A novel laccase enzyme facilitates engineering of C-lignin

**Background**
- Catechyl lignin (C-lignin) is a linear homopolymer of caffeoyl alcohol found in the seed coats of diverse plant species. Its properties make it a natural source of carbon fibers and high-value chemicals, but the mechanism of *in planta* polymerization of caffeoyl alcohol remains unclear.
- *Cleome hassleriana* is an excellent model system for studying C-lignin biosynthesis, as the lignin produced in the seed coat switches abruptly from G- to C-lignin at around 12 days after pollination.

**Conclusions**
- RNA sequencing analysis identified ChLAC8 as a seed-coat specific laccase that is expressed at the onset of C-lignin biosynthesis.
- ChLAC8 has the unique property of oxidizing caffeoyl alcohol.
- The protein structure of ChLAC8 possesses a unique glutamine residue (Q289) in the active site that stabilizes caffeoyl alcohol binding.
- ChLAC8 is necessary and sufficient for the synthesis of C-lignin from supplied caffeoyl alcohol in transgenic *Arabidopsis thaliana*.

**Significance**
- LACCASE8 plays a critical role in initiating C-lignin polymerization.
- Given a successful strategy for engineering sufficient levels of caffeoyl alcohol, ChLAC8 can be an important component of a gene toolkit for engineering of C-lignin into vegetative tissues of commercial biomass crops such as switchgrass and poplar.
- This work also demonstrates that individual laccase specificity, in addition to availability of the required monolignol building blocks, can control the composition of lignin.

Wang, X et al. (2020). Substrate-specificity of LACCASE 8 facilitates polymerization of caffeoyl alcohol for C-lignin biosynthesis in the seed coat of *Cleome hassleriana*. *Plant Cell*. [https://doi.org/10.1105/tpc.20.00598](https://doi.org/10.1105/tpc.20.00598) (with In Brief commentary article, [https://doi.org/10.1105/tpc.20.00858](https://doi.org/10.1105/tpc.20.00858)).