

U-235 Fission Game

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The poster consists of four labeled regions which correspond to some of the materials that are found inside a nuclear reactor: Uranium-235, Uranium-238, Boron-10. And water. As one person spins the board, students with nerf guns and nerf darts will shoot at the board, where hitting different regions will award a number of points. Here, the nerf dart represents a neutron, and the board represents a reactor. When a student hits the Uranium-235 region, fission occurs and 3 points is awarded. Uranium-238 and water will scatter the neutron and only one point is awarded. Boron-10 will absorb the neutron and award no points. The object of this game is to see if the student is subcritical, critical, or supercritical.

In the E-week event, the students were given 7 neutrons to shoot at the reactor. Once the students had used up all neutrons, depending on the score, they will get back neutrons for the next round. For example, if a student scores 10 points, they will get back 10 neutrons for the next round. But if a student scores 5, they will only get back 5 neutrons. This process is repeated for 3 rounds, although this can be varied depending on time limitations. After each round, depending on how many neutrons the students get back, they are told whether they are subcritical, critical, or supercritical. For example, if a student scores less than 7 points, they are told they are subcritical. A student scoring 7 will be told they are critical, and a student scoring more than 7 will be told they are supercritical. The person running the activity will then explain to them how these criticality states relate to reactor power. At the end, candy was given out to the participants.



Prior to the activity, students were given some background on the concepts the game tries to teach. This was done with the help of a scaled-down version of a pressurized water reactor fuel assembly, a wooded uranium pellet, and a poster explaining the fission process. First, the students were asked if they knew anything about nuclear reactors to gauge the level of knowledge. Then, using the assembly model, the students were explained the content of the fuel, where the fuel pellets are located, where the water is, where the control rods are and what they do, and how fission occurs in the fuel. Using the fission poster, the students were explained how fission works, how fission chain reactions occur in the fuel, and how this produces heat which can be used for electricity. It was explained to them how the control rods were used to control the neutron population. Additionally, a quick rundown of how heating water results in producing electricity was also given. After this was done, and questions answered, the students then participate in the activity to reinforce what was taught.

Activity Tips:

This is a list of some of the tips that will make the activity run smoother, or will improve the activity. This was gathered from experience in running the activity for E-Fair.

1. Have two nerf guns for two students to participate at the same time, students enjoyed much more the competition aspect.
2. If enough resources/expertise, have the board be mounted on a ceiling fan or something with an electric motor because manual spinning the board is exhausting and you would need additional people to keep track of student's scores since once person is too focused on spinning and can't see the poster well. In this case, the spinning was achieved using a lazy turntable bearing.
3. Use nerf darts with suction heads on them so they stick. Also, the poster should be made of a material where the darts can stick. In this case, the board was laminated. Furthermore, the poster must be flush with the board or else the darts will not stick.
4. The poster was made using Adobe Illustrator. Use similar software than can create images with good quality so the image does not look pixelated.
5. There is a lot of freedom when it comes to building the mount. One thing to keep in mind is the mount should be sturdy enough to not sway when hit by darts, or else the darts will bounce. The mount should also be stable enough where the spinning will not cause it to fall. In this case, the mount was built using wooden boards from Lowe's, and was supported using nails and heavy-duty glue. It was painted using acrylic paints. It should be inexpensive to build this, although more sophisticated models would give better durability.

