BioSafety and Sterile Techniques

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2026.01

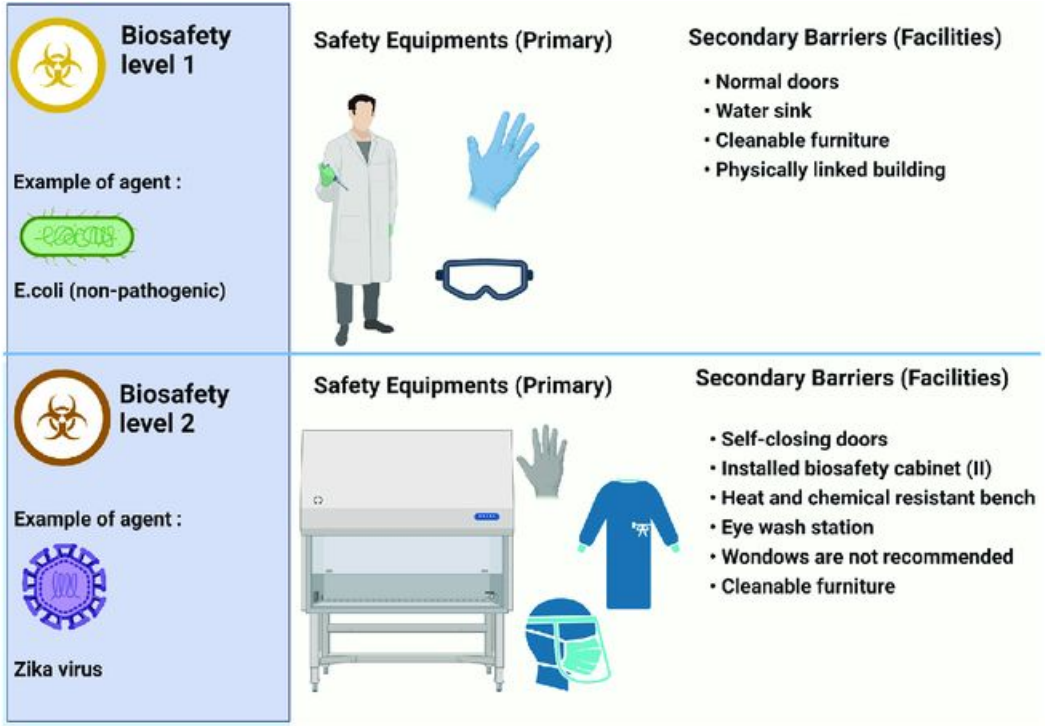
Why Learn Biosafety and Sterile Techniques?

Biosafety: keep yourself and others safe

Sterile techniques: keep your experiments free from contamination

ALWAYS follow relevant biosafety regulations.

Primary and Secondary Barriers



Dangerous chemicals should be handled in a fume hood (shown above). Sterilization of reusable items with bleach should be done in a fume hood.

Laith, A. E., & Alnemri, M. (2022). Biosafety and biosecurity in the era of biotechnology: The Middle East region. Journal of Biosafety and Biosecurity, 4(2), 130-145.
Deglr6328. Laboratory fume hood from Argonne labs. Wikipedia.

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Biosafety Levels

HTGAA experiments are designed to be <u>BSL-1</u>

Low Risk Organisms → **High Risk Organisms**

https://www.cdc.gov/training/quicklearns/biosafety/
https://aspr.hhs.gov/S3/Pages/Biosafety-Levels.aspx

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Choose a Suitable Working Space

- No interruptions from outside
- Far from plants, animals, and other biological materials
- No air turbulence
- Sink and tap water for handwashing
- BSL-2 lab space would be ideal

Midjourney GenAI

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Remove Jewellery and Wash Hands

Jewellery hides germs, remove them

Wash hands thoroughly before and after experiments

https://blog.cola.org/insider/5-steps-cdc-recommends-for-hand-washing
https://opentextbc.ca/clinicalskills/chapter/sterile-gloving/

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Wear Proper Personal Protective Equipment (PPE)

BSL-1: Wear long pants, closed-toed shoes, lab coat over personal clothing, tie back long hair, wear appropriate gloves for the materials.

Laith, A. E., & Alnemri, M. (2022). Biosafety and biosecurity in the era of biotechnology: The Middle East region. Journal of Biosafety and Biosecurity, 4(2), 130-145.
https://www.cdc.gov/training/quicklearns/biosafety/#
https://ehs.msu.edu/news/2023-06-13-bsl-and-labs.html

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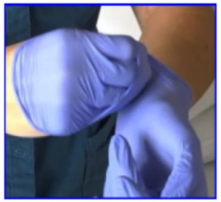
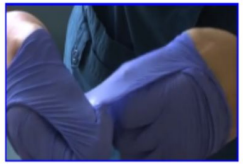
Removing Gloves

"Beak Method" Glove Removal Steps

		
STEP 1: Using one gloved hand, pinch and pull the base of the other gloved hand.	**STEP 2:** Use the middle finger to scoop the cuff of the glove.	**STEP 3:** Pull the glove inside out over all the fingers and thumb to form a "beak."
		
STEP 4: With the beaked hand, pinch the opposite glove at the base and pull the cuff.	**STEP 5:** Roll the glove inside out and off the hand.	**STEP 6:** With the ungloved hand, use the index finger to pull the beaked glove off at the base of the beak and dispose into the appropriate waste container. Always wash your hands after glove removal.

https://www.ehs.wvu.edu/biosafety/biosafety-manual/chapter-10-personal-protective-equipment-for-biohazards

Clean Working Space Before Experiments

- Clean space with 10% bleach solution. (Don't ever mix bleach with other cleaning agents). Wipe down with water.

- Alternatively, clean with soap and water, then wipe down with 70% ethyl or isopropyl (rubbing) alcohol.

Not product endorsement, pictures for illustrative purposes only

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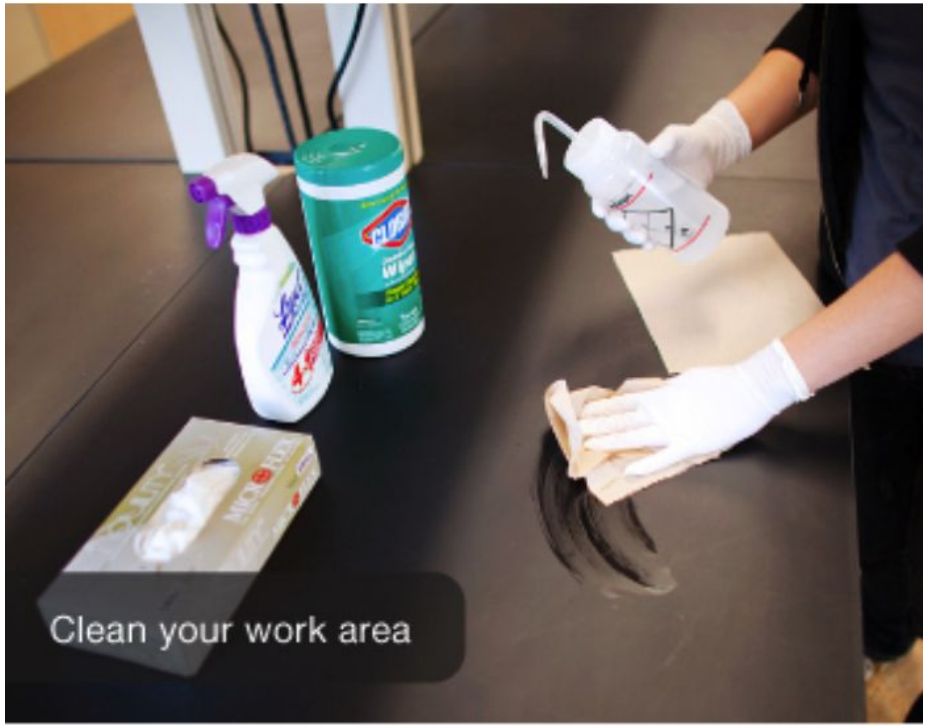
Clean Working Space Before Experiments



Keeping Materials Sterile

- Tie back long hair and loose clothing.
- Make sure wrist and arms are fully covered.
- Do not breathe into, sneeze into sterile materials. If you want, wear a mask.
- Work at arm's length, not close to face.
- Do not open lids unless you want to immediately access the covered material.
- Try to hold lid in your hand and not set lid down on the surface.
- Samples and sterile things should only get in contact with sterile things.
- More sterile techniques during culture will be shared in *Culturing Microorganisms* presentation

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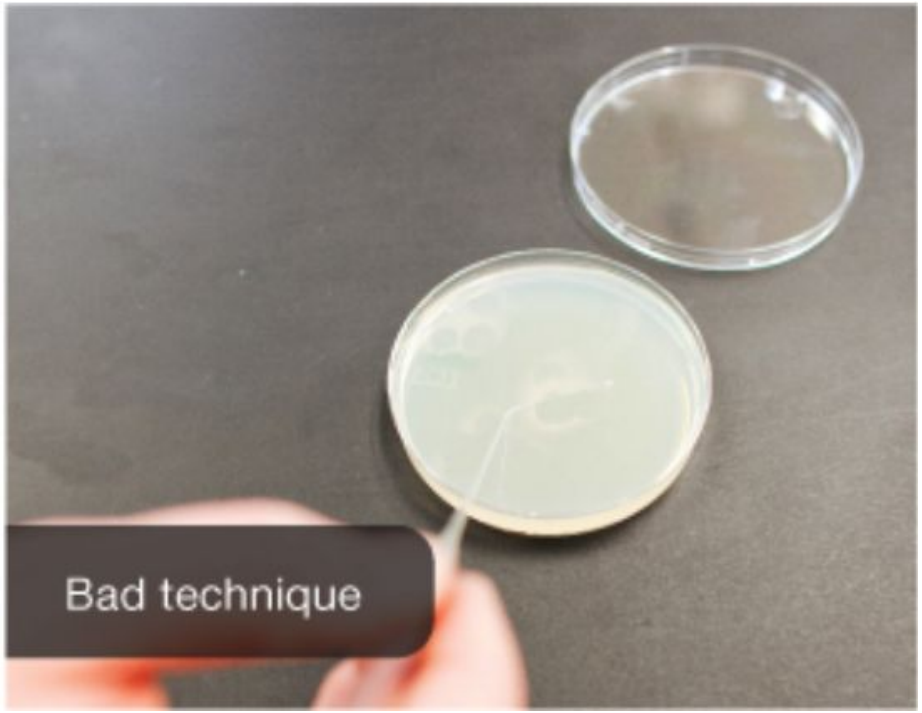
Keeping Materials Sterile



https://teach.genetics.utah.edu/content/microbiology/steriletechnique/

Lab Waste Disposal - Decontamination

- Treat contaminated disposable items with 10% bleach. Leave for 20 minutes, then wash down the drain with lots of water. DO NOT leave bleach and material unattended! DO NOT mix bleach with other cleaning agents, such as alcohol. Sterilize the reusable items in a fume hood if you have access to one.
- Sterilize non-disposable items with flame or placed into 70% ethyl or isopropyl (rubbing) alcohol.

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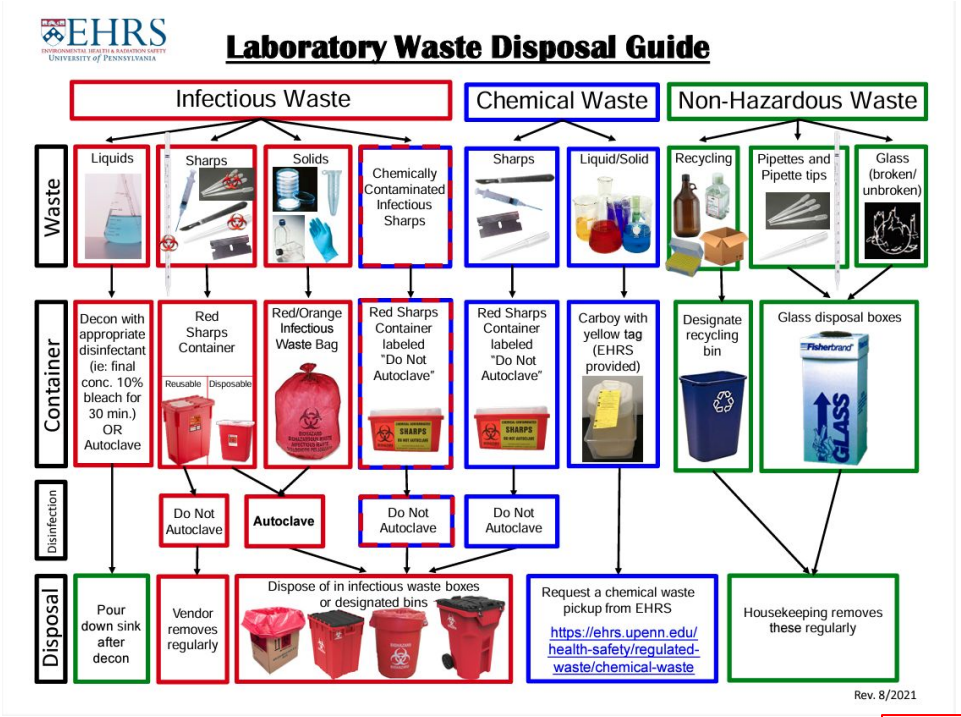
Lab Waste Disposal - Different Bins for Different Waste



- Use closed lid biohazard waste container
- Use separate rigid container for biohazard sharps
- Follow MSDS sheets when handling and disposing of chemical reagents

https://ehrs.upenn.edu/sites/default/files/inline-files/Waste%20Flow%20Chart%208x11_3.pdf

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Clean Working Space After Experiment

- Clean space with 10% bleach solution. (DO NOT mix bleach with other cleaning agents). Wipe down with water.

- Alternatively, clean with soap and water, then wipe down with 70% ethyl or isopropyl (rubbing) alcohol.

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Consult Your Local Biosafety Regulations

Each institution and each jurisdiction/country probably have different regulations on biosafety, make sure you look them up and follow them.

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Pop-Up Quiz

Question (Hypothetical Scenario):
A student proposes an HTGAA course project involving the **the AI-assisted computational design and wet lab validation of a modified *E. coli*** with significantly enhanced tolerance to **extreme heat and alkaline environments**. The student notes the traits could be relevant for real-world applications.

Which statement best reflects whether this project is appropriate for the course?

A. It is appropriate because YOLO
B. It is appropriate if no laboratory experiments are performed during the course
C. It is not appropriate because the proposed traits challenge standard biosafety assumptions
D. It is appropriate as long as no pathogenic genes are involved

Correct answer: C

Explanation:
Even when framed as theoretical, proposing traits that would undermine routine biosafety controls raises concerns beyond the intended scope of an HTGAA class.

Resources for Biosafety and Sterile Techniques

1. Center for Disease Control and Prevention, National Institute of Health. (2020). Biosafety in Microbiological and Biomedical Laboratories, 6th Edition. https://www.cdc.gov/labs/pdf/SF__19_308133-A_BMBL6_00-BOOK-WEB-final-3.pdf
2. CDC Quick Learn Lesson - Recognizing the Biosafety Levels. https://www.cdc.gov/training/quicklearns/biosafety/
3. OSHA. Laboratory Safety Resources. https://www.osha.gov/publications/bytopic/laboratory-safety
4. UK Health and Safety Executive. Resources on Biosafety and microbiological containment. https://www.hse.gov.uk/biosafety/index.htm
5. WHO. (2020). Laboratory biosafety manual, 4th edition. https://www.who.int/publications/i/item/9789240011311
6. Addgene. Personal Protective Equipment (PPE) for BSL-1 and BSL-2 Labs. https://www.addgene.org/protocols/ppe/
7. Addgene. Youtube Video on Sterile Techniques. https://www.youtube.com/watch?v=wttvhJU9PZM
8. Fume hood vs. Biosafety Cabinet. https://www.biocompare.com/Editorial-Articles/602634-Biosafety-Cabinet-and-Fume-Hood-Comparison/

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