

RRRPS District Standards: SCIENCE

Grade 9
10/2006

STRAND I: SCIENTIFIC THINKING AND PRACTICE

NM State Content Standard I: Understand the processes of scientific investigations and use inquiry and scientific ways of observing, experimenting, predicting, and validating to think critically.

NM State Benchmarks Grades 9-12

RRPS Grade 9 Power Standards

All benchmarks must be taught; Power Standards are consistently emphasized.

NM State Benchmark I-A: Grades 9-12

Use accepted scientific methods to collect, analyze, and interpret data and observations and to design and conduct scientific investigations and communicate results.

Power Standard I (Benchmark I-A)

Design and conduct scientific investigations that include:

NM Grade 9 Performance Standards

1. Describe the essential components of an investigation, including appropriate methodologies, proper equipment, and safety precautions.
2. Design and conduct scientific investigations that include:
 - testable hypotheses
 - controls and variables
 - methods to collect, analyze, and interpret data
 - results that address hypotheses being investigated
 - predictions based on results
 - re-evaluation of hypotheses and additional experimentation as necessary
 - error analysis.
3. Use appropriate technologies to collect, analyze, and communicate scientific data (e.g., computers, calculators, balances, microscopes).
4. Convey results of investigations using scientific concepts, methodologies, and expressions, including:
 - scientific language and symbols
 - diagrams, charts, and other data displays
 - mathematical expressions and processes (e.g., mean, median, slope, proportionality)
 - clear, logical, and concise communication
 - reasoned arguments.
5. Understand how scientific theories are used to explain and predict natural phenomena (e.g., plate tectonics, ocean currents, structure of atom).

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NM State Benchmark II-A: Grades 9-12

Understand that scientific processes produce scientific knowledge that is continually evaluated, validated, revised, or rejected.

Power Standard 2 (Benchmark II-A)

Understand how scientific processes produce valid, reliable results, including:

NM Grade 9 Performance Standards

1. Understand how scientific processes produce valid, reliable results, including:
 - consistency of explanations with data and observations
 - openness to peer review
 - full disclosure and examination of assumptions
 - testability of hypotheses
 - repeatability of experiments and reproducibility of results.
2. Use scientific reasoning and valid logic to recognize:
 - faulty logic
 - cause and effect
 - the difference between observation and unsubstantiated inferences and conclusions
 - potential bias.
3. Understand how new data and observations can result in new scientific knowledge.
4. Critically analyze an accepted explanation by reviewing current scientific knowledge.
5. Examine investigations of current interest in science (e.g., superconductivity, molecular machines, age of the universe).
6. Examine the scientific processes and logic used in investigations of past events (e.g., using data from crime scenes, fossils), investigations that can be planned in advance but are only done once (e.g., expensive or time-consuming experiments such as medical clinical trials), and investigations of phenomena that can be repeated easily and frequently.

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- full disclosure and examination of assumptions
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NM State Benchmark III-A: Grades 9-12

Use mathematical concepts, principles, and expressions to analyze data, develop models, understand patterns and relationships, evaluate findings, and draw conclusions.

Power Standard 3 (Benchmark III-A)

Create multiple displays of data to analyze and explain the relationships in scientific investigations.

NM Grade 9 Performance Standards

1. Create multiple displays of data to analyze and explain the relationships in scientific investigations.
2. Use mathematical models to describe, explain, and predict natural phenomena.
3. Use technologies to quantify relationships in scientific hypotheses (e.g., calculators, computer spreadsheets and databases, graphing software, simulations, modeling).
4. Identify and apply measurement techniques and consider possible effects of measurement errors.
5. Use mathematics to express and establish scientific relationships (e.g., scientific notation, vectors, dimensional analysis).

STRAND II: CONTENT OF SCIENCE

NM State Content Standard II (Physical Science): Understand the structure and properties of matter, the characteristics of energy, and the interactions between matter and energy.

NM State Benchmarks Grades 9-12

RRPS Grade 9 Power Standards

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NM State Benchmark II-C: Grades 9-12

Understand the motion of objects and waves, and the forces that cause them.

Power Standard 4 (Benchmark III-A)

Apply Newton's Laws to describe and analyze the behavior of moving objects, including:

NM Grade 9 Performance Standards

Forces

1. Know that there are four fundamental forces in nature: gravitation, electromagnetism, weak nuclear force, and strong nuclear force.
2. Know that every object exerts gravitational force on every other object, and how this force depends on the masses of the objects and the distance between them.
3. Know that materials containing equal amounts of positive and negative charges are electrically neutral, but that a small excess or deficit of negative charges produces significant electrical forces.
4. Understand the relationship between force and pressure, and how the pressure of a volume of gas depends on the temperature and the amount of gas.
5. Explain how electric currents cause magnetism and how changing magnetic fields produce electricity (e.g., electric motors, generators).
6. Represent the magnitude and direction of forces by vector diagrams.
7. Know that when one object exerts a force on a second object, the second object exerts a force of equal magnitude and in the opposite direction on the first object (i.e., Newton's Third Law).

- displacement, velocity, and acceleration of a moving object
- Newton's Second Law, $F = ma$ (e.g., momentum and its conservation, the motion of an object falling under gravity, the independence of a falling object's motion on mass)
- circular motion and centripetal force.

Power Standard 5 (Benchmark III-A)

Describe how waves are used for practical purposes (e.g., seismic data, acoustic effects, Doppler effect).

Motion

8. Apply Newton's Laws to describe and analyze the behavior of moving objects, including:
 - displacement, velocity, and acceleration of a moving object
 - Newton's Second Law, $F = ma$ (e.g., momentum and its conservation, the motion of an object falling under gravity, the independence of a falling object's motion on mass)
 - circular motion and centripetal force.
9. Describe relative motion using frames of reference.
10. Describe wave propagation using amplitude, wavelength, frequency, and speed.
11. Explain how the interactions of waves can result in interference, reflection, and refraction.
12. Describe how waves are used for practical purposes (e.g., seismic data, acoustic effects, Doppler effect).

STRAND II: CONTENT OF SCIENCE

NM State Content Standard III (Earth and Space Science): Understand the structure of Earth, the solar system, and the universe, the interconnections among them, and the processes and interactions of Earth's systems.

NM State Benchmarks Grades 9-12

RRPS Grade 9 Power Standards

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NM State Benchmark I-A: Grades 9-12

Examine the scientific theories of the origin, structure, contents, and evolution of the solar system and the universe, and their interconnections.

Power Standard 6 (Benchmark I-A)

Understand the scale and contents of the universe, including:

NM Grade 9 Performance Standards

1. Understand the scale and contents of the universe, including:
 - range of structures from atoms through astronomical objects to the universe
 - objects in the universe such as planets, stars, galaxies, and nebulae.
2. Predict changes in the positions and appearances of objects in the sky (e.g., moon, sun) based on knowledge of current positions and patterns of movements (e.g., lunar cycles, seasons).
3. Understand how knowledge about the universe comes from evidence collected from advanced technology (e.g., telescopes, satellites, images, computer models).
4. Describe the key observations that led to the acceptance of the Big Bang theory and that the age of the universe is over 10 billion years.
5. Explain how objects in the universe emit different electromagnetic radiation and how this information is used.
6. Describe how stars are powered by nuclear fusion, how luminosity and temperature indicate their age, and how stellar processes create heavier and stable elements that are found throughout the universe.
7. Examine the role that New Mexico research facilities play in current space exploration (e.g., Very Large Array, Goddard Space Center).

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NM State Benchmark II-A: Grades 9-12

Examine the scientific theories of the origin, structure, energy, and evolution of Earth and its atmosphere, and their interconnections.

Power Standard 7 (Benchmark II-A)

Describe the characteristics and the evolution of Earth in terms of the geosphere, the hydrosphere, the atmosphere, and the biosphere

NM Grade 9 Performance Standards

Characteristics and Evolution of Earth

1. Describe the characteristics and the evolution of Earth in terms of the geosphere, the hydrosphere, the atmosphere, and the biosphere.
2. Recognize that radiometric data indicate that Earth is at least 4 billion years old and that Earth has changed during that period.
3. Describe the internal structure of Earth (e.g., core, mantle, crust) and the structure of Earth's plates.
4. Understand the changes in Earth's past and the investigative methods used to determine geologic time, including:
 - rock sequences, relative dating, fossil correlation, and radiometric dating
 - geologic time scales, historic changes in life forms, and the evidence for absolute ages (e.g., radiometric methods, tree rings, paleomagnetism).
5. Explain plate tectonic theory and understand the evidence that supports it.

Power Standard 8 (Benchmark II-A)

Describe convection as the mechanism for moving heat energy from deep within Earth to the surface and discuss how this process results in plate tectonics, including:

- geological manifestations (e.g., earthquakes, volcanoes, mountain building) that occur at plate boundaries
- impact of plate motions on societies and the environment (e.g., earthquakes, volcanoes).

Energy in Earth's System

6. Know that Earth's systems are driven by internal (i.e., radioactive decay and gravitational energy) and external (i.e., the sun) sources of energy.
7. Describe convection as the mechanism for moving heat energy from deep within Earth to the surface and discuss how this process results in plate tectonics, including:
 - geological manifestations (e.g., earthquakes, volcanoes, mountain building) that occur at plate boundaries
 - impact of plate motions on societies and the environment (e.g., earthquakes, volcanoes).
8. Describe the patterns and relationships in the circulation of air and water driven by the sun's radiant energy, including:
 - patterns in weather systems related to the transfer of energy
 - differences between climate and weather
 - global climate, global warming, and the greenhouse effect
 - El Niño, La Niña, and other climatic trends.

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Geochemical Cycles

9. Know that Earth's system contains a fixed amount of natural resources that cycle among land, water, the atmosphere, and living things (e.g., carbon and nitrogen cycles, rock cycle, water cycle, ground water, aquifers).
10. Describe the composition and structure of Earth's materials, including:
- the major rock types (i.e., sedimentary, igneous, metamorphic) and their formation
 - natural resources (e.g., minerals, petroleum) and their formation.
11. Explain how layers of the atmosphere (e.g., ozone, ionosphere) change naturally and artificially.
12. Explain how the availability of ground water through aquifers can fluctuate based on multiple factors (i.e., rate of use, rate of replenishment, surface changes, and changes in temperature).

Power Standard 9 (Benchmark II-A)

Know that Earth's system contains a fixed amount of natural resources that cycle among land, water, the atmosphere, and living things (e.g., carbon and nitrogen cycles, rock cycle, water cycle, ground water, aquifers).

STRAND III: SCIENCE AND SOCIETY

NM State Content Standard I: Understand how scientific discoveries, inventions, practices, and knowledge influence, and are influenced by, individuals and societies.

NM State Benchmarks Grades 9-12

RRPS Grade 9 Power Standards

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NM State Benchmark I-A: Grades 9-12

Examine and analyze how scientific discoveries and their applications affect the world, and explain how societies influence scientific investigations and applications.

NM Grade 9 Performance Standards

Science and Technology

1. Know how science enables technology but also constrains it, and recognize the difference between real technology and science fiction (e.g., rockets vs. antigravity machines; nuclear reactors vs. perpetual-motion machines; medical X-rays vs. Star-Trek tricorders).
2. Understand how advances in technology enable further advances in science (e.g., microscopes and cellular structure; telescopes and understanding of the universe).
3. Evaluate the influences of technology on society (e.g., communications, petroleum, transportation, nuclear energy, computers, medicine, genetic engineering) including both desired and undesired effects, and including some historical examples (e.g., the wheel, the plow, the printing press, the lightning rod).
4. Understand the scientific foundations of common technologies (e.g., kitchen appliances, radio, television, aircraft, rockets, computers, medical X-rays, selective breeding, fertilizers and pesticides, agricultural equipment).
5. Understand that applications of genetics can meet human needs and can create new problems (e.g., agriculture, medicine, cloning).
6. Analyze the impact of digital technologies on the availability, creation, and dissemination of information.
7. Describe how human activities have affected ozone in the upper atmosphere and how it affects health and the environment.
8. Describe uses of radioactivity (e.g., nuclear power, nuclear medicine, radiometric dating).

STRAND III: SCIENCE AND SOCIETY

NM State Content Standard V: Understand how scientific discoveries, inventions, practices, and knowledge influence, and are influenced by, individuals and societies.

NM State Benchmarks Grades 9-12

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Science and Society

- 9. Describe how scientific knowledge helps decision makers with local, national, and global challenges (e.g., Waste Isolation Pilot Project [WIPP], mining, drought, population growth, alternative energy, climate change).
- 10. Describe major historical changes in scientific perspectives (e.g., atomic theory, germs, cosmology, relativity, plate tectonics, evolution) and the experimental observations that triggered them.
- 11. Know that societal factors can promote or constrain scientific discovery (e.g., government funding, laws and regulations about human cloning and genetically modified organisms, gender and ethnic bias, AIDS research, alternative-energy research).
- 12. Explain how societies can change ecosystems and how these changes can be eversible or irreversible.
- 13. Describe how environmental, economic, and political interests impact resource management and use in New Mexico.
- 14. Describe New Mexico's role in nuclear science (e.g., Manhattan Project, WIPP, national laboratories).

Science and Individuals

- 15. Identify how science has produced knowledge that is relevant to individual health and material prosperity.
- 16. Understand that reasonable people may disagree about some issues that are of interest to both science and religion (e.g., the origin of life on Earth, the cause of the Big Bang, the future of Earth).
- 17. Identify important questions that science cannot answer (e.g., questions that are beyond today's science, decisions that science can only help to make, questions that are inherently outside of the realm of science).
- 18. Understand that scientists have characteristics in common with other individuals (e.g., employment and career needs, curiosity, desire to perform public service, greed, preconceptions and biases, temptation to be unethical, core values including honesty and openness).
- 19. Know that science plays a role in many different kinds of careers and activities (e.g., public service, volunteers, public office holders, researchers, teachers, doctors, nurses, technicians, farmers, ranchers).

Power Standard 10 (Benchmark I-A)

Describe how environmental, economic, and political interests impact resource management and use in New Mexico.

Power Standard 11 (Benchmark I-A)

Know that science plays a role in many different kinds of careers and activities (e.g., public service, volunteers, public office holders, researchers, teachers, doctors, nurses, technicians, farmers, ranchers)