Curriculum

Exploring watersheds through meaningful connections

RiverXchange is about meeting language arts and science curriculum standards while learning about our watersheds. Each class will be partnered with one or more classes in a different area of NM, different state or country. **The big idea is to communicate with your partners by posting projects and/or writing to your blog after each presentation and responding to what your partners have posted.**

A firm "handshake" will get your partnership off to a great start! Within two weeks of getting your partnership assignments, contact each other by phone, Skype, or FaceTime, to establish a working relationship. Communicating and getting to know one another is **key** to creating a beneficial partnership throughout the year.
With this initial meeting you can:

- share your hopes for the partnership as an educator and for your students, discuss concerns you have with implementing the program
- discuss local water-related issues
- share concerns you have about implementing the program and strategize how to work around them
- share teaching styles, structure and requirements from your school and some personal background, as you choose

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?

Blog Postings and Student Assignments:

All of the project sections in our curriculum include a list of suggestions for "**Blog Postings / Student Assignments"**. These can be expressed through writing, photos, video, audio, powerpoint, or other projects. Follow your students curiosity and use your imagination to come up with your own projects. **The only requirement is that you post a project after each presentation, and respond to what your partners have posted.**

Suggestions include:

- Create a public service announcement
- Create a news cast with various reporters discussing different areas
- Create a short documentary (using a service like iMovie or Vimeo)
- Write to legislators about water challenges in your community
- 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 KidBlog
- Do a small project on school grounds - post your posters in the hallways, make an announcement at lunch, add small rocks to an area with drainage to prevent erosion then have students post a reflection about their experiences

Tips for using the Blog:

We know that with all the other pressures in schools today, it may be difficult to find time to share on the KidBlog. 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 blog.
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. Other group roles could be: scribe, photographer, data collector, visual artist, etc.
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. Modify the style of writing or project to match what you are planning to cover at that point in the year.
2. After a guest speaker comes to your class, post as soon as possible.
3. Consider creating a science, social studies or language arts unit with RiverXchange material over the course of your scheduled presentations. You could plan ahead to schedule computer lab time, if necessary.
4. Whatever subject you need the most support with, 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, acequia history and cultural impacts on our region
    b. Math: calculate water use, waste, length of rivers, etc
    c. Science: volume, density, states of matter, water quality testing
    d. Language arts: reading informational texts, reference citations, write a narrative essay or poem, public speaking
    e. Other specialized topics such as engineering, green careers, art, music, theater

Curriculum Overview

The curriculum is mostly a reference point for you, we encourage you to use it as it fits best in your classroom and to be creative and incorporate your own favorite lessons to encourage students understanding of place. You may 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

Unit 1: Understanding a Watershed

Project 1: River Geography

Blog Postings / Student Assignments

Write a letter to your partners or create a video 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 & Materials

- *Follow the Water from Brook to Ocean* by Arthur Dorros, or *Paddle-to-the-Sea* by Holling C. Holling
- *One Well: The Story of Water on Earth* (CitizenKid) by Strauss, Rochelle
- *Bosque Education Guide*, Bosque Background, Ch. 2
- *Albuquerque Journal:* "As Bad as it Gets: Drought Returns to New Mexico."
- *Albuquerque Journal:* "Drought Affecting 99% of New Mexico."

Classroom Activities

1. Read the following books, *Follow the Water from Brook to Ocean,* (about the Colorado River), *Paddle-to-the-Sea*, or *One Well*. Explain how water flows from smaller bodies of water into a larger body. *One Well* includes several extension activities to choose from.
    - As a class, explore what a watershed is and their signficance. 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. Explore the interactive *All About Watersheds* posters to learn about watersheds in New Mexico.
    - Show students the *Everything is Connected in a Watershed* poster, 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.
    - To demonstrate the connections of rivers to one another, show students this video of major rivers feeding into the Mississippi Watershed.

2. Have students identify the Rio Grande on a large map such as the *North American River Map*, and show them where your school is located in relation it (north, south, east, west). Figure out where the Rio Grande 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).

3. Pass out the *North American River Map*. Ask students to identify flow direction of each river named. 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. Using this *interactive USGS US map*, Trace your river's path to the ocean, recording each body of water it passes through.

4. Watch Save Water - Save Our Rio!, a 17 minute video created by local summer camp students, sponsored by Albuquerque Water Utility Authority. Follow up with ABQWUA activity: *When is the Drought Out?*.

5. Locate your school and your partners' school on the *Precipitation Map*. How many inches of precipitation does your area receive? Compare with your partner's ecosystem. You may want to read the Albuquerque Journal article: As bad as it Gets: Drought Returns to New Mexico.

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. You may wish to have your students read this Albuquerque Journal article: Drought Affecting 99% of New Mexico.

Materials

- *What is a Watershed?*
- *Basic information about the Continental Divide*
- *Nasa video - Mississippi Watershed*
- *North American River Map*
- *Interactive US Rivers Map*
- *Precipitation Map*
- *Major Cities and Rivers Map*
- *Everything is Connected in a Watershed* poster and *All About Watersheds* website

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.

Project 2: Watershed Model

This is presented by a guest speaker with a watershed model, the Enviroscape.

Blog Postings / Student Assignments

Write a *persuasive* paragraph, or create another type of project, about how we can help keep stormwater clean and why it is important to do so. OR Write a letter to a local legislator about your concerns of stormwater pollution and ideas for how to make a difference.

Informational Texts

- *Science News for Kids* article. "Suffocating Waters"
- *CNN* article. "Garbage Man of the River"

Classroom Activities

1. Watch *The Human Solution to Water Pollution* video (find video on the right side of webpage).
   - Follow up assessment questions to video.
   - 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).
   - Watch Mid Rio Grande Stormwater Quality Team's educational video to learn about Albuquerque's and Rio Rancho's stormwater system.

2. Read news articles: "Garbage Man of the River" and "Suffocating Waters" about garbage in rivers and dead zones caused by nutrients in agricultural runoff. Review the *Top Ten Ways to Protect Our Precious Water* handout, and brainstorm other ways to reduce **nonpoint-source pollution**.

3. For a great math-based extension activity, try *Don't Trash Our Rio* 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.

4. Watch the mockumentary *The Majestic Plastic Bag* video. For a 60 minute class activity, include this lesson to explore the Great Pacific Garbage Patch and what students can do to respond.
   - Explore The Ocean Cleanup project and how an 18 year old started with a simple idea which is now making a difference in the effort to clean up the world's oceans.

Materials

- *Top Ten Ways to Protect Our Precious Water* handout
- Watershed model such as Enviroscape, **OR** USGS poster – *Watersheds: Where We Live* and *Watershed Activity* 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
- ***Don't Trash Our Rio*** activity and supplies:
  - 1 33 gallon trash bag

- **Great Pacific Garbage Patch lesson plan** and Laysan Albatross photos **(Caution - these photos are graphic, preview before sharing with students.)**

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 ground water 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.

Project 3: Infiltration and Runoff

Blog Postings / Student Assignments

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 & Handouts

- *USA Today* article. "La Niña Brings Flood Risks, Drought to the West"
- *LA Times* article. "3 days after rain, beach water can still make swimmers ill, study says"

Classroom Activities

1. Review the six major components of the water cycle: **precipitation, runoff, infiltration, evaporation, transpiration,** and **condensation.** 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. 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. Discuss how runoff can cause flash floods. Explain how all plants move water from the ground to the air through the process of transpiration.

1. Read the *USA Today* article 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? 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. Read the LA Times article about pollution from stormwater.

2. Using ***Investigating the School Grounds*** 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**.

3. 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.

4. For a math-based extension, test infiltration on various surfaces, using ***Does it Soak Right In?*** as a guide. Graph the data as a class to build data analysis skills.

Materials

- ***Investigating the School Grounds*** activity
  - map of the school property (the class could design their own)
- ***Does It Soak Right In?*** activity
  - A soup can for each group, all the same size, with both ends cut off
  - Stopwatches
  - Rulers
  - Measuring cupss

Vocabulary

- **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.
- **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 icemelt in surrounding areas.
- **Arroyo:** A Spanish word for a drainage ditch, gully or ravine which was carved by water drainage.

Project 4: Forests and Wetlands

Blog Postings / Student Assignments

Write and post a *persuasive* paragraph, about why wetlands and forests are important in our watersheds. Post a video of students building and/or testing the Erosion or Wetland Model. Have students create an advertisement for an ecosystem service and post a picture..

Informational Texts

- *ABQ Journal* article. "River Diversions Halted Due to Burn Scar Runoff"
- American Forests. "Forests and Water"
- *Rapid City Journal* article. "Federal Government Confirms Wetland Channels Are Keeping Rapid Creek Cleaner"

Classroom Activities

1. Build an erosion model using this activity by Soil Science Society of America, or watch this 8 minute video *Erosion and Soil*, to learn about how vegetation helps prevent **erosion**.

2. Read the *ABQ Journal* "River Diversions Halted Due to Burn Scar Runoff" about erosion from wildfires polluting the Rio Grande River.

3. Do the ***Wetland Model*** activity from the back of the USGS poster – Wetlands: Water, Wildlife, Plants (the poster can be shown on a smartboard) 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."
   - Introduce ecosystem services with The National Wildlife Federation article through this activity.

4. Watch *Keeping the Rio Grand*, (minutes 13:12-16:01 elaborate on a local constructed wetland). Even in desert areas like New Mexico, there are wetlands, and **riparian areas**. Many are constructed (man-made) specifically for cleaning stormwater. Read the *Rapid City Journal* article on how constructed wetlands help keep their creek clean. 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. Ask your partners if they live near wetlands. Find books from your library on different kinds of wetlands, and discuss the differences in wildlife and plant communities they support – *OR* watch this *NatureWorks* video.

6. Do the ***Water Treatment Plants*** activity 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.

Materials

- **Erosion Model Activity:** materials listed in link
- USGS poster, *Wetlands: Water, Wildlife, Plants* – ***Wetland Model*** activity and supplies:
  - Small rectangular plastic storage containers, or baking pans or paint trays
  - Modeling clay
  - Small pieces of carpet

- ***Water Treatment Plants*** activity and supplies:
    - Celery sticks
    - Cups of colored water

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.
- **Ecosystem services**: any positive benefit that wildlife or ecosystems provide to people. There are four types of ecosystem services: provisioning, regulating, cultural and supporting.

Unit 2: Water in Our Society

Project 5: Commercial Uses of Our Waterways

This is usually presented by a guest speaker from the county's Cooperative Extension.

Blog Postings / 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"
- *National Geographic* article. "Parched: A New Dust Bowl Forms in the Heartland"

Classroom Activities

1. Show students the *Major Cities and Rivers Map*, and ask them why they think so many big cities are located near major bodies of water. Research the major commercial use(s) of your river/waterway (such as agricultural **irrigation**, shipping/transportation, electricity, fisheries and/or recreation). In New Mexico, the only major commercial use of the Rio Grande is agriculture – 80% of the water goes to irrigation! 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).

2. Show students the USGS poster - *Navigation: Traveling the Water Highways* (the poster can be shown on a smartboard). Discuss how some communities use their river for transportation. New Mexico students may not be familiar with **dams, locks** and boats traveling on the river.

3. Watch *Nuestras Acequias* (20 minutes) and/or *South Valley Acequias* (4 minutes). Discuss the **acequia** system which was put in place by the Pueblo people and early Spanish settlers, how is it organized amongst the community and maintained? What is it's cultural and ecological signicance? Read the *Albuquerque Journal* article about water rights. Explore the acequia tradition further with ***El Agua Es Vida*** lessons.

4. 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.

5. ***Water Ripples games.*** Interactive games created by New Mexico State University. Review ways our society uses water, particularly in agriculture.

6. ***Water Rights.*** Using the *Prior Appropriation* activity guide, 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.

Materials

- USGS poster - *Navigation: Traveling the Water Highways*
- ***El Agua Es Vida*** lessons and supplies (see link for full list). Kits can be rented for $15 from Maxwell Museum of Anthropology. If you'd like assistance with materials, please contact RiverXchange staff.
- ***Water Ripples*** *games activity*
- ***Water Rights*** activity and supplies*:*
    - various colored cards for role play
    - rope

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.

Project 6: Drinking Water

This is presented by a guest speaker from the water utility.

Blog Postings / Student Assignments

Have students write a narrative essay or paragraph from the perspective of a drop of water falling from the sky and traveling to their faucet. Write a *persuasive* paragraph explaining why it is important to conserve water, and what we should do. Use the water footprint calculator (as a class or small group) and have students draw a diagram of or write about how much water households use, including virtual water that is used in agriculture and other industries.

Informational Texts

- Santa Fe drinking water article, Albuquerque Journal, 2010.
- Albuquerque drinking water article, Albuquerque Journal, 2008.
- Albuquerque drinking water information from Albuquerque Water Utility Authority
- *LA Times* article. "Americans use twice as much water as they think they do, study says"
- *A Long Walk to Water*, by Linda Sue Park (2010: Clarion Books, 128 pages)

Classroom Activities

1. Discuss the *Indoor Water Use* pie graph, 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 New Mexico, 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. Do ***The Value of Water*** activity from the back of the USGS poster - *Water: The Resource That Gets Used & Used & Used For Everything* (the poster can be shown on a smartboard). 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 (links above).

4. ***Water Footprint and Water Use in Other Countries.*** Calculate your impact using an online tool. Students can calculate their water footprint with their family at home. You can also use this link to learn more about water use in other countries compared to water use in the U.S.A.
   - Show and discuss the *Water Footprint Network* presentation with your class. This is a great introduction into the water costs of things we use and consume everyday.

5. Read the book *A Long Walk to Water*, by Linda Sue Park.

6. ***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 attached activity. *(Note: this video is a download).*

Materials

- *Indoor Water Use Graph*

- USGS poster -*Water: The Resource That Gets Used & Used & Used For Everything* and ***The Value of Water*** activity and supplies:
    - 1 2-liter soft drink container
    - Collection box
- *Water Footprint & Water Use in Other Countries Network* presentation
- ***Water Footprint Calculator***
- ***The Water-Energy Connection***
    - *Power Couple: The Shocking True Story of Water and Electricity* video, with viewers' guide and posters.

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.
- **Virtual Water**: all of the water consumption necessary for an agricultural or industrial production, or a service. In other words, this corresponds to the total quantity of water needed to produce something. The term 'virtual water' is used because the water consumed is generally not found in the finished products.

Project 7: Groundwater

Blog Postings / Student Assignments

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

- *ABQ Journal* article. "State: Kirtland Jet Fuel Leak Massive"
- *ABQ Journal* article. "KAFB Ramps Up Fuel Spill Cleanup"
- *LA Times* article. "Groundwater contamination a growing problem in L.A. County wells"

Classroom Activities

1. Watch one of the following videos (each 3-5minutes) *Groundwater, The Hidden Source of Life* or *Groundwater, A Hidden Resource* to learn the the significance of **groundwater**.
    - Show students the *Major U.S. Aquifers* map and locate your **aquifer**. Watch this short PSA (3 minutes) about the City of Rio Rancho's Aquifer Injection Project.

2. Do the activity ***Recharge-Discharge*** from the back of the USGS poster – *Groundwater: The Hidden Resource* (the poster can be shown on a smartboard). 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 grounwater, and vice versa. Also, if one person pumps too much groundwater fromtheir well, it can affect their neighbors' wells.

3. 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.

4. Read articles from the Albuquerque Journal about a jet fuel leak from Kirtland Air Force Base (AFB) (see links above) and/or watch this update from Kirkland AFB on the clean up process. 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.

5. Read the resources about groundwater from the Groundwater Foundation or check out this interactive slide show. Review the *Top Ten Ways to Protect Our Precious Water* handout. Brainstorm other ways to prevent groundwater pollution.

Materials

- *Major U.S. Aquifers* map
- *Top Ten Ways to Protect Our Precious Water* handout
- USGS poster – *Groundwater: The Hidden Resource*. - ***Recharge-Discharge*** activity 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
- *The Groundwater Foundation* - Uses of groundwater including chart
- *The Groundwater Foundation* - Contamination

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.

Project 8: Wastewater

This is presented by a guest speaker from the water utility.

Blog Postings / Student Assignments

Write a *narrative* or *creative* paragraph, or create another type of project, explaining the journey of your community's wastewater or continue the water drop's journey excercise from the drinking water section.

Informational Texts

- *KOAT* news. "Aging Pipes Mean Higher Water Bills"
- Combined sewer overflows article, by Anne Jefferson, a geology professor from Kent State.

Classroom Activities

1. Do the activity ***Where Does Your Used Water Go?*** on the back of the USGS poster - *How Do We Treat Our Wastewater?* (the poster can be shown on a smartboard).

2. Read the article about Albuquerque's crumbling sewer infrastructure, and/or the article about combined sewer overflows. If possible, you may want to watch the video, *A Drop's Life*, about combined sewer overflows in the Washington, DC water system.

3. Show students the *Septic System* poster (the poster can be shown on a smartboard 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. Watch the *Dirty Jobs* video, including the *Septic tank technician part*. If your community has mostly septic systems, discuss how important it is to have the tanks pumped out regularly to avoid groundwater pollution.

4. 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. 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. Bring in three glass jars to your class, in one put toilet paper, in another a face tissue and in the third a baby wipe. Shake them up and then observe over the week how and if they dissolve.

6. 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?* and ***Where Does Your Used Water Go?*** activity supplies:
    - 14 feet of yarn, string or rope
    - Shredded paper or packing peanuts and a cardboard box
- *Septic System* poster
- 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.
- *Dirty Jobs* and *Dirty Jobs: Septic Tank Technician* video **(Caution – the 2nd video has one bad word at 1:16)**

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.

Unit 3: River Ecosystem Field Trip

Project 9: Field Trip

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. On the field trip, students may gather data about pH, temperature, turbidity and dissolved oxygen.

Blog Postings / Student Assignments

Write a *narrative* paragraph or a *friendly letter* to your partners, or create another type of project, about your field trip:
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*
- *The Water Down Under* booklet
- Local ecosystem articles
  - *ABQ Journal* article. "Battle with Beavers"
  - *Santa Fe New Mexican* article. "Man-made beaver style-dams help restore land in New Mexico"
  - *Santa Fe New Mexican* article. "Crews complete restoration project at Buckman recreation area"
  - *The Washington Times* article. "NM water release aims to help silvery minnow"

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. Discuss 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 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. Watch the EarthEcho International's inspirational video about service learning projects in the Chesapeake Bay that help clean up rivers.

4. Watch a newscast by frogs, *Frogline News.* to revisit how pollution gets into surface water. Discuss the significance of frogs (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. Watch the video *How Acid Rain Works*.

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 reduces 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. Read one or more of the provided articles about issues in your local ecosystem. You could compare the two beaver articles and talk about varying perspectives on natural resources, the rights of wildlife to access these resources, or the benefits and consequences of restoration.

3. ***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. Use Bosque plant and animal cards to do ***The Web*** activity, discussing how all living things depend on each other.

Materials

Pre-Field Trip Activities:

- *Frogline News* video
- *How Acid Rain Works* video

Post-Field Trip Activities:

- ***The Web*** food web activity

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 US.
- **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 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).