

Let's make  
learning fun!



**education**  
EXPERIENCES

This book belongs to: **Teacher**

Class: **Dr Heartbeat**

## Education Objectives

The objectives of this programme are to give your group the opportunity to:

- Explore design and computer control of smart robots using a special version of the LEGO® MINDSTORMS NXT software for teachers and students.
- Test the performance of their robots in a special micro-environment.
- Put into practice the principles of computer control through Hands On activities using the LEGO MINDSTORMS for schools.
- Relate Hands On activities in the workshop to the experience of the attractions in LEGOLAND® Windsor.

Different activities are built into the programme to enable pupils to work at their own pace and according to their individual needs.

Although rides and attractions cannot be reserved, your group is encouraged to enjoy the Hands On and Body On activities before and/or after the workshop.

There are height restrictions on the rides so it is advisable to check these before you visit. If your group has special needs requirements there is a guide available that will help to make the most of your visit.

## National Curriculum Mapping

This resource corresponds to the following areas of the National Curriculum:

### KS2

|   |         |
|---|---------|
| <b>Design &amp; Technology</b>                    | KS2: 4c |
| <b>Information &amp; Communication Technology</b> | KS2: 2b |

### KS3

|   |                      |
|---|----------------------|
| <b>Design &amp; Technology</b>                    | KS3: 1b, e; 5c, d, f |
| <b>Information &amp; Communication Technology</b> | KS3: 2b; 4b          |



Dear Class,

Yesterday we heard that you are all coming on a school trip to LEGOLAND® Windsor. We are sure that you will have a great time while you are here! There are lots of exciting things to see and do in the Park. Your teacher will tell you more about them.

One of the great things about your visit is a special workshop that you will be taking part in. Here you will be working with our LEGO® MINDSTORMS NXT technology robotics system and learning how to programme your own robot. You will then perform a series of life saving operations, inject medicines, repair a broken vein, get a grip on weird and unwanted cells and much more.

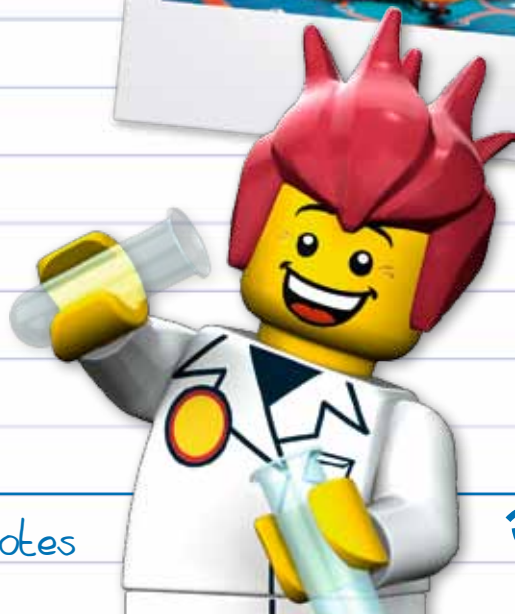
Other pupils have already performed amazing operations with their robots, but I bet you can do better than them, especially if you prepare for the workshop. Think about the different types of computers that you see everyday and discuss how you think they work.

So, when you come to LEGOLAND Windsor, it would be great if you can help us in our quest to create the perfect robotic operation.

See you soon

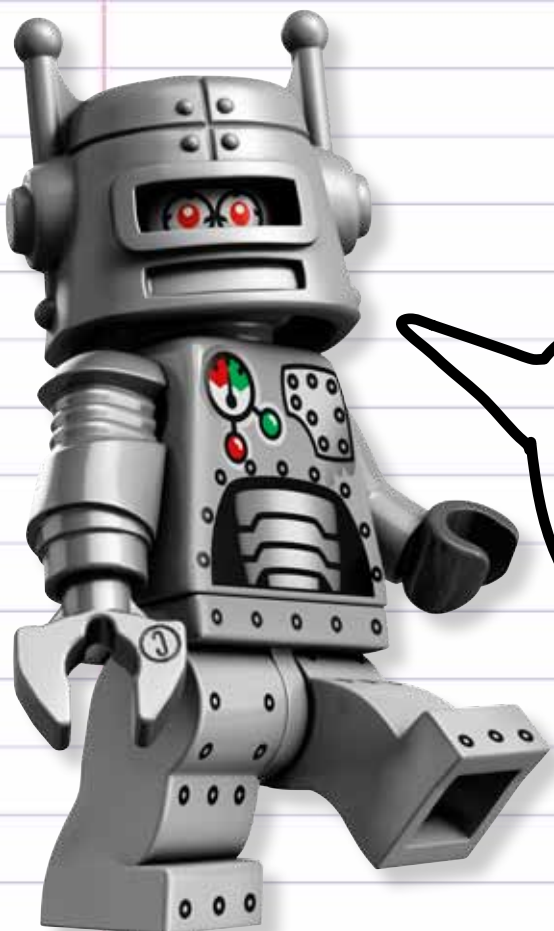
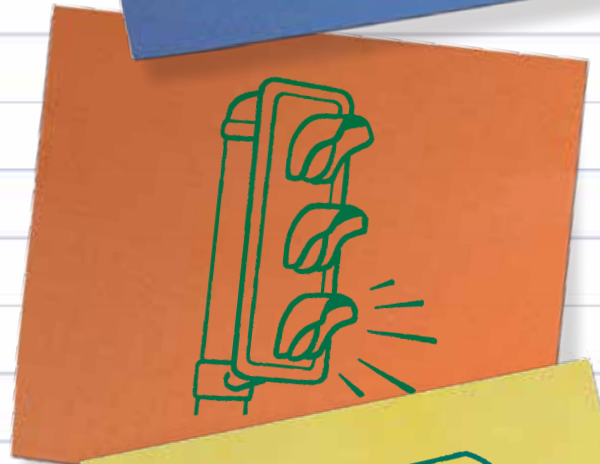
Professor Albrick

Professor Albrick  
Dept. LEGOLAND Learning  
LEGOLAND Windsor



# Computers in Control

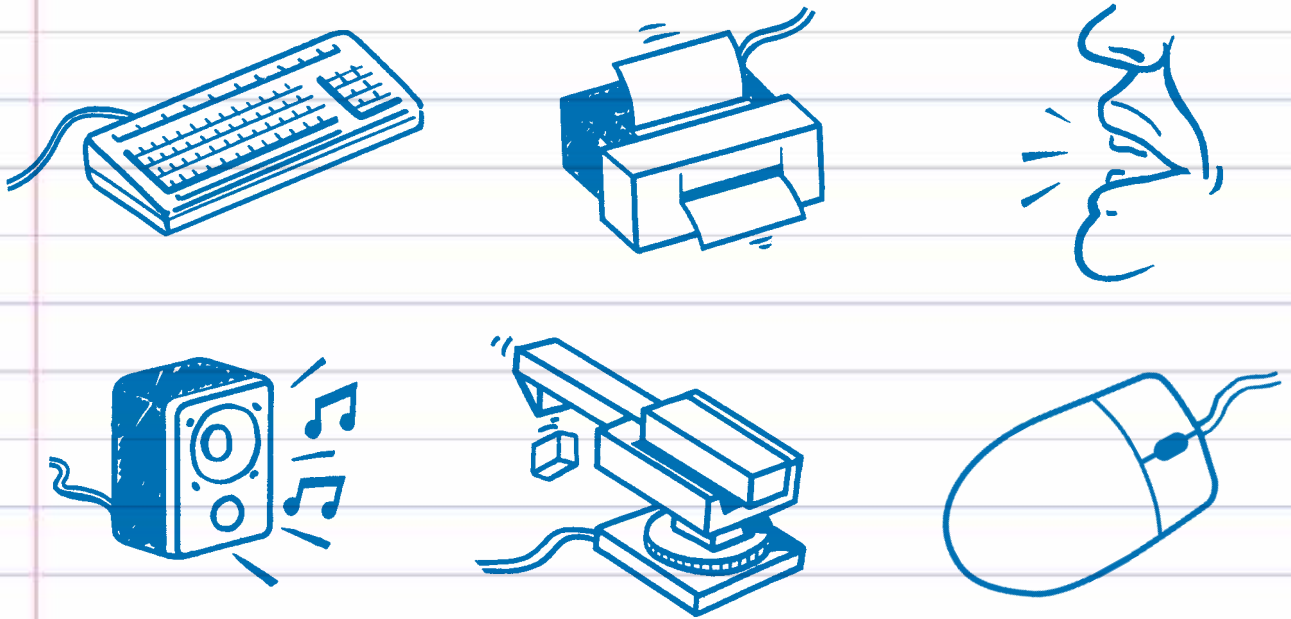
- The use of computers has resulted in huge advances in the fields of medicine. We use them for the storing of vital information, minute detail imaging of the body, research and surgical procedures, all playing a major part in patient care and recovery.
- The first general purpose 'computer' was used as far back as the 19th century. It was an 'analytical engine' which could be instructed, or programmed to perform different sets of mathematical operations.
- Today we are surrounded by computers though we do not always see or recognise them as such: cash registers, traffic lights, washing machines, toys etc. in simple terms a computer operates according to a sequence of instructions called a program. The program tells the computer how to perform.



Robots rely on a computer program to operate



Information provided to the computer program is called input. Input can arrive via various sources such as a keyboard, a mouse, a barcode reader or a voice.



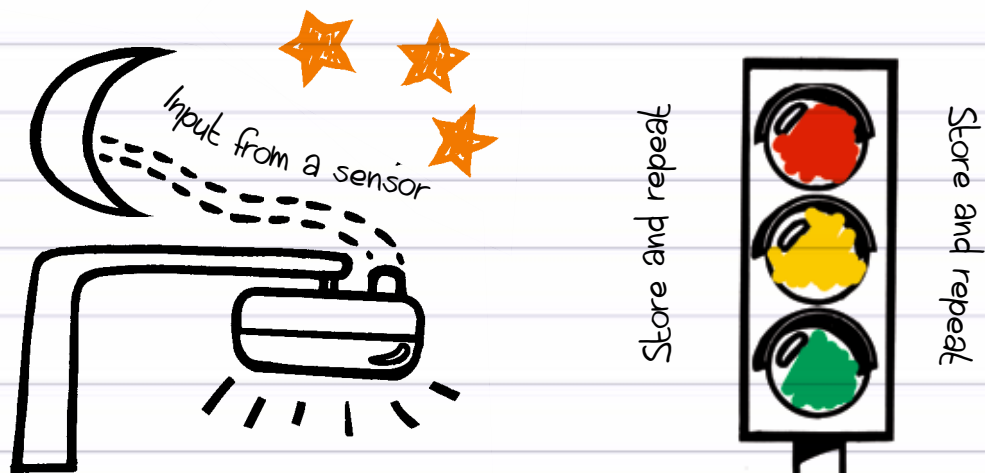
Once the computer has been told to do its task it must then show us the result, which is called output. This can occur in a number of ways: on screen, on a printout, by sound or by causing something to operate.

**The real benefit of using computers appears when:**

- the same action has to be performed several times
- you have to handle large amounts of information.

**Computer control falls into two broad categories:**

- Sequenced computer control - a series of commands is stored and repeated. Typically used for such things as traffic lights, rotating advertising boards, and production equipment.
- Feedback control - the computer reacts to input from a sensory device. For example the windows in a modern greenhouse will open when the temperature reaches a certain level; street lamps will switch on when it gets dark; the burglar alarm will start when there is a movement in the room... and so on.





## Activities before the visit

- Show your pupils the map of LEGOLAND Windsor. Discuss their expectations of the visit and any concerns, e.g. what to do if they are separated from the group or they feel unwell during the day.
- Talk about the activities that will take place.
- Introduce the pupils to the concept of computer control.
- Talk to them about:
  - what they think computer control means
  - what computer-controlled things they are familiar with
  - which kinds of control they are familiar with (sequenced and feedback control)
  - which kind of computer control they will encounter during their visit to LEGOLAND Windsor (see worksheets).

## Activities after the visit

- Use the worksheets to reinforce the importance of giving precise instructions within computer control.
- Tasks through direct commands:
  - The pupils work in pairs: one is a controller, the other the robot.
  - The controller must command the robot to carry out a task such as pick up a book, walk round a table and place the book on a shelf or perform a silly walk or dance.
  - The robot can only react to specific instructions from the controller. To say “walk” is not enough. The instruction needs to be precise, such as: “Lift a leg. Move leg forward and put it down on the floor 15cm in front. Shift body weight onto left leg and repeat action with right leg.”



### Dr. Heartbeat Workshop

A 45-minute workshop challenges pupils on four levels to program a robot using NXT technology. They investigate how different strategies affect the performance of robots in a special micro-environment and enjoy assisting a scientist in developing new surgical techniques.

### Pirate Falls Dynamite Drench

A flume ride during which pupils will encounter a series of computer-controlled models, some of which respond to sensor input.



### The Dragon

A coaster ride during which pupils will see a series of computer-controlled models, all of which respond to sensor input.



### Miniland

This miniature wonderland offers lots of opportunities for observing computer-controlled models: locks, bridges, an underground station, cranes and many more. The worksheet in this resource deals with bridges. You may ask your pupils to observe and note down sets of instructions for other Miniland models as well.

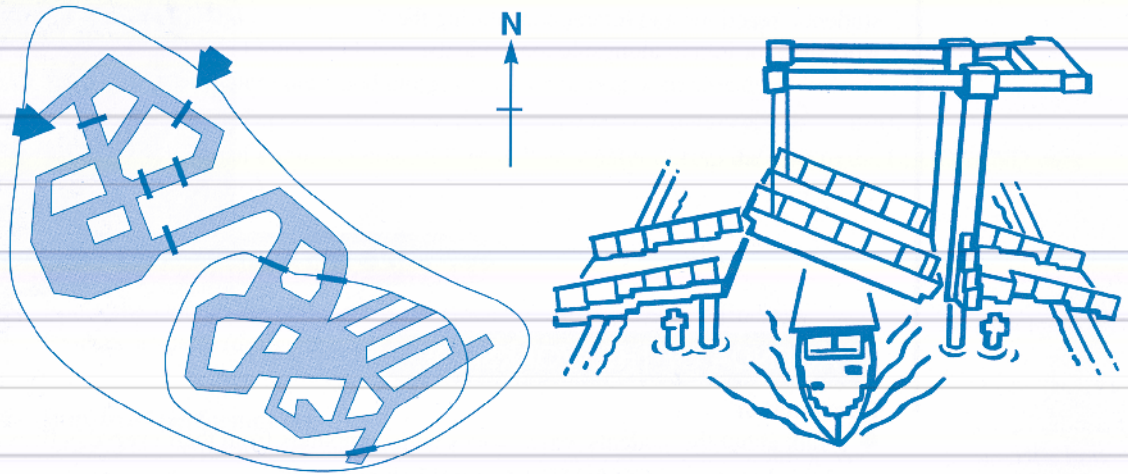




# Opening Bridges

Pupil Name \_\_\_\_\_

There are two identical bridges in Amsterdam. They are located as indicated on the map of Holland in Miniland.



Study the bridges and think of what set of instructions they might be following.

**Note the instructions down.**



# The Cannon Attack

Pupil Name \_\_\_\_\_

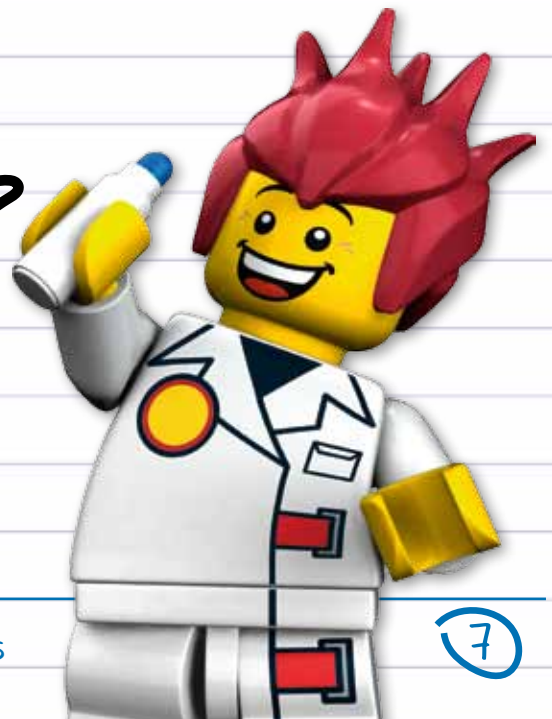
During the ride at the Pirate Falls you saw a lot of moving LEGO models in the various scenes you passed. Some of them move all of the time. Others move only when they receive a signal from sensors (photoelectric cells) which tell the models that a log is approaching.

One of the sensor-prompted scenes from the ride is illustrated to the right. Do you remember what happened?

**Write down the series of instructions that you think were passed to make the model move.**



The smallest models at LEGOLAND Windsor are the LEGO pigeons in Trafalgar Square each made from just 5 LEGO bricks.



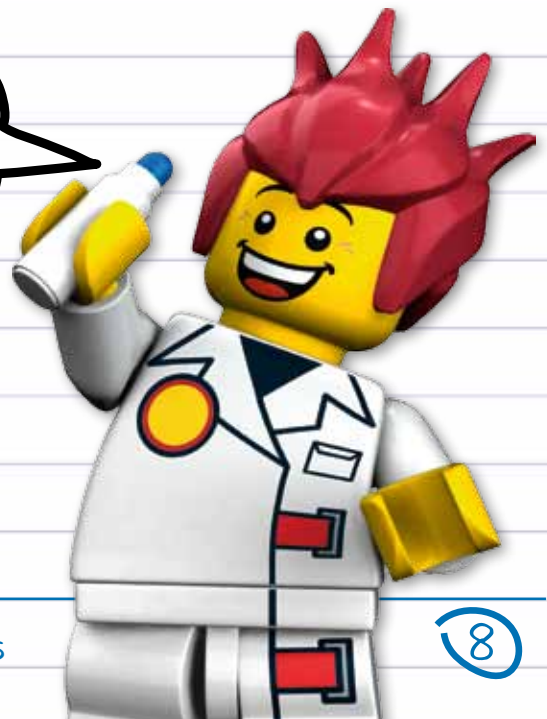
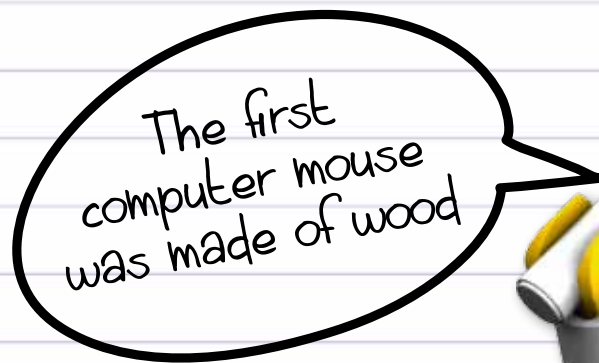
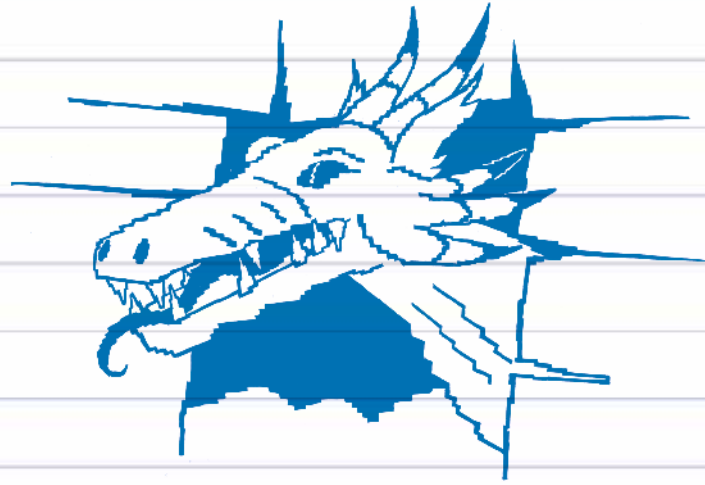


# The Dragon Coaster

Pupil Name \_\_\_\_\_

The dragon is keeping watch over his treasure and you will see him as you go around on the dragon ride. He is operated by three different motors that assist him to move forwards and backwards, move his neck left and right and move his head left and right. He moves when a signal is received by sensors telling him that a train is arriving.

**Study the Dragon as you go past and think of what set of instructions he might be following.**



# Teachers' Hints

## Opening Bridges

If a boat is approaching the bridge a proximity sensor in the water will register it and the following set of instructions will run:

- Wait x seconds.
- Start lowering the leaf of the bridge (i.e. motor left on for x seconds).
- Stop the motor when the leaf of the bridge is at its lowest position (when another proximity sensor is activated).

## The Cannon Attack

A photoelectric cell will register if a log is approaching. When the cell is activated the following set of instructions will run:

- Start motor A to turn the turntable to the left
- Start the 'cannon firing' timer
- Switch on the light (fuse)
- Stop motor A when the turntable activates the proximity sensor
- When the 'cannon firing' stops, start the sound (cannon firing and cannon ball splash down)
- Stop the light and sound
- Wait x seconds
- Reverse motor A to turn the turntable to the right
- Stop motor A when the turntable activates the proximity sensor.

## The Dragon

As your train approaches the dragon's lair, a proximity sensor on the track will register it and the following set of instructions will run:

- Start motor A for x seconds to move the dragon forward
- Start motor B for x seconds to move the dragon's head left and right
- Start motor C for x seconds to move the dragon's head and open his jaws
- Reverse motor A for x seconds to move the dragon backwards
- Reverse motor B for x seconds to move the dragon left and right
- Reverse motor for x seconds to close the dragon's jaws
- Stop the motors when another proximity sensor is triggered by the departure of the train from the area.

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