

The Cubes Inquiry Lesson

Objective: This lesson is best used primarily to introduce the process of inquiry and/or the scientific method. Depending on the group, it is also an effective lesson for teaching some subjects relating to the philosophy of science, such as the meanings of evidence, proof, and theory.

Set-Up & Materials: Two cubes, one simply displaying numbering similar to the sides of a die (cube 1), the other more complex (cube 2), involving names, number patterns, and color patterns (see attached plan for construction of a cube). Putting the cubes on a table away from a wall works well so that students can move around and observe all the sides of the cubes, and for the methods for discovery of the bottom of the second cube. Plan an hour if the students are unfamiliar with the scientific method, 30 minutes if they know it well. This activity works best for students that are 5th grade level and up. For students at the lower end of that spectrum, ask them to focus on only one or two variables (e.g. two sets of numbers, the colors and a set of numbers, etc). Keep in mind that they will not be able to see the name on the bottom at any time.

Facilitation: The goal of this activity is for students to learn about the bottom of a cube based on observations they make about the other five sides. It is an ESSENTIAL part of this activity that the students never see the entire bottom side of the cube. Instructors should always handle the cubes, from putting it on the table, to removing it at the end of the lesson. Cube 1 is used solely to introduce the scientific method, while Cube 2 allows the students to practice in a more complex, applied setting. Regardless of prior knowledge, the first cube should be used to ensure that all students are following the same process. I'll lay out how I run this activity step by step from here on.

1. Throw out the 'hook'. I usually tell a 1 or 2 minute story about how I discovered two strange objects and that I think they're from space, and that I've brought them in to figure out as a group what they are. It gets their attention pretty well, but do what works for you.
2. Put cube 1 on the table. I like to pull the cubes out of a paper bag, because I can be sure that the bottom side stays in contact with the table at all times. Ask students what they notice about the cube.
3. After students have had a minute or two to make observations and share them with a neighbor, introduce the word 'observation'. At this point, one student will usually tell you that it's a die, and try to tell you what's on the bottom side. I take this opportunity to talk about incorporating prior knowledge into observations, and also to talk about the difference between knowing something because you've seen it and knowing something because you inferred its existence. Remind them to think carefully about what they know and what they don't.
4. Once students have had 5 or so minutes to make observations, guide them toward asking questions about the bottom. Introduce the term 'scientific method' at this point, and then introduce each successive step as you get to it. Guide them toward asking the question "What's on the bottom of the box?"
5. Go through each step of the scientific method as a group with this first cube. Keep it as short as possible, but be sure to write the steps on a whiteboard

- somewhere so that the students can refer to it later. For the methods, make sure that the instructor is the only one to touch the cube. Also, it works better if you don't give a good view of the bottom for very long. I usually pull up one side about an inch or so for a few seconds so that most students can see it.
6. Once the entire process is finished for the first cube, bring out cube 2. At this point, the students should be able to self-guide their way through the process of learning about the bottom of this cube, using the same question. (Thus the scientific method needs to be written somewhere so that they don't skip steps.)
 7. Break up students into pairs to work on cube 2. Make it clear that when they get to the methods section, they will only be able to view one corner of the bottom. They choose the corner, come to the instructor and ask to see a particular corner that will help to support or refute their hypothesis. After checking in, the instructor will slide the cube to the edge of the table, exposing a corner for the students to see. Be sure that only one group at a time sees the corners. Discourage sharing of information between groups at this point, because it will happen later. I've found it helpful as the instructor to check on each group's progress at certain intervals. I use the Data Collection step as a good break for them to tell me their hypothesis, rationale, and methods.
 8. After a group sees a corner, ask them to go revise their hypothesis if they need to. If they don't, have them go think about seeing another corner to help them further support their hypothesis. Each group should see two corners, but no more.
 9. Once all the groups have seen two corners, ask them to continue on to the analysis and conclusions step. I usually ask them to answer the following three questions in full sentence, paragraph format.
 1. What did you see on the bottom of the box, and where did you see it? (draw a picture)
 2. Did what you see support your hypothesis? Why or why not?
 3. What would you do next?
 10. Once they have finished their conclusions (5 minutes), ask whether anyone in the room knows for sure what's on the bottom of the box. (No one should think that they do.) Then ask how many people are confident in their thoughts about what's on the bottom. Depending on the group, I usually take a couple minutes here to talk about evidence versus proof. I end the activity by talking about the idea that the box is like an ecosystem. There are lots of pieces of an ecosystem that can be seen directly, but there are some things that can't. Science is a tool to be able to get an idea of what's happening on the bottom of the ecosystem box, and while no one knows for sure, the observations of lots of people taken together give us a pretty good idea about what the bottom of the box looks like.
 11. At this point, the activity is over, and I put cube 2 back into the bag, making sure not to let the students see the bottom. I encourage them to discuss among themselves the different results that they got in order to piece together an image of what the bottom of the box looks like.

Plan for Building a Cube

This is one possible plan for building a cube. Feel free to build one that suits your purpose. I've always made mine from cardboard squares stuck together with masking tape, and covered in construction paper for the colors.

The patterns on this one are fairly straightforward. Numbers in the upper right are the number of letters in the name on the same side. Bottom left number is the number of letters the names on opposing sides share in common. Upper left numbers are the sum of the other two. Colors are artistic opposites (opposite sides of the color wheel). Opposing names are opposite genders.

