

Title: Hornworts provide new perspectives on a photosynthesis enhancing organelle

Abstract: Rubisco, the enzyme responsible for carbon fixation, has a relatively low turnover rate and is competitively inhibited by oxygen, causing it to perform poorly in environments where CO₂ is scarce. Some photosynthetic organisms have overcome these limitations through CO₂ concentrating mechanisms (CCMs), which enhance photosynthesis by increasing the concentration of CO₂ around Rubisco. In algae and one group of land plants—hornworts—the CCM is organized around a membraneless organelle called a pyrenoid, where Rubisco is concentrated. While pyrenoids in the green alga *Chlamydomonas* have been studied extensively, much less is known about the pyrenoids of hornworts, the only land plants to possess these organelles. I will present my work establishing *Anthoceros agrestis* as a new model for pyrenoid biology, revealing how a CO₂ concentrating mechanism is organized outside algae. I will then discuss the biophysical properties of *A. agrestis* pyrenoids and the discovery of an unconventional Rubisco small subunit whose C-terminal extension mediates pyrenoid formation. Finally, I will discuss what this means for engineering photosynthesis, and where hornwort pyrenoid biology goes next.