Landslide activity 3: **Make a debris flow**

Description: This lab demonstration is an easy and fun way to effectively produce a model debris flow landslide in the classroom. It can be used once as a simple demonstration or can become an experiment comparing the results of different slope angles and different sediment textures.

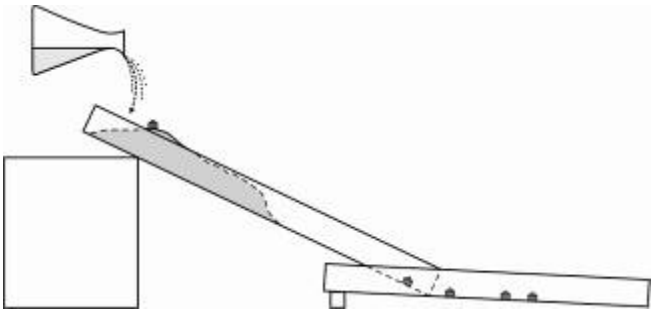
Purpose:

To demonstrate the effect of saturated groundwater conditions and heavy rainfall on unstable slopes and to observe the process of landslide movement and resulting landforms.

Materials:

- ~ 75 cm length of eaves trough or split pipe.
- Large flat pan
- Beakers of water
- Pail of earth

  Note: Use whatever loose sediment can be found locally. The demo works best if sand or a mixture dominated by sand is used and is particularly effective if some granules and very small pebbles are mixed in with the sand. It is important that the sand is wet in advance, but not soggy, so that the sediment can pack together.
- Empty boxes of various heights that can be used to support or tilt the trough and pan
- Protractor
- Small plastic houses from Monopoly game (optional)



Teacher instructions:

1. **Introduction:** Inform class that one type of landslide is known as a debris flow. In a debris flow, loose material, in a saturated state, loses cohesion and flows downslope in a fluid-like manner, carrying with it any trees, buildings etc. that were on the slope. The flow loses momentum when the slope becomes gentle and the debris spreads out in a fan shaped deposit and the water drains out of the debris. This type of failure is very common in western Canada and can be associated with heavy losses if it occurs in a populated area or along a transportation route. These landslides are generally triggered by heavy or prolonged rainfall or heavy snow melt.
2. Set up as in diagram.
   - Slightly elevate one side of the large pan to help drain water. The pan represents a break in slope and the flat land at the bottom of the slope.
   - Tilt the eaves trough at ~ 25° angle, supporting the high end with a tall box and placing the other end in the pan. Trough represents a steep bedrock slope.

- Pack dampened sand mixture tightly in the upper end of the trough, as shown. Sand represents loose sediment on the slope.
- Monopoly houses can be placed on the sediment and out on the 'flat land' of the pan to represent a community.

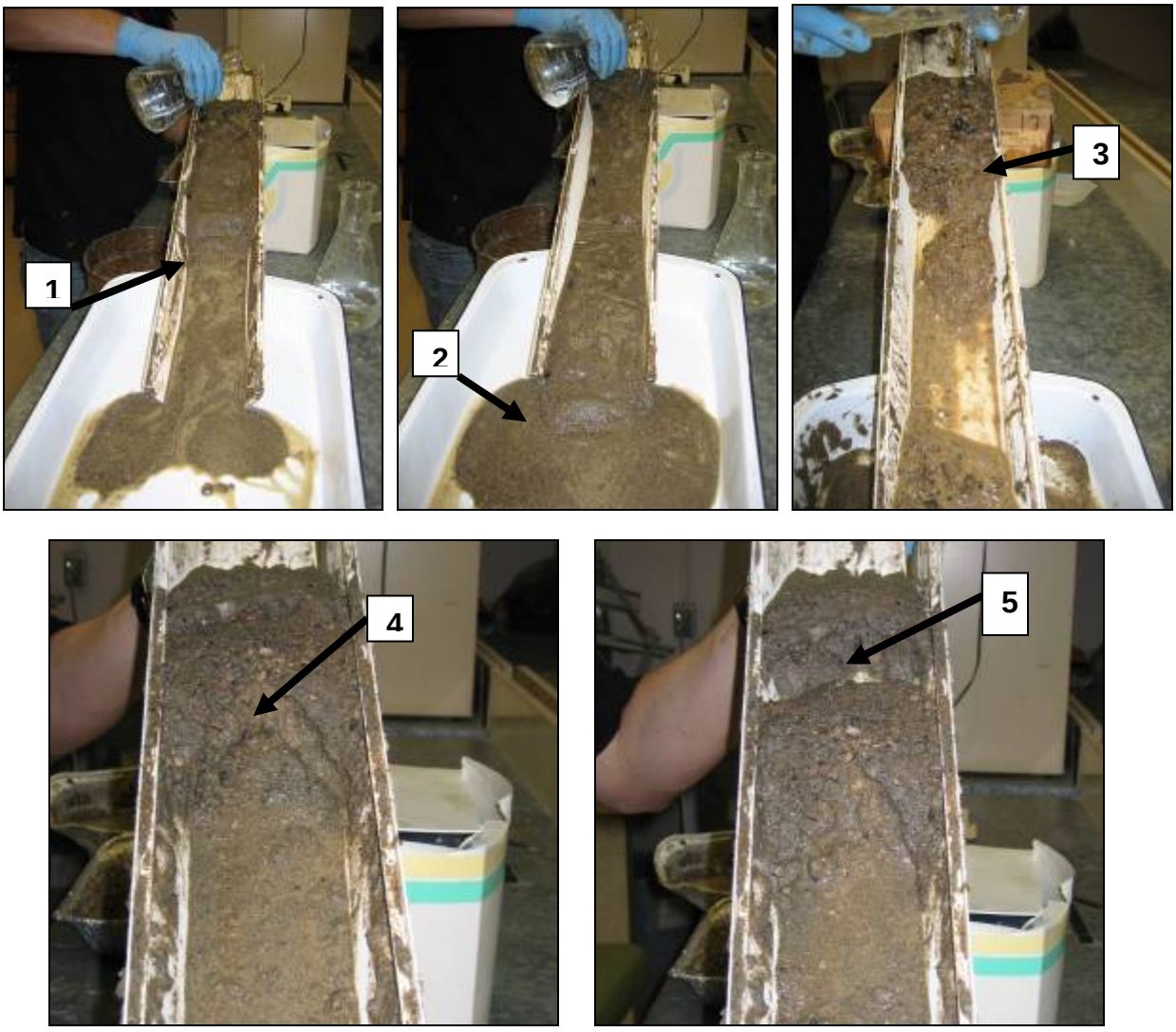
3. **Slowly** and **gently** pour water (representing rainfall) onto the sand at the top of the trough. Pause regularly to observe results.
4. Clean out the pan and refill the trough with more damp sand and repeat. Try different slope angles and observe the results.

Observations: See photos on page 3.

- Sand does not move until additional water is added (saturation).
- Much of the water sinks into the sand, moves through it and emerges at the lower end.
- The lower end of the sand becomes totally saturated and begins to move.
- Concave tension cracks may develop on the surface near the lower end, followed by a complete collapse of a saturated 'block' of sediment which then flows downslope in a slurry of wet mud. This action is repeated sequentially as the failure scarp moves back upslope. The flow may assume a lobate shape.
- Once it starts, the debris flow moves quickly.
- If addition of water stops, the landslide slows or stops. This is a laboratory case. In reality, the landslide is not so closely controlled by the rainfall of the moment.
- The debris flow stops at the break of slope, forming a fan-shaped landform. Some size sorting of the sediment may be visible. Concentric ridges may form on the fan.

Note: Results may vary depending on the angle of slope and the texture of sediment. If the sediment is very cohesive, like clay, water may flow downslope on the surface or between the packed sediment and the trough wall. If the sand is too dry at the start, water may only wet the surface layer and flow on the surface. If the slope angle is too low, water may flow on the surface. All the above would create a model of a fluvial system with little or no landsliding. On the other hand, if the slope angle is very high, a different type of landslide will occur. This type, known as a 'translational slide', moves as a more-or-less intact body, sliding on the underlying hard substrate.

Demonstration of a debris flow



Movement of a model debris flow:

1. Failure does not start at the top of the slope.
2. The top of the debris flow retrogresses upslope. Debris forms a fan at the bottom.
3. Most sediment has flowed downslope.
4. Close-up of a failure scarp (arrow) as a block begins to move as a mud slurry.
5. Separation and movement of a large mass.