

NOTE: All materials are those of the
project team and do not represent KDE
endorsement.

Classroom Embedded Assessment [CEA] Title: Earth's Spheres

a. Targeted Performance Expectation(s)

5-ESS2-1: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

b. Learning Goal(s)

- 1 Develop a model (drawing) that shows two of Earth's spheres interacting with one another.
- 2 Identify at least 2 key components in each of the spheres that are central to the targeted interaction.
- 3 Explain how energy flows and matter cycles across and between the identified components (interactions).
- 4 Characterize changes in the systems (both fast and slow changes as appropriate).

c. Instructional Context

a. This CEA was administered at the end of our unit.

b. Lesson Summary:

- Videos, pictures, and discussions illustrating phenomena relevant to Earth's spheres; showing examples of the spheres and how they interact, including time-lapse video. Discussion targeted energy flow and matter cycling as key aspects of the interactions. As the appropriate domain was addressed, Greek prefixes were introduced (Bio=life, Hydro=water, Geo=ground, Atmo=air)
- Walk-About activity- Students were given task cards with different scenarios on them – some small scale such as the school playground, others larger scale such as Kentucky map of waterways and drainage patterns. Students had to determine two spheres that were interacting with one another based off the scenario (more than one possible answer for each scenario, depending on focus). They then grouped themselves with others who had the same two interacting systems. Sharing (components, energy flow, matter cycling, changes) first within their group, then across whole class to hear many examples of system interactions.
- Creating the model: Having had prior instruction on the practice of modeling, students were aware that scientific models are tools for thinking about how things work. Students were given the CEA task in part **d** below to formatively assess their understanding at this point (3 dimensions assessed).

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d. Student Task/Prompt

- a. Draw a model of Earth's spheres (at least 2) interacting with one another in a specific scenario.
- b. Use your model to write a paragraph explaining how the spheres are interacting.
 - i. For each sphere, identify at least 2 key components in your model
 - ii. Include information about energy flow and matter cycling
 - iii. Describe how these interactions cause change over time

SEP= developing and using models; DCI= Earth Materials and Systems; CCC= Systems and System Models

e. Success Criteria

Series of Criteria:

- 1 Did the student's model identify at least 2 components in each sphere?
- 2 Was at least one energy flow correctly identified?
- 3 Was at least one transfer or cycling of matter correctly identified?
- 4 Was one change over time identified?

Exemplary Response (using student work sample 1 as a starting point – Hydrosphere/Biosphere with drawing showing scenario of river running between grass fields and trees).

- Hydrosphere components = water flowing in river, water on the ground (e.g. from rain) which soaks in and some of it flows to river. Biosphere components = tree, grass [*NOTE: these could be labeled on the model*]
- Trees and grass get energy from the Sun and use water as part of their living/growing process. This creates a demand for more water, which is pulled from the ground by the roots. So ultimately the Sun's energy flows to the biosphere which then interacts with the hydrosphere to get water. [*NOTE: details of water transpiration from leaves are not expected at this age*]
- Some of the biosphere matter, such as leaves and dead grass, eventually get washed into the river by rain and then the river (hydrosphere) carries that matter downstream. Eventually that matter will settle out and possibly help create fertile soil for other biosphere components, like flowers or more trees, to grow.
- The hydrosphere changes (erodes) the geosphere much more slowly when biosphere components like grass help prevent washouts. Also, the kinds of plants and animals that can survive depend on how much water is available, so if the hydrosphere changes to have much less water, the trees and grass may die and other types of desert plants like cactuses and lizards may be present.

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f. Next Instructional Steps

Identify which of the 4 success criteria listed above a student was able to include in their explanation. In groups determined by which aspect was missing (e.g. not able to identify components), use pictures or videos of scenarios showing at least 2 of Earth's spheres interacting, and target ONLY the piece missing (e.g. "what are some components of ... in this picture?")

Then regroup based on next criteria (e.g. energy flow) and do similar exercise with picture or video stimuli. Repeat for cycling of matter and change over time.

The intent is to focus on only ONE aspect of the system (components) or interactions (energy, matter, change) at a time to reduce complexity. With additional experiences targeting just one thing, then add additional aspects as students are ready.

For students who got all (or most) of the model explanation reasonably complete, one task for them (while others are revisiting scenarios in small groups targeting one aspect at a time) might be to ask them to create a physical model of two interacting Earth's spheres (e.g. aquarium with plants/fish; stream table with water flowing over sand, dirt, and rocks; fan blowing (atmosphere) on a miniature landscape of sand). They would characterize how that model demonstrates interacting spheres, and then evaluate the model for how it does and doesn't help describe some naturally-occurring situation (strengthening their practice of modeling by identifying limitations and affordances).

Students who created/explained physical models could then demonstrate and explain for the whole class once all other students (including those who needed the most support from the original assessment) are ready, so that those who did not have the opportunity to create a physical model can benefit from that work as well.

g. Student Work Samples

NOTE: The original student work is from a prior version of this CEA which was less structured in the explanation requested – I simply asked them to "explain how the systems are interacting" and did not explicitly ask for components, energy flow, matter cycling, or changes. By being more explicit in this iteration, I am able to better formatively assess where individual students are confused. The work samples below are from the less explicit instructions "write an explanation..." and you will note that from these responses, I found it challenging to know how/if students were thinking of energy and/or matter interactions.

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Student 5 Model

Hydrosphere/Biosphere

I drew a picture of the hydrosphere and biosphere. The hydrosphere in the picture is the river and the biosphere is the living things in the picture. The way they interacted is the hydrosphere is giving the biosphere water so they can survive.

Student 2 Model

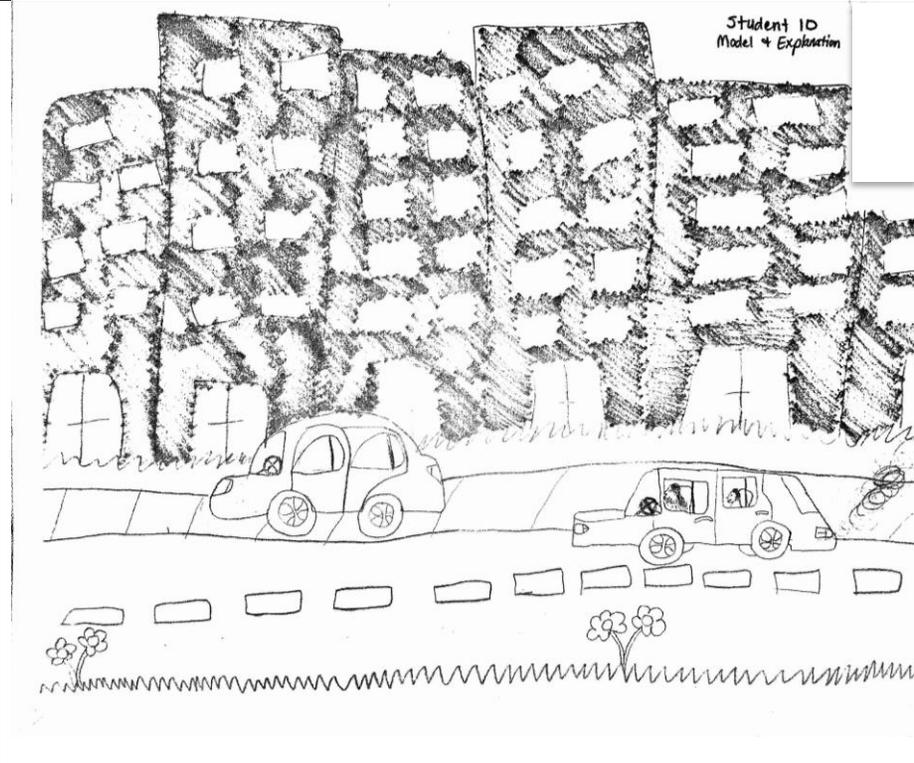
It is chasing me!

run!

The atmosphere and the Biosphere interact with each other because the tornado that I drew could destroy things such as trees, plants, animals.

I drew a picture of the hydrosphere and biosphere. The hydrosphere in the picture is the river and the biosphere is the living things in the picture. The way they interacted is the hydrosphere is giving the biosphere water so they can survive.

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Student ID
Model + Explanation

I chose the Biosphere and the Atmosphere. The person represents the Biosphere. The air is part of the Atmosphere. The Biosphere and Atmosphere react because the person who is part of the biosphere is driving the car, which is sending lots of pollution to the air which is the Atmosphere.

I chose the Biosphere and the Atmosphere. The person represents the Biosphere. The air is part of the Atmosphere. The Biosphere and Atmosphere react because the person who is part of the biosphere is driving the car, which is sending lots of pollution to the air which is the atmosphere.

h. Reflection and Revision

More explicit emphasis placed on systems thinking in this revision (reflected in details above). Specifically, structured the student discussions and examples to identify a few components of each sphere – since these are usually visible, concrete ‘things’ they can often do this. Then focused their attention on energy flow and matter cycling as key aspects of interaction. Finally asked them to consider changes over time, to underscore that Earth is a complex dynamic system that is always changing.