

# Constituent components of diffusion

Understanding equations as conjunctions of principles

- Diffusion of a substance on a 3-manifold is governed by physical quantities
  - concentration  $C \in \Omega_t^0$
  - (negative) diffusion flux  $\phi \in \widetilde{\Omega}_t^2$
  - diffusivity  $k \in \Omega^0$
- ... which satisfy
  - $\partial_t C = \star d\phi = \star d(k\star)dC$

# Constituent components of diffusion

Understanding equations as conjunctions of principles

- $\partial_t C = \star d\phi = \star d(k\star)dC$
- This is really the conjunction of two physical principles:
  - **Fick's first law:**  $\phi = k \star dC$
  - **Conservation of mass:**  $\partial_t C = \star d\phi$
- Informally, both of these give us holes in which we can plug the same two variables:  $C$  and  $\phi$
- We can formalise this using **multispans** and **undirected wiring diagrams**