14. Cottonwood Creation

Description: Students learn about cottonwood seedling survival through two steps. Step 1 identifies the conditions a seed needs to germinate (start growing) by using cotton balls on the river model. In Step 2, students toss coins or dice to try to grow seedling roots fast enough to keep up with a lowering water table. Students realize that very few cottonwood seeds actually become trees and that altered river conditions are very limiting for cottonwood establishment.

Materials: River model (see activity "Changing River")

1. cotton balls (ideally 200 to 600, usually sold in bags of 200 or 300)
2. a place to grow the seedling roots, the top of which represents the surface, or ground level, and the bottom of which represents the lowest annual level for the water table. Some ideas for this are:
   a. a copy of Root Race (page 197) for each student (laminate for repeated use), or
   b. a chalkboard or corkboard where 10 to 12 students can work at once, or
   c. laminated graph poster board (for use with dry-erase markers)
3. something to represent the seedling roots (one per student or student pair), depending on your choice above:
   a. writing tool for Root Race page (erasable markers for laminated sheets), or
   b. chalk for the chalkboard, or
   c. dry-erase markers for the laminated poster board

14. Cottonwood Creation

Grades: 3–8

Time: two hours which can be divided into two or four sessions (two parts with old and new river models)

Subjects: science, math

Terms: germinate, ground water, hydrology, overbank flooding, seedling, water table

4. something to represent the water table at least the length of the area you are working in, i.e. chalkboard, etc. It should be relatively simple to adjust the water table depth, and allow for seedling roots to extend below it. Examples are:
   a. on the Root Race sheet, students can simply draw horizontal lines to represent the water table, or
   b. students can suspend blue yarn on each side with thumb tacks or tape and drop this line down with each water table adjustment
5. pennies (or dice or spinner, or other device to randomly determine 1 or 2, or 1, 2, or 3), one per student or pair
6. rulers to measure distances (or copies of the "Root Race" sheet)

Part One: Cottonwood Cotton Game—How Trees Get Started

Objective: Students will see that although cottonwood seeds may settle everywhere, only a few places will provide the right conditions for the seeds to germinate (begin to grow).

Procedure:

Section A: Rio Bravo

1. Set up the river model to represent the old river (Rio Bravo). For guidelines, see the activity "Changing River."
2. Hand out at least 30 cotton balls to each student. Explain that each cotton ball represents a cottonwood seed. Emphasize the difference between true cotton and cottonwood seeds. (True cotton comes from an agricultural plant; cottonwood seeds are surrounded by a mass of fine threads that resemble cotton and allow the wind and water to transport the seeds away from the mother tree.)
3. Have students stand around the sides of the river model. Tell the students that they will mimic the female cottonwood trees by tossing the cotton balls on the model at the same time. Since the seeds are transported by wind they will land at random locations. Ask students to toss their cotton balls into the air and onto the model on the count of three. Students may touch only cotton balls that do not land on the model in order to retoss them so all the balls are on the model.
4. Explain the conditions a cottonwood seed needs to germinate, including sunlight (no shade), bare soil, and wet soil. In the old river this would include areas that received overbank flooding, particularly where existing plants were scoured away by the flood. For this round, instruct students to collect all the cotton balls:

on sand bars and within one hand's length (wrist to fingertips) of the river edge; and
that are not touching any other vegetation such as grass, shrubs, trees, or cattails or the water.

Place them in a "germinated" pile. Pick up all the other cotton balls and put them in a "did not germinate" pile. Have students count the number of cotton balls in each pile and write these numbers down (on the board or in their class journals). Discuss the difference in the size of the piles. The "germinate" pile should be smaller than the pile that did not germinate because there are fewer available sites for the seeds to start to grow. If the piles are equal or the "germinate" pile is larger, ask the students if they understood the directions and repeat this step if necessary. Ask students why they think cottonwood trees make so many seeds.

5. You may want to move to Part Two, Root Race, and determine the fate of the young seedlings before moving on to the Rio Manso section, for the second section of the Cottonwood Cotton Game.

Section B: Rio Manso

6. Change the river model to represent the altered river (Rio Manso). For guidelines, see the activity "Changing River."
7. Repeat Steps 2 and 3, handing out the same number of cotton balls as before.
8. Explain to the students that in this changed river ecosystem, there is very limited overbank flooding. The only seeds that germinate will be on bare sand bars or right on the edge of water (rivers, ditches, drains, etc.). Ask students to once again pick up the cotton balls from the model and make two piles, one for successfully germinated seeds and one for seeds that did not germinate. Count the piles and compare the results with the old river activity. There should be a significant reduction in the number of seeds that germinated. Ask the students why it is less. Some answers may include: lack of flooding left fewer wet sites, straightening the river left less river edge, etc.
9. Move on to Part Two, Root Race, to determine the fate of the newly germinated seedlings.

Part Two: Root Race—How Seedlings' Roots Must Keep Up With the Lowering Water Table

Objective: Students learn that a cottonwood seedling's roots must grow as fast or faster than the water table drops in order to survive by playing a game visually demonstrating water table levels and root growth.

Section A: Rio Bravo

1. Explain to the students that once a cottonwood seed germinates, its next hurdle is to grow roots fast enough to keep up with the water table as it lowers after the flood. Students will play the Root Race game for each of the cotton balls in the pile of successfully germinating seeds from Step 4 of the Cottonwood Cotton Game. Root Race can be played on the chalkboard, on a laminated poster board with dry-erase markers, on material, or on the Root Race sheet (page 197).
2. Have each student or student pair take a piece of cotton from the pile that did germinate in the old river. Place this cotton at the top of the chart. Mark the chart (or chalkboard, etc.) off in regular increments with at least 12 increments of depth. Each increment will represent approximately four inches of soil depth.
3. Set the water level even with ground level at the top of the chart. Explain that this represents the seasonal flood that corresponds with the release of seeds from the cottonwood trees.
4. Have each student or student pair flip a coin. If heads, move root one increment; if tails, move root two increments (or roll the dice—odd move one increment, even move two).
5. To determine how the water level moves each round, have one student flip a coin or roll a dice for the whole class. Explain that the water table may lower faster in some areas than others, but, generally, within a close area the water table lowers at the same rate. Therefore, only one flip per round for each chalkboard or activity sheet is needed for the water table. If the coin is heads, move the water table down one increment; if tails, move the water table down two increments (or if using dice, odd move one increment, even move two increments).
6. Any time the water level drops below the root, that seedling dies. Take the cotton ball from the chart and place it in a "dead" pile. If the root of the seedling reaches the bottom of the chart before the water table, place that cotton ball in the "live" pile. Explain that the bottom of the chart represents the lowest level of water table for that area.

7. Repeat this process for all of the cotton pieces that germinated in Step 1 for the Rio Bravo. Count the number of seedlings that died and lived and record these on the board or in student journals.
8. Discuss the difference between the number of seeds that reached the bottom of the chart and those that didn't. Based on this activity, what chance did a germinated cottonwood seed have of surviving?

Section B: Rio Manso

9. Have students play the Root Race game for each of the cotton balls in the pile of successfully germinating seeds from Step 8 of the Cottonwood Cotton Game. Explain that the "rules" have changed since the conditions along the river are different. Since the hydrology is different in the new river, explain that the water table will drop by increments of one, two, or three, but trees still grow in increments of one and two.
10. Repeat Steps 2–4 as above.
11. Now that the hydrology (the way water moves above and below ground) has been changed by the dams, levees, and irrigation, the water table responds differently than it did with the old river. When flipping for the water table, have students flip the coin twice. If they flip two heads, the water table drops one increment. If they flip one head and one tail, the water table drops two increments. If they flip two tails, the water table drops three increments. (With dice, a one or a two equals one increment, a three or a four equals two increments, and a five or six equals three increments.)
12. Repeat this process for all of the cotton pieces that germinated in the Rio Manso round. Count the number of seedlings that died and lived and record these on the board or in student journals.
13. Lead a discussion on this activity. Have students compare the results of established cottonwood seedlings between Rio Bravo and Rio Manso. In which environment did more cottonwoods get started? Many people today believe that young cottonwood trees are not being established to replace older trees. What do the students think? How does this activity compare with the way cottonwood trees are really established? What other factors may affect cottonwood tree establishment?

Section C: Rio Nuevo

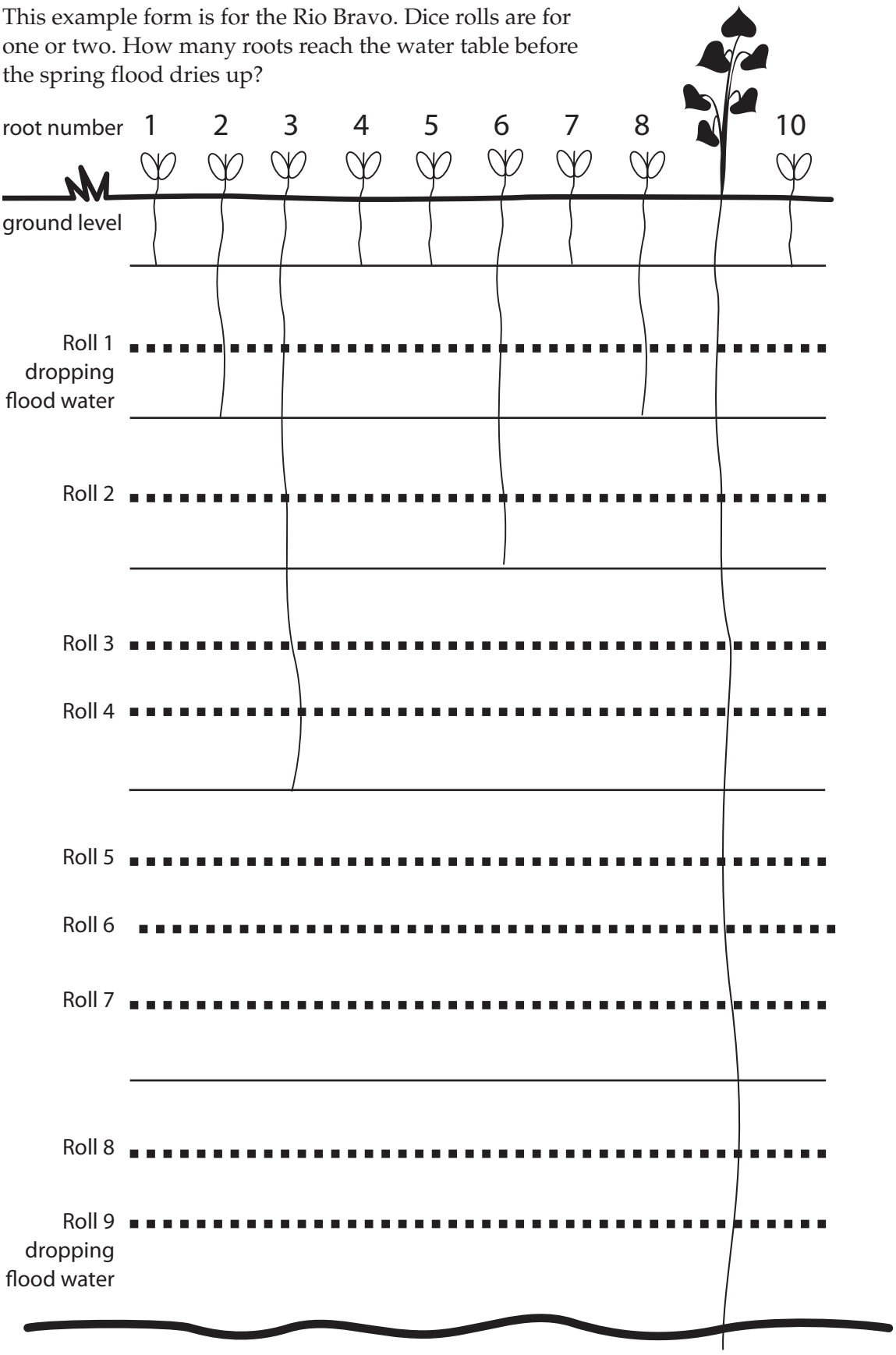
14. In the third river, Rio Nuevo, new management strategies have goals of bringing as many of the characteristics of the Rio Bravo as possible within the levees to today's river. This includes overbank flooding and creating conditions for cottonwoods to sprout and thrive (see Rio Nuevo discussion in "Changing River" activity). Ask students how various restoration projects can impact cottonwood establishment. List the projects to improve cottonwood establishment and show these projects on the model.

Extensions:

1. For a variation the teacher may choose to have a "heavy summer rainfall" so the ground water does not drop during one round.
2. Graph all the results to help understand the differences. Calculate percent of cottonwood seeds that survived and did not survive.

Teacher's Example Form: Root Race

This example form is for the Rio Bravo. Dice rolls are for one or two. How many roots reach the water table before the spring flood dries up?



Root Race

How many roots will reach the water table before the spring flood dries up?

root number 1 2 3 4 5 6 7 8 9 10

ground level

water table