

Laboratory Ergonomics

Christina Kulakowski

November 5, 2018

Overview

- Define Ergonomics
- Anatomy and Physiology and common MSDs (musculoskeletal disorders)
- Risk Factors in the Laboratory
- Ergonomics Programs
- Ergonomic Solutions
 - Proper work station set up
 - work practices
 - Injury prevention

Objectives

At the end of this course you will be able to:

- ✓ Define ergonomics and describe how it impacts your work environment
- ✓ List the common symptoms of MSD's and steps you can take to prevent them
- ✓ Describe components of a successful ergonomics program.
- ✓ Understand injury prevention techniques and ergonomics solutions

Ergonomics

Ergos = work

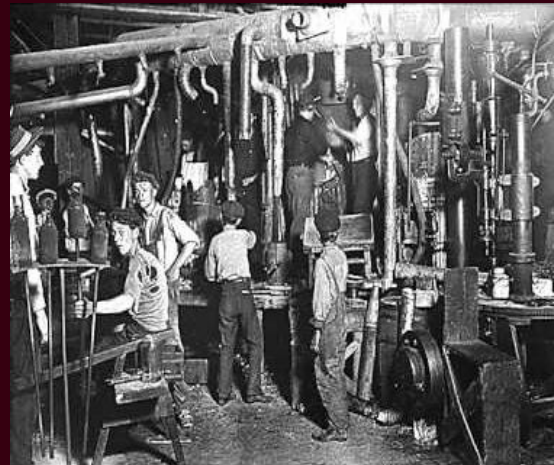
Nomos = natural law

Ergonomics = the natural laws of work



History of Ergonomics

- Industrial revolution:
 - Was about the job more than the people completing the job
 - The first ergonomic concepts emerged in the late 1800s and were focused on how to get the worker to operate more productively.

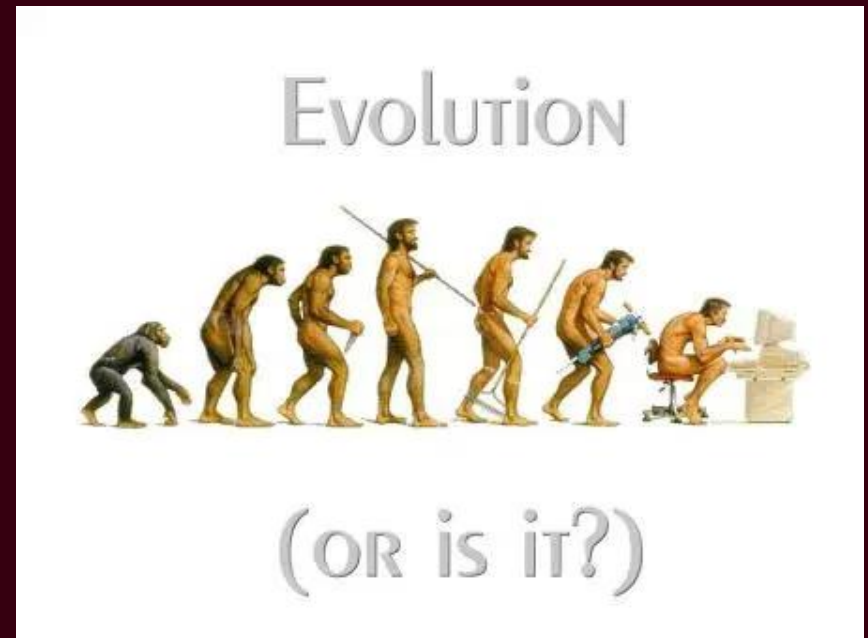


History of Ergonomics

- 1940's
 - People started to realize that that people/workers were more efficient and produced more if they were given products and tools that were safer and easier to use and thus improved the work process.
- 1949
 - The word ergonomics was officially proposed and accepted in 1950.
- 1957
 - United States formed the “Human Factors Society” where the focus was on the “role” of the individual within a complex system.

History of Ergonomics

- 1960-Present
 - Positioning ergonomics was emphasized.
 - Goal to archive neutral postures
- Present:
 - Dynamic Ergonomics
 - Emphasis on neutral postures, but allowing or dynamic movement throughout the day.
 - The key is to build movement variety into the normal work day



Modern Meaning of Ergonomics

“Make the work fit the person, not the person fit the work”

- The science of designing and organizing equipment such that people use equipment safely and efficiently, with the ultimate goal of minimizing risk factors for injury caused *over time*.
- Matching products and task with the people.
- It considers body dimensions, mobility, and the body's stress behavior

Why?

Because . . .

- “Work-related musculoskeletal disorders (WMSDs) are the single largest job-related injury and illness problem in the United States.”
– Occupational Safety and Health Administration (OSHA) November 14, 2000
- 29-35% of all occupational injuries and illnesses involving missed days with an average of 57 per incident
- 2014, Utah Bureau of Labor Statistics
- Worker’s compensation claims from ergonomic injuries represent an estimated \$45 to \$54 billion
- CDC
- Total costs are estimated to be \$120 billion annually when lost productivity and other intangible costs are considered.
- “Ergonomics: The Study of Work” U.S. Department of Labor, Occupational Safety and Health Administration, OSHA 3125, 2000 (Revised), pg. 4

OSHA and Ergonomics

“Employers are responsible for providing a safe and healthful workplace for their workers. In the workplace, the number and severity of MSDs resulting from physical overexertion, and their associated costs, can be substantially reduced by applying ergonomic principals.”

Musculoskeletal Disorders (MSDs)

Physiology and Anatomy

Vertebral Column

Wrists

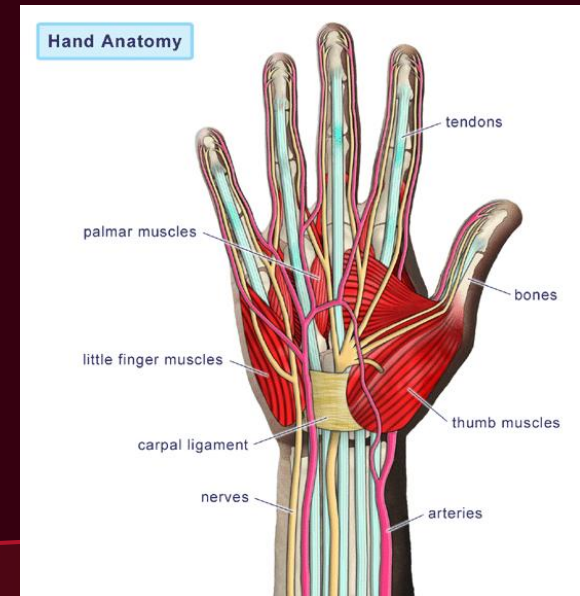
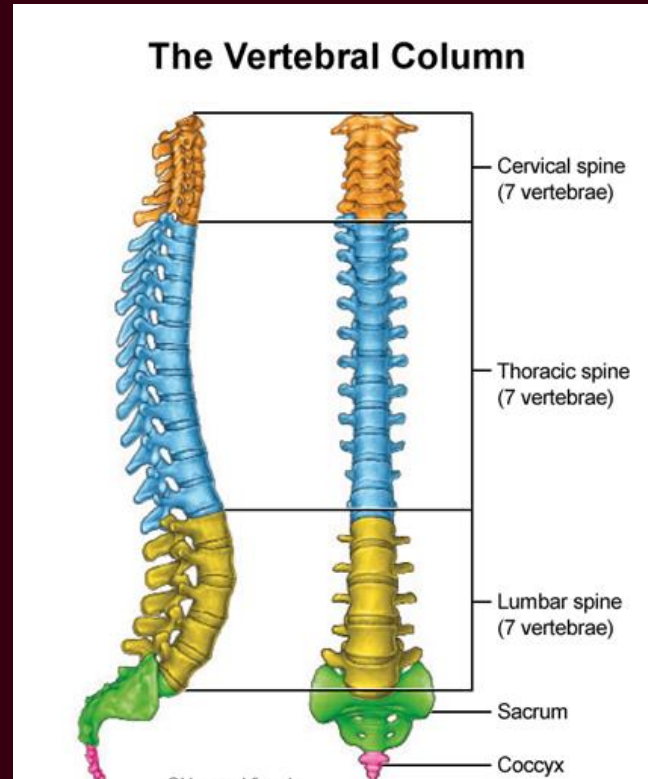
Muscles

Bones

Ligaments

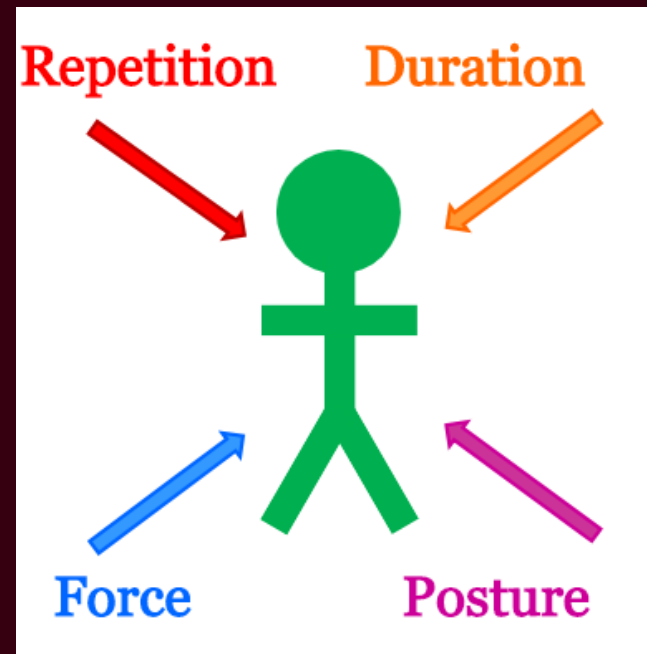
Tendons

Nerves



Risk of Injury

- MSDs occur from repeated movement resulting in trauma to muscles, tendons, ligaments blood vessels and nerves.
- The risk of injury depends on the following factors:
 - **Posture** and body type
 - **Duration** of the activity (how long)
 - **Frequency** of the activity (how often)
 - **Intensity** of the activity (how much)



Musculoskeletal Disorders

MSDs occur when:

- Daily stress to anatomical structures that occur when a person is exposed to certain activities
- If the accumulating stress exceeds the body's normal recuperative ability, inflammation of the tissue can follow
- Chronic inflammation may lead to the development of MSDs
- May require weeks, months or years for repair and recovery

MSD's

May also be known as. . .

1. Cumulative Trauma Disorders – CTD
2. Repetitive Trauma Disorders – RTD
3. Repetitive Strain Injuries – RSI
4. Repeated Motion Disorders – RMD
5. Overuse Syndromes
6. Regional musculoskeletal disorders
7. Soft tissue disorders
8. Thoracic outlet syndrome

Musculoskeletal Diagnoses

Occupational disorders that involve soft tissues such as muscles, tendons, ligaments, joints, blood vessels and nerves and include:

- Carpal tunnel syndrome
- Tendonitis
- Tenosynovitis
- Rotator cuff injuries
- Epicondylitis (tennis or golfers elbow)
- Trigger finger – locking of finger joints
- Muscle strains
- Low back injuries

Signs and Symptoms of MSD's

- ✓ Painful joints, tingling or numbness
- ✓ Muscle Strain/Fatigue
- ✓ Swelling or inflammation
- ✓ Stiffness
- ✓ Burning sensations
- ✓ Weakness or clumsiness in hands; dropping things
- ✓ Blurred vision, eye pain
- ✓ Headaches
- ✓ Sleep disruption
- ✓ Develop cysts over time in hands and wrists

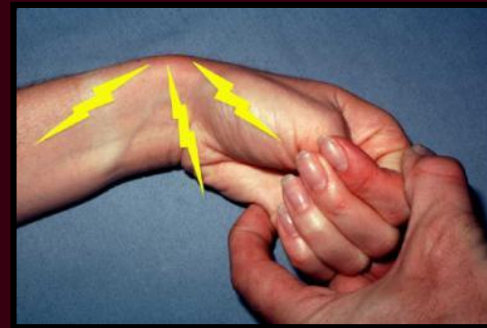
Carpal Tunnel Syndrome

- Most widely referred to MSD
- Compression of the median nerve at the wrist
- Tunnel made up of nine flexor tendons and one peripheral nerve
- Numbness and tingling on the thumb side of the hand
- Difficult to prove laboratory acquired – typing, sewing, knitting, comorbidities such as diabetes, fibromyalgia, medicines



De Quervains (tenosynovitis)

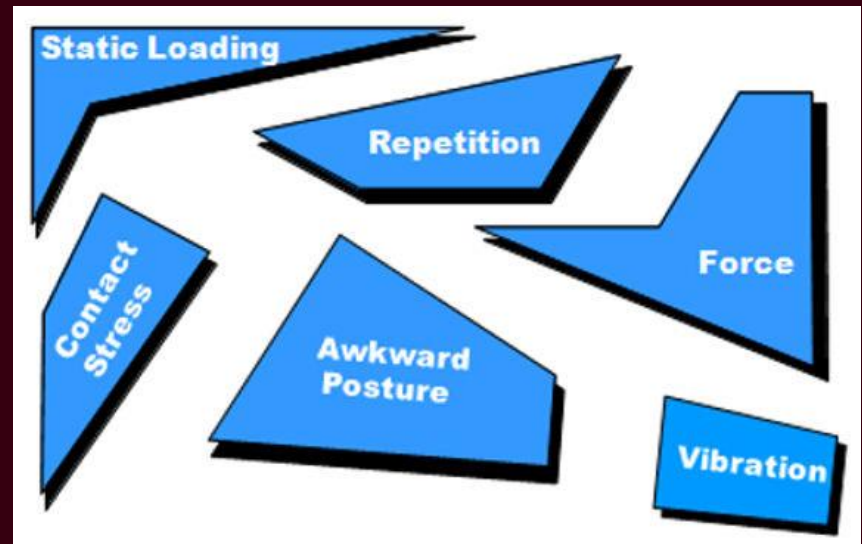
- Wringing washcloths, clothes
- Typing on the computer keyboard
- Cutting with scissors
- Pinching
- Stirring for a long period of time
- Opening jars



Ergonomic Risk in the Laboratory

Risk Factors

- Posture and Positioning:
 - Static Postures
 - Awkward postures
- Pressure points
- Repetitive tasks
- Force
 - Forceful exertion
- Vibration

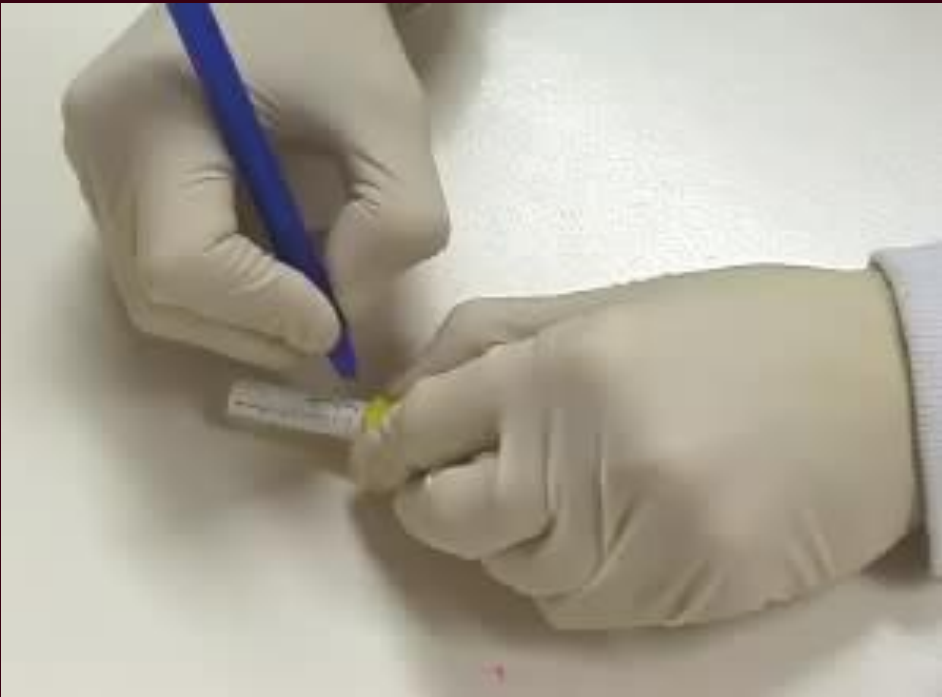


- *Risk of injury increases with:
- Prolonged exposure to any of these ergonomic risk
 - Presence of multiple risk factors within a single job or task

Force and Forceful Exertion

- Forceful exertion increases muscle fatigue and reduces circulation resulting in injury.
- Common problems in laboratories and offices involve hand exertions such as pipetting, opening and closing vials and using excess force when typing.
- Situations that may increase the risk of forceful exertion injury include:
 - Gripping, or pinching an object
 - Handling slippery objects
 - Pressing or striking with fingers or hands
 - Manipulation of or writing on small object
 - Poorly fitting gloves

Forceful Exertion



Extreme Posture Angles and Awkward Postures

- Awkward postures include:
 - Arms raised above elbows
 - Neck bend forward or sideways more than 30°
 - Back bent more than 30°
 - Twisting or reaching
 - Kneeling or squatting



Laboratory Ergonomic Risks

- Pipetting
- Posture
 - chemical fume hoods,
 - biosafety cabinets,
 - bench tops
- Microscopes
- Keyboard/computer work
- Lifting
- Vortex vibrations
- Eyestrain



Tools and Equipment

- Improper Equipment –
 - Furniture and tools are not suited to the task or the individual
- Equipment in poor condition
- Improper placement or furniture and/or tools
- Incorrect use
- Incorrectly installed/sized/adjusted
- Manual rather than powered equipment for large or repetitive tasks



Pipetting Risks

- Repetition
- Force
- Static posture
- Awkward posture
- Pressure points



Biosafety Cabinet and Chemical Fume Hood Risks



- Static posture
- Awkward posture
 - Twisting
 - Reaching
- Pressure points
- Repetition



Microscope Risks

- Static posture
- Awkward posture
- Pressure points
- Repetition



Bench Work Risks

- Static Posture
- Awkward and repetitive tasks
 - Pinching, gripping, twisting
- Vibration



Ergonomics Programs

The Goal of Ergonomics Programs

- Employee Health and Safety
- Employee Awareness
- Injury Prevention
- Regulatory Compliance



The Goal of Ergonomics Programs

- Finding ways to make strenuous, often repetitive work, less likely to cause muscle and joint injuries -- and still get the job done.
- Keeping young bodies from *wearing* out prematurely, and mature bodies from *giving out* early.

Ergonomic Program Benefits

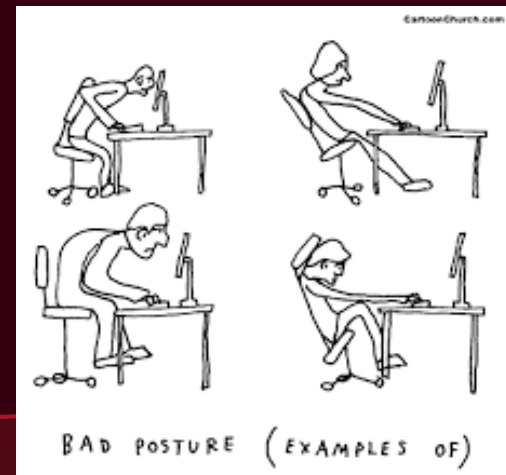
Benefits of Ergonomics Include:

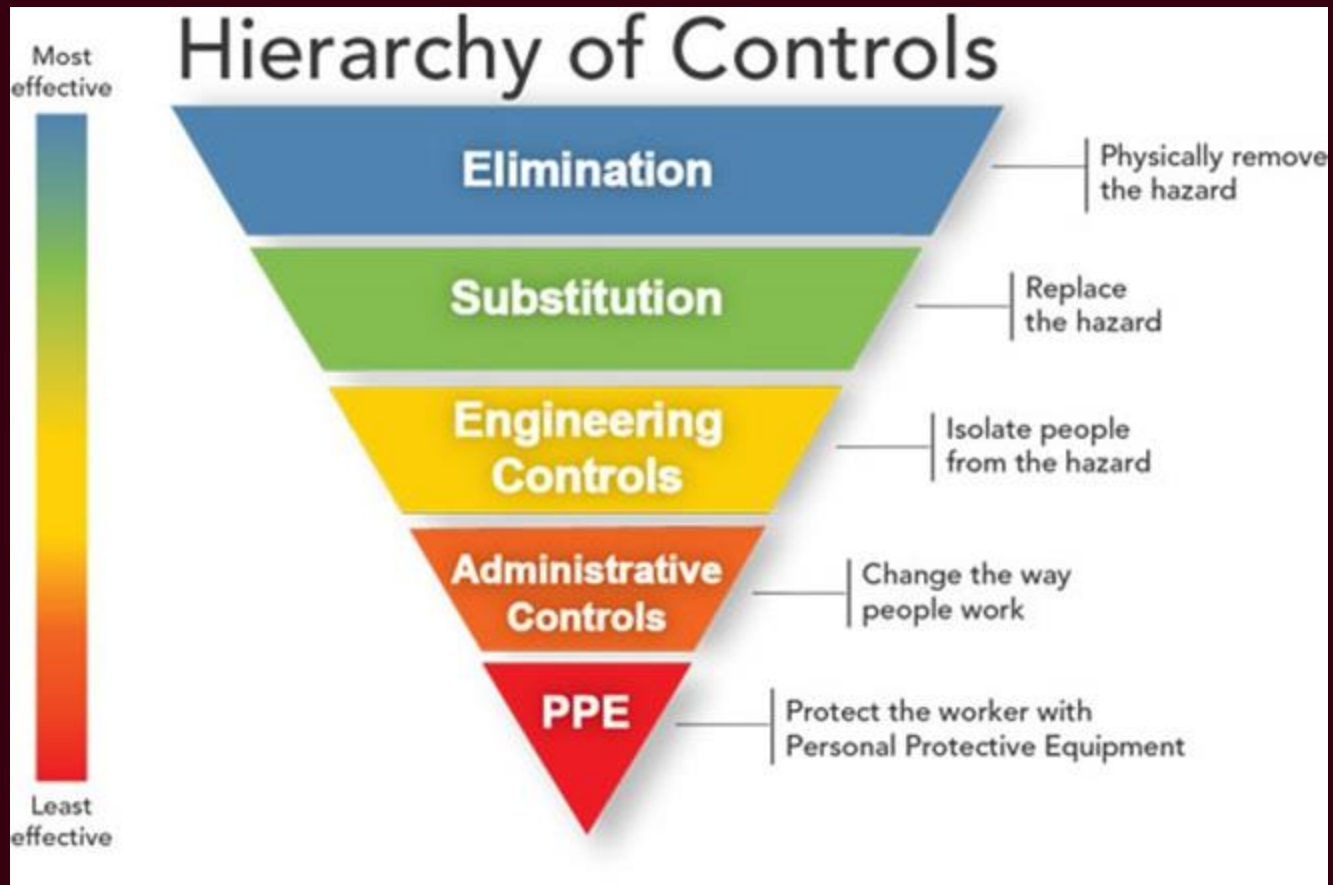
- safer jobs with fewer injuries
- increased efficiency and productivity
- improved quality and fewer errors
- improved morale



Ergonomics Policy

- Define basic ergonomic principles
- Describes recognition of hazards and signs and symptoms of cumulative trauma
- Outlines good ergonomic work practices
- Requires workstation design to follow ergonomics principles
 - Safety review of new workstation design
- Defines ergonomic assessments and evaluations
 - evaluates equipment for ergonomic safety
 - Self assessments
 - Formal assessments to safety personnel
- Requires employees to use proper lifting techniques and posture
- Training requirements
 - at time of hire, annually thereafter
- Encourages early reporting of injuries





Micro-Breaks

- 20:1 Rule
 - For every 20 mins of stagnation (static posture) you should have at least 1 minute of stimulation
 - Can improve productivity
 - Relieve joint and muscle pain
 - Increase overall alertness



Stretching Exercises



SAFE STRETCHING

For each stretch, take a deep breath, count to three, exhale, and repeat the exercise on the opposite side.

UPPER-BODY STRETCHES



SHOULDER ROLL

- Roll shoulders back in a full circle
- Roll shoulders forward in a full circle



NECK STRETCH

- Tilt head to side
- Maintain a long neck
- Extend arm to side for full stretch



ROTATOR CUFF STRETCH

- Place back of hand in center of back
- Reach hand around to touch fingers of hand on back
- Change sides



BACK EXTENSION STRETCH

- Feet shoulder width apart
- Place hands in curve of spine at low back
- Push hips forward, don't tip head back



SHOULDER & CHEST STRETCH

- Feet shoulder width apart
- Clasp hands behind back
- Slightly raise arms until you feel a stretch

MID-BODY STRETCHES



WRIST STRETCH

- Bend wrist forward
- Flex wrist back
- Opposite hand on top to assist with stretch



PALM PRESS STRETCH

- Palms together
- Press & lower until you feel a stretch
- Do not raise shoulders!



SIDE BENDING STRETCH

- Hand one waist, other above head
- Lean to side, focus eyes where neck feels neutral



SIDE TURNING CHEST STRETCH

- Place one hand on opposite hip
- Extend other arm & lean towards wall slightly
- Do not twist body back



CAT STRETCH

- Feet shoulder width apart
- Hands on thighs
- Round back, tucking chin to chest

LOWER-BODY STRETCHES



HAMSTRING

- Bend one knee
- Extend other leg in front of you & sit back until you feel a stretch
- Do not extend bent knee over toe



QUAD

- Support body weight
- Grab ankle of one foot & bend knee
- Keep bent knee close to straight leg



CALF

- Step forward with one leg, bend knee and place hands on thigh
- Back leg is straight
- Lean forward slightly to feel stretch along back leg, back toe pointing straight forward with heel pressing down



HIP FLEXOR

- Legs as far apart as flexibility & balance will allow
- Slight lunge down
- Tuck tailbone under to feel stretch along front of the back hip



INNER THIGH

- Bend one knee while extending other leg to side
- Lean towards bent knee
- Sit back to keep knee from extending over big toe

Insurance coverage is not advice; the only limit is provided by Allstate Life Insurance Company, a duly licensed subsidiary of Western Cooperative Fund, doing business as WCF Insurance, NAIC 4667.

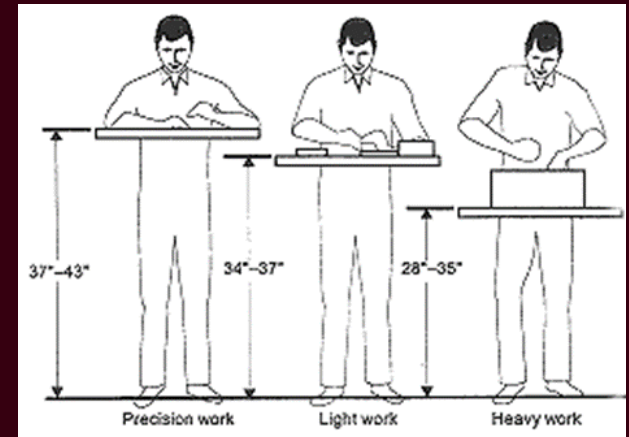
Self Assessment Exercise

CHAIR			
Is your chair properly adjusted?	Yes	No	N/A
Adjust your seat height so that your feet are positioned flat on the floor and fully supported.			
Your knees should be at the same height as your hips.			
Thighs and hips should be parallel to the floor or angled slightly down.			
The lumbar support should make contact with the small curve in your lower back.			
Hands, wrists and forearms should be straight, in-line and roughly parallel to the floor.			
Place shoulders in a relaxed position with upper arms hanging at the side of the body.			
Make sure that you maintain a distance of one to two inches (or two finger widths) between the front edge of the seat pan and the backside of your knees. If the seat pan is too deep, you may need a lumbar wedge or pillow.			
Verify that the seat pan width is adequate by making sure that there are 1-2 inches (or two finger widths) of space between the thigh and the chair edge.			

Ergonomic Solutions

Ergonomic Solutions: Starts with Design

- Facility Design
 - Work stations should be designed to accommodate the full range of required movements of a worker
 - Sufficient space should be provided for the knees and feet
 - Workstations ideally have adjustable heights to accommodate for different types of work and workers
 - Store objects 30" or more above floor
 - Machine controls should be reachable and equally accessible by both right and left-handed operators



Ergonomic Solutions: Tools

- Attention must be given to the selection and designs of the tools used in the workplace to prevent the tools from having a negative effect
 - use automated tools and equipment if available
- Workers should be permitted to test tools in the actual work environment before purchasing new tools
- A variety of tool sizes should be available with consideration to handle sizes, right and left-handed workers, weight, center of gravity, and adequacy for gloved hands

Ergonomic Tool Options



Ergonomics Tools to Consider

- Anti- fatigue mats
- Foot rests
 - For standing and sitting
- Adjustable, supportive chair
- Keyboard tray
- Monitor arms



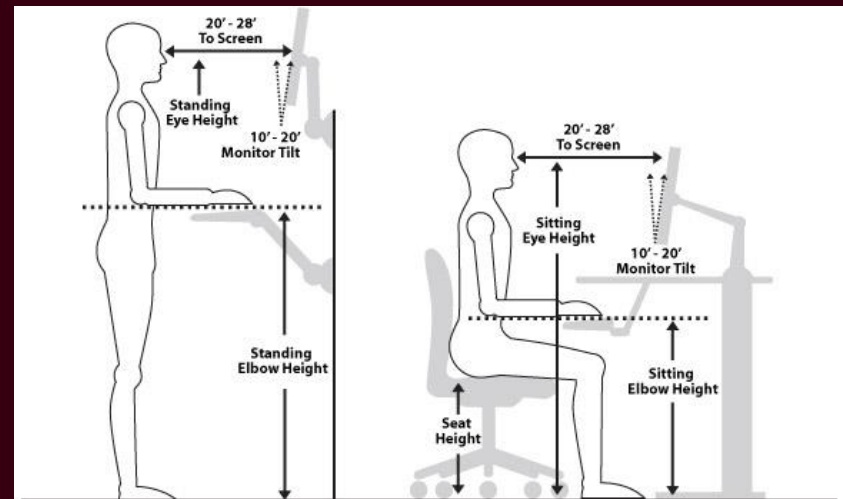
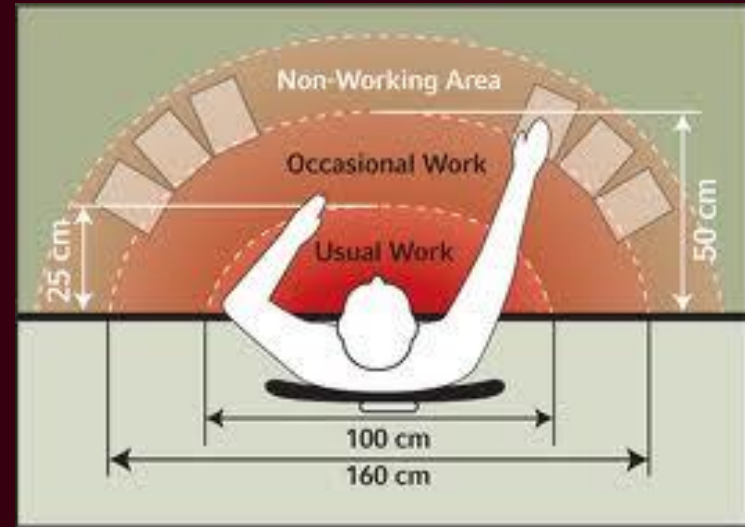
Keyboarding Solutions

- Keyboard trays WITH wrist support
- Flat or negative positioning of keyboard
- Use of a keyboard tray
- Document holder to minimize head / eye & neck movements



Proper Work Station Setup: Lab Bench

- Monitors should be no more than 28 inches from body
- Monitor height should allow eyes to fall within top 2 inches of the screen
- Monitor should be tilted back 10-20°
- Frequently used items should be within 18" or less
- Bench, desk or keyboard tray allows for neutral arm and wrist position



Pipetting Solutions

The following actions can reduce the risk factors associated with pipetting

- Limit continuous pipetting to 20 mins or less
- Take a 2 min stretch break for every 20 mins of pipetting
- Work with arms close to your body
- Keep head not more than 30 degrees forward
- Keep arms low, do not hold arms elevated without support for long periods of time.
- Use light-touch pipettes or electronic pipettes for large volume pipetting.

Pipetting Solutions

- Choose a pipette that:
 - Is light touch for adding a tip
 - Low force on manual thumb plunger and tip ejector
 - Can keep your wrist in a neutral position
 - Choose electronic or multichannel
- Keep elbows close to your body
 - No winged elbows
 - Hand and arm elevation exceeding 12" causes stress to neck and shoulders

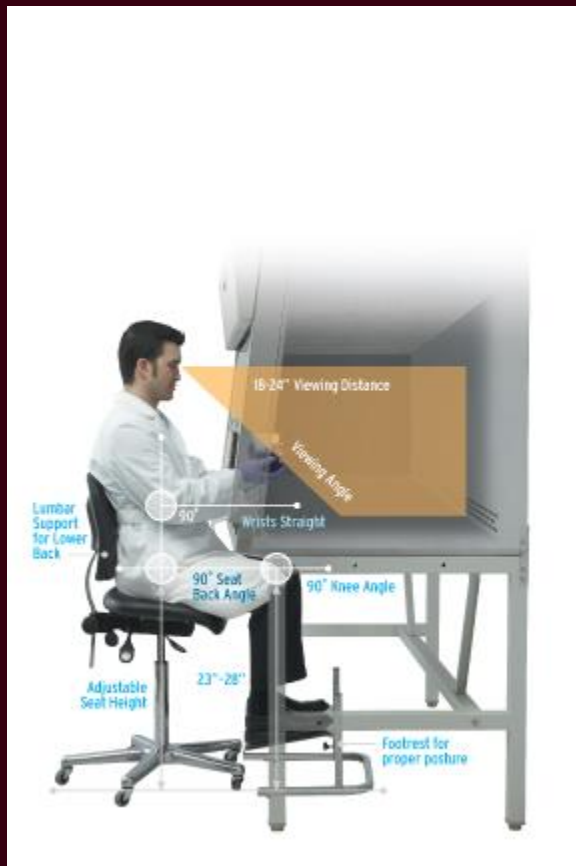


Pipetting Solutions

- Maintain loose and relaxed grip
 - Increases hand strength, endurance and productivity
 - A “clenched” fist increases stress, reduces available hand strength and productivity
- Maintain a straight and neutral position for wrist.
 - Over rotated wrists, exceeding 90 cause stress on wrist, elbows and hand.

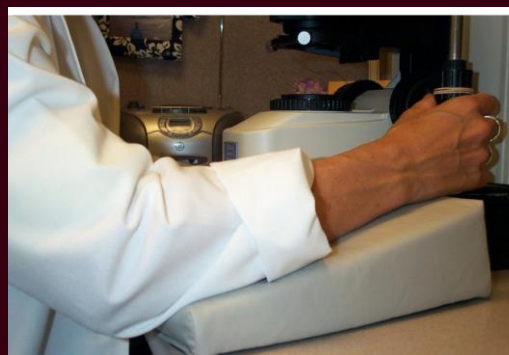
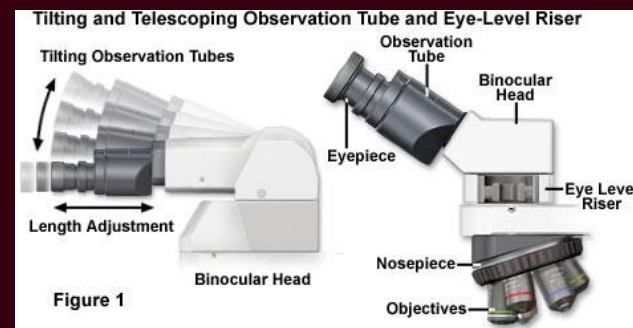


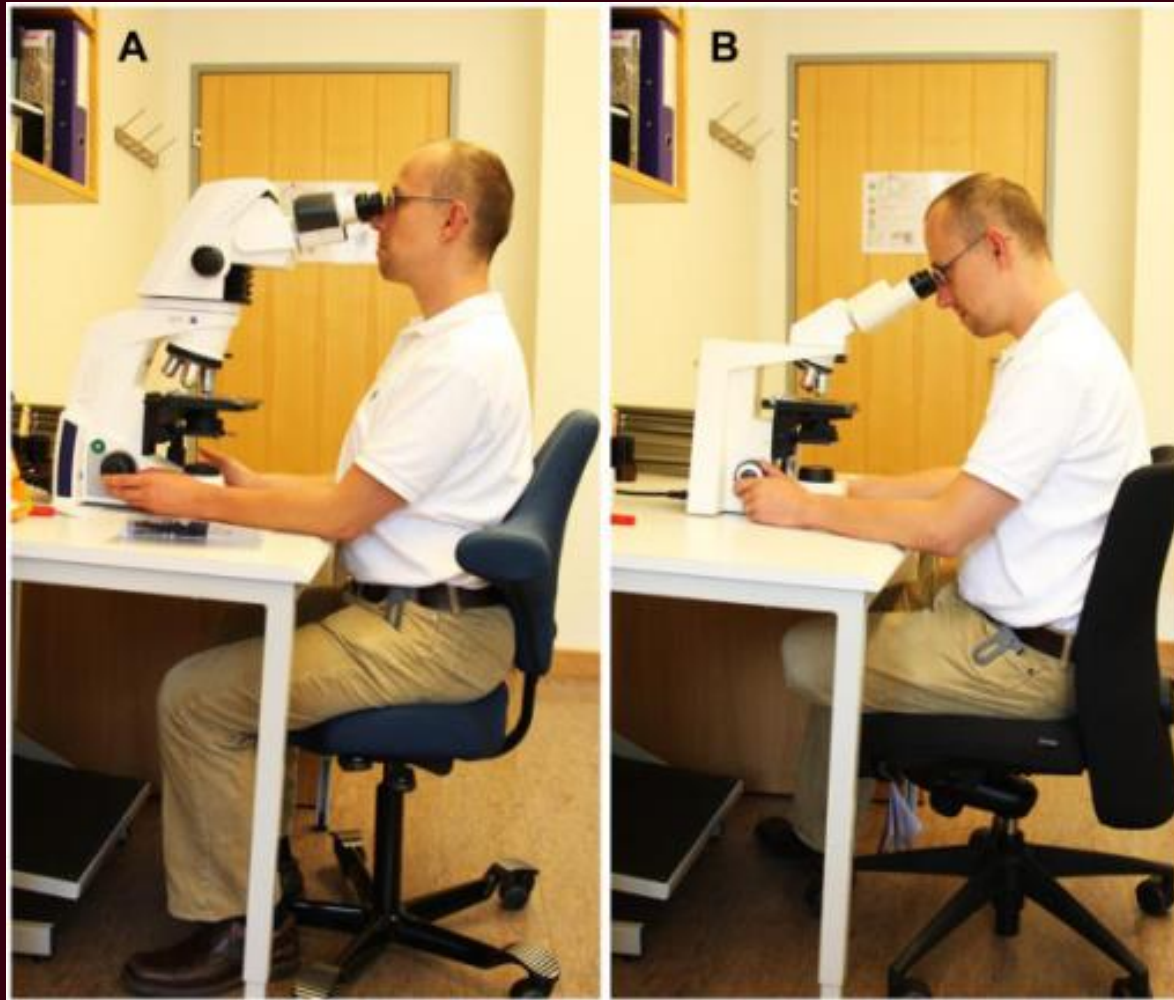
Proper Workstation Set-up: Hood



Microscope Solutions

- Modifications that can be made to existing scope:
 - Lower stage adjustments and fine focus control
 - Tilting and telescoping eye pieces/observation tubes
- Microscope tables and tools
 - Allow closer body position to the scope
- Arm wedges
 - Provide angled arms rests so arms are neutral and supported when using stage adjustments

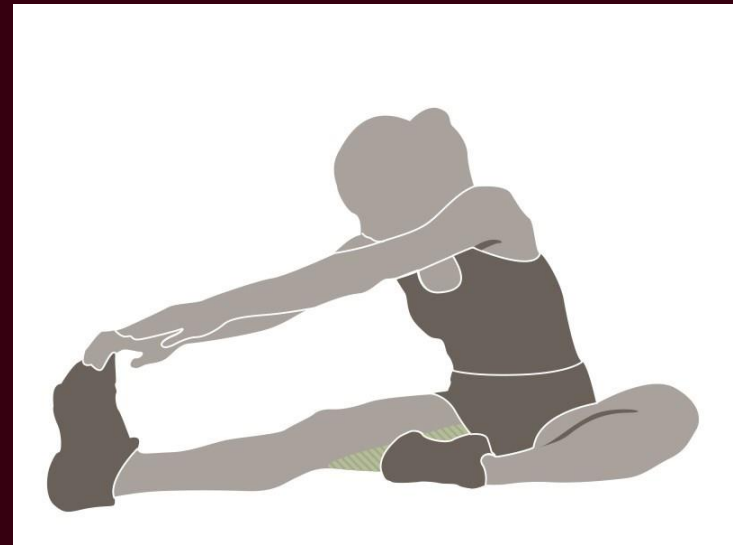




What can YOU do?

Stretch

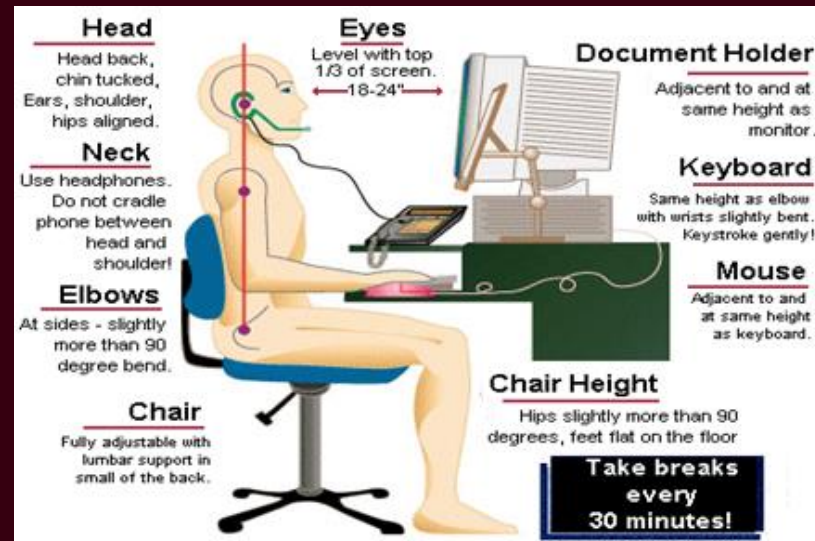
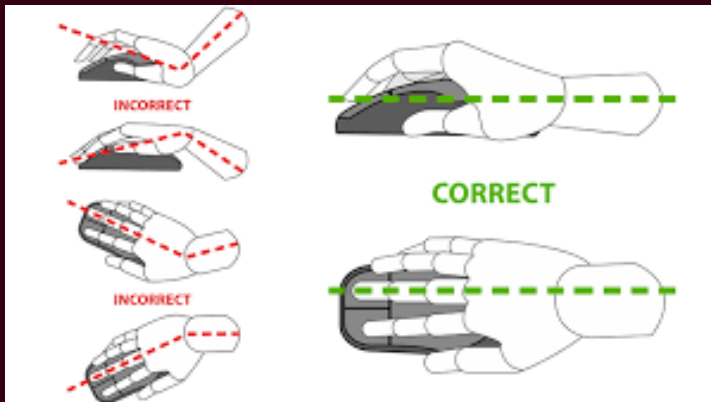
- Prepares muscles to do work
- Flexible muscles not easily injured
- Tight muscles are more easily injured
 - Morning/After Lunch
 - Stress
 - Previous strain/sprain



What can YOU do?

Find Neutral and Comfortable Positions to work in...

- Wrists straight
- Shoulders relaxed with elbows close to body
- Head / shoulders & back in vertical alignment



What can YOU do?

Achieve a Neutral Sitting posture:

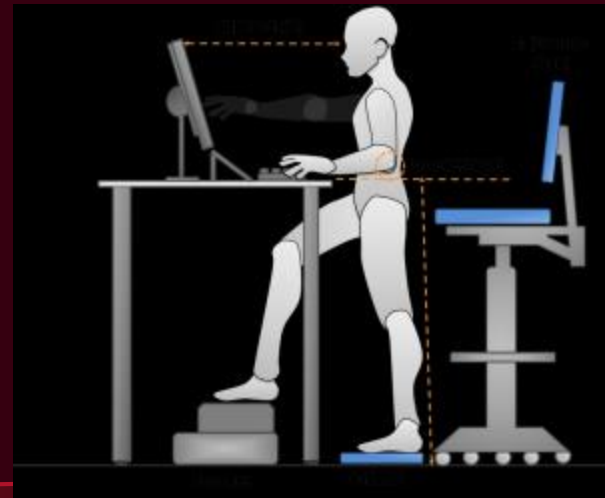
- Sit upright with your elbows, hips and knees bent at just slightly greater than 90° right angles and your feet flat on the floor or on a footrest
 - This position is biomechanically correct, but it can fatigue your back muscles over time
 - Fatigue can lead to slouching, even on a chair with lumbar support



What can YOU do?

Achieve a Neutral Standing Posture

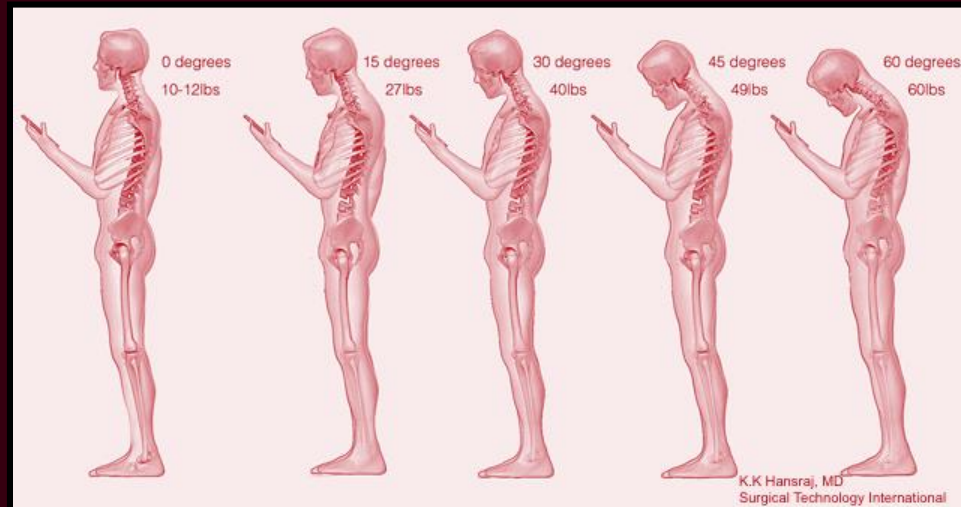
- Standing provides the biggest change in posture, and is a good alternative to prolonged sitting
- Standing can be fatiguing, ideally alternate between standing and sitting positions
- When standing for long periods of time, prop one foot up on a low footrest occasionally to help shift your weight and take pressure off your lower back



Injury Prevention

AVOID being in these work positions for more than 2 hours total per day

- Hands above head
- Elbows above shoulder
- Back bent forward more than 30 degrees
- Neck bent more than 30 degrees
- Squatting
- Kneeling



Injury Prevention

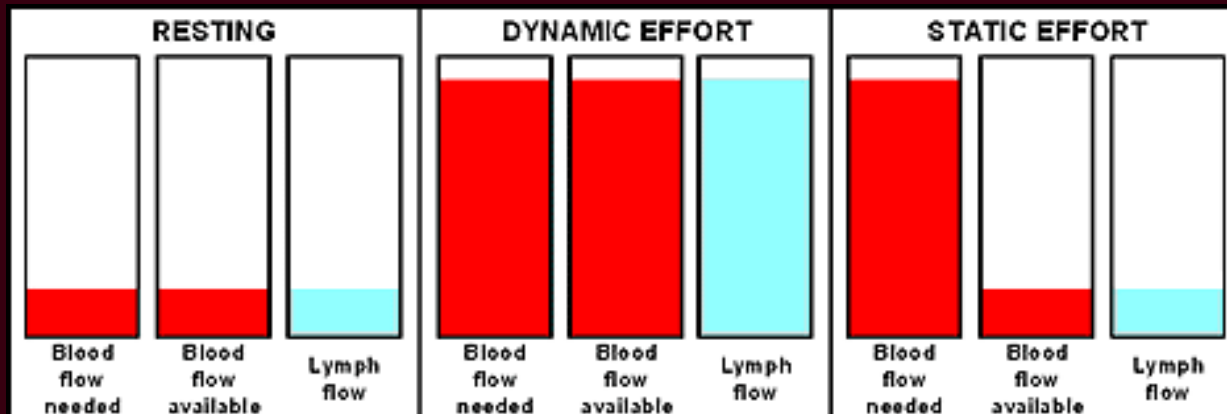
AVOID

- Awkward Postures
- High Hand Force
- Highly Repetitive Motion
- Repeated Impact
- Heavy, Frequent or Awkward Lifting
- Moderate to High Hand-Arm Vibration



Injury Prevention

- MOVE...
 - Eliminate static postures and allow for dynamic movement throughout your work day
 - Get up from your chair
 - Stretch
 - Walk
 - Take micro-breaks



Eliminating Static Postures



Injury Prevention

- Eliminate pressure points
 - Wrists
 - Back of legs
- Set up your work area and activity to minimize or eliminate
 - Twisting
 - Reaching
 - Heavy lifting



Consider Leisure Time Activities



Summary

- Defined Ergonomics
- Discussed musculoskeletal disorders
- Risk Factors in the Laboratory
- Ergonomics programs
- Ergonomic Solutions

Where to find more information

- National Safety Council
- CDC
- OSHA Website
- Dept. of Labor & Industries
- The Internet – general information search



©2018 ARUP Laboratories

ARUP IS A NONPROFIT ENTERPRISE OF THE UNIVERSITY OF UTAH AND ITS DEPARTMENT OF PATHOLOGY.