SCIENCE

Alaska

GRADE	SCORES		TOTAL SCORE
F	Content and Rigor	1/7	2/10
	Clarity and Specificity	1/3	

REPORT CARD

Content & Rigor	**1.2**
Scientific Inquiry & Methodology	2
Physical Science	2
Physics	0
Chemistry	0
Earth & Space Science	1
Life Science	2
Clarity & Specificity	**1.1**

Average numerical evaluations

Overview

When Fordham first looked at Alaska's science standards more than ten years ago, the entire document was three pages long. It contained so little information that it could not be reviewed. Although the current iteration is bulkier, the standards still comprise just twenty-seven pages for all grades, three through eleven. (Alaska provides no science standards for Kindergarten through second grade or twelfth grade.) They are thin ice, indeed, for curriculum developers, test writers, parents, or teachers.

Organization of the Standards

The Alaska science content standards—brief as they are—are divided into seven strands: science as inquiry and process; concepts of physical science; concepts of life science; concepts of earth science; science and technology; culture, social, personal perspectives, and science; and the history and nature of science. For each strand, the state provides three or four broad standards meant to span all grades. For example, in the "concepts of life science" strand, a student who meets the content standard should "develop an understanding of the structure, function, behavior, development, life cycles, and diversity of living organisms."

A second document presenting performance standards further articulates the content standards. It provides grade-level expectations for each of the broad content standards for all grades, 3-11.

Content and Rigor

Between what is missing and what is shortchanged, it is hard to consider the Alaska document a set of real standards at all. Indeed, the state makes no provision for high school biology, chemistry, or physics, leaving an enormous body of essential content completely untouched.

Scientific Inquiry and Methodology

Four of Alaska's seven strands (described above) address scientific inquiry and methodology: science as inquiry and process; science and technology; cultural, social, personal perspectives, and science; and history and nature of science. All but the last suffer from an over-eagerness to give voice to "different ways of thinking" rather than

Document(s) Reviewed

- *Alaska Content Standards: Science; Fourth Edition*. Revised March 2006. Accessed from: http://www.eed.state.ak.us/contentstandards/Science.html
- *Alaska Science Performance Standards (Grade-Level Expectations)*. 2005. Accessed from: http://www.eed.state.ak.us/tls/assessment/GLEHome.html

to outline specific content that students should master. For instance, in the "cultural, social, personal perspectives" strand, students are to "develop an understanding that some individuals...use other beliefs and methods in addition to scientific methods to describe the world" and to "develop an understanding of the importance of recording and validating cultural knowledge." While these are admirable goals, they are not central to an education in the sciences. Indeed, there is much mention of "local knowledge" and how it "correlates" with the science standards. In early grades, students are asked to explore "local or traditional stories," explain a natural event, connect these stories to observations of nature, and identify "multiple explanations (e.g., oral traditions, folklore, scientific theory) of everyday events." Again, although exploring cultural heritage is a valuable and necessary part of education, it distracts from the matter at hand—education in scientific practice and content.

Incoherence abounds. In fourth grade, students are expected to support "their ideas with observations and peer review"; how the latter is to function is left unstated. In eleventh grade, students should be able to "describe the importance of logical arguments (i.e., thought experiments by Einstein, Hawking, Newton)." But there is scant evidence that the students have been given the opportunity to acquire the scientific background without which such description is empty.

Physical Science/High School Physics/High School Chemistry

The flaws in Alaska's treatment of physical science are impressive. The sole mention of electrical circuits, in ninth grade, is this: "The student demonstrates an understanding of how energy can be transformed, transferred, and conserved by...recognizing simple electrical circuits." But at least the phrase appears. A reader would search in vain for other critical terms: acids and bases, atomic number and atomic mass, formulas, chemical equations, isotopes.

The physical science category also is rife with outright errors. In the fifth-grade expectations, for example, students should be able to classify "the changes (i.e., heat, light, sound, and motion) that electrical energy undergoes in common household appliances (i.e., toaster, blender, radio, light bulb, heater)." That's inaccurate (and poorly written). Heat, light, sound, and motion are not "changes."

Similarly, students are asked first to recognize (in third grade) and then to explain (in fourth grade) how "temperature changes cause changes in phases of substances (e.g., ice changing to liquid water and liquid water to water vapor." But that's wrong. Heat, not temperature, causes phase changes; temperature remains constant during a phase change.

Earth and Space Science

The Alaska standards for earth and space science are woefully inadequate. In a state where nature is spectacular—gorgeous glaciers, active volcanoes, history of a great earthquake, mountains, active subduction, beautiful rocks and minerals—the standards provide no understanding or appreciation of it, with the exception of a mention of the aurora. For instance, despite the fact that volcanic eruptions and earthquakes are a real hazard in the state, they are only mentioned twice—once in sixth grade and once in seventh. And even then, the coverage is far too broad and ignores the workings of these important phenomena. Students are asked only to describe "how the surface can change rapidly as a result of geological activities (i.e., earthquakes, tsunamis, volcanoes, floods, landslides, avalanches)" in sixth grade and to describe "how the movement of tectonic plates results in both slow changes (e.g., formation of mountains, ocean floors, and basins) and short-term events (e.g., volcanic eruptions, seismic waves, and earthquakes) on the surface" in seventh grade.

The coverage of other topics is equally superficial or nonexistent. The word "mineral" appears only once in the entire document, and it is before the word "rights" in eleventh grade. The rock cycle is mentioned in several grades, but only sedimentary processes receive any detailed coverage. Stars are mentioned in a number of contexts, but not as organization of matter, and galaxies are missing entirely.

Weather is reasonably well covered. In third grade, students are asked to demonstrate "an understanding of cycles influenced by energy from the sun and by Earth's position and motion in our solar system by...using recorded weather patterns (e.g., temperature, cloud cover, or precipitation)." In seventh grade they are asked to describe "the weather using accepted meteorological terms (e.g., pressure systems, fronts, precipitation)." Climate is also covered adequately, if uninspiringly, in high school.

Life Science

Across all grades, the Alaska standards contain little useful content in biology—less than what is conveyed in most states' middle school standards alone. For example, high school students are to "[relate] the structure of DNA to characteristics of an organism" (grade 11); to "[explain] that cells have specialized structures in which chemical reactions

occur" (grade 10); and to "[recognize] that all organisms have chromosomes made of DNA and that DNA determines traits" (grade 9). While true, these statements are so general that they provide no meaningful content or direction as to what students should know or be able to do.

One bright spot is physiology, which is reasonably well covered and includes several clear and rigorous standards. For instance, in tenth grade, students are asked to "[explain] the functions of organs of major systems (i.e., respiratory, digestive, circulatory, reproductive, nervous, musculoskeletal, and excretory)." Unfortunately, the incongruous presence of this specific section amid all the vagueness looks more like a freak accident than a glimpse of substance.

To its (limited) credit, Alaska does not split hairs about evolution, at least in principle. In the introductory material, the standards say that a student who meets the "concepts of life" standard should "develop an understanding of how science explains changes in life forms over time, including genetics, heredity, the process of natural selection, and biological evolution," among other things.

Sadly, that admirably straightforward requirement fizzles quickly with the absence of follow-through. Without specific content to support it, the statement of purpose loses force.

Given Alaska's mountainous errors and sweeping generalities, the state can earn no more than a one out of seven for content and rigor. (See Appendix A: Methods, Criteria, and Grading Metric.)

Clarity and Specificity

While the Alaska standards are generally clearly written and easy to follow, the lack of specificity makes them virtually useless. Nothing short of scrapping this document and starting from scratch (or borrowing the recipe of one of the nation's "A" states) could result in a useful basis for curriculum writing, test preparation, and textbook writing.

Worse, on the rare occasions where the Alaska standards do strive for specifics, they often—dismayingly often—miss the mark.

Consider the eighth-grade section on chemistry, which asks students to demonstrate "an understanding of the interactions between matter and energy and the effects of these interactions on systems by exploring changes of state with increase or decrease of particle speed associated with heat transfer" and by "exploring through a variety of models (e.g., gumdrops and toothpicks) how atoms may bond together into well defined molecules or bond together in large arrays."

Exactly how does one demonstrate by exploring? What does it mean to explore? Go into the lab and watch ice cubes melt or water boil? How can these activities be connected to the speed of particles? (More likely the writers meant molecules, an unfortunate use of the wrong terminology.) From the standards, at least, it's impossible to say.

This overabundance of buzzwords (like "demonstrate" and "explore") further clouds the state's already-murky science material. As such, Alaska's score for clarity and specificity is a troubling one out of three. (See Appendix A: Methods, Criteria, and Grading Metric.)