Questions from the Science Textbook

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Is oxygen only a supporter of burning or combustion? Or does it burn itself!

Ever since our elementary classes we have been studying in our textbooks about the importance of air. There are many experiments that can be done with oxygen, such as making a paper pinwheel and blowing it to feel the flow of air, or putting an empty inverted glass in water to show that the empty glass is not really empty but is filled with air.

As we go to higher classes we learn about the various features of air such as its solubility. To show that air dissolves in water, we take water in a pan and heat it. Just before it boils, we notice some bubbles at the inner surface of the pan. These bubbles are formed because of the air dissolved in water. We can also prove that air is matter. Yes! The same experiment where two balloons are inflated with air and tied to the ends of a wooden rod, indicating that air has weight and it also occupies space.

Based on these experiments and findings, we realise that there is invisible and essential matter around us that is very important for life and which has both direct and indirect impact on all living and non-living things. Such activities connect science with real life and play an important role in making children understand concepts of science.

However, many a time children surprise us with their observations, logic and the questions that they raise. I experienced this while teaching a chapter on air in class VIII, where the first part the chapter on Air is basically about understanding the specificity and utility of oxygen, nitrogen and carbon dioxide and it motivates children to adopt a scientific approach based on findings from exploration, activities and experiments. The second part of the chapter creates awareness and sensitivity about global environmental issues such as greenhouse effect and acid rain. I started this lesson with an activity.

Teacher (myself) – Let us try and stop the air today and see what happens.

Children (surprised) – Teacher! How can stop the air!

T - Oh, we do not have to stop the air around us. We should try to hold our breath and see for how long can we do it and what is this experience like.

(The children started discussing this idea with each other, saying that 'I will not be able to stop it for long ... no, I cannot!')

T (After activity) - Children, how did you feel?

C - Teacher, we were feeling suffocated and in the end, in order to compensate for the shortage of air, we had to breathe hard.

(When we calculated the average time of holding the breath, it came to about 12-15 seconds.)

I asked the children - Is there any difference between the air taken in (inhaled) by the nose and the air that is exhaled?

C – Yes, we take oxygen in and when we exhale, we breathe out carbon dioxide.

But some children started saying - No, no. We inhale and exhale the same thing.

I asked - How can we check this?

Homu - Teacher, we can check the carbon dioxide that is released from the body by using alkaline phenolphthalein and observing the change in its colour. (This answer was possibly based on the experiments done in the acid-alkali lesson studied in the previous session)

So based on the above suggestion, we immediately did the experiment and found that the alkaline phenolphthalein (pink) becomes colourless because of the air that came out from the mouth. Hence, it was concluded that we used different types of air which meant that air is also made up of different types of air.

Moni - Teacher, how can we know what is air made of? What are the components present in it?

Lomu - Teacher, the book says that there are a lot of gases in the air such as nitrogen, oxygen, carbon dioxide, argon etc.

I said – Yes, you are right. Let's look at another

experiment to understand it.

We divided children into five groups with six children in each group and performed the bell jar experiment. We concluded from the experiment that there is something in the air that helps to burn the candle and when that something finishes in the bell jar the candle extinguishes. Meanwhile, another group tried to do a different kind of experiment...

Vinu - (attempting to remove the air that helps in burning by blowing, flicking the glass, covering the candle) - Hey! Look! The candle got extinguished immediately?

The group again kept the glass upside down on the candle and found that the candle got extinguished faster than before and the level of water also did not rise much. In this way the children were able to figure out that there is one gas in the air which helps in burning while the other one extinguishes the candle.

I said - Can we make these gases in the laboratory?

A few children (happily) - Yes! Let's make them.

I - But how?

Children - With the help of materials available in the laboratory and the activity given in the book!

I said - Ok! But we will have to work very carefully.

The children started experimenting in the group on their own. When they were heating potassium permanganate to make oxygen, they saw that the water in the water-filled test tube was being replaced by a certain gas.

I said - Children, how to confirm that the gas prepared by heating potassium permanganate is oxygen?

Koki - Teacher, in the presence of oxygen things burn rapidly and are extinguished as soon as the oxygen gets over, so if the test tube has oxygen, then the burning matchsticks should make it burn faster.

Again the children started testing the gas in their group. The matchstick, which had got extinguished while being taken to the test tube, started burning much more brightly as soon as it was inserted into oxygen gas and extinguished after some time.

Dipu (repeatedly putting matchstick in and out of the test tube) - Hey! The match starts diminishing when taken out and burns when it is taken in.

But after some time, when the burning matchstick was taken back to the test tube then things did not happen as before.

Moni – Teacher! The matchstick is not burning anymore! Where would the oxygen present in the test tube have gone?

Chetu - The oxygen in the test tube will not remain there! It must have got mixed in the air.

Sana - The oxygen present in the test tube was used to burn the matchstick and it must have got over.

Moni - But, the book says that oxygen helps in burning but does not burn itself. According to this, oxygen should not get over. And if the oxygen is getting over then all the oxygen on the earth should also finish.

The question was natural. When we say oxygen helps in burning, we assume that it only helps in burning, whereas the fact is that it also gets over. In my discussions with the children, I tried to make them understand that oxygen, together with combustible substances (wood, coal, fossil oil) that mostly contain carbon content, produces heat and carbon dioxide gas. I told them we will learn about this in detail when we study about carbon. Again a question was raised by a child.

Moni – What happens if hot iron is put in the test tube? Because that is Fe.

Though the question was asked by one child the whole class was eager to know the answer and understand it.

I - We should do it and see what happens.

We again collected oxygen in the test tube and passed a thin red-hot iron rod in the test tube. Observation showed that the brightness of the iron rod increases as it is introduced to the gas sample that has been trapped in the test tube, but not when the process is repeated again and again. The children were surprised.

Homu - Oh yes! Even now oxygen is getting over.

Moni (logically) - Teacher! Either carbon is present in iron or iron also has the quality of combustion, just like carbon.

Sana – That means oxygen helps in burning, but after making the new substance it also gets over. So we cannot say that oxygen is only a supporter of burning or combustion.

I said – Going further, we will study about metals, non-metals and carbon, perhaps then we will get more accurate conclusions!

Children doing experiments

It was a very interesting experience for me and also for the children. After this activity, we made carbon dioxide from vinegar and soda and examined its fire extinguishing nature. We also learnt about the application of nitrogen. Further, we tried to learn about the global issues of air pollution through news, newspaper cutting and debate, which I will not be discussing now. All these interesting experiments- related to air, logical questions and answers, confirmation through experiments and drawing conclusions- helped in adopting scientific thinking and approach in children. Most importantly, on the basis of above experience I could teach and make children understand certain other topics such as chemical reactions, carbon, metals and non-metals

In this manner, textbooks can be the starting point of discussions in the class, leading to learning what is in the text.

[This article was originally written in Hindi. It was translated to English by Nalini Ravel.]

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