



# ERGONOMICS PROGRAM

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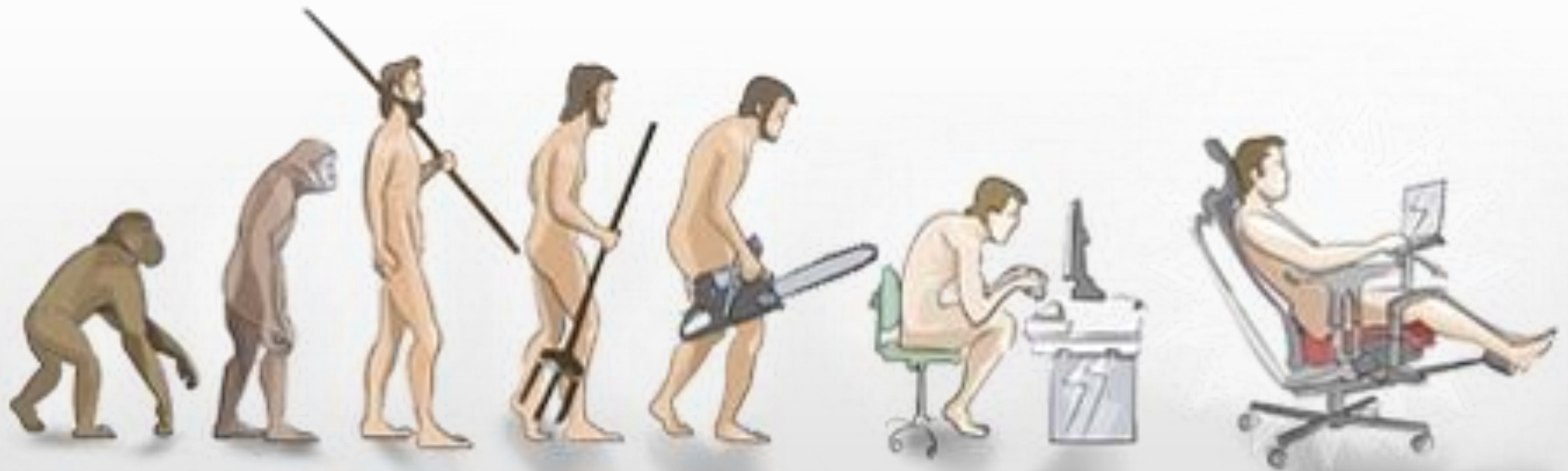
Chapter II

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## Common Definitions

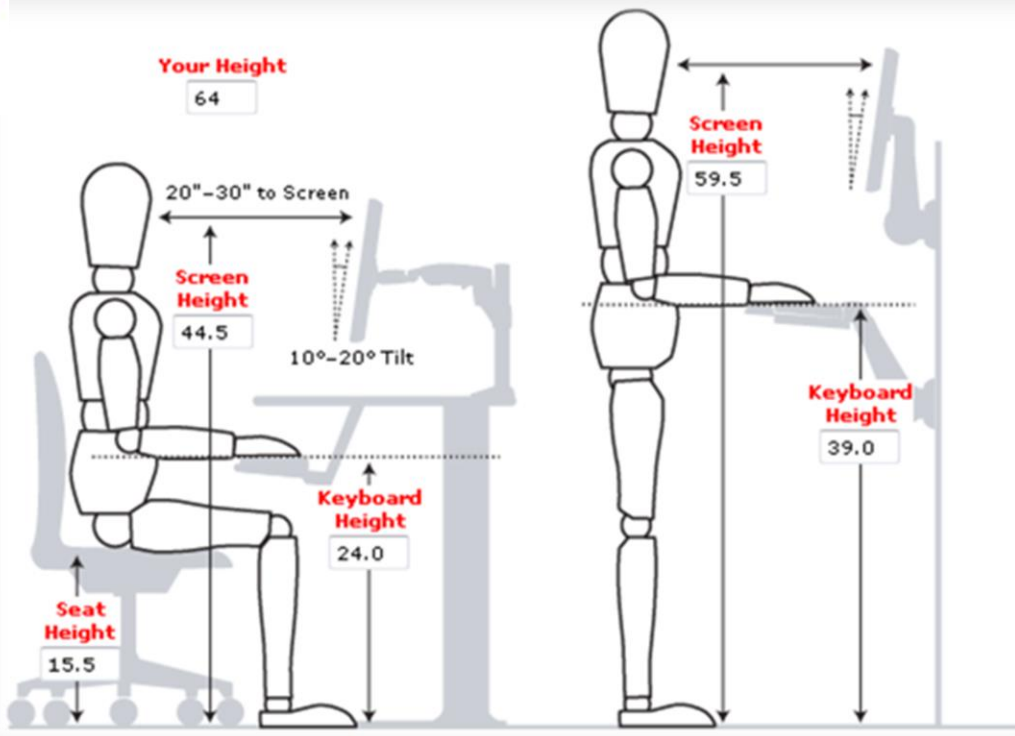
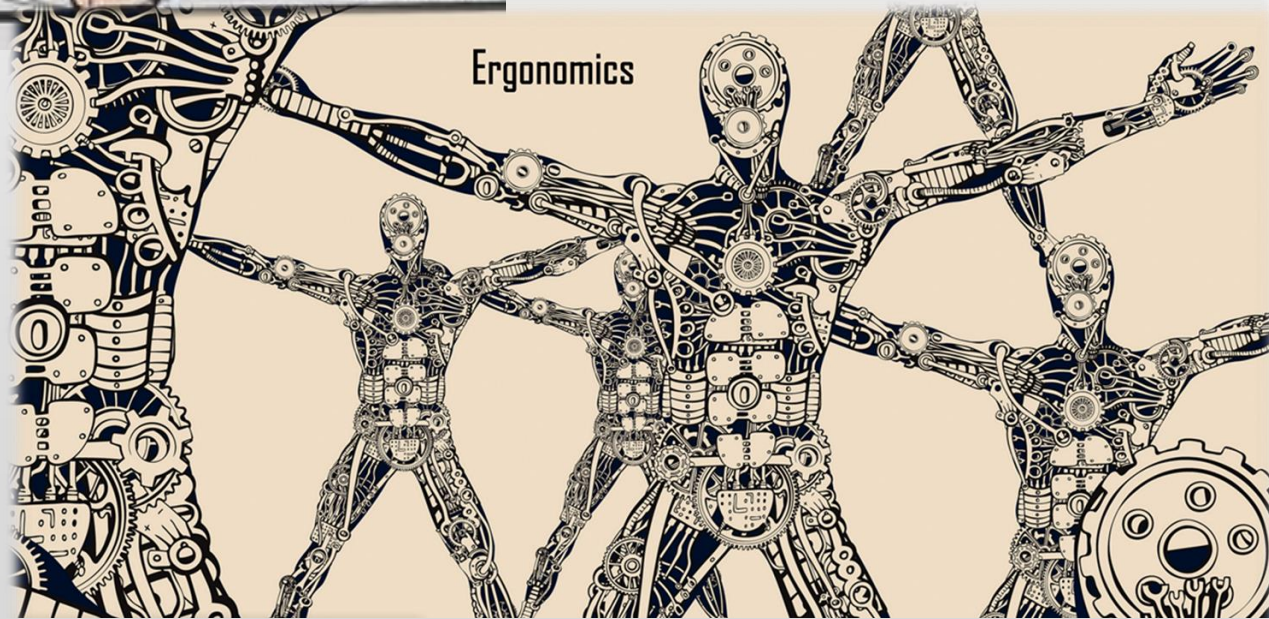
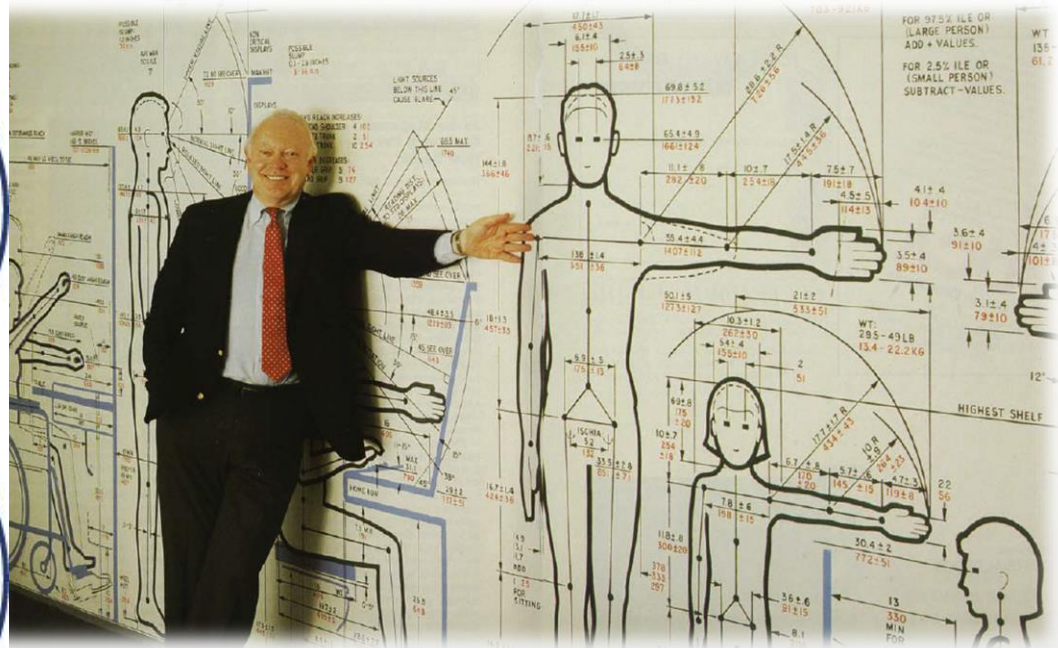
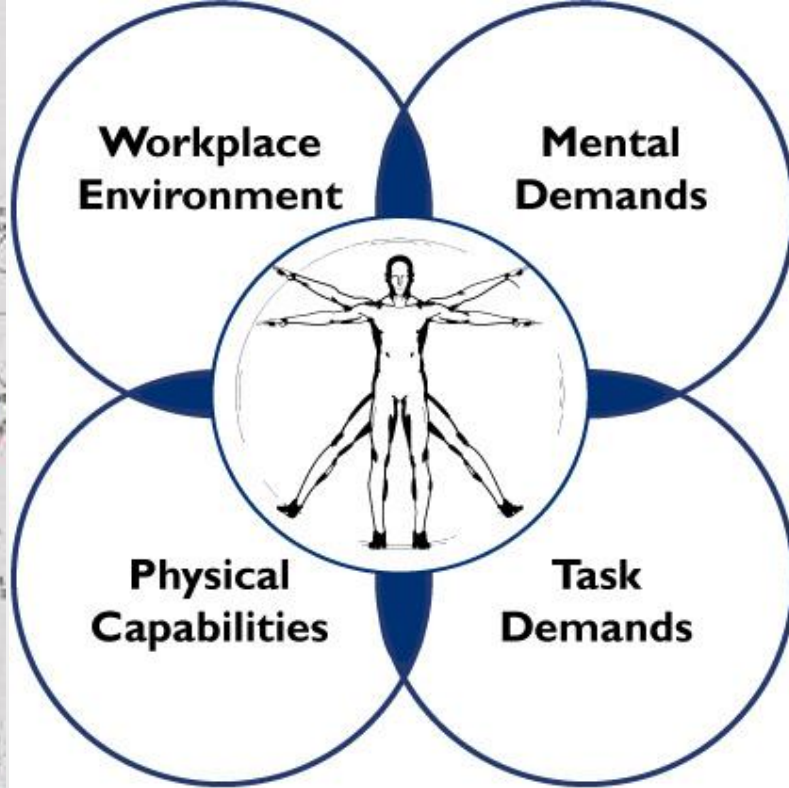


Based on many researchers, Ergonomics can be defined simply as the **study of work**. More specifically, it is the science of *designing the job to fit the worker*, rather than *physically forcing the worker's body to fit the job*.

# Cont...

- Ergonomics removes barriers to quality, productivity and human performance by fitting products, tasks, and environments to people. **ErgoWeb.com**
- Limitations and capabilities of people have been taken into account as a priority. The main aims of Ergonomics are making sure of fitting workers with the environment, information, tasks and equipment.
- **Alternative Names**
  - Humans Factors Engineering
  - Human Engineering
  - Occupational Psychology
  - Engineering Psychology
  - Applied Experimental Psychology

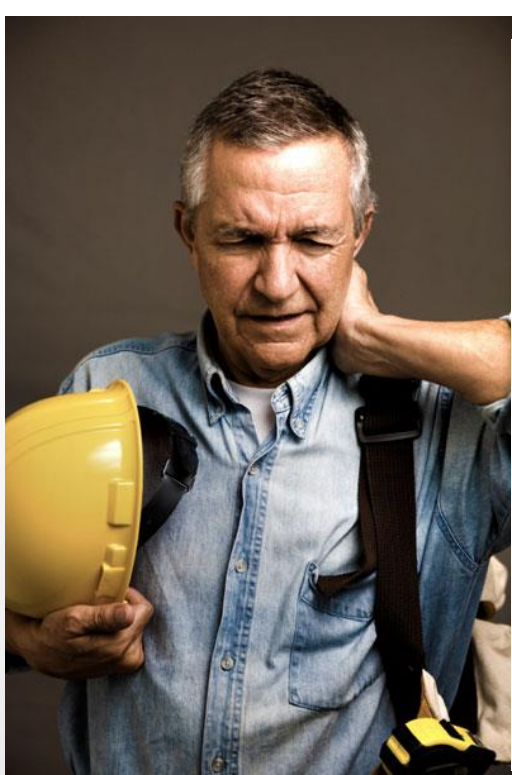




# The Need for Ergonomics

## Evidence from Epidemiology

- Disabling work injuries in US (1990) = 1.8 million
- Sprains/Strains account for 43% of work injuries
- Musculoskeletal conditions in US (1988) = \$126 Billion
- Reduction of worker's compensations costs by 36-91% by companies using Ergonomics in workplace
- Areas of Injury : 61%(back), 8%(knee), 7%(ankle), 6%(shoulder), 3.3%(wrist), 3%(neck)
- Causes of Injury : Overexertion (31%), impact (24%), and falling (17%), other (28%)





Wojciech Jastrzębowski

RYS

**ERGONOMJI**

czyli

**NAUKI O PRACY**

opartej na prawdach poczerpniętych  
z Nauki Przyrody

AN OUTLINE OF

**ERGONOMICS,**

Or

**THE SCIENCE OF WORK**

based upon the truths drawn  
from the Science of Nature

1857

Ergonomic is not  
new Science

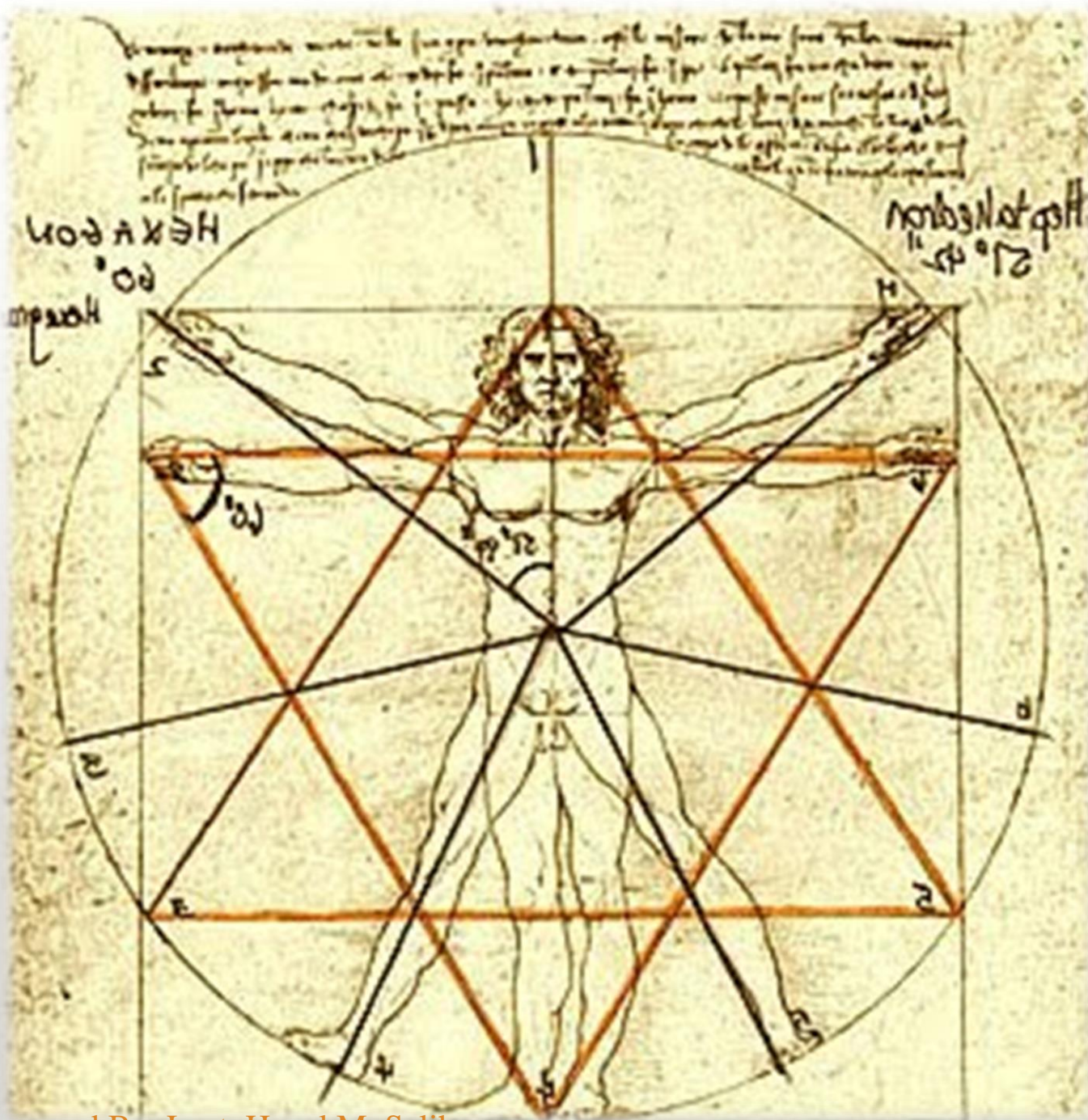
Ergonomic is not a new science. The fact that the word ergonomics was coined by a Polish scholar, **Wojciech Jastrzębowski**, in **1857** became widely known when his book in Polish was reprinted with English translation in 1997.

- According to Selki's study, it is a new for the most under developed countries including Iraq.
- Similarly, Inyang, believes that it is a global issue. The nature of work plays an important factor having risk level. Thus, the ergonomic is not only specified to one industry. Vice versa, it can be applied in many industries, for instance it is very useful program for construction industry to prevent or at least minimize the accident. (Sélki, H., 2017)

# A brief History of Ergonomics

Ergonomics is derived from two Greek words:

- Ergon: meaning work
- Nomos: meaning principles or laws principles or laws
- Ergonomics = The Science of Work Ergonomics or the laws of work



- Through the history, in the age of Roman, Egypt and Greek, the work related health problem always have been reported.
- An Italian physician which is called “Bernardino Ramazzini” (1633-1714), he stressed that the most systematized from occupational health perspective is the right link between pathology and working condition.
- The “International Ergonomics Association” (IEA) was founded in 1959, is one of the most famous organization which works on ergonomic program and it has published many manual, guidelines and papers related avoiding work related risks.
- In addition, many international conferences have been held by this organization every three years in different countries around the world including Birmingham, Stockholm, Sydney, Tokyo, Beijing and many mores.

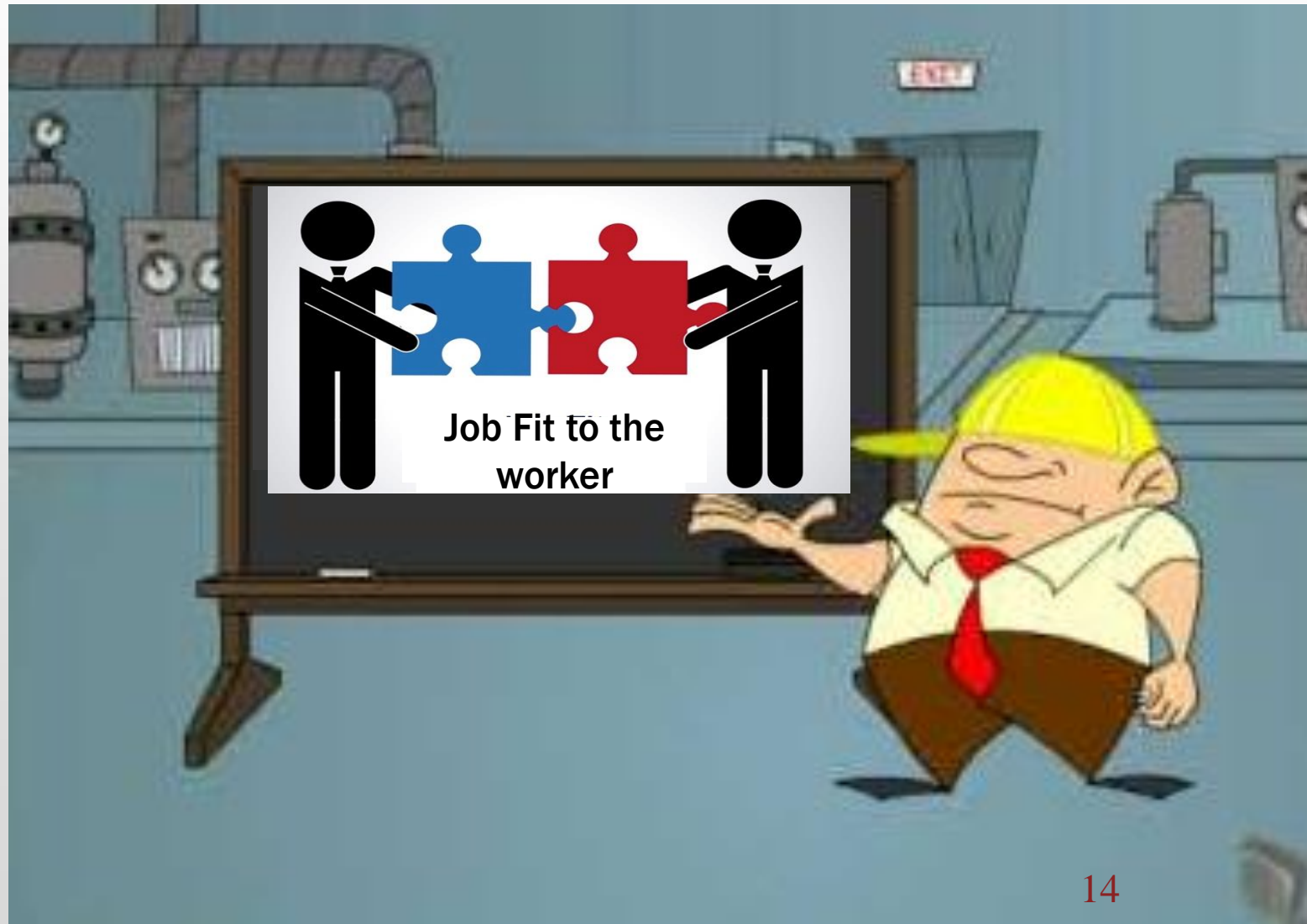
# Ideally, ergonomics

- Makes the job safer by preventing injury and illness



# Ideally, ergonomics

- Makes the job easier by adjusting the job to the worker



# Ideally, ergonomics

- Makes the job more pleasant by reducing physical and mental stress.

**I**   
**MY**  
**work.**

It's Not a Job, It's  
My Life!!



# Ideally, ergonomics

- Saves money

\$\$\$\$\$\$\$\$\$\$\$\$!!!





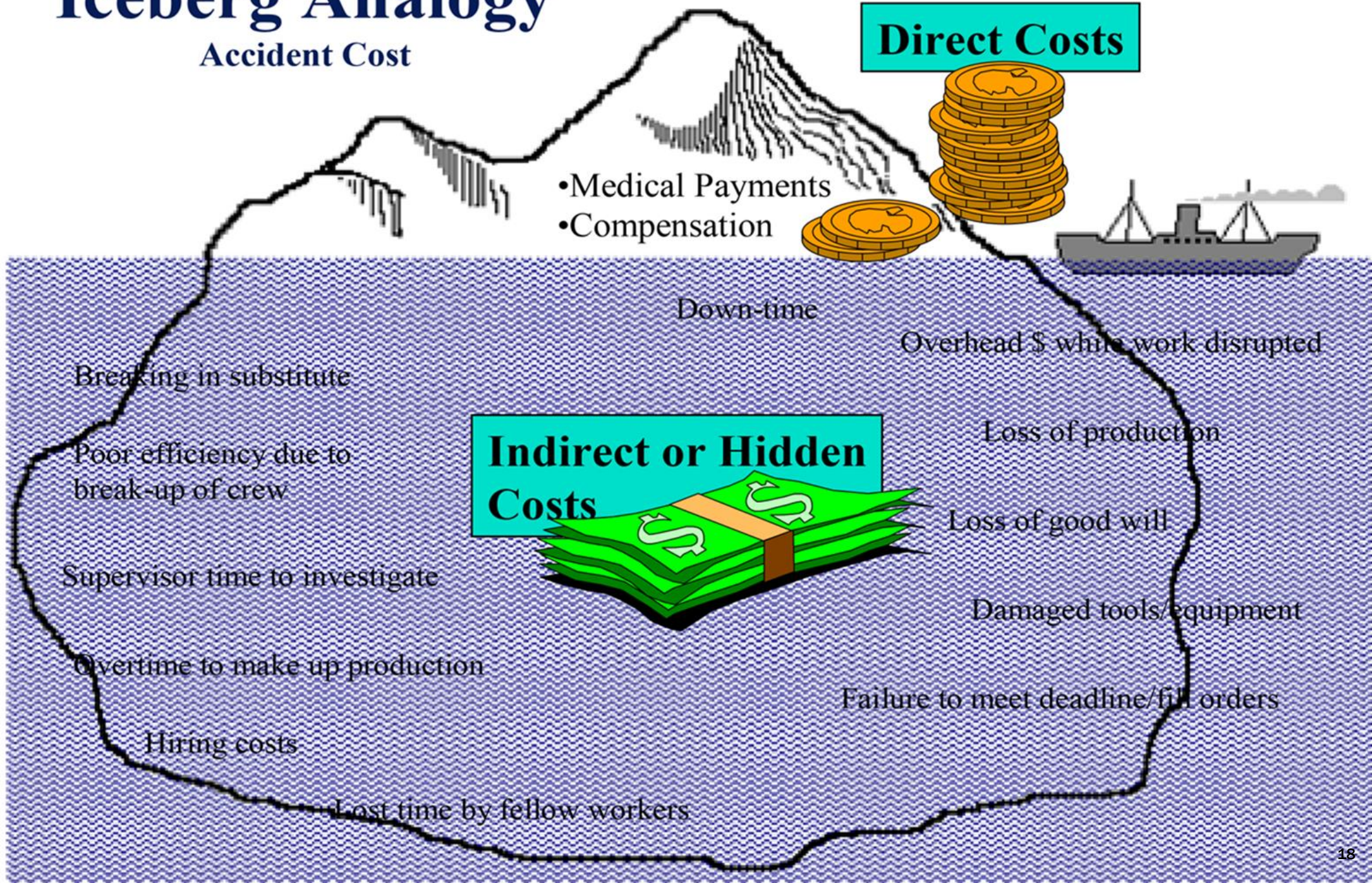
# Cost And Benefits Associated With An Ergonomics Process

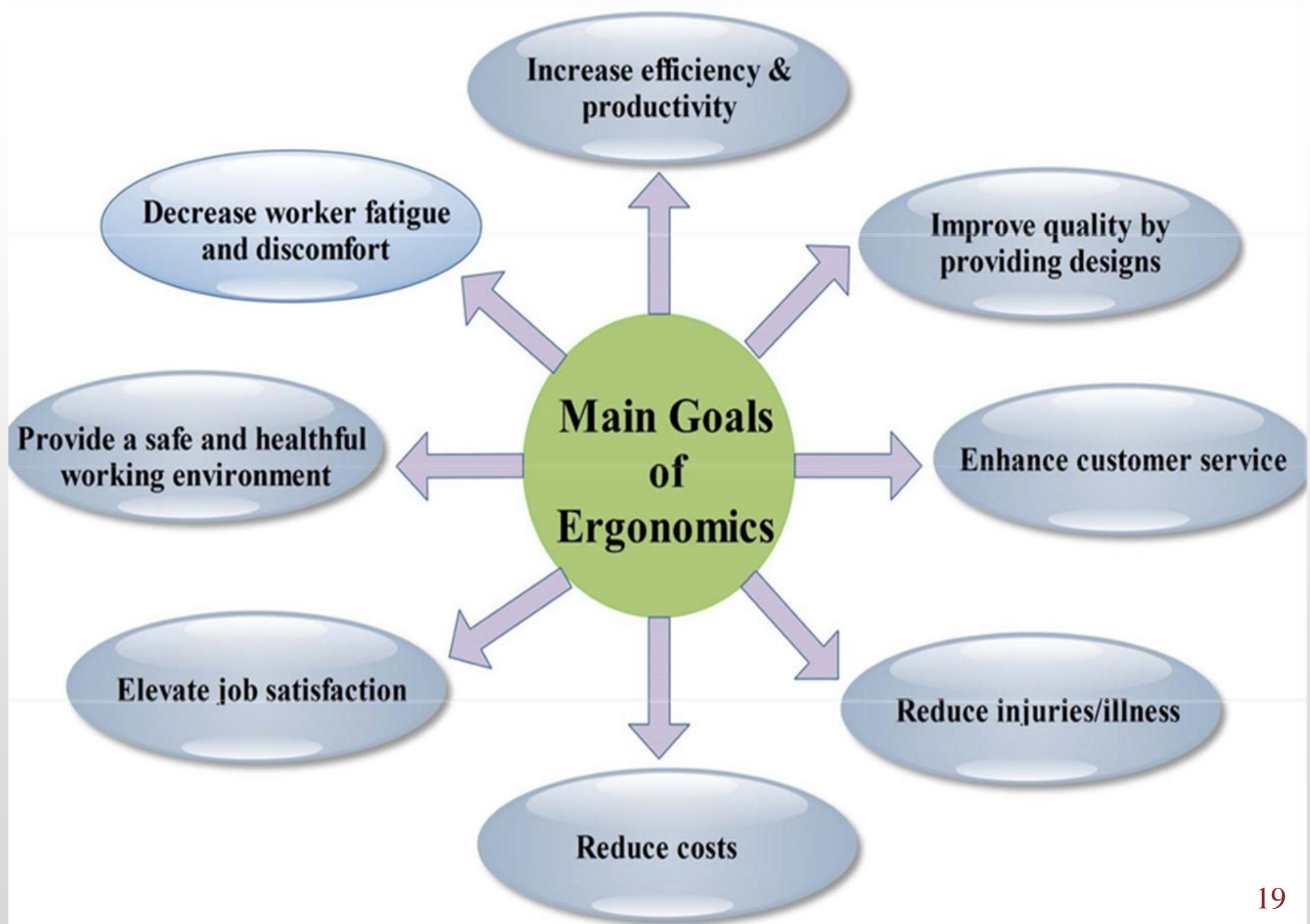


- The direct cost of an injury includes the medical and indemnity costs.
- Indirect costs of injuries are usually 1 to 4 times as much as the direct costs

# Iceberg Analogy

## Accident Cost





# Ergonomic Concepts

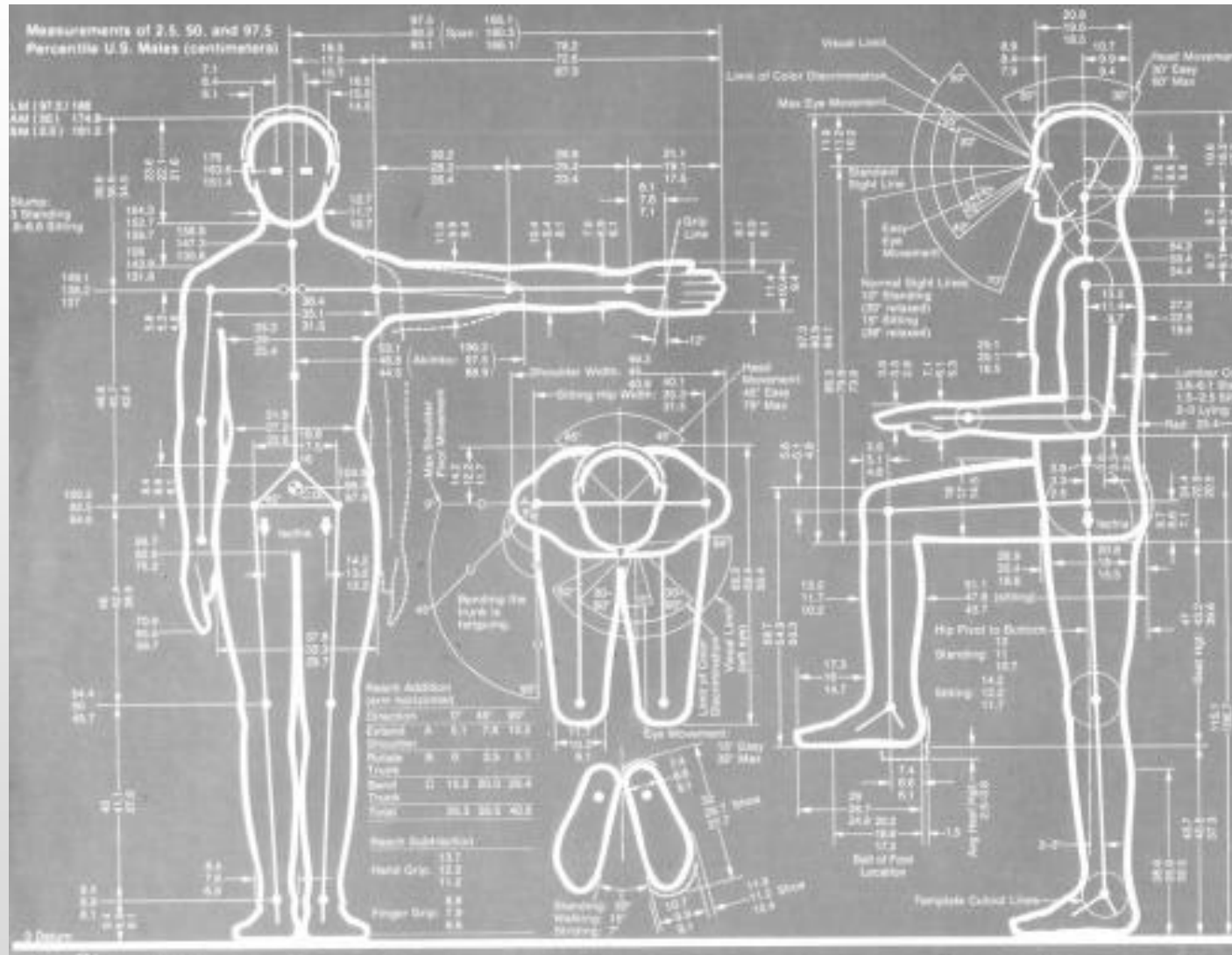
Ergonomic seeks to **adapt** work to human **physical and psychological** capabilities and limitations. It draws many disciplines such as anatomy, physiology, psychology and sociology.



# Ergonomics Concept

## Physical

- Body size and shape
- Fitness and strength
- Posture
- The senses, vision, hearing, touch
- Stresses and strains on muscles, joints, nerves.



# Ergonomics Concept



- Psychological
  - Mental abilities
  - Personality
  - Knowledge
  - Experience

# Why Consider Ergonomics?

Poorly designed working environment (ergonomic risk factors) damages the "Primary Tool"

- Musculoskeletal System
- Cardiovascular System
- Mental System

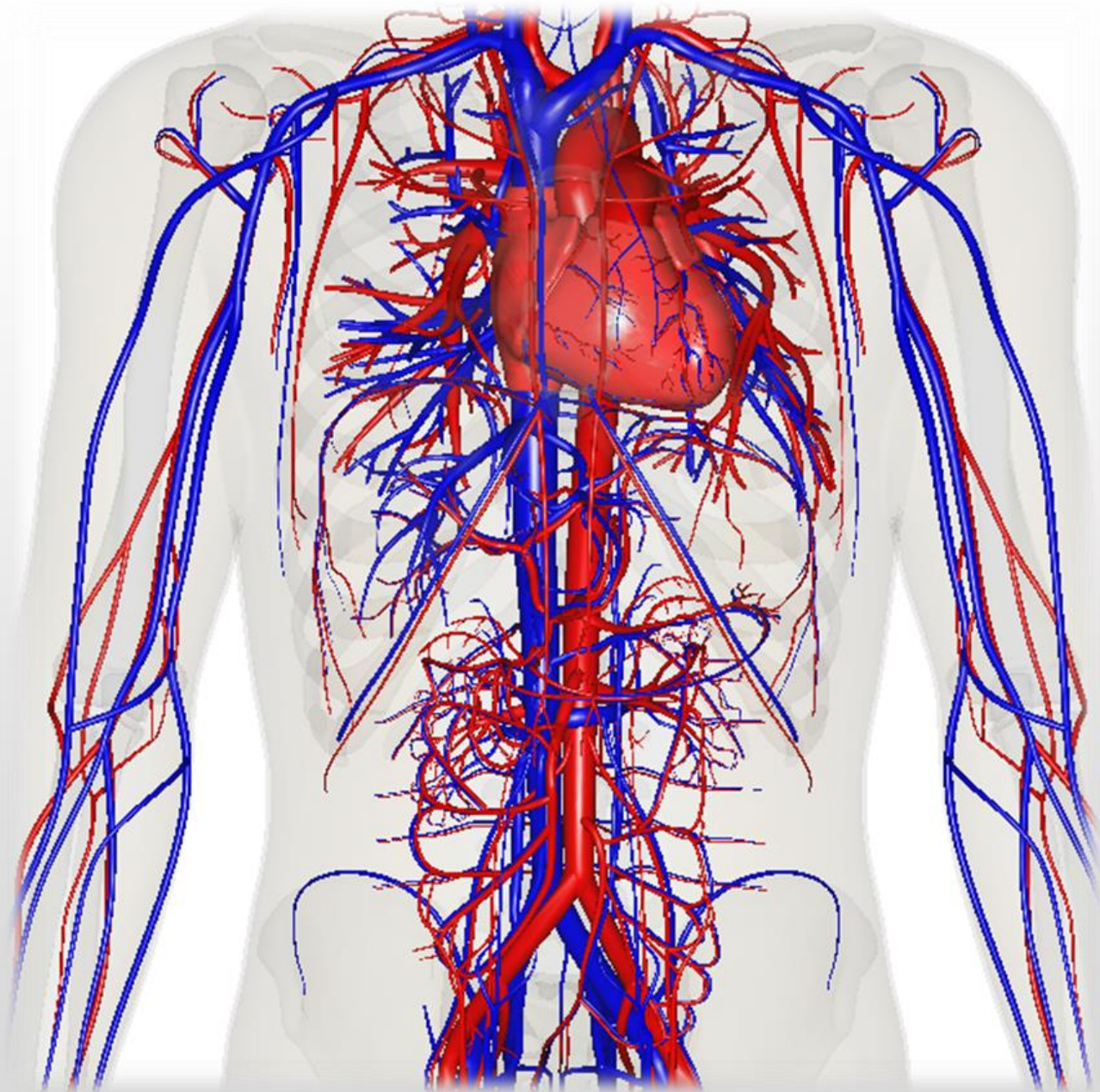
THE EVIL CHAIR



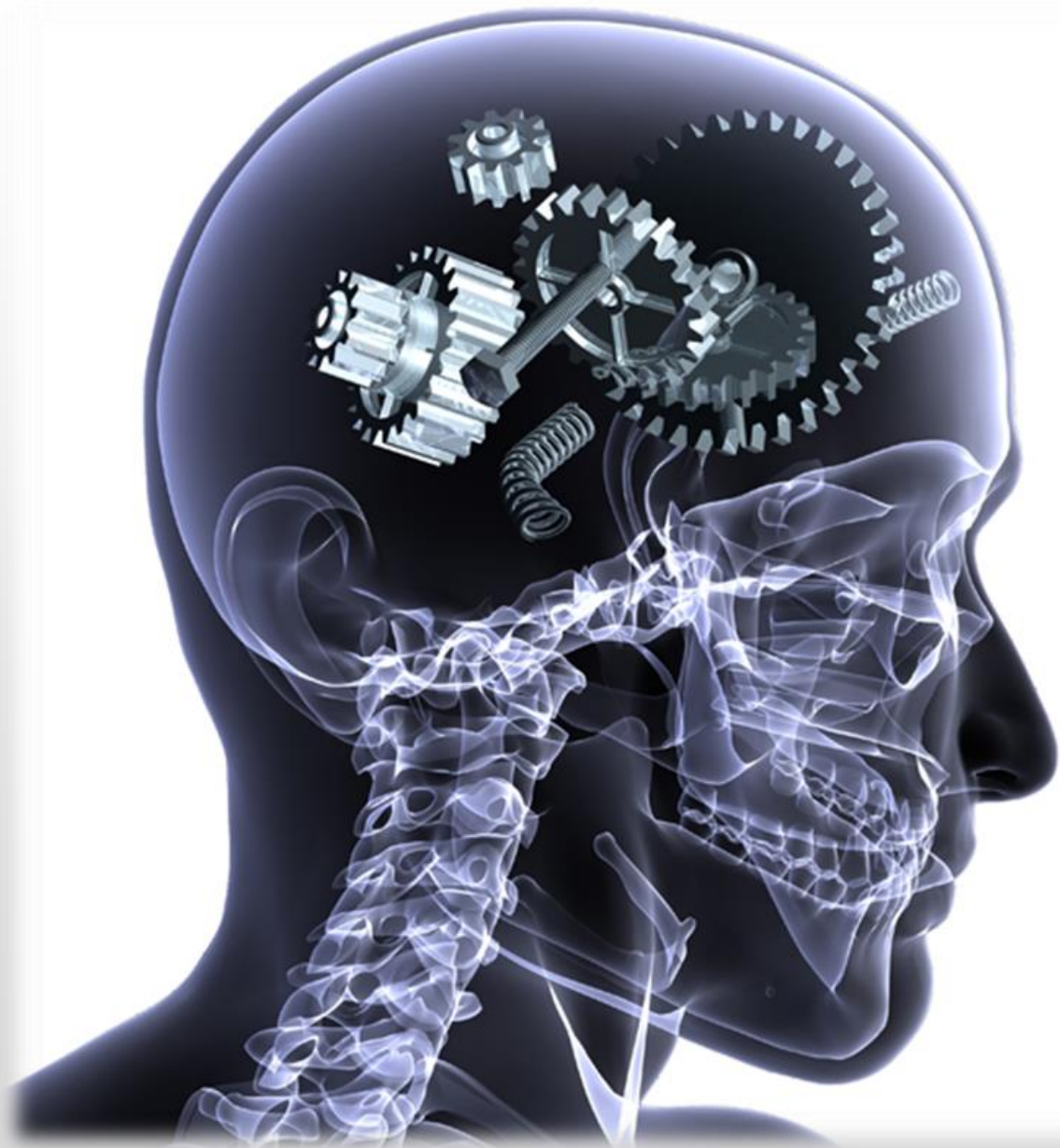


# Musculoskeletal System





# Cardiovascular System



# Mental System

# Why Consider Ergonomics?

These damages will affect directly the productivity and competitive edges of :

- ✓ The individual
- ✓ The company
- ✓ The nation

# Musculoskeletal Disorders (MSDs)

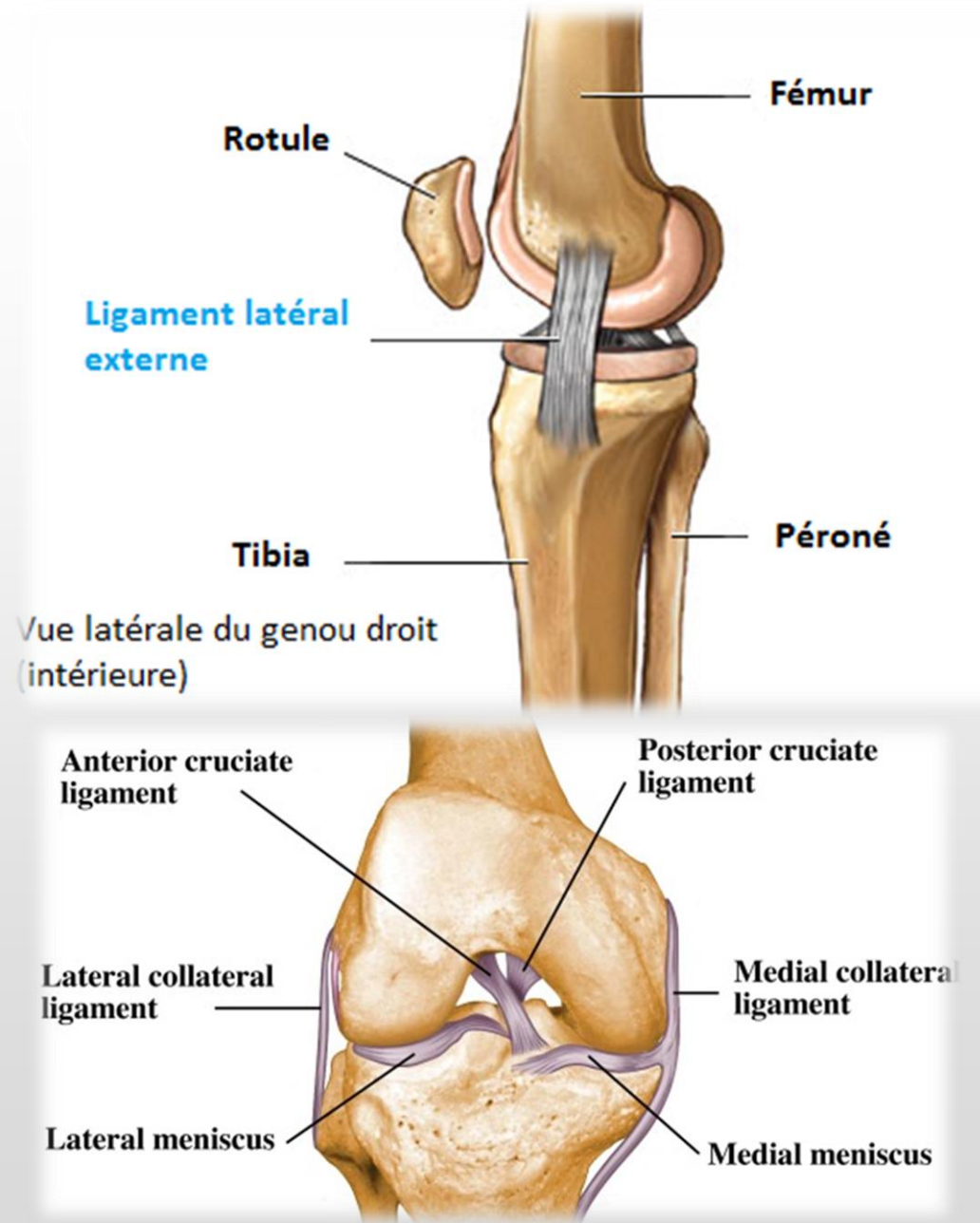
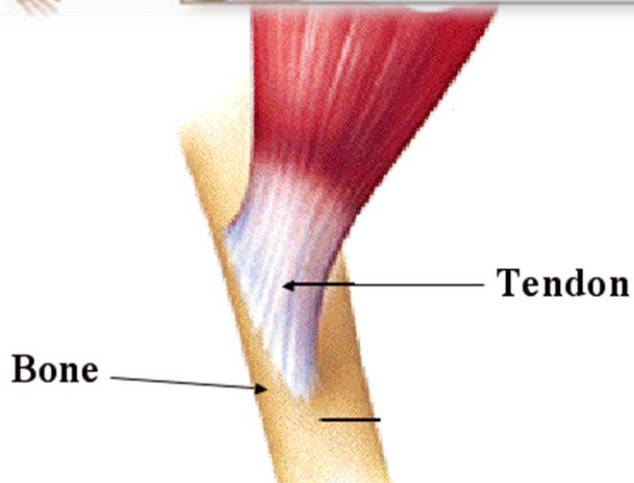
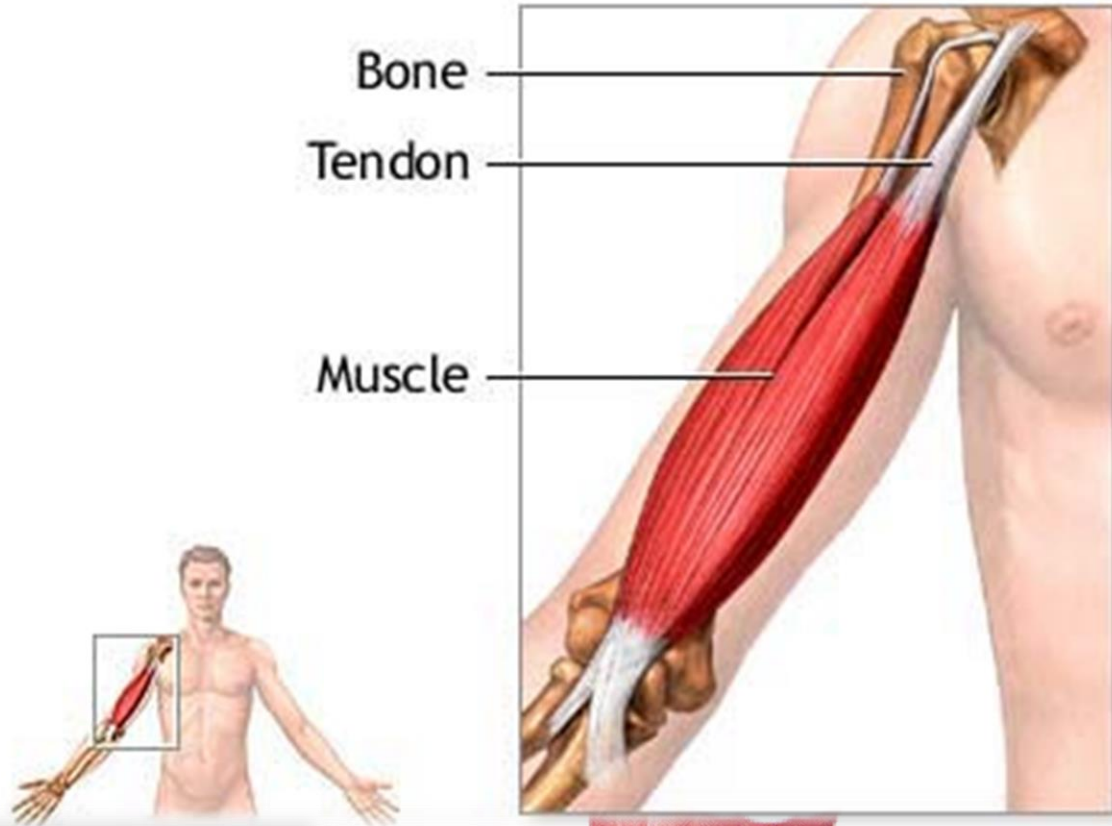
Any injury or disorder related to musculoskeletal system is called “**musculoskeletal disorders**” that affect the human body's movement or **musculoskeletal** system which the consequences of workplaces' risk factors (Sélki, H., 2017)

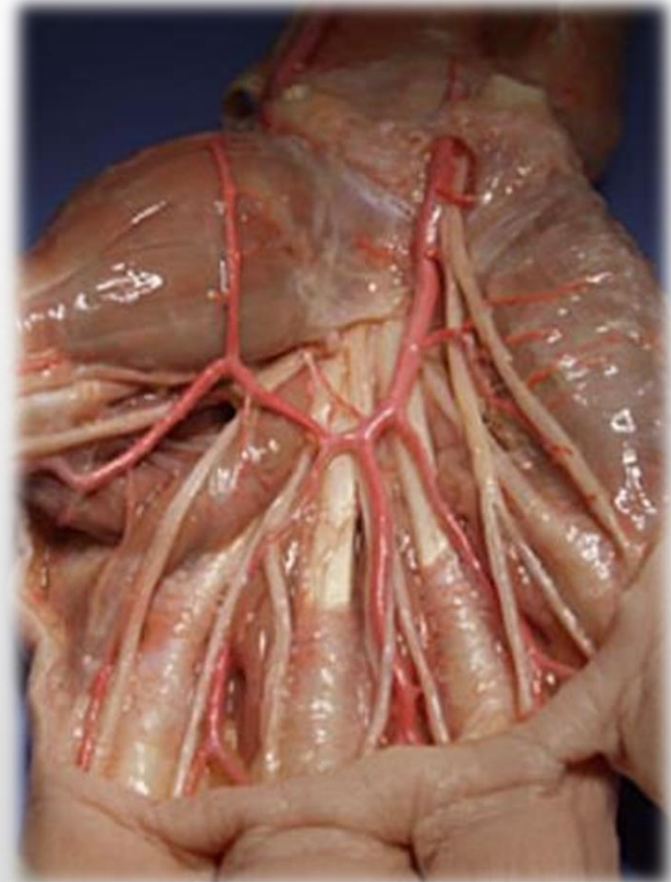
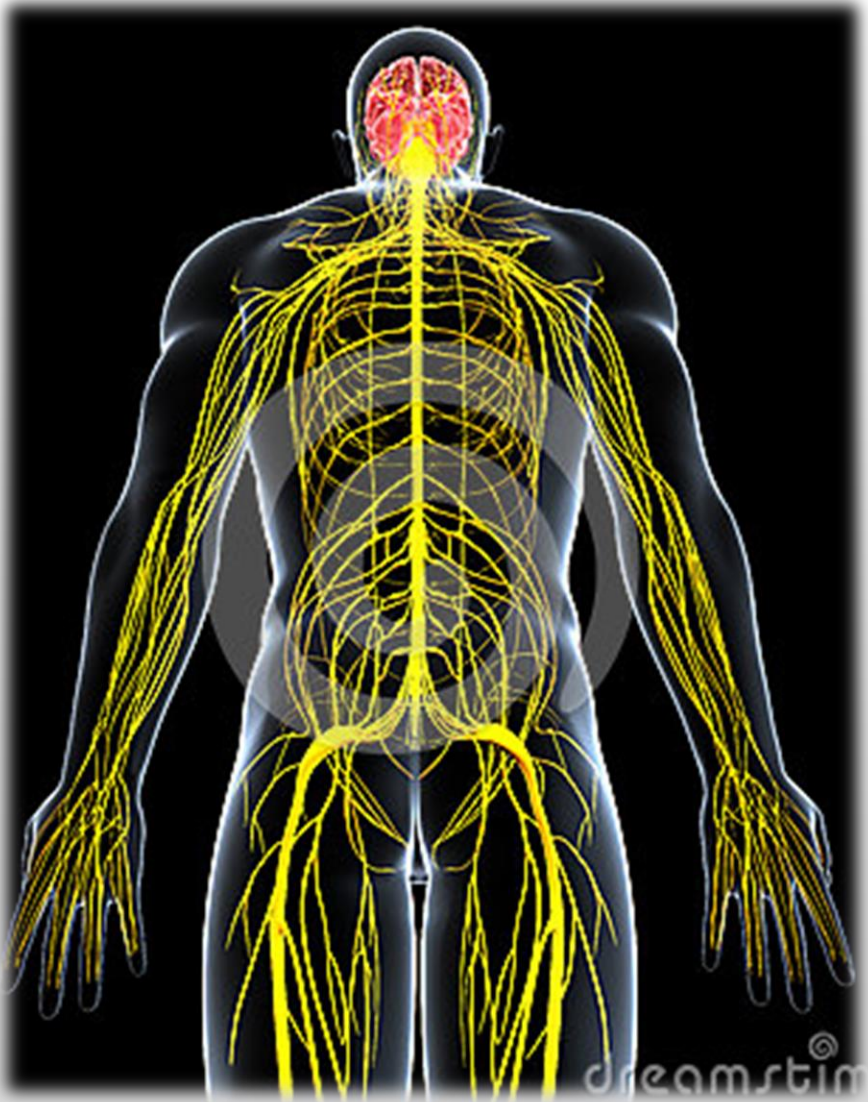
The MS consists of bones, muscles, ligaments, tendons, joints .... etc.

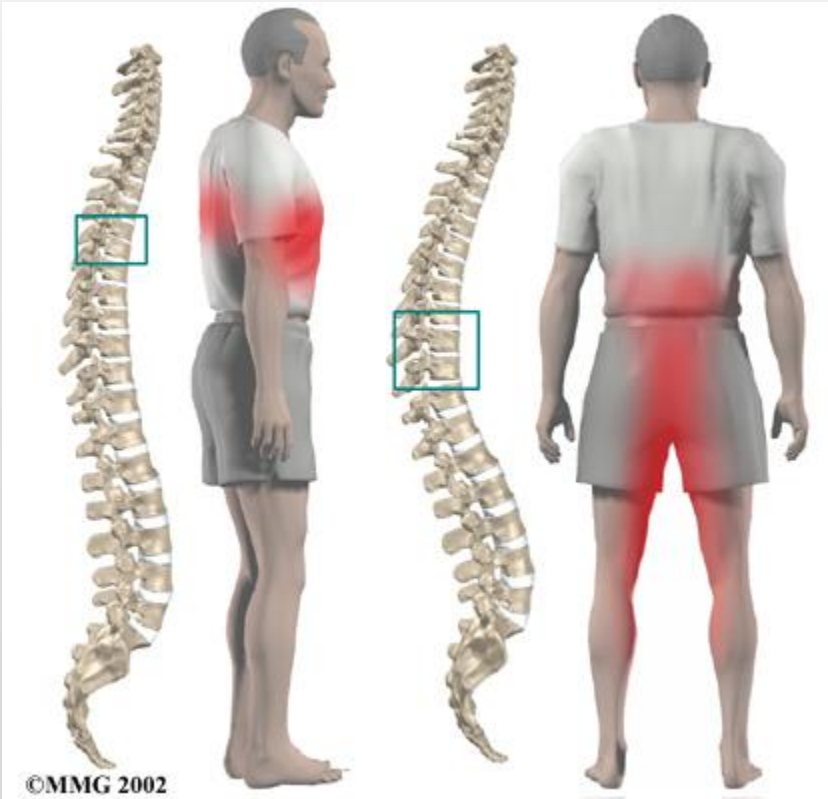
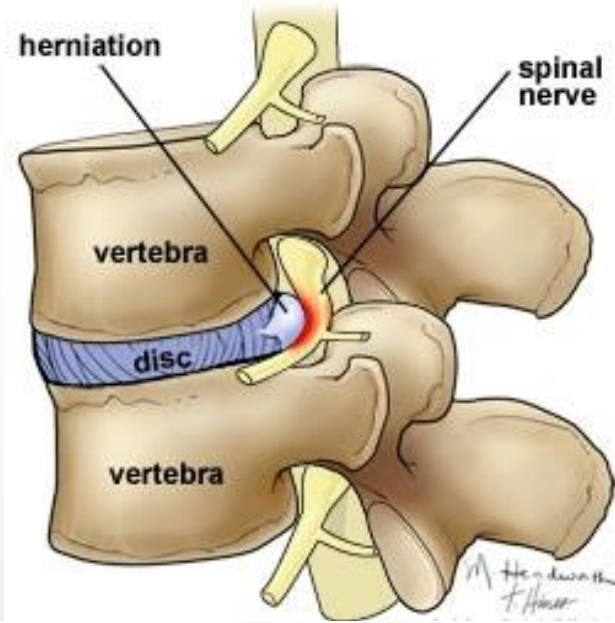
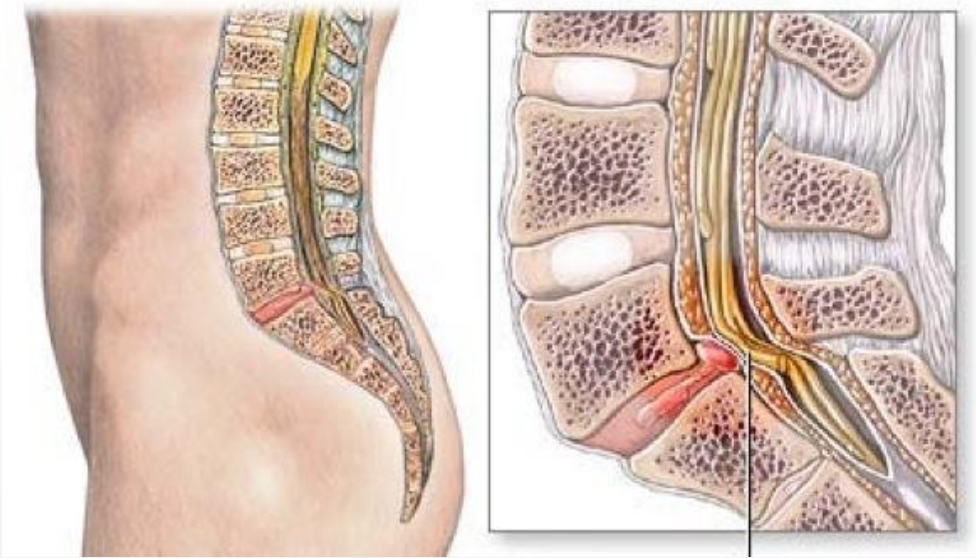
- ✓ Cumulative - happen gradually as opposed to accidents
- ✓ Chronic - effects last a long time

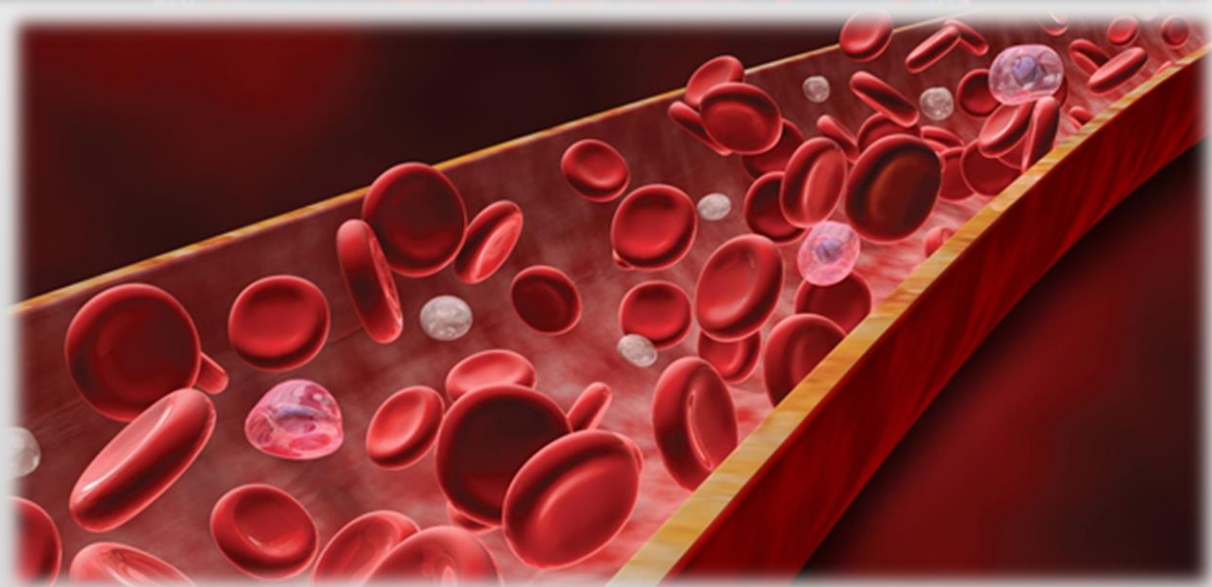
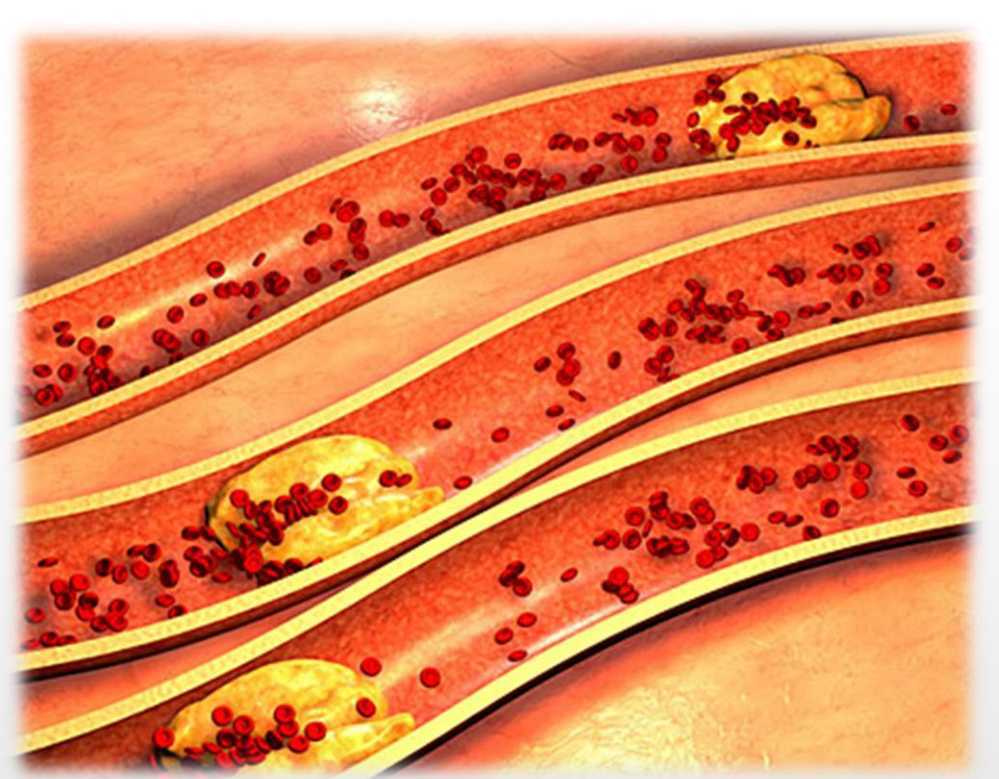
○ Also called:

- Cumulative Trauma Disorders ( CTDs )
- Repetitive Strain Injuries ( RSIs )







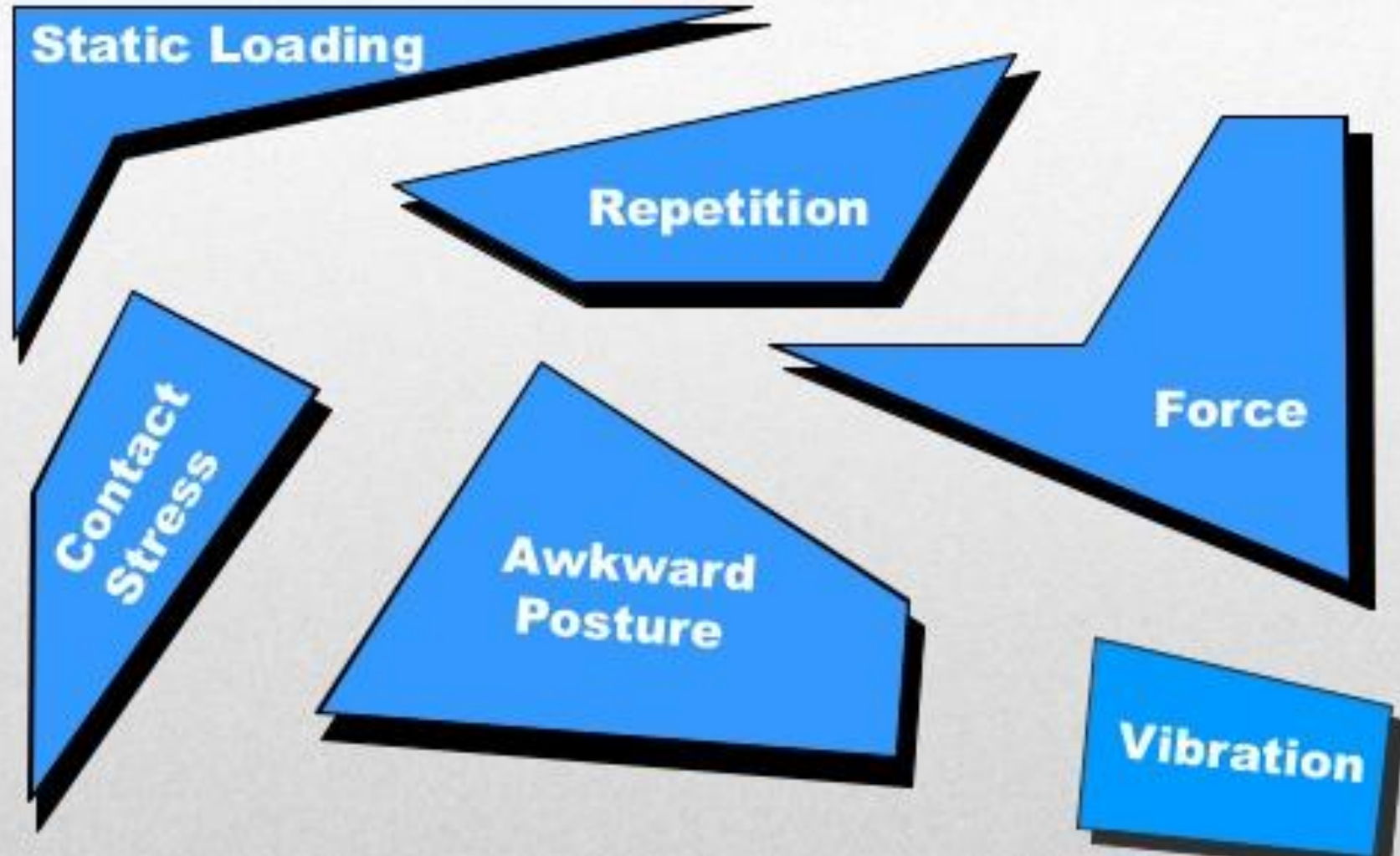




# Ergonomic Risk factors (ERF)

➤ Any **biomechanical stress** on the workers, resulted from their **jobs or tasks** is called ERF. The balance between Individual's ability and soft tissue fatigue is the key factor to be recovered from MSD's formation. To prevent such injuries, recognizing ergonomics principles is very important. Thus, employees shall be familiar with ERF in regards to their works and methods of reducing such hazards.

# Ergonomic Risk Factors



# Ergonomics Risk Factors: Repetition

Repetitive motions are usually performed with small muscle groups, like your hand and finger muscles, and often do not have high force demands. The motions, or cycle times, can be repeated from every **few seconds** to every few minutes and are repeated for **two or more continuous hours** during the work shift.

Excessive repetition of movements can **irritate tendons** and **increase pressure on nerves** in a work day

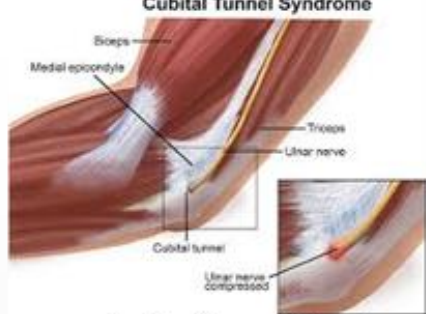


# Ergonomics Risk Factors: Repetition

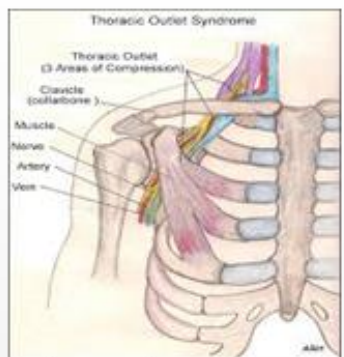
The more repetitive the motion, the more frequent the muscle contractions occur. When muscles contract repeatedly, fatigue may be experienced. Over a period of time, the repetitive motions, particularly when combined with excessive force or awkward posture, may lead to inflammation and soreness. It happens by doing the same movements such as:

- ✓ Using equipment controls
- ✓ Machine paced assembly tasks
- ✓ Packing or unpacking items
- ✓ Quality control inspections
- ✓ Using computers (keyboard and mouse)

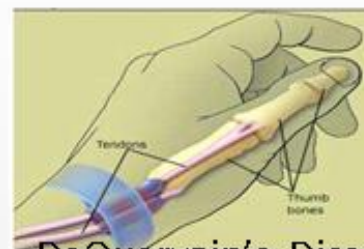




Cubital Tunnel Syndrome



Thoracic outlet syndrome



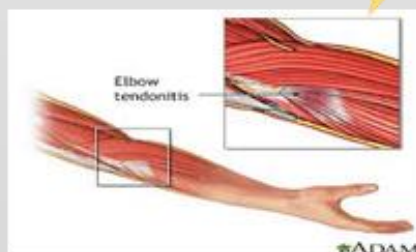
DeQuervain's Disease



Tenosynovitis



Carpal Tunnel Syndrome



Tendoniti



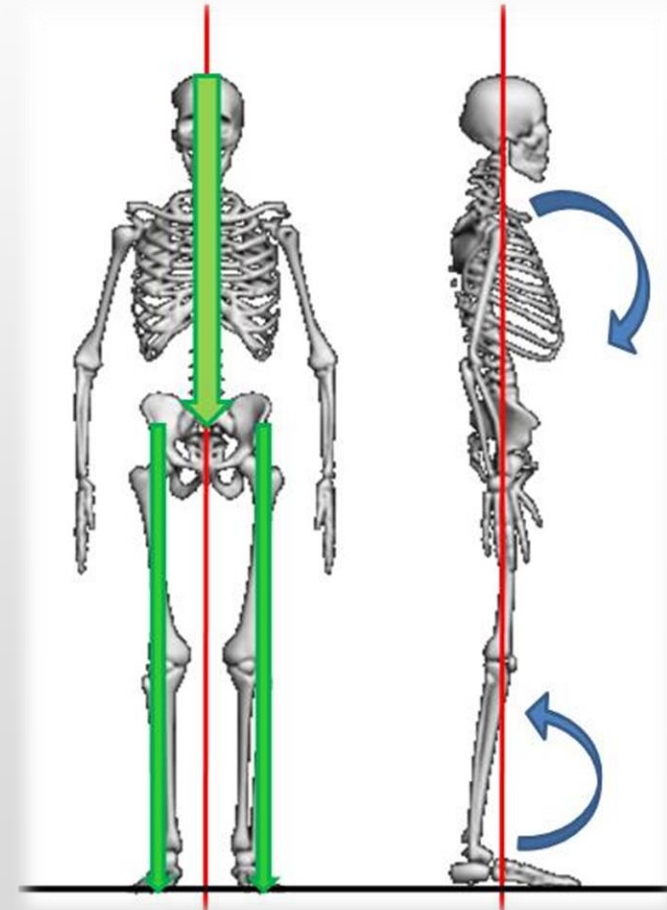
Adverse mechanical



# Ergonomics Risk Factors: Posture

# Ergonomics Risk Factors: Awkward Postures

- **Neutral** is the optimal position of each joint that provides the most strength and control.
- A “**neutral**” body position is safest and most efficient position in which to work.
- Generally, **Awkward posture** refers to positions of the body while performing work activities that deviate significantly from the neutral position. When you are in an Awkward Position muscles operate **less efficiently** and **more force** must be expended to do the task.



# Ergonomics Risk Factors: Awkward Postures

- ❖ Examples of awkward postures is **twisting, bending, and reaching, pulling or lifting**. Other examples of awkward posture is working with the **hands above the head, elbows above the shoulders**, working with the neck or back bent more than 30 degrees without support and without the ability to vary posture.
- ❖ Where working surfaces are very low, employees may have to kneel or squat, which places very high forces on the knees to maintain the position and the weight of the body. Working surfaces that are too low usually affect the lower back and occasionally the neck

(Environmental Health and Safety. Awkward posturw, 2014).



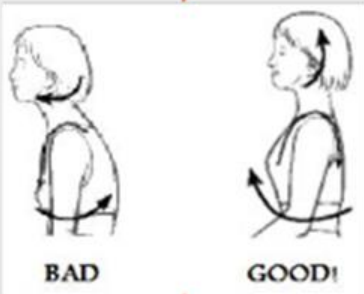


Awkward Posture

Awkward back Posture



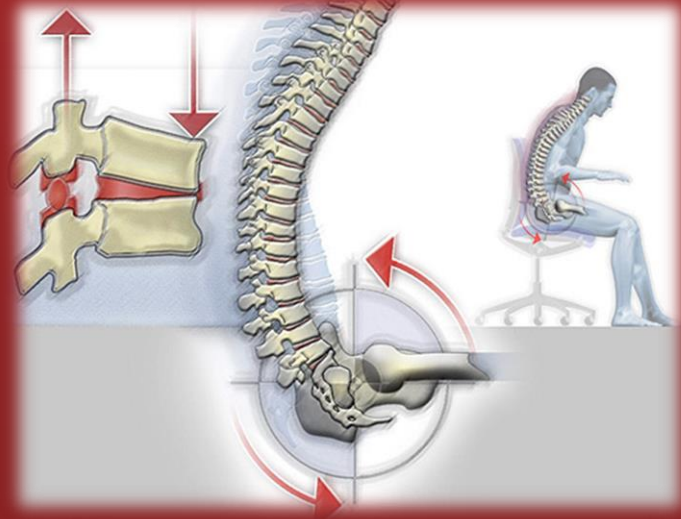
Awkward shoulder Posture



Awkward Neck Posture



Standing or sitting in the same position for an extended period of time is a common cause of back, neck, and leg pain. Awkward posture often stresses the spine and causes muscle fatigue and pain. A few minutes of walking or stretching will increase circulation and help you feel better and be more productive.



# PREVENTIVE MEASURES AND CONTROLS :

Become aware of your posture. **Good posture maintains the natural curve of the spine** and includes relaxed shoulders that are held slightly back and level, ears in line with the shoulders, chin tucked slightly inward, and pelvis shifted forward to allow the hips to align with the ankles.

- ✓ Sit close to your work to avoid stretching.
- ✓ Maintain neutral wrist/arm postures as much as possible.
- ✓ Avoid twisting and bending motions. These types of movements can put pressure on the spine's discs.
- ✓ Use both hands instead of one to lift or complete tasks.
- ✓ Respect your discomfort or pain. Change positions, stretch to ease stiff muscles, take a short break or change tasks.

# Ergonomics Risk Factors: Static Posture

- ❑ Static posture occurs when one position is held for a prolonged period of time.
- ❑ The muscles will become fatigued from a lack of blood flow during a static posture.
- ❑ This fatigue can lead to discomfort and even injury.
- ❑ For example, when we sit and work at computers,

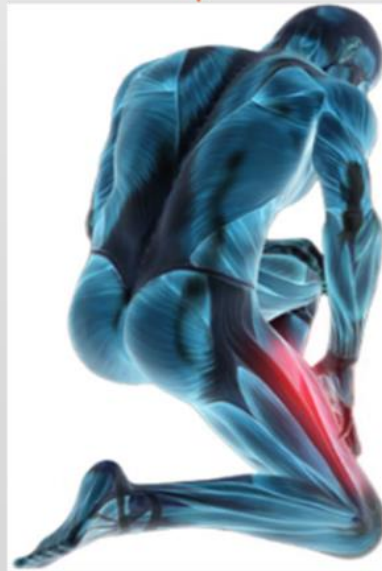
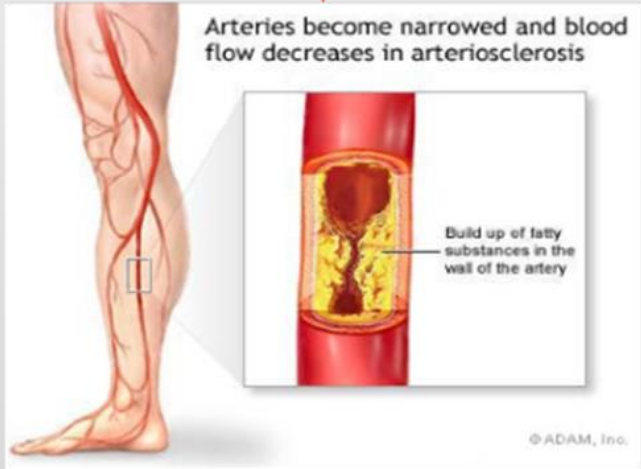




Static Posture

Restricted blood flow

Fatigue of muscle



# Static Postures

# What can Good Posture do for you?

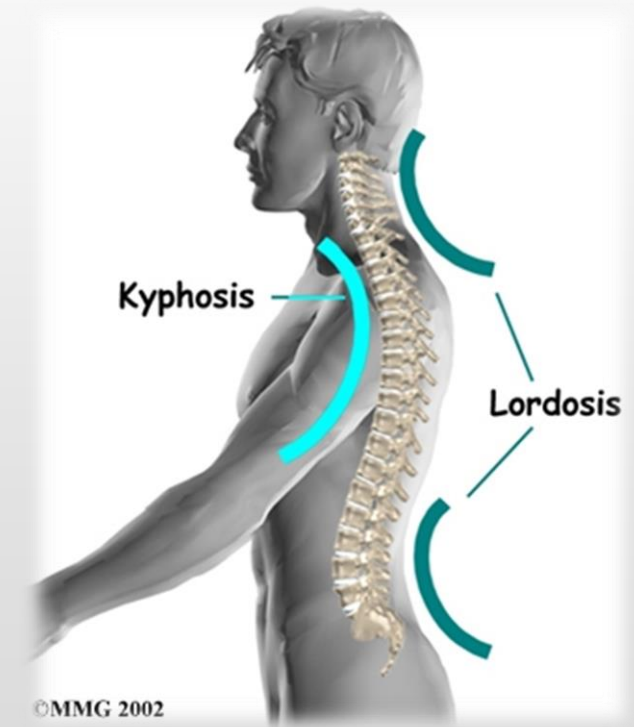
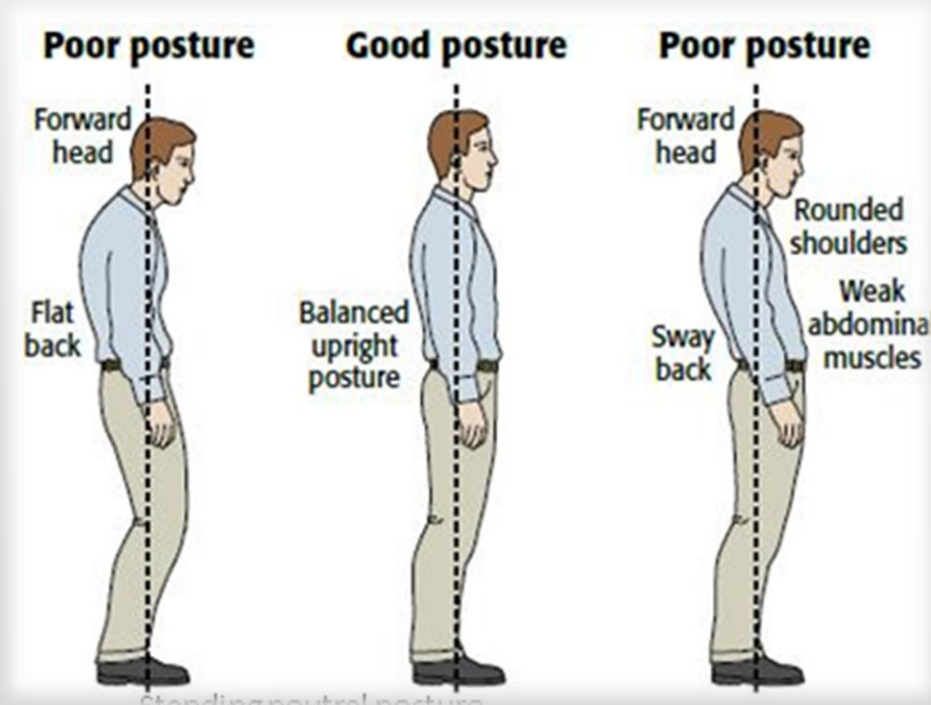
- Optimize breathing and circulation
- Maintain the bones and joints in the correct alignment so that muscles are being used properly and efficiently
- Decrease the stress on the soft tissues, such as ligaments, muscles, tendons and discs
- Prevent the spine from becoming fixed in abnormal positions
- Prevent fatigue because muscles are being used more efficiently, allowing the body to use less energy

# What can Good Posture do for you?

- Prevent postural strain or overuse problems
- Prevent neck or back pain
- Contributes to a healthy image or appearance

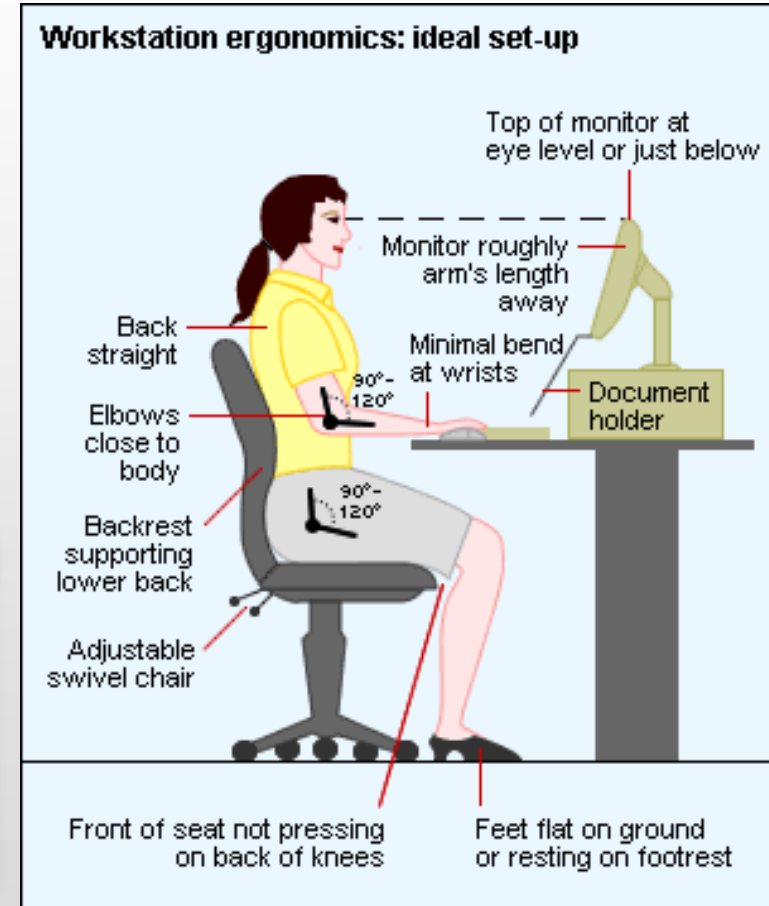
# Here are some helpful hints

- Keep your back straight, maintain all 3 natural curves in your spine
- Distribute your weight evenly on both hips
- Keep your head and neck aligned over your shoulders



# Here are some helpful hints

- Sit back in your chair; your back should be supported by the seat back
- Adjust your chair height so that your hips are slightly higher than your knees
- Be sure your feet are supported by the **floor or a footrest**





# Here are some helpful hints

- Avoid sitting for long periods of time; get up from your chair at least once every hour
- Do not twist or bend your back from a seated position



Bulging disk puts pressure on the nerve

Herniated disk puts pressure on the nerve





# Ergonomics Risk Factors: Vibration

- Exposure to vibration can occur while using power tools or while driving equipment.
- Vibration from power tools can place stress on the tissues of the fingers, hand and arms.
- Whole body vibration from driving puts stress on the spinal tissues.

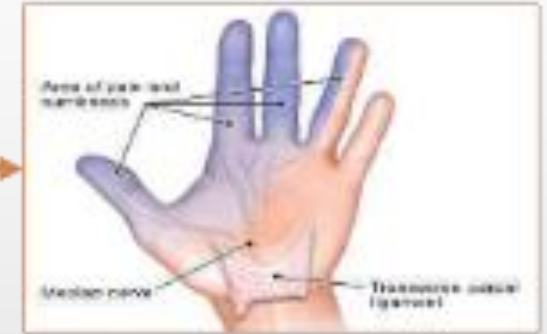


## Effect of Hand Arm Vibration

Painful finger blanching attacks



- Loss of sense of touch and temperature.
- Numbness and tingling.



Loss of grip strength



Loss of manual dexterity



# Effect of Whole-Body Vibration

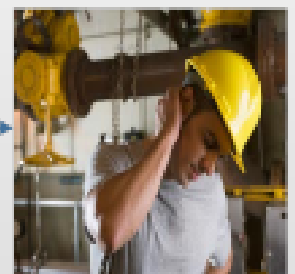
low back pain



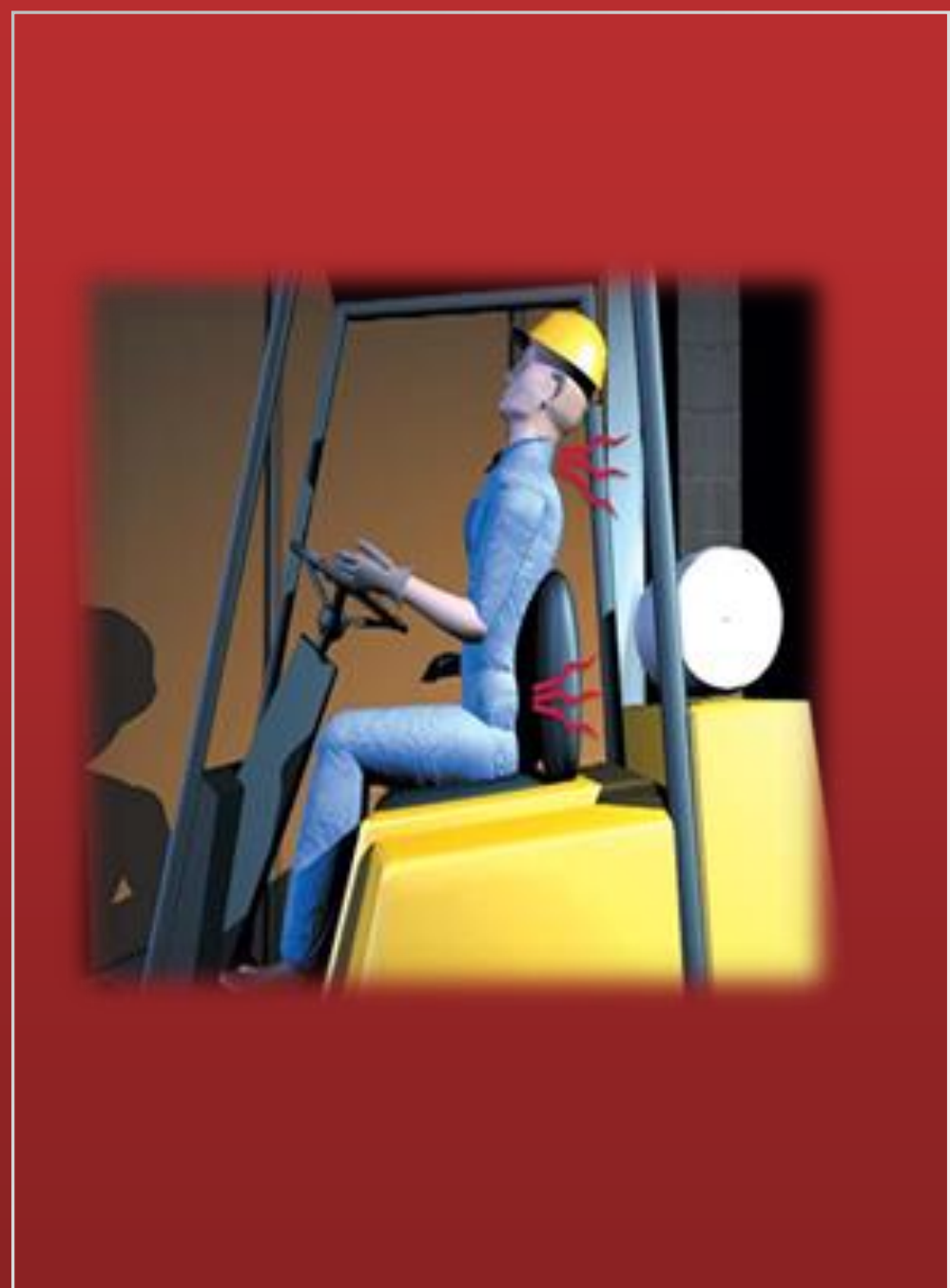
Shoulder pain



Neck pain



Foot pain



# Preventive measures and Controls

- Reduce the duration of the exposure to vibration.
- Recognize early on the signs and symptoms of exposure.
- Select ergonomically designed anti-vibration tools.
- Use anti-vibration full fingered gloves.
- Grasping the tool as lightly as possible.
- Rest the tool on a support as much as possible.
- Avoid smoking because nicotine enhances the ability of blood vessels to go into spasm (YEHS, ).



# Ergonomics Risk Factors: Excessive Force

- Force is the amount of physical effort required by a person to do a task or maintain control of tools or equipment.
- Higher force means higher mechanical load to the muscles, ligaments, tendons and joints. This will result in fatigue and reduces physical work capacity.
- Can cause acute effect or long term effect (chronic) if excessive load are not handled correctly.
- Example: Lifting heavy loads, pinch grips
- A pinch grip produces 3-5 times more force on the tendons in the wrist than a grip with the whole hand.

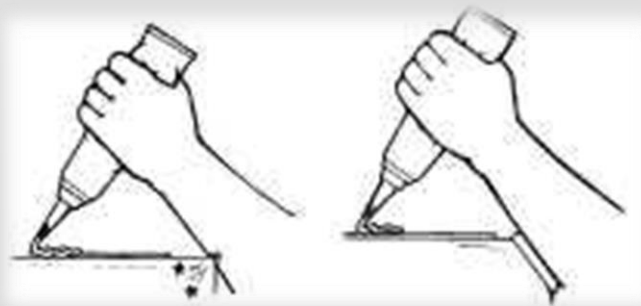


# Ergonomics Risk Factors: Contact Stress

Contact stress occurs when an object presses on soft tissue. This concentration of force on small areas reduce blood flow and nerve transition and can damage the soft tissue.

Examples:

- Kneeling on a hard floor or against sharp edges
- Leaning against a hard work surface or edge



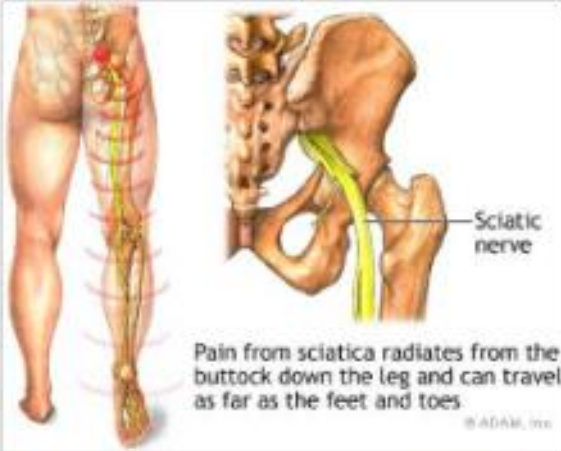
# Ergonomics Risk Factors: Contact Stress

- Holding tools that end within the hand
- Handling objects with grooved, sharp, or uneven edges, or objects made of hard material that presses on the hand
- Holding down palm-type control buttons or pressing buttons frequently
- Using power tool triggers with sharp edges
- Sitting in chairs that are too high (i.e., the worker's legs are angled downward) without adequate foot support

Contact stress

Nerve Damage

Inflammation of the tendon

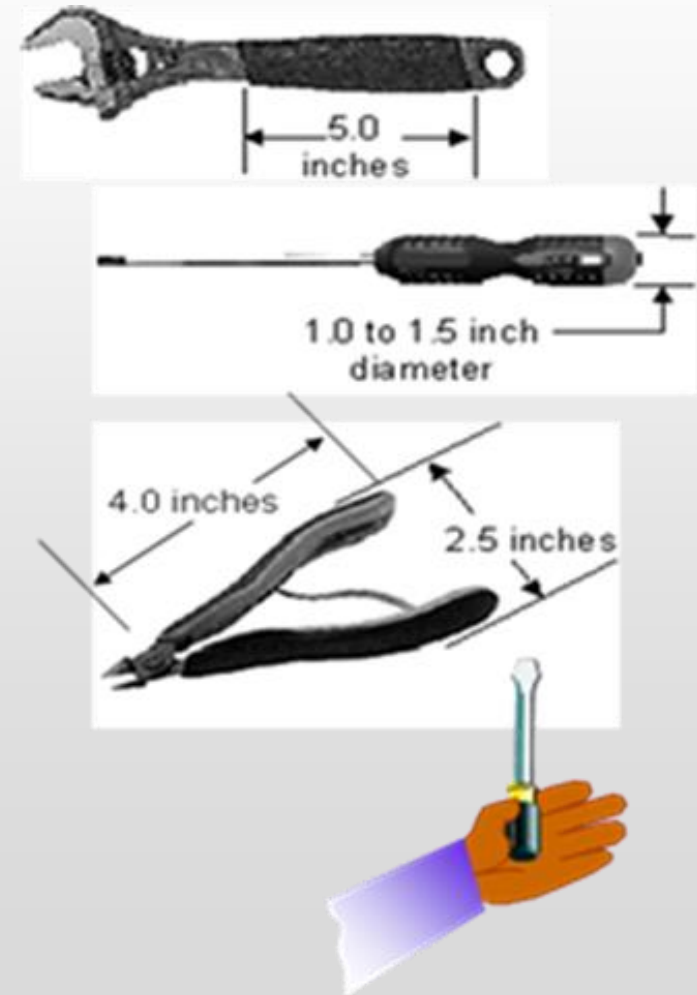


Contact stress



# How to Minimize Contact Stress

- Select hand tools that conforms to the geometry of the hands
  - Pistol grip & in-line tools:
  - Recommended handle length: 5.0 inches
- Recommended handle diameter: 1.0 to 1.5 inches
- Pliers & crimping action tools:
  - Recommended handle length: 4.0 inches (minimum)
  - Recommended handle span: 2.5 inches



# How to Minimize Contact Stress

- Avoid handles that end in the palm of the hand
- Avoid pressure on palms, wrists, and elbows:
  - Use padding on hard or sharp surfaces
  - Change your position to eliminate the stress
- Avoid pressure on knees:
  - Avoid kneeling on hard surfaces for prolonged periods
  - Use knee pads when kneeling tasks are unavoidable



# Ergonomics Risk Factors: Extreme Temperature

Extreme temperatures can cause various problems for workers. Hot temperatures can lead **to dehydration and muscle fatigue**, especially in conjunction with high humidity. Cold temperatures make the **muscles less flexible**, resulting in **muscle strain and pulls**.

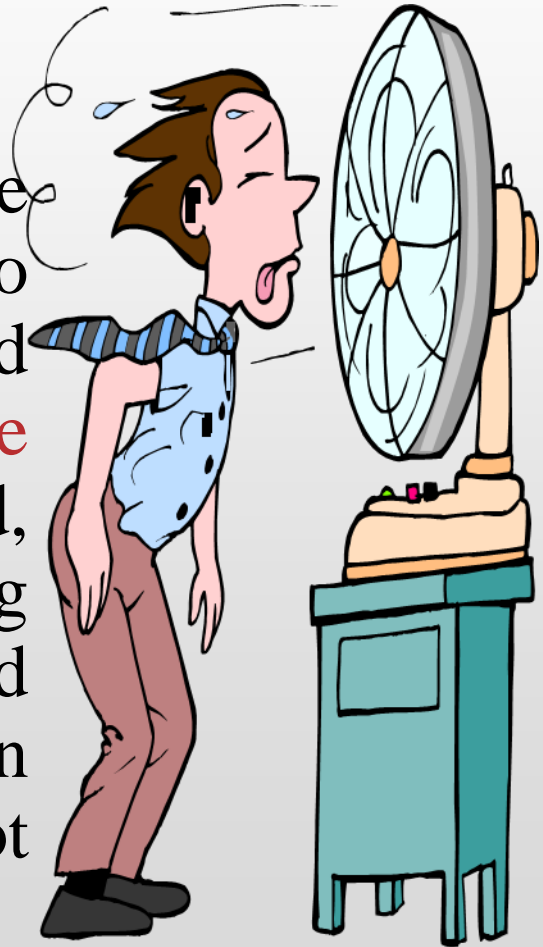
Problems may include:

- trouble breathing,
- fatigue,
- reduced dexterity,
- sensory sensitivity,
- and reduced grip strength.

# Ergonomics Risk Factors: Extreme Temperature

## Hot Environment

- When a worker is subjected to a high heat environment, the internal body temperature rises resulting in the bodies attempt to regulate its temperature through increased blood circulation and increased perspiration. Relatively **less** blood goes to the **active muscles, brain, and other internal organs**; strength is reduced, and **fatigue** occurs sooner. If the body is prevented from cooling down, the body will continue to try to cool down and expend more energy, increasing fatigue. Heat stroke and heat exhaustion are the most serious health issues caused by working in hot environments.

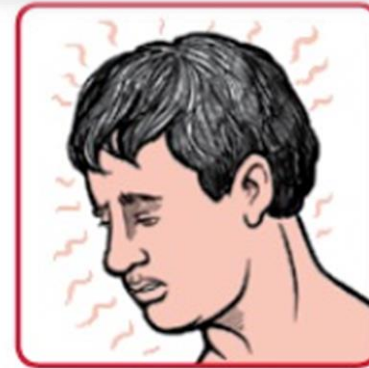


# Ergonomics Risk Factors: Extreme Temperature

- **HEAT STROKE** can be fatal and victims usually don't recognize the symptoms. While the symptoms vary from person to person, they include dry, hot skin (due to a failure to sweat), an elevated body temperature, and ultimately a partial or complete loss of consciousness.
- **HEAT EXHAUSTION** is caused by a loss of body fluid through excessive sweating. Symptoms include heavy sweating, weakness, dizziness, intense thirst, nausea, headache, vomiting, diarrhea, muscles cramps and possibly palpitations.



Sweaty skin



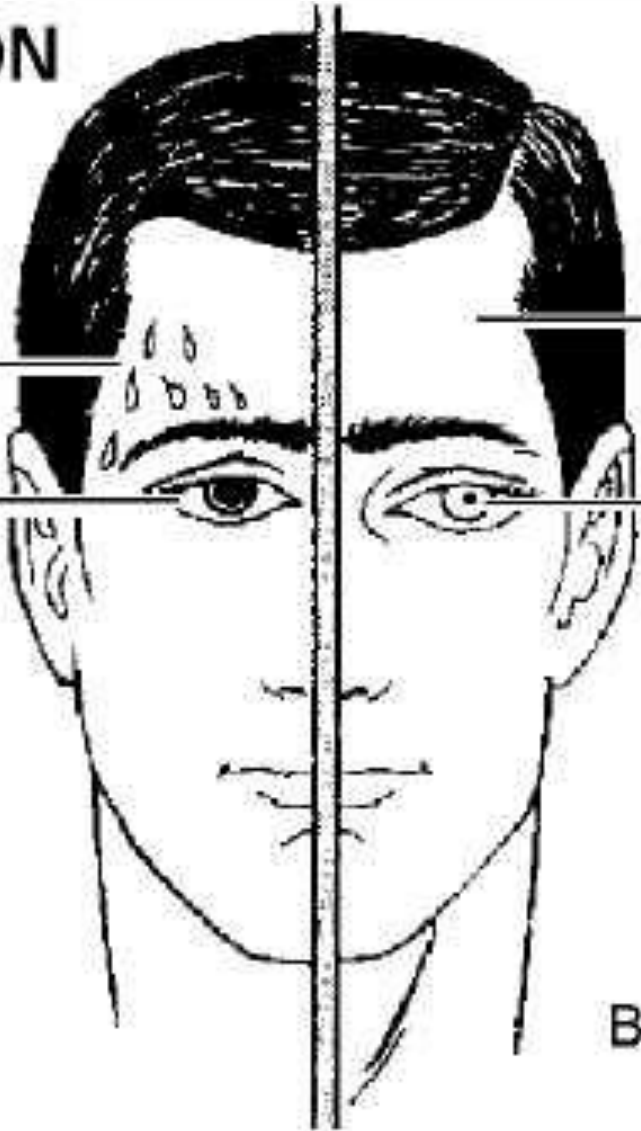
Red, hot, dry skin



# HEAT EXHAUSTION

# HEAT STROKE

1. MOIST & CLAMMY SKIN
2. PUPILS DILATED
3. NORMAL OR SUBNORMAL TEMPERATURE



1. DRY HOT SKIN
2. PUPILS CONSTRICTED
3. VERY HIGH BODY TEMPERATURE

BMRf1416

# How to prevent the risk of hot environment



The best solution to working in a hot environment is to **reduce the temperature** or remove the worker. This should be attempted first by increasing **ventilation** and/or **cooling** or providing heat shields as appropriate. This is not always practical and other solutions may have to be employed to **mitigate** the **impact of the heat** to the individual. Alternating work or implementing a work-rest schedule may provide relief. Additionally, workers should:

- Drink fluids, preferably water, throughout the day to replace lost water.
- Limit caffeine intake,



# How to prevent the risk of hot environment



- Protect yourself when working outdoors by covering up as much as possible,
- Wear light weight, breathable fabrics,
- When working outdoors, perform strenuous work during the coolest times of the day, reserving lighter tasks for the high heat periods.
- Take rest periods to allow the body time to cool off,
- Know the signs of heat stress and heat exhaustion.



# Ergonomics Risk Factors: Extreme Temperature

## Cold Environment

Low temperatures **reduce sensory feedback, dexterity, blood flow, muscle strength, and balance.** This can impact performance of complex mental and physical tasks and may even lead to potentially lethal side effects.

A cold environment takes away body heat which can result in a **lowering of the inner body temperature** to dangerously low levels.



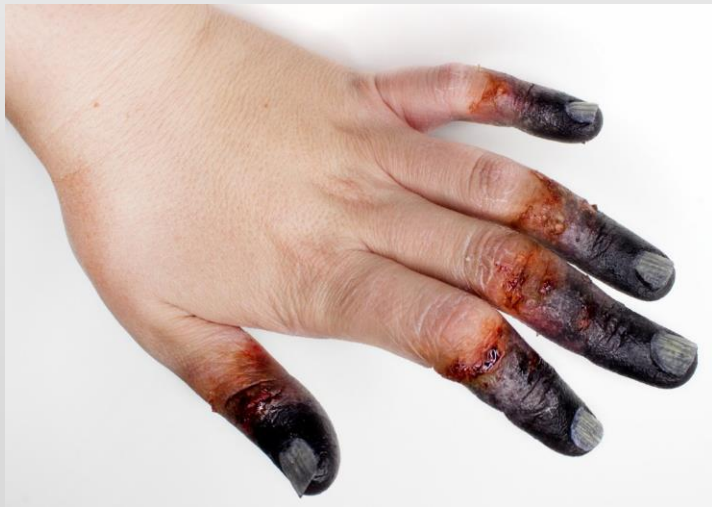
# Ergonomics Risk Factors: Extreme Temperature

**HYPOTHERMIA** is a common cold injury associated with low body heat. This occurs when the body loses energy faster than it is produced, dropping the body temperature. Warning signs are numbness, stiffness, drowsiness, and poor coordination.



# Ergonomics Risk Factors: Extreme Temperature

**FROSTBITE** is another common cold injury. The **nose, ears, cheeks, fingers, and toes** are the most often affected. The low temperature constricts blood vessels, which impair blood flow and may cause permanent tissue damage. If damage is only to the skin and underlying tissue, complete recovery may be expected. However, if blood vessels are affected, the damage may be permanent and could result in amputation of the affected part.



# How to reduce the risk of cold environment



- To cope with working in a cold environment you should stay **active, dress warmly**, and follow the basic safety rules. Working in a cold environment increases the risk of back injuries and other musculoskeletal injuries. Perform “warm up” stretching exercises before doing heavy work or handling heavy equipment and material.
- Important points to remember are:
  - ✓ Dress in multiple layers of loose, dry, protective clothing.



# How to reduce the risk of cold environment

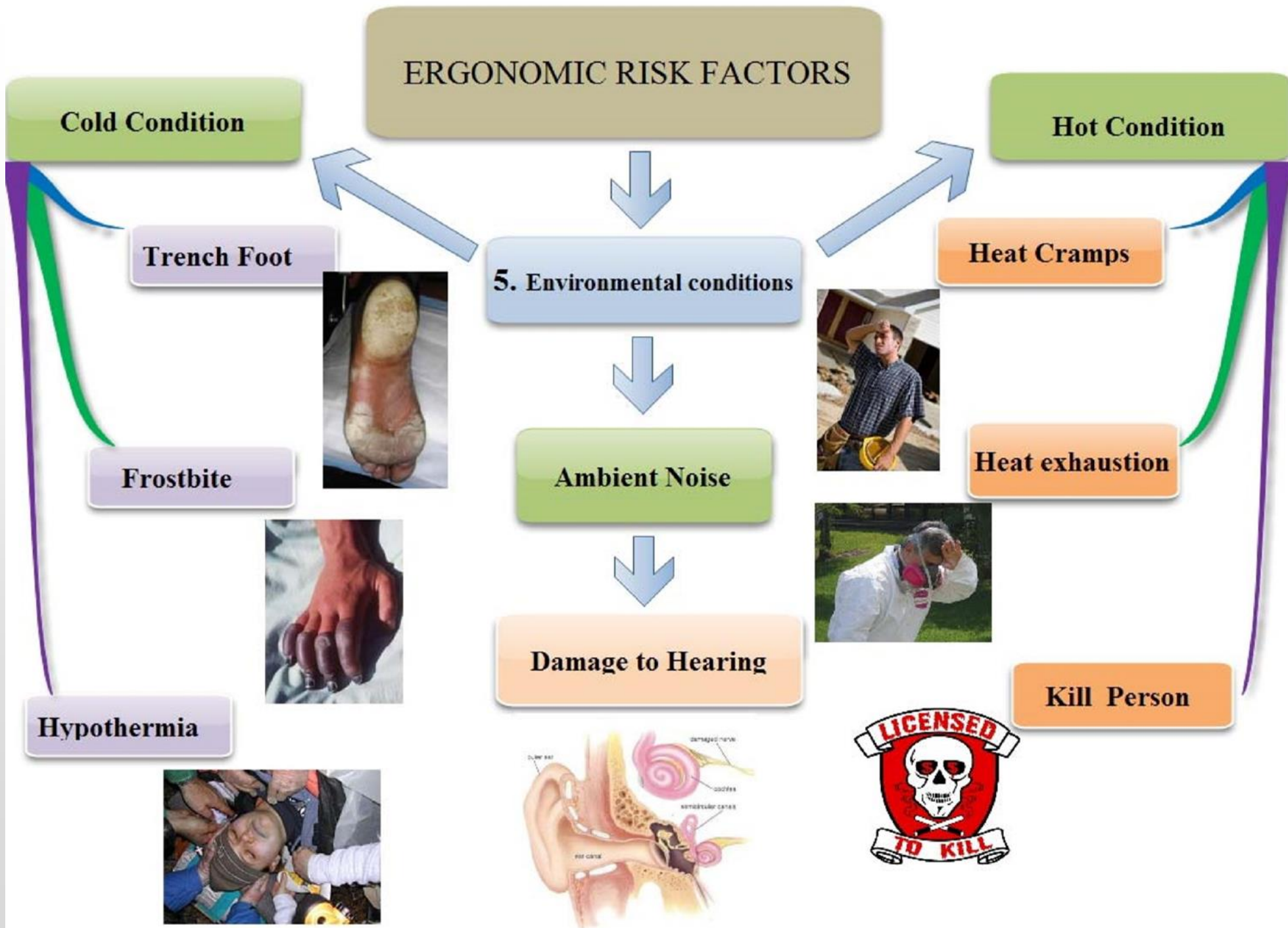


- ✓ Ensure that your hands, feet, face, head, and eyes are covered.
- ✓ Avoid getting wet,
- ✓ Keep moving,
- ✓ Take regular breaks in a warm location.

(Yale environmental health and safety, 2014)







# Ergonomics Risk Factors: Psycho-social Issues

- Stress, boredom, job dissatisfaction and anxiety can contribute to the possibility of developing a MSD.
- Psycho-social issues can create increased muscle tension and reduce a person's awareness of work technique.



Psychosocial risk factors	Description	Examples of risk factors being present in the workplace
Work demands and mental load	The mental and physical requirements of the job	<ul style="list-style-type: none"> <li>• Working very fast</li> <li>• Working intensely</li> <li>• High work load</li> <li>• High information processing demands Constant time pressures</li> <li>• Pressure to work overtime</li> </ul>
Job control	The amount of input that workers perceive they have over the way they do their work.	<ul style="list-style-type: none"> <li>• Little or no control over work speed</li> <li>• Little or no opportunity to schedule own work</li> <li>• Limited break opportunity</li> <li>• Poor task variation</li> <li>• Little or no opportunity to make own decisions</li> </ul>
Co-worker social support	The support that workers perceive they receive from co-workers.	<ul style="list-style-type: none"> <li>• Little or no help received from colleagues and immediate superiors</li> <li>• Poor willingness of colleagues and immediate superiors to listen to work problems</li> </ul>

<b>Psychosocial risk factors</b>		<b>Examples of risk factors being present in the workplace</b>
<b>Sense of community</b>	The degree to which workers feel that they are part of a community	<ul style="list-style-type: none"> <li>• Poor general atmosphere at work</li> <li>• Poor co-operation between colleagues</li> <li>• Poor relationships between colleagues</li> </ul>
<b>Management feedback</b>	The feedback that workers perceive they receive from colleagues and immediate superiors	<ul style="list-style-type: none"> <li>• Little or no opportunity to talk about work performance with managers</li> <li>• Little or no opportunity to talk about work performance with colleagues</li> </ul>
<b>Quality of leadership</b>	The degree to which workers perceive their immediate superiors to be good leaders	<ul style="list-style-type: none"> <li>• Poor ability of managers to plan work</li> <li>• Poor ability of managers to solve problems</li> </ul>
<b>Work stress</b>	The degree to which workers are experiencing signs of work stress	<ul style="list-style-type: none"> <li>• High levels of fatigue</li> <li>• High levels of emotional tiredness</li> <li>• High levels of frustration</li> <li>• Poor work-life balance</li> </ul>

# Disadvantages of Psycho-social Issues

- ❖ Workers have little control over their work and work methods (including shift patterns).
- ❖ Workers are unable to make full use of their skills.
- ❖ Workers, as a rule, are not involved in making decisions that affect them.
- ❖ Work is machine or system paced (and may be monitored inappropriately).
- ❖ Work systems limit opportunities for social interaction.
- ❖ High levels of effort are not balanced by sufficient reward (resources, remuneration, self-esteem, status)

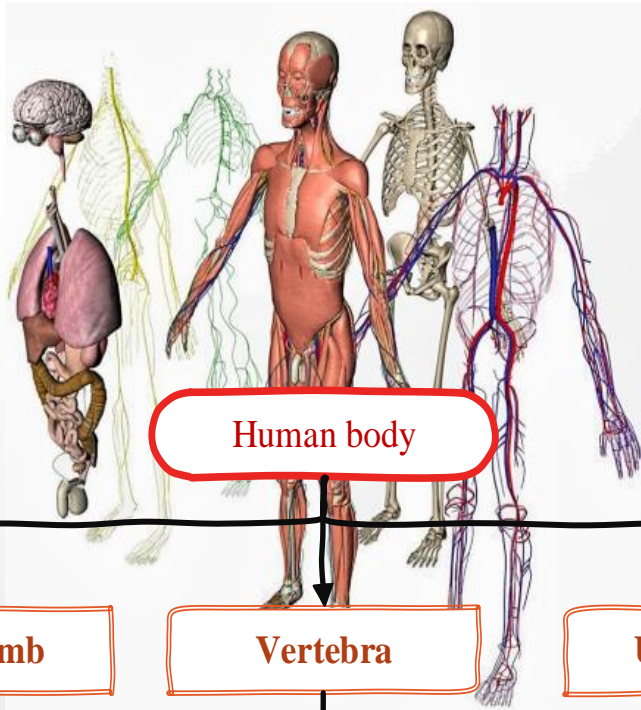
(What are psychosocial risk factors?, 2000).

# How can we reduce the risks of Psychosocial Factors?

- ❖ Reducing the monotony of tasks where appropriate.
- ❖ Ensuring there are reasonable work load (neither too much nor too little) deadlines and demands.
- ❖ Ensuring good communication and reporting of problems.
- ❖ Encouraging teamwork.
- ❖ Monitoring and control shift work or overtime working.
- ❖ Reducing or monitoring payment systems which work on piece rate.
- ❖ Providing appropriate training.

(What are psychosocial risk factors?, 2000).

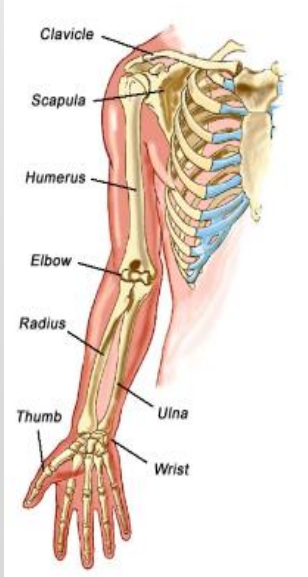
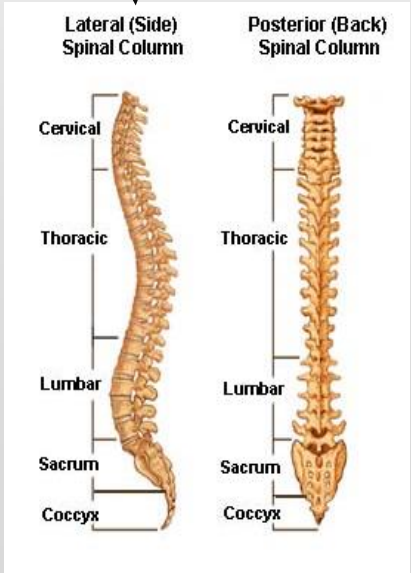
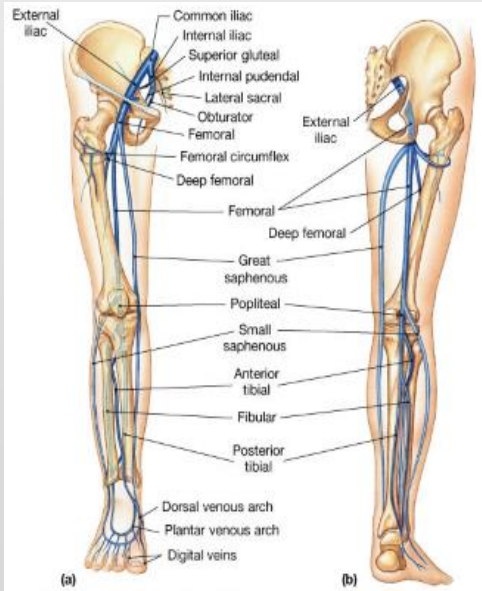
# Summary



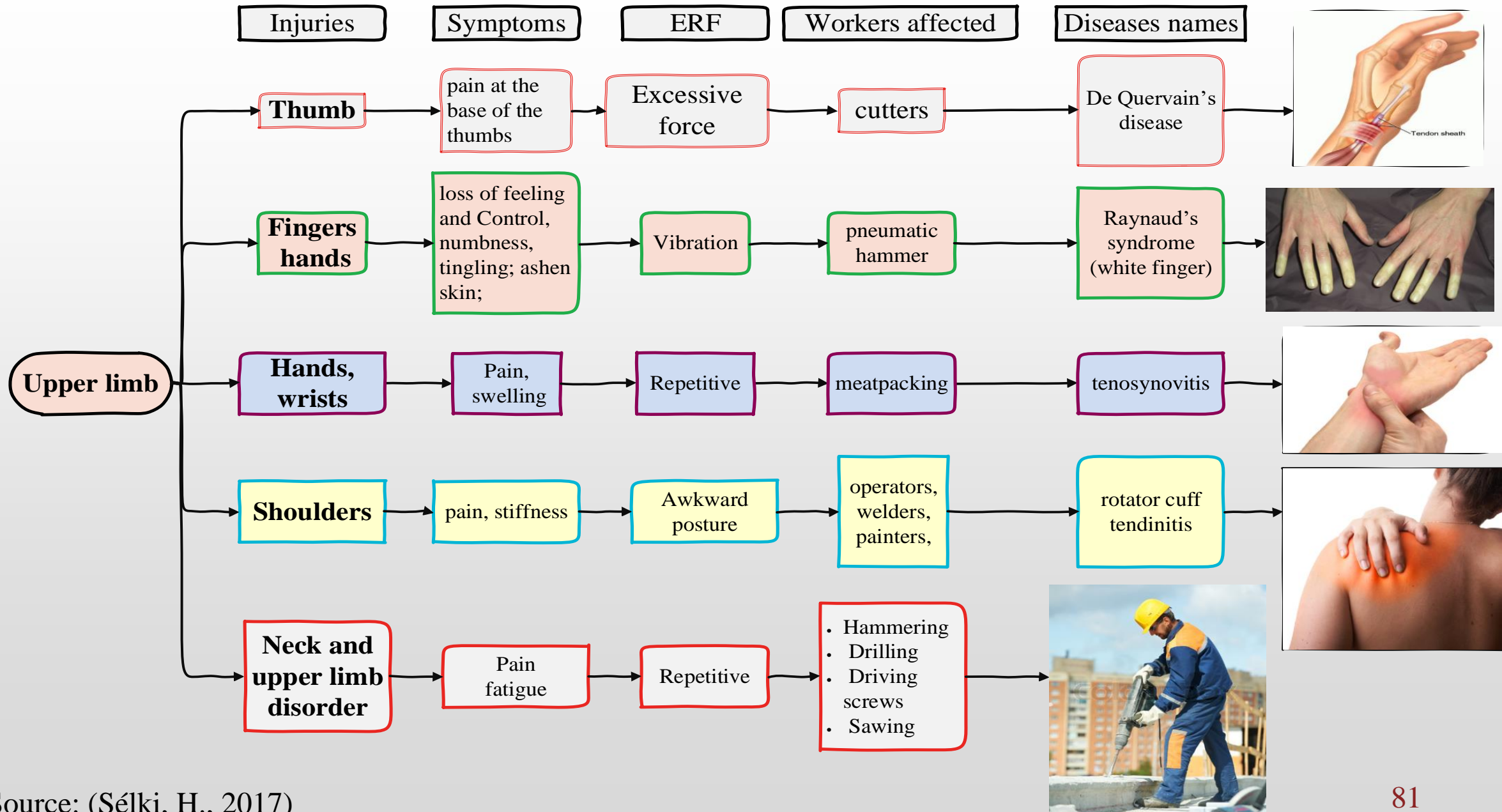
**Lower limb**

**Vertebra**

**Upper limb**







Injuries

Symptoms

ERF

Workers affected

Diseases names

Vertebra

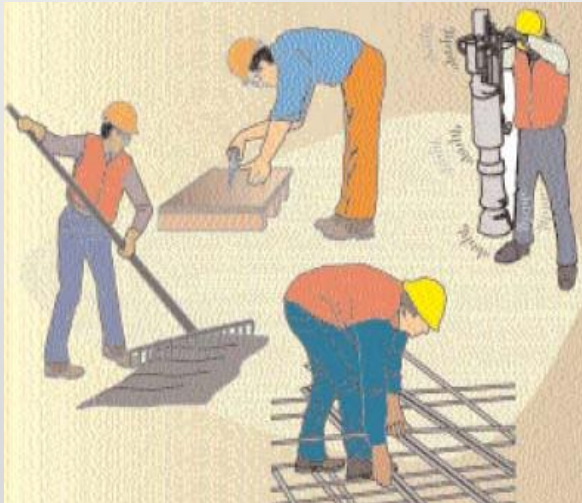
Back

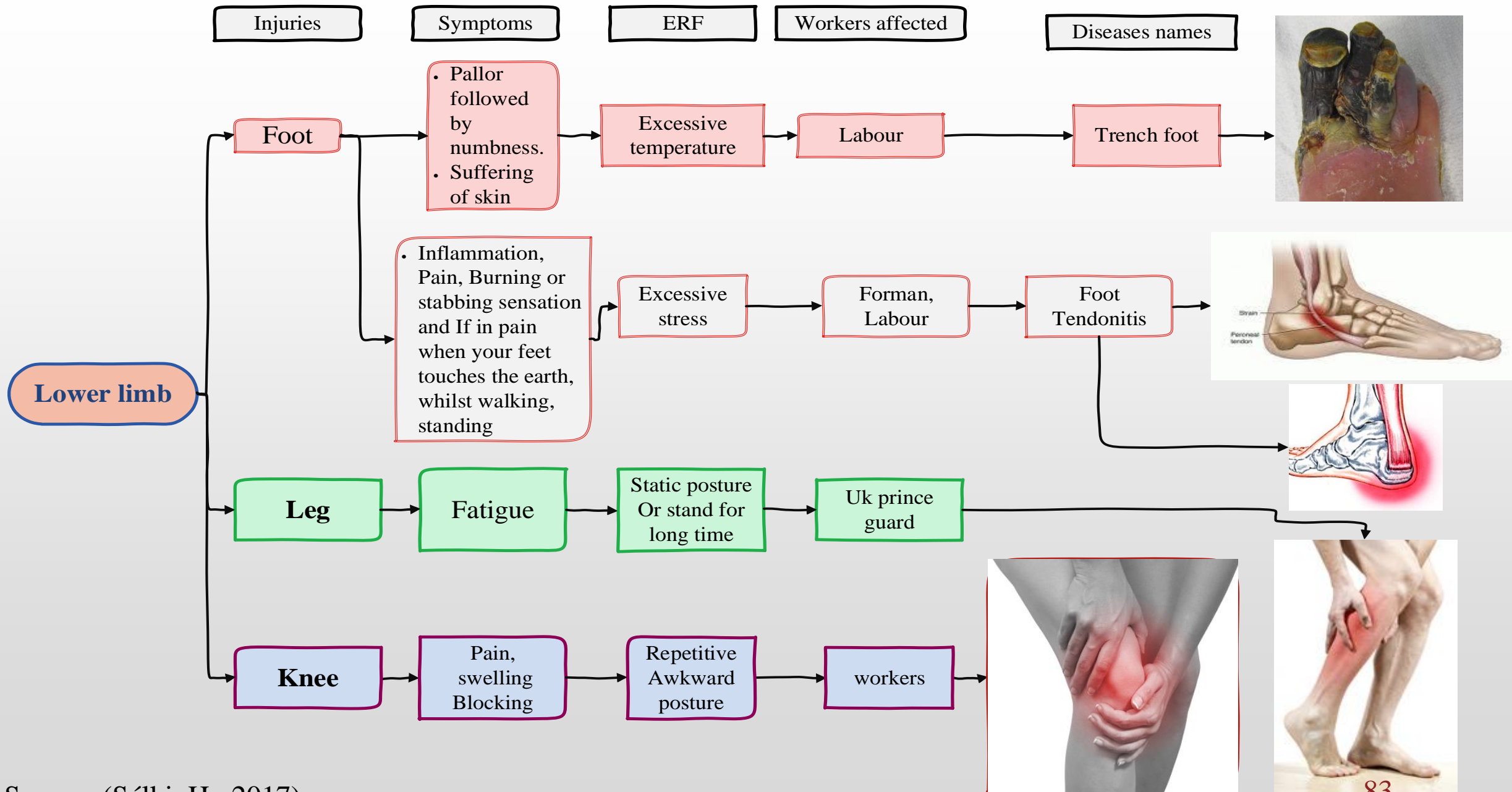
low back pain,  
shooting pain  
or  
numbness in  
the  
upper legs

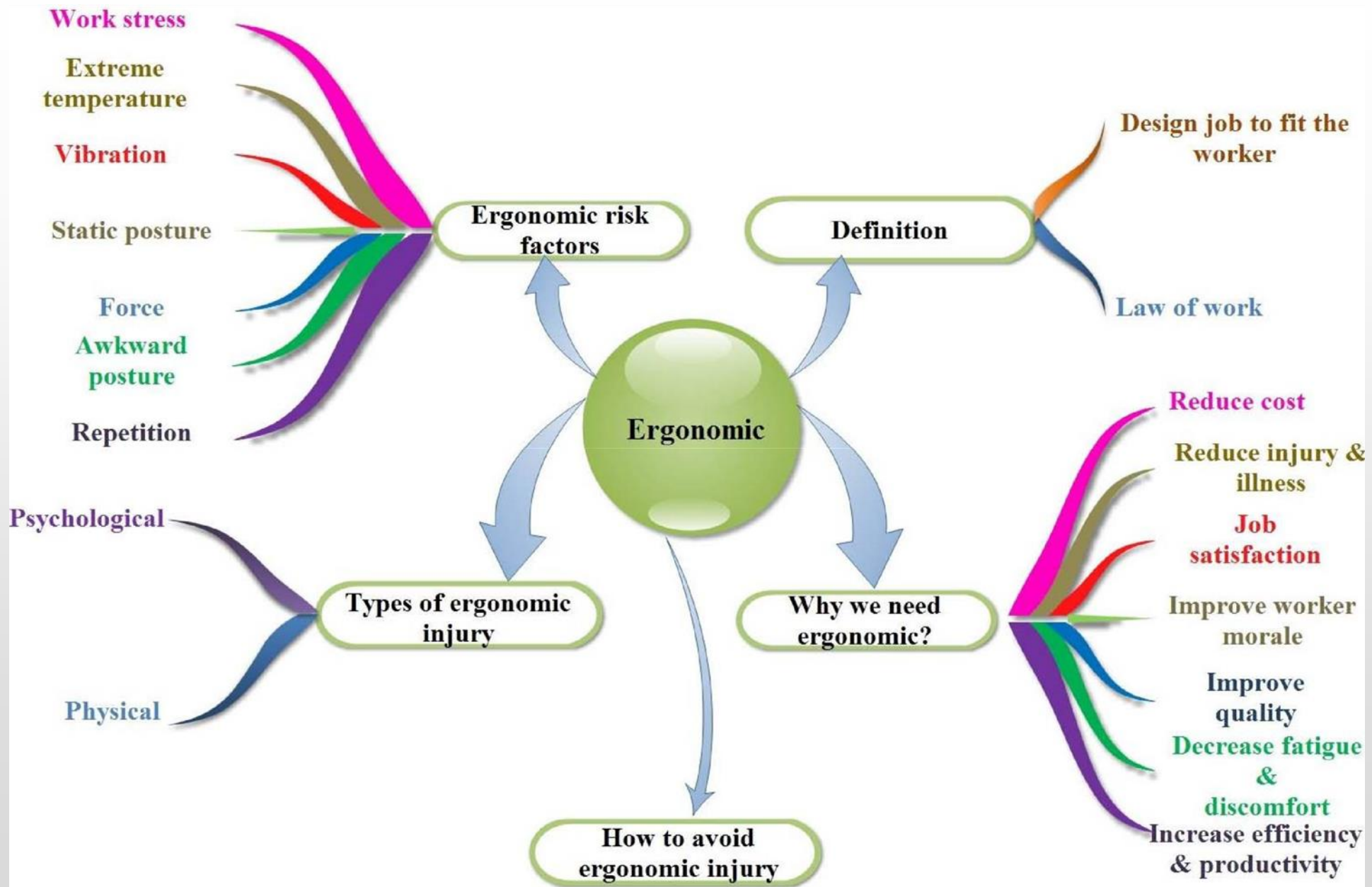
- whole body Vibration
- Awkward posture
- Static posture

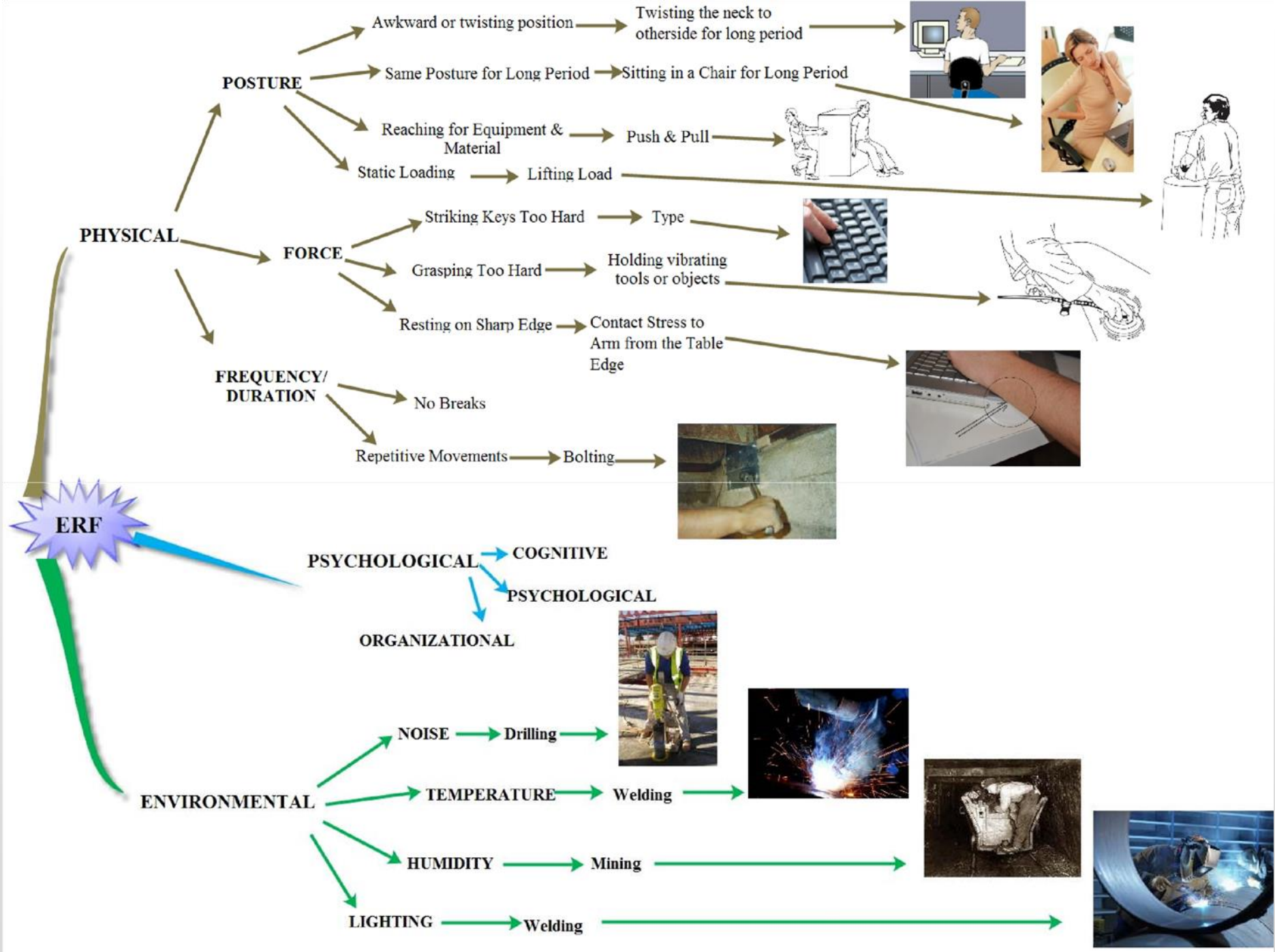
truck and bus  
drivers, tractor  
and subway  
operators;  
ware-  
house  
workers;  
nurses aides;

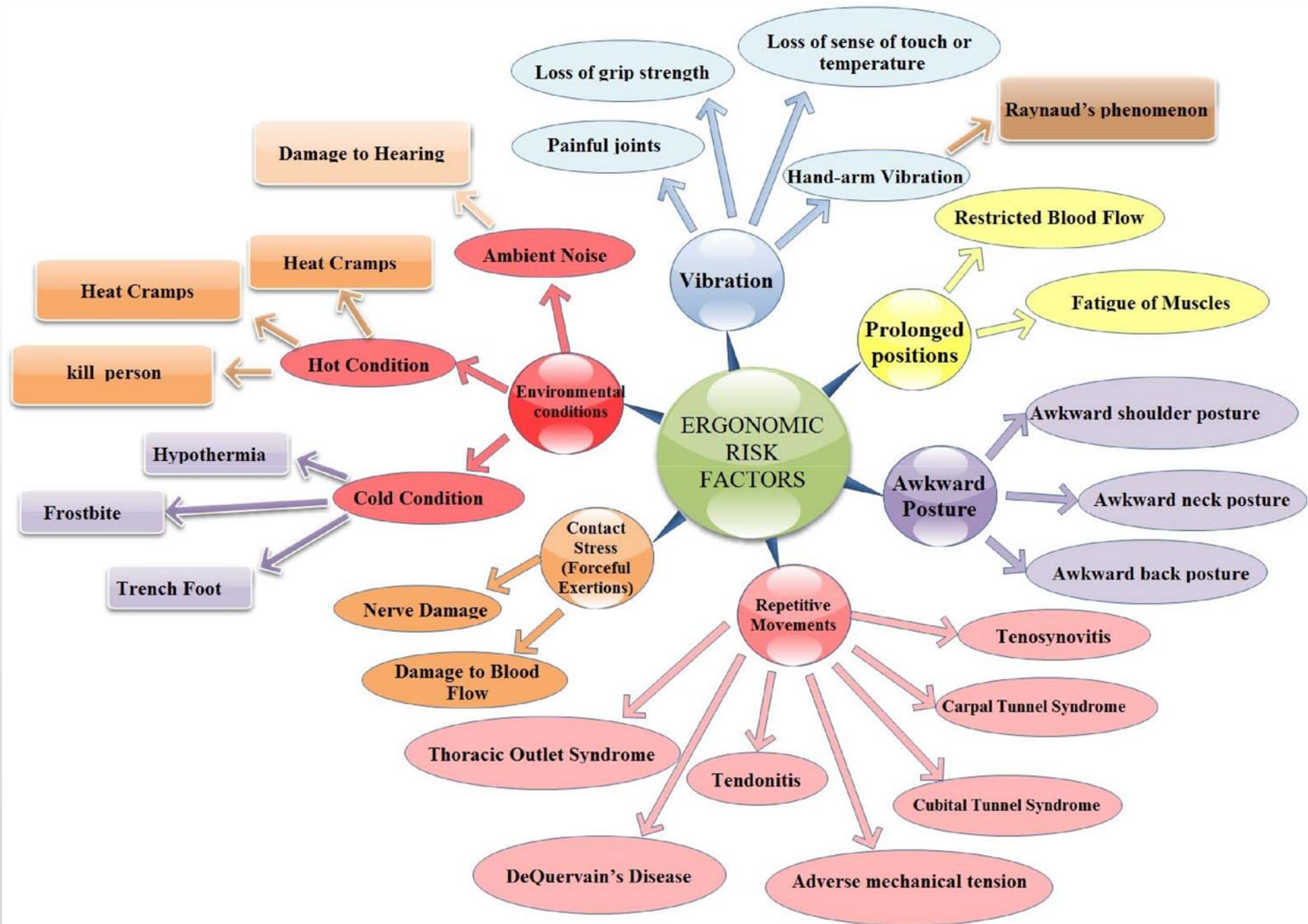
back disability













Thank you  
End of Chapter XIII  
Part A