

## Using *Cutting Edge Chemistry* in the classroom

This document has three sections:

1. some general advice about ways to use *Cutting edge chemistry* in the classroom;
2. brief synopses of the contents of each chapter for the busy teacher; and
3. links to other documents that give cross references for each chapter of *Cutting Edge Chemistry* to specific post-16 specifications.

### 1. General advice

*Cutting edge chemistry* is aimed at post-16 chemistry students. It is a resource that can be used in many ways by chemistry teachers.

- Teachers might read the book for interest and enjoyment - as a means of updating their own knowledge and enlivening their teaching (both post- and pre-16) with up-to-date examples and anecdotes.
- Specific chapters could be used by students as background reading before they tackle corresponding topics in their post-16 course to inspire them and give them a feel for the context of this particular topic.
- A chapter could be read by students after they have completed a topic on a similar area of chemistry so that they can see how the principles they have studied are used in real life, and where the topic leads.
- Chapters could be used, together with the questions they contain, as comprehension exercises or parts of chapters could be used as passages on which to base comprehension questions for exam practice.
- The reading of a chapter and answering of the questions within it could be set as a meaningful exercise during the absence (planned or unplanned) of the teacher.
- Students could read the book simply for interest and enjoyment using the questions as an aid to understanding as they read.

*Cutting Edge Chemistry* has been developed from another Royal Society of Chemistry book, *The Age of the Molecule*. Teachers may find this useful to give them further background, in more depth, to some of the topics in *Cutting Edge Chemistry*.

### 2. Chapter synopses

*Cutting edge Chemistry* has ten chapters, each of which illustrates an area of chemistry where there have been significant developments in recent years. It is worth bearing in mind that some themes that are central to chemistry, such as *Formulae, equations and amounts of substance* and *Bonding and structure* pervade the whole book and no attempt has been made to refer to these themes individually.

An outline of the content of each chapter is shown below:

## **Chapter 1 Make me a molecule**

This chapter deals with:

- the history of organic synthesis of from the mid-1800s to the present day;
- the importance of stereochemistry in modern day synthesis;
- chirality as an important aspect of modern synthesis; and
- combinatorial chemistry - as a way of making large arrays of related compounds.

It embraces most of the fundamentals of organic chemistry including nomenclature, functional groups and their reactions.

## **Chapter 2 Analysis and structure of molecules**

This chapter deals with:

- 'classical' chemical analysis including chromatography;
- the instrumental techniques;
  - UV/visible spectrophotometry;
  - IR spectrophotometry;
  - mass spectroscopy;
  - X-ray, neutron and electron diffraction; and
  - NMR.

## **Chapter 3 Chemical marriage brokers**

This chapter deals with:

- the history of catalysis;
- homogeneous and heterogeneous catalysts and catalytic cycles;
- industrial examples of catalysts;
- zeolites as catalysts; and
- transition metals as catalysts.

## **Chapter 4 Following chemical reactions**

This chapter deals with:

- following fast reactions;
- reaction profiles;

- spectroscopic techniques for following reactions, for example, flash photolysis; and
- reaction mechanisms.

### **Chapter 5 New science from new materials**

- This chapter deals with:
- transition metal oxides - magnetic and electric properties;
- clusters of atoms; and
- fullerenes.

### **Chapter 6 Liquid crystals**

This chapter deals with:

- the history and uses of liquid crystals; and
- the properties of liquid crystals related to molecular shape and intermolecular forces.

### **Chapter 7 Polymers**

This chapter deals with:

- applications of polymers;
- the history of polymers;
- addition polymers;
  - free radical polymerisation
  - properties related to intermolecular forces
  - crystallinity and stereoregularity
  - Ziegler-Natta catalysts;
- condensation polymers
  - polyurethane
  - polyamides
  - polyesters; and
- novel polymers with special properties.

### **Chapter 8 Electrochemistry**

This chapter deals with:

- batteries / electrochemical cells;
- fuel cells;
- electrolysis, including industrial examples;
- electrochemistry in analysis; and
- $E^\ominus$  values.

### **Chapter 9 Computational chemistry**

This chapter deals with:

- molecular modelling using computers;
- predicting shapes and properties of molecules from first principles;
- intermolecular forces; and
- applications to the discovery of new drugs.

### **Chapter 10 The chemistry of life**

This chapter deals with:

- the history of some drugs;
- protein chemistry and synthesis;
- DNA / the genetic code / genetic engineering; and
- examples of drug design and the modes of action of some drugs.

### **3.Specification cross-references**

Every chapter has some relevance to post-16 courses as shown in the table *Cutting edge chemistry - links to A- and AS-level chemistry*.

Table

Cutting edge chemistry – links to A- and A/S-level chemistry

	Formulae, equns & amounts	Atomic structure	Bonding and structure	Energetics	Kinetics	Equilibrium	Redox	Inorganic & PT	Organic chemistry	Analytical techniques
Make me a molecule	p		p			s			w	
Analysis & structure	p	s	s							w
Chemical marriage brokers	p		s	s	w			s		
Following reactions	p	s	s	s	p					s
New materials	p		p				s	p		s
Liquid crystals	p		p						w	
Plastics	p		p						w	
Electro-chemistry	p			s		s	p			s
Computational chemistry	p	p	p	p						
Life chemistry	p		p						w	

Key

w = whole chapter, p = a significant part of chapter, s = a small part of chapter

More specific links to individual board specifications are available in the following documents:

AQA;

Edexcel;

Edexcel Nuffield;

OCR;

Northern Ireland;

WJEC/CBAC;

Scottish Higher; and

Scottish Advanced Higher.