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CHEMICAL COMMUNICATIONS IN ENGLISH FOR SPECIFIC PURPOSES

Recommended by Igor Sikorsky KPI Methodological Council as a study e-book for undergraduate students of specialty 161 “Chemical technologies and engineering”

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The Study Electronic Book

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CHEMICAL COMMUNICATIONS IN ENGLISH FOR SPECIFIC PURPOSES

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ABSTRACT. This study e-book is recommended for classroom work with undergraduate students of the faculty of chemical technology. The main goal of the publication is to develop future chemists' competences in English speaking, listening, reading, writing as well as development and improvement of translation skills. This book consists of five units and six creative projects which comprise real professional themes for teaching chemists. In addition, there are worksheets useful for group work. This e-book corresponds to the requirements of the study program of credit modules within the discipline "Foreign Language".

CONTENTS

Preface

Chemical communications in English for Specific Purposes is a set of practical exercises, creative projects and photocopiable worksheets for future chemists who study English as a foreign language at tertiary level. It contains audio transcripts and full answers.

There are five units on the basic topics of chemistry. These are *chemistry as a science, chemistry as the study of matter, properties of elements, compounds and mixtures, creating and interpreting chemical graphs, and chemistry as a profession.* Each unit consists of listening, reading, writing, speaking and translation tasks. At the end of each unit there is a writing task. The book covers key facts and concepts from Chemistry, thereby giving students a running start for when they tackle these topics again in their faculty work.

Chemical communications in English for Specific Purposes is designed to improve the communication skills and specialist language knowledge of chemists; with an emphasis on speaking in pairs or in small groups.

The book contains exercises and projects to foster creativity in the English for Specific Purposes. It is based on the belief that creative approach provides deeper insight into content and leads to stronger learning outcomes. This approach fosters multimedia and art elements usage in the English for Specific Purposes. Thus, some of the tasks of creative projects refer to online recycling programs, virtual tours of universities, mobility programs. The idea is to help students get used to searching for information in English. Creative tasks of the book involve poster drawing, creating recycled robots, making videos, writing poems, creating quizzes, and describing sculptures.

Authentic texts and infographic used in the book are taken from chemistry books or online resources mentioned in the reference. All exercises and projects were developed by the authors.

We hope that this book will be practical and motivating for your students.

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Unit 1

Chemistry as a Science

SPEAKING AND VOCABULARY

1. Answer the questions.

1.What branches of chemistry do you know?

2.What branch do you major in?

2. Match the branches of Chemistry in A with the correct area of emphasis in B.

A	B
1. Organic chemistry	a) The behavior and changes of matter and the related energy changes
2. Inorganic chemistry	a) Components and composition of substance
3. Physical chemistry	b) In general, matter that does not contain carbon
4. Analytical chemistry	c) Most carbon-containing chemicals
5. Biochemistry	d) Matter and processes of living organism

READING AND VOCABULARY

3. a) Add more ideas to column A in Ex. 2.

b) Compare your answers with the ideas from the text.

Sub-branches of chemistry include **astrochemistry** (the chemistry in stars and interstellar gas and dust), **electrochemistry** (what happens when electrical currents flow through chemicals), **food chemistry**, **geochemistry** (the study of the composition of the Earth), **nuclear chemistry, polymer chemistry, spectroscopy, theoretical chemistry**, and many others.

TRANSLATION

4. Translate the sentences into your native language.

A. Match each of the following research topics with the branch of chemistry that would study it: water pollution, the digestion of food in the human body, the composition of a new textile fiber, metals to make new coins, a treatment for AIDS.

B. Metallurgy is the branch of applied science that studies and designs methods for extracting metals and their compounds from ores.

C. You now know much of the basic chemistry on which advanced chemistry is based. This chapter introduces an important branch of chemistry called electrochemistry. Electrochemistry is the study of the process by which chemical energy is converted to electrical energy and vice versa.

D. An entire branch of chemistry, called organic chemistry, is devoted to the study of carbon compounds.

E. We hope to encourage you in your studies and to help you learn to solve problems in ways you can apply in all areas of your professional and personal lives.

F. One study based on data from 27 countries showed an inverse relationship between the cancer death rate and the selenium content of soil in a particular region (low cancer death rate in areas with high selenium content).

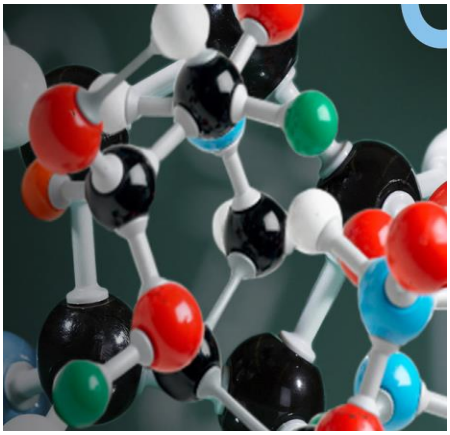
SPEAKING AND VOCABULARY

5. a) Look at the photos and answer the questions.

1. What branches of chemistry do they show?
2. How would you depict other branches of chemistry?

b) Draw the picture and let your partner guess the branch.

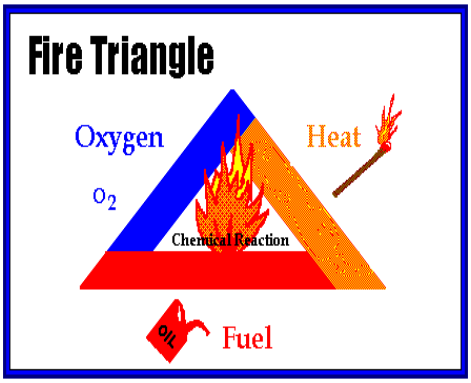
1.



2.

3.

4.



5.

6.

6. a) Answer the question.

What branches of chemistry can these phrases belong to?

Use the dictionary if necessary.

Plastics	**Pharmaceuticals**	**Minerals**	**Metals and nonmetals**	
Semiconductors	**Reaction rates**	**Food nutrients**	**Quality control**	
Metabolism	**Fermentation**			

b) Discuss your ideas with your partner.

LANGUAGE IN USE

7. Find *Present Simple* mistakes in these sentences/questions.

A. What process the figure show?

B. What the colored particles represent?

C. The pharmaceutical industry one of the most profitable worldwide.

D. Scientists works with various models of carbon structures.

E. Chemistry are traditionally broken down into the branches listed in the Table.

F. Environmental chemistry deal with the role chemicals play in the environment.

G. Nutrients are the components in food that an organism use to survive and grow.

H. The electrical conductivity of a semiconductor opposite to that of a metal.

READING AND VOCABULARY

8. a) Answer the questions.

1. Why did you choose your branch of chemistry?
2. Would you like to study organic chemistry?

b) Read the text and explain the words in bold. Use the dictionary if necessary.

c) Think of five different questions to this text. Work in pairs and ask each other.

HOW IS ORGANIC CHEMISTRY DIFFERENT FROM REGULAR CHEMISTRY?

Organic chemistry is the study of carbon **compounds**[1]. Carbon is special. It is small and has only six electrons. Two of them are in the low energy inner **cloud**[2], leaving four in the outer cloud where they can form **bonds**[3] with other atoms. These two things are what make carbon special.

Being small, carbon can easily fit into **molecules**[4] that would not have room for larger atoms. Being small also means that the electrons are close to the **nucleus**[5], so strong bonds can be formed. Having four outer electrons means that carbon also has four **empty slots**[6] for electrons from other atoms, since the second **electron shell**[7] has room for eight electrons. Carbon can form lots of bonds with other atoms, forming long **chains**[8], **loops**[9], **sheets**[10], branching tree-like structures, and many other forms. This **versatility**[11] is what leads to life. We call carbon chemistry organic because life is based on carbon compounds.

Organic chemistry is the study of carbon compounds whether or not they come from **living things**[12]. We can see carbon compounds in interstellar dust, inside meteorites, in coal and **petroleum**[13], and in the flames as carbon-based fuels burn. Organic chemistry is usually thought of as the chemistry of compounds that have a C-H bond (carbon bonded to hydrogen), although there are organic molecules that have no hydrogen, such as Teflon.

The study of chemical reactions in living things is a separate branch of chemistry called biochemistry. Of course, the two fields (organic chemistry and biochemistry) are closely related and **overlap**[14] in many areas. Inorganic chemistry also with organic chemistry, as many simple carbon compounds such as chalk and carbon dioxide are considered inorganic, even though both are usually made by living things.

LISTENING AND SPEAKING

9. a)  **[1]Listen and complete the sentences.**

Your _____[1] has lots of examples of chemistry.
_____[2], _____[3], _____[4] are actually one chemical.
_____[5] water is the example of liquid.
Due to heat energy molecules hit like _____[6].

b) Answer the questions.

What other examples of everyday chemistry do you know?

What would you show in the poster on this topic?

c) Prepare your own poster on kitchen chemistry in a group of 3-4 students. Present it in a group. In the photos (Appendix A) you can see some ideas of students of inorganic chemistry department of Igor Sikorsky KPI.

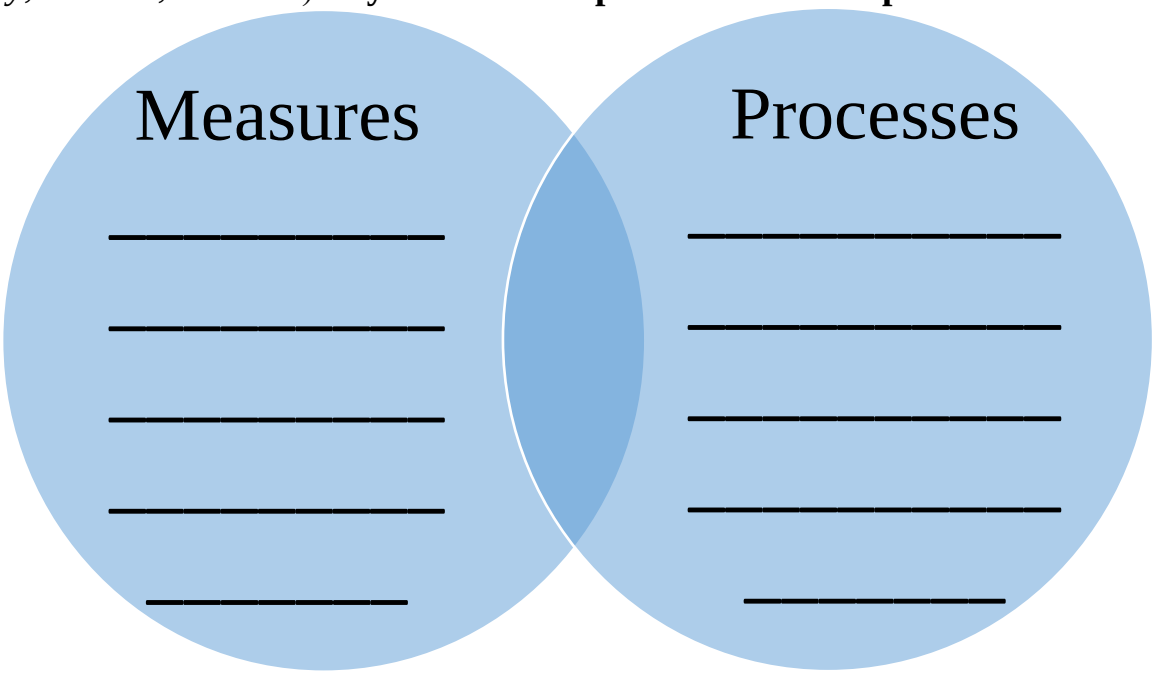
WRITING

10. a) Answer the question.

What is your favourite recipe?

b) Check some recipes online.

c) Work in pairs to brainstorm as many items of quantity/measurement (*for example, a teaspoon, a litre of, a bunch of …*) **and processes** (*to boil, to chop, to fry, to roast, to stir…*) **as you can. Complete the mind map.**



11. a) Work with Worksheet F.

b) Write your own recipe including a title, a short introduction, the exact measurements of each ingredient, and processes. In the introduction state the overall cook time, what occasion your dish is best for, why you like it. Write 200-250 words.

Unit 2

Chemistry as the Study of Matter

SPEAKING AND VOCABULARY

1. a) Answer the questions.

What do you know about……

a) composition/structure of matter,
b) physical properties of matter,
c) chemical properties of matter,
d) states of matter?

b) Match a-d from Ex. 1 a with 1-4 below.

1.	Gas, liquid, solid
2.	**Color**[1], shape, **hardness**[2], texture, **luster**[3], **solubility**[4], boiling point, melting point, **density**[5], **magnetism**[6], mass, volume, length
3.	**Reactivity**[7] with other chemicals, **toxicity**[8], **flammability**[9], chemical **stability**[10], types of chemical bonds
4.	atoms and molecules [tightly bonded groups of atoms].

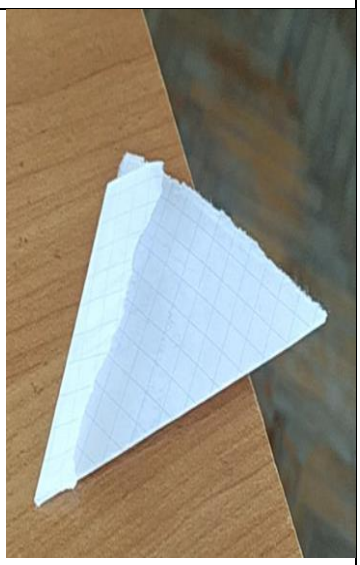
LANGUAGE IN USE

2. Make adjectives from nouns in bold (1-10) in the table.

WRITING AND SPEAKING

3. a) Describe the states and properties of matter in the photos.
b) Discuss in pairs

		
1. Alloy is a solid substance. It is malleable, ductile, strong, hard, conductive, corrosion-resistant.	2.	3.

		
4.	5.	6.
		
7.	8.	9.
		
10.	11.	12.

READING AND SPEAKING

4. a) Answer the questions.

1. Why is it important to know the properties?
2. How can engineers use the properties?

b) Read and compare your answers with the ones in the text.

Engineering Connection

Engineers use the properties of matter to decide what materials to use when creating and building things. For example, metals have certain properties that allow them to bend or not bend, to expand and contract, and to hold certain amounts of weight. Engineers also use the chemical properties of different elements to develop mixtures and substances for new medicines and products.

5. a) Answer the questions.

1. Are all things around us matter?
2. Are heat and light, love, shadows, echoes, rainbow matter?
3. Why do you think so?

b) Read the conclusion in the table.

1. *Matter has mass and takes up space*
2. *It can be expressed with a chemical formula from the elements on the periodic table.*

c) Come up with more examples of things that are not matter.

SPEAKING AND VOCABULARY

6. a) Answer the questions.

May states of matter be changed? What is needed to make this possible?

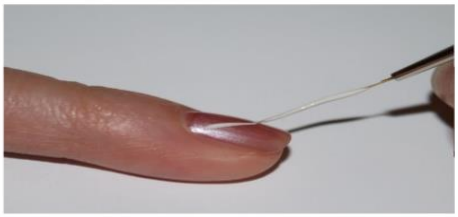
Study the changes of matter in each picture.

b) Decide if the change is chemical or physical.

c) Write the answers in the table as in the example.

d) Compare your answers with your partner. Discuss them in pairs.

	What is changing?	**What kind of change?**
	1. *Stretching rubber may change its color and shape*	*Physical change: it's still made of rubber and it is still a rubber band*

Leaves decomposing 	2.	
 A car wreck	3.	
Painting fingernails 	4.	
	5.	

	6.	
 Melting ice cream	7.	
 	8.	
 Wood burning	9.	
	10.	

Wrinkled shirt/ ironed shirt 	11.	
	12.	

e) Think of other examples of changes and answer the questions.

1. What is changing and what kind of change is it?
2. Can it be both chemical and physical change?

f) Discuss in pairs.

TRANSLATION

7. a) Translate these examples of chemical changes.

Chemical changes	Translation
1. Rusting of iron	
2. Combustion of wood	
3. Metabolism of food in the body	
4. Mixing an acid and a base, such as hydrochloric acid (HCL) and sodium hydroxide (NaOH)	
5. Digesting sugar with the amylase in saliva	
6. Milk going sour	
7. Mixing baking soda and vinegar to produce carbon dioxide gas	
8. Electroplating a metal	
9. Explosion of fireworks	
10. Rotting bananas	

b) Prepare the same list of physical changes.

WRITING AND LISTENING

8. a) Write the definitions to the terms.

	Definition
1. Matter	
2. Atoms	
3. Compounds	
4. Molecule	
5. Elements	
6. Solid	
7. Liquid	
8. Gas	

b)  **[2] Listen and check your answers.**

c) Complete the gaps [1-8].  **[3] Listen and check your answers.**

Matter has _____[1] and occupies _____[2]. It is composed of tiny particles called _____[3].

■ Matter exists in three _____[4]:

• Solid − is a rigid substance with a definite _____[5]

• Liquid − has a definite volume but takes the shape of its container

• Gas – takes the shape and volume of its container

■ Elements contain only one kind of atom − elemental copper contains only _____[6] atoms, and elemental gold contains only _____ [7] atoms.

■ Compounds are substances that contain two or more kinds of atoms.

■ Compounds often contain discrete molecules.

■ A molecule contains atoms _____[8] together in a particular way − an example is, the water molecule, which is written H_2O.

READING AND VOCABULARY

9. a) Read and answer the questions.

1. What was the temperature of lava?
2. What substances were changing and how?

Cooling the Lava

The eruption came out of nowhere. Earthquakes had not even alerted the people who lived on the island of Heimay (part of Iceland). Even Icelandic seismologists thought nothing of them. Then it happened, on January 23rd, 1973- a new volcano erupting awakened the country.

The sounds that accompanied the eruption were equivalent to low-pitched roars. Then the volcano exploded violently, sending molten rock hurling into the air. Nearly all of the island's residents were evacuated to the mainland. For months the volcano would spill constant streams of lava (liquid or molten rock) over its edge. Its slow and steady progress began to approach the village on Heimay.

What worried the people of the island the most was that the volcano's lava migrated toward the harbor. It threatened to fill the harbor, which, was the center of the economic life of this fishing community.

On the third day of the eruption, there was a sudden onrushing of the lava and twenty-three houses and a large fish plant were engulfed in a single night. It was astonishing to see what an essentially liquid body of rock would destroy in its path.

b) Answer the question: In your opinion is it possible to cool the lava?

Cooling the lava was Thorbjorn's idea. That such a feat had not been tried, let alone accomplished, in the known history of the world did not burden Thorbjorn, a physicist, who had reason to believe it could be done. During a previous eruption, Thorbjorn watched lava approach the sea. He had noticed the lava flow to the beach and then follow the coastline for a long distance. "The sea cooled it," he explained. "Then lava ran along the cooled wall. I wondered could anything similar be done by man?"

The people on Heimey reasoned that buildings could be rebuilt, but if they lost the harbour it would be gone forever, and with it their livelihood. The Icelanders therefore sprayed seawater on the lava to try to slow or stop its movement. It was the largest effort ever exerted to control volcanic activity. More than 19 miles (30 km) of pipe and 43 pumps were used to deliver sea water at a rate of up to 1.3 cubic yards per second. By the end of the eruption, the people in Iceland had pumped 8 million cubic yards (6 million cubic meters) of water onto the flow.

The molten lava was about two thousand degrees Fahrenheit. Where the lava came in contact with the water it changed states from liquid to a solid, creating a wall of chilled lava to dam the flow. The water hitting the lava produced billows of steam. By early May, about 300 buildings had been engulfed in the lava despite the effort to try and restrict the lava flow.

Not only did the tremendous efforts save the port they actually improved it. The residents returned to rebuild their town and even use the heat from the cooling lava to construct a heating system. One scientist from Iceland said, "If we hadn't done something, I very much doubt that we would be here now.

c) Choose the word closest in meaning to these words from the text. Mark your choice *a, b, c*.

	a protect		a outbreak
1. alert	b awaken	2. eruption	b engulf
	c set		c flood
	a send		a stable
3. spill	b flow	4. steady	b changeable
	c walk		c positive
	a locate		a get away
5. migrate	b move	6. approach	b get closer
	c place		c get started
	A move		a strange
7. engulf	b flood	8. astonishing	b boring
	c destroy		c amazing
	a posed		a new
9. accomplished	b completed	10. similar	b alike
	c set		c few

	a argue		a hot
11. reason	b agree	12. chilled	b cool
	c arrange		c dry
	a struggle		a stop
13. effort	b war	14. restrict	b continuer
	c research		c limit
	a great		a renew
15. tremendous	b terrible	16. improve	b deteriorate
	c typical		c get better
	a step forward		a warmth
17. return	b stay	18. heat	b width
	c go back		c depth

LISTENING

10  4-6 **Listen to the podcasts and complete the gaps.**

a) Radon is the product of the decay of other unstable, radioactive elements such as radium, thorium and actinium. The colourless, _____[1], tasteless gas can be isolated from these sources but soon decays as it has no stable isotopes. The early _____[2] in the study of radioactivity, the Curies, had noted that radium appeared to make the surrounding air _____[3]. The discovery of radon is credited to a German physicist Friedrich Ernst Dorn, who traced this observed radioactivity to a gas which was given off by radium − a gas which he called 'radium emanation'. Similar 'emanations' were isolated from other elements - for example thorium, and eventually the gas was identified as the _____[4] of the noble gases, named radon, and given its rightful place in the periodic table.

b) Boron is usually isolated as a brown, _____[5] solid. I don't know anyone who thinks the element boron has anything _____[6] about it. But its unexpected side starts to emerge when you look at some _____[7] compounds of boron. Consider the nitride, for example - just the 2 elements at numbers 5 and 7 in the periodic table, but able to join forces to provide _____[8] diamond or _____[9] graphite-like structures, very similar to those of the 6th element, carbon.

Then there is the trifluoride - remember that acids were first classified as substances that could provide protons, but BF_3 is the archetypal Lewis acid, which doesn't have a proton in sight, yet is able to coordinate with lone pairs, allowing it to catalyse an array of reactions. It can achieve this chemistry because boron really does have two sides to it - it is set up to form 3 bonds with _____[10] atoms, but even in this state, readily forms an _____[11] bond in order to complete the 2nd main shell of 8 electrons. but when it does this, it acquires a _____[12] charge, and it can only regain neutrality by losing one of its bonds - it really does have a split personality.

c) Titanium. It is notoriously hard to make, but we have come to rely on it and indeed we couldn't do without this element or its compounds today.

So, why is it so important? The most _____[13] compound is the oxide TiO_2, which makes up 95% of the Ti used worldwide. We actually use 4 million tons of TiO_2 each year, a lot of it for paint and other applications that need something that is bright white, _____[14] and not toxic, like medicines and toothpaste. In the food industry it is _____[15] number E171, used to whiten things like confectionary, cheeses, icings and toppings.

It is also used in sunscreens, since it is a very _____[16] white and also very good at absorbing UV light. The ability to absorb UV light helps the TiO_2 to act as a photocatalyst. This means that when UV light falls upon it, it generates free electrons that react with molecules on the surface, forming very _____[17] organic free radicals. Now you don't want these radicals on your skin, so the TiO_2 used in sunscreens is coated with a _____[18] layer of silica or alumina.

11. a) Record an audio track (≈ 1 min.) describing the properties of a particular matter. Don't name the matter. Let other students listen and guess.

WRITING

12. a) Work with worksheet D.

b) Choose a particular element and write why it is important, where we can encounter it and how it is used. Write 200-250 words.

Unit 3

Properties of elements, compounds and mixtures

SPEAKING AND VOCABULARY

1. **a) Answer the question.**

   What types of properties of matter do you know?

   b) Group the words and phrases into the correct column A or B.

Color, shape, reactivity with other chemicals, hardness, types of chemical bonds, texture, toxicity, luster, solubility, boiling point, flammability, melting point, density, magnetism, mass, volume, length, chemical stability

A. Physical properties	B. Chemical properties

2. **a) Complete the table with the words.**

Water, oxygen, silver, white, solid, liquid

Table 1. Physical properties of common substances

Substance	Color	State at 25ºC	Melting point (ºC)	Boiling point (ºC)	Density (g/cm^3)
1)_____	colorless	Gas	-218	-183	0.0014
Mercury	3)_____	Liquid	-39	357	13.5
2)_____	colorless	5)_____	0	100	1.00
Sucrose	white	6)_____	185	Decomposes	1.59
Sodium chloride	4)_____	Solid	801	1413	2.17

b) Describe your partner the physical properties of common substances using the information from the Table 1. Tell your partner about physical properties of other substances.

3. Complete the gaps with the words *element(s)* or *compound(s)*.

1. Water is converted into two simpler substances, hydrogen and oxygen; furthermore, hydrogen and oxygen are always present in the same ratio by mass, 11.1% to 88.9%. These observations allow us to identify water as *a/an* _____.

2. *A/an* _____ is a substance that can be decomposed by chemical means into simpler substances.

3. Neither of the two gases obtained by the electrolysis of water − hydrogen and oxygen − can be further decomposed, so we know that they are _____.

4. Pure calcium carbonate (a white solid present in limestone and seashells) can be broken down by heating to give another white solid and a gas in the mass ratio 56.0:44.0. This observation tells us that calcium carbonate is *a/an* _____.

READING

4. a) Answer the questions:

1. What do the abbreviation IUPAC stand for?
2. How do we represent the elements?
3. Who names them?

b) Read the text and check your answers.

We use a set of symbols to represent the elements. These symbols can be written more quickly than names, and they occupy less space. The symbols for the first 109 elements consist of either a capital letter or a capital letter and a lowercase letter, such as C (carbon) or Ca (calcium).

In the past, the discoverers of elements claimed the right to name them, although the question of who had actually discovered the elements first was sometimes disputed. In modern times, each new element is given a temporary name and a three-letter symbol based on a numerical system. This designation is used until the question of the right to name the newly discovered element is resolved.

Decisions resolving the names of elements 104 through 112 have been announced by the Chemistry International Union of Pure and Applied (IUPAC), an international organization that represents chemical societies from 40 countries. IUPAC makes recommendations regarding many matters of convention and terminology in chemistry. These recommendations carry no legal force, but they are normally viewed as authoritative throughout the world.

LISTENING AND VOCABULARY

5. a) Write the name of the element for each symbol.

b) Listen to the song *The Periodic table of elements* https://www.youtube.com/watch?v=-I7l8TgtuLQ and check your answers

Ag	*silver*	F		Ni	
Al		Fe		O	
Au		H		P	
B		He		Pb	
Ba		Hg		Pt	
Bi		I		S	
Br		K		Sb	
C		Kr		Si	
Ca		Li		Sn	
Cd		Mg		Sr	
Cl		Mn		Ti	
Co		N		U	
Cr		Na		W	
Cu		Ne		Zn	

c) Read the chorus. Listen one more time and sing the song.

[Chorus]
This is the Periodic Table
Noble gas is stable
Halogens and Alkali react aggressively
Each period will see new outer shells
While electrons are added moving to the right

6. a) Answer the questions of the quiz:

What element(s)

1) Takes its name from the Latin *iris*, meaning "rainbow?"
2) Are named after the planets?
3) Include "sun", "earth", "moon"?
4) Are derived from the ores potash and soda.
5) Comes from Prometheus, who stole fire from heaven, Scandinavian goddess Vanadis, Titans, the first sons of the earth, Tantalos, father of the Greek goddess Niobe, and Thor, Scandinavian god of war?
6) Are "Geographical elements" shown on the map: the Latin names for Russia, France, Paris, and Germany?

7) Are honoring important scientists?

8) Is named in honor of the Dubna laboratory in the former Soviet Union, where important contributions to the creation of heavy elements have originated?

b) Do you know the origin of some other elements? Where do the names of the elements usually come from?

7.  **Listen and complete the gaps 1-5.**

■ All of the materials in the universe can be chemically broken down into about _____[1] different elements.

■ _____[2] elements account for about _____[3] of earth's crust, oceans, and atmosphere.

■ In the human body, oxygen, carbon, hydrogen, and nitrogen are the most _____[4] elements.

■ Each element has a name and a symbol.

• The symbol usually consists of the first one or two letters of the element's name.

• Sometimes the symbol is taken from the element's original _____[5] name.

WRITING AND VOCABULARY

8. Use the dictionary to write the definitions.

Electron	
Nuclear atom	
Nucleus	
Proton	
Neutron	
Isotopes	
Atomic number	
Mass number	

SPEAKING AND VOCABULARY

9. Answer the question:

If you discovered a new element, how would you name it and why?

10. a) Student A. Read out the facts a-h on your own, explain the meaning of new words to other students. Decide on the best order to read out the facts about gold starting from the least known.

Other students: Guess the name of a substance. Use modals MUST, MIGHT, COULD, CAN'T for deduction.

a) The biggest nugget that has ever been found weighed approximately 90 kilograms and was **unearthed** in Australia *to unearth – to get out of the earth*	b) The word **derives** from the Old English word Gelo meaning yellow. *to derive – to come from something*
c) There are more than 400 references to it in the Bible	d) The Greeks thought that it was a dense combination of water and sunlight.
e) Out of one ounce of this substance (app. 31 gram) one can make a **wire** almost 100 kilometer long. *wire – a piece of thin metal*	f) In 2008 China **overtook** South Africa as the world's largest producer of the substance *to overtake – to develop or increase more quickly*
g) In ancient Egypt, it was considered the skin or flesh of the gods, particularly the Egyptian sun god Ra.	h) When pure it is so soft that it can be moulded with the hands. *Mould – /məʊld/ – to make a soft substance a particular shape*

b) Answer the question: Which fact about gold is the most surprising to you?

READING AND VOCABULARY

11. a) Answer the questions:

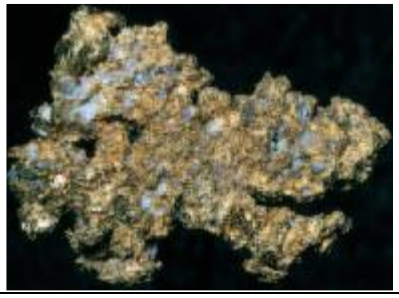
1. What is a Gold Rush? Why did it happen? Where and When?
2. Why is gold so expensive?
3. Why do people like wearing it?

b) Read and get more information about gold.

During the California gold rush, miners relied on gold's characteristic density (19 g/cm^3) to separate **valuable** gold-containing **flakes** from riverbed sand. In some cases, a single **intensive property** is unique enough for **identification**.

Another intensive property of gold is its distinctive appearance. Unfortunately, miners often learned that identification of gold based on appearance alone was **misleading**.

The Picture below shows a **nugget** of the relatively worthless mineral pyrite, often called "fool's gold," which looks very **similar** to actual gold nuggets. Such errors in identification based on the intensive property of **appearance** fooled many miners into falsely thinking they had become rich.

	
Gold	Pyrite

c) Answer the questions.

1. What do you know now about the physical properties of gold?
2. Can miners identify gold based on its appearance?
3. Is it possible to confuse gold with other substance?

d) Match the words in bold with the definitions

1	almost the same
2	likely to make someone believe something that is not true
3	the act of recognition
4	a small thin piece
5	independent of the amount property
6	worth a lot of money
7	a small rough piece of a valuable metal found in the earth
8	the way something looks

e) Answer the question.

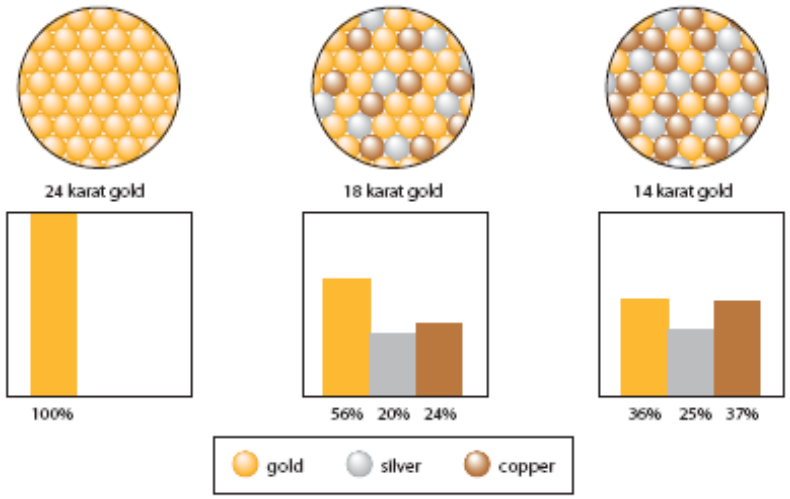
How many karats does your or your partner's ring/ear ring/chain have in your opinion?

f) Describe the Picture 1 below and read the text to get more information about karats.

If you wear a gold ring, you are wearing a mixture. Pure gold, is really quite soft. Because it bends easily, the pure form is not useful for jewellery. Only when we mix gold with other metals such as silver and copper does it become **sturdy** enough to make rings and chains.

Your ring might be 14-karat gold − that is, it contains 36 atoms of gold for every 25 atoms of silver and for every 39 atoms of copper. Or your ring might be 18-karat gold − that is, it contains 56 atoms of gold for every 20 atoms of silver and for every 24 atoms of copper. Mixtures of metals are called **alloys**.

Many gold alloys exist, containing varying amounts of gold, silver, and copper atoms. Alloys are mixtures − their composition varies. Twenty-four-karat gold is an element. It contains only gold atoms.



Picture 1

As I mentioned, gold is a relatively soft metal, so high-karat stuff are often easily damaged. A 24 karat item is generally reserved for display or ceremonial use. In the stores, most gold items have a karat rating in the range 9 to 18. In the US, the minimum karat value for gold jewelry to be sold is 10, but in the UK 9 karat is more common. In addition, gold purity does not affect its weight! Different color of gold is mixed with different other metals. For example, gold mixes copper is called red karat gold.

g) Answer the question.

What are the most expensive presents men/women get?

SPEAKING AND VOCABULARY

12. a) Answer the question.

What is a third-most-consumed industrial metal in the world, after iron and aluminum?

b) In pairs group the properties of copper from Table 1 into physical and chemical properties (columns A and B).

Table 1. Properties of copper	
• Reddish brown, shiny • Forms green copper carbonate compound when in contact with moist air • A deep blue solution appears when in contact with ammonia • Density = 8.92 g/cm^3 • Boiling point = 2570°C	• Easily shaped into sheets (malleable) and drawn into wires (ductile) • Good conductor of heat and electricity • Forms new substances when combined with nitric acid and sulphuric acid • Melting point = 1085°C
A. Physical properties --- --- --- ---	**B. Chemical properties** --- --- --- ---

c) Answer the questions.

- What is your favourite monument on the campus/in your country? Why?
- What material is it made of?
- How does the Statue of Liberty look like? What is it made of in your opinion?
- What are the most widely used metals in the world?
- What material are statues of **Table 1** made of? What are their names?
- Why is the statue number three green?

d) Write interesting in your opinion information about each statue in Table 1. Use Internet if necessary. Discuss with your partner.

Table 1. FAMOUS STATUES

 1.	 2.	 3.

LISTENING AND VOCABULARY

13. a) Write the definitions to the terms. Use dictionary if necessary.

	Definition
Physical properties	
Chemical properties	
Physical change	
Chemical change	

b)  [8] **Listen and check your answers.**

TRANSLATION

14. Translate the sentences into your native language.

a) Alkenes and alkynes are nonpolar compounds with greater reactivity than alkanes but with other properties similar to those of the alkanes.

b) You will relate the structures of synthetic polymers to their properties.

c) How will the properties of this substance change when these groups react to form bonds called crosslinks between the chains?

d) An organic compound in which a hydroxyl group replaces a hydrogen atom of a hydrocarbon is called an alcohol. Discuss the properties and uses of alcohols, ethers, and amines.

e) Ketones and aldehydes share many chemical and physical properties because their structures are so similar.

WRITING

15. a) Answer the question:

What format (1, 2 or 3) is more appropriate for writing the experimental section of a lab report?

1. I mixed 20.09 g of cyclohexanol with 6 mL of 85 % H_3PO_4.
2. Mix 20.09 g of cyclohexanol with 6 mL of 85 % H_3PO_4.
3. Cyclohexanol (20.1 g, 0.201 mol) was mixed with H_3PO_4 (85 %, 6 mL).

b) Scan a sample laboratory report here http://writing.engr.psu.edu/workbooks/labreport2.html **and learn more about its structure.**

16. Describe an experiment which proves a particular property. Include introduction, materials and methods, description of the results and conclusion. Write 250-300 words.

Unit 4

Creating and interpreting chemical graphs

SPEAKING AND VOCABULARY

1. a) Answer the questions.

1. Do you agree with the saying: "A picture is worth a thousand words"?
2. How can scientists visualize the data they got?
3. What types of graphs do you know?

b) Match the Graphs 1-4 with the types of graphs a-d

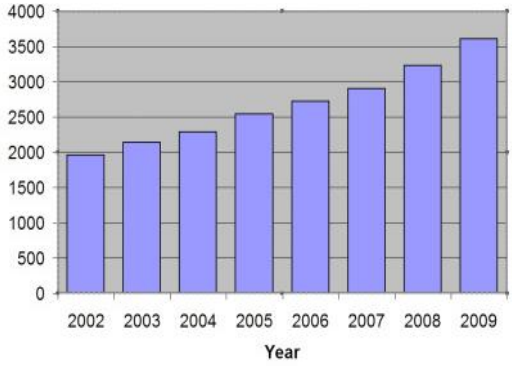
a) Bar chart

b) Histogram

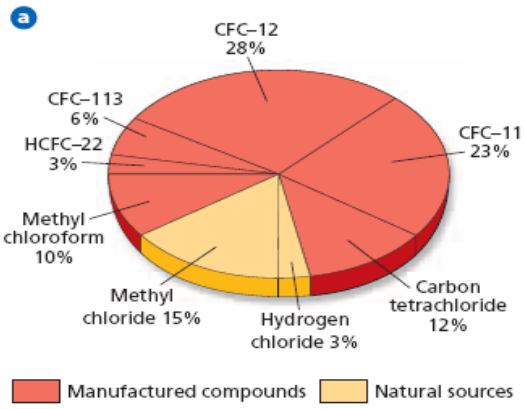
c) Circle graph / Pie chart

d) Line chart

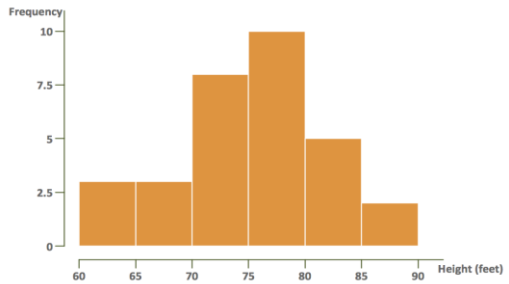
Graph 1 College of art and sciences total chemistry student enrolment in fall semester.



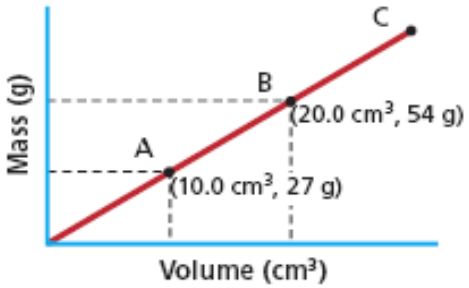
Graph 2 Sources of chlorine in the stratosphere



Graph 3 Black cherry tree



Graph 4 Density of aluminum



READING AND VOCABULARY

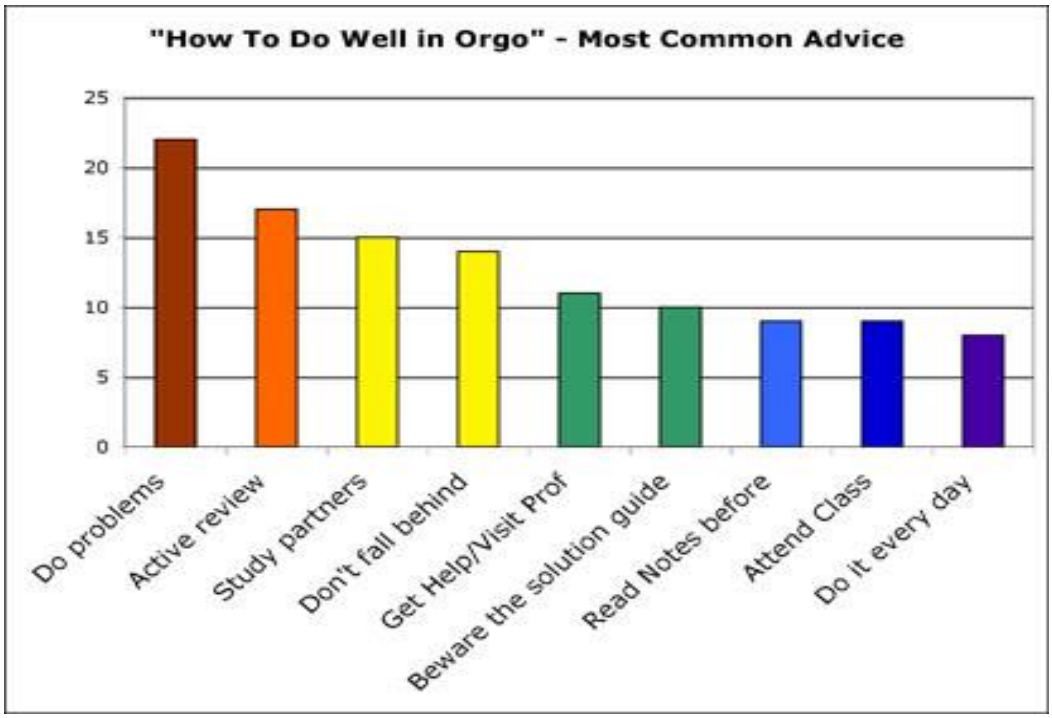
2. a) Answer the questions: 1. What advice do your professors give you to succeed in chemistry? 2. Which is the most effective for you?

b) Talk to your classmates about the things they consider to be the most important for succeeding in chemistry. Come up with some useful advice from your experience. Read the text and compare your ideas with the ideas from the text.

HOW TO SUCCEED IN ORGANIC CHEMISTRY CLASS

Over on Master Organic Chemistry, James does a fine job of summarizing the advice professors most often give their students of organic chemistry. Based on careful reading of 25 syllabi* containing essays on how to succeed, overwhelmingly ***REGULAR PRACTICE*** of ***PROBLEM SOLVING*** rises to the top. Studying with partners is also high on the list. O-chem students should scrutinize the bar graph below (lifted from James' site), read his full post, and think carefully about this. General chemistry students will also benefit from considering this carefully.

** syllabus – a list of the topics that will be studied in a course*



c) Answer the question.
Which piece of advice is the most / the least useful for you?

d) Discuss James's results with your partner. Answer the question.
Do you agree or disagree with James?

3. Complete the gaps with the words:

Circle graph, Wedges, circle, bar graph, location, axis, line graph, dependent variable, best fit line

1.	The _____[1] is sometimes called a pie chart because it is divided into _____[2] like a pie or pizza. It is useful for showing parts of a fixed whole. The parts are usually labelled as percentages with the _____[3] as a whole representing 100%.	2.	A _____[4] often is used to show how a quantity varies with factors such as time, _____[5], or temperature. In those cases, the quantity being measured appears on the vertical axis (*y*-axis). The independent variable appears on the horizontal _____[6] (*x*-axis). The relative heights of the bars show how the quantity varies.

3.	The points on a _____[7] represent the intersection of data for two variables. The independent variable is plotted on the *x*-axis. The _____[8] is plotted on the *y*-axis. Remember that the independent variable is the variable that a scientist deliberately changes during an experiment. The line must be drawn so that about as many points fall above the line as fall below it. This line is called a _____[9].

4. Look at Figure 1 and answer the questions 1-7.

1. What is the topic of the graph?
2. What is density?
3. What does the horizontal axis show?
4. What does the vertical axis show?
5. Which substance has the greatest density?
6. Which substance has a density of 11.4 g/cm^3?
7. Which substance has the least density?

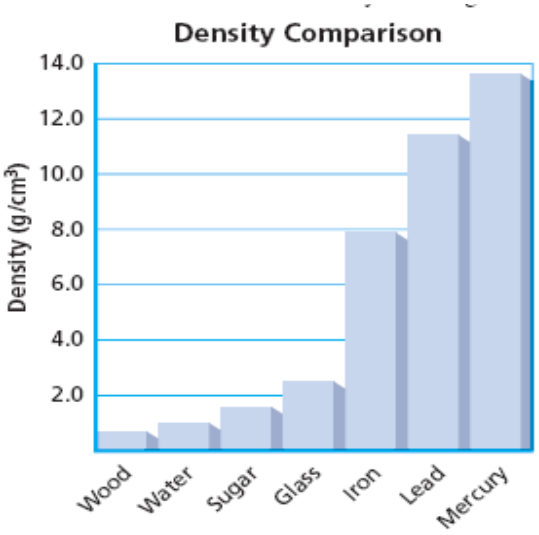


Fig. 1

5. a) Answer the questions.

1. Is it difficult to create a good graph? Why?
2. What advice would you give for good graphs?

b) Read and compare your ideas with the ones from the text.

Tips for Good Graphs

1. Give your graph a title. Something like **"The dependence of (your dependent variable) on (your independent variable)."**

2. The x-axis is your independent variable and the y-axis is your dependent variable.

3. **LABEL** your x-axis and y-axis. **GIVE THE UNITS!!**

4. When graphing data from lab, make line graphs because they tell you how one thing changes under the influence of some other variable.

5. **NEVER** connect the dots on your line graph.

Why? When you do an experiment, you always make mistakes. It's probably not a big mistake, and is frequently not something you have a lot of control over. However, when you do an experiment, many little things go wrong, and these little things add up.

As a result, experimental data never makes a nice straight line. Instead, it makes a bunch of dots which kind of wiggle around a graph.

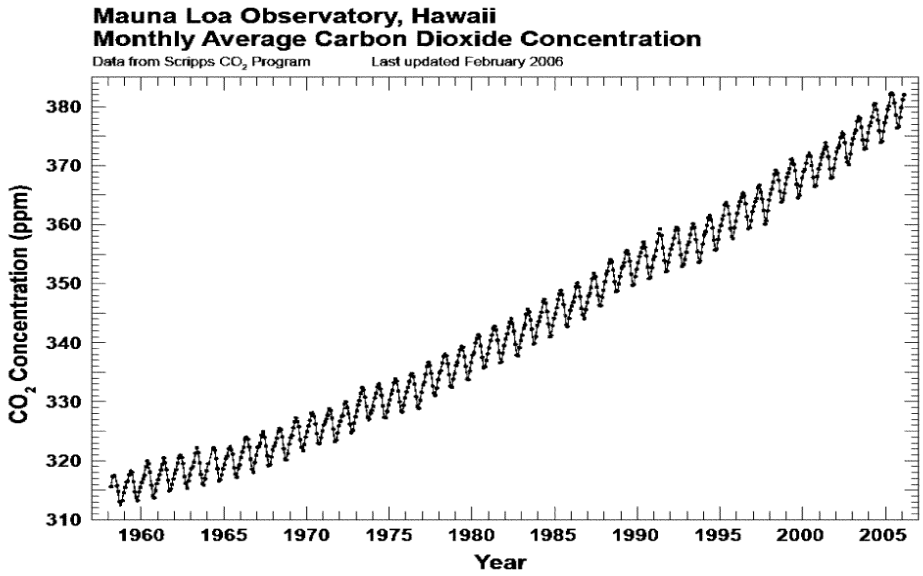
To show that you're a clever young scientist, your best bet is to show that you KNOW your data is sometimes lousy. You do this by making a line (or curve) which seems to follow the data as well as possible, without actually connecting the dots. Doing this shows the trend that the data suggests, without depending too much on the noise. As long as your line (or curve) does a pretty good job of following the data, you should be A-OK.

6. a) Look at the Graph 1 and answer the question.

What's the purpose of the Graph 1.?

b) Read and answer the question:

What phrases does the author use to describe the graph?



Graph 1. Atmospheric CO_2 measured at Mauna Loa (Keeling & Whorf, 2005)

Describing the graph: The x-axis shows the variable of time in units of years, and the y-axis shows the range of the variable* of CO_2 concentration in units of parts per million (ppm). The dots are individual measurements of concentrations – the numbers shown in Table 1. Thus, the graph is showing us the change in atmospheric CO_2 concentrations over time.
*variable: a factor or a condition that can be measured, observed, or changed
Describing the data and trends: The line connects consecutive* measurements, making it easier to see both the short- and long-term trends within the data. On the graph, it is easy to see that the concentration of atmospheric CO_2 steadily rose over time, from a low of about 315 ppm in 1958 to a current level of about 375 ppm. Within that long-term trend, it's also easy to see that there are short-term, annual cycles of about 5 ppm.
*consecutive – following one another in uninterrupted succession or order

Making interpretations: On the graph, scientists can derive additional information from the numerical data, such as how fast CO_2 concentration is rising. This rate can be determined by calculating the slope of the long-term trend in the numerical data, and seeing this rate on a graph makes it easily apparent. While a keen observer may have been able to pick out of the table the increase in CO_2 concentrations over the five decades provided, it would be difficult for even a highly trained scientist to note the yearly cycling in atmospheric CO_2 in the numerical data – a feature elegantly demonstrated in the sawtooth pattern of the line.

LANGUAGE IN USE

7. Answer the question.

Which words from the Table 1 are synonyms for ***go up / go down / quickly / greatly / step by step / without changes / change often / temperately***?

TABLE 1. Useful vocabulary to describe your graph

ADVERBS	VERBS	USEFUL PHRASES	TIME EXPRESSIONS
considerably	*increase*	*The graph clearly shows / highlights*	*Over the period*
moderately	*decrease*	*The chart provides a comparison of / The charts compare…*	*From 2010 to 2020*
sharply	*drop*	*Reach a peak*	*Between 2013 and 2020*
slowly	*grow*	*Coal accounted for 25,000 million billion Joules*	*In the following 5 years*
gradually	*decline*	*A half/ a third*	*In 2015*
rapidly	*rise*	*Sectors which represent*	
gently	*fall*	*Remain stable/constant*	
slightly		*Fluctuate*	
steeply		*Level off*	
significantly		*On the graph*	

LISTENING

8. [9] **Listen and answer the questions:**

1. Why is it important to distinguish between dynamic and static chart?
2. What vocabulary is good to use that shows change over time?

SPEAKING

9. a) Choose a graph from APPENDIX B. Don't show it to your partner.

b) Describe the graph to your partner using the words from the Table 1 in Ex. 7. Your partner should draw this graph in his/her copybook. Then check his/her graph showing the original one.

c) Change your roles and do it again.

TRANSLATION

10. Translate the sentences into your native language.

1. From the following incorrect formulas and formula names, identify the mistakes and design a flowchart to prevent the mistakes.
2. Learn about the latest advances in sickle cell disease research. Create a chart that shows major symptoms, their causes, and their treatment.
3. Triple point is the point on a phase diagram representing the temperature and pressure at which the three phases of a substance (solid, liquid, and gas) can coexist.
4. Realistic drawings of glassware and instrumentation found in the lab help students make real connections.
5. Rather than simply using the formulas to solve this problem, we will proceed by thinking it through. The situation is diagrammed in Fig. 1.10. First, we want to convert 98.68 F to the Celsius scale.
6. Fig. 3.5 illustrates a schematic diagram of a combustion device used to analyze organic compounds. Given that a certain amount of a compound containing carbon, hydrogen, and oxygen is combusted in this device, explain how the data relating to the mass of CO_2 produced and the mass of H_2O produced can be manipulated to determine the empirical formula.

WRITING

11. a) Check 20 recent IELTS graph samples with answers here https://www.ielts-mentor.com/writing-sample/academic-writing-task-1/59resource/2997-recent-ielts-graph-with-answers. **Answer the questions:**

1. What is the structure of graph descriptions?
2. What phrases are used to compare and contrast?
3. What phrases are used to summarise the main information?

b) Find a chemical graph about your country.

c) Describe the graph in details. Include introduction where you say what the graph is about, name its title and source and add conclusion. Write 150-200 words.

Unit 5
Chemistry as a Profession

SPEAKING AND VOCABULARY

1. a) Answer the questions.

1. Do you have any friends who work in the chemicals industry?
2. What did they tell you about their job?

b) Look at the diary and express your opinion about the chemists' daily routine. Discuss in pairs.

c) Answer the questions.

1. What were Maria and James doing at different times of the day last Monday?
2. Whose job is easier in your opinion? Why do you think so?

Maria Lewis **Chemist**	**James Smith** **Chemical Engineer**
Start at 8.00	*Pick up car from garage at 7.00*
analyze organic and inorganic compounds for determining physical and chemical properties at 9.00	*Test new products at 9.00*
diagnose malfunctions if any at 11.00	*assist in producing efficient products at 11.00-13.00*
Enjoy her coffee break 12.00	*Try new ways in research of biochemical products by using biotechnology equipment at 15.00*
conference with scientists and engineers at 14.00	*Meet senior officials and customers at 16.00*
Interpret test results at 16.00	*Improve the products by following advice of senior officials as well as customers at 17.00*
Prepare documentation at 17.00	*Leave his office at 17.55*
Go home at 18.00	

d) Student A: You are Maria Lewis. Compare your job with James'. Tell James Smith about your difficulties / tasks / favourite activities at work.

Student B: You are James Smith. Compare your job with Maria's. Tell Maria about your difficulties / tasks / favourite activities at work.

2. a) Answer the questions.

What are the positions of chemists in the chemical industry of Ukraine?

b) Compare your list with Chemistry and Chemical Engineering Jobs in the USA.

Positions found posted in the USA:

- Postdoctoral Fellow;
- Process Engineer;
- Analytical Chemist;
- Experimental Atomic Physicist;
- Principal Engineer − Fermentation Process Development;
- Associate* Scientist;
- Fixed Equipment Engineer;
- Synthesis Research Scientist;
- Sr. Process Engineer − Refining Technology Specialist;
- Senior Process Engineer;
- Assistant Professor;
- Biopharma Lab Manager;
- Computational chemist;
- Principal Statistician Model Validation;
- Chemical Engineering Assistant or Associate* Professor;
- Post-doctoral Scholar.

** Associate – having a rank below the highest level in an organization*

c) Answer the question.

What position would you choose and why?

d) Google for real responsibilities of the position chosen. Discuss in pairs.

READING AND VOCABULARY

A DAY IN THE LIFE OF A COMPUTATIONAL CHEMIST

3. a) Can you answer Zoe's questions [1-4] in bold? **What other questions have you always been fascinated by? Write them on the paper. Shuffle papers and try to answers your group mates' questions.** **b) Answer the question.** Why did you choose chemistry?	*This is a real blog – this time with a day in the life of Zoe, a Computational Chemist working as an Investigator – Lecturer at the Biomedical Research Foundation of the Academy of Athens.* I have always been fascinated by how the world around us works. **Why is the sky blue[1] ? Why are bubbles in a soft drink spherical[2] ? How do we fall in love[3] ? What are we really made of [4] ?** And when I got the answer, I always felt the urgency to explain everything I learned to others… (though they are not always willing to hear it!). Everything around us, what we hear, see, smell, taste, and touch involves chemistry and chemicals. Thousands of chemical reactions happen in your body when you smell a beautiful flower in a summer spring morning. I was pleasantly surprised

c) Read the blog and compare your answers with Zoe's.	when I learned in high-school that scientists called chemists could handle these reactions and even develop drugs that could save millions of lives worldwide.

Overwhelmed by chemists' discoveries, I decided to study Chemistry. But soon enough I realized that although it is a really amazing science with its reactions, chemicals, funnels, pipettes, benches, and fume hoods, being a chemist makes a huge mess or at least I made one in the lab! Fortunately, I then realized that computers exist and they make things much cleaner. I discovered that today it is possible to build chemicals, study reactions, or even make drugs within a desktop computer by performing virtual experiments in a similar way as the typical chemists. This type of chemistry is called "computational chemistry". So I became a computational chemist. Indeed, I literally live in a virtual reality world, where everything from chemical reactions to drugs, food, materials, cosmetics, electronics, and proteins is being modeled and simulated. And you won't believe it, but, yes, I do have a job I like.

d) Label these pictures using the phrases from the blue part of the text

1)

2)

3)

e) Explain the phrases in bold	I am a group leader at the Biomedical Research Foundation of the Academy of Athens. I specialize in "computer-aided drug design", so the computer **is my Virgil** in the world of drugs (to paraphrase the original Nobel Committee tagline).

The main activity of my lab is the design of anti-cancer **candidate drugs**. Employing software and high performance computing techniques, we predict the interactions of these candidate drugs with proteins that cause cancer. For decades, drug discovery was carried out using **trial and error experimental techniques** for screening large libraries of chemicals against a biological target (for example a protein), which is responsible for a disease. Recent advances in computer-aided drug design allow us to develop drugs specifically designed for a given **protein**, shortening the development **cycle** of new drugs. Understanding the detailed underlying molecular and atomic interactions involved in **drug-protein interactions** became central in guiding traditional experiments and therefore increasing the efficiency and decreasing cost in the drug discovery process.

In an ideal typical day of a computational chemist, there would be a lot of time for coffee and chatting since computers would do our job. But in reality there is

absolutely no time to waste. Why? Because every time your computer gives you some results, you **come up with tens of exciting new ideas** that you want to test immediately. Many times though, we do not **follow a standard protocol**, which means numerous trial and error attempts are performed to get **the right set up** for the virtual experiment. So, a typical day starts off with lots of positive thinking, but ends with angry keyboard banging after a day of debugging!

f) Write the nouns for adjectives in bold.	Larger "in silico experiments" (as we call our simulations) are carried out on big computer clusters. Such **specialized** clusters, which put together thousands of processors, represent a **powerful** tool for **simulating** complex processes such as the binding and unbinding of a drug or reactions of drugs with enzymes. These calculations may take weeks if not months to complete. Accessing these resources requires writing research proposals upraising the merits of a research project in order to justify using these expensive **computational** resources.

4. a) Answer the question.

What do you think, what will be your job responsibilities in the future?

b) Read the second part of the text and compare your answers with the responsibilities of a computational chemist.

c) Answer the questions. 1. What does Zoe do every week? 2. What activities from the list in italics are the most difficult in your opinion? **d) In pairs talk about your experience doing these activities.**	Other weekly activities include: • *writing papers,* • *keeping up to date with the literature,* • *mentoring and coaching my co-workers,* • *going to conferences, talks, and meetings,* • *communicating our research results,* • *teaching and of course dealing with bureaucracy.*

It is extremely rewarding and exciting when our predictions become **the brick and mortar** of a new thrilling discovery. Indeed, we, as computational chemists are members of **consortia** of synthetic chemists, geneticists, pharmacologists, medicinal chemists, biochemists, and biologists, and work together in a concerted effort in the war against diseases. Our predictions inspire and support the actual experimental work being performed on designing drugs for cancer. My routine **entails** meeting daily with experimentalists who test our predictions in a wet lab to **verify** that a candidate drug has the desired activity on cancer cells.

Computational chemistry emerges as a key tool in the drug design process, however, this tool is not as simple as running a computer program; it requires chemical intuition and **expertise** in other disciplines such as physics, biology, and computer programming in order to conceive models capable to **capture** efficiently the complex reality of life. For this reason computational chemistry was wonderfully recognized for its contribution with the 2013 Nobel Prize in Chemistry to Computational Chemists Martin Karplus of Harvard University and the University

of Strasbourg in France, Michael Levitt of Stanford University and Arieh Warshel of the University of Southern California in Los Angeles. In the 1970s, these three researchers **pioneered** powerful models that are now being used to understand and predict chemical processes. Simply stated, "This year's prize is about taking the chemical experiment to cyberspace." as Staffan Normark of the Royal Swedish Academy of Sciences put it.

I often find that scientists are being **looked upon as geeks** spurting out of Doctor Who or The Big Bang Theory. The public can be afraid of things they cannot understand, but the truth is that science is not all that hard and, honestly, it is pretty cool. Although scientific positions are in general **underpaid**, I believe that the contribution of science to the quality of our lives and to people's well-being is of central importance. Therefore, it is our duty to perform our work with social responsibility and communicate our **findings** and efforts in a way that can be **perceived** by the general public. Part of our work and efforts should focus on making our science accessible to everyone without any discrimination.

So a day in my lab life almost always includes science **outreach** – aimed at promoting public awareness and understanding of science and making informal contributions to science education. I **maintain** two blogs ("Life is Chemistry" and a Blogging Corner at the NGO "Science Communication") and their respective pages on Facebook and Twitter. I write for the Chemistry in Cancer Research Group Newsletter of the American Association for Cancer Research, co-organize conferences with scientific themes for the general public such as the TEDMED Live Athens conference, and promote activities like scientific cafes and scientific talks to the general public.

e) Explain the words in bold.

f) Answer the questions.

1. Does Zoe like her job? Why do you think so?
2. How can you describe Zoe as a professional?

I could not resist finishing this blog post by quoting a woman that continues to inspire me by her lifelong dedication and contributions to science. Marie Skłodowska-Curie helped forever change how the world perceived women in science and set a shining example for the future generations of scientists. She showed that rigorous and determined investigation can lead to remarkable discoveries, which can have a direct and positive impact on people's lives. As she said,

"Nothing in life is to be feared, it is only to be understood. Now is the time to understand more, so that we may fear less." – Marie Curie

g) Answer the questions.

1. Do you have any famous people who inspire you? Who and why?
2. Does Curie's words inspire you? Do you agree or disagree with her quote?
3. Do you know any other quotes?

h) Find on the Internet an interesting quote by a famous chemist and explain its meaning.

5. a) Answer the questions.

1. Is it possible to get satisfaction from your job?
2. Do you agree with Confucius that

'If you choose a job you love then you will never work a day in your life' ?

b) Fill in the responsibilities of a chemist (1-8) with these words:

Conduct / Analyze / Induce / Confer / Prepare

A chemist should:

1) _____ research, analysis, synthesis, and experimentation on substances, for such purposes as product and process development and application, quantitative and qualitative analysis, and improvement of analytical methodologies: devises new equipment, and develops formulas, processes, and methods for solution of technical problems.

2) _____ organic and inorganic compounds to determine chemical and physical properties, utilizing such techniques as chromatography, spectroscopy, and spectrophotometry.

3) _____ changes in composition of substances by introduction of heat, light, energy, and chemical catalysts.

4) _____ research on manufactured products to develop and improve products.

5) _____ research into composition, structure, properties, relationships, and reactions of matter.

6) _____ with scientists and engineers regarding research, and prepares technical papers and reports.

7) _____ standards and specifications for processes, facilities, products, and tests.

6. a) Answer the questions.

1. Would you like to be a chemistry teacher? Why/Why not?
2. Who is your favorite chemistry teacher?
3. What are the responsibilities of a chemistry teacher?

b) Read and check your answers.

Chemistry Teacher

Do you love chemistry? Would you like to help others love it − or at least understand it? If so, you might be an excellent chemistry teacher.

Chemistry teachers work in high schools and two-year and four-year colleges. They lecture, guide discussions, conduct experiments, supervise lab work, and lead field trips. High school teachers might also be asked to monitor study halls and serve on committees. College instructors might be required to do research and publish their findings.

SPEAKING

7. Play your role.

Student As:

- You have three internships for undergraduate chemistry students this summer. Conduct an interview with the candidates. Write a list of interview questions. Be ready to speak about your offer and responsibilities. Google for internships for undergraduate chemistry students to get more information. Choose the best candidate.

Student Bs:

- You want to try working for the first time and get real-world experience through internships. Tell about your education and motivation. Answer the employer's questions. Google for internships for undergraduate chemistry students to get more information.

LISTENING AND SPEAKING

8. a) Answer the questions.

1. Do you know any couples in which each half is a chemist?
2. Where do they usually meet each other?
3. Would you like to meet your second half across the lab bench or at the conference?
4. What challenges can the couples have in your opinion?

b) [10] **Listen and answer the questions.**

1. What two possible problems does the speaker mention?
2. How would you solve the problems mentioned?

c)  [11] **Listen and answer the questions.**

1. Where was Daniella going to study after her defence?
2. Where did Arjel and Daniella do their research together?

TRANSLATION

9. Translate the sentences into your native language.

1. Your job is to separate nitrogen (N_2) from methane (CH_4). How might you accomplish this task? You clearly need some sort of "molecular filter" that will stop the slightly larger methane molecules (size ≈ 430 pm) and allow the nitrogen molecules (size ≈ 410 pm) to pass through.
2. To experimentally determine the integrated rate law for a reaction, concentrations are measured at various values of t as the reaction proceeds. Then the job is to see which integrated rate law correctly fits the data.
3. We also greatly appreciate the work of Teresa Trego, Content Project Manager, who did an outstanding job of managing the production of this complex project.
4. One of the main jobs of a scientist is to delve into the macroscopic world and discover its "parts." For example, when you view a beach from a distance, it looks like a continuous solid substance. As you get closer, you see that the beach is really made up of individual grains of sand.
5. In analyzing a sample of polluted water, a chemist measured out a 25.00-mL water sample with a pipet. At another point in the analysis, the chemist used a graduated cylinder to measure 25 mL of a solution.
6. The first "chemist" to perform truly quantitative experiments was Robert Boyle (1627–1691), who carefully measured the relationship between the pressure and volume of air.

WRITING

10. You have just got one of the positions from exercise 2 b. Write the story entitled "My new responsibilities". Include the introduction, main body and conclusion paragraphs. Write 150-200 words.

Creative Projects

Project 1. Material properties.

Aim: understanding material properties; materials characteristics; measurements.

Creative skills: critical and creative thinking, imagination skills.

ESP skills: listening, speaking, reading, writing, translating about properties of different materials

Functional language: researching, comparing, reasoning, analysing.

Instructions:

a) Collect and bring into the class several examples of materials. Here are some examples: *metal, plastic, cotton, glass, grass, branches, corn, leaves, water, stone.*

b) Put all the materials brought on the table, look at them. Work in mini-groups. Prepare a list of physical and mechanical properties of the materials or adjectives describing them. Here are some examples: *tough, ductile, elastic, stiff, malleable, brittle, bumpy, slippery, stretchy, fusible, tasteless, odorless, magnetic, combustible, elastic, opaque, soluble, insoluble, renewable, transparent, conductive, toxic, corrosive.* The group with the biggest number of accurate words wins!

c) In mini-groups prepare a big poster. Use the offline dictionary mobile application to write English explanations for the properties of the materials and draw pictures to illustrate the properties of some of them.

d) Act out to present your poster. Students from other groups raise the hand with the material(s) you talk about and ask questions, agree or disagree. They get a point for the correct demonstration.

e) In groups think of the test/experiment you can do to demonstrate a property of the material. You can do it at home or in the lab. If you experiment out of the class, make a video commenting on all your actions in English.

f) Do you know which materials are used for famous monuments? Think of the materials The Statue of Liberty and the Motherland statue are made of and their properties. Express your ideas. Find out more information about these monuments including numerical information, shape, compare the height of The Statue of Liberty and the Motherland statue in Kyiv. Use the handouts given and a calculator to convert meters to feet and inches.

g) As a revision of the material in mini groups match physical and chemical properties with the definitions.

Physical/chemical property	Definition
Melting point	Ability to burn
Mass	To destroy or be destroyed, esp. by acid or rust, usually over a long period of time
Flammability	Mass per unit volume
Malleability	The amount of matter in any solid object or in any volume of liquid or gas
Boiling point	The temperature at which a substance boils
Electrical conductivity	The ability to be pounded into thin sheets
Density	The temperature at which a substance melts
Ductility	The ability to dissolve in another substance
Solubility	The ability to be drawn into a wire
Corrosion	The ability to transfer heat
Volume	The amount of space that is contained within an object or solid shape
Hardness	Not easy to bend, cut, or break
Odor	The property of allowing electricity to go through
Color	A particular smell
Thermal conductivity	The appearance that something has as a result of reflecting light

Project 2. Sustainable future

Aim: understanding environmental issues, robotics.

Creative skills: critical and creative thinking, imagination skills, personal expression.

ESP skills: listening, speaking, reading, writing about ecological issues and new technologies.

Functional language: summarizing**,** researching, comparing, reasoning.

Instructions:

a) In mini-group create a robot using recycled materials. Explain what materials you used. Answer the question:

How much does it take for each material of your robots and robots from Figure 1 to decompose?

Fig. 1: Works of students of Igor Sikorsky KPI in 2018

b) In mini groups match materials with time required to biodegrade. Present your predictions to the class. Discuss why do we use non-biodegradable products.

Material	Time Required to Biodegrade
Plain Cardboard (unwaxed)	2-4 weeks
Rope	3 months
Monofilament Fishing Line	3-6 months
Paper Towels, Apple Core /Orange Peel, Newspaper	1 year
Glass Bottle	5 years
Plastic Bottle	1-5 years

Disposable Diaper	10-20 years
Waxed Milk Carton	80-100 years
Ziploc™ Bag	200-400 years
Aluminum Can	300 years
Cigarette	400 years
6-pack Ring	450 years
Cotton cloth	600 years
Steel Can	Thousands to millions of years

Data from US Forest Service

c) Answer the questions: 1. What is the real process of making a robot?
2. What are the common stages?
3. What are the types of robots?

d) Use the Internet to find more information about robot production. Prepare short theses and retell your partner the information you got. Imagine that your recycled robot is a real one. In pairs speak about its type and functions.

e) Answer the questions:

1. What are the ecological (or environmental) issues worldwide?
2. Can robots help ecology (or help the environment)? If yes, then how?
3. What do you think of a robot in the tree which pecks at it just like a real woodpecker to scare away destructive bugs? Or virtual reality headset for chickens due to which they get more space and feel happier?

Visit *Robotanica* 2017 exhibition online site to see these and other robots! Work in pairs and discuss your opinion about them.

f) Work in pairs to think of an idea of a robot that can help the environment. Explain their tasks. Each pair should choose one best idea to present to the class. The winning pair is the one which gets most of the votes of the students.

g) Watch an English video about A famous robot Sofia. The robot has 72 facial emotions and obtained a citizenship of Saudi Arabia. Exchange your opinion about this robot and artificial intelligence in pairs.

h) Look at your recycled robot again! What is the problem of waste materials? Does it influence your health? Visit a Recycled Materials Museum in your city or a web site of a recycling program (for example, *Call2Recycle*). Choose one particular item exhibited and write how it affects the environment.

Project 3. Health and safety at work.

Aim: understanding ergonomics issues.

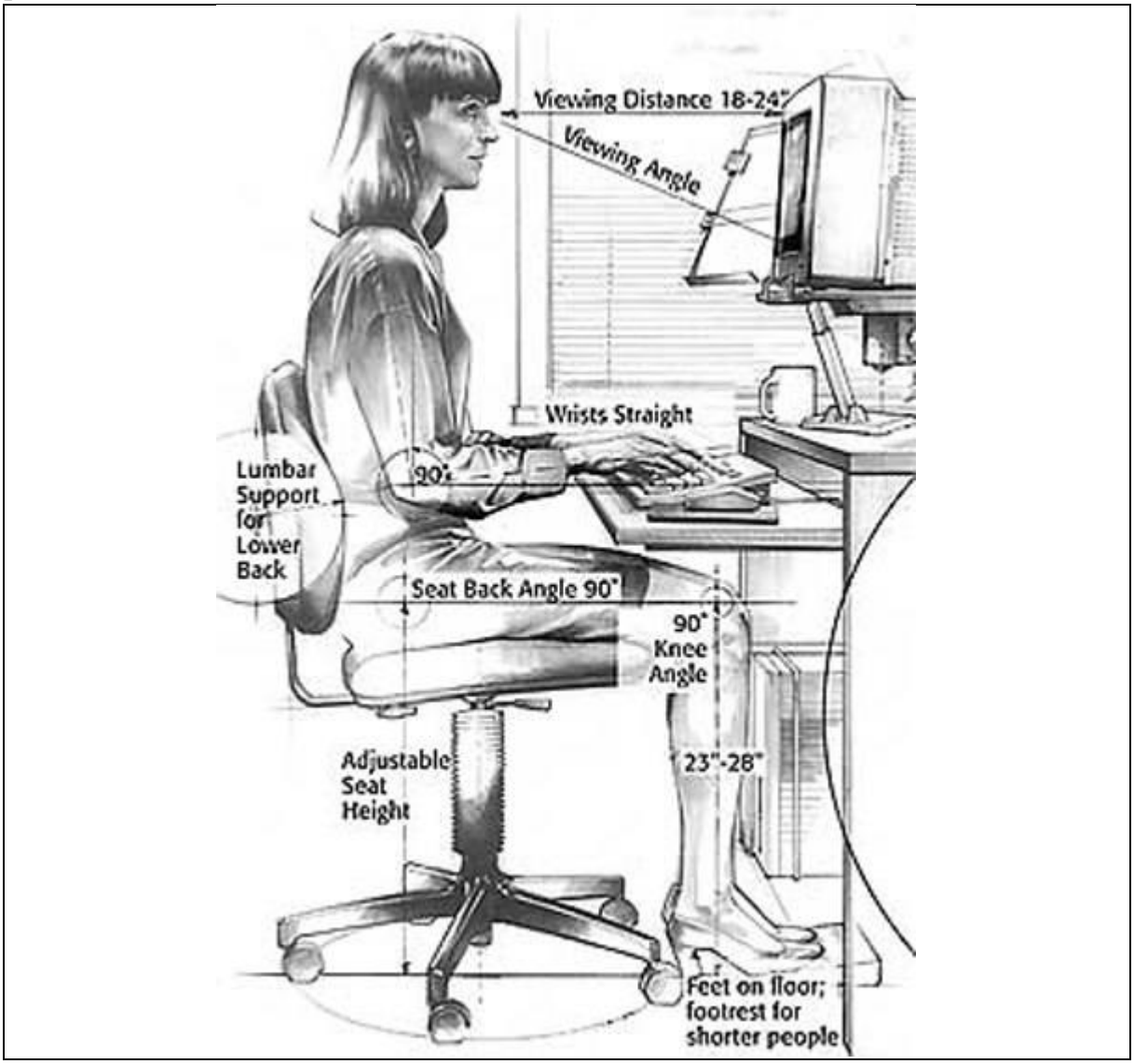
Creative skills: artistry, personal expression, critical and creative thinking, imagination skills.

ESP skills: listening, speaking, reading, writing about ergonomics issues, workspace, health, safety precautions.

Functional language: researching, comparing, reasoning, analysing.

Instructions:

a) Look at the picture. In pairs discuss your interaction with equipment and workplace.



b) Look at your workplace. What can you say about its ventilation, temperature, lighting, cleanliness, dimensions, seating, safety? Find these norms from *The Workplace Health, Safety and Welfare Regulations* handout. Choose the parameter you can measure with the help of the formulas given. Compare the result with the norm.

c) Work in groups to make as many words as possible from the letters in *S-a-f-e-t-y m-e-a-s-u-r-e-s.* The group with the biggest number of accurate words wins!

d) Use the *Workspace planner tool* online which will help you to place your equipment correctly to establish a proper posture and *Workspace assessment* tool to evaluate your current studying conditions.

e) Look at the picture and discuss why it is imperative to follow lab safety rules. Add more guidelines to the list.

f) Work in mini-groups to write a safety poem for a chemist. Start each line with a new letter of the phrase *Safety precautions.* Include lab safety rules as well.

g) Read the poem and find the words that rhyme with each other.

Welcome to the science lab (By Heidi Bee Roemer**)**

Please quietly enter
the science lab center,
Remember to follow the rules,
Lab work is awesome,
but always use caution
with chemicals, burners, and tools.
You will be given a pair
Of goggles to wear,
plus gloves, a lab coat or apron.
As you measure and pour
Always be sure
to wipe away spills at your station.
You may whip up a brew
of some gloppity goo;
Never act on the foolish notion
of tasting the stuff –
you may go belly up!
It might be a poisonous potion.
If you make a mistake
and a beaker should break,
bring it straight to your teacher's attention.
But don't mess around
Or you may be found
on the receiving end of a detention.
What a success!
You've proven your test.
Time to put your equipment away.
Wash your hands, now you are through.
You've learned something new –
and for lab safety you've earned an A!

h) In mini groups read your safety poem one more time. Try to substitute some of the words with the right rhyme.

i) Work in pairs. Tell your partner about the best office you have been to or the office of your dreams. What a video Exclusive Look Inside Facebook's Engineering Office (December 2019). What information do you find to be the most interesting/inspiring/unusual? What part of the office would you most often use?

j) Interview an engineer about his/her favorite place in the lab, working conditions, design of the office.

Project 4. Engineering jobs.

Aim: understanding engineering career, branches of engineering, key inventions.

Creative skills: artistry, personal expression, critical and creative thinking, imagination skills.

ESP skills: listening, speaking, reading, writing about in-demand engineering jobs, most successful companies, CV of an engineer.

Functional language: researching, comparing, reasoning, analysing.

Instructions:

a) What positions of engineers are most demanding in your country and abroad? Compare your answers with the *Most In-Demand Engineering Jobs for 2019 or 2020*. In your opinion which of them will be in-demand in ten years? Why do you think so? Discuss in pairs.

b) Check the official site of the ABB company. Answer the questions:

Where can you find information about engineering positions there?

What career path among the suggested online would you choose?

Work in pairs. Look at the Board of Directors page. Choose one of the executives to see his/her CV. Scan it and discuss the career growth, the structure of the resume.

c) Find an English CV of a chemist which attracted your attention. What information would you add or omit, discuss whether the best engineers are born or made, the basic things for success in your opinion.

d) Answer the question: What are the most common interview questions? Make a list of five interesting questions to interview a candidate applying for the position of a Lab Technician. Work in pairs. Ask each other your questions.

e) Work in pairs. Ask each other these top Lab Technician interview questions and try to answer.

1) What characteristics and skills do you have that make you a qualified lab technician?

2) What type of lab work and equipment are you familiar with handling?

3) How do you ensure your workspace doesn't become contaminated?

4) Tell me about a time you detected a problem while testing a sample. How did you respond?

5) Other than technical work, what duties have you been responsible for in a lab?

f) Read the answers. Compare with your answers. Discuss in pairs.

1) What characteristics and skills do you have that make you a qualified lab technician?
Lab technicians have to be highly detailed-oriented and self-disciplined in order to be able to fulfill their day-to-day responsibilities. They must have a strong background and passion for the sciences, especially chemistry and biology, as well as technical skills in the use of computers and electronics. Lab technicians may work alone or collaborate with others in research teams and so must also possess good communication and writing skills. What to look for in an answer:

- Ability to work alone or in a group setting
- Strong scientific and technical skills
- Focused individual

Example: "I'm a detail-oriented individual with a bachelor's degree in chemistry and a minor in computer science. I excel at working alone but can also work as part of a team when needed."

2) What type of lab work and equipment are you familiar with handling?

A qualified applicant should be familiar with the specific methodology and equipment that will be in use in your lab. They should be able to name and detail their previous lab experience with technology and procedures. This question will help you to determine if the skill set of the applicant fits in with the needs of your facility. What to look for in an answer:

- Specific equipment they're comfortable using
- Lab duties they're experienced at performing
- Previous laboratory experience

Example: "Throughout my years of laboratory work, I've become proficient at preparing samples for study, performing a variety of tests on specimens and recording data. I can also work and maintain centrifuges, titrators and pH meters."

3) How do you ensure your workspace doesn't become contaminated?

A clean work area is crucial for laboratory efficiency. An improperly cleaned workspace can lead to sample contamination and incorrect results, which can end up costing the lab money if tests have to be repeated. An unclean workspace can also be a safety concern if dangerous substances such as hazardous chemicals or infectious bacteria aren't properly sanitized. A qualified applicant must be knowledgeable about workplace safety and proper cleaning techniques. What to look for in an answer:

- Follows proper cleaning procedures
- Knowledgeable about laboratory safety
- Willingness to keep up with routine cleaning

Example: "I make sure to follow all safety and sanitation protocols during each step of a test procedure. I also stay up to date on all scheduled lab maintenance and clean up to ensure there are no contaminants present in the environment."

4) Tell me about a time you detected a problem while testing a sample. How did you respond?

In the lab, results can sometimes deviate from how things are in the textbook. It's important for a lab technician to have the mental flexibility to think outside of the box and effectively problem solve a situation when results do not come out as planned. The answer will give you insight into how well an applicant is capable of resolving unique situations on their own. What to look for in an answer:

- Problem-solving abilities
- Willingness to persevere until an answer is found
- Mental flexibility

Example: "Once, I was testing a sample that showed a liquid chromatography-mass spectrometry signature very unlike any of the control samples for that specimen. After a few days of running various types of analysis, I finally came to the conclusion the sample must have been contaminated on its way to the lab."

5) Other than technical work, what duties have you been responsible for in a lab?

Experiments and tests aren't the only types of work that lab technicians will be doing. Lab techs also have strict record-keeping requirements and must perform inventory and waste management duties as well. They're also responsible for communicating test results to physicians or researchers. Applicants should show experience in these crucial areas. What to look for in an answer:

- Record-keeping experience
- Inventory management ability
- Willingness to perform auxiliary roles

Example: "During my lab internship, I was responsible for keeping records of samples and specimens. I also fulfilled the role of inventory manager and was responsible for ordering supplies as needed."

g) Do you know any successful engineering companies? What do they produce? Google to get more ideas. In pairs think of your own engineering company; its name and slogan. Make a video advertising your company (3 min.). Show it to the bank workers and answer their questions concerning the branch of engineering, the type of product you are offering; the kind of premises you need; the equipment you need, the amount of money you would like to offer. The winner is the pair that gets the bank loan.

h) You are a famous engineer who wants to win the Best World Engineering Competition and get much investment for future investigations. Get a role card with the name of the greatest engineers of all time, his/her key biography facts and inventions. Remember this information, talk to each member of the group, tell about yourself, persuade others that you deserve winning. The winner is the person who gets the biggest number of votes in his/her support after talking.

Project 5. Engineering education.

Aim: understanding the importance of education.

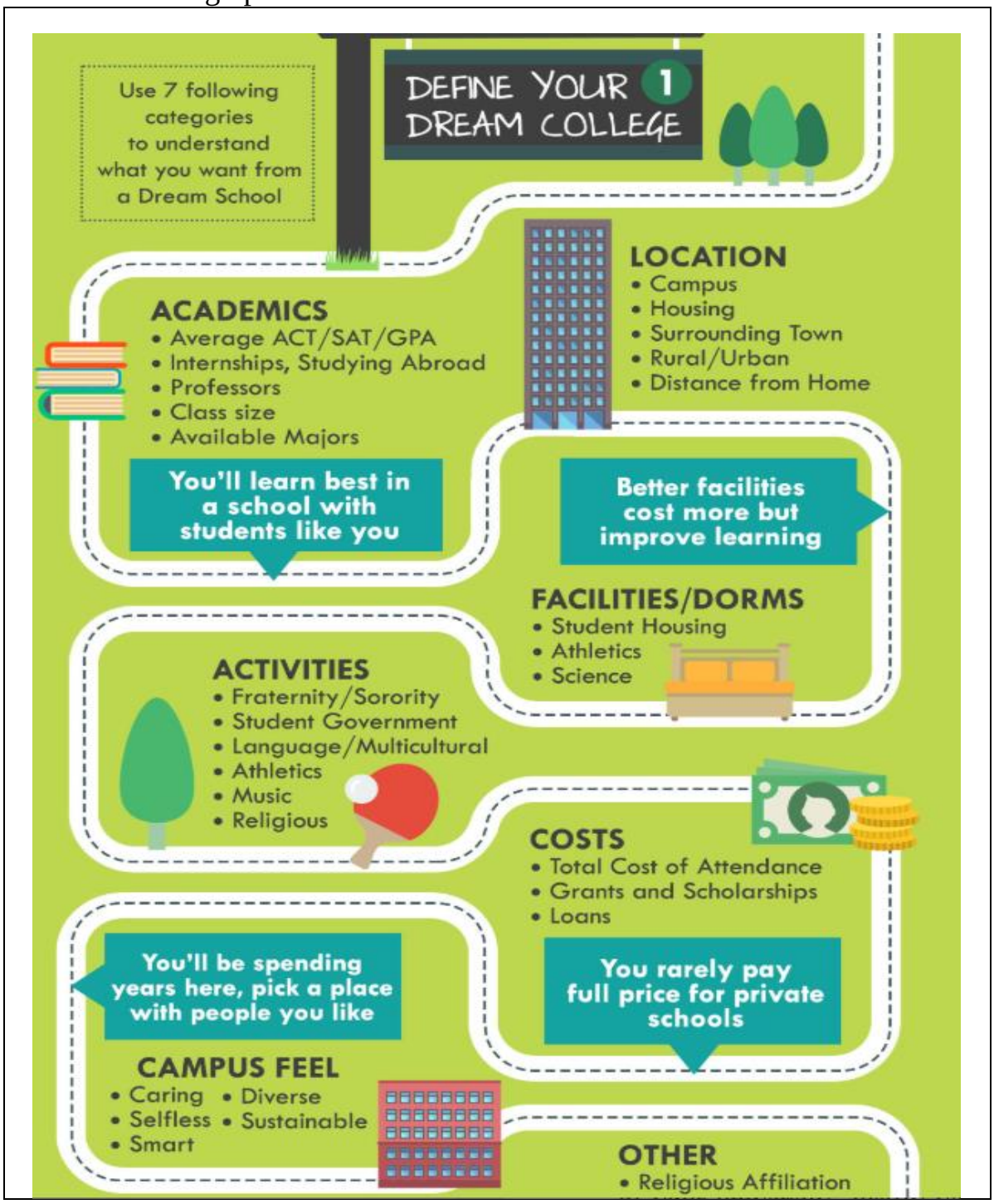
Creative skills: artistry, personal expression, critical and creative thinking, imagination skills.

ESP skills: listening, speaking, reading, writing university campus, inventions, engineering education.

Functional language: organizing data, researching, comparing, reasoning, analysing.

Instructions:

a) What criteria did you consider choosing where to study? In pairs discuss the ideas from the infographic.



See the full infographic here → https://venngage.com/gallery/post/3-easy-steps-find-college-of-your-dream/

b) Group A: Watch the Engineering campus virtual tour of Illinois College of Engineering.

Group B: Watch Harvard College virtual tour. Take notes.

Exchange information in pairs (Student A-Student B).

c) Open 3d online tour of your university. Discuss in pairs: what is similar and what is different between your campus and other campuses. What art objects and spaces are on the campuses? What would you like to change on your campus?

d) Work in mini-groups. Choose three art objects of your university (for example, painting, architecture, exhibited technique, art space). Mark it on the e-map of your university. Justify your choice. Deliver a short story about its significance, history, materials or resources used, including numerical information if possible.

e) In your mini-group prepare a 15-question quiz about famous scientists who studied or worked in your university and their inventions. Deliver it to students from other groups. Take the quiz of the other group and vote for the most interesting question.

f) Look at the World University rankings 2020 by subject: engineering and technology. Answer the questions:

What are the top universities in the world/in the USA / Canada / in Europe?

What performance indicators are included?

What do these factors involve in your opinion?

- Academic reputation
- Employer reputation
- Citations per faculty
- International student ratio
- Employability ranking

Do you agree that engineering universities should get a higher score for innovation and a lower for citations? Why?

Would you like to work as a lecture or scientist at your university after graduation? Why?

g) Answer the questions:

Do you know about academic mobility programs at your university?

Do you have any engineering experience abroad? Would you like to have?

h) Work in mini-groups. Open information in English about one of the events of The Fulbright program in your country or ERASMUS which is accessible at the academic mobility department of your university. In pairs discuss requirements for participants, your potential participation, pros and cons of the program.

Project 6. Water treatment

Part 1.

The aim of Part 1: Understanding the process of water treatment.

Creative skills: creative thinking, imagination, personal expression.

ESP skills: listening**,** speaking, reading, writing about the process of water treatment.

Functional language: asking questions, giving opinions**.**

Description: Answer the quiz on interesting water facts → https://www.britannica.com/quiz/water-fact-or-fiction

In your mini group prepare a 15-question quiz about water. Deliver it to students from other group. Take the quiz of the other group and vote for the most interesting question.

Match the terms with the explanations in pairs. The pair who matches the items correctly and faster than others wins.

Terms	Explanations
Hardness	The degree of purity of water, determined by measuring the substances physical, chemical and biological in water, besides water molecules
pH (potential Hydrogen)	A measure of water clarity how much the material suspended in water decreases the passage of light through the water
Flocs	How acidic or basic a substance is, measure on a scale of 1 (very acidic) to 14 (very basic).
Water Quality	The level of the minerals calcium and magnesium in water.
Concentration	The amount of one substance in a certain volume of another substance.
Water Pollution	The process of passing water through a series of screens that allow the water through, but not larger solid particles.

Turbidity	Sticky globs created by adding a chemical such as alum during water treatment.
Sewage	The process by which particles in a liquid clump together; a step in the water treatment process.
Coagulation	Water containing human wastes.
Point Source Pollution	Deposits of fine solids that settle out from wastewater during the treatment process.
Desalination	An underground tank containing bacteria that treat wastewater as it passes through.
Leach Field	The ground area around a septic tank through which wastewater filters after leaving the tank.
Septic tank	The process of obtaining fresh water from salt water by removing the salt.
Filtration	The addition of any substance that has a negative effect on water or the living things that depend on the water.
Sludge	A specific source of pollution that can be identified, such as a pipe.

Watch wastewater treatment Plant Virtual tours and write down the basic stages of water treatment.

Group A → https://www.youtube.com/watch?v=6vToJOFvi-I&feature=emb_rel_pause,

Group B → https://www.projectwet.org/resources/online-learning/wastewater-treatment-plant-virtual-tour.

Exchange your information in pairs (Student A-Student B).

In mini groups prepare a big poster exploring drinking water treatment. Act out to present your poster.

Part 2.
The aim of Part 2: Understanding the importance of high water quality.
Creative skills: artistry, creative thinking, personal expression, imagination.
ESP skills: listening**,** speaking, reading, and writing about water global crises.
Functional language: delivering a speech, asking questions**.**
Description: six thousand children die every day because of lack of potable water. Look at this infographic and in pairs speculate on the problems.

Deliver a 2-3-minute speech about the importance of maintaining high water quality, contamination sources such as industrial waste spills, pesticides and herbicides etc., landfills problems in your country and abroad, sanitation and hygiene problems evolved. Choose the most impressive in your opinion photo from online international exhibition *The water hub* showing the water global crises. Support your speech with the photo description.

Read and discuss the poem about water.

"Recycled" by Verne N. Rockcastle

The water you are about to drink
Deserves a second thought, I think;
For Avogadro, oceans, and those you follow
Are all involved in every swallow.

The molecules of water in a single glass
In number at least, five times out-class
The glasses of water in stream and sea,
Or wherever else that water can be.

The water you're about to taste
No doubt represents a bit of the waste
From prehistoric beast and bird,
A notion not at all absurd.

The water in you is between a' betwixt
And having traversed you is thoroughly mixed;
So someone slaking a future thirst
Could easily drink what you drank first.

The fountains spraying in the park
Distribute bits from Joan of Ark
And Adam, Eve, and all their kin;
You'd be surprised where your drink has been.

The water you cannot retain
Will some day hence return as rain,
Or be beheld as the purest dew,
Though long ago it passed through you.

Work in mini groups to write your own poem. Start each line with a new letter of the phrase *Water treatment.*

Part 3.

The aim of Part 3: Understanding the work of water treatment technologies.

Creative skills: creative thinking, personal expression.

ESP skills: listening**,** speaking, reading, writing about water treatment technologies

Functional language: brainstorming, summarizing, interviewing, giving opinions, analysing CV**.**

Description: Answer the questions:

How water treatment technologies can save life?

How chemical engineers can test water for bacteria?

Answer the *kahoot.it* quiz on waste water treatment. Read the article about *chlorination.* In pairs exchange your thoughts about this method.

Chlorination

How it works? Chlorine kills bacteria and viruses through a simple chemical reaction. The chlorine solution breaks down into different chemicals, including hypochlorous acid (HOCl) and hypochlorite ion (OCl-). Both of these chemicals kill microorganisms by destroying the enzymes and structures inside the cell. When enzymes come in contact with chlorine, hydrogen atoms in the enzymes are replaced by chlorine atoms. This causes the entire molecule to change shape or fall apart. When enzymes don't function properly, the cell or bacterium dies.

HOCl works faster because it is electrically neutral and is able to enter the negatively charged cell wall, while OCl- is electrically negative and is therefore repelled by the cell wall (like two negative magnets) and can only act on the surface. HOCl can kill microorganisms in several seconds, while OCl- may take up to 30 minutes. The pH of the water determines how much of the chlorine solution breaks into HOCl and how much breaks into OCl- . When the pH is low, more Hydrogen (H+) atoms exist in the water and OCl- can easily be converted to HOCl and the disinfection process is more effective. Ideal pH for chlorination is between 5.5 and 7.5. At a pH of 6, the ratio is 80% HOCl and 20% OCl- , at a pH of 7.5 equal amounts exist of each and at a pH of 8, the ratio is 20% HOCl and 80% OCl- . In Practice Chlorine gas (Cl_2) is the least expensive form of chlorine but is the most dangerous since it is stored in pressurized tanks. Calcium hypochlorite can also be used, but is more expensive. Sodium hypochlorite (NaOCl) is found in household bleach and is the most common form of chlorine used for small-scale/household-level treatment (be aware that the addition of NaOCl increases the pH.)

Procedure

The US EPA recommends the following chlorination procedure:

1. If cloudy, filter the water through a cloth or allow it to settle.

2. Add two drops per liter of unscented bleach (the bleach should contain 4-6% chlorine).

3. Stir and wait 30 minutes.

Time to Treat: about 35 minutes (5 minute preparation; 30 minute wait) regardless of quantity Cost: $0.10 per 100 L (liquid bleach); $0.10-$1 per 100 L (tablets).

Advantages	Disadvantages
Common (information available)	Can be dangerous if not used properly
Available in most countries	Taste and odor issues can arise
Very effective when used properly	Disinfection byproducts (DBPs) are created
Provides residual disinfection	Not effective against Cryptosporidium or Giardia
	Organic matter and particles can interfere
	Skepticism due to unchanged appearance

In pairs choose another water treatment method (*disinfection, filtration, coagulation, flocculation* etc.). Find information about it and write the main advantages and disadvantages of the method.

Talk to other pairs and exchange information. Prepare a big mind map to show technologies used by chemical engineers to purify water, their advantages and disadvantages.

Interview your groupmates using the questions:

What is the best way to purify water?

If you were the President, how would you change our current water treatment system?

What new water treatment technologies can you suggest?

Which treatment method would you recommend for a million gallons of water to be cleaned? What if water contains heavy metals and pharmaceuticals from industries?

Add more questions to the list and present the results of the survey.

In groups think of the experiment you can do to demonstrate water properties (test the starting concentration of contaminated water, tension, viscosity, electrical conductivity, turbidity etc.). You can do it in the lab as a home assignment. Make a video commenting all your actions in English.

Answer the question:

What lab equipment did you use for the experiment?

Translate the sentences:

1. Solar stills purify water through distillation, where pure water is vaporized out of collected dirty water and then condensed.

2. *In this lesson, we focus on two main indicators of water quality: coliform bacteria and turbidity.*

3. *Large-scale water treatment systems used in big cities include steps for filtering, coagulation and flocculation, sedimentation, chlorination and aeration, as well as (sometimes) lime (for softening) and fluoride.*

4. *Communicable diseases represent seven of the top ten causes of child mortality in developing countries around the world.*

5. *Are you willing to pay for municipal water treatment so that all the water we use to flush our toilets and irrigate our yards is safe enough for drinking?*

Answer the question.

Would you like to become a water purification chemist?

Read and discuss in pairs water purification chemist job duties, skills needed and salaries mentioned in the article. Think of five different questions to this text. Work in pairs and ask each other.

Career Path Guide

If you want to become a water purification chemist, you first need to determine if this career path is a good fit for you. If the following description sounds like you, then you're probably well suited for a career as a water purification chemist:

Those who become water quality analysts have a keen interest in the environment, the health and well being of others, as well as a concern for the sustainability and quality of our water supply.

They must have an education in science, an aptitude for mathematics and an objective approach to scientific activities. Water purification chemists must also be manually dexterous in order to utilize specialized equipment and conduct experiments.

Water purification chemists must be comfortable working in a laboratory setting as well as in the field, and they must be comfortable communicating their findings and opinions to others.

Education needed to become a water purification chemist

To become a water purification chemist, you need to begin by earning a Bachelor of Science degree in chemistry or a closely related field such as biochemistry. Completing coursework in biology, chemistry, biochemistry, environmental science, mathematics and statistics is a great way to build an educational foundation for your prospective career as a water purification chemist.

Although having a bachelor's degree may help you gain access to entry-level jobs in water purification chemistry, such as a lab assistant, it will be necessary to obtain a graduate degree in order to work as a chemist, a consultant or a researcher.

Graduate programs, such as a Master of Science program or a Ph.D. program, are extremely beneficial for future careers in water purification chemistry, as they place additional emphasis on laboratory work, as well as original research.

Water purification chemist job description

Water purification chemists are responsible for ensuring that water is suitable for human use and consumption. They must collect and analyze samples of municipal water and apply specific knowledge in chemical properties and processes to correct any shortfalls in quality.

Water purification chemist job duties

• Assess the taste and clarity of drinking water
• Use chemical processes to purify water
• Conduct further testing to ensure water is suitable for human use and consumption
• Oversee the work of laboratory and chemical technicians
• Record detailed notes during testing and purification processes
• Liaise with other staff, such as water purification technicians
• Contribute to the improvement of water purification processes
• May make recommendations for regulations and government policy

Who hires water purification chemists?

There are many organizations (both public and private) that are involved in testing water and in the remediation of any shortfalls in its quality. Many of these organizations employ water purification chemists. Water purification chemists may also find career opportunities with academic and regulatory organizations.

Organizations that hire Water Purification Chemists include:

• Municipal governments
• Public inspection agencies
• Private utility companies
• Environmental and engineering consulting firms
• Regional water or wastewater boards
• The federal government (for example, in the armed forces)
• Private utility companies
• Provincial/state parks
• Colleges and universities

Water purification chemist salary

The salary level of water purification chemists can vary depending on factors such as their level of experience, their level of education, where they work, the specific responsibilities of their job and many others.

Water Purification Chemist Salary Alberta: According to the 2011 Alberta Wage and Salary Survey, Albertans working in the CHEMISTS occupational group earn an average of between $28.03 and $45.00 per hour.

Water Purification Chemist Salary Canada: According to Service Canada, the average salary level of workers in the CHEMISTS occupational group is $63,190 per year.

Water Purification Chemist Salary United States: According to the United States Bureau of Labor Statistics, the median salary level of workers in the CHEMISTS AND MATERIALS SCIENTISTS occupational group is $69,790 per year.

Answer the question:

Is this career path a good fit for you?

Find an English CV of a water purification chemist that attracted your attention. What information would you add to his/her CV or omit, discuss whether the best engineers are born or made, the basic things for success in your opinion. Would you hire this person if you were the boss of a treatment company?

Part 4.

The aim of Part 4: Understanding the work of water treatment companies.

Creative skills: researching, imagination, personal expression, creative thinking.

ESP skills: listening**,** speaking, reading, writing about water treatment companies.

Functional language: comparing, evaluating and describing companies**.**

Description: Answer the questions.

Do you know any successful water treatment companies in Ukraine or abroad? Search Google to get more ideas. Visit the official sites of the companies. Discuss how strong their brands are, the products they offer.

Discuss this infographic in pairs. Speak about your experience.

In pairs think of your own water treatment company; name it; draw its brand, create your company's slogan. Watch and discuss video about making catchy portfolios in pairs, create an English portfolio for your company.

Consumers will follow brands or become "loyal" to certain brands because of particular aspects of that brand's identity. Let's take a look at the top 3 reasons people follow brands.

Brand Loyalty

What Are The Top 3 Things That Makes Consumers Loyal To A Brand?

88%
Say Quality

72%
Say Customer Service

50%
Say Price

50% said they were unlikely to read that brand's content again.

63% of consumers say they have engaged with negative brand content.

23% said they WILL NOT read that particular brand's content again.

Branding Gone Bad!

Brand Awareness, when done properly, is a great strategy. However, if you're not using your brand identity properly, it can turn people off of your business.

SOCIAL MEDIA & BRAND AWARENESS

These 2 Go Hand in Hand

71% of people say they are more likely to make a purchase from a brand they follow on social media

63% of people searching online are likely to follow a business if they have their business info on social media

58% of people with a Facebook account have liked a brand or followed a brand

41% of people with at least one social media account has shared a link, video or story about a brand

Part 5.

The aim of Part 5: Advertising water treatment company.

Creative skills: creative thinking, artistry, personal expression.

ESP skills: listening**,** speaking, reading, and writing about water treatment companies.

Functional language: negotiating, prioritizing, analysing**.**

Description: Answer the question.

What is your favourite advertisement?

Read the text and answer: What type of advertisement is the most efficient in your opinion?

TYPES OF ADVERTISEMENTS

1. PRINT ADVERTISING

The first print ad ran in England in 1472, according to Infolinks. Since then, this type of advertising has become available in newspapers, magazines, brochures, billboards, flyers, and similarly PORTABLE methods of carrying a brand's message to its ideal end user. In this ad method, the advertiser pays the publisher to place their ad in the publication.

2. RADIO ADVERTISING

Radio advertising dates back to 1920, when the first commercial radio stations were launched in the United States. Today, radio is still a relevant marketing and advertising platform for expanding the reach of a sponsored event or new product. In this ad method, the advertiser pays the radio station to play their ad during designated breaks between music or a radio show.

3. TELEVISION ADVERTISING

Television ads originated in the 1940s with the promotion of practical items and political campaigns. Advertisers can now use television to promote food, toys, stores, business services, and more − both to local TV channels and to national broadcast networks. In this ad method, the advertiser pays the regional or national TV network to show their ad during designated breaks in the network's regular programming.

4. INTERNET ADVERTISING

Internet advertising took root in the mid 1990s with the launch of "banner" advertisements for various telecommunications companies. These ads are placed in interstitial spots on a webpage. In this ad method, the advertiser pays the website owner to place their ads in exposed spaces that are peripheral to the website's own content. Internet advertising has gone on to include video, search engine marketing, sponsored social media posts, and more.

But, as you know, the advertising types above have evolved dramatically since their respective origins. What were once quite one-dimensional messages now carry clever, funny, or profound undertones that make the ads memorable years after they first ran.

In your group, discuss and answer the question: *How to create an advisement for your water treatment company*.

Read some suggestions from Lindsay Kolowich blog. Answer the question:

Which piece of advice is the most helpful for your water treatment company.

When you're trying to decide the best way to present your brand, ask yourself: What problem are you solving for your customers? What solution does your product or service provide? By hitting on that core issue in all of your messaging, you'll connect with consumers on an emotional level that is hard to ignore.

No matter how boring your product looks, it doesn't mean you can't tell your story in an interesting way. Be determined and differentiate your product in the same way.

Acknowledge not just your audience, but the challenges they face -- especially the ones that reflect your time or culture. Not every societal issue is off limits to marketers and advertisers. Take a stand on the ones you know your audience supports, and you'll access a customer base that identifies with your passion.

That's the most important takeaway from this campaign: Don't try to sell your company, product, or service as something it's not. Consumers recognize and appreciate honesty.

Watch videos about secrets of making a creative video, coming up with creative video ideas.

In pairs make a video advertising your water treatment company (up to 3 minutes).

Show your advertisement to the national bank workers (invited ESP teachers play their role and can give a business loan only to three companies).

Be ready to answer their additional questions concerning

- aims of your business;
- the type of product you are offering;
- the kind of premises you need;
- the equipment you want to have;
- ways to advertise your business,
- the amount of money you would like to get;
- the target audience;
- how are you going to sell the products (on the Internet, home delivery, fairs etc.).

The winner is the pair who gets the bank loan.

What do you think about the business risks in your country?

In pairs discuss the risks mentioned in the text related to your country.

7 BUSINESS RISKS EVERY BUSINESS SHOULD PLAN FOR

1. ECONOMIC RISK

The economy is constantly changing as the markets fluctuate. Some positive changes are good for the economy, which lead to booming purchase environments, while negative events can reduce sales. It's important to watch changes and trends to potentially identify and plan for an economic downturn.

2. COMPLIANCE RISK

Business owners face an abundance of laws and regulations to comply with. For example, recent data protection and payment processing compliance could impact how you handle certain aspects of your operation. Staying well versed in applicable laws from federal agencies like the Occupational Safety and Health Administration (OSHA) or the Environmental Protection Agency (EPA) as well as state and local agencies can help minimize compliance risks.

3. SECURITY AND FRAUD RISK

As more customers use online and mobile channels to share personal data, there are also greater opportunities for hacking. News stories about data breaches, identity theft and payment fraud illustrate how this type of risk is growing for businesses.

4. FINANCIAL RISK

This business risk may involve credit extended to customers or your own company's debt load. Interest rate fluctuations can also be a threat.

5. REPUTATION RISK

There has always been the risk that an unhappy customer, product failure, negative press or lawsuit can adversely impact a company's brand reputation. However, social media has amplified the speed and scope of reputation risk. Just one negative tweet or bad review can decrease your customer following and cause revenue to plummet.

6. OPERATIONAL RISK

Something could unexpectedly happen that causes you to lose business continuity.

That unexpected event could be a natural disaster or fire that damages or destroys your physical business. Or, it might involve a server outage caused by technical problems, people, or power cut. Many operational risks are also people-related. An employee might make mistakes that cost time and money.

7. COMPETITION (OR COMFORT) RISK

While a business may be aware that there is always some competition in their industry, it's easy to miss out on what businesses are offering that may appeal to your customers.

In this case, the business risk involves a company leader becoming so comfortable with their success and the status quo that they don't look for ways to pivot or make continual improvements. Increasing competition combined with an unwillingness to change may result in a loss of customers

Worksheet A

Talk to different students asking if the sentence is true or false and why do they think so. Analyse the answers and present the results.

✂

1. Evaporation of the water from the sodium chloride solution yields the original NaCl. Student 1 Student 2 Student 3 Student 4 Student 5 Student 6 Student 7	2. CO_2 and O_2 can not dissolve in water. Student 1 Student 2 Student 3 Student 4 Student 5 Student 6 Student 7	3. Seawater contains dissolved substances as well as suspended solids. Student 1 Student 2 Student 3 Student 4 Student 5 Student 6 Student 7	4. The body fluids of all life forms are solutions. Student 1 Student 2 Student 3 Student 4 Student 5 Student 6 Student 7
5. One can dissolve up to 70 grams of sugar in 100 grams of water at 0 °C. Student 1 Student 2 Student 3 Student 4 Student 5 Student 6 Student 7	6. The solubility of substances decreases with temperature. Student 1 Student 2 Student 3 Student 4 Student 5 Student 6 Student 7	7. If we mix 10 grams of water with 90 grams of alcohol, water would be considered the solvent. Student 1 Student 2 Student 3 Student 4 Student 5 Student 6 Student 7	1. The ice fish lives under the polar ice cap where the water temperature is - 4°C. This fish does not freeze at that temperature due to the solutes in its blood. Student 1 Student 2 Student 3 Student 4 Student 5 Student 6 Student 7
9. Naphthalene is used in chemical manufacturing and in some kinds of moth repellent. Student 1 Student 2 Student 3 Student 4 Student 5 Student 6 Student 7	10. The small batteries (AA, AAA, C, and D) that power household appliances and small electrical devices consist of double electrochemical cells. Student 1 Student 2 Student 3 Student 4 Student 5 Student 6 Student 7	11. Electrolysis can be useful to clean historic objects recovered from shipwrecks. Student 1 Student 2 Student 3 Student 4 Student 5 Student 6 Student 7	12. Sodium hydroxide is the key ingredient in drain cleaners. Student 1 Student 2 Student 3 Student 4 Student 5 Student 6 Student 7

Worksheet B

a) You are a famous scientist from the handout. Study this information, read additional data about your role online. You want to be a Nobel prize winner but only one person can win. Tell other famous people why you should win The Nobel prize in Chemistry and convince them that you are worth getting this prize.

b) Write down the two names who should win the Prize. Participate in the voting.

Student 1

You are **Louis Pasteur (1822–1895)**

Nationality: French

Famous for: The process of pasteurization and creation of vaccines for rabies and anthrax.

Your discovery that bacteria spread diseases has saved countless lives. You discovered the asymmetrical molecular structure on certain crystals. Also you made some of the earliest vaccines for rabies and anthrax.

Student 2

You are **John Dalton (1766–1844)**

Nationality: English

Famous for: Identification And Presenting The Atomic Theory. Recognized for your work on the atomic theory and research on color blindness. You successfully identified chemical compounds and reactions affected by interaction of atoms with one another.

Student 3

You are **George Washington Carver (1864–1943)**

Nationality: American

Famous for: Contributions to crop management and soil conservation. You discovered that sweet potatoes and legumes, including peanuts, provided additional food sources, but also increased the amount of nitrogen, a valuable nutrient, in the soil. You also introduced the concept of planting alternate crops as a way to preserve nutrients in the soil.

Student 4

You are **Michael Faraday (1791–1867)**

Nationality: British

Famous for: Contributions in electrochemistry and electromagnetism. You also studied chlorine as well as new chlorides of carbon. In addition, you made the earliest type of what we know today as the Bunsen burner. You played a critical role in providing a continuous source of electricity. Your continuous research works led to the discovery of diamagnetism as well.

Student 5

You are **Alfred Nobel (1833–1896)**

Nationality: Swedish

Famous for: Inventing the dynamite. One of your earliest inventions include the gas meter. At one time, you held nearly 350 patents on various items. Dynamite was then used all over the world for blasting tunnels, building railways, roads and cutting canals. You went on to create many other kinds of explosives and your work was recognized all over the world.

Student 6

You are **Antoine Lavoisier (1743–1794)**

Nationality: French

Famous for: Being the "father of modern chemistry". You showed the relationship between oxygen and metal, resulting in rust. You were able to show the role of oxygen in plant respiration and in animals. You showed that water was made of hydrogen and oxygen, and that air was composed mainly of oxygen and nitrogen in its gaseous state.

Student 7

You are **Marie Curie (1867-1934)**
Nationality: Polish
Famous for: the discovery of the elements polonium and radium in 1898. You were the first lady to teach in Sorbonne. In 1911, you received your second Nobel Prize, this time in chemistry for your discovery and isolation of radium and its compounds. You also proved that radium can successfully cure certain illnesses. You introduced the use of X-ray technology and radium in medicine.

Student 8

You are **Alice Hamilton (1869–1970)**
Nationality: American
Famous for: being a chemist and physician who directed the first governmental commission to investigate industrial hazards in the workplace, such as exposure to dangerous chemicals. Because of your work, laws were passed to protect employees from occupational hazards. In 1919 you became the first female faculty member of Harvard Medical School.

Student 9

You are **Rosalind Franklin (1920–1958)**
Nationality: British
Famous for: discovery of the DNA structure in genetics. Your contributions to science involve the study of the structures of coal, graphite, DNA, RNA, and viruses. You used the technique of X-ray diffraction to identify the differences between carbon atoms that get converted into graphite when heat is applied and those that do not. This led to the discovery of a new technology called carbon-fiber technology.

Student 10

You are **Edith Flanigen (born 1929)**
Nationality: American
Famous for: In the 1960s, you invented a process for making synthetic emeralds. In addition to their use for making beautiful jewelry, the perfect emeralds made it possible to make powerful microwave lasers. In 1992, you received the first Perkin Medal ever awarded to a woman, for your work synthesizing zeolites.

Student 11

You are **Mary Lyon (1797–1849)**
Nationality: American
Famous for: founding Mount Holyoke College in Massachusetts, one of the first women's colleges. At the time, most colleges taught chemistry as a lecture-only class. You made lab exercises and experiments an integral part of undergraduate chemistry education. Your method became popular. Most modern chemistry classes include a lab component.

Student 12

You are **Robert Boyle (1627-1691)**
Nationality: English, Irish
Famous for: being referred to as the "Father of Chemistry". You carried out many experiments that helped you to understand the relationship between the volume and pressure of gas. This resulted in Boyle's Law that states, when temperature is held constant, the volume of gas is inversely proportional to pressure. You also tested for the presence of salt in water using silver nitrate and devised a test for mineral-water analysis.

Worksheet C

a) Discuss the pictures taken in Igor Sikorsky KPI in pairs. Note down interesting details, the words or phrases you don't know but need.

b) Ask your partner as many questions as you can using *what, where, when, how, why* and *who* words. Discuss your impressions, thoughts and striking details about this picture.

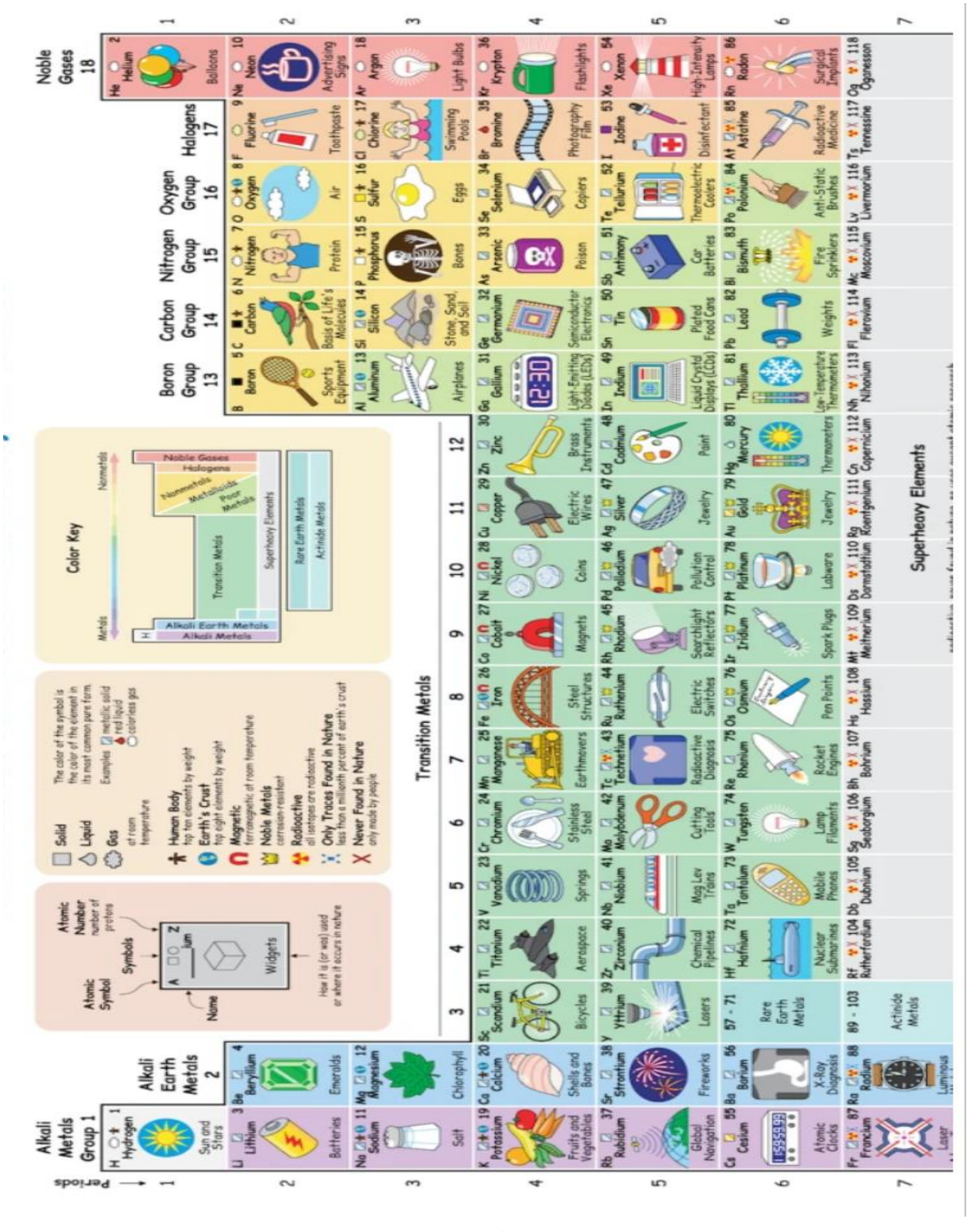
c) Write a poem based on the picture (6-10 lines). Rhymes are not required.

d) At home take a photo on the topic "My major is chemistry and I love it". Share the photo with your groupmates and describe it. Read a metaphor or a famous quote you associate with the image.

Worksheet D

a) Follow the link https://elements.wlonk.com/ElementsTable.htm. “The Periodic Table of Elements, in Pictures and Words” was created by Boeing software engineer Keith Enevoldsen. Discuss where we can encounter each element in our life.

b) In small groups choose 5 elements. Deliver your speech about the uses of the chosen elements in our lives.



Worksheet E

a) Answer the questions: Do you think love is something mystical and supernatural or it is just a simple chemistry? Make sure you understand the meaning of the words and phrases:

biological imperative,
a drive to survive,
our life is threatened,
conscious, visceral,
in my gut,
a feedback system,
to be in harmony,
receiving fear,
external consequence,
to gird,
relevance,
maintenance of the body.

b) Watch a video https://www.youtube.com/watch?v=HybUnUFu1xw . Do you agree or disagree with Dr. Bruce Lipton? Why?

c) Listen to the song by Lou Reed "My love is chemical" and complete the gaps.

When I see the way you _____[1] your lips
and I _____[2] your perfume
when I see the _____[3] new color
that you've dyed your hair, too
I know, you know, it's more than physical
My love, my love, my love, love is chemical

Well I know the saying goes
that all in love and _____[4] is fair
but I've never stood a chance
against your chemical warfare
The _____[5] on your fingernails
_____[6] on your eyes
the lotion you _____[7] on at night
to make sure your hands ain't _____[8]
My love, my love, my love, love is chemical

I know, I know, it's more than physical, hey baby
My love, my love, my love, love is chemical

Well I hope that you won't take _____[9]
it's not that you're not pretty
it's only that I feel like
I'm in love with _____[10] city
I know with you, I'm on the pinnacle
I'm on the _____[11], babe
My love, my love, my love, love is chemical
we're not just talking physical desire here

I know with you, it's more than physical
much more than just carnal lust
My love, my love, my love, love is chemical

My, my love, oh, love is chemical
my, my, my love is chemical
It's so much more than physical, honey
it's much more than physical
My love, my love, my love, love is chemical

My, my, my, my love is chemical
hey baby, my, my, my, my love is chemical
So much more than physical, honey, why don't you come here
my love is chemical
I'd like to _____[12] with you directly
my love is chemical

So much more than physical

d) Listen one more time and sing.
e) Answer the questions of the quiz https://www.thoughtco.com/questions-on-basic-chemistry-quiz-609618

Worksheet F

1. **Work in pairs to put the stages of the recipe in the correct order.**

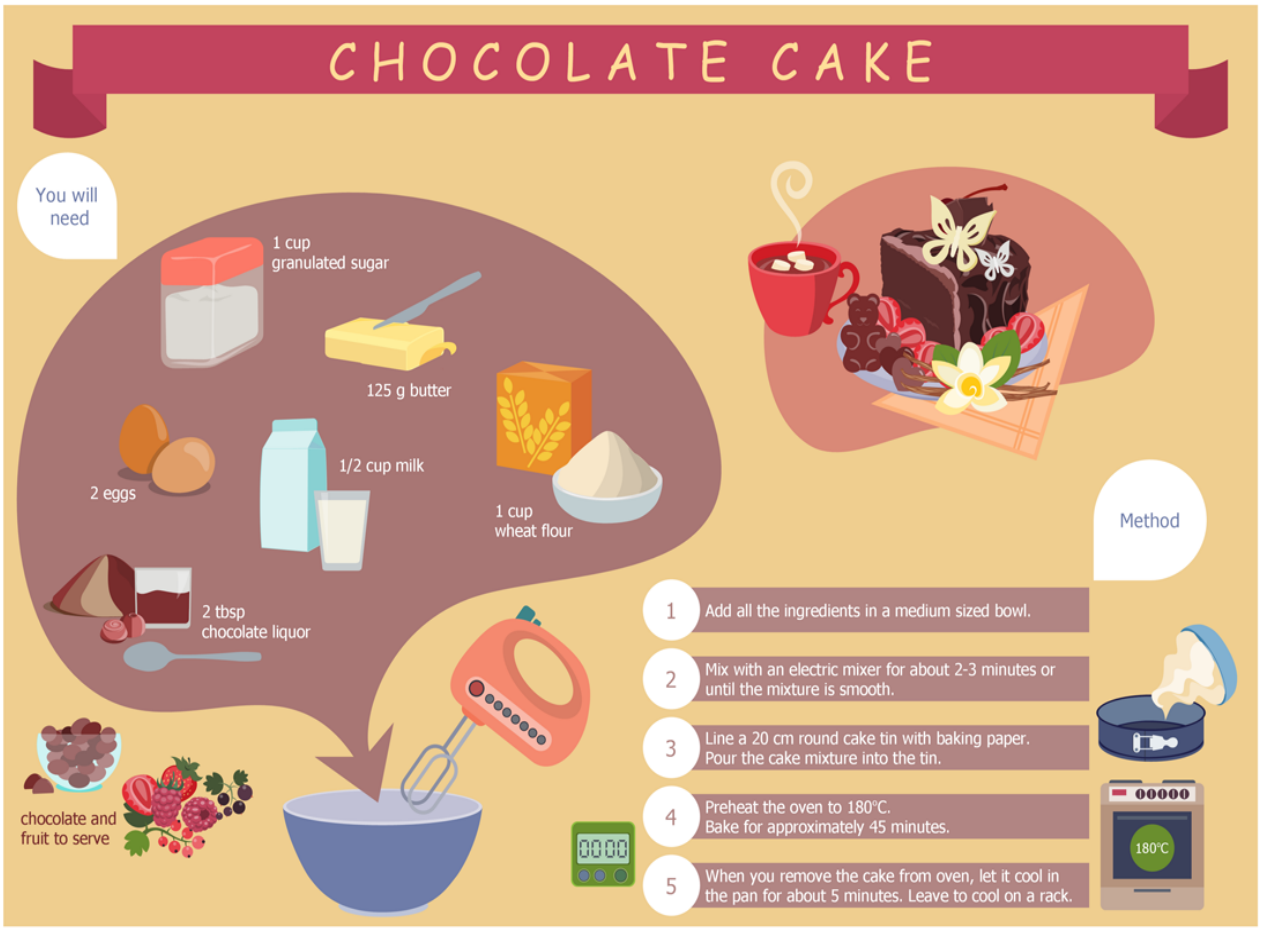
Stir until the dough is the right consistency.
Bake until you like the color.
Knead the dough for a while on the floured cutting board.
Dump some flour into a bowl.
Let it double in a greased bowl with a damp cloth cover.
Add some yeast.
Add some water gradually.
Preheat the oven to 400°F (204°C).
Form a loaf on a baking sheet.

2. **Work in mini groups. Read and describe each other your recipe.**

Student A

Student B

Student C



Worksheet G

It is a fast quiz. The winner is the one who get the biggest number of correct answers for minute.

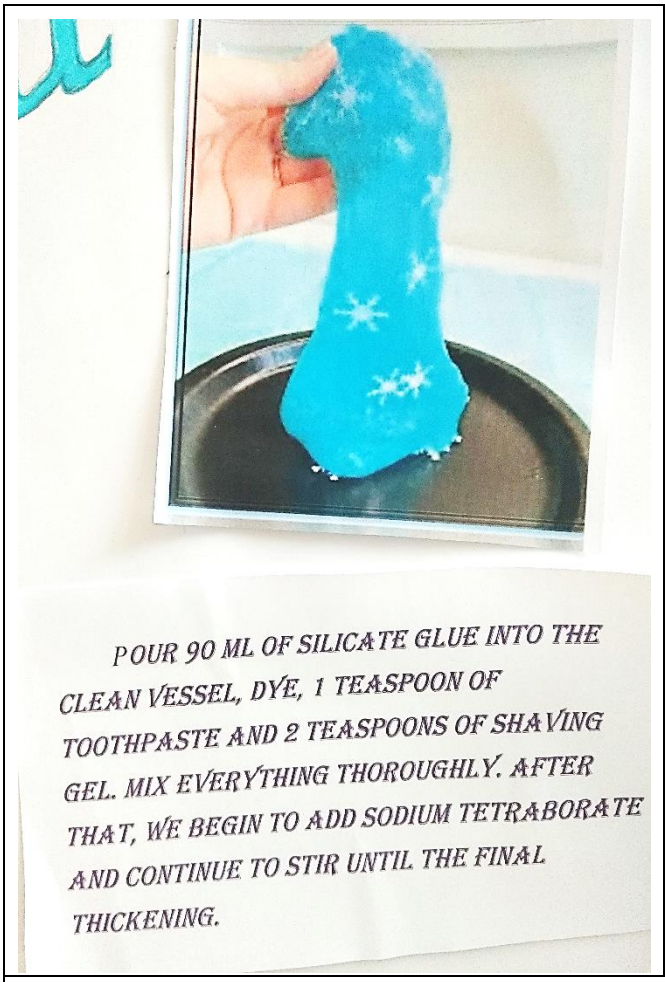
Chemistry quiz from http://www.sciencekids.co.nz/quizzes/chemistry.html

1. What is the first element on the periodic table?
2. What is the centre of an atom called?
3. True or false? Acids have a pH level below 7.
4. What is the main gas found in the air we breathe?
5. True or false? An electron carries a positive charge.
6. Famous New Zealand scientist Ernest Rutherford was awarded a Nobel Prize in which field?
7. What is the chemical symbol for gold?
8. K is the chemical symbol for which element?
9. What orbits the nucleus of an atom?
10. At room temperature, what is the only metal that is in liquid form?
11. True or false? A neutron has no net electric charge.
12. A nuclear reaction where the nucleus of an atom splits into smaller parts is known as nuclear fission or nuclear fusion?
13. What is H_20 more commonly known as?
14. What is the third most common gas found in the air we breathe?
15. What is the name given to substances that are initially involved in a chemical reaction?
16. True or false? Bases have a pH level below 7.
17. Is sodium hydroxide (NaOH) an acid or base?
18. Atoms of the same chemical element that have different atomic mass are known as?
19. True or false? A proton carries a positive charge.
20. What is the fourth most abundant element in the universe in terms of mass?

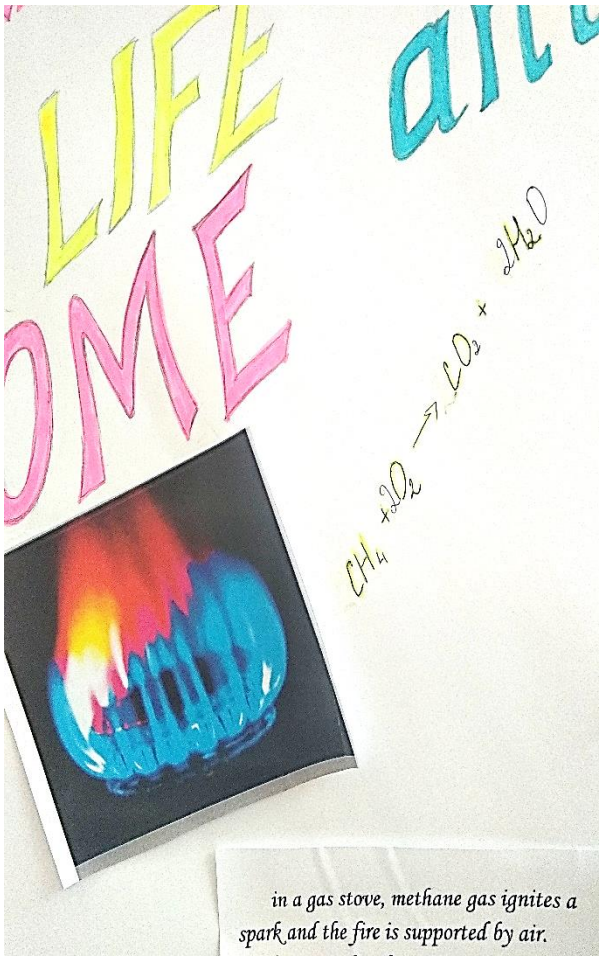
Chemistry Quiz Answers

1. Hydrogen	2. A nucleus	3. True	4. Nitrogen (around 78%)
5. False	6. Chemistry	7. Au	8. Potassium
9. Electrons	10. Mercury	11. True	12. Nuclear fission
13. Water	14. Argon (around 1%)	15. Reactants	16. False
17. Base	18. Isotopes	19. True	20. Carbon

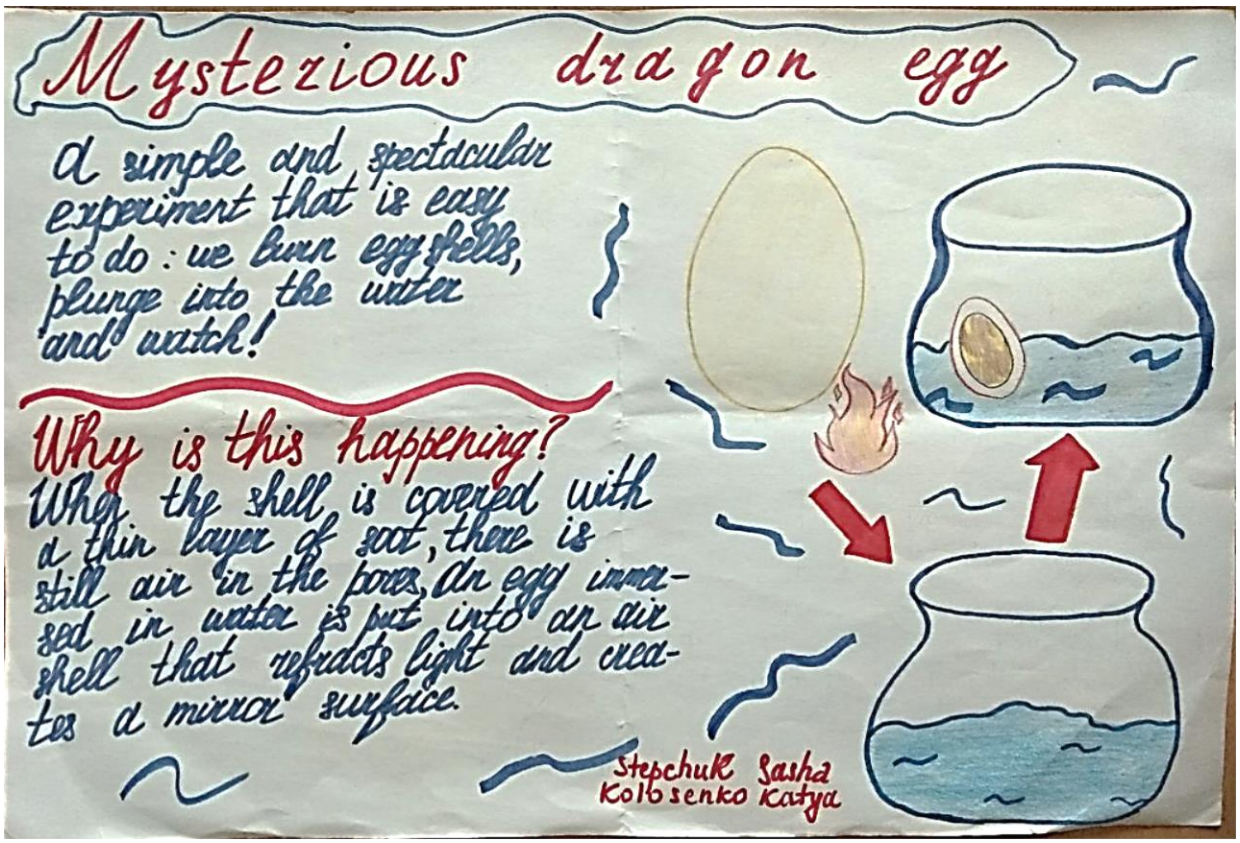
APPENDIX A

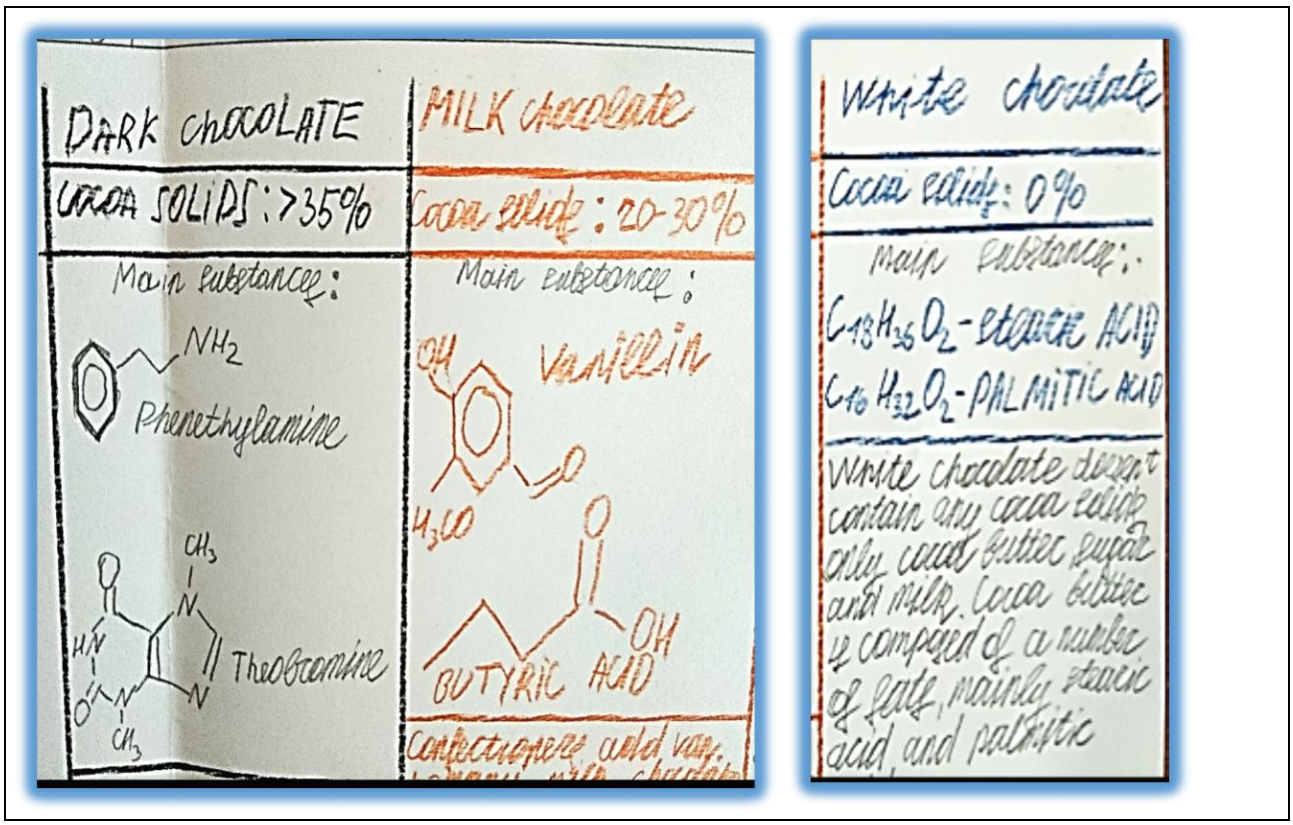


POUR 90 ML OF SILICATE GLUE INTO THE CLEAN VESSEL, DYE, 1 TEASPOON OF TOOTHPASTE AND 2 TEASPOONS OF SHAVING GEL. MIX EVERYTHING THOROUGHLY. AFTER THAT, WE BEGIN TO ADD SODIUM TETRABORATE AND CONTINUE TO STIR UNTIL THE FINAL THICKENING.

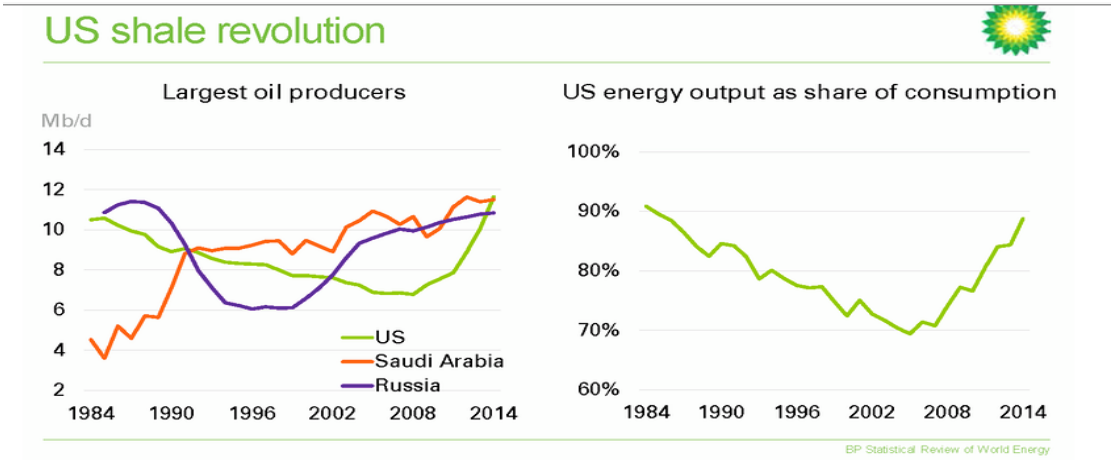


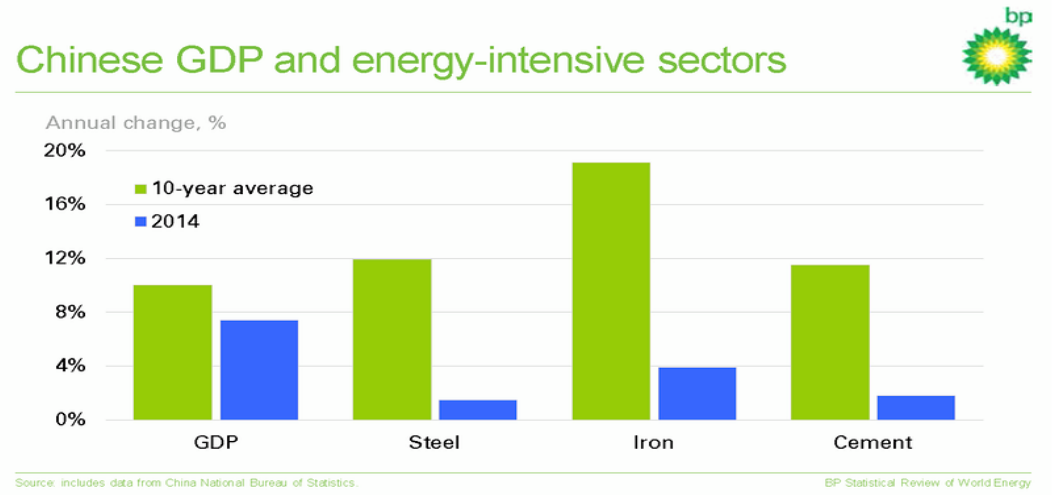
in a gas stove, methane gas ignites a spark and the fire is supported by air.




DARK CHOCOLATE
COCOA SOLIDS: >35%
Main substances:
NH2
Phenethylamine
CH3
HN
O
N
N
CH3
Theobromine
MILK chocolate
Cocoa solids: 20-30%
Main substances:
OH
Vanillin
H3CO
O
OH
BUTYRIC ACID
White chocolate
Cocoa solids: 0%
Main substances:
C18H36O2 - stearic acid
C16H32O2 - PALMITIC ACID
White chocolate doesn't contain any cocoa solids only cocoa butter sugar and milk. Cocoa butter is composed of a number of fats, mainly stearic acid and palmitic

APPENDIX B


US shale revolution
Largest oil producers
Mb/d
14
12
10
8
6
4
2
1984
1990
1996
2002
2008
2014
US
Saudi Arabia
Russia
US energy output as share of consumption
100%
90%
80%
70%
60%
1984
1990
1996
2002
2008
2014
BP Statistical Review of World Energy


Chinese GDP and energy-intensive sectors
bp
Annual change, %
20%
16%
12%
8%
4%
0%
10-year average
2014
GDP
Steel
Iron
Cement
Source: includes data from China National Bureau of Statistics.
BP Statistical Review of World Energy

ANSWERS

<table>
<tr><th colspan="4">UNIT 1</th></tr>
<tr><th>Ex. 2</th><th>Ex. 5 a</th><th>Ex. 6 a</th><th>Ex. 7</th></tr>
<tr>
<td>1 d
2 c
3 a
4 b
5 e</td>
<td>Sometimes more than one answer is correct as some branches of chemistry are closely related.
1 organic
2 biochem
3 analytical
4 chemistry of fire
5 inorganic
6 inorganic or PET chemistry</td>
<td>Plastics – polymer;
Pharmaceuticals – bio/med;
Minerals – geochem.;
Metals and nonmetals – inorg.;
Semiconductors – electro.;
Reaction rates – chemical kinetics (the branch of physical chemistry);
Food nutrients – bio;
Quality control – analytical;
Metabolism and Fermentation – bio.</td>
<td>a does
b do
c is
d work
e is
f deals
g utilizes
h is</td>
</tr>
<tr>
<td colspan="3">Ex. 8. b

1 Compound – A substance whose molecules consist of unlike atoms and whose constituents cannot be separated by physical means.
2 Cloud – he electron CLOUD is the region of negative charge surrounding an atomic nucleus that is associated with an atomic orbital.
3 Bond – The strong attractive force that holds together atoms in molecules and crystalline salts.
4 Molecule – A group of atoms held together by chemical forces.
5 Nucleus – the positively charged center of the atom consisting of protons and neutrons.
6 Empty slot - a place available to something.
7 Electron shell – is the outside part of an atom around the atomic nucleus.
8 Chain – a series of linked atoms (generally in an organic molecule).
9 Loop – the curved shape.
10 Sheet - something that is very thin as compared with its length and width
11 Versatility – variety.
12 Living thing – things which are now or once were alive.
13 Petroleum – a kind of oil that comes from below the ground and that is the source of gasoline and other products.
14 Overlap – to extend over or past and cover a part of.</td>
<td>Ex. 9. a
1 kitchen,
2 running water,
3 ice,
4 steam,
5 running,
6 ping pong balls.</td>
</tr>
</table>

<table>
<tr><th colspan="3">UNIT 2</th></tr>
<tr><th>Ex. 1 b</th><th>Ex. 2</th><th>Ex. 3</th></tr>
<tr><td>1 d
2 b
3 c
4 a</td><td>1 colorful
2 hard
3 lustrous
4 soluble
5 dense
6 magnetic
7 reactive
8 toxic
9 flammable
10 stable</td><td>2.Uranium glass – green, radioactive, transparent, fluorescent.
3. Rubber – abrasion resistant, tear resistant, water resistant, bouncy, elastic.
4. Mirror – reflective (it reflects light), made of a flat, polished layer of aluminum (or perhaps silver) covered by a protective glass coating.
5. Polymer – strong, stiff, light weight, resistant to corrosion, lack of conductivity, low cost.
6. Match (wood) – stiff, hydroscopic, bad conductor of heat and electricity
7. Pyrite (/ˈpaɪraɪt/) – brittle, hard, opaque, greenish-black.
8. Graphite – has a high melting point, similar to that of diamond, insoluble in water, hard, has a layer structure.
9.Antibacterial hand gel – antiseptic, liquid, transparent.
10. Solution of Nickel chloride – liquid, transparent.
11. Crystal – hard, the lack of rotational symmetry, solid, consisting of flat faces with sharp angles.
12. Paper – solid, hard but brittle, thin, flexible.</td></tr>
<tr><th>Ex. 5</th><th colspan="2">Ex. 6</th></tr>
<tr><td>1. No
2. Heat and light, love, shadows, echoes, rainbow matter are not matter as they don’t have mass</td><td colspan="2">2. The leaves decomposing are chemically changing as they decompose into phosphorus, nitrogen, and other matter that will become nutrients in the air, water, and soil.
3. When a car is turned into a wreck, this involves a physical change because the molecular composition of the car doesn't change.
4. Painting your nails would be a physical form because you are adding the polish to your nails, but the nail remains the same.</td></tr>
</table>

	5. Papermaking is a series of physical and chemical changes. The physical and chemical changes will depend on raw material used 6. Baking a cake is a chemical change 7. Ice cream melting is a physical change 8. The process of crystallization is a physical change. 9. Burning of wood is a chemical change as new substances which cannot be changed back (e.g. carbon dioxide) are formed. 10. When bees collect nectar, they chemically change it by using enzymes to bring about supersaturation. 11. This involves a physical change 12. The process of making glass involves a chemical change.

Ex. 9 a

1. The molten lava was about two thousand degrees Fahrenheit.

2. Where the lava came in contact with the water it changes states from liquid to a solid, creating a wall of chilled lava to dam the flow. The water hitting the lava produced billows of steam.

Ex. 9 c

1b;2a;3b;4a;5b;6b;7b;8c;9b;10b;11a;12b;13a;14c;15b;16c;17c;18a.

Ex. 10

track 4 – 1 odourless; 2 pioneers; 3 radioactive; 4 heaviest;

track 5 – 5 amorphous; 6 interesting; 7 simple; 8 hard; 9 soft; 10 adjacent; 11 extra; 12 negative;

track 6 – 13 important; 14 insoluble; 15 additive; 16 opaque; 17 reactive; 18 protective.

UNIT 3

Ex. 1 b

Physical properties**:** color, shape, hardness, texture, luster, solubility, boiling point, melting point, density, magnetism, mass, volume, length
Chemical properties**:** reactivity with other chemicals, toxicity, flammability, chemical stability, types of chemical bonds

Ex. 2 a	**Ex.3**
1 Oxygen; 2 water; 3 silver; 4 white; 5 liquid; 6 solid.	1,2,4 – Compound **3.** Elements

Ex. 4 a

1. International Union of Pure and Applied (IUPAC)
2. With a capital letter *or* a capital letter and a lowercase letter
3. Scientists

Ex. 5 b

Ag silver (*argentum*)	F fluorine	Ni nickel
Al aluminum	Fe iron (*ferrum*)	O oxygen
Au gold (*aurum*)	H hydrogen	P phosphorus
B boron	He helium	Pb lead (*plumbum*)
Ba barium	Hg mercury (*hydrargyrum*)	Pt platinum
Bi bismuth	I iodine	S sulfur
Br bromine	K potassium (*kalium*)	Sb antimony (*stibium*)
C carbon	Kr krypton	Si silicon
Ca calcium	Li lithium	Sn tin (*stannum*)
Cd cadmium	Mg magnesium	Sr strontium
Cl chlorine	Mn manganese	Ti titanium
Co cobalt	N nitrogen	U uranium
Cr chromium	Na sodium (*natrium*)	W tungsten (*Wolfram*)
Cu copper (*cuprum*)	Ne neon	Zn zinc

Ex. 6 a

1. Iridium takes its name from the Latin *iris*, meaning "rainbow."
2. Mercury is named after the planet. Neptunium and Plutonium for the next two planets, Neptune and Pluto.
3. "Celestial elements" include helium ("sun"), tellurium ("earth"), selenium("moon")
4. Potassium and sodium are derived from the ores potash and soda.
5. The names promethium (Prometheus, who stole fire from heaven), vanadium (Scandinavian goddess Vanadis), titanium (Titans, the first sons of the earth), tantalum (Tantalos, father of the Greek goddess Niobe), and thorium (Thor, Scandinavian god of war) all arise from Greek or Norse mythology.
6. "Geographical elements," shown on the map, sometimes honoured the discoverer's native country or workplace. The Latin names for Russia (*ruthenium*), France (*gallium*), Paris (*lutetium*), and Germany (*germanium*) were among those used.
7. Elements honoring important scientists include curium, einsteinium, nobelium, fermium, and lawrencium.
8. Dubnium is named in honor of the Dubna laboratory in the former Soviet Union, where important contributions to the creation of heavy elements have originated.

Ex. 7	**Ex. 8**
1 100; 2 Nine; 3 98%; 4 Abundant; 5 Latin or Greek.	**Electron -** a very small particle of matter that has a negative charge of electricity and that travels around the nucleus of an atom **Nuclear atom -** An atomic structure consisting of dense, positively charged nucleus (neutrons and protons) surrounded by a corresponding set of negatively charged electrons. **Nucleus -** the positively charged center of the atom consisting of protons and neutrons **Proton -** a very small particle of matter that is part of the nucleus of an atom and that has a positive electrical charge **Neutron -** a very small particle of matter that has no electrical charge and is part of the nucleus of all atoms except hydrogen atoms **Isotope -** any one of various forms in which the atoms of a chemical element can occur **Atomic number -** an experimentally determined number characteristic of a chemical element that represents the number of protons in the nucleus in which a neutral atom equals the number of electrons outside the nucleus and that determines the place of the element in the periodic table

	Mass number - an integer that approximates the mass of an isotope and designates the number of nucleons in the nucleus

Ex. 10

Gold

Ex. 11 a

1. A **gold rush** is a period of feverish migration of workers to an area that has had a dramatic discovery of gold deposits. Major gold rushes took place in the 19th century in Australia, New Zealand, Brazil, Canada, South Africa, and the United States, while smaller gold rushes took place elsewhere.

2. Gold, unlike many other metals, is relatively expensive to produce, thus making the base price fairly high. It does not readily oxidize thus; it maintains a constant weight.

Ex. 11 d

1 similar	almost the same
2 misleading	likely to make someone believe something that is not true
3 identification	the act of recognition
4 flake	a small thin piece
5 intensive property	independent of the amount property
6 valuable	worth a lot of money
7 nugget	a small rough piece of a valuable metal found in the earth
8 appearance	the way something looks

Ex. 12 a

Copper ranks as the third-most-consumed industrial metal in the world, after iron and aluminum, according to the U.S. Geological Survey (USGS).

Ex. 12 c

The Statue of Liberty is made of copper. The internal structure is comprised of cast iron and stainless steel.

Iron is the most-used metal on the planet − it is the main ingredient in the alloys called “steel”, and steel alloys are basically the “bread and butter” of metals for most engineers. Steels are usually very

Ex. 12 b	
Chemical prop. • Forms green copper carbonate compound when in contact with moist air • A deep blue solution appears when in contact with ammonia • Forms new substances when combined with nitric acid and sulphuric acid	cheap, strong, and relatively easy to work with. **Aluminum** is the next-most-common metal. Aluminum is lightweight, corrosion-resistant, and very easy to machine into just about any shape you can think of. Aluminum is more expensive than most Steel alloys, and usually is not quite as strong. **Copper** is the third most common metal. Copper is heavy, but very ductile and malleable, and very electrically and thermally conductive. It is also very corrosion-resistant but its use in construction is limited by it's high price and relatively low strength.

Ex. 12 d

1. **The Motherland Monument** – the stainless steel statue stands 62 m (203 ft)
2. **Christ the Redeemer** – it is made of reinforced concrete and soapstone, and was constructed between 1922 and 1931
3. **The Little Mermaid (statue)** – The sculpture is made of bronze and granite. The statue was commissioned in 1909 by Carl Jacobsen, son of the founder of Carlsberg, who had been fascinated by a ballet about the fairytale in Copenhagen's Royal Theatre and asked the ballerina, Ellen Price, to model for the statue. The little mermaid has several times been the victim of vandalism. Twice she has lost her head, once the arm was sawn off, and several times she has had paint poured on her.

Ex. 15 a

1. Wrong: I mixed 20.09 g of cyclohexanol with 6 mL of 85 % H3PO4. (Don't use first person active)
2. Wrong: Mix 20.09 g of cyclohexanol with 6 mL of 85 % H3PO4. (Recipe format – not historical.)
3. Right: Cyclohexanol (20.1 g, 0.201 mol) was mixed with H3PO4 (85 %, 6 mL). (Third person passive, past tense)

UNIT 4

Ex. 1 b.

a – 3; b – 1;
c – 2; d – 4.

Ex. 3

1 circle graph; 2 wedges; 3 circle; 4 bar graph; 5 location; 6 axis; 7 line graph; 8 dependent variable; 9 best fit line.

Ex. 4

1 Density comparison
2 The mass of a substance per unit volume
3 Substance
4 Density
5 Mercury
6 Lead
7 Wood

Ex. 6

a) To show monthly concentration of CO_2 measured at Mauna Loa.
b) The x-axis shows, the y-axis shows, the graph is showing us, On the graph, steadily rose over time, concentration is rising, seeing this rate on a graph.

Ex. 7

Go up – increase, grow, rise.
Go down – decrease, drop, decline, fall.
Quickly – sharply, rapidly, steeply.
Greatly – considerably.
Step by step – gradually.
Without changes – stable, constant.
Change often – fluctuate.
Temperately – moderately, gently.

Ex. 8

1. Well, it's important because the kind of language and the kind of vocabulary you're going to use is different depending on which type of diagram you're looking at.

2. All these verbs like *increased, decreased, rose, fell, showed a decrease, showed a decline* are good when you're showing change over time.

UNIT 5

Ex. 3 a

1. Molecules in the air scatter *BLUE* light from the sun.
2. To minimize surface tension.
3. Can be different answers including this - Our brain habituates to the cocktail of "in-love" chemicals. Oxytocin and vasopressin, the pair-bonding endorphins, take over.
4. Almost 99% of the mass of the human body is made up of six elements: oxygen, carbon, hydrogen, nitrogen, calcium, and phosphorus. Only about 0.85% is composed of another five elements: potassium, sulfur, sodium, chlorine, and magnesium.

Ex. 3 d

1. Benches 2. Fume hoods 3. Funnels

Ex. 3 e

to be one's Virgil – to be something one is good at. Virgil – is an ancient Roman poet; the author of the Aeneid;
candidate drug − a compound (small molecule, antibody, etc.) with strong therapeutic potential and whose activity and specificity have been optimised;
trial and error experimental techniques – repeated attempts until success;
cycle − a group of events that happen in a particular order, one following the other, and are often repeated;
drug-protein interactions − bind to a protein molecule;
come up with tens of exciting new ideas – create new solutions;
follow a standard protocol – to do as required in the document;
the right set up − the correct way of organization.

Ex. 3 f

specialisation, power, simulation, computer.

Ex. 4 e

The brick and mortar – refers to a physical presence of an organization or business in a building or other structure.
Consortia (sing. consortium) – a combination of financial institutions, capitalists, etc.
Entail – involve. **Verify –** check.
Expertise – noun /ˌɛkspəːˈtiːz/ **–** expert skill or knowledge in a particular field.
Capture – take into control.
Pioneer – to be the first to use or apply.
Looked upon as geeks – considered to be someone who is intelligent but not fashionable or popular.
Underpaid – people who are not paid enough money for the job that they do.
Findings – results.
Perceive – interpret or regard (someone or something) in a particular way.
Outreach – The act or practice of visiting and providing the services (of a charity or other organization) to people who might not otherwise have access to those services.
Maintain – keep.

Ex. 5 b

1 conduct
2 analyze
3 induce
4 conduct
5 conduct
6 confer
7 prepare

Ex. 8 b

-What two possible problems does the speaker mention?
Trying to figure out how to leave chemistry problems at work. Or navigating the two-body problem, which is figuring out how to find two jobs that won't geographically separate you as a couple.
-Where was Daniella going to study after her defence?
She was preparing to defend and move on to a postdoc at New York University.
-Where did Arjel and Daniella do their research together?
At Yale.

ANSWERS FOR WORKSHEETS

A

2. F (Although carbon dioxide and oxygen are nonpolar gases, they do dissolve slightly in water).
6. F (one can dissolve up to 90 grams of sugar in 100 grams of water.)
7. F (The solubility of substances increases with temperature).
8. F (If we mix 10 grams of water with 90 grams of alcohol, water would be considered the solute).
10 F. The small batteries (AA, AAA, C, and D) that power household appliances and small electrical devices consist of **single** electrochemical cells.

E

When I see the way you **paint**[1] your lips
and I **smell**[2] your perfume
when I see the **brand**[3] new color
that you've dyed your hair, too
I know, you know, it's more than physical
My love, my love, my love, love is chemical

Well I know the saying goes
that all in love and **war**[4] is fair
but I've never stood a chance
against your chemical warfare
The **polish**[5] on your fingernails
maskara[6] on your eyes
the lotion you **rub**[7] on at night
to make sure your hands ain't **dry**[8]
My love, my love, my love, love is chemical

I know, I know, it's more than physical, hey baby
My love, my love, my love, love is chemical

Well I hope that you won't take **offense**[9]
it's not that you're not pretty
it's only that I feel like
I'm in love with **test tube**[10] city
I know with you, I'm on the pinnacle

F a.

1. Dump some flour into a bowl.
2. Add some yeast.
3. Add some water gradually.
Stir until the dough is the right consistency.
5. Knead the dough for a while on the floured cutting board.
6. Let it double in a greased bowl with a damp cloth cover.
7. Form a loaf on a

	I'm on the **pinnacle**[11], babe My love, my love, my love, love is chemical we're not just talking physical desire here I know with you, it's more than physical much more than just carnal lust My love, my love, my love, love is chemical My, my love, oh, love is chemical my, my, my love is chemical It's so much more than physical, honey it's much more than physical My love, my love, my love, love is chemical My, my, my, my love is chemical hey baby, my, my, my, my love is chemical So much more than physical, honey, why don't you come here my love is chemical I'd like to **communicate**[12] with you directly my love is chemical So much more than physical	baking sheet. 8. Preheat the oven to 400°F (204°C). 9. Bake until you like the color.

ANSWERS FOR CREATIVE PROJECTS

Creative project 1

Physical/chemical property	Definition
Flammability	Ability to burn
Corrosion	To destroy or be destroyed, esp. by acid or rust, usually over a long period of time
Density	Mass per unit volume
Mass	The amount of matter in any solid object or in any volume of liquid or gas
Boiling point	the temperature at which a substance boils
Malleability	The ability to be pounded into thin sheets

Melting point	The temperature at which a substance melts
Solubility	The ability to dissolve in another substance
Ductility	The ability to be drawn into a wire
Thermal conductivity	The ability to transfer heat
Volume	The amount of space that is contained within an object or solid shape
Hardness	Not easy to bend, cut, or break
Electrical conductivity	The property of allowing electricity to go through
Odor	A particular smell
Color	The appearance that something has as a result of reflecting light

Creative project 2

Material	Time Required to Biodegrade
Paper Towels, Apple Core /Orange Peel, Newspaper	2-4 weeks
Plain Cardboard (unwaxed)	3 months
Cotton cloth	3-6 months
Rope	1 year
Waxed Milk Carton	5 years
Cigarette	1-5 years
Disposable Diaper	10-20 years
Steel Can	80-100 years
Aluminum Can	200-400 years
Ziploc™ Bag	300 years
6-pack Ring	400 years

Plastic Bottle	450 years
Monofilament Fishing Line	600 years
Glass Bottle	Thousands to millions of years

Creative project 6

Terms	Explanations
Water Quality	The degree of purity of water, determined by measuring the substances physical, chemical and biological in water, besides water molecules
Turbidity	A measure of water clarity how much the material suspended in water decreases the passage of light through the water
pH (potential Hydrogen)	How acidic or basic a substance is, measure on a scale of 1 (very acidic) to 14 (very basic).
Hardness	The level of the minerals calcium and magnesium in water.
Concentration	The amount of one substance in a certain volume of another substance.
Filtration	The process of passing water through a series of screens that allow the water through, but not larger solid particles.
Flocs	Sticky globs created by adding a chemical such as alum during water treatment.
Coagulation	The process by which particles in a liquid clump together; a step in the water treatment process.
Sewage	Water containing human wastes.
Sludge	Deposits of fine solids that settle out from wastewater during the treatment process.
Septic tank	An underground tank containing bacteria that treat wastewater as it passes through.
Leach Field	The ground area around a septic tank through which wastewater filters after leaving the tank.
Desalination	The process of obtaining fresh water from salt water by removing the salt.
Water Pollution	The addition of any substance that has a negative effect on water or the living things that depend on the water.
Point Source Pollution	A specific source of pollution that can be identified, such as a pipe.

Tapescripts

Unit 1

1.

You are right! Chemistry here! Chemistry is a superhero. And I bet you didn't know that your kitchen …yep! the one in your house is a real life chemistry lab. Don't believe me? Come on! You know what ice is, right? Maybe you have some ice cubes in your freezer. When ice gets warmer, it melts and you get water like the stuff in your tap. And what do you get when water gets even hotter and boils? That's right! Steam! So here is the core thing. Ice, running water and steam are all the same chemical - H_2O. It is just in different states: solid, liquid and gas. Any here is an even cooler thing. Any chemical can be a solid, liquid or gas. It's heat and pressure that make them change. Let's look inside the steam! There is so much heat energy in this boiling water. It is making the molecules bounce around like pin-pong balls. How much heat is needed to make substance change depends on what it is. Uhhh... I need to cool down.

Unit 2

2.

Matter – key terms for section 2.1. The nature of matter.

	Definition
1. Matter	The material of the universe
2. Atoms	The fundamental units of which elements are composed
3. Compounds	Substances made of two or more different elements joined together in a specific way
4. Molecule	A collection of atoms bonded together that behave as a unit
5. Elements	A substance that cannot be decomposed into simpler substances by chemical or physical means. It consists of atoms all having the same atomic number
6. Solid	One of the three states of matter. It has a fixed shape and volume
7. Liquid	One of the three states of matter. It has a definite volume that takes the shape of its container
8. Gas	One of the three states of matter. A substance with no definite shape or volume

3.

■ Matter has mass and occupies space. It is composed of tiny particles called atoms.

■ Matter exists in three states:

• Solid − is a rigid substance with a definite shape

• Liquid − has a definite volume but takes the shape of its container

• Gas − takes the shape and volume of its container

■ Elements contain only one kind of atom − elemental copper contains only copper atoms, and elemental gold contains only gold atoms.

■ Compounds are substances that contain two or more kinds of atoms.

■ Compounds often contain discrete molecules.

■ A molecule contains atoms bound together in a particular way − an example is the water molecule, which is written as H_2O.

4.

Radon is the product of the decay of other unstable, radioactive elements such as radium, thorium and actinium. The colourless, **odourless**, tasteless gas can be isolated from these sources but soon decays as it has no stable isotopes. The early **pioneers** in the study of radioactivity, the Curies, had noted that radium appeared to make the surrounding air **radioactive**. The discovery of radon is credited to a German physicist Friedrich Ernst Dorn, who traced this observed radioactivity to a gas which was given off by radium − a gas which he called 'radium emanation'. Similar 'emanations' were isolated from other elements − for example thorium, and eventually the gas was identified as the **heaviest** of the noble gases, named radon, and given its rightful place in the periodic table.

5.

Let's start with the boring bit. Boron is usually isolated as a brown, **amorphous** solid. I don't know anyone who thinks the element boron has anything **interesting** about it. But its unexpected side starts to emerge when you look at some **simple** compounds of boron. Consider the nitride, for example − just the 2 elements at numbers 5 and 7 in the periodic table, but able to join forces to provide **hard** diamond or **soft** graphite-like structures, very similar to those of the 6^{th} element, carbon. Then there is the trifluoride − remember that acids were first classified as substances that could provide protons, but BF_3 is the archetypal Lewis acid, which doesn't have a proton in sight, yet is able to coordinate with lone pairs, allowing it to catalyse an array of reactions. It can achieve this chemistry because boron really does have two sides to it − it is set up to form 3 bonds with **adjacent** atoms, but even in this state, readily forms an **extra** bond in order to complete the 2^{nd} main shell of 8 electrons. but when it does this, it acquires a **negative** charge, and it can only regain neutrality by losing one of its bonds − it really does have a split personality.

6.

Titanium. It is notoriously hard to make, but we have come to rely on it and indeed we couldn't do without this element or its compounds today.

So, why is it so important? The most **important** compound is the oxide TiO_2, which makes up 95% of the Ti used worldwide. We actually use 4 million tons of TiO_2

each year, a lot of it for paint and other applications that need something that is bright white, **insoluble** and not toxic, like medicines and toothpaste. In the food industry it is **additive** number E171, used to whiten things like confectionary, cheeses, icings and toppings.

It is also used in sunscreens, since it is a very **opaque** white and also very good at absorbing UV light. The ability to absorb UV light helps the TiO_2 to act as a photocatalyst. This means that when UV light falls upon it, it generates free electrons that react with molecules on the surface, forming very **reactive** organic free radicals. Now you don't want these radicals on your skin, so the TiO_2 used in sunscreens is coated with a **protective** layer of silica or alumina.

Unit 3

7.

■ All of the materials in the universe can be chemically broken down into about 100 different elements.

■ Nine elements account for about 98% of earth's crust, oceans, and atmosphere.

■ In the human body, oxygen, carbon, hydrogen, and nitrogen are the most abundant elements.

■ Each element has a name and a symbol.

• The symbol usually consists of the first one or two letters of the element's name.

• Sometimes the symbol is taken from the element's original Latin or Greek name.

8.

Key terms for section 2.2. – Properties of matter.

Physical properties	The characteristics of a substance that do not involve changing to another substance
Chemical properties	Characteristic that describes the ability of a substance to change to a different substance
Physical change	A physical change involves a change in one or more physical properties. But no change in composition
Chemical change	A chemical change transforms a substance into one or more new substances.

Unit 4

9.

Dynamic charts and static charts. So, what do I mean? **A dynamic chart is one that shows change over time** like the one we have right in front of us. So, you can see that we've got a progression of change happening throughout this period here. In this case, it happens to be from 1995 to 2002. We call this dynamic because it shows change.

On the other hand, **a static bar chart does not show change over time**. It just shows us really, as I call it, a snapshot of a moment in time and we'll look at that in a minute as well.

Now, why is this distinction important? Well, it's important because the kind of language and the kind of vocabulary you're going to use is different depending on which type of diagram you're looking at. So, if it's static, you're going to be using different kinds of language than you will if you're looking at a dynamic bar chart. And again, not just a bar chart but potentially a line graph or a pie chart as well. So, what I have found in my experience as an IELTS teacher is that when people start preparing for IELTS, when they start learning vocabulary for task 1, they very correctly start learning all these verbs like **increased, decreased, rose, fell, showed a decrease, showed a decline.** All of that is great and good. It's important to learn that vocabulary, but again it's only relevant if you have this kind of thing in front of you **where you're showing change over time**.

Unit 5

10.

Kerri: Those are couples in which each half is a chemist, or at least a scientist with ties to chemistry.

Linda: For instance, Barbara is a lecturer in the Chemistry and Biochemistry Department at California State University, Dominguez Hills. And her wife, Shelley, is the manager of the Flow Cytometry/Cell Sorting Facility at the California Institute of Technology.

Kerri: Barbara and Shelley are just one of the many chemistry couples we heard from while working on this podcast. I don't think we were expecting to get so many responses to our call on social media asking for your stories.

Linda: Yeah, we got dozens of responses in just a couple of days. And although every story was unique, we definitely noticed some trends.

Kerri: For instance, it's no surprise to hear that chemists met and fell in love in school, across the lab bench, or at conferences. The couples also face a lot of similar challenges.

Linda: Like trying to figure out how to leave chemistry problems at work. Or navigating the two-body problem, which is figuring out how to find two jobs that won't geographically separate you as a couple.

Kerri: In this episode, *Stereo Chemistry* will be playing third wheel to five different chemistry couples to talk about their love, their struggles, and of course, the nerdy ways they met.

11

Kerri: Working in the same lab kept them close, but it also created a sense of competition between them. Based on what we know of romantic comedies, we have to believe there was some truly captivating will-they, won't-they tension in the lab, right up until Danielle was graduating.

Linda: Danielle was two years ahead of Arjel, so she was finishing up, **preparing to defend and move on to a postdoc at New York University.** So they had a decision to make.

Kerri: Cue the grand gesture.

Arjel Bautista: You know I was thinking to myself, and I was like, "I cannot let her leave without me telling her how I feel about her." So what I actually did was I took the *JACS*, so the *Journal of the American Chemical Society*, their template, and I wrote her a communication.

Danielle Guarracino: Yes.

Arjel Bautista: Like basically a letter in a communication format.

Danielle Guarracino: Yep.

Arjel Bautista: And put figures in with pictures of things we'd done while we were **together at Yale**.

Kerri: But wait. There's more.

Danielle Guarracino: He came to my apartment and he actually sang to me and he brought a rose. It was really very TV, it was very romantic comedy. But it was so sweet and he basically was saying, like, don't forget me.

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