



Understanding the Nature of a Benchmark: A Study Procedure

An important part of every Project 2061 workshop is helping participants study Project 2061 tools in a way that increases their understanding of benchmarks. Benchmarks tend to be interpreted within the context of what is currently being taught or what teachers themselves learned in school, and participants often overestimate or underestimate the extent of learning that is intended in a benchmark. As a result of seeing how often educators jump to conclusions about what benchmarks mean, Project 2061 staff have included in their workshops a procedure in which participants are asked to read and discuss with one another what a particular benchmark is expecting students to know or be able to do. Then they are asked to examine other parts of *Science for All Americans (SFAA)* and *Benchmarks for Science Literacy (Benchmarks)* that can shed light on the benchmark's intent. Participants read and discuss five items:

- **The *SFAA* section from which the benchmark originated.**
SFAA recommends goals for adult science literacy; *Benchmarks* recommends specific learning goals for grades 2, 5, 8, and 12 that can contribute to adult literacy. There is a corresponding *Benchmarks* section for each *SFAA* section. Reading the *SFAA* section helps participants understand what literacy in that topic is defined to be, and thus where the benchmark is aiming.
- **All other benchmarks from the K-12 list of benchmarks in the same *Benchmarks* section.**
Reading the other benchmarks helps participants understand the level of sophistication intended by the benchmark.
- **Introductory essays in the *Benchmarks* section for the benchmark being studied.**
The section introduction and grade-level essays help participants understand difficulties students may have with the benchmark topic. They also offer some suggestions for helping students achieve the benchmark.
- **Summaries of research on the topic from *Benchmarks*, Chapter 15.**
The research selection suggests likely limitations in student understanding of the benchmark (and therefore its grade placement) and points participants to the original research articles.
- **A relevant strand map from *Benchmarks on Disk*.**
A strand map helps participants see how other benchmarks relate to the benchmark being studied and their importance for understanding that benchmark.

After each reading, participants discuss with one another in their small groups and then in the large group what the reading has contributed to their understanding of the benchmark's intent. By studying and discussing Project 2061 tools, participants usually get a clearer understanding of the benchmark. The kinds of changes in understanding of benchmarks that can result through this study are illustrated in participant comments before and after they read related parts of *Science for All Americans* and *Benchmarks for Science Literacy*.

Workshop Participants Comments

The following comments relate to participant understanding of what Benchmark 4B The Earth (K-2)#3 expects K-2 students should know about the Water Cycle.

After reading just the benchmark, some participants commented:

“This benchmark is about evaporation.”

“Students should understand states of matter and changes of state.”

“Students should have a quantitative sense of volume.”

“They should know about properties of water—for example, that water is a colorless liquid.”

After also studying related sections of *Benchmarks* and *SFAA*, participants commented differently:

“This is just about what happens when the container has a lid versus when it doesn't.”

“This is strictly about observation—no explanation is needed.”

“The map shows that K-2 students aren't held accountable for the term ‘evaporation’.”

“We can expect that by the end of grade 2 students will be familiar with this phenomenon.”

“Research says it's OK to stop with the phenomenon.”

The next participant comments relate to understanding what Benchmark 5E Flow of Matter and Energy (6-8)#1 expects middle-school students to know about the Flow of Matter in Ecosystems.

After reading just the benchmark, some participants *underestimated* its intent:

“This benchmark is expecting students to know about food chains and food webs.”

“Students should know about producers and consumers.”

“They should know the composition of food—carbohydrates, proteins, etc.”

“Students should know about the needs of living things.”

After reading just the benchmark, some participants *overestimated* its intent:

“This wants students to know about the atomic structure of matter.”

“Students need to know the photosynthesis equation.”

“They should know about non-living cycles—water cycle, carbon cycle.”

After also studying related sections of *Benchmarks* and *SFAA*, some participants commented in this vein:

“The other 5E(6-8) benchmarks deal with energy flow and conservation of matter, [so] this benchmark is just about matter flow.”

“Plant and animal needs are dealt with in earlier grade 5E benchmarks.”

“The term photosynthesis is never used.”

“The strand map shows that the molecular structure of matter [that is dealt with] in [*Benchmarks*] 4D connects to matter flow in ecosystems by the end of 8th grade.”

Workshop leaders are invited to send to Project 2061 participant comments on their understanding of these or other benchmarks. Comments like these benefit other educators by helping Project 2061 improve its workshops and publications.

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