Teaching Geologic Time and Rates of Landscape Evolution with Dice, Sandboxes, & Cutting-Edge Thermochronology

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Abstract

Debate over rapid vs. secular resource consumption and the validity of religious and scientific views of Earth history shapes the public discourse on climate change, and these concepts effectively remain a challenge to students in a variety of settings. We present a design-based inquiry student intervention that introduces these concepts using dice, sandboxes, stopwatches, and cutting-edge thermochronology research to early landscape evolution, and illustrate how the basic models can be adapted to challenge students in grades 3-8 with visualization, auditability and visual learning styles and diverse backgrounds.

Learning Landscapes: Virtual Adventure Race

Activity & Evaluation I: The Peristylus Adventure Race

For the basic activity, students should understand how to make sandbox topography models based on simplified topographic maps. For this TRIATHLON, include 3 different challenges: 1) describe dimensions of an area, and in the case of a triangle, calculate the area; 2) estimate the amount of water needed; 3) create a topographic map from map data.

Materials:
- Map: Laminated topographic map accurately using vertical & horizontal scales.
- Tools: Laminated topographic map & water-based marker, water-proof tray, water, bucket, sand, compass, grid, water clock, transparency sheets for cross-sections, and protractors.
- Students should be familiar with the concept of topographic maps and the use of water-based markers and water-proof trays.

Erosion, Deposition, & Landscape Evolution

Activity 3: Can sedimentary (clastic), chemical, or biological processes change a landscape? Build a river basin model to illustrate how a river changes over time. Students should understand how to create a river basin model using sand, water, and vegetation.

Materials:
- Sand: Sand, water, vegetation
- Tools: Watering can, spatula, tweezers

Measuring Rates of Landscape Evolution

Activity 4: How do we measure rates of landscape evolution? Introduce the Stream Power Law, & learn concepts of independent variables, dependent variables, hypothesis, & gather data using the Stream Power Law to determine the rates of landscape change.

Materials:
- Water: Water, sand, vegetation
- Tools: Watering can, spatula, tweezers

Sandboxes & Topographic Maps

Activity Evaluation I: The Peristylus Adventure Race

For the initial sandbox landscape exploration activities, students need an Laminated topographic map & water-based marker, water-proof tray, water, bucket, sand, compass, grid, water clock, transparency sheets for cross-sections, and protractors. Students should be familiar with the concept of topographic maps and the use of water-based markers and water-proof trays.

Materials:
- Map: Laminated topographic map accurately using vertical & horizontal scales.
- Tools: Laminated topographic map & water-based marker, water-proof tray, water, bucket, sand, compass, grid, water clock, transparency sheets for cross-sections, and protractors.
- Students should be familiar with the concept of topographic maps and the use of water-based markers and water-proof trays.

Dice & Dating with Geologic “Stopwatches”

Activity 2: How do we measure rates of landscape evolution? Introduce the Stream Power Law, & learn concepts of independent variables, dependent variables, hypothesis, & gather data using the Stream Power Law to determine the rates of landscape change.

Materials:
- Water: Water, sand, vegetation
- Tools: Watering can, spatula, tweezers

How do we measure rates of landscape evolution? Introduce the Stream Power Law, & learn concepts of independent variables, dependent variables, hypothesis, & gather data using the Stream Power Law to determine the rates of landscape change.

Materials:
- Water: Water, sand, vegetation
- Tools: Watering can, spatula, tweezers

How long does it take for rocks to cool or erode? Introduce the Stream Power Law, & learn concepts of independent variables, dependent variables, hypothesis, & gather data using the Stream Power Law to determine the rates of landscape change.

Materials:
- Water: Water, sand, vegetation
- Tools: Watering can, spatula, tweezers

How do we measure rates of landscape evolution? Introduce the Stream Power Law, & learn concepts of independent variables, dependent variables, hypothesis, & gather data using the Stream Power Law to determine the rates of landscape change.

Materials:
- Water: Water, sand, vegetation
- Tools: Watering can, spatula, tweezers