Is it Alive?

Abstract

Students look at cards and categorize them as living or non-living. The set includes several tricky examples to encourage discussion about what exactly makes something alive.

Learning Objective

- There are criteria that some use to determine if something is living or not, but some examples are tricky.
- Living things are made of cells.
- Cells are the smallest unit that can be said to be alive.

Estimated time

- 20 minutes

Materials

- Copies of cards. *Note: works best when printed in color.*

Instructions

1. Print & cut out cards to create sets. Make enough to give a set to each group or pair of students.
2. Distribute sets of cards. Have students sort the cards into groups: living and non-living. You can suggest up front or later that students also make an in-between category, or even multiple in-between categories – E.g., once was living, has the potential to live, came from something living.
3. Have students share what they did, either through a whole-group discussion or by having each group put their cards on display.
    a. Discuss tricky examples as a group.
    b. Focus on students' reasoning: Why did they choose one category over the other?

Students may come to different conclusions about some of the in-between examples, and that's ok. We have intentionally chosen examples that are muddy and challenging. What's more important is that (1) students arrange the clear examples correctly, and (2) they can provide sound reasoning or explanations for why they categorized each card the way they did.

Some examples students may find challenging:

- Chicken egg & sunflower seed may have a living embryo inside, or not.
- Rhinovirus – It's debatable whether viruses are living or not.

- Soil & rivers usually have both non-living & living components but aren't in themselves alive.
- Sliced turkey, wood & coal were once living but are no longer alive.
- Feathers, milk, and many book materials came from living things.
- Fossil required a living thing to form, but they are not alive.

Discuss

- What is it that makes something living or not?
    - What criteria did students use? Students may come up with criteria such as movement (this can be on the cellular level); growth & development; reproduction; respond to stimuli; obtain & use energy (i.e., metabolism); composed of one or more cells.
- Introduce the PMC model, described below in the Supplemental Information. You can use the simpler terms Instructions, Energy, and Container.
- Bring the discussion around to cells. All living things that we know of on earth are made up of cells—either one cell or groups of cells. The functions above happen at the cellular level.

Other Implementation Ideas

- **Open-ended sort**: Tell students to come up with their own sorting criteria. Have them compare criteria or sort multiple times using different criteria. Eventually steer them to living/non-living.
- **Astrobiology quest**: Use this activity as a springboard to ask what characteristics astrobiologists should look for as they search for life on other planets and expolanets. If we find new life forms, how can we recognize them as living, especially if they're chemically different from life on Earth? Or flip it: What if aliens came to earth? What fundamental characteristics could they use to make sense of living vs. non-living things on our planet?
- **Graphic organizer**: Have each group fill in a graphic organizer to describe their grouping (e.g., have students fill in categories, members, and reasoning). Then do a jigsaw where students compare opinions about what makes something living, followed by a whole-class discussion to compile consensus criteria.

Supplemental Information

On the surface, the question of what makes something living or not may not seem very interesting. Basically, most people feel like they know it when they see it. And, for the most part, they do. But it's actually a question that scientists continue to debate.

The only life that we know about in the universe is the cell-based, chemical life on Earth. With only one available example, it's not really possible to come up with a definition that works for potential life forms that we haven't found yet. The best we can do is to come up with a set of criteria that are common to the life forms on earth.

Some scientists use the PMC model of life, which describes 3 interconnected criteria:

1. **Program** – This includes a way to encode **instructions** for building the life form, a way to read those instructions, and a way to replicate them to make more living things (i.e., reproduction).

2. **Metabolism** – Mainly, this is a way to capture and use **energy**. It can also include building molecules that the life form needs.

3. **Container** – This is a barrier (i.e., cell membrane) that keeps the life form separate from its environment. Often the container selectively lets things in and out.

Other definitions of life—of which there are hundreds—include slightly different or additional criteria.

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Chicken egg

5.5 centimeters

Feather

15 centimeters

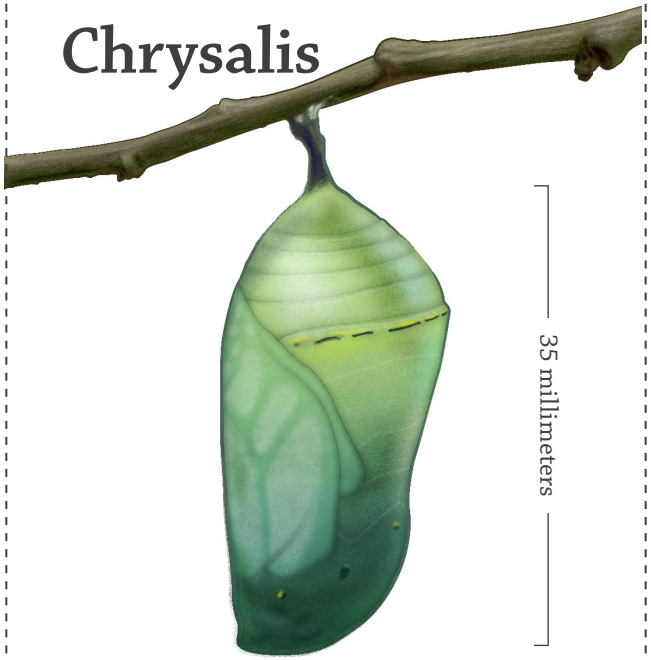
Corn

3.5 meters

Sliced turkey

22 centimeters

Chrysalis



35 millimeters

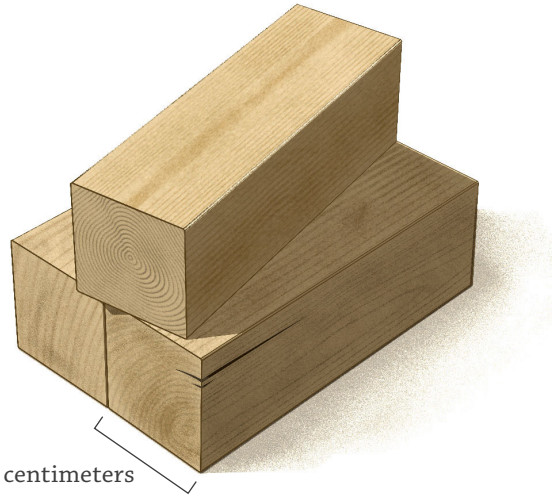
Sunflower seed

20 millimeters

Fossil

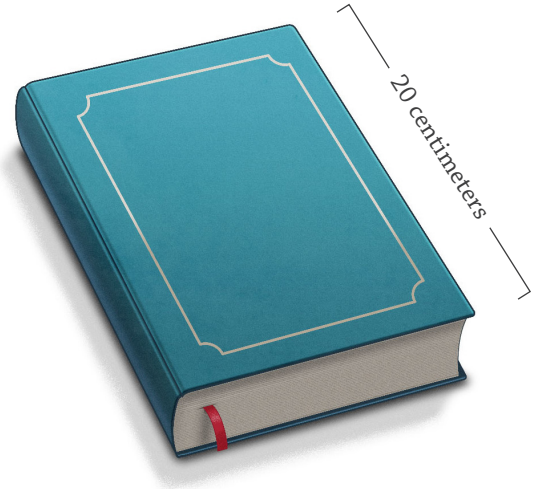
60 centimeters

Wood



10 centimeters

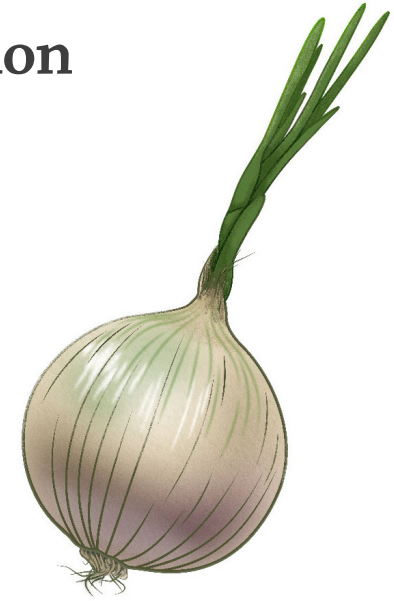
Book



Sun

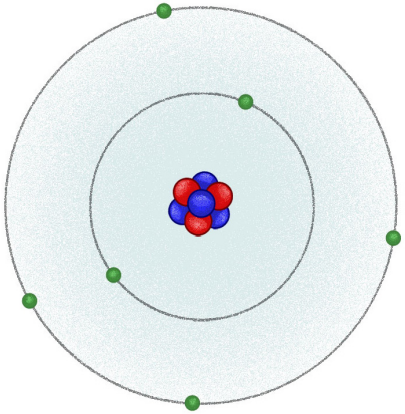
1.4 million kilometers

Onion



7 centimeters

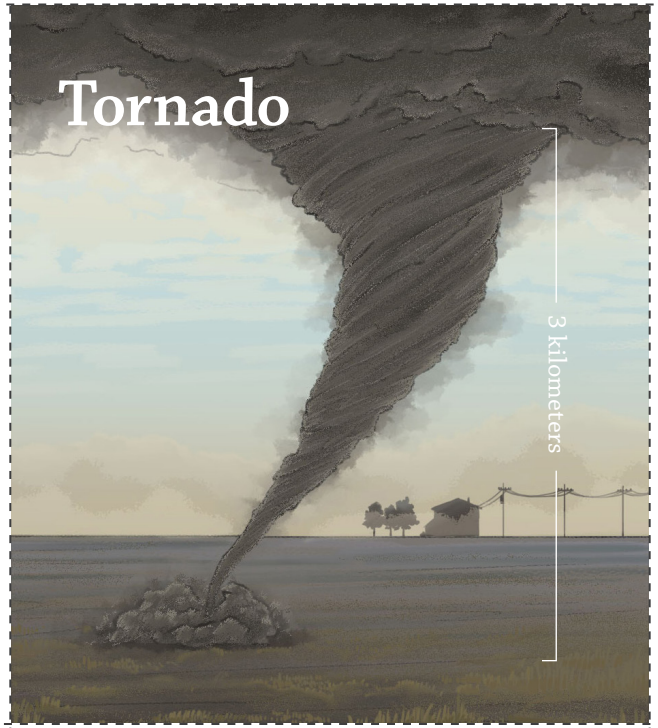
Carbon atom



340 picometers

Person

Tornado



Milk

Coal

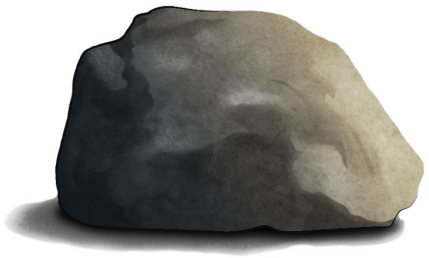
Soil

Bread mold

Self-driving car

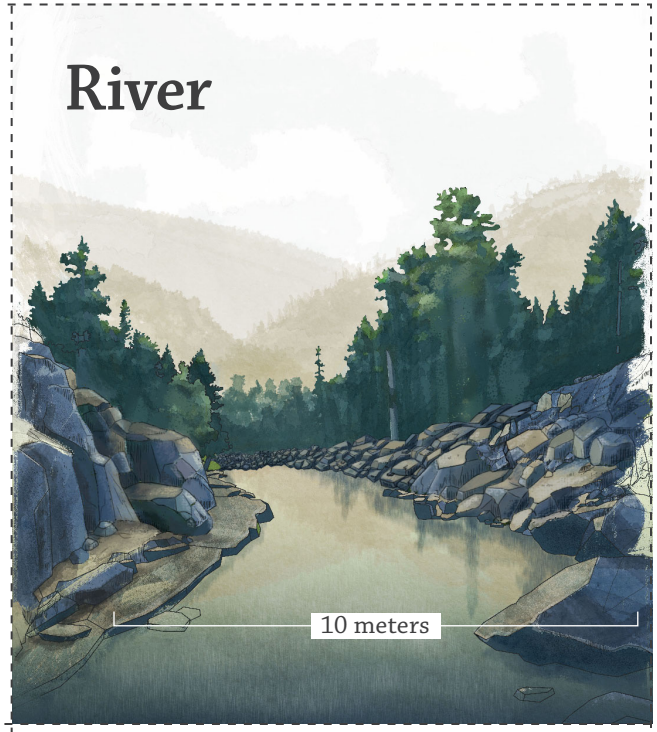
4.7 meters

Rock

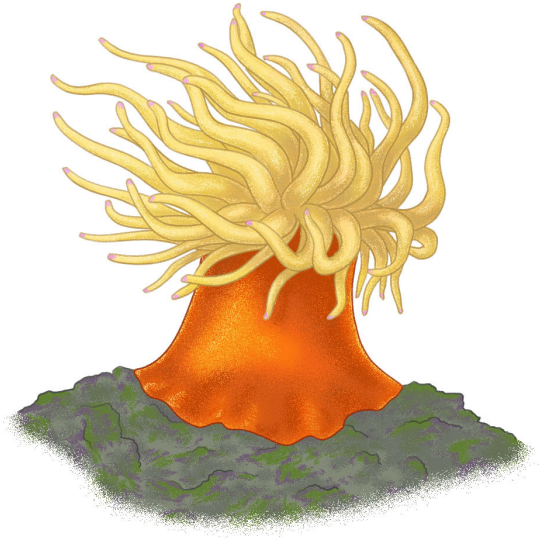


1 meter

River



Sea anemone

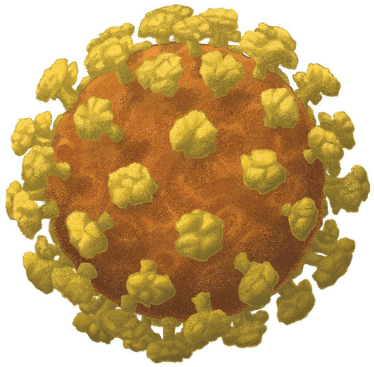


25 centimeters

Streptococcus bacteria

1 micrometer

Coronavirus *(respiratory virus)*



30 nanometers