

# One Day, Multiple Feedback Loops

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*The Feedback Loop: Using Formative Assessment Data for Science Teaching and Learning, pp. 95-100*

I am a middle school science teacher-researcher engaging my students in the process of modeling about Earth science phenomena. I center my work in questions relevant to students' lives or of interest due to my students' innate curiosity about the world. I went through multiple trips through the feedback loop in a single day as I gradually improved the quality of the tools, data, inferences, and feedback I provided students in an eighth grade plate tectonics unit. My students find earthquakes to be a fascinating and engaging topic, so I focused my whole unit on plate tectonics around this phenomenon. I started with a puzzling question, "What causes earthquakes?"

I had already done some initial assessment at the beginning of the unit that allowed me to infer that only about 5% of my students had anything approaching a scientific explanation for the source of earthquakes. Most students used the term "plate tectonics" in a vague way that did not include an understanding of plate movement. Like Wegener's detractors, my students were incredulous that the ground could be moving over an inner mantle of fluid rock. Where was the mechanism for that? Students also struggled with the scale of time over which these processes take place; the idea that time can extend for millions and billions of years when talking about Earth's history is difficult for students to understand. We had already wrestled with this idea during our erosion unit, but students had started to build an evidence-based understanding that small processes over long periods of time could transform the surface of the Earth. Finally, in terms of argumentation, my students were quite adept at constructing claims and supporting them with evidence by the plate tectonics unit; however, they were still having trouble connecting evidence to claims through the use of scientific principles—the reasoning piece.

Early in the unit, I had engaged students in a number of activities about earthquakes and the evidence gained from studying them. This included how evidence of the way in which different types of earthquake waves differentially travel through the center of the Earth has helped scientists come to understand the fluid nature of the mantle. Many of my students were surprised—and a little disturbed—to find out that the Earth they were standing on was not actually so solid after all. This new learning was connected to our prior lessons on the convection currents that occur in the atmosphere, understandings gained during our study of weather and climate. Once students accepted that the Earth's mantle could have convection currents, they began to see how plates might exist and be moving across the surface of the Earth.