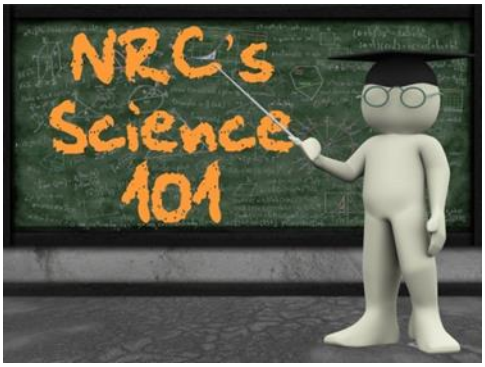
The Nuclear Regulatory Commission's Science 101: What is Ionizing Radiation?



Let's first talk about radiation in general and then build up to the concept of ionization.

In previous NRC Science 101s, we've talked about the composition of an atom, including electrons, protons and neutrons. In 1913, physicist Niels Bohr made adjustments to an earlier model which imagined that the structure of an atom was similar to a solar system: electrons in circular orbits around a "sun" otherwise known as an atomic nucleus.

While modern atomic science has a more accurate understanding of the atom, Bohr's model is still useful. It is easy to visualize and helps us to think about the relationship between electrons and energy. So, for the purposes of this NRC Science 101, let's use Bohr's atomic model.

Radiation is simply the transfer of energy through a medium. The medium can be anything: water, air or even the vacuum of outer-space. The transfer of energy can be carried out by particles or by electromagnetic waves.

Let's conduct a small experiment. Imagine putting your face close to (but not touching) a bare 100-watt light bulb in a lamp. If you did this, and closed your eyes, could you still tell if the light was on? Could you feel the heat on your face, even though you are not touching the bulb?

Of course you could. That's radiation! Light, heat, pressure waves in the air (sound), radio signals, and x-rays are all forms of radiation.

As noted in prior NRC Science 101s, the core of an atom (the nucleus) is surrounded by orbiting electrons, like planets or comets around a sun. The number of electrons (each with one negative electric charge) usually equals the number of positive charges in the center (from an equal number of protons). These charges cancel out. However, if an orbiting electron is pushed out of its orbit (due to it absorbing energy from an outside source), the charges are now unequal.

The result? An "ion pair" has been formed. The creation of an "ion pair" is called . . . ionization.

Ionizing radiation is radiation with enough energy to create ion pairs in atoms. It is ionizing radiation that is of particular interest to the NRC because of its potential to cause health effects.

To help you visualize this, think again about Bohr's model. Imagine a comet (standing in place of an electron) passing through our solar system. As the comet approaches the sun, it feels an intensifying push as light from the sun imparts more and more energy to the comet. Eventually, there is so much "push" that the comet either changes speed or changes direction. Now where will it go? Will it now be on course to strike a planet or will it veer out of our solar system? It's exactly what could happen to an electron in the subatomic universe it occupies.

But this example is nothing compared to the bizarre realm of atomic physics where a solar system (an atom) might spit out a mini-version of itself, split into two, or where two twin comets (electrons) might appear out of nothing!