Strongly-interacting dispersed particles may aggregate extensively resulting in phase separation, gelation, sedimentation or creaming. The ultimate fate of such dispersions is often framed in the context of “colloidal-scale” phase behavior, which links parameters such as the interparticle interactions and volume fraction of the particles to these behaviors. This is a convenient approach because it provides tangible connections between the macroscopic behavior and controllable variables, such as particle size. However, this approach does not consider any kinetic aspects of these processes and consequently predictions do not often match the experimental observed behavior. This leaves us wanting for more realistic models that anticipate and incorporate time-dependent changes in these mixtures. Ultimately, this should allow a far more accurate and rational connection between design variables and resulting characteristics of the dispersion to attain optimal systems.

As an example, the poroelastic model applies to colloidal gel and provides a connection between time dependent changes in the gels and tractable design variables. The model suggests a balance between gravitational, viscous and elastic forces leads to gel collapse in a predictable fashion:

\[
\frac{h_0 - h(t)}{\Delta h} = 1 - \exp\left(-\frac{t}{\tau}\right)
\]

such that the normalized, time-dependent height of the gel can be described in terms of simple exponential where $\tau$ is related to volume fraction of particles, viscosity of the continuous fluid, height of the bottle, and porosity and elasticity of the gel microstructure. However, this relationship is oversimplified in many cases as gels often exhibit structural reorganization (i.e. ageing) and even cracking behaviors on the time scale of the collapse. Further, this model is limited to describing gels and does not consider the variety of other behaviors.
exhibited by these mixtures.

Dispersions of strongly interacting particles are ubiquitous in academic and industrial systems. It is understood that they undergo time-dependent changes and exhibit a variety of properties. There is a need for a physical and mathematical framework to connect both with fundamental variables to attain optimal systems.