




EDINBURGH INTERNATIONAL SCIENCE FESTIVAL

generation science

EDF ENERGY

The Science behind the Show

There are many different definitions of a robot but there is a general agreement between experts that it is a mechanical device that can perform tasks automatically. Robots usually do some or all of the following: move, sense and exhibit intelligent behaviour. They also need to be guided, either by a programme or circuitry.

The robots used in this workshop are LEGO MINDSTORMS NXT robots. They are built from Lego pieces and contain an intelligent, computer-controlled brick which allows you to programme how the pieces move. The robots have been built to move around and have three different sensors which work in much the same way as human senses when they take in information about the world.

The system uses special software to programme the robots. Children use on screen instruction blocks placed in a line to give the robot instructions. These are downloaded onto the robot's intelligent-block using a USB cable. The robot follows this list of instructions when the start button is pressed.

A microprocessor is a small electronic circuit that performs the same functions as the central processing unit of a computer. If you were comparing a robot to a human, the microprocessor in our robot's computer-controlled Lego brick would be the equivalent of the brain. It sends instructions of when motors are to move and processes information the sensors have collected.

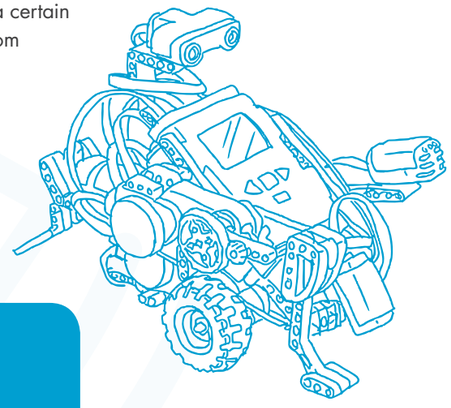
A computer programme is a sequence of instructions written by a person and put on to a computer. The computer interprets these instructions and executes them. There are different types of languages that programmes can be written in – for example, Java and C++.

A sensor is a piece of equipment that measures its surroundings. The robots in this workshop have three sensors.

Light Sensor – this sensor detects light and dark (or black and white). The robot can be programmed to only move over black which means it can follow a black line or to stay within a boundary.

Touch sensor – this sensor detects when a button has been pushed and can be used to detect an obstacle. The robot can be programmed to do something different when the touch sensor is activated – for example, stop or turn by 180°.

Distance sensor – this sensor allows the robot to measure distance. It emits ultrasonic sound waves and measures the time it takes for them to bounce back to calculate the distance of an object. Like the touch sensor, this means the robot can be instructed to do something different when it reaches a certain distance from an object.



Some Useful Links

www.csiro.au/en/Education/DIY-science

scratched.media.mit.edu/

Scottish Charity Registration Number: SC003790
Generation Science, Harbourside House, 110 Commercial Street, Edinburgh, EH6 6NF

LEGO MINDSTORMS CHALLENGE

Welcome to Generation Science!

Brought to you by the Edinburgh International Science Festival, our shows and workshops spark pupils' curiosity and bring science to life.

What we do

Each show or workshop is fully equipped and delivered by trained science communicators. We create fun, interactive environments where everyone gets out of their seats and gets involved. Our inspiring demonstrations and engaging activities are linked to the Curriculum for Excellence, explaining key concepts in a unique and memorable way.

Event Description

Lego Mindstorms Challenge is a hands on, interactive workshop which allows pupils to programme their own robots. The class explores what a robot is and why they are useful, what the term programming means and how robots work.

Following an introduction to the specialist programming software, pupils work in small groups to programme their group's robot. They use their new programming knowledge and problem-solving skills to make their robot complete a number of challenges, each more complicated than the last.

Curriculum Links

Lego Mindstorms Challenge complements the following experiences and outcomes:

TCH 1-01a: By exploring and using technologies in the wider world, I can consider the ways in which they can help.

TCH 1-03a/TCH 2-03a: As I extend and enhance my knowledge of features of various types of software, including those which help find, organise, manage and access information, I can apply what I learn in different situations.

TCH 1-09a: I am developing problem solving strategies, navigation and co-ordination skills, as I play and learn with electronic games, remote control or programmable toys.

MTH 2-17a: I have investigated angles in the environment, and can discuss, describe and classify angles using appropriate mathematical vocabulary.

Learning Outcomes

- Define what a robot is and describe why they are useful
- Create basic computer programmes for robots to perform simple tasks
- Inspect basic computer programmes to identify why a robot is not performing as expected
- Explain how different sensors on a robot can be used to control its movement and identify which should be used for different challenges
- Explain the concept of "unlimited" when referring to computer programming
- Explain the concept of a "loop" when referring to computer programming

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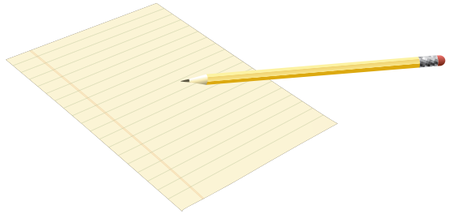
www.sciencefestival.co.uk/education

FOLLOW-UP CLASSROOM ACTIVITY 1

Programme a Human

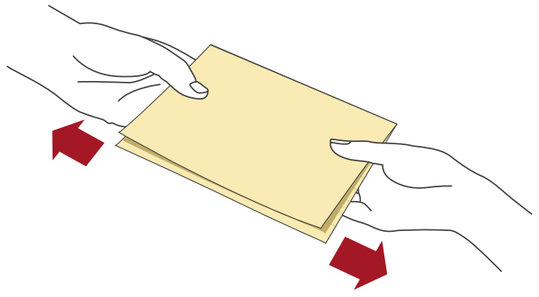
You will need:

- Paper
- Pen or pencil



1. In a small group, think of a simple task; such as walking to the door and opening and closing it, or walking to the bin and sharpening a pencil.

2. Together, plan and write down step by step instructions (a programme) for a human to complete the task as if they have never done it before.



3. Test the instructions on someone in the group. They must only move how the instructions tell them to. Can they complete the task?

4. Swap instructions with another group and see if your programme works.

Were there more or less instructions than you were expecting?
Did you find these simple tasks simple to programme?

Explanation

In order for robots to move how we need or want them to, we must give them a set of instructions. We call these instructions a programme, and the robot will only do what the programme instructs it to. It is important to keep this set of instructions as simple as possible, otherwise they can become very long and complicated.

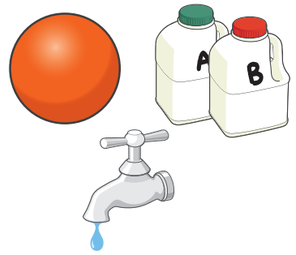
It is also possible to include instructions on how the robot should react to information gathered by its sensors. Sensors can tell robots how close they are to objects, how light or dark it is or even how much sound there is. We behave the same when we make decisions on how to move depending on what we hear, see or feel.

FOLLOW-UP CLASSROOM ACTIVITY 2

Mind to Muscle Challenges

You will need:

- Large ball (e.g. a football)
- Big space
- A friend
- Two containers that hold 500ml
- Water



Activity 1

1. Find an open space and stand around 2 metres away from your friend. Throw the ball underarm and record the number of times they catch it out of 10 throws.

2. Have the catcher close their left eye and record the number of times they catch the ball out of 10 throws. Repeat with their right eye closed. Swap places and repeat.

What did you find? Did left handed people get different results from right handed people?

Activity 2

1. Label the two 500ml containers "A" and "B" and fill each one half way up with exactly the same amount of water.

2. Have a friend close their eyes and carefully put one container in each of their hands. Ask them how the weights compare (they should feel the same).

3. Take the containers back and with your friend's eyes still closed, add some more water to container "A".

Give the containers back to your friend and ask them compare the weights again, and if they can feel a difference. If they can, ask which container is heavier. Are they right?

Remove the containers and repeat the test to make sure it wasn't a lucky guess.

Tip: *if they can't tell the difference between containers, try adding a little more water to container "A".*

Explanation

Our muscle, bones and central nervous system work together to create the mechanics of our movement, but it is our senses that help our brain decide how we want to move.

We have five senses – sight, touch, smell, taste and hearing. These experiments use our sense of sight and touch. When we are trying to catch an object we have to judge its speed and position and having two eyes allows us to do this more easily.

In both experiments our senses – sight, touch or sensing weight through our muscles – send information via the central nervous system to our brain. Our brain processes this information and decides how to react, sending signals back to muscles telling them how to move.