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Patterns on Pollen: a polysaccharide phase transition process ASJA RADJA, MAXIM LAVRENTOVICH, ERIC HORSLEY, RANDALL KAMIEN, ALISON SWEENEY, University of Pennsylvania — Pollen grains are famous for the beauty and diversity of the micron-scale patterns decorating their tough outer coating. These patterns are extraordinarily robust and reproducible within a species, yet different species have extremely variable patterns. Previously, we showed that these patterns could result from a first-order phase transition on a sphere, and this mechanism also informs the pattern reproducibility within a species as well as variation across species. Here we present micrographic evidence that the phase-transitioning material responsible for pattern formation is a polysaccharide mesh deposited on the cell surface prior to pattern development. We found that the phase transition of this material creates the negative spatial template of the final pattern observed on the mature cell. We also analyzed the various monosaccharide components of the polysaccharide mesh of two different species (and therefore pattern types) to investigate the linkage between a species' polysaccharide composition and its phase behavior. Finally, we calculated a phase diagram of possible pollen patterns given the theoretical statement of pattern formation in our previous work, and discussed how parameters from the existing theory map to the biological materials we observe.

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