



**THE ERGONOMICS CENTER**  
OF NORTH CAROLINA

# Ergonomics - Stressors for Musculoskeletal Disorders & Prevention

Presented By:

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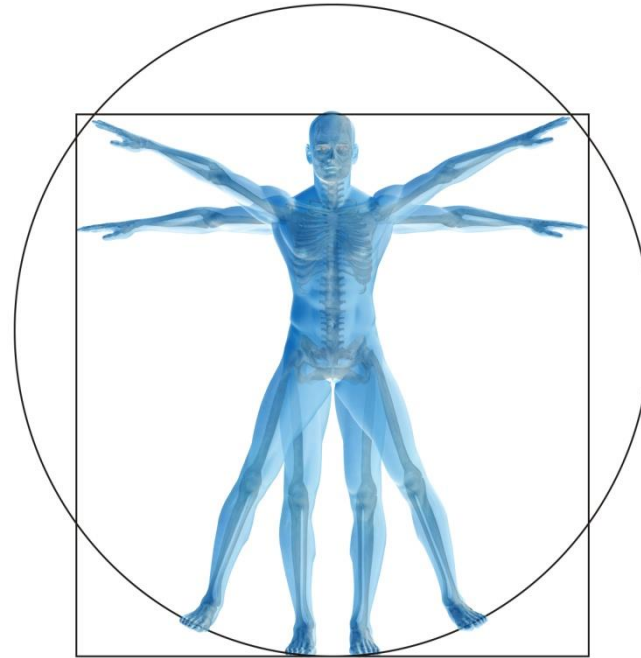
Executive Director

October 5, 2017, 9-10 am



**NC STATE UNIVERSITY**

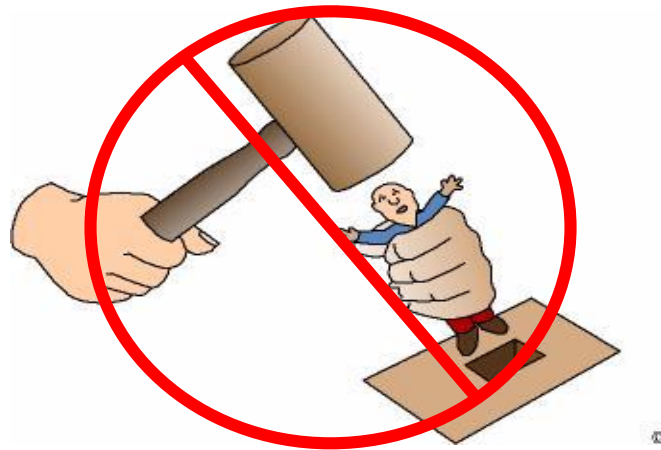
# Fundamentals of Ergonomics



# 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***



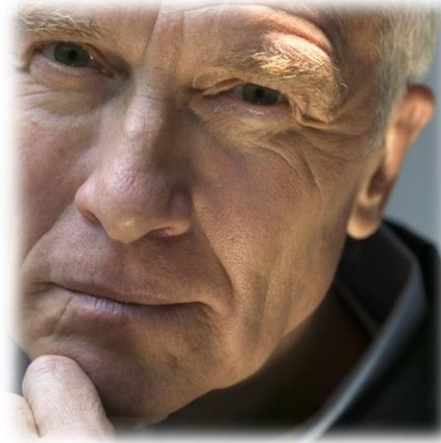
# Benefits of Ergonomics

- 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



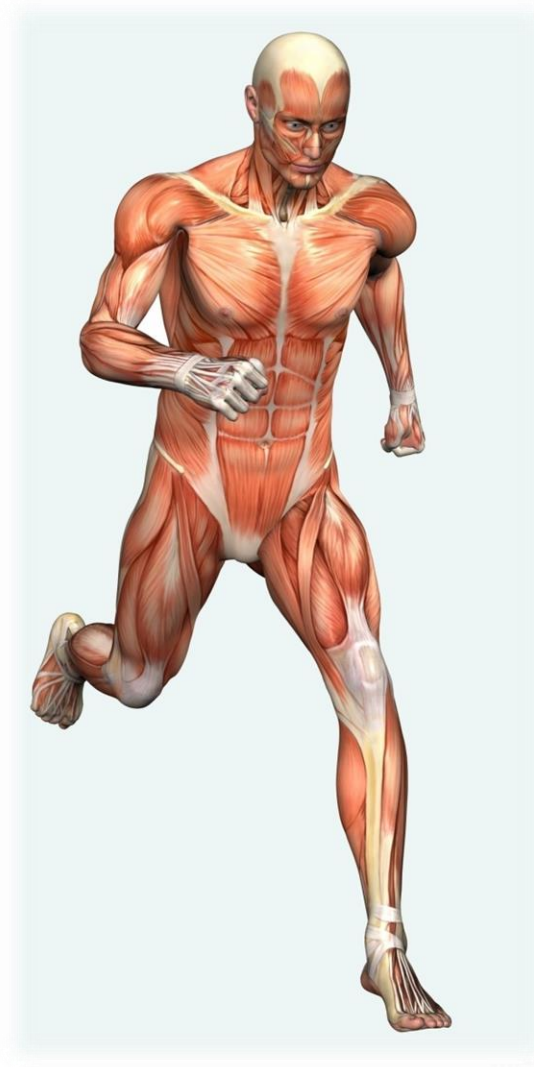


# Magnitude of the Problem - Need for Ergonomics

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- 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:**

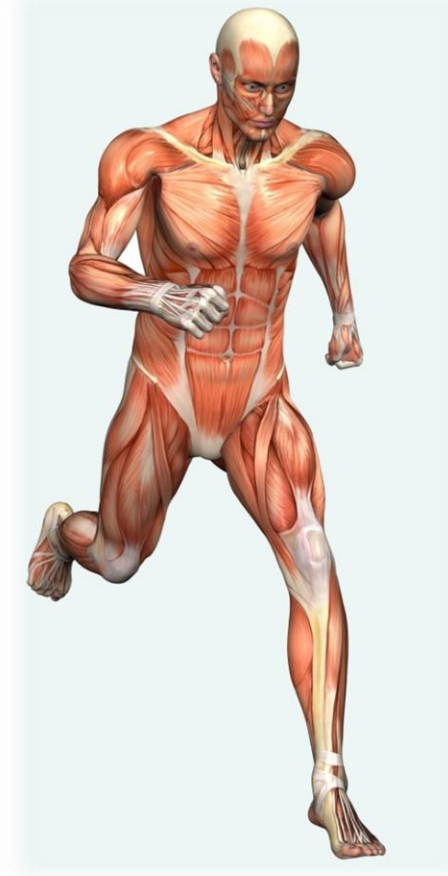
- Connect bone to bone

## **Cartilage:**

- Provides cushioning and lubrication

## **Bursa:**

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





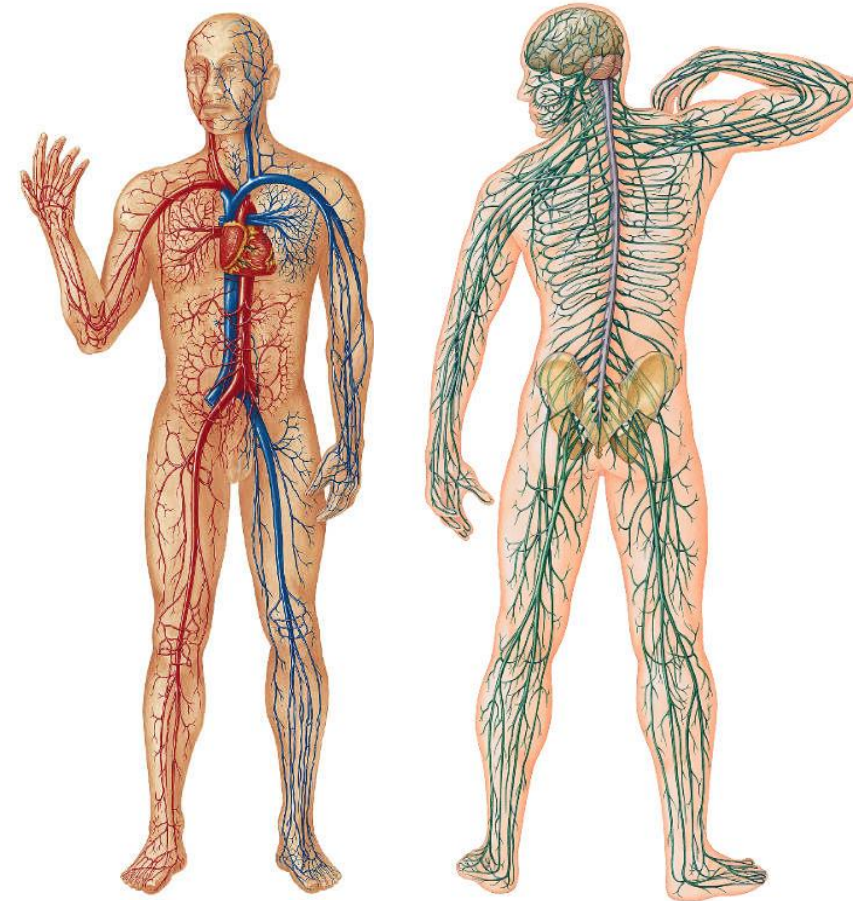
# Other Important Components

- **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

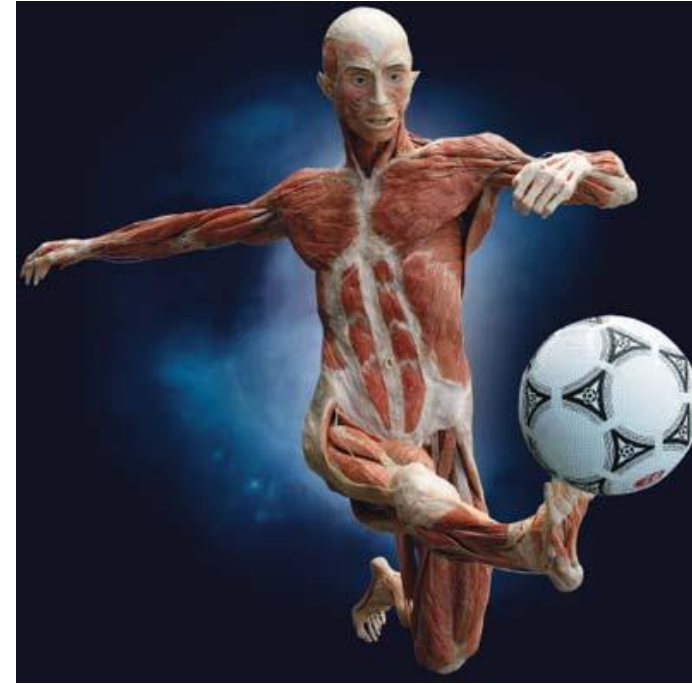


**Circulatory  
network**

**Nerve  
network**

# Muscles Need...

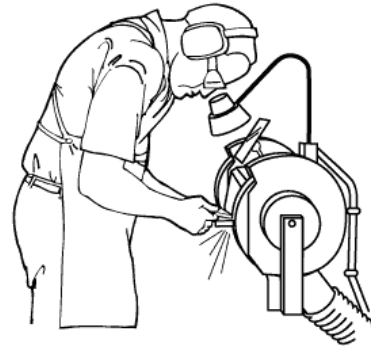
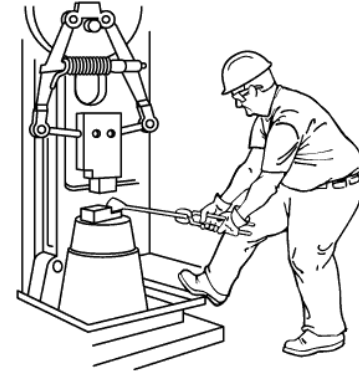
- Circulation
- Motion
- Recovery
- Efficient positioning
- Efficient recruitment



<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?





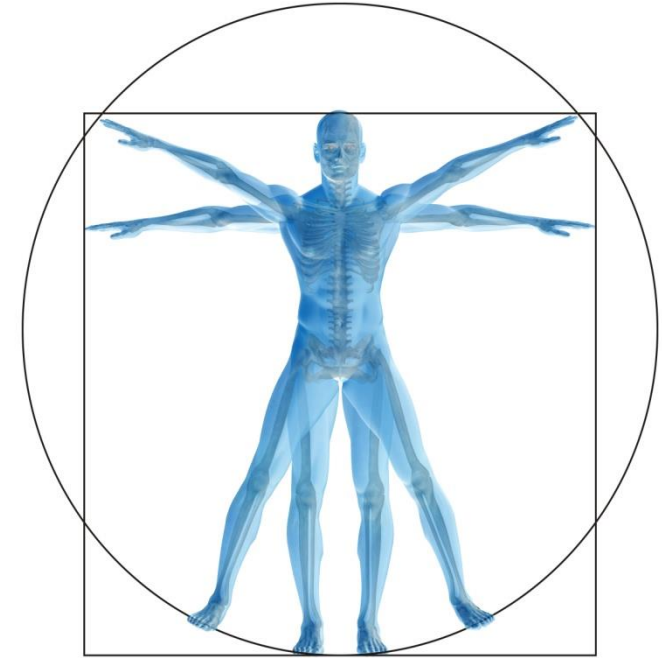
Can you find the hidden tiger?

***Well, did you pass the test?***

# Ergonomic Stressors

## BIG THREE:

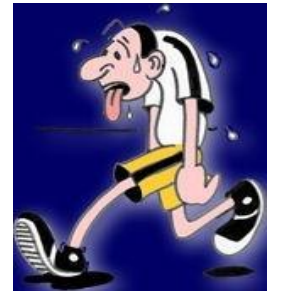
1. Force
2. Deviated Body Postures
3. Movement
  - Repetitive Actions
  - Static or Sustained Efforts



***Multiple stressors = Greater chance of injury***

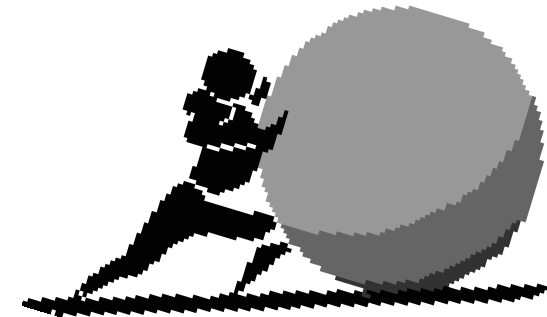
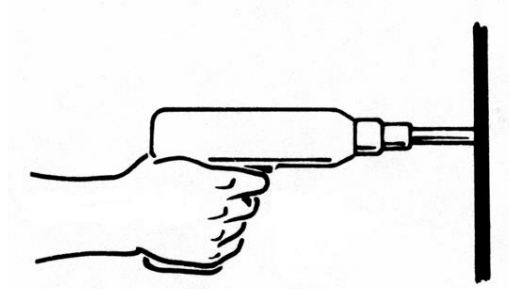
# Force

- 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



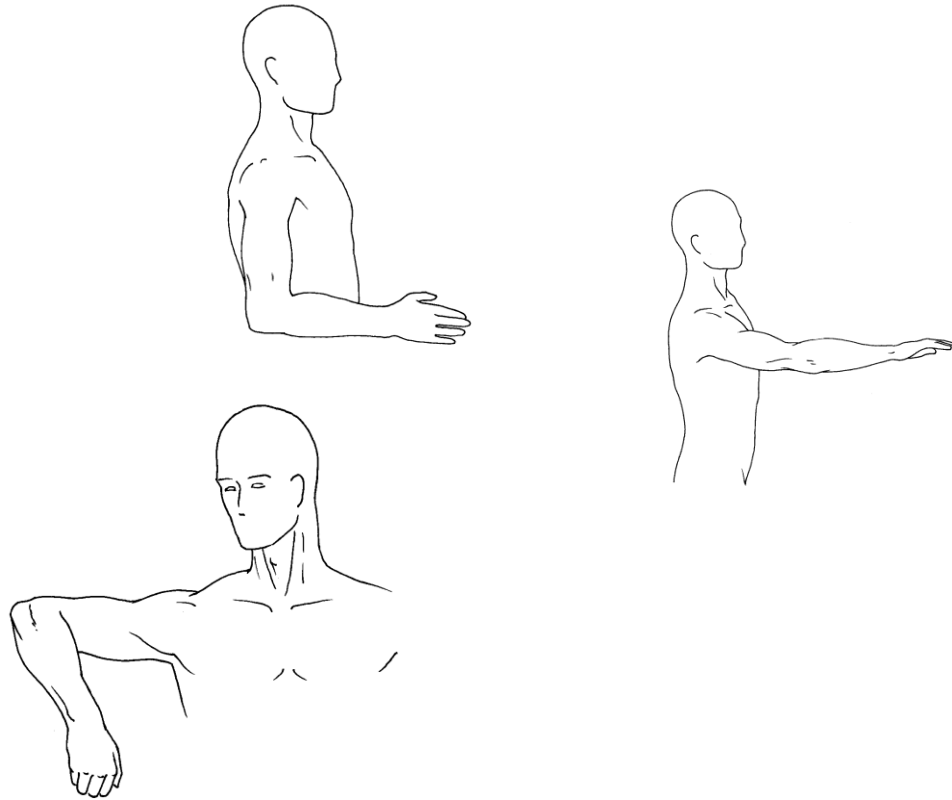
Manually handling (lifting, tipping, sliding) pallets (wood pallets = 45 – 70+ lb)



# Force Stressor Example



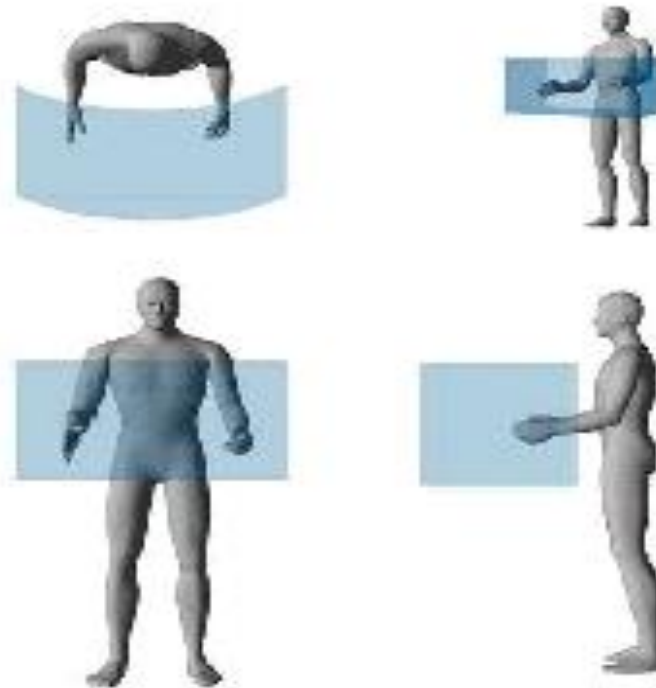
# Posture



- 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

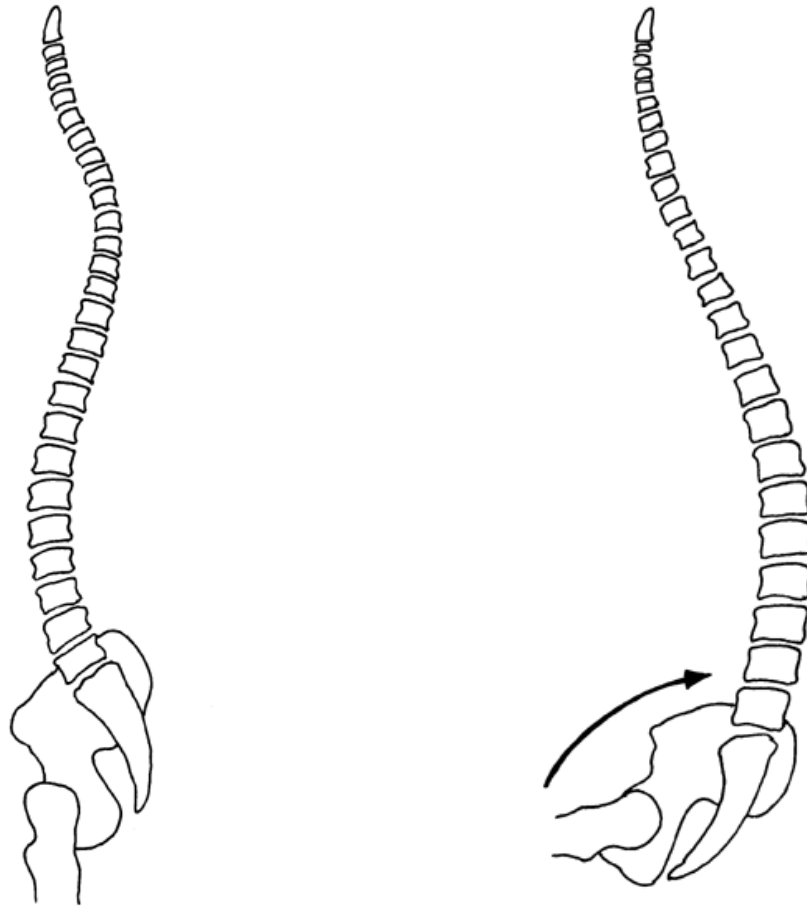
Stand up straight  
Arms to the side  
Shoulders relaxed  
Elbows in 90° bend  
Wrists straight  
("handshake" position)



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

# Back posture when seated

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# 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



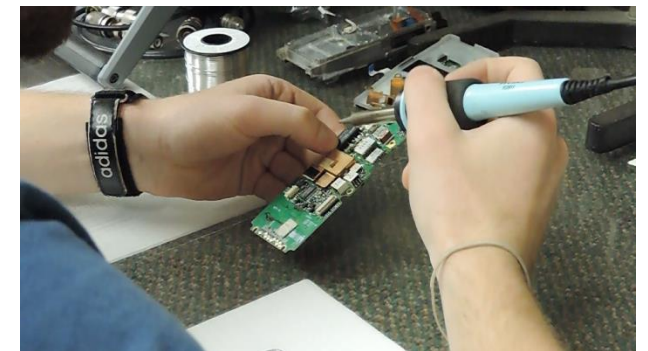
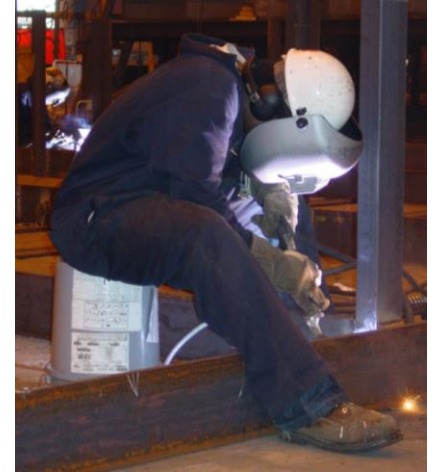


# Movement Stressor Example



# 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.*

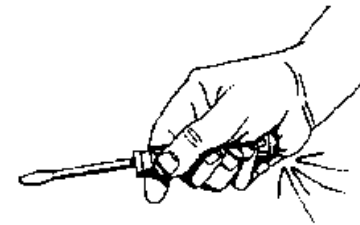
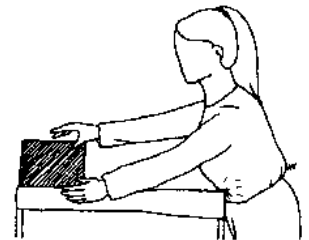


# Contact Stress

- 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

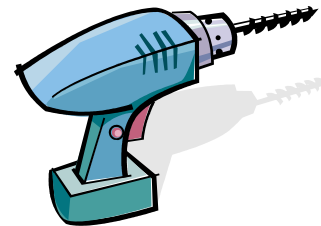
## Examples

- 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



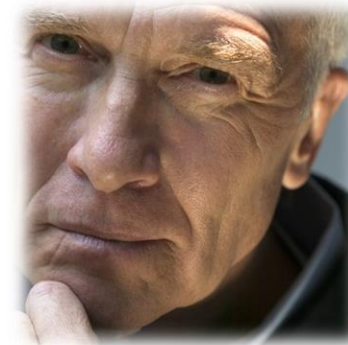
# Work Environment

- 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

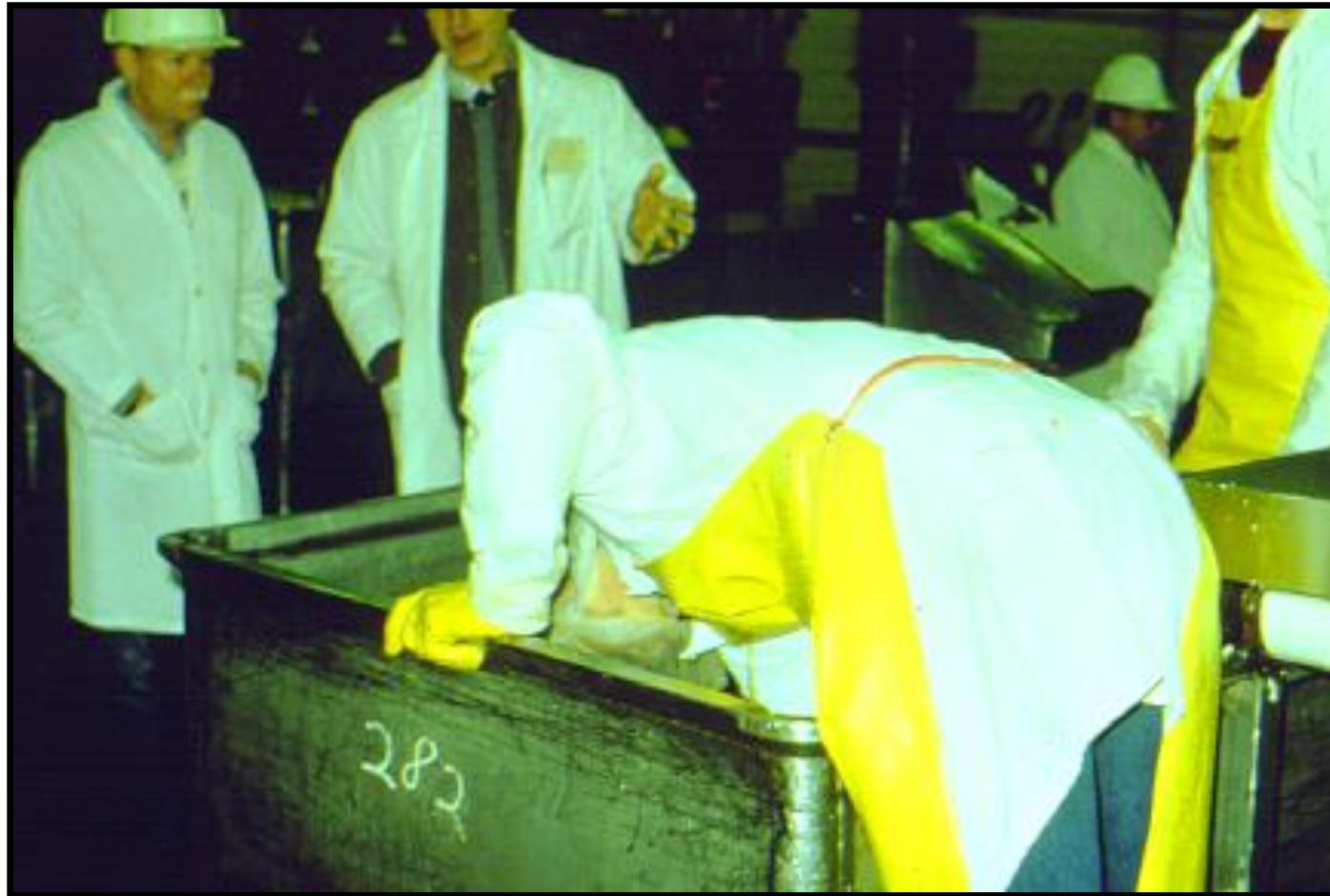
### 2. Administrative Controls

- 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



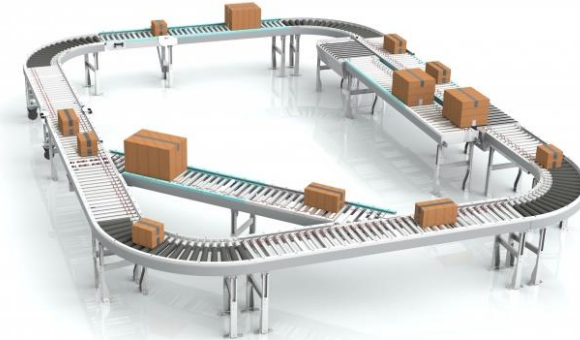
Lift Tables and Lift Carts



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



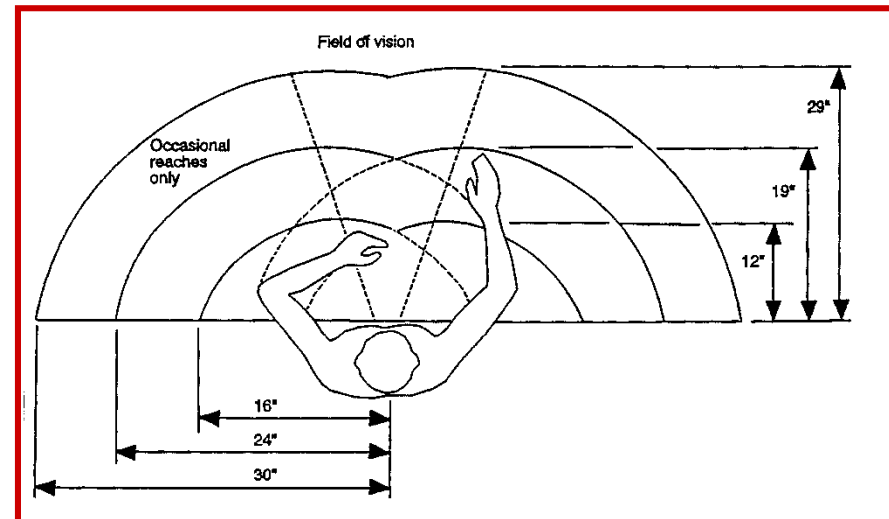
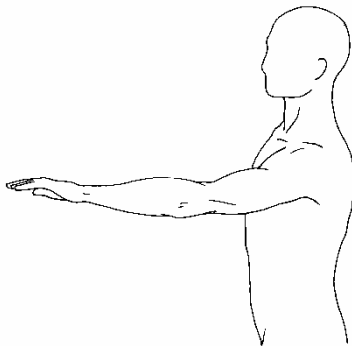
Height / Tilt Adjustable Work Tables



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

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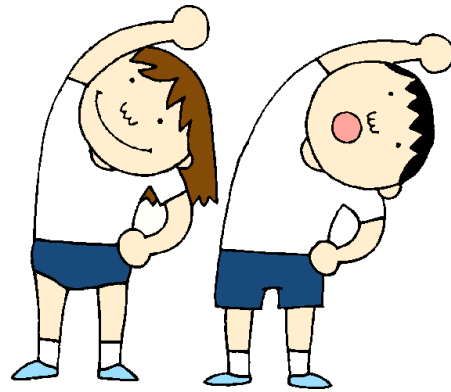
- Avoid awkward back postures by storing material at waist level
- Slide products instead of lifting
- Push instead of pull
- Keep motions smooth and controlled
- Get assistance when moving heavy or oddly shaped objects
- Avoid awkward grips and hand/wrist postures
  - Use power grip vs. pinch grip and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