

Principles of Ergonomics

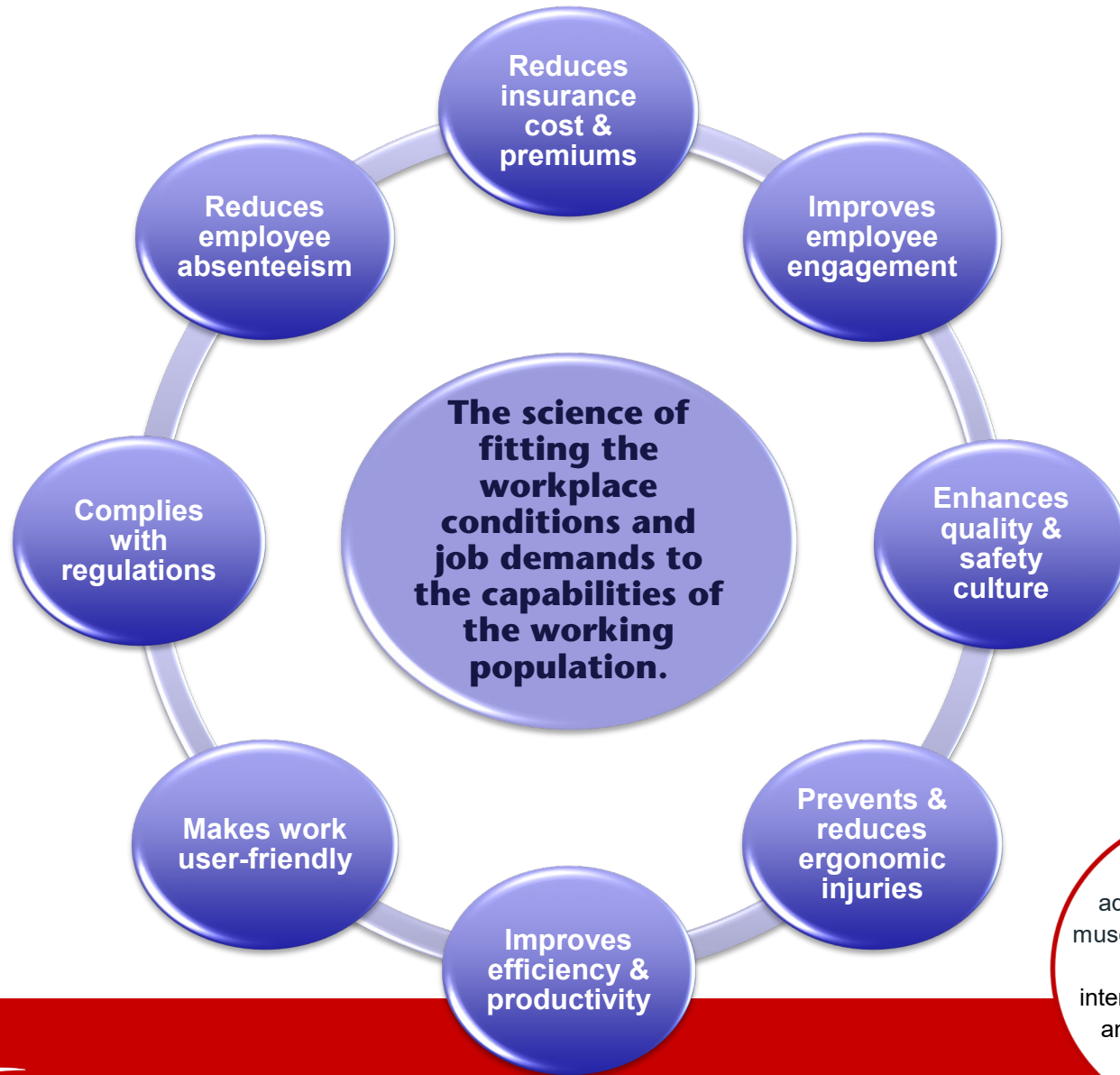
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Ergonomics and Its Benefits



It is an approach to addressing work-related musculoskeletal disorders by understanding the interactions among workers and other elements of a system.

Work-related Ergonomics Injuries

- Account for over 30% of all worker injury and illness cases in the United States.
- Are among the most frequently reported causes of lost or restricted work time.
- Are identified by several names including Musculoskeletal Disorders (MSDs), Repetitive Stress Injuries (RSIs), Cumulative Trauma Disorders (CTDs), and Repetitive Motion Injuries (RMIs).
- **Do not occur instantaneously**, but over an extended period of time due to repetitive use, awkward postures during static or dynamic movements and/or forceful exertions of the body.

Work-related Ergonomics Injuries

Musculoskeletal Disorders (MSDs) are injuries/disorders that are cumulative and chronic since they occur gradually over a long period of time.

Repetitive Stress Injury (RSI) is used as a general term for a wide range of injuries to the hands, wrists, arms, elbows, shoulders, neck and even the back, the result from repetitive work. Also referred to as Repetitive Motion Injury (RMI) or Repetitive Strain Injury (RSI).

Cumulative Trauma Disorders (CTDs) is a condition where a part of the body is injured by repeatedly overusing or causing trauma to that body part. The pain workers feel daily turns into MSDs gradually.

Work-related Ergonomics Injuries

These injuries develop gradually over periods of weeks, months, or years due to repeated stresses on a particular body part, leading to wear and tear of the muscles, nerves, tendons, ligaments, cartilage, bones and/or joints.

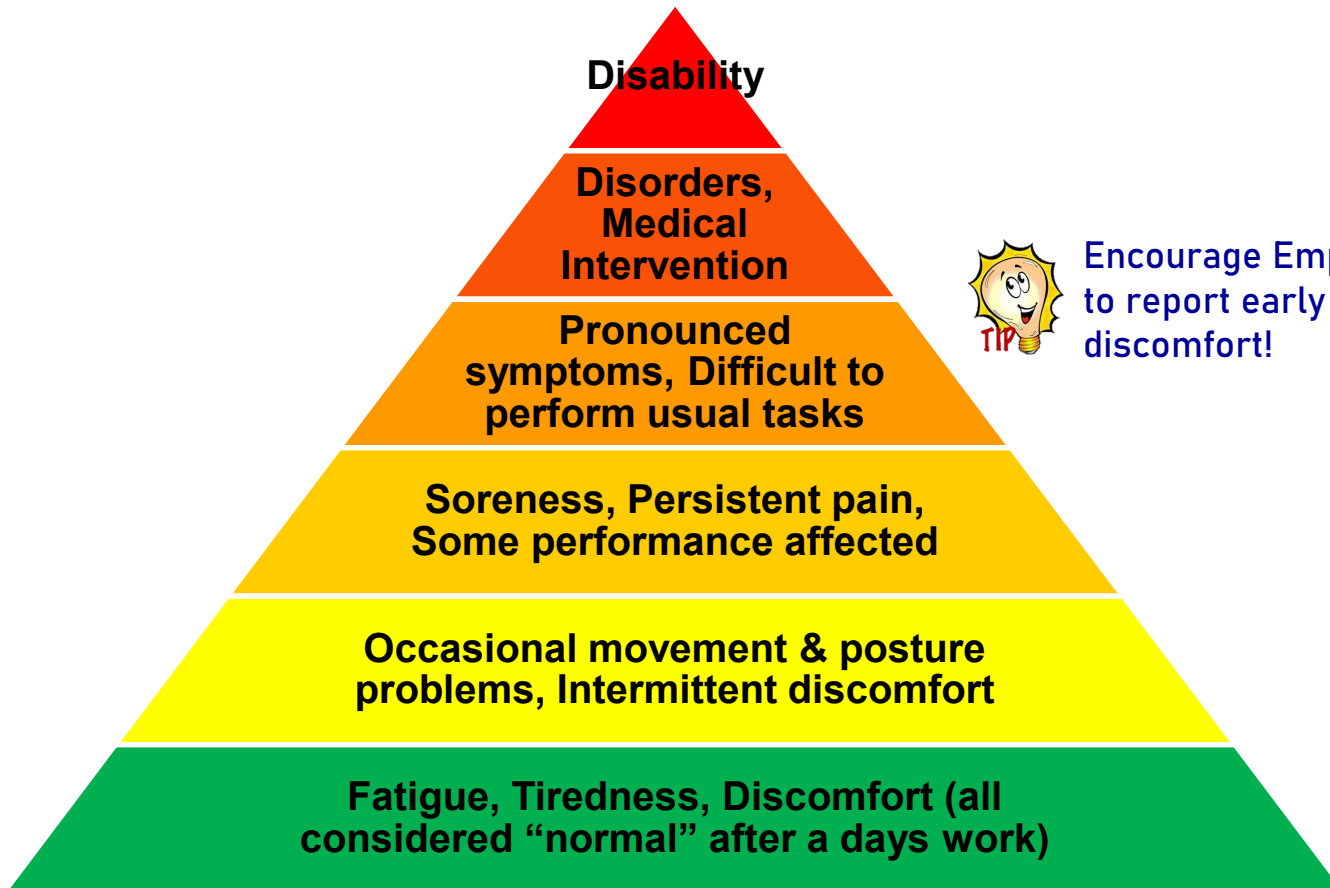
Common Signs & Symptoms

- Local or distal pain (*subjective*)
- Tingling sensation
- Swelling
- Soreness
- Numbness
- Joint stiffness
- Redness
- Local skin warmth
- Loss of strength
- Limited range of motion
- Popping or cracking in the joints

Importance of Early Intervention

- Lost Work Time
- Surgery

LATE



Encourage Employees to report early signs of discomfort!

**R
E
P
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I
N
G**

EARLY

- Quick Recovery
- Easier to Treat

Principle #1

Work in Neutral Posture

Neutral postures are the best positions in which to work.

- A neutral posture is achieved when the muscles are at their resting length and the joint is naturally aligned.
- A posture is considered —awkward when it moves away from the neutral posture toward the extremes in range of motion.

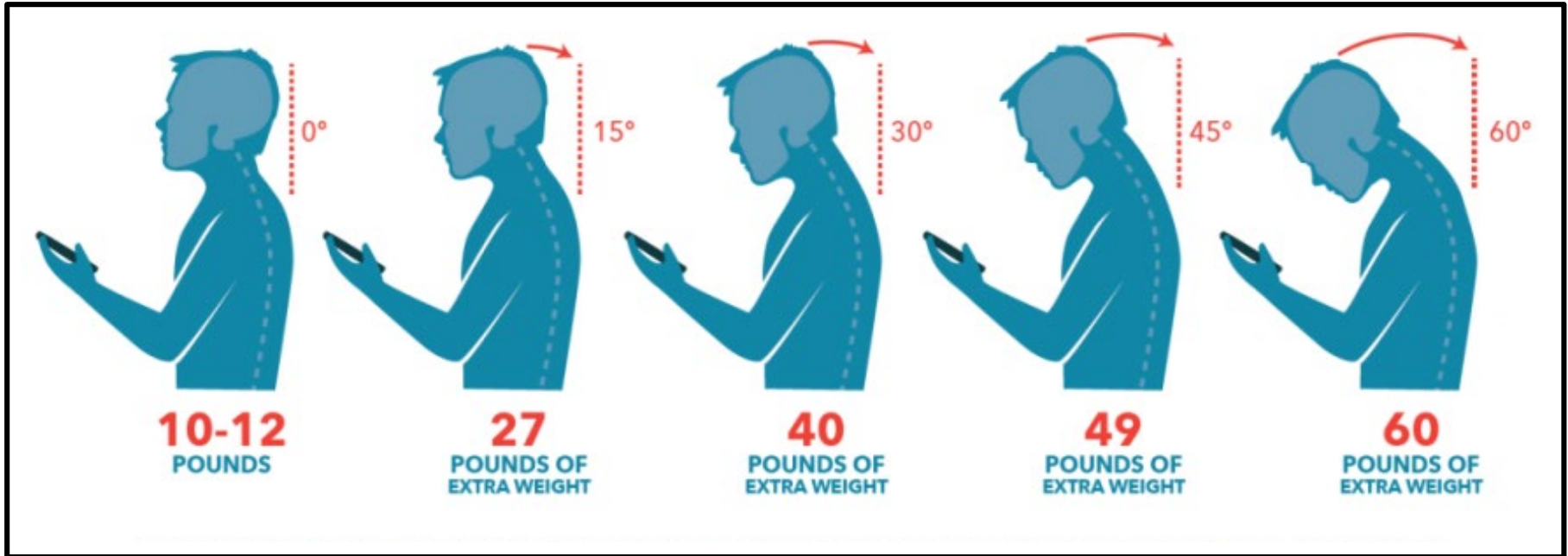
Principle #1

Work in Neutral Posture

Neutral vs. Awkward Postures

- Maximum muscle force producible in neutral postures is greater than maximum muscle force producible in awkward postures.
- Fatigue occurs sooner when working in awkward postures.
- Working in extreme awkward postures (near extreme ranges of motion) causes stress on muscles and joints.

Neutral Posture - The Neck

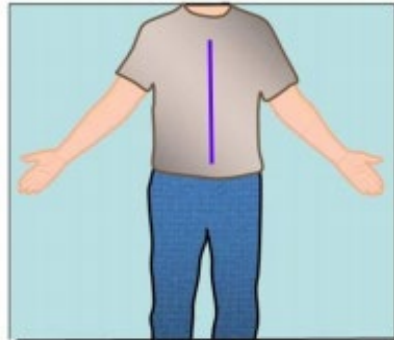


Keep neck aligned.
Avoid extra pressure on the spine/back.

Neutral Posture - The Back

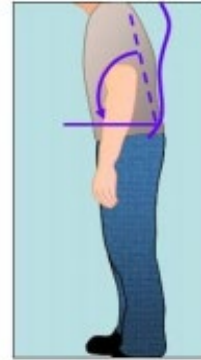
Maintain the "S-curve" of the spine.

Neutral Posture

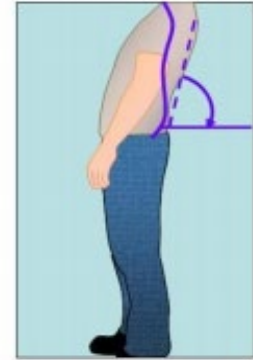


Awkward Postures

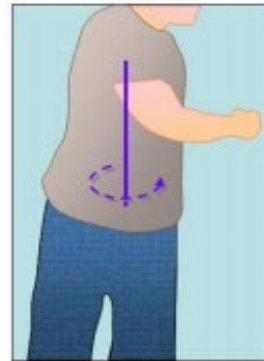
Back Flexion



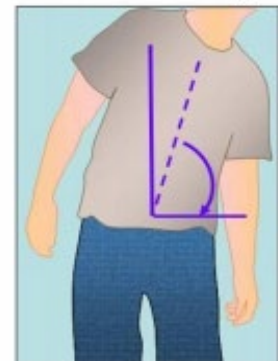
Back Extension



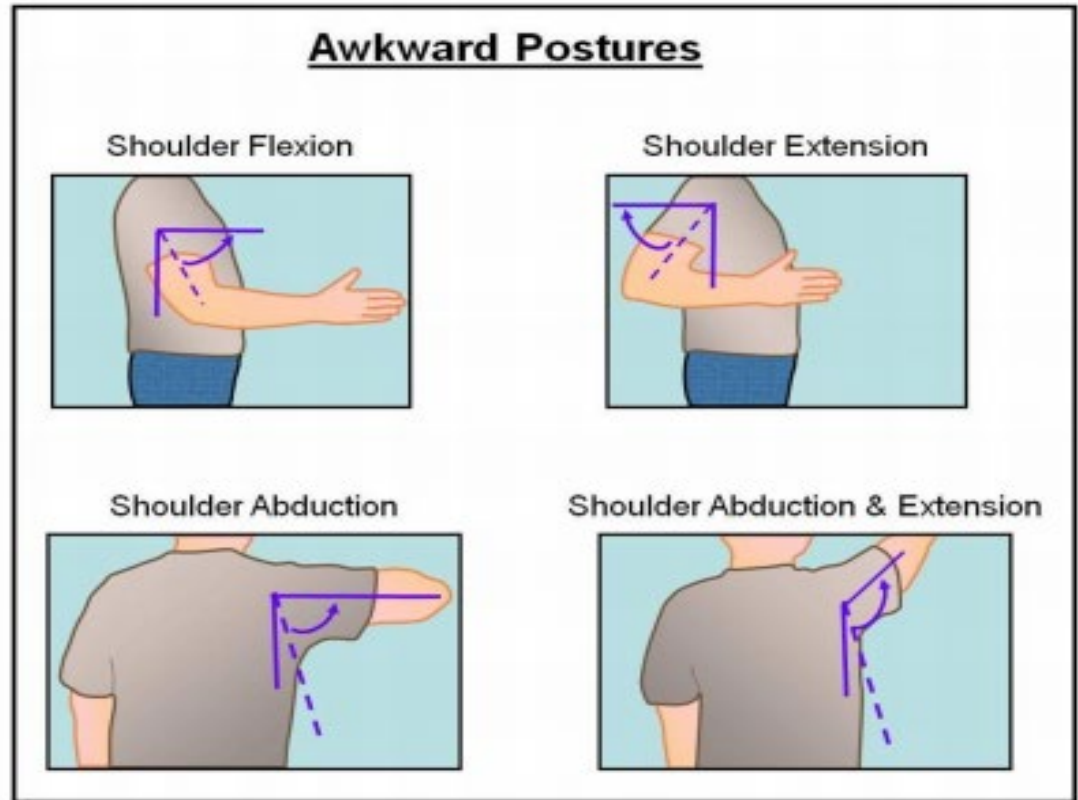
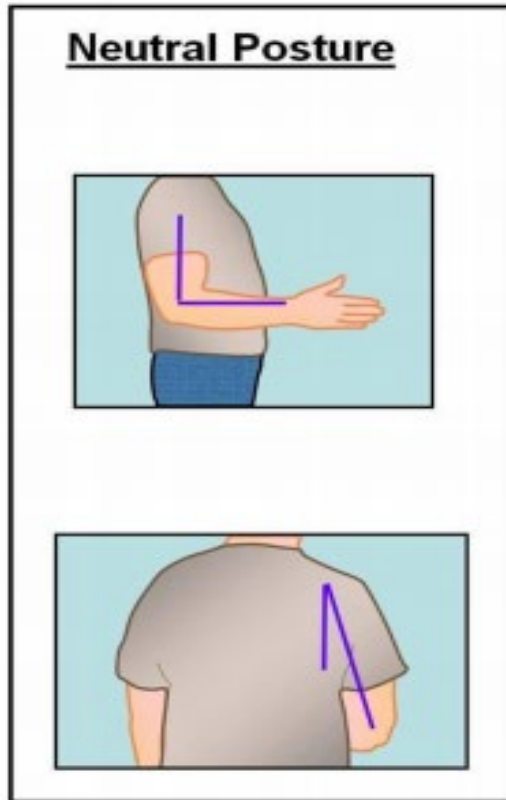
Twisting about Waist



Lateral Bending



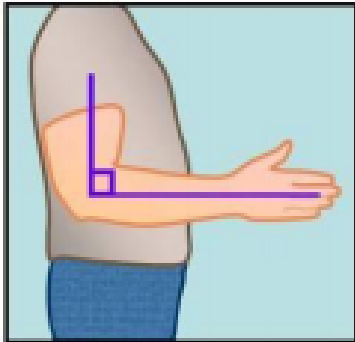
Neutral Posture - *The Shoulder*



Avoid overreaching, reaching behind the body, and lengthy periods with arms over the head.

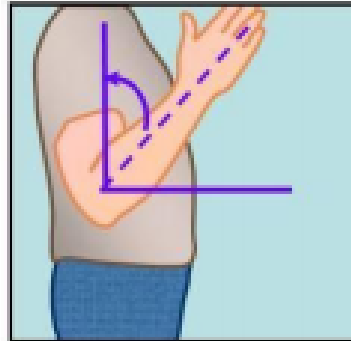
Neutral Posture - *The Elbow*

Neutral Posture

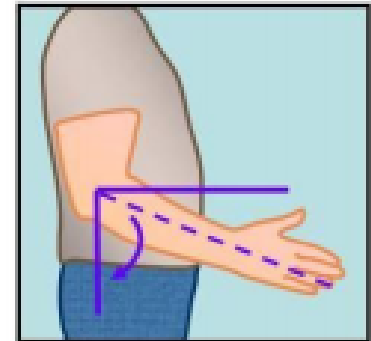


Awkward Postures

Elbow Flexion

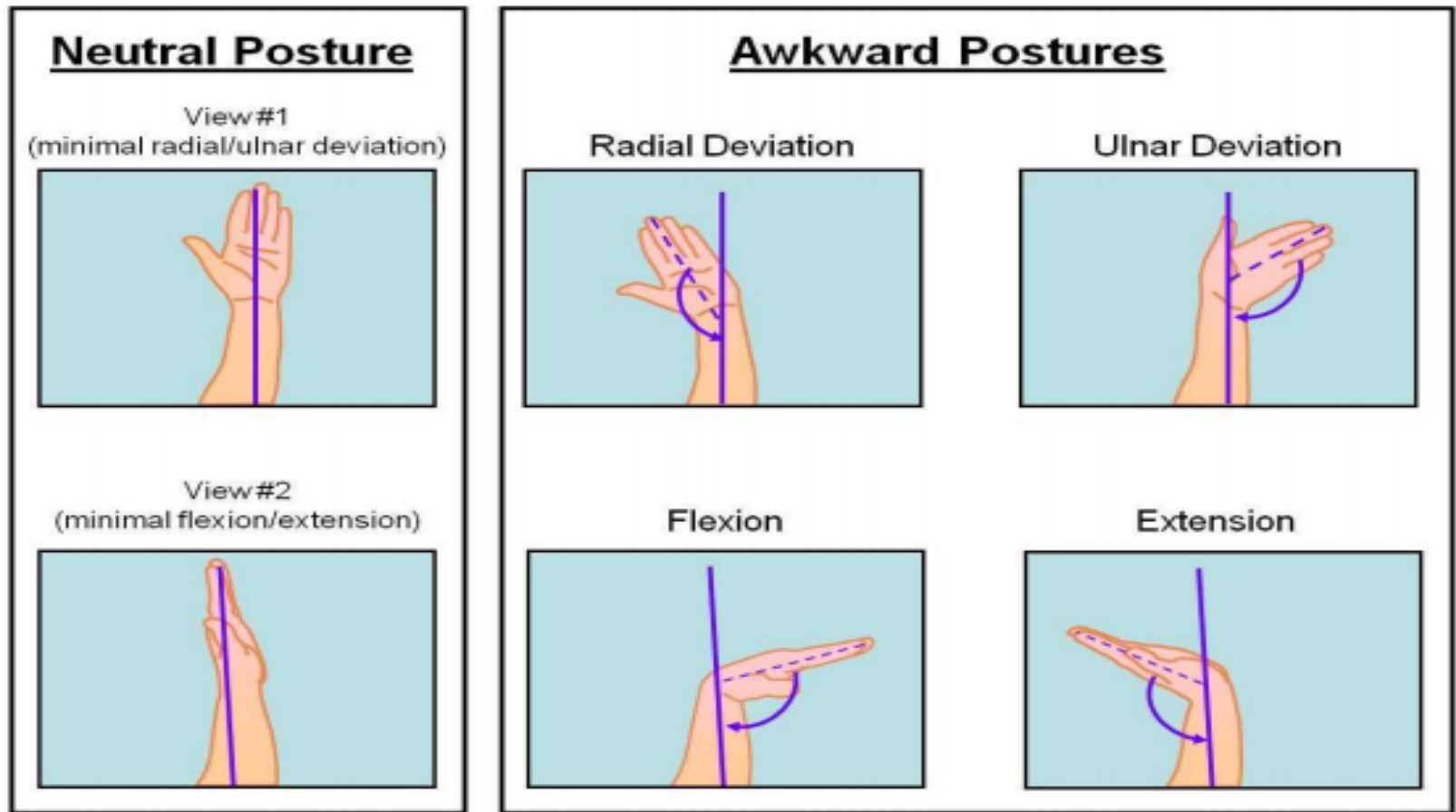


Elbow Extension



Keeps elbows at sides.

Neutral Posture - *The Wrist*



Keeps wrist in neutral position.

Principle #2

Reduce Excessive Force

Excessive force on the human body can lead to fatigue and ergonomic-related injuries.

- Force is the amount of physical effort a person uses to perform a task.
- Muscle effort increases in response to high force requirements which increases fatigue and risk of MSDs.
- Fatigue can be minimized by the load (force) and duration. It is influenced more by the load than duration.



Recognize when a job or task requires excessive force and then find ways to reduce that force.

Examples of Force Reduction

BEFORE



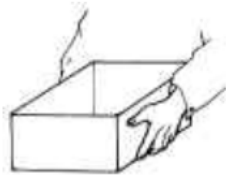
IMPROVEMENT



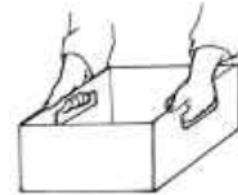
AFTER



Using mechanical assistive devices will reduce work effort and muscle exertions.



Having the handhold reduces the exertion your hands need to carry the same amount of weight.



If load is too heavy or awkward for one person to carry, ask for help to reduce work effort and muscle exertions.



Principle #3

Keep Everything within Reach

Keeping your body aligned and balanced ensures it remains under minimal stress during the task.

- Things that you use extremely frequently should be within the reach envelope of your forearms (*primary zone*).
- Things that you use frequently should ideally be within the “reach envelope” of your full arm (*secondary zone*).
- Things that require additional bodily movement like standing up if seated (*reference zone*).

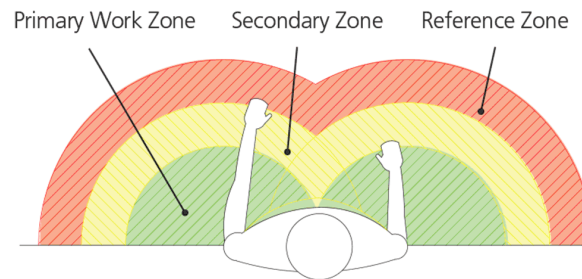
Principle #3

Keep Everything within Reach

Primary Zone is for recurrent tasks and frequently used tools should be positioned within the “reach envelope” of your forearms.

Secondary Zone is for materials and tools used less frequently are placed.

Reference Zone is for infrequently used items such as reference manuals or drawings storage and personal items.



Observe your movements and address overstretching by rearranging your work area and moving things closer to you.

Principle #4

Work at Proper Height

Working at the right height is also a way to make things easier.

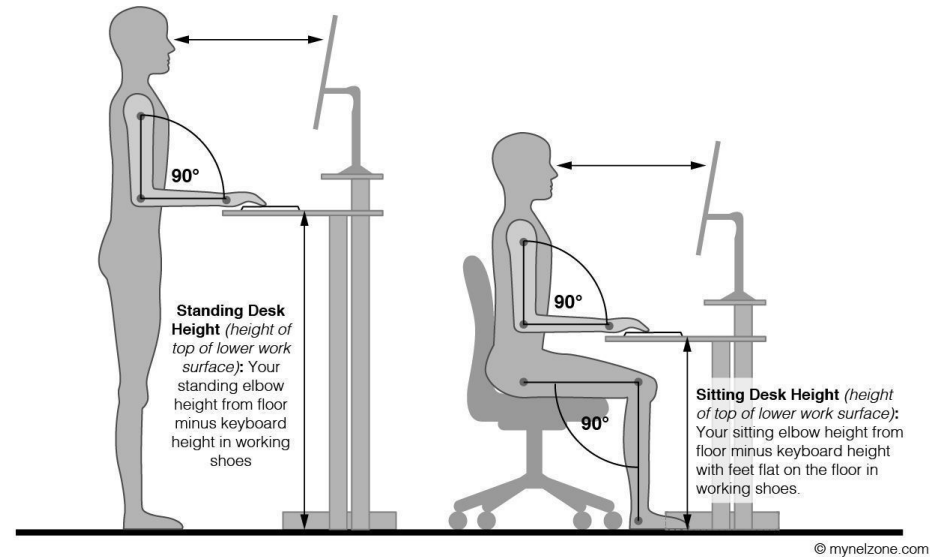
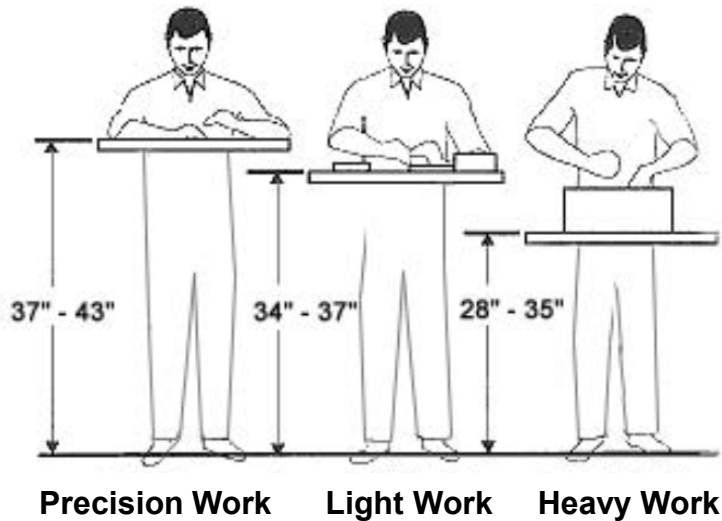
Good Rule of Thumb: Most work should be done at roughly elbow height, whether sitting or standing.

Exceptions to this rule:

- Heavier work is often best done lower than elbow height.
- Precision work or visually intense is often best done at heights above the elbow.

Principle #4

Work at Proper Height



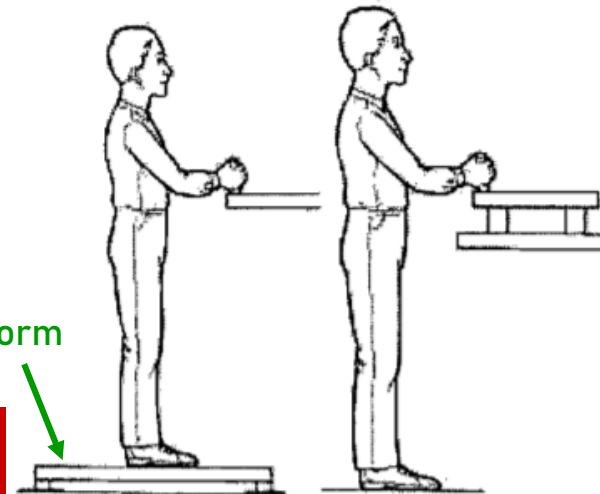
Consider adjustable tables or stable risers and platforms to adjust heights.

Platform

Riser

NJIT

New Jersey Institute of Technology



Principle #5

Reduce Excessive Motion

High task repetition, when combined with other risks factors such high force and/or awkward postures, can contribute to the formation of MSDs.

- Note the number of motions you make throughout a day, whether with your fingers, your wrists, your arms, or your back.
- Excessive or unnecessary motions should be reduced if at all possible.
- If the reduction of motion is not possible, eliminating excessive force requirements and awkward postures is vital.

Principle #5

Reduce Excessive Motion

Ways to Reduce Excessive Motion

- **Job rotation** alleviates physical fatigue and stress of a particular set of muscles and tendons by rotating employees among other jobs that use different muscle-tendon groups
- **Stretch or micro breaks** can be used to elevate muscle fatigue from repetitive activities or static positions. They can be less than two minutes long and is a break from using a particular set of muscles, not a break from work. (*e.g. walking to use the copier is a break from typing*)
- **Use power tools when possible**
- **Eliminate unnecessary movement** by eliminating uneven surfaces and/or changing the layout of the workstation or equipment

Principle #6

Minimize Fatigue & Static Load

Holding the same position for a period of time is known as static load. It creates fatigue and discomfort and can interfere with work.

Examples of Static Load



Example: Holding your arms over your head

Potential Solution: Change the orientation of the work or add an extender to the tool.



Example: Holding parts/tools too hard or continually for a long duration

Potential Solution: Loosening your grip if possible or use a fixture to hold part.



Example: Standing for long periods of time

Potential Solution: Footrest allows repositioning of the legs. Anti-fatigue mats can help improve comfort from standing on hard floors.

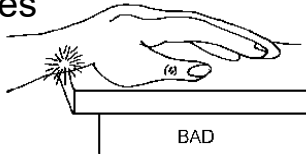
Principle #7

Minimize Pressure Points

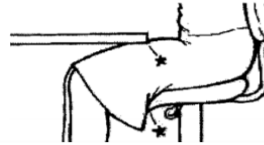
Continuous contact or rubbing between hard or sharp objects/surfaces and sensitive/soft body tissue creates localized pressure on a small area of the body or “pressure points”, which can inhibit blood, nerve function, or movement of tendons and muscles.

Examples of Contact Stress

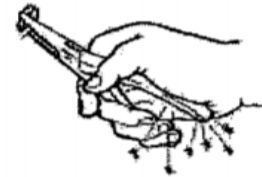
Leaning forearm against hard, sharp edges



Sitting in chairs without cushion or rounded edges for a long duration or lack of clearance between thigh & desk

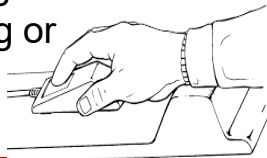


Squeezing hard on tools



Ways to Improve Discomfort

Round the edges or use padding or wrist rest.



Ensure ample clearance between the desk & thigh and the back of knee & chair. Cushions and rounded edges can also improve comfort.

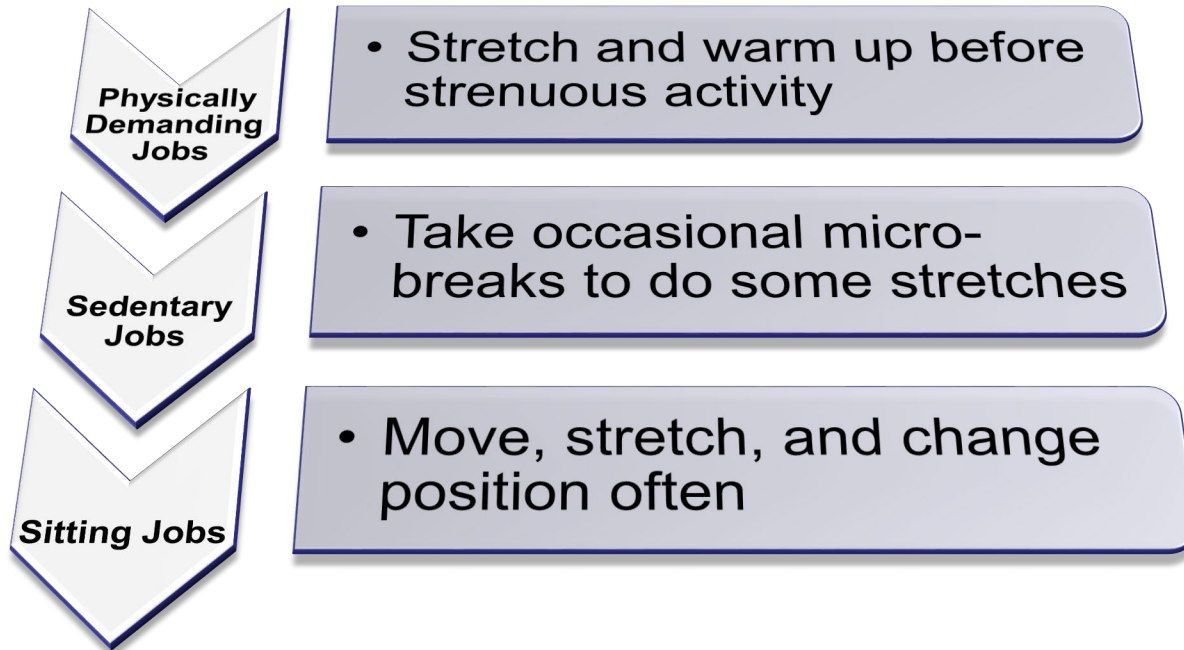
Use tools with a cushioned grip and contoured handle to fit your hand.



Principle #8

Stretch & Exercise

Muscles need to be stretched to reduce discomfort and injuries, and the heart rate needs periodic elevation to improve blood flow to the muscles and overall health of the body.



Principle #9

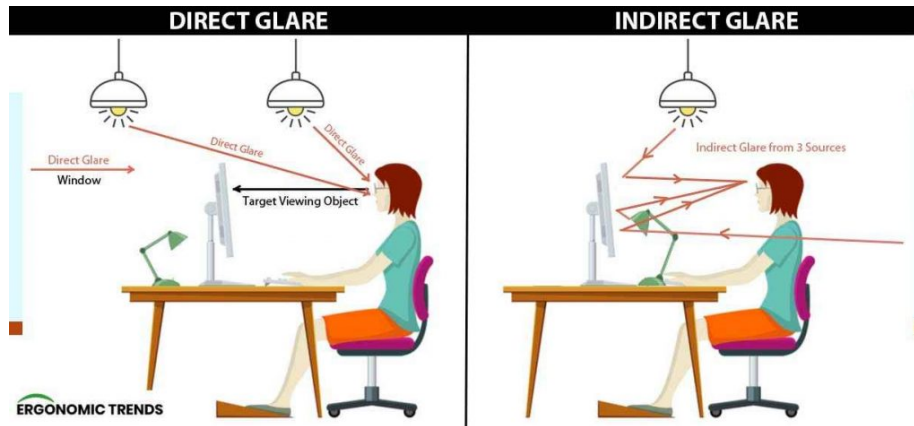
Ensure Adequate Lighting

Poor lighting is a common problem in the workplace that can affect a worker's comfort level and performance.

- Dimly lit work areas and glare can cause eye fatigue and headaches.
- Improperly lit areas put workers at greater risk for other types of injuries.
- Highly-polished computer screens and reflective surfaces bounce back the light around it.

Principle #9

Ensure Adequate Lighting



- Consider adjustable task lighting at your workstation to improve dimly lit workspace.
- Consider relocating task or light source, reducing the light intensity, or rearranging workstation to control glare.
- Ensure the computer monitor is not placed in front of a window or a bright background to reduce the contrast between foreground and background.
- Consider an anti-glare screen filter to control glare.



Principle #10

Reduce Excessive Vibration

Vibration exposure occurs when the body is exposed to pulsation, shaking or tremors usually produced by a vibrating object such as a power hand tool.

- Regular and frequent exposure to vibration can lead to permanent adverse health effects when vibration exposure is a regular and significant part of a person's job.
- Vibration restricts the blood supply to the hands and fingers, which, depending on the vibration level and duration of exposure, can contribute to an ergonomic injury such as Hand-arm vibration syndrome, carpal tunnel syndrome, and tendinitis.
- Signs and symptoms include numbness, pain, and turning pale.



COMPUTER WORKSTATION

The Elbow & Shoulder

Awkward Postures

- Reaching forward
- Reaching behind
- Reaching to either side
- Reaching upward
- Deviated wrist
- Hunched shoulders



Hunched shoulders



TIP

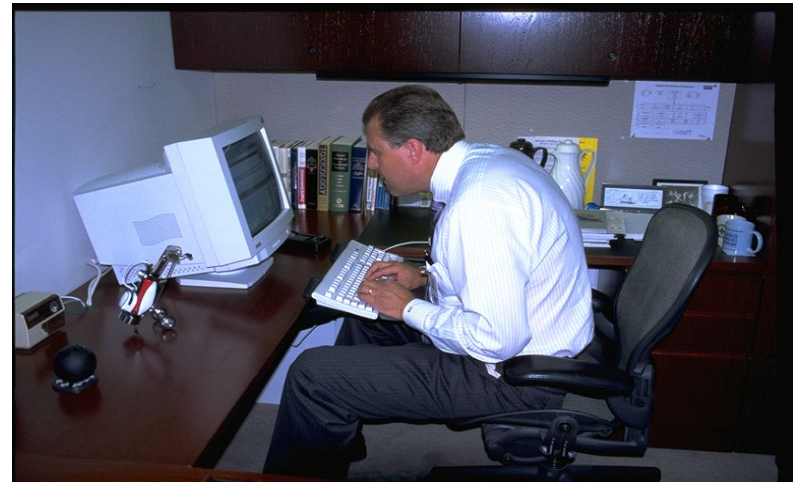
Place a pen length-wise on top of hand-wrist-arm while hand is in typing positioning as shown in photo. If you can fit finger between the pen and wrist, you have too much deviation in the wrist. The flatter the wrist, the better.



The Back

Awkward Postures

- Leaning forward or backward
- Sitting on front edge of seat
- Unsupported back
- Reaching upward



The Eye

- Continuous focus at the screen without adequate breaks or looking off at something in the distance periodically causes strain
- Fuzzy or grainy font resolution fatigues the eye
- Improper monitor height and distance causes leaning

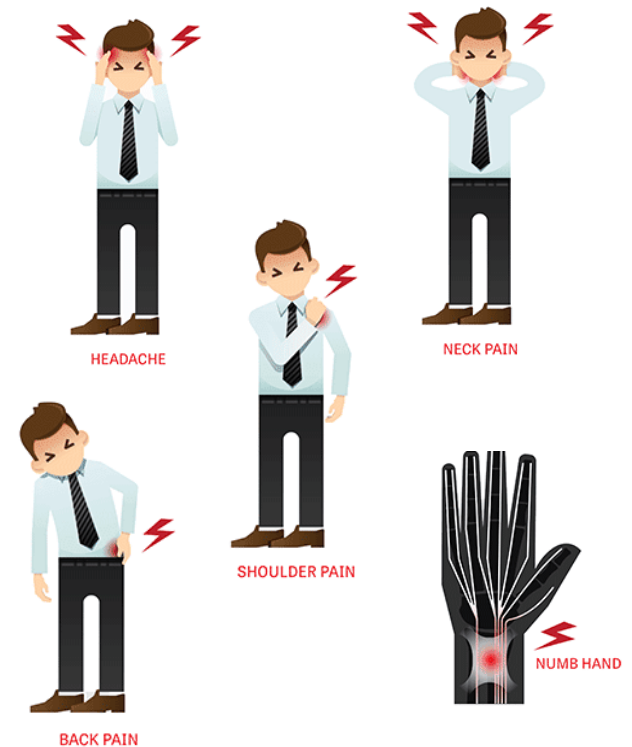
Common Signs of Eye Strain

- Blurred vision
- Eye discomfort
- Headaches



Symptoms of Awkward Postures

- Restriction of movement, stiffness, sore muscles
- Pain, tenderness, swelling
- Tingling or numbness
- Feeling of “Pins and Needles”
- Pain or numbness at night
- General discomfort



Pressure Points



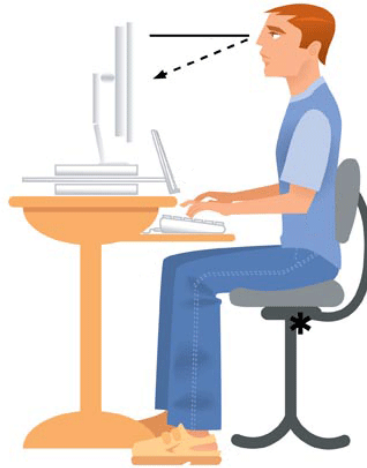
Results:

- Tissue compression
- Nerve impairment
- Additional force

Contact Stress:

Pressure on wrists, forearms, and elbows from hard surfaces, such as desktops and edges



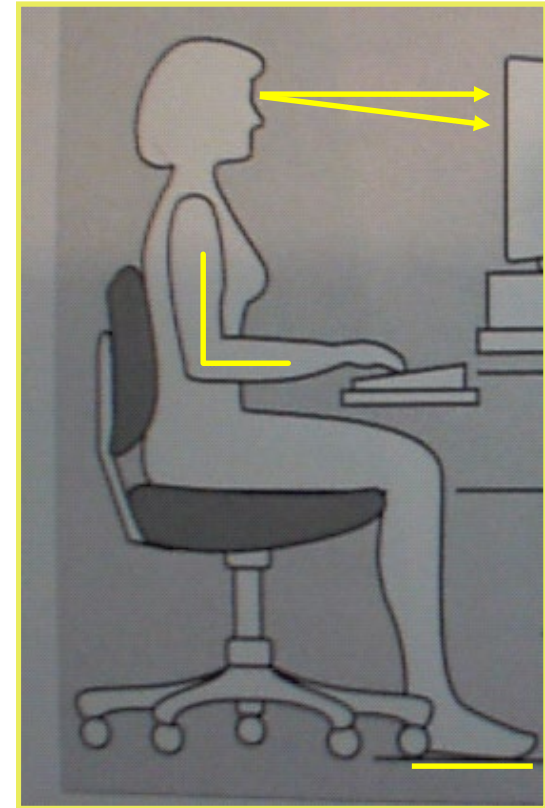


COMPUTER WORKSTATION SETUP

Basic Workstation Setup

Neutral posture alleviates stress on the body.

- Straight wrists
- Feet flat on floor or footrest
- Back supported
- Elbows at approximately 90 degrees
- Top of monitor slightly below or at eye level
- Keyboard & mouse close to each other
- Monitor close enough to avoid leaning



Optimal Chair Setup

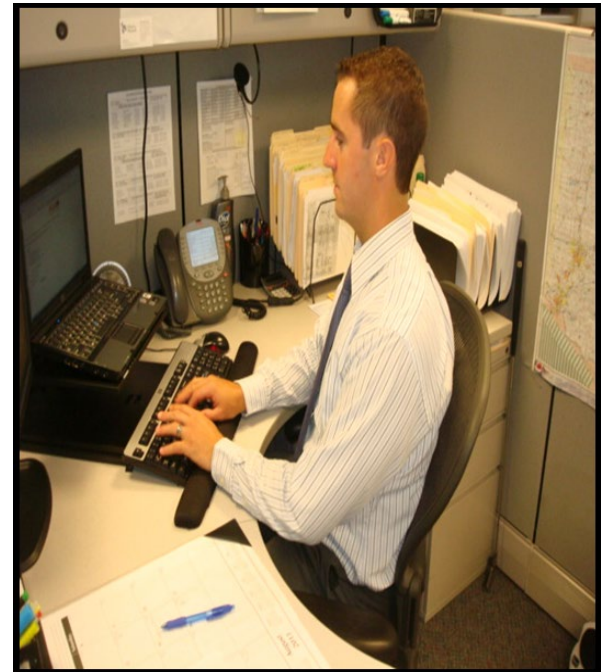
Chair needs to fit the individual.

3 Main Areas to Adjust:

- **Seat position and height**
 - Height to achieve flat wrist position
 - Seat width, depth and pan angle
 - Use a Foot Rest if necessary to avoid under thigh compression
- **Back support**
 - Lower back arch supported
 - Position of back support can be adjusted and locked
- **Arm rest position**
 - Proper height serves to relax shoulders and allow wrists to move freely while typing
 - Maintains elbows close to body and prevents shoulders from being pushed up

Keyboard & Mouse Positioning

- Keep elbows parallel and close to body, and wrists in a straight, neutral position
- Position keyboard close to seated work and at the same height as the mouse, and mouse to right/left of keyboard
- Look for signs of contact stress
- Keyboard tray provides some flexibility for neutral postures
- Adjust mouse sensitivity, if necessary (*via the control panel*)

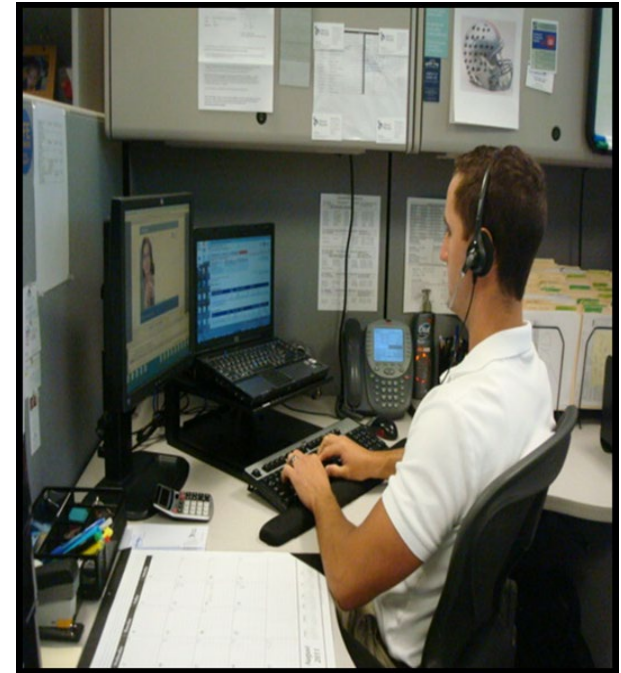


Monitor Placement

- Position monitor in front of torso to avoid twisting neck and body
- Position monitor at a minimum distance of about 20" from eyes

Think “Arm’s Length”

- Position top of screen at or slightly below eye level
- Control glare from windows, lamps, and overhead lights
- Keep monitors at right angles from major light sources
- Tilt monitor slightly (*vertically and horizontally*) to eliminate glare



Dual Monitor Positioning

- Ideally, centered to the user and angled inward slightly
- What the user looks at most should be centered and matched in size
- What the user look at occasionally should be off to the side(s)
- Flat panel displays should not be paired with CRT monitors
- Both monitors should be placed as close as possible to each other



Sit-Stand Desks

- **Benefit:** Allow breaks from extended sitting to reduce fatigue
- **Potential Risk:** Increase fatigue in legs, back, neck, arms when standing too long in a static position
- **Use Fundamental Principles**
 - Monitor Height and Placement
 - Keyboard & Mouse Placement
- **Training is Critical.**
 - The user must know how properly operate and adjust the sit/stand desk top.
 - Change posture from sitting to standing fairly frequently to get the maximum comfort benefit.
 - Alternating between postures allows for rest and recovery time for affected body parts.

Sit-Stand Desks

Example



Advantages

- Boost productivity and cognitive function.
- Burns more calories and increases muscle activity compared to sitting.
- Eases pain in the body associated with sitting all day, by helping the body stretch out and increasing blood flow.
- Users report having increased energy and alertness.

Disadvantages

- Standing for lengthy periods can lead to joint & back pain, swelling, and fatigue.
- Standing for too long without any movement can cause the blood to pool in the areas of ankles and calves, and increased risk of varicose veins.
- Sit-stand desks are best used for working on monitor screens, not laptop.
- Decreased privacy due to standing above colleagues.
- Sitting uses less energy and helps stabilize the body to perform fine motor tasks like computer work or fine micro-surgery

Example





How to Minimize Discomfort

Avoid Workstation Clutter

- Arrange desk top to avoid repeated forward reaches to get frequently used items such as the phone.
- Keep area under desk clear.
- Clutter can restrict body movement and positioning.
- Clutter can restrict ability to turn chair or cause tripping.



Minimize Eye Strain

- Take “micro breaks” to rest and refocus on distant objects.
- Lighting should be uniform and free from glare & flicker.
- Adjust contrast & brightness on computer screen to a comfortable level.
- Brightness of screen should match brightness of hardcopy.
- Get regular eye exams.

Avoid Fatigue

- More frequent micro-breaks are better than infrequent long duration breaks
- Getting up to stretch back, arms and neck periodically is very important
- To give your back a break try standing when you are on a phone call

Helpful Ergonomic Accessories

- Wrist Rests
- Foot Rests
- Back Supports
- Glare Screens
- Copy Holders
- Monitor Stands
- Keyboard Trays
- Surface Extensions
- Telephone Headset
- Speaker Phone
- Alternate input devices
- Mouse Pad
- Seat pads

Ergonomic Workstation Assessments

WHAT is an assessment?

An interactive process completed with the employee to assess the employee's workstation with a goal of achieving an ergonomically correct setup.

WHY is this important?

- To promote good work posture and habits that will increase comfort and productivity.
- To reduce the risk of discomfort or injury, and encourage early reporting of a problem or discomfort to a manager.

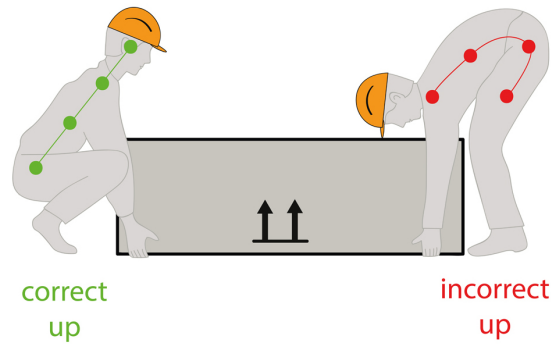
WHO conducts the assessments?

Trained employees.

Ergonomic Workstation Assessment

- Be flexible. Changes should increase comfort.
- Be positive. Changes may feel uncomfortable at first.
- Complete a Ergonomic Self-Assessment Form to get started.
- Submit the form to EHS.
- EHS will contact you to schedule an appointment.

Give it a try!



MANUAL MATERIAL HANDLING (MMH)

Manual Material Handling

- Manual material handling (MMH) work contributes to a large percentage of the over half a million cases of musculoskeletal disorders (MSDs) reported annually in the United States often involving strains and sprains to the lower back, shoulders, and upper limbs.
- Manual material handling may expose workers to physical conditions (*e.g., force, awkward postures, and repetitive motions*) that can lead to injuries, loss of productivity, and wasted time.

MMH Primary Risk Factors

The primary risk factors associated with the development of injuries in manual material handling tasks include:

- **Awkward postures**
(e.g., bending, twisting)
- **Repetitive motions**
(e.g., frequent reaching, lifting, carrying)
- **Forceful exertions**
(e.g., carrying or lifting heavy loads)
- **Pressure points**
(e.g., grasping [or contact from] loads, leaning against parts or surfaces that are hard or have sharp edges)
- **Static postures**
(e.g., maintaining fixed positions for a long time)

Types of MMH Improvements

1. Engineering Improvements

These include rearranging, modifying, redesigning, providing or replacing tools, equipment, workstations, packaging, parts, processes, products, or materials.



Scissor Lift

*To raise or lower
the work surface*



Angled Shelving

*To improve access
to containers*



Portable Platforms

*To adjust height of
worker*



Shoulder Pad

*To provide cushioning
& abrasion protection*



**Containers with
Handles**

for better grip



Step Stool

*To adjust height
of worker*

Types of MMH Improvements

2. Administrative Improvements

Observe how different workers perform the same tasks to get ideas for improving work practices or organizing the work.

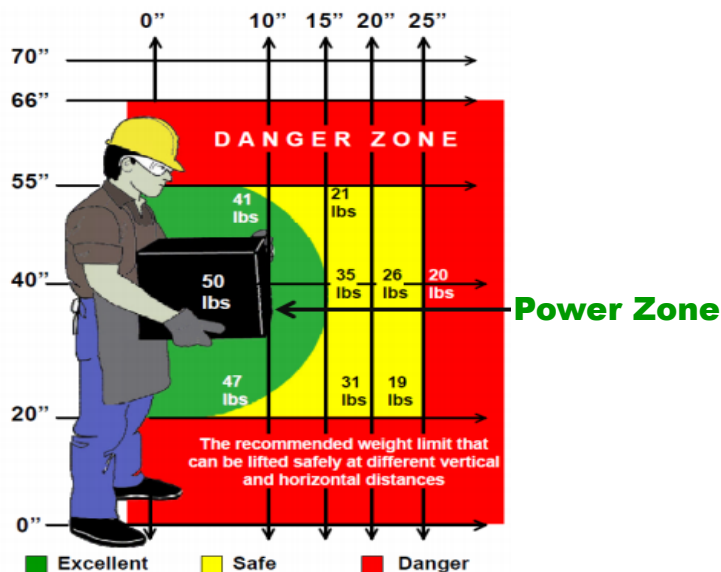
Consider the following improvements:

- Alternate heavy tasks with light tasks.
- Provide variety in jobs to eliminate or reduce repetition (*Avoid overuse of the same muscle groups*).
- Adjust work schedules, work pace, or work practices.
- Provide recovery time (*Use short rest breaks*).
- Modify work practices so workers perform work within their power zone (*i.e., above the knees, below the shoulders, and close to the body*).
- Rotate workers through jobs that use different muscles, body parts, or postures.

Power Zone & Safe Lifting

POWER ZONE

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



SAFE LIFTING

Before You Lift...
THINK & PLAN AHEAD!!



1. Get close to the object/load.
2. Stand with feet apart. Ensure your balance and position are stable.
3. Keep back straight and bend at the knees.
4. Ensure the weight is within your limits and you can maintain a firm grip.
5. Tighten abdominal muscles and lift with your legs and a straight back.
6. Lift slowly in a smooth motion. Exhale as you lift.
7. Keep the object/load close to your body.



**Take time to look at your work space with a
new set of eyes!**

Key Reminders...

Fix the job,
not the worker



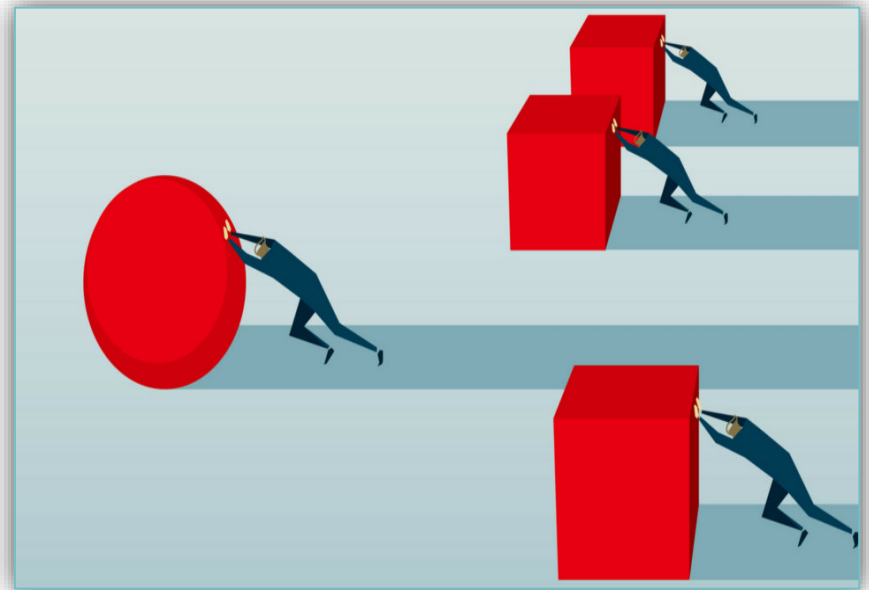
Key Reminders...

Use your brain,
not your back



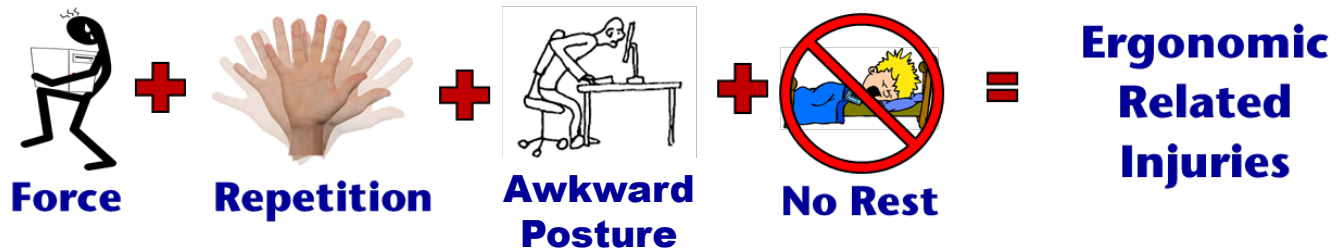
Key Reminders...

Work smarter,
not harder.



Key Reminders...

Reduce the risk
factors, not the
productivity



RESOURCES

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