

6th Grade: Water Energy Connection

The Water-Energy Connection: 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!

Science

Str/std/bch	Performance Standard
II.II.I	6. 2. Describe how weather and geologic events (e.g., volcanoes, earthquakes) affect the function of living systems. <i>Drought or global warming could influence how much water and electricity is available.</i> 6.3. Describe how organisms have adapted to various environmental conditions. <i>We can learn from desert organisms about water conservation.</i>
III.I.I	6.1. Examine the role of scientific knowledge in decisions (e.g., space exploration, what to eat, preventive medicine and medical treatment). <i>How can we make the electricity we need? Should we be reducing our needs?</i>
III.I.I	6. 5. Understand factors that create and influence weather and climate, including: • factors that can impact Earth's climate (e.g., volcanic eruptions, impacts of asteroids, glaciers). <i>Increased CO₂ in the atmosphere or La Nina.</i>
II.I.II	6.1. Identify various types of energy (e.g., heat, light, mechanical, electrical, chemical, nuclear). <i>How do we make electricity using these types of energy?</i>
II.II.III	6. 1. Explain how fossil fuels were formed from animal and plant cells. 6.2. Describe the differences between substances that were produced by living organisms (e.g., fossil fuels) and substances that result from nonliving processes (e.g., igneous rocks). <i>See Extension Below</i>

Extension – Divide your class into groups. Ask each group 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.

7th Grade: There Is No Point to this Pollution

Students learn about water quality and the cumulative impacts of nonpoint source pollution.

Science

Str/std/bch	Performance Standard
I.I.I	7.2. Use models to explain the relationships between variables being investigated. (Modeling pollution in a lake.)
II.I.I	7.1. Explain how matter is transferred from one organism to another and between organisms and their environment (e.g., consumption, the water cycle, the carbon cycle, the nitrogen cycle). <i>Fertilizer in the lake is eaten by algae, algae eaten by bacteria causing lower oxygen in environment.</i>
II.II.I	7.3. Explain how individuals of species that exist together interact with their environment to create an ecosystem (e.g., populations, communities, niches, habitats, food webs). 7.4. Explain the conditions and resources needed to sustain life in specific ecosystems. 7.5. Describe how the availability of resources and physical factors limit growth (e.g., quantity of light and water, range of temperature, composition of soil) and how the water, carbon, and nitrogen cycles contribute to the availability of those resources to support living systems.
II.III.I	7.2. Explain how energy from the sun supports life on Earth.
II.III.II	7.3. Know that changes to ecosystems sometimes decrease the capacity of the environment to support some life forms and are difficult and/or costly to remediate.
III.I.I	7. 3. Describe how scientific information can help individuals and communities respond to health emergencies (e.g., CPR, epidemics, HIV, bio-terrorism).

Social Studies

Str/std/bch	Performance Standard
Geog.II.II-A	7.2. Describe factors affecting location of human activities, including land use patterns in urban, suburban, and rural areas.
Geog.II.II-C	7. 4. Explain a contemporary issue using geographic knowledge, tools, and perspectives.
Geog.II.II-D	7. 1. Explain how physical processes influence the formation and location of resources. 7.3. Explain how ecosystems influence settlements and societies.
Geog.II.II-E	7. 2. Describe and analyze how the study of geography is used to improve our quality of life, including urban and environmental planning
Econ.IV.IV-A	7.2. Explain why cooperation can yield higher benefits.

Extension I - Ask students to use the data from the eight sites to make four bar graphs, one for each of the parameters: Dissolved oxygen, Turbidity, Fertilizers/Nutrients, and Temperature. Each graph will have eight bars, one for each sampling location.

Extension II - Draw students' attention to the idea that we have to dispose of hazardous waste properly. Some wastes have to be taken to the Hazardous Household Waste Center, (e.g. paint, turpentine, roach killer, weed killer, automobile wastes (used motor oil, batteries, antifreeze, fluorescent light bulbs, nail polish remover. For a more complete list of waste disposal, visit <http://www.cabq.gov/envhealth/householdwaste.html> Also, computers and screens must be recycled at computer recycling centers.

We can cut down on other sources of nonpoint source pollutants like motor oil from streets and driveways (keep car tuned, etc.) and fertilizers/nutrients from their yards (xeriscape, use natural fertilizers, pick up your dog's feces, etc.) Ask students to write a paragraph about ideas for reducing nonpoint pollution. How will they tell city residents about the dangers of nonpoint pollution?

8th Science: Early Runoff

Students design an experiment to investigate the effects of dirt on snow to see if it may impact spring runoff. They analyze how the early spring runoffs we are seeing might impact New Mexico in the future.

Science

Str/std/bch	Performance Standard
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: <ul style="list-style-type: none">• 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

Extension: Students think about how we might be able to capture early spring runoffs and make a map or model of their plan.

HS Biology: Biodiversity is Grand on the Rio

Students learn about how we have impacted the Rio Grande and some of the unexpected results of our actions. By pulling cards, one at a time, they cover the diverse riparian ecosystem with invasive species that end up replacing native plants and wildlife.

Science

Str/std/bch	Performance Standard
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.1	Know that an ecosystem is complex and may exhibit fluctuations around a steady state or may evolve over time.
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.4	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).
III.I.I.	Science and Society 9-12. 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).

Extension: Students research invasive species in New Mexico and present their finding to the class.

Afterwards, each student should write a fictional, futuristic short story that focuses on the story of the invasive species or the native species that are replaced by the invasive.

HS Earth: Pollution Detective

Students observe how ground water transports pollutants, and simulate ground water testing to discover the source of contamination.

Science

Str/std/bch	Performance Standard
I.I.I.	9-12.2. Design and conduct scientific investigations that include: <ul style="list-style-type: none"> • 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
II.I.I.	9-12. 4. Identify and apply measurement techniques and consider possible effects of measurement errors.
II.III.II.	Geochemical Cycles 9-12. 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).
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Social Studies

Str/std/bch	Performance Standard
Hist.I.I-A.	9-12. 2. Analyze the geographic, economic, social, and political factors of New Mexico that impacted United States and world history, to include: <ul style="list-style-type: none"> • role of water issues as they relate to development of industry, population growth, historical issues, and current acequia systems/water organizations
Geog.II.II-D.	9-12.1 Analyze how the Earth’s physical processes are dynamic and interactive. 9-12.2 Analyze the importance of ecosystems in understanding environments. 9-12.3. Explain and analyze how water is a scarce resource in New Mexico, both in quantity and quality.
Geog.II.II-E.	9-12.1.Analyze the factors influencing economic activities (e.g., mining, ranching, agriculture, tribal gaming, tourism, high tech) that have resulted in New Mexico’s population growth.
Geog.II.II-F.	9-12.1 Compare the ways man-made and natural processes modify the environment and how these modifications impact resource allocations. 9-12.2 Analyze how environmental changes bring about and impact resources.

Extension – *Read and discuss the article below. Ask students to draw an editorial cartoon about the article. To brainstorm, ask students to write nouns, adjectives, and verbs about drinking water. For those who are having trouble getting started, ask them to write nouns, adjectives, and verbs about jet fuel. Ask them to randomly pick a “drinking water” word and a “jet fuel” word. How can they use these two words in a cartoon?*

Science

Str/std/bch	Performance Standard
III.I.I.	9-12.3. 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 .

Jet Fuel Leak Discovered at Kirtland

July 17, 2008

Albuquerque Journal

Yes, there is a large jet-fuel leak originating under Kirtland Air Force Base. And yes, it has reached the underground aquifer outside Kirtland grounds.

No, it won't affect drinking water supplies any time soon, according to state and Kirtland officials.

Estimates say that the jet fuel, sitting more than a foot deep on top of groundwater in some areas, will take more than 25 years to reach any wells that produce drinking water, said Baird Swanson, an environmental scientist with the New Mexico Environment Department.

"It's on the order of decades before migrating to drinking water supplies," he said.

Kirtland officials released the news to local media Friday, explaining that a leak they had been cleaning up since 1999 was larger than anyone had anticipated. The leak itself was revealed at the time.

The fuel has been leaking, Swanson estimates, since sometime in the 1970s. He said the amount of fuel that escaped the line over the years is impossible to know, but the leakage had to have been significant.

"(The fuel line) would have been releasing for a very long time in a large amount," Swanson said.

He said jet fuel can cause cancer if ingested.

Fuel cleanup project manager Mark Holmes said they expect to be able to clean up the fuel before it reaches drinking wells but would institute other -- and extremely expensive -- plans to remove the fuel if it creeps too close.

It is estimated to be about 1.5 miles from a drinking water well in Albuquerque's Ridgecrest neighborhood, which is the direction the leak is headed based on underground geography, Col. Robert E. Suminsby, Kirtland's base commander, said Wednesday.

The leak is closer to two wells inside the base, including 1,100 feet from one that serves the New Mexico Veterans Affairs Medical Center, but it is unlikely the plume would travel in that direction, Holmes said. Swanson said the fuel moving toward the hospital well would be akin to fluid moving across a flowing river instead of downstream.

The plan is to drill 11 more monitoring wells at a cost of \$2.8 million of Air Force funds to find the exact dimensions of the leak and any other information, and to continually update plans to remove the fuel as more data is available, Suminsby said.

And while the Air Force is moving as quickly as possible to properly clean up the leak, he said, no one will be in danger for quite some time.

"This is not an immediate cause for panic," Suminsby said.

Besides, the Air Force has already got two Ford V8 engines on the job 24-7, Holmes said.

The engines, attached to hoses that connect to various monitoring wells at different depths, suck up the jet fuel just like a normal car engine and burn the fuel to keep the engines running, he said.

That means the engines are powered by the same fuel they are cleaning up and can run constantly, with small pauses for oil and spark plug changes, Holmes said. Catalytic converters clean the emissions from the engine before they are released into the air, making it a fairly clean process, he said.

The engines have already sucked 130,000 gallons of the fuel from the ground.

Brent Wilson, base civil engineer director, said it was possible the engines could be used to power other devices and the Air Force was looking into the possibility of using the energy produced by the jet-fueled engine with other projects.

The engines have been in place since shortly after the leak was discovered in 1999, but the Air Force is looking into buying another twin engine machine to speed up the process now that the leak is known to be larger, Holmes said.

The Air Force drew immediate criticism from the Southwest Research and Information Center, an Albuquerque group that monitors groundwater contamination, for not notifying the public about the leak for several months.

Suminsby said Air Force officials immediately contacted the state Environment Department and kept both the city and the city-county Water Utility Authority in the loop about the leak once they discovered it had spread in February 2007.

The Air Force found out the leak had spread outside base grounds after new monitoring wells were completed in November 2007 and also shared that information with local and state governments, he said.

As for releasing the information to the media, Suminsby said they simply didn't know enough about the leak's spread.

"The natural inclination is everyone wants to know the problem ... But we won't know that until we drill the remainder of the monitoring wells," Suminsby said. "We didn't have enough answers."

<http://www.military.com/news/article/jet-fuel-leak-discovered-at-kirtland.html?ESRC=topstories.RSS>

HS General: Water Mediation

Students learn how conflicts involving water quality and quantity (and other issues) can be resolved through mediation.

Science

Str/std/bch	Performance Standard
II.II.I.	Ecosystems 9-12.3. 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).
III.I.I.	9-12. 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). 9-12.12. Explain how societies can change ecosystems and how these changes can be reversible or irreversible. 9-12.13. Describe how environmental, economic, and political interests impact resource management and use in New Mexico.

Social Studies

Str/std/bch	Performance Standard
Geog.II.II-B.	9-12.2. Analyze how the character and meaning of a place is related to its economic, social, and cultural characteristics, and why diverse groups in society view places and regions differently. 9-12.3 Analyze and evaluate changes in regions and recognize the patterns and causes of those changes (e.g., mining, tourism).
Geog.II.II-D.	9-12.1. Analyze how the Earth's physical processes are dynamic and interactive. 9-12.2. Analyze the importance of ecosystems in understanding environments. 9-12.3. Explain and analyze how water is a scarce resource in New Mexico, both in quantity and quality. 9-12.4. Explain the dynamics of the four basic components of the Earth's physical systems (atmosphere, biosphere, lithosphere, and hydrosphere).
Econ.IV.IV-A.	9-12.5. Describe and analyze how economic incentives allow individuals, households, businesses, governments, and societies to use scarce human, financial, and natural resources more efficiently to meet economic goals.

Extension – Ask students to research one of the topics presented in this activity and to actually take the case to a mock courtroom.

Information about how to set up a mock court in your classroom is at

http://www.19thcircuitcourt.state.il.us/bkshelf/resource/mt_conduct.htm

or visit http://www.swa.org/pdf/hs_post_pre_lesson.pdf, to find a mock trial set up for a Florida river which could easily be changed to the Rio Grande.

See Standards and Benchmarks above.

HS Physics: Calculate a Watershed

Students build a watershed with a lake and dam. They measure the watershed's approximate area to come up with a linear equation and graph describing the level of rainfall the lake can safely accommodate.

Science

Str/std/bch	Performance Standard
I.I.I.4	<p>Content and Skills Standards:</p> <p>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.</p>
I.I.I.5	<ul style="list-style-type: none"> • 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.

Extension – 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, an estimation of square km that it covers and the 2-variable equation describing the effect of rain on water stored in the lake.

Students should also discuss methods for runoff or rain storage, and suggest a successful strategy for NM to plan for early spring runoff.