

# Unit 02 Atomic Theory

Content Area: **Science**  
 Course(s): **IB Chemistry, HL**  
 Time Period: **First Marking Period**  
 Length: **3 weeks**  
 Status: **Published**

## Unit Overview

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Physical and chemical properties depend on the ways in which different atoms combine

## STAGE 1- DESIRED RESULTS

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### 2020 New Jersey Student Learning Standards- Science

**HS-PS1-8.** Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.

**SCI.9-12.HS-PS1-7** Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

## Cross Cutting Concepts

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### Energy and Matter

In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. (HS-PS1-8)

### Structure and Function

Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. (HS-PS2-6)

## Science and Engineering Practices

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### Developing and Using Models

Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and

show relationships among variables between systems and their components in the natural and designed worlds.

Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS1-8)

Use a model to predict the relationships between systems or between components of a system. (HS-PS1-1)

## Essential Questions

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Where is the mass of an atom concentrated?

Given the atomic number, what is the electron configuration of an element up to atomic number 36?

## Enduring Understanding

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- Atoms contain a positively charged dense nucleus composed of protons and neutrons (nucleons).
- Negatively charged electrons occupy the space outside the nucleus.

## Students will know...

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- Emission spectra are produced when photons are emitted from atoms as excited electrons return to a lower energy level.
- The line emission spectrum of hydrogen provides evidence for the existence of electrons in discrete energy levels, which converge at higher energies.
- The main energy level or shell is given an integer number,  $n$ , and can hold a maximum number of electrons,  $2n^2$ .
- A more detailed model of the atom describes the division of the main energy level into s, p, d and f sub-levels of successively higher energies.
- Sub-levels contain a fixed number of orbitals, regions of space where there is a high probability of finding an electron.
- Each orbital has a defined energy state for a given electronic configuration and chemical environment and can hold two electrons of opposite spin.
- Atoms contain a positively charged dense nucleus composed of protons and neutrons (nucleons).
- Negatively charged electrons occupy the space outside the nucleus.
- The mass spectrometer is used to determine the relative atomic mass of an element from its isotopic composition.
- In an emission spectrum, the limit of convergence at higher frequency corresponds to the first ionization energy.
- Trends in first ionization energy across periods account for the existence of main energy levels and sub-levels in atoms.
- Successive ionization energy data for an element give information that shows relations to electron configurations.

## Misconception:

Only one model of the atom is correct.

The electrons in an atom orbit its nucleus like planets in our solar system orbit the sun.

Electron clouds are pictures of electrons in their orbits.

The electron cloud is like a rain cloud, with electrons inside of it like drops of water.

An electron cloud has electrons in it, but the cloud itself is made of some other material.

Hydrogen is a typical atom.

Electrons are larger than protons.

Electrons and protons are the only fundamental particles.

The current model of the atom is the right model.

Atoms can disappear after time.

Atoms are microscopic versions of elements—hard or soft, liquid or gas, and so forth.

Atoms can be seen with a microscope.

Atoms move, so they are alive.

An electron shell is hard, like an eggshell.

Atoms “own” the electrons in their orbits.

## **Students Will be able to**

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- Use the nuclear symbol notation  $A_ZX$  to deduce the number of protons, neutrons and electrons in atoms and ions.
- Do calculations involving non-integer relative atomic masses and abundance of isotopes from given data, including mass spectra.
- Describe the relationship between color, wavelength, frequency and energy across the electromagnetic spectrum.
- Distinguish between a continuous spectrum and a line spectrum.
- Describe the emission spectrum of the hydrogen atom, including the relationships between the lines and energy transitions to the first, second and third energy levels.
- Recognize the shape of an s atomic orbital and the  $p_x$ ,  $p_y$  and  $p_z$  atomic orbitals.
- Apply the Aufbau principle, Hund’s rule and the Pauli exclusion principle to write electron configurations for atoms and ions up to  $Z = 36$ .
- Solve problems using  $E = h\nu$ .
- Calculate the value of the first ionization energy from spectral data which gives the wavelength or frequency of the convergence limit.
- Deduce the group of an element from its successive ionization energy data.
- Explain the trends and discontinuities in first ionization energy across a period.

## **STAGE 2- EVIDENCE OF LEARNING**

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### **Formative Assessment**

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- 3- Minute Pause
- A-B-C Summaries
- Analogy Prompt
- Choral Response
- Debriefing
- Exit Card / Ticket
- Hand Signals
- Idea Spinner
- Index Card Summaries
- Inside-Outside Circle Discussion (Fishbowl)
- Journal Entry
- Misconception Check
- Observation
- One Minute Essay
- One Word Summary
- Portfolio Check
- Questions & Answers
- Quiz
- Self-Assessment
- Student Conference
- Think-Pair-Share
- Web or Concept Map

### **Authentic Assessments**

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Atomic model project

Investigating the flame test.

## Benchmark Assessments

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Past IB Exam Question on unit 2

## STAGE 3- LEARNING PLAN

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### Instructional Map

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- Description of the relationship between color, wavelength, frequency and energy across the electromagnetic spectrum.
- Distinction between a continuous spectrum and a line spectrum.
- Description of the emission spectrum of the hydrogen atom, including the relationships between the lines and energy transitions to the first, second and third energy levels.
- Recognition of the shape of an s atomic orbital and the px, py and pz atomic orbitals.
- Application of the Aufbau principle, Hund's rule and the Pauli exclusion principle to write electron configurations for atoms and ions up to  $Z = 36$ .

### Modification/Differentiation of Instruction

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#### Differentiation Strategies for Special Education Students

- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in "chunks"
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill

- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

### Differentiation Strategies for Gifted and Talented Students

- Increase the level of complexity
- Decrease scaffolding
- Variety of finished products
- Allow for greater independence
- Learning stations, interest groups
- Varied texts and supplementary materials
- Use of technology
- Flexibility in assignments
- Varied questioning strategies
- Encourage research
- Strategy and flexible groups based on formative assessment or student choice
- Acceleration within a unit of study
- Exposure to more advanced or complex concepts, abstractions, and materials
- Encourage students to move through content areas at their own pace
- After mastery of a unit, provide students with more advanced learning activities, not more of the same activity
- Present information using a thematic, broad-based, and integrative content, rather than just single-subject areas

### Differentiated Strategies for ELL Students

- Remove unnecessary materials, words, etc., that can distract from the content
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Gradually increase the level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials, including visuals
- Use technology, if available and appropriate
- Differentiate homework and products
- Varied questioning strategies

- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Allow students to work at their own pace
- Presenting ideas through auditory, visual, kinesthetic, & tactile means
- Role play
- Provide graphic organizers, highlighted materials
- Strategy and flexible groups based on formative assessment

### Differentiation Strategies for At Risk Students

- Remove unnecessary materials, words, etc., that can distract from the content
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Gradually increase the level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Differentiate homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Presenting ideas through auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment

### **504 Plans**

Students can qualify for 504 plans if they have physical or mental impairments that affect or limit any of their abilities to:

- walk, breathe, eat, or sleep

- communicate, see, hear, or speak
- read, concentrate, think, or learn
- stand, bend, lift, or work

Examples of accommodations in 504 plans include:

- preferential seating
- extended time on tests and assignments
- reduced homework or classwork
- verbal, visual, or technology aids
- modified textbooks or audio-video materials
- behavior management support
- adjusted class schedules or grading
- verbal testing
- excused lateness, absence, or missed classwork
- pre-approved nurse's office visits and accompaniment to visits
- occupational or physical therapy

## **Modification Strategies**

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- Cooperative Grouping
- Extended Time
- Frequent Breaks
- Highlighted Text
- Interactive Notebook
- Modified Test
- Oral Directions
- Peer Tutoring
- Preferential Seating
- Re-direct
- Repeated Drill and Practice
- Shortened Assignment
- Teacher Notes
- Tutorials
- Use of Additional Reference Materials
- Use of Audio Resources

## **Differentiation Strategies**

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### **High Preparation**

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- Alternative Assessments
- Choice Boards
- Games and Tournaments
- Group Investigations
- Guided Reading
- Independent Research / Project
- Interest Groups
- Learning Contracts
- Leveled Rubrics
- Literature Circles
- Multiple Intelligence Options
- Multiple Texts
- Personal Agendas
- Project Based Learning (PBL)
- Stations / Centers
- Think-Tac-Toe
- Tiered Activities / Assignments
- Varying Graphic Organizers

### **Low Preparation**

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- Choice of Book / Activity
- Cubing Activities
- Exploration by Interest (using interest inventories)
- Flexible Grouping
- Goal Setting With Student
- Homework Options
- Jigsaw
- Mini Workshops to Re-teach or Extend Skills
- Open-ended Activities
- Think-Pair-Share by Readiness, Interest, or Learning Style

- Use of Collaboration
- Use of Reading Buddies
- Varied Journal Prompts
- Varied Product Choice
- Varied Supplemental Materials
- Work Alone / Together

## **Horizontal Intergration- Interdisciplinary Connections**

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See Appendix

## **Vertical Integration- Discipline Mapping**

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Eighth grade Chemical Interactions

Tenth grade CP and Honors Chemistry.

## **Additional Materials**

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Pearson Chemistry by Mike Ford & Catrin Brown, 2nd ed.

Richard Thornley IB Video lessons. <https://www.youtube.com/playlist?list=PL6C2085C0AD5772A8>

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