We are surrounded by plastic: plastic bags, water bottles, takeaway containers, chocolate wrappers, the list is endless. Unfortunately, many people ignore the massive waste problems associated with plastic, especially single-use plastic, and much of our plastic waste breaks down into microplastics. Now, microplastic pollutants seem to be present everywhere, even in remote areas of our planet like the Arctic and Antarctic.

Knowing they pose a serious threat to many aquatic species, Dr Julie Peller, from Valparaiso University in Indiana in the US, has been assessing the levels of microplastics, in particular microfibres, in a Lake Michigan watershed and other Great Lakes ecosystems. Undergraduate research students also contribute to this project, not only to increase awareness about the importance of scientific research but also to contribute to the pool of knowledge as the magnitude of the problem grows daily. As Julie warns, “The negative effects will be exasperated if we do not address the problem.”

WHY IS PLASTIC SUCH A BIG ISSUE?
Plastic is not biodegradable. Unfortunately, instead of being recycled, most of it ends up in a landfill or in the environment, where...
sunlight and other weathering processes break it down into tiny particles called microplastics. Scientists know that these particles can be extremely dangerous, with studies showing how they stunt growth, disrupt reproduction and alter feeding habits of fish and other aquatic species.

Microplastics are also shed from clothes made from synthetic fabrics, such as polyester, when they are washed. Standard washing machines were never manufactured to remove all these microfibres and they end up in our wastewater. Most of these microfibres can be removed in wastewater treatment plants, but a small percentage remains in the water and flows to natural surface waters, including the oceans.

Previous studies looking at the microplastic content in Lake Michigan (part of the Great Lakes in the USA) motivated Julie to test for the presence of microplastics and microfibres in surface waters flowing into Lake Michigan. “The water in local streams and creeks flows into Lake Michigan, and we were interested in determining the extent of microplastics contamination in both the water and sediment,” says Julie.

AN EXPERIMENT AIMED AT UNDERGRADUATE STUDENTS

The twist in the research was that it was adjusted to be part of first-year undergraduate students’ chemistry curriculum. Julie and her colleagues wanted to engage these students in active scientific research by exploring the current worldwide problem of microplastics contamination. Over the course of a three-week experiment, students collect soil samples from two locations, one near a local wastewater treatment plant. Using different lab techniques, they remove particles larger than 5 microns. The next step involves chemical oxidation to reduce the natural organic matter, leaving the plastics and some inorganics behind. This is done by exposing the samples to the Fenton reagent, a solution of hydrogen peroxide (H₂O₂) and iron (II) chloride. The mixture is heated until it stops foaming, which is an indication that most of the reactive organic matter is chemically broken down. After this mixture is filtered, students count microfibres present in each sample using a microscope.

From the research project, the amount of microfibres found in the samples collected closer to the wastewater treatment plant, and the samples collected further away (and presumably not affected by household sewage) were similar. For Julie, this indicates that the water from the wastewater treatment plant is not the only source for the high amount of microfibres in this area of the Lake Michigan watershed. “The data showed that a significant amount of synthetic microfibres are discharged daily to Lake Michigan,” says Julie. “We analysed just one main tributary and expect that it is somewhat representative of others”.

The big question now is how to reduce these pollutants and minimise their adverse effects. Scientists are still learning about the consequences of these contaminants in our environment, but this research needs to be done with a great deal of urgency. Our world is drowning in plastic with more and more being added every day.

GOOD NEWS FOR FUTURE RESEARCH

Julie believes that recent studies of Lake Michigan green algae with microfibres may offer insight into ways to battle against this type of plastic. Certain aquatic plants are able to trap and cling to microplastics. If researchers learn more about these natural mechanisms, they may be able to develop ways to reduce the discharge of microplastics into aquatic environments.

In addition to the valuable data collected from microplastics research, Julie’s project also helps undergraduate students become more aware of how scientific research is used to solve everyday problems. As a bonus, this work made most participants more conscious about the dangers of plastic pollution and consider reducing the amount of plastic they use in their life. This is ideal preparation to enable these students to lead citizen science projects in the future.

Julie and her team at Valparaiso University are keen to offer public outreach programmes for schools and young people, which may be a good way to find out more about becoming a chemist. Choosing a career in chemistry can be extremely rewarding. Many chemists work in a lab, but there is so much more they can do. Chemists can develop new textiles for the latest fashion trends or even play a key role in criminal investigations. It is fascinating to think where chemistry could take you!
HOW TO BECOME A CHEMIST

- A good place to discover the wide range of career options in the chemical sciences is the American Chemical Society: https://www.acs.org/content/acs/en/careers/college-to-career/chemistry-careers.html

- Typical employers include health services, research institutes, military and law enforcement, industry and schools.

- In the UK, you could work towards chartered status, including Chartered Chemist (CChem) and Chartered Scientist (CSci).

- According to the American Chemistry Council, the average annual salary of a US chemical industry employee is $87,000.

PATHWAY FROM SCHOOL TO CHEMISTRY

To become a chemist, you usually need a degree in either pure chemistry or in a specific field, such as analytical chemistry or biochemistry. Some employers may favour a relevant postgraduate qualification.

You may also be able to get into this career through a laboratory scientist higher apprenticeship or start as a laboratory technician and train while working by doing a relevant qualification.

The education website for the Royal Society of Chemistry is a good resource if you are considering a future as a chemist: https://edu.rsc.org/future-in-chemistry/
WHAT WERE YOUR INTERESTS AS A CHILD?
I mainly pursued my interest in music and took piano lessons throughout my younger years. I was admitted to one of the top music schools in the US when I was 18 but began to recognise my interest in science and in the chemistry courses I took during my freshman year. Obviously, I transitioned to science, but still play piano almost daily.

WHO OR WHAT INSPIRED YOU TO BECOME A SCIENTIST?
I cannot pinpoint any one single person who inspired me to become a scientist but attribute my path to teachers and professors who taught and encouraged me.

WHAT ATTRIBUTES HAVE MADE YOU A SUCCESSFUL SCIENTIST?
I love to learn, to investigate and to solve problems. I also enjoy sharing these experiences with friends, collaborators, students, colleagues and community. I believe that when you enjoy getting up in the morning and pursuing your interests, you can accomplish a great deal.

HOW DO YOU OVERCOME OBSTACLES IN YOUR WORK?
Science requires supplies and equipment, which can be costly and challenging. It is not always possible to have the resources that you want to carry out research, and this is often a large obstacle. Also, as a university professor, much of my time is devoted to teaching and service, in addition to research. These challenges are met with resourcefulness and effective time management, especially when you are interested in making progress in your work.

WHAT ARE YOUR PROUDEST CAREER ACHIEVEMENTS?
I would say that I feel most proud when my students offer sincere gratitude for the experiences and education that I have provided for them. I also feel that I have contributed to science when I publish new findings with my collaborators.

WHAT WOULD BE YOUR ‘DREAM’ RESEARCH PROJECT TO WORK ON?
I am grateful that I am able to pursue my research interests thanks to many great institutions, collaborators, colleagues and students. I aspire to create greater awareness of critical environmental problems, such as plastic waste. I find that once people are aware of the problems, they are more inclined to participate in the solutions.