



to the 20.109 lab!

Orientation (M0D0):

1. EHS laboratory-specific training
2. Introductions
3. Prelab: Laboratory logistics
4. Orientation exercise – your first protocol
5. Preparations for M1D1

Lab-Specific Biosafety Training for 20.109

Why do we start with **safety**?

- This lab space contains a number of chemical and biological **hazards**
- Risk of **injury** and infection for anyone work in or visiting the lab space
- Risk of producing and releasing **environmentally dangerous** material
- Improper use and containment of hazards can also **contaminate** lab stock material and ongoing experiments

Hazards are categorized by biosafety level



- Biosafety level always posted at the door of the lab
- A combination of:
 - lab practice / technique
 - safety equipment
 - facility design
- Based on concept of “containment”
- For protection of:
 - personnel
 - lab
 - environment

B L 2

What does BL2 mean?

- Suitable for work involving agents that pose **moderate hazards** to personnel and the environment.
- Organisms associated with disease that is rarely serious and often **treatable**

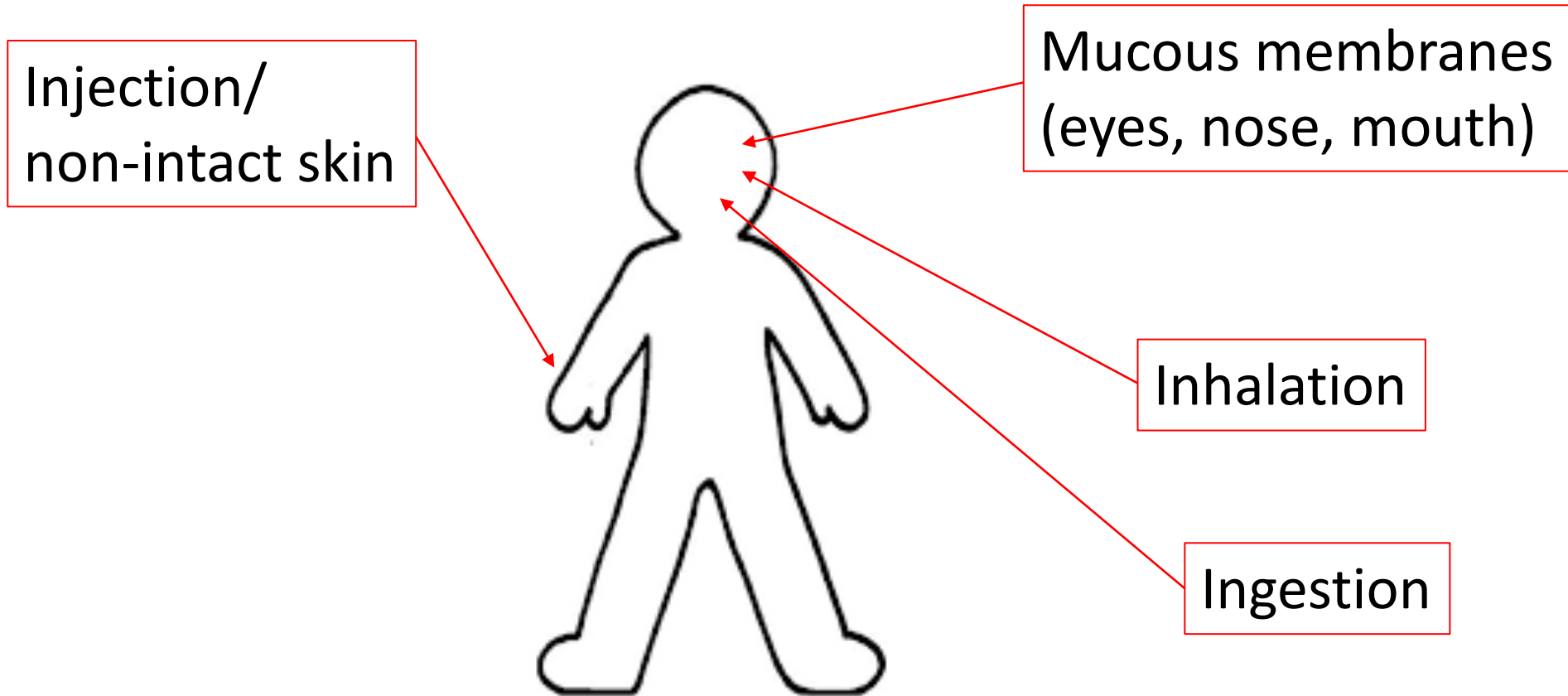
Why are we BL2?

- Work with **human derived material** including established and primary human cell lines/culture.
- **Viral Vectors**: lentiviral vector, Adenoviral vector

What factors determine your risk when working in a BL2 space?

- **Infectivity**
- **Pathogenicity**
- Availability of **prophylaxis**
 - Before exposure (e.g. vaccination)
 - After exposure but before infection (e.g. antibiotics, antivirals)
- Your **health status**
 - Consult with MIT Occupational Health or your personal physician about your research activities

Routes of exposure and transmissibility



Minimizing exposure when working with BL2 materials

Standard Microbiological Procedures

- Restrict or limit access to space
- Wear PPE
- Wash your hands!
- Disinfect containers and surfaces



Prohibited activities

- Eating (chewing gum)
- Drinking
- Smoking
- Applying cosmetics, i.e. lip balm
- Handling contact lenses
- Avoid touching face or biting your nails



No food or drink can be stored in the lab

- In bag in cubby is fine
- Not at bench
- Must eat and drink outside the lab door



Personal Protective Equipment (PPE)

DO wear:

- Lab coat
- Gloves



DO NOT wear:

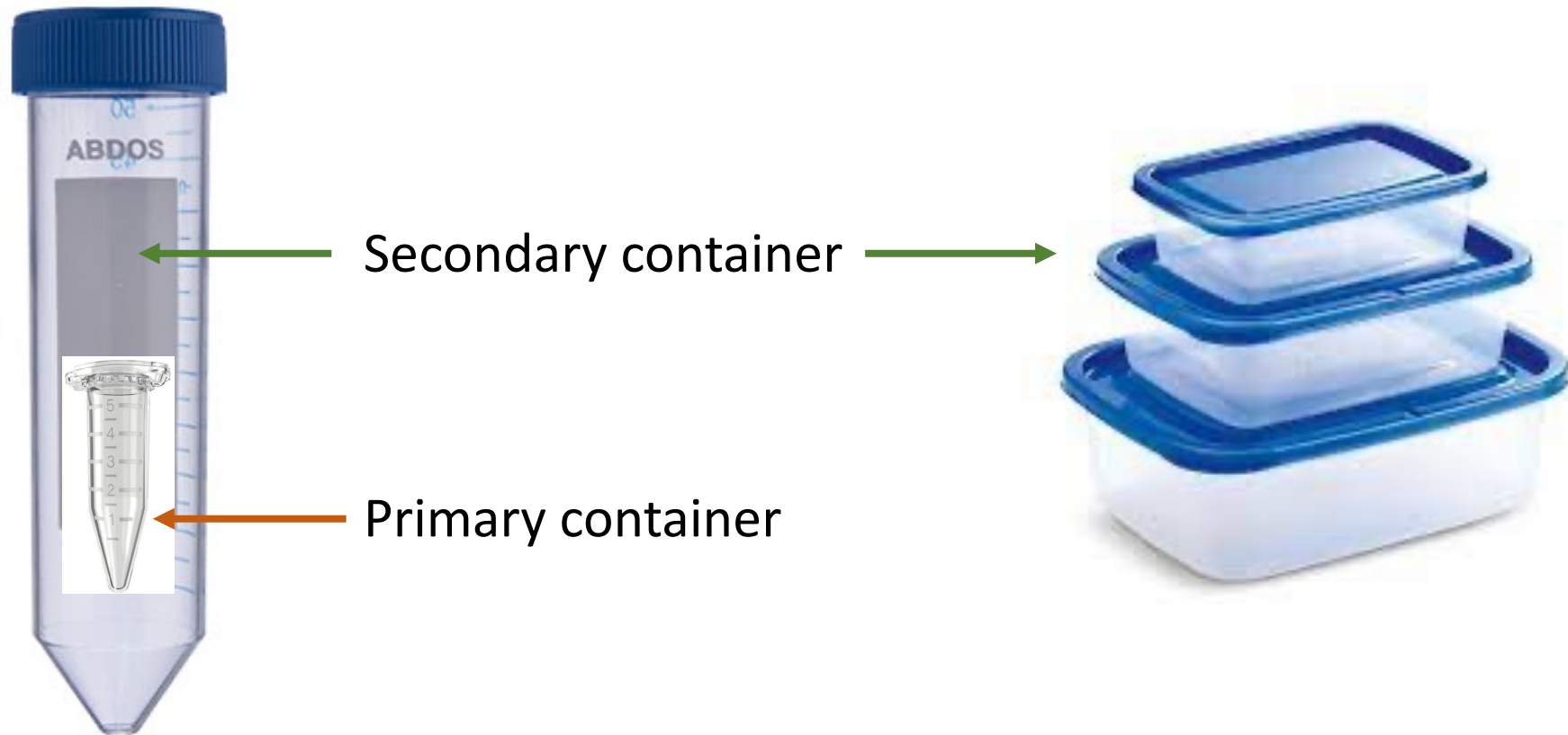
- Skirts/shorts without additional leg coverings
- Open-toed shoes



PPE should remain in the research area

- **Lab coats** should be left in the lab when leaving the room
 - To an auxiliary space to use equipment
 - To go to the TC room
- **Gloves** should not be worn when touching:
 - Phones
 - Door handles
 - Elevator buttons
- Use the “One glove rule” when carrying samples outside the lab

Carry samples in a secondary container



Safe disposal of hazardous materials in the lab

Disposing of biohazardous waste

- Researcher has responsibility for management of research material from “cradle to grave”

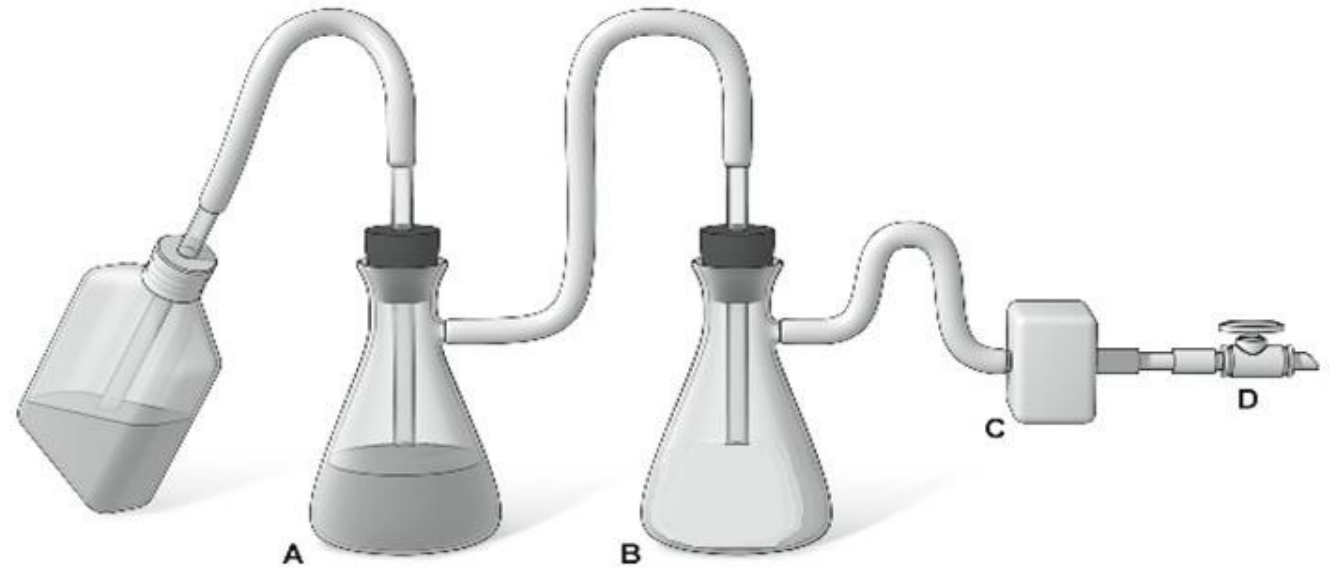
- Types of biological waste:

- Liquids
- Solids
- Sharps



Liquid biological waste collection

- Liquid biological waste (cell media) can be aspirated into a collection flask using a vacuum pump
- These are for biological waste only
- Chemical waste is collected in jugs and disposed of separately



A = primary collection flask with disinfectant
B = overflow flask with disinfectant
C = hydrophobic or HEPA filter
D = to vacuum pump

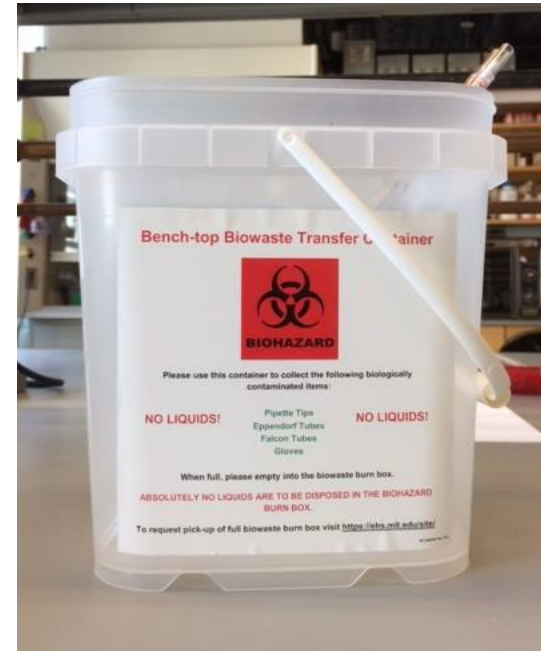
Neutralizing liquid biological waste

- Instructors perform this task– notify us if the waste level is high
- Use chemical disinfectant
 - Clorox bleach (1:10 final volume)
 - Let sit for at least twenty minutes
 - Pour down the drain and flush with water
- Because aspirator waste is mixed with a **reactive chemical** and **disposed down the drain**, it is important not to mix in chemical waste

Solid biohazard waste

- Solid biohazard waste should be collected at the bench in biowaste transfer containers
- This includes:
 - Tubes (conical and microcentrifuge)
 - Serological pipets
 - Pipet tips
 - ALL GLOVES
- At the end of lab, transfer the contents of the transfer container to the burn box at the front of the room

Biowaste Transfer Container



"Burn Box"



Sharps disposal

- Anything that can puncture or cut the skin
 - Pasteur pipettes
 - Glass vials, slides
 - Glass culture tubes
- Dispose of **biological sharps** in red sharps bins at bench or in hood
- Dispose of **chemical sharps** in clear sharps bins (provided when needed)
- Notify instructors when bins are full



What if something goes wrong?

What if you are exposed to a biological hazard?

- If direct contact to your face or skin or if stuck by a needle or sharp
 - Immediately, wash the area with soap and water for 10-15 minutes
 - If it's in your eyes, nose or mouth, flush with water for 15 minutes
 - Tell the Instructors or TA immediately
- Go to the Medical Department (E23)
- Instructor must submit an incident report



Cleaning up biohazardous spills



- Alert instructors, put on appropriate PPE, gather spill kit and appropriate equipment
 - **Remove** any broken glass or sharps
 - **Cover** the spill with paper towels
 - **Disinfect** the spill: Saturate paper towels with disinfectant, let sit for 20 minutes
 - **Clean** up the spill and dispose of spill materials in bio box
 - **Repeat** steps 2-5 as needed

Emergencies

- MIT Alert
<http://emergency.mit.edu/mitalert/>
- **617-253-1212** (fire/ injury/ police 24/7)
- Dial **100** from lab phone
- Use emergency response guide posted in the lab


Massachusetts Institute of Technology

Emergency Response Guide

EMERGENCY NUMBERS

Fire/Medical/Police call MIT Police **100** or **617-253-1212**

Facilities Operations Emergency Service Request **FIXIT 617-253-4948**

EHS After Hrs Emergency **617-253-4948** 8-5 Business Hrs **617-452-3477**

STAY CALM AND FOLLOW INSTRUCTIONS

<div style="background-color: red; color: white; padding: 2px; font-weight: bold;">FIRE</div> <p>Immediate Action</p> <ul style="list-style-type: none"> ☐ PULL FIRE ALARM ☐ Alert Others ☐ Evacuate ☐ Call MIT Police from a safe location. <p>Additional Information</p> <ul style="list-style-type: none"> ☐ Do NOT use elevators. ☐ Close Doors as you leave. ☐ Feel Doors with the back of your hand. Do NOT open doors that hot. <p><small>Wait for Emergency Personnel at the Department's (Emergency Preparedness Plan) designated Waiting and Meeting Area to provide any useful information.</small></p> <ul style="list-style-type: none"> • Fire Location, • What happened, • If there are injuries, and • Your name, location, and telephone number. 	<div style="background-color: red; color: white; padding: 2px; font-weight: bold;">Medical Emergency</div> <p>FOR LIFE THREATENING SITUATIONS OR MENTAL HEALTH EMERGENCIES</p> <p>Call MIT Police</p> <p><small>Examples of life threatening emergencies:</small></p> <ul style="list-style-type: none"> • Serious injuries or burns • Poisoning • Unconsciousness • Shock <ul style="list-style-type: none"> • For non-life threatening situations dial MIT Urgent Care: 617-253-4481 - 24 hours/day • Urgent care walk in service 7a.m. – 11 p.m. E23 	<div style="background-color: red; color: white; padding: 2px; font-weight: bold;">Active Shooter</div> <p style="text-align: right; font-size: small;">Silence Cell Phone</p> <p>RUN (Pursue the area if safe to do so) if the sound of gun shots are far away and you can safely access an exit</p> <ul style="list-style-type: none"> ☐ GET OUT! Leave immediately and get away from the MIT Campus ☐ Notify MIT Police ☐ Get updates from www.emergency.mit.edu <p>HIDE (Take immediate refuge) if you feel the shooter is close to you and you cannot safely exit the building</p> <ul style="list-style-type: none"> ☐ Look down, use door stops, bar door with desks, turn off lights. ☐ Search for objects that can be used as weapons <ul style="list-style-type: none"> ☐ Call Police via land line ☐ MIT Police can trace where you are. <p>FIGHT (Attack the shooter) if the shooter has entered the room you are in</p> <ul style="list-style-type: none"> ☐ Obtain improvised weapons (axisaera, letter opener, fire extinguisher) ☐ Immediately attack shooter, direct your attack at his/her head/face ☐ Do not attempt to plead or bargain with the shooter
<div style="background-color: red; color: white; padding: 2px; font-weight: bold;">Facilities Operations Emergency</div> <p>EMERGENCY SERVICE REQUESTS <small>DIAL FIXIT (3-4848) from any campus telephones. Press "1" to speak with someone immediately.</small></p> <ul style="list-style-type: none"> ☐ After Hours HAZMAT incidents ☐ Gas or Burning Odor ☐ Burst Pipe ☐ Elevator Entrapment ☐ Loss of utilities, such as: <ul style="list-style-type: none"> • Electrical • Chilled water ☐ Any situation that may pose an immediate threat of serious injury to personnel or damage to property. 	<div style="background-color: red; color: white; padding: 2px; font-weight: bold;">HAZMAT Spill</div> <p><small>MAJOR SPILL - Major hazardous material and waste spills CALL Police(100 or 617-253-1212) and also report incident to your supervisor.</small></p> <p><small>MINOR SPILL - Minor hazardous materials or waste spills that present no immediate threat to personal safety, health, or the environment. Call EHS (617-252-3477)</small></p>	<div style="background-color: red; color: white; padding: 2px; font-weight: bold;">Threats</div> <p>The person who receives the call/package/threat should remain in the area to talk to the MIT Police officers when they arrive.</p> <p>SUSPICIOUS PACKAGES</p> <ul style="list-style-type: none"> • Do not touch or disturb object • Move to a safe location and contact MIT Police • Use a landline / NO CELL PHONE USE. <p>Tell MIT Police what makes it suspicious to you.</p> <ul style="list-style-type: none"> • If told to evacuate, look around for anything else suspicious and report. <p>PHONE THREATS</p> <ul style="list-style-type: none"> • Remain calm and try to obtain as much information as possible from caller • Obtain an accurate description of what the caller said and try to obtain as much information as possible. (Where, When, What, Who, distinctive speech, accent, sex, background noise) • Record the number indicated in caller ID • Contact MIT Police

SCAN

OR

See Something - Say Something

Revision 1, Date: 5/19/2013

This concludes 20.109 lab-specific safety training

In the next lab...

- You will be given a sign in sheet that indicates you have completed this training
- You will provide:
 - Your name
 - Your MIT ID number

Introductions

- What year are you at MIT?
 - Do you have any research experience you want to share?
 - Where in the universe would you go if you got the chance?
- OR**
- What is something interesting you did/saw this summer?



Where can you find the instructors?

- **Noreen Lyell**

- Office: 16-317
- Email: nllyell@mit.edu

- **Becky Meyer**

- Office: 16-319
- Email: rcmeyer@mit.edu

- **Jamie Zhan**

- Office: 16-469
- Email: zhanj@mit.edu



Office hours will be established

Core missions of 20.109

- Collect **authentic** data
 - Elements of design, unknown outcomes
- Practice **communicating** your science
 - Written & oral, in homework and assignments, a lot of feedback
- Working in **collaboration** with colleagues
 - Experiments completed in teams
 - Assignments are completed individually or in teams (as noted)
 - Class-wide collaboration (for data acquisition and analysis)
 - Integrity (*personal* reflections)
- The faculty are here to help – **come to us with questions!**



Key deadlines this semester

Assignment	% final grade	Due date
Research talk	5	9/30
Data Summary	15	10/11 (draft), 10/21 (revision)
Journal article presentation	15	10/24 or 10/26
Research article	20	11/20
Research proposal presentation	20	12/7
Lab notebook	5	at the end of each module
Homework	10	daily
Participation	5	daily for notebooks, 4 blog posts
Quizzes	5	2 per module

individual : 65%

team: 35%

Homework helps!

- A chance to **practice** technical/ scientific writing
 - Technical writing is a very specific style
 - Requires conciseness, clarity, and precision
- Each piece of homework will become a **component of a major assignment**
 - Allows you to get individualized feedback on first draft of work
- Homework, collectively, is only worth 10% of your final grade
 - Not because it isn't important
 - Gives you a chance to make mistakes without serious damage to your grade
- Homework must be submitted by 1:05pm on the day of lab
 - Submit as .doc or .pdf to Canvas
 - Write your name in the text of the document
 - **Document name: Your name assignment name/identifier**

HOW TO BECOME A TECHNICAL WRITER

— *A Beginner's Guide* —

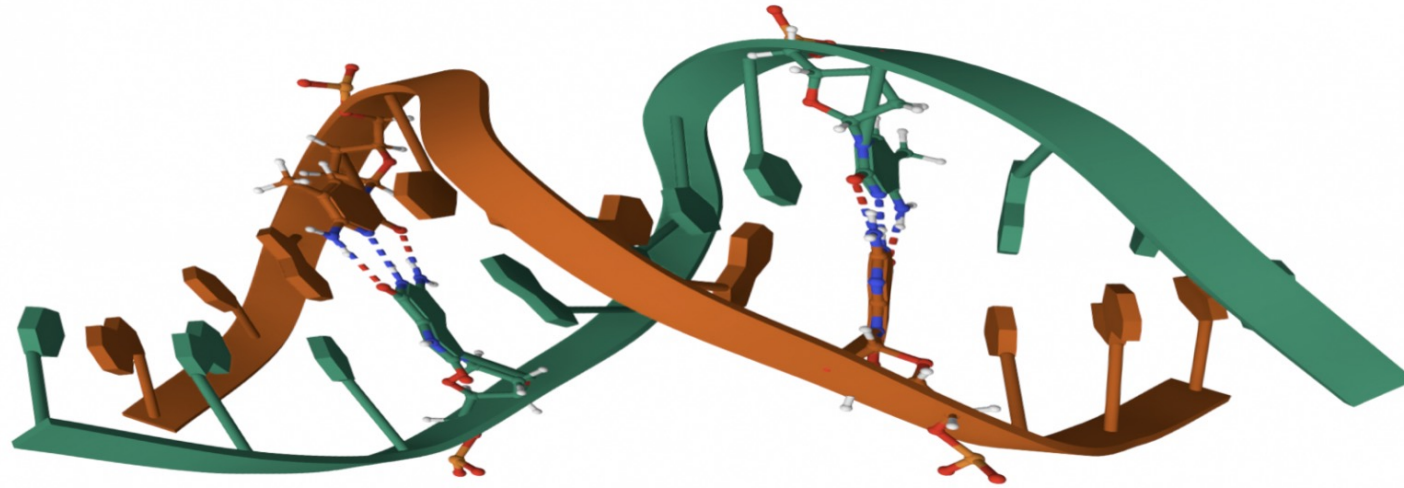
Class policies to note (also on wiki!)

- **Absences from lecture** will impact participation points accumulated throughout the semester.
 - You are responsible for getting lecture material even if you are absent
- **Laboratory attendance is mandatory**
 - Excused absences should be discussed with the Instructors as soon as possible.
 - Unexcused absences = 1/3 of a letter grade deduction from the final grade on the major assignment for the module (for example, a B+ would become a B).
 - If absent, you may be required to attend a different laboratory section to complete experiments.
- **Late policy for homework and major assignments** is very generous!
 - In lieu of extensions
 - Each day late for homework = -0.3pts /10
 - Each day late for major assignment = -3pts /100
 - Work will not be accepted 1 week past the due date

Welcome to the wiki! The wiki is your lifeline...

[http://engineerbiology.org/wiki/20.109\(F23\):Fall_2023_schedule](http://engineerbiology.org/wiki/20.109(F23):Fall_2023_schedule)

20.109(F23): Laboratory Fundamentals of Biological Engineering



[Fall 2023 schedule](#)

[FYI](#)

[Assignments](#)

[Homework](#)

[Class data](#)

[Communication](#)

[Accessibility](#)









[M1: Genomic instability](#)

[M2: Drug discovery](#)

[M3: Project design](#)

Welcome to 20.109! It is our goal to make this class a useful and fun introduction to the experiments and techniques used in biological engineering. Though there is not enough time to show you everything needed to do research, after this class you will feel confident and familiar with some fundamental experimental approaches and laboratory protocols. You will develop good habits at the bench, which will increase the likelihood of success in your work and ensure the health and safety of you and your labmates. By the end of the semester, you will also be well-versed in good scientific practices - through your experience with scientific writing, notebook keeping, and orally presenting data and novel ideas. All of us involved in teaching 20.109 hope you will find it a satisfying challenge and an exciting experience that has lasting value.

If the wiki is your lifeline, the Schedule page is your best friend

MODULE	DATE	LECTURER	LABORATORY EXPERIMENTS	ASSIGNMENTS
	R/F Sep 7/8	NLL  Lecture slides	Orientation and laboratory tour	
M1D1	T/W Sep 12/13	BPE 	Learn best practices for mammalian cell culture	Orientation quiz Homework due
M1D2	R/F Sep 14/15	BPE 	Prepare and treat cells for γ H2AX experiment	Homework due
M1D3	T/W Sep 19/20	BPE 	Use immunofluorescence staining to assess γ H2AX experiment	Homework due
	R/F Sep 21/22	BE Comm Lab	Career Day holiday	
M1D4	T/W Sep 26/27	BPE 	Complete data analysis for γ H2AX experiment	Laboratory quiz Homework due
M1D5	R/F Sep 28/29	BPE 	Treat cells for CometChip assay	Homework due Research talk due Sat, Sep 30 at 10 pm
M1D6	T/W Oct 3/4	BPE 	Image and analyze data for CometChip assay	Homework due
M1D7	R/F Oct 5/6	BPE 	Examine experimental data using statistical methods	Laboratory quiz Homework due
	T/W Oct 10/11		Indigenous Peoples' Day holiday	Data Summary draft due Wed, Oct 11 at 10 pm [Blog post due] Thu, Oct 12 at 10 pm

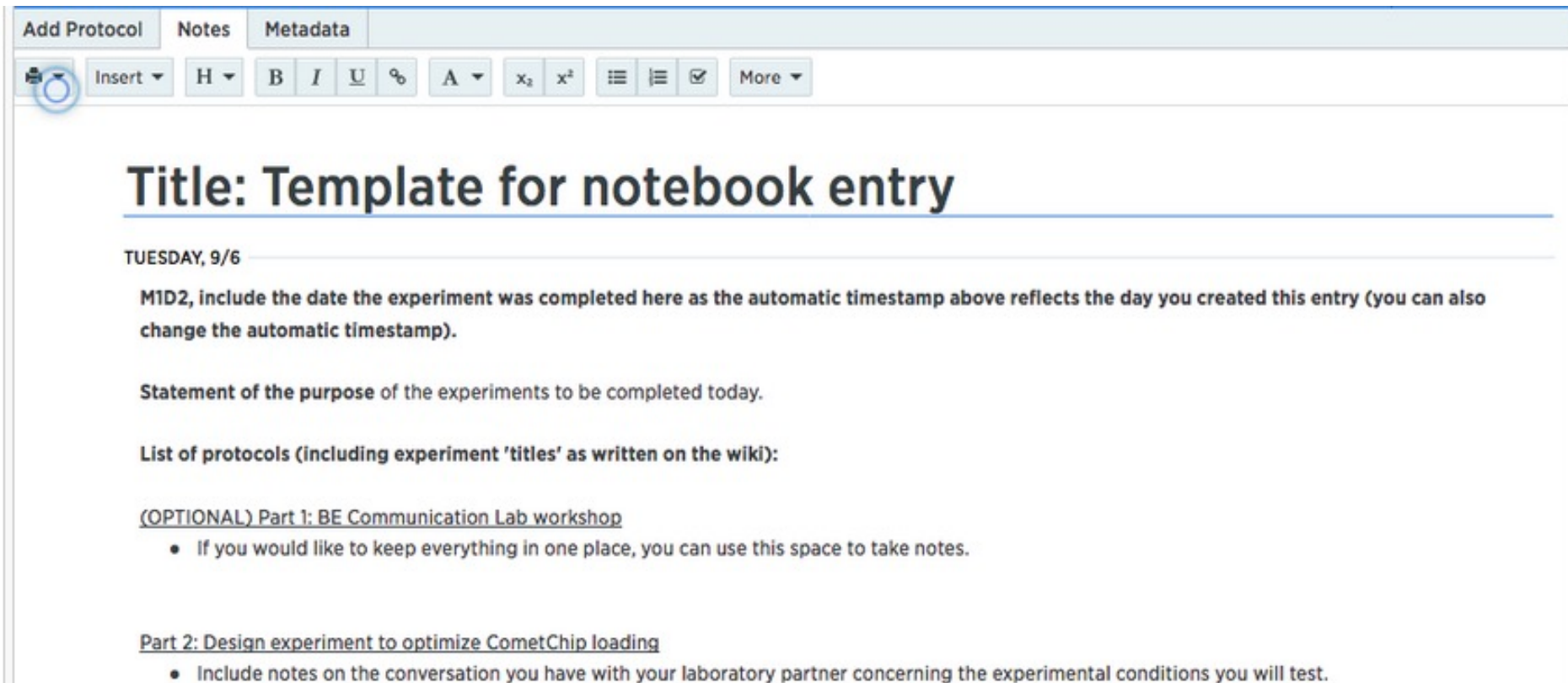
A laboratory day in the life of a 109er

- **Lab** starts at 1:05pm
 - **You must alert me in advance if you will be late or are sick**
- **Quiz** starts immediately at 1:05pm (on lectures and laboratory material)
 - M1D4, M1D7, M2D4, M2D7...as noted on the wiki!
- Submit **homework** to Canvas by 1:05pm
- **Participate** in interactive prelab discussion
 - Typically 15-45 minutes with focus on experimental details
- Design and **Experiment!**
 - Keep notes in electronic laboratory notebook (Benchling)
 - Q & A throughout the afternoon

Record your science in Benchling

- Set up your account: benchling.com
- Title your project “20.109(F23)_YourName”
 - Make each module a new folder
 - Make each day a new entry within the appropriate module folder
- Share with your Instructor and TA

Becky (rcmeyer@mit.edu) and Simone (swall22@mit.edu)



Title: Template for notebook entry

TUESDAY, 9/6

M1D2, include the date the experiment was completed here as the automatic timestamp above reflects the day you created this entry (you can also change the automatic timestamp).

Statement of the purpose of the experiments to be completed today.

List of protocols (including experiment 'titles' as written on the wiki):




(OPTIONAL) Part 1: BE Communication Lab workshop

- If you would like to keep everything in one place, you can use this space to take notes.

Part 2: Design experiment to optimize CometChip loading

- Include notes on the conversation you have with your laboratory partner concerning the experimental conditions you will test.

Remember your personal protective equipment (PPE)

Item	Worn (BE guidelines)
<p>Gloves</p> 	<ul style="list-style-type: none">- When working with chemical or biological materials➤ Change when entering tissue culture room!
<p>Lab coat</p> 	<ul style="list-style-type: none">- When working with chemical or biological materials➤ Change when entering tissue culture room!
<p>Goggles</p> 	<ul style="list-style-type: none">- When handling large quantities of powder or liquid due to chance of splash- When pipetting toxic chemicals (mutagens)- When using ethanol burners- In conjunction with face shield at UV transilluminator

Correctly dispose of waste



regular trash can



benchtop waste



sharps container



liquid waste vacuum flask

Please empty
benchtop
waste every
lab



biowaste box

For today:

- Complete lab orientation with a partner
 - Your "forever" lab partner will be assigned prior to the next lab session based on questionnaire responses or by request

[http://engineerbiology.org/wiki/20.109\(F23\):Laboratory_tour](http://engineerbiology.org/wiki/20.109(F23):Laboratory_tour)

- Orientation quiz on M1D1!

For M1D1:

- Prepare for orientation quiz
- Complete homework assignments (see 'Homework' tab on wiki)
[http://engineerbiology.org/wiki/20.109\(F23\):Homework](http://engineerbiology.org/wiki/20.109(F23):Homework)
 - Complete, screen capture EHS training certificate(s) and submit to Canvas
 - Read Mod1 overview page and M1D1 introduction

REQ	DLC Emergency Preparedness Training	EHS00404	COMPLETED	✓
REQ	General Biosafety for Researchers	EHS00260	COMPLETED	✓
REQ	General Chemical Hygiene	EHS00100	COMPLETED	✓