

## BIO 26 PAL Worksheet

### Week 11 (#2): COVID-19 case study

All viruses, including SARS-CoV-2 (the virus that causes COVID-19), change over time. Unfortunately, a new variant emerges during the Fall '22 semester, and the variant's origin is – of all places – the California State University campus in Sacramento. Local virologists are still busy fighting prominent variants such as Alpha, Beta, Delta, and Omicron, so your group is tasked with developing an urgent, robust, and professional response to this variant. After all, you are the expert now!

1. In order to avoid confusion, your group has to name this variant (e.g. COVID-Bio26 😊). Start your (whiteboard) campaign with a name for your variant!
2. Just as SARS-CoV-2, the new variant is spherical and has a (transmembrane) spike protein, allowing it to penetrate host cells and to initiate infection. Next to your virus' name, draw your variant with its new spike protein. Make sure your spike protein is “special” so that (later on, under 5.) antibodies can easily neutralize the virus.
3. Also similar to SARS-CoV-2, the principal mode by which people are infected with your variant is through exposure to respiratory fluids carrying infectious virus. Advise the public on how to avoid exposure to your variant.
4. Research findings indicate that your variant attacks the respiratory system, causing a) pneumonia but also b) lymphopenia in infected individuals.
  - a) On your whiteboard, outline the affected organ system and show your variant entering a cell. Which non-specific barrier/surface defense is your variant able to penetrate? Can you name one cell type that is infected early on during this disease?
  - a) There is a strong link between lymphopenia, a condition defined by abnormally low counts of lymphocytes, and multi-organ failure and death. Explain!
5. Laboratories all over the country are trying to keep up with the demand for mRNA vaccines for older variants, and your group is instructed to use a more traditional vaccine development method. You agree since you are familiar with the spike protein of your variant (see 2.).
  - a) On your whiteboard, draw the antibody you are hoping to develop (one that neutralizes your variant).
  - b) Think of one method your group would use to create active immunity and one method to create passive immunity.
  - c) How will your vaccine ensure that another exposure (a year later) to the variant leads to a swift and powerful immune response?
  - d) Would you recommend a booster shot? If so, why?

Bonus: A small research study investigates the immune response in participants vaccinated with your vaccine. Results show that their response is mainly due to the humoral-mediated branch. Why is there almost no cell-mediated response? Hint: how do these branches differ with respect to first stimulation?