Dr. Liz Sockett – scientist – FAQs

What sort of science are you involved in?
I work on microscopic swimming bacteria (single-celled creatures) that have tiny propellers called flagella. Tiny motors inside the bacteria make the propellers go round and round, allowing the bacteria to swim through liquids. In my lab we are trying to find out what the motors are made of and how they rotate. We also look at why it is an advantage for these bacteria to be able to swim. We know that some pathogenic (disease- causing) bacteria use their ability to swim to invade the human body and cause illness. Other bacteria are useful to humans because they swim to find waste substances which they then eat, so they actually clean up water and soils.

Who do you work with?
There are several full time scientists in the lab and we also work with scientists who visit us from other labs. Some are experienced and others are training to be scientists, studying for PhD degrees so that they can become "doctors" in science. In the lab at the moment are:

- **Matt and Karen** who are working on the flagellar propellers of bacteria called *Rhodobacter* (meaning 'red bug') that live in ponds.

- **Julie** who is working on swimming bacteria called *Pseudomonas* that can cause wound infections. She works alongside **John and Adrian** from the maths department. They are modelling what happens in infected wounds. John has been learning some of the science, too.

- **Carey** who is studying swimming bacteria called *Bdellovibrio* that chase and eat other bacteria. These could be very useful in treating infections.

- **Kate**, from the engineering department, who is working on bacteria that can "digest" waste oil from drilling rigs.

- **Marilyn** who helps us to maintain the lab and to prepare some of the chemicals that we need to do our experiments.

In addition "project students" from the University come into the lab for 6-9 months to do some experiments and learn practical science while they study for their degrees. It's a friendly atmosphere in the lab - most people who work here are in their 20s or 30s.

What is life like in the lab?
We work hard but we're not always very serious! Most people have started work by 9.30 am and everyone has normally left by 7pm. The day usually starts with a look at the results of experiments we've set up the day before, checking if bacteria have grown on petri plates, seeing if DNA sequencing has come back via e-mail, looking at cultures down microscopes, checking if the chemicals we need have been delivered and many other things. We sometimes have the radio on to get us going, but if people need to concentrate on something tricky, we turn if off. People often joke about the mess on someone's lab bench, or how difficult it is to get a particular experiment to

work, or chat about who won the badminton match last night or what people did at the weekend.

Lunch might be chips in the canteen or a sandwich while listening to another scientist talking about their work at a seminar. Once a week (or more often if it's somebody's birthday,) we have lunch at the local pub with people from neighbouring labs. (We don't drink too much though as there are safety rules about drinking and lab work!)

What sort of place do you work at?
I work in the Institute of Genetics at University of Nottingham. Some scientists work in companies or research institutes where all they do is carry out experiments. I enjoy working in a university as part of my job is explaining science to others as well as running science experiments in the lab. Sometimes I meet genius students, far brighter than me, who may go on to be world famous scientists. Most of the time I'm teaching those who will go on to all sorts of jobs, some in science and some outside science. I enjoy my contact with all of them and I'm glad that university science gives me a job that involves people as well as bacteria, DNA and test tubes.

We're lucky in the Institute of Genetics as the scientists in the neighbouring labs all do other interesting things with genes, DNA and proteins. This means that we can all help each other by sharing new methods and ideas.

Did you always want to be a scientist when you were at school?
No, not really. I used to enjoy lots of subjects including languages, history and geography, but I began to find biology more and more interesting as I learned more about it. So I started looking into what you needed to do if you wanted to have a career in biology. I found that it was a good idea to do some kind of biological degree at university. I read that you should study chemistry & physics too, so I did those for my A levels (even though I didn't really like physics at all!). I've found that the languages I did at 16 are still useful when I go to foreign conferences and when we work with labs abroad.

Looking back to when you were younger, did you have any hobbies and interests that made you interested in the sort of scientific work that you do now?
Yes several things:

Dinosaurs When I was tiny I loved dinosaurs and stories about them. They were always a mystery as, being extinct, you knew you'd never be able to meet one face to face! These days working on bacteria gives me a little bit of the same feeling. Bacteria are very tiny so you can't meet one face to face, you can only see them at the end of a microscope. Working out what they do gives me some of same sense of mystery as thinking about dinosaurs once did.

Code-cracking When I was in 6th form a speaker brought a replica Enigma machine into school and explained how the codes it produced were deciphered by British intelligence officers in World War 2. In our lab we spend lots of time "decoding" the DNA sequences that specify the different parts of the bacteria's flagellar motors. So now I look back and realise that we are code breaking in our genetics work.

Uncovering history on "digs" When I was growing up we lived in Newcastle near Hadrian's Wall. My mum and dad were both very keen on archaeology and I used to go on Roman digs with them. I used to love finding things such as coins that had been dropped by the Romans and picked up by me thousands of years later. In our experiments in the lab we make discoveries about the bacteria that we're working on. We all get a buzz from being the first people to discover things about the bacteria and how they swim. It's a bit like the buzz of finding something on a dig!

Aeroplanes I suppose I was a bit of a tomboy as a kid in that I liked old aeroplanes and airshows. I used to watch displays where they flew in formation, doing aerobatics. When I look down the microscope at our swimming bacteria and see them swimming gracefully, sometimes moving around in groups, it's a bit like watching an aerobatic display taking place under water!

In addition to my hobbies **one teacher** at my school encouraged us to think about biology in more depth. She was Mrs Towns and she used to explain to us how chemical cycles inside living things were the machinery of life. This was the first time that I really understood the links between the chemistry I was studying and the biology that I loved. I realised how eating food and converting the chemicals it was made of allowed us to grow. When we were 17 some of us worked with Mrs Towns to prepare for an extra exam in biology (called an S level). Because she encouraged us to understand things for ourselves, we started to go and find things out. I went to London for a weekend with my family and asked them to leave me for the afternoon at the Natural History Museum.

Instead of just looking at all the cases of animals I realised that I could find things out to help me with my exam by seeing how the animals and microbes all related to each other in food chains. I sat in front of an exhibition of seashore creatures and wrote loads of notes on what they were and how they interacted. I was really pleased to find that when I sat my exam a question came up where I could use some of the information from the Museum. I guess this was one of my first bits of proper "research" (we didn't have the internet to look things up then) and I was delighted it paid off!

What do you think are the big advances in your area of science at the moment?
The biggest thing affecting us at the moment is "genomics". That means putting together the sequence information of all of the genes that form the codes for a living creature. The genomes for many bacteria have been sequenced lately, including some like *Rhodobacter* that we are working on. The human genome has been sequenced recently, so many human gene sequences are now known too.

Many surprises are coming out of genomic work, but there is still a lot left to discover. Bacteria have genomes containing about 4,000 genes. These create the codes for all the things that are required to make a living single-celled bacterium. At the moment looking at each gene sequence is a bit like looking at a recipe for a curry and wondering what the finished curry will taste like. Although we have the instructions written down in DNA sequence we now have to work out what the proteins they code for are like and how they work.

It can be helpful to look at the same gene sequence in different bacteria that live in different conditions. For example, we are working with a Japanese research group to compare the bacteria they are studying that live in salty water with our *Rhodobacter* bacteria which live in fresh water.

You work in a Genetics Institute. Do you just study genetics all day?
No actually we use lots of skills (and lots of "ologies") in our science. In the lab as well as **genetics** (studying DNA & how genes are inherited), we work on **microbiology** (studying bacteria), **biochemistry** (studying the chemicals inside living cells), **computing** (using all sorts of analysis packages, word-processing and drawing pictures graphs and diagrams), **photography** (taking pictures down microscopes and of experiments in the lab) and **surveillance** - using a video microscope (and some clever software first designed to monitor road traffic) to watch how & where bacteria move (& to check if they're breaking the speed limit!). We also have to practise giving talks and presentations to explain what our science is all about.

Some of the other skills are more of the "Blue Peter" variety; we sometimes have to invent small gadgets to help us do our work using things like sticky-backed plastic and pegs. Now and again we also have to take something apart and fix it, so we keep a set of screwdrivers handy.

What makes you think bacteria are so clever?
1) They can swim really quickly using their flagella and use swimming to find food, all of this without having any brain, nerves or muscles.

2) They can communicate by producing signalling molecules to know how many of their kind are nearby. This is a bit like each type of bacterium producing a different perfume and then deciding how many of its "friends" of the same sort are nearby depending on the strength of the correct "smell".

3) Bacteria can live in communities called mixed biofilms with other types of bacteria and microbes. This kind of bacterial "village" can work as a group and get benefits from the others in its community. Some of these communities are very useful to human beings as they can break up complicated pollutants in a step by step process, like getting rid of sewage.

4) Bacteria are specialised to grow on almost anything you could name. Different bacteria can:
   - "eat" concrete;
   - grow at the bottom of the ocean in the boiling water of volcanic vents;
   - live on the polar ice caps;
   - make vitamins inside our intestines for us to use;
   - turn nitrogen gas from the air into the protein that our bodies are made of;
   - use light energy for photosynthesis just as plants do;
   - be so deadly that eating 100 of them could kill you;
   - recycle all sorts of waste cleaning up polluted water or land;
   - produce natural dyes and pigments;
   - ferment raw materials into delicious cheeses, yoghurt and beers;
   - be essential to the healthy working of our bodies.

Bacteria sometimes get a bad press when they're called "germs", but these are only the "bad bacteria". I think of bacteria as being like humans: most of them do very useful things in the world and only a very few are dangerous and antisocial.

5) Bacteria are tiny single living cells (1000 of them would fit end to end across a one millimetre division on a ruler) and they only have about 4000 genes (or recipes) in them, yet this is enough to make tiny living creatures that have independent lives. It's interesting that some human genes are also found in bacteria, so by studying bacteria we can find out what those genes might do in people.

What are the good & bad things about being a scientist?

There aren't too many bad things but they include sometimes needing to work long hours and having to write lots of applications for funds to pay for people to work on projects in the lab. (These applications go to government and charity organisations that fund science). I'm often busy answering letters and writing reports, but it is interesting.

Good things include working at a job that is exciting and different every day, being reasonably well paid, working with people who are fun and who are fascinated by what they are doing, travelling to interesting countries abroad to present your findings at conferences or to work with other scientists (we often go to the USA and I've been lucky enough to visit Japan, Israel and Mexico as part of my work). It's also really great when you meet one of your former students years later and hear about all the exciting science that they're doing.

Want to ask a different question?

Go to www.scienceyear.com/chalkface/index.html for her email address.