**Using MOF and zeolite nanoparticles to produce microporous water**

In fall 2023, Jarad Mason from Harvard University was awarded the ACS Award in Pure Chemistry for his contributions to the fields of phase-change materials, microporous materials, and materials chemistry. In this literature discussion, students will examine his recent paper [“Microporous water with high gas solubilities," *Nature,* 2022, **608**, 712-718](https://doi.org/10.1038/s41586-022-05029-w), which is related to that work. You will apply a variety of inorganic concepts to understand what is so exciting about what he and his collaborators are doing.

1. *Nature* is one of the top journals in all of science. On its website, it describes its Aim and Scope as:

Nature is a weekly international journal publishing the finest peer-reviewed research in all fields of science and technology on the basis of its originality, importance, interdisciplinary interest, timeliness, accessibility, elegance and surprising conclusions.

Why do you think this particular research is worthy of publication in this journal?

1. Who is supporting this research financially (hint: this is usually found in the Acknowlegements, which for a *Nature* paper, is found in the online version of the article)? Based on the introduction to the paper, why might these organizations be interested in the research that Professor Mason and coworkers are doing?
2. Why do the authors want to create microporous water? What are the advantages of creating microporous water for gas storage vs. existing systems?
3. In order to form microporous water, the pores must remain “dry” so that the gas molecules can be absorbed there. What approach do the authors use to keep the pores dry?
4. Explain the rationalization behind the “∆Ggas<0, ∆Gwater>0” shown as part of Fig 1a. Are these primarily entropic or enthalpic effects (or both!)?
5. Solid state chemists frequently use polyhedral representations of solids to simplify their pictures. Based on Figure 1d, draw an atomic level representation (with NO polyhedra!) of one tetrahedron in the structure connected to another tetrahedron. (Hint: the name for ZIF-8 is zinc(II) methylimidazolate)
6. Classify how the imidazolates are binding to the zinc ions. Be as specific as possible!
7. How do the authors make versions of the ZIFs and the zeolites that are able to be dispersed in water?
8. The left side of Figure 1d shows the covalent modification of one of the imidazolate N’s. Given your structure above, why doesn’t this not destroy the structure of the MOF?
9. In your own words, what is the main point of Figure 1b?
10. In Figure 1 e-g, dynamic light scattering (DLS) for three of the solids are shown. What is interesting/different about the x-axis of the plots? What does DLS stand for? Briefly explain how it works and what it tell you about the nanoparticles in the solutions.
11. At the beginning of the caption for Figure 2, the authors say that “(t)he density of a porous solution with dry micropores will be lower than the density of an analogous non-porous solution with solvent-filled micropores.” Explain why this should be true.
12. In Figure 4b and 4c, the results of O2 release and delivery of the functionalized MOFs and zeolites are summarized. In your own words, describe what these figures show in just a sentence or two each.
13. The American Chemical Society gave an award to Professor Mason for work in the field of “pure chemistry”. In your own words, explain what you think is meant by this term. Do you think this particular paper qualifies as “pure chemistry”? Why or why not?