Mystery Boxes

1 hour lesson

More info from Scool Lab https://scoollab.web.cern.ch/3d-printable-mystery-box

Equipment

- 10 mystery boxes
  These contain a 5mm steel ball
  Each has a chamber with some form of wall. Only one has no wall at all
  Each of the 10 is different, no two are identical.
- 10 small neodymium magnets

Before they start

Tell students that the boxes are sealed/glued. They cannot open them.
All inferences can only be based on indirect measurements.

Risk assessment

- The magnets are relatively strong. Keep away from materials sensitive to magnetic fields, such as hard drives, pacemakers etc

Lesson (30-40 min)

1. Form groups of 3-4. Three is best
2. (5 min) Place a mystery box on each of the benches. Tell them that their job is to determine the arrangement of the walls. They have 3-4 minutes to come up with a model
3. While working with the mystery box, highlight the following points:
   a. You are doing science.
   b. The students are making observations.
   c. Based on their observations, the students can act like a scientist and create a model.
4. (5 min) Have the students draw their model. This can be done individually or in small groups. Students can whiteboard their model or use pen and paper. Encourage creativity.
5. Students now rotate to another model, noting the colour of the mystery box. Repeat, by rotating between 4 groups (so a class with 8 groups will have two sets of rotations

6. The set of 4 groups now get together and share the models from the class, from the same colour. Guide the discussion about models:
    a. Are all models identical?
    b. Is it acceptable for scientists to have different models for the same observed phenomenon?
       Is there an activity or experiment you can do to support or refute one of the models?
7. (5mins) Now give students a magnet and use it to revise / modify/ confirm their model
8. While working with the mystery box with the magnets, highlight the following points:
    a. The idea of the magnet is that they are using new observations, newer tools, allow greater precision to validate their model

Some questions to consider

1. The boxes cannot be opened. There is no way to directly observe the wall arrangement.
    a. How can students know for sure the true arrangement
       (Ans: *they cant, they can only have a model that has strong evidence*)
    b. What, apart from you observations make a model stronger
       (*Ans: other observations and inferences from other people getting the same results - reliability*)
    c. What scientific concepts can this activity model?
       (Ans: *atomic model, particle theory, biological evolution, Big Bang Theory*)

Afterwards

Please ensure all boxes are returned as well as magnets and placed end on end in case