MYP 4
UNIT 3
LESSON 1

TOPIC: NUTRITION

UNIT TITLE: HOW DO ORGANISMS SUSTAIN THEMSELVES

Objectives.

By the end of the lesson, the students will be able to:

- ❑ Define what a balanced diet is.
- ❑ Identify the main nutrients, their food sources, and their importance.
- ❑ Explain the causes of deficiency diseases.

Starter Activity: Build the Plate

1. Work in pairs or groups of 5.
2. Look at the blank plate on the board.
3. Choose foods to create a balanced meal for a 14-year-old.
4. Include at least 4 nutrient groups (carbohydrates, proteins, fats, vitamins/minerals).
5. Be prepared to explain one food choice and its importance.

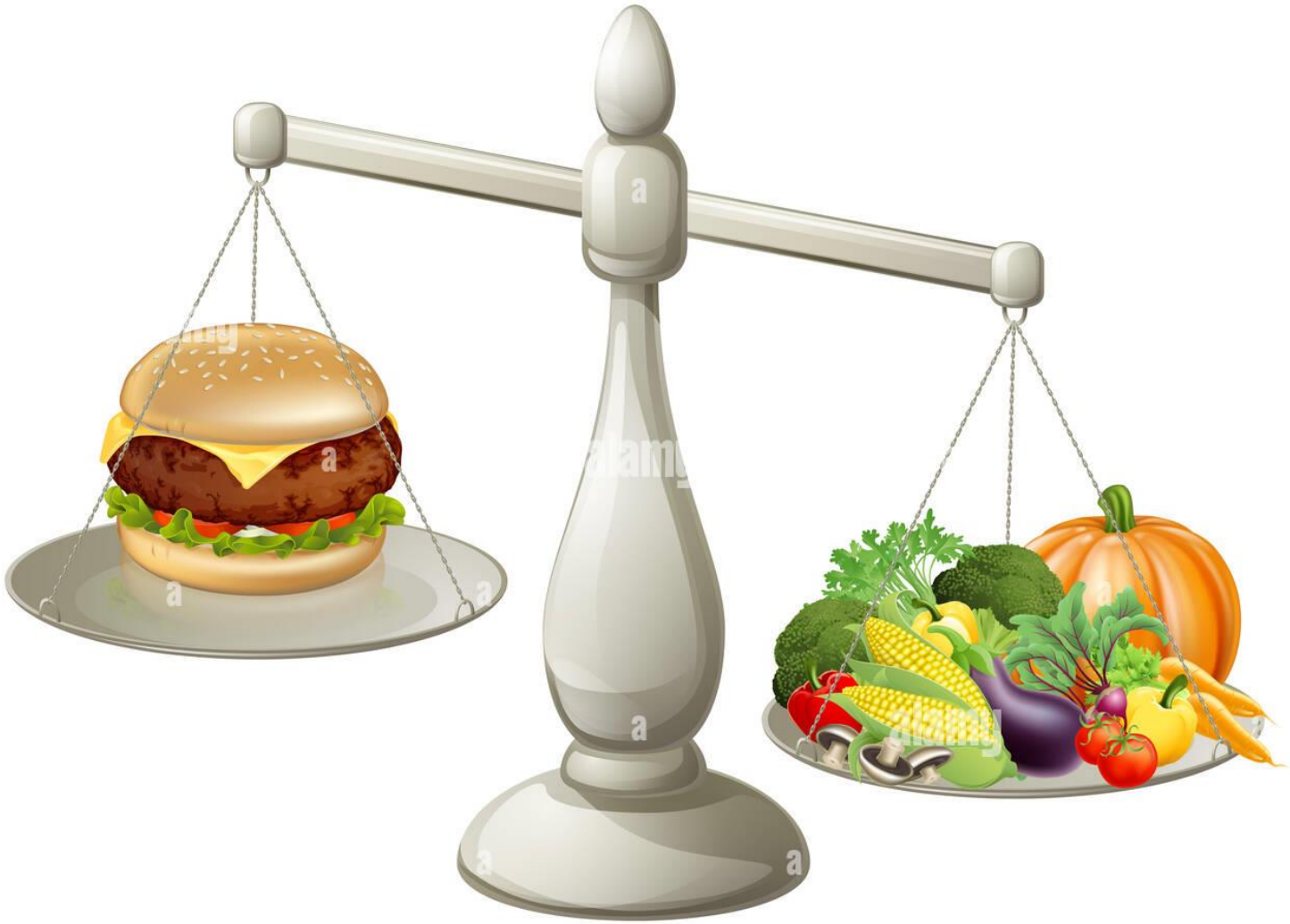
The need for food

- All living organisms need **food.**
- **Plants** make their own food in their **leaves,** while **animals** must eat **plants or other animals.**

Food is used for:

- **Growth:** provides the materials necessary to form new cells and tissues.
- **Repair and replacement:** replaces worn-out cells (e.g., red blood cells, skin) and repairs damaged tissues.
- **Energy:** releases energy during respiration for life processes such as movement, heartbeat, nerve impulses, and maintaining body temperature.

What is meant by a 'balanced diet'?



Balance Diet

A **balanced diet** is a diet that contains all the essential nutrients in the correct proportions to maintain good health.

The nutrients needed are;

- ✓ Carbohydrate
- ✓ Fat
- ✓ Protein
- ✓ Vitamins
- ✓ Minerals
- ✓ Fibre (roughage)
- ✓ water.

The need for a balanced diet.

A balanced diet provides:

Carbohydrates and fats for energy

Proteins for growth and repair of tissues

Vitamins and minerals for healthy body functions

Fibre for good digestion

Water for all body processes

Energy from Food

Energy from food is measured in **kilojoules (kJ)** or **calories**.

- **Carbohydrates & proteins:** ~16–17 kJ per gram
- **Fats:** ~37 kJ per gram
- Average daily energy need: **~12 000 kJ**

Table 7.1 Energy requirements in kJ

8 hours asleep	2 400
8 hours awake; relatively inactive physically	3 000
8 hours physically active	6 600
Total	12 000

Energy needs vary with:

Activity level
More exercise or manual work, more energy needed.

Age
Children need more for growth; adults need less as metabolism slows.

Gender
Females usually need less due to a lower average body mass.

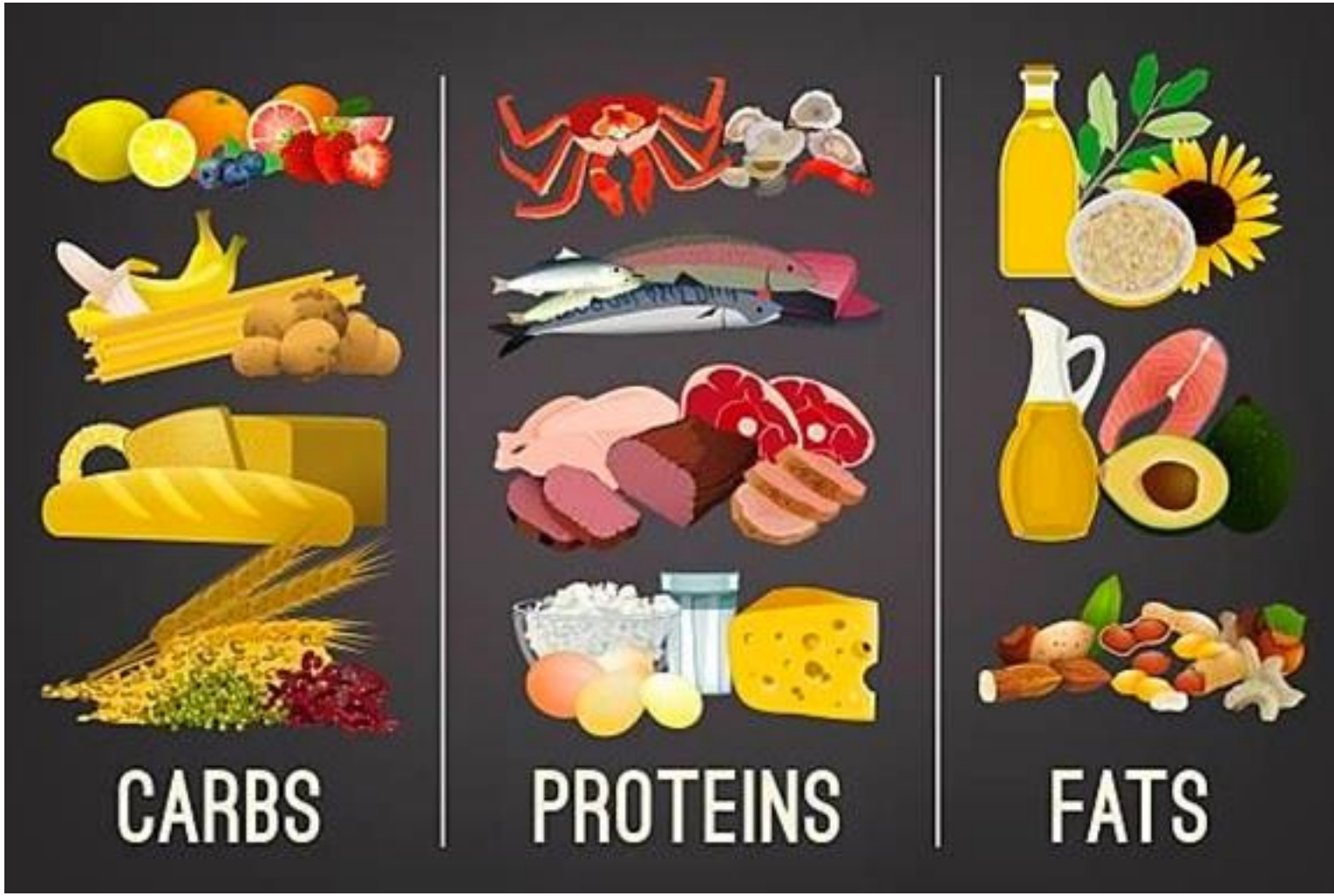
Molecules in Food

- ✓Food contains **small units** and **large molecules (macromolecules)** made by joining smaller units together.
- ✓Large molecules are built from **smaller building blocks**.
- ✓Different foods contain different **elements**, but all contain **carbon, hydrogen, and oxygen**.
- ✓There are **three main food groups, each composed of** different types of molecules.

Classes of food

- The three main classes or groups of food are:

1. **Carbohydrates**
2. **Proteins**
3. **Fats**



Carbohydrates

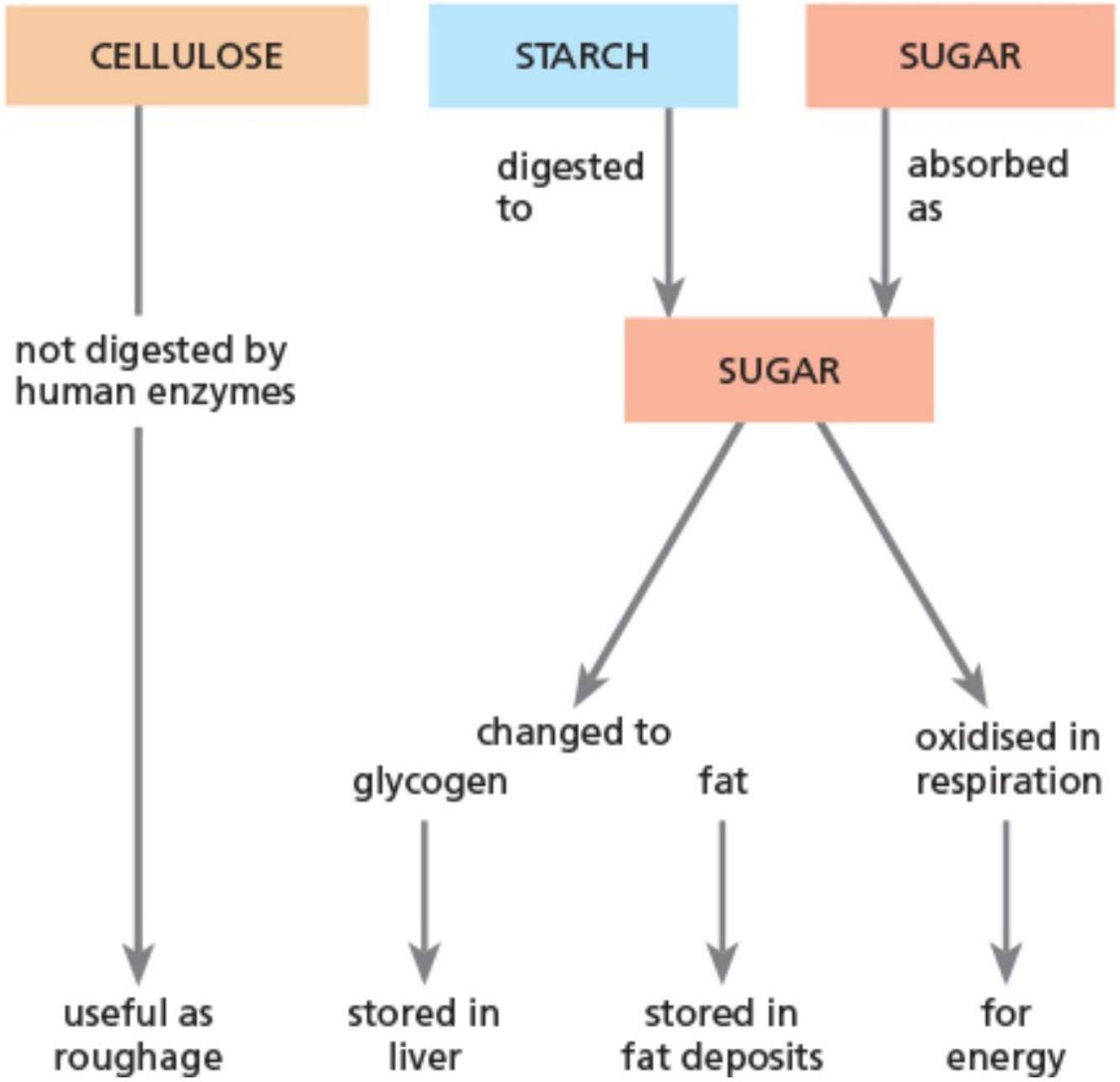
Made of **carbon, hydrogen, and oxygen**
Small units: simple sugars such as **glucose**
Macromolecules: starch, glycogen, cellulose (made from many glucose units)

Sources:
- Starch: potatoes, bread, rice, maize, cereals
- Sugars: sucrose (table sugar), fruits (glucose & fructose)

Importance:
- The main and cheapest **source of energy**
- 1 g provides about **16 kJ of energy**
- Excess carbohydrates are stored as **glycogen** (liver & muscles) or **fat**

- *The cellulose in the cell walls of all plant tissues is a carbohydrate.*
- *Cannot be digested*
- *Important for **healthy digestion***

- *Digestion and use of carbohydrate*



- *Glucose contains six carbons and so can be drawn, for simplicity, as a hexagon.*

Figure 3.3 Starch is made from many glucose units

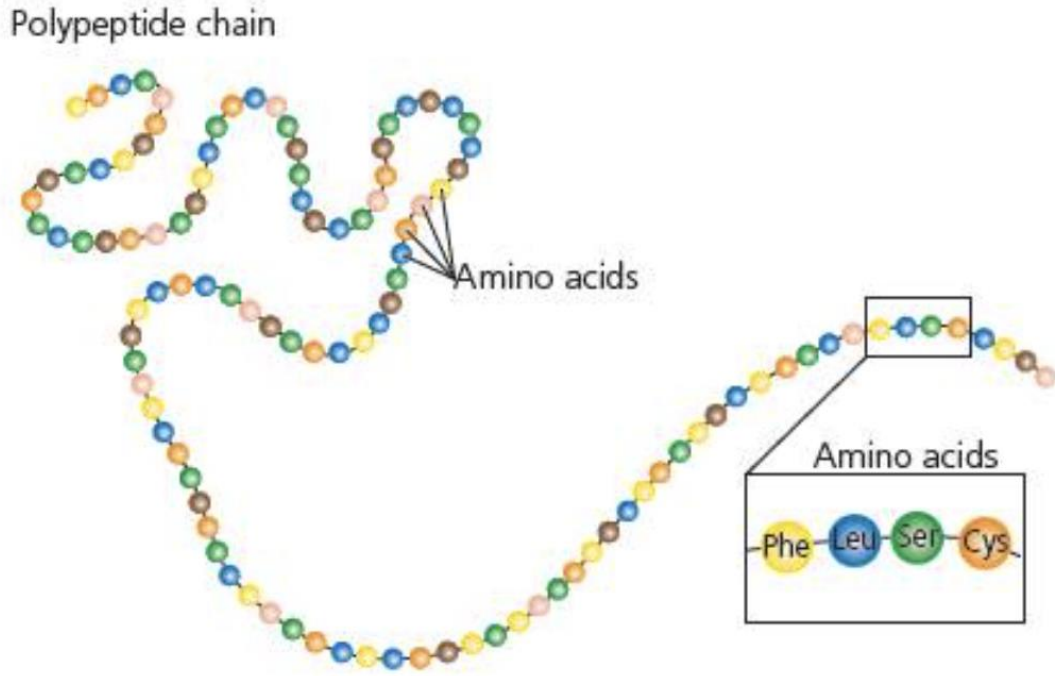
Proteins

Made of **carbon, hydrogen, oxygen, and nitrogen** (some also contain sulfur).
Small units: amino acids (20 types; some must come from food).
Macromolecules: proteins are made of many amino acids joined together.

Importance:
- Needed for **growth and repair** of tissues (muscle, skin, blood, bones).
- They form **enzymes** and are part of the **cytoplasm** of cells.
- 1 g of protein provides about **17 kJ of energy**.

Sources:
- **Animal:** meat, fish, eggs, milk, cheese
- **Plant:** soybeans, beans, nuts, seeds, cereals

Other key points:
- Excess amino acids cannot be stored; they are converted to **glycogen or energy.**
- **Vegetarians and vegans** must eat a **variety of plant foods** to get all essential amino acids.



Amino acids

Ala: Alanine	His: Histidine	Ser: Serine
Arg: Arginine	Ile: Isoleucine	Thr: Threonine
Asn: Asparagine	Leu: Leucine	Trp: Tryptophane
Asp: Aspartic acid	Lys: Lysine	Tyr: Tyrosine
Cys: Cysteine	Met: Methionine	Val: Valine
Gln: Glutamine	Phe: Phenylalanine	
Glu: Glutamic acid	Pro: Proline	

Figure 3.4 Proteins are made from long chains of amino acids. There are 20 different amino acids – the structure and function of the protein depends on the amino acids it is made from and the order in which they are put together

Lipids (Fats and Oils)

- Made of **carbon, hydrogen, and oxygen**
- **Small units: glycerol** and **three fatty acids**
- **Macromolecule:** fat molecule
- Fatty acids can be **saturated** or **unsaturated**

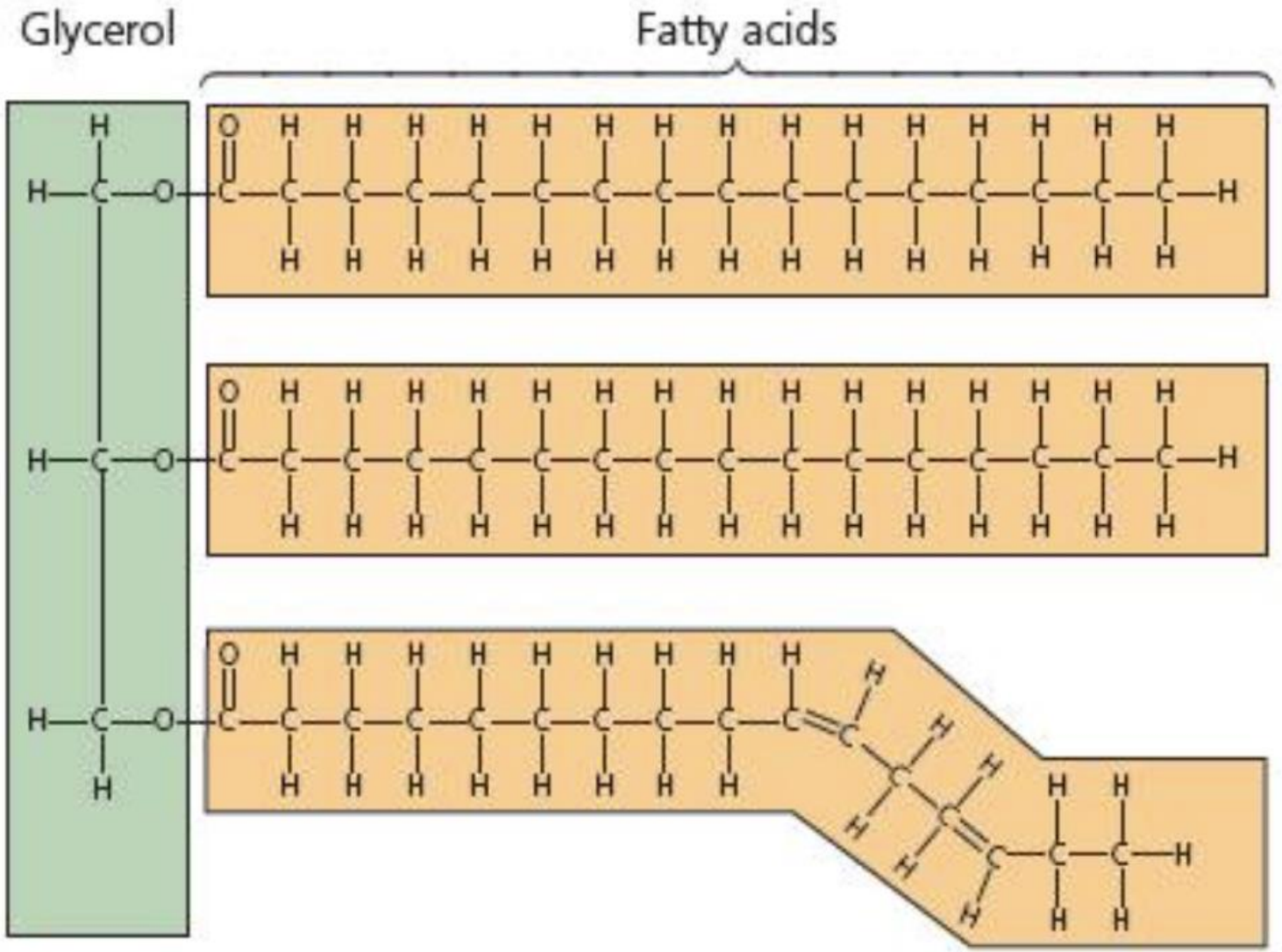
Sources:

- **Animal:** meat, milk, cheese, butter, egg yolk
- **Plant:** vegetable oils (e.g., palm, sunflower)

Importance:

- Part of **the cell membranes**
- Provide **energy** (1 g gives **37 kJ**)
- Stored as **long-term energy reserves**
- **Insulation**: reduces heat loss under the skin.

- Lipids are made from glycerol and three fatty acids



Summary table for carbohydrates, fats/oils, and proteins

Nutrient	Good food sources	Use in the body
carbohydrate	rice, potato, yam, cassava, bread, millet, sugary foods (cake, jam, honey)	storage; source of energy
fat/oil (oils are liquid at room temperature, but fats are solid)	butter, milk, cheese, egg-yolk, animal fat, groundnuts (peanuts)	source of energy (twice as much as carbohydrate); insulation against heat loss; some hormones; cell membranes; insulation of nerve fibres
protein	meat, fish, eggs, soya, groundnuts, milk, Quorn, cowpeas, falafel	growth; tissue repair; enzymes; some hormones; cell membranes; hair; nails; can be broken down to provide energy

Vitamins and Minerals

- In addition to carbohydrates, proteins, and fats, the diet must include **vitamins and minerals**.
- **Minerals** (e.g., iron) are needed for important functions such as **healthy blood**.
- **Vitamins** are required in **very small amounts** but are essential for **normal body function**.

The vitamins you need, and sources of each, and why you need them, are summarized in the following table.

Table 3.1 Vitamins needed as part of a balanced diet

Vitamin	Source	Function
A	Fish liver oils, animal liver, made in body from carotene	Required for normal **immune system** function and for production of cells in the retina of the eye
D	Fish liver oils, butter, egg yolk, made in the body by action of sunlight	Needed for the absorption of calcium in the body
E	Plant oils	Antioxidant
K	Dark green leafy vegetables, made by bacteria of gut	Needed for blood clotting
B_1	Widely occurring	Needed for an enzyme used in respiration
B_2	Widely occurring	Needed for an enzyme used in respiration
B_3	Meat, yeast extract, potatoes, made from the amino acid tryptophan	Needed to make enzymes involved in respiration
B_5	Widely occurring	Needed to make an enzyme involved in respiration

B_6	Meat, fish, eggs, some vegetables	Needed to make an enzyme involved in the formation of amino acids
B_{12}	Liver, yeast, not found in plants	Needed to make an enzyme involved with cell division; for nerve function
folic acid	Liver, white fish, raw leaf vegetables	Needed to make an enzyme involved in DNA replication
H (biotin)	Liver, yeast, egg white, made by bacteria in the human gut	Used to make an enzyme involved with metabolic reactions
C (ascorbic acid)	Potatoes, green vegetables, fruits	Used to make an enzymes needed for protein metabolism; involved in iron absorption

- About 15 minerals are known to be essential for a healthy body.
- They are obtained from food sources where they are present in low concentrations.

Table 3.2 Minerals needed as part of a balanced diet

Major minerals	Daily intake
Calcium	0.9 g
Phosphorus	1.5 g
Potassium	3.2 g
Sodium	3.4 g
Chloride	5.2 g
Magnesium	0.3 g
Iron	14.0 mg
Zinc	11.4 mg

Trace elements	Daily intake
Fluoride	1.82 mg
Copper	1.63 mg
Selenium	0.06 mg
Iodine	0.024 mg
Manganese	5.0 mg
Chromium	0.09 mg
Cobalt	0.3 mg

Examples of why minerals are needed by the body:

- **Phosphorus** is needed in the production of DNA and cell membranes.
- **Calcium** is needed for healthy teeth and bones.
- **Sodium and chloride ions** are used in the control of the composition of body fluids.
- **Iron** is needed to make haemoglobin – the oxygen-carrying molecule in red blood cells.

Dietary Fibre (Roughage)

- Fibre comes from **plant cell walls**, which are made of **cellulose**.

Humans **cannot digest cellulose**, so it passes to the **large intestine (colon)**.

- Fibre:
  - Increases the contents of the colon
  - Helps retain water
  - **Softens faeces** and speeds up the removal of waste
- This helps **prevent constipation** and keeps the colon healthy.
- **Good sources**: vegetables, fruits, whole-meal bread, whole grains
  Low fibre foods: white flour, white bread

Water

- About **70% of body tissues** are made of water.
- Water is a major part of **cytoplasm, blood, lymph, and tissue fluid**.

It acts as a **solvent and transport medium** for:

✓Digested food, salts, and vitamins

✓Waste products like urea and excess salts

✓Water is needed for **digestion** and many **cellular reactions**.

- We lose water through **sweating, breathing, urinating, and evaporation**, so it must be **replaced regularly** in the diet.

Malnutrition

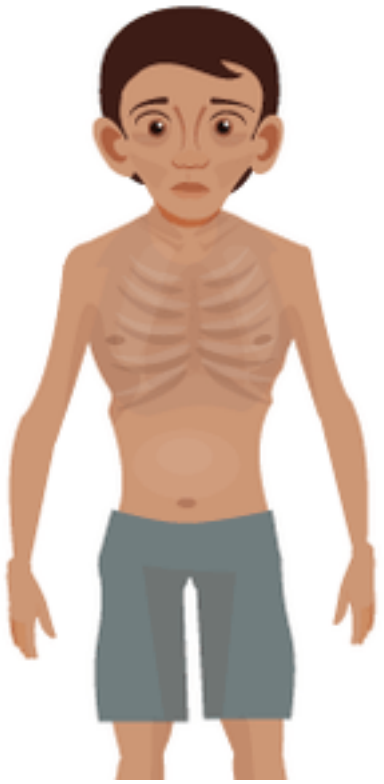
- When the body does not get the right amount of nutrients.
- Can lead to weakness, stunted growth, and poor immunity.

Deficiency Disorders / Diseases

•Caused by a lack of specific nutrients.

•Examples:

- **Scurvy** – Vitamin C deficiency
- **Rickets** – Vitamin D deficiency
- **Anaemia** – Iron deficiency



Overweight and Obesity

•Excessive body weight due to too much fat.

•Increases risk of heart disease, diabetes, and joint problems.

ACTIVITY: Food tests

ATL

Critical-thinking skills: Interpret data

Food can be tested for carbohydrates, protein and lipids, using the following food tests.

Testing for starch (a complex carbohydrate)

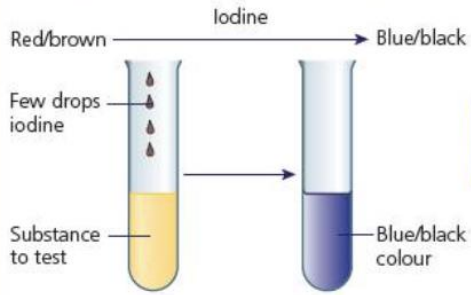


Figure 3.6 Starch test

Testing for glucose (a simple carbohydrate)

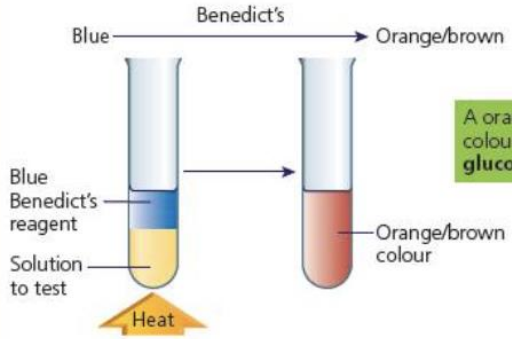


Figure 3.7 Test for glucose – a simple sugar. A water bath set at 70 °C can be used to heat the solution

Testing for protein

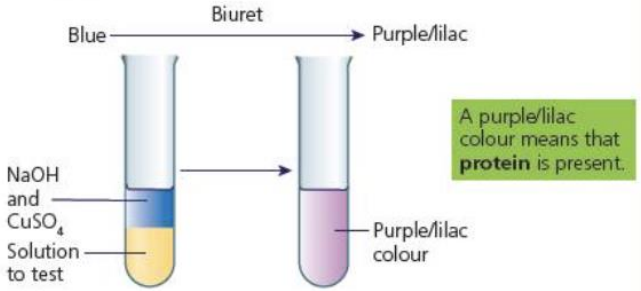


Figure 3.8 Test for protein

Testing for lipids

A simple test for lipid is to put a little of your sample onto a piece of paper. If it leaves a greasy mark when it is dry, lipid is present.

Alternatively, an emulsion test can be carried out. A small quantity of alcohol is added to the test solution – the mixture is shaken vigorously. A milky-white emulsion is formed if fats are present.

Your teacher will provide you with a 'mystery solution' containing at least two different food groups. Can you work out which groups it contains?

Safety: Wear eye protection. Take care with the water bath when carrying out the Benedict's test. Wash your hands at the end of the practical.

- **Carry out each of the food tests on the mystery solution and observe the results.**
- **Accurately interpret your data and explain results using correct scientific reasoning.**

Assessment opportunities

- In this activity you have practised skills that are assessed using Criterion C: Collect data; Interpret data and explain results using scientific reasoning.

Testing for starch (a complex carbohydrate)
Iodine
Red/brown → **Blue/black**
A blue/black color means starch is present.

Testing for glucose (a simple carbohydrate)
Benedict's reagent
Blue → **Orange/brown**
An orange/brown color means that glucose is present.

Biuret
Blue → **Purple/lilac**
A purple/lilac color means that protein is present.

Testing for lipids
A simple test for lipid is to put a little of your sample onto a piece of paper.
If it leaves a **greasy mark** when it is dry, lipid is present.
Alternatively, an **emulsion test** can be carried out.
A small quantity of alcohol is added to the test solution and shaken vigorously.
A **milky-white emulsion** is formed if fats are present.

DISCUSS

Discuss in a small group what you have learnt about the nutrients organisms need to survive. What are macromolecules? What are the building blocks of macromolecules?

REVIEW

- What are the seven food groups that make up a balanced diet?
- What are the constituent parts of carbohydrates, lipids and proteins?
- How do you test food for:
  - starch
  - glucose
  - protein
  - lipid?

Reference

- ***Hodder Education (MYP):***
  Hodder Education. MYP Biology by Concept. Hodder Education, 2018, pp. 56–59.
- ***Cambridge IGCSE Biology:***
  Jones, Mary, and Geoff Jones. Cambridge IGCSE™ Biology. 4th ed., Cambridge University Press, 2014, pp. 262–268.