An Innovative Approach to promote Science Education Through Hands-on Activities

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Abstract. *Children are observant as well as curious. They love to explore the world around them. But in the classrooms they are suppressed by the way science is taught, although the science teachers have at their disposal the single most powerful tool in all education – the lecture cum hands-on demonstrations. The scientific skills of the students can be improved by teaching them the concepts of the relevant scientific principle with activity based hands-on experiments. Historically "show and tell" or "seeing is believing" has probably been the best educational technique ever employed. A demo experiment not only gives a better understanding of the scientific ideas, but also makes the study interesting and fun for the students as well as the teachers concerned. This paper presents some demonstration experiments which definitely motivate the students for better understanding of basic physics. The author is one of the senior resource persons of two projects since 2005, a joint venture of Vigyan Prasar(Govt. of India) and IIT- Kanpur for the Teachers' Orientation Programmes and West Bengal District Scheme Interactive Science Workshops for the middle school students.*

Keywords. Hands-on experiments, No-cost, Low-cost

1. Introduction

Science is being taught in our schools since years only through 'chalk and talk'. This certainly affects students' perception of the world and consequently their interest in following scientific careers. In his book "The Art of Teaching", Gilbert Highet [1] discussed "A picture is worth a thousand words and that people learn most quickly by doing something and seeing something done". It is difficult to surpass the learning impact of the combination of 'hearing', 'seeing' and 'doing'. According to the old Chinese proverb ' **I hear and I forget, I see and I remember, I do and I understand',** learning by doing is considered to be the best way of learning science. According to Hans Christian Oersted, the famous discoverer of electromagnetism, "all scientific advances must start from experimentation" [2]. We, the science teachers enjoy finding innovative ways to demonstrate the principles of science, which help the students to develop an intuitive feeling for the real world, for how things work; they also increase the understanding of the basic concepts. Hands-on demonstrations remain the best means of reaching the widest possible audience.

2. Demonstration Experiments:

Out of about seventy five hands-on experiments with no-cost, low-cost materials a few are described here

Experiment No.1: Action and reaction

Theory: According to Newton's third law of motion, to every action there is an equal and opposite reaction and they must act on different bodies.

Method: After placing two ring magnets in the attractive mode on the scale pan, the reading is noted. The magnets are now placed in the repulsive mode, so that the upper magnet floats in air. The reading is same as before. As the lower magnet has to support the upper magnet, an equal and opposite reaction force is applied to the scale pan by the lower magnet. Hence no change in the scale pan reading.

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Experiment No.2: Floating of balloon due to difference in air pressure

Theory: An increase in the speed of fluid occurs simultaneously with a decrease in pressure.

Method: An inflated balloon is placed on each of the two thermocole glasses, one having some windows and the other having no window. Also each of them having a hole at the bottom through which a straw is inserted. When air is blown through the straws, the speed of air inside the glass is increased creating low pressure. The air with higher pressure from outside presses the balloon on the mouth of the glass. But in case of the glass having windows, this air of higher pressure rushes inside the glass and makes the balloon to fly away.
With the same principle, a ping-pong ball can be thrown outside a glass tumbler by blowing air horizontally.

Experiment No.3: Burning of candles in a limited supply of air

Theory: Air expands when hot.

Method: The experiment of the rise of water label when a burning candle is covered by an inverted glass tumbler is a very common experiment used by many teachers to verify the compositions of Nitrogen and Oxygen present in air. But using more numbers of candles it can be shown that the rise of water labels are different- more the number of candles, more the rise of water label. This can be explained by using the fact that air expands when hot.

Experiment No.4: Fork-spoon-match system in equilibrium

Theory: Any object whose centre of mass is below its support or pivot point will not topple.

Method: If the fork and spoon are forced together with the match placed between the tines of the fork, the entire apparatus can be balanced on the edge of a glass-tumbler. An interesting situation can be achieved by lighting the end of the matchstick which extends over the edge of the glass tumbler. The wood of the stick will burn until the glass acts as a heat sink and consequently the temperature of the stick drops below the kindling temperature of the matchstick. In this situation the flame will be extinguished leaving the fork and spoon balanced on the tiny portion of the matchstick, which seems to be balanced on practically nothing.

3. Conclusion and Discussion

The author is working with the students of class VIII to class XII standard and their teachers for last six years in different projects and bagged more than seventy five demo-experiments [3]. He has the experience that the hands-on demonstration experiments are very encouraging among the students as well as their teachers. These demo experiments help the students to develop inquisitive temper for learning science. At the end of 3-day workshop, each student is instructed to demonstrate a new experiment which is invented by him. Also they submit a feed–back where they mention the utility of such kinds of hands-on demonstrations and how they help them understanding the basic physics.

According to Prof. M.F.M.Costa, the Hands-on Science Network Coordinator, 'The pursuit of experimental hands-on work by the students on or off the classroom is a powerful way to help science teachers to reach our basic goals'[4]. Any hands-on activity claims that the students are transformed from passive learners to active learners. Learning not only means gathering of information but to use these information in practice.

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