

1, 2, 3, code ! - Cycle 1 activities - Lesson 2.3. Thymio in Investigator mode

Summary	Students discover Thymio's turquoise mode and prepare a route that Thymio can follow alone.
Key ideas (see Conceptual scenario)	"Robot" <ul style="list-style-type: none"> • A robot can perform actions: move, make a sound, produce light, etc. • A robot has sensors that let it perceive its surroundings.
Inquiry-based methods	Observation, experimentation
Equipment	For each group: <ul style="list-style-type: none"> • A Thymio, with its batteries charged • Large sheets of white drawing paper, black paint, small paint rollers (4 cm wide) For the teacher: <ul style="list-style-type: none"> • Handout 8 (used in Lesson 2.1) • The A3 poster created during the previous lesson
Glossary	Capteur, piste
Duration	30 min

Foreword

There are two different ways to approach this lesson.

- The first (described here) is for the teacher to prepare a route that Thymio will be able to follow. In half an hour, the students can both explore the turquoise mode and quickly draw conclusions about the concept of "sensor" while describing the types of routes that work well.
- A second option (the lesson variation) will take longer (one to two hours, done partly during art class) because students will have to learn about the sensors and explore how sensitive they are by creating routes in various materials that work well (or not). They will analyze the shape as well as the color and materials of the routes Thymio sees.

Preparation

The day before the lesson, the teacher can prepare the black route sections (straight, curved, etc.) using a paint roller and poster or acrylic paint. The route should be around 4 cm wide. Be sure to try it out ahead of time with the robot to make sure it works!

Just before the lesson, the teacher turns on the Thymio robots and places them in turquoise mode.

Starting the activity

Each group observes that Thymio turns around and around when placed on the table. The teacher explains that Thymio is looking for a route and the students are going to give it one.

Experiment: Drawing routes for turquoise Thymio (in groups)

Students will glue route sections provided by the teacher onto their pieces of drawing paper. The routes can be straight, curved, open or closed. A track in a figure-8 shape is simple and provides an interesting experience.

When the route is ready, students can place their Thymio (still in turquoise mode) on their paper near the route. They will notice that the robot follows the route all on its own.



Kindergarten class, Caroline Fayard, Paris.

Note that rough textured paper is not ideal for this type of route (see the list of suitable materials below).

Group discussion

Each group shows the class its route and describes how Thymio followed it. The teacher writes down the features of the routes that worked well on the board:

- Continuous routes (at each break between two segments, Thymio turns back the way it came)
- Gentle curves (Thymio has trouble managing hairpin turns)

Whether the route is open or closed or features intersections, Thymio is able to follow it: It either turns around at the end of an open route, continues along closed routes or generally goes straight at an intersection.

The teacher mentions the term "sensor" again so that students understand how the robot was able to "see" the route. When students lift their Thymio up, they can see two sensors under the frame at the front of the robot.

The teacher asks students how they know these are the sensors that let Thymio "see" the route. The class comes to a consensus with a short experiment: cover the sensors with a piece of paper taped to the underside of the robot. Now, Thymio cannot "see" any route, which confirms the initial hypothesis.

Scientific note:

The two sensors on the robot's frame detect the presence or lack of a route (black or another dark color versus white or another light color). For example, if the right sensor detects white but the left sensor detects black, Thymio will turn left to follow the route, which is certain to be a left turn. If both sensors detect white, Thymio turns around in a circle until it finds a route. If both sensors detect black, Thymio moves straight forward, which will also happen if both sensors are blinded by sticky tack.

As a class, students describe this behavior with an adjective (e.g., *investigator*, because it investigates a route, older children may suggest *explorer*). Avoid using the term *follower*, because the green *friendly* mode can follow a hand placed in front of it.

Conclusion and lesson recap activity

The class summarizes together what they learned in this lesson:

- *Turquoise Thymio can follow routes drawn in black on a white background.*

On the board, the teacher completes the poster from the previous lesson, adding a description of the fifth mode and labeling it with the color, the adjective used to describe it (and/or an icon chosen by the class to designate the behavior, such as a smiley).

Further study

- Kindergarten students may want to try out other routes with other shapes to see how turquoise Thymio reacts to more complex routes.

Variation

In this variation, the teacher lets the students create their own routes. This takes time (i.e., letting the paint dry) and results can vary. Here are a few things to keep in mind with regards to the materials and shapes children can use:

- Materials:
 - What works: black Bristol board, ink, acrylic, poster paint, garbage bags
 - What doesn't work: textured paper, tissue paper, felt
- Shapes that work:
 - Continuous routes
 - Gentle turns
 - A smooth surface (Thymio's movement can be hampered by irregularities in texture, glue blobs, folds, etc.)



The routes on the right (in poster/acrylic paint) worked well, but Thymio was unable to detect the one on the left (textured paper). The route in pencil (graphite, in the middle) is being tested. Kindergarten class, Caroline Fayard, Paris.

After trying out different materials, kindergarten or Cycle 2 students can extend their study by creating a black route on a black background. A route on Bristol board will be seen by Thymio even if glued onto a black textured background.