Introduction

Welcome to Chemistry EAP - a complete course for international students preparing to study Chemistry in English at university level.

What's in the course?

Chemistry EAP is designed specifically to improve your ability to study Chemistry effectively in English. It is for students who are planning to embark on an undergraduate programme. With this course, you will develop your knowledge of academic and scientific conventions and you will improve your skills in the following areas:

- reading and understanding of general Chemistry articles
- listening to lectures, understanding sign-posting language, main points and note-taking
- writing for different audiences, genres and purposes within the same discipline
- contributing effectively in seminars and discussions
- preparing and giving effective scientific presentations
- Improving academic vocabulary and prominent grammar features
- improving academic writing skills and academic conventions
- improving study skills such as planning and note-taking
- improving your critical reading and writing skills with peer-review evaluations and in

What's in a unit?

English for Chemistry EAP has eleven units. It has been designed to analyze, sequence and present the target language in a way that accords to foreign language learning needs. It is an attempt to match the goals and objectives of a General Chemistry program and English for Academic Purposes (EAP) featuring formality, paraphrasing, summarising and use of evaluative language. Each unit starts with the learning objectives for that unit and a short discussion task to get you thinking about the theme in that unit. At the back of the book there is a glossary and audio scripts.

Warm up activities are designed so as to ensure that the learner is engaged by the text and is willing to authenticate it by taking interest.

Stimulating activities challenge students, arouse interest, generate discussion, introduce the topic of the unit and encourage rapid progression. The discussion section contains pictures, diagrams, tables and photos contributing to the interest of the reading text.

Reading

The readings although simplified offer undergraduate students of Chemistry a balanced coverage of texts on a large variety of General Chemistry topics. Learners are exposed to only a few samples of authentic language that maintains the specific features of cohesion and coherence and genre analysis. To ensure that the texts are accessible to learners at this early stage, texts were written, edited or chosen in accordance to the criteria of length, density of new information and presence of accompanying material such as pictures and diagrams.

Reading comprehension

Each text is followed up by an appropriate reading comprehension task. Students are often asked to read for and identify specific information or show understanding of the general gist, match topics to paragraphs and classify information.

Vocabulary building

Context is seen as vitally important. The book has established a coherent context and is written in support of thematically integrating skills and as such all the skills-building sections are thematically linked. Units and exercises connect in terms of topic, pattern of skill development and lexical/grammatical 'progression'. Exercises, either lexical or grammatical, are meaningful and correspond to how the learner is expected to engage with the text.

Grammar

This textbook also offers meaningful examples and a variety of techniques for teaching structural units and general English for Academic purposes reading and writing skills. At the same time, students are led into discovering language rules for themselves since structural units are designed so as to leave space for an inductive teaching approach of grammar.

Writing

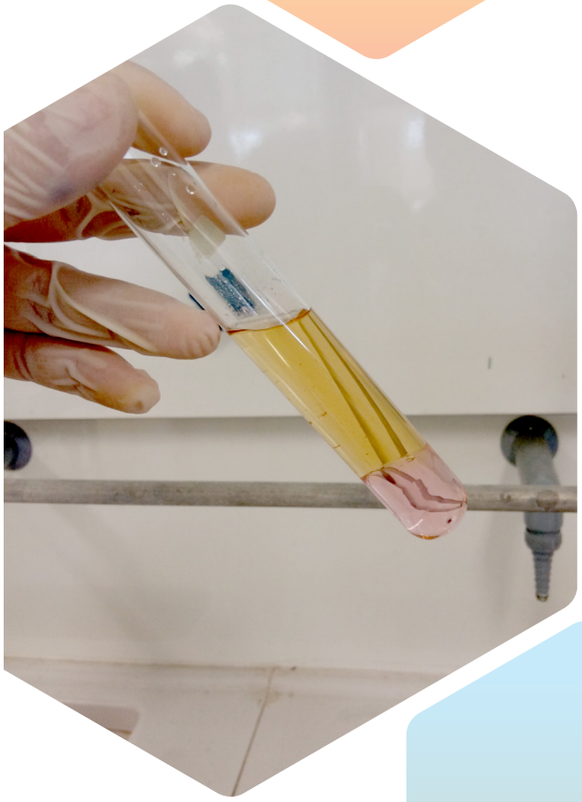
Finally, the focus on the function of language and the writing practice demonstrate the various devices for controlling and guiding content in writing. They build on the functions of language such as coherence and cohesion, exemplifying, cause and effect, summarising, peer-reviewing and evaluating. Students are given guidance to develop these important skills in confidence.

I hope this text will come up to your expectations. I wish you every success and hope you enjoy your time learning English for Chemistry.

Acknowledgements

Special thanks to all my students for piloting this with me and providing valuable input. I would also like to thank all the Chemistry Faculty of the University of Crete, Dr. Tamsyn Montagnon, research fellow in organic Synthesis at University of Crete, and Stephen Bruce from Dublin International Foundation College that contributed to the skills and content of this book with valuable recommendations. I am also grateful to Mara Kandyli for the photographs, and Graham Hodgetts for his support throughout. Finally, a million thanks to the authors of the authentic articles granting me with permission to use them and to the native speakers, Clive Birch, Graham Hodgetts, Katherine M. Julian, Katie Wrightson and Dr. Tamsyn Montagnon that lent their voices so that there is a wide variety of British accents featuring in this book.

1 Properties and states of matter



Themes
States of matter, properties of matter, physical and chemical properties, surface tension, energy types

Reading skills
Skimming and scanning
Identifying main points

Vocabulary
Collocations
Adjective suffixes

Writing skills
Paragraph structure;
Identifying topic sentences

Note-taking skills
Taking linear notes from a lecture on "States of matter"

Introducing formality and academic register
Introducing formality by comparing and contrasting two webinars on "States of matter"

Reading Strategies Skimming, scanning & intensive reading

Discussion

1 All matter exists in at least three states: solid, liquid and gas. In pairs, decide whether the following examples of matter are solid, liquid or gas: cast iron, potassium, nitrogen, steel, chlorine, mercury, carbon, carbon dioxide, chalk, sand, salt and purple cabbage extract.

2 What is needed for states of matter to change phase?

Reading

University students are often asked to read a lot of resources before they decide what is relevant to their needs at the time. To save time, they often use two speed reading techniques such as skimming and scanning.

Skimming involves locating the main points or prevalent themes without reading every word in the text. You can do so by identifying the purpose of the article and reading the topic sentences or the subheading if there are any. You can also look for any illustrations or signposting language like "Unlike the properties of solids,…". If you are familiar with the subject discussed you might as well skip it altogether.

Task 1 Skim the text and answer the following questions:

- What is the purpose of the text?
- What are the main points raised in it?
- How is the article organised?

Scanning involves locating more detailed information such as numbers, symbols and long words. It becomes easier if it follows skimming. As such, university students tend to read the introduction and the conclusion so as to check if they are relevant and useful for them.

Task 2 Find words in the text that describe the word "arrangement".

SCANNING		
		arrangement
		arrangement

Intensive and Active reading involves reading every single word in the text highlighting and underlying key points and details. Students are often encouraged to use a dictionary.

Task 3 What example illustrates crystalline and amorphous solids?

Reading

Definition of matter

Matter is anything that **occupies** space and has **mass**. All matter exists in at least three states: solid, liquid and gas depending on **temperature** and **pressure**. All three states of matter consist of **particles**, whose behaviour determines the state and the energy required for bond making and bond breaking. In fact, the differences in **spacing** and **speed** are some of the main reasons for the different **properties** of the three states of matter.

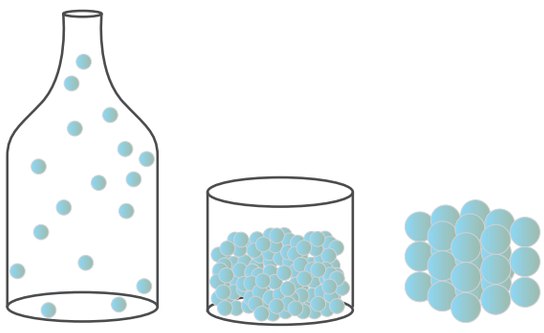


Figure 1 Visual representation of gaseous, liquid and solid particles in a container.

Classification of Solids and properties

Solids can be either **crystalline** or **amorphous**. The particles composing a crystalline solid, such as diamonds or salt, have an **ordered internal arrangement**. Solids that do not have a fixed, symmetrical internal structure are called amorphous. A species comprising an amorphous solid is a permanently super-cooled liquid, such as glass. Due to their fixed shape or **volume**, solids cannot be **compressed** or **expanded**. Although solids feature a high degree of order, their particles tend to vibrate about fixed positions and their vibrations increase with increasing energy supply. When sufficient energy is supplied, solid particles overcome the attractive (cohesive) forces that keep them together and they separate.

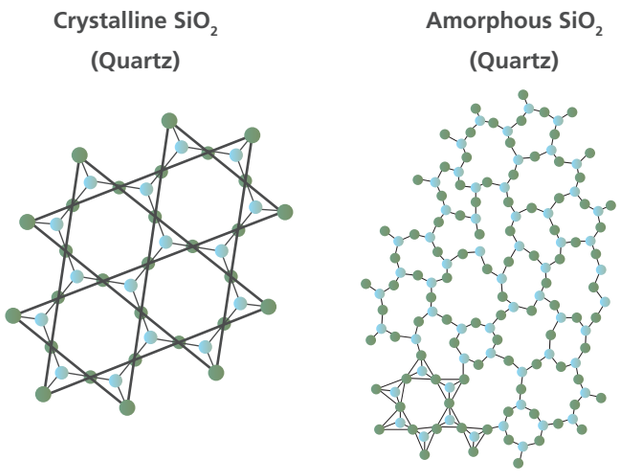


Figure 2 Visual representation of Crystalline SiO_2 and amorphous Sio_2

Properties of liquids

As in solids, liquid particles are very close together, but there is no regular or ordered arrangement. They exhibit considerable **mobility**, which increases as the temperature rises. In liquids there is a **short-range** order and a long-range disorder; hence, we often claim that they are in between the ordered solid state and the random gaseous state. Their molecules are in constant motion and they take the shape of the container they are in. Also, near the surface their

molecules cohere more strongly to the molecules adjacent to them featuring a property known as surface tension. As such, liquids with low surface tension tend to evaporate more easily.

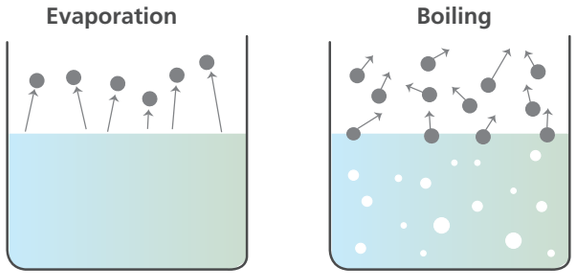


Figure 3 Visual representation of evaporation and boiling. During evaporation, bubbles cannot form when the vapour pressure is lower than atmospheric pressure. During boiling, bubbles form and rise as vapour pressure can overcome atmospheric pressure.

With the provision of more energy, liquid molecules can also overcome the attractive forces and enter the vapour phase through evaporation. The temperature drops as soon as liquid molecules turn into gas. The energy required for this separation is called heat of vaporisation and there are two key physical properties of liquids relevant to it; **boiling point** and **pressure**. The boiling point corresponds to the temperature at which the vapour pressure of the liquid equals the surrounding environmental pressure. Yet, boiling point is proportional to pressure. The lower the pressure, the lower the boiling point. Increasing the pressure applied raises the boiling point.

The nature of gases

The gaseous state is a totally **disordered** state of matter in which particles are in constant motion and attractive forces between them are negligible. In the gas state, particles have broken away from each other and are free to move around. Their random motion leads to collisions that are very elastic so there is little loss of kinetic energy. Gases that obey **Boyle's law** are known as Ideal Gases and obey the following equation $PV = k$ where P is the pressure of the gas, V is the volume of the gas, and k is a constant.

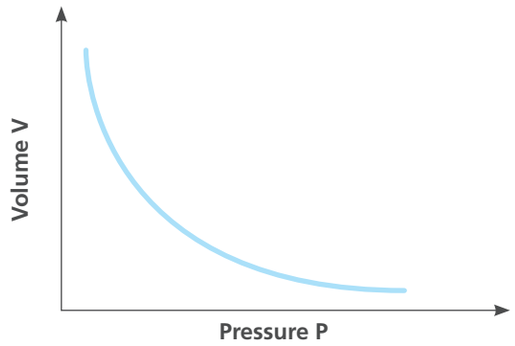


Figure 4 Visual representation of Boyle's Law

Gases compress or expand to fill the available space and **exert** a uniform force i.e. pressure on the walls of their container. However, the concepts of pressure and temperature deserve a little more discussion. The former is a measure of the force exerted by a gas per unit area with SI units of **Newtons per square metre (Nm-2)**, more commonly referred to as **Pascals (Pa)**. The latter is a measure of the average translational kinetic energy of the molecules. In a hot gas, for example, the molecules are faster than those in a cold gas; due to the increased velocity of the molecules, the temperature (i.e kinetic temperature) is greater while the mass remains the same.

Types of energy

Without energy matter cannot escape from one state to another. There are two important classifications of energy; potential energy and kinetic energy. In fact, an object possesses energy by virtue of its position (**potential** energy) or by motion (**kinetic** energy).

Figure 5 Examples of potential and kinetic energy

4 Laboratory safety issues

Themes
Laboratory safety issues and regulations, laboratory tools and equipment

Introduction to Paraphrasing
Causes and effects of lab accidents

Expressing purpose
Note-taking task

Following instructions
Note-taking task

Adverbial phrases

Adjectives
Negative prefixes

Tenses
Past simple, past continuous

Discussion

Task 1 Look at the chemist in the photo. Is she wearing appropriate lab attire on page 84?

Task 2 Look at the precautionary labels below. In pairs, write down the purpose of each precautionary label.

Figure 1 *Old Hazard Symbols by the Indian Institute of Technology Indore (2017)*

Task 3 What can be the causes of the following accidents? What are the precautions that should have been taken in advance?

- blindness
- burnt skin or hands, minor blast or implosion damage

- stains or fabric penetration of aggressive chemicals
- breathing problems
- a fracture
- poisoning
- electric shock and fire form sparks

Task 4 **Before you read the text, work with your partner and suggest examples of how the following attitudes may lead to an accident in the laboratory.**

- lack of personal hygiene
- insufficient provision of ventilation
- avoiding impervious personal protective equipment
- poor storage practices
- electrical hazards
- poor precautionary labelling
- unaware personnel in the event of an emergency
- personal responsibility

Reading

Task 5 **In pairs, read the topic sentences and give each section a subheading.**

A It is often argued that accidents are fortuitous. Yet, this is not so. In principle, were we sensible enough all causes are foreseeable, most of the potential hazards are known in advance; **thus**, most accidents can be prevented. Not surprisingly, **the predominant cause of** laboratory accidents is mainly the laboratory worker who might inadvertently overlook signs, precautionary measures and regulations.

B Inappropriate lab attire or eye protection **can often be the reason for** irrevocable injury. For instance, goggles might be replaced by glasses, which may render protection totally inadequate. Likewise, face protection might not always meet accepted standards as a half-shield mask leaves mouth, chin and neck exposed. As for clothing, the rate of permeation of aprons or glove materials might have not been appropriately tested **resulting in** aggressive chemicals penetrating the fabric. What is more, loose sleeves, unrestrained long hair, a wristwatch with a porous or absorbent strap are pertinent examples of unsuitable personal dress.

C Hazards can also **stem from** improper ventilation. Hoods in poor condition, inadequate drafts, improperly located hood exhausts that recirculate noxious fumes back into the laboratory are predominant causes of air poisoning and suffocation.

D Poor personal hygiene also **accounts for** laboratory accidents. Although pipetting by mouth is not allowed, it is at times used. Beakers, flasks, watch glasses, petri dishes or other pieces of equipment are sometimes used instead of cups, saucers, and bowls for the consumption of food and drink. What is more, some personnel regularly apply cosmetics while in the laboratory and use the eye wash fountain as a source of drinking water.

E The occurrence of electric hazards is more than frequent and **is mainly attributed to** poor maintenance. Electrical wiring may not be in compliance or completely violates the National Electric Code. Some sockets may support a tangled array of plugged-in wires; frayed wires and corroded plugs and sockets may still be in service; wires are likely to be spilled by a nearby oxidising reagent.

F Inadequate storage of chemicals **can also provoke** hazards and **result in** accidents. Incompatible chemicals are not segregated into separate storage locations. In some unlikely cases, there is

no provision for storage in approved flammable liquid storage cabinets; for instance, cardboard boxes containing glass or metal containers of flammable liquids are stored in a flammable liquid storage cabinet. Sadly, we have become witnesses of non-explosion-proof refrigerators used to store liquids that produce explosive vapours (Young, 2003).

G Inappropriate equipment is one of the **most prevalent causes of** accidents and equipment related accidents **result from** a variety of reasons; fire extinguishers are not regularly maintained, records are not available, no plans exist for shutting off utilities in case of emergency, emergency evacuation plans do not include provision for specified meeting place, fire doors are routinely left open or blocked and emergency drills are rarely carried out.

H **Therefore**, it is advisable we use the approved guidelines and become conducive to eliminating most accidents in the laboratory.

References

Young J.A. (Ed.) (2003) Safety in Academic Chemistry Laboratories: accident prevention for college and university students, Vol.1. American Chemical Society (ACS) Retrieved from: https://www.acs.org/content/dam/acsorg/about/governance/committees/chemicalsafety/publications/safety-in-academic-chemistry-laboratories-students.pdf (accessed on 26/06/2017)

Introduction to paraphrasing strategies

As plagiarism is an academic crime, students are advised to paraphrase the original source and provide in text citations in order to acknowledge the authors. Unlike other disciplines, chemistry writers are not expected to use direct quotations, which renders mastering paraphrasing skills a vital writing component. Although there is is no remedy for legitimate paraphrasing, the following strategies when combined wisely, they can contribute to legitimate paraphrased versions:

- Using synonyms or antonyms
- Using different forms of speech to express an idea (nouns to verbs, adjectives to adverbs.
- Using passive voice vs active voice
- Changing the order of information in the paragraph.
- Acknowledging the author(s)

Vocabulary building

Task 5 Match the following adjectives on the left with their synonyms on their right:

fortuitous	harmful
predominant	improper
foreseeable	permeable
inadequate	accidental
porous	inappropriate
unsuitable	prevailing
noxious	predictable
advisable	useful

Antonyms

As well as synonyms, the opposite meaning of a word can be used. This can be done either by the use of antonyms or by using the negative prefixes.

Negative adjective Prefixes

The opposite of an adjective can be formed if you add in the beginning the prefixes un-, im-, il-, in-, ir-, or dis- anti -non.

Task 6 Look at the following list of opposite adjectives. Can you induce the rules for some of them?

proper	improper	qualified	disqualified
appropriate	inappropriate	suitable	unsuitable
sufficient	insufficient	relevant	irrelevant
legal	illegal	bacterial	antibacterial

Task 7 What are the opposite adjectives? In what other ways can we express the opposite meaning of adjectives?

compatible	available	approved
regular	corrosive	wise
specified	proportional	absorbent
resistant	flammable	careful

Task 8 Paraphrase the following sentences by using using passive voice and changing the order of information provided.

1 A number of applications derive from recent research into porous materials such as porous aluminosilicates.

2 Researchers point out the rich possibilities for new material structures bearing a broad array of ligands, structural, magnetic, optical and catalytic properties.

3 In order to make a coordination polymer, a potentially bridging ligand needs to react with a metal ion that has more than one vacant to labile site (figure 2).

4 Ion exchange is another property of zeolites which has lead to their applications of detergents and water softeners.

5 Researchers have recently reviewed advances in inorganic porous frameworks based on elements such as metal phosphates, sulphides and chlorides.

Sentences adapted and abridged from James S.L. (2003) Metallic Organic Frameworks. Chem. Soc. Review. 32; pp: 276–288.

Task 9 Paraphrase the previous sentences changing only forms of speech. You can turn verbs to nouns, adjectives to adverbs and vice versa.