UNIVERSITY OF LEEDS

Medicine – not just about medics

with STEM at the University of Leeds

Why study science, technology, engineering or maths (STEM)?

Medicine is a field which interests many students, but not everyone will become a doctor. Medics are not the only essential people involved in medicine – teams of scientists, engineers and mathematicians work alongside, helping them to understand the spread of disease, find better treatments and cures, and develop technology for more accurate diagnoses.

How can STEM degrees link to the field of medicine?

Know your options

These case studies are about looking at your science subjects in a new way, introducing you to areas you may not have experienced before, and thinking about whether a STEM subject (some of which can lead into medically related fields) could be the right path for you and your career.

For those who are considering a medicine degree, it's common knowledge that medicine is very competitive – the University of Leeds alone has eight applicants per place for its medical degrees, and can generally only accept students predicted to achieve AAA at A-level (or ABB if coming through the University's Access to Leeds scheme), along with good GCSE results and impressive non-academic achievements. All students applying to medicine are advised to consider their extra UCAS option and think about a back-up plan should they not gain entry to a medicine course.

Higher education courses in STEM

There are a wide range of degree courses that you might find interesting and which can lead into worthwhile careers. This includes areas such as:

- food science and nutrition
- human physiology
- mathematics and statistics (mathematical biology)
- medical biochemistry
- medical engineering
- medical microbiology
- medical sciences
- medicinal chemistry
- microbiology with immunology virology
- nanotechnology
- neuroscience
- pharmacology
- physics (bionanophysics/ medical physics).

How well do you know your human anatomy?

An NHS pathology lab can get very busy. We commonly use a variety of dyes to stain microscope slides in the laboratory in order to demonstrate different cell structures and organelles. Investigating which parts of the body various stained cells or tissues originate from, using microscopes, can be part of the job.

About Chloe

I graduated in July 2015 with a first-class honours BSc Medical Science degree from the University of Leeds. I took a lot of opportunities throughout university to gain as much experience as possible in different areas. I did an industrial placement year working in STEM outreach for both the University and West Yorkshire's STEM ambassadors network. In my final year, I completed a lab-based dissertation looking at indications of subfertility/infertility on the surface of sperm cells – it's something only a few other people had ever looked into before! Work on this could have a huge impact on the future diagnosis and treatment of infertility.

I studied biology, chemistry and psychology at A-level, with mathematics at AS-level, and came to Leeds through the Access to Leeds scheme. I was always interested in the human body and diseases that can affect it, alongside how they can be treated and diagnosed. After following what I enjoyed through secondary school, sixth form and university, I'm now applying to become a physician associate, who assists GPs or hospital doctors in diagnosing and treating patients.

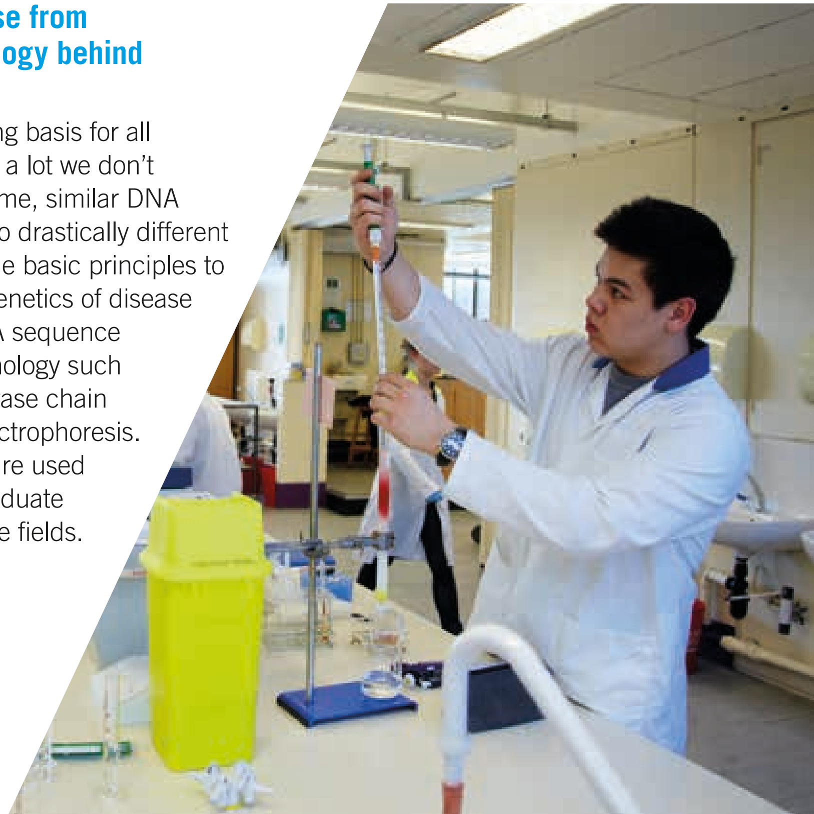
About Zee

I am a Biomedical Scientist employed at the Department of Histopathology at an NHS hospital in West Yorkshire. I attended The Grange School, Bradford where I developed a keen interest in biology and chemistry. After completing my GCSEs and A-levels, I studied biomedical sciences at Bradford University and went on to to achieve a Masters degree from Sheffield Hallam University, as well as a Specialist Diploma in Cellular Pathology from the Institute of Biomedical Sciences.

My job involves handling patient biopsies and tissues that have been removed to test for particular diseases or illnesses. My daily duties include preparing the tissue for suitable analyses and ensuring the correct tests are carried out accurately.

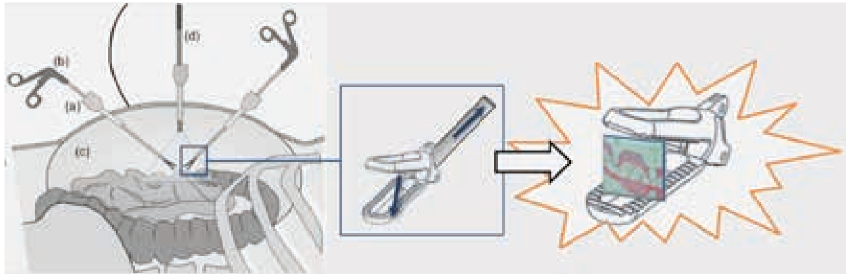
Diagnosing disease from DNA – the technology behind the tests

DNA is the fascinating basis for all life, however there is a lot we don't know. At the same time, similar DNA mutations can lead to drastically different symptoms. One of the basic principles to understanding the genetics of disease is looking at the DNA sequence in detail, using technology such as PCR (the polymerase chain reaction) and gel electrophoresis. These experiments are used throughout undergraduate courses in bioscience fields.



Getting a grip on surgery with science and engineering

Imagine trying to eat your lunch, on a covered plate, with chop sticks, through a small hole, with only a video of your plate shown on a computer in front of you – this is the kind of problem a surgeon faces everyday while performing laparoscopic keyhole surgery.



Keyhole Laparoscopic surgery – the surgeon uses long instruments through ports

Graspers are used to grip tissue and move it around …

… but grip too hard and the tissue gets damaged

About Ashley

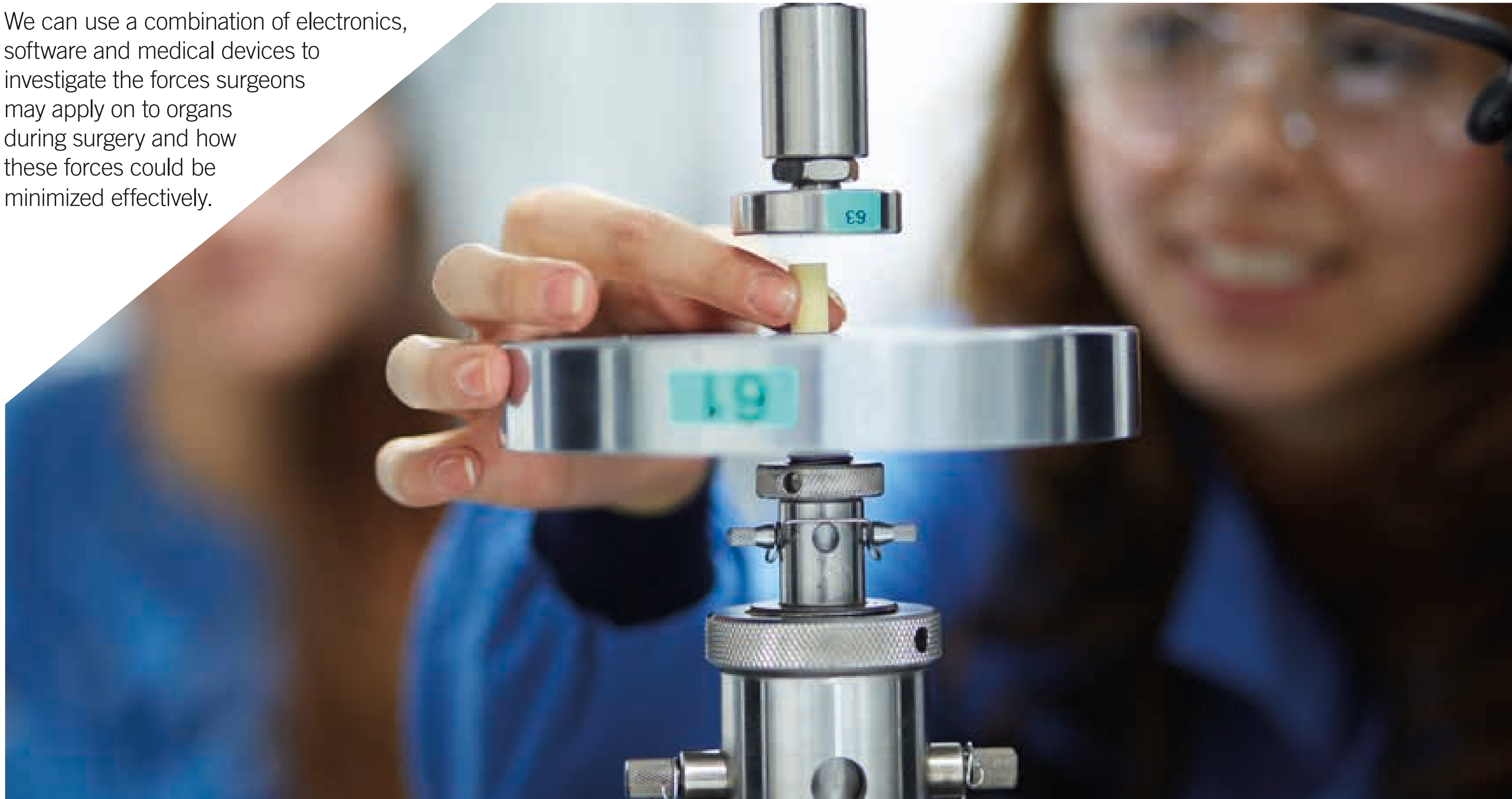
I completed a PhD in the School of Mechanical Engineering at the University of Leeds.I always loved science at school, so I studied all three sciences at A-level as I wanted to become a GP or doctor, but I discovered a passion for physics which I decided to study at University. I really enjoyed lab work and research, which led me to look for a PhD position.

The project I worked on aimed to provide reversible adhesion between devices and tissue during surgery, by mimicking the way a tree frog walks on a wet surface. This project was mainly experimental with some modelling to describe how the surfaces stick together. The project really interested me as it allowed me to continue with experimental work and look at the underpinning physics involved while having a medical application which will hopefully one day help surgery advance.

Modern surgery increasingly uses minimally-invasive surgical (MIS) techniques, known as keyhole surgery. In MIS the surgeon operates on tissues using a camera and long instruments inserted into the body though small access ports.

The advantages of MIS are substantial, including faster recovery and fewer complications for the patient; however, the long instruments make it difficult for the surgeon to feel the tissues inside the body. This is a particular problem with surgical graspers, which are plier-like instruments used in place of the surgeon's hand to hold and move tissues. Appropriate use of the graspers is crucial, but difficult, for the surgeon to achieve. Grasping or pulling too hard causes tissue damage with potentially fatal consequences for the patient, but grasping too lightly risks the tissue slipping – complicating and lengthening the operation.

We can use a combination of electronics, software and medical devices to investigate the forces surgeons may apply on to organs during surgery and how these forces could be minimized effectively.



Allergen detection: looking for a needle in a haystack

Food allergy affects about 1% of the UK population and is usually caused by unusual proteins found in our food. These proteins are often very difficult to digest and can find their way into our bloodstream. Once inside our body, our immune system raises the alarm by triggering rapid inflammation response (redness, heat, pain and swelling). This response to a food allergen can be very serious and at the moment the best way to prevent an allergic response is to avoid eating the culprit food. Easier said than done! Detecting food allergens can be very difficult due to their low levels in processed foods. We use antibodies (proteins already found in the body that bind to other proteins in a very specific way) to detect these allergens in food. By joining the antibodies to a colouring reaction we can see the presence of allergens in a solution.

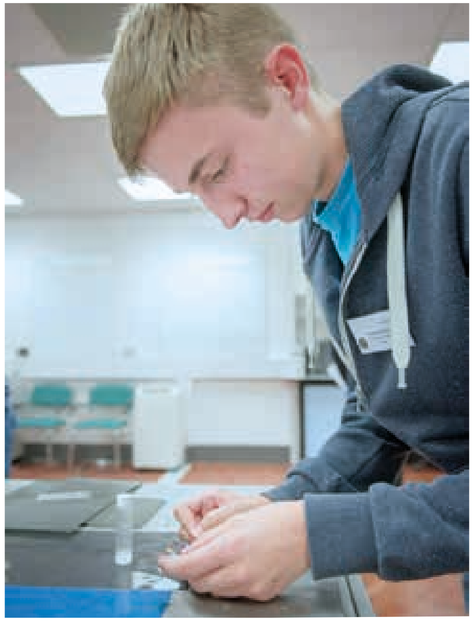
About Caroline

Dr Caroline Orfila is an Associate Professor in Nutrition and a registered nutritionist.

In the School of Food Science and Nutrition we have expertise in the detection of all kinds of food antigens, including egg, milk, peanut and shellfish. We also have antibodies for detecting other nasty molecules in foods such as aflatoxins (cancer causing molecules found in mouldy nuts and rice) and cyanogenic glucosides (found in apple pips and almonds). Food science and nutrition is a multidisciplinary subject that allows you to explore the role of food in not only preventing, but also causing disease.

Analysis of blood plasma to detect a possible drug overdose

Chemists play a vital role in the design of new drugs to combat illness and disease, which is a huge area for both research and industry. However, drugs aren't always used for positive effect and can cause great harm, even death if used incorrectly. Forensic scientists specialising in chemistry use a range of analytical techniques to detect and identify drugs in the body. By testing the level of a drug in the bloodstream, for example using UV-vis spectroscopy or high-performance liquid chromatography, they can work out if it was the cause of death and if a crime has been committed.



About Sam

I went to a high school in Rochdale and achieved 11 A–C GCSE grades including dual award science (AA), and then Oldham Sixth Form (where Brian Cox went) and got three A-levels in electronics, chemistry, and maths with statistics. This took me to the University of Huddersfield to study chemistry. During my year in industry I worked with P&G who make Ariel, Gillette and Lacoste perfumes amongst others. I finished with a first-class Masters of Chemistry (MChem) and then started a PhD at the University of Leeds.

My PhD research project attempted to make smart textiles. This means putting electronics onto your clothes. We hope that in the future vests can be made to monitor hospital patients to make nurses' jobs easier. This would allow patients to go home earlier because computers could be used to send information to nurses and doctors.

In my project I tried to use polymers instead of copper wires. Polymers are things like plastic bags, fibres in your clothes and rubber. Everybody knows that rubber does not conduct electricity, but my job was to make a polymer that is bendy and would conduct electricity as well as a metal.

Microbubbles

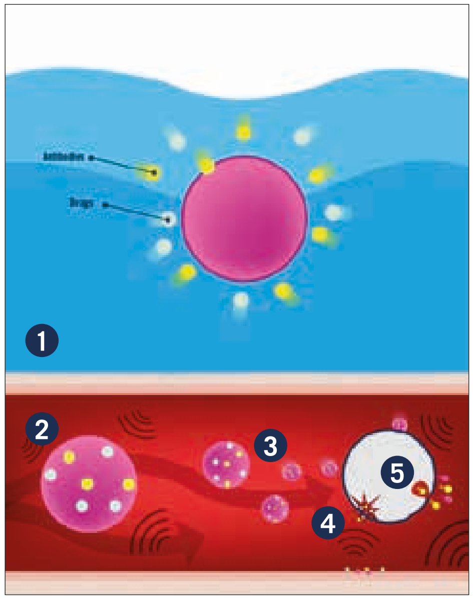
Imagine a soap bubble that's 100th the size of a human hair – that's a microbubble. Developed in the 1990s to help improve the clarity of ultrasound, microbubbles have a gas core and a surrounding shell that reflects ultrasound waves better than tissues, so it's easier to see what's happening in the body when microbubbles are injected into the bloodstream.

At the University of Leeds, a diverse group of experts have made the University a world-leader in microbubble production. Scientists started thinking, 'if these bubbles can safely travel around the human body, let's get a drug to hitch a ride and be dropped off exactly where we want it to go'. So, the next generation of microbubbles will be used to deliver drugs directly where they need to go! By delivering small doses directly to a tumour, more powerful drugs could come into use and be personalised to a patient on the spot, thanks to a portable device, the HORIZON, developed at Leeds.

We need to consider different parameters when making a microbubble to specifically target a disease in the body. This means optimizing the bubble size, delivery method, types of drugs to include and shell material to make the best microbubble for the situation. It's no easy task!

How a microbubble works

1. 10 million drug-carrying microbubbles are mixed with water and injected into a patient.
2. Because gas in the bubbles produce a different resolution to tissue, ultrasound can track bubbles until they get to where they're needed.
3. The antibodies on the bubble are attracted to a cancer tumour, making the bubbles congregate in the correct place.
4. Ultrasound agitates the bubbles and makes them burst, releasing the drug.
5. The waves also agitate and temporarily rupture a cell's membrane long enough for the drug to get inside.



About Adam

I went to school and college in South West London, always splitting myself between science and art. After receiving a distinction-level Foundation Art diploma from Kingston University, I decided to return to science to study nanotechnology at the University of Leeds where I obtained a first-class degree. After working on nanotoxicology in the School of Chemistry, I took up a molecular and nanoscale physics PhD project, between the universities of Leeds and Sheffield, based in the School of Physics and Astronomy. It covers the microfluidic production of microbubbles towards hydrophobic drug delivery.

About Seb

I grew up in Bradford, and after GCSEs I studied A-levels in chemistry, biology, history and philosophy. From this point I went to the University of Manchester to do a chemistry degree with a year in industry. During my industrial placement I worked at a company called Syngenta that develops pesticides for use in agriculture. After finishing my Masters in Chemistry with a first-class degree, I moved to the University of Leeds to start a PhD.

My PhD project is focused on finding new ways of performing chemical reactions. Currently, the chemical industry uses large amounts of very expensive (and sometimes toxic) metals, such as palladium, rhodium and even gold, as catalysts in chemical reactions. I am trying to develop methods that don't use any of these costly precious-metals but still give the same results; in particular using UV light as an alternative 'reagent'. This means that chemicals such as pharmaceuticals will be cheaper to make, and the cost to people will be lower.

NOTES

Find out more

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