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Demystifying Radioactivity A GEOTRACES Activity

Notes on Classroom Use: (Connections to NGSS noted at the bottom)

- Middle School – Both Engagement Activities & the Graphic Analyzer
- High School – Full Activity

Background:

Radioactivity, both naturally occurring and anthropogenic, is highly debated and largely misunderstood. For most people their introduction to radioactivity is through a challenging event, an accident or a situation of exposure and/or contamination. The Fukushima Daiichi Nuclear Disaster of March 2011 is an example of such an incident.

We anticipate with ever increasing energy needs nuclear energy will play an increasingly prominent role in public debate, whether it is through localized power needs or global incidents like Fukushima. In addition to the powerful curricular model of connecting topics from science instruction to real world applications, developing students who can independently assess public debate and media reports on radioactivity is important in creating a scientifically literate future citizenry.

Radioactivity, and the resulting radiation, is invisible. Many have been led to overreact to the perceived risk from this. One of the challenges is that people do not always understand or take the time to break down the:

- Varied pathways that radiation can use to travel
- The mechanisms it uses to transfer (inhalation, ingestion, direct exposure)
- Half lives of the material and questions about the long term exposure

ENGAGE: What's in a dose?

a) Start with Activity 1:

Note: Can be completed with or without the use of the accompanying Lab Report

Students work in groups to attempt to order the radioactive dosages represented on the cards. When completed ask them to explain their reasoning in their chosen ordering of the items. Then have the answers available for them.

The second part of the activity asks them to identify if the radioactivity is naturally occurring or human or anthropogenic in origin. Students can stack the cards into two groups of (N) or (A).

b) Move to Activity 2:

Note: Can be completed with or without the use of the accompanying Lab Report

Still in their groups students identify different radiation statements as “Fact, Myth or Possible” sorting the cards into three stacks (F), (M) or (P). Have them compare with other groups in the room to see if there is consensus. Discuss. Provide the ‘answer sheet’ and discuss again this time considering if there were any biases in the understanding of radioactivity.

EXPLORE:

c) Graphic Analysis: The power of graphics

- Distribute copies of a few of the graphics in the graphic folder.
- Students complete the **Graphic Assessment Grid** activity annotating their graphic in order to better understand what they are seeing and what the author is trying to relay.

c) Article Analysis: Untangling the words (note these are fairly accessible journal articles for an upper middle school to high school level student)

- Using the **Article Assessment form**, read and annotate the article
- Consider the Claims – Evidence – Reasoning
- OR complete the Lab

EXPLAIN:

d) Class Discussion:

Discuss the worksheets as a class. How did the different articles represent the same situation?

Share this New York Times Article and Animation:

<http://www.nytimes.com/interactive/2011/03/16/science/plume-graphic.html?ref=science>

ELABORATE:

E) As a class develop a checklist for considering future situations. This will require some additional research on the parts of the students.

- 1) What is the source of the information?
- 2) Is the radioactivity that's been detected attributed to the correct source? There is a background for a lot of these. Correlation does not always equal causation.
- 3) How much radioactivity?
- 4) What type of radioactivity?
- 5) What radionuclide?
- 6) What element?
- 7) Half life?
- 8) What is the environmental behavior when released?
 - a. How is it getting **to** me – (Transportation & transformation pathway processes)
 - i. Dilution
 - ii. Scavenging
 - iii. Dispersion
 - b. How is it getting **into** me

EVALUATE:

Introduce Another Article for the students to analyze.

A couple of recommended ones are:

“The Radioactive Boy Scout” Harper’s Magazine November 1998

“El Cobalto” Window on State Government, August 2014

CONNECTIONS TO NGSS

Disciplinary Core Ideas:

1. MS & HS Earth Systems
2. MS Human Impacts - HS. Human Sustainability

Science & Engineering Practices

1. Computational Thinking
2. Constructing Explanations
3. Engaging in Argumentation from Evidence

Crosscutting Concepts

1. Cause & Effect
2. Systems & System Models
3. Influence of Science, Engineering & Technology on Society & the Natural World