

Biological Safety Training

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UNIVERSITY OF
CAMBRIDGE
Department of Engineering



General philosophy:

- ▶ Take **reasonable** care of your own safety and **others'**
- ▶ Use equipments, chemicals, bio-agents **safely**
- ▶ Only undertake tasks for which adequate **training** has been given
- ▶ **Cooperate** with colleagues to ensure a healthy and safe workplace
- ▶ Follow the University and Department's **procedures**
- ▶ **Report** all incidents and hazards

Introduction

Health & Safety Executive



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<http://www.hse.gov.uk/>

- ▶ Responsible for the *encouragement, regulation and enforcement of workplace health, safety and welfare*
- ▶ Get advice from advisory committees
 - e.g. *Advisory Committee on Dangerous Pathogens (ACDP)*
- ▶ Provides specific guidelines
- ▶ Numerous publications on the website

Introduction

University of Cambridge & Department of Engineering



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Central Administration

- ▶ Occupational Health and Safety Service (OHSS)
- ▶ Safety Office
 - ▶ Publications, links:
<http://www.admin.cam.ac.uk/offices/safety/>
 - ▶ Training:
<http://www.training.cam.ac.uk/ohss/>

Department of Engineering

- ▶ Department of Engineering Health & Safety:
<http://safety.eng.cam.ac.uk/>
- ▶ Safety Committee & Safety Officer
- ▶ Local Safety Coordinators (LSC or “LORS”)
- ▶ Laser, Radiation & *Biological* Safety Officers



Main functions:

- ▶ Review & approve¹ biological Risk Assessments
 - ▶ Provide specialist advice on biological safety issues
 - ▶ containment, storage, security, transport, disposal, disinfection, emergency...
 - ▶ Provide and arrange training for handling bio-agents
 - ▶ Ensure biological incidents are reported and investigated
- ⇒ You have the main responsibility!

¹most of the time...



~~Don't do it!~~ How can you do it safely?

Hazard: something with the potential to cause harm

- ▶ Physical, chemical, ergonomic, *biological*

Risk: likelihood of the potential harm from hazard being realised

- ▶ likelihood of occurrence
- ▶ potential severity of the outcome
- ▶ number of people who may be affected
- ▶ type of people who may be affected

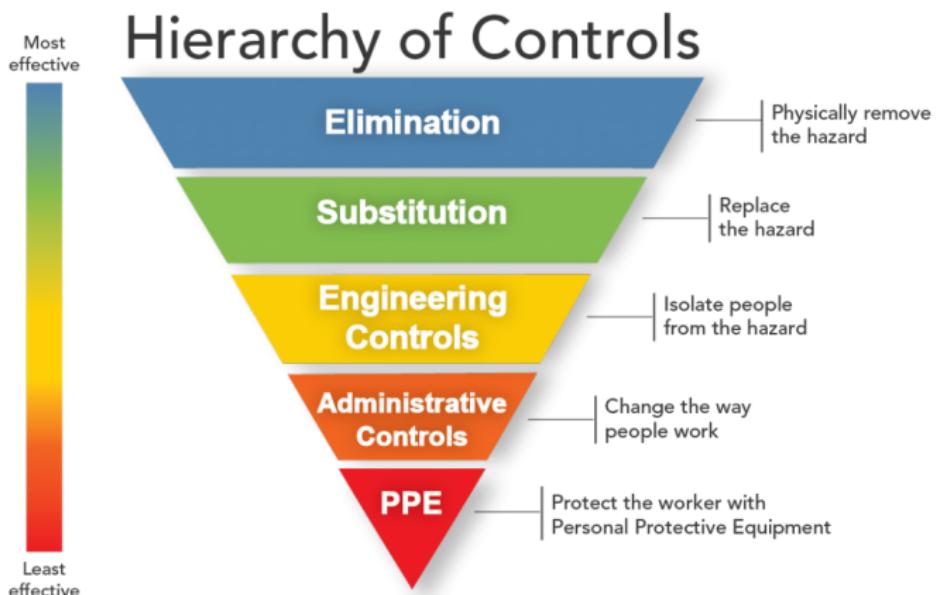
⇒ Control strategies



Control of Substances Hazardous to Health (CoSHH)

- ▶ What is the substance?
 - ▶ Chemicals, dusts, *biological agents*, other
- ▶ How will you be using it
- ▶ How might exposure occur
- ▶ Who may be exposed
- ▶ For how long
- ▶ How to dispose of it

⇒ Control strategies





HSE define a biological agent as “a micro-organism, cell culture, or human endoparasite which may cause infection, allergy, toxicity or other hazard to human health”

- ▶ micro-organisms: bacteria, viruses, moulds...

Routes of infection:

- ▶ ingestion (mouth)
- ▶ inhalation via aerosols (respiratory tract)
- ▶ instillation (eyes mucosa)
- ▶ percutaneous (damaged skin)

In general, no exposure standards are set for biological agents
(no dose-response relationship...)

Biological Agents

Hazard Groups



When classifying a biological agent it should be assigned to one of the following groups according to its level of risk of infection to humans:

| hazard group | cause human ² disease | spread to community | prophylaxis or treatment | examples |
|--------------|----------------------------------|---------------------|--------------------------|----------------------------|
| 1 | unlikely | - | - | disabled <i>E. Coli</i> |
| 2 | potential | unlikely | available | <i>Streptococcus</i> |
| 3 | severe | potential | available | <i>Hepatitis B</i> |
| 4 | severe | likely | not available | <i>Ebola</i> |

²healthy, no pregnancy, no allergy...

Biological Agents

Control of Biological Hazards → Containment



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Choosing the containment level:

| hazard group (pathogens) | containment level (laboratories) |
|-----------------------------|-------------------------------------|
| 1 | 1 |
| 2 | 2 |
| 3 | 3 |
| 4 | 4 |



Cell lines:

| Hazard | Cell line | Containment level |
|--------|---|-----------------------------------|
| Low | Well characterised, authenticated cell lines of human or primate origin; low risk of endogenous infection with a biological agent presenting no apparent harm to laboratory; tested for the most serious pathogens. | CL1 |
| Medium | Finite or continuous cell lines/strains of human or primate origin; not fully characterised or authenticated, except where there is a high risk of endogenous biological agents, e.g. blood-borne viruses. | CL2 |
| High | Cell lines with endogenous biological agents or cells that have been deliberately infected. | Appropriate to the agent |
| | Primary cells from blood or lymphoid cells of human or simian origin. | Appropriate to the potential risk |

Live animals

- ▶ No animal facility in the department

Human tissue (surgical specimens or cadavers)

- ▶ Ethical approval required
- ▶ The department does not have permission to **store** human tissue samples under the Human Tissue Act 2004



Risk assessment (RA) includes biological agents and/or in a biolab:

1. You must fill an RA online form & attach the CoSHH forms³
2. Forms sent to Biological Safety Officer for review
3. Forms sent to Local Safety Coordinator for review
4. Forms sent to Departmental Safety Officer for review

³<https://safety.eng.cam.ac.uk/safe-working/risk-assessment-procedure>



- ▶ GMO: organisms whose genes have been **artificially** altered to modify their characteristics
- ▶ Controls are set out in the “*Genetically Modified Organisms (Contained Use) Regulations 2000*”
- ▶ “Contained Use”: limit contact between GMO and **people** or the **environment**. It relates to:
 - ▶ the actual process of genetic modification
 - ▶ the use, storage, transport & destruction of GMOs
- ▶ Need a **specific, separate** Risk Assessment made under the GMO (CU) Regulations 2000

Risk Assessment

Genetically Modified Organisms (GMO)



- ▶ For GM micro-organisms, the risk assessment **must** contain details about:
 - ▶ recipient micro-organism (hazard group, wild/disable, survival)
 - ▶ inserted gene (expression, action)
 - ▶ donor (species)
 - ▶ vector (viral, cellular, plasmid)
 - ▶ resulting GM micro-organisms
- ▶ Assess separately the risks for **human health & safety** and for **environmental harm**.
- ▶ Assign a **provisional** class & containment level:

| Risk | Class (GM micro-organism) | Containment level (laboratories) |
|------------|------------------------------|-------------------------------------|
| Negligible | 1 | 1 |
| Low | 2 | 2 |
| Moderate | 3 | 3 |
| High | 4 | 4 |



- ▶ GMO Risk Assessment must be signed by:
 - ▶ You and your supervisor
 - ▶ BSO
- ▶ Only Class 1 work is allowed in the department
- ▶ We encourage users/supervisors to attend the training
<http://www.training.cam.ac.uk/ohss/>
search "Risk Assessment of Genetically Modified Organisms"
(runs regularly)
- ▶ HSE guidance can be found here:
<http://www.hse.gov.uk/biosafety/gmo/acgm/acgmcomp/>



Hygiene

- ▶ No eating, no drinking, no applying cosmetic, no smoking...
- ▶ Always wear lab coat
- ▶ Avoid contamination of keyboards, telephone, door handles...
- ▶ Wash your hand before leaving the laboratory
- ▶ Remove laboratory coat before leaving (hung in the Biolab foyer)



Housekeeping

- ▶ Keep floor and benches **tidy**
- ▶ Keep floor and benches **clean** and **disinfected**
- ▶ All containers clearly **labeled**: content, user, date
- ▶ Do not leave **unattended scalpels** on benches; use sharp bins
- ▶ Waste container closed and marked
- ▶ Do not leave **used glassware** in the sinks: put it in the dishwasher (will be started by the technician once full)
- ▶ Some items need to be washed by hand: do it before you leave
- ▶ **Clean** balances and **turn off** after use





Instruments

- ▶ Only use instruments you've been trained for
 - Ask the technician
- ▶ If you find the instrument broken
 - Tell the technician immediately
- ▶ If the instrument breaks
 - Tell the technician immediately



Equipment

- ▶ Impervious & resistant surfaces, easy to clean
- ▶ Autoclave on site

System of work

- ▶ No eating, drinking, smoking, etc.
- ▶ Door closed during work
- ▶ Observation window
- ▶ Protective clothing
- ▶ Disinfection available
- ▶ Minimize aerosol production

Waste

- ▶ Dedicated bins for contaminated solid waste
- ▶ Validated inactivation of liquid waste



Equipment

- ▶ Impervious & resistant surfaces, easy to clean
- ▶ Autoclave **in the building**
- ▶ Negative pressure if possible, microbiological safety cabinet

System of work

- ▶ No eating, drinking, smoking, etc.
- ▶ Door closed during work, **access restricted**
- ▶ Observation window, signage
- ▶ Side or back fastening lab coats, appropriate gloves, spill trays
- ▶ Disinfection available, **specified decontamination procedures**
- ▶ Minimize aerosol production, **control aerosol dissemination**
- ▶ Safe storage of biological agents
- ▶ Written record of staff training

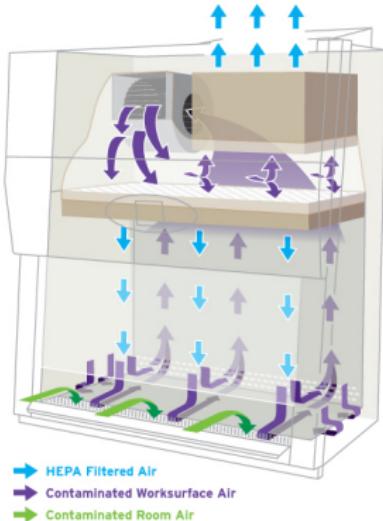
Waste

- ▶ Dedicated bins for contaminated solid waste
- ▶ Validated inactivation of liquid waste

Containment Levels

Microbiological Safety Cabinets

- ▶ Different from a fume hood (for hazardous chemicals)
- ▶ Requirement according to risk assessment (e.g. aerosols)
- ▶ Class II cabinet with HEPA⁴ filter protects **worker** and **work**



credit: nuaire.com

⁴High-Efficiency Particulate Air

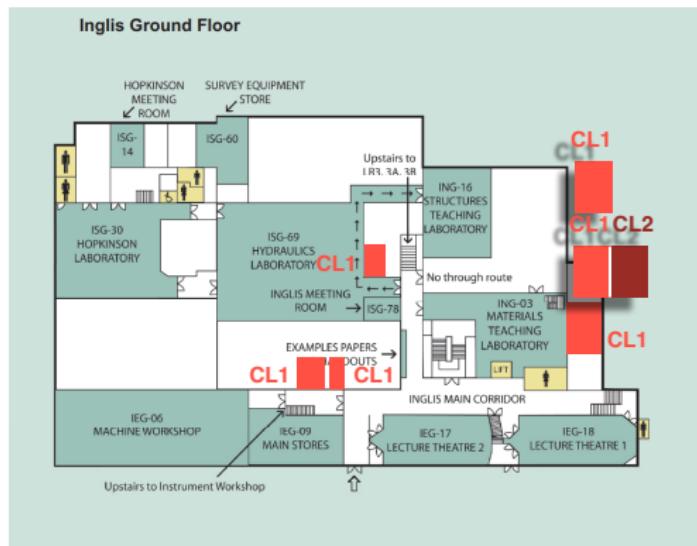
Containment Levels

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- ▶ INO-03/07 Biolab 1 - Inglis mezzanine: CL1+CL2
- ▶ ING-09/10 Biolab 2 - via materials teaching lab: CL1
- ▶ INO-13/14, ISG-86 & ISG-75 Synthetic Biology lab: CL1
- ▶ ISG-84 Bioengineering teaching lab: CL1



Containment Levels

Nanoscience Centre



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- ▶ Bay 4 (including cell culture room): **CL1**
- ▶ Module 1: **CL1**



Contaminated solid waste

- ▶ Dispose into **dedicated** clinical waste bins
- ▶ Do not tape clinical waste to benches
- ▶ Do not overfill
- ▶ Company (Novus Environmental) pick-up bins at the beginning of the month (first thursday)



credit: initial.co.uk

Contaminated sharps

- ▶ Must be placed in dedicated sharps bins
- ▶ Place pipette tips in provided **puncture-proof** containers
- ▶ Orange-lidded bins for blood (human or animal) contamination



credit: Hillcroft supplies



Sharps can be:

- ▶ Needles
- ▶ Blades eg scalpels, microtome blades
- ▶ Other (medical) instruments that could cause an injury by cutting/pricking the skin

Items such as glass coverslips, microscope slides, glass Pasteur pipettes can also be 'classed' as sharps, as can bone fragments.

DO NOT place any sharps into the general waste stream

Appropriate secure sharps disposal containers must be used and located close to the work area at a suitable height.

Safe use of sharps:

<https://www.safety.admin.cam.ac.uk/system/files/hsd192b.pdf>



Biological liquid waste

- ▶ Must be deactivated
 - ▶ Treat with an appropriate disinfectant (e.g. Distel)
 - ▶ Allow sufficient contact time (see manufacturer's guidelines)
- ▶ Dispose in an appropriate lab sink
- ▶ Flush down with copious amounts of water



Transport of hazardous substances should be minimized

- ▶ Internal transport (same building)
 - ▶ Minimum quantities
 - ▶ Secondary containment
 - ▶ Use (goods) lift if possible
- ▶ Transport between buildings
 - ▶ Sealed, leakproof primary container
 - ▶ Leakproof, closable secondary container
 - ▶ signage, list of content
- ▶ External transport
 - ▶ Highly regulated, extremely complicated
 - ▶ Talk to BSO



General procedure

- ▶ Evacuate area (if you can not assess the spill, large spills)
- ▶ BSO must **assess** the spill
- ▶ Ventilate area, allow aerosols to settle
- ▶ **Contain**, and apply **disinfectant** (e.g. Virkon powder)
- ▶ **Clean** up, fumigation may be needed
- ▶ **Waste disposal**
- ▶ Need **permission** for re-entry



- ▶ Bleed the wound and wash the area with soap and water
- ▶ Scrubbing should be avoided
- ▶ Cover the wound with a waterproof dressing
- ▶ Contamination on skin eye or mucous membranes should be washed immediately
- ▶ Seek advice on post-exposure prophylaxis
- ▶ Report the accident

Risk Assessments & Enquiries

Biological Safety in the Department of Engineering



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References

- ▶ Safe biological practice at the University of Cambridge:
<https://www.safety.admin.cam.ac.uk/policy-guidance/biological>
- ▶ Biological Safety @CUED:
<https://safety.eng.cam.ac.uk/safe-working/biological-safety>
- ▶ The Approved List of biological agents:
<http://www.hse.gov.uk/pubns/misc208.pdf>