WHAT IF WE COULD DEVELOP A SENSOR THAT CAN DETECT POLLUTANTS LIKE HEAVY METALS?

Antimicrobial resistance (AMR) is a significant issue that needs to be better understood so that researchers can find solutions in the near future. Dr Helen Bridle is based at Heriot-Watt University in the UK and is conducting research to explore the relationship between antimicrobial resistance and pollutants in India.

Clearly, AMR is a significant issue that needs to be better understood so that researchers can find solutions in the near future. Dr Helen Bridle is based at Heriot-Watt University in the UK and is conducting research to explore the relationship between AMR and pollutants. One of the areas of her team’s focus is in India, which has one of the highest per capita use of antibiotics in the world.

WHY DOES INDIA RELY SO HEAVILY ON ANTIBIOTICS COMPARED TO OTHER COUNTRIES IN THE WORLD?
The more we use antibiotics, the more opportunities bacteria have to develop resistance. If people are not aware of this, they are unlikely to change their behaviour. A lack of understanding is one of the major factors behind increased incidence of AMR. “One of the main problems in India is the cheap unregulated access to antibiotics, e.g. over-the-counter sales with a prescription, which means that there is little control over whether antibiotics are used appropriately or at the correct dose,” explains Helen. “Other problems arise in the healthcare system, such as doctors receiving compensation for antibiotic prescriptions and relatively high levels of healthcare associated infection, which also contributes to the heavy usage of antibiotics in India.”

WHAT ARE HELEN AND HER TEAM HOPING TO UNDERSTAND IN THEIR RESEARCH?
It is known that water – particularly wastewater – plays a significant role in the spread and transfer of AMR, although there have been relatively few studies in this area to date. Helen’s research is designed to explore the relationship between AMR and pollutants, specifically heavy metals and additives such as triclosan (which is used in soap and toothpaste). Because these heavy metals and additives are also harmful to bacteria, they are likely to change their behaviour. A lack of understanding is one of the major factors behind increased incidence of AMR. “One of the main problems in India is the cheap unregulated access to antibiotics, e.g. over-the-counter sales with a prescription, which means that there is little control over whether antibiotics are used appropriately or at the correct dose,” explains Helen. “Other problems arise in the healthcare system, such as doctors receiving compensation for antibiotic prescriptions and relatively high levels of healthcare associated infection, which also contributes to the heavy usage of antibiotics in India.”

HOW WILL THE SENSORS WORK?
The sensors that the team at Heriot-Watt University are developing will target the presence of AMR genes in a water sample. In order to do this, the system needs to extract DNA from bacteria found in the water and then identify the specific sequences that are known to be associated with AMR. “We place recognition molecules on the sensor surface and when they are exposed to DNA, binding takes place,” explains Helen. “We can then measure the binding that enables us to check water quality without the need to access specialised lab facilities.”

It is hoped that the technology could one day be used by pollution control boards in India and around the world.

WHEN WILL THE SENSORS BE READY TO BE USED IN THE FIELD?
The project is already well underway and Helen’s colleagues in India have started regularly monitoring different sites. They have identified which pollutants are typically found in different locations and the AMR genes that are most prevalent. This has demonstrated the effectiveness of the research, although more work needs to be done before it can be fully rolled out.

The team hopes to be testing prototype systems and comparing them with existing techniques within the next year. Ultimately, by understanding the relationship between AMS and pollutants, solutions and preventive measures can be developed. Helen’s project is an important step in a global move toward minimising AMR, which could save trillions of dollars and – more importantly – countless lives around the world.
Engineering and physical sciences is an extraordinarily broad field of research, encompassing fields as varied as technologies and structural engineering. Students of engineering and physical sciences will build the skills, knowledge and, eventually, experience necessary to address scientific and technological challenges around the world.

HOW WOULD HELEN DESCRIBE THE PHYSICAL SCIENCES AND ITS LINKS TO ENGINEERING AT HERIOT-WATT?

In Helen’s current investigations, the knowledge required within the physical sciences ranges from the very small, such as the behaviour of molecules, through to the extremely large, such as modelling pollution spread and interactions in bodies of water.

ABOUT ENGINEERING AND PHYSICAL SCIENCES

• Tomorrow’s Engineers is a huge resource
• SCIENTIST
• AN ENGINEER AND/
• and activities to get you excited about the
• It is jam-packed with useful information
• you might want to do in the future.
• In a kind of self-feeding loop, these opportunities are created because people see them as valuable. We need to get better at creating and communicating these opportunities.

PATHWAY FROM SCHOOL TO ENGINEERING AND/OR PHYSICAL SCIENCES

Helen highly recommends studying mathematics at school and college to become well-versed in the subject by the time you get to university. You should also study at least one other physical science, depending on the specific type of physical sciences or engineering you might want to do in the future.

For instance, if you are interested in chemical engineering, then chemistry would be the most obvious route. You can find out more here: https://nationalcareers.service.gov.uk/jb-profiles/chemical-engineer

On the other hand, you could investigate potential alternatives to university, such as the apprenticeship route. The UK government has a website dedicated to future engineers which contains a wealth of information on the possibilities out there: https://www.engineering.gov.uk/future-engineers

HELEN’S TOP TIPS

1. Always be open to opportunities as and when they present themselves. You never know what is around the corner, so grabbing opportunities with both hands could take you in places and directions you might never have foreseen.

2. It is highly likely there will be possibilities to undertake summer projects or work experience placements – some of which are paid – in the sciences and engineering. These will help you progress and give you a real understanding of the areas you like and those you’re not so keen on.

3. Physical sciences and engineering offers so many different opportunities to be creative and come up with ideas to solve problems, work in teams, and develop theories, systems and products to help people. If that sounds like something you would like to do in your career, then this is the field for you!