

Webinar Q&A Report:

Using SARS-CoV-2 to Teach Physiology and Science

1. What happens to the 442 other amino acids of angiotensinogen?

D. Silverthorn: The AGT remnant is called des-angio I-angiotensinogen and using it as a search term in PubMed brings up only 3 papers from the 1980s, from a group in France that made a specific antibody for it. They used des-angio I-angiotensinogen as an indirect measure of ANG I production. No one really knows much about the biological actions, metabolism, or fate of des-angio I-angiotensinogen.

2. What eye cells/tissue has ACE-2 receptors?

D. Silverthorn: Most studies discuss Ace2 on the ocular surface and conjunctiva. A recent citation network analysis summarizes the literature on this:

Sánchez-Tena MÁ, Martínez-Perez C, Villa-Collar C, Alvarez-Peregrina C. Impact of COVID-19 at the Ocular Level: A Citation Network Study. *J Clin Med*. 2021;10(7):1340. Published 2021 Mar 24. doi:10.3390/jcm10071340

3. Is the virus load associated with severity of disease?

D. Silverthorn: A few studies that have been done suggest that higher load is associated with more severe disease. See, for example,

Fajnzyblber, J., Regan, J., Coxen, K. et al. SARS-CoV-2 viral load is associated with increased disease severity and mortality. *Nat Commun* 11, 5493 (2020). <https://doi.org/10.1038/s41467-020-19057-5>

4. Do you spread your topic over the weeks? Incorporate it in various organ systems?

D. Silverthorn: Yes, I put it in wherever it provides a good application/example of a mechanism or process they have studied.

5. How come the virus increases the coagulation process?

D. Silverthorn: Apparently it is not the virus causing the clots, but an autoantibody that is a result of the body's immune response.

6. The reduced saturation has nothing to do with hemoglobin ability to bind to O₂?

D. Silverthorn: Everything I have seen says reduced saturation is primarily the result of low plasma P_{O₂} (dissolved oxygen). Fever will shift the curve to the right and decrease saturation.

7. Is there evidence that introducing COVID related material makes students more motivated to approach studying physiology in the integrated manner?

D. Silverthorn: I don't know that anyone has formally studied this but many people, including some who left notes during the seminar, say their students pay more attention when COVID is mentioned.

8. What is causing the loss of taste and smell in COVID-19?

D. Silverthorn: Loss of smell occurs when the virus destroys the sustentacular support cells, which have ACE2. Neurons don't have ACE2. The olfactory neurons do lose their cilia when the support cells are destroyed. Loss of taste is not well understood.

9. Why are young children less susceptible to COVID-19?

D. Silverthorn: There are two theories: children have fewer ACE2 proteins on their cell surfaces, or most infection occurs through the cranial sinuses, and those are not fully developed in children until about age 12.

10. When the mRNA vaccine is given and taken up by muscle cells, the muscle cell supposedly puts the spike protein, that was made on its membrane, attached to MHC1 molecules. This activates cytotoxic T cells. Do these cytotoxic T cells attack the muscle cell that had the MHC1 molecule?

D. Silverthorn: Most literature I have seen suggests that the vaccine is not taken up specifically by muscle cells. According to the CDC, the IM injection technique is the way to get the vaccine most rapidly into the bloodstream where it is taken up by immune cells that make the spike protein and display it. A free article on mRNA vaccines that predates COVID:

Pardi N, Hogan MJ, Porter FW, Weissman D. mRNA vaccines - a new era in vaccinology. *Nat Rev Drug Discov.* 2018 Apr;17(4):261-279. doi: 10.1038/nrd.2017.243. Epub 2018 Jan 12. PMID: 29326426; PMCID: PMC5906799.

11. In which scenario did you use the SARS-CoV2 material? Seminar on pathophysiology? Integration of physiology systems? Pieces in physiology classes?

D. Silverthorn: I insert the material into my normal introductory physiology class in pieces where it applies to a particular system. It is also useful at the end of the course to help show the integration of systems.

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