, which lie in Canada. The other waterfalls are located on the US side: the American Falls and the Bridal Veil Falls with a combined width of 208 metres.

Height: There are approximately 500 waterfalls in the world that are higher than the Niagara Falls. Measured from the top of the Falls to the river below, the height of Niagara is at a maximum 57 metres (the Horseshoe Falls being slightly shorter than the American Falls).

Flow: Some of the higher falls have very little water flowing over them. In contrast, at its peak during the summer tourist season, more than 2,800 cubic metres of water per second flows over the overhang of Niagara Falls. Out of season, more water is diverted to two hydroelectric power stations, so the flow is less, at 1400 cubic metres per second.

Speed: The rapids above the Niagara Falls reach a maximum speed of 40 km per hour (25mph). As the water flows over the overhang, it plunges at 109km per hour (68mph).

Erosion: Niagara Falls has retreated 11km (7 miles) in 12,500 years. Its current rate of erosion is approximately 30cm per year. In 50,000 years, at the present rate of erosion, the remaining 32km (20 miles) to Lake Erie will have been undercut and Niagara Falls will no longer exist- replaced by a river channel with a series of rapids.

Using the water from Niagara: The water from the Niagara River is used by over 1 million people in USA and Canada. Some of the water is used for drinking; however the majority of the water is used to produce hydro-electric power. On the USA side, the Robert Moses Niagara Hydroelectric Power Station and the Lewiston Pump Generating Plant produce enough power to light 24 million 100 watt light bulbs. In Canada the Sir Adam Beck Stations 1 and 2 are the largest of several plants that harness the water from the River Niagara.

The **1950 Niagara Treaty** stipulates the amount of water that can be diverted. From April to September (the peak tourist season) less water can be diverted for hydro-electric power, ensuring that visitors to the Falls have a spectacular view!

Tourists: 12 million tourists visit Niagara Falls each year.

Formation: The Great Lakes that flow into the Niagara Falls were formed during the ice age as the ice retreated.

The Angel Falls

The Angel Falls is the highest waterfall in the world, falling 979 metres from the flat-topped plateau, Auyán-Tepuí or Devils Mountain. It is located in the Canaima National Park (a UNESCO World Heritage Site) on the Churun River, south east Venezuela. The Canaima National Park is 30,000km². The waterfall is best seen during the rainy season between June and December.

The Angel Falls is called Salto Ángel in Spanish and Kerepakupai Vená – “waterfall of the deepest place” in the indigenous Pemon language. The falls were named after James Angel, an American adventurer who, in 1939, crash-landed his plane nearby.

To see the Angel Falls requires a plane journey into the Canaima National Park, followed by a four hour boat trip along the Churun River and finally an hour's hike through dense forest.

Under certain conditions, a visitor can feel small water drops from 1 km away.

High Force

The High Force waterfall is located on the River Tees, in the Yorkshire Pennines. The waterfall drops 21 metres into the plunge pool below. The gorge left by the retreating waterfall is 700 metres long. Every year the waterfall retreats by five to six mm. To view a video clip of High Force in action go to the BBC website <http://www.bbc.co.uk/education/clips/z63qxn> Play the first half of the clip only.

Gaping Gill

Gaping Gill waterfall is located on the south west slopes of the high peak of Ingleborough, North Yorkshire. At 98 metres Gaping Gill, on the river Fell Beck, is the highest unbroken waterfall in England. However, it cannot be seen from the surface because the river abruptly and dramatically plunges the 98 metres into a pothole, finally reaching a large cavern below known as the Main Chamber. Pothole clubs hold regular ‘winch meets’ to allow tourists to venture down into the cavern to see the waterfall.

Measuring the height of waterfalls

A waterfall can have an ‘unbroken’ height, in which the water flows uninterrupted from the overhang to the river below. The height of a waterfall can also be measured from the overhang to the river below, but may be interrupted by rock outcrops or ledges; in this case the height is a cumulative total of several drops. Some waterfalls occur on the surface and others below ground. On this basis it is difficult to collate a list of the UKs ‘highest’ waterfalls as many claim the title.