Summary

Unit 3 /13 - Periodicity

Subject	Year	Start date	Duration
Chemistry	IB1	Week 1, October	5 weeks 14 hours

Course Part

Core and Higher level

Description

The arrangement of elements in the periodic table helps to predict their electron configuration. The Periodic Table represents one of the great intellectual achievements of humanity and scientific endeavour. The first steps towards working out this table were taken long before anyone had any ideas about the structure of atoms. The number of elements discovered increased steadily during the nineteenth century, and chemists began to find patterns in their properties. Döbereiner, Newlands and Meyer all described groupings of elements with similar chemical and physical characteristics.

Inquiry & Purpose

Inquiry / Higher Order Questions

Type	Inquiry Questions
Concept-based	How do classification and categorisation in science help or hinder the pursuit of knowledge?

Curriculum

Aims

Appreciate scientific study and creativity within a global context through stimulating and challenging opportunities

Acquire a body of knowledge, methods and techniques that characterize science and technology

Develop a critical awareness of the need for, and the value of, effective collaboration and communication during scientific activities

Develop an appreciation of the possibilities and limitations of science and technology

Objectives

Demonstrate knowledge and understanding of

facts, concepts, and terminology

Apply

methods of communicating scientific information

Formulate, analyse and evaluate

scientific explanations

Syllabus Content

Core

3. Periodicity

3.1 Periodic table

Nature of science:

Obtain evidence for scientific theories by making and testing predictions based on them - scientists organize subjects based on structure and function; the periodic table is a key example of this. Early models of the periodic table from Mendeleev, and later Moseley, allowed for the prediction of properties of elements that had not yet been discovered.

Understandings:

The periodic table is arranged into four blocks associated with the four sub-levels - s, p, d, and f.

The periodic table consists of groups (vertical columns) and periods (horizontal rows).

The period number (n) is the outer energy level that is occupied by electrons.

The number of the principal energy level and the number of the valence electrons in an atom can be deduced from its position on the periodic table.

The periodic table shows the positions of metals, non-metals and metalloids.

Applications and skills:

Deduction of the electron configuration of an atom from the element's position on the periodic table, and vice versa.

3.2 Periodic trends

Nature of science:

Looking for patterns - the position of an element in the periodic table allows scientists to make accurate predictions of its physical and chemical properties. This gives scientists the ability to synthesize new substances based on the expected reactivity of elements.

Understandings:

Vertical and horizontal trends in the periodic table exist for atomic radius, ionic radius, ionization energy, electron affinity and electronegativity.

Trends in metallic and non-metallic behaviour are due to the trends above.

Oxides change from basic through amphoteric to acidic across a period.

Applications and skills:

Prediction and explanation of the metallic and non-metallic behaviour of an element based on its position in the periodic table.

Discussion of the similarities and differences in the properties of elements in the same group, with reference to alkali metals (group 1) and halogens (group 17).

Construction of equations to explain the pH changes for reactions of Na_2O, MgO, P_4O_{10}, and the oxides of nitrogen and sulfur with water.

Additional higher level

13. The periodic table - the transition metals

13.1 First-row d-block elements

Nature of science:

Looking for trends and discrepancies - transition elements follow certain patterns of behaviour. The elements Zn, Cr and Cu do not follow these patterns and are therefore considered anomalous in the first-row d-block.

Understandings:

Transition elements have variable oxidation states, form complex ions with ligands, have coloured compounds, and display catalytic and magnetic properties.

Zn is not considered to be a transition element as it does not form ions with incomplete d-orbitals.

Transition elements show an oxidation state of +2 when the s-electrons are removed.

Applications and skills:

Explanation of the ability of transition metals to form variable oxidation states from successive ionization energies.

Explanation of the nature of the coordinate bond within a complex ion.

Deduction of the total charge given the formula of the ion and ligands present.

Explanation of the magnetic properties in transition metals in terms of unpaired electrons.

13.2 Coloured complexes

Nature of science:

Models and theories - the colour of transition metal complexes can be explained through the use of models and theories based on how electrons are distributed in d-orbitals.

Transdisciplinary - colour linked to symmetry can be explored in the sciences, architecture, and the arts.

Understandings:

The d sub-level splits into two sets of orbitals of different energy in a complex ion.

Complexes of d-block elements are coloured, as light is absorbed when an electron is excited between the d-orbitals.

The colour absorbed is complementary to the colour observed.

Applications and skills:

Explanation of the effect of the identity of the metal ion, the oxidation number of the metal and the identity of the ligand on the colour of transition metal ion complexes.

Explanation of the effect of different ligands on the splitting of the d-orbitals in transition metal complexes and

colour observed using the spectrochemical series.

ATL Skills

Approaches to Learning

Thinking

- In this unit, we will

  ask students to formulate a reasoned argument to support their opinion or conclusion

  give students time to think through their answers before asking them for a response

  ask open questions

  set students a task which required higher-order thinking skills (such as analysis or evaluation)

  build on a specific prior task

  help students to make their thinking more visible (for example, by using a strategy such as a thinking routine)

Social

- In this unit, we will

  have students work in small groups

  allocate, or ask students to allocate among themselves, different roles in a classroom discussion or activity

  have students peer assess their group performance or process

  support students in resolving a conflict in a team

  give students feedback on how they worked as a group

  encourage students to consider alternative points of view or to take the perspective of others

Developing IB Learners

Learner Profile

Communicators

Balanced