17. Working Water

Agriculture Along the River

Description: This activity concentrates on the agricultural aspect of the Rio Grande Valley. Students lay out an irrigation system on the "River of Change" model, thus building a realistic picture of the human influence on the Rio Grande.

Objectives: Students will understand:

- one of the main users of the river—agriculture;
- the physical characteristics and layout of an agricultural district; and
- some of the science and engineering behind operating an irrigation system.

Materials:

1. one copy of Working Water student cards
2. five copies of agricultural components in this activity
3. scissors
4. envelopes or sandwich bags to hold the pieces and information cards
5. colored pencils or markers (optional)
6. material (listed by color) for various waterways:
   a. gray or earth-tone rectangular piece of paper or felt for the diversion/utility dam; cut at least the width of the river
   b. two long strips of light-blue fabric or ribbon approximately the length of the river for the high-line canal (these are in addition to the strips or flagging used in "Changing River" to represent the drains alongside the levees and described in f. below)

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Grades: 2–12

Time: initial materials preparation about 30 minutes; another hour to assemble the river, learning where each component goes and how it affects the river system

Subjects: science, social studies

Terms: irrigation district, high-line canal, lateral, ditch, acequia, riverside drain, dam, check, turnout, gaging stations, suspended sediments, real-time data

c. eight shorter strips of blue fabric or yarn for the laterals, acequias, and ditches; they should be about one-fourth the length of the river
d. 20 or so circles, about an inch in diameter, for turnouts
e. trapezoids or rectangles to represent checks
f. two long thin strips of fabric the length of the river for the river-side or interior drains (or use the Rio Manso drains)
g. six to eight silver or black cylinders or film canisters for the gaging stations
h. black or red yarn to outline the conservancy district's boundaries
i. River model set up as Rio Manso

Background: Irrigation districts, or conservancy districts, are groups of farmers who have come together and pooled their resources so as to reduce the time, money and effort required for profitable irrigation-based agriculture. Instead of trying to maintain their own individual ditches and diversion structures and manage their own allotments of water, farmers can form an irrigation district that is responsible for all the aspects of an agriculture community. These aspects can include ditch maintenance, water delivery scheduling, system improvements, water managing and possible legal actions, to name a few. Typically, taxes and water delivery fees are collected by the irrigation district for these uses. The benefit of an irrigation district is obvious in a place like the Rio Grande Valley. It is much more efficient for 10,000 individual farmers to work together, as they do here, than for each one to work on his or her own.

The major purpose of an irrigation district is to efficiently deliver water from a given river to farmers who have water rights on that river. Irrigation districts use gravity as the key force to move water efficiently. Gravity is the force that one body, the earth, has on a second body, in this case water. The important idea to remember here is that the force of gravity on earth pulls all objects towards the center of the earth, and thus always pulls downhill. This being the case, irrigation districts can use gravity to their advantage to convey the water to the desired fields. **Diversion dams**, the structures that divert water from the river, are located at the highest point in the district. Diversion dams feed high-line canals, which are the major artery of the irrigation district. **High-line canals** tend to follow the highest points in the valley that are possible while the water is still flowing downhill, so that as much land as possible can receive water. **Laterals, ditches** and **acequias** branch off the high-line canals and run downhill towards the farmer's fields. Often a farmer will have a personal ditch that delivers water to particular fields the farmer irrigates. These also move water via gravity. In general, all the ditches in an irrigation district drop in elevation more slowly

than the river from which the water came. This way, water that is not used by the farmers can return to the river downstream via the force that originally removed the water.

Sometimes the level of water at a particular point in a ditch is too low to feed a turnout to an offshoot ditch. A **turnout** is basically a pipe coming off a ditch which can be open and closed as is needed. This problem is solved by the use of a **check** structure. A check is a miniature dam that can be put in place and removed as needed. By placing a check in a ditch that would otherwise have a water level too low to feed a turnout, the level of water above the check will rise and eventually force water into the desired turnout. This is a major way the irrigation engineers manipulate gravity.

The lowest part of the system are the drains. These lower the ground-water level so that irrigation water will move through the soil and away from plants' roots. An analogy is a house plant in a pot. There is always a hole in the bottom of the pot for excess water to drain out so the roots don't get saturated. Drains in irrigated lands flow into the river, returning water to the Rio Grande.

Irrigated agriculture has been practiced in the Rincon and Mesilla valleys since the 1600s. The Elephant Butte Irrigation District (EBID) was formed in 1918 to oversee irrigation of 90,640 acres (36,690 ha*) downstream of Elephant Butte Dam. Today, EBID operates and maintains the Percha, Leasburg and Mesilla Diversion Dams, as well as 357 miles (575 km) of canals and laterals within the district. Irrigation water supports a variety of crops, including cotton (26%), alfalfa (24%), pecans (23%), vegetables (16%), small grains (6%) and other crops (5%). The Rincon Valley irrigation water is delivered through 76 miles (122 km) of canals and laterals to more than 18,100 acres (7,325 ha) of farms and small tracts. These facilities carry a volume of 1,645 cubit feet (47 cubic meters) of water per second at full capacity. The Mesilla Valley is divided into eight irrigation units in the upper Mesilla Valley, as well as some properties in the Texas area that irrigate off of New Mexico canals and lateral. The upper and lower portions of the Mesilla Valley are composed of more than 72,500 acres (29,340 ha) of farms and small tracts. There are approximately 281 miles (452 km) of canals and laterals in the Mesilla Valley. At full capacity, these structures deliver approximately 6,320 cubic feet (179 cubic meters) of water per second. The EBID is governed by a nine-member board of directors, which is elected at large.

* ha=hectare: a metric unit of area equal to 10,000 square meters, or 2.47 acres

Procedure:

1. Begin by asking the students what they know about the flow of water and irrigation.

   What causes rivers to flow? Gravity

   How do many farmers in the valley irrigate their fields? From ditches. Some use pumps to bring up ground water, but our focus will be those who use ditches/acequias/laterals to irrigate.

   What powers the system of ditches? Gravity

   So, making use of the laws of gravity, irrigation water is distributed throughout the valley. Remember as you work on this activity that water does not flow uphill! You will be placing a diversion dam to pull water into high-line canals and you want to keep the canal along the far edge of the mesa, so it slowly flows downhill, and you can use gravity to drain into fields toward the river.

Doing the activity:

2. Divide the class into eight groups and pass out one Working Water card and appropriate items to each group.
3. Have students read the cards and place their items on the model—The Rio Manso model of the "Changing River" activity—when instructed to do so.
4. Tell the students to place items on the model in the following order. Each group should describe what they have placed to the entire class.
   a. irrigation district
   b. diversion dam (at the most upstream location in the district)
   c. high-line canal (take in the widest section of the valley to maximize available farmland)
   d. lateral ditches and acquias
   e. farm fields
   f. turnouts for fields
   g. check dam to make turnouts work
   h. gaging stations where you want to know how much water is being used (at the diversion and other places)
   i. drains if they are not already in place
5. Discuss students' experiences with irrigation, ditches, etc. Do their families irrigate? Do they walk along ditches in the valley?

A diversion dam of the Middle Rio Grande Conservancy District near Algodones. Photo by Letitia Morris

The metal structure on the left is a check. When it is closed the water in the high-line canal or lateral builds up to a level that will flow through the turnout, shown at lower right, into a farm field or smaller ditch. Photo by Anders Lundahl

Schematic of a conservancy district water system