Possible Broad Scientific Discovery Goals in 1st or 2nd year CUREs

Information Literacy
- Distinguish between different types of information sources and develop skills for searching for primary literature.
- Begin to evaluate claims in scientific papers, popular science media, and other sources using evidence-based reasoning.
- Provide background information about the scientific question or problem to be tested (Scientific content)

Scientific Process: Question Formulation
- Define the hallmarks of a good experiments and/or studies that would address specific hypotheses.
- Develop research questions based on your own or others’ observations.
- Formulate testable hypotheses and state their predictions.

Scientific Process: Study Design
- Compare the strengths and limitations of various study designs.
- Design controlled experiments, including plans for analyzing the data.
- Execute protocols and accurately make and record measurements and observations (Organize, and annotate data sets)
- Identify methodological problems and suggest how to troubleshoot them.
- Evaluate and suggest best practices for responsible research conduct (e.g., lab safety, record keeping, proper citation of sources).

Scientific Process: Data Interpretation and Evaluation
- Use observational skills to describe experimental outcomes.
- Analyze data related to the question or problem
- Use appropriate quantitative methods to evaluate results
- Create and interpret informative graphs or other data visualizations.
- Summarize patterns in the data
- Describe sources of error and uncertainty in data.
- Make evidence-based arguments using your own and others' findings and draw appropriate conclusions.
- Describe the iterative nature of science and how new evidence can lead to the revision of scientific knowledge
- Relate conclusions to original hypothesis, consider alternative hypotheses, and suggest future research directions based on findings.

Scientific Communication
- Develop a process for writing/communicating
- Use appropriate language and style to communicate science effectively to targeted audiences (e.g., general public, biology experts, collaborators in other disciplines).
- Use a variety of modes to communicate science (e.g., oral, written, visual).
- Demonstrates conventional and proper use of sources in scientific writing.
- Relate concepts from more than one scientific area to interpret phenomena related to the question or problem.
Possible Pedagogical Goals in 1st or 2nd year CUREs

Science Identity
- Express increased confidence and enthusiasm in science and math
- Gain satisfaction in solving scientific problems
- Decrease stereotype threat
- Develop confidence that you can understand and do science
- Opportunities to reflect or work on things that you personally value or feel proud of
- Develop tolerance for obstacles faced in the research process
- Understand that failure is common to the process of science
- Understand how scientists work on real problems and that science is done by diverse teams

Metacognition
- Demonstrate willingness to seek help from others (teacher, peers, TA) when working on academic problems
- Know and use a variety of problem-solving strategies
- Evaluate your own understanding and skill level
- Learn strategies to plan, monitor, and evaluate your learning
- Embrace a growth mind-set with respect to intelligence and ability

Community
- Become part of a collaborative group and develop a sense of belonging in the scientific community
- Value equity and inclusion practices in community engagement
- Work with teammates to establish and update group plans and expectations (e.g., team goals, project timeline, rules for group interactions, individual and collaborative tasks).
- Elicit, listen to, and incorporate ideas from teammates with different perspectives and backgrounds.
- Work effectively with teammates to complete projects.
- Evaluate feedback from others and revise work or behavior appropriately.
- Critique others’ work and ideas constructively and respectfully.

Ethics
- Identify and employ the characteristics of research integrity in experimental design, data collection, analysis, and communication.

Technical Skills
- These will likely be discipline specific...
Sources


Classroom Undergraduate Research Experience (CURE) survey. Lopatto D. Grinnell College.

Cooper KM, Soneral PAG, Brownell SE. (2017) Define your goals before you design a CURE: A call to use backward design in planning course-based undergraduate research experiences. Journal of Microbiology and Biology Education. 18: 1-7.