

## Warm-Up

## Properties and Uses of Saturated Hydrocarbons

**Basics of Organic Chemistry**

- Organic chemistry is the chemistry of carbon compounds.
- Carbon's **valence** shell has four electrons.
- Carbon can form four covalent bonds.

**Hydrocarbons**

Hydrocarbons:

- contain only carbon and **hydrogen** atoms.
- do not contain oxygen, nitrogen, halogen, or other atoms in structure.

**Lesson Objectives**

By the end of this lesson, you should be able to:

- Describe the properties of straight-chain alkanes, **branched-chain** alkanes, and cycloalkanes.
- Use the system for naming the ten simplest linear hydrocarbons and **isomers** that contain single bonds.
- Identify uses of saturated hydrocarbons.

**Science Practice:** Build vocabulary knowledge by learning how to name hydrocarbons.

**Words to Know**

Fill in this table as you work through the lesson. You may also use the glossary to help you.

substituents	a general name for any atoms or groups of atoms that branch from the main chain of an organic molecule
saturated hydrocarbon	a hydrocarbon that contains only single bonds
alkane	a hydrocarbon containing only single bonds
cycloalkane	an alkane with one or more carbon ring
unsaturated hydrocarbon	a compound that is composed of carbon and hydrogen and contains at least one double or triple bond between carbon atoms

## Instruction

## Properties and Uses of Saturated Hydrocarbons

Slide

1

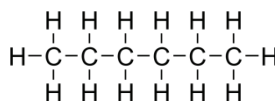
## Lesson Question

What are the properties and uses of hydrocarbons that only contain single bonds?

2

## Saturated and Unsaturated Hydrocarbons

- **Saturated hydrocarbons** are hydrocarbons that contain only **single** bonds.
- Saturated hydrocarbons are also called **alkanes**.



- **Unsaturated hydrocarbons** are hydrocarbons that contain at least one **double** or triple bond.

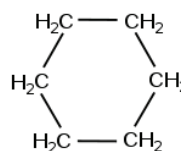
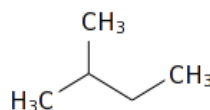
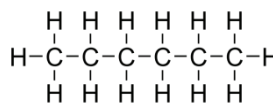


4

## Straight Chains, Branched Chains, and Cycloalkanes

There are **three** main classes of alkanes:

- Straight chains
- Branched chains
- Cycloalkanes



- Cycloalkanes have carbons arranged in a **ring**.
- Every carbon is bonded to two other **carbons** and **two** hydrogens.

## Instruction

## Properties and Uses of Saturated Hydrocarbons

Slide

7

**Properties of Hydrocarbons**

Properties of hydrocarbons:

- Fairly **unreactive**
- Combustible
- **Insoluble** in water
- Soluble in ether and other **organic** solvents
- Boiling point increases as molecular **mass** increases

9

**Uses of Alkanes**

- Gasoline (pentane and **octane**)
- Natural gas (**methane** and ethane)
- **Lubricating** oil (carbon lengths of 17–35 carbons)
- **Asphalt** (carbon lengths above 35 carbons)

## Instruction

## Properties and Uses of Saturated Hydrocarbons

Slide

11

## Naming Hydrocarbons

Structure	Name
$\text{CH}_4$	methane
$\text{CH}_3\text{CH}_3$	ethane
$\text{CH}_3\text{CH}_2\text{CH}_3$	propane
$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$	butane
$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$	pentane
$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$	hexane
$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$	heptane
$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$	octane
$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$	nonane
$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$	decane

13

## Numbering the Chain

- Identify and name the **longest** chain.
- Identify and name **substituents**. Substituent is a general name for any atom or group of atoms that branches from the main chain of an organic molecule.
- Number carbons so the lowest number is given to a group near one end of the chain.
- List all substituent groups **alphabetically** in front of the name of the longest chain.
- Use **prefixes** to designate the number of each substituent group.

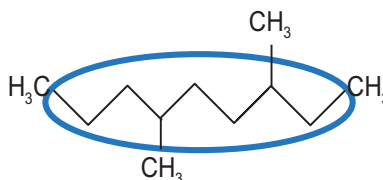
## Instruction

## Properties and Uses of Saturated Hydrocarbons

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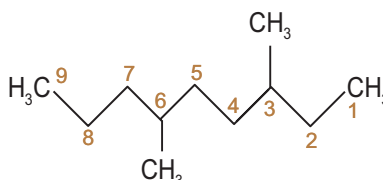
13

## Naming a Branched Hydrocarbon



1. Identify the longest chain (  carbons).
2. Name the chain: .
3. Identify and name substituents: 2 methyl groups.

## Naming a Branched Hydrocarbon



4. Number the carbon atoms in the longest chain, starting at the end with the closest branch.
5. List all substituent groups alphabetically.  groups are at carbons 3 and 6.
6. Use prefixes to designate number of each substituent group.

The name of this branched hydrocarbon is .

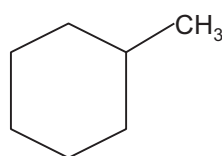
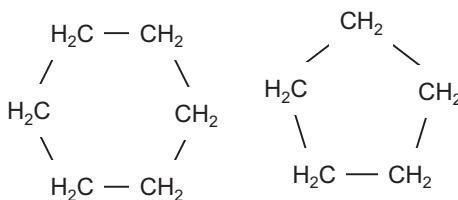
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## Properties and Uses of Saturated Hydrocarbons

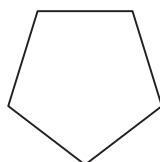
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16

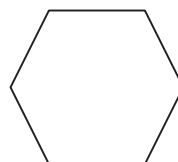
## Cycloalkanes



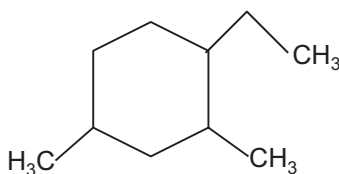
- This ring has a **substituent**, a side chain. so its name is methylcyclohexane.



Cyclopentane



Cyclohexane



- This cyclohexane has one **ethyl** group and **two** methyl groups.
- So we start numbering with the ethyl group because it's the **longest**.
- This molecule is named **1-ethyl**-2,4-dimethylcyclohexane.

## Summary

## Properties and Uses of Saturated Hydrocarbons

**Lesson Question**

What are the properties and uses of hydrocarbons that only contain single bonds?

**Answer**

(Sample answer) Saturated hydrocarbons have only single bonds. They may have straight chains, branched chains, or ring shape (that is, cycloalkanes). Alkanes are soluble in organic solvents and have high boiling points. Alkanes are commonly used, as in materials such as lubricating oil and fuel.

Slide

2

**Naming Hydrocarbons**

- Naming **linear** hydrocarbons
- **Numbering** of chain
- Naming **side** chains
- Naming cycloalkanes

# Summary

## Properties and Uses of Saturated Hydrocarbons

Slide

2

### Alkanes and Their Uses

- Shapes of **hydrocarbons**: straight chain, branched chain, and cycloalkanes
- Properties: solubility, **boiling** point, and reactivity
- Uses of hydrocarbons: gasoline, natural gas, **lubricating** oil, and asphalt

*Use this space to write any questions or thoughts about this lesson.*