**Ergonomics**

**Wikipedia: Ergonomics**

Ergonomics is the **scientific discipline** concerned with **designing** according to human needs, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance. [2] The field is also called **human engineering**, and **human factors**.

Ergonomics is the science of designing the job, equipment, and workplace to fit the worker. Proper ergonomic design is necessary to prevent repetitive strain injuries, which can develop over time and can lead to long-term disability.[1]
Ergonomic Tips for Computer Users. Employees who use a desktop computer, whether at work or home, can improve their own personal ergonomics — and avoid injury — by incorporating a few basic principles.[6]

**Five aspects of ergonomics**

There are five aspects of ergonomics: safety, comfort, ease of use, productivity/performance, and aesthetics. Based on these aspects of ergonomics, examples are given of how products or systems could benefit from redesign based on ergonomic principles.

1. **Safety** - Medicine bottles: The print on them could be larger so that a sick person who may have bad vision (due to sinuses, etc.) can more easily see the dosages and label. Ergonomics could design the print style, color and size for optimal viewing.

2. **Comfort** - Alarm clock display: Some displays are harshly bright, drawing one’s eye to the light when surroundings are dark. Ergonomic principles could re-design this based on contrast principles.

3. **Ease of use** - Street Signs: In a strange area, many times it is difficult to spot street signs. This could be addressed with the principles of visual detection in ergonomics.

4. **Productivity/performance** - HD TV: The sound on HD TV is much lower than regular TV. So when you switch from HD to regular, the volume increases dramatically. Ergonomics recognizes that this difference in decibel level creates a difference in loudness and hurts human ears and this could be solved by evening out the decibel levels.

5. **Aesthetics** - Signs in the workplace: Signage should be made consistent throughout the workplace to not only be aesthetically pleasing, but also so that information is easily accessible.

http://www.hfes.org/web/AboutHFES/about.html
http://www.ergonomics.org.uk/page.php?s=6&p=84


**Technically Cool Computing**

A pilot project of Puget Sound Human Factors and Ergonomics Society

*Technically Cool Computing* is a pilot project sponsored by the Puget Sound Human Factors and Ergonomics Society (PSHFES) to develop a computer ergonomics learning activity module for students. The module will teach students how to evaluate their computer workstations and work habits in order to reduce their risk for musculoskeletal injuries. Our goal is to develop a user-friendly learning module that can be easily implemented by teachers in the classroom environment. Students will gain an understanding of the basic concepts of computer ergonomics in order to be able to establish lifelong habits of safe computing.

As the use of computers has increased significantly over the last twenty years, so has the rate of
repetitive use musculoskeletal injuries such as carpal tunnel syndrome, neck strain and other conditions of the neck/spine, wrists, hands and shoulders. What are seldom considered, however, are the increased use of computers by children, the long term effects of awkward postures on children, and the lack of size appropriate computer workstation equipment available to school aged youth.

It has been reported that approximately 23% of elementary school children complain of back pain, a statistic that increases to about 33% among secondary school children. Fifty six percent of teenage males and 30% of females in the US were identified as having degeneration of the spine by X ray imaging. In 1999, the average American child was reported to be spending between one and three hours per day using a computer. Add to that the increased use of mobile devices such as cell phones for text messaging and gaming devices, and the exposure to risk increases exponentially. With so many children using electronic devices at an early age, concerns regarding the long term effects of this chronic exposure and the potential for the early onset of debilitating injuries have begun to surface. Providing education for students to achieve comfort, efficiency and safety in their computer habits early on will assure a healthy workforce for our future.

For additional information or to be involved in the trial phase of this project, please contact Susan Murphey, PSHFES P

**Good Working Positions**
Rick Goggins, Ergonomist for Washington State Department of Labor and Industries and a member of the PSHFES Executive Council.

**Scientific meeting which contain aspects of ergonomics**
http://sigchi.org/conferences/
http://sigchi.org/conferences/calendarofevents.html
http://www.aota.org/ConfandEvents/Conf.aspx
http://www.ergoexpo.com/NECE/schedule.asp

There are a wide variety of possible solutions that can be implemented to reduce or eliminate the ergonomic risk associated with jobs or work tasks in the workplace.

mitigate MSDs (musculoskeletal disorders)

**Millions of people work with computers every day. This eTool* illustrates simple, inexpensive principles that will help you create a safe and comfortable computer workstation. There is no single “correct” posture or arrangement of components that will fit everyone. However, there are basic design goals, some of which are shown in the accompanying figure, to consider when setting up a computer workstation or performing computer-related tasks.**

Consider your workstation as you read through each section and see if you can identify areas for improvement in posture, component placement, or work environment. This eTool provides suggestions to minimize or eliminate identified problems, and allows you to create your own "custom-fit" computer workstation.
OSHA computer Workstations recommendations
Top of monitor at or just below eye level
Head and neck balanced and in-line with torso.
Shoulders relaxed.
Elbows close to body and supported.
Lower back supported
Wrist and hands in-line with forearms.
Adequate room for keyboard and mouse.
Feet flat on the floor.

Good Working Positions
To understand the best way to set up a computer workstation, it is helpful to understand the concept of neutral body positioning. This is a comfortable working posture in which your joints are naturally aligned. Working with the body in a neutral position reduces stress and strain on the muscles, tendons, and skeletal system and reduces your risk of developing a musculoskeletal disorder (MSD). The following are important considerations when attempting to main neutral body postures while working at the computer workstation:

1. Hands, wrists, and forearms are straight, in-line and roughly parallel to the floor.
2. Head is level, or bent slightly forward, forward facing, and balanced. Generally it is in-line with the torso.
3. Shoulders are relaxed and upper arms hang normally at the side of the body.
4. Elbows stay in close to the body and are bent between 90 and 120 degrees.
5. Feet are fully supported by the floor or a footrest may be used if the desk height is not
adjustable.
0. Back is fully supported with appropriate lumbar support when sitting vertical or leaning back slightly.
0. Thighs and hips are supported by a well-padded seat and generally parallel to the floor.
0. Knees are about the same height as the hips with the feet slightly forward.

Regardless of how good your working posture is, working in the same posture or sitting still for prolonged periods is not healthy. You should change your working position frequently throughout the day in the following ways:
0. Make small adjustments to your chair or backrest.
0. Stretch your fingers, hands, arms, and torso.
0. Stand up and walk around for a few minutes periodically.

These four reference postures are examples of body posture changes that all provide neutral positioning for the body.

**Upright sitting posture.** The user's torso and neck are approximately vertical and in-line, the thighs are approximately horizontal, and the lower legs are vertical.

**Standing posture.** The user's legs, torso, neck, and head are approximately in-line and vertical. The user may also elevate one foot on a rest while in this posture

**Declined sitting posture.** The user's thighs are inclined with the buttocks higher than the knee and the angle between the thighs and the torso is greater than 90 degrees. The torso is vertical or slightly reclined and the legs are vertical.

**Reclined sitting posture.** The user's torso and neck are straight and recline between 105 and 120 degrees from the thighs

**Monitors**

Choosing a suitable monitor and placing it in an appropriate position helps reduce exposure to **forceful exertions**, **awkward postures**, and **overhead glare**. This helps prevent possible health effects such as excessive fatigue, eye strain, and neck and back pain.

Consider the following issues to help improve your computer workstation:

- **Viewing Distance**
- **Potential Hazards**

0. Monitors placed too close or too far away may cause you to assume awkward body positions that may lead to eyestrain.

Viewing distances that are too long can cause you to lean forward and strain to see small text. This can fatigue the eyes and place stress on the torso because the backrest is no longer providing support.

Viewing distances that are too short may cause your eyes to work harder to focus (convergence problems) and may require you to sit in awkward postures. For instance, you may tilt your head backward or push your chair away from the screen, causing you to type with outstretched arms.

![Figure 1. Preferred viewing distance is 20 to 40 inches](image-url)
Possible Solutions

0. Sit at a comfortable distance from the monitor where you can easily read all text with your head and torso in an upright posture and your back supported by your chair. Generally, the preferred viewing distance is between 20 and 40 inches (50 and 100 cm) from the eye to the front surface of the computer screen (Figure 1). Note: text size may need to be increased for smaller monitors.

0. Provide adequate desk space between the user and the monitor (table depth). If there is not enough desk space, consider doing the following:
   Make more room for the back of the monitor by pulling the desk away from the wall or
divider; or
Provide a flat-panel display, which is not as deep as a conventional monitor and requires less desk space (Figure 2); or
Place monitor in the corner of a work area. Corners often provide more desk depth than a straight run of desk top.

0. Move back and install an adjustable keyboard tray to create a deeper working surface.
0. **Viewing Angle-Height and Side-to-Side**
0. **Viewing Time**
0. **Viewing Clarity**

You should choose a monitor and consider its placement in conjunction with other components of the computer workstation, including the **keyboard**, **desk**, and **chair**.

**Keyboards**

Proper selection and arrangement of the computer keyboard helps reduce exposure to **awkward postures**, **repetition**, and **contact stress**.

Consider the following factors when evaluating your computer workstation.

- **Keyboard Placement - Height**

Potential Hazard

0. Keyboards, **pointing devices**, or **working surfaces** that are too high or too low can lead to awkward wrist, arm, and shoulder postures. For example, when keyboards are too low you may type with your wrists bent up, and when keyboards are too high, you may need to raise your shoulders to elevate your arms. Performing keying tasks in **awkward postures** such as these can result in hand, wrist, and shoulder discomfort.

*Figure 1. Keyboard tray*

*Figure 2. Side view illustration showing the recommended range for keyboard placement*
Possible Solutions

0. Adjust the chair height and work surface height to maintain a neutral body posture. Elbows should be about the same height as the keyboard and hang comfortably to the side of the body. Shoulders should be relaxed, and wrists should not bend up or down or to either side during keyboard use.

0. Remove central pencil drawers from traditional desks if you can’t raise your chair high enough because of contact between the drawer and the top of the thighs. The work surface should generally be no more than 2 inches thick.

0. A keyboard tray (Figure 1) may be needed if the work surface or chair cannot be properly adjusted. The keyboard tray should
   - Be adjustable in height and tilt,
   - Provide adequate leg and foot clearance, and
   - Have adequate space for multiple input devices (for example, a keyboard and pointer/mouse).

0. The keyboard’s vertical position should be maintained within the recommended range shown in Figure 2. The tilt of the keyboard may need to be raised or lowered using the keyboard feet to maintain straight, neutral wrist postures while accommodating changes in arm angles.

0. **Keyboard Placement - Distance**
   Potential Hazard
0. A keyboard or pointer/mouse that is too close or too far away may cause you to assume
awkward postures such as reaching with the arms, leaning forward with the torso (Figure 3), and extreme elbow angles (Figure 4). These awkward postures may lead to musculoskeletal disorders of the elbows, shoulders, hands, and wrists.

Possible Solutions

0. Place the keyboard directly in front of you at a distance that allows your elbows to stay close to your body with your forearms approximately parallel with the floor.

0. A keyboard tray may be useful if you have limited desk space or if your chair has armrests that interfere with adequate positioning.

0. **Design and Use**

0. **Left Hand Key Usage**

You should choose a keyboard and consider its placement in conjunction with other components of the computer workstation, including the pointer/mouse and wrist/palm rests.

**Design and Use**

Potential Hazard

- A traditional keyboard may cause you to bend your wrists sideways (Figure 5) to reach all the keys. Keyboard tilt, caused by extending the legs on the back of the keyboard or by a steep design angle, may cause the wrist to bend upward (Figure 6). Smaller keyboards, such as those found on laptops, may also contribute to stressful postures. These awkward wrist postures can create contact stress to the tendon sheath and tendons that must move within the wrist during repetitive keying.
Possible Solutions

0. Reduce awkward wrist angles by lowering or raising the keyboard or chair to achieve a neutral wrist posture.

0. Elevate the back or front of keyboards to achieve a neutral wrist posture. For example, if the operator sits lower in relation to the keyboard, slightly elevating the back of the keyboard may help maintain a neutral wrist. Similarly, raising the front of the keyboard may help maintain neutral wrist postures for users who type with the keyboard in a lower position. Do not use keyboard feet if they increase bending of the wrist.

Consider alternative keyboards (Figures 8 and 9) to promote neutral wrist postures. Alternative keyboards may be provided on a case-by-case basis. Users may need time to become accustomed to these devices. Note: alternative keyboards help maintain neutral wrist postures, but available research does not provide conclusive evidence that using these keyboards prevents discomfort and injury.

- Keyboards should be of appropriate size and key-spacing to accommodate most users. Generally, the horizontal spacing between the centers of two keys should be 0.71-0.75 inches (18-19 mm) and the vertical spacing should be between 0.71-0.82 inches (18-21 mm) (Figure 7).
Left hand key usage

Potential Hazard

0. Most keyboards are manufactured with a 10 key keypad permanently affixed to the right side of the keyboard. This arrangement can be limiting to left handed workers or right handed workers who are recovering from injury and are attempting to remain functional during their recovery. This arrangement is also a problem if one is attempting to create work-rest regimens by alternating principle hand usage during the work day or work week.

Possible Solutions

1. Alternative left hand keyboards which have the keypad permanently affixed to the left side of the keyboard are available as are keyboards with a detached keypad. These allow the user to switch positions for either left or right hand use. These may be especially useful for applications where workers share computers.

2. Programmable stand alone keypads are available which can be programmed to facilitate either right or left hand usage.
A programmable keypad allows keys to be defined to user preference


(RSI) is also called repetitive stress injury or repetitive motion injury. It's an increasingly common condition that affects muscles, tendons, and nerves in the hands, wrists, arms, and back caused by overuse when muscles are kept working or tense for long periods of time. RSI has been observed in many of today's working professionals and is widely considered an occupational syndrome of individuals who work regularly on a computer or with a similar tool that requires the same repetitive motion. A recent study shows that the average office worker spends approximately six hours each day on a computer. It's no wonder that there's a growing incidence of wrist pain today. Wacom products offer a supplemental way to work with your computer, providing a more comfortable and natural way to work. Alternating among input devices such as a mouse, a keyboard, and a pen is an effective way to reduce stress on your
hand and wrist. Time and time again, our customers tell us that using a pen has helped them alleviate mouse-induced repetitive stress injuries.

**Bamboo: A Pen Tablet for Your Computer** Bamboo, a new pen tablet by Wacom, provides working professionals all the benefits of pen input, including Wacom’s patented, battery-free wireless pen. It plugs into your computer (Mac or PC) through your USB port and is priced at just $79.

[http://www.wacom.com/lp/ergo.cfm?gclid=CPTXifKM7JoCFR0Sagodqi7PBw](http://www.wacom.com/lp/ergo.cfm?gclid=CPTXifKM7JoCFR0Sagodqi7PBw)

Bamboo is a more comfortable and natural way to work, giving you a supplement to keyboard input and helping reduce mouse-related stress on your hand and wrist. Alternating among input devices such as a mouse, a keyboard, and a pen is an effective way to reduce strain on delicate muscles, tendons, and nerves.