

# E&I Research Studentship project proposal 2019

**Project title: Microplastic Contamination: Environmental Impact in Terrestrial Ecosystems**

**Supervisory team:**

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## Project Highlights:

- Contribute to the understanding of a contemporary environmental issue
- Multidisciplinary (chemistry/biology) laboratory based project using advanced analytical techniques
- Industry placement with a UK Polymer company

## Project Description:

Man-made plastics are now ubiquitous in the natural environment; with their presence used to stratigraphically mark the likely beginning of a new geological epoch called the Anthropocene. Estimates suggest that there are >5 trillion pieces of plastic (270,000 tonnes) in the world's oceans, the majority of which have travelled through terrestrial environments to get there (80 %). Current scientific research into the impact of plastics is heavily skewed towards the marine environment, despite plastic being found in almost all ecosystems (Figure 1). This projects seeks to address this imbalance by investigating the impact of plastics in the terrestrial environment.

The terrestrial environment has a distinct lack of data regarding the accumulation and impact of plastics despite decades of unintentional plastic pollution, the use of plastic products directly within soils (e.g. mulch films) and the spreading of waste derived fertilisers containing plastic contaminants. Research activity in this area has largely focused on soil health and crop yield. There is however a knowledge gap regarding the vitality of animals at the base of the food web and the role they play in creating and spreading microplastics (small plastic particles measuring <5mm). Newer biodegradable alternatives, so-called bioplastics, have been proposed as one solution to plastic pollution, but is this proposal justified from an ecotoxicity viewpoint?

This environmental science project can be tailored to the strengths of the applicant with a focus on either chemistry, biology or an overarching multidisciplinary approach. Applicants may be interested in exploring any number of the following themes:

1. The absorption of chemicals to plastic materials and transference to terrestrial organisms;
2. Using environmental soil biosensors to investigate ecotoxicological differences between fossil fuel derived plastics and newer biodegradable alternatives, i.e. bioplastics;
3. Understand the timescales and microbiology involved with plastic degradation in a variety of terrestrial environments (e.g. river sediments and terrestrial soils).
4. Study *as a model system* in soil the interactions of several different types of microplastics with the nematode worm *Caenorhabditis elegans*.



**Figure 1:** Fluorescent polystyrene microspheres in the gut of the nematode worm *C. elegans*.

## Research Methods:

This project will use advanced analytical chemistry and biological techniques tailored towards the research question(s). The Open University has well-resourced laboratories that can: simulate natural environments under laboratory conditions; chemically analyse pollutants within fauna, flora and materials; measure the biodegradability of plastic materials; analyse ecotoxicological effects in biologically-relevant model organisms; screen environmental and chemical samples *in vitro*.

It is envisaged that the student would use microscopy, gas chromatography mass spectrometry, fourier-transform infra-red spectroscopy, solid phase extraction, HPLC and nuclear magnetic resonance spectroscopy for chemical identification. Bespoke respiration rigs with infra-red gas analysers would be used to investigate biodegradation. Genetic and behavioural studies would use soil biosensors.

## Partners and collaboration:

This studentship would closely with a UK polymer manufacturer who would offer a placement and contribute resources.

## Indication of project timeline:

**Year 1:** Establish the focus of the PhD, training on analytical techniques with the expectation that original data is generated by 9 months for inclusion in the progress report.

**Year 2:** Laboratory intensive year dedicated to generating and analysing original data. Opportunity to attend national academic and industrial conferences and visit other University institutions. Undertake the industry placement.

**Year 3:** Year is dedicated to writing up the thesis with the expectation of handing in within 3 years. Opportunity to attend an international conference.

## References:

- Koelmans, A.A., et al., Microplastic as a Vector for Chemicals in the Aquatic Environment. *Environmental Science & Technology*, 2016. **50**(7): p. 3315-3326.
- Rocha-Santos, T. and A.C. Duarte, A critical overview of the analytical approaches to the occurrence, the fate and the behavior of microplastics in the environment. *Trac-Trends in Analytical Chemistry*, 2015. **65**: p. 47-53
- Tosetto, L., et al. Microplastics on beaches: ingestion and behavioural consequences for beachhoppers. *Marine Biology*, 2016. **163**(10).

## Candidate Applications

- Students should have an enthusiasm for interdisciplinary science and environmental research. The student will join a well-established environmental and analytical team researching plastic waste materials at the Open University. Please contact Dr Carl Boardman (Carl.Boardman@open.ac.uk) for further information.
- 1000 word cover letter outlining how they are equipped in their educational background and expertise to conduct the research project,
- a CV including contact details of two academic references
- An Open University application form, downloadable from: <http://www.open.ac.uk/postgraduate/research-degrees/how-to-apply/mphil-and-phd-application-process> (Note: This is an Advertised studentship and you do not need to submit a proposal).
- IELTS English Language test scores on application. An average of 6.5 and no less than 6 in anyone of the four components. Applicant should have these results when applying.

Applications should be sent to [STEM-EI-Research@open.ac.uk](mailto:STEM-EI-Research@open.ac.uk) by 28 February 2019