

Unfortunately, this simulation is programmed using Java script and will not work on iPads or iPhones. You will need a laptop in order to do these simulations. However, they may be programmed using HTML-5 in the future, which would allow the simulations to be done using iPads or iPhones.

In this activity, you will be investigating Nuclear Fission by using a simulation (<https://phet.colorado.edu/en/simulation/legacy/nuclear-fission>). The simulation has three different components that cover:

- One Atom
- Chain Reaction
- Nuclear Reactor

➤ The first segment will cover One Atom, which is uranium-235.

1. What is the composition of a uranium-235 nucleus?

*92 protons, 143 neutrons*

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2. How do you make uranium-235 unstable?

*Fire a neutron at the nucleus.*

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3. Look at the graph at the bottom. The yellow line represents the Total Energy of the system. What happens to the total energy of the system when the neutron gun is fired?

*When the neutron is fired, the total energy of the system increases.*

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4. What does uranium-235 turn into when it captures the neutron?

*It turns into an unstable uranium-236 nucleus.*

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5. What happens to the nucleus after it captures the neutron? What free particles are emitted?

*The nucleus breaks apart into two stable portions and emits free neutrons.*

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➤ Next, click on the Chain Reaction tab at the top of the window.

6. Set the number of uranium-235 nuclei to 25, and fire the neutron gun. How many nuclei decay after one firing? What is the percentage of nuclei that decay after one firing?

*Around 75% of nuclei decay after one firing.*

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➤ When the radioactive decay of one nucleus leads to more nuclei decaying, this is called a chain reaction.

7. Increase the number of uranium-235 nuclei to 50, 75, and 100, and determine the percentage of these nuclei that decay after one firing of the neutron gun. What happens to the percentage of nuclei that decay when the number of uranium-235 nuclei increases?

*When more uranium-235 is added to the system, a higher percentage of nuclei are decayed.*

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8. Now, change the number of uranium-235 nuclei to zero, and put in one nucleus of uranium-238. What happens when a uranium-238 nucleus captures a neutron?

*When uranium-238 captures a neutron, it transforms into uranium-239, which is stable. No chain reaction occurs when uranium-238 is involved because no free neutrons are emitted during the reactions.*

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9. Why is uranium-235 a good source for a chain reaction compared to uranium-238?

*Uranium-235 is a good source for a chain reaction because free neutrons are emitted when nuclear fission takes place.*

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➤ Finally, click on Nuclear Reactor at the top of the window.

10. Click on Fire Neutrons. What happens when the neutrons are fired?

*When the neutrons are fired, a uranium-235 nucleus decays and emits free neutrons that are then used to decay more uranium-235.*

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11. Repeat this process five to ten times. What happens to the uranium-235 over time? Do all of the neutrons that are fired cause nuclear reactions? Explain.

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*The uranium-235 decreases over time, as it decays when inundated with neutrons. Not every neutron firing causes a nuclear reaction, as not every neutron interacts with a uranium-235 nucleus.*

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12. Why does the reaction not take place all throughout the entire reactor? What is the purpose of the control rods?

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*The control rods prevent the reaction from spreading throughout the entire reactor at once. If this occurred, the power output would be very high for a very short amount of time.*

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13. When the reactions are taking place, there is a reading on the Power Output energy graph. What determines the amount of power that is being output at any given time?

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*The power output depends on the rate that the nuclear reactions take place.*

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14. What happens to the Energy Produced graph over time?

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*The energy produced increases over time, as it is the total amount of nuclear energy that is released when the uranium-235 nuclei undergo fission.*

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