Lesson Plan
How One Part Relates to Others (3-5)

Estimated Time: 2–3 class periods.

Central Benchmarks
11A Systems(3-5)#1
In something that consists of many parts, the parts usually influence one another.

11A Systems(3-5)#2
Something may not work as well (or not at all) if a part is missing, broken, worn out, mismatched, or misconnected.

Objective
At the end of this lesson students will be able to give evidence of how one part of an object affects other parts of that object and suggest how the object's ability to work might be affected if a part were broken or missing.

Advance Preparation
Locate suitable objects for study. Work with these objects to get a sense of what students may be able to discover when working with them. Next, decide what questions you might ask to assist students in their work. Then, generate possible student responses to your questions. (Note: These would not be the right or only answers, but some likely possibilities.) For the activity on assembling an object, refer to the HANDOUT: Puppet Pieces. Each student will need an envelope containing the puppet pieces cut from this drawing.

List of Materials
For the class:
A toy that has many parts, such as a monkey and stick toy, a toy crane, or a scooter
TRANSPARENCIES:
Dancing Puppet Diagram
Questions About Parts of a Toy
Questions About Parts of a Toy (#2)
Questions About Parts of a Leaf
Questions About Parts of a Celery Stalk
For each student:
An envelope containing the parts to make the dancing puppet
8 brass fasteners
2 pieces of string about 20 cm. long
1 piece of string about 40 cm. long
A leaf (leaves may vary in kind and size)
HANDOUTS:
Questions About Parts of a Toy
Questions About Parts of a Toy (#2)

Questions About Parts of a Leaf
Questions About Parts of a Celery Stalk

For each pair:

Scissors
HANDOUT: Dancing Puppet Diagram
Celery stalk
Celery stalk that has been standing in red dye

Motivation

Show the class a toy that has many parts. Have the students use the think-pair-share[1] strategy to identify as many parts of the toy as they can. List some or all of these parts on the board or a transparency.

Tell the class: *I am going to make the toy work. Please watch carefully*. [Allow time for students to watch the toy working.] *Choose an interesting part from the list of parts and answer these questions about it* [TRANSPARENCY and HANDOUT Questions About Parts of a Toy may be used]*:*

- *How does this part help the toy work?*
- *How did you figure out what this part does?*
- *If the part does not help the toy work, is there some other way in which it is important to the toy?*
- *Does this part affect other parts in any way?*
- *Could you put the parts of this toy together in a different way and still have the toy work as it does now? Explain your answer, using drawings if you wish.*
- *Could we take away any part of this toy without changing the way the toy works? If so, which part?*

Ask students to write one sentence telling something they have learned about the toy. Have several sentences read aloud. As students share what they have learned, continue to emphasize the many parts the toy has and how these parts relate. Ask students whether what they have learned about this toy would also be true of other toys. Let several students explain their answers.

Development

1. Assembling an object from its parts.

Give each pair of students an envelope containing the parts for a dancing puppet. Ask students to examine the parts and consider how they might be put together to make a toy. [Note: Encourage the students to make any kind of toy they wish, not necessarily a dancing puppet.]

Allow students to experiment with the parts for a time. Have students share their ideas with other groups. Then show the class the completed sample of the dancing puppet. Say: *This is one kind of toy you can make with these parts*. Distribute the HANDOUT and show the TRANSPARENCY

[1] In the think-pair-share strategy, two partners first reflect on the response to a question individually and then share their responses with each other. Some pairs then share their responses with the whole group. This cooperative learning strategy serves to involve all participants in reflecting about and responding to a question.

of the Dancing Puppet Diagram. Have students work in pairs to construct the toys they invented or the dancing puppet as shown in the diagram, as they wish.

Have students work in pairs to write directions for making the toy they constructed. Have each pair meet with another pair and evaluate the effectiveness of the directions.

You may wish to have students color and decorate their toys. Students could do this on their own time, and their finished products could be displayed.

After the toys are constructed from the separate parts, instruct students to make their toy work. Allow students time to play with the toy. Then have students, working alone or in pairs, as they wish, write answers to the following questions [TRANSPARENCY and HANDOUT Questions About Parts of a Toy (#2) may be used]:

- *List the parts of the toy.*
- *Select one part and describe how it affects another part.*
- *Can any part be left out if the toy is to work? Name the part that can be left out and explain your reasoning.*
- *Could any part be substituted for another part and the toy still work? Explain your answer.*
- *What might happen if a part were made from another material?*

Now have the class examine the importance of each part. Organize the class into teams of four. Have each person demonstrate his or her toy for the group. Ask: *Do all of the toys you have made work equally well? What might explain the differences in how well the toys work?* (Among possible answers for the dancing puppet toys: the holes in the figures are too small or too big, feet might have been put on backwards, etc.)

Ask students how they could test their explanations. (They could make the toy again, giving special attention to the part identified as the possible problem. If students do this, and find the problem is solved, help them to conclude that, "This tells us that something may not work as well, or at all, if a part is mismatched or misconnected."

2. Looking at parts of objects in the natural world.
Comment: *It isn't always easy to see how one part of an object with many parts affects another part of that object. What are some of the things we were able to do with objects we studied today to learn about how one part affects other parts?* Accept answers. Help students see that we were able to manipulate parts of the toy and that we put several parts together to construct the toy. Comment: *Sometimes we are not able to do these things*.

Say: *Let's look at some objects from the natural world.* Distribute leaves to teams and ask each pair in a team to list the parts they observe. Instruct the pairs to answer the following questions [TRANSPARENCY and HANDOUT: Questions About Parts of a Leaf]:

- *Choose any part. What might this part do for the leaf?*
- *How did you figure out what this part might do for the leaf?*
- *How might this part affect other parts of the leaf?*
- *What might this part do for the whole plant?*
- *How did you figure out what this part might do for the whole plant?*
- *What might we do to find evidence that the part actually does what we think it does?*

Have students share their answers with their teams and then among all teams. Help students realize that investigating part-whole relationships is not always easy: sometimes it is difficult to identify or even see the parts; sometimes it is difficult to separate the parts from each other.

Distribute celery stalks to the teams and ask each pair to list the parts they observe. [Use the TRANSPARENCY and HANDOUT Questions About Parts of a Celery Stalk.] Ask the pairs to answer the questions on the handout.

- *Choose any part. What might this part do for the celery stalk?*
- *How did you figure out what this part might do for the celery stalk?*
- *How might this part affect other parts of the celery stalk?*
- *What might this part do for the whole celery plant?*
- *How did you figure out what this part might do for the whole plant?*
- *What might we do to find evidence that the part actually does what we think it does?*

As students report their findings, challenge them to justify their answers.

Take a stalk of celery and have students watch closely as you pull out a vascular bundle. Ask students what they think this part does. Ask how they could obtain evidence that this part has the function they suggest.

Now fill a beaker half full with water. Add several drops of food coloring, and place several stalks of celery in the beaker.

After about two hours, cut across one of the stalks, and show it to the students. Ask what they think is happening to the red water. (The cross section of the vascular bundles should be red, indicating that the red water is rising in the celery stalk.)

Have students observe the celery after 24 hours. The red coloring should have spread to the leaves. Again, have students watch closely as you remove a (now red) vascular bundle from the celery stalk. Ask how this part helps the plant. (Students should conclude that it carries water up the stem of the plant to the leaves.) Ask students to explain how the investigation with the red dye provides evidence for this.

Ask students to tell what they have learned about parts and wholes in objects from the natural world. Lead students to articulate the idea that objects in the natural world have many parts and that one part affects other parts so that if one part is missing, the whole thing may be affected.

Summary
Ask several students to summarize what was done today and to tell how one part of the lesson related to other parts.

Evaluation
Have students complete journal entries for these assignments:

- List two things they could tell their parents about the relationships between parts and wholes in an object they studied today.

- Name an object they did not study today and tell how one of its parts might affect another part or the whole object.

Plan further instruction on the central benchmarks based on the level of understanding shown in these journal entries.

Extensions

- Have students identify parts and their relationships to other parts in new objects, such as seedlings, insects (do not harm), their own bodies, etc.

- Have students assemble working structures from Lego kits, etc.

- Have students take apart assembled objects.

- Have the students give their directions for making their toys to 4th graders. Have the 5th graders watch the 4th graders work and then revise their directions based on how easily the 4th graders could use them.