

**RRPS District Standards:**  
**Biology Grade 11**  
**6/2009**

| <b>STRAND I: SCIENTIFIC THINKING AND PRACTICE</b>   |   |
|---|---|
| <i>NM State Content Standard I: Understand the processes of scientific investigations and use inquiry and scientific ways of observing, experimenting, predicting, and validating in order to think critically.</i>   |   |
| <b><u>NM State Benchmarks Grades 9-12</u></b>   | <b><u>RRPS Grade 11 Power Standards</u></b><br><i>All benchmarks must be taught; Power Standards are consistently emphasized.</i>   |
| <b><u>NM State Benchmark I-A: Grades 9-12</u></b><br>Use accepted scientific methods to collect, analyze, and interpret data and observations and to design and conduct scientific investigations and communicate results.  | <b><u>Power Standard 1 (Benchmark I-A)</u></b><br>Design, conduct, and communicate scientific investigations that include: <ul style="list-style-type: none"> <li>• Testable hypothesis</li> <li>• Controls and variables</li> <li>• Methods to collect, analyze, and interpret data</li> <li>• Results that address hypothesis being investigated</li> <li>• Predictions based on results</li> <li>• Re-evaluation of hypotheses and additional experiments as necessary</li> <li>• Error analysis</li> </ul><br><b><u>Power Standard 2 (Benchmark I-A)</u></b><br>Understand how scientific theories are used to explain and predict natural phenomena (e.g. plate tectonics, ocean currents, structure of atom). |
| <b><u>NM Grade 11 Performance Standards</u></b> <ol style="list-style-type: none"> <li>1. Describe the essential components of an investigation, including appropriate methodologies, proper equipment, and safety precautions.</li> <li>2. Design and conduct scientific investigations that include: <ul style="list-style-type: none"> <li>• testable hypotheses</li> <li>• controls and variables</li> <li>• methods to collect, analyze, and interpret data</li> <li>• results that address hypotheses being investigated</li> <li>• predictions based on results</li> <li>• re-evaluation of hypotheses and additional experimentation as necessary</li> <li>• error analysis.</li> </ul> </li> <li>3. Use appropriate technologies to collect, analyze, and communicate scientific data (e.g., computers, calculators, balances, microscopes).</li> <li>4. Convey results of investigations using scientific concepts, methodologies, and expressions, including: <ul style="list-style-type: none"> <li>• scientific language and symbols</li> <li>• diagrams, charts, and other data displays</li> <li>• mathematical expressions and processes (e.g., mean, median, slope, proportionality)</li> <li>• clear, logical, and concise communication</li> <li>• reasoned arguments.</li> </ul> </li> <li>5. Understand how scientific theories are used to explain and predict natural phenomena (e.g., plate tectonics, ocean currents, structure of atom).</li> </ol> |   |

**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 Benchmark II-A: Grades 9-12**  
Understand that scientific processes produce scientific knowledge that is continually evaluated, validated, revised, or rejected.

**RRPS Grade 11 Power Standards**  
*All benchmarks must be taught; Power Standards are consistently emphasized.*

**NM Grade 11 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 identify:
  - 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.

**Power Standard 3 (Benchmark II-A)**  
Understand how new data and observations can result in new scientific knowledge.

**Power Standard 4 (Benchmark III-A)**  
Create multiple displays of data to analyze and explain the relationships in scientific investigations while considering possible effects of measurement errors.

**Power Standard 5 (Benchmark III-A)**  
Identify and apply measurement techniques and consider possible effects of measurement errors.

**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.

**NM Grade 11 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 (Life Science): Understand the properties, structures and processes of living things and the interdependence of living things and their environments.*

**NM State Benchmarks Grades 9-12**

**RRPS Grade 11 Power Standards**

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

**NM State Benchmark I-A: Grades 9-12**

Understand how the survival of species depends on biodiversity and on complex interactions, including the cycling of matter and the flow of energy.

**Power Standard 6 (Benchmark I-A)**

Describe how organisms cooperate and compete in ecosystems (e.g. producers, decomposers, herbivores, carnivores, omnivores, predator-prey, symbiosis, mutualism etc).

**NM Grade 11 Performance Standards**

**Ecosystems**

1. Know that an ecosystem is complex and may exhibit fluctuations around a steady state or may evolve over time.
2. Describe how organisms cooperate and compete in ecosystems (e.g., producers, decomposers, herbivores, carnivores, omnivores, predator-prey, symbiosis, mutualism).
3. Understand and describe how available resources limit the amount of life an ecosystem can support (e.g., energy, water, oxygen, nutrients).
4. Critically analyze how humans modify and change ecosystems (e.g., harvesting, pollution, population growth, technology).

**Power Standards 7 (Benchmark I-A)**

Understand and describe how available resources limit the amount of life an ecosystem can support

**Power Standard 8 (Benchmark I-A)**

Explain how matter and energy flow through biological systems and how the total amount of matter and energy is conserved but some energy is always released as heat to the environment.

**Energy Flow in the Environment**

5. Explain how matter and energy flow through biological systems and how the total amount of matter and energy is conserved but some energy is always released as heat to the environment.
6. Describe how energy flows from the sun through plants to herbivores to carnivores and decomposers.
7. Understand and explain the principles of photosynthesis (i.e., chloroplasts in plants convert light energy, carbon dioxide, and water into chemical energy).

**Power Standard 9 (Benchmark I-A)**

Understand and explain the principles of photosynthesis (i.e., chloroplasts in plants convert light energy, carbon dioxide, and water into chemical energy)/

**Power Standard 10 (Benchmark I-A)**

Understand and explain the hierarchical classification scheme (i.e., domain, kingdom, phylum, class, order, family, genus, species), including:

- classification of an organism into a category
- similarity inferred from molecular structure (DNA) closely matching classification based on anatomical similarities
- similarities of organisms reflecting evolutionary relationships.

**Biodiversity**

8. Understand and explain the hierarchical classification scheme (i.e., domain, kingdom, phylum, class, order, family, genus, species), including:
  - classification of an organism into a category
  - similarity inferred from molecular structure (DNA) closely matching classification based on anatomical similarities
  - similarities of organisms reflecting evolutionary relationships.
9. Understand variation within and among species, including:
  - mutations and genetic drift
  - factors affecting the survival of an organism
  - natural selection.

## STRAND II: CONTENT OF SCIENCE

### NM State Benchmarks Grades 9-12

#### NM State Benchmark II-A: Grades 9-12

**Understand the genetic basis for inheritance and the basic concepts of biological evolution.**

#### NM Grade 11 Performance Standards

##### **Genetics**

1. Know how DNA carries all genetic information in the units of heredity called genes, including:
  - the structure of DNA (e.g., subunits A, G, C, T)
  - information-preserving replication of DNA
  - alteration of genes by inserting, deleting, or substituting parts of DNA.
2. Use appropriate vocabulary to describe inheritable traits (i.e., genotype, phenotype).
3. Explain the concepts of segregation, independent assortment, and dominant/recessive alleles.
4. Identify traits that can and cannot be inherited.
5. Know how genetic variability results from the recombination and mutation of genes, including:
  - sorting and recombination of genes in sexual reproduction result in a change in DNA that is passed on to offspring
  - radiation or chemical substances can cause mutations in cells, resulting in a permanent change in DNA.
6. Understand the principles of sexual and asexual reproduction, including meiosis and mitosis.
7. Know that most cells in the human body contain 23 pairs of chromosomes including one pair that determines sex, and that human females have two X chromosomes and human males have an X and a Y chromosome.

##### **Biological Evolution**

8. Describe the evidence for the first appearance of life on Earth as one-celled organisms, over 3.5 billion years ago, and for the later appearance of a diversity of multi-cellular organisms over millions of years.
9. Critically analyze the data and observations supporting the conclusion that the species living on Earth today are related by descent from the ancestral one-celled organisms.
10. Understand the data, observations, and logic supporting the conclusion that species today evolved from earlier, distinctly different species, originating from the ancestral one-celled organisms.

### RRPS Grade 11 Power Standards

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

#### Power Standard 11 (Benchmark II-A)

Know how DNA carries all genetic information in the units of heredity called genes, including:

- the structure of DNA (e.g. nucleotides)
- information-preserving replication of DNA
- alteration of genes by inserting, deleting, or substituting parts of DNA

#### Power Standard 12 (Benchmark II-A)

Explain the concepts of segregation, independent assortment, and dominant/recessive alleles.

#### Power Standard 13 (Benchmark II-A)

Know how genetic variability results from the recombination and mutation of genes, including:

- sorting and recombination of genes in sexual reproduction result in a change in DNA that is passed on to offspring
- radiation or chemical substances can cause mutations in cells, resulting in a permanent change in DNA

#### Power Standard 14 (Benchmark II-A)

Understand the principles of sexual and asexual reproduction, including meiosis and mitosis.

#### Power Standard 15 (Benchmark II-A)

Understand the data, observations, and logic supporting the conclusion that species today evolved from earlier, distinctly different species, originating from the ancestral one-celled organisms approximately 3.5 billion years ago.

## STRAND II: CONTENT OF SCIENCE

*NM State Content Standard II (Science): Understand the properties, structures, and processes of living things and the interdependence of living things and their environments.*

### NM State Benchmarks Grades 9-12

11. Understand that evolution is a consequence of many factors, including the ability of organisms to reproduce, genetic variability, the effect of limited resources, and natural selection.
12. Explain how natural selection favors individuals who are better able to survive, reproduce, and leave offspring.
13. Analyze how evolution by natural selection and other mechanisms explains many phenomena including the fossil record of ancient life forms and similarities (both physical and molecular) among different species.

### NM State Benchmark III-A: Grades 9-12

Understand the characteristics, structures, and functions of cells.

### NM Grade 11 Performance Standards

#### **Structure and Function**

1. Know that cells are made of proteins composed of combinations of amino acids.
2. Know that specialized structures inside cells in most organisms carry out different functions, including:
  - parts of a cell and their functions (e.g., nucleus, chromosomes, plasma, and mitochondria)
  - storage of genetic material in DNA
  - similarities and differences between plant and animal cells
  - prokaryotic and eukaryotic cells.
3. Describe the mechanisms for cellular processes (e.g., energy production and storage, transport of molecules, waste disposal, synthesis of new molecules).
4. Know how the cell membrane controls which ions and molecules enter and leave the cell based on membrane permeability and transport (i.e., osmosis, diffusion, active transport, passive transport).
5. Explain how cells differentiate and specialize during the growth of an organism, including:
  - differentiation, regulated through the selected expression of different genes
  - specialized cells, response to stimuli (e.g., nerve cells, sense organs).
6. Know that DNA directs protein building (e.g., role of RNA).

#### **Biochemical Mechanisms**

7. Describe how most cell functions involve chemical reactions, including:
  - promotion or inhibition of biochemical reactions by enzymes
  - processes of respiration (e.g., energy production, ATP)
  - communication from cell to cell by secretion of a variety of chemicals (e.g. hormones).

### RRPS Grade 11 Power Standards

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

#### Power Standard 16 (Benchmark II-A)

Analyze how evolution by natural selection and other mechanisms (e.g., genetic drift explains many phenomena including fossil record of ancient life forms and similarities (both physical and molecular) among different species.

#### Power Standard 17 (Benchmark III-A)

Describe the mechanisms for cellular processes (e.g., energy production and storage, transport of molecules, waste disposal, synthesis of new molecules)

#### Power Standard 18 (Benchmark III-A)

Describe how most cell functions involve chemical reactions, including the role of enzymes and the processes of photosynthesis and respiration.

#### Power Standard 19 (Benchmark III-A)

Know how DNA directs protein building (e.g., transcription, translation, roles of RNAs).

**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 11 Power Standards**

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

**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.

**Power Standard 20 (Benchmark I-A)**

Understand how advances in technology enable further advances in science (e.g. microscopes and cellular structure; telescopes and understanding of the universe).

**NM Grade 11 Performance Standards**

**Science and Technology**

1. Know how science enables technology but also constrains it, and describe 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-ray, 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).

**Power Standard 21 (Benchmark I-A)**

Evaluate the influences of technology on society including both desired and undesired effects, and including some historical examples.

**Power Standard 22 (Benchmark I-A)**

**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 11 Power Standards**

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

**NM State Benchmark I-B: Grades 9-12**

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

**Power Standard 23 (Benchmark I-B)**

Describe major historical changes in scientific perspectives (e.g. atomic theory, germs, cosmology, relativity, plate tectonics, and evolution) and the experimental observations that triggered them.

**NM Grade 11 Performance Standards**

1. 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]
2. Describe major historical changes in scientific perspectives (e.g., atomic theory, germs, cosmology, relativity, plate tectonics, evolution) and the experimental observations that triggered them.
3. 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).
4. Explain how societies can change ecosystems and how these changes can be reversible or irreversible.
5. Describe how environmental, economic, and political interests impact resource management and use in New Mexico.
6. Describe New Mexico's role in nuclear science (e.g.. Manhattan Project, WIPP, national laboratories).

**Power Standard 24 (Benchmark I-B)**

Know that societal factors can promote or constrain scientific discovery.

**Power Standard 25 (Benchmark I-A)**

Explain how societies can change ecosystems and how these changes can be reversible or irreversible.

**Power Standard 26 (Benchmark I-A)**

Identify important questions that science cannot answer .

**Science and Individuals**

7. Identify how science has produced knowledge that is relevant to individual health and material property.
8. Know 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).
7. 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 the realm of science).
8. 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).
9. 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).