ROBOSPORTS

A LEGOLAND® California
Educational Resource Guide
Grades 3-6

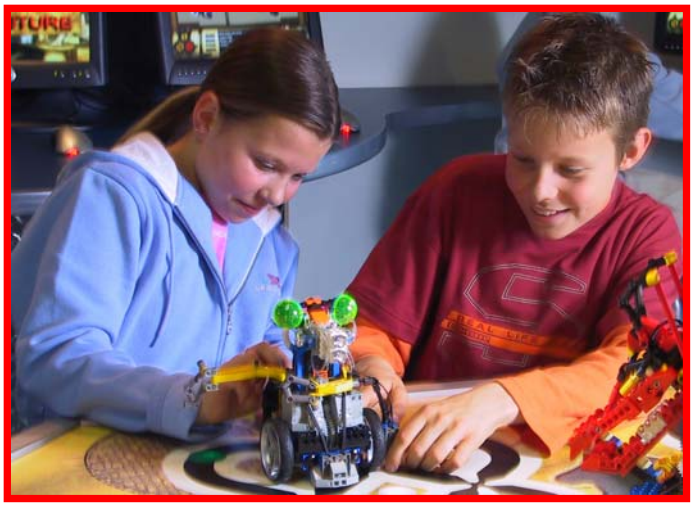


Table of Contents

Welcome to LEGOLAND California!

Education Programs: "Robosports" has been developed by LEGO® Education and LEGOLAND Education Department. For information on LEGOLAND Education programs, visit www.LEGOLAND.com/edu.

Directions: From Interstate 5, buses exit Palomar Airport Road East. Turn LEFT on Hidden Valley Road, and LEFT into LEGOLAND. Cars exit Cannon Road East and turn RIGHT on LEGOLAND Drive.

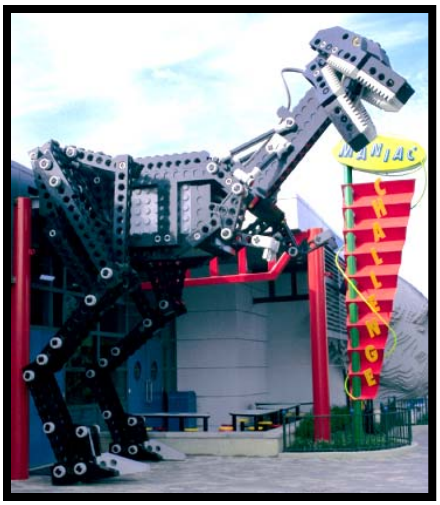
Arrival and Entry: Please arrive 30 minutes before your scheduled program. Teachers must be present during the 45-minute instructional program.

Lunches: School groups may bring lunches in disposable containers and use self-storage bins. Lunches may be pre-ordered when you book your program, or purchased at LEGOLAND restaurants.

Safety: LEGOLAND parks are build to the highest standards of quality and safety. Height restrictions apply on selected attractions throughout the park.

Background Information

Robots are everywhere!



Where do we find robots?
All around us! Some robots you know are garage door openers, ATM machines, cell phones, and VCR's.

How do we know if a machine is a robot?
Robots have three elements in common:

- Body: A physical body--usually does not look human.
- Program: Tells the robot what to do in certain situations.
- Behavior: A robot takes action.

For example, based on reading a card and keypad input, an ATM knows how much cash to dispense and when to do it, as well as what account to debit. The ATM can perform this task over and over without human help.

What is NOT a robot?
Clocks and wind-up toys are not robots. They do not have a program that tells them what to do in certain situations. They just move mechanically until they run out of power.

BODY: How are the shape, size, and materials of a robot's body determined?
That depends on what the robot will do. For example, the size of a surgical robot must be small enough to work inside the human body. A cell phone must be made of lightweight materials.

PROGRAM: How do you control, or program, a robot?
It takes three things working together:

- **Input**: Information comes in through a robot's sensors.
  For example: On a cell phone, the incoming call numbers are input for the phone.
- **Program**: A robot is programmed to respond when it receives certain information from sensors.

For example: A cell phone may be programmed to ring in a certain way for certain incoming numbers.

- **Output**: A robot takes action, usually using motors (movement), lights, or sound.
  For example: When an incoming call is sensed, a cell phone lights up and rings the chosen ringtone. The phone can choose programmed ringtones for different numbers over and over without human help. This makes a cell phone a robot!

What are sensors?
Sensors "see" and "feel" for the robot. Sensors send information so the robot can respond with action. For example, an air conditioning system has a temperature sensor that "feels" heat. The robot's program tells it to turn on the air conditioning, and to turn it off when a cooler temperature has been reached.

BEHAVIOR: Get the program right to get the expected behavior.
Every robot takes action. For example, a robotic door at the grocery store opens when it senses motion, and a fire alarm sounds when it senses smoke.

Sometimes the robot does not do what we expect. This may be because the program is not just right. For example, for safety reasons, a touch sensor on elevator doors must be programmed to respond to a light touch, so the door will re-open immediately if a person touches it. A robot does exactly what the program tells it to do, so the program needs to be right.

Hands-On Activities

LEGO MINDSTORMS® Robosports

Call the plays and the robot makes goals!

Check out the robot's body.

- Find the RCX brick, a tiny computer that is the robot's "brain."
- Find the infrared window, which receives instructions for action.
- Find the light sensor, programmed to sense the difference between black and white.
- Choose a motorized attachment which can throw or dump a ball, and connect it to the main body.

Create a program on the screen.

For example, click and drag the commands to go forward 5 seconds, and throw the ball. This program would use motors and timers.

Sensors can be used as well. For example, click and drag the commands to follow the black line until antenna is pushed, then stop. Shoot the ball. This program would use a light sensor to follow the line, and a touch sensor to know when to stop.

Take Action!

Download the program to the robot:

- Turn the robot "On."
- Face the robot's black window toward the small, black tower.
- Click download. The program travels to the robot through infrared light.
- Listen for the beep that tells that the download is complete.

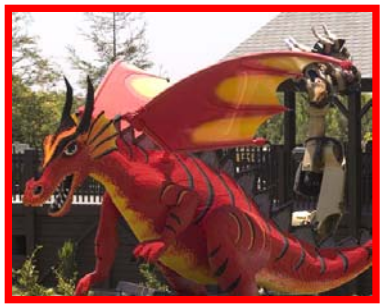
Put the robot on the playing field and press, "Run." Did the robot do what you expected? Adjust the program so the robot can make a goal more easily or quickly. Or add a victory dance--make the robot turn left, right and beep!

Discovery Worksheet

More LEGOLAND Robotics!

Knights' Tournament

Choose the power of your ride!
Robotic arms are programmed
to deliver five levels of power.
Within each power level,
random combinations of movement
have been programmed
to make each ride
a unique experience.



The Dragon Coaster

Ride The Dragon, then solve the challenges faced when engineers animated the robotic models.
Hint: Think about programming robots with sensors, motors, and timers.

Challenge #1: The coaster will pass through the castle at random times. How will the castle models come alive just as a coaster approaches?

_____

Challenge #2: Motor 1 moves the dragon's body up, Motor 2 moves the head up, and Motor 3 opens the jaws. With only three motors, how do we cause these movements: body down, head down, and jaws closed?

_____

Challenge #3: The dragon's eyes light up and we hear him roar! How do we get him to stop this outburst without having to turn the switch off after each ride?

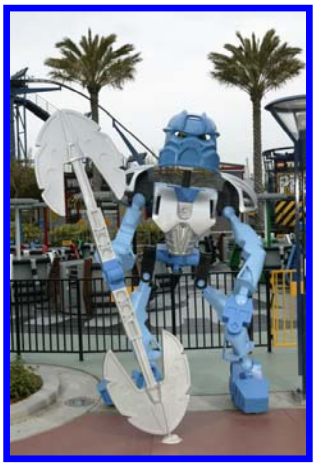
_____

Teacher Notes: 1. A light sensor crosses the track. When the coaster breaks the beam, a signal is sent to the dragon's motors to start. 2. Each motor is programmed to operate first in forward, then in reverse! 3. The light and sound are originally triggered by another light sensor crossing the track. The light and sound are on a timer, programmed for a certain number of seconds.

Before and After the Visit: Minds-On Activities

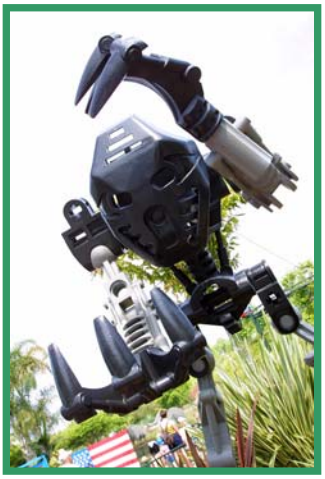
Over the years, robots have done amazing things.

- **Tiros**,the first weather satellite, was launched into orbit around Earth in 1960. It sends information back to Earth.
- **Robodoc**, a surgical robot, was first used in 1992 to help perform a hip replacement operation.
- **ROV** (remote operated vehicle), of The Woods Hole Oceanographic Institution, gathers information about the ocean floor and water conditions. This has helped scientists map the ocean floor and identify hundreds of new species of ocean plants and animals.
- **Dante II** was built by scientists and engineers at NASA and Carnegie Mellon University. In 1994, Dante II entered Mt. Spurr, an active volcano near Anchorage, Alaska, and sent back data about temperature and gasses.
- **Deep Blue**, a robot built by IBM, won a 1996 chess game against international chess champion Garry Kasparov.



What would your robot do?

Invent a robot.
What does it do?
Write your ideas.



About Robosports

Educational Objectives

- Explore computer programming with motors and sensors to complete tasks with a robot.
- Predict and investigate how different strategies affect a robot's performance.
- Learn to use light and touch sensors.
- Relate the Hands-On activities to the experience of LEGOLAND attractions.

California Content Standards

Grade Three

Science: Investigation and Experimentation

5a. Students will repeat observations to improve accuracy and know that the results of similar scientific investigations seldom turn out exactly the same because of differences in the things being investigated, methods used, or uncertainty in the observation.

5b. Differentiate evidence from opinion and know that scientists do not rely on claims or conclusions unless they are backed by observations that can be confirmed.

5d. Predict the outcome of a simple investigation and compare the result with the prediction.

Math: Measurement and Geometry

2.6 Identify common solid objects that are the components needed to make a more complex solid object.

Grade Four

Science: Investigation and Experimentation

6a. Students will differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.

6c. Formulate and justify predictions based on cause-and-effect relationships.

6d. Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.

6f. Follow a set of written instructions for a scientific investigation.

Grade Five

Science: Investigation and Experimentation

6b. Develop a testable question.

6c. Plan and conduct a simple investigation based on a student-developed question and write it so others can follow to carry out the procedure.

6f. Select appropriate tools… to make quantitative observations.

Grade Six

Science: Investigation and Experimentation

7a. Develop a hypothesis.

7b. Select and use appropriate tools and technology…to perform tests, collect data, and display data.

7e. Recognize whether evidence is consistent with a proposed explanation.