THE JCB ACADEMY

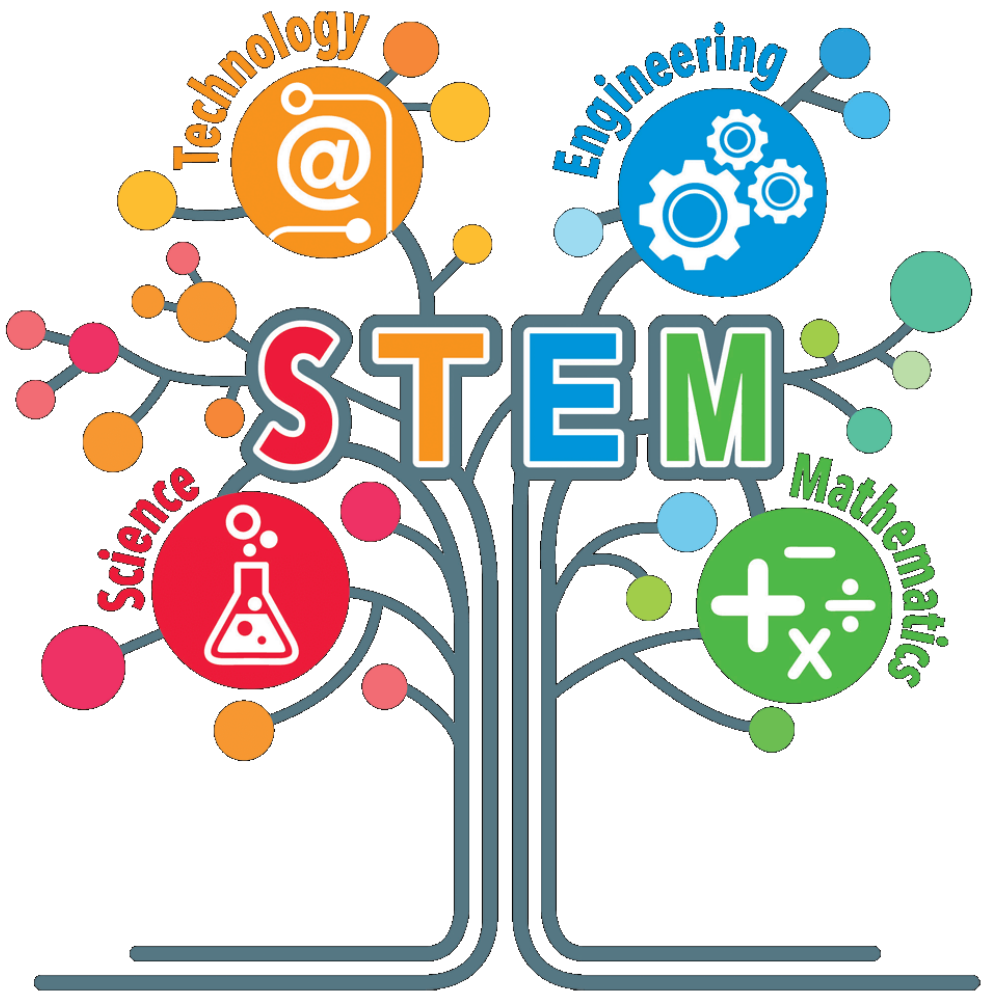
STEM Challenges

What's it like at the JCB Academy?

https://jcb-academy.com/

STEM Challenge

What is STEM?



STEM stands for -

Science

Technology

Engineering

Mathematics

These subjects are linked directly to each other and this task will highlight your skills in each of these subject areas.

Objectives To understand what is meant by STEM. To demonstrate the effect of friction

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.

Count the Dots—*Binary Numbers*

Skills

- Counting
- Matching
- Sequencing
- Literacy (reading)

Ages

- 7 and up

Materials

You will need to make a set of five binary cards (see slide 5) for the demonstration.

Each child will need:

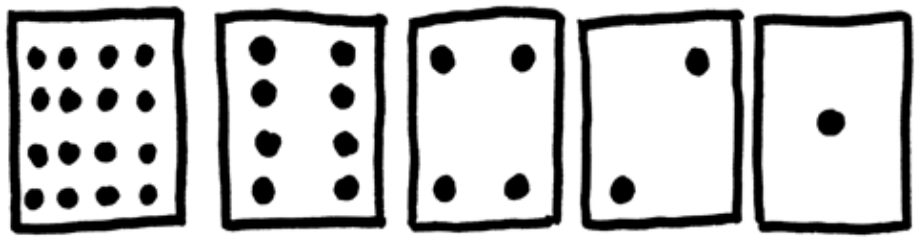
A set of printable binary cards (see attached file)

Binary Numbers

Introduction

Before giving out the worksheet, it can be helpful to demonstrate the principles to kids.

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:



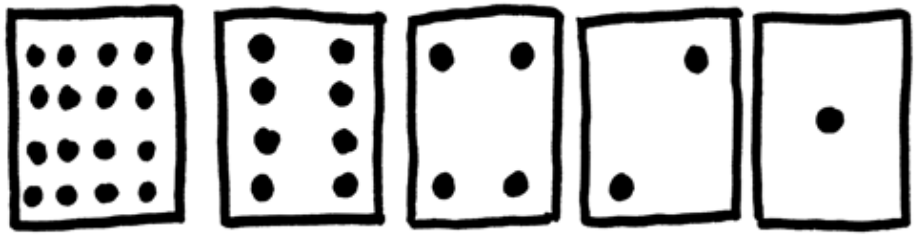
Binary Numbers

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)…

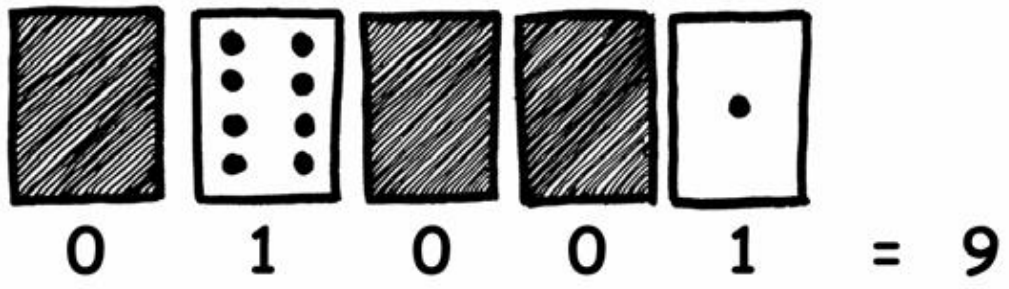


Binary Numbers

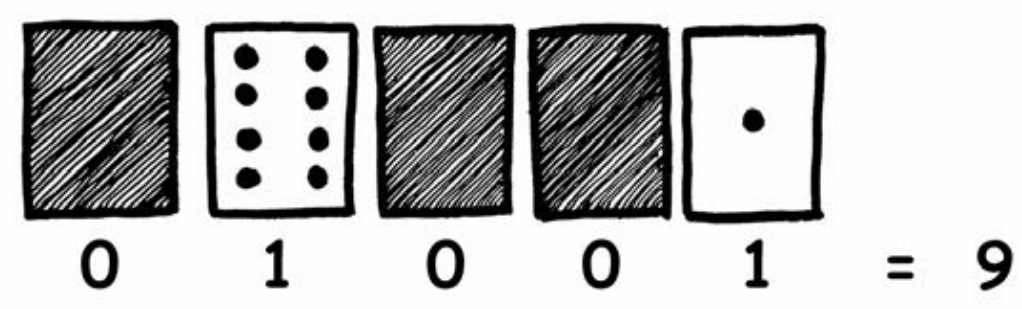
Now try counting from zero onwards.

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.



Binary Numbers



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.

Activity 1: Binary Numbers

Learning how to count

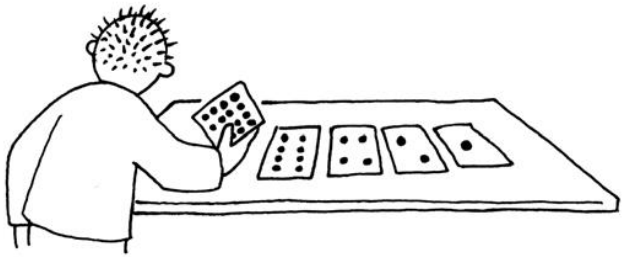
So, you thought you knew how to count? Well, here is a new way to do it! Did you know that computers use only zero and one?

Everything that you see or hear on the computer—words, pictures, numbers, movies and even sound is stored using just those two numbers!

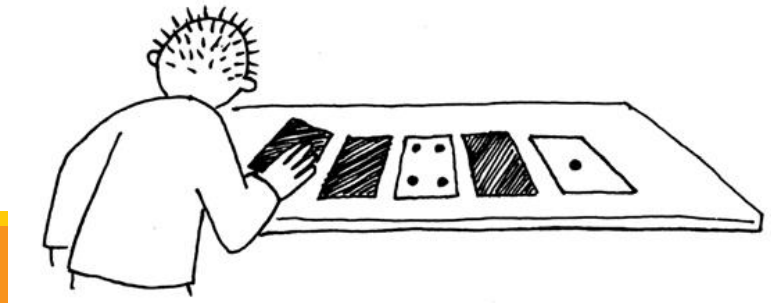
These activities will teach you how to send secret messages to your friends using exactly the same method as a computer.

Instructions

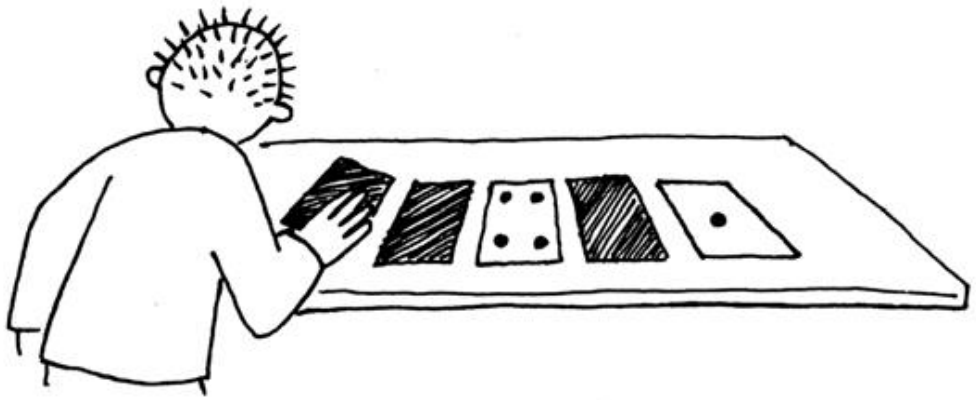
Cut out the cards on your sheet and lay them out with the 16-dot card on the left as shown here:



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!



Activity 1: Binary Numbers



Answer these questions

Find out how to get 3, 12, 19 and 21.

Is there more than one way to get any number?

What is the biggest number you can make?

What is the smallest?

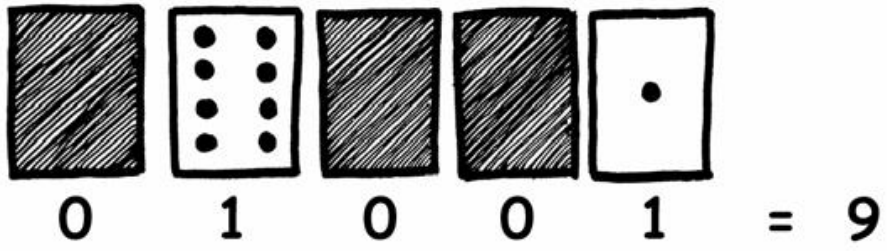
Is there any number you can't make between the smallest and biggest numbers?

Activity 2: 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:



Answer the following Questions

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)

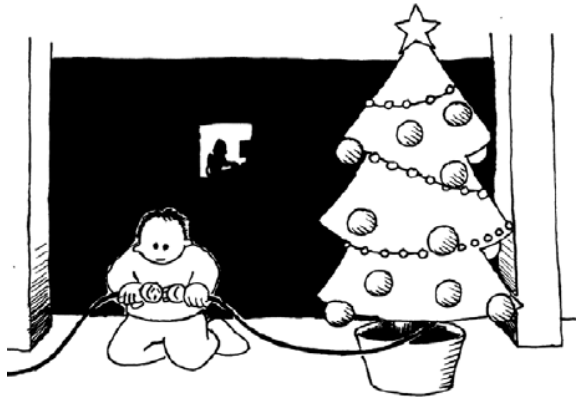
Extension Activity

Tom is trapped on the top floor of a department store. It's just before Christmas and he wants to get home with his presents. What can he do? He has tried calling, even yelling, but there is no one around. Across the street he can see some computer person still working away late into the night. How could he attract her attention? Tom looks around to see what he could use. Then he has a brilliant idea—he can use the Christmas tree lights to send her a message! He finds all the lights and plugs them in so he can turn them on and off. He uses a simple binary code, which he knows the woman across the street is sure to understand.

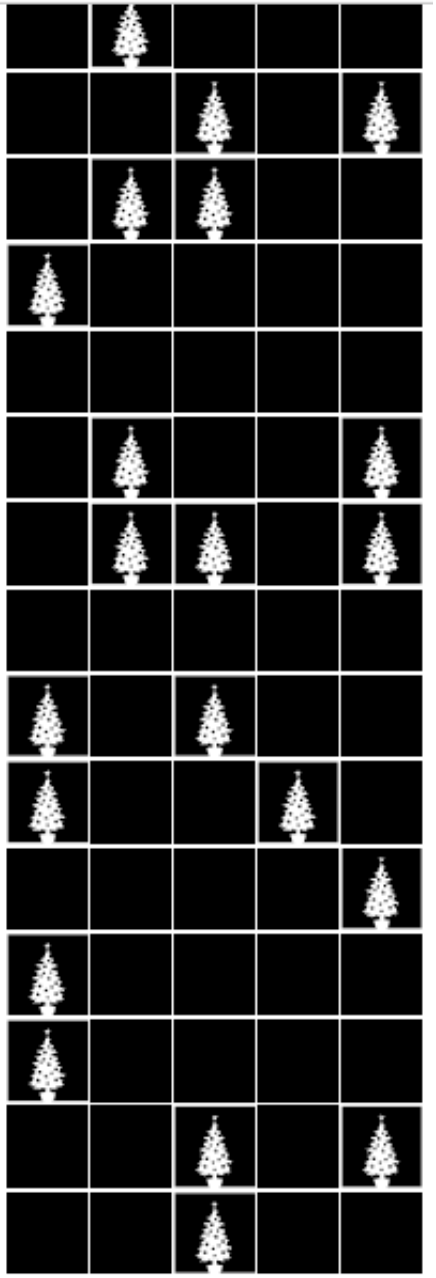
Can you work it out?

Hint: workout the number each row →

Then match it to the corresponding letter below.



1	2	3	4	5	6	7	8	9	10	11	12	13
a	b	c	d	e	f	g	h	i	j	k	l	m
14	15	16	17	18	19	20	21	22	23	24	25	26
n	o	p	q	r	s	t	u	v	w	x	y	z



STEM Challenge

What's next?

- **Share your achievements**
  - Send pictures or videos of your activities to us. Make sure its clear what school you are from.

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Please let us know if you are **not** happy with us sharing your images on our own social media forums and website.

- **Try some more Challenges from our website!**