Inquiry Based Field Science in the Schoolyard:
Investigation of Elevation Change in School Landscape

Adapted from **Olympic Park Institute's** field science curriculum in the Old Growth Forest of the Olympic National Park

Overview and Objectives This is a guided inquiry in which students will conduct a **descriptive field science investigation** to determine the profile of a steep slope in the schoolyard. Later they will conduct a **comparative investigation** to determine whether the profile has changed over time. The **manipulated/independent variable** is time; the responding/dependent variable is the profile of the slope. (At Olympic Park Institute we use guided inquiries to prepare students for more complex open inquiries where *they* determine the investigative question.) Students will use simple equipment to gather data; develop descriptions, explanations and predictions related to a real world situation; think critically and logically to relate evidence and explanations; and communicate scientific procedures and explanations.

Based on the **National Science Education Standards,** all students in grades K – 12 should develop abilities necessary to do scientific inquiry and understandings about scientific inquiry. This investigation complements the following curriculum topics: mathematical slope, graphing, land and water interactions, native plant restoration, beach profiling, coastal habitat, and stewardship.

The Story behind the Investigation of Elevation Profile The building of this school required large amounts of earth materials to be moved to create a flat plane where the building now stands. The steep slope located on the west edge of the property is a remnant of the original construction. Now, the grounds crew is concerned about the stability of this slope due to erosion during heavy winter storms. They are asking the **essential question**: How can soil retention be improved on this steep slope? The crew is considering the following options: re-grading the slope, building terraces, and adding rocks and native plants. Students are asked to find an answer to two **investigative questions:** 1. What is the elevation profile of the steep slope? 2 Is the elevation profile of the steep slope changing over time?

Materials for Each Group of Four Students

- 1-2 Compasses
- 3 Meter Sticks: one marked "Back", one marked "Front", one marked "Horizontal" with a small level attached
- ~50 meter rope marked in 1 meter increments or a 50 meter tape measure
- (may include a still or video camera)

Safety and Management

All students will be going outdoors together and collecting data on a steep slope in the schoolyard. They will:

- Work respectfully within their assigned groups (3 or 4 students per group)
- Stay within the boundaries described by their teacher
- Refrain from engaging the attention of students in any other class
- Use science equipment only as instructed
- Wear appropriate clothing for an outdoor investigation
- Avoid horse play (pushing shoving, climbing, etc.)
- Follow all rules previously outlined for classroom behavior by the teacher

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Procedure for Data Collection

1. *In the classroom* introduce the story and **focus question**. Show pictures of the slope; use a map of the property or go outside to take a fresh look at the site. Find out what they know about erosion. Ask students how they would answer the **investigative questions**. Each group can develop its own procedure or use the one given by the teacher. Students should record the **questions**, their **hypothesis,** and the **procedure** in their notebooks.
2. Describe safe behavior for the investigation. Students should write three safety rules in their notebooks.
3. Introduce the chaperone.
4. In the classroom, with the help of one group of students, demonstrate the method for measuring the profile of a slope.
    a. Find a starting point for the **transect line** at the top of the slope. Mark this point with some permanent feature or marker that you can easily describe AND find again.
    b. From the top of the slope use the compass to identify a line to the bottom. Lay the 50 m rope along that bearing; this is the **transect line**.
    c. Set the **Back meter stick** at the starting point for the **transect line**. The 0 cm mark is at the top of the stick.
    d. Set the **Front meter stick** one meter away along the transect line. Again, the 0 cm is at the top of the stick.
    e. Place the **Horizontal** stick on top of either the **Back** or **Front** sticks (whichever one is lower) and adjust so that it is level (see illustration). Both the **Back** and **Front** sticks must be vertical.
        i. If the ground slopes down, the **horizontal stick** will intersect the **Back stick** part way down the stick. Read the distance on the **Back stick** to find the elevation loss. This reading will be negative, e.g. -2.5 cm (-0.025 m)
        ii. If the ground is sloped up, the **horizontal stick** will intersect the **Front stick** part way down the stick. Read the distance on the **Front stick** to find the elevation gain. This reading will be positive, e.g. + 0.5 cm. (-0.005 m)
    f. **Record** the distance from the starting point, the elevation change and any comments pertinent to this measurement (e.g. large bolder at this point).
    g. For the next measurement, first move the **Back stick** to the location of the **Front stick**, then move the **Front stick** 1 m farther down the transect line. Repeat steps e and f.
    h. Continue to move, measure and record all the way to the bottom of the slope.
    i. Every team should look ahead for features to stop on and measure. If some feature does not occur at a horizontal interval of one meter, make the horizontal distance smaller (e.g. 0.6 m). Then, on the next measurement move ahead a small amount in order to get back on a spacing of one meter intervals (e.g. 0.4 m). Keeping the set interval in whole meters will help with data analysis later.
    j. If you reach the end of the **transect line** before reaching the bottom of the slope, you should stand at the end of the profile line, shoot a new bearing with your compass, and move the **transect line** down the slope on the bearing line.
5. Gather input from students to determine **variables** that should be held **constant**, e.g. **Back** and **Front** sticks should be held vertical. Students will record **field notes** about the site including date, time, temperature, weather, location, and nearby vegetation in their notebooks. Ask students to create their own **data table** or use the one provided.
6. *Prepare to leave the classroom*. Students wear appropriate clothing bringing equipment and notebooks.
7. Lead students near the slope and form a circle. Identify boundaries for the data collection.
8. Groups select their test area on the slope and collect data.
9. Return to class. Students sit with their groups to analyze data.
10. Students repeat this investigation two and four months later after heavy rainfall or winter storms.

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Data Analysis for the Descriptive Investigation After collecting data for the first time, students will:

1. Create a graph representing a profile of the slope using the x-axis for the horizontal distance from the top to the bottom of the slope and the y-axis for the vertical drop in meters. (Use graphing technology if available.)
2. Compare elevation profiles with other students to understand the topography of the steep slope.
3. Predict whether the elevation profile will change or be stable when measured again two and four months later.

Data Analysis for the Comparative Investigation After collecting data for the second and third times, students:

1. Prepare a graph of the elevation profile using the same scale as before.
2. Compare elevation profiles of the same transect line at different times.
3. Calculate mathematically the slope of the land at its steepest point.
4. Identify areas of the slope which are stable, eroding, or depositing using evidence from the class data.

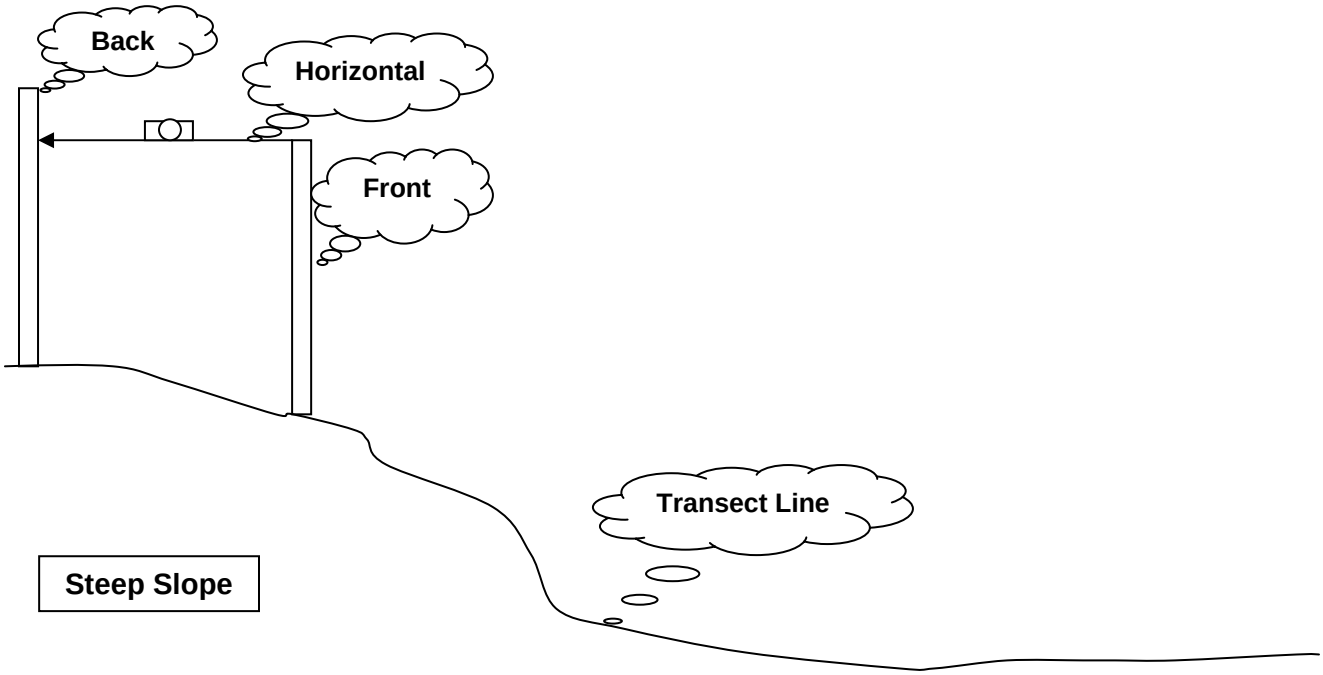
Conclusion Students will:

1. Write a conclusive statement which answers the **investigative questions**.
2. Include supporting **data**, for slope stability or change.
3. Use explanatory language (explain how these data support your conclusion).
4. Include error analysis:
   - Identify two possible sources of error in the investigation.
   - Describe how each source of error could have affected the investigation results.
   - Explain how the investigation results could be made more reliable.
   - Discuss whether additional data collection is necessary to satisfactorily answer the **investigative questions**. Describe a plan to complete further work if needed.
5. Identify new questions and plan a new investigation that would provide additional evidence to answer the **essential question.**

Communication Students will:

1. Prepare a presentation of final results for the grounds crew in the form of a letter, oral presentation, poster, or video.
2. Practice presentation to group members or whole class. Use feedback from peers to improve presentation.
3. Deliver presentation to grounds crew.

Illustration: Measuring the Profile of a Slope



Data Table Investigation of Elevation Change in School Landscape

Student Name	Group Member	Group Member	Group Member

Date		Time	
Weather		Location	

Position	Distance from Starting Point (m)	Distance of Front stick from Back stick (m)	Elevation Change (m)	Total Elevation Change (m)	Comment
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