Chemistry Kickstart Workshops 2020

1. Spectroscopy Instruments

2.5 hour workshop

This workshop takes place in our second-year teaching labs where students will use the following spectroscopic techniques to identify an unknown substance.

Students will participate in IR Spectroscopy and UV-Vis Spectrophotometry, and watch demonstrations of NMR Spectroscopy and AAS. They will use the spectra produced from IR and NMR Spectroscopy, along with Mass Spectrometry data, to identify an unknown substance. Students will use the results of UV-Vis and AAS to determine the concentration of a metal ion in water.

Assumed knowledge for this workshop: Module 7 Organic Chemistry. If the module hasn't been completed, students at a minimum need to understand nomenclature and structure of organic compounds, including key functional groups. An introduction to the basics of spectroscopy before this workshop is also useful.

Module 8: Applying Chemical Ideas

Analysis of Inorganic Substances

- Conduct investigations and/or process data to determine the concentration of coloured species and/or metal ions in aqueous solution, including but not limited to, the use of:
    - Ultra-violet-visible spectrophotometry
    - Atomic absorption spectroscopy
- conduct qualitative investigations – using flame tests to test for the presence in aqueous solution ions

Analysis of Organic Substances

- conduct qualitative investigations to test for the presence in organic molecules of the following functional groups:
    - carbon–carbon double bonds
    - hydroxyl groups
    - carboxylic acids (ACSCH130)
- investigate the processes used to analyse the structure of simple organic compounds addressed in the course, including but not limited to:
    - proton and carbon-13 NMR
    - mass spectroscopy (ACSCH19) - *from Feb 2020*
    - infrared spectroscopy (ACSCH130)

2. Analysing Inorganic Substances

2.5 hour workshop

In this workshop, students will conduct four practical experiments for inorganic substance analysis and equilibrium.

Students will:

- Determine the equilibrium constant or iron(III) thiocyanate using visible spectrometry.
- Conduct a gravimetric analysis to determine the concentration of sulfate ions in solution.
- Measure the hardness of water using a complexometric titration.
- Determine the chlorine content of a water sample using precipitation titration.

Assumed knowledge for this workshop: An understanding of titration and concentration calculations.

Module 5: Equilibrium and Acid Reactions

- conduct an investigation to determine K_{eq} of a chemical equilibrium system, for example:
    - K_{eq} of the iron(III) thiocyanate equilibrium.

Module 8: Applying Chemical Ideas

- conduct qualitative investigations – using flame tests, precipitation and complexation reactions as appropriate – to test for the presence in aqueous solution of the following ions:
    - cations: **barium (Ba^{2+})**, calcium (Ca^{2+}), **magnesium (Mg^{2+})**, lead(II) (Pb^{2+}), **silver ion (Ag^{+})**, copper(II) (Cu^{2+}), iron(II) (Fe^{2+}), iron(III) (Fe^{3+})
    - anions: **chloride (Cl^{-})**, bromide (Br^{-}), iodide (I^{-}), hydroxide (OH^{-}), acetate ($CH3COO^{-}$), carbonate (CO_3^{2-}), **sulfate (SO_4^{2-})**, phosphate (PO_4^{3-})
- conduct investigations and/or process data involving:
    - gravimetric analysis
    - precipitation titrations
- conduct investigations and/or process data to determine the concentration of coloured species and/or metal ions in aqueous solution, including but not limited to, the use of:
    - colourimetry

3. Acid Rain and the Environment

Available from June 2020

2.5 hour workshop

In this workshop, students will explore the effect of acid rain on the environment. After modelling the reaction of acidic rain with minerals, students will quantify the result of this reaction using acid/base chemistry, complexation titration and gravimetric analysis.

Assumed knowledge for this workshop: An understanding of titration and concentration calculations.

Students will:

- Investigate the pH of solutions before and after contact with minerals, using pH probes and titration
- Conduct a complexation titration to quantify the concentration of Ca^{2+} in solution
- Conduct a colorometric analysis to quantify the concentration of Al^{3+} in solution

Module 6: Acid/Base Reactions

- predict the products of acid reactions and write balanced equations to represent:
  - acids and bases
  - acids and carbonates
- conduct a practical investigation to measure the pH of a range of acids and bases
- calculate the pH of the resultant solution when solutions of acids and/or bases are diluted or mixed
- conduct practical investigations to analyse the concentration of an unknown acid or base by titration
- explore acid/base analysis techniques that are applied:
  - using digital probes and instruments

Module 8: Applying Chemical Ideas

- conduct qualitative investigations – using flame tests, precipitation and complexation reactions as appropriate – to test for the presence in aqueous solution of the following ions:
  - **calcium (Ca^{2+})**
- conduct investigations and/or process data to determine the concentration of coloured species and/or metal ions in aqueous solution, including but not limited to, the use of:
  - colourimetry
  - ultraviolet-visible spectrophotometry

Depth Study Support

We can offer suggestions on how to incorporate any of our workshops into a Depth Study on request. If this is something you and your students are interested in please email us at science.kickstart@sydney.edu.au