This part is in Word to facilitate joint editing by multidisciplinary collaborators.

**Model goals:**

* Basic framework for multiscale model of COVID19 dynamics in lung epithelium
* Modular and extensible – later add
* Simple and fast enough to give early insights and high-throughput on HPC
* Link to nanoHUB for rapid dissemination and testing of prototype models.

**Basic model assumptions:**

* Tightly packed cell monolayer.
  + 2D for first prototypes.
  + Cell monolayer + mucus coating later.
  + Zero background birth and apoptosis rates for now.
* Virions are endocytosed with probability proportional to exposure time and local virion concentration
* Endocytosed virion needs to be uncoated in the cell
* SARS-CoV-2 is a single-stranded RNA virus. Uncoated virus immediately starts making virus proteins.
  + Replication occurs in cytoplasm.
  + Relication is largely independent of cell cycle status.
* Virus proteins are assembled into virions
* Virions are released from living cells (at some rate proportional to number of assembled virions)
  + Cell lysis is not necessary for virion release.
* Viral load is used for a basic PD: AUC of viral load increases probability of cell apoptosis
* Apoptosed cells lyse and release all contents:
  + Uncoated virus
  + Viral RNA
  + Viral proteins
  + Assembled virions
* Uncoated virus, viral RNA, viral proteins, and assembled virions all diffuse.
* In future prototypes, we’ll add immune cell components.
  + Death of epithelial cells should expose basement membrane and contribute to inflammation
  + Uncoated virions, viral RNA, viral protein, vrion, and inflammatory excretions could all contribute

**Custom cell data:**

Viral uncoating rate

Viral internalization rate

**Parameter estimates:**

Virion diffusion coefficient: ~15 micron^2 / sec 🡪 900 micron^2 / min

<https://bionumbers.hms.harvard.edu/bionumber.aspx?s=n&v=5&id=105948>

Let’s say uncoated virion has same diffusion.

Let’s say all others are ~10x more diffusive (smaller bits)

Let’s suppose that virus does not decay, but uncoated virus, viral rna, viral protein do have slow decay rates. For initial value, let’s make them survive 48 hours, so decay rate is ~ 1/(48\*60) 1/min