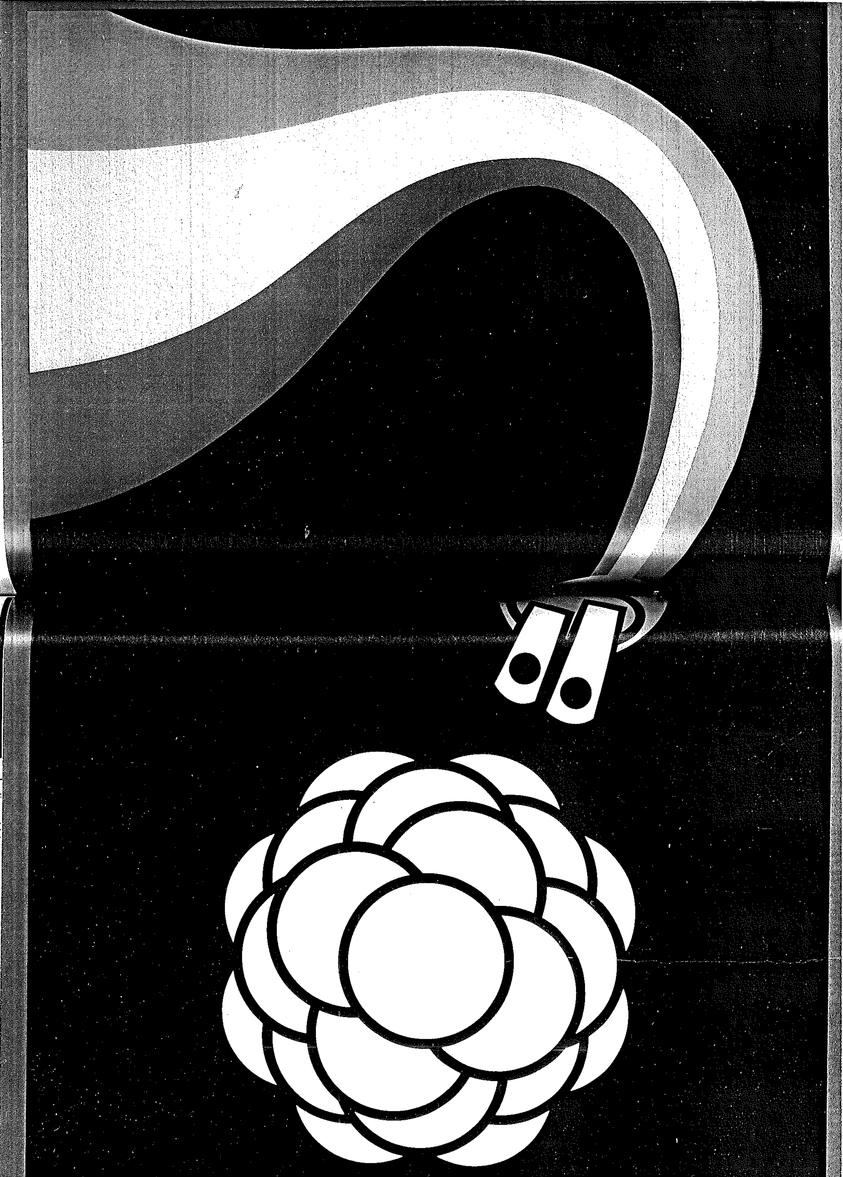
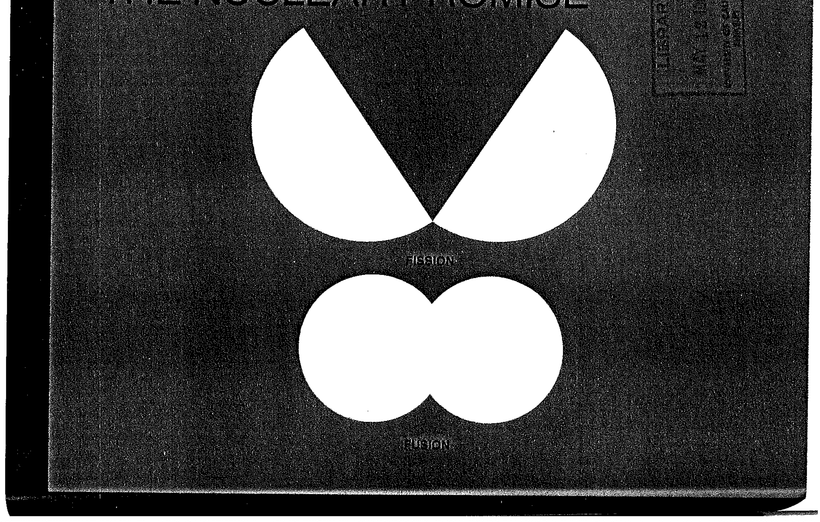


NUCLEAR PROMISE

WE CAN RELEASE ENERGY FROM THE NUCLEUS OF THE ATOM, AND THIS PROCESS IS POTENTIALLY OUR LARGEST NEW SOURCE OF THE ENERGY WE NEED. THE CHALLENGES LIE IN TECHNOLOGICAL DIFFICULTIES AND SOCIAL ISSUES.

Third in a series of three posters designed for an energy-enriched curriculum.

THE NUCLEAR PROMISE



1

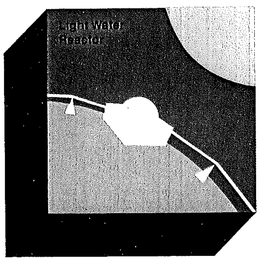
As old energy sources are depleted, our search for new ones increasingly takes the form of processing energy, as opposed to discovering it. Nuclear energy is a promising resource for processing.

When we burn coal, carbon atoms and oxygen atoms join and release energy. Energy can also be released by the joining of nuclei, which is how the sun's energy originates. This is a "fusion" reaction. Generating energy by splitting a nucleus is called "fission".

While nuclear fission is now producing electric power in almost 80 reactors in the U.S., nuclear fusion is still in the laboratory. But researchers expect that by the mid 1980's new experimental reactors will produce more energy from fusion than they use.

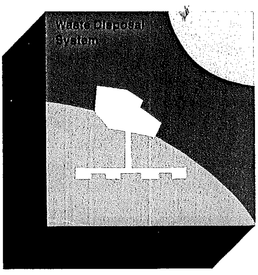
Fission reactors use uranium as fuel, and fusion reactors could use a form of hydrogen called deuterium. The complete fissioning of a kilogram (2.2 lbs.) of uranium would release as much energy as burning 3,000 tons of coal. The *fusion* of nuclei in a kilogram of deuterium would release energy equivalent to that in *30,000* tons of coal.

When a uranium nucleus is split it releases energy which makes steam and turns an electric generator. The U.S. reactors now in commercial operation are called "Light Water Reactors" because they use ordinary (rather than "heavy") water to cool the reactor and slow neutrons down to a speed at which fission is caused. (There are also "Heavy Water Reactors" *in other countries.*)



Most of the uranium in LWR fuel rods does not undergo fission. If the neutrons have enough energy, however, they can change this uranium into another fuel element, plutonium.

A reactor can be built for that conversion process. Called a "breeder reactor" because it can "breed" more fuel than it uses to produce power, it could get about 50 times as much energy from the uranium fuel as the LWR does.



The used LWR "fuel rods" are now stored, because they are dangerous (radioactive) and valuable (they contain usable fuel). But those taken from the breeder will have to be reprocessed to recover the plutonium formed in them, which can then be used to fuel LWR's. And for hundreds of years thereafter, the radioactive leftovers from reprocessing will have to be kept from contact with living things.

Although LWR's do not fully exploit the energy of their fuel, there is enough uranium ore already located to operate 200 LWR's for 30 or 40 years. If breeder reactors are developed, however, then *all* the uranium can be used – enough to make electricity for thousands of years.

Although a pound of uranium goes a long way, nuclear plants are more expensive to build and operate than coal plants, so the cost of the electricity from LWR's and coal-fired plants is about the same. And we don't know exactly how much it will cost to build commercial breeders.

In addition to the technological and economic problems, there are health and safety concerns. Besides the fear of radioactive wastes, there is the fear of radioactivity leaking into the atmosphere, the fear of an explosive nuclear accident, and the fear that increased nuclear energy will lead to increased nuclear armament.

In our present reactors, containment and filter systems keep the routine emission of radioactivity at safe levels. As for nuclear accidents, although an LWR cannot explode like a nuclear weapon, the reactor core does contain an enormous amount of radioactive material. A malfunction that caused the core to heat up might break the containment. But so far the safety systems designed to prevent such accidents have worked, and there have been no deaths or injuries attributable to commercial reactor accidents. But there is still uncertainty over long-term effects.

The plutonium produced in breeder reactors and removed from reprocessed fuel could be used to make nuclear explosives, and would require extremely tight security.

Solutions to these problems call for the creation of a full-scale Federal nuclear energy plan, including provisions for disposal of waste and for reactor security.

2

ACTIVITY. This activity identifies a basic set of facts that adversaries in the nuclear controversy agree on. A factually based consensus will not, of course, resolve the controversy, but it can be a first step. The eight statements listed here should elicit like responses from technically knowledgeable students, regardless of their stance on nuclear issues. The teacher can experiment with building consensus from these statements, in an effort to approach a broader consensus on the political, social, economic and ethical issues.

The following list of references represents a spectrum of viewpoints on the subject of nuclear energy:

ACCIDENTS WILL HAPPEN by the Environmental Action Foundation, edited by Lee Stephenson and George R. Zacher. New York: Harper and Row, 1980.

Duderstadt, James J. and Chihiro Kikuchi. NUCLEAR POWER: TECHNOLOGY ON TRIAL. Ann Arbor: The University of Michigan Press, 1979.

NUCLEAR POWER AND THE ENVIRONMENT: RADIATION (Book 1); FUEL/WASTE (Book 2); SAFETY/RISKS (Book 3). La Grange Park, IL: American Nuclear Society, 1982.

A NUCLEAR POWER PRIMER: ISSUES FOR CITIZENS; also, A NUCLEAR WASTE PRIMER. Washington, D.C.: League of Women Voters Education Fund, 1981.

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3

NUCLEAR ENERGY ACTIVITY

Please indicate whether you agree or disagree with the statements below.

Agree	Disagree	
☐	☐	1. A nuclear reactor (LWR) cannot explode like a nuclear bomb.
☐	☐	2. There have been no deaths or injuries attributed to nuclear related accidents in commercial nuclear reactors.
☐	☐	3. A Federal system of long-term radioactive waste storage is in place and operating.
☐	☐	4. Nuclear power plants are less expensive to build than coal-fired power plants of the same generating capacity.
☐	☐	5. The additional amount of radiation received under routine operating conditions by people living near a nuclear power plant is less than they receive from other natural (background) sources of radiation.
☐	☐	6. While there is regional variation, the total cost of electricity from nuclear power plants is about the same as that of electricity from coal-fired power plants.
☐	☐	7. It is possible to make a nuclear explosive device from the plutonium produced in a breeder reactor.
☐	☐	8. If breeder reactors are used, there is sufficient uranium available in this country to produce enough electricity for our needs for thousands of years.

Count and record the class response. Create a bar graph to compare the results.

	Agreed	Disagreed
1.	☐	☐
2.	☐	☐
3.	☐	☐
4.	☐	☐
5.	☐	☐
6.	☐	☐
7.	☐	☐
8.	☐	☐