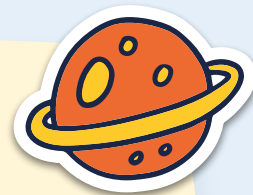


# Subject Specific Tools: Chemistry



Dr. Deepty Gupta, IUCTE,  
Varanasi

# WHAT IS THE NATURE OF CHEMISTRY



Chemistry is that branch of science dealing with the study of composition, structure, and properties of matter.

Chemistry is a basic science whose central concerns are:

1. structure and behavior of atoms.
2. composition and properties of compounds.
3. reactions between substances

# WHY DO WE NEED TO DEVELOP E-CONTENT FOR CHEMISTRY

- Supplement to traditional teaching
- Simple and quick
- For illustrating complex or abstract concepts
- Promote a deeper understanding of concepts
- Removing barriers of traditional science laboratories
- Trigger the use of laboratory equipment
- Could experience dangerous phenomena like chemical reactions for better observation
- Augmented reality, Animations, Virtual reality , Online tutorials, Simulations for better understanding

# Type of e-content in Chemistry

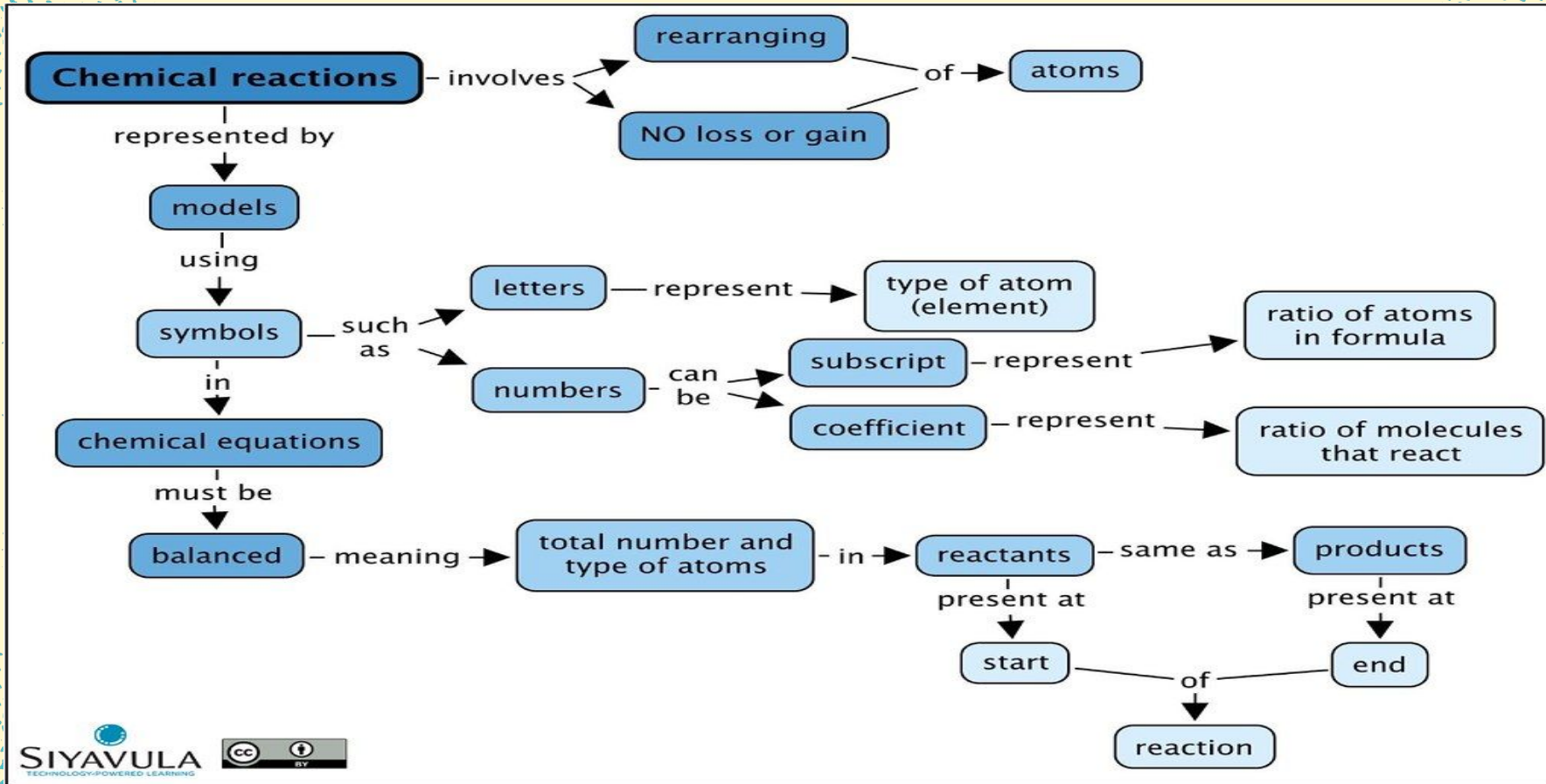
- Simulations
- Animations
- Mind Maps
- Infographics
- Interactives
- Video
- Audio
- Immersive Content (AR/VR)
- Textual
- Stop Motion Video

# GENERIC SOFTWARES/TOOLS

- H5P (INTERACTIVES)
- FREEPLANE (MINDMAPPING SOFTWARE)
- EASELly (INFOGRAPHICS)
- SCRATCH (ANIMATION)



# MIND MAP



# MARIE CURIE



**First Woman to  
win Noble Prize**



**The Electrifying World  
of Radioactivity**



**Birthplace: Poland**

**Radioactivity is the release of energy from the decay of the nuclei of certain kinds of atoms and isotopes.**

Canva

# e-content for Chemistry

- DIKSHA
- Audio Books
- Olabs
- Phet
- Toys from Trash
- Go Lab





# DIKSHA

diksha.gov.in/ncert/play/collection/do\_31306100249858048011949?contentType=TextBook

Skip to Main Content | Accessibility Corner | Site Map | A- A A+ | D

Search or enter QR code Search English G

Science Textbook for ( Class X )  
State (Himachal Pradesh) • English • Class 10

Chemical Reactions Part - I

Watch later Share

CHEMICAL REACTIONS

1:01 / 18:56

Chemical Reactions Part - I

4 ★

All Video Interactive Docs

3 - Metals and non-metals

Video

- Properties and Application of metals

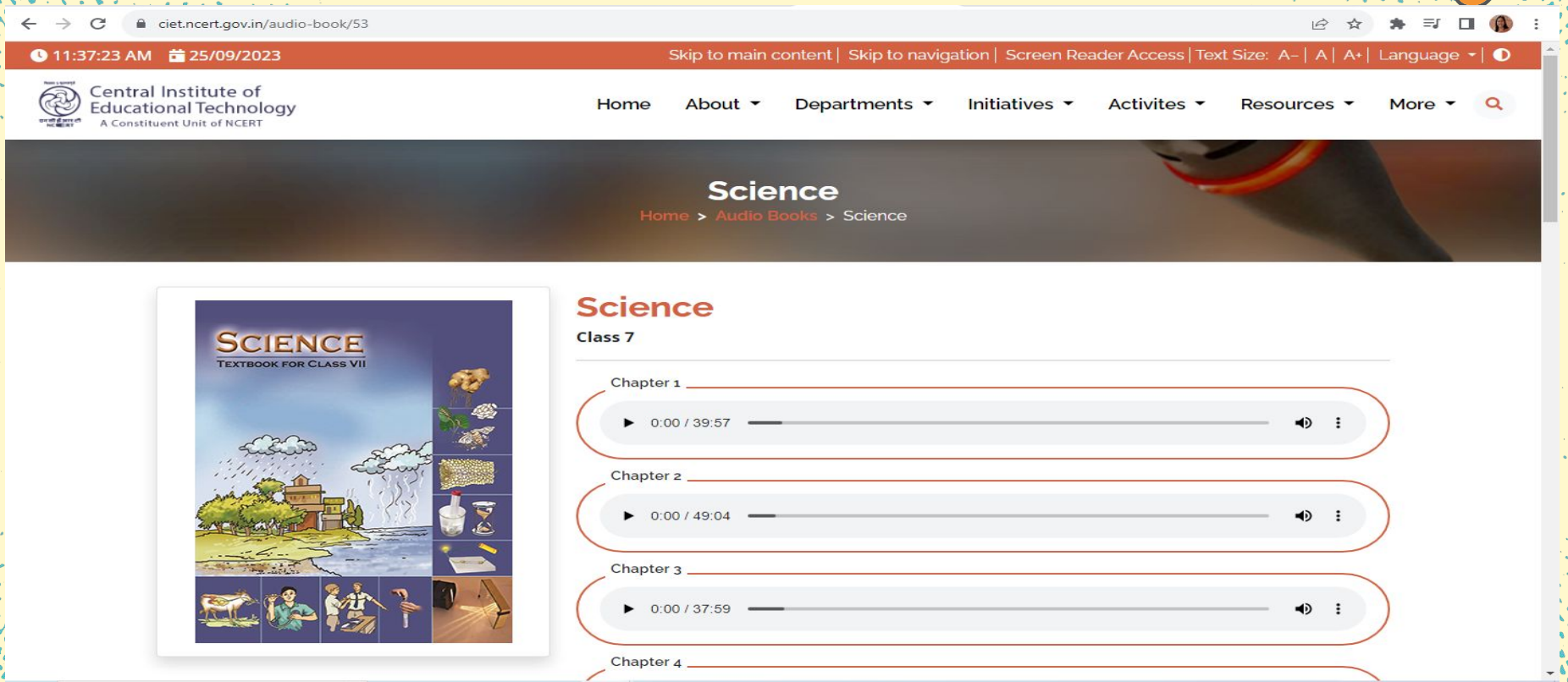
Interactive Resources

- Quiz: Properties of metals & non-metals
- Quiz: Reactivity & extraction of metals

Credits and Licence information



# AUDIO BOOKS



The screenshot shows a web browser window with the URL [ciet.ncert.gov.in/audio-book/53](https://ciet.ncert.gov.in/audio-book/53). The page header includes the time 11:37:23 AM on 25/09/2023 and navigation links such as "Skip to main content", "Skip to navigation", "Screen Reader Access", and "Text Size: A- | A | A+ | Language". The logo of the Central Institute of Educational Technology (Ciet) is visible, along with the text "Central Institute of Educational Technology, A Constituent Unit of NCERT". A navigation menu contains links for Home, About, Departments, Initiatives, Activites, Resources, and More. The main content area features a banner for "Science" with a breadcrumb trail: Home > Audio Books > Science. Below the banner, there is a grid of science-related images. To the right, the text "Science Class 7" is displayed. A list of audio books is provided, each with a play button, a progress bar, and a duration: Chapter 1 (0:00 / 39:57), Chapter 2 (0:00 / 49:04), Chapter 3 (0:00 / 37:59), and Chapter 4.

11:37:23 AM 25/09/2023

Skip to main content | Skip to navigation | Screen Reader Access | Text Size: A- | A | A+ | Language

Central Institute of Educational Technology  
A Constituent Unit of NCERT

Home About Departments Initiatives Activites Resources More

Science  
Home > Audio Books > Science

Science  
Class 7

Chapter 1  
▶ 0:00 / 39:57

Chapter 2  
▶ 0:00 / 49:04

Chapter 3  
▶ 0:00 / 37:59

Chapter 4

# OLABS



Biology



Chemistry



Physics



Maths




Example

# Toys from Trash

← → ↻ arvindguptatoys.com/toys.html

Toys from Trash

"The best thing a child can do with a toy is break it!"

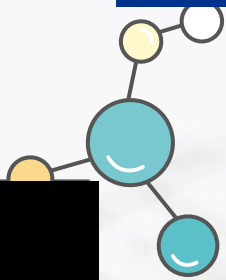


Grid of 20 toy categories:

- Gleam in the Eye
- Air and water
- Amazing Astronomy
- Beginner's Biology
- Electricity and Magnetism
- Flying Toys
- Force Fun
- Fun with Light
- Fun with Pressure
- Magic Miscellany
- Math Magic
- Motor and Generator
- Newton Unplugged
- Paper Fun
- Pumps from the Dump
- Simple Sounds
- Spinning Toys
- String Games

Example

# PhET

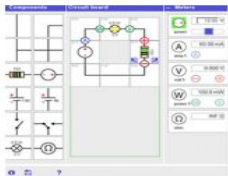


<https://phet.colorado.edu/sims/html/build-an-atom/latest/build-an-atom-en.html>

# Go-Lab

golabz.eu

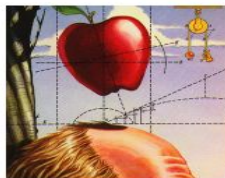
## LAB



### Electrical Circuit Lab

In the Electrical Circuit Lab students can create their own electrical circuits...

## LAB



### Gravity Force Labs

There are two similar labs that you can see if you create a spa

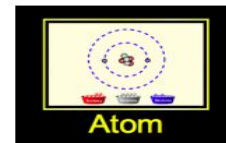
## APP



### Hypothesis Scratchpad

The Hypothesis Scratchpad helps learners formulate hypotheses.

## LAB



### Build An Atom

Build an atom out of protons, neutrons, and electrons, and see how the element...

## LAB



### Acid-Base Solutions

How do strong and weak acids differ? Use lab tools on your computer to find out!

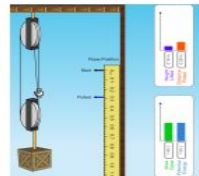
## LAB



### Rate Of Photosynthesis Lab (Html5)

This lab is an abridged Html5 version of the Flash-based

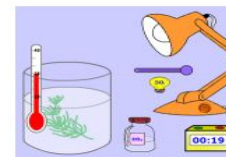
## LAB



### Pulley Simulation

This simulation allows students to visualize some characteristics of a working...

## LAB



### Photolab

There is an updated version of this lab.



NOVA



Concord



Smithsonian  
*Learning Lab*

<https://learninglab.si.edu/>

LabXchange™

Example

Think  
Chem

Example

Chem Collective

Chem Collective



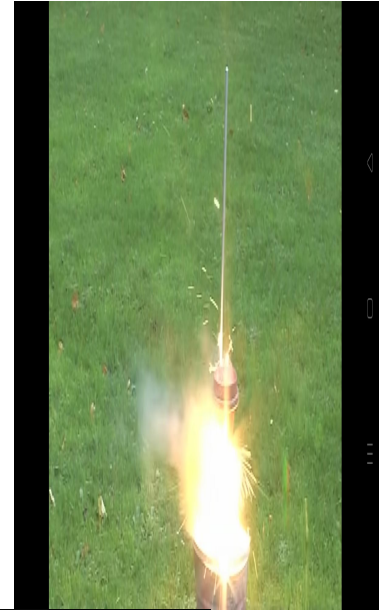
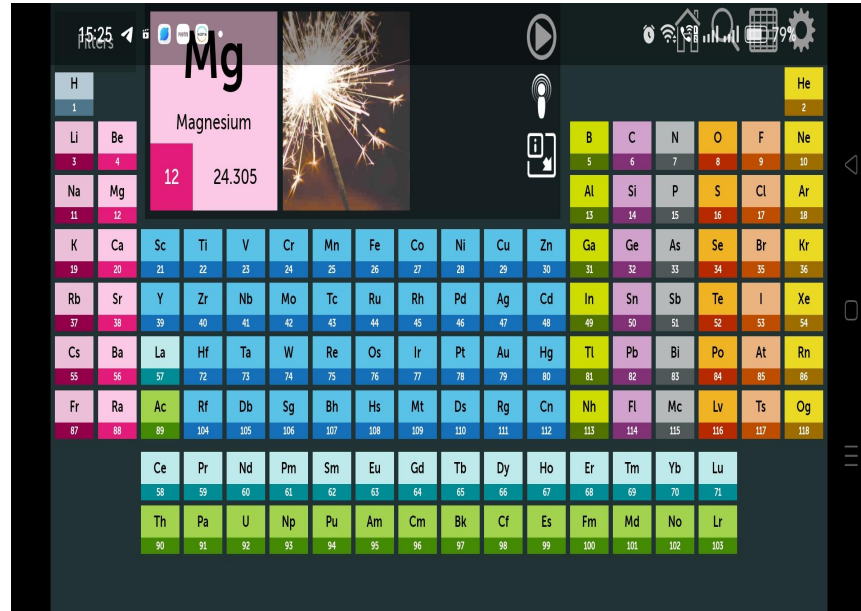


# Mobile Apps





- Periodic table
- Beaker
- Chemspider
- Chairs!
- Happy Atoms
- My Molecularium



PM eVIDYA AR

Mobile App

Classes 9 and 10



PM e-Vidya AR

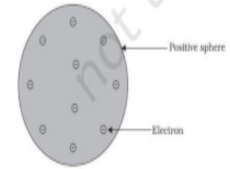


Fig.4.1: Thomson's model of an atom

Page No - 47

Class - 09

Science

Chapter 1 - M...

Fig 4.1 : Thoms...

Load Activity

# CHEMISTRY SOFTWARES



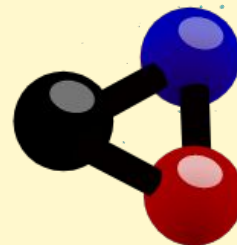
AVOGADRO

<https://avogadro.cc/>



JMOL

<http://jmol.sourceforge.net/>



KALZIUM

<https://edu.kde.org/kalzium/>



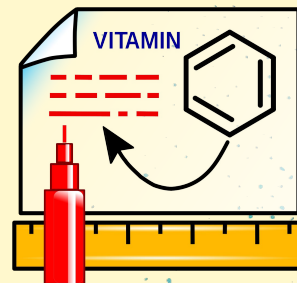
Ptable

<https://www.ptable.com/>



Molecular workbench

(<http://mw.concord.org/mo-del/index.html>)



Chemsketch

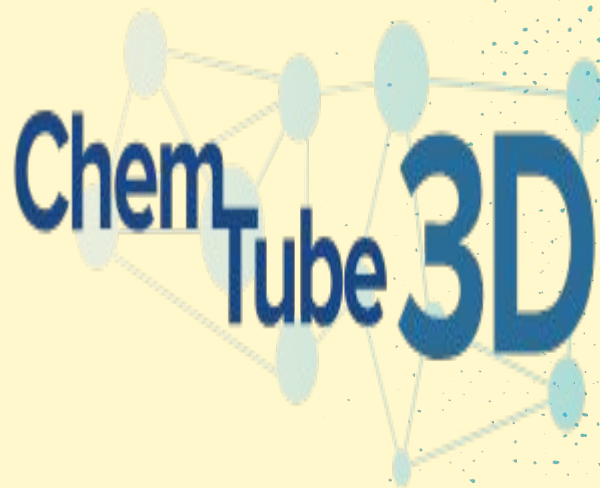
<https://www.acdlabs.com/products/chemsketch/>

# KALZIUM



The image shows a screenshot of a chemistry software interface. The main window displays the element Gold (Au) with its atomic number 79. The interface includes a menu bar (File, View, Tools, Settings, Help), a toolbar with icons for 'Classic Periodic Table', 'Scheme', 'Graphics', 'Isotope Table', 'Molecular Editor', and 'Pertinent Calculations'. A search bar is visible. The periodic table is color-coded by blocks: s-Block (purple), d-Block (yellow), p-Block (green), and f-Block (red). A legend at the bottom left identifies these blocks. The text 'Gold' and 'Au' are prominently displayed on the left side of the window.

# ChemTube3D



<https://www.chemtube3d.com/>

Software interface for a chemistry simulation. The top navigation bar includes: + New, Download Image, Save to Cloud, ? Help, What's New, English, Follow @ChemixLab, and Sign in.

**Search apparatus**

**Chemistry**

- Containers
  - Test Tube
  - Test Tube With Side Arm
  - Bung / Stopper
  - Beaker
  - Displacement Beaker
  - Conical Flask
  - Conical Flask With Side Arm
  - Boiling Flask
  - Volumetric Flask
  - Round Bottom Flask
  - Watch Glass
  - Gas Jar
  - Tank
  - Ice Bath

**Beaker Properties**

- Liquid
- Width: 80
- Height: 100
- Spout

**Tools**

- Appearance
  - Reset to default
  - Flip horizontally
  - Flip vertically
- Ordering

**Simulation:** A beaker containing liquid is on a brown table. A label  $H_2O$  with an arrow points to the liquid. A flask is pouring liquid into the beaker.

**Zoom:** 25% 50% 100% 200% 300%

CHEMIX

# For writing Chemical Equations

| Edraw



KingDraw

EdDraw

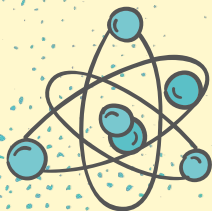
Chemical Equation  
Expert

FX Chem

# JMOL



- JMOL is an **open-source software** to create chemical structures in 3D
- It can be used on Windows, Mac OS X, and Linux/Unix systems.
- It requires **Java application** that runs on the desktop
- The structures created can be embedded into web pages
- More accurate perspective of the molecules structure and geometry.
- Molecular modeling possible to rotate, zoom in and out



- **JSmol** is a JavaScript framework that allows web developers to create pages that utilize either Java or HTML5 (no Java).
- Supports a wide range of chemical file formats, including **Protein Data Bank (PDB)** and Chemical Markup Language (CML).
- Scripting language which can be used to control the visual representation of the molecule.
- Available in **16 Languages**

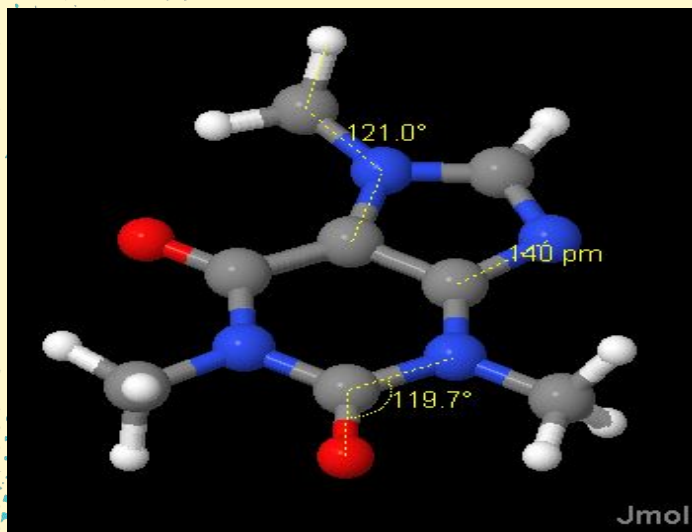
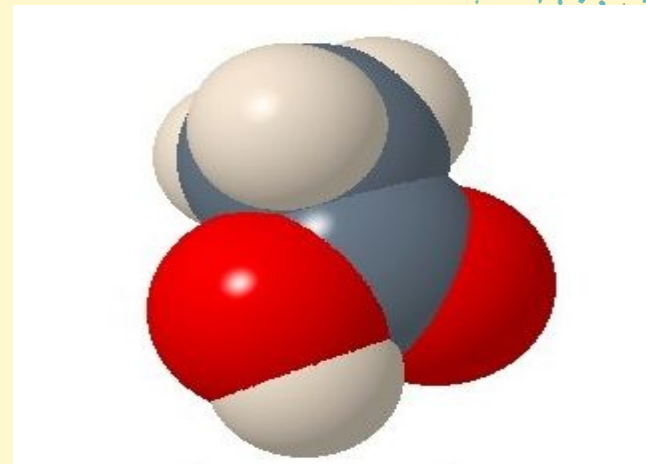


# FOUR WAYS OF VISUALISING MODEL

- Wireframe Model
- Stick Model
- Ball and Stick Model
- Space Filled Model

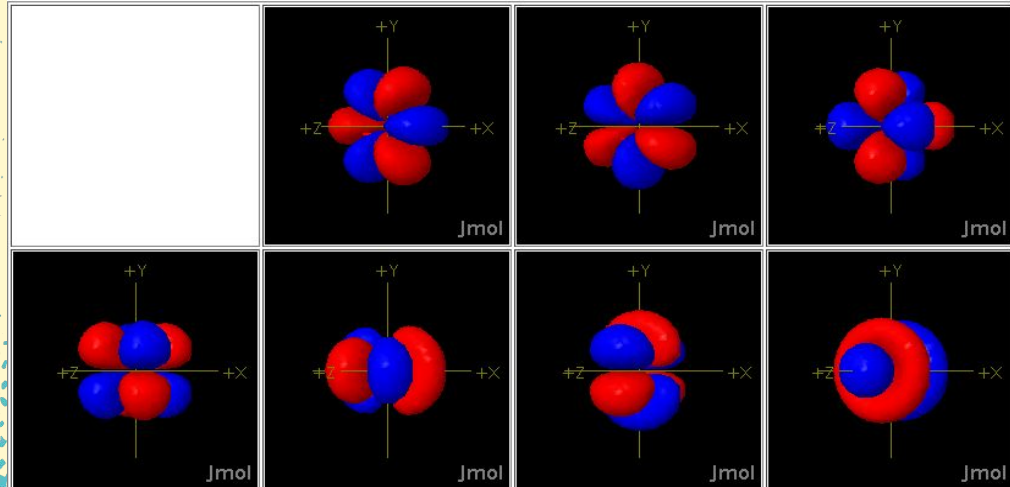
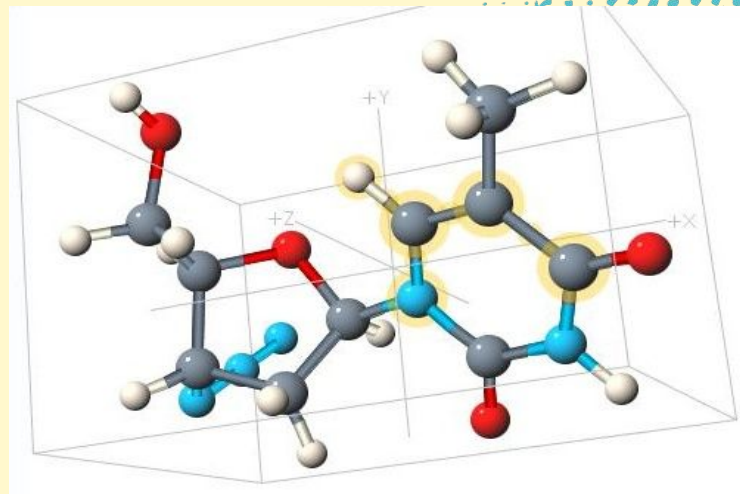
# DIFFERENT VIEW OF STRUCTURES

## SPACE FILLED ATOMS



DISTANCE AND ANGLE  
MEASUREMENTS

# Display of bounding box and Axes of coordinates space



The 4f-orbitals

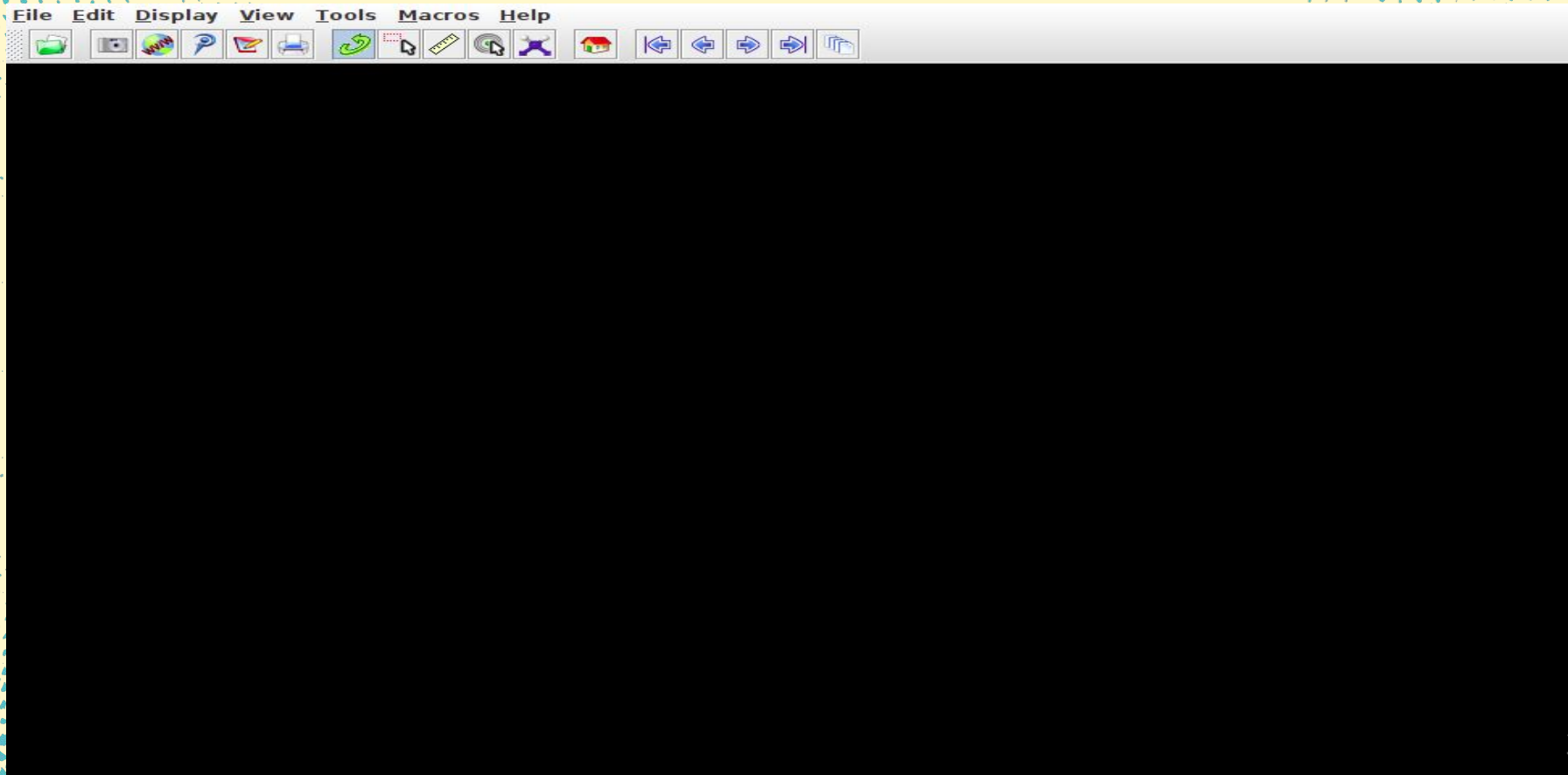
# POINTS TO DISCUSS

1. Jmol panel, Menu bar, toolbar
2. Create model of simple organic molecules
3. Construct different molecules by substituting with other atoms
4. Minimize energy for stabilisation of molecules
5. Saving the structure created
6. Adding and deleting the atoms and bonds
7. Finding the bond length and angles of the molecules created

# STEPS

1. Downloading the software (The current release is version 14)
2. Run/ Install
3. Open the software and create the structure
4. Save the file in JPEG format

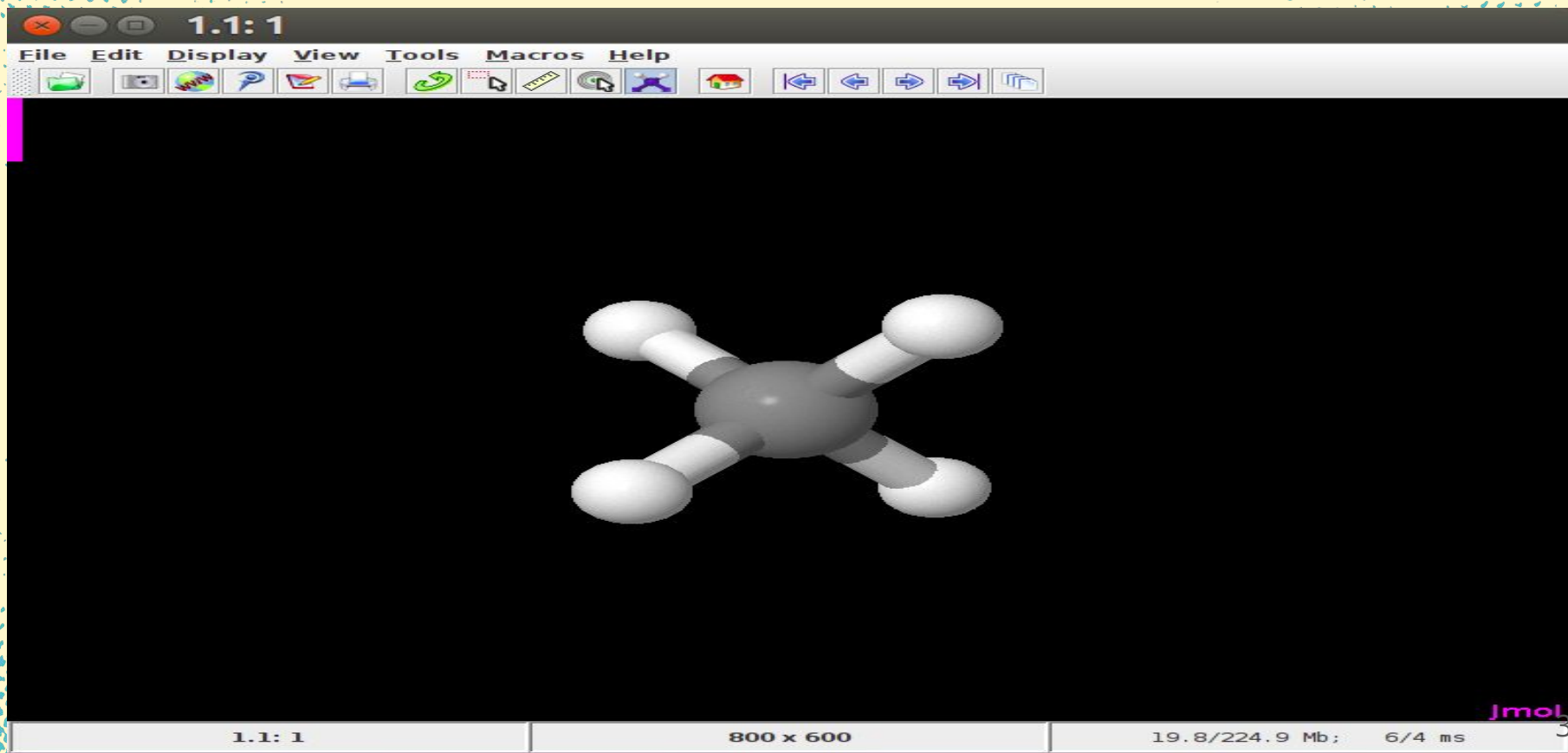
# Jmol Panel



# Tool / Menu Bar



# Use of Model Kit Icon to Create Structures

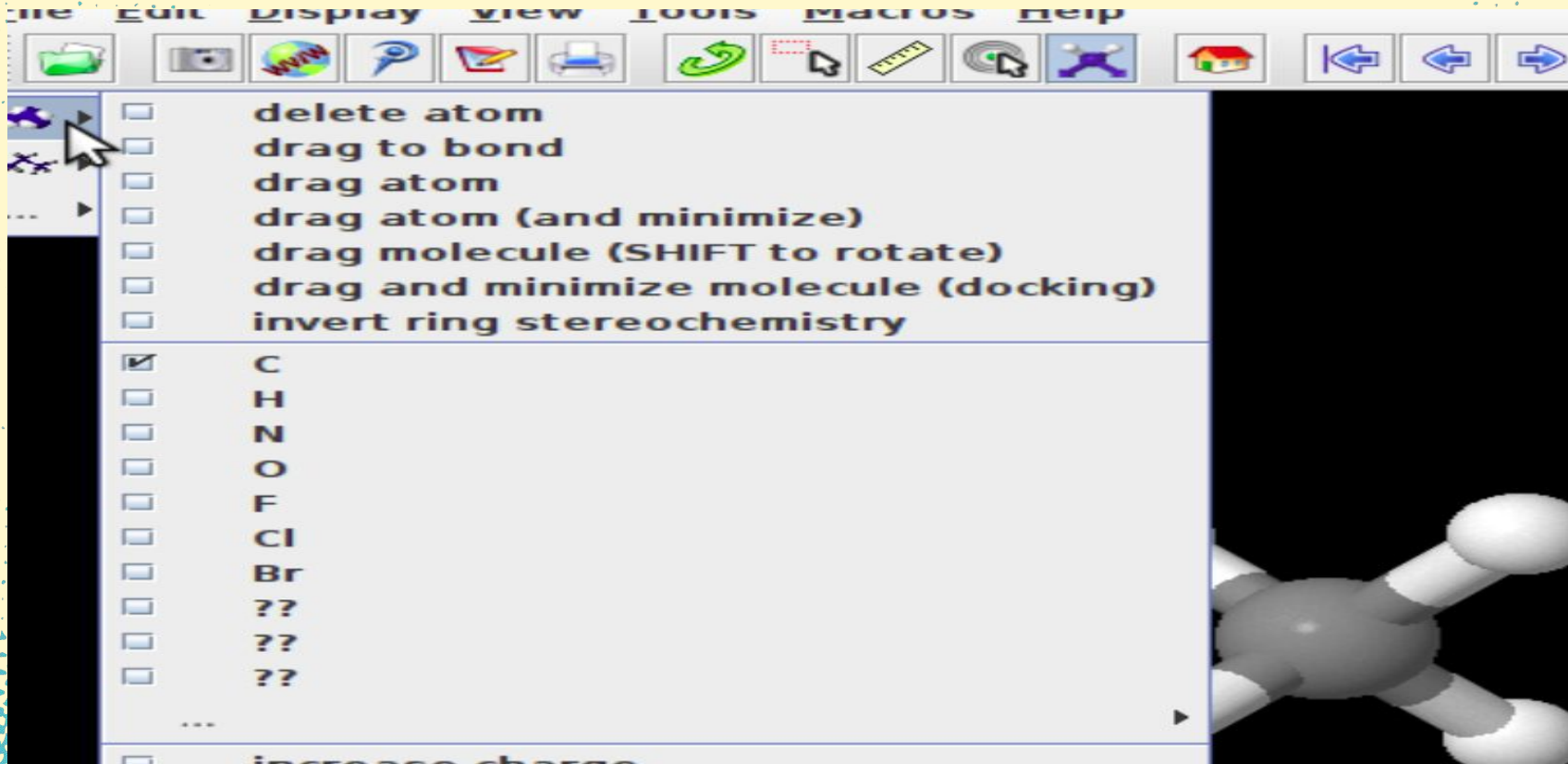


The image shows a screenshot of the Jmol software interface. The window title is "1.1: 1". The menu bar includes "File", "Edit", "Display", "View", "Tools", "Macros", and "Help". The toolbar contains various icons for file operations, viewing, and editing. The main display area shows a ball-and-stick model of a central grey atom bonded to six white atoms in an octahedral arrangement. The status bar at the bottom displays "1.1: 1", "800 x 600", "19.8/224.9 Mb", and "6/4 ms". The Jmol logo is visible in the bottom right corner.

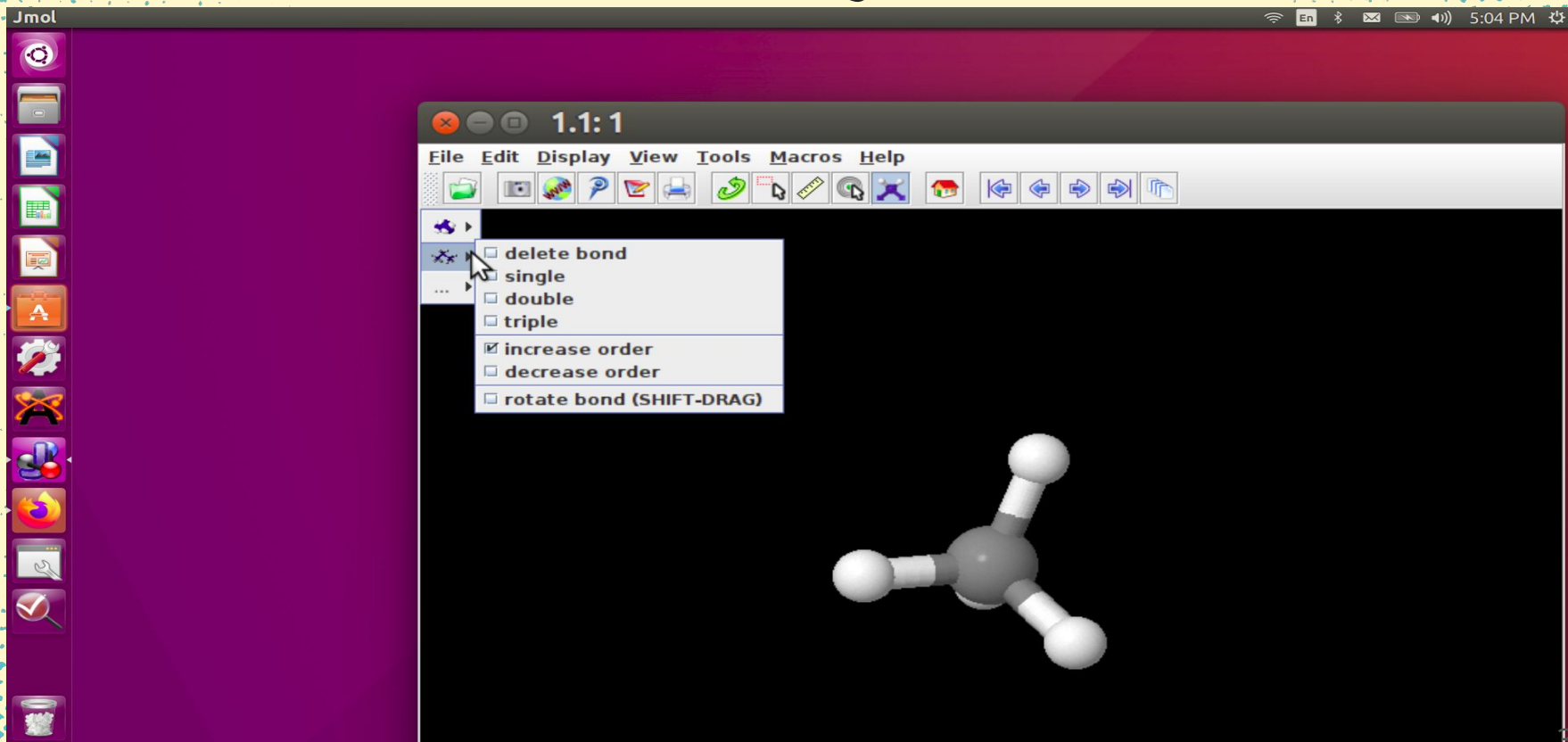


# Tools of Model Kit Menu

## 1. To add/delete atom



# To create Type of bond

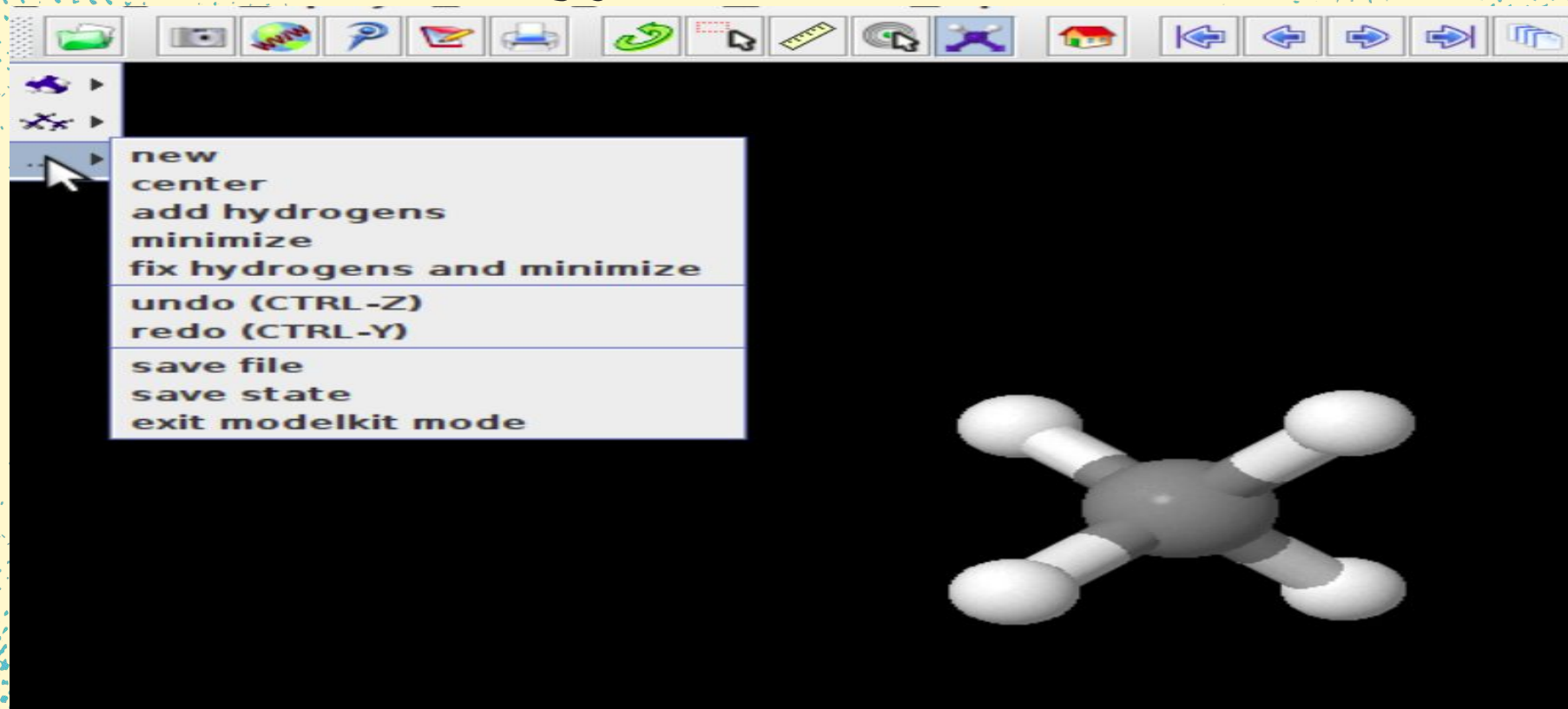


The screenshot displays the Jmol software interface. The main window has a title bar with "Jmol" on the left and system icons on the right, including a Wi-Fi icon, "En", a Bluetooth icon, a mail icon, a volume icon, and the time "5:04 PM". The main window contains a toolbar with various icons for file operations, viewing, and editing. A context menu is open over a bond in a 3D ball-and-stick model of a molecule. The menu options are:

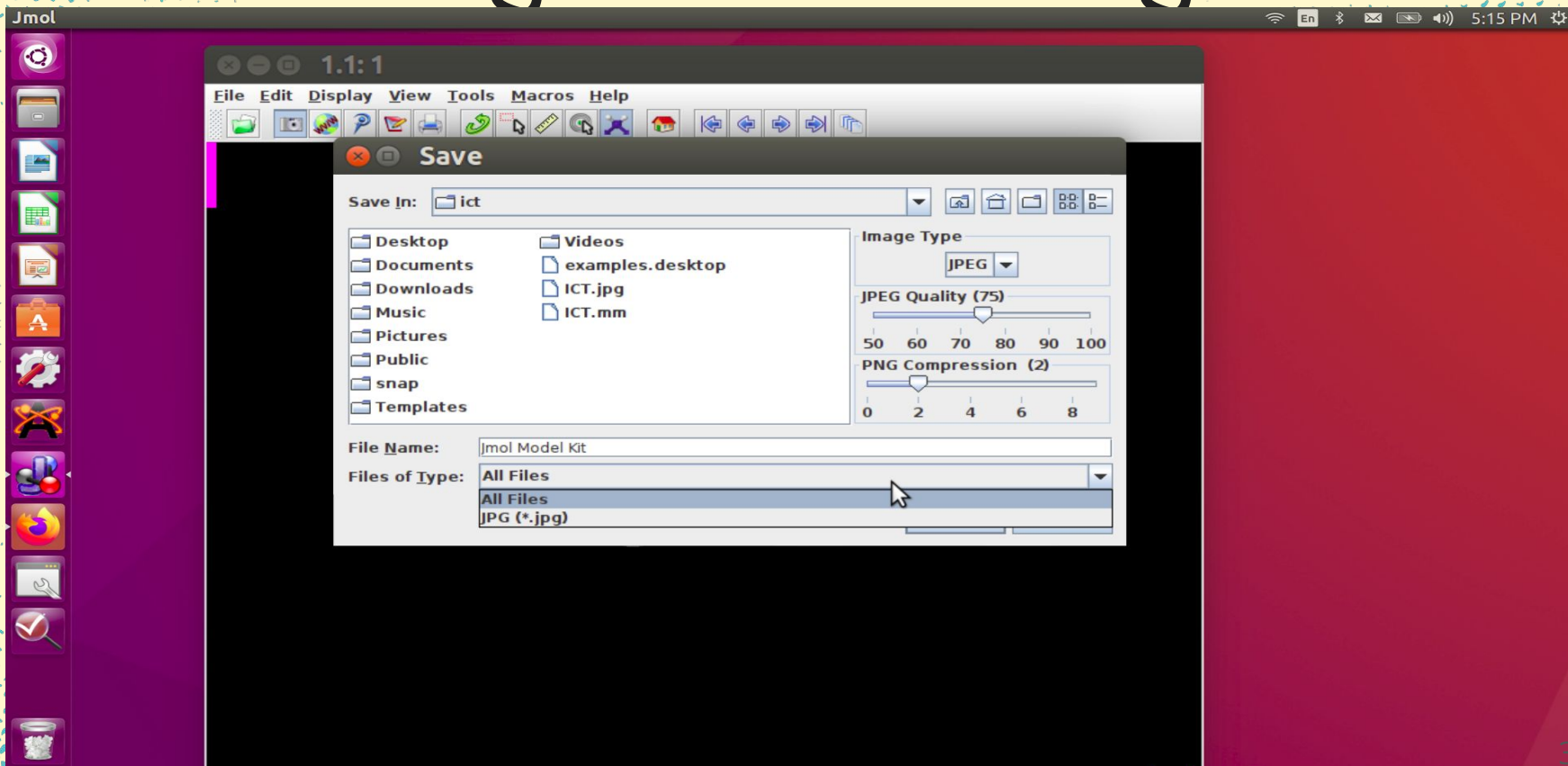
- delete bond
- single
- double
- triple
- increase order
- decrease order
- rotate bond (SHIFT-DRAG)

The 3D model shows a central grey atom bonded to three white atoms, with one bond highlighted in white. The background of the Jmol window is black.

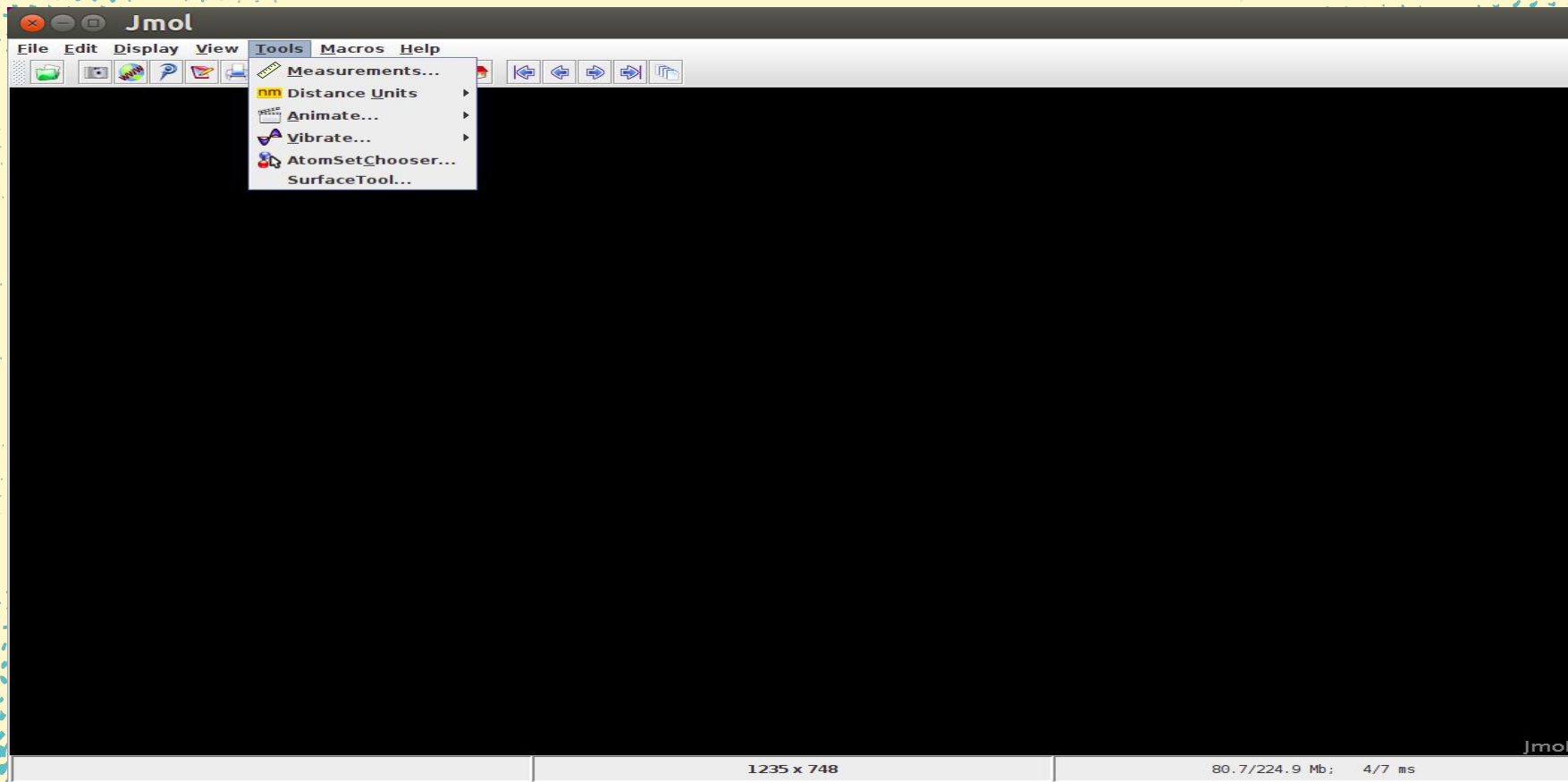
# For energy minimisation and exit



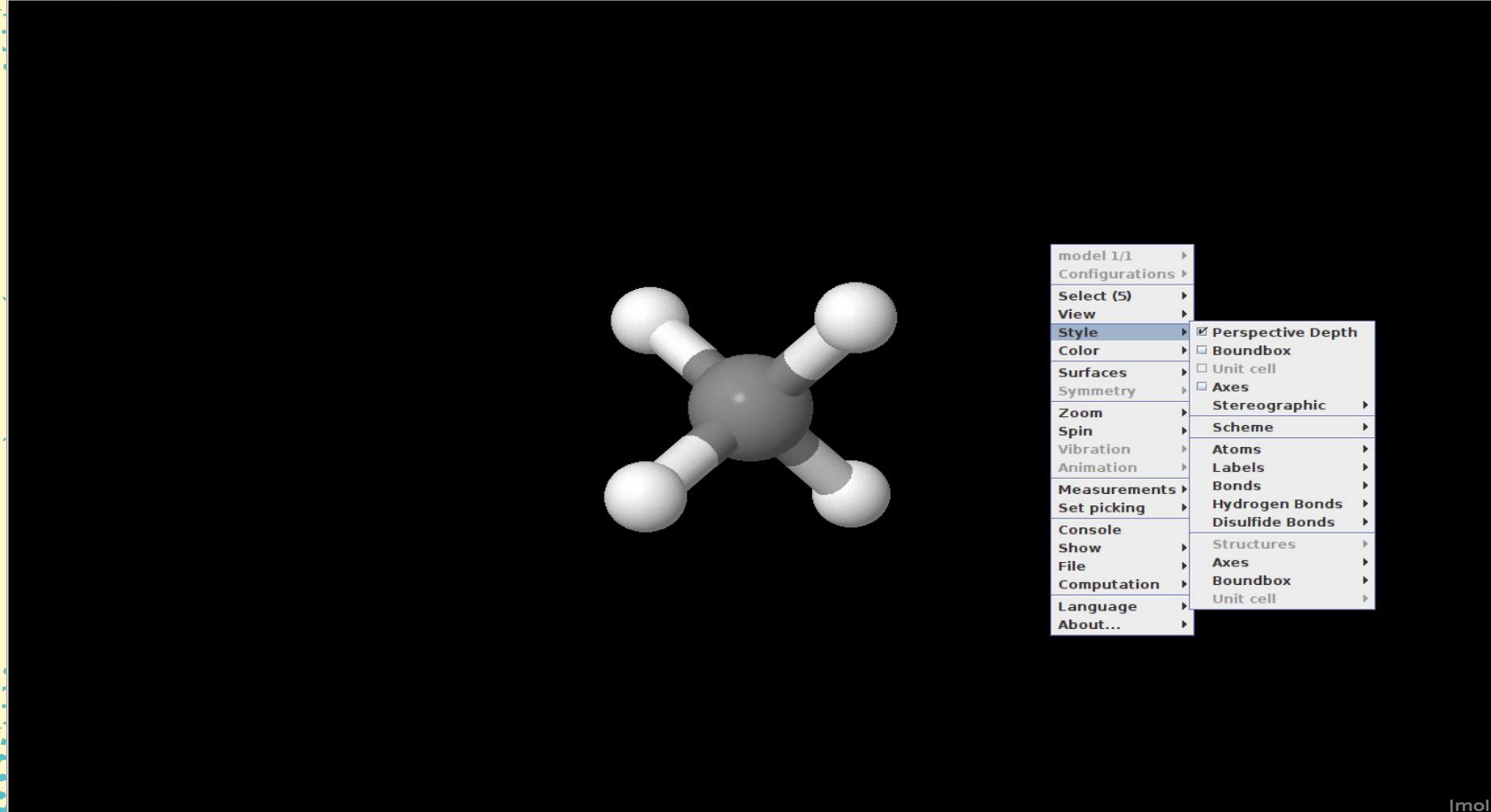
# Saving the file as Image



# To measure distance and bonds



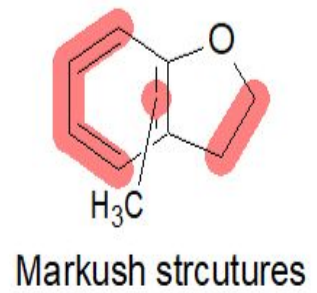
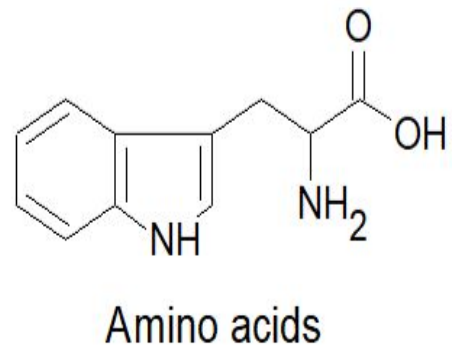
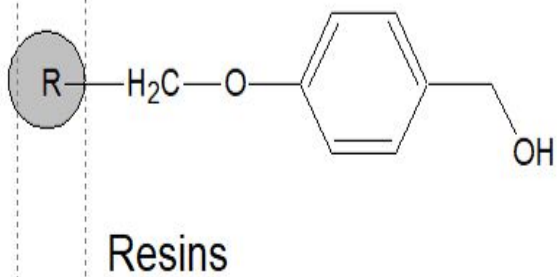
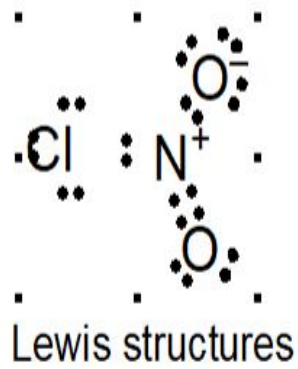
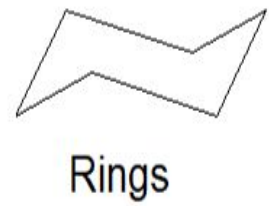
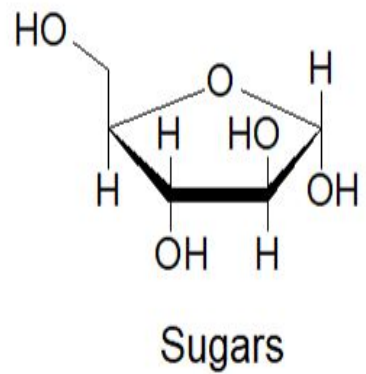
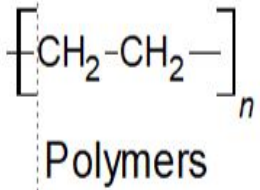
The image shows a screenshot of the Jmol software interface. The window title is "Jmol". The menu bar includes "File", "Edit", "Display", "View", "Tools", "Macros", and "Help". The "Tools" menu is open, showing options: "Measurements...", "nm Distance Units", "Animate...", "Vibrate...", "AtomSetChooser...", and "SurfaceTool...". The "nm Distance Units" option is highlighted. Below the menu bar is a toolbar with various icons, including a ruler and navigation arrows. The main area of the window is black. At the bottom of the window, there is a status bar with the text "1235 x 748", "80.7/224.9 Mb;", and "4/7 ms". The Jmol logo and the number "37" are visible in the bottom right corner.



- model 1/1 >
- Configurations >
- Select (5) >
- View >
- Style** >  Perspective Depth
- Color >  Boundbox
- Surfaces >  Unit cell
- Symmetry >  Axes
- Zoom > Stereographic >
- Spin > Scheme >
- Vibration > Atoms >
- Animation > Labels >
- Measurements > Bonds >
- Set picking > Hydrogen Bonds >
- Console > Disulfide Bonds >
- Show > Structures >
- File > Axes >
- Computation > Boundbox >
- Language > Unit cell >
- About... >

# Chemsketch

- ACD/ChemSketch is a molecular structure drawing application
- Generate IUPAC names for small molecules
- Draw molecular structures such as organic molecules, organometallics, biomolecules, polymers, 2D and 3D structure representations, delocalized Markush structures, peptide sequences
- Edit structures to customize the chemical bond type, stereo configuration, atom type and charge, radical label, atom numbering, and more
- Easily draw reactions and complex chemical schema
- Insert pre-drawn templates of amino acids, aromatics, carbohydrates, steroids, sugars, and more
- Use graphical templates to insert objects including molecular orbitals, Lewis structures, Newman projections, laboratory equipment, and more
- Produce an optimized 3D model of your 2D structure





# How you can integrate these tools in your teaching

- Creating e- content and adding in your video lessons
- Creating molecules and uploading it your own webpage
- Creating your own etext for chemistry
- Demonstrating the already created e- content in your classroom
- Giving the self assessment activities to students through PhET simulations
- Let students build their own molecules and explore
- Let them explore the properties of elements through Kalzium and ptable
- Let them create the simple activities like arvind gupta toys
- Let them make stories by using scratch as 2D animation
- Giving individual and group work to students
- Let the students try the simulations and games of chemistry of their own

# Thanks

Slides templates by Slidesgo

<https://www.mooc4dev.org/TCT>