

Lesson 2



The Concept of Systems

Lesson Length: Approximately 2 hours

Curriculum Alignment Code

GOAL 1	GOAL 2	GOAL 3	GOAL 4	GOAL 5	GOAL 6
x	x	x	x	x	x

Instructional Purpose

- To explore the concept of systems
- To think about the aspects of the parts of things and how one part connects to and affects another (predict the effects of removing or changing parts)
- To investigate and develop an understanding of system concepts (recognizing interactions—attending to what affects what)
- To think about aspects of the relationship between language and systems

Assignment Overview

- Discuss what makes a system.
- Brainstorm many types of systems.
- Use the Taba Model of Concept Development to explore system components.

Materials

- **Teacher Resource Page 2A**
- **Student Activity Pages 2A, 2B, 2C, and 2D**
- Post-It® notes of various sizes
- Chart paper
- Markers

Background/Context

Throughout this unit, students will return to and reflect on a set of generalizations about systems:

- Systems have parts (elements).
- Systems have boundaries.
- Systems have inputs and outputs.
- A system's elements interact with each other and with a system's inputs.

Before encountering this set of five generalizations, however, students will generate their own examples and generalizations about systems, engaging in the Taba Model of Concept Development. This critical thinking process involves both deductive reasoning, as students generate examples and non-examples of systems, and inductive reasoning, as students categorize their examples and develop generalizations about systems. This concept development model is explained in greater detail in "The Taba Model of Concept Development," in Section 2.

1. Discuss What Makes a System


- Use **Teacher Resource 2A** to capture student discussion on a school cafeteria as a system. Post system words as you use them in the activity. Have students use **Student Activity Page 2A** to record the discussion. The school cafeteria is a system. Have them use the idea of the school cafeteria to take a closer look at how systems work.
- Ask: What are the parts or **elements** of the cafeteria? (students, teachers, floor, tables, chairs, stage, lunch staff, utensils, plates, food, napkins, milk, juice, water fountain, appliances such as stoves, refrigerators)
- Ask: What are the **boundaries** of the school cafeteria? (walls, doors, windows, daily schedule, rules, floors, ceilings)
- Ask: Are there any **interactions**? (conversations, sharing, eating, drinking, lunch line, cleaning)
- Ask: What **input** is added to the system? (students, food, drink, personnel, water, soap)
- Ask: What is leaving the system—**output**? (trash, students, personnel, waste water from kitchen)

2. Explore an Example of a System

- Brainstorm and create an ongoing class list of many different types of systems.
- Explain that throughout the unit, students will be thinking about systems: systems in themselves, systems in language, and systems in the world around them.
- Investigate the components of a fish bowl system. Have students look at **Student Activity Page 2B**. Have them draw in the elements of the fish bowl. Next have them label the parts of the fish bowl using the system vocabulary: elements (fish, bowl, water, decorations, plants, pump and filter), interactions (fish breathing air from the water, fish eating, plants growing), input

(food, water, light), output (oxygen given off by plants, fish growing, plants growing), and boundaries (fish bowl). If students did not add elements such as plants, pump and filter, snails, and food, then they can add these in the class discussion about the system elements. When they have finished explaining their systems, discuss whether there were any elements in their fish bowl system that did not belong.

3. Generate Examples of Systems

- Tell students that they will do a four-part activity in groups to explore systems. Divide the class into groups of four to five students. Distribute four sheets of chart paper, Post-It® notes, and markers to each group.
- 

Tip
The activity can be done as a whole class if students need more support.
- Brainstorm a couple of systems with the whole class before asking students to work in groups. Then ask students to think of all the kinds of systems to write or draw on their Post-It® notes and stick on the chart paper. Use the following questions to promote students' thinking:
 - What are some systems in nature?
 - When is something a part (element) of a system?
 - Are some systems man-made?
 - How small can a system be?
 - Are there systems in school? At home?
 - Can systems be made up of other systems?
 - Is language a system? Why or why not?
 - Circulate around the room as groups brainstorm and discuss. Use the discussion questions to help groups that are struggling or to further discussion.
 - After groups complete their brainstorming, have them share their ideas with the class to form a class list of systems.

4. Categorize Examples of Systems

- Have students look at **Student Activity Page 2C**. Explain that a *category* is a group of things or ideas that are similar in one or more ways. Tell students to look at the systems that they have on their chart paper. What kinds of groups could their systems be organized into? Tell students that they will need to think of the category title for each of their groups of systems.
- To get started, model categorizing some of the examples from the class list of systems. Point out that there are many ways to categorize the systems and you are showing them one way of thinking about a group of systems.
- Have the groups write the category titles on a larger Post-It® note for each category. Use the following questions to guide discussion.
 - Review your systems. How are they alike? Should you put similar systems together for a category? Why or why not?
 - Do all of your system examples fall into a group? Could some of them be in more than one group?
 - Are there different ways to group some of the systems? Are there other categories you could use?
- Circulate around the room as groups are working and discussing their categories. Use the discussion questions to trigger additional discussions or to help a group that is struggling.
- After groups finish categorizing all of the systems, have them share their categories with the rest of the class. Then work together to categorize the remaining items on the classroom list. Display this class list throughout the unit, as students will continue to add systems or categories as they discover them.

5. Generate Non-Examples of Systems

- Tell students to brainstorm a list of things that are not systems. If students have difficulty generating ideas, begin a classroom list of things that are not systems: *randomness, chaos, surprise, infinity*.
- Circulate around the room as groups brainstorm and discuss what systems are and what they are not. Use the discussion questions to trigger additional discussion and to help struggling groups.
- After groups have finished brainstorming, have them share their ideas with the rest of the class:
 - What are some things that are always part of a system?
 - Are systems always dependent on one another?
 - Do all systems have patterns?
 - Compare groups of systems; how are they alike and different?
 - How might you group elements that are not systems?
 - How do you know these things are not systems?

6. Develop Generalizations About Systems

- Ask students to pair-share their thoughts about systems. Ask students if their ideas about systems have changed after thinking about systems more carefully.
- Explain that a *generalization* is a statement that is always or almost always true. Tell students to consider their examples of systems and categories of systems. Invite students to make their own generalizations, stating things that are true about systems.

- Have students work in pairs or groups, if they are able, to create additional generalizations about systems on chart paper. Circulate around the room as the pairs or groups of students are discussing their generalizations.
- After pairs or groups finish, have them share their generalizations with the rest of the class. Create group or class charts of the system generalizations to display throughout the unit.

7. Consider the Unit Generalizations

- After students share their own generalizations about systems, introduce the following generalizations. Explain that the class will be thinking about these generalizations throughout the unit. Discuss the generalizations, using the following questions as a guide:
 - **Systems have parts (elements).** Can elements be in more than one system at a time? (circulatory system in a body system—share parts)
 - **Systems have boundaries.** Can boundaries change as input and interactions change? (i.e. growing bodies)
 - **Systems have inputs and outputs.** What inputs could be in a language system? (letters, words, sentences, stories) What outputs could be in a language system? (sounds, written stories, books, homework)
 - **A system's elements interact with each other and a system's inputs.** How does a language interact with inputs? (people write and talk using language, TV, radio)
- Write each generalization on a separate sheet of chart paper. Have students round robin in pairs or small groups to write examples or draw illustrations for each generalization. When students have finished, discuss their examples.



Notes to Teacher

- Post the generalizations about systems in the classroom for reference throughout the unit.
- The concept development model used in this lesson is explained in greater detail in “The Tabo Model of Concept Development,” in Section 2. Some steps of the process have been revised to account for the needs of younger students. Revise them further if necessary.
- This unit provides the opportunity to emphasize interdisciplinary connections. For example, the concept of systems may help students begin to see the connections and interactions of many objects around them and in the real world. The concept of systems also relates to many topics students may study in science and social studies. Emphasize these connections through further discussion following this lesson, by referring to the generalizations about systems during lessons across the curriculum and through such activities as suggested in the “Extensions” section of this lesson.

Connect to

Social Studies

- Have students use newspaper or magazine articles that tell about systems. Have them share the article with the class. Have them explain the parts of the system. Engage the class with discussion on which generalizations are illustrated in the article.

Connect to

Science

- Use plastic sandwich bags or clear plastic cups with students to show the germination of seeds and observe the roots of the plants developing as well as the initial sprouting of the leaves. You can easily help the students identify the system components and label the elements as well as discuss the interactions as the seeds begin to grow.
- Have students compare and contrast different systems in nature such as ecosystems with solar systems, or the water system with the circulatory system.



Homework

The following assignments may be given to students for homework:

- Have students complete the Venn diagram on **Student Activity Page 2C**.
- Have students choose one of their systems to complete the System Diagram on **Student Activity Page 2D**.



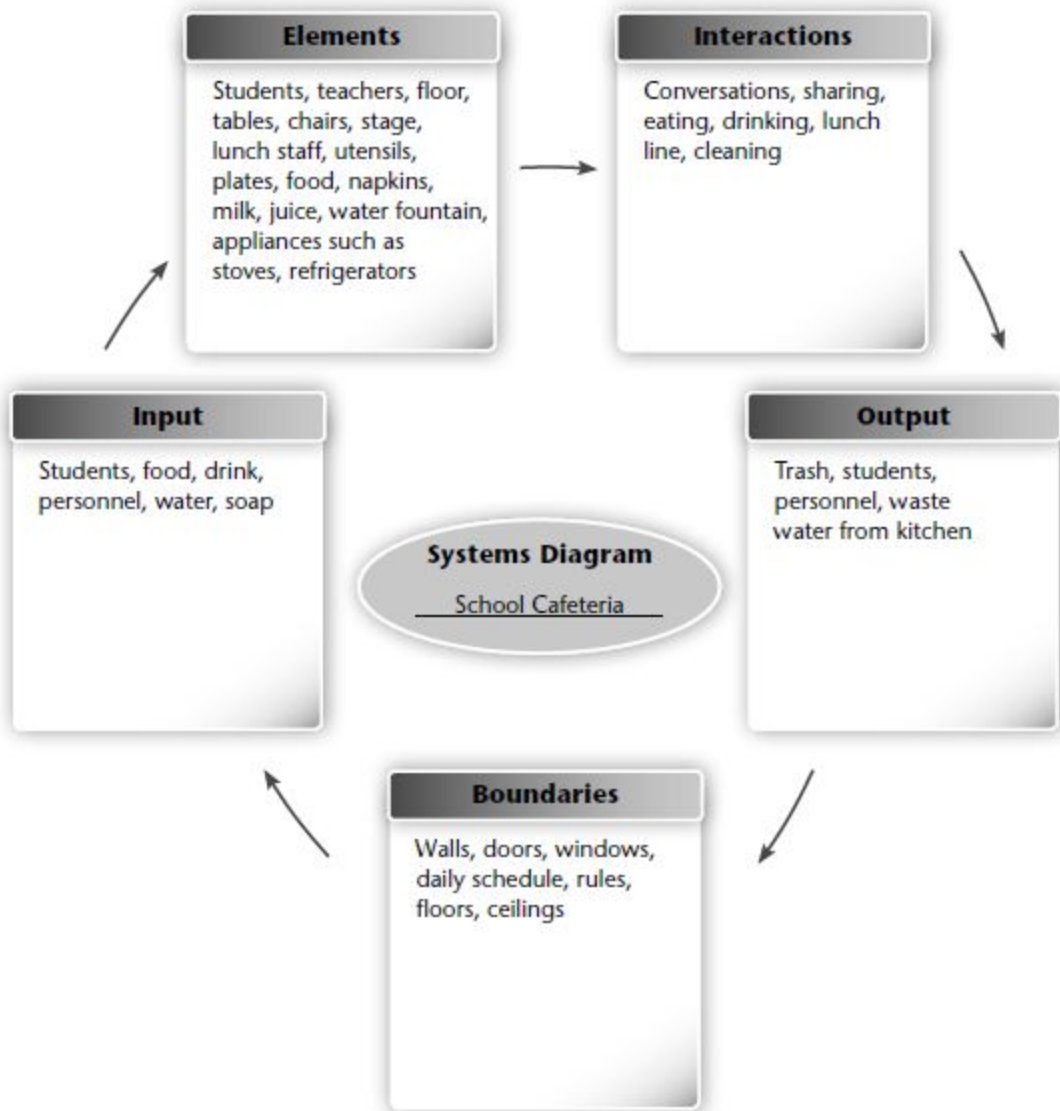
Extensions

The following options may be given to students as extension activities:

- Have students explore books on a variety of systems.
- Provide students with a variety of dissectible and rearrangeable objects such as: gear trains, toy vehicles, conventional blocks, Legos, dolls and doll houses.
- Provide students with a variety of simple systems such as the pencil, table, swing and Mr. Potato Head to put together and take apart.

Systems Diagram Sample: School Cafeteria

2A

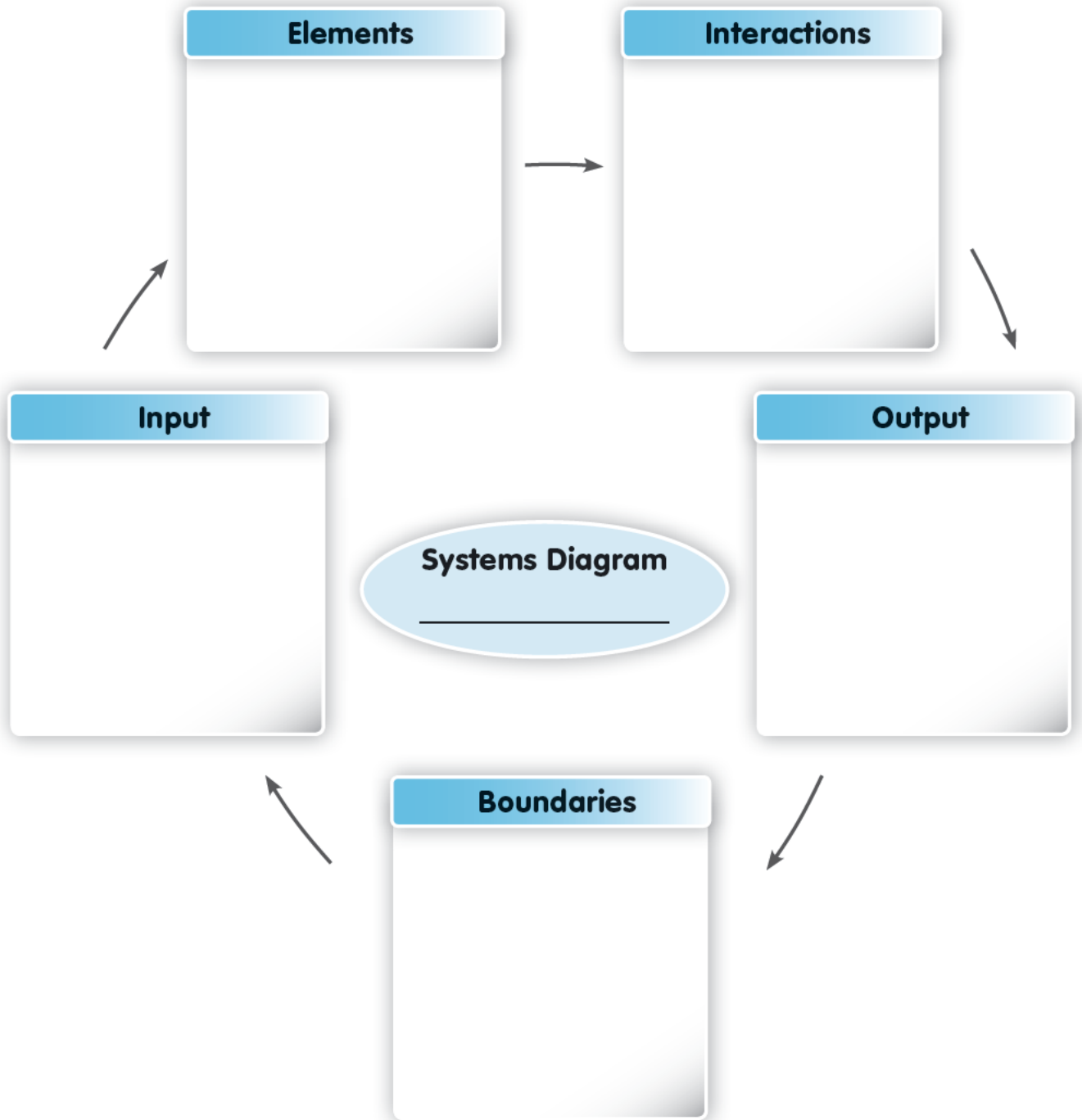


Name: _____ Date: _____



Activity 2A

Systems Diagram



Copyright © Kendall Hunt Publishing Company

Name: _____ Date: _____



Activity 2B

Fish Bowl

Directions: Draw in the elements of your fish bowl system.

Input

Elements

Output



Boundaries

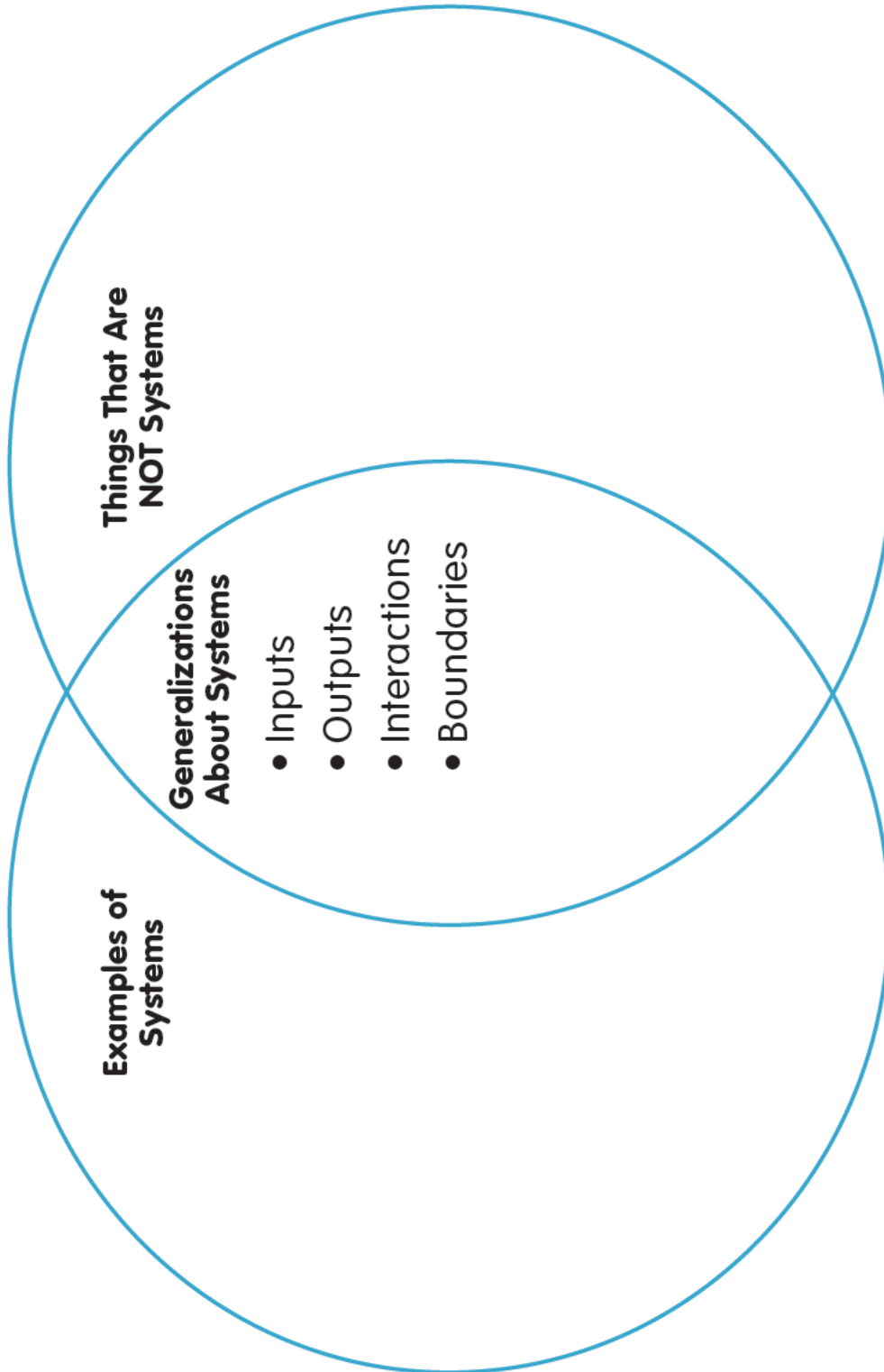
Interactions

Copyright © Kendall Hunt Publishing Company

Exploring Systems Venn Diagram



Activity 2C



Copyright © Kendall Hunt Publishing Company

- Systems have parts (elements).
- Systems have boundaries.
- Systems have inputs and outputs.
- A system's elements interact with each other and a system's inputs.

Name: _____ System: _____



Activity 2D

Systems Diagram Chart

Interactions	
Output	
Input	
Boundaries	
Elements	

Copyright © Kendall Hunt Publishing Company