Refresh for Relevance

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Rake It or Leave It

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GRADES:
5th–6th

OBJECTIVE
The goal of this activity is to provide students with experience in estimation, spatial sense, and visual reasoning, with an extension exercise in "shortest paths" graph theory.

MATERIALS NEEDED
- **Plastic jack-o'-lantern leaf bags (variety of sizes)**
- **5-gallon grocery sack of leaves**
- **Leaves to rake**
- **Meter or yardsticks**
- **Wheelbarrows**
- **Rakes**

Pull-Out Section

IN-CLASS ACTIVITY

TEACHER TALK

The ordinary chore of raking and gathering leaves is a perfect setting for practicing estimation skills and learning a little graph theory to boot. First, students will estimate the size leaf pile that will fit into various size bags. Then they'll have to collect the leaf bags in the most effective manner. We added some incentive by making this into a business transaction (see **Figure 1** on the Homework Page) and gave the kids a model to practice with before doing it for real. This can be a great Halloween mathematics exercise that makes full use of your students' energy and abilities.

BRINGING IN THE LEAVES

First, the students draw lots to see who is responsible for raking an 11-, 20-, or (groan) 40-gallon Jack-O'-Lantern bag full of leaves. As a reference, I bring a 5-gallon bag of leaves, which is about the size of a large paper grocery bag with the leaves lightly packed.

The students work in cooperative groups of three to use a system of estimation to determine the size of the pile they will rake. They use either the small pile of leaves or the grocery sack as a reference, figuring out the measurements of the reference pile and then calculating the size of the new pile.

After they calculate the measurement, we traipse outdoors to the schoolyard or the park and rake leaves. When the group rakes a pile of leaves that matches their estimated measurement, I give them the appropriate bag. They bag the leaves to verify their estimate.

When explaining the activity, I ask the students to think about how the pile of leaves will look, but I don't labor the point. It's a lot of fun to watch their reactions as they realize that raking a pile of leaves 20 inches long, 8 inches wide, and 72 inches high can be a problem!

TEACHER TALK

Now discuss the concept of "shortest paths" with the students. Read the description and instructions aloud from the Homework Page and tell them that you'll be looking forward to seeing some of their solutions and strategies for finding the shortest path.

We've included the gallon sizes of the leaf bags in the homework exercise so the kids can figure out how much money they could make, as well as feet between the leaf bags.

The next day, have different members of the class talk about what they did to come up with the best answers.

Now have the students try doing the problem with real leaves and a real wheelbarrow. What are some of the problems they find that they didn't have to deal with when they did the problem on paper?

ASSESSMENT

The purpose of this assessment is to gain insight on the way the students think about the problem and on their ability to communicate their ideas on solutions. Before raking leaves, each student explains the group's method of estimation in his/her math journal. When we return from outdoors, the students record their reactions to the activity with emphasis on the discoveries they made.

The students will also explain their strategies for leaf collection in their journals, apart from class discussion.

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HOMEWORK PAGE

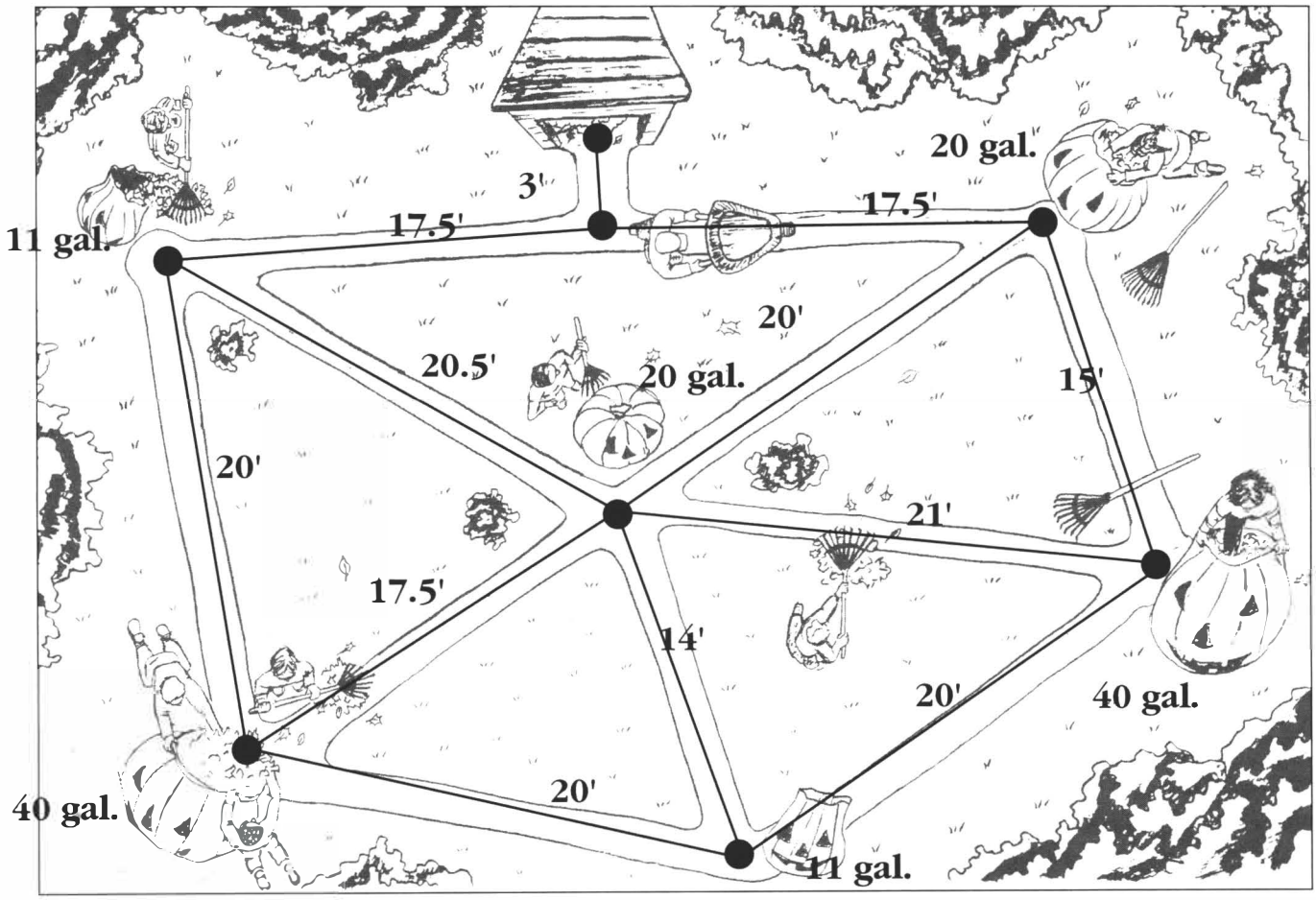

Figure 1. A diagram of the shortest path problem.

HOMEWORK PAGE

MODELING SHORTEST PATHS

A shortest path problem is one of optimization, and uses graph theory as a tool.

A "shortest path" problem is one where you want to find a minimum distance to travel from one place to other fixed points and then return to your starting spot. People at schools and businesses need to solve this problem in many situations. For example, the school bus needs to pick up children at many different streets and get them to school on time. They also need to spend the least amount of money on gas to do so within a fixed budget.

There are other examples too. Phone companies get millions of calls a day and must find the shortest path to route the calls so customers pay the least and get the best service. Can you think of other examples?

Now let's solve a real problem here—how do we go about collecting the leaves in the most efficient and cost-effective manner? To make this interesting, let's look at this as a business proposition, as well as an ecological solution for the proper protection of seedlings in a plant nursery.

Look at Figure 1. We've put the distance (in feet) between the piles so you can develop a model.

The local garden store needs plenty of leaf mulch to protect its young plants in the winter months. The owner is willing to buy the leaves you raked during class. Here are the conditions:

- You receive $1 for each gallon of leaves you return to the garden store. However, you have to pay 5¢ for every foot you travel to pick up and deposit the leaves with the wheelbarrow.

- You must start at the mulch house to pick up the wheelbarrow.

- You must return the leaves to the mulch house and leave off the wheelbarrow.

Which is the shortest path you can take to pick up the leaves to make the most money?

What are some of the problems you find doing this problem?