Building the foundation of a research-rich curriculum

Gary Reiness

Department of Biology, Lewis & Clark College, Portland, OR

We want our graduates to:

- **understand the process of scientific inquiry**
- **be independent learners**
- **recognize that 'facts' are hypotheses well-supported by evidence**
- **be able to draw appropriate conclusions from experimental data**
- **understand what kinds of issues are amenable to scientific inquiry and what kinds are not**
- **be able to collaborate effectively**

Like many of you, we try to achieve those goals by emphasizing student-designed, inquiry-driven laboratories

Use lecture time to teach experimental design and data analysis

Experimental Design

Two options

Manipulative: where the investigator actually does something to the system and measures the effects of these manipulations on variables of interest.

Correlational: makes use of natural variation to look for the effect of one factor on another.

Bird Tail Feather Example

Hypothesis:

Long tail feathers seen in many species of birds have evolved to make males more attractive to females.

Correlational approach

See which bird gets the most mates during the breeding season.

Manipulative approach

Shorten feathers | Extend feathers | Manipulation control

Group 1 | Group 2 | Group 3

Manipulate tail length, band birds, and monitor the number of matings.

Courtesy of Peter Kennedy

Introduce Primary Literature

- Even first semester students can read carefully chosen papers
- Class discussions are used to develop ability to critically evaluate experiments
- Students develop “taste” from comparing good and flawed work
- Good experiments provide models for students designing their own

Provide feedback on projects prior to execution

- Student groups present research proposals to peers
- Proposals are critiqued by peers and course staff
- Students receive feedback on their experimental plan, and
- Learn from the strengths and weaknesses of other proposals

Monitor progress of experiments

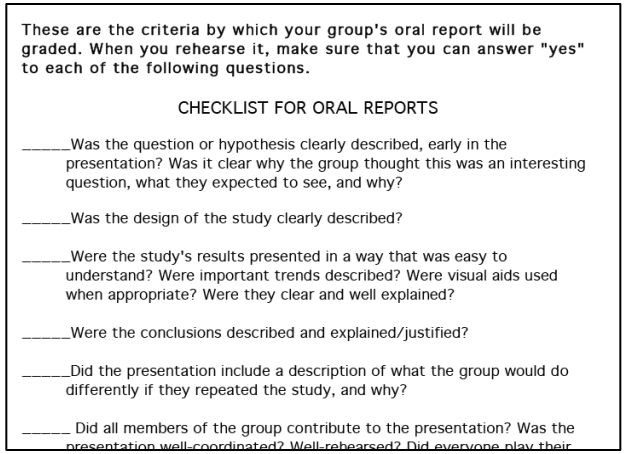
- Obtain regular reports on progress of experiments (or make site visits to field studies)
- Helps students stay on task and assists in troubleshooting or modifying experiment
- Helps reduce last-minute scrambles for data or failed studies

Assign written reports to be drafted in stages, with revision

- For multi-week projects, students write Introduction and Methods before obtaining Results.
- Instructor critiques these and students revise them
- Student groups outline Introduction, Results, and Discussion sections in lab (with instructor feedback) to assure common understanding, enrich collaborative interpretation, and reduce "you write section A and I'll write B" discontinuities.

Assign oral presentations of results, with emphasis on “research lessons learned”

- Students must describe what they would do differently if repeating their experiment
- The lab manual provides a grading rubric



These are the criteria by which your group's oral report will be graded. When you rehearse it, make sure that you can answer "yes" to each of the following questions.

CHECKLIST FOR ORAL REPORTS

_____Was the question or hypothesis clearly described, early in the presentation? Was it clear why the group thought this was an interesting question, what they expected to see, and why?

_____Was the design of the study clearly described?

_____Were the study's results presented in a way that was easy to understand? Were important trends described? Were visual aids used when appropriate? Were they clear and well explained?

_____Were the conclusions described and explained/justified?

_____Did the presentation include a description of what the group would do differently if they repeated the study, and why?

_____ Did all members of the group contribute to the presentation? Was the presentation well-coordinated? Well-rehearsed? Did everyone play their