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# Biosafety and Biosecurity

## Module 4, Part 1:

### Introduction

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# Biosafety

- Knowledge, techniques, and equipment to prevent exposure
- Containment conditions for the safe manipulation of infectious agents





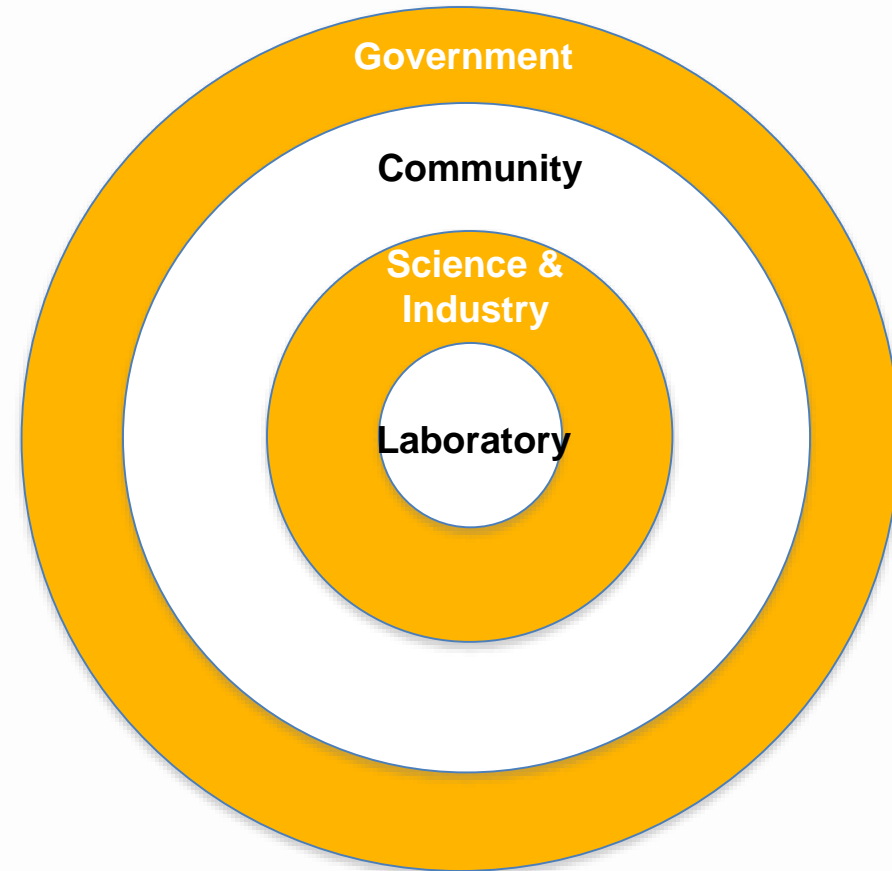
# Biosecurity

## Laboratory biosecurity:

Safekeeping of valuable biological materials, collections and reference strains

## Community biosecurity (also

**biodefense):** Measures to prevent, detect, respond to, and/or recover from biological threats





# Biosafety versus Biosecurity

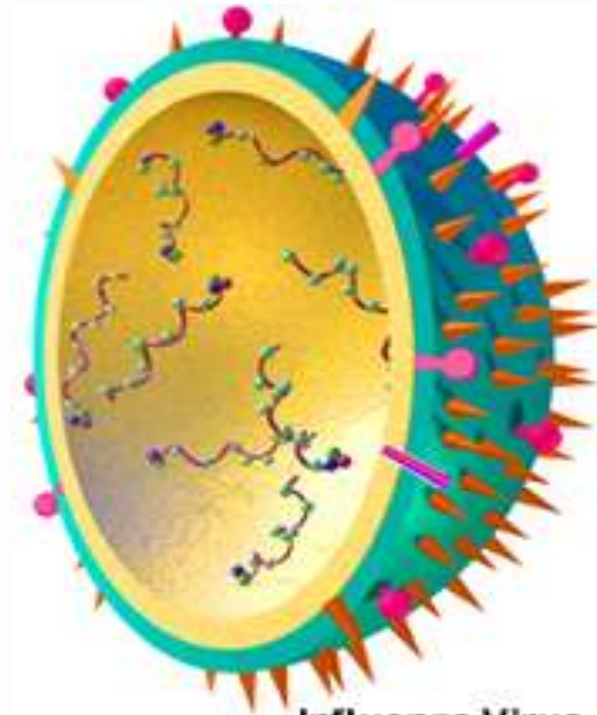
- Biosafety - *Accidental* infection
- Biosecurity - *Deliberate* attempts
- Some policy overlap with agricultural security, biodiversity, counter-terrorism





# Agents and Risks

- The “agent” creates the risk
- Risks to the worker or environment are often unknown
- What constitutes “acceptable risk?”



**Influenza Virus**

Credit: NIAID



# Assessing Risk

There is always risk!

- The risk must be
  - Identified
  - Evaluated
  - Measured
  - Minimized





# What is Acceptable Risk?

- “Safe” means “acceptable” risk
- Judging risk is subjective
  - Records of determinations must be kept
- Measuring risk is objective
  - Guidelines, data, documentation





# Who Determines Acceptable Risk?

- A biosafety professional in partnership with the principal investigator (PI)
- Assessment presented to the Institutional Biosafety Committee (IBC) for approval







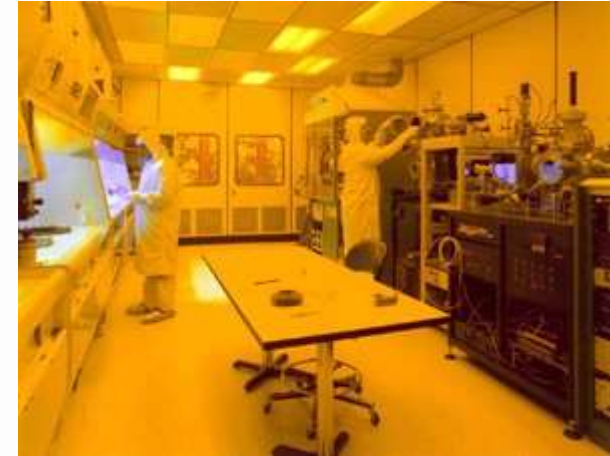
# Evaluating Risk Acceptability

- Worst-case scenario
- Likelihood of an event
- Seriousness of the incident
- Actions needed to resolve the incident



# Identifying Risk

- Must understand:
  - The biology of the agent
  - Susceptibility of and transmission to the host
  - Hazards associated with equipment and procedures
- Goal:
  - *Highest practical protection and lowest practical exposure*





# World Health Organization (WHO)

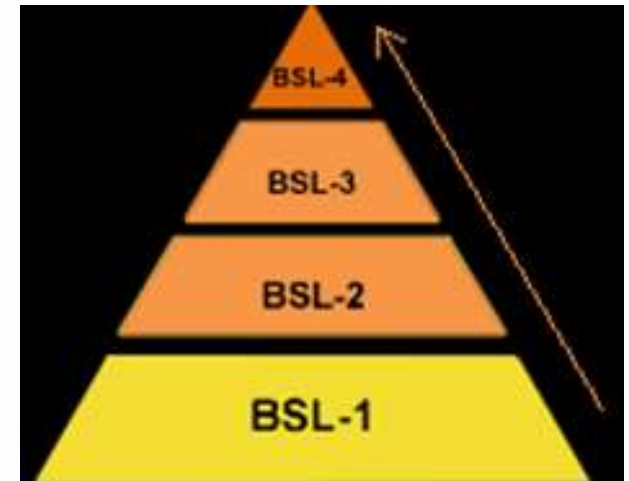
Risk Group (RG)	Agent Risk Description	Examples
<b>RG-1</b>	Agents that are not associated with disease in healthy adult humans	<i>Bacillus subtilis</i> , <i>Escherichia coli</i> K12, adeno-associated virus (AAV)
<b>RG-2</b>	Agents that are associated with human disease which is rarely serious and for which preventive or therapeutic interventions are <b>often</b> available	<i>Staphylococcus aureus</i> , <i>Salmonella</i> sp, Herpes simplex viruses, Adenovirus
<b>RG-3</b>	Agents that are associated with serious or lethal human disease for which preventive or therapeutic interventions <b>may be</b> available	<i>Mycobacterium tuberculosis</i> , <i>Bacillus anthracis</i> , HIV
<b>RG-4</b>	Agents that are likely to cause serious or lethal human disease for which preventive or therapeutic interventions are <b>not usually</b> available	Ebola virus, Marburg virus, Lassa virus





# Biosafety Levels (BSLs)

- Different than risk groups!
  - Risk groups - risk assessment
  - BSLs - risk management
- Keep control over *the agent*
  - Facilities, safety equipment, best practices, personal protective equipment
- Proposed action assessed, appropriate BSL determined





# BioSafety Level 1 (BSL-1)

Personal  
protective  
equipment



- Well-characterized, non-pathogenic organisms or agents
- Open bench - no containment
- Good laboratory practices
- Example agent: *E. coli* K-12 strain

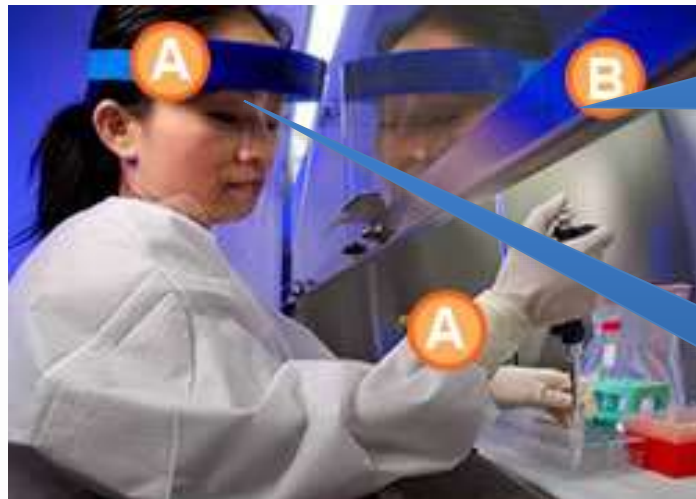
Open bench or  
table





# BioSafety Level 2 (BSL-2)

- Moderately hazardous agents
- Restricted access & containment during certain processes
- Biological safety cabinets, fume hoods and autoclaves
- Good laboratory practices
- Example agents: most non-respiratory, non-lethal bacteria



Biological  
safety  
cabinet

Personal protective  
equipment

# BioSafety Level 3 (BSL-3)

- Highly hazardous agents
- Easily transmissible and potentially lethal
- Controlled, negative pressure environments with limited access to “cleared” individuals
- Example agents: *SARS & Mycobacterium tuberculosis*

Self-closing and locking doors



Biological safety cabinet

Respirator



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# BioSafety Level 4 (BSL-4)

- Highly hazardous agents
- Easily transmissible & potentially lethal
- No vaccines and/or treatment
- Total containment: “Submarine” doors, air pumps, negative pressure, HEPA filters
- Positive-pressure “moonsuits”

Full body, air-supplied, positive-pressure suit

