Talk 1.

The hydraulic life of 'dead wood': biophysics of water transport in plants.

Trees can be called masters of microfluidics. In the stem of an average tree, the number of interconnected water transport conduits can exceed hundreds of millions, and their total length can be greater than several thousand kilometers. Furthermore, on a sunny day, a tree can transport hundreds of gallons of water from the soil to its leaves, and apparently do it effortlessly, without making a sound and without using any moving parts. On a global scale, the movement of water through plants makes a major contribution to the hydrologic cycle by providing the principal pathway through which water moves from the soil to the atmosphere.
The physics that underlies water transport through plants is not exotic; rather, the application of that physics in the microfluidic wood matrix results in transport regimes operating far outside our day-to-day experience.
In this presentation I will seek to highlight both the physical challenges and the biological solutions employed by those silent bioengineers.

Talk 2.

Principles of leaf hydraulic design: How micro-scale rheology mediates plant-environment interactions.

Leaves are complex structures charged with the task of balancing CO2 uptake and water loss. The main role of leaf venation is supplying water across the photosynthetic surface to sustain the evaporative demand that allows access to atmospheric CO2. As in man-made irrigation systems, uniformity of delivery remains the 'gold standard' for optimal design. Thus one can expect that evolution of vascular plants should show some level of optimization of transport system, despite the tremendous variety of natural venation networks that result from leaf developmental patterns and their interaction with micro-environment. In this presentation I will provide an overview of major patterns of leaf venation architectures within the context of their water distribution function and discuss physical constraints on the biological freedom of hydraulic leaf designs.