



# **Airflow and BSC**

***Biosafety and Biosecurity Awareness Training  
For Afghan and Pakistani Bioscientists***

**December 7-9, 2009**

SAND No. 2008-0480P

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company,  
for the United States Department of Energy's National Nuclear Security Administration  
under contract DE-AC04-94AL85000.



# Biological Safety Cabinets (BSCs)

- **Primary means of containment**
- **Three design types**
  - Class I, Class II, and Class III
- **Designed to provide protection for**
  - Personnel
    - **Directional flow of air into cabinet**
  - Environment
    - **HEPA filtered exhaust**
  - Product (except Class I)
    - **Laminar flow of HEPA filtered air**
- **But, how?**





# Primary Barriers – Ventilation Equipment

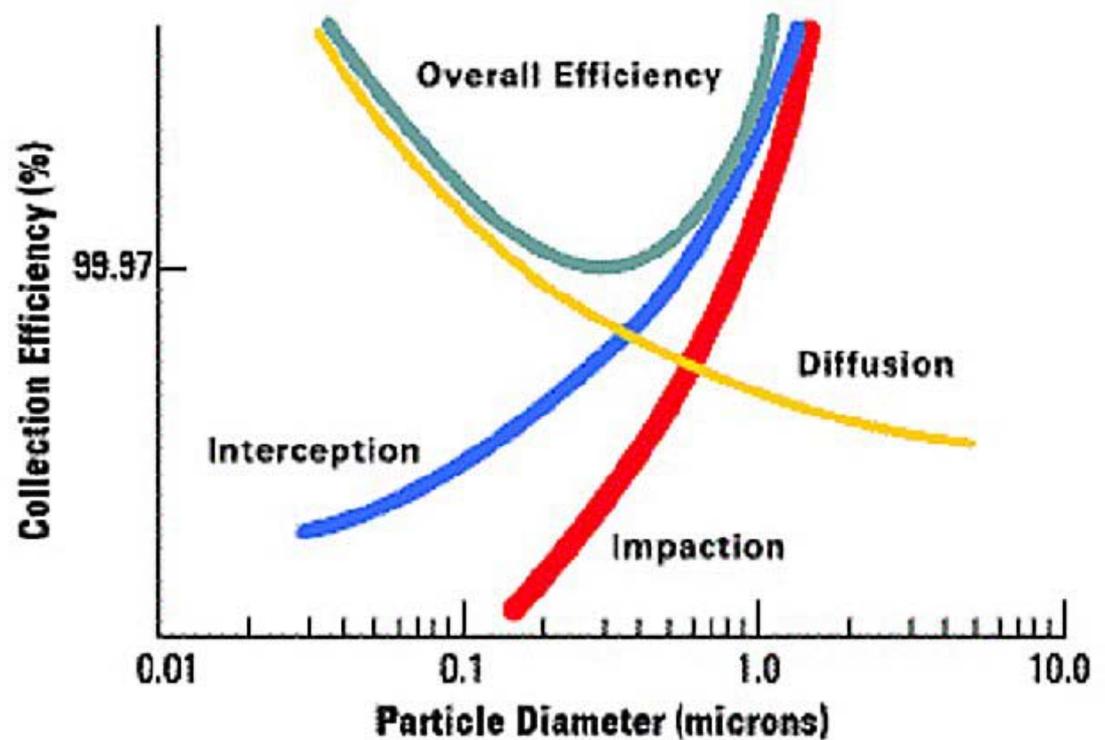
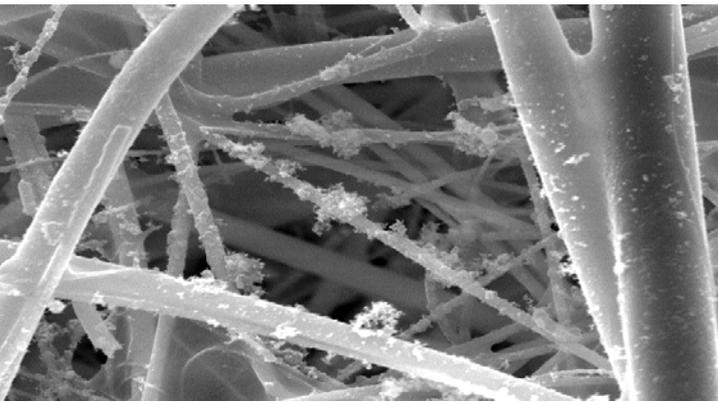


	Personnel	Product	Environment
<b>Chemical Fume Hoods</b>	X		
<b>Laminar Flow Clean Benches</b>		X	
<b>Class I Biological Safety Cabinet</b>	X		X
<b>Class II Biological Safety Cabinet</b>	X	X	X
<b>Class III Biological Safety Cabinet</b>	X	X	X
<b>Isolators</b>	X	X	X



# How do HEPA Filters Work?

- HEPA = **H**igh **E**fficiency **P**articulate **A**ir
- Minimum efficiency of 99.97% removal of 0.3 micron particles
- HEPA filters do not filter out gases, vapors or volatile chemicals, they only filter out particulates (bacteria and viruses)



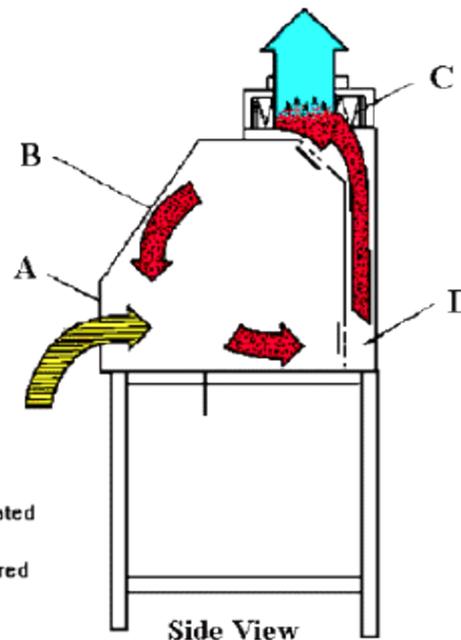


# Class I Biosafety Cabinet

- Provides personnel and environmental protection, but no product protection
- Typical applications include: Housing centrifuges, fermenters, cage dumping in an animal lab



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- A. Front opening
- B. Sash
- C. Exhaust HEPA
- D. Exhaust plenum



LABCONCO



# Class II Biosafety Cabinet

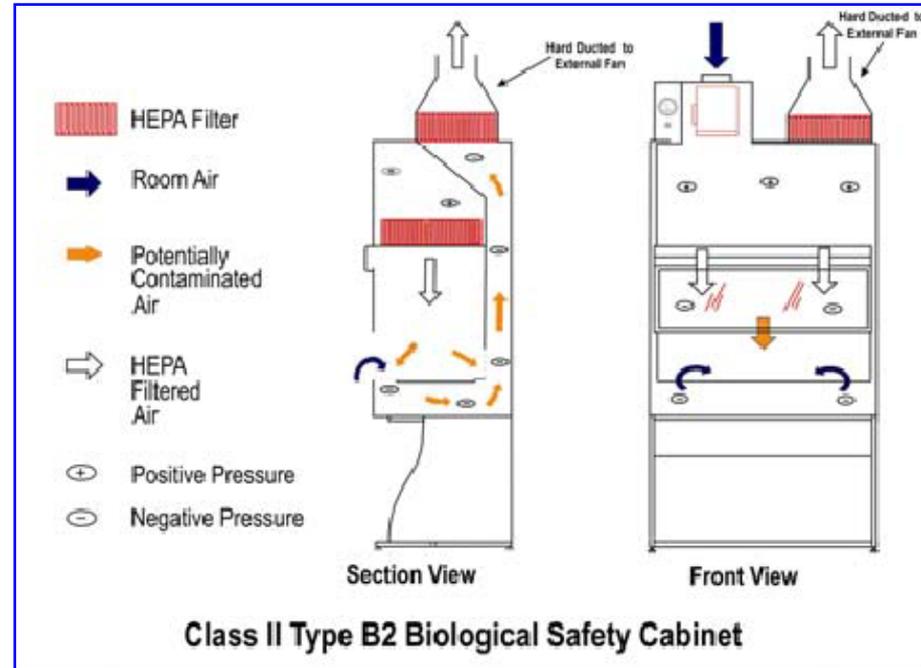
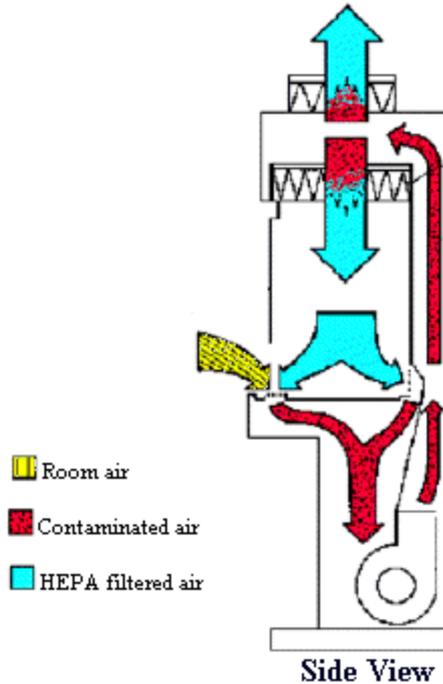
- **Provides personnel, environmental, and product protection**
- **Type A2**
  - Exhaust to room or outside through thimble connection
  - 30% recirculated, 70% exhausted
- **Type B2**
  - Must be hard ducted to outside
  - Total exhaust (100%)
  - Pro: may be used with volatile chemicals
  - Con: more expensive to operate, harder to balance airflows in lab





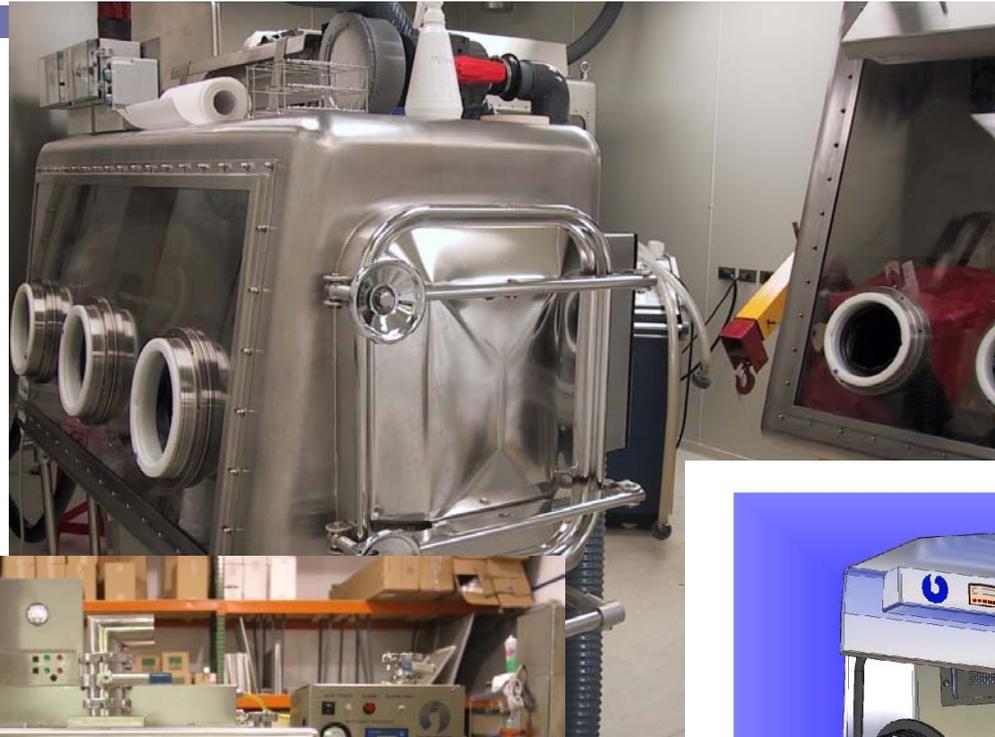
# Class II, Types A2 and B2

Class II, Type A





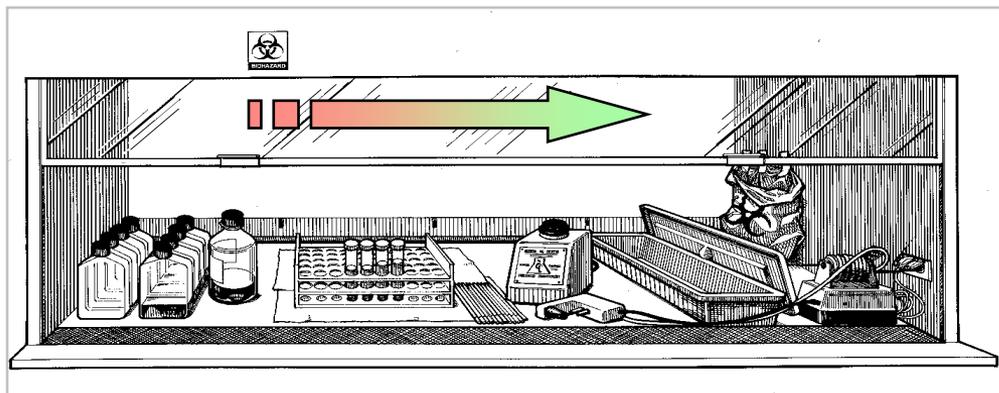
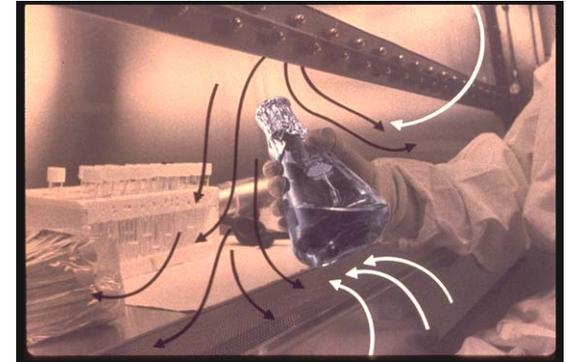
# Class III Biosafety Cabinet





# Primary Barriers: Working in Biosafety Cabinets

- **Proper technique is critical to maintaining personnel and product protection!**
- **Elements**
  - Decontamination
  - Setup
  - Work flow
  - Locations of supplies and waste containers
  - Movement in and out
  - Others
- **Workflow from clean to contaminated (“dirty”)**





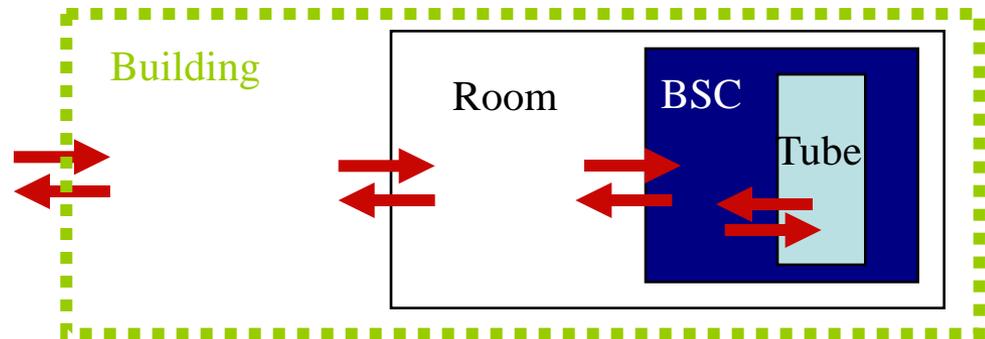
# Recognizing the Limitations of BSCs

- **Personnel protection depends on inward airflow through the work opening**
  - Requires proper techniques by user
- **Only small quantities of volatile chemicals in any type of BSC**
  - Motors on standard BSCs are not sparkproof
- **Should not use bunsen burners or alcohol lamps in BSCs**
  - Over time, heat can damage the HEPA filter
  - Heat can create turbulent airflow, compromising protection
  - And, potential for fire to destroy BSC
    - **Buildup of flammable vapors with 70% recirculation**
- **BSCs need to be tested and certified regularly to have assurance getting expected protection**
  - Prior to service
  - After repairs or relocation
  - Annually



# Secondary Barriers

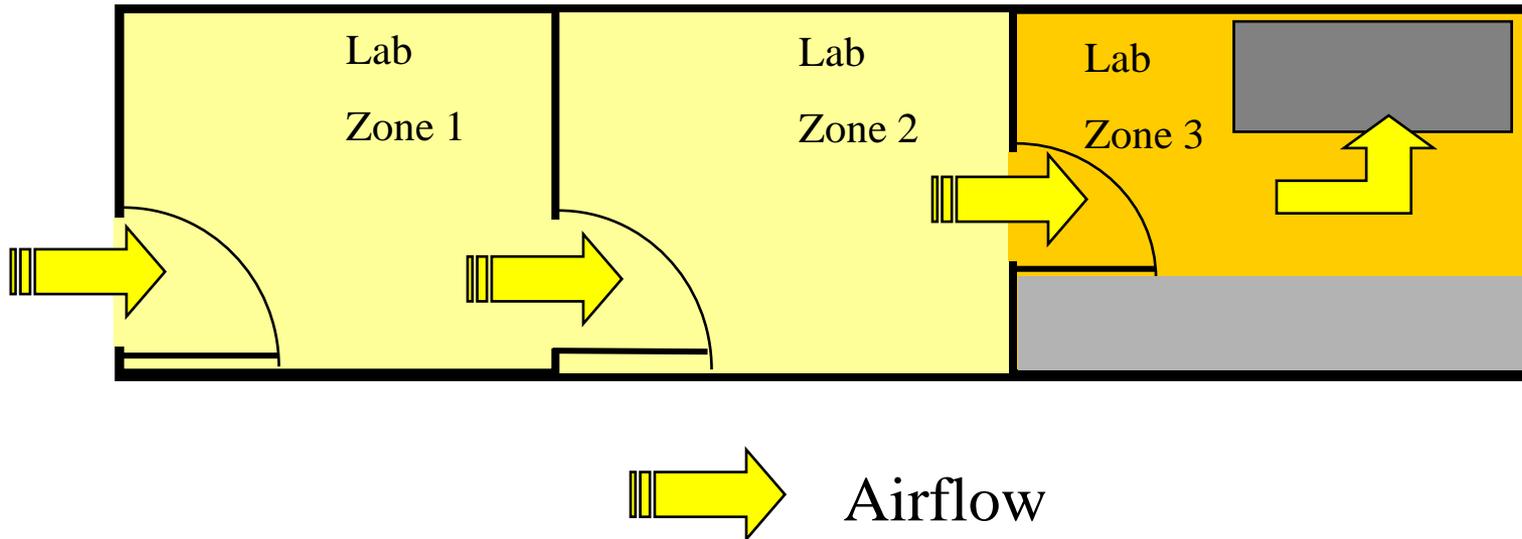
- **Contain the agent within the room or facility *in case an agent escapes from the primary barriers***
  - **Building & Room Construction**
    - **Separated from public areas**
    - **Easily cleaned**
    - **For containment laboratories:**
      - Room penetrations sealed
      - Double-door entry
  - **HVAC Issues:**
    - **Directional airflow**
    - **Exhaust filtration**
  - **Other Engineering Controls:**
    - **Solid waste treatment**
    - **Wastewater treatment**





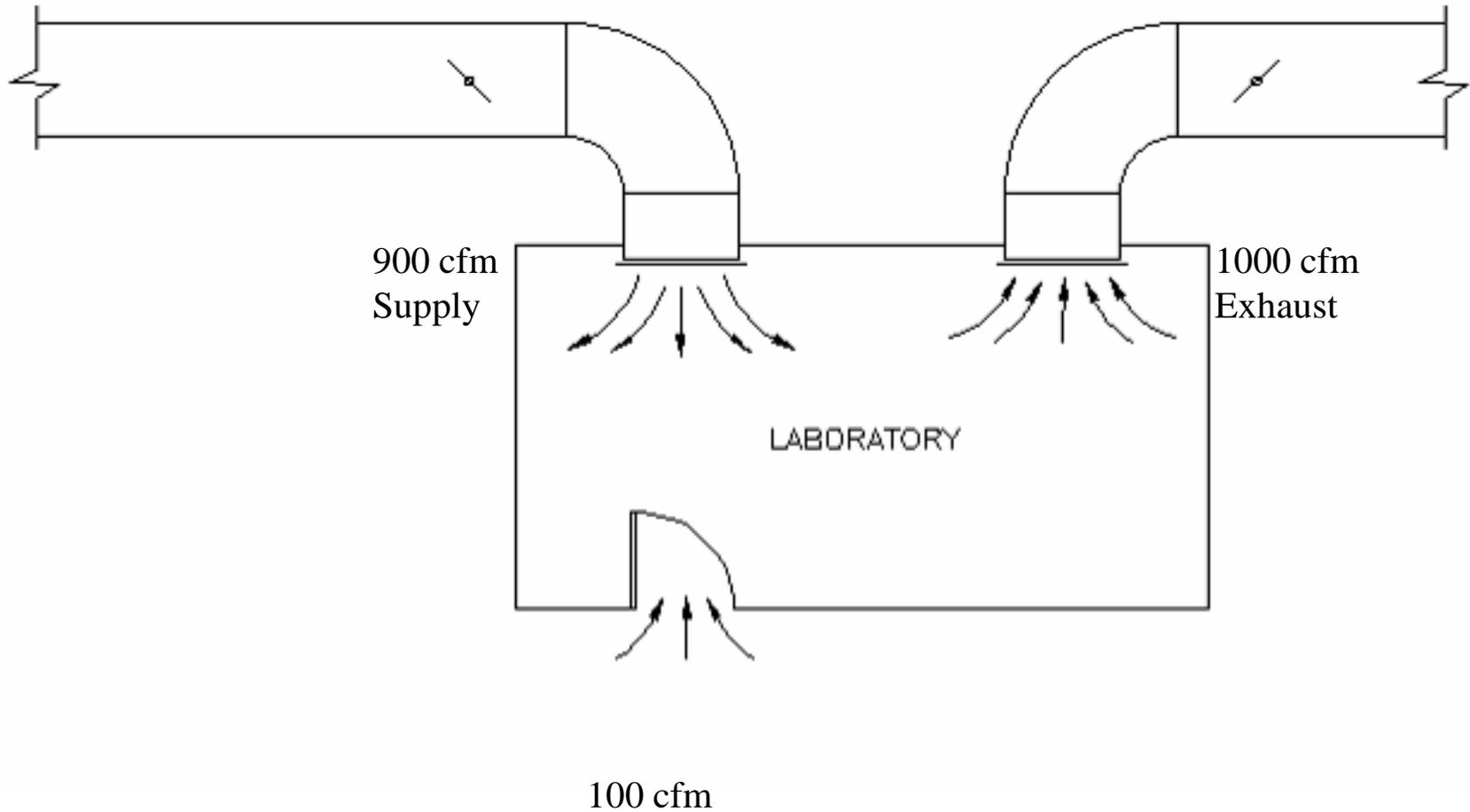
# How do You Establish Directional Airflow?

- **Airflow Offset Control**
  - Relies on airflow through doors at all times
  - “Leaky Box” concept
  - Provides “Zone Control” of hazards and odors





# Airflow Offset Control





# Verifying Correct Airflow Before Entering Lab





# Heating Ventilation and Air Conditioning (HVAC) Issues



- Pressure monitoring devices at entry
- Smoke test
- HVAC controlled to prevent sustained positive pressurization
- Interlock exhaust/supply
- Alarms for HVAC failure (inside and outside the facility)
- Exhaust air HEPA filtered (sometimes necessary)
- Sealed ductwork
- Backflow prevention on supply air (Damper, HEPA)

