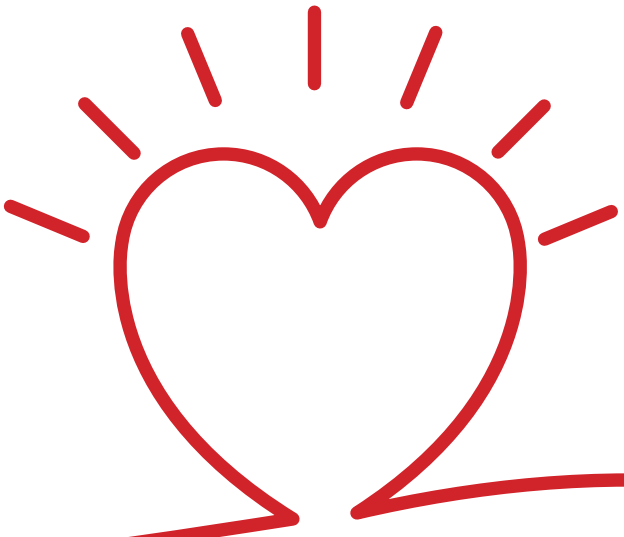
# UK Pharmaceutical Industry

## Introduction and Overview – as an opportunity it's breathtaking, as a career it's life-giving

Imagine touching the lives of millions of people everywhere. Imagine reaching beyond the ordinary. Imagine playing a key role in some of the most critical issues facing healthcare today – **imagination can come to life by working in the pharmaceutical industry and contributing to the next generation of medicines. New medicines that will make better health a reality for generations to come.**

Even at the start of the 21st century there are many diseases which cannot be cured by existing medicines and surgical treatment. The pharmaceutical industry meets this challenge by researching, developing and supplying new medicines. From antibiotics to the contraceptive pill, products that treat many common illnesses and ailments including allergies and infections through to heart disease and cancer – most of the medicines that are currently on sale originated in the laboratories of pharmaceutical companies. The industry is also responsible for the safety and effectiveness of the products it manufactures.

**Bioscience is destined to be *the science* of the 21st century.** Couple *the science* of the century with *the technology* of the century – digital technology – and the stage is set for maintaining pharmaceuticals at the forefront of healthcare systems in the developed world. As records are moved to digital format and this is coupled with enhanced media bandwidths, global communications and evermore powerful computers, the result will be more effective construction and interrogation of datasets. The nature of research, treatments and product development will alter at pace as pharmaceuticals becomes more integrated as a health management service for 'personalised medicine'.



The medicines that are available for doctors to prescribe are made, and most of them were discovered, by pharmaceutical companies. Pharmaceutical companies put a massive investment into research and development – put into context this comes to over a quarter of all UK industry–supported research. Historically the UK led the world in the supply of skills that support the discovery and development of new drugs. In fact, one in five of the world's top medicines were discovered and developed in the UK – more than any other country other than the USA. **So discovery and development of new medicines is still very important.** This importance can be highlighted by the fact that one fifth of the UK population has a chronic or long–term illness, and in people over 75 this ratio rises to more than half.

The pharmaceutical industry employs around 67,000 people and generates around another 250,000 jobs in related industries. It takes about 12 years for a new medicine to go through the tests that are required before it can be prescribed by doctors in the UK. During this time the medicine passes through a large number of tests. These are designed to check that the medicine will work in the disease it is intended for and that it will be safe for people to take.

# Examples of specialisms within the industry

In order to develop a new medicine, **scientists in the pharmaceutical industry work in multi–disciplinary project teams** to pool their knowledge of the compound they are working on. For example, *biologists'* identification of biological targets at which new drugs might act e.g. the enzymes or receptors involved in the disease, plus *pharmacologists'* awareness of how medicines interact with tissues and organs, and the *chemists'* understanding of molecular structure and properties – are combined with the specialist knowledge of those working in the area of drug metabolism, which is the study of the interaction between the body and the drug. This information is crucial to the understanding of whether or not a drug will be safe for use in humans and gives information about dose and possible side effects.

The following introduces some of the main specialisms involved in the pharmaceutical industry:

## Chemists

At the earliest stage of the discovery process, hit compounds are sought. Teams of *design and synthetic chemists*, working alongside *computational chemists, chemoinformaticians and screening biologists* will look to identify compounds that demonstrate signs of activity against the target protein.

*Chemical technologists* familiar with robotic or automated techniques may then design and make small quantities of hundreds of related chemical compounds in a hit–follow–up phase. Once a promising chemical series has been identified, new compounds are designed and then synthesised to enable further tests to be carried out to assess their suitability as potential medicines and to enable the most promising to be selected for more detailed studies. *Development chemists*, sometimes called *process chemists*, improve and scale up a synthetic route to produce the compound in much larger quantities to support pre–clinical safety studies and clinical trials.

# Case study

## Danny

Synthetic Organic Chemist

### Describe what your work involves

I am a bench chemist working in a laboratory and my role is to identify original design methods to synthesise new molecules. The compounds we synthesised would then be passed on to our biology colleagues for biological testing, and, hopefully, will one day become a drug.

### Why did you choose this type of work?

I have always enjoyed studying organic chemistry and also working in a laboratory. I relish the challenge of synthesising new molecules because there are always a number of possible ways to synthesise the same molecule. **There is a sense of achievement when you have succeeded in making a very complex molecule.**

### When at school, were you aware of the pharmaceutical industry?

I have to be honest to say that when I was at school, I really didn't know much about the pharmaceutical industry, but it was partly due to the fact that I didn't actively look into it as I wasn't sure at the time what I wanted to do

### How did you get started?

I have always liked science, in particular chemistry and biology, but it was at A level when I realised I wanted to study chemistry to a greater depth and that was why I chose to read medicinal chemistry at university. However, in my first two years of university study, I still wasn't sure whether I wanted to pursue a career as a synthetic organic chemist. It was only after I carried out a summer placement project at the university at the end of my third year (of a 4 year MChem degree) when I realised that being a synthetic organic chemist was what I wanted to do. That was when I started to do some research on the pharmaceutical industry and asked people at the university for advice.

### What is the importance of maths or science in your work?

**I can't really stress the importance of science and maths enough, they are crucial to what we do.** As a synthetic organic chemist, apart from being knowledgeable in chemistry, **being capable in maths is also very important** as it underpins much of what I do and is a key factor in understanding what's going on. Being appreciative of other areas of science like biology and physics also helps to give us a better understanding of how our work impacts on the whole project.

## What subjects did you study at school?

A broad range of subjects at GCSE followed by A level in Biology, Chemistry, Maths and Physical Education.

## What could you earn?

For chemists entering at the graduate level, they could be expected to earn around £23,000 per annum as a starting salary. For chemists entering at the PhD level, they could be expected to earn in excess of £33,000 per annum as a starting salary.

## What excites you most about your work?

The thing that excites me most about my work is the constant challenges that we are being presented with. In research, experiencing failures is part of the job because they occur on a regular basis, but there is often a lot to learn from failures which would give us a better chance of success the next time around. It is the sense of satisfaction that I get from solving a very difficult problem which motivates me most in my work.

## What tips could you give to someone who wants to enter this type of work?

I would say to people who want to enter this field that having the enthusiasm for science is perhaps the important thing. When I was studying science at school/university, I have always tried to relate the things I saw/used everyday to science, and vice versa. This is what drove, and still drives, my enthusiasm for science. It goes without saying that to succeed in this field, as it is with any other fields, hard work and dedication are essential. Being observant also helps because attention to detail is often the first step to solving a problem. Ground–breaking research often stems from people's curiosity, so don't be afraid to have many "what if's" in your mind. Finally, don't be afraid of failure, because that is research!

## How do you see the future for your area of work?

As synthetic organic chemists in the pharmaceutical industry, we have to look out for new developments in academic research and apply it to our own research, to primarily shorten the time it takes to synthesise compounds and/or to improve the efficiencies of the process. **I still see a bright future in synthetic organic chemistry because it is still one of the bedrocks of a pharmaceutical company** and we have a big part to play.

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Analytical chemists analyse a range of substances to define their chemical composition. They determine the identity and purity of samples that synthetic chemists make, solving problems relating to chemical structures, developing methods of checking concentrations, and ensuring the purity of a batch of medicine that is about to be released for sale. Analytical chemists are involved in developing new analysis methods, recording the data obtained according to strict guidelines, interpreting it and presenting their findings in written reports, scientific literature or in presentations. **Computers and specialist software packages are increasingly being used to handle data.**

# Case study

## Marie

Analytical Chemist

### Describe what your work involves

I work in Discovery Chemistry, where medicinal chemists synthesise new molecules in collaboration with biologists to create new medicines for various therapeutic areas. My main role is in Analytical Chemistry, where we purify compounds and check they are the correct structure, before they go to biological testing.

### Why did you choose this type of work?

I started as a technician after my A levels. I wanted to do something I found challenging, and be able to carry on with higher education whilst working. My company allowed me to complete a Masters degree through day release. I like to have variety in my day–to–day work, and be in a fast–paced environment which provides intellectual stimulation.

### When at school, were you aware of the pharmaceutical industry?

I was aware of the pharmaceutical industry during my GCSEs but didn't really have any idea what was actually involved until I started here at 18

### How did you get started?

I saw an advert in the local newspaper for a technician role. When I went to the interview I made sure the interviewers knew I wanted to do a degree on day release. Once I had completed my degree in Chemistry I was able to move into a more technical role, but the experience I had as a technician helped considerably.

### What is the importance of maths or science in your work?

**I wouldn't be able to do the job I do now without having studied science, especially chemistry and maths,** and having obtained good qualifications in those subjects. If I hadn"t done an A level in chemistry I wouldn't have been able to get the job as a technician, or get on my degree course.

## What subjects did you study at school?

I did chemistry, biology and physics as three separate subjects at GCSE, as well as the standard subjects. I did chemistry, biology and geography at A level. I did chemistry at degree level.

## What excites you most about your work?

I love the variety in my job, and the opportunities I have been able to get. By being proactive, I have been able to complete a secondment in another area, and I find it very rewarding to learn new things, so this has been a fantastic opportunity. I am not just involved in science, I have been a health and safety representative for my department, and done some project management too. **Being in the pharmaceutical industry means you are at the cutting edge of technology, and knowing you may work on a project that creates a new drug to combat a disease is very rewarding.**

## What tips could you give to someone who wants to enter this type of work?

You really need to get a degree, and do a year in industry at a pharmaceutical company, or have a PhD. Experience is really important. I was lucky to be able to start in a pharmaceutical company at 18 years of age and work my way up, I don't know of many other people who have done this.

## How do you see the future for your area of work?

Recent years have seen tougher times in the pharmaceutical industry, but there are still opportunities for bright and talented individuals.

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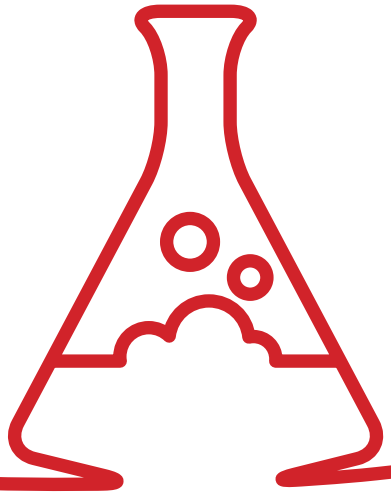
Physical chemists investigate the physical properties of compounds to enhance the effectiveness of new drugs and the chemical process used to manufacture them. As development of the potential drug continues, transfer of the process to manufacture takes place. Development chemists work with *chemical engineers* to devise methods to scale up the production of potential medicines which have been identified in research, to reach the levels needed for full scale manufacture.



# Case study

## Alan

Pharmaceutical Technologist

### Describe what your work involves

My role is overseeing the commercial scale manufacture of chemotherapeutic compounds, namely antibiotics. I support the manufacturing process by helping to resolve problems when they occur, implementing changes to increase manufacturing effectiveness and other project management.

### Why did you choose this type of work?

My career in the pharmaceutical industry started with microbiology bench work in a laboratory. I went into my current role as I wanted to gain experience in a different sector of the industry. Many of the materials I tested in the laboratory were used as components of the products we manufacture.

### When at school, were you aware of the pharmaceutical industry?

Yes, I was aware of the industry as an entity, however I didn't know then what my career path would be at that point. The relevance of the industry only became more apparent to me when I started at university.

### How did you get started?

Through third party job agencies post graduation. **I also undertook an industrial placement year in a microbiology laboratory as part of my B.Sc. This is an invaluable way of gaining precious practical experience** to compliment your theoretical knowledge learnt at university.

### What is the importance of maths or science in your work?

These disciplines are the bedrock of science. **I handle data sets daily, which require manipulation and statistical analysis to ascertain conclusions.** All scientists need to be numerate individuals, if not working with raw data directly, then to appreciate and understand the findings of fellow scientists publishing results in journals.

## What subjects did you study at school?

At GCSE level I studied Chemistry, Biology, and Physics as separate subjects. At A level I studied Biology, Geography, and History.

## What could you earn?

Remuneration in this industry is performance related. You can expect to earn around £23,000 starting off in a laboratory (with a degree). If you perform well, and your career progression is good, salaries well in excess of £30,000 plus are usual, with outstanding performers earning much more than this.

## What tips could you give to someone who wants to enter this type of work?

**The best way in to the industry is via graduate recruitment programmes.** The pharmaceutical companies are in the best position to cherry pick only the very best candidates, so the selection process is very competitive. You will need to hold an honours degree ( 2.1 or better), and pass a barrage of psychometric tests during the selection process, designed to assess whether you are the 'right type of person' in addition to your academic achievements. Use your careers advice service at university. They can help you with mock interviews to hone your technique.

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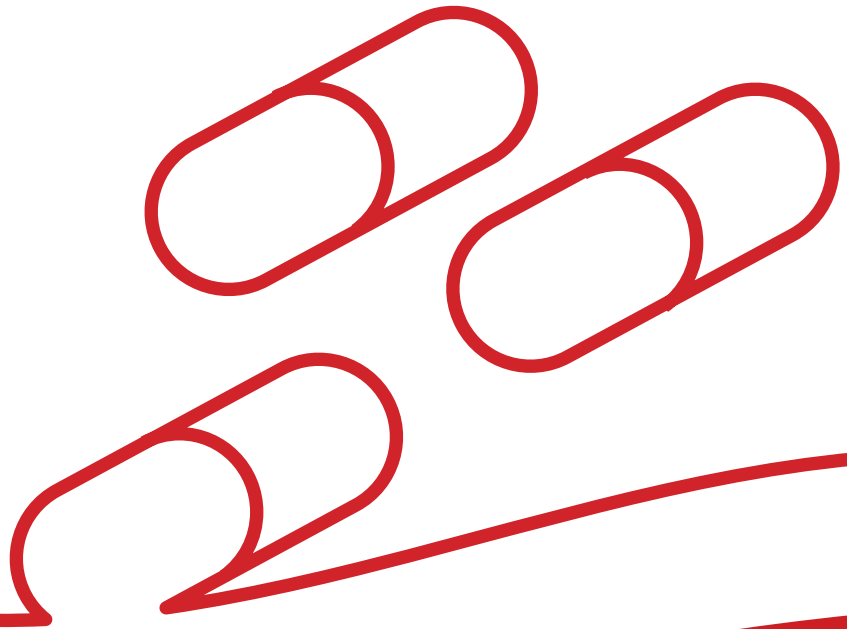
*Pharmaceutical chemists* are involved in designing how the medicine is made up, for example, in tablet, ointment or inhalation form. Pharmacists play a key part in the development, manufacture and marketing of new medicines. Examples of the different functions that pharmacists can work on include working out the right formulation for new medicines, making test batches for clinical trials, and preparing regulatory documents for approval by governments around the world.



# Case study

## Sonia

Pharmacist

### Describe what your work involves

I'm a pharmacist working in the pharmaceutical industry. I develop a 'recipe' for the ingredients, also known as excipients, that need to be mixed together to manufacture tablets for clinical trials (an essential stage in the 10 – 12 year development of a medicine from discovering it to making it available to patients). Each drug has different physical and chemical properties and so requires a different tablet 'recipe'. It's my job to apply my scientific knowledge and design experiments to develop a clinical formulation – and so in this way I'm a bit like a cook, but use tablet ingredients!

### Why did you choose this type of work?

It was tough deciding on a career in science at school because I liked Art, Literature, Sport and Music equally as much! However, **choosing a career in the pharmaceutical industry which makes medicines that help and improve patients' lives drives me tremendously, much more so than any of the other careers I considered.** Your career is something that you'll do for the best part of your adult life, so it's important to choose a field that motivates you enough to want to do it everyday!

### When at school, were you aware of the pharmaceutical industry?

No, not at all unfortunately. I didn't know about it until I went to university to study Pharmacy.

### How did you get started?

Being in the right place at the right time! I thought I'd become a pharmacist in hospital or the local pharmacy, but I happened to meet some industrial pharmacists at a conference who inspired me to give it a go for a summer.

### What is the importance of maths or science in your work?

It's incredibly important as I use science and maths every day.

### What subjects did you study at school?

Biology, Chemistry and Maths at A level.

### What could you earn?

Salaries in the pharmaceutical industry are competitive with other science careers. A 2008 survey of industrial pharmacists found that the median salary range was £70,000 – £80,000

### What excites you most about your work?

I am at the heart of an incredibly fast-paced industry working with and learning from experts in their fields on a daily basis. It can be challenging at times because developing a new medicine is difficult. But it's the small chance of discovering a new medicine that makes it through the laboratory, clinical testing and gets a licence to be prescribed that keeps it exciting and motivates me.

### What tips could you give to someone who wants to enter this type of work?

**Give it a go by trying to secure a placement during your holidays.** This snapshot will give you a real feel for whether you want to pursue a career in the pharmaceutical industry – and **if you like science, a fast-pace and working in teams to solve problems, the chances are that the adventures of developing a medicine is for you!**

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## Biotechnologists

Biotechnologists help to develop products that have a biological ingredient or action, such as vaccines, antibiotics, and hormones. They are at the cutting edge of biologics – the interface between biology and chemistry allowing finely tailored chemical and molecular design of drugs to be realised through biological control. **Underpinning the dramatic growth in the importance of biotechnology has been the human genome project,** which has led to the sequence of DNA for every single gene in a complete set of human chromosomes to be found. Greater understanding of the human genome will direct the development of medicines to help treat and prevent diseases.

Some biotechnologists are concerned with pure research, focusing on subjects such as:

- proteomics – studying the structure and function of proteins
- functional genomics – studying the function of individual genes

The growth of new genomics, proteomics, and bioinformatics technologies will greatly improve the speed of the entire drug discovery, testing, and approval process. In their work, biotechnologists design and conduct experiments, make observations and analyse data using sophisticated equipment and computer technology.

# Biologists

Once a pharmaceutical company has chosen which disease area to research, it must be studied to understand what the underlying problems are. A discovery team can then select a molecular target within a biochemical pathway, such as an enzyme or a receptor, where inhibiting or stimulating effects may lead to changes which result in treatment of the disease. Once the molecular target has been identified, it can be used to develop biological tests. These will be used to identify which chemical compounds interact with the target, each one that does is called a 'hit'.

The whole process is automated so hundreds or thousands of chemical compounds can be tested very quickly. Compounds may come from libraries that the company holds, may be based on existing medicines, or may have been designed to fit the target using computer modelling. From these, lead compounds are developed which represent the best chance of becoming a successful medicine. **One chemical compound will eventually be selected to be made into a medicine, but will need to be tested for safety and efficacy in cells, animals and ultimately humans.**

Biology specialists involved in research include *immunologists* who investigate the immunological system, how it is implicated in disease and how it might be manipulated to treat disease. *Cell biologists, enzymologists, biochemists* and *pharmacologists* are also likely to be involved in early research on potential new medicines.

## Pharmacologists

Pharmacology is the study of how chemicals affect the body. Through their research pharmacologists help to discover new medicines to treat diseases and ease pain, and work to ensure that they are used safely and effectively – **the role is vital to the advance of medicine.** Pharmacologists may:

- design tests to study how medicines or drug compounds affect cells, animals or humans
- model experiments by computer simulation
- supervise laboratory tests
- write scientific papers
- present their findings to colleagues

The work involves collaboration with other scientists, including other biologists, chemists and toxicologists. Pharmacologists use cells, animal tissues and whole animals to predict what effects a potential medicine might have in humans. Compounds that have been selected to have the best chance of becoming a successful medicine will be tested *in vitro* (which may involve living cells or tissues cultured in the laboratory) and *in vivo* (tests using live animals). The animals used for in vivo research are cared for by specialist animal technicians and vets. All work involving animals is strictly regulated through the Animals (Scientific Procedures) Act in the UK. **The law ensures that the animal houses, laboratories and animal care procedures meet very high standards.** These tests include measures of effectiveness and safety as well as for duration of effect.

### Toxicologists

It is important to find out if a potential new medicine has any side effects as soon as possible during its development. Safety pharmacology and toxicology tests are carried out to check for adverse effects. Biological scientists may specialise in toxicology through postgraduate courses.

## Clinical trials

Clinical research is the longest stage in the process of developing a new medicine, and the most expensive. All new medicines are thoroughly tested before they are marketed to ensure they are safe and effective for patients. Clinical trials are carried out in three phases which must all be completed before an application can be made to market a new medicine. Initial tests on a small number of closely monitored human volunteers are carried out to establish the dose that is likely to be effective in patients. Phase II studies are carried out in a few hundred patients to see if it works as a treatment for the disease, and phase III trials involve thousands of patients and are designed to gather evidence to check effectiveness in a wider population and to more fully understand the safety profile of the medicine.

Further trials may be carried out post–marketing to gather additional data on the long–term benefits, or to include recommendations for use in special groups, such as children.

Clinical studies are organised by clinical research associates, working with medically qualified doctors and company scientists. The data collected must provide evidence of safety, effectiveness and benefit to patients, so statisticians are involved from initial planning of studies through to interpretation of results. All the data on a new medicine has to be brought together and submitted to regulatory authorities to seek approval to market the medicine. This is done by scientists working in Regulatory Affairs.

## Manufacturing and Supply

Medicines are manufactured in two stages; firstly the active pharmaceutical ingredient is made, then the actual tablet, capsule or other dosage form is created. It is essential that every tablet contains exactly the right dose of a medicine and that it is of high quality. Packaging of the medicine also needs careful consideration to ensure that the medicine is protected from light and moisture and has a reasonable shelf life.

Many scientists and engineers are involved in the manufacture and supply of medicines, especially *chemists, pharmacists, chemical and process engineers. Manufacturing and packaging operatives* also have a responsible part to play; if a batch does not meet the specification it can cost the company many thousands of pounds.

The work of industry scientists is mainly carried out in laboratories, but they may also spend time in offices or manufacturing sites. Some scientists travel internationally to present findings and attend conferences.

# Sales and Marketing

Within the commercial side of a company there are a large number of people working towards promoting the medicines their company produces. Prescription medicines are not allowed to be advertised to the general public in the UK. Instead they are promoted to doctors, who then choose whether to prescribe them. Adverts in medical journals, conferences and presentations tell doctors about the medicine, but most information comes from medical representatives. Medical representatives visit doctors on a regular basis to tell them about their company's new products, and to answer any questions they have. They must have a good knowledge of the products, and how they work, to be able to discuss them with doctors. Many medical representatives have science qualifications. Sales managers, health economics experts, healthcare communication professionals and product managers all work together with the aim to promote new medicines for the benefit of patients. People working in pharmacovigilance monitor side effects in marketed products.

# Case study

## Emma

Pharmacist

### Describe what your work involves

I process Adverse Event case reports arising from problems suffered by patients that have been identified with marketed medicines. These come from a wide range of sources and all require assessing, entering onto the central database and reporting. I also prepare Periodic Safety Reports – legally required documents reviewing the on–going safety of our products.

### Why did you choose this type of work?

I preferred the more developmental side of the pharmacy area and always wanted to be more involved in making sure that appropriate drugs were available to pharmacists in hospitals and the community.

### When at school, were you aware of the pharmaceutical industry?

Through relatives who worked in it, but I was not aware of the scope or the variety of jobs that were available within the industry.

### How did you get started?

I qualified as a pharmacist and then started temping in a Pharmacovigilance Department (which is responsible for the detection, assessment, understanding and prevention of adverse side effects from medicine). As soon as a permanent position came up I applied and got the job.

### What is the importance of science or mathematics in your work?

**I use my scientific knowledge of biology and chemistry every day** when looking at adverse event cases, as knowledge of how the active ingredient works helps me to understand the events the patient suffered and how likely our drug is to have caused this.

### What subjects did you study at school?

Geography, Biology and Chemistry at A level.

### What could you earn?

Up to around £60,000

### What excites you most about your work?

The knowledge that my work makes a difference to people receiving our products.

### What tips could you give to someone who wants to enter this type of work?

I didn't know about Pharmacovigilance before I worked in it, **so contact companies and learn as much as possible about all the departments that they have. It might lead on to a job you love!**

### How do you see the future for your area of work?

Pharmacovigilance is always increasing in importance as Safety is an important aspect of pharmaceuticals. The potential to be involved in many different projects is exciting and **being in an area of growth means I should have a secure career.**

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## The importance of STEM subjects, skills and personal qualities

The *'Skills Needs for Biomedical Research' report (ABPI survey 2008)* found that companies were seeking ***"people who have studied scientific subjects, engineering or maths at school, college and university. These are the core disciplines in demand within the pharmaceutical and biopharmaceutical industry.***" This message was reinforced by the Confederation for British Industry (CBI) survey, *('Taking stock: CBI education and skills survey, 2008)* which found that six out of ten employers are having difficulty in recruiting enough STEM–skilled individuals to meet their needs, and a third of firms were concerned by the shortage of STEM graduates.

The number of students studying chemistry, biology and maths at A level or equivalent has been rising over the last five years, and increased numbers are entering higher education. However, **the percentage of students taking these subjects is low: in 2008 only 5% of total A level entries were for chemistry, 6.6% biology and 7.8% maths.**

Companies look to employ people highly motivated by **practical activity, which can often be encouraged through undergraduate industrial placements.** The personal qualities most sought by employers include team working, problem solving, and communication skills – and work experience or industrial placements on sandwich degree courses often help young people to develop these important employability skills. Many degrees are now 4 year courses and lead to a masters qualification. These often allow a student to work in industry for a year or part of a year. These courses will enable the student to develop many of the skills required by industry, particularly practical skills, and will provide an advantage over others when applying for jobs in industry.

**Some pharmaceutical companies recruit a small number of apprentices,** often in manufacturing or engineering areas, but also a few in laboratory areas. All apprenticeships include day release for further study, often leading to BTEC National or Higher National qualifications, with the possibility of progressing to an Honours degree.

The ABPI report from 2005, *'Sustaining the skills pipeline in the pharmaceutical and biopharmaceutical industries'* recommended the development of a **Diploma in Science** aimed at 14 – 19 year olds. The Foundation Level (equivalent to 5 GCSEs grades D to G) and the Higher Level (equivalent to 7 GCSEs grades A* to C) will be available from September 2011, and the Advanced Level (equivalent to 3.5 A levels) will be available from September 2012. The Diploma will aim to enhance the mathematics capabilities of science students, and also help to meet the pharmaceutical industry's need for young people with high levels of practical skills and the ability to apply scientific knowledge.

The lack of mathematical skills is often a factor in rejecting applicants for a role in industry *('A review of science–based skills requirements in research & development and manufacturing at Pfizer', April 2007).* Interpretation of data and application of mathematical skills are important, and companies cite the **lack of maths skills in candidates as worrying**. Mathematical modelling techniques are increasingly a core part of the development of a new medicine, for instance within computational science, bioinformatics, and medicinal chemistry. The review also points out that an **understanding of statistics is vital to many areas of drug development**, and a lack of knowledge in these areas is a barrier to recruitment. Demand for statistics skills will increase with moves towards personalised medicines.

For links to potential pharmaceutical recruiters of apprentices, work experience placements, industry/sandwich placements, and graduate training programmes, access the ABPI (Association of the British Pharmaceutical Industry) site – http://abpi–careers.org.uk/getting–into–industry/pharmaceutical–recruiters/pharmaceutical–recruiters

Details of degree courses can be found on the Universities and Colleges Admissions Service (UCAS) website – www.ucas.ac.uk

Information about the new Diploma in Science can be found via – http://www.sciencediploma.co.uk/

# Mythbusters

## 1. There is an over-reliance on in vivo tests (i.e. using live animals)

Over the years researchers have identified many ways of replacing, reducing and refining animal research, such as:

- replacing some research in animals with computer simulations and in vitro techniques, where tests are done on individual cells, cultures or tissues
- applied statistical methods to research, so that there can be more confidence in results obtained using many fewer animals; a mathematical model can be used to stimulate 'what if' scenarios to begin to translate what we expect to happen in humans
- introducing the use of biological imaging that can track physical and chemical changes caused by treatment over time in the same animals, instead of comparing treated animals at different stages with a population of control (i.e. non–treated) animals; imaging techniques can also provide data on biomarkers of disease, providing an efficient way to accurately evaluate the effectiveness of some new medicines

## 2. Much time is spent on repetitive analysis

Multiple experiments are very repetitive, but now robotics is used extensively, as these systems are more effective and efficient than using humans. Robotics enables the humans to focus on the more cutting edge work to ensure the development of pharmaceutical solutions.

# Positive reasons for taking a Bioscience related degree

When people employed in the pharmaceutical industry are asked what motivates them, the answer is usually – **to make people's lives better, as not many jobs offer more of a chance to do this**. To continue to produce new medicines to treat and cure the diseases which still cause suffering and death throughout the world, the pharmaceutical industry in the UK needs highly motivated and skilled individuals – to improve the quality of life of millions of people throughout the world.

**For people who want to make a real difference, there are opportunities to research into diseases of the developing world.** This can lead to the discovery, development and availability of new drugs and vaccines for treatment or prevention of diseases of the developing world, primarily the World Health Organisation's three priority diseases: malaria, HIV and tuberculosis.

Sir James W. Black (1924 – 2010) – Nobel Prize winner for Medicine in 1988 (Image courtesy of the University of Dundee)

**Sir James W. Black (1924 – 2010) – Nobel Prize winner for Medicine in 1988**

Sir James Black is an example of someone **working in pharmacology who has made a real difference to millions of people's lives.** Black was a Scottish doctor and pharmacologist, who joined ICI Pharmaceuticals in 1958 and developed the drug propranolol, a beta blocker used for the treatment of heart disease. Propranolol became the world's best–selling drug, and its discovery was hailed as the greatest breakthrough in the treatment of heart disease since the 18th century and has benefited millions of people. In 1964 Black joined Smith, Kline and French and developed his second major drug, cimetidine, which was used to treat stomach ulcers – this outsold propranolol to become the world's largest–selling prescription drug. He was awarded the Nobel Prize for Medicine in 1988 for work leading to the development of two life–enhancing drugs and his contribution to pharmacology in the 20th century.

## What's new, and what are the future prospects?

The *'Life Sciences & Pharmaceuticals: Future Skills Review' (Cogent, Semta & Skills for Health SSCs, 2009)* concludes that **the emerging technologies in the pharmaceutical and biotechnology sectors have significant growth potential**, with new demand for new treatments and replacement demand for out–moded technologies and products. The age profile of the workforce suggests a **significant workforce replacement demand due to retirement in the years leading to 2020.** The net effect is predicted to be stable employment overall, provided the UK retains capability in the emerging technologies.

The pharmaceutical industry of the future will need to meet the challenge of a rising global population. In the developed economies the ageing population will lead to increased demand for healthcare, especially for the diseases of old age – such as diabetes, dementia, cancer, arthritis.

Translational medicine is a key step between basic scientific research and patient care, translating scientific discoveries into real therapies and medicines. This discipline is becoming **increasingly significant in the pharmaceutical industry as focus moves to a more patient–driven approach to drug development.**

There is an **increasing demand for computational scientists who use mathematical modelling techniques to build hypotheses for drug targets.** The use of computational science and bioinformatics allows large data sets to be collected and analysed quickly – therefore increasing the need for candidates with mathematical modelling skills and the ability to analyse large, increasingly complex biological and chemical data sets.

**The development of stem cells for therapeutic purposes, including cell therapy and regenerative medicine, is emerging as a major field of pharmaceutical research.** Stem cell technology is also making in–roads in drug discovery. This technology offers great potential for understanding disease mechanisms and identifying targets, and for effective toxicology screening.

# Websites and links to classroom resources

**Association of the British Pharmaceutical Industry (ABPI)** – http://www.abpi-careers.org.uk – Dedicated careers website for the pharmaceutical industry aimed at young people. Includes case studies of industry scientists and a resources section where leaflets such as – *'Life enhancing careers – careers for scientists in the pharmaceutical industry'* – can be ordered.

http://www.abpischools.org.uk/– This website provides an invaluable link between science topics studied in school and their applications in industry and research.

http://www.atworkwithscience.com – This site is mainly aimed at teachers and students at Key Stage 4 and in post-16 education. Includes classroom activities to help to bring alive some of the issues and processes related to the pharmaceutical industry.

**The Design Studio** – http://thedesignstudio.rsc.org/ – An interactive assignment challenging A level students to design a medicine

**AstraZeneca** – http://inspiringcareers.co.uk/career-opportunities/career-profiles/ – Career profiles that provide examples of the differing opportunities available in a pharmaceutical company

**Cogent** – http://www.cogent-careers.com/careerpathways/flash?industry=phamaceuticals – Includes role profiles and case studies of people working in manufacturing

**British Pharmacological Society (BPS)** – http://www.bps.ac.uk– The BPS provides free information on careers in pharmacology, including the CD Rom – *'Careers in Pharmacology'* – which is aimed at 14 – 18 year olds.

**The British Toxicology Society** – http://www.thebts.org/index.php?content=1i – Website designed for toxicologists and includes a careers advice section.

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