SCIENCE

Nevada

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

REPORT CARD

Content & Rigor	**1.8**
Scientific Inquiry & Methodology	0
Physical Science	4
Physics	0
Chemistry	0
Earth & Space Science	4
Life Science	3
Clarity & Specificity	**1.3**

Average numerical evaluations

Document(s) Reviewed

- *Nevada K-12 Science Standards*. 2007-08. Accessed from: http://www.doe.nv.gov/Standards_Science.html
- *Nevada Science Achievement Indicators*. 2007-08. Accessed from: http://www.doe.nv.gov/Standards_Science.html

Overview

The Nevada science standards are lamentably brief. Complicating matters, educators must piece together information from two separate and confusing documents to form a complete picture of what students must know and be able to do. Altogether, the materials furnish a very shaky foundation in the sciences.

Organization of the Standards

A table totaling thirteen pages constitutes the complete set of K-12 science standards for Nevada. Within this table, the standards are first divided into four strands: nature of science, earth and space science, physical science, and life science. Each strand is then divided into content standards (or sub-strands), and finally, benchmarks are provided for each of four grade bands: K-2, 3-5, 6-8, and 9-12.

Along with these overly concise standards, the Silver State presents four documents listing science achievement indicators aligned to the benchmarks and organized into the same grade bands. These indicators explain what students in each grade band should know and be able to do across four achievement levels: emergent/developing, approaches, meets, and exceeds.

Content and Rigor

The Nevada science standards suffer from the twin flaws of not offering enough content and bungling what little information they provide. None of the content areas is well covered and strengths are difficult to find. The lack of rigor is particularly appalling in high school—often, even at the "exceeds" level.

Scientific Inquiry and Methodology

The material on scientific inquiry and methodology is rife with platitudes but provides no guidance for what students should know or be able to do. For example, one standard asks students to "identify scientists as people." (As opposed to what, one wonders?) Elsewhere, the flaws are graver. Students in Kindergarten through fifth grade should "understand that many people, from all cultures and levels of ability, contribute to the fields of science and technology." Well, yes, but the same can be said of contributors to professional football.

This sort of woolliness is exacerbated by the writers' steadfast aversion to the discussion of concepts—such as theory or hypothesis—that are essential to understanding what science involves and whether everyone can contribute to that enterprise. The term "theory" is introduced only in relation to specific theories (e.g., "theory of evolution") and not as a general concept within science. "Hypothesis" doesn't appear anywhere.

Physical Science/High School Physics/High School Chemistry

The writing is simplistic and pitched at a low level, and often concepts are presented that have not been defined previously in the document. Examples include heat of formation, solubility, entropy, and density. A few topics, like conservation of mass and the properties of solids, liquids, and gases, are repeated grade span after grade span.

Nothing in the documents is appropriate to a high school physics course, nor is any distinction made between a ninth-grade physical science course and a higher-level physics or chemistry course. One might stretch one's imagination and infer that the "meets" level is intended for a ninth-grade physical science course and the "exceeds" level is geared to higher-level chemistry and physics courses. But it is odd indeed to build a course around "exceeded" expectations. Here is a typical example of the difference between the two columns:

> **Meets: Describe the motion of an object using Newton's Laws.**
>
> **Exceeds: Calculate force, acceleration, time, and velocity to accurately predict the motion of an object. (grades 9-12)**

But even the "exceeds" benchmark lacks sufficient detail to be useful for a physics course.

The standards addressing elements of chemistry, like those for physics, are noteworthy more for what's missing than for what's included. They make no reference to atomic models, or ionic, covalent, metallic, or hydrogen bonding. There is one reference to spectra, in the context of identifying substances, and one mention of bonding by electron sharing or transfer. There is nothing about moles or stoichiometry, and just a brief mention of writing and balancing simple equations.

Earth and Space Science

Earth and space science suffers from a generally weak presentation. Though concise and containing few errors, the standards are often too broad to be rigorous, as in the following example:

> **Compare the characteristics of planets in our solar system. (grades 6-8)**

Another problem is that many of the specific content expectations are relegated to the achievement indicators, where the rigor of the expectations is often poorly calibrated. Often, the "emergent" and "approaches" levels are so trivial as to be almost insulting: Students in sixth through eighth grades, for example, are considered to be "approaching" one standard if they merely "understand that Nevada's weather changes." That said, the upper levels of the rubric are sometimes no better. For example, in the third through fifth grades, the student who "exceeds" expectations need only "explain how fossils are evidence of extinct species." And, ironically, there are occasions when the entries on the lower levels of the rubric might be more difficult than the higher ones. In third through fifth grades, an "emergent" standard asks students to "explore fossil formation," a complex task, while the "meets" expectation asks student to "describe how fossils are evidence of past life," the definition of a fossil.

Despite these shortcomings, however, the Nevada earth and space science standards contain few errors. Though they lack the depth needed for a strong set of standards, they cover almost all necessary content, with the water cycle and treatment of the Earth's layers handled particularly well.

Life Science

The life science offerings are vaguely presented and scanty in content. The words gene and chromosome are never used; there is no mention of photosynthesis or any other metabolism. Understandings about cellular and physiological function at the high school level are glosses ("explain the relationship between cell functions and major cell structures"; "discuss the levels of organization specialized to the human anatomy"; "describe the different organ systems in the human body"); it is impossible to evaluate what students will actually be taught, or be expected to know, from such statements.

Far too often, confusion reigns. For example, in sixth through eighth grades, the student who "meets" expectations, according to the achievement indicators, can explain that genetic information is passed from one generation to the next, while the student who "exceeds" expectations can identify DNA as the site of genetic information.

In addition, the standards are fraught with errors. For instance, in sixth through eighth grades, students are to learn that "multicellular organisms can consist of thousands to millions of cells working together." In fact, it's usually hundreds of millions to trillions. Then in grades nine to twelve, the "meets" level student is asked to "explain that DNA is the template to assemble proteins." In reality, however, DNA encodes the sequence of amino acids in a protein.

The treatment of evolution is mixed at best. In the elementary and middle school grades, we have a list of banalities—from students knowing that "differences among individuals within a species give them advantages and/or disadvantages in surviving and reproducing" (grades 3-5), to students knowing that "fossils provide evidence of how life and environmental conditions have changed throughout geologic time" (grades 6-8).

Things improve a bit in high school. There, students are expected to know that "organisms can be classified based on evolutionary relationships," that "similarity of DNA sequences gives evidence of relationships between organisms," and that "the fossil record gives evidence for natural selection and its evolutionary consequences." Students are also expected to know that "the extinction of species can be a natural process" and that "biological evolution explains diversity of life," as well as to know "the concepts of natural and artificial selection." And in the achievement indicators, students are explicitly asked to "classify organisms using evolutionary relationships, including DNA evidence." Though overly broad, this sentence implies a host of useful activities.

Taken as a whole, the science content is poor to absent, earning Nevada an average score of two out of seven for content and rigor. (See Appendix A: Methods, Criteria, and Grading Metric.)

Clarity and Specificity

Despite its rather elaborate system for charting progress, the Nevada standards are mired in confusion and will do little to aid curriculum builders or teachers. The gradations at times seem artificial or forced, with meaningful distinctions rarely made between achievement levels.

Take, for example, the K-2 content standard shown in Figure 1. Will any student in Kindergarten, first, or second grade not know that animals and plants have differences? Will any achieve the "meets" level who cannot manage the "exceeds" level?

Other times, however, the jumps between achievement levels seem unachievable. For instance, in third through fifth grades, a student who can describe heat conduction meets expectations, but it takes understanding of conduction, convection, and radiation to exceed them.

Figure 1. Content Standard L.2.A.2 (grades K-2)

L.2.A.2 Students know differences exist among individuals of the same kind of plant of animal. [*sic*]	
Emergent/Developing	**Recognize that animals and plants have differences.**
Approaches ...	**Describe differences among animals and plants.**
Meets ...	**Describe differences among individuals of the same kind of animal or plant.**
Exceeds ...	**Provide examples of differences among individuals of the same kind of plant or animal.**

Further complicating matters, there is often no clear relation between the benchmark and the achievement indicators or between one indicator and the next, making it nearly impossible for a teacher to discern what, specifically, he should be teaching at each grade level. Yet the achievement indicators provide *more* detail than can be found in the skimpy benchmarks themselves.

Like the content standards, the indicators comprise a bewildering jumble. For example, students in grades six through eight are asked in a single indicator to "distinguish between an open and a closed circuit" and gain "ability to describe kinetic energy." How does the trivial task of distinguishing between an open and closed circuit concern a discussion of kinetic energy? And then later, the vague directive to identify density as one of the "properties of matter" (grades 6-8) would be better described as "know that the ratio of an object's mass divided by its volume is called density and that density is a physical property of matter."

The Nevada science standards are disappointing, at best. The meager detail provided by the achievement indicators helps Nevada eke out an average score of one out of three for clarity and specificity. (See Appendix A: Methods, Criteria, and Grading Metric.)