



Grade 9

Example for Place-Based Learning

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Big Ideas for Science

B BIOLOGY

Cells are derived from cells.

C CHEMISTRY

The electron arrangement of atoms impacts their chemical nature.

P PHYSICS

Electricity is the flow of electrons.

E EARTH SCIENCES

The biosphere, geosphere, hydrosphere, and atmosphere are interconnected as matter cycles and energy flows through them.

This Example focuses on one of the Science disciplines **E** Earth Sciences.

PLACE: local ecosystem

1 Experience Place

TONE: open-minded, unburdened, curious, playful

The activity starts with a general, open-ended inquiry in a local natural place through direct experience. If possible, invite an Elder for the latter half of the time to speak of interconnectedness. Use HCTF's resource, Exploring Place with Inquiry, for student engagement in place and the generation of student questions that will be used later for discovery and exploration in the Big Idea. NOTE: Some simple tools for engagement are required and are listed in the resource paper.

- Encourage students to direct their focus with their specific equipment
- What are you looking at?
- What do you think influences it?
- Any idea what "sphere" it is within?
- What can we learn from First People's traditional knowledge about the interconnectedness of everything (both living and nonliving)?

2 Questioning and Predicting

TONE: more focused, curious, reflective

Leading off from the activity, Exploring Place with Inquiry, as a class collectively consider the compilation of all questions that emerged. Arrange the questions to one of four areas to which they relate: biosphere, geosphere, hydrosphere, and atmosphere.

Have students choose a local environmental issue affecting an ecosystem. Make use of the questions compiled and create others, reworking them into multiple hypotheses with predicted multiple outcomes (e.g. if looking at a forest ecosystem with insect devastation, consider the insect impact as related to air temperature, forest practices and change in air moisture, etc., or if looking at an estuary with low productivity, consider faecal coliform pollution, change in ocean temperature, change in ocean pH, etc.)

A testable question or hypothesis has two characteristics:

1) it can be supported or falsified by evidence, i.e., the opposite occurs; and 2) it's possible to observe whether it is true or false, i.e., it should be possible to design an experiment to test the hypothesis.

Students create a mindmap, e.g., using MindMeister, of their existing understanding, of the different spheres and the interconnectedness between them, including labels for matter that cycles and energy that flows within and between spheres within their area of inquiry.

Students formulate multiple hypotheses and predict multiple outcomes.

3 Planning and Conducting

TONE: creative, restrained, calculating, collaborative

Student groups plan, select and use various investigation methods, including fieldwork, experiments, and research, including sources of First People's perspective through stories, oral histories or guest speakers (see "science First People's Teacher Resource Guide www.fnesc.ca) to collect reliable data (quantitative and qualitative). Have students assess risks and address ethical, cultural and/or environmental issues associated with their proposed methods and those of others. Students select and use equipment, including digital technologies to systematically and accurately collect and record data and need to ensure that safety and ethical guidelines are followed in the investigations.

Watch: Earth as a System (5 minute animation) www.pbslearningmedia.org/resource/ess05.sci.ess.earthsyst.hologlobe/earth-as-a-system/

4 Processing and analyzing data and information

TONE: observant, methodical

Employ the use of Quora for answers to questions, which may also lead to further questions. Keep the focus of investigation specifically local within a generic context of the interactions of the spheres.

Experience and interpret the local environment. Apply First People's perspectives and knowledge. Seek and analyze patterns, trends, and connections in the data, including describing relationships between variables (dependent and independent) and identifying inconsistencies. Pay attention to the interconnections with other spheres, particularly as matter (N, C, P and H₂O) cycles. Consider what energy is the original energy that drives the whole Earth system and the impacts of this. Analyze and interpret models and/or diagrams. Analyze cause and effect relationships.

Consider using Flipboard, Pocket, or Zotero, to log the information.

5 Evaluating

TONE: discerning, reflective, interdependent, collaborative

Write a critique, considering the following:

Consider the information and findings in light of the multiple hypotheses. Draw conclusions. How do the four spheres of Earth interact?

An interaction is a kind of action that occurs when two or more objects/subjects have an effect on one another. The interaction may be direct or indirect. An example of a direct interaction is wolves preying on elk. An example of an indirect interaction is ladybugs eating aphids that are feeding on plants - the ladybugs have an indirect effect on the plants, by affecting the aphids.

With regard to energy and matter consider Einstein's equation: $E=mc^2$. How do matter and energy move through the spheres; move through local ecosystems? How do First Peoples' view the cycling of matter and energy? How does their view of the oneness of everything compare with Western Science's perspective? How does place-based knowledge reveal the relationships between the spheres and the cycling of matter and energy. How can understanding the interactions of Earth's spheres help us to prepare for natural disasters? Consider how one's understanding of place influences project design. How can you demonstrate ways of knowing that your work and the work of others is valid, free of bias, and acknowledges limitations? How does your understanding of place affect the ways in which you collect evidence and evaluate it?

Redraw the mindmap with new understandings (retaining initial map for comparison).

6 Applying and Innovating

TONE: creative, open-minded, interconnected, engaging

Consider your local place example within an understanding of the generic interconnectedness of the four spheres. Apply First People's perspective on interconnectedness to a local issue for a sustainable future; draw from an example of sustainable practice. Consider the impact of humankind in the local situation. Apply new understandings and consider ways to reduce the impact. Create a strategy or plan for implementation.

7 Communicating

TONE: confident, engaging, interpretive, expressive, sensory, using technology

Demonstrate an understanding of place, First People's perspective on interconnectedness, and interactions between the spheres. Use an app or software to communicate a significant finding of the investigations relative to the hypotheses, with a focus on the local place example. Choose from:

- www.canva.com/create/presentations
- Focusky
- Slides
- Slide Bean
- Projeqt
- Slidesnack
- Haiku Deck
- www.powtoon.com/blog/best-free-presentation-software-and-powerpoint-alternative
- www.emaze.com
- slidedog.com