

# Laboratory Design Best Practices

## *Student Guide*





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**Introductions**

- Instructors
- Students
  - Your name?
  - Where are you from?



Slide 2

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# Action Plan

By the end of this lesson, I would like to:

KNOW		FEEL		BE ABLE TO DO	
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*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



**Key Messages**

- Building zoning and organization should address functional relationships as well as biosafety and biosecurity concerns, service requirements, containment levels and construction types.
- Efficiency in laboratory layouts reduces labor, reduces energy and water consumption and simplifies safety and security design.
- Biological safety requires consideration at all levels of design, from the placement equipment in a room, to the organization of containment barriers around a zone, to the airflow strategy within the building.
- Biosecurity design can be integrated seamlessly into the building layout when considered early in planning.
- Laboratory design should be developed in conjunction with the protocols followed when personnel or materials or animals move from one space to another.
- To be sustainable laboratory designs must be flexible.

Page 4



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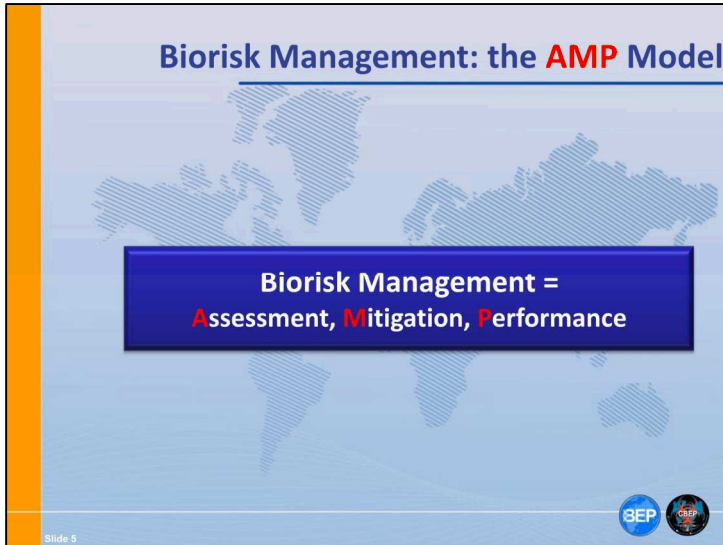
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**Key Components of Biorisk Management**

☣ **Biorisk Assessment**

- Process of identifying the hazards and evaluating the risks associated with biological agents and toxins, taking into account the adequacy of any existing controls, and deciding whether or not the risks are acceptable



Slide 6

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**Key Components of Biorisk Management**

🔒 **Biorisk Mitigation**

- Actions and control measures that are put into place to reduce or eliminate the risks associated with biological agents and toxins



Slide 7



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**Key Components of Biorisk Management**

**Performance**

- The implementation of the entire biorisk management system, including evaluating and ensuring that the system is working the way it was designed. Another aspect of performance is the process of continually improving the system.



Slide 4



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**Programming & Pre-Design**

Programming and Pre-Design activities give form to the **problem**, in order to inform the design activities which will later provide the **solution**.



By asking a well-rounded group of stakeholders questions about their **needs**, **wants**, and **desires**.



Slide 10

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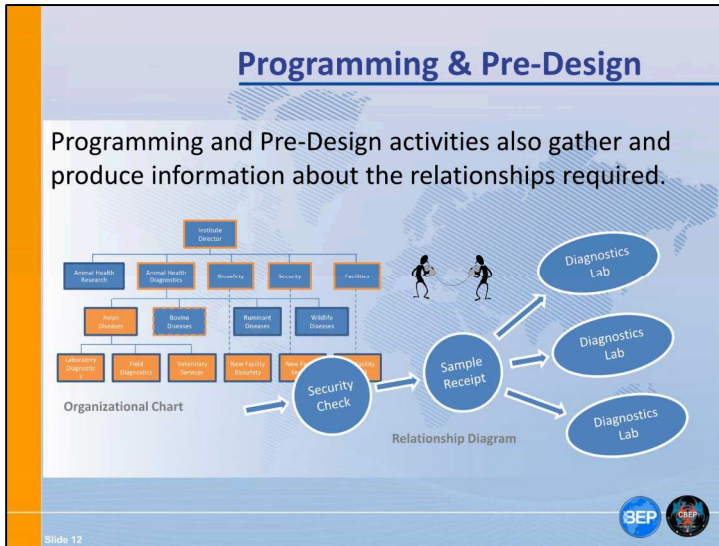
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**Programming & Pre-Design**

Programming and Pre-Design activities also work to balance the user's needs, wants and desires with the requirements of ***budget, regulations, biosafety and biosecurity***.



The illustration shows four stick figures on a light blue background. From left to right: 1. A figure stands on a large yellow padlock. 2. A figure holds a yellow biohazard sign. 3. A figure holds a document with a red biohazard symbol. 4. A figure holds a large money bag with a dollar sign. In the background, there is a book titled 'GUIDE FOR LABORATORY ANIMALS' and a globe. At the bottom right of the illustration are two circular logos: 'BEP' and 'OBEP'.

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**Laboratory Design Best Practices**

**“Big Picture” organization**

Once design criteria is gathered through programming and pre design work, the first step is to look at options for the overall organization of the project.

```
graph TD; Loading[Loading] --> Support[Support]; Support --- Labs[Labs]; Labs --- Office[Office]; Office --- Security[Security]; Labs --- Security; Security --- Entry[Entry]
```

Slide 14



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**Laboratory Design Best Practices**

“Big Picture” organization will later have a profound influence on:

- Functional Relationships
- Biosecurity Design
- Containment Concepts
- Biosafety Protocols
- Service Layouts
- Building Construction

The diagram illustrates a laboratory layout within a 'Security Zone' bounded by a 'Containment Barrier'. It shows two main areas: 'Laboratories' and 'Animal Holding'. Arrows indicate bidirectional flow between these areas. An 'Entry' point is shown on the left with arrows pointing into the 'Laboratories' area. An 'Animals In' point is shown on the right with an arrow pointing into the 'Animal Holding' area. The slide also features logos for BEP and OSEP.

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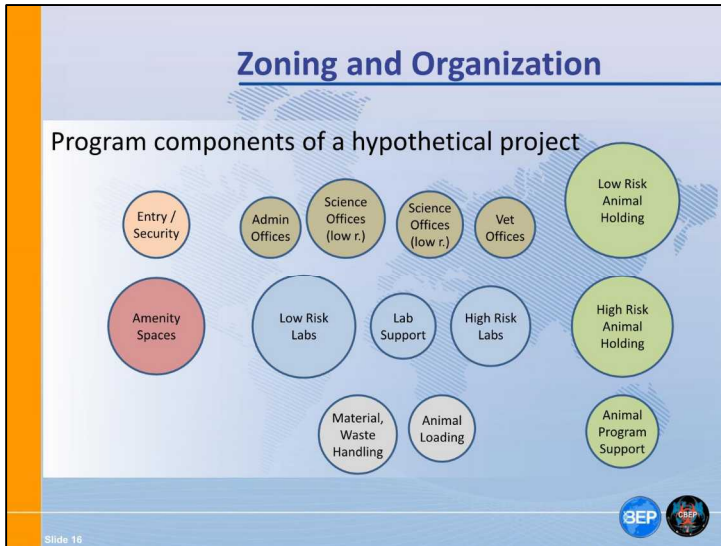
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### Zoning and Organization

#### Space Adjacency Matrix

5 = Very strong relationship, close adjacency is required.  
 4 = Strong relationship, adjacency is highly desirable.  
 3 = Moderate relationship, adjacency is desirable.  
 2 = Minor relationship, adjacency has benefits but is not necessary for building to function well.  
 1 = Weak relationship, adjacency may be convenient but isn't necessary.  
 0 = No adjacency required between these elements.

	Entry / Security Check	Lobby/Amenity/Receiving Spaces	Administrative Offices	Science Offices (low r.)	Science Offices (high r.)	Veterinary Offices	Low Risk Laboratories	High Risk Laboratories	Laboratory Support	Low Risk Animal Holding	High Risk Animal Holding	Animal Program Support	Material & Waste Handling	Animal Loading
Entry / Security Check	5	0	0	0	0	0	0	0	0	0	0	0	0	0
Lobby/Amenity/Receiving Spaces	5	5	1	4	3	2	2	0	0	0	0	0	0	0
Administrative Offices	5	5	5	2	2	1	0	0	0	0	0	0	0	0
Science Offices (low r.)	3	4	2	5	4	2	4	0	0	0	0	0	0	0
Science Offices (high r.)	3	4	2	4	4	2	2	0	2	0	0	0	0	0
Veterinary Offices	1	3	1	2	2	5	0	0	4	4	0	0	0	2
Low Risk Laboratories	1	2	0	2	0	0	5	2	1	0	3	0	0	0
High Risk Laboratories	1	2	0	2	0	0	5	5	0	0	3	0	0	0
Laboratory Support	0	0	0	0	0	0	5	3	2	0	0	3	0	0
Low Risk Animal Holding	0	0	0	0	0	4	2	0	0	2	5	4	5	0
High Risk Animal Holding	0	0	0	0	0	4	1	4	0	3	2	4	5	0
Animal Program Support	0	0	0	0	0	0	0	0	5	5	4	5	0	0
Material & Waste Handling	0	0	0	0	0	0	3	3	4	4	4	4	5	1
Animal Loading	0	0	0	0	0	2	0	0	0	5	5	5	1	1

BEP CBEP

Slide 17

Zoning & Organization Exercise

Group Activity:

We will now see **3 organizational diagrams** based upon the program components and the desired adjacencies we have been given.

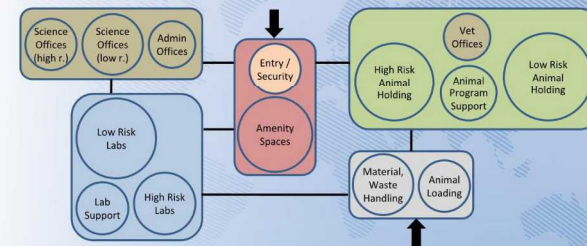
Your group will then analyze these and discuss what you think are the most **important criteria** for judging their **success or failure**.



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Zoning and Organization

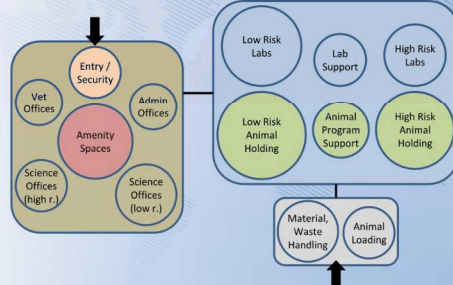
Zoning Diagram 1 - Lab and animal areas grouped separately



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Zoning and Organization

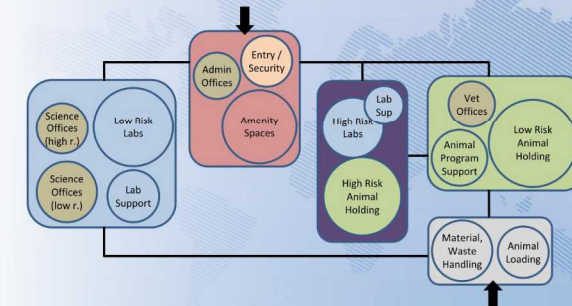
Zoning Diagram 2 - Bioscience spaces consolidated



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Zoning and Organization

Zoning Diagram 3 - Higher Risk Areas Consolidated




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Zoning & Organization Exercise

**Group Activity:**

In your groups, please spend **15 minutes** analyzing and discussing the 3 organizational diagrams. Make note of the strengths and weaknesses of each & the criteria for judging these.

**Select the diagram** you think would lead to the most successful design and briefly present your reasoning to the class.



Slide 22

Make note of the criteria you use for judging the strengths and weaknesses of the organizational diagrams.

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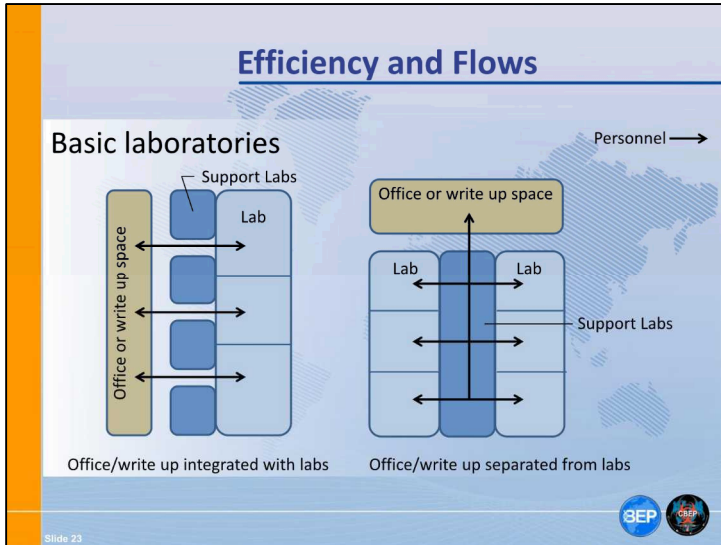
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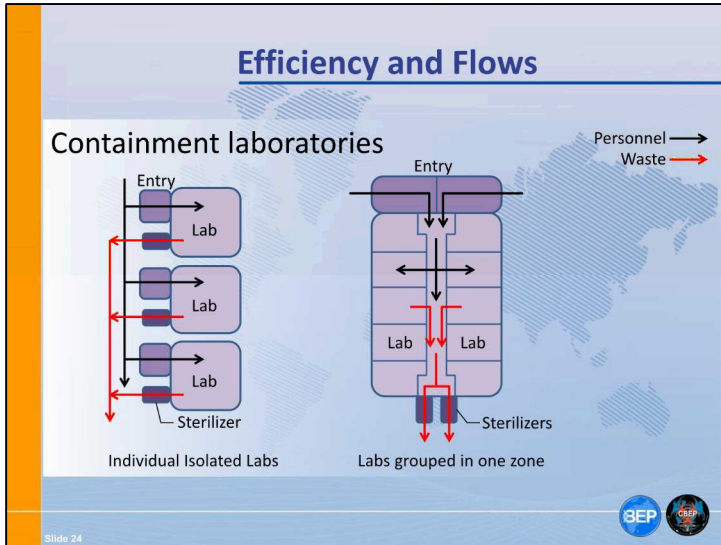
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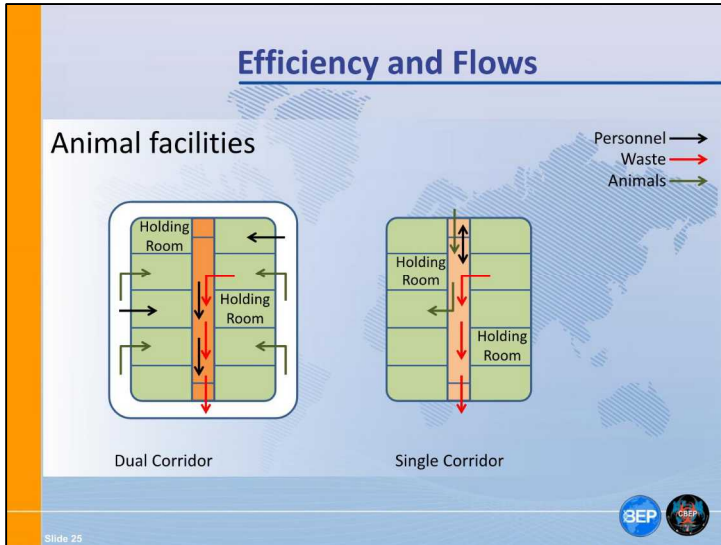
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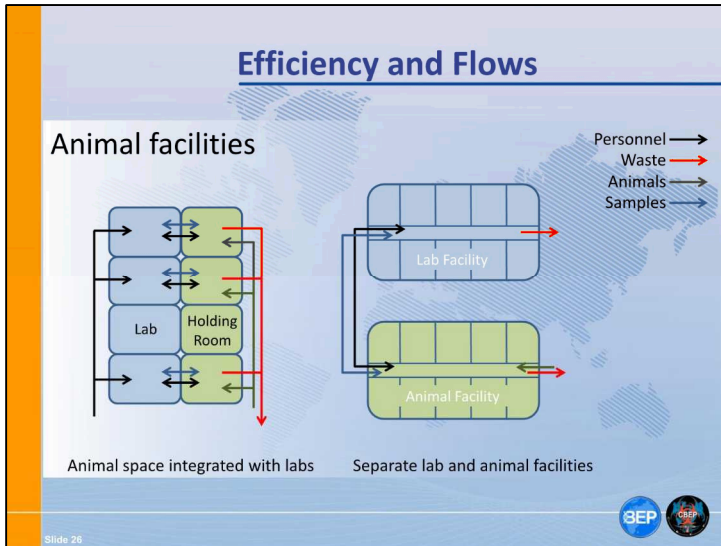
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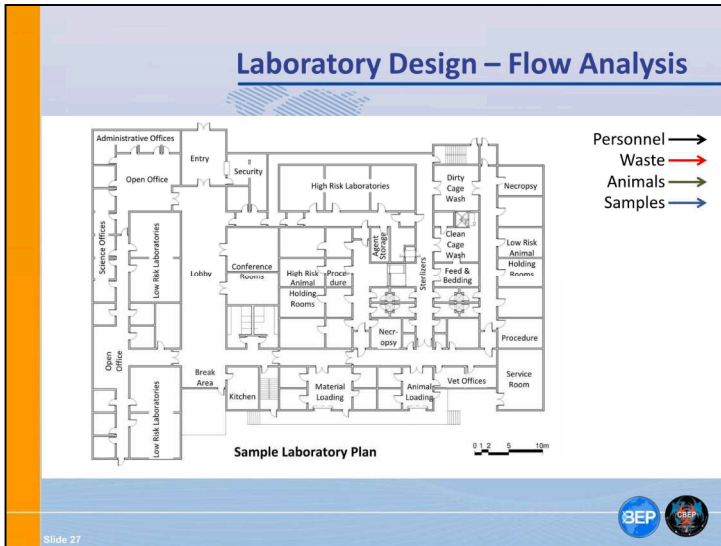
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**Laboratory Design – Flow Analysis**


**Group Activity:**

In your groups, please spend **20 minutes** analyzing the laboratory plan and drawing the paths of:

*Personnel flow* – **Black** pen      *Waste flow* – **Red** pen  
*Animal flow* – **Green** pen      *Sample flow* – **Blue** pen

Make note of the strengths and weaknesses you discover and be prepared to present your drawings and comments to the class.

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**Biological Safety – Design Principles**

- Safety protocols and design features that help:
  - Protect Users
  - Protect those outside labs
  - Protect the environment



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**Biological Safety – Design Principles**


- Create a **containment zone**.



The diagram illustrates two architectural approaches to creating a containment zone. On the left, a large light blue rectangle labeled 'Main Building' contains a smaller dark purple rectangle labeled 'Containment zone'. On the right, a light blue rectangle labeled 'Main Building' is connected to a separate dark purple rectangle labeled 'Containment zone' by a thin horizontal line, representing a separate wing or building.

- Note the containment zone may be an isolated area within the building, a separate wing, or a separate building.

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Biological Safety – Design Principles

- Clearly identify and **Restrict access** to the containment zone.
  - Use signage, door locks and other access control measures to ensure only trained and authorized personnel enter the containment zone.



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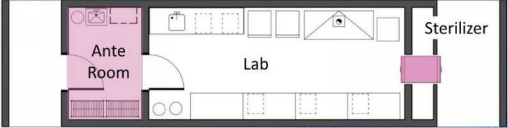
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**Biological Safety – Design Principles**

- Include spaces and equipment to support **protocols** for moving personnel and materials in and out of the containment zone.



The diagram shows a rectangular layout of a laboratory containment zone. On the left is a pink-shaded 'Ante Room' containing a sink and a door. To its right is a larger 'Lab' area with a sink, a fume hood, and several workstations. On the far right is a 'Sterilizer' area with a door leading to the lab. The entire area is enclosed by a thick black border representing the containment zone.

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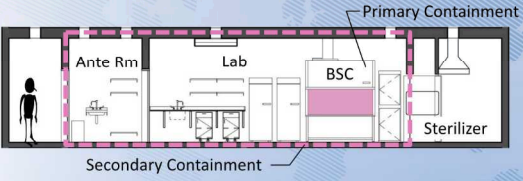
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**Biological Safety – Design Principles**

- Design to support **primary containment equipment** such as biosafety cabinets (BSCs) within the laboratories and animal areas.
- When primary containment equipment is used the laboratory spaces provide **secondary containment**.



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**Biological Safety – Design Principles**

- Create clearly defined containment barriers.
- A **containment barrier** is the wall (and any doors or equipment built into that wall), as well as the floor and ceiling, surrounding the containment zone.
- Containment barriers may also be created between spaces within a containment zone.

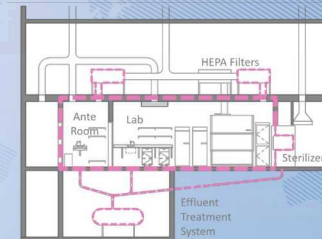


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**Biological Safety – Design Principles**

- Equipment that is built into the containment barrier, and any services that penetrate the containment barrier, become a part of the barrier as well.

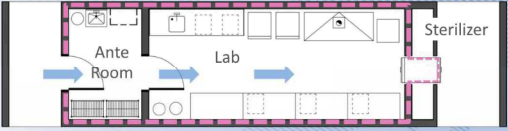
- HEPA Filters
- Sterilizers
- Dunk tanks, pass boxes
- Doors and windows
- Plumbing penetrations
- Electrical penetrations



Slide 35


**Biological Safety – Design Principles**

- Design to allow for **directional airflow**.



- Where openings through the containment barrier are required **directional airflow**, from low risk areas in towards higher risk areas, helps to prevent the escape of infectious agents.

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**Laboratory Design – Biosafety Analysis**

**Group Activity:**  
In your groups, please spend **20 minutes** analyzing the laboratory plan and diagram:

**Containment Barrier(s)** – Outline the overall containment zone and any barriers within using **Red** pen

**Protocol points** – Identify points where materials and personnel cross containment barriers using **Black** pen

**Directional airflow** – Draw arrows showing directional airflow across doorways using **Blue** pen



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**Biological Security – Design Principles**

- Security protocols and design features that help:
  - Protect Users
  - Protect those outside labs
  - Protect the environment



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**Biological Security – Design Principles**

- Biological agents or toxins should be secured in locked and monitored freezers or cabinets as appropriate to the material.
- Access should be restricted to only those who need the material to carry out their work.



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**Biological Security – Design Principles**

- The freezer or cabinet should be located in a secured, restricted access area.
- This may be a lab or freezer room. Many facilities utilize freezers in the lab for working samples and freezer rooms for longer term storage.



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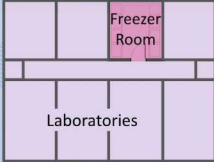
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**Biological Security – Design Principles**

- The freezer room or secure lab will generally be located within a larger secure laboratory zone.



The diagram illustrates a laboratory layout. A central area is labeled 'Laboratories' and is divided into several rectangular sections. Above this area, a smaller section is labeled 'Freezer Room'. The entire layout is contained within a larger rectangular boundary, representing a secure laboratory zone.

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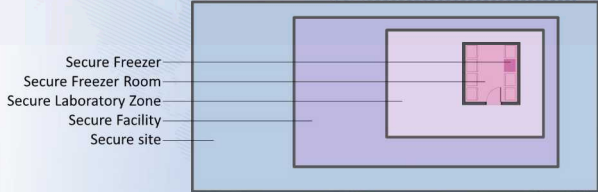
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**Biological Security – Design Principles**


- The lab zone will usually be within a larger secure facility, which in turn should be located on a secured site, creating multiple layers of protection.



Secure Freezer  
Secure Freezer Room  
Secure Laboratory Zone  
Secure Facility  
Secure site

- These layers are referred to as security zones.

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**Biological Security – Design Principles**

- When a person moves to a higher security zone there should be some type of ***access control***.
- Access control can be achieved by an appropriate combination of:
  - Guards
  - Secure walls or fences
  - Locked doors or gates

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Biological Security – Design Principles

- **Access control devices** can be as simple as a guard opening a gate or as complex as an iris scanning or finger print reading device opening an electronic lock on a door.



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**Biological Security – Design Principles**

- Restricting and controlling access to biological agents and toxins should be accompanied by a process for **monitoring access** as well.
- Monitoring can be any combination of:
  - Recording who enters and exits the secure areas
  - Recording who accesses the agents
  - Visually monitoring access control points and secure storage areas

Slide 45



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Biological Security – Design Principles

- Minimize travel distance for sample movement within the building
- Provide for safe handling and storage of inbound and outbound samples



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Laboratory Design – Biosecurity Analysis

**Group Activity:**  
In your groups, please spend **20 minutes** analyzing the laboratory plan and diagram:

**Security Zones** – Outline, shade and label the security zones.

Remember that the intent is to provide multiple layers of security for the highest risk areas.



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**Safety and Security Discussion**

**Class Activity:**  
Each group will have **5 minutes** to present to the class:

**Biosafety Features & shortcomings** – Describe to the class at least 2 positive features and 2 areas for improvement.

**Biosecurity Features & shortcomings** – Describe to the class at least 2 positive features and 2 areas for improvement.

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**Detailed Planning Principles**

- **Laboratory Plan**
  - BSCs placed away from traffic areas
  - Hand washing sink near exit
  - Shared sink and equipment accessed without disruption of work areas
  - Incubators/fridges/ bench space near BSC

6.4m

6.4m

1.5m

Bench

BSC

3EP 3EPP

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Notes:

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**Detailed Planning Principles**

- **Laboratory Plan**
  - Circulation through lab (to entry, other lab area) does not interrupt individual work zones
  - Sterilizer and wash up area near lab exit

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**Detailed Planning Principles**

- **Rodent Holding Room**
  - Clear path from racks to cage changing station
  - BSC for in room procedures (where allowable)
  - Wash up area and waste bins near exit

4.3m

7.0m

BSC

Cage Changing

Rodent Rack

SEP

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Notes:

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**Detailed Planning Principles**

- NHP/other animals
  - Wide clearance between cages
  - Clear path for cart and cage movement
  - Wash up/hose station area near exit
  - Low level exhaust
  - Trench drains
  - Observation window

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Notes:

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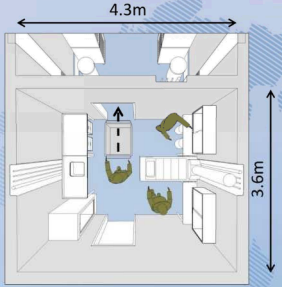
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**Detailed Planning Principles**

- Procedure Room
  - Procedure room directly adjacent animal holding when possible
  - Access on 3 sides of procedure table
  - Clear path for moving carts/animals without disrupting procedures



4.3m

3.6m

3EP

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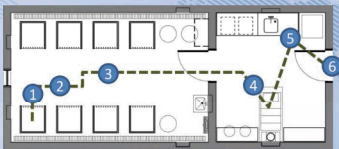
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### Balancing Design with Protocols

- Protocol mapping
  - Mapping out step by step protocols identifies areas of risk and uncovers needs
  - When risks are discovered design team works with the scientific & biosafety personnel to solve with a combination of design and protocols



1. Animal subject sedated in cage
2. Subject removed once asleep
3. Subject placed on cart, covered and moved to procedure
4. Subject placed on table, blood or tissue sample taken
5. Sample packaged at bench and placed in double container
6. Sample taken from procedure area to lab for analysis

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### Balancing Design with Protocols

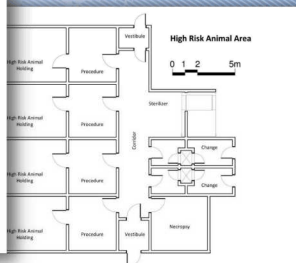
- Plan and protocols

**Protocol Mapping Scenario.**

Users of the High Risk Animal Area have described the following protocols. Clarify the protocols into step by step procedures and map those out on the given plan. You may modify the plan as you see fit if necessary to create a safe & efficient combination of design and protocols.

Users of the High Risk Animal Area anticipate they will work a variety of species and will study the diseases they needed to identify, with human genetics, history and culture. Some of the diseases need to be highly infectious and will require users to wear fully gowned air purifying respirators.

The users anticipate that higher risk programs will require them to take body showers upon exit from the animal area, but other programs may require less stringent protocols. These less stringent protocols will likely include wearing full body disposable coveralls, shoe decontaminators for the shoe area, gloves and full masks for respiratory protection. For a minimum all programs will require users to remove all personal items, gloves and shoe coverings and to wash their hands in the risk individual animal handling/maintenance areas, and all users will remove their lab coats and shoes, gowns and any other required PPE (personal protective equipment) in this exit the animal holding area.



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### Balancing Design with Protocols

**Group Activity:**  
 In your groups, please spend **20 minutes** analyzing the given protocols and partial laboratory plan

Map out the protocols showing where each step should be carried out

Propose modifications to the design if necessary to add or remove spaces

Each group will have **3-5 minutes** to present their analysis to the class

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**Flexibility**

- Laboratories and animal areas will be better utilized and last longer if they are flexible to accommodate changes over time.
- A ***flexible design*** can easily accommodate changes in function and equipment
- An ***adaptable design*** can easily be changed to suit a new purpose
- An ***expandable design*** can grow as needs increase over time

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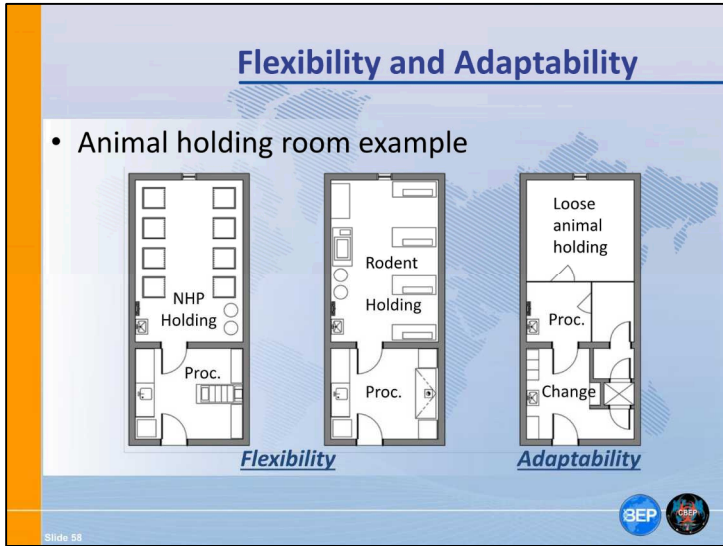
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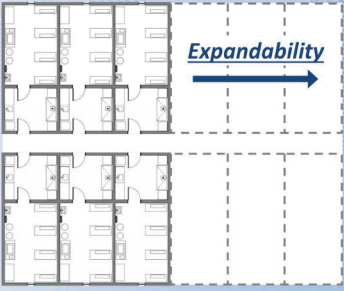
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**Expandability**

- Animal facility example



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Review of [course name or course section]

**Review**

To wrap-up, let's discuss what we learned about Laboratory Design Best Practices

What did we learn?      What does it mean?      Where do we go from here?



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### Key Messages

- Building zoning and organization should address functional relationships as well as biosafety and biosecurity concerns, service requirements, containment levels and construction types.
- Efficiency in laboratory layouts reduces labor, reduces energy and water consumption and simplifies safety and security design.
- Biological safety requires consideration at all levels of design, from the placement equipment in a room, to the organization of containment barriers around a zone, to the airflow strategy within the building.
- Biosecurity design can be integrated seamlessly into the building layout when considered early in planning.
- Laboratory design should be developed in conjunction with the protocols followed when personnel or materials or animals move from one space to another.
- To be sustainable laboratory designs must be flexible.



 

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- Biosecurity design can be integrated seamlessly into the building layout when considered early in planning.
- Laboratory design should be developed in conjunction with the protocols followed when personnel or materials or animals move from one space to another.
- To be sustainable laboratory designs must be flexible.

### Action Plan

By the end of this lesson, I would like to:

KNOW	FEEL	BE ABLE TO DO																	
<p><i>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.</i></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">What more do I need to know or do?</th> <th style="width: 25%;">How will I acquire the knowledge or skills?</th> <th style="width: 25%;">How will I know that I've succeeded?</th> <th style="width: 25%;">How will I use this new learning in my job?</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>				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?												
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  

*Remember your action plan!*



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## Reference Materials for Further Study

A Design Guide for Energy Efficient Research Laboratories. Website. <http://ateam.lbl.gov/Design-Guide/>

ASHRAE Laboratory Design Guide. 2002. Ian B.D. McIntosh, Chad B. Dorgan, Charles E. Dorgan. American Society of Heating, Refrigerating and Air Conditioning Engineers.

Biosafety in Microbiological and Biomedical Laboratories (BMBL) 5<sup>th</sup> Edition, 2009. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institutes of Health. Available online at: <http://www.cdc.gov/biosafety/publications/bmbl5/>

Building Type Basics for Research Laboratories. 2<sup>nd</sup> Edition, 2001. Daniel D. Watch, Stephen A. Kliment, Perkins & Will. John Wiley & Sons, Inc.

CWA 15793, CEN Workshop Agreement, Laboratory Biorisk Management. 2011. European Committee for Standardization. Available online at: [ftp://ftp.cenorm.be/CEN/Sectors/TCandWorkshops/Workshops/CWA15793\\_September2011.pdf](ftp://ftp.cenorm.be/CEN/Sectors/TCandWorkshops/Workshops/CWA15793_September2011.pdf)

Guide for the Care and Use of Laboratory Animals. 8<sup>th</sup> Edition, 2011. Institute for Laboratory Animal Research, National Research Council of the National Academies. The National Academies Press.

International Building Code. 2006 International Code Council. Available online at: <http://publicecodes.cyberregs.com/icod/ibc/2006f2/index.htm>

Laboratory Biosafety Manual. 3rd Edition, 2004. World Health Organization. Available in multiple languages online at: [http://www.who.int/csr/resources/publications/biosafety/WHO\\_CDS\\_CSR\\_LYO\\_2004\\_11/en/](http://www.who.int/csr/resources/publications/biosafety/WHO_CDS_CSR_LYO_2004_11/en/)

Laboratory Biosecurity Handbook. 2007. Reynolds Mathewson Salerno, Jennifer Marie Guadoso. CRC Press.

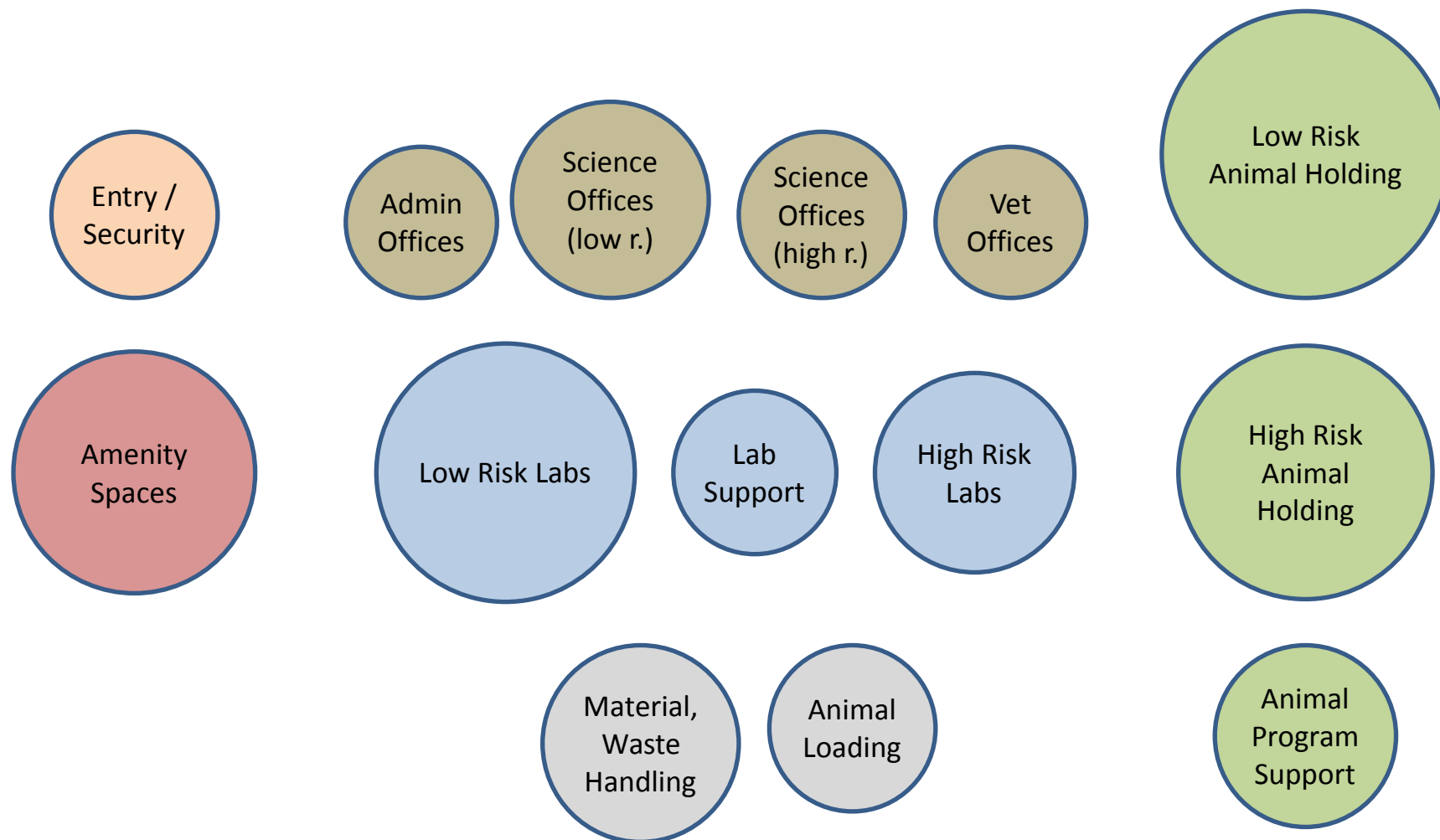
Laboratory Design Guide. 3<sup>rd</sup> Edition, 2005. Brian Griffin. Architectural Press, Elsevier.

NFPA 45: Standard on Fire Protection for Laboratories Using Chemicals. 2011. National Fire Protection Association. Available online at: <http://www.nfpa.org/>

Problem Seeking: An Architectural Programming Primer. 5th Edition, 2012. William M. Peña, Steven A. Parshall. John Wiley & Sons, Inc.

Whole Building Design Guide. Website. <http://www.wbdg.org/>


## Program components of a hypothetical project





## Space Adjacency Matrix

	Entry / Security Check	Lobby/Amenity/Meeting Spaces	Administrative Offices	Science Offices (low r.)	Science Offices (high r.)	Veterinary Offices	Low Risk Laboratories	High Risk Laboratories	Laboratory Support	Low Risk Animal Holding	High Risk Animal Holding	Animal Program Support	Material & Waste Handling	Animal Loading
Entry / Security Check		5	5	3	3	1	1	1	0	0	0	0	0	0
Lobby/Amenity/Meeting Spaces	5		5	4	4	3	2	2	0	0	0	0	0	0
Administrative Offices	5	5		2	2	1	0	0	0	0	0	0	0	0
Science Offices (low r.)	3	4	2		4	2	4	0	0	0	0	0	0	0
Science Offices (high r.)	3	4	2	4		2	0	2	0	0	0	0	0	0
Veterinary Offices	1	3	1	2	2		0	0	0	4	4	0	0	2
Low Risk Laboratories	1	2	0	4	0	0		3	5	2	1	0	3	0
High Risk Laboratories	1	2	0	0	2	0	3		3	0	4	0	3	0
Laboratory Support	0	0	0	0	0	0	5	3		0	0	0	3	0
Low Risk Animal Holding	0	0	0	0	0	4	2	0	0		3	5	4	5
High Risk Animal Holding	0	0	0	0	0	4	1	4	0	3		5	4	5
Animal Program Support	0	0	0	0	0	0	0	0	0	5	5		4	5
Material & Waste Handling	0	0	0	0	0	0	3	3	3	4	4	4		3
Animal Loading	0	0	0	0	0	2	0	0	0	5	5	5	3	



5 = Very strong relationship, close adjacency is required.

4 = Strong relationship, adjacency is highly desirable.

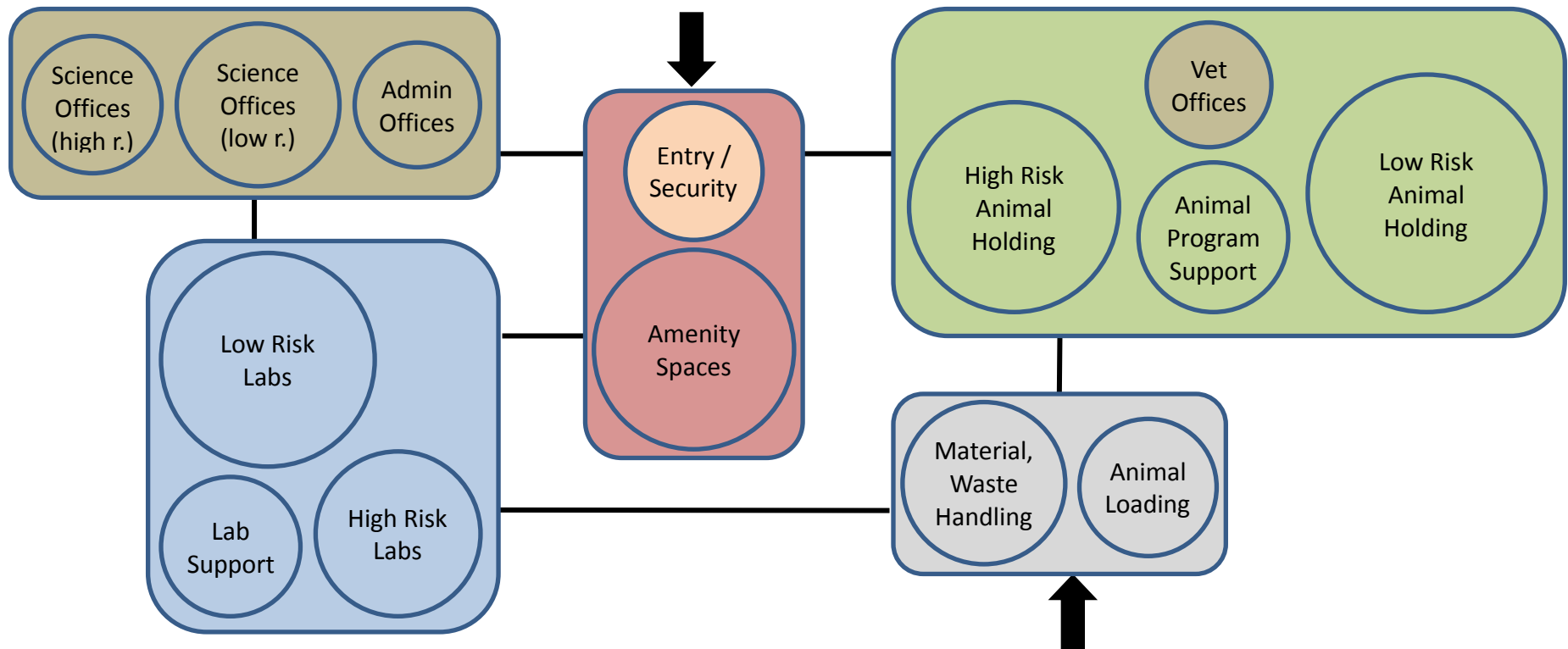
3 = Moderate relationship, adjacency is desirable.

2 = Minor relationship, adjacency has benefits but is not necessary for building to function well.

1 = Weak relationship, adjacency may be convenient but isn't necessary.

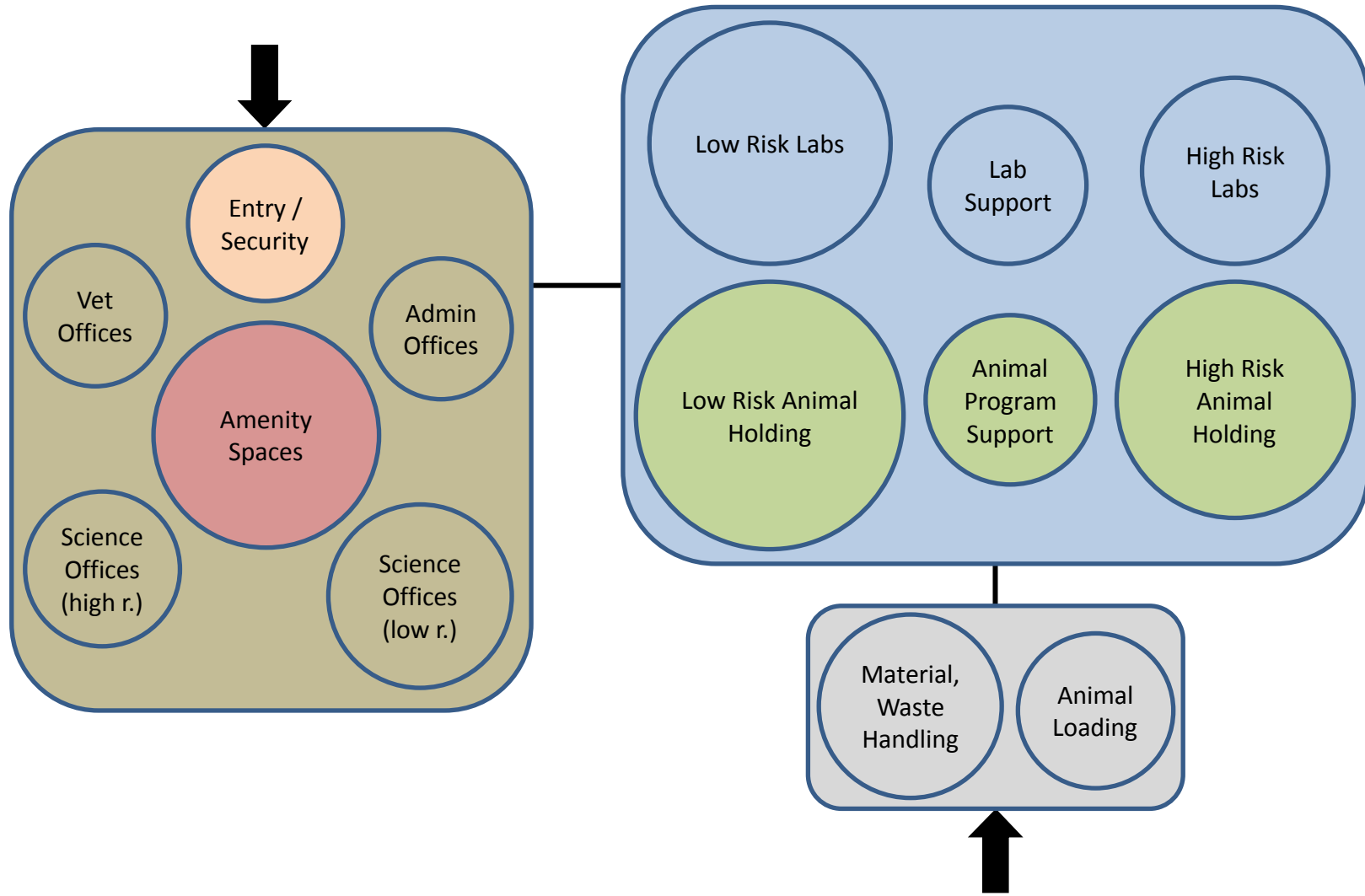
0 = No adjacency required between these elements.

## Zoning Diagram 1 – Lab and animal areas grouped separately



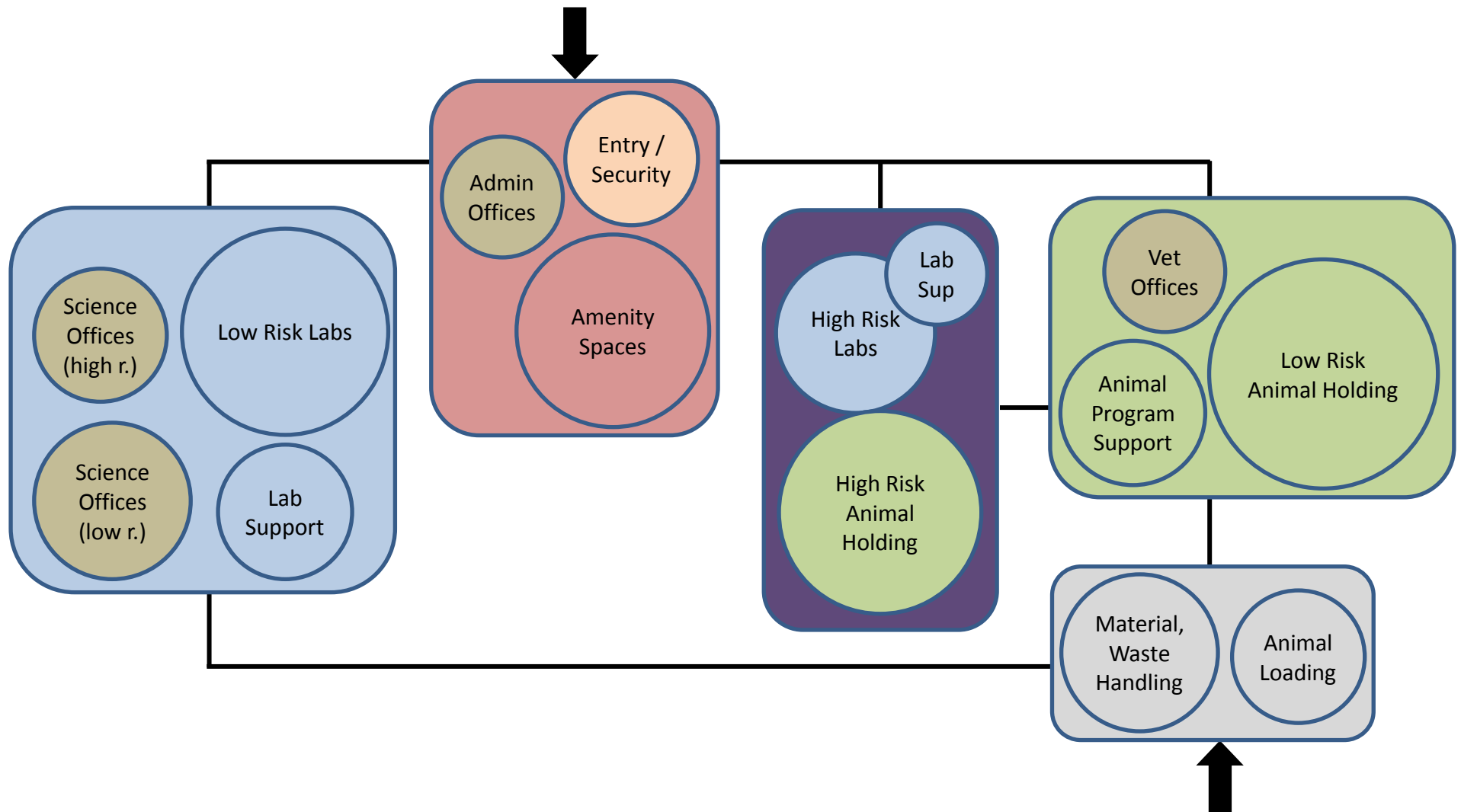


## Zoning Diagram 2 – Bioscience spaces consolidated

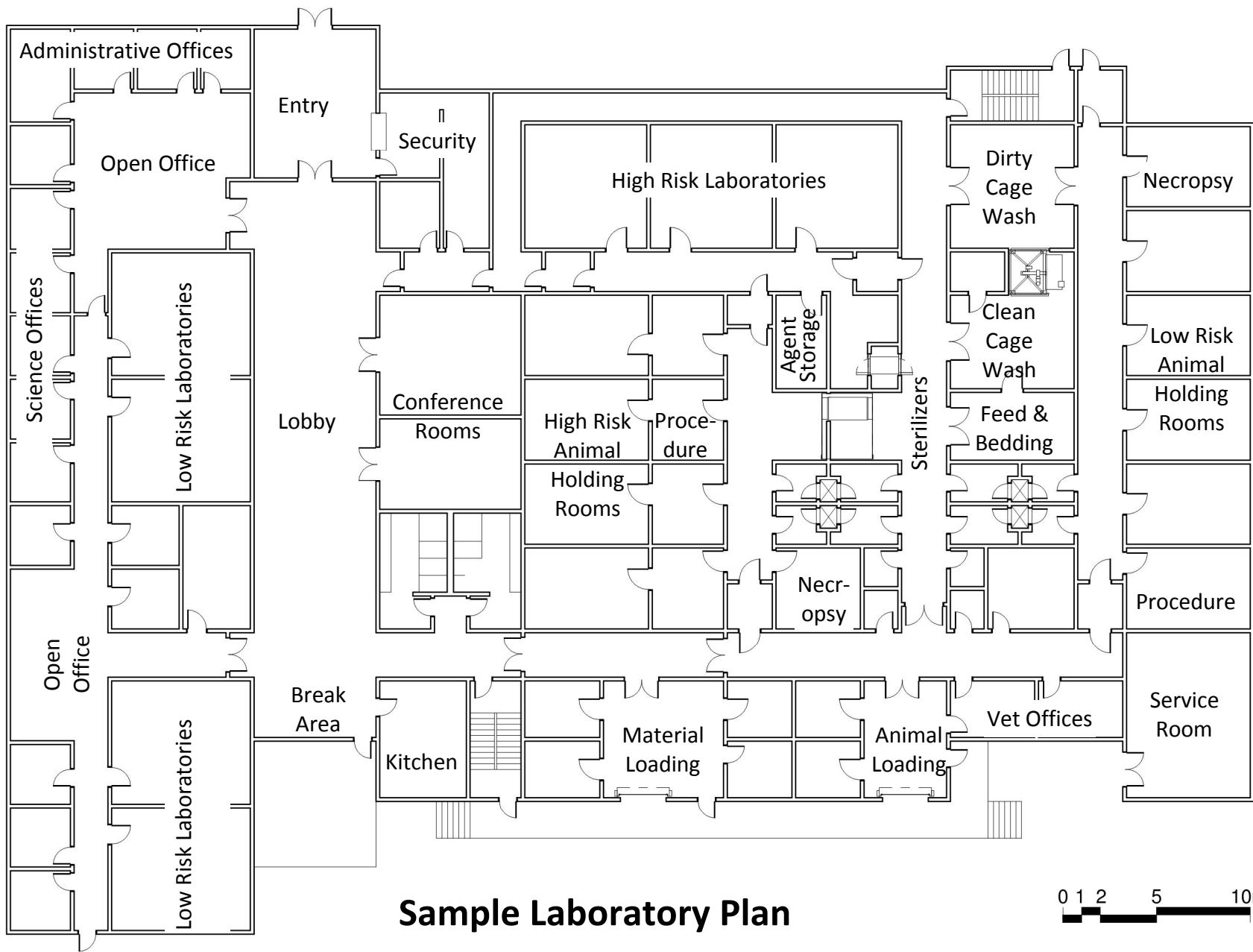




### Zoning Diagram 3 – Higher Risk Areas Consolidated







**Sample Laboratory Plan**









## Protocol Mapping Scenario.

Users of the High Risk animal area have described the following protocols. Clarify the protocols into step by step procedures and map these out on the given plan. You may modify the plan as you see fit if necessary to create a safe & efficient combination of design and protocols.

Users of the High Risk area anticipate they will work a variety of agents and will study the diseases they manifest in poultry, non human primates, rabbits and rodents. Some of the diseases may be highly infectious and will require users to wear PAPRs (powered air purifying respirators).

The users anticipate that higher risk programs will require them to take body showers upon exit from the animal area, but other programs may require less stringent protocols. These less stringent protocols will likely include wearing full body disposable coveralls, shoes dedicated to the lab area, gloves and N95 masks for respiratory protection. At a minimum all programs will require users to remove lab overcoats, gloves and shoe coverings and to wash their hands as they exit individual animal holding/procedure areas, and all users will remove their lab dedicated shoes, coveralls and any other required PPE (personal protective equipment) as they exit the animal holding area.

