Biological Definition of Life

MS / Science

Being, Definition, Life & Death, Science, Molecules, Organisms

Launch Activity:

Make a list of ten things in nature that you would consider to be living and ten things that you would consider non-living. Discuss as a class what you think the differences between the living and non-living things might be.

Inspectional Read:

Distribute the text and ask participants to anticipate what they expect to learn from a close examination of this text. Note, for example, that it is a complex definition consisting of seven separate elements; also, that it is a “biological” definition, which might be different from another type. Read the text aloud to the participants while they mark any unfamiliar terms for future study.

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1 See Next Generation Science Standard LS1: From Molecules to Organisms: Structures and Processes.
Background Information:

Share that since Aristotle, scientists have struggled to define living vs. non-living things in a consistent way. The definition has evolved over the centuries as our ability to identify or measure certain attributes of life (cells, metabolism, etc.) has developed. Our text is a relatively simple version of the most recent biological definition of “life.”

Vocabulary:

Create a common list of unfamiliar terms and add the following (adapt, cells, change, develop, energy, homeostasis, metabolism, living, non-living, reproduce, respond, stimuli) plus any other core scientific vocabulary that you anticipate using in your questions or the students needing in their discussion and/or writing.

Analytical Read:

(Give instructions on a slide/poster.) Divide the class into seven groups and assign one of the seven characteristics of living things to each group. Have the groups translate the characteristic as given into common, non-scientific terms and provide two examples of things that have that characteristic. Each group then shares their translations and examples while the entire group takes notes on their versions of the text.

Pre-Seminar Process

Define and state purpose for Paideia Seminar.
Describe the responsibilities of facilitator and participants.
Have participants set a Personal Goal.
Agree on a Group Goal.
Seminar Questions

Opening (Identify main ideas from the text):

- Of the seven elements in the Biological Definition of Life, which is most important? (round-robin response)
- Why? (spontaneous discussion)

Core (Analyze textual details):

- The definition begins with the admission that there is no “unequivocal definition of life” but that scientists believe that a living thing “exhibits all or most of the … traits.” What does this mean? How does it affect how we use this definition?
- Pick two or more elements in the definition; how are they related?
- Based on this definition, is fire a living thing?
- Is a computer a living thing? Why or why not?
- Based on this definition, can a non-living thing become a living thing? How?
- Based on the text, is it possible for something to live forever?

Closing (Personalize and apply the ideas):

- In your opinion, does a farmer create life by growing crops and raising animals? Why or why not?

Post-Seminar Process

Have participants do a written self-assessment of their personal participation goal.
Do a group assessment of the social and intellectual goals of seminar.

Note reminders for next seminar.

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Post-Seminar Content

Transition to Writing:

Have participants take notes to brainstorm ideas that they heard, said, and thought during seminar related to the ideas under discussion. Encourage them to revisit their notes from the Launch Activity and reconsider the items they listed there.

Writing Task:

What role does a farmer play in relation to “life” (by growing crops and raising animals)? After reading and discussing the Biological Definition of Life, write an essay for other science students in which you address the question and analyze the role that a farmer plays in relation to “life.” Support your position with evidence from the text. (Argumentation/Analysis)

(LDC Task#: 2)

Brainstorm:

Invite participants to talk in pairs for two minutes to share thoughts about what the writing task is asking. As appropriate, suggest a variety of possible verbs for what a farmer does in relation to life: create, cultivate, facilitate, perpetuate, etc.

Structure the Writing:

Allow a few minutes for all to draft an outline for their writing and refine their thinking. Provide students with one or more possible organizational templates as needed.
First Draft:
Challenge all to draft their descriptive essays by writing the paragraphs defined by their outlines. Refer to the original definition in order to illustrate key points.

Collaborative Revision:
Have participants work in pairs to read their first drafts aloud to each other with emphasis on reader as creator and editor. Listener says back one point heard clearly and asks one question for clarification. Switch roles. Give time for full revisions resulting in a second draft.

Edit:
Once the second draft is complete, have participants work in groups of three-four and this time take turns reading each other’s second drafts slowly and silently, marking any spelling or grammar errors they find. (Have dictionaries and grammar handbooks available for reference.) Take this opportunity to clarify/reteach any specific grammar strategies you have identified your students needing. Give time for full revisions resulting in a third and final draft.

Publish:
Publish (either virtually or on paper) the final copies of the resulting personal essays in a collection to be shared via the class web site and as exemplary personal essays for future students.

This Paideia Lesson Plan was created by:

Name: Terry Roberts
Organization: National Paideia Center
Biological Definition of Life²

Since there is no unequivocal definition of life, the current understanding is descriptive. Life is considered a characteristic of something that exhibits all or most of the following traits:

1. **Homeostasis**: Regulation of the internal environment to maintain a constant state; for example, electrolyte concentration or sweating to reduce temperature.
2. **Organization**: Being structurally composed of one or more cells — the basic units of life.
3. **Metabolism**: Transformation of energy by converting chemicals and energy into cellular components (anabolism) and decomposing organic matter (catabolism). Living things require energy to maintain internal organization (homeostasis) and to produce the other phenomena associated with life.
4. **Growth**: Maintenance of a higher rate of anabolism than catabolism. A growing organism increases in size in all of its parts, rather than simply accumulating matter.
5. **Adaptation**: The ability to change over time in response to the environment. This ability is fundamental to the process of evolution and is determined by the organism's heredity, diet, and external factors.
6. **Response to stimuli**: A response can take many forms, from the contraction of a unicellular organism to external chemicals, to complex reactions involving all the senses of multicellular organisms. A response is often expressed by motion; for example, the leaves of a plant turning toward the sun (phototropism), and chemotaxis.
7. **Reproduction**: The ability to produce new individual organisms, either asexually from a single parent organism, or sexually from two parent organisms.

² For a fuller discussion of the background of this “text” as well as the source for this version, see http://en.wikipedia.org/wiki/Life.