



The SWEET Deal:

Safe Working Environment Ergonomics Training

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Lecture Objectives

- Main Topics
 - * Ergonomics
 - * Musculoskeletal disorders
 - * Correct working postures
 - * Task-related ergonomic suggestions
 - * Workplace design considerations



Ergonomics

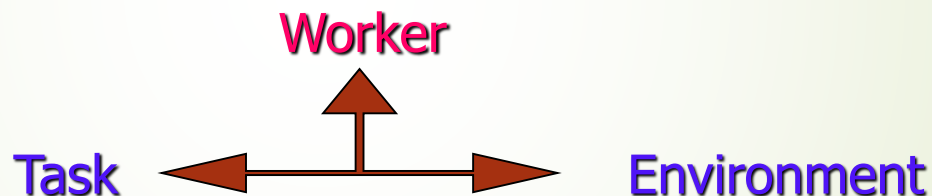
Ergonomics

- The word stems from the Greek language
 - ❑ Ergon meaning work
 - ❑ Nomos meaning laws
- Another name is Human Factors Engineering



Ergonomics

- The One Simple Principle of Ergonomics
 - ❑ Make the task and the environment fit the worker/s, without exceeding their abilities or ignoring their limitations



- The Goal of Ergonomics
 - ❑ To reduce stress and eliminate injuries and disorders associated with the overuse of muscles, bad posture, and repetitive tasks

Ergonomics

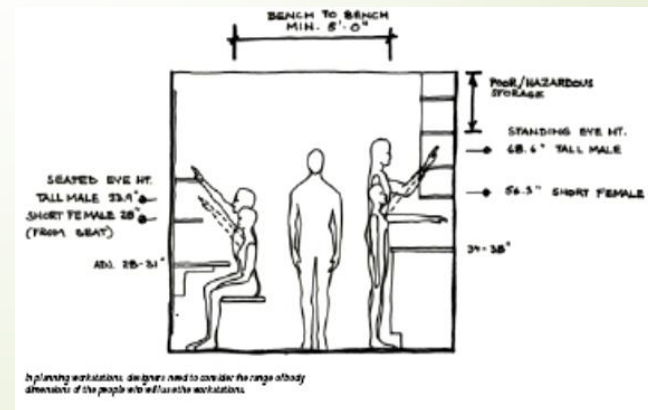
➤ Some of the fields of study

Anthropometrics	Size, shape, dimensions, weight and strengths of people
Biomechanics	Studies of the mechanical forces in human movement
Situational analysis	Social and physical task environment
Preventive medicine	Determine motions or activities that can be substituted for damaging motions

Study of Ergonomics

➤ I. Anthropometrics

- ❑ Defines objective, measurable physical variables, such as a person's size, form and functional capacities
- ❑ Used to evaluate the interaction of workers with tools, machines, vehicles and personal protective equipment to determine the degree of protection afforded against hazardous exposures, whether chronic or acute



Study of Ergonomics

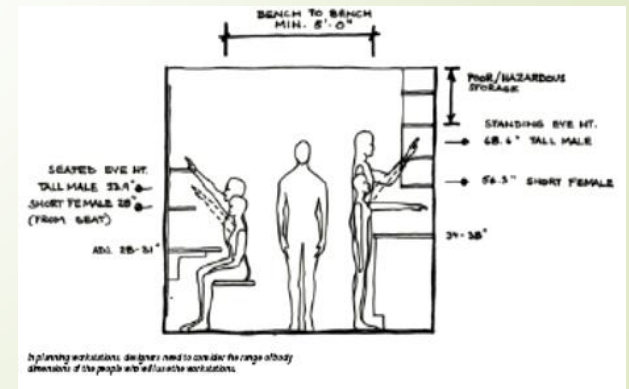
► Anthropometrics

❑ People are different from one another

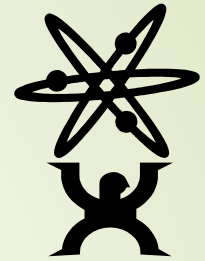
- Bone structure, weight distribution, limb length, body contours and propensity for right or left-handedness

❑ Variations between 5th percentile female to 95th percentile male

- ~13.8" in standing height
- ~7" in sitting height
- ~4.8" from buttock to knee
- ~5.5" elbow rest height
- ~120 lbs. in weight



Study of Ergonomics



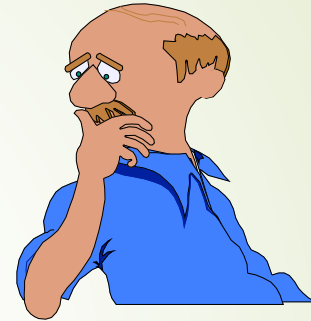
➤ II. Biomechanics (Life Machine)

- ❑ Applies the principles of mechanics and physics to measure the forces in human movement that are exerted by and upon living forms and is used to
 - Establish tolerances
 - Maximize worker's performances
 - Protect the safety and health of the individual
- ❑ Particularly useful when selecting equipment and tools and justifying the need for automation

Study of Ergonomics

➤ Biomechanical Risk Factors

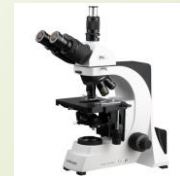
- ❑ Excessive force
- ❑ Repetitive motions
- ❑ Awkward postures
- ❑ Vibration



Biomechanical Risk Factors

➤ Excessive Force

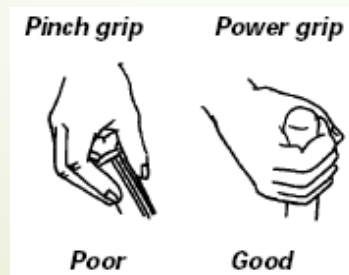
- ❑ It is possible to be totally unaware of the amount of force being used to perform a routine task
 - Opening specimen jars, bottles and cassettes
 - Squeezing dispensers or squirt bottles
 - Using tools, such as forceps or scalpels
 - Turning microtome and cryostat handwheels or microscope controls



Biomechanical Risk Factors

► Excessive Force

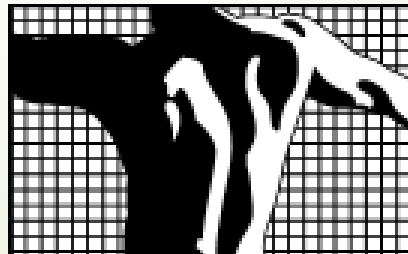
- ❑ Gripping is a combination of a force with a posture
 - The risk of injury is influenced by the
 - Size of the hand
 - Size of the object
 - Exertion used to manipulate the object
- ❑ A pinch grip requires much greater force than a power grip



Biomechanical Risk Factors

► Excessive Force

- ❑ Using high amounts of force has been associated with musculoskeletal disorders at the
 - Forearm/wrist/hand
 - Shoulder/neck
 - Lower back
- ❑ Whenever possible, use the largest appropriate muscle groups available to perform tasks requiring force



Biomechanical Risk Factors

➤ Repetitive Motions

- ❑ What task ISN'T repetitive in your working environment?



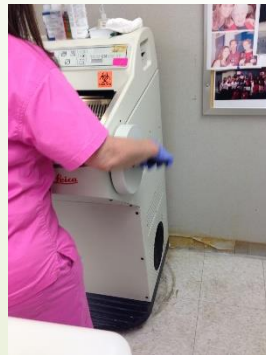
...from order entry to microscopic examination...

Biomechanical Risk Factors

➤ Repetitive Motions

❑ High Risk Repetitious Tasks

- Have very short “duty cycles” (activities that take less than 30 seconds to perform once)
- Are performed for a large component (>50%) of a worker's day

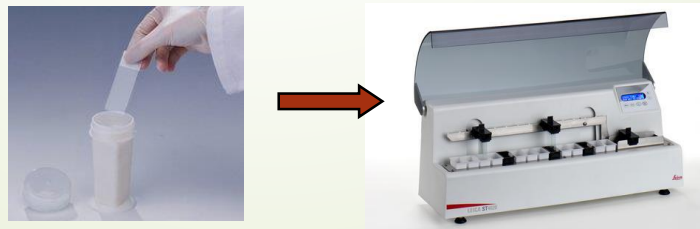


Biomechanical Risk Factors

► Repetitive Motions

- ❑ To reduce the ill effects of repetitious tasks
 - Alternate duties
 - Take mini breaks (15 seconds to 2 minutes every 20-30 minutes)
 - Do strengthening exercises and self massage
 - Request a professional evaluation of tasks and work habits

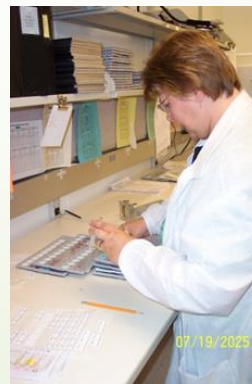
❑ Automate wherever possible!



Biomechanical Risk Factors

► Awkward Working Postures

- ❑ Posture determines which muscle groups are used during physical activity
- ❑ Humans will override instinct, pain and discomfort to accomplish a perceived goal
- ❑ Humans will also invent new movements and postures, some of which are not always good choices



Biomechanical Risk Factors

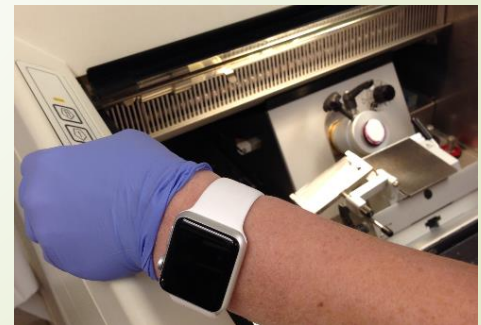
- Awkward working postures associated with injury

Wrist	Repeatedly bending up/down and in/out
Shoulder/Arms	Holding upper arms out to the side or above shoulder level; having slumped shoulders or elbows winged out
Neck	Holding the head when it is tilted backward or the neck is forward or bent to the side
Lower back	Excessive bending/twisting at waist, especially when lifting or with sudden movements

Biomechanical Risk Factors

- Biomechanical risk factors are further characterized by:
 - ❑ Frequency (how often is the task done)
 - ❑ Repetition (how many times do you do the task)
 - ❑ Duty cycle (how long does the task take)
 - ❑ Duration of exposure (over what time period do you perform the task)

The degree of risk is proportionate to the combination of all of the risk factors



Study of Ergonomics

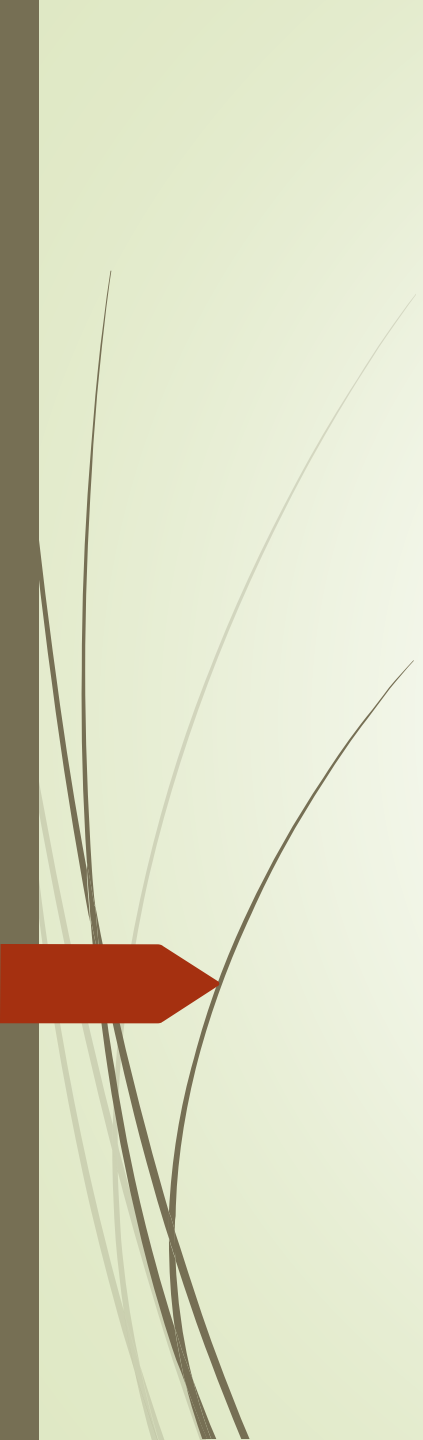
➤ III. Situational Analysis

- ❑ Explores the psychological, social and physical task environment
 - How work is organized and carried out (total time worked per shift, extended hours, pace, and length of uninterrupted periods of work)
 - Quality of training
 - Physical conditioning
 - Cognitive or emotional stresses (job demands, security, satisfaction)
- ❑ Stressed, exhausted or unhappy workers make more mistakes and incur more accidents and injuries

Study of Ergonomics

➤ IV. Preventive Measures

- ❑ Includes determining and implementing motions and activities that can substitute for damaging ones
- ❑ Identifying aggravating factors
 - May not always be evident to the worker
 - They almost always involve
 - Working in extreme joint positions at angles that amplify biomechanical forces
 - Using highly repetitive movements without allowing time for rest and healing
- ❑ Almost always involves changes in work habits...



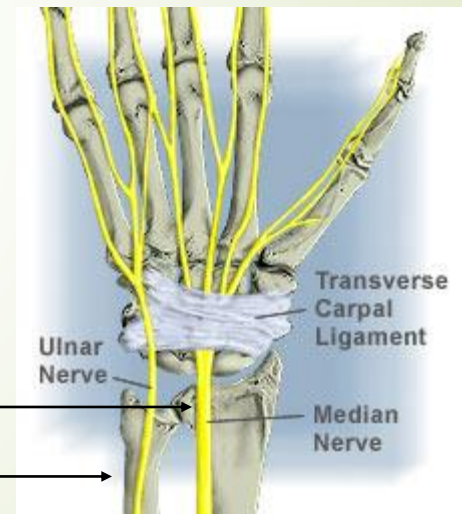
* Musculoskeletal Disorders (MSD)

They are sometimes confused with ergonomics, but they are actually the problem and ergonomics is the solution!

MSD

➤ Common MSD Classifications

- ☐ Ganglion Cysts (Bible Bumps)
- ☐ Tendinitis
- ☐ Tenosynovitis
- ☐ DeQuervain's
- ☐ Trigger Finger
- ☐ Shoulder Tendinitis
- ☐ Forearm Tendinitis
- ☐ Carpal Tunnel Syndrome
- ☐ Ulnar Nerve Disorders
- ☐ Thoracic Outlet Syndrome
- ☐ Raynaud's Disease

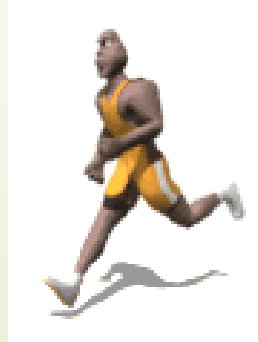


MSD

➤ Off Hours Activities

❑ “Background” rate of occurrence in the general population can be caused by

- Predispositions
- Sports (tennis, golf, basketball, etc.)
- Hobbies (carpentry, gardening, sewing, etc.)
- Driving
- Position of the hands while sleeping



MSD

➤ Warning Signs

- ☐ Pain (may or may not have), burning, aching, or shooting
- ☐ Fatigue (the body's way of sending a distress signal) or lack of endurance
- ☐ Weakness in hands or forearms
- ☐ Tingling, numbness, loss of sensation
- ☐ Clumsiness, stiffness, heaviness
- ☐ Difficulty using hands
- ☐ Lack of control or coordination
- ☐ Cold hands or fingertips
- ☐ Frequent self massage



MSD



➤ Actions to Avoid

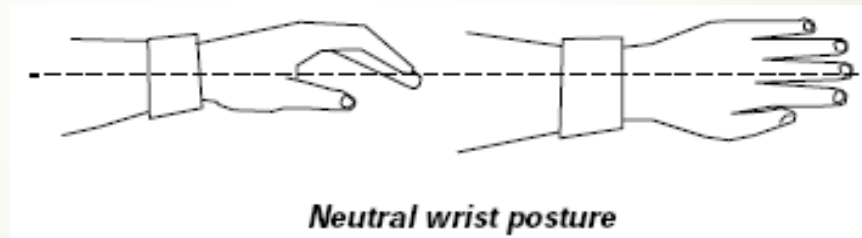
- ☐ Poor posture
- ☐ Resting wrists on hard or sharp work surfaces
- ☐ Holding thumb or little finger up
- ☐ Using forceful actions
- ☐ Reaching too high or far
- ☐ Repeated radial deviation
- ☐ Hands held too long in dorsiflexion
- ☐ Excessive finger motion or gripping
- ☐ Elbows raised or bent at right angles
- ☐ Excessive up and down wrist & finger movement



*Correct Working Postures

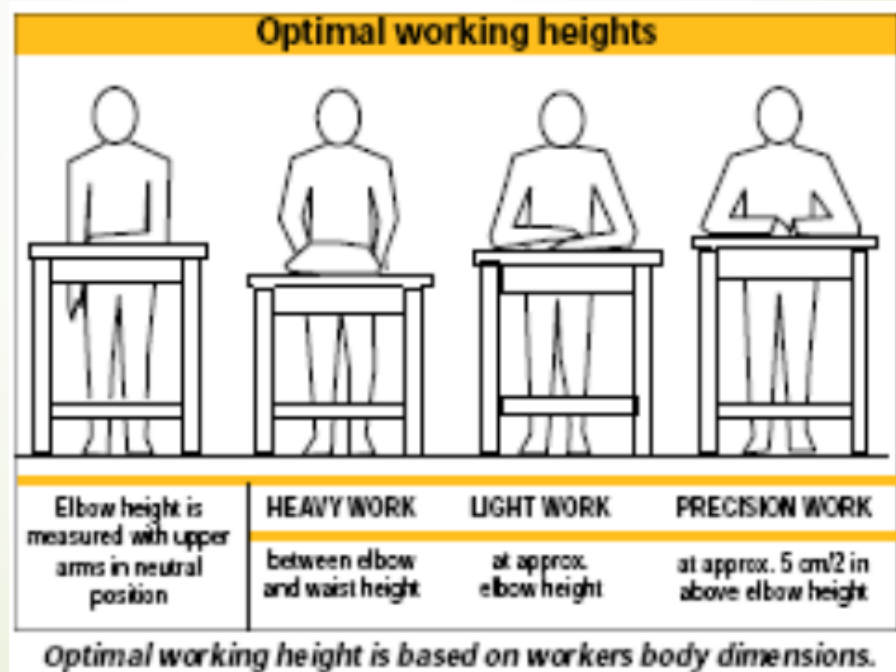
Correct Working Postures

- ▶ Tasks should be performed with joints at about the mid-point of their range of motion (neutral position)



Correct Working Postures

- The correct work height (not counter height) will vary depending on the type of work being done



Correct Working Postures

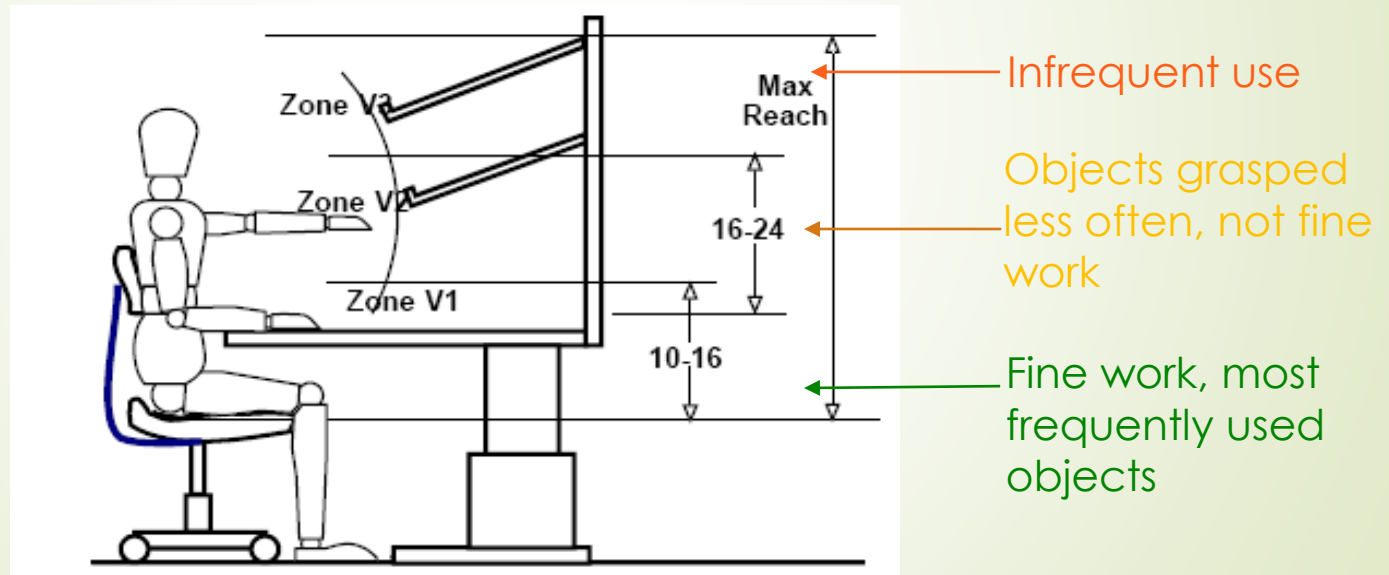
➤ Reach Zone (Comfort Zone)

- ❑ The area right in front of us where we
 - are the strongest
 - have the best dexterity
 - have the best visual acuity
 - can work in neutral postures



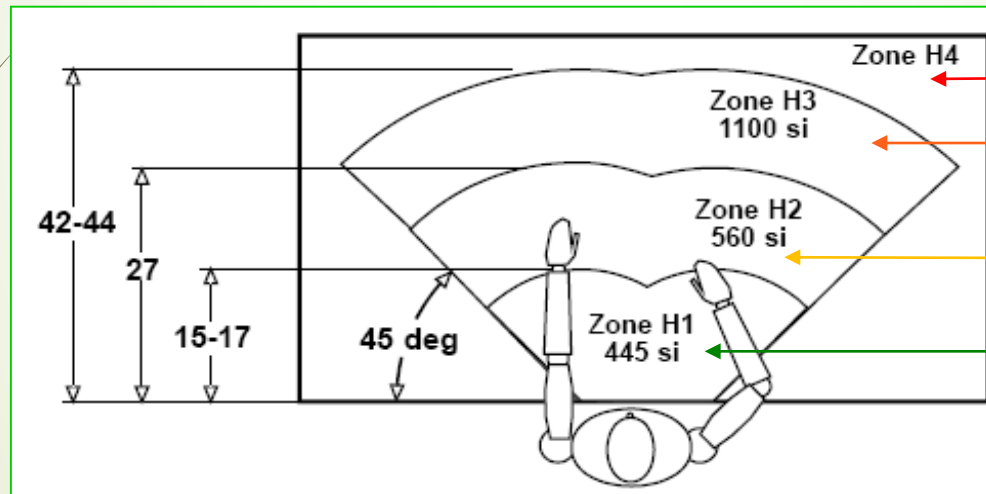
Correct Working Postures

➤ Vertical Reach Zone



Correct Working Postures

► Horizontal Reach Zone



Rare use

Infrequent use

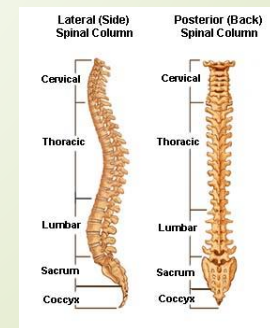
Objects grasped less often, not for fine work

Fine work, most frequently used objects

Correct Working Postures

► Standing

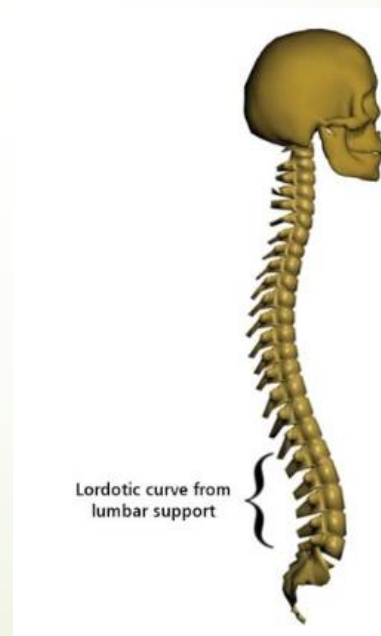
- ❑ Stand with your back's natural curves in their normal, balanced alignment (avoid a swayback)
 - When properly aligned, ears, shoulders and hips are in the same plane
- ❑ Stand with one foot up; change positions to shift weight often
- ❑ Walk with good posture, keeping the head high, chin tucked in, and toes straight ahead
- ❑ Wear supportive, low heeled shoes
- ❑ Use cushioned mats



Correct Working Postures

➤ Sitting

- ❑ The back's natural curves allow us to stand upright with minimal muscle activity—but sitting is a different story



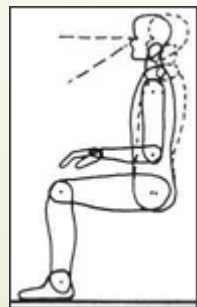
Correct Working Postures

- Sitting recommendations
 - ❑ Use a chair that provides good back support and sit against the back of the chair
 - ❑ If your feet cannot rest flat on the floor, lower the chair, adjust the foot ring or get a footrest

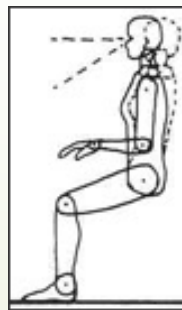


Correct Working Postures

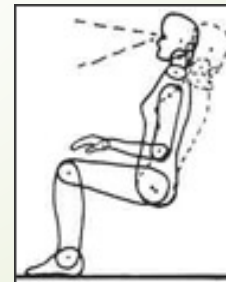
90° angle



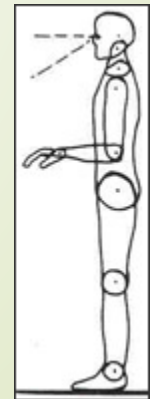
Declined



Reclined



Standing



Correct Working Postures

- One of the greatest gifts you have is the ability to make positive changes in your life ... so start making yourself feel better!
 - ❑ Request an ergonomic evaluation of your movements
 - If no one can do it, evaluate your movements using a full length mirror or make a video of yourself
- Pay attention to what your body is telling you
 - ❑ Subtle signs are early indicators that need immediate attention
 - ❑ Not-so-subtle signs indicate a larger problem



*Task Related Ergonomic Suggestions

Task Related Ergonomic Suggestions

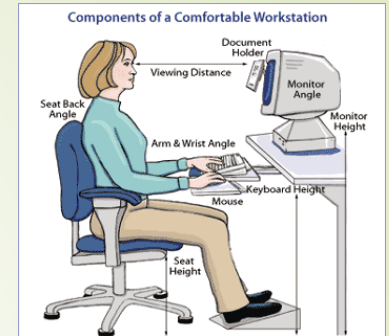
► Some High Risk Tasks

- ❑ Computer data entry
- ❑ Mapping, grossing, and inking specimens
- ❑ Manual cryotomy/microtomy
- ❑ Manual staining
- ❑ Manual coverslipping
- ❑ Microscopy

Task Related Ergonomic Suggestions

► Computer Data Entry

- ❑ Maintain correct sitting position
- ❑ Use adjustable keyboard platform under lab bench that will accommodate the mouse beside the keyboard
- ❑ Keep wrists in neutral position, floating above keyboard, and rest on cushioned surface only when not typing
- ❑ Place monitor so viewing distance is between 18"-20" with the top of the screen at eye level
- ❑ Use a document holder to place documents in the same plane as the computer screen



Task Related Ergonomic Suggestions

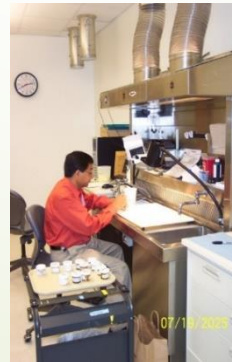
► Computer Data Entry

- ❑ Use an appropriate keyboard and mouse
- ❑ Use a gentle touch, do not bang, keep fingers curved
- ❑ Do not hold thumb or pinkie in the air
- ❑ Don't cradle phone on shoulder when keyboarding
- ❑ Beware when using bifocals or progressive lenses
- ❑ Adjust light sources to eliminate reflections and glare
- ❑ Take mini-breaks and do mild hand exercises/stretching
- ❑ Do not do keyboarding activities without a break to let hands recover



Task Related Ergonomic Suggestions

- Mapping, grossing and inking specimens
 - ❑ Maintain proper sitting position
 - ❑ Create an ergonomic workstation that permits working within comfortable reach zones
 - ❑ Use sit/stand seating for frequent movements
 - ❑ Use ergonomic tools (forceps, scissors, scalpels, etc.)
 - ❑ Have excellent lighting



Task Related Ergonomic Suggestions

► Microtomy/Cryotomy

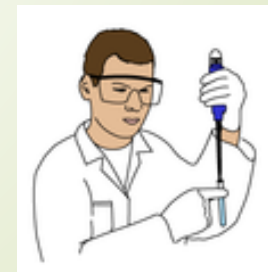
- ❑ Maintain good posture when either sitting or standing
- ❑ Protect hands from cold temperatures that can reduce feeling and sensitivity
- ❑ Do not lean into the chamber or stretch to reach things
- ❑ Do not rest forearms on any surfaces while actively working
- ❑ Use whole arm to make complete revolutions of the handwheel **DO NOT ROCK THE HANDWHEEL!!!**
- ❑ Keep arms close to your body with elbows in
- ❑ Keep shoulders and neck relaxed
- ❑ Take mini breaks, exercise and do self massage
- ❑ **Automate if possible!**



Task Related Ergonomic Suggestions

► Manual staining

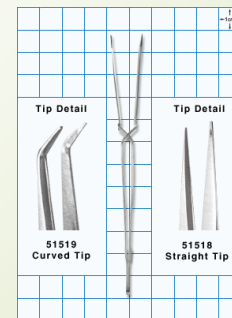
- ❑ Avoid repeatedly dipping slides
- ❑ Use a slide holder to stain in coplin jars to avoid forceps
- ❑ Avoid squeezing small reagent bottles and squirt bottles
- ❑ Allow time for hands to recover when doing pipetting
- ❑ Be aware of reach zone, use caution in getting materials from underneath counter or overhead shelves
- ❑ Prop one foot up or stand with one foot forward and alternate feet often
- ❑ **Automate if possible**



Task Related Ergonomic Suggestions

► Manual Coverslipping

- ❑ Avoid static postures; take multiple mini breaks and do stretching exercises
- ❑ Alternate tasks
- ❑ Use forceps that do not require force to hold an object
- ❑ Do not rest arms on countertop
- ❑ Maintain a neutral wrist position (not in dorsiflexion)
- ❑ Be aware of head/neck position
- ❑ **Automate if possible**



Task Related Ergonomic Suggestions



➤ Microscopy

- ❑ Avoid static postures – get up and stretch every 30 minutes
- ❑ Sit close to the work surface (cut-out benchtop is ideal)
- ❑ Work with head upright
- ❑ Adjust chair, work surface or microscope as needed
- ❑ Close the eyes or focus on something in the distance every 15 minutes
- ❑ Keep elbows close to sides
- ❑ Focus and stage movement controls should be within your reach
 - If controls are not within reach, use an inclined soft pad to elevate forearms so they can be easily reached

General Ergonomic Laboratory Work Recommendations

► A Brief Review

- ❑ Sit close to the work area and keep all necessary objects within the near reach zones
- ❑ Work with joints in a neutral position
- ❑ Keep shoulders relaxed and elbows close to sides
- ❑ Avoid repetitive or forceful motions
- ❑ Select ergonomic furniture and equipment
- ❑ Select ergonomic tools that are lightweight and the right size for the operator's hands
- ❑ Do not rest hands or arms on sharp, hard surfaces
- ❑ Use thin, flexible gloves that fit properly
- ❑ Add cotton gloves covered by non-latex gloves for added warmth



* Workplace Design Considerations

Workplace Design Considerations

- Invest in an ergonomic chair that is task supportive and appropriate for YOUR body

- Considerations

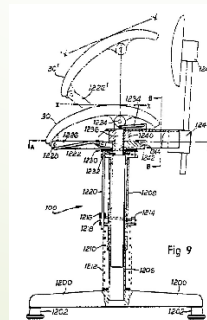
- Adjustment controls
 - Seat height, depth, width and angle
 - Backrest height, support contour and adjustments
 - Armrest height, length and distance between
 - Swivel
 - Base
 - Castors and glides
 - Upholstery



Workspace Design Considerations

➤ Alternative seating

- ❑ All the rules change when work is spread out, in the far reach zone or there is no leg room
 - Higher chairs make moving easier
 - Getting up and down is hard on the body
 - Sit/stand seating might be preferable



Workspace Design Considerations

➤ Foot rests

❑ Use a foot rest if you

- Sit with your feet on the chair base
- Sit forward in chair to get feet to reach the floor
- Only work in near reach zone
- Don't need to move from place to place

❑ Features

- Height and tilt adjustable
- Tread to keep from slipping



Workplace Design Considerations

► Height adjustable work stations

□ Lower work surfaces

- Accommodate high profile or top loading equipment
- Eliminate step stools and awkward working positions

□ Higher work surfaces

- Reduce awkward working positions
- Increase leg space when seated





* Conclusion

Conclusion

- Solving ergonomic issues is a shared responsibility between the employee and the employer



Conclusion

➤ Employers

❑ Provide a safe working environment

- Minimize job stress and moderate the work pace
- Encourage task rotation and employee fitness
- Assist workers by facilitating ergonomic assessments of working postures and motions
- Provide continuing education about ergonomics and other safety related topics
- Allow workers to feel free to offer suggestions without fear of repercussion

Conclusion

➤ Employees

- ❑ Contribute to safe work performance in a non-threatening way
 - Study and practice the principles of proper body mechanics
 - Accept recommendations for safe work methods
 - Be willing to replace bad habits with safer ones
 - Report potential MSD symptoms as soon as they are noticed and make helpful suggestions for eliminating the source of the problem
 - Keep current on ergonomic instrumentation and techniques and inform coworkers and management of their potential to decrease MSD

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- Herman, G. E., Elfont, E. A., Genaw, C., Leone K., Elfont, D.M. and Boback, A.M. (1995) *Histologists, Microtomy, Chronic Repetitive Trauma, and Techniques to Avoid Injury: Part I. A Statistical Evaluation of the Job Functions Performed by Histologists*, Journal of Histotechnology, Vol. 18, No. 2, June 1995. pp. 139-143.
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- *Prevention of Musculoskeletal Symptoms Among Histotechnologists by using Ergonomics And Biomechanical Analysis*; Kothiyal, Kamal and Said, Bassam; School of Safety Science, University of New South Wales / Sydney NSW 2052 / Australia <http://www.prevencionintegral.com/canal-orp/papers/orp-2002/prevention-musculoskeletal-symptoms-among-histotechnologists-using>
- Nikon (ergonomics for microscope users) <http://www.microscopyu.com/articles/ergonomics/ergointro.html>
- Allsteel Ergonomics and Design Reference Guide White Paper <http://www.allsteeloffice.com/SynergyDocuments/ErgonomicAndDesignReferenceGuideWhitePaper.pdf>

References

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<https://www.osha.gov/Publications/laboratory/OSHAfactsheet-laboratory-safety-ergonomics.pdf>
- ❑ CDC – Work-Related Musculoskeletal Disorder Prevention
<http://www.cdc.gov/workplacehealthpromotion/implementation/topics/disorders.html>
- ❑ Department of Defense Ergonomic Working Group
<http://www.ergoworkinggroup.org/>
- ❑ CDC – Ergonomics and Musculoskeletal Disorders
<http://www.cdc.gov/niosh/topics/ergonomics/default.html>
- ❑ CDC/NIOSH -- Musculoskeletal Disorders and Workplace Factors <http://www.cdc.gov/niosh/docs/97-141/>
- ❑ CDC – Anthropometry
<http://www.cdc.gov/niosh/topics/anthropometry/>

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► Website References for ergonomic seating information

- ❑ The Ergonomic Seating Guide Haworth
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- ❑ Humanscale (Ergonomic design company)
<http://www.humanscale.com/>
- ❑ Nottingham Sit/Stand Seating
<http://nottinghamchair.com/>
- ❑ Human Solution (Ergonomic chairs) BizChair (Laboratory)
<http://www.thehumansolution.com/ergonomic-chairs.html>

Thank you for
attending the
SWEET Deal ...

Do you have any questions





* High-Risk Areas in The Laboratory

There are a lot of them...

High-Risk Areas in The Laboratory

- Two surveys of Histology Personnel have been taken
 - ❑ The First Survey of Histology Personnel, USA—1995
 - 253 out of 1000 questionnaires were completed and Returned
 - 157 with pain potentially related to MSD
 - 22 with a clinical diagnosis of carpal tunnel syndrome (CTS)
 - 36 with a clinical diagnosis of MSD other than CTS
 - 27 under physicians care with no specific diagnosis
 - 63 experienced pain but had not sought medical attention

Published in the Journal of Histotechnology, Vol. 18, No. 2, June 1995, pp. 139-143

High-Risk Areas in The Laboratory

➤ Conclusions of the U.S. Survey

❑ Carpal tunnel syndrome implications

- Manual coverslipping
- Computer data entry

❑ MSD other than carpal tunnel syndrome implications

- Manual embedding
- Computer data entry

❑ Manual microtomy

- Associated with pain (especially by individuals using poor posture and non-ergonomic techniques)
- No direct association in clinically proven CTS
- Possible correlation with other physician-diagnosed MSDs

High-Risk Areas in The Laboratory

- The Second Survey —Australia — 2002
 - ❑ This survey was more comprehensive
 - Personal and Employment details
 - Task details and perceived associations with MSD
 - MSD/symptoms
 - General health and free comments
 - ❑ 100/170 questionnaires were completed and returned
 - (60 females 40 males)
 - ❑ 63% of respondents complained of MSD symptoms

High-Risk Areas in The Laboratory

The Australian Survey reported the following symptoms...

Females

71.7%-MSD

57% had up to 4 symptoms

46.7% neck

46.7% right shoulder

38% low back

31.7% left shoulder

30% wrist

20% fingers

Males

50%-MSD

37.5% had up to 4 symptoms

40% neck

17.5% right shoulder

27.5% low back

5% left shoulder

20% wrist but 3x as many elbow

7.5% fingers

On average, females cut and embedded more than their male counterparts

High-Risk Areas in The Laboratory

➤ What else did the Australian Survey Say...

☐ Relationship of task to symptom

- Blocks cut/day—lower back, hands and fingers
- Hours/day doing microtomy—left shoulder
- Years doing microtomy—elbow
- Number of cassettes embedded/day—left shoulder
- Number of blocks/session—wrist

High-Risk Areas in The Laboratory

➤ Conclusion of Australian Survey

- ❑ The amount of time spent doing microtomy related tasks significantly affected the symptoms of the upper limbs
- ❑ Many routine tasks are related to MSDs
- ❑ MSD could be reduced by having
 - Better job and workstation design
 - A reduction in time spent doing microtomy
 - Proper task allocation and training