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Visual Ergonomics: Visual Considerations at Computer Workstations
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PROBLEM



<http://www.ergonomics4schools.com/lzone/office.htm>

Spending almost eight hours on a computer five days a week, I experience headaches, focusing difficulties, burning eyes, tired eyes, general eyestrain, aching eyes, dry eyes, double vision, blurred vision, light sensitivity, and neck and shoulder pain. My eyes hurt and head aches. And there I sit, peering at my computer monitor. If you have to use computers every day — either for work or personal use — you may experience eyestrain as a result; also known as Computer Vision Syndrome (CVS).

CVS: Signs and symptoms

1. Common signs and symptoms include:
2. Sore, tired, burning or itching eyes
3. Watery eyes
4. Dry eyes
5. Blurred or double vision
6. Headache and sore neck
7. Difficulty shifting focus between monitor and paper documents in your
8. work area

7. Color fringes or afterimages when you look away from the monitor

8. Increased sensitivity to light

Eyestrain associated with computer use isn't thought to have serious or long-term consequences, but it's disruptive and unpleasant. Though you may not be able to change the nature of your job or all the factors that can cause eyestrain, you can take steps to reduce the strain.

More than 50 percent of computer users experience eyestrain, headaches, blurred vision and other visual symptoms related to sustained use of the computer. This type of stress on the visual system can also cause body fatigue and reduced efficiency at work. In addition, there are now indications that heavy computer users are at risk for Glaucoma.

Many of these symptoms can be reduced through a combination of correcting workstation conditions, posture, stress-relieving lenses prescribed specifically for computer operation, special anti-glare screens, and eye exercises

Exercise 1

Palming: The palming exercise will teach you to relax your eyes, which in turn will bring healthy energy to your eyes.

First, rub your hands together until they feel warm (about 15 to 20 seconds). Then place your cupped hands over your closed eyes, being careful not to touch your eyes with the palms of your hands. The fingers of each hand should overlap and rest gently on the center of your forehead. Don't create any unnecessary pressure on your face. If your arms get tired, rest your elbows on a table.

Sit quietly for one to two minutes with your hands over your eyes. The more relaxed you become, the blacker the darkness you will see with your eyes closed.

Exercise 2

Near-far focus - this exercise improves eye flexibility:

Hold your thumb six inches from your nose. Focus on your thumb. Take one deep breath and exhale slowly. Then focus on an object about 10 feet away. Take another deep breath and slowly exhale. Repeat back and forth 15 times

Exercise 3

Scanning - this exercise helps you increase the flexibility of your eyes.

Sitting or standing at one end of a room, let your eyes scan around the edges of objects in the room - clocks, televisions, doors, lights, computers, etc. The object of this exercise is to keep your eyes moving in a loose and fluid way. Do this exercise for two minutes. Remember to breathe.

Exercise 4

Hydrotherapy

Place a bowl of hot water and a bowl of cold water in front of you. The hot water should be hot but not so hot that it burns you. The cold water should be ice cold, so either put ice cubes in it or get it out of the refrigerator. Put a wash cloth in each bowl. Place the wash cloth from the bowl of hot water against your closed eyes for 30 seconds. Then do the same with the wash cloth from the bowl of cold water. Continue to alternate the hot and cold wash cloths. Finish by gently massaging your closed eyes with a dry towel. Do this for two minutes.

Exercise 5

Head Rolls - this exercise is to relax your neck, head and face muscles and reduce shoulder tension.

Take a deep breath and close your eyes. On the exhale, slowly drop your chin to your chest. Relax your neck and shoulders. As you inhale deeply again, slowly and gently roll your head around to the left, then back, keeping your shoulders still and relaxed. Make

your movements slowly, carefully and deliberately. Now exhale full as you roll your head to the other side and down to your chest again. Repeat this sequence twice then change directions and repeat twice more.

<http://www.visionworksusa.com/computereyestrain.htm#checklist>

BACKGROUND DISCUSSION

Can ergonomics positively affect some of the concerns associated with poor vision and eyestrain at the computer workstation? Visual discomfort occurs at a computer workstation when the visual demands of your task exceed your visual abilities. The problem can be resolved by treating your visual condition, if any, or by making your visual task less demanding. A thorough eye examination is necessary to determine whether you have any visual problems. The examination must include analysis of the functioning of your eyes at near working distances. It's also important to provide the examining doctor information about your viewing distance (from your eyes to the screen) and the location of the screen in your field of view. Eye and vision problems are frequently received complaints among computer users. There is no evidence that prolonged computer use can cause permanent eye damage. However, because computer work is visually demanding, people with no previous eye problems may experience eyestrain and develop a need for glasses. It also can make the symptoms more noticeable for people with existing eye problems. The common eye problems associated with computer use are irritation, eye fatigue, blurriness and headaches. Below are some of the special computer glasses for use while working on computers:

Single vision lens

This type of lens is adjusted for the distance from eye to the monitor screen and documents. It is preferable for those who use the computer for extended periods of time and rarely do distance work.

Bifocal Lens

This lens has a near focus on the bottom and intermediate viewing on the top specifically for computer work. They can be used for those whose near range vision is narrow and need little distance viewing.

Trifocal lens

It has a near focus on the bottom and an intermediate focus in the middle for monitoring view and distance focusing on the upper portion. These lens are good for people who perform tasks that require near and distance viewing.

Task-specific progressive addition lenses

Unlike the lenses described above, additional lens power is added gradually for near, intermediate and distance viewing. It is claimed that this lens minimizes blurring that can occur in the single, special bifocal and trifocal computer lenses.

If you wear corrective lens, the easiest way to avoid the change of visual fields is adjust the computer monitor until your correction works comfortably. For people who wear bifocal lenses, it is preferable to place the computer at a low position to avoid the need of tilting the head backward to see the monitor.

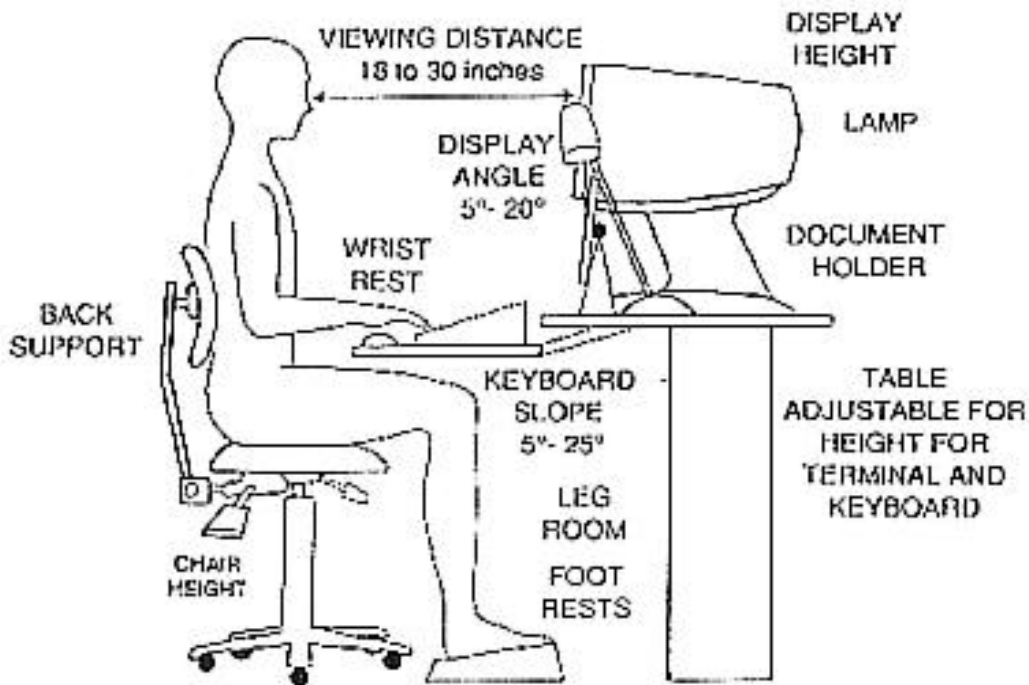
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Eyes have a very hard time focusing on pixel characters. They focus on the plane of the computer screen, but cannot sustain that focus. They focus on the screen and relax to a point behind the screen, called the Resting Point of Accommodation (RPA) or dark focus. The RPA is different for every individual, but for almost everyone, it is further away than the working distance to the computer. The working distance is the distance from the computer user's eyes to the front of the screen. So, the eyes are constantly relaxing to the RPA, and then straining to refocus on the screen. It is similar to raising the arm in a position like when volunteering for something or voting by hand and pumping the fist open and closed 40,000 times. The raised arm would get tired; let alone the hand, which symbolizes the focusing that the eyes must do in an 8 hour day. This constant flexing of the focusing (ciliary body) muscles is what creates fatigue, and generates burning and tired eyes. If you spend increasing amounts of time at your computer workstation, it is necessary to be aware of how the design and arrangement of the workstation, chair, monitor and keyboard can affect our vision.

HFE CONSIDERATIONS AND SUGGESTIONS



<http://web.princeton.edu/sites/ehs/healthsafetyguide/A4.htm>

DESK/WORKSTATION

Standard furniture cannot accommodate everyone's needs. A taller person may need a one-time adjustment to have his or her work surface raised somewhat; a shorter person may need a footrest or other accessories. Adjustable furniture may be needed in situations where people share or use the same workstation. Purchase ergonomic

furniture to assure proper screen locations and posture. Poor ergonomic setup is a cause of head, neck, shoulder, and back pain.

1. The desktop should be organized so that frequently used objects are close to the user to avoid excessive extended reaching.
2. The work surface should have a matte finish to minimize glare or reflections.
3. The area underneath the desk should always be clean/uncluttered to accommodate the user's legs and allow for stretching.
4. If a fixed-height desk is used, add a keyboard tray that adjusts vertically to provide added adjustability.
5. A footrest should be used if, after adjusting the height of the chair, feet do not rest flat on the floor.
6. Use a headset or speaker phone to avoid neck and shoulder discomfort if you use a phone frequently throughout the day.
7. Place the phone on the side of your non-dominant hand (i.e., left side if right-handed, right side if left-handed)
8. Position your desk lamp (if you use one) so that it illuminates source documents without causing either glare on the computer screen or direct illumination to your eyes.
9. A document holder should be used if documents are referred to during keying. The document holder should:
 10. Be stable and adjustable (height, position, distance, and angle of view).
 11. Support your document on either side of the monitor.
 12. Be at the same distance from your eyes as the display screen to avoid frequent changes of focus and you should be able you to look from one to the other without moving your neck or back.

CHAIR ADJUSTMENTS

Sitting, which most people believe is relaxing, is hard on the back. Sitting for long periods of time can cause increased pressure on the intervertebral discs — the spongy discs between the vertebrae. Sitting is also hard on the feet and legs. Gravity tends to pool blood in the legs and feet and create a sluggish return to the heart.

The following recommendations can help increase comfort for computer users:

1. "Dynamic sitting", don't stay in one static position for extended periods of time.
2. When performing daily tasks, alternate between sitting and standing or take small walking breaks throughout the day.
3. The chair back should have a lumbar support
4. Adjust height of backrest to support the natural inward curve of the lower back.
5. It may be useful to use a rolled towel, lumbar roll or cushion to support the low back.
6. The angle of the back rest is subjective but the trunk and upper legs should form an angle between 90 to 115 degrees.
7. Adjust height of chair so feet rest flat on floor

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8. Sit upright in the chair with the low back against the backrest and the shoulders touching the backrest.
9. Thighs should be parallel to the floor and knees at about the same level as the hips.
10. Back of knees should not come in direct contact with the edge of the seat pan. There should be 2-4 inches between the edge of the seat and the back of the knee
11. Arm rests should be removable and the distance between the arm rests should be adjustable.
12. Adjust height and/or width of armrests so they allow the user to rest arms at their sides and relax/drop their shoulders while keyboarding.
13. Don't use armrests to slouch. Also, chair arms should not noticeably elevate your shoulders or force you to move your arms away from your body to use them.
14. Elbows and lower arms should rest lightly on armrests so as not to cause circulatory or nerve problems.
15. Use a footrest when attempts to adjust your chair and the rest of the workstation fail to keep your feet on the ground.
16. Ensure that you have some space (2-3") between the top of your thighs and the underside of your workstation.
17. Have enough space under your work surface so that you can pull your self all the way up to the edge of the desk with room for your legs and knees to fit comfortably.

MONITOR

Once the chair and work surface height are properly adjusted, the computer monitor should be placed so the top of the screen is at or just below eye level when seated in an upright position. The following suggestions can help prevent the development of eye strain, neck pain and shoulder fatigue while using your computer workstation:

1. Make sure the surface of the viewing screen is clean.
2. Adjust brightness and contrast to optimum comfort.
3. Position the monitor directly in front of the user to avoid excessive twisting of the neck.
4. User must position the monitor at a comfortable viewing distance, approximately 18-30 inches from the user.
5. Position monitors at right angles from windows to reduce glare. Close window blinds as needed to reduce glare from sunlight.
6. Position monitors away from direct lighting which creates excessive glare or use a glare filter over the monitor to reduce glare.
7. Adjust the monitor tilt so that ceiling lights do not reflect on your screen.
8. If a document holder is used, it should be placed at approximately the same height as the monitor and at the same distance from the eyes to prevent frequent eye shifts between the monitor screen and reference materials.
9. Get regular eye check-ups.
10. Adjust as needed for larger screens. You may need to sit farther away and increase the font size to take full advantage of the larger screen.

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Bifocal and trifocal wearers have to pay particular attention to the placement of their monitor. Wearers of bifocals and trifocals often unknowingly tilt their heads backwards so they can read the screen through the lower portion of their glasses. This can sometimes lead to neck, shoulder, and back discomfort. Potential solutions include either lowering the computer monitor or purchasing glasses designed specifically for working at the computer. Proper lighting can reduce eyestrain and glare. Glare is created by glare on walls and other surfaces, reflections from the computer screen, bright light coming in from outside, and bright light inside. To decrease light and reflections from external light, close drapes or blinds. When you use a computer, lighting should be about half of that used in most offices. Using fewer light bulbs or florescent bulbs or use lower intensity bulbs can reduce glare caused by overhead lighting. Take a 10-15 minute break every hour to reduce eyestrain.

Look away from the computer screen every 10-15 minutes and focus for 5-10 seconds on a distant object outside or down the hallway or get up and take a short walk. People tend to stare at the computer and blink less. Staring and decreased blinking dry the eyes out. Taking frequent breaks allows normal blinking and better wetting of the eyes. Office buildings tend to be dry environments that also reduce tearing. If you are experiencing significant dryness, ask your eye doctor about artificial tears or eye drops that you can use during the day.

By modifying your work area, you can reduce eyestrain. If you need to look back and forth between the printed or written page and the computer, eyestrain can occur. Place written pages on a copy stand next to the monitor. Properly light the copy stand. Adjust your workstation and chair to the correct height. Place your monitor directly in front of you, not off to one side. It should be about 20 to 26 inches away from you. Make sure your monitor is just right for you, not too high and not too low. You may need to raise or lower your chair. If you reposition your chair, keep in mind that your arms should be parallel to the floor when you type, and your feet should be flat on the floor or on a footstool. Finally, maintain good posture at your desk: keep your back straight and your shoulders back. Adjust the contrast between the background and the characters on the screen by adjusting the brightness on your computer screen.

Reflections on the screen decrease the visibility of text on the screen by decreasing contrast. To determine whether this is a problem, you can temporarily use light shields (such as file folders) to shield the screen from annoying light sources. If this results in a noticeable increase in the contrast and clarity of the text, the reflections are a problem and should be taken care of.

1. An antireflection screen can be placed over the display. Glass screens perform better than mesh screens. Look for screens that have been approved by the American Optometric Association. (Alternatively, a hood can be purchased and placed over the display to shield it from offending sources; however, hoods often don't perform as well as antireflection screens.)
2. Eliminate or cover the sources of the reflections—typically windows and other bright lights behind you.

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3. Use dark characters on a light background; they are less affected by reflections than are light characters on a dark background.
4. Some people experience a flickering sensation when viewing the screen. If this is annoying, try turning down the brightness, or use a dark background instead of a light one. If all else fails, using a display with a higher refresh rate might solve the problem.
5. Good screen resolution is important, especially for extended work. Screens with more pixels generally provide better resolution. Monochrome monitors usually have better resolution than color monitors; if the job doesn't require color, it's often best to use a monochrome monitor.
6. Adjust the screen brightness and contrast so that character definition and resolution are maximized. The screen brightness should match the general background brightness of the room (this is much easier to do with light background screens).
7. Black characters on a white background are probably the best combination. Other combinations can be comfortable as long as the contrast between the characters and the background is high. It's best to avoid dark backgrounds.
8. The size of the text should be three times the size of the smallest text you can read. You can test this by viewing the screen from three times your usual working distance; you should still be able to read the text.
9. For color monitors, small dot pitches (less than 0.28 mm) are desirable.

KEYBOARD

Many ergonomic problems associated with computer workstations occur in the shoulder, elbow, forearm, wrist, and hand. Continuous work on the computer may expose soft tissues in these areas to repetition, awkward postures, and forceful exertions, especially if the workstation is not set up properly.

The following adjustments should be made to your workstation to help prevent the development of an ergonomic problem in the upper extremities:

1. First adjust your chair as mentioned above, then with your arms resting comfortably at your side, raise your forearms to form a 90 degree angle with your upper arms.
2. Adjust keyboard height so shoulders can relax and allow arms to rest at sides. An articulating keyboard tray is often necessary to accommodate proper height and distance.
3. Position the keyboard directly in front and be close to the user to avoid excessive extended reaching.
4. Forearms parallel to the floor (approximately 90 degree angle at elbow).
5. Mouse should be placed adjacent to keyboard and at the same height as the keyboard. Avoid extended and elevated reaching for keyboard and mouse. The back of the wrist should be kept flat (in a neutral position). Do not rest the hand on the mouse when your are not using it. Rest hands in your lap when not entering data.

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6. A padded wrist rest will help to keep your wrist in a straight and neutral position while typing and keep your arms off the sharp edges of the work surface.
7. Do not rest your wrists or hands on a palm or wrist rest when you are keying. These rests are designed to provide support only during breaks from keying.
8. The slope of the keyboard may need to be adjusted so that it is flat in order that your wrists are straight and not bent back while you are typing.
9. Press the keys gently; do not bang them or hold them down for long periods. Keep your shoulders, arms, hands, and fingers relaxed.

If your work surface is too high and not adjustable, adjust your chair to bring your arms to the proper position. If you raise your chair make sure your feet are properly supported.

LIGHTING

Lighting not suited to working with a computer is a major contributing factor in visual discomforts including eyestrain, burning or itching eyes, and blurred or double vision. The lighting in most office environments is too bright for optimal computer screen viewing. The illumination may be reduced by removing 2 bulbs in a 4-bulb fluorescent fixture, removing the bulbs in every other fixture, or turning off overhead lights altogether. Supplemental desk lighting is better than overhead lighting for reading or printed copy.

Although the quantity of illumination is important, it's probably more important to have good light distribution. This is accomplished when all the objects in your field of view have approximately equal brightness. Bright lights or windows are common offending sources that can cause discomfort. To determine whether overhead lights or windows are a problem, shield them from your field of view with your hand or a file folder, simulating a visor; if you experience a small but immediate sense of relief, the bright source is contributing to your discomfort.

Here are some suggestions and tips for improving the lighting:

1. Use blinds or drapes on windows to eliminate bright light. Blinds should be adjusted during the day to allow light into the room without enabling you to see bright light directly.
2. Wear a visor to shield your eyes from bright overhead lights. (Indirect lighting systems often provide the best visual environment.)
3. Reorient the workstation so that bright lights aren't in your field of view. Turn off fluorescent light fixtures in your field of view if they're bothersome (though of course be considerate of the effect on others who are working nearby).
4. Most offices have too much light. Too much room illumination makes the room too bright compared to the display screen, resulting in visual discomfort and too many screen reflections.
5. If you use auxiliary desk lighting, it should usually be low wattage and should be directed so that it doesn't directly enter your eyes or directly illuminate the display screen. It's usually inadvisable to put additional lighting on reference documents, because this makes them too bright compared to the screen.

6. Avoid white reflective surfaces. Desktops and other furnishings should have a matte, medium reflective surface. The ceiling should be white and the walls should be medium light, also with a matte finish

The following recommendations help to reduce eyestrain and eye fatigue:

1. Close drapes/blinds to reduce glare.
2. Adjust lighting to avoid glare on screen (light source should come at a 90 degree angle, with low watt lights rather than high).
3. Avoid intense or uneven lighting in your field of vision.
4. Place monitor at 90 degree angle to windows (where possible).
5. Reduce overhead lighting (where possible).
6. Use indirect or shielded lighting where possible.
7. Walls should not be painted with a reflective finish.
8. Use a glare screen or monitor shield to reduce glare from overhead lighting.

EXPECTED RESULTS

After having inspected my office and workstation and examined all areas as to whether they ergonomically were appropriate to my height, I found many areas that needed changes. After completing changes in my office I shared my findings with my co-workers and hope to find them in ergonomically redesigned offices before very long. It is very important to establish viewing conditions that minimize stress to our eyes. Repetitious static work (working at the computer) is very fatiguing on your upper extremities as well as your eyes. It is important that breaks from working at the computer be taken every 20 to 40 minutes in order for your body to rest and recover. Taking a short break (3 to 5 minutes) does not mean you have to stop working, other activities such as talking to a co-worker, making copies, filing, etc. could be done during breaks from typing. It is also important to change positions periodically. Sitting in one position or leaning on your arms for an extended period of time can interfere with circulation.

CONCLUSION

Ergonomics, the science of fitting the job to the person, is now recognized as an integral part of any workplace. In computer-related work settings ergonomic principles play a crucial role in preventing poor vision and eyestrain at the computer workstation. The position of the monitor is probably the most important factor in an ergonomically correct workstation arrangement, since monitor position determines where you look and therefore how you hold yourself. You should also position your workstation facing towards windows instead of away from them to prevent window glare from being reflected in the monitor.

It is important that you have regular eye exams. Be sure to tell the examining ophthalmologist or optometrist that you do computer work. Other useful information to have for the examination: the size of your monitor screen, the distance from your eyes to the screen, average hours per day you use a computer, and the tasks you do on the computer. Individuals who use computers for extended periods of time may experience

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eye fatigue and pain or discomfort in the hands, wrists, arms, shoulders, neck or back. This is usually caused by poor work habits, poor work station design or improper use of workstation components. In most cases, corrective measures are relatively simple and inexpensive.

Remember that taking regular breaks from your chair and computer monitor are important. You can take a load off of your back in short breaks by simply leaning back in your chair. You can avoid eyestrain by simply blinking and looking away from your computer monitor frequently. It's also important to get up from your computer desk to stand and stretch. These ergonomic breaks are not a waste of time. They are critical for your well-being and your work efficiency.