

I'm an applied mathematician working at the interface between fluid mechanics and soft matter, specifically studying poroelasticity (the behaviour of porous, deformable media). I have a particular interest in hydrogels, soft elastic solids formed of a polymer matrix surrounded by water molecules, and their swelling and drying behaviour.



Apr 2024 – Postdoctoral research fellow, **Mathematics Institute, Uni. of Warwick**
'Shape-Transforming Active Matter', Leverhulme Trust-funded project led by [Professor Tom Montenegro-Johnson](#).

Education and prizes

- 2020 – 2024 PhD applied maths, **Department of Applied Mathematics and Theoretical Physics, Uni. of Cambridge**
Supervised by [Professor Grae Worster](#), thesis available online: [Dynamics of super-absorbent hydrogels](#)
- 2019 – 2020 Part III Mathematics (MMath), **Trinity College, Uni. of Cambridge**
Exams not held due to COVID-19, essay 'Viscous fingering instabilities' supervised by [Dr Katarzyna Kowal](#)
- 2016 – 2019 MA (Cantab.) Mathematics, 2.i, **Trinity College, Uni. of Cambridge**
Undergraduate summer research with Prof Herbert Huppert FRS (2018, 2019)
- 2025 Finalist, **IMA Lighthill-Thwaites Prize** for 'Cryosuction and freezing hydrogels' (7)
- 2022 Group 1, **Smith-Knight and Rayleigh-Knight Prize, Uni. of Cambridge** joint top result in cohort
- 2022 First prize, **DAMTP fluids second year talks, Uni. of Cambridge** for 'Dynamics of super-absorbent hydrogels'
- 2019 Shortlisted finalist, **STEM for Britain** for 'Stokes drift through corals'

Publications




Links are DOI references to the full text, preprints (in grey) available on request

- 10 **Surfing on chemical waves: a simple yet dynamically rich two-sphere responsive gel swimmer**
[Webber, J. J. and Montenegro-Johnson, T. D.](#) 2025 under review
- 9 **Oscillating chemical reactions enable communication between responsive hydrogels**
[Webber, J. J. and Montenegro-Johnson, T. D.](#) Phys. Rev. Research, accepted 2025 [10.1103/xbvn-5b59](#) [arXiv:2508.02399](#)
- 8 **Poromechanical modelling of responsive hydrogel pumps**
[Webber, J. J. and Montenegro-Johnson, T. D.](#) J. Fluid Mech., 1009:A38 2025 [10.1017/jfm.2025.249](#)
- 7 **Cryosuction and freezing hydrogels**
[Webber, J. J. and Worster, M. G.](#) Proc. Roy. Soc. A 481:20240721 2025 [10.1098/rspa.2024.0721](#)
- 6 **Wrinkling instabilities of swelling hydrogels**
[Webber, J. J. and Worster, M. G.](#) Phys. Rev. E 109:044602 2024 [10.1103/PhysRevE.109.044602](#)
- 5 **A linear-elastic-nonlinear-swelling theory for hydrogels. Part 2. Displacement formulation**
[Webber, J. J., Etzold, M. A. and Worster, M. G.](#) J. Fluid Mech. 960:A38 2023 [10.1017/jfm.2023.201](#)
- 4 **A linear-elastic-nonlinear-swelling theory for hydrogels. Part 1. Modelling of super-absorbent gels**
[Webber, J. J. and Worster, M. G.](#) J. Fluid Mech. 960:A37 2023 [10.1017/jfm.2023.200](#)
- 3 **Stokes drift through corals**
[Webber, J. J. and Huppert, H. E.](#) Environ. Fluid Mech. 21:1119-1135 2021 [10.1007/s10652-021-09811-8](#)
- 2 **Stokes drift in coral reefs with depth-varying permeability**
[Webber, J. J. and Huppert, H. E.](#) Phil. Trans. Roy. Soc. A 378:20190531 2020 [10.1098/rsta.2019.0531](#)
- 1 **Time to approach similarity**
[Webber, J. J. and Huppert, H. E.](#) Q. J. Mech. Appl. Math. 72:1-23 2020 [10.1093/qjmam/hbz019](#)

Research leadership

- 2024- **Coordinator, UK Hydrogels Network** *founding organiser of cross-disciplinary network*
- 2024-2025 **Soft Matter Lunches, Uni. of Warwick** *seminar series organised jointly with Physics Department*
- Dec 2024 **Organiser, Modelling hydrogels: building networks in the Mathematical Sciences workshop**
- Dec 2022 & Dec 2023 **Undergraduate admissions interviewer, Trinity College, Cambridge** *devised questions and carried out admissions interviews in-person and online*
- 2022-2024 **Organiser, Institute of Theoretical Geophysics lunches, Uni. of Cambridge** *informal weekly seminar series*

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- **Peer review** journals include J. Fluid Mech. and Phys. Chem. Chem. Phys.
 - **Conference session chair** at EFDC2, Dublin 2025 – minisymposium on ‘Poroelastic Flows’


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-  **pgfcet** A tikz library to allow the use of the colorcet colour maps with pgfplots
 -  **texnically** A L^AT_EX-to-SVG tool that embeds the original source into the SVG metadata for easy future editing
 -  **fix-matlab-eps** A utility to fix the vector output of Matlab’s `contourf`, removing artefacts from the EPS output

Research project supervision

- 2024- **Informal co-advisor, Xietao Wang Lin (MSc+PhD, Uni. of Warwick)** *with T. D. Montenegro-Johnson*
Machine-learning accelerated simulation of suspensions of elastic microfilaments
- 2024-2025 **Co-advisor, Usmaan Mirza (MMath research project, Uni. of Warwick)** *with T. D. M.-J.*
An analytical and numerical framework for modelling self-oscillating hydrogels
- 2024 **Small group co-advisor, Summer Research Programme for Undergraduates from Underrepresented Groups, Uni. of Warwick** *with T. D. M.-J.*
The digital epidemic

Teaching


- **MA4N4 Transport Processes in Mathematical Biology, Uni. of Warwick** (Autumn 2025) 30 lectures
- **MA256 Introduction to Mathematical Biology, Uni. of Warwick** (Autumn 2024) 6/30 lectures, cohort size ~ 120
- **Part IA Introduction to Mechanics, Uni. of Cambridge** (Michaelmas 2022) 5/9 lectures, cohort size ~ 30

Part III Preparatory Workshops, Uni. of Cambridge (Michaelmas 2023, 2 hours + 10 videos) *Designed and delivered revision content for incoming Part III (masters) students covering all aspects of continuum mechanics, including a series of 10 introductory videos* ( tinyurl.com/partiiivideos). Content reused and delivered by other instructors in 2024 & 2025.

Supervisions for Cambridge undergraduate mathematicians (> 300 hours) *small group (usually 2:1) tutorials in applied mathematics*

Part II (3rd year) Fluid Dynamics (Michaelmas 2020); **Part IB (2nd year) Fluid Dynamics** (Lent 2021-2024 + revision in Easter 2021-2023); **Part IB Methods** (Michaelmas 2021-2023 + revision in Easter 2023); **Part IB Variational Principles** (Michaelmas 2021-2023 + revision in Easter 2023)

Outreach

- 2025 **Origami artwork** based on ‘Poromechanical modelling of responsive hydrogel pumps’ (8) with [Coco Sato](#)
- 2021 **Cambridge Festival** wrote and produced a video ( [link](#)) on poroelasticity and coffee makers
- 2019-2020 **Captain, BBC University Challenge** captained the semi-finalist team for Trinity College, Cambridge

- 2025 ① **2nd European Fluid Dynamics Conference, Dublin, Ireland**
 Poromechanical modelling of pumping with responsive hydrogels (28/08/25)
Uni. of Warwick, UK
 SUMR Meeting 7: How to prepare and present maths posters (20/08/25)
- ① **British Applied Mathematics Colloquium, Exeter, UK**
 Getting stressed about frozen gels (25/06/25)
- ① **Fluid Mechanics Seminars (online), Royal Society Publishing** [10.52843/cassyni.4wj1kq](https://doi.org/10.52843/cassyni.4wj1kq)
 Freezing of hydrogels: modelling cryosuction, deformation and ice growth (18/06/25)
- ① **Department of Materials, ETH Zurich, Switzerland**
 Modelling hydrogels at both ends of the temperature spectrum (27/05/25)
- 2024 **Modelling hydrogels: building networks in the Mathematical Sciences, Uni. of Warwick, UK**
 Deswelling response to temperature changes (09/12/24)
- ② **77th Annual Meeting of the Division of Fluid Dynamics (APS), Salt Lake City, USA**
 XOXO, Gossip Gel: oscillating chemical reactions facilitate communication between responsive hydrogels (25/11/24)
Uni. of Warwick, UK
 How to make a poster: ...also how you shouldn't, why you should care, and why they matter (28/08/24)
- ① **Mathematical Biology Meeting, University College London, UK**
 Smart responsive gels: designing the building blocks of squishy bio-inspired devices (30/10/24)
- Soft Matter Lunch, Uni. of Warwick, UK**
 Tubular hydrogel pumps through a responsive LENS (30/09/24)
- ① **Soft Lab Seminar, Bristol Robotics Laboratory, Uni. of Bristol, UK**
 A linear-elastic-nonlinear-swelling model for hydrogels (03/07/24)
- ② **UKFN BioActive & Non-Newtonian Fluids SIG Meeting, University College London, UK**
 Buckling and swelling instabilities of super-absorbent gels (18/06/24)
- ① **Physics of Fluids and Soft Matter seminar, Uni. of Manchester, UK**
 A linear-elastic-nonlinear-swelling model for hydrogels (17/05/24)
- ② **Warwick–Cambridge Quantitative Cell Biology Symposium, Uni. of Warwick, UK**
 Freezing soft porous gels (16/05/24)
- ① **Warwick Applied Maths seminar, Uni. of Warwick, UK**
 A linear-elastic-nonlinear-swelling theory for hydrogels (03/05/24)
- 2023 ① **Squishy Journal Club, Uni. of Oxford, UK**
 Buckling and swelling instabilities of super-absorbent hydrogels (28/11/23)
- ② **76th Annual Meeting of the Division of Fluid Dynamics (APS), Washington DC, USA**
 Wrinkling instabilities of swelling hydrogels (21/11/23)
- ② **15th Annual InterPore Meeting, Edinburgh, UK**
 Linear stability analysis for the formation of wrinkles on confined swelling hydrogels (24/05/23)
- 2022 ② **75th Annual Meeting of the Division of Fluid Dynamics (APS), Indianapolis, USA**
 A linear-elastic-nonlinear-swelling theory for hydrogels: displacements and differential swelling (20/11/22)
- ② **14th Annual InterPore Meeting, online**
 Multidirectional gel swelling and drying: a linear-elastic-nonlinear swelling theory for hydrogels (02/05/22)
- DAMTP Friday Fluids second year talks, Uni. of Cambridge, UK**
 Dynamics of super-absorbent hydrogels (27/05/22)
- 2020 ① **Pure & Applied Maths colloquium, Open University, UK**
 Stokes drift through coral reefs (04/02/20)
- 2019 ② **Stokes200 Symposium, Uni. of Cambridge, UK**
 Stokes drift through corals (17/09/19)