Living vs. Non-Living

Introduction

What features distinguish living from non-living things? This demonstration is designed to challenge and provoke students to think about the definition of life. Observe the properties of organisms that a lifeless system can imitate.

Concepts

- Living vs. non-living
- Formulation of hypothesis
- Observation skills
- Characteristics of life

Background

What are the differences, if any, between living and non-living things? Physically many similarities exist between the two. Both living and non-living objects are comprised of many of the same materials. However, living organisms do have characteristics that make them unique from the non-living. In order for an organism to be considered alive it must exhibit organization, utilize energy, and also undergo reproduction, growth and development, response, and adaptation. Some of these characteristics are found in non-living things as well, but in order to be considered alive organisms must have all of the above attributes.

All living creatures are highly organized. They exhibit specialized structures that are designed to perform specific functions. The basic unit of organization of life is a *cell*. All organisms are made of cells. Organisms such as protists and bacteria are *unicellular*; that is, they consist of only one cell. Multicellular organisms such as humans and plants are made up of trillions of cells.

Energy exists in many forms such as thermal, sound, radiant, and chemical. Living things utilize many different forms of energy. All forms of life are capable of taking energy from their environment and converting it to a form that is needed to sustain life. For example, plants are able to use light energy to make food from carbon dioxide and water.

Growth and development are also essential for life. *Growth* is defined as an increase in size. Development is a change in form or shape over time. The amount of growth varies greatly between species. A paramecium does not grow very much from its original size. A giraffe grows from a fertilized egg to a several-thousand-pound adult. Development also varies between organisms. A caterpillar undergoes a significant change in development to become a butterfly.

All living things originate from other living things. Reproduction is the process by which living things are formed. *Reproduction*, which involves the formation of new cells, is necessary for survival of a species. It can vary from creation of an exact duplicate of the parental organism to a duplicate that deviates from the original.

Living organisms must also be able to respond and adapt to stimuli in their environment. Scratching an itch would be an example of a learned response to a stimulus. Responses are generally referred to as individual changes or reactions to conditions. Adaptations occur when a population of organisms responds to changes in their environment. Adaptations are passed on to future generations within a species due to natural selection. Over time, natural selection causes the population of polar bears in the cold arctic waters and armadillos in the desert to developed adaptations that allow them to thrive in adverse environments.

Materials

- Iron(III) chloride, $FeCl_3 \cdot 6H_2O$, 0.5 g
- Olive oil, 20 mL
- Sodium silicate solution, saturated, 20 mL
- Sudan IV, 0.02 g
- Dish soap, 1 drop
- Graduated pipets, 2
- Overhead projector
- Petri dishes, plastic, 2
- Spatula

Publication No. 10992
091117

Safety Precautions

Iron(III) chloride is a skin and body tissue irritant and is slightly toxic by ingestion. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Wash hands thoroughly with soap and water before leaving the laboratory. Follow all laboratory safety guidelines. Please review current Safety Data Sheets for additional safety, handling and disposal information.

Procedure

Part A

1. Obtain a clear plastic Petri dish and place it on the overhead projector.
2. Fill the Petri dish about one-half full with saturated sodium silicate solution.
3. Add several small particles of iron(III) chloride randomly to the solution (see Figure 1) and observe.

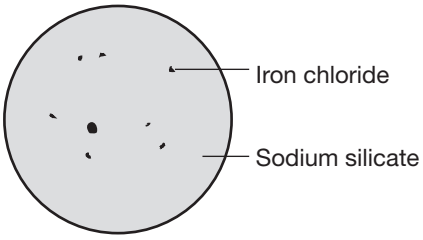

Figure 1.

Part B

4. Pre-lab prep: Add 0.02 g Sudan IV solid to 20 mL olive oil. Mix well.
5. Obtain a second Petri dish and place it on the overhead projector.
6. Fill the Petri dish about one-half full with tap water.
7. Using a graduated pipet, add about 10 drops of red oil randomly to the Petri dish.
8. Using a clean graduated pipet, add 1 drop of dish soap to the center of the oil droplets. Observe any changes in appearance.

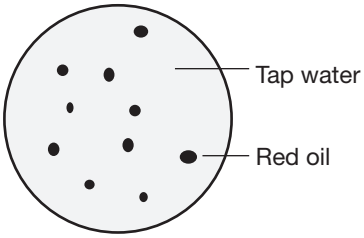

Figure 2.

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures, and review all federal, state and local regulations that may apply, before proceeding. Filter the mixture obtained in Part A and dispose of the precipitate according to Flinn Suggested Disposal Method #26a. The remaining solutions from parts A and B may be disposed of according to Flinn Suggested Disposal Method #26b. Wash Petri dishes with mild detergent and warm water, rinse thoroughly, and store for future demonstrations.

NGSS Alignment

This laboratory activity relates to the following Next Generation Science Standards (2013):

Disciplinary Core Ideas: Middle School
MS-LS1 From Molecules to Organisms: Structures and Processes
LS1.A: Structure and Function
LS1.B: Growth and Development of Organisms

Disciplinary Core Ideas: High School
HS-LS1 From Molecules to Organisms: Structures and Processes
LS1.A: Structure and Function
LS1.B: Growth and Development of Organisms

Science and Engineering Practices
Developing and using models
Constructing explanations and designing solutions

Crosscutting Concepts
Patterns
Systems and system models

Tips

- The heat of the overhead projector is important for Part A. If a classroom projection system is used instead, dilute the sodium silicate to a 15% solution. This will also increase the speed of the demo if an overhead is used.
- Part A is very slow. Recheck its progress over the course of the class time or dilute the sodium silicate solution to 15%.

- Part B is very fast. A clean Petri dish or lid must be used each time to ensure no soap residue prevents the "response" from occurring.
- Part A demonstrates growth and development. The $FeCl_3$ reacts with the sodium silicate to form ridges of insoluble, rust colored iron silicate plus colorless NaCl. The solid iron silicate "grows" with time and "develops" protrusions and ridges.
- Part B demonstrates a response to a stimulus. The Sudan colored oil droplets "contract" then "rush away from" the drop of soap.

References

Lisowski, M.; Strauss, E. *Biology: The Web of Life;* Addison Wesley Longman: United States of America; 1998.

Materials for *Living vs. Non-Living* are available from Flinn Scientific, Inc.

Catalog No.	Description
FB1983	Life Characteristics—Biological Demonstration Kit
F0006	Iron(III) Chloride, 100 g
Q0004	Olive Oil, 200 mL
S0102	Sodium Silicate Solution, 500 mL

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.