

The Development of Scientific Theories

Science Grade-Level Expectations

The exercises in this instructional task address content related to the following science grade-level expectations:

- SI-M-B3 Explain how technology can expand the senses and contribute to the increase and/or modification of scientific knowledge (SI GLE 29)
- SI-M-B5 Recognize the importance of communication among scientists about investigations in progress and the work of others (SI GLE 1)
- ESS-M-A2 Explain the historical development of the theories of plate tectonics, including continental drift and sea-floor spreading (GLE 9)
- ESS-M-C8 Communicate ways that information from space exploration and technological research have advanced understanding about Earth, the solar system, and the universe (GLE 48)

	Objectives
Task	<ul style="list-style-type: none"> - Analyze historical development of scientific knowledge - Compare the development of plate tectonic theory to the development of scientific knowledge in astronomy
<u>Sample Student Exemplar Response</u>	

Implementation Tips:

- This task is intended to be integrated into a larger unit that contains hands-on science opportunities, student-led investigations, non-fiction reading, and a variety of other instructional strategies.
- Teachers may choose to use or modify the task as part of an instructional lesson or as a formative or summative assessment.
- Strategic instructional decisions will need to be determined prior to implementation such as:
 - Should the provided text be read aloud to students or read independently by students?
 - Will students work collaboratively or individually to complete the task?
 - What content knowledge and skills will students need to have prior to attempting the task?
 - Does the task need to be modified based on the needs of the students at the time of implementation?

Task

- Read [Origins of Plate Tectonic Theory](#)
- Read [Microplate Discovery Dates Birth of the Himalayas](#)
- Read [Milky Way's Black Hole May be Spewing Out Cosmic Rays](#)

How does scientific theory and knowledge advance? Compare the advancements of scientific understanding of plate tectonics and black holes. Identify the leading factor in these advancements and describe its impact on the fields of geology and astronomy.

Sample Student Exemplar Response

A scientist or researcher does not discover or understand everything at once as an individual. The understanding of large concepts in science like plate tectonics and black holes comes through asking one question or studying one piece of the process and then asking another or picking out an additional piece of the process. As the tools of science are developed and technology opens opportunities to the scientist and researcher, more information is collected, shared, discussed analyzed, communicated, critiqued, resulting in more options and greater understanding.

Wegener saw continents that fit together like a puzzle and began a discussion on the movement of units of the Earth's crust. Other scientists questioned, discussed, and discovered through new equipment searching the bottom of the ocean things like the dynamic process of sea floor spreading (a mechanism for moving the crustal plates). Wegener's simple vision was developed into a theory of how the Earth works which is known as Plate Tectonics. Scientists continue to refine that theory as more evidence is collected. What were once seen as single large plates pushed aside by lava at the ocean ridges and colliding to form mountains are now being further studied at the ocean floor and from satellites above for examples of smaller units of crust-microplates. One microplates was discovered in 2015 in India.

The field of study around black holes began with the thought that stars could be dense enough that the gravity of the star would prevent light from escaping. The idea of the invisible stars was advanced by the work of Einstein with his mathematical work to show large masses tightly packed would be able to warp space. The puzzle continues to grow using equations and data now being collected by large telescopes. The unexpected appears to be happening: material is being sucked into the black hole and energy flow is being emitted. Current technology is allowing scientists to study this phenomenon.

Technology has been the key factor in allowing these theories to move forward, from modern computers to large telescopes to increased communication among scientists using technology. There is an important need to continue the scientific work to refine and further the understanding of what drives the crustal plates on our Earth and what is fueling the Black Hole at the center of our own galaxy. This will take ongoing questioning, more modeling, continued data collection, communication and argumentation.