# Dam burst danger

## Modelling the collapse of a natural dam in the mountains – and the disaster that might follow

When glaciers in high mountain regions melt they often leave behind deep lakes. The lake waters are held back by natural dams, formed by piles of rocks, sand and clay dumped by the melting glacier. This debris is called moraine.
Moraines often contain large hidden blocks of ice among the debris. These can take years to melt, and when they do, the natural dam may break suddenly, releasing a flood of lake water, which rushes down the mountainside, sweeping all before it.

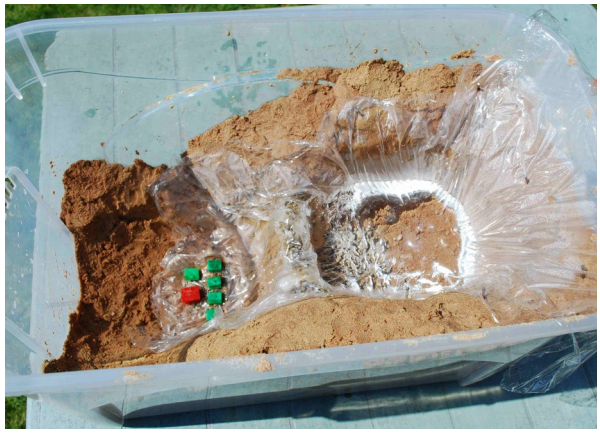
A glacial lake drained rapidly when the moraine dam collapsed, releasing tonnes of grey debris onto the valley floor below. Artesancocha, Cordillera Blanca, Peru.
(*Photo: © RGSL 2009)*

Villages sited in the valleys below the dams may be destroyed and people drowned.

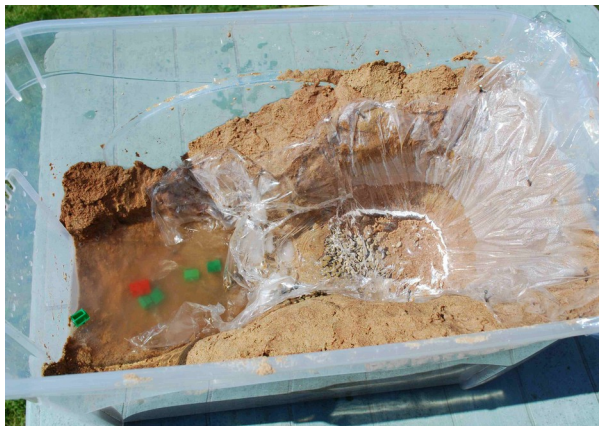
This village had a narrow escape when a moraine dam burst and the flood brought rock debris very close to the houses. Tsabai Tsho, Nepal. (*Photo: © RGSL 2009)*

Try making a model to see what might happen as follows:
Make a deep valley in a container, using modelling clay or damp sand. Near the lower end of the valley, place some ice cubes and cover them lightly with loose dry gravel or sand to make a mound, representing the moraine. Cover the model loosely with a very thin plastic sheet and raise one end on a block. Fill the valley with hot (not boiling) water to make a lake. Put some model houses below the dam.
Leave the model in a warm place to allow the ice cubes to melt (or warm the 'moraine dam' with a hair drier). See what happens when the ice cubes melt. Does the dam collapse? Does the flood water wash away the 'houses'? What do you think it might have been like to be there at the time?

The valley model, with the ice-cored 'moraine' before being covered by the plastic sheet *(Photo*: *Peter Kennett*)

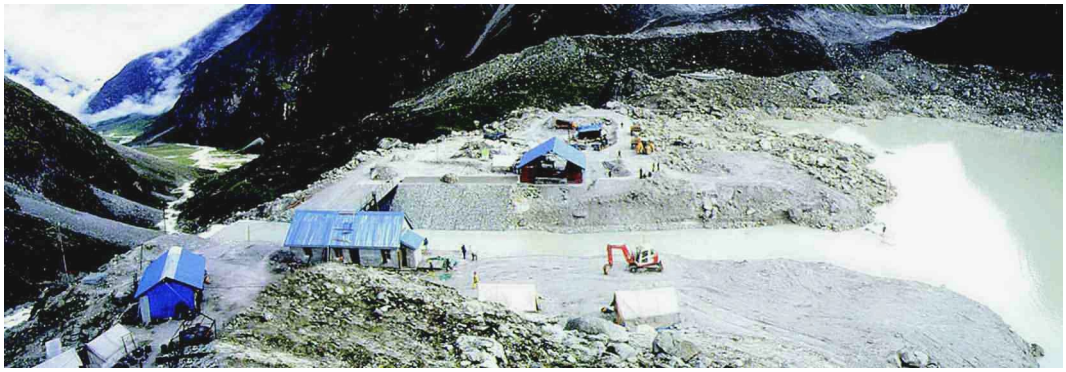


The valley model with houses in place and the 'lake' filled with water (*Photo*: *Peter Kennett*)



After the flood – the water has broken through the dam where the ice blocks have melted and washed away half a "village". (*Photo: Peter Kennett*)

What do you think could be done to avoid such a disaster – to save the people and to save their homes?



A spillway and sluice gates, built to control the release of water from the moraine-dammed lake, Tsho Rolpa, Nepal (*Photo: © RGSL 2009)*

## The back up

**Title:** Dam burst danger

**Subtitle:** Modelling the collapse of a natural dam in the mountains – and the disaster that might follow.

**Topic:** Finding out what happens when ice blocks that have been trapped in a model moraine melt to release a 'lake' of water.

**Age range of pupils:** 11–18 years

**Time needed to complete activity**: 30 minutes, depending upon the rate of melting of the ice cubes

**Pupil learning outcomes:** Pupils can:
- explain how glacial debris, including ice blocks, may form a natural dam;
- explain why living in the valley below such a dam may be hazardous, even though the dam may have been stable for many years;
- suggest ways of reducing the hazard in a real life situation.

**Context:**
People who live in mountainous regions mostly have to live in the valley bottoms where the land is flatter. Lakes formed by moraine dams may be many metres above the settlements and are often used as sources of water or for the generation of hydro electric power. Moraines frequently contain hidden blocks of ice, which melt many years after the glacier has retreated. If this produces a low point in the natural moraine dam, water will flow over it and the erosional power of the flowing water and the pressure of water in the lake may cause catastrophic failure of the dam, with disastrous consequences to the people living below it. Geophysical methods (e.g. resistivity and ground penetrating radar) can be used to detect hidden ice blocks in areas of potential danger. The risk of dam failure can be reduced by building spillways to prevent the lake level from becoming too high. Failing that, a good evacuation plan is needed.

**Following up the activity:**
- If the model is made up before the pupils have seen it, and before the plastic sheet is in place, ask them to probe the dam with a thin stick to see if they can find the ice blocks.
- Ask pupils to predict where they think the dam will fail first.
- Pupils could carry out research for such situations in their own country, or carry out a web search for high level lakes in mountainous regions such as Nepal or Tibet.

**Underlying principles:**
- Rock debris is a good heat insulator and buried ice blocks can remain for many years before they melt.
- Geophysical methods (e.g. resistivity and ground penetrating radar) may be used to detect hidden ice blocks.

**Thinking skill development:**
Pupils establish a pattern that buried ice blocks can cause dam collapse when they melt, on a model scale and then apply their knowledge to some real situations (bridging).

**Resource list:**
- a waterproof container, such as a gutter or a plastic food box
- enough damp sand or modelling clay to model a valley
- a little dry sand or gravel to model the moraine
- a few ice cubes
- some very thin plastic sheet e.g. Clingfilm™
- hot water
- toy houses or similar objects

**Useful links:**
www.geologyuk.com for case studies etc.

**Source:** This activity was devised by Peter Kennett of the Earthlearningidea team, based on work by Prof. John M. Reynolds (see website above).
We are most grateful to Prof Reynolds for his comments on this activity and for the use of his photographs. These photographs may not be used in other applications without first seeking the author's permission.