T Level – Laboratory Sciences

Preparing to study T Level Science

This pack contains a variety of activities and resources to prepare you to start T Level Science in September. It has been designed for you to complete during the remainder of your Y11 lessons in the Summer term ready for you to start the course in the Autumn.

Course Overview

The T Level Science course in Y12 will not only teach a variety of advanced scientific theory, concepts and practical-based skills, it will impart the knowledge in order for you to engage fully and comprehend the range of scientific concepts that we encounter in our lives every day. Building you both knowledge and skills to transition into a successful STEM based career amongst your peers in Higher Education.

Course Outline

The course will be divided up into 3 main elements. Core Component A, which aims to familiarise and teach you the essential skills and knowledge to have a career in a working laboratory. It will also inform you of the relevant processes, guidelines and legislation you would need to follow during your industrial placement and career after course completion.

Core Component B which is divided into B1 Core Science Concepts and B2 Further Science Concepts follows the more traditional study of Biology, Chemistry and Physics at an advanced level.

Core Component A

A1 Working within the health and science sector

A2 The Science Sector

A3 Health, safety and environmental regulations in science

A4 Application of safety, health and environmental practices in the work place

A5 Managing information and data in the health and science sector

A6 Data handling and processing

A7 Ethics

Core Component B

B1 Core science concepts

B2 Further Science Concepts

How am I assessed?

The assessments in Y12 will consist of 2 externally assessed exams for the Core Component and a series of tasks assessed throughout the year for the employer-set project.

The employer-set project requires that you contextualise the core knowledge taught throughout Y12 and demonstrate this through various Core Skills.

Core Skills (CS) taught to achieve the requirements of the Employer-set Project

CS1 Project management

CS2 Researching

CS3 Working with others

CS4 Creativity and innovation

CS5 Problem solving

CS6 Communication

CS7 Reflective evaluation

Section title:

Key ideas identified:

Key word definitions:

What previous topics does this link to?

Where can this topic be found in your textbook?

Useful diagrams/tables etc..

Questions I need to ask in the lesson

Core Course Knowledge Prep – All must be completed

You will have come across all these topics and concepts listed below before during GCSE Science. However, it is very important to make sure that you fully understand them as they are fundamental to course content found in the Science T Level.

For each of the following topics listed below you need to use the online resources in order to produce at least one page of notes. If you are unsure of the topics below, feel free to use any of your own resources or other websites to help you to fully understand. If you really don't understand then please email me: matthew.breese@ursulinehigh.merton.sch.uk

You need to complete these tasks use the flipped-learning sheet on the previous page to help lay out your notes.

Topic 1: The Cell

The cell is the building block of all living creatures on Earth. Each of us starts life as a single cell and then grows into a complex multicellular organism. Read through the links found above and created detailed notes on animal and plant eukaryotic cells and prokaryotic cells

The Cell | STEM

Topic 2: The Immune System

The immune system is a complex interaction of many specialised cells all communicating and acting together to keep us healthy. Click on the link below and make key notes on the functions of B cells and T cells and the structure and function of antibodies.

Immune system | STEM

Topic 3: Drug Development

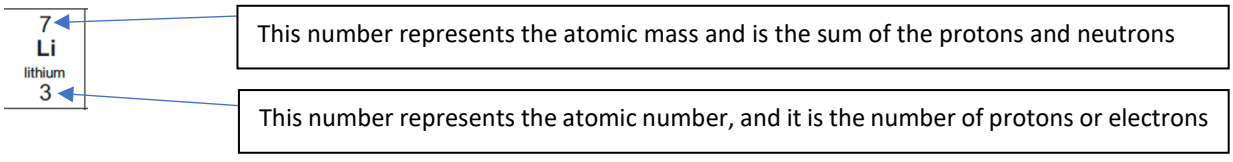
The development of new drugs and medicines has never been more relevant to our lives today. The quick development and testing of a novel vaccine for the Coronavirus is a testament to advances in laboratory science. Read through the documents on Health and Safety, Making a drug and the Story of Pharma and make notes on all three.

Drugs | STEM

Topic 4: Electronic Structure in Atoms

A periodic table can give you the proton / atomic number of an element, this also tells you how many electrons are in the atom.

You will have used the rule of electrons shell filling, where: The first shell holds up to 2 electrons, the second up to 8, the third up to 8 and the fourth up to 18 (or you may have been told 8).



So, Lithium with its atomic number of 3 has 3 protons and 3 electrons or Li = 2,1

You will learn that the electron structure is much more complex than this, especially for the Transition metals. These more complex electron configurations can be used to explain the majority of an element's chemical properties. The 'shells' or energy levels can be sub-divided into orbitals, which are given the following letter: s, p and d.

You can read more about orbitals here:

atomic orbitals (chemguide.co.uk)

Familiarise yourself with this new way of writing electron configurations. For example, Lithium is: $1s^2$, $2s^1$.

a) Ca
b) Al
c) S
d) Cl
e) Fe
f) Ar
g) O
h) Ni
i) Zn
j) As

Topic 5: Chemical Equations

Balancing chemical equations is an integral skill in Chemistry and paves the way to being able to carry out much more complicated calculations with ease. There is a variety of many websites to help you remember how to apply this skill, here are a few:

ChemTeam: Balancing Chemical Equations

Balancing Chemical Equations (colorado.edu)

Q1 Balance the following equations

a. $H_2 + O_2 \rightarrow H_2O$ b. $S_8 + O_2 \rightarrow SO_3$

c. $HgO \rightarrow Hg + O_2$ d. $Zn + HCl \rightarrow ZnCl_2 + H_2$

e. $Na + H_2O \rightarrow NaOH + H_2$ f. $C_{10}H_{16} + Cl_2 \rightarrow C + HCl$

g. $Fe + O_2 \rightarrow Fe_2O_3$ h. $C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O$

i. $Fe_2O3 + H_2 \rightarrow Fe + H_2O$ j. $Al + FeO \rightarrow Al_2O3 + Fe$

Topic 6: Symbols and Prefixes

In Science, we use a variety of different symbols and prefixes to help us display very large or small numbers easily. You will have encountered many of these before and some you may be less familiar. Try to memorise the entire table and then complete the questions below.

Prefix	Symbol	Power of ten
Nano	**n**	**x10^{-9}**
Micro	**µ**	**x10^{-6}**
Milli	**M**	**x10^{-3}**
Centi	**C**	**x10^{-2}**
Kilo	**K**	**x10^{3}**
Mega	**M**	**x10^{6}**
Giga	**G**	**x109**

Q1 Solve the following:

1. How many metres in 2.4 km?
2. How many joules in 8.1 MJ?
3. Convert 326 GW into W.
4. Convert 54600 mm into m.
5. How many grams in 240 kg?
6. Convert 0.18 nm into m.
7. Convert 632 nm into m.
8. How many m in 11 km

Topic 7: Waves

In either GCSE Physics or Combined Science, you will have studied various different waves, whether transverse, longitudinal or electromagnetic. You will need to be able to use the wave equation to calculate the speed, frequency and wavelength in a variety of scenarios.

Use the following links to review and make notes on waves.

Waves - GCSE Combined Science Revision - AQA Trilogy - BBC Bitesize

Introduction to waves (video) | Khan Academy

Careers – Complete the following tasks

The T Level course in Y12 will aim to build you a confident picture of what it would like for you to begin a career in a working science laboratory. The Y12 curriculum will allow you an insight into the day-to-day activities of these labs and will prepare you for you 45-day placement in industry in Y13.

Visit the following websites:

Applied Science Jobs - May 2021 | Indeed.com

Explore roles | Health Careers

Bachelor of Applied Science Jobs | Career Trend

1) Create a wordle of the job titles that you have come across during your research. Aim to get a good range of different job types. Create Your Wordle - Wordle Creator
2) From 2 of the jobs you have found the most interesting, write a job description for each in the style of a job advert that you might see online or in a newspaper. Include the salary, qualifications and skills needed and what the activities in the job will include.
3) Write down what you currently think about what you would like to do after the T Level. Has anything changed after you have done your research?

Example job description - **Specialist Quality Assurance Technician**

Department: Pharmacy Salary: Band 6 - £31,365 - £37,890 per annum Hours: 37.5 HOURS PER WEEK

Brief Description of the Role:

We are looking for a pro-active, self-motivated individual with strong problem solving skills who shows a passion for improving and developing services to work in our small, dedicated team in pharmacy QA. This established role will suit an individual with good critical thinking skills, who has a background in the life sciences, microbiology, chemistry, pharmacy or engineering. The role is open to pharmacy technicians, however, this is not a pre-requisite, and individuals with relevant qualifications outside of pharmacy are also invited to apply.

The role involves providing a technical pharmacy service to both internal and external customers – primarily NHS Trusts. This will involve occasionally visiting other trusts (sometimes staying overnight) and undertaking physical and environmental monitoring tasks in pharmacy cleanrooms and radiopharmacies, therefore a good understanding of GMP and clean room behaviours is required. This role also involves a significant amount of manual handling.

On site, the role requires the management and processing of non-pathogenic microbiological samples, and therefore the individual will also need to demonstrate a clear understanding of GLP. This role also involves providing advice and support to customers, clinical hospital teams, and occasionally patients. The QA team advise on the use and safety of unlicensed medicines, the stability of medicines made in the licensed aseptic unit (and radiopharmacy), medicines defects, safe storage of medicines (GDP) and aspects of COSHH. The successful candidate will be expected to support all of these aspects as a primary part of their role. All necessary training will be provided. The post is also likely to include line management at a future stage.

Summary of Qualifications and Skills required:

• NVQ3 in Pharmacy Services or BTEC equivalent level qualification or MSc in Clinical Pharmaceutical Sciences or A suitable degree in associated science disciplines of chemistry or biology

• Diploma in Pharmacy Technology and Quality Assurance would be desirable, if the candidate does not hold this qualification they would be expected to undertake it during the first three years of work

• Knowledge of Good Manufacturing Practice, Good Distribution Practice and Good Laboratory Practice, including clean room behaviour

• Good verbal and written command of English and ability to follow written and verbal instructions

• Ability to work effectively under pressure

• Good communication/interpersonal skills

• Ability to manage staff and team workload

• Demonstrates a caring, compassionate and empathetic approach to work

• Ability to plan own time, use own initiative and act independently within the bounds of existing knowledge and skills

• Capable of working within a multidisciplinary team

• Computer literate

Laboratory Skills – Complete the following tasks

Throughout your first year of the T Level you will develop and apply you laboratory based investigation and practical skills in order to allow you a successful and rewarding industry placement and a smooth transition into your chosen career.

The foundation of the skills lies in you being able to fully comprehend the various health and safety aspects and legislation surrounding working in this environment. The following tasks are a part of Core Component A and will be assessed in your final exam. However, to have been exposed to this information prior to September, the following tasks will need to be completed.

Laboratory Safety

When working in a scientific environment one of the major aspects to take into account is safety. Many of the chemicals scientists work with could be considered dangerous, as are some of the procedures they follow, or pieces of equipment they use.

In a scientific place of work, a scientist must know about the dangers associated with equipment and chemicals or the risks involved with given experimental procedures that they undertake. This ensures a safe working environment for the scientist.

Equipment, chemicals, or in some cases the actual procedure used could represent a hazard. There are many different types of hazard. Each type has its own associated risk, for example: one may burn the skin on contact, whilst another may be a certain procedure that requires nitrile gloves and goggles. It is important for scientists to know about hazards so they can protect themselves against them.

For chemicals and other materials that we use during experiments, there is a method which uses symbols to identify the different types of hazard. The symbols can be bought on orange sticky tape, which can be stuck onto the bottles, containers or equipment which represent these hazards.

In a school the science technician will have labelled each material / chemical you use and your teacher will know the risk that each chemical represents.

In an industrial setting, scientists should be aware of all the different categories of hazard. Each of these categories of hazard, represent different risks to the scientist.

Task 1:

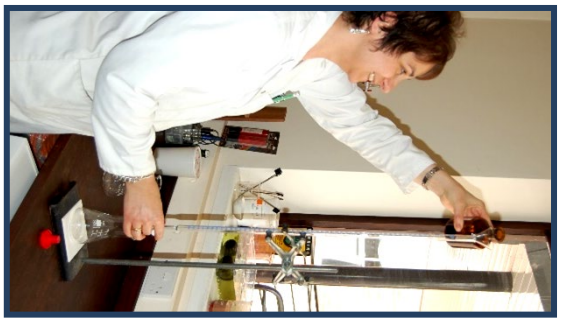
Research the different hazards that are found in the laboratory (school and industrial settings) Include information on:

- Hazard types (including categories)
- Effect of hazards
- Precautions when using these hazards i.e control and emergency procedures.

Technicians

One of the most important employees within a school science department is the science technician. If the department is large enough, there may be more than one technician.

There are many aspects to the role of science technician. This can range from preparing chemicals, to training teaching staff on particular scientific techniques.



In order for the technician to advise staff on different matters, they need to have knowledge of the chemicals and materials they work with, along with the hazard or risk the materials represent.

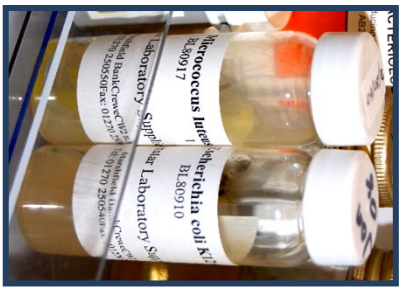
Laboratory technicians are trained to a high standard in terms of the practical skills needed to carry out their role. Within industry those skills can be limited to a very narrow field e.g. growing bacterial cultures on a variety of mediums. Within the school science department, the range of skills needed would be more diverse.

There are a number of companies and organisations out there that provide training or advice to science technicians.

Task 2:

Research the role of the science technician. You may wish to include:

The range of activities they undertake.
The safety guidelines they must adhere to, including CLEAPSS, COSHH.
Specific procedures they carry out regarding health and safety.
Training they undergo.



Reducing the Risk

When working in a scientific environment one of the major aspects to take into account is safety.

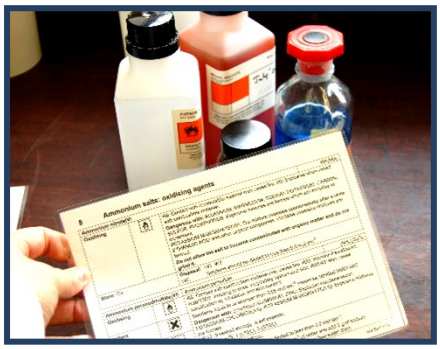
In order to reduce the risk a hazard represents, it is necessary to know as much information about the hazard as possible.

One source of information is the *Hazcard.*

Information about each chemical used within the science laboratory can be found in the Hazcard box within the technician's room. There is a hazcard for each chemical and biological hazard.

Remember - a hazard is something – a chemical, a procedure, or a piece of apparatus – that has the potential to be a danger to someone.

In school practicals, hazcards are issued with each chemical/ biohazard requested. They are an essential part of a risk assessment, and should be read before any practical work is carried out.



Risk Assessment

A risk assessment is a process of assessing the risk of an activity. This could mean ensuring you use gloves for certain concentrations of acid; or wearing goggles when handling certain chemicals.

The actions, as a result of a risk assessment vary considerably, however the purpose of all risk assessments remains the same – to evaluate the chance of harm, and take precautions to avoid such incidents.

Later in the course you will need to fill out a risk assessment form for each science investigation you do.

Task 3:

Research risk assessments and the use of Hazcards in science.

Your report should include:

What a Risk Assessment is.
- Where they are used.
- How they are produced.
- Examples of risk assessments you have produced.
- What a Hazcard is.
- Where they are used.
- How they should be used.
- What information they contain.

Practical Skills

The development and application of your practical skills will be integral to your study of the T Level. While we are unable to physically do practicals in a lab-based setting currently, there are a variety of resources online which allow you to complete these experiments following the same principles that you learnt in KS3 and 4.

Sign up to the link below delivered below by the Open University, which is entirely free to complete these activities.

Follow the instructions provided to you on each of the virtual labs to be able to fully engage with the tasks.

The Open Science Laboratory

The Open Science Laboratory: virtual microscope
The Open Science Laboratory: Analysing blood samples
The Open Science Laboratory: Elementary flame test
The Open Science Laboratory: DNA quantitation