CH280-15 Chemistry for Sustainability

26/27

Department
Chemistry
Level
Undergraduate Level 2
Module leader
Ross Hatton
Credit value
15
Module duration
10 weeks
Assessment
Multiple
Study location
University of Warwick main campus, Coventry

Description

Introductory description

This module will introduce students to the critically important role chemists are playing in humanity's transition to a sustainable way of life and the primary motivations for this transition. The challenges posed by anthropogenic climate change, environmental pollution and the limited supply of natural resources critical to our current way of life will be considered. Sustainable solutions to these challenges for which chemistry is particularly relevant will be considered, including in the areas of sustainable agriculture, tackling water pollution (whilst also meeting growing demand for drinking water), affordable clean energy for all, tackling atmospheric pollution and sustainable chemical feedstocks for our material needs. The interconnectedness of these topics will also be considered.

Module web page

Module aims

This module will enable the students to appreciate the relevance of, and apply, the chemical knowledge they have acquired in the first-year of their degree to understanding and addressing the major challenges of our time. The topics covered are aligned with the United Nations 17 sustainable development goals, and so this module will serve to highlight the important role chemists are playing in enabling a sustainable future for all, opening their eyes to the broad range

of opportunities their chemical education presents for them to contribute to these exciting topics at a critical early stage in their degree.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

This module is taught in the following sections:

Introduction and motivation: (2 Lectures) Introduction to UN sustainability goals, climate change and the circular economy.
Topic 1: Energy (6 Lectures including guest lecture). The importance of heat in the energy landscape. Solar thermal energy, heat pumps and thermal batteries: underpinning physical science and principles of operation. The circular economy for sustainable energy materials.
Topic 2: Water (6 Lectures including 1 guest lecture). What is the equilibrium chemistry controlling ocean acidification, how can we measure ocean pH and can increasing acidification be mitigated. How to provide clean drinking water. How can water be recycled - waste water treatment. Water pollution. Conversion of seawater to drinking water (desalination) via reverse osmosis and distillation, energy considerations and thermodynamics. Challenges faced by the developed versus the developing world.
Topic 3: Green Synthesis and Recycling (6 Lectures including 1 guest lecture). Green synthesis guidelines and challenges. Recycling. Challenges with polymer recycling, microplastics pollution and ways to combat this.
Topic 4: Atmospheric and agricultural chemistry (6 lectures including 1 guest lecture). The reasons and remedies for air pollution including smog, acid rain, and the hole in the ozone layer. Benefits and negative impacts of fertilisers and pesticides for the environment and human nutrition.

Learning outcomes

By the end of the module, students should be able to:

- Understand how chemistry can play a key role in meeting the sustainability challenges given the earth’s limited resources and the challenges posed by climate change and pollution, in line with the UN sustainability goals, including current real-world examples.
- Describe the role chemistry plays in (i) promoting sustainable agriculture, (ii) providing clean water, (iii) addressing the challenges of affordable and clean energy, with a particular focus on heat, (iv) tackling air pollution, and (v) responsible consumption and production (green synthesis, biodegradability, recycling).
- Perform calculations to quantify the impacts on sustainability (e.g. coefficient of performance of heat pump, energy storage in thermal batteries, rates of atmospheric pollution, pH of acidified waterways, atom economy of reactions).
- Assemble and present an appraisal of an endangered element's use, supply, and sustainability

Indicative reading list

Reading lists can be found in Talis

Subject specific skills

Problem solving: The students will learn to tackle a range of quantitative and chemical problems relating to a broad range of topics in the area of sustainability. They will be applying fundamental knowledge acquired during year 1 of the degree to solving real world problems, which will help to open their eyes to the broad range of opportunities for current and future employment in the sustainability space.
Critical thinking: The students will learn to think critically about a broad range of challenges and potential solutions relating to sustainability, including potential trade-offs and the interconnectedness and inherent complexity of many topics in sustainability.
Digital Literacy: The students will research a topic for the poster presentation and in doing so learn to judge the validity, merits and limitations of a broad range of digital sources of information on their assigned topic.

Transferable skills

Critical thinking: The students will learn to think critically about major complex applied problems of our time, that have broad relevance to current and future employment opportunities for chemists.
Problem solving: Student will learn how to solve quantitative and chemical problems.
Communication skills: Written, presentation and oral communication skills will be developed as part of the assessed work component.
Research Skills: Students will learn to assess the merits / limitations of sources of digital information when researching for the poster presentation.

Study

Study time

Type	Required
Lectures	26 sessions of 1 hour (17%)
Practical classes	4 sessions of 1 hour (3%)
Private study	90 hours (60%)
Assessment	30 hours (20%)
Total	150 hours

Private study description

N/A

Costs

No further costs have been identified for this module.

Assessment

You do not need to pass all assessment components to pass the module.

Assessment group D2

	Weighting	Study time	Eligible for self-certification
2 minutes poster presentation on element sustainability	20%	30 hours	No
A 2 minute poster presentation. Students are assigned one of the elements in the periodic table for which there is a supply threat and are asked to prepare a poster and give a 2 minute oral presentation of the poster explaining: (i) Why the element is important (i.e. what is it used for in the modern world); (ii) To what extent its supply is limited/under threat and why? ; (iii) Whether it is currently sustainably sourced, and if not how could it be or what are the potential sustainable alternatives?			
Centrally-timetabled examination (On-campus)	80%		No
Examination			

- Periodic Tables
- Answerbook Green (8 page)

Assessment group R2

	Weighting	Study time	Eligible for self-certification
Examination	100%		No

- Periodic Tables
- Answerbook Green (8 page)
- Students may use a calculator

Feedback on assessment

Feedback on assessed work provided via Moodle. Cohort level examination feedback will be provided after the June examination period.

Past exam papers for CH280

Availability

Pre-requisites

To take this module, you must have passed:

- All of
  - CH155-30 Practical and Professional Chemistry Skills I
  - CH164-15 Atoms and Molecules
  - CH165-15 Chemical Change
  - CH166-15 Molecules and Materials across the Periodic Table
  - CH167-15 Carbon and the Chemistry of Life
  - CH168-15 Data Science for Chemists

Courses

This module is Optional for:

- UCHA-4 Undergraduate Chemistry (with Intercalated Year) Variants
  - Year 2 of F101 Chemistry (with Intercalated Year)
  - Year 2 of F122 Chemistry with Medicinal Chemistry (with Intercalated Year)
- UCHA-3 Undergraduate Chemistry 3 Year Variants
  - Year 2 of F100 Chemistry
  - Year 2 of F121 Chemistry with Medicinal Chemistry
- UCHA-F110 Undergraduate Master of Chemistry (with Industrial Placement)
  - Year 2 of F110 MChem Chemistry (with Industrial Placement)
  - Year 2 of F112 MChem Chemistry with Medicinal Chemistry with Industrial Placement
- Year 2 of UCHA-F107 Undergraduate Master of Chemistry (with Intercalated Year)
- UCHA-F109 Undergraduate Master of Chemistry (with International Placement)
  - Year 2 of F109 MChem Chemistry (with International Placement)
  - Year 2 of F111 MChem Chemistry with Medicinal Chemistry (with International Placement)
- UCHA-4M Undergraduate Master of Chemistry Variants
  - Year 2 of F105 Chemistry
  - Year 2 of F125 MChem Chemistry with Medicinal Chemistry
- Year 2 of UCHA-F127 Undergraduate Master of Chemistry with Medicinal Chemistry(with Intercalated Year)