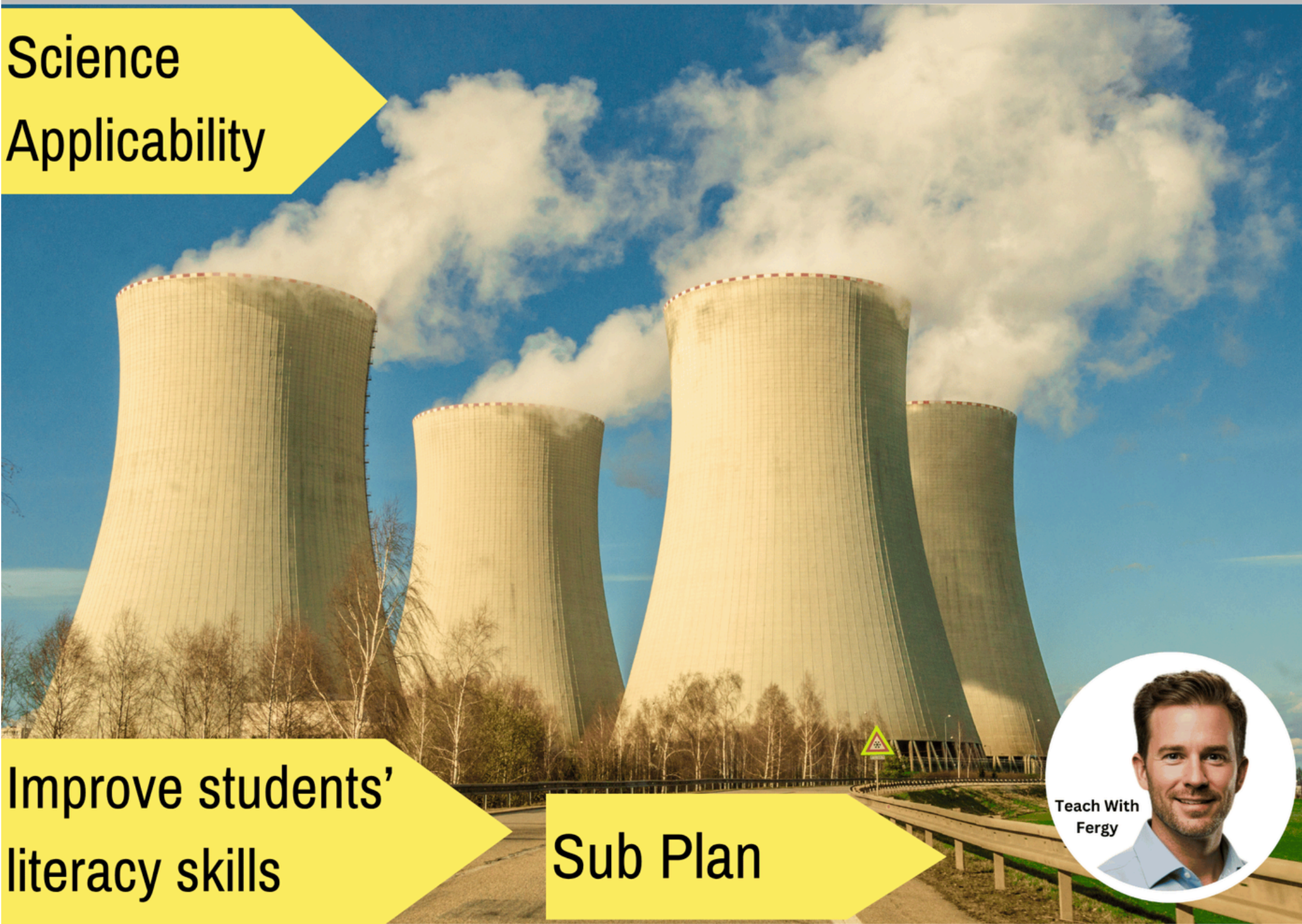


NUCLEAR ENERGY - FUSION AND FISSION GRADE 8 AND UP READING

Science
Applicability



Improve students'
literacy skills

Sub Plan



Reading Comment



Extremely satisfied - Great resource to work on student reading comprehension and it tied into the topic I was teaching. My students have been struggling with reading and I've been incorporating more reading into my lessons. Thank you for the resource.



SCROLL
to take a look inside!

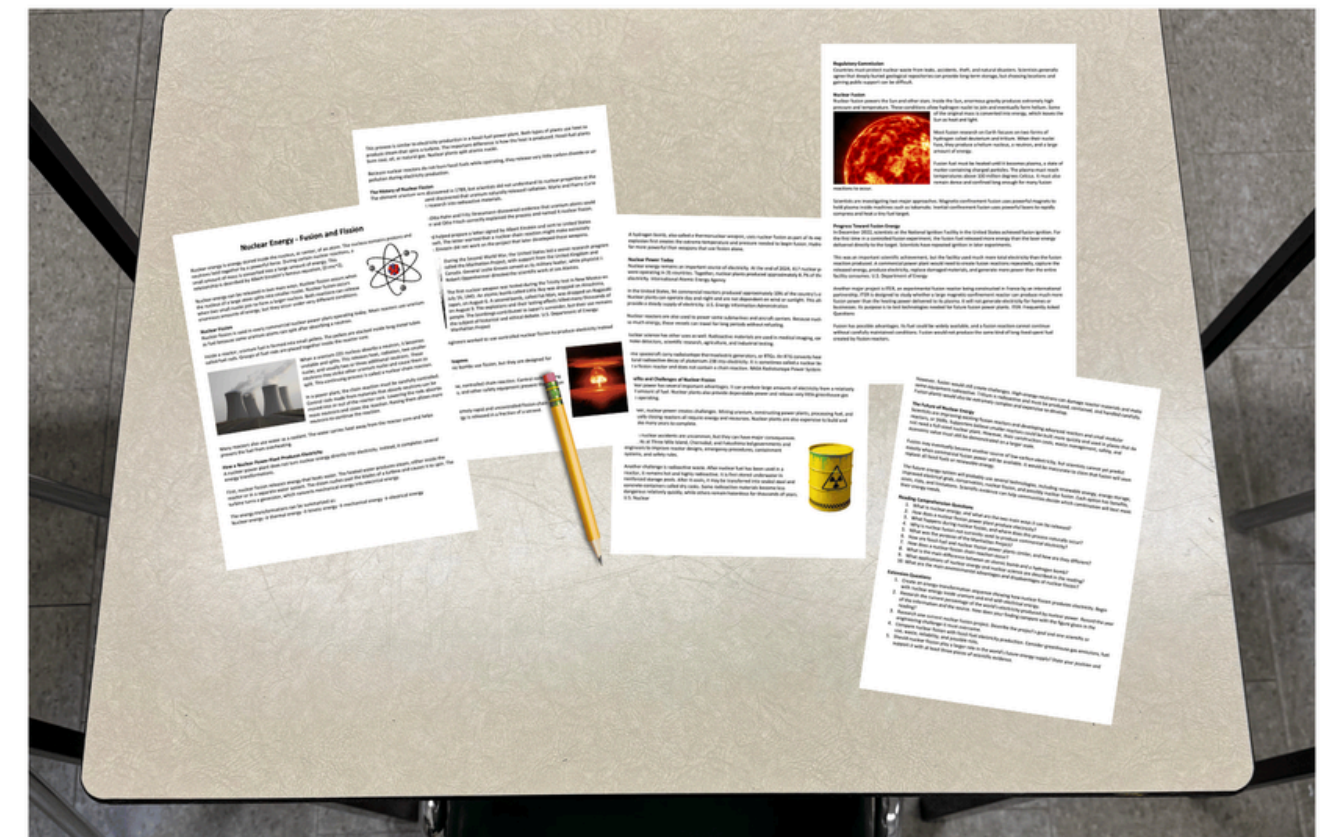


THE PROBLEMS YOU FACE

- **Limited time to teach scientific literacy and strengthen students' reading and analysis skills.**
- **Need meaningful extension activities to engage fast-moving learners.**
- **Difficulty creating effective last-minute sub plans that still support student learning.**

NO-PREP - PRINT/UPLOAD

- **CLASSROOM READY - No Prep, Ready-to-Use:** Print or assign digitally with Google Docs, Microsoft Word, and PDF formats for flexible classroom use
- **Questions and Answer Key**
- **Includes Varied Question Types:** Knowledge, thinking, connecting, application, and open-ended questions.



What Will Your Students Learn?

READING COMPREHENSION ARTICLE & QUESTION BUNDLE

Article with
Comprehension
Questions

Grade 8 and Up

Print & Digital

- Nuclear Energy Stored Inside Atomic Nuclei
- Differences Between Nuclear Fission and Fusion
- How Nuclear Fission Chain Reactions Occur
- Uranium Fuel, Neutrons, and Control Rods
- How Nuclear Power Plants Generate Electricity
- Energy Transformations in Nuclear Power Production
- The History of Nuclear Fission and the Manhattan Project
- Differences Between Nuclear Reactors and Nuclear Weapons
- Current Uses of Nuclear Energy and Radioactive Materials
- Environmental Benefits and Challenges of Nuclear Power
- Radioactive Waste Storage and Nuclear Safety
- How Nuclear Fusion Powers the Sun and Stars
- Current Fusion Research, Achievements, and Challenges
- Small Modular Reactors and the Future of Nuclear Energy

Reading Comprehension Questions

1. What is nuclear energy, and what are the two main ways it can be released?
2. How does a nuclear fission power plant produce electricity?
3. What happens during nuclear fusion, and where does this process naturally occur?
4. Why is nuclear fusion not currently used to produce commercial electricity?
5. What was the purpose of the Manhattan Project?
6. How are fusion fuel and nuclear fission power plants similar, and how are they different?
7. How are fusion and nuclear fission different?
- 8.
- 9.
- 10.

Extended Questions

1. Nuclear energy is energy stored inside the nucleus, or center, of an atom. The nucleus contains protons and neutrons held together by a powerful force. During certain nuclear reactions, a small amount of mass is converted into a large amount of energy. This relationship is described by Albert Einstein's famous equation, $E=mc^2$.
2. Nuclear energy can be released in two main ways. Nuclear fission occurs when the nucleus of a large atom splits into smaller nuclei. Nuclear fusion occurs when two small nuclei join to form a larger nucleus. Both reactions can release enormous amounts of energy, but they occur under very different conditions.

Nuclear Fission

Nuclear fission is used in every commercial nuclear power plant operating today. Most reactors use uranium as fuel because some uranium atoms can split after absorbing a neutron.

Inside a reactor, uranium fuel is formed into small pellets. The pellets are stacked inside long metal tubes called fuel rods. Groups of fuel rods are placed together inside the reactor core.



When a uranium-235 nucleus absorbs a neutron, it becomes unstable and splits. This releases heat, radiation, two smaller nuclei, and usually two or three additional neutrons. These neutrons may strike other uranium nuclei and cause them to split. This continuing process is called a nuclear chain reaction.

In a power plant, the chain reaction must be carefully controlled. Control rods made from materials that absorb neutrons can be moved into or out of the reactor core. Lowering the rods absorbs more neutrons and slows the reaction. Raising them allows more neutrons to continue the reaction.

Many reactors also use water as a coolant. The water carries heat away from the reactor core and helps prevent the fuel from overheating.

How a Nuclear Power Plant Produces Electricity

A nuclear power plant does not turn nuclear energy directly into electricity. Instead, it uses a process called energy transformation.

First, nuclear fission heats water, which turns into steam. The steam turns a turbine, which is connected to a generator. The generator produces electricity.

Energy transformation: nuclear energy → heat → mechanical energy → electrical energy

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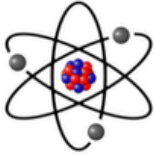
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Your Reading

Nuclear Energy - Fusion and Fission

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How a Nuclear Power Plant Produces Electricity

A nuclear power plant does not turn nuclear energy directly into electricity. Instead, it completes several energy transformations.

First, nuclear fission releases energy that heats water. The heated water produces steam, either inside the reactor or in a separate water system. The steam rushes past the blades of a turbine and causes it to spin. The turbine turns a generator, which converts mechanical energy into electrical energy.

The energy transformations can be summarized as:
Nuclear energy → thermal energy → kinetic energy → mechanical energy → electrical energy

This process is similar to electricity production in a fossil-fuel power plant. Both types of plants use heat to produce steam that spins a turbine. The important difference is how the heat is produced. Fossil-fuel plants burn coal, oil, or natural gas. Nuclear plants split atomic nuclei.

Because nuclear reactors do not burn fossil fuels while operating, they release very little carbon dioxide or air pollution during electricity production.

The History of Nuclear Fission

The element uranium was discovered in 1789, but scientists did not understand its nuclear properties at the time. In 1896, Henri Becquerel discovered that uranium naturally released radiation. Marie and Pierre Curie later conducted important research into radioactive materials.

In 1938, German scientists Otto Hahn and Fritz Strassmann discovered evidence that uranium atoms could split. Physicists Lise Meitner and Otto Frisch correctly explained the process and named it nuclear fission.

In 1939, physicist Leo Szilard helped prepare a letter signed by Albert Einstein and sent to United States President Franklin D. Roosevelt. The letter warned that a nuclear chain reaction might make extremely powerful weapons possible. Einstein did not work on the project that later developed those weapons.



During the Second World War, the United States led a secret research program called the Manhattan Project, with support from the United Kingdom and Canada. General Leslie Groves served as its military leader, while physicist J. Robert Oppenheimer directed the scientific work at Los Alamos.

The first nuclear weapon was tested during the Trinity test in New Mexico on July 16, 1945. An atomic bomb called Little Boy was dropped on Hiroshima, Japan, on August 6. A second bomb, called Fat Man, was dropped on Nagasaki on August 9. The explosions and their lasting effects killed many thousands of people. The bombings contributed to Japan's surrender, but their use remains the subject of historical and ethical debate. U.S. Department of Energy: Manhattan Project

After the war, scientists and engineers worked to use controlled nuclear fission to produce electricity instead of explosions.

Nuclear Fission and Nuclear Weapons

Both nuclear reactors and atomic bombs use fission, but they are designed for completely different purposes.

A power reactor maintains a slow, controlled chain reaction. Control rods, cooling systems, containment structures, and other safety equipment prevent the reaction from increasing uncontrollably.

An atomic bomb creates an extremely rapid and uncontrolled fission chain reaction. A huge amount of energy is released in a fraction of a second.



A hydrogen bomb, also called a thermonuclear weapon, uses nuclear fusion as part of its explosion. A fission explosion first creates the extreme temperature and pressure needed to begin fusion. Hydrogen bombs can be far more powerful than weapons that use fission alone.

Nuclear Power Today

Nuclear energy remains an important source of electricity. At the end of 2024, 417 nuclear power reactors were operating in 31 countries. Together, nuclear plants produced approximately 8.7% of the world's electricity. International Atomic Energy Agency

In the United States, 94 commercial reactors produced approximately 19% of the country's electricity in 2024. Nuclear plants can operate day and night and are not dependent on wind or sunlight. This allows them to provide a steady supply of electricity. U.S. Energy Information Administration

Nuclear reactors are also used to power some submarines and aircraft carriers. Because nuclear fuel contains so much energy, these vessels can travel for long periods without refueling.

Nuclear science has other uses as well. Radioactive materials are used in medical imaging, cancer treatments, smoke detectors, scientific research, agriculture, and industrial testing.

Some spacecraft carry radioisotope thermoelectric generators, or RTGs. An RTG converts heat from the natural radioactive decay of plutonium-238 into electricity. It is sometimes called a nuclear battery, but it is not a fission reactor and does not contain a chain reaction. NASA Radioisotope Power Systems

Benefits and Challenges of Nuclear Fission

Nuclear power has several important advantages. It can produce large amounts of electricity from a relatively small amount of fuel. Nuclear plants also provide dependable power and release very little greenhouse gas while operating.

However, nuclear power creates challenges. Mining uranium, constructing power plants, processing fuel, and eventually closing reactors all require energy and resources. Nuclear plants are also expensive to build and may take many years to complete.

Serious nuclear accidents are uncommon, but they can have major consequences. Accidents at Three Mile Island, Chernobyl, and Fukushima led governments and engineers to improve reactor designs, emergency procedures, containment systems, and safety rules.

Another challenge is radioactive waste. After nuclear fuel has been used in a reactor, it remains hot and highly radioactive. It is first stored underwater in reinforced storage pools. After it cools, it may be transferred into sealed steel and concrete containers called dry casks. Some radioactive materials become less dangerous relatively quickly, while others remain hazardous for thousands of years. U.S. Nuclear



Regulatory Commission

Countries must protect nuclear waste from leaks, accidents, theft, and natural disasters. Scientists generally agree that deeply buried geological repositories can provide long-term storage, but choosing locations and gaining public support can be difficult.

Nuclear Fusion

Nuclear fusion powers the Sun and other stars. Inside the Sun, enormous gravity produces extremely high pressure and temperature. These conditions allow hydrogen nuclei to join and eventually form helium. Some of the original mass is converted into energy, which leaves the Sun as heat and light.



Most fusion research on Earth focuses on two forms of hydrogen called deuterium and tritium. When their nuclei fuse, they produce a helium nucleus, a neutron, and a large amount of energy.

Fusion fuel must be heated until it becomes plasma, a state of matter containing charged particles. The plasma must reach temperatures above 100 million degrees Celsius. It must also remain dense and confined long enough for many fusion reactions to occur.

Scientists are investigating two major approaches. Magnetic-confinement fusion uses powerful magnets to hold plasma inside machines such as tokamaks. Inertial-confinement fusion uses powerful lasers to rapidly compress and heat a tiny fuel target.

Progress Toward Fusion Energy

In December 2022, scientists at the National Ignition Facility in the United States achieved fusion ignition. For the first time in a controlled fusion experiment, the fusion fuel released more energy than the laser energy delivered directly to the target. Scientists have repeated ignition in later experiments.

This was an important scientific achievement, but the facility used much more total electricity than the fusion reaction produced. A commercial power plant would need to create fusion reactions repeatedly to capture the released energy, produce electricity, replace damaged materials, and generate more power than the entire facility consumes. U.S. Department of Energy

Another major project is ITER, an experimental fusion reactor being constructed in France by an international partnership. ITER is designed to study whether a large magnetic-confinement reactor can produce much more fusion power than the heating power delivered to its plasma. It is not designed to generate electricity for homes or businesses. Its purpose is to test technologies needed for future fusion power plants. ITER: Frequently Asked Questions

Fusion has possible advantages. Its fuel could be widely available, and a fusion reaction cannot continue without carefully maintained conditions. Fusion would not produce the same kind of long-lived spent fuel created by fission reactors.

However, fusion would still create challenges. High-energy neutrons can damage reactor materials and make some equipment radioactive. Tritium is radioactive and must be produced, contained, and handled carefully. Fusion plants would also be extremely complex and expensive to develop.

The Future of Nuclear Energy

Scientists are improving existing fission reactors and developing advanced reactors and small modular reactors, or SMRs. Supporters believe fission reactors could be built more quickly and used in places that do not need a full-sized nuclear plant. However, their construction costs, waste management, safety, and economic value must still be demonstrated on a larger scale.

Fusion may eventually become another source of low-carbon electricity, but scientists cannot yet predict exactly when commercial fusion power will be available. It would be inaccurate to claim that fusion will soon replace all fossil fuels or renewable energy.

The future energy system will probably use several technologies, including renewable energy, energy storage, improved electrical grids, conservation, nuclear fission, and possibly nuclear fusion. Each option has benefits, costs, risks, and limitations. Scientific evidence can help communities decide which combination will best meet their energy needs.

Reading Comprehension Questions

1. What is nuclear energy, and what are the two main ways it can be released?
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4. Why is nuclear fusion not currently used to produce commercial electricity?
5. What was the purpose of the Manhattan Project?
6. How are fossil-fuel and nuclear fission power plants similar, and how are they different?
7. How does a nuclear fission chain reaction occur?
8. What is the main difference between an atomic bomb and a hydrogen bomb?
9. What applications of nuclear energy and nuclear science are described in the reading?
10. What are the main environmental advantages and disadvantages of nuclear fission?

Extension Questions

1. Create an energy-transformation sequence showing how nuclear fission produces electricity. Begin with nuclear energy inside uranium and end with electrical energy.
2. Research the current percentage of the world's electricity produced by nuclear power. Record the year of the information and the source. How does your finding compare with the figure given in the reading?
3. Research one current nuclear fusion project. Describe the project's goal and one scientific or engineering challenge it must overcome.
4. Compare nuclear fission with fossil-fuel electricity production. Consider greenhouse gas emissions, fuel use, waste, reliability, and possible risks.
5. Should nuclear fission play a larger role in the world's future energy supply? State your position and support it with at least three pieces of scientific evidence.

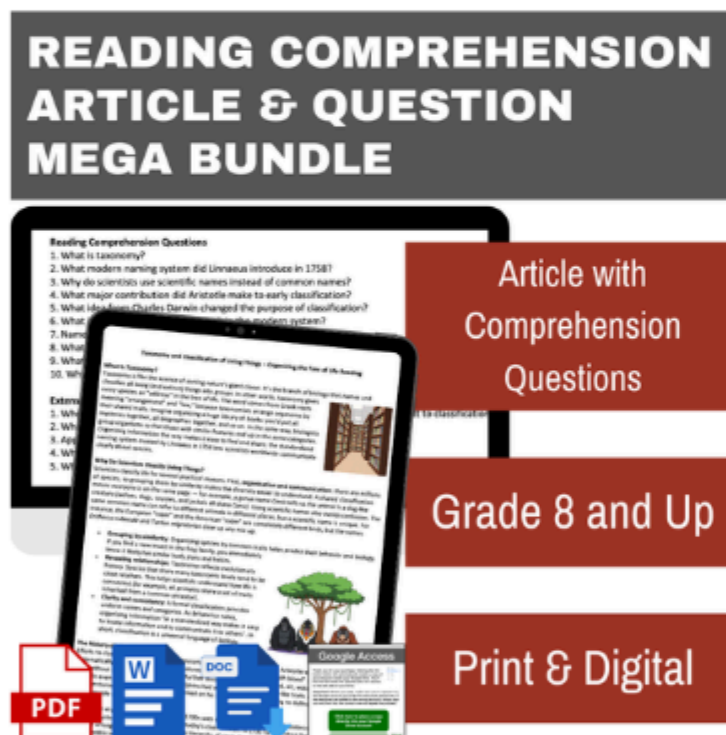
Full Answer Key Included

Comprehension and Extension Questions



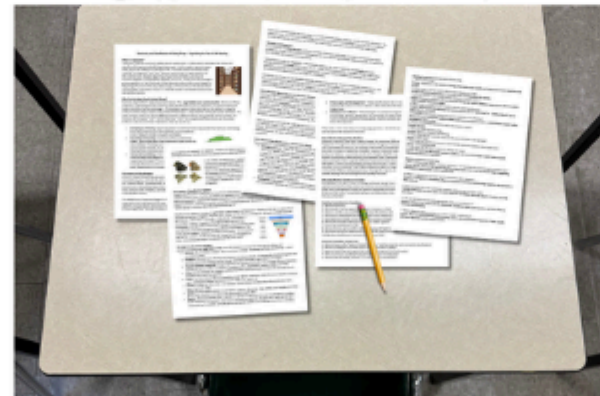
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- Questions and Answer Key
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- **Includes Varied Question Types:** Knowledge, thinking, connecting, application, and open-ended questions.



★★★★★ Extremely satisfied - It is a good supplemental activity either for review and at the same time introducing some concept. I also use this for sub plan. It is well presented, organized and interesting.

★★★★★ Extremely satisfied - This a great resource. I used this for a sub plan. It was fun and engaging for my students.

Grade 8 and Up Scientific Reading Comprehension Article Mega Bundle

ALL my current and future grade 8 and up readings, covering the following subject areas:

Biology
Chemistry
Earth and Space
Ecology and the Environment
Energy
Health
Natural Disasters
Physics



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**for your interest
in this resource!**

I am a real person and if
you have any questions,
suggestions, or concerns,
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Connect!*

