**Biological Warfare**

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*For the use of* [*biological agents*](https://en.wikipedia.org/wiki/Biological_agent) *by terrorists, see* [*bioterrorism*](https://en.wikipedia.org/wiki/Bioterrorism)*.*

*"Germ Warfare" redirects here. For the* M\*A\*S\*H *episode, see* [*Germ Warfare (M\*A\*S\*H)*](https://en.wikipedia.org/wiki/Germ_Warfare_%28M%2AA%2AS%2AH%29)*.*

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**Biological warfare** (BW) — also known as **germ warfare** — is the use of [biological toxins](https://en.wikipedia.org/wiki/Toxin#Biotoxins) or [infectious agents](https://en.wikipedia.org/wiki/Pathogen) such as bacteria, viruses, and [fungi](https://en.wikipedia.org/wiki/Fungus) with intent to kill or incapacitate humans, animals or plants as an act of war. [Biological weapons](https://en.wikipedia.org/wiki/Biological_agent) (often termed "bio-weapons", "biological threat agents", or "bio-agents") are living [organisms](https://en.wikipedia.org/wiki/Organism) or replicating entities (viruses) that reproduce or replicate within their [host](https://en.wikipedia.org/wiki/Host_%28biology%29) victims. [Entomological (insect) warfare](https://en.wikipedia.org/wiki/Entomological_warfare) is also considered a type of BW.

Biological weapons may be employed in various ways to gain a strategic or [tactical](https://en.wikipedia.org/wiki/Tactic_%28method%29) advantage over an adversary, either by threats or by actual deployments. Like some of the [chemical weapons](https://en.wikipedia.org/wiki/Chemical_weapons), biological weapons may also be useful as [area denial weapons](https://en.wikipedia.org/wiki/Area_denial_weapons). These agents may be lethal or [non-lethal](https://en.wikipedia.org/wiki/Non-lethal_weapon), and may be targeted against a single individual, a group of people, or even an entire population. They may be developed, acquired, stockpiled or deployed by [nation states](https://en.wikipedia.org/wiki/Nation_state) or by non-national groups. In the latter case, or if a nation-state uses it [clandestinely](https://en.wikipedia.org/wiki/Clandestine_operation), it may also be considered [bioterrorism](https://en.wikipedia.org/wiki/Bioterrorism).

There is an overlap between BW and [chemical warfare](https://en.wikipedia.org/wiki/Chemical_warfare), as the use of [toxins](https://en.wikipedia.org/wiki/Toxin) produced by living organisms is considered under the provisions of both the [Biological Weapons Convention](https://en.wikipedia.org/wiki/Biological_Weapons_Convention) and the [Chemical Weapons Convention](https://en.wikipedia.org/wiki/Chemical_Weapons_Convention). Toxins and [Psychochemical weapons](https://en.wikipedia.org/wiki/Psychochemical_weapons) are often referred to as *mid-spectrum agents*. Unlike bioweapons, these mid-spectrum agents do not reproduce in their host and are typically characterized by shorter incubation periods.

**Overview**

Offensive biological warfare, including [mass production](https://en.wikipedia.org/wiki/Mass_production), stockpiling and use of biological weapons, was outlawed by the 1972 Biological Weapons Convention (BWC). The [rationale](https://en.wikipedia.org/wiki/Theory_of_justification) behind this [treaty](https://en.wikipedia.org/wiki/Treaty), which has been [ratified](https://en.wikipedia.org/wiki/Ratification) or acceded to by [165 countries](https://en.wikipedia.org/wiki/List_of_parties_to_the_Biological_Weapons_Convention) as of 2011, is to prevent a biological attack which could conceivably result in large numbers of civilian fatalities and cause severe disruption to economic and societal infrastructure. Many countries, including signatories of the BWC, currently pursue research into the defense or protection against BW, which is not prohibited by the BWC.

A nation or group that can pose a credible threat of mass casualty has the ability to alter the terms on which other nations or groups interact with it. Biological weapons allow for the potential to create a level of destruction and loss of life far in excess of nuclear, chemical or conventional weapons, relative to their mass and cost of development and storage. Therefore, biological agents may be useful as strategic deterrents in addition to their utility as offensive weapons on the battlefield.

As a tactical weapon for military use, a significant problem with a BW attack is that it would take days to be effective, and therefore might not immediately stop an opposing force. Some biological agents ([smallpox](https://en.wikipedia.org/wiki/Smallpox), [pneumonic plague](https://en.wikipedia.org/wiki/Pneumonic_plague)) have the capability of person-to-person [transmission](https://en.wikipedia.org/wiki/Transmission_%28medicine%29) via [aerosolized](https://en.wikipedia.org/wiki/Aerosol) [respiratory droplets](https://en.wikipedia.org/wiki/Transmission_%28medicine%29#Droplet_Contact). This feature can be undesirable, as the agent(s) may be transmitted by this mechanism to unintended populations, including neutral or even friendly forces. While containment of BW is less of a concern for certain criminal or terrorist organizations, it remains a significant concern for the military and civilian populations of virtually all nations.

**History**

Main article: [History of biological warfare](https://en.wikipedia.org/wiki/History_of_biological_warfare)

Rudimentary forms of biological warfare have been practiced over and over again throughout history. Many examples are recorded from antiquity. During the 6th century BC, the [Assyrians](https://en.wikipedia.org/wiki/Assyrian_people) poisoned enemy wells with a fungus that would render the enemy delirious. In 184 BC, [Hannibal of Carthage](https://en.wikipedia.org/wiki/Hannibal) had clay pots filled with [venomous snakes](https://en.wikipedia.org/wiki/Venomous_snakes) and instructed his soldiers to throw the pots onto the decks of [Pergamene](https://en.wikipedia.org/wiki/Pergamon) ships.

Historical accounts from medieval Europe detail the use of infected animal carcasses, by [Mongols](https://en.wikipedia.org/wiki/Mongol), Turks and other groups, to infect enemy water supplies. In 1346, the bodies of Mongol warriors of the [Golden Horde](https://en.wikipedia.org/wiki/Golden_Horde) who had died of plague were thrown over the walls of the besieged [Crimean](https://en.wikipedia.org/wiki/Crimea) city of [Kaffa](https://en.wikipedia.org/wiki/Caffa). It has been speculated that this operation may have been responsible for the advent of the [Black Death](https://en.wikipedia.org/wiki/Black_Death) in [Europe](https://en.wikipedia.org/wiki/Europe). The last known incident of using plague corpses for BW purposes occurred in 1710, when [Russian](https://en.wikipedia.org/wiki/Russia) forces attacked the [Swedes](https://en.wikipedia.org/wiki/Sweden) by flinging plague-infected corpses over the city walls of [Reval](https://en.wikipedia.org/wiki/Reval) (Tallinn).

The [British army](https://en.wikipedia.org/wiki/British_army) at least once attempted to use [smallpox](https://en.wikipedia.org/wiki/Smallpox) as a weapon, when they [gave contaminated blankets](https://en.wikipedia.org/wiki/Pontiac%27s_War#Siege_of_Fort_Pitt) to the [Lenape](https://en.wikipedia.org/wiki/Lenape) during [Pontiac's War](https://en.wikipedia.org/wiki/Pontiac%27s_War) (1763–66). It is suspected by [Ward Churchill](https://en.wikipedia.org/wiki/Ward_Churchill_academic_misconduct_investigation), but not confirmed, that BW was used against Native Americans at other times as well.

The advent of the [germ theory](https://en.wikipedia.org/wiki/Germ_theory) and advances in [bacteriology](https://en.wikipedia.org/wiki/Bacteriology) brought a new level of sophistication to the theoretical use of [bio-agents](https://en.wikipedia.org/wiki/Bio-agent) in war. Biological sabotage – in the form of [anthrax](https://en.wikipedia.org/wiki/Anthrax) and [glanders](https://en.wikipedia.org/wiki/Glanders) — was undertaken on behalf of the [Imperial German](https://en.wikipedia.org/wiki/German_Empire) government during World War I (1914–1918), with indifferent results. Use of such bio-weapons was banned in international law by the [Geneva Protocol](https://en.wikipedia.org/wiki/Geneva_Protocol) of 1925. (The 1972 [Biological and Toxin Weapons Convention](https://en.wikipedia.org/wiki/Biological_and_Toxin_Weapons_Convention) (BWC) extended the ban to almost all production, storage and transport. However, both the [Soviet Union](https://en.wikipedia.org/wiki/Soviet_Union) and [Iraq](https://en.wikipedia.org/wiki/Iraq), at a minimum, secretly defied the treaty and continued research and production of offensive biological weapons, despite being signatories to it. Major public proof of the Soviet program, called [Biopreparat](https://en.wikipedia.org/wiki/Biopreparat), came when [Dr. Kanatjan Alibekov](https://en.wikipedia.org/wiki/Dr._Kanatjan_Alibekov), its first deputy director, defected to the U.S. in 1992.)

[Shiro Ishii](https://en.wikipedia.org/wiki/Shiro_Ishii), commander of [Unit 731](https://en.wikipedia.org/wiki/Unit_731)

During the [Sino-Japanese War (1937–1945)](https://en.wikipedia.org/wiki/Sino-Japanese_War_%281937%E2%80%931945%29) and World War II (1939–1945), the [Special Research Units](https://en.wikipedia.org/wiki/Special_Research_Units) of the [Imperial Japanese Army](https://en.wikipedia.org/wiki/Imperial_Japanese_Army), such as [Unit 731](https://en.wikipedia.org/wiki/Unit_731), conducted [human experimentation](https://en.wikipedia.org/wiki/Human_experimentation) on thousands of Chinese, among others. In its military campaigns, the Japanese used BW on Chinese soldiers and civilians. This employment has been largely viewed as ineffective due to inefficient delivery systems. However, firsthand accounts testify that the Japanese infected civilians through the distribution of plagued foodstuffs and newer estimates suggest over 580,000 victims, largely due to plague and cholera outbreaks.

In response to suspected BW development in [Nazi Germany](https://en.wikipedia.org/wiki/Nazi_Germany), the U.S., U.K., and Canada initiated a BW development program in 1941 that resulted in the weaponization of [anthrax](https://en.wikipedia.org/wiki/Anthrax_disease), [brucellosis](https://en.wikipedia.org/wiki/Brucellosis), and [botulism](https://en.wikipedia.org/wiki/Botulism) toxin. Fear of the German program turned out to be vastly exaggerated. The center for U.S. military biological warfare research was [Fort Detrick, Maryland](https://en.wikipedia.org/wiki/Fort_Detrick%2C_Maryland). The biological and chemical weapons developed during that period were tested at the [Dugway Proving Grounds](https://en.wikipedia.org/wiki/Dugway_Proving_Grounds) in [Utah](https://en.wikipedia.org/wiki/Utah). Research carried out in the U.K. during World War II left [Gruinard Island](https://en.wikipedia.org/wiki/Gruinard_Island) in Scotland contaminated with anthrax for the next 48 years.

Considerable research into BW was undertaken throughout the [Cold War](https://en.wikipedia.org/wiki/Cold_War) era (1947–1991) by the U.S., U.K. and U.S.S.R., and probably other major nations as well, although it is generally believed that such weapons were never used. This view was challenged by China and [North Korea](https://en.wikipedia.org/wiki/North_Korea), who accused the U.S. of large-scale field testing of BW against them during the [Korean War](https://en.wikipedia.org/wiki/Korean_War) (1950–1953), but this claim has been [disputed](https://en.wikipedia.org/wiki/Allegations_of_biological_warfare_in_the_Korean_War). The U.S. maintained a stated national policy of never using BW under any circumstances since an Executive Decision in November 1969, by [President Richard Nixon](https://en.wikipedia.org/wiki/President_Richard_Nixon). In 1972, the U.S., U.K., U.S.S.R., and many other nations signed the BWC, which banned "development, production and stockpiling of microbes or their poisonous products except in amounts necessary for protective and peaceful research." By then, the U.S. and U.K. had transparently destroyed all their bio-weapons stockpiles. By 2011, 165 countries had signed the treaty and none are proven—though nine are still suspected—to possess offensive BW programs.

**Modern BW operations**

**Offensive**

It has been argued that rational people would never use biological weapons offensively. The argument is that biological weapons cannot be controlled: the weapon could backfire and harm the army on the offensive, perhaps having even worse effects than on the target. An agent like smallpox or other airborne viruses would almost certainly spread worldwide and ultimately infect the user's home country. However, this argument does not necessarily apply to bacteria. For example, anthrax can easily be controlled and even created in a garden shed. Also, using microbial methods, bacteria can be suitably modified to be effective in only a narrow environmental range, the range of the target that distinctly differs from the army on the offensive. Thus only the target might be affected adversely. The weapon may be further used to bog down an advancing army making them more vulnerable to counter attack by the defending force.

**Anti-personnel**

The international [biological hazard](https://en.wikipedia.org/wiki/Biological_hazard) symbol

Ideal characteristics of a biological agent to be used as a weapon against humans are high [infectivity](https://en.wikipedia.org/wiki/Infectivity), high [virulence](https://en.wikipedia.org/wiki/Virulence), non-availability of [vaccines](https://en.wikipedia.org/wiki/Vaccine), and availability of an effective and efficient [delivery system](https://en.wikipedia.org/wiki/Delivery_system). Stability of the [weaponized](https://en.wikipedia.org/w/index.php?title=Weaponization&action=edit&redlink=1) agent (ability of the agent to retain its infectivity and virulence after a prolonged period of storage) may also be desirable, particularly for military applications, and the ease of creating one is often considered. Control of the spread of the agent may be another desired characteristic.

The primary difficulty is not the production of the biological agent, as many biological agents used in weapons can often be manufactured relatively quickly, cheaply and easily. Rather, it is the weaponization, storage and delivery in an effective vehicle to a vulnerable target that pose significant problems.

For example, '[Bacillus anthracis](https://en.wikipedia.org/wiki/Bacillus_anthracis)' is considered an effective agent for several reasons. First, it forms hardy [spores](https://en.wikipedia.org/wiki/Spore), perfect for dispersal aerosols. Second, this organism is not considered transmissible from person to person, and thus rarely if ever causes secondary infections. A pulmonary anthrax infection starts with ordinary [influenza](https://en.wikipedia.org/wiki/Influenza)-like symptoms and progresses to a lethal [hemorrhagic](https://en.wikipedia.org/wiki/Hemorrhagic) [mediastinitis](https://en.wikipedia.org/wiki/Mediastinitis) within 3–7 days, with a fatality rate that is 90% or higher in untreated patients. Finally, friendly personnel can be protected with suitable [antibiotics](https://en.wikipedia.org/wiki/Antibiotic).

A large-scale attack using anthrax would require the creation of aerosol particles of 1.5 to 5 [microns](https://en.wikipedia.org/wiki/Micrometre): larger particles would not reach the lower respiratory tract, while smaller particles would be exhaled back out into the atmosphere. At this size, [conductive](https://en.wikipedia.org/wiki/Electrical_conductivity) powders tend to aggregate because of [electrostatic charges](https://en.wikipedia.org/wiki/Electric_charge), hindering dispersion. So the material must be treated to insulate and neutralize the charges. The weaponized agent must be resistant to degradation by rain and ultraviolet radiation from sunlight, while retaining the ability to efficiently infect the human lung. There are other technological difficulties as well, chiefly relating to storage of the weaponized agent.

Agents considered for weaponization, or known to be weaponized, include bacteria such as *Bacillus anthracis*, [*Brucella*](https://en.wikipedia.org/wiki/Brucella) *spp.*, [*Burkholderia mallei*](https://en.wikipedia.org/wiki/Burkholderia_mallei), [*Burkholderia pseudomallei*](https://en.wikipedia.org/wiki/Burkholderia_pseudomallei), [*Chlamydophila psittaci*](https://en.wikipedia.org/wiki/Chlamydophila_psittaci), [*Coxiella burnetii*](https://en.wikipedia.org/wiki/Coxiella_burnetii), [*Francisella tularensis*](https://en.wikipedia.org/wiki/Francisella_tularensis), some of the [Rickettsiaceae](https://en.wikipedia.org/wiki/Rickettsiaceae) (especially [*Rickettsia prowazekii*](https://en.wikipedia.org/wiki/Rickettsia_prowazekii) and [*Rickettsia rickettsii*](https://en.wikipedia.org/wiki/Rickettsia_rickettsii)), [*Shigella*](https://en.wikipedia.org/wiki/Shigella) *spp.*, [*Vibrio cholerae*](https://en.wikipedia.org/wiki/Vibrio_cholerae), and [*Yersinia pestis*](https://en.wikipedia.org/wiki/Yersinia_pestis). Many viral agents have been studied and/or weaponized, including some of the [Bunyaviridae](https://en.wikipedia.org/wiki/Bunyaviridae) (especially [Rift Valley fever virus](https://en.wikipedia.org/wiki/Rift_Valley_fever)), [Ebolavirus](https://en.wikipedia.org/wiki/Ebola), many of the [Flaviviridae](https://en.wikipedia.org/wiki/Flaviviridae) (especially [Japanese encephalitis virus](https://en.wikipedia.org/wiki/Japanese_encephalitis)), [Machupo virus](https://en.wikipedia.org/wiki/Bolivian_hemorrhagic_fever), [Marburg virus](https://en.wikipedia.org/wiki/Marburg_virus), Variola virus, and [Yellow fever virus](https://en.wikipedia.org/wiki/Yellow_fever). Fungal agents that have been studied include [*Coccidioides*](https://en.wikipedia.org/wiki/Coccidioides) *spp.*.

Toxins that can be used as weapons include [ricin](https://en.wikipedia.org/wiki/Ricin), [staphylococcal enterotoxin B](https://en.wikipedia.org/wiki/Staphylococcal_Enterotoxin_B), [botulinum toxin](https://en.wikipedia.org/wiki/Botulinum_toxin), [saxitoxin](https://en.wikipedia.org/wiki/Saxitoxin), and many [mycotoxins](https://en.wikipedia.org/wiki/Mycotoxin). These toxins and the organisms that produce them are sometimes referred to as [select agents](https://en.wikipedia.org/wiki/Select_agent). In the United States, their possession, use, and transfer are regulated by the [Centers for Disease Control and Prevention](https://en.wikipedia.org/wiki/Centers_for_Disease_Control_and_Prevention)'s Select Agent Program.

The former [US biological warfare program](https://en.wikipedia.org/wiki/US_biological_warfare_program) categorized its weaponized anti-personnel bio-agents as either **Lethal Agents** (*Bacillus anthracis*, *Francisella tularensis*, Botulinum toxin) or **Incapacitating Agents** (*Brucella suis*, *Coxiella burnetii*, Venezuelan equine encephalitis virus, Staphylococcal enterotoxin B).

**Anti-agriculture**

**Anti-crop/anti-vegetation/anti-fisheries:**
The United States developed an anti-crop capability during the Cold War that used plant diseases ([bioherbicides](https://en.wikipedia.org/wiki/Bioherbicide), or [mycoherbicides](https://en.wikipedia.org/wiki/Mycoherbicide)) for destroying enemy agriculture. Biological weapons also target fisheries as well as water-based vegetation. It was believed that destruction of enemy agriculture on a strategic scale could thwart [Sino-Soviet](https://en.wikipedia.org/wiki/Sino-Soviet_relations) aggression in a general war. Diseases such as [wheat blast](https://en.wikipedia.org/wiki/Wheat_blast) and [rice blast](https://en.wikipedia.org/wiki/Rice_blast) were weaponized in aerial spray tanks and cluster bombs for delivery to enemy watersheds in agricultural regions to initiate epiphytotics (epidemics among plants). When the United States renounced its offensive biological warfare program in 1969 and 1970, the vast majority of its biological arsenal was composed of these plant diseases. Enterotoxins and Mycotoxins were not affected by Nixon's order.

Though herbicides are chemicals, they are often grouped with biological warfare and chemical warfare because they may work in a similar manner as [biotoxins](https://en.wikipedia.org/wiki/Biotoxin) or bioregulators and also because the Army Biological Laboratory tested them and the Army's Technical Escort Unit which all chemical, biological, radiological (nuclear) materials. Scorched earth tactics or destroying livestock and farmland were carried out in the Vietnam war (cf. Agent Orange) and [Eelam War](https://en.wikipedia.org/wiki/Sri_Lankan_Civil_War) in Sri Lanka.

Biological warfare can also specifically target plants to destroy crops or defoliate vegetation. The United States and Britain discovered plant growth regulators (i.e., [herbicides](https://en.wikipedia.org/wiki/Herbicides)) during the Second World War, and initiated an [herbicidal warfare](https://en.wikipedia.org/wiki/Herbicidal_warfare) program that was eventually used in [Malaya](https://en.wikipedia.org/wiki/British_Malaya) and [Vietnam](https://en.wikipedia.org/wiki/Agent_Orange) in [counterinsurgency](https://en.wikipedia.org/wiki/Counterinsurgency) operations. In 1962, the counterinsurgency school in Vietnam moved to Okinawa. USNS Schuyler Otis Bland (T-AK-277) was known to have brought highly classified "agriculture products" under armed guard to southeast Asia, Okinawa, and Panama. The ship’s logbook was found by Michelle Gatz and shows the ship was carrying classified cargo that was offloaded under armed guard at White Beach a U.S. Navy port on Okinawa’s east coast on April 25, 1962. After departing Okinawa in spring 1962, the Bland sailed to the Panama Canal Zone where, the Panamanian government asserts, the U.S. tested herbicides in the early 1960s.

The late author [Sheldon H. Harris](https://en.wikipedia.org/wiki/Sheldon_H._Harris) in his book "Factories of Death: Japanese Biological Warfare, 1932-1945, and the American cover up" wrote that, *The test program, [this could be part of* [*Project AGILE*](https://en.wikipedia.org/wiki/Project_AGILE) *or Project OCONUS] which began in fall 1962 and which was funded at least through fiscal year 1963, was considered by the Chemical Corps to be “an ambitious one.” The tests were designed to cover “not only trials at sea, but Arctic and tropical environmental tests as well.” The tests, presumably, were conducted at what research officers designated, but did not name, “satellite sites.” These sites were located both in the continental United States and in foreign countries. The tests conducted there were aimed at both human, animal, and plant reaction to BW. It is known that tests were undertaken in* [*Cairo*](https://en.wikipedia.org/wiki/Cairo)*,* [*Egypt*](https://en.wikipedia.org/wiki/Egypt)*,* [*Liberia*](https://en.wikipedia.org/wiki/Liberia)*, in* [*South Korea*](https://en.wikipedia.org/wiki/South_Korea)*, and in Japan’s satellite province of* [*Okinawa*](https://en.wikipedia.org/wiki/Okinawa) *in 1961, or earlier.(Harris, 2002)*

Sheldon H. Harris continued that; *The Okinawa anti-crop research project may lend some insight to the larger* [*projects 112*](https://en.wikipedia.org/wiki/Project_112) *sponsored. BW experts in Okinawa and “at several sites in the Midwest and south: conducted in 1961 “field tests” for wheat rust and rice blast disease. These tests met with “partial success” in the gathering of data, and led, therefore, to a significant increase in research dollars in fiscal year 1962 to conduct additional research in these areas. The money was devoted largely to developing “technical advice on the conduct of defoliation and anti-crop activities in Southeast Asia.” By the end of fiscal year 1962, the Chemical Corps had let or were negotiating contracts for over one thousand chemical defoliants. The Okinawa tests evidently were fruitful.(Harris, 2002)*

**Anti-livestock:**
In 1980s Soviet Ministry of Agriculture had successfully developed variants of [foot-and-mouth disease](https://en.wikipedia.org/wiki/Foot-and-mouth_disease), and [rinderpest](https://en.wikipedia.org/wiki/Rinderpest) against cows, [African swine fever](https://en.wikipedia.org/wiki/African_swine_fever) for pigs, and [psittacosis](https://en.wikipedia.org/wiki/Psittacosis) to kill chicken. These agents were prepared to spray them down from tanks attached to airplanes over hundreds of miles. The secret program was code-named "Ecology".

Attacking animals is another area of biological warfare intended to eliminate animal resources for transportation and food. In the First World War, German agents were arrested attempting to inoculate draft animals with anthrax, and they were believed to be responsible for outbreaks of [glanders](https://en.wikipedia.org/wiki/Glanders) in horses and mules. The British tainted small feed cakes with anthrax in the Second World War as a potential means of attacking German cattle for food denial, but never employed the weapon. In the 1950s, the United States had a field trial with [hog cholera](https://en.wikipedia.org/wiki/Hog_cholera). During the [Mau Mau Uprising](https://en.wikipedia.org/wiki/Mau_Mau_Uprising) in 1952, the poisonous [latex](https://en.wikipedia.org/wiki/Latex) of the [African milk bush](https://en.wikipedia.org/wiki/Euphorbia_grantii) was used to kill cattle.

Unconnected with inter-human wars, humans have deliberately introduced the rabbit disease [Myxomatosis](https://en.wikipedia.org/wiki/Myxomatosis), originating in South America, to Australia and Europe, with the intention of reducing the rabbit population – which had devastating but temporary results, with wild rabbit populations reduced to a fraction of their former size but survivors developing immunity and increasing again.

**Entomological warfare**

Main article: [Entomological warfare](https://en.wikipedia.org/wiki/Entomological_warfare)

Entomological warfare (EW) is a type of biological warfare that uses insects to attack the enemy. The concept has existed for centuries and research and development have continued into the modern era. EW has been used in battle by Japan and several other nations have developed and been accused of using an entomological warfare program. EW may employ insects in a direct attack or as vectors to deliver a [biological agent](https://en.wikipedia.org/wiki/Biological_agent), such as [plague](https://en.wikipedia.org/wiki/Plague_%28disease%29). Essentially, EW exists in three varieties. One type of EW involves infecting insects with a [pathogen](https://en.wikipedia.org/wiki/Pathogen) and then dispersing the insects over target areas. The insects then act as a [vector](https://en.wikipedia.org/wiki/Vector_%28epidemiology%29), infecting any person or animal they might bite. Another type of EW is a direct insect attack against crops; the insect may not be infected with any pathogen but instead represents a threat to agriculture. The final method uses uninfected insects, such as bees, wasps, etc., to directly attack the enemy.

**Defensive**

Main article: [Biodefense](https://en.wikipedia.org/wiki/Biodefense)

**Research and development into medical counter-measures**

In 2010 at The Meeting of the States Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and Their Destruction in [Geneva](https://en.wikipedia.org/wiki/Geneva) the [sanitary epidemiological reconnaissance](https://en.wikipedia.org/wiki/Sanitary_epidemiological_reconnaissance) was suggested as well-tested means for enhancing the monitoring of infections and parasitic agents, for practical implementation of the [International Health Regulations](https://en.wikipedia.org/wiki/International_Health_Regulations) (2005). The aim was to prevent and minimize the consequences of natural outbreaks of dangerous infectious diseases as well as the treat of alleged use of biological weapons against BTWC States Parties.

**Role of public health and disease surveillance**

It is important to note that all classical and modern biological weapons organisms are animal diseases, the only exception being smallpox. Thus, in any use of biological weapons, it is highly likely that animals will become ill either simultaneously with, or perhaps earlier than humans.

Indeed, in the largest biological weapons accident known– the anthrax outbreak in Sverdlovsk (now [Yekaterinburg](https://en.wikipedia.org/wiki/Yekaterinburg)) in the [Soviet Union](https://en.wikipedia.org/wiki/Soviet_Union) in 1979, sheep became ill with anthrax as far as 200 kilometers from the release point of the organism from a military facility in the southeastern portion of the city (known as [Compound 19](https://en.wikipedia.org/w/index.php?title=Compound_19&action=edit&redlink=1) and still off limits to visitors today, see [Sverdlovsk Anthrax leak](https://en.wikipedia.org/wiki/Sverdlovsk_Anthrax_leak)).

Thus, a robust surveillance system involving human clinicians and veterinarians may identify a bioweapons attack early in the course of an epidemic, permitting the prophylaxis of disease in the vast majority of people (and/or animals) exposed but not yet ill.

For example in the case of anthrax, it is likely that by 24–36 hours after an attack, some small percentage of individuals (those with compromised immune system or who had received a large dose of the organism due to proximity to the release point) will become ill with classical symptoms and signs (including a virtually unique [chest X-ray](https://en.wikipedia.org/wiki/Chest_X-ray) finding, often recognized by public health officials if they receive timely reports). By making these data available to local public health officials in real time, most models of anthrax epidemics indicate that more than 80% of an exposed population can receive antibiotic treatment before becoming symptomatic, and thus avoid the moderately high mortality of the disease.

**Identification of bioweapons**

The goal of [biodefense](https://en.wikipedia.org/wiki/Biodefense) is to integrate the sustained efforts of the national and homeland security, medical, public health, intelligence, diplomatic, and law enforcement communities. Health care providers and public health officers are among the first lines of defense. In some countries private, local, and provincial (state) capabilities are being augmented by and coordinated with federal assets, to provide layered defenses against biological weapons attacks. During the [first Gulf War](https://en.wikipedia.org/wiki/First_Gulf_War) the United Nations activated a biological and chemical response team, [Task Force Scorpio](https://en.wikipedia.org/wiki/Task_Force_Scorpio), to respond to any potential use of weapons of mass destruction on civilians.

The traditional approach toward protecting agriculture, food, and water: focusing on the natural or unintentional introduction of a disease is being strengthened by focused efforts to address current and anticipated future biological weapons threats that may be deliberate, multiple, and repetitive.

The growing threat of biowarfare agents and bioterrorism has led to the development of specific field tools that perform on-the-spot analysis and identification of encountered suspect materials. One such technology, being developed by researchers from the [Lawrence Livermore National Laboratory](https://en.wikipedia.org/wiki/Lawrence_Livermore_National_Laboratory) (LLNL), employs a "sandwich immunoassay", in which fluorescent dye-labeled antibodies aimed at specific [pathogens](https://en.wikipedia.org/wiki/Pathogen) are attached to silver and gold nanowires.

In the [Netherlands](https://en.wikipedia.org/wiki/Netherlands), the company [TNO](https://en.wikipedia.org/wiki/Netherlands_Organisation_for_Applied_Scientific_Research) has designed [Bioaerosol Single Particle Recognition equipment](https://en.wikipedia.org/w/index.php?title=BiosparQ&action=edit&redlink=1) (Biospar). This system would be implemented into the national response plan for bioweapons attacks in the Netherlands.

Researchers at [Ben Gurion University](https://en.wikipedia.org/wiki/Ben_Gurion_University) in Israel are developing a different device called the BioPen, essentially a "Lab-in-a-Pen", which can detect known biological agents in under 20 minutes using an adaptation of the [ELISA](https://en.wikipedia.org/wiki/ELISA), a similar widely employed immunological technique, that in this case incorporates fiber optics.

**Synthetic BW**

Theoretically, novel approaches in biotechnology, such as synthetic biology could be used in the future to design novel types of biological warfare agents. Special attention has to be laid on future experiments (of concern) that:

1. Would demonstrate how to render a vaccine ineffective;
2. Would confer resistance to therapeutically useful antibiotics or antiviral agents;
3. Would enhance the virulence of a pathogen or render a nonpathogen virulent;
4. Would increase transmissibility of a pathogen;
5. Would alter the host range of a pathogen;
6. Would enable the evasion of diagnostic/detection tools;
7. Would enable the weaponization of a biological agent or toxin

Most of the biosecurity concerns in synthetic biology, however, focused on the role of DNA synthesis and the risk of producing genetic material of lethal viruses (e.g. 1918 Spanish flu, polio) in the lab.

**List of BW institutions, programs, projects and sites by country**

**United States**

Main article: [United States biological weapons program](https://en.wikipedia.org/wiki/United_States_biological_weapons_program)

* [Fort Detrick](https://en.wikipedia.org/wiki/Fort_Detrick), Maryland

Researchers working in [Class III cabinets](https://en.wikipedia.org/wiki/Biosafety_level) at the [U.S. Army Biological Warfare Laboratories](https://en.wikipedia.org/wiki/U.S._Army_Biological_Warfare_Laboratories), [Camp Detrick](https://en.wikipedia.org/wiki/Camp_Detrick), [Maryland](https://en.wikipedia.org/wiki/Maryland) (1940s).

* + [U.S. Army Biological Warfare Laboratories](https://en.wikipedia.org/wiki/United_States_Army_Biological_Warfare_Laboratories) (1943–69)
		- [Building 470](https://en.wikipedia.org/wiki/Building_470)
		- [One-Million-Liter Test Sphere](https://en.wikipedia.org/wiki/One-Million-Liter_Test_Sphere)
		- [Operation Whitecoat](https://en.wikipedia.org/wiki/Operation_Whitecoat) (1954–73)
	+ [United States Army Medical Unit](https://en.wikipedia.org/wiki/United_States_Army_Medical_Unit) (1956–69)
	+ [U.S. Army Medical Research Institute of Infectious Diseases](https://en.wikipedia.org/wiki/United_States_Army_Medical_Research_Institute_of_Infectious_Diseases) (USAMRIID; 1969–present)
	+ [U.S. entomological warfare program](https://en.wikipedia.org/wiki/Entomological_warfare#United_States)
		- [Operation Big Itch](https://en.wikipedia.org/wiki/Operation_Big_Itch)
		- [Operation Big Buzz](https://en.wikipedia.org/wiki/Operation_Big_Buzz)
		- [Operation Drop Kick](https://en.wikipedia.org/wiki/Operation_Drop_Kick)
		- [Operation May Day](https://en.wikipedia.org/wiki/Operation_May_Day)
	+ [National Biodefense Analysis and Countermeasures Center](https://en.wikipedia.org/wiki/National_Biodefense_Analysis_and_Countermeasures_Center) (NBACC; Projected: 2008)
* [Project Bacchus](https://en.wikipedia.org/wiki/Project_Bacchus)
* [Project Clear Vision](https://en.wikipedia.org/wiki/Project_Clear_Vision)
* [Project SHAD](https://en.wikipedia.org/wiki/Project_SHAD)
* [Project 112](https://en.wikipedia.org/wiki/Project_112)
* [Horn Island Testing Station](https://en.wikipedia.org/wiki/Horn_Island_Testing_Station)
* [Fort Terry](https://en.wikipedia.org/wiki/Fort_Terry)
* [Granite Peak Installation](https://en.wikipedia.org/wiki/Granite_Peak_Installation)

**United Kingdom**

Main article: [United Kingdom and weapons of mass destruction#Biological weapons](https://en.wikipedia.org/wiki/United_Kingdom_and_weapons_of_mass_destruction#Biological_weapons)

* [Porton Down](https://en.wikipedia.org/wiki/Porton_Down)
* [Gruinard Island](https://en.wikipedia.org/wiki/Gruinard_Island)
* [Nancekuke](https://en.wikipedia.org/wiki/RRH_Portreath)
* [Operation Vegetarian](https://en.wikipedia.org/wiki/Operation_Vegetarian)
* [Operation Harness](https://en.wikipedia.org/w/index.php?title=Operation_Harness&action=edit&redlink=1) off [Antigua](https://en.wikipedia.org/wiki/Antigua), 1948–1949.
* [Operation Cauldron](https://en.wikipedia.org/wiki/Operation_Cauldron) off [Stornoway](https://en.wikipedia.org/wiki/Stornoway%2C_Outer_Hebrides), 1952. The [trawler](https://en.wikipedia.org/wiki/Commercial_trawler) *Carella* accidentally sailed through a cloud of pneumonic plague bacilli ([*Yersinia pestis*](https://en.wikipedia.org/wiki/Yersinia_pestis)) during this trial. It was kept under covert observation until the incubation period had elapsed but none of the crew fell ill.
* [Operation Hesperus](https://en.wikipedia.org/w/index.php?title=Operation_Hesperus&action=edit&redlink=1) off [Stornoway](https://en.wikipedia.org/wiki/Stornoway), 1953.
* [Operation Ozone](https://en.wikipedia.org/w/index.php?title=Operation_Ozone&action=edit&redlink=1) off [Nassau](https://en.wikipedia.org/wiki/Nassau%2C_Bahamas), 1954.
* [Operation Negation](https://en.wikipedia.org/w/index.php?title=Operation_Negation&action=edit&redlink=1) off Nassau, 1954-5.

**Soviet Union and Russia**

Main article: [Soviet biological weapons program](https://en.wikipedia.org/wiki/Soviet_biological_weapons_program)

* [Biopreparat](https://en.wikipedia.org/wiki/Biopreparat) (18 labs and production centers)
	+ [Stepnagorsk Scientific and Technical Institute for Microbiology](https://en.wikipedia.org/wiki/Stepnagorsk_Scientific_and_Technical_Institute_for_Microbiology), [Stepnogorsk](https://en.wikipedia.org/wiki/Stepnogorsk), northern [Kazakhstan](https://en.wikipedia.org/wiki/Kazakhstan)
	+ [Institute of Ultra-Pure Biochemical Preparations](https://en.wikipedia.org/wiki/Vladimir_Pasechnik), [Leningrad](https://en.wikipedia.org/wiki/Leningrad), a weaponized plague center
	+ [Vector State Research Center of Virology and Biotechnology](https://en.wikipedia.org/wiki/Vector_State_Research_Center_of_Virology_and_Biotechnology) (VECTOR), a weaponized smallpox center
	+ [Institute of Applied Biochemistry](https://en.wikipedia.org/w/index.php?title=Institute_of_Applied_Biochemistry&action=edit&redlink=1), [Omutninsk](https://en.wikipedia.org/wiki/Omutninsk)
	+ [Kirov bioweapons production facility](https://en.wikipedia.org/w/index.php?title=Kirov_bioweapons_production_facility&action=edit&redlink=1), [Kirov, Kirov Oblast](https://en.wikipedia.org/wiki/Kirov%2C_Kirov_Oblast)
	+ [Zagorsk smallpox production facility](https://en.wikipedia.org/w/index.php?title=Zagorsk_smallpox_production_facility&action=edit&redlink=1), [Zagorsk](https://en.wikipedia.org/wiki/Zagorsk)
	+ [Berdsk bioweapons production facility](https://en.wikipedia.org/w/index.php?title=Berdsk_bioweapons_production_facility&action=edit&redlink=1), [Berdsk](https://en.wikipedia.org/wiki/Berdsk)
	+ [Bioweapons research facility](https://en.wikipedia.org/w/index.php?title=Bioweapons_research_facility&action=edit&redlink=1), [Obolensk](https://en.wikipedia.org/w/index.php?title=Obolensk&action=edit&redlink=1)
	+ [Sverdlovsk bioweapons production facility](https://en.wikipedia.org/wiki/Sverdlovsk_Anthrax_leak) (Military Compound 19), [Sverdlovsk](https://en.wikipedia.org/wiki/Yekaterinburg), a weaponized anthrax center
* [Institute of Virus Preparations](https://en.wikipedia.org/wiki/Institute_of_Virus_Preparations)
* [Poison laboratory of the Soviet secret services](https://en.wikipedia.org/wiki/Poison_laboratory_of_the_Soviet_secret_services)
* [Vozrozhdeniya](https://en.wikipedia.org/wiki/Vozrozhdeniya)
* [Project Bonfire](https://en.wikipedia.org/w/index.php?title=Project_Bonfire&action=edit&redlink=1)
* [Project Factor](https://en.wikipedia.org/w/index.php?title=Project_Factor&action=edit&redlink=1)

**Japan**

Main article: [Special Research Units](https://en.wikipedia.org/wiki/Special_Research_Units)

* [Unit 731](https://en.wikipedia.org/wiki/Unit_731)
* [Zhongma Fortress](https://en.wikipedia.org/wiki/Zhongma_Fortress)

**Iraq**

*Main articles:* [*Iraqi biological weapons program*](https://en.wikipedia.org/wiki/Iraqi_biological_weapons_program) and [*Iraq and weapons of mass destruction*](https://en.wikipedia.org/wiki/Iraq_and_weapons_of_mass_destruction) (passim)

* [Al Hakum](https://en.wikipedia.org/wiki/Al_Hakum_%28Iraq%29)
* [Salman Pak facility](https://en.wikipedia.org/wiki/Salman_Pak_facility)
* [Al Manal](https://en.wikipedia.org/w/index.php?title=Al_Manal&action=edit&redlink=1) facility

**South Africa**

Main article: [South Africa and weapons of mass destruction#Biological and chemical weapons](https://en.wikipedia.org/wiki/South_Africa_and_weapons_of_mass_destruction#Biological_and_chemical_weapons)

* [Project Coast](https://en.wikipedia.org/wiki/Project_Coast)
* [Delta G Scientific Company](https://en.wikipedia.org/wiki/Delta_G_Scientific_Company)
* [Roodeplaat Research Laboratories](https://en.wikipedia.org/wiki/Roodeplaat_Research_Laboratories)
* [Protechnik](https://en.wikipedia.org/wiki/Protechnik)

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