

Joseph Webber

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Date of birth: 1997 | **Nationality:** British citizen | **Last updated** December 12, 2024

Employment history

Apr 2024- **Mathematical Institute, University of Warwick**
Postdoctoral research fellow
'Shape-Transforming Active Matter', Leverhulme Trust-funded project led by Professor Tom Montenegro-Johnson.

Education

- 2020-2024 **Department of Applied Mathematics and Theoretical Physics, University of Cambridge**
PhD Fluid Dynamics, supervised by Prof M. Grae Worster
Thesis examiners: Dr Duncan Hewitt (Cambridge), Prof Christopher MacMinn (Oxford). C-CLEAR DTP (NERC-funded) research entitled *Dynamics of super-absorbent hydrogels*.
- **Smith-Knight and Rayleigh-Knight Prizes 2022:** awarded Group 1 (highest category).
 - **DAMTP Friday Fluids second year talks 2022:** first prize for talk *Dynamics of super-absorbent hydrogels*.
- 2019-2020 **Trinity College, University of Cambridge**
Part III Mathematics (MMath), no grade due to COVID-19 pandemic
One-year taught integrated master's course including an essay, *Viscous Fingering Instabilities*, on the Saffman-Taylor Instability. Courses taken:
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|-------------------------------------|---------------------------------|-----------------------------|
| • Fluid Dynamics of the Solid Earth | • Non-Newtonian Fluid Mechanics | • Fluid Dynamics of Climate |
| • Slow Viscous Flow | • Perturbation Methods | • Hydrodynamic Stability |
- 2016-2019 **Trinity College, University of Cambridge**
MA (Cantab.) Mathematics, 2.i
Specialised in applied mathematics, specifically fluid mechanics and classical physics.
- 2009-2016 **Walton High, Milton Keynes**
GCSEs (2014); 'A' levels and STEP (2016)

Papers

- Webber, J.J. & Montenegro-Johnson, T.D. **Oscillating chemical reactions for communication between responsive hydrogels** *Physical Review Letters* (2024+, in preparation)
- Webber, J.J. & Worster, M.G. **Cryosuction and freezing hydrogels** *Proceedings of the Royal Society A* (2024, submitted)
- Webber, J.J. & Montenegro-Johnson, T.D. **Tubular hydrogel pumps through a responsive LENS** *Journal of Fluid Mechanics* (2024, submitted)
- Webber, J.J. & Worster, M.G. **Wrinkling instabilities of swelling hydrogels** *Physical Review E* 109:044602 (2024) <https://doi.org/10.1103/PhysRevE.109.044602>
- Webber, J.J., Etzold, M.A. & Worster, M.G. **A linear-elastic-nonlinear-swelling theory for hydrogels. Part 2. Displacement formulation** *Journal of Fluid Mechanics* 960:A38 (2023) <https://doi.org/10.1017/jfm.2023.201>
- Webber, J.J. & Worster, M.G. **A linear-elastic-nonlinear-swelling theory for hydrogels. Part 1. Modelling of super-absorbent gels** *Journal of Fluid Mechanics* 960:A37 (2023) <https://doi.org/10.1017/jfm.2023.200>
- Webber, J.J. & Huppert, H.E. **Stokes drift through corals** *Environmental Fluid Mechanics* 21:1119-1135 (2021) <https://doi.org/10.1007/s10652-021-09811-8>
- Webber, J.J. & Huppert, H.E. **Stokes drift in coral reefs with depth-varying permeability** *Philosophical Transactions of the Royal Society A* 20190531 (2020) <https://doi.org/10.1098/rsta.2019.0531>

- Webber, J.J. & Huppert, H.E. **Time to approach similarity** *Quarterly Journal of Mechanics and Applied Mathematics* 72:1-23 (2020) <https://doi.org/10.1093/qjmam/hbz019>

Talks & posters

- 📢 "Deswelling response to temperature changes" – *Modelling hydrogels: building networks in the Mathematical Sciences*, University of Warwick, 9th December 2024
- 📢 "XOXO, Gossip Gel: oscillating chemical reactions facilitate communication between responsive hydrogels" – *77th Annual Meeting of the Division of Fluid Dynamics (APS)*, Salt Lake City, USA, 25th November 2024
- 📢 "Smart responsive gels: designing the building blocks of squishy bio-inspired devices" – *Mathematical Biology Meeting*, University College London, 30th October 2024
- 📢 "Tubular hydrogel pumps through a responsive LENS" – *Soft Matter Lunch*, University of Warwick, 30th September 2024
- 📢 "How to make a poster: ...also how you shouldn't, why you should care, and why they matter" – *Warwick Summer Undergraduate Research programme*, 28th August 2024
- 📢 "A linear-elastic-nonlinear-swelling model for hydrogels" – *Soft Lab Seminar*, University of Bristol / Bristol Robotics Laboratory, 3rd July 2024
- 📢 "Buckling and swelling instabilities of super-absorbent gels" – *UKFN BioActive & Non-Newtonian Fluids SIG Meeting*, University College London, 18th June 2024

- 🎤 “A linear-elastic-nonlinear-swelling model for hydrogels” – *Physics of Fluids & Soft Matter seminar, University of Manchester*, 17th May 2024
- 🎤 “Freezing soft porous gels” – *Warwick-Cambridge Quantitative Cell Biology Symposium 2024*, 16th May 2024
- 🎤 “A linear-elastic-nonlinear-swelling model for hydrogels” – *Warwick Applied Maths Seminar*, 3rd May 2024
- 🎤 “Buckling and swelling instabilities of super-absorbent gels” – *Squishy Journal Club, University of Oxford*, 28th November 2023
- 🎤 “Wrinkling instability of swelling hydrogels” – *76th Annual Meeting of the Division of Fluid Dynamics (APS)*, Washington DC, USA, 21st November 2023
- 🎤 “Linear stability analysis for the formation of wrinkles on confined swelling hydrogels” – *15th Annual InterPore Meeting*, Edinburgh, 24th May 2023
- 🎤 “A linear-elastic-nonlinear-swelling theory for hydrogels: displacements and differential swelling” – *75th Annual Meeting of the Division of Fluid Dynamics (APS)*, Indianapolis, USA, 20th November 2022
- 🎤 “Multidirectional gel swelling and drying: a linear-elastic-nonlinear swelling theory for hydrogels” – *14th Annual InterPore*

Teaching

- Preparation and delivery of Part III Preparatory Workshop for Continuum Mechanics, October 2023 (2 hours).
- Produced a series of 10 introductory videos (<https://tinyurl.com/partiiivideos>) covering key Continuum Mechanics content for incoming Part III students
 - Suffix notation
 - Basics of fluid mechanics
 - Flows in a rotating frame
 - Variational principles
 - Stokes flow
 - Lubrication theory
 - Boundary layers
 - Hydrodynamic instabilities
 - Internal gravity waves
 - Asymptotic expansions
- Cover lectures for University of Warwick **MA256 Introduction to Mathematical Biology**, October 2024 (6/30 lectures in course written by **Lukas Eigentler**)
- Cover lectures delivered for University of Cambridge Part IA (1st year) Mathematics *Introduction to Mechanics*, October 2022 (5/9 lectures in course).
- “How to make a poster: ...also how you shouldn’t, why you should care, and why they matter” talk for summer undergraduate researchers, August 2024

Supervision

- Co-supervisor (with T.D. Montenegro-Johnson) for three students on the Warwick Summer Research Programme for Undergraduates from Underrepresented Groups (August 2024)
- Co-advisor for fourth-year undergraduate R-project (**MA4K9**) student, 2024-
- Informal co-advisor for **Xietao Wang Lin** (MSc+PhD project with T.D. Montenegro-Johnson), 2024-
- Supervisor (small group teaching) for Cambridge undergraduate mathematics, over 300 hours of teaching time. Courses taught include
 - Part II (3rd year) Fluid Dynamics (2020)
 - Part IB (2nd year) Fluid Dynamics + revision (2021, 2022, 2023, 2024)
 - Part IB Variational Principles (2021, 2022+revision, 2023)
 - Part IB Methods (2021, 2022+revision, 2023)

Meeting, 2nd June 2022 (online)

- 🎤 “Dynamics of super-absorbent hydrogels” – *DAMTP Friday Fluids second year talks*, 27th May 2022 - awarded first prize
- 📖 “Dynamics of super-absorbent hydrogels” – *C-CLEAR / ARIES Doctoral Alliance Symposium 2022*, London, 17th March 2022
- 🎤 Various talks at (internal) Institute of Theoretical Geophysics seminars *February, May, October 2021; November 2022; January, November 2023*
- 🎤 “Transport of larvae into and out of porous reefs by waves” – *14th International Coral Reef Symposium, Bremen, Germany*, July 2020 (cancelled due to COVID-19 pandemic)
- 🎤 “Stokes drift through coral reefs” – *Open University Pure & Applied Maths Colloquium, Milton Keynes*, 4th February 2020
- 🎤 “Stokes drift through corals” – *Stokes200 Symposium, University of Cambridge*, 17th September 2019
- 📖 “Stokes drift through corals” – *STEM for Britain 2019, Houses of Parliament, London* (shortlisted finalist)
- 🎤 “An interesting experiment” – *International Conference for Technology Policy and Innovation 2015, Milton Keynes*, 17th June 2015

Professional experience

- **Organiser:** *Modelling hydrogels: building networks in the Mathematical Sciences* one-day meeting at the University of Warwick (9th December 2024).
- **Seminar organiser:** Soft Matter Lunches (Warwick, 2024-) Institute of Theoretical Geophysics weekly meetings (Cambridge, 2022-2024).
- **Undergraduate admissions interviewer:** Trinity College Cambridge (Mathematics) (December 2022 & 2023).
- **Undergraduate summer research:** with Prof Herbert Huppert FRS, DAMTP, University of Cambridge (2018-2019).
- **Research work experience:** with Dr Anthony Lucas-Smith, Department of Design and Innovation, Open University (2014-2016).

Other skills

- **Outreach:** Public outreach video on poroelasticity and coffee makers for the 2021 Cambridge Festival <https://www.youtube.com/watch?v=8zcdtzTBDdM>
- **Languages:** English (native), French (CEFR level B2 “upper intermediate”)
- **Computing:** comfortable in Windows or (Ubuntu) Linux. Proficient in C#, MATLAB, Mathematica, HTML/CSS, XAML. Some experience in FORTRAN 90. Capable user of \LaTeX for typesetting.
- **Quiz:** captained Trinity College Cambridge’s semi-finalist team on BBC’s *University Challenge* for the 2019-20 series.

Open-source tools

- **fix-matlab-eps:** A utility to fix the vector output of MATLAB’s contourf, removing white line artefacts by modifying the EPS output.
github.com/JWebber/fix-matlab-eps