Office of Safety, Health & Environment

NUS LABORATORY ERGONOMICS MANUAL

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Amendment

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00	November 14, 2011	New document	Bufford Ang
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1 INTRODUCTION

1.1 Policy

The National University of Singapore (NUS) Ergonomics Policy is established for the purpose of protecting the safety and health of the University staff, students and visitors on campus from ergonomic hazards. The University is committed to reducing and/or eliminating the risk factors associated with musculoskeletal disorders (MSD). This policy supports the other University safety and health policies.

An ergonomics program is a systematic process that communicates information to ensure that adequate and feasible solutions to ergonomic risks can be implemented to improve the workplace. The two most essential pieces of a successful ergonomics program are management commitment and employee involvement.

NUS has implemented an Ergonomics Program that includes the following components:

- A written ergonomics program and designated Ergonomics Program Coordinator (OSHE)
- Identification and prioritization of high-risk jobs and tasks
- Training for management and employees
- Implementation of control measures and follow-up evaluation
- A process for early intervention and medical management

1.2 The Laboratory Ergonomics Program and Manual

The ergonomics program at the National University of Singapore (NUS) is established to support a safe and healthy work environment by minimising the risk of developing musculoskeletal disorders (MSD) that is associated with forceful exertions, repetitive motion, and prolonged, awkward or static postures.

The program is coordinated by the Office of Safety, Health and Environment (OSHE) which will provide expert advice and consult on reducing discomforting levels of strain and repetitive motion.

OSHE has developed this manual to assist the University in complying with the Workplace Safety and Health Act (2006) to provide a safe workplace and reduce work-related musculoskeletal disorders by adapting the work to fit the person, instead of making the person to adapt to the work. This Manual is also to provide general guidance for all users working in laboratory

This Manual should be used in conjunction with other laboratory safety manuals, i.e.:

- NUS Laboratory Design Standard – provides reference point in planning, building and inspecting laboratories
- NUS General Laboratory Safety Manual – provides safety and health requirements on issues common to all laboratories, for example, commissioning and decommissioning of laboratory, laboratory sign posting, personal protective equipment, first aid, contractors management, etc.
- NUS Laboratory Chemical Safety Manual – provides safety and health requirements for working with chemical substances, such as flammable materials, toxic chemicals, acids and base, peroxides, poisons, etc.
- NUS Laboratory Biorisk Management Manual – provides safety and health requirements for working with materials of biological origin, including genetically modified organisms (GMOs) in laboratories.

1.3 Scope

This guideline applies to all staff and students involved in sustained and / or repetitive tasks

1.4 Definitions

Ergonomics: Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance. *(International Ergonomics Association)*

Musculoskeletal disorders (MSD): Musculoskeletal disorders are illnesses and injuries that affect one or more parts of the musculoskeletal system and can include:

- Sprains
- Strains
- Tears
- Degeneration

1.5 Contact Details

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http://www.nus.edu.sg/osh/aboutus/staff.htm#staff_fac.

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Office of Safety, Health & Environment (OSHE)
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20 Lower Kent Ridge Road, Singapore 119080.

2 ERGONOMIC HEALTH ISSUES

2.1 Musculoskeletal Disorders (MSD)

In a laboratory, there are many activities unique to that environment that can increase risk for Musculoskeletal Disorders (MSD). MSD are illnesses and injuries that affect one or more parts of the musculoskeletal system and can include: –

- Sprains
- Strains

- Tears
- Degeneration

Symptoms can include: –

- Discomfort
- Pain
- Muscle fatigue
- Swelling
- Inflammation
- Stiffness
- Numbness
- Tingling
- Burning sensations
- Heaviness
- Weakness or clumsiness in the hands (dropping things)

Other common terms for some musculoskeletal disorders are: –

- Repetitive strain injury (RSI)
- Occupational overuse syndrome (OOS)
- Cumulative trauma disorder (CTD)
- Tenosynovitis
- Tendonitis
- Epicondylitis (tennis elbow/golfers elbow)
- Carpal tunnel syndrome
- De Quervain's disease
- Rotator cuff tendonitis
- Degenerative disc disease

There are several types of MSD commonly found among laboratory personnel.

2.1.1 Tendonitis and tenosynovitis (DeQuervain's Disease and Trigger Finger)

Use of tools that have handles that are too big or small with sharp or hard edges, opening and closing vials, pipetting, and cover slip applications can cause these disorders if precautions are not taken.

DeQuervain's tenosynovitis may be precipitated by forceful grasping and turning, particularly of hard objects such as vials. The thumb is used repetitively with a large number of laboratory activities, so it is especially prone to injury. Swelling, pain and tenderness at the base of the thumb are the symptoms of DeQuervain's.

Trigger Finger is another form of tenosynovitis where the tendon sheath undergoes progressive constriction. Both the tendon and the sheath become inflamed, resulting in pain and difficulty flexing a finger or the thumb. There is resistance to re-extension of the finger or thumb after it has been flexed, producing a snapping that is both felt and heard.

2.1.2 Rotator cuff tendonitis

This is a disorder involving the tendons and muscles of the shoulder. Symptoms include shoulder pain that sometimes radiates down the arm, which is worse with movement. Pain, stiffness, and weakness at night also occur. Rotator cuff injuries are common among workers who perform repetitive tasks with their elbows above mid-torso height.

2.1.3 Thoracic Outlet Syndrome (TOS)

This is a disorder where there is a compression of the nerves in the neck extending into the armpit where the major nerves of the arm branch. In the laboratory, holding the head forward, rolling the shoulders and extending the arms while using a microscope or doing hood work increases the risk for TOS.

2.1.4 Carpal Tunnel Syndrome (CTS)

If there is numbness or tingling in the first three fingers and/or pain in the wrist, forearm and elbow, one *might* have CTS. Symptoms may wake a person at night. CTS can be precipitated by resting the wrist on a hard surface or edge, such as the edge of a hood, or while performing surgery or microscope work.

2.1.5 Wrist ganglion cysts

Ganglion cysts are a herniation of the fluid in a tendon sheath due to wear and tear. They pose no problem in and of themselves, but indicate overuse of a tendon.

2.1.6 Back injuries

One of the main causes of low back injuries in the lab is awkward lifting. Once back muscles or ligaments are strained from repetitive pulling and lifting, injuries are more likely due to weakening of the back muscles, discs, and ligaments. Reaching overhead to lift material off of shelves and general rearrangement of heavy equipment are often sources of back strain.

2.2 Risk Factors

Above all, ***neutral posture*** is the most important thing to remember when working in the laboratory (or in any other situation). The rest of "ergonomics" is simply a means to achieve this posture. “Neutral” means that the body is under the least amount of strain and is in a comfortable position. The forces of gravity and the compression of nerves, blood vessels, tendons, and muscles cause permanent damage in our bodies. Neutral posture prevents damage. To achieve neutral posture, please follow these guidelines:

- Ears over the shoulders
- Shoulders in line with the hips
- Forearms 90° angle or more from the upper arms
- Wrists straight (not bent, angled, or twisted)
- Shoulders relaxed
- Elbows hanging close to the sides (e.g. Avoid reaching away from the body or working with “winged elbows”.)

Some of the most common risk factors in the laboratory and potential solutions are listed in the table below. More detail will be provided as will be discussed with each type of lab activity in the following sections.

Risk Factors	**Solutions**
Contact stress (e.g., leaning on elbows on hard work surface)	• Use padding and tubing to reduce pressure and force.
Force	• Use equipment requiring less force. • Clean equipment and make sure valves, knobs, etc. are in good working order.

	• Use a relaxed grip.
Repetition	• Change tasks frequently throughout the day. • Take short rest breaks every 20 minutes to stretch. It is most important to build stretch breaks into the daily routine, regardless of the work load.
Static Posture	• Shift weight often when standing. • Alternate methods for holding objects. • Vary tasks and activities and take rest breaks every 20 minutes.
Awkward Posture	• Maintain neutral posture of body, arms, hands, and neck. • Sit close to work. • Keep tools and supplies within easy reach. • Use proper lifting techniques for large objects.
Vibration	• When mixing tubes with a vortex machine, reduce the speed, use an elbow pad (if it is necessary to lean on the surface), use tight-fitting caps to avoid finger hold, install an accessory holder, and keep the machine at the edge of the bench

2.3 Other Health Concerns

2.3.1 Pregnancy

A study conducted by the National Institute for Occupational Safety and Health (NIOSH) and the American Cancer Society found no increase in the risk of spontaneous abortion (miscarriage) associated with using computers in the workplace. Working with computers does not increase a woman's risk of delivering a baby of reduced birth weight or delivering prematurely. The conventional scientific opinion is that computer use is not a radiation hazard for the pregnant worker. However, computer workstations and work tasks may have to be modified to accommodate pregnant workers. Ergonomic principles that apply to non-pregnant workers also apply to pregnant workers throughout the duration of their pregnancy.

Strenuous physical labour (e.g., prolonged standing, heavy lifting) during late term pregnancy is a recognised risk. Women over 32 weeks pregnant should limit time standing while at work. The natural S-curve in the spine is altered during pregnancy as the curve in the lower back increases. The pregnant worker's lower back muscles have to work harder to maintain balance of the body and can increase stress on the spine. These individuals should perform the majority of their work duties from a stool or chair. Pregnant women are more prone to ergonomic injuries induced by pregnancy, such as carpal tunnel syndrome or back pain. Make sure to maintain proper body mechanics and posture and ensure that the work environment is ergonomically correct for the users' needs.

3 ERGONOMICS PROGRAM ADMINISTRATION

3.1 Overview

The University aims to evaluate, prevent, and manage work-related musculoskeletal disorders by the following methods:

1. Risk assessment

   An assessment that identifies jobs and workstations that may present musculoskeletal hazards, the risk factors that the hazards pose, and the causes of the risk factors.

   The principle of conducting a risk assessment is to identify the ergonomic hazard that the tasks can pose to the user, determine the risk level and implement measures to control the hazard and reduce the risk to acceptable level.

   All PIs are responsible for conducting the risk assessment for the respective laboratories that they are in charge of and communicate it to his staff and students working in the laboratory.

2. Hazard prevention and control

   Eliminating or minimising the hazards identified in the workplace assessment by changing the job design, workstation, tools or work environment to fit the worker.

3. Injury management

   The effective use of available health-care resources (eg. physiotherapy, medical) to prevent or manage work-related musculoskeletal disorders using an early intervention approach.

4. Training and education

   A method to give both staff and supervisors an understanding of the potential risk of injuries, their causes, symptoms, prevention and treatment.

3.2 Roles and Responsibilities

The Institutional Laboratory Safety Committee (ILSC) is the University level committee to oversee the development and implementation of the Laboratory Ergonomics Program. The Office of Safety, Health and Environment (OSHE) is the administrator of this Program.

3.2.1 NUS President

The President of NUS represents the University as the Employer. The ultimate responsibility for safety and health in the University rests with the President. The President may delegate the authority and responsibility to the ILSC, Deans, Administrators and Head of Departments (HODs) for the effective supervision of the occupational safety and health of staff and students under his / her management.

The ILSC and OSHE shall report any incident or conditions of non-compliance to the NUS President, Senior Deputy President, Provost, Deputy Presidents and Vice Presidents, who are entitled to partially or fully close the laboratories or facilities until all safety issues are addressed.

3.2.2 NUS Institutional Laboratory Safety Committees (ILSC)

The ILSC is appointed by the Provost. The Terms of Reference for the ILSC are:

- Review NUS Laboratory Safety Policy and recommend to NUS President in specific action items related to the Laboratory Ergonomics Program.
- Review Directive, Manual and guidance documents related to laboratory ergonomics at University, faculty and departmental level and recommend revision to the Director of OSHE.
- Serve in an advisory capacity to OSHE on all ergonomics related matter.
- Review NUS Laboratory Ergonomics Program, as well as any audit and inspection findings conducted by OSHE or other independent parties or faculties and departments.
- Continually review of the Laboratory Ergonomics Program.

3.2.3 Deans and Head of Departments

All Deans and HODs of the respective departments have management responsibility for the implementation of Laboratory Ergonomics Program. The HOD, with the assistance of the Departmental Safety Committee or Faculty Safety & Health Officer, is to evaluate the risk assessment of PIs.

3.2.4 Principal Investigator and Supervisor

The Principal Investigators (PIs) and Laboratory Supervisors are primarily responsible to conduct ergonomic risk assessment for all activities in the laboratory. They are responsible to ensure that all reasonably practicable control measures are implemented and the measures are effective in eliminating or minimizing the risk.

They are also responsible in communicating the ergonomic hazards involved, the purpose of various control measures implemented. The PIs and Supervisors are to ensure that their reporting staff and students received adequate information and instructions to help minimise the risk of musculoskeletal injuries. They should ensure that staff and students under their control use the ergonomic equipment and materials provided.

3.2.5 Staff and Students

All staff and students are responsible to carry out their work safely. Staff and students shall cooperate with all ergonomic safety instructions of their supervisor. They should attend ergonomics training as directed by supervisor and apply principles to their tasks. They are to make proper use of all ergonomic equipment and materials provided. They should report potential ergonomic hazards, problems and symptoms to their supervisor.

3.2.6 Office of Safety, Health and Environment

The Office of Safety, Health and Environment (OSHE) is the designated Ergonomics Program Coordinator. It will provide administrative support to the ILSC, maintain the University Laboratory Ergonomics Manual, manage all registration and reporting processes for the ILSC, maintain appropriate records, and serve as liaison with all faculties, departments and external agencies in the ongoing implementation of the University's Laboratory Ergonomics Program.

OSHE will also coordinate the provision of ergonomics training to relevant staff and students. OSHE is the university body tasked to coordinate any incident or accident investigations as called for by the ILSC or the President.

The Occupational Health Clinic shall oversee the medical management of possible and confirmed work-related musculoskeletal disorders.

4 RISK MANAGEMENT

Staff at all levels are responsible for developing an understanding of and becoming competent in the implementation of risk management principles and practices in their work areas.

This is a three-phase process. 1. Hazard Identification 2. Risk Evaluation and 3. Risk Control

Hazard Identification

Identification of hazards associated with ergonomics should be undertaken by:

- Reviewing the duties to identify ergonomic risks (task variation, work load etc)
- Consultation with staff and students
- Direct observation of work practices
- Inspection of the task or work area
- Reviewing workplace injury records, if possible, to identify where and in what jobs occupational overuse injuries have occurred
- Completing self assessment checklist

Risk Evaluation

Risk evaluation should occur:

- After the risk identification process
- Following the report of occupational over symptoms

And should take into account the following risk factors:

- Workplace and workstation layout
- Working posture and position
- Work environment
- Task variation

Risk Control Measures

Risk control is the process of eliminating or reducing identified and assessed risk factors. Such measures could include:

- Provision of alternate equipment
- Job re-design
- Provision of training
- Review resource allocation

The Laboratory Ergonomics Evaluation Checklist (see Appendix A) is a useful tool to complete to ensure appropriate workstation set up.

4.1 ACTIVITY-BASED RISK ASSESSMENT

The principle of risk management is to identify the ergonomic hazards, assessing the risk levels, prioritizing and implement measures to control the hazards and reduce the risks to acceptable level. As part of the risk management, adequate and effective control measures are necessary to control the hazards identified during the risk assessment and reduce the risks to acceptable level. Implementation of control measures will reduce the likelihood of occurrence of the adverse consequences but the severity of the potential injury will remain unchanged during risk assessment evaluation.

When determining the type of control measures, one should always consider the Hierarchy of Control:-
a. Elimination,
b. Substitution,
c. Engineering control,
d. Administrative control and lastly
e. Personal Protective Equipment (PPE)

Elimination of potential hazards will be given the first priority, while PPE will be the last resort in all control measures implemented in laboratories. In most instances, a combination of controls is required to manage the risk effectively.

Instructions to Employers & Persons Conducting Risk Assessment (per MOM guidelines):

1. Before completing the risk assessment form, complete the **Inventory of Work Activities Form**. You may use one inventory form for each work process.

2. Outline the process workflow and indicate the process location under the "Process / Location" column.

3. For each work process, list all activities (routine and non-routine) in sequence under the "Work Activities" column. One (1) Risk Assessment Form may be used for each work process.

4. Record the names and designations of risk assessment team members in the Risk Assessment Form.

5. Start with the first activity listed in the Inventory of Work Activities Form. Record in columns 1a and 1b of the Risk Assessment Form (found in a separate Appendix)

6.Identify the hazards associated with each activity and record these in column 1c.

7. For each hazard identified, determine the consequence (possible accident / ill health and persons-at-risk) and record this in column 1d.

8. If there is any existing control measure(s) for the hazard, record this in column 2a.

9. Determine the severity of the accident or incident or ill health based on the table below, and record this in column 2b.

Table 1. Severity levels of a hazard, per MOM guidelines

Severity	**Description**
Minor	No injury, injury or ill health requiring first aid treatment only (includes minor cuts and bruises, irritation, ill health requiring first aid treatment only)
Moderate	Injury requiring medical treatment or ill health leading to disability
Major	Fatal, serious injury or life-threatening occupational disease (includes amputations, major fractures, multiple injuries, fatal diseases)

10. Taking into consideration the existing control measure(s), estimate the likelihood of occurrence of each accident or incident or ill health based on Table 4, and record this in column 2c.

Table 2. Likelihood levels of encountering a hazard, per MOM guidelines

Likelihood	**Description**
Remote	Not likely to occur
Occasional	Possible or known to occur
Frequent	Common or repeating occurrence

11. Based on the severity and likelihood, assign the Risk Level for each hazard using the risk matrix of Table 5, and record this in column 2d.

Table 3. 3 x 3 Risk Assessment Matrix, per MOM guidelines

Severity	Likelihood		
	Remote	Occasional	Frequent
Major	Medium Risk	High Risk	High Risk
Moderate	Low Risk	Medium Risk	High Risk
Minor	Low Risk	Low Risk	Medium Risk

12. Based on the Risk Level assigned, suggest appropriate risk control measures and record these in column 3a following the hierarchy in Table 6**.**

Table 4. Recommended Actions for different levels of risk and acceptability, per MOM guidelines

Risk Level	Risk Acceptability	Recommended Actions
Low Risk	Acceptable	No additional risk control measures may be needed. However, frequent review may be needed to ensure that the risk level assigned is accurate and does not increase over time.
Medium Risk	Moderately acceptable	A careful evaluation of the hazards should be carried out to ensure that the risk level is reduced to as low as is practicable within a defined time period. Interim risk control measures, such as administrative controls, may be implemented. Management attention is required.
High Risk	Not acceptable	High Risk level must be reduced to at least Medium Risk before work commences. There should not be any interim risk control measures. They should not be overly dependent on personal protective equipment or appliances. If need be, the hazard should be eliminated before work commences.

13. With the consensus of management or employer, assign a suitable person to implement the recommended risk control(s), and indicate the follow-up date in column 3b.

14. Repeat risk assessment for other activities and processes listed in the Inventory of Work Activities Form.

15. Management or employer must endorse and approve the risk assessment; communicate all risk assessments to employees; monitor follow-up actions, and keep the risk assessment records for at least 3 years.

16. Conduct another round of risk assessment after the risk control measures have been implemented; use a new form to indicate the reduction in risk levels.

17. Review the risk assessment records every 3 years or whenever there are changes in processes or work activities or after an accident/incident, whichever is earlier.

Figure 1. Activity-Based Risk Assessment Form

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Activity-Based Risk Assessment Form

Name of Department _____ Location of Lab _____

Name of Laboratory _____ Name of PI _____

Name of Researcher/LO _____ Name of Activity/Experiment _____

No	Description/Details of Steps in Activity	Hazards	Possible Accident / Ill Health & Persons-at-Risk	Existing Risk Control (Mitigation)	Severity	Likelihood (Probability)	Risk Level	Additional Risk Control	Person Responsible	By (Date)
1							0			
2							0			
3							0			
4							0			
5							0			
6							0			
7							0			
8							0			
9							0			
10							0			

Conducted By _____

_____

_____

_____

Approved By

Name _____

Signature _____

Approval date _____ Next Revision date _____
(Maximum 3 years)

5 GENERAL ERGONOMIC GUIDELINES

5.1 Safe Work Practices for Repetitive Tasks

The following information can be used as a guideline for correctly adjusting a workstation or workbench. In addition to this information, the Laboratory Ergonomics Evaluation Checklist (see Appendix A) is a useful tool to complete to ensure appropriate workstation set up.

5.2 Job Design and Work Breaks

Many jobs require the user to adopt a sustained posture and fixed visual focus, e.g. microscopy and computer data encoding. Additional unrelated tasks involving dynamic muscle movement should be included wherever possible. This will increase task variety and allow time for muscles to recover from static muscle strain.

Breaks away from the computer are required at regular intervals to relieve muscle fatigue and eyestrain and to restore the level of concentration. The best means of providing breaks is to vary the tasks through job design and by providing a variety of work and autonomy over the order in which tasks are performed.

Where the job does not provide adequate breaks through task variation, it is recommended that short frequent breaks should be taken during periods of intensive work, i.e. 2 – 3 minutes every 20 – 30 minutes. These breaks should involve whole body movement to restore circulation to relieve muscle fatigue. In addition, pause / stretch exercises should be frequently completed throughout the day. Back fatigue is relieved by alternating from a sitting to a standing posture and walking around.

5.3 Task Rotation

Rotating tasks throughout the day can provide breaks from sustained posture work. Rostering some tasks within a work group can also provide variety and breaks away from computer use. Each team needs to identify high volume or repetitive tasks and ensure that adequate breaks and or task variation are incorporated.

5.4 Computer Work and Video Display Terminals (VDTs)

Many researchers spend a significant amount of time entering data with their keyboard and mouse resting on a lab bench. Many lab benches are too high, and require the researcher to elevate the arms and excessively deviate the wrists while inputting data. Depending upon the location of the mouse, awkward reaches and manipulations of the mouse with bent wrists may occur. The following are recommended for control of ergonomic hazards associated with the use of computers in the lab:

- Install adjustable keyboard platforms under lab benches that accommodate use of the mouse beside the keyboard.
- Where possible, position computer workstations in corners or other areas away from doors, entrances, and passageways.
- Provide fully adjustable seating.
- Place monitors so the user's viewing distance is between 35 to 75 cm.
- Place monitor so the top of the screen is approximately eye level. This allows the eyes to naturally gravitate toward the centre of the screen.
- Use a document holder placed adjacent to and in the same plane as the computer screen.
- Provide foot rests, where possible, for individuals in order for them to change leg positions throughout the day.

- Provide for a choice of keyboards and mouse or other input devices for individuals who have existing musculoskeletal problems.
- Encourage mini-breaks of 2 - 3 minutes for every 20 - 30 minutes of keyboarding or mouse work. These breaks can be spent doing mild hand exercises or stretches.
- Laboratory personnel should not go from keyboarding to pipetting activities (or vice versa) without an adequate break (at least 15 minutes) to allow the hands to recover.

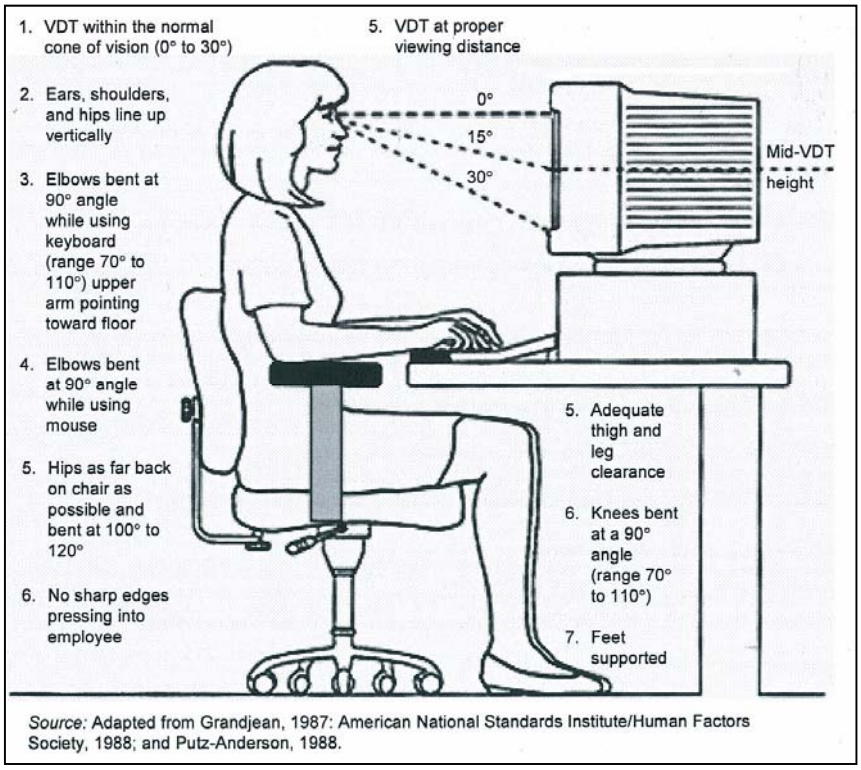


Figure 2. Guideline for computer workstation set up
(based on SS 514:2005 Code of Practice for Office Ergonomics)

5.4.1 Posture

The user of VDTs must be able to adopt a comfortable work posture to avoid muscular fatigue and discomfort. The design of workplace furniture should be easily adjustable to comfortably accommodate a large range of body sizes and shapes.

In a comfortable working posture at the computer: -

- the feet are supported on the floor, or a footrest (if knees are at a greater than 90° angle).
- the thighs are supported by the chair seat with no pressure caused by the front edge of the seat under the thighs
- the upper body is upright with the lower back firmly supported by the backrest
- the shoulders are in a relaxed position and are not hunched
- the elbows and upper arms are close to the body
- the forearms are parallel to the ground (or in a downward sloping position), and the wrists are in a neutral position (straight) when utilising the keyboard and mouse
- the neck remains in a neutral position (i.e. not looking upwards or downwards) when viewing the monitor

5.4.2 Chairs

Important aspects of chair design are: -

- Stability (a 5 star base)
- An easily adjustable height range suited to the workstation
- A stable, independently adjustable backrest
- Adequate lumbar support
- Seat base size is appropriate for the leg length of the user
- Freely moving castors when used on carpet or glides for use on a hard floor surface

5.4.3 Desks

Height adjustable desks are the preferred option to give the user maximum flexibility in adjusting their work posture. The height adjustment mechanism should be safe and easy to operate.

- If a fixed height desk is provided, the height to the top of the work surface should be between 68 cm and 72 cm above floor level
- The area of the work surface should be large enough to allow the equipment to be positioned as required by the operator and to provide space for any documents or reference materials used
- The minimum work surface area for mixed tasks (keyboard and clerical work) should be 15 cm x 90 cm.
- The volume of leg space should be a minimum of 80 cm wide x 55 cm deep x 58 cm high
- The viewing distance to work should be between 35 cm and 75 cm
- There should be no sharp edges, protrusions or rough surfaces
- If an adjustable keyboard tray is fitted, it should be large enough to accommodate both a keyboard and a mouse on the same level

5.4.4 Computer Monitors

The location of the computer screen should take into account the visual needs of the user as well as ensuring a comfortable position of the head and neck.

It is recommended that: -

- the screen is located at approximately an arm's length away from the user (when in an upright seated position)
- the screen is located directly in front of the user and raised if required by a monitor raiser to ensure that the neck remains in a neutral position when viewing
- the top of the screen is at approximately eye level and the bottom of the screen can be read without a marked inclination of the head. This usually means the centre of the screen will need to be near shoulder height
- glare and reflections on the screen are eliminated

5.4.5 VDTs and Vision

- The American Academy of Opthalmology describes VDTs as presenting no hazard to vision. VDT exposure does not result in cataracts or any other damage to the eye. According to the National Safety Council, any close work can cause discomfort and stress with time. Occasionally the user should:
  - Stretch
  - Look away from the work
- Get up
- Do other tasks to alter work routines throughout the day

5.5 Laptop Computers

Laptop computers have the potential to cause major musculoskeletal and visual problems if used for extended periods. Problems can result as the computer screen normally cannot be separated from the keyboard, resulting in excessive (looking downwards) neck flexion during use. Experience has also shown that people with larger hands may find it difficult to use the small keyboards or the in built mouse in laptop computers.

To minimise these problems, when using the laptop for extended periods -

- Utilise external keyboard and mouse
- Position the laptop so that the screen is at a comfortable viewing distance (connecting laptop to a standard monitor may be required)
- Laptop should be positioned at an appropriate height to ensure neutral neck positioning (for example using either a monitor arm, monitor raiser or docking station)

5.6 Keyboarding Duration

A total of 4 hours (not including breaks) of intensive keyboard work per day is regarded as a "safe working level" (this may be less for individuals with underlying medical conditions or injuries, and any recommendations from treating medical practitioners should be followed).

5.7 Computer Mouse

A well-designed computer mouse should not cause undue pressure on the wrist and forearm muscles. A large bulky mouse may keep the wrist and forearm continuously at an uncomfortable angle. Pressure can be reduced by releasing the mouse at frequent intervals, by selecting a slim-line, low profile mouse and by using the mouse at a comfortable distance from the body. Repeated or sustained use of the mouse may result in muscular fatigue of forearm and upper body muscles.

To minimise fatigue when using the mouse: -

- Place the mouse on a mouse mat (this restricts the area of movement for the hand and arm)
- Ensure the wrist remains in a neutral position and so the elbow is positioned close to the side of the body when utilising the mouse

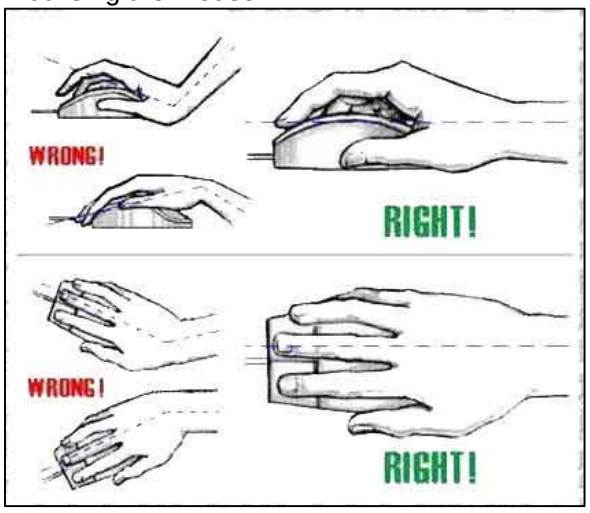


Figure 3. Incorrect and correct hand positioning relative to computer mouse

- The mouse pad should be placed as close as possible to the keyboard to avoid arm extension which will impact on shoulder / neck muscles

- The keyboard and mouse should be positioned at the same level. This will minimise shoulder strain required to elevate the shoulder

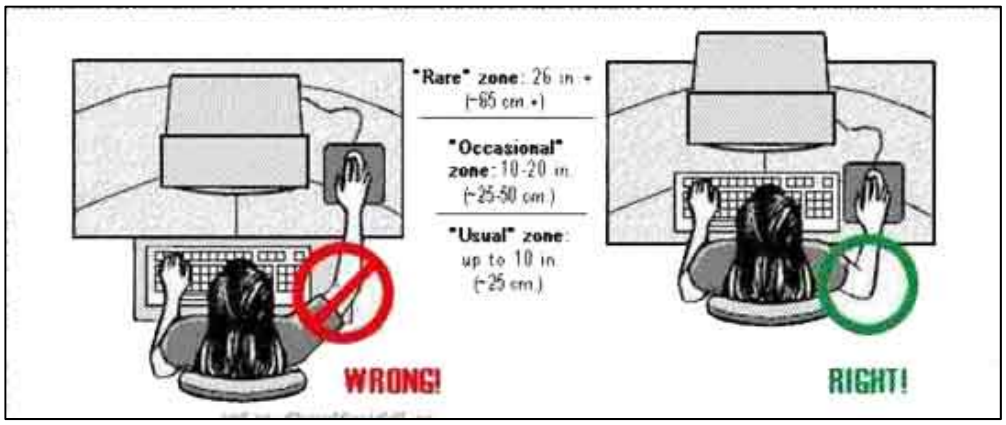


Figure 4. Incorrect and correct wrist position relative to computer mouse

5.8 Ergonomic Accessories

Well-designed workstation accessories can be used to improve posture and work efficiency of the computer operator. It is recommended that a workplace ergonomic assessment is conducted by to assist with identifying required ergonomic equipment.

A footrest is recommended when keyboard users are unable to firmly position their feet on the ground, or when there is pressure on the undersides of the thighs, when the chair height is appropriately adjusted (so that wrists, elbows and forearms are in a neutral position). Optimal back and pelvis support is achieved when the feet are firmly supported.

Document holders are useful for assisting the neck to remain in a neutral position when viewing documentation whilst using the computer. Ideally, documentation should be positioned between the keyboard and the monitor. If this is not possible then the document holder should be positioned close to the computer screen at eye level.

Monitor stands and monitor arms can be used to raise the monitor to ensure an appropriate height for viewing (when the neck remains in a neutral position). Monitor arms provide additional flexibility in allowing the screen to be placed anywhere (within an arc) over the workstation surface.

Wrist supports – can be utilised to ensure that the wrist remains in a neutral position when utilising the keyboard and mouse. A wrist support should only be used when the wrist is unable to achieve a neutral position.

Headsets – are important for ensuring that the neck remains in a neutral position, and to minimise unnecessary muscle activity in the arms and shoulders when the phone is used for frequent and or extended periods of time.

Screen filters are used to reduce visual discomfort caused by the appearance of reflections and glare on the screen. However, they do reduce the brightness and sharpness of screen characters. Before resorting to a filter, identify the source of the reflections and/or glare and endeavour to provide a solution to control the problem. Common solutions are: -

- Change the angle or position of the screen
- Ensure appropriate overhead lighting and diffusers
- Install or adjust curtains or blinds to control natural light

5.9 Desk Top Layout

Frequently used items should be positioned so that they can be reached within an arms distance from a seated position, and so that twisting / rotating of the trunk is not required.

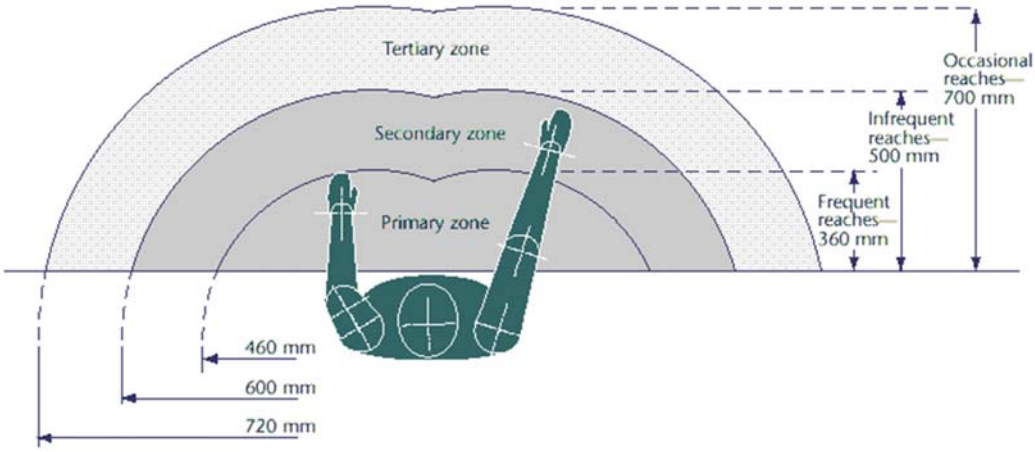


Figure 5. Primary, secondary and tertiary zones of reach (based on SS 514:2005 Code of Practice for Office Ergonomics)

6 ERGONOMIC RISK CONTROLS FOR LABORATORIES

Apart from the potential risk of working daily with hazardous substances and equipment, laboratory personnel also have the potential to be exposed to many ergonomic risk factors due to the nature of their work (i.e. work benches and cabinets) and the research they conduct (i.e. micromanipulation and long hours).

Many laboratory activities involve awkward and static postures, high repetition, excessive force, contact stresses, vibration, and pinch grip among others.. These activities include pipetting, microscopy, cell counting, using forceps, using a cryostat and working in a glove box, biosafety cabinet or fume hood. Those who work in a laboratory are at an increased risk of repetitive stress injuries.

Tasks involving repetitive actions and sustained postures are major factors to the development of musculoskeletal disorders. Injuries can be minimised by:

- Using automation where possible, e.g. electronic pipettes, electric staplers, electronic/hydraulic lifting devices, rollers.
- Changing the job design to include tasks that use different muscle groups and provide relief from repetitive actions, static or awkward postures, excessive forceful exertions and mental and muscular fatigue.
- Job rotation to prevent injury by using different muscle groups and preventing muscle fatigue.

Where the task requires a sustained period of repetitive actions or sustained posture, and significant task variation is not possible, then work pauses or breaks should be provided. The exact length and frequency of the pauses will depend on the nature of the task. However, it is generally agreed that frequent short breaks are preferable to infrequent longer breaks.

The need for, and the frequency and duration of work pauses, should be determined by supervisors in consultation with users, taking into account factors such as organisation of the work, overall work environment, and the physical capability of the worker. If it is determined that work pauses are required, it is recommended that such pauses be provided.

The purpose of this guide is to provide laboratory personnel with information about how they can control laboratory ergonomics risk factors, improve their level of comfort while performing their jobs, and allow them to make changes that will reduce the risk of injury and to consider ergonomics when purchasing new laboratory equipment.

6.1 Laboratory Workbenches and Setup

When used inappropriately, laboratory workbenches can expose laboratory people to a variety of ergonomic risk factors to MSD including neck, shoulder, and back strain depending on the laboratory procedure being used. Most workbenches at the University are of fixed heights and cannot be adjusted (raised or lowered). In general they are the same height and were designed for light to slightly heavy work.

Using a laboratory workbench as a computer workstation is an example of inappropriate use, since it forces the worker to assume a variety of awkward postures and may increase the likelihood of acquiring MSD. Laboratory workbenches are at fixed heights and have been designed using general accepted. These guidelines are as follows:

- Precision Work - Workbench height should be above elbow height.
- Light Work - Workbench height should be just below elbow height.
- Heavy Work - Workbench should be 10 to 15 cm below elbow height.

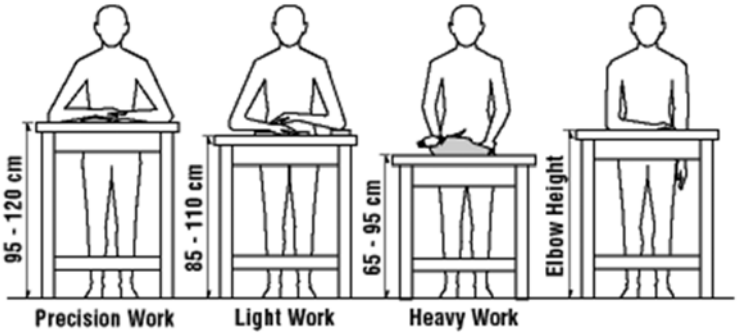


Figure 6. Laboratory workbench guidelines for varying levels of work (Source: International Labour Organization)

It is best to have a workstation evaluation (refer to Appendix A – Laboratory Ergonomics Evaluation Checklist) to know what the correct height for surfaces should be. If a person must work at a bench that is an awkward height, try to adapt to it by standing or sitting, raising or lowering the work with platforms, or pulling out a top drawer and placing a sturdy board on top to create a lower surface. Elevate the chair and use a footrest rather than working at a surface that is too high.

There are greatly improved workbenches now available, so if a lab is to be redesigned or rebuilt, these should be considered. Height adjustable downdraft necropsy tables, backdraft biosafety cabinets and hoods, and "multidraft" tables are now available to accommodate laboratory workers of all heights and to reduce the awkward postures of working under a hood.

6.2 Chairs and stools

Use a lab stool with enhanced lumbar support so the back is supported against the backrest. Ensure that sufficient knee and leg space is available to pull up close to the work surface. Create adequate leg space by removing drawers, cabinet doors, and boxes of supplies often stored beneath workbenches.

Avoid using the foot ring on lab chairs and stools. Foot rings place pressure on the back of the thighs, restricting circulation. Instead, use a footstool/footrest in front. This will enable the hips to bend, supporting weight on the feet, rather than rounding the neck, back and shoulders.

6.3 Prolonged Standing

Keeping and sustaining the body, even while standing motionless, in an upright position requires significant muscular effort that can be unhealthy. It decreases the blood flow to the loaded muscles and hastens the onset of fatigue and causes pain in the muscles of the legs, back and neck (these are the muscles used to maintain an upright position).

In addition to muscular strain, prolonged standing can cause other discomforts as well. Due to gravity, it causes blood to pool in the legs and feet. When standing occurs continually over prolonged periods, this can result in inflammation of the veins. This inflammation may progress over time to chronic and painful varicose veins.

To reduce the discomfort of working in a standing position:

- Adjust the height of the work according to body dimensions, using elbow height as a guide.
- Organize the work so that the usual operations are done within easy reach.

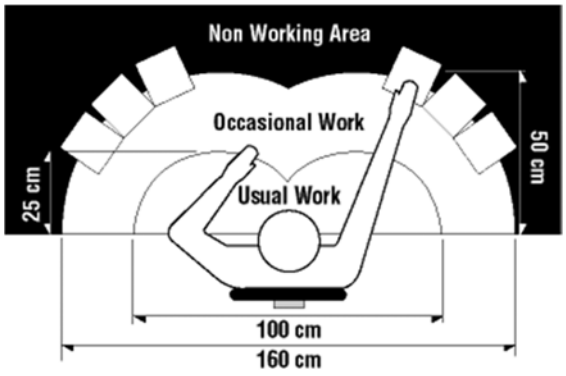


Figure 7. Varying reach distances according to work frequency type

- Always face the object of work.
- Keep body close to the work.
- Adjust the workplace to get enough space to change working position.
- Use a foot rail or portable footrest to shift body weight from both to one or the other leg.
- Use a seat whenever possible while working, or at least when the work process allows for rest.

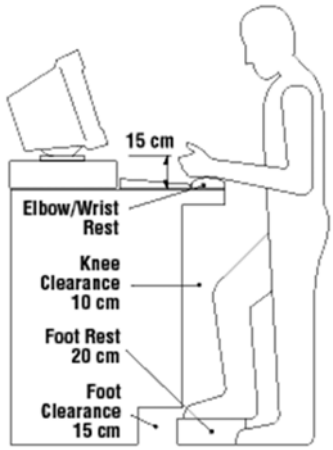


Figure 8. Measurement guidelines when working with video display terminals at a standing position

- If standing for a long time at the workbench, provide anti-fatigue matting or supportive shoes.
- Wear shoes that do not change the shape of the foot. The feet can only be as comfortable as the footwear permits.

Figure 9. Shoes should not change the shape of the foot.

6.4 Pipetting

This laboratory procedure is highly repetitive and involves a variety of risk factors. Repetitive Strain Injuries (RSI) may occur when a laboratory worker pipettes for two hours a day or longer on a continuous basis.

Figure 10. Pipet for liquid transfer containing a measured volume of the substance

Associated Risk Factors

- Repetitive motion of the hands, forearm and thumb, or fingers
- Pinch grip when handling pipette tips, or opening vials
- Bending and twisting of the wrist
- Working with "winged" elbows (elbow held at an elevated position away from the body)

Figure 11. Proper way of liquid transfer from pipet to tubes

- Neck bent forward or to the side and/or jutted chin
- Awkward and static postures
- Excessive force of the thumb
- Overreaching
- Standing for long periods of time

Preventive Measures

The manual plunger-operated pipette has long been at the top of the "bad guys" list. Whenever possible, this type of pipette should be replaced with electronic and multi-channel pipettes that greatly reduce excessive thumb force and repetition. Electronic pipettes are strongly recommended for highly repetitive tasks.

Figure 12. Electronic pistol-grip pipettes (VistaLab Ovation)

Otherwise, use as short a pipette as possible, use pipettes where the thumb dispenses and the index finger aspirates, and alternate using the right and left hand to pipette.

Use thin-walled pipette tips that are easy to eject, or use two hands to eject tips. Use of a pipette for dispensing should be avoided when possible due to its repetitive nature.

The choice of pipette is highly individual. The following factors are important in choosing a pipette that is comfortable for the user.

Hand size. This is the most important consideration. Someone with a large hand will likely find a different pipette comfortable to hold than a person with a small hand.3

Weight. A light weight pipette requires less force to hold.

Location of controls. Multi-finger controls help distribute the force among several fingers rather than continuously using the same finger. Some pipettes have a button on the top which may require the thumb to be repeatedly extended out of a relaxed, neutral position.

Force. It is best to use a pipette that requires as little force as possible to control.

To avoid repetitive pinching, use special tools (microtube openers) to open the micro vials.

Figure 13. Microtube Openers from Bel-Art (L) and Daigger (R).

Helpful Tips

1. Use adjustable chairs or ergo-task stools with built-in solid footrest.
2. Do not twist or rotate the wrist while pipetting.
3. Hold the pipette with a relaxed grip. Use minimal pressure while pipetting.
4. Limit periods of continuous pipetting to 20 minutes or less. Vary activities, or take frequent short breaks (e.g., 2 minutes for every 20 minutes of pipetting).
5. Share tasks with someone else or or plan the work day so that other tasks are interspersed frequently. Pipetting for longer than 2 hours on a continuous basis per day may increase the risk for MSD.

- Avoid elevating arms and elbows above shoulder for lengthy periods to prevent static work of arm, and shoulder strain

Perform the work only at appropriate heights. Adjust the height and position of sample holders, solution container, and waste receptacle to prevent twisting and bending of the wrist, neck and arms, elevation of the shoulders, and overreaching. Heights should all be approximately the same, and these items should be within easy reach in a logical work order. Keep head and shoulders in a neutral position (bent forward no more than 30 degrees).

- Work with arms close to the body to reduce strain on shoulders. Reduce shoulder strain; avoid working with winged elbows/arms. Don't elevate the arm without support for lengthy periods.
- Use low profile waste receptacles for used tips. These should be no higher than the top of the tubes being filled.

6.5 Microscopy

Operating a microscope for long hours will strain the neck, shoulders, eyes, lower back, arms and wrists. Working at a microscope that is not at the correct height and angle requires a hunched position and contact stress on the forearms from the work surface edge. Poor posture and awkward positioning are the primary risk factors for full-time microscopists, and can lead to musculoskeletal disorders.

Figure 14. Light microscopy, researcher at a hunched position

Associated Risk Factors

- Awkward and static posture of the lower back
- Lack of adequate leg and knee clearance under work table
- Working with elbows winged
- Pinch grip when adjusting binocular eyepiece
- Wrist and palm contact pressure in the carpal tunnel area
- High repetition
- Eye strain and fatigue
- Awkward and static posture of the neck and head

Preventive Measures

Many new microscopes now incorporate many features that reduce soft tissue problems and other strains.

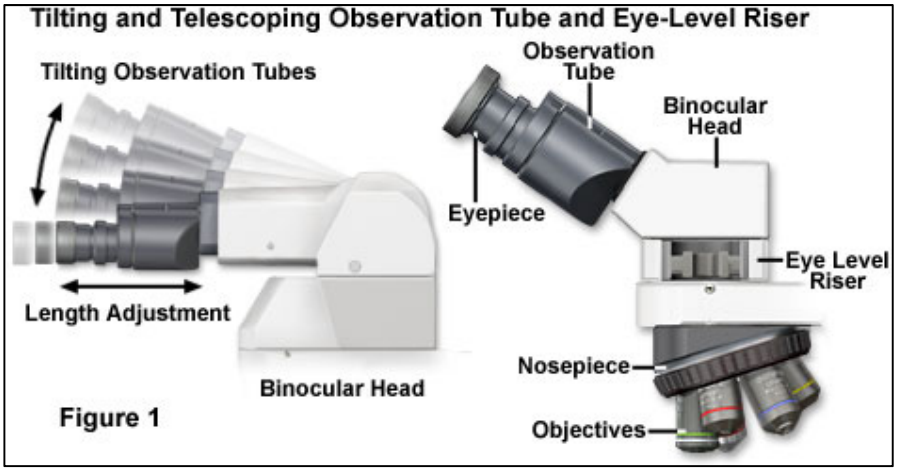


Figure 15. Microscopes with tilting observation tubes (Nikon)

Older microscopes do not account for variability in operator sizes and positions. If a new microscope is not in the budget, there are numerous options for adapting an older microscope to the user. These are generally not expensive and can greatly increase comfort level. Provided here are some basic guidelines, which if followed, may reduce the incidence of musculoskeletal disorders, by achieving and maintaining a neutral body posture while using a microscope:

Posture and positioning

1. Pull the microscope toward the edge of the work surface that has enough space for forearm support. Set it over a space with adequate room for the legs so the user can sit directly under the microscope.

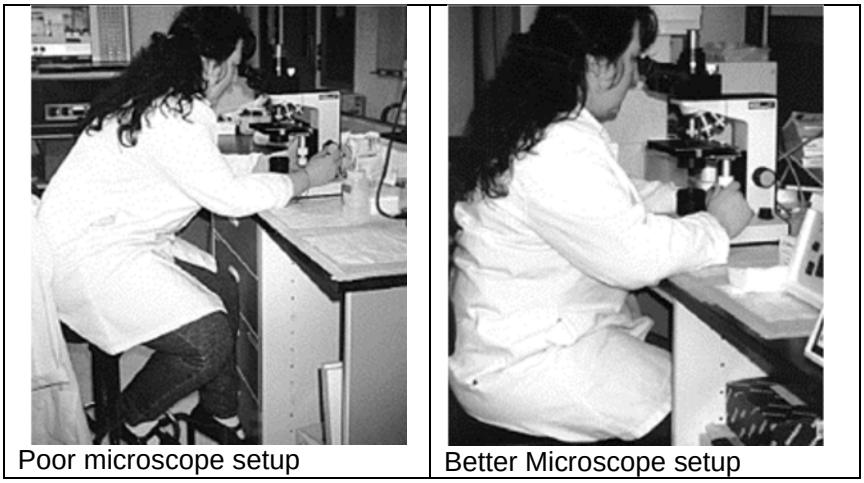


Figure 16. Poor vs. good body setup for microscopy tasks

2. The head should be upright and the line of sight approximately 30-45º below straight ahead vision. Tilting the head forward causes increased strain on the neck and shoulders. An upright head weighs approximately 4.5-8.0 kg. Tilting the head 15º forward increases the load to approximately 15 kg.

3. Adjust the microscope height and angle, in addition to bringing it close to the edge of the work surface, to allow the head position to be upright. Use extended eye tubes, optical wedges (positioned between the binocular head and the body of the microscope) and/or variable height and slant adapters to achieve proper neck and head position. A 5 cm binder can be used to angle the microscope forward if a more elegant solution is not available.

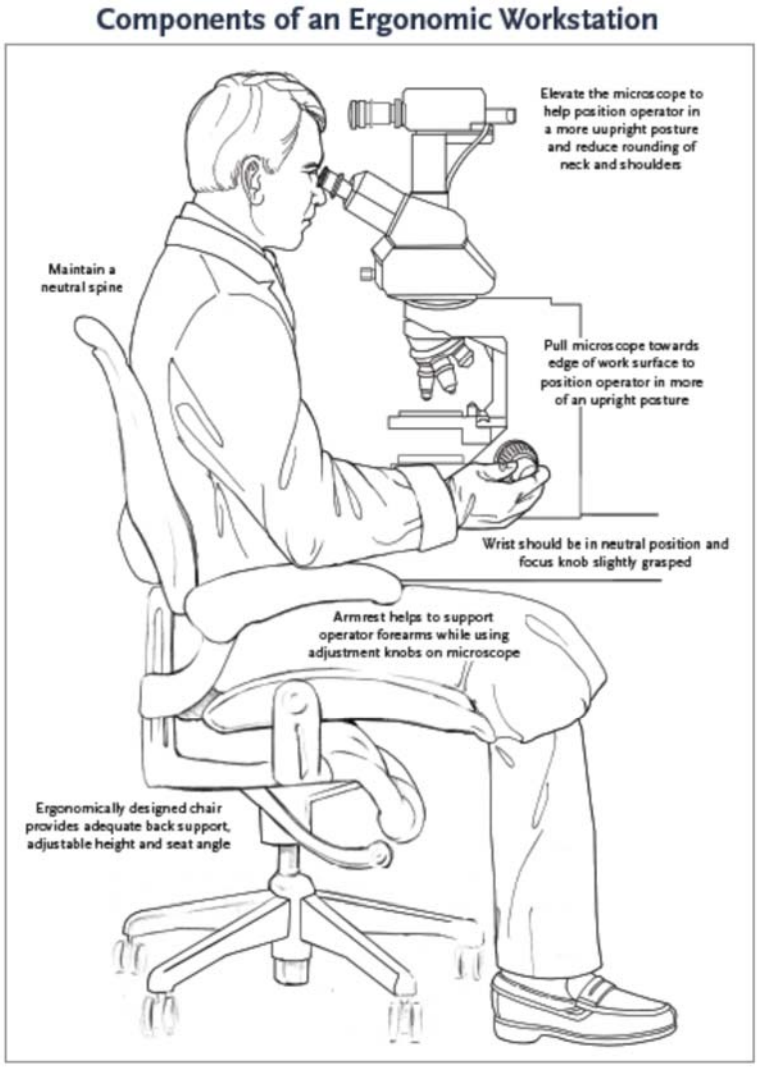


Figure 17. Ergonomic tools for a microscopy task (Photo Credit: National Institute of Health, US)

Figure 18. Height and slant adjustment of microscope (MarketLab)

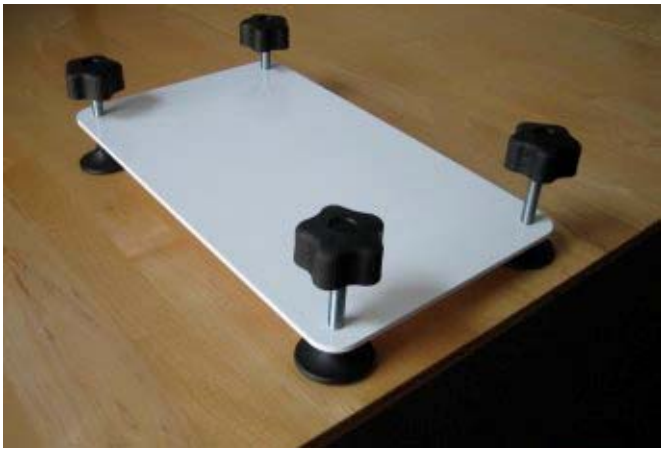


Figure 19. Adjustable Microscope Base (Point-O-Care)

Figure 20. Extended Eyetube (Bay Optical)

Figure 21. Microscope Height Adapter (Bay Optical)

Figure 22. Optical Wedges (Bay Optical)

4. Remove armrests from chairs if they interfere with the arms. Armrests designed specifically for lab work that support the arms in the forward position while adjusting the knobs are helpful. Apply padding to the edge of the work surface in the form of foam rolls or padded edge protectors where arms are in contact with surface edges.

Figure 23. Microscope Arm Rests

5. There are a number of new innovations in the microscope technology which will make the job of researchers easier and less stressful to the body. This microscope (Lynx from Vision Engineering) enables a wide range of head movement and body position that greatly reduces fatigue.

Figure 24, Lynx stereo zoom microscope (Vision Engineering)

6. Tilt storage bins toward the user to reduce awkward postures while reaching for supplies.

Figure 25. Microscope Organization Station (MarketLab)

7. Enlarge small hand tools by placing cylindrical foam around them.

Figure 26. Foam tubing (GripWorks)

8. Make simple tool modifications if users are not able to keep the wrists straight.

Eye strain prevention

1. Make sure the scope is clean, lighting is adequate, and the microscope lamp and optical pathway are correctly aligned.
2. Whenever possible, use a video display terminal to view the sample; this will also reduce neck strain. The monitor needs to be placed at eye level, straight ahead and at an easy viewing distance to avoid eye and neck strain. The MiniVid camera fits into the eye tube of most microscopes and can be used to view or record digital or video images with a TV or other multi-media equipment. It can also be used as a hand-held camera.

Figure 27. MiniVid Microscope Camera (Microscopes USA)

The Isis eyepieces from Vision Engineering can fit onto most microscopes and through lenticular array technology, allows viewing from a greater distance, healthy head movement and easier use of glasses.

Figure 28. Isis 'Expanded-Pupil' eyepieces (Vision Engineering)

3. An eye exam is needed if the user is having problems seeing the work and wear glasses if needed, especially if there is astigmatism. Blink often, closing eyelids completely to keep eyes moist.
4. Focus on a distant object, at least 3 meters away, every 15 minutes to rest the eyes from close-up focusing.
5. Cup the hands and place them gently over the eyes for a minute to rest them from the light, though don't touch or rub the eyes. (refer to Appendix B – Eye Exercises)
6. Check the lab environment for excessive glare and reflections from overhead lighting, and adjust internal microscope light to compensate. Excessive microscope illumination can cause a high level of light and contrast, resulting in eye strain. This can be reduced by proper configuration of the lamp voltage and the condenser aperture.

Operating a microscope for long hours puts much strain on the neck, shoulders, eyes, lower back, and arms/wrists.

Helpful Tips

- Do not work with elbows winged. Keep elbows close to sides, below 45-degree angle.
- Objects that must be accessed frequently should be kept close enough to avoid having to stretch and strain, usually within a distance of 20-65 cm.
- Make sure to work with wrists in neutral (straight) position. Avoid forearm and wrist contact pressure.
- Ensure that feet are flat on floor or supported by footrest.
- Avoid raising shoulders and bending neck while looking through microscope's eyepiece.
- Prevent repetition, and alter prolonged awkward posture. Take adequate small breaks, or perform other job tasks that require less repetition, rest the eyes, neck, and shoulders.
- Use a fully adjustable ergo-task chair or stool with built-in solid footrest.
- Reduce fatigue by taking micro-breaks, 20-180 seconds at 10 to 15 minute work intervals. Use this time to stand and/or stretch, and allow the eyes to focus at a distance
- Use lifters and angled microscope arm supports to relieve fatigue and strain.
- Ensure that sufficient knee and leg space is available.

Additional recommendations based on time spent per day at the microscope:

1-2 hours/day

- Adequate clearance (a minimum of 5 cm) between the thigh and desk or counter with the leg-well free from obstructions.

2-4 hours/day

- Microscope tilted slightly forward or utilization of wedges, extenders, and/or eye-level adjustments.
- Proper arm support, keeping the limbs close to the body with the forearm parallel to the floor and resting on the bench top. Use armrests for older microscopes having controls located in high positions.
- Padded edges for workstations or countertops to avoid contact stress on arms.

4-6 hours/day

- Adjustable microscope eyepieces should be installed, if possible.
- Electrically powered focus adjustments and objective rotation if more than half the total time on the microscope is spent twisting the coarse and fine knobs while transitioning the magnification factor.

6 hours or more/day

- Adjustable microscope eyepieces and ergonomically positioned microscope controls.
- Electrically powered focus and objective rotation. If configurations permit, powered control of the condenser aperture diaphragm, illumination intensity, and beam splitters.
- Video monitor or television screen for examination of repetitive specimens (the monitor should be placed in the operator's primary field of view).
- Easily adjustable work surface variables, such as bench height, armrest base angle, observation eye-level, and microscope height (essential in a multi-user workstation environment).

6.6 Biosafety Cabinets (BSCs) and Laboratory Hoods

Working in Biological Safety Cabinet (BSC's) or fume hoods often requires laboratory personnel to assume a variety of awkward postures due to limited work access and space, which restrict arm movement, and therefore significantly increase the amount of stress on joints of the upper limbs, neck, and back. Posture is forward, often hunched, and the worker must reach forward.

Figure 29. Awkward posture during a pipetting process

Associated Risk Factors:

- Repetitive motions of the hands, wrist, and forearms, especially when pipetting is involved
- Constrained knee and leg space, especially in fume hoods and older BSCs
- Contact pressure on the forearms, wrists and knees, or legs
- Awkward and static posture of the neck, torso, legs, arms and wrists
- Constrained body position, overloading muscles, tendons, and joints in asymmetrical manner
- Working with elbows winged
- Overreaching
- Prolonged standing in unnatural positions or in restricted postures

Preventive Measures

New technology are available that can minimise the bent, forward posture of traditional hoods by providing height adjustable tables with downdraft or backdraft rather than the traditional updraft exhausting.

Newer BSC's incorporate the following features:

- A perforated front grill reduced by 2.5-5 cm allows the work platform to be closer to the worker
- Adjustable height
- Non-glare glass on the sash window and/or adjustable plexiglass barriers
- A platform with wells for placement of tall containers to reduce reaching

Figure 30. Ergonomic chair with adjustable height

Figure 31. Armrest and elbow rest at a BSC

Figure 32. Adjustable footrest

Work Practices

- Avoid prolonged contact pressure (forearm and wrists contact with sharp edges).
- Reduce eyestrain and awkward posture by keeping viewing window of hood/BSC clean, and line of sight unobstructed.
- If possible, raise cabinet 5 cm upward to create a more conformable leg and thigh clearance.
- Position materials in laboratory hoods/BSCs as close as possible to avoid extended reaching. Perform work at least 15 cm back into the laboratory hood for safety reasons.
- Use a fully adjustable ergo-task chair or stool with built-in solid footrest. Apply foam padding to the front edge of the hood/BSC (away from the downdraft) to reduce contact forces with the forearm and wrists.
- Use an anti-fatigue mat or supportive shoes if the user will be standing for long periods of time while working in hoods/BSCs.
- To prevent eyestrain, make sure that lights in hoods/BSCs are working properly.
- Use proper sitting posture and positioning.
- Take frequent mini-breaks to stretch muscles and relieve forearm and wrist pressure caused by leaning on front edge of hoods/BSCs.

6.7 Microtomes

Manual rotary microtome used in histology laboratories requires performing many repetitive tasks. A laboratory personnel may use between 40 and 50 cassettes or blocks a day and turn the microtome wheel for at least a thousand times. Turning the microtome's wheel also requires force or forceful exertion. Other repetitive microtome-related functions such as replacement of specimens and use of trimming wheel increase the probability of acquiring MSD.

Figure 33. Microtome handling

Preventive Measures

If feasible, provide an automatic microtome to replace a manual unit. Retrofit the existing handle with an adapter that will allow the operator to use the handwheel in a pistol grip, thus alleviating repetitive wrist flexion and extension.

Figure 34. Automatic microtome (Vibrotome)

Work Practices

- Reduce force when operating handwheel.
- Adjust the feed wheel position to reduce stress.
- Use motorized cutting.
- Use an external control unit like a front pedal instead of the hand-operated wheel.
- Apply padding to the work surface and the edge of the work surface to eliminate sharp edges and increase the amount of blood flow to the hands.
- Rotate tasks and take frequent short breaks every 20 minutes.
- Use a fully adjustable ergo-task chair or stool with built-in solid footrest.
- Place the microtome on an appropriate height work bench for standing or sitting. If sitting, make sure there is adequate clearance for legs and thighs.

6.8 Cryostats

Figure 35. Cryostat handling

The following are recommended for control of ergonomic hazards associated with the use of a cryostat:

- Consider using an automatic foot operated cryostat when frequent cryosectioning is performed.

Figure 36. Cryostat with foot control (Leica)

- Avoid placing utensils such as forceps inside of the cryostat. Forceps should be placed outside of cryostat when not being used. This will keep the utensils at room temperature and reduce cold exposure to the hands and fingers.
- Use a fully adjustable ergo-task chair or stool with built-in footrest.
- Apply padding to the edge of the cryostat to reduce contact stresses.
- Take short stretch breaks every 20 minutes.

6.9 Cell Counters

The following are recommended for control of ergonomic hazards associated with the use of a cell counters:

- Purchase an electronic differential tally counter to replace manual counter. Soft keys permit accurate and fast counting with decreased hand fatigue.

Figure 37. Soft-Key Electronic Cell Counter
(Modulus Data Systems)

- Reduce the force needed to strike the manual counter.
- Use an edge protector to reduce stress on the forearm and wrist.
- Take frequent short breaks.
- Rotate tasks among several people.
- Use an adjustable chair or ergo-task stool with built-in solid footrest.

6.10 Flow Cytometers

The use of a flow cytometer requires frequent lateral bending, neck and back flexion, and extended arm reaching. This is due to the receiving port being located on the bottom of the flow cytometer. The operator must sit in awkward positions in order to see the controls.

Figure 38. Flow cytometer handling

The following are recommended for control of ergonomic hazards associated with using a flow cytometer:

- Raise the flow cytometer by placing a block between the flow cytometer and the workbench.
- Purchase an electric or hydraulic adjustable table. Laboratory technicians will be able to adjust the flow cytometer to a height that is most comfortable for them.
- Use a fully adjustable ergo-task chair or stool with built-in solid footrest. Position the display so the top of the screen is approximately at eye level.

6.11 Glove Boxes or Anaerobic Chambers

Working in glove boxes or anaerobic chambers requires extended static loading on the shoulders. Extending the arms for more than a couple of minutes can become very exhausting. In addition to static loading and frequent side reaching, the thick gloves also make the user over compensate on grip strength.

Figure 39. Glove boxes/anaerobic chamber handling

Where possible, the following controls are recommended for ergonomic hazards associated with using a glove box:

- Move all materials to be used for the experiment from the side chamber to the main chamber at one time to reduce the amount of side reaching.
- Use highly absorbent hand powder for glove comfort.
- Utilize job enlargement to avoid long continuous use of glove boxes.
- Provide anti-fatigue mats for extended use of glove box.
- Take short breaks to perform stretching exercises to relieve static loading from the shoulders. This improves blood circulation to the arms and hands.

6.12 Micro-manipulation and fine motor skills

Many laboratory procedures require repetitive use of the extensor and flexor muscles of the fingers and wrist. For example, removing caps and screw-off lids from vials, reaching into bins, use of forceps, etc. all require the use of these small muscle groups or result in awkward postures.

The following are recommended for control of ergonomic hazards associated with micromanipulation techniques:

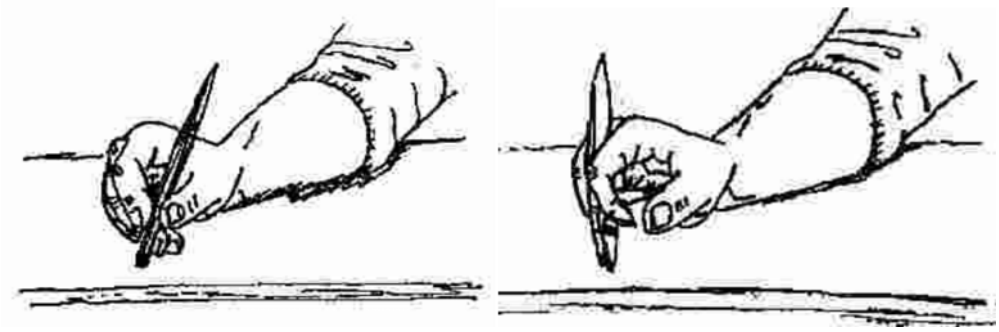
- Use plastic vials with fewer threads to reduce twisting motions during capping and uncapping lids.
- Use small pieces of foam, similar to the type used on pencils and pens to prevent soreness on the fingertips, where fingers and forceps articulate. This will distribute the force out over a greater surface area, thus reducing the compressive forces on the soft tissue.

Figure 40. Precision tweezers with foam/molded grips (Excelta)

Figure 41. Forceps grip enlarged with foam tubing.

Figure 42. Dissecting Needle grip enlarged with foam tubing

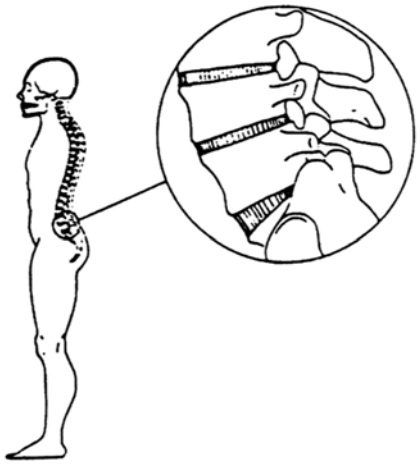
- Practice using forceps between the first and second digits instead of using the thumb and the first digit. Then try alternating between the two positions to reduce the use of the thumb extensors and flexors. The thumb is used repetitively with almost every job task performed in the laboratory.



- Tilt storage bins toward the worker to reduce wrist flexion while reaching for supplies.
- Take short breaks and do hand, wrist and forearm exercises

7 MANUAL MATERIALS HANDLING

Manual materials handling or lifting and moving tasks is another area in which injuries to laboratory personnel can occur. This type of work entails lifting, bending, and twisting, which can cause great damage to the human body if done improperly. The figure below points out the region most frequently injured from manual lifting activities.



7.1 General Lifting Guidelines

Plan the Lift

Before lifting or moving an object, plan out the movements. Make sure there is enough room to perform the task properly and ensure that any travel path is clear of obstacles. If lifting or moving an object as a team, make sure that all in agreement with how the lift and/or move will take place. Perform a countdown before actually lifting the object ("3-2-1-LIFT!") – communication and coordination is a key part of a well-executed team lift!

Close and Centered

Whenever lifting an object, start with and keep the object close to the body. A good way to do this is to have a diagonal footing when lifting an object off the floor (one foot to the side of the object, the other foot behind the object). If lifting straight up with this footing, the object will remain close to the body. The further the person lifts and/or holds an object away from the body, the more strain it places on the back muscles and bones.

Keep the object centered in relation to the body. Keeping the object centered will help to discourage from twisting or contorting the back while lifting or holding the object. Twisting, even while lifting or carry little or no weight, can cause back injuries.

Use "Core Strength"

Having a strong "core" essentially means having strong upper, middle, and lower abdominal muscles. By tightening up the core muscles when lifting and moving objects, it will place the back muscles in a good position for lifting/moving and will help to prevent excessive force on the spine. Doing sit-ups and leg lifts will strengthen the abdominal muscles and will do a lot to protect from a back injury.

Bend the Knees, Lift with the Legs

When lifting objects from down low, bend the knees and keep the back straight when setting up the lift. While lifting the object, use the large, powerful muscles of the legs to straighten the body up (rather than the smaller, weaker, and more vulnerable muscles of the back and arms). Keep the abdominal muscles tight when lifting.

Look Ahead

Keep eyes looking in front of and slightly upward when lifting and moving objects – this will keep the upper back and neck in the best position for lifting. Avoid bending the head or neck downwards when lifting.

Don't Go It Alone

If an object is too heavy, large, or awkward to lift or move for one person, get some help.

7.2 Working with Large Bins

Lifting objects from the bottom of large receptacles or bins can be difficult and often painful if performed improperly. This is because the sides of the bin restrict the ability to bend the knees to get down low to lift the object. There are a few techniques that can be used, however, to make this task a little easier and less risky.

The Tip-Down

If there is a relatively large and somewhat to very heavy object at the bottom of a bin that needs to be get out, consider using the "Tip-Down" technique. This technique involves tipping the bin on its side and squatting or kneeling to down to drag the object out of the bin. When squatting to drag the object out, bend the knees and keep the back straight.

The Golfer's Lift

If there is a small and light object that a person can pick up with one hand and that needs to be retrieved from a deep bin, use the Golfer's Lift. The Golfer's Lift gets its name from a type of lift often seen on the golf course for tee or ball retrieval.

Receptacle/Bin Set-Up

If there is a need to frequently move or store items in a deep bin, consider the type of bin used or simple alterations that can be made to an existing bin to make it easier to lift the objects out. Some bins have a fold-down panel that allow more freedom for knee bending when retrieving objects from the bottom of a large box or bin:

Figure 43. Bin with fold-down panel (Bremco)

Some bins have a cut-out section where items can be accessed more easily:

Figure 44. Bin with cut-out sections (ModLaundry)

If users do not have access to a bin with these special modifications, alterations can be made on existing bin to make it easier to move objects in and out. Place some empty boxes or other small, stable, and lightweight structures at the bottom of the bin to raise the "floor" of the bin. Once the heavier objects are placed higher up in the bin, it will require less effort to move the objects in and out:

7.3 Oversized Objects

Very large and/or heavy objects should always be moved in teams. The size of the team will vary depending on the weight and/or size of the object. Team members should be placed, at a minimum, at the ends of the object to maximize chances for even weight distribution. The lift and/or move should be planned out in advance and should be conducted with very good communication and coordination. Team members must avoid sudden movements.

7.4 Odd-Shaped Objects

Odd-shaped objects, especially if they are large, should also be lifted and moved in teams (see "Oversized Objects" above for more information on team lifting/moving). If moving a smaller, odd-shaped object alone, examine the object to determine how its weight is distributed before attempting to lift or move it. If the object has an unequal weight distribution (e.g., a sack full of grain), consider using the Tripod Lift.

7.5 Working with Bags and Boxes

There are many specific techniques for lifting and moving boxes and/or bags detailed in following section of this manual.

7.6 Proper Lifting Techniques

7.6.1 Basic Lift (Diagonal Lift) - This lift is the most common method of good lifting technique. Use the basic lift for objects small enough to straddle where there is enough room to use a wide stance.

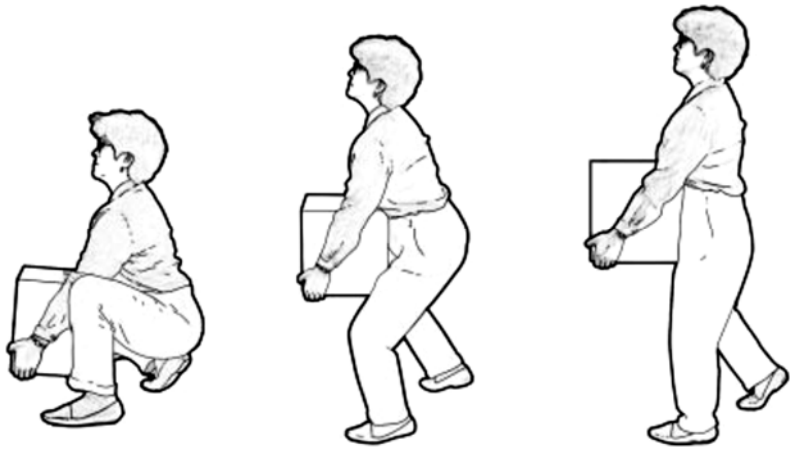


Figure 45. Basic (Diagonal) Lift

1. Get close to the object.
2. Stand with a wide stance: put one foot forward and to the side of the object.
3. Keep the back straight, push the buttocks out, and use the legs and hips to lower down to the object.
4. Move the load as close to the body as possible.
5. If the box has handles, grasp the handles firmly and go to step 9.
6. Put the hand (that is on the same side of the body as the forward foot) on the side of the object furthest from the body.
7. Put the other hand on the side of the object closest to the body. The hands should be on opposite corners of the object.
8. Grasp the object firmly with both hands.
9. Prepare for the lift: look forward.
10. Lift upwards following the head and shoulders. Hold the load close to the body. Lift by extending the legs with the back straight, the buttocks out, and breathe out as the object is lifted.

If done correctly, the head will lift up first, followed by the straight back. If the hips come up first and bend the back as the person straighten up, the lift is done incorrectly.

7.6.2 Power Lift - Use the power lift for objects too large for the person to straddle. This lift is very similiar to the basic lift. In the power lift, the object shifts the center of gravity forward, and must push the buttocks out to compensate. (Professional weight lifters lift using this position.)

Figure 46. Power Lift

1. Put one foot in front of the other using a wide stance.
2. Keep the back straight, push the buttocks out and use the legs and hips to lower oneself down to the object.
3. Move the load as close to the body as possible.
4. Grasp the object firmly with both hands.
5. Prepare for the lift: look forward.
6. Lift upwards following the head and shoulders. Hold the load close to the body. Lift by extending the legs with the back straight, the buttocks out (exaggerate this position), and breathe out as the object is lifted.

7.6.3 Tripod Lift - Use the tripod lift for objects with uneven weight distribution (example: sacks of food). Recommended for people with decreased arm strength. Not recommended for people with bad knees.

Figure 47. Tripod Lift

1. Put one foot next to the object. Keep the back straight, push the buttocks out and slowly lower self down onto one knee. (For support as the person lowers self down, put one hand on a stool or on the thigh for support.)
2. Position the object close to the knee on the ground.
3. Grasp the object firmly with both hands.
4. Slide the object from the knee on the ground to mid-thigh. Keep the head forward, the back straight, and the buttocks out, and lift the object onto the opposite thigh.
5. Put both of the forearms under the object (with the palms facing upward) and hug the object to the stomach and chest.
6. Prepare for the lift: look forward.

7. Lift upwards following the head and shoulders. Hold the load close to the body. Lift by extending the legs with the back straight, the buttocks out, and breathe out as the object is lifted.

7.6.4 Partial Squat Lift - Use the partial squat lift for small light objects with handles close to knee height.

Figure 48. Partial Squat Lift

1. Stand with the object close to the side.
2. Place the feet shoulder width apart, with one foot slightly ahead of the other.
3. Place one hand on a fixed surface (such as a table or stool) or on the thigh.
4. Keep the back straight, push the buttocks out and slowly lower down to reach the object's handles.
5. Prepare for the lift: grasp the object and look forward.
6. For support as the object is lifted, push down on the fixed surface (or on the thigh).
7. Lift upwards following the head and shoulders. Lift by extending the legs with the back straight, the buttocks out, and breathe out as the object is lifted.

7.6.5 The Golfer's Lift - Use the golfer's lift for small light objects in deep bins and to pick small objects off the floor. Recommended for people with knee problems or decreased leg strength.

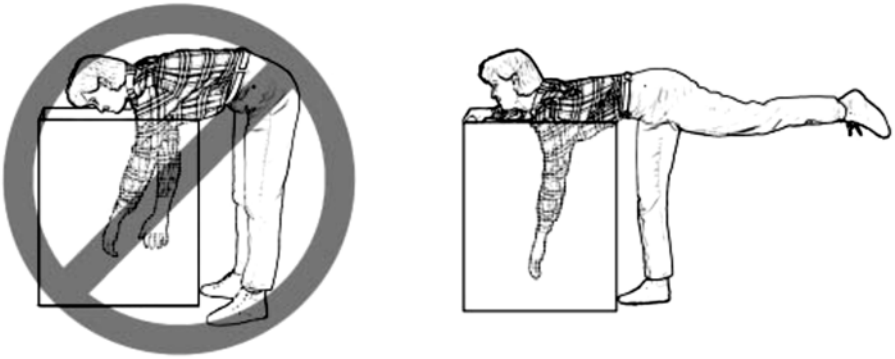


Figure 49. The Golfer's Lift

1. Place hand near the edge of a fixed surface (such as the edge of a table or bin). This hand will support the upper body during the lift.
2. Keep the back straight and raise one leg straight out behind while leaning down to pick up the object. The weight of the leg will counterbalance the weight of the upper body.
3. Grasp the object firmly.
4. Prepare for the lift: look forward. Keep the leg raised as the lift is started.
5. To lift, push down on the fixed surface leg is lowered. Keep the back straight and breathe out as the object is lifted.

7.6.6 Straight Leg Lift - Use the straight leg lift when obstacles prevent from bending the knees. Be careful! Lifts over obstacles that prevent from bending the knees increase risk for muscle strain. If possible, avoid this lift. Only use this lift when absolutely necessary (i.e. lifting out of a grocery cart, car trunk).

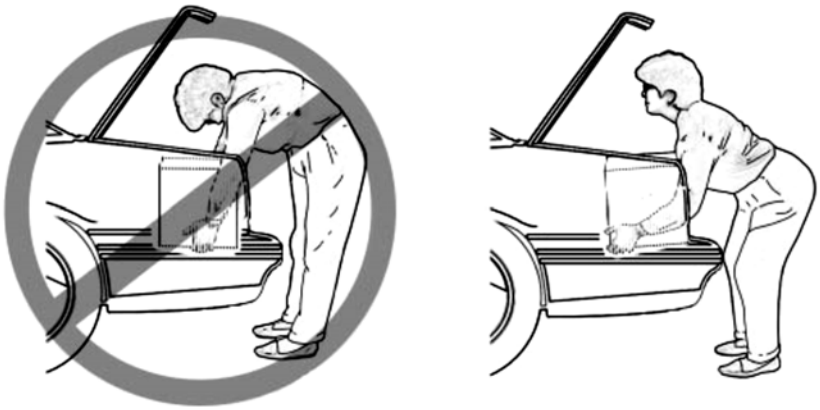


Figure 50. Straight Leg Lift

1. Stand as close to the object as possible with knees slightly bent.
2. Do not bend the waist! Push the buttocks out.
3. If the obstacle (preventing from bending the knees) is stable, lean the legs against the obstacle for support. Use the legs and hips to lower down to the object.
4. Grasp the object firmly with both hands.
5. Prepare for the lift: look forward.
6. Lift upwards following the head and shoulders. Hold the load close to the body. Lift by extending the legs with the back straight, the buttocks out (exaggerate this position), and breathe out as the object lifted.

7.6.7 Overhead Lift - Use the overhead lift to place objects on an overhead shelf. This lift begins with the object in the hands. Be careful! Overhead lifts increase the risk for muscle strain. It can be difficult to maintain balance during the lift. If possible, avoid this lift. Only use this lift when absolutely necessary.

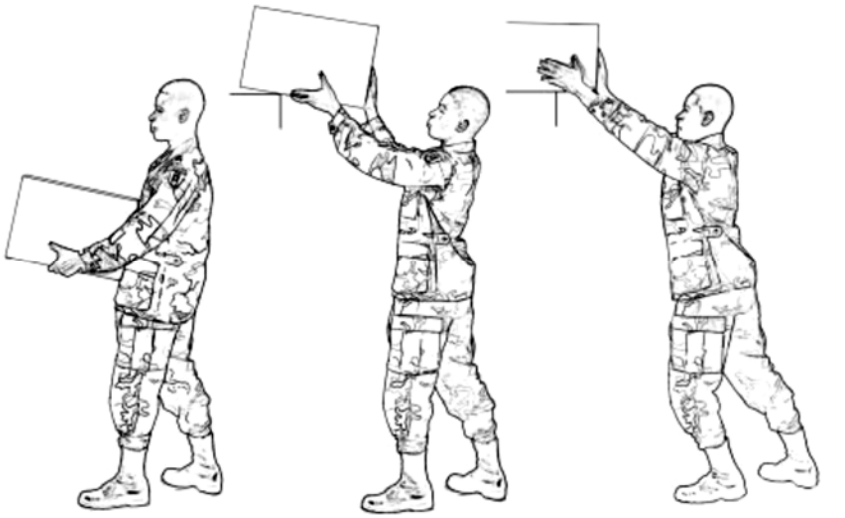


Figure 51. Overhead Lift

1. Hold the object very close to the body.
2. Keep feet shoulder width apart, one foot slightly ahead of the other.
3. Prepare for the lift: look forward.
4. Raise the object to shelf height using the arm and shoulder muscles. Keep the object close to the body and breathe out as the object is lifted.
5. While reaching the shelf, slowly shift the weight from the back foot to the forward foot. Keep the back straight.
6. When the load reaches the edge of the shelf, push the object onto the shelf.

7.6.8 Pivot Technique - When lifting an object and then turning to carry it away, it is common to twist the body. Twisting while lifting can cause serious damage to the tissues of the back. Use the pivot technique to avoid twisting while lifting.

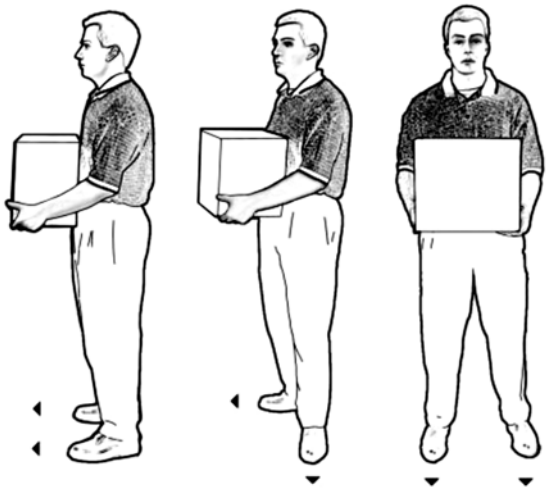


Figure 52. Pivot Technique

1. Lift the load using any of the previous techniques.
2. Hold the load very close to the body at waist level.
3. Turn the leading foot 90 degrees toward the direction to turn.
4. Bring the lagging foot next to the leading foot. Do not twist the body!

7.7 Examples of Lifting and Moving Tasks in the Laboratory

7.7.1 Centrifuge Rotors

Centrifuge rotors present a unique lifting hazard in the laboratory. Centrifuge rotors can weigh up to 15 kg and are awkward in shape. The following are recommended for control of ergonomic hazards associated with lifting centrifuge rotors:

Figure 53. Handling a centrifuge rotor

- Use a team approach to removing heavy centrifuge rotors. If the employee is small or not strong enough, use a second person to assist with the lifting task.
- Design a harness, which would wrap around the rotor and attach to straps that would come up out of the centrifuge to the laboratory worker. With a strap on each side of the rotor, two workers could pull out the rotor in the centrifuge. This would reduce low back flexion and decrease the load by one-half.
- Use a cart to transport the rotors

7.7.2 Overhead lifting

Due to limited space in the laboratory, many laboratory workers must store equipment and supplies on overhead shelves. This is a recognized risk factor for ergonomically related disorders.

The following are recommended for control of ergonomic hazards associated with overhead lifting:

- Use a footstool or stepladder to reach objects that are stored on shelves. Avoid asymmetric lifting (twisting while lifting). The object to be lifted should be directly in front of the worker.
- Store materials that are frequently used on shelving units no higher than shoulder height. Store heavy objects on shelves below shoulder height when possible.
- Store materials as close to the employee as possible or permitted. This reduces excessive reaching for objects.

8 ERGONOMIC HAZARDS IN MACHINE WORKSHOPS

Some tools in machine workshops are advertised as “ergonomic” or are designed with ergonomic features. A tool becomes “ergonomic” only when it fits the task the machine shop worker is performing, and it fits the hand without causing awkward postures, harmful contact pressures, or other safety and health risks. If a machine shop worker uses a tool that does not fit his/her hand or uses the tool in a way it was not intended, he/she might develop an injury, such as carpal tunnel syndrome, tendonitis, or muscle strain. These injuries do not happen because of a single event, such as a fall. Instead, they result from repetitive movements that are performed over time or for a long period of time, which may result in damage to muscles, tendons, nerves, ligaments, joints, cartilage, spinal discs, or blood vessels.

8.1 Epidemiological studies

Several case reports in literature have cited certain occupational risk factors at machine workshops which give rise to musculoskeletal disorders. In addition, epidemiologic studies (cross-sectional and case-control retrospective studies) have examined the association between job risk factors (such as repetition, awkward postures, and force) and excess musculoskeletal morbidity. While more studies are needed to quantify the relationship between job risk factors and musculoskeletal disease outcome, there is enough information to show there is a relationship between the two. A proactive approach to reduce these risk factors should result, in time, in a reduction in occupationally-related musculoskeletal disorders.

8.2 Upper Limb Injuries

Work-related musculoskeletal disorders (WRMDs) of the upper limbs have been associated with job tasks at machine workshops, which include: (1) repetitive movements of the upper limbs, (2) forceful grasping or pinching of tools or other objects by the hands, (3) awkward positions of the hand, wrist, forearm, elbow, upper arm, shoulder, neck, and head, (4) direct pressure over the skin and muscle tissue, and (5) use of vibrating hand-held tools.

Engineering controls are the preferred methods to reduce WRMDs. Examples include selecting the right tool for the job, using power tools instead of non-power tools, and providing jigs and fixtures to hold and orient parts so the job can be done in a comfortable manner. Administrative controls such as work rotation can be used as an interim measure.

8.3 Lower Back Injuries

Occupational risk factors at machine workshops for low back injuries include manual handling tasks, twisting, bending, reaching, lifting excessive weights, prolonged sitting, and vibration. Some nonoccupational risk factors other than physical stress for low back injury include obesity, genetic factors, and job satisfaction. Controlling and preventing job-related low back pain can be accomplished, in part, through the evaluation of jobs and the identification of job risk factors. Redesign of jobs can lead to the reduction of these risk factors and good job design initially will prevent back injuries. Multiple approaches such as job redesign, worker placement, and training may be the best methods for controlling back injuries and pain.

8.4 Ergonomic Hazards in NUS Machine Workshops

Powered tools and hand tools like drills, grinding and welding machines, cutting machine and saw, are commonly used in machine workshops. Activities like lifting, lowering, pushing,

pulling, carrying or moving load are rather common in machine workshops. If manual handling is carried out without proper postures or use of lifting aids, musculoskeletal disorders (MSDs) may result. MSDs can affect body parts including muscles, joints, tendons and nerves.

In NUS, machine workshops can be found at the Civil, Environmental, Mechanical Engineering and Physics Departments. Some of their activities include arc and gas welding (silver soldering); the use of band saw, circular saw, lathe, vertical milling, turning, bench-mounted grinding, and horizontal surface grinder machines, pedestal grinders, carbide cutters, power hydraulic press; hand and explosive tools; clamping, cutting, and drilling activities.

8.5 Ergonomic Risk Controls for Machine Workshops

Ergonomic Hazard	Risk Controls
 Manual handling hazard: lifting and carrying loads	Adopt proper lifting technique. Step 1: Assess the load and plan the lift. Do you need help? Can you use any lifting equipment? Clear the path of any obstruction. Place one foot at the side of the load and one foot behind the load.  Step 2: Bend your knees and keep your body straight. Bring the object close to your body, grasp the object firmly and hold the object close to the body. Keep your arms, chin and elbows as close to your body as possible. Distribute your body weight equally to both feet.  Step 3: Lift the object by pushing up on your legs. Avoid jerking or twisting your back.  Step 4: Ensure feet are stable. Ensure a good grip on object before moving off. Keep your head up while moving.

Awkward postures that strain the neck, shoulders, elbows, wrists, hands, or back(e.g., bending, stooping, twisting, and reaching)

- Adopt a steady posture. Avoid awkward posture and over-stretching.

Ergonomic Hazard

Pinch grip

Use of pinch grip: a hand grip that

Risk Controls

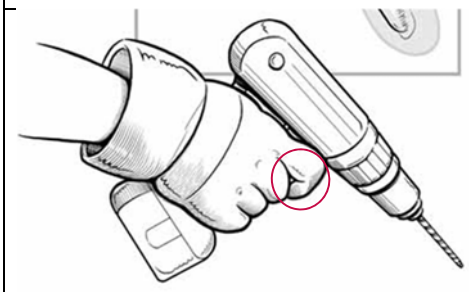
Use power grip

provides control for precision and accuracy. The tool is gripped between the thumb and the fingertips. The problem is this type of grip produces less power. Exerting force with a pinch grip means the employee has to work harder to get the job done.	Power grip is recommended if the employee works in a cramped area and high force is required.
 Sitting while troubleshooting an equipment (e.g., removing/tightening screws)	 Stand while repairing equipment or removing tightening screws. This helps in eliminating awkward posture of the arm, elbow and wrist, and minimizes pain and fatigue of the arms.

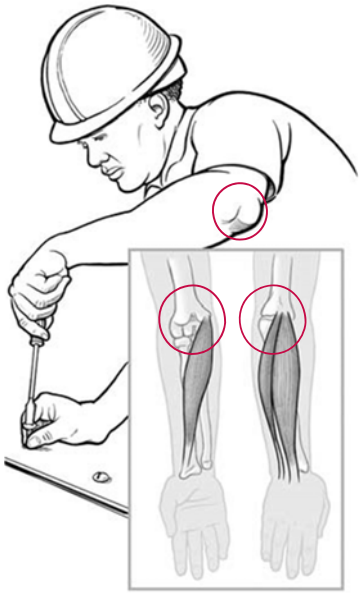
Ergonomic Hazard	**Risk Controls**
	

 Standing while repairing an equipment (e.g., removing, tightening screws)	 Reposition the workpiece (above) in such a way that the arm and elbow will be at the same level of the work surface. Working also on a lower work surface (below) will help avoid bending of elbow and arm.
 Use of a tool handle when the hand force is applied horizontally	 Use a tool with bent handles when the force is applied horizontally (i.e., in the same direction as your straight forearm and wrist.

Ergonomic Hazard	**Risk Controls**
	

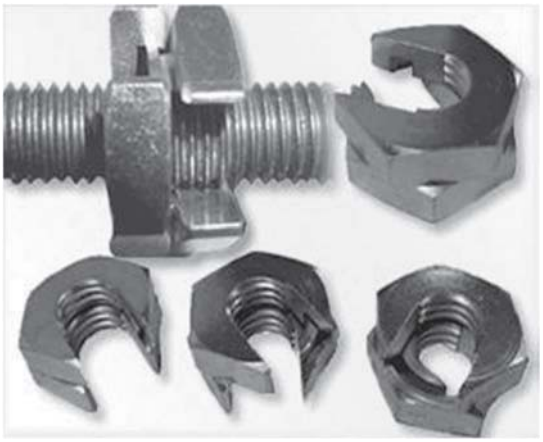
Use of tool with bent handles when hand force is applied vertically	Use a tool with straight handles when hand force is applied vertically.
	
Use of a tool whose handle is too short. The end will press against the palm and may cause an injury.	For tasks requiring high force, select a tool with a handle length longer than the widest part of your hand, usually 4 to 6 inches. The end of the handle should not press on the nerves and blood vessels in the palm of your hand.
	
Repeated pressure on a finger (such as when using the trigger on a power tool) may strain the tendon running to that finger, as well as the tendon covering. This may cause discomfort or pain.	Use a tool that is powered by battery or pneumatic (i.e., powered by compressed air). This way, there is no need to pull the trigger. This eventually reduces stress to fingers, hand and the forearm. An example is the power caulker gun above where pulling the trigger is not needed in applying the caulk or sealant.

Ergonomic Hazard	**Risk Controls**
	Pick a tool that will keep the wrist and elbow straight when it is used. A tool with a bent handle may work best if horizontal force is applied (i.e., in the same direction as the straight forearm and wrist). A tool with a straight handle may work best if an upward or



Forceful twisting motions may cause strain on elbow tendons, causing discomfort or pain. This condition can lead to epicondylitis, also known as tennis elbow. A good example is tightening a standard lock nut around the thread on a long rod.

downward force is applied.

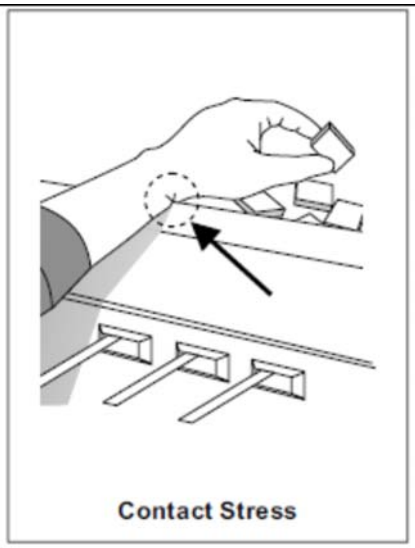
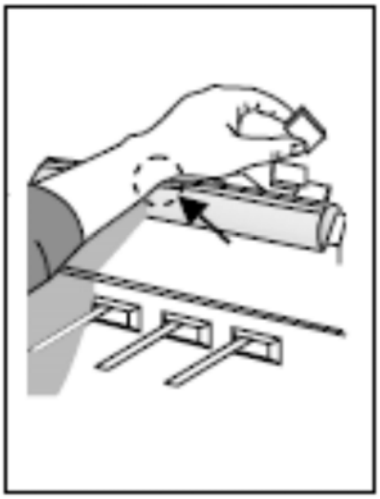


If the twisting of the hand is caused by tightening a standard lock nut around the thread on a long rod, a quick-threading lock nut can be used. Depending on the type of nut, these can either snap onto an all-thread rod at any position, or slide up and down the rod freely. This helps eliminate the repeated hand, wrist, forearm, and elbow twisting. It also reduces the time spent working above the shoulders because they can go on faster into the rod.

Ergonomic Hazard	**Risk Controls**

 Tools having finger grooves. This can possibly strain the hand, wrist and forearm.	 Use tools with soft grip and spring-loaded handle, or tools with offset handles that can help keep the wrist straight.
 Operating vibrating tools like needle guns, chipping hammers and rotary hammer drills may lead to finger discoloration, tingling, and numbness. Gangrene is possible in the most severe cases.	 Use reduced vibration power tools. These tools should always be used with fully-fingered anti-vibration gloves that are certified to meet ISO 10819. Always keep your hands warm when using any vibrating tool, and use as light a hand grip as possible.

Ergonomic Hazard	Risk Controls

 Repeated or continuous contact with hard or sharp objects , such as non-rounded desk edges or unpadded, narrow tool handles may create pressure over one area of the body (e.g., the forearm or sides of the fingers that can inhibit nerve function and blood flow.	 Install round or pad edges of guards, containers or work tables.
 Wrist deviations	 Use a turntable with fixture to hold the work. Select a tool that reduces wrist deviations.

9 MEDICAL MANAGEMENT

The University provides medical care to all employees injured at work. Staff and students who experience discomfort or symptoms associated with MSD should immediately report verbally and/or in writing, to their direct supervisor.

In the event of a possible work-related injury or illness, the staff or student should seek medical consult with the Occupational Health Clinic or the University Health Center (UHC).

Occupational Health Clinic
Office of Safety, Health & Environment (OSHE)
University Health Centre, Basement
20 Lower Kent Ridge Road, Singapore 119080.

University Health Centre (UHC)
http://www.nus.edu.sg/uhc/

Main Clinic
Kent Ridge Campus
20 Lower Kent Ridge Road
University Health Centre, Level 1
Operating Hours

Mon – Thur	8.30am – 6pm
Fri	8.30am – 5.30pm
Closed on	Sat, Sun & Public Holidays

Closed for lunch from 12.30pm – 1.30pm
Last registrations are 15 mins before closing time
General Enquiries: 6601 5035
uhc_health@nus.edu.sg

Satellite Clinic
Bukit Timah Campus
469G Bukit Timah Road
Block B, #02-01, Multipurpose Auditorium
Operating Hours

Mon/ Wed/ Fri	8.30 – 10.30am (during term only)
Closed on	Tue, Thu, Sat, Sun & Public Holidays

Last registrations are 15 mins before closing time
General Enquiries: 6467 5492
uhc_health@nus.edu.sg

The medical professional will:
- Provide diagnosis and treatment
- Determine if reported MSD signs or symptoms are work-related
- Recommending restricted, modified, or transitional work duties when appropriate
- Refer the staff/student to other clinical resources for therapy or rehabilitation

Any injury identified and diagnosed as a work-related MSD by a medical professional should be immediately reported to OSHE via the online Accident/ Incident Reporting System (AIRS) http://nus.edu.sg/osh/services/airs.htm.

10 REFERENCES

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APPENDICES

Appendix A – Laboratory Ergonomics Evaluation Checklist

Reducing Ergonomic Risks in Laboratories

This document will help you identify risk factors associated with laboratory environments. Designed for use by both safety specialists and laboratory workers, the checklist also includes information to help eliminate or reduce identified risks.

How to Use the Checklist

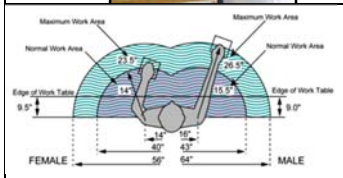
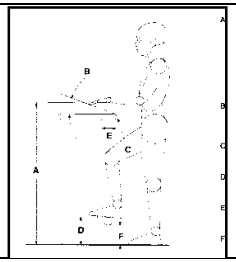
Step One: If you work with a safety and health professional or safety and health committee, see if the following information if available for your laboratory: (1) list of musculoskeletal injuries; and (2) worker complaints or concerns about performing specific tasks.

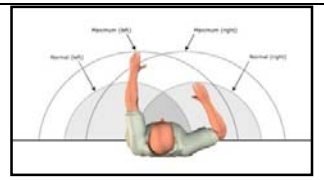
Step Two: Contact the staff and supervisor and discuss the purpose for performing the ergonomic survey. Ask the supervisors and workers if there are any issues or concerns that they have regarding laboratory work tasks.

Step Three: Complete the Laboratory Checklist for the tasks being completed in the laboratory. Answer N/A if the question does not apply to the task. Include all meaningful comments for each area.

Step Four: *Each "NO" answer indicates a risk of injury or sub-optimal condition*. For each "NO" answer, consider changes or modifications to the workstation or task to result in a yes response. When considering changes, obtain input from the workers, supervisors, and other safety and health specialists if available. Whenever possible, evaluate equipment before making purchases and before modifying the work areas or tasks. This process will help increase product acceptance, test product usability, and durability, and take advantage of worker experience.

Laboratory Ergonomics Checklist

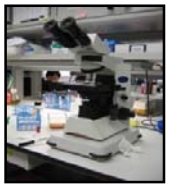
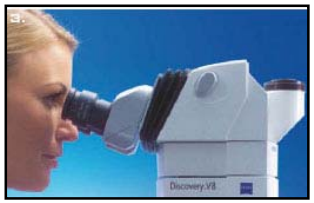
		Yes	No	Change/Modification	Comments
	Standing Bench				
	1. Is the height of the bench appropriate for the work performed? a. Work can be positioned close to elbow height (~90-100 cm) b. Work can be performed with shoulders relaxed	☐	☐	☐ Adjustable height benches ☐ Adjustable chair ☐ Temporary standing platforms ☐ Move the task to a seated bench with adjustable chair	
	2. Are primary work tools and supplies located within arm's reach (10-45 cm) from table edge?	☐	☐	☐ Reposition tools and supplies within 18" distance ☐ Provide tool organizers, turntable workstations, turntables, storage bins, pipette holders and carousels	
	3. Is there knee and foot clearance when completing standing tasks in front of the bench? a. 10 cm deep knee clearance b. 10 cm high and 10 cm deep foot clearance	☐	☐	☐ Work at open bench cut outs ☐ Remove supplies and equipment from bench cut out areas ☐ Modify bench surface with clamp on cut out extensions to increase knee and foot clearance	
	4. Is a foot rail or prop available (15 cm from floor)	☐	☐	☐ Install rails or foot props ☐ Use footrest ☐ If bench has undersurface cabinet, open or remove door and place foot on lower shelf	
	5. Are there floor mats in areas where prolonged standing tasks are completed?	☐	☐	☐ Provide floor mats ☐ Use cushioned shoes and in-soles	

		Yes	No	Change/Modification	Comments
					
	6. Does the bench have rounded or padded edges to reduce contact stress?	☐	☐	☐ Add edge rests and protectors to eliminate sharp edges ☐ Use gel pads on surface to protect elbows ☐ Wear custom padded sleeves under lab coat	
	7. Is standing bench available for tasks requiring frequent movement between workstations?	☐	☐	☐ Redesign work to reduce movement between stations to optimize workflow	
	Seated Bench				
	8. Are bench cutouts available for seated workers? a. Minimum 45 cm depth b. Minimum 50 cm width	☐	☐	☐ Redesign benches to provide cut-outs for seated work ☐ Provide sit-stand chairs to improve knee clearance when working ☐ Clear out cutouts if cluttered with supplies or equipment	
	9. Are work items within close reach? a. Maximum ~60 cm	☐	☐	☐ Reposition tools and supplies within 24” distance ☐ Provide tool organizers, turntable workstations, turntables, storage bins, pipette holders and carousels	

		Yes	No	Change/Modification	Comments
	10. Is seated bench available for tasks requiring precision and close inspection?	☐	☐	☐ Provide arm supports for stability if not available ☐ Provide sit-stand stools ☐ Provide adjustable work platforms to position work at optimal height	

	Laboratory Chairs	**Yes**	**No**	**Change/Modification**	**Comments**
	11. Can the laboratory chairs be adjusted to accommodate all workers? a. Seat height appropriate for work at height of benches? b. Feet supported on floor, ring or footrest?	☐	☐	☐ Provide chairs with adjustable height and angle seats and backrests ☐ Provide chairs with foot rings ☐ Provide footrests	
	12. Are armrests adjustable or removable if they interfere with work?	☐	☐	☐ Adjust armrests to provide support with shoulders in neutral postures ☐ Remove armrests	
	13. Are appropriate footrests or footrings provided?	☐	☐	☐ Provide industrial footrest ☐ Install foot ring on chair ☐ Install rail or platform	
	14. Do employees know how to adjust chairs?	☐	☐	☐ Train employees to adjust chair	
	Microscopes	**Yes**	**No**	**Change/Modification**	**Comments**

	15. Can employees view the eyepiece with neutral neck, shoulder and back postures? (Neck flexion < 25°, shoulders relaxed, back upright and supported by chair?)	☐	☐	☐ Reposition microscope ☐ Adjust height ☐ Adjust angle ☐ Reposition worker ☐ Adjust posture ☐ Adjust seat height ☐ Adjust seat angle ☐ use arm support/pad	

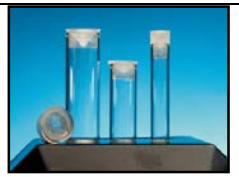
	Microscopes	**Yes**	**No**	**Change/Modification**	**Comments**
	16. Is the microscope positioned within easy reach of the worker? (i.e., generally close to the edge of the workbench)	☐	☐	☐ Reposition microscope ☐ Move closer to front of counter ☐ Reposition worker ☐ Adjust posture ☐ Sit closer to bench	
	17. Can the microscope be positioned to promote neutral head, neck, shoulders and arm postures when used?	☐	☐	☐ Reposition microscope ☐ Use microscope adapters ☐ Positioning plate ☐ Ergo adapter ☐ ScopEase ☐ Optical wedge ☐ Extended eyetube ☐ Eyepiece adapter ☐ Use video system	
	18. Are arms supported by worksurface, chair armrests, or pads for prolonged work?	☐	☐	☐ Use arm supports ☐ Use pads ☐ Adjust armrests ☐ Adjust worker position	

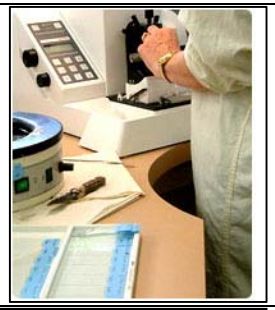
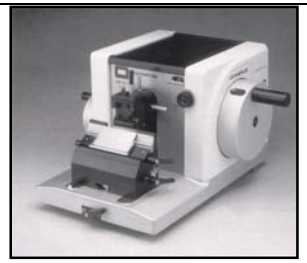
	19. Can the worker use the microscope controls with arms supported and relaxed?	☐	☐	☐ Reposition microscope ☐ Use microscope adapters ☐ Use arm supports/pads ☐ Adjust armrests ☐ Adjust worker position	
	20. Is there sufficient legroom and foot support when using the microscope?	☐	☐	☐ Work at bench cut-out ☐ Clear cut-out of clutter ☐ Provide footrest ☐ Provide foot ring	
	21. Are microscope work breaks provided?	☐	☐	☐ Institute work rotation ☐ Institute work breaks	

	Pipettes	**Yes**	**No**	**Change/Modification**	**Comments**
	22. Is manual pipette use limited to less than 4 hours per day?	☐	☐	☐ Institute work rotation ☐ Institute work breaks ☐ Consider use of alternative pipettes	
	23. If pipette use is more than 4 hours per day, are multi-channel, electronic or latch mode pipettes available?	☐	☐	☐ Evaluate use of alternative pipettes ☐ Electronic ☐ Latch-mode ☐ Multi-channel	
	24. Have employees been trained to select appropriate pipettes for pipetting task?	☐	☐	☐ Employee training	

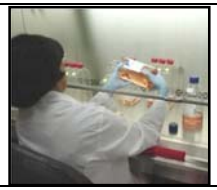
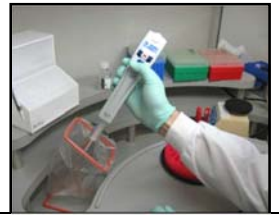
 	25. Are racks, trays, beakers and supplies available and placed within easy reach?	☐	☐	☐ Provide racks and trays ☐ Position supplies within close reach ☐ Use pipette racks and organizers	
	26. Are vials, tubes and receptacles as low profile as possible?	☐	☐	☐ Provide short beakers and vials ☐ Provide short tips and tubes ☐ provide short/angled waste receptacles	

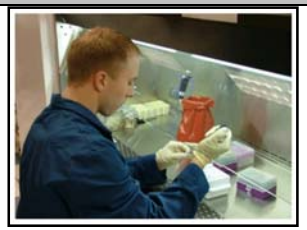
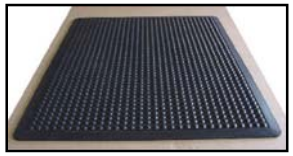
	Pipettes	**Yes**	**No**	**Change/Modification**	**Comments**
	27. Do workers pipette with shoulders relaxed, and arms and wrists in neutral postures?	☐	☐	☐ Employee posture training ☐ Adjust work position ☐ Adjust workstation set-up	
	28. Are rest breaks provided?	☐	☐	☐ Provide work breaks or work rotation	
	Micromanipulation	**Yes**	**No**	**Change/Modification**	**Comments**
	29. If forceps are used for prolonged periods, are locking mechanisms, o-rings or other adapted aides used to reduce prolonged or static pinch forces?	☐	☐	☐ Provide adapted tweezers/forceps ☐ O-rings ☐ Pads/foam grips ☐ Self-closing ☐ Low force tools ☐ Alternate fingers/hands	

	30. Are vials easy to cap and thread?	☐	☐	☐ Provide easy opening caps ☐ Provide vials with minimal number of threads	
 	31. Are cap openers available?	☐	☐	☐ Provide decapping tools	
	32. Are clamps and holders available to support test tubes and other materials that must be handled for prolonged periods?	☐	☐	☐ Provide vial clamps ☐ Provide racks, holders, shelves, or organizers	
	Microtome/Cryostat	**Yes**	**No**	**Change/Modification**	**Comments**
	33. Can workers operate the microtome with hands in a pistol grip position? (i.e., wrist aligned with forearm and in handshake position)	☐	☐	☐ Re-position worker ☐ Re-position height, angle or position of microtome ☐ Employee training in work postures ☐ Use foot operated controls ☐ Modify handle position	

	34. Is equipment placed in a bench cut out allowing for adequate leg and knee clearance?	☐	☐	☐ Work at bench cut-out ☐ Clear area around microtome/cryostat of obstacles	
	35. Is an adjustable chair available at the microtome or cryostat that provides back and foot support?	☐	☐	☐ Provide adjustable chair ☐ Provide chair with head support if working in reclined position ☐ Consider mirror system to improve view of samples	
	36. Do employees have access to a motorized microtome/cryostat for high intensity/volume work?	☐	☐	☐ Consider electronic cryostat for high volume workloads	

	Laboratory Hoods and Biosafety Cabinets	**Yes**	**No**	**Change/Modification**	**Comments**

	37. Is leg, knee clearance available to promote neutral sitting postures when using the hood or cabinet?	☐	☐	☐ Clear knee area under cabinet or hood ☐ Use sit/stand stool	
	38. Can workers work with shoulders relaxed when sitting or standing?	☐	☐	☐ Consider height adjustable hood or cabinet ☐ Use height adjustable stool/chair	
	39. Is padding available to reduce soft tissue compression (edge padding or arm pads)?	☐	☐	☐ Use elbow pads ☐ Use edge padding ☐ Use arm supports	
	40. Are materials inside the hoods and cabinets as close as possible to the worker to avoid over-reaching?	☐	☐	☐ Position receptacles within close reach ☐ Use turntables, rotating organizers, angled platforms	

	Laboratory Hoods and Biosafety Cabinets	Yes	No	Change/Modification	Comments
	41. Are vials, tubes and receptacles as low profile as possible?	☐	☐	☐ Provide low profile vials, tubes and receptacles ☐ Angle receptacles to position within closer reach	
	42. Are anti-fatigue mats used if employees stand for more than 4 hours per day?	☐	☐	☐ Provide anti-fatigue mats ☐ Provide foam insoles for shoes ☐ Provide supportive shoes	
	Miscellaneous	**Yes**	**No**	**Change/Modification**	**Comments**
 	43. Are bottle dispensers and bottom dispensing carboys available to dispense liquids?	☐	☐	☐ Provide bottle dispensers ☐ Provide bottom dispensing carboys ☐ Provide bottles with handles	
	44. Is there adequate and appropropriate storage for supplies? a. Is sufficient space available for supplies? b. Are heavy bottles and boxes stored on low shelves?	☐	☐	☐ Provide storage for supplies ☐ Place heavy items on shelves between knees and chest level	

	Miscellaneous	Yes	No	Change/Modification	Comments

	45. Are cut-outs clear of storage and available for use?	☐	☐	☐ Clear cut-outs of clutter ☐ Provide cut-out areas for working at bench using work surface cut-outs or platforms	
	46. Are jars easy to open or are jar openers available?	☐	☐	☐ Provide jar openers	
	47. Are temporary platforms available for tasks that require elevting arms above chest level for prolonged periods?	☐	☐	☐ Consider standing platforms or elevated work areas (Consider safety issues and reduce fall risks before using)	

	Miscellaneous	**Yes**	**No**	**Change/Modification**	**Comments**

	48. Are there adequate bins and racks for frequently used items?	☐	☐	☐ Provide bins, racks and shelves for frequently used items	

Appendix B - Eye Exercises and Stretches

Eye Comfort Exercises

A. Blinking (produces tears to help moisten and lubricate the eyes)
B. Yawning (produces tears to help moisten and lubricate the eyes)
C. Expose eyes to natural light

Palming

A. while seated, brace elbows on the desk and close to the desk edge
B. let weight fall forward
C. cup hands over eyes
D. close eyes
E. inhale slowly through nose and hold for 4 seconds
F. continue deep breathing for 15-30 seconds

Eye Movements

A. close eyes
B. slowly and gently move eyes up to the ceiling, then slowly down to the floor
C. repeat 3 times
D. close eyes
E. slowly and gently move eyes to the left, then slowly to the right
F. repeat 3 times

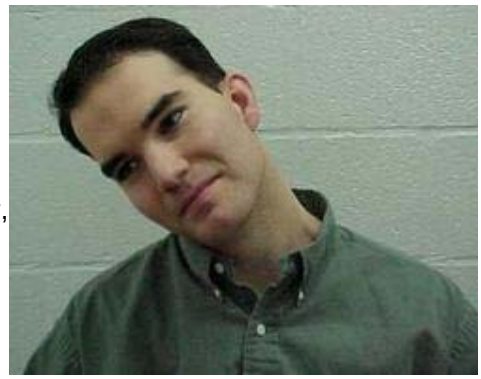
Focus Change

A. hold one finger a few centimetres away from the eye
B. focus on the finger
C. slowly move the finger away
D. focus far into the distance and then back to the finger
E. slowly bring the finger back to within a few centimetres of the eye
F. focus on something more than 2.5 metres away
G. repeat 3 times

Appendix C - Musculoskeletal System Exercises and Stretches

Deep Breathing

A. while standing, or in an otherwise relaxed position
B. place one hand on the abdomen and one on the chest
C. inhale slowly through the nose
D. hold for 4 seconds
E. exhale slowly through the mouth
F. repeat



Cable Stretch

A. while sitting with chin in, stomach in, shoulders relaxed, hands relaxed in lap, and feet flat on the floor, imagine a cable pulling the head upward
B. hold for 3 seconds and relax
C. repeat 3 times

Sidebend: Neck Stretch

A. tilt head to one side (ear towards shoulder)
B. hold for 15 seconds
C. relax
D. repeat 3 times on each side

Diagonal Neck Stretch

A. turn head slightly and then look down as if looking in your pocket
B. hold for 15 seconds
C. relax
D. repeat 3 times on each side

Shoulder Shrug

A. slowly bring shoulders up to the ears and hold for approx 3 seconds
B. rotate shoulders back and down
C. repeat 10 times

Executive Stretch

A. while sitting, lock hands behind head
B. bring elbows back as far as possible
C. inhale deeply while leaning back and stretching
D. hold for 20 seconds
E. exhale and relax
F. repeat 1 time

Foot Rotation

A. while sitting, slowly rotate each foot from the ankle
B. rotate 3 times in one direction, then 3 times in the opposite direction
C. relax
D. repeat 1 time

Hand Shake

A. while sitting, drop arms to the side

B. shake hands downward gently
C. repeat frequently

Hand Massage (Note: Perform very gently!)

A. massage the inside and outside of the hand using the thumb and fingers
B. repeat frequently (including before beginning work)

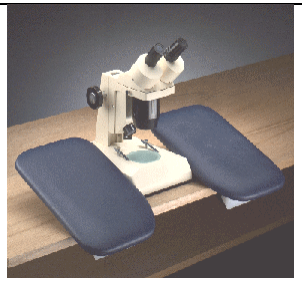
Finger Massage (Note: Perform very gently!)

A. massage fingers of each hand individually, slowly, and gently
B. move toward nail gently
C. massage space between fingers
D. perform daily

Wrist Stretch

A. hold arm straight out in front of you
B. pull the hand backwards with the other hand, then pull downward
C. hold for 20 seconds
D. relax
E. repeat 3 times each

Appendix D – Laboratory Ergonomics Products and Equipment

Laboratory Ergonomics	Features/Options	Image	Applications
Arm Supports/Padding			
Wedge-Ease Ergonomic Forearm Supports Source: http://www.wedge-ease.com/new/ Ships internationally: http://www.askergoworks.com/shippinginfo.aspx	• Vinyl w/ nonslip base • Four different sizes can be combined/stacked • Also available in ESD • and Clean Room • Four styles available in sloped wedge or flat.		• Can be used to provide angled and flat forearm support and to protect against contact stress. • Can be used in front of microscopes and to support forearms when doing precision tasks.
Morency Forearm support for microscopes Source: http://www.morencyrest.com/msm.htm Ships internationally for orders above $300: http://www.alimed.com/shipping-and-handling/	• 8” wide and 5” wide versions. • Includes a clamp the fits from 5/8 to 1 3/4 inch thick work surfaces. • Adaptor available for thicker workstations		Angle-adjustable forearm support for microscope users
Edge Rest Source: http://www.thehumansolution.com/deluxe-edge-protector-73075.html Ships internationally: http://www.thehumansolution.com/insh.html	• Attaches securely with self-adhesive hook and loop tabs. • 1 1/8" thick expanded urethane • Self-skinned foam surface wipes clean.		Fits over top edge of table surface for protection from sharp edges

Laboratory Ergonomics	Features/Options	Image	Applications
Alimed Ulnar Gel Pads 78336 Source: http://www.alimed.com/alimed/product/AliMedreg-Ulnar-Gel-Pads-Hand-Rest-Gel-Sleeves,14597,141.htm Ships internationally: http://www.4mdmedical.com/t-shipping.aspx	• Gel pads to place under elbow • Sold in pairs		Useful for pipetting and other high-precision tasks where the elbow rests on a hard surface
AliEdge Edge Protector http://www.alimed.com/Alimed/product/AliEdge,14448,132.htm Ships internationally: http://www.opentip.com/shipping.php	• Expanded polyethylene edge rest. • A hook and loop fastener is included for easy attachment. • Also available for corners		• Edge rest. • Can be used on the front edge of biosafety cabinets away from the downdraft
Nuaire Foam Elbow Pads Source: http://www.scientificvisions.com/catalog/product_info.php?cPath=32&products_id=30 Local distributor: **GAIA Science PTE, Ltd.** Blk 102F Pasir Panjang Road#06-03, 118530 **Email:** info@gaiascience.com.sg **Phone**+65 6276 8884	• Disposable white foam pad • Does not absorb liquid • Package of 10 • Self-stick adhesive tape		Easy to remove and replace foam elbow pads used to pad surface of biological safety cabinet to reduce soft tissue compression and discomfort.

Laboratory Ergonomics	Features/Options	Image	Applications
Micromanipulation – De-Capping Devices			
Decapitator 2 Drummond Scientific Company http://www.pipetaid.com/pages/new/new04.html Local distributor: **Bio-REV Pte Ltd**. 36 Toh Gulan Road East, #101-39 Enterprise Hub, Singapore 608580 Phone: 65-6273-3022 Email: sales@biog-rev.com	• Accommodates tube sizes from 0.2 mL to 2.2 mL • Comes with a sturdy lab bench stand.		• One-handed method for uncapping micro centrifuge tubes. • The unit provides two slots into which the user can insert the appropriate sized tube cap. Once secured, a slight downward pressure opens the tube.
MicroTube Tool Source: http://www.daigger.com/catalog/product?deptId=Microcentrifuge+Tube+Tools&prodId=4321 Ships internationally: http://www.daigger.com/service/index.jsp	Pack of 4		Tool to open snap caps and screw caps to Avoid pinching when opening microtubes.

Laboratory Ergonomics	Features/Options	Image	Applications
Microcentrifuge Tube Opener 199250001 http://www.belart.com/shop/199250001-microcentrifuge-tube-opener-p-199250001.html?cpath=18_114&oscsid=xogoeikoq LOCAL DISTRIBUTOR: Francis Ning Business Manager – Cole Parmer Asia Phone: (65) 67741394 Fax: (65) 67791062 fning@coleparmer.com	• 79mm long • 3 per bag • One end opens 1.5 to 2.2ml tubes • Forked blade on opposite end opens smaller sizes: 250m, 400m, and 550m tubes		Tube opener easily open all sizes of micro centrifuge tubes with just one hand.
Jar Openers			
Dycem Multi-Purpose Jar Openers http://www.amazon.com/dp/B002BUKCV4/ref=asc_df_B002BUKCV4845487?smid=A2VSTQ09J8RDTA&tag=dealt15484-20&linkCode=asn Ships internationally: http://www.berktree.com/info.html	• Non-slip plastic dome or sheet • Sheet diameter is 5 1/2" • Dome measures 2" high and 4 1/2" in diameter • 1/8" thick • Latex free.		Facilitate removal of stubborn jar and bottle lids. Simply place nonslip plastic dome or sheet on lid, grasp tightly and twist.

Laboratory Ergonomics	Features/Options	Image	Applications
Progressive International Multi-Opener Source: http://www.amazon.com/Progressive-GT-2950-International-Multi-Opener/dp/B0008D7GO2/ref=pd_sim_k_1 Ships internationally, access link above	• Opens 6 different types of seals and lids • Durable and comfortable grip • It has a hidden blade that zips open bags		Jar and seal opener that can be used with a variety of seals, lids and bags.
Micromanipulation Tools and Padding			
Thermo-Pellets for custom handles Source: http://www.ncmedical.com/item_961.html Ships internationally: http://www.ncmedical.com/custserv.html	1 and 3 lbs packages		• Low-temperature thermoplastic pellets mold together quickly and easily to adapt handles, splints and equipment. The pellets can be used to build up handles. • When heated to 60C, pellets soften quickly and can be formed into a mass that can be molded and remolded as needed. • Heat in water, on a heating plate or in a microwave oven. The thermoplastic will stick to most porous surfaces.
Precision hand tools with foam/molded grips Source: http://www.gripworks.com/stock-hand-grips.htm Ships internationally: http://www.gripworks.com/gripworks-locations.htm	Multiple styles of precision hand tools Foam grips		Molded and foam grips for precision hand tools manufactured by Excelta.

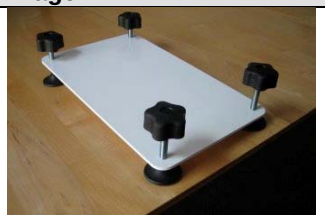
Laboratory Ergonomics	Features/Options	Image	Applications
Low Force Forceps Source: http://www.leica-microsystems.com/products/total-histology/consumables/autopsy-dissection/dissection/details/product/512-14cm-ergonomic-1/ Local distributor: Leica Microsystems (SEA) Pte Ltd All Microscopy Phone: +65 6779 7823	Low force forceps		Reduces force required to hold specimens in forceps while processing.
Dumont Medical Tweezers with Clamping Ring Source: http://www.emsdiasum.com/microscopy/products/tweezers/dumont.aspx Local distributors: www.analytical-online.com Email: azsolve@singnet.com.sg email: lim.susan@fmb.com.sg	• Variety of sizes • Clamping ring to lock in closed position		The clamping ring eliminates the need to apply constant finger pressure for gripping.
Negative-Action Style Tweezers (Self-Closing) Source: http://www.emsdiasum.com/microscopy/products/tweezers/dumont.aspx Local distributors: www.analytical-online.com	• Variety of sizes • Default position is closed rather than open		Negative-Action Style Tweezers (Self-Closing) eliminate the need to apply constant finger pressure for gripping.

Laboratory Ergonomics	Features/Options	Image	Applications
Email: azsolve@singnet.com.sg email: lim.susan@fmb.com.sg			
Storage Bins, Racks and Holders			
Double Bin Storage Source: http://www.scientificvisions.com/catalog/product_info.php?cPath=32&products_id=37 Local distributor: **GAIA Science PTE, Ltd.** Blk 102F Pasir Panjang Road#06-03, 118530 **Email:** info@gaiascience.com.sg **Phone**+65 6276 8884	• Flip-top Lids • Slide Resistant Rubber Feet • Each Bin: 6" x 5" x 6"		• For Storing Microtubes, Pipet Tips or any Bulk Items • Angled openings
Acrylic Dispensing Bins Source: http://www.marketlabinc.com/product.asp?P_ID=3847 Ships internationally: http://www.alibaba.com/product-gs/307881872/Acrylic_Dispensing_Bins.html	Available in different sizes		• The flip top lids on the top and on the front of these general use dispensing bins keeps supplies clean and dust-free. • The lid is designed to have a slight overhang, so you can lift it and pick up the items inside with one hand. • Holds tube caps, cotton balls, pipette tips, analyzer cups.
Horizontal Pipette Holder Source: http://www.scientificvisions.com/catalog/product_info.php?cPath=26&products_id=74 Local distributor: **GAIA Science PTE, Ltd.** Blk 102F Pasir Panjang Road#06-03, 118530 **Email:** info@gaiascience.com.sg	• Accessible Storage of 1ml - 25ml Pipettes • Easy-to-Clean White Plastic • Lightweight and Durable		Horizontally Mounted Under Shelf or Cabinet

Laboratory Ergonomics	Features/Options	Image	Applications
Phone+65 6276 8884			
Vertical Pipette Holder SV-7010 Source: http://www.scientificvisions.com/catalog/product_info.php?cPath=26&products_id=35 Local distributor: **GAIA Science PTE, Ltd.** Blk 102F Pasir Panjang Road#06-03, 118530 **Email:** info@gaiascience.com.sg **Phone**+65 6276 8884	• Accessible Storage of 1 ml to 25 ml Pipettes • Easy-to-clean White Plastic • Lightweight and Durable		Can be Vertically Mounted on Side of Safety Cabinet or Laminar Airflow Hood
Tilted Pipette Racks http://www.marketlabinc.com/products/details/1036 Ships internationally: http://www.egeneralmedical.com/shipin.html	Measures 3.5” w x 11.5”d x 16”h.	 ML2170	• Tilted acrylic pipette rack with four angled compartments for easy retrieval of pipettes. Constructed of durable acrylic. • Holds 0.1 to 25ml pipettes or cans and has small footprint.
Turntable Workstations Source: http://www.daigger.com/catalog/product?deptId=&prodId=1120# Ships internationally: http://www.daigger.com/service/index.jsp	• Solid, chemical-resistant PVC, easy 360° rotation. • Available with one, two or three tiers. • Each tier has four 6 x 6" compartments.	 2 tiers	Single or stacked turntable organizer can be used in deep cabinets, corners, or shared workstations to reduce reach and optimize storage

Laboratory Ergonomics	Features/Options	Image	Applications
		 3 tiers  1 tier	
ML9970 Deluxe Rotating Organizers Source: http://www.egeneralmedical.com/mkl-ml9970.html Ships internationally: http://www.egeneralmedical.com/shipin.html	• 14"L x 13.5"W x 12.5"H • Easy fingertip rotation for quick access to supplies • Extra large capacity within a small 1 square foot footprint • Built-in dispensers and compartments fit a wide variety of office and lab supplies • Constructed of durable PVC	 ML9970	Turntable organizer can be used in corners or shared workstations to reduce reach and optimize storage
Organization Station ML7324 Source: http://www.marketlabinc.com/product.asp?P_ID=3896 Ships internationally: http://www.egeneralmedical.com/shipin.html	• 14"W x 11"D x 11"H • Customizable microscope organizer • Detached divider boxes allow you to customize your storage; simply attach them with double-sided foam tape included • Constructed of acrylic	ML7324 	• Customizable microscope organizer with detachable boxes that can be placed where desired with double sided foam.

Laboratory Ergonomics	Features/Options	Image	Applications
ML2117 Medium Step Shelf Source: http://www.egeneralmedical.com/mkl-ml2117.html Ships internationally: http://www.egeneralmedical.com/shipin.html	• 18"L x 6"W x 10"H • Utilizes vertical space • Designed to fit over gas and water outlets or other protrusions • Cords and wire fit through space at lower back •		• Instant Step Shelves make use of vertical space, and keep items up and out of the way on wet surfaces. Designed to fit over gas and water outlets or other protrusions. Cords and wires fit through the space at the lower back.
Turntable Source: http://www.daigger.com/catalog/product?deptId=&prodId=1120 Ships internationally: http://www.daigger.com/service/index.jsp	• 100% Stainless Steel • Autoclavable • Easily Cleaned and Sterilized • 12" Diameter • Stainless Steel Ball Bearing Design •		Stainless steel rotating table brings work closer to the user to decrease reaching and allows more efficient use of space. Can be used in biosafety cabinets.
Microscope Positioners/Adapters			
Positioning plates Source: http://www.microscopestage.net/pifoc_piezo_objectives_z-scanners.php Local distributor: PI (Physik Instrumente) Singapore LLP 20 Sin Ming Lane #05-60 Midview City Singapore 573968 Tel: (+65) 665 98400 Email: info-sg@pi.ws http://www.pi-singapore.sg	• Solid construction with non-skid surface • Weighted for stability • Positioning Plate = 11.5"L x 8.5"W x 2"H • Height adjustability between 2" to 2.75"		Good posture is critical when working at a microscope. The Microscope Positioning Plate allows you to adjust your scope's height from 2" to 2.75" by simply dialing the thumb wheels in the corners. The threaded leveling feet on the plate allow you to dial to an infinite number of heights and ergonomic positions.

Laboratory Ergonomics	Features/Options	Image	Applications
Point-O-Care Adjustable Microscope Base AF340 Source: http://www.medexsupply.com/products/pid-11810/PointOCareAdjustableMicroscope.htm Ships internationally: https://www.medexsupply.com/policy.php#shipping	• Large 14.5" x 8.5" powder coated steel plate will accept most all brands of microscope • 2" of adjustment from 1" to 3" • Infinite number of heights and angles by adjusting threaded leveling feet • Non-skid feet		Perfect posture is just a knobs turn away with this adjustable microscope base. Raise and/or tilt your microscope into the ergonomic position you need.
Microscope Stands Source: http://www.professionalmicroscopes.com/microscope-stands.html Ships internationally: http://www.professionalmicroscopes.com/contactus.html	• Available for variety of models and applications • Adjustable height, tilt and horizontal positioning		Mounting brackets and stands used to position microscopes and microscope components to reduce eye and neck strain associated with prolonged microscope use.
ErgoAdapter Source: http://www.bayoptical.com/ergoadapter.html Email: ergoadap@bayoptical.com for possibility of international shipping	• Simple locking knob adjusts microscope height • High-precision, stainless steel, linear ball bearing • Height adjustment range of +3/4" to +5 inches • Can rotate 180º for left-or right-handed operation • Optical and mechanical alignments constant at any position or inclination angle		• ErgoAdapter inserts between microcope binocular head and optics carrier. • When work surfaces are set at elbow height to facilitate hand operations, the ErgoAdapter allows users to set the microscope's eyepiece height to achieve a good ergonomic neutral posture. • Adjustability eliminates raised shoulders and bent necks, which can cause discomfort.

Laboratory Ergonomics	Features/Options	Image	Applications
Extended Eyetube Binocular Source: http://www.bayoptical.com/extendedeyetube.html Email: ergoadap@bayoptical.com for possibility of international shipping	• 90MM extension • Available as a new item or as a retrofit of existing binocular head (depending on the binocular model) • Can be combined with the ErgoAdapter and an Optical Wedge for greatly enhanced workstation flexibility		• Extended Eyetube Binocular is an ergonomic device for use with quality stereomicroscopes. Its longer-than-standard eyetube length enables the microscope user to comfortably move back from the workstation, helping to relieve postural fatigue. • Ideal for most microscopes, especially those used with machines, bonders, heated stages, solder stations, under hoods or anywhere operators are otherwise forced into a cramped viewing posture.
Optical Wedge Source: http://www.bayoptical.com/opticalwedge.html Email: ergoadap@bayoptical.com for possibility of international shipping	• Easily installed due to self-aligning flanges • Offers a 0º or 90º in-line viewing angle • Maintains parfocality and optical alignments at any inclination angle		• Adds new flexibility to microscope workstations. • 0º/90º Optical Wedge is positioned between the binocular head and the optics carrier. It complements existing 45º binoculars, providing two additional viewing angles.
ISIS Ergonomic Eyepiece Source: http://www.optimaxonline.com/newsdetails.php?newsId=23 Email: info@visioneng.asia	• Fits most brands of conventional binocular microscopes • Expanded-Pupil technology expands field of vision • Enables wearing of prescription spectacles • Eliminates direct contact with the eyepieces • Removes optical the disturbances known as mouches volantes (floaters) • Far less costly than replacing entire instrument		• Allows glasses to be worn in complete comfort, with common weaknesses (long and short sight astigmatism) no longer affecting user efficiency. • Designed to fit most microscopes with standard diameter eyepiece tubes (23mm or 30mm) and can be used with many microscopes, including Kyowa, Leica, Meiji, Motic, Nikon, Olympus, Wild, Zeiss.

Laboratory Ergonomics	Features/Options	Image	Applications
Microscope Video Systems Sources: http://www.edmundoptics.com/products/displayproduct.cfm?productid=2749 Ships internationally: http://www.edmundoptics.com/about-us/terms/	• Easy to attach to a microscope • Variety of magnifications available • Provides wider viewing area and increased working distance		• Camera systems provide remote viewing of microscope image on computer monitor to eliminate awkward head and neck postures associated with viewing through an eyepiece.
Microdesk Source: http://www.backdesigns.com/store/Regular-Microdesk-P555C66.aspx Ships internationally: http://www.backdesigns.com/Ordering-information-W47.aspx#4	• Transparent acrylic • Adjustable height and slope • Two sizes available • Removable bottom lip accommodates large documents and media (e.g., blueprints, x-rays). • Easily lifted and stored when not in use.		• The Microdesk is an adjustable sloped writing platform for the keyboard work position. It enables easy access to the keyboard while working with papers and books. Prevents reaching and twisting as your papers are placed directly in front of you. Can be used to “stack” work to keep materials within close reach zone. •
Pipettes and Accessories			
Rainin Pipet Lite LTS http://www.pharmaceutical-int.com/article/rainin-pipet-lite-with-magnetic-assist.html Ships internationally: http://www.anachem.co.uk/aboutus/delivery	• Reduces pipetting force by 70% • Magnetic assist locates and holds zero position • LTS tip ejection system reduces tip ejection force		• Reduces total force by 70% • Magnetic assist helps locate and hold zero position for improved results.

Laboratory Ergonomics	Features/Options	Image	Applications
Rainin EDP3 Plus Advanced Electronic Pipette (Single and Multichannels available) Source: http://www.rainin.com/products/product_list.asp?class=46 Local distributor: Mettler-Toledo (S) Pte Ltd., 28 Ayer Rajah Crescent #05-01, 139959 Singapore, Tel # +65 6890 0011	• Reduces pipetting force by 95% • Seven pipetting cycles • LTS tip ejection system reduces tip ejection force		• Reduce pipetting forces by 95%.
Biohit MLine pipette (Single and multichannel pipettes available Source: http://www.biohit.com/liquid-handling/pipettes-mechanical/products/1/mline-mechanical-pipette Local distributor: **Biohit Representative Office** 1 North Bridge Road #12-01 High Street Center Singapore 179094 victor.ng@biohit.com Tel : +65 9797 0280	• Low force • Light weight • Volume locking button • Patented Optiload tip loading mechanism for perfect tip sealing and effortless tip ejection • Clear and easy-to-read display with big numbers and small increments • Volume range colour-coding for easy pipette selection and 5 colour-coding caps		• Light weight and short length. • It has an easy to read and adjust volume dial. • Plunger depression and tip ejection forces are low.

Laboratory Ergonomics	Features/Options	Image	Applications
BioHit eLine Electronic Pipettes (Single and multichannel available) Source: http://www.biohit.com/view/products.asp?document_id=612 Local distributor: **Biohit Representative Office** 1 North Bridge Road #12-01 High Street Center Singapore 179094 victor.ng@biohit.com Tel : +65 9797 0280	• High accuracy and precision with unique DC motor concept • Light tip ejection with the unique electronic tip ejection • Can be used with left or right hand • Patented Optiload mechanism in multichannel models for perfect tip sealing • 6 user defined pipetting protocols for easy recalls • Different charging options (charging stand, charging carousel and direct charging.		• The fully electronic design of the Biohit eLine pipette and the electronic tip ejection system make pipetting faster and easier. • Available in single-channel models covering the volume range from 0.2 µl to 5000 µl and in 8- and 12-channel models from 0.2 µl to 1200 µl. The lower parts of the eLINE pipettors are autoclavable (excluding the multichannel 50-1200 µl pipettors).
Vistalab Ovation Manual and Electronic Single and Multiple Channel Pipettes Source: http://www.vistalab.com/OvationProductsMenu.asp Local distributor: **Focus Biotech (S) Pte Ltd** 36, Toh Guan Road East #01-39, Enterprise Hub 608580 Singapore Phone: +(65) 6273 3022 E-mail: aikkai@focusbiotech.com.sg	• Low-force, form-fitting plunger manually controls aspiration and dispensing speeds with minimal effort • Light tip ejection force • Adjustable finger hook • Disposable battery		• Reduces shoulder elevation, wrist deviation and wrist flexion and extension.

Laboratory Ergonomics	Features/Options	Image	Applications
Pipette Carousels Source: http://www.biohit.com/view/products.asp?document_id=1029&cat_id=276 Local distributor: **Biohit Representative Office** 1 North Bridge Road #12-01 High Street Center Singapore 179094 victor.ng@biohit.com Tel : +65 9797 0280	• Carousel for 6 pipettes in a minimal space for storing all Research pipettes (single and multi-channel) • Carousels available for variety of models of pipettes		• The rotating pipette stand makes for an organized workplace. The new kind of attachment means that the pipette is no longer held at the bottom, ruling out potential contamination of a pipette by it being put on a stand.
Pipette Linear Stands http://www.biohit.com/view/products.asp?document_id=1029&cat_id=276 Local distributor: **Biohit Representative Office** 1 North Bridge Road #12-01 High Street Center Singapore 179094 victor.ng@biohit.com Tel : +65 9797 0280	• Biohit Linear Stand is especially designed for mLINE, Proline mechanical and ePET electronic pipettors. • Pipettes can be placed on both sides to optimize space		• The pipettors to be placed on both sides of the stand, which enables it to hold more pipettors at the same time compared to conventional linear stands on the market. • Thus the stand saves valuable bench space in the laboratory and the pipettors can be reached from both sides of the laboratory bench.

Laboratory Ergonomics	Features/Options	Image	Applications
FinnPipette Focus Short Source: http://www.thermo.com/com/cda/product/detail/1,,15882,00.html Local distributor: **Thermo Fisher Scientific Singapore** 11 Biopolis Way Helios Units #12-07/08 138667 Singapore Tel: +65 6872 9718	• Snap on handle cover in 3 sizes • Soft tip ejection • Short cone tip • Fast volume adjustment		• FinnPipette Focus Short is an extremely accurate and precise pipette. • Handle covers available in 3 sizes and the short cone tip length to reduce shoulder elevation when pipetting.
FinnPipette Novus Electronic Single Channel Pipette Source: http://www.thermo.com/com/cda/product/detail/1,,116521,00.html Local distributor: **Thermo Fisher Scientific Singapore** 11 Biopolis Way Helios Units #12-07/08 138667 Singapore Tel: +65 6872 9718	• Backlit display • Trigger action buttons allow dispensing with index fingers reducing thumb motion • Adjustable finger rest • Lightweight • 10 pipetting functions • 9 speeds • 6 language interface		• First electronic pipette is the first pipette to have backlit technology. • Lightweight and has an adjustable finger rest for use with either hand. • Multiple pipetting functions and multiple speeds

Laboratory Ergonomics	Features/Options	Image	Applications
FinnPipette Novus Electronic Multi Channel Pipette Source: http://www.thermo.com/com/cda/product/detail/1,1055,10120040,00.html Local distributor: **Thermo Fisher Scientific Singapore** 11 Biopolis Way Helios Units #12-07/08 138667 Singapore Tel: +65 6872 9718	• Backlit display • Trigger action buttons allow dispensing with index fingers reducing thumb motion • Adjustable finger rest • Lightweight • 10 pipetting functions • 9 speeds • 6 language interface		• First electronic pipette is the first pipette to have backlit technology. • Lightweight and has an adjustable finger rest for use with either hand. • Multiple pipetting functions and multiple speeds
Magnifier Lamps # 45-3357 Source: http://www.sciencelab.com/page/S/PVAR/10175/45-3357 Ships internationally: http://www.sciencelab.com/data/help.htm	• 2X magnification, 36 in. reach • Convenient front handle • Spring counterbalance • Control knobs lock magnifier in place • Large viewing area, 4 x 21/2 in. • Incandescent 60w bulb • 120V 60Hz, 0.5A • UL listed and CSA approved		• Adjustable position light magnifier can reduce awkward postures and eye strain when viewing laboratory tasks that require magnification.
Laboratory Scissor Jack Source: http://www.sciencelab.com/page/S/PVAR/10-90034 Ships internationally: http://www.sciencelab.com/data/help.htm	• Laboratory Jack 10-9003 collapsed height is 3" and expanded height is 10". • Laboratory jack 10-9004 collapsed height is 3.5" and expanded height is 10.25".		• Laboratory scissor jacks constructed of high quality stainless steel to raise equipment height. Supports up to 200 lbs. Two plate sizes.

Laboratory Ergonomics	Features/Options	Image	Applications
Test Tube Clamps Source: http://www.indigo.com/science-supplies/gph-science-supply/lab-support-stand.html Ships internationally: http://www.indigo.com/ordering/order.html	• Clamps can support test tubes and flasks • Support rings hold beakers & flasks		• Clamps with stands that hold and position test tubes or cylinders to minimize static postures associated with holding them for extended periods of time
Flexible Gooseneck Arms with Electrode Holder Source: http://www.belart.com/shop/183152322-flexible-with-weighted-base-p-183152322.html?cPath=19 Local distributors: BioGen Pte. Ltd.: www.biogensin.com Chokim Scientific (S) Pte. Ltd.: www.chokimscientific.com Eloh Enterprise: www.eloh.com.sg Fisher Scientific Pte, Ltd.: www.fishersci.com.sg Labquip (S) Pte. Ltd.: www.labquipasia.com	• 46cm (18") long x 25mm (1") in diameter arm • One end has a 12.7mm (1/2") diameter stainless steel pin for attachment to a clamp or base. • Attach electrode holder to other end • Molded of chemical and corrosion resistant acetal copolymer links with ball-and-socket joints • Base and electrode holder sold separately• Chemical resistant		• Flexible gooseneck arm and base with electrode holder can be used to position a Ph meter or similar tool and eliminate prolonged gripping of tools.
Bottles and Dispensers			
Plastic Wash Bottles (Squeeze Bottles) Source: http://www.daigger.com/catalog/product?deptId=&prodId=2757D Ships internationally: http://www.daigger.com/service/index.jsp	• Low density polyethylene with leakproof screw cap • 1-pc. cap/spout		• Transfer small amounts of unmeasured liquids in place of test tubes or beakers.

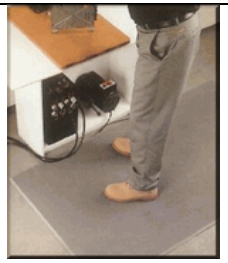
Laboratory Ergonomics	Features/Options	Image	Applications
Graduated Cylinder with Handle Source: http://www.usplastic.com/catalog/product.asp?catalog%5Fname=US Plastic&category%5Fname=14&product%5Fid=12826&cookie%5Ftest=1 Ships internationally: https://www.usplastic.com/content/contact.aspx?clickid=footer	• Standard polypropylene • Double scale and octagonal base • Steam autoclavable at 250°F		• The generously sized handle makes pouring from a tall cylinder safer and more convenient
Bottle Jacket Source: http://www.fishersci.com/ecomm/servlet/fsproductdetail?aid=54076&storeId=10652 Local distributor: **Thermo Fisher Scientific Singapore** 11 Biopolis Way Helios Units #12-07/08 138667 Singapore Tel: +65 6872 9718	• Tough polyethylene shell encapsulates a 4L or 1-gal. bottle • Two-piece jacket with unique threading design firmly connects top and bottom • Blocks out light to reduce solvent degradation. •		• Easy grip handle improves ability to grip and pour gallon or 4-liter bottles of liquids. • Reduces spill hazards in case of breakage.

Laboratory Ergonomics	Features/Options	Image	Applications
Brinkmann Bottletop Dispensers Source: http://www.daigger.com/catalog/product?deptId=&prodId=20565&q=bottle+dispensers Ships internationally: http://www.daigger.com/service/index.jsp	• Precise volume settings • Filling tube adjusts to fit reagent bottle • Dispensers rotate 360° • Calibration certificate		• Makes reagent dispensing as quick and easy as possible. • Dispensers are available in fixed-volume or adjustable volume sizes to cover the range of 0.5 to 100 mL.
Two Handle Dispensing Jugs 1026 Nalgene Safety Dispensing jug Source: http://www.labsafety.com/search/jug/24529963/ Ships internationally: https://www.labsafety.com/form/contact-us.aspx	• Low-density polyethylene jug includes top and bottom safety handle • Guaranteed leakproof • Permanently attached pour spout reduces splash • 83mm polypropylene closure • Not autoclavable.		• Double-handle design makes carrying and pouring easier and safer to accomplish.

Laboratory Ergonomics	Features/Options	Image	Applications
Bottom Dispensing Carboy www.daigger.com www.usplastic.com Ships internationally: http://www.daigger.com/service/index.jsp https://www.usplastic.com/content/contact.aspx?clickid=footer	• Bottom dispenser • Rounded octagonal shape increases strength • Offset neck makes pouring easier.		• Bottom dispensing carboy used to dispense large volumes of liquids from bottom of container. Eliminates need to lift bottle and pour or twist off cap or lid.
Chairs, Footrests and Mats			
SomaHybrid Sit-Stand and Medical Stool Source: http://www.soma.tv/content/chairs/somahybrid.shtml Ships internationally: http://www.ergopro.com/index.php?main_page=shippinginfo&zenid=a1a8fc04791f43b68ddb955f867a11a5	• Available in multiple seat sizes and styles • RSI-preventive Thorsac™ backrests • Three multi-adjust mechanisms • Large 5-leg base for stability! • Easy-to-reach adjustments		• It's a chair, it's a stool, it's a chest rest. You can sit, you can stand, you can move with the SomaHybrid™ chair and change positions while you work to reduce fatigue.

Laboratory Ergonomics	Features/Options	Image	Applications
Bambach Stool Source: http://www.backdesigns.com/Bambach-Saddle-Chair-P566C158.aspx Ships internationally: http://www.backdesigns.com/Ordering-information-W47.aspx#4	• Seat tilts 5° backward and 10° forward for comfort. • 27" base is provided with tall lifts used with a footring for greater stability at no additional charge. • Oversize 60mm hooded casters for smooth rolling on carpet or hard floors. • Optional braking, locking, and industial casters also available. •		• Shaped like a saddle to enable the body to maintain ideal posture when sitting.
Hag Capisco Laboratory chair Source: http://www.ergodepot.com/HAG_Ultrasound_Chair_p/8106u.htm Ships internationally: http://www.ergodepot.com/Terms.asp	• Non-traditional saddle seat design. Flat seat is available at no additional charge. • Adjustments: seat depth, seat height, back height, tilt tension backward, and three-position tilt lock. • Provides full trunk and arm support when seated backwards. • Aluminum base with curved/arched footring		• HAG's award-winning Capisco chair can be modified for ultrasound, radiology and laboratory applications. The tall 265mm lift offers nearly ten inches of seat height variation. • Footring (or optional Step-Up) allows for infinite positions for your feet. • Ideal for sit/stand applications, the chair encourages, alternate sitting positions - forwards, backwards or sideways.

Laboratory Ergonomics	Features/Options	Image	Applications
Labster BIMOS Chair Source: http://www.industrysearch.com.au/News/New_Bimos_Labster_Worlds_First_Pure_Lab_Chair-35827 Ships internationally:https://ru.vwr.com/app/Header?tmpl=/contacts/main_contact_details.htm	• Clean design with no harp edges or crevices • Covered star base for stability and easy cleaning • Height adjustable footrest • Compact footprint • Seat tilt • Tilting molded backrest		• Specifically designed for laboratory work, with no sharp edges or crevices and a closed base for easy cleaning. • Compact design provides small footprint for small spaces.
Adjustable footrest SV-973-700 Source: http://www.scientificvisions.com/catalog/product_info.php?cPath=26&products_id=33 Local distributor: **GAIA Science PTE, Ltd.** Blk 102F Pasir Panjang Road#06-03, 118530 Singapore **Email**info@gaiascience.com.sg **Phone**+65 6276 8884	• Adjustable • Slide Resistant Rubber Feet • Easily Cleaned • Non-skid Foot Surface •		Adjustable, tall, heavy duty footrest provides support for feet when sitting at lab bench or using safety cabinet.
ISE Steel Frame Footrest Source: http://airtechcorp.stores.yahoo.net/qfstlisestfr.html Ships internationally: http://www.airtech.net/orandshin.html	• Adjusts in 1” increments between 4-14” in height • 3 tilt angle adjustments • Steel platform on non-skid pads		Very sturdy footrest can be used to support feet when working at lab bench or in safety cabinet or hood.

Laboratory Ergonomics	Features/Options	Image	Applications
BioFit Industrial Footrest Source: http://www.labsafety.com/BIO-FIT-Industrial-Footrests_24548808/ Ships internationally: http://www.labsafety.com/custserv/default.htm	• Adjust height in 1 in. increments from 3-11 in. • Fixed 10o slope • Nonslip rubber matting coating • Durable steel tubing frame with powder coat finish		Industrial grade footrest that can support feet when working at a lab bench or safety cabinet.
Ortho Mat Floor Mats Source: http://airtechcorp.stores.yahoo.net/protormat.html **Ships internationally:** http://www.huntoffice.ie/help.php?section=contactus&mode=update	• Closed cell mat eliminates absorption of liquids, fluids and airborne pathogens • Infection control "antimicrobial" prevents mold, mildew and bacterial growth • Light weight, easy to clean with disinfectants. • Custom sizes available		• Floor mats designed to reduce back, leg, foot, and ankle fatigue when standing for prolonged periods to complete lab tasks.
Dawg Vinyl Floor Mat 488 Source: http://www.dawginc.com/floor-safety/anti-fatigue/vinyl-mat.php Ships internationally: http://www.dawginc.com/contactus/	• Vinyl non-porous surface with Nitricell sponge base • Anti-microbial • Abrasion and chemical resistance		• Floor mats designed to reduce back, leg, foot, and ankle fatigue when standing for prolonged periods to complete lab tasks.

Laboratory Ergonomics	Features/Options	Image	Applications
3M Fatigue Resistant Matting Source: http://www.jestac.com.sg/3m_entrance_matting_systems.php?gclid=CMmhxK-a8asCFUUa6woduhkesg Local distributor: **Jestac Pte Ltd** No. 2 Kim Chuan Drive #02-06 CSI Distribution Centre Singapore 537080 Telephone: (65) 6288 8290 Facsimile: (65) 6287 3252 Email: sales@jestac.com.sg	• Provides superb cushioning which reduces fatigue, due to long hours of standing, thus increasing productivity. • Z-web design features a tapered profile that effectively scrapes off oil and grime without leaving any greasy residue to meet the highest safety standards. • Reduces risk of slipping and losses due to accidents around work stations or kitchen. Safe, fire resistant and non-flammable. •	 	• Floor mats designed to reduce back, leg, foot, and ankle fatigue when standing for prolonged periods to complete lab tasks.
Countertop Extender Source: http://cndproducts.com/labcare.php Ships internationally: https://www.medexsupply.com/forms/order_application.pdf	• Dual slide out work surfaces • Shelves then store neatly under the raised work surface when not in use • Non-skid, anti-vibration feet • Can be cleaned with disinfectant •		• Countertop Extender instantly adds valuable work space to any counter. It has dual slide out work surfaces to allow extra work space on any bench. The two spring-assisted shelves then store neatly under the raised work surface when not in use. • The rugged construction can support even heavy bench top equipment. The non-skid, anti-vibration feet will keep the countertop extender in place. •