GBRMC

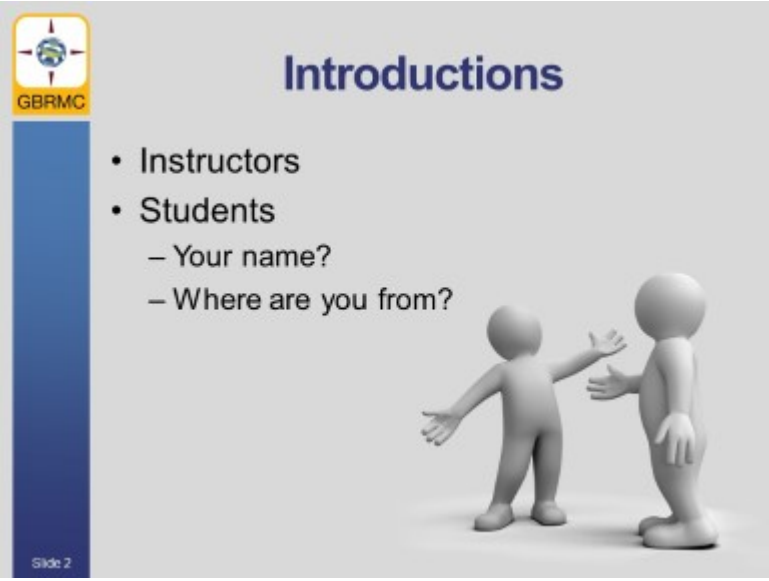
# Understanding & Maintaining Facilities and Equipment for Biorisk Management

Student Guide

2013

GLOBAL BIORISK MANAGEMENT CURRICULUM


Welcome to Understanding & Maintaining Facilities and Equipment for Biorisk Management


GBRMC
Introductions
• Instructors
• Students
– Your name?
– Where are you from?
Slide 2

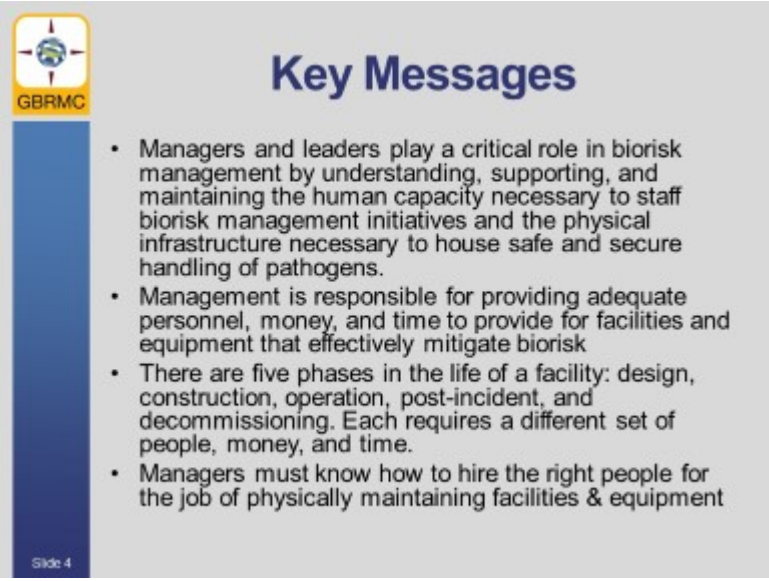
# Action Plan

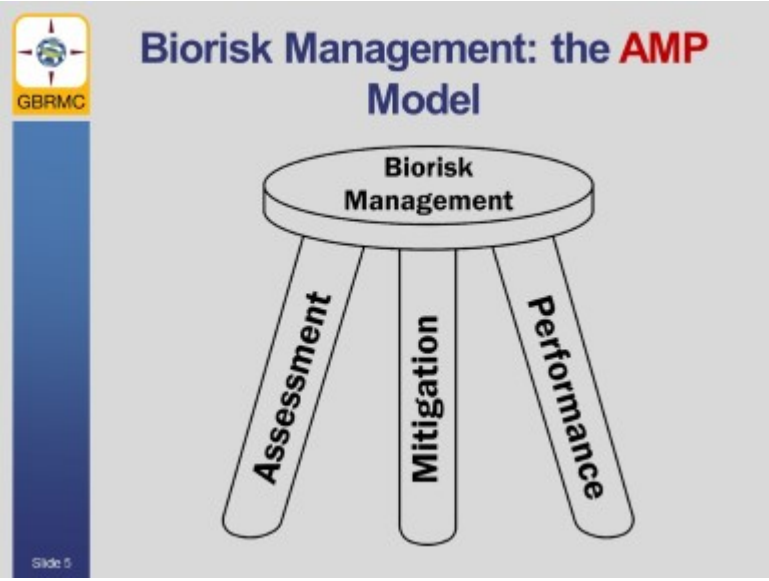
| By the end of this lesson, I would like to: | | | | | |
|---|---|---|---|---|---|
| KNOW | | FEEL | | BE ABLE TO DO | |

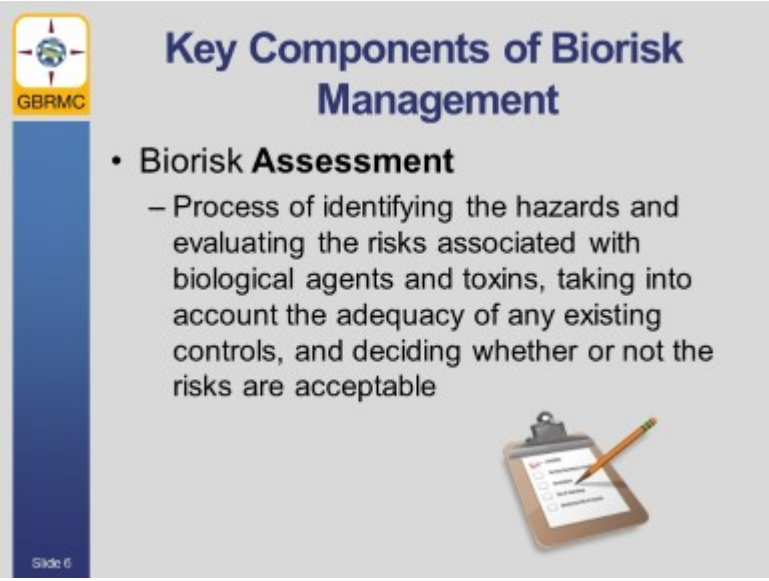
*Your learning doesn't stop with this lesson. Use this space to think about what else you need to do or learn to put the information from this lesson into practice.*

| What more do I need to know or do? | How will I acquire the knowledge or skills? | How will I know that I've succeeded? | How will I use this new learning in my job? |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

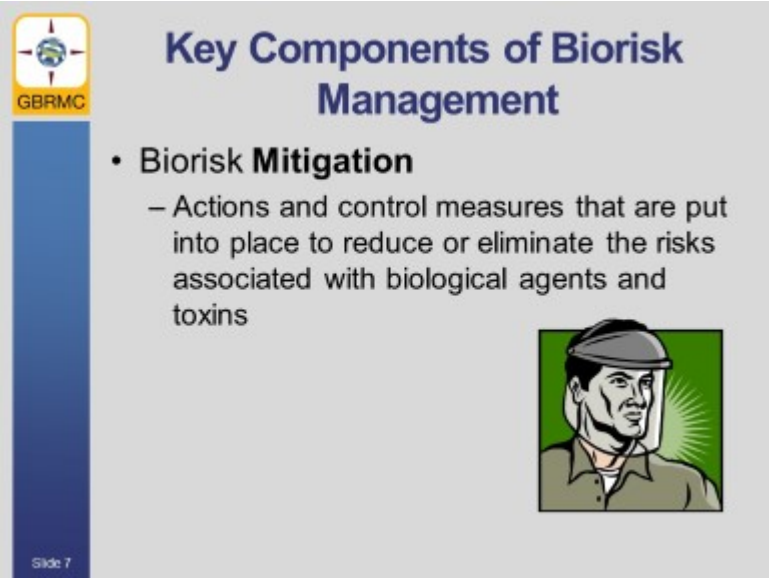
3


GBRMC
Key Messages
• Managers and leaders play a critical role in biorisk management by understanding, supporting, and maintaining the human capacity necessary to staff biorisk management initiatives and the physical infrastructure necessary to house safe and secure handling of pathogens.
• Management is responsible for providing adequate personnel, money, and time to provide for facilities and equipment that effectively mitigate biorisk
• There are five phases in the life of a facility: design, construction, operation, post-incident, and decommissioning. Each requires a different set of people, money, and time.
• Managers must know how to hire the right people for the job of physically maintaining facilities & equipment
Slide 4


GBRMC
Biorisk Management: the AMP Model
Biorisk Management
Assessment
Mitigation
Performance
Slide 5




Define Biorisk Assessment




Define Biorisk Mitigation


Define Biorisk Performance

GBRMC

## Mitigation Control Measures

There are five major categories of measures for controlling biological risks in the laboratory.

1. **Elimination or Substitution**
2. **Engineering Controls**
3. **Administrative Controls**
4. **Practices and Procedures**
5. **Personal Protective Equipment**

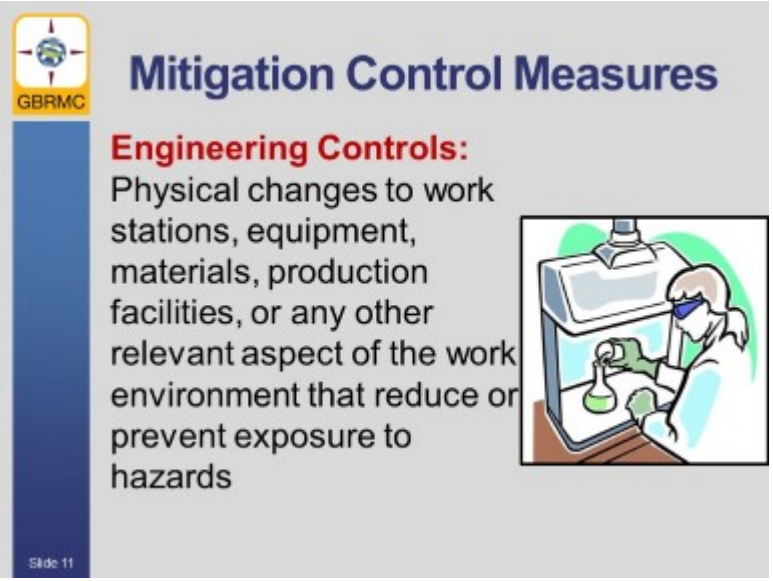
Slide 9

GBRMC

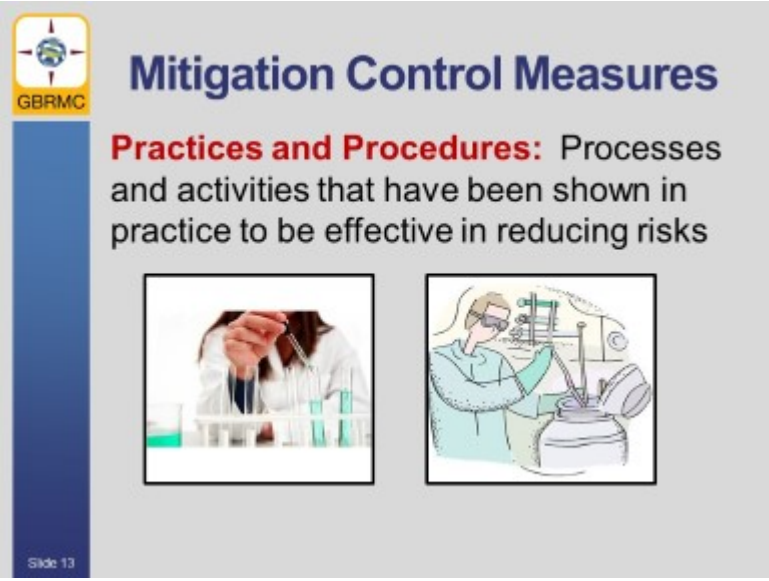
## Mitigation Control Measures

**Elimination or Substitution:** Removing the hazard, not working with the agent or replacing the hazard with something less dangerous


Slide 10

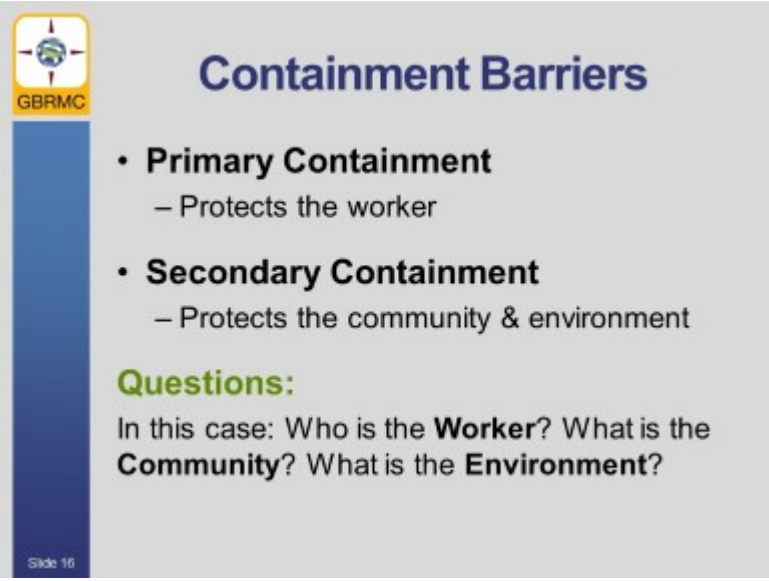

GBRMC
Mitigation Control Measures
Engineering Controls:
Physical changes to work stations, equipment, materials, production facilities, or any other relevant aspect of the work environment that reduce or prevent exposure to hazards
Slide 11


GBRMC
Mitigation Control Measures
Administrative Controls: Policies, standards and guidelines used to control risks
Slide 12


GBRMC
Mitigation Control Measures
Practices and Procedures: Processes and activities that have been shown in practice to be effective in reducing risks
Slide 13


GBRMC
Mitigation Control Measures
Personal Protective Equipment:
Devices worn by the worker to protect against hazards in the laboratory
Slide 14

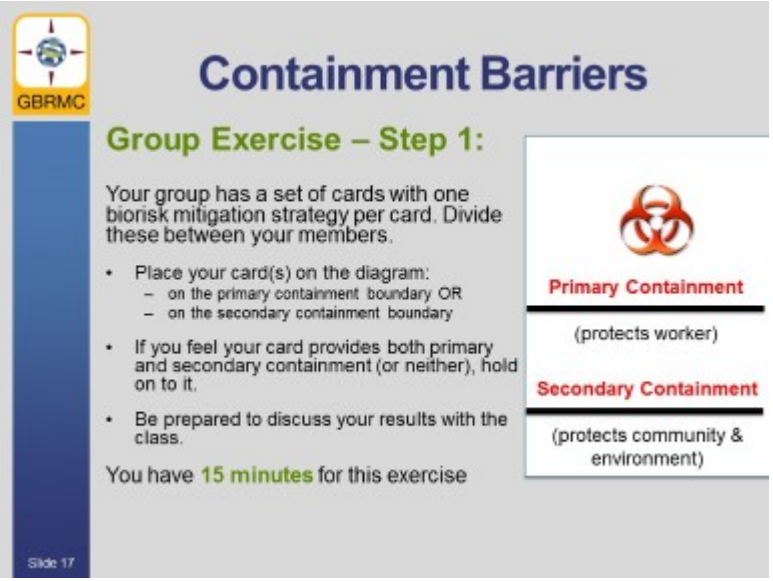

GBRMC
Leadership Roles
Understand, Support, and Maintain:
– Human Capacity
• Personnel Management
• Worker Health
– Physical Infrastructure
• Facilities & Equipment
• Physical & Information Security
• Risk Mitigation Strategies
Slide 15



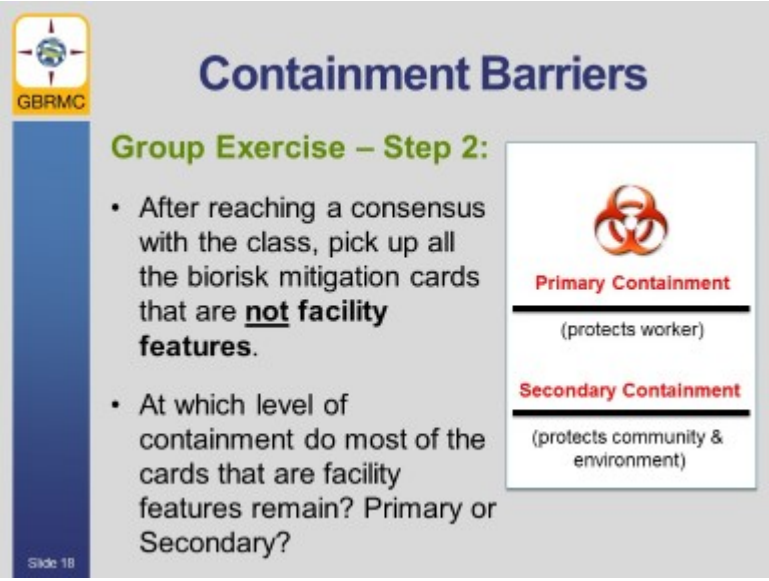

Who is the worker?

What is the Community?

What is the Environment?

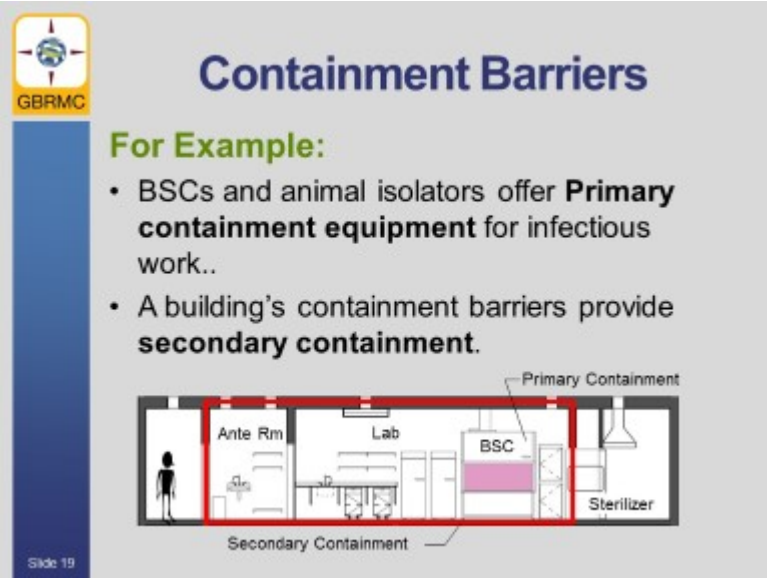

GBRMC
Containment Barriers
Group Exercise – Step 1:
Your group has a set of cards with one biorisk mitigation strategy per card. Divide these between your members.
Place your card(s) on the diagram:
on the primary containment boundary OR
on the secondary containment boundary
If you feel your card provides both primary and secondary containment (or neither), hold on to it.
Be prepared to discuss your results with the class.
You have 15 minutes for this exercise
Primary Containment
(protects worker)
Secondary Containment
(protects community & environment)
Slide 17

Examples:




At which level of containment do most of the cards that are facility features remain? Primary or Secondary?

Why?


GBRMC
Containment Barriers
For Example:
• BSCs and animal isolators offer Primary containment equipment for infectious work..
• A building's containment barriers provide secondary containment.
Primary Containment
Ante Rm
Lab
BSC
Sterilizer
Secondary Containment
Slide 19

Examples:


Access Points –

Surfaces –

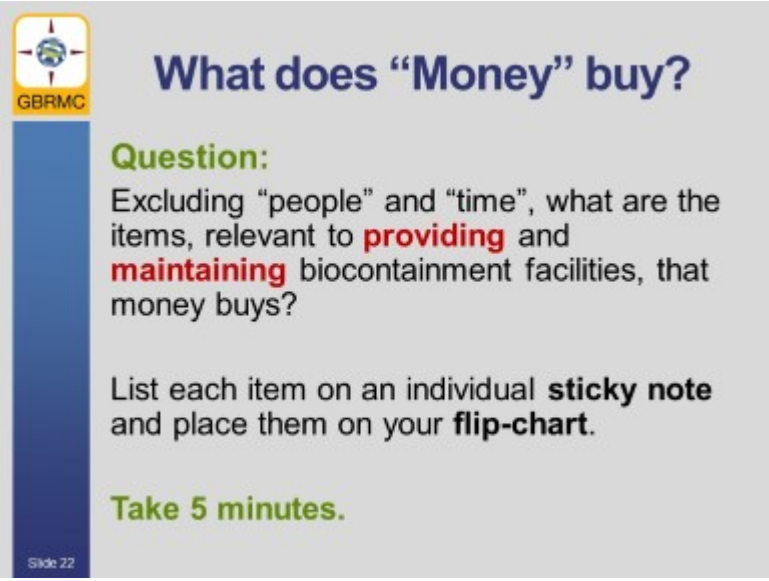
Air Flow and Quality –

Monitors & Alarms –

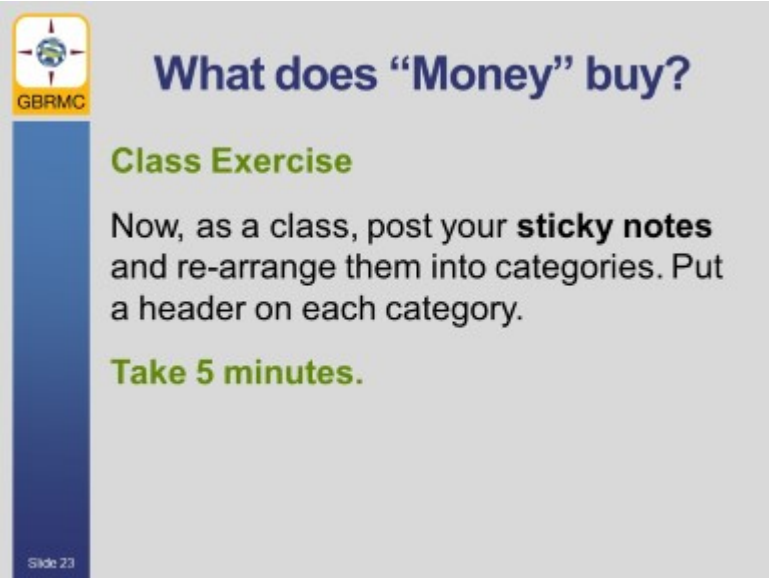
Redundant Systems –

Decontamination –

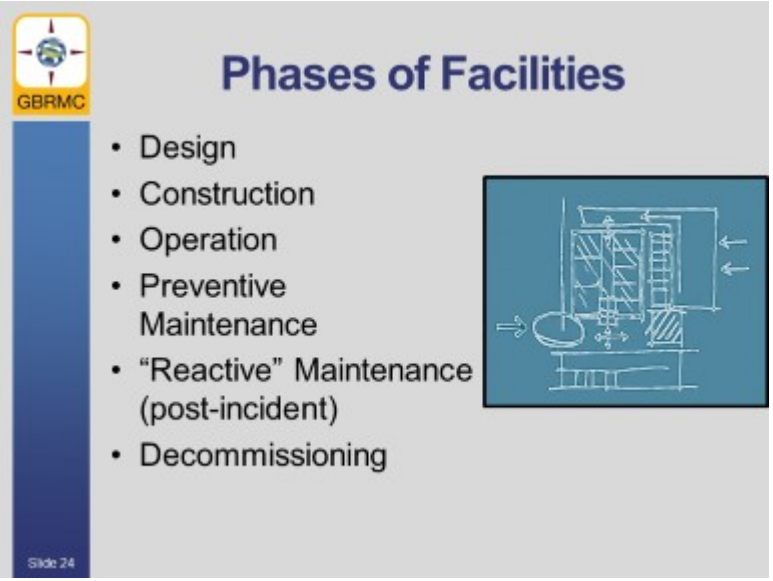

GBRMC
Management of Facilities
Management is responsible for providing adequate. . .
– People
– Money
– Time
. . .to provide for facilities that effectively mitigate biorisk
Slide 21

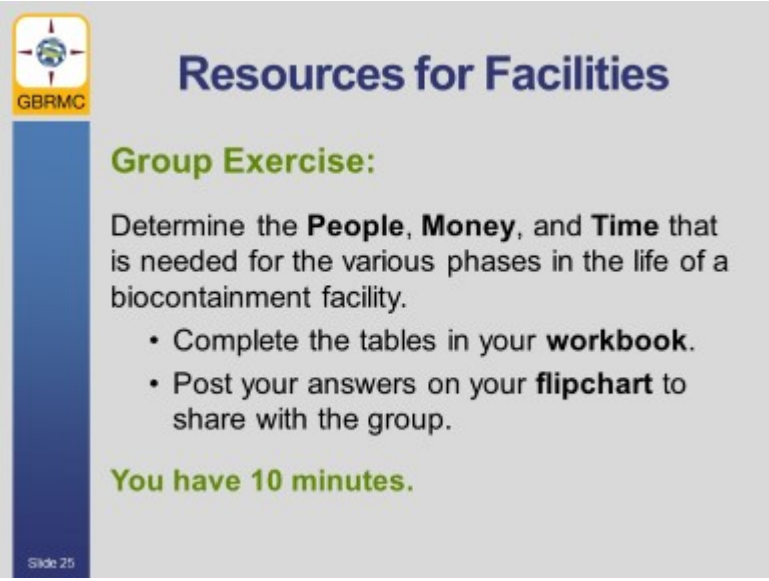

GBRMC
What does "Money" buy?
Question:
Excluding "people" and "time", what are the items, relevant to providing and maintaining biocontainment facilities, that money buys?
List each item on an individual sticky note and place them on your flip-chart.
Take 5 minutes.
Slide 22

Other items:




What are the categories?


GBRMC
Phases of Facilities
• Design
• Construction
• Operation
• Preventive Maintenance
• "Reactive" Maintenance (post-incident)
• Decommissioning
Slide 24


GBRMC
Resources for Facilities
Group Exercise:
Determine the People, Money, and Time that is needed for the various phases in the life of a biocontainment facility.
• Complete the tables in your workbook.
• Post your answers on your flipchart to share with the group.
You have 10 minutes.
Slide 25

| | People | Money | Time |
|---|---|---|---|
| Design | | | |
| Construction | | | |
| Operation | | | |

| | People | Money | Time |
|---|---|---|---|
| Preventive Maintenance | | | |
| Reactive Maintenance | | | |
| Decommissioning | | | |

Slide 27

GBRMC

## Critical Biocontainment Equipment

- Biological Safety Cabinets
  - Other ventilated equipment
- Autoclaves
- Incinerators

Slide 30

GBRMC

## Biological Safety Cabinets (BSCs)

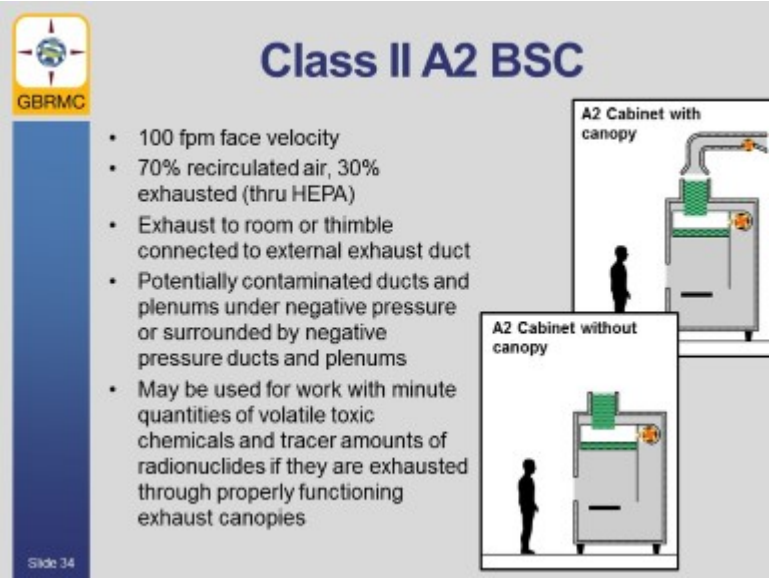
- Primary means of containment
- Three design types
  - **Class I, Class II, and Class III**
- Designed to provide protection for
  - **Personnel**
    - Directional flow of air into cabinet
  - **Environment**
    - HEPA filtered exhaust
  - **Product (except Class I)**
    - Laminar flow of HEPA filtered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

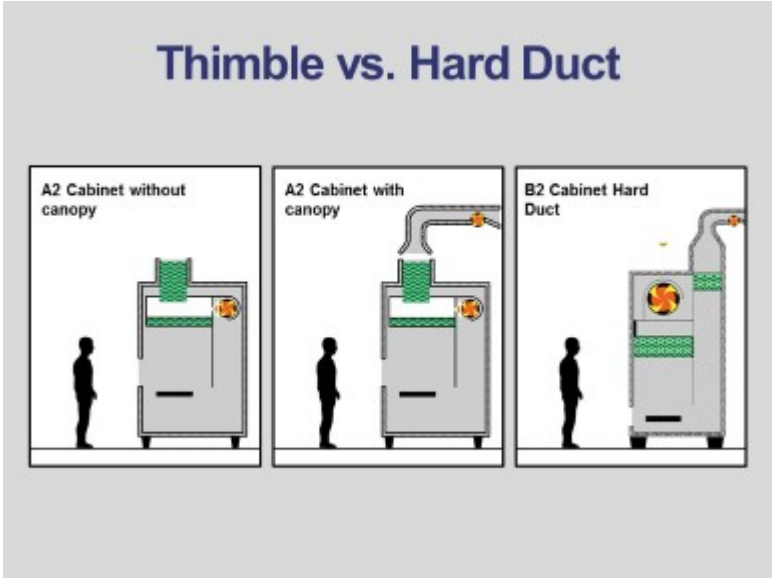
**How is protection achieved?**

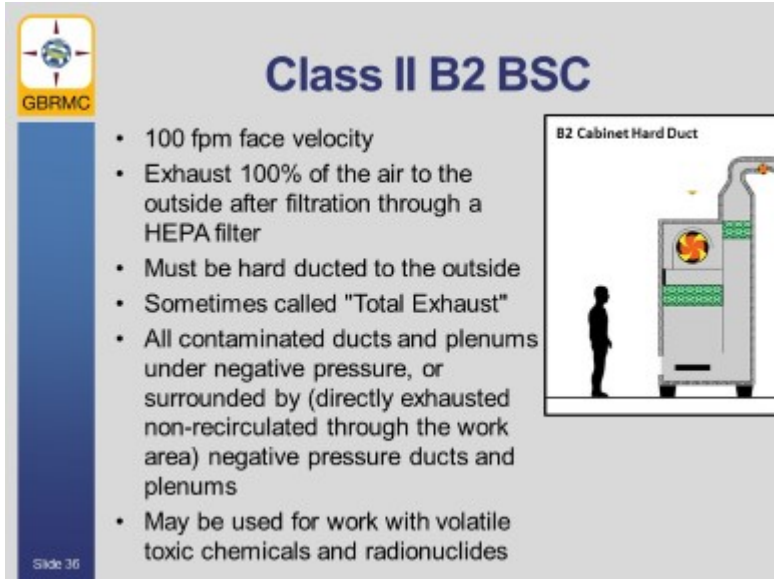
Slide 31

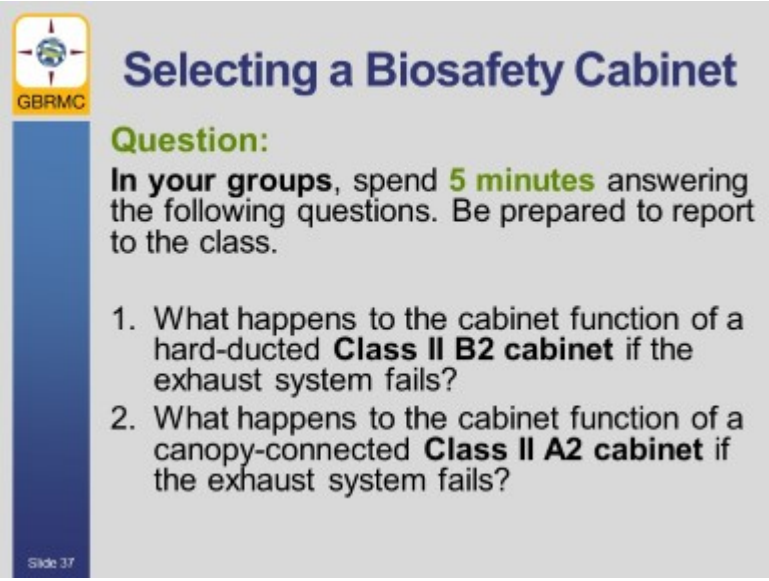

GBRMC
Directional Airflow in BSC
Slide 32


GBRMC
Class I BSC
• Unfiltered room air passes over the work area
• Exhaust air is HEPA filtered before returning to the room
• No product protection
Slide 33


GBRMC
Class II A2 BSC
100 fpm face velocity
70% recirculated air, 30% exhausted (thru HEPA)
Exhaust to room or thimble connected to external exhaust duct
Potentially contaminated ducts and plenums under negative pressure or surrounded by negative pressure ducts and plenums
May be used for work with minute quantities of volatile toxic chemicals and tracer amounts of radionuclides if they are exhausted through properly functioning exhaust canopies
A2 Cabinet with canopy
A2 Cabinet without canopy
Slide 34


Thimble vs. Hard Duct
A2 Cabinet without canopy
A2 Cabinet with canopy
B2 Cabinet Hard Duct


GBRMC
Class II B2 BSC
100 fpm face velocity
Exhaust 100% of the air to the outside after filtration through a HEPA filter
Must be hard ducted to the outside
Sometimes called "Total Exhaust"
All contaminated ducts and plenums under negative pressure, or surrounded by (directly exhausted non-recirculated through the work area) negative pressure ducts and plenums
May be used for work with volatile toxic chemicals and radionuclides
B2 Cabinet Hard Duct
Slide 36


GBRMC
Selecting a Biosafety Cabinet
Question:
In your groups, spend 5 minutes answering the following questions. Be prepared to report to the class.
1. What happens to the cabinet function of a hard-ducted Class II B2 cabinet if the exhaust system fails?
2. What happens to the cabinet function of a canopy-connected Class II A2 cabinet if the exhaust system fails?
Slide 37

GBRMC

## Class III BSC

- Maximum containment, gas tight enclosure with glove ports
- Can be joined in a "line" to provide larger work area
- Usually custom built
- Heavy duty rubber gloves
  - Restriction of movement
- Interlocked interchange box allows material in and out

Slide 38

GBRMC

## Limitations of BSCs

Only **small quantities** of volatile chemicals may be used in **any** type of BSC

- Motors on standard BSCs are not spark-proof

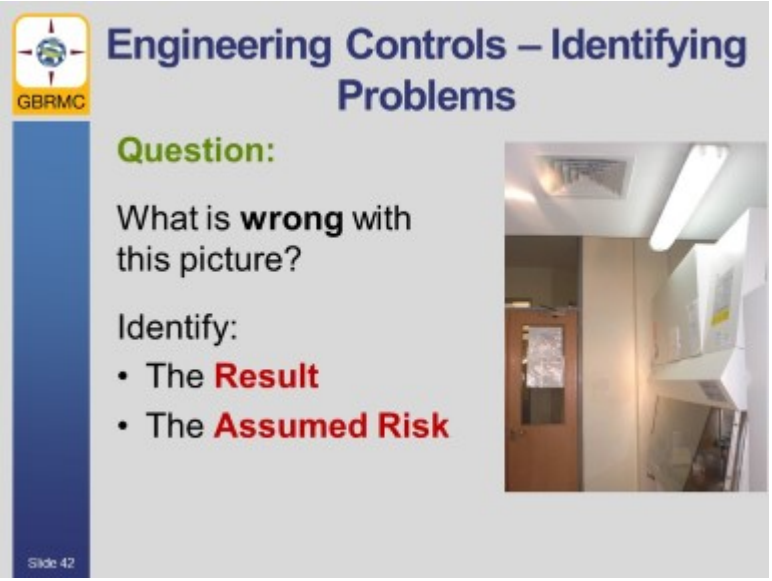
Should **not use Bunsen burners** or **alcohol lamps** in BSCs

- 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

Slide 39


GBRMC
Limitations of BSCs
BSCs need to be tested and certified regularly to assure they are providing the expected protection
– Prior to service
– After repairs or relocation
– Annually
Slide 40


BSC Certification
Slide 41


GBRMC
Engineering Controls – Identifying Problems
Question:
What is **wrong** with this picture?
Identify:
• The **Result**
• The **Assumed Risk**
Slide 42


GBRMC
Engineering Controls – Fixing Problems
Same lab, same machine, better set up!
Slide 43

GBRMC

## Chemical Fume Hoods

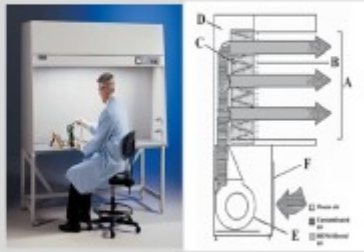
- Designed for use with chemicals
- Provides personnel protection through inward air flow
- Usually no HEPA filtration
- 100% exhaust through hard ducting to exterior of the building

Slide 44

GBRMC

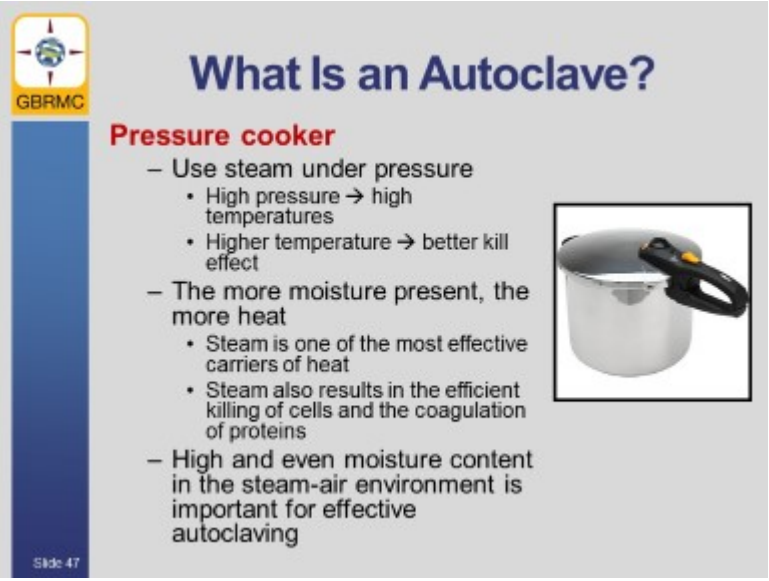
## Clean Bench or Laminar Flow Hood

- Outward air flow is directed toward the worker's breathing zone (no personnel protection)
- Provides a sterile environment
- Used primarily with non-hazardous material (media prep)



Slide 45


GBRMC
Autoclaves
Slide 46


GBRMC
What Is an Autoclave?
Pressure cooker
– Use steam under pressure
• High pressure → high temperatures
• Higher temperature → better kill effect
– The more moisture present, the more heat
• Steam is one of the most effective carriers of heat
• Steam also results in the efficient killing of cells and the coagulation of proteins
– High and even moisture content in the steam-air environment is important for effective autoclaving
Slide 47

GBRMC

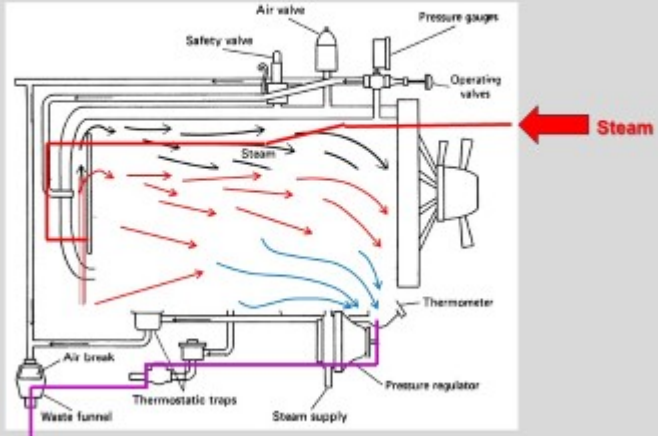
## Principles of Autoclave Sterilization

- Direct exposure to steam at the required temperature and pressure for a specific time
  - 121 °C – 123 °C
  - 15 psi; 1.05 kg/cm2
- Time required depends on the nature of the material to be sterilized. (Generally 1 hr for waste)

Slide 48

GBRMC

## How Does the Autoclave Work?




Slide 49

GBRMC

## Steam Penetration

- Steam must directly contact all areas of the load (bags should be loosely gathered)
- If the steam can't penetrate a dry container, you have dry heat, which takes much longer to achieve kill.
- Add ~ 50 - 250 ml of water to bags prior to autoclaving to facilitate steam saturation

Slide 50

GBRMC

## Engineering Controls – Identifying Problems

**Question:**

What is **wrong** with this picture?

Identify:

- The **Result**
- The **Assumed Risk**

Slide 51

GBRMC

## Incineration

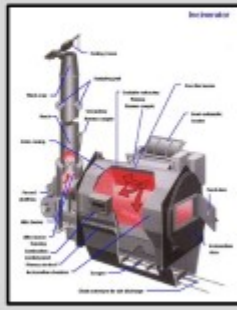
- Treatment of choice for animal bedding, carcasses and pathological wastes; but not plastics!
- Reduces volume of waste by up to 95%
- May allow energy generated to be recovered
- Operation parameters:
  - Primary chamber: 1400°F-1800 °F (760 °C-982 °C)
  - Secondary chamber: >2000 ° F (1093 °C)

Slide 52

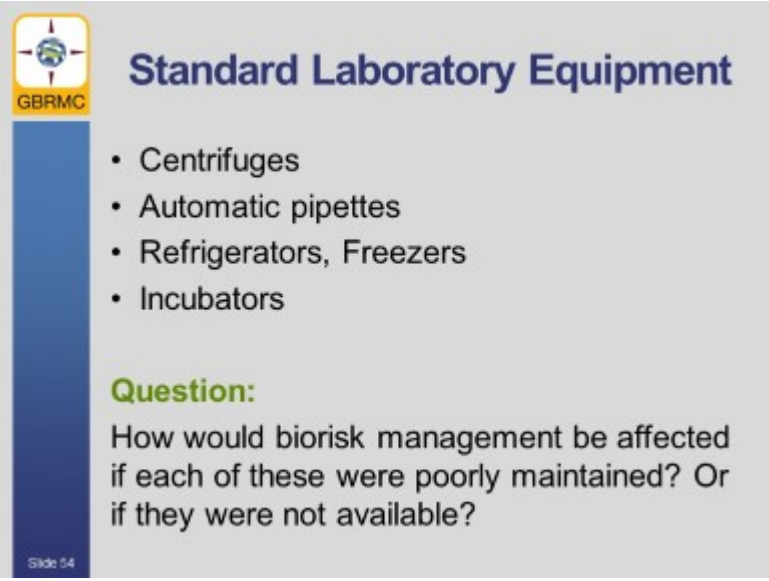
GBRMC

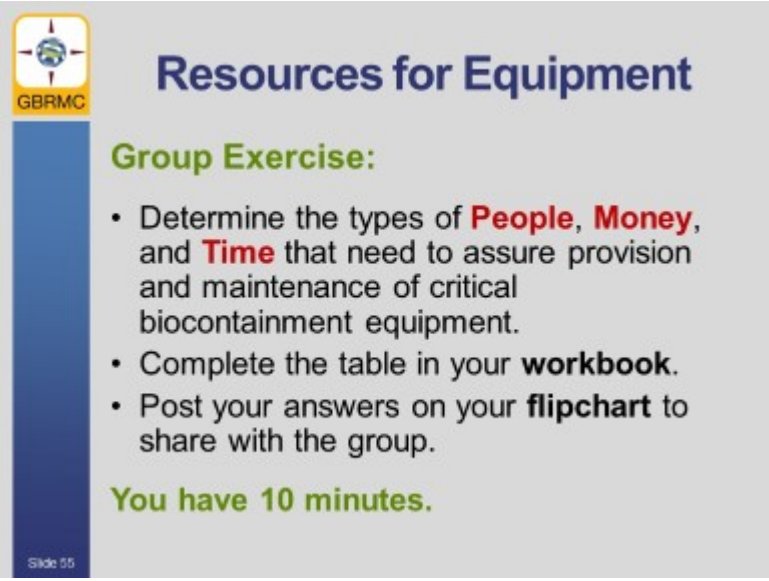
## Incineration Concerns

- Can generate smoke, residues with heavy metals, gases (e.g., HCl, CO, PCBs, etc.)
- May require pollution control devices, e.g., wet/dry air scrubbers, electrostatic precipitators
- Loading needs to be controlled
- May require permits



Slide 53


GBRMC
Standard Laboratory Equipment
• Centrifuges
• Automatic pipettes
• Refrigerators, Freezers
• Incubators
Question:
How would biorisk management be affected if each of these were poorly maintained? Or if they were not available?
Slide 54


GBRMC
Resources for Equipment
Group Exercise:
• Determine the types of People, Money, and Time that need to assure provision and maintenance of critical biocontainment equipment.
• Complete the table in your workbook.
• Post your answers on your flipchart to share with the group.
You have 10 minutes.
Slide 55

| | People | Money | Time |
|---|---|---|---|
| Biological Safety Cabinet | | | |
| Autoclave | | | |
| Incinerator | | | |
| Standard Lab Equipment | | | |

Slide 56

GBRMC

## People

Many of the people who will be involved in provision and maintenance of facilities & equipment will be vendors and contractors.

**Questions:**

How do you know if you have the right person for the job?

How do you make sure that biorisk management expectations are met with external contractors?

Slide 58

GBRMC

## Performance Indicators

Establishing specific performance indicators is beyond the scope of this course, but think about general approaches that should be in place.

**Question:**

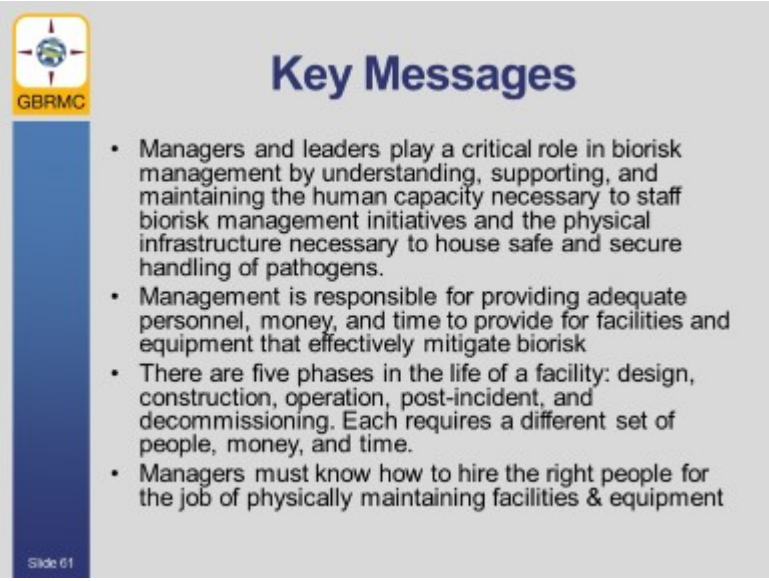
How do you know if facilities and equipment are operating as designed, specified, and installed?

List 3 to 5 ideas and write them in your **workbook**.

You have **5 minutes**.

Slide 59


GBRMC
Review
To wrap-up, let's discuss what we learned about Understanding & Maintaining Facilities and Equipment for Biorisk Management.
What did we learn?
What does it mean?
Where do we go from here?
Slide 60


GBRMC
Key Messages
• Managers and leaders play a critical role in biorisk management by understanding, supporting, and maintaining the human capacity necessary to staff biorisk management initiatives and the physical infrastructure necessary to house safe and secure handling of pathogens.
• Management is responsible for providing adequate personnel, money, and time to provide for facilities and equipment that effectively mitigate biorisk
• There are five phases in the life of a facility: design, construction, operation, post-incident, and decommissioning. Each requires a different set of people, money, and time.
• Managers must know how to hire the right people for the job of physically maintaining facilities & equipment
Slide 61

# Action Plan

| By the end of this lesson, I would like to: | | | | | |
|---|---|---|---|---|---|
| KNOW | | FEEL | | BE ABLE TO DO | |

*Your learning doesn't stop with this lesson. Use this space to think about what else you need to do or learn to put the information from this lesson into practice.*

| What more do I need to know or do? | How will I acquire the knowledge or skills? | How will I know that I've succeeded? | How will I use this new learning in my job? |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

*Use space on back, if needed*

GBRMC

# Reference

| BSC | Air Flow (%) | | Exhaust System | Volatile Toxic Chemicals/Radionucleotides |
|---|---|---|---|---|
| | Recirculated | Exhausted | | |
| Class I | 0 | 100 | Exhaust to room, hard duct or thimble connection | Yes if hard ducted to building exhaust |
| Class IIA1 | 70 | 30 | Exhaust to room or thimble connection to building exhaust | No |
| Class IIA2 – vented outside | 70 | 30 | Exhaust to room or thimble connection to building exhaust | Yes (Minute amounts) |
| Class IIB1 | 30 | 70 | Hard duct | Yes (Small amounts) |
| Class IIB2 | 0 | 100 | Hard duct | Yes |
| Class III | 0 | 100 | Hard duct | Yes |

Slide 64