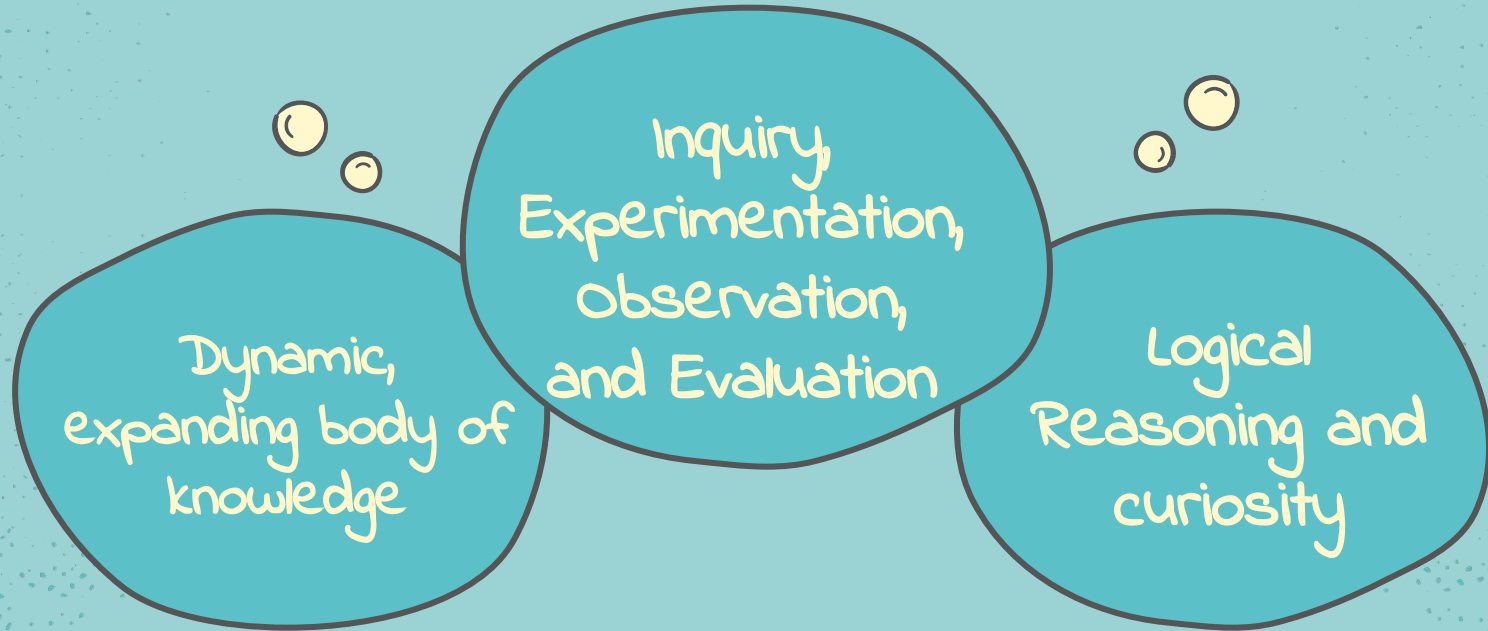


# Developing e-content for Teaching and Learning of Chemistry

**Dr. Deepty Gupta**  
**Inter University Centre for Teacher Education**  
**(IUCTE), Varanasi**



# what is science all about



# 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, quick, and intuitive
- 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, Immersive virtual reality , Online tutorials, Simulations for better understanding

# What Type of e-content in Chemistry

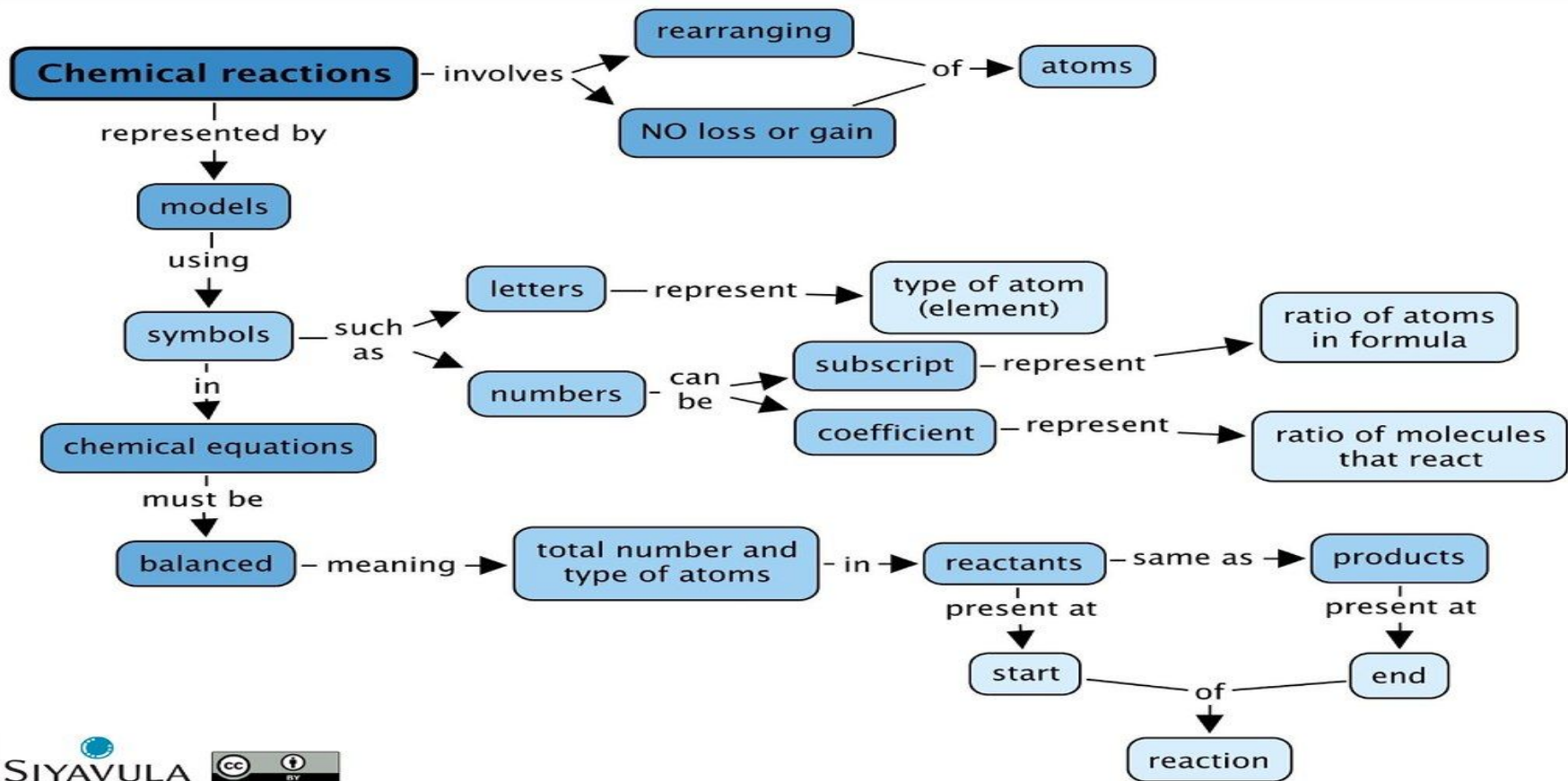
- Simulations
- Animations
- Mind Maps
- Infographics
- Interactives
- Video
- Audio
- Immersive Content (AR/VR)
- Textual
- Stop Motion Video

# 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





Search or enter QR code

Search

English

G



## Science Textbook for( Class X )

State (Himachal Pradesh) • English • Class 10

Share

Chemical Reactions Part - I

Watch later Share

1:01 / 18:56

YouTube

### Chemical Reactions Part - I

• 4 ★



Share



Fullscreen

All

Video

Interactive

Docs

### 3 - Metals and non-metals

Video

Properties and Application of metals

Interactive Resources

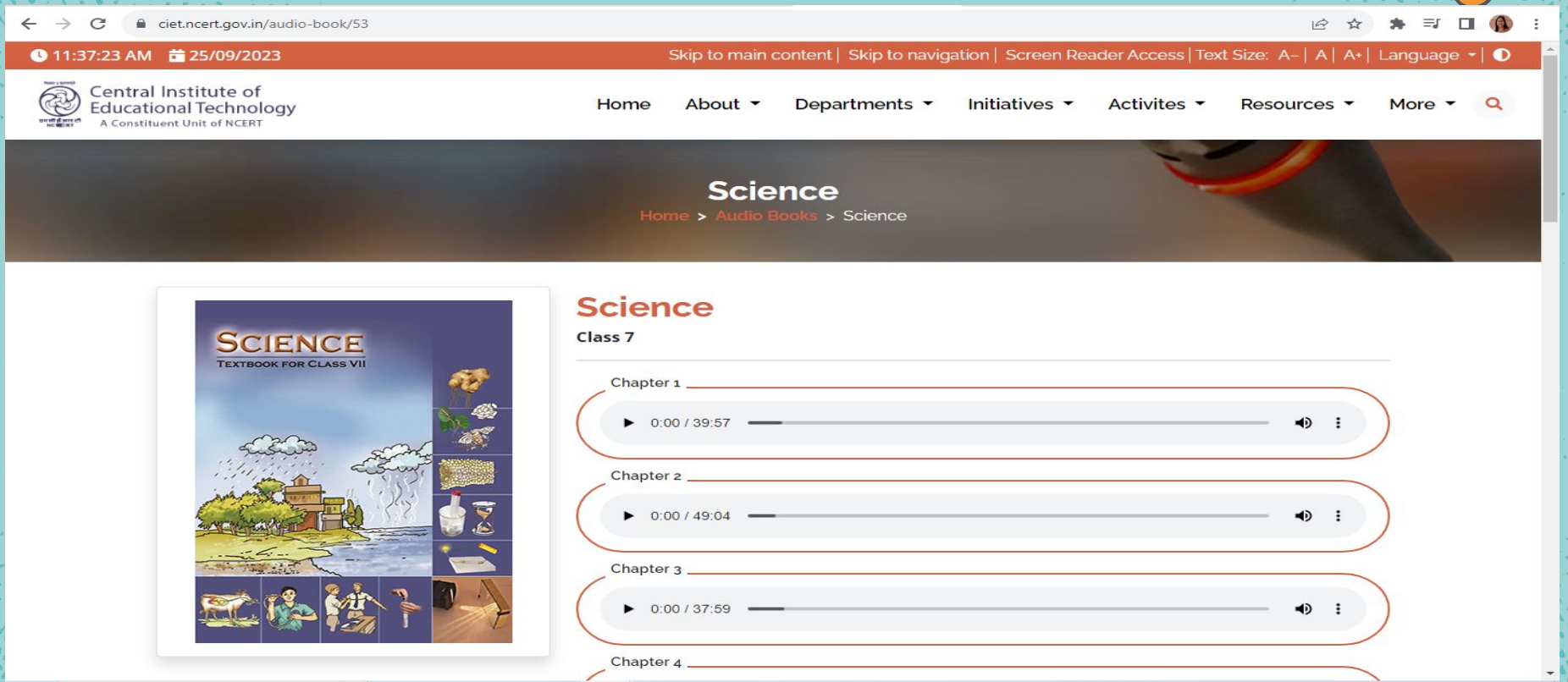
Quiz: Properties of metals & non-metals

Quiz: Reactivity & extraction of metals

Credits and Licence information



# AUDIO BOOKS



The screenshot shows a web browser displaying the Central Institute of Educational Technology (CIET) website. The page is titled "Science" and is for "Class 7". It features a navigation menu with options like Home, About, Departments, Initiatives, Activities, Resources, and More. The main content area displays the cover of the "SCIENCE TEXTBOOK FOR CLASS VII" and a list of audio books for Chapters 1, 2, 3, and 4. Each chapter has a play button, a progress bar, and a duration. The duration for Chapter 1 is 0:00 / 39:57, for Chapter 2 is 0:00 / 49:04, and for Chapter 3 is 0:00 / 37:59. Chapter 4 is partially visible.

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 Activities 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!"

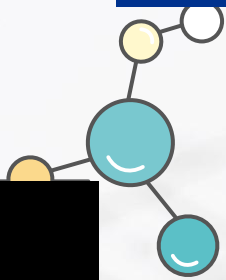


The image shows a grid of 20 small images representing different toys made from trash. Each image is accompanied by a caption. The captions are: Glean in the Eye, Air and water, Amazing Astronomy, Beginner's Biology, Electricity and Magnetism, Flying Toys, Force Fun, Fun with Light, Fun with Pressure, Magic Miscellany, Math Magic, Motor and Generator, Newton Unplugged, Paper Fun, Pumps from the Dump, Simple Sounds, Spinning Toys, and String Games.

					
Glean 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

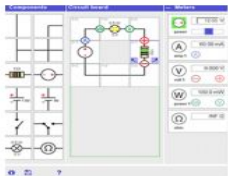


<https://phet.colorado.edu/sims/html/build-an-atom/latest/build-an-atom-en.html>

# Go-Lab

golabz.eu

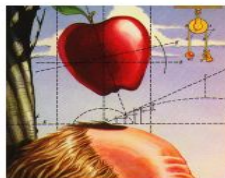
## LAB



### 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

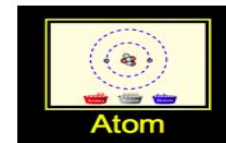
## APP



### 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!

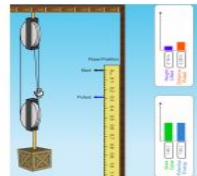
## LAB



### Rate Of Photosynthesis Lab (Html5)

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

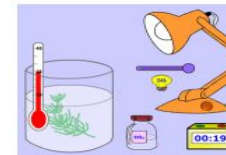
## LAB



### Pulley Simulation

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

## LAB



### Photolab

There is an updated version of this lab.



NOVA



The Concord  
Consortium

Concord

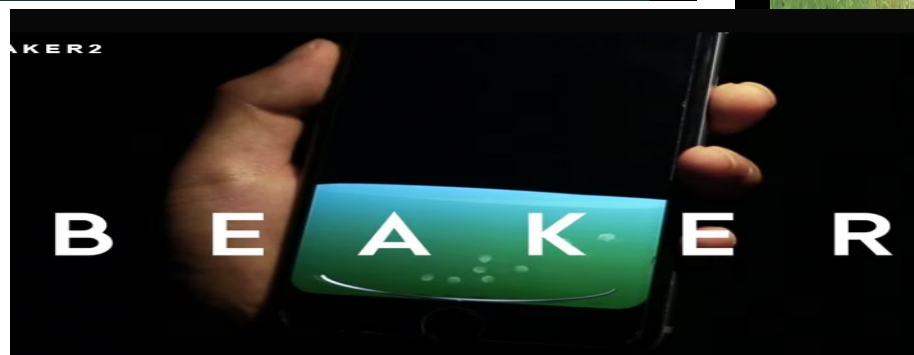
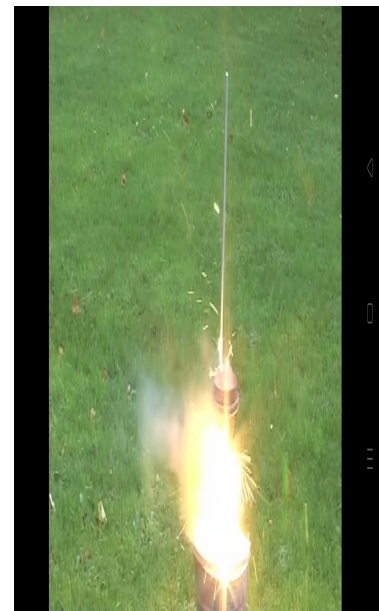
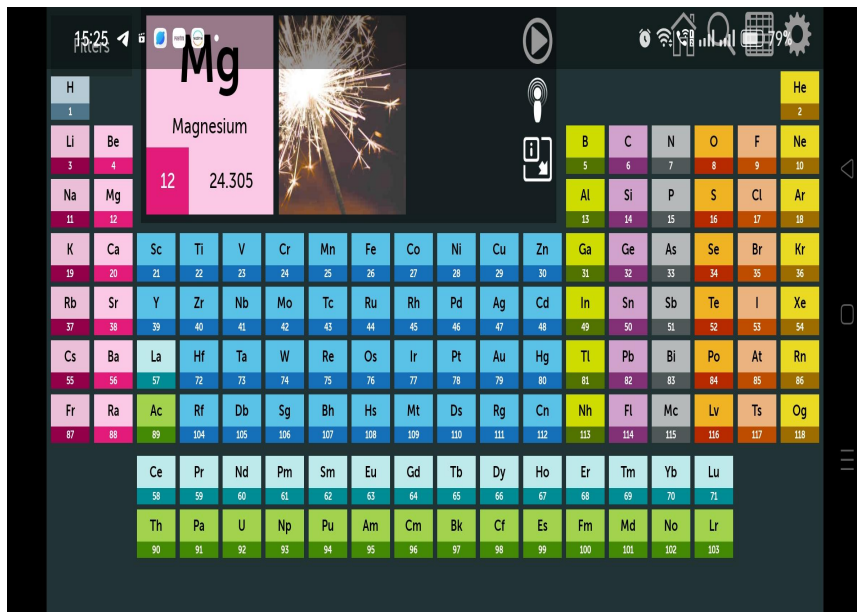


Chem Collective



# MOBILE APPS FOR CHEMISTRY

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



PM eVIDYA AR

Mobile App

Classes 9 and 10



PM e-Vidya AR

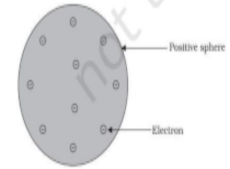


Fig.4.1: Thomson's model of an atom

Page No - 47

Class - 09

Science

Chapter 1 - M...

Fig 4.1 : Thoms...

Load Activity

# CHEMISTRY SOFTWARES



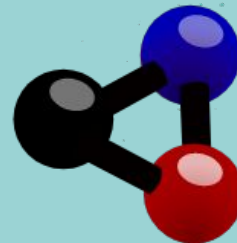
AVOGADRO

<https://avogadro.cc/>



JMOL

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



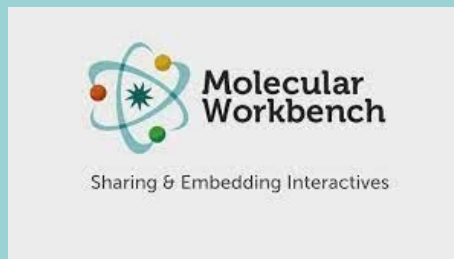
KALZIUM

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



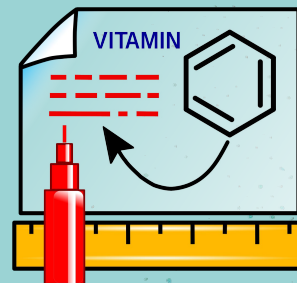
Ptable

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



Molecular workbench

[http://mw.concord.org/mo-  
deler/index.html](http://mw.concord.org/mo-<br/>deler/index.html)



Chemsketch

[https://www.acdlabs.com/p-  
roducts/chemsketch/](https://www.acdlabs.com/p-<br/>roducts/chemsketch/)

# KALZIUM



The screenshot displays the ChemTUBE 3D software interface. The main window shows a periodic table with elements color-coded by block: s-block (purple), d-block (yellow), p-block (green), and f-block (red). A detailed view of Gold (Au) is shown on the left, with its atomic number 79 and symbol Au. The interface includes a menu bar (File, View, Tools, Settings, Help), a toolbar with icons for 'Classic Periodic Table', 'Scheme', 'Graphics', 'Escape Table', 'Molecular Editor', and 'Perform Calculations', and a search bar. A legend at the bottom identifies the color-coded blocks: s-Block (purple), d-Block (yellow), p-Block (green), and f-Block (red). The status bar at the bottom right shows 'Gold [79], Mass: 196.966569u'.

# ChemTube3D



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

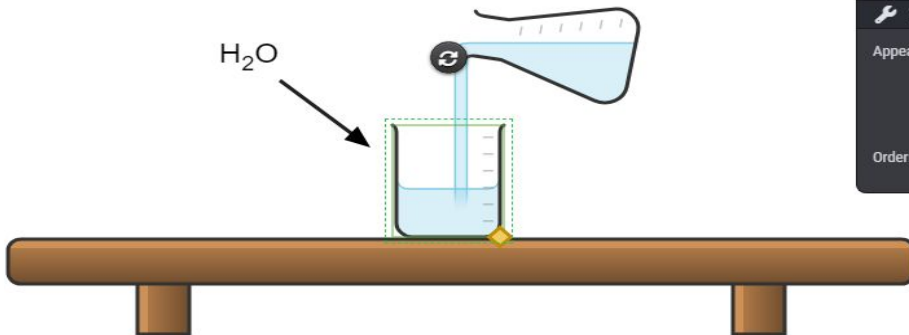


Search apparatus

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

25% 50% 100% 200% 300%

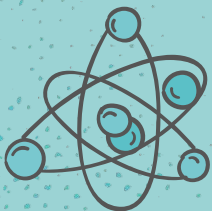


CHEMIX

# 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**

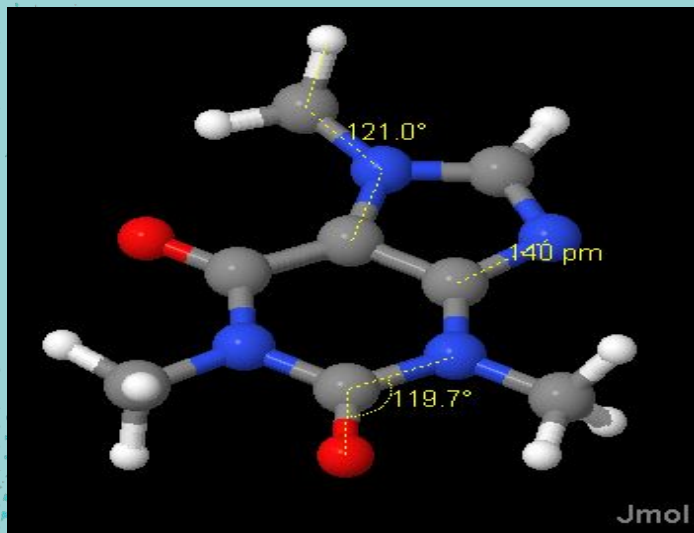
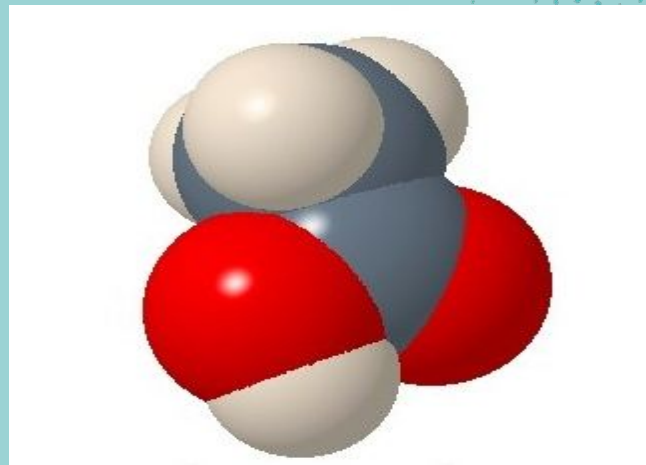
# FOUR WAYS OF VISUALISING MODEL

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



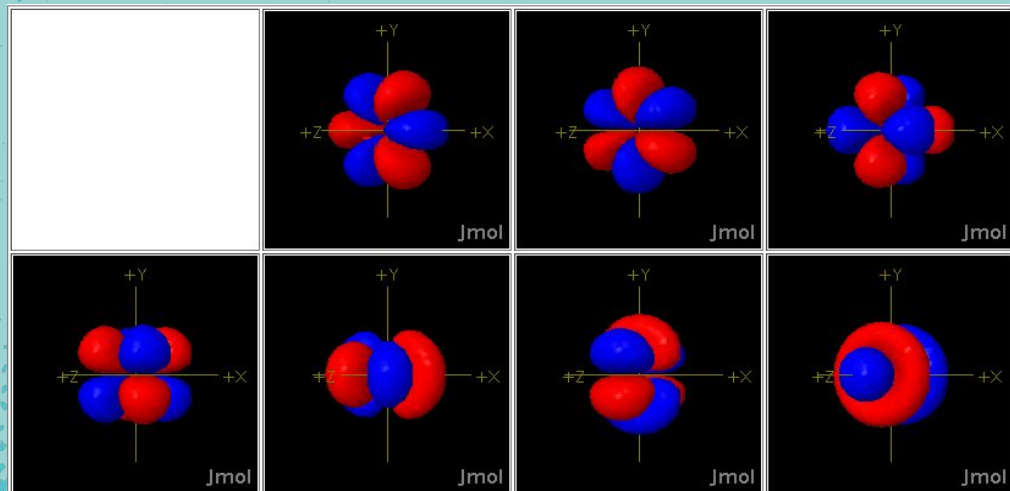
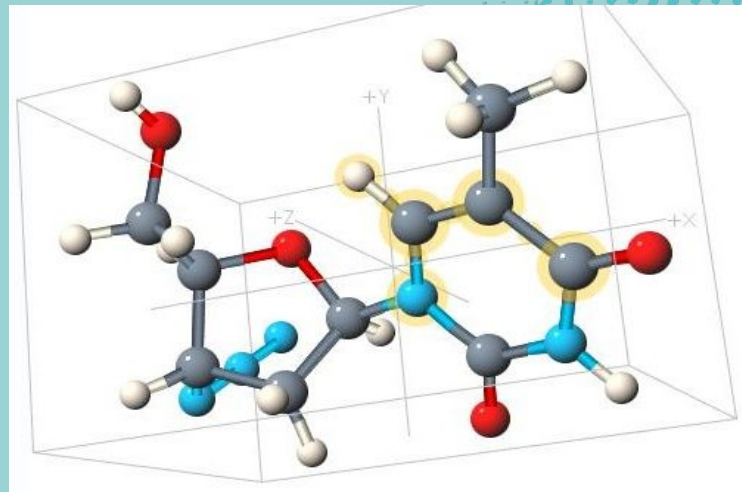
# DIFFERENT VIEW OF STRUCTURES

## SPACE FILLED ATOMS



## DISTANCE AND ANGLE MEASUREMENTS

# Display of bounding box and Axes of coordinates space



The 4f-orbitals

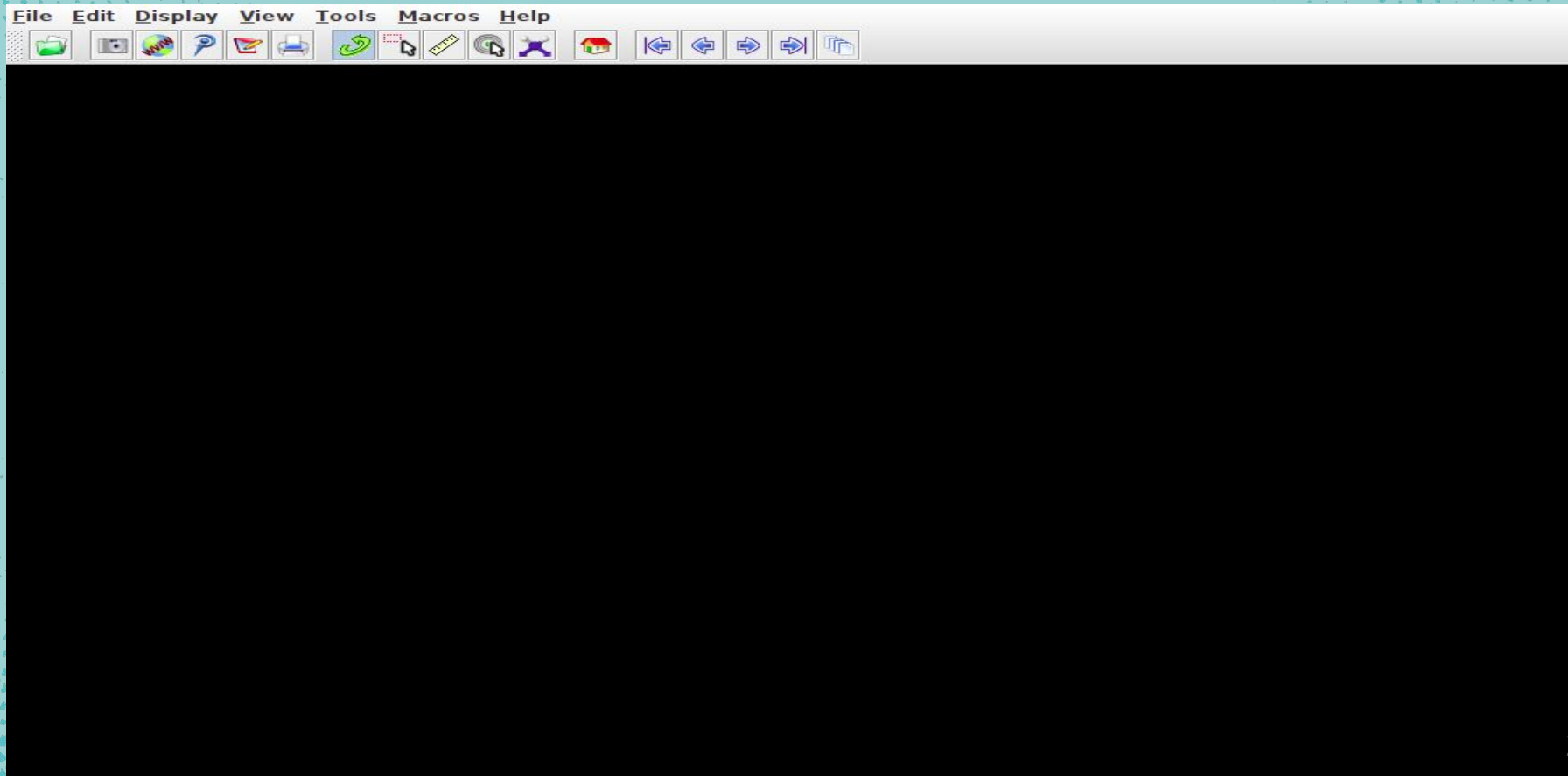
# POINTS TO DISCUSS

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

File Edit Display View Tools Macros Help

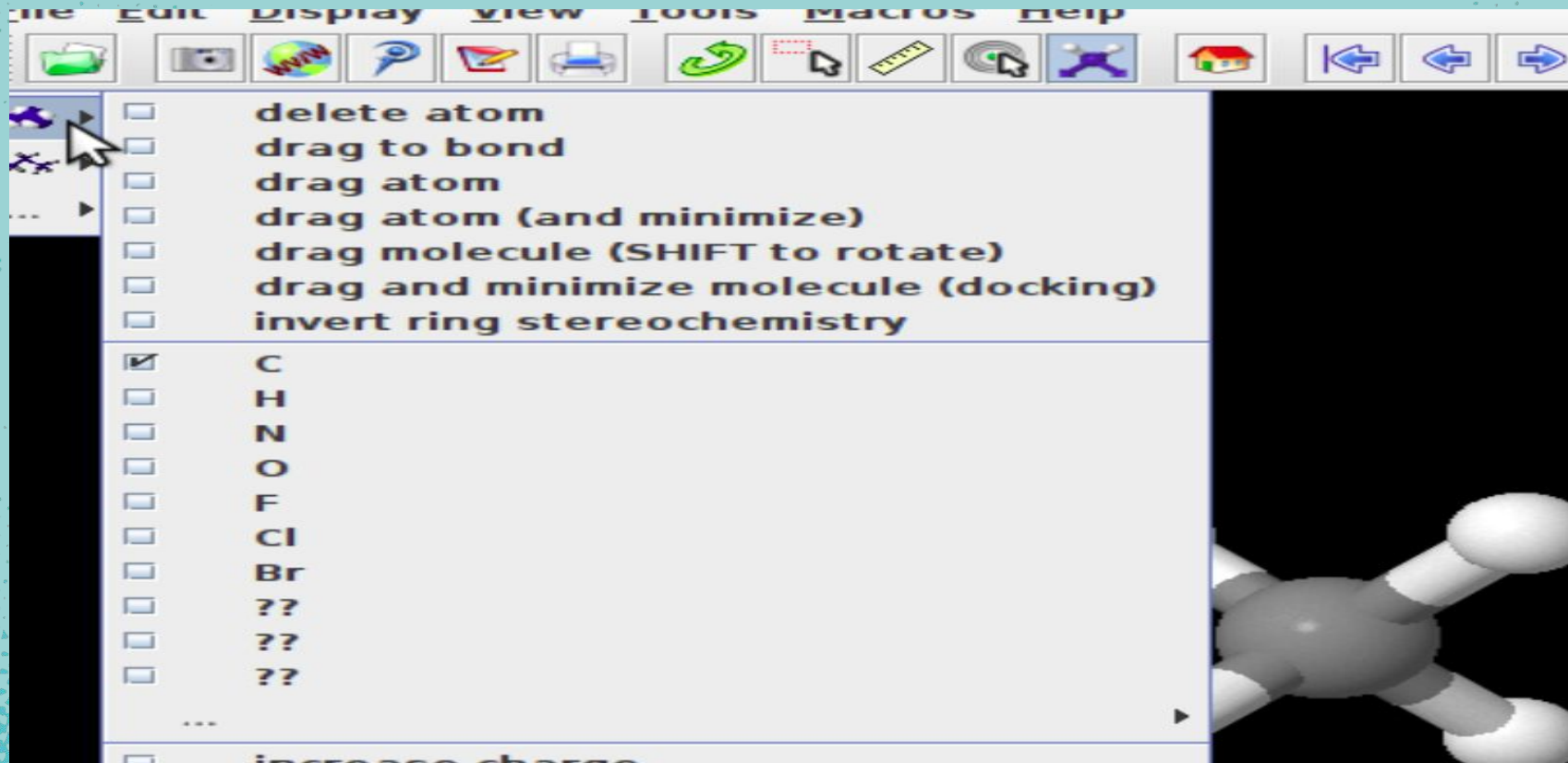


# Use of Model Kit Icon to Create Structures

The image shows a screenshot of a Jmol application window. The window title bar displays "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 is black and 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 shows "1.1: 1", "800 x 600", "19.8/224.9 Mb:", and "6/4 ms". The word "Jmol" is visible in the bottom right corner of the window.

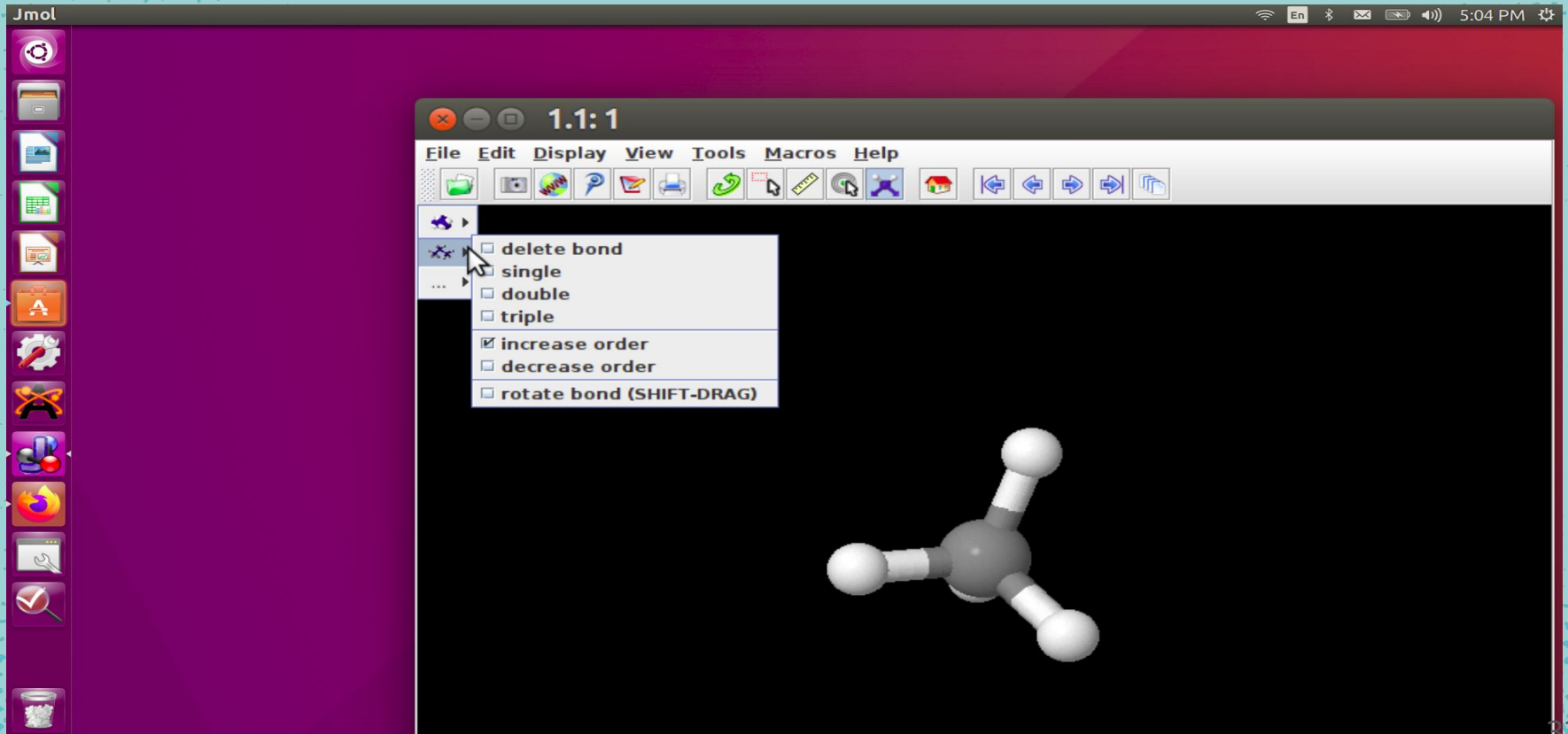
# Tools of Model Kit Menu

## 1. To add/delete atom





# To create Type of bond

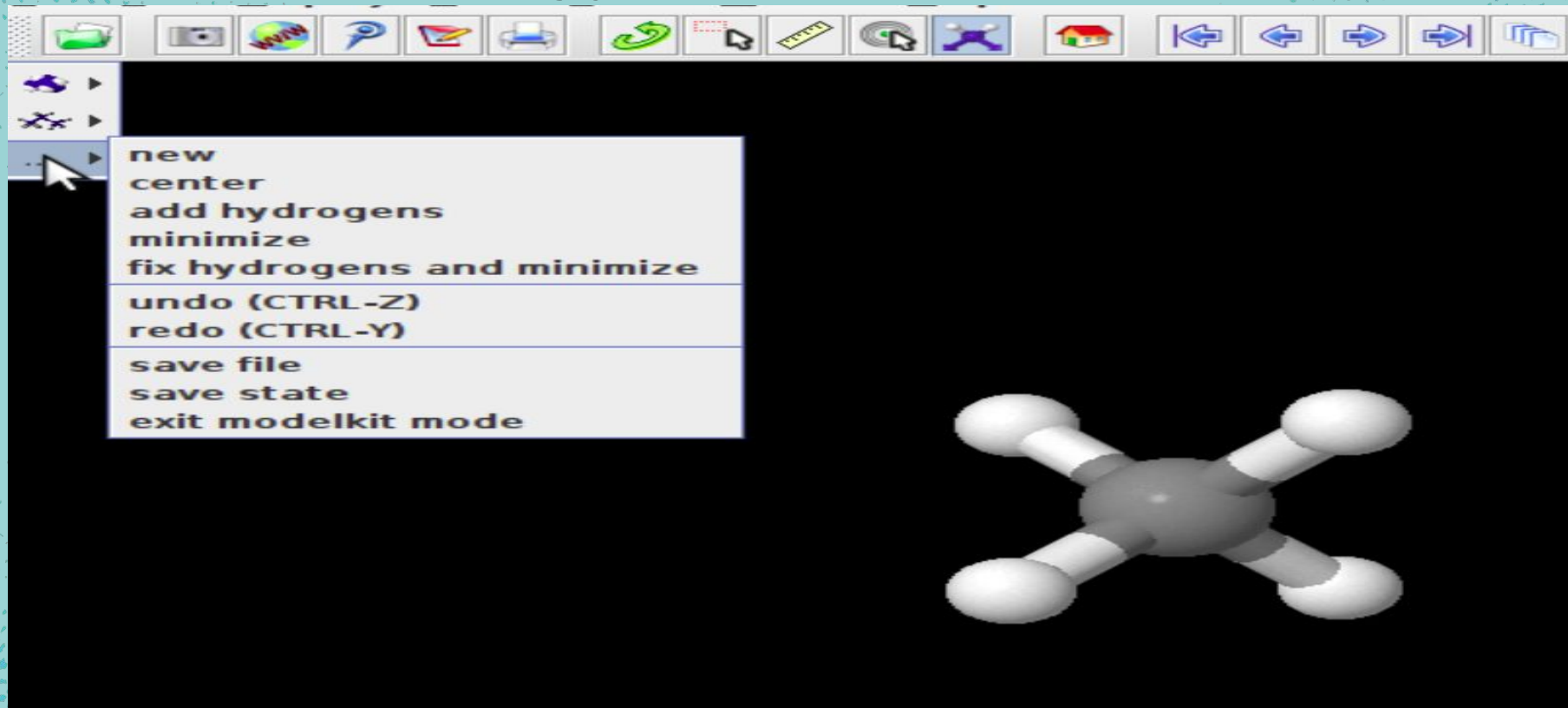


The screenshot displays the Jmol software interface. The main window has a title bar with "Jmol" on the left and system icons (Wi-Fi, En, Bluetooth, Mail, Network, Speaker, 5:04 PM) on the right. A vertical toolbar on the left contains various icons for file operations, display, and editing. The main window contains a smaller window titled "1:1:1" with a menu bar: "File Edit Display View Tools Macros Help". Below the menu bar is a toolbar with icons for file operations, display, and editing. A context menu is open over a bond in a ball-and-stick model of a molecule (CH<sub>3</sub>OH). The menu options are:

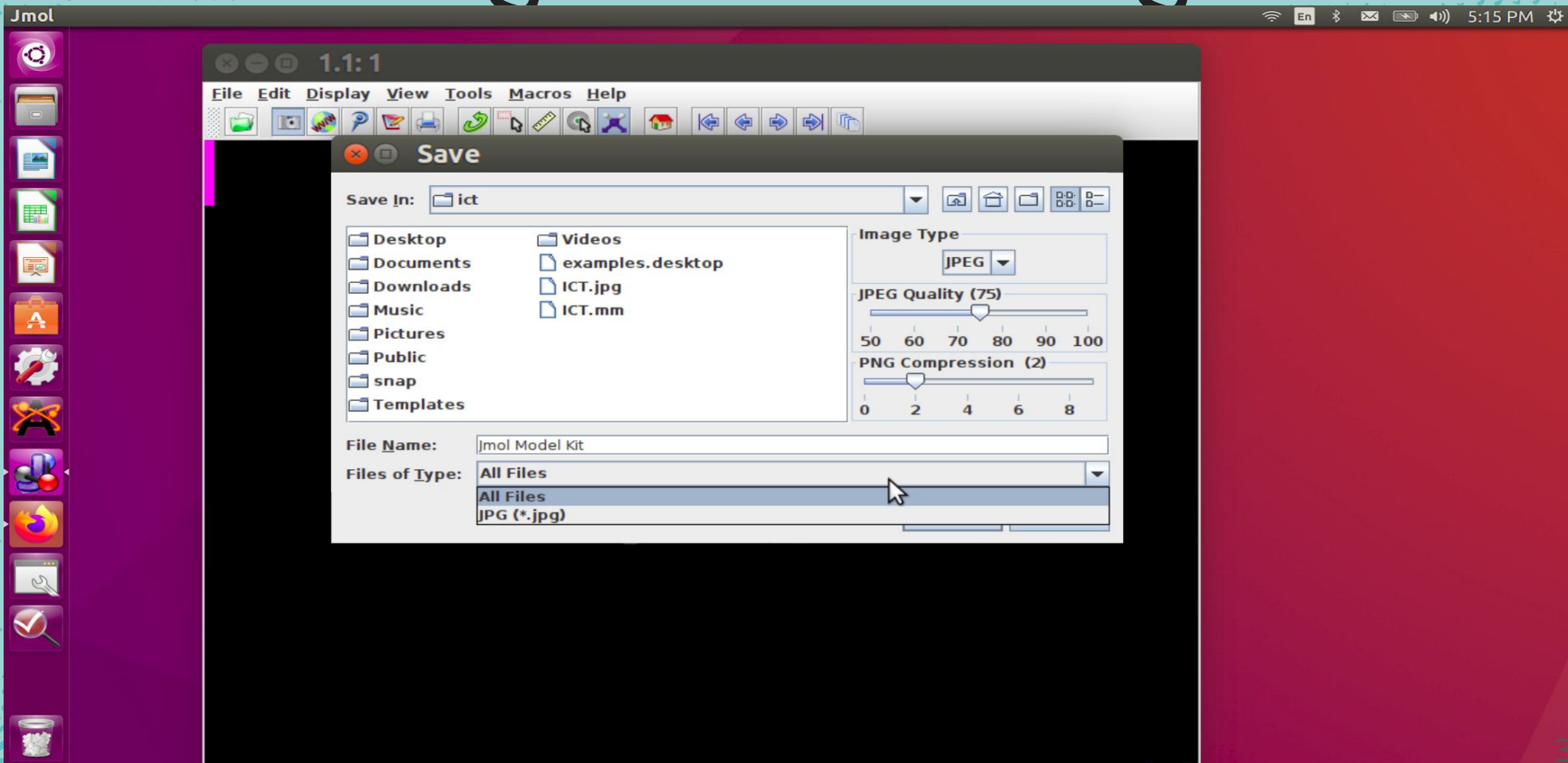
- delete bond
- single
- double
- triple
- increase order
- decrease order
- rotate bond (SHIFT-DRAG)

The ball-and-stick model shows a central grey carbon atom bonded to three white hydrogen atoms and one red oxygen atom. The oxygen atom is also bonded to a white hydrogen atom.

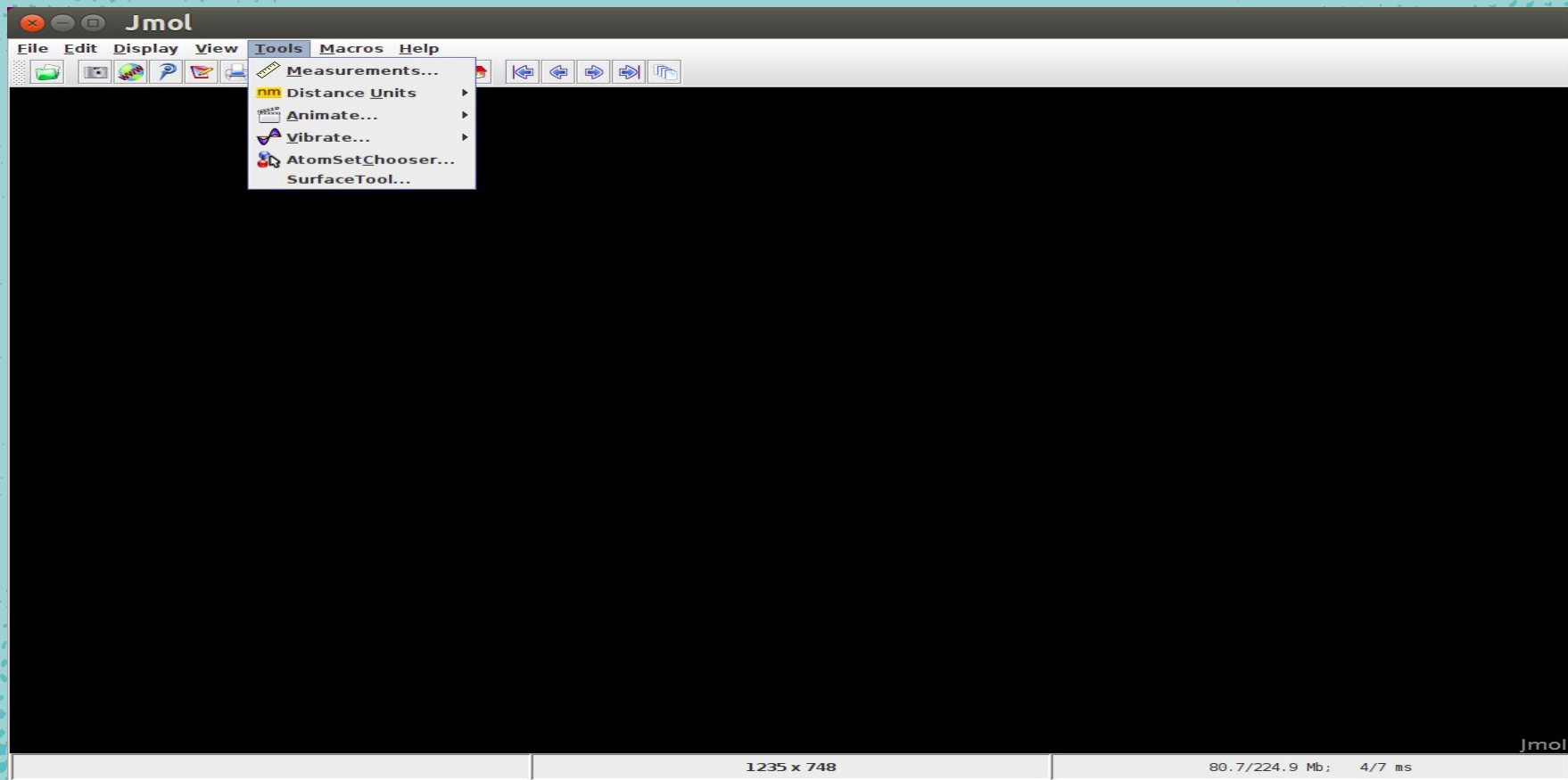
# For energy minimisation and exit



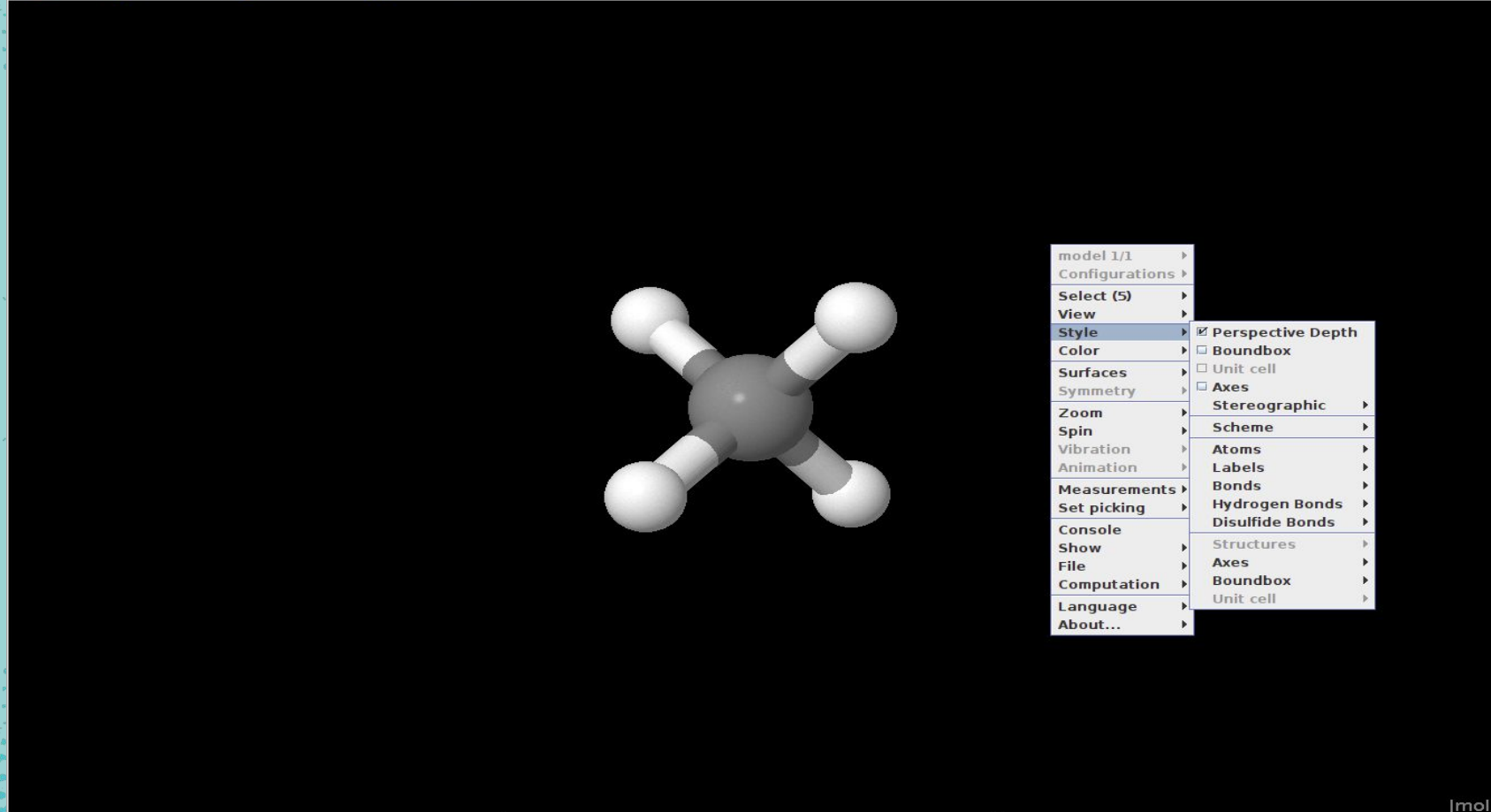
# Saving the file as Image



# 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...", "Distance Units", "Animate...", "Vibrate...", "AtomSet Chooser...", and "SurfaceTool...". The "Distance Units" option is highlighted with a yellow background. Below the menu bar is a toolbar with various icons, including a ruler and 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 word "Jmol" is visible in the bottom right corner of the status bar.



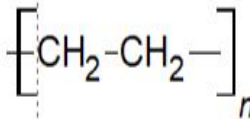
- model 1/1 >
  - Configurations >
  - Select (5) >
  - View >
  - Style** >
  - Color >
  - Surfaces >
  - Symmetry >
  - Zoom >
  - Spin >
  - Vibration >
  - Animation >
  - Measurements >
  - Set picking >
  - Console >
  - Show >
  - File >
  - Computation >
  - Language >
  - About... >
- Perspective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

# Chemsketch

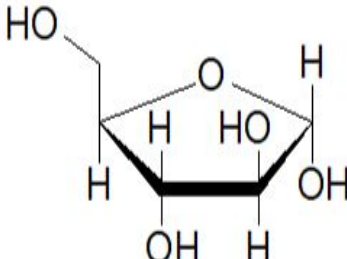
- ACD/ChemSketch is a molecular structure drawing application
- Generate IUPAC names for small molecules
- Draw molecular structures such as organic molecules, organometallics, biomolecules, polymers, 2D and 3D structure representations, delocalized Markush structures, peptide sequences
- Edit structures 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

Structure Draw 147%


mm 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210



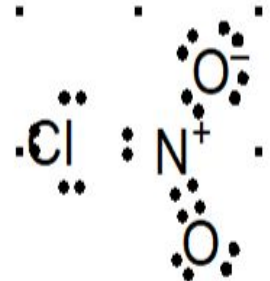
Polymers



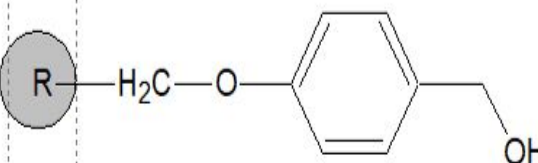
Sugars



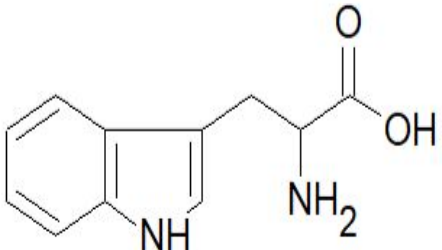
Rings



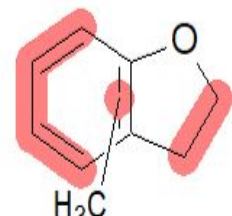
Lewis structures



Resins



Amino acids



Markush structures

9

# 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