Activity 1

Count the Dots—*Binary Numbers*

Summary

Data in computers is stored and transmitted as a series of zeros and ones. How can we represent words and numbers using just these two symbols?

Curriculum Links

- ✓ Mathematics: Number Level 2 and up. Exploring numbers in other bases. Representing numbers in base two.
- ✓ Mathematics: Algebra Level 2 and up. Continue a sequential pattern, and describe a rule for this pattern. Patterns and relationships in powers of two.

Skills

- ✓ Counting
- ✓ Matching
- ✓ Sequencing

Ages

- ✓ 7 and up

Materials

- ✓ You will need to make a set of five binary cards (see page 6) for the demonstration. A4 cards with smiley face sticker dots work well.

Each child will need:

- ✓ A set of five cards.
  Copy Photocopy Master: Binary numbers (page 6) onto card and cut out.
- ✓ Worksheet Activity: Binary numbers (page 5)

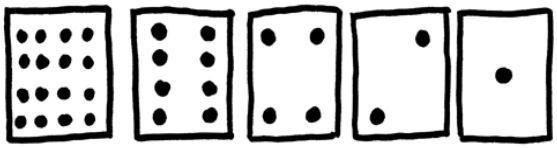
There are optional extension activities, for which each child will need:

- ✓ Worksheet Activity: Working with binary (page 7)
- ✓ Worksheet Activity: Sending secret messages (page 8)
- ✓ Worksheet Activity: Fax machines and modems (page 9)
- ✓ Worksheet Activity: Counting higher than 31 (page 10)
- ✓ Worksheet Activity: More on binary numbers (page 11)

Binary Numbers

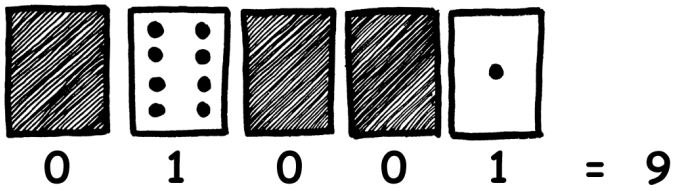
Introduction

Before giving out the worksheet on page 5, it can be helpful to demonstrate the principles to the whole group.
For this activity, you will need a set of five cards, as shown below, with dots on one side and nothing on the other. Choose five children to hold the demonstration cards at the front of the class. The cards should be in the following order:



Discussion

What do you notice about the number of dots on the cards? (Each card has twice as many as the card to its right.)
How many dots would the next card have if we carried on to the left? (32) The next…?
We can use these cards to make numbers by turning some of them face down and adding up the dots that are showing. Ask the children to make 6 (4-dot and 2-dot cards), then 15 (8-, 4-, 2- and 1-dot cards), then 21 (16, 4 and 1)…
Now try counting from zero onwards.
The rest of the class needs to look closely at how the cards change to see if they can see a pattern in how the cards flip (each card flips half as often as the one to its right). You may like to try this with more than one group.
When a binary number card is **not** showing, it is represented by a zero. When it **is** showing, it is represented by a one. This is the binary number system.



Ask the children to make 01001. What number is this in decimal? (9) What would 17 be in binary? (10001)
Try a few more until they understand the concept.
There are five optional follow-up extension activities, to be used for reinforcement. The children should do as many of them as they can.

Worksheet Activity: Binary Numbers

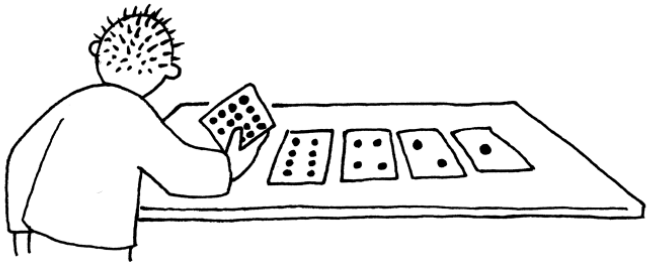
Learning how to count

So, you thought you knew how to count? Well, here is a new way to do it!

Did you know that computers use only zero and one? Everything that you see or hear on the computer—words, pictures, numbers, movies and even sound is stored using just those two numbers! These activities will teach you how to send secret messages to your friends using exactly the same method as a computer.

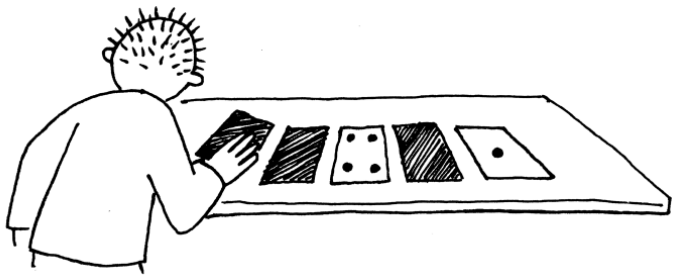
Instructions

Cut out the cards on your sheet and lay them out with the 16-dot card on the left as shown here:



Make sure the cards are placed in exactly the same order.

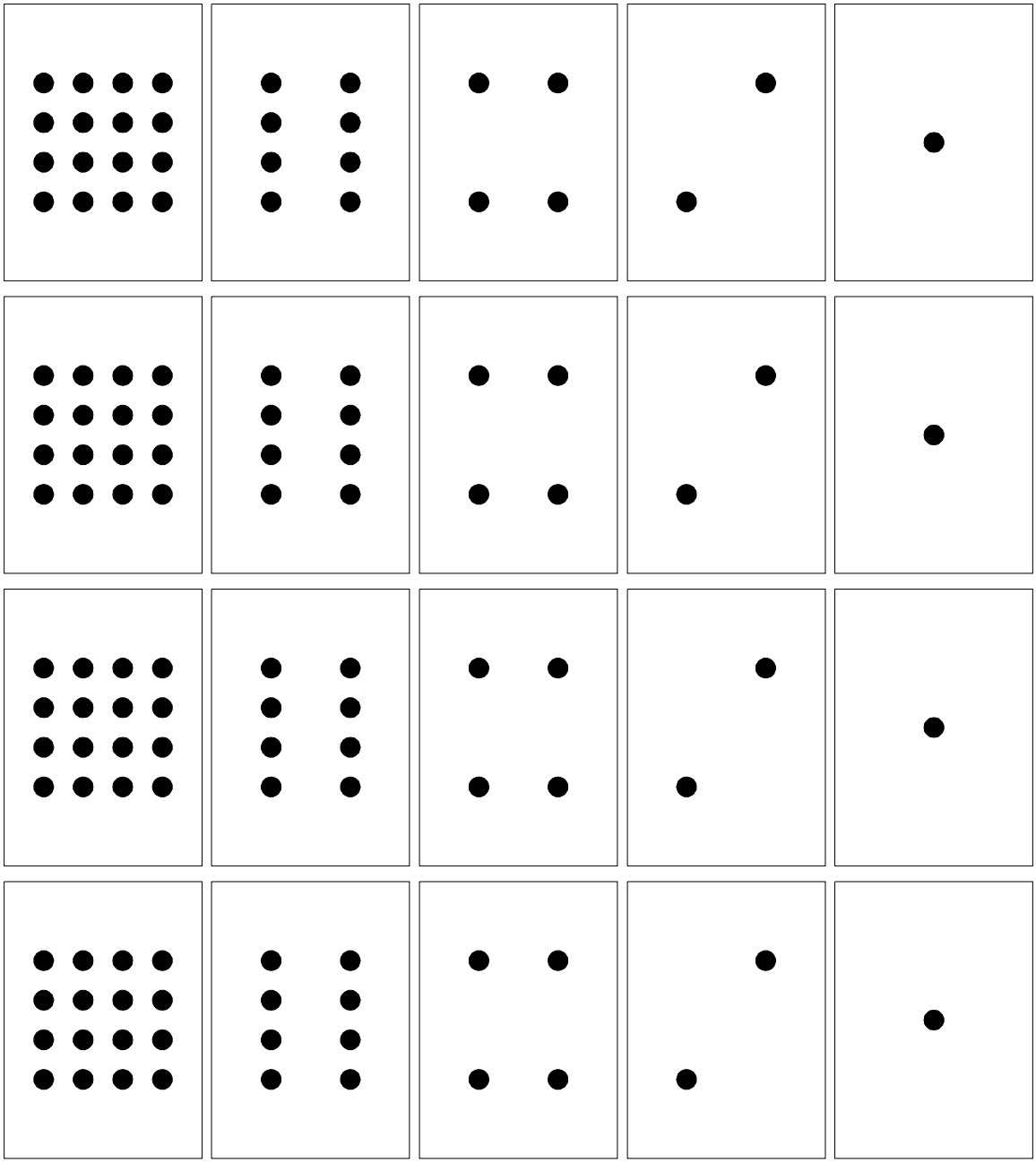
Now flip the cards so exactly 5 dots show—keep your cards in the same order!



Find out how to get 3, 12, 19. Is there more than one way to get any number? What is the biggest number you can make? What is the smallest? Is there any number you can't make between the smallest and biggest numbers?

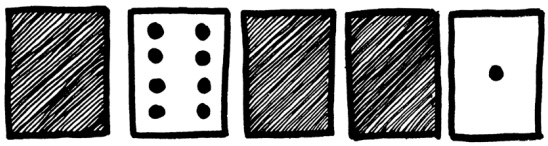
Extra for Experts: Try making the numbers 1, 2, 3, 4 in order. Can you work out a logical and reliable method of flipping the cards to increase any number by one?

Photocopy Master: Binary Numbers



Worksheet Activity: Working With Binary

The binary system uses **zero** and **one** to represent whether a card is face up or not. **0** shows that a card is hidden, and **1** means that you can see the dots. For example:



0 1 0 0 1 = 9

Can you work out what **10101** is? What about **11111**?

What day of the month were you born? Write it in binary. Find out what your friend's birthdays are in binary.

Try to work out these coded numbers:

☒☑☒☒☑ =
(☑=1, ☒=0)

👍👎👍👎 =
(👍=1, 👎=0)

⇧⇩⇧ =
(⇧=1, ⇩=0)

✚✚✖✚ =
(✚=1, ✖=0)

○○○○○ =
(⊙=1, ○=0)

↻↻↻↻↻ =
(↻=1, ↺=0)

📬📪 =
(📬=1, 📪=0)

▲▼▲▼▼ =
(▲=1, ▼=0)

☹ =
(☺=1, ☹=0)

♠♠♠♠♠ =
(♠=1, ♣=0)

Extra for Experts: Using a set of rods of length 1, 2, 4, 8 and 16 units show how you can make any length up to 31 units. Or you could surprise an adult and show them how they only need a balance scale and a few weights to be able to weigh those heavy things like suitcases or boxes!