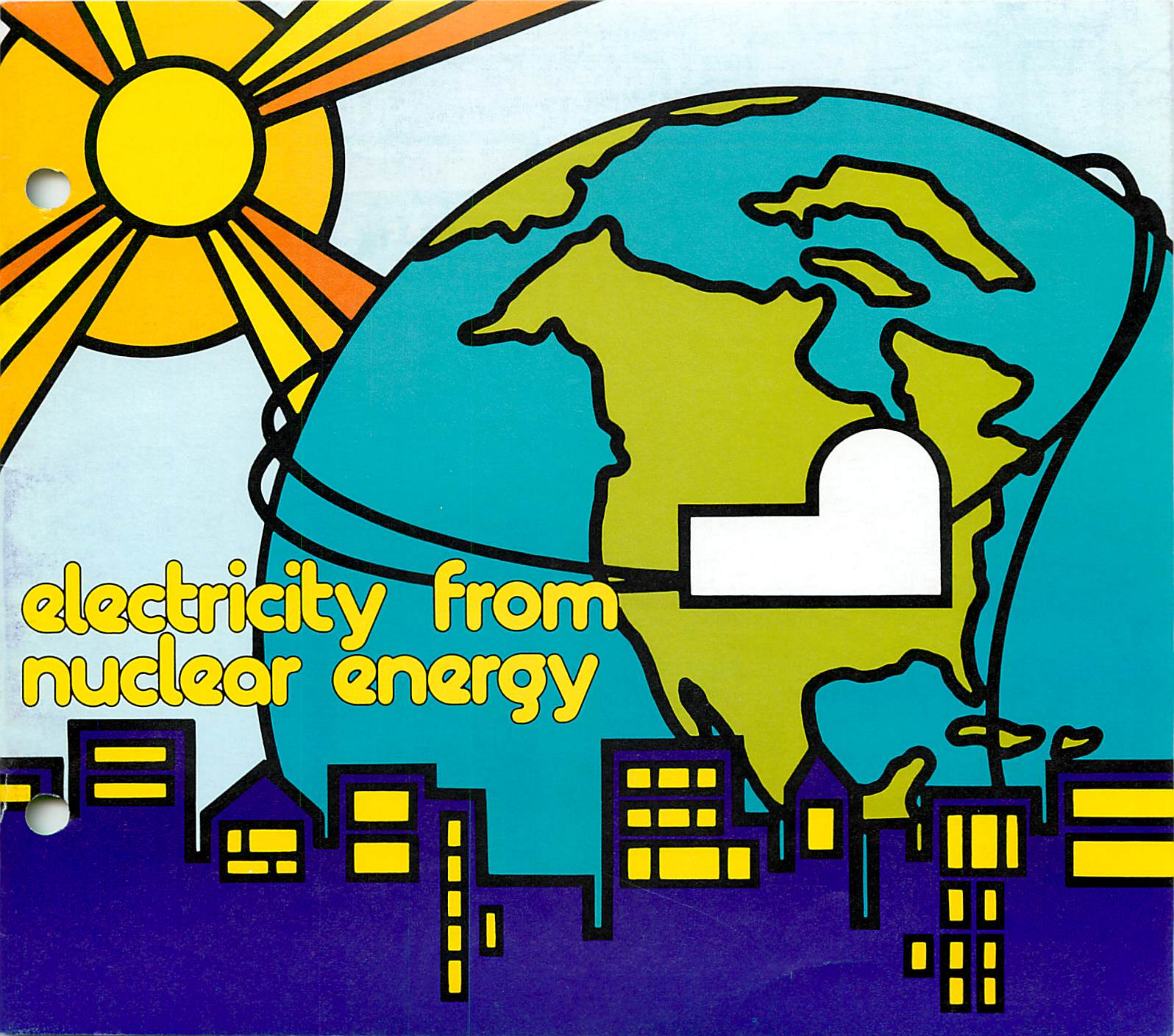
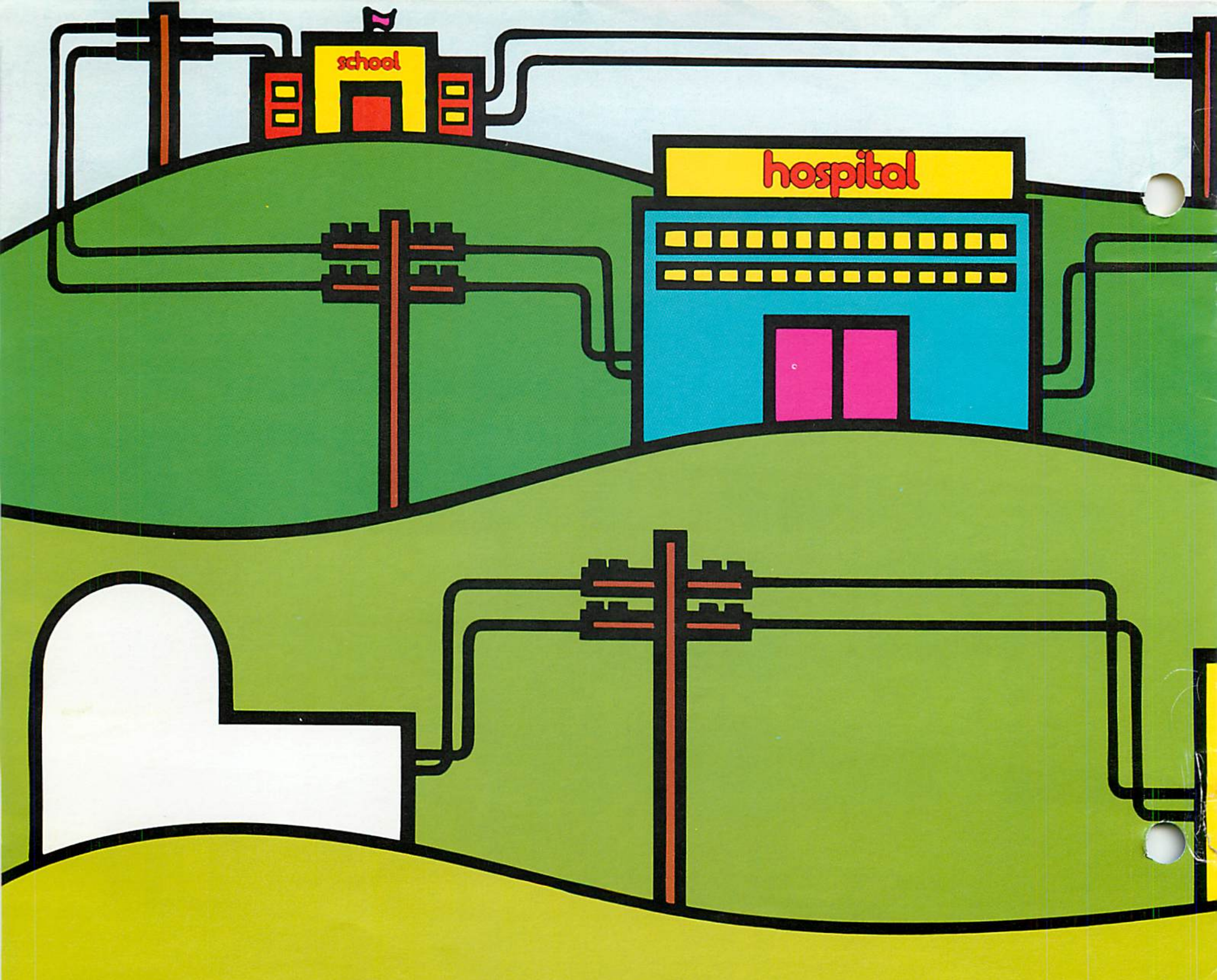
electricity from nuclear energy

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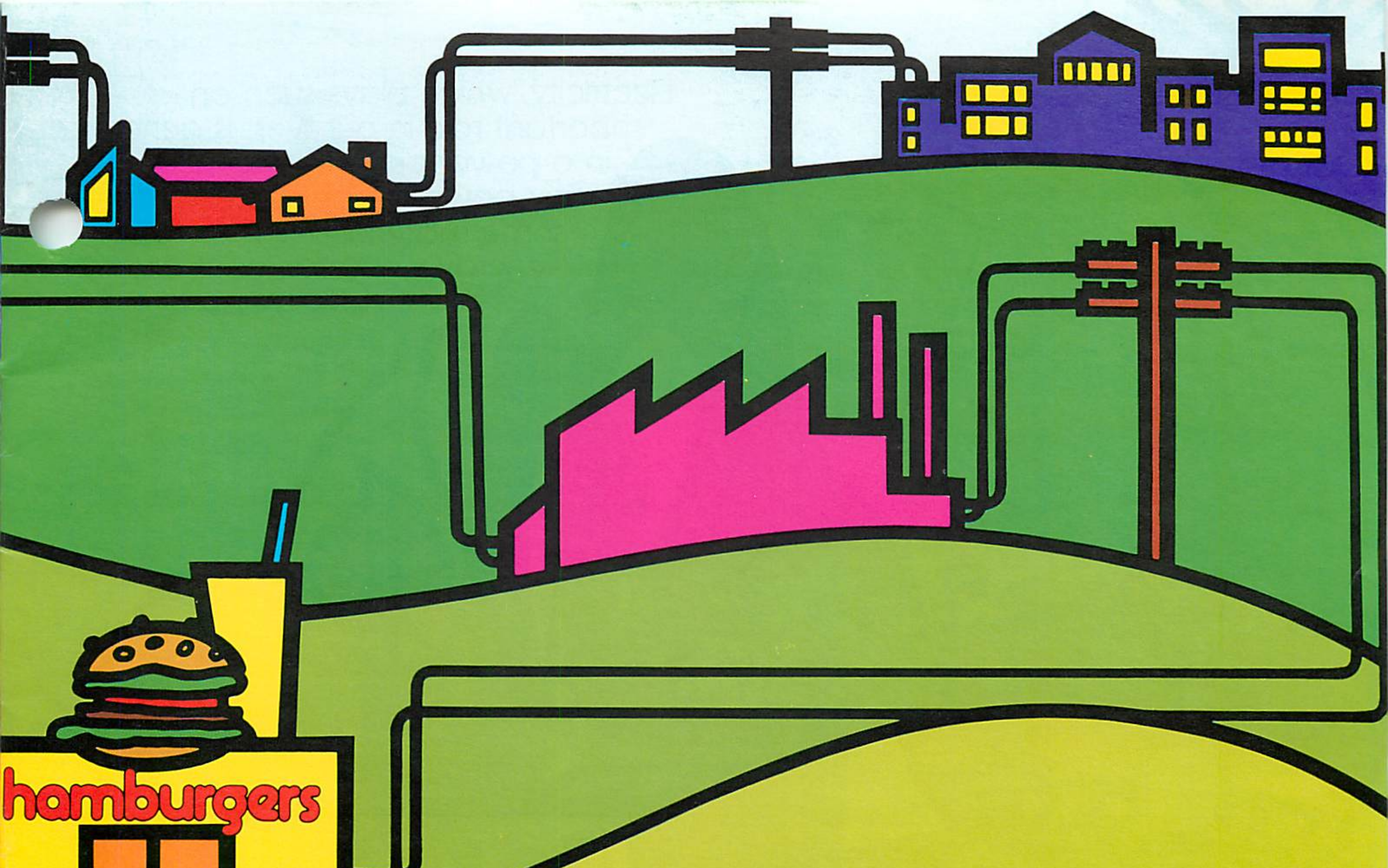
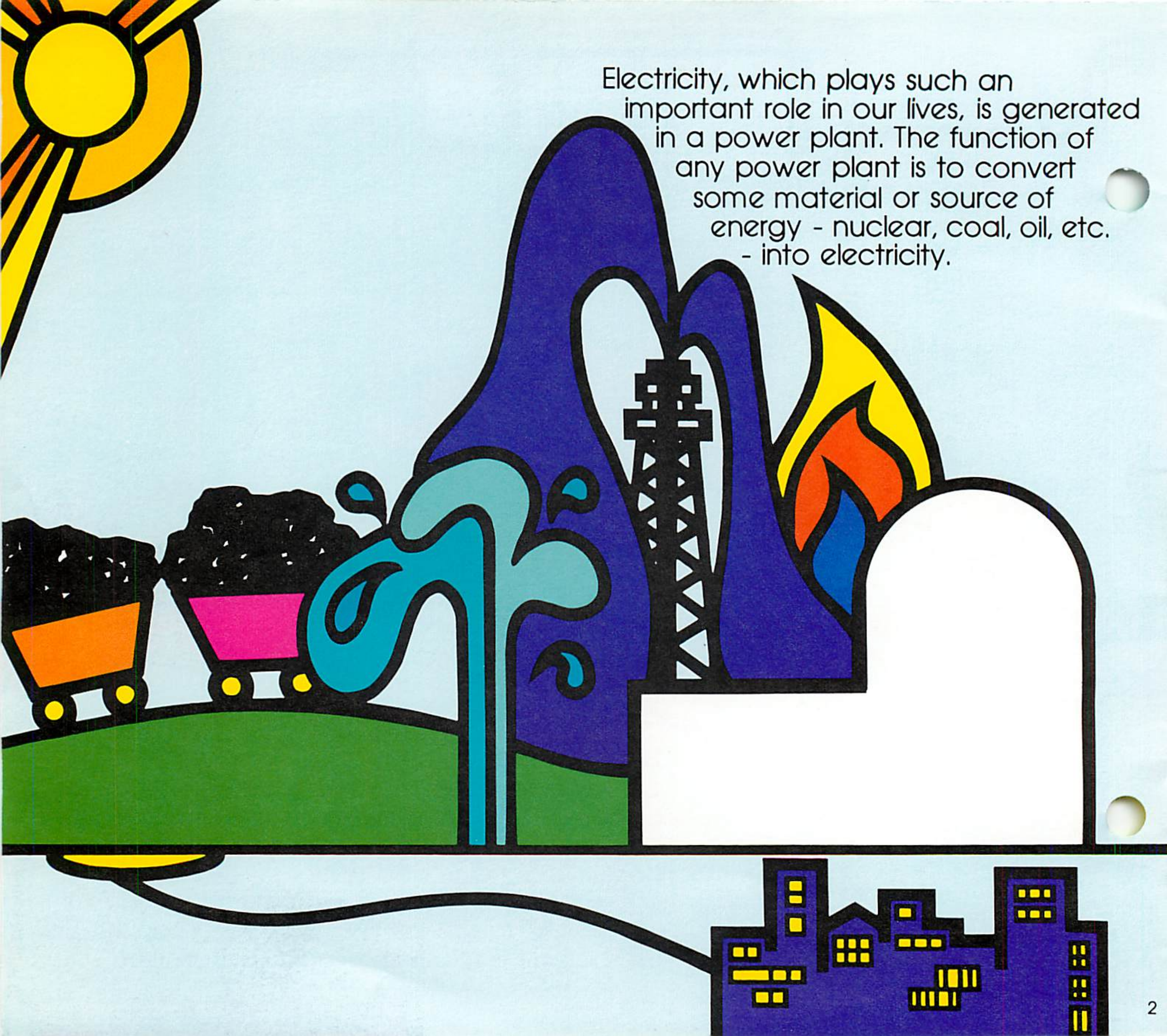
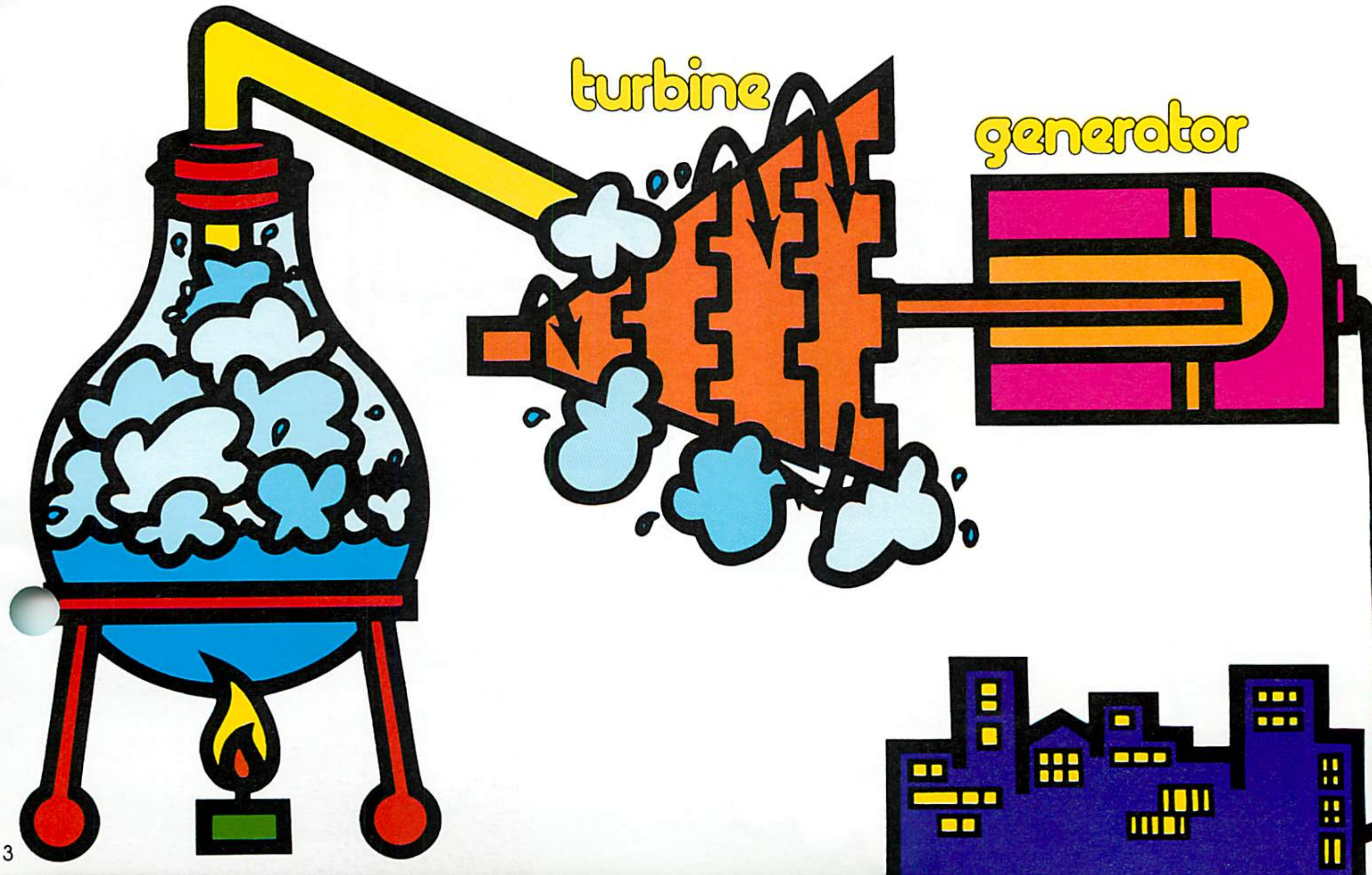


Electricity is a very important part of our lives and our most versatile form of power. We use electricity to light and heat our homes, to store and prepare our food, to power our factories, hospitals, schools and businesses, and to communicate across town or across the nation. It is flexible; it can be adapted to a variety of uses; and it is relatively simple to transport.

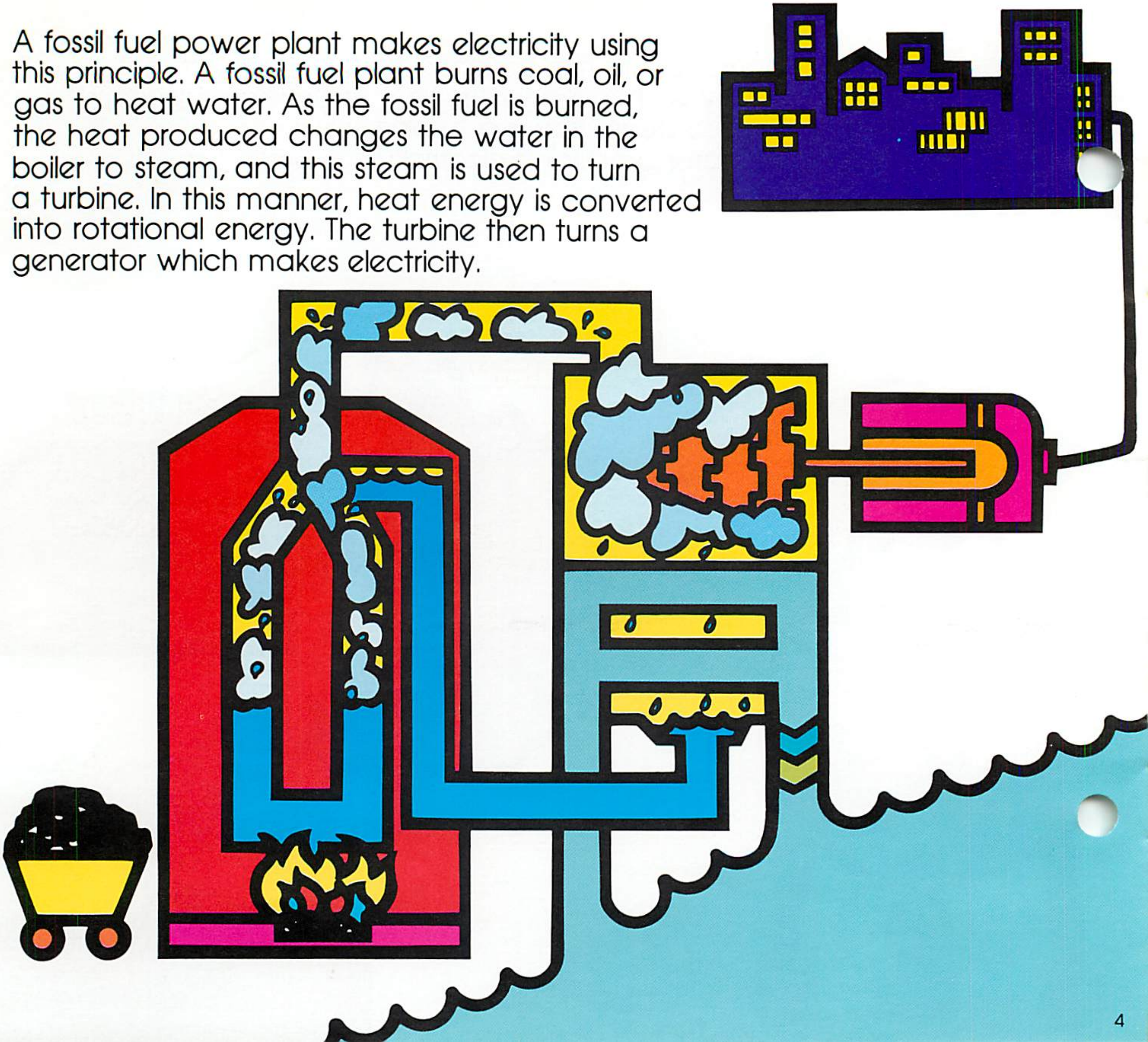
Electricity, which plays such an important role in our lives, is generated in a power plant. The function of any power plant is to convert some material or source of energy - nuclear, coal, oil, etc. - into electricity.



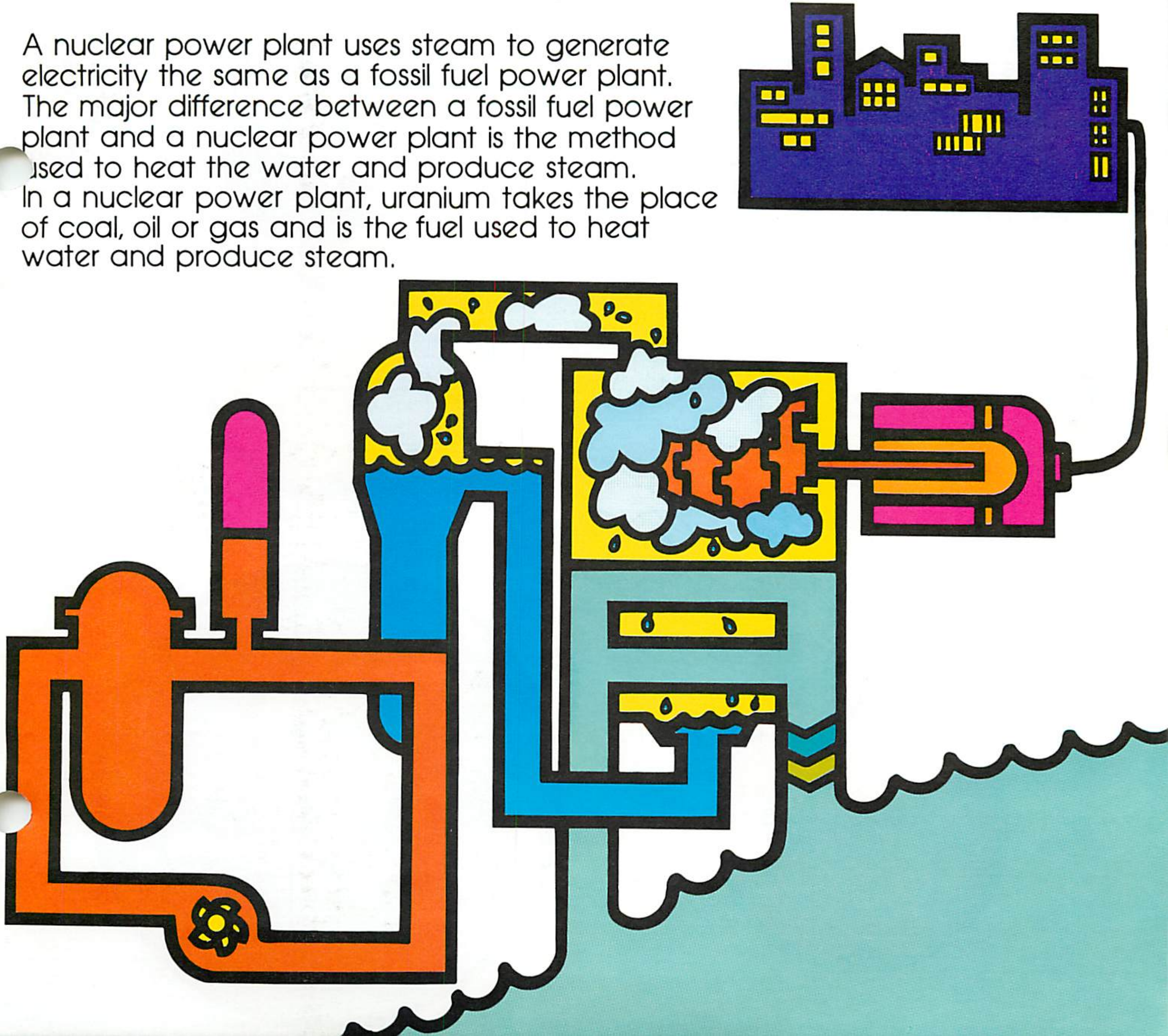
Today, most power plants are designed to generate electricity by heating water to produce steam. The steam drives a turbine that runs a generator producing electricity.



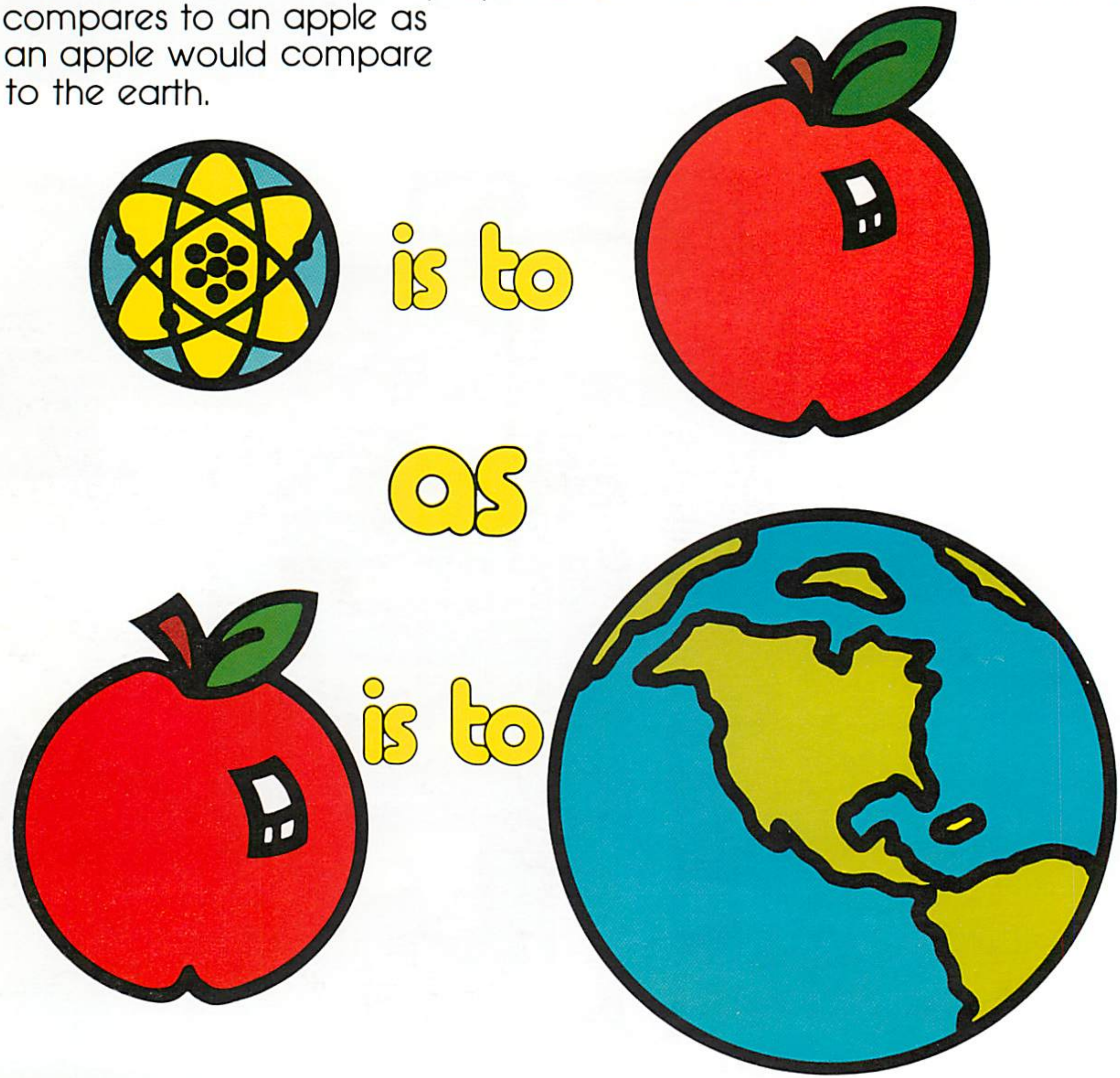
A fossil fuel power plant makes electricity using this principle. A fossil fuel plant burns coal, oil, or gas to heat water. As the fossil fuel is burned, the heat produced changes the water in the boiler to steam, and this steam is used to turn a turbine. In this manner, heat energy is converted into rotational energy. The turbine then turns a generator which makes electricity.



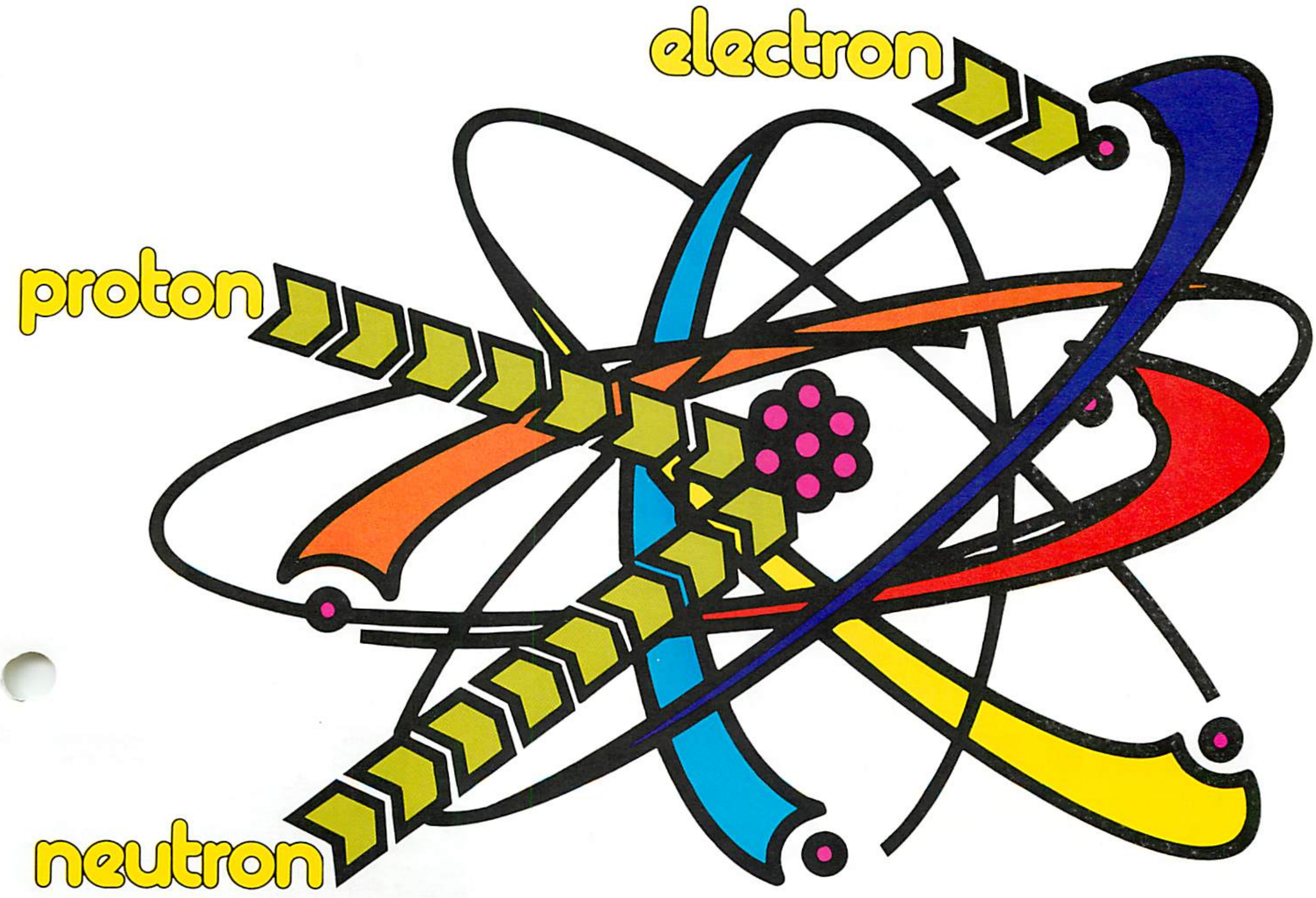
A nuclear power plant uses steam to generate electricity the same as a fossil fuel power plant. The major difference between a fossil fuel power plant and a nuclear power plant is the method used to heat the water and produce steam. In a nuclear power plant, uranium takes the place of coal, oil or gas and is the fuel used to heat water and produce steam.

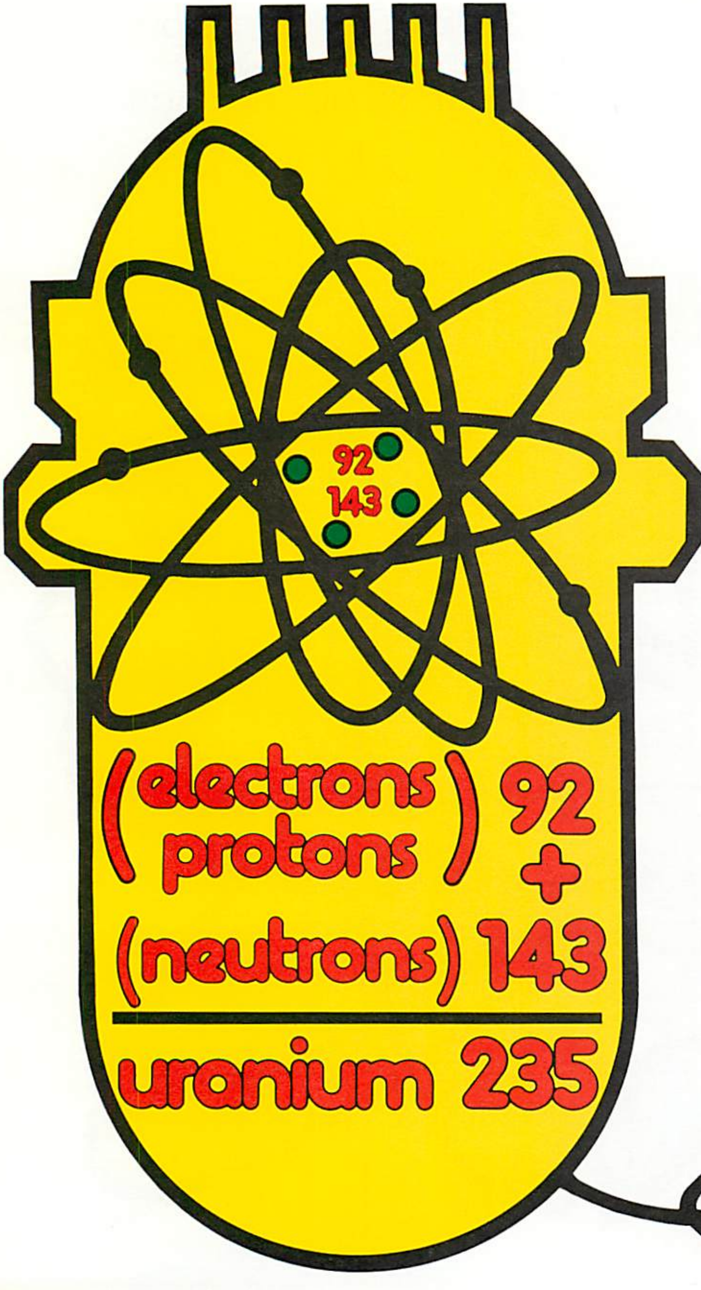


Let's see how uranium is used as a fuel and releases heat by a process called fission. First, it is important to remember that an atom is the basic component of all matter. An atom is the smallest part of an element that has all the chemical properties of that element. In size, an atom compares to an apple as an apple would compare to the earth.

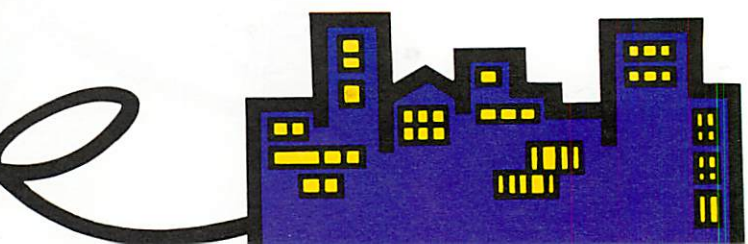


Atoms, in turn, are composed of even smaller particles called protons, neutrons, and electrons. Typically, protons and neutrons are held together in the nucleus or center of an atom. Electrons, the third part of the atom, circle or orbit the nucleus.

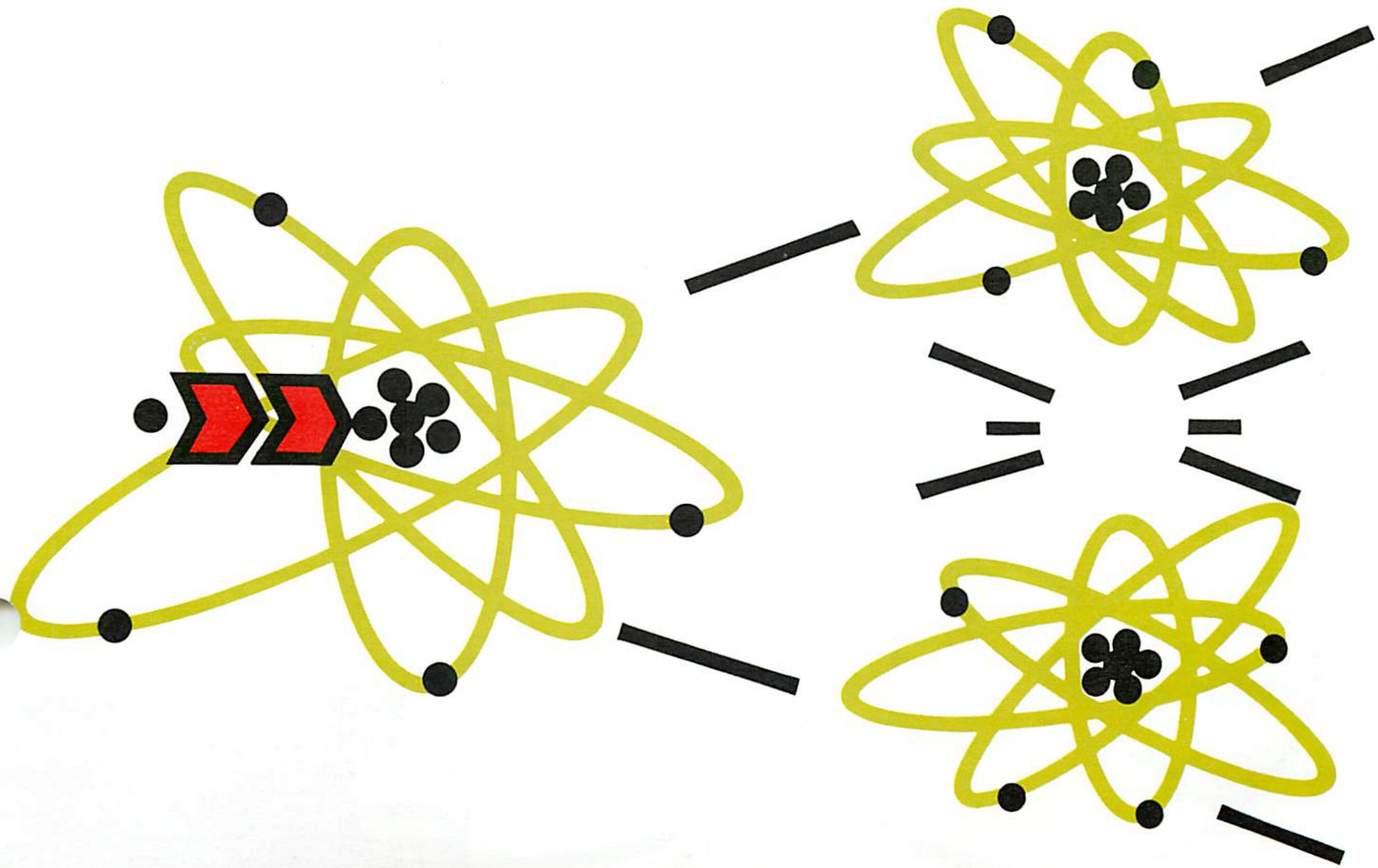


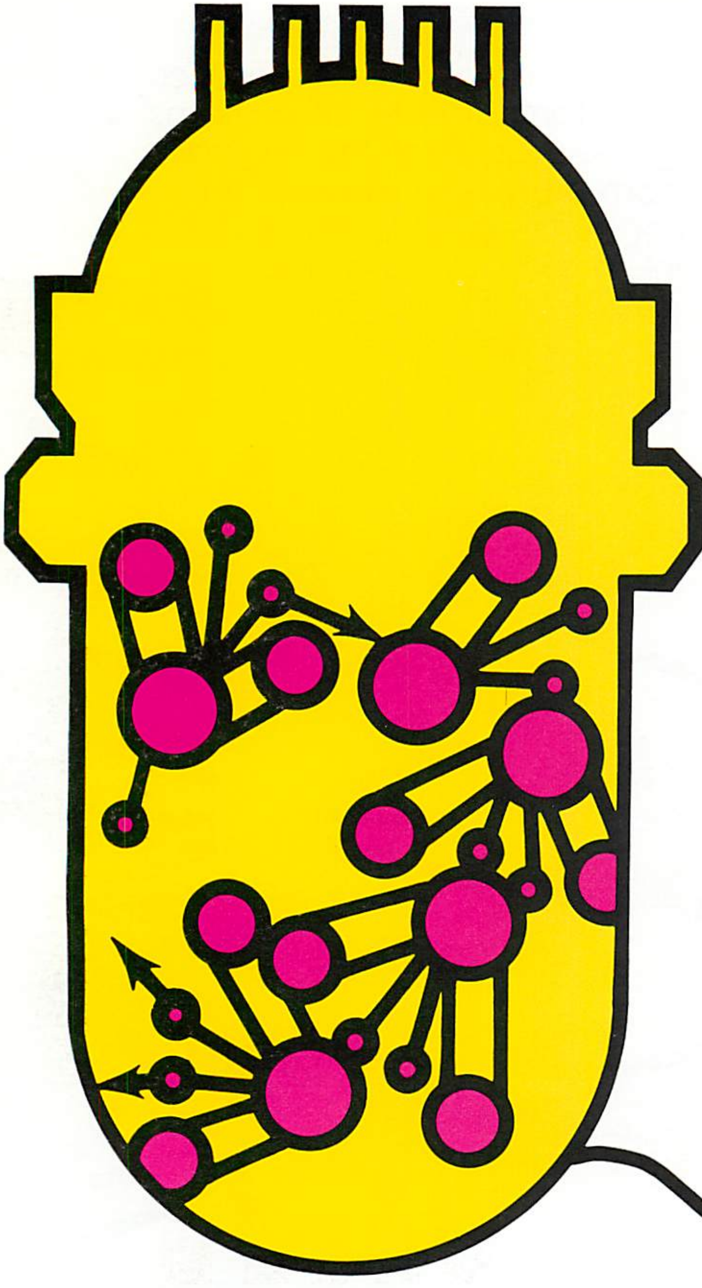


Although atoms of the same element have an equal number of protons in the nucleus, the atoms can have different numbers of neutrons. These different forms of the same element are called isotopes. The important isotope for reactor fuel is uranium-235; but uranium-235 is not burned as coal and oil are burned. Instead, the process by which uranium-235 releases heat is called fission. Fission is the splitting apart of a heavy atom into two new atoms having slightly less mass. During the fission process, this slight difference in mass is changed into a tremendous amount of energy.

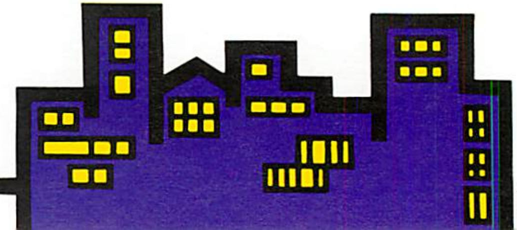


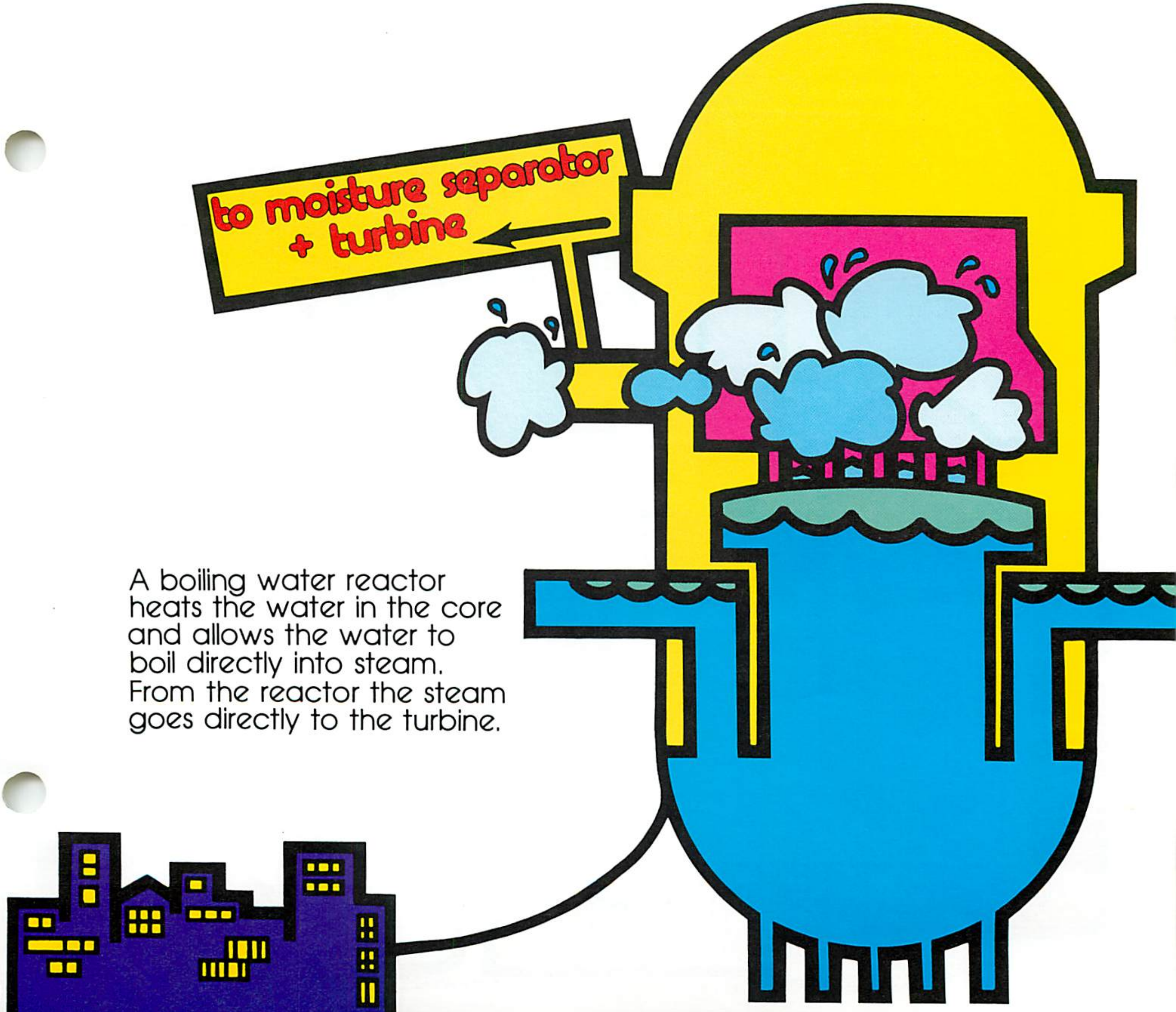
In a nuclear power plant a neutron from one atom strikes another atom of uranium and splits the uranium atom into two new atoms. Together, the new atoms have slightly less mass than the original uranium atom and release energy (from the loss of mass) in the form of heat. At the same time, two or three neutrons are also released, which in turn split other uranium atoms, and so the fission or chain reaction continues.





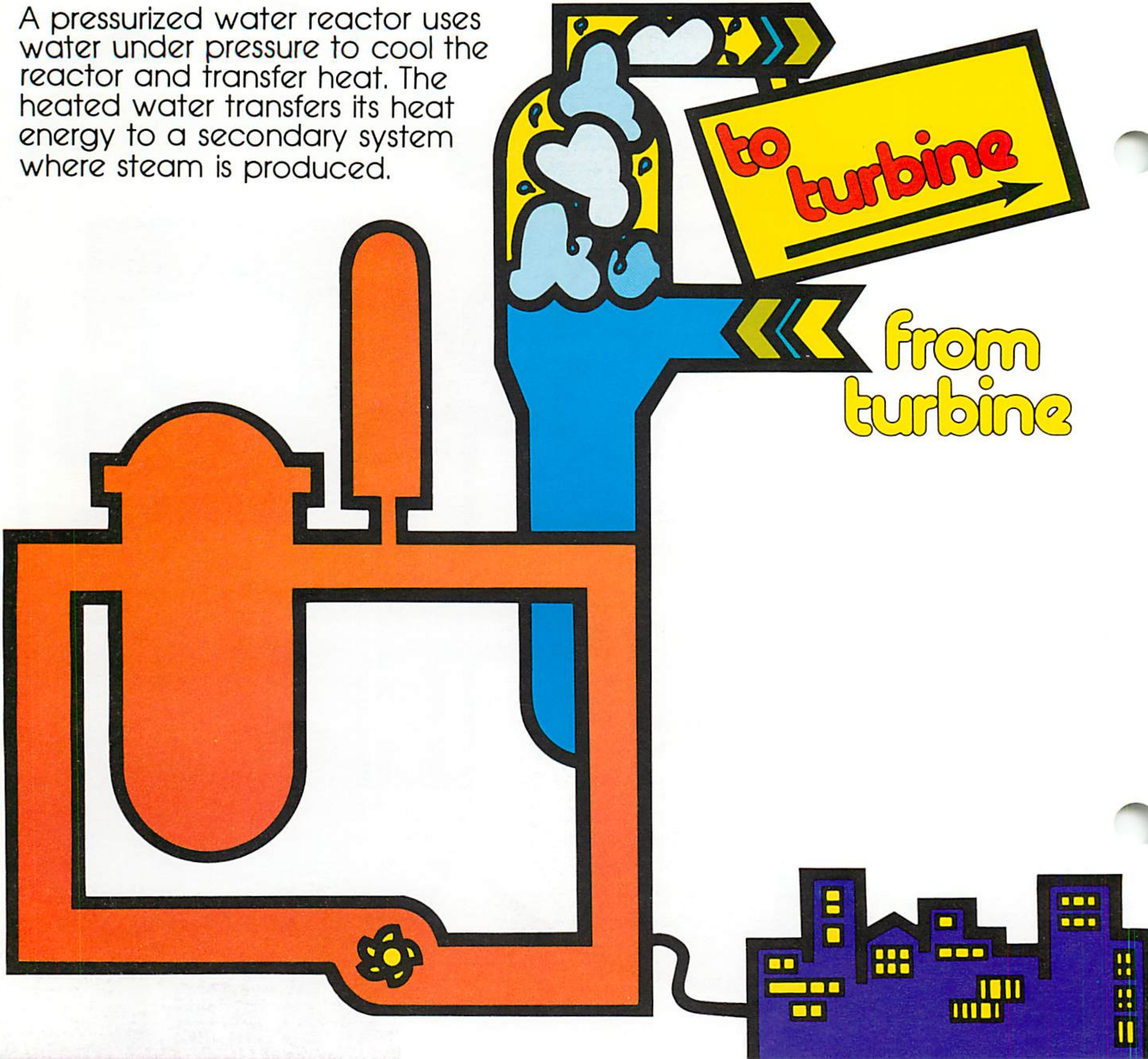
This heat-producing fission process is controlled in the reactor. Basically, the reactor in a nuclear power plant performs the same function as a boiler does in a fossil fuel plant. Today, the two main types of power plant reactors are boiling water reactors and pressurized water reactors.

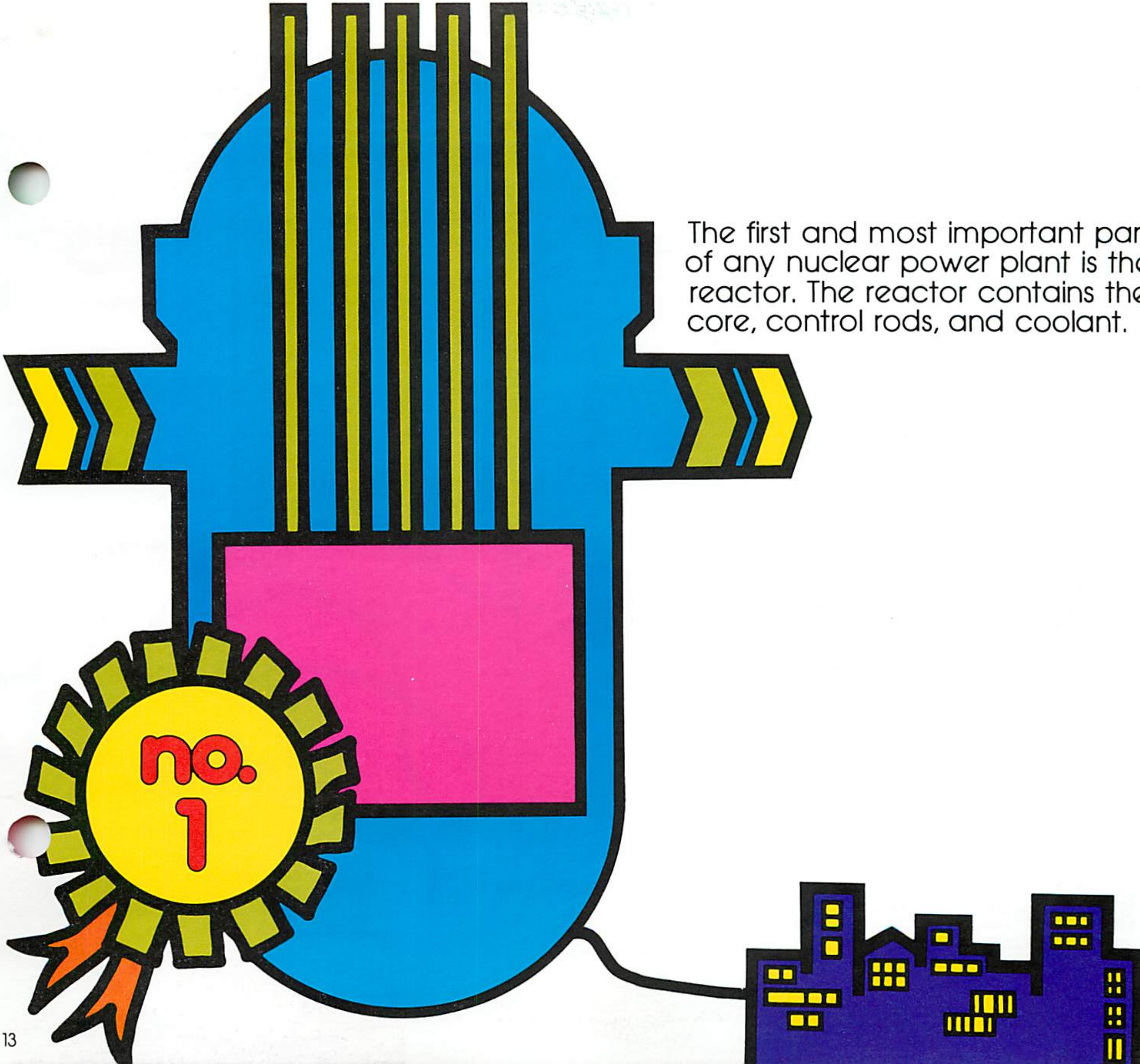




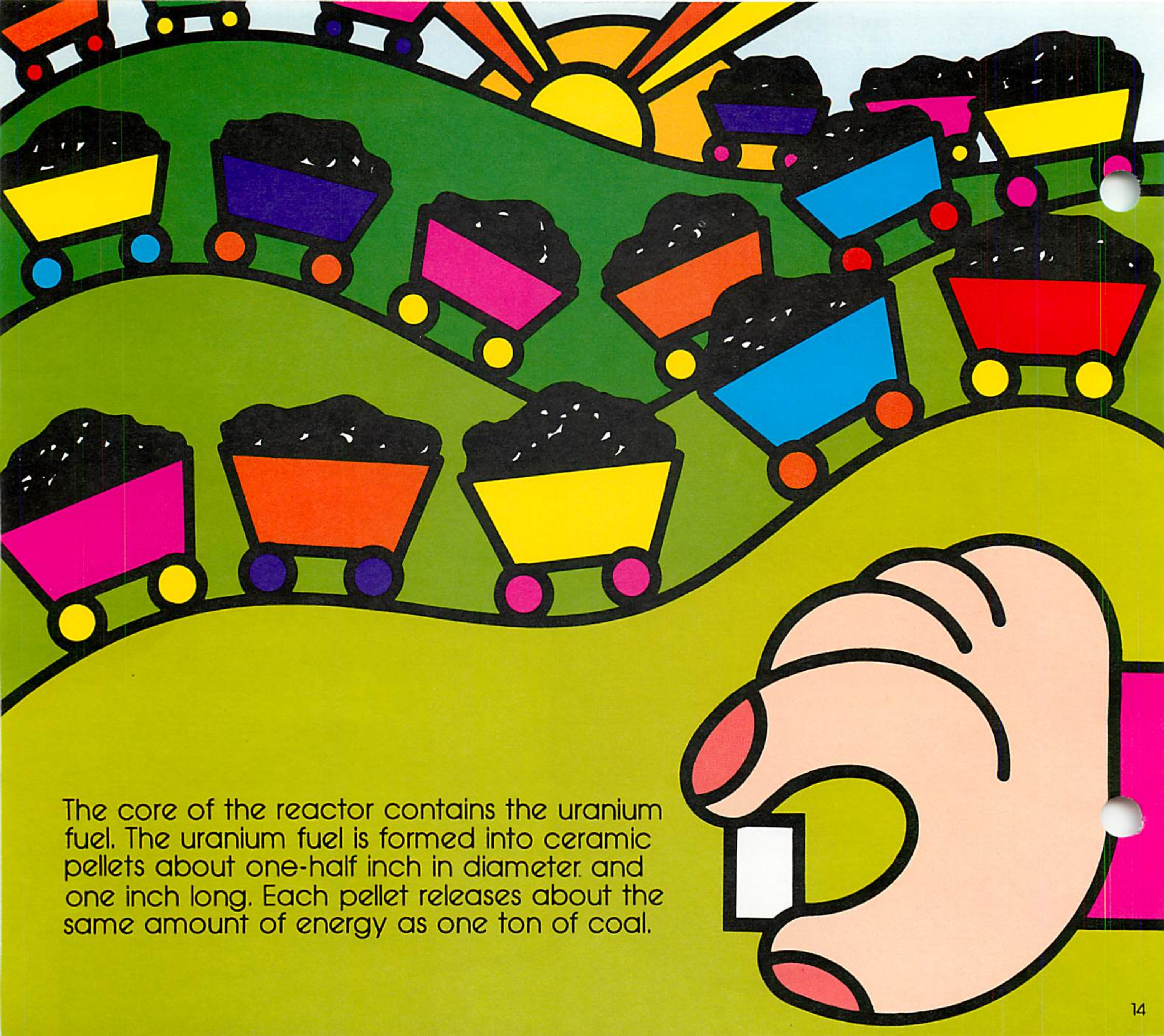
A boiling water reactor heats the water in the core and allows the water to boil directly into steam. From the reactor the steam goes directly to the turbine.

A pressurized water reactor uses water under pressure to cool the reactor and transfer heat. The heated water transfers its heat energy to a secondary system where steam is produced.

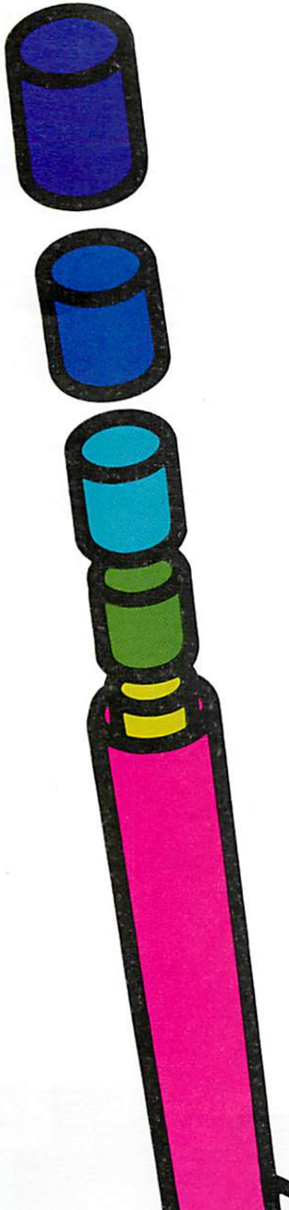




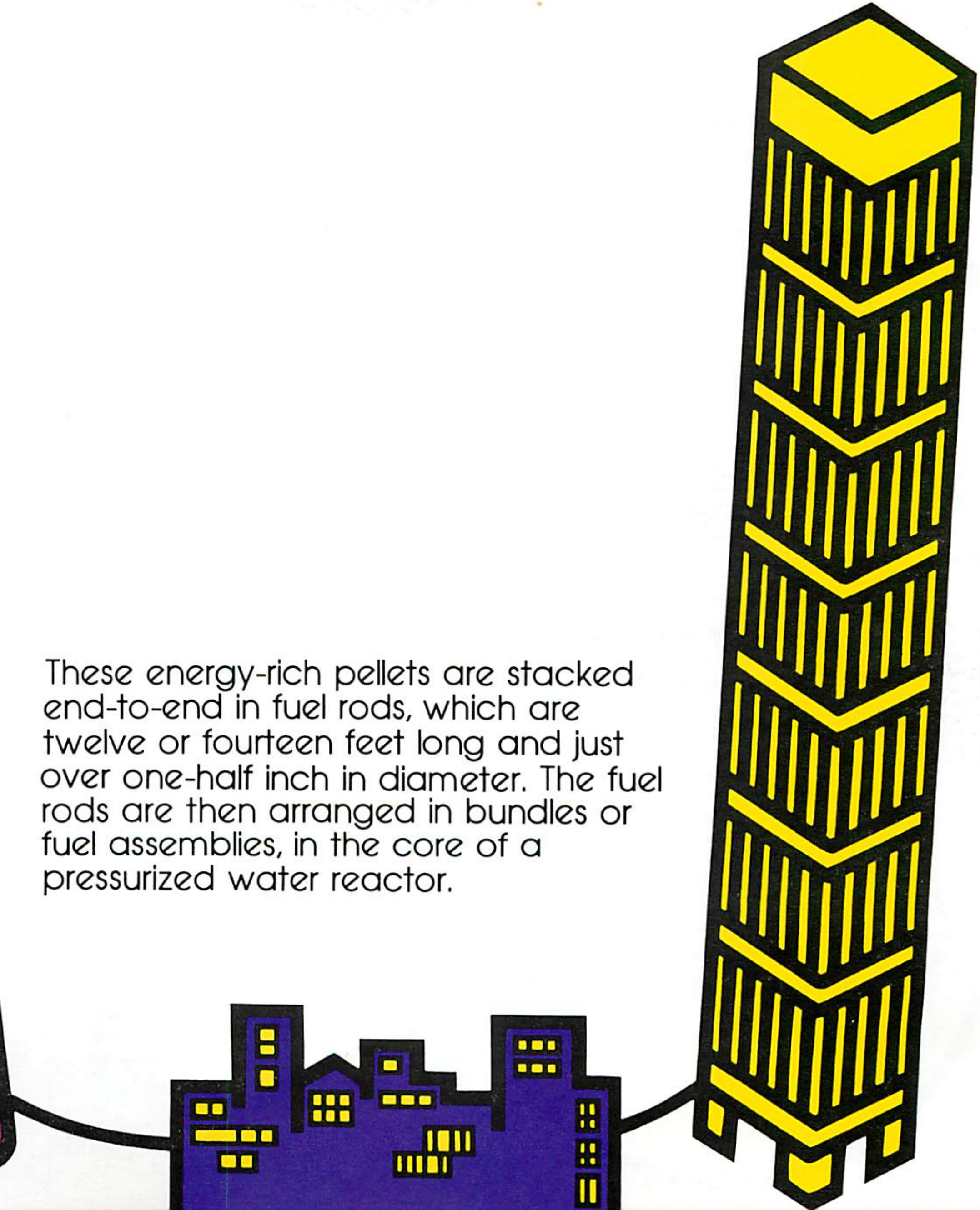
The first and most important part of any nuclear power plant is the reactor. The reactor contains the core, control rods, and coolant.

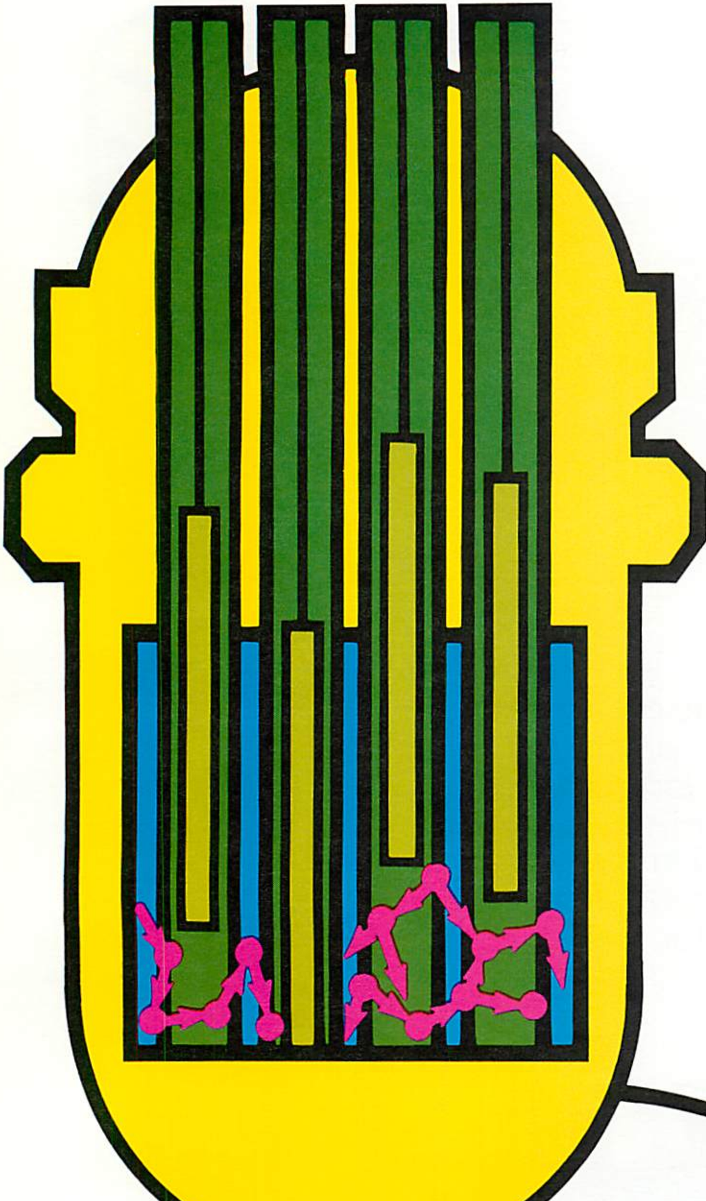


The core of the reactor contains the uranium fuel. The uranium fuel is formed into ceramic pellets about one-half inch in diameter and one inch long. Each pellet releases about the same amount of energy as one ton of coal.



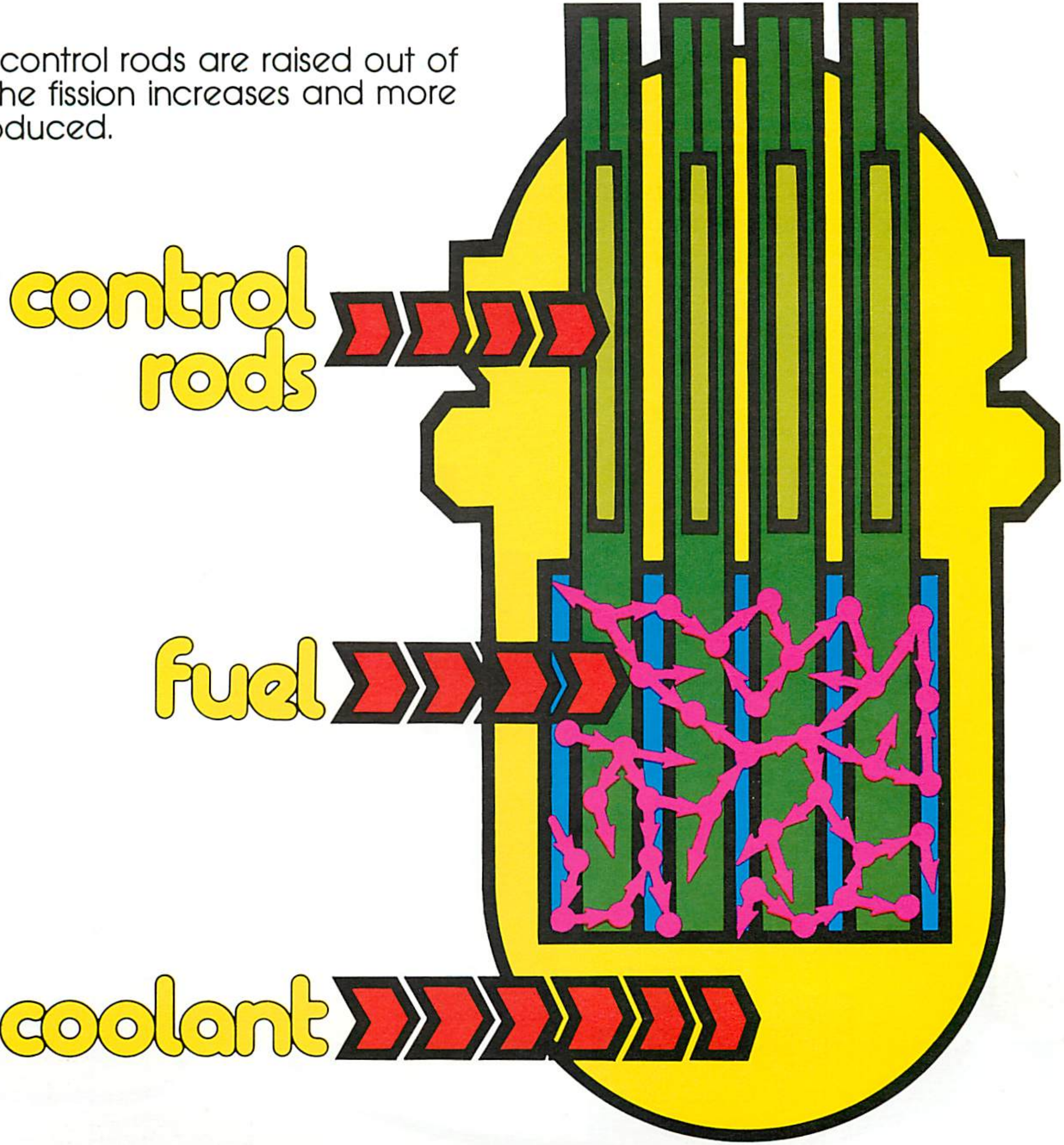
These energy-rich pellets are stacked end-to-end in fuel rods, which are twelve or fourteen feet long and just over one-half inch in diameter. The fuel rods are then arranged in bundles or fuel assemblies, in the core of a pressurized water reactor.



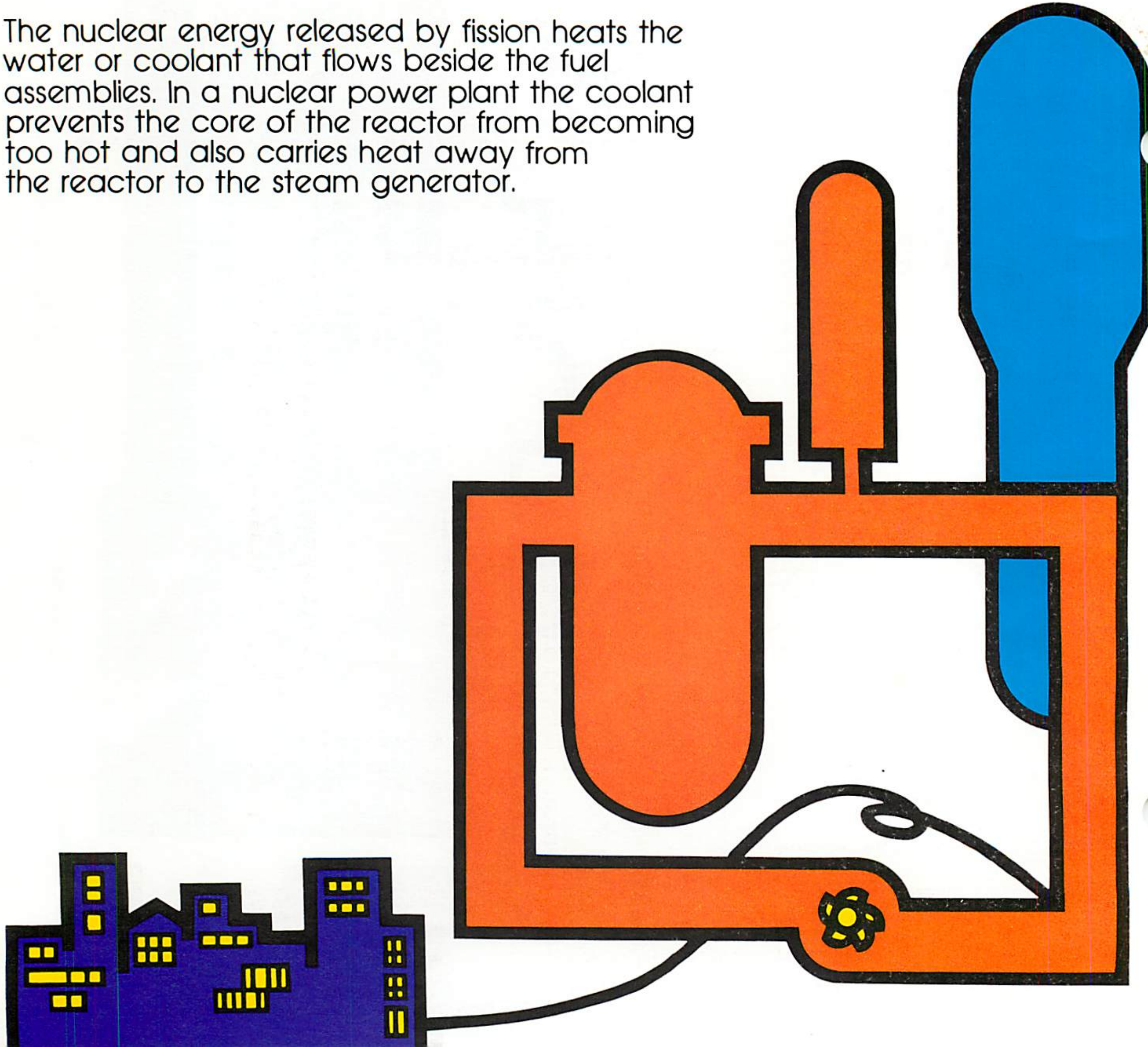


The fission process takes place within the fuel assemblies in the reactor core and is controlled by the control rods. Control rods, made of a material which absorbs neutrons, are lowered into the core of the reactor to slow down the chain reaction.

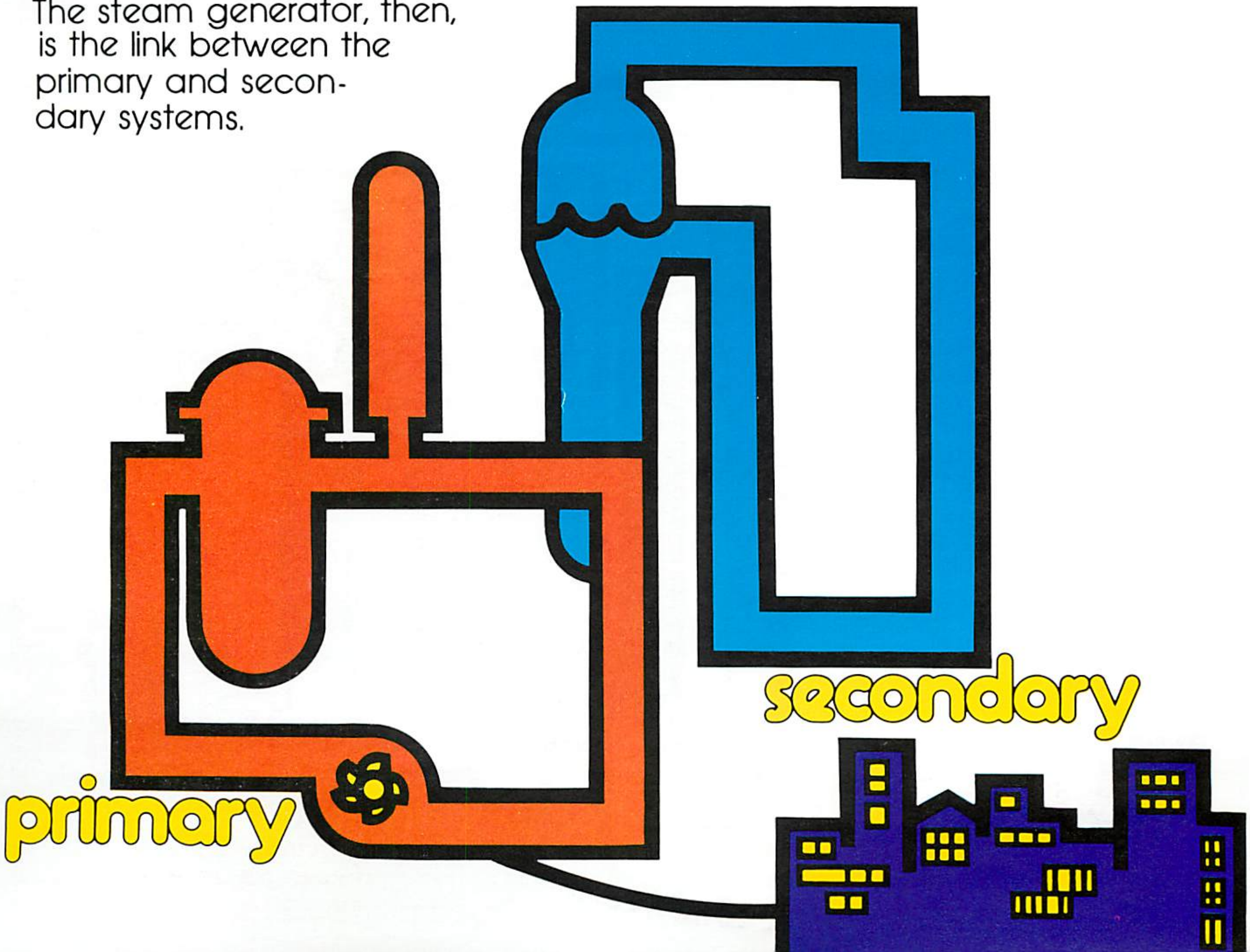
When the control rods are raised out of the core, the fission increases and more heat is produced.



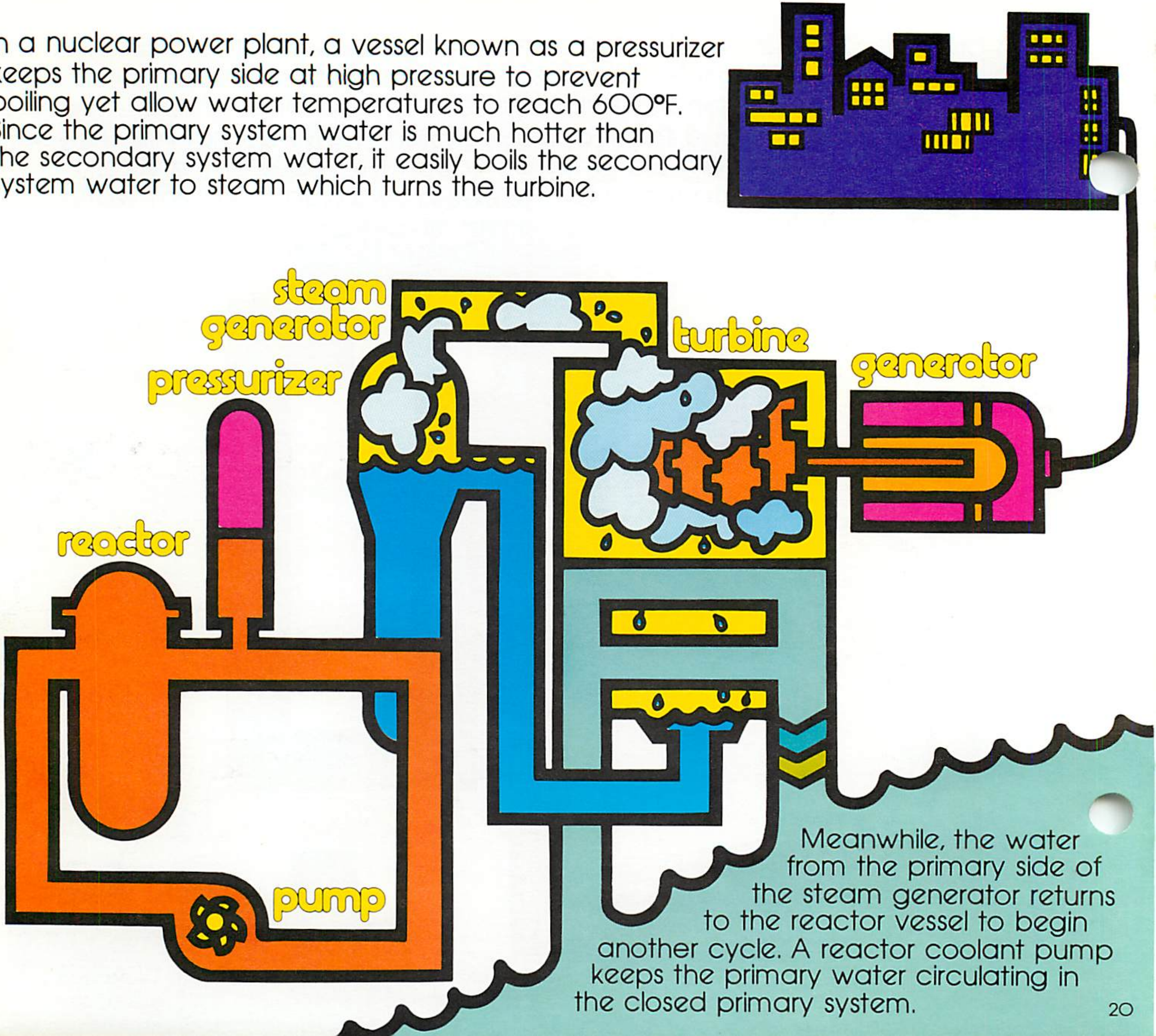
The nuclear energy released by fission heats the water or coolant that flows beside the fuel assemblies. In a nuclear power plant the coolant prevents the core of the reactor from becoming too hot and also carries heat away from the reactor to the steam generator.



In a pressurized water reactor, the system of piping which contains the coolant is called the primary side. The separate system of piping where steam is produced to spin the turbine is called the secondary side. The primary system water and the secondary system water do not mix. Instead, the heated primary system water flows through the tubes of the steam generator which are surrounded by the cooler secondary system water. The steam generator, then, is the link between the primary and secondary systems.



In a nuclear power plant, a vessel known as a pressurizer keeps the primary side at high pressure to prevent boiling yet allow water temperatures to reach 600°F. Since the primary system water is much hotter than the secondary system water, it easily boils the secondary system water to steam which turns the turbine.



Meanwhile, the water from the primary side of the steam generator returns to the reactor vessel to begin another cycle. A reactor coolant pump keeps the primary water circulating in the closed primary system.

Because the fission process can also release radioactivity, several barriers against the release of radioactivity are built into every plant. These are:

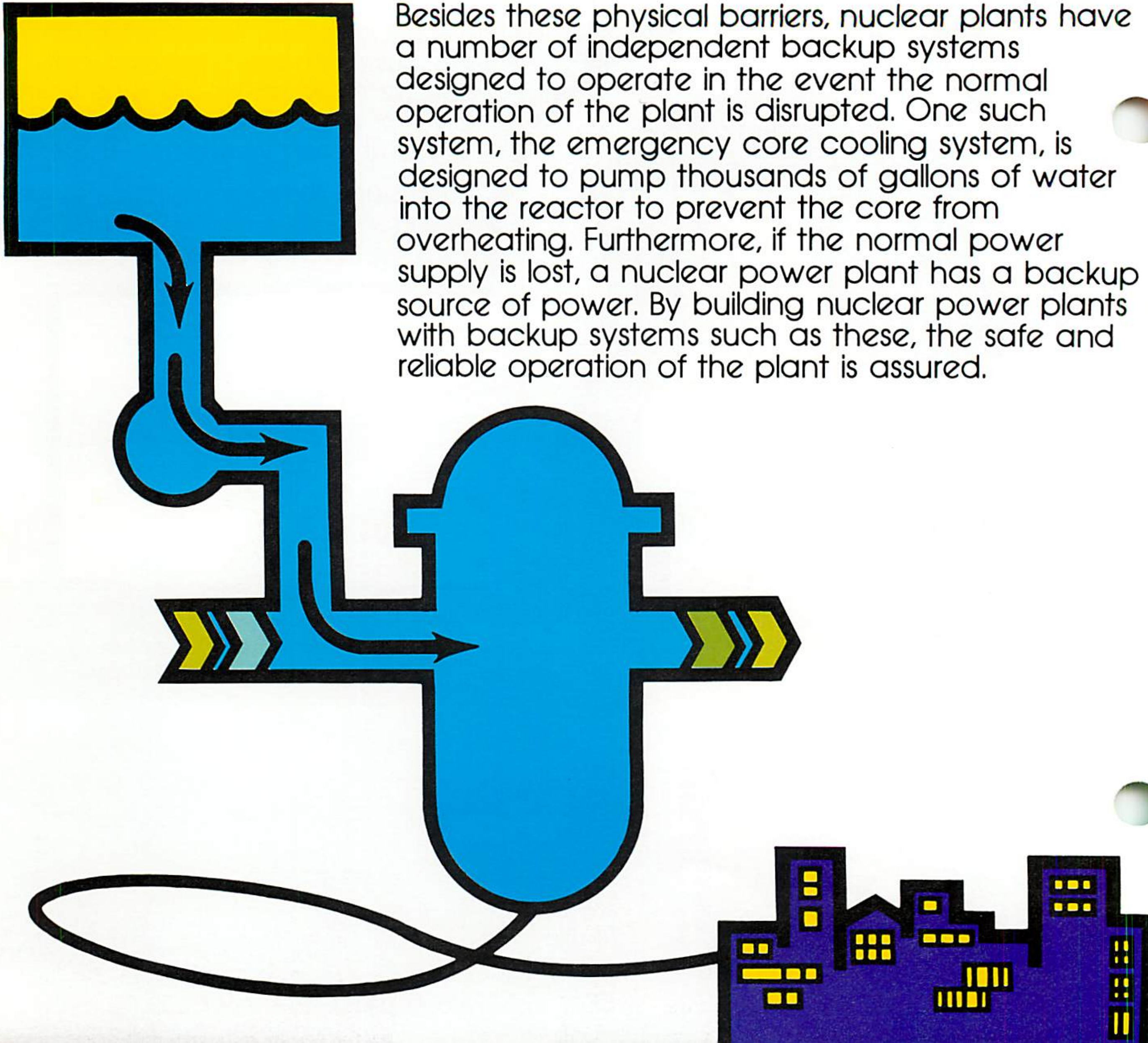
- The uranium is formed into ceramic pellets which seal in the radioactive material.

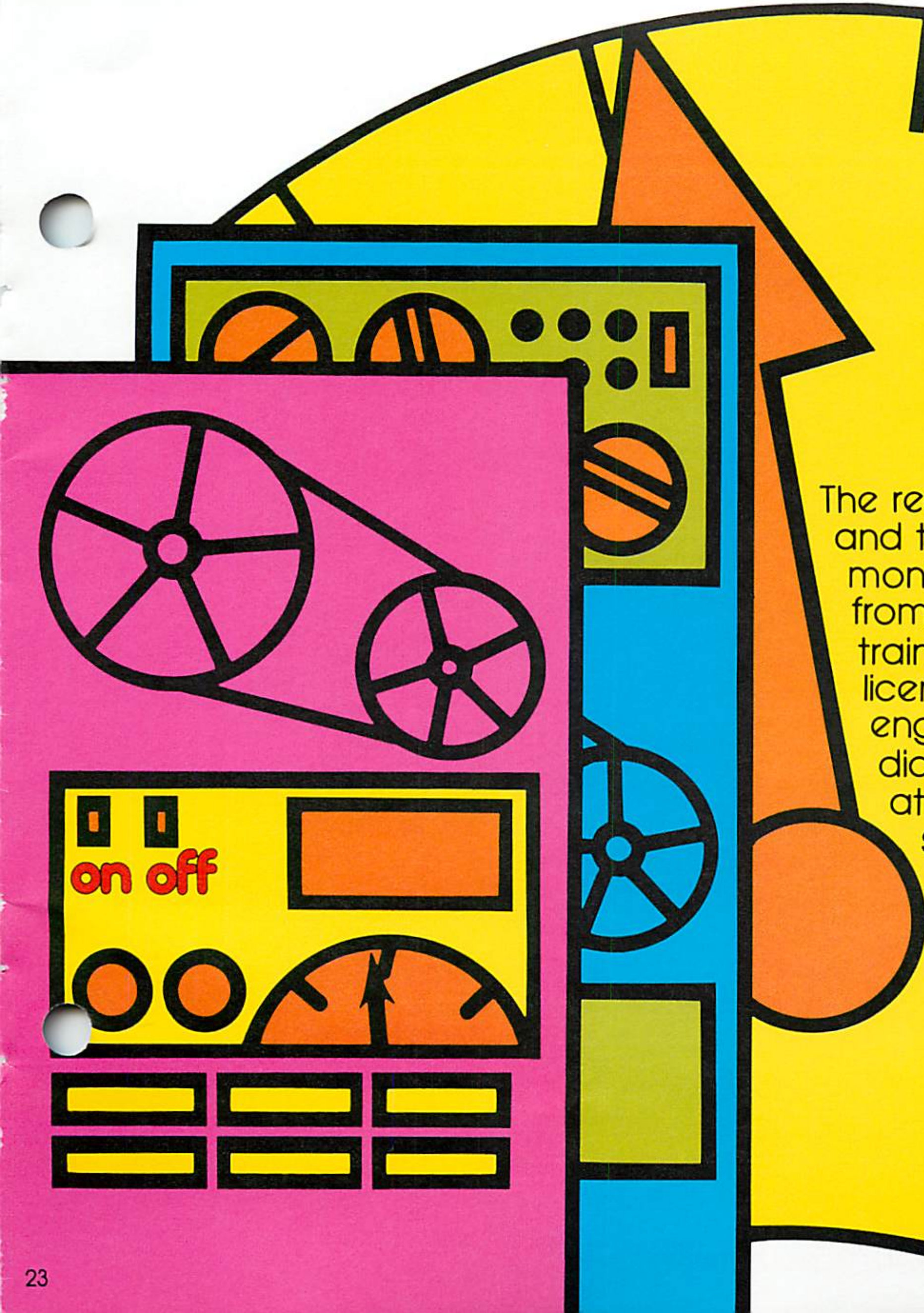
- The fuel pellets are packed into zirconium rods which act as a barrier against the release of radioactivity.

- The core, where the fission process occurs, is placed in a shielded, 450-ton steel reactor vessel approximately eight inches thick.

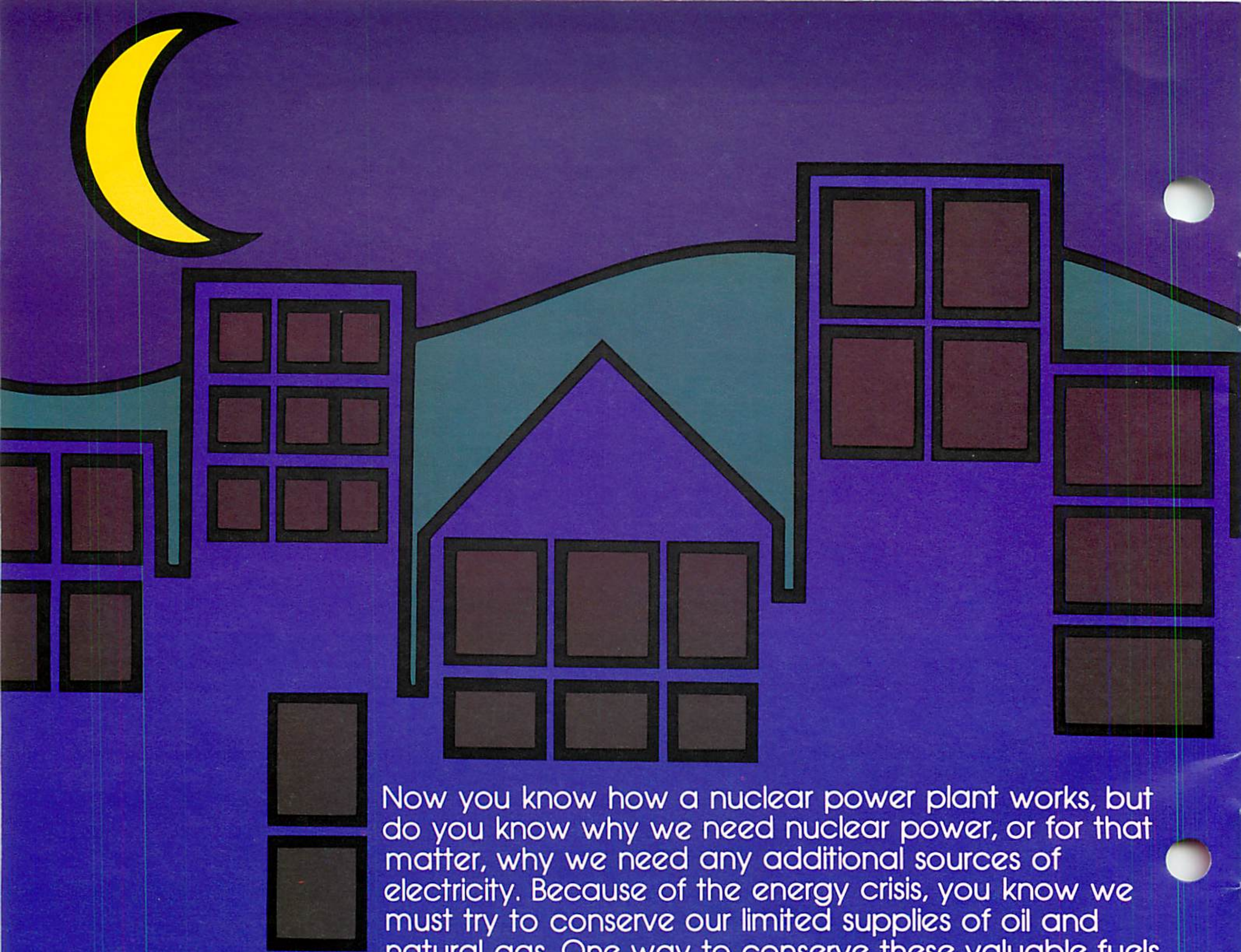
- The reactor is housed in the containment, an airtight building typically made of steel-reinforced concrete approximately three feet thick.

Besides these physical barriers, nuclear plants have a number of independent backup systems designed to operate in the event the normal operation of the plant is disrupted. One such system, the emergency core cooling system, is designed to pump thousands of gallons of water into the reactor to prevent the core from overheating. Furthermore, if the normal power supply is lost, a nuclear power plant has a backup source of power. By building nuclear power plants with backup systems such as these, the safe and reliable operation of the plant is assured.





The reactor, all the safety devices, and the plant itself are constantly monitored and controlled from the control room. Highly trained technicians, government-licensed operators, and nuclear engineers observe computers, dials, gauges, and controls at all times. So, if something serious should go wrong in the plant, the reactor can be automatically shut down from the control room.



Now you know how a nuclear power plant works, but do you know why we need nuclear power, or for that matter, why we need any additional sources of electricity. Because of the energy crisis, you know we must try to conserve our limited supplies of oil and natural gas. One way to conserve these valuable fuels is to stop using oil and gas to produce electricity. But, what if we didn't have enough electricity to light our homes, run our hospitals or power our factories? Would you want to live in a world without electricity?

Although many people dream of a day when windmills will spin and the sun will shine to produce electricity, these sources of electricity are not practical or economical now, nor will they be for many years to come. Our nation must have an abundant and available source of electricity to prosper and to grow. Nuclear energy, together with energy supplied by coal-fired power plants, can help to provide the electricity we need today and tomorrow.

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