Appendix B: Discussion of Options Around Lab and Studio Courses

The Substantive Curriculum and Modes of Delivery subcommittee discussed extensive issues around labs and similar courses that are normally very dependent on in-person modalities. This appendix provides additional comments and discussion related to Recommendation 11 in the main report.

While this section focuses on lab, studio, field and performance courses, the issues are similar for other courses where in-person instruction is critically required to meet the learning outcomes. The principles below, if not the specific details, may serve as guidelines for evaluation of alternatives in such courses.

Lab learning outcomes: There are a wide range of learning outcomes associated with labs. While the specific outcomes vary, they often fall into one of four categories:

- Support and reinforcement of content from discipline courses (many times integrated within other courses but also standalone)
- Development of skills using, and/or gaining familiarity with, discipline specific physical hardware and procedures (e.g. organic synthesis, musical instruments, mechanical tests, design)
- Development of data analysis, presentation, and/or communication skills
- Development of teamwork skills

Within any given discipline, some of these learning outcomes may be achieve effectively through online alternatives but achieving all will often be challenging. For example, within engineering and physical sciences, hands-on experience with realistic hardware is critical for student development and may have no parallel through simulation or demonstrations (e.g. look and feel of electrical connectors, physical scale of testing hardware, debugging of experimental problems).

Lab environment challenges: De-densifying the lab environment poses additional challenges compared to lecture environments.

- Capacity limits: Ensuring social distancing within labs will depend critically on the nature of the physical spaces. In many cases, the unique nature of the lab spaces result in less total utilization in normal semesters, and thus replicating lab sections if viable in a hybrid (partially in person) modality. However, for labs that require occupancy reduction to 20% of normal capacity or are already fully scheduled, other alternatives will be necessary.
- Social distancing limits: Many labs traditionally have much closer (and pedagogically critical) interactions between students in lab groups (e.g. safety, teamwork). Social distancing may be extremely difficult and enhanced PPE mitigation of risks may be required. In some performance-based labs, even this will be difficult (e.g. choral groups).

Mitigation strategies: There will be no single solution applicable across the range of lab experiences in either a fully online or hybrid teaching model in the fall. Unique challenges will require a variety of solutions tailored to the structure and outcomes of each type course. However, there were some takeaways from spring offerings and ideas that have been offered for the fall.

- Defer labs, and courses with integrated labs, to spring
  - There is no certainty that spring social distancing requirements will be any less restrictive than fall requirements
  - Delaying to spring or beyond likely will cause more problems than it solves as they are often prerequisites, are linked to courses that must be offered, and in labs offered each semester the schedule will be unlikely able to manage the capacity in the spring alone
For upper level labs, may be a necessary option but must be considered within the context of ensuring no delay in graduation (defer sophomore labs to junior year)

- **Conversion to online only labs**
  - Viable for many of the computer-based labs with support from tools such as AWS Apps on Demand
  - Viable where learning outcomes do not require physical access to specialized hardware (especially when focused on other learning outcomes such as data analysis or teamwork development)
  - Likely viable in the large introductory chemistry, physics, and biology courses given adequate financial support for supplies and staff time
  - Long term, as computer-based virtual and augmented reality become common, more labs could move from physical regimes to online; however, this will require development of new course materials (few current examples, and hardware limitations prohibit broad application of those – e.g. Michigan’s virtual human dissection).

- **Virtual labs through instructor video demonstration and/or remote operation**
  - Viable in many cases, with reduced achievement of the learning outcomes
  - Significant concerns over student engagement and learning outcomes associated with hardware familiarity, debugging, experimental design
  - Can be integrated into future course offerings as background and/or instructional videos

- **Development of distributable “home kits” for remote labs**
  - In cases where hardware or materials are readily available, labs may be managed by students in their own spaces with instructional staff support. Examples from the spring (successful) include an ECE project lab using distributed Arduino and Raspberry Pi kits
  - Cost, support and equity are concerns. There may be wide disparities in student environment, expertise, and support that impacts learning outcome achievement
  - Potential liability concerns depending on nature of labs (e.g. chemical synthesis)

- **Deployment of technical solutions to address remote-delivery limitations**
  - Remote control hardware for specialized instruments in labs (microscopes)
  - In performance arts, suggestions of access to low-latency software/hardware, scholarships for individual instruction in remote location, shipping instruments/supplies; also requires training on technology for performers with staff support

- **Shifted emphasis of labs (learning outcomes) within the curriculum**
  - Focus on other learning outcomes: data analysis, communications/presentation skills, teamwork (cf. studio/performance solutions)
  - Increased emphasis on secondary teaching goals (e.g. history/theory/culture or pedagogy/methods courses); emphasis on virtual concerts and performances and/or solo performance modalities

**Staffing needs:** Discussion of online labs must all address the discipline specific staff with unique expertise that are critical to success of student learning. Concerns for staff include:

- Retention of staff while online to ensure restart of labs when we return to in-person instruction
- New roles for staff: one-on-one or small group guidance in lab techniques for students at home to replicate “instantaneous feedback” of in-person labs
- Scaling up of resources for multiple sections ... staffing and supporting TA lines
**Managing Course Interruptions:** Like lecture/discussion courses, both hybrid and fully online lab offering in the fall will require robust strategies for addressing both instructor and student absence for limited or extended times. In many cases, the instructor challenge is slightly less severe as there is usually redundancy in the coverage through permanent and temporary instructional staff (multiple TAs).

For labs, the greater challenge is addressing (i) students who are not residential in a hybrid instructional model and (ii) students incapacitated for extended time periods for quarantine or illness. Unlike lecture courses where materials would naturally exist in a remote delivery format (video recording of lectures), the discussion above mostly imagines some level of direct interaction for physical lab experiences. There are only limited solutions to both of these cases.

- **Non-residential students:** This will need to be a course and department specific solution. In some cases, this may involve modification of curriculum requirements (when the lab is not critical for licensure or pedagogical advancement). Other programs may develop alternative programs that achieve many of the same outcomes within the remote environments (alternative design experiences). In limited cases, there may be no option but to defer the lab course to a subsequent semester.

- **Extended absences:** As above, extended absences will also require flexibility on the part of programs. A natural division of absences may be the two-week mandatory quarantine envisioned for Covid-19 exposure; absence beyond this window could be addressed with more liberal INCOMPLETE policies for health-related concerns. However, courses should explicitly consider and plan for absences up to two weeks during any point of the semester. Solutions may range from reduced requirements (4 or 5 labs), relaxed in person requirements (analyze results from another group), make-up sessions, to individualized tutoring.