

Science Benchmark Clarification, Instruction, and Assessment

Strand I: Construct New Scientific and Personal Knowledge

Content Standard 1: All students will ask questions that help them learn about the world; design and conduct investigations using appropriate methodology and technology; learn from books and other sources of information; communicate findings of investigations using appropriate technology. (Constructing)

Benchmark

Ask questions that can be investigated empirically. (SCI.I.1.HS.1)

Benchmark Clarification

Empirical investigations are based on the results of experiments, observations and/or experiences. In order to formulate a scientific question, a student must have working knowledge about the problem.

Students will:

- Formulate questions that can be investigated using: testing, measuring, data gathering, observing, and acquiring verifiable information.
- Investigate and evaluate background information when forming their questions.

Key Concepts (voc.)/Tools

Questions often build on existing knowledge

Real-World Context

Any in the sections on Using Scientific Knowledge

Resources:

<http://mtn.merit.edu/mcf/SCI.I.1.HS.1.html>

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Benchmark

Design and conduct scientific investigations. (SCI.I.1.HS.2)

Benchmark Clarification

Students will:

- Given a scientific question, be able to:
 1. Form a hypothesis
 2. Design a test or an experiment with a control
 3. Analyze the data they generate
 4. Form a conclusion based on the data and hypothesis
- Evaluate an experiment to find the key components of a scientific investigation.

Key Concepts (voc.)/Tools

- Types of scientific knowledge: hypothesis, theory, observation, conclusion, law, data, generalization.
- Aspects of field research: hypothesis, design, observations, samples, analysis, conclusion.
- Aspects of experimental research: hypothesis, design, variable, experimental group, control group, prediction, analysis, conclusion. Investigations are based on questions about the world.

Real-World Context

Any suggested in Using Scientific Knowledge benchmarks for which students would design and/or conduct investigations.

Resources:

<http://mtn.merit.edu/mcf/SCI.I.1.HS.2.html>

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Benchmark

Recognize and explain the limitations of measuring devices. (SCI.I.1.HS.3)

Benchmark Clarification

In any investigation, measurements are limited by the devices used and the skill of the experimenter. Students should recognize and be able to explain the following factors affecting measurement:

- Uncertainty is the estimation of a unit beyond the smallest unit of measurement available on a device
- Error is the amount of difference between an accepted value and a measured value
- Range is the difference between the highest and lowest measured values
- Tolerance is the range of uncertainty allowed as determined by a measuring device
- Accuracy is how close a measurement is to an accepted value
- Precision is how well measurements are reproduced

Students will use measuring devices listed in the tools section for this benchmark.

Key Concepts (voc.)/Tools

- Uncertainty
- Error
- Range
- Tolerances
- Accuracy
- Precision

Tools:

Balance, measuring tape, thermometer, graduated cylinder, electronic measuring devices.

Real-World Context

Designing an experiment that uses quantitative data

Resources:

<http://mtn.merit.edu/mcf/SCI.I.1.HS.3.html>

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Benchmark

Gather and synthesize information from books and other sources of information.
(SCI.I.1.HS.4)

Benchmark Clarification

Scientists rely upon more than their own observations and research. They depend upon journal articles, books, computers, reference materials, and other resources to find information. This information is then collected, organized, evaluated and communicated with others.

Students will be able to find, collect, organize, and interpret information that they gather from scientific journals, books, other resources and computer reference materials.

Key Concepts (voc.)/Tools

Scientific journals, text and computer based reference materials.

Real-World Context

Libraries, technical reference books, World Wide Web, computer software.

Resources:

<http://mtn.merit.edu/mcf/SCI.I.1.HS.4.html>

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Benchmark

Discuss topics in groups by making clear presentations, restating or summarizing what others have said, asking for clarification or elaboration, and taking alternative perspectives and defending a position. (SCI.I.1.HS.5)

Benchmark Clarification

Students will logically and clearly present information that they have gathered through observation, documents, and/or opinions. Students will seek clarification of all information and consider several points of view. Based on the discussion, students will take a position and defend it.

Key Concepts (voc.)/Tools

- Logical argument
- Summary
- Clarification,
- Elaboration
- Alternative perspectives.

Real-World Context

Newspaper or magazine articles discussing a topic of social concern.

Resources:

<http://mtn.merit.edu/mcf/SCI.I.1.HS.5.html>