The Discovering Biological Science (DBS) Curriculum

Lab explorations in the DBS curriculum begin with observations or questions, which are sometimes centered on issues that are relevant to students' personal or civic lives that initiate and set the context for the lab exploration. Labs are also structured around the cycle of learning which is not only informed by learning theory but also models the process of scientific discovery (Figure 1).

The curriculum is also designed to gradually provide students with guided practice and feedback on thinking scientifically. Early *Practicing Inquiry* labs explore biological concepts and processes while developing student's scientific inquiry skills. Students then build on knowledge obtained from the previous labs to make more decisions about the focus, design, and analysis of lab explorations (*Performing Inquiry*) (Table 1).

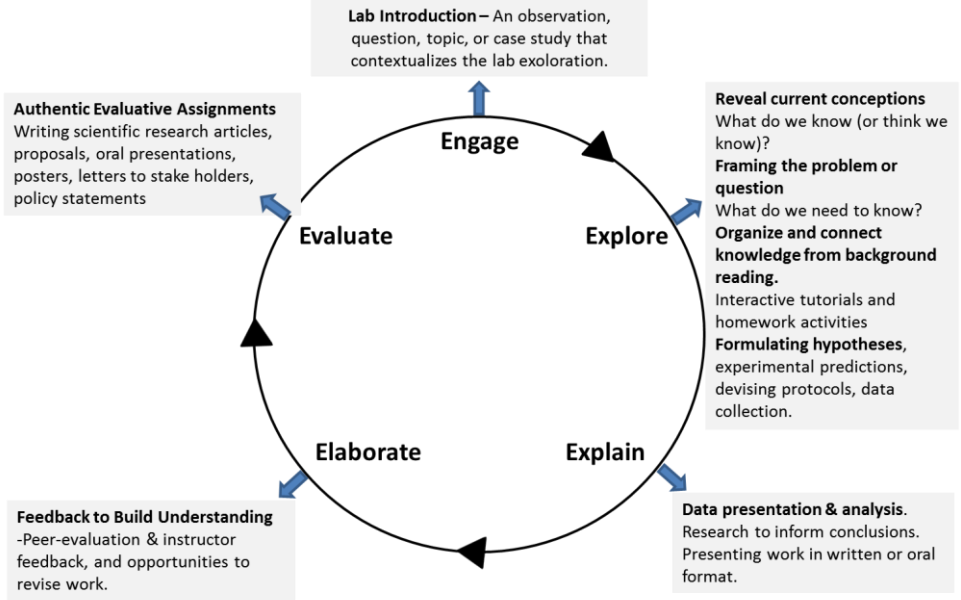

Figure 1. The Learning Cycle in an inquiry-based lab experience.

Table 1. Features of science laboratories categorized by stage of inquiry and teaching method.

Stage of Inquiry	Traditional	Practicing Inquiry		Performing Inquiry
Background research	Initial content lecture by lab instructor	Instructor assigns reading on background content.	Instructor assigns reading; students do independent research.	Students decide what background knowledge is required, and what learning resources to use.
Scientific question	Question provided by teacher	Students sharpen or clarify question	Students select among questions	Students pose the question
Evidence	Data given to students and told how to analyze	Data given to students and students analyze	Students are directed on how to collect certain data	Students decide on what evidence to collect and how to collect it.
Explanations	Students told how to formulate.	Students given several possible ways to formulate	Teacher coaches students in formulation	Students formulate
Connections to concepts	Students are given connections	Students guided towards connections	Students receive minimal coaching	Independently by student research teams.
Communication of findings	Explicitly directed	Organized by teacher or lab manual	Limited coaching by teacher	Independently by students. Peer review is stressed.

DBS I focuses on cellular and molecular biological concept, while the conceptual focus of **DBS II** is evolution, animal and plant anatomy/physiology and ecology/conservation biology. Each lab curriculum culminates in a student-directed independent project. Working in research teams, students identify an aspect of a biological concept they wish to explore further. Within the context of a manageable framework, students work collaboratively to formulate a question and design and conduct their own experiment. Peer-review, as with professional science, occurs both at the proposal and final

product stages, and students share their work with their peers through articles, posters or oral/poster presentations. In this way students not only learn **about** key biological processes, but also **how we know** about these processes and how scientific knowledge is generated, shared and evaluated by the scientific community.

Instructional Support - College lab instructors, who are often graduate teaching assistants, typically have little experience teaching inquiry-based, collaborative & student-centered labs. Therefore a variety of instructional support materials are provided with the labs to provide students with essential structure they need to engage in more student-directed inquiry and to provide instructional support. Each lab comes with a Team Lab Notebook (TLN) which helps lab teams plan and organize their findings. Homework activities, and interactive tutorials help students to explore concepts relevant to the lab exploration. Each lab also comes with an instructor guide which not only provides information about lab setup, but also theory-based pedagogical suggestions which are intended to help instructors effectively facilitate a student-centered, inquiry-based and collaborative learning environment.