DR. HEARTBEAT

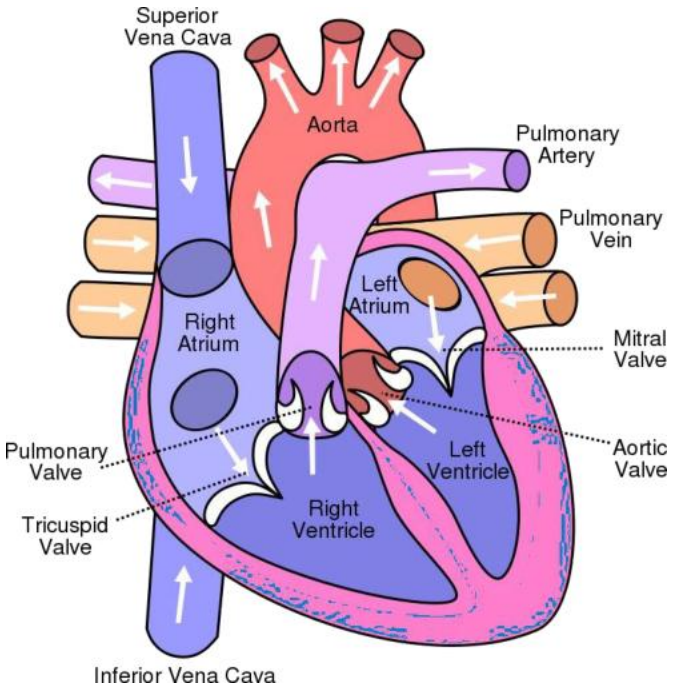
A LEGOLAND® Malaysia Educational Resource Guide

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 heart transfers the oxygen-rich 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, 100,000 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 maneuvering 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 are operated through small incisions in the patient's body.

To perform a surgery, the surgeon uses master controls to maneuver 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 at the surgeon's direction, 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 by 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 with no hands 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.

Hands-On Activity

Dr. Heartbeat at LEGOLAND® Malaysia

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

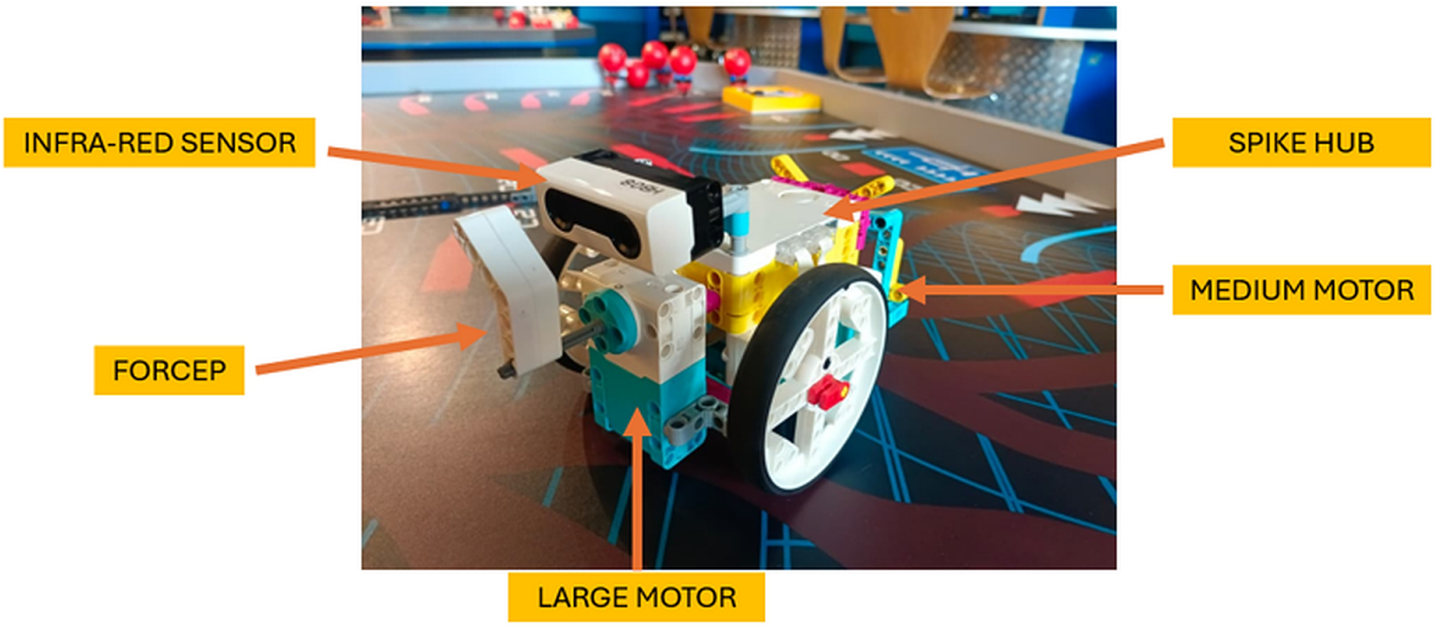
Dr. Heartbeat introduces the group to the microsurgical tasks that they need to complete. Students work in pairs with a robot, attachments, and computer loaded with Dr. Heartbeat's surgical software.

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:



Create a program on the screen:

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

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