Read Before You Review:
Thank you for reviewing this Storyboard! This proof represents the content, assessment, and description of the functionality, from which a pilot course will be developed. As an **SME Reviewer**, consider the following questions as you review this content and formulate your comments. Please, refer to these questions several times during your review.

Course Instructional Content:
Are the objectives appropriate based on the need and CDC organizational goals?
Are the key concepts addressed?
Does the content represent a real need for the learners?
Does this project set and meet expectations for the learner?
Do the examples, analogies, case studies, and suggested simulations represent accurate information and practice?
Are the content and conceptual information factually accurate?
If appropriate, do the challenges and activities effectively convey or demonstrate the content?
Are the graphical representations, illustrations, and textural descriptions accurate?
Is the level of detail in the graphic representations, illustrations, and textural descriptions appropriate?
Is quoted material cited correctly?

As a reviewer, please, focus on information in the “Content on Screen” area and information below the headings. Limit your comments to these areas.

To **create a comment**, first highlight the text, graphic, or area of the screen you wish to comment on. Then, either **right-click** or select the **Insert Tab** from the Word menu at the top of your screen. Click **New Comment** or **Comment** in the menu. Enter your comment in the area provided. You may also directly track wording changes you recommend to the content. Ensure “Track Changes“ has been initiated on the top ribbon.

To **delete a comment**, click on any part of the comment within the text and **right-click**. Select **Delete Comment** from the menu near the cursor.

Thank you again for reviewing this content!!

Please contact the project leader if you have specific questions about the content and review process.

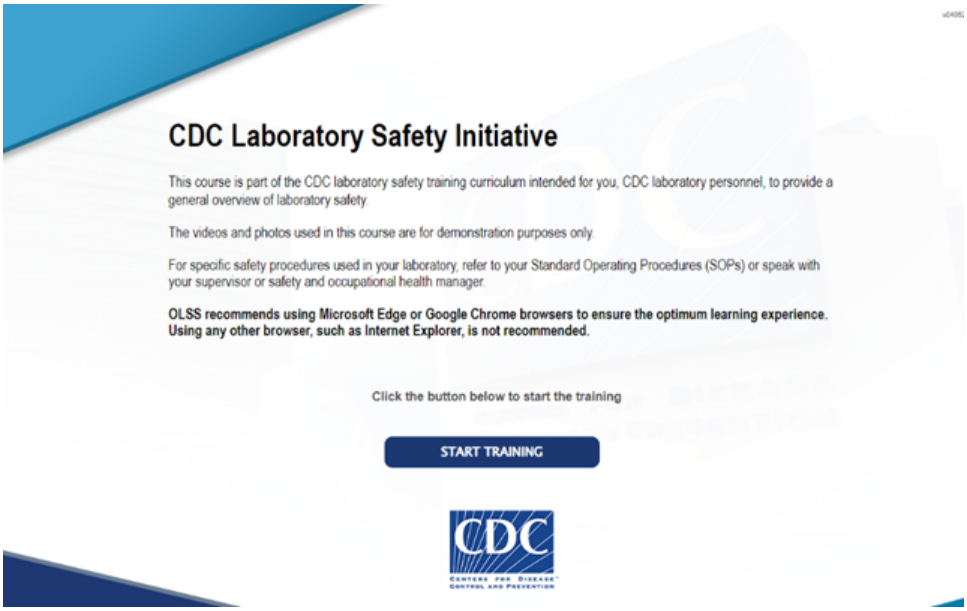
Course Title: Overview of Biological and Chemical Materials in the BSL-3 Laboratory

Shortened title will be: BSL-3 Overview of Biological and Chemical Materials. This title will be used for all correspondence about the course.

Date:	Version:	Description:	Name:
09/23/24	092324		Jane Nguyen

General Programming Notes
This course will be developed in HTML5 using the Lectora authoring tool. Graphic format: PNG ☐ JPG ☒ Combination ☐ Audio format: MP3 ☒ SWF ☐ Other ☐ Tablet/Mobile Device Compatible? Yes ☐ No ☐
Description: Key Words:
ISD Inputs and Other Development Materials
ISD inputs and other development materials are located at:

Page 00000	Screen X of X
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS	



Select Next to Continue

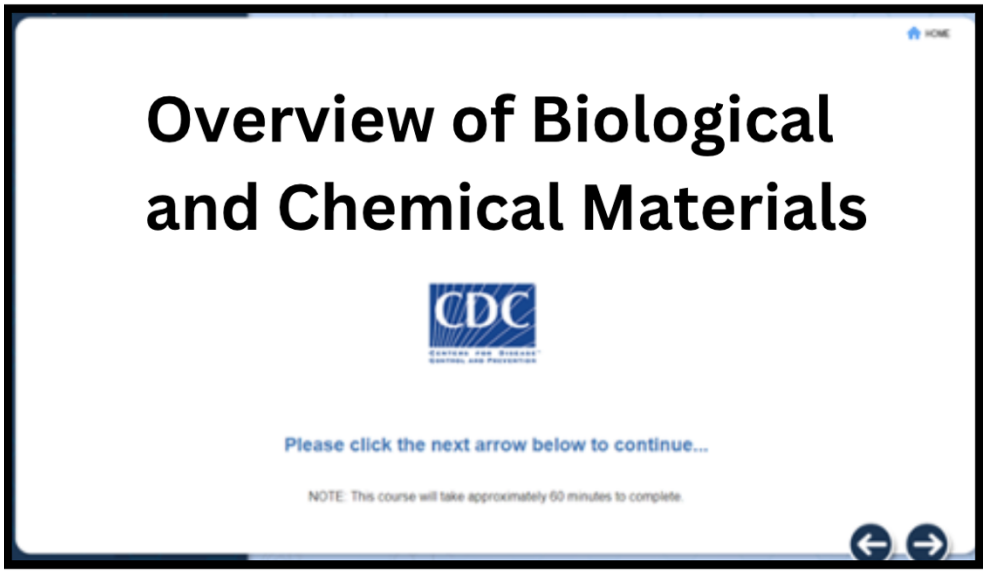
Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Programming
Developer: Ensure new branding is utilized.

Page 00005	Screen X of X
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS	



Select Next to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Programming
Developer: Add appropriate graphics.

Page 00010	Screen X of X
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS	

OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS
DISCLAIMER, SECTION 508, AND EXTERNAL LINKS

Use of trade names and commercial sources in this training activity is for identification only and does not imply endorsement by the Centers for Disease Control and Prevention (CDC), the Public Health Service, or the U.S. Department of Health and Human Services. Product names, logos, brands, and other trademarks featured or referred to within this CDC presentation are the property of their respective trademark holders. These trademark holders are not affiliated with CDC. CDC does not sponsor or endorse these materials but references them as examples of materials to use for learning activities and demonstrations.

This course was developed to comply with Web Content Accessibility Guidelines 2.0 - Level AA (WCAG 2.0 AA). If you would like to report any accessibility-related issues, please email the Laboratory Training Activity at OLSSTraining@cdc.gov.

The graphic notice ( ) means that you are leaving a U.S. Department of Health and Human Services (HHS) web site. This external link provides additional information that is consistent with the intended purpose of a federal site. The HHS cannot attest to the accuracy of a non–federal site. Linking to a non–federal site does not constitute an endorsement by HHS or any of its employees of any information or products presented on the site. You will be subject to the destination site's privacy policy when you follow the link.

Browser and Hardware Guidance

Navigation Help

Links

Contacts

Select Next to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Programming
Developer: Links go to respective next pages in the storyboard. **Hyperlink - mailto:OLSSTraining@cdc.gov**

Page 00015	Screen X of X
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS	
SYSTEM REQUIREMENTS BELOW ARE THE MINIMUM SYSTEM REQUIREMENTS FOR CDC E-LEARNING OLSS recommends using Microsoft Edge or Google Chrome browsers to ensure the optimum learning experience. Using any other browser, such as Internet Explorer, is not recommended. Appropriate browser (See above) • JavaScript enabled • Popup blocker disabled • Intel® Pentium® III Processor • 512 MB RAM • Broadband Internet connection • Microsoft Windows® Media® player for multimedia support Browser plug-ins The following system plugins are available for download and installation to optimize your learning experience. Adobe® Reader®	
Select Next to Continue	
Navigation Bar	

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Programming
Developer:

Page 00020	Screen X of X
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS	
NAVIGATION HELP STANDARD NAVIGATION Select the BACK arrow to go to the previous page in the course. Select the NEXT arrow to go to the next page in the course. Select the CHAPTER title at the top of the page to navigate to a specific chapter in this course. The HOME button takes you back to the first screen in the course. Underlined words indicate a link to additional information. The RESOURCES and WEB LINKS buttons display links and downloads that relate to the course. The EXIT button closes the course and bookmarks the last screen visited. When you return to the course you will be able to return to the last screen visited. **Note:** The job aids will open in a separate window. Select the "X" on the toolbar to return to the course**.**	
Select Next to Continue	
Navigation Bar	

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Programming
Developer:

Page 00025	Screen X of X
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS	
RESOURCES AND OTHER FILES FOR YOUR USE BMBL (Biosafety in Microbiological and Biomedical Labs 6th) Pathogen Safety Data Sheets - Canada.ca Defining Hazardous Waste Biosafety Manual (cdc.gov) Biological Agents Code of Practice Hierarchy of Controls Risk groups | my.ABSA.org - For the Biosafety and Biosecurity Professional NIH Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules (NIH Guidelines) CDC Lab Standards CDC BLOODBORNE PATHOGENS PROGRAM Biocontainment - eCFR :: 7 CFR 33.12 HHS Occupational Health and Safety Manual NCIRD BSL-3 Safety Training: Online Defining Hazardous Waste: Listed, Characteristic and Mixed Radiological Wastes | US EPA Introduction to Hazardous Waste Identification (epa.gov) OSHA Regulation 1910.119 from CFR Table 29 - Process safety management of highly hazardous chemicals. OSHA Regulation 1910.120 from CFR Title 29 - Hazardous waste operations and emergency response HW Listing Reference Document - Sep 2012(F).pdf (epa.gov) Occupational Exposure to Hazardous Chemicals in Laboratories OLSS_ChemicalHygienePlan_CDC-001-00354_rev3_final.pdf Chemical Safety | Safety Practices | OSSAM (cdc.gov) Chemical Storage Guidelines (cdc.gov) Selected EPA-Registered Disinfectants | US EPA	
Select Next to Continue	
Navigation Bar	

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Programming
Developer:

Page 00030	Screen X of X
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS	
CONTACT US If you have any questions or concerns about the functionality of this course, please contact the Office of Laboratory Science and Safety (OLSS) at OLSSTraining@cdc.gov.  	
Select Next to Continue	
Navigation Bar	

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Programming
Developer:

Page 00035	Screen X of X
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS	
COURSE PURPOSE This eLearning course is designed to provide laboratory personnel with essential knowledge about characteristics and control measures for infectious biological and hazardous chemical materials in a BSL-3 laboratory setting. Participants will learn about how these materials impact the laboratory environment. Through videos, animations, interactive diagrams, self-assessment quizzes, case studies, and scenarios, participants will understand different risk groups for infectious biological agents and the significance of transmission routes, incubation times, susceptibility to disinfectants, and more.	
Select Next to Continue	
Navigation Bar	

Graphics

Filename	Graphic Description	Alt Text/Title Tag
	Decorative Graphic	

Programming
Developer:

Page 00040	Screen X of X
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS	
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS COURSE OBJECTIVES (1 of 2) **By the end of this course, participants will be able to** • Describe inherent characteristics of infectious biological agents handled in the BSL-3 laboratory • Identify routes of transmission, environmental stability, signs and symptoms of infection, incubation times, and susceptibility to disinfectants for infectious biological agents handled in a BSL-3 laboratory • Categorize infectious biological agents into risk groups • Describe biosafety levels and their requirements	
Select Next to Continue	
Navigation Bar	

Graphics

Filename	Graphic Description	Alt Text/Title Tag
	Decorative Graphic	

Programming
Developer:

Page 00045	Screen X of X
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS	
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS COURSE OBJECTIVES (2 of 2) **By the end of this course, participants will be able to** • Describe control measures used when working with infectious biological agents • Describe the risks associated with common hazardous chemicals handled in the BSL-3 laboratory • Describe control measures used when working with hazardous chemical materials • Identify appropriate selection, preparation, and use of chemical disinfectants for work in the BSL-3 laboratory	
Select Next to Continue	
Navigation Bar	

Graphics

Filename	Graphic Description	Alt Text/Title Tag
	Decorative Graphic	

Programming
Developer:

Page 01000	Screen X of XX
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS	
INTRODUCTION VIDEO  Example Video	
Select Next to Continue	
Navigation Bar	

Graphics

Filename	Graphic Description	Alt Text/Title Tag
	Selectable door	

Narrated Text	Graphics
Welcome to the BSL-3 Overview of Biological and Chemical Materials! I'm your virtual laboratory guide.	*Introduce the course title with an animated Avatar.*
This course will introduce you to biological and chemical materials frequently used in BSL-3 laboratories. Our goal is to provide you with the fundamental knowledge and skills necessary to work safely and effectively with these materials. In doing so, you protect yourself, your co-workers, and the environment.	*Show samples of some of the materials, people working in a laboratory, protocols and procedures, and research processes.*
You will begin by examining characteristics of infectious biological agents, including prevalence, environmental stability, and susceptibility to disinfectants.	*Display 3D animations of various type of infectious agents and associated characteristics.*

You will distinguish between Biosafety Levels and Risk Groups and examine common pathogens used at BSL-3.	*Use a 3D animation to show the four biosafety levels, four risk groups, and a selected set of pathogens handled at BSL-3.*
You'll recognize the full range of characteristics of these pathogens and discern why BSL-3 containment is necessary.	*Show 3D models of various aspects of BSL-3 containment enhancements.*
You will also be aware of the potential risks associated with hazardous chemicals, including toxicity and poisoning, chemical burns and skin irritation, flammability and explosion reactions, and inhalation of harmful vapors.	*Show hazardous chemicals and their potential for toxicity and poisoning, chemical burns and skin irritation, flammability and explosive reactions, and inhalation of harmful vapors.*
You'll understand the importance of proper labeling, specific training on handling and storage protocols, as well as emergency responses and spill management.	
The course will highlight control measures for infectious biological agents and hazardous chemical materials and how additional control measures beyond BSL-2 are required. These control measures include access controls, air handling systems, biosafety cabinets, and more.	*Animate a BSL-3 laboratory, focusing on access controls, entry/exit procedures, and air handling systems.*
You will engage in activities to enhance your awareness of potential hazards related to infectious biological and hazardous chemical materials.	*Fly through animation of the BSL-3 laboratory and biological and chemical hazards therein.*
Finally, you will apply your knowledge through scenario-based assessments to ensure you can effectively implement the lessons and material covered.	*Use branching animations to show the outcomes of different choices.*
This overview will lay the foundation for your journey through the BSL-3 curriculum, in an effort to prepare you for each element.	*3D animated summary of the course highlights. Show a progress bar or roadmap of the curriculum.*

Selectable Item	**Popup Box Interaction**

	Selectable door appears AFTER video completion. Learner ‘enters’ a modified, 508-compliant version of the 360 classroom.

Programming
Developer: After video completion, selectable graphic appears.

Page 01005	Screen X of X
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS	
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS **Lesson 1: Characteristics of Infectious Biological Materials**	
Select Next to Continue	
Navigation Bar	

Graphics

Filename	Graphic Description	Alt Text/Title Tag
	Decorative Graphic	

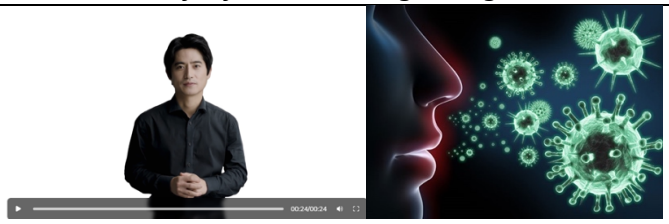
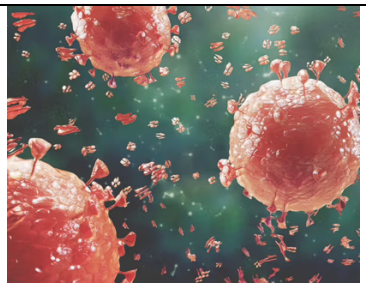
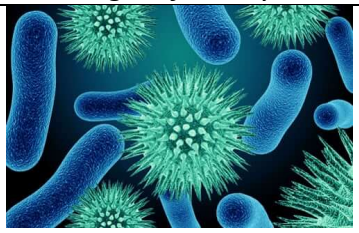
Programming
Developer:

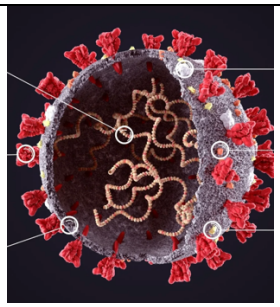
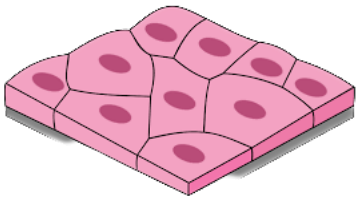
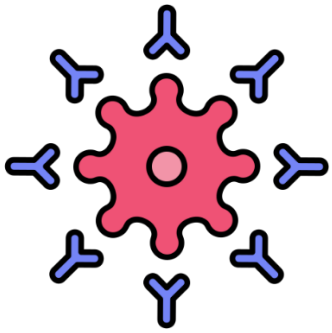
Page 01010	Screen X of XX
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS	
INFECTIOUS BIOLOGICAL AGENTS IN BSL-3 LABORATORIES 	
Select Next to Continue	
Navigation Bar	

Graphics

Filename	Graphic Description	Alt Text/Title Tag
	BSL-3 Classroom	360 view of a classroom room with blue floors, tables, office chairs, a large TV screen, and visible ceiling pipes.

Selectable Item	Popup Box Interaction
	Learner selects to view video.
	After viewing video, learners will utilize navigation controls to transport to alternate classroom area.

Narrated Text	Graphics
Let's begin by discussing characteristics of infectious biological agents. Infectious biological agents requiring BSL-3 containment include those that can cause serious or potentially lethal diseases.	 *Avatar begins speaking, introducing the topic of characteristics of infectious biological agents.*
These agents often have low infectious doses and no known treatment or vaccines, necessitating stringent safety measures to prevent laboratory-acquired infections (LAIs). The following are important considerations for biological agents requiring BSL-3 containment:	
is the extent to which a pathogen can enter, survive, and multiply in the host. It is measured by the ratio of infected to the number exposed.	 *High Infectivity*
Pathogenicity is the ability of a pathogen to cause disease in a host. Highly pathogenic organisms can cause severe disease.	 *High Pathogenicity*

Virulence is the degree to which a pathogen can cause a severe infection. A pathogen with high virulence is likely to cause an infection in the intended host.	 *High Virulence*
Toxicity is the ability of a substance, potentially produced by a pathogen, to cause harmful health effects. The acute toxicity of a substance may be low, but the pathogen can cause severe or chronic disease.	 *Toxicity*
Invasiveness is the ability of a pathogen to penetrate and spread throughout the tissue. The invasiveness for a BSL-3 pathogen is usually moderate or high.	 *(Usually) Moderate or High Invasiveness*
Immunogenicity is the ability of a substance containing antigens to cause the body to make an immune response against that substance.	 *(Usually) Moderate or High Immunogenicity*

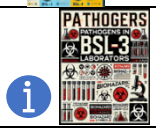
Programming
Developer: The user will see a modified, 508-compliant version of the classroom and select the video. Ensure all images and media have a polished and innovative aesthetic.

Page 01015	Screen 14 of XX
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS	
BSL-3 CLASSROOM Select each poster to view its content.  	
Select Next to Continue	
Navigation Bar	

Graphics

Filename	Graphic Description	Alt Text/Title Tag
	BSL-3 Classroom	
	Selectable Poster 1	
	Selectable Poster 2	
	Selectable Poster 3	
	Selectable Poster 4	

Selectable Item	Popup Box Interaction
	**Leads to screens XX** : CHARACTERISTICS OF INFECTIOUS BIOLOGICAL AGENTS
	**Leads to screen XX** : CLASSIFICATION SYSTEM FOR INFECTIOUS BIOLOGICAL AGENTS

	**Leads to screens XX** : BIOSAFETY LEVELS VS. RISK GROUPS
	**Leads to screens XX** : PATHOGENS IN BSL-3 LABORATORIES

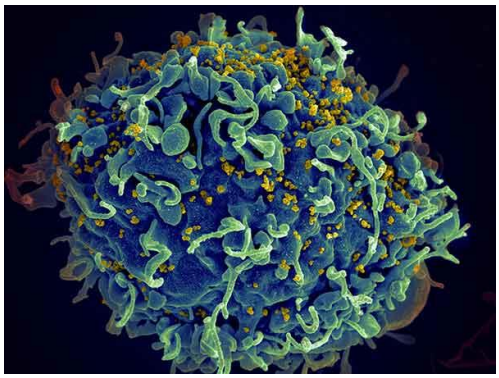
Programming
Developer: • Users must select and view all screens associated with the first poster before unlocking the second poster. • Then, users must view all screens associated with the second poster before unlocking the third poster, and so on.

Page 01020	Screen X of X

OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

CHARACTERISTICS OF INFECTIOUS BIOLOGICAL AGENTS

When making safety, handling, and equipment-related decisions about infectious biological agents, personnel in BSL-3 laboratories must consider various characteristics of the agents.



- Prevalence
- Environmental Stability
- Susceptibility to Disinfectants
- Modes of Transmission
- Host Range
- Infectious Dose
- Incubation Time
- Signs and Symptoms of Infection
- Methods of Inactivation
- Preventative Measures
- Treatments

Select Next to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Programming
Developer:

Page 01025	Screen 24 of XX

OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

CHARACTERISTICS OF INFECTIOUS BIOLOGICAL AGENTS
KNOWLEDGE CHECK 1

Brenda, a laboratory scientist in a Biosafety Level 3 (BSL-3) laboratory, is preparing to work with *Coxiella burnetii*, the causative agent of Q fever. Brenda must decide what type of respirator to use during her experiments. She focuses on a few aspects of the pathogen: the aerosolized particles emitted from contaminated animal products, such as placenta, urine, feces, and milk; how *Coxiella burnetti* can survive for long periods in soil and dust; and how a past colleague was infected and was treated with doxycycline.

Which of the following characteristics did Brenda not focus on?

A. Environmental Stability
B. Host Range
C. Availability of Treatment
D. Routes of Transmission

Select Submit to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Multiple Choice Interaction
Correct Feedback
Correct! Brenda did not think about host range. Host range refers to the variety of host organisms that a particular pathogen (such as a virus, bacterium, fungus, or parasite) can infect. The host range can be narrow or broad.
First Try Incorrect Feedback
Not quite. *(Include rationale)* Try again!
Second Try Incorrect Feedback
Not quite. *(Include rationale)* Try again!
Third Try Incorrect Feedback

Your answer is still not correct, and you have exhausted all your attempts. Brenda did not think about host range. Host range refers to the variety of host organisms that a particular pathogen (such as a virus, bacterium, fungus, or parasite) can infect. The host range can be narrow or broad.

Programming
Developer: After this question is complete, learner should be returned to BSL-3 classroom (Screen X) with selectable posters. Poster 2 is unlocked.

Page 01030	Screen X of X

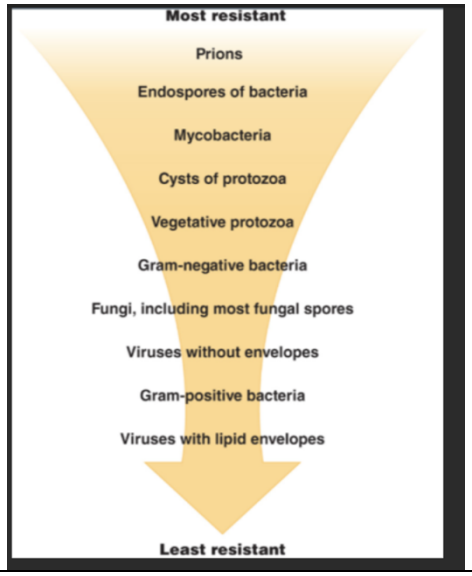
BSL-3 OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

CLASSIFICATION SYSTEM FOR INFECTIOUS BIOLOGICAL AGENTS

Hierarchy of Pathogen Resistance

The hierarchy ranks different classifications of microbes from most resistant to disinfection to least resistant to disinfection. Spores are considered the most resistant to disinfection, followed by mycobacteria, protozoa, Gram-negative bacteria, fungi, non-enveloped viruses, Gram-positive bacteria, and enveloped viruses.

The graphic to the right depicts this hierarchy.



Select Next to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Programming
Developer: The image shown is not to be used unless the word VESTEX is removed.

Page 01035	Screen X of X

OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

CLASSIFICATION SYSTEM FOR INFECTIOUS BIOLOGICAL AGENTS

Risk Groups

Biological agents are classified into four Risk Groups (RGs) according to their relative pathogenicity and risk of infection for healthy adult humans. Classification is based on the National Institutes of Health classification system. Select a Risk Group to learn more.

Select Next to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag
	Risk Group 1 box	
	Risk Group 2 box	
	Risk Group 3 box	
	Risk Group 4 box	

Selectable Item	Popup Box Interaction
Risk Group 1	**Risk Group 1 (RG1**): Agents that are not associated with disease in healthy adult humans. This group includes a list of animal viral etiologic agents in common use. These agents represent no or little risk to an individual and no or little risk to the community.
Risk Group 2	**Risk Group 2 (RG2):** Agents that are associated with human disease which is rarely serious and for which preventive or therapeutic interventions are often available. These agents represent a moderate risk to an individual but a low risk to the community.

Risk Group 3	**Risk Group 3 (RG3)**: Agents that are associated with serious or lethal human disease for which preventive or therapeutic interventions may be available. These agents represent a high risk to an individual but a low risk to the community.
Risk Group 4	**Risk Group 4 (RG4)**: Agents that are likely to cause serious or lethal human disease for which preventive or therapeutic interventions are not usually available. These agents represent a high risk to the individual and a high risk to the community.

Programming
Developer:

Page 01040	Screen 24 of XX

OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

CLASSIFICATION SYSTEM FOR INFECTIOUS BIOLOGICAL AGENTS

KNOWLEDGE CHECK 2

Francisella tularensis can cause severe illness in humans, and it is transmitted through multiple routes including insect bites and direct contact with infected animals. Which risk group does *Francisella tularensis* belong to?

A) Risk Group 1

B) Risk Group 2

C**) Risk Group 3**

D) Risk Group 4

Select Submit to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Multiple Choice Interaction
Correct Feedback
Correct! *Francisella tularensis* belongs in Risk Group 3 because it is highly pathogenic and can cause severe and potentially fatal disease in humans. There is a risk of community spread. Though person-to-person transmission is unlikely, treatments such as Streptomycin, Gentamicin, and Doxycycline are available if it occurs.
First Try Incorrect Feedback
Not quite. *(Include rationale)* Try again!
Second Try Incorrect Feedback
Not quite. *(Include rationale)* Try again!
Third Try Incorrect Feedback
Your answer is still not correct, and you have exhausted all your attempts. *Francisella tularensis* belongs in Risk Group 3 because it is highly pathogenic and can cause severe and potentially fatal disease in humans. There is a risk of community spread. Though person-to-person transmission is unlikely, treatments such as Streptomycin, Gentamicin, and Doxycycline are available if it occurs.

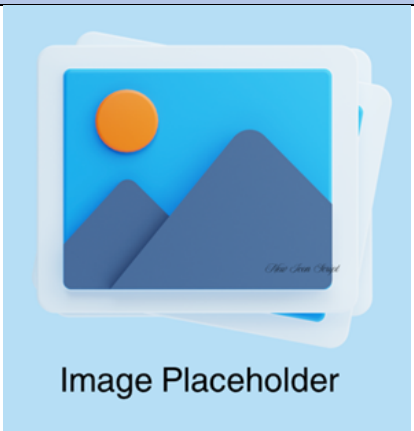
Programming

Page 01045	Screen XX of XX

OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

CLASSIFICATION SYSTEM FOR INFECTIOUS BIOLOGICAL AGENTS

KNOWLEDGE CHECK 3



Bacillus subtilis is widely found in soil and the gastrointestinal tract of humans and animals. It is not associated with disease in healthy individuals, nor does it typically infect humans or animals. Rather, it feeds on dead or decaying organic matter. Which Risk Group does *Bacillus subtilis* belong to?

A. Risk Group 1
B. Risk Group 2
C. Risk Group 3
D. Risk Group 4

Select Submit to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag

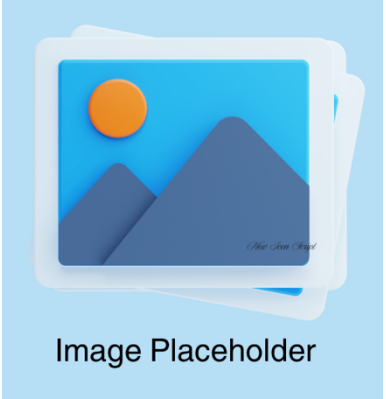
Multiple Choice Interaction
Correct Feedback
Correct! A Risk Group 1 (RG1) agent is not associated with disease in healthy adult humans. Since *Bacillus subtilis* does not typically infect humans and does not cause disease in healthy humans, it belongs in Risk Group 1.
First Try Incorrect Feedback
Not quite. *(Include rationale)* Try again!
Second Try Incorrect Feedback
Not quite. *(Include rationale)* Try again!
Third Try Incorrect Feedback
Your answer is still not correct, and you have exhausted all your attempts. A Risk Group 1 (RG1) agent is not associated with disease in healthy adult humans. Since *Bacillus subtilis* does not typically infect humans and does not cause disease in healthy humans, it belongs in Risk Group 1.

Programming

Page 01050	Screen X of X

OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

CLASSIFICATION SYSTEM FOR INFECTIOUS BIOLOGICAL AGENTS



Subjectivity of Risk Assessment

Risk assessment is ultimately a subjective process as it involves human judgement. The investigator must make an initial assessment based on the Risk Group (RG) of an agent.

Guidance in Biosafety in Biomedical and Microbiological Laboratories and NIH Guidelines for Research provides non-exhaustive classification lists of biological agents. Only agents in risk groups 2 – 4 are listed. If the agent you are working with is not on the list, you will need to determine the categorization based on the criteria previously covered.

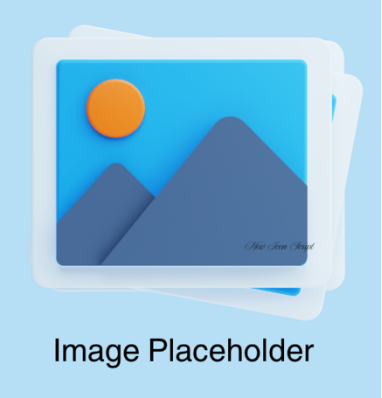
Select Next to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Programming
Developer:

Page 01055	Screen X of X
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS	
CLASSIFICATION SYSTEM FOR INFECTIOUS BIOLOGICAL AGENTS Subjectivity of Risk Assessment (cont'd) Biological agents should not be automatically categorized into Risk Group 1. Activities that involve RG3 and RG4 agents are more highly regulated than RG2 organisms. There are exceptions, however; some RG2 organisms that are Tier 1 Select Agents are highly regulated. Note that if the biological agent to be assessed cannot be classified clearly in one of the aforementioned groups, it shall be classified in the highest risk group among the alternatives. Biological agents should not be automatically categorized into Risk Group 1.	
Select Next to Continue	
Navigation Bar	

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Programming
Developer: After this screen is complete, learner should be returned to BSL-3 classroom (Screen X). Poster 3 is unlocked.

Page 01060	Screen X of X

OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

BIOSAFETY LEVELS VS. RISK GROUPS

The four Biosafety Levels (BSL-1, BSL-2, BSL-3, and BSL-4) are **not the same as** Risk Groups (RG1, RG2, RG3, and RG4).

An agent in a higher Risk Group should not automatically be handled in a correspondingly high BSL.

Select the items below to learn why some agents are handled at a Biosafety level different from their Risk Group level.

Select Next to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag
	Sars CoV-2 Virus	
	Hendra Virus	
	Coxiella burnetti	
	Mycobacterium bovis (BCG strain)	

Selectable Item	Popup Box Interaction
 **SARS CoV-2**	COVID-19, caused by the SARS-CoV-2 virus, is classified under Risk Group 3 (RG3) because it can lead to severe illness, hospitalization, and death, particularly in older adults, individuals with underlying health conditions, and immunocompromised individuals. It also has a high rate of transmission between people through respiratory droplets, aerosols, and close contact. However, while virus isolation from cell culture is handled at BSL-3, diagnostics can be performed at BSL-2 or higher.

 **Bacteriophage T4 Virus**	Bacteriophage T4 is a virus that specifically infects Escherichia coli (E. coli) bacteria. It is classified as Risk Group 1 because it does not infect humans and is not associated with disease in healthy individuals. However, if T4 bacteriophage is genetically modified or used in experiments involving recombinant DNA technology that could potentially alter its behavior, such as displaying foreign peptides or proteins on its surface. Bacteriophage T4 might be handled at BSL-2 or BSL-3 to mitigate unforeseen risks, or to avoid any risk of environmental contamination, especially if the laboratory is conducting research in close proximity to high-density human or animal populations.
 ***Coxiella Burnetti***	*Coxiella burnetti* is in Risk Group 2 because it poses moderate individual risk and low community risk. However, it requires BSL-3 containment when handled in the laboratory because it is highly infectious through aerosol transmission and has a very low infectious dose.
 ***Mycobacterium bovis* (BCG Strain)**	*Mycobacterium bovis* (BCG strain) is in Risk Group 2 because it poses moderate individual risk and low community risk. However, it requires BSL-3 containment due to its potential to cause serious disease and the need for enhanced safety measures to prevent aerosol transmission.

Programming

Page 01065	Screen XX of XX

OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

BIOSAFETY LEVELS VS. RISK GROUPS

KNOWLEDGE CHECK 4

Chlamydia psittaci, the causative agent of psittacosis (also known as parrot fever), is highly infectious and can be transmitted through inhalation of aerosols containing the bacteria. It can cause disease but is not typically a serious hazard. The pathogen can survive in dust for extended periods of time, increasing the risk of airborne transmission and indirect exposure.

Which risk group do you think Chlamydia psittaci is in and what containment level does it require?

a) Risk Group 1, BSL-4
b) Risk Group 2, BSL-3
c) Risk Group 3, BSL-3
d) Risk Group 2, BSL-2

Select Submit to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Multiple Choice Interaction
Correct Feedback
Correct! *Chlamydia psittaci* belongs in Risk Group 2 and requires BSL-3 containment because it is not a serious hazard, but it is highly infectious through airborne transmission. Enhanced safety measures of BSL-3 facilities provide the necessary controls, including specialized ventilation systems, controlled access, and the use of PPE to mitigate risks.
First Try Incorrect Feedback
Not quite. *(Include rationale)* Try again!
Second Try Incorrect Feedback
Not quite. *(Include rationale)* Try again!
Third Try Incorrect Feedback
Your answer is still not correct, and you have exhausted all your attempts. *Chlamydia psittaci* belongs in Risk Group 2 and requires BSL-3 containment because it is not a serious hazard, but it is highly infectious through airborne transmission. Enhanced safety measures of BSL-3 facilities

provide the necessary controls, including specialized ventilation systems, controlled access, and the use of PPE to mitigate risks.

Programming

Page 01070	Screen XX of XX

OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

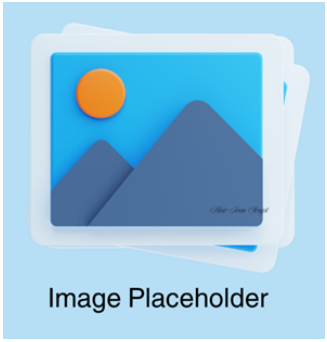
BIOSAFETY LEVELS VS. RISK GROUPS

KNOWLEDGE CHECK 5

Joseph is working with Brucella abortus, a bacterium that primarily infects cattle, causing a disease known as brucellosis. Though it can infect humans or animals, it is generally not life-threatening, nor can it cause severe disease in healthy individuals. It also does not easily spread from person to person. Control measures, such as vaccination and proper sanitation, can be implemented to help reduce risk. The work Joseph is doing involves high concentrations and large quantities of the pathogen. The focus is on virulence factors and pathogenic mechanisms.

What Risk Group is Brucella abortus in and what level of containment does it require in this situation?

a) Risk Group 2, BSL-2
b) Risk Group 2, BSL-3
c) Risk Group 3, BSL-3
d) Risk Group 4, BSL-3



Select Next to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Multiple Choice Interaction
Correct Feedback
Correct! Brucella abortus is in Risk Group 2 because it poses only moderate risk for harm, it is not easily transmissible from person to person, and there are effective prevention and control measures in place. However, BSL-3 containment is required in situations where high concentrations or large quantities of the pathogen are being used because this increases the risk of exposure and infection. Additionally, virulence studies involve creating or handling more virulent strains or genetically modified variants, necessitating enhanced safety measures.
First Try Incorrect Feedback
Not quite. *(Include rationale)* Try again!
Second Try Incorrect Feedback
Not quite. *(Include rationale)* Try again!
Third Try Incorrect Feedback

Your answer is still not correct, and you have exhausted all your attempts. Brucella abortus is in Risk Group 2 because it poses only moderate risk for harm, it is not easily transmissible from person to person, and there are effective prevention and control measures in place. However, BSL-3 containment is required in situations where high concentrations or large quantities of the pathogen are being used because this increases the risk of exposure and infection. Additionally, research studies involving more virulent strains or genetically modified variants require enhanced safety measures.

Programming
Developer: When this screen is complete, learner should be returned to the BSL-3 Classroom (Screen X). Poster 4 should be unlocked.

Page 01075	Screen X of XX
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS	
PATHOGENS IN BSL-3 LABORATORIES *Bacillus anthracis* 	
Select Next to Continue	
Navigation Bar	

Graphics

Filename	Graphic Description	Alt Text/Title Tag
	BSL-3 Classroom	360 view of a classroom room with blue floors, tables, office chairs, a large TV screen, and visible ceiling pipes.

Selectable Item	Popup Box Interaction
	Learner selects to view video.

Narrated Text	Graphics

Certain pathogens require BSL-3 containment due to their potential for causing severe diseases, the type of work or research being done, and the risks associated with exposure.	 *Avatar begins speaking, discussing pathogens in BSL-3 laboratories.*
We'll look at two of them closely, beginning with Bacillus anthracisthe causative agent of anthrax.	
Work with *Bacillus anthracis* often focuses on pathogenesis; vaccine development, therapeutic interventions; genetic studies; evaluation of new antibiotics, and antitoxins.	*Graphics should reflect the audio narration.*
The infectious dose for *Bacillus anthracis* varies by species and route. Inhalation anthrax Lethal Dose (LD) for humans is 2,500-55,000 spores, while cutaneous anthrax can occur with as few as 10 spores. Incubation time varies depending on the route of infection. Inhalation anthrax is typically 1-7 days. Cutaneous anthrax 1-12 days; and gastrointestinal anthrax 1-7 days.	*Graphics should reflect the audio narration.*
Bacillus anthracis, which form spores, is extremely stable in the environment and can survive for decades in soil and animal products. These spores are resistant to heat, desiccation, UV light, and chemical disinfectants. They can remain viable on some surfaces for years. This makes spores a persistent threat in contaminated areas. Effective disinfecting agents include chlorine dioxide and formaldehyde. Autoclaving and incineration may also be used for inactivation.	*Graphics should reflect the audio narration.*

	Graphics should reflect the audio narration.
Some laboratory personnel may choose to take preventative measures before working with *Bacillus anthracis* such as taking a pre-exposure vaccination. Environmental controls should also be implemented to reduce exposure.	*Graphics should reflect the audio narration.*
Signs and symptoms after an exposure to Bacillus anthracis are fever, cough, chest discomfort, shortness of breath, muscle aches, severe abdominal pain, painless skin lesion, nausea, vomiting, or diarrhea.	*Graphics should reflect the audio narration*
Treatments – A combination of antibiotics and anti-toxins are available if this occurs.	*Graphics should reflect the audio narration.*

Programming
Developer: The user will see a modified, 508-compliant version of the classroom and select the video. Ensure all images and media have a polished and innovative aesthetic.

Page 01080	Screen X of XX

BSL-3 OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

PATHOGENS IN BSL-3 LABORATORIES

Mycobacterium Tuberculosis complex

Select Next to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag
	BSL-3 Classroom	360 view of a classroom room with blue floors, tables, office chairs, a large TV screen, and visible ceiling pipes.

Selectable Item	Popup Box Interaction
	Learner selects to view video.

Narrated Text	Graphics

Mycobacterium tuberculosis, the causative agent of tuberculosis (TB), is another agent commonly used at BSL-3.	 *Avatar begins speaking, discussing Mycobacterium Tuberculosis.*
Some laboratory studies may examine the genetic makeup of *Mycobacterium tuberculosis* to understand mechanisms of infection and resistance or develop and test new antibiotics and vaccines. Other studies investigate the bacterium's interaction with the host immune system to identify potential therapeutic targets.	
Mycobacterium tuberculosis occurs globally, with the highest burden in Southeast Asia, Africa, and the Western Pacific. TB disease is common in areas with high HIV prevalence and limited access to healthcare.	*Graphics should reflect the audio narration.*
This pathogen is known for high environmental stability because it can survive desiccation and resist disinfectants for weeks to months, remaining viable on surfaces and in aerosols, especially under conditions of low humidity and absence of direct sunlight. To inactivate the pathogen, use autoclaving, UV radiation, bleach, alcohol, hydrogen peroxide, or phenolic disinfectants.	*Graphics should reflect the audio narration.*
Mycobacterium tuberculosis is transmitted via inhalation of airborne droplets. Its infectious dose is very low: as few as 1-10 organisms, and its incubation time is commonly 2 to 12 weeks. Active disease can develop within months of exposure, while	*Graphics should reflect the audio narration.*

latent infections can persist for years before reactivating.	
Bacille Calmette-Guérin (BCG) vaccine is available and used in many countries, but not generally recommended in the U.S. Preventive measures include TB skin testing and interferon-gamma release assays (IGRAs). Infection with tuberculosis can cause persistent cough, chest pain, coughing up blood, fever, night sweats, weight loss, and fatigue. Treatment involves prolonged courses of antibiotics, typically isoniazid, rifampin, ethambutol, and pyrazinamide. Multi-Drug Resistant (MDR) and Extensively Drug Resistant (XDR) strains require second-line drugs and more complex regimens.	*Graphics should reflect the audio narration.*

Programming
Developer: The user will see a modified, 508-compliant version of the classroom and select the video. Ensure all images and media have a polished and innovative aesthetic.

Page 01085	Screen X of X

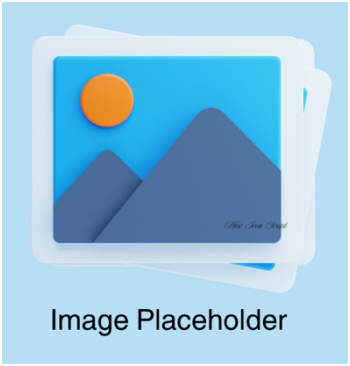
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

PATHOGENS IN BSL-3 LABORATORIES

Other BSL-3 Pathogens

For information on other BSL-3 pathogens, refer to

- Biosafety in Microbiological and Biomedical Laboratories (BMBL) 6th Edition
- American Biological Safety Association (ABSA) Fact Sheets
- Canadian Pathogen Safety Data Sheets



Select Next to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Programming
Developer: Learner should go to Lesson 2 (Screen X) after this screen.

Page 02000	Screen X of X
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS	
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS **Lesson 2: Control Measures for Infectious Biological Materials**	
Select Next to Continue	
Navigation Bar	

Graphics

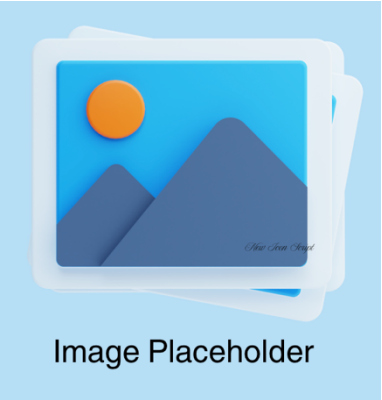
Filename	Graphic Description	Alt Text/Title Tag
	Decorative Graphic	

Programming
Developer:

Page 02005	Screen X of X

BSL-3 OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

BIOSAFETY AND BIOSECURITY



Biosafety refers to principles, practices, and procedures implemented to prevent unintentional exposure to biological agents and toxins, or their accidental release. Biosafety protects laboratory personnel, the environment, and the public.

Biosecurity involves strategies and practices designed to protect against the theft, misuse, or intentional release of harmful biological agents and toxins. It focuses on preventing the deliberate introduction of pathogens or biotoxins into the environment.

Select Next to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Programming

Page 02010	Screen XX of XX

OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

BIOSAFETY AND BIOSECURITY

KNOWLEDGE CHECK 6

In a BSL-3 laboratory, Perry notices Anita acting suspiciously around the storage area where high-risk pathogens are kept. Perry informs their supervisor, Nadine, who reviews security footage and confirms Anita is accessing a storage area without proper authorization and tampering with security locks.

Is the situation a biosafety or biosecurity concern?

A. Biosafety
B. Biosecurity

Select Submit to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Multiple Choice Interaction
Correct Feedback
Correct! This is a biosecurity concern because an individual is suspected of deliberately attempting to steal or misuse harmful biological agents, posing a threat of intentional release into the environment. Biosecurity focuses on preventing the intentional introduction of pathogens or biotoxins by malicious actors, rather than accidental exposure or release.
First Try Incorrect Feedback
Not quite. *(Include rationale)* Try again!
Second Try Incorrect Feedback
Not quite. *(Include rationale)* Try again!
Third Try Incorrect Feedback
Your answer is still not correct, and you have exhausted all your attempts. This is a biosecurity concern because an individual is suspected of deliberately attempting to steal or misuse harmful biological agents, posing a threat of intentional release into the environment. Biosecurity focuses on preventing the intentional introduction of pathogens or biotoxins by malicious actors, rather than accidental exposure or release.

Programming

Page 02015	Screen 14 of XX

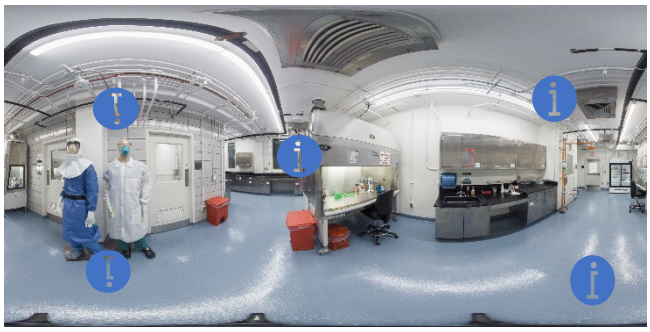
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

BSL-3 LABORATORY

BSL-3 ENHANCEMENTS

BSL-2 and BSL-3 laboratories have the same standard microbiological practices. However, in BSL-3, where biological and chemical hazards increase significantly, enhanced measures ensure higher levels of safety and containment.

Select the information icons to learn more about the safety and containment requirements of BSL-3 laboratories beyond those of BSL-2.



Select Next to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag
	BSL-3 Laboratory	
	Access Controls	
	Entry/Exit	
	PPE	
	Handwash & Eyewash Station	
	Biosafety Cabinet	
	Air Handling Systems	
	Training graphic	
	Emergency Response	
	Incident Reporting	

Selectable Item	Popup Box Interaction
Access Controls	Leads to screen XX: ACCESS CONTROLS

Entry/Exit Procedures	Leads to screen XX: ENTRY/EXIT PROCEDURES
Personal Protective Equipment	Leads to screen XX: PERSONAL PROTECTIVE EQUIPMENT
Handwashing Stations	• Handwashing sinks in BSL-3 laboratories are hands-free and operate automatically. • If a laboratory suite is segregated into different zones, a sink is available for handwashing in each zone.
Eyewashing Stations	• Eye-washing stations are located near areas where hazardous biological materials are handled to provide immediate decontamination in case of exposure. • Eye-washing stations are designed for rapid, hands-free operation, allowing users to flush their eyes thoroughly in the event ofaccidental splashes or contamination.
Biosafety Cabinets	• Class II Biosafety Cabinets are used in BSL-3 laboratories. • Class II BSCs have HEPA-filtered supply and exhaust air and vertical air flow to minimize contamination.
Air Handling Systems	Leads to screen XX: AIR HANDLING SYSTEMS
Specialized Training	• Laboratory personnel receive specific training in handling hazardous agents. They are supervised by scientists competent in handling infectious agents and associated procedures. • Training includes annual updates and additional training when equipment, procedures, or policies change.
Safety Manual & Emergency Response	• The safety manual contains protocols for emergency situations including exposures, medical emergencies, laboratory malfunctions, and other potential emergencies. • Personnel receive training in emergency response procedures.
Incident Reporting	Leads to screen XX: INCIDENT REPORTING

Programming
Developer: Make sure there are no PPE mannequins in the image chosen for this screen.

Page 02020	Screen X of XX

OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

BSL-3 ENHANCEMENTS

Access Controls

Select Next to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag
	BSL-3 Classroom	360 view of a classroom room with blue floors, tables, office chairs, a large TV screen, and visible ceiling pipes.

Selectable Item	Popup Box Interaction
	Learner selects to view video.

Narrated Text	Graphics

BSL-3 enhancements include restricted access. Only persons whose presence in the facility or laboratory areas is required for scientific or support purposes are authorized to enter. Access to the laboratory is through **two** consecutive self-closing doors. The laboratory is separated from areas that are open to unrestricted traffic flow within the building. Some laboratories have advanced access control devices, such as biometrics.	 *Avatar begins speaking about access controls.* *Graphics should match the narration.*

Programming
Developer: The user will see a modified, 508-compliant version of the classroom and select the video. After the video completes, the learner should be returned to screen X (BSL-3 Laboratory) to select another information icon. Ensure all images and media have a polished and innovative aesthetic.

Page 02025	Screen X of XX
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS	
BSL-3 ENHANCEMENTS **Exit/Entry Procedures** 	
Select Next to Continue	
Navigation Bar	

Graphics

Filename	Graphic Description	Alt Text/Title Tag
	BSL-3 Classroom	360 view of a classroom room with blue floors, tables, office chairs, a large TV screen, and visible ceiling pipes.

Selectable Item	Popup Box Interaction
	Learner selects to view video.

Narrated Text	Graphics

All persons entering the laboratory are advised of the potential hazards and meet specific entry/exit requirements in accordance with institutional policies. All persons who enter operational laboratory areas are provided information on signs and symptoms of disease and may receive occupational medical services including medical evaluation, surveillance, and treatment, as appropriate. Staff are also offered available immunizations for agents handled or potentially present in the laboratory.	 *Avatar begins speaking about entry/exit procedures.* *Graphics should match the narration.*

Programming
Developer: The user will see a modified, 508-compliant version of the classroom and select the video. After the video completes, the learner should be returned to screen X (BSL-3 Laboratory) to select another information icon. Ensure all images and media have a polished and innovative aesthetic.

Page 02030	Screen X of XX

BSL-3 OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

BSL-3 ENHANCEMENTS

Personal Protective Equipment

Select Next to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag
	BSL-3 Classroom	360 view of a classroom room with blue floors, tables, office chairs, a large TV screen, and visible ceiling pipes.

Selectable Item	Popup Box Interaction
	Learner selects to view video.

Narrated Text	Graphics

Laboratory personnel wear protective clothing with a solid-front (tie-back or wrap-around gowns, scrub suits, or coveralls). Protective clothing is not worn outside the laboratory. Reusable clothing is decontaminated before being laundered. Clothing is changed when contaminated. Two pairs of gloves and shoe covers are worn when appropriate. Respiratory protection is considered based upon a risk assessment, along with enrollment in a properly constituted respiratory protection program. Medical clearance is required to work in a BSL-3 laboratory. If respirators are required, wearing a N95 requires annual fit testing. Powered Air-Purifying Respirators do not require annual fit testing.	 *Avatar begins speaking about personal protective equipment.* *Graphics should match the narration.*

Programming
Developer: The user will see a modified, 508-compliant version of the classroom and select the video. After the video completes, the learner should be returned to screen X (BSL-3 Laboratory) to select another information icon. Ensure all images and media have a polished and innovative aesthetic.

Page 02035	Screen X of XX

OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

BSL-3 ENHANCEMENTS

Air Handling Systems

Select Next to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag
	BSL-3 Classroom	360 view of a classroom room with blue floors, tables, office chairs, a large TV screen, and visible ceiling pipes.

Selectable Item	Popup Box Interaction
	Learner selects to view video.

Narrated Text	Graphics

Equipment that may produce infectious aerosols is used within a biological safety cabinet (BSC) that exhaust air through HEPA filtration before being discharged into the laboratory. These HEPA filters are tested annually and replaced as needed. A ducted mechanical air ventilation system is required. This system provides sustained directional airflow by drawing air into the laboratory from “clean” areas toward “potentially contaminated” areas. The laboratory is designed such that under failure conditions the airflow will not be reversed at the containment barrier. When present, HEPA filter housings have gas-tight isolation dampers, decontamination ports, and/or bag-in/bag-out (with appropriate decontamination procedures) capability.	 *Avatar begins speaking about air handling systems.* *Graphics should match the narration.*

Programming
Developer: The user will see a modified, 508-compliant version of the classroom and select the video. After the video completes, the learner should be returned to screen X (BSL-3 Laboratory) to select another information icon. Ensure all images and media have a polished and innovative aesthetic.

Page 02040	Screen X of XX

OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

BSL-3 ENHANCEMENTS

Incident Reporting

Select Next to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag
	BSL-3 Classroom	360 view of a classroom room with blue floors, tables, office chairs, a large TV screen, and visible ceiling pipes.

Selectable Item	Popup Box Interaction
	Learner selects to view video.

Narrated Text	Graphics

MyCority is used to report and document near misses, laboratory accidents, exposures, unanticipated absences due to potential LAIs, and for medical surveillance of potential LAIs. Incidents that result in exposure to infectious materials are immediately evaluated. All such incidents are reported to the laboratory supervisor, as with BSL-2, but also institutional management, and appropriate safety, compliance, and security personnel.	 *Avatar begins speaking about incident reporting.* *Graphics should match the narration.*

Programming
Developer: The user will see a modified, 508-compliant version of the classroom and select the video. After the video completes, the learner should be returned to screen X (BSL-3 Laboratory) to select another information icon, or NEXT if they are finished viewing all hotspots/info icons. Ensure all images and media have a polished and innovative aesthetic.

Page 02045	Screen XX of XX

OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

BSL-3 ENHANCEMENTS KNOWLEDGE CHECK 7

Researchers Mark, Patricia, and Jean are working with *Mycobacterium tuberculosis* in a high-security laboratory. Mark receives a request from Dr. Nguyen, a visiting researcher, to enter the BSL-3 laboratory to observe the ongoing tuberculosis experiments. In a controlled-access environment, there are many requirements for a person to enter and observe. Which of the following are among those requirements?

A. Expertise in the infectious agent being used
B. Completion of the required training
C. Obtaining necessary clearance, including a background check

Select Submit to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Multiple Answer Interaction
Correct Feedback
Correct! In a BSL-3 laboratory, all personnel, including visiting researchers, must complete specialized training before entering. This training ensures they understand the specific safety protocols, procedures, and emergency responses. Without this training, individuals may inadvertently compromise the safety of the laboratory and its personnel. Due to the sensitive nature of the work conducted in a BSL-3 laboratory, individuals who gain access must also undergo a thorough background check and obtain necessary clearance. This helps to mitigate the risk of malicious intent, such as theft or misuse of dangerous pathogens.
First Try Incorrect Feedback
Not quite. *(Include rationale)* Try again!
Second Try Incorrect Feedback
Not quite. *(Include rationale)* Try again!
Third Try Incorrect Feedback
Your answer is still not correct, and you have exhausted all your attempts. In a BSL-3 laboratory, all personnel, including visiting researchers, must complete specialized training before entering. This training ensures they understand the specific safety protocols, procedures, and emergency responses. Without this training, individuals may inadvertently compromise the safety of the laboratory and its personnel. Due to the sensitive nature of the work conducted in a BSL-3

laboratory, individuals who gain access must also undergo a thorough background check and obtain necessary clearance. This helps to mitigate the risk of malicious intent, such as theft or misuse of dangerous pathogens.

Programming

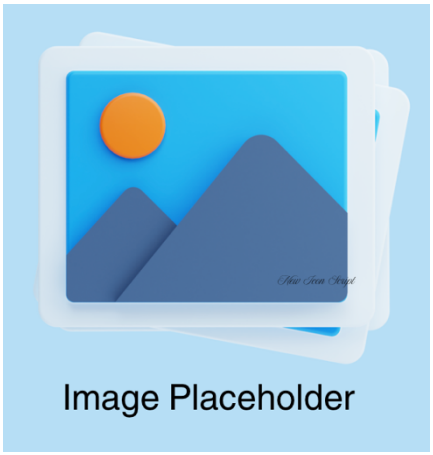
Page 02050	Screen X of X

OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

BSL-3 LABORATORIES AT THE ROYBAL CAMPUS

The CDC Roybal Campus houses many BSL-3 laboratories that each focus on a particular concern. Examples include but are not limited to:

- Highly infectious viruses
- Influenza
- Tuberculosis
- Mosquito-borne viruses
- Agents risky for bioterrorism
- Gastrointestinal diseases
- Parasitic infections
- Bacterial pathogens
- Respiratory illnesses
- Environmental microbes
- Fungal infections
- Poxviruses and rabies
- HIV/AIDS
- Vector-borne diseases
- Sexually transmitted infections



Select Next to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag

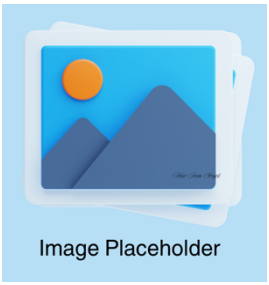
Programming

Page 02055	Screen X of X
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS	
REVIEW OF CONTROL MEASURES **Biosafety** refers to principles, practices, and procedures implemented to prevent unintentional exposure to biological agents and toxins, or their accidental release. Enhancements beyond BSL-2 ensure higher levels of safety and containment at BSL-3. This includes hands-free handwashing, Class II BSCs, restricted access, double self-closing doors, and more. PPE enhancements, such as double-gloving, respirators such as N95 and PAPRs, and shoe covers, are also used at BSL-3.	
Select Next to Continue	
Navigation Bar	

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Programming

Page 02060	Screen X of X
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS	
REVIEW OF CONTROL MEASURES (cont'd) A ducted mechanical air ventilation system provides sustained directional airflow by drawing air into the laboratory room from clean areas toward potentially contaminated areas. The laboratory is designed such that under failure conditions the airflow will not be reversed at the containment barrier. Laboratory staff should be trained to assess airflow conditions prior to performing work. Issues with airflow should be reported using MyCority.  Image Placeholder	
Select Next to Continue	
Navigation Bar	

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Programming
Learner should be taken to Lesson 3 (screen X) after this scree**n.**

Page 03000	Screen X of X
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS	
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS **Lesson 3: Hazardous Chemical Characteristics and Control Measures**	
Select Next to Continue	
Navigation Bar	

Graphics

Filename	Graphic Description	Alt Text/Title Tag
	Decorative Graphic	

Programming
Developer:

Page 03003	Screen X of X

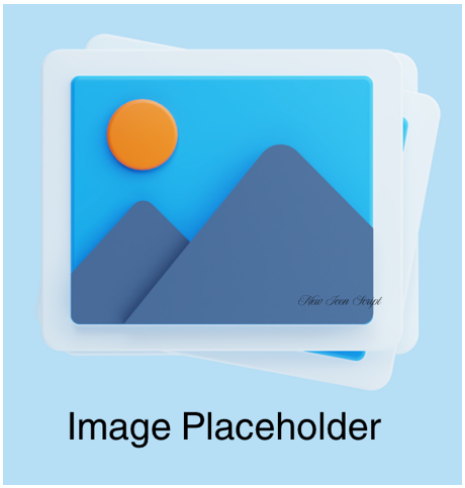
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

DEFINITION OF HAZARDOUS CHEMICALS

Hazardous chemicals are any element, compound, or mixture of elements that is a physical hazard or a health hazard (29 CFR Section 1910.1200(c) and 40 CFR Section 370.2).

Health hazards include, among others, chemicals that are carcinogens, toxics, reproductive toxins, irritants, corrosive, neurotoxins, hepatotoxins, and chemicals that damage the lungs, skin, eyes, or mucous membranes (29 CFR Section 1910.1200(c)).

Physical hazards include, among others, chemicals that are combustible, explosive, flammable, oxidizers, reactive, unstable, water-reactive, as well as compressed gases (29 CFR Section 1910.1200(c)).



Select Next to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Programming

Page 03005	Screen X of X

OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

CHARACTERISTICS OF HAZARDOUS CHEMICALS

Characteristics of hazardous chemicals include

- **Toxicity:** can cause acute or chronic health effects such as respiratory issues, skin irritation, and organ damage upon exposure
- **Corrosiveness**: can cause severe burns and tissue damage on contact with skin or eyes
- **Flammability or explosiveness:** present fire and explosion hazards if not handled and stored correctly

Select Next to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Programming

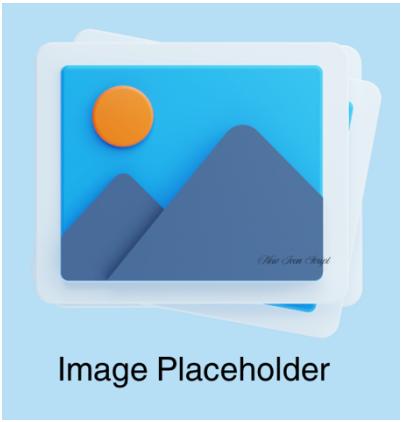
Page 03010	Screen X of X

OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

CHARACTERISTICS OF HAZARDOUS CHEMICALS (cont'd)

Hazardous chemicals are substances that pose significant risks to health, safety, and the environment due to their inherent properties. These characteristics include

- **Reactivity**: can undergo dangerous reactions when exposed to certain conditions, such as heat, light, or other chemicals, leading to potentially violent outcomes
- **Carcinogenicity**: can cause cancer
- **Mutagenicity**: can cause genetic mutations
- **Teratogenicity:** can cause developmental defects



Select Next to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Programming

Page 03015	Screen 14 of XX

OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

COMMON HAZARDOUS CHEMICALS IN BSL-3 LABORATORIES

In BSL-3 laboratories, a number of chemicals are used for research, and for disinfection, decontamination, and inactivation. With exposure, all pose safety risks that laboratory personnel must be aware of.

Formaldehyde, ethanol, and hydrogen peroxide are all commonly used at BSL-3, though may also be used at other biosafety levels. Select the icons to learn more about them.

Check the chemical hygiene plan for other chemicals used in your BSL-3 laboratory.

Select Next to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag
	Formaldehyde icon	
	Ethanol icon	
	Hydrogen Peroxide icon	

Selectable Item	Popup Box Interaction
Formaldehyde information icon	**Hazards**: • Carcinogenic cancer-risk • Respiratory irritation (coughing, wheezing, difficulty breathing) • Skin irritation (redness, itching, dermatitis) • Eye Irritation (redness, tearing, and burning)
Ethanol information icon	**Hazards:** • Highly flammable: significant fire hazard • Respiratory irritation (coughing, sore throat, shortness of breath) • Central nervous system effects (dizziness, headache, drowsiness, unconsciousness)

	• Skin and eye irritation (redness, dryness, burning)
Hydrogen Peroxide information icon	**Hazards:** • Oxidizing agent: can react violently with combustible or flammable materials, leading to fire or explosions • Skin and eye irritation:(eye/skin burns, redness, pain, tissue damage) • Respiratory irritation: (coughing, sore throat, difficulty breathing) • Gastrointestinal distress: ingestion of hydrogen peroxide can cause nausea, vomiting, and abdominal pain

Programming
Developer:

Page 03020	Screen XX of XX

OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

COMMON HAZARDOUS CHEMICALS IN BSL-3 LABORATORIES

KNOWLEDGE CHECK 8

Which chemical is an oxidizing agent that can react violently with combustible or flammable materials and lead to fire or explosions?

A) Formaldehyde
B) Ethanol
C) Hydrogen Peroxide

Select Submit to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Multiple Choice Interaction
Correct Feedback
Correct! Refer to the chemical hygiene plan for information about chemicals used in your BSL-3 laboratory.
First Try Incorrect Feedback
Not quite. *(Include rationale)* Try again!
Second Try Incorrect Feedback
Not quite. *(Include rationale)* Try again!
Third Try Incorrect Feedback
Your answer is still not correct, and you have exhausted all your attempts. The correct answer is Hydrogen Peroxide. Refer to the chemical hygiene plan for information about chemicals used in your BSL-3 laboratory.

Programming

Page 03025	Screen X of XX

OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

COMMON HAZARDOUS CHEMICALS IN BSL-3 LABORATORIES

Robotics for Safety Enhancement

Select Next to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag
	BSL-3 Classroom	360 view of a classroom room with blue floors, tables, office chairs, a large TV screen, and visible ceiling pipes.

Selectable Item	Popup Box Interaction
	Learner selects to view video.

Narrated Text	Graphics

Now let's cover how chemical disinfectants such as Formaldehyde and Hydrogen Peroxide play a role in the use of Robotics. Robotics in BSL-3 laboratories enhance safety in handling hazardous biological agents by minimizing direct human interaction. This reduces the risk of exposure and contamination. These robotic systems are designed to perform a variety of tasks, including sample handling, processing, and decontamination, with high precision and consistency.	 *Avatar begins speaking, discussing robotics and the use of chemical disinfectants.*
To ensure the safety and functionality of these robotic systems, hazardous chemicals are employed for the decontamination and sterilization of both the equipment and the biological agents they handle. Chemicals such as formaldehyde, hydrogen peroxide, and chlorine dioxide are used to effectively inactivate pathogens on robotic surfaces and components, ensuring that any biological agents are neutralized before maintenance or human intervention.	 *Graphics should reflect the audio narration.*
This rigorous chemical decontamination process not only protects laboratory personnel but also maintains the integrity and performance of the robotic systems, ensuring they operate in a safe and sterile environment. The integration of robotics with stringent chemical decontamination protocols represents a significant advancement in biosafety, enhancing both safety and efficiency in high-containment laboratory settings.	*Graphics should reflect the audio narration.*

Programming
Developer: The user will see a modified, 508-compliant version of the classroom and select the video. Ensure all images and media have a polished and innovative aesthetic.

Page 03030	Screen XX of XX

OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

COMMON HAZARDOUS CHEMICALS IN BSL-3 LABORATORIES

KNOWLEDGE CHECK 10

Which statements below are true about the use of robotics in BSL-3 laboratories? (Select all that apply.)

A. Robotics minimize direct human interaction.
B. Robotics reduce the risk of exposure and contamination.
C. Robotics are self-cleaning and do not need to be disinfected.
D. Robotics are relied on for precision and consistency.

Select Submit to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Multiple Answer Interaction
Correct Feedback
Correct!
First Try Incorrect Feedback
Not quite. *(Include rationale)* Try again!
Second Try Incorrect Feedback
Not quite. *(Include rationale)* Try again!
Third Try Incorrect Feedback
Your answer is still not correct, and you have exhausted all your attempts. The true statements are as follows. Robotics minimize direct human interaction. Robotics reduce the risk of exposure and contamination. Robotics are relied on for precision and consistency.

Programming

Page 03035	Screen X of XX
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS	
HANDLING CHEMICALS IN BSL-3 LABORATORIES 	
Select Next to Continue	
Navigation Bar	

Graphics

Filename	Graphic Description	Alt Text/Title Tag
	BSL-3 Classroom	360 view of a classroom room with blue floors, tables, office chairs, a large TV screen, and visible ceiling pipes.

Selectable Item	Popup Box Interaction
	Learner selects to view video.

Narrated Text	Graphics

The use of hazardous chemicals in BSL-2 and BSL-3 laboratories differ in the level of containment and safety measures required. This is due to varying risk associated with the biological agents handled.	 *Avatar begins speaking, discussing handling chemicals in BSL-3 laboratories*
In BSL-2 laboratories, hazardous chemicals are used for disinfection and sterilization to manage moderate-risk agents that can cause human disease but are typically not severe and have available treatments. Common chemicals include, but are not limited to, ethanol, sodium hypochlorite (bleach), and phenolic compounds, which are used with standard safety protocols such as gloves, laboratory coats, and basic ventilation systems.	 *Graphics should reflect the audio narration.*
In contrast, BSL-3 laboratories handle high-risk agents that can cause severe or potentially lethal diseases, necessitating more stringent chemical usage and safety practices. Hazardous chemicals like formaldehyde, glutaraldehyde, and chlorine dioxide are employed for comprehensive decontamination. This requires specialized equipment such as biosafety cabinets and advanced ventilation systems to prevent aerosolized pathogens from escaping.	*Graphics should reflect the audio narration.*
Additionally, personnel in BSL-3 labs must use enhanced personal protective equipment (PPE), including respirators (like N95s or PAPRs) and full-body coveralls, and undergo rigorous training in chemical handling and emergency procedures to ensure a higher level of protection against the more dangerous agents present. This will be discussed in greater detail later in the course.	*Graphics should reflect the audio narration.*

Programming

Developer:
The user will see a modified, 508-compliant version of the classroom and select the video.
Ensure all images and media have a polished and innovative aesthetic.

Page 03040	Screen X of X

OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

HANDLING CHEMICALS IN BSL-3 LABORATORIES

Planning and Preparation

Since fume hoods are not available for containment, BSL-3 laboratory personnel must plan and prepare for handling hazardous solutions and chemicals.

- Ensure certified biosafety cabinets are in place
- Recognize properties of chemicals
- Be aware of potential interactions
- Be familiar with specific protocols to follow

Select Next to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Programming

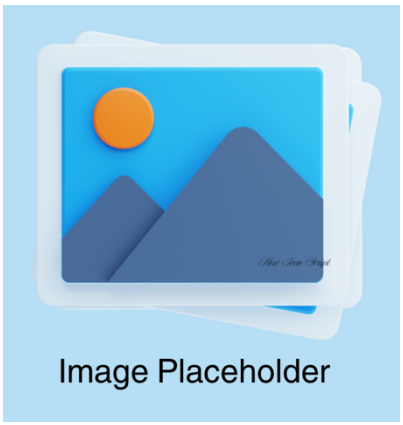
Page 03045	Screen X of X

OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

HANDLING CHEMICALS IN BSL-3 LABORATORIES

Autoclaving

In BSL-3 laboratories, hazardous chemical waste cannot be autoclaved for a variety of reasons:



- High temperature and pressure involved in autoclaving can cause hazardous chemicals to become volatile or react violently, posing significant safety risks.
- Many chemicals can degrade under autoclave conditions, potentially producing toxic fumes or dangerous byproducts that could harm personnel or damage equipment.
- Certain chemicals can corrode or damage the autoclave's materials, leading to costly repairs and potential contamination of future loads.
- Some chemicals may not be effectively neutralized by autoclaving, leaving residual hazardous waste that still requires proper disposal.

Select Next to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Programming

Page 03050	Screen X of X
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS	
HANDLING CHEMICALS IN BSL-3 LABORATORIES **Disposal** Proper disposal of hazardous chemical waste requires specialized procedures and equipment to ensure safety and compliance with regulatory standards.  	
Select Next to Continue	
Navigation Bar	

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Programming

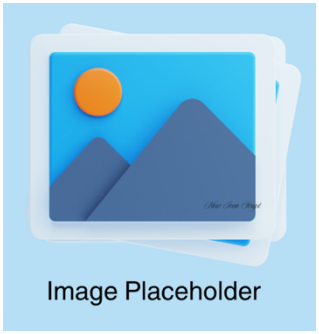
Page 03055	Screen XX of XX

OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

HANDLING CHEMICALS IN BSL-3 LABORATORIES

KNOWLEDGE CHECK 11

Why can't hazardous chemical waste be autoclaved in BSL-3 laboratories?



A. **The high temperatures and pressures involved can cause hazardous chemicals to become volatile or react violently, posing significant safety risks.**

B. Many chemicals can degrade under autoclave conditions, potentially producing toxic fumes or dangerous byproducts that could harm personnel or damage equipment.

C. Certain chemicals can corrode or damage the autoclave's materials, leading to costly repairs and potential contamination of future loads.

D. Autoclaving does not reach high enough temperatures to neutralize hazardous chemicals.

E. Autoclaving is too expensive to be used for hazardous chemical waste.

Select Submit to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Multiple Answer Interaction
Correct Feedback
Correct!
First Try Incorrect Feedback
Not quite. *(Include rationale)* Try again!
Second Try Incorrect Feedback
Not quite. *(Include rationale)* Try again!
Third Try Incorrect Feedback
Your answer is still not correct, and you have exhausted all your attempts. The reasons hazardous chemical waste cannot be autoclaved are as follows. High temperatures and pressures can cause volatile or violent reactions. Many chemicals degrade under autoclave conditions, potentially

producing toxic fumes or dangerous byproducts. Certain chemicals can corrode or damage the autoclave's materials, leading to costly repairs and potential contamination.

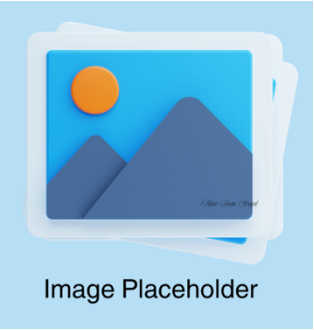
Programming

Page 03060	Screen X of X

OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

HANDLING CHEMICALS IN BSL-3 LABORATORIES

Biological Safety Cabinets (BSCs)



Hazardous chemicals that, even in small quantities, pose severe health risks through inhalation, contact, or accidental ingestion require a Class II Type B2 biosafety cabinet.

Class II Type B2 BSCs draw HEPA-filtered downflow air from the laboratory and exhaust all inflow and downflow air into the atmosphere after HEPA filtration. This design makes these cabinets suitable for work involving volatile chemicals as an adjunct to microbiological applications. The BSC should have a thimble connection to the air outflow duct, providing 100% exhaust from the procedure room.

Select Next to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Programming

Page 03065	Screen 14 of XX

OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS

HANDLING CHEMICALS IN BSL-3 LABORATORIES

BSCs

Other chemicals that require a biosafety cabinet are shown below. Select each image to learn why.

Select Next to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag
	Acrylamide	
	Formaldehyde	
	Phenol Chloroform	
	Beta-mercaptoethanol	

Selectable Item	Popup Box Interaction
Acrylamide	**Reason for BSC Use**: While preparing acrylamide solutions, especially in powdered form, there is a risk of inhaling the neurotoxic and potentially carcinogenic particles. A BSC helps contain any dust or aerosolized particles, reducing the risk of exposure.
Formaldehyde	**Reason for BSC Use**: Formaldehyde is used for tissue fixation and as a disinfectant. It releases fumes that are toxic and carcinogenic. A BSC provides proper ventilation to capture and filter these fumes, protecting the user from inhalation.
Phenol Chloroform	**Reason for BSC Use**: Used in nucleic acid extraction, both phenol and chloroform are highly toxic and can cause severe burns. Phenol is also

	volatile, and inhaling its vapors is dangerous. A BSC helps in containing vapors and aerosols, preventing inhalation and skin contact.
Beta-mercaptoethanol	**Reason for BSC Use**: It is highly toxic and volatile, emitting harmful vapors. When used in procedures like protein denaturation, a BSC is necessary to protect the user from inhaling these toxic fumes.

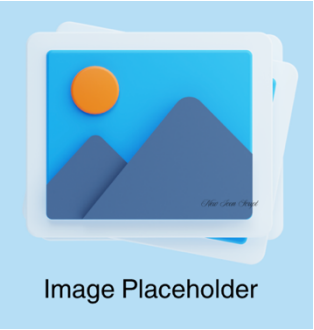
Programming
Developer:

Page 03070	Screen X of X
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS	
HANDLING CHEMICALS IN BSL-3 LABORATORIES	

Canopies and Limiting Work

A canopy connection could also be used to contain hazardous chemicals by providing a barrier that controls and contains airflow and prevents the release of aerosols and vapors into the laboratory environment.

Another option is to limit work with hazardous or volatile chemicals to miniscule volumes.



Select Next to Continue

Navigation Bar

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Programming

Page 03075	Screen X of X
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS	
COURSE WRAP-UP Good job! You've reached the end of the learning content. Let's look at some key take-aways before you move on to the final assessment to reinforce what you've learned.	
Select Next to Continue	
Navigation Bar	

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Programming

Page 03080	Screen X of X
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS	
KEY TAKEAWAYS: BIOLOGICAL MATERIALS Understanding the characteristics of different pathogens used at BSL-3, such as infectivity, pathogenicity, and virulence, helps you make decisions about handling and safety measures. Likewise, knowing modes of transmission, environmental stability, and susceptibility to disinfectants, are key to implementing best safety practices. Laboratory personnel should use risk assessment tools and refer to helpful resources, like the BMBL, to help assess risk and categorize pathogens in their proper risk group.	
Select Next to Continue	
Navigation Bar	

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Programming

Page 03085	Screen X of X
OVERVIEW OF BIOLOGICAL AND CHEMICAL MATERIALS	
KEY TAKEAWAYS: HAZARDOUS CHEMICAL MATERIALS Those working at BSL-3 will also handle hazardous chemicals and need an awareness of the appropriate selection, preparation, and use of chemical disinfectants. Safety Data Sheets can help with this. In working with hazardous chemicals, laboratory personnel must ensure certified biosafety cabinets are in place, recognize properties of chemicals, and be aware of potential interactions and specific protocols to follow.	
Select Next to Continue	
Navigation Bar	

Graphics

Filename	Graphic Description	Alt Text/Title Tag

Programming

Final Assessment Questions:

Multiple Choice/Answer and True/False Questions

1. A team member points out that *Yersinia pestis* has outer proteins (Yops) that disrupt host immune responses and other toxins that can cause widespread cellular damage and systemic effects. Which pathogen characteristic(s) is the team member observing? (Select all that apply).

   A. Antigenicity
   B. Toxicity
   C. Invasiveness
   D. Pruritus

2. *Yersinia pestis* has high infectivity and potential for aerosol transmission. It can cause serious or lethal human disease. Community risk is moderate to low when proper containment and control measures are in place. Antibiotics are available in the case of spread. What Risk Group do you think Yersinia pestis is in?

   A. Risk Group 1
   B. Risk Group 2
   C. Risk Group 3
   D. Risk Group 4

3. **True**/False: *Coxiella burnetti* is an agent in Risk Group 2 that requires BSL-3 containment because it is highly infectious through aerosol transmission and has a very low infectious dose.

4. True/**False**: Access to a BSL-3 laboratory is through one door to mitigate risk.

5. If a pathogen requires BSL-3 containment, but you are not sure if the pathogen should be classified in Risk Group 1 or Risk Group 2, what should you do?

   A. Consult with Schedule 1 of the Code of Practice, which provides a classification list of biological agents.
   B. Classify the pathogen in the lowest risk group among the alternatives.
   C. Classify the pathogen in the same risk group as the biosafety level.

6. A team member uses a standard disinfectant solution containing sodium hypochlorite (bleach) to clean the surfaces of equipment after handling samples containing Mycobacterium tuberculosis. Despite thorough cleaning, subsequent tests reveal the presence of *Mycobacterium tuberculosis* on the surfaces. What should this person do?

A. Increase the concentration of sodium hypochlorite.
B. Use a combination of sodium hypochlorite and alcohol.
C. Switch to a different disinfectant that Mycobacterium tuberculosis is not resistant to.
D. Use glutaraldehyde at a lower concentration and for a longer contact time.

7. True/**False**: Mutagenicity refers to a chemical's ability to, upon exposure, cause acute or chronic health effects such as respiratory issues, skin irritation, and organ damage.

8. **True**/False: Hydrogen Peroxide is an oxidizing agent that can react violently with combustible or flammable materials, leading to fire or explosions.

9. A team member using *Mycobacterium tuberculosis* is selecting a PPE gown before she enters the work area. You see her choose and begin to don a standard white laboratory coat with front snaps. How should you advise her?

A. No guidance is necessary. Future trainings can give her insight into what to wear at BSL-3.
B. Suggest that she wear a solid-front tie-back gown that provides a higher level of protection.
C. Tell her that what she is wearing offers basic protection against splashes and spills and is sufficient.
D. Inform her that BSL-3 pathogens have low risk for infection, so her PPE choice is appropriate.

10. True/**False**: Hazardous chemical waste can be autoclaved in BSL-3 laboratories.