

Lesson Update and CRT Addendum	
Lesson/Activity Title: Earth's Declining Magnetism	ID: 4-193
Subject: Interpreting graphic data, estimation and prediction, calculating percents	Grade: MS
URL: https://www.nasa.gov/pdf/417438main_Magnetic_Math.pdf	
Summary: Given graphical data students interpret and manipulate data.	
Materials for Lesson: In addition to common classroom technology teacher can utilize magnets, iron filings, and various objects for students to manipulate. Could do an electromagnet extension with nail, copper wire, and battery, if available. Could also create compasses with cork, needle, and wool.	

Review and Recommendations	
ALIGNMENT TO STANDARDS	
NGSS	N/A
Common Core State Standards in Mathematics	6.SP, 7.EE, 7.SP, 8.EE, 8.SP
CULTURAL RESPONSIVE TEACHING (CRT) RECOMMENDATIONS	
5E Lesson/Description	
1. Engage	<p>If available give students magnets and various objects. Some students can work with iron filings on white paper. Let students have 10-15 minutes to make discoveries, before coming together to discuss and document what students already know or have discovered about magnets and magnetism.</p> <p>If desired the packet includes a primer on magnetism that the teacher and student can use to begin the exploration.</p> <p>Teacher should elicit students prior experience with graphing and linear functions.</p> <p>Note: In the activity the quantity measure is given as VADM, which is an acronym for virtual (axial) dipole moments.</p>
2. Explore	<p>Great concise explanation for background can be found in the resource section titled "Earth's Magnetic Field and its Changes in Time".</p>

	<p>A detailed explanation for how we know the magnetic field has changed and what the strength of the field has been at different points in Earth’s history can be found in the Space.com resource found below.</p> <p>In the activity itself teacher should make sure to explain their reasoning/strategies and carefully critique the reasoning of others.</p> <p>Students and teachers should make decisions as to whether to use graphing calculators or use paper, pencils, and rulers.</p>
<p>3. Explain</p>	<p>As teacher introduces the beginning three paragraphs, lead the students to discuss what they see in the graphs. Ask the students why the gray area, representing uncertainty, gets smaller as the measure moves to the right.</p>
<p>4. Expand/Enhance</p>	<p>Using student’s native language as relevant, special attention should be given to the words: range, field, plot, scale, and rate. Also, the word dipole is introduced for the first time in the unit so the teacher may need to explain what it means.</p> <p>When you get to Problem 4, the teacher can have students discuss possible ramifications of a near-zero dipole field on the Earth and its inhabitants and discuss possible solutions to problems they divine including possibly making models/diagrams/etc.</p> <p>Much of the language in the task can be simplified. For example, the sentence “The strength of this field is commonly measured in terms of a quantity called VADM with the units of Ampere meter² (Am²). “could be replaced by “VADM is the quantity used to measure the strength of the field and the units used are Ampere meter² (Am²).” Also, BP needs to be explained (before present).</p> <p>Apart from the mathematical terms listed in iii above, other words, such as present, current, etc. may need to be explicitly taught. The word current for example is</p>

	used twice in the body of the text, but with different meanings (electric current, current era).
5. Evaluate	Look at answers to the given problems and methods of solving them. Student participation in the collaborative effort can be evaluated, as well as, any models/diagrams that are created during expansion.

Additional Resources:

Earth's Magnetic Field and its Changes in Time:

<http://image.gsfc.nasa.gov/poetry/tour/AAmag.html>

Space.com "Early Earth's Magnetic Field Was a Weakling":

<http://www.space.com/8006-early-earth-magnetic-field-weakling.html>