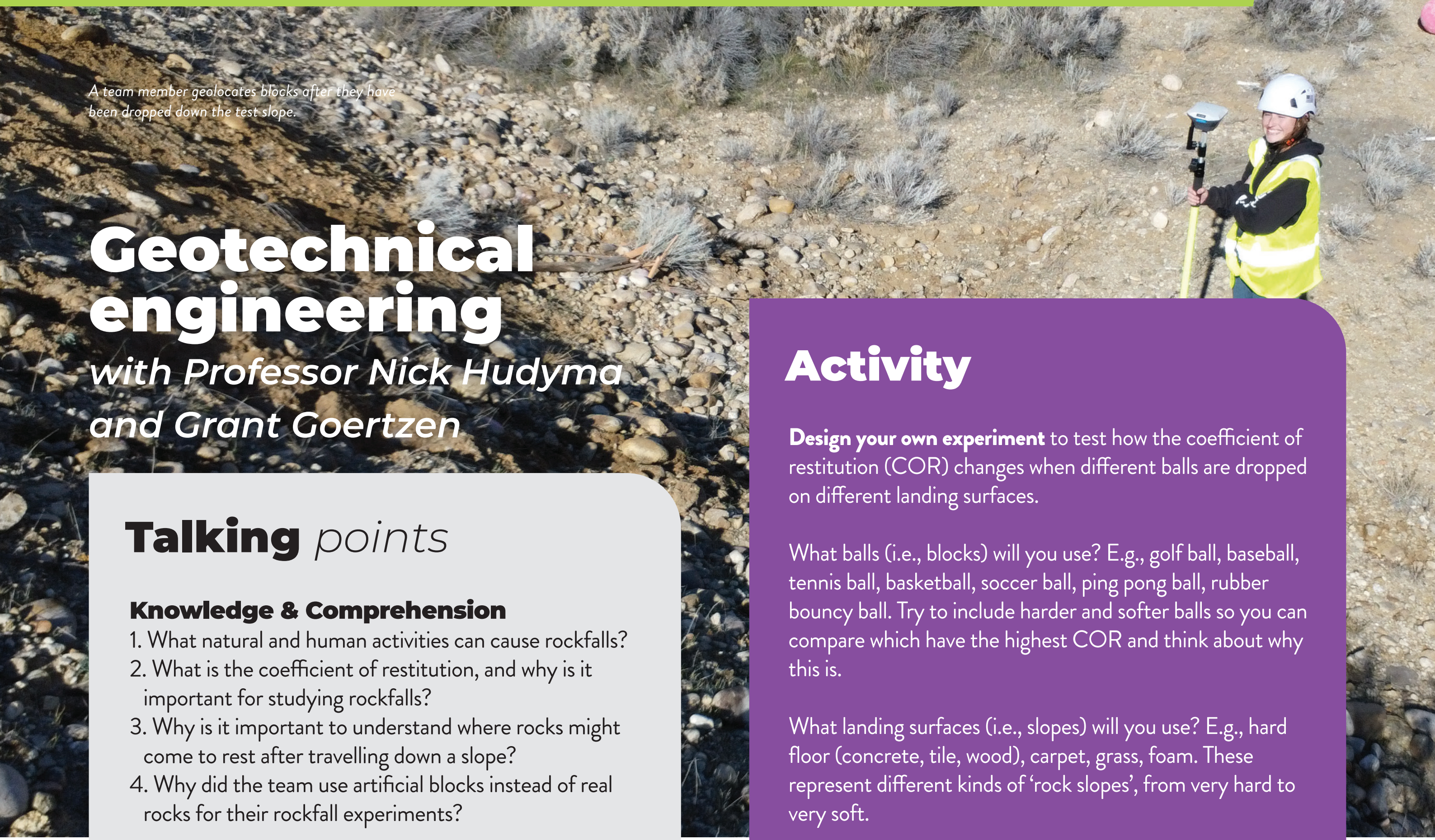

*A team member geolocates blocks after they have been dropped down the test slope.*

# Geotechnical engineering

## *with Professor Nick Hudyma and Grant Goertzen*

## **Talking** *points*

### Knowledge & Comprehension

1. What natural and human activities can cause rockfalls?
2. What is the coefficient of restitution, and why is it important for studying rockfalls?
3. Why is it important to understand where rocks might come to rest after travelling down a slope?
4. Why did the team use artificial blocks instead of real rocks for their rockfall experiments?

### Application

5. How do you think the preliminary maps and simulations helped the team decide where to place cameras and sensors during the experiments? How else do you think these maps and simulations informed the logistics of the test day?
6. How could geotechnical engineers use the team's findings to design protection measures along a mountain road?

### Analysis

7. Why do you think the artificial blocks were painted pink?
8. Why do you think block shape has such a significant impact on block motion during a rockfall?

### Evaluation

9. To what extent do you think simulations based on controlled experiments with artificial blocks can accurately predict real rockfalls?

## **More** *resources*

- The Geo-Institute of the American Society of Civil Engineers has a YouTube channel containing interviews with geotechnical engineers: **youtube.com/user/GeoInstituteASCE**
- This news report highlights the logistics of how the Idaho Transportation Department (which owns the gravel pits where Nick's team conducted their rockfall experiments) protected a road from rockfall hazards: **itd.idaho.gov/news/us-12-emergency-rock-scaling-project-starts-today-to-reduce-likelihood-of-rockfall**

## Activity

**Design your own experiment** to test how the coefficient of restitution (COR) changes when different balls are dropped on different landing surfaces.

What balls (i.e., blocks) will you use? E.g., golf ball, baseball, tennis ball, basketball, soccer ball, ping pong ball, rubber bouncy ball. Try to include harder and softer balls so you can compare which have the highest COR and think about why this is.

What landing surfaces (i.e., slopes) will you use? E.g., hard floor (concrete, tile, wood), carpet, grass, foam. These represent different kinds of 'rock slopes', from very hard to very soft.

What data will you collect before each test to define the ball and surface characteristics? E.g., ball type, ball diameter, whether the ball feels hard or soft, drop height, landing surface.

What data will you collect during and after each test? For each drop:
- Measure the rebound height (how high the bottom of the ball bounces back up).
- Do three drops for each ball–surface combination and take an average rebound height.
- Optional: Take slow-motion videos to help you see the rebound height more clearly.
- Record any observations: Does it make a loud sound? Does it squish? Does it roll after bouncing?
- Safely conduct your experiment and record your observations and results.
- Calculate the coefficient of restitution (COR) which, for vertical drops, is related to how much height the ball gets back after bouncing:

$$COR = \frac{Rebound\ \ height}{Drop\ \ height}$$

Compare COR values for different balls and surfaces, then answer questions such as:
- Which ball had the highest COR on a hard surface?
- How did COR change on softer surfaces like carpet or foam, and why?
- How does this relate to real rockfalls, where harder rocks and harder slopes often lead to bouncier, further-travelling blocks?