Interlinking High School Science with Environment: Some Pedagogical Connections

Rashmi Sharma

R.I.E., Bhopal
E mail –rashminerie666@gmail.com,

Environmental consciousness is a major theme of almost all global and local deliberations and discussions in today's time. Environmental education is also an integral part of education at all levels of schooling. As per the guidelines of the Honourable Supreme Court of India, environmental education is a compulsory subject in schools. Apart from this, some topics pertaining to environmental education are a part and parcel of every discipline at school level. However, there are still some gaps reflected in the attitude of our students in regard to environmental awareness and sensitivity.

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Introduction

Environmental consciousness is a major theme of almost all global and local deliberations and discussions in today's time. Environmental education is also an integral part of the syllabus at all levels of schooling. As per the guidelines of the Honourable Supreme Court of India, environmental education is a compulsory subject in schools. Apart from this, some topics pertaining to environmental education are a part and parcel of every discipline at school level. However, there are still some gaps reflected in the attitude of our students in regard to environmental awareness and sensitivity.

NCF-2005 recommends that environmental education should be taught through infusion approach with other school subjects rather than a separate discipline at the school level. For this purpose almost all textbooks reflect the concern for environmental education wherever possible. Science textbooks also incorporate the chapters which generate the awareness and attitude towards the environment and environmental conservation. The NCERT Science textbooks for Classes IX and X includes chapters which are directly related with environment. There are many other chapters in these books where the environmental concerns are reflected along with the science concepts.

In spite of all these incl usions, there is still a lot which needs to be reflected in the practices of our students for a healthy and happy life. The efforts of bringing environmental concerns in practice seems to be insufficient. The present scenario of the sensitivity and attitude towards environment needs to be changed. School teachers are expected to take the lead for this purpose, as teacher's personality always positively affects the behaviour and personality of the students.

The infusion method suggests that the interlinking of environmental awareness, attitude, skills etc., with the text of any discipline (in this case with science), whatever and whenever possible. For this, teachers

are required to be imparted training in such a way that they can easily relate the topics / concepts of science with environment. The teachers should be able to generate the required awareness related to environment amongst the students. In turn students can reflect environmental sensitivity and can relate the local/global environmental issues with the text being taught. Pedagogically also, it is essential because excitement in learning comes only where the importance of the subject to real life problems is pointed out during teaching. Learning becomes joyful for the students and they feel motivated to learn if teaching is made in a context which shows the relevance of the subject. When a student is able to recognise the connections between environmental issues/problems and the concepts of science, the teaching is expected to be enhanced and applied for the betterment of the environment.

Pedagogy of Infusion: Some guidelines are suggested hereby for ready reference of high school science teachers for infusion of environmental concerns with science concepts.

1. While emphasising the close relationship between science and environment, it is necessary to highlight the distinct nature of science. (set the priorities)
2. Teach a topic from science textbook while giving it main focus. (knowledge)
3. Try to recognise the linkage between the topic and the environmental concern and generate the awareness about it amongst the learners. (identification of environmental components)
4. Once, when the topic is within the cognitive reach of the learners, immediately focus on the environmental concern. (interlinking with environmental problem)
5. Make learners understand that how a particular science concept is related with the environmental issue. (strengthening the links)
6. Make them realise that how an environmental problem would be rectified or how its ill effects can be minimised. Learners should be able to realise about their contribution as an individual with reference to a particular problem. (skill development)

For example, a chapter from Class X Science textbook of NCERT *'Carbon and Its Compounds'* is illustrated here. Three concepts from the chapter have been interlinked here with the environmental concerns/issues.

Carbon and its Compounds

Concepts

1. Carbon is everywhere
2. Compounds of carbon
3. Combustion reactions of carbon

Carbon is Everywhere

Many of the things we use in our daily life are made up of carbon. All living structures are based on carbon in spite of its small amount available in the nature (0.02% in the earth crust and 0.03% in the atmosphere)

Once the concept is understood by the students, teacher may initiate the discussion that carbon does have ill effects on the environment and human beings. An activity for further understanding of the related environmental issues may also be given to the students.

Environmental Concerns: Ill effects of carbon black and carbon–14 on human health—

- Elemental carbon is of very low toxicity.
- Exposure to carbon black (a material produced by the incomplete combustion of heavy petroleum products as tar coal, even a small amount from vegetable oil) may result in damage to lungs and heart and leads to various skin problems. Carbon black has been reported as carcinogenic by International Agency for Research on Cancer.
- Carbon - 14 (a radioactive isotope of carbon) is one of the long lived radionuclide which has been involved in the testing of nuclear weapons. This carbon -14 increases the cancer risks and can endanger fetuses as it can cross the placenta and become organically bound in developing cells.

Activity: List out the situations where the exposure of carbon black to the humans is very high. Discuss about the measures through which the exposure to the carbon black may be minimised.

Compounds of Carbon

Among many of the carbon compounds, carbon dioxide and carbon monoxide have adverse effects on the environment. Along with the other compounds of carbon, CO and CO_2, their effects on environment and ways to reduce CO_2 emissions may also be discussed.

Environmental Concerns

- Carbon dioxide (CO_2) is not normally considered as a pollutant because it is a normal constituent of air. However, excess of carbon dioxide is considered a pollutant because it leads to adverse effects on the environment. Higher concentration of carbon dioxide in the atmosphere is likely to increase the temperature of the atmosphere. Carbon dioxide permits the short wavelength visible radiations to pass through it but traps the longer wavelength infra-red radiations (heat waves) reflected by the earth's surface. This trapping of heat waves causes excessive heating of earth's atmosphere. This heating effect on the earth produced in this way is called the green house effect. The excessive heating of earth and its atmosphere can have adverse effect on our climate, which will affect all the living beings. The climate will become gradually hot. According to an estimate, the average temperature of the earth has increased by 10^0 C in the last 50 years. It is predicted that if the global temperature rises by 3.6^0 C, the polar ice caps and glaciers would melt. This would increase the water level of oceans by about 100 m and hence lead to the flooding of low-lying coastal areas of the earth.
- Carbon monoxide (CO) can cause harmful health effects by reducing

oxygen delivery to the body's organs (like the heart and brain) and tissues. At extremely high levels, CO can cause death. Exposure to CO can reduce the oxygen-carrying capacity of the blood. For people having heart disease, short-term CO exposure can cause chest pain, as they already have a reduced capacity for pumping oxygenated blood to the heart.

- If a person is exposed to very high levels of carbon monoxide gas in a poorly ventilated room, one can develop headache, shortness of breath, nausea and vomiting, rapid breathing, chest pain, a rapid or irregular heartbeat, fatigue, dizziness, clumsiness or difficulty in walking, vision problems, confusion and impaired judgement, etc.
- Hydrocarbons cause smog and are important in the formation of ozone, a pollutant. Methane (CH_4) which is a principal component of natural gas is a major contributor of global warming.
- Volatile organic compounds include many substances that are suspected to cause cancer. For example, polycyclic aromatic compounds.

Combustion Reactions of Carbon

Combustion is discussed when the other chemical reactions of carbon are discussed. Students may be made aware about the ill effects of incomplete combustion on environment and human health.

Environmental Concerns: Incomplete combustion of carbon gives a sooty flame. One of the negative effects of the combustion on the environment (particularly greenhouse gas (GHG) emissions released to the atmosphere) contributes to global warming. Climate change resulting from global warming is one of the greatest challenges before the world.

Environmental Impacts of Combustion

Incomplete combustion of carbon in fuel emits CO_2 (carbon dioxide) which is the main culprit for global warming whereas incomplete combustion of carbon in fuel emits CO (carbon monoxide) which produces smog. Combustion of sulphur in fuel is SO_2 (sulphur dioxide) which too leads to smog and causes acid rain. By-products of most combustion processes are NOX (oxides of nitrogen) which are contributors of acid rain and by-products of some combustion processes are N_2O (nitrous oxide), the contributors in global warming process. Combustion of hydrogen in fuel results in H_2O (water vapors) which is a cause of localised fog. Unburned or partially burned carbon and hydrocarbons, also ash and dirt in fuel are the source of particulates (dust, soot, fumes) which lead to smog. Combustion of air containing halogens (Cl, F, Br, I) are the source of halogenated compounds emission. Those are potential carcinogens and leads to global warming also.

Activity: List out the activities through which you produce the green house gases. How can this be minimised?

Conclusion

Though the task of interlinking is difficult but it is not impossible. The overcrowded curriculum is also a big hurdle. The lack of appropriate information which can be related with science concepts also may be a problem for practicing teachers. But for sure,

if teachers decide to take this responsibility all problems can be easily overcome. It is high time to join the hands together to develop our students as the responsible environmentally literate citizens. The people who are sensible and sensitive towards the environment will only lead the future. Inclusion will help us to achieve our objectives of this category.

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