Ergonomic Guideline

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1 INTRODUCTION

1.1 Purpose
The purpose of this guideline is to promote employee health by limiting risk factors associated with Musculoskeletal Disorders (MSDs) through sound ergonomic guidance for Washington University in St. Louis (WUSTL) Faculty, Staff, and Students.

MSDs affect the muscles, nerves, blood vessels, ligaments and tendons. Workers in many different occupations can be exposed to risk factors at work, such as lifting heavy items, bending, reaching overhead, pushing and pulling heavy loads, working in awkward body postures and performing the same or similar tasks repetitively. Exposure to these known risk factors for MSDs increases a worker's risk of injury.

Work-related MSDs can be prevented. Ergonomics --- fitting a job to a person --- helps lessen muscle fatigue, increases productivity and reduces the number and severity of work-related MSDs.

1.2 Scope and Application
WUSTL is responsible for providing a safe and healthful workplace for their workers. In the workplace, the number and severity of MSDs resulting from physical overexertion, and their associated costs, can be substantially reduced by applying ergonomic principles. WUSTL Environmental Health & Safety (EH&S) will, as they are able, provide guidance relating to Ergonomics throughout the University. Part of this will be:

Provide Management Support - A strong commitment by management is critical to the overall success of an ergonomic process. Management should define clear goals and objectives for the ergonomic process, discuss them with their workers, assign responsibilities to designated staff members, and communicate clearly with the workforce.

Involve Workers - A participatory ergonomic approach, where workers are directly involved in worksite assessments, solution development and implementation is the essence of a successful ergonomic process. Workers can:

- Identify and provide important information about hazards in their workplaces.
- Assist in the ergonomic process by voicing their concerns and suggestions for reducing exposure to risk factors and by evaluating the changes made as a result of an ergonomic assessment.

Provide Training - Training is an important element in the ergonomic process. It ensures that workers are aware of ergonomics and its benefits, become informed about ergonomics related concerns in the workplace, and understand the importance of reporting early symptoms of MSDs.

Identify Problems - An important step in the ergonomic process is to identify and assess ergonomic problems in the workplace before they result in MSDs.
Encourage Early Reporting of MSD Symptoms - Early reporting can accelerate the job assessment and improvement process, helping to prevent or reduce the progression of symptoms, the development of serious injuries, and subsequent lost-time claims.

Implement Solutions to Control Hazards - There are many possible solutions that can be implemented to reduce, control or eliminate workplace MSDs.

Evaluate Progress - Established evaluation and corrective action procedures are required to periodically assess the effectiveness of the ergonomic process and to ensure its continuous improvement and long-term success. As an ergonomic process is first developing, assessments should include determining whether goals set for the ergonomic process have been met and determining the success of the implemented ergonomic solutions.

1.3 Definitions

Awkward Posture – Posture is the position of the body while performing work activities. Awkward posture is associated with an increased risk for injury. It is generally considered that the more a joint deviates from the neutral (natural) position, the greater the risk of injury.

Specific postures have been associated with injury. For example:

Wrist
- Flexion/extension (bending up and down)
- Ulnar/radial deviation (side bending)

Shoulder
- Abduction/flexion (upper arm positioned out to the side or above shoulder level)
- Hands at or above shoulder height

Neck (cervical spine)
- Flexion/extension or bending the neck forward and to the back
- Side bending as when holding a telephone receiver on the shoulder

Low back
- Bending at the waist, twisting

Cumulative Trauma Disorders (CTDs) – Term used for injuries that occur over a period because of repeated trauma or exposure to a specific body part, such as the back, hand, wrist and forearm. Muscles and joints are stressed, tendons are inflamed, nerves pinched or the flow of blood is restricted. Common occupational induced disorders in this class include carpal tunnel syndrome, epicondylitis (tennis elbow), tendinitis, and low back pain.
**Ergonomics** – The study of the relationship between people, their work and their physical work environment. The major goal of ergonomics is to fit the job to the individual and promote healthy and safe work practices.

**Ergonomic program** – A systematic process for anticipating, identifying, analyzing and controlling ergonomic risk factors.

**Lighting** – The level of illumination in the workplace. Poor lighting can lead to visual symptoms of eyestrain, eye focusing breakdown, eye coordination abnormalities, and eye fatigue while performing select activities such as video display terminal tasks.

**Material Handling** – Lifting, carrying, and moving materials without mechanical aide.

**Musculoskeletal Disorders (MSD)** – Injuries and disorders of the muscles, nerves, tendons, ligaments, joints, cartilage and spinal disc; examples include carpal tunnel syndrome, rotator cuff tendonitis, and tension neck syndrome.

**Recovery Time** – Recovery time is the length of rest between exertions. Short work pauses can reduce discomfort. Inadequate rest periods between exertions can decrease performance. As the duration of the uninterrupted work increases, so does the amount of recovery time needed.

**Repetition** – Repetition is the number of a similar exertions performed during a task. A warehouse worker may lift three boxes per minute from the floor to a countertop; an assembly worker may make 20 units per hour. Repetitive motion has been associated with injury and worker discomfort.

    Generally, the greater the number of repetitions, the greater the degree of risk. However, there is no specific repetition limit or threshold value (cycles/unit of time, movements/unit of time) associated with injury.

**Risk Factor** – Actions in the workplace, workplace conditions, or a combination thereof, that may cause or aggravate a Work Related Musculoskeletal Disorders; examples include forceful exertion, awkward postures, repetitive exertion, and environmental factors such as temperature.

**Work Related Musculoskeletal Disorders (WMSD, WRMSD)** – Injuries and disorders of the muscles, nerves, tendons, ligaments, joints, cartilage and spinal disc due to physical work activities or workplace conditions in the job. Examples include: carpal tunnel syndrome related to long term computer data entry, rotator cuff tendinitis from repeat overhead reaching, and tension neck syndrome associated with long term cervical spine flexion.

### 1.4 Responsibility

**Washington University in St. Louis** – Provide their employees with a place of employment that "is free from recognizable hazards that are causing or likely to cause death or serious harm to employees."

**Environmental Health & Safety** – Provide guidance on ergonomic concerns for all employees; research, clinical, and support. This may be accomplished through document aids, online self-
assessments and other documents, Health Fair booths, and in certain circumstances, one on one assistance.

WUSTL Employees – Review provided documentation and apply the suggestions to their work environment.

1.5 Key Principles of Ergonomics
Principle 1 Maintain Neutral Posture

Neutral postures are postures where the body is aligned and balanced while sitting or standing, placing minimal stress on the body and keeping joints aligned.

Neutral postures minimize the stress applied to muscles, tendons, nerves and bones and allows for maximum control and force production.

The opposite of a neutral posture is an “awkward posture.” Awkward postures move away from the neutral posture toward the extremes in range of motion. This puts more stress on the worker’s musculoskeletal system, is a contributing risk factor for Musculoskeletal Disorders (MSDs), and should be avoided.

Following are examples of Neutral vs. Awkward postures for the wrist, elbow, shoulder and back. When you put on your “ergo eyes”, you’ll immediately begin to notice when workers are in awkward postures and when they are maintaining a neutral posture.

Neutral and awkward wrist postures
Neutral and awkward elbow postures

Neutral and awkward shoulder postures

Neutral and awkward back postures
Neutral and awkward back postures

Pistol grip vs. inline grip drivers to maintain neutral posture

Principle 2 Work in the Power / Comfort Zone
This principle is very similar to maintaining a neutral posture, but is worth expounding upon here.

The power zone for lifting is close to the body, between mid-thigh and mid-chest height. This zone is where the arms and back can lift the most with the least amount of effort.

This can also be called the “hand shake zone” or “comfort zone.” The principle here is that if you can “shake hands with your work”, you are minimizing excessive reach and maintaining a neutral posture.

Working from the power / comfort / handshake zone ensures that you are working from proper heights and reaches, which reduces MSD risk factors and allows for more efficient and pain-free work.

Now when you notice workers who are working with extended reaches and at improper heights, you’ll know they are outside their comfort zone and risk factors are present.

**Principle 3 Allow for Movement and Stretching**

The musculoskeletal system is often referred to as the human body’s *movement system*, and it is designed to move.

Working for long periods of time in a static position will cause your body to fatigue. This is what is known as static load.

For example:

- Raise your hands over your head for the next 30 minutes
- Remain standing in the same position for the next 8 hours
- Write with a pencil for 60 minutes straight

If you do those things, you will experience static load. The first few seconds or minutes don’t seem too bad, but the cumulative effect of holding these seemingly stress-free positions over time will cause fatigue and discomfort.

Now, what is the first thing you will naturally do once you are finished with these tasks?

You will stretch.

You’ll stretch out your shoulders and back. You’ll stretch out your legs and maybe do some squats. You’ll stretch out your fingers and wrist.

Stretching reduces fatigue, improves muscular balance and posture and improves muscle coordination. Everyone is an athlete in life, so you need to prepare your body for work by warming up to improve performance and lower injury risk. A warm-up stretching regimen is a great way to prepare your body for work.

It is also beneficial to take periodic stretch breaks over the course of your work day to get your blood moving and restore your energy.
Principle 4 Reduce Excessive Force

Excessive force is one of the primary ergonomic risk factors. Many work tasks require high force loads on the human body. Muscle effort increases in response to high force requirements which increases fatigue and risk of an MSD.

There are numerous conditions that affect force, but the idea is to recognize when a job or task requires excessive force and then find ways to reduce that force.

Eliminating excessive force requirements will reduce worker fatigue and the risk of MSD formation in most workers. Using mechanical assists, counter balance systems, adjustable height lift tables and workstations, powered equipment and ergonomic tools will reduce work effort and muscle exertions.

Principle 5 Reduce Excessive Motions

Repetitive motion is another one of the primary ergonomic risk factors. Many work tasks and cycles are repetitive in nature, and are frequently controlled by hourly or daily production targets and work processes. High task repetition, when combined with other risks factors such high force and/or awkward postures, can contribute to the formation of MSD. A job is considered highly repetitive if the cycle time is 30 seconds or less.

Excessive or unnecessary motions should be reduced if at all possible. In situations where this is not possible, it is important to eliminate excessive force requirements and awkward postures.

Other control methods to consider are Job enlargement, job rotation and counteractive stretch breaks.

Principle 6 Minimize Contact Stress

According to OSHA, contact stress results from continuous contact or rubbing between hard or sharp objects/surfaces and sensitive body tissue, such as soft tissue of the fingers, palms, thighs and feet. This contact creates localized pressure for a small area of the body, which can inhibit blood, nerve function, or movement of tendons and muscles.

Examples of contact stress include resting wrists on the sharp edge of a desk or workstation while performing tasks, pressing of tool handles into the palms, especially when they cannot be put down, tasks that require hand hammering, and sitting without adequate space for the knees.

Principle 7 Reduce Excessive Vibration

Multiple studies have shown that regular and frequent exposure to vibration can lead to permanent adverse health effects, which are most likely to occur when contact with a vibrating tool or work process is a regular and significant part of a person's job.

Hand-arm vibration can cause a range of conditions collectively known as hand-arm vibration syndrome (HAVS), as well as specific diseases such as white finger or Raynaud's syndrome, carpal tunnel syndrome and tendinitis. Vibration syndrome has adverse circulatory and neural
effects in the fingers. The signs and symptoms include numbness, pain, and blanching (turning pale and ashen).

**Principle 8 Provide Adequate Lighting**

Poor lighting is a common problem in the workplace that can affect a worker's comfort level and performance. Too much or too little light makes work difficult – just imagine trying to do your job without sight!

Dimly lit work areas and glare can cause eye fatigue and headaches and improperly lit areas put workers at greater risk for all types of injuries.

Providing workers with adjustable task lighting is often a simple solution to lighting problems. At a computer workstation, take steps to control screen glare, and make sure that the monitor is not placed in front of a window or a bright background.
2 Guidelines

2.1 Ergonomic Training
EH&S will provide ergonomic training to departments at their request. This can include office, research, support (facilities, custodial) and other work environments. The training is intended for groups where a self-assessment or one on one assessment is impractical.

2.2 Office Ergonomics
Office ergonomics remain a common concern at WUSTL. The first step in implementing ergonomics in the office is to analyze the work being done. A careful analysis will help find the true cause of the problem and apply the appropriate resources. Many times the analysis will reveal that only small changes are necessary, in which case a more involved analysis may not be necessary. Other times, more complex problems will require a more thorough evaluation.

Below are 10 key points to remember when working at your desk.

1) Make sure that the weight of your arms is supported at all times. If your arms are not supported, the muscles of your neck and shoulders will be under strain throughout the day.

2) Watch your head position, and try to keep the weight of your head directly above its base of support (ears over your shoulders). Don’t “crane” your head and neck forward.

3) Slouching puts more pressure on the discs and vertebrae of your back. Use the lumbar support of your chair and avoid sitting in a way that places body weight more on one side than on the other. Move your chair as close to your work as possible to avoid leaning and reaching. Make sure to “scoot” your chair in every time you sit down.

4) The monitor should be placed directly in front of you, with the top no higher than eye level. The keyboard should be directly in front of the monitor so you don’t have to frequently turn your head and neck.

5) Talking on the phone with the phone receiver jammed between the neck and ear can cause neck and shoulder strain.

6) The keyboard and the mouse should be close enough to prevent excessive reaching which strains the shoulders and arms.

7) Avoid eye strain by making sure that your monitor is not too close or too far. Ideally it should be 18-30 inches away.

8) Take steps to control screen glare, and make sure that the monitor is not placed in front of a window or a bright background.
9) You can rest your eyes periodically for several seconds by looking at objects at a distance to give your eyes a break. Remember the 20/20/20 rule. For every 20 minutes, look 20 feet away for 20 seconds.

10) The feet should not be dangling when you are seated. If your feet don’t comfortably reach the floor or there is pressure on the backs of your legs, use a footrest or lower the keyboard and chair.

2.3 Laboratory Ergonomics

Laboratory ergonomics bring about other concerns beyond office ergonomics. However, many of the same principles still apply. The body still needs to be in a neutral posture, but there are additional challenges to achieving that.

**Posture**

- Avoid maintaining the same body position (e.g. sitting or standing) for an extended period of time:
  - Take micro breaks of about one minute every 20 to 30 minutes.
  - Shift your weight around often.
  - Alternate tasks frequently.

- Avoid awkward body postures.

- Avoid resting arms on sharp table edges. Pad table edges with foam, or use a cushion.

**Seating**

Before working, always adjust your chair properly. Here are some guidelines:

- Your feet should rest comfortably on the floor or footrest.
- Sit all the way back. The chair should provide adequate back support.
- The front edge of the chair should not press against the back of the knees.
- Armrests should not hinder your work activities.
- Remove items from under your workstation to provide legroom.

**Standing**

If standing for a long time, use the following tips:

- Rest one foot on a step stool. Alternate feet regularly.
- Wear low-heeled shoes with good cushioning. Floor mats with cushioning can provide additional comfort.

**Shoulders**
• Keep your shoulders relaxed and your elbows by your sides. Place frequently used items close to your body to avoid excessive reaching.

• Avoid raising your elbows higher than shoulder level. Use ladders and stools to reach for items on high shelves.

**Pipetting**

• Take frequent micro breaks (about one to two minutes every 15 to 30 minutes). Switch activities to avoid long periods of continuous pipetting.

• Maintain straight wrists. Keep elbows close to your body.

• Alternate pipetting between right and left hands. Rotate pipetting tasks with other qualified lab colleagues.

• Keep waste bins, beakers, and other frequently used items as close to you as possible.

• Maintain a relaxed grip on the pipette.

• Use shorter pipettes and pipette tips when possible.

• Choose pipettes that require minimal hand and finger effort.

• Use automated processes or multi-channel pipettes for highly repetitive jobs.

• See posture, seating, and standing tips in other tabs.

**Microscope Use**

• Take frequent micro breaks (about one to two minutes every 15 to 30 minutes) to rest your eyes.

• Momentarily close eyes or refocus on distant objects to vary focal distance.

• Divide microscope work throughout the day or rotate tasks with colleagues.

• Maintain straight wrists. Keep elbows close to your body.

• Avoid tilting your head and neck, by, for example:
  
  o Adjusting the microscope's position so that you're in an upright and neutral posture.
  
  o Moving the microscope to the edge of the counter to avoid tilting your neck.

• Keep microscopes clean and in good condition.

• See posture, seating, and standing tips in other tabs.

**Hood work**

• Position materials and equipment in lab hoods and cabinets as close to your body as possible, but at least six inches into the hood (for safety reasons).
• Avoid resting arms on the sharp edges of hoods. Use padding if possible and take frequent micro breaks (about one to two minutes every 15 to 30 minutes).

• See posture, seating, and standing tips in other tabs.

### 2.4 Clinical Ergonomics
To be added

### 2.5 Laptop Ergonomics

**Un-ergonomic Laptops** - the design of laptops violates a basic ergonomic requirement for a computer, namely that the keyboard and screen are separated. In the early days of personal computing desktop devices integrated the screen and keyboard into a single unit, and this resulted in widespread complaints of musculoskeletal discomfort. By the late 1970's a number of ergonomics design guidelines were written and all called for the separation of screen and keyboard. The reason is simple - with a fixed design, if the keyboard is in an optimal position for the user, the screen isn't and if the screen is optimal the keyboard isn't. Consequently, laptops are excluded from current ergonomic design requirements because none of the designs satisfy this basic need. This means that you need to pay special attention to how you use your laptop because it can cause you problems.

**Laptop User Type** - how do you use your laptop? Are you an occasional user who works on your laptop for short periods of time or are you a full-time user with the laptop as your main computer? Occasional users will have less risk of problems than full-time users. All users should pay some attention to how they use their laptop, but full-time users may have more problems.

**Laptop Posture** - as indicated above, laptops violate basic ergonomic design requirements, so using a laptop is a tradeoff between poor neck/head posture and poor hand/wrist posture.

- **Occasional Users** - because the neck/head position is determined by the actions of large muscles, you are better off sacrificing neck posture rather than wrist posture. For occasional use:
  - find a chair that is comfortable and that you can sit back in
  - positioning your laptop in your lap for the most neutral wrist posture that you can achieve
  - angling the laptop screen so that you can see the screen with the least amount of neck deviation
- **Full-time Users** - if you use your laptop at work as your main computer you should:
  - Position this on your desk/work surface in front of you so that you can see the screen without bending your neck. This may require that you elevate the laptop off the desk surface using a stable support surface, such as a computer monitor pedestal.
  - Use a separate keyboard and mouse. You should be able to connect a keyboard and mouse directly to the back of the laptop or to a docking station
  - use the keyboard on a negative-tilt keyboard tray to ensure a wrist neutral posture
- use the mouse on an adjustable position mouse platform
- follow the postural guidelines for working at a computer workstation

**Laptop dimensions** - many laptops offer large screens (15” plus) and can work as desktop replacements (giving the viewing area of a 17” monitor). However, think about where you will most use your laptop to help you choose the best size. The larger the screen the more difficult it will be to use this in mobile locations (e.g. airplane, car, train). There are a number of smaller notebook and ultraportable laptops on the market. Consider issues of screen size and screen resolution. A small screen (e.g. 12.1”) will be useful in mobile settings, but if the resolution is high (e.g. XGA - 1024 x 768) make sure that you can read the screen characters and can easily use the input device to point to areas on the screen. The smaller the laptop, the smaller the keyboard, so make sure that you can comfortably type on a keyboard that may be only 75% the size of a regular keyboard.

**Laptop weight** - if you are a mobile professional who will be frequently transporting your laptop think about the weight of the system. By the word 'system' I mean the weight of the laptop plus the required accessories (e.g. power supply, spare battery, external disk drive, zip drive, CD_RW, DVD, Blu Ray etc.). Many lightweight portables can become as heavy as regular laptops when you add the weight of all of the components together. If your laptop + components weigh 10lbs or more then you should certainly consider using a carry-on bag that you can pull along. If you want a smaller bag and can comfortably carry your laptop consider a good shoulder bag design

### 2.6 Lifting and Material Handling

Lifting and Material handling, if done improperly, can end in minor to significant injuries. A correct lifting technique is more than just using your legs rather than your back. Below are guidelines to assure proper lifting.

**Assess all safety aspects**

Can the material be moved safety? Are there other factors to consider beyond just weight?

- How heavy is the material?
- How large is it?
- Will it obstruct your view?
- Where is the path you will follow once you pick up the material?
- Are there obstructions or tripping hazards in your way?
- Are there slip hazards, electrical hazards, fire hazards?
- Will it require you to utilize a poor position?

**Poor Positions and Lifting Technique**

Always avoid the below poor positions while lifting, regardless of the weight.

- Lifting with the back rather than the legs.
• Twisting at the waist
• Awkward (non-neutral) position
• Load can’t be secured.
• Poor Posture (try for ears over shoulders over hips)
• Reaching
• Unbalanced Load
• Poor Stance (knees should track over feet)

**Proper Lifting Technique**

Maintaining proper form will allow you to lift the material safely. Follow the below steps to achieve a safe lift.

- Test Weight
  - Do you need help from a coworker?
  - Do you need lifting equipment?
- Load directly in front of you
- Tighten your core (think about sucking your belly button towards your spine)
- Feet shoulder width apart
  - Flat footed or
  - One foot flat footed the other leg on your knee
- Flat back (Straight line from your hips to your head)
- Load close to body
- Look straight ahead

**Lifting Aids**

Whether using dollies, pallet jacks, or other lifting devices, the below steps should be taken into account.

- Secure the load
- Follow all the guidelines for the lifting equipment
- Do not use the lifting equipment other than intended.
  - Do not kick out the legs of appliance dollies.
  - Do not go over the maximum weight that the lifting equipment was intended to carry.
- Do not carry an unbalanced load.
- Use lifting aids to get lighter loads to chest height. Loads that may be too heavy to lift but not too heavy to carry should be brought up to chest height first and then carried.
- Make sure the lifting equipment is secure before you move the material on to it.

**Stretching and Strength**

Improving your strength and flexibility can go a long way to avoiding lifting injuries. Appendix I has different stretching and strength exercises that can improve overall fitness. Understand that these are suggestions and intended for healthy adults. Employees undertaking any exercise/stretching should consult with their personal physician before undertaking these exercises.
3  Ergonomic Assistance Process

3.1  Discomfort Associated with the Workstation
This document is designed to help those that are having discomfort associated with their workstation. It gives detailed information to aid in setting up a workstation to a proper ergonomic arrangement.

Additionally, employees working at a computer workstation can use our online self-assessment (link below), to get a step by step aid in setting up their workstation. This will guide you through the different aspects of desk ergonomics and assist you in how to adjust your workstation.

At the end of this is an ergonomic request submittal that can be filled out to request a one on one workstation assessment. Once this submittal is received, we will wait two weeks to see if the adjustments you made have helped. At the end of two weeks we will contact the employee to see if further assistance is needed.

https://ehsaweb.wusm.wustl.edu/ergoselfeval/index.asp

3.2  Medical Problems Associated with the Workstation

3.2.1  No Medical Referral
For those employees that are having medical problems (carpal tunnel, tendinitis. etc.) associated with their workstation (work related or not work related), they can use the below online self-assessment and fill out the request for further assistance at the end.

Once this submittal is received, we will wait two weeks to see if the adjustments you made have helped. At the end of two weeks we will contact the employee to see if further assistance is needed.

https://ehsaweb.wusm.wustl.edu/ergoselfeval/index.asp

3.2.2  Physician or Physical Therapist Medical Referral

For employees that are having medical problems (carpal tunnel, tendinitis. etc.) associated with their workstation (work related or not work related), a one on one ergonomic assessment can be requested. For these assessments contact the below individuals to get these scheduled. Please be prepared to discuss the medical problem and how it is affected by your workstation / work environment.

Medical School Campus and Clinics

Jon Kruyne  kruynej@wustl.edu  314-747-8412
Tony Nardi  nardia@wustl.edu  314-362-6930
3.3 Non-Computer Workstation Ergonomic Assistance

3.3.1 Laboratory/Research Ergonomic Assistance
For those working in a research lab, they can use this document along with other information we provide on our website below. For those that are continuing to have ergonomic concerns, a one on one assessment can be requested. Use the below contacts to request an assessment.

See Appendix: F, I, J, K, M

3.3.2 Clinical Ergonomic Assistance
For those that are having ergonomic concerns associated with working in a clinic, a one on one assessment can be requested. Use the below contacts to request an assessment.

Jon Kruyne  kruynej@wustl.edu  314-747-8412

3.4 EH&S Evaluations
For those that have a one on one assessment done by EH&S, the below steps will be taken.

1. EH&S will schedule a one hour time slot that works with you to come by and take a look at your workstation / work environment
2. We will watch you work, discuss your medical concerns, and make suggestions about adjustments to your workstation.
3. During the assessment we will take notes and fill out a report.
4. After completion of the assessment we will compile our notes and send a report to you and your supervisor.
5. Any suggestions for new equipment (mouse, keyboard tray, chair, etc.) are just suggestions and you and your department are not obligated to follow through with these suggestions.
Appendix A

Frequently Asked Questions

Does EH&S Provide us with equipment they recommend?

No, we do not provide equipment to individuals. All equipment must be purchased by the department through Marketplace or through Washington University Furniture and Design.

Is our department required to purchase the equipment that is recommended by EH&S?

No, the recommendations we make are suggestions and your department is not required to purchase the equipment we recommend.

Are all new chairs good ergonomic choices?

No, there are significant differences between many of the new chairs that are out today. Additionally, just because a company claims that their chair is an ergonomic chair, does not mean it is. Many companies claim to produce ergonomic furniture when it is anything but.

Is a standing workstation a good option?

No, standing desks are not good options. There is a lot of information out there today that states we are sitting too much during the day. While this may be true, completely moving to a standing desk is not a good option. The goal is to move and change our position. However, if we are stuck in one position, sitting is better than standing.

What about sit/stand desks. Are they good options? Are they necessary?

Sit/stand desks can be a good option. For people who are stuck at their desk all day, this can be a way to mix up the day so that we are not stuck in one position. However, if we are able to get up from our desk, we can get an equal benefit from getting up on a regular basis (every 20-30 minutes) and walking around or doing some stretching for a minute or less.

Can I use an exercise ball for my desk chair?

No, exercise balls are definitely a bad idea for a chair for several reasons. They are difficult to get at the correct height, they do not provide any back support, they promote a poor posture while at the desk, and they are a fall hazard. For these and other reasons we do not recommend exercise balls as chairs for any reason.

What are the key points for ergonomics?

First off always maintain a neutral posture as explained in this document. Secondly, taking frequent breaks (every 20-30 minutes) for a minute or less and moving around or stretching, or change your tasks on a frequent basis.
Appendix B

Computer Workstation Guide

Environmental Health & Safety
Ergonomic Guidelines
Office Workstation Setup

Head Position
1. Eyes level at top casing of monitor.
2. Distance to monitor is 18"-30" or arms length.
3. Ears should be over the shoulders (in line with the torso) with the chin parallel to the ground.
4. Documents holders should be as close as possible to the monitor, ideally directly next to it.

Back Position
5. Sit back into the chair utilizing the chair back.
6. Adjust the height of the chair back to get the lumbar support into the small of your back.
7. Shoulders should be relaxed, and above or slightly behind your hips.
8. Sit back at approximately 100 to 110 degrees.

Arm Position
9. Elbows are at your side, not forward back or splayed.
10. The mouse is close to the keyboard.
11. Elbows should be bent at 90° or slightly greater.
12. Shoulders should not shrug forward, up or down.
13. Wrists should be neutral. That is, they should be flat and straight.
14. Float wrists above the keyboard and mouse. Use the wrists rests when not typing or mousing.
15. Set arm rests directly below your elbows (at your side) and use them only as needed.
16. Center the spacebar in front of you for general use. For heavy number pad and mouse work, center on the whole keyboard.

Leg Position
17. Feet should be flat on the floor or footrest.
18. Knees should be at or slightly lower than your hips.
19. Do not cross your legs or tuck them underneath you.
Standing all day to work is problematic, just as sitting all day can be. Standing is more tiring, can lead to spinal compression, carotid atherosclerosis and varicose veins, and reduces the performance of many fine motor skills.

Sit-Stand desks can be a good alternative to sitting or standing all day. However, they are generally not recommended as they are not cost effective and do not show benefits that can easily be gained by simply moving around or changing tasks. Those who need to stay at their desk all day can find good benefit in using these desks. If you choose to go in this direction make sure you still follow the guidelines supplied on this document.

Environmental Health & Safety
Ergonomic Guidelines
Office Workstation Setup

1. The primary reach zone is where you should put everything you use on a constant basis. This would be your keyboard and mouse. They should be where you can reach while sitting back with your elbows at your side.

2. The secondary zone should be used for items that you use frequently, but not constantly. These would be items like your phone or scanner. They should be positioned where you are sitting back in your chair but can reach them by extending out your arm.

3. The tertiary zone should be all other things and should be reachable by either moving your chair or getting out of your chair. Do not extend your body to reach these items. Micro breaks should be taken every 20-30 minutes. These can be short 1 minute breaks. They should include looking away from your computer at a distance, stretching and at least once an hour getting up and walking around.

Much of the above information applies to standing at a desk. Here are the key points that differ.

Standing Position

1. Stand with your ears above your shoulders and your shoulders over your hips.

2. Occasionally shift your weight from leg to leg. This alters your stance and avoids a static position.

3. Aim for 20 minutes of sitting, 8 minutes of standing, followed by 2 minutes of active movement (otherwise 15 min/hour of standing). Standing longer than this can lead to issues such as back pain. Standing for long periods of time is worse than sitting for long periods of time.

4. Make sure shoulders are relaxed and wrists are straight and flat. This can be achieved by having the keyboard at or slightly below elbow height.
Appendix C
Laboratory Workstation Guide

Environmental Health & Safety
Ergonomic Guidelines
Laboratory Work

Posture

- Use a chair that has good back support and sit back into the chair.
- If your feet dangle, use the footring or get a foot rest to get your upper knees at the same or near the same height as your hips.
- If working in a forward position, tilt the seat pan forwards rather than leaning forward.
- Adjust the work or the chair so that you are sitting in an upright position.
- Always try to work at a bench height so you can get closer to your work.
- Use supportive shoes and/or cushioned mats if required to stand a long time. Mat should be solid, non-porous and cleanable.
- Keep frequently used equipment within arm's reach.

Relaxed Arms and Hands

- Keep shoulders relaxed and elbows at your side. Avoid reaching beyond this as much as feasible.
- Maintain neutral straight wrists.
- Sit close to the bench and have the height of the chair set where your elbows are slightly above the bench top.
- Avoid repetitive or forceful twisting and turning motions.
- Select equipment that are the right size for your hands.
- Use thicker grip tools (cylinders, forceps, etc.) rather than thinner.
- Use flexible gloves that fit properly and are appropriate for the hazard you are working with. Poor-fitting gloves increase pinch and grip force.

Static Postures

- When standing, shift your weight often and use a footrest to rest one foot. Switch the resting foot occasionally.
- Alternate how you hold equipment like forceps or pipettes.
- Micro breaks should be taken every 20-30 minutes. These can be short 1 minute breaks. They should include looking away from your computer at a distance, stretching at least once an hour getting up and walking around.

Source: Occupational Safety & Health Administration
Environmental Health & Safety
Ergonomic Guidelines
Laboratory Work

Pipetting
- Elevate the chair rather than reaching up to pipette.
- Do not twist or rotate the wrist while pipetting.
- Alternate hands or use both hands when pipetting.
- Hold the pipette with relaxed grip.
- Use electronic pipettes or light touch models whenever possible.
- Use minimal pressure when pipetting.
- Use light force or two hands when changing tips.
- Use low profile tubes, solution containers, and waste receptacles.
- Select a light weight pipette, properly sized for your hand.
- Use pipette with finger aspirators and thumb dispensers to reduce thumb strain.
- Use latch-mode or electronic pipettes for repetitive pipetting.
- Take a 1-2 minute break after every 20 minutes of pipetting.

Using Hoods and Biosafety Cabinets
- Remove unnecessary supplies from the work area.
- Perform all work 6 inches inside the hood.
- Position work supplies in their order of use (left to right or right to left), with most frequent used near the front of the hood if possible, but not closer than 6 inches from the face of the hood.
- Place equipment on approved elevated turntables for easy retrieval.
- Use diffused lighting to limit glare.
- Take short breaks to stretch muscles and relieve forearm and wrist pressure.
- Adjust chair to a height that allows the shoulders to relax.

Microscope Work
- Keep elbows close to your side and use arm rests to keep your shoulders relaxed and in a neutral position.
- Adjust chair, workbench, or microscope as needed to maintain upright head position.
- Elevate or move the microscope close to the edge of the counter to avoid bending the neck.
- Use adjustable eyepieces or mount your microscope on a 30° angle stand for easier viewing.
- Spread microscope work throughout the day.
- Take short breaks every 15-20 minutes. Every 30 minutes get up and walk around, stretch your arms and legs.

Work Heights

- Precision Work: 65 - 110 cm
- Light Work: 65 - 95 cm
- Heavy Work: 65 - 125 cm
- Ettar Height: 65 - 120 cm
Appendix D

Recommended Ergonomic Equipment

Environmental Health & Safety
Recommended Ergonomic Equipment

Chairs:
- Ergocentric Geocentric Tall Back chair—Multi Tilt mechanism
- Ergocentric Aircentric chair—Multi Tilt mechanism
- Ergocentric tCentric chair—Multi Tilt mechanism
- Ergocentric Saffron High Back chair—Multi Tilt mechanism

Suggested Chair Options
- Swivel Arm Rests
- Air Lumbar Support
- Triple Density Foam Seat Pad
- Hard Surface Casters
- Other mechanisms may be useful for certain individuals

Keyboards & Mice
- Microsoft Sculpt Keyboard & Mouse
- Microsoft Natural 4000 Keyboard
- Exscluent Vertical Mouse
- Contour Design Contour Mouse
- Goldtouch Comfort Mouse
- Logitech M570

Sit Stand Desks
- Taskmate Go
- Ergotron WorkFit TL
Environmental Health & Safety
Recommended Equipment

Keyboard Trays
- Humanscale 5G
- Humanscale 6G
- Workrite Pinnacle arm w/platform choice
- Intellaspace Cobra System

Document Holders
- Any document holder that keeps the paper near the monitor should work fine. Ideally it will keep the paper directly below the monitor or directly next to the monitor.

Foot Rests
- Foot rests should be substantial and able to hold up to the weight of the legs without giving way. Additionally, angle adjusting foot rests are beneficial.
- If you are working at counter height, as in a research lab, you can use the ring of the chair or you may need to use a higher foot rest.

Other Equipment
- Corner Makers—For working in a 90° or curved corner
- Anti Glare Screens
- Anti Fatigue Mats—For standing for long periods
- Monitor Risers—if your monitor is too low
- Wrist Rests—Good idea for most people for the keyboard and mouse.
- Phone Headset—For simultaneous phone and computer work
Appendix E

How to use an Ergocentric Chair

SEAT DEPTH - To adjust the seat depth, pull up on the bar under the front edge of the seat and move the seat forward or backward in relation to the backrest. Release the bar to lock.

INFINITE FORWARD TILT LOCK OUT - To prevent the seat from tilting forward when in the free float mode, tilt the seat pan slightly backward and turn the handle on the left side of the seat clockwise. Turn this handle counter-clockwise to allow the seat to tilt forward.

SPRING TENSION - To adjust the spring tension, turn the knob located under the front right corner of the seat. Turn the knob clockwise to increase the spring tension and counter-clockwise to decrease the spring tension.

SEAT ANGLE / FREE FLOAT - To adjust the seat angle, pull up on the CIRCULAR paddle and shift your weight forward or backward until the seat is at the desired angle. Push this paddle down to lock. To free float the chair, pull this paddle all the way up and leave it in the up position.

SEAT HEIGHT - To raise the seat, pull up on the SQUARE paddle while raising your weight off the chair. To lower the seat, pull up on the paddle while sitting. Release the paddle to lock.

BACK HEIGHT - To adjust the back height, push the OVAL paddle back away from the seat and adjust the backrest up or down to the desired height. Pull this paddle towards the seat to lock.

BACK ANGLE - To adjust the back angle, pull up on the TRIANGULAR paddle and hold it in the up position. Lean backward or forward until the backrest is at the desired angle. Release the paddle to lock. When adjusted correctly the angle between your upper body and thighs should be greater than 90 degrees.

Read this or visit ergo1.ca to view a 90-second video on how to adjust this chair. Simply click play.
# Appendix F
## Work Environment Lighting

<table>
<thead>
<tr>
<th>Area</th>
<th>Footcandles</th>
<th>Type of Lighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classrooms – general</td>
<td>50-75</td>
<td>fluorescent</td>
</tr>
<tr>
<td>Classrooms – art</td>
<td>50-75</td>
<td>fluorescent</td>
</tr>
<tr>
<td>Classrooms – computer</td>
<td>50-75</td>
<td>fluorescent (indirect)</td>
</tr>
<tr>
<td>Classrooms – drafting</td>
<td>75-100</td>
<td>fluorescent</td>
</tr>
<tr>
<td>Classrooms – sewing</td>
<td>75-100</td>
<td>fluorescent (task lighting)</td>
</tr>
<tr>
<td>Labs – general</td>
<td>50-75</td>
<td>fluorescent</td>
</tr>
<tr>
<td>Labs – demonstration</td>
<td>100-150</td>
<td>fluorescent (task lighting)</td>
</tr>
<tr>
<td>Auditorium seating areas</td>
<td>10-15</td>
<td>fluorescent</td>
</tr>
<tr>
<td>Auditorium concerts on stage</td>
<td>50-75</td>
<td>fluorescent</td>
</tr>
<tr>
<td>Kitchens</td>
<td>50-75</td>
<td>fluorescent</td>
</tr>
<tr>
<td>Cahiers</td>
<td>20-30</td>
<td>fluorescent (task lighting)</td>
</tr>
<tr>
<td>Dishwashing areas</td>
<td>20-30</td>
<td>fluorescent</td>
</tr>
<tr>
<td>Dining areas</td>
<td>10-20</td>
<td>fluorescent</td>
</tr>
<tr>
<td>Corridors and stairwells – elementary</td>
<td>10-15</td>
<td>fluorescent</td>
</tr>
<tr>
<td>Corridors and stairwells – middle</td>
<td>20-30</td>
<td>fluorescent</td>
</tr>
<tr>
<td>Corridors and stairwells – high</td>
<td>20-30</td>
<td>fluorescent</td>
</tr>
<tr>
<td>Gymnasiums</td>
<td>20-30</td>
<td>metal halide / fluorescent</td>
</tr>
<tr>
<td>Media Centers</td>
<td>50-75</td>
<td>fluorescent</td>
</tr>
<tr>
<td>Offices</td>
<td>75-100</td>
<td>fluorescent</td>
</tr>
<tr>
<td>Teacher workrooms</td>
<td>30-50</td>
<td>fluorescent</td>
</tr>
<tr>
<td>Conference rooms</td>
<td>30-50</td>
<td>fluorescent</td>
</tr>
<tr>
<td>Washrooms</td>
<td>20-30</td>
<td>fluorescent</td>
</tr>
<tr>
<td>Building exteriors and parking lots</td>
<td>1-2</td>
<td>sodium / metal halide</td>
</tr>
</tbody>
</table>
# REBA Employee Assessment Worksheet

## A. Neck, Trunk, and Leg Analysis

### Step 1: Locate Neck Position
- **Score A**:
  - Neck Score

### Step 2: Locate Trunk Position
- **Score A**:
  - Trunk Score

### Step 3: Legs
- **Score A**:
  - Leg Score

### Step 4: Look-up Posture Score in Table A
- Using values from steps 1-3 above, locate score in Table A.

### Step 5: Add Force/Load Score
- If load < 11 lbs: +0
- If load 11 to 22 lbs: +1
- If load > 22 lbs: +2
- Adjust: if shock or rapid build up of force: +1

### Step 6: Score A, Find Row in Table C
- Add values from steps 4 & 5 to obtain Score A.
  - Find row in Table C.

### Scoring:
- 1 = negligible risk
- 2 or 3 = low risk, change may be needed
- 4 to 7 = medium risk, further investigation, change soon
- 8 to 10 = high risk, investigate and implement change
- 11+ = very high risk, implement change

## B. Arm and Wrist Analysis

### Step 7: Locate Upper Arm Position
- **Score A**:
  - Upper Arm Score

### Step 8: Locate Lower Arm Position
- **Score A**:
  - Lower Arm Score

### Step 9: Locate Wrist Position
- **Score A**:
  - Wrist Score

### Step 10: Look-up Posture Score in Table B
- Using values from steps 7-9 above, locate score in Table B.

### Step 11: Add Coupling Score
- Well fitting handle and mid-range power grip, good: +0
- Acceptable but not ideal hand hold or coupling acceptable with another body part:
  - Fair: +1
  - Poor: +2
- No handles, awkward, unsafe with any body part:
  - Unacceptable: +3

### Step 12: Score B, Find Column in Table C
- Add values from steps 10 & 11 to obtain score B.
  - Find column in Table C and match with Score A in row from step 6 to obtain Table C Score.

### Step 13: Activity Score
- +1 1 or more body parts are held for longer than 1 minute (static)
- +1 Repeated small range actions (more than 4x per minute)
- +1 Action causes rapid large range changes in position or unstable base

---

Task name: 

Reviewer: 

Date: 

This tool is provided without warranty. The author has provided this tool as a simple means for applying the concepts provided in REBA.

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r.barker@ergosmart.com (816) 444-2667
# Appendix H

## Lifting Guidelines

### Good Lifting Technique Examples

<table>
<thead>
<tr>
<th>Step by Step</th>
<th>1. Test Weight &amp; Size</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
</tr>
<tr>
<td><strong>2. Load directly in front of you</strong></td>
<td><strong>3. Suck your gut in</strong></td>
</tr>
<tr>
<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
</tr>
<tr>
<td><strong>4. Feet flat and shoulder with apart</strong></td>
<td><strong>5. Back Flat</strong></td>
</tr>
<tr>
<td><img src="image5.png" alt="Image" /></td>
<td><img src="image6.png" alt="Image" /></td>
</tr>
<tr>
<td><strong>6. Load close to body</strong></td>
<td><strong>7. Always looking straight ahead</strong></td>
</tr>
<tr>
<td><img src="image7.png" alt="Image" /></td>
<td><img src="image8.png" alt="Image" /></td>
</tr>
<tr>
<td><strong>8. If load is too large?</strong></td>
<td></td>
</tr>
</tbody>
</table>
Appendix I

Strength / Stretching

- All exercises shown are intended for healthy adults. These are suggestions. Please see your personal physician before starting or attempting an exercise plan.

**Stretches for your Back**
Exercises for your Back

- Standing hamstring stretch
- Cat and camel
- Pelvic tilt
- Partial curl
- Extension exercise
- Quadruped arm/leg raise
- Gluteal stretch
- Side plank
Office Stretches

- Breathe easily
- No bouncing or forcing
- No pain!
- Feel the stretch
- Relax
- See Stretching Instructions, pp. 77 – 84

1. 5 sec, 3 times
   p. 82

2. 5 sec, 3 times
   p. 82

3. 5 sec, 2 times
   p. 81

4. 5 sec, 2 times
   p. 84

5. 5 sec
   p. 84

6. 5 sec each side
   p. 84

7. 5 sec
   p. 84

8. 10 sec each arm
   p. 81

9. 10 sec
   p. 82

10. 10 sec
    p. 81

11. 9 sec each side
    p. 82

12. 10 sec
    p. 79
# Appendix J

## Keyboard Shortcuts

### PC Keyboard Shortcuts

<table>
<thead>
<tr>
<th>Key</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Esc</td>
<td>cycles through open programs</td>
</tr>
<tr>
<td>Tab</td>
<td>cycles through open applications</td>
</tr>
<tr>
<td>Spacebar</td>
<td>Control menu (maximize, minimize, close, etc.)</td>
</tr>
<tr>
<td>Hyphen</td>
<td>opens the window’s control menu</td>
</tr>
<tr>
<td>F4</td>
<td>closes open window</td>
</tr>
<tr>
<td>Left, right arrows</td>
<td>Back/forward on web</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ctrl A</td>
<td>select all</td>
</tr>
<tr>
<td>Ctrl B</td>
<td>bold font</td>
</tr>
<tr>
<td>Ctrl C</td>
<td>copy</td>
</tr>
<tr>
<td>Ctrl D</td>
<td>change font</td>
</tr>
<tr>
<td>Ctrl E</td>
<td>center alignment</td>
</tr>
<tr>
<td>Ctrl F</td>
<td>find</td>
</tr>
<tr>
<td>Ctrl G</td>
<td>go to</td>
</tr>
<tr>
<td>Ctrl H</td>
<td>replace</td>
</tr>
<tr>
<td>Ctrl I</td>
<td>italic font</td>
</tr>
<tr>
<td>Ctrl J</td>
<td>justify</td>
</tr>
<tr>
<td>Ctrl K</td>
<td>insert hyperlink</td>
</tr>
<tr>
<td>Ctrl L</td>
<td>left alignment</td>
</tr>
<tr>
<td>Ctrl M</td>
<td>tabs five spaces</td>
</tr>
<tr>
<td>Ctrl N</td>
<td>new document</td>
</tr>
<tr>
<td>Ctrl O</td>
<td>open file</td>
</tr>
<tr>
<td>Ctrl P</td>
<td>print</td>
</tr>
<tr>
<td>Ctrl Q</td>
<td>resets tab on ruler</td>
</tr>
<tr>
<td>Ctrl R</td>
<td>right alignment</td>
</tr>
<tr>
<td>Ctrl S</td>
<td>save</td>
</tr>
<tr>
<td>Ctrl S/</td>
<td>save as</td>
</tr>
<tr>
<td>Tab</td>
<td>moves cursor backward</td>
</tr>
<tr>
<td>Page up</td>
<td>highlights cursor position to the beginning of the line</td>
</tr>
<tr>
<td>Page down</td>
<td>highlights cursor position to the end of the line</td>
</tr>
<tr>
<td>Shift F7</td>
<td>thesaurus</td>
</tr>
</tbody>
</table>

### Other Keys

<table>
<thead>
<tr>
<th>Key</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>help</td>
</tr>
<tr>
<td>F5</td>
<td>find and replace</td>
</tr>
<tr>
<td>F7</td>
<td>spell/grammar check</td>
</tr>
<tr>
<td>Windows Key</td>
<td>Start menu</td>
</tr>
<tr>
<td>Windows Key+D</td>
<td>Go to Desktop</td>
</tr>
<tr>
<td>Shortcut key</td>
<td>Shortcut menu</td>
</tr>
</tbody>
</table>
**MAC KEYBOARD SHORTCUTS**

<table>
<thead>
<tr>
<th>Option + Esc</th>
<th>Force quit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tab</td>
<td>cycles through open applications</td>
</tr>
<tr>
<td>F4</td>
<td>close document</td>
</tr>
<tr>
<td>Control + F2</td>
<td>control the menu bar with the keyboard</td>
</tr>
<tr>
<td>Control + F3</td>
<td>control the dock with the keyboard</td>
</tr>
<tr>
<td>Left, right arrows</td>
<td>Back/forward on web</td>
</tr>
</tbody>
</table>

**NOTE:** The following shortcuts apply primarily to Microsoft Office applications for the Mac

<table>
<thead>
<tr>
<th>A</th>
<th>select all</th>
<th>S</th>
<th>save</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>bold font</td>
<td>T</td>
<td>hanging indent</td>
</tr>
<tr>
<td>C</td>
<td>copy</td>
<td>U</td>
<td>underline</td>
</tr>
<tr>
<td>D</td>
<td>change font</td>
<td>V</td>
<td>paste</td>
</tr>
<tr>
<td>E</td>
<td>center alignment</td>
<td>W</td>
<td>closes file</td>
</tr>
<tr>
<td>F</td>
<td>find</td>
<td>X</td>
<td>cut</td>
</tr>
<tr>
<td>G</td>
<td>find next</td>
<td>Y</td>
<td>redo</td>
</tr>
<tr>
<td>H</td>
<td>replace</td>
<td>Z</td>
<td>undo</td>
</tr>
<tr>
<td>I</td>
<td>italic font</td>
<td>1</td>
<td>single space</td>
</tr>
<tr>
<td>J</td>
<td>justify</td>
<td>2</td>
<td>double space</td>
</tr>
<tr>
<td>L</td>
<td>left alignment</td>
<td>5</td>
<td>1.5 space</td>
</tr>
<tr>
<td>M</td>
<td>minimize</td>
<td>/</td>
<td>Help menu</td>
</tr>
<tr>
<td>N</td>
<td>new document</td>
<td>Home</td>
<td>top</td>
</tr>
<tr>
<td>O</td>
<td>open file</td>
<td>End</td>
<td>bottom</td>
</tr>
<tr>
<td>P</td>
<td>print</td>
<td>F2</td>
<td>Print Preview</td>
</tr>
<tr>
<td>Q</td>
<td>quit</td>
<td>Option + L</td>
<td>Spell check</td>
</tr>
<tr>
<td>R</td>
<td>right alignment</td>
<td>Option + R</td>
<td>Grammar check</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shift + Return</th>
<th>page break</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tab</td>
<td>moves cursor backward</td>
</tr>
<tr>
<td>Page up</td>
<td>highlights cursor position to the beginning of the line</td>
</tr>
<tr>
<td>Page down</td>
<td>highlights cursor position to the end of the line</td>
</tr>
</tbody>
</table>

**Other Keys**

<table>
<thead>
<tr>
<th>F1</th>
<th>undo</th>
<th>Option + Shortcut menu</th>
</tr>
</thead>
<tbody>
<tr>
<td>F7</td>
<td>spell/grammar check</td>
<td></td>
</tr>
</tbody>
</table>
# EXCEL-SPECIFIC KEYBOARD SHORTCUTS

## SELECTING CELLS
- Select current region around active cell: `CTRL+SHIFT + *`
- Extend selection by one cell: `SHIFT + ARROW`
- Extend selection to last nonblank cell: `CTRL + SHIFT + ARROW`
- Extend selection to start of row: `SHIFT + HOME`
- Extend selection to top left: `CTRL + SHIFT + HOME`
- Extend selection to last cell used: `CTRL + SHIFT + END`
- Select the entire column: `CTRL + SPACEBAR`
- Select the entire row: `SHIFT + SPACEBAR`
- Only select active cell: `SHIFT + BACKSPACE`
- Extend selection down one screen: `SHIFT + PAGE DOWN`
- Extend selection up one screen: `SHIFT + PAGE UP`
- Turn End mode on or off: `END`
- Extend selection to the last nonblank cell: `END or SHIFT + ARROW KEY`

## ENTERING DATA
- Start a new line in the same cell: `ALT + ENTER`
- Delete text to the end of the line: `CTRL + DELETE`
- Edit a cell comment: `SHIFT + F2`
- Fill the selected cell range with entry: `CTRL + ENTER`
- Finish entry and move up in a selection: `TAB`
- Finish entry and move right in selection: `SHIFT + TAB`

## FORMULA BAR
- Insert the sum formula: `ALT + =`
- Enter the time: `CTRL + SHIFT + :`
- Copy the value from above cell: `CTRL + SHIFT + “`
- Insert function arguments: `CTRL + SHIFT + A`

## FORMATTING
- Display the STYLE: `ALT + 4`
- General number format: `CTRL + SHIFT + ~`
- Commas and decimals: `CTRL + SHIFT + !`
- 1-Jan-00 format: `CTRL + SHIFT + #`
- Dollar format: `CTRL + SHIFT + `$`
- Percentage format: `CTRL + SHIFT + %`
- Outline border: `CTRL + SHIFT + &`
- Remove outline border: `CTRL + SHIFT + _`
- 1/1/1900 0:00 AM format: `CTRL + SHIFT + @`
- 00:00:00 AM or PM format: `CTRL + SHIFT + ^`

## MENUS/ WINDOWS/ DIALOG BOXES
- Show a shortcut menu: `SHIFT + F10`
- Show the window icon menu: `ALT + SPACEBAR`
- Switch to the next program: `ALT + TAB`
- Switch to the previous program: `ALT + SHIFT + TAB`
- Move to the next open file: `CTRL + TAB or CTRL + F6`
- Minimize workbook: `CTRL + F9`
- Maximize workbook: `CTRL + TAB or CTRL + PAGE UP/DN`
- Get to next tab in a dialog box: `CTRL + TAB`
- Get to previous tab in dialog box: `CTRL + SHIFT + TAB`

## SPECIAL KEYS
- Select cells referred to by formula: `CTRL + [`
- Select all cells that are directly or indirectly referred to by formulas: `CTRL + SHIFT +{`
- Select only cells with formulas that refer directly to the active cell: `CTRL + `
- Select only cells with formulas that refer directly or indirectly to the active cell: `CTRL + SHIFT + )`
- One screen right or left: `ALT + PAGE DOWN/UP`
Appendix K

Online Resources

OSHA E-Tools

Cornell University
http://ergo.human.cornell.edu/

Ergonomics Plus
http://ergo-plus.com/

How to use REBA Tables

UNC Chapel Hill
http://ehs.unc.edu/workplace-safety/ergonomics/

NC State
https://www.ergocenter.ncsu.edu/

List of Ergonomic Sites
http://ergo-plus.com/office-ergonomics-guide/

CDC Ergonomic Principles
Appendix L

WUSTL Preferred Vendors

Advanced Ergonomics  https://advan-ergo.com/

Worksafe Products  http://wsergo.com/