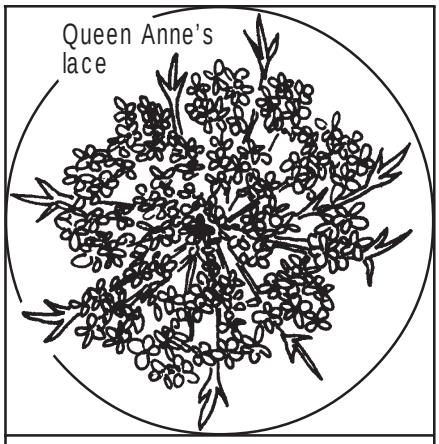
Outwit-Outplant-Outlast



Method

Students will play the parts of native plants, invasive plants, and herbivores in a game. They will quickly see the advantages that invasives have over natives. The invasives need fewer resources and reproduce a lot faster than their native competitors. In fact, it won't take many "seasons" for a few invasives to displace the native plants and take over the playing field.

Getting Ready

1. Prepare the playing field by making 25 one-yard squares. You will need three people to help make the grid. See directions for using a chalk line on page 58. Alternatively, use carpet squares or paper plates to make the playing field.
2. Find two colors of tokens to represent sunshine and water/nutrients. Use poker chips, milk caps, or paper squares.

Introducing the Activity

When you watch a nature show on TV about a pride of lions, a herd of zebras, and a pack of hyenas, it's easy to understand how competition controls the sizes of these populations. It's a little harder to understand how competition works with plants. These three games will help you understand some of the factors that decide who wins and who loses in the plant world.

Doing the Activity

Game One

Discover how plants invade an empty field.

This playing field represents a recently plowed field. Each square on the grid has enough space (soil) for one plant. In real life, many different plants and their seeds would invade this bare field. In order to simplify the process and analyze what is happening, we are going to assume that only one seed from an invasive species sprouts in the first year and that no other seeds from other plants can enter the field.

1. **Discuss what plants need to survive.** (Sunshine, water, nutrients, soil).

Objectives

- Experience the vulnerabilities of native species, such as competition, predation, and dependence on nutrients, water, and space.
- List reasons why invasive species have a competitive advantage over native species, such as longer growing season, lower nutrient requirements, and lack of predators.
- Chart the advancement of invasives as they spread throughout a natural area.

Grades

5 – 12

Group Size

15 – 30

Activity Time

One or two 50-minute periods

Setting

Outdoors or gym

Materials

- Chalk line
- Chalk dust for refilling
- Tape measurer
- Sidewalk chalk
- Water/nutrient tokens (100)
- Sunshine tokens (100)
- Cowbell or other noisemaker

Connections

See next page.

Academic Standards

Grades 5 – 8

- Environmental Education: B.8.8, B.8.21
- Math: B.8.7
- Science: F.8.2, F.8.8, F.8.9,

Grades 9 – 12

- Environmental Education: B.12.3, B.12.4, B.12.6
- Science: F.12.7, F.12.8

2. **Explain the tokens.** Show students the water/nutrient tokens and sunshine tokens. Scatter the tokens around the playing field.
3. **Ask one student to represent an invasive plant and to stand in a corner of the grid.**
4. **Start the game.** At the sound of the bell, the student must pick up three water/nutrient tokens and three sunshine tokens. Allow several seconds before sounding the bell again to stop the collecting. The student can't leave the grid square to collect the tokens. After all, plants have roots! **Note:** The student should be able to obtain the necessary tokens easily.
5. **Reproduce.** This invasive weed produces many seeds, but only four of them land and sprout inside the grid. Add four more students to adjacent grid squares.
6. **Renew the supply of tokens.** Redistribute the water/nutrient and sunshine tokens on the playing field.
7. **Sound the bell and have the "plants" collect their requirements. Note:** Distribute tokens so that all the plants survive.
8. **Reproduce.** These plants now all produce lots of seeds, but only four of the seeds produced by each plant survive. Add 20 students. The grid is now full.

Discuss

- How many plants can this field support? (25)
- What would happen if two plants tried to live in the same square? (They might both be small and spindly, or the weaker one might die. However, if enough water/nutrient and sunshine tokens are present, they might both survive.)
- If all 25 plants survive and reproduce, how many seeds will sprout the next year? (100)
- Continue the math for a few more years. What would a graph of this population's growth look like?
- The playing area is full of plants. What happens to all the extra seeds? (While some might sprout and die, many lie dormant in the soil waiting for the ideal conditions to grow.)
- What factors did we ignore in this game? (Most importantly, we ignored the fact that many plants invade at once. In reality, a variety of pioneer plants may have covered the field in the first year. Plants don't live forever; some would have died during the game. Nothing ate the plants. There were no parasites or diseases. There were always plenty of tokens; sometimes plants don't get the things they need to survive.)

Game Two

Discover how natives occupy a natural area.

It didn't take long for the plants in the first game to invade the empty field and completely take over. The soil was bare. There was no competition. Water/nutrients and sunshine were plentiful. What do you think happens in a field that is full of native wildflowers and grasses? Let's try it.

1. **Adjust the size of the grid.** Using sidewalk chalk, "X" out the unneeded squares so that the playing area contains squares equal to one third the number of students. For example, a class of 30 would require a grid with 10 squares. The grid does not have to be square.
2. **Fill the squares with students, one student per square.**
3. **Send in a deer.** Select one student to be a hungry deer that eats two of the plants. (Remind students that they can't move from their squares!) Remove these "plants" from the playing field.
4. **Gather tokens.** The wildflowers need five water/nutrient tokens and five sunshine tokens to survive. Ring the bell to begin and end collecting time.
5. **Reproduce.** All plants that didn't collect enough requirements die. These plants must leave the grid. Plants that did get enough are able to reproduce successfully. They produce quite a few seeds, but only two seeds per plant land in the playing field. Calculate how many seeds the plants will produce. Decide which students will be these seeds.
6. **Send in a mouse.** Designate one student to be the mouse that will eat the seeds. Each year, the mouse will eat half of all seeds produced by the plants. At the signal, the mouse can "eat"/tag the correct number of the seeds on the sideline.
7. **Germinate.** At the signal, the "seeds" can try to take over the empty spaces on the grid. Any unsuccessful seeds return to the sidelines.
8. **Count the number of plants on the grid.** Compare this to the number at the beginning. Talk about what happened. If we played another round, how many plants would we probably have at the end of the round? If the students don't understand that the answer would be the same, play another round to show that while the individual plants may change, the number of wildflowers in the field stays the same.

Discuss

- Why did the population end up the same? (Some plants died because they didn't collect enough tokens or because herbivores ate them. The plants that did survive reproduced and filled the empty spaces.)

Game Three

Discover how weeds invade a natural area.

It was a little harder for an individual wildflower to survive when the field was full of plants. However, the wildflowers as a whole did just fine. When a plant died or was eaten by an herbivore, a seed sprouted in the available space. What would happen if we put the two games together? What if an invasive weed seed sprouted in one of the empty squares?

1. **Place students in the squares without "X"s.** Fill all the squares except one with students representing native wildflowers. Fill the empty square with a student representing an invasive plant. To differentiate between the two, ask the students representing the invasive plants to look "prickly" or wear armbands.
2. **Send in the hungry deer.** The deer doesn't recognize the new plant as a food plant, but it does dine on two of the native plants.
3. **Allow the plants to gather tokens.** At the signal, the invasive plant can begin to collect its requirements. The invasive plant needs three of each kind of token. A few seconds later, ring the bell again and invite the native plants to collect. Remind the natives that they need five of each colored token. If the natives protest, explain that invasive plants often turn green earlier in the year and stay green longer in the fall, so they should have more time to collect their tokens. Many invasive plants can also survive on smaller amounts of water, nutrients, and sunshine.
4. **Reproduce.** All plants that didn't collect enough water or sunshine die. These plants must leave the grid. Plants that did get enough are able to reproduce successfully. The invasive produces many seeds, but only four land on the grid. The natives also produce quite a few seeds, but only two per plant land in the playing field. Calculate how many seeds the plants produce. Decide which students will represent these seeds.
5. **Send in the mouse.** Designate one student to be the mouse that will eat the seeds. Each year, the mouse will eat half of all seeds produced by the *native* plants. The mouse doesn't eat the seeds from the invasives, because they are hairy and unpalatable. At the signal, the mouse can "eat"/tag the correct number of the native seeds on the sideline.
6. **Germinate.** At the signal, the "seeds" can try to take over the empty spaces on the grid. Any unsuccessful seeds return to the sidelines.
7. **Repeat steps 2 – 6 until invasive plants completely overrun the field.** Optional: You could allow two invasives to occupy each square, since invasives often need less space than natives do.

Discuss

- What advantages did the invasive species have over the native species? (They produced more seeds. Herbivores didn't eat either the plants or the seeds. They needed fewer tokens to survive. They began collecting tokens before the natives.)
- Do the native species have a chance in this game? (No, not really. It's rigged!)
- Do the native species have a chance in the real world? (No, not in the presence of extremely invasive species. That's rigged too!)
- Why are herbivores less likely to eat invasive plants? (In addition to invasives just not being recognized as food, some invasives are toxic or contain chemicals that repel herbivores.)
- In the game, the deer and mouse continued to eat the plants and seeds of the native wildflowers, no matter how many there were. Is this realistic? (Maybe not. As the concentration of natives decreased, the herbivores would probably look other places to find food. However, if there is nowhere else to go, herbivores will remain in the area.)

This activity is adapted from "Outwit–Outplant–Outlast." **Non-Native Invasive Species Learning Kits — Meet the Invaders**. United States Forest Service. 2005.

Assessing the Learning

Ask students to chart and graph the plant populations in each of the three games and to write short paragraphs explaining what they predict will happen in future generations.

Extending the Learning

Play Game Three again. This time try to control the spread of the invasive at varying times. What if someone removes the first plant before it makes seeds? What if people don't begin to control the plant until after it produces seeds? Ask students to find out how many seeds invasive plants actually produce. Find out how long the seeds remain viable in the soil. This game makes a strong case for early intervention and rapid response to a plant invasion!

Finding Out More!

Alien Plant Invaders of Natural Areas. Plant Conservation Alliance. 2005. <www.nps.gov/plants/alien/factmain.htm>

Invasive Plants: Weeds of the Week. United States Forest Service: Northeastern Area. 2005. <http://na.fs.fed.us/fhp/invasive_plants/weeds/index.shtm>

Making a Chalk Line

Use a tool called a chalk line to quickly make the playing field for the game.

1. Hold onto the metal tab and pull about 20 feet of string out of the chalk line. Ask two students to hold the string tight just above the surface of the parking lot. A third student should snap the line once by pulling it up about five inches and letting go. The line should hit the ground and leave a line of chalk dust. Use the reel to rewind the string so that it is *rechalked* for the next line.
2. Repeat Step 1 to make a 20-foot chalk line perpendicular to one end of the original chalk line. See Figure 1.
3. Use the tape measure and sidewalk chalk to mark off five sections that are one yard wide along the original chalk line and along an imaginary line where the top of the grid will be. See Figure 2.
4. Following the directions in Step 1, make chalk lines at each of the marks. When you are done with this step, your grid should look like Figure 3.
5. Measure five sections that are one yard wide along the two sides of the grid. See Figure 4.
6. Make chalk lines on each mark. Your grid should be five squares wide and five squares tall. Don't worry if it is a little skewed! See Figure 5.

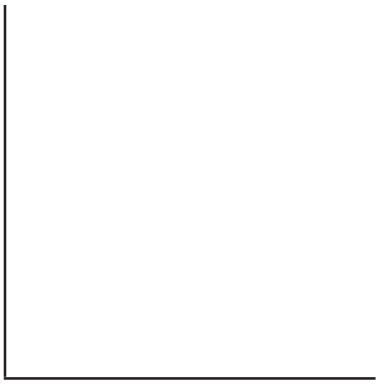


Figure 1

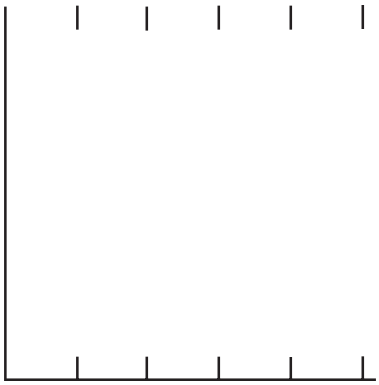


Figure 2

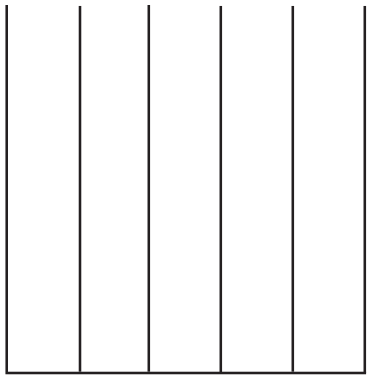


Figure 3

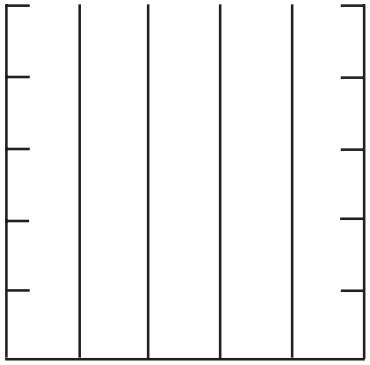


Figure 4

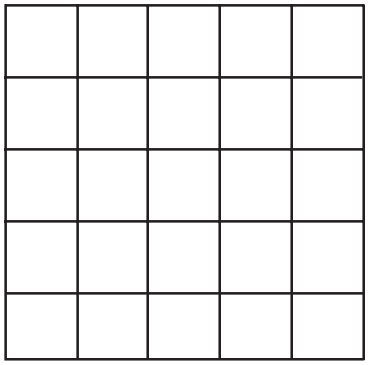


Figure 5