

Introduction to Robots and Automated Systems

Teacher Background

This introduction to the topic of robotics assumes that the teacher does not have a background in the subject. It has been designed to provide students with the opportunity to learn and apply science-related skills and concepts such as observing, synthesising information and explaining their thought process and outcomes. This section will give the teacher some of the basic definitions needed to help students identify robotic or automated systems and parts thereof. A second section is supplied to identify theme-related activities. Please refer to Annex A for a list of vocabulary words to be reviewed with your students.

A robotic or automated system is “a machine or device that works automatically or by remote control”. The word “robot” comes from the Czech “robota” meaning compulsory labour. Although the vision of an android or other machine in a human form comes to mind when we talk about robots, automated systems such as darkness sensing toasters or electric ranges can fall under this definition.

In the development of the International Space Station, Canada is one of the key participants, using its expertise in the development of robotics systems to be marked as the developer and keeper of the International Space Station. The Canadian Remote Manipulator System (Canadarm), the Space Station Remote Manipulator System (SSRMS) and the Special Purpose Dextrous Manipulator (SPDM) make up the Canadian designed robotic components that will serve to build and maintain the International Space Station.

Below are examples of robotic and automated systems to be used to introduce the notion that robots and automated systems can be found and are used in our daily lives.

Chart 1 - Type of Robotic and Automated Systems

<i>Automatic Coffee Pot</i>	<i>This system is designed to turn on or off in response to timed sequences or water temperature sensors.</i>
<i>Elevator</i>	<i>An elevator functions as a result of a number of different systems working hand-in-hand. A human hand presses a button either inside or outside the elevator cabin to begin the sequence of events. If there is more than one elevator in the system, each will have sensors to detect the position of the other. And, each will also have sensors to detect its own position (which floor it is on) and whether its doors are opened or closed.</i>
<i>Airplane on Automatic pilot</i>	<i>In this mode, the aircraft uses sensors to identify the position of the aircraft and to maintain or change its course and altitude as required by the flight plan. This automated system can even ensure that a plane lands safely without the pilot or air traffic controller interfering in the process.</i>
<i>Vending Machines</i>	<i>The automated systems in a vending machine are able to identify coins by their size and are therefore able to calculate whether or not enough money has been inserted to pay for the product chosen. Once the system has confirmed appropriate payment an element in the system automatically controls the mechanisms to dispense the product.</i>



<i>Automobiles</i>	<i>Sensors and sensor systems monitor the workings of the engine, cooling system, environmental control system, brakes, transmission and others. Their outputs are used by the automobile central processor to evaluate the operation of the automobile and to modify the operation of the vehicle to keep it within operating limits. Should the automated system be unable to do this the driver of the vehicle is alerted via dash panel warning lights.</i>
<i>Spacecraft</i>	<i>Orbiting and interplanetary spacecraft use sensing systems such as star finders, temperature sensor, timers, and switches in conjunction with operating parameters supplied from Earth through the communications system to operate and guide the spacecraft to its final destination.</i>
<i>Home Heating and Cooling system (Furnace and Air Conditioner)</i>	<i>Home heating and cooling systems adjust the temperature in the house to the values desired by the occupants. Thermostats (heat sensors) and the temperature outside the home affect these systems.</i>

The following activities have been designed to complement a unit covering an introduction to robotics, the scientific method of problem solving and the identification and grouping of shapes and colours.

Description of Activity:

In this three part activity the students:

- 1) brainstorm and discuss the different components of robotic systems and identify possible different configurations of these systems; (30 – 45 minutes)
- 2) build their own robotic system from the student pages supplied (45 – 60 minutes); and
- 3) review colours and shapes by colouring a robot made of those shapes (20 – 30 minutes).

Materials:

- Student Sheets
- Scissors
- Glue
- Legal sized paper (on which robots can be built/glued together)
- Markers, crayons or other colouring equipment

Part 1

Step 1:

- a) Brainstorm in small groups or as a class to identify at least ten examples of robotic or automated systems with which students are familiar.
- b) Use the examples as a vocabulary list.
- c) Have the children draw 3 examples that can then be displayed on a theme board (bulletin board).

Step 2:

- a) Use the Teachers' Chart to identify each part of the robot and explain how it contributes to the system's ability to function. *These systems are similar to those that make up the human body.*



Chart 2 –Teachers’ Chart

<i>Robotic System</i>	<i>How used</i>	<i>Examples</i>
<i>Central Processor</i>	<i>The central processing unit is the brains of the operations. It is responsible for interpreting the commands given to the robot and is responsible for controlling all the other functions</i>	<ul style="list-style-type: none"> • <i>Human Brain</i> • <i>Computer chip with memory and program</i> • <i>Computer system</i>
<i>Transportation</i>	<i>This system is responsible for the movement of the robotic system. Some robots are fixed like those on the floor of manufacturing facilities, others have wheels or legs and feet to move them around.</i>	<ul style="list-style-type: none"> • <i>Wheels</i> • <i>Feet</i> • <i>Pogo Stick</i> • <i>Snowboard</i> • <i>Wings</i> • <i>Propellers</i> • <i>Rockets</i>
<i>Sensors</i>	<i>These are special systems that allow the robot to gather information about the world around it. Touch, heat, light, speed, sound sensing systems can all be part of a robotic system. A special version of this kind of sensor is a vision system</i>	<ul style="list-style-type: none"> • <i>Touch sensors in the skin</i> • <i>Nose</i> • <i>Taste buds</i> • <i>Ears</i>
<i>End effectors</i>	<i>End effector systems are systems that allow the robot to do things other than move. These may include hand-like objects or clamps, drills or latches. The end effectors may be tools themselves, such as the Canadarm end effector or it may be a vehicle for other tools such as the Special Purpose Dexterous Manipulator of the International Space Station Canadarm.</i>	<ul style="list-style-type: none"> • <i>Arms</i> • <i>Legs</i> • <i>Poles</i> • <i>Hands</i> • <i>Screw Drivers</i> • <i>Drills</i> • <i>Hammers</i> • <i>Brooms</i>
<i>Vision Systems</i>	<i>This system is responsible for the gathering of visual signals similar to the human eyes. This system can “see” in other parts of the light spectrum such as radar or infrared.</i>	<ul style="list-style-type: none"> • <i>Eyes</i> • <i>TV camera</i>
<i>Remote link or communications system.</i>	<i>This system is responsible for the communications to an operator or controller usually at some distance from the robot.</i>	<ul style="list-style-type: none"> • <i>Telephone</i> • <i>Fax</i> • <i>Internet</i>

The System Chart can be reproduced on the board or on chart paper with the students brainstorming the robots.

Chart 3 - System Chart

Type of System	Human Body (examples)	Robots (Examples)
Intelligence	Brains	Central Processing Unit / Computer Brain
Transportation	Legs	Cars, trains, planes
Sensors	Touch, taste, sight, hearing	...
End Effectors	Arms, legs, hands	...
Vision Systems	Eyes	...
Communications	Voice, sign language	...

Part 2:

Step 1:

- Hand out the student sheets entitled Robotic Systems Chart.
- Ask the students to identify different robotic systems.
- Have the students colour, cut out and assemble their robot on a legal-sized sheet.
- If the student wishes they may create their own system element. The student may also create a "body" for the robot.
- Ask the students to decorate the scene behind the robots and to give the robot a name.

Step 2:

- Have the students explain why their robots look the way they do and what functions they perform.

Part 3: (Specifically for kindergarten and grade 1)

- Review shapes and colours by asking the students to colour the robot picture entitled 'My Robot' with the colour appropriate to the shapes given. Some variation may occur since some students in grade 2 and 3 may measure the rectangular objects to determine if they are squares.

Annex A

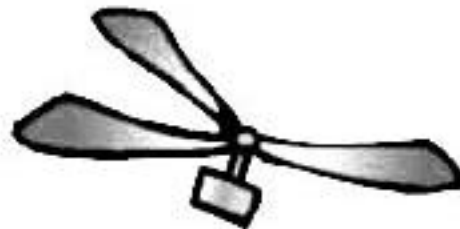
Vocabulary:

- Communications
- Vision
- Transportation
- Motor
- Movement
- Remote Control
- End Effectors
- Sensor
- Robot
- Automated System



1

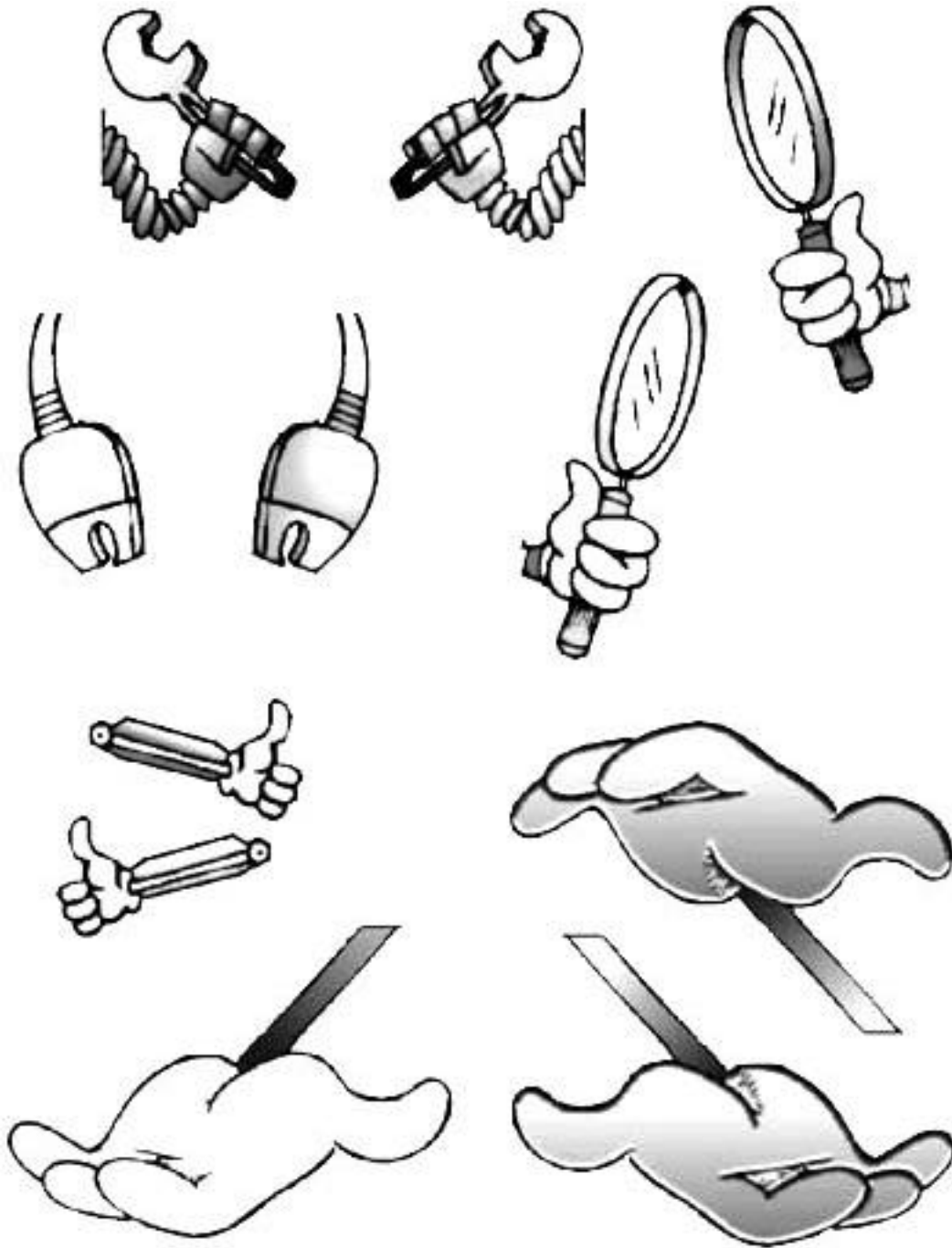






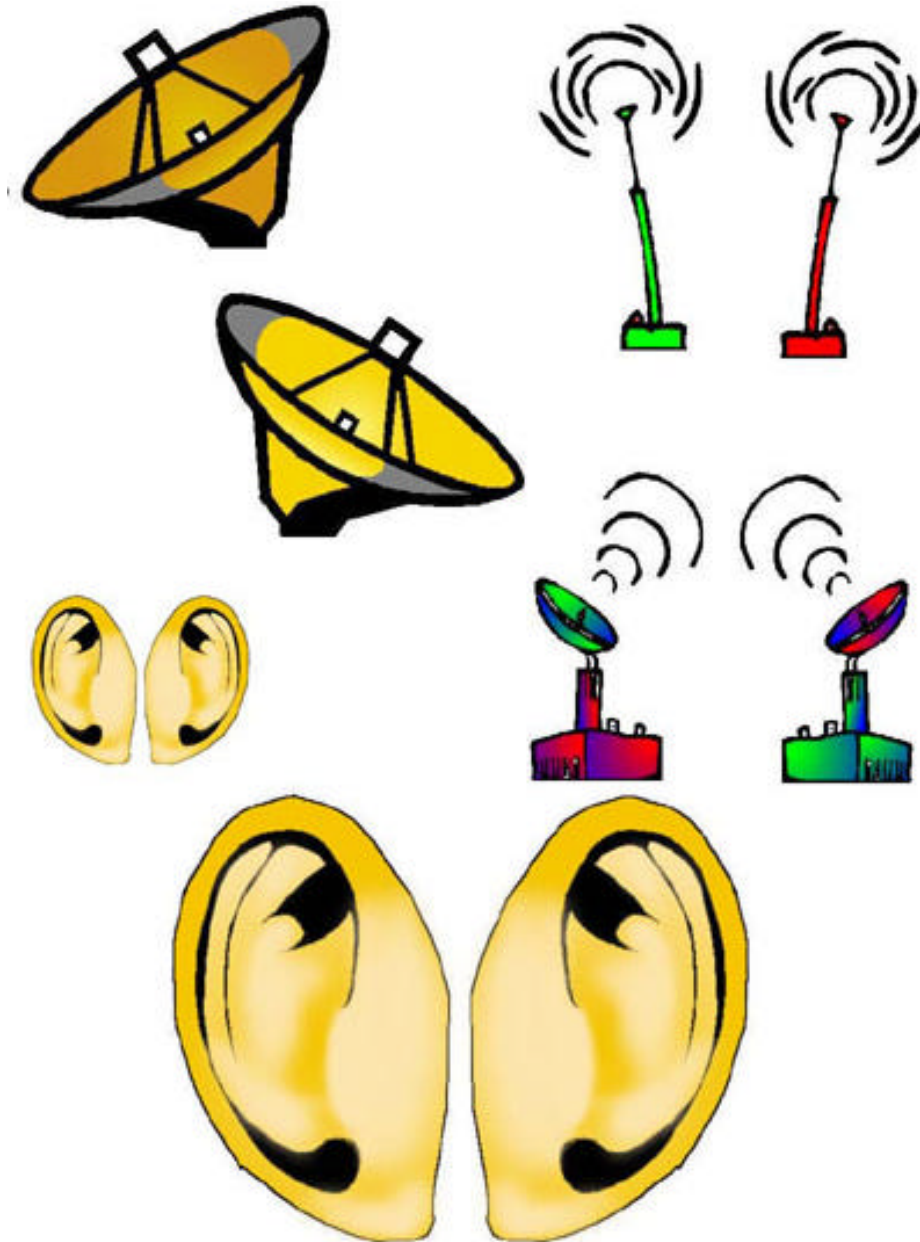
2





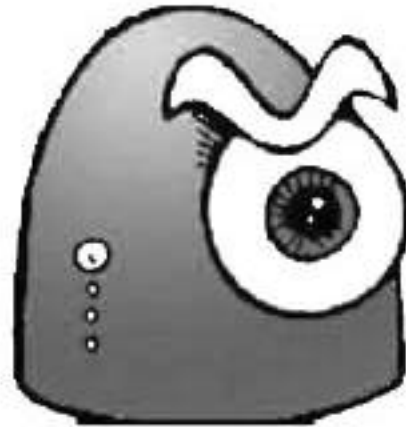


3














Colour:

Triangles: RED 

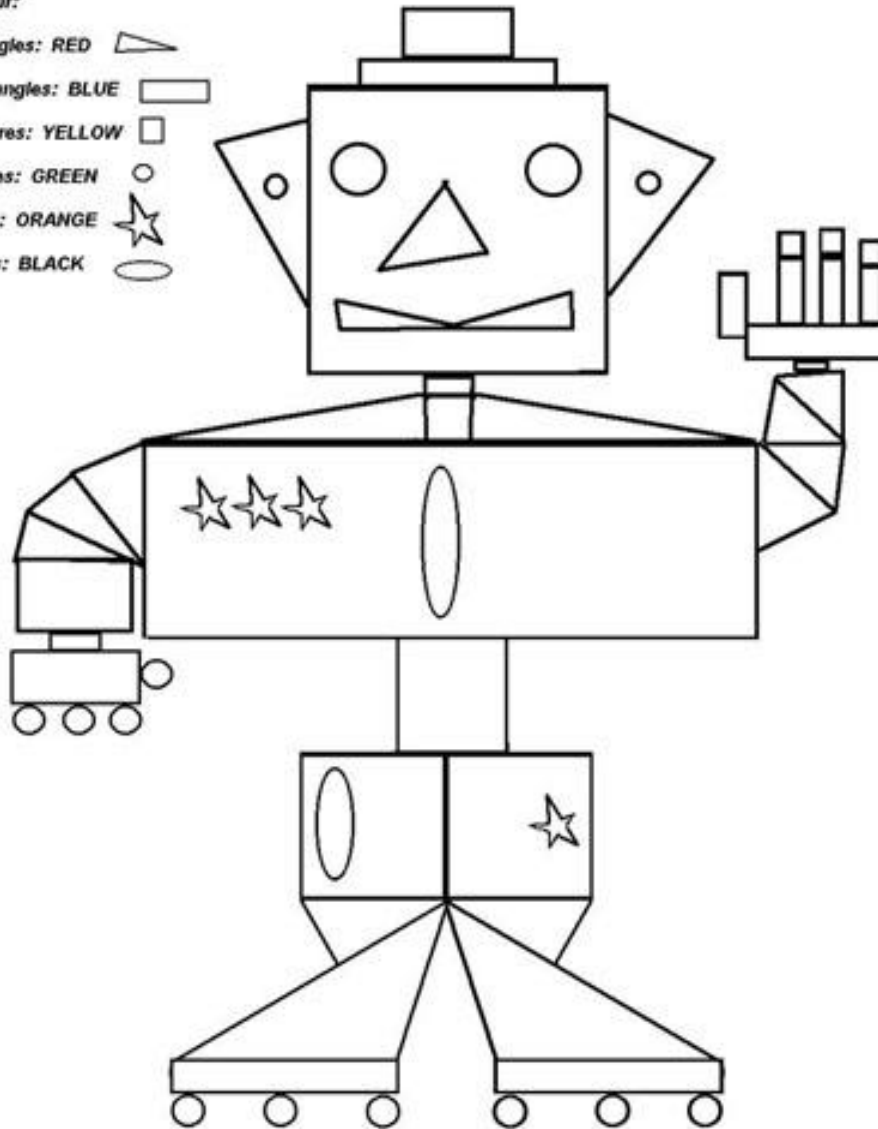
Rectangles: BLUE 

Squares: YELLOW 

Circles: GREEN 

Stars: ORANGE 

Ovals: BLACK 





Canadian Space Agency
Agence spatiale
canadienne

