**Biological Warfare**

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

Biological warfare (BW), also known as a germ warfare, biological weapons, and bioweapons, is the use of any [pathogen](http://en.wikipedia.org/wiki/Pathogen) ([bacterium](http://en.wikipedia.org/wiki/Bacterium), [virus](http://en.wikipedia.org/wiki/Virus_%28biology%29) or other disease-causing organism) as a [weapon](http://en.wikipedia.org/wiki/Weapon) of [war](http://en.wikipedia.org/wiki/War). Using nonliving toxic products, even if produced by living organisms (e.g., toxins), is considered [Chemical warfare](http://en.wikipedia.org/wiki/Chemical_warfare) under the provisions of the [Chemical Weapons Convention](http://en.wikipedia.org/wiki/Chemical_Weapons_Convention). A biological weapon may be intended to kill, incapacitate or seriously impede an adversary. It may also be defined as the material or defense against such employment. Biological warfare is a military technique that can be used by [nation-states](http://en.wikipedia.org/wiki/Nation-state) or non-national group. In the latter case, or if a nation-state uses it clandestinely, it may also be [bioterrorism](http://en.wikipedia.org/wiki/Bioterrorism).

**Overview**

The creation and stockpiling of biological weapons ("offensive BW") was outlawed by the 1972 [Biological Weapons Convention](http://en.wikipedia.org/wiki/Biological_Weapons_Convention) (BWC), signed by over 100 countries. The BWC remains in force. The rationale behind the agreement is to avoid the devastating impact of a successful biological attack which could conceivably result in millions, possibly even billions, of deaths and cause severe disruptions to societies and economies. Oddly enough, the convention prohibits only creation and storage, but not usage, of these weapons. However, the consensus among military analysts is that, except in the context of [bioterrorism](http://en.wikipedia.org/wiki/Bioterrorism), BW is of little military use. Many countries pursue "defensive BW" research (defensive or protective applications) which are not prohibited by the BWC. As a tactical weapon, the main military problem with a BW attack is that it would take days to be effective, and therefore, unlike a [nuclear](http://en.wikipedia.org/wiki/Nuclear_warfare) or [chemical](http://en.wikipedia.org/wiki/Chemical_warfare) attack, would not immediately stop an opposing force. As a strategic weapon, BW is again militarily problematic, although with a possible exception with the Soviets, the weaponized biological agents did not spread from person to person. Spread is less of a concern for terrorists, but it was very much a concern for post-WWII BW development by major powers.

**History**

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| [**War**](http://en.wikipedia.org/wiki/War) |
| [Military history](http://en.wikipedia.org/wiki/Military_history) |
| [**Eras**](http://en.wikipedia.org/wiki/Category%3AWarfare_by_era) |
| [Prehistoric](http://en.wikipedia.org/wiki/Prehistoric_warfare) · [Ancient](http://en.wikipedia.org/wiki/Ancient_warfare) · [Medieval](http://en.wikipedia.org/wiki/Medieval_warfare)[Gunpowder](http://en.wikipedia.org/wiki/Gunpowder_warfare) · [Industrial](http://en.wikipedia.org/wiki/Industrial_warfare) · [Modern](http://en.wikipedia.org/wiki/Modern_warfare) |
| [**Battlespace**](http://en.wikipedia.org/wiki/Battlespace) |
| [Air](http://en.wikipedia.org/wiki/Aerial_warfare) · [Information](http://en.wikipedia.org/wiki/Information_warfare) · [Land](http://en.wikipedia.org/wiki/Land_warfare) · [Sea](http://en.wikipedia.org/wiki/Naval_warfare) · [Space](http://en.wikipedia.org/wiki/Space_warfare) |
| [**Weapons**](http://en.wikipedia.org/wiki/Weapon) |
| [Armor](http://en.wikipedia.org/wiki/Armoured_warfare) · [Artillery](http://en.wikipedia.org/wiki/Artillery) · **Biological** · [Cavalry](http://en.wikipedia.org/wiki/Cavalry)[Chemical](http://en.wikipedia.org/wiki/Chemical_warfare) · [Electronic](http://en.wikipedia.org/wiki/Electronic_warfare) · [Infantry](http://en.wikipedia.org/wiki/Infantry) ·[Nuclear](http://en.wikipedia.org/wiki/Nuclear_weapon) · [Psychological](http://en.wikipedia.org/wiki/Psychological_warfare) |
| [**Tactics**](http://en.wikipedia.org/wiki/Military_tactics) |
| [Attrition](http://en.wikipedia.org/wiki/Attrition_warfare) · [Guerilla](http://en.wikipedia.org/wiki/Guerrilla_warfare) · [Maneuver](http://en.wikipedia.org/wiki/Maneuver_warfare)[Siege](http://en.wikipedia.org/wiki/Siege) · [Total war](http://en.wikipedia.org/wiki/Total_war) · [Trench](http://en.wikipedia.org/wiki/Trench_warfare) |
| [**Strategy**](http://en.wikipedia.org/wiki/Military_strategy) |
| [Economic](http://en.wikipedia.org/wiki/Economic_warfare) · [Grand](http://en.wikipedia.org/wiki/Grand_strategy) · [Operational](http://en.wikipedia.org/wiki/Operational_warfare) |
| [**Organization**](http://en.wikipedia.org/wiki/Military_organization) |
| [Formations](http://en.wikipedia.org/wiki/Formation_%28military%29) · [Ranks](http://en.wikipedia.org/wiki/Military_rank) · [Units](http://en.wikipedia.org/wiki/Military_unit) |
| [**Logistics**](http://en.wikipedia.org/wiki/Military_logistics) |
| [Equipment](http://en.wikipedia.org/wiki/Military_technology_and_equipment) · [Materiel](http://en.wikipedia.org/wiki/Materiel) · [Supply line](http://en.wikipedia.org/wiki/Military_supply_chain_management) |
| [**Lists**](http://en.wikipedia.org/wiki/Category%3AMilitary_lists) |
| [Battles](http://en.wikipedia.org/wiki/List_of_battles) · [Commanders](http://en.wikipedia.org/wiki/List_of_military_commanders) · [Operations](http://en.wikipedia.org/wiki/List_of_military_operations)[Sieges](http://en.wikipedia.org/wiki/List_of_sieges) · [Theorists](http://en.wikipedia.org/wiki/List_of_military_theorists) · [Wars](http://en.wikipedia.org/wiki/List_of_wars)[War crimes](http://en.wikipedia.org/wiki/List_of_war_crimes) · [Weapons](http://en.wikipedia.org/wiki/List_of_weapons) · [Writers](http://en.wikipedia.org/wiki/List_of_military_writers) |

Biological warfare has been practiced repeatedly throughout history. Before the 20th century, the use of [biological agents](http://en.wikipedia.org/wiki/Biological_agent) took three major forms:

* Deliberate [poisoning](http://en.wikipedia.org/wiki/Poison) of [food](http://en.wikipedia.org/wiki/Food) and [water](http://en.wikipedia.org/wiki/Water) with infectious material
* Use of microorganisms, toxins or animals, living or dead, in a weapon system
* Use of biologically inoculated fabrics

**The Ancient World**

During the 6th century B.C, the [Assyrians](http://en.wikipedia.org/wiki/Assyrian_people) poisoned [enemy](http://en.wikipedia.org/wiki/Enemy_%28military%29) wells with [ergot](http://en.wikipedia.org/wiki/Ergot), a [fungus](http://en.wikipedia.org/wiki/Fungus) that would make the enemy delusional, and [Solon](http://en.wikipedia.org/wiki/Solon) of [Athens](http://en.wikipedia.org/wiki/Athens) used the poisonous herb [Veratrum](http://en.wikipedia.org/wiki/Veratrum) to poison the water supply of [Phocaea](http://en.wikipedia.org/wiki/Phocaea) during his siege of the city. During the 4th century B.C. [Scythian](http://en.wikipedia.org/wiki/Scythia) archers used arrows with tips covered with animal [feces](http://en.wikipedia.org/wiki/Feces) to cause the wounds of the enemies to get [infected](http://en.wikipedia.org/wiki/Infection). In 204 B.C, [Hannibal of Carthage](http://en.wikipedia.org/wiki/Hannibal_Barca) had clay pots filled with [venomous snakes](http://en.wikipedia.org/wiki/Venomous_snakes) and instructed his soldiers to throw the pots onto the decks of [Pergamene](http://en.wikipedia.org/wiki/Pergamon) ships.

**Medieval Biological Warfare**

The [Mongol Empire](http://en.wikipedia.org/wiki/Mongol_Empire) established commercial and political connections between the Eastern and Western areas of the world. It is probable that the Mongol armies and merchant caravans inadvertently brought the [bubonic plague](http://en.wikipedia.org/wiki/Bubonic_plague) from central Asia to the Middle East and Europe. The [Black Death](http://en.wikipedia.org/wiki/Black_Death) swept through [Eurasia](http://en.wikipedia.org/wiki/Eurasia), killing approximately one third to one half of the population and changing the course of Asian and European history.

During the [Middle Ages](http://en.wikipedia.org/wiki/Middle_Ages), victims of the [bubonic plague](http://en.wikipedia.org/wiki/Bubonic_plague) were used for biological attacks, often by flinging their corpses and excrement over castle walls using [catapults](http://en.wikipedia.org/wiki/Catapult). In 1346, the bodies of [Tatar](http://en.wikipedia.org/wiki/Tatar) [warriors](http://en.wikipedia.org/wiki/Warriors) of the [Golden Horde](http://en.wikipedia.org/wiki/Golden_Horde) who had died of plague were thrown over the walls of the besieged Crimean city of [Kaffa](http://en.wikipedia.org/wiki/Theodosia#Caffa) (now [Theodosia](http://en.wikipedia.org/wiki/Theodosia)). It has been speculated that this operation may have been responsible for the advent of the [Black Death](http://en.wikipedia.org/wiki/Black_Death) in Europe.

In 1422, during the [siege](http://en.wikipedia.org/wiki/List_of_sieges) of the [Bohemian](http://en.wikipedia.org/wiki/Bohemia) castle of [Karlstein](http://en.wikipedia.org/wiki/Karl%C5%A1tejn), [Hussite](http://en.wikipedia.org/wiki/Hussite) attackers used catapults to throw in dead bodies (albeit not plague-infested) and 2000 carriage-loads of [dung](http://en.wikipedia.org/wiki/Dung) over the walls. The last known incident of using plague corpses for biological warfare occurred in 1710, when [Russian](http://en.wikipedia.org/wiki/Russia) forces attacked the [Swedes](http://en.wikipedia.org/wiki/Sweden) by flinging plague-infected corpses over the city walls of [Reval](http://en.wikipedia.org/wiki/Reval) (Tallinn). However, during the 1785 siege of [La Calle](http://en.wikipedia.org/wiki/La_Calle), [Tunisian](http://en.wikipedia.org/wiki/Tunisia) forces flung diseased clothing into the city.

**Modern Times**

**The 17th century**

Though not germ warfare, which implies the deliberate use of germs against an enemy, the inadvertent spread of [diseases](http://en.wikipedia.org/wiki/Infectious_diseases) across the Atlantic during the European age of exploration did tremendous damage to the indigenous populations of North and South America. The effects of the "[Columbian exchange](http://en.wikipedia.org/wiki/Columbian_exchange)" of diseases upon the Native Americans was catastrophic, reducing the population of affected tribes by as much as 50-90%.[[5]](http://en.wikipedia.org/wiki/Biological_warfare#_note-3#_note-3) When the [Pilgrims](http://en.wikipedia.org/wiki/Pilgrims) arrived in the New World in 1620, the native population of the Plymouth area had already been virtually eliminated by diseases that traveled with European fishing expeditions to the waters of the Northeast. The Spanish conquest of the [Aztecs](http://en.wikipedia.org/wiki/Aztecs) in Mexico and the English predominance in North America might not have occurred if not for the devastating effect of diseases that had been previously unknown in the Americas and against which the local populations had not built up any immunities.

**The 18th century**

Amherst's suggestion

The [Native American](http://en.wikipedia.org/wiki/Indigenous_peoples_of_the_Americas) population was decimated after contact with the [Old World](http://en.wikipedia.org/wiki/Old_World) due to the introduction of many different fatal diseases. There is, however, only one documented case of alleged germ warfare, involving British commander Lord [Jeffrey Amherst](http://en.wikipedia.org/wiki/Jeffrey_Amherst) and a Swiss-British officer, Colonel [Henry Bouquet](http://en.wikipedia.org/wiki/Henry_Bouquet), whose correspondence included a reference to the idea of giving [smallpox](http://en.wikipedia.org/wiki/Smallpox)-infected blankets to Indians as part of an incident known as [Pontiac's Rebellion](http://en.wikipedia.org/wiki/Pontiac%27s_Rebellion) which occurred during the [Siege of Fort Pitt](http://en.wikipedia.org/wiki/Pontiac%27s_Rebellion#Siege_of_Fort_Pitt) late in the [French and Indian War](http://en.wikipedia.org/wiki/French_and_Indian_War) (1756-1763). Historians have been unable to establish whether or not this plan was implemented, particularly in light of the fact that smallpox was already present in the region. The roots of many diseases that killed millions of indigenous peoples in the Americas can be traced back to Eurasians living for millennia in close proximity with domesticated animals. Without long contact with domesticated animals, indigenous Americans had no resistance to plague, measles, tuberculosis, smallpox or most influenza strains. (Attempts by missionaries to provide inoculation to local tribespeople were usually met with suspicion, thus leaving the native population completely vulnerable to epidemics.) Despite the lack of historical evidence, the claim that British and American soldiers used germ warfare against North American tribes has remained fairly strong in certain oral traditions and in popular culture. Such oral histories of smallpox infested blankets being used are especially strong in the oral traditions of native nations along the west coast of Canada.

**The 19th century**

It can be difficult to separate malice from ignorance. In 1834 Cambridge Diarist [Richard Henry Dana](http://en.wikipedia.org/wiki/Richard_Henry_Dana%2C_Jr.) (Two Years Before the Mast; available in Project Gutenberg) visited [San Francisco](http://en.wikipedia.org/wiki/San_Francisco) on a merchant ship. His ship traded many items including blankets with Mexicans and Russians who had established outposts on the northern side of the San Francisco Bay. Local histories document that the California smallpox epidemic began at the Russian fort soon after they left. Blankets were a popular trading item, and the cheapest source of them was second-hand blankets which were often contaminated.

Native peoples in [Aptos](http://en.wikipedia.org/wiki/Aptos%2C_California) gave [Spaniards](http://en.wikipedia.org/wiki/Spaniards) gifts of freshly cut flowers wrapped in leaves of [poison oak](http://en.wikipedia.org/wiki/Poison_oak). The natives themselves were immune to poison oak, and they also used it for other purposes such as dying their baskets.

During the [American Civil War](http://en.wikipedia.org/wiki/American_Civil_War), [General Sherman](http://en.wikipedia.org/wiki/William_Tecumseh_Sherman) reported that [Confederate](http://en.wikipedia.org/wiki/Confederate_States_of_America) forces shot farm animals in ponds upon which the Union depended for drinking water.

**The 20th century**

Twentieth-century advances in microbiology enabled the first pure-culture biological agents to be developed by WWII. There was a period of development by many nations, and Japanese biological attacks in China. Programs were generally ended in response to the [Biological Weapons Convention](http://en.wikipedia.org/wiki/Biological_Weapons_Convention) of 1972.

**Before and during World War II**

The [Geneva Protocol](http://en.wikipedia.org/wiki/Geneva_Protocol) of 1925 banned the use of biological weapons under international law.

**1937-1945**

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During the [Sino-Japanese War (1937-1945)](http://en.wikipedia.org/wiki/Sino-Japanese_War_%281937-1945%29) and [World War II](http://en.wikipedia.org/wiki/World_War_II), [Unit 731](http://en.wikipedia.org/wiki/Unit_731) of the [Imperial Japanese Army](http://en.wikipedia.org/wiki/Imperial_Japanese_Army) conducted [human experimentation](http://en.wikipedia.org/wiki/Human_experimentation) on thousands, mostly [Chinese](http://en.wikipedia.org/wiki/China) and [Korean](http://en.wikipedia.org/wiki/Korea). In military campaigns, the Japanese army used biological weapons on Chinese soldiers and civilians. This employment was ineffective due to inefficient delivery systems([Williams 1989](http://en.wikipedia.org/wiki/Biological_warfare#CITEREF_Williams_1989#CITEREF_Williams_1989)). However, new information has surfaced within the last decade, which alleges a more active Japanese usage. For example, firsthand accounts testify the Japanese infected civilians through the distribution of plagued foodstuffs, such as dumplings and vegetables. There are also reports of contaminated water supplies. Such estimates report over 580,000 victims, largely due to plague and cholera outbreaks. In addition, repeated seasonal outbreaks after the conclusion of the war bring the death toll much higher.

In response to biological weapons development in Germany and Japan, the United States, United Kingdom, and Canada initiated a BW development program in 1941 that resulted in the weaponization of [tularemia](http://en.wikipedia.org/wiki/Tularemia), [anthrax](http://en.wikipedia.org/wiki/Anthrax_disease), [brucellosis](http://en.wikipedia.org/wiki/Brucellosis), and [botulism](http://en.wikipedia.org/wiki/Botulism) toxin. The center for U.S. military BW research was [Fort Detrick](http://en.wikipedia.org/wiki/Fort_Detrick), Maryland, where [USAMRIID](http://en.wikipedia.org/wiki/USAMRIID) is currently based; the first director was pharmaceutical executive [George W. Merck](http://en.wikipedia.org/wiki/George_W._Merck).

Some biological and chemical weapons research and testing was also conducted at [Dugway Proving Grounds](http://en.wikipedia.org/wiki/Dugway_Proving_Ground)" in Utah, at a munition manufacturing complex in [Terre Haute, Indiana](http://en.wikipedia.org/wiki/Terre_Haute%2C_Indiana), and at a tract on [Horn Island, Mississippi](http://en.wikipedia.org/wiki/Horn_Island%2C_Mississippi).

Field testing carried out in the [United Kingdom](http://en.wikipedia.org/wiki/United_Kingdom) during [World War II](http://en.wikipedia.org/wiki/World_War_II) left [Gruinard island](http://en.wikipedia.org/wiki/Gruinard_island) in [Scotland](http://en.wikipedia.org/wiki/Scotland) contaminated with anthrax for the next 48 years.

**1946 to 1972**

During the [Cold War](http://en.wikipedia.org/wiki/Cold_War), US [conscientious objectors](http://en.wikipedia.org/wiki/Conscientious_objectors) were used as consenting test subjects for biological agents in a program known as [Operation Whitecoat](http://en.wikipedia.org/wiki/Operation_Whitecoat). There were also many unpublicized tests carried out on the public during the [Cold War](http://en.wikipedia.org/wiki/Cold_War).

E120 biological bomblet, developed before the U.S. signed the Biological and Toxic Weapons Convention

Considerable research on the topic was performed by the [United States](http://en.wikipedia.org/wiki/United_States) (see [US Biological Weapon Testing](http://en.wikipedia.org/wiki/US_Biological_Weapon_Testing)), the [Soviet Union](http://en.wikipedia.org/wiki/Soviet_Union), and probably other major nations throughout the [Cold War](http://en.wikipedia.org/wiki/Cold_War) era, though it is generally believed that such weapons were never used after [World War II](http://en.wikipedia.org/wiki/World_War_II). This view was challenged by China and [North Korea](http://en.wikipedia.org/wiki/North_Korea), who accused the United States of large-scale field testing of biological weapons, including the use of disease-carrying insects against them during the Korean War (1950-1953). According to, recently revealed documents indicate that this was [disinformation](http://en.wikipedia.org/wiki/Disinformation) produced by Soviet intelligence. The relevance of these documents to this question has been disputed.

At the time of the Korean War, the US had only weaponized one agent, [tularemia](http://en.wikipedia.org/wiki/Tularemia), which is caused by *Franciscella tularensis*. The original weaponized form used the E120 bursting spherical bomblet, which is visually distinctive. While the specific form of the biological bomb was classified at the time of the Korean War and some years later, it is interesting that in the various exhibits of alleged biological weapons dropped on their country, nothing resembled a E120 bomblet. There were ceramic containers that had some similarity to Japanese weapons used against the Chinese in WWII, developed by Unit 731 ([Williams 1989](http://en.wikipedia.org/wiki/Biological_warfare#CITEREF_Williams_1989#CITEREF_Williams_1989)). Some of the Unit 731 personnel were imprisoned by the Soviets, and would have been a potential source of information on Japanese weaponization.

[Richard Nixon](http://en.wikipedia.org/wiki/Richard_Nixon) signed an executive order on November 1969, which stopped production of biological weapons in the U.S. and allowed only scientific research of lethal biological agents and defensive measures, as [immunization](http://en.wikipedia.org/wiki/Immunization) and [biosafety](http://en.wikipedia.org/wiki/Biosafety). The biological munition stockpiles were destroyed, and approximately 2,200 researchers lost their jobs.

**After signing the Biological Weapons Convention**

*Main article:* [*Soviet program of biological weapons*](http://en.wikipedia.org/wiki/Soviet_program_of_biological_weapons)

In 1972, the U.S. signed the [Biological and Toxic Weapons Convention](http://en.wikipedia.org/wiki/Biological_Weapons_Convention), which banned the "development, production and stockpiling of microbes or their poisonous products except in amounts necessary for protective and peaceful research." By 1996, 137 countries had signed the treaty. It is, however, believed that since the signing of the Convention the number of countries capable of producing such weapons has increased.

The [Soviet Union](http://en.wikipedia.org/wiki/Soviet_Union) continued research and production of offensive biological weapons in a program called [biopreparat](http://en.wikipedia.org/wiki/Biopreparat), despite having signed the convention. The United States was unaware of the program until Dr. Vladimir Pasechnik defected in 1989, and [Dr. Kanatjan Alibekov](http://en.wikipedia.org/wiki/Dr._Kanatjan_Alibekov), the first deputy director of [Biopreparat](http://en.wikipedia.org/wiki/Biopreparat) defected in 1992.

After the 1991 Persian Gulf War, Iraq admitted to the United Nations inspection team to having produced 19000 L of concentrated botulinum toxin, of which approximately 10000 L were loaded into military weapons. These 19000 L of concentrated toxin are not fully accounted. In principle, this is approximately 3 times the amount needed to kill the entire current human population by inhalation. In practice, it would be impossible distribute it so efficiently, and, unless it is protected from oxygen, it deteriorates in storage.

Beginning on [September 18](http://en.wikipedia.org/wiki/September_18), [2001](http://en.wikipedia.org/wiki/2001), several letters were received by members of the U.S. Congress and media outlets containing anthrax. The attack killed five people. The identity of the perpetrator remains unknown as of 2007. See [2001 anthrax attacks](http://en.wikipedia.org/wiki/2001_anthrax_attacks).

*References for this section include (*Eitzen & Takafuji, 1997*)*

**Biological weapons characteristics**

The international biological hazard symbol.

Ideal characteristics of biological weapons are high infectivity, high potency, availability of vaccines, and delivery as an aerosol.

Diseases most likely to be considered for use as biological weapons are contenders because of their lethality (if delivered efficiently), and robustness (making [aerosol](http://en.wikipedia.org/wiki/Particulate) delivery feasible).

The biological agents used in biological weapons can often be manufactured quickly and easily. The primary difficulty is not the production of the biological agent but delivery in an effective form to a vulnerable target.

For example, anthrax is considered an effective agent for several reasons. First, it forms hardy spores, perfect for dispersal aerosols. Second, pneumonic (lung) infections of anthrax usually do not cause secondary infections in other people. Thus, the effect of the agent is usually confined to the target. A pneumonic anthrax infection starts with ordinary "cold" symptoms and quickly becomes lethal, with a fatality rate that is 80% or higher. Finally, friendly personnel can be protected with suitable antibiotics.

A mass attack using anthrax would require the creation of aerosol particles of 1.5 to 5 micrometers. Too large and the aerosol would be filtered out by the respiratory system. Too small and the aerosol would be inhaled and exhaled. Also, at this size, nonconductive powders tend to clump and cling because of electrostatic charges. This hinders dispersion. So, the material must be treated with silica to insulate and discharge the charges. The aerosol must be delivered so that rain and sun does not rot it, and yet the human lung can be infected. There are other technological difficulties as well.

Diseases considered for weaponization, or known to be weaponized include [anthrax](http://en.wikipedia.org/wiki/Anthrax_disease), [Ebola](http://en.wikipedia.org/wiki/Ebola), [Marburg virus](http://en.wikipedia.org/wiki/Marburg_virus), [bubonic plague](http://en.wikipedia.org/wiki/Bubonic_plague), [cholera](http://en.wikipedia.org/wiki/Cholera), [tularemia](http://en.wikipedia.org/wiki/Tularemia), [brucellosis](http://en.wikipedia.org/wiki/Brucellosis), [Q fever](http://en.wikipedia.org/wiki/Q_fever), [machupo](http://en.wikipedia.org/wiki/Machupo), [Coccidioides mycosis](http://en.wikipedia.org/wiki/Coccidioides_mycosis), [Glanders](http://en.wikipedia.org/wiki/Glanders), [Melioidosis](http://en.wikipedia.org/wiki/Melioidosis), [Shigella](http://en.wikipedia.org/wiki/Shigella), [Rocky Mountain spotted fever](http://en.wikipedia.org/wiki/Rocky_Mountain_spotted_fever), [typhus](http://en.wikipedia.org/wiki/Typhus), [Psittacosis](http://en.wikipedia.org/wiki/Psittacosis), [yellow fever](http://en.wikipedia.org/wiki/Yellow_fever), [Japanese B encephalitis](http://en.wikipedia.org/wiki/Japanese_encephalitis), [Rift Valley fever](http://en.wikipedia.org/wiki/Rift_Valley_fever), and [smallpox](http://en.wikipedia.org/wiki/Smallpox) Naturally-occurring toxins that can be used as weapons include [ricin](http://en.wikipedia.org/wiki/Ricin), [SEB](http://en.wikipedia.org/w/index.php?title=Staphylococcal_enterotoxin_B&action=edit), [botulism toxin](http://en.wikipedia.org/wiki/Botulism_toxin), [saxitoxin](http://en.wikipedia.org/wiki/Saxitoxin), and many [mycotoxins](http://en.wikipedia.org/wiki/Mycotoxin). The organisms causing these diseases are known as [select agents](http://en.wikipedia.org/wiki/Select_agent). Their possession, use, and transfer are regulated by the [Centers for Disease Control and Prevention](http://en.wikipedia.org/wiki/Centers_for_Disease_Control_and_Prevention)'s Select Agent Program.

**Attacking crops and animals**

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](http://en.wikipedia.org/wiki/Herbicides)) during the Second World War, and initiated a [Herbicidal Warfare](http://en.wikipedia.org/wiki/Herbicidal_Warfare) program that was eventually used in [Malaya](http://en.wikipedia.org/wiki/Malaya) and [Vietnam](http://en.wikipedia.org/wiki/Agent_Orange) in counter insurgency. Though [herbicides](http://en.wikipedia.org/wiki/Herbicides) are chemicals, they are often grouped with biological warfare as [bioregulators](http://en.wikipedia.org/w/index.php?title=Bioregulators&action=edit) in a similar manner as biotoxins. Scorched earth tactics or destroying livestock and farmland were carried out in the Vietnam war and [Eelam War](http://en.wikipedia.org/wiki/Sri_Lankan_Civil_War) in Sri Lanka.

The United States developed an anti-crop capability during the Cold War that used plant diseases ([bioherbicides](http://en.wikipedia.org/wiki/Bioherbicide), or [mycoherbicides](http://en.wikipedia.org/wiki/Mycoherbicide)) for destroying enemy agriculture. It was believed that destruction of enemy agriculture on a strategic scale could thwart [Sino-Soviet](http://en.wikipedia.org/w/index.php?title=Sino-Soviet&action=edit) aggression in a general war. Diseases such as [wheat blast](http://en.wikipedia.org/wiki/Wheat_blast) and [rice blast](http://en.wikipedia.org/wiki/Rice_blast) were weaponized in aerial spray tanks and cluster bombs for delivery to enemy water sheds 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.

In 1980s Soviet Ministry of Agriculture had successfully developed variants of [foot-and-mouth disease](http://en.wikipedia.org/wiki/Foot-and-mouth_disease) and [rinderpest](http://en.wikipedia.org/wiki/Rinderpest) against [cows](http://en.wikipedia.org/wiki/Cow), [African swine fever](http://en.wikipedia.org/wiki/African_swine_fever) for [pigs](http://en.wikipedia.org/wiki/Pig), and [psittacosis](http://en.wikipedia.org/wiki/Psittacosis) to kill [chicken](http://en.wikipedia.org/wiki/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](http://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](http://en.wikipedia.org/wiki/Hog_cholera).

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

**The role of public health departments and disease surveillance**

It is important to note that all of the 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](http://en.wikipedia.org/wiki/Sverdlovsk) (now [Yekaterinburg](http://en.wikipedia.org/wiki/Yekaterinburg)) in the [Soviet Union](http://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](http://en.wikipedia.org/w/index.php?title=Compound_19&action=edit) and still off limits to visitors today, see [Sverdlovsk Anthrax leak](http://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](http://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](http://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 state (province) capabilities are being augmented by and coordinated with federal assets, to provide layered defenses against biological weapons attacks. The traditional approach toward protecting agriculture, food, and water: focusing on the natural or unintentional introduction of a disease 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](http://en.wikipedia.org/wiki/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](http://en.wikipedia.org/wiki/Lawrence_Livermore_National_Laboratory) (LLNL), employs a "sandwich immunoassay", in which fluorescent dye-labeled antibodies aimed at specific pathogens are attached to silver and gold nanowires. Researchers at [Ben Gurion University](http://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](http://en.wikipedia.org/wiki/ELISA), a similar widely employed immunological technique, that in this case incorporates fiber optics.

**See also**

**BW institutions and programs by country**

According to the United States [Office of Technology Assessment](http://en.wikipedia.org/wiki/Office_of_Technology_Assessment), since disbanded, seventeen countries were believed to possess biological weapons in 1995: [Libya](http://en.wikipedia.org/wiki/Libya), [North Korea](http://en.wikipedia.org/wiki/North_Korea), [South Korea](http://en.wikipedia.org/wiki/South_Korea), [Iraq](http://en.wikipedia.org/wiki/Iraq), [Taiwan](http://en.wikipedia.org/wiki/Taiwan), [Syria](http://en.wikipedia.org/wiki/Syria), [Israel](http://en.wikipedia.org/wiki/Israel), [Iran](http://en.wikipedia.org/wiki/Iran), [China](http://en.wikipedia.org/wiki/China), [Egypt](http://en.wikipedia.org/wiki/Egypt), [Vietnam](http://en.wikipedia.org/wiki/Vietnam), [Laos](http://en.wikipedia.org/wiki/Laos), [Cuba](http://en.wikipedia.org/wiki/Cuba), [Bulgaria](http://en.wikipedia.org/wiki/Bulgaria), [India](http://en.wikipedia.org/wiki/India), [South Africa](http://en.wikipedia.org/wiki/South_Africa), and [Russia](http://en.wikipedia.org/wiki/Russia).

**United States**

*Main article:* [*US Biological Weapon Testing*](http://en.wikipedia.org/wiki/US_Biological_Weapon_Testing)

* [Fort Detrick](http://en.wikipedia.org/wiki/Fort_Detrick), Maryland
	+ [United States Army Medical Research Institute of Infectious Diseases](http://en.wikipedia.org/wiki/United_States_Army_Medical_Research_Institute_of_Infectious_Diseases) (USAMRIID)
	+ [National Biodefense Analysis and Countermeasures Center](http://en.wikipedia.org/wiki/National_Biodefense_Analysis_and_Countermeasures_Center) (NBACC)
	+ [Building 470](http://en.wikipedia.org/wiki/Building_470)
	+ [One-Million-Liter Test Sphere](http://en.wikipedia.org/wiki/One-Million-Liter_Test_Sphere)
	+ [Project Bacchus](http://en.wikipedia.org/wiki/Project_Bacchus)
	+ [Project Clear Vision](http://en.wikipedia.org/wiki/Project_Clear_Vision)
* [Operation Whitecoat](http://en.wikipedia.org/wiki/Operation_Whitecoat)
* [Project SHAD](http://en.wikipedia.org/wiki/Project_SHAD)

**United Kingdom**

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

* [Porton Down](http://en.wikipedia.org/wiki/Porton_Down)
* [Gruinard Island](http://en.wikipedia.org/wiki/Gruinard_Island)
* [Nancekuke](http://en.wikipedia.org/wiki/RRH_Portreath)

**Soviet Union and Russia**

*Main article:* [*Soviet program of biological weapons*](http://en.wikipedia.org/wiki/Soviet_program_of_biological_weapons)

* [Biopreparat](http://en.wikipedia.org/wiki/Biopreparat)
* [Sverdlovsk Anthrax leak](http://en.wikipedia.org/wiki/Sverdlovsk_Anthrax_leak)
* [Stepnagorsk Scientific and Technical Institute for Microbiology](http://en.wikipedia.org/w/index.php?title=Stepnagorsk_Scientific_and_Technical_Institute_for_Microbiology&action=edit), a bioweapons facility at [Stepnogorsk](http://en.wikipedia.org/wiki/Stepnogorsk), northern [Kazakhstan](http://en.wikipedia.org/wiki/Kazakhstan)
* [Vector State Research Center of Virology and Biotechnology](http://en.wikipedia.org/wiki/Vector_State_Research_Center_of_Virology_and_Biotechnology)
* [Vozrozhdeniya Island](http://en.wikipedia.org/wiki/Vozrozhdeniya_Island)
* [Kirov bioweapons production facility](http://en.wikipedia.org/w/index.php?title=Kirov_bioweapons_production_facility&action=edit), [Kirov, Kirov Oblast](http://en.wikipedia.org/wiki/Kirov%2C_Kirov_Oblast)
* [Zagorsk smallpox production facility](http://en.wikipedia.org/w/index.php?title=Zagorsk_smallpox_production_facility&action=edit), [Zagorsk](http://en.wikipedia.org/wiki/Zagorsk)
* [Berdsk bioweapons production facility](http://en.wikipedia.org/w/index.php?title=Berdsk_bioweapons_production_facility&action=edit), [Berdsk](http://en.wikipedia.org/wiki/Berdsk)
* [Institute of Applied Biochemistry](http://en.wikipedia.org/w/index.php?title=Institute_of_Applied_Biochemistry&action=edit), [Omutninsk](http://en.wikipedia.org/wiki/Omutninsk)

**Japan**

*Main article:* [*Japanese war crimes#Experiments on humans and biological warfare*](http://en.wikipedia.org/wiki/Japanese_war_crimes#Experiments_on_humans_and_biological_warfare)

* [Unit 731](http://en.wikipedia.org/wiki/Unit_731)
* [Zhongma Fortress](http://en.wikipedia.org/wiki/Zhongma_Fortress)
* [Unit 100](http://en.wikipedia.org/wiki/Unit_100)
* [Unit 2646](http://en.wikipedia.org/wiki/Unit_2646)
* [Unit 8604](http://en.wikipedia.org/wiki/Unit_8604)
* [Unit Ei 1644](http://en.wikipedia.org/wiki/Unit_Ei_1644)

**Iraq**

*Main article:* [*Iraq and weapons of mass destruction*](http://en.wikipedia.org/wiki/Iraq_and_weapons_of_mass_destruction) (*passim*)

* [Al Hakum](http://en.wikipedia.org/wiki/Al_Hakum)
* [Salman Pak facility](http://en.wikipedia.org/wiki/Salman_Pak_facility)

**Treaties banning or restricting BW**

* [Geneva Protocol](http://en.wikipedia.org/wiki/Geneva_Protocol)
* [Biological Weapons Convention](http://en.wikipedia.org/wiki/Biological_Weapons_Convention)

**People**

***Bio-weaponeers***

* [Anton Dilger](http://en.wikipedia.org/wiki/Anton_Dilger)
* [Paul Fildes](http://en.wikipedia.org/wiki/Paul_Fildes)
* [Rihab Rashid Taha](http://en.wikipedia.org/wiki/Rihab_Rashid_Taha)
* [William C. Patrick III](http://en.wikipedia.org/wiki/William_C._Patrick_III)
* [Kenneth Alibek](http://en.wikipedia.org/wiki/Kenneth_Alibek)
* [Yuri Ovchinnikov](http://en.wikipedia.org/wiki/Yuri_Ovchinnikov)

***Writers and activists***

* [Matthew Meselson](http://en.wikipedia.org/wiki/Matthew_Meselson)
* [Jeanne Guillemin](http://en.wikipedia.org/wiki/Jeanne_Guillemin)
* [Richard Preston](http://en.wikipedia.org/wiki/Richard_Preston)

**Other**

* [Chemical warfare](http://en.wikipedia.org/wiki/Chemical_warfare)
* [Asymmetric warfare](http://en.wikipedia.org/wiki/Asymmetric_warfare)
* [Biosecurity](http://en.wikipedia.org/wiki/Biosecurity)
* [Biological agent](http://en.wikipedia.org/wiki/Biological_agent)
* [Biological hazard](http://en.wikipedia.org/wiki/Biological_hazard)
* [Antibiotic resistance](http://en.wikipedia.org/wiki/Antibiotic_resistance)
* [Ethnic bioweapon](http://en.wikipedia.org/wiki/Ethnic_bioweapon)
* [Weapons of mass destruction](http://en.wikipedia.org/wiki/Weapons_of_mass_destruction)
* [Ten Threats](http://en.wikipedia.org/wiki/Ten_Threats) identified by the [United Nations](http://en.wikipedia.org/wiki/United_Nations)
* [AIDS conspiracy theories](http://en.wikipedia.org/wiki/AIDS_conspiracy_theories)
* [*Just a Couple of Days*](http://en.wikipedia.org/wiki/Just_a_Couple_of_Days)*,* a satirical novel involving biological weaponry
* [Causes of hypothetical future disasters](http://en.wikipedia.org/wiki/Disaster#Causes_of_hypothetical_future_disasters)
* [List of infectious diseases](http://en.wikipedia.org/wiki/List_of_infectious_diseases)
* [Mortality from infectious diseases](http://en.wikipedia.org/wiki/Infectious_disease#Mortality_from_infectious_diseases)
* [Pandemic](http://en.wikipedia.org/wiki/Pandemic)