

# **CHEM Year 1 Practical: Fundamentals of Practical Chemistry**

An introductory manual for the Year 1  
Practical courses

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# 1. Course overview

This course overview is a short summary of the key features of the laboratory experience that you can expect in the first year of your degree. More detailed instructions for the experimental work that you need to undertake will be provided at the start of the laboratory course.

## 1.1 Where is it?

The practical courses in Chemistry are hosted in one of the teaching laboratories in B29.

**Level 4 (B29:4005)** is the teaching laboratory where you will undertake experiments to determine, and understand, the properties of inorganic and organic materials;

**Level 5 (B29:5005)** is the teaching laboratory where you will learn how to synthesise complex inorganic and organic compounds from simpler starting materials and use spectroscopic techniques to determine their structures

In addition to the main laboratories there are instrument rooms (B29:5013) and computer suites (B29:3012 and B29:4015) where you will spend some of your time during the courses.

## 1.2 When is it?

You will be allocated to a group which will have a practical session at the same time in each week of the semester. The first week of the semester will involve some introductory sessions. Laboratory sessions start in the second week and continue for a total of ten practical sessions.

**First years** will have practical sessions on a Monday or a Tuesday from 12:30 until 18:00.

## 1.3 Who runs it?

The following staff oversee the delivery of the practical courses in each of the teaching laboratories. During every laboratory session you will also be tutored by academic staff and post graduate teaching assistants.

<b>Level 4</b>	Colin Flowers <i>Laboratory Manager</i>	<a href="mailto:C.M.Flowers@soton.ac.uk">C.M.Flowers@soton.ac.uk</a> ; room 29:4007	23327 or 023 8059 3327
<b>Level 4</b>	Tom Ogden <i>Technician</i>	<a href="mailto:T.J.Ogden@soton.ac.uk">T.J.Ogden@soton.ac.uk</a> , room 29:4009	24117 or 023 8059 4117
<b>Level 5</b>	Dr Thomas Logothetis <i>Laboratory Manager</i>	<a href="mailto:thomas.logothetis@soton.ac.uk">thomas.logothetis@soton.ac.uk</a> , room 29:5001	22193 or 023 8059 2193
<b>Level 5</b>	Deeptee Horil Roy <i>Technician</i>	<a href="mailto:D.Horil-Roy@soton.ac.uk">D.Horil-Roy@soton.ac.uk</a> room 29:5007	23614 or 023 8059 3614

## 1.4 How does it work?

### CHEM Year 1 practicals laboratory work

CHEM Year 1 practicals is the practical module associated with several core courses as per table below:

Module codes					
		Lab module	ORGANIC	PHYSICAL	INORGANIC
Year 1	Sem 1	Y1-Practical	CHEM1031	CHEM1033	CHEM1035
	Sem2		CHEM1032	CHEM1034	CHEM1036

Chemistry students will attend all courses and the associated practicals, whereas Natural Science students attend those practicals associated with their course choice(s).

Each week your laboratory session will require that you complete pre-laboratory exercises before you attend your session.

The practical part of the course commences at 12:30 and continues until 18:00. It is important that you manage your time to complete the work, allowing a period for clearing up as the laboratory will close promptly at 18:00.

The chemistry content of CHEM Year 1 practicals is organised in two broad areas.

One area consists of experiments that will illustrate techniques used in the **synthesis** of both **organic and inorganic materials**. It will also introduce you to several **spectroscopic methods** that will allow you to **work out their structure**. These experiments will be carried out in the Level 5 teaching laboratory.

The second area relates to using experiments to understand the **physical chemistry** that underpins the **reactivity of matter** (thermodynamics and kinetics) and which is the **basis of the spectroscopic and analytical methods** used to determine molecular or material structure. These experiments will be carried out in the Level 4 teaching laboratory.

Many experiments will involve work at the interface between these two broad areas. Whichever area of chemistry you are covering in your laboratory work the learning outcomes specified at the beginning of the experiment will make it clear what you are expected to achieve.

### Mathematics workshops

Year 1 also contains a **maths component** which is taught through workshops in both semesters 1 and 2. You will be allocated one workshop per week on your timetable. The maths component is examined at the end of each Semester, with the exam marks to the lab component of the Physical Chemistry part(s).

## 2 Learning outcomes

Each experiment will have specified learning outcomes and your assessment will judge whether you have achieved them, and the degree of expertise you have demonstrated. In addition to these specific learning outcomes there are some general ones below that summarise the areas of competence that you will develop throughout your entire first year practical experience.

- i. Understand the importance of experimental safety and risk assessments;
- ii. Interpret experimental guidance (written, video, lectured) with care and attention to detail;

- iii. Apply a variety of techniques and methodologies to the synthesis and analysis of molecules and materials;
- iv. Manage time effectively in the laboratory and in report writing to ensure that allocated tasks are completed on schedule;
- v. Describe experimental methods and outcomes in an appropriate laboratory record to a standard that would allow a skilled scientist to repeat your experimental work;
- vi. Organise experimental data clearly, logically and according to appropriate conventions;
- vii. Analyse experimental data to provide an explanation for the observed experimental outcome
- viii. Apply appropriate formulae and conversions to generate quantitative information in preparation for experimental work and in the evaluation of the results arising from it;
- ix. Discuss experimental outcomes with respect to reliability of results in relation to concepts such as accuracy, precision, ambiguity and levels of confidence;
- x. Measure materials and properties with accuracy, precision and reproducibility.

### **3 Academic integrity**

When you join our courses you sign up to a set of regulations which define what the University expects of you with regard to your academic conduct. A fundamental aspect part of this is the concept of academic integrity. This requires that you conduct your academic life in the professional manner described via the SUSSED portal in the University Calendar, see <http://www.calendar.soton.ac.uk/sectionIV/academic-integrity-statement.html>.

The essence of this statement is captured in the following key points that involve you:

- Taking responsibility for your own work.
- Respecting the rights of other scholars.
- Behaving with respect and courtesy when debating with others even when you do not agree with them.
- Fully acknowledging the work of others wherever it has contributed to your own.
- Ensuring that your own work is reported honestly.
- Following accepted conventions, rules and laws when presenting your own work.
- Ensuring you follow the ethical conventions and requirements appropriate to your discipline.
- Supporting others in their own efforts to behave with academic integrity.
- Avoiding actions which seek to give you an unfair advantage over others.

## 4 Breaches of Academic Integrity

If you are to work with academic integrity there are a number of practices you must avoid, including:

- Plagiarism - The reproduction or paraphrasing, without acknowledgement, from public or private (*i.e.* unpublished) material attributable to, or which is the intellectual property of another, including the work of students.
- Cheating – Seeking to gain an unfair advantage before, during or after an assessment or assisting another student in doing so.
- Falsification – Any attempt to present fictitious or distorted evidence, data, references, experimental results and/or knowingly to make use of such material.
- Recycling – Where a piece of work which has already been used and assessed in one context is used again (without declaration) in a different context.

*Please note that in cases where a person assists another in a breach of academic integrity, both parties will be penalized equally.*

The University and the School regard breaches of academic integrity as reprehensible and an attempt to defraud other students and potential employers. Such breaches are taken very seriously and are dealt with according to the procedures noted in a related section in the University Calendar (<http://www.calendar.soton.ac.uk/sectionIV/academic-integrity-procedures.html>). Any breach of academic integrity that is confirmed will result in a note being placed on the student(s) file(s) and the following penalty will be imposed

- (i) With 'minor cases', a mark of zero will be given for effected area of work, subject to the approval of the Academic Integrity Officer.
- (ii) In more severe cases the Academic Integrity Officer can consider penalties from a mark of zero for a module up to termination of the course after appropriate investigation.

**IMPORTANT:** If you are missing or have collected poor data for a practical, you are not permitted to use another persons data (even if you acknowledge this in your write-up) UNLESS you have received permission to do so from the Lab Manager. Using another persons data without the Lab Managers permission will be treated as a breach of academic integrity by both yourself and the person who provided the data.

## 5 Course organisation in more detail

### 5.1 CHEM Year 1 Practicals Semester 1

1. Each of you will be allocated to a laboratory practical group early in the first week of the semester. The correct information on your laboratory group will be posted on the Year 1 notice-boards in B29: level 2 (near the round tables) and you should check your on line timetable against this information. If there is a difference between the two you should contact Alison Tubb ([timetabling@soton.ac.uk](mailto:timetabling@soton.ac.uk), 25506 or 023 8059 5506) for clarification.
2. Also contact Alison Tubb if you become aware of any timetable clashes. Do keep a check on your emails to see if there are any instructions regarding the practical courses.
3. Starting from Week 2 you will have one weekly practical session, always on the same day, which will start at 12:30 and will run until 18:00. It is permissible for you to take a short break during the practical session provided that (a) it is safe to do so (b) you do not miss any teaching and (c) you finish your work and leave the lab by 18:00.

4. Throughout the semester you will alternate between the two teaching laboratories. For example your group will spend Weeks 2, 4, 6, 8 and 10 in B29:4005 **and** Weeks 3, 5, 7, 9, and 11 in B29:5005 **or** the other way around.
5. In your allocated laboratory you will do the experiments in each laboratory in the same order as everyone else. You will undertake one experiment per week and most of the glassware you need will be provided (usually in trays) in the area of the laboratory where you work. More specialist equipment will be provided separately.
6. You will perform the work with help from written guidance and from the tutors who will be in the laboratory with you. Careful use of both will ensure that you know what to do in the lab and what to do for your report.
7. You will be helped to organize your time to ensure that you complete your work and can leave before 18:00. *No work can be carried out after this time.*
8. Before you can leave the laboratory you will need to clean any equipment that you have used and return it to its starting location. This, and the tidiness of your workspace, will be checked by a tutor who will not allow you to leave until these tasks have been completed properly. A proportion of your assessment is related to this process.

## 5.2 CHEM Year 1 practicals Semester 2

The second semester has the same organization as the first with the following exceptions:

- a. The experiments in each laboratory will be conducted in a 'circus' format. Every week all five of the experiments will be active with a group of between 5 and 8 students attending each. By the end of the course you will all have done the same experiments but in a different order.
- b. Each experiment will have a specific location in the laboratory and the equipment for each will be provided at this location.
- c. In addition to the laboratory experiments there will also be a (CHEM1034) Computational practical. ALL students will be timetabled to perform this during Week 1 of Semester 2. There is no lab report associated with this practical – Instead, throughout the semester, groups of students will be timetabled to present their work/analysis and the assessment of the presentation will replace the report mark. More details of about this can be found on the Level 4 Lab Website ([www.l4labs.soton.ac.uk](http://www.l4labs.soton.ac.uk)).

## 6 What do we expect of you?

CHEM Year 1 practicals is a core module which means that it must be completed successfully before you can progress to the next academic year. You are expected to:

- Attend 100% of the laboratory sessions that are allocated to you\*. Attendance in L5 is monitored by lab-book sign-off and cleaning; and in L4 is monitored by submission of the in-lab assessment.
- Complete a laboratory notebook throughout the practical sessions as instructed by your tutors.
- Submit laboratory reports by the deadlines specified, as directed in this course manual \*\*.
- Attend the maths workshops and complete the maths assessments.

- Participate fully in the learning experience offered in your laboratory classes.
- Provide us with your thoughts on the course by completing a course questionnaire at the end of the course.

**PLEASE NOTE THAT IT IS NOT POSSIBLE TO PASS THE LAB COMPONENT OF THE MODULE IF YOU HAVE ANY UNVALIDATED ABSENCES.**

### \* Absence from the course

If for any reason you miss one of your laboratory sessions, you must inform the relevant staff (**using [inform-chem@lists.soton.ac.uk](mailto:inform-chem@lists.soton.ac.uk)**) as soon as possible.

As soon as you return you must contact the relevant Lab Manager to obtain a Laboratory Absence Form.

Once the form has been satisfactorily completed (*i.e.* the absence has been validated) it must be returned to the Lab Manager in person, where:

- If it is possible the missed session will be rescheduled.
- Where rescheduling is impractical, an alternative assignment will be issued to you. This must be completed/submitted within one week. The work will be assessed and this assessment will count towards your final mark (in place of the missed lab report).

**IMPORTANT:** The paperwork validating your absence must be submitted within two of your return from the absence.

### \*\* Late submission of coursework

Reports that are submitted late will have a deduction in marks applied with the size of the reduction rising in proportion to the time beyond the submission deadline. This procedure is described in the University Late Submission policy

([http://www.soton.ac.uk/quality/docs/Extensions\\_and\\_Late\\_Submission\\_Penalties.doc](http://www.soton.ac.uk/quality/docs/Extensions_and_Late_Submission_Penalties.doc)).

**IMPORTANT NOTE:** Reports submitted more than five working days late will not be accepted (*i.e.* will receive a mark of zero) and other assessed work (*i.e.* pre-labs, lab-books and interim reports) will not be accepted after the specified deadline.

Note: More details on attendance, absence and the procedures to follow in the event of an absence (or known future absence) can be found at

<http://www.l4labs.soton.ac.uk/policies/absence.htm>

## 7 How will we assess you?

CHEM Year 1 practicals is a core module which means that it must be completed successfully before you can progress to the next academic year. This means that you have to complete the tasks that are set and do so to a standard that we judge meets the pass mark (35%) or better. Each of the tasks will be related to the learning outcomes described in Section 2 (and also the ones related to each specific experiment) and the assessments will allow your tutors to be sure that you will have achieved these learning outcomes by the end of the course.

The experiments in the two different teaching laboratories have slightly different assessment requirements which will be described in more detail in subsequent sections. However, the following will always be important:

- Completion of the associated Prelab exercises by midnight on the day before your lab session;
- Attendance at the laboratory sessions – mandatory and a prerequisite for all else!
- Maintaining a laboratory notebook throughout your laboratory sessions;
- Submission and assessment of a short interim assessment completed during the laboratory session (not all experiments);
- Quality and quantity of chemical products produced in experiments;
- Quality of the measurements/ data/ spectroscopic results collected during experiments;
- Safe, efficient and well organised laboratory work and appropriate cleaning and clearance of work area and equipment before leaving the laboratory;
- Organisation and analysis of measurements/ data/ spectra collected during experiments;
- Written report of the experimental outcomes completed after the laboratory session;
- Submission of your work before the deadline specified.

For the Level 4 Laboratory, the breakdown of the assessments that will contribute toward your practical mark are detailed in the practical lab scripts.

For the Level 5 Laboratory, the various assessments will contribute towards your final mark as follows:

Pre-Lab:	10%
Lab (e.g. notes, tidiness, safety):	30% *
Main Report:	60% *

*\*Quality of results will be assessed as part of the lab notes and the report. Overall, theory aspects and practical aspects will contribute roughly equally to the grade of a practical*

## 8 How do we support you?

Your learning experience will be supported with resources to help you complete your experimental work, and to understand what you have done, why you have done it and how it works. It is also important that we help you understand what you have to do to succeed on the course. There are three main points of delivery of this support: in advance, during and post assessment.

### 8.1 Advance support - The Blackboard portal

There is a major Blackboard ([www.blackboard.soton.ac.uk](http://www.blackboard.soton.ac.uk)) resource you will use during your practical course – identified by the course code CHEM Year 1 practicals. This will contain all resources for your learning and also the Prelab materials.

### 8.2 Teaching and learning during laboratory sessions

When you are in the laboratory your learning will be supported by a combination of academic staff, teaching fellows and trained teaching assistants. All of them will teach you throughout your time in the laboratory with a combination of group sessions and one-to-one tuition.

In addition, you will each have extensive written guidance for each experiment and web access to the resources mentioned above.



An important aspect of any learning process is giving each student **feedback** on performance. *This is a continuous process during your laboratory sessions.* Informal discussion between students and/ or between staff and students is of incredible value in increasing understanding. You should make sure that you take full advantage of the feedback opportunities available throughout your sessions by getting involved in discussion about chemistry with your colleagues and tutors. *Remember that effective feedback starts with an effective input from you!*

You can expect to have discussion about the techniques that you are using, the theory based on them and the quality of the reporting that you accomplish in your laboratory notebook.

In some experiments there will be a requirement to complete an interim report which will be part of the assessment and which offers another opportunity for feedback before you complete a final report.

Finally, you will have your laboratory notebooks checked at the end of every laboratory session where comments will be provided on the standard you are achieving. At the same time you will have your work area checked to ensure that your space is clean and tidy – an important part of Health and Safety in the laboratory environment.

### **8.3 Feedback after each laboratory session**

Once you have completed an experiment and report has been submitted it will be assessed. The purpose of the assessment is to arrive at a mark that will contribute to your module grade. In addition, the assessment will identify your strengths and weaknesses and comments on these will be provided – another example of useful feedback.

There are three routes by which post laboratory feedback is provided to you which are noted below:

- Once a grader has assessed the report feedback is available on the submitted report in Turnitin. To access the information you need to navigate yourself to the link where you submitted the report and “view” the outcome. Further details how to submit reports and access feedback will be provided separately on Blackboard. Electronic feedback (comprising the assessor’s report describing the strengths and weaknesses of your work) will normally be available one week after the submission deadline of your report (provided the report was submitted by the deadline); however note the official policy that it will be made available within 10 working days of submission.
- If, having read the online feedback, you wish to clarify or discuss in greater depth the feedback you have received you are welcome to make an appointment with the laboratory manager to do so. Please refer to <http://www.l4labs.soton.ac.uk/policies/fb.htm> for information of the procedure used to request clarification. Please note that this is an opportunity for clarification of clearly defined queries. The grade will not be discussed on such occasions.
- Provisional marks will also be posted either on the feedback site or via Grade-center on Blackboard. Seeing how your own performance develops against the benchmark of the rest of your colleagues is a useful resource when used sensibly. This information will typically be made available within 10 working days of feedback submission.

To make the best use of your online feedback you should read it in conjunction with a copy of your report, so you can identify exactly what it was you did well and what could be improved. In order to facilitate this process, and to have a record for your own development, we recommend to keep a feedback diary, where critical points are recorded for your perusal – reflection on feedback helps.

Your work will be assessed by academic staff or teaching assistants with the whole assessment being overseen and moderated by the appropriate laboratory manager. If you have anything you wish to discuss about your work you should contact the laboratory manager. Should the lab manager arrange for you to have an appointment with a member of the assessment team please make sure you stick to the time agreed. If you do wish to raise issues with grading or feedback, please do so in a timely fashion. Missing an agreed appointment without prior notification and without valid reason will forfeit your right to further additional feedback.

Note: Further information on online feedback (e.g. how to interpret/apply it, procedure to request clarification) can be found on <http://www.l4labs.soton.ac.uk/policies/fb.htm>.

### Your chance to give essential feedback to us

During your final week **questionnaires** will be issued. After that week's work has been completed please take the time to anonymously fill in and submit the questionnaire – this feedback is valued and is used to refine the course, to make it a more relevant, productive and enjoyable experience for future students.

## 9 Health and safety in the laboratory environment

### 9.1 Emergency procedures

<b>Fire alarm</b>	Turn off any naked flame and leave the laboratory by the nearest exit. Follow the teaching staff to the muster area outside the building <i>without delay</i>
<b>Fire in work area</b>	Immediately notify teaching staff and <i>do not</i> take any action that puts yourself or others at risk
<b>First aid</b>	If you have any need for first aid, or see someone else in the laboratory who needs it, call one of the teaching staff in the laboratory.
<b>Minor chemical contamination or burn</b>	Go to the nearest sink and rinse effected area with plenty of cold water while asking someone to get a member of staff to assist you
<b>Major chemical contamination</b>	Remove effected clothing and rinse effected area in cold water. In extreme cases utilise the drench showers present near the exits if each teaching lab.
Please note that misuse of any safety equipment is considered to be a serious disciplinary matter.	

### 9.2 Personal protective equipment (PPE) and appropriate clothing

You will be provided with a laboratory coat and a pair of safety glasses as part of your laboratory equipment. Any replacement of either item will be at your own expense. Please note the following laboratory rules with regard to the use of PPE, your own clothing and your belongings.

- Laboratory coats\* and safety glasses are to be worn in the laboratory at all times;
- Safety gloves will be provided and must be worn as instructed;
- Long hair (including fringes) must be tied/ held back. If you use a hat for this purpose it must not reduce vision or hearing or be offensive to others;
- Legs, ankles and feet must be fully covered while in laboratory. Shorts, skirts and open toed footwear are not allowed;

- Phones, mp3 players and similar devices must not be used in the laboratory at any time.

*\* Please note that we only allow laboratory coats to be labelled with your name (front and back). Anyone with anything else on their coats will be required to replace it at their own cost.*

### 9.3 Other safe laboratory practices (including fume cupboards)

Working safely is mostly about applying your common sense and knowledge to your work. While Most of the statements below are common sense always remember that if you understand what you are doing you will have a better chance of doing it safely and effectively. Be prepared when you come to the laboratory and think while you are doing you work.

- Do not eat or drink or use mobile phones in the laboratory;
- Do not undertake practical work unless a member of staff is present;
- If you have an accident of any sort you must immediately inform the laboratory staff regardless of how minor the incident might have been;
- Never leave naked flames unattended and only leave apparatus that is under vacuum unattended with the approval of your supervisors;
- Make sure that you keep all communal areas clean and tidy, e.g. balances, instrument rooms, melting point apparatus, computer workstations;
- All waste chemicals and solutions must be disposed of according to the guidance provided;
- When the practical work has been completed make sure all apparatus that has been used has been cleaned and that your work area is clean and tidy.

**Fume cupboards (f/c)** are used to minimise a chemist's exposure to harmful vapours. You will often be using them during the practical course particularly when synthesising inorganic or organic materials. Some general guidelines for their proper use are outlined below.

- When not using the f/c make sure that the sash front is pulled down to its lowest point.
- When using the f/c work with the sash front as low as possible without compromising your mobility.
- If the air flow alarm on your f/c goes off, stop working, lower the sash front and make sure a member of staff knows of the problem.
- Do not allow too much clutter to build up in your f/c – it interferes with the airflow through it and increases the risk of vapours escaping through the front of the f/c.

### 9.4 Disposal of waste materials

From the environmental, financial and Health and Safety perspective waste disposal should be kept to a minimum. Where disposal is essential in the laboratory environment it is crucial that different classes of materials are disposed of in away that is considerate of the risk to the person disposing of them *and* the person who will be dealing with the disposed item.

<b>Paper and cardboard</b>	There will be a labelled location to collect this material for recycling
<b>Uncontaminated combustible waste</b>	Gloves, tissues, scraps of paper etc. should go in the bins under the sinks
<b>Solid waste</b>	Dispose of with care using the methods described in the manual
<b>Organic solvents</b>	All non-aqueous solvents must be disposed of into the appropriate sol-

	vent waste container, <i>not down the sink</i> .
<b>Aqueous waste</b>	<i>Unless otherwise specified</i> in your experimental details this may be disposed of down the sink with dilution using tap water.
<b>Broken glassware</b>	Must be decontaminated (if necessary) and disposed of in the appropriately labelled containers. <i>Glassware for disposal must not go into any other container.</i>
<b>TLC plates and capillaries</b>	There will be dedicated, labelled containers for the disposal of these materials.

Careless disposal of waste from experimental work is dangerous to you and those around you. If such practice is noted it will impact on the assessment of your laboratory skills and, if sufficiently serious, lead to a formal warning regarding hazardous practice that would be recorded in your student record.

### 9.5 Segregation of 'clean' and 'dirty' work areas

In a laboratory environment 'clean' means an area where chemicals are not in use and 'dirty' means an area where the experimental work is being carried out. There are strict rules that must be observed to ensure that contamination of a 'clean' area does not arise from work done in a 'dirty' area.

You must not carry chemicals into, or wear laboratory coats in, a clean area. All computer suites in the School of Chemistry are clean areas and the main stairwell and access corridors in the School are 'clean'. You will be shown how to get from the teaching laboratories to other work spaces via 'dirty' corridors when the need arises.

Within a working laboratory you must also be considerate to avoid contamination. Most particularly you must not use a keyboard interface (or other instrument controls) with gloves on.

### 9.6 Risk assessment during the laboratory courses

It is a legal requirement that all experimental work is assessed to determine the risk associated with it. The purpose of the assessment is to ensure that risks are minimised to a level where they are judged to be acceptable.

The experiments that you are doing have had an overall risk assessment completed by your laboratory manager. However, as the person doing the work you will need to undertake your own assessment too. Clearly this has to happen before you start the experimental work. You have more time for the actual experiment is, if this is done before coming the laboratory class.

Some of the key terms (and some useful weblinks) involved in risk assessment are described below:

<b>Hazard</b>	The way in which a material or a process could cause harm to a user, their colleagues or their environment.
<b>Risk</b>	The likelihood that the potential hazard associated with a material or a process would become reality.
<b>Control measure</b>	The method(s) applied to ensure that the risks associated with using a material or a process are minimised to an acceptable level.
<b>Risk factors</b>	Any factor that might impact on risk: for example the work environment, the

	skill of the operator, equipment, substance, and scale characteristics.
<b>Risk assessment</b>	An assessment which identifies control measures that minimise the risk associated with the collective hazards of materials and processes.
<b>Risk and Safety phrases</b>	These can still be found in outdated documentation. Since 2014 these have been replaced by Hazard statements, Precautionary statements and signal words. A table is available in the labs and on Blackboard. H and P numbers on MSDS and in scripts refer to these statements.
<b>Material Safety Data Sheets (MSDS)</b>	A summary of the physical properties and hazards associated with the named chemical, including all hazard and precautionary statements. Copies are available in the laboratory.
<b>Workplace Exposure Limit (WEL)</b>	WELs define limits which are legally binding describing the maximum amount of a specific chemical acceptable in the environment of any workplace.