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Mathematical modelling of flow and transport processes in tissue engineering bioreactors SARAH WATERS, NATALIE PEARSON, JAMES OLIVER, University of Oxford, REBECCA SHIPLEY, University College London — To artificially engineer tissues numerous biophysical and biochemical processes must be integrated to produce tissues with the desired *in vivo* properties. Tissue engineering bioreactors are cell culture systems which aim to mimic the *in vivo* environment. We consider a hollow fibre membrane bioreactor (HFMB), which utilises fluid flow to enhance the delivery of growth factors and nutrients to, and metabolite removal from, the cells, as well as provide appropriate mechanical stimuli to the cells. Biological tissues comprise a wide variety of interacting components, and multiphase models provide a natural framework to investigate such interactions. We present a suite of mathematical models (capturing different experimental setups) which consider the fluid flow, solute transport, and cell yield and distribution within a HFMB. The governing equations are simplified by exploiting the slender geometry of the bioreactor system, so that, *e.g.*, lubrication theory may be used to describe flow in the lumen. We interrogate the models to illustrate typical behaviours of each setup in turn, and highlight the dependence of results on key experimentally controllable parameter values. Once validated, such models can be used to inform and direct future experiments.

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