Popularizing Physics Through Low Cost/ No Cost Experiments

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There has been a general deterioration in the level of understanding of science in India although many research institutions have been established nation-wide. This can be attributed to a lack of scientific culture. We present here a very effective method that creates interest in science, especially Physics with help of Low-cost / no cost experiments. In this paper four experiments are presented out of many that we have been using in Physics shows. These shows have been given to a variety of audiences and have been very effective in attracting students towards science.

The first half of the twentieth century saw tremendous development of scientific research in India marked by the remarkable achievement of J.C.Bose, C.V.Raman, S.N.Bose, M.N.Saha and many others. In the second half of the 20 th century a number of research institutions were established with intention of focussing on high quality scientific research. The outcome, however did not come up to the expected level. For quite some time the undergraduate teaching and scientific research activities in Indian universities has been passing through a state of inertia. Although new institutions such as Indian Institute of Science Education and Research (I.I.S.E.R.) and National Institute of Science Education and Research (N.I.S.E.R.) specializing in high quality Science Education and Research have come up, the interest in science at mass level is poor, so popularizing science and making science teaching thrilling is a great challenge.

Physics is one of the basic Physical Science. It is the impression of most of the students that this subject is difficult and dreary. The engineering and medical entrance examinations have converted this very important subject into a long list of facts to be memorized and problems to be solved. Most of the students go through their school and college education with somewhat this kind of impression. But Physics is much more than this. The subject can be presented to the students in a manner that makes it much more interesting and brings it closer to real life. We have worked with Dr. H.C. Verma, Department of Physics, IIT Kanpur, to develop a simple low-cost demonstration of experiments in Physics that can be used in class-rooms to stimulate lively discussions in science. Some innovative low cost / no cost physics experiment for class room demonstrations and informal lab activities are given below.

- **How much is one newton force?** We read about different units in our textbooks. Often we have no idea how much the different units mentioned in our text books represent. A very simple live demonstration can be used to illustrate this point. If you ask the students in a class to apply a force of one newton on a body, you will find them typically applying a force ten times larger. Only one or two students will make the mental estimation that the weight of a 100g body is 1 N. This can be demonstrated by taking a single pan balance and asking different students to press it down applying 1 N force. The observations will be revealing.

- **What is your reaction time?** When we are faced with a situation, we do not respond to it instantly. We take some time to react. Reaction time is defined as the time taken by a person to notice and act in response to a stimulus. The following simple experiment gives an idea of typical reaction time. A meter scale is held vertically with the hand. The subject is asked to keep his hand near the bottom end of the scale so that he can catch it as soon as it is released. The scale is suddenly released without warning. It falls down a certain distance before the subject realizes this and catches it. The time duration between the release of the scale and catching it can be calculated from the distance that the scale has fallen through. If this distance is d then time taken is $t = \sqrt{2d/g}$. This is the required reaction time.

- **Total Internal Reflection demonstration:** When light goes from a denser medium to a rarer medium, the light will get fully reflected from the surface if the angle of incidence is larger than a critical angle,. If the angle of incidence is smaller than the critical angle, part of light is reflected back and part of it refracted. This is very effectively demonstrated using a laser torch and a small glass bottle. The bottle is half filled with water in which a very small amount of soap has been dissolved. The upper part of the bottle is filled with smoke from burning incense stick. Laser light is thrown at an angle from below at

the surface of the water. Due to the presence of soap the path of laser beam in water is visible. It is clearly observed that when the angle of incidence is greater than critical angle, there is total internal reflection while for angle of incidence less than critical angle there is only partial reflection and partial refraction.

Fig 1: A demonstration of total internal reflection of light

- **Demonstration of electromagnetic damping:** Electromagnetic damping is the slowing down of a moving magnet near a conductor due to induced current. This can be demonstrated by using a strong magnet and an aluminium tube. The aluminium tube is kept vertical. When a strong magnet is released inside the tube from the top, it is observed that the magnet takes considerable more time to fall through the tube, compared to what a non-magnetic body will take to fall through the same tube. This slowing down is due to the strong eddy currents produced in the aluminium tube due to electromagnetic induction when subjected to moving magnetic field. The magnet in turn experiences a force that opposes the relative motion.

The above four are examples of the low cost demonstrations experiments that can be used to enliven Physics teaching and create interest in Physics through shows and demonstrations. We have worked with Dr. H.C. Verma, IIT Kanpur to develop a number of low-cost Physics experiment kits and conducted workshops on effective use of the classroom demonstrations for science-teaching. We have conducted shows with help of these and many other experiments. These shows have attracted attention of students and encouraged them to ask relevant questions in science. Such efforts help in demystifying science and developing scientific thinking in students.