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MICROSCOPY TRAINING

Work Health and Safety

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Welcome

MyScope was developed by Microscopy Australia to provide an online learning environment for those who want to learn about microscopy. The platform provides insights into the fundamental science behind different microscopes, explores what can and cannot be measured by different systems and provides a realistic operating experience on high end microscopes.
We sincerely hope you find our website: www.myscope.training an enjoyable environment. In there you can explore the microscopy space and leave ready to undertake your own exciting experiments.

Module Contents

Introduction

Work Health and Safety (WHS) should be the most important priority at all times. You should always be responsible for your own safety and for the safety of others around you.
Many of the laboratory incidents and near misses are not purely accidental. They are often caused by the lack of knowledge and awareness about the potential risks and hazards around you.
If you do notice a risk or a potential hazard at a microscopy facility, you have a duty to communicate with the facility WHS team to ensure that it is correctly addressed. Often the best outcomes will arise if you work together with the local WHS staff to study and investigate a solution, rather than simply to do nothing and wait.
Even if you are only supervising or instructing someone else to carry out the procedures, you could still be held responsible for incidents or damages if proper care was not taken within your ability.
All microscopy facilities should make an effort to establish a set of rules and guidelines for WHS, and all users of the facility should ensure that they are well informed about these prior to commencing work on the microscopes.
This WHS module is intended to enhance awareness amongst microscope users of the general safety norms, structures and procedures that are typical in microscope facilities, designed to support the user in taking responsibility for their safety and that of those around them.

Typical hazards at a microscopy facility

Hazards at a microscopy facility can be broadly categorised into three key areas:
1. Your specimen
2. Microscopy specimen preparation
3. Microscope operation

Your specimen

You cannot expect everyone at the microscopy facility to be familiar with the safety requirements of your particular research material. You should be the person who is the most informed about the safe handling, storage and disposal of your research specimens.
If you are receiving specimens from external clients to carry out microscopy studies on their behalf, it is up to you to make sure that the supplier provides full safety information about the specimen.

Examples of typical hazards include:
- Biological samples that are not appropriately processed or fixed (e.g. still alive or frozen), and may still pose contamination risks.
- Particles that may be inhaled or absorbed, particularly nanoparticles (< 100 nm) that can be easily airborne and cause acute reactions to the human body.
- Chemical compounds that can be poisonous, hazardous (e.g. corrosive, flammable), carcinogenic, or hazardous to the environment.
- Controlled substances that are regulated by the local government authorities.

Each microscopy facility should have specific guidelines about bringing in certain items (e.g. particle specimens must be suspended in liquid, biological specimens must be pre-prepared at a certified containment laboratory elsewhere).

Many facilities require the user to declare any items brought into the centre, and provide key information such as:
- Origin of acquisition or purchase.
- Storage location, labelling.
- Purpose of use.
- Disposal, useful life

The important point is to identify whether the items (e.g. your specimens or associated chemicals) are hazardous, and whether you are fully aware of the risks and dangers involved.
The obvious message here is that, if you are unable to provide this basic information then you should not be handling the items in the first place.
No items should be left in storage without adequate information. Accidents can occur because of some old materials (e.g. chemicals) left behind by a previous researcher, where other people have no idea about what they are and how to correctly store/dispose of them. Every item should have a fixed finite disposal date so that it does not become abandoned in storage.

Microscopy specimen preparation

Many incidents and risks at a microscopy facility tend to occur during the specimen preparation stage. This is because the process often involves mechanical cutting and grinding, high or low temperatures, or the use of hazardous chemicals.
One common pitfall is to continue to use outdated, hazardous protocols (e.g. exposed laser systems, unsafe dicing saws, highly radioactive stains, picric acid, hydrofluoric acid), simply because this is the way it was always done for decades, and is endorsed by the senior researchers.
Often the best control measure to avoid potential risks is simply to find a better, safer alternative.
Although certain hazardous procedures are unavoidable and are essential to high quality microscopy, you should not forget to search for alternative procedures to achieve the same goal in a safer way.
Such alternative procedure may cost more money, or take longer time to carry out, but it could also save you and your colleagues from potential health risks and injuries.
Accidents are more likely to occur when a user tries to rush the procedure by taking shortcuts or attempts to handle larger volumes than usual.

Microscope operation

Most microscopes are commercial products, in which the manufacturer has taken the appropriate duty of care to ensure that the users are not exposed to high risk scenarios. However, since most microscopes are intended for use in restricted areas by the appropriately trained operators, you must first receive a thorough training and induction that is specific to each instrument configuration.
Having prior experience in similar platforms could help to some degree, but does not necessarily guarantee that the safe operation procedures for the previous instrument holds true for the specific instrument provided.

Optical microscopes

Examples of typical hazards:

- Extremely bright illumination source (e.g. mercury lamp).
- Laser source and beam paths.
- Environmental chamber gases (e.g. carbon dioxide).
- Flammable chemicals (e.g. solvents) near ignition sources.
- Cuts from glass slides and hand tools

Electron microscopes

Examples of typical hazards:

- High tension voltage (e.g. 300,000V) and extensive electrical wiring.
- X-ray leak.
- Asphyxiation gas (sulphur hexafluoride - SF6).
- Cryogenic gas/liquid (liquid nitrogen)

Likelihood of these risks is low as long as the users follow the correct procedures. Restricted access areas should be clearly indicated in the room (e.g. back end of the instrument).
X-ray and gas leaks should be checked periodically by the local safety staff to ensure that safety measures have not been accidentally breached.
Instruments purchased from the original manufacturer are usually tested for safety during the initial installation and commissioning phase. However, safety issues often arise from cases such as modifications or repairs being carried out, handover of second-hand equipment, and errors in use by the end users.
X-ray or laser incidents are a common concern for facilities that undertake many development projects and modifications, where some safety protective covers may be temporarily removed. The staff carrying out these projects should not only be an expert in the instrumentation, but must also provide full attention and care to prevent potential incidents.

Local rules

Each institution should have a Work Health and Safety Policy that describes the requirements for all activities conducted by all personnel (including students and temporary visitors), and documentation on common processes that support these activities. These policies and documents are often similar across many institutions, but not necessarily the same.
Where appropriate, institutions may be structured such that they incorporate an overseeing WHS organisation, and a local WHS committee for the area (e.g. faculty, school, or building). These may act as your key point of contact if you have any questions related to safety.
It may be beneficial to know who the local qualified first aid officers and fire/emergency wardens are, if these are appointed. Depending on the nature of your activities, it may be also be beneficial to know if any specific safety advisers (e.g. radiation, laser, biological materials)are appointed in your facility.
When you first visit the microscopy facility as a user, WHS practises and structures are often highlighted as part of an initial safety induction by the local staff.

Safety inductions may be composed of a physical tour of the facility to identify the key locations such as:

- Fire escape route.
- Fire extinguishers.
- First aid kit.
- Chemical spill kit.
- Hazardous areas and safety signs

The induction might describe some basic safety information such as:

- Your requirements and obligations to work safely in the centre.
- Training and documentation requirements to start your activities.
- Appropriate clothing and protective equipment (e.g. types of shoes).
- How to report incidents or potential hazards

Supporting documentation

During the initial induction process, you should be introduced to the standard safety documentation that is approved for use in the facility.

Some of the common documents widely used around the world are:
- Safe Work procedure (SWP).
- Risk Assessment (RA).
- Safety Data Sheet (SDS)

The names and formatting of these documents may differ between each facility depending on the local government legislations or the standard templates accepted. However, the underlying aim should always be to keep the working environment as safe as possible.

Typically, the facility staff should provide you with these documents for the standard routine procedures. You should read these and be familiar with the information. Often these documents are provided as part of the instruction manual, or as an assessment topic during the basic training session.

If your research requires you to conduct procedures that differ from those already documented by the facility, you will be expected to draft these documents by working with the facility staff, and be assessed for approval by the facility WHS committee.

Safe work procedure

Safe work procedure (SWP) can also be called Standard operating procedure (SOP) or Safe work methods Statements (SWMS).
This is a document that is written by the person willing to conduct a particular procedure, and outlines some key points that the users should be aware of when conducting the procedure.
The aim is not to write a full instruction manual (which can often be too long), but to ensure that the reader is fully informed about the risks and hazards involved, and can carry out the procedure safely by following the rules and cautions set out in the document.

Some of the key information SWP should include are:
- Issue and review dates.
- Authorized personnel, rooms, training requirements.
- List of potential hazards and risks.
- Personal protective equipment.
- Safety checks before, during, and after conducting the procedures.
- Emergency shutdown procedures.
- What to do in case of accidental spills, etc.
- Disposal and clean-up

Each facility should have a template format to write an SWP. There should also be an expiry date set out for each document (e.g. one year), to ensure that the document is reviewed and modi ed as necessary to suit the existing working environment at the time.

Risk assessment

Risk assessment is another standard document that is widely used around the world in both the industrial and academic environment. Any professional scientist is expected to be able to write a risk assessment for their particular expertise.
In the microscopy context, you should rst make a list of all the potential risks involved in the procedure (e.g. use of hazardous chemicals, climbing onto a high platform).
For each of these risks, you will need to evaluate the likelihood and the consequences if no control measures are in place (e.g. injury from a fall, burn, blindness, death).
Adjacent to this, write down the list of safety measures implemented, and the resultant residual risks, if any. There may also be a section to write down any additional safety measures that should but have not yet been implemented.
Each institution should have a “risk rating” matrix to rate each risk from “very high” to “very low”, based on how likely it is to occur, and what are the possible consequences.
For example, an exposed electrical high voltage wiring could have a very high likelihood that someone will touch it, and the consequence could be a serious electrocution. Therefore the risk rating is “very high”. The safety measures may be to put a double protective insulation cover and a warning sign, which may reduce the risk to “low”.

Safety Data Sheet

Safety Data Sheet (SDS), also known as the Material Safety Data Sheet (MSDS), is a document that provides detailed instructions for the safe use and potential hazards associated with a particular material or product.

SDS document format is broadly speci ed by each country's government regulations. It is typically provided by the supplier of materials such as hazardous chemicals, and is not generally written by an end user.

SDS is used as a basis to write the safe work procedure and risk assessment documents, particularly for the correct protective equipment required, and the safe disposal procedure.

Any reputable chemical/material supplier should be able to provide a full SDS document upon purchase. It is often a good way to identify whether the supplier is well informed about the products that they are selling.

For common materials (e.g. solvents and acids), a wide variety of SDS can be downloaded from the internet. However, it is important to obtain the correct SDS that is appropriate for your local government regulations. These documents are typically printed and placed near the entrance of the laboratory, since the emergency services team are trained to refer to these so that they are aware of the potential risks when an incident occurs in the laboratory.

Summary

Work Health and Safety (WHS) should be a two-way strategy. Your microscopy facility staff should provide you with comprehensive training, induction and support to ensure that you can work safely throughout your research project. In return, you must comply with the local rules and act sensibly to become aware of the hazards around you.
A common excuse such as “This is how it was done at my old university” or “This is how it is written on this journal paper” is not acceptable, particularly if it is used as a reason to bypass or shortcut the existing safety protocols.
A proficient microscopist must always consider health and safety as the first priority and continue to learn about the current up-to-date information. They should take an active role in making sure that there is a good environment in which to work together with others to find solutions, instead of causing risks to themselves and the people around them.