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Chapter 1 : Effects of nuclear explosions on human health - Wikipedia

When there is a surrounding material such as air, rock, or water, this radiation interacts with and rapidly heats it to an equilibrium temperature (i.e. so that the matter is at the same temperature as the atomic bomb's matter).

This section recounts the first atomic bombing. While President Truman had hoped for a purely military target, some advisers believed that bombing an urban area might break the fighting will of the Japanese people. Hiroshima was a major port and a military headquarters, and therefore a strategic target. Also, visual bombing, rather than radar, would be used so that photographs of the damage could be taken. A T-shaped bridge at the junction of the Honkawa and Motoyasu rivers near downtown Hiroshima was the target. The bomb exploded some 1, feet above the center of the city, over Shima Surgical Hospital, some 70 yards southeast of the Industrial Promotional Hall now known as the Atomic Bomb Dome. Crewmembers of the Enola Gay saw a column of smoke rising fast and intense fires springing up. The burst temperature was estimated to reach over a million degrees Celsius, which ignited the surrounding air, forming a fireball some feet in diameter. Eyewitnesses more than 5 miles away said its brightness exceeded the sun tenfold. In less than one second, the fireball had expanded to feet. The blast wave shattered windows for a distance of ten miles and was felt as far away as 37 miles. The hundreds of fires, ignited by the thermal pulse, combined to produce a firestorm that had incinerated everything within about 4. To the crew of the Enola Gay, Hiroshima had disappeared under a thick, churning foam of flames and smoke. It caused contamination even in areas that were remote from the explosion. Radio stations went off the air, and the main line telegraph had stopped working just north of Hiroshima. Chaotic reports of a horrific explosion came from several railway stops close to the city and were transmitted to the Headquarters of the Japanese General Staff. Military headquarters personnel tried to contact the Army Control Station in Hiroshima and were met with complete silence. The Japanese were puzzled. They knew that no large enemy raid could have occurred, and no sizeable store of explosives was in Hiroshima at that time, yet terrible rumors were starting. A young officer of the Japanese General Staff was instructed to fly immediately to Hiroshima, to land, survey the damage and return to Tokyo with reliable information for the staff. Headquarters doubted that anything serious had occurred, but the rumors were building. When the staff officer in his plane was nearly miles km from Hiroshima, he and his pilot noticed a huge cloud of smoke from the bomb. In the bright afternoon, the remains of Hiroshima were burning. The plane soon reached the city and circled it. A great scar on the land was still burning, covered by a heavy cloud of smoke. They landed south of Hiroshima, and the staff officer immediately began to organize relief measures, after reporting to Tokyo. The primary target was the Kokura Arsenal, but upon reaching the target, they found that it was covered by a heavy ground haze and smoke. This section recounts the atomic bombing of Nagasaki, Japan. Like Hiroshima, the immediate aftermath in Nagasaki was a nightmare. More than forty percent of the city was destroyed. Major hospitals had been utterly flattened and care for the injured was impossible. Schools, churches, and homes had simply disappeared. Many of the survivorsâ€"Hibakushaâ€"have recorded their memories of those days. Fujie Urata Matsumoto, relates this scene: I looked at the face to see if I knew her. It was a woman of about forty. She must have been from another part of town â€" I had never seen her around here. A gold tooth gleamed in the wide-open mouth. A handful of singed hair hung down from the left temple over her cheek, dangling in her mouth. Her eyelids were drawn up, showing black holes where the eyes had been burned outâ€¦She had probably looked square into the flash and gotten her eyeballs burned. I was four then. I remember the cicadas chirping. For decades abnormally high amounts of cancer, birth defects, and tumors haunted victims. Both Hiroshima and Nagasaki have memorialized the events of August, with museums, sculpture, peace ceremonies, and parks. They want no one to forget. The citizens of Nagasaki pray that this miserable experience will never be repeated on Earth. We also consider it our duty to ensure that the experience is not forgotten but passed on intact to future generations. It is imperative that we join hands with all peace-loving people around the world and strive together for the realization of lasting world peace. The Mitsubishi plant, so complete Infrastructure Damage: Hiroshima was in ruins. Buildingsâ€"even strong modern structuresâ€"had suffered significant damage, some pushed off their foundations, some gutted by fire, others utterly destroyed. Many steel and concrete buildings appeared intact at first glance, but their outer walls hid internal damage due to the downward pressure of the air burst. Cemeteries were uprooted, and churches had become rubble. The survivors, known as hibakusha, sought relief from their injuries. However, 90 percent of all medical personnel were killed or disabled, and the remaining medical supplies quickly ran out. Their symptoms ranged from nausea, bleeding and loss of hair, to death. Flash burns, a susceptibility to leukemia, cataracts and malignant tumors were some of the other effects.

Chapter 2 : Nuclear weapon - The effects of nuclear weapons | www.nxgvision.com

Thermal Radiation. A primary form of energy from a nuclear explosion is thermal radiation. Initially, most of this energy goes into heating the bomb materials and the air in the vicinity of the blast.

Emotional Story The difficulty of climate communication is we often have to explain statistical concepts that are complex, abstract, dry and opaque - everything opposite to a sticky idea. This is even more important when debunking misinformation. Not only do we need to show how the myth is wrong, we also have to replace the myth with a credible, more compelling alternative narrative. The Heath brothers summate this process with characteristic stickiness: A sticky way of communicating this in a visual manner is the Escalator graph. The power of a sticky visual is demonstrated by the fact that the Escalator has been featured in a PBS documentary and by Senator Whitehouse on the senate floor. Another sticky way of expressing this same idea is to examine the physical reason why there is a long-term warming trend - because the planet is building up heat. The long-term warming trend is grounded in physical reality - the planetary energy imbalance. So I suggest a sticky way to communicate global warming is to express it in units of Hiroshima bombs worth of heat. This ticks all the sticky boxes: Almost noone realises just how much heat our climate system is accumulating. It tells a story - the idea that second after second, day after day, the greenhouse effect continues to blaze away and our planet continues to build up heat. The only downside of this metaphor is it is emotional - the Hiroshima bomb does come with a lot of baggage. The fact that out of a conference full of talks, rousing speeches and fascinating workshops, an AAP journalist chose that specific metaphor as the headline in an article picked up by media across the globe testifies to the stickiness of the Hiroshima metaphor. In our paper, we analyzed global heat data, created by combining pentadal 5-year average ocean heat content data to a depth of 2, meters from Levitus et al. So, how do we come up with 4 Hiroshima atomic bomb detonation equivalents per second from this data? Over the past decade, the rate is 8 x Joules per year, or 2. The yield of the Hiroshima atomic bomb was 6. That has to be the worst pause ever. The data used in Nuccitelli et al.

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Chapter 3 : The After-Effects of The Atomic Bombs on Hiroshima & Nagasaki -

The medical effects of the atomic bomb on Hiroshima upon humans can be put into the four categories below, with the effects of larger thermonuclear weapons producing blast and thermal effects so large that there would be a negligible number of survivors close enough to the center of the blast who would experience prompt/acute radiation effects.

Bring fact-checked results to the top of your browser search. The effects of nuclear weapons Nuclear weapons are fundamentally different from conventional weapons because of the vast amounts of explosive energy they can release and the kinds of effects they produce, such as high temperatures and radiation. The prompt effects of a nuclear explosion and fallout are well known through data gathered from the attacks on Hiroshima and Nagasaki , Japan; from more than atmospheric and more than 1, underground nuclear tests conducted worldwide; and from extensive calculations and computer modeling. Longer-term effects on human health and the environment are less certain but have been extensively studied. The impacts of a nuclear explosion depend on many factors, including the design of the weapon fission or fusion and its yield; whether the detonation takes place in the air and at what altitude , on the surface, underground, or underwater; the meteorological and environmental conditions; and whether the target is urban, rural, or military. Blast and radiation effects at different ranges for a kiloton nuclear explosion detonated at ground level. When a nuclear weapon detonates, a fireball occurs with temperatures similar to those at the centre of the Sun. The energy emitted takes several forms. Approximately 85 percent of the explosive energy produces air blast and shock and thermal radiation heat. The remaining 15 percent is released as initial radiation, produced within the first minute or so, and residual or delayed radiation, emitted over a period of time, some of which can be in the form of local fallout. Blast The expansion of intensely hot gases at extremely high pressures in a nuclear fireball generates a shock wave that expands outward at high velocity. The greater the overpressure, the more likely that a given structure will be damaged by the sudden impact of the wave front. An ordinary two-story, wood-frame house will collapse at an overpressure of A one-megaton weapon exploded at an altitude of 3, metres 10, feet will generate overpressure of this magnitude out to 7 km about 4 miles from the point of detonation. The winds that follow will hurl a standing person against a wall with several times the force of gravity. Within 8 km 5 miles few people in the open or in ordinary buildings will likely be able to survive such a blast. Enormous amounts of masonry, glass, wood, metal, and other debris created by the initial shock wave will fly at velocities above km miles per hour, causing further destruction. Thermal radiation As a rule of thumb, approximately 35 percent of the total energy yield of an airburst is emitted as thermal radiation â€”light and heat capable of causing skin burns and eye injuries and starting fires of combustible material at considerable distances. The shock wave, arriving later, may spread fires further. If the individual fires are extensive enough, they can coalesce into a mass fire known as a firestorm, generating a single convective column of rising hot gases that sucks in fresh air from the periphery. The inward-rushing winds and the extremely high temperatures generated in a firestorm consume virtually everything combustible. At Hiroshima the incendiary effects were quite different from those at Nagasaki, in part because of differences in terrain. The firestorm that raged over the level terrain of Hiroshima left Initial radiation A special feature of a nuclear explosion is the emission of nuclear radiation, which may be separated into initial radiation and residual radiation. Initial radiation, also known as prompt radiation, consists of gamma rays and neutrons produced within a minute of the detonation. Beta particles free electrons and a small proportion of alpha particles helium nuclei, i. Gamma rays and neutrons can produce harmful effects in living organisms, a hazard that persists over considerable distances because of their ability to penetrate most structures. Though their energy is only about 3 percent of the total released in a nuclear explosion, they can cause a considerable proportion of the casualties.

DOWNLOAD PDF THE ATOMIC BOMB AND THERMAL RADIATIONS

Chapter 4 : www.nxgvision.com - Destructive Effects

The thermal radiation consisting of ultraviolet rays, infra-red and light rays follows a nuclear explosion which creates a tremendous amount of heat, comparable to the interior of the sun in a volume of space a few inches in diameter.

Some victims were vaporized instantly, many survivors were horribly disfigured, and death from radiation was uncertainâ€"it might not claim its victims for days, weeks, months, or even years. The initial death count in Hiroshima, set at 42,â€"93,, was based solely on the disposal of bodies, and was thus much too low. Later surveys covered body counts, missing persons, and neighborhood surveys during the first months after the bombing, yielding a more reliable estimate of , dead as of November A similar survey by officials in Nagasaki set its death toll at 60,â€"70, Its plutonium bomb was more powerful, but its destructive range was limited by surrounding hills and mountains. Additional counts indicated high levels of short-term mortality in both cities: Most persons close to ground zero who received high radiation dosages died immediately or during the first day. While casualty rates exceeded death rates, they both were highest near ground zero and declined at similar rates by increasing distance from ground zero. Cumulative death rate of atomic bomb victims. Even now, after over half a century later, many aftereffects remain: Stages of A-bomb illness 1. Acute stages Acute stages ran overall from initial exposure to 4th month, with both primary and secondary thermal burns. Numerous A-bomb casualties deaths occurred almost simultaneously with explosion, but both injury and mortality rates fell with increased distanced. His waist was protected by a thick waist band. Atomic bomb trauma â€"secondary injuries sustained from flying debris, burial under rubble, and blast compression 3. A-bomb radiation illness â€"Radiation injury penetrates deeply into human body and injures cells, and thus molecules, resulting in cell death, inhibited cell division, abnormalities of intracellular molecules and membranes. These rays do not travel very far, but once in the body, they can penetrate more than 10, cells within their range. This set of alpha tracks magnified times occurred over a hour period. The plutonium particle that emitted them has a half-life of 24, years. DT , 39 â€"Actively regenerating and proliferating cells are most sensitive to radiation, e. Radiation blood injury - lethal dosage Severe illness occurs with 1, rads, causing destruction of bone marrow, marked drop in white cell counts, anemia, bleeding, destruction of stomach and intestinal fluids mucosa. Most victims died within 30 days. Immediate disorientation and coma occur with 10, rads, and death follows within hours. Hiroshima, 14, rads; Nagasaki: Degree of shielding can reduce dosage danger. Blood injuries Especially damage to bone marrow and lymphatic tissue. Severe cases subjected to â€" rads died within 14 days. Of all blood injuries, severe cases died within 40 days after exposure. General conditions of blood injury: People beyond the direct effects of primary radiation near ground zero suffered effects of radioactivity in fallout. Actual numbers are unknown, but besides local residents, affected persons included relief and first-aid teams. One survey lists 57, early entrants and 9, engaged in rescue activity for Hiroshima, and respective numbers of 21, and 3, for Nagasaki. Unhealed scars Persons who suffered thermal burns within 1. The majority of thermal injuries within 2. But the flash-burn scars altered markedly by thickening to become keloids after 3 to 4 months. Keloids Keloid is an overgrowth of scar tissue on the wound surface of a thermal burn during the reparative stage. The latter is usually caused by a secondary burn, and a keloid results from a primary thermal burn. Plastic surgery was performed on many to remove keloid scars, though recurrence of these scars was not uncommon. A-bomb cataracts In a cataract the ocular lens becomes opaque. This condition appeared a few years after the atomic bombings; the first was found in in Hiroshima; and the next, the following year in Nagasaki. Occurrence was related to age at time of exposure and distance from ground zero. Severe cases appeared earlier than mild cases. Between June and October , some patients with A-bomb cataracts were found among survivors seen at the ophthalmology clinic of Hiroshima Red Cross Hospital. Of these, 87 were exposed within 2. Leukemia Leukemia is a malignant tumor or cancer of the blood cells, with an excessive overgrowth of young white cells. Consequently, there is a decrease in red cells and platelets, followed by anemia and a tendency to bleed. While it is possible with medication to achieve periods of remission, there is unfortunately no radical treatment or cure. By a total of 1, cases were diagnosed as leukemia in Hiroshima and Nagasaki. Of these, were exposed within 10 km from ground zero. Incidence peaked in in both cities. High incidence among females. Some cases first discovered by autopsy. Exposure to rads or more made risk 3. Peak incidence was found higher among women ages First case noted in Hiroshima in , with 37 cases in Nagasaki soon added. A large-scale survey revealed 3, lung cancers in 10, deaths, with correlation of high risks to high radiation dosage. Chromosome changes Chromosomes are present in constant numbers in the nuclei of cells, and can be seen as visible entities during cell division. The count in humans is a constant Chromosome aberrations were first noted in exposed survivors in Hiroshima and Nagasaki in Subsequent systematic surveys revealed a high frequency of aberrations in blood cells and lymphocytes in fetuses exposed to large radiation doses in utero in the womb or soon after birth. Although chromosome aberrations increased with higher radiation doses, frequency of aberrations was consistently high at all dose ranges. As late as , chromosomal aberrations in somatic body cells persisted among exposed survivors. Exposure in utero and microcephaly A Nagasaki survey of 98 pregnant women exposed at a distance of 2. Besides high mortality rates, retarded growth and development was also indicated. Most notable in those exposed within 1. Genetic surveys Genetic surveys have not yielded positive evidence of genetic hazards due to atomic bomb radiation. Even so, possible A-bomb-induced effects such as spontaneous abortions, stillbirths, congenital malformations, and more, require continued study.

Chapter 5 : Atomic Bomb - History Learning Site

The Atomic Bomb and Radiation Radiation as a carcinogen was first established in December after Roentgen's discovery of X-rays. In , the first radiation induced cancer was reported emerging from an ulcerated area of the skin.

Blast damage[edit] Overpressure ranges from 1 to 50 psi 6. The thin black curve indicates the optimum burst height for a given ground range. Military planners prefer to maximise the range at which 10 psi, or more, is extended over when attacking countervalue targets, thus a m height of burst would be preferred for a 1 kiloton blast. To find the optimum height of burst for any weapon yield, the cubed root of the yield in kilotons is multiplied by the ideal H. B for a 1 kt blast, e. The high temperatures and radiation cause gas to move outward radially in a thin, dense shell called "the hydrodynamic front". The front acts like a piston that pushes against and compresses the surrounding medium to make a spherically expanding shock wave. Within a fraction of a second the dense shock front obscures the fireball, and continues to move past it, now expanding outwards, free from the fireball, causing the characteristic double pulse of light seen from a nuclear detonation, with the dip causing the double pulse due to the shock waveâ€”fireball interaction. As a general rule, the blast fraction is higher for low yield weapons. Furthermore, it decreases at high altitudes because there is less air mass to absorb radiation energy and convert it into blast. Describes effects, particularly blast effects, and the response of various types of structures to the weapons effects. Much of the destruction caused by a nuclear explosion is due to blast effects. Most buildings, except reinforced or blast-resistant structures, will suffer moderate damage when subjected to overpressures of only This can reasonably be defined as the pressure capable of producing severe damage. The range for blast effects increases with the explosive yield of the weapon and also depends on the burst altitude. Contrary to what one might expect from geometry, the blast range is not maximal for surface or low altitude blasts but increases with altitude up to an "optimum burst altitude" and then decreases rapidly for higher altitudes. This is due to the nonlinear behaviour of shock waves. When the blast wave from an air burst reaches the ground it is reflected. For each goal overpressure there is a certain optimum burst height at which the blast range is maximized over ground targets. In a typical air burst, where the blast range is maximized to produce the greatest range of severe damage, i. The optimum height of burst to maximize this desired severe ground range destruction for a 1 kt bomb is 0. Two distinct, simultaneous phenomena are associated with the blast wave in air: Static overpressure , i. The overpressure at any given point is directly proportional to the density of the air in the wave. Dynamic pressures , i. These winds push, tumble and tear objects. Most of the material damage caused by a nuclear air burst is caused by a combination of the high static overpressures and the blast winds. The long compression of the blast wave weakens structures, which are then torn apart by the blast winds. The compression, vacuum and drag phases together may last several seconds or longer, and exert forces many times greater than the strongest hurricane. Acting on the human body, the shock waves cause pressure waves through the tissues. These waves mostly damage junctions between tissues of different densities bone and muscle or the interface between tissue and air. Lungs and the abdominal cavity , which contain air, are particularly injured. The damage causes severe hemorrhaging or air embolisms , either of which can be rapidly fatal. The overpressure estimated to damage lungs is about 70 kPa. Some eardrums would probably rupture around 22 kPa 0. The drag energies of the blast winds are proportional to the cubes of their velocities multiplied by the durations. These winds may reach several hundred kilometers per hour. Many of the burn injuries exhibit raised keloid healing patterns. Nuclear weapons emit large amounts of thermal radiation as visible, infrared, and ultraviolet light, to which the atmosphere is largely transparent. This is known as "Flash". On clear days, these injuries can occur well beyond blast ranges, depending on weapon yield. This results in the range of thermal effects increasing markedly more than blast range as higher and higher device yields are detonated. In urban areas, the extinguishing of fires ignited by thermal radiation may matter little, as in a surprise attack fires may also be started by blast-effect-induced electrical shorts, gas pilot lights, overturned stoves, and other ignition sources, as was the case in the breakfast-time bombing of Hiroshima. The noncombustible debris produced by the blast frequently covered and prevented the burning of combustible material. There are two types of eye injuries from the thermal radiation of a weapon: Flash blindness is caused by the initial brilliant flash of light produced by the nuclear detonation. More light energy is received on the retina than can be tolerated, but less than is required for irreversible injury. The retina is particularly susceptible to visible and short wavelength infrared light, since this part of the electromagnetic spectrum is focused by the lens on the retina. The result is bleaching of the visual pigments and temporary blindness for up to 40 minutes. Burns visible on a woman in Hiroshima during the blast. Darker colors of her kimono at the time of detonation correspond to clearly visible burns on the skin which touched parts of the garment exposed to thermal radiation. Since kimonos are not form-fitting attire, some parts not directly touching her skin are visible as breaks in the pattern, and the tighter-fitting areas approaching the waistline have a much more well-defined pattern. A retinal burn resulting in permanent damage from scarring is also caused by the concentration of direct thermal energy on the retina by the lens. Retinal burns may be sustained at considerable distances from the explosion. The height of burst, and apparent size of the fireball, a function of yield and range will determine the degree and extent of retinal scarring. A scar in the central visual field would be more debilitating. Generally, a limited visual field defect, which will be barely noticeable, is all that is likely to occur. When thermal radiation strikes an object, part will be reflected, part transmitted, and the rest absorbed. The fraction that is absorbed depends on the nature and color of the material. A thin material may transmit a lot. A light colored object may reflect much of the incident radiation and thus escape damage, like anti-flash white paint. The absorbed thermal radiation raises the temperature of the surface and results in scorching, charring, and burning of wood, paper, fabrics, etc. If the material is a poor thermal conductor, the heat is confined to the surface of the material. Actual ignition of materials depends on how long the thermal pulse lasts and the thickness and moisture content of the target. Farther away, only the most easily ignited materials will flame. Incendiary effects are compounded by secondary fires started by the blast wave effects such as from upset stoves and furnaces. It is not peculiar to nuclear explosions, having been observed frequently in large forest fires and following incendiary raids during World War II. Despite fires destroying a large area of the city of Nagasaki, no true firestorm occurred in the city, even though a higher yielding weapon was used. Nagasaki probably did not furnish sufficient fuel for the development of a fire storm as compared to the many buildings on the flat terrain at Hiroshima. Depending on the properties of the underlying surface material, the exposed area outside the protective shadow will be either burnt to a darker color, such as charring wood, [18] or a brighter color, such as asphalt. Under these conditions, opaque objects are therefore less effective than they would otherwise be without scattering, as they demonstrate maximum shadowing effect in an environment of perfect visibility and therefore zero scattering. This, as part of the mushroom cloud, is shot into the stratosphere where it is responsible for dissociating ozone there , in exactly the same way as combustion NOx compounds do. Studies done on the total effect of nuclear blasts on the ozone layer have been at least tentatively exonerating after initial discouraging findings.

Chapter 6 : Effects of nuclear explosions - Wikipedia

Radiation Effects of a Nuclear Bomb Beside shock, blast, and heat a nuclear bomb generates high intensity flux of radiation in form of Î³-rays, x-rays, and.

The melting of metal like this occurred during the ensuing fires and firestorms , long after the bombs had exploded. The main causes of death and disablement in this state are thermal burns and the failure of structures resulting from the blast effect. Injury from the pressure wave is minimal in contrast because the human body can survive up to 2 bar 30 psi while most buildings can only withstand a 0. Therefore, the fate of humans is closely related to the survival of the buildings around them. In a nuclear explosion the human body can be irradiated by at least three processes. The first, and most major, cause of burns is due to thermal radiation and not caused by ionizing radiation. Thermal burns from infrared heat radiation, these would be the most common burn type experienced by personnel. If people come in direct contact with fallout , beta burns from shallow ionizing beta radiation will be experienced, the largest particles visible to the naked eye in local fallout would be likely to have very high radioactivity because they would be deposited so soon after detonation; this fraction of the total fallout is called the prompt or local fallout fraction. It is likely that one such particle upon the skin would be able to cause a localized beta burn. This local fallout, termed Bikini snow after the Pacific island weapon tests, [8] was experienced by the crew on the deck of the Lucky Dragon fishing ship following the explosion of the 15 megaton Shrimp device in the Castle Bravo event. However, these particular decay particles beta particles are very weakly penetrating and have a short range, requiring almost direct contact between fallout and personnel to be harmful. Rarer still would be personnel who experience radiation burns from highly penetrating gamma radiation. This would likely cause deep gamma penetration within the body, which would result in uniform whole body irradiation rather than only a surface burn. In cases of whole body gamma irradiation c. In the picture above, the normal clothing a kimono that the woman was wearing attenuated the far reaching thermal radiation ; the kimono, however, would naturally have been unable to attenuate any gamma radiation , if she were close enough to the weapon to have experienced any, and it would be likely that any such penetrating radiation effect would be evenly applied to her entire body. Beta burns would likely be all over the body if there was contact with fallout after the explosion, unlike thermal burns, which are only ever on one side of the body, as heat radiation infrared naturally does not penetrate the human body. In addition, the pattern on her clothing has been burnt into the skin by the thermal radiation. This is because white fabric reflects more visible and infrared light than dark fabric. As a result, the skin underneath dark fabric is burned more than the skin covered by white clothing. There is also the risk of internal radiation poisoning by ingestion of fallout particles, if one is in a fallout zone. The term is generally used to refer to acute problems caused by a large dosage of radiation in a short period, though this also has occurred with long-term exposure to low-level radiation. Many of the symptoms of radiation poisoning occur as ionizing radiation interferes with cell division. There are numerous lethal radiation syndromes, including prodromal syndrome, bone marrow death, central nervous system death and gastrointestinal death. Bone marrow death[edit] Bone marrow death is caused by a dose of radiation between 2 and 10 Gray and is characterized by the part of the bone marrow that makes the blood being broken down. Therefore, production of red and white blood cells and platelets is stopped due to loss of the blood-making stem cells 4. The loss of platelets greatly increases the chance of fatal hemorrhage , while the lack of white blood cells causes infections; the fall in red blood cells is minimal, and only causes mild anemia.

Chapter 7 : Avalon Project - The Atomic Bombings of Hiroshima and Nagasaki

Blast, heat and radiation It takes around 10 seconds for the fireball from a nuclear explosion to reach its maximum size, but the effects last for decades. A nuclear explosion releases vast amounts of energy in the form of blast, heat and radiation.

Next The most striking difference between the explosion of an atomic bomb and that of an ordinary T. But in addition to its vastly greater power, an atomic explosion has several other very special characteristics. Ordinary explosion is a chemical reaction in which energy is released by the rearrangement of the atoms of the explosive material. In an atomic explosion the identity of the atoms, not simply their arrangement, is changed. A considerable fraction of the mass of the explosive charge, which may be uranium or plutonium, is transformed into energy. The significance of the equation is easily seen when one recalls that the velocity of light is , miles per second. The energy released when a pound of T. The nuclear fission of a pound of uranium would produce an equal temperature rise in over million pounds of water. The explosive effect of an ordinary material such as T. A wave of high pressure thus rapidly moves outward from the center of the explosion and is the major cause of damage from ordinary high explosives. An atomic bomb also generates a wave of high pressure which is in fact of, much higher pressure than that from ordinary explosions; and this wave is again the major cause of damage to buildings and other structures. It differs from the pressure wave of a block buster in the size of the area over which high pressures are generated. It also differs in the duration of the pressure pulse at any given point: The next greatest difference between the atomic bomb and the T. Most of this radiation is "light" of some wave-length ranging from the so-called heat radiations of very long wave length to the so-called gamma rays which have wave-lengths even shorter than the X-rays used in medicine. All of these radiations travel at the same speed; this, the speed of light, is , miles per second. The radiations are intense enough to kill people within an appreciable distance from the explosion, and are in fact the major cause of deaths and injuries apart from mechanical injuries. The greatest number of radiation injuries was probably due to the ultra-violet rays which have a wave length slightly shorter than visible light and which caused flash burn comparable to severe sunburn. After these, the gamma rays of ultra short wave length are most important; these cause injuries similar to those from over-doses of X-rays. The origin of the gamma rays is different from that of the bulk of the radiation: The gamma rays on the other hand are emitted by the atomic nuclei themselves when they are transformed in the fission process. The gamma rays are therefore specific to the atomic bomb and are completely absent in T. The light of longer wave length visible and ultra-violet is also emitted by a T. A large fraction of the gamma rays is emitted in the first few microseconds millionths of a second of the atomic explosion, together with neutrons which are also produced in the nuclear fission. The neutrons have much less damage effect than the gamma rays because they have a smaller intensity and also because they are strongly absorbed in air and therefore can penetrate only to relatively small distances from the explosion: After the nuclear emission, strong gamma radiation continues to come from the exploded bomb. This generates from the fission products and continues for about one minute until all of the explosion products have risen to such a height that the intensity received on the ground is negligible. A large number of beta rays are also emitted during this time, but they are unimportant because their range is not very great, only a few feet. The range of alpha particles from the unused active material and fissionable material of the bomb is even smaller. Apart from the gamma radiation ordinary light is emitted, some of which is visible and some of which is the ultra violet rays mainly responsible for flash burns. The emission of light starts a few milliseconds after the nuclear explosion when the energy from the explosion reaches the air surrounding the bomb. The observer sees then a ball of fire which rapidly grows in size. During most of the early time, the ball of fire extends as far as the wave of high pressure. As the ball of fire grows its temperature and brightness decrease. Several milliseconds after the initiation of the explosion, the brightness of the ball of fire goes through a minimum, then it gets somewhat brighter and remains at the order of a few times the brightness of the sun for a period of 10 to 15 seconds for an observer at six miles distance. Most of the radiation is given off after this point of maximum brightness. Also after this maximum, the pressure waves run ahead of the ball of fire. The ball of fire rapidly expands from the size of the bomb to a radius of several hundred feet at one second after the explosion. After this the most striking feature is the rise of the ball of fire at the rate of about 30 yards per second. Meanwhile it also continues to expand by mixing with the cooler air surrounding it. At the end of the first minute the ball has expanded to a radius of several hundred yards and risen to a height of about one mile. The ball now loses its brilliance and appears as a great cloud of smoke: This cloud continues to rise vertically and finally mushrooms out at an altitude of about 25, feet depending upon meteorological conditions. The cloud reaches a maximum height of between 50, and 70, feet in a time of over 30 minutes. It is of interest to note that Dr. Hans Bethe, then a member of the Manhattan Engineer District on loan from Cornell University, predicted the existence and characteristics of this ball of fire months before the first test was carried out. To summarize, radiation comes in two bursts - an extremely intense one lasting only about 3 milliseconds and a less intense one of much longer duration lasting several seconds. But the first flash is especially large in ultra-violet radiation which is biologically more effective. People may be injured by flash burns at even larger distances. Gamma radiation danger does not extend nearly so far and neutron radiation danger is still more limited. The high skin temperatures result from the first flash of high intensity radiation and are probably as significant for injuries as the total dosages which come mainly from the second more sustained burst of radiation. The combination of skin temperature increase plus large ultra-violet flux inside 4, yards is injurious in all cases to exposed personnel. Beyond this point there may be cases of injury, depending upon the individual sensitivity. The infra-red dosage is probably less important because of its smaller intensity.

Chapter 8 : Thermal Radiation

The effects of nuclear weapons. Nuclear weapons are fundamentally different from conventional weapons because of the vast amounts of explosive energy they can release and the kinds of effects they produce, such as high temperatures and radiation.

Blast, thermal radiation, and prompt ionizing radiation cause significant destruction within seconds or minutes of a nuclear detonation. The delayed effects, such as radioactive fallout and other possible environmental effects, inflict damage over an extended period ranging from hours to years. Each of these effects are calculated from the point of detonation. For a burst over or under water, the corresponding point is generally called "surface zero". The term "surface zero" or "surface ground zero" is also commonly used for ground surface and underground explosions. In some publications, ground or surface zero is called the "hypocenter" of the explosion. Blast Effects Most damage comes from the explosive blast. The shock wave of air radiates outward, producing sudden changes in air pressure that can crush objects, and high winds that can knock objects down. In general, large buildings are destroyed by the change in air pressure, while people and objects such as trees and utility poles are destroyed by the wind. The magnitude of the blast effect is related to the height of the burst above ground level. For any given distance from the center of the explosion, there is an optimum burst height that will produce the greatest change in air pressure, called overpressure, and the greater the distance the greater the optimum burst height. As a result, a burst on the surface produces the greatest overpressure at very close ranges, but less overpressure than an air burst at somewhat longer ranges. Some of the material that used in be in the crater is deposited on the rim of the crater; the rest is carried up into the air and returns to Earth as radioactive fallout. For the most part, a nuclear blast kills people by indirect means rather than by direct pressure. Thermal Radiation Effects Approximately 35 percent of the energy from a nuclear explosion is an intense burst of thermal radiation, i. The effects are similar to the effect of a two-second flash from an enormous sunlamp. Since the thermal radiation travels at roughly the speed of light, the flash of light and heat precedes the blast wave by several seconds, just as lightning is seen before thunder is heard. The visible light will produce "flashblindness" in people who are looking in the direction of the explosion. Flashblindness can last for several minutes, after which recovery is total. If the flash is focused through the lens of the eye, a permanent retinal burn will result. At Hiroshima and Nagasaki, there were many cases of flashblindness, but only one case of retinal burn, among the survivors. On the other hand, anyone flashblinded while driving a car could easiIy cause permanent injury to himself and to others. Skin burns result from higher intensities of light, and therefore take place closer to the point of explosion. First-degree, second-degree and third-degree burns can occur at distances of five miles away from the blast or more. Third-degree burns over 24 percent of the body, or second-degree burns over 30 percent of the body, will result in serious shock, and will probably prove fatal unless prompt, specialized medical care is available. The entire United States has facilities to treat 1, or 2, severe burn cases. A single nuclear weapon could produce more than 10, The thermal radiation from a nuclear explosion can directly ignite kindling materials. In general, ignitable materials outside the house, such as leaves or newspapers, are not surrounded by enough combustible material to generate a self-sustaining fire. Fires more likely to spread are those caused by thermal radiation passing through windows to ignite beds and overstuffed furniture inside houses. Another possible source of fires, which might be more damaging in urban areas, is indirect. Blast damage to Stores, water heaters, furnaces, electrical circuits or gas lines would ignite fires where fuel is plentiful. Direct Nuclear Radiation Effects Direct radiation occurs at the time of the explosion. It can be very intense, but its range is limited. For large nuclear weapons, the range of intense direct radiation is less than the range of lethal blast and thermal radiation effects. However, in the case of smaller weapons, direct radiation may be the lethal effect with the greatest range. Direct radiation did substantial damage to the residents of Hiroshima and Nagasaki. Human response to ionizing radiation is subject to great scientific uncertainty and intense controversy. It seems likely that even small doses of radiation do some harm. Fallout Fallout radiation is received from particles that are made radioactive by the effects of the explosion, and subsequently distributed at varying distances from the site of the blast. While any nuclear explosion in the atmosphere produces some fallout, the fallout is far greater if the burst is on the surface, or at least low enough for the firebalI to touch the ground. The significant hazards come from particles scooped up from the ground and irradiated by the nuclear explosion. The radioactive particles that rise only a short distance those in the "stem" of the familiar mushroom cloud will fall back to earth within a matter of minutes, landing close to the center of the explosion. Such particles are unlikely to cause many deaths, because they will fall in areas where most people have already been killed. However, the radioactivity will complicate efforts at rescue or eventual reconstruction. The radioactive particles that rise higher will be carried some distance by the wind before returning to Earth, and hence the area and intensity of the fallout is strongly influenced by local weather conditions. Much of the material is simply blown downwind in a long plume. Rainfall also can have a significant influence on the ways in which radiation from smaller weapons is deposited, since rain will carry contaminated particles to the ground. The areas receiving such contaminated rainfall would become "hot spots," with greater radiation intensity than their surroundings. Page 2 of

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Basic Effects of Nuclear Weapons. Nuclear explosions produce both immediate and delayed destructive effects. Blast, thermal radiation, and prompt ionizing radiation cause significant destruction within seconds or minutes of a nuclear detonation.

C N Trueman "Atomic Bomb" historylearningsite. The History Learning Site, 25 May The atomic bomb was first used in warfare at Hiroshima and Nagasaki in August and the bomb played a key role in ending World War Two. The atomic bomb A bomb , created via the Manhattan Project , was first exploded at the top secret base of Alamogordo on July 16th, Half of that energy was consumed when the explosion generated an ultra high air pressure which resulted in a very strong bomb blast. One third of the rest of the energy created was consumed when the explosion generated heat, while the rest of the energy that was created was consumed in the creation of radiation. Directly beneath the centre of the explosion the hypocentre , the temperature rose to about 7, degrees F. Directly underneath the hypocentre and not far from this point the damage was massive. Yet buildings etc that had areas protected by a human body were relatively unchanged as the body had taken the full impact of the heat and had absorbed it. The heat created was so great that clothes caught fire on people over one and a quarter miles from the centre of the explosion; roof tiles a third of a mile away melted. The wind speed on the ground directly beneath the explosion was believed to have been mph and this speed generated a pressure the equivalent to 8, lbs per square feet. One third of a mile from the bomb blast, the wind speed was thought to be mph which created a pressure of 4, lbs per square feet. Such a force would simply flatten most buildings â€" which is why the post-bomb photographs of Hiroshima show barely any buildings standing. One mile from the centre of the blast, the wind speed was still mph and this speed created a pressure the equivalent of 1, lbs per square feet. Such a force would still be very capable of bringing down the most sturdy of buildings. Alpha and beta rays were absorbed by the air but gamma and neutron rays did reach the ground and it was these rays that affected the people of Hiroshima. Radiation poisoning killed many people in the city. Nearly all the people who survived the bomb blast but lived within a half-mile of it died within 30 days. People who entered the zone around where the bomb had been most devastating were also exposed to very high levels of radiation if they did so in the first hours after the explosion. The city government of Hiroshima kept records from on but it is estimated that from August to , some 60, people died of radiation poisoning â€" an average of 8, a year.