

# MYSTERY BOXES

ideas for teachers on how to use mystery boxes in their classroom

## CONTENT

- 5 boxes containing one ball and a different internal structure for each box
- 5 neodymium magnets

A box with an unknown internal structure contains a steel ball, whose movement is determined by the constrained path hidden in the box. By moving the box, students try to figure out when the ball moves freely and when it encounters a wall. They must build models and test them to arrive at a description of the box's internal structure.

## ACTIVITY TYPE

Group work

## DURATION

45-50 minutes

## ACTIVITIES PLAN

### Engage

Show a box to the class and move it in various directions. Describe the object and explain that inside it there is a ball whose movement is constrained by the internal structure of the box. Encourage students to share ideas on how to explore this structure. Emphasise that the box cannot be opened. Divide the class into groups and assign each group a box: it's time to start the investigation!

### Explore

Give students time to examine the mystery box and ask them to develop a theoretical model of its internal structure. For assistance, you can draw an image of a possible internal structure and guide them in formulating their first idea to test. Students should focus carefully on the sound produced by the ball as it moves through the box. For example, if the internal structure is a square shape, students are expected to perceive four impacts when they rotate the box on itself. It is advisable that they represent their model by drawing on a sheet of paper for better visualisation of the expected dynamics. Once the model is completed, they should test the hypotheses and record the observations. If the observations do not agree with the hypotheses, it is important for them to improve the model and draw a new version on paper.

## Explain

Each group shares its observations and conclusions reached with the others. It is likely that no one has yet formulated a precise description of the internal structure of the box. Ask them to explain why this is the case and what they would like to do to improve in their experiments. It is time to introduce the use of an instrument that would allow more accurate measurements: the magnet. Each group receives a small magnet that can attract the steel ball when brought close enough. Using the magnets, students can re-test their models: if the ball cannot be pulled into a certain area of the box, this indicates the presence of a barrier preventing its movement. This approach will enable them to formulate more solid conclusions. Make sure that each step in the process is clearly understood and that conclusions are based on verified models.

## Elaborate

At this stage, the exchange of boxes between groups takes place. Students will be engaged with a different structure, repeating the process. By this time, they should have established familiarity with the investigative method and proceed more quickly. At the end of the activity, allow time for them to discuss and compare the conclusions reached by the different groups relative to the same box. If divergent conclusions emerge, they may decide to repeat the experiment and agree on a common strategy.

## Evaluate

At this stage, the class can go over what was done during the two lessons, analyse the differences between the two activities and discuss the difficulties encountered.

Aspects that should emerge are:

- Science is an empirical process made up of hypotheses and experiments
- Science is a creative process
- Scientific models change over time
- Science is a collective effort. It takes time to arrive at scientific discoveries