

Managing Occupational Health and Safety Risks

Lecture Title:
From Chemistry to Biology

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Date:



**Undergraduate Diploma in
Occupational Health and Safety**

Chemical Hazards

- **Are inanimate (not having life ex. Stones)**
- **Do not replicate**
- **Can be detected by sensors, indicator, monitoring**
- **Effects are dose-dependent (the dose makes the poison)**



Biological Hazards

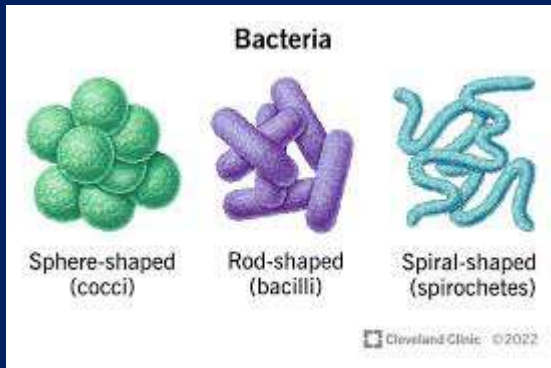
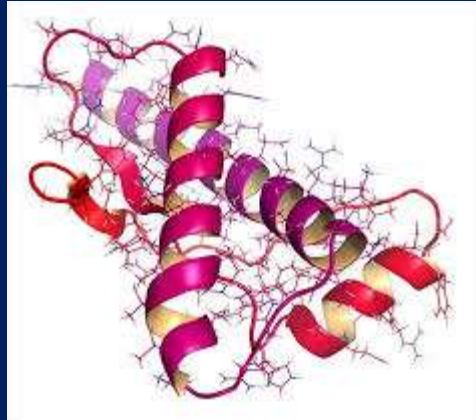
- **Are living (capable of replication)**
- **Replicate- one bacterium can become million in hours**
- **Concentration increases over time if conditions allow**
- **Sometimes cannot be detected by human senses**

A chemical spill is contained, cleaned up, and the hazard is gone. A biological spill that is not properly decontaminated can lead to ongoing exposure and potential outbreaks.

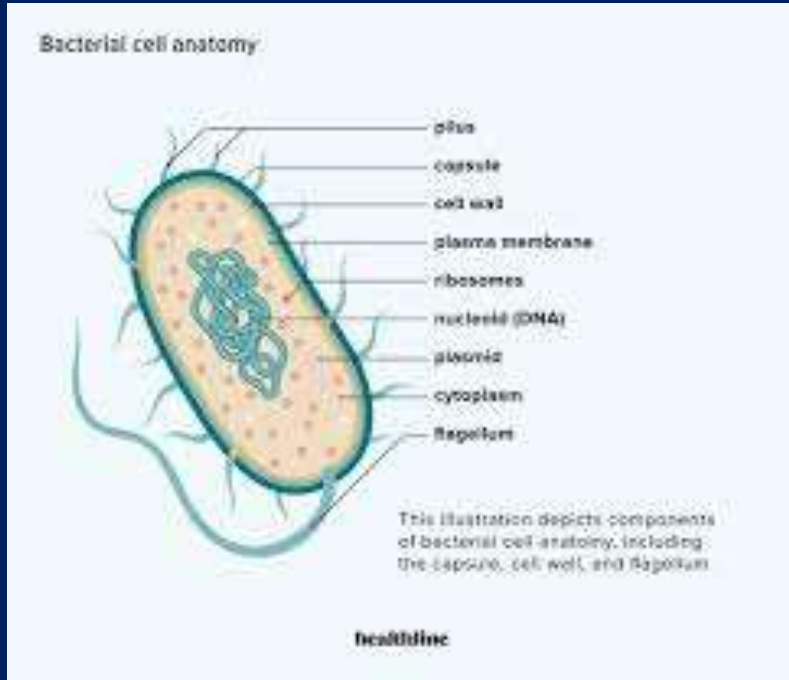


What are Biological Hazards??

- Biological hazards are biological substances that pose a threat to the health of living organisms, primarily humans.

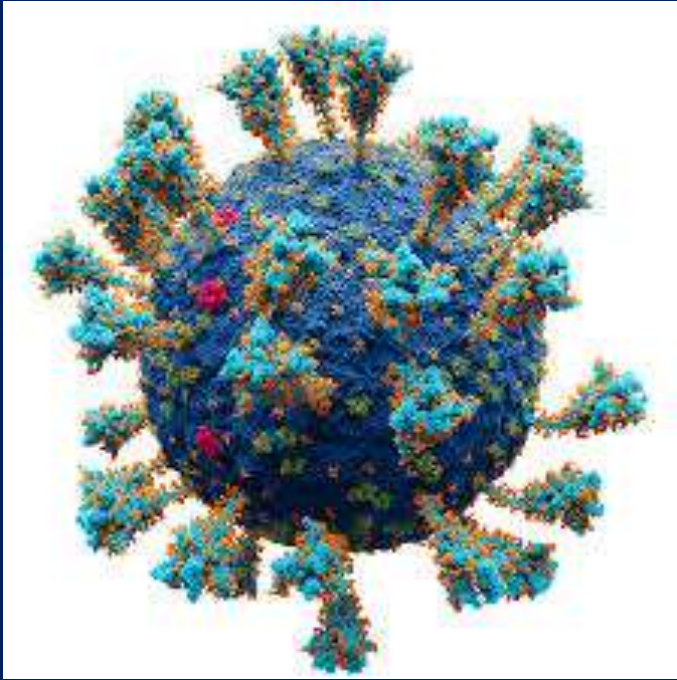


Bacteria



- Single-celled microorganisms
- Can survive and multiply independently
- Examples: Mycobacterium tuberculosis (TB), Salmonella, Legionella pneumophila, Staphylococcus aureus
- Treatments: Antibiotics

Virus



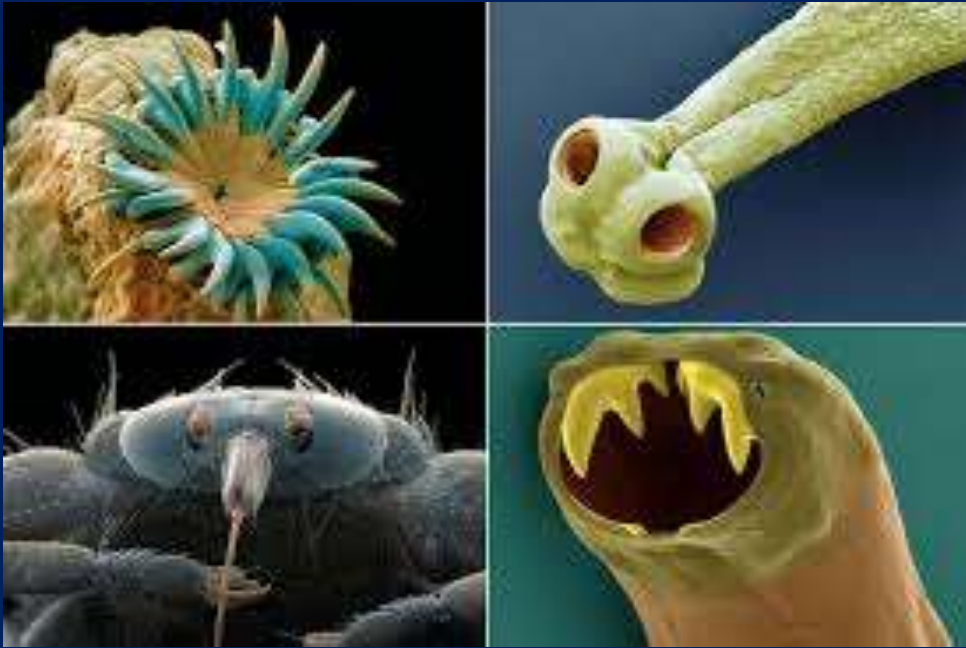
- Sub-microscopic infectious agents
- Require host cells to replicate
- Examples: Covid- 19 Hepatitis B and C, HIV, Influenza, SARS-CoV-2, Ebola
- Treatments: Antiviral medications, vaccines for prevention

Fungi



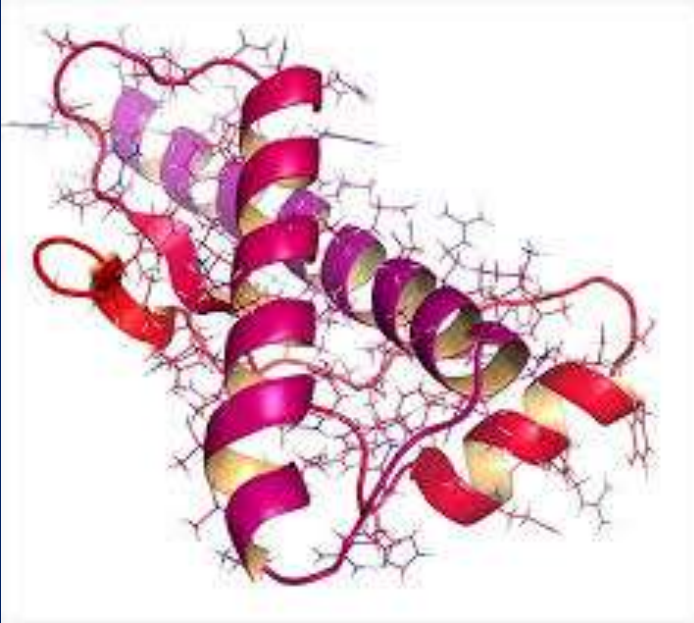
- Eukaryotic organisms including molds, yeasts, mushrooms
- Can produce spores that become airborne
- Examples: *Aspergillus fumigatus*, *Candida albicans*
- Health effects: Allergies, respiratory infections, systemic

Parasites



- Organisms that live on or inside a host
- Examples: Malaria (Plasmodium), Toxoplasma gondii
- Often have complex life cycles involving multiple hosts

Prion



- Misfolded proteins that cause progressive neurological disease
- Not living organisms but still infectious
- Examples: Creutzfeldt-Jakob Disease (CJD), Bovine Spongiform Encephalopathy (BSE)
- Extremely resistant to normal decontamination methods

Philadelphia Legionnaires Outbreak



<https://www.youtube.com/watch?v=x1ELZC9SdEM>

Risk Groups 1-4 Classification of Biohazards

- The World Health Organization and national bodies classify biological agents into four Risk Groups based on:
 - Pathogenicity (ability to cause disease)
 - Transmission (how easily it spreads)
 - Availability of treatment
 - Availability of vaccination



Risk Group 1

- **DEFINITION: No or low individual and community risk**
- **Unlikely to cause disease in healthy adults**
- **Typically non-pathogenic strains**
- **Examples: Non-pathogenic E. coli, Bacillus subtilis**
- **Containment: Basic laboratory (BSL-1)**
- **Control: Standard microbiological practices**



RISK GROUP 2

- **DEFINITION: Moderate individual risk, low community risk**
- **Can cause disease in healthy adults**
- **Effective treatment and/or vaccine available**
- **Limited spread in community**
- **Examples: Salmonella, Hepatitis B, Staphylococcus aureus, Legionella, Influenza virus**
- **Control: Practices plus PPE, some engineering**

RISK GROUP 3

- **DEFINITION:** High individual risk, low community risk
- **Causes serious disease in healthy adults**
- **May spread to others**
- **Effective treatment and/or vaccine usually available**
- **Examples:** *Mycobacterium tuberculosis*, SARS-CoV-2, HIV, Brucella, Yellow fever virus
- **Control:** Advanced engineering, controlled access, specialized PPE

RISK GROUP 4

- **DEFINITION: High individual and high community risk**
- **Causes life-threatening disease**
- **Easily transmissible**
- **NO effective treatment or vaccine available**
- **Examples: Ebola virus, Marburg virus, Lassa fever,**
- **Smallpox (variola)**
- **Containment: BSL-4**
- **Control: Maximum containment, positive pressure suits, isolated facilities**



Routes of Exposure for Biological Agents

Inhalation

Most common route of occupational exposure

Aerosols generated by:

- Pipetting, mixing, shaking
- Centrifugation
- Sonicators, vortex mixers
- Animal handling
- Cleaning spills with high-pressure sprays
- Agents: *Mycobacterium tuberculosis*, influenza, *Aspergillus*
- Control: Biological safety cabinets, respiratory protection

Skin Contact

- **Contact with contaminated surfaces**
- **Splashes to eyes, nose, mouth**
- **Cuts, abrasions, dermatitis**
- **Agents: Staphylococcus aureus, Hepatitis B, HIV**
- **Control: Gloves, gowns, eye protection, hand washing**

Puncture

- **Needlesticks, broken glass, scalpel blades**
- **High risk because agent is injected directly into tissue**
- **Agents: Hepatitis B (highly infectious), HIV, Hepatitis C**
- **Control: Sharps disposal, needle-safe devices, no recapping**

Ingestion

- **Hand-to-mouth transfer after handling contaminated materials**
- **Eating, drinking, smoking in work areas**
- **Pipetting by mouth (prohibited but historically practiced)**
- **Agents: Salmonella, Shigella, Hepatitis A**
- **Control: No eating/drinking in work areas, hand washing**

Case Study: The Outbreak in Serrah Hospital Care

Serrah Hospital Care noticed an unusual pattern of illnesses in the past two weeks. Patients of all ages reported symptoms such as high fever, persistent cough, vomiting, severe diarrhea, and fatigue. Laboratory testing revealed multiple infections:

- **Bacterial infection:** *Escherichia coli* (E. coli) identified in stool samples of patients with diarrhea.
- **Viral infection:** Influenza A virus detected in patients with fever and respiratory symptoms.
- **Parasitic infection:** *Giardia lamblia* found in children with gastrointestinal disturbances.
- **Further investigation suggested that contaminated water from the local supply and improper sanitation in food handling were major contributing factors. Additionally, some healthcare workers reported mild symptoms, raising concerns about biohazard exposure and the need for strict infection control measures.**

The health center has a limited isolation facility, and staff are struggling to follow proper PPE protocols due to shortages. The local community is unaware of the potential risks, increasing the chance of further spread.



- **Identify the pathogens present in this outbreak and classify them as bacteria, virus, or parasite.**
- **Describe how these pathogens could have been transmitted to patients and healthcare workers.**
- **Recommend practical steps to prevent further infections, considering hygiene, sanitation, and biohazard safety.**





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