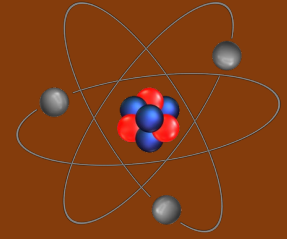
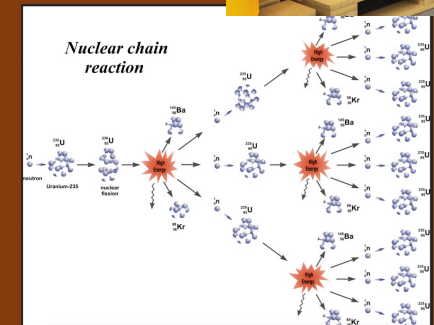
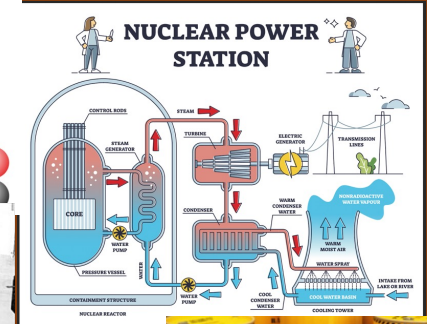
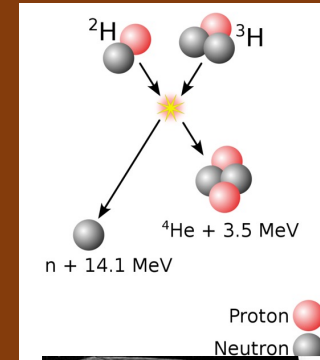


Nuclear Energy Fission and Fusion



- Atoms – Structure and Function
- Nuclear Energy
- Fission
- Neutron absorption → Nucleus splitting → Neutron release → chain reaction → Energy release
- Fission Safety
- Chernobyl Disaster Case Study
- Nuclear Weapons – Fission
- Fusion and Controlled Fusion
- Controlled Fusion Challenges and Benefits
- Nuclear Energy Applications
- Nuclear Weapons - Fusion



Preview File

Please enjoy this preview of your Student Version of the presentation. Please note within this sample file:

- Some slides appear blank because they have been removed
- Student versions have portions of the text removed which is given in the teacher version and appear as _____ which the students are to fill in
- Other slides may have on them, this represents writing that has been removed on this sample

**The paid full version of your resource includes
both Google Slides and PowerPoint and is
Google Classroom Ready**



Lesson Objective:

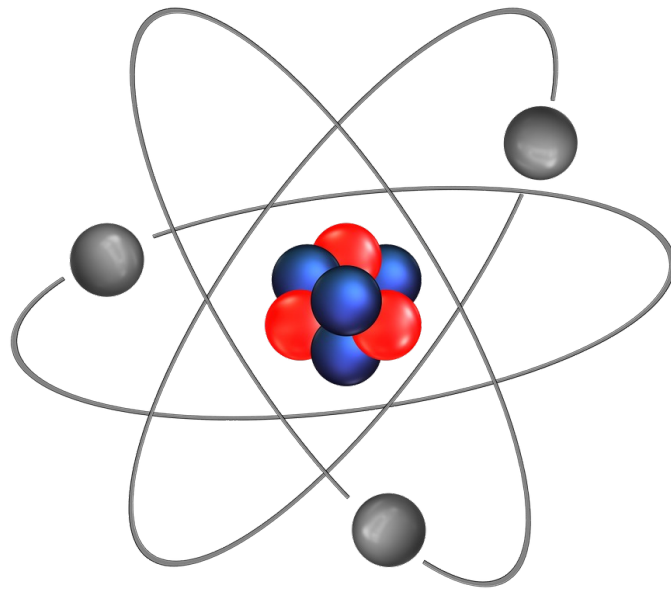
The objective of this lesson is to introduce students to the concepts of nuclear energy, specifically focusing on nuclear fission and fusion, and their applications

The lesson will also discuss the benefits and drawbacks of each.

With the person beside you, answer the following

1. What is an atom and what are the major parts of it?
2. What is nuclear energy?
3. What are the two different kinds of nuclear energy generation and how are they different?
4. How do we currently use nuclear energy?

Atoms

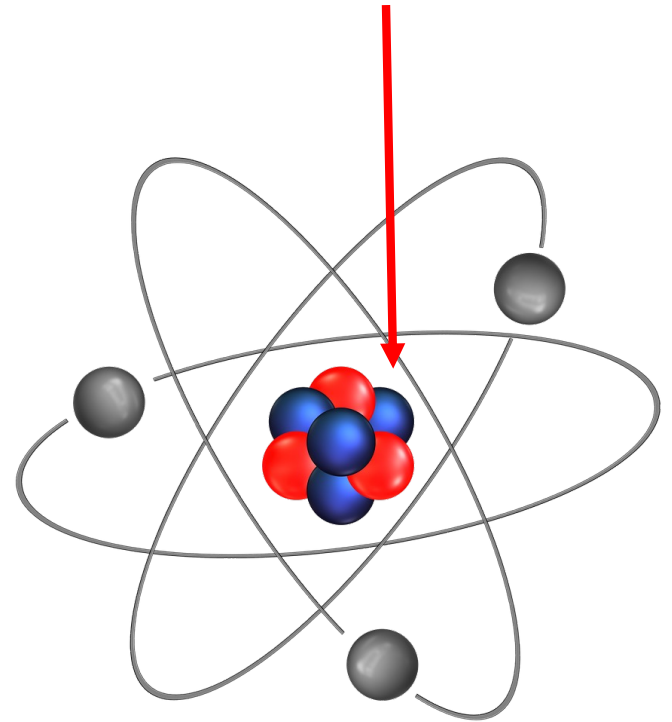


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Structure of an Atom - Proton

- Protons (blue) have a positive (+) charge

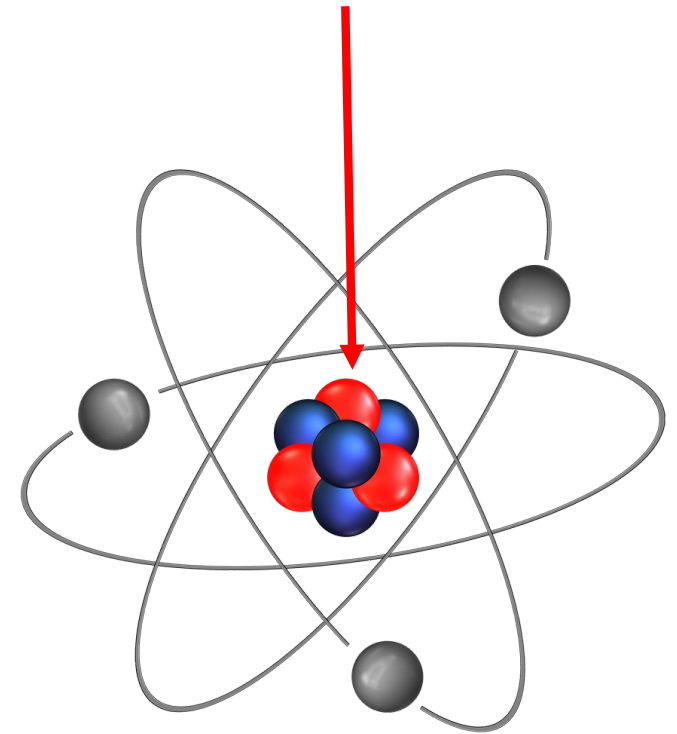
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Structure of an Atom - Neutron

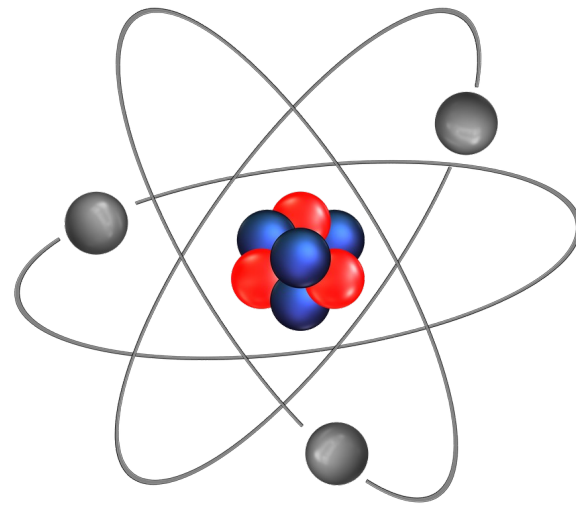
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- They're found inside the nucleus



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Nuclear Energy

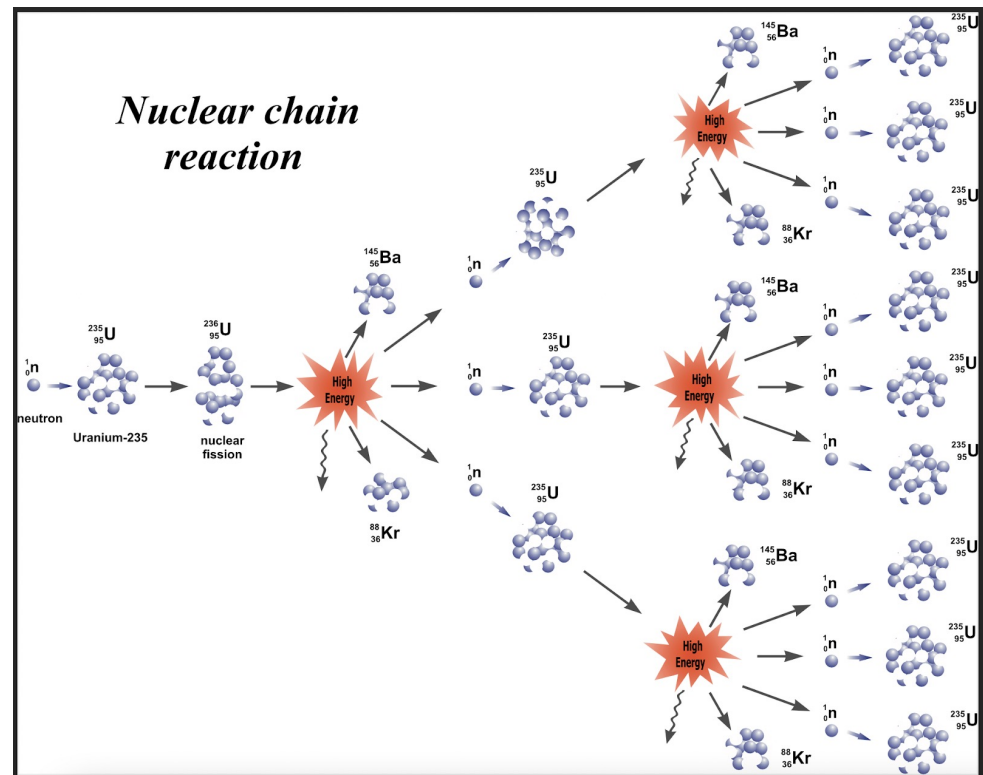


Fission – Breaking Atoms Apart

- Fission is used in our current nuclear power plants
- _____



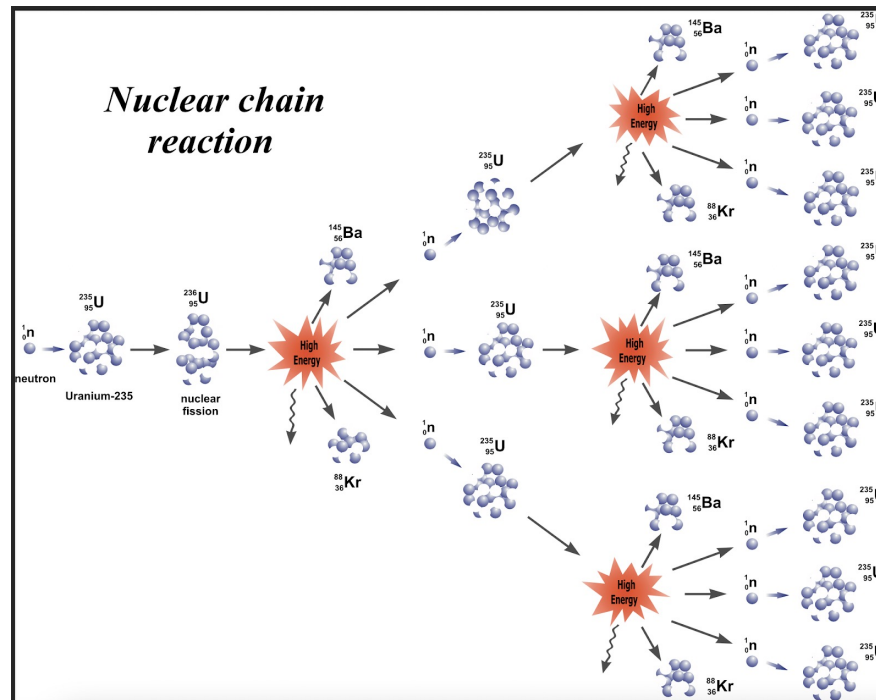
Nuclear Reactor



Fission

- Nuclear fission is the process in which the nucleus of a heavy atom is split into two smaller nuclei

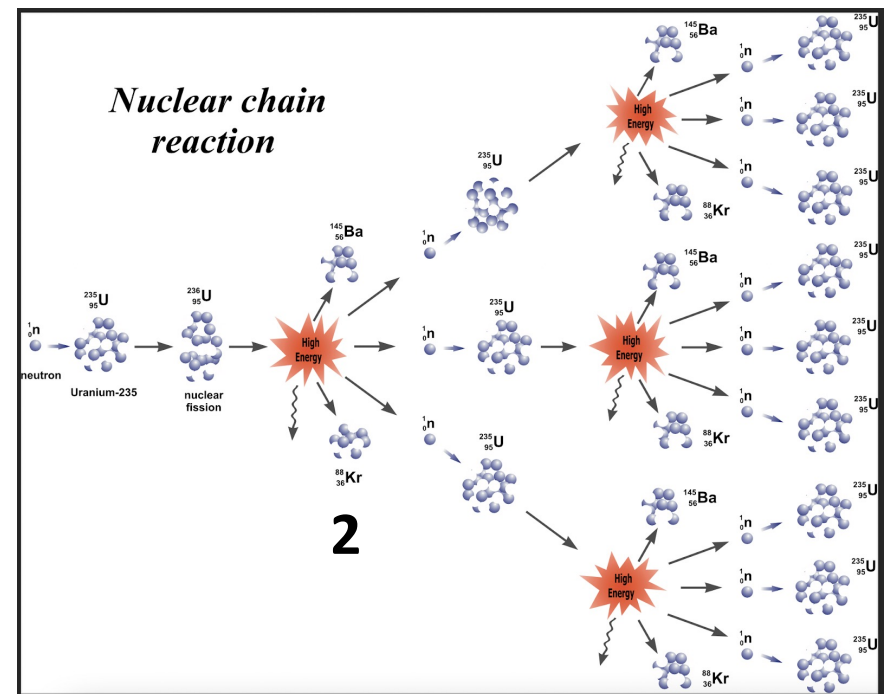
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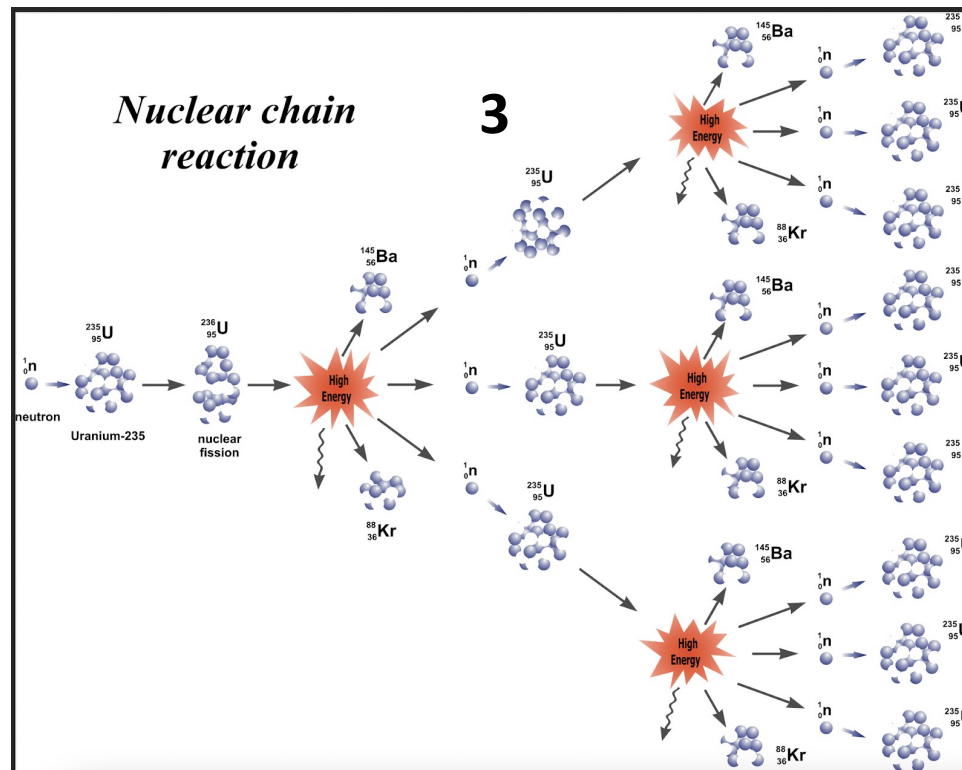
Fission – Nucleus Splitting

- As a result of neutron absorption, the uranium-235 nucleus becomes highly unstable and starts to vibrate
- This instability leads to the nucleus splitting into two smaller nuclei, known as fission fragments (2)



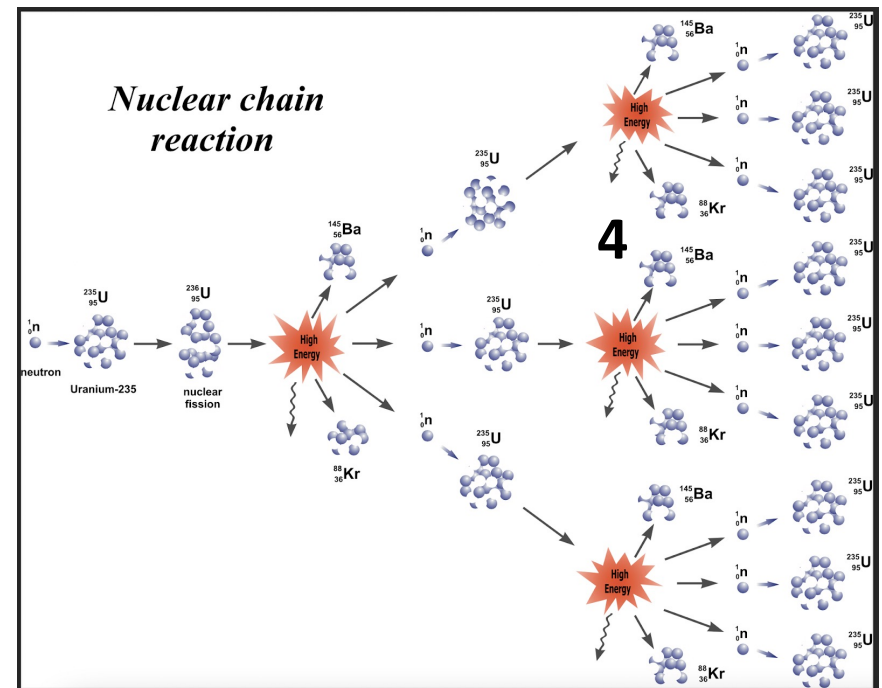
Fission – Neutron Release

- As the uranium-235 nucleus splits, it releases two or three high-energy neutrons
- _____



Fission – Chain Reaction

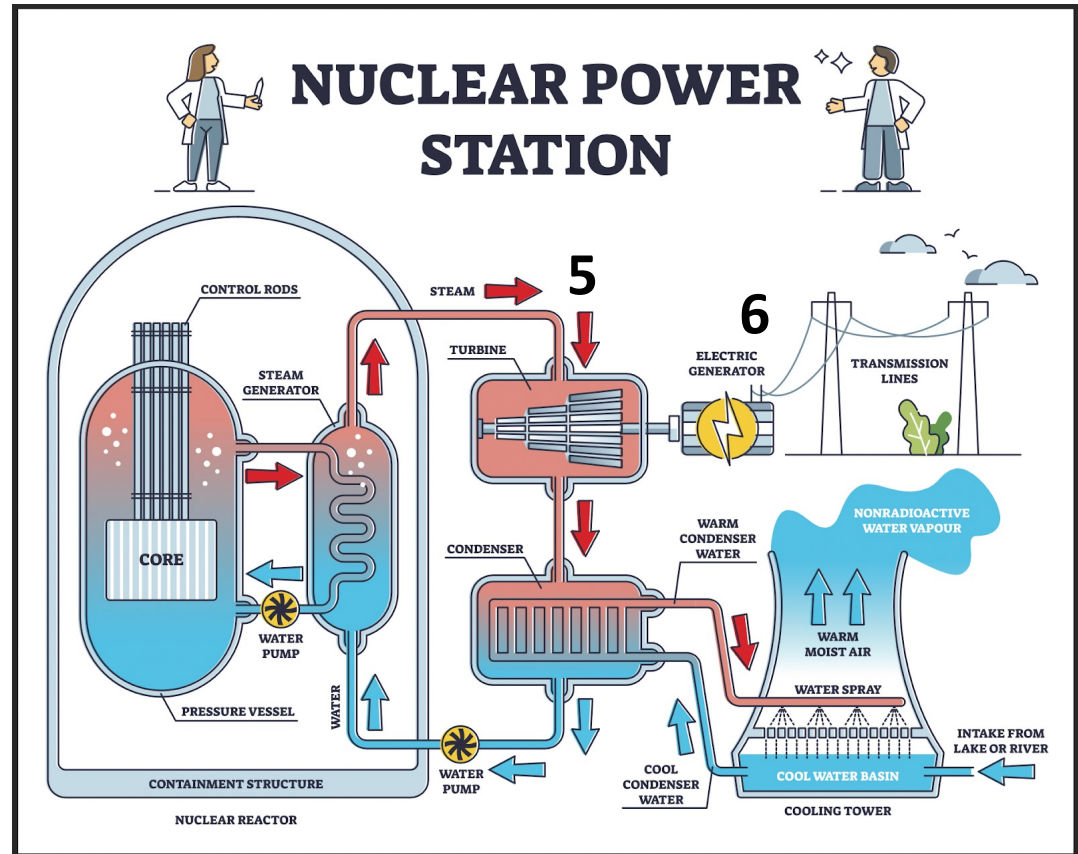
- This creates a chain reaction in which each fission event releases more neutrons that trigger subsequent fissions (4)



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Fission – Energy Release

- The released energy is used to heat water which becomes steam (5)



Fission

- Nuclear fission releases a tremendous amount of energy, which makes it a highly efficient and concentrated source of energy

- _____



Fission Disaster - Chernobyl

- The Chernobyl disaster was a nuclear accident that occurred in 1986 at the Chernobyl fission nuclear power plant, in the north of the Ukrainian SSR in the Soviet Union
- The Chernobyl accident was primarily caused by a combination of design flaws and operator errors during a reactor test



Chernoby

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Fission Disaster - Chernobyl

- The release of radioactive materials into the atmosphere resulted in the evacuation and resettlement of nearby communities, affecting approximately 350,000 people
- ---



Chernoby

- _____



Chernobly

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Fission – Nuclear Weapons

- _____

- The first nuclear bomb was created by the United States during World War II



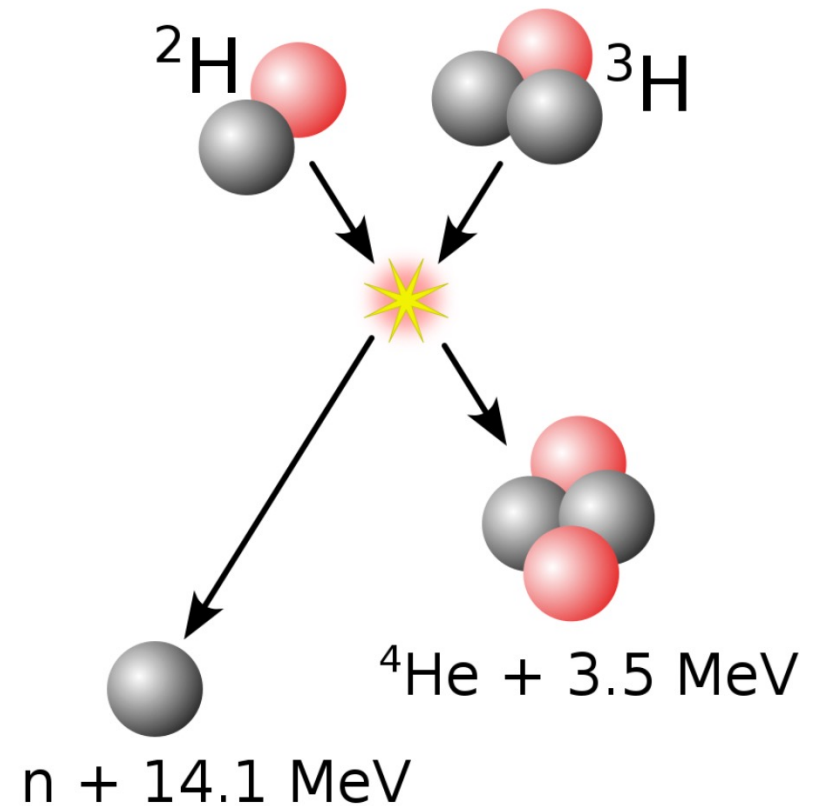
Fission – Nuclear Weapons

- On July 16, 1945, the United States dropped the first atomic weapon called “Little Boy” on Hiroshima, Japan killing 140,000 people either instantly or within months via radiation poisoning
- Three days later, a second fission bomb was dropped on Nagasaki, Japan killing 80,000 more and effectively ended the war



“Little Boy”

Fusion – Combining Atoms

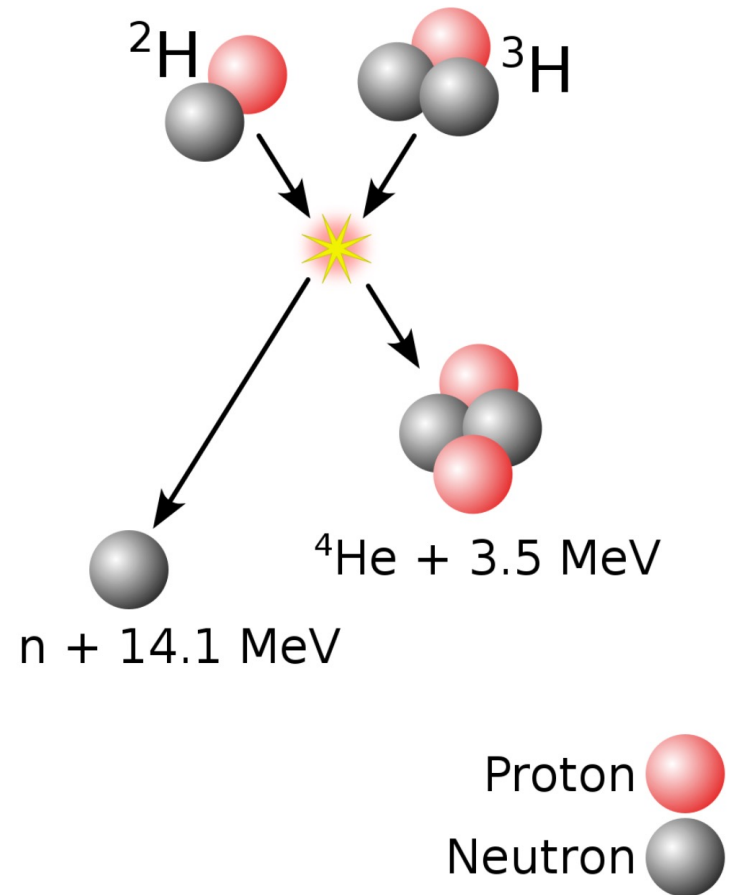


Proton 
Neutron 

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Fusion – Combining Atoms

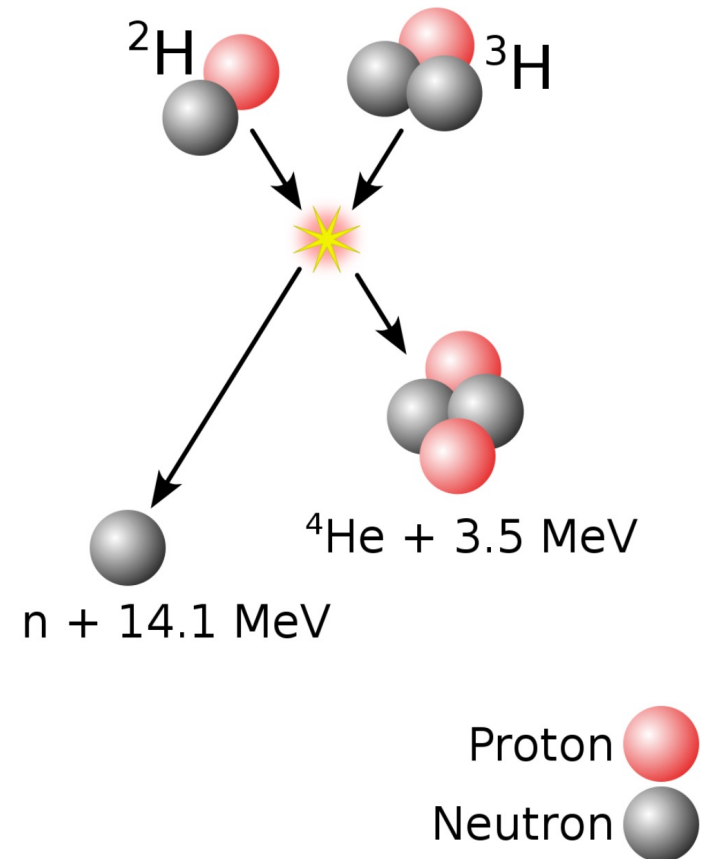
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- This environment causes the atomic nuclei bind together
- When the atomic nuclei fuse, they release a vast amount of energy in the form of light and heat



Fusion – Combining Atoms

-

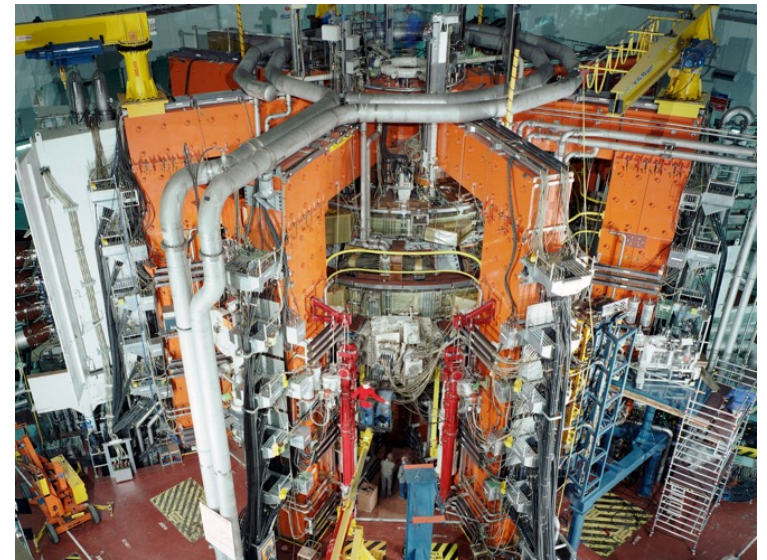
- Deuterium is a stable isotope of hydrogen with one neutron and one proton, while tritium is a radioactive isotope with one proton and two neutrons
- Hydrogen typically only has 1 proton and no neutrons



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Controlled Fusion

- Achieving controlled fusion on Earth is a major scientific and technological challenge, but if successful, _____
- However, it also poses unique challenges and concerns which makes it difficult to implement



The Joint European Torus (JET)

Controlled Fusion – Challenges

1. _____
2. Plasma confinement: The fuel for fusion, typically isotopes of hydrogen, needs to be heated to the point where it becomes a plasma. Plasma, a state of matter consisting of charged particles, is difficult to confine and control.
3. Energy input versus output: One of the challenges is to ensure that the energy required to initiate and sustain the fusion reaction is less than the energy released by the reaction itself.
4. Materials and engineering: The intense conditions of nuclear fusion can place enormous stress on the materials used in fusion reactors. Finding suitable materials that can withstand the extreme temperatures, radiation, and neutron bombardment is a major engineering challenge.

Controlled Fusion – Benefits

1. Nearly limitless fuel supply. Fusion fuel sources, such as isotopes of hydrogen, are abundant in nature, particularly deuterium, which can be extracted from seawater.
2. High energy density. Nuclear fusion releases an incredibly high amount of energy compared to conventional energy sources such as fossil fuels.
3. _____
4. Inherently safe. Fusion reactors do not carry the risk of a runaway chain reaction or meltdown as seen in nuclear fission reactors.

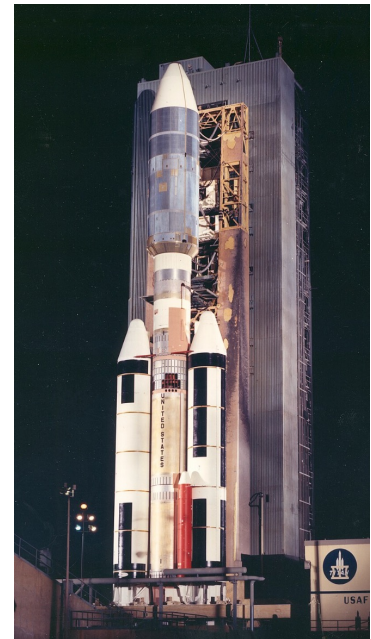
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Current Nuclear Energy Applications

Similarly, nuclear power systems on spacecraft provide the necessary energy for long-duration missions, such as those exploring outer space or traveling to distant planets.



USS Nautilus, the first nuclear-powered submarine



Both Viking 1 and Viking 2 used nuclear Power on the surface of Mars. Viking launch vehicle pictured.

Current Nuclear Energy Applications

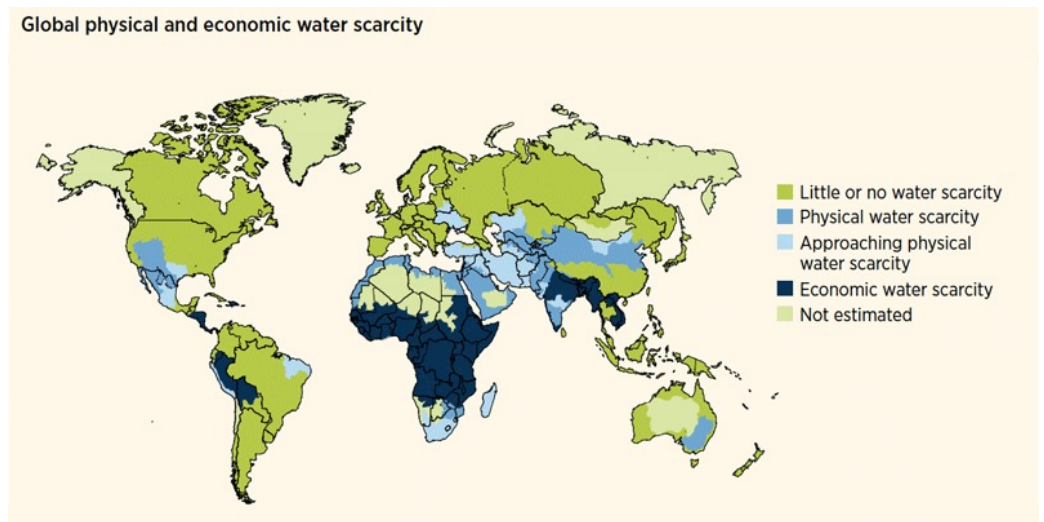
- Nuclear energy has important applications in the field of medicine
- _____
- In scientific research, nuclear techniques are used to study the structure and properties of materials at the atomic level



Current Nuclear Energy Applications

- Desalination: Nuclear power can be utilized to power desalination plants, converting seawater into freshwater through processes such as reverse osmosis or distillation

- _____

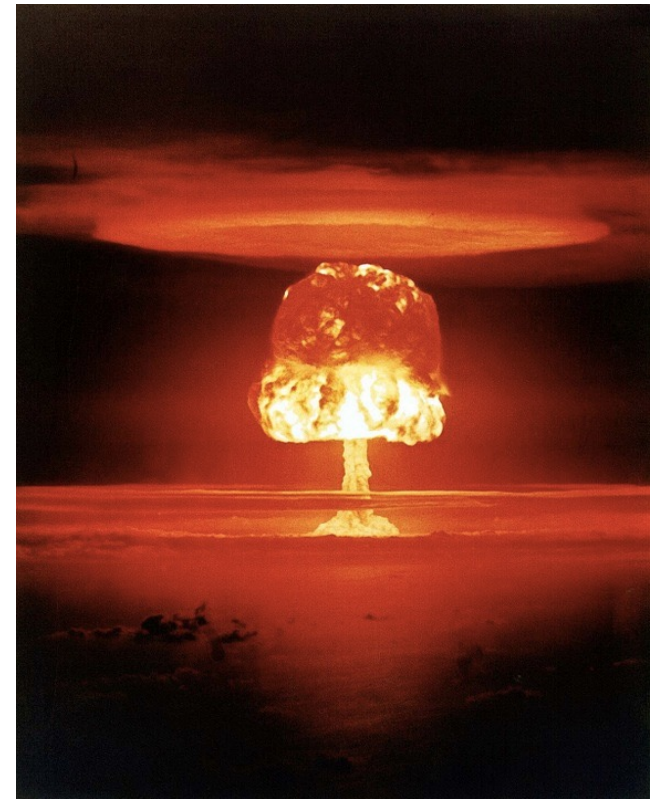


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Uncontrolled Fusion – Nuclear Weapons

- Although fusion nuclear power plants are still in their development phase, fusion bombs have been around since 1952 because in a bomb, we're not trying to control the explosion

- _____



Summary

- _____
- Nuclear fission involves splitting the nucleus of a heavy atom, like uranium-235, into two smaller nuclei, releasing a significant amount of energy
- Neutrons play a critical role in initiating and sustaining a chain reaction in nuclear fission
- The energy released during nuclear fission is used to heat water, produce steam, and generate electricity in nuclear power plants
- _____
- Nuclear fusion releases a tremendous amount of energy and is the process that powers the Sun and other stars
- Achieving controlled nuclear fusion on Earth presents challenges, but its potential benefits include a virtually limitless and environmentally friendly energy source
- Nuclear energy has various applications, including electricity generation, nuclear propulsion, industrial processes, and medical and scientific applications
- _____

Thinking Critically Activity: Evaluating Nuclear Energy and Sustainable Alternatives