UNIT 15

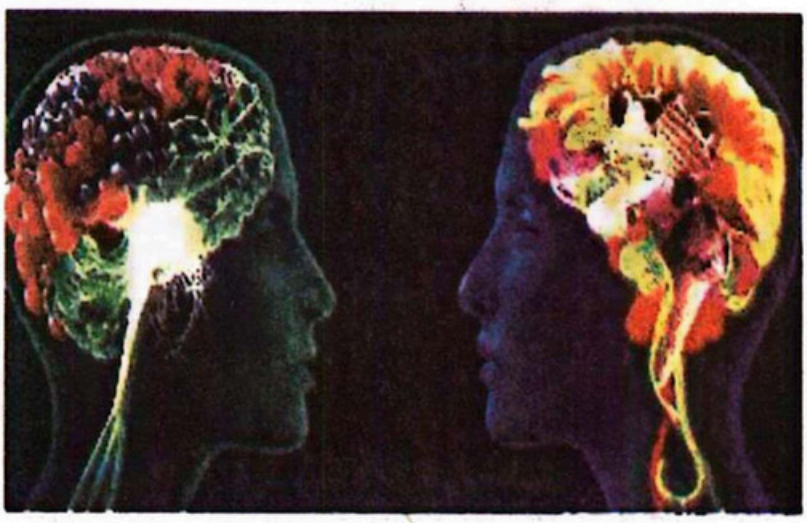
BIOCHEMISTRY

Student Learning Outcomes (SLOs)

After completing this lesson, the student will be able to:

- Explain the importance and basics of nutrition and healthy eating.
- Recognize the main biomolecules, carbohydrates, proteins, lipids, and nucleic acids, their sources along with the required daily intake for young adults.
- Identify carbohydrates as a source of energy.

INTRODUCTION



Think about your brain. It works 24/7, even while you are asleep. Your brain supervises all your body functions, your thoughts, your breath, your heartbeat even your senses. In this scenario, your brain requires a constant supply of fuel. Food is a fuel that drives the processes of life. That "fuel" comes from the foods you eat and what's in that fuel makes all the difference. If your brain couldn't get good-quality nutrition, it can affect the functioning of brain. It means what you eat directly affects the structure and function of your brain and, finally, your life.

15.1 NUTRITION AND HEALTHY EATING

Figure 15.1: Healthy Diet

Nutrition is the source of food required by living things to stay alive. Our food choices impact our health. Good nutrition forms an important part of a healthy lifestyle. All living organisms are made up of molecules that carry out characteristics of life. The total number of molecules or nutrients that we need is called nutrition or diet.

15.1.1 The Importance of Healthy Nutrition/Diet:

- Reduces high blood pressure.
- Lowers high cholesterol.
- A healthy balanced diet can prevent certain diseases, such as obesity, diabetes, cardiovascular diseases, cancer, and skeletal problems.

15.1.2 What is a Healthy Eating/Balanced Diet?

A "balanced diet" provides all the nutrients in suitable amounts needed to carry out the life processes. At every life stage, our diet is fundamental to our overall health and happiness. A healthy diet can lower the risk of disease. It also increases bone health and muscle strength.

A balanced diet includes a variety of foods in limited amounts and proportions to satisfy the needs for calories, proteins, minerals, vitamins, and other nutrients. A balanced diet should contain the correct proportion of six basic nutrients e.g., carbohydrates, lipids, proteins, vitamins, minerals, water, and dietary fibre.

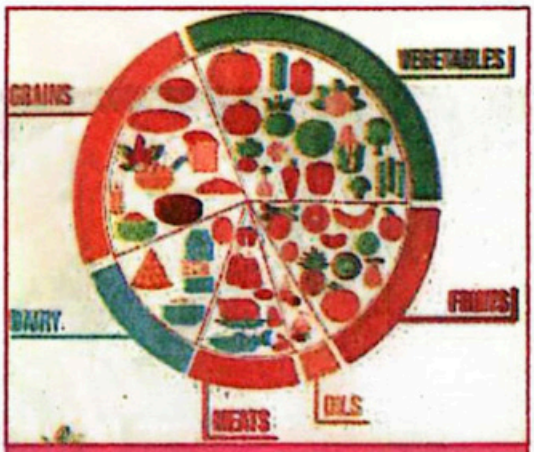


Figure 15.2: Healthy foods in daily routine

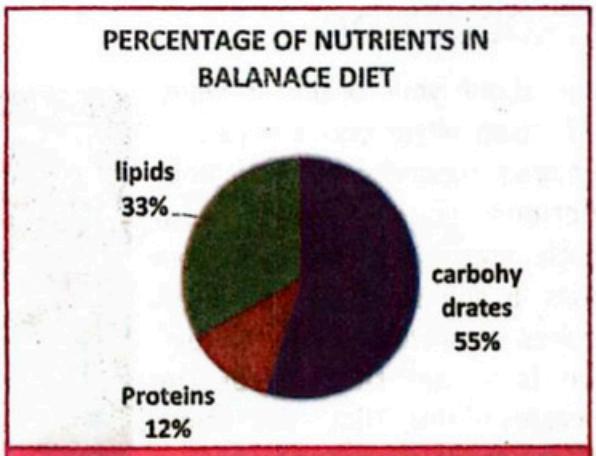


Figure 15.3: Percentage of nutrients in balance diet

15.2 BIOCHEMISTRY

Biochemistry is a combination of biology and chemistry. It is the study of living matter. The study of organic and inorganic molecules present in a living organism is known as biochemistry.

Carbohydrates, fats or lipids, protein and amino acid provide energy to the body that it needs to grow, play, and repair.

15.3 CARBOHYDRATES-A SOURCE OF ENERGY

Carbohydrates or hydrates of carbon are macromolecules made of carbon, hydrogen, and oxygen. The primary function of carbohydrates is to supply energy to all cells of body.

1 gram of carbohydrate ⟶ 4 kilocalories energy.

Carbohydrates are broken down by the body into glucose - a type of sugar. Your body cells, tissues, and organs use glucose as fuel. When your body does not get suitable carbohydrates, it looks for another energy source, breaking down the protein in your muscles and body fat to use as energy. Glucose is the preferred fuel for the brain, which can't simply use other fuel resources like fat or protein for energy.

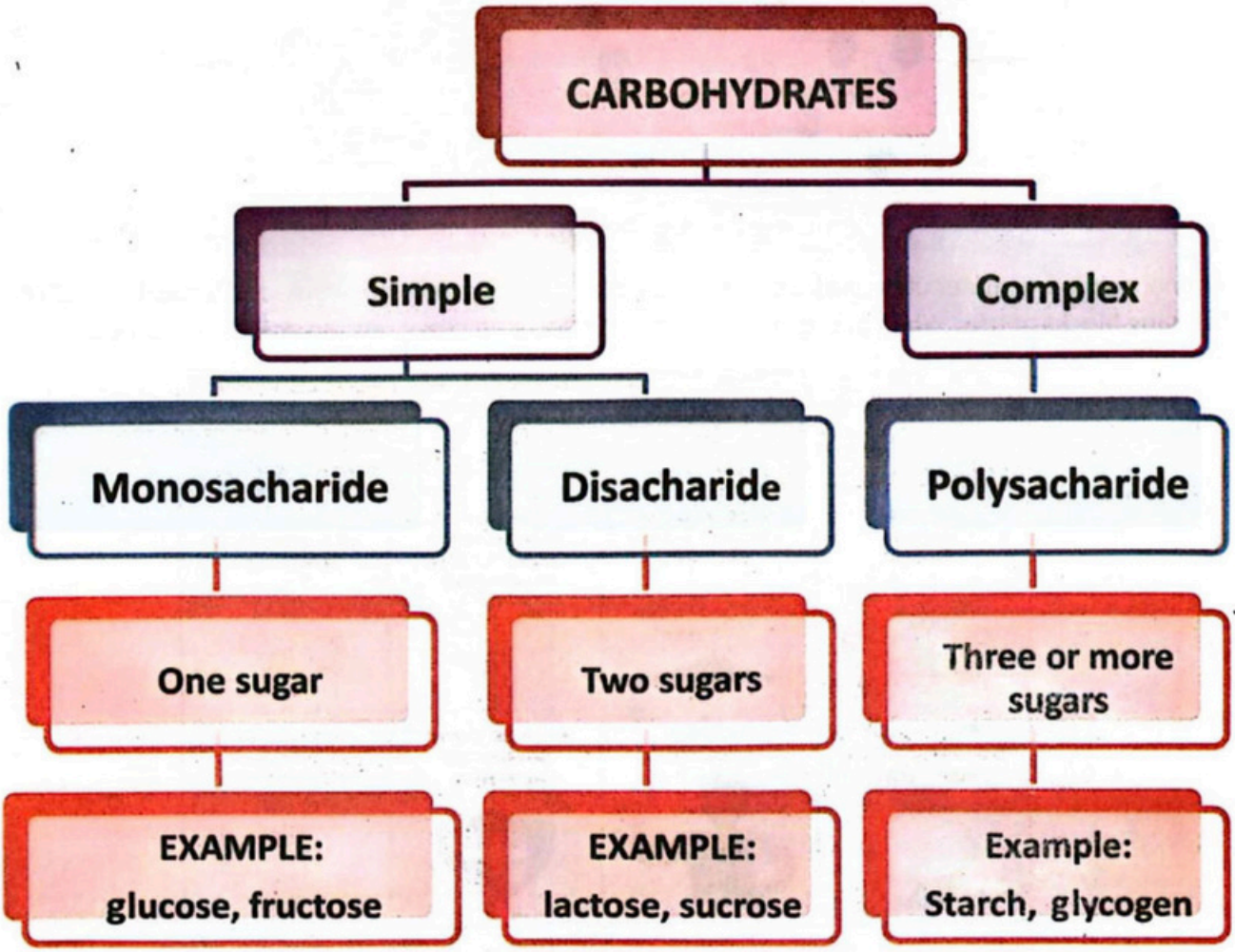
DO YOU KNOW?

A calorie is a unit that is used to measure the energy in your food.A calorie is the energy that it takes to raise the temperature of 1 gram of water by 1 degree centigrade. Calories are the amount of energy released when your body breaks down (digests and absorbs) food. The more calories a food has, the more energy it can provide to your body.

Figure 15.4: Benefits of carbohydrates

15.3.1 Classification of carbohyrates:

Carbohydrates can be classified based on how many sugars are in the molecule. The table below summarizes the three types of carbohydrates and examples.



15.4 PROTEINS:

Every cell in the human body contains protein. The basic structure of protein is a chain of amino acids. Proteins are macromolecules that are responsible for most of the functions that take place in the body. They do most of the work in cells and are required for the structure, function, and regulation of the body's tissues and organs. The building blocks of proteins are amino acids.

1 gram protein ⟶ 4 kilocalories energy

DO YOU KNOW?

Enzymes are proteins that act as biological catalysts in living organisms. They help speed up chemical reactions in the human body.

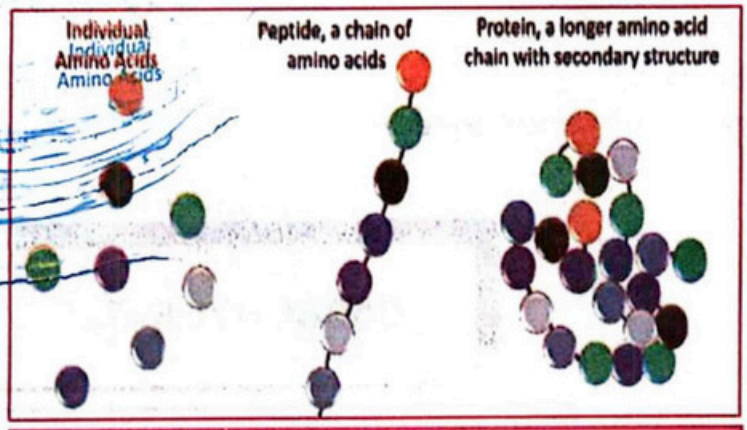


Figure 15.5: Structure of protein

Amino acids are molecules that combine to form proteins. Amino acids and proteins are the building blocks of life. When proteins are digested or broken down, amino acids are the result.

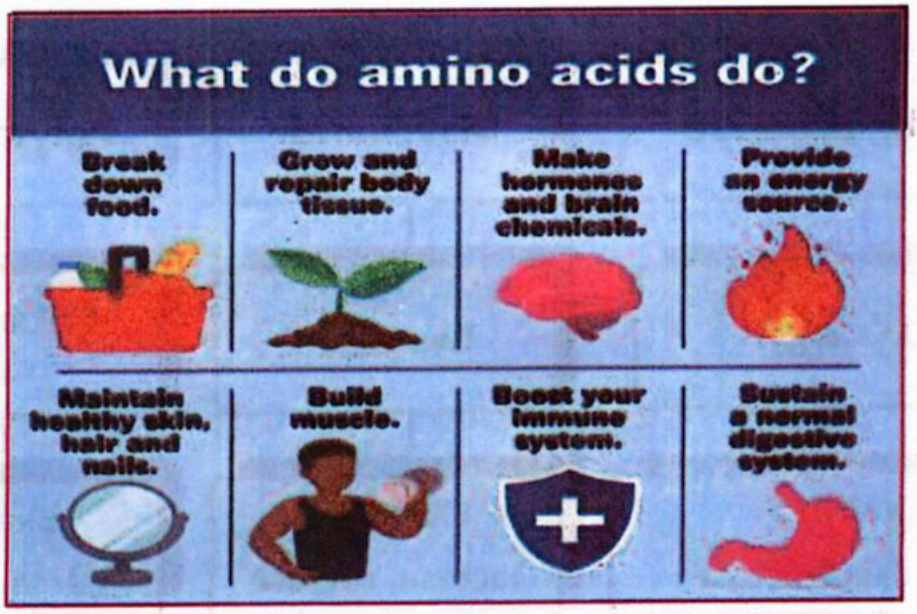


Figure 15.6: Functions of amino acids

15.5 LIPIDS:

Lipids are fatty, waxy, or oily compounds that are soluble in organic solvents like alcohol, chloroform and insoluble in polar solvents such as water. Lipids are mainly composed of hydrocarbons and little oxygen, making them an excellent form of energy storage. Lipids are fatty compounds that perform a variety of functions in your body. They're part of your cell membranes and help control what goes in and out of your cells. They help with moving and storing energy, absorbing vitamins, and making hormones.

DO YOU KNOW?

Where do lipids come from?
Most of the cholesterol in your body is produced by your liver. Your lifestyle choices, including diet, have a major influence on the production of cholesterol and triglycerides

Vitamin A, D, K, and E are the four fat-soluble vitamins and can be found in different foods like

butternut squash, broccoli, and salmon fish. Eating dietary fat in a balanced diet helps you to absorb these fat-soluble vitamins, such as a cabbage salad with olive oil dressing and walnuts. Below are images of foods that contain the four fat-soluble vitamins.

1 gram of lipids provides 9 kilocalories energy

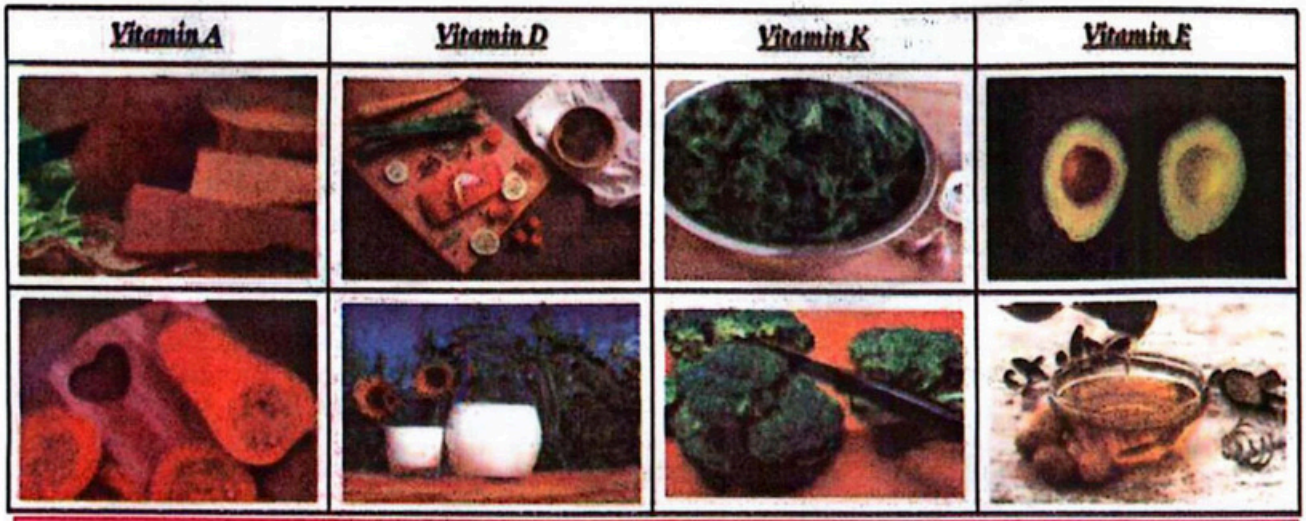
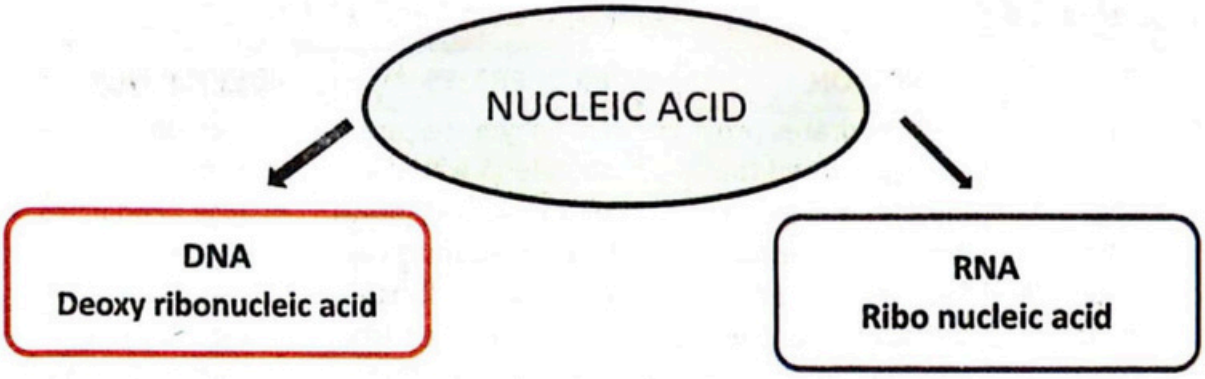


Figure 15.7: Foods that contain fat-soluble vitamins

15.6 NUCLEIC ACIDS:

Nucleic acids are large biomolecules (macromolecules) that play essential roles in the cells. Nucleic acids contain genetic information and play a key role in protein biosynthesis. They are macromolecules formed by nucleotides. Nucleotide is the basic building block of nucleic acids (RNA and DNA).



15.6.1 DNA:

DNA (deoxyribonucleic acid) is a double stranded form of nucleic acid that contains the genetic substance employed for the growth and functioning of all inferred living organisms

15.62.2 RNA:

RNA is a single-stranded nucleic acid that converts genetic information from genes into amino acid sequences of proteins.

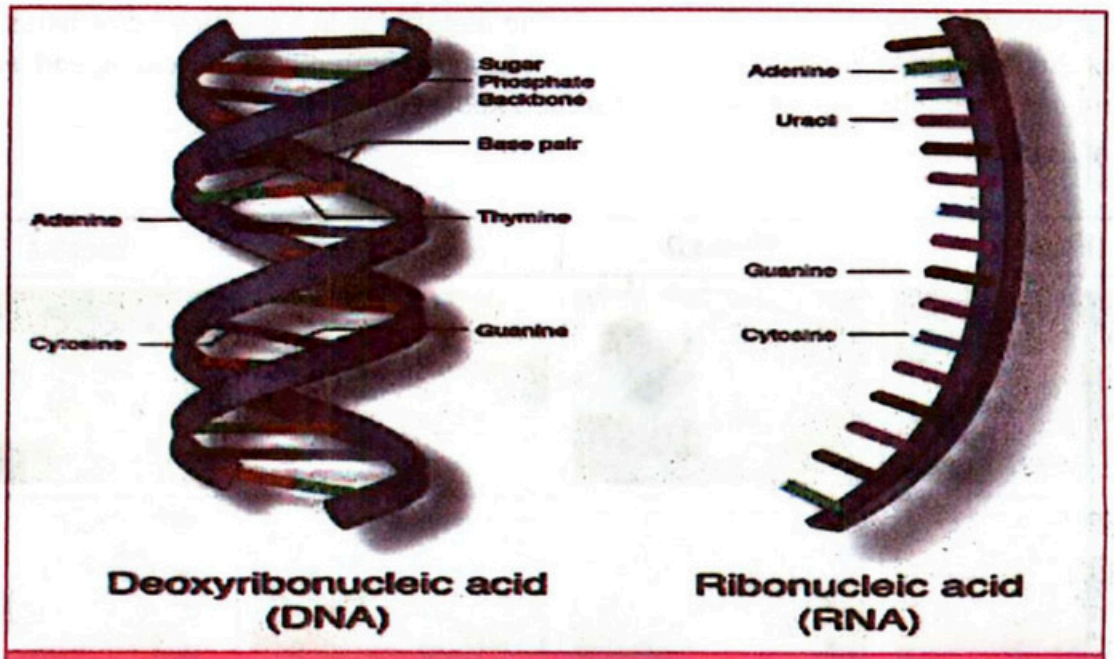


Figure 15.7: Nucleic acids

CONCEPT ASSESSMENT EXERCISE 15.1

1. Differentiate between DNA and RNA
2. Differentiate between proteins and lipids.

15.7 BASIC COMPONENTS OF FOOD:

CARBOHYDRATES			
SOURCE	**FUNCTION**	**PROPERTIES**	**DEFICIENCY**
Carbohydrates are the body's main energy source. Dairy products such as yogurt, milk, ice-cream, fruits, grains, plant-based proteins, and beans are major sources of carbohydrates.	Carbohydrates provide energy to feed the muscles and brain, while fiber helps to feel full and aids digestion and elimination.	Carbohydrates are soluble in water and readily broken down into sugars that can be oxidized during cellular respiration. These properties allow for carbohydrates to be a source of fuel for living things. Carbohydrates can be converted into fats and amino acids.	A carbohydrate-deficient diet may cause headaches, fatigue, weakness, difficulty concentrating, nausea, constipation, bad breath, vitamin and mineral deficiencies.

PROTEINS			
SOURCE	**FUNCTION**	**PROPERTIES**	**DEFICIENCY**
Proteins; are found in meat, fish, and eggsfrom animals and in peas, pulses, and beans from plants. Soya beans are one of the major sources. They contain very little fat.	The main role of proteins is to carry out functions for cells. Proteins are also essential for wound healing and for brain function. Proteins also help other types of communication within the body. Many hormones, or chemical messengers, are proteins. They speed up chemical reactions.	Proteins are colourless and usually tasteless. Proteins are digested in the stomach and small intestine and absorbed as amino acids. Proteins are used to make enzymes.	Little growth in children, brittle hair and nails, poor wound healing, anemia, unintentional weight loss, and scaly skin.
LIPIDS			
SOURCE	**FUNCTION**	**PROPERTIES**	**DEFICIENCY**
Meat and animal foods, e.g., eggs, milk, and cheese, are rich in saturated fats and cholesterol. Plant sources such as sunflower seeds and peanuts are rich in unsaturated fats.	Lipids primarily function as an energy reserve. Lipids are an important source of energy. They are insoluble in water. They also provide insulation to the body.	Lipids and fats are digested in small intestines and absorbed as fatty acids, and glycerol. The body can store unlimited amounts of fats contributing to obesity. lipids are not soluble in water but are thus soluble in solvents such as chloroform.	Dry rashes, hair loss, a weaker immune system, decreased growth in infants, and children, increased risk of different infections.

Nucleic acids			
SOURCES	**FUNCTION**	**PROPERTIES**	**DEFICIENCY**
Seeds, grain, and fish eggs are good sources of the genetic material, DNA.	DNA is a type of genetic material that contains all a person's genetic information. DNA also allows genetic information to be passed down from one generation to the next. RNA play a role in the expression of DNA's genetic code by generating certain proteins.	Nucleic acid carries genetic information which is read in cells to make the RNA and proteins by which living things work. Nucleic acids play a central role in a wide variety of cellular processes, including metabolic regulation and the storage and utilization of genetic information.	Lesch-Nyhan syndrome (a rare congenital (A birth disorder that affects a child's brain and behavior.), and ataxia telangiectasia also known as Louis-Bar syndrome, a rare inherited childhood neurological disorder that affects the part of the brain that controls motor movement, intended movement of muscles and speech.

15.8 REQUIRED DAILY INTAKE FOR YOUNG ADULTS:

A healthy diet requires lots of different nutrients in appropriate amounts that include fats, proteins, and carbohydrates; micronutrients such as vitamins and minerals; and an adequate amount of water to meet the needs for human nutrition.That means eating a variety of foods from each of the main food groups.

Consider the following tips for your meal:

- Eat more vegetables and fruit.
- Eat less carbohydrates.
- Eat less sugar.
- Eat less salt.
- Eat less fat.

The food pyramid shown here illustrates this diet.

Figure 15.8: Daily food intake for young adults

SUGGESTED HEALTHY EATING FOR TEENAGERS (AGED 12 TO 17)	SUGGESTED HEALTHY EATING FOOD FOR ADULTS
Grains: 4 - 6 bowls	Grains: 3 - 8 bowls
Vegetables: at least 3 servings	Vegetables: at least 3 servings
Fruits: at least 2 servings	Fruits: at least 2 servings
Meat, fish, egg, and alternatives: 200-300 grams	Meat, fish, egg and alternatives: 250 - 400 grams
Milk and alternatives: 2 servings	Milk and alternatives: 1- 2 servings
Fat/oil, salt, and sugar: Eat the least.	Fat/oil, salt, and sugar: Eat the least.
Fluid: 6 - 8 glasses	Fluid: 6 - 8 glasses

FACTS TO KNOW

Malnutrition is a condition that develops when the body is deprived of vitamins, minerals, and other nutrients. Malnutrition occurs in people who are either undernourished or over nourished.

Marasmus is a disease caused by insufficient levels of nutrition in the diet. Marasmus is severely undernutrition – a deficiency in all the macronutrients that the body requires to function, including carbohydrates, proteins, and fats

Research proves that food consisting of mostly high-calorie-density foods has a high risk of weight gain and obesity. Calorie density also affects hunger. Low-calorie-density foods tend to provide less fat and more water and fibre. Look at the density chart and examine:

1. Which food causes high blood pressure?
2. What are the dangers of high-calorie foods?
3. Why is it good to eat low-calorie foods? And why?

KEY POINTS

- A balanced diet describes all nutritional needs of the body.
- Carbohydrates, proteins, and lipids are biomolecules.
- Carbohydrates are the main energy source of the human diet.
- Lipids are organic compounds that are fatty acids or their derivatives. They are insoluble in water but soluble in organic solvents like chloroform. They include many natural oils, waxes, and steroids.
- Proteins are biomolecules that are responsible for most of the functions that take place in the body.
- Nucleic acids are large biomolecules that play essential roles in all cells.

REVIEW QUESTIONS

1. Encircle the correct answer.

(i) In small village children frequently suffered from different infectious diseases due to weak immune systems. Which major nutrients were lacking in their food?

(a) Amino acids (b) Carbohydrates
(c) Proteins (d) Lipids

(ii) Which of the following food components are rich in fats:

(a) Rice and maize (b) Pulses and wheat
(c) Milk, egg, and beans (d) Cheese, butter, and oil

(iii) Potatoes, cereals, beans, pulses, and oats are rich in:

(a) Proteins (b) Carbohydrates
(c) Amino acids (d) Fats

(iv) What is a bond between amino acids called?

(a) ionic bond (b) Acidic bond
(c) Peptide bond (d) Hydrogen bond

(v) The major function of carbohydrates includes:

(a) Storage (b) Structural framework
(c) Defense system of body (d) Messenger

(vi) Which of the following disorders is NOT caused by the deficiency of proteins?

(a) Weight loss (b) Muscle fatigue

(c) Loss in muscle strength (d) Constipation

(vii) Foods containing starch and carbohydrates are important because:

(a) They make your bones strong.

(b) They stop you from getting overweight.

(c) They are easy to cook. (d) They give you energy.

(viii) Meat, fish, and other alternatives provide the following important nutrients:

(a) Carbohydrates (b) Protein

(c) Lipids (d) Sugar

(ix) Which nutrient builds, maintains and repairs body tissues and cells?

(a) Carbohydrates (b) Protein

(c) Lipids (d) Water

(x) Marium's doctor told her that she is facing shortage of blood and have anemia. What nutrients are lacking in Marium's diet?

(a) Carbohydrates (b) Protein

(c) Lipids (d) Water

2. Give short answer.

(i) Give three reasons why living organisms need food.

(ii) What is a balanced diet? What is the importance of balance diet?

(iii) State four functions of proteins. Give one example to illustrate your answer.

(iv) Suggest two major foods a mother could give to her growing child? And why.

(v) Carbohydrates are a major source of energy. Defend the statement.

(vi) Fatima has fond of junk food like French fries, burgers, and pizza. What will happen if Fatima only eats junk food? What should she add to her routine food?

3. What are lipids? How are lipids important to our body?

4. How do you maintain a balanced diet?

5. What percentage of fat is required in a balanced diet? Why is the percentage of fat being lowest in major food components? Justify

6. What are the sources and functions of nucleic acids?

7. Imagine you are a nutritionist task to design a meal plan for athletes participating in a marathon. Explain the role of carbohydrates can affect an athlete's performance during the marathon.

PROJECT

Make a healthy meal diet plan and also identify food group of each food item.