UNIVERZITA PAVLA JOZEFA ŠAFÁRIKA V KOŠICIACH
Filozofická fakulta

KATEDRA ANGLISTIKY A AMERIKANISTIKY

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Poďakovanie

RNDr. Samuelovi Velebnému, CSc., za pomoc a nákazlivé nadšenie pre chémiu.

CONTENTS

INTRODUCTION

The following material has been created during the two years of teaching English for Chemists at the Faculty of Science of the Pavol Jozef Šafárik University and is therefore designed to meet the needs of this course. The main motivation was the lack of appropriate materials, especially as the groups generally comprise students with a very diverse level of English. This diversity therefore became the main criterion determining both the form and the content of this text.

In the ten units that provide material for a one semester course, the emphasis is put on teaching the students vocabulary and terminology, which is introduced via authentic texts, depending on the topic of each unit. Students are encouraged to learn the meaning of new words in context. Grammar is included too, with the aim of demonstrating and explaining grammatical rules by means of examples taken directly from the texts. For the more advanced students, grammatical exercises in this material can serve for revision while the beginners might need more supplementary materials.

I hope that this material, the preparation of which has been a challenging as well as enjoyable experience will be useful for future teachers and the students of this course.

Author

Unit 1
SCIENCE

- **What is Science?**
- **Branches of Science**
- **Word Formation**

What is Science?

1. What do the following words mean? Match them with their definitions
science a science scientific scientist

– the study of the nature and behaviour of natural things and the knowledge obtained about them

– a particular area of scientific knowledge and study, or the study of an area of a human behaviour

– describes things that relate to science

– someone who works in science

2. What is the difference between 'science' and 'a science'?

Branches of Science

1. Which branches of science study each of these areas?

environment
human mind and behaviour
language
numbers, quantities and shapes
people, society and culture
substances and their reactions
weather
political systems
living things
matter and forces
money, industry and trade
celestial objects
water
rocks and soil
society and social behaviour

2. What is the difference between economy and economics?

3. Can biology be further subdivided?

4. Put the branches of science into the following 4 main groups.

I. Mathematics and logic

- not based on experimental testing but they can be considered a part of science because they are essential tools in almost all scientific study.

II. Physical science

- examines the nature of the universe

III. Life science

- also called biological sciences or biology, the study of living organisms

IV. Social sciences

- deal with the individuals, groups and institutions that make up human society.

5. Where would you put e.g. history, literature, religion, philosophy?

6. What is the main difference between sciences and humanities?

7. How do we call the scientists who specialise in the following fields of study? How are the names formed?

ecology	anthropology
psychology	chemistry

linguistics
biology
physics
economy
astronomy

history
philosophy
theology

meteorology
sociology
political science
mathematics

Are there any other words that can be formed from these words?

Word Formation

1. **Combine the words in brackets with suitable SUFFIXES to complete the sentences. Choose from the following suffixes:**

-er, -or, -ing, -ion, -ness, -ity

1. A _____ (boil) is a closed vessel in which water or other fluid is heated.
2. _____ (compress) is the reduction in size of data in order to save space or transmission time.
3. In chemistry, the _____(dense) of many substances is compared to the_____ (dense) of water.
4. _____(transmit) is the act of passing something on.
5. _____ (hard) is the characteristic of a solid material expressing its resistance to permanent deformation.
6. Combustion process is also called _____ (heat).

-ful, -less, -ous, -al, -ive

1. It can be _____ (use) to write a summary of your argument first.

2. Metals containing iron are called _____ (ferrum).

3. You can ask him if you want to but it's _____ (use). He doesn't want to talk about it.

4. Hydrogen and oxygen are _____ (chemistry) elements.

5. I f any material is _____ (conduct), it means it conducts electric current.

-ify, -ise/-ize

1. I think this plan is too complicated. You should _____ (simple) it.
2. There used to be some disputes between the 2 countries but recently they have managed to _____ (normal) their relations.
3. I hope you _____ (real) that you are wrong.
4. When a liquid substance becomes solid, it _____ (solid).

What part of speech do the words you have just created belong to?

2. Match the following PREFIXES with their meanings.

bi-, mono-, multi-, poly-, dis-, in-, mal-, un-, de-, over-, ultra-, super-, re-, mis-

number:

degree or size:

negativeness:

reverse:

repetition:

Now match the following words with appropriate prefixes. Some words can be combined with several prefixes.

_____lingual	_____expected	_____atomic	_____compose
_____advantage	_____function	_____hydrate	_____violet

_____accuracy	_____cellular	_____frost	_____live
_____understand	_____charge	_____flow	_____take
_____open			

3. The following words can have 2 meanings – they can be CONVERTED. What are they?

chemical	smile	smell
work	diet	taste
love	rest	

4. Match the words on the left with those on the right to form COMPOUNDS.

class	brush
self	tax
science	lights
tooth	control
income	fiction
traffic	house
green	room
generation	gap

Exercises:

Exercise 1 Fill in the correct prefix. Use mega- , under- , hyper- , sub-

1. _____ water - used bellow the surface of water
2. _____ weight - weighing less than normal
3. _____ way - a path that goes under a road (GB) / an electric underground railway (US)
4. _____ watt - a million watts
5. _____ title - text added to foreign language movies
6. _____ structure - the lowest supporting part of a structure
7. _____ phone - a cone-shaped device used for making one's voice louder
8. _____ graduate – a university or college student studying for their first degree

9. _____ statement - less than true
10. _____ standard - of secondary quality
11. _____ size - smaller than normal
12. _____ section - a secondary part of a thing
13. _____ nourished - not well fed
14. _____ normal - bellow normal average
15. _____ pay - not to pay well enough
16. _____ sonic - less than the speed of sound
17. _____ merge - to go under (water)
18. _____ line - to emphasise
19. _____ -urban - lying in the outskirts of a town or city
20. _____ tension - blood pressure higher than normal
21. _____ text - text store in a computer system that contains links that allow the user to move between texts
22. _____ bole - exaggeration

Adapted from: http://www.nonstopenglish.com/exercise.asp?exid=583

Exercise 2 Choose the correct alternative to complete these statements.

1. If you can see very clearly through a material, the material is
   a translucent b translucid c transparent
2. If you cannot see through a material, it is
   a opal b opalescent c opaque
3. A substance that dissolves in liquid is
   a dissolute b dissolvable c soluble
4. A liquid that dissolves substances is a
   a solvent b soluent c solutent
5. A material that is hard but breaks easily is
   a battle b brittle c bristle
6. If a material bends easily, it is
   a bendible b flexible c flectable
7. A material that does not bend easily is
   a rancid b rigorous c rigid

8. A metal that can easily be beaten into new shapes is

   a beatable b malleable c mullible

9. A material that conducts electricity is

   a conducive b conductive c conductor

10. A material that catches fire easily is

    a flameable b flammable c inflammable

MASCULL, Bill. 1997. *Key Words in Science and Technology*. Collins Cobuild, 1997, p. 133.

Unit 2
CHEMISTRY

- **What is Chemistry?**
- **Plural in English**
- **Latin and Greek Plural**
- **Fundamental Concepts of Chemistry**

What Is Chemistry?

1. How would you define chemistry? What is the scope if its study?

2. What definition of chemistry was mentioned in Unit 1?

3. Read the article. What is the meaning of the words in bold?

If you look 'chemistry' up in Webster's Dictionary, you'll see:

"chem·is·try n., pl. -tries. 1. the science that systematically studies the **composition**, **properties**, and activity of **organic** and **inorganic** substances and various elementary forms of matter. 2. chemical properties, reactions, **phenomena**, etc.: the chemistry of carbon. 3. a. sympathetic understanding; rapport. b. sexual attraction. 4. the constituent elements of something; the chemistry of love. [1560-1600; earlier chymistry]."

My definition is the short and sweet, "scientific study of **matter**, its properties, and **interactions** with other matter and with energy".

An important point to remember is that chemistry is a science, which means its **procedures** are systematic and **reproducible** and its **hypotheses** are tested using the scientific method.

Chemists, scientists who study chemistry, **examine** the properties and composition of matter and the **interactions** between substances. Chemistry is closely related to physics and to biology. As is true for other sciences, mathematics is an **essential tool** for the study of chemistry.

Adapted from: http://chemistry.about.com/cs/chemistry101/f/bldefinition.htm

4. How many meanings of the word chemistry are mentioned in the article? Does the word 'chémia' have the same meanings in Slovak?

5. Which branches of science are, according to the article, closely related to chemistry? Do you agree?

6. Why, according to the article, is chemistry a science? What criteria are mentioned?

7. Do you think that mathematics is an essential tool for the study of chemistry, as the article says? Do you as the students of chemistry need to study mathematics?

8. What is the meaning of the following words?

thesis **hypothesis**

Plural in English

1. Find the examples of plural words in the text. What are the rules for forming plural in English?

2. Are there any exceptions to these rules?

3. Some English words only occur in plural. Can you think of any examples?

Some of these words look like plural but are used with a verb in singular, e.g.:

Politics is a very interesting topic.

Mathematics is an essential tool for studying other sciences.

4. Some English words only occur in singular. Can you think of any examples?

Latin and Greek plural

Some words which retain their original Greek and Latin forms make their plurals according to the rules of Greek and Latin with English pronunciation.

Latin words:	**singular ending**	**plural ending**
	alg**a**	alg**ae**
	radi**us**	radi**i**
Exception:	corp**us**	corp**ora**
	curricul**um**	curricul**a**
Greek words:	**singular ending**	**plural ending**
	synthes**is**	synthes**es**
	hypothes**is**	_____
	phenomen**on**	phenomen**a**
	criteri**on**	_____

Some of these words have double plural form:	formul**a**	formul**ae** formula**s**
Some words follow the English rules:	dogm**a**	dogma**s**

Why do you think this is so?

Adapted from: ORESKÁ, A. et al. 2004. *Activity Book English for Chemists*. Bratislava: STU, 2005, p. 17.

Fundamental concepts of chemistry

1. Read the text and fill in the gaps with the following expressions in appropriate forms. Use each expression only once.

chemical formula, chemical equation, proton, neutron, element, electron, atomic nucleus, molecule, cation, anion, chemical compound, chemical reaction, chemical bonds, ion, molecule, atomic number

An **atom** is a collection of **matter consisting of** a positively **charged core** (the _____ _____) which **contains** _____ and _____ and which **maintains** a number of electrons to **balance** the positive charge in the nucleus. The atom is also the smallest **portion** into which an _____ can be divided and still **retain** its properties, made up of a **dense**, positively charged nucleus surrounded by a system of _____.

The most basic chemical **substances** are the chemical **elements**. They are building blocks of all other substances. An element is a class of atoms which have the same number of protons in the nucleus. This number is known as the _____ _____ of the element. For example, all atoms with 6 protons in their nuclei are atoms of the chemical element **carbon**, and all atoms with 92 protons in their nuclei are atoms of the element **uranium**. Each chemical element is made up of only one kind of atom. The atoms of one element **differ** from those of all other elements. Chemists use letters of the alphabet as symbols for the elements. In total, 117 elements have been observed as of 2007, of which 94 occur naturally on Earth. Others have been produced **artificially**.

An _____ is an atom or a **molecule** that has lost or **gained** one or more electrons. Positively charged _____ (e.g. **sodium** cation Na^+) and negatively charged _____ (e.g. **chloride** Cl^-) can form **neutral salts** (e.g. **sodium chloride** NaCl).

Electrical forces at the atomic level create _____ _____ that join two or more atoms together, forming _____. Some molecules consist of atoms of a single element. **Oxygen** molecules, for example, are made up of two oxygen atoms. Chemists represent the oxygen molecule O_2. The 2 indicates the number of atoms in the molecule.

When atoms of two or more different elements **bond together**, they form a _____ _____. Water is a compound made up of two **hydrogen** atoms and one oxygen atom. The _____ _____ for a water molecule is H_2O.

Compounds are formed or broken down by means of _____ _____. All chemical reactions **involve** the **formation** or **destruction** of chemical bonds. Chemists use _____ _____ to express what **occurs** in chemical reactions. Chemical equations consist of chemical formulas and symbols that show the substances **involved in** chemical change. For example, the equation

$$C + O_2 \longrightarrow CO_2$$

expresses the chemical change that occurs when one **carbon** atom **reacts**, or bonds, with an oxygen molecule. The reaction produces one molecule of **carbon dioxide**, which has the formula CO_2.

Adapted from:
The World Book Encyclopedia. Volume 3. 1992. Chicago: World Book Inc, 1992, pp. 366-7.
http://www.onpedia.com/encyclopedia/chemistry
http://www.wikipedia.org

2. Read the article again. The names of which chemical elements and compounds can you find there?

3. What is the meaning of the following expressions:

chemical bonds **bond together**

dense **density**

Exercises:

Exercise 1 Choose the correct form of the verb, singular or plural.

1. Physics was / were my best subject in school.
2. Can I borrow your scissors? Mine isn't / aren't sharp enough.
3. Do you think the people is / are happy with the government?

4. Gymnastics is / are my favourite sport.
5. The trousers you bought for me doesn't / don't fit me.

Exercise 2 Change the following sentences from plural to singular.

1. What criteria did the scientists use?
2. The formulae represent the molecular structures of the substances.
3. The investigated phenomena are not frequent.
4. The analyses of the results did not prove his hypotheses.
5. Electrolysis is used for purifying certain metals.

Exercise 3 Write the plural form of the words in *italics*.

1. Even the best psychiatrists sometimes make mistakes in their *diagnosis* and treatment.
2. Nuclear energy is produced using the heat generated by splitting the *nucleus* of atoms of certain elements.
3. Atoms emit or absorb *quantum* of equal energy.
4. Chemical *equilibrium* may be classified into two groups, namely homogenous and heterogenous *equilibrium*.
5. After analyzing the *datum*, they were able to draw conclusions.

Adapted from: ORESKÁ, A. et al. 2004. *Activity Book English for Chemists*. Bratislava: STU, 2005, p. 17.

Unit 3
LABORATORY

- **Laboratory Equipment**
- **Countable and Uncountable Nouns**
- **Alchemy**

Laboratory Equipment

Match the following expressions with pictures. What are their Slovak equivalents?

single neck flat bottom flask

Erlenmeyer flask

graduated cylinder

filtering flask

three neck round bottom flask

beaker

round bottom boiling flask

separatory funnel

test tube

pH meter

buffers

watch glass

condenser

Petri dish

volumetric flask

vial

analytical balance

Buchner funnel

crucible

mortar and pestle

pH sticks

burette (buret)

oven

tongs

stand

bath

pH

ring

Buchner flask

pipette

funnel

filter paper

1 

2 

3 

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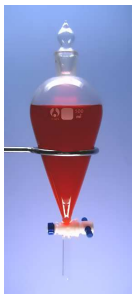
9 

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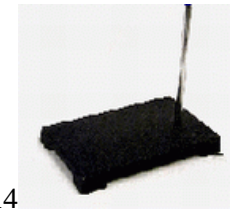
14 

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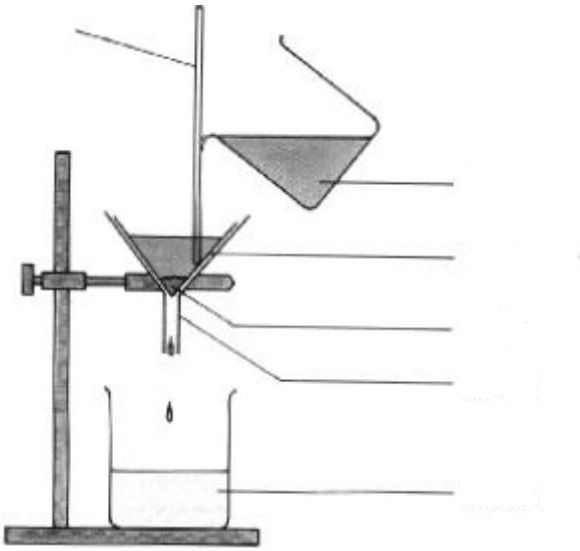
26  27  28  29  30 

Fill the following schemes with suitable expressions. What are their Slovak equivalents?



funnel

filter paper

mixture

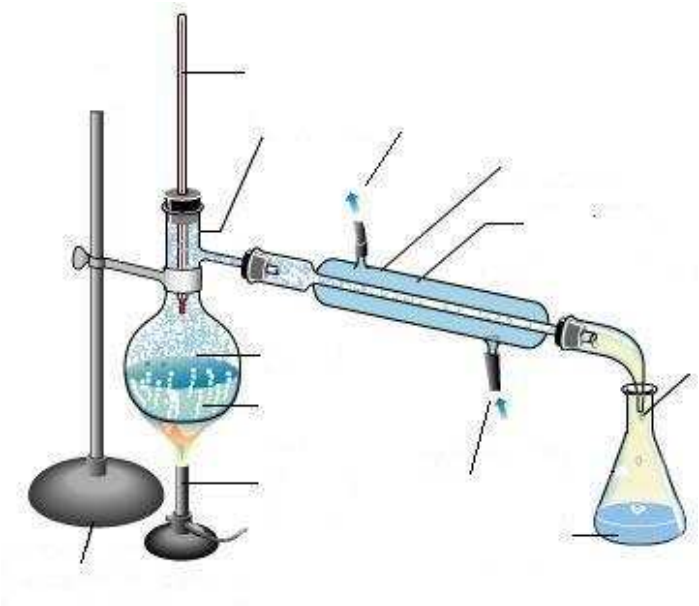
residue

glass rod

filtrate

Filtration

Adapted from: http://library.thinkquest.org/11430/research/filtration.htm



Bunsen burner
condenser
cooling water
condensed water
thermometer
mixture
stand
distillate
distillation flask
water outlet steam
cold water inlet

Distillation
Adapted from: http://student.britannica.com/eb/art/print?id=66040&articleTypeId=0

Countable and uncountable nouns

1. Fill in the gaps with the following words in their appropriate forms.

item, glassware, neck, laboratory, approximate, boiling tube, container, mass, weight, experiment, weigh

1. Laboratory _____ refers to a variety of equipment, traditionally made of glass, used for scientific _____ and other work in science, especially in chemistry and biology _____. There are many different kinds of laboratory glassware _____.
2. A _____ _____ is essentially a scaled-up test tube, being about 50% larger in every aspect.
3. A bottle is a small _____ with a _____ that is narrower than the body and a "mouth."
4. Rounded numbers are only _____.
5. _____ is a measurement of how much matter is in an object; _____ is a measurement of how hard gravity is pulling on that object. Your _____is the same wherever you

are - on Earth, on the moon, floating in space. But your _____depends on how much gravity is acting on you at the moment. You would _____ less on the moon than on Earth,

2. Identify the nouns in these sentences.

3. Which of the nouns are countable and which uncountable?

countable	**uncountable**

4. Here are some rules about using countable and uncountable words. Write C, if they are true for countable and U for uncountable words.

_____ are also called mass nouns

_____ can be both singular and plural.

_____ have only one form e.g. rice.

_____ can be used alone – without articles.

_____ must be used with articles – a/ an or the.

_____ are used with much and little

_____ are used with many and few

Alchemy

1. What is alchemy? What is the difference between alchemy and modern science?

2. Have you ever read a book or seen a film that dealt with alchemy?

3. Are there any famous alchemists you know?

4. Read the following article. What do the words in bold mean?

5. What is the meaning of the expressions in *italics*?

Alchemy in the Middle Ages was a mixture of science, philosophy and mysticism. At the heart of **medieval** alchemy was the idea that all matter was composed of four **elements**: earth, air, fire and water. With the right combination of elements, any substance on earth might be formed. This included **precious metals** as well as elixirs **to cure** disease and **prolong** life. Alchemists believed that the "transmutation" of one **substance** into another was possible; thus we have the **cliché** of medieval alchemists **seeking to** *"turn lead into gold."*

Goals:

- To find the *"philosopher's stone,"* an elusive substance that was believed to make possible the creation of an *elixir of immortality* and the transmutation of common substances into gold.
- In the later Middle Ages, to use alchemy as a tool in the **advancement** of medicine.

Achievements:

- Medieval alchemists produced **hydrochloric acid**, **nitric acid**, **potash** and **sodium carbonate**.
- They were able to identify the elements **arsenic**, **antimony**, and **bismuth**.
- Through their experiments, medieval alchemists **invented** and **developed** laboratory devices and procedures that are, in modified form, still used today.
- The practice of alchemy **laid the foundation** for the development of chemistry as a scientific discipline.

Adapted from: http://historymedren.about.com/od/alchemy/p/alchemy.htm

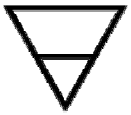
6. Were the goals of alchemy achieved?

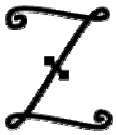
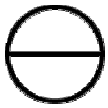
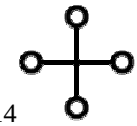
7. What are the goals of modern chemistry?

There were often many symbols for an element. For a time, the astronomical symbols of the planets were used **to denote** the elements. However, as alchemists came to be **persecuted**, particularly in medieval times, secret symbols were invented. This led to a great deal of **confusion**, so you will find some **overlap** of symbols. The symbols were in common use through the 17th century; some are still in use today.

8. Look at the following symbols that alchemists used. Can you guess which elements they symbolize? One element can have several symbols.

copper tin mercury gold silver air earth fire iron salt

1  2  3  4  5  6  7 

8  9  10  11  12  13  14 

Adapted from: http://chemistry.about.com/od/periodictableelements/ig/Alchemy-Symbols/index_t.htm

9. What was the meaning of the word 'element' in the Middle Ages? Is it different now?

10. What symbols do we use for elements today?

Exercises:

Exercise 1 Use these words in the sentences. Make sure you know the difference between the uncountable and countable meanings.

drink/ a drink hair/ a hair paper/ a paper

1. She has dark _____ - just like her mother.
2. There's _____ in my soup!
3. Did you buy _____ today?
4. All the models in the exhibition were made of _____.
5. _____ was the cause of all their family problems.
6. May I invite you for _____?

Exercise 2 Which of the underlined parts of these sentences are correct?

1. I thought there was somebody in the house because there was light/ a light on inside.
2. Light/ a light comes from the sun.
3. I was in a hurry this morning. I didn't have time/ a time for breakfast.
4. "Did you have a good vacation?" "Yes, we had wonderful time/ a wonderful time.
5. Sue was very helpful. She gave me some very useful advice/ advices.
6. I had to buy a/ some bread because I wanted to make some sandwiches.
7. It's very difficult to find a work/ job at the moment.

Adapted from: MURPHY, Raymond. 2002. *Grammar in Use. Intermediate*. 2nd edition. Cambridge: Cambridge University Press, 2002, p. 135.

Unit 4
PERIODIC TABLE

- **Periodic Table**
- **Consist, Contain, Include**
- **Chemical Elements**
- **British v. American English**

Periodic Table

1. Put the following expressions into correct places in the Periodic Table on the next page. Then read the text about the Periodic Table and use the same expressions to fill the gaps.

symbol, atomic weight, name, atomic number, group, row, alkali metals, halogens, noble gases, lanthanides, actinides, alkaline earth metals

The most convenient presentation of the chemical elements is in the **periodic table** of the chemical elements, which groups elements by _____ _____. Due to its **ingenious** arrangement, **columns,** or _____, and _____, or **periods**, of elements in the table either share several chemical properties, or follow a certain trend in characteristics such as **atomic radius**, **electronegativity**, **electron affinity**, etc.

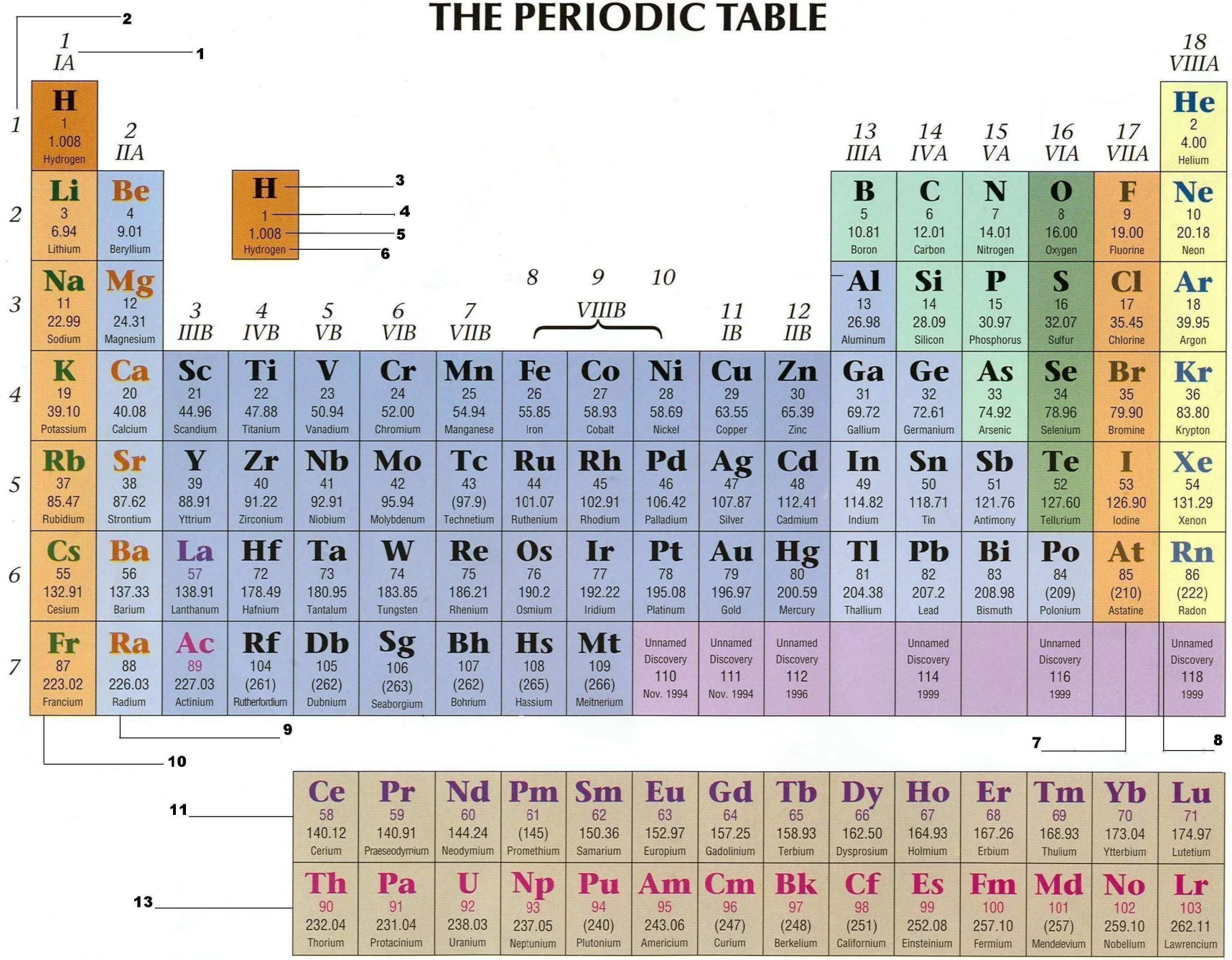
The main value of the periodic table is the **ability** to **predict** the **chemical properties** of an element based on its **location** on the table. The properties vary differently when moving vertically along the _____ of the table, than when moving horizontally along the _____.

The periodic table was first **devised** in 1869 by the Russian chemist Dmitri Mendeleev. Mendeleev intended the table to illustrate **recurring ("periodic")** trends in the properties of the elements. The **layout** of the table has been **refined** and **extended** over time, as new elements have been discovered, and new theoretical models have been developed to explain chemical behaviour. Various layouts are possible to **emphasize** different aspects of behaviour; the most common forms, however, are still quite similar to Mendeleev's original design.

For a truly unique design – **Periodic Table Table** – see http://www.theodoregray.com/PeriodicTable/

Adapted from: www.wikipedia.org

THE PERIODIC TABLE



2. Which elements are:

metals **nonmetals** **metalloids**

3. What does the term 'chemical series' mean?

4. What are the synonyms of the following words used in the article?

ingenious

location

recurring

to refine

to emphasize

unique

5. What is the difference between the following words? Are they synonyms?

devise

develop

invent

discover

Consist, contain or include?

The periodic table **consists of** rows and columns
It **contains** elements.
Different elements **include** carbon, sulphur, hydrogen, oxygen etc.

1. The classic symptoms of exposure to toxic chemicals _____ headaches, sore throats, vomiting, etc.
2. The word's trees _____ between 460-800 billion tones of carbon.
3. The local fauna _____ wolves, snakes and a wide range of unpleasant insects.
4. The graphs do not _____ information about the use of the cell.

5. Other greenhouse gasses _____ carbon dioxide, methane and chlorofluorocarbons.
6. I could hardly _____ my excitement.

Adapted from: ORESKÁ, A. et al. 2004. *Activity Book English for Chemists*. Bratislava: STU, 2005, pp. 18 – 19.

Chemical Elements

1. How are the following elements called in Slovak?

2. How are they pronounced?

Aluminium Br.	/ˌæljʊˈmɪnɪəm/	Al
Aluminum Am.	/əˈluːmɪnəm/	Al
Argentums	/ˈɑːdʒəntəm/	Ag
silver	/ˈsɪlvəʳ/	Ag
Antimony	/ˈæntɪməni/	Sb
arsenic	/ˈɑːsᵊnɪk/	As
Astatine	/ˈæstətiːn/	At
boron	/ˈbɒrɒn/	B
barium	/ˈbærɪəm/	Ba
Bromine	/ˈbrəʊmiːn/	Br
carbon	/ˈkɑːbᵊn/	C
calcium	/ˈkælsiᵊm/	Ca
Chlorine	/ˈklɔːriːn/	Cl
Chromium	/ˈkrəʊmiəm/	Cr
copper	/ˈkɒpəʳ/	Cu
fluorine	/ˈflʊəriːn/	F
ferrum	/ˈferrəm/	Fe
iron	/aɪən/	Fe
hydrogen	/ˈhaɪdrɪdʒən/	H
helium	/ˈhiːliəm/	He
hydrargyrum	/haɪˈdrɑːdʒɪrəm/	Hg
Mercury	/ˈmɜːkjʊri/	Hg
iodine	/ˈaɪədiːn/	I
kalium	/ˈkæliəm/	K
potassium	/pəˈtæsiəm/	K
Lithium	/ˈlɪθiəm/	Li
magnesium	/mægˈniːziəm/	Mg
manganese	/ˈmæŋgəniːz/	Mn
nitrogen	/ˈnaɪtrədʒən/	N
Sodium	/ˈsəʊdiəm/	Na
neon	/ˈniːɒn/	Ne
nickel, nickle	/ˈnɪkl/	Ni
Oxygen	/ˈɒksɪdʒən/	O
phosphorus	/ˈfɒsfᵊrəs/	P
plumbum	/ˈplʌmbəm/	Pb
lead	/led/	Pb
platinum	/ˈplætɪnəm/	Pt
Radium	/ˈrɪdiəm/	Ra
sulphur Br, sulfur Am.	/ˈsʌlfəʳ/	S
silicon	/ˈsɪlɪkən/	Si
stannum	/ˈstænəm/	Sn
tin	/tɪn/	Sn
uranium	/jʊˈreɪniəm/	U
wolfram	/ˈwʊlfrəm/	W
tungsten	/ˈtʌŋstən/	W
zinc	/zɪŋk/	Zn

British v American English

1. What are the usual spelling differences between British and American English words? Can you find any such words on the article about Periodic Table?

2. Look at the following table. In each pair, one of the words is British and one American. Try to fill in the missing words.

British English	**American English**
Autumn	
	Subway
	Vacation
Car park	
	one way ticket
	Apartment
Underground	
	1st floor
Elevator	

Adapted from: REDMAN, S. 1997. *English Vocabulary in Use. Pre-intermediate and Intermediate.* Cambridge: Cambridge University Press, 1997, pp. 200-201.

3. Can you think of other similar pairs of words?

Exercises:

Task 1 Fill the gaps with consist of, contain or include in their appropriate forms.

1. Does the price _____ the tax?
2. The tour _____ a visit to the Science museum.
3. The committee _____ ten members.

4. Her report _____ several inaccuracies.
5. The diet _____ largely _____ vegetables.
6. You should _____ some examples in your essay.
7. This drink doesn't _____ any alcohol.
8. I was so furious I couldn't _____ myself.

Task 2 Choose the correct synonym for each term.

1.	renowned	a famous	b unknown
2.	raise	a lower	b elevate
3.	use	a employ	b enable
4.	deteriorate	a strengthen	b weaken
5.	expand	a excite	b increase
6.	equilibrium	a balance	b liquid
7.	terminate	a begin	b end
8.	substantial	a massive	b less

Unit 5
MATTER

- **States of Matter**
- **Revision of Tenses**
- **Passive Voice**

States of Matter

1. Read the following article. What is the meaning of the expressions in bold?

There are four main **states of matter**: **solids, liquids, gases** and **plasmas**. Each of these states is also known as a **phase**. Elements and compounds can move from one phase to another phase when special **physical forces** are present. One example of those forces is **temperature**. The phase or state of matter can change when the temperature changes. Generally, as the temperature rises, matter moves to a more active state.

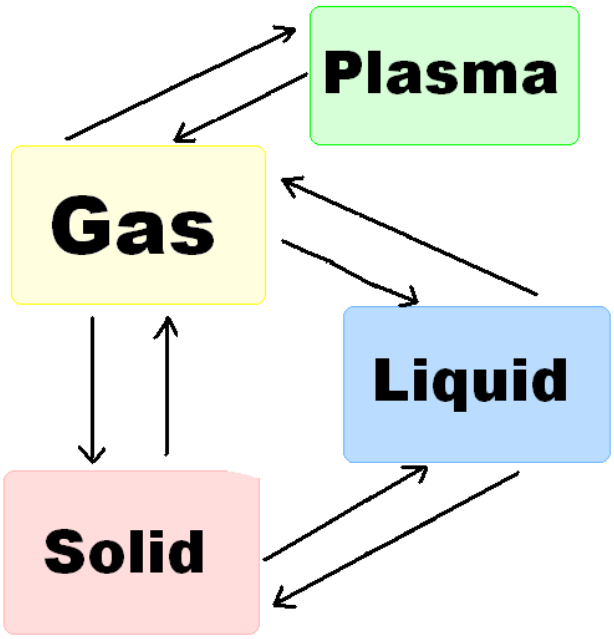
Phase describes a physical state of matter. The key word to notice is physical. Things only move from one phase to another by physical means. If **energy is added** (like **increasing** the temperature or **increasing pressure**) or if energy **is taken away** (like **freezing** something or **decreasing pressure**) you have created a physical change.

One compound or element can move from phase to phase, but still be the same substance. You can see **water vapor** over a boiling **pot** of water. That vapor (or gas) can **condense** and become a **drop of water**. If you put that drop in the freezer, it would become a solid. No matter what phase it was in, it was always water. It always had the same chemical properties. On the other hand, a **chemical change** would change the way the water acted, eventually making it not water, but something completely new.

Adapted from: http://www.chem4kids.com/files/matter_states.html

2. What is a 'phase transition'? Insert the following terms into the phase transition scheme.

melting	**condensation**	**deposition**	**vaporization**
ionization	**deionization**	**freezing**	**sublimation**



Adapted from: http://en.wikipedia.org/wiki/Image:Phase_change_-pn.png

2. Choose the corrects answer

1. What is the term used to describe the phase change as a liquid becomes a solid?
   evaporation condensation freezing

2. What term is used to describe the phase change of a solid to a liquid?
   freezing melting boiling

3. What is the term used to describe the phase change of a liquid to a gas?
   boiling condensation melting

4. Of gases, liquids, and solids, what is the densest state of matter?
   solids liquids gases plasmas

Adapted from: http://www.chem4kids.com/extras/quiz_mattersolid/index.html

3. Find the synonyms of the following expressions in the article.

phase of matter rise of temperature drop of temperature

4. What is the meaning of the following words? Which changes of state do they correspond with?

melting point boiling point freezing point

5. What is the difference between:

melting point – melting pot boiling point – boiling pot

6. What is the difference between chemical and physical forces?

Revision of Tenses

Which tense are used in the article above?

1. <u>Present Simple (do)</u> or the <u>Present Continuous (is doing)</u> tense.

1. What's that noise? Somebody (play)_____the piano.
2. At work he usually (sit)_____all day.
3. They (go)_____on holiday every winter.
4. The days (be)_____ longer in summer.
5. She often (talk)_____ to herself.
6. She (have)_____ a shower at the moment.

What are the <u>rules</u> for using the Present Simple and Continuous tenses?

2. <u>Past Simple (did)</u> or <u>Past Continuous (was doing)</u> tense.

1. When we (wake up)_____she was already having breakfast.
2. We (dance)_____and John was drinking wine.
3. Someone (bring)_____me my towel when I was swimming.
4. I (turn off) _____ the TV and (go) _____ to bed.
5. My mother (cook)_____a very nice dinner yesterday.

What are the <u>rules</u> for using the Past Simple and Continuous tenses?

3. <u>Past Simple (did)</u> or <u>Present Perfect (have done)</u> tense.

1. Tom (just come) _____Do you want to talk to him?
2. She (just finish) _____her homework. She can go out with friends.
3. My father (translate) _____two pages yesterday.
4. He (live) _____here since 1989. I believe he will live here forever.
5. (you watch) _____the game last night?
6. (you send) _____the letter yet?

Adapted from:
MURPHY, Raymond. 2002. *Grammar in Use. Intermediate*. 2nd edition. Cambridge: Cambridge University Press, 2002, pp. 5-15.

What are the <u>rules</u> for using the Present Perfect tense?

Passive voice

1. What is passive voice? Find examples of passive voice in the above text.

2. What are the rules for transforming active sentences into passive?

-
-
-

Forming passive sentences:

	ACTIVE	PASSIVE
Present simple	People *study* chemistry at this university.	
Present continuous	We *are studying* English now.	
Past simple	They *studied* English at the primary school	
Past continuous	This time last week *we were studying* English.	
Present perfect	They *have studied* this phenomenon for 3 years.	

3. When do we use passive voice?

-
-
-
-

4. Compare the following 2 sentences. Why is the agent/doer not mentioned in the first one?

This element is called hydrogen. Periodic Table was devised by Mendeleev.

When is it not necessary to mention the doer?

Exercises:

Exercise 1 Transform these sentences into passive or active voice.

1. They make Rolls Royce cars in England.
2. Rice is grown in China.
3. The telephone was invented by Bell in 1876.
4. Thieves have stolen 2 pictures from the museum last night.
5. The factory will produce 10,000 cars next year.
6. She was given this watch by her aunt.
7. British policemen don't carry guns.
8. Periodic Table was devised by Mendeleev.
9. They will publish the news tomorrow.
10. They were doing this experiment yesterday at 9am.

Exercise 2 Find passive sentences in the text and transform them into active.

The Fourth State of Matter

There are three classic states of matter: solid, liquid, and gas; however, plasma is considered by some scientists to be the fourth state of matter. The plasma state is not related to blood plasma, the most common usage of the word; rather, the term has been used in physics since the 1920s to represent an ionized gas. Lightning is commonly seen as a form of plasma.

Plasma is found in both ordinary and exotic places. When an electric current is passed through neon gas, it produces both plasma and light. Lightning is a massive electrical discharge in the atmosphere that creates a jagged column of plasma. Part of a comet's streaming tail is plasma from gas ionized by sunlight and other unknown processes. The Sun is a 1.5-millionkilometer ball of plasma. It is heated by nuclear fusion.

Scientists study plasma for practical purposes. In an effort to harness fusion energy on Earth, physicists are studying devices that create and confine very hot plasmas in magnetic fields. In

space, plasma processes are largely responsible for shielding Earth from cosmic radiation, and much of the Sun's influence on Earth occurs by energy transfer through the ionized layers of the upper atmosphere.

Adapted from: http://scitechantiques.com/MMs_project/MMs_background_material/index2.htm

Unit 6
INORGANIC CHEMISTRY

- **Types of Inorganic Chemical Reactions**
- **Inorganic Nomenclature**
  - **Binary compounds**
  - **Ternary compounds**
  - **Acids**
- **Phrasal Verbs**

1. How would you define inorganic chemistry?

2. What is the difference between inorganic and organic chemistry?

Types of Inorganic Chemical Reactions

1. Read the following article. What is the meaning of the words in bold?

Elements and compounds **react with** each other in numerous ways. Almost every inorganic chemical reaction falls into one or more of four broad categories.

I. Combination Reactions

Two or more **reactants form** one **product** in a combination reaction. An example of a combination reaction is the formation of **sulfur dioxide** when sulfur is burned in air:

$S (s) + O_2 (g) \rightarrow SO_2 (g)$

II. Decomposition Reactions

In a decomposition reaction, a compound **breaks down** into two or more substances. Decomposition usually results from **electrolysis** or **heating**. An example of a decomposition reaction is the **breakdown** of **mercury (II) oxide** into its component elements.

$2HgO (s) + heat \rightarrow 2Hg (l) + O_2 (g)$

III. Single Displacement Reactions

A single displacement reaction is characterized by an atom or ion of a single compound **replacing** an atom of another element. An example of a single displacement reaction is the displacement of copper ions in a **copper sulfate solution** by zinc metal, forming **zinc sulfate**:

$Zn\ (s) + CuSO_4\ (aq) \rightarrow Cu\ (s) + ZnSO_4\ (aq)$

Single displacement reactions are often subdivided into more specific categories, e.g., **redox reactions** -chemical reactions which involve oxidation and reduction.

IV. Double Displacement Reactions

Double displacement reactions also may be called **metathesis reactions**. In this type of reaction, elements from two compounds displace each other to form new compounds. An example of a double displacement reaction occurs when solutions of **calcium chloride** and **silver nitrate** react to form **insoluble silver chloride** in a solution of **calcium nitrate**.

$CaCl_2\ (aq) + 2\ AgNO_3\ (aq) \rightarrow Ca(NO_3)_2\ (aq) + 2\ AgCl\ (s)$

A **neutralization reaction** is a specific type of double displacement reaction that occurs when an **acid** reacts with a **base**, producing a **solution of salt and water**. An example of a neutralization reaction is the reaction of **hydrochloric acid** and **sodium hydroxide** to form **sodium chloride** and water:

$HCl\ (aq) + NaOH\ (aq) \rightarrow NaCl\ (aq) + H_2O\ (l)$

Remember that reactions can belong to more than one category. Also, it would be possible to present more specific categories, such as **combustion reactions** or **precipitation reactions.**

Adopted from: http://chemistry.about.com/cs/generalchemistry/a/aa072103a.htm

2. What are the main types of inorganic chemical reactions?

3. What is the difference between single and double displacement reactions?

4. What other types of inorganic reactions – apart from the 4 main ones – are mentioned in the article?

5. What is the difference between:

chemical reaction **chemical equation**

6. What is the difference between:

to break down **breakdown**

7. What is the meaning of the following abbreviations used in chemical equations in the text?

(s) **(g)**

(l) **(aq)**

Inorganic nomenclature

1. Read the article again and find the names of inorganic compounds. How are they called in Slovak?

2. What seems to be the major difference between Slovak and English inorganic nomenclature?

3. What is the meaning of the following expressions?

oxide	**nitrate**	**iodide**
chloride	**hydroxide**	**fluoride**
sulfate/sulphate	**acid**	**bromide**

4. How do we call fluorides, chlorides, bromides and iodides?

5. Divide the compound mentioned in the article into the following groups:

Binary compounds

Ternary compounds

Acids

Binary compounds

I. containing a metallic element

- metal with a **fixed charge**

  Which of the compounds mentioned in the article falls into this group?

  ____ - _____

  K_2O - potassium oxide

  $ZnCl_2$ - _____

  ZnO - _____

  What does the fact that the metallic element has a fixed charge mean?

- metal with a **non-fixed charge**

  - Fe_2O_3 - ferr**ic** oxide FeO - ferr**ous** oxide

    CuS - _____ Cu_2S - _____

    Which suffix means higher valence and which lower valence?

    - ic - _____

    - ous - _____

    These are called 'trivial names'. What does it mean?

Which of the compounds mentioned in the article falls into this group? Why does its name look different?

- _____ - _____ Hg_2O - mercury (I) oxide

  So, according to this system:

  Fe_2O_3 - _____ FeO - _____

CuS - _____ Cu_2S - _____

Which names would you prefer to use? Trivial or systematic ones? Why?

Why is there no such problem with the 1st group – compound containing a metal with a fixed charge?

II. <u>containing a non-metallic element</u>

CO - carbon **mono**xide

CO_2 - _____

OsO_4 - _____

N_2O_3 - **di**nitrogen **tri**oxide

N_2O_5 - _____

<u>Ternary compounds</u>

- if there is **only 1 such compound**

  Na_2CO_3 - sodium carbon**ate**

  Na_2BO_3 - _____

- if there are **2 such compounds**

  $NaNO_2$ - sodium nitr**ite** $NaNO_3$ - sodium nitr**ate**

  Na_2SO_3 - _____ Na_2SO_4 - _____

  Which suffix means higher oxidation number and which lower oxidation number?

  - ite - _____

  - ate - _____

Which of the compounds mentioned in the article are ternary compounds? Which of the 2 groups do they fall into?

Acids

I. Hydrogen acids

HCl - hydrochlor**ic** acid

HF - _____

II. Oxoacids/Oxyacids

H_2SO_4 - sulfur**ic** acid H_2SO_3 - sulfur**ous** acid

HNO_3 - _____ HNO_2 - _____

Which suffix means higher oxidation number and which lower oxidation number?

- ic - _____

- ous - _____

Adapted from: http://www.fch.vutbr.cz/angl2/maker.php?print=on&lesson=lessons/07/lesson.txt

Phrasal verbs

1. What are phrasal verbs? Why are they different from other verbs?

2. Can you find any phrasal verbs in the article Types of Inorganic Chemical Reactions?

3. Match the following phrasal verbs with suitable expressions:

bring up	look out	look forward to
take after	break down	show up
take place	turn off	get rid of
take part in	turn on	make up

_____ you father _____ children

_____ a competition _____ in Košice next week

_____ the light _____ the computer

_____ a story _____ the end of the semester

_____ the rubbish _____ your mind

Exercises:

Exercise 1 Give the names of the following compounds:

PI_3 - _____

P_2O_5 - _____

SO_3 - _____

$Ca(NO_3)_2$ - _____

$Ca(NO_2)_2$ - _____

NaOH - _____

$Ca(OH)_2$ - _____

Exercise 2 Write the formulas for the following compounds.

Nitrogen monoxide - _____

Dinitrogen monoxide - _____

Iron (II) suplhide - _____

Iron (III) sulphide - _____

Unit 7
Organic Chemistry

- **10 Carbon Facts**
- **Comparison of Adjectives**
- **Organic nomenclature**
- **Word Order**

Life on earth **depends on** the chemical element carbon, which is present in every living thing. Carbon is so important, it forms the **basis** for two branches of chemistry, **organic chemistry** and **biochemistry**.

10 Carbon Facts

The Chemical Basis for Life
By Anne Marie Helmenstine, Ph.D., About.com

1. Read the 10 facts about carbon and match the 2 parts of each statement.

2. What is the meaning of the words in bold?

1. Carbon is the basis for organic chemistry_____
2. Carbon is a nonmetal that can **bond with itself** and many other chemical elements, _____
3. **Elemental carbon** can take the form of one of the hardest substances (diamond) _____
4. Carbon is made in the interiors of stars, _____
5. Carbon compounds have **limitless** uses. In its **elemental form**, diamond is a **gemstone** and used for **drilling/cutting**; graphite is used in pencils, as a lubricant, and to protect against **rust**; _____
6. Carbon has the highest melting/sublimation point of the elements. The melting point of diamond is ~3550°C, _____
7. **Pure carbon** exists free in nature _____
8. The origin of the name 'carbon' comes from the Latin word carbo, for **charcoal**. _____
9. Pure carbon is considered non-toxic, _____
10. Carbon is the fourth most **abundant** element in the universe - _____

a _____ as it **occurs** in all living organisms.

b _____or one of the softest (**graphite**).

c _____ though it was not produced in the Big Bang.

d _____ and has been known since prehistoric time.

e _____ forming **nearly** ten million compounds.

f _____ hydrogen, helium, and oxygen are found in higher **amounts**, by mass.

g _____ although inhalation of **fine particles**, such as soot, can damage **lung tissue**.

h _____ The German and French words for charcoal are similar.

i _____ while charcoal is used to remove **toxins**, **tastes**, and **odors**.

j _____ with the sublimation point of carbon around 3800°C.

Adapted from: http://chemistry.about.com/od/elementfacts/a/carbonfacts.htm

Comparison of Adjectives

1. Read the article again and find the adjectives.

2. Which of the adjectives are positive, comparative and which superlative?

positive	**comparative**	**superlative**

3. What are the 2 ways of forming comparative and superlative forms of adjectives in English?

4. How do we know which of the 2 ways to use?

5. Are there any exceptions to these rules?

6. What are comparative and superlative forms of the following adjectives?

	comparative	**superlative**
thin		
pretty		
far		
big		
often		
quiet		
simple		

Organic nomenclature

1. Read the following paragraph. What is the meaning of the words in bold?

The simplest organic compounds are **hydrocarbons**. Hydrocarbons contain only two elements, hydrogen and carbon. A **saturated hydrocarbon** or **alkane** is a hydrocarbon in which all of the carbon-carbon bonds are **single bonds**. Each carbon atom forms four bonds and each hydrogen forms a single bond to a carbon. The bonding around each carbon atom is **tetrahedral**, so all bond **angles** are 109.5°. As a result, the carbon atoms in higher alkanes are **arranged** in zig-zag rather than linear **patterns**.

Adapted from: http://chemistry.about.com/library/weekly/bl052503a.htm

2. What does the term 'saturated hydrocarbons' mean?

3. Which hydrocarbons are 'unsaturated'? What type of bonds do they have?

4. How are the following names of hydrocarbons pronounced in English?

Alkanes	**alkenes**	**alkynes**
methane	__	__

ethane	ethene	ethyne
propane	propene	propyne
butane	butene	butyne
pentane	pentene	pentyne
hexane	hexene	hexyne

5. Some of these carbohydrates also have trivial names. Match them.

ethylene propylene acetylene methylacetylene butylene

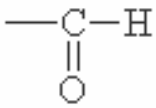
6. How do we form the names of cyclic carbohydrates?

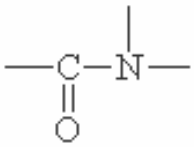
7. What does the term 'derivative' mean?

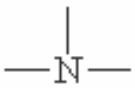
In chemistry, a **derivative** is a compound that is formed from a similar compound if one atom is replaced with another atom or group of atoms. Different organic compounds containing similar carbon or non-carbon groups - so-called **functional groups** - within the molecules react similarly. This leads to the compounds being grouped in families according to the functional groups that they contain.

8. What is a functional group? Here are some of the functional groups.

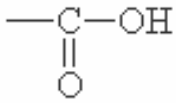
What are their English names and how are they pronounced?

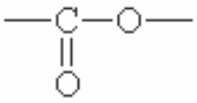


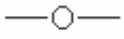


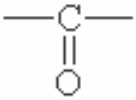


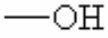
_____ _____ _____











Adapted from: http://chemistry.about.com/library/weekly/aa062703a.htm

9. Match the systematic and trivial names of the following carboxylic acids:

methanoic acid	propionic acid
ethanoic acid	formic acid
propanoic acid	butyric acid
butanoic acid	acetic acid
pentanoic acid	valeric acid
dodecanoic acid	stearic acid
hexadecanoic acid	lauric acid
octadecanoic acid	palmitic acid

Word Order

1. Look at the following sentences and identify sentence elements. How are individual sentence elements called in English?

Carbon is the basis for organic chemistry.

We can find carbon in all living organisms.

2. What is the usual order of sentence elements in English?

He watched TV quietly in his room until 6 pm.

3. Is the word order right or wrong? Correct the sentences that are wrong.

1. I walks every morning to school.
2. I don't like very much football.
3. She ate quickly her dinner and went out
4. I met on my way home a friend of mine.
5. We enjoyed the concert very much.

4. Is the word order of questions different?

Exercises:

Exercise 1 Complete the sentences. Use superlative or comparative forms of the words in brackets.

1. We stayed at _____ hotel in town. (cheap)
2. Our hotel was _____ than the others in the town. (cheap)
3. The United States is very large but Canada is _____.(large)
4. What's _____ river in the world? (long)
5. He was a little depressed yesterday, but he looks _____ today. (happy)
6. What is _____ sport in your country? (popular)

Adapted from: MURPHY, Raymond. 2002. Grammar in Use. Intermediate. 2nd edition. Cambridge: Cambridge University Press, 2002, p. 209.

Exercise 2 Put the parts of the sentences in the right order.

1. (she won / easily / the game) _____
2. (slowly / the door / I closed) _____
3. (I / quite well / speak / Italian) _____
4. (tennis / does / play / he / every weekend?) _____
5. (so late / why / you come / home / did?) _____

Unit 8
ENVIRONMENTAL CHEMISTRY

- **Environmental Chemistry**
- **Green Chemistry**
- **Twelve Principles of Green Chemistry**
- **Hazard Symbols**
- **Relative Pronouns**

Environmental Chemistry

1. Read the following article about environmental chemistry and fill the gaps with appropriate forms of the words in brackets. Use prefixes and suffixes.

Environmental chemistry is the_____(science) study of the_____(chemistry) and _____(biochemistry) phenomena that occur in _____ (nature) places. It can be defined as the study of the **sources**, reactions, transport, effects, and fates of _____ (chemistry) **species** in the air, soil, and water environments; and the effect of human activity on these. Environmental chemistry is an _____(discipline) science that includes _____(atmosphere), _____ (aqua) and soil chemistry, as well as _____ (heavy) **relying on** _____(analysis) chemistry and being related to _____(environment) and other areas of science.

Environmental chemistry involves first _____(understand) how the **uncontaminated** environment works, which chemicals in what **concentrations** are present, and with what effects. Without this it would be _____(possible) to _____(accurate) study the effects humans have on the environment through the **release** of chemicals.

Adapted from: www.wikipedia.org

2. What is the meaning of the word 'interdisciplinary'?

3. What branches of chemistry are essential for environmental chemistry?

4. What is the meaning of the following terms? Match them with their definitions.

pollutant	**CFCs**
contaminant	**pH**
biochemical-oxygen demand (BOD)	**dissolved oxygen (DO)**

_____ a class of volatile compounds consisting of carbon, chlorine, and fluorine. Commonly called **freons**, which have been in refrigeration mechanisms, and, until banned from use several years ago, as propellants in spray cans.

_____ a substance that has a **detrimental impact** on the environment it is in

_____ a substance present in the environment as a result of human activity, but without **harmful** effects. However, it is sometimes the case that toxic or harmful effects from contamination only become apparent at a later date.

_____ one of the most important **indicators** of the condition of a water body, necessary for the life of fish and most other aquatic organisms.

_____ the amount of oxygen, expressed in **milligrams per liter**, that is removed from aquatic environments by the life processes of micro-organisms. It is used in water quality management and **assessment**, ecology and environmental science.

_____ the measure of the **acidity** or **alkalinity** of a solution

Green Chemistry

1. What is the difference between 'environmental chemistry' and 'green chemistry? Can these 2 terms be used as synonyms?

2. Read the following paragraph and fill the gaps with these 2 terms, as appropriate.

_____, also called sustainable chemistry, is a chemical philosophy encouraging the design of products and processes that reduce or eliminate the use and generation of hazardous substances. Whereas _____ is the chemistry of the natural

environment, and of pollutant chemicals in nature, _____ seeks to reduce and prevent pollution at its source.

Adapted from: www.wikipedia.org

Twelve Principles of Green Chemistry

1. Read the following 12 points and choose the best alternative for each of the underlined expressions.

1. **Prevent waste:** Design chemical synthesies/syntheses to prevent **waste**, leaving no waste to treat or clean up/clean down.
2. **Design safer/more safe chemicals and products:** Design chemical products to be full/fully effective/efficient, yet have little or no toxicity.
3. **Design less hazardous chemical syntheses/synthesies:** Design syntheses/synthesies to use and generate matters/substances with little or no toxicity to humans and the environment.
4. **Use renewable/renewible feedstocks:** Use **raw materi**als and **feedstocks** that are renewable/renewible rather than **depleting**.
5. **Use catalysts, not stoichiometric reagents:** Minimize waste by using **catalytic** equations/reactions. **Catalysts** use/are used in small amounts and can carry out/carry a single reaction many times.
6. **Avoid chemical derivates/derivatives:** Avoid using blocking or protecting groups or any temporary modifications if possible. Derivatives/derivates use additional **reagents** and generate waste.
7. **Maximize atom economy/economics:** Design synthesies/syntheses so that the final reactant/ product contains/includes the maximum proportion of the starting materials.
8. **Use safer solvents/soluents and reaction conditions:** Avoid using soluents/solvents, **separation agents**, or other auxiliary chemicals. If these chemicals are necessary, use **innocuous** chemicals.
9. **Increase/decrease energy efficiency:** Run chemical reactions at **ambient** temperature and pressure whenever possible.

10. **Design chemicals and products to degrade after use:** Design chemical products to break down/break up to innocuous substances after use so that they do not accumulate in the environment.
11. **Analyze in real time to prevent pollution:** Include in-process real-time monitoring and control during syntheses/synthesies to minimize or eliminate the formation of **byproducts**.
12. **Minimize the potential for accidents:** Design chemicals and their formulas/forms (solid, liquid, or gas) to minimize the potential for chemical accidents consisting of/including explosions, fires, and **releases** to the environment.

Adapted from: http://www.epa.gov/greenchemistry/pubs/principles.html

2. What is the meaning of the words in bold?

3. Do you agree with these principles?

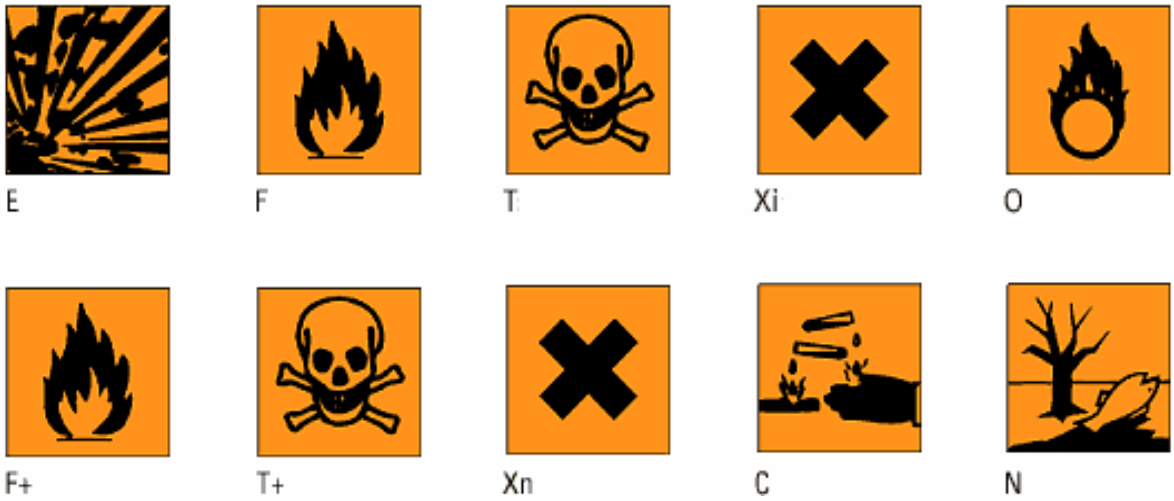
4. Do you think these principles should be observed and that it is possible to observe them?

Hazard symbols

1. Which products are hazardous?

2. What is the meaning of the following symbols? Match the phrases with symbols:

irritant	**harmful**	**highly flammable**	**dangerous for the environment**	**explosive**
toxic	**corrosive**	**oxidizing**	**extremely flammable**	**very toxic**



3. These symbols are combined with the so called 'S statements' and 'R statements'. Do you know what they are?

4. Now match the symbols with the phrases explaining their meaning.

_____ Living tissues as well as equipment are destroyed on contact with these chemicals.

_____ Substances that are very hazardous to health when breathed, swallowed or in contact with the skin and may even lead to death.

_____ Substances which are harmful to the aquatic, as well as the non-aquatic environment or which have a detrimental effect at longer term.

_____ Substances which may explode under certain conditions.

_____ Substances that can ignite combustible material or worsen existing fires and thus make fire-fighting more difficult.

_____ Substances which may have an irritant effect on skin, eyes and respiratory organs.

_____ 1. Liquids with flash points below 0°C and a boiling point of max. 35°C.
2.Gaseous substances which are flammable in contact with air at ambient temperature and pressure.

_____ 1. Spontaneously flammable substances
2. Substances sensitive to moisture.
3. Liquids with flash point bellow 21°C.

Relative Pronouns

1. Look at the underlined relative pronouns in the above sentences. When do we use them?

2. When do we use 'that', 'which' and 'who'? Complete the sentences.

1. The woman _____ lives next door is a doctor.
2. Anyone _____ is interested in the job must apply before next Friday
3. I don't like the stories _____ have unhappy endings.
4. The machine _____ broke down has now been repaired.
5. An architect is someone _____ designs buildings.

3. What other relative pronouns do you know? Complete the following sentences using 'whose', 'whom' or 'where'.

1. He recently went back to the town _____ I was born.
2. I met a man _____ sister knows you.
3. The person _____ I wanted to see is away on holiday.
4. An orphan is a child _____ parents are dead.
5. The place _____ we spent our holiday was really beautiful.

4. Can we omit relative pronouns in any of these sentences? Why?

5. Compare the following 2 sentences. Where is it possible to omit the relative pronoun?

Do you know the woman **that** Tom is talking to?

The woman **that** lives next door is a doctor.

Exercises:

Task 1 Put the relative pronouns you don't need to use in brackets ( ).

1. Have you found the keys that you lost?
2. The people who work in the office are very friendly.
3. It was an awful movie. It was the worst movie that I've ever seen.
4. It was an awful experience. It was the worst thing that has ever happened to me.

Task 2 Join the sentences into 1. Use who, that or which.

1. A girl was injured in the accident. She is now in the hospital.
2. A building was destroyed in the fire. It has now been rebuilt.
3. A bus goes to the airport. It runs every half hour.
4. A man answered the phone. He told me you were away.
5. A waitress served us. She was very polite.

Adapted from: MURPHY, Raymond. 2002. Grammar in Use. Intermediate. 2nd edition. Cambridge: Cambridge University Press, 2002, pp. 179 – 183.

Unit 9
ANALYTICAL CHEMISTRY

- **Titration**
- **Mathematical Operations**
- **Flame Tests**
- **Articles**

1. How would you define analytical chemistry? What is the scope of its study?

2. Is analytical chemistry concerned with a particular type of chemical compounds, like organic or inorganic chemistry?

3. What is the difference between <u>qualitative</u> and <u>quantitative analysis</u>?

Titration

1. Match the following terms with their definitions:

analyte titrant endpoint indicator solution solute

_____ a homogeneous mixture composed of two or more substances

_____ a substance that is dissolved in another substance, known as solvent. These two are present in a solution.

_____ is a solution of the substance whose concentration is unknown and sought in the analysis

_____ is a solution in which the concentration of a solute is precisely known

_____ is the point at which the titration is complete, as determined by an indicator.

_____ is a substance used to show the presence of a chemical substance by its colour

Adapted from:
http://www.fpharm.uniba.sk/fileadmin/user_upload/english/Physical_Chemistry/0-Titration.pdf

2. Read the following article and fill the gaps with the above expressions. They can be used more than once.

3. Number the individual steps of the titration analysis to put them into chronological order.

A titration is a method of analysis that will allow you to determine the precise _____ of a reaction and therefore the precise quantity of reactant in the titration flask. A buret is used to deliver the second reactant to the flask and an _____ or pH Meter is used to detect the _____ of the reaction.

☐ Begin by preparing your buret. Your buret should be **conditioned** and **filled with** _____ solution. You should check for air bubbles and leaks, before proceeding with the titration.

☐ As you approach the _____, you may need to add a **partial** drop of _____. You can do this with a rapid spin of a teflon **stopcock** or by partially opening the stopcock and **rinsing** the partial drop into the flask with a **wash bottle**.

☐ Use the buret to deliver a stream of _____ to within a couple of mL of your expected _____. You will see the _____ change color when the _____ hits the solution in the flask, but the color change disappears upon **stirring**.

☐ When you have reached the _____, read the final volume in the buret and record it in your notebook.

☐ Approach the _____ more slowly and watch the color of your flask carefully. Use a wash bottle to **rinse** the sides of the flask and the tip of the buret, to be sure all _____ is mixed in the flask.

☐ Prepare the _____ to be analyzed by placing it in a clean Erlenmeyer flask or beaker. If your sample is a solid, **make sure** it is completely dissolved. Put a magnetic **stirrer** in the flask and add _____.

☐ **Subtract** the initial volume to determine the amount of _____ delivered. Use this, the concentration of the _____, and the **stoichiometry** of the titration reaction to calculate the number of moles of reactant in your _____ solution.

☐ Take an **initial volume reading** and record it in your notebook. Before beginning a titration, you should always calculate the expected _____ volume.

Adapted from: http://www.dartmouth.edu/~chemlab/techniques/titration.html

4. The following items of laboratory equipment are mentioned in the text. Match their names with the pictures.

Mathematical operations

1. What is the meaning of the word 'subtract' used in the above article?

subtract – subtraction

divide – division

multiply – multiplication

add – addition

2. How do we read numbers in English? Read the following:

2.7 + 4.3 = 6

9x – 8 = 11x – 10

2, 452 : 2 = 1226

1/3 + 5/3 = 2

3 x 4^2 = 48

Flame Tests

Trial by Fire

1. What is the meaning of the phrase 'Trial by Fire', used as a subtitle to this article?

2. Read the following article and fill the gaps with suitable forms of the words in brackets. Use prefixes and suffixes.

3. What is the meaning of the expressions in bold? Match them with their definitions:

to change

to wash something with clean water

to discover the facts about something

to put something quickly into a liquid and take it out again

What is the flame test?

The flame test is used to _____ (visual) **determine** the identity of an _____(known) metal or metalloid ion based on the _____ (character) colour the salt turns the flame of a bunsen burner. The heat of the flame **converts** the metal ions into atoms which become excite and emit visible light. The _____ (character) **emission spectra** can be used to **differentiate** between some elements.

How is the test performed?

First, you need a clean wire **loop**. Platinum or nickel-chromium loops are most common. They may be cleaned by **dipping** in hydrochloric or nitric acid, followed by **rinsing** with _____ (distill) or _____ (deionise) water. Test the _____ (clean) of the loop by

inserting it into a bunsen burner flame. If a burst of color is produced, the loop was not _____ (sufficient) clean. Ideally, a **separate** loop is used for each sample to be tested, but a loop may be _____ (careful) cleaned between tests. The clean loop is dipped in either a powder or solution of an ionic salt. The loop with sample is placed in the clear or blue part of the flame and the **resulting** colour is observed.

What are the limitations of this test?

The value of the flame test is limited by interference from other brighter colours and by **ambiguities** where certain different metals cause the same flame colour. Sodium, in particular, is present in most compounds and will colour the flame. Sometimes a coloured glass is used to filter out light from one metal. Cobalt glass is often used to filter out the yellow of sodium.

4. What is the singular of the word 'spectra'?

5. Some of the sentences in the article are passive. Turn them into active.

Flame Test Colours

6. Fill the names of the chemical elements into the following chart.

Symbol	**Element**	**Color**
As		Blue
B		Bright green
Ba		Pale/Yellowish Green
Ca		Orange to red
Cs		Blue
Fe		Gold
In		Blue
K		Lilac to red
Li		Magenta to carmine

Mg	Bright white
Mo	Yellowish green
Na	Intense yellow
P	Pale bluish green
Pb	Blue
Rb	Red to purple-red
Sb	Pale green
Se	Azure blue
Sr	Crimson
Te	Pale green
Tl	Pure green
Zn	Bluish green to whitish green

Adapted from:
http://chemistry.about.com/library/weekly/aa110401a.htm
http://chemistry.about.com/od/analyticalchemistry/a/flametest.htm

7. How do we distinguish different shades of colours?

8. What is the meaning of the suffix –ish?

blue – bluish green – greenish white - whitish

Articles

1. What are the meanings of the word 'article'? Underline the articles used in the above article Flame Tests.

2. Read the following sentences:

First, you need **a** clean wire loop. Test the cleanliness of **the** loop by inserting it into a bunsen burner flame. If a burst of color is produced, **the** loop was not sufficiently clean.

What are the basic rules for using the definite and indefinite article?

3. Fill the following chart. Use ✔ or ✘ depending on whether it is possible to use the article or not.

	a/an	**The**	**Zero article**
singular			
plural			

4. How can the articles influence the meaning? How does the use of articles depend on the context?

5. Match the sentences with their explanations:

a Hey, Robert, what's that?
It looks like a flying saucer.

b Turn off the light and look at the sky.

c Can you reach the large camera on the shelf behind your chair?

d I think we got at least one good photo of the saucer.

e Let's send it to a newspaper.

1 She is not talking about any particular one; it isn't important or she doesn't know.

2 She doesn't expect him to know which one because she's pointing it out for the first time.

3 She expects him to know which one because she is describing it precisely.

4 She expects him to know which one because they have mentioned it before.

5 She expects him to know which one without describing it (because it is the only one she can mean).

6. Fill the gaps with a or the.

There's _____ town in Italy called Pompeii. It stands near _____ volcano. In 79 AD _____ volcano erupted and it destroyed _____ town and killed nearly all _____ people who lived there.

My friends live in _____ old house in _____ small town. There is _____ beautiful garden behind _____ house. I would like to have _____ garden like that.

There are two cars parked outside: _____ blue one and _____ gray one. _____ blue one belongs to my neighbours; I don't know who _____ owner of _____ gray one is.

Exercises:

Exercise 1 Fill the gaps with a or the.

One day _____ young prince arrived at _____ castle of King Ottar and fell in love with _____ king's youngest daughter, who was very beautiful. 'You can only marry my daughter,' said _____ king, 'if you can recognize her, and you must marry the woman you choose.' 'That's easy,' said the prince, and King Ottar put all his daughters behind _____ wall that had _____ space at _____ bottom, so _____ prince could only see seven pairs of feet, and _____ feet all looked _____ same. Suddenly, one of _____ feet moved and so _____ prince said 'That is _____ woman I love.'
Unfortunately, it was not; it was King Ottar's eldest daughter, who was not at all beautiful, but _____ prince had to marry her. In fact, she was extremely intelligent and had a good sense of humour, so that very soon _____ prince did fall in love with her and they lived happily ever after. _____ moral of this story is that love is _____ very unreliable thing.

Adapted from:

FORSYTH, W., LAVANDER, S. 1994. *Grammar Activities. Intermediate*. Oxford: Heineman, 1994, pp. 5-6.

MURPHY, Raymond. 2002. *Grammar in Use. Intermediate*. 2nd edition. Cambridge: Cambridge University Press, 2002, p. 139.

Unit 10
EVERYDAY CHEMISTRY

- **Everyday Chemistry**
- **Modal Verbs**
- **Abstract**

1. Do you remember the definition of chemistry from Unit 2? What does it say?
How many meanings does the word 'chemistry' have?

2. Read the following short article. What is the meaning of the words in bold?

Chemistry helps you to understand the world around you. Cooking is chemistry. Everything you can **touch** or **taste** or **smell** is a chemical. When you study chemistry, you come to understand a bit about how things work. Chemistry isn't secret knowledge, useless to anyone but a scientist. It's the explanation for everyday things, like why laundry **detergent** works better in hot water or how baking soda works or why not all **pain relievers** work equally well on a **headache**. If you know some chemistry, you can make educated choices about everyday products that you use.

Adapted from: http://chemistry.about.com/od/chemistry101/a/basics.htm

3. Do you agree that chemistry is the explanation of everyday things?
Can you give some other examples of chemistry in everyday life?

Everyday Chemistry Quiz

1. Take the following Everyday Chemistry Quiz. What is the meaning of the words in bold?

1. Two household chemicals you should never mix include:

a Vinegar and baking soda. Those bubbles could be toxic!
b **Bleach** and water. **Diluting** bleach only makes it more dangerous.

c Oil and water. They don't mix and aren't meant to!
d Bleach and ammonia. Chloramine vapors can be deadly!

2. The sweat-blocking ingredient in antiperspirant is often:

a An aluminum compound.
b A calcium compound.
c A magnesium compound.
d A tin or stannous compound.

3. The acid in most car batteries, sometimes known as 'Oil of Vitriol', is:

a Acetic acid.
b Hydrochloric acid.
c Nitric acid.
d Sulfuric acid

4. One important source of Vitamin C is citrus fruit. Vitamin C is:

a Ascorbic acid.
b Citric acid.
c Salicylic acid.
d Tricarboxylic acid.

5. Soft drinks may contain many different acids. The acid that produces fizz or bubbles is:

a Ascorbic acid.
b Carbonic acid.
c Citric acid.
d Phosphoric acid.

6. If you are making soaps and detergents from scratch, one of your starting ingredients will be:

a Potassium hydroxide.
b Sodium hydroxide.
c Sodium chloride.
d Calcium carbonate.

7. Chocolate and cocoa naturally contain relatively high levels of which two metals?

a Cadmium and lead.
b Aluminum and iron.
c Cadmium and mercury.
d Lead and cobalt.

Adapted from: http://chemistry.about.com/library/weekly/bl070103a.htm

3. What is the meaning of the phrase '*make something from scratch*', used in question 6?

Modal verbs

1. What are modal verbs? Why are they different from other verbs?

2. Can you find any modal verbs in the above quiz and article? What is their meaning?
3. Write the following modal verbs in the correct space:

must mustn't should shouldn't can can't

1. _____ is used to say that something is possible
2. _____ is used to say that something is not possible.
3. _____ is used to advise someone to do something.
4. _____ is used to advise someone not to do something.
5. _____ is used to order someone to do something.
6. _____ is used to order someone not to do something

What is the difference between *must* and *mustn't*? What is the negative of must?

4. Match the sentences with their meanings.

1. I think you should marry him; I know you love each other.
2. You can marry him, if you really love him.
3. You must marry the Duke, for me and for the family.
4. You shouldn't marry him because you don't love him.
5. I may or may not marry him; I haven't decided yet
6. You can't marry him; he's you brother.
7. You mustn't marry him. If you do I shall never speak to you again.

a I order you to marry him.

b I order you not to marry him

c I think it's a good idea for you to marry him.

d I don't think it's a good idea for you to marry him.

e You are allowed to marry him.

f You are not allowed to marry him.

g It is possible that I will/will not marry him.

Adapted from: FORSYTH, W., LAVANDER, S. 1994. *Grammar Activities. Intermediate*. Oxford: Heineman, 1994, p. 35.

5. What other meaning can the verb *must* have? Compare the following 2 sentences.

I **must** finish this work before I can go out with you.

You **must** be very tired after such a long day.

6. Compare the following pairs of sentences. In each pair, one sentence contains a modal verb, the other does not. How are they different?

She speak**s** English and Italian fluently.	She can speak English and Italian fluently.
She **doesn't** speak French yet.	She **can't** speak French yet.
Does she speak any other language?	**Can** she speak any other language?

7. What are the past forms of the following modal verbs?

can	_____	may	_____
must	_____	might	_____
should	_____	have to	_____

Abstract

1. Modal verbs are often used in scientific papers. Which of them are used in the following abstract?

2. What is an abstract? What information should it contain?

3. Read the following abstract. Match the following expressions with individual parts of the abstract according to the information they contain.

methods results background/reasons problem conclusions/significance

Alteration of the platelet serotonin transporter in romantic love

_____ The evolutionary consequences of love are so important that there must be some long-established biological process regulating it. Recent findings suggest that the serotonin (5-HT) transporter might be linked to both neuroticism and sexual behaviour as well as to obsessive-compulsive disorder (OCD).

_____ The similarities between an overvalued idea, such as that typical of subjects in the early phase of a love relationship, and obsession, prompted us to explore the possibility that the two conditions might share alterations at the level of the 5-HT transporter.

_____ Twenty subjects who had recently (within the previous 6 months) fallen in love, 20 unmedicated OCD patients and 20 normal controls, were included in the study. The 5-HT transporter was evaluated with the specific binding of 3H-paroxetine (3H-Par) to platelet membranes.

_____ The results showed that the density of 3H-Par binding sites was significantly lower in subjects who had recently fallen in love and in OCD patients than in controls.

_____ The main finding of the present study is that subjects who were in the early romantic phase of a love relationship were not different from OCD patients in terms of the density of the platelet 5-HT transporter, which proved to be significantly lower than in the normal controls. This would suggest common neurochemical changes involving the 5-HT system, linked to psychological dimensions shared by the two conditions, perhaps at an ideational level.

Adapted from: http://www.biopsychiatry.com/lovesero.htm

4. Try to identify individual parts in the following abstracts. Do they all have the same structure?

Tumbling toast, Murphy's Law and the fundamental constants

We investigate the dynamics of toast tumbling from a table to the floor. Popular opinion is that the final state is usually butter-side down, and constitutes prima facie evidence of Murphy's Law ('If it can go wrong, it will'). The orthodox view, in contrast, is that the phenomenon is essentially random, with a 50/50 split of possible outcomes. We show that toast does indeed have an inherent tendency to land butter-side down for a wide range of conditions. Furthermore, we show that this outcome is ultimately ascribable to the values of the fundamental constants. As such, this manifestation of Murphy's Law appears to be an ineluctable feature of our universe.

http://www.iop.org/EJ/abstract/0143-0807/16/4/005

Chickens prefer beautiful humans

We trained chickens to react to an average human female face but not to an average male face (or vice-versa). In a subsequent test, the animals showed preferences for faces consistent with human sexual preferences (obtained from university students). This suggests that human preferences arise from general properties of nervous systems, rather than from face-specific adaptations. We discuss this result in the light of current debate on the meaning of sexual signals, and suggest further tests of existing hypotheses about the origin of sexual preferences.

http://www.physicsforums.com/archive/index.php/t-93336.html

For more information on unusual scientific research see http://improbable.com/ig/

(Everyday Chemistry Quiz answers: 1d, 2a, 3d, 4a, 5b, 6b, 7a)

Exercises:

Exercise 1 Complete the sentences using the following modal verbs. Use their past forms if necessary.

can could must might should have to

1. Ted's flight from Amsterdam took more than 11 hours. He _____ be exhausted after such a long flight. He _____ prefer to stay in tonight and get some rest.
2. Hiking the trail to the peak _____ be dangerous if you are not well prepared for dramatic weather changes. You _____ research the route a little more before you attempt the ascent.
3. Jenny's engagement ring is enormous! It _____ have cost a fortune.
4. When you have a small child in the house, you _____ leave small objects lying around. Such objects _____ be swallowed, causing serious injury or even death.
5. I _____ speak Arabic fluently when I was a child and we lived in Egypt. But after we moved back to Canada, I had very little practice and forgot almost everything I knew as a child. Now, I _____ just say a few things in the language.
6. Oh no! Frank's wallet is lying on the coffee table. He _____ have left it here last night.

Adapted from: http://www.englishpage.com/modals/interactivemodal1.htm

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