

## CHLORINE AND THE ENVIRONMENT

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This program topic will help participants explore the issue of chlorine and its potential threats to the environment and human health.

### What you will need...

- \* Chalkboard, flip chart, or large sheet of paper that can be displayed in a place where all participants can see it.
- \* Flip chart page or large sheet of paper with the following list of chlorine products clearly written on it:

luggage, handbags, umbrellas, watch straps, billfolds, shoes, belts, raincoats, magnetic recording tape, inflatable boats and water floats, baby strollers, bibs, crib bumper pads, mattress covers, card tables and chairs, packaging for food products, garden hoses, lawn furniture, school and office supplies, floor coverings, wallpaper, siding, gutters, window and door frames, pipes and fittings, film, electrical insulation for wire and cable, adhesives, automobile upholstery, pharmaceuticals, water treatment, nonstick cookware, paint removers, dry cleaning, refrigerators, aerosols, paper, coffee filters, tissues, paper towels, herbicides and pesticides, paints and varnishes, foam cushions, brake fluids, plastics, bulletproof glass, compact discs, soft drinks, suntan lotion, pacemaker batteries, swimming pool disinfectant, household bleach...

- \* Index cards with the following instructions printed on them:

Card #1 - You are representatives from the International Joint Commission (IJC).

Card #2 - You are representatives from the Chlorine Institute.

Card #3 - You are representatives from the U.S. Environmental Protection Agency (EPA).

Card #4 - You are concerned citizens. You may be concerned about the effects of chlorine on the environment and human health, about the economic impacts of the proposed ban on chlorine, or both.

### Getting started...what do you know about chlorine?

*Begin the lesson by asking the group, "What comes to your mind when you think of chlorine?" or "What products do you know of that are made from or with chlorine?" List the group's responses on the blackboard, flip chart, or large sheet of paper for everyone to see. **Note:** Wait until later in the lesson to hand out the participants' lesson sheets.*

*After the group has listed as many products as possible, display the list of chlorine products so that everyone can see it. Explain that all of these products either contain chlorine or use chlorine in their production process. You might want to add that this is not a complete list! Give the group some time to react to the list. Did they realize that so many things in our modern world contain chlorine?*

The element chlorine is part of many different substances, including common table salt (sodium chloride). Elemental chlorine gas does not exist in nature, but it can be produced by a process which separates the sodium from the chlorine in saltwater. This elemental chlorine reacts strongly with other substances, particularly those containing the

element carbon. The substances resulting from these reactions between chlorine and carbon compounds are called *organic compounds of chlorine*.

According to *Technology Review* magazine, chlorine and its compounds are used in about 15,000 products having estimated annual U.S. sales of \$71 billion. Chlorine is used to produce polyvinyl chloride (PVC) plastics, herbicides, pesticides, and pharmaceutical drugs; to bleach pulp and paper; and to disinfect drinking water. About 96 percent of all crop-protection chemicals and 85 percent of all pharmaceuticals depend on chlorine, and chlorine compounds are used to disinfect 98 percent of the United States' publicly supplied drinking water. *Plastics and Engineering* magazine claims that 40 percent of U.S. jobs and income are in some way dependent on chlorine.

In addition to the 15,000 chlorine products manufactured by humans, nature produces between 1,500 and 2,000 chlorine compounds. Marine algae, kelp, rotting wood, and burning wood, to name but a few, all release chlorine compounds to the environment.

### **What's the problem with chlorine?**

Chlorine compounds and their by-products are suspected to cause a number of environmental and human health problems. One of the earliest examples of this problem was the pesticide DDT, an organic compound of chlorine which imitates the action of certain hormones like estrogen. In the 1950s populations of several bird species, including the bald eagle, dropped drastically. It was suspected that DDT in the environment caused female birds to produce eggs with thin shells, and caused males to be born with feminized reproductive organs. Another group of chlorine compounds, the polychlorinated biphenyls (PCBs), has had similar effects in birds and fish of the Great Lakes region. PCBs were once used widely in the electrical industry. Yet another group, the chlorofluorocarbons (CFCs), breaks down the Earth's protective ozone layer. CFC's have a multitude of uses, including serving as refrigerants in air conditioners and refrigerators, as an ingredient in polystyrene (Styrofoam®), and as propellants for aerosol cans.

DDT and PCBs are now banned in the United

States, and CFCs are being phased out. Still, these chemicals will remain in the environment for years to come, as will their harmful effects. Furthermore, many scientists believe certain still-legal chlorine compounds may imitate human hormones, causing serious health problems, such as low sperm counts, testicular cancer, and breast cancer. Also, the dioxins--which are by-products of combustion, industrial processes involving chlorine, and chlorine bleaching of pulp and paper--are known to cause cancer in laboratory animals.

The problem of chlorine in the environment is complex. It is compounded by the fact that some organic compounds of chlorine are *persistent*. That is, they do not biodegrade, or break down, very easily. Some of these compounds *bioaccumulate* in the tissues of animals, including people. In particular, some chlorine compounds have a tendency to accumulate in fat tissues. Also, some chlorine compounds *biomagnify*, meaning the concentration of the compounds gets higher in animals higher up the food chain. So, larger animals which feed on smaller animals, as human beings do, can be expected to have higher concentrations of these chlorine compounds in their bodies.

Not everyone agrees that chlorine compounds pose a serious threat to the environment and to human health. Scientifically proving a direct link between chlorine and a human health problem is difficult because it is hard to isolate the effects of any one chemical from those of many others that may be present in the environment. Determining what dose of a chemical should be considered dangerous is also difficult. Some scientists believe the level of chlorine compounds present in the environment is not high enough to cause real problems. Some point out that nature introduces higher levels of chlorine into the environment than do human activities. Much more research will be needed to determine the extent of the threat chlorine compounds pose in the environment.

### **What should we do about chlorine?**

What should we as a society do about chlorine? Some feel the risks associated with chlorine are great enough that it should be banned altogether. In 1992 the **International Joint Commission (IJC)**, an environmental advisory group organized by the

U.S. and Canadian governments, formally recommended that the use of chlorine and chlorine compounds be phased out. The IJC recently renewed this recommendation in its 1994 biennial report. Several European organizations have voiced their agreement with the IJC, and, in 1994, the American Public Health Association, a professional society, issued a call to industry to reduce or eliminate the use of organic chlorine compounds. Greenpeace, an outspoken environmental organization, supports the chlorine ban, but so does the National Wildlife Federation, widely considered to be a moderate environmental group.

Industry's position on the chlorine issue is represented by various organizations, including the **Chlorine Institute**, a nonprofit association of more than 200 chemical industry companies. The Chlorine Institute describes its mission as supporting industry and serving the public by promoting safe use of chlorine. The institute argues that chlorine and its compounds are essential to modern life, and that a complete ban on chlorine would be very costly to society. Instead, industry recommends evaluating each chemical individually and banning only those found to be harmful. This is the system the U. S. **Environmental Protection Agency (EPA)** uses to regulate chemicals. On the other hand, the International Joint Commission argues that individually evaluating chemicals is a slow and tedious process, much too slow to adequately protect the environment and human health. They believe enough evidence exists to eliminate the use of all chlorine compounds.

One option that industry currently has is to voluntarily cut back on the use of chlorine and chlorine compounds, replacing them with other chemicals and other ways of accomplishing the same tasks. An example is the pulp and paper industry: Since chlorine releases dioxins during the bleaching process, some companies have begun substituting other bleaching agents for chlorine. Still, shifting to chlorine-free technologies is likely to be expensive and time-consuming. And in some cases, the chlorine-free technologies may turn out to be as bad, or worse, for the environment as chlorine.

What can or should the government do about chlorine? At the state level, individual states can examine their existing laws and regulations to

evaluate whether they provide adequate protection to the environment and human health. For example, at the request of the governor, the Michigan Environmental Science Board carried out a six-month investigation of the chlorine issue. In its 1994 report, the board concluded that certain chlorine compounds, namely those that are toxic at low levels and are persistent in the environment, should be of concern. The report added that current methods of monitoring and testing for these compounds may not be adequate. However, the Board also concluded that a complete phaseout of chlorine, as recommended by the International Joint Commission, is not necessary.

At the federal level, the **EPA** has announced that it will "develop a national strategy for substituting, reducing, or prohibiting the use of chlorine and chlorinated compounds." Because the agency regulates chemicals by evaluating each one at a time, a slow process, it will address the chlorine issue by forming a task force to study the risks associated with chlorine. It will also study the possibilities of substituting chlorine-free technologies for those using chlorine. Some suggest that the EPA is taking a middle ground between environmentalists and industry with this action. Additionally, the EPA will release a new reassessment of the health effects of dioxins. This report is due to be released in late 1995.

As with most environmental issues, there is no easy or clear-cut answer for how society should deal with the chlorine problem. As Dr. Gordon Graff, writing for *Technology Review*, put it, "Society will clearly have to determine what tradeoffs it is willing to accept as the chlorine controversy plays out in legislative halls, corporate boardrooms, and the media."

*At this point in the lesson, distribute participant lesson sheets to everyone. Divide the group into four smaller groups. Give each group one of the index cards listed under "What you will need...." Give the following directions to the whole group:*

*"We are going to stage a mock public meeting about the chlorine problem. Each group is going to assume the role described on its index card. Using the information presented in the lesson and in your participant lesson sheet, take the next five to ten minutes deciding as a group what your*

position on the issue will be and how you wish to present it in the public meeting. You may appoint a spokesperson for your group if you wish."

After five to ten minutes of small group discussion, begin the public meeting by asking one of the groups to present its side of the issue. Encourage each group to present its point of view, and debate with other groups if appropriate.

### What do you think?

After staging your public meeting, invite the group as a whole to offer answers to these discussion questions. Emphasize that there is no absolute right or wrong answer to any of the questions.

- \* Who did you identify with most in the public meeting?
- \* How much evidence is necessary before we take action on an environmental problem like chlorine? How much risk is acceptable?
- \* What is (are) the most important factor(s) to consider when dealing with an environmental problem like the chlorine problem? Risks to wildlife? to humans? to the economy? to our way of life?

### What can you do about the chlorine problem?

As consumers, we have the power to make a difference in environmental problems like chlorine. Here are some ways you can reduce the amount of chlorine and chlorine compounds that make their way into the environment.

- \* Use water-based paint removers, which do not contain chlorine compounds.
- \* Minimize your use of insecticides around the home and garden. Look for natural

insect control methods when you really need an insecticide.

- \* Avoid dry cleaning your clothes. The dry cleaning process uses a chlorine compound. (A new environment-friendly dry cleaning process is now available in some parts of the country.) Try spot-cleaning or hand-washing those dry-cleanable fabrics.
- \* Use fewer plastic and vinyl products. Particularly avoid plastics with the number 3 recycling symbol, which indicates they are PVC, or polyvinyl chloride.
- \* Use unbleached paper products.
- \* Use less chlorine bleach.

### References

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*Trade or company names are given for information only. No endorsement or recommendation to the exclusion of other products that also may be suitable is intended.*