1, 2, 3, code ! - Cycle 1 activities - Review: What is a robot?

Summary	Whether they worked with an "unplugged" avatar or a Thymio robot, students learn to define what a robot is: a machine that can interact with its surroundings.

Key ideas *(seeConceptual scenario)*	"Robot"
	• A robot is a machine that can interact with its surroundings.
	• A robot has sensors that let it perceive its surroundings.
	• A robot can perform actions: move, make a sound, produce light, etc.
	• A robot has a computer that decides which actions to take in which situations.
	• If you compare a robot to an animal, you can say that:
	  • Its sensors are like sensory organs
	  • Its motors are like muscles
	  • Its computer is like a brain
	  • The parts taken together are like a body

Inquiry-based methods	Observation, discussion

Equipment	For classes that have done Sequence II
	• For the teacher:
	  • A Thymio robot
	  • A screwdriver
	  • Handout 9
	• For students:
	  • The drawing of Thymio created at the start of Sequence II (Lessons 2.1 and 2.2)
	For classes that have done Sequence I, Sequence II, or both
	• For students:
	  • Handout 10
	  • Handout 11
	• For the class
	  • Poster(s) created at the start of the sequence

Glossary	Sensor, motor, computer, robot
Duration	45 minutes, split into two sessions

Foreword

This review lesson can be done at the end of Sequence I, during which students will have done unplugged activities, or at the end of Sequence II, during which students will have handled robots (here, Thymio).

This lesson is divided into three parts:

- A transition for classes having just completed Sequence I
- A transition for classes having just completed Sequence II
- A section applicable to both to help the class fully define what a robot is.

Teachers who have taught both sequences may choose to do only one of the two transitions, most likely the one related to the sequence they most recently finished. In any event, it provides an opportunity to re-hang all of the posters created during the lessons.

Transition for classes having just completed Sequence I

Starting the activity

Students created programs that made it possible to guide the avatar (when the route is known ahead of time) and have it collect rewards. The teacher asks the students to discuss the problem of an unknown route, i.e., the maze. If you want the avatar to be able to get out of the maze alone, without telling it step by step what to do or where to go, what do you do?

Discussion: sensors, motors, programs

Covering the idea of "test" again, the students can consider conditional constructs such as *"IF there is an obstacle in front of an avatar, THEN the avatar turns right."* This is a good approach.

The next question to ask is *"How does the avatar know when there is an obstacle?"* If the students have a hard time answering, help them by making a connection with living beings: *What would a dog do to get out of a maze? A person?* Students will bring up the senses, such as sight, smell, touch, etc., which leads to the key idea of *"sensor."* You can mention auditory, optic, olfactory and tactile sensors and the like. The test that students did (*"Is the chest green?"*) requires an optical sensor. Obstacle detection happens through sensors.

Group discussion

The class summarizes what they have covered: with sensors, the avatar can observe its surroundings. With a program, you can tell the avatar what to do depending on the circumstances.

The teacher adds that to move on its own, the avatar would need muscles and feet, legs, etc. In mechanics, we would say it needed *"motors."*

> **Teaching note:**
>
> With older students, the need for motors can also be a discussion topic.

In this case, the final question will be: *What do we call objects that have sensors, motors and programs?*

Transition for classes having just completed Sequence II

Starting the activity

The teacher shows the class a Thymio (turned off). They ask them to imagine what might be inside. The students should be able to repeat the terms "robot," "sensors," "motors," and "wheels" that were already covered. If they have a hard time coming up with ideas, the teacher can guide them using questions such as:

- *"What makes Thymio's wheels turn?"*

- *"How does Thymio get energy to move or turn on its lights?"*
- *"Do we need to fill it up with gas or feed it?"*
- *"How does it decide which direction to go in when it detects an obstacle?"*

Observation: What is inside a Thymio robot? (entire class)

The teacher tells the students that certain parts of the Thymio robot can be taken apart to see what is inside. After removing several screws, the teacher can show the students the robot's electronic components. Because the robot is fragile in this state, it is best that the teacher alone handles it.

The teacher points out and names the various parts:

- The sensors and the red lights that light up automatically when the sensor detects something.
- The electric wires that link the sensors to small black boxes (microprocessors) that act as a computer for Thymio: they are what let it decide what it must do when the sensors detect something.
- The "ambiance" lights that turn Thymio a different color based on its mode.
- The two motors, connected to wheels, that obey orders from the microprocessors.
- The battery that gives Thymio energy and that can be recharged.

Teaching note:

- Students will likely not understand the importance of microprocessors and/or the program if they haven't completed Sequence I. They will understand why the wheels are important for moving around and the sensors for detecting obstacles, but the interpretation and decision-making aspects will be unclear. To help them, have a student pretend to be a robot – i.e., obey without asking questions. Tell them to walk straight. The student will walk straight towards the back wall and will begin to worry if they do not receive another order. Rather than run into the wall, they will stop on their own. The teacher can then ask why they disobeyed. Their eyes saw the wall, and their brain told their legs to stop to not get hurt. The computer is the robot's brain.

The teacher then asks the students to explain what Thymio is.

Review: What is a robot?

Etude documentaire

Next (or during a second time slot), the teacher passes out Handout 10 and Handout 11 and asks the students to sort the objects, without telling them how many categories to create. It is possible that the students will instinctively separate the humanoid robots into one category and the non-humanoid robots into another, but they may also do it by shape or color.

Once they have done an initial sorting, the teacher adds the robot drawings from the first lesson. The class concludes that all these objects are part of the same broad category, "robots." Despite their different shapes, they all have sensors, motors and computers. While they do not look alike (and may not necessarily look like humanoids), they all work in a similar way. Our definition of a "robot" is:
A machine with sensors, motors and a computer, which can perceive its surroundings and take action accordingly.

Teaching note:

You can explain to students that we project our preconceived ideas about robots onto them. When we see a humanoid robot, we think it will be "smart" because its shape resembles a person. But in reality, they are often not any more sophisticated than a robotic vacuum cleaner.

Scientific notes:

- What is the difference between an automated machine and a robot? The question can be asked when we, as adults, consider certain machines (such as a machine tool). Originally, they were programmed to reproduce a movement; however, this did not make them robots but rather automated machines. An automated machine is programmed to always repeat the same movement ("bend the arm to 45°," "descend the drill," "drill down 5 cm," "straighten the arm for 45 seconds"), but does not have sensors. If the joint is blocked, the machine will still try to perform the other actions; if the drill is no longer fitted with a drill bit, it will drill empty space, etc. Mechanical arms used today are robots: a pressure sensor confirms that it is in contact with the plate to drill, a gauge tells it if there is enough oil in its joints, an actuator confirms the joint rotation angle, and a program tells it how to adapt or stop if a parameter changes. Many current technological devices are robots. If your toaster knows when to eject your toast before the bread burns, that means it is equipped with sensors and a program.
- Below are the special features of the robots on Handout 10 and Handout 11:
  - Mechanical arms have sensors to control their gestures and consumable levels.
  - Baxter is equipped with shape recognition to know which objects to pick up from a conveyor belt.
  - BigDog adapts the way it walks to the terrain to be able to continue moving forward despite obstacles in the way.
  - When in a group, Eporo robots imitate schools of fish to travel together, without causing traffic jams or accidents.
  - Robots can be used to help scientists explore locomotion mechanisms, such as the Harvard Ambulatory Micro-Robot, which walks on several legs (it is available in a centipede-inspired version), the Honda P2 for bipedal walking, RoboBee for flight or the G9 robotic fish for swimming.
  - Han explores emotion recognition and reproduction via subtle facial movements.
  - Roomba is a vacuum that moves around the room on its own and goes back to its docking station when the batteries run down. It closely resembles Thymio's yellow mode.
  - The Sojourner rover is one of many robotic solar system explorers (the first was Lunokhod 1, sent to the moon in 1970).

Group discussion

To reinforce this key idea, the teacher can compare robots to animals:

- Its sensors are like sensory organs
- Its motors are like muscles
- Its computer is like a brain
- The parts taken together are like a body

Conclusion and lesson recap activity

The class summarizes together what they learned in this lesson:

- *A robot has a computer, sensors and actuators that are all interconnected.*

Further study

- Have students draw more robots. Some will draw humanoid androids again, while others will draw from science fiction. See how many draw cubic robots this time.
- Suggest a "philosophical" workshop on this question: Are machines smart?

Cycle 1 activities
