It CAN Be Done!

NM Content Standards & Benchmarks That Can Be Met Through Inquiry-Based Student Research Projects in

Grades 9-12

An Overview of Science, Language Arts, Mathematics, and Social Studies Standards & Benchmarks That Can Be Met Via Inquiry-Based Student Research Projects

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Inquiry-Based Research Projects Meet and Beat the Standards!

LANGUAGE ARTS

Every year, teachers across the United States search for ways to meet National and State Educational Standards and Benchmarks in a variety of content areas.

Those who discover a way to meet many standards across several content areas with a single activity feel like they have found a hidden treasure. That is why inquiry-based student research projects are like pure gold these days!

When students select a research topic, their first job is to find out more about it. Related language arts standards & benchmarks are met as students sort out fact from fiction in the information that they read. Young investigators create drawings or narratives to summarize the main ideas and list details to support what they have discovered. Finally, all students also use additional related standards & benchmarks in telling their story and presenting their projects in a logical manner. This provides great opportunities for editing and rewriting. At the middle and high school level, students may explain and defend their findings to other teachers, parents and judges. This provides them with experience in both the listening and oral communication related standards & benchmarks.

MATHEMATICS

Mathematics is the language of Science. Student research provides ample opportunities to tie in the Mathematics Standards. One of the hidden bonuses is that many students who are traditionally afraid of math finally see a way and a reason to apply their skills! The collection and analysis of data requires the use of integers, fractions, and decimals, or "Number Sense." "Data Analysis" and "Probability" are the key to the proof or rejection of a hypothesis. Projects commonly use bar graphs and pie charts to show their results and support their conclusions. Good research projects incorporate a number of mathematics standards & benchmarks.

SOCIAL STUDIES

One of the very first steps in beginning a student research project is a review of other scientists' work. In other words, a search for existing information in current and past literature in its many forms (ex: scientific journals, online articles, scholarly papers, newspaper/magazine articles, etc.). And the rest is, as they say, is history! Students learn about historical time lines and world history in the context of the topic of their research project. Many projects involve patterns of land use and its problems, which includes both geography and geology related standards. Disagreements over the use of protected or threatened lands often lead to the integration of civics and government standards. Junior economists often choose to analyze the cost and efficiency of everything from bubble gum to nail polish. So, who says Social Studies has nothing to do with Science?

SCIENCE

Inquiry-based student research projects help students use all of their acquired skills, develop new skills, and explore their natural talents. It is well known that the science standards & benchmarks are addressed by student research projects, but many other standards in all grades are addressed, as well.

HEALTH

Many student research projects are health or medicine related. Every year there are studies regarding which foods are healthier, whether boys are better than girls at one thing or another, how much bacteria is on everything from doorknobs to toilet seats, the effects of music on comprehension, memory & learning, etc. These studies not only pave the way for future medical research, they address even more state standards!

So, teachers, please take the challenge! Engage your students in inquiry-based research projects and meet LOTS of standards & benchmarks at the same time. You can't go wrong…neither can your students. The ability to conduct inquiry-based research and to then present information orally as well as in writing are skills that last a lifetime.

LANGUAGE ARTS

NM Standards & Benchmarks Potentially Met Via Inquiry-Based Student Research Projects

Strand: Reading and Listening for Comprehension

Content Standard I: Students will apply strategies and skills to comprehend information that is read, heard, and viewed.

9-12 Benchmark I-A: Listen to, read, react to, and analyze information

GRADE	PERFORMANCE STANDARDS
9	2. Instruct an audience in how to perform a specific operation or procedure. 3. Form and refine a question for investigation using a topic of personal choice and answer that question.
10	1. Produce reminiscences (about a person, event, object, place, animal) that engages the audience. 2. Respond reflectively (through small group discussion, class discussion, journal entry, essay, letter, dialogue) to written and visual texts. 3. Create responses that evaluate problems & offer solutions to a reader/listener. 4. Evaluate the information, explanations, or ideas of others.
11	1. Demonstrate increasing insight and reflection to print and non-print text through personal expression. 2. Reflect and respond expressively to texts so that the audience will discover multiple perspectives, investigate and articulate connections, explore how life experiences influence a response to a selection, recognize that responses of others may be different. 3. Respond to informational texts.
12	1. Express reflections and reactions to print and non-print texts as well as to personal experience. 2. Analyze and critique texts from various perspectives and approaches.

Strand: Reading and Listening for Comprehension

Content Standard I: Students will apply strategies and skills to comprehend information that is read, heard, and viewed.

9-12 Benchmark I-B: Synthesize and evaluate information to solve problems across the curriculum

GRADE	PERFORMANCE STANDARDS
9	1. Use a variety of techniques for researching topics. 2. Synthesize a variety of types of visual information including pictures and symbols.
10	1. Use a variety of information resources to critically interpret and evaluate experiences, language, and ideas. 2. Make extensive use of primary sources when researching a topic and make in-depth analyses of the validity and reliability of primary source information. 3. Use multiple resources to gather information to evaluate problems, examine cause and effect relationships, and answer research questions to inform an audience.
11	1. Conduct research using data from in-depth field studies. 2. Synthesize information from multiple research studies to draw conclusions that go beyond those found in any of the individual studies. 3. Inform an audience by using a variety of media to research and explain insights. 4. Demonstrate proficiency in accessing and sending information electronically.
12	1. Identify and defend research questions and topics that will be important in the future. 2. Use a variety of resources to gather information to critically analyze texts to gain meaning, develop thematic connections, and synthesize ideas. 3. Demonstrate increasing sophistication in the selection and use of resources to define issues and use argument effectively.

Strand: Reading and Listening for Comprehension

Content Standard I: Students will apply strategies and skills to comprehend information that is read, heard, and viewed.

9-12 Benchmark I-C: Demonstrate critical thinking skills to evaluate information and solve problems

GRADE	PERFORMANCE STANDARDS
9	1. Examine texts for arguments and develop informed opinions. 2. Support informed opinions by providing relevant and convincing reasons, using various types of evidence, language, and organizational structure, and demonstrating an awareness of possible questions, concerns, or counter-arguments. 3. Create and use criteria to evaluate the effectiveness of communication. 4. Represent abstract information (e.g., concepts, generalizations) as explicit mental pictures.
10	1. Examine controversial issues. 2. Critically interpret and evaluate experiences, literature, language, and ideas. 3. Identify critical questions that would lead to a broader understanding of a selection. 5. Read critically and independently to draw conclusions from research.
11	3. Analyze overall effectiveness of one's own writing.
12	1. Research, define, and present issues of public concern.

Strand: Reading and Listening for Comprehension

Content Standard I: Students will apply strategies and skills to comprehend information that is read, heard, and viewed.

9-12 Benchmark I-D: Apply knowledge of reading process to evaluate print, non-print, and technology-based information.

GRADE	PERFORMANCE STANDARDS
9	1. Explain meaning, describe processes, and answer research questions to inform others. 2. Demonstrate increasing comprehension and ability to respond personally to texts by selecting and exploring a wide range of literary forms. 3. Accurately interpret information from and detect inconsistencies in a variety of informational, literary, and technical texts. 4. Scan reading selections to determine whether a text contains relevant information. 5. Use discussion with peers as a way of understanding information. 6. Effectively use a variety of interactive technologies to enhance understanding of reading selections (e.g., internet, email, CD-ROM, on-line publications, digital images, video).
10	1. Pose questions prompted by text and research answers. 2. Analyze the ideas of others by identifying the ways in which writers, introduce and develop a main idea, choose/incorporate significant, supporting, relevant details, relate the structure & organization to the ideas, use effective word choice as a basis for coherence, & achieve a sense of completeness & closure. 3. Demonstrate increasing comprehension and ability to respond personally to texts by selecting and exploring a wide range of works that relate to an issue, author, or theme. 4. Identify complex, implicit hierarchic structures in informational texts and relationships between the concepts and details in these structures.
11	2. Reorganize the concepts and details in informational texts in new ways and describe the advantages and disadvantages of the new organization. 3. Recognize how new information changes one's personal knowledge base. 4. Understand complex dialogues and analyze the stylistic effect of those dialogues on a selection, including interpreting culturally specific ambiguities, subtleties, contradictions, ironies, and nuances. 5. Accurately interpret info. presented in a technical format (e.g., charts, diagrams, tables). 6. Use an array of media and technologies to examine and comprehend information.
12	1. Read a wide variety of informational and literary texts and selections to understand and express reflections and reactions to print and non-print text, as well as, personal experience, inform an audience, develop an argument to support an issue or position, conduct research and make in-depth analyses of information, and synthesize ideas and generate new understanding to increase a knowledge base. 4. Identify and select appropriate text for a specific task using an array of advanced technologies (e.g., web resources, interactive media, software, email, networks).

Strand: Writing and Speaking for Expression

Content Standard II: Students will communicate effectively through speaking and writing.

9-12 Benchmark II-A: Communicate information in a coherent and persuasive manner using verbal and non-verbal language

GRADE	PERFORMANCE STANDARDS
9	2. Ask questions to broaden and enrich discussions. 3. Express an informed opinion that clearly states a personal view, is logical and coherent, and engages the reader's interest. 4. Support an informed opinion by using appropriate language, reason, and organizational structure for the audience and purpose.
10	1. Produce responses to editorials/literature for a neutral audience by providing a clearly stated position or proposed solution and a relevant, reliable support. 2. Make well-informed and well-organized formal presentations with a clear main point, adjusting the message, wording, and delivery to the particular audience and context. 3. Defend argumentative positions on literary and non-literary issues by sharing and evaluating initial personal response, presenting researched and summarized information, creating a context to discuss the issue, researching and compiling data to organize the argument, and presenting data
11	1. Use language persuasively in addressing a particular issue by finding and interpreting information effectively, recognizing propaganda as a purposeful technique, establishing and defending a point of view, and responding respectfully to viewpoints and biases. 2. Identify, analyze, and evaluate criteria used for formal and informal discussions to determine how well others engage in discussion.
12	1. Develop oral formal presentations using clear enunciation, gestures, tone, vocabulary, and organization appropriate for a particular audience. 2. Make explicit use of various techniques for effective presentations (e.g., voice, inflection, tempo, gestures). 3. Organize and deliver an argument so that an intended audience will respond by wording the claim clearly, specifying convincing reasons to support the claim, and adopting a stance and appropriate tone toward the issue. 4. Design and apply criteria for evaluating oral presentations and arguments before delivering them.

Strand: Writing and Speaking for Expression

Content Standard II: Students will communicate effectively through speaking and writing.

9-12 Benchmark II-B: Apply grammatical and language conventions to communicate

GRADE	PERFORMANCE STANDARDS
9	1. Identify and correctly use clauses (e.g., main and subordinate), phrases (e.g., gerund, infinitive, participle), and mechanics of punctuation. 2. Demonstrate understanding of sentence structure (e.g., parallel structure, subordination, proper placement of modifiers), and consistency of verb tense and voice. 3. Demonstrate control of grammar, paragraph and sentence structure, diction, and syntax.
10	1. Demonstrate appropriate manuscript requirements that include title page, pagination, spacing and margins, and integration of source and support material (e.g., citations, reference lists, direct quotations) with appropriate punctuation and format. 2. Use systematic strategies to organize and record information (e.g., anecdotal scripting, annotated bibliographies).
11	1. Demonstrate control of grammar, diction, paragraph, and sentence structure. 2. Use a variety of technology tools to present information appropriate for the purpose and audience. 3. Develop presentations by using clear research questions and creative and critical research strategies (e.g., field studies, oral histories, interviews, experiments).
12	1. Demonstrate the ability to comprehensively, coherently, and concisely expound upon ideas.

Strand: Speaking and Writing for Expression

Content Standard II: Students will communicate effectively through speaking and writing.

9-12 Benchmarks II-C: Demonstrate competence in the skills and strategies of the writing process to inform and persuade

GRADE	PERFORMANCE STANDARDS
9	1. Use jargon and/or lingo appropriate for a specific purpose and audience. 2. Use descriptive language to create images in the mind of the audience. 3. Compose written arguments that develop and support informed opinions.
10	2. Clearly articulate a position through the use of a thesis statement, anticipate and deal with counter-arguments, and develop arguments using a variety of methods.
11	1. Use argument to interpret researched information, establish and defend a point of view, address concerns of the opposition, use logical strategies, use techniques, and develop a sense of completion. 2. Synthesize and organize information from a variety of sources in order to inform and persuade an audience. 3. Analyze the works of others for consistency of facts, ideas, tone, voice, development of argument or plot, and clarity and conciseness.
12	1. Use and apply grammatical, metaphorical, or rhetorical devices to inform and persuade others. 3. Analyze own work for consistency of facts, ideas, tone, voice, development of argument or plot, and clarity and conciseness.

Strand: Literature and Media

Content Standard III: Students will use literature and media to develop an understanding of people, societies, and the self.

9-12 Benchmarks III-A: Use language, literature, and media to understand the role of the individual as a member of many cultures

GRADE	PERFORMANCE STANDARDS
9	3. Respond to a variety of literary works and media (e.g., memoirs, vignettes, narratives, diaries, newspaper, movies) that offer an audience an understanding of a student's personal reactions, a sense of how the reaction results from careful consideration of the text, and an awareness of how personal and cultural influences affect the response.

MATHEMATICS

Grades 9-12

NM Standards & Benchmarks Potentially Met Via Inquiry-Based Student Research Projects

Strand: **ALGEBRA, FUNCTIONS, AND GRAPHS**

Standard: Students will understand algebraic concepts and applications.

9-12 Benchmark.A.1: Represent and analyze mathematical situations and structures using algebraic symbols.

GRADE	PERFORMANCE STANDARDS
9-12	1. Use the special symbols of mathematics correctly and precisely. 5. Use a variety of computational methods, recognize when an estimate or approximation is more appropriate than an exact answer, and understand the limits on precision of approximations.

Strand: **ALGEBRA, FUNCTIONS, AND GRAPHS**

Standard: Students will understand algebraic concepts and applications.

9-12 Benchmark A.2: Understand patterns, relations, functions, and graphs.

GRADE	PERFORMANCE STANDARDS
9-12	13. Read information and draw conclusions from graphs, and identify properties of a graph that provide useful information about the original problem.

Strand: **GEOMETRY AND TRIGONOMETRY**

Standard: Students will understand geometric concepts and applications.

9-12 Benchmark G.1: Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships.

GRADE	PERFORMANCE STANDARDS
9-12	1. Understand that numerical values associated with measurements of physical quantities must be assigned units of measurement or dimensions; apply such units correctly in expressions, equations and problem solutions that involve measurements; and convert a measurement using one unit of measurement to another unit of measurement. 4. Identify the hypothesis and conclusion in examples of conditional statements. 5. Use definitions in making logical arguments. 7. Explain the difference between inductive and deductive reasoning and provide examples of each.

Strand: **DATA ANALYSIS AND PROBABILITY**

Standard: Students will understand how to formulate questions, analyze data, and determine probabilities.

9-12 Benchmark D.1: Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.

GRADE	PERFORMANCE STANDARDS
9-12	1. Explain the differences between various methods of data collection. 2. Describe the characteristics of a well-designed and well-conducted survey by differentiating between sampling and census, and a biased and unbiased sample. 3. Describe the characteristics of a well-designed and well-conducted experiment by differentiating between experiments and observational studies, and recognizing the sources of bias in poorly designed experiments. 4. Explain the role of randomization in well-designed surveys and experiments.

Strand: **DATA ANALYSIS AND PROBABILITY**

Standard: Students will understand how to formulate questions, analyze data, and determine probabilities.

9-12 Benchmark D.2: Select and use appropriate statistical methods to analyze data and make predictions.

GRADE	PERFORMANCE STANDARDS
9-12	1. Distinguish measurement data from categorical data, and define the term *variable*. 2. Explain the meaning of *univariate* and *bivariate* data. 3. Display the distribution of univariate data, describe its shape using appropriate summary statistics, and understand the distinction between a statistic and a parameter. 4. Calculate and apply measures of variability (e.g., standard deviation). 5. Compare distributions of univariate data using back-to-back stem and leaf plots and parallel box and whisker plots. 6. Describe the characteristics of a normal distribution. 7. Compare and draw conclusions between two or more sets of univariate data using basic data analysis techniques and summary statistics. 8. Describe the shape of a scatterplot. 9. Use linear patterns in data to make predictions. 10. Use technological tools to find the line of best fit. 11. Describe the relationship between two variables and determine its strength with and without technological tools. 12. Explain why correlation does not imply a cause-and-effect relationship. 13. Use the results of simulations to explore the variability of sample statistics from a known population and construct sampling distributions. 14. Describe how sample statistics, including the law of large numbers, reflect the values of population parameters and use sampling distributions as the basis for informal inference. 15. Evaluate published reports that are based on data by examining the design of the study, the appropriateness of the data analysis, and the validity of conclusions.

Strand: **DATA ANALYSIS AND PROBABILITY**

Standard: Students will understand how to formulate questions, analyze data, and determine probabilities.

9-12 Benchmark D.3: Understand and apply basic concepts of probability.

GRADE	PERFORMANCE STANDARDS
9-12	1. Explain the concept of a random variable. 2. Explain how the relative frequency of a specified outcome of an event can be used to estimate the probability of the outcome. 3. Use the results of simulations to compute the expected value and probabilities of random variables in simple cases. 4. Compute the probability of an event using the complement rule, addition rule for disjoint and joint events, multiplication rule for independent events, and rules for conditional probability.

SOCIAL STUDIES

NM Standards & Benchmarks Potentially Met Via Inquiry-Based Student Research Projects

Strand: History

Content Standard I : Students are able to identify important people and events in order to analyze significant patterns, relationships, themes, ideas, beliefs, and turning points in New Mexico, United States, and world history in order to understand the complexity of the human experience.

9-12 Benchmark I-D—Skills: Use critical thinking skills to understand and communicate perspectives of individuals, groups, and societies from multiple contexts.

Grade	Performance Standards
9-12	1. Understand how to use the skills of historical analysis to apply to current social, political, geographic, and economic issues. 2. Apply chronological and spatial thinking to understand the importance of events. 3. Describe primary and secondary sources and their uses in research. 4. Explain how to use a variety of historical research methods and documents to interpret and understand social issues (e.g., the friction among societies, the diffusion of ideas). 5. Distinguish "facts" from authors' opinions and evaluate an author's implicit and explicit philosophical assumptions, beliefs, or biases about the subject. 6. Interpret events and issues based upon the historical, economic, political, social, and geographic context of the participants. 7. Analyze the evolution of particular historical and contemporary perspectives. 8. Explain how to use technological tools to research data, verify facts and information, and communicate findings.

SCIENCE

NM Standards & Benchmarks Potentially Met Via Inquiry-Based Student Research Projects

Strand I: **Scientific Thinking and Practic**e

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

9-12 Benchmark I: Use accepted scientific methods to collect, analyze, and interpret data and observations and to design and conduct scientific investigations and communicate results.

GRADE	PERFORMANCE STANDARDS
9 - 12	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 the atom).

Strand I: **Scientific Thinking and Practic**e

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

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

GRADE	PERFORMANCE STANDARDS
9 - 12	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.

Strand I: **Scientific Thinking and Practice**

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

9-12 Benchmark III: Use mathematical concepts, principles, and expressions to analyze data, develop models, understand patterns and relationships, evaluate findings, and draw conclusions.

GRADE	PERFORMANCE STANDARDS
9 - 12	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 III: **Science and Society**

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

9-12 Benchmark I: Examine and analyze how scientific discoveries and their applications affect the world, and explain how societies influence scientific investigations and applications.

GRADE	PERFORMANCE STANDARDS
9 - 12	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).