Does It Have a Life Cycle?

By Page Keeley

Assessment serves many purposes in the elementary classroom. Formative assessment, often called assessment *for* learning, is characterized by its primary purpose—promoting learning. It takes place both formally and informally, is embedded in various stages of an instructional cycle, informs the teacher about appropriate next steps for instruction, and engages students in thinking about their own ideas. Formative assessment can take many forms. One form that has been used successfully in science education is the formative assessment probe. The *Uncovering Student Ideas in Science* series published by NSTA provides science educators with an extensive bank of formative assessment probes (see Internet Resource for information on the series). These probes are used to reveal the ideas students bring to their learning before instruction (preconceptions) as well as the conceptions formed throughout the instructional cycle. Merely gathering this information does not make a probe formative. It is only formative when the information is used to improve teaching and learning. Each month, this column features a probe and describes how elementary science teachers can use it to build their formative assessment repertoire and improve teaching and learning in the elementary science classroom. See NSTA Connection for more background on using formative assessment probes.

Life cycles, a common topic in elementary science, help students develop an understanding of the continuity of life. The K–4 National Science Education Standards state that students should know that plants and animals have life cycles that include being born, developing into adults, reproducing, and eventually dying. The details of this life cycle are different for different organisms (NRC 1996). Beginning in the early grades, children have firsthand experiences observing and describing the life cycle of living organisms such as the butterfly, frog, mealworm, or bean plant. Direct experiences observing how an organism changes from egg to adult contribute to an understanding of the cyclic nature of birth, growth, development, and reproduction—concepts that lead to the bigger idea of life continuing from generation to generation. If life continues from generation to generation, then all plants and animals must go through a life cycle, even though it may be different from organism to organism. Is this what students have "learned," or do they have their own private conceptions about life cycles? The formative assessment probe "Does It Have a Life Cycle?" reveals some surprising ideas children have about life cycles (Keeley, Eberle, and Dorsey 2008). Take the time to uncover your students' preconceptions before teaching a unit on life cycles.

Limitations of Context

The "Does It Have a Life Cycle?" probe (Figure 1) is designed to find out whether students recognize that all living multicellular organisms go through a life cycle. Everything on the list goes through a life cycle,

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but these cycles vary in length and the type of development juveniles go through. Hundreds of responses from students in grades 1–4 were analyzed from this probe, and more than 80% of the students failed to check off all of the organisms. One of the common reasons given was that an organism has to "go through a change" to have a life cycle. After further probing it was revealed that many of these students considered change to be the type of physical transformation organisms such as frogs and butterflies go through during complete metamorphosis. These students checked off the frog, butterfly, and other insects, but did not check off plants or organisms such as the cow or humans. Was context a factor that inhibited these students' learning? Perhaps the students experienced a butterfly or frog unit, but failed to develop the generalization that all animals, not just frogs and butterflies, have life cycles. The results of this probe can be used to inform teachers of the limitations of context. If you are teaching about life cycles using the butterfly's life cycle, which students can directly observe, then you must be sure to help students understand that the butterfly is one example of an organism that has a particular type of life cycle. All organisms have life cycles, and some of their life cycles may be very different from the butterfly's life cycle.

Using the Probe

This particular type of probe is a form of assessment probe called a "justified list" (Mundry, Keeley, and Landel 2010). This type of probe asks students to check off all the things that fit a particular statement. In this case, all the things that have a life cycle. Students then have to describe the rule or reasoning they used to decide on the examples they picked. It is this part of the probe that allows you to get into your students' heads and examine their thinking. As you uncover reasons for their failure to generalize, the information is used to inform instruction that will address these learning barriers. Make sure the organisms on the list are familiar to students. Remove or replace ones that your students may not recognize. Consider combining words with pictures for younger students or English language learners.

A written assessment in which students check off the things that have a life cycle, explain their reasoning, and turn it in for analysis is one way to administer the probe. As an assessment that promotes learning, a more powerful way to use this probe with young children is through science talk. During "circle time," present one example at a time to the class, by either writing the name of the organism on a chart or holding up a picture of the organism and asking if it has a life cycle—why or why not. As students agree and disagree with each other, carefully listen to their

Figure 1.

Does It Have a Life Cycle? probe.

Does It Have a Life Cycle?

How do you decide if an organism goes through a life cycle? Put an X next to the organisms that have a life cycle.

___ frog	___ cow	___ daisy
___ butterfly	___ mushroom	___ chicken
___ grasshopper	___ grass	___ maple tree
___ fern	___ earthworm	___ human
___ shark	___ snail	___ beetle
___ bean plant	___ mold	___ crab
___ snake	___ spider	___ moth

Explain your thinking. Describe the rule or reason you used to decide if an organism has a life cycle.

ideas without passing judgment on whether they are right or wrong. Guide the class to come up with a general rule to decide whether an organism has a life cycle, and carefully note the organisms students have difficulty agreeing on. Then, decide on ways to challenge students with their thinking over the course of the lessons you will use to address students' preconceptions.

Another way to implement the probe is with the formative assessment classroom technique (FACT) called a *card sort* (Keeley 2008). The organisms on the justified list are placed on cards (words or pictures can be used). Students work in small groups to arrange the cards into three groups—things that have a life cycle, things that don't have a life cycle, and things they aren't sure about yet. Students discuss each organism before placing it into a category, justifying their reasons for doing so. If the group cannot agree, the card is placed in the third category and revisited later or during the whole class discussion. As students are actively discussing their ideas, circulate among the groups, listening carefully to their reasoning and noting the examples that are most problematic. Make stops to probe each group's thinking. For example, say some students were using the cyclic representation to decide which organisms had a life cycle. If they had seen drawings that depicted the stages the organism went through as it developed (e.g., egg, larva, pupa, adult) represented in a circular diagram, they interpreted this as a life cycle. To them, the other organisms lived and died (such as humans) but they didn't have "cycles" because their pictures as they go through life are not shown as a circle diagram. This influence of a type of representation may not have surfaced without probing the group further. Clearly this is formative information that can be used to make sure representations students see in their textbooks and instructional materials do not contribute to this misconception.

Make It Formative

Remember, a probe is not formative unless you use the data to inform your teaching. One of the ways a justified list probe can inform teaching, not only about life cycles but with many topics in science, is to point out the limitations of context. For students to really learn a concept or idea, they must be able to transfer it to a variety of examples and develop generalizations that apply in a variety of contexts. The "Does It Have a Life Cycle?" probe is one example of a probe that alerts teachers to the need to make sure multiple examples are used during instruction. The butterfly or frog unit is a relevant and engaging context in which to learn about life cycles. However, if the context unintentionally implies that organisms only have life cycles if they go through stages similar to the organism they studied in their life cycle unit, then instruction really has not fully addressed the important learning goal from the National Science Education Standards. Will your students' ideas be limited by the context in which they learned about life cycles? Try out this probe—your students' answers might surprise you and lead you to using other probes to examine the effect of instructional contexts on your students' ideas.

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Internet Resource

Uncovering Student Ideas in Science series
www.nsta.org/publications/press/uncovering.aspx

NSTA Connection

Read the introduction to *Uncovering Student Ideas in Science, Volume 1,* and download a full-size "Does It Have a Life Cycle?" probe at *www.nsta.org/SC1011.*