

## Microorganisms Standard and ILOs

### **Science Benchmark:**

Microorganisms are those living things that are visible as individual organisms only with the aid of magnification. Microorganisms are components of every ecosystem on Earth. Microorganisms range in complexity from single to multi-cellular organisms. Most microorganisms do not cause disease and many are beneficial. Microorganisms require food, water, air, ways to dispose of waste, and an environment in which they can live. Investigation of microorganisms is accomplished by observing organisms using direct observation with the aid of magnification, observation of colonies of these organisms and their waste, and observation of microorganisms' effects on an environment and other organisms.

### **STANDARD V:**

Students will understand that microorganisms range from simple to complex, are found almost everywhere, and are both helpful and harmful.

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*Objective 1:* Observe and summarize information about microorganisms.

- a. Examine and illustrate size, shape, and structure of organisms found in an environment such as pond water.
- b. Compare characteristics common in observed organisms (e.g., color, movement, appendages, shape) and infer their function (e.g., green color found in organisms that are producers, appendages help movement).
- c. Research and report on a microorganism's requirements (i.e., food, water, air, waste disposal, temperature of environment, reproduction).

*Objective 2:* Demonstrate the skills needed to plan and conduct an experiment to determine a microorganism's requirements in a specific environment.

- a. Formulate a question about microorganisms.
- b. Develop a hypothesis for a question about microorganisms based on observations and prior knowledge.
- c. Plan and carry out an investigation on microorganisms. (Note: Teacher must examine plan and procedures to ensure the safety of students; for additional information, you may wish to read microbe safety information on Utah Science Home Page.)
- d. Display results in an appropriate format (e.g., graphs, tables, diagrams).
- e. Prepare a written summary or conclusion to describe the results in terms of the hypothesis for the investigation on microorganisms.



*Objective 3:* Identify positive and negative effects of microorganisms and how science has developed positive uses for some microorganisms and overcome the negative effects of others.

- a. Describe in writing how microorganisms serve as decomposers in the environment.
- b. Identify how microorganisms are used as food or in the production of food (e.g., yeast helps bread rise, fungi flavor cheese, algae are used in ice cream, bacteria are used to make cheese and yogurt).
- c. Identify helpful uses of microorganisms (e.g., clean up oil spills, purify water, digest food in digestive tract, antibiotics) and the role of science in the development of understanding that led to positive uses (i.e., Pasteur established the existence, growth, and control of bacteria; Fleming isolated and developed penicillin).
- d. Relate several diseases caused by microorganisms to the organism causing the disease (e.g., athlete's foot – fungi, streptococcus throat – bacteria, giardia – protozoa).
- e. Observe and report on microorganisms' harmful effects on food (e.g., causes fruits and vegetables to rot, destroys food-bearing plants, makes milk sour).

**Science language students should use:**

Algae, fungi, microorganism, decomposer, single-celled, organism, bacteria, protozoan, producer, hypothesis, experiment, investigation, variable, control, culture.

## Intended Learning Outcomes for Sixth Grade Science

The Intended Learning Outcomes (ILOs) describe the skills and attitudes students should learn as a result of science instruction. They are an essential part of the Science Core Curriculum and provide teachers with a standard for evaluation of student learning in science. Instruction should include significant science experiences that lead to student understanding using the ILOs.

**The main intent of science instruction in Utah is that students will value and use science as a process of obtaining knowledge based upon observable evidence.**

By the end of sixth grade students will be able to:

### 1. Use Science Process and Thinking Skills

- a. Observe simple objects, patterns, and events, and report their observations.
- b. Sort and sequence data according to criteria given
- c. Given the appropriate instrument, measure length, temperature, volume, and mass in metric units as specified.
- d. Compare things, processes, and events.
- e. Use classification systems.
- f. Plan and conduct simple experiments.
- g. Formulate simple research questions.
- h. Predict results of investigations based on prior data.
- i. Use data to construct a reasonable conclusion.

### 2. Manifest Science Attitudes and Interests

- a. Demonstrate a sense of curiosity about nature.
- b. Voluntarily read or look at books and other materials about science.
- c. Pose questions about objects, events, and processes.
- d. Maintain an open and questioning mind toward new ideas and alternative points of view.
- e. Seek and weigh evidence before drawing conclusions.
- f. Accept and use scientific evidence to help resolve ecological Problems.

### 3. Understand Science Concepts and Principles

- a. Know and explain science information specified for the grade level.
- b. Distinguish between examples and non-examples of concepts that have been taught.
- c. Solve problems appropriate to grade level by applying science principles and procedures.

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- 4. Communicate Effectively Using Science Language and Reasoning**
    - a. Record data accurately when given the appropriate form (e.g., table, graph, chart).
    - b. Describe or explain observations carefully and report with picture, sentences, and models.
    - c. Use scientific language in oral and written communication.
    - d. Use reference sources to obtain information and cite the source.
    - e. Use mathematical reasoning to communicate information.
  - 5. Demonstrate Awareness of Social and Historical Aspects of Science**
    - a. Cite examples of how science affects life.
    - b. Understand the cumulative nature of science knowledge.
  - 6. Understand the Nature of Science**
    - a. Science is a way of knowing that is used by many people, not just scientists.
    - b. Understand that science investigations use a variety of methods and do not always use the same set of procedures; understand that there is not just one “scientific method.”
    - c. Science findings are based upon evidence.

- **Instruction should include significant science experiences that lead to student understanding using ILOs.**