Project Overview (7th grade)

Name of Project: Storm Drain Pollution - Fertilizer

Month: December or January
Big Ideas: Biodiversity, classification, Populations, Ecology, Interactions
Essential Question: How do resources and physical factors limit/support living systems? How does energy from the sun support life? How do living and non-living rely on each other?

Subject/Course: 7th Grade Science

Grade Level: 7

Project Idea: Study the effects of fertilizer (from runoff) on our water systems. After intro from ABCWUA, students do inquiry from *Teach Engineering* web site: "Pea Soup Ponds," which asks students to analyze the effects of varying amounts of fertilizer on algae formation.

Driving Question: How do we all contribute to water pollution? How can we help stop polluting the Rio Grande?

ABCWUA support: Intro Presentation – *There Is No Point to this Pollution.* Students learn about water quality and the cumulative impacts of nonpoint source pollution.

Culminating Products and Performances: After researching local water pollution issues through ABCWUA and Storm Drain web sites, students write a pamphlet, a commercial, or a skit to teach us how to "Keep the Rio Grand!"

Content and Skills Standards:

- II.II.I.7 Know how to classify organisms (algae).
- II.III.I.1 Explain why Earth is unique in its ability to sustain life.
- II.III.I.2 Explain how sun's energy supports life.
- II.I.II.1 Know how energy is transformed through organisms and ecosystems and effects of mankind's use of energy and other activities on living systems (water quality).
- II.II.I.1 Identify living and nonliving parts of an ecosystem.
- II.II.I.3. Explain how individuals exist together and interact with their environment to create an ecosystem.
- II.II.I.4 Explain conditions and resources needed to sustain life in specific ecosystems.
- II.II.I.5 Describe how the availability of resources and physical factors limit growth and how nitrogen and water cycles support life systems.

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Project Overview (8th grade)

Name of Project: Water and Weather	**Month:** September **Big Ideas:** Properties of matter, Water cycle, states of matter **Essential Question:** How does matter combine to make different things?
Subject/Course: 8th-Grade Science	**Grade Level:** 8

Project Idea: Putting Water in the Bank – A Plan for Water Storage

Driving Question: Although we don't yet know why, we are seeing early runoff from the spring snow melt. We need to know why, but until then, how can we start planning ways to store this water to make sure it is available during long, dry summers.

ABCWUA support: Intro Presentation – *Early Runoff* (standards and benchmarks on web) Students see if dirt could be the reason we are getting early runoff and brainstorm ideas for solving the problem once they have better ideas of what is causing the problem.

Culminating Products and Performances: Students make a map or 3-D model of their plan to help the school catch rain water, or to help Albuquerque store river water.

Content and Skills Standards:

- I.I.II.1 Examine alternative explanations for observations. (Global warming or dirt?)
- I.I.II.2 Describe ways in which science differs from other ways of knowing and from other bodies of knowledge (e.g. experimentation, logical arguments, skepticism).
- I.I.II.3 Know that scientific knowledge is built on questions posed as testable hypotheses, which are tested until the results are accepted by peers.
- II.I.I.7 Know that phase changes are physical changes that can be reversed (e.g. evaporation, condensation, melting).
- II.III.II.2 Understand the unique role water plays on Earth, including:
  - ability to remain liquid at most Earth temperatures
  - properties of water related to processes in the water cycle: evaporation, condensation, precipitation, surface run-off, percolation
  - dissolving of minerals and gases and transport to the oceans
  - fresh and salt water in oceans, rivers, lakes, and glaciers
  - reactant in photosynthesis

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Project Overview (A)

Name of Project: Step into a Less Diverse Future

Month: September

Big Ideas: Understand the interactions of organisms with each other and their environment.

Essential Question: Where do adaptations come from and how do they spread through a population? What causes ecosystems to change over time? Why can the environment be described as a system of interdependent components affected by human activity and natural phenomena? How do changes in ecosystems fluctuate over time?

Subject/Course: **A** Biology

Grade Level: high school

Project Idea: Study the effects of people and natural phenomena on the riparian ecosystem and how that would affect the people who live in Albuquerque. After playing the ABCQUA biodiversity activity, they study possible future ecological events based upon the outcomes of the activity.

Driving Question: Why is biodiversity important?

ABCWUA support: Intro Presentation – *Biodiversity on the Rio Grande*. (standards and benchmarks on web) Students play a game with beads representing animals and plants that make up the riparian ecosystem along the Rio Grande. Good and poor decisions, as well as natural phenomena, take place during the game to ultimately limit biodiversity so that when disease and/or drought hits, the ecosystem is hit very hard.

Culminating Products and Performances: Students write a futuristic short story that starts where the ABCWUA activity leaves off. The story must have a drawing of the Rio Grande before and after the disaster and must list at least five ecological events that were caused by the disaster.

Content and Skills Standards:

- II.II.I.1 Know that an ecosystem is complex and may exhibit fluctuations around a steady state or may evolve over time.
- II.III.I.2 Describe how organisms cooperate and compete in ecosystems (e.g. producers, decomposers, herbivores, carnivores, omnivores, predator-prey, symbiosis, mutualism.
- II.II.I.3 Understand and describe how available resources limit the amount of life an ecosystem can support (e.g. energy, water, oxygen, nutrients).
- II.II.I. Critically analyze how humans modify and change ecosystems (e.g. harvesting, pollution, population growth, technology).
- II.II.I.5. Explain how matter and energy flow through biological systems (e.g. organisms, communities, ecosystems) and how the total amount of matter and energy is conserved but some energy is always released as heat to the environment,

- II.III.II.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.
- II.III.II.8 Describe 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 Nino, Las Nina, and other climatic trends.
- II.III.II.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 temp).

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Project Overview (6th grade)

Name of Project: Water Energy System

Month: January
Big Ideas: Atmosphere, Weather, Water Cycle, Life
Essential Question: What factors influence our weather and climate?
How are living things influenced by their environments?

Subject/Course: 6th Grade Science

Grade Level: 6

Project Idea: Water and electricity are connected. It is surprising but true that we rely on the water cycle to generate electricity. On the other hand, we rely on electricity to pump, clean, and deliver water to our cities. In this project, students are divided into groups to draw a diagram showing how we use water to make electricity. PNM (http://www.pnm.com/systems/plants.htm), power plants use:

- Coal: *Four Corners Power Plant, The San Juan Generating Station*
- Natural Gas: *Delta-Person Generating Station, Reeves Generating Station*
- Nuclear: *Palo Verde Nuclear Generating Station*
- Wind: *The New Mexico Wind Energy Center*

For more complete info about all of PNM's plants, visit the web site listed above.
Ask students to answer these questions in their diagram.

1. Map the location of the power plant PNM uses.
2. Does this source use energy to boil water? Would reducing our electricity needs reduce our water needs?
3. Is the source of energy produced by living organisms or by nonliving processes?
4. What force actually spins the turbine?
5. How is energy transformed during this process? For example, at the wastewater sewage plant we make electricity from methane gas produced by bacteria in the sludge. The gas is pumped to generators that run like giant car engines, like this:
    - Bacteria create gas from digesting sludge (chemical energy)
    - Methane gas explodes with spark, like in a car engine (chemical energy)
    - Explosion moves piston (mechanical energy)
    - Piston spins copper coil around magnet (mechanical energy)
    - Electricity flows through copper wire (electrical energy)
6. Students share their diagrams to get a full picture of where our electricity comes from.

Driving Question: What energy changes occur when we use coal-, gas-, nuclear- or wind-energy to generate electricity?

ABCWUA support: Intro-*Water Energy Connection* presentation by ABCWUA
In this activity, students must supply their town with electricity by using water. They'll need that electricity to supply drinking water! Decisions must be made when drought strikes!

Culminating Products and Performances: In this project, students are divided into groups to draw a diagram showing how we use water to make electricity. In Albuquerque, we get our electricity from:

- Coal

- Natural Gas
- Nuclear
- Wind

Ask students to answer these questions in their diagram.

7. Map the location of the power plant PNM uses.
8. Does this source use energy to boil water? Would reducing our electricity needs reduce our water needs?
9. Is the source of energy produced by living organisms or by nonliving processes?
10. What force actually spins the turbine?
11. How is energy transformed during this process? For example, at the wastewater sewage plant we make electricity from methane gas produced by bacteria in the sludge. The gas is pumped to generators that run like giant car engines, like this:
    - Bacteria create gas from digesting sludge (chemical energy)
    - Methane gas explodes with spark, like in a car engine (chemical energy)
    - Explosion moves piston (mechanical energy)
    - Piston spins copper coil around magnet (mechanical energy)
    - Electricity flows through copper wire (electrical energy)
12. Students share their diagrams to get a full picture of where our electricity comes from.

Note: This project leads naturally to questions about how our water and electricity supplies are affected by weather and how weather (drought) is affected by heat, air movement, pressure, humidity, oceans, clouds, global patterns like El Nino, etc.

Content and Skills Standards:

STRAND II: Content of Science
STANDARD I (Physical Science): Understand the structure and properties of matter, the characteristics of energy, and the interactions between matter and energy.
5-8 Benchmark II: Explain the physical processes involved in the transfer, change, and conservation of energy.
II.I.II.1 Identify various types of energy (e.g., heat, light, mechanical, electrical, chemical, nuclear).

STRAND II: Content of Science
STANDARD II: (Life Science): Understand the properties, structures, and processes of living things and the interdependence of living thing and their environments.
5-8 Benchmark I: Explain the diverse structure and functions of living things and the complex relationships between living things and their environments.
II.II.I.1 Understand how organisms interact with their physical environments to meet their needs (i.e., food, water, air) and how the water cycle is essential to most living systems.

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Project Overview (Environmental Studies)

Name of Project: Pollution Detective	**Month:** March **Big Ideas:** Water distribution, water management, water conservation, water pollution, wastewater treatment **Essential Question:** The given essential questions are not compatible. A compatible essential question might be, "How do we get and use water in the United States and Albuquerque?"
Subject/Course: Environmental Studies	**Grade Level:** high school

Project Idea: Students learn about ways we dirty our water (before and after we pump it) and how we clean it.

Driving Question: How can we protect the quality of our water?

ABCWUA support: Intro Presentation – *Pollution Detective*. (standards and benchmarks on web) Students try to find the source of groundwater pollution using pH paper to look in the soil for contamination.

Wastewater Tours – Students learn about how we clean wastewater and tour of the Southside Water Reclamation Plant, seeing water from intake to outfall, the Rio Grande.

Culminating Products and Performances: Students produce a public service announcement or pamphlet to teach people how to protect surface water and ground water.

Content and Skills Standards:

- III.I.I.12. Explain how societies can change ecosystems and how these changes can be reversible or irreversible.
- III.I.I.13. Describe how environmental, economic, and political interests impact resource management and use in New Mexico.
- III.I.I.2. Understand how advances in technology enable further advances in science (e.g. microscopes and cellular structure; telescopes and understanding of the universe.

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Project Overview (B)

Name of Project: Radiation and the Watershed	**Month:** January **Big Ideas:** The nuclei of atoms can change releasing energy and forming different elements. Nuclear energy has a variety of uses in medicine, archaeology, technology, and can be harnessed as an energy source. **Essential Question:** What role does nuclear science play in our society's medical technology, energy sources, radiometric dating and history?
Subject/Course: B Chemistry	**Grade Level:** high school

Project Idea: Students learn about radioactivity and research/discuss the issue of how Los Alamos National Laboratories might affect our watershed. Students try to mediate the issue of Dixon farmers vs. LANL.

Driving Question: What guidelines should be in place for LANL in order to make sure that everyone in the watershed has access to uncontaminated water?

ABCWUA support: After students learn about nuclear reactions, ABCWUA educators present *Water Mediation*. (standards and benchmarks on web) Students read an article from the Albuquerque Journal about the Dixon famers objecting to LANL making plutonium pits for bombs. In small groups, they choose who will represent the farmers and who will represent the Labs. One student in each group is the mediator. Afterwards, groups share their solutions.

Culminating Products and Performances: Students research an issue directly related to the nuclear industry in New Mexico and write a letter to their senator. Students in each class vote on which letter(s) are the best and those are mailed.

Content and Skills Standards:

- II.III.II.12. Explain how the availability of ground water through aquifers can fluctuate based on multiple factors (i.e. rate of use, rater of replenishment, surface changes, and changes in temperature).
- III.I.I.8. Describe uses of radioactivity (e.g. nuclear power, nuclear medicine, radiometric dating).
- III.I.I.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).
- III.I.I.12. Explain how societies can change ecosystems and how these changes can be reversible or irreversible.
- III.I.I.13. Describe how environmental, economic, and political interests impact resource management and use in New Mexico.
- III.I.I.15. Identify how science has produced knowledge that is relevant to individual health and material prosperity.

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Project Overview (C)

Name of Project: Model a Watershed	**Month:** August **Big Ideas:** Scientific thinking and practice, metric system, math models, measurement **Essential Question:** How do scientists use mathematical concepts, principles, and expressions to analyze data, develop models, understand patterns and relationships, evaluate findings, and draw conclusions?
Subject/Course: C Physics/Earth Science	**Grade Level:** high school

Project Idea: Now that we are seeing changes in global temperatures, scientists need to plan for future extreme weather events. Students build a watershed and measure its area to find a linear equation that tells them when to let water of the lake to protect the dam.

Driving Question: How do scientists use math to prepare for future weather events?

ABCWUA support: Presentation – *Mathematical Watershed Model*. (standards and benchmarks on web) Students build a watershed and measure its approximate area to come up with a linear equation describing the level of rainfall the lake can safely accommodate. Students learn ways we can conserve water during long dry spells which we have since we live in a desert.

Culminating Products and Performances: Students prepare a report describing how to know when a weather event will cause the level in a dam to be unsafe. The report will include a description of the watershed and an estimation of square km that it covers. The report should include a description of why only 20% of the rainfall becomes runoff. Finally, students should include a linear equation in slope/intercept form that informs the dam manager when they would need to let water out of the lake to protect the safety of the dam.

Content and Skills Standards:

- I.I.I.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, and reasoned arguments.
- I.I.I.5 Understand how scientific theories are used to explain and predict natural phenomena (e.g. plate tectonics, ocean currents, structure of atom).
- 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, and repeatability of experiments and reproducibility of results.
- I.I.II.3 Understand how new data and observations can result in new scientific knowledge.

- I.I.III.1. Create multiple displays of data to analyze and explain the relationships in scientific investigations.
- I.I.III.2. Use mathematical models to describe, explain, and predict natural phenomena.
- I.I.III.4. Identify and apply measurement techniques and consider possible effects of measurement errors.
- I.I.III.5. Use mathematics to express and establish scientific relationships (e.g. scientific notation, vectors, and dimensional analysis).
- III.I.I.15. Identify how science has produced knowledge that is relevant to individual health and material prosperity.

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