



UNDERSTANDING BIOSAFETY, BIOSECURITY, AND EMERGING THREATS

Biotechnology and National Security:
Biosecurity, Biosafety, and the Threat of Biowarfare

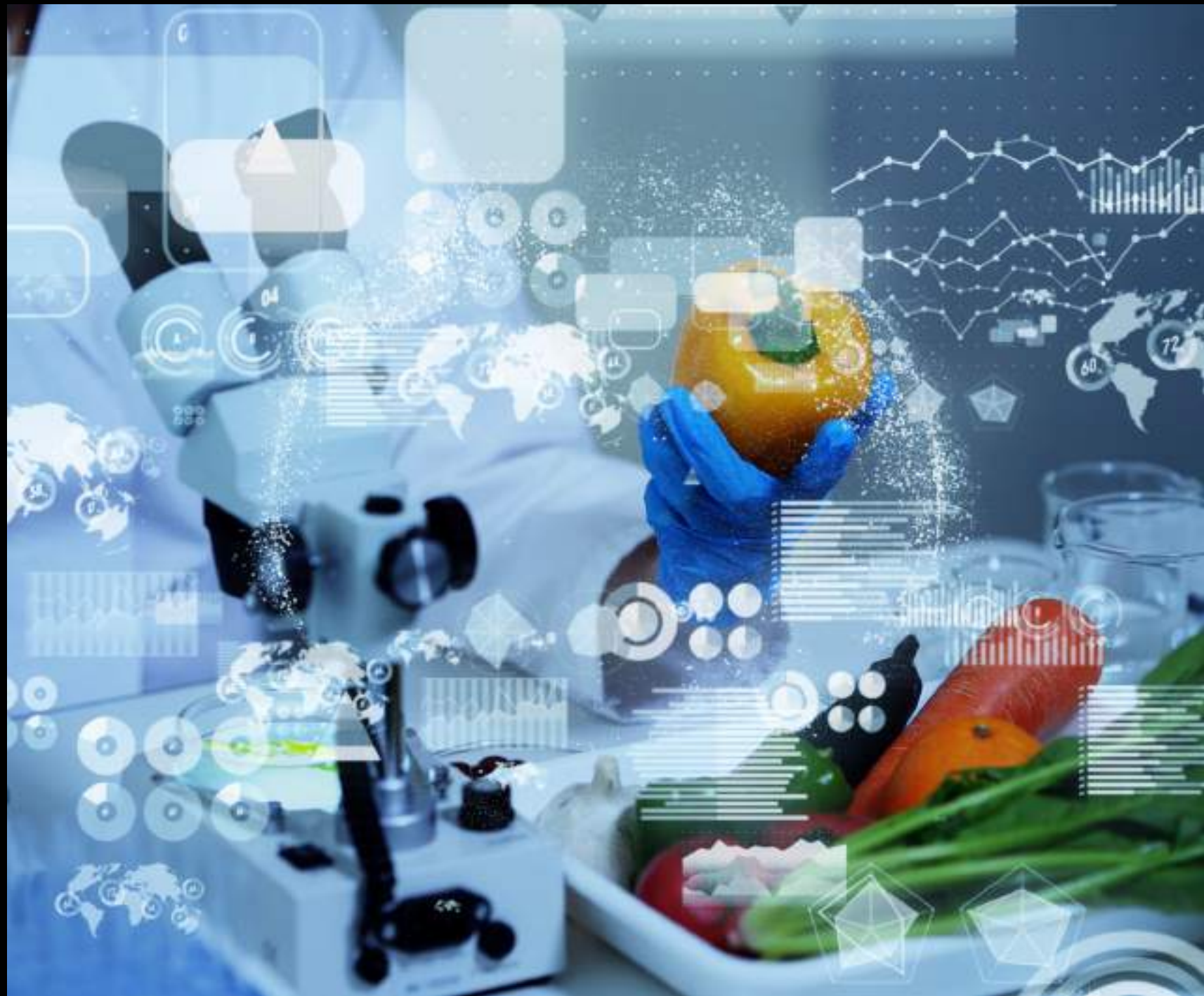


WHAT IS

BIOTECHNOLOGY?



BIOTECHNOLOGY



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- Biotechnology is the application of biological systems and organisms to develop technologies and products intended to improve the quality of life.
- It draws from **biology, engineering, genetics, and medical technology.**
- Applications span **healthcare, agriculture, environment, and national security.**

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IS IT BIOLOGY AND ENGINEERING?



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- Biotechnology often combines **biological knowledge** with engineering principles.
- Example: Designing a **bio-reactor** to mass-produce vaccines.
- Understanding such intersections enables **cadets from technical backgrounds** to appreciate military-grade biotechnological applications.

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IS IT GENETICS?



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- Genetics is foundational to biotechnology — modifying genes enables development of **disease-resistant crops, customized medicine**, and even **biological weapons**.
- **CRISPR** and **genome editing** are transformative but require careful oversight.

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ARE GENETIC ENGINEERING & SYNTHETIC BIOLOGY THE SAME?



GENETIC ENGINEERING

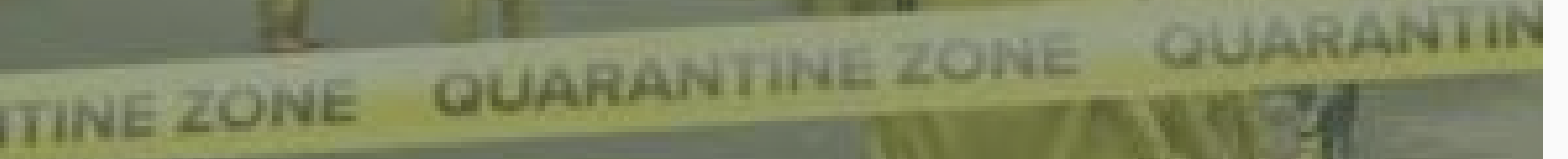
Genetic engineering involves the direct modification of an organism's DNA to introduce new traits or functions. Techniques like CRISPR

SYNTHETIC BIOLOGY

Synthetic biology extends this by enabling the design of entirely new biological systems. Synthetic biology can construct genetic circuits and even artificial life forms.



WHAT IS BIO-WARFARE?





BIO-WARFARE

- Biological warfare involves the **intentional use of pathogens**—such as bacteria, viruses, or toxins—as weapons to cause disease or death in humans, animals, or crops.
- These agents can be **engineered** for higher lethality, resistance to treatment, or silent spread before detection.
- Today, the threat is amplified by advances in synthetic biology and gene editing, which make such weapons easier to develop but harder to detect.

BIOLOGICAL WEAPONRY

Weaponized Agents:

- Bacteria: Anthrax, plague, tularemia
- Viruses: Smallpox, viral hemorrhagic fevers
- Toxins: Botulinum toxin, ricin
- Fungi: Various plant and animal pathogens

Delivery Mechanisms

- Aerosol dissemination systems
- Contamination of food and water supplies
- Direct contact methods
- Vector-borne transmission

Characteristics Making Agents Dangerous

- **Infectivity:** Ability to cause infection
- **Virulence:** Severity of disease caused
- **Transmissibility:** Ease of person-to-person spread
- **Environmental stability:** Survival outside host organisms
- **Availability of countermeasures:** Vaccines, treatments, detection methods

Biological warfare has ancient roots, with documented cases spanning millennia.

Historical examples include:

14th century BC

Hittite armies infected rams with tularemia to attack enemies

1346

Mongol forces catapulted plague-infected corpses over city walls during the siege of Caffa

1763

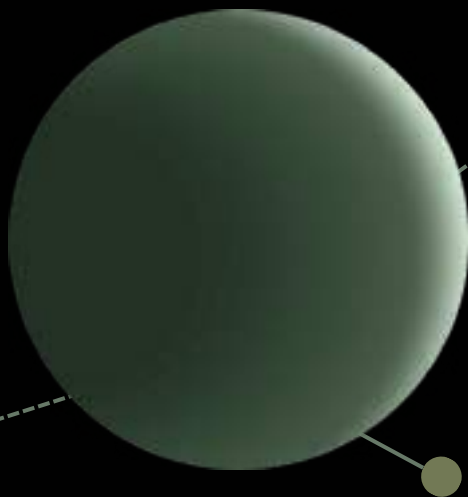
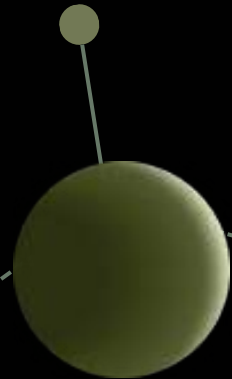
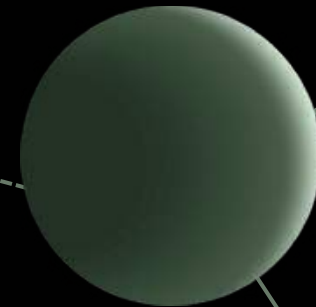
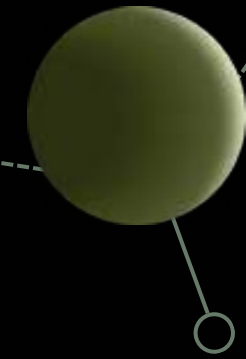
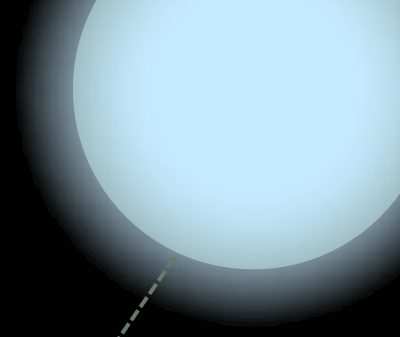
British forces provided smallpox-contaminated blankets to Native Americans during the French-Indian War

World War I

German forces infected horses and mules with glanders and anthrax

World War II

Japan's Unit 731 conducted extensive biological weapons research, killing thousands in human experiments



BIO SAFETY AND BIO SECURITY

A person wearing a full-body white biohazard suit, including a hood, gloves, and a respirator mask, stands in a forest. They are holding a large, bare, brown branch in front of their chest. The background consists of many thin, vertical tree trunks, suggesting a dense forest.

**WHAT ARE
THESE TERMS
AND WHY THEY
MATTER!**

BIOSAFETY

- Focuses on preventing accidental exposure to or release of biological agents.
- Involves:
 - Lab protocols
 - Containment levels (BSL 1–4)
 - Training and emergency response
- Every person entering scientific labs should be aware of these protocols.



BIOSAFETY LEVELS (BSL)

The Centers for Disease Control and Prevention (CDC) has established four biosafety levels, each with increasing containment requirements

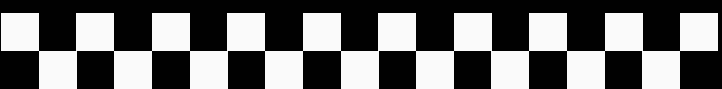
Biosafety Level	Risk Level	Examples	Key Safety Measures
BSL-1	Minimal risk	Non-pathogenic E. coli, Bacillus subtilis	Standard lab practices, minimal PPE
BSL-2	Moderate risk	HIV, Salmonella, Hepatitis B	Biosafety cabinets, access control, immunisations
BSL-3	High risk	Tuberculosis, West Nile virus, Yellow fever	Controlled ventilation, strict access control, and respiratory protection
BSL-4	Extreme risk	Ebola, Marburg, Lassa fever	Maximum containment, positive pressure suits, isolated facilities

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Appropriate PPE forms the final barrier between laboratory personnel and biological hazards:

Standard PPE Components:

- **Laboratory coats or gowns:** Prevent contamination of personal clothing
- **Gloves:** Protect hands from direct contact with hazardous materials
- **Eye protection:** Safety glasses or goggles to prevent splash exposure
- **Respiratory protection:** N95 respirators or more advanced breathing apparatus for higher-risk work



BIOSECURITY

- Refers to protection against theft, sabotage, or misuse of biological agents.
- Requires:
 - Inventory control
 - Access restrictions
 - Personnel reliability checks
- Especially critical in institutions working with pathogens or genetically modified organisms.



BIO SAFETY VS BIO SECURITY

BIO SAFETY	BIO SECURITY
Prevent accidental exposure or release of biological agents	Prevent intentional misuse or theft of biological agents
Protecting people and environment from biological risks	Protecting biological materials from unauthorized access
Laboratories, hospitals, research facilities	High-containment labs, storage units, border control points
Lab containment procedures, PPE, waste disposal	Access control, personnel vetting, pathogen inventory checks

WHY DO THESE DIFFERENCES MATTER?



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- Misunderstanding these terms leads to regulatory loopholes.
- Neglecting biosafety causes lab accidents.
- Neglecting biosecurity invites bioterror or theft.
- A competent security framework demands both disciplines.

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BIOTERRORISM

- Bioterrorism is the deliberate use of biological agents by non-state actors to cause harm, fear, or disruption.
- Targets are usually civilian populations, public spaces, or critical infrastructure.
- Bioterror attacks are difficult to predict due to their low-cost, high-impact nature, and the invisibility of biological agents.

Common goals include:



Creating mass panic



Overwhelming healthcare systems



Destabilizing governments or economies





BIOTERROR AGENTS, DELIVERY METHODS, AND IMPACT

- Quite similar to Biowar Attack! The difference is that here the aggressor is not a state but an individual or a terror organization
- The symptoms often appear hours or days later, making detection and containment difficult.
- Such attacks aim to cause mass panic, public health emergencies, and economic disruption, without traditional military engagement.
- Civilians are the primary targets, and the goal is psychological and infrastructural damage, not territorial gain.

2001 Anthrax attacks in the U.S. via postal letters caused widespread panic.

5 deaths
17 infections



WHY IS IT UNDER ESTIMATED?

- Delayed effects make attribution difficult
- Dual-use nature complicates detection
- Psychological impact exceeds physical damage
- Low cost compared to conventional weapons

COVID-19 Lessons:

The pandemic demonstrated global vulnerability to biological threats and the cascading effects of infectious disease outbreaks.

7,097,572 deaths
704,753,890 infections

MODERN CASES

- 1984: Rajneeshee cult contaminates salad bars with *Salmonella* (751 infected)
- 1995: Aum Shinrikyo failed anthrax attack in Tokyo
- 2001: Anthrax letters in US postal system (22 cases, 5 deaths)
- 1979: Sverdlovsk anthrax accident (66 deaths)



Future Risks by 2030:

Emerging Concerns:

GLOBAL BIOSAFETY FRAMEWORK

- **Biological Weapons Convention**
- **Cartagena Protocol on Biosafety**
- **International Health Regulations**



BWIC

Biological Weapons Convention

BWOC

- The BWC is the global foundation for preventing biological warfare—but its success depends entirely on international cooperation and trust.
- It prohibits the development, production, stockpiling, and transfer of biological weapons.
- Member states are expected to use biotechnology for peaceful purposes only.
- Unlike other WMD treaties, the BWC lacks a formal verification mechanism, making compliance trust-based.
- It is overseen by the United Nations Office for Disarmament Affairs (UNODA).



1972 Year of Signing

First multilateral treaty banning an entire class of weapons: biological and toxin weapons.

INDIA'S CONTRIBUTIONS AND POSITION ON BWC

India is an original signatory and strong supporter of the BWC.

National agencies like DRDO, ICMR, and DBT contribute to biosafety and bio-defense capacity.

India participates in BWC review conferences, working groups, and global bio surveillance efforts.





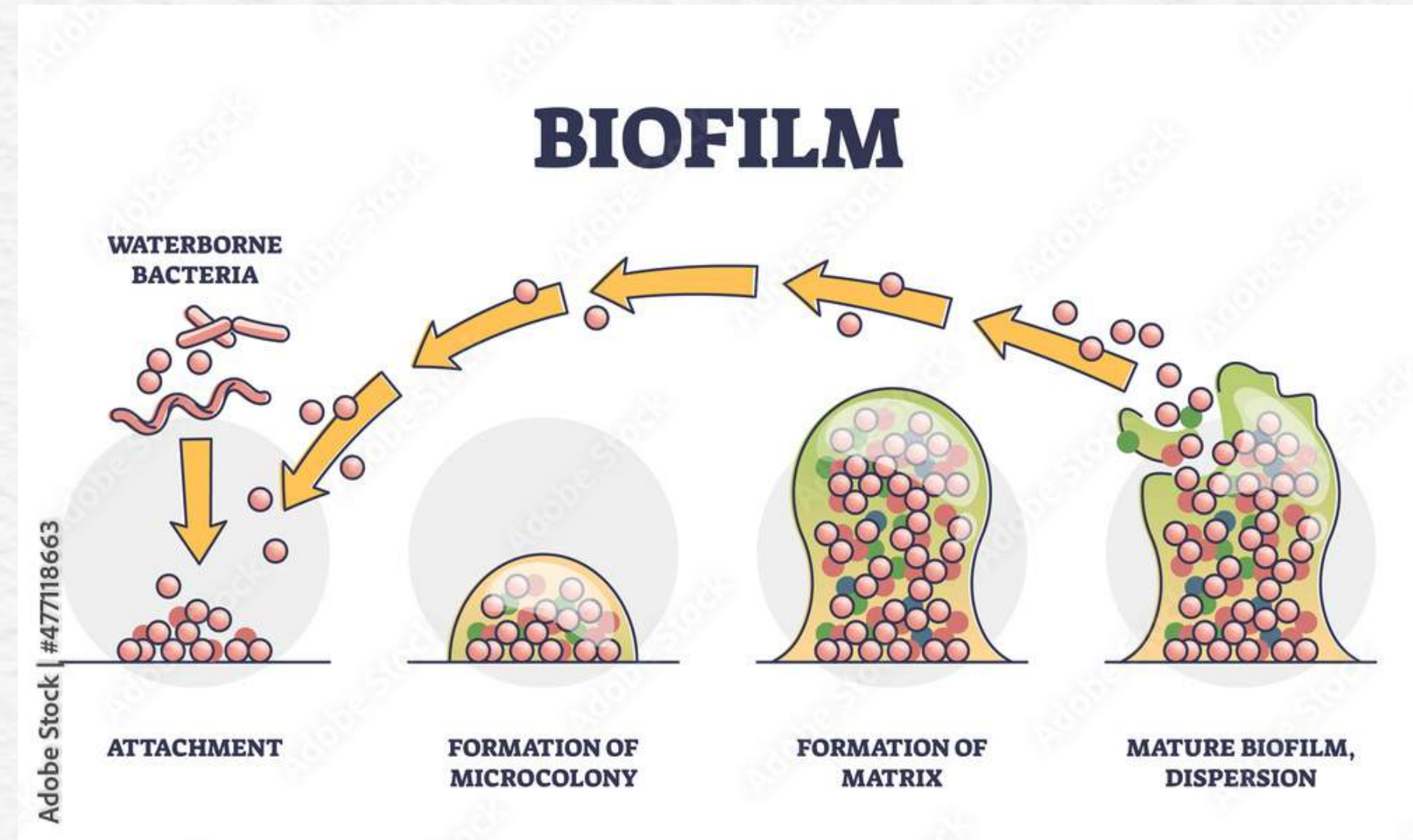
ABOUT OUR CURRENT PROJECT

AUREOLYZE

Stay tuned, exciting new content is
coming soon



BIOFILMS



- Biofilms are communities of microorganisms attached to surfaces.
- They are a significant factor in persistent bacterial infections.
- Biofilms exhibit notably greater resilience to antibiotics compared to free-floating bacteria.

Global AMR Crisis: AMR is projected to cause 10 million annual deaths by 2050. In 2019, AMR directly caused 1.27 million global deaths and was associated with 4.95 million.

India's Burden: In 2019, India saw 297,000 direct AMR deaths and 1,042,500 associated deaths. MRSA, a significant concern in India (13-47% prevalence in ICUs), directly caused over 100,000 global deaths in 2019.

BIOFILMS



According to some estimates, 65–80% of total human infections are associated with biofilm formation and include: periodontitis/dental caries, cystic fibrosis lung infection, chronic otitis media, infective endocarditis, chronic osteomyelitis, chronic rhinosinusitis, chronic tonsillitis, chronic peritonitis, chronic prostatitis, chronic wounds, recurrent urinary tract infections (UTIs), bloodstream infections (BSIs), ventilated-associated pneumonia and infections associated with indwelling medical devices (e.g., contact lenses, heart valves, joint prostheses, and other orthopedic implants, intrauterine devices, intravascular catheters, urinary tract catheters, peritoneal catheters, etc.)

MRSA is a significant concern in India, with prevalence rates in *S. aureus* ICU infections ranging from 13-47%.

Projections indicate South Asia (including India) will have the highest future AMR deaths, with an estimated 11.8 million direct deaths between 2025 and 2050.

AUREOLYZE

Our Solution: Engineered Aureolyze's ESP Protease

We present Aureolyze's ESP Protease, an innovative therapeutic agent engineered to combat *S. aureus* biofilms with two key advantages:

1. Potent *S. aureus* Biofilm Disruption: Our protease retains its *S. aureus* biofilm activity, effectively breaking down these protective structures. This increases bacterial susceptibility to antibiotics and host immunity.
2. IL-33 Preservation: Crucially, Aureolyze's ESP Protease is engineered to not degrade IL-33. This preserves a vital component of the innate immune response, enabling a stronger host defense.



AUREOLYZE

The Impact: A New Era in Infection Control

Aureolyze's ESP Protease offers the potential to:

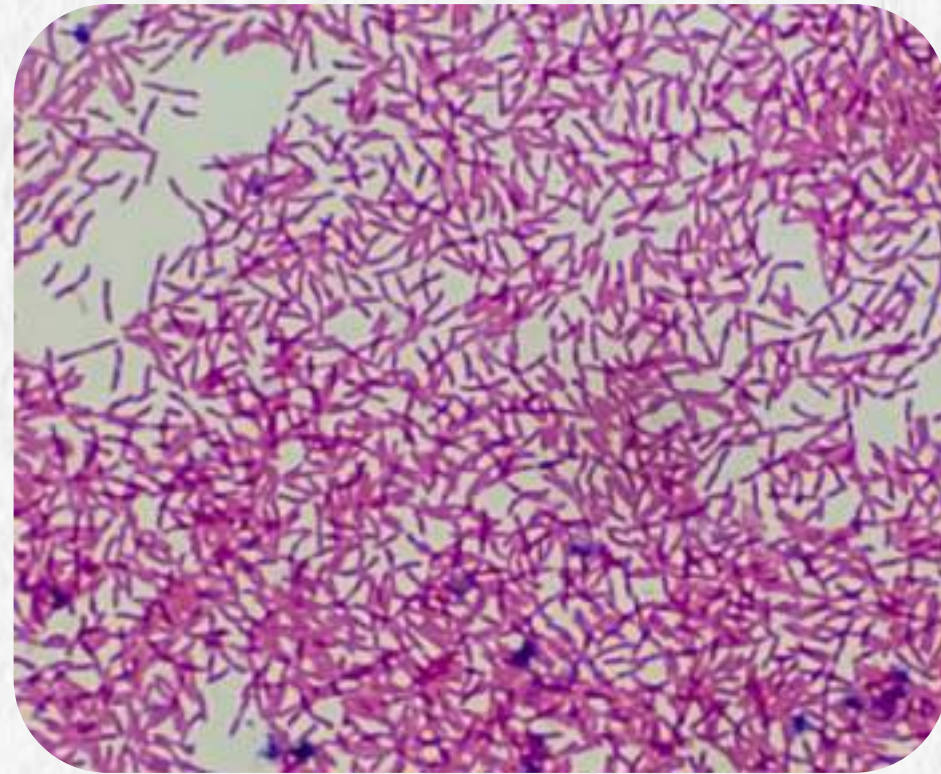
- Enhance Antibiotic Efficacy: Makes resistant bacteria susceptible again.
- Reduce Morbidity & Mortality: Decreases patient suffering, hospital stays, and infection-related deaths.
- Improve Outcomes in High-Risk Settings: Vital for device-related and chronic wound infections.
- Combat the AMR Crisis: Provides a non-antibiotic approach to mitigate AMR's growing threat.

Aureolyze's ESP Protease is a strategic innovation to redefine biofilm infection treatment and turn the tide against antimicrobial resistance.

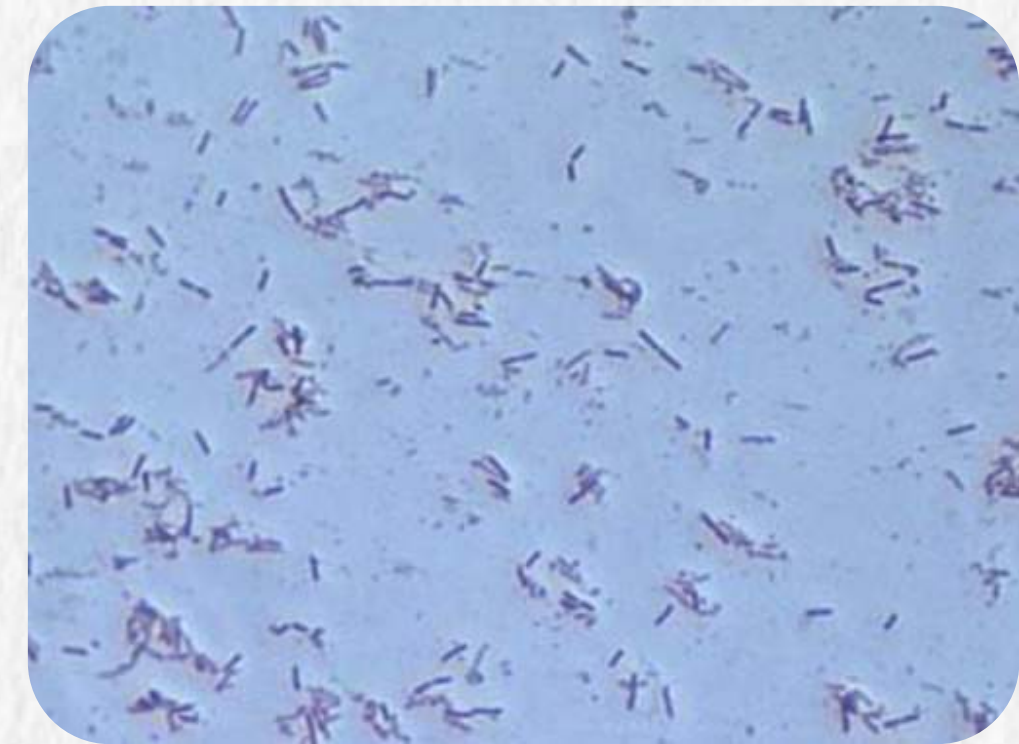
Join us in revolutionizing the fight against tenacious bacterial infections.



BIOFILM FORMING BACTERIA



**STAPHYLOCOCCUS
AUREUS**



**PSEUDOMONAS
AERUGINOSA**



THANK YOU

