



HS Biology: Biodiversity is Grand on the Rio Grande



Summary: 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.

Supplies:

- 9 student kits (each has a gameboard, a die, an envelope of plant/animal cards, an envelope of carp (fish) cards, an envelope of salt cedar cards, and the first rules card).
- Three event cards (can be left in the kits or you can hand them out as you go).
- Laminated Cottonwood photo and salt cedar photo.

Common Core Standards

Reading Literacy: [CCSS.ELA-Literacy.RST.9-10.10](#)

By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.

Next Gen Standards

[LS2.C: Ecosystem Dynamics, Functioning, and Resilience](#)

A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. (HS-LS2-2),(HS-LS2-6)

Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. (HS-LS2-7)

[LS4.D: Biodiversity and Humans](#)

Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). (*secondary to HS-LS2-7*)

Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change... (*secondary to HS-LS2-7*) (*Note: This Disciplinary Core Idea is also addressed by HS-LS4-6.*)

New Mexico Science Standards and Benchmarks

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).

Intro – 10 minutes

Vocabulary: diversity, resilience, monoculture, adaptations

1. Warm Up: Ask students *What is diversity?* Write their ideas on the board. Is diversity a desirable thing? Talk about how we don't want everyone to be a teacher but we need teachers. We don't want everyone to be an engineer, but we need engineers, etc. Would you like all of your friends to be the same?
2. Write Diversity = Resilience on the board. *What does it mean to be resilient?* (able to withstand or recover quickly from difficult conditions). We want to have a variety of friends, a variety of careers so that we can use our limited resources effectively and to help us handle any unexpected changes in our lives (adaptations). What are examples of adaptations a person might have to make? (bad economy, personal loss, accident, sickness, etc.)
3. Ecosystems are the same. They need a variety of organisms to use resources effectively and to be able to adapt. If one organism takes over and replaces other organisms, we call that a monoculture. *Is a monoculture a resilient community?*
4. In this activity we are going to see how small changes to an ecosystem can have huge consequences to those who depend on the ecosystem, and how human intervention strategies (solutions) sometimes work well and sometimes don't.

II. Activity (30 minutes)

1. Divide class into groups of 3-4 students. Hand out a Biodiversity kit to each group. Ask students to take out the board, the die and the first card. Explain that they are to roll the die. If they roll 1-5 they are to pull a white card. Students place the card on the board in a place where it would thrive. For example, place an owl or a cicada up in a cottonwood tree, but place a rabbit in an open area near grasses. Layer cards on top of each other. Coyotes would be placed on top of rabbits. If a student rolls a 6, there was not enough rain to support a new animal or plant that year. Let students play for about 5 minutes or until they begin to get restless.

2. Stop the game and hand out or ask them to pull out the first event card. Explain that carp uproot plants and muddy the water. They eat the eggs of native fish. They can outcompete native fish because they can live in almost any kind of water. Draw their attention to the new rules. Let them play for a 1-2 minutes.
3. Stop the game and hand out or ask them to pull out the second event card. Explain the changes we made to the river (straightening river, dams) and why we made them (store water, reduce flooding). Show them cottonwood and salt cedar photos. Explain reasons why salt cedar outcompetes cottonwood.
 - Cottonwood seeds germinate with natural floods cycle (which no longer occur due to dams)
 - Cottonwood seeds are released once per year during spring runoff season
 - Salt cedar produces seeds three of the four seasons during the year
 - Salt cedar leaves (dropped each fall) make the soil increasingly "salty," which impedes growth for most native riparian plants

Explain new rules. Let them play for a 2 – 3 minutes.

4. Stop the game and hand out or ask them to pull out the third event card. Explain how salt cedar transfers fire into the top of the cottonwoods, which then die. Salt cedar comes back even stronger after fire. Explain new rules. Let them play.
5. Stop the game and hand out or ask them to pull out the last event card. Explain how we are getting rid of salt cedar. Don't bring out the insects yet. Do that at the end. Explain the rule changes. Let them play.

III. Discussion (10 minutes)

- Why were changes in the natural flow of the Rio Grande been made in the Albuquerque area? (primarily to control flooding)
- Why is biodiversity good? Does it affect me?
- Talk about the 2011 fire in the Jemez Mountains and the fact that Albuquerque currently is not able to use water from the Rio Grande -- all because of poor forest management practices. Carp will come out the winner with this mucky water, too. What we do on land affects our water!

Take Away: Now that we have seen how little things can make big changes, let's talk about how we can make small changes that affect our water future.

1. Turn off the water while brushing teeth, shaving, washing face and hands. What if you only save one gallon of water a day? If we all do it, we'll save 600,000 gallons a day! Multiply by 365, and that little change saves over 200, 000, 000 gallons a year.
2. Talk about showers. If they can't get down to 5 minutes, can they cut back by 5 minutes? Use a low flow shower head?
3. Water in the cool part of the day.
4. Fix leaks. If you don't know how or have resources to do so, catch what leaks in a bucket and water plants or wash the floor.