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Using Expansion Microscopy for Nanoscale Imaging of Biological Structures

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Advancements in super-resolution microscopy (SRM) techniques provide researchers with an unprecedented view of biological structures by circumventing the diffraction limit of light. Unfortunately, most of these techniques come with increased cost and complexity beyond that of a conventional fluorescence microscope, restricting the number of researchers who may benefit from the improved resolution. Expansion Microscopy (ExM) is a novel technique that, by modifying how samples are processed, converts a conventional fluorescence microscope into a super-resolution one, greatly diminishing the required cost and expertise needed for SRM. ExM embeds a tissue or cell sample into a swellable hydrogel that isotropically expands the sample when placed in water, improving the resolution of a labeled structure through physical magnification [1,2]. Researchers have therefore adapted ExM to the study of various model organisms and biological structures, from single cells to whole organs [3-5]. During this workshop, I will present the benefits of ExM, explain how ExM is implemented and validated, and provide some examples of what ExM has been able to reveal. Lastly, I will describe a novel application of ExM, where immunostaining and in situ labeling of genomic DNA is combined for the study of chromatin states of genes within single cells [6].

References:

[1] Chen, F., Tillberg, P. W. & Boyden, E. S. Science **347** (2015), p. 543–548.
[2] Chozinski, T. J. et al. Nature Methods **13** (2016), p. 485–488.
[3] Halpern, A. R., et al. ACS Nano **11** (2017), p. 12677–12686.
[4] Chozinski, T. J. et al. Scientific Reports **8** (2018).
[5] Tillberg, P. W. & Chen, F. Annu. Rev. Cell Dev. Biol. **35** (2019), 683–701.
[6] Woodworth, M. A. et al. Nucleic Acids Research **49** (2021), e82.