Grades 5–12: Search for Life

Continuum Activities

What is a living thing? (Pre) Activity #1

Students will be able to, define life, establish criteria to classify living and non-living objects, classify objects as living or non-living and construct a Venn diagram, resent their findings and rationale to the class, and elaborate upon the life processes of organisms.

Materials

Choose a minimum of fifteen objects that combine inanimate objects, living objects and objects that may have once been living. Here are some suggestions for such items:

- Rocks
- Lit Candles
- Plants
- Cut Flowers
- Plastic or silk flowers
- Green Leaves
- Plastic or silk leaves
- Dead Leaves
- Seeds
- Dormant Yeast
- Antacids
- Live bug, Dead Bug & plastic Bug
- Protists (mixed culture with algae)
- Inoculated Petri dish
- Deep well slide
- Discovery worksheets (Per student)
- Hand Magnifying Lens
- Dirt/soil

Pre-setup

- Establish stations around the class with the materials chosen.

Procedure

1. Hand out Discovery worksheets 1 (found in Appendix I)
2. Begin brainstorming KWL chart of What is a living thing? See appendix II for "K-W-L How to Guide"
3. Have cooperative groups visit each station in turn and classify the objects as living or non-living.
4. Cooperative groups in grades 5-10 can fill out their worksheets.
5. Cooperative groups are to report upon the criteria they established for classifying the objects, as well as the reasoning for their criteria and findings.
6. Instructors may facilitate a debate utilizing possible discrepant objects to fuel the dialogue for grades 5-10.
7. Complete KWL charts in Discovery worksheets.

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Microbes abound everywhere! (Pre) Activity #2

Students will be able to, define and explain what fomites are, predict and identify which fomites yield the most medium growth, and inoculate an agar plate.

Materials

- Agar plates
- Sterilized cotton swabs
- Non-latex gloves
- Markers
- Tape

Pre-setup

Each cooperative group of two should receive:

- 1 agar Petri dish
- 2 pairs of non-latex gloves
- 1 Marker
- 1 sterile cotton swab
- Tape

Procedure

1. Initiate this activity by inquiring where the class thinks microbes exist.
2. Define what fomites are. (A fomite is defined as an inanimate object that serves to transmit an infectious agent from person to person. Examples include doorknobs, keys, pencils, etc.)
3. In cooperative groups of two, have students make predictions about which fomites may be the most common vectors for the common cold.
4. Have students pick one fomite.
5. Describe proper procedures for inoculating Petri dishes. Students should use a sterile swab and wipe over the selected fomite. Then students should gently uncover the Petri dish and extremely carefully swab the agar in a Z-shape. See diagram below.
6. After sealing the Petri dish with parafilm tape, place them in a warm locality. Observe over the next several days.
7. Do not open the Petri dishes for observations. When the experiment is finished, throw the Petri dishes away in a sealed plastic bag.

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Profile an Extremophile! (Post) Activity

Students will be able to define and explain what extremophiles are, research and articulate the characteristics and environments of extremeophiles, prepare a multidisciplinary project to present their research findings, make inferences about the nature of life and the possibility of life on other planets, and explore the science of microbiology and astrobiology.

Materials

- Research and resource materials used in pre-visit activities.
- Additional research resources.
- Due to the open-ended nature of this project educational and art materials will be needed as students conceive and implement their work.

Pre-setup

Print out list of extremophiles listed below. Cut them up individually. Place in box or hat.

Procedure

1. Initiate this activity by having class begin a KWL chart about extremophiles drawing from the pre-activities and the Virtual Visit. Keep chart posted.
2. Create cooperative groups or keep existing groups. The group size can be in a range of 2-5 students depending on the make-up of your class.
3. Have cooperative groups pick an extremophile randomly from box, hat or other container.
4. Have cooperative groups research their extremophile by studying habitat, characteristics, what it eats, how it lives, chemical make-up, conditions for life and anything else they can find.
5. Each cooperative group will need to:
    a. Conceive of a creative way to represent their findings in writing.
    Examples: scientific report or notebook, poem, play, interview, first person, story, "day in the life of."
    b. Sketch/draw and label their extremophile.
    c. Sketch/draw and label their extremophiles' habitat.
    d. Compile and publish research and work. Examples: In a science notebook, on a blog, on a class website, a poster presentation.
    e. Prepare for presentation.
6. A second Virtual Visit will be established with the New York Hall of Science so the cooperative groups can present/perform their research and work, gain feedback and culminate their Virtual Visit Unit. The class and facilitator will complete the "Learned" part of the KWL together and discuss what the students still wonder after the completion of the project.

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Extremophile List

There are many different classes of extremophiles; each corresponding to the way its environmental niche differs from those of the majority of terrestrial mesophile organisms. These classifications are not exclusive. Many extremophiles fall under multiple categories. For example, organisms living inside hot rocks deep under Earth's surface are both *thermophilic* and *barophilic*.

- *Acidophile:* An organism with an optimum pH level at or below pH 3.
- *Alkaliphile:* An organism with optimal growth at pH levels of 9 or above.
- *Barophile:* Bacteria which live in environments characterized by high gas or liquid pressure; synonymous with piezophile.
- *Endolith:* An organism that lives in microscopic spaces within rocks, such as pores between aggregate grains. These may also be called cryptoendoliths. This term also includes organisms populating fissures, aquifers, and faults filled with groundwater in the deep subsurface.
- *Halophile:* An organism requiring at least 2M of salt, NaCl, for growth.
- *Hyperthermophile:* An organism that can thrive at temperatures between 80-121 °C, such as those found in hydrothermal systems.
- *Hypolith:* An organism that lives inside rocks in cold deserts.
- *Lithoautotroph:* An organism (usually bacteria) whose sole source of carbon is carbon dioxide and exergonic inorganic oxidation (chemolithotrophs) such as Nitrosomonas europea These organisms are capable of deriving energy from reduced mineral compounds like pyrites, and are active in geochemical cycling and the weathering of parent bedrock to form soil.
- *Metalotolerant:* capable of tolerating high levels of dissolved heavy metals in solution, such as copper, cadmium, arsenic, and zinc.
- *Oligotroph:* An organism capable of growth in nutritionally limited environments.
- *Piezophile:* An organism that lives optimally at high hydrostatic pressure. See also Barophile Common in the deep terrestrial subsurface, as well as in oceanic trenches.
- *Polyextremophile:* An organism that can survive different extreme conditions. Psychrophile/Cryophile: An organism that grows better at temperatures of 15 °C or lower. Common in cold soils, permafrost, polar ice, cold ocean water.

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Search For Life Beyond Earth

Middle School 5-8

NS.5-8.1 SCIENCE AS INQUIRY
As a result of activities in grades 5-8, all students should develop
- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

NS.5-8.3 LIFE SCIENCE
As a result of their activities in grades 5-8, all students should develop understanding
- Structure and function in living systems
- Regulation and behavior
- Populations and ecosystems
- Diversity and adaptations of organisms

NS.5-8.4 EARTH AND SPACE SCIENCE
As a result of their activities in grades 5-8, all students should develop an understanding
- Structure of the earth system
- Earth's history
- Earth in the solar system

NS.5-8.7 HISTORY AND NATURE OF SCIENCE
As a result of activities in grades 5-8, all students should develop understanding of
- Science as a human endeavor
- Nature of science
- History of science

NS.9-12.1 SCIENCE AS INQUIRY
As a result of activities in grades 9-12, all students should develop
- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

NS.9-12.3 LIFE SCIENCE
As a result of their activities in grades 9-12, all students should develop understanding of
- Biological evolution
- Interdependence of organisms
- Matter, energy, and organization in living systems
- Behavior of organisms

NS.9-12.4 EARTH AND SPACE SCIENCE
As a result of their activities in grades 9-12, all students should develop an understanding of
- Energy in the earth system
- Origin and evolution of the earth system
- Origin and evolution of the universe

NS.9-12.7 HISTORY AND NATURE OF SCIENCE
As a result of their activities in grades 9-12, all students should develop an understanding of
- Science as a human endeavor
- Nature of scientific knowledge
- Historical perspectives