THE UNIVERSITY of EDINBURGH

Job Description

Internship Title: Generating the first 3D of the rooting system of the fossil plant *Rhynia gwynne-vaughanii* and their relationship with mineral soils.

Department/ School	Institute of Molecular Plant Sciences, School of Biological Sciences, University of Edinburgh, Kings Buildings Campus
Reports To	Alexander Hetherington (PI, Hetherington Lab) sandy.hetherington@ed.ac.uk Ana Julia Sagasti (PDRA, Hetherington Lab) anaju.sagasti@ed.ac.uk PhD Mentor: Jeremy Wyman, jwyman@ed.ac.uk, Hetherington lab

Job Purpose

Generating a digital 3D reconstruction of an extinct 407 million-year-old land plant to investigate major questions in rooting system evolution. Fossils held in the Hetherington lab will be imaged and digitally reconstructed into a 3D model using the SPIERS computer software suite. The 3D structure of the rooting system will be quantified for the first time allowing new comparisons to be drawn with rooting systems of living land plants.

Main Responsibilities

- Aligning the peels in SPIERSalign - 15%
- Masking the peels in SPIERSedit - 15%
- Measuring branching points of the reconstruction in Blender- 20%
- Analysing the position of hemispherical projections in RStudio- 20%
- Writing report and presentation in lab meeting -20%
- Attending lab meetings and Progressive Palaeontology conference -10%

Knowledge Skills and Experience (required for the role)

Attribute	Essential	Desirable
Education, Qualifications & Training	- Background in biology with an emphasis on plant sciences - Passion for plant evolution	- Training in plant evolution - Continuous engagement in personal development relevant to the stage of career

Knowledge & Experience	- R coding experience - Excellent written and verbal communication skills with the ability to build rapport with colleagues and collaborators.	- Desire to work in an interdisciplinary environment

Person Specification

Planning and Organising

- The post holder will be responsible for the day-to-day organisation of the research activity under the guidance of the mentor and supervisors. It is expected they will prioritise activities in order to meet agreed milestones and deadlines.

Problem Solving

- The post holder is expected to use initiative to analyse and interpret research data and draw conclusions from it.

Decision Making

- Taken independently: Organise own workload according to priority and adapt as necessary to address specific research aims
- In collaboration with others: Problem solving and data interpretation, experimental design and discussion of short-term research aims and potential new research strategies
- Level of Direction Given: The mentor and supervisors will offer general orientation and advice, in addition to support in developing and implementation of research strategy, there will be an appropriate degree of independence.

Key Contacts:

Alexander Hetherington (PI, Hetherington Lab) sandy.hetherington@ed.ac.uk
Ana Julia Sagasti (PDRA, Hetherington Lab) anaju.sagasti@ed.ac.uk
PhD Mentor: Jeremy Wyman, jwyman@ed.ac.uk, Hetherington lab

Dimensions

Closing date for applications: Wednesday 14th May 2025 (Midnight)
Preferred start date: 16th June to 6 weeks
Hours per week and preferred pattern/ restrictions (if applicable) – 35 hours per week

Additional Information

Project Outline

Rooting structures are essential for plants, enabling anchorage to the substrate and the means to acquire water and nutrients (Kenrick and Strullu-Derrien, 2014; Hetherington and Dolan, 2018). However, the fragmentary nature of the fossil record and the fragility of rooting systems reduce their fossilization potential in most sedimentary environments. This means that we currently have a fragmentary understanding of the evolution of these key structures. Geothermal systems from the Devonian of Aberdeenshire (Scotland, UK),

collectively known as the Rhynie cherts, record sedimentation environments that favoured the formation of exceptional fossil deposits, allowing for the identification and study of anatomically preserved plants and microorganisms. The Hetherington Lab has access to a collection of Rhynie chert samples composed of chert blocks, thin sections, and peels. These fossils offer a unique perspective to study the early evolution of rooting systems in land plants, and the aim for this project is to use these fossils to characterise the rooting system of one of these species specifically, *Rhynia gwynne-vaughanii.*

Previous reconstructions of *R. gwynne-vaughanii* have differed significantly in their interpretation of it rooting system. This makes it an ideal target for investigation using the novel digital 3D reconstruction approach used by our lab (Turner et al., 2023; Wyman, 2024 [unpublished manuscript]), this project intends to generate a more complete picture of *R. gwynne-vaughanii*, particularly focused on the branching patterns of prostrate axes, the position of rhizoid bearing hemispherical projections and interactions with early soils.

For this project, we have preselected a collection of 100 consecutive peels that have been scanned and photographed. To develop a 3D digital reconstruction, the post holder will use the SPIERs software suite (Sutton et al., 2012)**.** The first step is aligning the images of the peels in SPIERSalign, this stage should take between 3 days and a week. The second part of the project is masking relevant structures using SPIERSedit (one week). Following this reconstruction, the model is rendered with Blender. Finally, the analysis of branching points and position of hemispherical projections is done with Blender and RStudio (two weeks). The post holder will then write a report and a presentation to share with members of the Hetherington Lab. During their placement, the post holder will participate in weekly meetings with the supervisors and mentor to discuss progress in the project and any arising need. All members of the Hetherington Lab participate in weekly meetings to share research advances and gain feedback on methods and presentations.

The Molecular Palaeobotany and Evolution Group (Hetherington Lab) investigates the evolution of key innovations in land plants. Taking an interdisciplinary approach at the interface between the Life and Earth Sciences, our work is focused on plant evolution using fossils and molecular biology. The mentor for this research proposal, MScR Jeremy Wyman is working on the evolution of rooting systems of early Lycophytes from the Carboniferous of Scotland. Due to his experience working with the SPIERS suite, his mentorship will be key to the success of this project. Supervisor Dr. Ana Julia Sagasti has worked on the study of anatomically preserved land plants from geothermal systems since 2018, and the Rhynie chert since 2023. Her knowledge of the anatomy of fossil plants and segmentation tools will contribute further to the development of the project. The overall project will be supervised by the PI, Dr. Alexander Hetherington.

The post holder will also be encouraged to attend the Progressive Palaeontology conference at the University of Edinburgh (18^{th}-19^{th} of June). This conference is aimed at early career researchers and represents an opportunity to learn about the research conducted by palaeontology PhD researchers from the UK and network in a relaxed environment among peers.

References

Hetherington AJ, Dolan L. 2017 Bilaterally symmetric axes with rhizoids composed the rooting structure of the common ancestor of vascular plants. Phil. Trans. R. Soc. B 373: 20170042.
http://dx.doi.org/10.1098/rstb.2017.0042
Kenrick, P., Strullu-Derrien, C. 2014. The origin and early evolution of roots. Plant Physiology 166: 570–280. doi/10.1104/pp.114.244517
Kerp H. 2017 Organs and tissues of Rhynie chert plants. Phil. Trans. R. Soc. B 373: 20160495.
http://dx.doi.org/10.1098/rstb.2016.0495
Turner HA, Humpage M, Kerp H, Hetherington AJ. 2023. Leaves and sporangia developed in rare non-Fibonacci spirals in early leafy plants. Science. 380: 1188-1192. DOI: https://doi.org/10.1126/science.adg4014
Wyman, J. 2024. Reinvestigating the rooting system of a Lower Carboniferous lycopsid, *Oxroadia*, through 3D reconstruction. [Unpublished manuscript]

Budget

A maximum of £500 towards project costs is available.

Location

Daniel Rutherford Building, University of Edinburgh, Max Born Crescent, The King's Buildings, Edinburgh EH9 3BF
The student will have access to a desk, a desktop computer, light microscopes including a Nikon SMZ18 stereo microscope, an Epson Perfection V600 scanner, and a VHX 7100 Keyence microscope

Health & Safety Requirements for the role

The project will be carried out in office and lecture spaces in King Building´s campus. No health and safety requirements are predicted for this role.

Key Job hazard information specific to the role

This role may result in potential exposure to certain hazards as listed below:
Common workplace health hazards.

These will be risk assessed by the school or department, which may require the student to participate in, for example, health surveillance or follow other health and safety requirements.

Programme Information

The Research Experience Programme (REPs), funded by NERC, offers paid research opportunities for undergraduate students. The programme is designed to address both demographic and diversity challenges in the environmental sciences, as well as thematic skills gaps, such as quantitative skills.
This is a valuable opportunity to gain hands on research experience, boost your employability, and explore potential pathways into further study or careers in environmental science.

For full details on how to apply and the selection process, please visit our REP webpage

Application Support

The University's Careers service provides a wide range of resources to support your application, including guidance on CVs, cover letters, and interview preparation. Students undertaking a REP placement will also have the opportunity participate in the Edinburgh Award - a structured programme that helps you reflect on and gain recognition from the University for the skills and attributes developed during your internship. For more information, you can book an appointment with a Careers Consultant via **MyCareerHub.**

Eligibility Criteria

To be eligible for a REP placement, applicants must meet **all** of the following criteria:

• Be currently studying towards their first undergraduate degree studies (including integrated Master's degrees) in a UK Higher Education institution, in any science discipline ***Note:*** *Final year students are eligible if they still hold student status at the* ***start of the placement,*** *even if the student graduates during the course of the placement.*

- Be eligible for subsequent NERC PhD funding as defined here:
- A UK citizen who has been living in the UK for at least the past 3 years OR
- An EU citizen with pre-settled or settled status under the EU Settlement Scheme OR
- A non-EU citizen who has obtained the right to remain in the UK - known as 'indefinite leave to remain' (ILR) OR
- An International/EU student currently studying in the UK under a Tier 4 or Student Route Visa with validity until at least September 2025.

REPs **do not** meet the requirements for visa sponsorship. As such, students who are not currently residing in the UK or who do not hold a valid UK visa are not eligible to apply.

You cannot take part if you are a visiting student, or have previously taken part in REP programme.

Privacy Statement

In addition to the University's HR Privacy Information Notice, please read the Student and Graduate Privacy Statement: Internships and work experience programmes to understand how your personal information will be collected, used, and stored as part of the application process. .

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