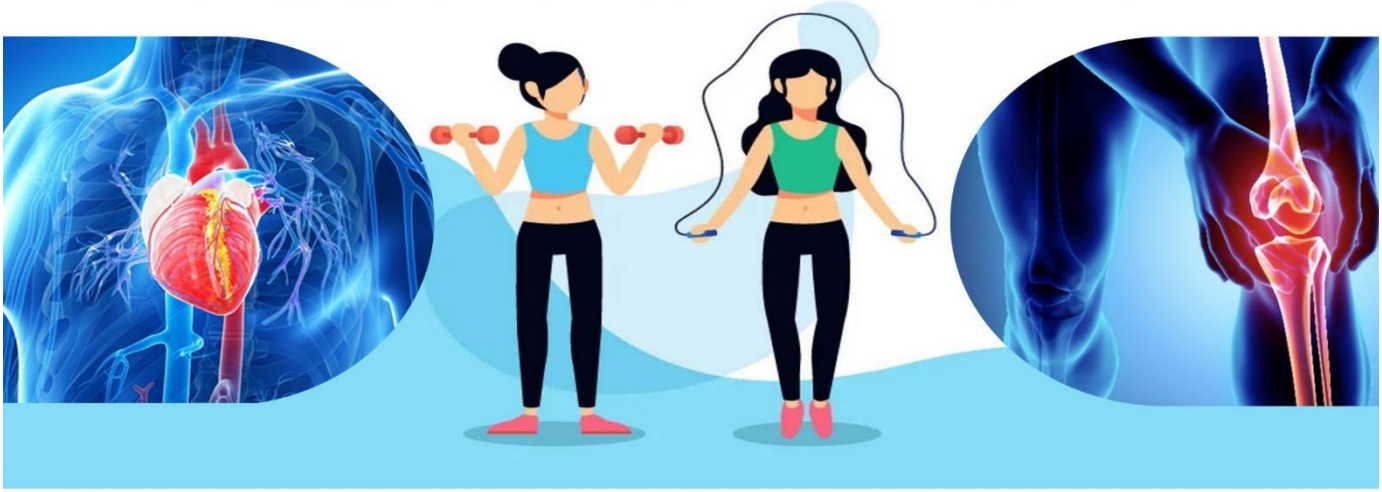
Q5. Discuss the Sit and Reach Test in detail. Explain its aim, procedure, scoring, advantages, and limitations.

UNIT - VII

PHYSIOLOGY & INJURIES IN SPORTS



CONTENT:

1. Physiological factors determining components of physical fitness
2. Effect of exercise on the Muscular System
3. Effect of exercise on the Cardio-Respiratory System
4. Physiological changes due to aging
5. Sports injuries: Classification
6.

GIST : *This unit explores how the body supports physical fitness through muscles, heart, and lungs, and how exercise enhances their functions. It explains the effects of ageing on the body and highlights common sports injuries, their types, and management. This promotes fitness awareness, injury prevention, and lifelong physical well-being.*

LEARNING OUTCOMES

By the end of this unit, you will be able to:

1. Identify key physiological factors that affect physical fitness components.

2. Understand how the muscular system benefits from regular exercise.

3. Explain how exercise improves the function of the heart and lungs.

4. Recognize how ageing affects body systems and the role of physical activity in healthy ageing.

5. Classify and describe different types of sports injuries and understand basic prevention and management techniques.

LEARNING OBJECTIVES:

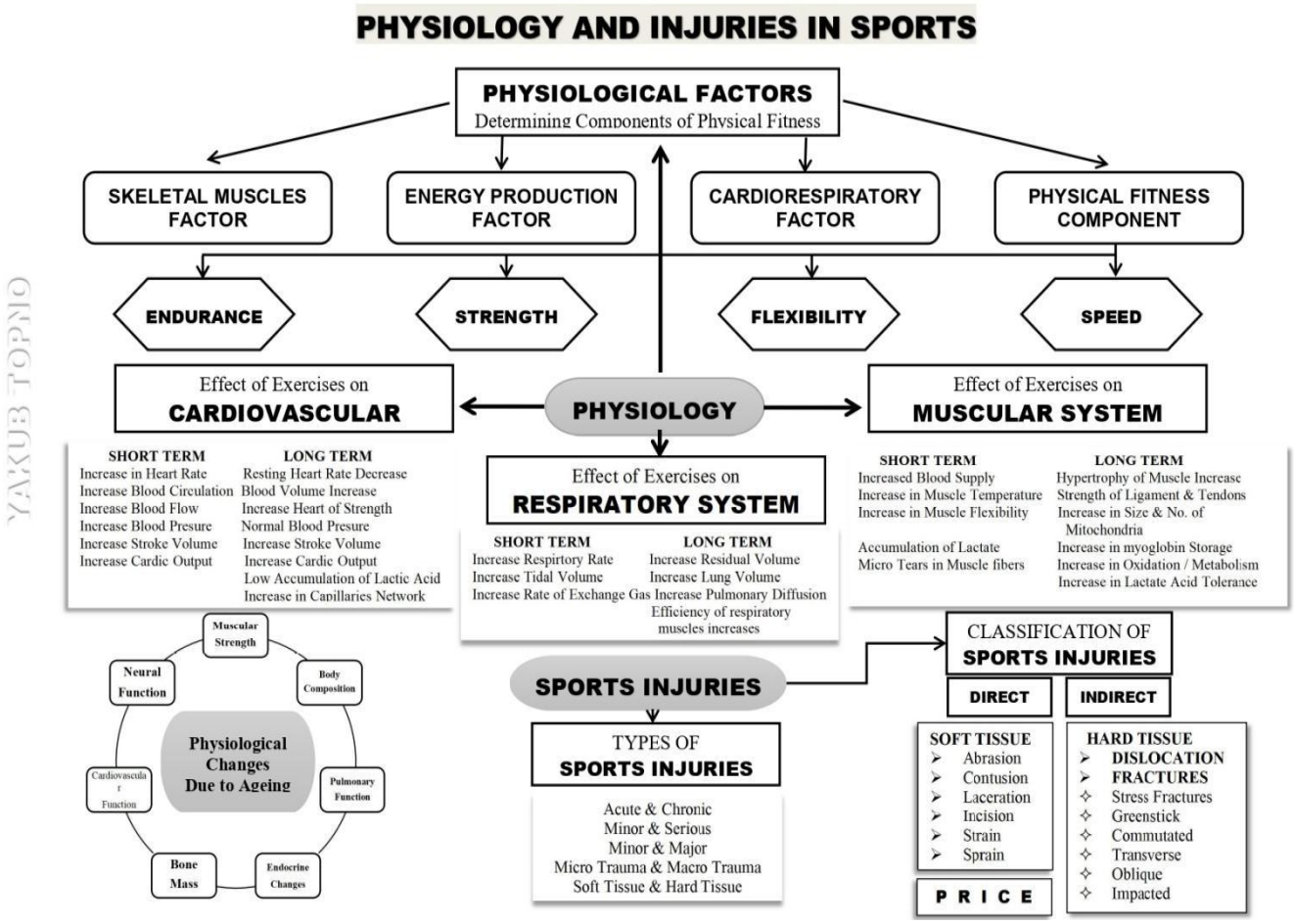
1. Recognize the physiological factors determining the components of physical fitness.
2. Comprehend the effects of exercise on the Muscular system and cardiorespiratory systems.
3. Figure out the physiological changes due to ageing
4. Classify sports injuries with their management.

UTILITY OF THE UNIT IN DAILY LIFE

Understanding *Physiology and Injuries in Sports* is highly beneficial in everyday life. It helps individuals recognize how their body functions during physical activities and the importance of maintaining fitness through regular exercise. By learning about muscular and cardiorespiratory responses, one can design safer and more effective fitness routines. The knowledge of ageing effects encourages healthy lifestyle habits from an early age. Additionally, awareness of common sports injuries and their management empowers individuals to take timely action, apply first aid, and prevent further harm. This unit fosters responsible participation in sports, promotes injury-free activity, and builds a foundation for lifelong health and fitness. It is essential for students, athletes, coaches, and anyone involved in physical activity.

MIND MAP

MARKS WEIGHTAGE – 04 + 04b*



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7.1 Physiological Factors Determining Components of Physical Fitness

Exercise physiology is all about how our body reacts and adapts when we exercise. Think of your body as a well-coordinated team, where each system has a special role to play during physical activity.

When you work out or play sports, many systems in your body – like muscles, nerves, heart, lungs, hormones, and more – work together. But each system responds in its own unique way depending on what kind of exercise you're doing.

- The **metabolic system** gives you energy and controls how much energy you use or save.
- The **cardiovascular system** (heart and blood vessels) pumps oxygen and nutrients to your muscles and carries away waste products.
- The **respiratory system** (lungs) brings in fresh oxygen and removes carbon dioxide when you breathe.
- The **muscular and skeletal systems** help you move by contracting muscles and supporting your body.
- The **nervous and hormonal systems** help keep everything balanced, adjusting to stress and maintaining your internal stability (called ***homeostasis***).

Different exercises affect your body in different ways. For example, running, lifting weights, and yoga all improve fitness, but they challenge your body systems differently—through different intensity, duration, and purpose.

In this , we will focus on **three main physiological factors** that influence your physical fitness:

- **Muscle fiber types**
- **Energy systems**
- **Cardiorespiratory functions**

Each of these plays a key role in how strong, fast, or fit you become.

7.1.1 Muscle Fiber Factor – What Makes You Fast or Enduring?

Our muscles are made up of different types of muscle fibers. These fibers decide whether you're naturally better at endurance sports like marathon running or power sports like sprinting and weightlifting.

There are two main types of muscle fibers:

1. Slow-Twitch Fibers (Type I) – The Endurance Experts

- **Colour**: Red (they have more blood supply and oxygen)
- **Work Style**: Use oxygen to produce energy slowly (aerobiC)

- ✧ **Best For**: Long-duration activities like running, swimming, cycling
- ✧ **Strength**: They don't get tired quickly
- ✧ **Speed**: Contract slowly, not suitable for explosive speed

2. Fast-Twitch Fibers (Type II) – The Power Performers

- ✧ **Colour**: White (less blood supply)
- ✧ **Work Style**: Work without oxygen (anaerobiC) and produce quick bursts of energy
- ✧ **Best For**: High-power activities like sprints, jumps, weightlifting
- ✧ **Strength**: Very strong but get tired quickly
- ✧ **Speed**: Contract very fast for explosive movements

Muscle Fiber Distribution (Varies by Activity)

Type of Athlete	Slow-Twitch Fibers	Fast-Twitch Fibers
Marathon Runners	70–80%	20–30%
Sprinters	25–30%	70–75%
Average Non-Athletes	~50%	~50%

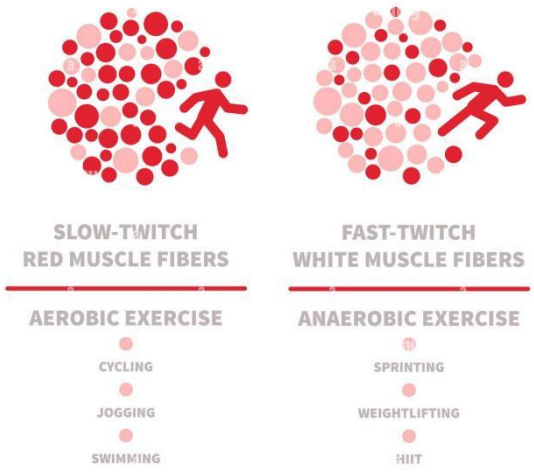


Fig.1: *Diagram showing both fiber types inside a muscle*

Quick Fact:

You are born with a certain mix of fiber types. Training can improve their performance, but your basic mix is genetic.

7.1.2 Energy Production Factor – How Your Body Powers Every Move

Every time you move, play, or even blink – your body uses energy. During sports or exercise, your body has to act fast to supply this energy, and it does so using **three different energy systems**. Each one works based on how intense and how long the activity is.

Let's understand these systems like fuel tanks – some give you quick power, others last longer.

1. ATP-CP System – The Instant Power Boost

- **Duration**: Only up to 10 seconds
- **Fuel Used**: Stored ATP (adenosine triphosphate) and CP (creatine phosphate) in muscles
- **Oxygen Used**: No (AnaerobiC)
- **Best For**: Short, explosive efforts like high jump, 100m sprint, or a shot-put throw
- **Speed**: Super-fast but doesn't last long.

2. Anaerobic System – Power Without Oxygen

- **Duration**: From 10 seconds to 2 minutes
- **Fuel Used**: Glucose, broken down without oxygen
- **Oxygen Used**: No (AnaerobiC)
- **Best For**: Medium bursts of effort like 200m or 400m races
- **Speed**: Fast energy, but creates lactic acid, which causes fatigue.

3. Aerobic System – Long-Lasting Energy

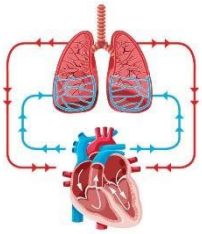
- **Duration**: More than 2 minutes
- **Fuel Used**: Carbohydrates, fats (with oxygen)
- **Oxygen Used**: Yes (AerobiC)
- **Best For**: Long-duration sports like marathon, football, hockey
- **Speed**: Slow to start, but keeps you going for a long time

Best Way to Remember

System	Duration	Fuel Used	Sports Example
ATP-CP	0–10 sec	ATP, CP	Shot put, 100m sprint
Anaerobic	10 sec–2 min	Glucose	400m run, boxing round
Aerobic	2+ min	Carbs, fats	Marathon, football

7.1.3 Cardiorespiratory Factor – How Your Heart & Lungs Help You Perform?

Imagine your muscles are like engines. Just like engines need fuel and oxygen to run, your muscles need oxygen-rich blood during physical activity. This is where the cardiorespiratory system steps in. It includes your heart, blood vessels, and lungs, and it plays a key role in building stamina, improving performance, and helping you recover faster.



What Does the Cardiorespiratory System Do?

Delivers oxygen from lungs to muscles

Removes carbon dioxide (waste gas) from the body

Carries nutrients (like glucose) to working muscles

Keeps the body cool by increasing blood flow

The better your cardiorespiratory system, the **fitter and more energetic** you feel during sports or workouts!

Key Terms to Know

Term	Meaning
VO_2 Max	The maximum amount of oxygen your body can use during intense exercise
Stroke Volume	The amount of blood your heart pumps out with **each beat**
Cardiac Output	The **Total Blood** pumped by the heart in **One Minute** Formula: Cardiac Output = Heart Rate × Stroke Volume

Quick Fact:

Athletes like swimmers and runners train to improve their VO_2 max and cardiac output to boost performance.

7.1.4 Physical Fitness Components Determined by Physiological Factors

Now that we understand how our muscles, energy systems, heart and lungs respond to exercise, let's see how these systems help build the four main components of physical fitness:

1. Strength | 2. Speed | 3. Endurance | 4. Flexibility

1. Strength – Your Muscle Power

"*How much force your muscles can produce in a single effort*."

The stronger the muscles and the more fast-twitch fibers you have, the greater your strength.

Main Factor Involved:

- ✧ Muscle Fiber Type – Especially Fast-Twitch Fibers (Type II) which contract quickly and powerfully
- ✧ Energy System – ATP-CP system gives short, explosive energy for lifting or pushing

Example Activities: Weightlifting, Shot Put, Wrestling

2. Speed – How Fast You Can Move

"*The ability to perform a movement in the shortest time possible.*"

Speed depends on how fast your brain and muscles communicate + how quickly energy is supplied.

Main Factor Involved:

- ✧ Fast-Twitch Fibers – For rapid contraction
- ✧ ATP-CP System – Instant, explosive energy for movements under 10 seconds
- ✧ Neuromuscular Efficiency – Faster nerve signals = quicker reactions

Example Activities: Sprinting, Table Tennis, Badminton smashes

3. Endurance – Keep Going Without Getting Tired

"*The ability to perform an activity for a long period without fatigue.*"

The more oxygen your muscles get, the longer you can perform without tiring.

Main Factor Involved:

- ✧ Slow-Twitch Fibers – Use oxygen efficiently and resist fatigue
- ✧ Aerobic Energy System – Provides long-term energy using oxygen
- ✧ Cardiorespiratory Fitness – Strong heart and lungs supply steady oxygen

Example Activities: Long-distance running, Swimming, Football

4. Flexibility – How Easily You Can Move Your Joints

"The ability of joints to move through their full range of motion."

Flexibility isn't about muscle size—it's about how elastic and healthy your muscles and joints are.

Main Factor Involved:

- ✧ Muscle and Tendon Elasticity
- ✧ Warm Muscles (higher temperature improves stretch)
- ✧ Joint Structure and connective tissue health

Example Activities: Gymnastics, Yoga, Martial Arts

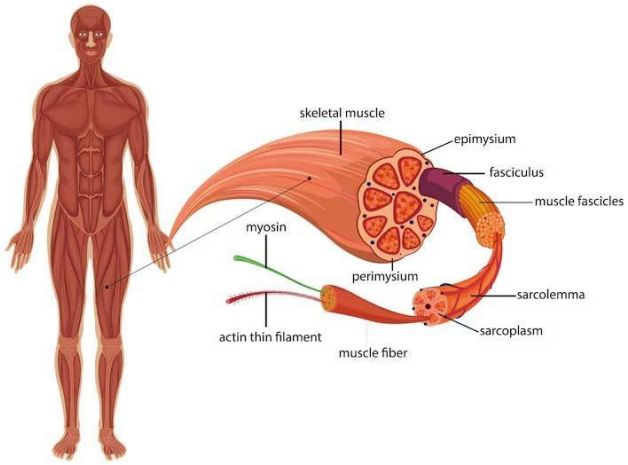
Summary Table

Component	Main Physiological Factor(s)	Example Activities
Strength	Fast-twitch fibers, ATP-CP system	Weightlifting, Shot Put
Speed	Fast-twitch fibers, nerve signal speed	Sprinting, Badminton
Endurance	Slow-twitch fibers, Aerobic system, VO_2 Max	Marathon, Football
Flexibility	Muscle temperature, joint health, elasticity	Gymnastics, Yoga

Each fitness component relies on different systems in your body. That's why athletes train differently based on their sport—some focus on building power, others on stamina or flexibility.

2. Effects of Exercise on the Muscular System

When you exercise or play sports, your muscles don't just move – they change. Some effects happen right away, while others take weeks or months of training to show.



Let's explore what happens to your muscles in the short term (immediately) and long term (after regular training).

A. Short-Term Effects (During or Right After Exercise)

These are the changes your body feels while exercising or shortly after. You've probably felt these before!

1.**Increased Blood Flow to Muscles:** Your body sends more blood to the working muscles to supply oxygen and remove waste.

2.Higher Muscle Temperature: Muscles heat up as they work harder – this helps with flexibility and movement.

3.Improved Flexibility: Warm muscles are easier to stretch and less likely to get injured.

4.Lactic Acid accumalation: When you push hard, your muscles may burn – that's due to lactic acid, a temporary waste product.

5.Micro-Tears in Muscle Fibers: Tiny tears occur in muscles during strength training. This is normal and necessary for growth.

B. Long-Term Effects (With Regular Exercise Over Time)

When you train consistently over weeks or months, your muscles begin to adapt in powerful ways:

1.Muscle Hypertrophy: Muscles grow bigger and stronger – this is how you build strength and size.

2.Stronger Tendons and Ligaments: Not just muscles, but the connective tissues also get stronger, reducing injury risk.

3.More Mitochondria: These are the "power plants" of your cells – more mitochondria = more energy production.

4.Increased Myoglobin Content: Myoglobin helps store oxygen in muscles, improving endurance.

5.Greater Glycogen Storage: Muscles store more fuel (glycogen), so you don't get tired as quickly.

6.Better Fat Burning: Your body becomes more efficient at using fat as energy – great for fitness and weight control.

7.Improved Lactate Tolerance: You can handle more exercise without feeling that burning fatigue.

3. Effects of Exercise on the Cardiorespiratory System

Your heart and lungs are your body's power supply team. When you exercise, these systems work harder to get oxygen to your muscles and remove carbon dioxide.

These changes can be short-term (right after exercise) or long-term (with regular training).

3.1 Cardiovascular System – Heart and Blood Vessels

A. Short-Term Effects (Immediate Changes)

1.Increased Heart Rate: Your heart beats faster to pump more blood and oxygen to the muscles.

2.More Blood Circulation: Blood flows quicker throughout the body, especially to working muscles.

3.Higher Blood Pressure: The force with which blood flows through your vessels increases.

4.Greater Stroke Volume: With each beat, your heart pumps more blood than usual.

5.Higher Cardiac Output: Total blood pumped per minute increases = more oxygen delivered.

B. Long-Term Effects (From Regular Training)

1.Stronger Heart Muscle: Like other muscles, the heart becomes more powerful and efficient.

2.Lower Resting Heart Rate: A fit heart doesn't need to work hard all the time—fewer beats per minute at rest.

3.Improved Blood Pressure Control: Exercise helps maintain normal blood pressure over time.

4.More Capillaries in Muscles: Extra tiny blood vessels form, improving nutrient and oxygen delivery.

5.Less Lactic Acid Buildup: With better oxygen supply, your muscles produce less lactic acid = less fatigue.

3.2 Respiratory System – Lungs and Breathing

A. Short-Term Effects

1.Faster Breathing Rate: You may go from 12–20 breaths per minute to 40+ during intense exercise.

2.Increased Tidal Volume: You take deeper breaths, pulling in more air each time.

3.Faster Gas Exchange: Oxygen goes into your blood faster, and carbon dioxide comes out quicker.

B. Long-Term Effects (With Regular Aerobic Exercise)

1.Stronger Breathing Muscles: Muscles like the diaphragm and intercostals get stronger, making breathing easier.

2.Bigger Lung Capacity: Your lungs can hold more air, allowing better oxygen supply.

3.Improved Oxygen Exchange Efficiency: Your body gets better at absorbing oxygen and using it effectively.

4.Increased Residual Volume: A small amount of air always remains in your lungs – even this improves with training.

4. Physiological Changes Due to Aging

As we grow older, our body slowly starts to change and slow down. These changes affect our muscles, bones, heart, lungs, and nerves—which can reduce our physical performance over time.

But the good news? Staying physically active can delay many of these effects and help you age healthily.

What Happens to the Body with Age?

A. Muscular System

✧ Peak strength is usually between ages 20 to 40.

- ✧ After 40, muscle mass starts to reduce – up to 40–50% by age 80.
- ✧ Muscles become weaker, and fibers shrink or die.
- ✧ This makes lifting, walking, and balance harder if not managed with exercise.

B. Nervous System

- ✧ Aging reduces the number of connections in the spinal cord by around 40%.
- ✧ Nerve signals slow down by about 10%, leading to slower reaction times.
- ✧ Movement becomes less coordinated.

C. Cardiovascular System

- ✧ The maximum heart rate decreases with age.
- ✧ Cardiac output (blood pumped per minute) also reduces.
- ✧ As a result, less oxygen and nutrients reach muscles during activity.

D. Respiratory System

- ✧ The chest wall becomes stiff, making it harder to breathe deeply.
- ✧ Lung capacity goes down, so oxygen intake is reduced.
- ✧ Slower breathing response to exercise.

E. Bone Mass

- ✧ After 60, 30–50% of bone density may be lost, especially in women.
- ✧ Bones become brittle and weak, leading to conditions like osteoporosis.
- ✧ Fractures and joint pain become more common.

F. Body Composition

- ✧ Body fat increases, while muscle mass and water content decrease.
- ✧ Total body weight may decrease, but fat percentage increases – especially around the waist.

Summary Table – Changes Due to Aging

Body System	Changes with Age
Muscles	Weaker, smaller, reduced strength
Nerves	Slower reflexes and coordination
Heart	Lower heart rate and blood flow
Lungs	Less air capacity, slower breathing
Bones	Loss of density, higher fracture risk
Body Composition	More fat, less muscle

5. Sports Injuries – When the Game Hurts

Sports keep us fit, but sometimes they come with risks. A sports injury is any damage to body tissues that causes pain, swelling, or limits movement during or after physical activity.

Whether you're a beginner or an athlete, knowing how injuries happen, how to prevent them, and how to treat them can keep you safe and active.

A. Based on the Cause

1.Direct Injury: Caused by an external force like a collision, fall, or getting hit.

Example: Getting hit by a ball, or falling during a match.

2.Indirect Injury: Happens due to internal stress—like overstretching or improper movement.

Example: Pulling a hamstring during a sprint.

3.Overuse Injury: Caused by repeating the same movement again and again without rest.

Example: Tennis elbow, runner's knee.

B. Based on the Tissue Affected

1.Soft Tissue Injuries – Skin, muscles, tendons, ligaments

2.Hard Tissue Injuries – Bones and cartilage

5.2 Soft Tissue Injuries

These are the most common in sports and can range from minor cuts to painful sprains.

A. Skin Injuries: These injuries often occur in contact sports or from falls on rough surfaces.

Type	Description
Abrasion	Scraping off the top layer of skin
Laceration	Irregular, jagged tear in the skin
Incision	Clean, deep cut usually by a sharp object

B. Muscle & Ligament Injuries

Type	Description
Contusion	A bruise caused by a D**irect blow**
Strain	Tearing or stretching of M**uscle or Tendon**

Sprain	Tearing or stretching of a L**igament (Joint)**

Treatment: RICE Method (For Most Soft Tissue Injuries)

Step	What to Do
R-Rest	Stop the activity and avoid pressure
I-Ice	Apply a cold pack to reduce swelling
C-Compression	Use an elastic bandage to control swelling
E-Elevation	Raise the injured part above heart level

5.3 Hard Tissue Injuries – Bones & Joints

These are serious injuries that usually need medical attention and sometimes surgery.

A. Joint Dislocation

- ✧ Occurs when bones are forced out of their normal position
- ✧ Caused by fall, collision, or trauma
- ✧ Symptoms: Pain, swelling, visible deformity, loss of movement
- ✧ Treated by a doctor to relocate bones safely

B. Bone Fractures (Broken Bones)

Type	Description
Stress Fracture	Small cracks from repeated stress (common in runners)
Greenstick	Bone bends but doesn't break completely (common in children)
Comminuted	Bone breaks into **multiple pieces** (severe traumA)
Transverse	**Straight horizontal break** across the bone
Oblique	**Angled or diagonal break**
Impacted	Ends of bones are **jammed together** (from hard falls)

Summary Table

Injury Type	Example	Treatment
Skin Injury	Abrasion, incision	Clean + Bandage

Muscle/Ligament	Sprain, Strain, Contusion	RICE Method
Bone Injury	Fracture, dislocation	Medical intervention needed

KEY TERMS TO REMEMBER

ATP: Energy currency of cells

Hypertrophy: Muscle growth

VO2 Max: Maximum oxygen consumption

Cardiac Output: Heart Rate × Stroke Volume

Aerobic: With oxygen

Anaerobic: Without oxygen

Myoglobin: Oxygen-carrying protein in muscles

Osteoporosis: Bone weakening disease

1. Multiple Choice Questions (MCQs) 1 MARK

(Choose the most appropriate option)

1.The muscle fiber type most helpful in long-distance running is:

A) Type II-a B) Type II-b C) Type I D) Mixed Fiber

Answer: C) Type I

2.Which energy system provides energy for a 100m sprint?

A) Aerobic system B) Anaerobic system

C) Lactic system D) ATP-CP system

Answer: D) ATP-CP system

3.VO_2 Max refers to:

A) Maximum number of heartbeats B) Volume of food intake

C) Maximum oxygen used during exercise D) Breathing rate at rest

Answer: C) Maximum oxygen used during exercise

4.A greenstick fracture is common in:

A) Adults B) Elderly C) Athletes D) Children

Answer: D) Children

5.Muscle hypertrophy occurs due to:

A) Flexibility training B) Overeating

C) Regular strength training D) Excess rest

Answer: C) Regular strength training

6.Which of the following improves flexibility?

A) Cold muscles B) Anaerobic training

C) Warm-up exercises D) Weightlifting

Answer: C) Warm-up exercises

7.Which system provides energy for a 1500m race?

A) ATP-CP B) Anaerobic C) Aerobic D) None of these

Answer: C) Aerobic

8.What helps in maintaining internal balance during exercise?

A) Digestive system B) Endocrine and immune systems

C) Skeletal system D) Reproductive system

Answer: B) Endocrine and immune systems

9.In the RICE method, “C” stands for:

A) Cold B) Care C) Compression D) Clean

Answer: C) Compression

10.Which fiber type gets tired quickly but contracts fast?

A) Slow Twitch B) Fast Twitch C) Elastic D) Mixed

Answer: B) Fast Twitch

11.Lactic acid is produced during:

A) Aerobic respiration B) Walking slowly

C) Anaerobic glycolysis D) Sleep

Answer: C) Anaerobic glycolysis

12.Strength depends largely on:

A) Lung capacity B) Myoglobin

C) Fast-twitch fibers D) Skin thickness

Answer: C) Fast-twitch fibers

13.The role of myoglobin in muscles is to:

A) Transport fat B) Produce energy

C) Store oxygen D) Remove waste

Answer: C) Store oxygen

14.Residual volume refers to:

A) Water in lungs B) Air left after exhalation

C) Maximum inhaled air D) Muscle energy

Answer: B) Air left after exhalation

15.Age-related muscle loss can be reduced by:

A) Medication B) Deep sleep

C) Regular physical activity D) High sugar intake

Answer: C) Regular physical activity

UNSOLVED QUESTIONS & ANSWERS

16.The component of fitness improved by aerobic training is:

A) Speed B) Flexibility C) Endurance D) Power

17.Which is the part of the cardiorespiratory system that pumps blood?

A) Lungs B) Veins C) Heart D) Capillaries

18.The soft tissue injury involving torn ligaments is:

A) Strain B) Sprain C) Contusion D) Fracture

19.Dislocation occurs when:

A) Muscle swells B) Bones break

C) Bones shift from joints D) Tendons stretch

20.The aerobic system uses energy from:

A) Lactic acid B) ATP C) Glucose and fats D) None

2 MARKS- Very Short Answer Questions : (Each answer within 60–90 words)

1. Define exercise physiology and its importance.

Answer : Exercise physiology is the study of how the human body responds and adapts to physical activity. It helps us understand how muscles, heart, lungs, and energy systems work together during exercise. This knowledge improves training, prevents injuries, and promotes overall health. It is essential for athletes, fitness enthusiasts, and even for healthy aging.

2. What are slow-twitch muscle fibers?

Answer : Slow-twitch fibers (Type I) are red-colored muscle fibers that work with oxygen (aerobiC). They contract slowly but are fatigue-resistant, making them ideal for endurance activities like marathon running and swimming. They support long-duration, low-intensity efforts.

3. What is VO_2 Max?

Answer : VO_2 Max is the maximum amount of oxygen your body can utilize during intense physical activity. It is an indicator of aerobic fitness and endurance. Higher VO_2 Max means better stamina and performance in sports like running or cycling.

4. Name the three energy systems.

Answer : The three energy systems are:

i. ATP-CP system (for quick bursts)
ii. Anaerobic system (for short-term effort without oxygen)
iii. Aerobic system (for long-duration effort using oxygen)

5. What is muscle hypertrophy?

Answer : Muscle hypertrophy refers to the increase in muscle size due to regular strength training. It results from the repair of micro-tears in muscle fibers after workouts, making muscles stronger and bigger.

6. Define cardiac output.

Answer : Cardiac output is the total volume of blood the heart pumps per minute. It is calculated by multiplying heart rate by stroke volume. It increases during exercise to deliver more oxygen to the muscles.

7. What is a sprain?

Answer : A sprain is a soft tissue injury involving the stretching or tearing of ligaments at a joint. It is commonly caused by a sudden twist or impact during physical activity.

8. Name two soft tissue injuries.

Answer : Two soft tissue injuries are:

Strain – a tear in muscles or tendons

Abrasion – a scraped layer of skin

9. What are fast-twitch fibers used for?

Answer : Fast-twitch fibers (Type II) contract quickly and provide powerful movements. They are used in high-intensity, short-duration sports like sprints, jumps, and weightlifting. However, they get tired quickly.

10. Mention one benefit of the RICE method.

Answer : The RICE method (Rest, Ice, Compression, Elevation) helps reduce swelling, pain, and promotes healing in soft tissue injuries like sprains and strains.

11. State two effects of exercise on the respiratory system.
12. How does age affect muscular strength?

13. What happens to bone mass after the age of 60?

14. What is an abrasion injury?

15. What is the aerobic energy system?

3 MARKS Short Answer Questions (Each answer within 100–150 words)

1. Explain the differences between slow-twitch and fast-twitch muscle fibers.

Answer : Slow-twitch fibers (Type I) are red in color due to high oxygen supply and are best suited for endurance activities. They contract slowly but do not get tired easily, making them ideal for long-distance sports like marathon running and swimming. Fast-twitch fibers (Type II) are white, contract quickly, and produce powerful movements. However, they fatigue rapidly. These fibers are used in activities like sprinting, weightlifting, and high jumps. While slow-twitch fibers rely on the aerobic energy system, fast-twitch fibers work mostly under anaerobic conditions. Athletes train based on their sport's requirement—endurance athletes focus on slow-twitch, while power athletes depend on fast-twitch.

2. Describe the ATP-CP energy system and give two examples where it is used.

Answer : The ATP-CP energy system provides immediate energy for high-intensity, short-duration activities lasting up to 10 seconds. It uses stored **ATP** *(adenosine triphosphate*) and *creatine phosphate* (**CP**) in muscles. This system does not require oxygen and is ideal for explosive efforts such as a 100m sprint or a shot put throw. It is the fastest way to supply energy but gets depleted quickly. Recovery of this system takes a few minutes of rest. Athletes doing power sports rely heavily on this system to perform at peak levels during quick movements.

3. What are the short-term effects of exercise on the muscular system?

Answer : Short-term effects on muscles occur during or right after exercise. These include increased blood flow, higher muscle temperature, and improved flexibility. Muscles may feel stiff or sore due to lactic acid buildup. Tiny micro-tears occur in the muscle fibers, especially during strength training. These tears are part of the muscle-building process. As a result, muscles temporarily lose strength and feel fatigued. However, these responses help the body adapt and become stronger when recovery and proper nutrition are provided after workouts.

4. State the long-term effects of regular exercise on the respiratory system.

Answer : With consistent aerobic training, the respiratory system adapts to become more efficient. Breathing muscles like the diaphragm get stronger, and the lungs increase their capacity to hold and move air. Gas exchange in the alveoli becomes faster and more effective. The breathing rate at rest decreases as each breath becomes deeper. Residual volume (the air left in lungs after exhalation) also increases. These adaptations allow more oxygen to enter the bloodstream and help athletes perform longer without fatigue.

5. How does training affect the cardiorespiratory system in the long term?

Answer : Long-term training strengthens the heart muscle, allowing it to pump more blood with fewer beats. This lowers resting heart rate and improves stroke volume and cardiac output. Blood vessels expand and increase in number, especially capillaries around muscles. The lungs increase their capacity, and breathing becomes deeper and more efficient. All these adaptations allow the body to deliver more oxygen and remove waste faster, improving stamina and performance in endurance sports.

6. List the types of fractures and briefly explain any three.

Answer : Types of fractures include:

- Stress fracture
- Greenstick fracture
- Comminuted fracture
- Transverse fracture
- Oblique fracture
- Impacted fracture

i. **Stress Fracture:** Tiny cracks from overuse, common in runners.
ii. **Greenstick Fracture**: Partial bending of bone, mostly in children.
iii. **Comminuted Fracture**: Bone breaks into multiple pieces, usually due to severe trauma.

7. Explain the role of the aerobic energy system in sports performance.

8. What is the RICE method? Explain its importance in sports injuries.

9. Explain the concept of cardiorespiratory endurance.

5 MARKS- Long Answer Questions (Each answer within 200–300 words)

1. Explain in detail the three energy systems of the human body with suitable examples.

Answer : The body uses three energy systems to supply **ATP *(adenosine triphosphate)*** during physical activity:

1. ATP-CP System (Phosphagen System):

Provides instant energy for high-intensity, short-duration activities (up to 10 seconds).

Uses stored ATP and creatine phosphate (CP).

No oxygen is used (anaerobiC).

Example: *100m sprint, shot put.*

2. Anaerobic Glycolytic System:

Active during moderate-duration, high-intensity efforts (10 sec–2 min).

Breaks down glucose without oxygen, producing lactic acid.

Example: *400m race, fast swimming.*

3. Aerobic System:

Supplies energy for long-duration, moderate-intensity activities.

Uses oxygen to convert carbohydrates and fats into ATP.

Example: *Marathon, football, cycling.*

2. Describe the short-term and long-term effects of exercise on the muscular system.

Answer : Short-Term Effects:

- Increased blood flow and muscle temperature
- More flexibility due to warmed-up muscles
- Lactic acid buildup causing fatigue
- Micro-tears in muscle fibers (leads to muscle soreness)

Long-Term Effects:

- Muscle hypertrophy – increase in muscle size and strength
- Strengthening of tendons and ligaments
- Increased number of mitochondria (better energy production)
- Higher levels of myoglobin and glycogen storage
- Improved metabolism and fat-burning ability
- Better lactate tolerance

3. What is aging? Explain how aging affects physical fitness.

Answer : Aging is a natural process where body functions decline over time. It begins noticeably after 40 and accelerates with age.

Muscular System:

- Muscle mass reduces (up to 50% by age 80)
- Strength and flexibility decline

Nervous System:

- Slower nerve impulses
- Poor coordination and reaction time

Cardiovascular System:

- Reduced cardiac output and blood flow
- Lower maximum heart rate

Respiratory System:

- Stiffer chest, lower lung capacity
- Slower breathing response

Skeletal System:

- Bone loss increases fracture risk
- Osteoporosis is common

Despite these, regular exercise can delay aging effects, improve health, and maintain independence in older adults.

4. Discuss the effects of exercise on the cardiovascular and respiratory systems in both short and long term.

5. Describe the different types of muscle fibers and how they influence athletic performance.

4 MARKS- Case Study Based Questions

1. Case Study

Priya is a sprinter training for the 100m race. Her coach is focusing on improving her reaction time and explosive power. She trains using short bursts of maximum effort exercises.

Q1. The primary energy system Priya uses during sprinting is the _____.

Q2. Which muscle fiber type will be dominant in her muscles?

Q3. True or False: Priya's activity uses the aerobic energy system.

Q4. Match the following:

A. Sprinting –	(i) Type I
B. Marathon –	(ii) Type II

Answers:

1. ATP-CP system
2. Fast-twitch
3. False
4. A–ii, B–i

2.Case Study

Ravi plays football regularly. He can run for long durations and recovers quickly after each match. His breathing remains steady even after 90 minutes of play.

Q1. Which energy system is mainly responsible for Ravi's performance?

Q2. True or False: Ravi has a strong aerobic capacity.

Q3. Fill in the blank: _____ fibers are responsible for Ravi's endurance.

Q4. Name any one cardiorespiratory adaptation Ravi would have.

Answers:

1. Aerobic system
2. True
3. Slow-twitch
4. Lower resting heart rate / Increased lung capacity

Case Study 3:

Sunita, a 65-year-old woman, finds it difficult to climb stairs. Her bones are weak, and she complains of joint pain. Her doctor suspects age-related bone degeneration.

Q1. Name the condition Sunita might be suffering from.

Q2. True or False: Flexibility increases with age.

Q3. Fill in the blank: Aging can cause up to _____% loss of muscle mass by age 80.

Q4. Match the systems with effects of aging:

A. Muscular –	(i) Lower lung capacity
B. Respiratory –	(ii) Muscle fiber loss

Answers:

1. Osteoporosis
2. False
3. 50
4. A–ii, B–i

Case Study 4:

Arjun slipped during a kabaddi match and twisted his ankle. His coach immediately applied the RICE method to treat the injury.

Q1. What type of injury has Arjun likely suffered?

Q2. What does "C" in RICE stand for?

Q3. True or False: A fracture is a soft tissue injury.

Q4. Fill in the blank: To stop further movement of the injured limb, the injured person should-----

Answers:

1. Sprain
2. Compression
3. False
4. Rest

Unsolved Questions

Case Study 5:

Reena is preparing for a yoga competition. Her focus is on joint movement and maintaining a full range of motion. She practices stretching daily.

Q1. Name the fitness component Reena is focusing on.

Q2. Fill in the blank: Flexibility depends on joint structure and _____.

Q3. True or False: Flexibility has no role in injury prevention.

Q4. Match the activities with the fitness component:

A. Yoga –	(i) Strength
B. Weightlifting –	(ii) Flexibility

Case Study 6:

Manav trains in the gym 5 days a week. He performs heavy lifting and aims to grow muscle size. He also takes a protein-rich diet.

Q1. What is the physiological term used to refer to muscle growth?

Q2. True or False: Lactic acid helps in muscle recovery.

Q3. Fill in the blank: Muscle growth results from _____ in fibers during training.

Q4. Match the terms:

A. Hypertrophy –	(i) Muscle soreness
B. Micro-tears –	(ii) Muscle enlargement