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

2015 Report

Presented by
Orilla Consulting, LLC

June 12, 2015
EXECUTIVE SUMMARY
RiverXchange is an innovative, long-term outreach program that integrates water resource topics with computer technology, student writing, and a hands-on curriculum to meet specific, measurable outcomes. Since 2007, the program has enabled upper elementary classes from New Mexico to become “high tech pen pals” with a class outside the state to share what they learn about the geography, culture, and ecology of their local river and watershed. Including these partner classes, we have served over 14,000 students! Each student spends about 25 hours engaged with the program over the course of the school year.

The curriculum incorporates hands-on activities, multiple classroom presentations by local water resources professionals, and a field trip to the local river or an important watershed feature. The field trip includes water quality monitoring and/or a service learning project. Students write about the various curriculum topics and the field trip via a private wiki website that can be viewed by their partner class. 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. RiverXchange is a great way to teach 21st Century Skills such as Collaboration, Communication, Creativity, and Critical Thinking.

This year, funding enabled 48 NM classes (1,200 students and 53 teachers) to participate. The majority of participating schools were Title I schools. Each NM class was partnered with a class outside the state for a total of nearly 2,400 participants. All program costs and coordination are provided free of charge to NM teachers. Training, technical support, and curriculum materials are provided free of charge to partner teachers. The program required $70,188 in cash and received non-federal match valued at $209,873.94, in the form of in-kind contributions including the wiki technology platform, workshop space and computer lab use, classroom resources, and presenters' time in the classroom as well as the teachers' and students' time.

All major “Next Steps” recommended in the RiverXchange 2014 Report were completed, including improvements to the program such as requiring teachers to communicate by phone to form a stronger relationship, and creating a more user-friendly online forum for teachers. Our pre- and post-survey showed a significant increase in water conservation behaviors. Students demonstrated significant knowledge of water resources issues on three online assessments. We saw many wonderful student video and PowerPoint projects as well as great writing that demonstrated critical thinking skills and understanding of the connections between issues.

Teachers faced a major challenge this year with the implementation of the new computer-based PARCC test, which made it more difficult to access computer labs. Feedback indicated that teachers found the program helpful in teaching Common Core standards as well as 21st Century Skills. Those who did participate in the program were especially committed, and many plan to return next year.
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PROGRAM DESCRIPTION

Mission
The mission of RiverXchange is to deepen students’ and teachers’ understanding and appreciation for their local river ecosystem, motivate participants to protect local water resources by conserving water and keeping their source water clean, and to provide a high quality, high impact outreach opportunity for funders and in-kind contributors.

The Big Water Questions
The curriculum frames program outcomes as “guiding questions” known as 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. 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.

Understanding a Watershed
• Is every place in the world part of a watershed?
• Where does your community’s stormwater go?
• How can surface water become polluted?
• How does the water cycle relate to weather?
• How are groundwater and surface water connected?
• How can groundwater become polluted?
• What actions can all of us take to keep water clean?

Water in Our Society
• In what ways does our society use water?
• Where does your community’s drinking water come from?
• Does everyone have the right to use as much water as they want?
• Where does your community’s wastewater go?
• What actions can all of us take to conserve water?

River Ecosystem
• How does water affect living things in an ecosystem?
• What role do forests play in a watershed?
• What role do wetlands play in a watershed?
• What are some of the ways scientists can determine the health of a river, lake, bay or ocean?
• What actions can all of us take to improve the health of our ecosystem?

Background
As producers of children’s water festivals and other grade K-12 water resources outreach in NM since 2007, we observed early on that NM elementary teachers rarely incorporated water concepts in the classroom beyond what is required by the state (e.g., water cycle), and that most elementary teachers considered “water” strictly as a science topic. While teachers personally acknowledged the importance of conserving water and keeping source water clean, we continued to find that upper elementary students had little or no understanding of major water resources topics unless the teacher specifically integrates a wide range of water topics into the curriculum.
We created RiverXchange to provide a free program that is fun, interesting, and easy to integrate into the normal curriculum. Our hope was to motivate participants to explore water resources topics in depth. The program is carried out over eight months so that students spend more time developing a sense of pride and personal connection to their own river ecosystem, as well as a personal connection to a distant river ecosystem and the students who live near it.

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, featuring partnerships between two fourth grade classes in Albuquerque, NM, and two fifth grade classes in Godfrey, IL. 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 what they had learned. The upper elementary 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 enabled us to overcome limitations such as the high cost, availability and time zone logistical issues associated with video teleconferencing — and easily involve more classes. The curriculum was updated to incorporate the writing component, and we introduced classroom guest speakers to reduce teacher work load and bring up-to-date technical information into the classroom.

In 2012, ownership of RiverXchange transferred to Amy White of Orilla Consulting, LLC, who has managed the program since its inception. Since 2007, we have served over 14,000 students!

This year, the program featured the following components:
- Standards-based curriculum including hands-on science and social studies lessons, as well as writing assignments.
- Coordination of class partnerships
- Pre-formatted wiki website
- Teacher training on curriculum implementation and use of the wiki technology
- Ongoing technical and motivational support
- Three online student assessments and a teacher survey
- Payment for teacher workshop substitute teachers (NM only)
- Coordination of at least four guest speakers into the classroom (NM only)
- Coordination of a field trip to the local river or important watershed feature (NM only)
- Field trip bus transportation payment (NM only)
- Field trip leadership and activity planning (NM only)
- A mid-year teacher gathering for support and motivation (NM only)

**Program Management and Financial Support**

The program timeframe was July 1, 2014 through June 30, 2015. All components including fundraising, design, planning, implementation and analysis were carried out by Orilla Consulting, LLC, an Albuquerque-based consulting firm owned by Amy White. In addition to Ms. White, work was carried out by the following team of independent contractors:
- Bonnie Schmader, **Field Trip Coordinator**
- Melissa McLamb, **NM Teacher Coordinator** (hired in April 2015)
- Michelle Watson, **NM Teacher Coordinator** through May 2015
- Carolyn Gregory, **Partner Teacher Coordinator** through November 2014
Sponsors

- Southern Sandoval County Arroyo and Flood Control Authority (16 classes)
- Mid Rio Grande Stormwater Quality Team (22 classes)
- US EPA: Urban Waters Small Grant, in partnership with Ciudad Soil and Water Conservation District (9 classes)
- Environmental Education Association of New Mexico: US EPA Region 6 Small Grant, in partnership with New Mexico Water Conservation Alliance (teacher workshop for all classes)

Sponsors provided $70,188 in cash. Program expenses included:
- Substitute teachers for NM teacher workshops
- Field trip bus transportation for NM classes
- Field trip portable toilet rentals for NM classes
- USGS water education posters for each teacher
- Coordination services (planning, implementing and assessing all program components)

New Mexico In-Kind Partners

- Albuquerque Bernalillo County Water Utility Authority
- Bernalillo County Cooperative Extension, 4-H
- CDM Smith, Inc.
- City of Albuquerque – Open Space Division
- City of Rio Rancho – Environmental Programs Office
- Ciudad Soil and Water Conservation District
- Daniel B. Stephens and Associates
- OMI
- Sandoval County Cooperative Extension, 4-H
- Santa Ana Pueblo
- Southern Sandoval County Arroyo and Flood Control Authority
- Water for People

In-kind contributions totaled $209,873.94. For NM classes, in-kind contributions included classroom guest speakers, field trip docents, workshop space and computer lab use, wiki technology, and classroom resources. This year, we were informed that teachers' and students' time attending the presentations and field trips could be counted as non-federal match. For partner classes, in-kind contributions included classroom guest speakers, field trip docents and field trip bus transportation. Sponsors and in-kind partners were recognized on our website and in presentations.

Participant Selection

All 48 participating NM classes were fifth grade classes. The majority of participating schools were Title I schools. There were approximately 1,200 students and 53 teachers, distributed as follows:
Bernalillo County | Sandoval County
---|---
Arroyo Del Oso Elementary School (3 classes) *Title I* | Algodones Elementary (1 class) *Title I*
Bandelier (4 classes) | Bernalillo Elementary (1 class) *Title I*
Bellehaven Elementary (2 classes) *Title I* | Cielo Azul Elementary (2 classes) *Title I*
Cochiti Elementary (2 classes) *Title I* | Cochiti Elementary and Middle School (1 class) *Title I*
Eubank Elementary (3 classes) *Title I* | Colinas del Norte Elementary (3 classes) *Title I*
Georgia O’Keeffe Elementary (2 classes) | Martin Luther King, Jr. Elementary (5 classes) *Title I*
Lew Wallace Elementary (1 class) *Title I* | Placitas Elementary (1 class)
Monte Vista Elementary (1 class) | Rio Rancho Elementary School (5 classes) *Title I*
Mountain View Elementary (3 classes) *Title I* |  
Navajo Elementary (2 classes) *Title I* | Valencia County
Osuna Elementary (3 classes) | Del Rio Academy (1 class)
Zia Elementary (2 classes) *Title I* |  
700 students, 31 teachers | 500 students, 22 teachers

Partner classes were located in 13 U.S. States, as well as in Australia, Greece, Gabon, Rwanda, Russia, and Romania. We have an especially high number of teachers in Washington state. There were about 1,200 students and 35 teachers (some teachers had more than one class participating). We have found that partner teachers are highly motivated and come to the program with a willingness to participate even though our NM-based funding cannot be used to help coordinate their classroom guest speakers, arrange the field trip, or pay for any direct costs.

**Teacher Professional Development Workshop**

Although preparation began many months earlier, RiverXchange officially kicked off in September with a full-day teacher workshop for NM teachers and online training sessions for partner teachers. Teachers learned how to implement the activities in the curriculum and how to operate and manage a class wiki. Guest speakers were on hand at the NM workshops to schedule classroom presentations. Michelle Watson and Eubank Elementary’s technology teacher Angela Boltman spoke about the changing world of technology that our children are entering. Michelle led teachers in exploring how to create videos with the various technologies available to them.

**Wiki Technology**

A wiki enables one or more users to edit any page or to create new pages within the wiki web site. It is similar to a blog, with each student using their own page as a blog. We chose PBWorks as our web-based communication network. We created the wikis as well as the student accounts prior to the workshop, in order to streamline the training for teachers. One of the most important, yet challenging, aspects of program implementation continued to
be the training of teachers on how to use the wiki especially in a way that builds confidence and competent use of the program throughout the school year.

**Online Partner Training**
Teachers were able to view an online slide show explaining basic wiki procedures, then log in at an appointed time to participate in a live discussion and demonstration of the basic wiki procedures. We used GoToMeeting, a virtual meeting platform that allows participants to see the presenter's computer screen as they demonstrate procedures, and communicate with the presenter to ask questions. Time zone differences and teachers’ schedules necessitated that we hold several online trainings.

**Curriculum**
A key component of RiverXchange is the hands-on curriculum, which is carried out from September through May. 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 pals. 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 including Common Core Standards. Each student spends about 25 hours engaged with the program over the course of the school year!

Each class learns about its own local water resources issues through hands-on activities, classroom guest speakers and a field trip. Students write about what they are learning via a private wiki website that can be viewed by their partner class. The computer technology and writing components provide a unique opportunity to reinforce what was learned, increase student motivation to learn, and collect valuable metrics about student performance.

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.

All activities are correlated to NM state standards and benchmarks for Science and Social Studies. All activities (because they require that students communicate information on the wiki) address Common Core Language Arts standards for writing, which went into effect this year. Some activities also address Common Core Mathematics standards. For a summary of the RiverXchange Curriculum, see Appendix 1.

**Guest Speakers**
We coordinated four guest speakers to visit each NM classroom. In all cases, guest speakers were water resources professionals from local agencies. Guest speakers introduced technical information that was often completely new to a teacher. Topics included:

- watershed/nonpoint source pollution
- drinking water
- wastewater
- water and agriculture

Partner teachers were strongly encouraged to invite guest speakers into the classroom to help carry out the curriculum. Since program funding is NM-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.
Field Trips
The program requires that all classes attend at least one field trip to their local river or important watershed feature, which should incorporate a service learning component, if possible. We coordinated all NM field trips. Throughout the winter and spring, students helped plant more than 500 trees and shrubs in the Rio Grande riparian area. Some of the fall and spring field trips included a water quality monitoring component.

New Mexico Field Trip Locations

Alamo Farm
Managed by City of Albuquerque Open Space, this property is located in on the west side of the Rio Grande, about ½ mile south of Paseo del Norte. This farm is a wildlife preserve and provides valuable habitat for bosque wildlife, especially migratory birds like Sandhill Cranes. While students planted native trees, they got to see porcupines, bald eagles, coyotes and other bosque animals. Students participated in the ABCWUA Paseo del Norte project, a drinking water mitigation project, which included planting native vegetation along a silvery minnow channel.

Tingley 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, tested water quality, and observed macroinvertebrates.

Teachers were encouraged to invite additional water-related guest speakers into the classroom and/or go on additional field trips. Several teachers organized additional field trips to Albuquerque’s Southside Water Reclamation Plant, Cooperative Extension’s “Kids, Kows, and More” event, or a Bosque Ecosystem Monitoring Program site, to expand upon what their students learned through RiverXchange.

Partner Field Trip Locations
Since program funding is NM-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. We know that many of them did water quality testing.
EVALUATION

Teacher Surveys

Using FluidSurvey, we asked for feedback from NM and partner teachers, to help us identify areas in which we could improve the program to make it easier and more useful for them. The response rate was about 25%, and we received very useful information from those who did respond. Here are a few major points:

- Teachers struggled to maintain communication with their partners, even though we encouraged them to get in touch by phone at the beginning of the year and develop a working relationship.

- Teachers liked the new training videos we developed this year, and many used them to train their students on how to use the wiki.

- Scheduling computer time proved to be especially difficult this year with many teachers reporting that they had extremely limited access to computers due to the PARCC test and other computer-based tests taking up the computer labs for the majority of the year.

- Many teachers still felt they could do the program next year, using classroom computers or their smart board, even with the computer-based testing making it difficult to get into the computer lab.

- Teachers observed that group projects resulted in high-quality work and had the added benefit of requiring less computer time, yet many teachers still wanted to have students do individual projects.

How did you most often do projects for the wiki?

<table>
<thead>
<tr>
<th>Response</th>
<th>Chart</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual</td>
<td>![Chart]</td>
<td>60.9%</td>
<td>14</td>
</tr>
<tr>
<td>Group</td>
<td>![Chart]</td>
<td>52.2%</td>
<td>12</td>
</tr>
<tr>
<td>Whole class</td>
<td>![Chart]</td>
<td>26.1%</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total Responses</strong></td>
<td></td>
<td></td>
<td>23</td>
</tr>
</tbody>
</table>


Almost all teachers found RiverXchange helpful in teaching Common Core standards.

*How useful is RiverXchange in helping your students achieve Common Core English/Language Arts Standards in the following areas?*

Many teachers felt there was value in having an authentic audience for students to write to, and reported that their students enjoyed learning about the other school in another state and were excited to teach their pen pals what they had learned. Here are some of their comments:

“*My students have loved learning about water and the importance of taking care of our Earth’s natural resources.*”

“The partnership component really gets kids enthused.”

“They like having a personal connection/real reason to write and share what they have learned. I like having a real audience (other than the teacher).”

“My students learned that rivers are important, even in areas where there is plenty of rainfall, as our partner school has in New Hampshire.”

“*[Students discovered] that other kids in other states learn similar components about our watersheds, but also how different our watersheds/environments are. The students were always wanting to share their new learning with their partner classes in NM.*”
As always, New Mexico teachers were thrilled with the guest speakers and field trips.

“The classroom presentations have been wonderful! They have learned and we have had great conversations about water.”

“I enjoy the curriculum and the activities. The children learn a lot about NM water and how valuable it is to our community and their future. The presentations are always outstanding and a great way to get kids to think about their environment.”

RiverXchange also helped overwhelmingly in teaching students 21st Century Skills.

**How useful is RiverXchange in helping your students develop the following 21st Century Skills?**

<table>
<thead>
<tr>
<th>Skill</th>
<th>Very helpful</th>
<th>Somewhat helpful</th>
<th>Not that helpful</th>
<th>I really haven't explored this much yet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical thinking/Problem solving</td>
<td>4.3%</td>
<td>3.3%</td>
<td>34.8%</td>
<td>56.5%</td>
</tr>
<tr>
<td>Teamwork</td>
<td>4.3%</td>
<td>8.7%</td>
<td>26.1%</td>
<td>69.6%</td>
</tr>
<tr>
<td>Adaptability to new learning/working structures</td>
<td>4.3%</td>
<td>8.7%</td>
<td>13.0%</td>
<td>73.9%</td>
</tr>
<tr>
<td>Communication skills</td>
<td></td>
<td></td>
<td>34.8%</td>
<td>65.2%</td>
</tr>
<tr>
<td>Taking initiative</td>
<td></td>
<td>9.1%</td>
<td>40.9%</td>
<td>50.0%</td>
</tr>
<tr>
<td>Accessing and analyzing information</td>
<td>4.3%</td>
<td></td>
<td>39.1%</td>
<td>56.5%</td>
</tr>
<tr>
<td>Curiosity/Imagination</td>
<td></td>
<td></td>
<td>30.4%</td>
<td>69.6%</td>
</tr>
</tbody>
</table>

**Student Surveys**

A key component of RiverXchange is its specific, measurable goals relating to student performance. We collected quantitative data on student performance for each curriculum unit via three online student surveys, and qualitative data by reading what students wrote on their wiki pages. We also surveyed students about their actions before and after participating in RiverXchange.
**Pre/Post Behavior Survey**
We asked students about their actions regarding water use before and after the program; improvements were observed in several areas, most notably picking up dog poop!

**How often do you or your family do the following things? (PRE)**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Always (or Very Often)</th>
<th>Sometimes</th>
<th>Never (or Not Very Often)</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turn off the faucet while brushing your teeth</td>
<td>4.4%</td>
<td>23.6%</td>
<td>72.0%</td>
<td></td>
</tr>
<tr>
<td>Spend less than 10 minutes in the shower</td>
<td>16.9%</td>
<td>30.5%</td>
<td>52.6%</td>
<td></td>
</tr>
<tr>
<td>Pick up your dog’s poop, if you have any</td>
<td>17.8%</td>
<td>29.5%</td>
<td>52.7%</td>
<td></td>
</tr>
<tr>
<td>Drop your trash on the ground if you can’t find a trash can</td>
<td>3.0%</td>
<td>16.6%</td>
<td>80.4%</td>
<td></td>
</tr>
<tr>
<td>Water your outdoor plants during the coolest part of the day, if you have any</td>
<td>17.8%</td>
<td>25.7%</td>
<td>73.2%</td>
<td></td>
</tr>
<tr>
<td>Wash chemicals or oil off your driveway into a storm drain</td>
<td>8.9%</td>
<td>17.9%</td>
<td>80.8%</td>
<td></td>
</tr>
<tr>
<td>Sweep grass clippings and leaves into a storm drain</td>
<td>7.2%</td>
<td>12.0%</td>
<td>80.8%</td>
<td></td>
</tr>
<tr>
<td>Do a full load when you’re doing laundry</td>
<td>13.7%</td>
<td>35.9%</td>
<td>50.4%</td>
<td></td>
</tr>
<tr>
<td>Apply fertilizer and/or pesticides right before it’s forecast to rain</td>
<td>8.6%</td>
<td>22.9%</td>
<td>68.5%</td>
<td></td>
</tr>
<tr>
<td>When you wash your car, take it to a carwash</td>
<td>13.4%</td>
<td>35.1%</td>
<td>51.5%</td>
<td></td>
</tr>
<tr>
<td>Pour fats, oils or grease down the drain</td>
<td>11.2%</td>
<td>25.0%</td>
<td>63.8%</td>
<td></td>
</tr>
<tr>
<td>Use your toilet as a trash can (flush it just to get rid of tissues, Q-tips or other trash)</td>
<td>5.8%</td>
<td>15.9%</td>
<td>78.3%</td>
<td></td>
</tr>
<tr>
<td>Visit your local river</td>
<td>15.3%</td>
<td>24.8%</td>
<td>59.9%</td>
<td></td>
</tr>
</tbody>
</table>
How often do you or your family do the following things? (POST)

- Turn off the water while brushing your teeth: 4.1% (Always or Very Often), 22.1% (Sometimes), 73.8% (Never)
- Spend less than 10 minutes in the shower: 8.8% (Always or Very Often), 34.5% (Sometimes), 56.7% (Never)
- Pick up your dog’s poop, if you have a dog - otherwise leave blank: 9.5% (Always or Very Often), 19.8% (Sometimes), 70.6% (Never)
- Drop your trash on the ground if you can’t find a trash can: 5.3% (Always or Very Often), 18.8% (Sometimes), 75.9% (Never)
- Water your outdoor plants during the coolest part of the day, if you have any - otherwise leave blank: 70.4% (Always or Very Often), 37.6% (Sometimes), 15.2% (Never)
- Wash chemicals or oil off your driveway into a storm drain: 9.5% (Always or Very Often), 20.1% (Sometimes), 70.4% (Never)
- Sweep grass clippings and leaves into a storm drain: 3.5% (Always or Very Often), 11.8% (Sometimes), 84.7% (Never)
- Do a full load when you’re doing laundry: 4.2% (Always or Very Often), 36.9% (Sometimes), 58.9% (Never)
- Apply fertilizer and/or pesticides right before it’s forecast to rain: 4.8% (Always or Very Often), 16.9% (Sometimes), 78.3% (Never)
- When you wash your car, take it to a carwash: 14.7% (Always or Very Often), 37.3% (Sometimes), 48.5% (Never)
- Pour fats, oils or grease down the drain: 5.9% (Always or Very Often), 24.7% (Sometimes), 69.4% (Never)
- Use your toilet as a trash can (flush it just to get rid of tissues, Q-tips or other trash): 2.3% (Always or Very Often), 19.9% (Sometimes), 77.8% (Never)

Visit your local river: 16.1% (Always or Very Often), 15.5% (Sometimes), 68.5% (Never)
Online Unit Assessments

Students demonstrated a good knowledge of water resources concepts on three online. Incentives were awarded to four NM and two partner classes, who produced the best wiki writing and had also taken the student assessments.

Unit 1: Understanding Watersheds

1. WHAT IS A WATERSHED (ALSO KNOWN AS A CATCHMENT OR DRAINAGE BASIN)? CHOOSE ONE ANSWER.

<table>
<thead>
<tr>
<th>Response</th>
<th>Chart</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is a building where we store water.</td>
<td></td>
<td>13.6%</td>
<td>50</td>
</tr>
<tr>
<td>It is an area of land that drains to a river, lake, bay or ocean.</td>
<td></td>
<td>66.6%</td>
<td>245</td>
</tr>
<tr>
<td>It is a water body such as a river, lake, bay or ocean.</td>
<td></td>
<td>18.8%</td>
<td>69</td>
</tr>
<tr>
<td>I don’t know.</td>
<td></td>
<td>1.1%</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total Responses</strong></td>
<td></td>
<td><strong>368</strong></td>
<td></td>
</tr>
</tbody>
</table>

2. HOW MUCH PRECIPITATION DOES YOUR COMMUNITY RECEIVE EACH YEAR? CHOOSE ONE ANSWER.

<table>
<thead>
<tr>
<th>Response</th>
<th>Chart</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than 10 inches</td>
<td></td>
<td>61.4%</td>
<td>226</td>
</tr>
<tr>
<td>11-30 inches</td>
<td></td>
<td>18.8%</td>
<td>69</td>
</tr>
<tr>
<td>31-40 inches</td>
<td></td>
<td>4.3%</td>
<td>16</td>
</tr>
<tr>
<td>more than 40 inches</td>
<td></td>
<td>3.3%</td>
<td>12</td>
</tr>
<tr>
<td>I don’t know.</td>
<td></td>
<td>12.2%</td>
<td>45</td>
</tr>
<tr>
<td><strong>Total Responses</strong></td>
<td></td>
<td><strong>368</strong></td>
<td></td>
</tr>
</tbody>
</table>
3. **WHERE DOES YOUR RIVER START? CHOOSE ONE ANSWER.**

<table>
<thead>
<tr>
<th>Response</th>
<th>Chart</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Mexico</td>
<td></td>
<td>7.4%</td>
<td>27</td>
</tr>
<tr>
<td>Utah</td>
<td></td>
<td>1.1%</td>
<td>4</td>
</tr>
<tr>
<td>Texas</td>
<td></td>
<td>2.7%</td>
<td>10</td>
</tr>
<tr>
<td><strong>Colorado</strong></td>
<td></td>
<td><strong>74.5%</strong></td>
<td><strong>272</strong></td>
</tr>
<tr>
<td>Gulf of Mexico</td>
<td></td>
<td>9.0%</td>
<td>33</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>2.7%</td>
<td>10</td>
</tr>
<tr>
<td>I don’t know.</td>
<td></td>
<td>2.5%</td>
<td>9</td>
</tr>
</tbody>
</table>

**Total Responses 365**

4. **INTO WHAT OCEAN DOES YOUR RIVER EVENTUALLY FLOW? CHOOSE ONE ANSWER.**

<table>
<thead>
<tr>
<th>Response</th>
<th>Chart</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacific Ocean</td>
<td></td>
<td>21.3%</td>
<td>78</td>
</tr>
<tr>
<td>Indian Ocean</td>
<td></td>
<td>2.5%</td>
<td>9</td>
</tr>
<tr>
<td><strong>Atlantic Ocean</strong></td>
<td></td>
<td><strong>53.3%</strong></td>
<td><strong>195</strong></td>
</tr>
<tr>
<td>Arctic Ocean</td>
<td></td>
<td>4.1%</td>
<td>15</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>11.7%</td>
<td>43</td>
</tr>
<tr>
<td>I don’t know.</td>
<td></td>
<td>7.1%</td>
<td>26</td>
</tr>
</tbody>
</table>

**Total Responses 366**

Many students wrote in Gulf of Mexico under “Other”.

Page 16
5. WHEN IT RAINS, WHERE DOES YOUR COMMUNITY’S STORMWATER GO? CHOOSE ONE ANSWER.

<table>
<thead>
<tr>
<th>Response</th>
<th>Chart</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>It goes through storm drains into a river, lake, bay or ocean.</td>
<td></td>
<td>77.5%</td>
<td>283</td>
</tr>
<tr>
<td>It goes to a wastewater treatment plant.</td>
<td></td>
<td>16.2%</td>
<td>59</td>
</tr>
<tr>
<td>I don’t know.</td>
<td></td>
<td>6.3%</td>
<td>23</td>
</tr>
<tr>
<td><strong>Total Responses</strong></td>
<td></td>
<td><strong>365</strong></td>
<td></td>
</tr>
</tbody>
</table>

6. HOW CAN SURFACE WATER (LIKE A RIVER, LAKE, BAY OR OCEAN) BECOME POLLUTED? CHOOSE ALL ANSWERS THAT APPLY.

<table>
<thead>
<tr>
<th>Response</th>
<th>Chart</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind can blow trash into surface water.</td>
<td></td>
<td>82.5%</td>
<td>301</td>
</tr>
<tr>
<td>Stormwater can carry dog poop and chemicals from roads and parking lots into surface water.</td>
<td></td>
<td>89.3%</td>
<td>326</td>
</tr>
<tr>
<td>All of the pollution comes from factories.</td>
<td></td>
<td>21.4%</td>
<td>78</td>
</tr>
<tr>
<td>Soil can erode after a forest fire, and then stormwater can carry the soil into surface water.</td>
<td></td>
<td>65.5%</td>
<td>239</td>
</tr>
<tr>
<td>All of the pollution comes from just a few people.</td>
<td></td>
<td>9.6%</td>
<td>35</td>
</tr>
<tr>
<td><strong>Total Responses</strong></td>
<td></td>
<td><strong>365</strong></td>
<td></td>
</tr>
</tbody>
</table>

Students are clearly getting the message that keeping trash and dog poop out of our river are important. This is an increase compared to the behavior pre-survey results for dog poop and chemicals.
7. WHAT ACTIONS CAN ALL OF US TAKE TO KEEP WATER CLEAN? CHOOSE ALL ANSWERS THAT APPLY.

<table>
<thead>
<tr>
<th>Response</th>
<th>Chart</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>We can pick up trash.</td>
<td></td>
<td>93.7%</td>
<td>344</td>
</tr>
<tr>
<td>We can pick up dog poop.</td>
<td></td>
<td>92.1%</td>
<td>338</td>
</tr>
<tr>
<td>We can use extra fertilizers and pesticides right before it’s going to rain.</td>
<td></td>
<td>11.7%</td>
<td>43</td>
</tr>
<tr>
<td>We can wash our car at a car wash so that the dirty water gets cleaned and recycled.</td>
<td></td>
<td>65.7%</td>
<td>241</td>
</tr>
<tr>
<td>We can take oil and chemicals to be recycled instead of dumping them in storm drains or on the ground.</td>
<td></td>
<td>76.6%</td>
<td>281</td>
</tr>
<tr>
<td>If a car is leaking fluids, we can wash the chemicals off the driveway and into the gutter.</td>
<td></td>
<td>24.0%</td>
<td>88</td>
</tr>
<tr>
<td>We can sweep grass clippings and trash into a storm drain.</td>
<td></td>
<td>10.4%</td>
<td>38</td>
</tr>
<tr>
<td><strong>Total Responses</strong></td>
<td></td>
<td><strong>367</strong></td>
<td></td>
</tr>
</tbody>
</table>

8. HOW DOES THE WATER CYCLE RELATE TO WEATHER? CHOOSE ALL ANSWERS THAT APPLY.

<table>
<thead>
<tr>
<th>Response</th>
<th>Chart</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>The water cycle determines our daily weather, bringing more or less precipitation at certain times of the year.</td>
<td></td>
<td>81.1%</td>
<td>297</td>
</tr>
<tr>
<td>If the water cycle speeds up, the weather gets better.</td>
<td></td>
<td>23.8%</td>
<td>87</td>
</tr>
<tr>
<td>The water cycle can bring long-term weather patterns like La Niña and El Niño.</td>
<td></td>
<td>52.2%</td>
<td>191</td>
</tr>
<tr>
<td>If the water cycle stops, the weather will stay the same.</td>
<td></td>
<td>24.0%</td>
<td>88</td>
</tr>
<tr>
<td>The water cycle has no effect on our weather.</td>
<td></td>
<td>18.3%</td>
<td>67</td>
</tr>
<tr>
<td><strong>Total Responses</strong></td>
<td></td>
<td><strong>366</strong></td>
<td></td>
</tr>
</tbody>
</table>

The concept of La Niña and El Niño may be a bit complex for 5th graders, and we have not found a really good activity to teach this, except for a few news articles we provide for students to read.
9. WHAT ARE THE SIX MAJOR COMPONENTS OF THE WATER CYCLE? CHOOSE ALL ANSWERS THAT APPLY.

<table>
<thead>
<tr>
<th>Response</th>
<th>Chart</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>evaporation</td>
<td></td>
<td>92.1%</td>
<td>328</td>
</tr>
<tr>
<td>condensation</td>
<td></td>
<td>78.4%</td>
<td>279</td>
</tr>
<tr>
<td>participation</td>
<td></td>
<td>33.4%</td>
<td>119</td>
</tr>
<tr>
<td>precipitation</td>
<td></td>
<td>80.1%</td>
<td>285</td>
</tr>
<tr>
<td>transpiration</td>
<td></td>
<td>70.5%</td>
<td>251</td>
</tr>
<tr>
<td>flotation</td>
<td></td>
<td>25.6%</td>
<td>91</td>
</tr>
<tr>
<td>infiltration (or percolation)</td>
<td></td>
<td>53.4%</td>
<td>190</td>
</tr>
<tr>
<td>anticipation</td>
<td></td>
<td>15.7%</td>
<td>56</td>
</tr>
<tr>
<td>runoff (or surface runoff)</td>
<td></td>
<td>62.9%</td>
<td>224</td>
</tr>
<tr>
<td><strong>Total Responses</strong></td>
<td></td>
<td><strong>356</strong></td>
<td></td>
</tr>
</tbody>
</table>

Infiltration and runoff were chosen slightly less than the other correct choices. Many teachers in grades K-5 do not teach transpiration, infiltration, and runoff as part of the water cycle, so this is progress.

10. WHAT IS A WETLAND? CHOOSE ONE ANSWER.

<table>
<thead>
<tr>
<th>Response</th>
<th>Chart</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>A water theme park.</td>
<td></td>
<td>4.2%</td>
<td>15</td>
</tr>
<tr>
<td>An area that is covered with shallow water or where the soil is naturally soaked with water.</td>
<td></td>
<td>69.4%</td>
<td>247</td>
</tr>
<tr>
<td>Land that is covered or soaked with water by farmers, to irrigate their crops.</td>
<td></td>
<td>9.8%</td>
<td>35</td>
</tr>
<tr>
<td>A rainforest.</td>
<td></td>
<td>13.2%</td>
<td>47</td>
</tr>
<tr>
<td>I don't know.</td>
<td></td>
<td>3.4%</td>
<td>12</td>
</tr>
<tr>
<td><strong>Total Responses</strong></td>
<td></td>
<td><strong>356</strong></td>
<td></td>
</tr>
</tbody>
</table>
11. WHAT ROLE DO WETLANDS PLAY IN A WATERSHED? CHOOSE ALL ANSWERS THAT APPLY.

<table>
<thead>
<tr>
<th>Response</th>
<th>Chart</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wetlands just smell bad and breed mosquitoes.</td>
<td></td>
<td>11.3%</td>
<td>40</td>
</tr>
<tr>
<td><strong>Wetlands support a diverse community of plant and animal life.</strong></td>
<td></td>
<td>71.5%</td>
<td>254</td>
</tr>
<tr>
<td>Wetlands just take up space where we want to build houses.</td>
<td></td>
<td>14.1%</td>
<td>50</td>
</tr>
<tr>
<td><strong>Wetlands help control flooding by storing the runoff and releasing it slowly.</strong></td>
<td></td>
<td>72.4%</td>
<td>257</td>
</tr>
<tr>
<td>Wetland plants help clean stormwater before it goes into a river, lake, bay or ocean.</td>
<td></td>
<td>65.6%</td>
<td>233</td>
</tr>
<tr>
<td>Total Responses</td>
<td></td>
<td>355</td>
<td></td>
</tr>
</tbody>
</table>

12. WHAT ROLE DO FORESTS PLAY IN A WATERSHED? CHOOSE ALL ANSWERS THAT APPLY.

<table>
<thead>
<tr>
<th>Response</th>
<th>Chart</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Forests help control flash flooding and erosion by holding the soil in place.</strong></td>
<td></td>
<td>73.4%</td>
<td>259</td>
</tr>
<tr>
<td>Forests just suck up all the water that should be going into our rivers and lakes.</td>
<td></td>
<td>21.5%</td>
<td>76</td>
</tr>
<tr>
<td><strong>Trees near rivers and lakes shade the water and help keep it cool.</strong></td>
<td></td>
<td>57.8%</td>
<td>204</td>
</tr>
<tr>
<td>Forests just cause forest fires.</td>
<td></td>
<td>8.8%</td>
<td>31</td>
</tr>
<tr>
<td><strong>Forests support a diverse community of plant and animal life.</strong></td>
<td></td>
<td>65.7%</td>
<td>232</td>
</tr>
<tr>
<td>Total Responses</td>
<td></td>
<td>353</td>
<td></td>
</tr>
</tbody>
</table>

The forests and wetland activity is a teacher-led activity, so inevitably not all teachers do it.
Unit 2 – Water in Our Society

1. HOW HAS WATER INFLUENCED HUMAN SETTLEMENTS AND CULTURE? CHOOSE ALL ANSWERS THAT APPLY.

<table>
<thead>
<tr>
<th>Response</th>
<th>Chart</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humans have usually settled near water for drinking, farming, fishing, to put out fires, and/or transportation.</td>
<td></td>
<td>92.2%</td>
<td>165</td>
</tr>
<tr>
<td>Humans have usually just settled wherever they want, without worrying about water.</td>
<td></td>
<td>10.1%</td>
<td>18</td>
</tr>
<tr>
<td>Humans have sometimes abandoned their settlements if there was not enough water.</td>
<td></td>
<td>73.7%</td>
<td>132</td>
</tr>
<tr>
<td>Humans have developed new technologies over time to solve water problems.</td>
<td></td>
<td>57.0%</td>
<td>102</td>
</tr>
<tr>
<td><strong>Total Responses</strong></td>
<td></td>
<td></td>
<td>179</td>
</tr>
</tbody>
</table>

2. WHAT ARE THE MAJOR COMMERCIAL USE(S) OF YOUR RIVER? CHOOSE ALL ANSWERS THAT APPLY.

<table>
<thead>
<tr>
<th>Response</th>
<th>Chart</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial fishing</td>
<td></td>
<td>37.1%</td>
<td>66</td>
</tr>
<tr>
<td>Shipping/transportation</td>
<td></td>
<td>19.7%</td>
<td>35</td>
</tr>
<tr>
<td>Agricultural irrigation</td>
<td></td>
<td>64.0%</td>
<td>114</td>
</tr>
<tr>
<td>Commercially operated recreation</td>
<td></td>
<td>29.2%</td>
<td>52</td>
</tr>
<tr>
<td>Electricity generation</td>
<td></td>
<td>36.5%</td>
<td>65</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>18.0%</td>
<td>32</td>
</tr>
<tr>
<td><strong>Total Responses</strong></td>
<td></td>
<td></td>
<td>178</td>
</tr>
</tbody>
</table>

Students are confused about what commercial use means. Many students wrote in “drinking water” under Other. Actually, though, many adults in NM don’t really know that agriculture uses so much of our river water.
3. WHAT CAN THESE COMMERCIAL USERS DO TO CONSERVE WATER OR PREVENT POLLUTION OF OUR WATER RESOURCES?

Most kids did not seem to understand the difference between commercial uses of the river and personal use. Many answered with ideas for things we could all do to help keep the river clean, but there were some answers relating to agriculture and to governmental management of the river, such as:

“Farmers can use drip or sprinkler irrigation instead of flood irrigation to help conserve water and can water their crops in the early morning or at night.”

“You can put trees that are adapted to our river like cottonwood and willows then they won’t use as much water and filter it when the water is coming to the river and one other important one, slowing down run-off.”

“They can take as little water as needed for their crops and they can try not to throw trash into the water while having fun in the water. They should also save storm water and not let it go away and run.”

4. IN WHAT WAYS IS DRINKING WATER USED IN AND AROUND OUR HOMES? CHOOSE ALL ANSWERS THAT APPLY.

<table>
<thead>
<tr>
<th>Response</th>
<th>Chart</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>washing dishes</td>
<td></td>
<td>73.0%</td>
<td>130</td>
</tr>
<tr>
<td>brushing teeth</td>
<td></td>
<td>85.4%</td>
<td>152</td>
</tr>
<tr>
<td>showering</td>
<td></td>
<td>71.3%</td>
<td>127</td>
</tr>
<tr>
<td>drinking</td>
<td></td>
<td>93.3%</td>
<td>166</td>
</tr>
<tr>
<td>watering yard with rainwater</td>
<td></td>
<td>14.0%</td>
<td>25</td>
</tr>
<tr>
<td>watering yard with a hose</td>
<td></td>
<td>55.6%</td>
<td>99</td>
</tr>
<tr>
<td>flushing toilets</td>
<td></td>
<td>64.0%</td>
<td>114</td>
</tr>
<tr>
<td>washing clothes</td>
<td></td>
<td>62.9%</td>
<td>112</td>
</tr>
<tr>
<td><strong>Total Responses</strong></td>
<td></td>
<td><strong>178</strong></td>
<td></td>
</tr>
</tbody>
</table>

The intent of this question was to see if students know that all of these things use our clean drinking water, except rainwater harvesting. We may revise the wording for next year, but the results are probably pretty accurate. Hose, toilet, and washing machine water were not readily identified as the same water as drinking water. We will continue to emphasize that the conservation message also applies to these household uses. Many adults actually don’t know that clean drinking water is used in flushing toilets.
5. FROM WHAT SOURCE DOES YOUR COMMUNITY GET ITS DRINKING WATER? CHOOSE ALL ANSWERS THAT APPLY.

<table>
<thead>
<tr>
<th>Response</th>
<th>Chart</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>clouds</td>
<td></td>
<td>39.5%</td>
<td>70</td>
</tr>
<tr>
<td>glaciers and icebergs</td>
<td></td>
<td>15.8%</td>
<td>28</td>
</tr>
<tr>
<td>groundwater/aquifer (wells) (correct for all NM communities)</td>
<td></td>
<td>86.4%</td>
<td>153</td>
</tr>
<tr>
<td>lake</td>
<td></td>
<td>18.6%</td>
<td>33</td>
</tr>
<tr>
<td>ocean</td>
<td></td>
<td>10.7%</td>
<td>19</td>
</tr>
<tr>
<td>river (correct for Albuquerque and many other places, but NOT Rio Rancho or most rural communities)</td>
<td></td>
<td>64.4%</td>
<td>114</td>
</tr>
</tbody>
</table>

We always struggle with how to word this question so that students don’t think they have to go all the way back to clouds in the water cycle. In fact, 97% of non-Albuquerque students chose groundwater and only 14.5% of them chose river, which is great because with all the news about Albuquerque river usage in local media it would be easy for kids in other communities to be confused about whether they are getting river water too.

6. DOES EVERYONE HAVE THE RIGHT TO USE AS MUCH WATER AS THEY WANT? CHOOSE ONE ANSWER.

<table>
<thead>
<tr>
<th>Response</th>
<th>Chart</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes, we can use as much as we want as long as we can pay for it.</td>
<td></td>
<td>18.7%</td>
<td>32</td>
</tr>
<tr>
<td>No, we need to be careful not to use too much because it is a limited resource that must be shared.</td>
<td></td>
<td>77.2%</td>
<td>132</td>
</tr>
<tr>
<td>I don’t know.</td>
<td></td>
<td>4.1%</td>
<td>7</td>
</tr>
</tbody>
</table>

Total Responses 177
7. **WHAT ACTIONS CAN ALL OF US TAKE TO CONSERVE WATER? CHOOSE ALL ANSWERS THAT APPLY.**

<table>
<thead>
<tr>
<th>Response</th>
<th>Chart</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drink less water.</td>
<td></td>
<td>22.6%</td>
<td>40</td>
</tr>
<tr>
<td><strong>Take shorter showers.</strong></td>
<td></td>
<td>95.5%</td>
<td>169</td>
</tr>
<tr>
<td>Drink bottled water or juice instead.</td>
<td></td>
<td>28.2%</td>
<td>50</td>
</tr>
<tr>
<td><strong>Turn off the water when brushing your teeth.</strong></td>
<td></td>
<td>95.5%</td>
<td>169</td>
</tr>
<tr>
<td><strong>Water outdoor plants during the coolest part of the day so less evaporates.</strong></td>
<td></td>
<td>66.1%</td>
<td>117</td>
</tr>
<tr>
<td>Water outdoor plants during the hottest part of the day.</td>
<td></td>
<td>14.7%</td>
<td>26</td>
</tr>
<tr>
<td><strong>Fix leaking faucets, toilets and outdoor water pipes.</strong></td>
<td></td>
<td>91.5%</td>
<td>162</td>
</tr>
<tr>
<td><strong>Total Responses</strong></td>
<td></td>
<td></td>
<td>177</td>
</tr>
</tbody>
</table>

Not quite as many students identified watering during the coolest part of the day as a way to conserve water (although this is more than last year.) Many students of this age are not aware of their household watering schedule, or may live in apartments.

8. **HOW CAN DROUGHT OR FLOODING AFFECT OUR DRINKING WATER? CHOOSE ALL ANSWERS THAT APPLY.**

<table>
<thead>
<tr>
<th>Response</th>
<th>Chart</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flooding just means there is more drinking water available for everyone.</td>
<td></td>
<td>11.4%</td>
<td>20</td>
</tr>
<tr>
<td><strong>Drought means there is less drinking water available for everyone.</strong></td>
<td></td>
<td>84.0%</td>
<td>147</td>
</tr>
<tr>
<td>Drought and flooding do not affect our drinking water.</td>
<td></td>
<td>10.3%</td>
<td>18</td>
</tr>
<tr>
<td><strong>Floodwater is dirty and can contaminate drinking water supplies or ruin equipment.</strong></td>
<td></td>
<td>80.6%</td>
<td>141</td>
</tr>
<tr>
<td><strong>Total Responses</strong></td>
<td></td>
<td></td>
<td>175</td>
</tr>
</tbody>
</table>
9. HOW CAN OUR GROUNDWATER (AQUIFER) BECOME POLLUTED? CHOOSE ALL ANSWERS THAT APPLY.

<table>
<thead>
<tr>
<th>Response</th>
<th>Chart</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>A leak from an underground tank can pollute groundwater.</td>
<td></td>
<td>72.2%</td>
<td>127</td>
</tr>
<tr>
<td>Dogs can poop in groundwater.</td>
<td></td>
<td>55.7%</td>
<td>98</td>
</tr>
<tr>
<td>Wind can blow trash into groundwater.</td>
<td></td>
<td>51.7%</td>
<td>91</td>
</tr>
<tr>
<td>Chemicals and oil on top of the soil surface can pollute groundwater, especially after it rains.</td>
<td></td>
<td>92.0%</td>
<td>162</td>
</tr>
<tr>
<td>Leaves, sticks and rocks can pollute groundwater.</td>
<td></td>
<td>26.7%</td>
<td>47</td>
</tr>
<tr>
<td><strong>Total Responses</strong></td>
<td></td>
<td><strong>176</strong></td>
<td></td>
</tr>
</tbody>
</table>

While the majority of students correctly identified groundwater pollution, there still seems to be a bit of confusion on what groundwater is, since a significant number of them also chose wrong answers.

10. HOW ARE GROUNDWATER AND SURFACE WATER CONNECTED? CHOOSE ALL ANSWERS THAT APPLY.

<table>
<thead>
<tr>
<th>Response</th>
<th>Chart</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical pollution can travel between groundwater and surface water.</td>
<td></td>
<td>67.4%</td>
<td>120</td>
</tr>
<tr>
<td>Fish can travel between groundwater and surface water.</td>
<td></td>
<td>14.6%</td>
<td>26</td>
</tr>
<tr>
<td>Dirt can travel between groundwater and surface water.</td>
<td></td>
<td>75.3%</td>
<td>134</td>
</tr>
<tr>
<td>Trash can travel between groundwater and surface water.</td>
<td></td>
<td>57.9%</td>
<td>103</td>
</tr>
<tr>
<td>Clean water can travel between groundwater and surface water.</td>
<td></td>
<td>62.4%</td>
<td>111</td>
</tr>
<tr>
<td>If we pump too much of either one, it can affect the other.</td>
<td></td>
<td>65.7%</td>
<td>117</td>
</tr>
<tr>
<td><strong>Total Responses</strong></td>
<td></td>
<td><strong>178</strong></td>
<td></td>
</tr>
</tbody>
</table>

This is a tricky question that many adults do not know how to answer. There is definitely some confusion about what can get into groundwater. The groundwater lesson is teacher-led, so probably not all classes did it.
### 11. WHERE DOES YOUR COMMUNITY’S WASTEWATER GO? CHOOSE ONE ANSWER.

<table>
<thead>
<tr>
<th>Response</th>
<th>Chart</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>It goes into a sewer system, which carries it through underground pipes to a centralized treatment plant (correct for Albuquerque and Rio Rancho.)</td>
<td></td>
<td>50.6%</td>
<td>85</td>
</tr>
<tr>
<td>It goes into a storm drain system.</td>
<td></td>
<td>11.9%</td>
<td>20</td>
</tr>
<tr>
<td>It goes into your drinking water system.</td>
<td></td>
<td>4.2%</td>
<td>7</td>
</tr>
<tr>
<td>It goes into a septic system, which treats it in an underground tank near the home or building (correct for most rural communities.)</td>
<td></td>
<td>15.5%</td>
<td>26</td>
</tr>
<tr>
<td>It goes directly into the river, lake, bay or ocean.</td>
<td></td>
<td>8.3%</td>
<td>14</td>
</tr>
<tr>
<td>I don’t know.</td>
<td></td>
<td>9.5%</td>
<td>16</td>
</tr>
</tbody>
</table>

**Total Responses** 168

### 12. WHAT IS THE DIFFERENCE BETWEEN STORMWATER, WASTEWATER, AND DRINKING WATER? CHOOSE ONE ANSWER.

<table>
<thead>
<tr>
<th>Response</th>
<th>Chart</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wastewater is dirty; stormwater and drinking water are clean.</td>
<td></td>
<td>22.6%</td>
<td>38</td>
</tr>
<tr>
<td><strong>Wastewater goes through the sewer system to a treatment plant, stormwater goes through the storm drains, and drinking water goes through nice clean pipes to your faucet.</strong></td>
<td></td>
<td>61.9%</td>
<td>104</td>
</tr>
<tr>
<td>Stormwater and wastewater both go straight to the river, lake, bay or ocean; drinking water goes through different pipes.</td>
<td></td>
<td>11.9%</td>
<td>20</td>
</tr>
<tr>
<td>None, it's all just water and all the pipes are connected.</td>
<td></td>
<td>3.6%</td>
<td>6</td>
</tr>
</tbody>
</table>

**Total Responses** 168

This is a tricky question that many adults do not know how to answer.
Unit 3: River Ecosystems

1. WHAT ARE SOME OF THE WAYS SCIENTISTS CAN DETERMINE THE HEALTH OF A RIVER, LAKE, BAY OR OCEAN? CHOOSE ALL ANSWERS THAT APPLY.

<table>
<thead>
<tr>
<th>Response</th>
<th>Chart</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>They can look under its tongue or in its ears.</td>
<td></td>
<td>2.5%</td>
<td>6</td>
</tr>
<tr>
<td>They can check pH, turbidity, temperature, and dissolved oxygen.</td>
<td></td>
<td>82.0%</td>
<td>196</td>
</tr>
<tr>
<td>They can check the weather channel.</td>
<td></td>
<td>7.1%</td>
<td>17</td>
</tr>
<tr>
<td>They can look at the types of macroinvertebrates that are living in it.</td>
<td></td>
<td>78.2%</td>
<td>187</td>
</tr>
<tr>
<td>If the water looks clean, they know it is healthy.</td>
<td></td>
<td>15.5%</td>
<td>37</td>
</tr>
<tr>
<td>They can look at the diversity of animals and plants living in and around it.</td>
<td></td>
<td>84.1%</td>
<td>201</td>
</tr>
<tr>
<td><strong>Total Responses</strong></td>
<td></td>
<td><strong>239</strong></td>
<td></td>
</tr>
</tbody>
</table>

2. HOW DOES WATER AFFECT LIVING THINGS IN AN ECOSYSTEM? CHOOSE ALL ANSWERS THAT APPLY.

<table>
<thead>
<tr>
<th>Response</th>
<th>Chart</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Many animals that do not live in the water eat fish and/or insects that come from the water.</td>
<td></td>
<td>65.5%</td>
<td>156</td>
</tr>
<tr>
<td>All living things need water that is clean or at least not too polluted.</td>
<td></td>
<td>87.4%</td>
<td>208</td>
</tr>
<tr>
<td>Some living things do not need any water.</td>
<td></td>
<td>8.0%</td>
<td>19</td>
</tr>
<tr>
<td>Fortunately, water pollution has no effect on humans, because we are not part of an ecosystem.</td>
<td></td>
<td>7.1%</td>
<td>17</td>
</tr>
<tr>
<td>If there is not enough water (drought), humans can learn to conserve.</td>
<td></td>
<td>61.8%</td>
<td>147</td>
</tr>
<tr>
<td>If there is not enough water (drought), some plants and animals can adapt, but others may die.</td>
<td></td>
<td>78.2%</td>
<td>186</td>
</tr>
<tr>
<td><strong>Total Responses</strong></td>
<td></td>
<td><strong>238</strong></td>
<td></td>
</tr>
</tbody>
</table>
3. WHAT ROLE DO AQUATIC MACROINVERTEBRATES PLAY IN THE FOOD WEB? CHOOSE ONE ANSWER.

<table>
<thead>
<tr>
<th>Response</th>
<th>Chart</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plants eat them.</td>
<td></td>
<td>5.5%</td>
<td>13</td>
</tr>
<tr>
<td>They provide food for many other animals in the ecosystem.</td>
<td></td>
<td>76.9%</td>
<td>183</td>
</tr>
<tr>
<td>They are at the top of the food web.</td>
<td></td>
<td>5.0%</td>
<td>12</td>
</tr>
<tr>
<td>They are just annoying and gross.</td>
<td></td>
<td>0.4%</td>
<td>1</td>
</tr>
<tr>
<td>I don't know.</td>
<td></td>
<td>12.2%</td>
<td>29</td>
</tr>
<tr>
<td><strong>Total Responses</strong></td>
<td></td>
<td><strong>238</strong></td>
<td></td>
</tr>
</tbody>
</table>

4. WHY DO SCIENTISTS STUDY AQUATIC MACROINVERTEBRATES? CHOOSE ALL ANSWERS THAT APPLY.

<table>
<thead>
<tr>
<th>Response</th>
<th>Chart</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Because we want to figure out how to get rid of them.</td>
<td></td>
<td>8.9%</td>
<td>21</td>
</tr>
<tr>
<td>Because they are important in the food web and we want to make sure they are healthy.</td>
<td></td>
<td>83.4%</td>
<td>196</td>
</tr>
<tr>
<td>They serve as indicators of water pollution and tell us a lot about water quality and health.</td>
<td></td>
<td>80.9%</td>
<td>190</td>
</tr>
<tr>
<td>Because the more bugs we see, the more polluted the water is.</td>
<td></td>
<td>8.9%</td>
<td>21</td>
</tr>
<tr>
<td><strong>Total Responses</strong></td>
<td></td>
<td><strong>235</strong></td>
<td></td>
</tr>
</tbody>
</table>

These results are impressive, because most adults do not know what macroinvertebrates are, and it is very unlikely that students have been exposed to this topic before RiverXchange.
5. WHAT ARE SOME OF THE WAYS HUMANS HAVE CHANGED RIVER ECOSYSTEMS? CHOOSE ALL ANSWERS THAT APPLY.

<table>
<thead>
<tr>
<th>Response</th>
<th>Chart</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constructed dams for water storage, flood control, irrigation, or electricity generation.</td>
<td></td>
<td>89.9%</td>
<td>214</td>
</tr>
<tr>
<td>Introduced non-native plants and animals.</td>
<td></td>
<td>67.6%</td>
<td>161</td>
</tr>
<tr>
<td>Straightened river channels, making water flow faster.</td>
<td></td>
<td>56.3%</td>
<td>134</td>
</tr>
<tr>
<td>Put more water into the river, making it overflow.</td>
<td></td>
<td>10.9%</td>
<td>26</td>
</tr>
<tr>
<td>Taken too much water from rivers, making it difficult for plants and animals to survive.</td>
<td></td>
<td>65.1%</td>
<td>155</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>18.1%</td>
<td>43</td>
</tr>
<tr>
<td>Total Responses</td>
<td></td>
<td></td>
<td>238</td>
</tr>
</tbody>
</table>

Many students named also other human changes, like pollution, jetty jacks, irrigation channels, and building houses by the river. Human impacts on our river may not have been fully addressed in all classes.

6. WHAT ACTIONS CAN PEOPLE TAKE TO IMPROVE THE HEALTH OF OUR ECOSYSTEM? CHOOSE ALL ANSWERS THAT APPLY.

<table>
<thead>
<tr>
<th>Response</th>
<th>Chart</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>We can conserve water so that there is more water left for wildlife and plants.</td>
<td></td>
<td>88.6%</td>
<td>210</td>
</tr>
<tr>
<td>We can use as much water as we want.</td>
<td></td>
<td>4.2%</td>
<td>10</td>
</tr>
<tr>
<td>We can study the ecosystem to understand what is happening.</td>
<td></td>
<td>89.5%</td>
<td>212</td>
</tr>
<tr>
<td>We can plant native plants and create wetlands to restore the ecosystem.</td>
<td></td>
<td>77.6%</td>
<td>184</td>
</tr>
<tr>
<td>We can remove non-native plants and animals.</td>
<td></td>
<td>52.7%</td>
<td>125</td>
</tr>
<tr>
<td>We can cut down trees and pave over wetlands.</td>
<td></td>
<td>3.0%</td>
<td>7</td>
</tr>
<tr>
<td>We can let chemicals and trash go down storm drains.</td>
<td></td>
<td>4.2%</td>
<td>10</td>
</tr>
<tr>
<td>Total Responses</td>
<td></td>
<td></td>
<td>237</td>
</tr>
</tbody>
</table>
7. WHAT ARE SOME NATIVE SPECIES IN YOUR ECOSYSTEM?
Students named many native species, including cottonwoods, willows, turtles, Rio Grande silvery minnow and other native fish, porcupines, Sandhill Cranes, roadrunners, hawks, and coyotes.

8. WHAT ARE SOME INVASIVE SPECIES IN YOUR ECOSYSTEM?
Many students were able to name Siberian Elm, Russian Olive, Tree of Heaven, Saltcedar, and Russian Thistle (tumbleweed).

Student Writing
The writing component is one of the most valuable components of the program, yet it continues to be our biggest challenge. We are continually striving to improve participation in this area because it helps teachers integrate writing in the content areas, and reinforces student understanding of key water resources concepts. Teachers faced a major challenge this year in getting access to computer labs, which are tied up for much of the year with the PARCC and other computer-based tests.

Many teachers told us they planned to use RiverXchange as a major component of their writing program for implementing the Common Core Language Arts standards, which require they focus more on writing within content areas and utilize or produce informational texts. Each year, we strongly encourage teachers to have students write and edit paragraphs before going to the computer lab, because this promotes higher-quality thinking and writing. When students do go through this process, it shows. We also encouraged teachers to use various forms of communication in addition to writing, such as videos, PowerPoint presentations, or audio files.

This year, we stayed with essentially the same wiki format as last year, which was more conducive to group projects than previous formats. We saw many excellent PowerPoint and video projects, but we still saw a lot of great individual writing. Much of the writing clearly shows critical thinking, as well as a broad understanding of how our ecosystem, stormwater, drinking water, wastewater, and agriculture are connected.

Obviously, the more often students communicated on the wiki, the more fun they had with the pen pal component. Teachers and students expressed frustration if the pen pals did not write back quickly or at the same pace. We explain to teachers that the writing component is valuable for students even if pen pals don’t post, because students in the same class could read and comment on each other’s writing. Still, our biggest challenge is to increase the number of successful partnerships, in which both partners are actively engaged.

This year, we gave teachers a rubric for their initial conversation with their partner, outlining important questions they should ask and issues they should discuss, hoping that they would form a more personal connection. Next year, we plan to adopt a simpler online sharing format that is more like a blog for each class, and all classes would be able to see all the other classes’ blogs.

With nearly 2,400 student pages to track throughout the school year, managing and analyzing this unique assessment component required regular and ongoing wiki review throughout the year. As in previous years, we saw less writing from our partners, who receive less support. We had to replace several partners, and the new partners had a difficult time getting started in the middle of the year; unfortunately some of them did not write on even one topic. On one hand, this is unexpected because partner teachers generally only participate because of the partnership component. On the other hand, this makes sense because we are able to train NM teachers in person, and students are highly motivated to write on the wikis after guest speakers visit.

We know from discussions with teachers that the absence of student writing does not mean they did not do the activities, or that no learning took place. Many teachers were also dealing with issues unrelated to the program,
such as new curriculum in other areas, school reorganization, or construction which prevented access to the computer lab for a portion of the year. We did our best to foster successful online partnerships, but even if there was not much activity on the wiki, students still benefited from the guest speakers and the field trip.

**Samples of Student Writing (spelling and punctuation are original)**

**River Geography**

Dear Friend,

The river here in New Mexico is called the Rio Grande meaning 'big river.' The head waters for our river is in Silverton, Colorado. The water here drains into the Gulf of Mexico. In our area the river is moving at a decent speed. Our river is about 50 to 75 yards wide. The water in our river is very muddy and not clear. Each year we get 5 to 10 inches of precipitation each year. We get most of our water in monsoon season which is July through September. We also get a lot of our water from snow melt in Colorado.

Sincerely, Kyle

Hello again i just had a really nice lady come to our school and give us a presentation. And I learned that we shouldn't litter anywhere not at the river not anywhere not in a million years .I hope you all decide not to litter too. My river starts in Colorado and ends at the Gulf of Mexico. My river is really long! I can't wait to go again. I love the Rio Grande it is so awesome! The name is our river is called the Rio Grande. It is very cool and muddy. It is perfect for fishing.

**Watershed Model**

A watershed is important because it gives us our food and water. I think we should keep our watershed clean. If we don’t keep our watershed clean, we will not have clean water to drink. It is important to keep our water shed clean for the animals to be safe because if they drink the water, they might die and some type of species will become extinct. Farm animals might die too because of different chemicals in the water.

I learned that people cause the watershed to be dirty to by semi trucks leaking oil, people using weed killer and they don’t read the fine print on the bottle and so they put a lot of weed killer and that weed killer does not soak in together right away .When it rains that weed killer will flow down throw the road and go into the watershed. People take there dogs for walks and guess what they do they make waste, and the people do not pick up the dogs waste ,those are ways that people don’t take care of our watershed . Another thing I learned is that factories and farms are effective to the watershed to o. The factory has chemicals that they use to make different products they make ,and the farm has the same ways that the people do to affect the watershed. Keep the watershed clean.

It is important to keep our watershed clean because if our watershed is not clean it can affect ocean life, sea life, any kind of water life. It can also affect decomposition. Because the dead bugs, or bacteria, and also manure. All decompose into the soil. Then that helps plants grow. If we don’t take care of our watershed it can affect animals to we can actually affect the circle of life, which is why it is so important. Even I am going to try my best to help the environment. Even if I have to be flexible and switch up my plans. I will do all I can do for the environment. If we don’t take care of our watershed we will have to suffer the consequences.

From my class’s guest speaker that talked about our watershed I learned that the name of our watershed is the Rio Grande watershed. The Rio Grande River flows from its headwaters in the San Juan Mountains of southern Colorado to the Gulf of Mexico. I found this very interesting when I first found out that I live in a watershed I was very excited to tell my family but I figured they probably already knew. So I didn’t get to tell
anyone I also learned that leaving dog or cat manure or pee can infect the watershed and make it hard to live for the fish. But they can’t complain to anyone like us so its unfair to them. It also affects the life cycle.

**Persuasive essay by Fiona**

You think “Oh, well, it doesn’t matter what goes into our storm drains, its not like it goes strait into the river, right?” Wrong. Not all of the water gets treated. All of the dog scat, urine, and cigarette buds you leave on the street goes into the river. The river is where our drinking water comes from, so you are basically drinking all that trash you pour down the drain. Also, with all of that dirt in the river takes out the oxygen and clogs the fish’s gills.

Now you think “Well, that is really bad. But what can I do? I’m just one person” “Or I’m just a kid”. But both of those answers are wrong. You can do anything to help, even if you’re a kid. First of all, if you’re a kid and you walk your dog, pick up its poop! Don’t just leave it on the street! If you’re an adult you’ve probably changed your cars oil. You know how it leaves oil on the ground. Put kitty litter over it then dispose of it properly. We can all make a change!

Hi my name is Renee. I'm a girl :) I'm from Albuquerque New Mexico. Today a women named Sarah came to our classroom and was teaching us about our watershed. I learned that you are supposed to pick up your dog’s waste. Waste means poop. $ Or else it will go into our river, we drink water from our river. Does someone want waste (poop) in their water? Speaking of rivers, our New Mexico river is the Rio Grande. Now a little bit about myself. I really like playing minecraft on my xbox 360. Please send back soon.

Dear McKenzie,

My name is Abbie and I go to Cochiti Elementary School in Albuquerque New Mexico. Today my class and I went to a presentation about a watershed. The woman that gave the presentation was named Mrs.Sarah and she used black frosting to represent oil from cars and chocolate as feces from animals and green and red Kool-Aid mix as fertilizer. At the end it rained, she used a spray bottle with water and everything went into the river, I realized that to help my city, the Rio Grande, and the environment that I have to help pick up trash around the neighborhood and tell my parents to go to Auto Zone to make sure that their cars don't leak. I am 10 years old and I also enjoy to cheer in fact I am a cheerleader for the Valley Vikings and my favorite color is blue.

Sincerely,

Abbie

Hello it's Asiana. A presenter came to our class and talked about how people polluted the river. There are so many ways a river can be polluted. You might not think these are ways but they are. A big way is when you are littering this littering washes into the river with rain. More ways of polluting the water shed is when you put too much fertilizer in your plants, the plants don’t absorb all that fertilizer and when it rains it washes into the river. Also with pesticides people put too much and when it rains it washes into the river. This happens with farm animals and dogs when they poop and the owner is irresponsible, they don’t pick it up and it washes into the river. Another big problem is that factories spill nasty chemicals into the river. Imagine all that waste spilling in our river. We take this water and drink it, shower with it, and wash dishes, cloths, and hands with it.

**Infiltration and Runoff**

Albuquerque's aquifer is getting very low. In 1960 it was full of water but in 1990 a lot of water was depleted. Infiltration is were water can go threw the ground. Runoff is were water runoff impermeable surface into a body of water. Ground water is water that goes threw permeable surfaces and soaks over 100 feet underground and we use it for drinking water.

Dear Partner,
Hi, my class and I did a science project and I would like to tell you about it. In this amazing, legendary, and extremely fun project we were trying to see where storm water goes once it hits our school property. We did this because we want to see if our water goes somewhere good, like soil with plants in it, or somewhere bad, like a storm drain. We took a tour around the school and were assigned different places. Then, we got into groups and took some notes. We also got to map our section and make compasses, map keys, and scales! Me and my friends did the playground.

What I observed was that there was a lot of feces around our property around our property. It was fun because we got to go around the school and go in places we usually can’t go. I also saw there are a lot of impervious surfaces. There were fourteen storm drains. Another thing that was fun was the map. It was fun drawing it.

Some improvements that could help our school are maybe a bio-swale. Bio-swales would help filter the water in the grass. A bio-swale is a space in the dirt that is filled with grass. It would also be good if we added more plants around our school property. That would help filter water, help it infiltrate, and make it healthier to eat. I think it would be great if we added a vegetation garden. A vegetation garden is a bunch of different types of plants that help the water infiltrate. With this variety of other improvements this school, Placitas Elementary, could be a great place in terms of nature.

Water in this part of the country is a scarce source, although it is in high demand. Now that I know what all of this is, I will continue to support it. Water is a needed source, we need to save it.

Forests and Wetlands

i went to wet land i saw some really small bugs they were in the lake i also saw some baby goose they are also called goslings they were so cute i could die. but lets get back on topic i love the river but there was some stuff in it and it was gross that people throw that stuff in there so please do not throw stuff in the river for me and all the animal that live there.

Water and Agriculture

Hey,

Lately we have been learning about the 3 types of irrigation, drip, sprinkler, and flood. They are all good methods but it really depends on your area. We were also lucky enough to go on a field trip to Amos Open Space to plant trees. We were planting native trees which mean that they naturally grow there. We planted them in the water table which is the water under the land. The closer you are to the water the farther down you must dig. Hope you learned as much as i did.

Sincerely, Lauren

Hello Washington! January 27, 2015

Today we had a presentation from the 4-H program. We learned 3 types of irrigation: Flood irrigation, Sprinkler irrigation, and drip irrigation. We also leaned about the Dust Bowl. There was a severe drought that caused a dust storm. It was so bad that people would go to sleep with a fresh pillow and wake up with dirt everywhere. Some people even got dust pneumonia and died. People did not like this so it caused mass-migration. After we did a experiment with seed’s dirt and Mini tractor’s then put 4 seeds in 3 rows. We then watered the seeds in three different ways. We used a spray bottle for sprinkler irrigation, a container full of water for flood irrigation, and container full of water with a spout at the end for drip irrigation. We recorded our results and found out sprinkler and drip were the best for our crops. But it depends on what region you live in. I hope you learned from this.

Sincerely, Sara

Dear Pen Pal,
For our River X Change I had learned about flood irrigation, drip irrigation, and sprinkler irrigation. I also learned that sprinkle irrigation is the best for the world and our crops. Flood irrigation uses too much water and is not even with other crops. So some would get too much water and some would not get enough water. Drip irrigation is too expensive because the pipes are very special and they are easy to break. In the winter they might freeze and bust. Then you have to buy them again and you waste a lot of money.

**Groundwater**

Hi guys,

We have been studying aquifers. An aquifer is an underground layer of water-bearing rock or other material. Our aquifer is becoming depleted because of how much we rely on it. We have also learned a lot about groundwater and infiltration. Groundwater is water located beneath the Earth's surface between soil particles and rocks. When rain falls on a permeable surface it is absorbed and becomes groundwater. If the surface is impermeable then the water will become runoff and flow into a nearby river. Infiltration is simply the process of water being sucked up by a permeable surface.

**Drinking Water**

Dear Pen Pal,

A week ago on the 22nd we had a guest speaker named Ms. Erin she came and talked to us about drinking water. We get our water from the Rio Grande and aquifers. We get 60% of our water from the Rio Grande and 40% of water from the aquifers. We didn't start using the water from the Rio Grande until 2008. We used to use 250 gallons a day per person, now we use 137 gallons a day per person. We did an experiment with water and found out that we use around 18,471 gallons of water in 1 year. I was so far from the correct answer and I was very surprised. We also found out that there is only 0.003% of water available for drinking water in the world for all 7 billion people. Did you know that the toilet uses 27.7% of water, a washer uses 21.7% of water, the shower uses 16.8% of water, Faucet uses 15.7% of water and a leak wastes 13.7% of water. I found out that if I take shorter showers and don't keep the water running while I brush my teeth, hopefully we can boost up the percentage of water we get.

We waste a lot of water because of leaks. 29.9% of our water goes into toilets. Some ways to conserve water are take short showers, check for leaks, and low flow toilets. Only 0.003% of our fresh water is available. We thought that we had a lot of water in our aquifer when we have a little bit. We have so little because it takes a long time for the water to replenish. Also it rains very rarely in New Mexico. There's so much rock and dirt that it takes a long time. We would have a lot more if we conserve.

Dear, Pen Pal

Today we watched a video of water and electricity work together. It says water depends on electricity and they need each other. So we have to help them stay together for a really long time. so we can save water and energy. We can save them by turning off the lights and talking out the phone chargers, fixing leaks, and 5 minute showers. I also learned that our water treat plant cleans out water.

We had another speaker talked to us about how much water we use a year in our homes. Toilets use 20.7%, Washer 21.7%, Shower 16.8%, Faucet 15.7%, and leaks 13.9%. If there is a leak in a pipe it wastes water and it costs more. Most of the water we drink is from our rivers, so if we use to much water we might run out later on in our lives. We can save water in many ways one way is by checking for leaks, another way to save water is by turning off the water when we are brushing our teeth.
Wastewater

Hi! Last week we have been learning about New Mexico's waste and storm water. In New Mexico the storm water does not get cleaned, the water goes through the drain to the Rio Grande. One the other hand the wastewater (from the sink, shower, toilet etc.) goes to a waste water treatment plant and gets clean. First the water goes at this big thing where there is a screen were it gets all the trash. They have three categories, trash, water and sludge. to clean the sludge they spin it around so the dirt and grit falls to the bottom. To get all of the poop out of the water the put microbes in to the water so they can "eat it". Then they have this light that they put over the water. Its called ultra violet light and it kills the bad stuff. Once the water is all clean they send it down the river. That is the process of cleaning the water.

Sincerely, Asia

Last Wednesday a lady from the Water Authorities and we got to seperate trash, water, and sludge. Then we got this thing that is plastic and it has holes in it. After we put all things in the cup we put this plastic thing on top of the cup and we put the trash in the trash and the water in the water and the sludge in the sludge. The experiment was AWESOME. in the factories they have this thing that has a UV light to kill the microbes. Then what they do with the water is they put it back in our Rio Grande River.

Hello its Keysean typing from Albuquerque, New Mexico and I am typing about waste water for household machines and what happens to the water. I am also going to be talking about how we can prevent bad storm water and how we clean the storm water so it can go into the river. Waste water from household machines goes through pipes and goes to a water treatmant plant. But in storm water it goes to the storm drains and goes to the local river. And if we litter than the storm water carries it to the storm drain and damages the river. And if we throw things in sinks or toilets like baby wipes and sometimes trash, people have to clean it out with all the other wastes. The water treatment plant recieves the water from the sewer and and filters it and uses all these microorganisms and it eats the poop and farts methane gas and it powers an electric plant and the water gets disinfected by ultraviolet light and destroys genetic bacteria and viruses. Then the clean water goes to the river and joins all the waste water from showers,toilets,sinks, and washers. And this is what I am typing about today and see you guys later....or girls.

Dear Pen Pal,

On Friday the 17th a lady named Ms. Sharon came and talked to us about the Water Treatment Plant and how the wastewater gets clean. There are three things that end up at the plant. 1) Water, pee 2) Sludge (poop, and anything that used to be food) 3) Trash. The wastewater goes through a large cycle to get clean enough for us to drink. The water that we is connected to the toilet, the sink, the hose, and pretty much anything around your house that has todo with water. I learned that water sometimes has a limit and we can't be greedy with the water that we have.

Sincerely, Abbie

Field Trips

Dear Tori,

My name is Ezra, your pen pal in New Mexico. Today we went to the Rio Grand River in the Bosqe (woods) to plant cotton wood and whip willows trees. I learned that we are in a drought because of trash, dams, and global warming. Also I learned that these trees are dormant and provide animal habitats like Canada geese, red tailed hawks, and porcupines. Different animals also live in the water like beavers, otters, and ducks. I got to learn many things that I never knew before and the animals that live there. I had to use different materials and tools I never used before. It was fun for teachers and my classmates. Mrs.Bonnie, Mr.Bill, Mr.Matthew were the names of the people who helped us. What field trips have you taken and what did you learn?
Dear PenPal,

I went to the Rio Grande or the bosque (which means woods). We planted cotton wood trees and whip willows. I learned that those were the only trees you could plant with the branches. I also learned how to use the tools and how far to bury the plants. We got to eat at a very special place, on the shore of the river. I had a great time there and hope I go there again.

Sincerely, Anthony

I planted over 15 trees with the help of my dear friend Naomi U. I love to get dirty! My friends are really girly and they don’t like to get dirty. We used branches from the coated wood trees some were only 5 feet tall but some were 10 feet tall!!! This is how you plant a tree... First you use a tool to dig a hole. You twist the tool and you pull it up. You will see than there is a lot of mud. Then you take out the tool... Oh I forgot to tell you that the tools name is called a auger. So, you take the tool out and bang it on the ground. That will get all the mud out. You do that tell you see water flowing. That is called a water way. When you see water pound the tree in to the ground. Finally you cover up the whole you dug. Make sure that there is not any air holes pack it in REALLY tight.

Tori

Dear RiverXchange partner,

Last week my class went to a place called Tingely Beach. It has our Bosque behind it with interesting things like the Russian Olive seed and they plant the seeds and the plant are from Russia, the cottonwood tree it is native and it has small seeds that has piece of cotton inside it and when it blooms it flows through Albuquerque, and we even saw some geese that had some baby geese in the edge of the Rio Grande. When we were at the wetlands we had to take tests on the water in the two different ponds the Bosque had we used PH and O and there was another one was called trumity.

Last Wednesday we went on a field trip to Tingley Beach at the Bosque we learned about a lot of stuff like how they develop water and how people can put trash into the water then leaving it there and don’t pick it up and throw it in the trash. We also learned about sticks then when you break the stick in the right place you can see a star which is cool. When we were there we took a little bag and a spoon and then look what we could find. We saw a porcupine, and a bird that was picking the tree with it’s beck of it’s nose then by the river we saw cute little gooses and they had baby ducklings it was cute. Then we kept walking it was a good walk. I liked the field trip it was fun when it was lunch time we sat by the pond then we a lot of Ducks, and Gooses. When we were there they gave us a bingo list it was fun it was a blackout. After that we had to go it was a fun day.

RECOGNITION

We acknowledged the exceptional commitment made by presenters and field trip providers, by sending thank you cards with quotes from student wiki writing about the activities they provided. We also acknowledged sponsors and in-kind contributors on our website.
NEXT STEPS

- As of July 1, RiverXchange will become a program of Ciudad Soil and Water Conservation District. Amy White will be employed as Ciudad’s Education Coordinator, and will continue to manage the program, while Ciudad will take over all fiscal management and the program will be covered under their State insurance policy.

- We have applied for funding from several sources for 2015-2016, including:
  - Southern Sandoval County Arroyo and Flood Control Authority
  - Mid Rio Grande Stormwater Quality Team
  - National Fish and Wildlife Foundation’s 5-Star Urban Waters grant

- Teacher Workshop:
  - Each year we invite a guest speaker to keep the workshop fresh for teachers who have participated for several years. Next year we hope to feature a puppeteer who will give teachers ideas for incorporating puppetry into student presentations to deliver their message in a unique and creative way.

- Partnerships:
  - Require teachers to communicate by phone with their partner twice a semester.
  - Provide a “rubric” to guide teachers through the types of information they need to find out from each other and planning issues they should discuss.
  - Partner teachers more systematically for mentoring and/or technologies available to them.

- Curriculum:
  - Revise the curriculum to include more engineering-focused activities to align with Next Generation Science Standards.
  - Revise wiki format based on teacher feedback: make format simpler, more like a blog for each class, and give all participating classes access to all the blogs.
  - Continue to encourage audio, video, or other presentation formats as an option instead of only writing assignments.

- Assessment:
  - Instead of a quiz for each unit, next year we plan to do a simplified online pre and post survey.
APPENDIX 1: CURRICULUM

Welcome to RiverXchange... learning and sharing across borders!

RiverXchange is about communication and developing 21st Century Skills while learning about our watersheds! Each class will be partnered with one or more classes in a different state. The big idea is to communicate with your partners at least twice each semester by posting projects on your shared wiki website and responding to what your partners have posted.

A firm "handshake" will get your partnership off to a great start! As soon as you get your partnership assignments, you MUST contact each other by phone, Skype, or FaceTime, to establish a working relationship. Most importantly, you will set two dates each semester for sharing your projects, and let your partner know what you plan to do. Then, post these dates on the Teacher Collaboration page of your wiki, which can be seen only by wiki administrators.

The curriculum in the following pages is what New Mexico teachers will be doing throughout the year, and is a rich resource for teachers in other states. However, many partner teachers will be doing other excellent river and watershed-related projects and will post about these on the wiki instead. Our goal is that students be able to understand and discuss all of the Big Water Questions by the end of the year.

The Big Water Questions

Understanding a Watershed
- What is a watershed?
- Where does your community’s stormwater go?
- How can surface water become polluted?
- How does the water cycle relate to weather?
- What role do forests play in a watershed?
- What role do wetlands play in a watershed?
- What actions can all of us take to keep water clean?

Water in Our Society
- In what ways does our society use water?
- From what source does your community get its drinking water?
- Does everyone have the right to use as much water as they want?
- What actions can all of us take to conserve water?
- How are groundwater and surface water connected?
- How can groundwater become polluted?
- Where does your community’s wastewater go?
- What is the difference between wastewater, stormwater, and drinking water?

River Ecosystem
- How does water affect living things in an ecosystem?
- What are some of the ways scientists can determine the health of a river, lake, bay or ocean?
- What are some of the ways humans have changed rivers or other aquatic ecosystems?
- What actions can all of us take to improve the health of our ecosystem?
Student Assignments:

All of the lessons in our curriculum include a “Student Assignment” which can be expressed through writing, photos, video, audio, PowerPoint, or other projects. The only requirement is that you post two projects each semester, and respond to what your partners have posted. This new format supports the essence of our program - meaningful sharing between classes.

Suggestions include:

- Create a public service announcement
- Create a news cast with various reporters discussing different areas
- Create a short documentary
- Create an animation (using a tool such as kid pix)
- Create a PowerPoint presentation
- Write a poem
- Write a book report for one of the suggested books
- Create a poster and post a photo of it on the wiki

We know that with all the other pressures in schools today, it may be difficult to find time to share on the wiki. Here are some suggestions we have gathered over many years of working with teachers on this great program.

Strategies for making the most of limited computer time:

1. Take videos on your smartphone, then post them yourself to group pages
2. Take pictures of posters or hand written assignments, then post to group pages.
3. Do a whole class project/posting using the Promethean or Smart Board. For instance, write down all the things that can pollute our river, group them by source/non-source, identify which ones the kids can help prevent, save and post the final diagram in each of the groups on the wiki.
4. Read postings from partners using Promethean or Smart Board, as a “Friday fun day” activity on the weeks they have posted. This could be done as a reading aloud/public speaking exercise.
5. Identify and train one student from each group to be the “tech leader.” Have just these students use the limited classroom computers to post the group projects.
6. Encourage posting from home as homework. Just be sure to monitor what was posted the next day. Even if not all students have computers at home, some will. Consider dividing students up so that at least one person in each group has computer access at home, and they could become the “tech leader.”

Strategies for planning and integrating with other curriculum:

1. When looking at your plans for the year, for all subjects, keep RiverXchange in mind. Remember, if you want to post “out of order” that is fine!
2. Modify the style of writing to match what you are planning to cover at that point in the year.
3. Posting shortly after a guest speaker comes to your class is recommended, so you could also consider rearranging your language arts curriculum (and scheduling your computer lab time) to coordinate with times when presenters are scheduled.
4. Whatever subject you enjoy the most, see how you can use RiverXchange to enhance it.
   a. Social studies: history of why early settlers lived where they did, economic impact of rivers and water, use of water by industries
   b. Math: calculate water use, waste, length of rivers, etc
   c. Science: volume, density, states of matter
   d. Language arts: writing is obvious but also poetry, reading informational texts, public speaking
   e. Other specialized topics such as engineering, careers, art, music
New Mexico Curriculum Overview

Remember, partners in other states may be doing their own curriculum, but we hope you will be able to have good discussion on several of these topics over the course of the year. You may also want to combine some of the lessons so that students do a project that incorporates elements of multiple topics from the curriculum. For example, you could have students write about their river’s geography while also talking about its watershed and ways to keep pollution out of it.

Unit 1: Understanding a Watershed
1. River Geography
2. Watershed Model
3. Infiltration and Runoff
4. Forests and Wetlands

Unit 2: Water in Our Society
5. Commercial Uses of Our Rivers
6. Drinking Water
7. Groundwater
8. Wastewater

Unit 3: River Ecosystems
9. Field Trip (with pre and post activities)

Unit 1: Understanding a Watershed (September-December)

Project 1: River Geography

Student Assignment
Write a friendly letter to your partners (on your group page) or create another type of project, explaining:

a) what a watershed is
b) the name of your river - this is also the name of your watershed!
c) the journey of your river from its headwaters to the ocean
d) what the river is like in your area - big/small, clear/muddy, fast/slow?
e) how much precipitation your area receives each year, and what season gets the most precipitation

Informational Texts
- Follow the Water from Brook to Ocean, by Arthur Dorros or Paddle-to-the-Sea, by Holling C. Holling

Classroom Activity – Flexible! Just do as much as you want, and feel free to substitute other activities.
1. Read the book, Follow the Water from Brook to Ocean, by Arthur Dorros (about the Colorado River) OR Paddle-to-the-Sea, by Holling C. Holling (most U.S. School or public libraries have one or the other, or they can be purchased online). Explain how water flows from smaller bodies of water into a larger body. Introduce the concept of a watershed as the land area that drains into a body of water, and explain that this is where surface water comes from.
2. Show students the U.S. Watersheds Map (see link below), pointing out your watershed and your partners’ watershed. Talk about the significance of the Continental Divide in North America, and show them
where it is in New Mexico. Ask students “Is every place in the world part of a watershed?” Even if there are no hills or mountains, and there is no visible surface water, every place IS in a watershed because precipitation that falls on that land area eventually drains somewhere.

3. Have students identify your river or stream on a large classroom map, and show them where your school is located in relation to your river (north, south, east, west). Figure out where your river or stream starts (headwaters), what tributaries flow into it, and what ocean it flows into at its delta (many students may not know that the Gulf of Mexico is part of the Atlantic Ocean).

4. Point out what towns (if any) are upstream from you and discuss how they could affect your water (quantity and quality) either positively or negatively. Discuss what towns are downstream (if any) and how your town could affect their water, either positively or negatively. Trace your river's path to the ocean, recording each body of water it passes through.

5. Locate your school and your partners' school on the Precipitation Map (see link below). How many inches of precipitation does your area receive? Compare with your partner’s ecosystem.

6. Discuss seasons, timing of your area’s precipitation, the altitude of your area and how these affect weather. Explain how precipitation and snowpack affect the river.

7. Show students the Major Cities and Rivers Map (see link below), and ask them why they think so many big cities are located near major bodies of water.

8. **Optional:** If you have time, students (or groups of students) could research major flora and fauna in different regions along the length of your river or tributaries and create a picture postcard from that place. Or, they could write a story about a journey down the river.

9. **Optional:** New Mexico classes -- for more information about the Rio Grande watershed in New Mexico, show students the Everything is Connected in a Watershed poster (in teacher packet), then visit the All About Watersheds website (see link below) to explore the interactive version.

**Vocabulary**

- **Watershed:** The land area from which snowmelt and rain drain into a river, lake or other body of water. Also known as a drainage basin or catchment.
- **Surface water:** Water collected on the ground or in a waterbody such as a stream, river, lake, wetland or ocean.
- **Continental Divide:** A drainage divide on a continent (in the U.S., the Rocky Mountains) such that the drainage basin on one side of the divide feeds into one ocean or sea, and the basin on the other side either feeds into a different ocean or sea.
- **Headwaters:** The source of a river (where it starts).
- **Tributary:** A creek, stream, or river which feeds a larger stream or river or a lake.
- **Delta:** The mouth of a river (so named because it is triangle-shaped like the Greek capital letter Delta).
- **Desert:** A region that receives less than 10” of precipitation per year.
- **Precipitation:** All the water that falls from the sky, in solid or liquid form, such as rain, snow or hail.
- **Snowpack:** The amount of snow that accumulates annually in a mountainous area.
- **Floodplain:** Land that may be submerged by flood waters, or a plain built up by materials deposited by a river.

**Materials**

- **U.S. Watersheds map:** [http://maps.howstuffworks.com/united-states-watersheds-map.htm](http://maps.howstuffworks.com/united-states-watersheds-map.htm)
- **Precipitation Map:** [http://www.wrcc.dri.edu/pcpn/us_precip.gif](http://www.wrcc.dri.edu/pcpn/us_precip.gif)
- **Major Cities and Rivers Map:** [http://cgee.hamline.edu/rivers/Resources/watershedmaps/quiz3.htm](http://cgee.hamline.edu/rivers/Resources/watershedmaps/quiz3.htm)
- **Optional:** Everything is Connected in a Watershed poster and All About Watersheds website link: [http://allaboutwatersheds.org/poster/poster_view](http://allaboutwatersheds.org/poster/poster_view)
Assessment Questions (these are the questions students will be asked on the online quizzes)

WHAT IS A WATERSHED (ALSO KNOWN AS A CATCHMENT OR DRAINAGE BASIN)?  CHOOSE ONE ANSWER.
   It is a building where we store water.
   It is an area of land that drains to a river, lake, bay or ocean.
   It is a water body such as a river, lake, bay or ocean.
   I don’t know.

HOW MUCH PRECIPITATION DOES YOUR COMMUNITY RECEIVE EACH YEAR?  CHOOSE ONE ANSWER.
   less than 10 inches (correct for Albuquerque and Rio Rancho)
   11-30 inches (correct for Santa Fe and Edgewood)
   31-40 inches
   more than 40 inches
   I don’t know.

WHERE DOES YOUR RIVER START?  CHOOSE ONE ANSWER.
   New Mexico
   Utah
   Texas
   Colorado (correct for Rio Grande)
   Gulf of Mexico
   Other __________

INTO WHAT OCEAN DOES YOUR RIVER EVENTUALLY FLOW?  CHOOSE ONE ANSWER.
   Pacific Ocean
   Indian Ocean
   Atlantic Ocean (correct for NM)
   Arctic Ocean
   Other __________

Project 2: Watershed Model
For NM classes, this is presented by a guest speaker. For partner classes, we encourage you to see if you can find someone from a local agency who has an watershed model, such as the Enviroscape.

Student Assignment
Write a persuasive paragraph, or create another type of project, about why it is important to keep stormwater clean and what we should do.

Informational Texts
- "Dead Zone" article. http://www.sciencenewsforkids.org/2012/03/suffocating-waters/

Classroom Activity – Flexible! Just do as much as you want, and feel free to substitute other activities.
1. Watch The Human Solution to Water Pollution video (see link below).
2. Schedule a guest speaker to bring a model of a watershed, OR make your own using the activity on the back of the USGS poster – Watersheds: Where We Live (the poster may be shown on a smart board – see link below, and a printable copy of the activity is on your wiki).
3. Discuss how the gutters in our streets lead to storm drains, which often lead directly to the nearest body of water. Discuss the difference between stormwater and wastewater (from household drains and toilets). Find out how your community handles stormwater – is it combined with a municipal wastewater (sewage) system?
4. Read news articles (see links below) about garbage in rivers and dead zones caused by nutrients in agricultural runoff. Review the Top Ten Ways to Protect Our Precious Water handout (in teacher packet), and brainstorm other ways to reduce nonpoint-source pollution.

5. Optional: For a great math-based extension activity, try Don’t Trash Our Rio (in teacher packet) where students learn how much trash is pulled from Albuquerque’s storm drain system yearly, and calculate how many trash bags or classrooms it would fill. Even though it is based on an Albuquerque news article, this activity is applicable to any area that has a storm drain system.


7. Optional: New Mexico classes, watch Segment 3 of the Mid Rio Grande Stormwater Quality Team’s educational video (link below) to learn about Albuquerque’s and Rio Rancho’s stormwater system.

8. Optional: Partner classes, Google “stormwater” in your area and see what information is there. Water districts, the Departments of Health and Environment etc. have many educational resources.

Materials
- The Human Solution to Water Pollution video: http://sscafca.org/teacher-resources/
- Top Ten Ways to Protect Our Precious Water handout (in teacher packet and on wiki Curriculum page)
- Watershed model such as Enviroscape, OR USGS poster – Watersheds: Where We Live (the poster is available at http://water.usgs.gov/outreach/Posters/watersheds/grade.html and a printable copy of the activity is on your wiki) and supplies:
  - Butcher paper (or newspaper) and plastic wrap
  - Several large baking pans or plastic containers (clear ones can be reused for Project 4: Groundwater)
  - Waterproof marker
  - Spray bottles filled with water
  - Small plastic houses, cows and cars (or little pieces of modeling clay to represent these)
  - Cocoa powder and colored drink powders
- Optional: Don’t Trash Our Rio activity (in teacher packet)
- Optional: The Majestic Plastic Bag video: http://www.youtube.com/watch?v=GLgh9h2ePYw
- Optional: Segment 3 of the Mid Rio Grande Stormwater Quality Team’s educational video: http://www.keeptheriogrand.org/downloads.htm

Vocabulary
- Watershed: The land area from which snowmelt and rain drain into a river, lake or other body of water. Also known as a drainage basin or catchment.
- Point-source pollution: Water pollution coming from a single point, such as a sewage-outflow pipe or a factory.
- Nonpoint-source pollution: Water pollution coming from a wide land area, not from one specific location. Occurs when rainwater, snowmelt, or irrigation runs off plowed fields, city streets, or suburban backyards, picking up soil particles and pollutants, such as nutrients, pesticides, and other chemicals.
- Storm drain: A drain, often under sidewalks, designed to collect excess rain and groundwater from impermeable surfaces such as streets, parking lots, sidewalks, and roofs. Also known as a storm sewer.
- First flush: The first surface runoff of a rainstorm. This is when we see the highest levels of pollution in water entering the storm drains.
- Stormwater: Runoff from a storm which either flows directly into a water body or is channeled into storm drains, which eventually discharge to surface waters.
- Wastewater: All the water that goes down a drain into a municipal sewer system or septic system. Also known as sewage.

Assessment Questions (these are the questions students will be asked on the online quizzes)
WHEN IT RAINS, WHERE DOES YOUR COMMUNITY’S STORMWATER GO? CHOOSE ONE ANSWER.
   It goes through storm drains into a river, lake, bay or ocean without being cleaned. (correct for NM)
   It goes to a wastewater treatment plant to be cleaned. (may be correct for other areas)
   I don’t know.

HOW CAN SURFACE WATER (LIKE A RIVER, LAKE, BAY OR OCEAN) BECOME POLLUTED? CHOOSE ALL ANSWERS THAT APPLY.
   Wind can blow trash into surface water.
   Stormwater can carry dog poop and chemicals from roads and parking lots into surface water.
   Soil can erode after a forest fire, and then stormwater can carry the soil into surface water.
   All of the pollution comes from factories.
   All of the pollution comes from just a few people.

WHAT ACTIONS CAN ALL OF US TAKE TO KEEP WATER CLEAN? CHOOSE ALL ANSWERS THAT APPLY.
   We can pick up trash.
   We can pick up dog poop.
   We can use extra fertilizers and pesticides right before it’s going to rain.
   We can wash our car at a car wash so that the dirty water gets cleaned and recycled.
   We can take oil to be recycled instead of dumping it on the ground.
   If a car is leaking fluids, we can wash the chemicals off the driveway and into the gutter.
   We can sweep grass clippings and trash into a storm drain.

**Project 3: Infiltration and Runoff**

**Student Assignment**
   Where does rainwater go when it falls on your school grounds? Write a *RACE* paragraph, or create another type of project, using evidence from your mini-field trip around the school.

**Informational Texts**
   - USA Today article. *La Niña Brings Flood Risks, Drought to the West* (a printable copy is on your wiki).
   - LA Times article. *3 days after rain, beach water can still make swimmers ill, study says*

**Classroom Activity – Flexible! Just do as much as you want, and feel free to substitute other activities.**
   1. Listen to the *Water Cycle Song* (see link below). You may want to print out the lyrics for students (a printable copy is on your wiki). Review the six major components of the water cycle: precipitation, runoff, infiltration, evaporation, transpiration, and condensation.
   2. Discuss how the sun’s energy starts the whole process, and how the water cycle relates to weather, recalling the amount and timing of your area's precipitation.
   3. Point out that when precipitation hits the ground, it can either run off, sink in (infiltration, also known as percolation) or evaporate back into the air. Explain how all plants move water from the ground to the air through the process of transpiration.
   4. Read the *USA Today* article (see link below) and discuss how La Niña and El Niño bring dry weather or wet weather to your area. Discuss what happens in different areas of the school when you have too much rain – are there areas that flood?
   5. Using *Investigating the School Grounds* (a printable copy is on your wiki) as a guide, take students on a “mini field trip” to investigate where rainwater goes on your school grounds to observe changes in land contours, and the location of downspouts and catchment areas. Discuss where runoff appears to be occurring, what affects infiltration, and the difference between permeable and impermeable surfaces.
6. Discuss how storm drains carry pollution from impermeable surfaces into the nearest body of water, whereas the process of infiltration into permeable surfaces helps filter out pollution.

7. Discuss how runoff can cause flash floods. In Albuquerque, concrete-lined arroyos are very dangerous because runoff comes from a larger area and the water moves very fast – people have drowned. In Rio Rancho, the arroyos in their natural state are generally safe unless rain clouds are visible.

8. Optional: For a math-based extension, test infiltration on various surfaces, using *Does it Soak Right In?* (a printable copy is on your wiki) as a guide. Graph the data as a class to build data analysis skills.

Materials
- *Investigating the School Grounds* activity (a printable copy is on your wiki)
- *Water Cycle Song* lyrics (a printable copy is on your wiki)
- *Optional: Does It Soak Right In?* activity (a printable copy is on your wiki)
  - A soup can for each group, all the same size, with both ends cut off
  - Stopwatches
  - Rulers
  - Measuring cups

Vocabulary
- **Precipitation**: All the water that falls from the sky, in solid or liquid form, such as rain, snow or hail.
- **Runoff**: The rain or snow that does NOT sink into the ground, that runs off the land into a river, lake or other body of water (often carrying dirt and pollution with it).
- **Infiltration**: The process of water sinking down into the ground to refill the aquifer. Also called percolation.
- **Evaporation**: The process by which water changes from liquid to vapor (water in a puddle, river, lake, ocean, or other body of water evaporates into the air).
- **Transpiration**: The process by which water comes out of the leaves of plants, primarily through openings in the leaves, and goes into the air.
- **Condensation**: The process by which water changes from vapor to liquid (water in clouds condenses to form rain).
- **Impermeable surface**: A material that water can NOT soak into (or infiltrate); also called an impervious surface.
- **Permeable surface**: A material that water can soak (or infiltrate) into; also called a pervious surface.
- **Flash flood**: A rapid flooding (less than six hours) of low-lying areas (such as washes, rivers, dry lakes, basins), caused by heavy rain, snow or sudden ice melt in surrounding areas.
- **Arroyo**: A Spanish word for a drainage ditch, gully or ravine which was carved by water drainage.

**Student Assessment Questions** (these are the questions students will be asked on the online quizzes)

**How does the water cycle relate to weather?** Choose **all** answers that apply.
- The water cycle determines our daily weather, bringing more or less precipitation at certain times of the year.
- If the water cycle speeds up, the weather gets better.
- The water cycle can bring long-term weather patterns like La Niña and El Niño.
- If the water cycle stops, the weather will stay the same.
- The water cycle has no effect on our weather.

**What are the six major components of the water cycle?** Choose **all** answers that apply.
- evaporation
- condensation
- participation
precipitation
transpiration
flotation
infiltration (or percolation)
anticipation
runoff

Project 4: Forests and Wetlands

Student Assignment
Write a persuasive paragraph, or create another type of project, about why wetlands and forests are important in our watersheds.

Informational Texts
- ABQ Journal article. River Diversions Halted Due to Burn Scar Runoff (a printable copy is on your wiki).

Classroom Activity – Flexible! Just do as much as you want, and feel free to substitute other activities.
1. Watch The Adventures of Junior Raindrop video (see link below) to learn about how vegetation helps prevent erosion.
2. Read the ABQ Journal article (a printable copy is on your wiki) about erosion from wildfires polluting the Rio Grande.
3. Do the Wetland Model activity from the back of the USGS poster – Wetlands: Water, Wildlife, Plants (the poster may be shown on a smart board – see link below, and a printable copy of the activity is on your wiki) to examine the effects of a wetland in reducing erosion and controlling flooding.
   - To model forests in the watershed, stick cotton balls in the clay and repeat the experiment again to see that the muddy water gets even cleaner as it travels through the “forest.”
4. Even in desert areas like New Mexico, there are wetlands, and riparian areas. Many are constructed (man-made) specifically for cleaning stormwater. Discuss how these areas also support a diverse community of living things, and how many people used to think wetlands were not important. In fact, they would fill them in with soil and build right on top of them!
5. Find books from your library on different kinds of wetlands, and discuss the differences in wildlife and plant communities they support – OR watch the NatureWorks video (see link below).
6. Optional: Do the Water Treatment Plants activity (see link below) to see how celery sticks, like wetland plants, can help filter water by absorbing pollution. This activity is very quick to set up, then just wait one day to see what happens.
7. Optional: New Mexico classes, watch Segment 2 of the Mid Rio Grande Stormwater Quality Team’s educational video (link below) to learn how stormwater from our roadways is handled, and how a constructed wetland helps clean stormwater.

Materials
- Supplies:
  o Small rectangular plastic storage containers, or baking pans or paint trays
  o Modeling clay
  o Small pieces of carpet
  o Cotton balls

- **Optional:** Water Treatment Plants activity (a printable copy is on your wiki)
  - Celery sticks
  - Cups of colored water

- **Optional:** Segment 2 of the Mid Rio Grande Stormwater Quality Team’s educational video: [http://www.keeptheriogrand.org/downloads.htm](http://www.keeptheriogrand.org/downloads.htm)

**Vocabulary**

- **Erosion:** The process in which a material (such as a river bank) is worn away by water or air, often due to the presence of abrasive particles in the stream.
- **Wetland:** An area such as a marsh or swamp that is covered with shallow water or where the soil is naturally soaked with water.
- **Riparian area:** The area around the banks of a natural body of fresh water, where the vegetation and landscape is directly influenced by that water.

**Student Assessment Questions** (these are the questions students will be asked on the online quizzes)

**What is a wetland? Choose one answer.**

- A water theme park.
- An area that is covered with shallow water or where the soil is naturally soaked with water.
- Land that is covered or soaked with water by farmers, to irrigate their crops.
- A rainforest.
- I don't know.

**What role do wetlands play in a watershed? Choose all answers that apply.**

- Wetlands just smell bad and breed mosquitoes.
- Wetlands support a diverse community of plant and animal life.
- Wetlands just take up space where we want to build houses.
- Wetlands help control flooding by storing the runoff and releasing it slowly.
- Wetland plants help clean stormwater before it goes into a river, lake, bay or ocean.
- Wetland plants help clean our community's wastewater.

**What role do forests play in a watershed? Choose all answers that apply.**

- Forests help control flash flooding and erosion by holding the soil in place.
- Forests just suck up all the water that should be going into our rivers and lakes.
- Trees near rivers and lakes shade the water and help keep it cool.
- Forests just cause forest fires.
- Forests support a diverse community of plant and animal life.

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**Unit 2: Water in Our Society (January-May)**

**Project 5: Commercial Uses of Our Waterways**

For NM classes, this is presented by a guest speaker from the county's Cooperative Extension. For partner classes, we encourage you to see if you can find someone from a local agency or business who can present on this topic.

**Student Assignments**

- Write an informational paragraph or a friendly letter to your partners, or create another type of project, explaining:
  - a) How was the river (or other waterway) important when people first settled in your community?
  - b) How has your waterway been used by people for commerce (to make money) in your community's history?
c) Do some people still rely on the waterway for their jobs, such as farming, fishing, shipping, or recreation?
d) What technologies have people developed to solve water problems in your area (like drilling wells, building dams, locks, and fish ladders, different kinds of irrigation, or technologies to conserve water or prevent pollution?)

Informational Texts
- ABQ Journal article. Deal Allows Farmers to Sell Irrigation Water (printable copy on your wiki).

Classroom Activity – Flexible! Just do as much as you want, and feel free to substitute other activities.

1. Research the major commercial use(s) of your river/waterway (such as agricultural irrigation, shipping/transportation, electricity, fisheries and/or recreation) and invite a guest speaker to present, or find an activity that relates. In New Mexico, the only major commercial use of the Rio Grande is agriculture – 80% of the water goes to irrigation!
2. Discuss how these commercial uses influenced the location/history of your community, and how these users can also help a community conserve water and keep water clean (such as conserving water when irrigating, controlling erosion, keeping boat engines in good repair).
3. Discuss how people have developed technological solutions to solve water problems. For example, many ancient settlements in the West were abandoned because of lack of water, but irrigation technology has made it easier to survive. Dams have made it easier to control the flow of rivers, reservoirs store water, and fish ladders are built so that dams don't prevent their migration. High-efficiency toilets and other appliances help conserve water.
4. In NM, discuss the acequia system which was put in place by the Pueblo people and early Spanish settlers. Watch one of the YouTube videos, or read an article about water rights (see links below).
5. Show students the USGS poster - Navigation: Traveling the Water Highways (see link below, and a printable copy of the activity is on your wiki). Discuss how some communities use their river for transportation, while New Mexico rivers are used mainly for agricultural irrigation. New Mexico students may not be familiar with dams, locks and boats traveling on the river. If your river is used for transportation, you may want to do the River Profile activity on the back of the poster.
6. Optional: Water Ripples games (see link below). Review ways our society uses water, particularly in agriculture.
7. Optional: Water Rights. Using the Pass the Jug activity guide (see link below), act out the two different methods of assigning water rights to all the water users. Discuss the difference between the Riparian Rights and Prior Appropriation doctrines. Research the history of water rights in your community and compare the differences in water rights issues with your partners' area. Prior Appropriation is used in the western states, which receive far less precipitation. Revisit the Precipitation Map and discuss why this makes a difference. Read about farmers being allowed to sell their water rights to allow more water for the ecosystem.

Materials
- Optional: Water Rights
  - Pass the Jug activity: http://www.earthsciweek.org/forteachers/passthejug_cont.htm
  - Precipitation Map: http://www.wrcc.dri.edu/pcpn/us_precip.gif
  - Ancient Irrigation video: http://www.youtube.com/watch?v=RUv2Tz1ayTc
  - Ditch Cleaning at Arroyo Hondo video: http://www.youtube.com/watch?v=YyqxdbsEObU
Vocabulary

- **Irrigation**: Watering crops. When natural precipitation is not enough for crops, farmers use flood irrigation (common in New Mexico), drip irrigation and/or overhead sprinklers.
- **Acequia**: An irrigation ditch used to distribute water from rivers to farms. Most are simple ditches with dirt banks, but they can be lined with concrete. An important form of irrigation in the development of agriculture in the American Southwest.
- **Erosion**: The process in which a material (such as a river bank) is worn away by water or air, often due to the presence of abrasive particles in the stream.
- **Dam**: A barrier built across a river to hold water back; sometimes used to generate electricity.
- **Lock**: A chamber with gates that close off for raising and lowering boats on a river or canal.

**Student Assessment Questions** (these are the questions students will be asked on the online quizzes)

**How has water influenced human settlements and culture?** Choose all answers that apply.

- Humans have usually settled near water for drinking, farming, fishing, to put out fires, and/or transportation.
- Humans have usually just settled wherever they want, without worrying about water.
- Humans have sometimes abandoned their settlements if there was not enough water.
- Humans have developed new technologies over time to solve water problems.

**What are the major commercial use(s) of your river?** Choose all answers that apply.

- Commercial fishing
- Shipping/transportation
- Agricultural irrigation (correct for NM)
- Commercially operated recreation
- Electricity generation
- Other ___________

What can these commercial users do to conserve water or prevent pollution of our water resources?

**Project 6: Drinking Water**

For NM classes, this is presented by a guest speaker from the water utility. For partner classes, we encourage you to see if your local utility can send someone to present.

**Student Assignments**

Write a persuasive paragraph (or create another type of project) explaining why it is important to conserve water, and what we should do.

**Informational Texts**

- *Jacksonville Journal Courier* article. *City Cracking Down on Water Use* (a printable copy is on your wiki).
- *ABQ Journal* articles (several on drought and drinking water; printable copies on your wiki).

**Classroom Activity** – Flexible! Just do as much as you want, and feel free to substitute other activities.
1. Discuss the *Indoor Water Use* graph (see link below), emphasizing that all of these activities use clean *drinking water*. Explain that in homes and other buildings there is one set of pipes that bring clean drinking water into the home and a different set of pipes that takes the dirty water away. Be sure to mention that in many parts of the country (like in NM) people use almost as much for watering plants outdoors as all their indoor water use combined. Discuss how *xeriscape* and watering during the coolest part of the day can help.

2. Schedule a guest speaker to present on where your drinking water comes from, how it is treated to make it safe for drinking, and/or ways to conserve water. OR research where your drinking water comes from, and do *The Value of Water* activity from the back of the USGS poster - *Water: The Resource That Gets Used & Used & Used For Everything* (see link below, and a printable copy of the activity is on your wiki). Students will examine their water use by using play money to record their daily usage, then brainstorm how to conserve. For a math-based extension activity, you can graph the data as a class to build data analysis skills.

3. Discuss how flooding or drought can affect your community’s drinking water. Look for articles in your local paper, or read one of the suggested articles (printable copies are on your wiki). The *Jacksonville Journal Courier* article talks about flooding in Illinois, while one *ABQ Journal* article talks about the emergency water restrictions in Las Vegas, NM. Other *ABQ Journal* articles discuss Albuquerque and Santa Fe drinking water projects and the current drought.

4. **Optional:** *Water Footprint*. Calculate your impact using an online tool (see link below).

5. **Optional:** *Water Use in Other Countries*. To learn more about water use in other countries, invite a guest speaker from Water for People (see link below) and/or watch the *Water for Life* video, and/or read the book *A Long Walk to Water*, by Linda Sue Park. Compare average indoor water use in the U.S. to that in other nations.

6. **Optional:** *The Water-Energy Connection*. Show students the *Power Couple* video and/or water-energy posters to learn about the connection between electricity and water use, then do the activity (see links below.).

**Materials**

- *Indoor Water Use Graph* http://www.epa.gov/WaterSense/pubs/indoor.html
- **Optional:** *Water Footprint Calculator*
- **Optional:** *Water Use in Other Countries*
  - Speaker: http://www.waterforpeople.org/assets/pdfs/committees/water-for-people-committee.pdf
- **Optional:** *The Water-Energy Connection*

**Vocabulary**

- **Drinking water:** Water that has been purified to standards set for human consumption.
- **Xeriscape:** The use of low water use plants in landscape (not “zeroscape”). *Xeros* is Greek for “dry.”
- **Conserve:** To use something wisely; not wasting.
La Niña: An irregularly occurring movement of deep cold water to the ocean surface along the western coast of South America that brings less precipitation to the southern U.S. and more to the northern U.S.

El Niño: An irregularly occurring flow of unusually warm surface water along the western coast of South America that brings more precipitation to the southern U.S. and less to the northern U.S.

Student Assessment Questions (these are the questions students will be asked on the online quizzes)

FROM WHAT SOURCE DOES YOUR COMMUNITY GET ITS DRINKING WATER? CHOOSE ALL ANSWERS THAT APPLY.
- clouds
- glaciers and icebergs
- groundwater/aquifer (wells) (correct for all NM communities)
- lake
- ocean
- river (correct for Albuquerque and many other places, but NOT Río Rancho or Edgewood)

WHICH OF THESE ACTIVITIES USE DRINKING WATER? CHOOSE ALL ANSWERS THAT APPLY.
- washing dishes
- brushing teeth
- showering
- drinking
- watering yard with rainwater
- watering yard with a hose
- flushing toilets
- washing clothes

DOES EVERYONE HAVE THE RIGHT TO USE AS MUCH WATER AS THEY WANT? CHOOSE ONE ANSWER.
- Yes, we can use as much as we want as long as we can pay for it.
- No, we need to be careful not to use too much because it is a limited resource that must be shared.
- I don’t know.

WHAT ACTIONS CAN ALL OF US TAKE TO CONSERVE WATER? CHOOSE ALL ANSWERS THAT APPLY.
- Drink less water.
- Take shorter showers.
- Drink bottled water or juice instead.
- Turn off the water when brushing your teeth.
- Water outdoor plants during the coolest part of the day so less evaporates.
- Water outdoor plants during the hottest part of the day.
- Fix leaking faucets, toilets and outdoor water pipes.

HOW CAN DROUGHT OR FLOODING AFFECT OUR DRINKING WATER? CHOOSE ALL ANSWERS THAT APPLY.
- Flooding just means there is more drinking water available for everyone.
- Drought means there is less drinking water available for everyone.
- Drought and flooding do not affect our drinking water.
- Floodwater is dirty and can contaminate drinking water supplies or ruin equipment.

Project 7: Groundwater

Student Assignment
How are groundwater and surface water connected? Write a RACE paragraph, or create another type of project, using what you learned from the aquifer model.

Informational Texts
**Classroom Activity** – **Flexible! Just do as much as you want, and feel free to substitute other activities.**

1. Watch *The Story of Groundwater* video (see link below) to learn the difference between **groundwater** and **surface water**.
2. Show students the **Major U.S. Aquifers** map (see link below) and locate your **aquifer**.
3. Do the activity **Recharge-Discharge** from the back of the USGS poster – *Groundwater: The Hidden Resource* (the poster may be shown on a smart board – see link below, and a printable copy of the activity is on your wiki). Students build a simple aquifer model to learn about the **water table**, how a **well** works, and how groundwater and surface water are connected. Discuss how if we pump too much of surface water it can deplete groundwater, and vice versa. Also, if one person pumps too much groundwater from their well, it can affect their neighbors' wells.
4. Leaking underground tanks (such as septic tanks or gas tanks beneath gas stations) are a major source of groundwater pollution. This can be demonstrated using small plastic cups with holes poked in the bottom. Sink a cup into the gravel of the model and fill it with colored water to see how pollution spreads through groundwater. Note that contaminated groundwater can pollute surface water and vice versa.
5. Read articles from the Albuquerque Journal about a jet fuel leak from Kirtland Air Force Base (printable copies are available on your wiki) or find articles about similar issues in your area. Discuss what types of pollution can get into groundwater and what can't. Solids such as trash and dog poop on the earth’s surface cannot travel down to the aquifer. Dissolved chemicals, heavy metals, and very large amounts of farm animal waste can, however.
6. Read articles about groundwater from the Groundwater Foundation. Review the **Top Ten Ways to Protect Our Precious Water** handout (in teacher packet). Brainstorm other ways to prevent groundwater pollution.

**Materials**

- **Major U.S. Aquifers** map [http://pubs.usgs.gov/ha/ha730/ch_a/gif/A004_us.gif](http://pubs.usgs.gov/ha/ha730/ch_a/gif/A004_us.gif)
- **Top Ten Ways to Protect Our Precious Water** handout (in teacher packet)
- USGS poster – *Groundwater: The Hidden Resource*. The poster is available at [http://water.usgs.gov/outreach/Posters/groundwater/grade.html](http://water.usgs.gov/outreach/Posters/groundwater/grade.html), and a printable copy of the activity is on your wiki.
- **Supplies:**
  - Several clear baking pans or plastic containers
  - Gravel to fill containers 2/3 full
  - Several pump tops from soft-soap or hand-lotion containers
  - Paper cups with holes punched in the bottom to sprinkle water
  - Colored drink powder


**Vocabulary**

- **Aquifer**: A wet underground layer of water-bearing rock or materials (gravel, sand, silt or clay) from which groundwater can be extracted using a well.
**Groundwater:** Water located beneath the earth’s surface in cracks between soil particles and fractures in rock formations. A large and usable quantity of groundwater is called an aquifer.

**Surface water:** Water collected on the ground or in a waterbody such as a stream, river, lake, wetland or ocean.

**Water table:** The top surface of an aquifer (how far you have to dig down to find water).

**Well:** A man-made hole with a pipe that goes down to the water table. A pump helps bring the groundwater up.

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**Student Assessment Questions** (these are the questions students will be asked on the online quizzes)

**How can our groundwater (aquifer) become polluted? Choose all answers that apply.**

- A leak from an underground tank can pollute groundwater.
- Dogs can poop in groundwater.
- Wind can blow trash into groundwater.
- Chemicals and oil on top of the soil surface can pollute groundwater, especially after it rains.
- Leaves, sticks and rocks can pollute groundwater.

**How are groundwater and surface water connected? Choose all answers that apply.**

- Chemical pollution can travel between groundwater and surface water.
- Fish can travel between groundwater and surface water.
- Dirt can travel between groundwater and surface water.
- Trash can travel between groundwater and surface water.
- Clean water can travel between groundwater and surface water.
- If we pump too much of either one, it can affect the other.

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**Project 8: Wastewater**

For NM classes, this is presented by a guest speaker from the water utility. For partner classes, we encourage you to see if your local utility can send someone to present.

**Student Assignment**

Write a narrative or creative paragraph, or create another type of project, explaining the journey of your community’s wastewater.

**Informational Texts**

- ABQ Journal article. Aging Pipes Mean Higher Water Bills (printable copy on your wiki).
- Combined sewer overflows article (Includes a fantastic video! Scroll way down to see "A Drop's Life").
  

**Classroom Activity – Flexible! Just do as much as you want, and feel free to substitute other activities.**

1. Invite a guest speaker to learn about where your community's wastewater goes, OR (if your community has a municipal sewer system) do the activity Where Does Your Used Water Go? on the back of the USGS poster - How Do We Treat Our Wastewater? (see link below; printable copy is on your wiki).
2. Show students the Septic System poster (a printable copy is on your wiki) and explain the difference between a sewer system and a septic system – they both treat wastewater essentially the same way, but a septic tank is right by the house and uses a drainfield in rural areas. If desired, watch the Dirty Jobs video (see link below). If your community has mostly septic systems, discuss how important it is to have the tanks pumped out regularly to avoid groundwater pollution.
3. Discuss what kinds of things NOT to put down the drain or toilet – for example, fats, oils, and grease can solidify in pipes and cause a backup. Read the articles about Albuquerque’s crumbling sewer...
infrastructure (a printable copy is on your wiki), read the article about combined sewer overflows by a geology professor from Kent State (see link below), or find local news articles about issues in your area.

4. Discuss how treated wastewater is recycled in many communities (such as watering golf courses), and how a community’s treated wastewater will be used by downstream communities.

5. Review the differences between stormwater, drinking water, and wastewater, emphasizing how different sets of pipes are involved, and that the “quality” of the water being transported is very different.

**Materials**
- USGS poster - *How Do We Treat Our Wastewater?* The poster is available at [http://water.usgs.gov/outreach/Posters/wastewater/grade.html](http://water.usgs.gov/outreach/Posters/wastewater/grade.html), and a printable copy of the activity is on your wiki.
- **Supplies:**
  - 14 feet of yarn, string or rope
  - Shredded paper or packing peanuts and a cardboard box
- **Septic System** poster (a printable copy is on your wiki).
- Combined Sewer Overflow video: *A Drop’s Life*. Applies to certain cities only, mostly in the eastern US, find out if your city has this type of system. [https://www.youtube.com/watch?v=5Ug1hravb9Q](https://www.youtube.com/watch?v=5Ug1hravb9Q)
- **Dirty Jobs: Septic Tank Technician** video (Caution – this video has one bad word at 1:16) [http://home.howstuffworks.com/home-improvement/plumbing/sewer2.htm](http://home.howstuffworks.com/home-improvement/plumbing/sewer2.htm)

**Vocabulary**
- **Wastewater:** All the water that goes down a drain into a municipal sewer system or septic system. Also known as sewage.
- **Sewer system:** A system of underground pipes used to transport human waste. In some communities, the sewer system is combined with the storm system (known as a combined sewer).
- **Septic system:** A small-scale sewage treatment system common in areas with no connection to a municipal wastewater system. A septic tank is a key component of a septic system.
- **Stormwater:** Runoff from a storm which either flows directly into a water body or is channeled into storm drains, which eventually discharge to surface waters.
- **Drinking water:** Water that has been purified to standards set for human consumption.

**Student Assessment Questions** (these are the questions students will be asked on the online quizzes)

**WHERE DOES YOUR COMMUNITY’S WASTEWATER GO?** CHOOSE ONE ANSWER.
- It goes into a sewer system, which carries it through underground pipes to a centralized treatment plant. *(correct for larger cities such as Albuquerque and Rio Rancho)*
- It goes into a storm drain system.
- It goes into your drinking water system.
- It goes into a septic system, which treats it in an underground tank near the home or building. *(correct for most rural areas)*
- It goes directly into the river, lake, bay or ocean.
- I don’t know.

**WHAT IS THE DIFFERENCE BETWEEN WASTEWATER, STORMWATER, AND DRINKING WATER?** CHOOSE ONE ANSWER.
- Wastewater is dirty; stormwater and drinking water are clean.
- Wastewater goes through the sewer system to a treatment plant, stormwater goes through the storm drains, and drinking water goes through nice clean pipes to your faucet.
- Stormwater and wastewater both go straight to the river, lake, bay or ocean; drinking water goes through different pipes.
- None, it’s all just water and all the pipes are connected.
Unit 3: River Ecosystem Field Trip (any time during the year)

Project 9: Field Trip

Student Assignment

Write a narrative paragraph or a friendly letter to your partners, or create another type of project, about your field trip experience:

a) If you tested the water, explain why we collect water quality data and what it means.
b) If you planted trees or did another service learning project, explain how your project will help the river ecosystem.

Informational Texts

- A Waterproof Case (in teacher packet)
- The Water Down Under booklet (in teacher packet)
- Local ecosystem articles (These are for NM, printable copies are on your wiki. Teachers in other areas should search local newspapers for articles about their own ecosystem).
  - ABQ Journal article. Battle with Beavers.
  - ABQ Journal article. Birds Divert Work on Buckman Project.
  - ABQ Journal article. COMING BACK - Fish Biologists Are Optimistic That the Silvery Minnow Will Recover After Being Close to Extinction.

Pre-Field Trip Activities

1. Define an ecosystem (the physical environment together with all the species that live there). Discuss how living things depend on the nonliving things, such as water, air, soil/rocks, and the sun.
2. Read The Water Down Under booklet to learn more about macroinvertebrates and water quality. OR watch Macroinvertebrate Lunch and have students complete the student guide (see link below) to learn about the role of aquatic macroinvertebrates in the food web and what they can tell us about the health of our ecosystem. Many animals depend on them for food. Some aquatic macroinvertebrates are sensitive to pollution, so one way scientists can tell how healthy a river ecosystem is by looking at which types of macroinvertebrates are living in the water. Many of them spend only part of their lives in the water, so if the water is polluted, it has far-reaching effects on the ecosystem. Discuss producers, consumers and decomposers, and where aquatic macroinvertebrates fit (some are consumers, some are decomposers).
3. Talk about the field trip and location, and what students can expect.
4. Optional: Frogline News. Watch a newscast by frogs (see link below) to revisit how pollution gets into surface water. Discuss the significance of the frog (i.e., the frog is a biological indicator species because it is very sensitive to water pollution). Remind students of the watershed model and how they can prevent nonpoint-source pollution.
5. Optional: Acid Rain. Watch the video How Acid Rain Works (see link below).

Field Trip

1. For New Mexico Classes: Field trips may include a service learning project, such as tree planting or an agricultural activity. Otherwise, they will incorporate hands-on lessons about riparian areas, wetlands, macroinvertebrates and water quality, and students will use a field journal. On the field trip, students will gather data about pH, temperature, turbidity and dissolved oxygen.
2. For Partner Classes: We strongly encourage you to take any water-related field trip available in your area, and we can help if you have trouble finding one. Please let us know if you’d like a water quality monitoring kit!
3. Water quality data will be sent to the World Water Monitoring Challenge program and will appear on their website. If you receive a water quality testing kit from us, please submit your data to the Partner Teacher Coordinator immediately after your field trip.

Post-Field Trip Activity
1. Review how land use affects water quality and what the water quality data tells us about the ecosystem.
   - Increased river temperature can be caused by many things including low river flow, large areas of impermeable surfaces, lack of vegetation, and stormwater that is warm from flowing over roads.
   - High temperature and/or fertilizers (including pet waste) can cause algae bloom, which can reduce dissolved oxygen.
   - Erosion or algae bloom can cause turbidity, leading to higher temperature.
   - Acid rain, mine drainage or algae bloom can cause low pH (normally pH is determined by the types of rocks or trees present in the watershed).
2. Compare the class data to other World Water Monitoring Day sites on the 2013 map on their website (see link below).
3. Read news articles about issues in your local ecosystem. A few articles for NM are provided (printable copies are on your wiki).
4. Optional: River Food Web. Make a food web for your local ecosystem, identifying producers, consumers and decomposers, native species and invasive species, as well as local endangered species. Discuss how wildlife are “water users” too. Like humans, wildlife needs clean water to live, so as a community we must consider their needs when making choices about water. NM Classes: use Bosque plant and animal cards to do The Web activity (a printable copy is on your wiki), discussing how all living things depend on each other. For Partner Classes: The Web activity can be applied to any ecosystem and is a simple, yet fun way to get kids thinking “on their feet”.

Materials
Pre-Field Trip Activities:
- Macroinvertebrate Lunch activity
  - Video, student sheet, answer sheet: [http://www.watersheds.org/earth/macro_resources.htm](http://www.watersheds.org/earth/macro_resources.htm)
- Frogline News video: [http://www.youtube.com/watch?feature=player_embedded&v=HhlPtNX5XTM](http://www.youtube.com/watch?feature=player_embedded&v=HhlPtNX5XTM)

Field Trip:
- Macroinvertebrate Data Sheets (if desired, printable copies are on your wiki).

Post-Field Trip Activities:
- Optional: The Web food web activity (a printable copy is on your wiki).

Vocabulary
- Ecosystem: All the living and nonliving things that interact in a particular place.
- Bosque: A Spanish word for woodlands, it refers to the riparian areas of stream and river banks in the southwestern U.S.
- pH: A measure of the acidity or alkalinity of water (or a solution) on a scale that ranges from 0 (extremely acidic) to 14 (extremely alkaline). Pure water has a pH of 7 (neutral).
- Turbidity: A measure of water clarity based on the amount of particles suspended in it.
- Dissolved oxygen: The concentration of oxygen dissolved in water, expressed in milligrams per liter or as a percent saturation.
- Riparian area: The area around the banks of a natural body of fresh water, where the vegetation and landscape is directly influenced by that water.
Aquatic macroinvertebrates: Animals that have no backbone, are visible with the naked eye, and spend all or part of their life in water. This diverse group of animals includes worms, mollusks, arachnids, crustaceans and insects.

Food web: A representation of the predator-prey relationships between species within an ecosystem.

Producers: Organisms, generally plants, that make their own food (using only the sun’s energy, water, and inorganic compounds), and are the foundation of the food chain.

Consumers: Organisms that obtain nutrients by eating other organisms (such as plants or other animals).

Decomposers: Organisms (such as bacteria, fungi, other plants and animals) that break down the remains of dead organisms, releasing the substances that can be used by other members of the ecosystem.

Native species: A species that naturally occurs in a particular ecosystem.

Invasive species: A plant or animal introduced from a different area that competes with native species that is taking over an area.

Endangered species: A plant or animal species existing in such small numbers that it is in danger of becoming extinct (dying out completely).

Student Assessment Questions (these are the questions students will be asked on the online quizzes)

What are some of the ways scientists can determine the health of a river, lake, bay or ocean? Choose all answers that apply.

- They can look under its tongue or in its ears.
- They can check pH, turbidity, temperature, and dissolved oxygen.
- They can check the weather channel.
- They can look at the types of macroinvertebrates that are living in it.
- If the water looks clean, they know it is healthy.

How does water affect living things in an ecosystem? Choose all answers that apply.

- Many animals that do not live in the water eat fish and/or insects that come from the water.
- All living things need water that is clean or at least not too polluted.
- Some living things do not need any water.
- Fortunately, water pollution has no effect on humans, because we are not part of an ecosystem.
- If there is not enough water (drought), humans can learn to conserve.
- If there is not enough water (drought), some plants and animals can adapt, but others may die.

Why do scientists study aquatic macroinvertebrates? Choose all answers that apply.

- Because we want to figure out how to get rid of them.
- Because they are important in the food web and we want to make sure they are healthy.
- They serve as indicators of water pollution and tell us a lot about water quality and health.
- Because the more bugs we see, the more polluted the water is.

What are some of the ways humans have changed rivers or other aquatic ecosystems?

- Constructed dams for water storage, flood control, irrigation, or electricity generation.
- Introduced non-native plants and animals.
- Straightened river channels, making water flow faster.
- Put more water into the river, making it overflow.
- Taken too much water from rivers, making it difficult for plants and animals to survive.
- Other: ________________

What actions can all of us to take to improve the health of our ecosystem? Choose all answers that apply.

- We can conserve water so that there is more water left for wildlife and plants.
- We can use as much water as we want.
- We can study the ecosystem to understand what is happening.
- We can plant native plants and create wetlands.
We can remove non-native plants and animals.
We can cut down trees and pave over wetlands.
We can let chemicals and trash go down storm drains.
WHAT ARE SOME NATIVE SPECIES IN YOUR ECOSYSTEM?
WHAT ARE SOME INVASIVE SPECIES IN YOUR ECOSYSTEM?