

Dr. Heartbeat

A LEGOLAND® Malaysia
Educational Resource Guide



Table of Contents

Welcome	Objectives	Page 1
Background Information:	The Human Heartbeat	Page 2
Before and After Visit:	Research and Action! Robotics in Human Surgery	Page 3
Discovery Worksheet:	Applied Robotics at LEGOLAND®	Page 4
LEGOLAND Investigations:	Hands-On Activity	Page 5

Welcome to LEGOLAND Malaysia!

Education Programs:

Dr. Heartbeat was developed by the LEGOLAND Education Department. For information on LEGOLAND Education programs, visit www.LEGOLAND.my/education.

Directions:

LEGOLAND Malaysia is located in Nusajaya, Johor. The Park is just **18 minutes** from Singapore via Tuas Second Link. From Tuas Second Link, proceed until you see the Nusajaya EXIT 312, within few minutes you will see LEGOLAND Malaysia Signage.

Just **30 minutes** from Johor Bahru, CIQ Johor and Singapore, LEGOLAND Malaysia is accessible via Coastal Highway. From Danga Bay, proceed all the way to Nusajaya. LEGOLAND Malaysia signage will be seen before reaching Kota Iskandar.

Located **30 minutes** from the North-South Highway and Senai Airport. Take Tuas/Nusajaya/Pontian/Tanjung Pelepas EXIT 253, proceed all the way to Nusajaya EXIT 312. LEGOLAND Malaysia signage will lead you to the destination.

Safety:

LEGOLAND Parks are built to the highest standards of quality and safety. Height restrictions apply on selected attractions throughout the Park.

Hands-on Investigations:

The Dr. Heartbeat program is a hands-on activity located at MINDSTORMS® in the LEGO® TECHNIC® area of the Park. The program is available on a first-come, first-served basis for park guests. Self guided programs are not guaranteed these activities. School groups must call in advance to reserve a class. This class is subject to availability. Please call reservations at +607-597 8888 for more information.

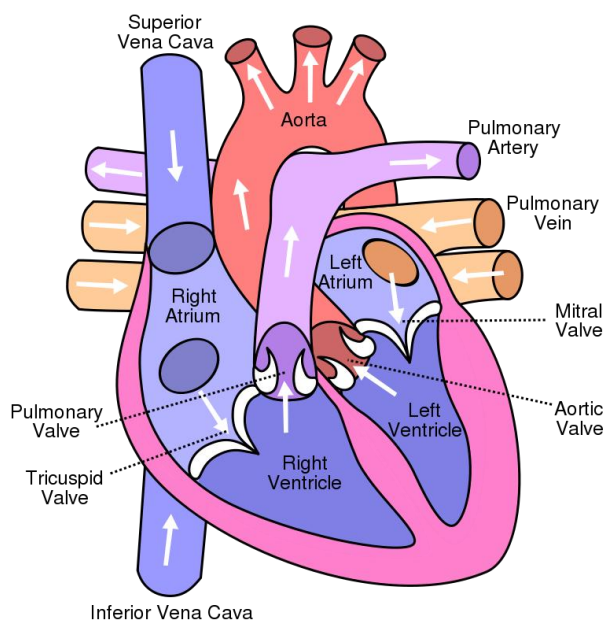
About Dr. Heartbeat

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 sound sensors
- Relate the Hands-On investigations to the experience of LEGOLAND attractions

Background Information

Learn about the human heartbeat!



The Circulatory System

The **heart** is the main organ in the circulatory system.

The **circulatory system** is made of the heart, blood, and blood vessels.

- **The heart** is a pump that moves blood through the body
- **Blood** carries oxygen and nutrients (food) to all the cells of the body and carries waste back from the cells.
- **Blood vessels** are tubes that carry the blood throughout the body. The tubes are called arteries, veins, and capillaries.

The Human Heart

- The human heart weighs less than one pound and is about the size of two clenched fists. The heart has four chambers—the left ventricle and left atrium and the right ventricle and right atrium.
- Blood is pumped from lungs to heart, from heart to body, from body back to heart, and from heart back to lungs. Here's how it works....

The Heartbeat

Breathe in! As you breathe, the lungs fill with oxygen that passes into the blood in the lungs.

Oxygen-filled blood from the lungs flows into the left chambers of the heart.

The left chambers of the heart pump oxygen-filled blood into the body through arteries. Arteries carry fresh oxygenated blood throughout the body. Oxygen passes into every organ, tissue, and cell in the body. Blood flows into the veins.

Veins send blood to the right chambers of the heart. This blood has no oxygen.

The right chambers of the heart pump blood into the lungs to get fresh oxygen. This cycle repeats with every heartbeat. Every heartbeat is one pump of the blood through the heart's chambers.

More Facts about the Heart

- On average, 1,000,000 barrels of blood are pumped through the heart in a lifetime
- The heart beats about 35,000,000 times in one year
- The heart beats about 100,000 times a day
- The sound of a heartbeat is created by the closing of the heart valves

Before and After the Visit: Research and Action!



Doctors Use Robots in Human Surgery

The System is called "Da Vinci" in part because Leonardo da Vinci invented the first robot, and he was very accurate in his drawings of the human body, using 3-D details to bring his works to life.

The Da Vinci System allows doctors to perform surgery through robotic arms. It is made up of:

- A surgeon's "desk" in the same room as the patient
- A cart at the patient's side with four robotic arms controlled from the surgeon's desk.

Three robotic arms hold the tools, such as a scalpel or scissors. The fourth arm holds a special, high-resolution "endoscopic" camera that allows the surgeon to see inside the patient's body!

The surgeon sits at the console and looks through two eye holes at a 3-D image while manoeuvring the arms with two foot pedals and two hand controllers.

The Da Vinci System translates the surgeon's hand movements into more precise micro-movements. The instruments operate through small incisions in the patient's body. To perform a surgery, the surgeon uses master controls to manoeuvre the robotic arms. To help the surgeon with accuracy and precision, instruments are designed to twist farther than the human hand. Also, the surgeon's hand motion is scaled down to tiny micro-movements, and there is less tremor, or shaking, than a human hand.

The Da Vinci System uses many safety features to detect human error. The surgical robot is never in control and is not autonomous; it operates only as the surgeon directs it, moment by moment.

The Da Vinci System improves on procedures like laparoscopy—where surgeons also use a camera for surgery in the abdominal area. With the old technique, the surgeon stands up using long instruments that have no “wrists”. The surgeon has to look away from the patient at a 2D monitor, and needs an assistant to position the camera just right. The Da Vinci System allows the surgeon to sit with eyes and hands in line with the instruments, and the surgeon controls the camera.

The Da Vinci System is designed to give surgeons better visualization, flexible movements, and precision. For the patient, a Da Vinci procedure can offer less pain, less blood loss and less need for blood transfusions. It can mean a shorter hospital stay, a quicker recovery and faster return to normal daily activities.

Discovery Worksheet

Ride the Dragon, and 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 second.

Hands-On Activity

Dr. Heartbeat at LEGOLAND®

Join Dr. Heartbeat and the LEGO® MINDSTORMS® NXT Nano-Bots! Complete life-saving missions like removing bad veins, dangerous cells, deliver anesthetics, and more!

Dr. Heartbeat introduces the group to the microsurgical tasks that they need to complete. Students work in pairs with a robot, attachments, and computer loaded with Dr. Heartbeat's surgical software.

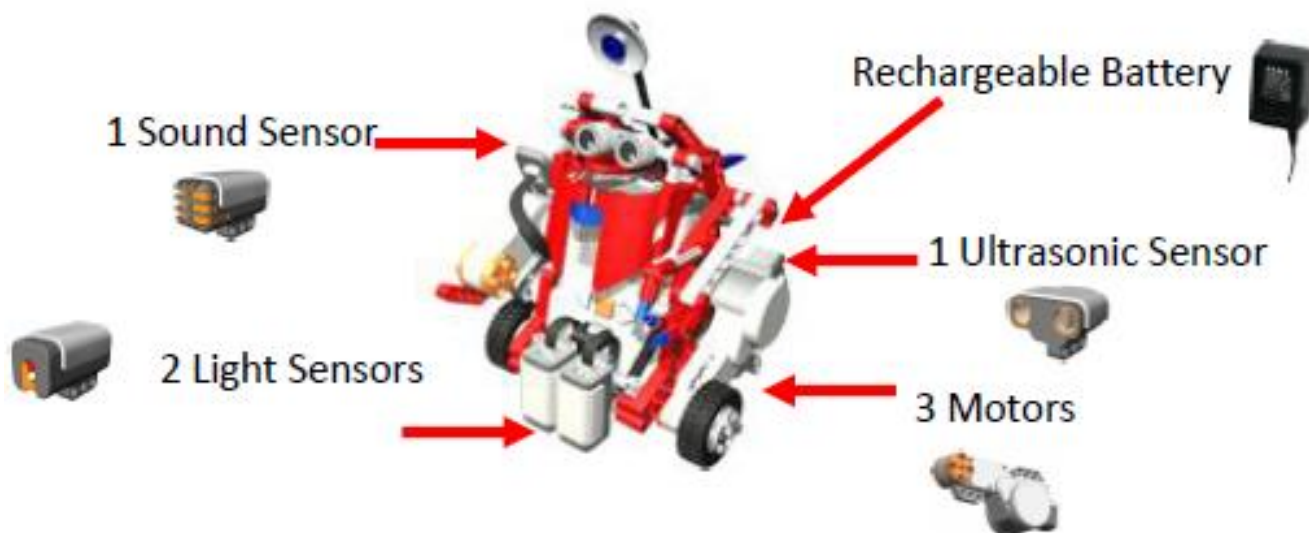
Each pair plans a strategy to complete the robotic tasks needed to save patients' lives and keep the LEGO heart beating!

Students use the icon-based program to set up their robot's actions, then test it on the "operating" table.

Students modify their program based on the results, until they successfully complete one or more missions. Then demonstrate their strategy to the group.

Check out the robot's body:

- Find the NXT brick, a tiny computer that is the robot's "brain"
- Use the Bluetooth to transfer your instructions
- Find the light sensor, programmed to read light intensity from the environment
- Choose a motorized attachment which can help you with a specific challenge



Create a program on the screen:

- Click and drag the commands to go forward, backward, left, right and finish off with a victory dance!