CUPA-CURE: A computational course-based undergraduate experience

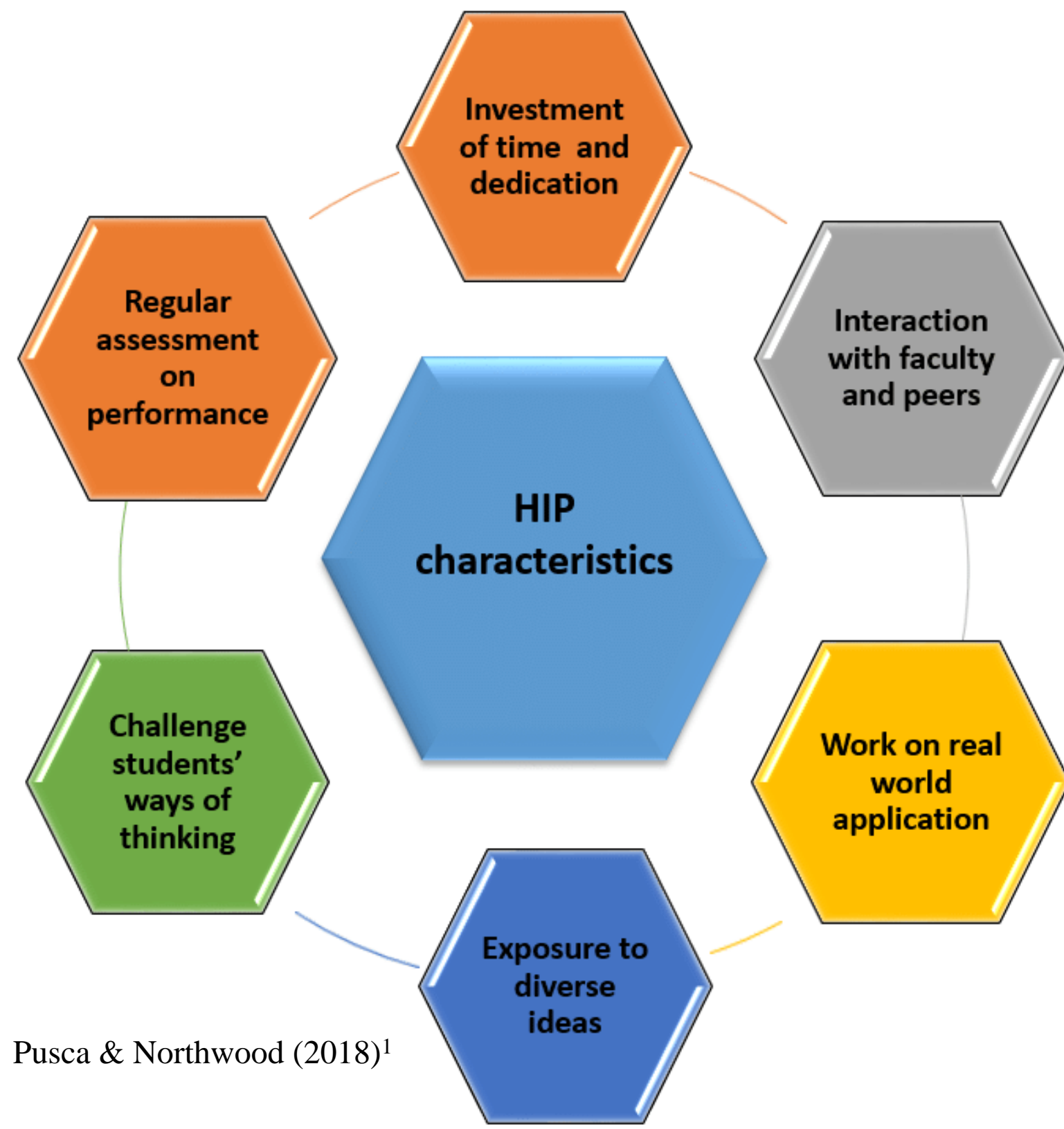**Amanda Storm**[1] and Amanda Hulse-Kemp[2,3]   [1]*Western Carolina University;* [2]*USDA-ARS;* [3]*NCSU*

The Cotton Uncharacterized Protein Annotation Course-based Undergraduate Research Experience (CUPA-CURE) engages students in an authentic research experience that contributes to the functional characterization of the cotton genome by manually annotating cotton proteins of unknown function.

HIP characteristics:
- Investment of time and dedication
- Interaction with faculty and peers
- Work on real world application
- Exposure to diverse ideas
- Challenge students' ways of thinking
- Regular assessment on performance

Pusca & Northwood (2018)[1]

As a characteristic High Impact Practice (HIP), this CURE provides students with benefits such as increased engagement and confidence in the field while at the same time developing subject-specific skills in bioinformatics and literature review.
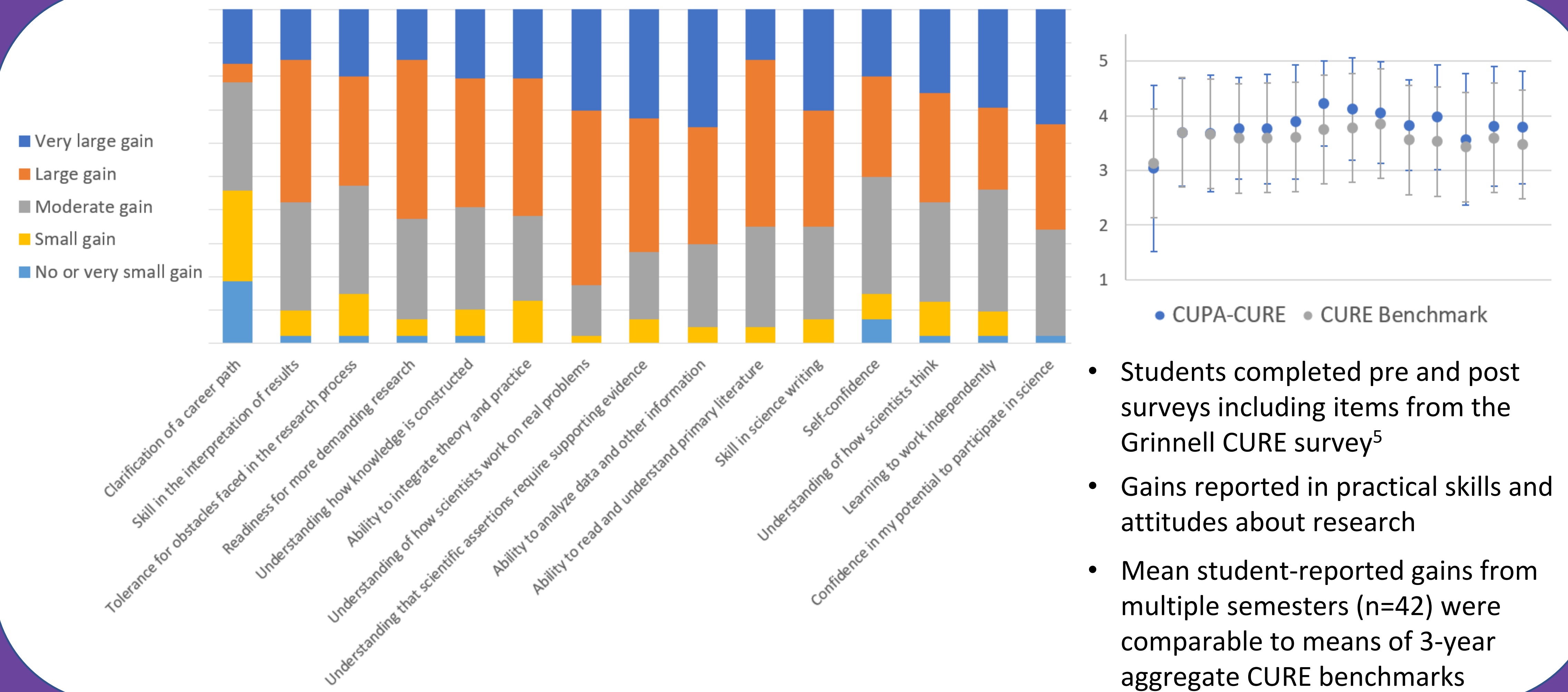
Learning Objectives address recommended subject-specific content in molecular biology (Structure and Function Core Concepts from AAAS 'Vision and Change'[2]), core competencies in bioinformatics (Core Competencies 1, 2, 4, 5, 8 from NIBLSEs[3]), and basic scientific literacy skills related to finding and evaluating sources (TOSLS[4]).

Sequence — Where does the protein function; What are predicted superfamily, family, domains, and motifs
- Predicting subcellular location and transmembrane regions
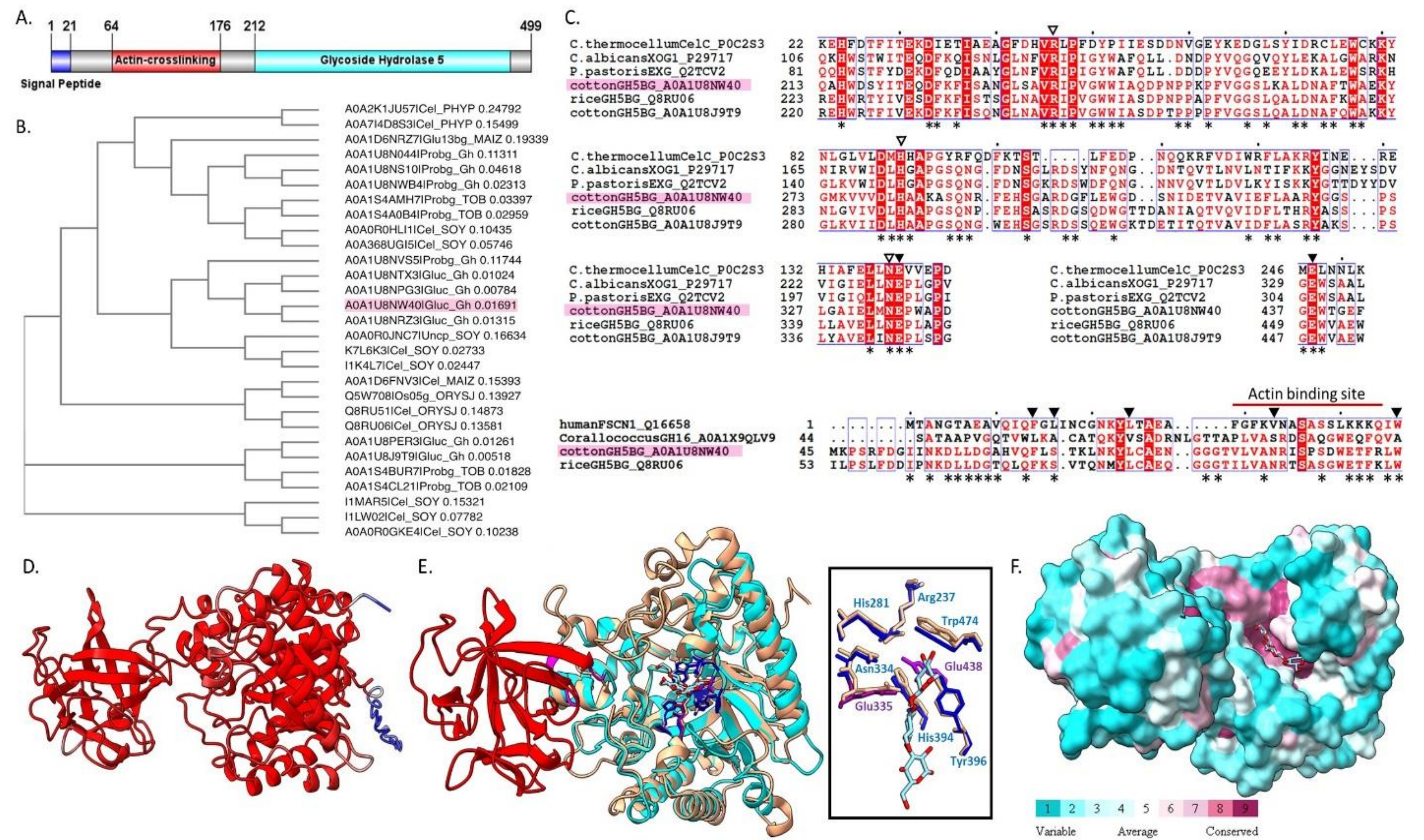- Navigating databases: UniProt and InterPro

Homology — What taxa have homologs; Where are conserved residues; How is the family structured
- Analyzing trees of gene families for relatedness
- Annotating homolog alignments using literature findings

Structure — What regions can be confidently modeled; Are there similar structures; Where are potential bindings sites
- Modeling and visualizing structural features
- Exploring markers of potential binding sites

Computational CUREs also have the unique advantage of adaptable modality and accessibility that minimize barriers to participation. This CURE has been taught at two institutions as an in-person capstone, an online summer course, an independent research project and a biochemistry lab.

References:
1. D. Pusca and D. Northwood, Implementation of high-impact practices in engineering design courses. 2018. World Trans Eng and Tech Ed. 16(2)
2. American Association for the Advancement of Science. Vision and Change in Undergraduate Biology Education: A Call to Action. 2011
3. Network for Integrating Bioinformatics into Life Sciences Education, Bioinformatics core competencies for undergraduate life sciences education. 2018. PLoS ONE; 13(6): e0196878
4. Developing a Test of Scientific Literacy Skills (TOSLS). 2017. CBE—Life Sciences Education. 11(4): doi.org/10.1187/cbe.12-03-0026
5. https://www.grinnell.edu/academics/resources/ctla/assessment/cure-survey

Assessment indicates comparable reported gains in standard CURE measures

Legend: Very large gain, Large gain, Moderate gain, Small gain, No or very small gain

Categories: Clarification of a career path; Skill in the interpretation of results; Tolerance for obstacles faced in the research process; Readiness for more demanding research; Understanding how knowledge is constructed; Ability to integrate theory and practice; Understanding of how scientists work on real problems; Understanding that scientific assertions require supporting evidence; Ability to analyze data and other information; Ability to read and understand primary literature; Skill in science writing; Self-confidence; Understanding of how scientists think; Learning to work independently; Confidence in my potential to participate in science

● CUPA-CURE   ● CURE Benchmark

- Students completed pre and post surveys including items from the Grinnell CURE survey[5]
- Gains reported in practical skills and attitudes about research
- Mean student-reported gains from multiple semesters (n=42) were comparable to means of 3-year aggregate CURE benchmarks

Student research is professionally communicated and contributes to the field

- Students communicate results in format of microPub article

  www.micropublication.org

- Interested students can continue with manuscript submission and revisions as first author

- 2 published, 4 submitted and indexed to CottonGen database