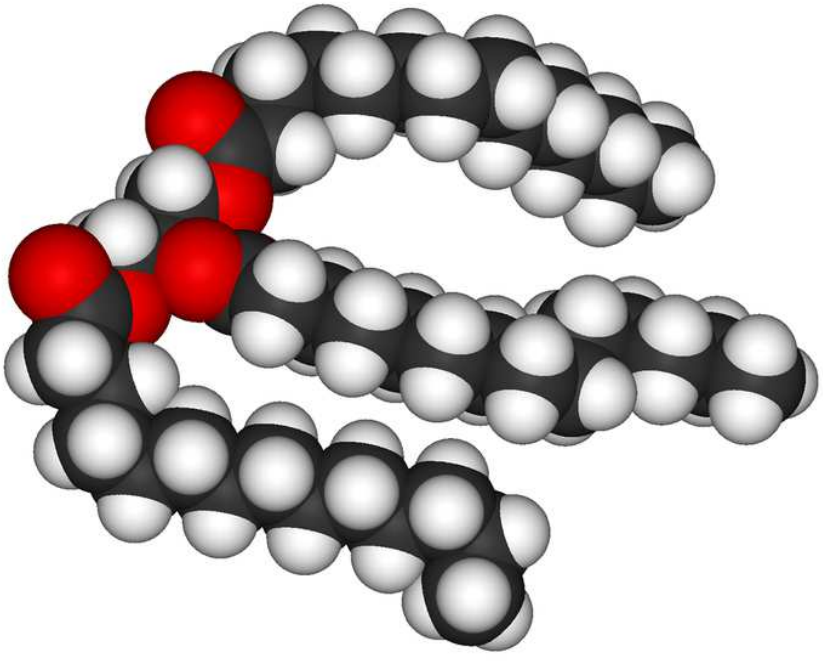
University of Glasgow

SCIENCE FUNDAMENTALS

CLASS HANDBOOK

2019-2020



SCIENCE FUNDAMENTALS - 1 CLASS HANDBOOK 2019 - 2020

UNIVERSITY OF GLASGOW

FOREWORD

How can birds and bees, which are denser than air, fly with ease? What is light, and how do we perceive it? How do flies and geckos stick to surfaces, sometimes upside down? What are the properties of water which make it suitable for living organisms? Why is life based on carbon, rather than on any other element? How do the 2 strands of DNA (deoxyribonucleic acid) stay together, yet separate for replication of the genetic material?

You may have wondered about the answers to these and many other questions about our planet and the many organisms that live on it. Answers to these questions are dependent on the properties of the physical world we live in.

Many of you studying this course will be starting on a degree in the biological sciences. But we believe that your understanding of how living organisms work will be greatly enhanced by achieving a thorough grasp of the ideas, facts and concepts included in this course.

Colleagues in mathematics, statistics, physics and chemistry have put this integrated course together as a foundation in those aspects of the physical and mathematical sciences most relevant to biologists. A number of you may have struggled with some of these ideas in your previous education: try to put these negative experiences aside and approach this course with a fresh mind. We believe that putting mathematical and physical ideas into a biological context will help them come alive for you, and greatly deepen your understanding of living organisms.

It is worth emphasising that a good understanding of this course will greatly help you in your future studies. Modern biology is full of mathematical and physico-chemical concepts, and is highly dependent on statistical techniques for the rigorous evaluation of data.

At university, with the large classes, you will have to organise your study time, check your progress and, if you have difficulties, ask for help. Nobody is penalised for asking for help or further explanation. The staff are here to help you, but we can only help if we know you have a problem. There are regular tutorials where you can ask questions. You can also ask the lecturer or any member of staff in a problem session if you require help. For any matters relating to administration or personal problems please consult the class head, Dr A. Lapthorn.

It is essential that you read this Handbook carefully. I would draw your attention, particularly, to the sections dealing with the Award of Credits and Absence. It is important that we have full details of any absences through illness or other problems during the year in order that these may be taken into account in the assessment of your work at the end of the course.

I am sure that you will find the Science Fundamentals course interesting and enjoyable and that you will be successful at the end of the course.

Dr A. J. Lapthorn, School of Chemistry

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AIMS

To provide a broad science course spread over two modules, 1X and 1Y; one module to be taught per semester, which will:-

Be appropriate to the interests, aptitudes, background and future intentions of its entrants.

Build on common experience.

Illustrate interactions of science and everyday life.

Present facts, applications, theories and calculations.

Develop general concepts, abstract ideas, numerical skills, physical and mathematical models and confidence in their use.

Develop understanding through group work and discussion and developing communication skills.

ENROLMENT

All students in the class must register and enrol online through MyCampus,

RECOMMENDED TEXTBOOK

All students **MUST** have a copy of **Science Fundamentals (third edition)**, University of Glasgow, Pearson custom publication. This textbook has been compiled to cover the chemistry, physics and statistics components of the course. It is available from the university bookshop and is packaged with other textbooks to reduce costs.

TEACHING AND LEARNING

LECTURES

There are 80 lectures and workshops, given over two semesters of 12 weeks each. The class meets in two sections, one at 10 am and one at 3 pm. Please check Moodle to confirm lecture location.

Lectures provide facts, theories, demonstrations, textbook references and background.

An overview of the main timetable is provided in Handbook. For the most up-to-date version check Moodle or MyCampus online.

REVISION TUTORIALS

Each block of lectures will have an associated revision tutorial. These are intended to give practice in the kinds of questions likely to occur in tests and exams.

WORKSHOP SESSIONS

On these days the lecture time is used for problem solving workshops, these are followed up by an online test in Moodle which contributes to your final mark. Answers to both the workshop and online test will be posted online. If you have particular problems then your lecturer may be able to help time permitting. **The short online workshop tests count towards your final mark for the year - regular attendance is essential.**

TESTS

There will be two one hour tests per module in lecture times. **The one hour tests also contribute towards your final assessment so you must not miss any.**

LEARNING

Means that you make the most of all the above, plus text books (see above), private study and practice, general reading and discussion.

The lecture slides are provided on Moodle typically after the lecture and as a result it is not essential to write down everything presented on the slides. The slides are provided online so that you can listen to what the lecturers say and engage in the subject matter rather than just copying down notes.

We know that you will not always understand topics fully during the lecture. Later reading, digestion and discussion are needed.

Book references may be given in lectures. **Look them up** and incorporate diagrams, examples *etc.* from them into your notes.

Keep the lecture notes safe, in a binder with your name. Lecturers cannot provide copies and it is expensive to photocopy other students' notes if you lose yours. Furthermore other students' notes can never be as good as your own.

STUDENT SUPPORT

Main support is provided through Moodle. Once you have enrolled onto Science Fundamentals you will be automatically enrolled into Moodle. https://moodle2.gla.ac.uk/login/index.php

Student Mathematical Support offers support to all Level 1 students and to other undergraduates studying first year level mathematics and/or statistics. To make a one-to-one appointment with the *Maths Adviser*, log onto your MyGlasgow student account through the following link:.

http://www.gla.ac.uk/services/sls/offer/mathsstats/

The Student Learning Service also runs workshops and individual appointments to help you with various aspects of academic skills. See the site:

http://www.gla.ac.uk/services/sls/offer/

ASSESSMENT

The final mark for each module (1X and 1Y) will be made up as follows:

Degree exam (2h)	60% (covering each module's work)
Class tests (1h)	20% (2 tests in lecture times)
Coursework	20% (covering the workshop tests)

Examinable topics include lecture, revision tutorial, and workshop material, knowledge, understanding and applications of these. **As 40% of the final mark is from continuous assessment it is important to work steadily *throughout* the year**.

MINIMUM REQUIREMENTS FOR THE AWARD OF CREDITS

Students may be awarded credits for each of the courses Science Fundamentals 1X and Science Fundamentals 1Y separately. To be awarded the credits for a course you must meet the following requirements in respect of that course:-

- Attend lectures.
- Perform satisfactorily in the degree examinations
- Sit the two class tests in each module
- Have a good attendance record in workshop problem sessions and submit answers to the associated brief tests.

Normally no grade or credits shall be awarded to a candidate who has not met these requirements.

EXAMINATIONS

The Degree Examinations (2 hours each) will take place in December and May (time still to be fixed). All questions are compulsory and should be attempted in the exam. Details of the times and exam format will be posted on the Moodle and are available from the Registry webpages:

http://www.gla.ac.uk/services/registry/

Exam papers from previous years are available from the University Library, however be aware that the format of the exams will have changed from previous years. Resits for both exams will take place in August.

It is important that you do well in the Degree Examinations as these form 60% of your final assessment. A poor performance in the tests will put pressure on you to work significantly harder for the degree exam. It is vitally important for you to plan your work from the start with this in mind. Extenuating circumstances (e.g. illness) at exam times **must** be reported to Dr. Lapthorn **at the time** (scifun@chem.gla.ac.uk) and an absence report **must** be submitted on MyCampus. The absence reporting should be supported by an electronic scan of any medical certificate or other appropriate documentation.

Please note that all examinations should be written on the right hand pages of the exam book in **ink**. Please do not use red pens as this can cause confusion when the papers are marked. Only clean, unannotated periodic tables will be allowed in tests and workshops and a copy will be included in the final examination papers. General scientific calculators are allowed in examinations, but programmable or graphical calculators where information can be stored are not permitted.

SUMMATIVE ASSESSMENT

All feedback on coursework used in assessment, including mid-year class exam/class test marks and laboratory grades, is strictly provisional for your guidance only, and is subject to ratification by the Board of Examiners and External Examiners at the end of the academic year. The University code of assessment is given in the University Calendar 2017/2018.
http://www.gla.ac.uk/services/senateoffice/policies/calendar/

PLAGIARISM

Plagiarism is defined as the submission or presentation of work, in any form, which is not one's own, without acknowledgement of the sources. The University's degrees and other academic awards are given in recognition of the candidate's personal achievement. Plagiarism is therefore considered as an act of academic fraudulence and as an offence against University discipline.

Allegations of plagiarism will be treated very seriously and referred to the Head of School. A full statement of the University of Glasgow procedure for dealing with cases of suspected plagiarism can be found at:
http://www.gla.ac.uk/services/senateoffice/studentcodes/staff/plagiarism/plagiarismstatement/

The University reserves the right to use plagiarism detection systems, which may be externally based, in the interests of improving academic standards when assessing student work.

This regulation applies to all work submitted for assessment, including lab reports, class tests, and research projects unless you have specifically been told otherwise, for example, in the case of a group project or when a number of students share experimental data. Special cases of plagiarism can arise from one student copying another student's work or from inappropriate collaboration.

http://www.gla.ac.uk/services/senateoffice/policies/calendar/
http://www.gla.ac.uk/services/senateoffice
You are required to sign a form stating that any work you hand in is your own. This form can be downloaded from Moodle.

GOOD CAUSE CLAIMS

If you miss an examination or an assessment deadline during this examination diet, or if you believe your assessment performance has been affected by adverse circumstances, you should submit a Good Cause Claim, and this must be via MyCampus.

Submission of a Good Cause Claim is the mechanism which allows your circumstances to be considered by the Board of Examiners. Please note all Good Cause Claims must be submitted within **a week** of the date of the affected assessment. The result of a successful good cause claim is that **the piece of assessment would be discounted completely** and where necessary or if possible retaken.

To submit a Good Cause Claim* on MyCampus:

1. Go to the 'Student Center' and select *My Good Cause* from the Academics menu.

2. Select the relevant course(s).

3. Complete the report in MyCampus (there is provision for particularly sensitive information to be provided separately, outwith the system, but a claim report must still be entered into MyCampus).

4. Add supporting evidence by uploading documents. (Scanners are available on level 3 of the University Library or room A4-03 in the Joseph Black Building.

*If you miss an examination due to adverse circumstances submit a Good Cause Claim instead of an Absence report.

If you encounter any difficulties with this process please contact the Science Fundamentals secretary on ext. 6438, immediately to let them know you have a problem with your Good Cause Claim.

What will happen to your Good Cause Claim

The Course Administrator and/or Course Co-ordinator will ensure that your claim is considered and this will be in accordance with the section of the Code of Assessment which covers incomplete assessment and good cause (paragraphs 16.45 to 16.53). The outcome of your claim will be posted into the Approval Information section on your Good Cause Claim in MyCampus. If it is accepted that your assessment was affected by good cause, the work in question will be set aside and you will (as far as is practicable) be given another opportunity to take the assessment with the affected attempt discounted.

ABSENCE FROM CLASSES

SIGNIFICANT ABSENCE FROM CLASSES

Significant absence is defined as absence of more than seven consecutive days or one which prevents a student from attending an examination or fulfilling any other requirement for the award of credit, such as attendance at a compulsory tutorial, laboratory class or deadline for handing in an assignment.

Students must complete a MyCampus absence report for any significant absence and are recommended to complete an absence report for any absence for which they would like the University to take account.

Documentary evidence is required for any significant absence. MyCampus has the facility for documentary evidence to be scanned in by the student to their record. It is the responsibility of the

student to keep all additional documentation and submit it to the Head of School or nominee on request. **Scanning facilities are available on Level 3 of the University Library.**

Further details are available at the following link:
http://www.gla.ac.uk/services/senateoffice/policies/studentsupport/absencepolicy/

For the overall assessment of the course, attendance credits will only be given if absence was adequately explained by this route.

GRADE POINT AVERAGES: GUIDELINES

Throughout the course you will be given feedback though marks in tests, lab reports and class examination together with verbal feedback in laboratories. This will enable you to see how you are doing in chemistry and enable you to seek help when necessary.

Grade	22-pont scale
A1	22
A2	21
A3	20
A4	19
A5	18
B1	17
B2	16
B3	15
C1	14
C2	13
C3	12
D1	11
D2	10
D3	9
E1	8
E2	7
E3	6
F1	5
F2	4
F3	3
G1	2
G2	1
H1	0

The grade awarded at the end of the course contributes towards your Grade Point Average. See University Calendar 2017/2018 which can be found on the following web page: http://www.gla.ac.uk/services/senateoffice/policies/calendar/

Total grade points = sum of credits x grade points
Grade point average (GPA) = Total grade points/Total credits

The grade point average and credit level requirement for B.Sc. and M.Sci. are given in full in the University of Glasgow Calendar and the Catalogue of Courses. Please consult your adviser of studies for full details. Some of the key points are listed below.

1. Your grade point average should normally be at 9 or above in each year of study.
2. Entry into level-3 courses requires a grade point average **over the first two years** of above 9 for B.Sc (Hons) and above 12 for M.Sci.
3. Entry to many level-3 courses is on a competitive basis with a preference given to those students with a high grade point average.
4. In addition level-3 courses have a minimum grade requirement for entry e.g. at least grade C3 in the level-2 pre-requisite subject(s) for entry into B.Sc (Hons)

WORKSHOP PROBLEM SESSIONS

These will be held at the normal lecture times and their purpose is for you to practise using the knowledge you have gained from lectures. Each problem session will last for 40 mins with a 10min assessed test at the end. You must sit as instructed, leaving ALTERNATE VACANT ROWS to allow staff to circulate and reach everyone.

We use online workshop tests via Moodle (https://moodle2.gla.ac.uk/login/index.php) and people who attend the workshop will be expected to complete the test on the specified date. Example quizzes are also provided to provide worked examples and as practice before an online test.

Equipment

You will need a *calculator* giving scientific notation, logs to base 10 (log x), logs to base e (ln x), and inverse functions. Please note that programmable and/or graphical calculators are not allowed in University examinations. If you have problem using your calculator then there is a calculator help session provided in week 5 of the first semester.

You will be provided with a periodic table which will be needed at some of the chemistry problem sessions (also for use in tests, and exams) - keep this periodic table clean for examination purposes.

Procedure

The topics of the sessions will be announced in advance. After a short introduction you will be asked to work through the problems collaborating with friends if you wish. Several tutors will be available. Raise your hand if you need help with the problems or related lecture material. ***Answers and explanations will be given as the session progresses but it's no use sitting waiting till they are written up - you won't have learned anything***. Towards the end of the workshop you will be given a brief written test to complete and hand in for marking.

Solutions

Complete solutions will be displayed on Moodle where appropriate for workshops and revision tutorials.

REVISION TUTORIALS

If you are having problems with a particular course you should see the lecturer concerned. Revision tutorial sessions have been time-tabled on certain days at normal lecture times. These give an opportunity for students to ask questions and to practice test/exam style questions. Tutorials are normally given by the course lecturer.

CLASS NOTICES

These are posted on the appropriate Science Fundamentals Moodle site, available from: https://moodle2.gla.ac.uk/login/index.php. Also e-mails and in exceptional circumstances text messages will be used to pass on information. Information will also be announced in Lectures.

LECTURE RECORDING

Please note that lecture recordings and ALL course materials provided are for your own personal use and can only be used in relation to your studies. Any unauthorised distribution of course materials, including uploading them onto unauthorised web sites and social media sites, such as YouTube or Course Hero, will be considered in breach of the code of conduct and will be subject to disciplinary action. Please see link below.

http://www.gla.ac.uk/services/senateoffice/policies/regulationsandguidelines/

MOBILE PHONES

Mobile phones **must be switched off** during lectures, problem sessions, tests, examinations, and in the University Libraries.

STAFF-STUDENT COMMITTEES AND OPINION SURVEYS

Two students from SCIENCE FUNDAMENTALS-1 will join a committee including staff members from the Schools of Mathematics, Statistics, Physics, and Chemistry, which will discuss course issues once a term. All students will have an opportunity sometime to comment on aspects of the course *via* questionnaires. Difficulties are most quickly resolved by informing Dr Lapthorn (scifun@chem.gla.ac.uk) or the lecturer involved.

STUDENT CLUBS

The Mathematics students club is called Mac Soc. It organises a programme of lectures and social events during the year, as well as a very popular Ceilidh just before Christmas.

The Physical Society meets on alternate Wednesdays in the first two terms for talks on subjects that are usually -- but not always -- related to physics. The society also organises social events, including an annual Christmas Ceilidh. For details see the PhySoc website at:

http://cobweb.physics.gla.ac.uk/physoc/?page_id=5

The Chemistry students club organises lectures, sports *etc*. and sells reprints of past exam papers. You can contact the Alchemists' Club through their website at:

http://www.chem.gla.ac.uk/alchemist/

OFFICE NUMBERS

Name	Room	Tel Number	E-mail
(Maths & Statistics Building)			
Mr R. Andrade	231	330 3894	Renato.AntunesCostadeAndrade@glasgow.ac.uk
Mr M. Waltenberger	344	330 6615	Michael.Waltenberger@glasgow.ac.uk
(Kelvin Building)			
Dr P. Murray	464	330 2298	Peter.Murray@glasgow.ac.uk
Dr T. Almeida	309a	330 2879	Trevor.Almeida@glasgow.ac.uk
(Joseph Black Building)			
Dr A. Lapthorn - Head	B3-06	330 5940	Adrian.Lapthorn@glasgow.ac.uk
Dr M.Symes – Deputy	A5-12	330 4416	Mark.Symes@glasgow.ac.uk
Dr L. Vila-Nadal	A4-38	-	Laia.Vila-Nadal@glasgow.ac.uk
Prof J Hargreaves	A4-25	330 5947	Justin.Hargreaves@glasgow.ac.uk
Dr C Watts	A5-20	330 7348	Ciorsdaidh.Watts@glasgow.ac.uk
Dr E. Gibson	A3-13	330 5952	Emma.Gibson@glasgow.ac.uk
Dr G Hedley	C4-12	330 1763	Gordon.Hedley@glasgow.ac.uk

Timetable Key

Course	Lecturer
Maths	RA – Mr R. Andrade
Statistics	MW – Mr M. Waltenberger
Physics	PM – Dr P. Murray TA – Dr T. Almedia
Chemistry	JH – Prof J. Hargreaves
Chemistry	LV – Dr L. Vila-Nadal
Chemistry	CW – Dr C. Watts
Chemistry	EG – Dr E. Gibson
Chemistry	GH – Dr G. Hedley

T	Class Test
WS	Workshop
RT	Revision Tutorial

Science Fundamentals 2019-20

Lectures, Revision Tutorials, Workshops and Tests will take place at:

10 - 11 am and 3 - 4 pm

Week	0	1	2	3	4	5	6	7	8	9	10	11	12	13	17	18	19	20	21	22	23	24	25	26	27	28	29
Begins	16 Sep	23 Sep	30 Sep	07 Oct	14 Oct	21 Oct	28 Oct	04 Nov	11 Nov	18 Nov	25 Nov	02 Dec	09 Dec	16 Dec	13 Jan	20 Jan	27 Jan	03 Feb	10 Feb	17 Feb	24 Feb	02 Mar	09 Mar	16 Mar	23 Mar	30Mar	
Mon am		Maths competency test	MATHS - RA					PHYSICS - TA							MATHS - RA				WS	PHYSICS - TA				WS	WS		
pm			MATHS - RA					PHYSICS - TA							MATHS - RA				WS	PHYSICS -TA				WS	WS		
																			maths					*phys*	*stats*		
Tues am		CHEM - JH		CHEM - LVN			RT	CHEM - CW				WS			CHEM - EG		CHEM - GH		RT	PHYSICS - PM				RT	RT		
pm		CHEM - JH		CHEM - LVN			RT	CHEM - CW				WS			CHEM - EG		CHEM - GH		RT	PHYSICS - PM				RT	RT		
							chem					*chem CW*							*maths*					*phys*	*stats*		
Wed am		CHEM - JH		CHEM - LVN		WS	PHYSICS - PM	CHEM - CW				RT	E x a m s	E x a m s	MATHS - RA					PHYSICS - PM	STATISTICS - MW						
pm		CHEM - JH		CHEM - LVN		WS	PHYSICS - PM	CHEM - CW				RT			MATHS - RA					PHYSICS - PM	STATISTICS - MW						
						chem						*chem CW*															
Thu am	GS	MATHS - RA						CHEM - CW			WS				CHEM - EG		CHEM - GH		WS		STATISTICS - MW				T		
pm	GS	MATHS - RA						CHEM - CW			WS				CHEM - EG		CHEM - GH		WS		STATISTICS - MW				T		
											phys								*chem*								
Fri am	IL	CHEM - JH		CHEM - LVN	WS		PHYSICS - PM	T	PHYSICS - PM		RT	T			CHEM - EG		CHEM - GH		RT	T							
pm	IL	CHEM - JH		CHEM - LVN	WS		PHYSICS - PM	T	PHYSICS - PM		RT	T			CHEM - EG		CHEM - GH		RT	T							
					maths						*phys*								Chem								

M	**MATHS**	C	**CHEMISTRY**
RA	Mr R Andrade	LVN	Dr L Vila-Nadal
S	**STATISTICS**	JH	Prof J Hargreaves
MW	M Waltenberger	CW	Dr C Watts
P	**PHYSICS**	GH	Dr G Hedley
PM	Dr P Murray	EG	Dr E Gibson
TA	Dr T Almeida		

T	Class Test
WS	Workshop
RT	Revision Tutorial

orientation and introductory lecture week

Class Head	Dr Adrian Lapthorn
Deputy Class Head	Dr Mark Symes

Science Fundamentals 1X

Title: Mathematics 1X.

Duration: 11 Hours

Lecturer: Mr R Andrade

Aims: To understand the importance of units of quantities and to be familiar with the SI system of units. To be able to undertake simple arithmetic exercises without the use of a calculator and be competent at making appropriate approximations in calculations. To be able to do calculations involving proportion. To understand the relationship between two variables connected by a linear equation and be able to calculate the equation of a given straight line. To be able to solve simultaneous equations. To know and be able to use the index laws. Know about roots of a number. Be able to use the distributive laws. Be able to factorise and expand expressions. Know and be able to use the Binomial Theorem in expansions. Be able to manipulate equations in order to solve them. Be able to complete the square in a quadratic and hence sketch a quadratic function. Be able to apply all of the above to a variety of practical and other problems.

Topics:

1. To recognise and use the SI unit system.
2. Solve simple arithmetic exercises without using a calculator
3. Solve equations involving proportion
4. Calculate the gradient and equation of a line
5. Solve simultaneous equations
6. Use Index laws
7. Use factorisation and expansion
8. Use and solve equations using the Binomial Theorem
9. Use "Completing the square" for converting the form of a quadratic
10. Construct graphs of quadratic functions

Course Outline: At the end of this course the student should have covered and consolidated fundamental skills in numeracy, algebraic manipulation, graphical work and applications of these skills to practical problems.

Title: Atoms and Molecules 1X

Duration: 6 Hours

Lecturer: Prof J Hargreaves

Aims: To introduce students, new to chemistry, to some properties of atoms, molar quantities, and bonding in small molecules.

Topics:

1. To be able to explain the terms Atomic number, isotope, atomic mass unit and recognise why atoms have different size.

2. To be able to describe covalent, ionic and hydrogen bonding and give examples. To be able to describe van der Waals interactions.

3. Construct chemical formulae and balance simple chemical equations.

4. Use the mole in elementary calculations, calculate molar quantities and reaction yields.

5. Use the Periodic Table to predict the properties of the elements.

6. Identify simple acids and bases.

7. Illustrate the mode of solvation of simple ionic compounds.

Course Outline: At the end of this course the student should have a basic knowledge of atoms, properties of atoms and be able to use the periodic table. In addition be able to work with chemical formulae and perform basic calculations involving moles.

Title: The Elements and the Periodic Table 1X.

Duration: 6 Hours + 2 hours workshop/revision

Lecturer: Dr L. Vila-Nadal

Aims: To review elements and their compounds, their occurrence, and importance. To look for generalizations about behaviour and properties of elements using the Periodic Table. To discuss ionic and covalent bonding in compounds, relate this to the position in the Periodic Table of the elements involved, and to examine chemical reactivity. To discuss non-metals (C, H, N, O, P, S) and metals (Na, K, Mg, Ca, Fe, Cu, Zn) of biological significance.

Topics:

1. Recognise the names and symbols for elements of groups 1, 2, 12-18, and of the first transition series (Sc-Cu). State the names and formulae of the ions $[NH_4]^+$, $[NO_3]^-$, $[CO_3]^{2-}$, $[SO_4]^{2-}$, $[OH]^-$, and $[CN]^-$.

2. Explain the concept and derivation of oxidation states of the elements above, when in their common compounds.

3. Write the electronic configuration of the elements, and the ions formed from them.

4. Recognise the basis of the periodic table in terms of electronic structures of the atoms. Use the Periodic table to rationalise or predict the properties of elements and compounds.

5. Explain the concepts of ionization energy, electron affinity and electronegativity of elements. Explain how these properties vary across the periodic table.

6. Explain the formation of single, double, or triple covalent bonds by electron pair sharing between atoms. Recognise that sharing of electron pairs between atoms of different electronegativities can lead to polar covalent bonds, and in the extreme case transfer of electrons from one element to another can lead to ionic bonds.

7. Relate the Periodic Table position of constituent elements of simple compounds to the type of bonding (ionic, covalent, or metallic) encountered. Recognise the dependence of the properties and structures of compounds on the types of bonding involved.

Course Outline: At the end of this course the student will be able to relate the electronic structures, ionization energies, electron affinities and electronegativities of representative elements to their position in the Periodic Table, and the relationship of element position to the nature and bonding of the compounds it forms. They should be able to describe how trends in these properties vary across the Periodic Table

Title: Waves, Light, and Sound 1X.

Duration: 4 Hours

Lecturer: Dr P. Murray

Aims: To provide, by study of the relevant physical principles, answers to questions such as: What is a wave? Why are all waves basically similar? What is light and how do we perceive it? What are the relative advantages of communicating using light and sound, and what limits the frequencies that organisms use?

Topics:

1. Describe waves using wavelength, frequency and period, speed.

2. Explain electromagnetic waves and recall the speed of light.

3. Explain the wave nature of light: wavelength, frequency, reflection, refraction.

4. Use Light rays and explain the focusing of light in the eye.

5. Recognise the particle nature of light: photons, relationship between energy of photon and frequency, no of photons required to stimulate retinal sensors, damage to biological systems by high energy photons.

6. Identify the nature of sound waves in air: speed, wavelength, frequency, detection of sound, limits to range of frequencies which can be detected by humans and other animals.

Course Outline: At the end of this course the student should be able to use the relation between wavelength and frequency for common waves; identify different regions of the electromagnetic spectrum; describe the phenomena which can be explained by light acting as a wave; describe an example of light behaving as particles; set down the limits of audible frequencies.

Title: Scales of length and time 1X

Duration: 1 Hour

Lecturer: Dr T Almeida

Aims: To describe the various scales of length time and mass which are important in the physical universe and for biological systems.

Topics:

1. Identify scales of length and time from different parts of electromagnetic spectrum. Powers of 10.

2. Identify Scales of length in physical world. (Universe, galaxy), solar system, earth, living creatures, cells, atoms, nuclei of atoms. (Or in opposite order). Length scales of animals.

3. Identify Scales of time. Atomic processes, electrical signals in orthodox conductors, electrical signals in nerves, chemical reaction rates, times in solar system, geological time. Lifespans of living organisms and how they scale. Scales of mass. Atoms, cells, organisms, astronomical objects.

Course Outline: At the end of this course the student should be able to: identify which length scales (in powers of 10) are appropriate for sub-atomic, biological, and astronomical systems; identify which time scales (powers of 10) are appropriate for sub-atomic, biological, and astronomical systems; identify which mass scales (powers of 10) are appropriate for sub-atomic, biological, and astronomical systems.

Title: Energy, Heat and Temperature 1X

Duration: 4 Hours

Lecturer: Dr T Almeida

Aims: To provide, by study of the relevant physical principles, answers to questions such as: - Why is fat such an efficient means of storing energy? What physical processes do animals use to keep warm and to keep cool? What is the ozone layer and why is it important for life on earth? What is global warming and why is it occurring?

Topics:

1. What is energy? Units of energy. Energy in different forms. Conservation of energy. Storage and conversion of energy. Heat as the ultimate form of energy.

2. Temperature as degree of hotness. Units of temperature. Simple calculations. Transfer of heat from hotter to colder bodies. Low and high temperatures, (absolute zero of temperature, temperature of sun).

3. Power as rate of energy use. Unit. Simple calculations.

4. Energy in biological systems. Storage. Energy balance.

5. Energy carried by electromagnetic radiation. Absorption of EM radiation – dependence on thickness of absorber, X-ray photographs, absorption of UV by ozone layer. Global warming.

6. Energy balance of earth. Importance of atmosphere and of water to life as we know it. Greenhouse effect and global warming.

Course Outline: At the end of this lecture course the student should be able to: explain the meaning of energy, temperature and power; describe how energy can change its form but the amount of energy is conserved; explain how heat energy is transferred from a hotter to a colder body; describe systems in energy balance, and what happens when energy balance breaks down; sketch the amount of light remaining as a function of thickness after passing through materials; show that earth must lie in the temperature zone which allows water to be liquid; understand why Earth's atmosphere acts like a greenhouse.

Title: Bioorganic Chemistry 1X

Duration: 11 Hours

Lecturer: Dr. C Watts

Aims: To discuss the distinctive characteristics, structures, shapes, naming conventions, reactions, applications, and natural occurrence of organic molecules; to interpret the reactions of organic molecules, and predict bonding using general principles; to consider the chemistry of key biological molecules and polymers, their uses, and to illustrate how their properties depend on their structures.

Topics:

1. Recall and compare the properties and reactivity of carbon and its compounds namely; alkanes, cycloalkanes, alkenes, alkynes, aromatics, alcohols, aldehydes, ketones, carboxylic acids, and esters.

2. Identify alkanes, cycloalkanes, alkenes, alkynes, aromatics, alcohols, aldehydes, ketones, carboxylic acids, esters, amines and amides based upon their functional group and structural formula.

3. Classify alcohols and amines as primary, secondary or tertiary.

4. Use the IUPAC convention for the naming and classification of organic molecules.

5. Represent molecules using molecular, structural, condensed structural, and stick formulae, and discuss structural and stereoisomerism (chirality).

6. Summarise the biological function of lipids, carbohydrates and proteins.

7. Compare and contrast the properties, structure and reactivity of fatty acids, fats, detergents, simple and complex sugars, amines, amino acids, and amides as discussed during this course.

8. Classify and summarise protein structure (primary, secondary, tertiary, and quaternary) and explain the role of side-chain functional groups in how enzymes function.

9. Relate the theory, knowledge and techniques introduced during this lecture course to associated exercises.

Course Outline: By the end of this course the student should have a basic understanding of carbon forming elaborate molecules found in living things, the nature of the covalent bond, and the limitations on bond angles and lengths. The influence of charge and polarity on molecular properties, solubility, and intermolecular interactions will also be introduced, along with the various conventions for naming and drawing molecules and molecular models. Structural isomers, geometric isomers, chirality and the influence of lone pairs on shape and reactivity will be discussed. Students should also understand and be able to interpret the "functional groups" present is bioorganic molecules, and predict how functional groups affect reactivity. The structure, reactivity, and biological function of lipids, carbohydrates and proteins are also covered in this course.

Science Fundamentals 1Y

Title: Mathematics 1Y.

Duration: 8 Hours

Lecturer: Mr R Andrade

Aims: To know the laws of logarithms. To understand the exponential function and its application to exponential growth and decay problems. To be able to apply logarithms and exponential functions to a variety of practical and other problems. To be able to convert between radian and degree measure. Know how to use a calculator to find the values of the trigonometric functions and be able to sketch the graphs of the trigonometric functions. Understand the motivation for the development of differentiation. Know and be able to apply the rules for differentiating combinations of the standard functions. Understand the connection between differentiation and rate of change. Be able to apply all of the above to a variety of practical and other problems.

Topics:

1. To use and compute logarithms
2. Use the exponential function and apply to exponential growth and decay
3. Identify applications of the logarithmic and exponential functions
4. Use Angles; specifically convert degree and radian measure
5. Use the trigonometric functions; sine, cosine and tangent
6. Reproduce graphical representations of periodicity, phase and amplitude
7. Recall how to differentiate standard functions
8. Calculate rates of change by differentiation.

Course Outline: At the end of this course the student should have an elementary understanding of the logarithmic and exponential functions, trigonometry and differentiation

Title: Aqueous Solutions 1Y

Duration: 6 Hours

Lecturer: Dr Gordon Hedley

Aims: To consider the general nature of aqueous solutions of all types and to introduce simple quantitative ideas for some of their properties. To be able to perform calculations to predict properties such as pH for a variety of aqueous solution.

Topics:

1. Represent the chemical structure of water, with reference to molecular shape and charge.

2. State a number of anomalous properties of water and relate these to the molecular structure of water.

3. Identify hydrogen bonded atoms and recognise their significance in different biological molecules.

4. Recall simple quantitative aspects of ionic equilibria in aqueous media. These include concepts of electrolytes, acid and bases, hydrogen ion concentration, pH and its measurement. Define and predict the dissociation state of strong and weak electrolytes in aqueous solution.

5. Calculate using appropriate equations the H^+/OH^- ion concentration and pH/ pOH of various aqueous solutions.

6. Recognise the important differences between Strong and Weak acid and bases.

7. Explain the basis of acid and base buffer solutions. Perform calculations using the *Henderson Hasselbalch* equation.

8. Recall the nature of the carbonate and phosphate buffers in biological systems, which location they have a significant function and explain how they work.

9. Apply the theory and techniques introduced during this course to related exercises.

Course Outline: By the end of this course the student should a basic understanding of the structure and properties of water, aqueous chemical solutions. Be able to perform calculations to determine the pH of various solutions containing strong and weak acids and bases. To know what constitutes a buffer, perform calculations and know what the significant biological buffers are.

Title: Chemical Kinetics 1Y

Duration: 6 Hours

Lecturer: Dr E. Gibson

Aims: To consider the various factors that determine how fast chemical reactions may go. To be able to derive the *rate law* from experiment for any chemical reaction and use it to perform calculations. Understand the basic ideas and equations used in enzyme kinetics.

Topics:

1. Explain in simple molecular terms why the rate of reaction may depend on physical factors such as size, shape, form, and temperature of the reactants.

2. Formulate expressions showing how the rates of chemical reactions might depend on concentrations of reactants and define what is meant by rate constant.

3. Identify the order of a chemical reaction from experimental measurements. The form of first and second order rate equations and what is meant by a rate determining step.

4. Recognise concepts such as reaction co-ordinate, transition states, and activation energy. Be prepared to reproduce a reaction energy profile and label key features on it.

5. Name the different types of catalysts and explain why they are separated into these categories.

6. Recall the underlying assumptions that are central to the *Michaelis-Menten* equation for enzyme kinetics. Explain the significance of the Michaelis constant, the maximum velocity, and the maximum turnover number.

Course Outline: By the end of this course the student should a basic understanding of chemical kinetics. Namely factors that affect rate, derivation of a rate law, *the collision model* of chemical kinetics, reaction profiles, types of catalysis, and enzyme kinetics

Title: Forces in Nature 1Y

Duration: 4 Hours

Lecturer: Dr T Almeida

Aims: To provide, by study of the relevant physical principles, answers to questions such as: - How do birds manage to fly? How do fish control buoyancy? What would organisms be like if gravity on Earth were like gravity on the moon? Why can a flea jump so many more times its body length than we can? How do flies, frogs and geckos stick to surfaces, sometimes upside down?

Topics:

1. Explain what is Force, Magnitude and direction. Unit. Weight as gravitational force. and Pressure.

2. State Newton's first and second Law. Relate this to static equilibrium as balance of forces

3. Explain how lift in wings and fins is caused by pressure differences – Use the basic Bernouilli equation to perform calculations.

4. Explain the concept of density and Archimedes principle. Use buoyancy force to perform calculations.

5. Recognise the relative forces on human form. State the relative sizes of gravitational attraction on earth and moon and explain the consequences.

6. Identify and calculate frictional forces.

7. Explain the conservation of total mechanical energy.

8. Explain air and water resistance and their influence on different classes of animals.

Course Outline At the end of this course the student will be able to: explain the concept that static equilibrium occurs when forces are balanced; sketch streamlines around an aerofoil and explain lift; reproduce Archimedes' principle, and explain buoyancy; know the relative size of the gravitational force on the Earth's surface and on the moon's surface; describe the relative size of common forces at different length scales.

Title: Atoms, Radioactivity and Electricity 1Y

Duration: 5 Hours

Lecturer Dr P. Murray

Aims: To provide, by study of the relevant physical principles, answers to questions such as: How do we know the age of the earth and the earliest life forms? (And why did Lord Kelvin get this wrong in the 19th Century)? How is it that inside living organisms, signals are communicated by electric currents, circulatory systems and diffusion? What factors determine the most appropriate communication method for a particular signal?

Topics:

1. Represent the structure of atoms with reference to the nucleus and electrons, charge, chemical processes.

2. Identify nuclear decay processes, types of radiation emitted. Use exponential Decay to solve simple calculations.

3. Summarise our understanding of the Universe - galaxies stars and planets

4. Identify and explain the basis of dating techniques to determine age of universe and bodies within it, and calibrate fossil records of life on earth.

5. State Kelvin's calculation of the age of the earth and explain why it is wrong.

6. Explain what is electricity and relate this to voltages and currents, size and nature of electrical signals in the body, how electricity kills.

Course Outline: At the end of this course the student will be able to: describe the basic (Bohr) model of the atom; identify the different types of radioactive decay; sketch the behaviour of activity of a radioactive sample as a function of time, and define the half-life; identify galaxies, stars and planets in our universe; describe how modern archaeological dating techniques work and why
Kelvin's calculations of earth's age were wrong; explain the difference between voltages and currents; write down the magnitudes of voltages and currents which make the nervous system work, in comparison with the size of those which cause damage in the body.

Title: Statistics 1Y

Duration: 8 Hours Lectures

Lecturer: Mr M. Waltenberger

Aims: To introduce basic ideas in exploratory data analysis, including data types, graphical displays and numerical summaries.

Topics:

1. Identify, and be able to distinguish among, various different types of data that arise in scientific research

2. Produce appropriate graphical displays of various different types of data.

3. Compute appropriate numerical summaries of a given set of data.

4. Describe a set of quantitative data in terms of location, spread and shape

5. Summarise the key features of a set of data accurately and concisely

6. Compare two or more data sets using numerical summaries and graphical displays

7. Summarise the key features of a scatterplot of bivariate continuous data.

8. Compute and interpret Pearson's coefficient of correlation

9. Compute linear regression equations and use these to make predictions

10. Perform transformations to linearity, i.e. by power and exponential functions

Course Outline: At the end of this course the student should be familiar with Illustrative scientific data sets with questions of interest: Univariate data, including quantitative data (measurements or counts), categorical data, circular data and time-series. Graphical displays: Stem-and-Leaf plot, Dotplot, Histogram, Barchart, line plot, circular plot. Description of data distributions (location, spread, shape). Numerical Data Summaries: Mean, median, mode, standard deviation, quartiles, coefficient of variation, five-number summary and boxplot, proportion, percentage. Making Comparisons: Graphical comparison of data distributions; Comparison of numerical summaries, including means, medians, percentages and coefficients of variation. Exploring Relationships. Bivariate data: measurement data, categorical data. Scatterplots. Tables. Pearson's correlation coefficient and its interpretation. Fitting Regression Lines: Computation of linear regression equation based on the method of least squares. Making predictions and inverse predictions from a fitted model. Transformations to linearity, illustrated by power laws and exponential laws. The Need for Statistical Inference: Samples and Populations. Generalising statistical findings to the population(s). Sample statistics. Sampling variability.