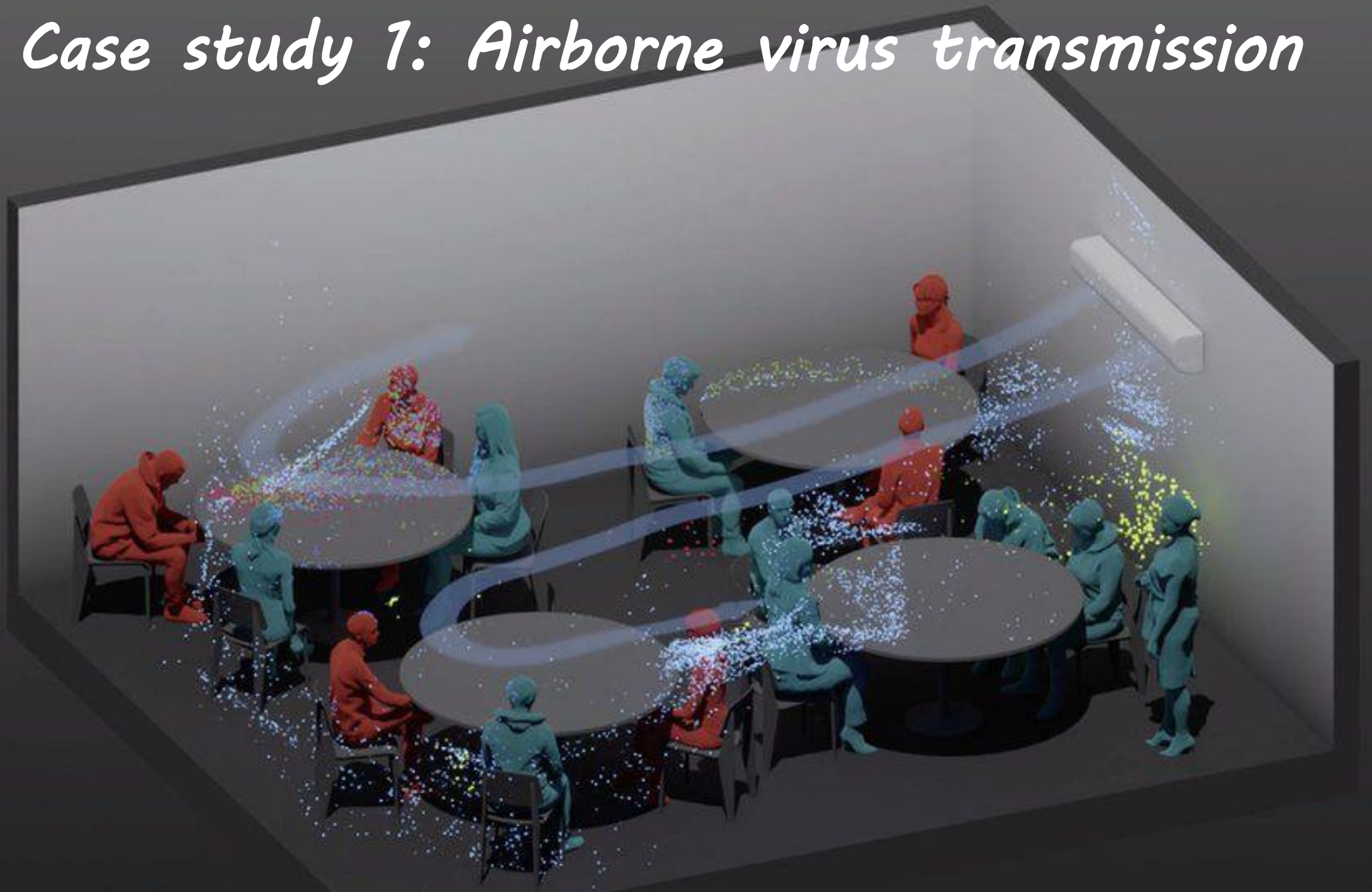


*Industrial Mathematics:
a Knowledge
Exchange Perspective*

*Ian Griffiths
Mathematical Institute
University of Oxford*

Case study 1: Airborne virus transmission





Llywodraeth Cymru
Welsh Government

*Can I eat dinner
with my friends?*



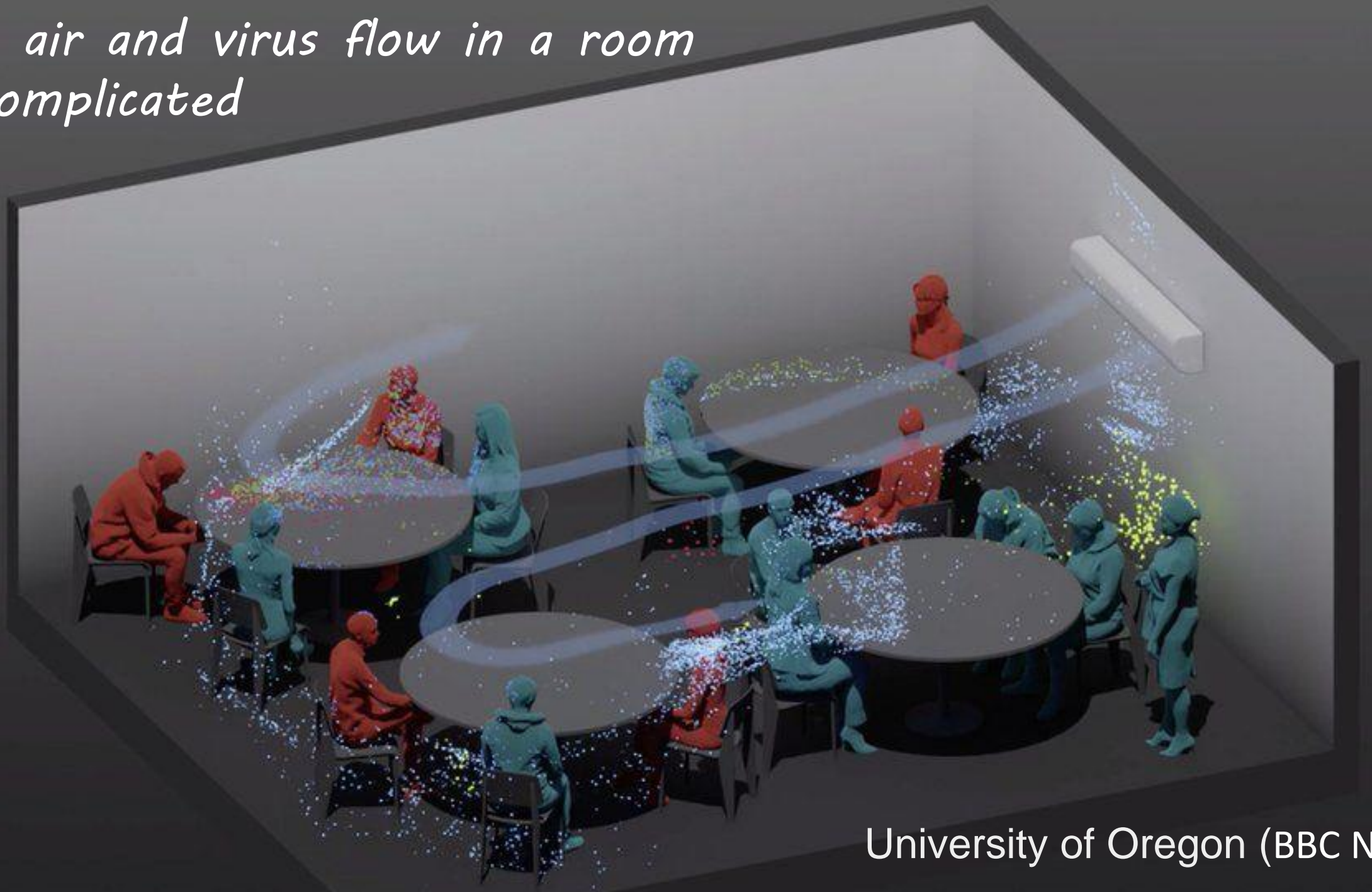
Is school safe?



Is the gym safe?








*The air and virus flow in a room
is complicated*



University of Oregon (BBC News)

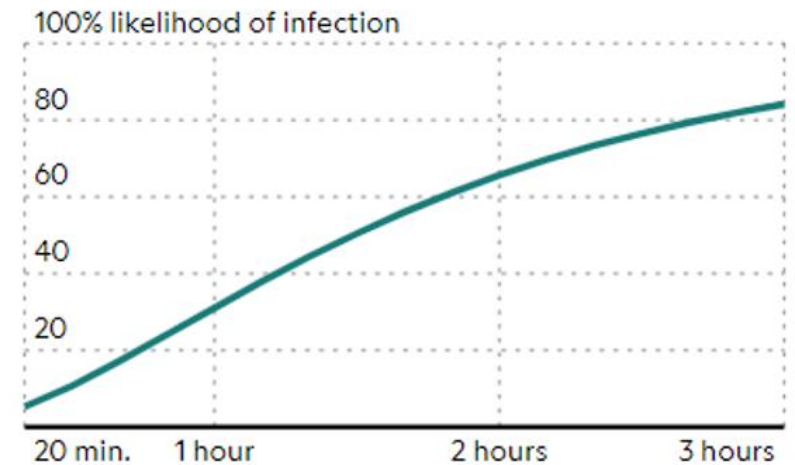
Most models assume the virus is spread uniformly in the room

The risk of infection from SARS-CoV-2 aerosols

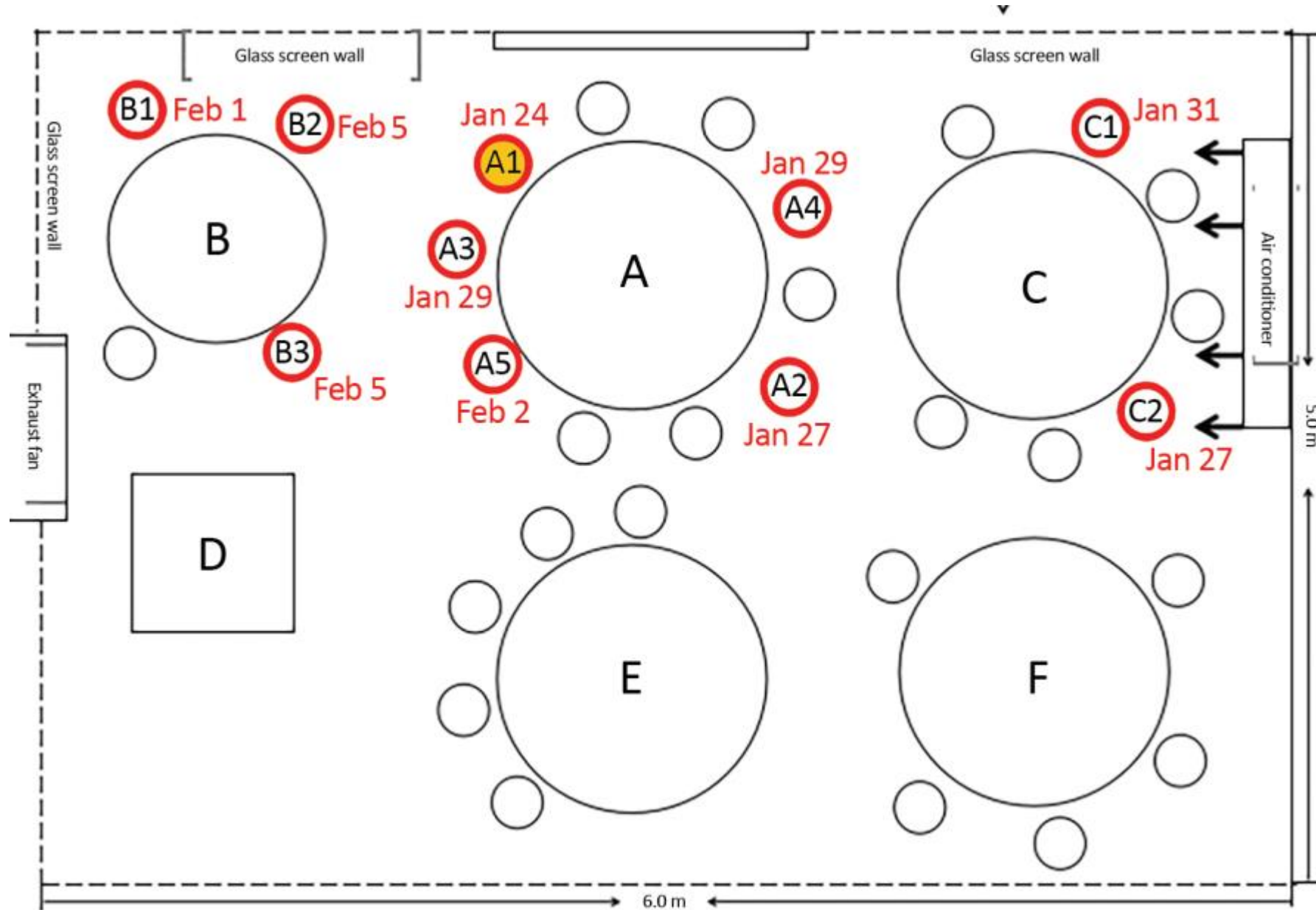
I live in an area where  0.81 percent of the population is infected. I'm wearing a mask that is  50 percent effective and have visited a room  20 times—it has  12 square feet of space per person. Everyone else in the room is wearing a mask that is  30 percent effective.

An indoor gathering

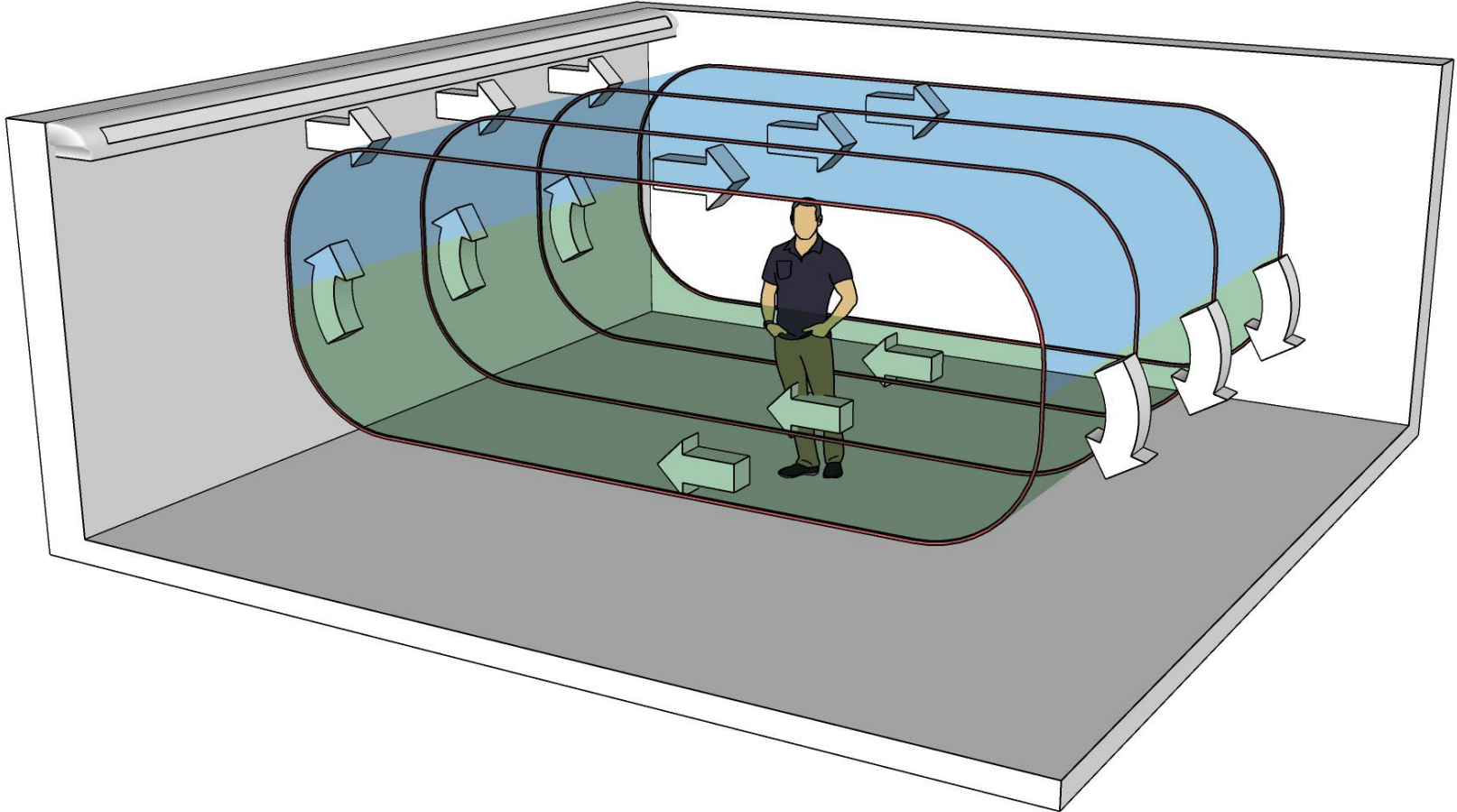
A poorly ventilated space with pervasive talking and movement



The Guangzhou restaurant superspreader incident, January 2020



We model the airflow as a loop pattern:

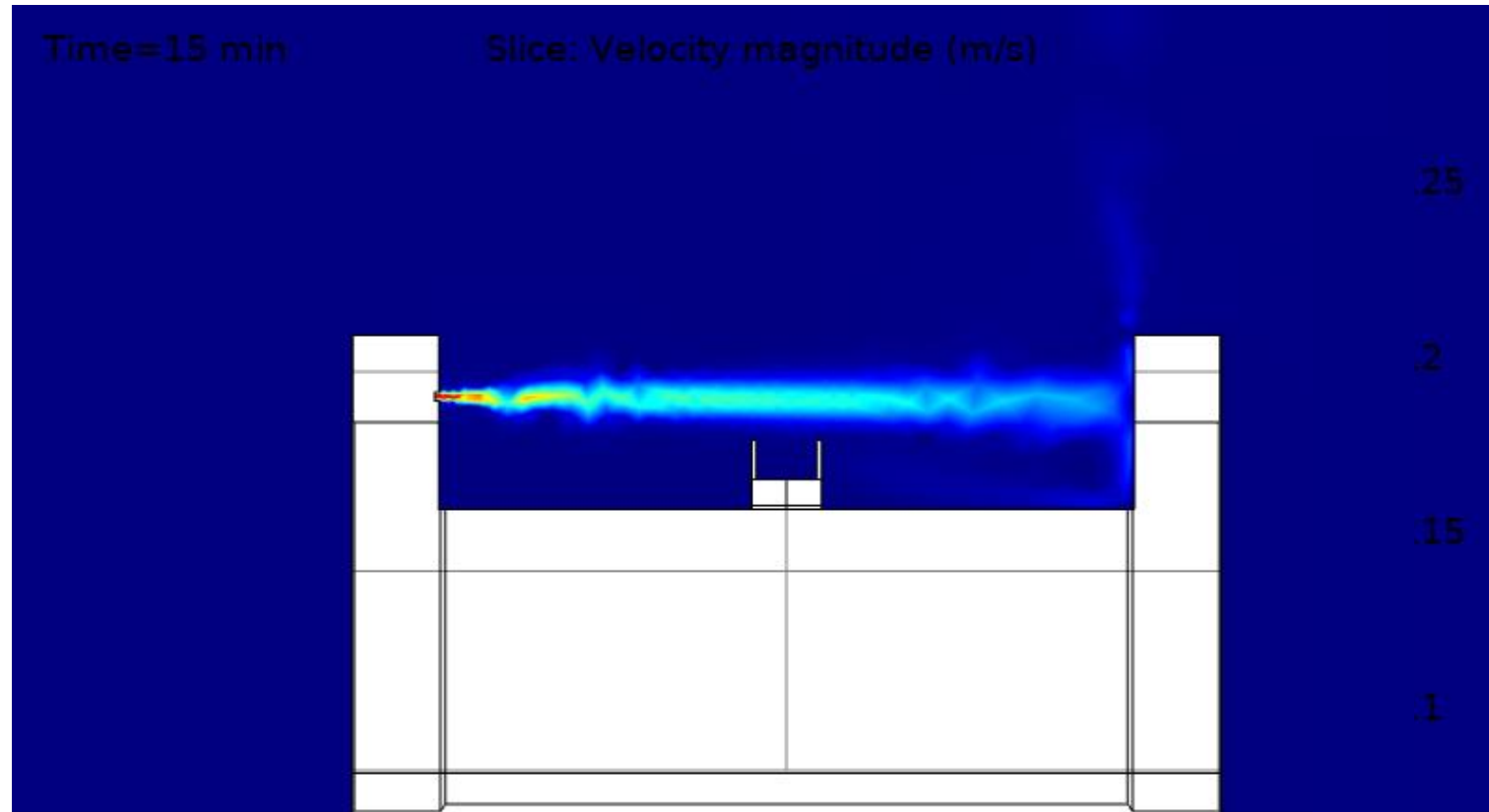


bit.ly/airvica

Smart Separations invented an air-purifier that removes coronavirus

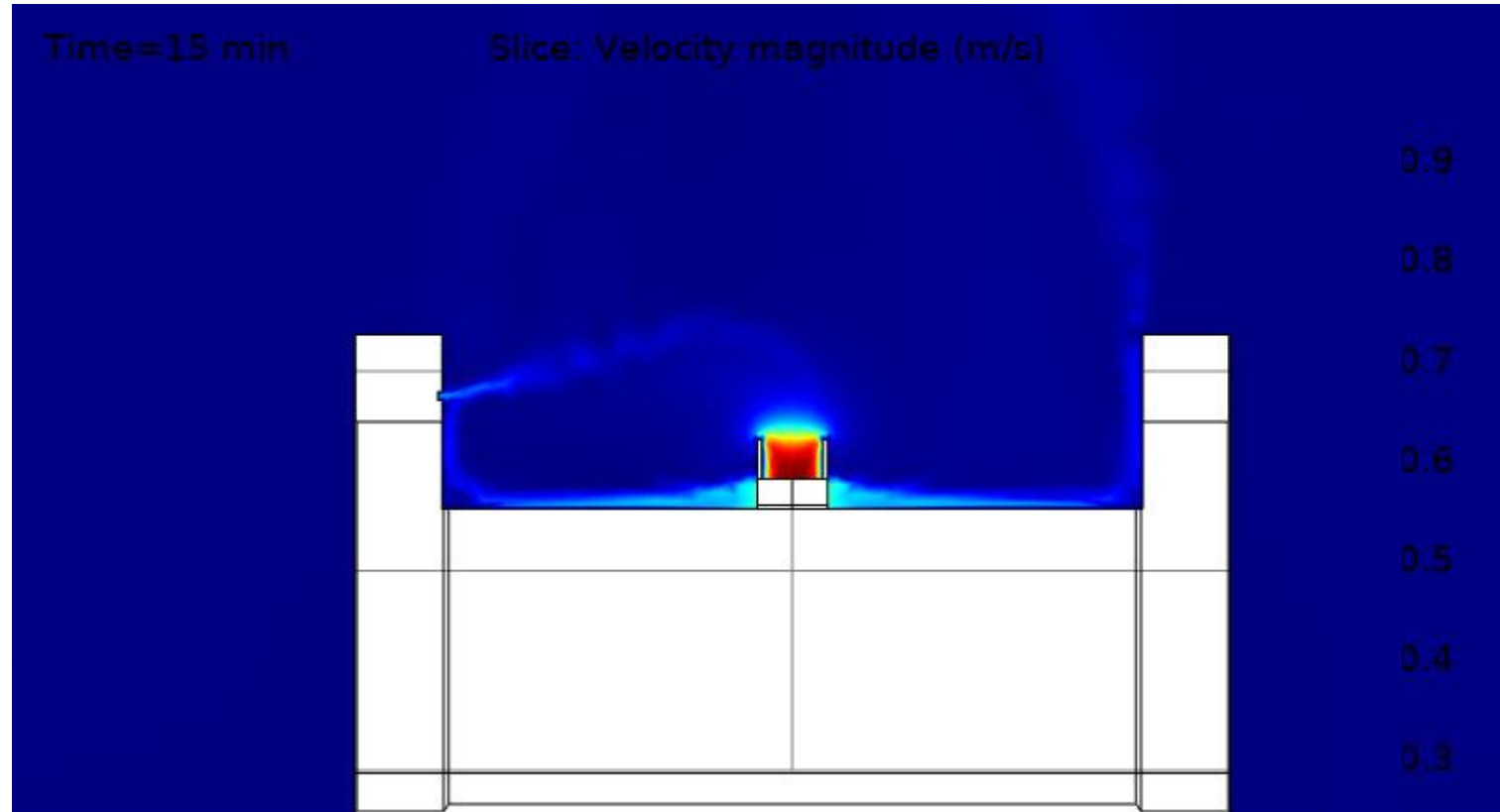


Computational simulations allow us to model the air flow



Talking across a table with an infected person

Computational simulations allow us to model the air flow



Gino captures the coronavirus air



Knowledge exchange



Academic journals are not always the best way to communicate our work



Close collaboration with industries allows for product tuning and redesign



Are web apps/interactive journals a better way of communicating our work? (eg, visualpde.com)

Case study 2: Extrusion processes



cookie cutter



golden syrup



What shape cookie cutter should we use to make a perfect gingerbread man once baked?

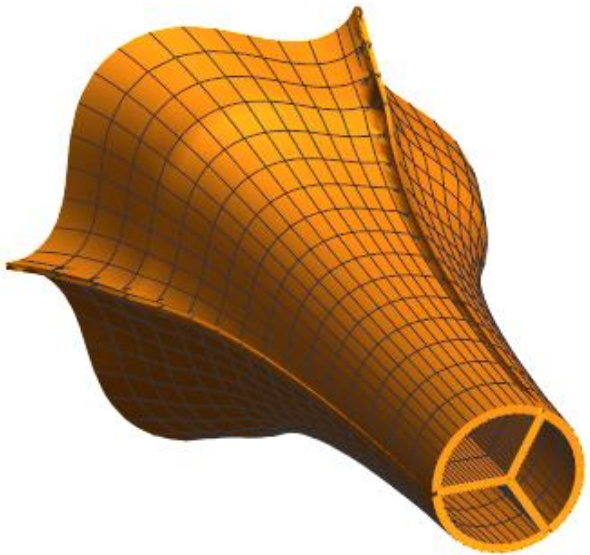
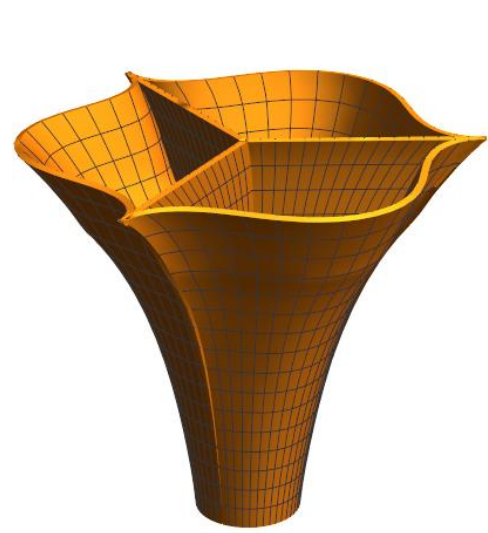
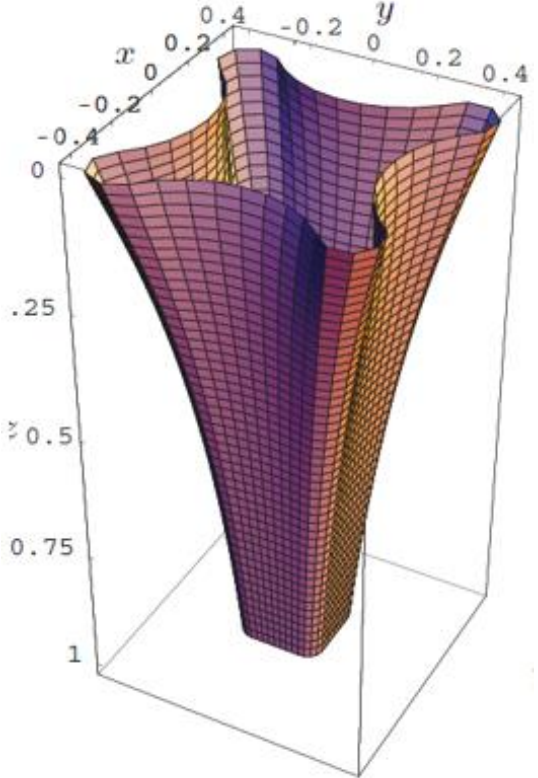
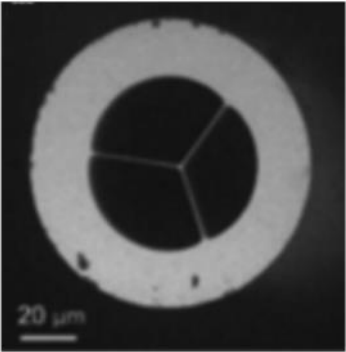
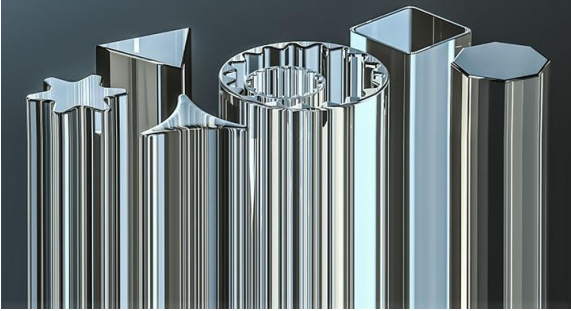


Play-Doh Fun Factory



Rigatoni pasta maker

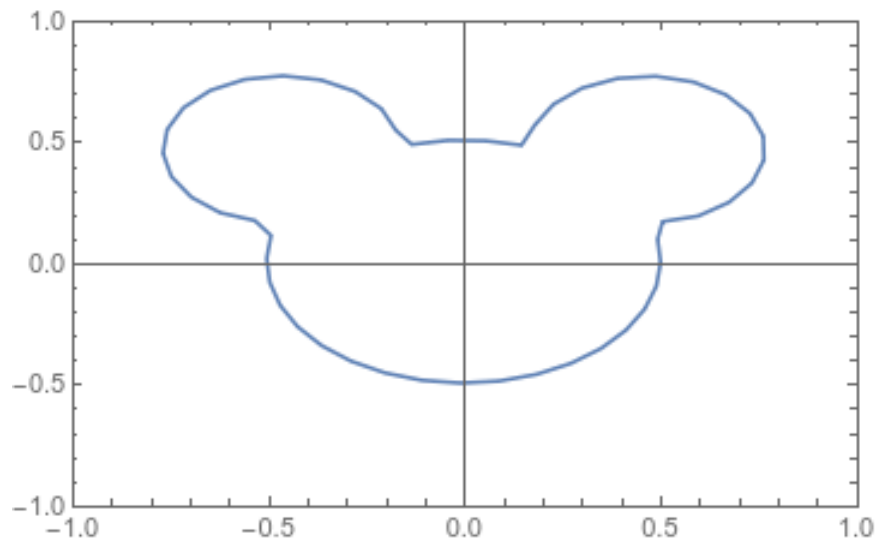
What shaped hole creates a desired final shape?



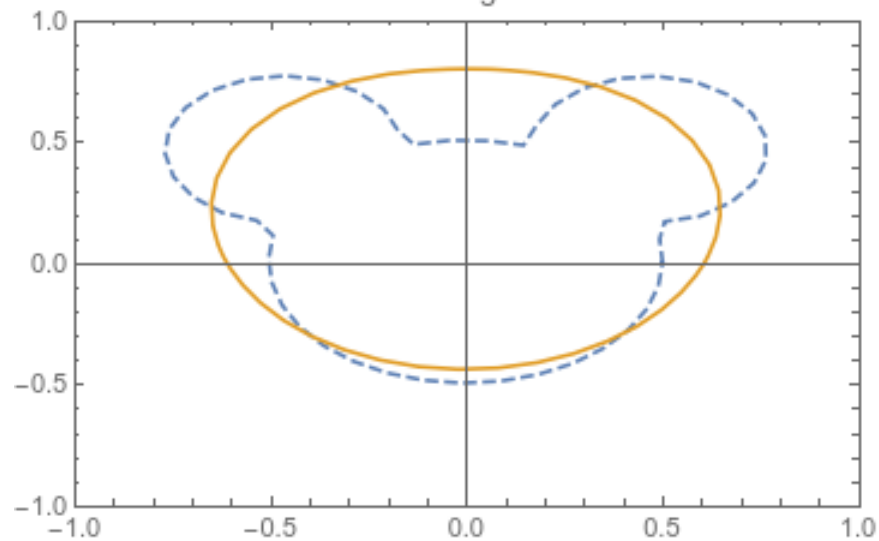




$t = 0.$

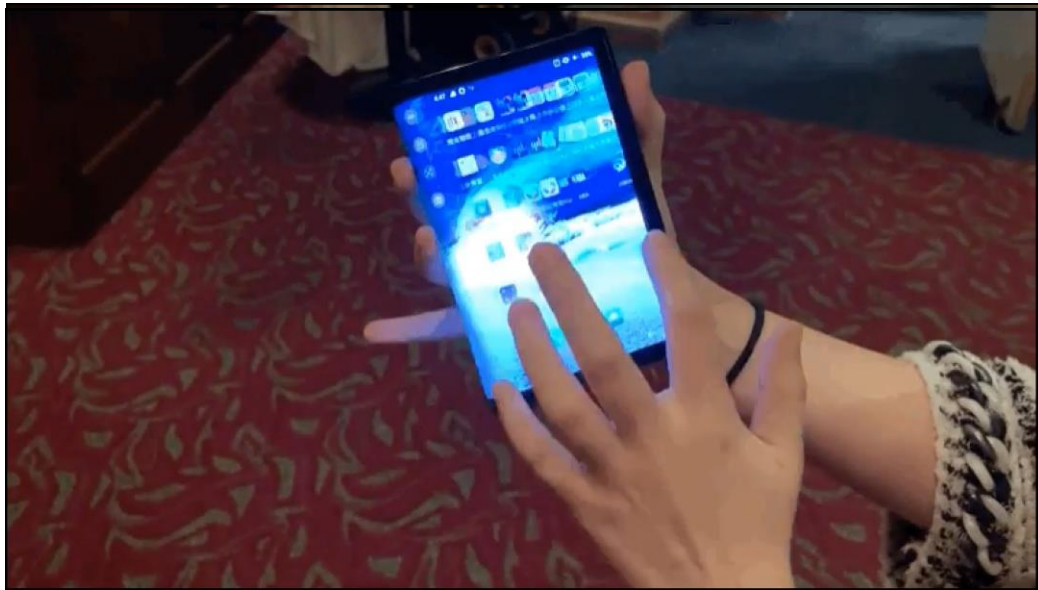


Final Configuration



Glass manufacture

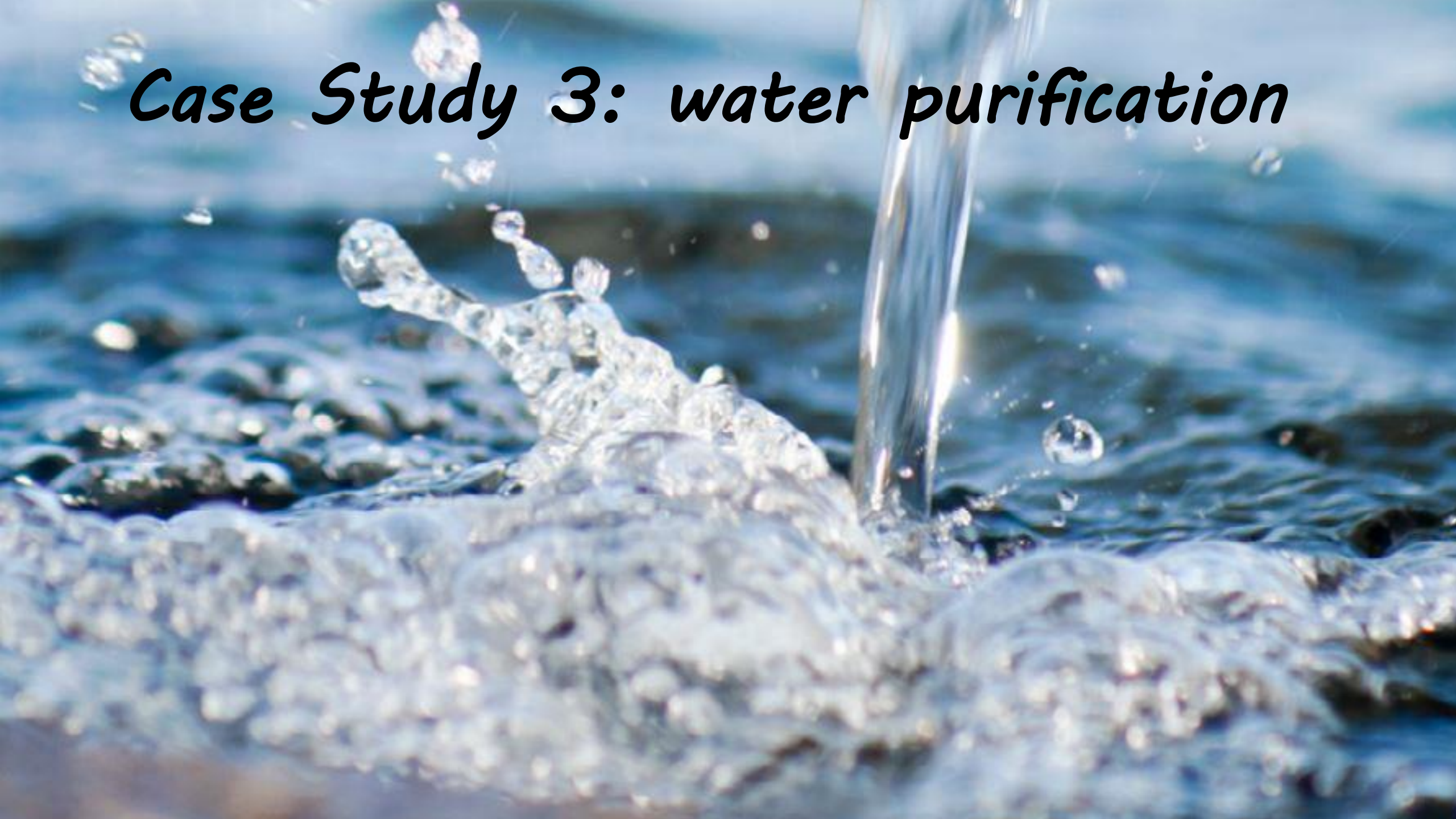
Our mathematics is now used to make the glass sheets for *Samsung* and *Huawei* mobile phones and for the new bendable smartphones and tablets



Knowledge exchange

- ✓ *Simple ways to communicate the ideas may be used for outreach*
- ✓ *Schott Simulation Group provide a bridge to technology translation*
- ✓ *Similar mathematics can lead to solutions to different problems*
- ? *Reduced problem approach not always welcomed*

Case Study 3: water purification



Bangladesh

Latest

> **Newsline**

Statistics

Contact us

Country website

Providing safe water for families in Bangladesh



By Naimul Haq

BAGERHAT DISTRICT, Bangladesh, 24 February 2010 — Defying stifling heat and humidity, Maya Begum walks more than an hour from her village to fill two large plastic containers with drinking water for her family of four.

The INDEPENDENT

Arsenic-tainted water from Unicef wells is poisoning half of Bangladesh

PETER POPHAM IN DHAKA | Saturday 05 September 1998



© Lathigra-F.S.P./Ganna, Paris

Karagas, The Lancet, 2010

A strategy for arsenic removal?

Iron-rich laterite soil removes arsenic



- *How do we know when a filter has expired?*
- *How do we upscale for a school or community?*

State of deployment

- Filters serve 150,000 people
- Filters now manufactured by two companies
- UNICEF have deployed 45 community-scale filters
- Now studying fluoride and reactive dye removal




Ambika Soudamini school 1500 litres per day



Dutta Pukur 2000 litres per hour

Knowledge exchange

 *Chemical engineers acted as a technology translator for practitioners*

 *Videos can give broader reach*

 *International engagement with a developing country*

 *Different timescales for the experimental and theoretical components of the study*

Departmental Knowledge Exchange

Public Engagement team

- *Social media:*
 - *70k Maths Twitter followers*
 - *368k Maths YouTube subscribers*
 - *University social media*
- *Public lectures*
- *Case Studies and videos*
- *Alumni newsletters >12k*
- *Knowledge Exchange Hub (Chris Breward, Rachael Harris)*



*We don't know who
the audience is*

Departmental Knowledge Exchange

Part of the Mathematical Institute is open to the public

Oxford Mathematics
Public Lecture

THURSDAY 23.02.23 | 5–6.15PM
Mathematical Institute, Oxford



Cascading Principles
*Conrad Shawcross and
James Sparks with
Fatos Ustek*

Oxford Mathematics **[XTX]**
MARKETS

Departmental Knowledge Exchange

- Industrial engagement in Oxford culminated in the *Industrially Focused Mathematical Modelling (InFoMM) Doctoral Training Centre*



- The centre has more than *70 industries* engaged:



Closing thoughts

- *A good working relationship with the end user*
- *Be aware of your end user's mathematical level*
- *An intermediary can be useful*
- *Identify similar methodologies for different challenges*
- *Explore different ways to disseminate your work (videos, web apps, social media)*
- *Be willing to try different approaches (even if they sometimes fail)*