Earth Science Teacher Guide: **About Gravity**

(Formation of the Earth, Learning Segment 09)

Students are generally familiar with gravity as a concept. We can leverage their understanding to help tell the story of how Earth formed. But in case you still have some questions (which is why, I assume, you're reading this guide), here is some more information about gravity that might be particularly helpful in discussing its role in our first model.

If you ask your students, "What is gravity?" you will likely get a number of conceptually sound responses, What might be more challenging is leading them to the idea that gravity played a central role in the formation of all planets in our solar system, whether they be rocky or gaseous (though we're primarily focusing on Earth). Gravity is often thought of as a ***force***- an attraction between two objects that have mass (in this case). Each object (let's say…you and the earth) exert force on each other, though because your mass is miniscule when compared to the Earth's, it exerts much more force on you than you do on it.

Understanding that the bigger the mass of an object (e.g. planet), the stronger the gravitational "pull" it exerts is one key piece of understanding gravity's role in formation of the Earth. The other key factor of gravitational force, distance can be understood through the "inverse square rule". Originally described by Newton, it essentially says that the closer objects are), the stronger the gravitational force between them. The equation below shows the mathematical relationships between the masses of the objects involved, their distance and the gravitational constant. Feel free to explore this with students. This is an opportunity to explore mathematical reasoning with your classes should you feel it would be helpful. But don't show the equation without exploration or introduce it as something to be memorized or as a means to complete decontextualized calculations (i.e. we want students to be able to connect gravity to formation of the Earth). Note that the force exerted on both objects (e.g. the Earth and you) is the SAME. The difference comes in how that amount of force affects the large versus small mass in terms of acceleration. (You can convince yourself of this if you work with the often-cited equation F=ma.)

Inverse square law: $F = \frac{G\, m_1 m_2}{r^2}$

F = force

G = gravitational constant ($6.674\times10^{-11}\ \frac{m^3}{kg \times s^2}$)

m_1 = mass of object one (i.e. earth)

m_2 = mass of object two (i.e. the sun)

r = distance between the center of mass of object 1 and 2

(i.e. distance between earth's core and the center of the sun

Helpful videos (for you, and perhaps for students):

https://www.youtube.com/watch?v=mezkHBPLZ4A&ab_channeld=Veritasium
https://www.youtube.com/watch?v=ybxSgIBbBh8&ab_channel=ScienceTime