

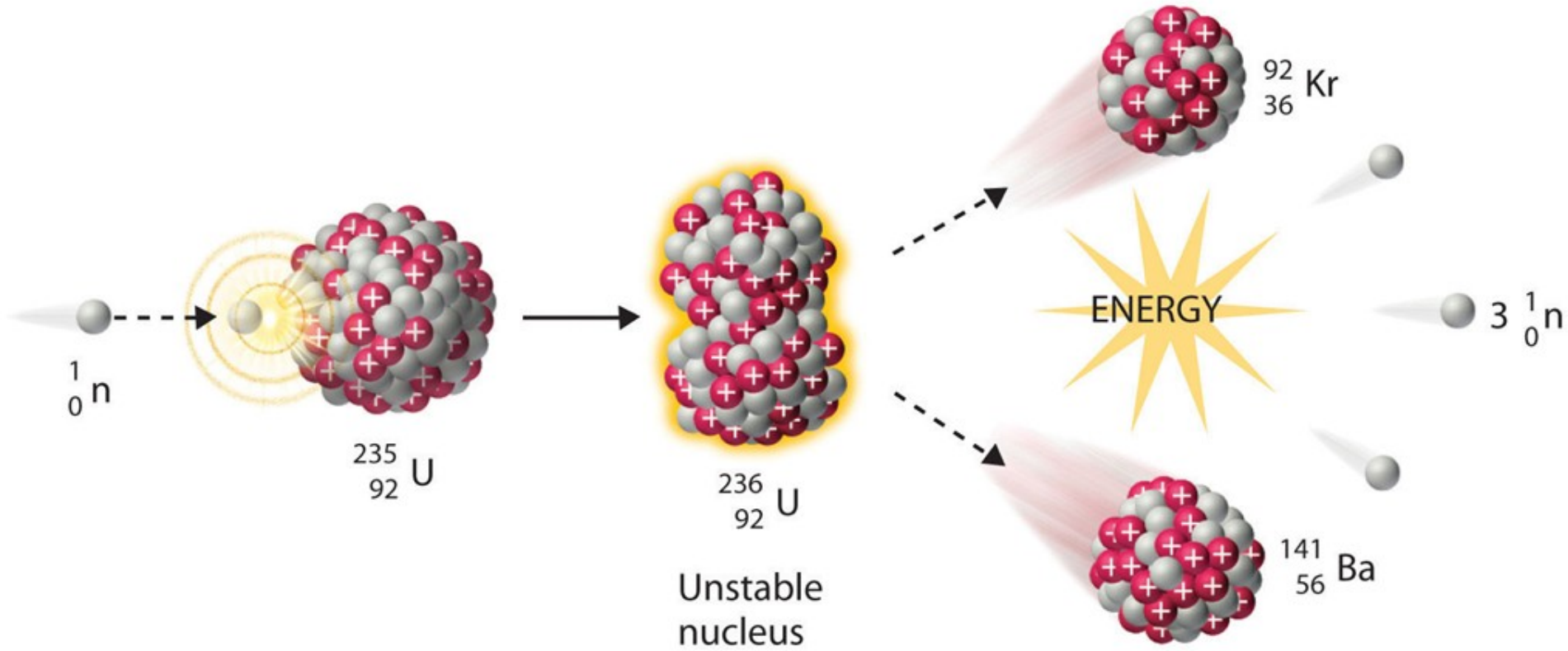
# Modern Technologies and Conflicts

## Nuclear and chemical weapons

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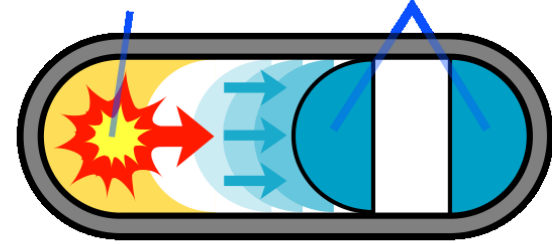
# Basic fission



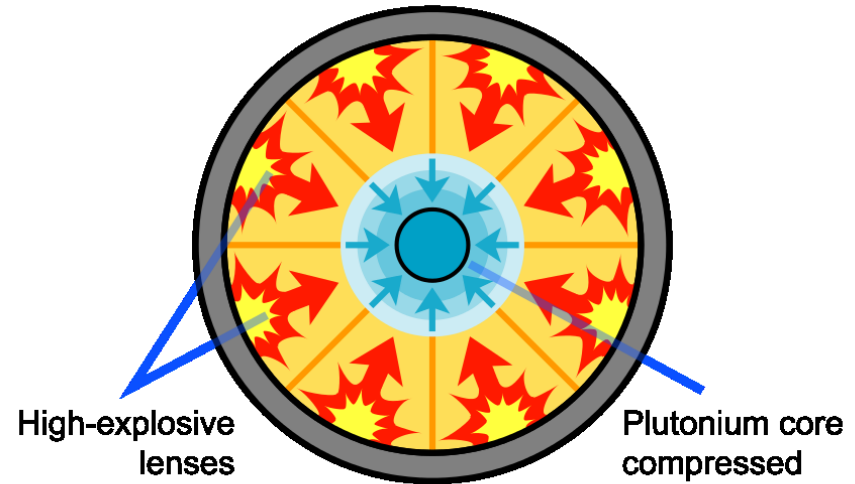
# Types

- gun-type
  - first, less efficient and simpler design
  - assembly of 2 subcritical parts
  - Little Boy (Hiroshima, 6.8. 1945)
- implosion
  - newer, more efficient design
  - conventional explosion compresses the core
  - Trinity test (Nevada, 16.7. 1945)
  - Fat Man (Nagasaki, 9.8. 1945)

Conventional chemical explosive      Sub-critical pieces of uranium-235 combined



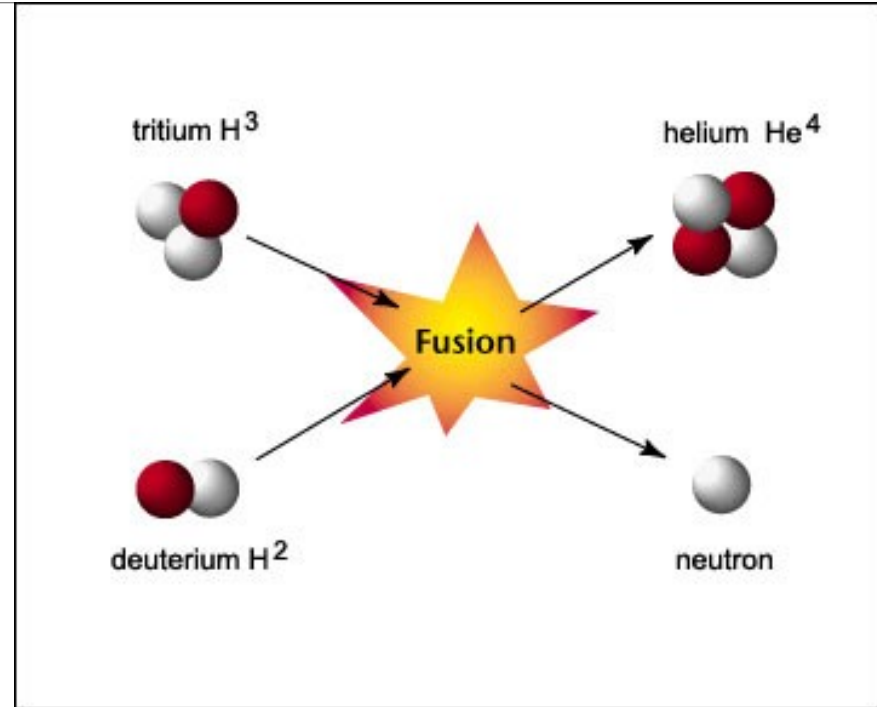
**Gun-type assembly method**



**Implosion assembly method**

# Nuclear fusion

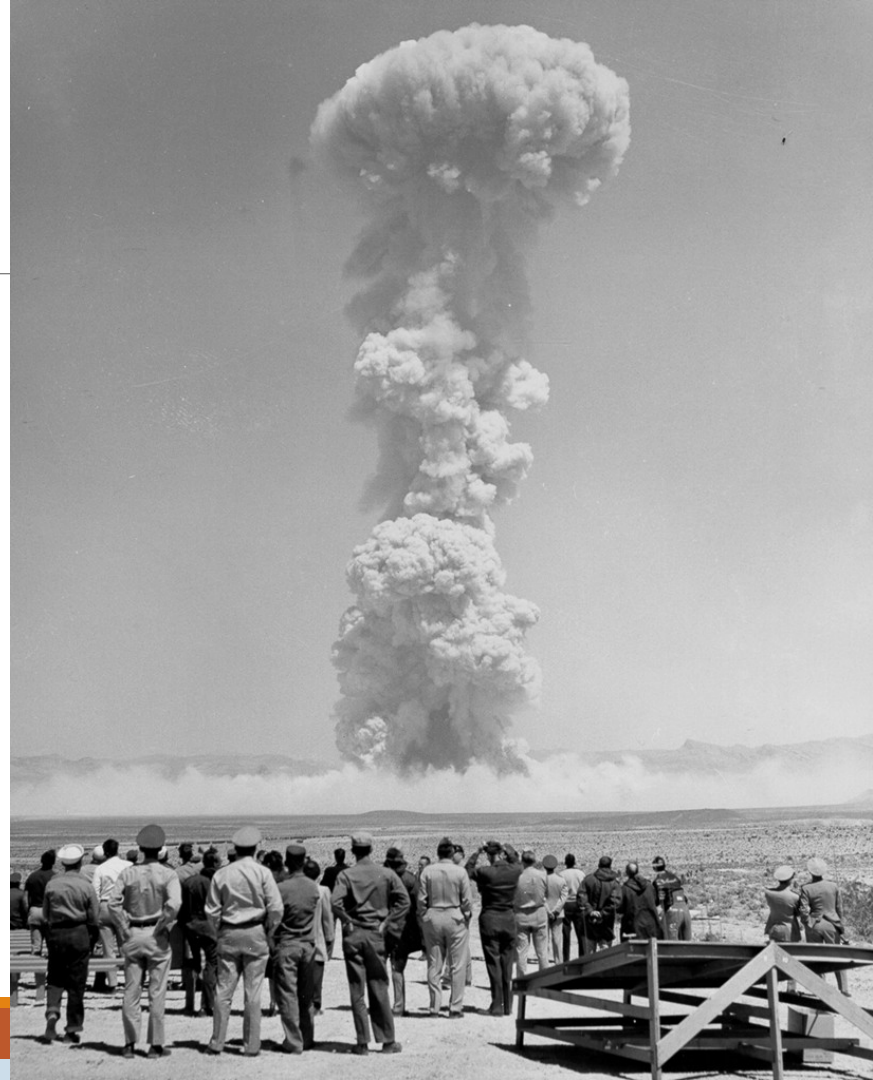
- boosted fission
  - boosting yield of fission bombs by adding helium isotopes (1940s)
- thermonuclear/hydrogen bombs
  - hydrogen core compressed via fission bomb
  - developed in 50s
  - Castle Bravo, 1954, 15 MT
  - Tsar Bomb, 1961, 50 MT
  - roughly 1000x stronger than WW2 bombs
  - commonly used today on ballistic missiles



# Other types

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- Enhanced Radiation Weapon
  - optimized for neutron radiation
  - minimal physical destruction
  - “kills people, leaves buildings standing”
  - can be used on tactical or ABM missiles
- Electromagnetic Pulse
  - optimized for gamma and x-ray radiation
  - overloads and destroys electronics
  - non-nuclear variant also exist





# Radiological weapons

- so called “dirty bomb”
  - spreading radiation through conventional explosion
  - tested as Denial-of-Access weapon
  - possibly attractive for terrorists
  - sounds scary but quite impractical
    - radiation too weak, temporary and can be cleaned up
    - primary threat is panic, not direct deaths

<https://youtu.be/WD1BRE-DBsA?t=43m11s>

- 2006, Litviněnko assassination

# Depleted uranium

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- by-product from uranium enrichment
- 50% heavier than lead, similar to tungsten
  - but cheaper and pyrophoric
- used in munitions, armour, shielding, counterweights...
- lasting controversy regarding its effect on health and environment
  
- no nuclear reaction taking place
- minimal level of radioactivity (comparable to banana)
- but can be quite toxic (similar to other heavy metals)





# History

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- nucleus and radioactivity discovered before WW1 (Rutherford, Currie)
- first principles developed in 30s (Leo Szilard, Otto Hahn)
- 1942 project Manhattan started
  - UK lacked the industrial capacity
  - Germany focused on rocketry
- 1945 end of WW2
- USSR (1949), UK (1952), France (1960), China (1964), Israel (196?), India (1974), Pakistan (1998), DPRK (2016?)



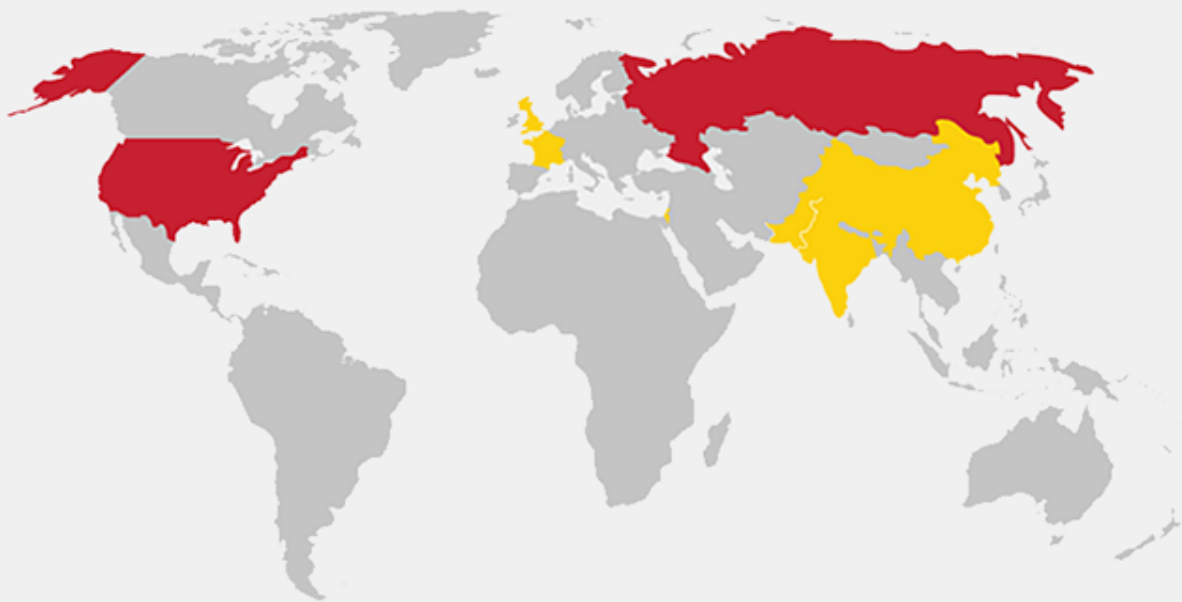


# Current arsenals

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- permanent members of UN SC
- plus India, Pakistan and Israel
- ongoing efforts by DPRK and Iran
- issue of post-soviet countries
- former programs in Libya, Iraq, Syria, South Africa, Brazil, Taiwan, Sout Korea, Yugoslavia, ...
- <https://www.ctbto.org/nuclear-testing/>
- [https://en.wikipedia.org/wiki/Nuclear\\_proliferation#/media/File:Nuclear\\_weapon\\_programs\\_worldwide\\_oct2006.png](https://en.wikipedia.org/wiki/Nuclear_proliferation#/media/File:Nuclear_weapon_programs_worldwide_oct2006.png)

# WORLD NUCLEAR WEAPONS STOCKPILE



TOTAL NUCLEAR WEAPONS: 15,375



FRANCE 300

CHINA 260

UK 215

PAKISTAN 130

INDIA 120

ISRAEL 80

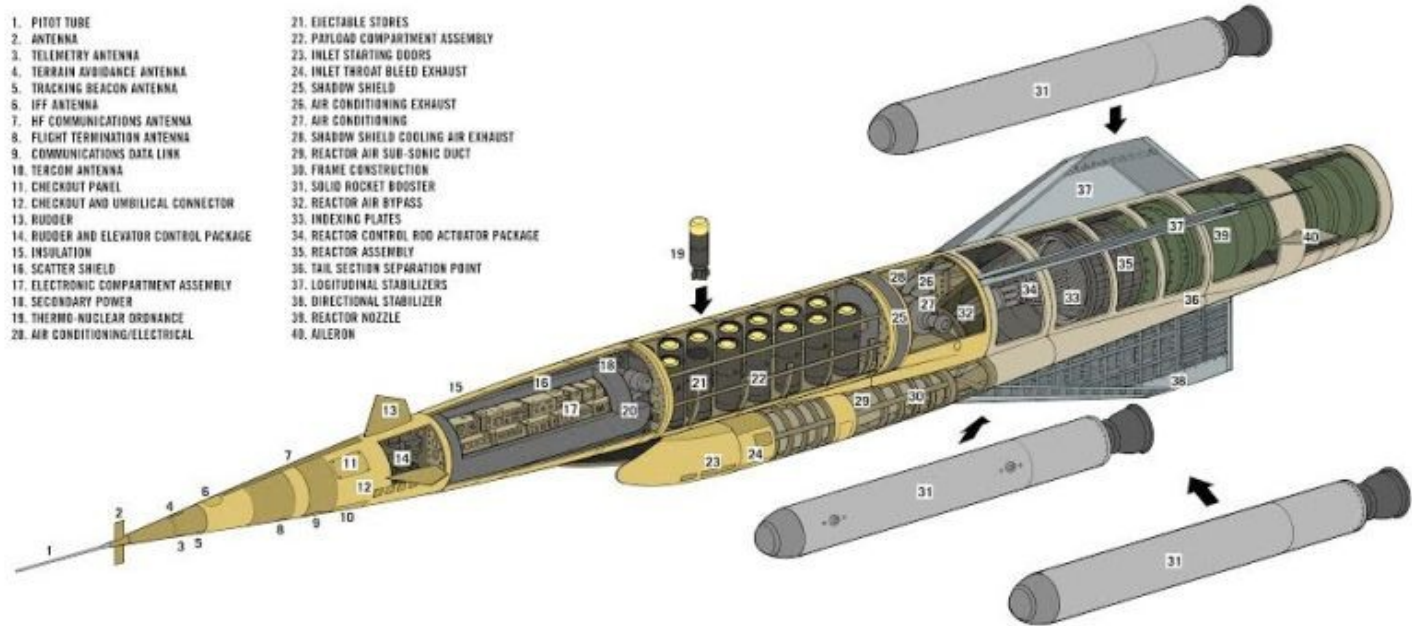
NORTH KOREA < 15

# Some notable weapon systems

- SLAM (1955-1964)  
doomsday weapon

## LING-TEMCO-VOUGHT SLAM (PLUTO)

- |   |  |
|---|--|
| 1. PITOT TUBE                           | 21. EJECTABLE STORES                     |
| 2. ANTENNA                              | 22. PAYLOAD COMPARTMENT ASSEMBLY         |
| 3. TELEMETRY ANTENNA                    | 23. INLET STARTING DOORS                 |
| 4. TERRAIN AVOIDANCE ANTENNA            | 24. INLET THROAT BLEED EXHAUST           |
| 5. TRACKING BEACON ANTENNA              | 25. SHADOW SHIELD                        |
| 6. IFF ANTENNA                          | 26. AIR CONDITIONING EXHAUST             |
| 7. HF COMMUNICATIONS ANTENNA            | 27. AIR CONDITIONING                     |
| 8. FLIGHT TERMINATION ANTENNA           | 28. SHADOW SHIELD COOLING AIR EXHAUST    |
| 9. COMMUNICATIONS DATA LINK             | 29. REACTOR AIR SUB-SONIC DUCT           |
| 10. TERCOM ANTENNA                      | 30. FRAME CONSTRUCTION                   |
| 11. CHECKOUT PANEL                      | 31. SOLID ROCKET BOOSTER                 |
| 12. CHECKOUT AND UMBILICAL CONNECTOR    | 32. REACTOR AIR BYPASS                   |
| 13. RUDDER                              | 33. INDEXING PLATES                      |
| 14. RUDDER AND ELEVATOR CONTROL PACKAGE | 34. REACTOR CONTROL ROD ACTUATOR PACKAGE |
| 15. INSULATION                          | 35. REACTOR ASSEMBLY                     |
| 16. SCATTER SHIELD                      | 36. TAIL SECTION SEPARATION POINT        |
| 17. ELECTRONIC COMPARTMENT ASSEMBLY     | 37. LONGITUDINAL STABILIZERS             |
| 18. SECONDARY POWER                     | 38. DIRECTIONAL STABILIZER               |
| 19. THERMO-NUCLEAR ORDNANCE             | 39. REACTOR NOZZLE                       |
| 20. AIR CONDITIONING/ELECTRICAL         | 40. AILERON                              |



DAMON MORAN  
2008

# Terrorism

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- ongoing speculations
  - esp. after collapse of USSR and 9/11
- regular news about efforts of terrorist groups to procure nuclear weapons or dirty bombs, without confirmation or results
- building a nuclear weapon from scratch impossible
- might steal it, buy it or attack a nuclear facility
- building dirty bomb is trivial, could be used to spread fear





# Types of chemical weapons I.

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- Nerve agents
  - block nerve signals > convulsions, paralysis of muscles > asphyxiation or heart failure
  - sarin, soman, tabun, VX, novichok
- Blood agents
  - absorbed into blood by inhalation or consumption > block oxygen
  - cyanide, arsenic, oxygen monoxide
- Choking agents
  - stings and destroys cells in lungs and membranes > lungs flood with liquid > asphyxiation
  - phosgene, chlorine

# Types of chemical weapons II.

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- Blistering agents
  - up to 24 hours after contact, chemical burns for days, extremely painful, necrotic
  - yperite (mustard gas), lewisite
- Psychoactive
  - temporary loss of consciousness, confusion, hallucinations
  - LSD-25, BZ, Kolokol-1
- Incapacitating
  - cause vomiting, burning in eyes, coughing, tears
  - chloracetophenon, CS, CR, adamsite





# History I.

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- use of smoke since time immemorial
- da Vinci's proposal for chemical grenade
- boom of chemistry since 19th century
- largest use in history during First World War
  - 1914 – tear gas, first use by France, unsuccessful
  - 1915 - chlorine, phosgene
  - 1917 - yperite (mustard gas)
  - over 1 million soldiers impacted, 100 thousand killed (primarily by phosgene)
  - all major powers used chemical weapons
- nerve gases discovered in Germany in 1930s



# History II.

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- very limited combat use during WW2 – why?
  - Germany did not know nobody else discovered nerve gas, worried about escalation
  - used a lot by Japan
  - planned use for defense of Great Britain
  - Zyklon B in extermination camps
- “gas race” during Cold War
- used in smaller conflicts in Middle East, Africa, etc.





# Technology used

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- methods of dispersion
  - wind, artillery, air bombs, spraying, binary munitions
- methods of protection
  - detection by sight and smells, damp cloth over face
  - later gas masks, continually improved, full suits
  - neutralizing chemical agents, antidotes, electronic detection

# Strategic and tactical aspect

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- highly dependent on weather
  - temperature, wind and humidity can limit the effect or even hit friendly forces
- contamination
- quite cheap and simple to produce
- very bad for PR
- not very effective when the armies are protected
- can escalate quickly



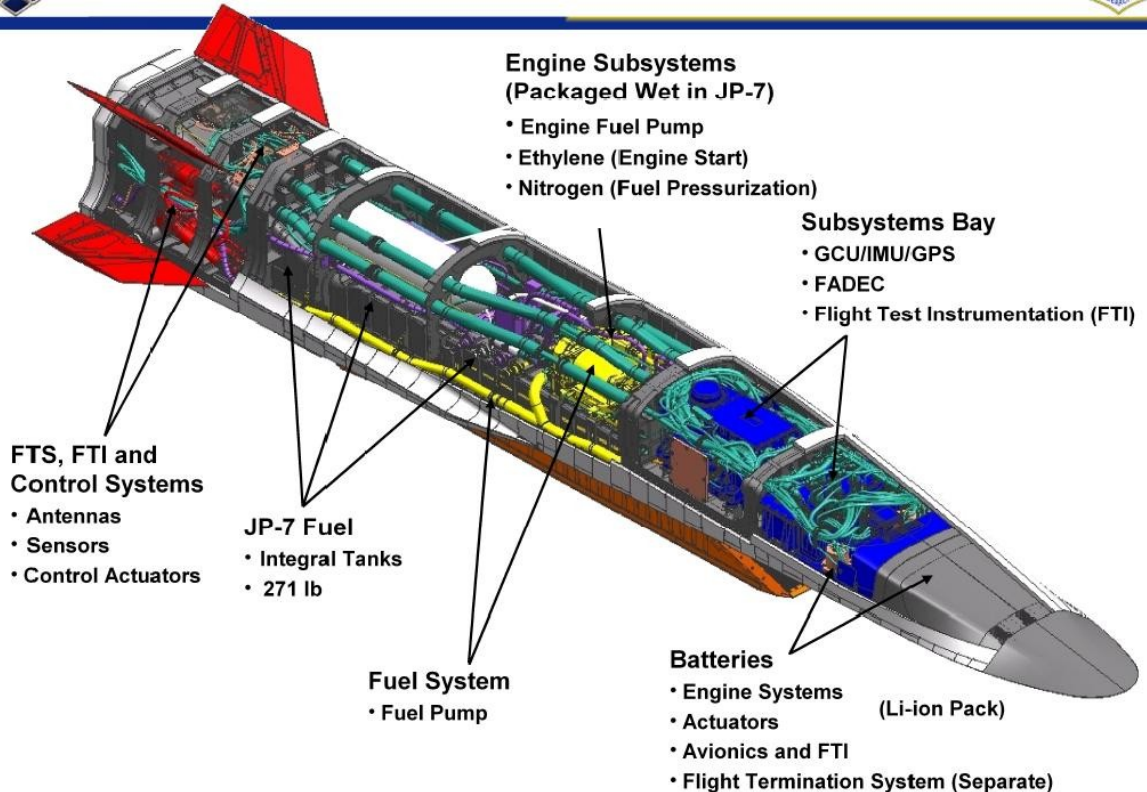
# Terrorism etc.

- chemical weapons are relatively easily procurable
- sometimes used to enhance conventional attacks
  - not effective
- Aum Shinrikyo
  - 1990-5: 10 attempts for chemical attack
    - (4x sarin, 4x VX, 1x phosgene and cyanide)
    - 2x successful, 14 killed, 4000 injured
- Moscow theater siege, kolokol-1 used by police, 2002
- attacks on chlorine tanks in Iraq, 2007
- use in Syria since 2012, multiple sides
  - (chlorine, sarin, yperite, tear gas)
- assassination of Kim Jong Nam, 13/2/2017, VX
- Sainsbury attack on Skripals, 04/04/2018, novichok



# Some notable weapon systems

- scramjet
- goal is fastest possible reaction when ballistic missiles cannot be used and cruise missiles are too slow
- hypersonic (mach5+)
- flight across pacific in 1-2h
- theoretical basics known since WW2
- mixed success in tests





# Some notable weapon systems

- Mach7+, range up to 200 km
- electromagnetic force instead of chemical combustion
- small “cheap” munition, less risky to store
- purely kinetic energy kill
- 11 kilograms @ Mach7  $\approx$  87t @ 100 km/h (locomotive)
- targets at land, sea and air
- first deployments “soon”

[https://www.youtube.com/watch?v=O2QqOvFMG\\_A&feature=youtu.be&t=8s](https://www.youtube.com/watch?v=O2QqOvFMG_A&feature=youtu.be&t=8s)

- problems:
  - o gun wear and durability
  - o power demands

