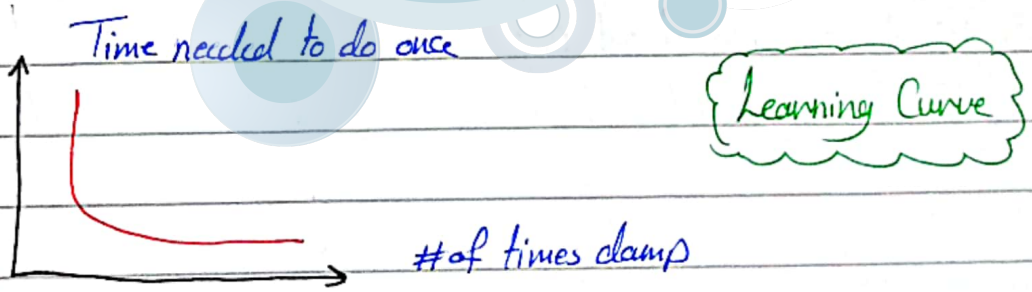
Subject Human Factors in Engineering Date No.

* Industrial engineers are "system engineers"
* As an engineers, we identify the problem.

* In general → The system is a combination of elements that affect each other.

* To check → you have to measure.
  - Audit : to check btwn planning & implementation (During all the time).
  - Feedback : review btwn outcomes & policy (At the end of management cycle).

⇒ The audit is interchangeable with inspection.



Learning Curve

KAIZEN TEAM

Subject Date No.

* 3 goals of human factors :
  - Safety → (Prevent injury)
  - Optimization / Performance → (reduce the error)
  - Competitiveness → (make people happy & comfortable)

* 3 branches of study human factors :

(Body) - Ergonomics : (Physical part)
  ↳ (Ergo + Nomics) which means "work rules".

(Mental) - Cognitive (Usability) :
  ↳ How the brain works for process info. & make decisions.
  ↳ establish in the brain by repeating.

(Soul) - Organizational Factors / Social Ergonomics :
  ↳ How to deal with people & how to interact with each other.

⇒ What we care about is :
The balance btwn human capacity & job demand.

KAIZEN TEAM

Subject Date No.

* Smart → relevant → short term goal, btwn long term goal.

(short-term goal had to be relevant to long-term goal)

* Ethics : is not about the action but about the impact of your actions on others.
  - Not to harm each other.
  - Make benifits.

iso : international organization for standardization

* ABet Code of ethics of engineers :

I. Using their knowlenge & skill for the enhancement of human welfare.

II. Being honest & impartial, and serving with fidelity the public, their employers & clients.

III. Striving to increase the competence & prestige of the engineering profession.

IV. Supporting the professional & technical societies of their disciplines.

* What does IISE stand for ?

The Institute of Industrial and Systems Engineers (IISE), is an international, nonprofit association that provides leadership for the application, education, training, research, and development of industrial & system engineering.

- Dedicated solely to the support of the profession & individuals involved with improving quality & productivity.

Subject Date No.

* Chunking : is a process of grouping information together and stores in a person's memory.

There are 2 major Categories of memory :

↳ Long-term memory : the capacity to recall memories from a longer time ago.

↳ Short-term memory : the capacity to recall a small amount of info. from a recent time periode.

⇒ So the phenomenon of chunking as a memory mechanism is easily observed in the way individuals group numbers. ---

For example : 395831295534684015 48

ا ← هاي الأرقام صعبة شوي نتذكرها وتحفظها لفترة لأنها عشوائية، يعني ممكن إنا نتذكر أول 6, 7, 8 أو حتى 10 بس مو معنى إنا نحفظهم كاملين (short-term mem.)

123588532112358853 21

ب لكن هاي الأرقام مرتبة بنمط معين سهلة لذاكرتنا إنها تحفظها وتخزنها (long-term mem.)

Subject Date No.

Social ergonomics : How to make people survive.
(we're survivalist.)

⇒ When we're under threat (face danger), the response prepares the body to either fight or flee. ((fight-or-flight response))
↳ (يعني في حال طلعلك حد بالشارع بالشوب)

* What happens to the body when you face fear/stress ??
Stress hormones like cortisol & adrenaline are released
→ your blood pressure & heart rate increase → you start breathing faster
→ your blood flows away from heart into your limbs ⟹ this making it easier for you to start fighting or run for your life.

⇒ Whether this threat is real or imaginary, the same triggers will happen to the body.

KAIZEN TEAM

Subject Date No.

NIOSH : National Institute for Occupational Safety & Health.

* stress increases the risk of illness, injury, and burnout.

* Job stress :- is a set of harmful physical & psychological responses that occure when the requirements of the job do not match the capabilities, resources, or needs of the worker.

* Sources of Job Stress

- Personal & Situational Factors
  - Personality.
  - Coping Skills.
  - Attitude.
- Working Conditions
  - Unrealistic deadlines & Workloads.
  - Lack of Control.
  - Lack of supervisory support.
  - Poorly defined work rules.

* Some personal & situational factors can reduce the impact of stressful conditions on health & safety
  - Balance btwn work & Personal life.
  - Supportive Coworkers.
  - Relaxed & Positive Outlook.

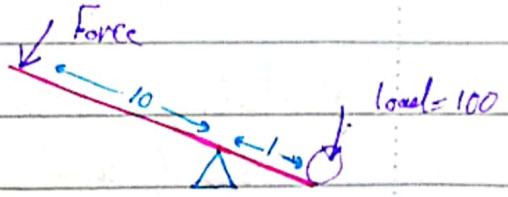
KAIZEN TEAM

Subject Date No.

* Anatomy and Biomechanics

mechanics : relationship of external & internal force with strength & load.

⇒ Lever systems

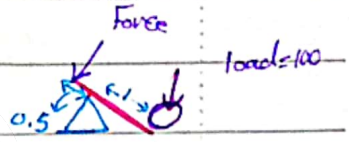


- $10 \times \text{Force} = 1 \times 100$

  $\text{Force} = 10\ N$

- mechanical advantage (η) $= \frac{L}{F} = \frac{100}{10} \times 100\% = 1000\%$

⇒ mechanical adv. : If the effort arm is longer than the resistance arm (more than 100%) ↳ less force is required.



- Here, we need to generate a big force (This is not smart)
- $F = \frac{1 \times 100}{0.5} = 200\ N$
- mechanical disadvantage $= \frac{100}{200} \times 100\% = 50\%$

⇒ mechanical disadv. : If the effort arm is shorter than the resistance arm (less than 100%) ↳ more force is required.

KAIZEN TEAM 改善

Subject Date No.

* Anthropometry → Anthro : human
  → Pometry : measurement
  (How we achieve the motion & how it's happen.!)

* Anatomy & Biomechanical
  ↳ (What's inside the human!)

Bones :
- 206 bones in the human body
- Support the body's framework
- Allow movement of the body

(See the slides)

Ligament :
made of very fine lines that connect bone to bone to hold the joints in place . (هو اللي يخلي العظام يرجع للشكل)

Joints → mobile joints
       → immobile joints

Degree of Freedom :- The no. of ways the joint can move
Range of Motion :- The angular displacement of the joint in each degree of freedom.

KAIZEN TEAM

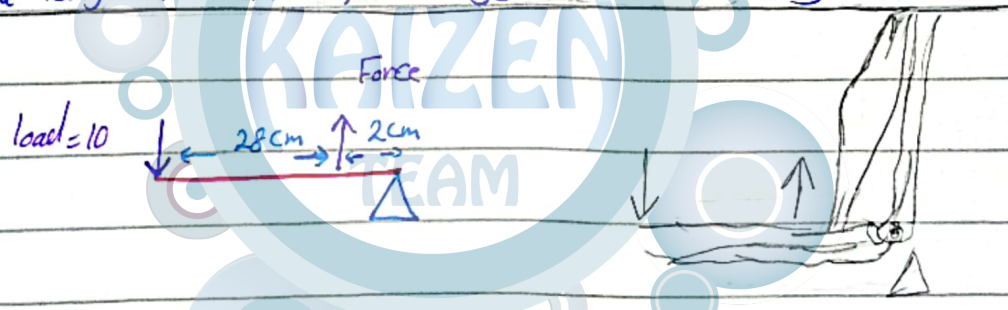
Subject Date No.

Tendons : (a white stuff)

- Attach muscles to bones .
- Very strong & inelastic .
- Some can withstand over 9 tones of pull force.

⇒ What makes the motion ? The muscles

- muscles are the motors .
- Connect to the bone طرف من with other bone طرف تاني من by joints
- muscles only contract to provide movement.
- when the body is stressed, muscles tense up.
- muscles could be prime mover or antagonist .
- the longer the muscle, the bigger the force they can do.



- $10 \times 30 = 2 \times F$ (muscle)

$F = 150\ N$ (The amount of force we have to exert is much more than the load)

- $\eta = \frac{L}{F} = \frac{10}{150} \times 100\% = 6.7\%$ mech. disadv.

⇒ So when we want to generate power, we use machines rather than people .

↳ because people are lousy machine with low efficiency.

NOTEBOOK

Subject Date No.

Nerves :

- Control muscles and provide sensory feedback.
- 25% of all Pacinian nerve endings (touch sensors) are in the hands.
- brings blood to the muscles.
* muscles don't move without signals brain.

There are 2 types of nerves :

- Sensory response : brings information to the brain from our senses
- Motor response : is connected to the muscle (moves the human)

改善 KAIZEN TEAM

Subject Date No.

* Muscles are made of fibers
* to know strength of fibers → use tensile machine
  if (force > strength) → failure

If
* Internal force on the fiber exceeds the strength → Causes failure
  ↳ so what damages the muscle is the internal force

⇒ Ergonomics Related Risk Factors :

1 Force : (How the force causes injury ?)
  ↳ when the internal force exceeds strength of the loaded fibers → it fails .

Subject Date No.

* muscles are made of fibers
* to know strength of fibers → use tensile machine
  if (force > strength) → failure

If
* Internal force on the fiber exceeds the strength → causes failure
  ↳ so what damages the muscle is the internal force

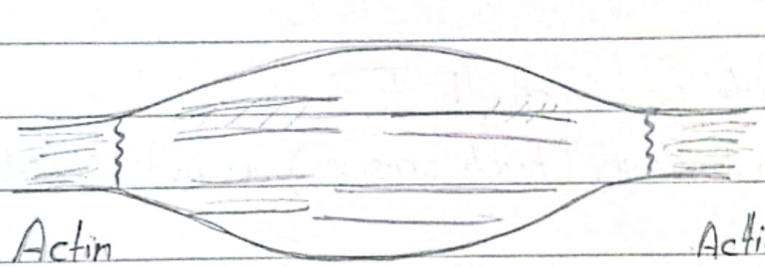
⇒ Ergonomics Related Risk Factors :

1 Force : (How the force causes injury ?)
  ↳ when the internal force exceeds strength of the loaded fibers → it fails.

2 Posture (It's about the best position in the body).

* Why the neutral posture is the best/stronger?
  1- muscles in relaxed length they are strongest
  2- the mechanical advantage of the system is optimize
  3- the loads are closed to the body (moment of the arm is shorter)
  4- bottom part of the back (disk) in the best position (in S-Curve)

KAIZEN TEAM



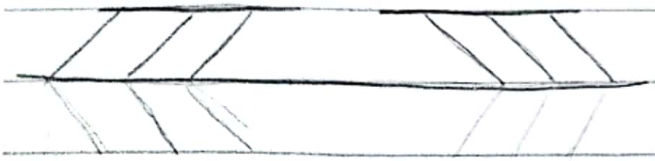
* The actin is connected to tendone → the tendon is Connected to bone.
* For each fiber there are Certain no. of bonds.
* Btwn actin & myosin there are ionic bonds. (أيونات الروابط البيتيدية ...)



The last 2 places we can't make benefit of them (we can't connect actin to myosin)
⇒ So less strength.



The best force that you can transfer btwn the actin & myosin is when the muscle in relaxed length.
⇒ the muscle strongest.



Here also you gonna have lesser chances of Connecting the actin to myosin
⇒ less strength.

KAIZEN TEAM

Subject Date No.

* The muscles are strongest when they're relaxed length because they're connected to the bone

* Muscles are the weakest length.

* If the external force causes an internal force on the fiber that exceeds its strength, this fiber will be cut (injury)

* During the Cramp injury → the muscle loses the connection with brain → So you cannot control the effected muscle
((Losing electrolytes))

---

* How to measure muscle force?

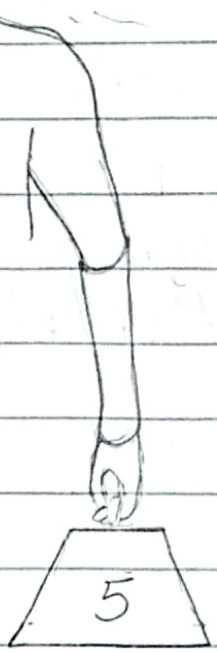
↳ By (MVC): Maximal Voluntary Contraction

- each muscle has MVC
- more than 15% MVC → Completely without O_2/no blood flow
  → So you feel tired quickly.
- the acceptable load value → 3 - 5% only

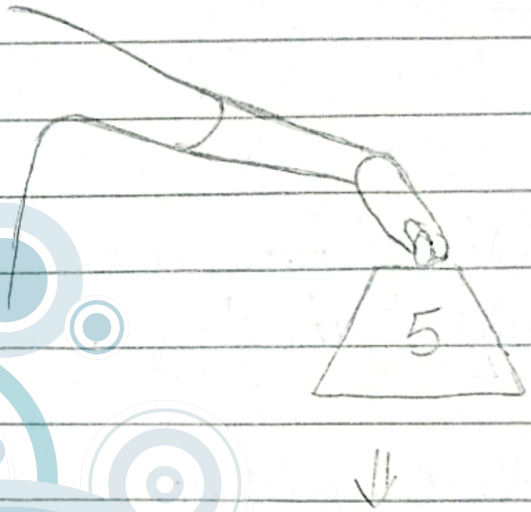
KAIZEN TEAM

Subject Date No.

* Which takes more work?



This way is easier to hold 5 kg → becaus it's Closer to the body ⇒ the moment of the arm is shorter.



It's hard to hold 5 kg in this way for a long time → because the moment of the arm on the back or shoulder is bigger.

* The distance btwn insertion point & fulcrum ↑ → bonds stronger

改善 KAIZEN TEAM

Subject Date No.

* Know your back.

⇒ We said that people when they get older they become shorter.

⇒ The structure of spinal column consists of 24 vertebrae
- → Cervical (7 bones)
- → Thoracic (12 bones)
- → Lumber (5 bones)



Spinal Column

⇒ btwn each vertebra (bone) and other one there is a disk

* The disk is basically round "pillow of jello" that seperates the bones & act as shock absorbers btwn each bone.

⇒ These pillows are ideal for withstanding compression, but they fail easily under torsion.

⇒ You have to keep these sits of the bone parallel (pure compression)

⇒ The back having the S-shaped curve
↳ because we want the load to transfer from bone to bone in a pure compression ⇒ that will safe the discs from failing

Kaizen TEAM 改善

Subject Date No.

⇒ Almost 1/3 of all injuries happen to the back.

to reduce it → Stand & sit up straight to keep your back in S-shaped.

→ Don't twist, don't carry and rotate.
(move your legs not your back)

⇒ The problems of discs:

1. No nerves in them (no warning for failure).
   ↳ This 2nd reason why we're lousy machine

2. No blood vissles → so we need to keep moving
   (Compression – decompression)

✱ 2 reasons to keep moving?

1. Healthy discs (related to the back)

The discs don't have any blood flow. They need O_2 & produce Co_2, they need food & produce waste, how?!

By (Synovial fluid) → the disk is submerged in the synovial fluid. and it exchange the nutrients, O_2, CO_2 from the disk through "Compression & release".

Think about the disk as sponge, in order to expell Co_2 & waste out, you have to press sicle then waste goes out.

KAIZEN TEAM

Subject Date No.

2- Encourage blood flow (related to the blood circulation).

By Contracting the muscle you press on the walls of arteries & veins. That will reduce the cross section of them and which reduce the blood circulated

When the muscle needs to contract, that means it needs energy, O_2, blood but at that time we prevent blood flow by contracting.

↳ 3rd reason why we're lousy machine

* Arteries & Viens

↳ They are flixable tube and they made of smooth muscles.

↳ They are inside fibers & btwn muscles and skin

KAIZEN TEAM 改善

Subject Date No.

Ch 2 : How the body does its work. (Metabolism)

⇒ The First law of thermodynamics is that :
Energy can neither be created nor destroyed, it converted from shape to shape.

⇒ Energy is required to : - enable growth & repair of tissue.
- maintain body temperature.
- Fuel physical activity.

⇒ Energy Comes From Foods.

* What do you get from food?
* Why do you eat?

we eat to get : - Calories.
- Minerals.
- Vitamins.
- Water. ⇒ water is very imp. to body, so that to keep health of the brain, health of the discs in the back, and muscles in general → keep drinking water (we need 3L / day of water)
- Fibers.

The fiber advantage is it keeps our stool hydrated & smooth, so the movement inside our intestines is good.

KAIZEN TEAM

Subject Date No.

Vitamins: are chemicals that are in the food.

2 types of vitamins

Fat-soluble	Water-soluble
They doesn't dessolve in water, they dessolve in fat.	They dessolve in water.
Vitamin A, D, E & K	Vitamine C & collection of B vitamins

{Back to the slides}

⇒ We can get vitamine D from milk.

↳ Because many people who live in places where sunlight is limited don't get enough vitamin d, now they're attach it in milk.

Minerals: when they're dessolved in water, they become ions and they're needed for nerve conductivity.

⇒ One of minerals that is hard to get by is iodine because many people don't get enough seafood, so that they attach iodine to salt.

{Back to slides}

KAIZEN TEAM 改善

Subject Date No.

* The types of food :

1- Carbohydrate (carbon & water)
2- Protein (animal & plant protein)
3- Fat

⇐ هاد الأكل بتحول لـ سكر (Glucose) ← لما بزيد في الدم البنكرياس باخد السكر وحوله لنشا (بتخزن في الكبد) ← لما بزيد النشا في الكبد بتكون دهون (fat) وبخزنه في المناطق اللي ما بتحرك.

* Energy Storage :

-Glucose : - The basic fuel on the human body is glucose.
- Everything you eat converted to glucose.
- The muscle uses sugar.
- If the sugar concentration in the blood increases, the liver will convert the glucose to glycogen.

-Glycogen (Starch) : If the concentration of glycogen in the liver increases, the liver transfer glycogen into fat.

- Fat : When the liver makes fat, it stores it in places that probably don't move much.

[Food you eat → extra glucose → extra glycogen → fat]

KAIZEN TEAM

Subject Date No.

* Energy Balance Equation (metabolism equation):

$$I = M = W + H + S$$

⇒ I : Ingestion
M : Metabolism.
W : Work.
H : Heat.
S : Storage.

Everything you ingest, will get metabolise and you will use it to do work, and with work you generate heat, and anything extra get stored. (no waste)

* Metabolism : → Chemical elaboration of energy stored in food.

→ The process by which the body changes food & drink into energy.

⇒ The beginning of the study of metabolism in 1624 by (Santorio Santori). He sat in a large weighing machine in order to account for the inputs & outputs of the human body.

KAIZEN TEAM

Subject Date No.

* Aerobic metabolism:

$C_6H_{12}O_6 + 6O_2 = 6CO_2 + 6H_2O + Energy.$

↳ in the presence of O_2 that is calling aerobic metab.

⇒ An aerobic produces less energy from the food.

⇒ When the respiratory system is not delivering enough O_2 to blood, ∴ then it will go into anaerobic metabolism

* Anaerobic metabolism

(In equation) → in the presence of CP, the energy is less than the other

↳ The problems of an anaerobic :-

1- It's inefficient (If you take one molecule glocus, it will make 36 ATP)

2- The production of lactic acid (when the concentration of lactic acid around the muscle is high, the muscle becomes weak)

KAIZEN 改善 TEAM

Subject Date No.

⇒ For every liter of O_2 you consume, you burn about 5 Calories

⇒ It's not practical to measure how much energy we produce & use by measuring how much food we eat, because it's complicated.

⇒ The aerobic eq. ⟶ tells us that energy elaboration from food is directly correlated to the amount of O_2.

* Measurement of O_2
This is called "Indirect Calorimetry" ⟶ instead of measuring Calories of food, we measure O_2

* Volumetric Oxygen Volumetric Capacity
⇓
VO_2 max
⇓
The maximum amount of O_2 a person can utilize aerobically.

* Aerobic capacity: is your ability to produce energy aerobically.
↳ affected by daily changes ⟹ mood / lack of sleep / lack of food / having a cold.

改善 KAIZEN TEAM

Subject Date No.

* How the VO_2 measured ?

↳ when the person stand on the treadmill we start increasing the speed, the movement increases, and therefore the O_2 Consumption increases.

⇓

we continue to increase until a point where if we increase the speed, the O_2 consumption is not increasing

⇓

That point would be present the max. volumetric oxygen Cons. that determines their capacity to produce the energy

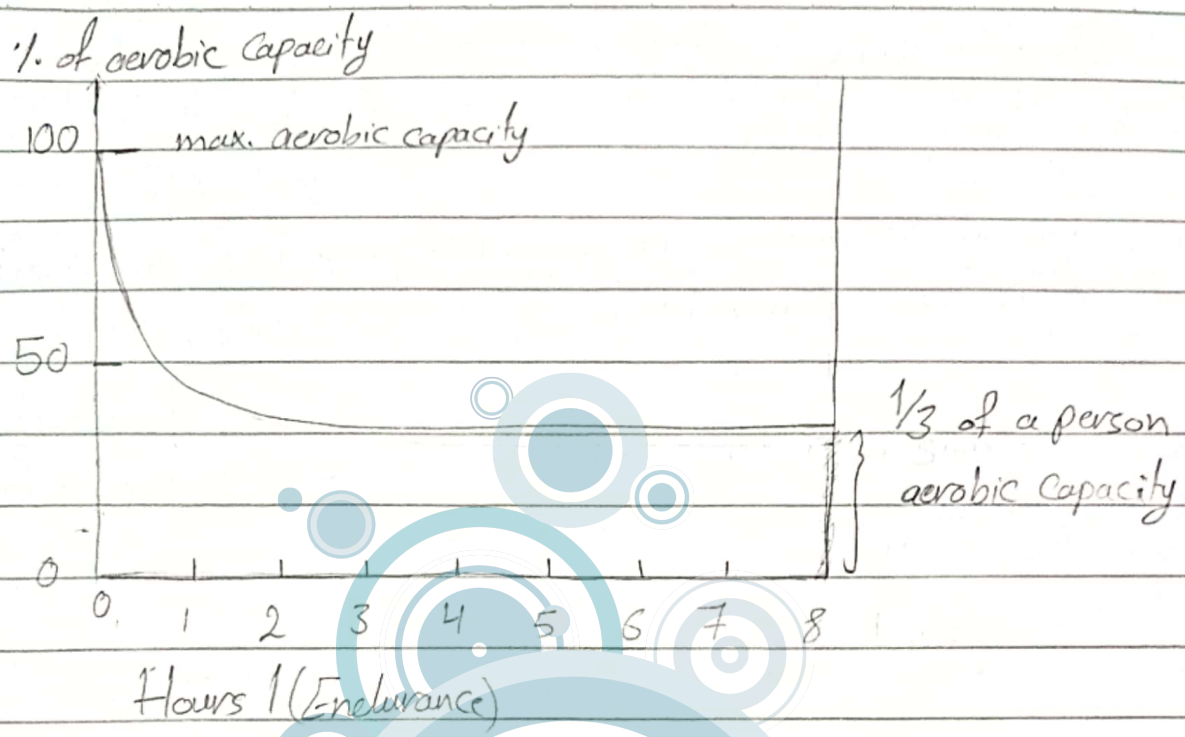
⇓

At that time we stop because then anaerobic mechanisms go into the muscles & produce lactic acid

⇒ The higher the ability to Consume O_2, the bigger the engine you're.

KAIZEN TEAM

Subject Date No.



⇒ A 100% in the C, the amount of time you can indure is zero.

⇒ If you're less than 1/3 → you are safe
⇒ If you're more than 1/3 → you are unsafe

* Work metabolism → is the O_2 consumption when you're doing the job.
* Resting metabolism → is when you're resting not doing anything, that is the least amount of energy consumed.

This level of metabolism going to keep your body alive

* Basel metabolism → (from basic) is same as resting but 2days before you are not allowed to eat any protein.

NOTEBOOK

Subject Date No.

* The Human Systems:
  - Respiratory
  - Circulatory
  - Metabolic

How these ↓ systems are controlled?

* Control mechanisms:-
  - Central nervous system :- The brain is the body's control centre: it sends messages to your body through "the nervous sys.", which controls your muscles, so that you can walk, run & move around.

- Limbic system :- is those systems that are controlled by the brain, but we don't think about it. (with time)
  It's similar to having learn something & get it to automaticity
  e.g. → heart rate

- Hormonal system :- It sends a chemical message to every part in the body
  Hormons are chemicals that are produced in glands in the human body to control it

KAIZEN TEAM

Subject Date No.

* Respiratory system (Breathing system)

↳ That's how you get O_2 inside your blood.
O_2 is important for the process of creating energy.

- Inhale → Oxygen
Air around us has 21% O_2, and the remaining is N_2

Exhale → Carbon Dioxide, Water, and Heat

The lungs and respiratory sys. letting the body get rid of CO_2 in the air breathed out.

your breath contains moisture. Because your mouth & lungs are moist, each breath you exhale contains a little bit of water in the form of water vapor.

you breathe out warm air all the time because your body temp. is normally higher than the environment. (37°) body

KAIZEN TEAM

Subject Capillaries sur Date No.

* Alveoli :- is a spherical space where the lungs & the blood exchange O_2 & CO_2 during the process of inhalation & exhalation.

  - It can expand in size like a balloon and once you pressure it, you can reduce its size
  - They never get to the point where their volume is zero

⇓

* Red Blood Cells (inside the capillaries surrounding the alveoli)

  - They contain a protein called "Hemoglobine", which is very important for transportation of O_2 & CO_2

(ينقل O_2 من الرئتين إلى الدورة، وينقل CO_2 من الدورة إلى الرئتين)

⇓

* Co (Carbon monoxide) → Connect to hemoglobine & doesn't leave. It happens when you have incomplete burning of fuel.

* Minute volume : the amount of air that you intake in your lungs

改善 KAIZEN TEAM

Subject Date No.

* Risk Factors :-

3- Repetition - is about the rate of repeating the muscle contraction.
- every muscle contraction requires energy.

- If the blood is not supplied in enough quantity meeting the demand for contractions → go into anaerobic metabolism → increasing the concentration of lactic acid → the muscle weakens.

- If there is no repetition → increase your risk of injury → Causes (lactic acid) muscle soreness.

* Carpal Tunnel Syndrome (type of injury)
It causes pain in your fingers, hand or arm
↳ this pain preventing people from having good night-sleep or to do their jobs.

- The most commonly throught of factor is repetitive trauma to the content of the tunnel at the wrist.

↳ due to activities which involve frequent movements of the fingers.

KAIZEN TEAM 改善

Subject Date No.

* How the Carpal Tunnel Happen ?!

Fingers don't have muscles, → they connected to the tendons that they connect to the muscle.

The sheath → is covering that attach to the bone
↳ inside the sheath is tendon

⇒ The fingers are moved through the relative movement btwn tendons & tendons sheath. → this causes friction

⇒ The friction causes → heat → btwn the tendon & sheath there is a lubricant called "synovial fluid" → so when do movement the lubricant will make that smooth with no damage. If you do it so many times → every time you generat heat and it becomes hot.

Hot → the lubricant loses its ability to lubricate → the tendon & sheath ripping against each other → injury

Micro injury → causes inflammation → the body responses to inflammation by sending Contisone → Contisone attract water & accumulates it which causes swelling.

改善 KAIZEN TEAM

Subject Date No.

* 2 types of inflammation
  - inflammation caused by germs
  - inflammation caused by injury

* 3 Types of injuries in the body
  - Any fiber that is cut under tension
  - Nerve tensions
  - What happen to the vertebral discs

* Mechanism of Harm:
  - Wear & Tear → because of friction → when you rub two things against each other → you gonna tear the surface of each. (make the parts weaker).

  - Causing nerve pinching through the CTS.

KAIZEN TEAM 改善

Subject Date No.

* Risk Factors :

4- Rest (Lack of rest → leads to build up of harmful by products of metabolism → which will make muscles & fibers weaker and more susceptible for injury.

* Why we take a break ?

↳ Due to O_2 deficit → the system not deliver O_2, it need time to give muscles this required level of O_2

⇒ To avoid happening the O_2 deficit → we need to make balance (work rest cycle)

⇒ Short breaks are better → due to the avg. level of fatigue is low, so that make you fresh

↳ you become healthier.

⇒ We try to take a break before we get tired.

改善 KAIZEN TEAM

Subject Date No.

** Revision **

* Explain the ergonomics related five risk factors.

1- Force :- loads & exertion are interrelated, but what directly affects the fibers is the internal exertion forces.

↳ Overexertion happens when the exertion force is over or higher than the strengthe of the fibers, which will cut or tear fibers & cause injury to the muscle.

Normally, the human body would not exert forces higher than what it can withstand, but with motivation or pressure muscles can contract beyond the safe limits of the (MVC)

2- Posture : Is the position in which someone holds their body.

In order to reduce exertions for the same load, work or activity should be done from an optimum position ⇒ The Neutral Posture.

改善 KAIZEN TEAM

The neutral posture is the best, why ?

- muscles in relaxed length & they are the strongest.
  - The Connection btwn actin & myosin is better
  - # of bones are achieved is maximized
- the mechanical advantage of the system is optimized.
- the loads are closed to the body → moment of arm is shorter.
- the back (disk) in the best position (S-Curve)
  (the pressure on the spinal disks is minimized.)

3- Repetition :- Is related to the frequency of contractions.

High frequency → produce high levels of friction btwn various parts of the body → leads to wear & tear, increase of temp. & loss of lubrication property of synovial fluid, over consumption of electrolytes → cause fatigue & increase the risk of injuries.

Static loads (no freq. of contraction) → are danger as high freq. tasks, because contractions reduces the flow of blood, and spinal disks deprived from nutrients (لأن تغذية الـdisk من خلال السوائل حتى بالوقت)

KAIZEN TEAM

Subject Date No.

4)- **Rest** :- Actually, it is the lack of rest.

The muscles need to rest after the work in order to make up for the O_2 deficit it occure.

If the resting period & activity is not enough to balance the defect of O_2 ⟶ the muscles become fatigued & the risk of injuries increases.

Changes in activities is needed during resting periods in order to encourage blood flow, and the feeding of the vertebral disks.

KAIZEN TEAM

Subject Date No.

* Nervous System is make up of : - The Brain
- The Spinal Cord.
- The millions of nerve cells

* Circulatory System is make up of : - The heart
- Arteries & Viens
- Very thin blood vessels called "Capillaries"

* Blood is make up of : - Red blood cells carrying O_2
- White blood cells that fight disease
- Platelets that help the blood to clot
- liquid called "plasma"

* Digestive System is make up of : - The alimentary canal.
- The liver
- The pancreas.
- other organs.

KAIZEN TEAM

Subject: Working in Hot & Cold Environment Date: No.

Thermal Comfort : is the condition of the mind that expresses satisfaction with the thermal environment.
↳ has a lot to do with the the temp. of the room

⇒ The temp. of the human body be at 37c.
↓
How can we keep 37 constant?
↳ It is an acting balance btwn heat gain & heat loss (through several mechanisms)

Heat transfer → Heat(Q) always moves from T-high to T-low (high temp. → low temp) → $T_2 > T_1$

⇒ The longer the rod of material, we gonna have a different gradients of temp.

⇒ The bigger the area, the bigger the heat transfer.

⇒ The higher Conductivity (k), the more heat you can conduct through the material.

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Subject Date No.

* Modes of heat transfer
↳ depending on the medium

- Conduction
(If heat transfer through solids & depends on temp. difference, area & material)

- Convection
(Is done through Fluids (water, air) & depends on temp. difference, area & material)

- Radiation (Does not need a medium (Vacuum))
(temp. difference)^4 → increase in the amount of heat as the temp. increase, but a higher level than others

* Evaporation : It is heat loss / gain through change of phase
(solid → liquid → gas)

Water evaporation (Latent heat) → when a molecule change phase from liq. → gas (water → vapor), it takes latent heat.
⇓
latent heat is much higher than what is needed to increase the temp. of the liquid

** Latent heat → is how much heat needed to evaporate 1 kg (

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Subject Date No.

Relative Humicity → affects the cooling & the amount of water we can evaporate.

↳ is a percentage that represents the amount of water vapor in the air at a given temp. compared to the max possible water vapor amount at that same temp.

10% Relative Humicity → the amount of water in the air is 10% of the max. amount of water that the air can hold.

⇒ High Humadity decrease evaporation (No evaporation at 100% RH)

Insulation → is a material that we put on the stuff that the mode of Heat transfer through it would be Conduction

⇒ It has low conductivity (k) →

** The most common insulation material depends on the quality of air to conduct heat (air is good in Convection) ,but if you try to make the molecule heat, it will be very poor Conductor (means it is good insulator)

KAIZEN TEAM

Subject Date No.

⇒ Fur of the bear → living in the cooler region
↳ he has a thick fur made of hair → btwn the hair there is air and it is a poor conductor of thermal which keeps the body of the bear warm

⇒ Other insulation materials : Polystyrene & fiberglass.
made of air inside

✱ Thermoregulation

⇒ T_{core} is greater than T_{shell} by about 4 to 20 degrees.

⇒ It is important to keep the core temp. 37°
↳ Core is what inside of body that contains organs.

⇒ The body controls the blood flow to the shell (the extremities)
→ by controlling, if you feel hot, the arteries & veins will send more blood to the skin → becomes more red
→ If you're cold, the skin becomes white (arteries & veins closes)

✱ If you're hot, you're red in the blood circulating on all of your body
✱ If you're cold, the blood circulation in the shell is very min.
✱ When you sleep → your muscles relaxing → veins & arteries are open so the skin hotter

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Subject Date No.

* 2 types of people (Eskimo vs. Maasai)

- live in a very cold region
- live in a very high temp. region

- Eskimo people → they are short & fat (gives them more insulation → smaller area to lose heat)
- Maasai people → they are very tall, so they have bigger area transfer heat

** smaller objects will heat faster than bigger objects.

⇒ What happens if Eskimo person ~~two~~ travel to work at the equator with the Maasai?
↳ Their shape will not change (shape changing is genetics) → there is a mechanism happens in the body called "Acclimatization"

Acclimatization → is a process that the body regulates its response to increase in temp. of the core temp.

moving from cold/mild to hot climate → the heart rate increases & pump more blood, so the blood pressure increases → more sweating occurs → reduce a person's ability to do physical & mental work.

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Subject Date No.

* What are the health effects of heat stress?

↳ The major effect of heat stress is Oxygen Solubility. The amount of O_2 dissolve in the blood and therefore the amount of oxygen delivered normal to muscles & organs.

Heat Injuries:

- Heat Rash: red skin, itching, over sweating or no sweating at all → happens because of vasodilation
- Radiation Burns (Sunburn): the heat comes from outside → the skin cells heat up to the point where they killed (die)
- Heat Fatigue: a normal load in a normal enviro. will not be a normal load in hot enviro. → it can be over load then feeling fatigue
- Heat Syncope (Fainting): If you continue working at the same level of loading → you might suffer from fainting (not enough O_2 coming to the brain)
- Heat Cramps: uncontrollable contraction of the muscle, because the brain lost connection with muscle (no ions)

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Subject Date No.

- Heat Exhaustion: Continuous exposure to hot environment → increase heart rate & blood pressure → once you stop working, you go to normal → this cycle of changing of heat response → effects to a point where the body cannot adjust anymore if you don't rest.

- Heat stroke Medical Emergency: means damage because of lack of oxygen
  ↳ Could happen to the brain, heart or any part of body.

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Subject Date No.

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Working safely in hot workplaces.

* When we design in hot work, we have to make sure that the core temp. of the person doesn't increase for long time.
  ↳ we can control that by giving the workers more breaks to cool down. (Cooling breaks)

* To design rest breaks, we need to know:
  - the level of metabolism.
  - the temp. of the environment.

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Subject Date No.

Measuring temperature.

WBGT (Wet Bulb Globe Temp.): is a type of appearent temp., which takes into account: air currents, relative humidity and solar load.

(WBGT) device has 3 thermometers inside:



Globe temp.
↓
measures solar racliation.

Wet-bulb Thermometer
↓
measures the rate of water-evaporation.
(↑evap. → ↓temp.)
↓
The most important temp.

Dry-bulb Thermometer
↓
measures the temp. of static air.

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Subject Date No.

WBGT & TLV - Screeng.

* As the temp. increases, the amount of breaks to cool down increases.

* As you move from light → mod. → heavy, you generated more heat and the temp. goes down.

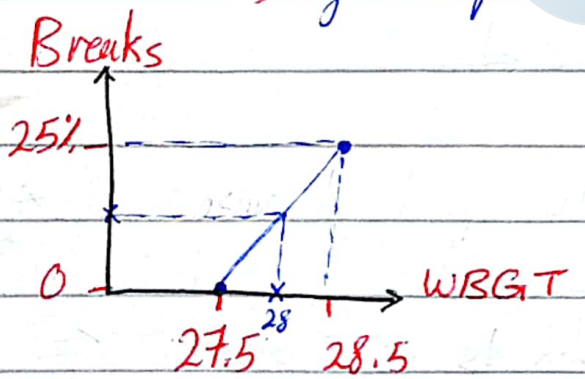
Calculations:

① Once we measure the WBGT, if we have a temp. of (28) and the level of work is moderate, what % of breaks we should apply?

Solution:

28 it comes btwn 27.5 & 28.5

↳ by interpolation formula: $y = \frac{(Y_2 - Y_1)}{(X_2 - X_1)} * (X - X_1) + Y_1$

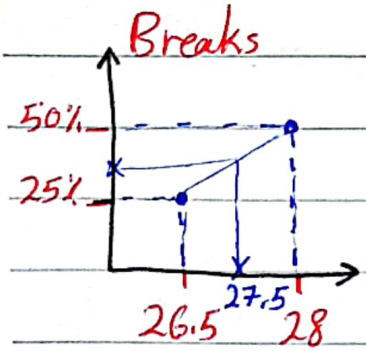


$\Rightarrow \frac{(25-0)}{(28.5-27.5)} * (28-27.5) + 0 = 12.5\%$

⇒ Cont WBGT

② New hired employee (unacclimatized), doing moderate work at temp. 27.5.

⇒ 27.5 it comes btwn 26.5 & 28
btwn 25 & 50 % rest



⇒ By interpolation

$$\frac{(50-25)}{(28-26.5)} * (27.5-26.5) + 25 \approx 42\%$$

③ To measure the temp. at 31, and the level of work is heavy.

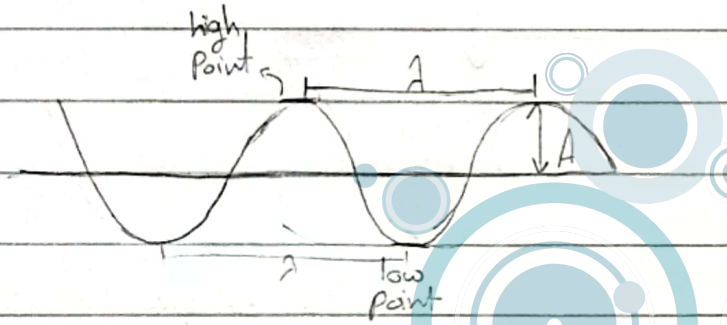
⇒ There is no work (it is not allowed)
↳ the max. temp. of heavy work is 30°

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Subject Noise & Vibration Date No.

* Noise & Hearing Conservation.

- Sound are usually represented by waves



wave length (λ) : distance btwn two successive crests or troughs of a wave.

Amplitude (A) : the peak height.

X-axis → is usually time or distance.

Y-axis → the pressure.

⇒ The sound waves is made of finite pieces of air (high pressure, low pressure...) and makes the waves → So, Sound is a pressure wave

* How to measure the sound ?

↳ Sound is energy that travels in waves.

measured in

- Frequency
- Amplitude

KAIZEN TEAM

Subject Date No.

* How to measure the sound?

Sound is energy that travels in waves.
measured in

Frequency	Amplitude
Reported in Hertz (Hz).	Reported on the decible (dB)
Measures the # of sound vibrations in one second	Measures its pressure or forcefulness.

⇒ we measure sound by decible.
↳ (there is decible meter or sound meter)

⇒ Near silence is expressed as (0 dB), but a sound measured at (10 dB) is 10 times louder

⇒ If sound measured at (20 dB), that's 100 times louder than near silence

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Subject Date No.

* What's the difference btwn Sound & noise ?

Sound → Any mechanical vibration that results in auditory vibration (Contains information).

Noise → Any unwanted or undesirable sound. (Containing no information).

For example Rock & roll, which is very loud music, could be pleasurable sound to one person and a noise to another.

* The anatomy of ear.

⇒ The outer ear contains pinna, & the external auditory canal (meatus) → at the end of canal we have the tympanic membrane → attached to the membrane we have 3 smalle bones (mallues, Incus & the staps) → as the wave comes and affect the diaphram, this linkage of bones will transfer the mechanical motion from the diaphram to the sensor → the sensor (in the inner ear), which is cochlea shaped.

⇓

There are 2 sensors →

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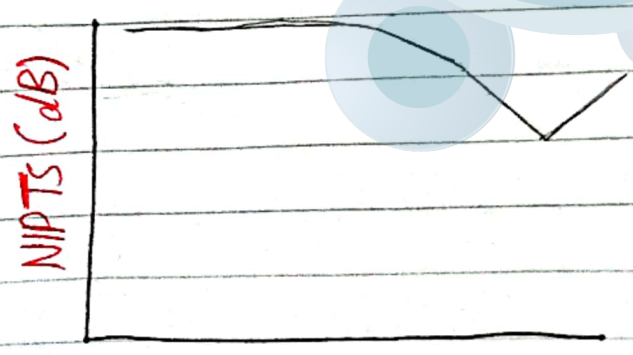
Subject Date No.

There are 2 sensors

↳ one is the Cochlea Cell (has round cross section) is filled with fluid that as it moves, it connects nerve ends and the signal transfered from mechanical (through the Cochlea) to electrical that goes to brain. ⟶ So what goes out of Cochlea is auditory nerve, which is connected to the brain (understanding)

⇒ The sensore gives us the sense of orientation
↳ Vestibular nerve

⇒ There are 2 nerves connected from the ear
↳ Auditory nerve.
↳ Vestibular nerve.



- Healthy hearing.
- Hearing range extends btwn 20 - 20000 Hz.
- Most critical is 500 - 4000 Hz

This is a hearing test / auclio graph for a person

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NOTE

Subject Date No.

Noise . why is this a problem ?

↳ because you could lose your hearing

- Effects on hearing → you might become deaf if you're exposed to high noise level continously.

- Effects on Communication → If you're talking to a person in a factory, and find yourself you have to shout → that means the noise level is above (85 dB)
(can't talk to people nearby)

- Effects on safety → people might not hear a warning signal or a hook of a car → this may cause an accident.

- Effects on mission performance → high noise level (100) → longer time to perform a task.

Threshold of Hearing → (0 dB) → you start hearing → you probably not understanding but you know there is a sound.

Threshold of pain → (140 dB) → it causes pain

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Subject Date No.

* Effects on Hearing

The ear has a self protection mechanism. If the noise is too loud for you, it will become less sensitive.
(it increases tension of the membrain & reduces the amount of the vibration transfer to the sensor)

⇒ The ear try to protect it self.

⇓

When you're in a party → there is the loud music, shouting & talking
→ if everything is stopped, you still have some kind attention or pressure on your ear that prevents you from hearing.

⇒ At that time, when you exposed to high noise, you (the ear) did temporary threshold shift (TTS)

(TTS) → shifting the minimum amount of noise needed or sound level needed to hear to higher level

⇓

Continuous occuring of (TTS), will lead to (PTS) permanent threshold shift
(If you always get expose, at the end you get like the ear stuck in the shift & becomes permanent)

⇒ The damage it could happen to the Conductive, sensory part.

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Subject Date No.

Noise-Induced Hearing Loss (NIHL)

↳ occurs when structures in the inner ear become damaged due to loud noises.

↳ when the hearing loss is rooted from a traumatic occurence.

(Occupational Safety & Health Administration)

OSHA 90

New OSHA 85 → The law identify a sound level at work that is safe.

85 or less → you don't have to do a hearing protection programs.

85 or more → you have to do a hearing protection programs.

⇒ This says that if the noise is (85 or less), you can work 8 hrs without any problem.

⇒ values of New OSHA → the pattern by adding 3 (+3)

⇒ values of hours → the pattern is halfing (*½)

safe exposure time

⇒ Knowing that 85 is safe limit for 8 hrs in the law

Subject Date No.

* Requirements of a Hearing Conservation Program

Noise survey (Noise mapping) : is to know the noise level in every part in your facility.

↳ we make a grid and in each node we measure the noise with a sound meter, then we connect the equal. lines & create iso noise level lines → it will show where is the acceptable level of noise (85 or less) and where is the unacceptable noise level areas and it can show where is the noise source (it could be the noisest place in the area of map)

⇒ Hearing loss might because by work and noise or by sickness.

⇒ at 85 & 80 dBA → 5% of people will experience also hearing loss → this because aging or the way they're health

⇒ They choose 85 → because that is how low is made it is a comprimized btwn the safety or the risk of having people injured & the cost of the implimintation of hearing prog.

Subject Date No.

* Methods For Noise Reduction

Source
- Modification. put a better bearing
- Substitution.
- Retrofit. you add things to it to make the noise damping
- Relocation.

Path
- Absorption.
- Enclosures.
- Partial Barrier

Receiver
we can do hearing production devices
- Relocation / Isolation.
- HPD's
- Administrative Control.

* How to Calculate a daily dosage.?

↳ If you work 8 hrs at 85 dB, that means that your full dosage is done (8/8 = 1 = 100% of your daily dosage hrs been consumed)

If you work 4 hrs (4/8 = 1/2 = 50% of the dosage is done

⇒ If you gonna work at 88 area you only have remaining 50% of your daily dosage and at 88 (means 50% * 4 = 2 hrs)

so working 4 hrs at 85 & 2 hrs at 88

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Subject Date No.

Earplugs & Earmuffs

→ each one will reduce the amount of noise for each freq.

Earplugs → at 1000, it will reduces about 1/3 dB

---

* Noise is a problem of modern life, before the industrial revolution we didn't have neither noise nor vibration problems.

* The things that do noise these days are motors, machines. ---

* There are good noise called "White noise" → it is a specific decible across all freq., we use an open office space to prevent people from hearing each other (you will not hear your neighbor in the next office)

"Pink noise" → Sound of waterfalls and has a relaxation sensation in it.

Subject Date No.

* Nibration (effect of vibration on human body)

↳ is like a Sound (it is a wave)

X-axis → time
Y-axis → displacement
} vibrations are oscillations

(X): changing location of the center of gravity.

⇒ Sources of vibrations → transportations (engines, motors, cars, ---)

⇒ Duration → how long we stay exposed to this freq. or vibration.

*How the vibration affect us?

- The human body as a receiver of both noise & vibration.
- Mechanical energy & acoustic energy.
- Transmission of energy from air to body or structure to body.
- Ear is a special receiver of energy.
  ↳ The ear has 2 sensor (auditory & coordination) and both contains liquid & hair, so vibrating outside might cause the liquid inside the cocklea to vibrate → once it vibrates it will give a signal that is not understandable to the brain that something unusual & disorientation and cause weird noise in the ear.

⇒ The eyes are subject to resonance too, because of the way they are attached inside our skull & free to move.

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Subject Date No.

* Effects of Vibration.

↳ The first major effect is Resonance.
(we want to avoid exposure to freq. or vibration that has freqs. at a natural freq. of the body → it will cause damage

- Reduced muscle control (fibers connect to each other through ionic, so it not easy to connect & disconnect as vibration)
  ↳ In a vibrating work place, we must not allow workers to do precise movements.

- Reduced Coordination 改善
- Digraded vision
- Distorted speech
- Fatigue (interfere with the movement of body fluids)

* Short-Term effects

- Hyperventilation (breathing more than you need)
  (more breathing)

** why happen? → If the lungs vibrate inside your body, it might be confusing to the brain as demand for O_2 & they start breathing harder & hyperly

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Subject Date No.

- Increased pulse rate & blood pressure
(If vibration affects the heart, also the heart might)

- Nausea (is associated withe the vibration of the stomach)
you might throw up if the liquid inside the stomach vibrates at an resonance level)

- Balance (orientation of our body is space)
- Pain (is happening when things vibrate)
- Fatigue (associated by the effect of the vibration on blood circulation)

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Caused by:

Hand & Arm vibrations → (the use of vibrating hand-held tools)

As you vibrate → blood is drained from muscles, hand, arm as you continue to hold the tool & press on, you are demanding contraction from the muscle and this will create an aerobic situation → where lactic acid will increase but not enough CO_2 is deliver until a point where cells start dieing → the cells that die first are nerve cells.

The effect on arm & hand vibration syndrom is associated with loss of senses & the hand's fingures → you can't sense because the nerve cells died → because the interference of vibration in the blood flow to the hand through the arm

NOTEBOOK

Subject Vision Date No.

⇒ The light, is it material or waves?
↳ light shows how the visible spectrum is very narrow relationship to the waves that are surrounding us.

⇒ The wavelengs (rainbow region) from 370-730 nm is what we can see

⇒ The eye changes the light to electrical pulse. (Inside)
⇒ The eye has muscles (made of fibers)

Eye Function:

- Ocular muscles
↳ Attach to the eye → they make it move left & right, up & down.
Have the same structure.
They do aerobic & anaerobic, and they get fatigue.
when your eyes get fatigue, you feel headaches → because the area is very close to the brain.

- Ciliary muscles.
↳ Responsible for the ability to focus. → we can make the lens thin or thick

⇒

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Subject Date No.

⇒ When you look to faraway things → the lens need to be thin, so the reflection goes back on the retina

⇒ When you focus on something near → the lens need to be thick, so it has proper reflection inside the eye.

⇓

These muscles as they contract → they make the lens thicker and they focus the image on the retina

↳ this called "accommodation".

- Intra-ocular muscles.

↳ They open & close the pupil/eyeshatter → to protect the eye

If there is much light → the pupil closes & prevents light from getting inside too much and damage the light.

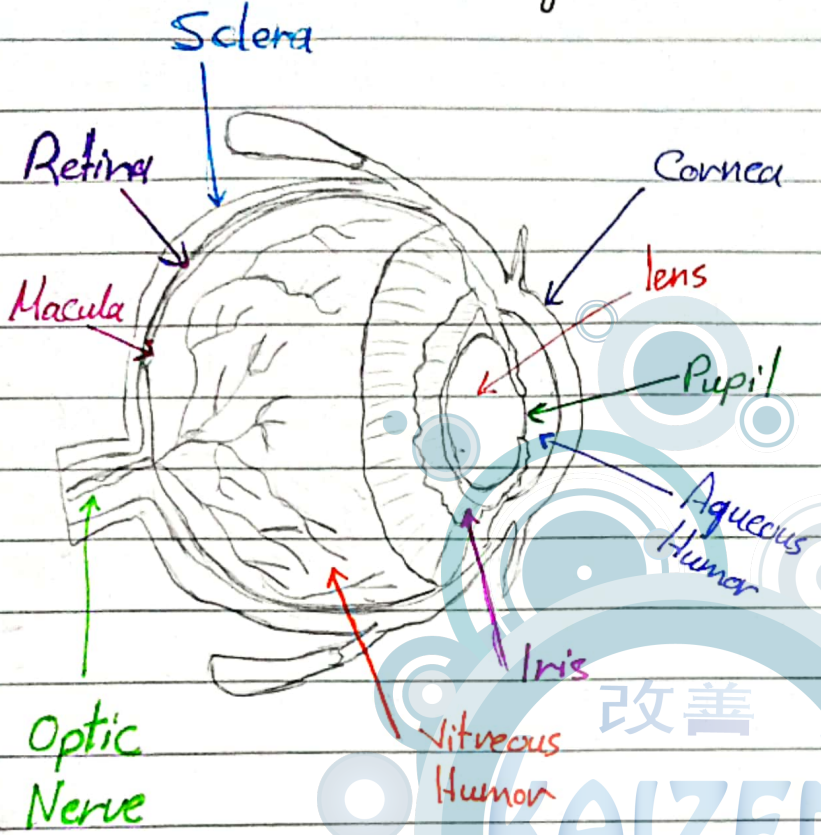
(dark)

If there is less light → the pupil opens big, so it allows max. no. of light beams inside.

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Subject Date No.

(Anatomy of the eye.)



⇒ Back side of the eye is the most important

Iris → Colored part of the eye.
Sclera → white of the eye.
Optic Nerve → transmits impulses to the brain.
Retina → a light-sensitive membrane, made of millions of sensors.
Macula → the most sensitive area (area of sharpest vision).
↳ That's why whenever we want to see something very good we put it in the front of our eye, so the reflection comes directly on the macula which we can see more details.

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Subject Date No.

How we see?

By having image in front of our eyes, beams of the light go inside → the lens focus the image to be reflected on the screen in the back.

* The eye (is ball) full of clear gel.
* The area that has the sensors → the retina
  all the sensors are connected to the vision nerve, and it takes the signal to the brain.

There are 2 types of sensors:

1. Rods → responsible for vision at low light levels (dark).
   ↳ located at all over retina.

2. Cones → responsible for vision at higher light levels (Color vision).
   ↳ located at macula area.

⇒ In the dark we have little light, that's not enough to activate Cones, but it's enough to activate rods
   ↳ That's why we see in black & white at night

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Subject Date No.

Glare.

is a bright spot in your visual field.

* when the glare is in visual field → the pupil will respond to protect the eye from too much energy coming.
→ the eye will adjust to that level, then you cannot see other stuff.

2 types of glare:

1. Direct Glare (you can see the source).
2. Indirect Glare (you can see the reflection of the glare).

⇓

Both are bad, so to minimize glare (for example) →
by placing monitor display 90 deg. to a window.

Subject Anthropometry & Accommodation Date No.

Anthropometry : Anthropo (Human) + Metry (measurements).
Is the study of the physical dimensions, proportions & composition of the human body.

* There is no an average person, there is an average dimension for a specific thing.

Five types of anthropometric data :

1. Dimensional (external dim. : the height, width, length of the arm ---)
(static)
2. Strength (how strong are people (pushing, pulling, lifting, twisting)).
(static / dynamic)
3. Reach (how far a person can reach (sitting, standing) where to put stuff in the design of the layout)
(dynamic)
4. Weight (total body weight / segmental weight (wieght of arm, hand, ---)
(static)
5. Specific (how big of an opening in a side panel of machine that I need to reach in with my hand to turn off a bulb)
(dynamic)

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Subject Date No.

Reference Planes:

planes system to describe the human body

- Frontal plane → divide the person into front & back.
- Medial plane → divide the person into left & right.
- Transverse plane → divide the person into upper half & lower half.

Figure 1-4: Approximate changes in stature with age

You are born about 22in (55 cm) → then you start gaining height until the age of (18).

After the (18) age up to (50) age → stay the same height.

After (50) age → you become shorter, why??
Because the thickness of the discs btwn the vertebrae (backbones) become thinner.
(loosing 2-3 cm in height).

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Subject Date No.

Who do we design for?

* we can't design for average, we design for a range of people.

↳ (ex. designing the door height) → if you design for avg. person, that means 50% of the population they gonna hit their head when they go through the door opening.

* In the design → you should consider the tall & short, male & female

For the door → we design for the tall people.
For the handle → we design for reach, for small people.
For the strength of the spring → we design for the weak people
For the shaft → we design for the strongest person.

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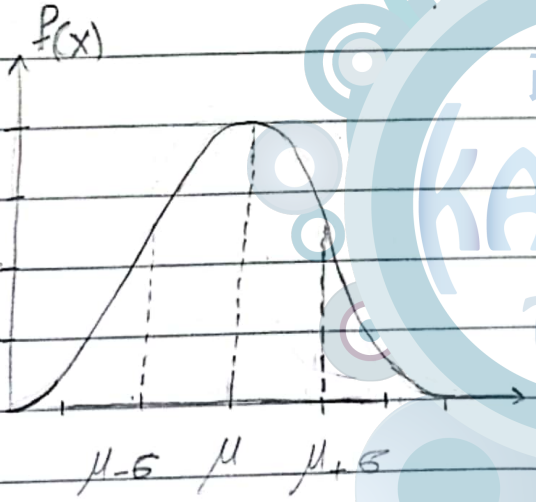
Subject Anthropometry. Date No.

Statistics Review.

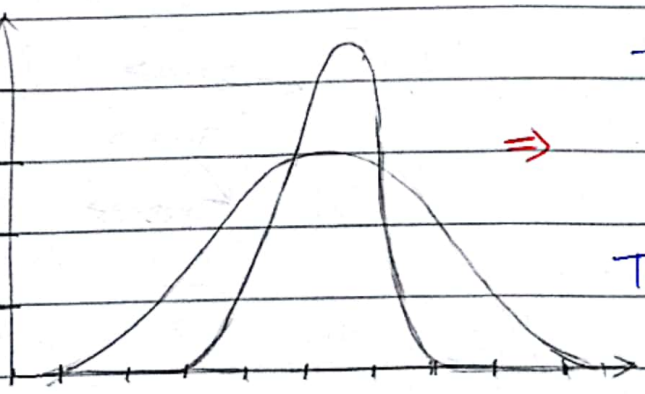
Normal Probability Distribution.

Normally distributed variable ⟶ variable that you can describe it with a : mean (μ) & standard deviation (σ)

The way to prepresent the normally dist. var. ⟶ $N(\mu, \sigma)$



⇒ Symmetric bell-shapeed around the mean.



⇒ The similarity : both have the same avg. (mean)

The difference : Fat curve has higher variability (standarel dev.)

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Subject Date No.

Coefficient of Variance (CV):

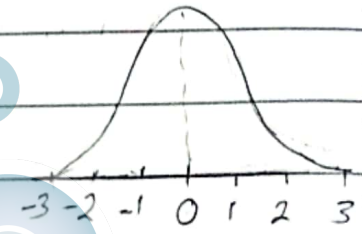
↳ is the ratio of the standard deviation to the mean

$$CV = \frac{\sigma}{\mu} \times 100\%$$

* CV for strength data is high 10-85%
* CV for body dimensions data is low 3-10%

In the normally dist. var.

- X-axis → the quantity.
- Y-axis → the frequency
- Area under the curve is always 100%.



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Subject Designing to Fit the Moving Body Date No.

Ergonomics Assessment Methods :

- The goal of an ergonomics assessment is: to identify the risk factors and quantify them so that you can make measurable improvements in the work environment.

*Standards classified to 2 Categories :

1. Performance (say the chair should be comfortable for user)
2. Specific (say the height of the seat should be at (51) cm)

ISO standard ⟶ performance standard.

3 Categories of ergonomics assessment methods :

1. Self-reported (workers report on the condition of their job).
   - Borg Scale (is a tool to measure a person's perception of their effort and exertion during phys. work).
   - Body part discomfort survey (Nordic Questionnaire) (giving people body sketch and ask them to rate pain / in which part they feel pain, and assess it in density & Frequency).

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2. Observational

(observing the worker doing job & rate the job)

3. Measurements

(we do measurements on the human or work to find out what is the problem)

↳ By using: Oxygen Consumption.
Heart rate.
Forces.
Motion Capture.

Ergonomics injuries.

Chronic → means something that takes long time exposure over & over

Acute → is sudden, something happens suddenly btwn the cause and consequence that doesn't take long time

Over-exertion injury → when we exert more than the fiber strength that break the fiber → is sudden.

Over-use injury → what happens in a cumulative effect.

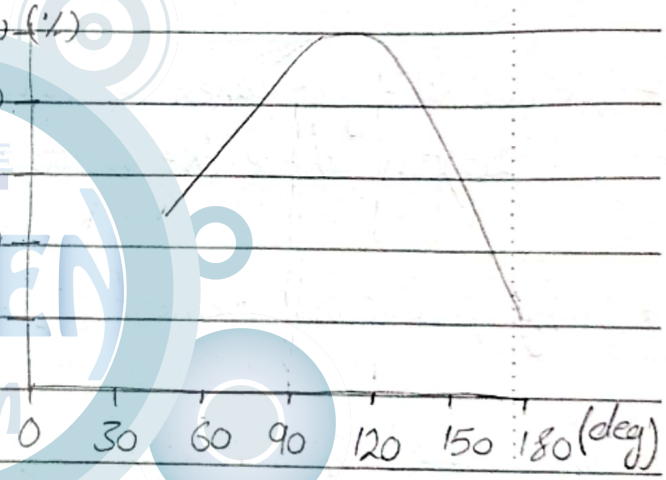
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Hands vs. Legs Control :

Arm Strength :

* we are stronger in pulling than pushing in the hand.
* The max. around 90° (btwn 90° & 120°)
  - ↳ closer to 120, because of the dead body weight used in the technique of pushing & pulling.



90° → neutral posture 改善

* If we pull or push, we need to have the axis of pulling / pushing aligned with the forearm → if it's not aligned, it will make a moment around the wrist
  - ↳ we need to keep it straight in the neutral posture.

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Foot Reach Envelop:

* The foot reach envelop for the leg while sitting is mush smaller than standing.

* If we are pushing for max. strength, we're maximize at around 155° or 165°.

* We are stronger when we have a back rest → must be about 20 cm above the buttocks to support the natural curvatur (S-shaped).

* Using precision movement → is best around 105°–110°.

* For strength optimization → up to 155°.

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Subject Date No.

Sitting vs. Standing Work.

* Standing requires more effort & energy than sitting

⇓

but when you stand you can control the (S-curve) of the back to reduce the amount of stress or pressure on the disk.

* → So, on one hand standing minimize the disk pressure, sitting minimize the energy required.

* Standing is more suitable for high forces.
* Standing is more suitable for reach more things. (you can walk around)
* Sitting is more suitable for precision.

* What is the strategy to design work, sitting or standing ?

→ It is best to design the job to be both.

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Subject Date No.

Height of Work Surface.

(medium force requirement)

* For a neutral posture position → the work surface should be at elbow height.

* Heavy force requirement → the work surface below elbow height, you can use the weight of your upper body.

* High precision → the work surface higher than elbow, closer to the eye.

Subject The Office (Computer) Workstation. Date No.

When we design a Computer station, we design a Compination of user, Computer, Furniture and tasks.

⇓

we should take input from what the task need & what are the skills of the person & how does he do the job.

Ergonomics is to find balance btwn the person needs, the tasks demands and design you furniture → so the person in the best situation (Optimize performance, minimize injuries)

Design Considerations

- Visual Requirement → for a person working on a Computer, he need to see the screen, keyboard and they are in different positions, so he need to keep moving his eyes, his need to achieve this visual demand.
- Manipulation Req.
- Body Posture Req. → we want to stay in neutral posture as much as possible.
- Continuity of Req. → what is the demand to continue working & when we can take a break.

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Subject Date No.

Typing Styles.

It's important to know if the person is touch typist or not
↳ we try to achieve in neutral posture putting things at elbow height, but it's too far for a person to look down we need to bring it up a little bit.

The goal can't achieved at the same time is:
↳ keeping neutral posture & meeting visual demand.

* We need to put the things that we use most in the best position.

Sit or Stand?!

Tasks that require extended use → design sitting (sitting all the time is bad)
* standing minimize disc pressure
* sitting minimize energy required
⇓
biomechanically we're disadvantage wheither we sit or stand.

Fig. 9-5 The more you open you back angle, would be better for disk pressure.
↓
*when you standing, your back pressure is 180 (it goes down)
* 90° gives you a certain pressure.

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* sitting without backrest increase the pressure over the level of standing by about 50%.

* the different types of sitting (relaxed, upright) doesn't have much differents in the guard to disc pressure

* Features in the angle in the seat:

↳ Seat inclined backward → Grenjeen was interested in designing chairs for airplanes, so tilting the angle backward will carry the weight of the body on the chair → so passenger in the airplane will feel relaxed & having less demand on muscles to do any activity.

→ Seat inclined forward → Mandal was looking at chairs for factories, doing tasks repetitively that requires lots of hand movement → to support your back, but if you open the angle btwn the back & the thigh → it will reduce the strain at the back.

Subject Date No.

* The bigger proplem in chair → is we are not really designed to sit

In standing → in neutral posture, you have a small curvature that is important to minimize disc pressure.

In sitting upright → rotating pelvis in this direction ↓ → you're straightening, pulling your spinal column away from having (S-curve)

Leaning Forward → exaggerate the pressure at the discs from the inside toward your belly

* this kind pushes the disc away and this would move the disc to hit the nerves in the back.

Adjustability types

- Accomodate different body sizes.
- Suitable for task(s) performed.
- Vary user's posture → like a sit-stand chair.
  best if the chair allows the user to change posture while sitting → so you can lean in back, lean forward, rotate → this will change the biomechanics inside the body that allows blood to circulate & relieve disc pressure

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* The most important adjustment in the chair is Seat height
** should allow you to sit in neutral posture
↳ you start with your feet in the floor (the weight of your feet should be resting on the floor), and the backrest should support the lumbar curvature.

** If a short person want to use a chair that have to deal with a fixed table → he has to lift it up to be able to keep the neutral posture for the elbow → might bring his feet up of floor.

⇓

So, we do a Footrest → to support the weight of the feet & have the person to sit in the neutral posture

sit-stand chair (long chair) → allows you to work from stations are designed to stand on it, but if you want to sit, you have to use a sit-stand chair.

What happens if you sit too low?!

↳ - You close the angle, so more pressure on the disc.
- You're crunching your stomach (there is more abdominal pressure compress the orgins on tummy)
- The pelvis rotation is rotated in wrong way → because as you sit lift your feet, you're forcing the pelvis rotation in this way.
- Contact area becomes less → means more pressure, pains, more blood in the butt

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What happens if you sit too high?!

- Feeling the pressure of the edge of the seat on the thighs
- Continue sitting → your leg will go to sleep, because of lack of O_2
- Because the weight is dangling of the lower leg → you're pulling yourself away from the backrest, so you lose the backrest support

* The proper seat height (neutral posture):
  - Feet → Carrying 15%
  - Seat pan → Carrying 80%
  - Backrest → Carrying 5%

* Foot rail → a crosspiece (btwn the legs of a table or chair), it changes the biomechanics of the back when we put our foot on it, it allows certain parts of the disc to relax & get nutrient in → to get waste out

* Saddle chair → it's not comfortable to sit for a computer use.

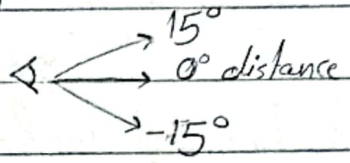
* The split seat chair → it allows you to lift one leg and lower the other one.
(change you posture without standing)

Subject Date No.

Figure 9-11 / visual demand.

* A primary vision area → it's determined by the Frankfurt plane
(Is what you connect the ear canal to ↵
the end of the eye)

⇓

You have 30° of primary vision → 

Dominant eye.

↳ is when you use one eye more than the other, have better vision in one eye, or can focus on something better with one eye.

* Anything that you want to monitor closely, put it closer to the dominant eye or exactly in the middle.

Keyboards.

It amazingly looks harmless, but it has a warning that it could cause a permanent disability in the hand (Carbal Tunnel Syndrome).

* keeping your wrist straight is more imp. than keeping your elbow
↳ wrist is related to the movement of the tendons that cause CTS
↳ elbow is related to exerting forces.

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Subject Date No.

* For the touch typist, the keyboard should be at or slightly below elbow height.

* For all tables that have higher than 5 cm thickness → it cannot be use as a computer station.

* The distance btwn the forearm & the thigh is very thin.

* keyboard too high → you force the hand to bend.

* keyboard too low → you force to bend in the other direction.

** It's important to keep the mouse & keyboard on the same level, because you're continuously moving btwn them.

Ergonomics of laptops.

If you use the laptop for long time, you need to use laptop stand with a separate keyboard & mouse (setup similar to desktop) → to achieve the ergonomic principle:

- the keyboard at elbow height
- the screen at eye level

KAIZEN TEAM

Subject Ergonomics of Hand Tools Date No.

Hand tool selection principles.

* To do the drilling task vertically, you need the pistol-grib

* If the workpiece is horizontal, you need Inline drill

↓↓

To keep your wrist straight (stronger)

* There are 3 parts system we need to think about: (affect the job)
  - The hand of the user.
  - The workpiece.
  - The tool.

* There are 2 types of Coupling:
  - Hand/Handle Coupling.
  - The end effect workpiece coupling.

KAIZEN TEAM

Subject Date No.

Types of Screw Heads.



Slotted → the problem

the Carpenter push along the edge of the slot and the screwdriver slips off.



Phillips → (Prevent slipping), because the screw driver tip is inclined, so the contact will be at an angle (the more you force it, the more it try to seperate from the screw head).



Hexagonal → the size took too much of the head, so many times the head will fail (breakage).



Square → eliminates the slippage and give more metal to the screwhead to prevent it from breaking.



Torx → better design, all auto manufacturers use this type.

Handle shape.

Finger grooves design is not good → because the tuck of the groove end up in the middle of the finger, which causing stress Concentration.

having one finger groove is better → you have an indexing, tells you where to put your hand.

NOTEBOOK

Subject Date No.

* Positive Coupling → is if you put that handle in the horizental space and you pull on it down. (not about using friction).

* Frictional Coupling → what's preventing the hand from slipping, transfering the force from the hand to the handle is the friction btwn the hand & the surface of Hand tool

* Rule in ergonomics → bend the tool, not the wrist.