

Statistical Thinking in Undergraduate Biology (STUB) network: Coordinating teaching and assessment

The practice of biology has transitioned over the last two decades to become increasingly reliant on quantitative approaches to drawing conclusions from data. Consequently, an introduction to both descriptive and inferential statistical thinking is now standard practice for the undergraduate biology course "Bio 101" - a course taken by over 1.2 million students in the U.S. annually. Despite the large numbers of students in introductory biology courses, there is a dearth of active discussion about teaching and assessment when integrating statistical thinking into biology courses. Recently, the statistics education community has established guidelines for assessment and instructional best practices when teaching statistics. Furthermore, there is a prominent movement to use modern, computationally-intensive statistical methods (simulation, randomization tests, and bootstrapping) that utilize active learning pedagogical strategies and have preliminary evidence of improving student learning. Despite these recent changes, there are limited venues to discuss and coordinate best practices for the teaching and assessment of statistical thinking for biology students - many of whom may never take an Introductory Statistics course or will take such a course at a very different time than their introductory biology course. To help address these challenges, the Statistical Thinking in Undergraduate Biology (STUB) network has formed with support from the National Science Foundation's Research Coordination Network – Undergraduate Biology Education program.

With particular focus on a diverse set of institutions, backgrounds, and learning environments (e.g., institutions serving large numbers of underrepresented and underserved students, including two-year colleges), the network has the potential for effecting a substantial change in the content and focus of the teaching of statistical thinking in undergraduate biology across the country.

As part of the network, participants engage in workshops and an online learning community dedicated to the discussion and sharing of ideas, resources, and techniques. A key tangible outcome of the workshops and online learning community are freely available, class-tested, and edited modules co-developed by biologists and statisticians for use in teaching statistical ideas in introductory biology courses. The STUB network will also compile best practices on assessment, vet potential assessment items, and share assessment results focused on statistical thinking. The STUB network provides a forum for serious and impactful discussions about teaching statistics in introductory biology courses as well as the impactful application of biology examples in introductory statistics courses, including overcoming institutional barriers. The goals of the network include (a) the development and wide dissemination of numerous freely available modules and assessment items for teaching, (b) published peer-reviewed articles on teaching best practices and assessment results related to statistical thinking in undergraduate biology courses, (c) a long-lasting improvement in the teaching of statistical thinking in the undergraduate biology curriculum, and (d) introductory statistics courses reflecting the needs and perspective of biology (and other quantitative science) students.

Proposed workshop schedule and location

We propose the following workshop schedule which will actively engage workshop participants in thinking about the role of statistics in undergraduate biology courses; connect participants with existing materials, readings, and results; and challenge participants to actively begin developing new content. In the post-workshop phase, workshop leaders will encourage the utilization of at least one new activity, continued development and peer-review of activities, assessments, and dissemination via existing STUB network infrastructure. All portions of the following workshop schedule will include initial comments by workshop leaders followed by active roundtable discussions and ‘sharing out’ by workshop participants.

Workshop location: The Inn at Morro Bay, Morro Bay, CA

Tentative schedule

Day/Time	Title	Description
Friday, September 7		
12:00-1:00PM	Check – in	See us in the conference room
1:00-1:30PM	Overview	Introductions from everyone present including disciplinary expertise/background; affiliation; Overview of schedule and goals of the workshop
1:30-1:45PM	Recent trends in undergraduate statistics education	Including GAISE, SBI, assessment results
1:45-2:15PM	Recent trends in biology education	Including trend to quantitative
2:15PM-3:00PM	Interdisciplinary conversations	What biological contexts might ask a statistical question and what is that question?
3:00-3:30PM	Groups report out	
3:30-4:00PM	Break	Snack break
4:00-4:15PM	Example of an activity	Presentation of a sample activity
4:15-5:15PM	Interdisciplinary conversations	Responses to sample activity; what they would do differently, similar; pick a context and begin outlining ideas
5:15-6:00PM	Groups report out	
6:00-6:30PM	Break	
6:30+	Dinner	Great American fish company; carpool to restaurant
Saturday September 8		
8:00-8:30AM	Breakfast	Buffet served in conference room
8:30AM-9:30AM	Interdisciplinary conversations	Sketch out activity and preliminary set of assessment questions
9:30-10:00	Report out	

10:00-10:30	Assessment ideas	Potential assessment initiative in fall? Proposed approach; potential questions (predetermined); discussion? Buy in?
10:30-11:00	Next steps	Stipends for completing materials; editorial review Assessment participation Workshop feedback/evaluation Ideas for future workshops/locations? How to achieve the 'flat network' idea.

The workshop will be **co-led by biologists and statisticians to ensure an equitable exchange of ideas**. Biology instructors will share experiences with innovative methods for incorporating statistical thinking in their courses. Statistics instructors will discuss trends in statistics education including GAISE, the trend towards simulation-based inference approaches and appropriate case studies for infusing data-centric ideas, while nurturing a space for the free sharing of ideas between and within disciplines.

Dissemination

All developed activities and assessments are anticipated to be freely disseminated online after vetting and editing via the STUB network website (URL www.causeweb.org/stub).

Funding

The grant is funding the workshop, including dinner on Friday night and breakfast on Saturday morning and lodging for those coming from out of the area.

STUB Network steering committee

Beth Chance (Cal Poly San Luis Obispo - statistics)
 Mark Condon (Dutchess County Community College - biology)
 Barbara Dolansky (Dutchess County Community College - statistics)
 Elena Keeling (Cal Poly San Luis Obispo - biology)
 Robert Gould (UCLA - statistics)
 Greg Murray (Hope College – biology)
 Noa Pinter- Wollman (UCLA - biology)
 Jeff Ploegstra (Dordt College - biology)
 Soma Roy (Cal Poly – San Luis Obispo - statistics)
 Todd Swanson (Hope College - statistics)
 Nathan Tintle (Dordt College - statistics)
 Jill Vander Stoep (Hope College - statistics)