Traveling Networks

What's the rule that tells you whether or not a network can be "traveled"?

Materials

- playground with painted game courts (hopscotch, four square, and so on) or other paved surface
- chalk
- paper and pencil (optional)

Group Size

small groups

Related Activity

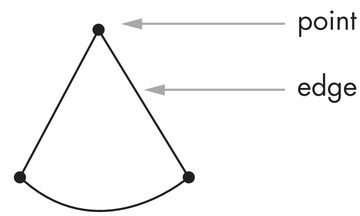
- Solving Playground Network Problems

Did You Know?

In the 1700s, the people of a town called Königsberg amused themselves by trying to cross each of Königsberg's seven bridges (edges) only once to end up at their starting point. Swiss mathematician Leonhard Euler (pronounced "oiler") studied the problem and found a way to prove whether or not the edges in any particular network could be traveled only once to complete a circuit—and showed that it was impossible to travel the seven bridges in this way.

Background

There are networks everywhere: computer networks, social networks, and networks of nerve cells in our brains. Networks consist of *points* (also called *nodes*)—the computers, people, and so on—and *edges* that connect the points to each other. All networks can be drawn with dots representing the points, and straight lines or curves representing the edges.



You can find networks painted on playgrounds, such as a four square court (although you'll have to add the points or imagine them), and you can draw your own. In this activity, you'll try to "travel" some playground networks.

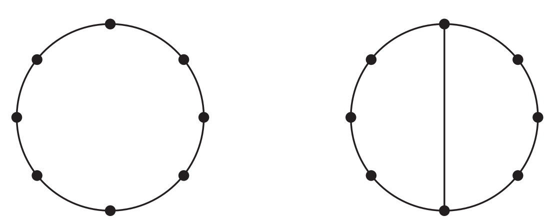
How to Travel a Network

For this activity, we'll only use networks that are closed. Your goal is to walk on every edge until you return to your starting point without walking on any edge more than once. You may cross a point any number of times.

NOTE: Some networks cannot be traveled. Some complicated networks can be traveled, but it may be difficult to discover the correct route.

Try This

1. Each group should draw these two networks on the playground. Make each about a meter across:



2. Try walking these networks to see if they can be traveled. Figure out a way to keep track of each edge that you walk on.
3. If you found that one of the networks couldn't be traveled, try again from a different starting point. How many times do you think you should try before deciding that it's impossible to travel a particular network? Write *possible* or *impossible* next to each network.
4. Identify some networks painted on the playground, or draw some of your own, and repeat steps 2 and 3 for each network. If a network seems impossible to travel, you might try starting from a different point, or you might try starting at the same point but making some different decisions about when and where you turn.
5. Look for a pattern or rule that could tell you which networks can be traveled and which cannot be traveled. Do you see anything that all the *possible* networks have in common or that all the *impossible* networks have in common? (Hint: count the number of edges that come into each point.)
6. If you have time, trade places with another group. See if you can travel any of the networks they thought were impossible, and vice versa. Or copy some of the impossible networks onto a piece of paper and try to work them out later.

What's Going On?

Points in a network can be described as odd or even. Odd points have an odd number of edges coming into them, and even points have an even number of edges. A network that makes a complete circuit can be traveled according to the rules of this activity only if all the points are even.

So What?

Figuring out the most efficient way to travel a network has a number of practical applications: People who plan the routes for trash and recycling collection, mail delivery, and street cleaning, for example, use this kind of geometry.