

Genetic Analysis of Invasive Species

OVERVIEW: Plant populations in the cedar glade are often small and fragile, as a result of the limited habitat available. The appearance of an introduced, non-native plant to the cedar glade could be especially troublesome, because of the already limited resources and the tendency of invasive plants to be hardy and adaptable. In this simulation, morphologically similar exotic grasses have invaded the cedar glade. The only way to identify them is to analyze their DNA, and use that information to remove them from the area.

GRADE LEVEL: 9 – 12

TIME: One class period (55 minutes)

SETTING: Classroom

OBJECTIVES: Students will perform a (simulation) DNA analysis to distinguish between morphologically similar plants.

LEARNING STANDARDS: CLE 3210.2.1; 3210.5.3; 3255.4.5; 3255.6.2

QUESTION: Which plants are invasive and need to be removed from the glade?

MATERIALS:

- 1 coffee filter or chromatography paper
- metric ruler
- pencil
- 5 toothpicks
- 5 (mock) DNA samples (see teacher information)
- 250 mL beaker with approximately 1 cm of water
- scissors

BACKGROUND: Several patches of grass in the cedar glades look suspiciously like an exotic invasive species (or two) are taking root, and need to be removed. However, the grasses look so much alike, it's difficult to tell them apart. Which are the native grasses?

Restriction Mapping is a process in which it is possible to distinguish one species from another. Strands of DNA are first clipped into segments by special enzymes that cut at specific sites. Next, the fragments are sorted in a process called *electrophoresis*, where the pieces of DNA are separated by their size. If samples from two organisms contain the same pattern of DNA fragments, they are the same species; if they do not, then they are different.

TEACHER PREPARATION:

To make the mock DNA solutions, use liquid food coloring as directed:

Solution #1: 4 drops each of red, yellow, green

Solution #2: 8 drops blue and 4 drops green

Solution #3: 4 drops each of blue, red

Solution #4: 4 drops each of red, yellow, green

Solution #5: 4 drops each of red, yellow, green

*These amounts are adequate for 8-10 lab groups

Solutions #1, 4, 5 are identical, and are native grasses.

Solutions 2 and 3 are different, and represent invasive, non-native grasses.

PROCEDURE:

1. Observe the 5 samples: Each have been taken from 5 different patches of grass in the cedar glade. Sample 1 has been obtained from an herbarium specimen collected by an expert so it is known (for sure) to be from the species of grass native to the glade.
2. Cut the flat part of the coffee filter so that you have a piece that is flat and measures approximately 10 cm wide and 10 cm long. Fold filter so that it will stand in the beaker.
3. Draw a pencil line about 2 cm above the lower edge of the filter paper. Make 5 dots along the pencil line, evenly spaced, and number these dots (1-5) below the line.
4. Using a *new toothpick for each solution*, transfer the DNA solutions to the locations marked with the same number. Let the solutions dry for 2 to 3 minutes.
5. While filter paper dries, pour about 1 cm of water into the beaker.
6. Position the dry filter paper into the beaker so that the treated end is in the water but ensure that the dots should be about 1 cm ABOVE the surface of the water.
7. After 10-15 minutes, remove the filter paper from the beaker and answer the following questions.

Name _____ Period _____ Date _____

Instructions:

1. Observe the 5 samples: Each have been taken from 5 different patches of grass in the cedar glade. Sample 1 has been obtained from an herbarium specimen collected by an expert so it is known (for sure) to be from the species of grass native to the glade.
2. Cut the flat part of the coffee filter so that you have a piece that is flat and measures approximately 10 cm wide and 10 cm long. Fold filter so that it will stand in the beaker.
3. Draw a pencil line about 2 cm above the lower edge of the filter paper. Make 5 dots along the pencil line, evenly spaced, and number these dots (1-5) below the line.
4. Using a *new toothpick for each solution*, transfer the DNA solutions to the locations marked with the same number. Let the solutions dry for 2 to 3 minutes.
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Analysis and Conclusions:

1. What happens to the drops of DNA after sitting above the water?
2. Which samples are most similar?
3. How do you know?
4. Which samples represent the native grass?
5. Which samples are from the non-native, invasive grass?
6. The U.S. Fish & Wildlife Service estimates that more than \$1.5 million will be spent over the next ten years in an effort to restore the endangered species of the Tennessee cedar glades. *Should endangered species always be rescued, despite the costs/risks? Why or why not?* Use the back of this paper to explain your position.

