Modelling hydrogels: building networks in the Mathematical Sciences

Mathematical Interdisciplinary Research at Warwick (MIR@W) Day
Warwick Mathematics Institute, 9th December 2024

Back row (L-R): *T. Ball (Warwick), P. Lewin-Jones (Warwick), M. Schuler (Warwick), S. Dooley (Warwick), C. MacMinn (Oxford), M. Butler (UCL), B. Davies (Warwick), G. Fortune (Cambridge), R. Cimpeanu (Warwick), G. Worster (Cambridge), D. Pihler-Puzović (Manchester), P. Pearce (UCL), T. Cole (Warwick), C. Cuttle (Oxford), W. Sharratt (Liverpool), M. Hennessy (Bristol), A. Münch (Oxford)*
Front row (L-R): *M. Ghosh (Oxford), D. Hewitt (Cambridge), J. Webber (Warwick), Z. Godard (Oxford), E. Jolley (Warwick), T. Montenegro-Johnson (Warwick), H. Wei (Oxford), A. Dsouza (Warwick), A. H. Namdar (Manchester), M. Liu (Birmingham), A. Juel (Manchester)*
Not pictured: *G. Alexander (Warwick), D. Booth (Warwick), J. Cook (Warwick), R. Holtzman (Coventry), E. Luckins (Warwick), J. Sprittles (Warwick), R. Style (ETH Zurich, online), M. Turner (Warwick)*

Post-it note task: what can we, as [part of] the UK gels community, do next?

One key take-away from all the responses to the task is that there is a clear appetite for something more permanent and structured bringing together both those within applied maths and in other fields working on hydrogels. Precisely what form this should take is not clear, but there is a desire that any such network:

- **Meets regularly:** meetings taking the form of one-day workshops, online seminars, or tutorial sessions?
- **Combines a number of disciplines:** takes input from experimentalists, theoreticians and those working numerically. Makes links with polymer physics/polymer solution researchers for wider appeal.
- **Has a mailing list** to share seminars/opportunities/news.
- Emphasises opportunities at the **interface with biology and medicine**

There were differing opinions on the form that this network should take – some were keen to follow the approach of a UK Fluids Network Special Interest Group (SIG). Others were concerned about the status of these groups given the upcoming changes to UKFN, and whether affiliating with the UKFN might align the group too closely with the fluid mechanics community when we want to remain interdisciplinary. However, these groups do provide a successful structure, have a wide reach, and other similar groups (for example, BioActive Fluids) successfully run workshops and a regular online seminar series.

Some responses also focused on the pedagogical role such a network could play, in the form of workshops on

- **Introduction to mathematical modelling of hydrogels**
- **Numerical techniques** and **computational methods**
- Learning about the physics of such materials **below continuum scale**

These suggestions perhaps reflect the mix of talks and attendees that we had on the day – with a strong "mathematical methods" nature to the talks, many of the suggestions took the form of what the continuum modelling/physics community could share with other researchers interested in hydrogels, but there were also suggestions for tutorials on:

- The **nature of biofilms and their biological relevance**
- Uses of **engineered hydrogels in medicine**
- The design of **functional devices with responsive gels**, from an engineering/materials science point of view

It was suggested that these aspects of a gels network could take the form of a summer school, if funding were available for such a large event.

Finally, some comments indicated a desire for stronger industrial ties, perhaps in the form of inviting industrial partners to share problems to which modelling solutions could be proposed. These could take the form of industry study days or ad-hoc collaborations with multiple members of the network.

Next steps	**Regular events?**	**Special events?**
• Create a gel network mailing list to remain in contact and plan our next steps • Plan the next meeting – should this be of a similar form or more interactive? • Share news widely with interested parties who don't necessarily operate in the same disciplines	• Online seminars • Regular network (in-person) meetings	• Tutorial sessions • Summer school