# How is Dose Measured?

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**Fact Sheet #5**

Division of Environmental Health
Office of Radiation Protection

Washington State Department of Health

## RADIATION DOSE

When radioactive material decays and the transformation of the atom occurs there is characteristic energy that is released. This energy is released in the form of what we call radiation. There are different types of radiation, but they all serve the same general purpose, ridding the atom of excess energy after it transforms. These radiations travel until, by losing energy, they "stop". Radiation loses its energy by interacting with atoms in its pathway and transferring energy to the atom during these interactions. When an interaction with radiation removes an electron from the atom it is called ionization. Other types of interactions include the excitation of an atom, the breaking of molecular bonds, and the heating of an atom or molecule. Ionization, excitation, and molecular bond breaking can cause biological damage; heat transfer does not necessarily cause biological damage. The purely physical event of energy deposited by a radiation in a given volume of material, i.e. tissue, is called the absorbed dose. The unit of absorbed dose is called the Rad, the international unit is the Gray (gy).

The absorbed dose quantifies the amount of energy transferred to a volume of material, but it does not reflect the biological damage that potentially occurred. Because of the physics of radiation, the biological effect of the same amount of absorbed energy may vary according to the type of the radiation. A quality factor, Q was developed, to be able to compare absorbed doses from different radiation types. For beta, gamma, and x-ray radiation the quality factor is defined to be 1; for alpha particle radiation it is 20. Multiplying the absorbed dose (in Rad or Gray) by the quality factor (also known as the radiation weighting factor) produces what is called the equivalent dose. The unit of equivalent dose is called the Rem, the international unit is the Sievert (Sv). Thus, an equivalent dose of 20 rem of x-rays should have the same biological effect as 20 rem of alpha particles when it is taken in by the same part of the body, even though the absorbed dose is different (i.e., 20 rad x-rays and 1 rad alpha particles).