



THE ERGONOMICS CENTER
OF NORTH CAROLINA

Ergonomics - Stressors for Musculoskeletal Disorders & Prevention

Presented By:

Tim McGlothlin, MS, CPE, FIISE

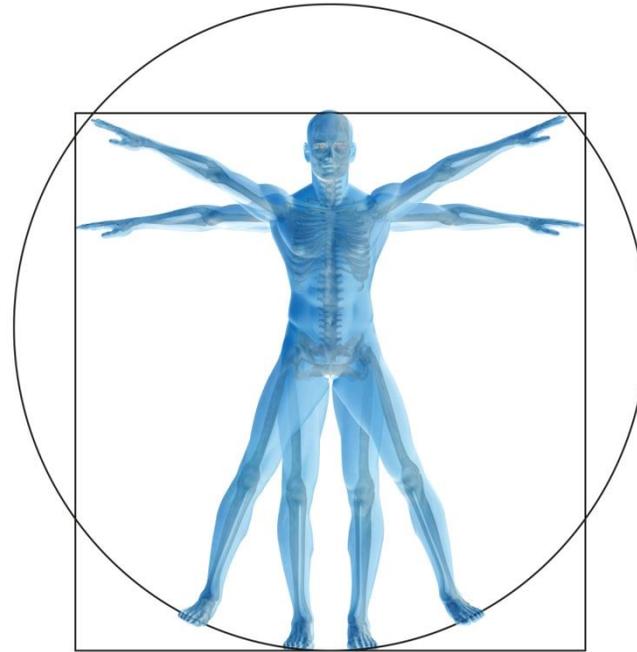
Executive Director

October 5, 2017, 9-10 am



NC STATE UNIVERSITY

Fundamentals of Ergonomics



What is Ergonomics?

The field of study concerned with finding ways to keep people safe, comfortable, and productive while they perform tasks at work and home.

Fitting the task to the person



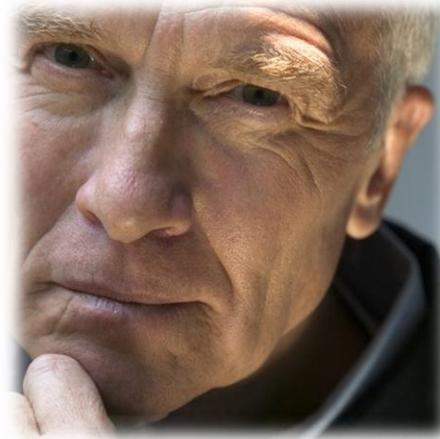
Benefits of Ergonomics

- Reduced lost work-time illnesses and injuries
- Reduced compensation costs
- Increased levels of productivity, efficiency, and quality
- Improved comfort and usability; reduced human error; increased reliability
- Reduced training/retraining & turnover
- Reduced equipment costs
- Increased employee morale



Ergonomic Trends

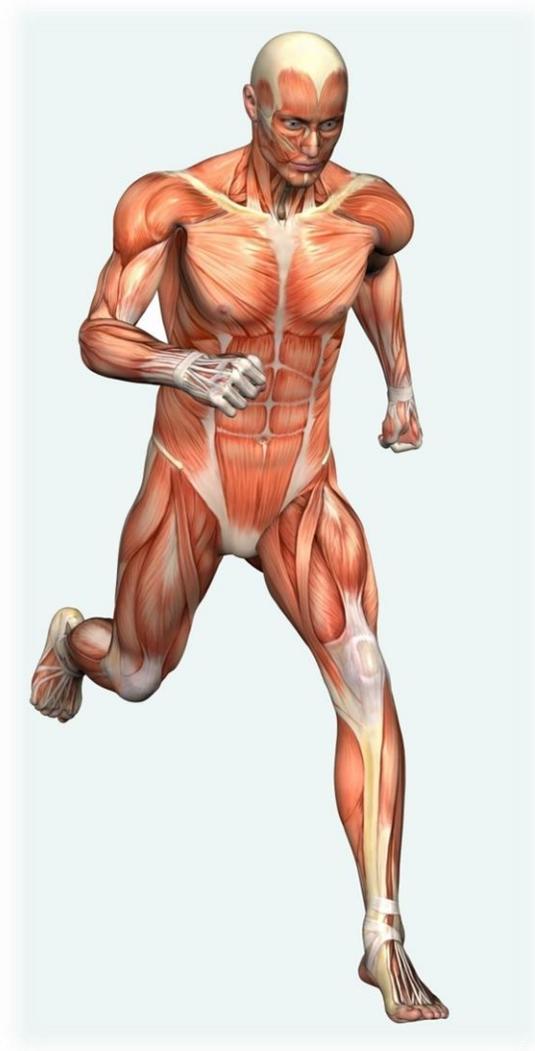
- Age
- Physical Fitness
- Awareness
- Melting Pot
- Technology



Magnitude of the Problem - Need for Ergonomics

- There were 5 million medically consulted injuries suffered by American workers in 2011 while on-the-job. (NSC, 2013)
 - Medical costs: \$52.3 billion
 - The total costs: \$189 billion
- More than half of private industry injury and illnesses cases reported nationally involved days away from work, job transfer, or restriction (DART cases). (BLS, 2014)

Ergonomics and The Human Body



Musculoskeletal System

Muscles:

- Contract to move bones

Bones:

- Provide structure, support, & protection

Tendons:

- Connect muscle to bone

Ligaments:

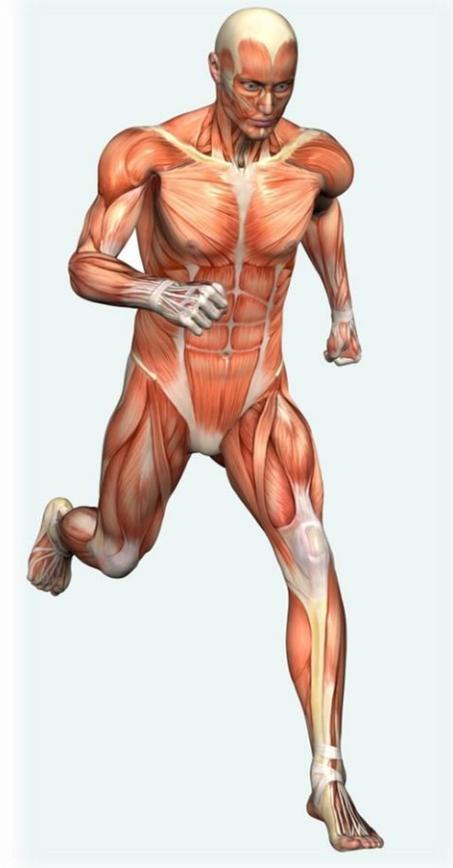
- Connect bone to bone

Cartilage:

- Provides cushioning and lubrication

Bursa:

- Fluid-filled sac that lubricates and cushions between points of friction



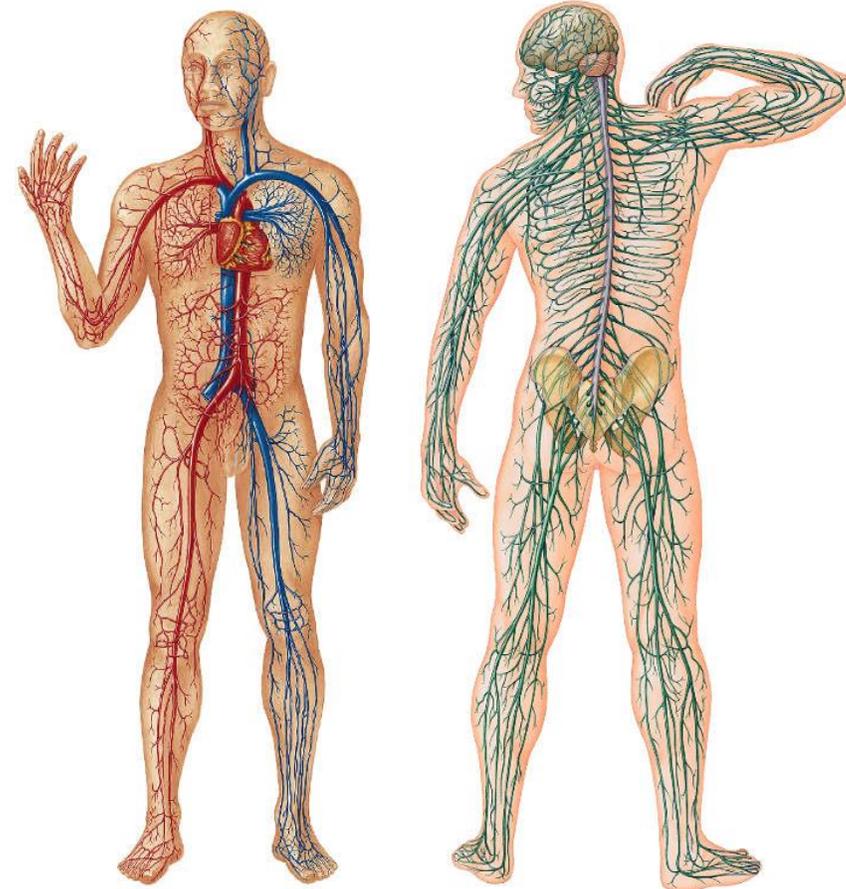
Other Important Components

- **Arteries/Veins**

- Transport blood
 - Deliver oxygen
 - Remove waste

- **Nerves**

- Determines which muscles to use
- Coordinates activities
- Provides feedback on pain and discomfort
- Provides tactility, sensation

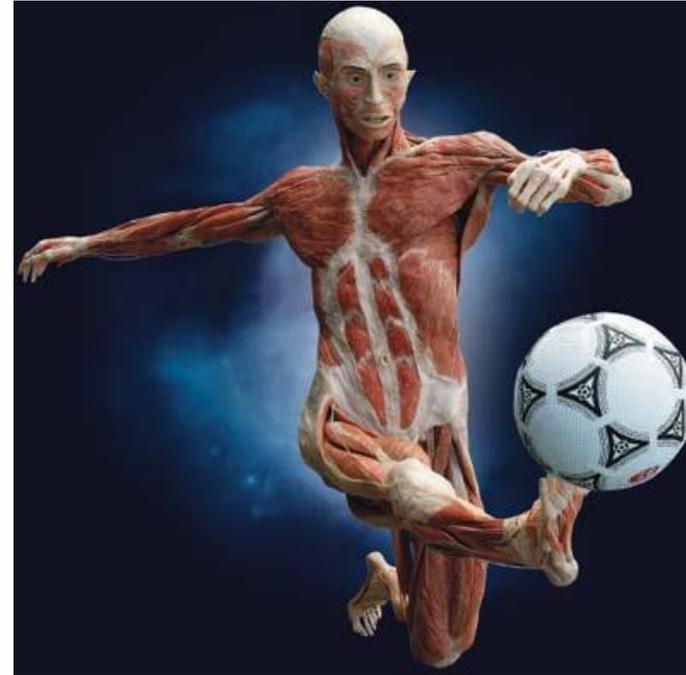


**Circulatory
network**

**Nerve
network**

Muscles Need...

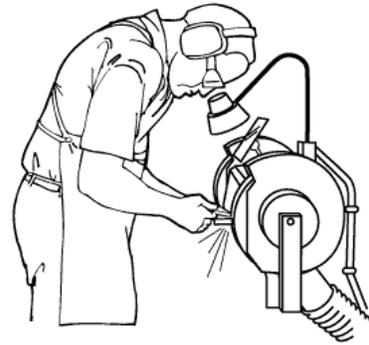
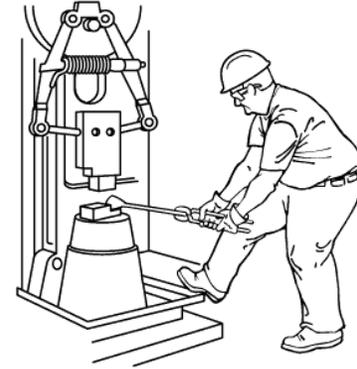
- Circulation
- Motion
- Recovery
- Efficient positioning
- Efficient recruitment



<http://www.bodyworlds.com/>

When deprived of any of these factors, muscles are prone to FATIGUE and MSDs.

Ergonomic Stressors



*Before we begin, let's see how
observant you are? **Ergonomic
Professionals** must have good
vision!!!*



Can you find the animal in the rose?



Do you see a hidden object?



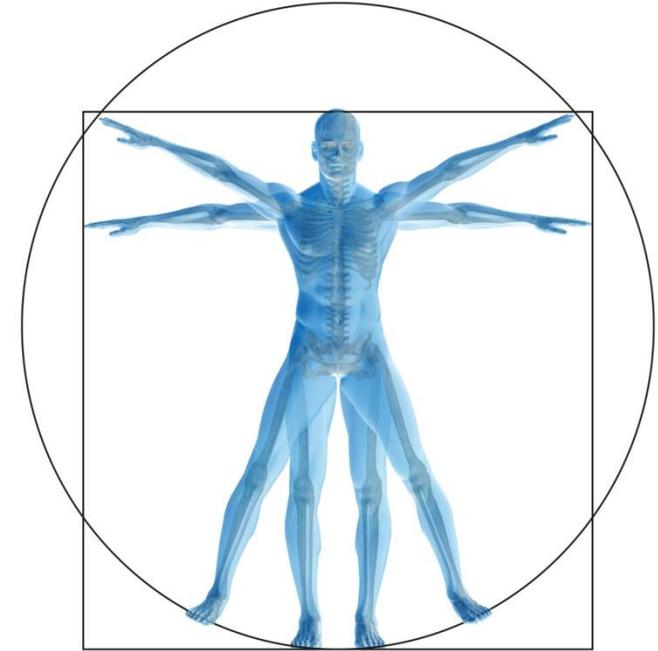
Can you find the hidden tiger?

Well, did you pass the test?

Ergonomic Stressors

BIG THREE:

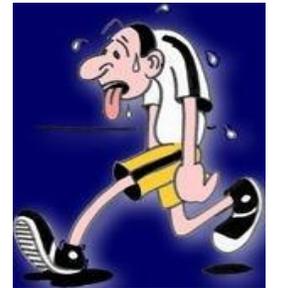
1. Force
2. Deviated Body Postures
3. Movement
 - Repetitive Actions
 - Static or Sustained Efforts



Multiple stressors = Greater chance of injury

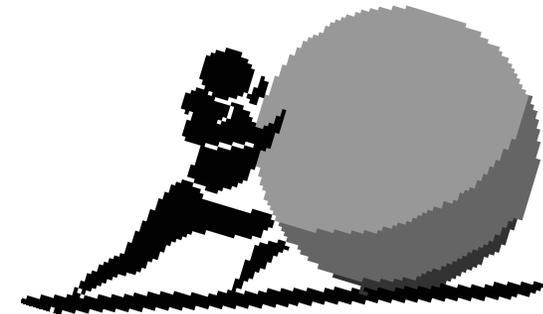
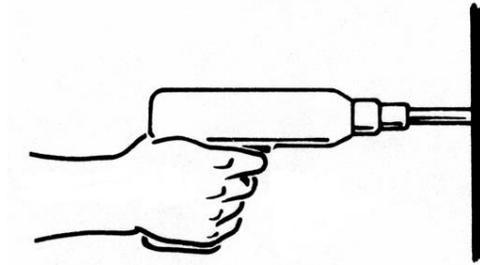
Force

- Muscles produce force to perform activities
- Overworked muscles experience fatigue
- Overuse is common when:
 - High forces are required
 - Forces are sustained for extended periods of time
 - Wrong tools are used for the job
 - Small muscle groups are used for large amounts of force (power grip vs. pinch grip)



Force is applied when...

- Lifting
- Lowering
- Carrying
- Pushing
- Pulling
- Gripping
- Pinching
- Typing
- Mousing



Force Stressor Example



- Manually push transfer cars (**380+ lb** initial force, **150+ lb** of sustained force)

Force Stressor Examples



Force Stressor Example

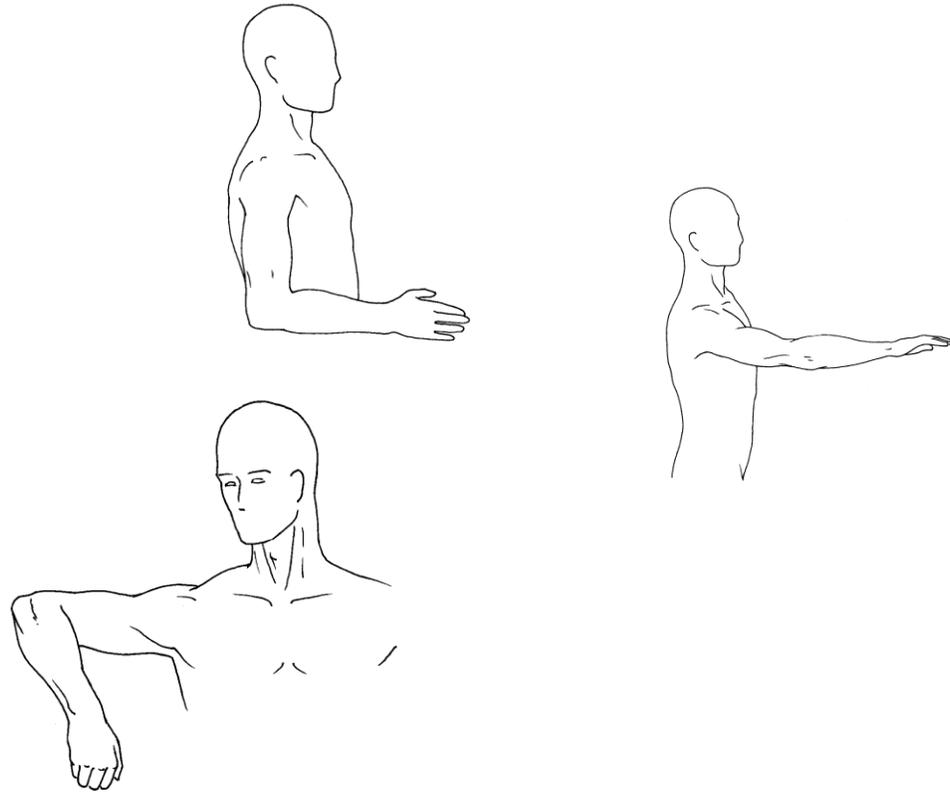


Manually handling (lifting, tipping, sliding) pallets (wood pallets = 45 – 70+ lb)

Force Stressor Example



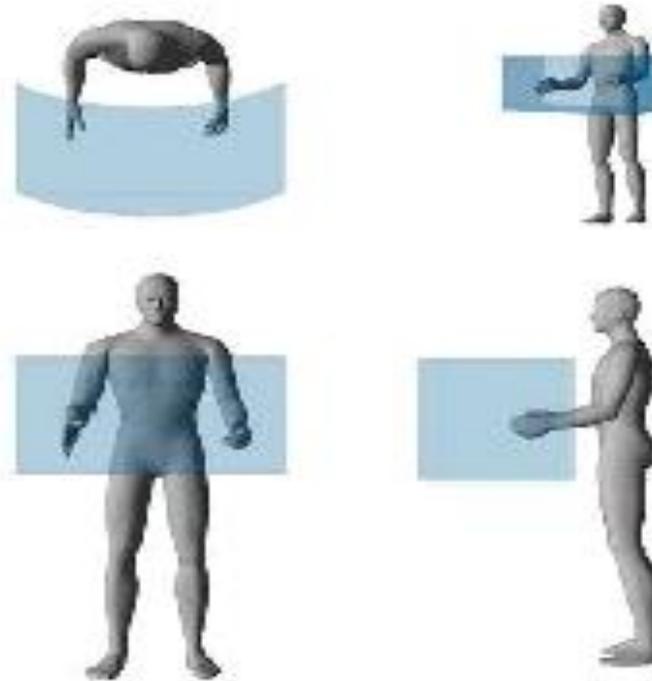
Posture



- Joints have ranges of motion
 - Neutral postures in mid range
 - Extreme postures at end of range
 - Awkward postures between neutral and extreme
- Extreme and awkward postures use time and energy inefficiently and can lead more quickly to fatigue.
- Body more prone to injury when joints are positioned in awkward or extreme postures

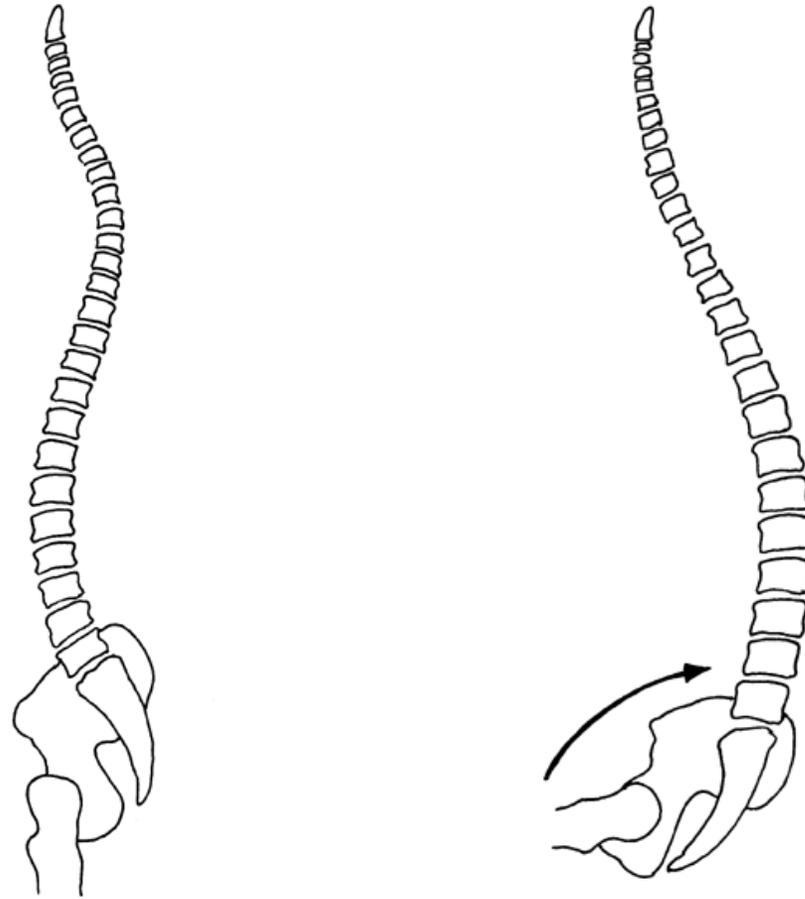
Neutral Posture: Standing

Stand up straight
Arms to the side
Shoulders relaxed
Elbows in 90° bend
Wrists straight
("handshake" position)



*In this position, the body is able to function in a
Safer, Stronger and more Efficient manner.*

Back posture when seated



Postural Stressor Example



Posture Stressor Example



Postural Stressor Example



Posture Stressor Example



Posture Stressor Example



Movement

- Jobs require combinations of tasks that are *repetitive* or require little to no movement (*static*)
- Both can be harmful to the body
- Look to the extremes
 - Static/sustained postures
 - Repetitive movements



Movement Stressor Example

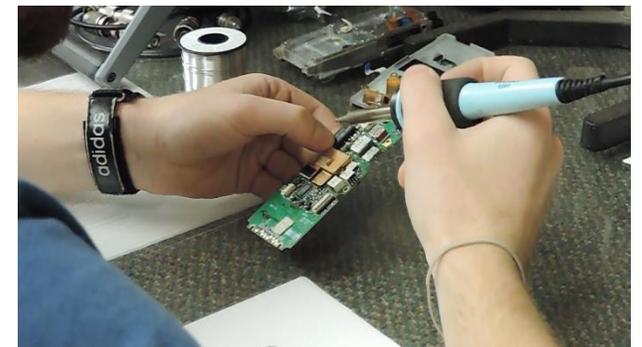
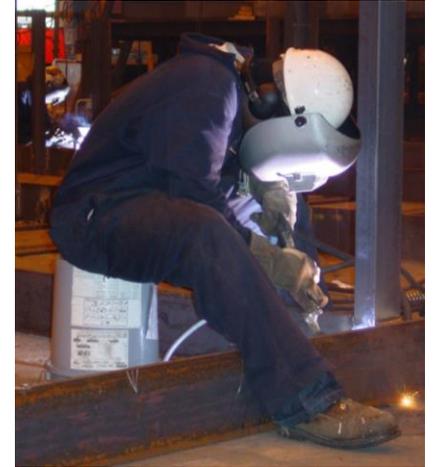


Movement Stressor Example



Static/Sustained Postures

- Depriving muscles of motion & circulation can lead to fatigue and discomfort
- Static awkward/extreme postures more stressful than static neutral
- Examples:
 - Using hand as a fixture
 - Continuous holding of a hand tool
 - Continuous overhead work
 - Continuous standing or sitting
 - Looking down or to the side



*It is easy to spot the motion in a job.
Take time to look for **LACK** of motion.*

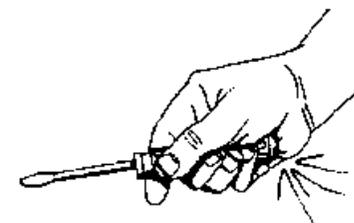
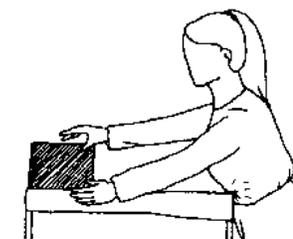
Contact Stress

- When part of the body is pressed or leaning on an edge or surface
- Decreases circulation
- Places pressure on nerves
- Affects moving parts and soft tissues



Examples

- Resting elbows on hard work surface
- Resting forearms on edge
- Using tool with handle that digs into palm
- Lower extremity contact with the work area



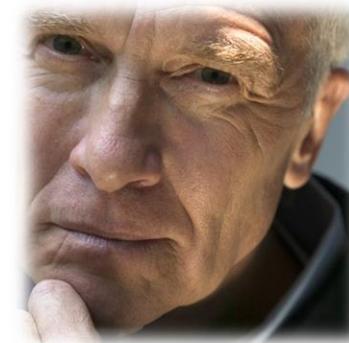
Work Environment

- Cold Environment
 - Reduced blood flow to extremities
 - Contracted muscles
 - Longer warm-up period
 - Heavier clothing
- Hot Environment
 - Accelerated fatigue
 - Increased risk of dehydration
- Wet Environment
- Lighting
- Vibration



Personal Stressors

- Strength
- Body size
- Flexibility
- Insufficient sleep, or recovery from exertion (fatigue)
- Smoking
- Lack of physical exercise (conditioning)
- Hobbies, Sports
- Prior Medical Conditions
- Obesity
- Aging Effects



Musculoskeletal Disorders

What are Musculoskeletal Disorders (MSDs)?

- Refers to damage or weakening of the musculoskeletal system
- May be one of two types:
 1. Acute Trauma
 2. Cumulative Trauma Disorders



Common Types of MSDs

- Carpal Tunnel Syndrome
- Thoracic Outlet Syndrome
- Tendonitis
- Tenosynovitis
- Epicondylitis
- Dequervain's Tendonitis

- Lumbar Strain/Sprain
- Muscle Strain



Signs & Symptoms of Musculoskeletal Disorders

- Symptoms
 - Pain and discomfort
 - Numbness, tingling
 - Pins and needles
- Signs
 - Weakness (trouble holding objects)
 - Restricted movement
 - Redness and swelling



Early reporting of symptoms & treatment may resolve problem without lost work time, restricted activity or surgery.

Ergonomic Controls and Solutions

Ergonomic Controls

Types of Ergonomic Controls:

1. Engineering Controls

- Changes made to workstations, tools, machinery, etc., that alter the *physical composition* of the work area or work process
 - Examples: hoist/crane, lift table, lift cart, conveyor

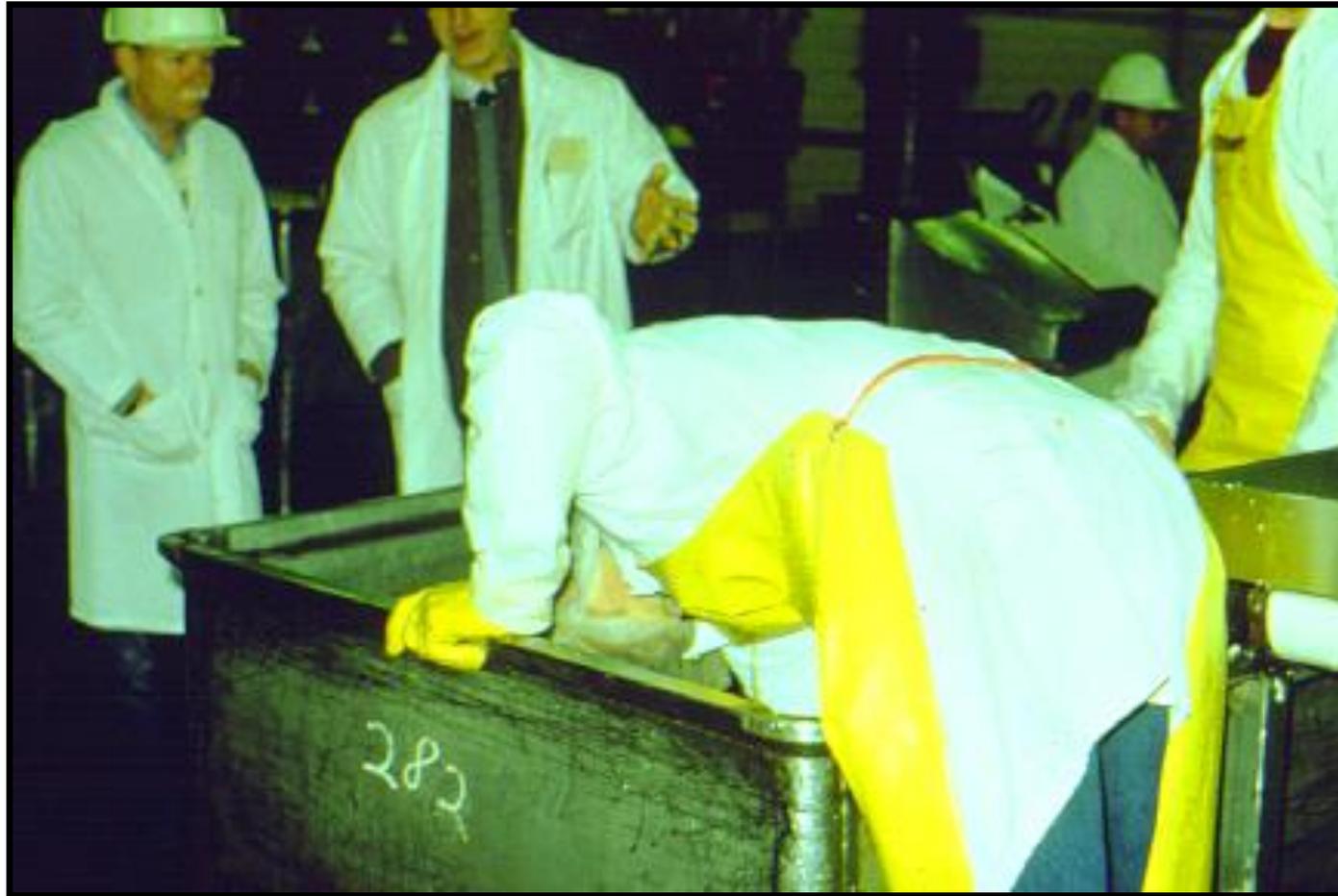
2. Administrative Controls

- Changes made to the work process or manner in which the work is performed *without physically altering* the workspace
 - Examples: job rotation, job enlargement, microbreaks & stretches, work methods training, work hardening

3. Personal Protective Equipment (PPE)

- Equipment worn to minimize exposure or impact of certain risks
 - Examples: gloves, padding, foot protection, respirators, body temp. regulation devices

What's the Problem? Proposed Solutions?



Before

Engineering Control Example



After

Engineering Controls: Material Handling and Ergonomic Solutions



Work Assist / Personnel
Lift Vehicle



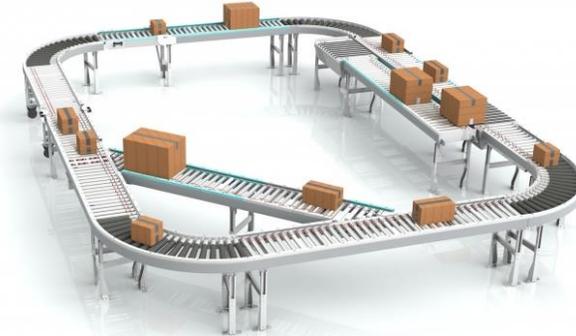
Overhead Lift Assists /
Intelligent Assist Devices



Lift Tables and Lift Carts



Height Adjustable Pallet Jacks



Portable Conveyors and Smart Conveyors

Engineering Controls: Proposed Solutions?



Lifting large and/or heavy boxes (40+ lb) to/from flat-bed carts and/or pallets.

Other Engineering Controls: Upper Extremity-Intensive / Awkward Posture Solutions



Tool Balancers



Tool Torque Arms



Adjustable Clamps and Jigs



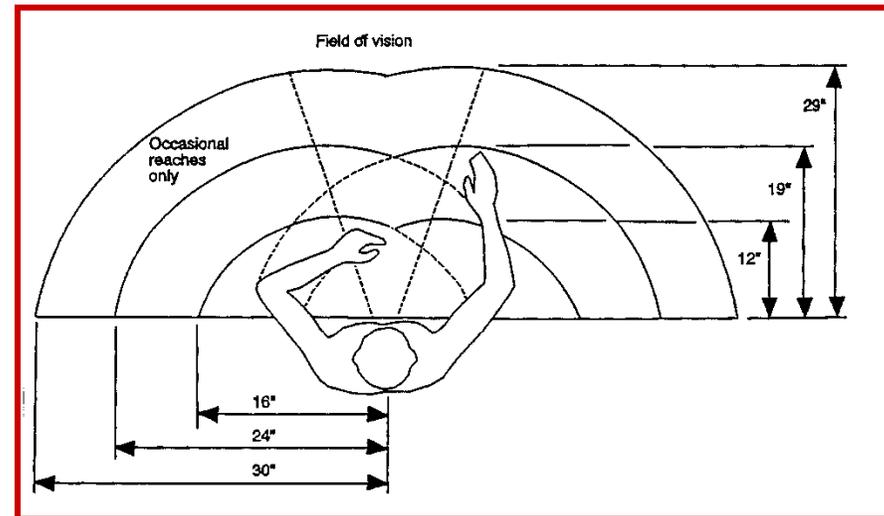
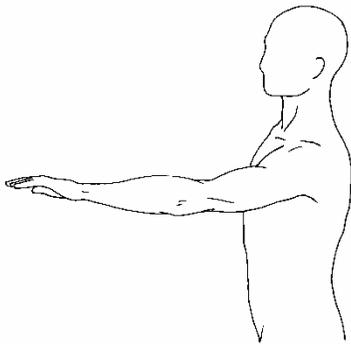
Height / Tilt Adjustable Work Tables



Adjustable Work Platforms

Workstation Layout

- **Rules of Thumb: Workstation Layout**
 - Materials used frequently within forearm reach
 - Items used less frequently within arm's length
 - Alternative: Locate less frequently used items further away in location that requires walking
 - Minimize twisting, turning, reaching, & bending



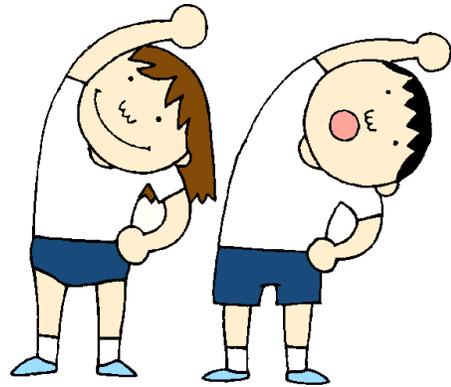
Administrative Controls: MMH Tips

- Avoid awkward back postures by storing material at waist level
- Slide products instead of lifting
- Push instead of pull
- Keep motions smooth and controlled
- Get assistance when moving heavy or oddly shaped objects
- Avoid awkward grips and hand/wrist postures
 - Use power grip vs. pinch grip and keep wrists straight



Administrative Controls: Breaks & Stretching

- During a break do the *opposite*
 - Doesn't necessarily mean an actual “work break”
- 2-5 min break from posture every hour
- Stretching facilitates circulation



Administrative Controls: Job/Task Rotation

Why may job/task rotation be beneficial?

- Provide the opportunity for recovery from localized muscle fatigue
- Minimize the risk for cumulative trauma MSDs
- For variety and new skill development (i.e. quality improvement & flexibility)
- Improve morale



***OK...Here's one more chance to
prove your skills of observation!***



What is it? now?



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Any Questions?

Thank You...



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