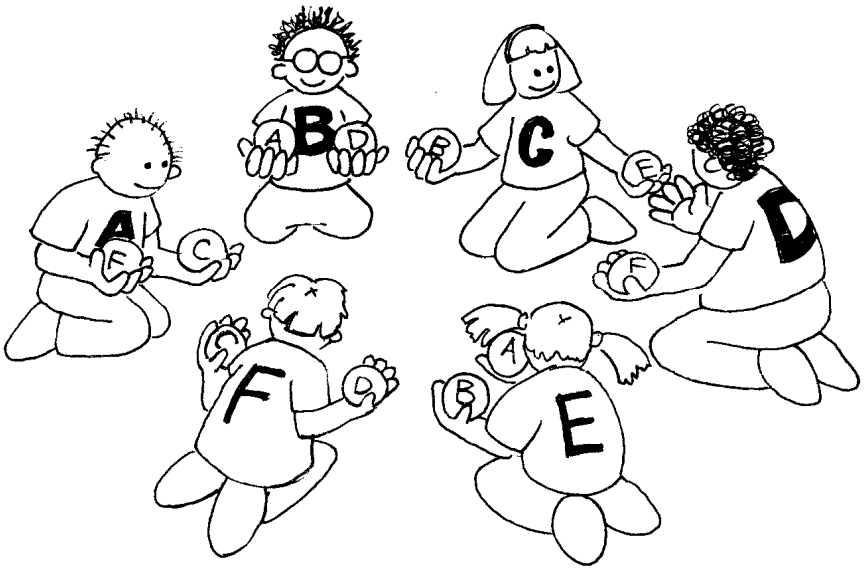
Activity 10

The Orange Game—*Routing and Deadlock in Networks*



Summary

When you have a lot of people using one resource (such as cars using roads, or messages getting through the Internet), there is the possibility of "deadlock". A way of working co-operatively is needed to avoid this happening.

Curriculum Links

- ✓ Mathematics: Developing logic and reasoning

Skills

- ✓ Co-operative problem solving
- ✓ Logical reasoning

Ages

- ✓ 9 years and up

Materials

Each child will need:

- ✓ Two oranges or tennis balls
- ✓ Name tag or sticker

The Orange Game

Introduction

This is a co-operative problem solving game. The aim is for each person to end up holding the oranges labelled with their own letter.

1. Groups of five or more children sit in a circle.

2. The children are labelled with a letter of the alphabet (using name tags or stickers). There are two oranges with each child's letter on them, except for one child, who only has one corresponding orange to ensure that there is always an empty hand.

3. Distribute the oranges randomly to the children in the circle. Each child has two oranges, except for one child who has only one. (No child should have an orange with their letter on it.)

4. The children pass the oranges around until each child gets the oranges labelled with their letter of the alphabet. You must follow two rules:

   a) Only one orange may be held in a hand.

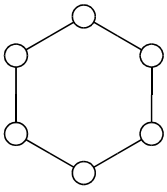
   b) An orange can only be passed to an empty hand of an immediate neighbour in the circle. (A child can pass either of their two oranges to their neighbour.)

Children will quickly find that if they are "greedy" (hold onto their own oranges as soon as they get them) then the group might not be able to attain its goal. It may be necessary to emphasize that individuals don't "win" the game, but that the puzzle is solved when everyone has their oranges.

Follow up Discussion

What strategies did the children use to solve the problem?

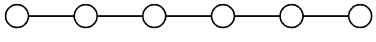
Where in real life have you experienced deadlock? (Some examples might be a traffic jam, getting players around bases in baseball, or trying to get a lot of people through a doorway at once.)

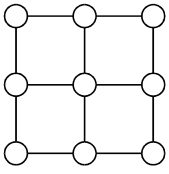


Extension Activities

Try the activity with a smaller or larger circle.

- Have the children come up with new rules.
- Carry out the activity without any talking.
- Try different configurations such as sitting in a line, or having more than two neighbours for some children. Some suggestions are shown here.





What's it all about?

Routing and deadlock are problems in many networks, such as road systems, telephone and computer systems. Engineers spend a lot of time figuring out how to solve these problems—and how to design networks that make the problems easier to solve.

Routing, congestion and deadlock can present frustrating problems in many different networks. Just think of your favourite rush-hour traffic! It has happened several times in New York City that the traffic in the streets has become so congested that it deadlocks: no-one can move their car! Sometimes when the computers are "down" in businesses (such as banks) the problem is caused by a communication network deadlock. Designing networks so that routing is easy and efficient and congestion is minimized is a difficult problem faced by many kinds of engineers.

Sometimes more than one person wants the same data at the same time. If a piece of data (such as a customer's bank balance) is being updated, it is important to "lock" it during the update. If it is not locked, someone else could update it at the same time and the balance might be recorded incorrectly. However, if this locking is interfered with by the locking of another item, deadlock may occur.

One of the most exciting developments in computer design is the advent of parallel computing, where hundreds or thousands of PC-like processors are combined (in a network) to form a single powerful computer. Many problems like the Orange Game must be played on these networks continuously (but much faster!) in order for these parallel computers to work.