

BOOK 9



POLLUTION

*We must all see ourselves as part of this earth,
Not as an enemy who imposes his will on it.
Being a living part of the earth,
We cannot hurt it without hurting ourselves.*

— *African proverb*

Pollution



concoction ? Ugh ! Of course not. You would not drink it because it looks dirty and may taste horrible, and you know that these substances in the water can make you sick. You know that the water is polluted (not pure or clean).

Pollutants (substances that pollute) cannot always be detected by sight or smell. Some substances which are normally present, such as carbon dioxide in the air, become harmful only when the quantity of the substance increases beyond certain limits. The tolerable level of pollution varies for different pollutants.

Drinking polluted water or breathing polluted air can harm your health directly. Our health can also be affected by eating food prepared from polluted materials. Children, old people and the undernourished whose resistance is low, are the most vulnerable to pollution-related diseases.

Pollution can also affect the well being and survival of the planet Earth itself. For a healthy environment, the air, water, land, flora and fauna — the five main systems that support life on earth — must be healthy. This depends on their capacity to neutralise pollutants. When there is too much of a pollutant, or it is piling up too fast, the system may no longer be able to sustain life. A water source may become so polluted that it is poisonous to drink, and no plants or animals can survive in it. Some hazardous substances such as pesticides, poisonous chemicals and nuclear wastes have a wide-ranging and long-lasting impact on the entire ecological system. These are especially dangerous.

Think about a day in your life. Are you exposed to polluted water or air ? What is the source of the pollution ? Do you or your family contribute directly to pollution ? What about burning crackers on Deepawali night ?

Water Pollution

A major source of water pollution in India is sewage. Untreated sewage flows into ponds, lakes, streams and rivers — which are the sources of drinking and cooking water. Sewage can be treated to kill disease-causing germs before it is dumped into a

Take a glass of water. Add a spoonful of soil. Put in a pinch of detergent, some cleaning powder, a few drops of ink and a couple of dead insects. Stir well. Would you drink this

river. But the sewage-treatment systems in most of our cities are very inadequate. Even in Delhi, some sewage goes directly into the Yamuna. Shallow wells can also be contaminated by sewage seeping through the ground. However, the water in deep borewells (when they are properly sealed) is safe.

Some organic waste materials literally choke up water bodies. This is because they consume the dissolved oxygen in the water faster than the rate at which oxygen can be produced by natural processes. All water-living organisms, particularly fish, are affected. Inorganic wastes too can reduce the dissolved oxygen by reacting with it. When the oxygen level in a stream or river goes down, it aggravates the effects of other pollutants in the water. When there is too much organic material in a waterbody, these supply an abundance of nutrients for micro-organisms and algae, which flourish. But these too consume oxygen. The result is that the oxygen level of the water falls further, and the pond or river "dies" in a process called eutrophication. Other plants and animals can no longer survive in it.

Chemical wastes from industries are often toxic (Poisonous). Such wastes, if discharged directly into rivers, poison the entire river system right down to the outlet in the sea. Modern agriculture too is aggravating water pollution. The fertilisers and pesticides, which high-yielding crop varieties require, flow along with the waste water into streams and rivers. Heavy metals like mercury, lead, arsenic and zinc, and organic chemicals, the chlorinated hydrocarbons such as DDT and aldrin, are especially hazardous. Radioactive substances also have a long-lasting impact on the entire aquatic system.

In the 1940s, the insecticide DDT was introduced in a worldwide campaign to kill disease-carrying mosquitoes and eradicate malaria. The initial results were dramatic. But later, it was discovered that DDT threatened human health and the survival of birds and fish. The quantity of pesticide required to kill mosquitoes kept on increasing. Today, malaria has reappeared all over the world, as mosquitoes have become

resistant to DDT. Unlike many other chemicals, DDT is not easily absorbed through the skin while spraying, but it is dangerous over time. It accumulates in the body tissue, and has even been detected in the breast milk of Indian mothers.

Both industries and power plants (which generate electricity) contribute to pollution in yet another way. Large amounts of water are used in many industrial processes. The waste water may be at a very high temperature. If this heated waste water is discharged directly into rivers, it results in a sudden rise in the temperature of the surrounding waters. Fish die because of thermal (heat) shock, and the aquatic ecosystem as a whole may also be affected.

Excessive soil erosion is yet another cause of choking up lakes and rivers. When the level of sediments increases beyond certain limits, organisms which live at the bottom of the water may get buried, and places where fish breed may be destroyed. A high level of sediments can obscure the sun's rays, and the lack of light may intensify eutrophication.

Among the most dangerous of all pollutants is fuel oil. Oil spills from tankers at sea, or leaks from underground storage tanks on land, are very difficult to control because oil spreads very fast, affecting a large area very quickly. Fuel oil is itself toxic to living organisms: oil spills at sea also decrease the oxygen level in the water. Many people do not realise that the Arabian Sea and the Indian Ocean are among the world's most polluted waters — due to oil.

Air pollution

Air pollution became a serious global problem after the Industrial Revolution in Europe. In India, the growth of new industries and rapid urbanisation after Independence has caused severe air pollution.

In December 1984, the worst industrial disaster in the world occurred in Bhopal, the capital of Madhya Pradesh, when the

deadly chemical methyl isocyanate (MIC) leaked out of a storage tank in the Union Carbide pesticide factory. More than 2,500 people in the city died of exposure to poisonous gases, and thousands more sickened. No one really knows what will be the long-term consequences of exposure to the poisonous gas.

The effects of air pollution are not always so dramatic. In fact, we may often be unaware of the harm that air pollution is

causing. Air quality can be measured through instruments, which tell us, for instance, that Indian women who cook on wood fires may be inhaling 40 times the level of pollutants considered safe for human health. Labourers who spray agricultural chemicals on the fields, and workers in stone quarries, mines, cement, asbestos or ammunition-manufacturing industries risk breathing polluted air.



Air pollutants

The sources and effects of air pollution are extremely varied and complex. Pollutants in the air may be solid particles or gases.

Suspended particulates are the solid particles and liquid droplets (or aerosols) with remain suspended in the air. Large particulates reduce visibility but are relatively less harmful to health. Fine particulates damage human eyes and lungs, and aggravate respiratory diseases. The most common particulates are dust and soot. Particulates also come from sea spray and volcanic emissions, or from industrial and domestic fuel combustion. In industry, they can be controlled by using electrostatic precipitators — a technique of scrubbing the air clean of pollutants before it is released.

Smoke or soot is the most easily visible form of air pollution. It is a product of incomplete combustion. Smoke comes from burning cigarettes, domestic wood or coal fires, the engines of automobiles and trains, and from industries and coal-burning power plants. Smoke consists of tiny carbon particles suspended in the air, which can be detected through powerful electron microscopes.

The air may also be polluted by trace metals, such as lead, nickel, iron, zinc, copper and cadmium. Lead can poison all living beings from micro-organisms to humans. It affects photosynthesis and respiration in plants, and inhibits the decomposition of organic matter. Lead accumulates in an organism, and these higher levels are permanent. This can affect the kidneys and the nervous system, especially of children, and the development of the unborn foetus. Lead in the air comes mainly from leaded gasoline — the lead added to petrol which makes automobiles run more smoothly. Although in India we now have more stringent laws to control the air pollution from automobiles, we have not stopped the use of lead.

Gaseous pollutants include compounds of sulphur and the oxides of nitrogen. Sulphur dioxide is emitted into the air both by natural processes (volcanic action, sea spray and decaying organic matter) and by industrial processes (the burning of coal and petroleum, smelting of non-iron ores, and the generation of electricity).

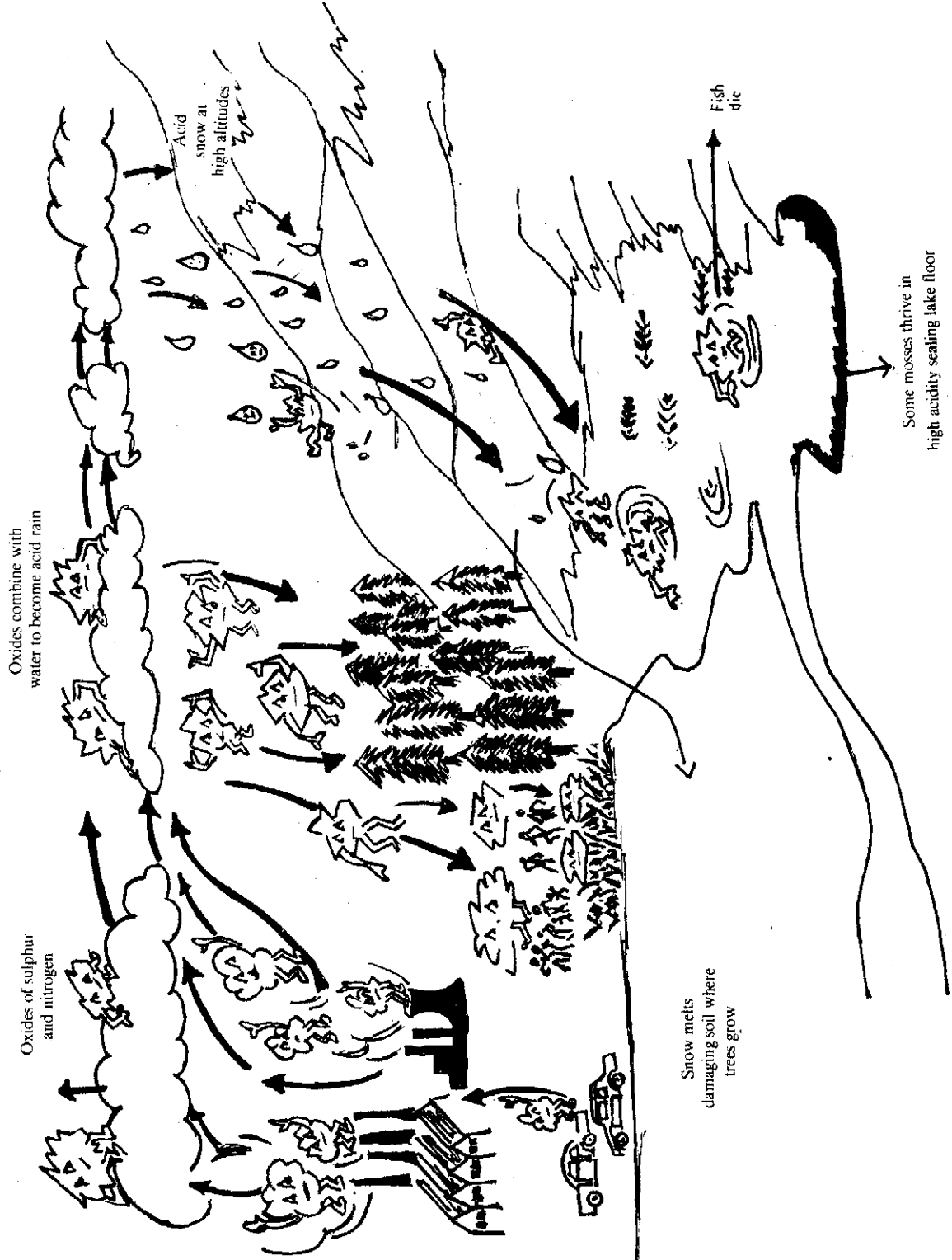
Nitrous oxide is formed naturally during lightning and by the decay and breakdown of organic matter. It is also emitted through high temperature combustion as in automobiles or some industrial activities such as electricity generation. It combines with the oxygen in the air to form nitrogen dioxide.

The oxides of sulphur and nitrogen combine with the water vapour in the air to form a highly corrosive compound, acid rain — which may come down as rain, snow, fog, mist or with swirling winds. It has caused the destruction of forests in Germany, lakes in Canada, and soils in southern Brazil. The acidic content may damage crops and some building materials, such as marble. Although acid rain is not yet a serious threat in India, changes had to be made in the Mathura Oil Refinery, so that its emissions should not cause corroding in the marble of the Taj Mahal at Agra. Wherever there is heavy industry or road traffic, acid rain is a potential danger.

The other group of gaseous pollutants are the hydrocarbons, which include a wide variety of compounds containing hydrogen and carbon. These compounds are mainly the result of incomplete combustion of petroleum in automobiles. The hydrocarbons react with other pollutants in the air, in the presence of sunlight, to produce yet more pollutants such as PAN (peroxyacetylnitrate), which damages vegetation.

When vehicular traffic is heavy, such as during congested peak hours in cities, photochemical smog may develop. This is a hazy mixture of suspended particles and gases, formed by the reaction (in the presence of sunlight) of nitrogen oxides and the hydrocarbons from automobile exhaust. Photochemical smog also contains PAN and ozone, both of which irritate the eyes.

ACID RAIN



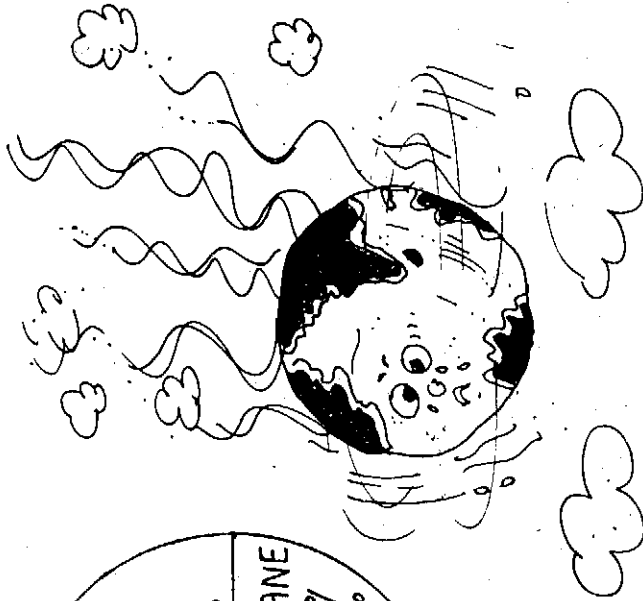
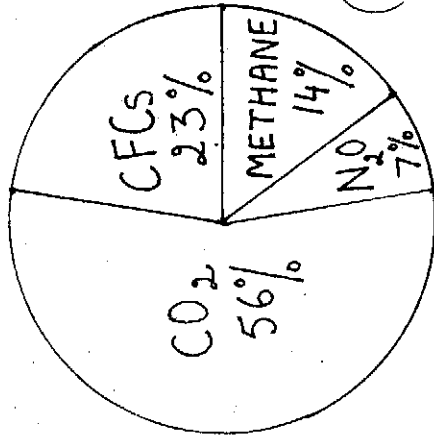
In India, there have been many instances of poor families choking to death in badly-ventilated houses because of an excess of carbon monoxide from a smouldering *chula*. This colourless, odourless gas is emitted through incomplete combustion and naturally through the process of decomposition. When it is inhaled, it inhibits the absorption of oxygen. This can damage the eyes, heart and mental coordination. Carbon monoxide also has an indirect effect on the atmosphere through processes that are related to the greenhouse effect.

The Greenhouse Effect

In many botanical gardens you can see an ordinary garden greenhouse, which has a glass roof, and perhaps sides, to let the sunlight through. This warms the inside for the plants which

need a higher temperature. The glass is a one-way heat trap, it prevents the warmth from escaping. This is exactly what may be happening to the earth. Certain gases, such as carbon dioxide seem to be increasing in the atmosphere. This traps solar energy inside, just as the greenhouse glass does.

The increase in carbon dioxide is mainly due to the burning of fossil fuels, particularly for power generation. The industrial nations of the west are mainly responsible for the huge increase in the carbon dioxide level. The destruction of tropical forests is also a contributory factor. The consequences of the greenhouse effect may be felt over the next few decades. There may be global climatic changes, and a rise in the sea level. The only long-term solution to reduce the greenhouse effect is to develop alternative sources of energy.



THE GREEN HOUSE EFFECT

CO₂

- BURNING FORESTS
- BURNING FOSSIL FUELS
- CEMENT PRODUCTION

CFCs

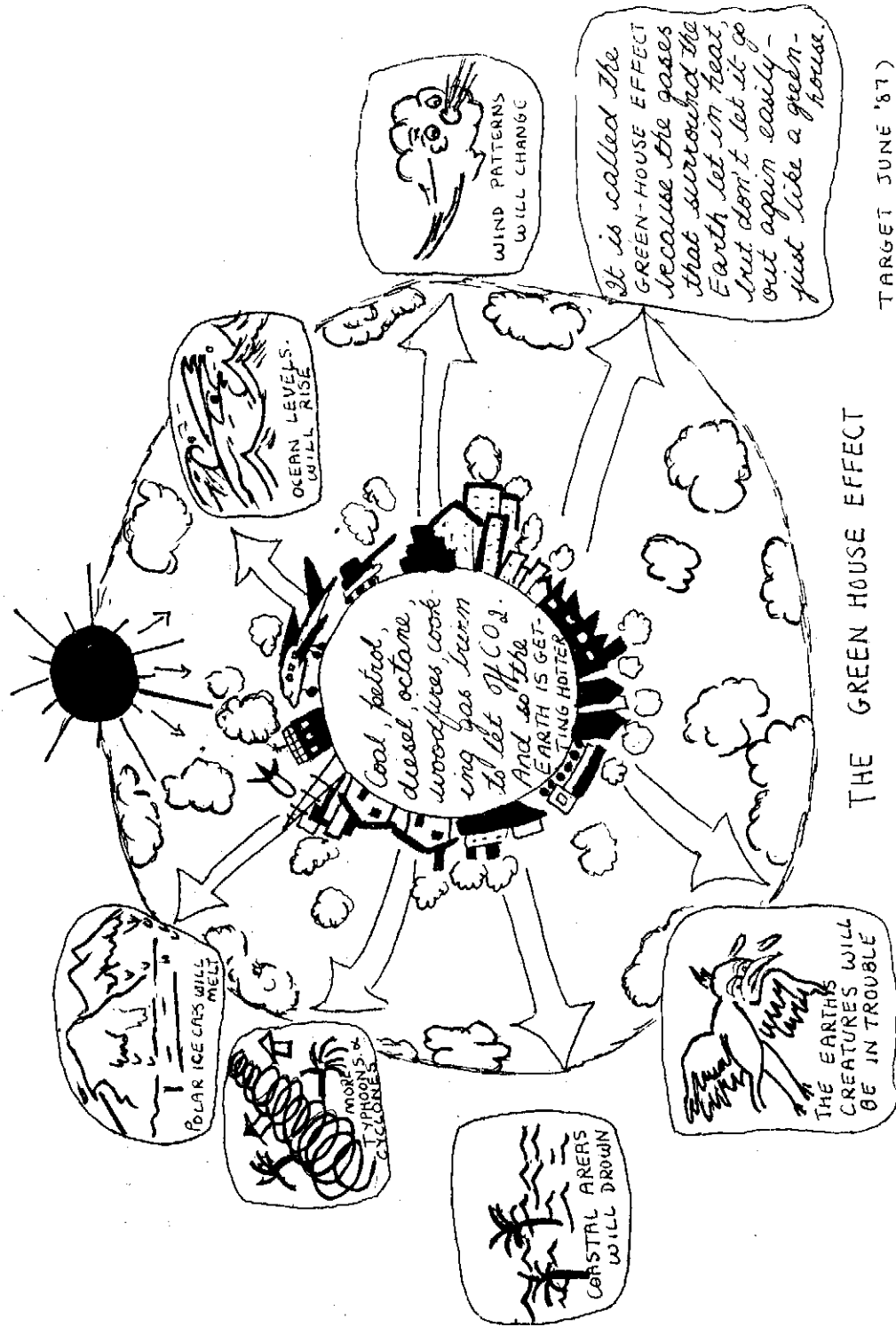
- REFRIGERATION
- AIR CONDITIONING
- AEROSOLS

METHANE

- ROTTING VEGETATION
- WASTE GASES FROM ORGANIC MATTER

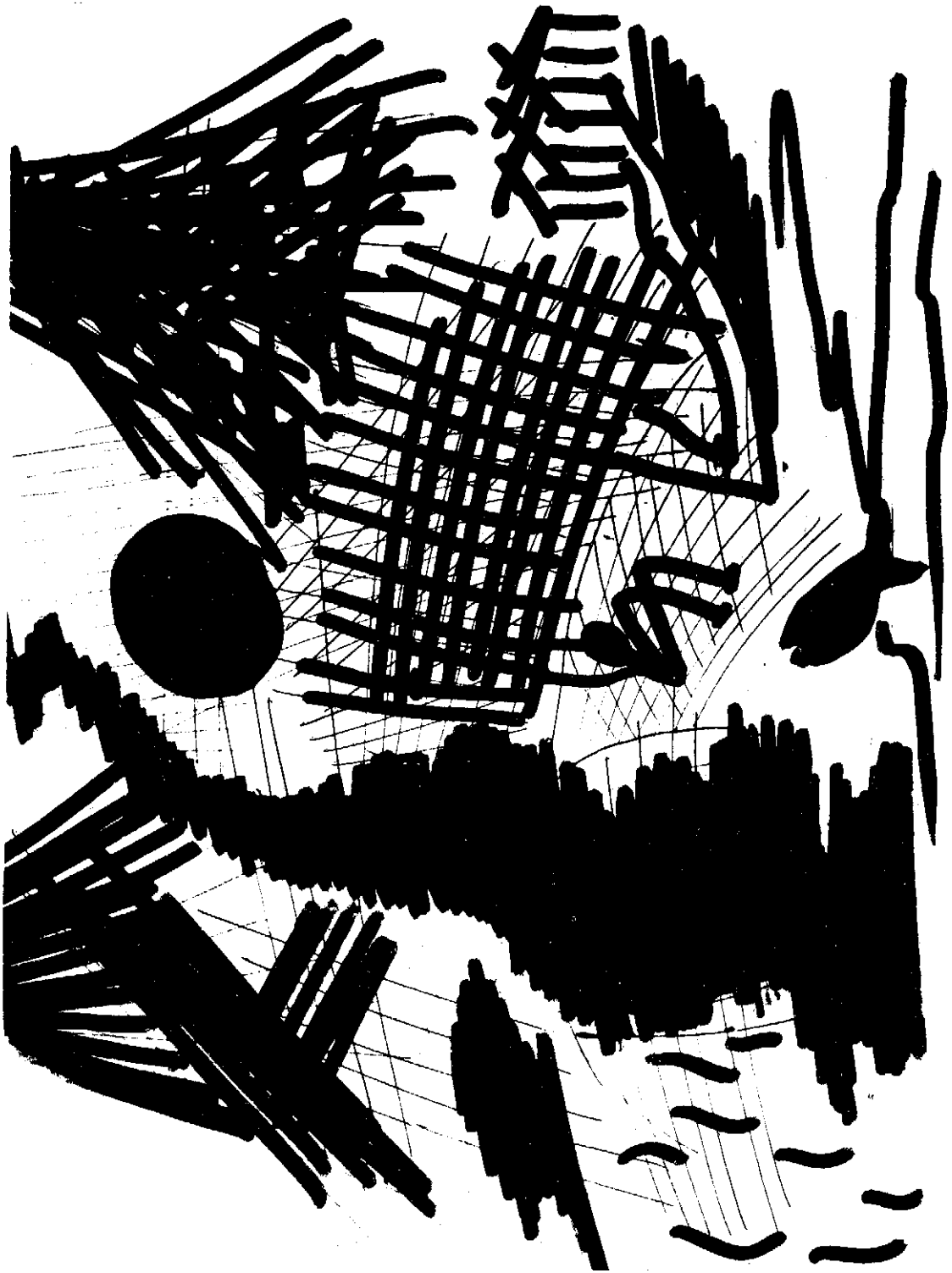
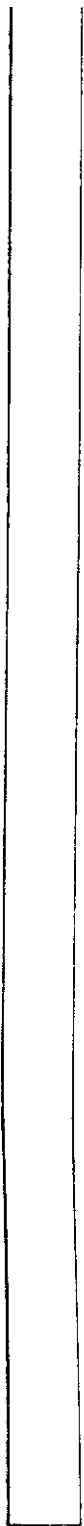
N₂O

- BREAKDOWN OF FERTILISERS



THE GREEN HOUSE EFFECT

TARGET JUNE '87



Activity

1

A Day in the Air of a City

The sun rose over the horizon and beamed upon the sleeping forms of Delhi-ites. People were gradually stirring. An occasional throb of a passing vehicle was heard and the distant toot of a night express nearing its destination. Shutters were pulled open, gates clanked as they were unlocked. A new day had begun in the massive Capital and industrial city of Delhi.

Even now, before the actual hustle and bustle of the day had started, the air did not seem as fresh as early morning air should. A deep breath in this still comparatively cleaner air made one inhale a number of germs and pollutants. The reason—all the poisonous pollutants released by the factories the day before still linger in the air.

As the day wore on, the vehicles started towards their destinations on the busy highways. Incomplete combustion in the engines led to the release of carbon monoxide in the atmosphere. In the factories all the diverse functions started with the burning of coal and other fuels. From the tall chimneys, smoke spewed out, thick, black, swirling and full of poisonous gases, hanging in the air like a huge serpent about to strike.

All this was visible to the naked eye, it was criticised and condemned. But the man who stands and talks about air pollution doesn't realise that the cigarette butt he has thrown down has also contributed to the pollution of the city air. Thousands of people walking around, thousands of people smoking, consuming nicotine and releasing poisonous smoke into the air.

Evening comes. With it the fog. The smoke and the fog become a heavy smog, suffocating our breath and that of our children. Who is responsible for this? For killing unborn babies? For destroying plant and animal life? For disturbing the balance of Nature?

No, do not point a finger at your neighbour. You are to blame! I am to blame. We are all at fault, and it is we who must do something. India is our country and Delhi is our Capital. The city we love and live in. Save it. Save it. Save the air, and do not let this historic landmark die!

— *Piya Mukherjee*
Mother's International School

Write a conversation between a city with clean, fresh air and a city with polluted air. You could, perhaps, even try to enact it.

*Only when the last tree has died,
only when the last river has been poisoned,
only when the last fish has been caught,
will man realise that you can't eat money.*

Activity

2

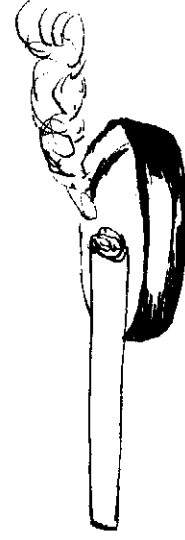
“Second Hand” Smoking

It is being increasingly recognised that tobacco smoke not only affects the smoker, but also those who live in the company of the smoker. This is due to the *side stream* smoke released from the lighted end of the cigarette/bidi when not being smoked. This is also called “second hand” or passive smoking. Respiratory infections are much more frequent in children of parents who smoke. Lung functions of these children are also low as compared to the children of non-smokers. Exposure to side-stream smoke can cause cough and breathlessness in non-smokers especially the patients of asthma, chronic bronchitis and emphysema.

—S. K. Jindal
(Department of Chest Diseases, Post-Graduate Institute of Medical Education and Research, Chandigarh.)

Design a poster campaign on the harmful impact of smoking. You can highlight issues such as the damage to the smoker's health, the dangers of “second hand” smoking, the need for enforcing non-smoking regulations in public places etc.

An Environmental Problem of the Month Poster Campaign is a good way of keeping alive the interest of children, and of involving a wider audience with the work that children are doing.

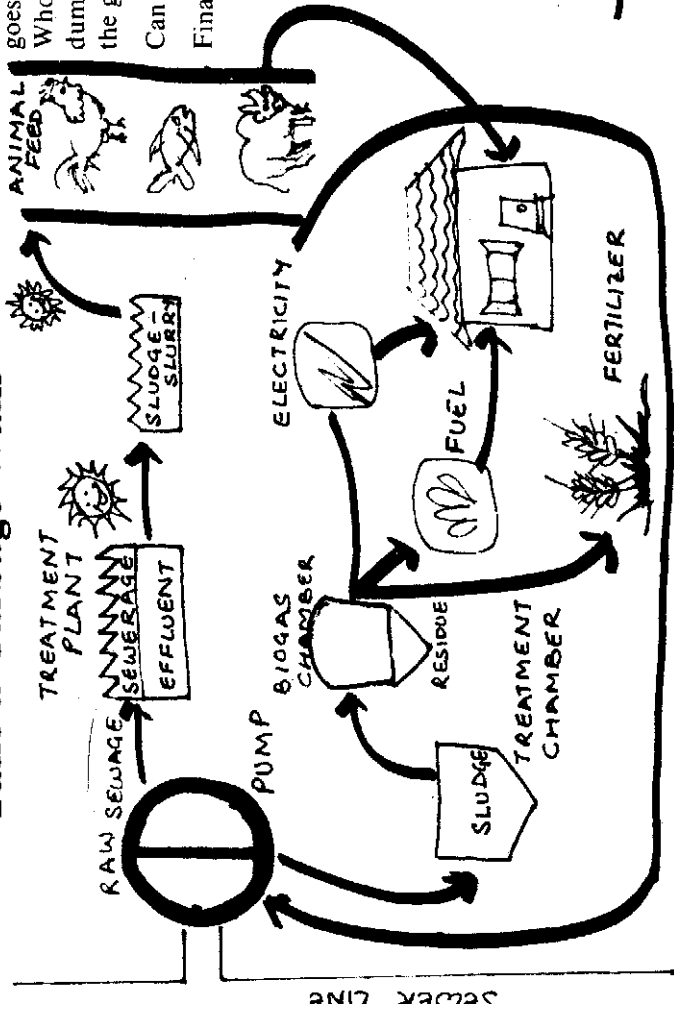


LUNG CANCER
Rs 10/- A PACKET

Activity

3

Take a Garbage Walk

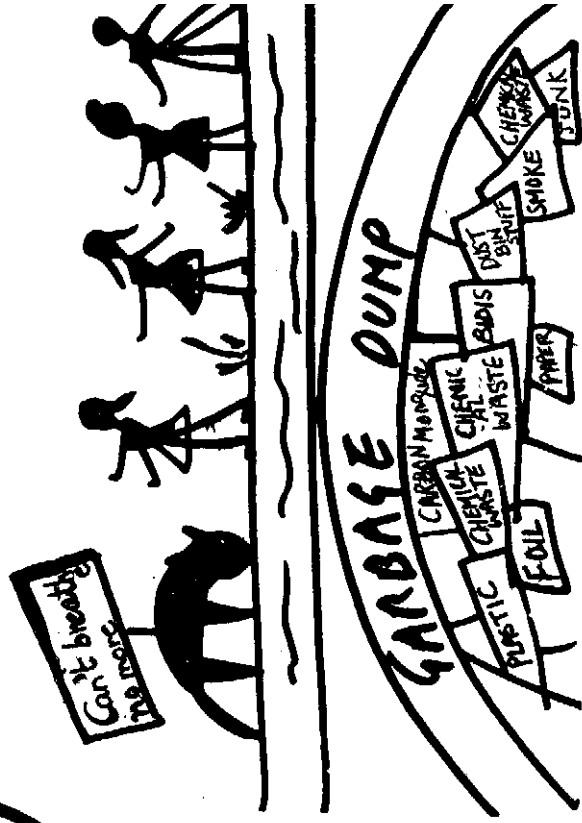


Explore the area around your school or home and note all the different kinds of pollution—smoke, dirty puddles of water, overflowing drains, and especially garbage. Instead of taking a walk, you could just sit by the window in the school bus and observe all the pollution points on the route from your home to school. When you actually begin to look, you will be surprised to see things that you may not have noticed before. Our minds seem to shut off things that we don't like to see. So, begin by using your senses—your nose, your eyes, and your ears—for too much noise is also a kind of pollution.

Next, find out where the garbage from your home or school goes. You can start with the waste basket in your class room. Who clears it, and into what? Does the school have a garbage dump? How often is it cleared, and who does it? Where does the garbage go when it leaves the school?

Can you think of ways to improve the system?

Finally, write a report about all that you have seen and done.



Activity

4

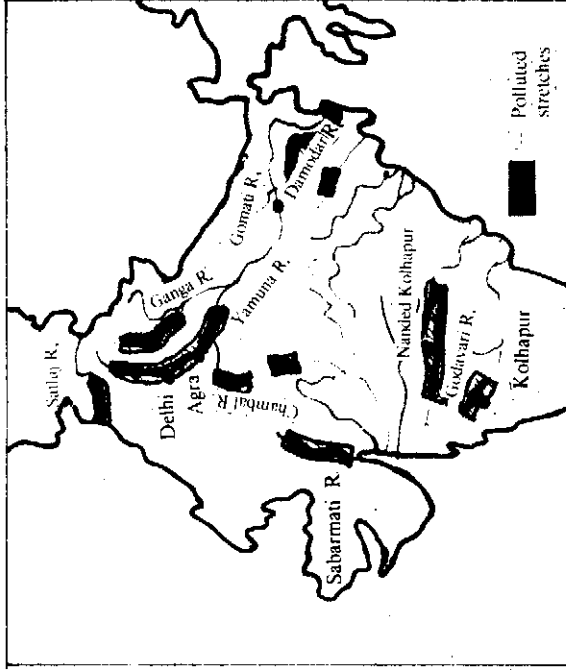
Rivers of Sewage

All the major rivers of India and many of the minor ones are polluted with sewage. Despite its high capacity for self-purification, the Ganga is among the most polluted of our rivers with sewage and industrial wastes flowing into it, all along the route through Uttar Pradesh, Bihar and West Bengal. None of the large cities on the banks of the Ganga has the facilities to treat all its sewage. Some cities have partial facilities. More than 100 big towns and cities are dumping untreated raw sewage into the river every day, all through the year. If you include other human activities, like bathing, washing clothes, immersing the ash from cremations or sinking dead bodies — the burden on the river is immense. The Ganga Action Plan is a huge programme, which has been launched by the Government to clean up the river.

The Yamuna too is highly polluted. Along its nearly 50 km stretch through Delhi, about 500 million litres each day of untreated sewage pour into the river. Less than half of all the sewage in Delhi is treated, and some of it only partially. It is not only the river that is polluted. The untreated sewage flows into the river via 17 open drains, all of which are distributing pollution.

The seven most polluted drains in Delhi are the ones at Najafgarh, Trans-Yamuna, Sen Nursing Home (near I.T.O.), Barapula, Maharani Bagh and the drains from Kalkaji and Tughlaqabad.

A river study may be taken up as a school project. Contact World Wide Fund for Nature (W.W.F.), New Delhi.



SOURCE OF POLLUTION	TOTAL	WITH TREATMENT PLANTS
Domestic Sewage	3110*	217*
Distilleries	178	8
Sugar	363	65
Pulp & Paper	330	41
Fertiliser	108	57
Oil Refinery	12	3

No. of towns/cities.

Source — Central Pollution Control Board, UNEP

Activity

5

No water to Waste

In some villages in India, the water that falls on the land is used not just once, but used and reused. For instance, the waste water and the overflow water around a well or a handpump is channelled through a small drain into a vegetable garden to irrigate a small crop. This prevents the surrounding of the pump from becoming a slushy breeding ground for mosquitoes, and saves the water for a useful purpose.

In Lahore, Pakistan, large-scale cultivation using waste water is said to have been tried successfully. Fodder crops have also been grown. Waste water and special sewerage ponds can also be used for raising fish. This is being done in some parts of Thailand.

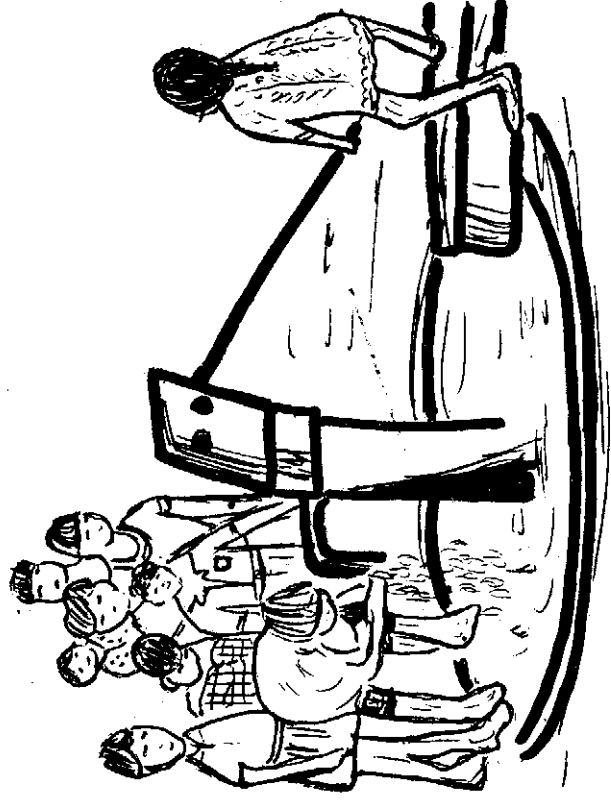
What happens to the waste water in your home — the water in which utensils and clothes are washed, or in which people bathe? Can you think of any way in which it could be used again? How?

Think of all the different kinds of waste products in your home or school. Devise a way to use any one of these again. Use your imagination. It can be as fanciful as you like. Sometimes good solutions come through what at first seem to be crazy ideas! Describe or draw it.

Encourage originality and ingenuity. Discussions on the practicality of the device can come later.

Let not a single drop of water
that falls on the land
go into the sea without serving
the people

— *Parakrama Bahu I*
King of Sri Lanka (1153-1186)



Activity

Dying Fish in the Gomti

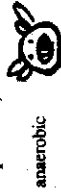
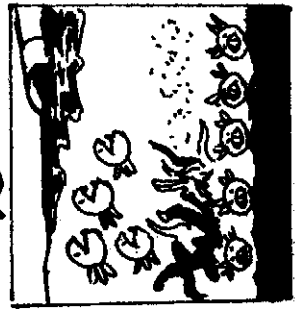
On 29 June 1974, fishermen noticed that the Gori, a rivulet, had suddenly turned brownish black. The Gori flows into the Sarain which is a tributary of the Gomti. On the same day, officials at Lucknow also noticed the colour change in the river Gomti. They learnt that the sugar mills and distilleries in Sitapur, and the Mohan Meakins Brewery at Lucknow, had suddenly discharged huge amounts of untreated effluents into the river.

Mollases (the treacle that is derived from sugar) is used in the distillation of alcohol. A long strike in the Lucknow brewery had resulted in the piling up of a huge stock of the brownish-black molasses, which eventually had to be dumped into the river. It was the monsoon season, and the industrialists probably thought this was a cheap way of disposing off their stock, which would be washed away by the rising river.

Because Sitapur is located in the upper reaches of the river and its tributaries, the effluents quickly flowed down beyond Lucknow. On the morning of 30 June, the citizens of Lucknow found that the water in their taps was brownish-yellow. By then millions of dead fish, of many different species, were floating in



aerobic



anaerobic



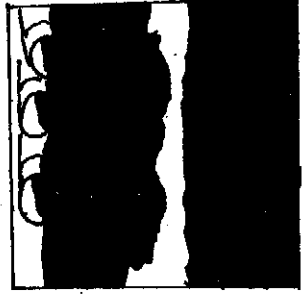
the Gomti at Lucknow. About 1000 quintal of fish are reported to have died within 24 hours.

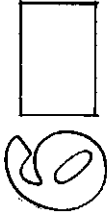
The money price of this quantity of fish, at that time, was Rs. 5,50,000. By 1 July 1974, two days after the incident, no live fish could be seen in the 60 km stretch between Sitapur and Lucknow. A vast natural resource had been destroyed in a matter of two days.

Twelve years later, as the fish in the river were gradually recovering at the end of December 1986, one factory at Lucknow discharged its effluents into the river Gomti. Yet again on 1 January 1987, the citizens of Lucknow saw the coloured water in their taps. Throughout January 1987 dead fish were being found in the river. The market cost of the dead fish was again a few lakh rupees.

The incident in 1974 occurred at the beginning of the spawning period — the time when fish lay their eggs in the water. In 1986, it was at the end of the spawning period. When spawning fish are killed, it means not just the loss of the fish but of future generations of fish. Scientists believe that it was the lack of oxygen, high nitrogen, ammonia and acidity produced by the huge amounts of effluents and molasses that resulted in this disaster.

DEATH OF A RIVER





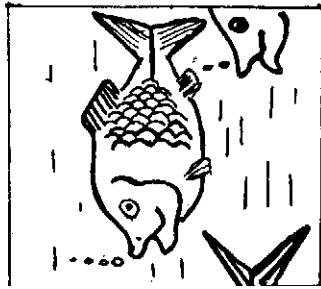
The 1986-87 episode was widely reported in the national Press. Look out for newspaper accounts of pollution. These might not always be major news items with big headlines. Often, the first account of such an incident may only be a few lines tucked away inside the newspaper.

Use this account of the dying fish in the Gomti, or a current

account of any other episode of river or air pollution in the newspapers, and imagine what steps you would take if you were the head of the Municipal Corporation of the city. You can present your opinions and plan of action as an interview that you give to the Press. Or enact a mock Press Conference.

SANGA THROUGH THE YEARS

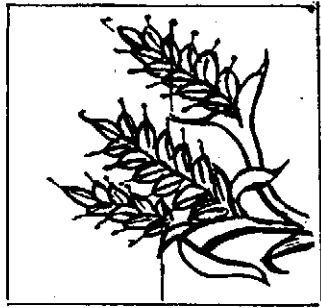
SOURCE - TARGET, JUNE 1985



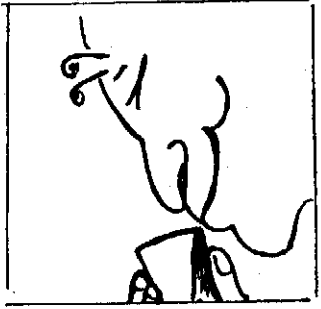
HARIDWAR 1950
Fish Galore!



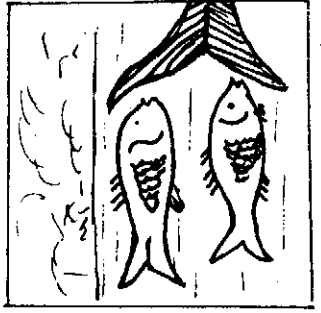
BARAUNI 1950
Lots of birds!



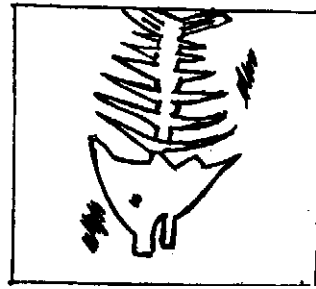
JWALAPARA 1950
Fields of golden corn!



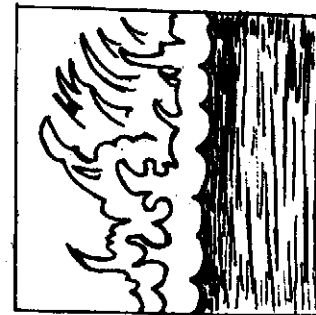
MOKAMEH 1950
Clean drinking water!



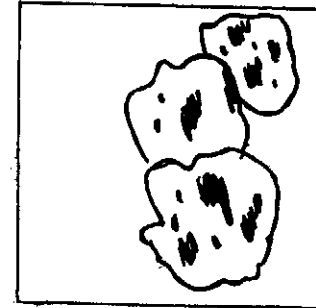
CALCUTTA 1950
Hilsa in the River!



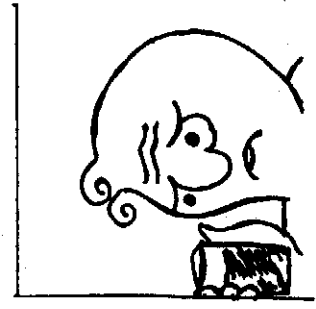
HARIDWAR 1984
Effluents from Industry kill fish



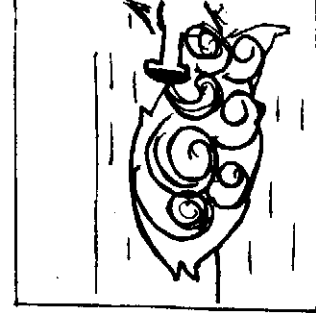
BARAUNI 1984
Water on fire!
Effluents from refinery kill birds



JWALAPARA 1984
Pock-marked potatoes, shrunk corn



MOKAMEH 1984
water full of harmful effluents. Ugh!



CALCUTTA 1982
Chemicals from industry pollute fish

Activity

Make your Own Paper

Have you ever thought of making your own paper? Although you cannot make very good quality paper out of the waste paper in your home or school, the process is not too difficult.

Here's how to do this :

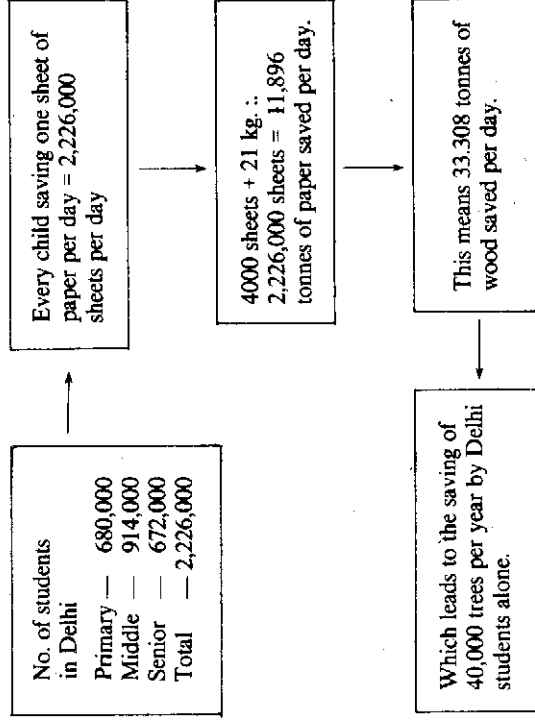
Industries make paper from the pulp of trees, long grasses and rags and scraps. All you need for handmade paper is scraps of paper from your old notebooks, or newspapers. You also need a perforated metal plate. You can use a fine wire mesh sieve as your perforated plate.

1. Tear the raw material — your scraps of paper — into very small pieces.
2. Put the pieces into a bucket or basin, and soak them in warm water.
3. Add a little starch. (This is to help bind the paper.)
4. After a few hours pound the paper with a mortar and pestle, or anything else handy, till it becomes soft and mushy. It should be completely shredded by now. This is called the pulp.
5. Add more starch to the pulp, till it has a thick consistency.
6. Mix it well. Now dip your perforated plate, edge first into the pulp. Lift the plate out and let the water drip out. This is your "paper", but it is not ready yet.
7. Lay the plate flat and leave it for about 10 minutes. Then, put a smooth and even weight on it (like an upside down *chakla*, or a chopping board) and press down every gently.
8. Turn the plate upside down on a large sheet of newspaper and carefully remove the plate. Your paper will be left on the newspaper. You can now put the *chakla*, or even a brick on it to

spread weight evenly on the paper while it dries out.
10. After about two more hours, lift off the weight, and let the handmade paper dry where it is. You now have your recycled handmade paper.

The handmade paper that you buy in a shop, which costs a lot, is much smoother and finer, because it is usually pressed and rolled by special equipment. You cannot write on your paper but you could paint on it, with thick colours. Think of other ways of using it.

SAVE PAPER



Source — Towards a cleaner Greener Delhi by Maneka Gandhi.

Activity

8

Cash in Cans

New York : The army of the poor march through the streets of Manhattan day and night, hauling large plastic bags or pushing shopping carts. In gloves or bare handed, they sift through waste cans, garbage heaps and black plastic household trash bags.

What they are looking for in the big city trash is money: Cans and bottles that carry a five-cent deposit in New York and eight other U.S. states.

The point of can deposit laws is to slow the growth of garbage volume by creating an incentive for consumers to return the empty containers to the grocery store.

The practice has in fact cut down slightly the total volume of trash, which in New York city alone, with some eight million people, averages around 32,000 tonnes a day.

—Times of India
12 September, 1989

In India, the *raddiwala* buys most kinds of household trash and sells it for recycling. Ragpickers, usually very poor children and old people, sift through garbage dumps to look for anything that can be saved and sold.

Make a list of all the items that the *raddiwala* buys, and their price. Find out what the *raddiwala* does with the items.



Activity

Poisons

Complete this crossword with the help of the clues. Use the table of toxic chemicals as a reference. You might then like to try making up a crossword puzzle of your own. You could include all kinds of pollutants.

Carcinogenic—A substance which encourages the spread of cancer in the body.
Teratogenic — A substance that increases the incidence of congenital (from birth) deformities.
Mutagenic — A substance that produces mutations or changes.

Across

- A hard brittle greyish white element, used in the cells which energise flashlights.
- The chief form in which nitrogenous waste is carried off. Its chemical name is carbamide.
- A white powder used to kill insects, but having long term disadvantages.
- Used in the aeroplane industry.
- Salts of an acid of orange-red colour, used in dyes.

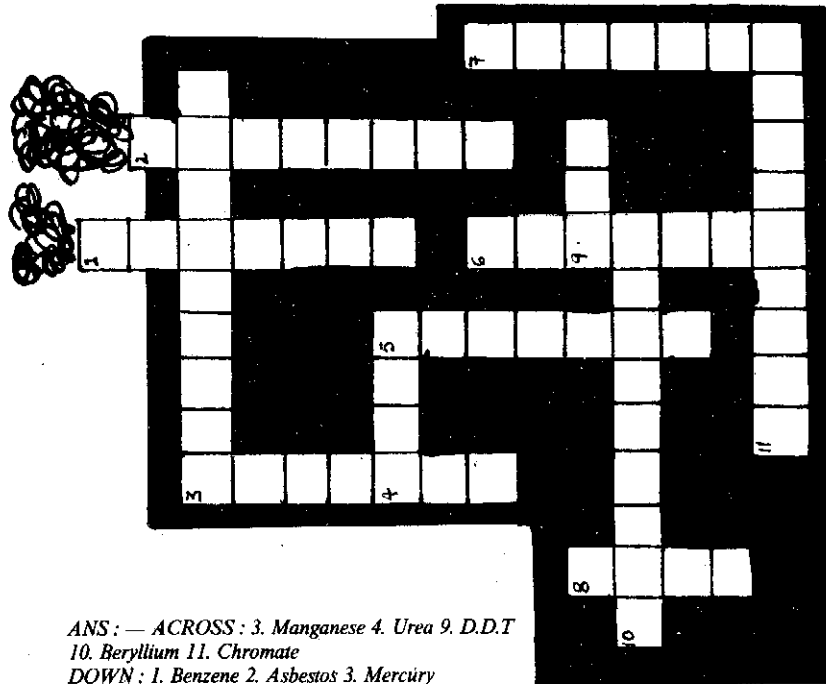
Down

- Its molecule consists of a ring of six carbon atoms with hydrogen atoms attached - its derivatives have wide uses in the chemical industry.
- A fine fibrous, substance which can be woven into incombustible cloth.
- A silvery metal, liquid at ordinary temperatures.
- A white poison which often appears in detective stories, and is also used in certain kinds of medical treatment.
- A white metal which occurs in zinc ores.

- Organic radicals which are found in the common household cleaning agent phenol. Other forms find uses in the electrical industry.

- Given out in exhaust fumes of cars.

HINT : The chemicals marked with an *do not appear in the crossword.



ANS : — **ACROSS** : 3. Manganese 4. Urea 9. D.D.T
 10. Beryllium 11. Chromate
DOWN : 1. Benzene 2. Asbestos 3. Mercury
 5. Arsenic 6. Cadmium 7. Phenyls 8. Lead



Selected list of toxic chemicals

	Use	Hazard
* Acrylonitrile	Acrylic fibres/synthetic rubber plastics	Highly toxic/carcinogenic/teratogenic
Arsenic	Pesticides/Unani medicines/glass	Toxic/dermatitis/muscular paralysis damage to liver and kidney/possibly carcinogenic and teratogenic.
Asbestos	Roofing/insulation/air-conditioning conduits/-plastics/fibre paper	Carcinogenic to workers and even family members.
Benzene	Octane number of gasoline/manufacture of many chemicals	Leukemia/chromosomal damage in exposed workers/behavioural changes
Beryllium	Aerospace industry/ceramic parts/household appliances	Fatal lung disease/heart and lung toxicity.
Cadmium	Electroplating/plastics/pigments/superphosphate fertilisers	Kidney damage/emphysema/possibly carcinogenic, teratogenic and mutagenic.
Chlorinated organics (DDT, BBC, etc.)	Pesticides/Fumigant	Depression of central nervous system/possibly carcinogenic
Chromates	Tanning/paints/pigments/corrosion inhibition/fungicides	Skin ulcers/kidney inflammation possibly carcinogenic/toxic to fish
Lead	Pipes/storage batteries/paints/printing/plastics/gasoline additive	Intoxicant/neurotoxin/affects blood system
Manganese	Mining/welding/dry cell	Nervous damage/damage to reproductive system
Mercury	Chloralkali cells/fungicides/Pharmaceuticals	Nervous damage/kidney damage
Polychlorobiphenyls	Transformers/insulation of electricity	Possibly carcinogenic/nerve, skin and Liver damage
* Sulphur dioxide	Sugar/bleeding agent/pollution from coalbased power stations.	Irritation to eyes and respiratory system damage to plants and monuments
Urea	Fertiliser	Bronchial problems/Kidney damage
S. Vinyl chloride.	Plastics/organic compounds synthesis	Systemically toxic/carcinogenic

From C.R. Krishnamurti Toxic Chemicals, in State of the Environment : Some Aspects, National Committee on Environmental Planning New Delhi

Activity

101

Effluents at Bharatpur

In the vicinity of Keoladeo National Park in Bharatpur there are about 67 factories which, it was suspected, would pollute the water bodies around the park. As these water bodies are inseparable components of the park's ecosystem and, as many of the bird species feed in those water bodies, maintenance of the quality of such water bodies is as important as the maintenance of the water bodies within the park itself.

When one of the factories, General Engineering Works, situated just four km from the park's border, presently manufacturing railway points, crossings, fasteners and steel wires sought permission to open a new plant for zinc-aluminium coated (galvalume) coils and plain and corrugated sheets in the premises of their existing plant, the Government of India constituted a committee to go through the pros and cons of it. The Bombay Natural History Society (BNHS) was represented in the committee.

A preliminary assessment was made. The effluents of the present plant were analysed in detail. The flora and fauna of the water body where the effluents join were also studied. Concentration of iron, copper, cadmium, lead and zinc in the water where the effluents join and, in the brain and muscle of a few fish species, namely *Mystus cavasius* and *Puntius sophore*, were determined. The values were quite high. The quality of the ground water in the area also showed high concentration of salts, iron, copper and lead.

These findings led to another comprehensive study to assess the pollution level in the water bodies around the park in which many of the fish-eating birds feed.

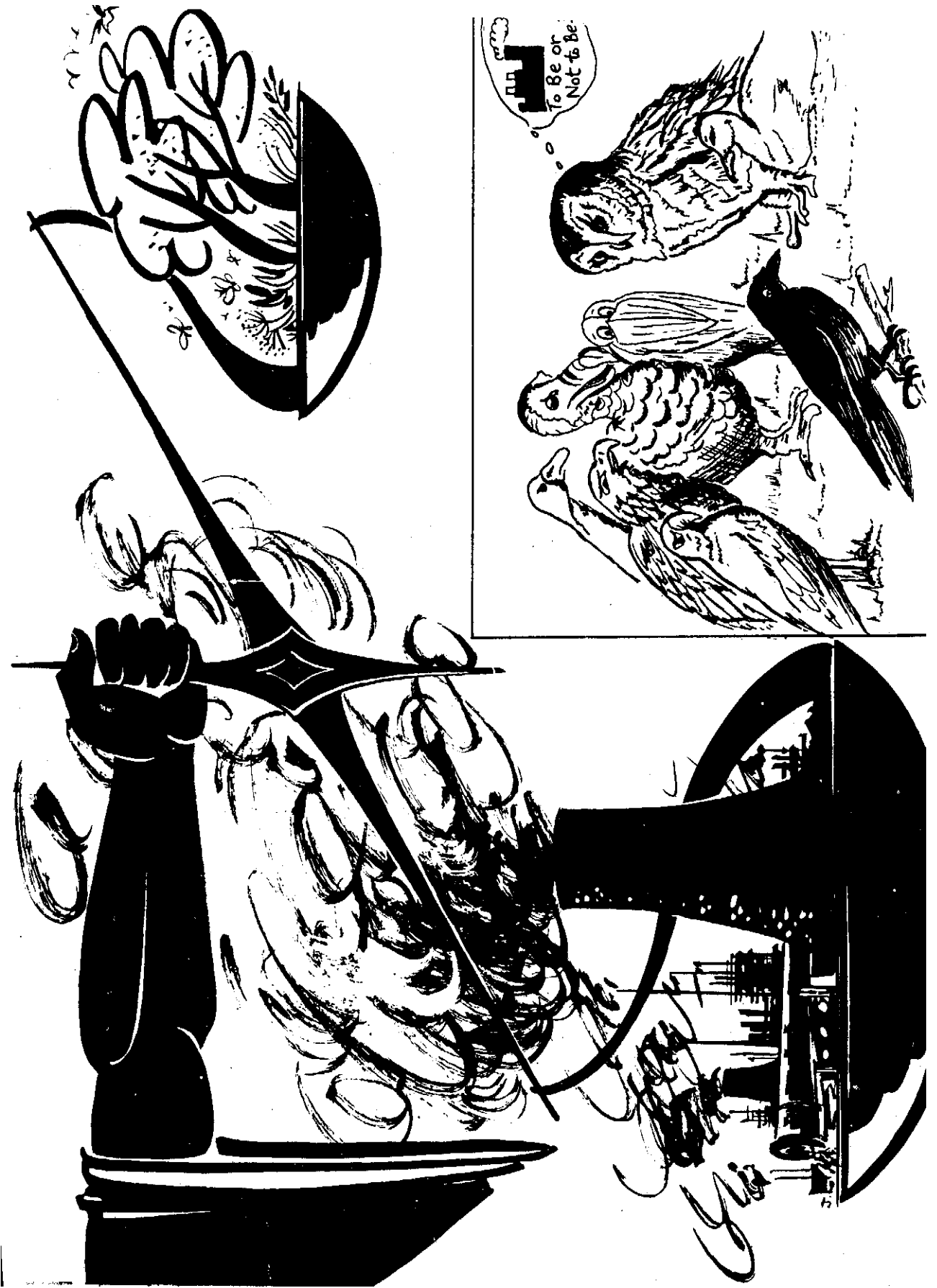
All the findings clearly show that the surroundings of the General Engineering Works factory at Bharatpur are polluted and the effluents discharged from the existing plants have high concentrations of pollutants. The quantity of the effluents to be let out from the proposed plant is estimated at 33 times more than what comes out of the existing plants. It is with this background that the ecological implications of the proposed plant should be evaluated.

A mere comparison of the quantity of chemicals utilised, the effluents discharged, the fuel that is burnt and the quantum of sulphur dioxide emitted every day by the existing plant with those of the proposed plant would give an idea of the magnitude of the problem. The impact will be manifold, as the quantum used is many times more. Chromic acid which is not being used in the present plant will be used in large quantities, about 2385 kg. every month, in the proposed plant.

The Keoladeo National Park which is well known for its migratory birds is a self-supporting ecosystem, extremely vulnerable to external environmental influences. Of the total park area of 29 sq. km. less than one third is wetland. Ducks, teals, geese, herons, egrets, cormorants, darters, storks, moorhens, jacanas, the black-winged stilt and other birds go out of the Park regularly to feed in the water bodies around. Therefore, any contamination of these feeding sites would affect the birds of the park also. Curative measures have to be taken to rectify the situation, instead of adding new pollutants.

—Dr. V.S. Vijayan
B.N.H.S. Bharatpur

Discuss the impact of industries on the environment. What are the alternatives. Collect newspaper reports to support your views. Debate the issue.

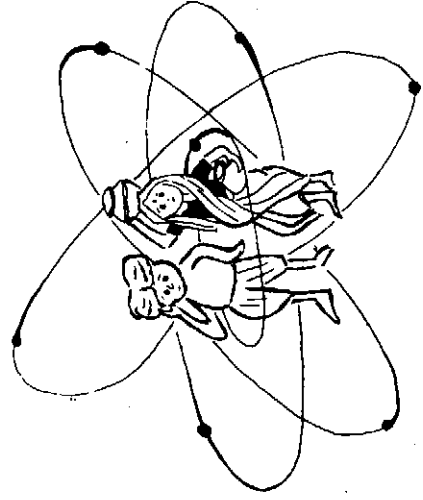


Activity

The Unseen Pollution

INDIA'S NUCLEAR POWER PROGRAMME UPTO 2000 A.D.

Station	Capacity MWe	Total MWe	Commissioner (Year)
OPERATIONAL UNITS			
TARAPUR-(BWR)-1&2	2x210	420	1969
RAJASTHAN-1&2	2x220	860	1973, 1981
MADRAS-1&2	2x235	1330	1983, 1985
NARORA-1	1x235	1565	1990
UNDER CONSTRUCTION			
NARORA-2	1x235	1800	1991
KAKRAPUR-1&2	2x235	2270	1991, 1992
KAIGA-1&2	2x235	2740	1995, 1996
RAJASTHAN-3&4	2x235	3210	1995, 1996
UNDER SANCTION			
KAIGA-3, 4, 5 & 6	4x235	4150	1996-1997
TARAPUR-3 & 4	2x500	5150	1997-1998
RAJASTHAN-5, 6, 7 & 8	4x500	7150	1998-2000
PLANNED			
KUDANKULAM-(PWR)-1&2	2x1000	9150	1998-1999
NEW PROJECTS	6x500	12150	1998-2000



Atomic power stations began the commercial production of electricity in the mid-1950s. This was hailed as the clean, safe, cheap energy source of the future. Today, atomic power makes up over 15% of the world's electricity. In India, it is less than 3%. With the commissioning of the Madras Atomic Power Station at Kalpakkam in 1983, India became the sixth country in the world (after USA, USSR, UK, France and Canada) which can design, construct, commission and operate an atomic power station all on its own. We already had Atomic power stations at Tarapur, near Bombay and in Rajasthan, set up with foreign help. Other atomic power plants are coming up at Narora in UP and Kakrapam in Gujarat.

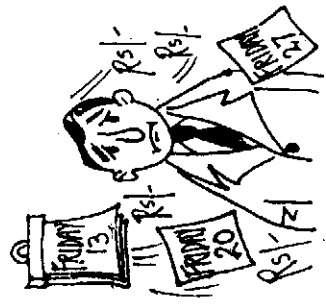
All atomic power stations use nuclear fission, i.e., the process of splitting the nucleus of an atom (in this case splitting Uranium atoms) into smaller atoms; this releases huge amounts of energy. 30 gm of Uranium burnt in a reactor contain as much energy as three tonnes of coal. For an atom to split, you need unstable or 'radioactive' atoms - whose nuclei are already in the process of changing. The energy given off by these unstable atoms is called radiation. The problem with nuclear fission is that it depends on a chain reaction, where unstable atoms produce more unstable atoms. When 'radioactive' atoms come into contact with other atoms of living organisms, they can make those atoms unstable as well. Since you can neither see radiation, smell it or taste it, there is no way of knowing beforehand if you are about to be contaminated by it. Radiation can be absorbed into the body through breathing, eating or drinking. There are four types of rays or particles given off in both natural and man-made radiation - *alpha particles*, which are not very penetrating; *betaparticles*, which can be stopped by a sheet of metal; *gamma rays*, which are very penetrating; and *neutrons* which make material they come into contact with radioactive. The danger lies in the length of time some of these unstable elements remain radioactive. This danger level is measured in 'half life'. The following figures explain what is meant by 'half life'.



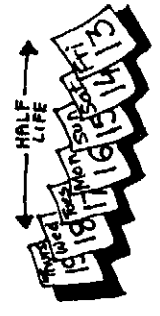
2. You had to give away half of all your money every Friday.



1. Suppose you had one million rupees.



3. On the first Friday you gave 500,000 on the second Friday you gave Rs. 250,000 on the third Friday Rs. 125,000 and so on.



4. Then we say the half life of your money is one week because in one week one half of your money disappears.

Uranium — an element as common as tin or zinc in the Earth's crust — is the fuel used in atomic power stations for fission. Like the other elements uranium is not renewable. India's main uranium ore reserves are in Singbhum district in Bihar; uranium ore is also present in Madhya Pradesh. Karnataka and Meghalaya. The mined ore is transported for fabrication to Hyderabad. Here it is pressed into pellets and loaded into long tubes, called fuel rods. These have to be transported once again to the reactor sites.

The controversy

It is nearly 50 years since the power of the atom was harnessed. Nuclear energy has brought benefits in medicine and industry, even as the atom bomb has wrought destruction in war. However, it is the use of nuclear energy for generating electricity that is the most controversial. People are becoming more and more concerned about the safety of nuclear reactors, following accidents at Three Mile Island, USA, and Chernobyl, USSR and about the disposal of radioactive wastes. **There is no known way to treat radioactive waste** — it has to be stored in concrete drums, and steel tanks, and buried in the land or at sea. Reactors release a huge quantity of heat in the waste water, and the mining and processing of nuclear fuel adds to the natural background radiation in the atmosphere.

There is also the fear of leaks or an explosion at a power station releasing huge amounts of radiation. Large doses of radiation can be mutagenic (cancer-causing) and destroy living tissue.

HALF-LIFE OF SOME RADIOACTIVE ISOTOPES

- U — 238 = 4,500,000,000 Years
- Radium = 1,620 Years
- Francium = 21 Minutes
- Thorium = 14,000,000,000 Years

Let children learn about nuclear energy by collecting information and talking to both supporters and critics. Help them to distinguish between arm-chair criticism and informed public discussion.

Activity

Life Without Chemicals ?

Today, chemicals are an increasing part of our daily lives. they are used in food and drink, fabrics, plastics, polythene and other industrial products, and in medicines and cosmetics.

For instance, an Indian buys and uses an average one kilogram of plastics every year. This is not much compared to the 50 kg. of plastics that an average citizen of the U.S. buys and uses, annually. But plastic materials are not *biodegradable*—when discarded they remain in the earth for decades. Polythene bags and plastic slippers may be convenient, but they do not make “good” garbage. Some plastics can be recycled.

India’s chemical industry is a century old. It produces goods worth more than Rs. 200 billion every year: fertilisers, pesticides, industrial chemicals, oils and fats, petrochemicals, plastics, drugs and artificial fibres. What are the chemical-based products that you and your family use ? Which of these products could you easily do without ? Which could you replace with non-chemical products ? And which would be difficult to stop using ?

“Without chemicals life itself would be impossible !” This slogan was coined by one of the world’s biggest industrial corporations. What do you think ? Have a class discussion on this topic.

Read : *Bhopal : the Lessons of a Tragedy* by Sanjoy Hazarika, Penguin India.

