

Indirect Measurement

Introduction

There are many things in nature that are either very difficult or impossible to measure directly. No one can weigh an electron directly, and yet science textbooks report it has a mass of 9.1083×10^{-28} grams. No one can weigh a blue whale directly, but the record books report weights in excess of 200 tons. No one can see X-rays, but physics books report they have a wavelength of 10^{-10} meters. Although it is impossible or impractical to measure many quantities directly, it is often possible to do so indirectly. In this exercise you will determine indirectly how many spots are on a cube.

Equipment and Materials

- 1 cube
- 1 container

Problem/Objective

How many faces of the cube are marked?

You will learn how many markings are on the cube without touching it and by seeing only one surface at a time. You cannot observe the cube during the shaking process.

Procedure

1. Look at the top face of the cube as it rests in the container; record your observation in the data table.
2. Shake the container. After the cube has come to rest, examine it again and record your observation.
3. Repeat this procedure 100 times. Record your results.

Analysis

During the 100 trials, we looked at 100 faces.

Number of spots observed: _____

Divide the number of spots observed by the total number of faces observed (100): _____

Since the cube has 6 faces, we find the probable number of spots on the whole cube by multiplying the number of spots per face (the number calculated above) by the number of faces (6): _____. This is an average and since either a whole spot or no spot was seen, if there is a decimal we disregard it.

Conclusions

1. List the steps you took to reach a conclusion.
2. How much evidence is enough?
3. Would it be safe to stop making observations after just six trials? After 50 trials? Explain your answer.

Mr. Oemig's 8th Grade Science Class

Observations

Indirect Evidence Data Table

Trial Number	Spot	No Spot	Trial Number	Spot	No Spot	Trial Number	Spot	No Spot	Trial Number	Spot	No Spot
1			26			51			76		
2			27			52			77		
3			28			53			78		
4			29			54			79		
5			30			55			80		
6			31			56			81		
7			32			57			82		
8			33			58			83		
9			34			59			84		
10			35			60			85		
11			36			61			86		
12			37			62			87		
13			38			63			88		
14			39			64			89		
15			40			65			90		
16			41			66			91		
17			42			67			92		
18			43			68			93		
19			44			69			94		
20			45			70			95		
21			46			71			96		
22			47			72			97		
23			48			73			98		
24			49			74			99		
25			50			75			100		

Conclusions:

1.

2.

3.