

<p>Title:</p> <p>Earth's Moving Parts: A Collaboration between Math and Science CCGPS</p>	<p>Grade: 6</p>	<p>BIG Idea:</p> <p>Math: Proportional Reasoning Science: Continental Drift</p>
<p>CCGPS Standards Addressed:</p> <p>S6E5. Students will investigate the scientific view of how the earth's surface is formed.</p> <p>MCC6.RP.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.</p> <p>MCC6.RP.2 Understand the concept of a unit rate a/b associated with a ratio $a:b$ with $b \neq 0$ (b not equal to zero), and use rate language in the context of a ratio relationship.</p> <p>MCC6.RP.3 Use ratio and rate reasoning to solve real-world and mathematical problems, e.g. by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.</p> <p>MCC6.RP.3b Solve unit rate problems including those involving unit pricing and constant speed.</p> <p>MCC6.RP.3d Use ratio reasoning to convert measurement units, manipulate and transform units appropriately when multiplying or dividing quantities.</p>	<p>Learning Goals:</p> <ol style="list-style-type: none"> 1. Students will use equivalent ratios to determine the rate of plate separation for the Arctic Ridge and East Pacific Rise. 2. Students will use tables to determine equivalent ratios. 3. Students will use a known benchmark (i.e., the length of their classroom and a football field) with which to compare plate movement over time. 	
<p>Materials:</p> <p>For Teacher:</p> <p>PowerPoint presentation Access to Internet – optional – to view link on a PPT slide Measuring device to measure length of classroom or ability to count square floor tiles</p> <p>Per Student Pairs:</p> <p>Centimeter ruler Paper/pencil</p>		

Teacher Notes:

The PowerPoint presentation opens with slides on Pangea, scientist Alfred Wegener, continental *drift*, and plate tectonics. These slides provide background information and/or a “refresher” of these subjects.

Mathematically, we can measure the distance that a plate moves annually. In the PowerPoint two plates are discussed – the Arctic Ridge and the East Pacific Rise. These represent the slowest- and fastest-moving plates, respectively. The Arctic Ridge moves at a rate of 2.5 cm/yr. and the East Pacific Rise at 15 cm/yr.

Ask students what they notice about the measurements 2.5 cm/yr. and 15 cm/yr. Possible answers include the following: The 15 cm/yr. plate moves six times as much as 2.5 cm/yr. plate; The 2.5 cm/yr. plate moves one-sixth as fast the 15 cm/yr. plate; they are both ratios – specifically, *unit rates*; etc.

Have students use a centimeter ruler to see how long 2.5 cm and 15 cm are. If students do not understand the multiplicative relationships discussed above (i.e., *six times* and *one-sixth*), have them count the number of 2.5 cm that can be made out of 15 cm. Having the ruler as a visual representation will allow students to see how infinitesimal these movements are annually.

Ask students if it is very meaningful to know the movement of these plates for *one* year. Ask if they could use a table to determine movement after two years, five years, ten years, etc.? Create tables of equivalent ratios like the one below for both unit rates –

Arctic Plate:

Length	2.5 cm	5 cm	7.5 cm	12.5 cm	25 cm
Year	1	2	3	5	10

Focus on questions that will lead to students thinking multiplicatively. For example,

- A). After two years, how can we describe what happened to the length? It doubled. We find this by multiplying our unit rate by 2.
- B) After three years, how can we describe what happened to the length? It tripled. We find this by multiplying our unit rate by 3.
- C) If we simplified each rate, how would they compare to the original unit rate? The rates would be 2.5 cm/yr. because these are all equivalent ratios.

East Pacific Rise:

Length	15 cm	30 cm	45 cm	75 cm	150 cm
Year	1	2	3	5	10

*Ask similar questions to those listed above for the East Pacific Rise table.

Without a benchmark to which we can compare, the values in the tables are random facts

without a context. Students are familiar with the length of their classroom, and, many know, first-hand, how a football field looks. Use these known lengths to make the unit rate movements more meaningful by placing them in a context.

Discuss with students the three elements necessary to *use* the unit rates to solve problems. If we want to know how long it would take the Arctic Plate to move the length of our classroom, what will we have to know?

A). The **length** of our classroom – This is a measure of **distance**. If the classroom is tiled, determine the length of a tile and multiply by the number of tiles. Either measure with centimeters or measure with feet and/or inches and convert to centimeters. There are 2.54 cm/inch.

B) **Rate** of plate movement – also known as **speed**

C) Amount of **time** it takes for the plate to move the length of the classroom –

If two of these measurements are known, we can find the third. Ask students to think of driving in a car. If I know the speed and amount of time I travel at this speed, what can I find? The answer is distance. Using the formula Distance = Rate x Time, students can fill in the known values and solve for the unknown.

Length of Classroom = Arctic Ridge Rate x Time

For example, in a 30-foot classroom...

$$30' \times \frac{12''}{ft.} \times \frac{2.54 cm}{in.} \approx 914 cm$$

$$D = Rate \times Time$$

$$914 cm = \frac{2.5 cm}{yr} \times t$$

$$914 cm \times \frac{yr}{2.5 cm} = t$$

366 yrs. \approx t Time it would take the Arctic Ridge plate to move 30 feet

Using the same 30-foot classroom length, it would take the East Pacific Rise approximately 61 years. Notice the original multiplicative relationship exists between the movements even now – 366 years is six times as long as 61 years. 61 years is one-sixth of 366 years.

Ask students to attempt to calculate, on their own, the amount of time it would take both plates to move the length of a football field. Make sure their conversations of yards to feet; feet to inches; and inches to centimeters is accurate.

Standard American football field length from goal line to goal line – 100 yds.

$$100 \text{ yds.} \times \frac{3 \text{ ft.}}{\text{yd.}} \times \frac{12''}{\text{ft.}} \times \frac{2.54 \text{ cm}}{\text{in.}} \approx 9144 \text{ cm}$$

Arctic Ridge calculations –

$$9144 \text{ cm} = \frac{2.5 \text{ cm}}{\text{yr}} \times t$$

$$3658 \text{ yrs.} \approx t$$

East Pacific Rise calculations –

$$9144 \text{ cm} = \frac{15 \text{ cm}}{\text{yr}} \times t$$

$$610 \text{ yrs.} \approx t$$

Notice the "six times" comparison still exists. 3658 years is approximately six times longer than 610 years. 610 years is one-sixth the amount of time as 3658 years.

Through the use of benchmarks, students can make meaningful connections to *their* world.