EaSiE Earth as a System is Essential

Systems Assessment

The world around us is made up of many systems and subsystems. Choose a natural system that interests you. Some examples of natural systems are:

A flower

The human digestive system

The ocean food chain

A thunderstorm

The Earth's atmosphere

The sun

Step 1: Choose one of the following options.

Option A: Essay

Write 3 or more paragraphs explaining why your system is a system. Your essay should include the answers to the following questions:

1. What are the boundaries of your system? How did you decide?
2. What are the parts of your system? What would happen if you removed one or more of them?
3. How do different parts of your system interact? What would happen if one or more of those interactions were blocked?
4. Is your example a subsystem of another system? What system? Does it contain its own subsystems?
5. (Your teacher will tell you if you are to answer this question.) Are there inputs and outputs? What are they? What would happen if the inputs or outputs were blocked?

Option B: Concept Map

Create a concept map for your system. The "bubbles" on your map should include the parts of your system, and the "lines" on your map should include statements that describe the interactions between the parts of your system. It should also include any subsystems. You should also show if your system is a subsystem of a larger system. (Optional: Include inputs and outputs if your teacher requires it.)

Answer the following questions:

1. Pick one part of your system. What would happen if it were removed?
2. Pick one interaction. What would happen if it were blocked?
3. What are the boundaries of your system? How did you decide?
4. (Optional) Pick one input or output. What would happen if it were removed?

Step 2: Answer the following questions.

1. How we define a system is different for everyone. For example, some students chose to include the rider as part of the bike system, while others thought that the rider just provided energy input.

a) If you and another student chose the same system, how might they be different?

b) What things could have been included in your system that you chose to leave out?

c) What parts of your system could have been left out? Does this make one better or worse than another? Why?

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2. Describe a situation where looking at a natural system with smaller boundaries would be more useful than looking at the system with larger boundaries.

(For example, if the brakes on your bike are squealing, you may want to just look at the brake system, rather than the entire bike.)

3. Why is it helpful for scientists and students to think of the natural world as a series of systems?

Rubric

Goal	Exceeds	Meets	Partially Meets	Does Not Meet
Understand that systems define small portions of a complex world (Step 2: Q 2,3)	Gives more than one specific examples with explanation. Explains with examples why it is helpful to look at the natural world as a series of systems.	Gives a specific example with explanation for defining smaller boundaries. Explains thoroughly why it is helpful to look at the natural world as a series of systems.	Gives a vague example with little explanation as to why defining smaller boundaries would be helpful. Brief explanation of why looking at the natural world as a series of systems is helpful.	No example or explanation. Does not explain why systems are helpful in investigating the natural world.
Defining a system (Essay/concept map)	Shows several interacting components working together in a complex what to achieve a goal. May include one or more feedback interactions.	Shows several interacting components working together to achieve a goal.	Shows only 2–3 interacting components and/or goal is not clear.	Does not correctly demonstrate the interactions between the components.
Defining boundaries & subsystems (Essay/concept map, Step 2:Q1)	Includes sophist-icated reasoning for why the system has specific boundaries. Includes detailed descriptions of more than one subsystem (or larger systems). Clearly explains with examples why one person may include some components while another may not.	Includes clear boundaries. Includes one or more subsystems (or explains how this system is a part of a larger system). Clearly explains why one person may include some components while another may not, with one or more examples.	Does not include a clear subsystem or mention of a larger system. Explains why one person may include some components while another may not, but with no examples.	Does not demonstrate any understanding of the following: • Subsystems • Boundaries Explanation for choosing which components to include is very vague.
Predicting patterns/outcomes from a system (Essay/concept map questions 1, 2 & optional question 4)[1]	Provides more than one reasonable outcome for the elimination of components, inputs, outputs or interactions.	Clearly explains what would happen if a component, input, output or interaction was eliminated from the system. Prediction may not be 100% accurate.	Predictions about elimination of components, inputs, outputs or interactions are vague.	No predictions about the result of missing components, inputs, outputs or interactions.
Understanding the role and effects of inputs and outputs (Optional)	Includes reasoning for why the system has specific inputs and/or outputs (or why the system has none).	Includes inputs/ outputs (or reasoning why the system has none.)	Missing inputs/ outputs or reasoning for their absence.	Does not demonstrate understanding of inputs or outputs.

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[1] Predictions about the results of removing inputs and outputs should only be evaluated if this optional content was covered in the lesson.

Systems Assessment

Teacher Notes

Goals

This assessment is designed to evaluate student performance towards the following goals:

- Understanding that systems define small portions of a complex world
- Defining a system
- Defining boundaries and subsystems of a system
- Prediction patterns/outcomes from a system
- Understanding the role and effects of inputs and outputs. (This goal is more appropriate for upper level students and materials relating to it are marked as "optional" throughout the lesson and assessment.)

Students do not need to be evaluated towards meeting all of the above goals, and teachers should choose the goals most appropriate to the class curriculum.

Preparation

Students will need copies of pages 1 and 2 of this assessment. They will also need writing paper or computers to complete their essays or concept maps. (Mapping software such as "Inspiration" may be helpful for students creating concept maps.)

Possible Modifications

This assessment was designed to evaluate student progress toward multiple goals. If necessary, eliminate sections of the rubric and related evidence to simplify the evaluation.

The concepts of inputs and outputs may be too advanced for many middle school students. However, they are appropriate for upper level students. If these ideas are to be evaluated, be sure to complete the related steps throughout the lesson, which are labeled "Optional."

Using the Rubric

Learning goals are listed down the left-hand column of the rubric on page iii, with the evidence in parentheses. For example, (Essay/concept map, Step2:Q1) means that evidence of student work towards that goal should be found in the essay or concept map and Step 2, Question 1.

This rubric does not include letter/number grades, and teachers should use a grading scale appropriate to their school/class scale. (Often, "Exceeds" is an "A", "Meets" is a "B", etc.)

Any goals that are not being assessed for a particular class should be removed from the rubric.

This Systems Assessment was developed by a group of middle school science teachers as a supplement to the EaSiE project's Systems lesson with funding from NOAA Environmental Literacy Grant NA07S-EC4690002. For more information and to download lessons from the *Earth as a System is Essential: Seasons and the Seas* (EaSiE) project, visit www.mmsa.org/easie