Carbon Compounds and Cells

All living organisms are composed of cells, from just one to many trillions
How are the ingredients for life put together?

• Most molecules that make up living things are very large and complex.

• Now, let’s learn about their structures and function.
Carbon Compounds

• Life, as we know it, is carbon-based.

• This means that most of the compounds you are made of contain the element “carbon”.
Carbon is unique among the elements

• A carbon atom can form chemical bonds with other carbon atoms in long chains or rings

• Some carbon compounds contain several thousand carbon atoms
You use carbon compounds every day

- Carbon compounds are not only found in living things.
- Plastic, rubber, and gasoline are carbon compounds.
- In fact, there are over 12 million known carbon compounds!!
The carbon compounds in living things are classified into four groups of MACROMOLECULES:

- Carbohydrates
- Lipids
- Proteins
- Nucleic acids
Macromolecules in YOU!

- Glucose in cells = **Carbohydrate**
- Fat layer beneath skin = **Lipids**
- Hair = **Protein**
- Nucleus of cell = **Nucleic acid (DNA)**
- Cell membrane = **Lipid**
- Body = 60% water
Macromolecules in your food
Check Your Understanding

What element is found in all living organisms?
All living organisms contain carbon.

What are the 4 carbon compounds, or macromolecules?
The 4 macromolecules are carbohydrates, lipids, proteins, and nucleic acids.
Carbohydrates

Short-term energy-rich compounds made from carbon, hydrogen, and oxygen atoms.
Plants and animals use carbohydrates

- Cells use carbohydrates as a \textit{short-term} energy source.

- Plants contain \textit{cellulose}, a carbohydrate, which gives them a rigid structure.
Carbohydrates are classified as sugars and starches.

- Sugars are **simple** molecules which are smaller than starches.
  - This group is called **monosaccharides**.

- Starch molecules are **complex** and very large.
  - They consist of many sugar molecules combined.
  - This group is called **polysaccharides**.
Monosaccharides are classified as **simple sugars**.

- **Mono** = one or **simple**
- **Saccharides** = **sugars**

- One type of sugar you are familiar with is glucose, from photosynthesis.

- You probably also heard of sucrose and fructose.
Glucose

• A simple sugar that plants make through photosynthesis.

• A sugar that is made of these atoms:
  • 6-carbon,
  • 12-hydrogen, and
  • 6-oxygen
Sucrose

• The type of sugar you use for everyday use.

• A sugar that is made of these atoms:
  • 12-carbon,
  • 22-hydrogen, and
  • 11-oxygen
Fructose

• The **sweetest** of all sugars, found in honey, flowers, and tree fruits.

• A sugar that has the same formula as glucose, but structured differently:
  - 6-carbon,
  - 12-hydrogen, and
  - 6-oxygen
Polysaccharides are classified as **starch** and **glycogen**.

- Poly = many, or **complex**
- Saccharides = sugars

- Starches are made exclusively by plants.
- Glycogen are made by animals.
Plant cells store **energy** as starch.

- Rice, potatoes, and wheat are plant starches.
- Many of the world’s staple foods contain starch.
The outer shells, or **exoskeletons**, of insects and crustaceans are called **chitin**, is an example of a polysaccharide.
How do plants and animals use carbohydrates?
Plants and animals use carbohydrates as a short-term energy source. Plants also use carbohydrates to give them a rigid structure.

What do plants store energy as?
Plants store energy as starch.

What are 2 types of carbohydrates and an example of where they are each found?
Monosaccharides are simple sugars found in fruits.
Polysaccharides are complex sugars, like starches and glycogen, found in starchy foods and the exoskeletons of insects and crustaceans.
Lipids

Long-term energy-rich compounds made from carbon, hydrogen, and oxygen atoms
Lipids include **fats, oils, and waxes**

- Lipids are organic compounds found in every type of plant and animal cells.
- They are **insoluble** in water, which means that water **cannot** dissolve them.
Lipids have many important functions, such as **insulation** and **energy storage**

- Lipids stored in animals are **fats**, and lipids in plants are **oils**.
- Animals that hibernate live off of fat stored in their cells.

Can you think of examples of lipids in plants or animals?
Examples of lipids in plants and animals
There are 2 types of lipids: saturated and unsaturated.

- **Saturated** fats are considered the “bad” lipids.

- **Unsaturated** fats are considered the “good” lipids.
Saturated lipids, or fats, are made from animal fats and animal products.

- These fats are **solid** at room temperature.
- Usually contain high **cholesterol**.
- These are fats you should eat **less** of.
Unsaturated lipids, or fats, are usually made from plant oils and plant products.

• These fats are **not** solid at room temperature.

• These are fats you should be eating **more** of.
How do plants and animals use lipids?
Lipids are used for storing energy for long periods of time.

What is a special characteristic of lipids in water?
Lipids are insoluble in water.

What are the 2 types of lipids, and give an example of where to find them.
Saturated lipids are found in animal fats and products, such as meats and cheeses.
Unsaturated lipids are usually found in plants, such as olive oil and nuts.
Proteins

Very large molecules made of carbon, hydrogen, oxygen, nitrogen, and sometimes sulfur.
Proteins are found in many animal parts like hair, fingernails, muscle, and skin.
Protein is also in your blood’s **hemoglobin**, which carries oxygen to your cells.
Foods high in protein include meats, eggs, fish, nuts, dairy products, and beans.
Enzymes are proteins

• An enzyme is a type of protein that cells use to **speed up** chemical reactions.

• Digestive enzymes are made by the pancreas.

• These enzymes help **break down** the foods you eat into smaller molecules that can be **absorbed** by your cells.
Proteins are made of amino acids

- Your cells combine different **amino acids** in various ways to make different **proteins**.
- There are **20** amino acids used by cells to make proteins.
Check Your Understanding

Where in your body can proteins be found?
Proteins can be found in hair, nails, skin, hemoglobin, and muscles.

What makes proteins?
Amino acids make proteins.

What is an enzyme?
An enzyme is a type of protein that cells use to speed up chemical reactions.
Nucleic Acids

Long, repeating chains of nucleotides that are made from carbon, hydrogen, oxygen, nitrogen, and phosphorus
Nucleic acids are compounds made of long repeating chains called nucleotides.

Each nucleotide contains
• a sugar molecule
• a phosphate molecule
• a base molecule
DNA and RNA are nucleic acids

- DNA contains the information cells need to make all of their proteins, like a storehouse for all of your genetic information.

- RNA translates the messages for protein building.
Check Your Understanding

What are nucleic acids made of?
Nucleic acids are made of long repeating chains called nucleotides.

What are the 3 components of a nucleotide?
Each nucleotide contains a sugar molecule, a phosphate molecule, and a base molecule.

Where in our bodies can we find nucleic acids?
DNA and RNA are nucleic acids, and they are responsible for making and translating proteins.
Check Your Understanding

Write a 5-sentence summary about each of the macromolecules and what they do for living organisms.