

Component 4: Hiroshima and Nagasaki: The Atomic Bombings and Resultant Biological Effects of Radiation

This component of the Japan Teaching Module is designed for middle grades and high school science methods students, students enrolled in introductory college physics or physical science courses, and high school physics and physical science students. Some parts of this component could also be useful to high school and introductory college level biology students.

Nuclear science is often perceived as a difficult element of the science curriculum. This component was specifically designed to present content in short segments so that student users might successfully master one component before moving on to another. To increase interest and decrease frustration, special effort was made to illustrate complex processes with graphics and photos and to provide links to animations and video footage whenever possible. A large selection of photos depicting damage according to distance from hypocenters is also included. The final module provides photos and video footage of survivors, along with their personal health stories, in audio in an effort to enable the reader/user to develop a personal connection to those affected.

Below are the titles and brief descriptions of the seven parts of this component:

Nuclear Fission: the process of nuclear fission and an explanation of the components of the atomic bombs and how they worked.

Energy Forms: a discussion of the three types of energy forms released by the bombs (heat, shock wave/air blast, and radioactivity).

Blast Damage to Structures and Environment: An examination of structural and environmental damage per distance from hypocenters.

Human Health Effects: The physical injuries suffered by humans per distance from hypocenters, radiation exposure levels per distance from hypocenters.

The Effects of Radiation on Cellular Processes

Comparison of Short and Long Term Health Effects of Radiation (documented health evidence of the survivors/victims)

Personal Health Stories of Victims/Survivors

Included in this component are links to other related and relevant sites, including links to activities and lesson plans associated with nuclear science especially useful to middle and high school teachers.

Each part contains easily identifiable keywords (in bold and underlined) necessary for comprehension of content. These keywords will be listed and defined in a "Note to Teachers" text box within each part.

Several parts include student worksheets intended for middle grades/high school students. These sheets were created for students to complete as they navigate throughout the parts of this component.

Nuclear Fission

Part 1

According to Hewitt (1997), within all known nuclei exist both an attractive force known as the nuclear strong force and a repulsive force created by electrical forces. In every known nucleus,

with the exception of the uranium atom, the nuclear strong forces dominate, holding the atom together. In the uranium atom, the nuclear strong forces may become compromised if the nucleus becomes elongated or stretched. This elongation is initiated when the uranium atom is hit with a neutron.

The Atomic Bombs: Nagasaki and Hiroshima **Part 2**

As we learned in PART ONE, a sustained nuclear fission (with critical mass) reaction in U-235 can result in a massive explosion if enough uranium material is involved. In the case of the atomic bomb dropped on Hiroshima, U-235 was the fissile material utilized. Within the bomb, U-235 was divided into two sections, both being below critical mass (to keep the bomb from exploding as soon as it was constructed).

Structural and Environmental Damage (Distance from Hypocenters) **Part 3**

According to the Hiroshima Peace Site (2006), because the atomic bomb was dropped almost directly over Hiroshima's center and because Hiroshima was located in relatively flat terrain, massive and instantaneous damage resulted in the city's almost complete destruction (90% of all buildings were destroyed). Figure 1 is an aerial view of the destroyed city of Hiroshima taken by United States Air Force Pilot of the Enola Gay, Paul Tibbets.

Human Health Effects of Radiation (Nagasaki and Hiroshima) **Part 4**

The physiological effects to humans from the atomic bombings of Hiroshima and Nagasaki are directly related to the distance individuals were from the hypocenters of the bombs at the time of the attacks. Figure 1 is a graph comparing casualties based upon varying distances from the Hiroshima hypocenter.

The Effects of Radiation on Cellular Processes **Part 5**

Of the four types of radiation emitted by the nuclear bombs deployed at Hiroshima and Nagasaki, gamma and neutron rays were the only types strong enough to reach ground and hurt people ([see PART 2](#)). The penetration of ionizing radiation into living human cells can result in cell alteration or death (Bertell, 1985). Figure 1 is a diagram depicting the process of ionization.

Atomic Bomb Injuries/Casualties and Long-term Effects **Part 6**

The populations of both Hiroshima and Nagasaki were drastically decreased due to the atomic bombing of these cities. Table 1 (Radiation Effects Research Foundation, 2003) shows the estimated population sizes of Nagasaki and Hiroshima pre- and post-bombings (post is within four months of the bombings).

Part 7

Personal Stories of Nagasaki/Hiroshima Victims/Survivors

In Japan, survivors of the bombings are called *Hibakusha*. The literal English translation is explosion-afflicted people. As of March 2005, 266,598 Hibakusha were still alive. The large majority of Hibakusha live in Japan, although some are in Korea and elsewhere.