Plants produce an impressive array of molecules important for both plant and human health. The discovery of biosynthetic pathways for plant natural products has classically been a slow process; as a consequence, few complete pathways are known and even fewer have been engineered. New plant genome sequences and synthetic biology tools have opened the door to three transformative research areas under investigation in my lab: 1) Identifying the minimum set of enzymes required to make plant-derived molecules used in the clinic and non-natural derivatives using engineered biosynthesis, and 2) discovering new molecules from plants important for plant fitness, and 3) metabolic engineering to systematically quantify the impact of dietary metabolites on human health. In this talk, I will describe some of our recent efforts to accelerate the discovery and engineering of complete plant pathways for known and novel molecules, not only in the model plant Arabidopsis but also in medicinal and crop plants.