Chapter 2: Atoms, Ions, and the Periodic Table

August 29, 2022

Chemistry Department, Cypress College

Lecture and Lab Weekly Agenda

Lab Section

- Lab lockers and safety quiz
- Start Exp 1 - Laboratory Techniques
- Using Bunsen burners

Lecture Section

- Finished Ch 1 - pg 1 – 55
- Go over Ch 2 - pg 56 – 88
- In-class Ch 2 worksheet

Bunsen Burner

- Each student will practice lighting a bunsen burner under supervision
- Safety goggles are available (free)
- Review proper use of bunsen burner - read the lab manual

Corrections to Lecture 3

- There is conservation of energy
- Amount of energy to do work is not 100%
- Scientific notation:

$$1.0 \times 10^{-2}\text{g} - 1.2 \times 10^{-3}\text{g} \tag{1}$$

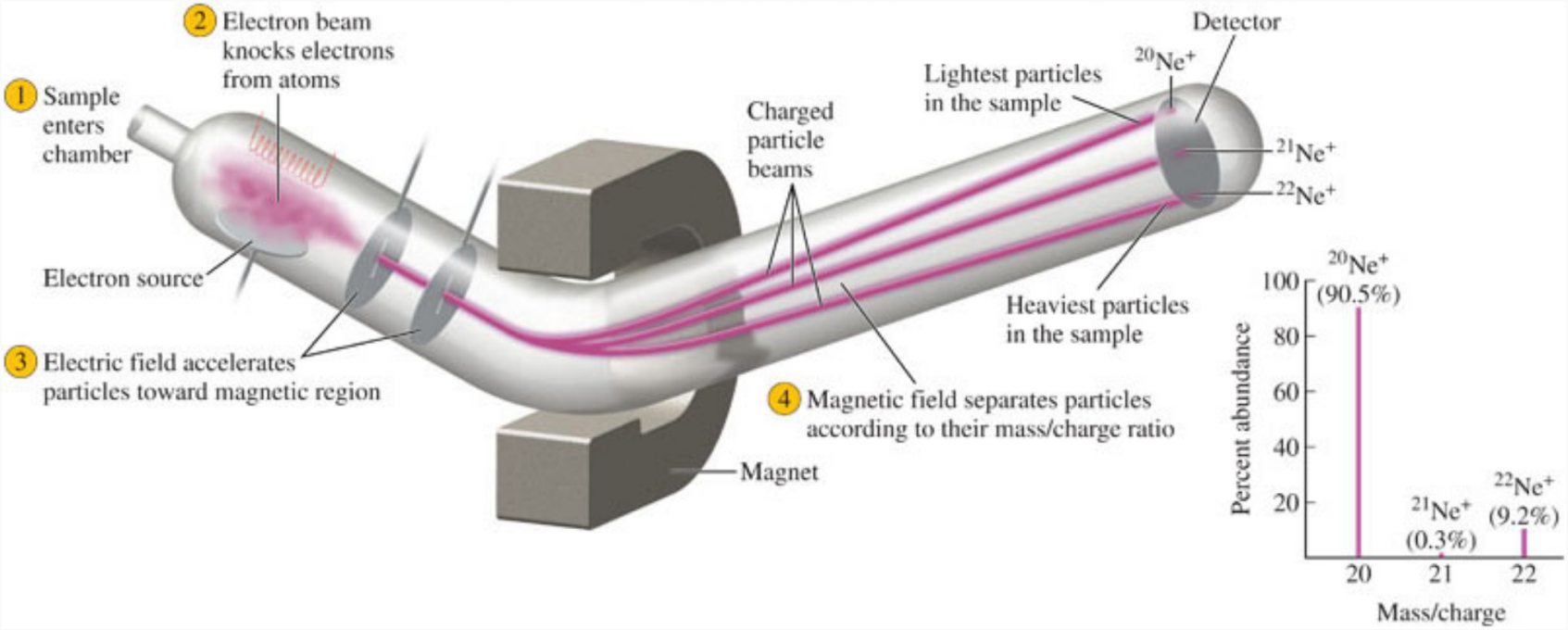
- Quiz - typos and mistakes on the quiz

Outline

Review: Relative Atomic Mass

Periodic Table - Grouped Elements

Experiment: Mass Spectroscopy



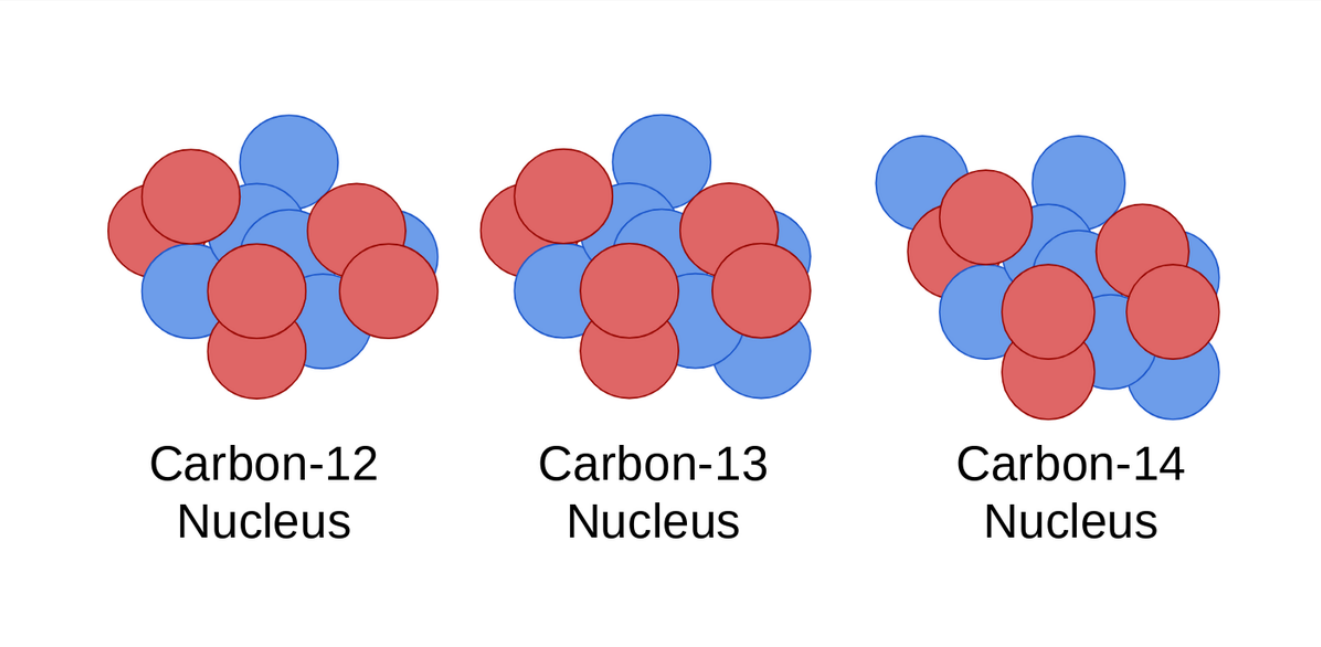
- Ionizes the atom and electric field accelerates atoms
- Time of flight - heavier atoms will travel slower than lighter ones
- Weighted average of atomic masses

Relative Atomic Mass

$$\text{Relative Atomic Mass} = (I_1 \times A_1) + (I_2 \times A_2) + \ldots \qquad (2)$$

where I is the mass of the isotope, and A is the relative abundance between 0 and 1

Carbon Isotopes



where red is the proton and blue is the neutron

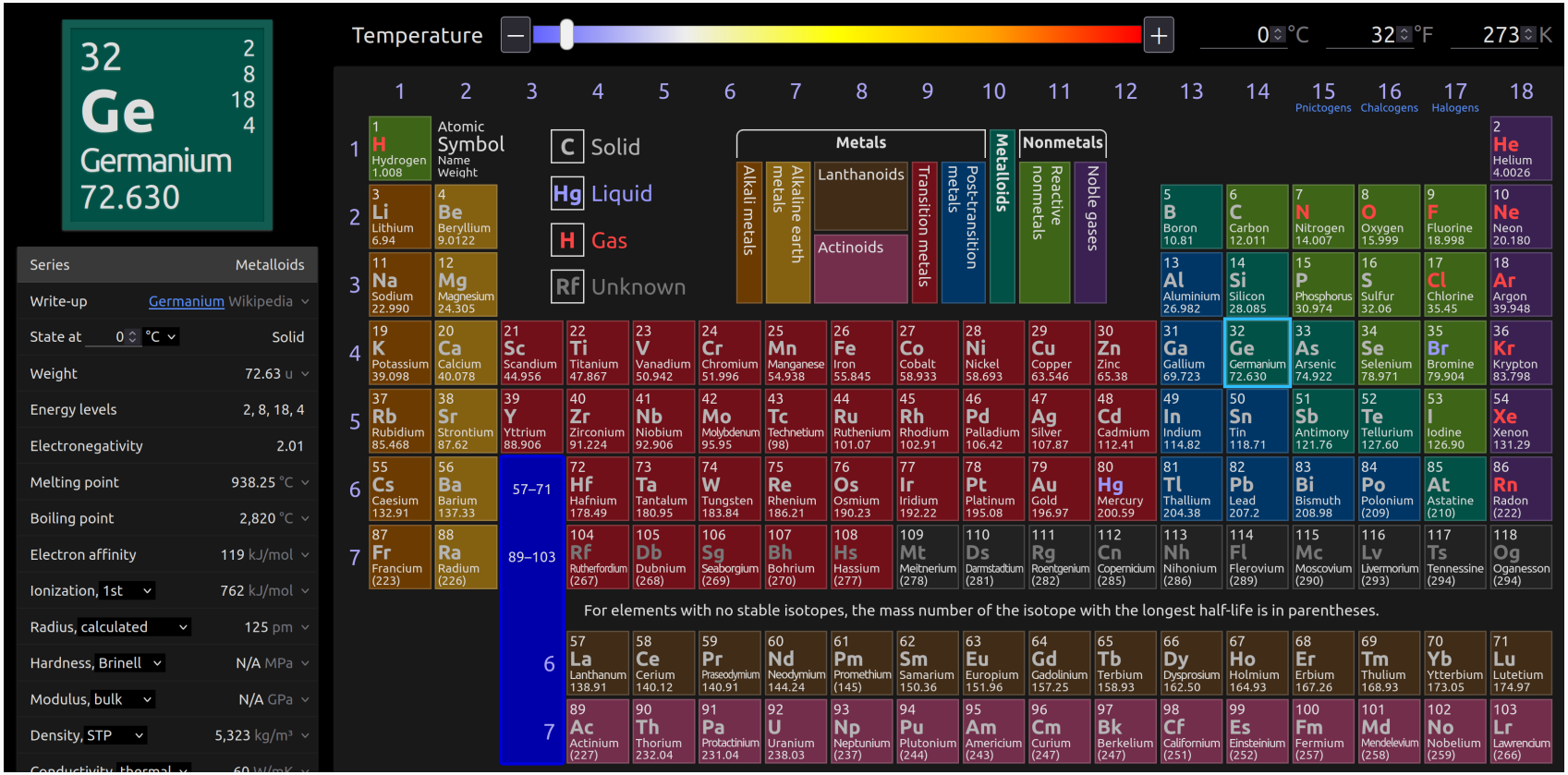
Question: Given the carbon isotopes C-12, C-13, and C-14 that are naturally occurring. Can you make a statement about which isotope is the greatest in abundance?

Outline

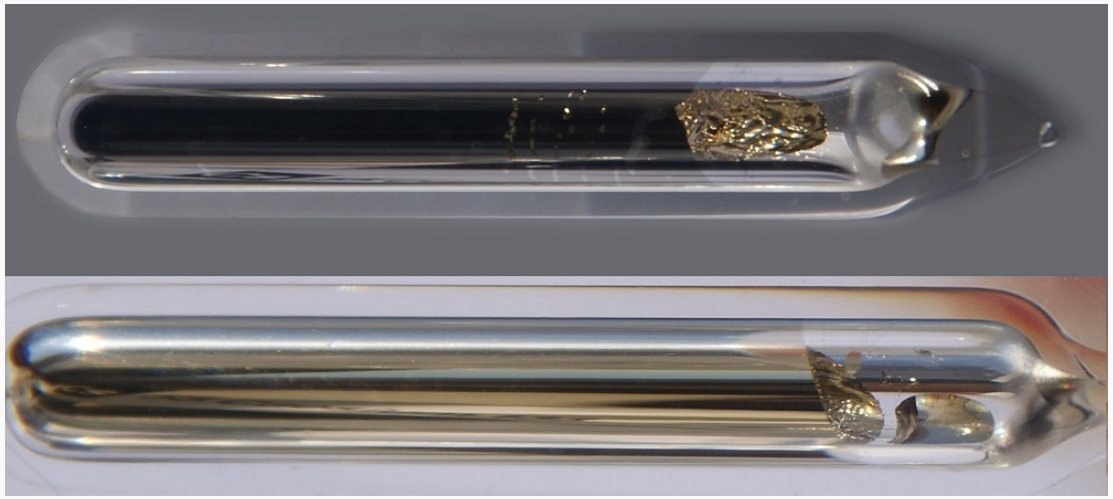
Review: Relative Atomic Mass

Periodic Table - Grouped Elements

Review: Modern Period Table



Alkali Metal



- Lower densities than other metals
- Extremely soft metals
- Highly reactive e.g. forming H_2 when in contact with water
- Prefer to lose an electron

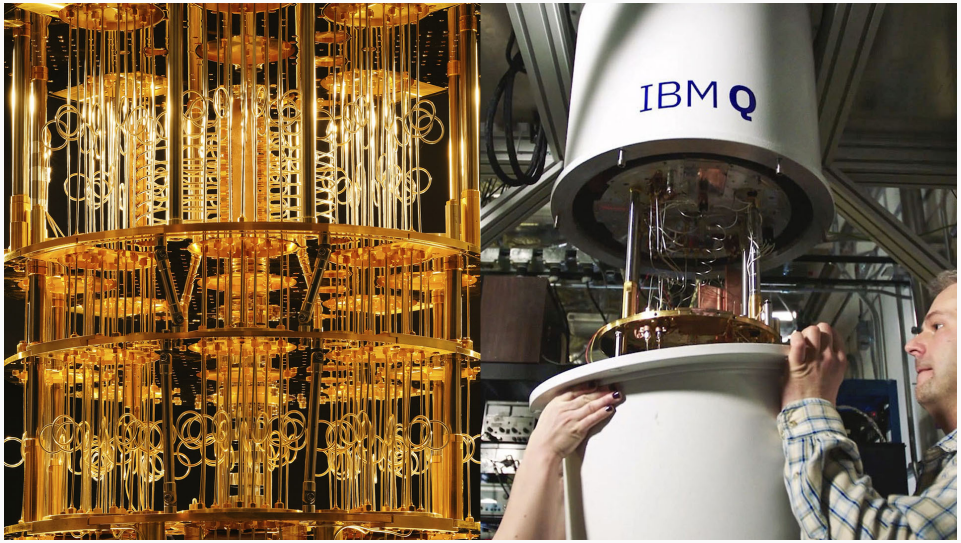
Alkaline Earth Metal

- Fairly reactive metals
- Can form solutions with a pH greater than 7 (more basic or alkaline)
- Calcium and magnesium important for life
- Prefer to lose 2 electrons

Transition Metals

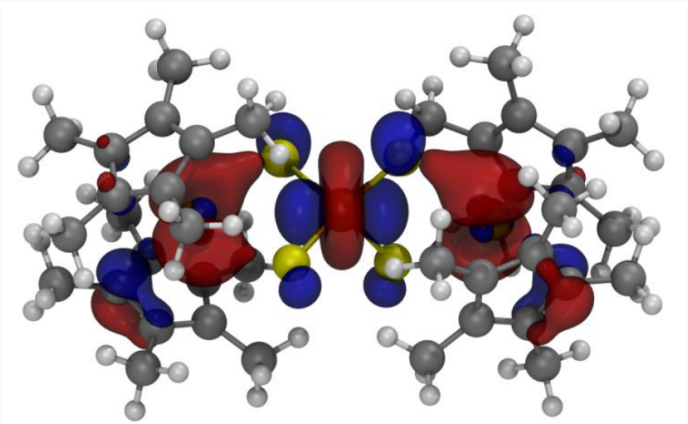
- Easily malleable and great conductors of heat and electricity
- High melting points except mercury (liquid at Room temperature)
- High densities
- Oxidation states (ability to gain/lose electrons) can vary between 1+ to 6+

Actinides and Lanthanides

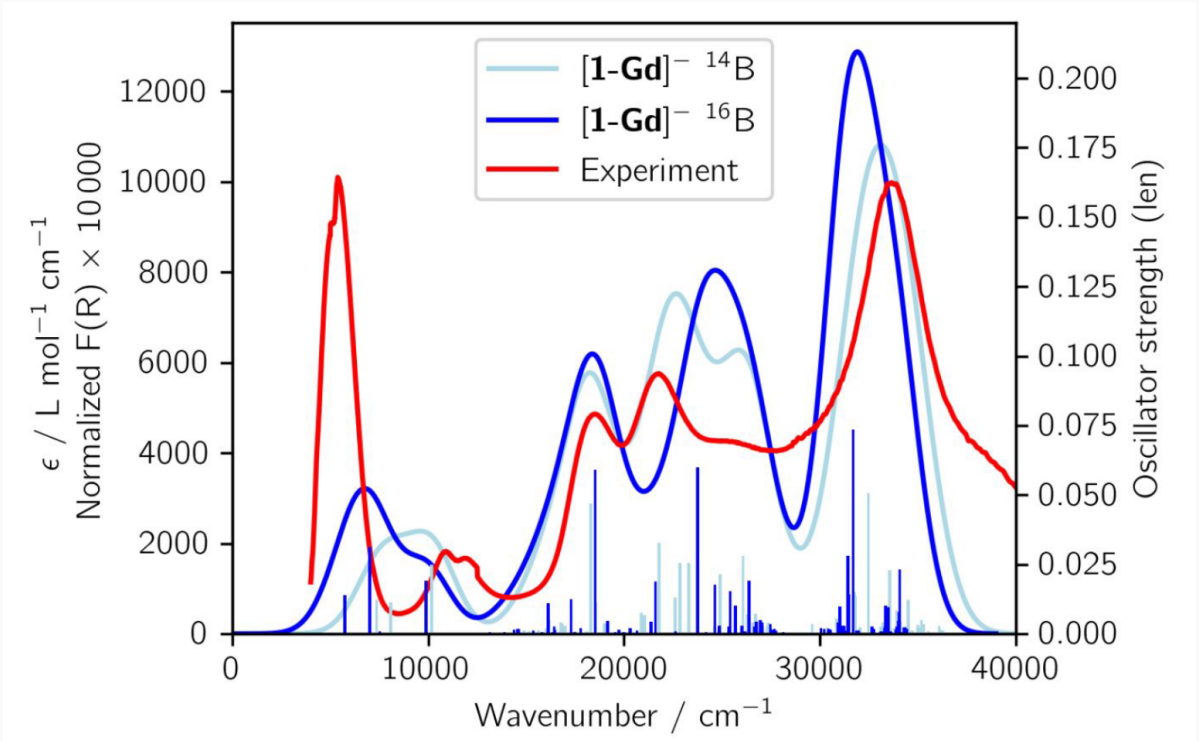


- Radioactive due to instability
- Silvery/silvery-white luster in metallic form
- Potential application to quantum computers and nuclear power
- Oxidation states can range from 2+ to 7+

Materials for Quantum Computing: Lanthanide Complexes

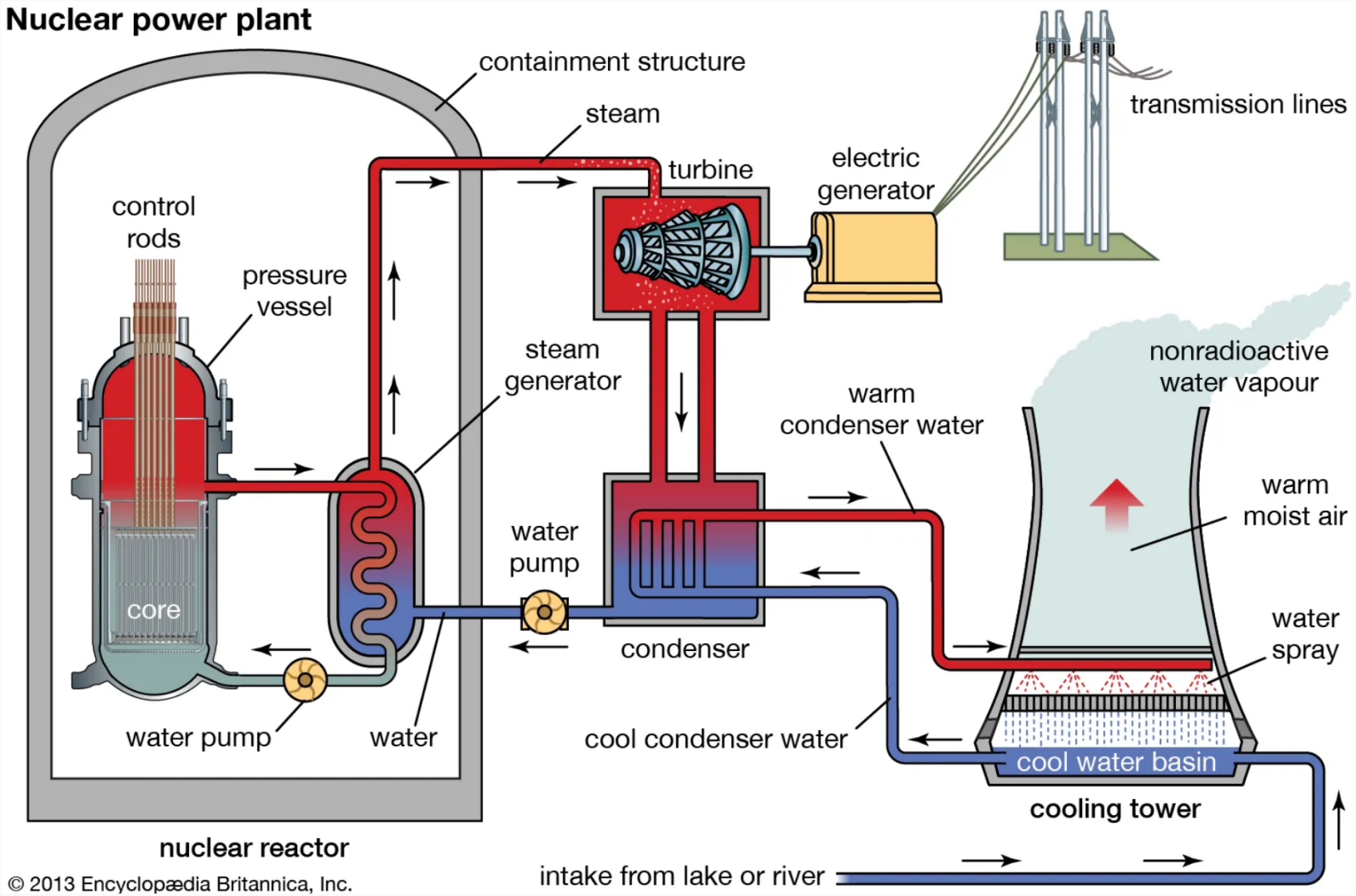


[1-Gd]$^{-1}$ HOMO



- Understanding the electronic structure
- Hysteresis - electronic spin memory
- Lanthanide MoS_4 research article

Nuclear Power Plants



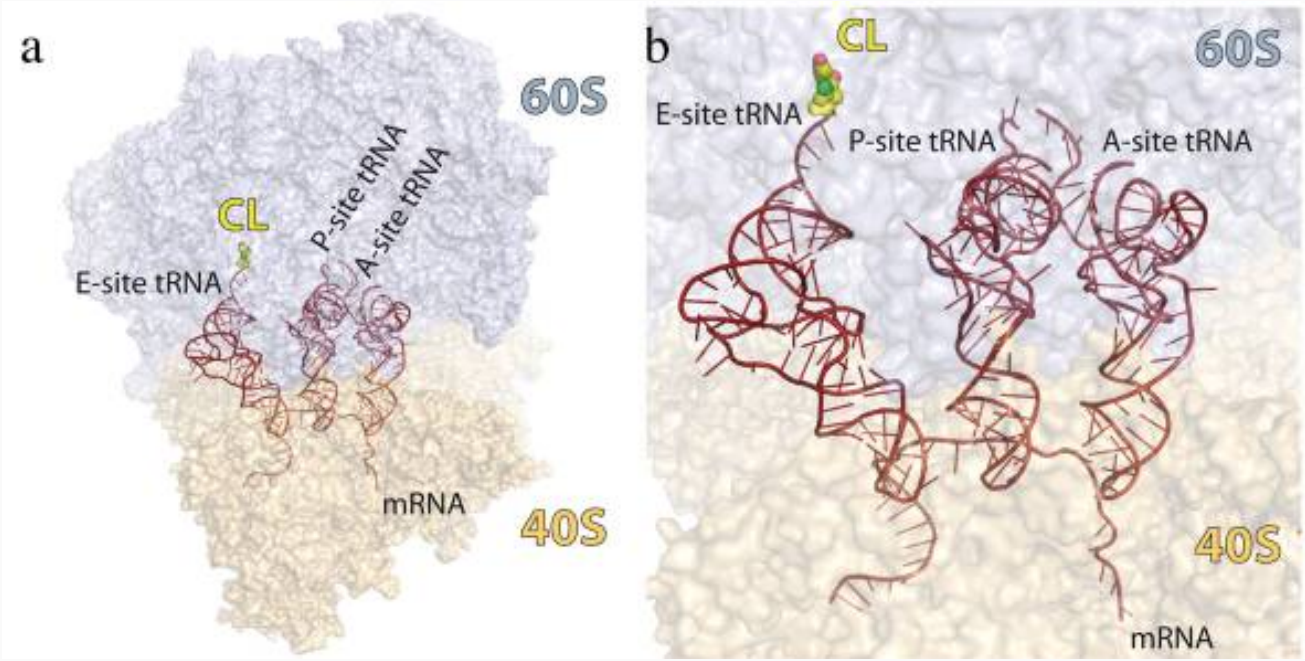
Halogens

- Fairly toxic and form acids when combined with hydrogen
- Readily react with metals to form salts e.g. NaCl
- Important for drug development due to their "sticky" nature
- Prefers to gain an electron

Cancer Therapeutics

- Chlorolissoclimide is a potent cancer drug that is naturally found in sea squirts
- Understanding the structure–activity relationships e.g. interactions between drug and ribosome

My Research Project: Chlorolissoclimide



- Chlorolissoclimide research article

Noble Gases

- Colorless, odorless, tasteless, and non-flammable under standard conditions
- Extremely non-reactive and most stable elements
- Do not like to gain or lose electrons

Practice: Periodic Table

Group the elements into the following groups

- Br
- K
- Mg
- Al
- Mn
- Ar
- U

Practice

What is the charge of the ions for each of the following elements?

- Al
- P
- Br
- S