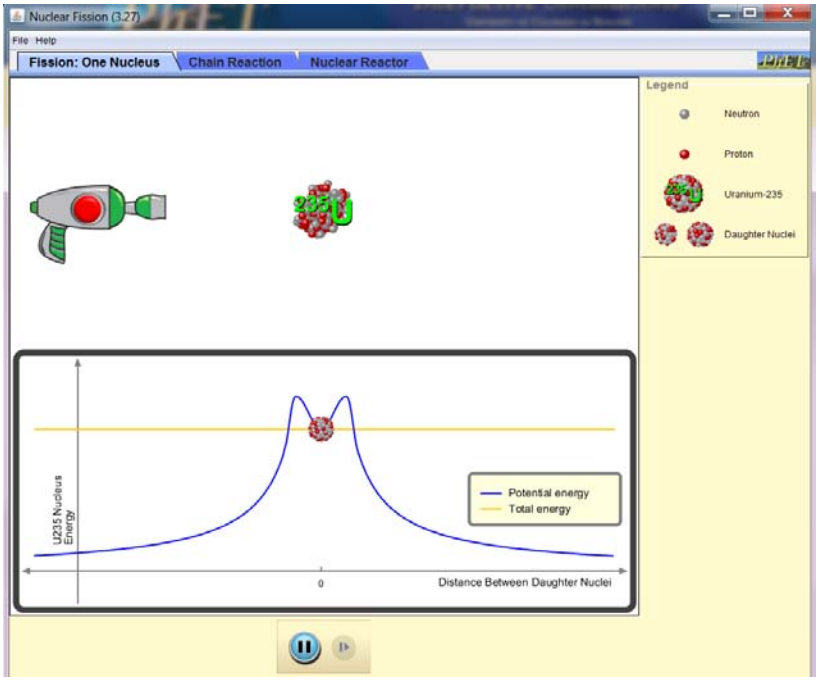
# Nuclear Fission Simulation

Open the "Nuclear Fission" simulation at this link:
http://phet.colorado.edu/simulations/sims.php?sim=Nuclear_Fission

You may either download the simulation or choose "Run Now." (I use the "Run Now" option when working with the simulation.) If you have trouble opening the sim, you may need to upload the latest version of Java for the simulation to run.

## Fission: One Nucleus




1) Define fission:

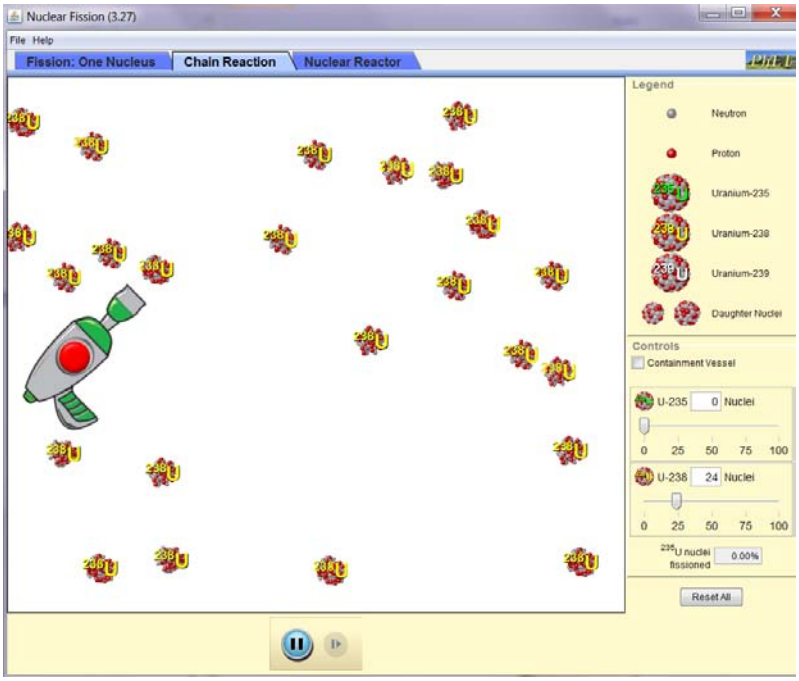
2) Click the tab "Fission: One Nucleus" and run the simulation. Before the gun is fired, is the material stable, or does it seem likely to radioactively decay?

3) When you operate the gun, what type of particle does it fire?

4) If the gun fires and "hits" the nucleus, what happens?

## Chain Reaction

Switch the tab to "chain reaction."




5) Remove the U-235 and add some uranium-238.

   The atom used in the previous tab was uranium-235. Is this new uranium-238" fissionable"? How does firing the gun on a U-238 atom change it? Write a nuclear equation to describe what happens. (Note you can aim the gun.)

6) Reset the sim (using the button) and this time add lots of fissionable (≈ 50) U-235. What happens? Why?

7) Normal levels of the U-235 isotope are about 0.72%, with the majority being U-238. Simulate a close approximation of this by adding one atom of U-235 and 99 atoms of U-238. Use the simulation to discover if naturally-derived uranium can start a chain reaction (and therefore be useful in either nuclear weapons or nuclear power plants): Is naturally derived uranium able to start a chain reaction, or must the sample be "enriched" to form U-235?

8) Use the simulation to find a minimum ratio of U-235 to U-238 (keep your total of atoms always at 100); what is the smallest percentage of U-235 that still starts a chain reaction?

9) How does the above compare to "weapons-grade" enriched uranium (about 80-85%)?

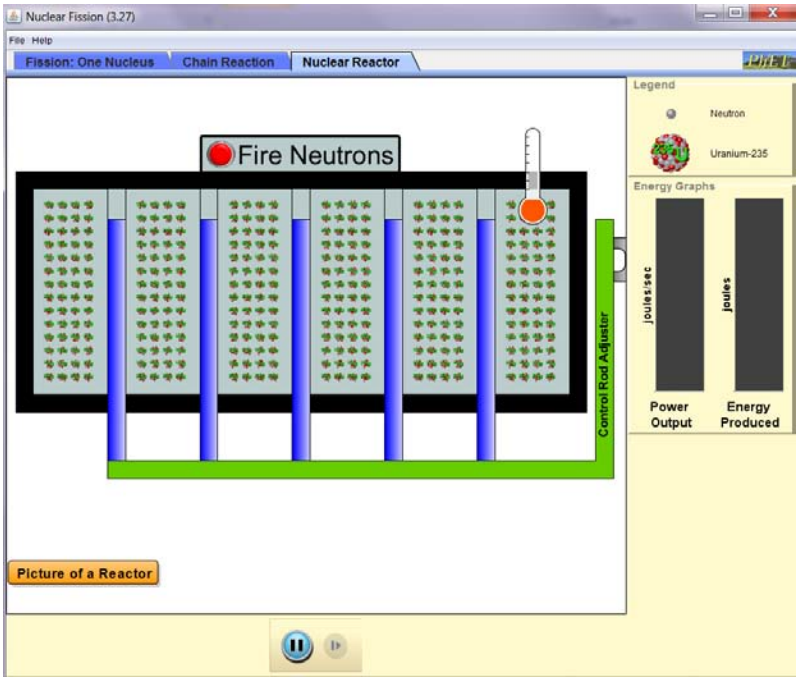
10) Use the simulation to make a nuclear weapon. What conditions are needed? (Hint, you'll need to check the box "containment vessel", and a certain level of enrichment that you must determine. Note that you can change the size of the containment vessel by dragging the handles.) Play with the conditions until you produce an atomic bomb.

11) Describe what happened.

12) What is a "dirty-bomb" (you may have to look it up online)? Is a high grade of uranium needed for a dirty-bomb to explode?

## Nuclear Power Plants

Switch to the "Nuclear Reactor" tab.




12) What is needed to start the nuclear reactor?

13) What effect does adjusting the control rods have on the Power Output and Energy Produced?

14) Without the control rods in position, what happens?

15) What is the apparent function of the control rods?