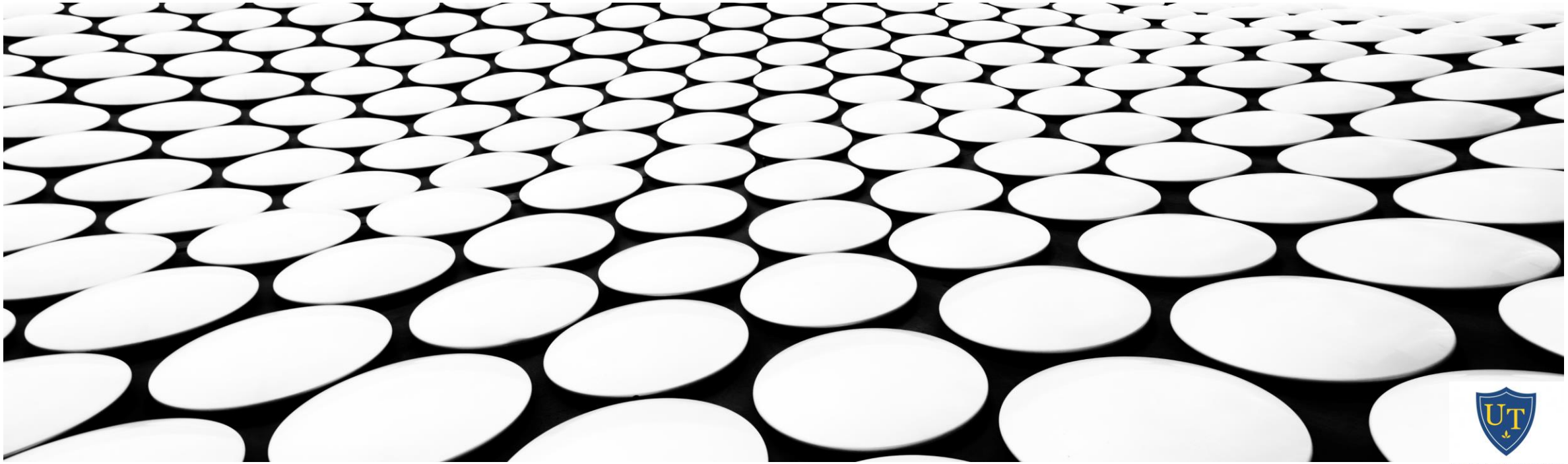
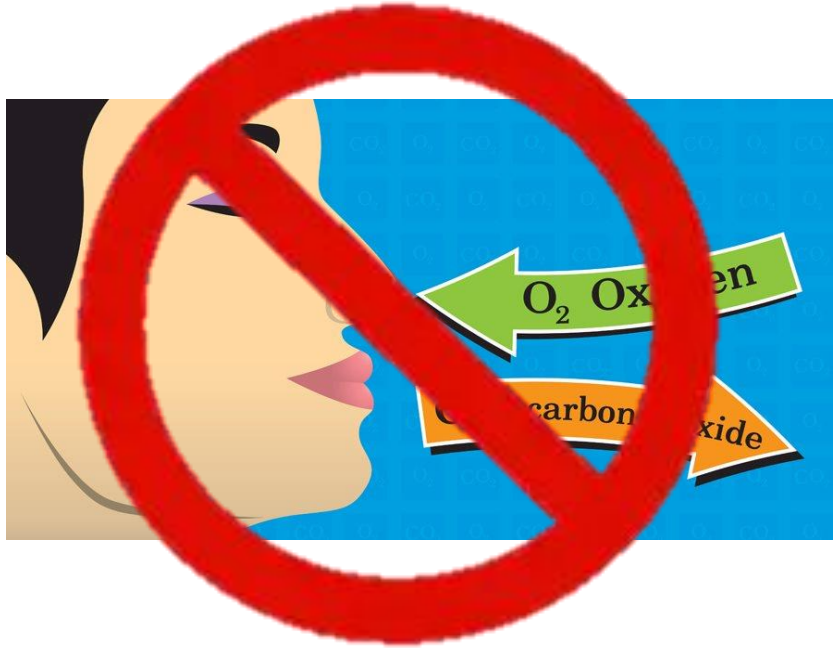
FACE MASKS

HOW DO THEY MEASURE UP



WHY WEAR A MASK

- Tiny particles come out of everyone's mouths and noses in many different ways:
  - Singing
  - Laughing
  - Yelling
  - Talking
  - Coughing
  - Sneezing
  - Breathing

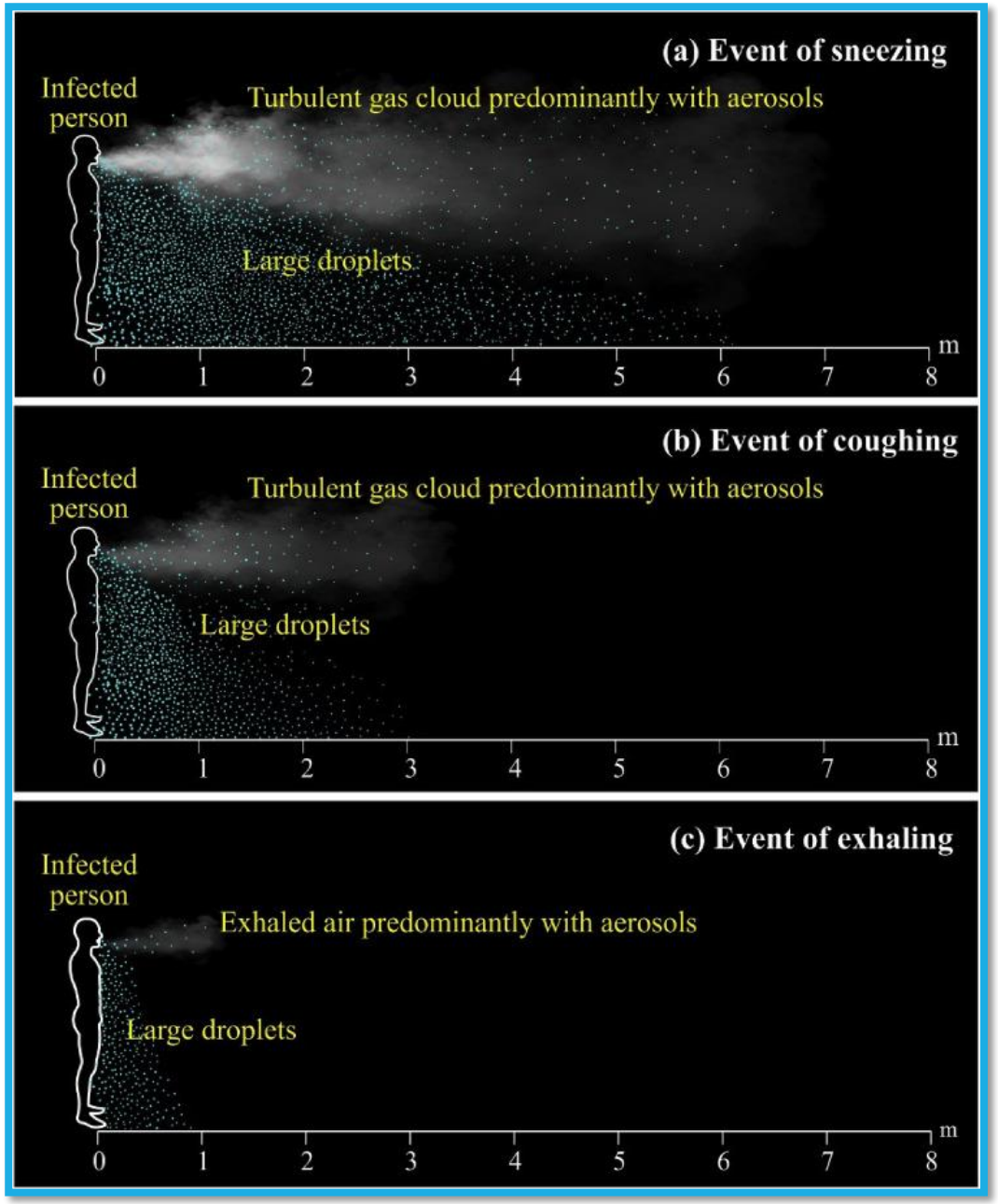


EXHALED AIR IS NOT JUST CO_2

- Gasses
  - 4% Carbon Dioxide
    - 0.04% inhaled
  - 79% Nitrogen
    - 79% inhaled
  - 16% Oxygen
    - 21% inhaled
- Water Vapor
  - Bacteria
  - Viruses

VIRUSES CLING TO PARTICLES

- Cannot “free-float” in the air
- Can stay in air for minutes to hours
- Thousands can be in one particle

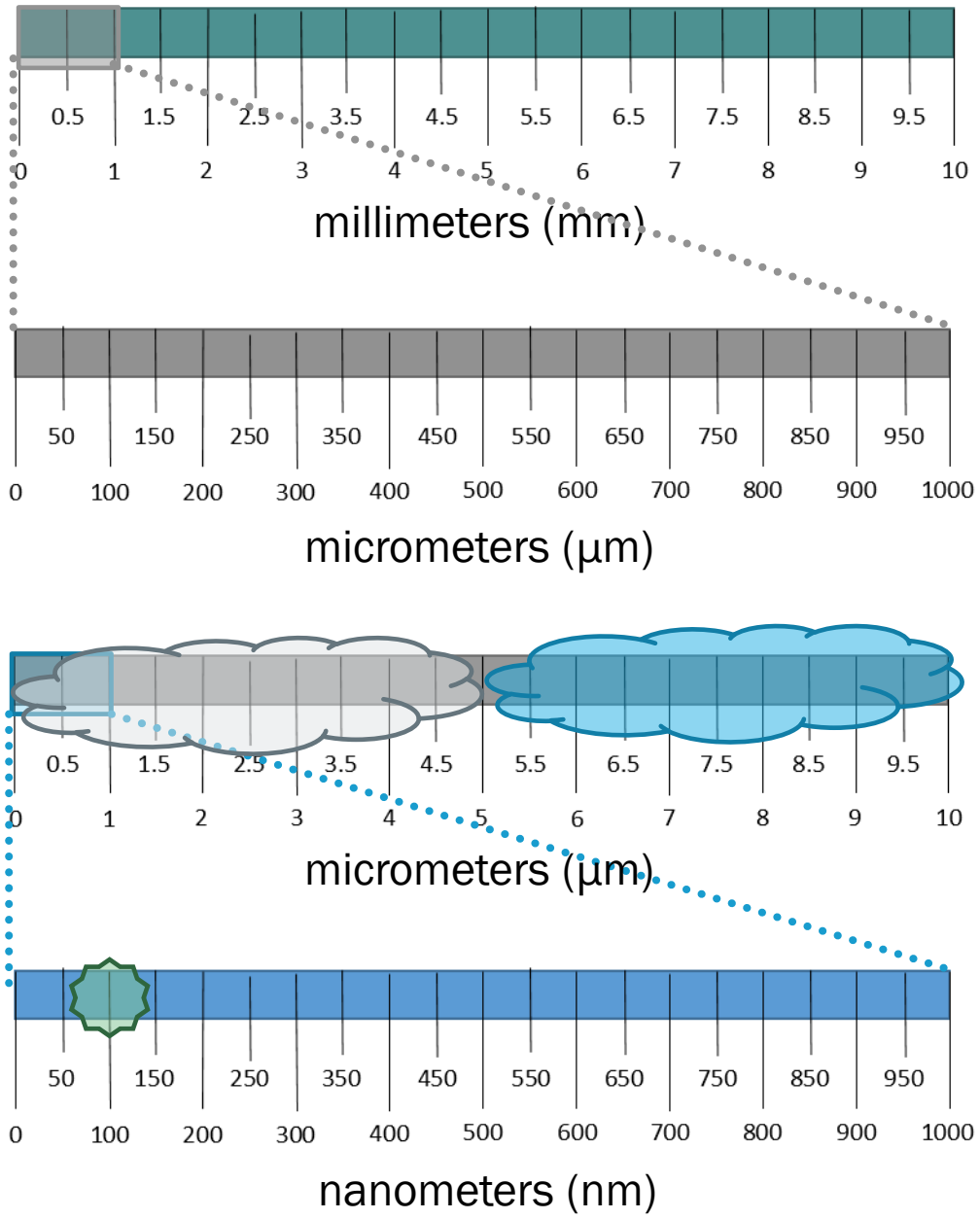


TYPES OF PARTICLES IN EXPIRATION

- Droplets
  - Sneezing, coughing, talking, chanting
  - Fall from the air relatively quickly
- Aerosols
  - Talking, laughing, singing, breathing
  - Can stay in the air for hours

1 meter ~ 1 yard ~3 feet

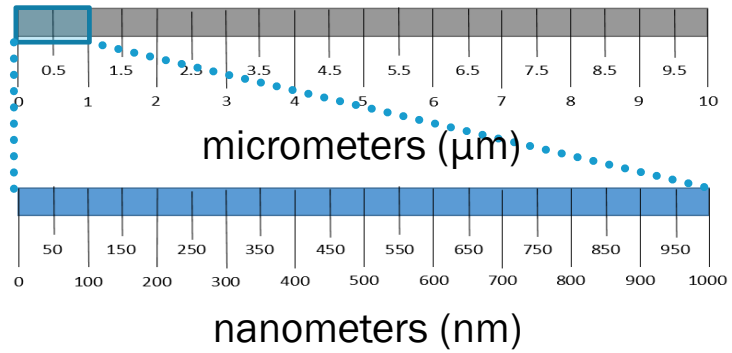
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7293495/figure/fig2/?report=objectonly



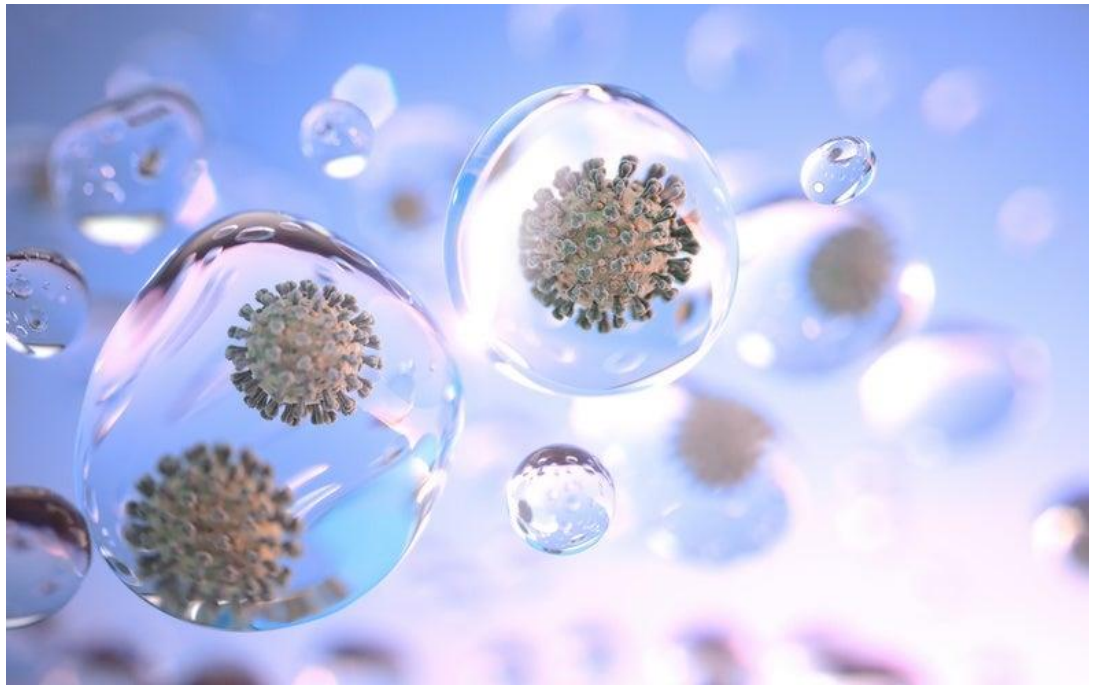
SIZING UP THE THREATS

- Covid 19: ~60-140 nanometers
- Droplets: larger than 5 micrometers
- Aerosols: smaller than 5 micrometers

DEBUNKING COMMON MYTHS

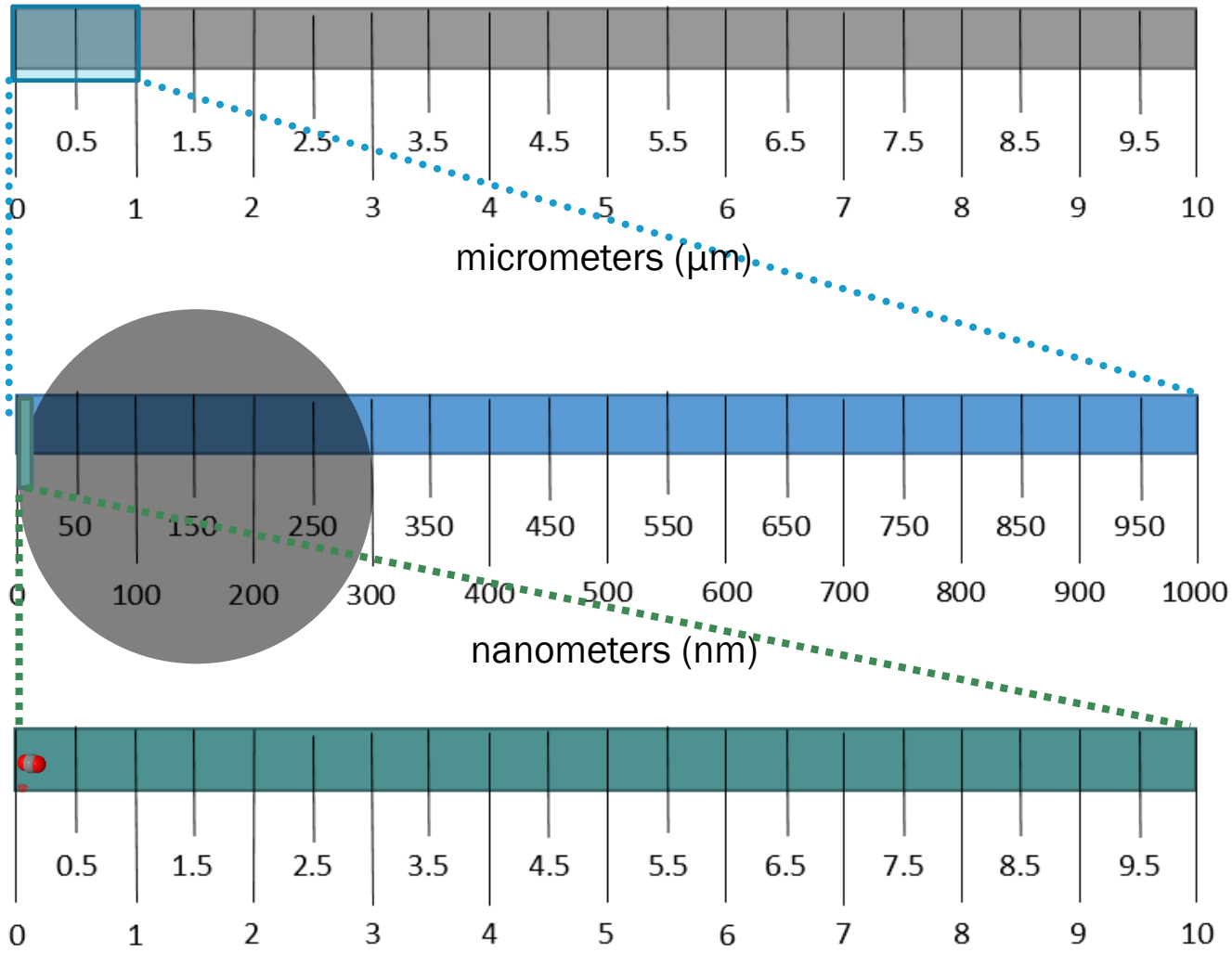


- **MYTH:** “Since the Covid-19 virus is so small, it can go through an N95 mask.”
- **FACT:** The novel coronavirus cannot exist in the air on its own, it floats in the air in droplets and aerosols, which are much larger.
  - In addition, N95 masks, surgical masks, and mask filters contain treated fibers that attract small particles.



DEBUNKING COMMON MYTHS

- **MYTH:** “Wearing a mask is bad because you breathe in your own carbon dioxide/you can’t get enough oxygen”
- **FACT:** Holes in an N95 mask are 300 nanometers wide (0.3 micrometers)
  - A carbon dioxide molecule measures 0.33 nanometers (0.00033 µm) in diameter.
  - An oxygen molecule measures 0.152 nanometers (0.000152 µm) in diameter.



PUTTING OUR MASKS TO THE TEST

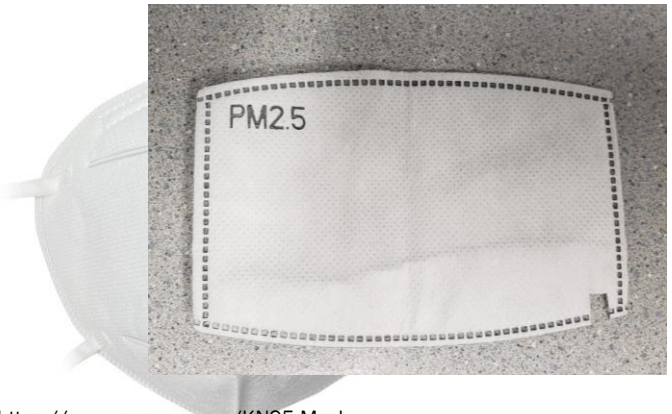
USING A SCANNING ELECTRON MICROSCOPE (SEM) TO EXPLORE THE EFFECTIVENESS OF DIFFERENT MASKS

† Mask effectiveness based on CDC guidelines: https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/cloth-face-cover-guidance.html

THE HYPOTHESIS

Effective† masks will have smaller holes and/or more layers

- Most effective/recommended:
  - Non-medical disposable masks
  - Tightly woven cloth masks
  - Masks with more than one layer
  - Masks with filters



https://www.amazon.com/KN95-Mask-Pack-of-50/dp/B086W7BKZZ

- Less effective/not recommended:
  - Loosely woven cloth masks
  - Masks with only one layer
  - Non-breathable cloth masks (leather, vinyl, etc)
  - Surgical or N95 masks*

*These masks should be reserved for medical professionals and those on the front lines of the pandemic

https://www.generalinsulation.com/products/safety/respirators-cartridges-filters/n95-particulate-respirator/

OUR MASKS

1. Gaiter
2. Neoprene
3. KN95 outside layer
4. KN95 inside layer
5. Cotton
6. PM 2.5 filter
7. Spandex
8. Disposable mask
9. Scarf
10. Bandana

https://ohioishome.com/shop/accessories/masks/gaiter-mask-face-covers/

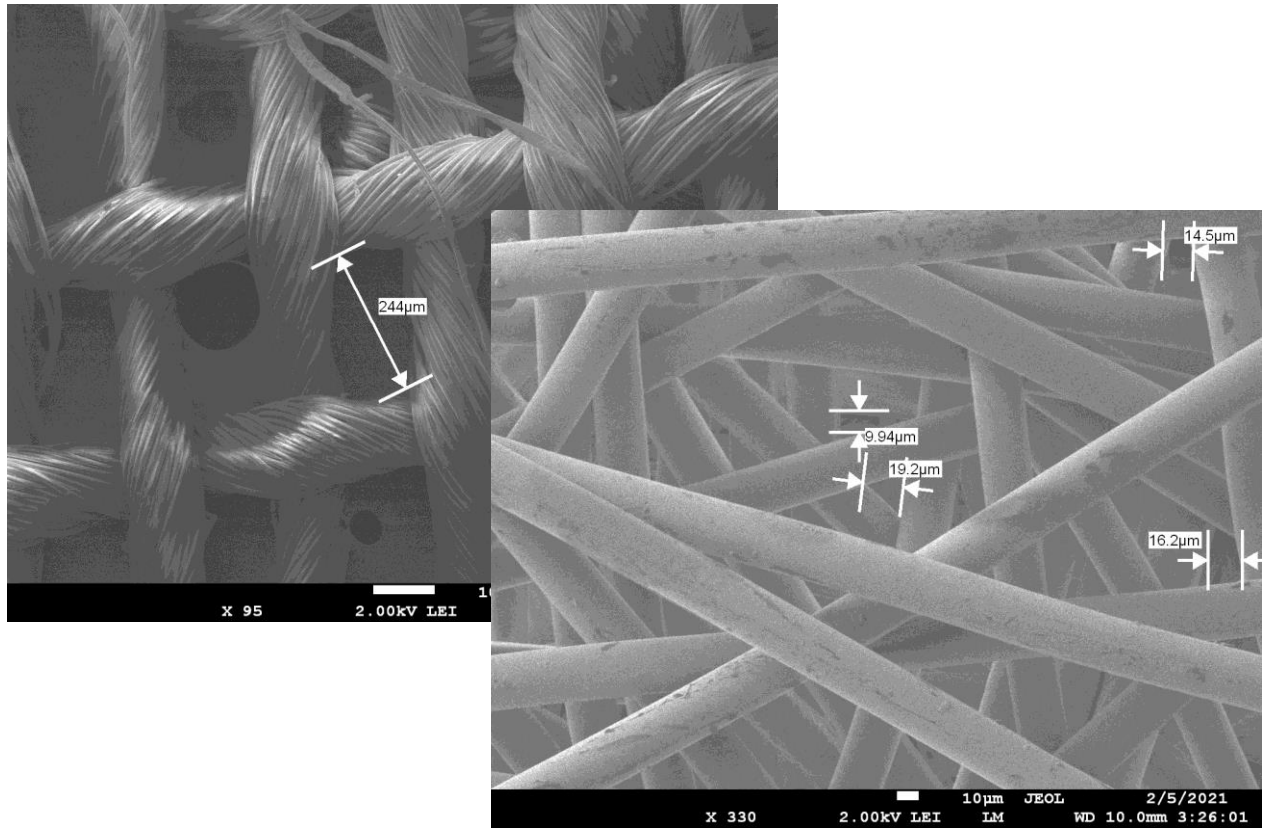
https://www.amazon.com/KN95-Mask-Pack-of-50/dp/B086W7BKZZ

https://www.inexgear.com/products/the-better-bandana-v2-navy?variant=32937764585565&currency=USD&utm_medium=product_sync&utm_source=google&utm_content=sag_organic&utm_campaign=sag_organic&gclid=Cj0KCQiAyJOBBhDCARIsAJG2h5eEWU7Rh8YBRAEVI6M1MyUKA_IHEnKbrG-AO-F2_oW4ke6SstXMmIIaApsjEALw_wcB

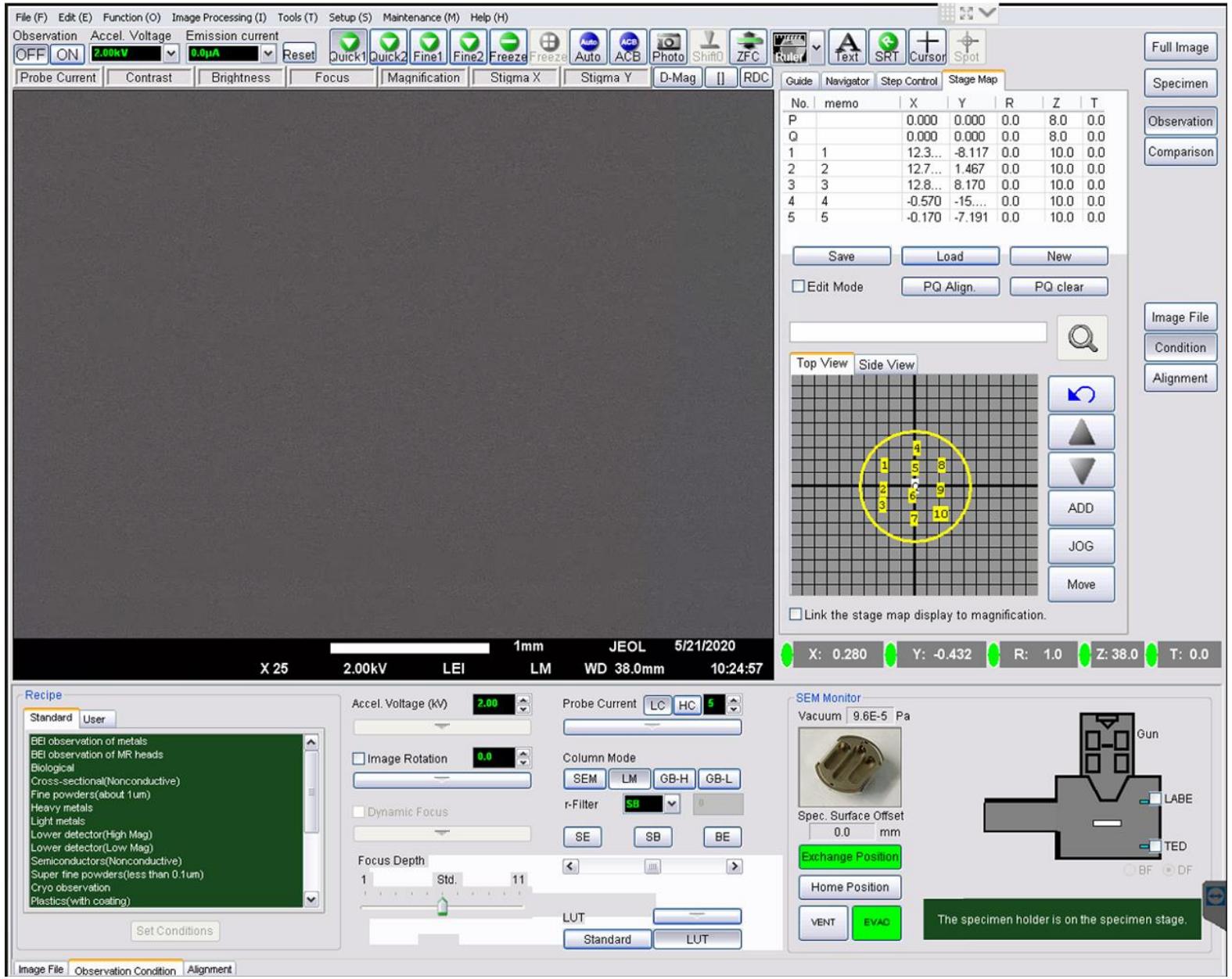
THE METHOD

Use the SEM to measure holes in different face types of face masks

- Zoom in on the fibers of a mask to see the holes
- Take a picture of the fabric
- Note observations
  - Can you see the carbon tape underneath?
  - Can you see holes before you start to zoom in?
  - Does the fabric look tightly or loosely woven?
- Measure the sizes of the holes using software tools



REMOTELY USING THE SEM



RESULTS/CONCLUSIONS

How our observations relate to our hypothesis

- Did the “more effective” masks have smaller holes or layers?
- Did all of the masks have uniform or regular weaving?
  - Which type of weaving is considered more effective?
  - Why do you think that type is more effective?