Is It Living?

Listed below are examples of living (which includes once-living) and nonliving things. Put an X next to the things that could be considered living.

___ tree	___ egg		
___ rock	___ bacteria		
___ fire	___ cell		
___ boy	___ molecule		
___ wind	___ Sun		
___ rabbit	___ mushroom		
___ cloud	___ potato		
___ feather	___ leaf		
___ grass	___ butterfly	___ fossil	___ mitochondria
___ seed	___ pupae	___ hibernating bear	___ river

Explain your thinking. What "rule" or reasoning did you use to decide if something could be considered living?

Is It Living?

Teacher Notes

Purpose

The purpose of this assessment probe is to elicit students' ideas about living and nonliving things. The probe is designed to find out what attributes children focus on when considering if something is or was once living.

Related Concepts

living things, life processes, characteristics of life

Explanation

Differentiating between living and nonliving is not a simple black-and-white task. There is no single criterion used to identify whether something is living. Additionally, some of the characteristics that are used to identify living things are not easily observable, such as extracting energy from food as opposed to being able to watch an organism "eat." Living things are made up of one or more cells and carry out basic life processes (e.g., acquire or make food, grow, respire, reproduce, react to stimuli, move, and eliminate waste). Not all living things show all of these characteristics all of the time. The tree, boy, rabbit, grass, seed, egg, bacteria, cell, mushroom, potato, leaf, butterfly, pupae, and hibernating bear can be considered living. Each is made up of one or more cells and is capable of performing one or more life processes. The tree, boy, rabbit, grass, bacteria, mushroom, butterfly, and hibernating bear are also complete living organisms. Some of the items listed are living organisms in various developmental stages of their life cycle such as the seed, egg (recognize that an egg from the supermarket is "once living"), and pupae. The potato and leaf are parts of a living plant. By themselves they are capable of carrying out some life processes

for a limited time.

The remaining items—cloud, fire, wind, Sun, feather, molecule, river, mitochondria, rock, and fossil—are nonliving. The feather was once part of a living thing, partially made up of cells as well as materials made by cells. However, by itself, it cannot sustain life. The mitochondria are parts of a cell that carry out the process of releasing energy from food but by themselves they are not living. Some things can be living without being a complete organism. For example, a leaf is a part of a complete plant. With a source of water and air, some leaf cuttings can continue to carry out life processes, develop roots, and eventually become an entire plant.

Curricular and Instructional Considerations

Elementary Students

Young children develop their ideas about living organisms based on their conception of living versus nonliving. Students in early elementary grades develop an understanding that living things have basic needs such as food, water, and air. As they progress through the elementary grades, students develop an understanding of several basic observable functions performed by living things such as eating, drinking, breathing, growing, and moving. At this level students are more likely to think of a whole organism as living rather than a part of an organism such as a leaf or cell. This probe is useful in identifying early ideas students have about the concept of living.

Middle School Students

As students investigate more unfamiliar life forms, they refine their early ideas about living. They begin to develop a more sophisticated understanding of the needs of cells and the life processes occurring at the cellular level—for example, extracting energy from food, removing waste products, taking in water, and cells dividing to make more cells. They also recognize that some living things perform their life functions as a single cell.

High School Students

By high school, students have a more complete understanding of the processes that support life, particularly at the cellular level. They have a greater ability to recognize the ubiquitous features and processes common to all life from the early stages of development to adult. They recognize death as the cessation of life processes. This probe is useful in comparing high school students' conception of living with elementary and middle school students' ideas and determining whether the high schoolers have accumulated the biological ideas that can be used to explain life and death.

Administering the Probe

During the administration of this task, consider interviewing students and/or using props. Tailor the items on this list to suit targeted instructional goals and the developmental levels of students. Remove items that are unfamiliar. Consider including additional items for

younger students, such as tadpoles, a cocoon or butterfly chrysalis, bulbs, and a plant cutting. For older students consider adding items like bread mold, yeast, a virus, DNA and proteins, additional parts of a cell, and/or a fresh bone. This task can also be used as a card sort. Provide students with cards printed with various examples and ask them to work with a partner or small group to sort them into piles of "living" and "nonliving." Listen carefully to their explanations as they sort.

Related Ideas in *National Science Education Standards* (NRC 1996)

K–4 Characteristics of Organisms

- Organisms have basic needs. For example, animals need air, water, and food; plants require air, water, nutrients, and light.

5–8 Structure and Function in Living Systems

- All organisms are composed of cells, the fundamental units of life.

9–12 Matter, Energy, and Organization in Living Systems

- Living systems require a continuous input of energy to maintain their chemical and physical organizations. With death, and the cessation of energy input, living systems rapidly disintegrate.
- The complexity and organization of organisms accommodate the need for obtaining, transforming, transporting, releasing, and eliminating the matter and energy used to sustain the organism.

Related Ideas in *Benchmarks for Science Literacy* (AAAS 1993)

K–2 Cells

- Most living things need water, food, and air.

3–5 Cells

- Some living things consist of a single cell. Like familiar organisms, they need food, water, and air; a way to dispose of waste; and an environment they can live in.

6–8 Cells

- All living things are composed of cells, from just one to many millions, whose details usually are visible only through a microscope.

Related Research

- Children have various ideas about what constitutes living. Some may believe objects that are "active" are alive—for example, fire, clouds, or the Sun. As children mature they include eating, breathing, and reproducing as essential characteristics of living things. People of all ages use movement, and in particular movement as a response to a stimulus, as a defining characteristic of life. When doing so, these individuals tend to omit plants from the living category. Some studies show that young children will infrequently give "growth"

as a criterion for life, the exception being when plants are identified as living—then "growth" is commonly given as the reason (Driver et al. 1994).

- A study by Stavy and Wax (1989) revealed that children seem to have different views for "animal life" and "plant life." In general, animals were more often recognized as being alive than plants.
- Some studies indicate that the ability to reproduce is occasionally given by young children as a criterion for life. However, some nonliving things were said to be living because they "reproduced" (Driver et al. 1994).
- Elementary and middle school students use observable processes such as movement, breathing, reproducing, and dying when deciding if things are alive or not. High school and college students use these same readily observable characteristics to determine if something is alive. They rarely mention ideas such as "being made up of cells" or biochemical aspects such as "containing DNA." It has been suggested that the learning of facts has contributed little toward understanding. Students may be able to quote the seven characteristics of life but may not be able to apply them when determining if something is living (Brumby 1982).
- In a study of 424 Israeli students ages 8–14, Tamir, Gal-Chappin, and Nussnovitz (1981) found no significant difference in age when students were asked to classify 16 pictures as living or nonliving things. On average, 20% of the items were grouped incorrectly, with trees, mushrooms, Sun, rivers, embryos, eggs, and seeds being problematic.
- Objects that children anthropomorphized are categorized as living things. For example, objects such as the Sun, cars, wind, and fire "felt" and "knew" things and were therefore alive. Studies indicate that there is a marked shift as students age from the view that objects and things (including living things) carry out certain tasks "because they want to" to reasoning that "they need to in order to live" (Driver et al. 1994).
- Carey (1985) suggested that progression in the concept of "living" is linked to growth in children's ideas about biological processes. Young children have little knowledge of biology. In addition, it isn't until around the age of 9–10 years that children begin to understand death as the cessation of life processes.
- Some of the earliest studies on children's conception of living were carried out by Piaget. His results showed a predictable pattern in students' development of the concept "living." From ages 0 to 5, students have almost no concept for living things; from ages 6 to 7 students believe things that are active or make noise are alive; from ages 8 to 9 students classify things that move as alive; from ages 9 to 11 students place things that appear to move by themselves (including rivers and the Sun) as living; and over age 11 through adulthood animals or animals

and plants are considered living (Driver et al. 1994).

Suggestions for Instruction and Assessment

- Engage students in thought-provoking exercises that allow them to "discover" why things are considered to be alive. Have students monitor and observe a number of items that are classified as "living"—from whole organisms to parts of organisms such as a carrot top placed in a dish of water. Have them generate their own characteristics of what makes these things "alive." Include items that may not be readily classified as "alive," such as plant seeds, flower bulbs, potatoes, mushrooms, and insect pupae.
- Give students an unusual object (e.g., strange-looking rock, dried piece of sponge, brine shrimp eggs, fossil, green "slime") and tell them it was found in an isolated area such as a remote rain forest. Challenge them to come up with ways to find out if it is alive, dead but once living, or never alive. Have them present their evidence to support their ideas.
- Place emphasis on the "living" aspects when studying life cycles and show that death is the end of the life cycle for an individual organism. Students often think that organisms in metamorphic or dormant states are dead. Counteract this with what happens after they emerge from such states and with the idea that they had to be alive for their life cycles to continue.
- Emphasis in the early grades should be placed on familiar animals (including people) and plants and progressing to more complex or unusual organisms (e.g., single celled) in later grades. Students should be encouraged to look for similarities when considering the needs and functions of living things.
- Beginning around third grade, students' observations of living things should include microscopic organisms. Students should be given the opportunity to make the connection that microscopic life has basic characteristics similar to more familiar, larger organisms. For example, they use the same things (e.g., food, water) and carry out similar processes that will keep them alive.
- Be sure to distinguish needs from processes. For example, a seed may not need water for many years while it is dormant, but once environmental conditions are right and it can take in water it will grow into a plant capable of sustaining life. Lessons should address the many life processes as students progress through the grades—use of food for energy, reproduction, reaction to stimuli, transport of materials, gas exchange, movement, waste elimination, and so forth.
- Be aware of the tendency of younger children to anthropomorphize. Explore the use of common phrases that imply nonliving things do the same things as living things—for example, a fire "breathes" or waves "grow." Pay close attention to lit-

erature and images that make nonliving things seem living, such as putting a face on the Sun or clouds.

- Have young students compare and contrast a stuffed animal toy with the real thing. Ask questions such as, What can the living animal do that the stuffed toy cannot do? Why is one considered living and the other not? Is the stuffed animal toy dead or was it never alive? How do you know?
- Use the mnemonic, MRS GREN, to help students identify the seven life processes that characterize life: M = movement, R = respiration, S = stimuli (reaction to), G = growth, R = reproduction, E = elimination of wastes, and N = nutrition (acquiring of or making food). Make sure students know what these processes mean and that not all living things will show all of them all of the time.
- In middle and high school, make sure students understand the cell as the basic unit of function that carries out the life processes. The idea that all living things are composed of cells (assuming viruses are nonliving) is the most fundamental way to define *living* or *once living*.

Related NSTA Science Store Publications and NSTA Journal Articles

Aram, R., and B. Bradshaw. 2001. How do children know what they know? *Science and Children* (Oct.): 28–33.

Driver, R., A. Squires, P. Rushworth, and V. Wood-Robinson. 1994. *Making sense of secondary science: Research into children's ideas.* London and New York: RoutledgeFalmer.

Keeley, P. 2005. *Science curriculum topic study: Bridging the gap between standards and practice.* Thousand Oaks, CA: Corwin Press.

Related Curriculum Topic Study Guides

(Keeley 2005)

"Characteristics of Living Things"

"Life Processes and the Needs of Organisms"

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