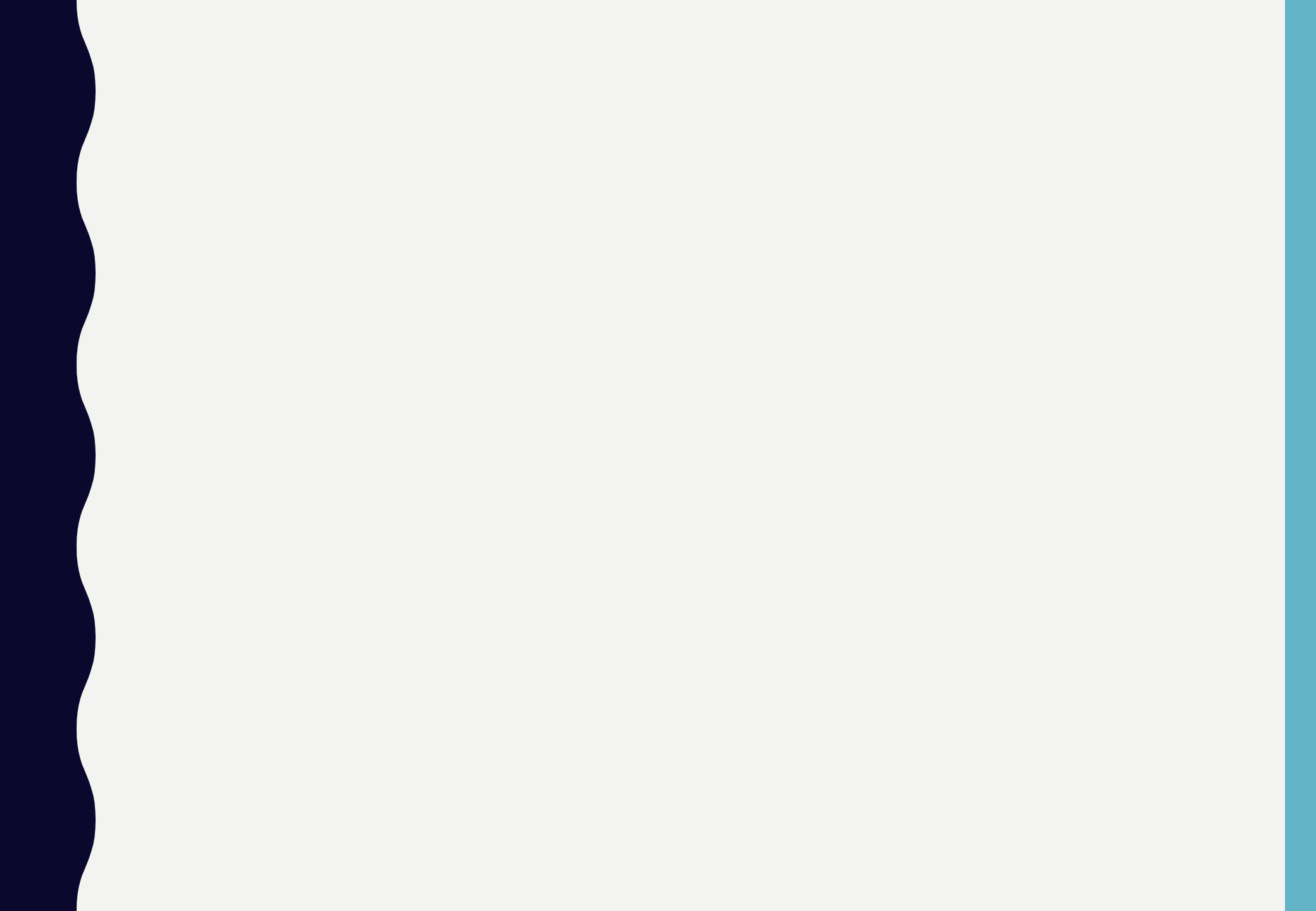


# **PHYSICAL ERGONOMICS**

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# SUMMARY OF PREVIOUS LECTURES

- Introduction
- Musculoskeletal system
- Metabolism
- Cardiovascular System
- Respiratory System
- Muscular effort
- Energy expenditure
- Rest periods

# LECTURE OUTLINE

- Muscle Strength and Endurance
- Heat balance
- Thermoregulation

# MUSCLE STRENGTH AND ENDURANCE

There are two basic conditions under which strength can be measured:

- Static strength – human subject applies as high a force as possible against an immovable object
  - Duration of test is short (e.g., a few seconds)
  - Results influenced by joint type (arm vs. leg) and joint angle
- Dynamic strength – tested under conditions that involve changes in joint angles and motion speed

# STATIC VS. DYNAMIC MUSCULAR ACTIVITIES

	Static muscular activity	Dynamic muscular activity
Description	Sustained contraction	Rhythmic contraction and relaxation
Examples	Holding a part in a static position Squeezing a pair of pliers	Cranking a pump handle Turning a screwdriver
Physiological effect	Reduced blood flow to tissue restricts oxygen supply and waste removal. Lactic acid is generated. Metabolism is anaerobic.	Adequate blood flow allows oxygen supply and waste removal needs to be satisfied. Metabolism is aerobic.

# FACTORS AFFECTING STRENGTH

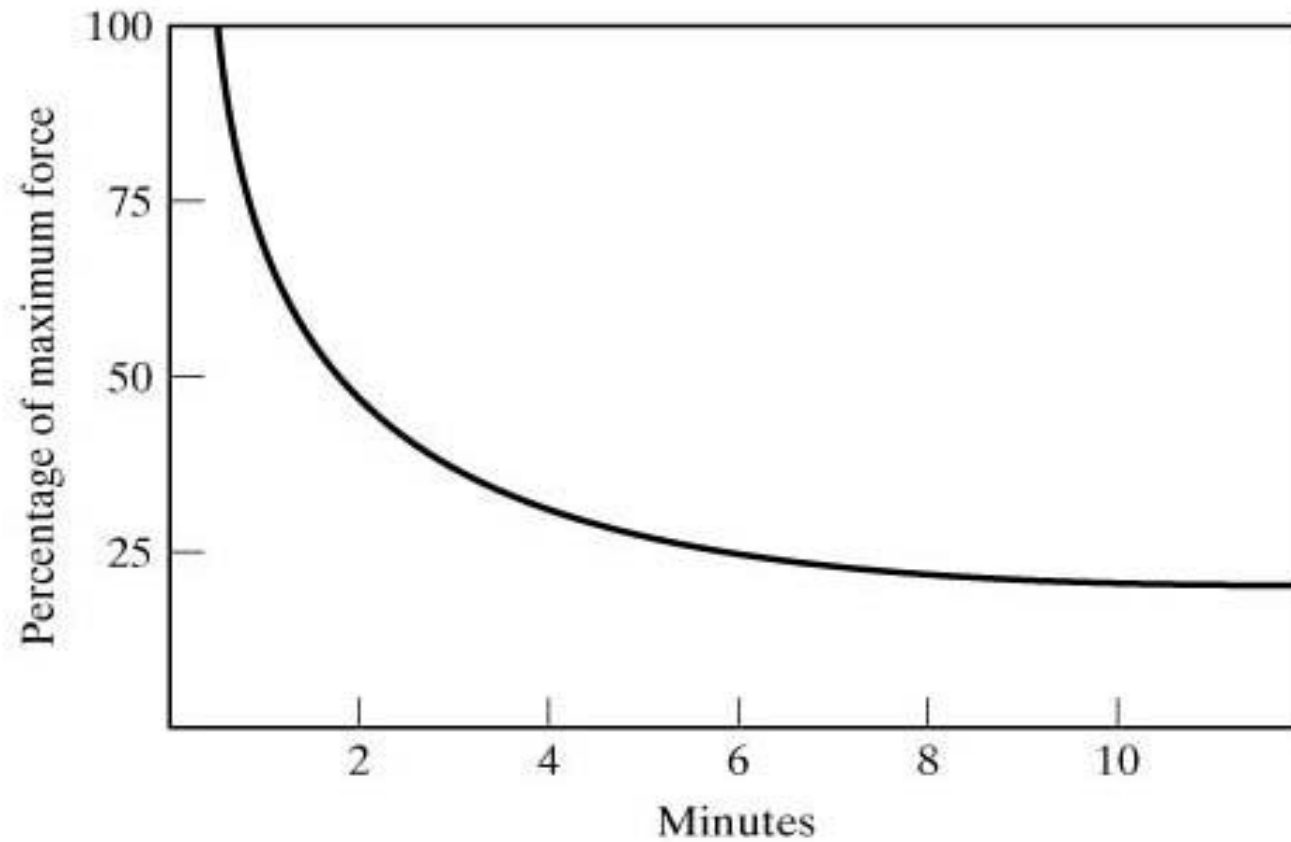
- Size (e.g., height, body weight, build)
- Gender
- Age
  - Maximum strength at age 23 to 35
  - About 80% of peak in mid-fifties
- Physical conditioning
  - Physical exercise can increase strength by as much as 50 percent

# MUSCLE ENDURANCE

- Muscle endurance is defined as the capability to maintain an applied force over time
  - Ability to maintain maximum static force lasts only a short time
  - After about 8 to 10 minutes, a person can only apply about 25% of maximum static force achieved at beginning of test
  - Finding supports the use of a mechanical workholder rather than requiring worker to grasp work unit



# Muscle Endurance



# HEAT BALANCE AND THERMOREGULATION

- Normal body core temperature = 37°C (98.6 °F)
- Body core temperatures above or below this value mean trouble
  - Above 38°C (100°F), physiological performance is reduced
  - Above 40°C (104°F), body is disabled
  - Above 42°C (107°F), death likely
  - Below 35°C (95°F), coordination is reduced
  - Below 32°C (90°F), loss of consciousness likely
  - Below 30°C (86°F), severe cardiovascular stress

# BODY'S THERMOREGULATION SYSTEM


$$\Delta HC = M - E \pm R \pm C - W$$

where

- $\Delta HC$  = net change in heat content in the body
- $M$  = metabolic energy produced
- $E$  = heat lost through perspiration and evaporation
- $R$  = radiant heat loss or gain
- $C$  = heat loss or gain through convection
- $W$  = work performed by the body

# REGULATING BODY TEMPERATURE

- Automatic body mechanisms
  - Sweating
  - Shivering
  - Constricting or dilating blood vessels
- Conscious actions
  - Clothing
  - Sun / shade
  - Exercising

A decorative graphic on the left side of the slide, consisting of two parallel, wavy, light blue lines that create a sense of movement or a stylized wave.

# **LECTURE CLOSING**

# DID YOU KNOW.....?????

- The body's machinery adapts to cope with heat
- Early each summer most of feel the heat and fatigue quite easily. With the progression of summer we 'get used to' the heat. That 'getting used to' is a phenomenon known as heat acclimatization and involves several adaptations including developing a larger blood volume (providing more blood to ferry heat to the skin for loss to the environment) and an increase in how much sweat we can produce (which carries heat off the body when it evaporates). Our sweat glands can become so well “trained” that in extreme cases we can sweat several litres per hour.

**Adaptation.**

# IF YOU WERE.....?????

- If you were a supervisor in a steel company who is taking care of the work done by the subordinates, how will you schedule their work and will you consider rest time, if yes then for how much time.....???



Most employees aren't totally  
loyal to their employers.

# 69%

are open to other opportunities  
or already seeking their next job.

# A BRIEF HISTORY OF HUMAN PHYSIOLOGY

- Physiological studies date back to the ancient civilizations of **India** and **Egypt** alongside anatomical studies, but did not utilize dissection or vivisection.
- 420 BC to the time of Hippocrates, also known as the “father of medicine”.
- Jean Fernel (1497–1558), a French physician, introduced the term “physiology”.
- To be continued..... 😊





# THANK YOU

