Innovative, Long-term Outreach Program for Upper Elementary Students Integrates Water Resources Topics with High Tech Pen Pal Partnerships and Measurable Outcomes

2011 Report

June 24, 2011

Presented by Experiential EE, LLC
EXECUTIVE SUMMARY

RiverXchange is an innovative, long-term outreach program that integrates water resources topics with computer technology, student writing, and a hands-on curriculum to meet specific, measurable outcomes. Since 2007, the program has enabled 80 upper elementary classes from New Mexico to become “high tech pen pals” with classes outside the state to learn the geography, culture, and ecology of their local river and watershed – and share what was learned.

Using *The Big Water Questions* as guided writing prompts, the curriculum incorporates hands-on activities, classroom presentations by local water resources professionals, and a field trip/service learning project at the local river or important watershed feature. Students write about what they are learning via a private wiki website that can be viewed by their partner class. Each student is assigned a pen pal, who is able to read and comment on what was written. The computer technology and writing components provide a unique way to reinforce what was learned, increase student motivation to learn, and enable organizers to collect valuable metrics. All components of the program are provided free of charge to New Mexico teachers. Training, technical support and some curriculum materials are provided free of charge to partner teachers.

This year, funding enabled 45 New Mexico classes to participate. Each New Mexico class was partnered with a class outside the state. Total participation was 2,117 students (1,075 New Mexico, 1,042 partner), and 95 teachers (50 New Mexico, 45 partner). The program required $48,237.50 in cash and received in-kind contributions valued at $67,600.25.

All “Next Steps” described in the *RiverXchange 2010 Report* were met. Several new tasks were also developed and met. Notable changes/additions to this year’s program included:

- Grew program from 14 to 45 partnerships; included classes from three New Mexico areas, 11 U.S. states, three Canadian provinces and two U.S. military bases in Italy.
- Curriculum implemented over the entire school year.
- Curriculum revised to incorporate USGS water education posters and activities.
- Created wikis for teachers before program launch. Teachers added student pages.
- Expanded field trip locations.
- Created *Don’t Trash Our Rio*, a math-based activity – new task.
- Created RiverXchange website, [www.riverxchange.com](http://www.riverxchange.com) – new task.
- Coordinated two or three additional guest speakers (total six or seven) in each New Mexico class – new task.
- Wrote articles and draft press releases for major sponsors – new task.

Teachers said the most valuable components of RiverXchange were learning about water resources topics, classroom guest speaker presentations, the field trip, and the high tech pen pal relationship. Difficulties continue to be student access to school computers and lack of instructional time. Most New Mexico teachers will participate again in 2011-2012.

Performance on the three online assessments showed that New Mexico students achieved *Proficiency* or higher on many water resources issues covered in the curriculum. Student wiki writing showed that 18% of New Mexico and 7% of partner classes met our goal of writing on seven or more water resources topics.
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PROGRAM DESCRIPTION

Purpose of Program
The purpose of RiverXchange is to deepen students’ and teachers’ understanding of and appreciation for their local river ecosystem, motivate participants to protect local water resources by conserving water and keeping source water clean, and provide a high quality, high impact outreach opportunity for funders and in-kind contributors. The program is carried out over eight or nine months so that students spend more time gaining a personal connection to their own river ecosystem and a sense of pride in it, and develop a personal connection to a distant river ecosystem and the students who live near it.

As organizers of children’s water festivals and other grade K-12 water resources outreach in New Mexico, we observed early on that New Mexico elementary teachers rarely incorporate water concepts in the classroom beyond what is required by the state (e.g., water cycle), and that most elementary teachers consider “water” strictly as a science topic. While teachers personally acknowledge the importance of conserving water and keeping source water clean, we continue to find that upper elementary students have little or no understanding of major water resources topics unless the teacher specifically integrates a wide range of water topics into the curriculum. We find that New Mexico fourth and fifth grade students do not understand the following critical water resources concepts:

- what a watershed is, how it functions, and where the student lives in relation to his/her watershed
- what makes water dirty (beyond trash)
- what stormwater is, where it goes, and that it transports pollution
- certain components of the water cycle (including infiltration, transpiration, runoff, and that the sun’s energy drives the process)
- their community’s source(s) of drinking water
- how much water the student might use in a day
- where their community’s wastewater goes
- other water users in our society besides individual home use
- that rivers have impacted human settlements and culture, and that humans impact rivers
- what wetlands are and what their role is in an ecosystem
- what aquatic macroinvertebrates are and what their role is in an ecosystem
- actions the student can take to conserve water and keep source water clean

We created RiverXchange to reverse the status quo -- and to do it in a way that is as easy as possible for a teacher to integrate into the normal curriculum, minimizes additional workload, is fun to do, is free of charge, and motivates students to remember what they have learned.
Background
RiverXchange began in 2007 as a pilot project of Experiential EE, LLC (under a services agreement with the New Mexico Water Conservation Alliance) and the National Great Rivers Research and Education Center (NGRREC), featuring partnerships between two fourth grade classes in Albuquerque, New Mexico, and two fifth grade classes in Godfrey, Illinois. A curriculum was developed, a field trip to the river was coordinated, and partner classes “met” three times during the year via video teleconferencing to present information they had learned. At that time, the goals were to create an opportunity for teachers to learn how to utilize technology to integrate water resources topics into the curriculum, take students on a field trip to the river, and provide a sophisticated and fun way to motivate students to remember what they learned. The upper elementary grade level was chosen because of our successful festival work with this age group.

After the pilot project, we transitioned to a web-based technology called a wiki. This technology enabled us to overcome limitations such as the high cost, availability and time zone logistical issues associated with video teleconferencing – and more easily involve more classes. In contrast, wiki technology is free, it is accessible to anyone who has access to a computer, and privacy can be maintained. The curriculum was updated to incorporate a language arts (writing) component, and we introduced the concept of classroom guest speakers to reduce teacher work load and bring up-to-date technical information into the classroom.

RiverXchange continues to be provided free of charge to participating teachers. Organizers strive to incorporate emerging water resources issues into the curriculum, increase networking opportunities for teachers, reduce teacher workload, and align the curriculum with public school curriculum priorities.

Today, the program features the following components:
- curriculum
- complete set of U. S. Geological Survey water education posters for each teacher
- coordination of class partnerships
- pre-formatted wiki
- teacher training to learn how to implement the curriculum and use the wiki technology
- ongoing technical and motivational support
- three online student assessments and a teacher survey
- recognition of participating teachers
- payment for teacher workshop substitute teachers (New Mexico only)
- coordination of at least four guest speakers into the classroom (New Mexico only)
- coordination of a field trip to the local river, tributary or important watershed feature (New Mexico only)
- field trip bus transportation payment (New Mexico only)
- field trip coordination (New Mexico only)
Program Management and Financial Support

The program timeframe was July 1, 2010 through June 30, 2011. All components including fundraising, design, planning, implementation and analysis were carried out by Experiential EE, LLC, an Albuquerque-based consulting firm owned by Katie Babuska. All work was carried out by the following team of independent contractors:

- Amelia White (Program Manager)
- Bonnie Schmader
- Alison Kerr
- Michelle Watson
- Katie Babuska (CEO/Owner)

The New Mexico Water Conservation Alliance (NMWCA) served as the fiscal partner. NMWCA is a nonprofit 501(c)(3) corporation comprised of municipal and industrial water conservation professionals dedicated to water conservation education and networking.

Sponsors

- U.S. Bureau of Reclamation
- Santa Fe County
- Southern Sandoval County Arroyo and Flood Control Authority
- Mid Rio Grande Stormwater Quality Team

Sponsors provided $48,237.50 in cash. Program expenses included:

- Substitute teachers for New Mexico teacher workshops
- Field trip bus transportation for New Mexico classes
- Field trip portable toilet rentals for New Mexico classes
- A set of nine USGS water education posters for each teacher
- Coordination services (e.g., fundraising, curriculum development, marketing, teacher training, guest speaker coordination, field trip coordination, participant assessment and analysis, reporting)

In-kind Partners – Classroom Guest Speakers

- Albuquerque Bernalillo County Water Utility Authority
- Bernalillo County Cooperative Extension, 4-H
- Bernalillo County Public Works
- City of Rio Rancho
- New Mexico Environment Department
- New Mexico Museum of Natural History and Science
- New Mexico Office of the State Engineer
- New Mexico State Land Office
- Sandoval County Cooperative Extension, 4-H
- Santa Fe County
- Santa Fe County Cooperative Extension, 4-H
- Southern Sandoval County Arroyo and Flood Control Authority
- U.S. Bureau of Reclamation
- Water for People (with representatives from CH2M Hill, Daniel B. Stephens, Weston Solutions, Bohannon Huston, CDM, Ciudad Soil and Water Conservation District, UNM Water Resources Program)
**In-kind Partners – Field Trip Docents**

- Alcalde Sustainable Agriculture Science Center (NMSU)
- Bernalillo County Cooperative Extension, 4-H
- Bernalillo County Open Space
- Bernalillo County Public Works
- City of Albuquerque Open Space
- City of Rio Rancho
- Ciudad Soil and Water Conservation District
- Friends of Rio Rancho Open Space, Inc.
- Keep Rio Rancho Beautiful
- La Plazita Institute
- Middle Rio Grande Conservancy District
- Sandoval County Cooperative Extension, 4-H
- Santa Fe County
- Santa Fe County Cooperative Extension, 4-H
- Small Farm Task Force (NMSU Cooperative Extension)

**In-kind contributions totaled $67,600.25.** For New Mexico classes, in-kind contributions included classroom guest speakers, field trip docents, computer lab use, workshop space, student assessment software, wiki technology, and classroom resources. For partner classes, in-kind contributions were valued at $8,320 and included classroom guest speakers, field trip docents and field trip bus transportation.

In addition to the above in-kind contributions, Experiential EE invested in the development and implementation of several new tasks not covered by our funders, to further enhance the program:

- *Don’t Trash Our Rio*, a math-based activity
- RiverXchange website, [www.riverxchange.com](http://www.riverxchange.com)
- Coordination of two additional guest speakers in most of the 45 New Mexico classes (64 presentations)
- Writing of article and draft press release for each sponsor

Sponsors and in-kind partners were recognized in many ways including on our website, and in press releases, presentations and articles. In December and April, we provided funders with articles suitable for press releases and website posting.

**Participant Selection**

Of the 45 participating New Mexico classes, 44 were fifth grade and one was fourth grade. There were 1,075 students and 50 teachers distributed as follows:

- **Albuquerque: 22 classes**
  - 518 students
  - 25 teachers

- **Rio Rancho: 13 classes**
  - 333 students
  - 14 teachers

- **Santa Fe County: 10 classes**
  - 224 students
  - 11 teachers
Of the 45 participating partner classes, about half were fourth grade and half fifth grade. To optimize the number of partner classes, we allowed both grade levels to participate. In general, partner teachers are highly motivated and come to the program with a willingness to participate even though our New Mexico-based funding cannot be used to help coordinate their guest speakers, coordinate the field trip or pay for any direct costs. Partner classes were located in 11 U.S. states, three Canadian provinces, and two Italian U.S. military bases.

### Participating schools and partnerships

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Curriculum

A key component of RiverXchange is the hands-on curriculum. It was developed to help students reach for deeper meaning through hands-on learning, and reinforce what they have learned through the process of writing to their pen pal. The curriculum spans September 15 to May 15.

Using the local river as a focal point -- and because a river is a common major geographical landmark in most parts of the world -- the curriculum integrates science, social studies, and math lessons with essential writing skills to cover three units:

Understanding a Watershed
Water in Our Society
River Ecosystem
Each class learns about its own local water resources issues through hands-on activities, classroom guest speakers and a field trip. Students are to write about what they are learning via a private wiki website that can be viewed by their partner class. Each student is assigned a pen pal, who is able to read and comment on what was written. The computer technology and writing components provide an unique opportunity to reinforce what was learned, increase student motivation to learn, and collect valuable metrics about student performance.

The hands-on activities are tied to the concepts covered in nine U.S. Geological Survey water education posters. All activities are correlated to New Mexico state standards and benchmarks for science, social studies and/or mathematics. Also, all activities -- because they involve students posting written information on the wiki -- address the language arts standards for writing. For the RiverXchange Curriculum, see Appendix 1.

Through RiverXchange, students take pride in sharing their knowledge of the local ecosystem, and learning from their peers about another river ecosystem. Comparing the two geographical areas gives students a broader understanding of the importance of a river ecosystem to human and other life. Students gain the unique opportunity to share personal experiences and ask questions about a distant place. Teachers feel this kind of personal connection is a big deal for kids – many of whom have never traveled beyond their city limits.

The basic curriculum was developed in 2007-2008, with minor modifications made each year. The curriculum has three units and frames outcomes as “guiding questions” known as The Big Water Questions. A long-term goal of RiverXchange is that students understand these questions and can formulate logical, fact-based answers by the time they finish elementary school. Most questions were developed in conjunction with children’s water festival Steering Committees from Albuquerque, Santa Fe and Rio Rancho. We believe that students who can synthesize water facts to understand larger water issues will have the proper critical thinking skills and foundation for further discussion in middle and high school so that they will become informed citizens and voters on water issues.

The Big Water Questions

- Why is water so important to life?
- How do all living things depend on each other?
- What is the water cycle?
- What is a watershed?
- Where does my drinking water come from?
- Where does my wastewater go?
- What makes water dirty?
- How much water does my family use each day?
- Who are the other water users in our society?
- Who owns our water?
- How can I protect our water?

Each curriculum unit integrates The Big Water Questions throughout (in italics).
Unit 1: Understanding a Watershed
- Students use maps to locate their watershed.
- Students learn the major river and tributaries of their watershed.
- Students incorporate what they know about the water cycle into their understanding of how a watershed works.
- They learn the effects of stormwater runoff and pollution and list ways to reduce nonpoint source pollution.
- They learn the terms watershed, water cycle, pollutants, tributaries, headwaters, and about maps and mapping techniques.
  - What is a watershed?
  - Where is my watershed?
  - What is the water cycle?
  - What makes water dirty?
  - How can I protect our water?

Unit 2: Water in Our Society
- Students learn about drinking water and the sources of drinking water.
- Students learn hands-on techniques to act out the water rights process.
- Students are asked questions about wastewater and where it goes.
- Students learn the importance of water conservation and brainstorm ways to conserve water as they are asked “how much water does my family use?”
- Students learn the other uses of water such as commercial, agricultural/irrigation and the cultural importance of water to their area.
- They create graphs on their water use.
- They learn terms such as wastewater, water rights and conservation.
  - Where does our drinking water come from?
  - Where does our wastewater go?
  - Who are the other water users in our society?
  - Who owns our water?
  - How much water does my family use each day?
  - How can I protect our water?

Unit 3: River Ecosystem
- Students learn about macroinvertebrates and how water pollution affects the species found in an ecosystem.
- Students are introduced to the food web and all the local species in it including the endangered species.
- Students learn the importance of natural resources.
- They determine who the other water users are in the watershed.
- Classes attend a field trip and/or services learning project.
  - Why is water so important to life?
  - How do all living things depend on each other?
  - Who are the other water users in our society?
  - How can I protect our water?
**Don’t Trash Our Río Math Activity**

This year, we developed a new activity called *Don’t Trash Our Río*. This math-oriented activity incorporates recently published statistics about the amount of trash collected by the Albuquerque Metropolitan Arroyo and Flood Control Authority in 2009 before the trash reached the Rio Grande. The activity was developed to help students understand the nature and magnitude of issues like trash and other forms of water pollution so that raw data (usually a very large number) become more meaningful to a fifth grader. New Mexico teachers received a packet containing:

- Activity instructions
- *Water Sifted Clean* article
- *Sources of e.coli* graph
- *Sources of gross floatables* graph
- *Don’t Trash Our Rio* student worksheet
- *Don’t Trash Our Rio* teacher answer sheet
- 33 gallon plastic trash bag
- *Keep the Rio Grand* bumper stickers
- *Scoop the Poop* bumper stickers
- Mid Rio Grande Stormwater Quality Team post-it note pads
- Mid Rio Grande Stormwater Quality Team pens
- *Keep the Rio Grand* brochures
- *Everything is Connected in a Watershed* poster

**Guest Speakers**

Once again, all teachers were strongly encouraged to invite guest speakers into the classroom to help carry out the curriculum. New Mexico teachers took full advantage of our ability to coordinate all guest speakers for them. With the addition of the New Mexico Office of the State Engineer and Water for People as new guest speaker organizations, we were able to coordinate up to seven guest speakers into each of our 45 classes, for a total of 282 guest speaker presentations.

In all cases, New Mexico guest speakers were water resources professionals from local agencies. Guest speakers introduced technical information that was often completely new to a teacher. In New Mexico, guest speakers made presentations on these topics:

- watershed/nonpoint source pollution
- drinking water
- wastewater
- water and agriculture
- water rights
- macroinvertebrates
- watershed/erosion

In addition to the guest speakers we coordinated for them, teachers were encouraged to invite additional water-related guest speakers into the classroom and/or go on additional field trips. In other words, teachers were not limited to the guest speakers or field trips we coordinated for them. Several teachers organized additional field trips to Albuquerque’s Southside Reclamation.
Plant, Cooperative Extension’s “Kids, Kows, and More” festival, or a Bosque Ecosystem Monitoring Program site, to expand upon what their students learned through RiverXchange.

Since program funding is New Mexico-based, we were not able to assist partner teachers with coordinating guest speakers into the classroom; however, we provided partner teachers with names of agencies located in most parts of the U.S. that may be able to assist.

**Samples of Student Writing about Guest Speakers**
*(Spelling and punctuation are unedited/original.)*

*About two weeks ago a few people came to our to teach us about waste water. Waste water is the water the you flush down the toyilet or the drain. When you flush the toyilet all of the stuff in it goes to the water treatment plant. Whenit gets there they filter it. After that they use micro organicisms to eat the waste. They use there methane gas to power that place. Then they turn the waste into compost for plants. Next they use a Ph tab to measure the level of oil. Then they disinfect it. After that it should be clean so they put it in to the river. Did you know our river feeds 6 to 10 million people! The reason we clean it is because of the plants and animals.*

*We all need water to cook and clean. The Rio Grand starts inthe mountains of colorado and ends in the golf of Mexico. Every one lives in some watershed The Venada Arroyo is the biggest arroyo is the biggest in Rio Rancho.NM only gets about 9 inches of rain fall a year and is mostly in the summer thats not a lot. pullution is any thing that makes water unsable like placite,and oil. during rain fall pullution gets washed in to the Rio Grand. Pestaside is chimals,trash,poop is difficlt to clean out it is easer to prevent.the first flush is a "big" storm that cleans bild up or "stuff". Keep our water clean by cleaning up after yourself and your pets like picking up pets after your pets.*

*Do you know that some farmers use lasers to water the whole field by leveling it.If you just want to water one spot you use drip irrigation. Now a days people use tractors instead of horses and oxen. water is very unlimited so we must be careful.you don't need a lot of water, but you still need some.Plants need vitamins like humans to stay alive. to start garden you'll need to compost first.Earth worms help with gardens by turning up the soil.If you spray a pesticide you can affect your watering system. I learned that flood irrigation is where you put to much water.Some times they use huge sprinklers to water the field.*

*We measured how much water would be wasted in one year from a drippy or leaking faucet. First, we we had to come up with a hypothesis (guess) for the amount of water that would be wasted in one year. I guessed 300 gallons but it wasn't even close to the actual answer witch was about 4,000 gallons a year. It was really fun!!!*

*What they did was bring a trailer and we went out side we partnered up and one person got a house and a animal and we set them were we thought they would work best. The trailer had a town with an water shed but it was all on sand. The sprinkler represented rain and when it got turned on half of the houses got swept away but i did not see any animals get swept away. After we were done the left over water in the bottum of it was filed with polishion from picking up every thing in the town. there was a jungle next to it and the water came out slower and cleaner because it was filtered more.*
The guest speaker told us how developing countries get their water. I got to see Aileen hold a gallon of water on her head. I am glad that I did not have to, because it looked like it hurt. Did you know that there are 6.6 billion people in the world?

Samples of Student Writing (About Activities Done in Class by Teachers)
About a week ago my class went on a tour of our school. We learned a bunch of stuff about the way our school uses water. When rain falls on the roof of our school pipes carry the water down and then the water runs off. We also learned what a detention pound is. We have a lot of detention ponds around our school. On our walk we found out our school has sertan slops on purpous. It has sertan slops to lead the water and keep the water away from our school. The body of water rain drains to is the Rio Grande. We also learned that some water infiltrats, some runsoff, and some evaporats. It was fun on our tour and I learnt a lot.

When rain hits the ground at our school it would hit artificial grass, wood chips, or asphalt. If it hits the asphalt or artificial grass it will run off into the Rio Grande. If it hits the woodchips it will soak in. The temperature has to be hot enough to evaporate the water. When the water gets up to the sky it has to be cold enough to rain. That is how the weather relates to the water cycle.

We did an science lab on how workers picked up 26,000 cubic yards of trash in the flood system which empties out into the Rio Grande and converted it into trash bags. Using math we found out that this added up to 1,616,000 trash bags of trash. That is also 95 classrooms filled with 1,500 bags of trash.

Field Trip/Service Learning Project
All classes go on at least one field trip to their local river or important watershed feature, which incorporates a service learning component if possible. We coordinated all New Mexico class field trips, which took place in Albuquerque, Rio Rancho, Santa Fe, and Alcalde. Field trips were taken in the fall or spring, whenever was convenient for field trip docents. An Experiential EE contractor helped plan and attended field trips in Albuquerque and Alcalde.

Albuquerque field trip locations
Sanchez Farm: this 14-acre tract of land located in Albuquerque’s South Valley, is owned by Bernalililo County Open Space and serves as a drainage retention basin for stormwater runoff. The property features a wetland, irrigation ditch, and working farm that is run by La Plazita Institute. Students planted garlic and fruit trees, learned how farms are flood irrigated, and how wetlands clean stormwater.

My class and I enjoyed the field trip quite a bit. We went to Sanchez Farms to see the wide open space and to see how a farm works. We saw a huge concrete barrier that kept all of the trash and junk out of the river (Rio Grand River) and keeps the river nice and clean. We also saw a 300 year old acequia (ditch).

We went to Sanchez Farms to see open space. We planted garlic, saw a concrete barrier that blocks trash from the river, and saw an acequia (ditch). We also saw marigolds, cabbage, and a dragonfly. My class and I had a great time! What is the main purpose of this acequia? To water farms, plants, and trees. What does every acequia need to move water? Goes on a slope and is forced by gravity. Why isn't there water in this acequia year-round? Well because the weather is too cold, and it's not the growing season and the plants will not grow.
Tingley Beach Wetland: this 18 acre tract, adjacent to the Bosque in downtown Albuquerque, is owned by the City of Albuquerque and features a restored constructed pond and peripheral wetlands include native and non-native aquatic habitat. Students took a hike into the Bosque, planted native shrubs near the wetland, and observed macroinvertebrates.

La Orilla Bosque: managed by City of Albuquerque Open Space, this property is located in northwest Albuquerque, adjacent to the Bosque and Rio Grande. Students took a nature hike, saw how irrigation water and stormwater travel through the area, planted native shrubs near the wetland, and learned about the ancient people who lived on the property.

Rio Rancho field trip location
Willow Creek Open Space: owned by the City of Rio Rancho, this 80 acre site is located in the far northeast side of town, adjacent to the Bosque and Rio Grande. Outreach educators from the City of Rio Rancho, Keep Rio Rancho Beautiful, and Friends of Rio Rancho Open Space served as docents. Students took a nature hike, learned the importance of native plants, learned how groundwater is monitored, and saw how a major stormwater diversion flows into the Bosque and Rio Grande.

"We had a field trip to the Bosque, and this was the first time some of my students have been to the river (besides driving over the river in a car).—Teresa Pickowitz, Maggie Cordova Elementary"

Santa Fe County locations
San Isidro Park: owned by Santa Fe County, this 36 acre tract is located west of Santa Fe in the village of Agua Fria. It is a riparian restoration project that presently sees limited down-stream flows and large erosive storm events. The Santa Fe Watershed Association and Santa Fe County have started the work to restore the Bosque and ephemeral streamflow. Students planted native trees and shrubs.

Alcalde Sustainable Agriculture Science Center: this 61 acre site, located on the east bank of the Rio Grande between Taos and Santa Fe, is owned by New Mexico State University. The center conducts research on sustainable agriculture to benefit the small family farms of north central New Mexico. Students became “scientists for the day” to learn about acequias, agriculture, and irrigation techniques.

Partner locations
Since program funding is New Mexico-based, we were not able to assist partner teachers with coordinating a field trip; however, we did provide partner teachers with names of agencies located in most parts of the U.S. that may be able to assist.

Teacher Professional Development Workshop
Although work began many months earlier, RiverXchange officially kicked off in September with a full-day teacher workshop for New Mexico teachers and a two-hour online training session for partner teachers. Three workshops and five online training sessions were held to train all 90 teachers. The workshops and trainings focused on how to implement the activities in the curriculum, and how to operate and manage a class wiki. New Mexico teachers learned how to implement several hands-on activities, and they were introduced to guest speakers who were on hand to schedule classroom presentations.
Prior to kick off, all teachers were given a *Letter of Understanding and Agreement*. They were asked to review what the program is about, agree to carry out all major components of the project, and protect student privacy. Teachers also received an information packet containing a copy of the Letter, written wiki instructions, and other program information.

**Wiki Technology**

One of the most important yet challenging aspects program implementation continues to be the training of teachers on how to use the wiki, so that they feel confident and remember what to do back in the classroom. A wiki enables one or more users to edit any page or to create new pages within the wiki web site. Although it has a blogging component, it is not a blog. We chose PBwiki as our web-based communication network. This year, we created the wikis for teachers prior to the workshop, in order to streamline the training. In addition to the training, teachers received written wiki instructions in their information packet.

**Online Partner Training**

Partner teachers were mailed an information packet ahead of time containing written wiki instructions and other program information. Once again, we used Wimba Classroom, a virtual classroom environment similar to web teleconferencing. Time zone differences and teachers’ schedules necessitated that we hold five online trainings lasting about two hours each. Teachers were able to log in at an appointed time to participate in a live discussion and demonstration of the basic wiki procedures. Through this technology, participants can see and hear the presenter in a video module, see the presenter's computer screen as they demonstrate procedures, and communicate with the presenter to ask questions.

**EVALUATION**

**Teacher Surveys**

Using Survey Monkey, we administered two online teacher surveys – one for New Mexico and one for partners - to help us identify areas in which we could improve the program to make it easier and more useful for teachers. The response rate was about one-third, on the New Mexico teacher survey as well as the partner teacher survey.

**Response Similarities – New Mexico and Partner Teachers**

- Technology (wiki, online resources, online assessments) were important to the program.
- The pen pal component was generally important.
- Online assessments were easy and fun, but a few teachers noted that it took too long for some students to get through the steps preceding the actual survey (e.g., short video, crossword puzzle, games).
- Availability of computers was the largest barrier to success.
- Instructional time was another barrier.
- It was somewhat difficult to sustain momentum throughout the year.
- All teachers would like even more reminding by organizers. New Mexico teachers asked for more “face time” from organizers to help teach the wiki to students.
- Most of the time, classes used the school computer lab. Classroom computers were used some of the time.
Most teachers thought students should write about every three weeks.

Response Differences
- New Mexico teachers really enjoyed the guest speakers, field trips, and networking with those making the presentations.
- There was some overlap in New Mexico guest speaker information.
- Networking with other teachers and professionals were rated as less valuable by partner teachers than by New Mexico teachers (likely because we were not able to provide any guest speaker/field trip coordination for partners).
- Curriculum and pacing worked well for New Mexico teachers. Ecosystem study does not occur at the same time or grade level as in New Mexico, where it is mostly covered during the fall of 5th grade.
- New Mexico teachers said it took a lot of time for their students to type on their wiki.
- Almost all partner teachers took at least one field trip.
- Most partner teachers received some financial contribution to the RiverXchange effort – either materials, in-kind presentations/field trip programs, or parents paying for field trips.

Teacher Survey Comments – New Mexico

I think the RiverX program is an amazing program that has invaluable rewards for the students and citizens of New Mexico. The most valuable component of the program is having real life water experts and stakeholders visit our classrooms. The presenters provide great information to the students about all water related topics, but more importantly they have passion for the subject, and that passion is contagious among the students. I think that while learning specific vocabulary and concepts related to water are important, I think the impression we leave on them about water a scarce and valuable resource is infinitely critical. I would love it at the end of the year if students remembered what watersheds are, what a delta is, and so on; but more importantly I want them to leave with the deep rooted idea that water is valuable, water is sacred, and here in New Mexico, water is scarce. Our future generation of citizens needs to be the stewards of water education, rights, and uses. From the teacher side of things, the RiverX protocol of maintaining a website is a huge motivator for my students. The program is genius in that [students] get to share what they've learned by summarizing those thoughts on an online website. Giving the students the time and motivation to reflect on what they've learned is invaluable as a tool to improve science content learning and their skills in writing as well. They love the idea of updating and maintaining their own personal website. It is that motivation that encourages them to write on their wikis with voice and passion. They love meeting water people. Especially Ben Z, he's such a cool guy!

I think my students have a very limited understanding of the world outside Albuquerque and the pen pal partnership helped them hear from other kids about their region of the country and their water usage.

The students practiced putting the observations into written word. Students were able to learn about another region. Students were able to analyze information from other students and ask questions. Students took pride in their work and sharing their knowledge.
Thank you for the upfront technology training. It helped us start off the program smoothly. FYI other teachers in the school heard about our wiki and we just help them set up summer reading blogs on kidsblog.org (teacher approval prior to post). Networking with professionals was also a very important component. Several of the guest speakers returned to judge our science fair and are helping us plan additional projects.

Guest speakers were by far the most valuable asset of the program. Knowing how to operate the wiki is definitely a requirement!

[On most valuable] The guest speakers and the field trip. There is nothing like the hands-on experiences that were brought in by these speakers. On my own, I could NEVER have gathered and organized this battalion of educators.

Students are learning how to be responsible citizens that respect resources. My students are constantly talking about making wise water decisions at home.

Students learn from exposure, I would recommend continuing guest speakers and field research trips. Great program, thank you.

Teacher Survey Comments -- Partner
The idea of communicating with someone their own age across the continent was certainly engaging. They were most interested in learning about New Mexico and telling about Alberta.

The difficulty I had this year was from issues on my end, not anything to do with the curriculum and/or standards. This project is such a great addition to the experiences the children have while learning about our rivers and others far away. I made it work as best I could this year and will make it work better on my end next year.

[On field trips] We went to our local river to watch spawning salmon. It was provided by the Seattle Aquarium because I am participating on their teacher advisory board. We will also go again next year. We also did two service projects. One was educating the school about using less paper towels and another was educating the school about the effects of dog waste on our watershed.

It really helps the students understand Idaho's history. From Lewis and Clark to the Oregon Trail and later development by white folks, water drives human expansion. River Exchange is the best program I've found to make that concept real to students.

Connecting with students and recognizing that environmental concerns are global; and that your water is our water and ours is yours.

[On what could we do differently next year] Could you add an additional half hour to my day?
Student Surveys
A unique component of RiverXchange is its specific, measurable goals relating to student performance. We collected student performance data on each curriculum unit via three online student surveys, and by reading what students wrote on their wiki student page. **Performance on the three online assessments showed that students achieved Proficiency or higher on many water resources questions relating to the curriculum.** “Proficiency” is defined as all students in a subgroup correctly answering the question at least 70% of the time.

Online Unit Surveys
Using Survey Monkey, we updated the three online student assessments to include a few new questions based on guest speaker presentation topics. We also requested survey question input from guest speakers. All pre-assessment online “activities” (e.g., viewing a video, crossword puzzle, playing a game) which we had added last year, were maintained. They are intended to help students “warm up” and remember what was covered during that unit. **See Appendix 2 for a computer screen shot of each survey.** This year, we customized the surveys so we were able to distinguish between answers from New Mexico students and partner students.

Response Rates
In all cases, a higher percentage of New Mexico students versus partner students completed the student assessment. All response rates were lower than we expected, as we informed teachers upfront that all students must take all three assessments. Organizers sent many reminders and motivational emails to teachers, urging them to have their students take the assessments and write more on their wiki page. Teachers said access to computers and lack of instructional time were two on-going barriers.

**Unit 1**
- 30.8% overall response rate (New Mexico and partner combined)
- 40.4% New Mexico
- 37.8% Albuquerque
- 45.3% Rio Rancho
- 38.8% Santa Fe County
- 20.9% Partner

**Unit 2**
- 19.5% overall response rate (New Mexico and partner combined)
- 30.4% New Mexico
- 28.8% Albuquerque
- 33.3% Rio Rancho
- 29.9% Santa Fe County
- 8.3% Partner

**Unit 3**
- 12.7% overall response rate (New Mexico and partner combined)
- 20.2% New Mexico
- 20.3% Albuquerque
- 13.2% Rio Rancho
- 29.9% Santa Fe County
- 4.9% Partner
**Performance Summary**
Performance on the three online assessments showed that New Mexico students achieved *Proficiency* on many questions. In general, partner students achieved a higher level of proficiency than New Mexico students. “Proficiency” is defined all students in the subgroup correctly answering the question at least 70% of the time. Proficiency levels are as follows:

- **Beginning Step** – score of < 60%
- **Nearing Proficient** – score of 60-69%
- **Proficient** – score of 70-79%
- **Advanced** – score of ≥ 80%

Performance on all answer options are shown, rather than a simple percent correct and incorrect. We feel this approach provides organizers, teachers, guest speakers and field trip docents with a more complete understanding of what students are thinking, where confusion exists, and how adults can help students become proficient in all areas. In some cases, the answer options will be re-worked in 2011-2012 to improve clarity/reduce student confusion.

Note that some questions on the survey were multiple choice and some were open-ended.

**Student Survey: Unit 1**

**Question 1:** What is your teacher’s name?

**Question 2:** What is a watershed?

![Unit 1/Q2: What is a watershed?](chart)

Proficient to Advanced for all students.
Question 3: What is the name of your watershed? (open-ended question)

- **Albuquerque**: 182 responses; 86.8% said Rio Grande – Advanced
- **Rio Rancho**: 146 responses; 91.8% said Rio Grande – Advanced
- **Santa Fe**: 82 responses; 62.3% said Rio Grande and 23.2% said Santa Fe – Advanced (some guest speakers and field trip docents taught Rio Grande while others taught Santa Fe).
- **Partner**: 208 responses; Androscoggin River, Boise Watershed, Bow River, Burnt Bridge Creek, Cascade, Cedar River, Columbia River, Farmington River, Hudson Bay, Icicle and Wanatchee River, Kentucky River, Licking River, Little Tennessee, Mississippi, New River, Ohio River.

Question 4: Where does your river start (headwaters) and end (delta or mouth)? (open-ended question)

- **Albuquerque**: 187 responses; 44.4% said the Rio Grande starts in Colorado and ends in Gulf of Mexico; 32% gave half of the answer (Colorado or Gulf of Mexico) – Beginning Step (however, students are Proficient if partial answers are acceptable).
- **Rio Rancho**: 136 responses; 64.0% said the Rio Grande starts in Colorado and ends in Gulf of Mexico – Nearing Proficient.
- **Santa Fe**: 72 responses; 16.7% said the Rio Grande starts in Colorado and ends in Gulf of Mexico; many students thought the question was about the Santa Fe River, not the Rio Grande – Beginning Step (regardless of confusion).
- **Partner**: 196 responses; did not analyze data.

Question 5: How much precipitation does your area receive each year?

![Unit 1/Q5: How much precipitation does your area receive each year?](chart)

Proficient for Albuquerque. Beginning Step for Rio Rancho, Beginning Step for Santa Fe. Albuquerque and Rio Rancho students should have marked “less than 10 inches.” Santa Fe students should have marked “11-30 inches.”
Question 6: What happens to rain water that runs down the road and into a storm drain or arroyo?

Unit 1/Q6: What happens to rain water that runs down the road and into a storm drain or arroyo?

Beginning Step to Nearing Proficient for all students.

Question 7: How can YOU protect your water from pollution?

Unit 1/Q7: How can YOU protect your water from pollution? (mark all correct answers - there may be more than one!)

Proficient to Advanced on most correct choices, except that students didn’t understand the car washing strategy.
Student Survey: Unit 2

Question 1: What is your teacher’s name?

Question 2: What state do you live in?

Question 3: How can you conserve our precious drinking water?

[Bar chart showing responses to Unit 2/Q3: How can you conserve our precious drinking water?]

Unit 2/Q3: How can you conserve our precious drinking water? (mark all correct answers - there may be more than one!)

Advanced, except that students didn’t understand the time of day landscape watering strategy.

Question 4: What changes have you made in your water use since participating in RiverXchange? (open-ended question) Not rated.

- **Albuquerque**: 144 responses; multiple answers often given by a student. Taking shorter showers: 56.2%. Turning off water when brushing teeth: 30.6%. Other responses included fixing leaks, turning off water while doing dishes, saving water outside, or that they are already conserving. A few students mentioned drinking less or drinking bottled water.

- **Rio Rancho**: 106 responses; multiple answers often given by a student. Taking shorter showers: 55.7%. Turning off water when brushing teeth: 47.2%. Other responses included saving water outside, turning off water while doing dishes, and fixing leaks. A few students mentioned they stopped drinking bottled water, but others said they drink less water, or drink bottled water or juice instead.

- **Santa Fe**: 67 responses; multiple answers often given by a student. Taking shorter showers: 28.1%. Turning off water when brushing teeth: 40.6%. Other responses included saving water outside, turning off water while doing dishes, and fixing leaks.

- **Partner**: 86 responses; over 76% mentioned taking shorter showers and turning off the water when brushing their teeth. Other responses included turning off water while doing dishes, fixing leaks, and not polluting the water.
Question 5: From what source(s) does your community pump its drinking water?

Correct answers vary. Advanced for Albuquerque students. Rio Rancho: Advanced for choosing Aquifer, but they should not have chosen River - Beginning Step (50% did not choose River). Advanced for Santa Fe, as students were taught Aquifer or Aquifer and River, depending on location in the county.

Question 6: How many gallons of water does the average person in your area use each day? (open-ended question)

Albuquerque: 140 responses, Beginning Step
- 15.7% below 10 gallons/day
- 22.9% 10-60 gallons/day
- 35.7% 70-150 gallons/day – correct
- 25.7% 160-millions gallons/day

Rio Rancho: 105 responses, Beginning Step
- 18.1% below 10 gallons/day
- 48.6% 10-60 gallons/day
- 8.6% 70-150 gallons/day – correct
- 24.7% 160-millions gallons/day

Santa Fe: 54 responses, Beginning Step
- 48.1% below 10 gallons/day
- 31.5% 10-60 gallons/day
- 9.3% 70-150 gallons/day – correct
- 11.1% 160-millions gallons/day

Partner: 81 responses, not rated
- 17.3% below 10 gallons/day
- 17.3% 10-60 gallons/day
- 44.4% 70-150 gallons/day
- 21.0% 160-tens of thousands gallons/day
Question 7: How many gallons of water do people in other parts of the world use each day? (open-ended question) Not rated.

- **Albuquerque**: 144 responses. Answers varied widely, obvious guessing, but also many comments. Typical comment: *People in poor countries use less water, but people in rich countries use more.*

- **Rio Rancho**: 102 responses. Answers varied widely, obvious guessing, but also many comments. Typical comment: *It all depends on where they live.*

- **Santa Fe**: 56 responses. Answers varied widely, obvious guessing, but some comments. Typical comment: *It depends because people that live in non developed places use less than people in developed places.*

- **Partner**: 74 responses. Answers varied widely, obvious guessing, many comments. Typical comment: *Well its different because some people do not get that much water and they do not use the same amount of water that people who do get more water.*

Question 8: Where does your household wastewater go, after it goes down the toilets or drains in your house?

![Unit 2/Q8: Where does your household waste water go, after it goes down the toilets or drains in your house?](chart.png)

Correct answers vary. Advanced for Albuquerque. Proficient for Rio Rancho. Not rated for Santa Fe, as students were taught either “to a sewage treatment plant” or “to a septic system” depending on their location.
Question 9: Which water rights rule applies in your area?

Beginning step for all New Mexico students. Not rated for Partners.

Question 10: Who (or what) are the other water users in our society, besides people’s homes?

All answers should have been chosen. Proficient to Advanced for Albuquerque, Rio Rancho, and Partners, but Santa Fe students did not understand that hospitals, factories, power plants and mines are water users.
Question 11: In New Mexico, 80% of the Rio Grande’s water is used for irrigation. If you live in New Mexico, how do farmers conserve and protect our water? If you live in another state, what is the most important commercial use of water in your area? (open-ended question). Not rated.

Albuquerque: 139 responses
- 33.1% by using drip and sprinkler irrigation (instead of flood)
- 18.1% careful watering/using less
- 7.2% time of day watering
- 5.0% keeping water clean/using less chemicals
- 36.7% other

Rio Rancho: 100 responses
- 32% by using drip and sprinkler irrigation (instead of flood)
- 8.0% careful watering/using less
- 5.0% time of day watering
- 7.0% keeping water clean/using less chemicals
- 48.0% other

Santa Fe: 55 responses
- 9.1% by using drip and sprinkler irrigation (instead of flood)
- 29.1% careful watering/using less
- 0% time of day watering
- 14.5% keeping water clean/using less chemicals
- 47.30% other

Partner: 39 responses
- Only a few respondents understood what was being asked.
Student Survey: Unit 3

Question 1: What class are you in?

Question 2: How are river ecosystems important to humans?

The swimming answer option is correct but probably confused students, as they may not be allowed to swim in the local river. Proficient to Advanced for Albuquerque and Rio Rancho students.

Question 3: What are some ways to tell how healthy a river is?

“Negative” wording of answer options 1 and 2 likely confused students.
Question 4: Why are aquatic insects (water bugs) important to the river’s food web?

![Bar chart showing the importance of aquatic insects in different areas.]

Proficient to Advanced for all students.

Question 5: Name three of the most important animals or plants in your area that depend on your river, and describe how each one needs the river to live. (open-ended question) Not rated.

**Albuquerque:** 96 responses. Fish, trees, dragonfly, foxes, deer, beaver

**Rio Rancho:** 37 responses. Fish, trees, water bugs, beaver, deer

**Santa Fe:** 61 responses. Fish, water bugs, beavers, humans, trees

**Partner:** 38 responses. Fish, ducks, water bugs, frogs, trees

Question 6: Name three things that are different between your river’s ecosystem and your partner’s river ecosystem. (open-ended question). Not rated.

**Albuquerque:** 84 responses. We live in desert, partner doesn’t. Climate is different.

**Rio Rancho:** 35 responses. They get more rain. Their river seems cleaner. Different bugs, animals.

**Santa Fe:** 52 responses. They get more rain. Climate is different. Their river is bigger.

**Partner:** 29 responses. Size of river. Animals. Climate is drier in New Mexico.
Question 7: What is a wetland?

Proficient to Advanced for all students.

Question 8: Why are wetlands important?

Nearing Proficient to Proficient for Albuquerque students, probably because field trip locations had a wetland component. Nearing Proficient to Proficient for Partner students, because most areas have more wetlands.
Question 9: How does pollution get into the river?

Proficient to Advanced, except for “erosion can wash dirt into the river.”

Question 10: What kinds of things can pollute our rivers?

Proficient to Advanced for most groups, but antifreeze, soap and dirt/soil were not clearly understood as pollutants.
Question 11: Have you talked to your family or other adults about what you're learning in RiverXchange? What did they think? (open-ended question) Not rated. A few interesting comments are included.

Albuquerque: 96 responses
- 74% yes. They thought it was cool/great/important.
- 21.8% no.
  - They were exited for me and they thought it was cool to know about other peoples watersheds and ecosytems.

Rio Rancho: 37 responses
- 64.9% yes. They thought it was cool/great/important.
- 35.1% no.
  - I told my family about all the taxas of animals that we recently learned about and they said that they never knew about that and they were jealous and said that I was getting a better education than they did.

Santa Fe: 54 responses
- 75.9% yes. They thought it was cool/great/important
- 24.1% no

Partner: 38 responses
- 57.9% yes. They thought it was cool/important.
- 42.1% no
  - I talked to my parents about it and they thought that i was learning lots and that the things they had there like the sacred datura was cool.
  - They thought it is a great way for students to exchange information to each other and a brand new way for kids to get 1 on 1 learning.

Student Writing

The writing component is one of the most valuable aspects of the project, and continues to be our biggest challenge. We are continually working to improve participation in this area, because it helps teachers integrate writing in the content areas (a hot topic in education) and reinforces student understanding of key water resources concepts.

As noted in the Teacher Surveys section, computer time was often the most significant barrier teachers faced in carrying out the project. Many teachers were also dealing with issues unrelated to the project, such as new curriculum in other areas, school reorganization, or construction which prevented access to the computer lab for a portion of the year.

With over 2,100 student pages to track throughout the school year, managing and analyzing this unique assessment component required regular and ongoing wiki review. For the first time, we tracked the number of different curriculum topics written on by each class. We did not track the number of times students wrote.

In the curriculum we provided as many as 14 topics to be covered by the teacher, guest speaker and/or field trip docent. The teacher was to cover any topic not presented by a guest speaker or field trip docent. Our hope was that all New Mexico classes/students would write on seven or eight topics, because we coordinated six or seven classroom guest speakers plus a field trip.
We met our goal of making sure 100% of New Mexico classes set up their student accounts and pages. After the initial setup, 98% of New Mexico classes and 87% of partner classes wrote about at least one topic. However, in some classes there was quite a bit of off-topic chatter, which we would like to discourage because it distracts students from the purpose of the project. Next year, we will drop any class that does not make at least one on-topic post by November 1.

**For New Mexico classes:**
- 53% wrote on 1 or 2 topics
- 29% wrote on 3 to 7 topics
- 18% wrote on 7 or more topics

**For Partner classes:**
- 22% wrote on 1 or 2 topics
- 71% wrote on 3 to 7 topics
- 7% wrote on 7 or more topics

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<th>Partner classes</th>
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The majority of writing took place during Unit 1 and Unit 2 (October through March 1), although many classes did make the effort to write about their field trips in the spring. Many teachers seemed to have difficulty getting back into the project after winter break, and again after testing and spring break. Next year, we hope to motivate teachers to keep up momentum with additional reminders and incentives.

Obviously, the more often students communicated on the wiki, the more fun the pen pal component was. Teachers and students expressed frustration if the pen pals did not write back quickly or at the same pace. We explained to teachers that the writing component was valuable for students even if pen pals didn’t post often or at all because students in the same class could read and comment on each other’s writing. Next year, we hope to strengthen the writing component, so that teachers can more easily see the value of the wiki writing for its own sake, regardless of how much their partners write.

Overall, students did a great job explaining what they learned. Most of the time, their writing took the form of an explanation of what a guest speaker said, or what the student/class did.

Today a man named Mike came into our class room. I came in late so I didn’t hear the whole speech but I did learn some things. We talked about a water shed, and how trash, cleaning products and animal poop can affect the Rio Grande River. My favorite part was when he brought out the spices he cold them animal poop, trash, uranium, and fertilizer he brought I a small look alike of a water shed.
We put the ‘spices’ on it and Raul plaid mother nature. He sprayed water on it and we watched the water take all the ‘spices’ down to the river. So that means we need to stop littering!! The water gets polluted over here and then keeps on picking up more trash as it floes down to Gulf of Mexico.

Sometimes, student writing also included personal feelings about the subject.

Our river is very important to me and lots other people. I like it because it is pritty and I get to swim in it but not always because it can be dangerous. In lots of ways people need the river four one thing it gives us water and some times fish. But some of our river can get polluted because trash and this might sound funny but even dog maneuver can go down water drains in the street and run into the river.

The Rio Grande is very polluted it is sad because what some people can do to mother nature how can somebody just walk away one time i was at the river i saw a three eyed fish it is really is sad i want to help the river!!

It was common for students to “jazz up” their writing with special font colors and styles. More technologically confident teachers taught their students how to upload graphs and photos. Some teachers required students to edit their writing before posting but most teachers allowed students to write and comment in a free form, conversational way. Next year, we will strongly encourage teachers to have students write paragraphs before going to the computer lab, because this promotes much more high-quality thinking and writing.

We know from discussions with teachers that the absence of student writing does not mean that no learning took place or no activities occurred. On the contrary, teachers said that they really enjoyed participating in RiverXchange and felt that their students learned a lot, but admitted that computer time and instruction time were in short supply. Almost all New Mexico teachers asked to participate again.

TEACHER RECOGNITION

We acknowledged the exceptional commitment made by RiverXchange teachers by sending a letter to each New Mexico teacher’s principal and superintendent, and to the principal at each partner school (with copies to teachers). We emphasized that RiverXchange teachers provide their students with a unique opportunity to expand critical thinking skills, and we commended the principals at these schools for allowing their teachers to take on such a big commitment.

NEXT STEPS

- 2011-2012 funding has been secured and will enable at least 60 New Mexico classes to participate. Classes will be located in Albuquerque, Rio Rancho, Santa Fe County and the City of Santa Fe. Additional locations may include Bernalillo, Placitas, Edgewood and Corrales. Funders:
  - Southern Sandoval County Arroyo and Flood Control Authority (20 classes)
  - U.S. Bureau of Reclamation (17 classes)
  - Mid Rio Grande Stormwater Quality Team (15 classes)
  - Santa Fe County (9 classes)
  - City of Santa Fe (up to 7 classes)
As we did last year, teachers will be required to return a Teacher Agreement to participate, which outlines the duties to be carried out by them, and what they can expect from program coordinators. One new stipulation is that students must post on the wikis before November 1. If there are no postings by this time, the class will not be able to continue participation.

If we are unable to secure enough partner classes (from outside New Mexico), we will partner RiverXchange classes within New Mexico.

We will revise the curriculum to include more specific writing assignments.

We will modify the format of the teacher workshop to include:

- a technical guest speaker to give teachers more detailed information about the water resources situation in our area
- partnering new teachers with returning teachers for mentoring
- detailed field trip information and expectations

A class wiki will be created for each teacher (instead of each partnership) prior to the teacher workshop, including student accounts and pre-formatted student pages. Pen pals are to be partnered in a systematic way (i.e., Student 1 from Class A will be pen pals with Student 1 from class B). This will further reduce the technological burden on teachers.

We will streamline our scheduling process and reminders for guest speakers.

We will coordinate guest speakers on just four core topics:

- watershed/nonpoint source pollution
- drinking water
- wastewater
- either agriculture, aquatic macroinvertebrates or erosion

Before and after each guest speaker and field trip, we will remind teachers about writing prompts.

We will provide teachers with contact information of additional guest speakers so that teachers can directly coordinate additional presentations, if desired.

Experiential EE contractors will make classroom presentations on core topics, if needed.

Experiential EE contractors will plan and attend all field trips.

We will revise student assessment questions, question formats, and answer options to improve clarity and ease of analysis.

New Mexico guest speakers and field trip docents will receive a copy of related assessment questions/answers ahead of time.

RiverXchange FAQs will be developed for field trip docents.

We will urge our funders and in-kind contributors to add the RiverXchange website link www.riverxchange.com to their websites, and to post information about the program.
APPENDIX 1: CURRICULUM

Our overarching goal for the curriculum is for students to be able to answer:

**The Big Water Questions**

- Why is water so important to life?
- How do all living things depend on each other?
- What is the water cycle?
- What is a watershed?
- Where does my drinking water come from?
- Where does my wastewater go?
- What makes water dirty?
- How much water does my family use each day?
- Who are the other water users in our society?
- Who owns our water?
- How can I protect our water?

Do your upper elementary students understand these questions?
Can they formulate logical answers to these questions?
### Unit 1 – Understanding a Watershed

**September 13-30**

1. **Our Rivers**
   ("Watershed Tourist")

   - 1 hour classroom time, 1 hour research time, 30 min student computer time
   - 1. Where is our watershed?

   **As a class:**
   - Show students the USGS Watershed page. Introduce the concept of a watershed because this is where river water comes from. Discuss seasonal, weather, timing of your area’s precipitation, and altitude of your area. Have students identify your river on a map, and trace its path to the ocean.
   - Show students a map where your school is located in relation to your river’s mouth. North, East, West, and what towns border your town upstream and downstream.
   - Discuss major geographic regions of your state and the geography along the length of your river. Have students research major climate, flora, and fauna in different regions of the state where your tributaries come from, and different regions along the length of your river.
   - Print a map showing your watershed. Post maps showing your river from headwaters to ocean (include your location and local tributaries), and pictures of your area on your activity page.
   - Students:
     - Have students make a *pond* on their own page, telling what the climate is like in your area and how other areas along the river are different, whether they have

### 4th Grade Standards:

- **Social Studies:**
  - II-A.1 Apply geographic tools of title, grid system, legends, symbols, scale, and compass rose to construct and interpret maps.
  - II-A.2 Translate geographic information into a variety of forms such as graphs, maps, diagrams, and charts.
  - II-A.3 Draw conclusions and make generalizations from geographic information and inquiry.
  - II-B.1 Identify a region as an area with unifying characteristics (e.g., human, natural, manufactured features of local, regional, state, national, and international locales).
  - II-B.2 Describe the regions of New Mexico, the United States, and the Western Hemisphere.
  - II-C.2 Understand how visual data (e.g., maps, graphs, diagrams, tables, charts) organize and present geographic information.
  - II-D.2 Describe the four provinces (plains, mountains, plateau, and basin and range) that make up New Mexico’s land surface.
### October 15-16

#### 2. Watershed Model - Guest Speaker

- **1 hour classroom time, 30 min student computer time**
- **What is a watershed?**
- **What makes water drop?**
- **How can I protect our waters?**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Details</th>
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</thead>
<tbody>
<tr>
<td><strong>As a class:</strong></td>
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</tr>
<tr>
<td><strong>Activity:</strong></td>
<td>Students work in small groups to create a model of a watershed.</td>
</tr>
<tr>
<td><strong>Task:</strong></td>
<td>Students gather information about the local watershed.</td>
</tr>
</tbody>
</table>

#### 3. Watershed Model - Field Trip

- **30 min student computer time**
- **What is a watershed?**
- **What makes water drop?**
- **How can I protect our waters?**

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</tr>
</tbody>
</table>

### October 15-21

#### 5. Infiltration and Runoff

- **1 hour outside time, 30 min classroom time, 30 min student computer time**
- **What is a watershed drainage basin?**
- **What is the water cycle?**

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</tr>
</tbody>
</table>

#### 6. Watershed Model - Guest Speaker

- **1 hour classroom time, 30 min student computer time**
- **What is a watershed?**
- **What makes water drop?**
- **How can I protect our waters?**

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<tr>
<td>RiverXchange Unit 2 – Water in Our Society</td>
<td>Items highlighted in yellow = teacher action items</td>
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<td>------------------------------------------</td>
<td>-------------------------------------------------</td>
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<tr>
<td><strong>November-January</strong></td>
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<tr>
<td>4. Water World – Guest Speaker</td>
<td>As a class:</td>
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<td></td>
<td>Students will learn about water issues that people face in other countries. They will learn how to ensure clean water is available. Students will learn about simple ways to pump, treat, and provide people with clean drinking water. Through a hands-on experiment, they will learn about basic water treatment. Students:</td>
</tr>
<tr>
<td></td>
<td>Students post on their page about what they learned, answering the question “Where does our drinking water come from?” Where do people in other parts of the world get their drinking water?” and “How much water does my family use compared to families in other parts of the world?”</td>
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<tr>
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<td>Science:</td>
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<tr>
<td></td>
<td>V-A.1 Know that science has identified substances called pollutants that get into the environment and can be harmful to living things.</td>
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<tr>
<td></td>
<td>Social Studies:</td>
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<tr>
<td></td>
<td>E.1 C. Explain how geographic factors have influenced people, including settlement patterns and population distribution in New Mexico, past and present.</td>
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<td>E.3 C. Describe how environments, both natural and man-made, have influenced people and events over time, and describe how places change.</td>
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<td>E.4 C. Describe how geographic factors influence the location and distribution of economic activities.</td>
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<td>III. D.1 Explain the difference between rights and responsibilities, why we have rules and laws, and the role of citizenship in processing them.</td>
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<td>IV-A.4 Discuss how resources and goods and services can be used in alternative ways, and sometimes, allocated to different users.</td>
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<td>IV-A.5 Understand that conflict may arise between private and public entities.</td>
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<td>IV-C.2 Explain how New Mexico, the United States, and other parts of the world are economically interdependent.</td>
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<tr>
<td></td>
<td>Social Studies:</td>
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<tr>
<td></td>
<td>E.1 C. Describe the contributions of science to understanding local or current issues (e.g., water-related decisions regarding water use).</td>
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<td>E.2 C. Identify and locate natural and man-made features of local, regional, state, national, and international locations.</td>
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<td>E.3 C. Describe human and natural characteristics of places.</td>
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<td>E.4 C. Discuss similarities, differences and patterns of change among regions of the globe.</td>
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<td></td>
<td>E.5 C. Describe how man-made and natural environment have influenced conditions in the past.</td>
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<td></td>
<td>E.6 C. Identify and define geographic issues and problems from accounts of current events.</td>
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<tr>
<td></td>
<td>IV-C.1 Understand how resources impact daily life.</td>
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<td></td>
<td>IV-A.2 Understand the impact of supply and demand on consumers and producers in a free market system.</td>
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<td>IV-A.3 Know that changes in the environment can have different effects on different organisms (e.g., some organisms move, some survive, some reproduce, some die).</td>
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</tbody>
</table>

| November                                      |                                                   |
| 5. Drinking Water – Guest Speaker            | As a class:                                     |
| The guest speaker will explain or demonstrate where your drinking water comes from. | 6th Grade Standards: |
| Science:                                     | V-A.1 Know that science has identified substances called pollutants that get into the environment and can be harmful to living things. |
| Social Studies:                               | E.1 C. Explain how geographic factors have influenced people, including settlement patterns and population distribution in New Mexico, past and present. |
|                                                   | E.3 C. Describe how environments, both natural and man-made, have influenced people and events over time, and describe how places change. |
|                                                   | E.4 C. Describe how geographic factors influence the location and distribution of economic activities. |
|                                                   | III. D.1 Explain the difference between rights and responsibilities, why we have rules and laws, and the role of citizenship in processing them. |
|                                                   | IV-A.2 Understand how resources and goods and services can be used in alternative ways, and sometimes, allocated to different users. |
|                                                   | IV-A.5 Understand that conflict may arise between private and public entities. |
|                                                   | IV-C.2 Explain how New Mexico, the United States, and other parts of the world are economically interdependent. |

*At the end of this unit, have students click the Unit 1 – Test Yourself link on your Front Page to take the quiz.*
December

6. Wastewater – Guest Speaker
1 hour classroom time, 30 min student computer time

Where does our waste water go?

and how it is treated to make it safe for drinking. Ask the guest speaker to discuss current issues surrounding the sustainability of your water supply (including requirements of downstream users), and how the location of your community was historically influenced by availability of water.

Post photos or video of students doing the activity on the activity page.

Students:
- Students post on their page about what they learned, answering the questions:
  - Where does our drinking water come from?
  - Compare to partner’s page. Does their water come from ground water (aquifer) or surface water (such as a river or lake)?

December/January

7. Prior Appropriation Game
1 hour classroom time, 30 min student computer time

Where does our waste water go?

As a class:
- Show students the USGS Abby Do We Trust Our Position? video.
- The guest speaker will talk about where our waste water goes, how wastewater is treated, how treated wastewater can be recycled (such as in using golf courses), how our treated wastewater is put back into the river and used by downstream communities (placido and TCI), and the difference between the sewer system and the water system.
- Post photos or video of students doing the activity on the activity page.
- Students:
  - Student post on their page about what they learned, answering the questions:
  - Where does our wastewater go?
  - Comment on partner’s page.

6th Grade Standards:
Science:
- 6A.1 Know that science has identified substances called pollutants that get into the environment and can be harmful to living things.
- 6A.4 Describe how human activity impacts the environment.
  - 6B.2 Describe how human activity impacts the environment.
  - 6B.4 Describe how human activity impacts the environment.

6th Grade Standards:
Social Studies:
- 6A.1 Demonstrate how different areas of the United States are organized and interconnected.
- 6A.2 Identify and locate natural and man-made features of local, regional, state, national, and international locations.
- 6A.3 Describe similarities, differences, and patterns of change among regions of the globe.
- 6A.4 Describe similarities, differences, and patterns of change among regions of the globe.
- 6A.5 Describe how different areas of the United States are organized and interconnected.

7th Grade Standards:
Science:
- 7A.1 Describe how changes in the environment can have different effects on different organisms (e.g., some organisms move, some survive, some reproduce, some die).
- 7A.4 Describe how human activity impacts the environment.
  - 7B.1 Describe how changes in the environment can have different effects on different organisms (e.g., some organisms move, some survive, some reproduce, some die).
  - 7B.2 Describe how changes in the environment can have different effects on different organisms (e.g., some organisms move, some survive, some reproduce, some die).

7th Grade Standards:
Social Studies:
- 7A.2 Demonstrate how different regions of the United States are organized and interconnected.
- 7A.3 Describe similarities, differences, and patterns of change among regions of the globe.
- 7A.4 Describe similarities, differences, and patterns of change among regions of the globe.
- 7B.2 Describe how different regions of the United States are organized and interconnected.
- 7B.3 Describe how different regions of the United States are organized and interconnected.

8th Grade Standards:
Science:
- 8A.1 Demonstrate how changes in the environment can have different effects on different organisms (e.g., some organisms move, some survive, some reproduce, some die).
- 8A.4 Describe how human activity impacts the environment.
  - 8B.1 Demonstrate how changes in the environment can have different effects on different organisms (e.g., some organisms move, some survive, some reproduce, some die).
  - 8B.2 Demonstrate how changes in the environment can have different effects on different organisms (e.g., some organisms move, some survive, some reproduce, some die).

8th Grade Standards:
Social Studies:
- 8A.1 Demonstrate how changes in the environment can have different effects on different organisms (e.g., some organisms move, some survive, some reproduce, some die).
- 8A.4 Describe how human activity impacts the environment.
  - 8B.1 Demonstrate how changes in the environment can have different effects on different organisms (e.g., some organisms move, some survive, some reproduce, some die).
  - 8B.2 Demonstrate how changes in the environment can have different effects on different organisms (e.g., some organisms move, some survive, some reproduce, some die).
- 8B.3 Demonstrate how changes in the environment can have different effects on different organisms (e.g., some organisms move, some survive, some reproduce, some die).
- 8B.4 Describe how human activity impacts the environment.
New Mexico’s water rights (Prior Appropriation), and discuss whether students think the allocation of water rights in your area is fair.

Post questions or role of students doing the activity, on the activity page.

Students:
- Students post on their page about what they learned, and answer the questions: “Who are the other water users in our society?”
- Comment on partner’s page.

January

“The Value of Water”

- As a class:
  - Show students the USGS water data.
  - Use data from USGS. www.waterdata.usgs.gov

1 week (~20 minutes/day)

50 min computer time

4th Grade Standards: Science

- 4.A.1 Conduct multiple trials to test a prediction and draw logical conclusions, and construct and interpret graphs from measurement data.

5th Grade Standards: Science

- 5.A.1 Plan and conduct investigations, including formulating testable questions, making systematic observations, developing logical conclusions, and communicating findings.

- 5.A.3 Use mathematical skills to analyze data.

How much water does my family use each day?

- Students:
  - Students post on their page about what surprised them at the end of their observation. Ask them to answer the question: “How can I save water?” by making a list of what they can do to conserve water.
  - Comment on partner’s page.

IV. A. Illustrate how resources can be used in alternative ways and, sometimes, allocated to different users.

IV. B. Understand and explain how conflict may arise between private and public incentives (e.g., new laws, pricing structures).

IV. C. Explain how patterns of waste and economic activity in New Mexico and their sustainability over time (e.g., farming, ranching, mining, retail, transportation, manufacturing, tourism, fishing).

IV. D. Explain the difference between private and public incentives (e.g., insurance, health care, education).

IV. E. Explain why some markets are not self-sustaining, and the role of government in promoting them.

IV. F. Explain how economic development impacts the environment.

IV. G. Explain how economic development impacts the environment.

IV. H. Explain how economic development impacts the environment.

IV. I. Explain how economic development impacts the environment.
February

9. Commercial Uses of the River – Guest Speaker

Farmers will have a different activity depending on their region.

~1 hour classroom time, 40 min student computer time.

How have rivers impacted Human settlements and culture?

How have humans changed our rivers?

A class:

- Have students the 1505 point. Name: Renaissance.
- Discuss: irrigation, markets, and trade.
- Divide into groups.
- Discuss: What do you think?
- Whole class:
- Discuss: How does this impact our environment?
- Small groups:
- Discuss: How does this impact our environment?
- Share:
- Discuss: How does this impact our environment?
- Whole class:
- Discuss: How does this impact our environment?
- Small groups:
- Discuss: How does this impact our environment?
- Share:
- Discuss: How does this impact our environment?
- Whole class:
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- Share:
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- Whole class:
- Discuss: How does this impact our environment?
### RiverXchange Unit 3 – River Ecosystem

#### February

**9. The Web**

(from Eugene Onegin Guide)

- In your classroom, 1 hr research time, 10 min student computer time

**Why is water so important to life?**

- How do all living things depend on each other?

**Who are the other water users in our society?**

As a class:
- Give students plant and animal cards, and use a string to construct a Bogus Web food web, discussing how all living things depend on each other. Discuss how webs are “water users,” too, and they need clean water to live, so we need to consider them when making choices about water.
- Assign each student an animal or plant from their local area or state, and have them research what it eats and where it lives. Make sure plants and insects are assigned – they are key parts.
- Create a large food web poster in a class, showing which species are connected with others. Post a photo of the poster on a website.

**Students:***

- Create a poster on their page about their assigned animal or plant. Describe key experiences they have had with these plants or animals, how it interacts with other living things in the ecosystem, and how it depends on the river.
- Encourage students to comment on each other’s posters, discussing changes humans make to the ecosystem, and tape it up to restore nature.

#### March

**10. “Wetland In A Bottle”**

- 1 hr classroom time, 30 min student computer time

**Why is water so important to life?**

- How do all living things depend on each other?

**Who are the other water users in our society?**

As a class:
- Have students the USGS Wetland poster.
- Discuss lessons from wetland names and plants, and combine different models of how wetlands help clean water and reduce flooding. (From EPA Water Sourcebook)
- Emphasize that wetlands are “water users,” too. Discuss how important wetlands are to the health of our rivers, how wetlands need water and how all living things depend on each other.

**Students:**

- Students post on their page, answering the questions “Why are wetlands important?” and “Why is water so important to life?”

#### April

**11. Rolling River – Guest Speaker**

- 30 min classroom time, 30 min student computer time

**How do all living things depend on each other?**

**How have humans changed?**

As a class:
- Share students the USGS Pollution poster, once again, and review the chapter of corresponding page number.
- Students experiment with a river model and simulation software, then examine the effects of pollution in reducing fish species. The guest speaker will discuss how other living things and other forms of pollution wash into the river and how they affect the ecosystem.

**Students:**

- Students post on their page, answering the questions “How have humans changed?” and “How do all living things depend on each other?”

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<table>
<thead>
<tr>
<th>8th Grade Standards: Science:</th>
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<tbody>
<tr>
<td>III-A.1 Identify the components of habitats and ecosystems (e.g., producers, consumers, decomposers and predators)</td>
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May

12. Microinvertebrate Mayhem – Guest Speaker

- 1 hour classroom time
- 10 min student computer time

Why is water so important to life?
How do all living things depend on each other?
Who are the other water users in our society?

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4th Grade Standards: Science:
III-A.1. Explain that different living organisms have distinctive structures and body systems that serve specific functions (e.g., walking, flying, swimming).
III-A.2. Know that human and other living things have senses to help them detect stimuli, and that sometimes (e.g., danger) and stimuli (e.g., changes in the environment) influence the behavior of organisms.
III-A.4. Describe the components of and relationships among organisms in a food chain (e.g., plants are the primary source of energy for living systems). III-B.1. Know that in any particular environment some kinds of plants and animals survive well, some survive less well, and others cannot survive at all.

At the end of this unit, have students click the Unit 3 Test Yourself link on your Front Page to take the quiz.
APPENDIX 2: STUDENT SURVEYS

Unit 1

*Greetings, RiverXchange students!*

1. Try out your map skills ...

   Answer the questions below by clicking on the picture.

   ![Map of the United States with precipitation data](image)

   What part of the U.S. gets the MOST rain each year?

   ![Question with options: Skip, Value 0, Re-start](image)

2. Do you know these water words?

   ![Crossword puzzle with water-related terms](image)

   Solve the crossword puzzle.

   **ACROSSES**

   1. The mouth of a river, which is triangle-shaped like a Greek capital letter Delta

   5. All the water that falls from the sky, in solid or liquid form, such as rain, snow, or hail

   **DOWN**

   1. Dirt or poison in the environment

   2. The process by which water comes out of the leaves of plants, primarily through openings in the leaves, and goes into the air

   3. The process by which water changes from vapor

3. Now **test your knowledge** about Watersheds!

4. If you have time, you can play this fun game... **Water Showdown!**
Unit 2

Greetings, RiverXchange students!

1. Watch this great cartoon - The Story of Groundwater!
2. Play this fun WaterSense game!
3. Do you know these water words?

4. Now test your knowledge about Water in Our Society!
Greetings RiverXchange students! Test your River Ecosystem knowledge:

1. Watch Frogline News to learn about how frogs are affected by watersheds.

2. Do you know these Water Words?

<table>
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<tr>
<th>Across</th>
<th>Down</th>
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<tbody>
<tr>
<td>1. Area such as a marsh or swamp that is covered with shallow water or where the soil is very wet all the time.</td>
<td></td>
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<tr>
<td>2. The process in which a material (such as a river bank) is worn away by water or wind.</td>
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<tr>
<td>3. A species that naturally invasive and take over an area.</td>
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3. Now test your knowledge about River Ecosystems!