

5



373en05

PHYSICAL AND PHYSIOLOGICAL ASPECTS OF PHYSICAL EDUCATION



Note

Anand is an athlete and is the medal winner in the 100 mt race in School annual sports meet. He is aspiring to compete in inter school and district athletic competition, for which he has to improve his performance through training from athlete experts. He consulted his school Physical Education teacher, who accompanied him to the district stadium of his locality and met the athletic coach of the stadium. The stadium coach listened to Anand and his school Physical Education Teacher and started suggesting Anand. The suggestions focused around essentials required to improve performance, benefits of exercise, type of exercise and training required to improve physiological and physical aspects of Anand. Anand could not understand the suggestions and was expecting his Physical Education Teacher to make him understand as to how physical activity can affect cardiovascular system, respiratory system and muscular system through exercises and training. On returning from the district stadium, school Physical Education Teacher started to explain the concepts discussed by the athletic coach to Anand, which are included in this chapter.



OBJECTIVES



After studying this lesson, you will be able to:

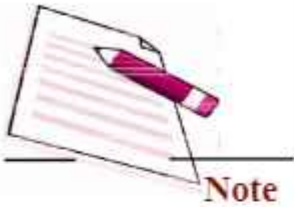
- explain the concept, types and components of physical activity;
- explain the concept and effects of exercise on the muscular system;
- learn the effects of exercise on the respiratory system;
- count the effects of exercise on the circulatory system and
- explain the concept of Yog Physiology.

5.1 CONCEPT OF PHYSICAL ACTIVITY

Exercise can be defined as “the collective efforts done by the body to perform a specific task” or any body movement done by the muscles, regulated by brain that results in energy expenditure. Here we are talking about physical activities

Physical Education and Yog





that include your anatomical posture, physiological systems, psychological efforts, social environment etc. Without physical, mental, emotional and social efforts physical activity can not be performed. There are ranges of physical activities which can be divided into three sections: aerobic activities, anaerobic activities and flexibility exercises. We have to understand the different types of activities, before we could understand their effects on different systems of our body. You are advised to do warmup, before you start any workout and after completion of workout you are advised to do cooling down.

5.1.1 Warm Up

Warm up are those exercises which are performed before any workout with a purpose of physiological and psychological preparation. We can divide warming up into two parts: general warm up and specific warm up. In general warm up, an individual does general physical movements like sport jogging, stretching, calisthenics etc. In specific warm up, an individual does physical movement specific to those group of muscles which are in major form involved in specific skill.

Repeat each exercise for 10 seconds

			
hops on the spot	side-to-side hops single leg	hops on the spot	side-to-side hops feet together
			
all back expansions	chest expansions	arm circles (wide)	arm circles
			
hops on the spot	side-to-side hops single leg	hip rotations	torso rotations

Source- <https://darebee.com/workouts/4-minute-warmup-workout.html>





Note

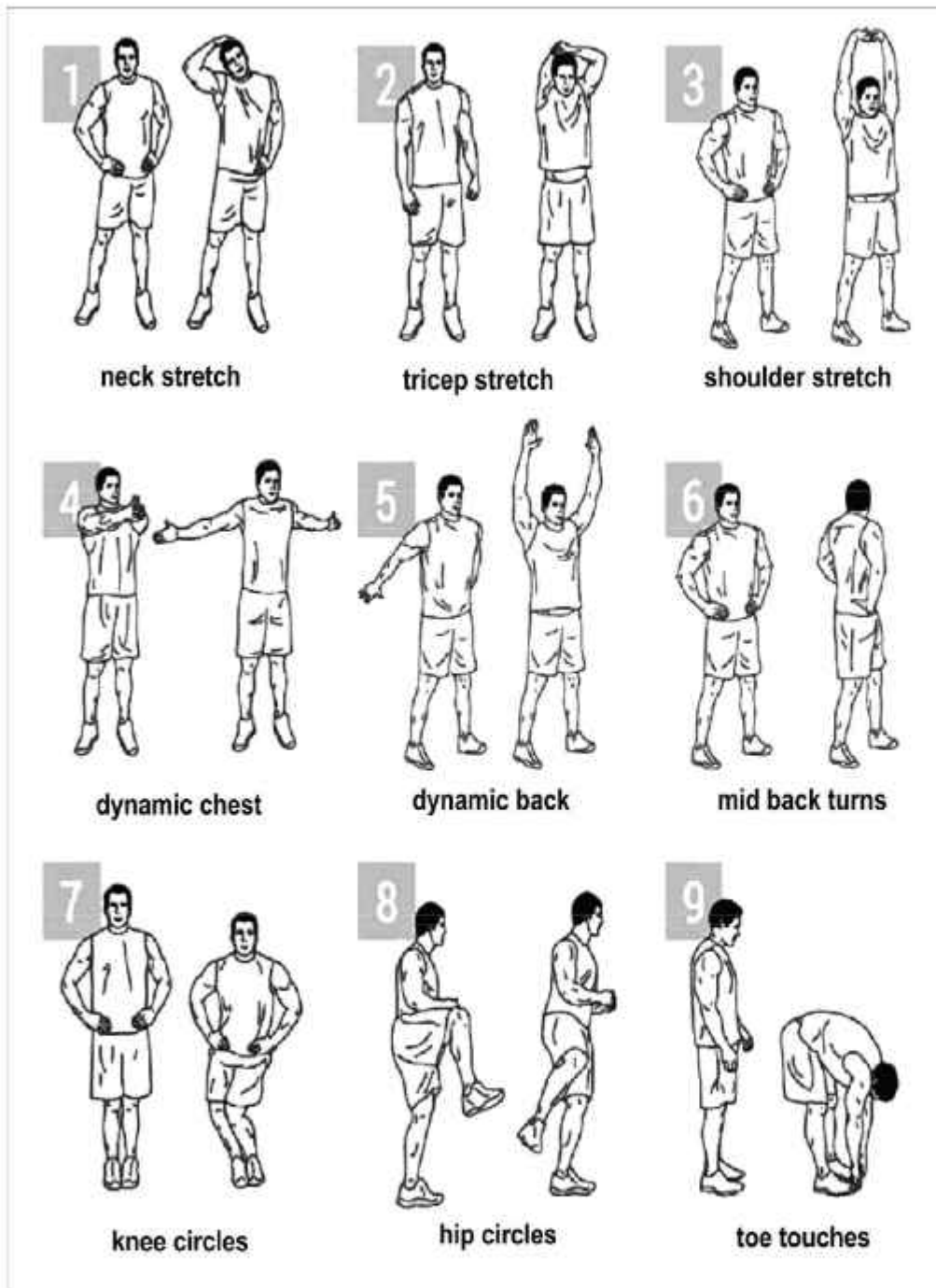


Fig.5.1a: Warming up Exercises

Source- <https://darebee.com/workouts/4-minute-warmup-workout.html>



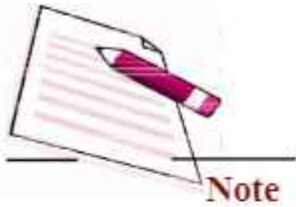


Fig.5.1b: Warming up Exercises

5.1.2 Effects of Warm up on Body Systems

- Enhances the body core temperature by 1 degree Celsius which brings basal metabolic rate (BMR) higher, resulting in better physical work capacity.
- Red blood cells carry more oxygen resulting in alertness and make you full of energy.
- Increases the stroke volume as per demand of the activity.
- Improves range of motion in joints.
- Enhances coordination, agility, reaction time.
- Increase in muscle blood flow,
- Increase in the speed of nervous impulse
- Nerve receptors work faster



- Improves flexibility and physical performance
- prevents sports injuries.

5.1.3 Types of Activity

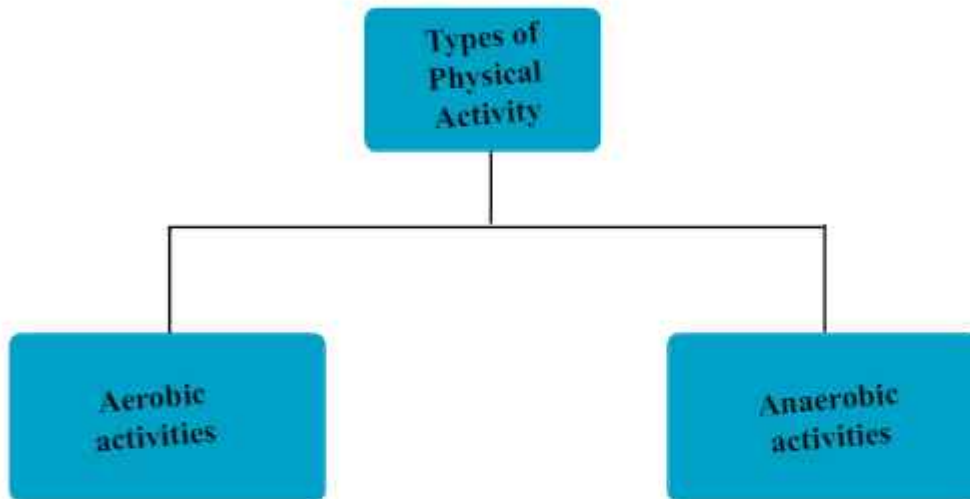


Fig.5.2: Types of Physical Activity

Aerobic Activities

Aerobic activities are those activities which are performed continuously with low and moderate intensity by the large groups of muscles, oxygen uptake is high. These activities require oxygenated blood for working muscles. For example, walking, running, skipping, swimming, rowing, hiking. Production of lactic acid in muscles in these activities is low.

Anaerobic Activities

Anaerobic activities are those activities which are performed in intervals with moderate to high intensity and low volume. The activity is either too fast or too intensive in which working muscle is unable to receive appropriate amount of oxygenated blood that triggers lactate acid formation. Sprinting, weight training etc. are suitable examples.

5.1.4 Components of Physical Activity

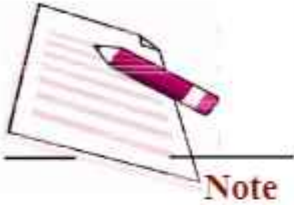
Effect of exercise or physical activity on body system depends on below mentioned factors:

- **Types of Physical Activity:** Different physical activities have varied energy demand, involvement of body parts, coordination & equipment used which produces a wide-range of load. Examples: running, weight lifting, playing tennis, playing kick boxing, badminton etc.



Note





- **Intensity of Activity:** amount of physical power that the body uses during the activity is known as intensity of activity. It may also be calculated by the amount of force or energy exerted in relation to time. Example: intensity in running can be measured by calculating the speed which may further be illustrated in units as m/sec or km/hr. in weight lifting intensity can be measured in Weight in Kgs or in tons etc.
- **Volume of the Activity:** Work done during exercise or activity is known as volume of activity. It can be measured by duration, distance and frequency of an activity. Example in running activity volume can be measured in second, minutes, hours or in meter, km. etc. in weight lifting volume can be measured in repetition / time.

5.2 MUSCULAR SYSTEM

Muscular system permits movement of the body, maintain posture and circulates blood throughout the body. There are more than 600 muscles and 206 bones in our body that help us to produce force and movement. It permits movement of the body, maintains posture and circulates blood throughout the body muscles contracts and relaxes. The muscles are of three types and have different characteristics and functions which are mentioned below:

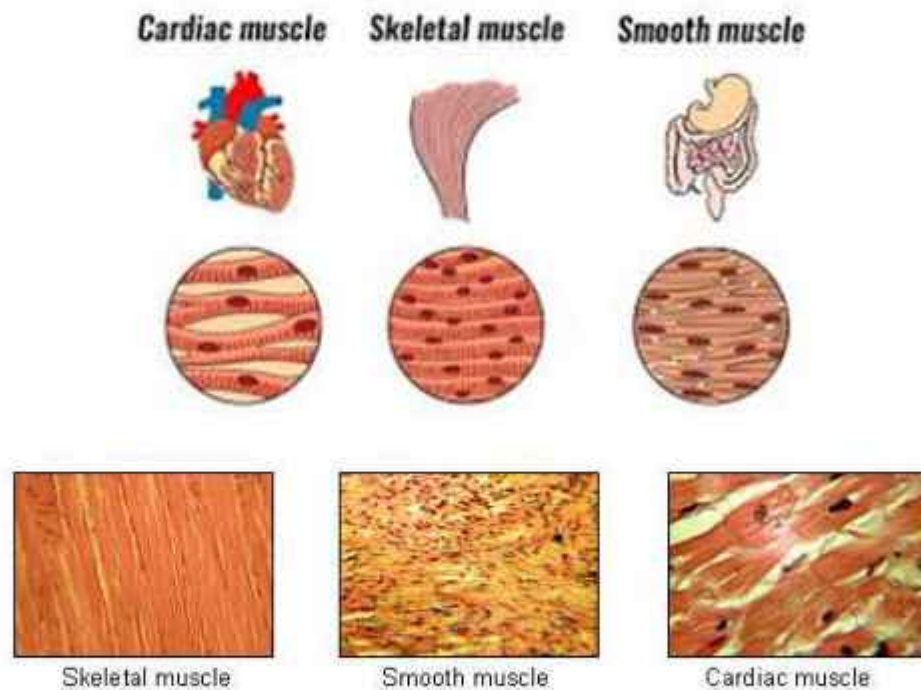


Fig.5.3: Types of Muscles



- **Smooth muscles** – It is an involuntary muscle which is not under control of conscious functioning of nervous system. These muscles are located in our organs like digestive system, respiratory system etc.
- **Cardiac muscles** – As per its name this type of muscle tissues are found in heart. It contracts automatically and quickly and repeatedly forcing the blood the throughout body. It work rhythmically without any fatigue. They are involuntary muscles in nature, so are not under conscious control.
- **Skeletal muscles** – known as striated muscle due to its appearance, skeletal muscle are under voluntary control or the conscious control. Contraction of this type of muscle results in pulling of the bones and creates movements. There are different types of activities which are controlled by the skeletal muscles. There are three types of muscle contractions:



Note

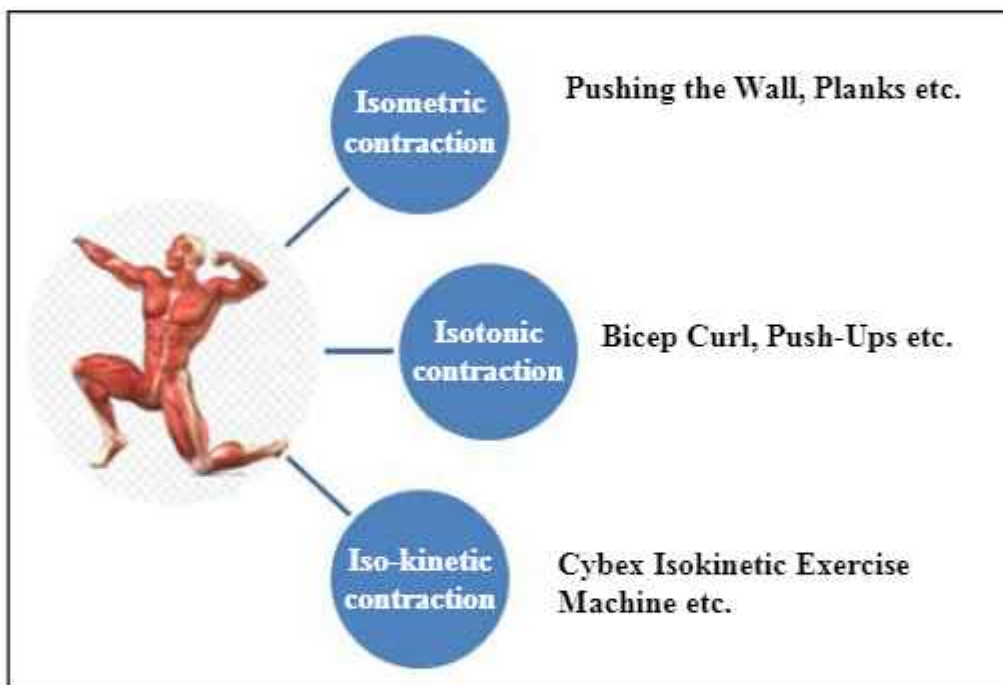


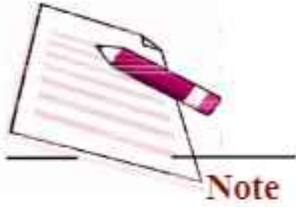
Fig. 5.4: Types of Muscle Contractions

- Isometric contraction:** during the process of contraction tension occurs but no visible change in the length of the muscle. Example pushing the wall, planks etc.



Fig. 5.5: Isometric Exercises





ii) **Isotonic contraction:** when muscle's shortening and lengthening process is visible while lifting a constant load. Example bicep curl, push ups etc.



Fig. 5.6: Isotonic Exercises

iii) **Iso-kinetic contraction:** it is executed on a constant pace where muscle shortening is maximal over full range of motion. Example XYZ isokinetic exercise machine.

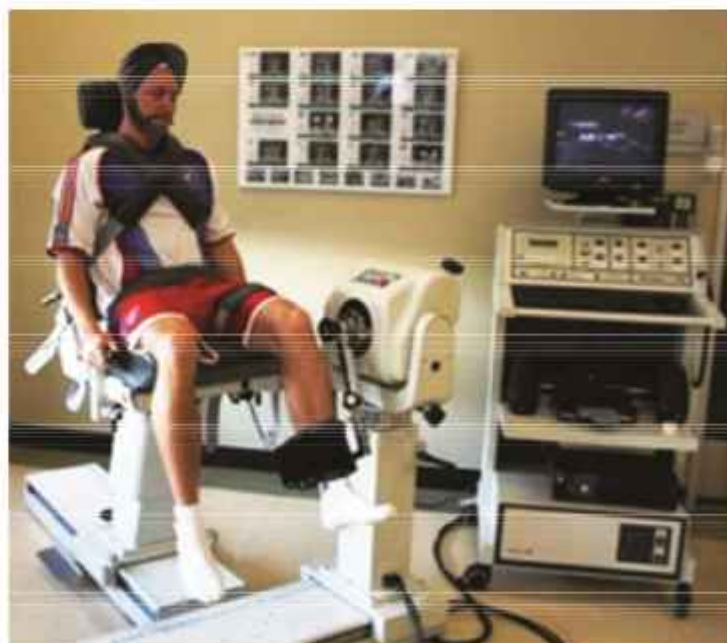


Fig.5.7: Iso-kinetic Exercise





DO YOU KNOW?

Skeletal muscles are composite of muscle fibres which can be divided in to two categories: Type I is also known as slow-twitch fibres and Type II known as fast-twitch. Our body has both categories of fibres; the composition may change depending upon the training:

- a) **Type I (slow-twitch) fibres** contracting slowly with less force, fatigue comes slowly which suits for long duration aerobic activities eg. Long distance races, Aerobics etc.
- b) **Type II (fast-twitch) fibres** contract faster and produce great force but fatigue comes faster; anaerobic activities suit this types of fibres eg. Short distance races, 100 M, 200 M etc.



Note



INTEXT QUESTIONS 5.1

- 1) Which type of muscle is under control of conscious functioning of nervous system?
- 2) Fill in the blanks with appropriate words.
 - a) If you have 80% of fibres in your muscles, then you can give good timings in sprint rather than marathon.
 - b) When we do exercise biceps curl repetition then we do muscle contraction.
 - c) In weightlifting, somebody is lifting the weight of 80% of his capacity that is known as
 - d) Contraction is executed on consistent pace where muscle shortening is maximum over full range of motion



ACTIVITY 5.1

Prepare a chart of 10 Isometric exercises and 10 Isotonic exercises.

Hint: Search on Internet

5.2.1 Effects of Exercises on Muscular System

When we do exercise, our muscle system responds differently according to long term or short term activity. These responses are known as acute responses caused



by short term activity and chronic responses caused by long term activity. Their effects has been shown in the figure below:

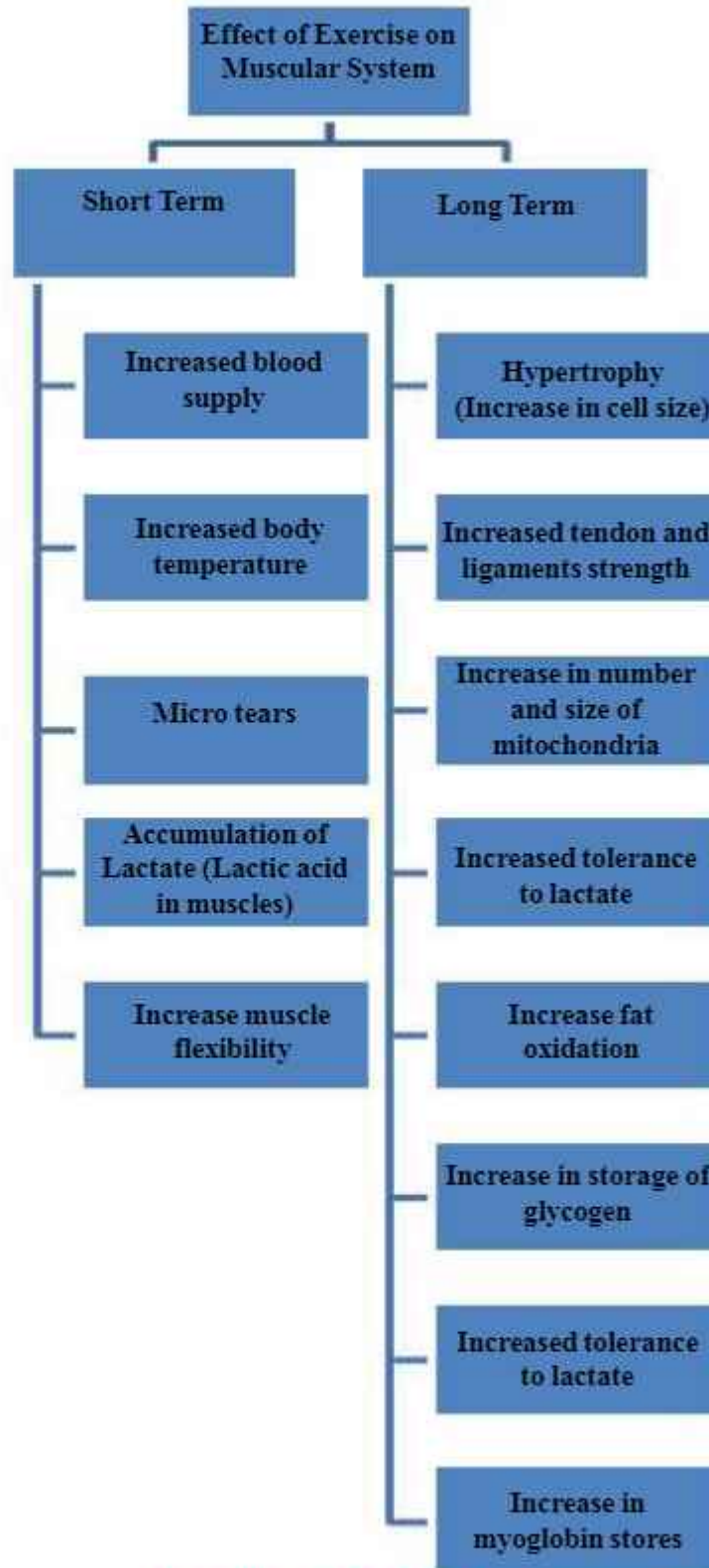
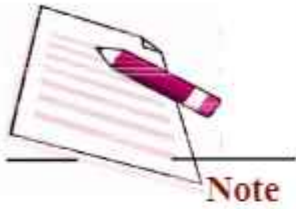


Fig.5.8:Effect of Exercise on Muscular system



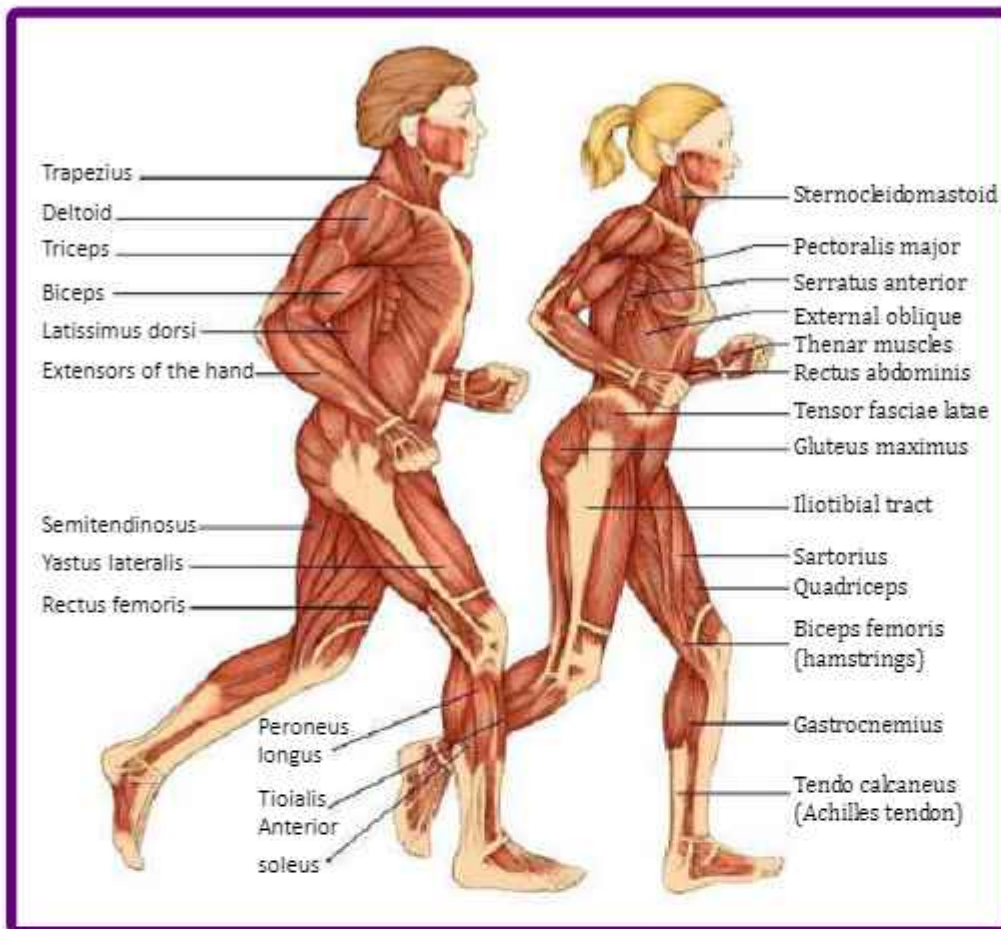


Fig.5.9:Muscular system

Source- <https://kidskonnnect.com/science/muscular-system/> Muscular Sytem Facts & Worksheets: <https://kidskonnnect.com/> - Kidskonnnect, June 7, 2018

5.2.1.1 Short Term Effects of Exercise on Muscular System

- **Increased blood supply**

As an effect of involvement in exercise our metabolic rate (rate of energy produced and released by the muscles) also increases gradually. Blood does not only work as to import oxygen but also to remove waste products like carbon dioxide.

- **Increased muscle temperature**

Effect of short term activity includes rise of the temperature of the body that happens because of chemical break down of fats and carbohydrates.

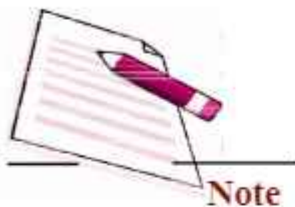
- **Increase muscle flexibility**

Due to increase in temperature during the activity muscles become more flexible, it means greater range of motion and possibilities of injuries are also reduced.



Note



**Note**

- **Accumulation of Lactate**

When we do short duration high intensity activity then we experience burning sensation in our muscle, this results due to accumulation of lactate acid in our muscles which results in insufficient supply of oxygen.

- **Micro tears**

In weight training, we put our muscle under stress that results in little tears in muscle fibres. Micro tears in our muscle cause pressure on nerve and never endings.

5.2.1.2 Long Term Effects of Exercise on Muscular System

- **Hypertrophy**

Increase in size of the muscle due to increase in the size of muscle cell is known as hypertrophy. Continuous weight training results in increasing the size of muscle and strength.

- **Increased tendon and ligaments strength**

Tendons are those connective tissue bands which connect bone to muscles and ligaments are those bands which connect one bone to another. Regular strength training activity increases the strength as well as flexibility of both and it has a positive impact on cartilages.

- **Increase in number and size of mitochondria**

As you know continuous weight training leads to hypertrophy, size of muscle fibres also increase. In muscle fibres there are mitochondria which are also known as power house, they produce energy because of increase in fibres. Their space also becomes bigger and their size also increases which leads to better aerobic and anaerobic performance.

- **Increase in myoglobin stores**

Myoglobin is protein is found in muscle tissue which is responsible for caring and storing of oxygen in skeletal muscles. Continuous and intensive activity increase the quality and quantity of myoglobin stored in your muscles. Myoglobin transports oxygen to mitochondria which produce energy.

- **Increase in storage of glycogen**

Long duration activity like running done continuously for several days can improve the storage of glycogen in your muscles. Muscle glycogen does not need oxygen to give energy. It means that if you have good storage of glycogen then you can do long term and intensive activity.



- **Increase in oxidation/metabolism**

After doing continuous activity for a long period your body is able to produce energy from fats through aerobic glycolysis process. It becomes an easy process to get energy from fat, during the process of training.

- **Increased tolerance to lactate**

Muscles can tolerate lactic acid and clear it fast during anaerobic training, in aerobic training due to increase in blood volume body gets more oxygen and removes lactate for our body.



Note

5.3 EFFECT OF EXERCISE ON RESPIRATORY SYSTEM

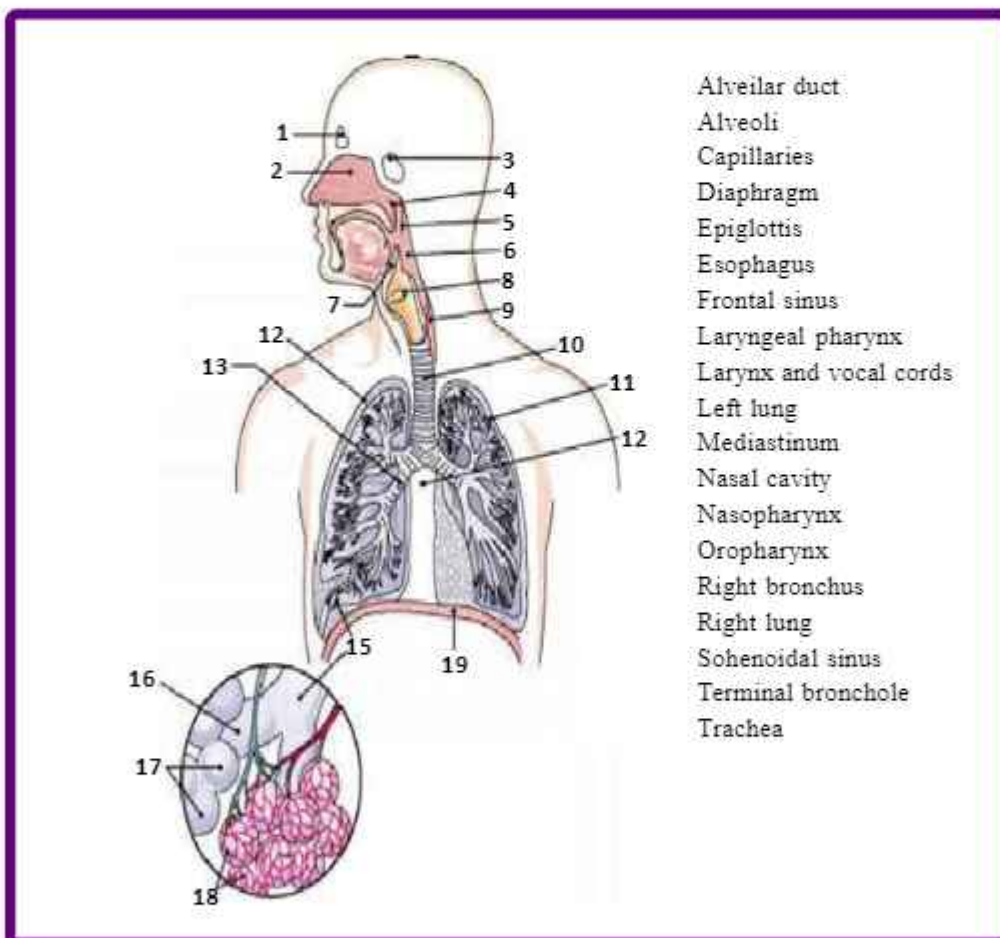


Fig.5.10: Respiratory System

System consists of series of organs responsible for taking in oxygen and expelling carbon dioxide. These organs are nose, pharynx, larynx, trachea, bronchi, lungs and alveoli. Respiration is exchange of oxygen and carbon di oxide in our body.



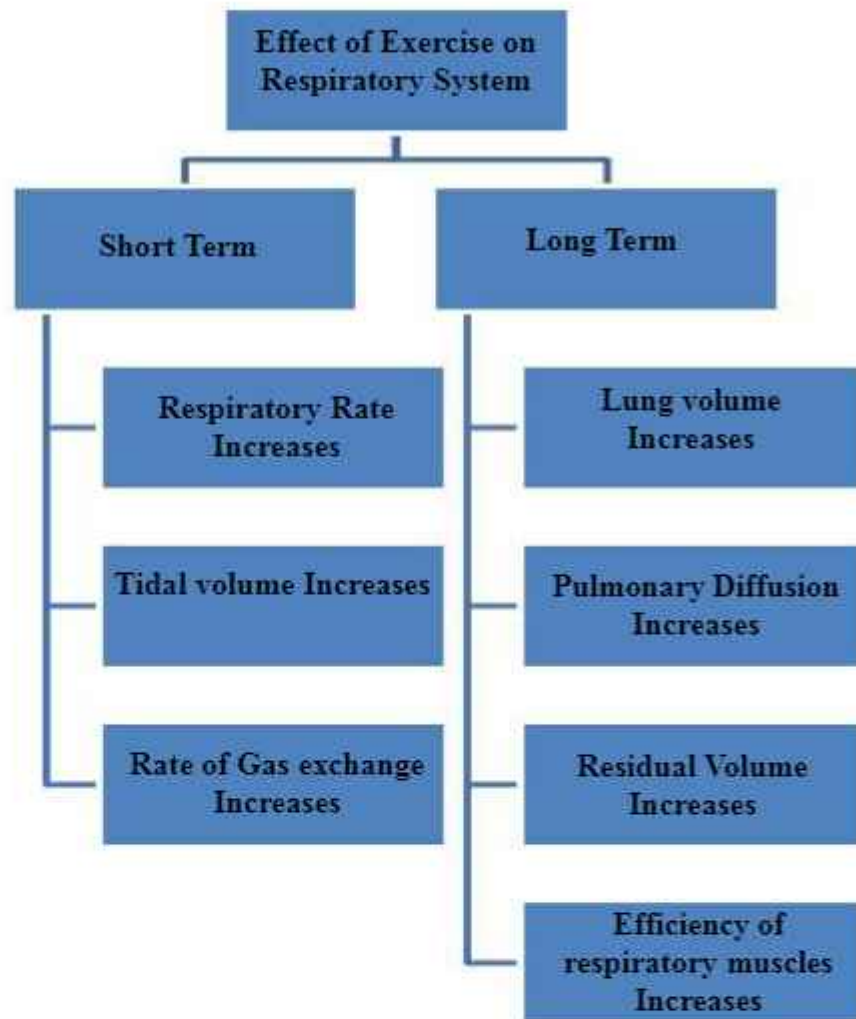
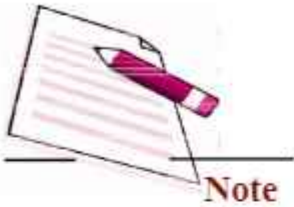


Fig.5.11: Effect of exercise on respiratory system

5.3.1 Short Term Effects of Exercise

- **Respiratory Rate Increases**

During activity our muscles require oxygen and produce carbon dioxide; to match the demand lungs have to work hard in this process so that lungs can pump more oxygen into blood and out to the muscles. Our breathing rate increases, sometimes it may reach to 40 breaths per minute as their resting breathing rate is around 15 per minute.

- **Tidal volume Increases**

The volume of air inhaled and exhaled in one breath is known as tidal volume. As you know pulmonary ventilation increases because of size in tidal volume and respiratory rate to meet increased oxygen demands.



Rate of Gas exchange Increase

The rate of diffusion of gas between alveoli and blood also increases, during maximal exercise exchanging capacity for oxygen increases by 300%. Their short term effects provides many long term benefits.

5.3.2 Long Term Effects of Exercise

Efficiency of respiratory Muscles Increases

The strength and endurance of respiratory muscles increases due to rapid inhalation and exhalation to meet the oxygen demand by the body. That may be seen in larger lung volumes of trained persons.

Lung volume Increases

Endurance activity done for long period results in increase of volume and capacity of lungs. Larger volume of air exhale after deepest possible inhale is known as vital capacity. Vital capacity increases up to 5-6 liters as compared to inactive individual who is having 3-4 liters.

Pulmonary Diffusion Increases

During the maximal activity alveoli size increases, which provide more space to exchange oxygen and carbon dioxide.

Residual Volume Increases

The volume of air that remains in lungs after maximal expiration is known as residual volume. During the activity residual volume increases which helps to exchange the gases in normal limits, it is a store house where air can remain.

Optimum amount of oxygen flow in our body helps in concentration, alertness, makes immune system stronger, gives energy etc., it has also emotional and social benefits.



DO YOU KNOW?

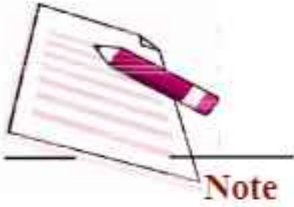
The air that is inhaled is about 20-percent oxygen, and the air that is exhaled is about 15-percent oxygen, so about 5-percent of the volume of air is consumed in each breath and converted to carbon dioxide. Therefore, a human being uses about 550 liters of pure oxygen (19 cubic feet) per day.

<https://health.howstuffworks.com/human-body/systems/respiratory/question98.htm>



Note





5.4 EFFECTS OF EXERCISE ON CIRCULATORY SYSTEM

Our body requires oxygen during long term activities; this need is fulfilled by the circulatory system. This system consists of blood, heart and vessels. This system not only carries oxygen but also supplies nutrition to cells and tissues, removes waste product, and carries hormones etc. Circulatory system is affected in following ways (Fig. 5.12) during exercise.

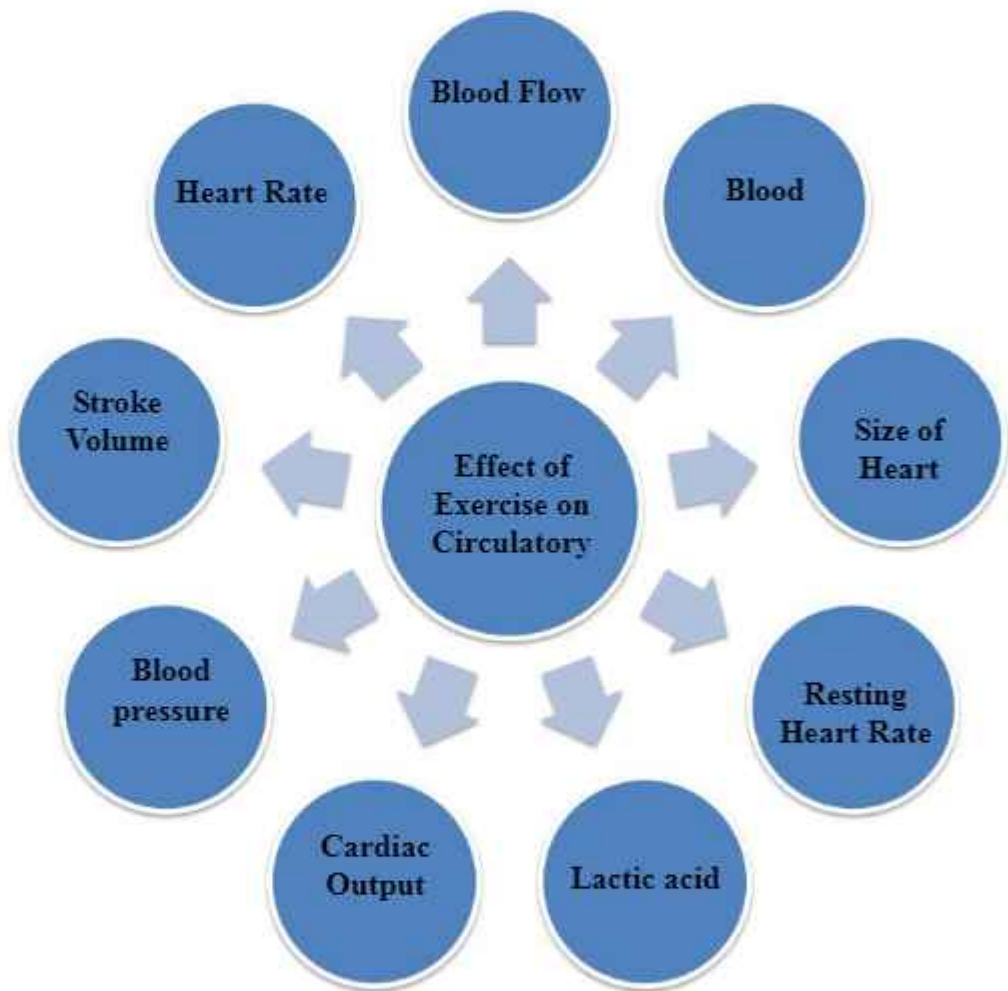


Fig.5.12: Effects of Exercise on Circulatory System





Note

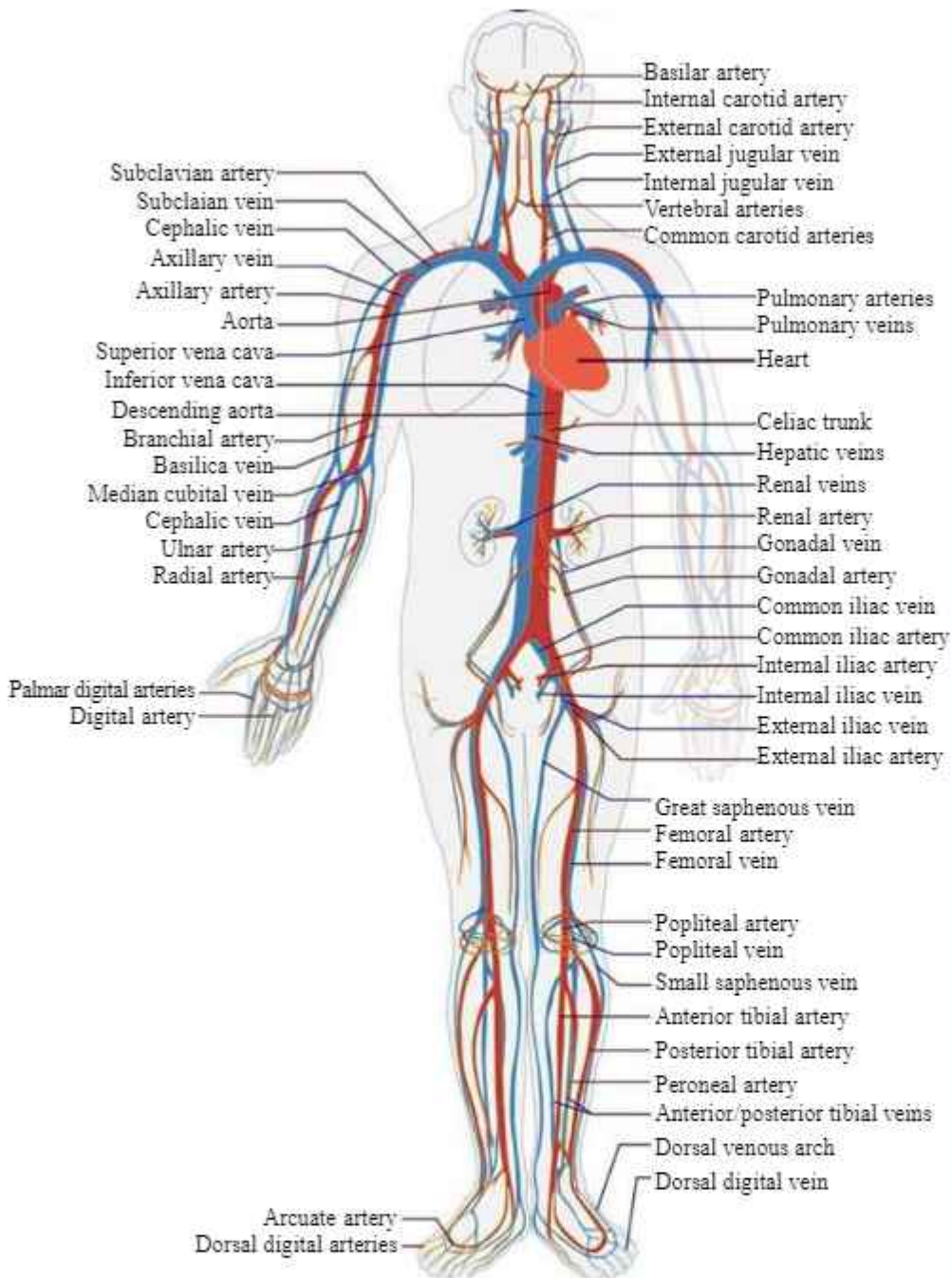
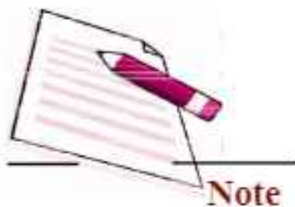


Fig.5.13:Circulatory Systems

• **Heart Rate Increase**

During the activity heart rate increases, resting heart rate is ranging 60-80 beat per minute. The rate and intensity of heart contraction is affected by type of activity, volume, intensity of activity, age, environment etc.





- **Stroke Volume increases**

Amount of blood pumped in every heart beat is known as stroke volume. It is a prime factor to determine the endurance capacity of an individual, due to small heart volume in females their stroke volume is also lower as compared to males. In resting position, an individual who is not involved in activity, his heart pumps 70 ml/ bt and in same state an individual who does regular activity their heart pumps 100 ml/bt.

- **Cardiac Output increases**

The amount of blood pumped in one minute by the heart is known as cardiac output, it can be calculated by heart rate x stroke volume. Due to increase in heart rate and stroke volume cardiac output also increases.

- **Blood pressure increases**

Participation in Physical activity immediately increases the blood pressure. Upper limit is known as systolic and lower limit known as diastolic pressure. There are factors which affect the blood pressure like age, sex, disease, exercise, psychological factors etc.; It depends on the type of activity. However prolonged participation in physical activity, maintains the blood pressure level.

- **Blood Volume increases**

Activity results in increase in blood volume due to increase in blood plasma and the number of red blood cells. Increase in volume of blood plasma results in decrease of blood thickness which leads to better blood circulation.

- **Blood Flow increases**

Active muscles need more oxygen and nutrition, that requirement can be fulfilled by more flow of the blood. Reasons of Increase in blood flow are increase in blood volume, increase in capillaries etc.

- **Size of Heart**

Long term continuous activity changes the function and structure of the heart. It is a pumping machine which supplies blood to the whole body. Continuous activities not only increase the ability of contraction but also increase the size of left ventricle.

- **Lactic acid**

Long term effect of activity includes lower level of accumulation of lactic acid, due to good circulation of blood which contains good amount of oxygen.



- **Resting Heart Rate**

Due to good circulation and hypertrophy of heart the resting heart rate decreases.



DO YOU KNOW?

- Normal Blood pressure Range is systolic = 120- diastolic = 80 mmHg
- Athletic Heart is a syndrome in which human *heart* is enlarged, and the resting *heart* rate is lower than normal.
- An average adult heart rate ranging between 60 beats per minute to 80 beats per minute, on an average 72 beats per minute.



INTEXT QUESTIONS 5.2

Choose the correct option.

- 1) Amount of blood pumped in every heart beat is known as:
 - a) Cardiac Output
 - b) Blood Volume
 - c) Stoke volume
 - d) Residual Volume
- 2) Which of the following is not an outcome of exercise on muscular system?
 - a) Increased tendon and ligaments strength
 - b) Hypertrophy
 - c) Pulmonary Diffusion Increases,
 - d) Increase in myoglobin stores

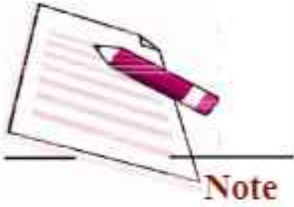
Complete the sentence with one of the term given below.

- 3) Increase in storage of glycogen is an effect of exercise and comes under
 - a) Circulatory system
 - b) Respiratory system
 - c) Muscular system
 - d) None of above



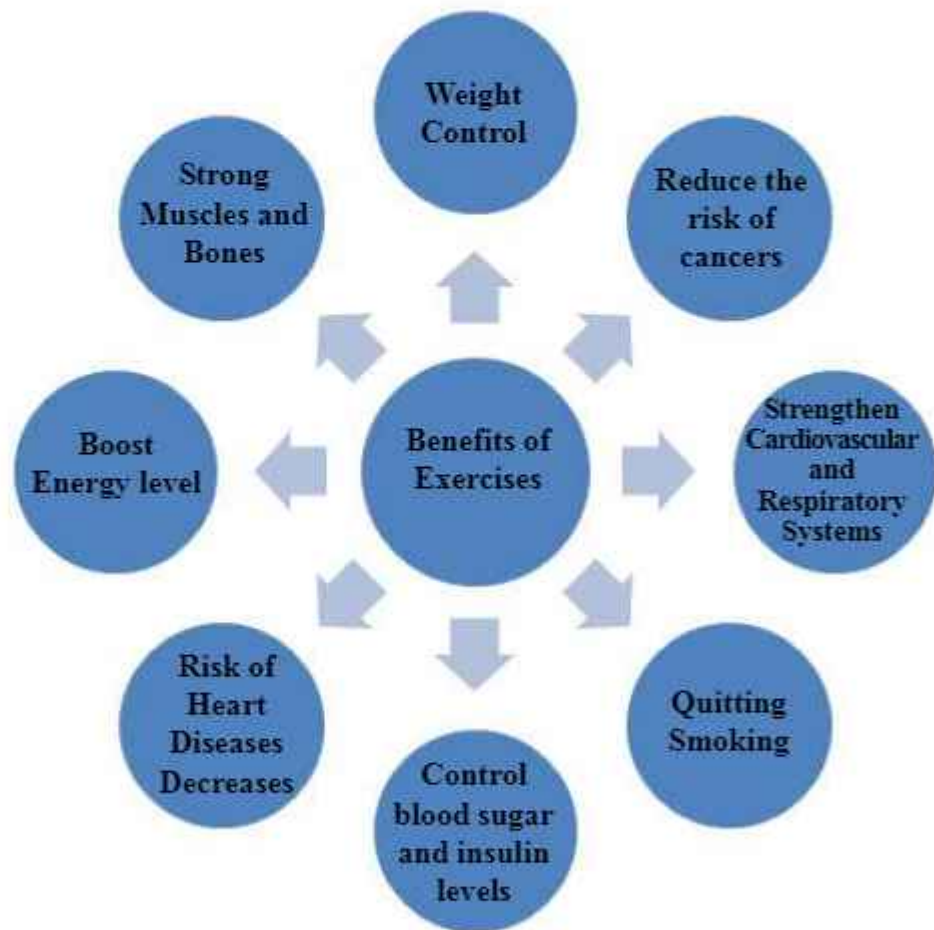
Note





- 4) Explain the role of Heart while doing activity.
.....
- 5) By what name is the volume of inhaled and exhaled air in one breathe known?
.....
- 6) Explain the impact of increase in volume of blood pressure.
.....
- 7) Explain the role of prolonged activity on the heart rate.
.....

5.5 GENERAL BENEFITS OF EXERCISES





DO YOU KNOW?

Our body has

- 37.2 trillion Cells
- 200 different types of cells
- 100 billion skin cells
- 100 billion neurons in brain
- 127 million retinal cells
- 6 litres of blood
- 42 billion blood vessels
- 30 trillion red blood cells
- 23040 breaths per day
- 115200 heart beats per day
- Heart pumps nearly 1.5 million barrels of blood during a lifetime
- 640 muscles
- 360 joints
- 206 bones in adult
- 300 bones in children



Note

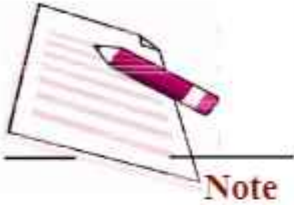
5.6 CONCEPT OF YOG PHYSIOLOGY

Before learning yog, an individual must have the understanding about anatomical and physiological aspects because incorrect and unsafe practices can lead to medical problems and it may also create new problems. An individual must know the individual differences and effects of yog on our body. Yog has been practised for thousands of years for development of physical, mental and spiritual personality. Physiological aspects of yog can be observed in shuddhi kiriyas, pranayama and asanas.

5.6.1 Physiological Aspects of Shuddhi Kriyas

- These help to prevent respiratory disease like bronchitis, asthma etc.
- These help to remove excess of mucus from our body, to cure cold and cough.





- These help to cure digestive system disorders like acidity, indigestion, constipation etc.
- These clean colon, removes gas and makes passage clear.
- Nauli massages muscles, intestine, excretory organs etc.
- Jal neti removes pollution from nasal passages and allows air flow without obstruction; and stimulates nerve passing from nose to improve the functioning of brain.

Physiological Aspects of Pranayam

- Helps in cooling the body systems and relaxes the eyes, nose and ears.
- Helps to cure the disease like blood pressure and purify the blood
- Its increases the flow of oxygen in blood that keep body fit and healthy.
- It strengthens the nervous system, relax the function of brain.
- It tones the organs and digestion.

Physiological Aspects of Asanas

- Asanas improve strength, flexibility and aerobic capacity.
- These provide positive changes in toning of muscles.
- These improves ability to recover from injury
- These has positive effect's on isometric and isotonic muscle contractions.
- Play important role in disease like arthritis, back pain, hypertension, various respiratory diseases, sinusitis, diabetes, obesity, indigestion.
- Help in reduction in blood pressure, cholesterol, body fat, blood glucose level.
- Improve the functioning of respiratory system, immune system, digestive system.



INTEXT QUESTIONS 5.3

Fill in the blanks to make the sentences meaningful.

- 1) Through shuddhi kriyas digestive disorders like and can be cured.
- 2) Practice of pranayama strengthens the nervous system and improves its
- 3) Asanas help to gain of muscle.





WHAT YOU HAVE LEARNT

- Three types of physical activities are: aerobic activities, anaerobic activities and flexibility exercises.
- Warming up is the series of exercises done before the main activity which has physiological and psychological benefits.
- In human body we can classify muscles in three groups as per their characteristic and functions; that are smooth muscle, cardiac muscle and skeletal muscle.
- Types, intensity, volume of the physical activity are the component of load.
- Skeletal muscle has two types of fibres namely slow-twitch fibres and fast-twitch ones.
- Effects of exercises on muscular system include increased blood supply, muscle temperature, muscle flexibility, accumulation of lactate acid, micro tears, DOMS, hypertrophy, increased tendon and ligaments strength, number and size of mitochondria, myoglobin stores, storage of glycogen, storage of fat and tolerance to lactate.
- Effect of exercise on respiratory system includes increase in respiratory rate, tidal volume, rate of gas exchange, efficiency of respiratory muscles, lung volume, pulmonary diffusion and residual volume.
- Effect of exercise on circulatory system includes increase in heart rate, stroke volume, cardiac output, blood pressure, blood volume, blood flow, size of heart, lactic acid and resting heart rate.
- General benefits of exercises include weight control, strong muscles and bones, boost in energy level, risk of heart diseases decreases, **control on blood sugar and insulin levels, quitting smoking**, strengthening cardiovascular and respiratory systems and reduction in the risk of cancers.
- Physiological effects of shuddhi kiriyas, pranayam and asana



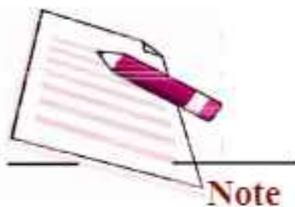
TERMINAL QUESTIONS

- List the effects of exercises on our Cardiovascular System.
- Explain the long term effects of exercise on muscular system.
- Explain the short term effects on cardiovascular system.
- Describe the changes that come in Respiratory system after physical activity.
- How does Yog affect the Physiological values of an individual?



Note





GLOSSARY

- Fatigue: weakness in something, such as a metal part or structure, often caused by repeated bending.
- Metabolic Rate: the amount of energy used by an animal per unit of time.
- Accumulation: a mass or quantity of something that has gradually gathered or been acquired.
- Glycolysis: the breakdown of glucose by enzymes, releasing energy and pyruvic acid.
- Contraction: the act, process, or result of making or becoming smaller or shorter and broader.
- Osteoporosis: a medical condition in which the bones become brittle and fragile from loss of tissue, typically as a result of hormonal changes, or deficiency of calcium or vitamin D.



ANSWERS TO INTEXT QUESTIONS

5.1

1. Skeletal muscle,
 - a) Fast,
 - b) Isotonic,
 - c) Intensity,
 - d) Isokinetic

5.2

1. Stroke volume,
2. Pulmonary Diffusion Increases,
3. Muscular system,
4. To Pump the blood,
5. Tidal Volume,
6. Blood circulation,
7. Decrease

5.3

1. Acidity, indigestion and constipation,
2. Functions,
3. Tones

