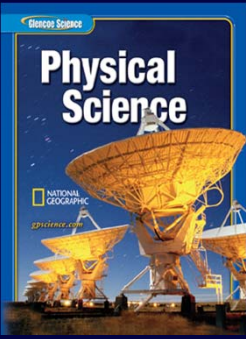


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Physical Science

NATIONAL GEOGRAPHIC

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## Unit 6: Interactions of Matter

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END

Simple Organic Compounds

24.1

## Organic Compounds

- Most compounds containing the element carbon are **organic compounds**.
- The others, including carbon dioxide and the carbonates, are considered inorganic.



24

CHAPTER RESOURCES

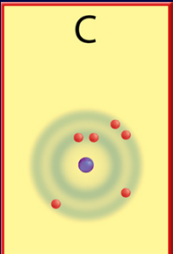
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Simple Organic Compounds

24.1

## Bonding

- You may wonder why carbon can form so many organic compounds.
- The main reason is that a carbon atom has four electrons in its outer energy level.
- This means that each carbon atom can form four covalent bonds with atoms of carbon or with other elements.



24

CHAPTER RESOURCES

END

Simple Organic Compounds

24.1

## Bonding

- A covalent bond is formed when two atoms share a pair of electrons.
- This large number of bonds allows carbon to form many types of compounds ranging from small compounds to complex compounds.

24

CHAPTER RESOURCES

END

Simple Organic Compounds

24.1

## Arrangement

- Another reason carbon can form so many compounds is that carbon can link together with other carbon atoms in many different arrangements—chains, branched chains, and even rings.

24

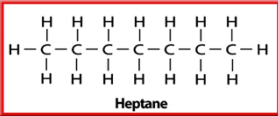
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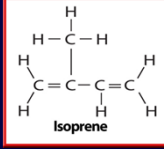
Simple Organic Compounds

24.1 Arrangement

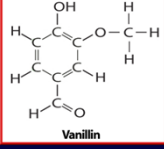
- It also can form double and triple bonds as well as single bonds.



Heptane



Isoprene



Vanillin

CHAPTER RESOURCES

Simple Organic Compounds

24.1 Hydrocarbons

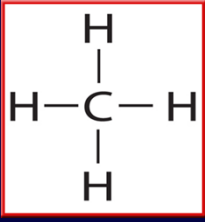
- A compound made up of only carbon and hydrogen atoms is called a **hydrocarbon**.
- A main component of natural gas is the hydrocarbon methane.
- The chemical formula of methane is  $\text{CH}_4$ .

CHAPTER RESOURCES

Simple Organic Compounds

24.1 Hydrocarbons

- Methane can be represented in two other ways.
- The structural formula uses lines to show that four hydrogen atoms are bonded to one carbon atom in a methane molecule.

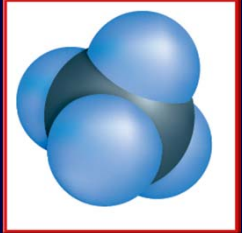


CHAPTER RESOURCES

Simple Organic Compounds

24.1 Hydrocarbons

- The second way, the space-filling model, shows a more realistic picture of the relative size and arrangement of the atoms in the molecule.

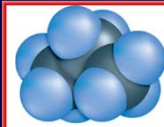


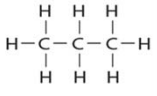
CHAPTER RESOURCES

Simple Organic Compounds

24.1 Hydrocarbons

- Another hydrocarbon used as fuel is propane.
- Propane's structural formula and space-filling model are shown.





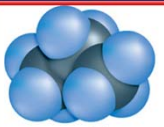
**Propane  $\text{C}_3\text{H}_8$**

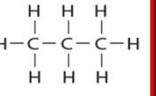
CHAPTER RESOURCES

Simple Organic Compounds

24.1 Hydrocarbons

- Methane and other hydrocarbons produce more than 90 percent of the energy humans use.





**Propane  $\text{C}_3\text{H}_8$**

CHAPTER RESOURCES

Simple Organic Compounds

**24.1 Single Bonds**

- The table lists four saturated hydrocarbons.
- Notice how each carbon atom appears to be a link in a chain connected by single covalent bonds.

Some Hydrocarbons		
Name	Chemical Formula	Structural Formula
Methane	CH <sub>4</sub>	<pre>       H             H-C-H               H           </pre>
Ethane	C <sub>2</sub> H <sub>6</sub>	<pre>       H H               H-C-C-H                 H H           </pre>
Propane	C <sub>3</sub> H <sub>8</sub>	<pre>       H H H                 H-C-C-C-H                   H H H           </pre>
Butane	C <sub>4</sub> H <sub>10</sub>	<pre>       H H H H                   H-C-C-C-C-H                     H H H H           </pre>

CHAPTER RESOURCES

END

Simple Organic Compounds

**24.1 Single Bonds**

- This figure shows a graph of the boiling points of some hydrocarbons.
- Notice the relationship between boiling points and the addition of carbon atoms.

Boiling Points of Hydrocarbons	
Boiling point (°C)	Number of carbon atoms in chain
-162	1 (Methane)
-89	2 (Ethane)
-42	3 (Propane)
0	4 (Butane)
36	5 (Pentane)

CHAPTER RESOURCES

END

Simple Organic Compounds

**24.1 Structural Isomers**

- The chemical formula of butane is C<sub>4</sub>H<sub>10</sub>.
- Another hydrocarbon called isobutane has exactly the same chemical formula.
- How can this be?

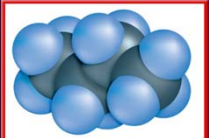
CHAPTER RESOURCES

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Simple Organic Compounds

**24.1 Structural Isomers**

- The answer lies in the arrangement of the four carbon atoms.
- In a molecule of butane, the carbon atoms form a continuous chain.



```

      H H H H
      | | | |
    H-C-C-C-C-H
      | | | |
      H H H H
          
```

**Butane**  
C<sub>4</sub>H<sub>10</sub>

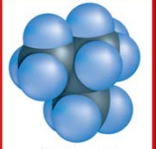
CHAPTER RESOURCES

END

Simple Organic Compounds

**24.1 Structural Isomers**

- The carbon chain of isobutane is branched.
- The arrangement of carbon atoms in each compound changes the shape of the molecule, and very often affects its physical properties.



```

      H H H
      | | |
    H-C-C-C-H
      | | |
      H | H
        |
      H-C-H
        |
        H
          
```

**Isobutane** C<sub>4</sub>H<sub>10</sub>

CHAPTER RESOURCES

END

Simple Organic Compounds

**24.1 Structural Isomers**

- Isomers** are compounds that have identical chemical formulas but different molecular structures and shapes.
- Generally, melting points and boiling points are lowered as the amount of branching in an isomer increases.

CHAPTER RESOURCES

END

Simple Organic Compounds

24.1 **Structural Isomers**

- You can see this pattern in the table.

Properties of Butane Isomers		
Property	Butane	Isobutane
Description	Colorless gas	Colorless gas
Density	0.60 kg/L	0.603 kg/L
Melting point	2135 C	2145 C
Boiling point	20.5 C	210.2 C

CHAPTER RESOURCES

Simple Organic Compounds

24.1 **Structural Isomers**

- Sometimes properties of isomers can vary amazingly.
- For example, the isomer of octane having all eight carbons in a straight chain melts at  $-56.8^{\circ}\text{C}$ , but the most branched octane melts at  $100.7^{\circ}\text{C}$ .

CHAPTER RESOURCES

Simple Organic Compounds

24.1 **Other Isomers**

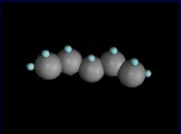
- Some isomers differ only slightly in how their atoms are arranged in space.
- Such isomers form what is often called right- and left-handed molecules, like mirror images.

CHAPTER RESOURCES

Simple Organic Compounds

24.1 **Other Isomers**

- Two such isomers may have nearly identical physical and chemical properties.



Click image to play movie

CHAPTER RESOURCES

Simple Organic Compounds

24.1 **Multiple Bonds**

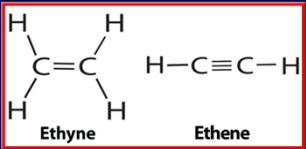
- Ethylene is another name for the hydrocarbon ethene,  $\text{C}_2\text{H}_4$ .
- This contains one double bond in which two carbon atoms share two pairs of electrons.
- The hydrocarbon ethyne contains a triple bond in which three pairs of electrons are shared.

CHAPTER RESOURCES

Simple Organic Compounds

24.1 **Multiple Bonds**

- Hydrocarbons, such as ethene and ethyne, that contain at least one double or triple bond are called **unsaturated hydrocarbons**.



Ethyne      Ethene

CHAPTER RESOURCES

Simple Organic Compounds

24.1 **Multiple Bonds**

- An easy way to remember what type of bond a hydrocarbon has is to look at the last three letters.
- Compounds ending with *-ane* have a single bond; the ending *-ene* indicates a double bond, and *-yne* indicates a triple bond.

CHAPTER RESOURCES

Section Check

24.1

**Question 1**

What element must a compound contain in order to be considered an organic compound?

A. carbon  
B. nitrogen  
C. oxygen  
D. hydrogen

CHAPTER RESOURCES

Section Check

24.1

**Answer**

The answer is A. Most compounds containing carbon are organic compounds.

CHAPTER RESOURCES

Section Check

24.1

**Question 2**

Which is a hydrocarbon?

A. propane  
B. ethanol  
C. acetic acid  
D. mercaptan

CHAPTER RESOURCES

Section Check

24.1

**Answer**

Propane is a hydrocarbon, made up of only carbon and hydrogen atoms.

Some Hydrocarbons		
Name	Chemical Formula	Structural Formula
Methane	CH <sub>4</sub>	<pre>       H             H-C-H               H           </pre>
Ethane	C <sub>2</sub> H <sub>6</sub>	<pre>       H H               H-C-C-H                 H H           </pre>
Propane	C <sub>3</sub> H <sub>8</sub>	<pre>       H H H                 H-C-C-C-H                   H H H           </pre>
Butane	C <sub>4</sub> H <sub>10</sub>	<pre>       H H H H                   H-C-C-C-C-H                     H H H H           </pre>

CHAPTER RESOURCES

Section Check

24.1

**Question 3**

Hydrocarbons containing only single-bonded carbon atoms are called \_\_\_\_\_.

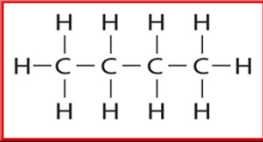
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Section Check

24.1

**Answer**

They are called saturated hydrocarbons. "Saturated" in this term means the compound holds as many hydrogen atoms as possible.



CHAPTER RESOURCES

END

Other Organic Compounds

24.2

**Aromatic Compounds**

- Chewing flavored gum or dissolving a candy mint in your mouth releases pleasant flavors and aromas.
- Many chemical compounds produce pleasant odors but others have less pleasant flavors and smells.

CHAPTER RESOURCES

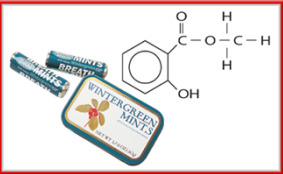
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Other Organic Compounds

24.2

**Aromatic Compounds**

- Smell is not what makes a compound aromatic in the chemical sense.
- To a chemist, an **aromatic compound** is one that contains a benzene structure having a ring with six carbons.



CHAPTER RESOURCES

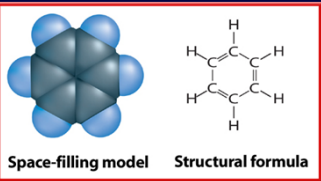
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Other Organic Compounds

24.2

**Benzene**

- Look at a model of benzene,  $C_6H_6$ , and its structural formula.
- As you can see, the benzene molecule has six carbon atoms bonded into a ring.



Space-filling model      Structural formula

CHAPTER RESOURCES

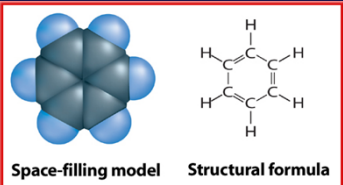
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Other Organic Compounds

24.2

**Benzene**

- The electrons shown as alternating double and single bonds that form the ring are shared by all six carbon atoms in the ring.



Space-filling model      Structural formula

CHAPTER RESOURCES


END

Other Organic Compounds

24.2

**Benzene**

- This equal sharing of electrons is represented by the special benzene symbol—a circle in a hexagon.
- Many compounds contain this stable ring structure.
- The stable ring acts as a framework upon which new molecules can be built.



Benzenesymbol

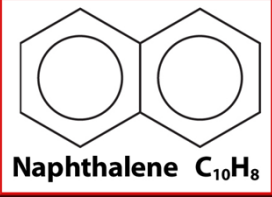
CHAPTER RESOURCES

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Other Organic Compounds

24.2 **Fused Rings**

- One type of moth crystal is made of naphthalene (NAF tuh leen).
- This is a different type of aromatic compound that is made up of two ring structures fused together.



Naphthalene  $C_{10}H_8$

CHAPTER RESOURCES

END

Other Organic Compounds

24.2 **Fused Rings**

- Many known compounds contain three or more rings fused together.
- Tetracycline (teh truh SI kleen) antibiotics are based on a fused ring system containing four fused rings.

CHAPTER RESOURCES

END

Other Organic Compounds

24.2 **Substituted Hydrocarbons**

- A substituted hydrocarbon has one or more of its hydrogen atoms replaced by atoms or groups of other elements.
- Depending on what properties are needed, chemists decide what to add.

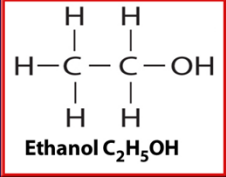
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Other Organic Compounds

24.2 **Alcohols and Acids**

- An **alcohol** is formed when  $-OH$  groups replace one or more hydrogen atoms in a hydrocarbon.
- Organic acids form when a carboxyl group,  $-COOH$ , is substituted for one of the hydrogen atoms attached to a carbon atom.



Ethanol  $C_2H_5OH$

CHAPTER RESOURCES

END

Other Organic Compounds

24.2 **Alcohols and Acids**

- Rubbing alcohol is a substituted hydrocarbon.
- Alcohols are an important group of organic compounds.
- They serve often as solvents and disinfectants, and more importantly can be used as pieces to assemble larger molecules.

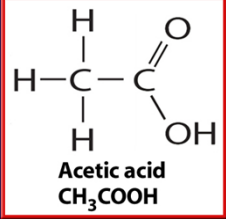
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Other Organic Compounds

24.2 **Alcohols and Acids**

- The structures of ethane, ethanol, and acetic acid are similar.
- Do you see that acetic acid, found in vinegar, is substituted hydrocarbon?



Acetic acid  
 $CH_3COOH$

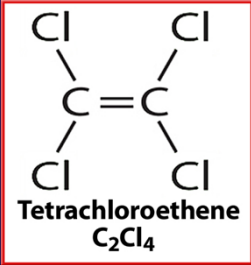
CHAPTER RESOURCES

END

Other Organic Compounds

24.2 **Substituting Other Elements**

- When four chlorine atoms replace four hydrogen atoms in ethylene, the result is tetrachloroethene (the truh klor uh eth EEN).



**Tetrachloroethene**  
 $C_2Cl_4$

CHAPTER RESOURCES

END

Other Organic Compounds

24.2 **Substituting Other Elements**

- Adding four fluorine atoms to ethylene makes a compound that can be transformed into a black, shiny material used for nonstick surfaces in cookware.

CHAPTER RESOURCES

END

Other Organic Compounds

24.2 **Substituting Other Elements**

- When sulfur replaces oxygen in the  $-OH$  group of an alcohol, the resulting compound is called a thiol, or more commonly a mercaptan.
- Most mercaptans have unpleasant odors. This can be useful to animals like the skunk.



CHAPTER RESOURCES

END

Other Organic Compounds

24.2 **Substituting Other Elements**

- Though you might not think so, such a powerful stink can be an asset, and not just for skunks.
- In fact, smelly mercaptans can save lives.

CHAPTER RESOURCES

END

Section Check

24.2

**Answer**

In the chemical sense, an aromatic compound is one that contains a benzene structure having a ring with six carbons.

CHAPTER RESOURCES


END

Section Check

24.2

**Question 2**

What is the result of electron sharing in a benzene molecule?



**Benzene symbol**

CHAPTER RESOURCES

END

Section Check

24.2

**Answer**

Sharing electrons causes a benzene molecule to be chemically stable.

CHAPTER RESOURCES

END

Section Check

24.2

**Question 3**

If a hydroxyl group replaces a hydrogen atom in a hydrocarbon, what type of compound results?

CHAPTER RESOURCES

END

Section Check

24.2

**Answer**

An alcohol is formed when -OH groups replace one or more hydrogen atoms in a hydrocarbon.

```

      H   H
      |   |
H - C - C - OH
      |   |
      H   H
    
```

**Ethanol C<sub>2</sub>H<sub>5</sub>OH**

CHAPTER RESOURCES

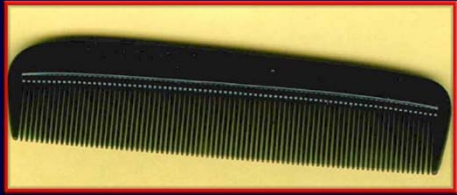
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Petroleum—A Source of Carbon Compounds

24.3

**What is petroleum?**

- What is petroleum?
- Do you carry a comb in your pocket or purse? What is it made from?



CHAPTER RESOURCES

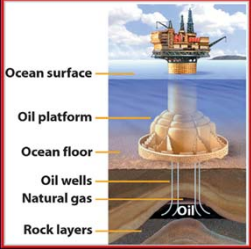
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Petroleum—A Source of Carbon Compounds

24.3

**What is petroleum?**

- Petroleum is a mixture of thousands of carbon compounds.
- To make items such as combs, the first step is to extract the crude oil from its underground source.



CHAPTER RESOURCES

END

Petroleum—A Source of Carbon Compounds

24.3

**What is petroleum?**

- Then, chemists and engineers separate the crude oil into fractions containing compounds with similar boiling points.
- The separation process is known as fractional distillation.


CHAPTER RESOURCES

END

Petroleum—A Source of Carbon Compounds

24.3 **What is petroleum?**

- If you have ever driven past a refinery, you may have seen big, metal towers called fractionating towers.




CHAPTER RESOURCES

END

Petroleum—A Source of Carbon Compounds

24.3 **What is petroleum?**

- They often rise as high as 35 m and can be 18 m wide and have pipes and metal scaffolding attached to the outside.



CHAPTER RESOURCES

END

Petroleum—A Source of Carbon Compounds

24.3 **The Tower**

- Inside the tower is a series of metal plates arranged like the floors of a building.
- These plates have small holes so that vapors can pass through.

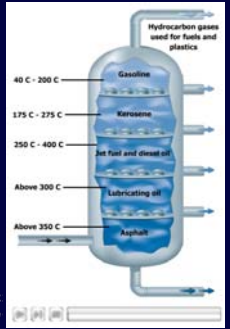
CHAPTER RESOURCES

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Petroleum—A Source of Carbon Compounds

24.3 **The Tower**

- The tower separates crude oil into fractions containing compounds having a range of boiling points.
- Within a fraction, boiling points may range more than 100°C.



MAC OS X users click here to view.

CHAPTER RESOURCES

END

Petroleum—A Source of Carbon Compounds

24.3 **How It Happens**

- The crude petroleum at the base of the tower is heated to more than 350°C.
- At this temperature most hydrocarbons in the mixture become vapor and start to rise.

CHAPTER RESOURCES

END

Petroleum—A Source of Carbon Compounds

24.3 **How It Happens**

- The higher boiling fractions reach only the lower plates before they condense, forming shallow pools that drain off through pipes on the sides of the tower and are collected.
- Fractions with lower boiling points may climb higher to the middle plates before condensing.

CHAPTER RESOURCES

END

Petroleum—A Source of Carbon Compounds

**24.3** **How It Happens**

- Finally, those with the lowest boiling points condense on the top most plates or never condense at all and are collected as gasses at the top of the tower.

CHAPTER RESOURCES

END

Petroleum—A Source of Carbon Compounds

**24.3** **How It Happens**

- Why don't the condensed liquids fall back through the holes?
- The reason is that pressure from the rising vapors prevents this.
- The separation of the fractions is improved by the interaction of rising vapors with condensed liquid.

CHAPTER RESOURCES

END

Petroleum—A Source of Carbon Compounds

**24.3** **Uses for Petroleum Compounds**

- The fractions that condense on the upper plates and contain from five to ten carbons are used for gasoline and solvents.

CHAPTER RESOURCES

END

Petroleum—A Source of Carbon Compounds

**24.3** **Uses for Petroleum Compounds**

- Below these are fractions with 12 to 18 carbons that are used for kerosene and jet fuel.
- The bottom fractions go into lubricating oil, and the residue is used for paving asphalt.

CHAPTER RESOURCES

END

Petroleum—A Source of Carbon Compounds

**24.3** **Polymers**

- Did you ever loop together strips of paper to make paper chains for decorations?
- A paper chain can represent the structure of a polymer.

- Some of the smaller molecules from petroleum can act like links in a chain.

CHAPTER RESOURCES

END

Petroleum—A Source of Carbon Compounds

**24.3** **Polymers**

- When these links are hooked together, they make new, extremely large molecules known as **polymers**.
- The small molecule, which forms a link in the polymer chain, is called a **monomer**.

CHAPTER RESOURCES

END

Petroleum—A Source of Carbon Compounds

24.3 **Common Polymers**


- One common polymer or plastic is made from the monomer ethene or ethylene.
- Under standard room-temperature conditions, this small hydrocarbon is a gas.
- However, when ethylene combines with itself repeatedly, it forms a polymer called **polyethylene**.

CHAPTER RESOURCES

Petroleum—A Source of Carbon Compounds

24.3 **Common Polymers**

- Polyethylene (pah lee EH thuh leen) is used widely in shopping bags and plastic bottles.
- Often two or more different monomers, known as copolymers, combine to make one polymer molecule.



CHAPTER RESOURCES

Petroleum—A Source of Carbon Compounds

24.3 **Common Polymers**

- Polymers can be made light and flexible or so strong that they can be used to make plastic pipes, boats, and even some auto bodies.
- Because so many things used today are made of synthetic polymers, some people call this "The Age of Plastics."

CHAPTER RESOURCES

Petroleum—A Source of Carbon Compounds

24.3 **Designing Polymers**


- The properties of polymers depend mostly on which monomers are used to make them.
- Like hydrocarbons, polymers can have branches in their chains.
- The amount of branching and the shape of the polymer greatly affects its properties.

CHAPTER RESOURCES

Petroleum—A Source of Carbon Compounds

24.3 **Designing Polymers**

- Sometimes the same polymer can take two completely different forms.
- For example, polystyrene (pah lee STI reen) that is made from styrene, forms brittle, transparent cases for CDs and lightweight, opaque foam cups and packing materials.



CHAPTER RESOURCES

Petroleum—A Source of Carbon Compounds

24.3 **Designing Polymers**

- To make this transformation, a gas such as carbon dioxide is blown into melted polystyrene as it is molded.
- Bubbles remain within the polymer when it cools, making polystyrene foam an efficient insulator.

CHAPTER RESOURCES

Petroleum—A Source of Carbon Compounds

24.3 **Designing Polymers**

- Other polymers can be spun into threads, which are used to make clothing or items such as suitcases and backpacks.
- Bulletproof vests are made of tightly woven, synthetic polymer.
- Some polymers remain rigid when heated, but others become soft and pliable when heated and harden again when cooled.

CHAPTER RESOURCES

Petroleum—A Source of Carbon Compounds

24.3 **Other Petroleum Products**

- Aromatic dyes from petroleum have replaced natural dyes, such as indigo and alizarin, almost completely.
- The first synthetic dye was a bright purple called mauve that was discovered accidentally in coal tar compounds.

CHAPTER RESOURCES

Petroleum—A Source of Carbon Compounds

24.3 **Depolymerization**

- Many polymers do not decompose.
- One way to combat this is by recycling, which recovers clean plastics for reuse in new products.



CHAPTER RESOURCES

Petroleum—A Source of Carbon Compounds

24.3 **Depolymerization**

- Another approach involves a process called **depolymerization**, which uses heat or chemicals to break the long polymer chain into its monomer fragments.
- These monomers can then be reused.
- Each polymer requires a different process, and much research is needed to make this type of recycling economical.

CHAPTER RESOURCES

Section Check

24.3 **Question 1**

Petroleum is a mixture of thousands of \_\_\_\_\_ compounds.

A. iron  
B. hydrogen  
C. carbon  
D. nitrogen

CHAPTER RESOURCES

Section Check

24.3 **Answer**

The answer is C. Petroleum is a flammable liquid often called crude oil.

CHAPTER RESOURCES

Section Check

24.3

**Question 2**

What process is used to separate crude oil into useable compounds?

CHAPTER RESOURCES

END

Section Check

24.3

**Answer**

Fractional distillation is used to separate crude oil into fractions containing compounds with similar boiling points. This process takes place in petroleum refineries.

CHAPTER RESOURCES

END

Section Check

24.3

**Question 3**

Which is not obtained from petroleum?

A. propane  
B. gasoline  
C. paving asphalt  
D. glycogen

CHAPTER RESOURCES

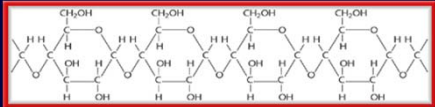
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Section Check

24.3

**Answer**

The answer is D. Glycogen is a glucose polymer that stores energy from starch in the liver and muscles.



CHAPTER RESOURCES

END

Biological Compounds

24.4

**Biological Polymers**

- Biological polymers are huge molecules.
- They are made of many smaller monomers that are linked together.
- The monomers of biological polymers are usually larger and more complex in structure.

CHAPTER RESOURCES

END

Biological Compounds

24.4

**Biological Polymers**

- Many of the important biological compounds in your body are polymers.
- Among them are the proteins, which often contain hundreds of units.

CHAPTER RESOURCES

END

Biological Compounds

24.4 **Proteins**

- **Proteins** are large organic polymers formed from organic monomers called amino acids.
- Even though only 20 amino acids are commonly found in nature, they can be arranged in so many ways that millions of different proteins exist.

CHAPTER RESOURCES

Biological Compounds

24.4 **Proteins**

- Proteins come in numerous forms and make up many of the tissues in your body, such as muscles and tendons, as well as your hair and fingernails.
- In fact, proteins account for 15 percent of your total body weight.

CHAPTER RESOURCES

Biological Compounds

24.4 **Protein Monomers**

- Amine groups of one amino acid can combine with the carboxylic acid group of another amino acid, linking them together to form a compound called a peptide.

CHAPTER RESOURCES

Biological Compounds

24.4 **Protein Monomers**

- The bond joining them is known as peptide bond.
- When a peptide contains a large number of amino acids—about 50 or more—the molecule is called a protein.

CHAPTER RESOURCES

Biological Compounds

24.4 **Protein Structure**

- Long protein molecules tend to twist and coil in a manner unique to each protein.
- For example, hemoglobin, which carries oxygen in your blood, has four chains that coil around each other.

CHAPTER RESOURCES

Biological Compounds

24.4 **Protein Structure**

- Each chain contains an iron atom that carries the oxygen.
- If you look closely, you can see all four iron atoms in hemoglobin.

CHAPTER RESOURCES

Biological Compounds

24.4 **Protein Structure**

- When you eat foods that contain proteins, your body breaks down the proteins into their amino acid monomers.
- Then your body uses these amino acids to make new proteins that form muscles, blood, and other body tissues.

CHAPTER RESOURCES

Biological Compounds

24.4 **Nucleic Acids**

- One kind of nucleic acid, called **deoxyribonucleic** (dee AHK sih ri boh noo klah ihk) **acid** or DNA, is found in the nuclei of cells where it codes and stores genetic information.
- This is known as the genetic code.

CHAPTER RESOURCES

Biological Compounds

24.4 **Nucleic Acid Monomers**

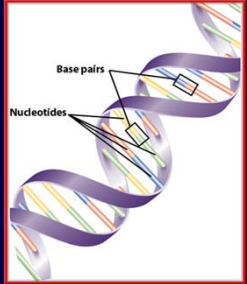
- The monomers that make up DNA are called nucleotides.
- Nucleotides are complex molecules containing an organic base, a sugar, and a phosphoric acid unit.

CHAPTER RESOURCES

Biological Compounds

24.4 **Nucleic Acid Monomers**

- In DNA two nucleotide chains twist around each other forming what resembles a twisted ladder or what is called the double helix.

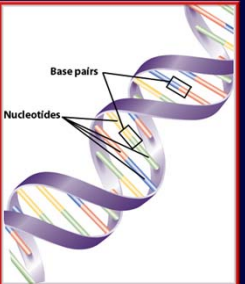


CHAPTER RESOURCES

Biological Compounds

24.4 **Nucleic Acid Monomers**

- Human DNA contains only four different organic bases, but they can form millions of combinations.
- The bases on one side of the ladder pair with bases on the other side.



CHAPTER RESOURCES

Biological Compounds

24.4 **DNA Fingerprinting**

- The DNA of each person differs in some way from that of everyone else, except for identical twins, who share the same DNA sequence.
- The unique nature of DNA offers crime investigators a way to identify criminals from hair or fluids left at a crime scene.

CHAPTER RESOURCES

Biological Compounds

24.4 DNA Fingerprinting

- Chemists can break up the DNA into its nucleotide components and use radioactive and X-ray methods to obtain a picture of the nucleotide pattern.
- Comparing this pattern to one made from the DNA of a suspect can link that suspect to the crime scene.

CHAPTER RESOURCES

Biological Compounds

24.4 Carbohydrates

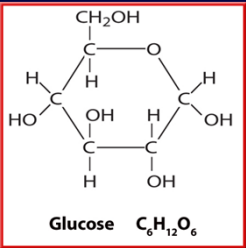
- Carbohydrates** are compounds containing carbon, hydrogen, and oxygen, which have twice as many hydrogen atoms as oxygen atoms.
- Carbohydrates include the sugars and starches.

CHAPTER RESOURCES

Biological Compounds

24.4 Sugars

- Sugars are a major group of carbohydrates.
- The sugar glucose is found in your blood and also in many sweet foods such as grapes and honey.



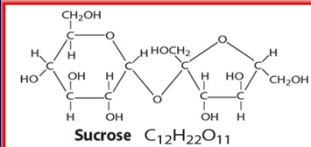
Glucose  $C_6H_{12}O_6$

CHAPTER RESOURCES

Biological Compounds

24.4 Sugars

- Common table sugar, known as sucrose, is broken down by digestion into two simpler sugars—fructose, often called fruit sugar, and glucose.
- Unlike starches, sugars provide quick energy soon after eating.



Sucrose  $C_{12}H_{22}O_{11}$

CHAPTER RESOURCES

Biological Compounds

24.4 Starches

- The energy from starches can be stored in liver and muscle cells in the form of a compound called glycogen.
- During a long race, this stored energy is released, giving the athlete a fresh burst of power.

CHAPTER RESOURCES

Biological Compounds

24.4 Lipids

- Fats, oils, and related compounds make up a group of organic compounds known as **lipids**.
- Lipids contain the same elements as carbohydrates but in different proportions.



CHAPTER RESOURCES

Biological Compounds

24.4 **Lipids**

- Lipids have fewer oxygen atoms and contain carboxylic acid groups.



CHAPTER RESOURCES

END

Biological Compounds

24.4 **Fats and Oils**

- These substances are similar in structure to hydrocarbons.
- They can be classified as saturated or unsaturated, according to the types of bonds in their carbon chains.
- Saturated fats contain only single bonds between carbon atoms.

CHAPTER RESOURCES

END

Biological Compounds

24.4 **Fats and Oils**

- Unsaturated fats having one double bond are called monounsaturated, and those having two or more double bonds are called polyunsaturated.

CHAPTER RESOURCES

END

Biological Compounds

24.4 **Fats and Oils**

- Animal lipids or fats tend to be saturated and are solids at room temperature.
- Plant lipids called oils are unsaturated and are usually liquids.



CHAPTER RESOURCES

END

Biological Compounds

24.4 **Fats and Oils**

- Evidence shows that too much saturated fat and cholesterol in the diet may contribute to some heart disease and that unsaturated fats may help to prevent heart disease.
- A balanced diet includes some fats, just as it includes proteins and carbohydrates.

CHAPTER RESOURCES

END

Section Check

24.4 **Question 1**

Proteins are large organic polymers formed from \_\_\_\_\_.

- glucose
- amino acids
- carboxylic acids
- nucleic acids

CHAPTER RESOURCES

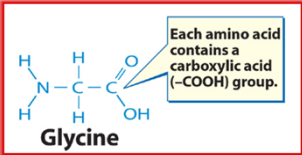
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Section Check

24.4

**Answer**

The answer is B, amino acids. Every amino acid contains a carboxylic acid group, as well as an amine group.



Each amino acid contains a carboxylic acid (-COOH) group.

Glycine

CHAPTER RESOURCES

END

Section Check

24.4

**Question 2**

Which of the following refers specifically to the bond linking amino acids?

A. ionic  
B. covalent  
C. metallic  
D. peptide

CHAPTER RESOURCES

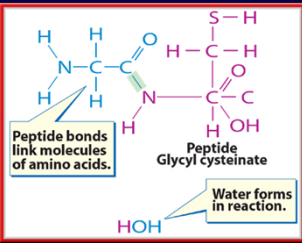
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Section Check

24.4

**Answer**

The answer is D. Peptides are compounds formed by the linking together of amino acids



Peptide bonds link molecules of amino acids.

Peptide Glycyl cysteinate

Water forms in reaction.

CHAPTER RESOURCES

END

Section Check

24.4

**Question 3**

What part of a nucleic acid monomer forms the “rungs” of a DNA ladder?

CHAPTER RESOURCES

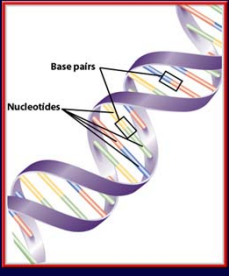
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Section Check

24.4

**Answer**

The four different organic bases in DNA form hydrogen bonds and make up the “rungs” of the ladder. The sugar and phosphate groups make up the backbone, or sides of the ladder.



Base pairs

Nucleotides




CHAPTER RESOURCES

END

Help

24

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