

## Climate 101 Week 5

### Introducing Earth System Science

#### Overview of the Week

- \* Participants explore the crosscutting concept of Systems and System Modeling to understand how planet Earth is a system that is made of component parts that are themselves systems (e.g., the atmosphere and hydrosphere).
- \* Systems have properties that are qualitatively different from those of their parts.
- \* Participants practice making system models that exemplify the concept of “systems within systems within systems” and also illustrate how systems have properties that are qualitatively different than their parts.
- \* Participants analyze a model of the Earth system consisting of Matter, Energy and Life, and that global climate is a property of the whole Earth system.

#### Before Teaching this Week:

We use Chapter 1 of *Dr. Art's Guide to Planet Earth* to introduce the concepts of systems and system models, and apply those concepts to planet Earth.

- \* Make **color** copies of Chapter 1 of *Dr. Art's Guide to Planet Earth* so each participant has a copy.
- \* Download the power point for the week, and review it. Notice there are notes for many of the slides so it may be most helpful for you to print the slides with the embedded notes.
- \* Make enough copies of the first page of “Matter, Energy and Life in the Earth System” handout for all participants. Note that the second page of that file has suggestions for things to look for and add to the group reports and whole class discussion.
- \* Make enough copies of the first page (Draw a System) of the Example System file for all participants and **color** copies of third page (A Home and Garden System) as well. Note that the second page of that file has suggestions to the instructor of things to look for and add to the group reports and whole class discussion.
- \* Have enough chart paper, colored pencils/pens/markers, and tape for Day 3 systems drawings.
- \* Become familiar with the DVD “Dr. Art Does Science.” Be prepared to share the selected video sections with sound in the class. See if there are enough copies of the DVD to give to all participants. If not, ask PREL or Art if they have copies to donate.
- \* Try to access the NASA video clip at the link below (you will probably have to manually copy and paste it into the browser)

[https://archive.org/details/NASA\\_Science\\_Earth\\_Clips34\\_35\\_36\\_HD](https://archive.org/details/NASA_Science_Earth_Clips34_35_36_HD)

If you can get the video to work, it provides an engaging way to review the system concepts. NASA made it using the ideas in Dr. Art's chapter. It is oriented to a USA audience, and the narrator does talk fast but there are large subtitles and you can pause it to help with comprehension. Stop the video when it switches to talking about mathematics, unless you want to connect the math practice of “representations” with the NGSS science and engineering practice of “developing and using models.”

### Day 1:

Introduce that to understand climate change globally and locally, we actually have to understand how our whole planet works. Give each participant a **color** copy of Chapter 1 (“Introducing Planet Earth”) of *Dr. Art’s Guide to Planet Earth*.

**Show Slides 1 through 4.** Have the participants follow instructions on Slide 4. Have the participants work in groups of two or three to look at these chapter features, and talk with each other about what they think the chapter will teach them. The idea is to NOT read the chapter yet, but just start to get ideas of what is in the chapter by looking at and reading some of these key features. Participants should also jot down a few words or phrases that they can share with the whole class.

Lead a whole class discussion of some of the things they saw and noted. Write notes that everyone can see either on a chart or projected on a screen. Make sure the list includes planet Earth, systems, parts of systems, matter, energy, life, cycles, flows and webs. Lead a whole class discussion. Use the slide notes to point out any important examples that participants missed. Try to help them describe what they think they may learn by reading the chapter. Also whether they think this is a literacy strategy that would help their students.

**Show Slide 5 (Science Ideas Come in Different Sizes) and Slide 6 (Awesome Ideas to Factoids).** Discuss the distinctions that Dr. Art makes between small facts (factoids), concepts and awesome ideas.

**Show Slide 7 through Slide 12.** Highlight the important features of systems that are illustrated on these slides. Use the notes included with the slides.

**Show Slide 13.** Note that Dr. Art describes planet Earth as a system that has three parts (Earth’s Matter, Earth’s Energy, and Earth’s Life). Divide the class into groups (about three people per group). Give the handout “Matter, Energy and Life in the Earth System” to each group. Make sure there is at least one group that will do “Matter,” at least one group that will do “Energy,” and at least one group that will do “Life.”

Have each group work for about 15 minutes, and then have them take turns sharing to the whole class first about matter, then about energy, and then about life. In each case, make sure that the key points have been shared loudly and clearly.

It is possible that you may not have enough time for the whole class discussion. If that is true, you can do the whole class discussion during the next class session.

Homework: Read Chapter 1, especially the parts that were not covered in depth in the class.

### Day 2:

If you did not have the whole class discussion at the end of the previous session, start this session by doing that.

**Show Slides 13 (Three Parts of the Earth System) through Slide 16 (Earth is a Networked System).** Use these slides to review this way of thinking of planet Earth as having three parts and that each part has a very different system property (closed system for matter, open system for energy, networked system for life). Note that for Earth's life that Earth's organisms are interconnected with each other and also intimately connected with Earth's cycles of matter and flows of energy.

**Play the Game Show section from the Dr. Art DVD.** You may need to explain that this is from a show that Art Sussman did for a science fair event in San Francisco, and that he is pretending they have expensive, invisible wireless technology for a game show.

**Show the One Act Play** section of the Dr. Art DVD. Briefly have participants talk about what they like, do not like, or find interesting about this way of teaching science ideas. Conclude by reviewing the three principles.

Have participants write in their student notebook a reflection that includes at least one important content idea that they learned, and at least one idea about how to help teach these ideas to their students and/or to help students understand science texts. Have participants take turns sharing one thing that they wrote. Try to avoid too much repetition of the same ideas.

If there is time, **show the NASA video clip** that reviews the properties of systems and also talks about Earth system science. You will probably have to manually paste the URL into the browser.

If there is even more time, **show the Three Phrases** section of the Dr. Art DVD. If there is still time in the class, you can share other things from the DVD, especially from the "Planet Earth Show" section and the "Climate Change" section.

### Day 3:

This session focuses on reinforcing the concept of systems and the tool of modeling systems. If you have not shown the video clips from the end of Day 2 you can show them at the end of Day 3 if there is time.

**Show Slide 9 (Important Features of Systems).** Begin by saying that today we are continuing to focus on the concept of systems and the tool of modeling systems.

Read the first feature on Slide 9 and ask participants for an example of a system that is made of parts that connect with each other. Be sure to include that planet Earth can be described as a system whose parts are Matter, Energy and Life. Make sure there are other examples as well.

Read the second feature. Mention that the phrase "systems within systems within systems" is another way of talking about this feature. Pick "Earth's Matter" as an example of a part of the Earth system. Ask if they think Earth's Matter is also a system that is made of parts.

Then ask what are the parts of “Earth’s Matter.” After several examples have been mentioned, you can summarize them as Earth’s atmosphere (gas stuff), hydrosphere (water stuff), and geosphere (most of the solid stuff: Earth’s crust, mantle and core).

Read the third feature: Ask what is an example of a system property of planet Earth? It would be some feature of planet Earth that the whole planet has that none of its parts by themselves have. They will probably have trouble with this, so you can **show Slide 17 (Earth’s Global Temperature)**. Discuss this whole system property, and compare with other examples of whole system properties (fuel efficiency of a car; temperature of a healthy person or temperature of a very sick person; scoring ability of a basketball team).

**Show Slide 18 (Begin to Draw A System, Part I)**. Working in pairs of two people, begin to draw and label a system. The system needs to be one of the following: a school, a taro patch, or a village. Make sure that each of these systems has at least one pair of people working on it. After they have been working on drawing their system for 5 minutes, **Show Slide 19 (Home and Garden System)** and give each person the Home and Garden System drawing to look at.

**Show Slide 20 (Draw A System, Part 2)**. Have each pair join another pair that has been working on the same system (e.g., a school) they have been working on. Have them share with each other, look at the Home System handout, and work together to create a group drawing of their system on a large chart paper. Have colored pencils, marking pens and different colored Post-Its available for them to use.

Remind each group to draw a system, label its parts, its flows (inputs and outputs), and one or more system properties that are different than its parts. Divide the class into groups of three or four people per group, and give them the handout “Draw a System.” Each group should make a big chart illustration of its system that it can attach to a wall. Make sure you give them enough time and assistance to have a good enough chart to share, and also still have time for each group to share its chart with the whole class.

Have them post their charts on different places on the walls. Take turns with the whole class going to look at each chart while that group explains what is on their chart. Make sure to highlight the parts of the system, the flows into and out of the system, and at least one system property that is different than those of the parts. Refer to the second page of the Example System word file for guidance in facilitating the presentations and discussions of the different charts.

In-Class or Homework Assignment is to write about our Two Guiding Reflections (same questions used at the end of every week):

- 1) Choose a concept of activity from this week. How would you teach this concept or activity with your students?
- 2) What would be hard for your students to understand about this concept or activity?

If it is done in class, have participants take turns sharing and discussing their reflections.