

Unit 1
Introduction to Earth Science
Suggested Time: 11 Hours

Unit Overview

Introduction

This unit introduces students to the nature of Earth science, its processes and its relationship to other scientific fields. Earth science utilizes a systems approach to the dynamic nature of Earth while at the same time retaining a uniqueness unlike other sciences.

The formation of our universe, solar system, and planet are key to understanding the processes that shape planet Earth. Earth as a sphere and a subset of four interacting spheres also plays a key role in understanding our planet.

Focus and Context

The focus of this unit begins with Earth science as a multidisciplinary science that relies on other sciences to understand the changing nature of Earth. It continues with the formation of Earth and the various systems that have been identified as comprising and changing our dynamic planet.

Science Curriculum Links

Students have previously studied characteristics of Earth's crust and interior in grade 7 in the context of continental drift and plate tectonics theory. This study is continued in grade 9 where the origin of Earth is compared to the origin of other planets in the solar system. Students are also introduced to the origin of the universe at this time. Earth Systems 3209 extends this study by approaching the Earth as a study of systems.

Curriculum Outcomes

STSE	Skills	Knowledge
<p><i>Students will be expected to</i></p> <p>Nature of Science and Technology</p> <p>114-2 explain the roles of evidence, theories and paradigms in the development of scientific knowledge</p> <p>114-6 relate various scientific and technological endeavours to specific science disciplines</p> <p>115-5 analyse why and how a particular technology was developed and improved over time</p> <p>Relationships Between Science and Technology</p> <p>116-6 describe and evaluate the design of technological solutions and the way they function, using scientific principles</p> <p>Social and Environmental Contexts of Science and Technology</p> <p>117-6 analyse why scientific and technological activities take place in a variety of individual and group settings</p> <p>117-11 analyse examples of Canadian contributions to science and technology</p>	<p><i>Students will be expected to</i></p>	<p><i>Students will be expected to</i></p> <p>332-3 describe major interactions among the hydrosphere, lithosphere, and atmosphere</p> <p>333-1 describe the formation of the universe using the big bang theory</p>

Earth Systems as a Science

Outcomes

Students will be expected to

- describe at least two aspects of Earth science that make it different from other sciences (114-6)
 - define Earth science (Geoscience)

- identify the major branches of Earth science. Include:
 - (i) astronomy
 - (ii) geology
 - (iii) oceanography
 - (iv) meteorology

- relate Earth science to other scientific fields.

Elaborations—Strategies for Learning and Teaching

Students should recognize that the following aspects make Earth science different from other sciences: 1) it draws from all other sciences (physics, chemistry, meteorology, astronomy, biology, etc.) to help us understand the Earth's environment; and 2) it requires consideration of vast amounts of time with sequencing of events (chronology) and ages.

As an introductory discussion, students could brainstorm why they think Earth science is a science. Remind students that the scope of Earth science is such that it incorporates many other scientific fields in its study of Earth processes.

Ask students to bring in newspaper and magazine clippings that illustrate the importance of Earth science to everyday life. Examples might include mining, meteorology, earthquake prediction, volcanoes, and prediction of volcanic activity, and perhaps even stories about basic civil engineering projects.

Teachers could provide students the following list of terms: crystallography; geomorphology; hydrology; mineralogy; paleontology; petrology; seismology; stratigraphy; volcanology; and sedimentology. Students could work in groups to develop brief descriptions of each field of study. Students could then categorize the terms under the main branches of Earth science: astronomy; geology; oceanography; and meteorology. Teachers could also utilize Topic 5 - Unit 1 in the Edukit available from Johnson GEO CENTRE to illustrate the branches of Earth science.

Students should be able to connect Earth science to other sciences. For example, the study of fossils (i.e. paleontology) demonstrates the evolution of life, which is clearly related to biology. The study of mineral properties such as mineral composition would utilize chemistry. The forces that create faults and folds would be studied through physics. Two other fields to consider are computer science and mathematics.

Earth Systems as a Science

Suggested Assessment Strategies

Performance

- Create a collage to highlight the various branches of Earth science.

Pencil and Paper

- Complete the Edukit “Branches of Earth Science Student Worksheet”.
- Complete a table linking the areas of study in Earth science to other sciences (biology, chemistry, physics). This can be done effectively using Smartboard® applications such as Vortex Sort®.

Resources

www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html

Edukit

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Conventions used in Resources Column

ST = Student Text

Origins of Planet Earth

Outcomes

Students will be expected to

- describe the formation of the universe using the big bang theory (333-1)
 - describe the four stages of the nebular hypothesis that led to the formation our solar system

- explain the roles of evidence, theories and paradigms in the development of scientific knowledge (114-2)
- analyse why and how a particular technology was developed and improved over time (115-5)
- describe and evaluate the design of technological solutions and the way they function, using scientific principles (116-6)
- analyse why scientific and technological activities take place in a variety of individual and group settings (117-6)
- analyse examples of Canadian contributions to science and technology (117-11)

Elaborations—Strategies for Learning and Teaching

Students should be introduced to the concept of an expanding universe, originating from a singular energy/matter source that eventually led to the creation of our own solar system. Teachers are cautioned to limit the scope of this introduction and discussion of the big bang theory. Treatment of this topic is limited in the student text and alternate sources of information will be required. Students may want to investigate other non-scientific ideas that describe the origin of the universe such as Creationism. This discussion would lead naturally into the origins of Earth and our solar system.

The nebular hypothesis extends from the big bang theory with specific emphasis on our solar system. It is important to note that these ideas are an attempt to explain the formation of the solar system and the universe. The large expanse of time over which these events are suggested to have occurred are sometimes difficult for students to grasp. Remind students that the intent behind these ideas is to make sense of difficult concepts.

The CORE STSE component of this unit incorporates a broad range of outcomes. More specifically, it addresses, in whole or in part, outcomes 114-2, 115-5, 116-6, 117-6, and 117-11. The STSE component, “The Search for Other Solar Systems”, can be found in Appendix A.

Origins of Planet Earth

Suggested Assessment Strategies

Performance

- Create and perform a song or skit to highlight the points of the big bang theory.

Pencil and Paper

- Complete the Edukit “Solar Nebular Student Worksheet” (Topic 2 - Unit 2).
- Relate the formation of the universe to The Big Bang Theory Theme Song found on YouTube. Encourage students to make up lyrics that are more relevant to the formation of the solar system with the nebular hypothesis.

Resources

www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html

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Edukit

Youtube - The Big Bang Theory
Theme Song

Appendix A

Oringins of Planet Earth (continued)

Outcomes

Students will be expected to

- describe the formation of the universe using the big bang theory (333-1)
 - describe the segregation/formation of Earth layers

- identify the various Earth layers. Include:
 - (i) inner core
 - (ii) outer core
 - (iii) mantle (asthenosphere)
 - (iv) lithosphere (crust)

Elaborations—Strategies for Learning and Teaching

The layering of Earth resulted from natural processes related to heat and gravity. Depth of treatment should therefore include heat (from radioactive decay, residual heat, and particle collisions), gravity, and density.

It is important to highlight the physical and compositional properties of each layer (e.g., state, temperature, relative density, and composition). However, teachers should take a qualitative approach to describing the layers and limit treatment of specific properties. For example, the mantle (asthenosphere) could be described as being like an “Eatmore” bar, a solid that can have fluid like qualities especially as temperature influences it.

Note that the layers are listed in column 1 based on increasing progression towards Earth’s surface. Students should know that pressure, density, and temperature all increase with increasing depth below the Earth’s surface.

Students should know that the inner core is solid and the outer core is liquid, and that both layers are comprised of nickel and iron due to the process of segregation. Segregation caused high density elements to sink towards the middle of Earth. The mantle is the thickest Earth layer. It is a solid but has fluid-like qualities, and is comprised of both low density and high density elements due to segregation. Students should know that the asthenosphere, the uppermost part of the mantle, besides having fluid-like qualities, is the weakest part of the mantle. The lithosphere (crust) is the top approximately 100 km of the Earth’s interior and is comprised mostly of low density elements. The thickness of the crust varies depending on whether it is continental or oceanic.

Teachers could reference Topic 3 - Unit 2 in the Edukit for supplemental materials such as Earth’s Interior Student Worksheet and demonstrations 2.1 and 2.2.

Oringins of Planet Earth (continued)

Suggested Assessment Strategies

Pencil and Paper

- Create a diagram showing the layered nature of Earth with the main layers highlighted.
- Complete the Edukit “Earth’s Interior Student Worksheet”.

Performance

- Create plasticine models to show the layered nature of Earth’s structure.

Resources

www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html

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ST pp. 20-23, 475-477
Edukit

Earth as a Complex System

Outcomes

Students will be expected to

- describe major interactions among the hydrosphere, lithosphere, and atmosphere (332-3)
- identify that Earth is a dynamic planet

- recognize that Earth processes operate within spheres. Include:
 - (i) atmosphere
 - (ii) geosphere
 - (iii) hydrosphere
 - (iv) biosphere

Elaborations—Strategies for Learning and Teaching

Students should recognize that Earth is an evolving planet and that many processes are at work in its evolution. As a result, Earth is ever changing; at times a slow pace over millions of years, while other times a rapid pace through earthquakes, volcanoes, and landslides. These features help define the dynamic nature of Earth. At this point in the course, teachers should introduce the concept of crustal plates and connect their movements to the processes above, particularly processes that occur at the boundaries of the plates. The topic of plate tectonics will be covered in more detail later in the course so it is not necessary to go into specific detail here.

This course incorporates a systems approach which will enable students to develop an understanding of the concept of systems and how systems interact with one another to form new, larger-scale systems. They should come to view Earth as a complex system made up of a number of other systems, and understand their place in those systems. This approach will ensure the course is relevant to student's day-to-day lives.

Teachers could use examples to illustrate this point. For example, the water cycle shows the interaction of Earth spheres as water moves from the ground and organisms to the atmosphere. Note that this example incorporates all four spheres. Another example would be a volcanic eruption where gases and molten material is spewed into the atmosphere and onto Earth's surface to later potentially affect life in the biosphere. Note that this example also incorporates all four spheres. A further example would be a shoreline, which is an obvious meeting point for rock, water and air. The biosphere is also well represented along shorelines when you consider the diversity of plants and animals that live on or near the shoreline.

Students should know that the spheres formed in the following order: geosphere; hydrosphere, atmosphere, biosphere.

Earth as a Complex System

Suggested Assessment Strategies

Presentation

- Create a slide show of images illustrating the changing nature of Earth. For example, before and after pictures of the Mount St. Helens eruption or pictures of Pangaea and the various arrangements of continents.
- Create a presentation highlighting the similarities between the Earth's spheres and their interactions and how car systems work together to make the car move.

Paper and Pencil

- Starting from the moment you woke this morning, list your personal interactions with each of the 4 different spheres.
- Describe how a rainstorm might impact each of the 4 spheres.
- Describe the impact a forest fire might have on each of the 4 spheres.
- How would development of a hydroelectric dam impact Earth's 4 spheres?

Performance

- Create a word search with all the terms from unit one.

Resources

www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html

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