Academic Plan for Enrollment

Report on Tier 3 Questions

California Polytechnic State University

College of Science and Math

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March 9, 2015

Introduction

The College of Science and Math is a diverse collection of departments and schools that embrace the learn-by-doing philosophy universally in their approaches to teaching, learning and scholarship. The description of how that is successfully accomplished is as diverse as the nature of the disciplines that span this collective college. From the quietly analytic, to the loud hectic gymnasium, from Skype communication with national leaders in statistics to spaces simulating a K-3 classroom environment, from the physical monitoring of the sea in San Luis Bay to research examining weight gain interventions, all of these are embraced within this college.

Specifically, the Departments of Biology, Chemistry and Biochemistry, Kinesiology, Liberal Studies, Mathematics, Physics, Statistics and the School of Education comprise the College of Science and Math. Research centers within the College include the Center for Coastal Marine Sciences (CCMS), the STRIDE (Solutions through Research in Diet and Exercise) Center, the Center for Excellence in STEM Education (CeSAME), the San Luis Obispo Science and Ecosystem Alliance, and the Kenneth N. Edwards Western Coatings Technology Center.

Important considerations within our college revolve around the hands-on nature of the programs taught. Many of our units have significant laboratory-based portions of their curriculum that require unique spaces and considerable resources. Also, much of our teaching is in support of other constituents in the university, such as CAFES and CENG. Within CSM, we take pride in the quality of the support and general education courses we teach. Dean Bailey speaks for all of us when he states “Every Cal Poly student is a College of Science and Math student.” The focus in this narrative is on the variety of curricular innovations in our college.

We have included a summary of the commonalities that exist within and throughout the diverse disciplines in CSM.
Shared Themes across the College

a. *Teaching, Learning, Scholarship*

For the academic programs you expect to offer and the students you expect to serve:

1) What effective approaches to teaching and learning are emerging in your field and related areas?

Responses indicate that we are a college of innovators. Every program reports successfully incorporating new active learning pedagogies. Chemistry, Physics, Mathematics, and Statistics have each developed their own version of studio classrooms. Faculty use the studio classroom environment to integrate technology, laboratory activities, active learning strategies, Skype conferencing with worldwide experts, and peer learning into their courses. Additionally, flipped courses, hybrid courses, collaborative projects, and inquiry based learning are all being used throughout the college. It is clear that there are many different approaches to teaching and learning that people in our programs have found effective. Requests abound for more ways to be innovative! Accommodating this will require a robust technology infrastructure and flexible teaching/learning spaces.

2) How should Learn By Doing incorporate new learning needs, opportunities and technologies?

Again, the college is replete with using technology to enhance Learn By Doing. Therefore, each program wants more access to technology and more integrative spaces to use for teaching and research. (See learning environments)

Other significant examples in this area include Biology’s practice of taking the class to the real world. They maintain several teaching/research field sites including the Pier at Avila, acreage at Ragged Point and the Chimineas Ranch and a shared field-research station with the US Forest Service at Hi Mountain Lookout. In Liberal Studies, the students get hands on teaching experiences in local elementary schools through programs like TEAMS (Teaching Assistants in Math and Science) and COISA (Teaching Ocean Science). On the other hand, the School of Education has a vision for a lab school to enhance their Learn by Doing capabilities but needs the resources and space to make that happen.

3) How does the teacher-scholar model fit?

Collaborating with students on research is frequently mentioned in the narratives as a means to this end. Requests for support for time and resources to focus on completing research projects spans the narratives. Summer funding was mentioned several times as a means of enhancing this model.
b. **Learning Environments**

What learning environments should Cal Poly develop or modify to accommodate (1) new modes of teaching and learning, (2) Learn by Doing, and (3) the teacher-scholar model in the future? Please respond in terms of the qualitative characteristics of the facilities and other spaces (including technology) critical to your programs and students:

1) **Formal, scheduled or organized instruction**

Probably the strongest common theme that emerged from the narratives presented by the constituents in the CSM was a desire for more space to teach and conduct research. The primary types of spaces requested are studio classrooms (similar to those used by chemistry, math, physics, and statistics), with perhaps more flexibility to include other types of concept learning within the college.

Having more computing available within learning environments was a ubiquitous request. Many programs requested the ability to have larger spaces that easily allow for collaboration and interaction with remote sites. Math specifically indicated a need for a high performance computing (HPC) infrastructure that is funded, supported, and upgraded periodically. Certainly the new cross-disciplinary program in Data Science, housed in the Statistics and Computer Science departments, would also benefit from enhanced HPC infrastructure.

2) **Informal student learning outside the classroom or laboratory.**

Unique and flexible spaces for student/faculty collaboration, informal discussion, learning, and research were universally requested within the CSM narratives.

One step forward in this area can be found in the design of Building 180, the Baker Center for Science and Mathematics. Each floor in the building has 60-70 seats at tables or benches adjacent to faculty offices and 30-40 seats in more casual areas. This vision of free, functional space was articulated in the planning stage by Dean Bailey to enhance student/faculty interaction. The college was able to achieve these goals due in large part to private funding and a generous building efficiency model (total gross area 187,000 sq ft, total assignable 110,000 sq ft, 59% building efficiency). Students and faculty both have commented positively on these interaction spaces. The success of this model should influence the design of future workspaces.

Finally, there is a need to maintain and develop more open green spaces. Students need space to think and grow. Cal Poly students have chosen to attend a university where they can spend time out of doors. Open green areas are essential to our spirit as a university. Maintaining the lawn areas around
campus, such as Mott lawn, Dexter lawn, and the lawn next to building 180 should be a paramount consideration as the University grows.

4) The teacher scholar model?

Faculty struggle to be teachers and scholars without the time, resources and appropriate space to facilitate their research endeavors. So again a strong common theme that emerged in response to this prompt was the desire for more available research space. Some requests were very specific for dedicated research space, and others were more flexible, describing collaborative open spaces that could be used for teaching as well.

The many requests for shared flexible research spaces indicate that large collaborations are being established. Requests suggest the need to span different departments, reach across different colleges, and even extend into established community partnerships. Because larger research questions are being examined, larger collaborations are necessary and should be facilitated. Thus, more flexibility within larger shared spaces appears to be a constant theme.

Most of the research done in our college includes undergraduate students. Logically then, as the designs for new open flexible teaching and learning spaces evolve, we must consider how to efficiently incorporate research innovations within the same space. At all levels we need to carefully consider all the new spaces we design.
Introduction

As I did in my November 2014 report on Tier 1 and 2 questions, I’d like to provide a context for this report with some observations about the field of statistics and Cal Poly’s undergraduate program in the subject:

• Statistics continues to be a rapidly growing discipline, including (perhaps especially) at the undergraduate level. I cited several reports and news articles about this in my November 2014 report, and article from the December 19, 2014 edition of the Washington Post titled “Women flocking to statistics, the newly hot, high-tech field of data science” has received considerable attention from statistics educators.

• The number of students majoring and minoring in Statistics at Cal Poly continues to grow dramatically. The target number of first-time freshmen majoring in Statistics for Fall 2015 is 35, which is a 52% increase over the actual number of first-time freshmen last year, which in turn was a record high number of first-time freshmen in Statistics. The target total number of Statistics majors in Fall 2015 is 113, which will be a record high. In addition, within the past two months a dozen additional students have filed an ICMA for changing their major to Statistics or have declared a second major in Statistics. One final note on this growth is that enrollments in the core 300-level courses in Statistics have grown from 161 in the 2010-11 academic year to 389 in the current academic year (based on current registration numbers for Spring 2015), an increase of 142%.

• The emerging phenomena of “big data” and “data science” continue to require rethinking of how best to prepare undergraduates for the workforce of the coming decades. This challenge is especially acute for, but certainly not limited to, students majoring in Statistics. My colleagues and I are engaging in far-reaching curriculum discussions this year about how best to develop our students’ skills with computing, as well as with statistical concepts/methods, mathematical underpinnings of our field, and effective communication.

• Closely related to the previous point, the Statistics Department is not only responsible for the major and minor programs in Statistics but is also mutually responsible, with the Computer Science Department, for the new cross-disciplinary studies minor program in Data Science that will begin in Fall 2015.

• Finally, before addressing the specific questions posed, I’d like to point out that faculty in the Statistics Department have been among national and international
leaders in the statistics education community with regard to developing innovative curriculum, designing and implementing pedagogical innovations, and conducting research into the effectiveness of these curricula and pedagogies. For example:

- Beth Chance and Soma Roy currently serve as co-Principal Investigators on a $550,000 grant from the National Science Foundation (award number 1323210) on “Broadening the impact and evaluating the effectiveness of randomization-based curricula for introductory statistics.”
- Heather Smith and John Walker designed an innovative capstone course on “statistical consulting and communication” (STAT 465) for which they were invited to give a presentation at the Eight International Conference on Teaching Statistics (http://iaseweb.org/documents/papers/icots8/ICOTS8_4H1_SMITH.pdf).
- Beth and I received a 2011 MERLOT (Multimedia Educational Resource for Learning and Online Teaching) Award for developing a collection of applets through which students explore statistical concepts.
- Six of our department faculty members, and four recent emeriti faculty members, have written or co-authored textbooks used in undergraduate statistics courses around the country.
- Beth served for many years as the assistant editor of the Statistics Education Research Journal, and Soma currently serves on the editorial board for the Journal of Statistics Education.

Teaching and Learning Questions

(1) What effective approaches to teaching and learning are emerging in your field and related interdisciplinary areas?

Emerging approaches in higher education in general, and science education more specifically, are also becoming more common in the field of statistics. Indeed, many statistics educators have played a leading role in developing and popularizing pedagogical innovations such as flipped classrooms, inquiry-based learning, and team- and project-based approaches.

Most of our teaching in Cal Poly’s Statistics Department involves introductory service/support courses for students majoring in other disciplines. My colleagues and I subscribe whole-heartedly to guidelines endorsed by the American Statistical Association for teaching such courses (www.amstat.org/education/gaise/GaiseCollege_Full.pdf), which include the recommendation to “use technology for developing conceptual understanding and for analyzing data.” We make considerable use of both statistical software packages and also software tools specially designed for facilitating learning as we teach these courses. One illustration is that computer simulations have been shown to be a very effective tool
for helping students to visualize and explore questions of “what would happen in the long run?,” which lie at the heart of many concepts of statistical inference.

Emerging trends in statistics and data science, as in other disciplines, also include online course and MOOCs. One notable example is the Johns Hopkins Specialization in Data Science (www.coursera.org/specialization/jhudatascience/1), which describes itself as the “largest data science program in the world” and boasts that it has enrolled more than 1.76 million participants as of March 2015. Some of our Statistics faculty have taken some of the courses in this program, and several Statistics majors are currently pursuing this specialization as part of their senior project work.

(2) What learning environments should Cal Poly develop or modify to accommodate new modes of teaching and learning in the future? Please respond in terms of the kind of teaching and learning spaces that are critical to your discipline for both (a) formal, scheduled or organized instruction, and (b) informal learning outside the classroom or laboratory.

My colleagues and I adopt many different paths for implementing the GAISE recommendation about effective use of technology in our classrooms. Some of us teach these courses in a Studio classroom that has one computer per student for every class meeting. Some others teach in a lecture/laboratory environment where the class meets in a computer lab for 1-2 hours per week and in a regular classroom for 2-3 hours per week. Still others hold every class meeting in a regular classroom and so rely on demonstrating the software tool with a computer projector and then asking students to conduct explorations outside of class time.

None of these implementations is ideal, in part because the different learning spaces (studio, computer lab, classroom) all impose constraints on the type of learning that come happen in a 50- or 110-minute period. Those who teach in the Studio and computer lab express frustration that the spaces are not well-suited for listening to lectures or for engaging in group discussions/activities. Those who teach in classrooms lament the lack of computers with which students could engage in their own explorations rather than observing a demonstration. Those who split their class time between a classroom and computer lab bemoan the difficulty of trying to ensure that the material/activity for one class session fits neatly into a 50-minute period and also remark about the difficulty of making a smooth transition to the following class meeting in the other learning environment.

Our students would be much better served by more imaginatively designed learning spaces that allow faculty more flexibility in selecting the pedagogical method to pursue on a day-to-day and perhaps even a minute-to-minute basis. Such classrooms would support flexible learning environments and would be computer-equipped as well as conducive to group work, discussions, and lectures. (Perhaps the need for being computer-equipped will soon become obsolete, replaced by the need to be amenable to students bringing their own electronic devices to class.) Such classrooms would facilitate “flipped” classrooms as well as interactive lab/studio formats. I envision that an instructor would ideally be able to decide minute-by-minute how best to spend a class session, perhaps by lecturing for 15 minutes, and then having students work individually
on a computer for 15 minutes, and then holding a small-group quiz for 10 minutes, and finally concluding with 10 minutes of instructor-led discussion to pull the lesson together.

Our previous Studio classroom in Building 2 was problematic in many ways, including the size and layout of the room. Now that we have taken control of the Studio classroom in Building 38 previously used for Physical Science courses, we have a much better learning environment, but still with the capability to be improved. We also could put to good use another two or more such Studio classrooms, because our Studio classroom is booked heavily and does not accommodate all faculty who would like to use it. We would also welcome the opportunity for faculty to hold office hours and for students to host tutoring sessions in a Studio environment. At present we also use a computer lab room in the library fairly heavily. But a big problem with using a library computer lab is the constraint that 1-2 sessions per week are designated as computer time and the other hours as lecture time. The library’s computer lab (35-111B) also lacks some desired functionality, such as the ability to project from the instructor’s computer to students’ computers.

Even though I prefaced this response by talking about introductory service/support courses, but the desirability of more flexible learning spaces that include computing tools for students applies equally well, if not more so, to upper-level courses for Statistics majors and minors as well.

Also, we are working toward incorporating a stronger emphasis on written and oral communication into our curriculum, so it would be very helpful to have classroom spaces in which both student presentations and also activities involving peer/group review of writing would work well. We also need the capability to use technology in such presentations and to videotape presentations for review with presenters afterward. Another need for the capstone course to which I alluded earlier is space in which students can hold real or mock consulting sessions with clients.

A related need is for access to a classroom that allows students to communicate easily with guests who visit from a distance via skype or similar technology. Beth Chance has developed a 400-level course in statistics education that includes in-person and Skype visits from leading statistics educators from around the country. But few classrooms on campus are conducive to having productive discussions between students in the classroom and off-campus guests. We could also make increased use of such a classroom as our students engage with more projects involving industry partners around the state and country.

Our Statistics major has traditionally enrolled a small number of students. As a result, one of the strengths and attractive features of our program has been the strong spirit of camaraderie and collaboration among our students and also between our students and faculty. This spirit has been enhanced by our being able to share and make use of a small computer lab and conference room near the department office. But as our numbers of both students and faculty increase, we have quickly outgrown this space. Therefore, with regard to the question about informal learning outside of classrooms and laboratories, we could greatly benefit from a larger space in which students could gather to work collaboratively on assignments and projects, ideally in the vicinity of faculty offices to facilitate faculty members stopping by often to interact with students.
Consulting in particular needs its own space for both faculty and students. Our department operates a free statistical consulting service that assists many dozens of faculty and students per quarter from across the university, and we involve several undergraduate students per year in this activity. We could provide a better service to our clients and also provide a better learning environment for our students if we had a physical space in which to hold these consulting sessions.

Speaking of the growing number of students and faculty in our program, a related point is that we have outgrown our department office and could use more space for storage.

*Learn by Doing: (1) How should Learn by Doing incorporate new learning needs, opportunities and technologies (in your field and related interdisciplinary areas), and (2) what are the facilities implications for both (a) formal instruction and (b) informal learning?*

To varying degrees we employ aspects of learn-by-doing in all of our courses, both introductory service/support courses as well as courses for Statistics majors and minors. The new cross-disciplinary program in Data Science will also emphasize learn-by-doing, perhaps to an even greater extent, as that program includes two capstone, project-based courses. With regard to formal instruction, the primary need here is the same as I described above: for many more flexible learning spaces that support a variety of teaching/learning styles. On the informal side, I again believe that the primary need is the same: for more spaces in which students can congregate and collaborate, ideally in close proximity to faculty offices in order to generate out-of-class support and collaboration that exemplify the learn-by-doing approach for which Cal Poly is so justifiably proud.
The Mathematics Department currently fulfills a number of roles related to both the University and the community at large. These consist of the following.

- **Mathematics Major**
  About 40-50 Cal Poly students graduate with a BS in Mathematics each year. These graduates typically follow one of three career paths: graduate school, primary or secondary teaching, industry.

- **Masters Program**
  About 5-10 students receive an MS in Mathematics each year. Some of these students proceed to PhD programs while others go on to careers as Community College teachers.

- **Support Courses**
  The Mathematics Department has a significant support function: Virtually every Cal Poly student takes at least one mathematics course.

- **Research**
  Mathematics Department faculty members are heavily invested in the teacher-scholar model. In addition to teaching, members of the department conduct research in the areas of pure and applied mathematics and mathematics education, at both the undergraduate and professional levels.

- **Outreach**
  Mathematics Department faculty members serve the neighboring community in several ways. These include workshops for elementary, middle and high school teachers, as well as enrichment activities for elementary and middle-school students.

The Mathematics Department sees itself serving in a similar role within Cal Poly for the next 15 years. However, it is expected that the number of mathematics majors will increase in a manner commensurate with the projected growth in overall enrollment at Cal Poly. We expect some expansion of the Masters Program, as the demand for highly mathematically trained employees is predicted to increase. The demand for in-service teacher training and learn by doing-style workshops for elementary and middle-school students is expected to increase as well. Each of these items has specific learning environment needs as described below.

**Lower-division & upper-division major and support courses:** Since we will be servicing the entire University’s needs for mathematics instruction, we will need continued access to traditional 35-40 student capacity classrooms outfitted with typical but upgraded smart room technologies as well as traditional large and multiple blackboards. As the University expands, we will need additional classroom space.
Support courses for our Teaching Concentration and Liberal Studies Majors:
These courses require flexible and configurable learning spaces. Assuming the demand for liberal studies and the teaching concentration grows, the demand for our one lab in 38-135 may exceed existing capacity as this lab is also being used for some of our applied mathematics courses. We therefore see the need for an additional second lab dedicated exclusively to Mathematics education instruction and outreach workshop activities. Ideally both of these labs would be in adjacent locations.

Support for research including undergraduate research and related professional activities: What is badly needed in our Department is quality collaborative space that we have control over. Right now, we have do not have spaces dedicated to mathematical research activities which would include technology, quiet rooms for collaboration, and a small lecture room for presentations. Our faculty and students are often in need of such spaces and the existing campus resources are limited. The space should have ability for collaboration with remote sites. The University is also in need of a high performance computing (HPC) infrastructure that is funded, supported, and upgraded.

Support for targeted resources for success in Mathematics courses for the University: As Cal Poly grows, it is likely that the need for additional resources will be needed to target larger populations of “at-risk” students in effective ways. This will require a realignment of existing similarly-purposed supplemental programs, as well as an expansion in capacity, availability, and updated technology infrastructure to serve this increased demand.
Academic Plan for Enrollment

Report on Tier 3 Questions

Physics Department

Prepared by Matt Moelter, Chair

(Document prepared by Moelter with input from physics faculty. The varieties of responses are represented here.)

Teaching, Learning, Scholarship

For academic programs we expect to offer and students we expect to serve in the future.

What effective approaches to teaching and learning are emerging in physics?

Faculty members in physics are exploring several different emerging (at least in physics) teaching and learning styles. All of these approaches are designed to foster active engagement of students during the learning process. While not uniformly implemented in the department many faculty members continue to evolve their teaching styles in ways that are informed by these different pedagogies.

** = currently being used in Cal Poly Physics

- ** Studio environment: Cal Poly physics uses a “studio” approach with three changes from traditional instruction: a) The time pattern is 3 days/week for 2 hours/meeting; b) there is no distinction between lecture and lab; c) the course takes place in a space that is technology rich (computers, sensors, audio/visual) and allows for collaborative student interaction. In addition, hands-on activities are frequently interspersed
- ** “Flipped” classroom: Students view videos or slides outside of class time for information gathering and in-class time is used for problem-solving, group activities, etc.
- ** Active engagement: A variety of approaches that are designed for student participation. “Clicker” style questions using clickers or voting cards.
- Computing in physics: While not a new teaching or learning approach, it seeks to reflect the way the field of physics is evolving. There should be more explicit computation in the curriculum. Not for the sake of computation, but as path to highlighting and gaining a deeper understanding of the physics.
- Process vs. content: Again, not a style as much as a change in emphasis. A focus more on process skills - communicating, modeling, interpreting, and solving more open-ended problems to help students think like physicist. Introductory courses should do this a little, our major courses more so.
- Modeling Instruction: Modeling is a pedagogical approach that explicitly identifies and has students participate in building models to describe physical phenomena.
While teaching and learning are evolving in physics, we do not yet have a roadmap to help guide us as we implement changes. This will be important as we provide support to those faculty members that wish to experiment and adopt new strategies.

How should “Learn By Doing” incorporate new learning needs, opportunities, and technologies?

- Lab courses: Continue to provide funding for more “expensive” lab courses that embody the “learn by doing” approach.
- Summer research: Continue and enhance these valuable experiences for students. We need to increase the summer research stipends to match existing NSF-funded Research Experiences for Undergraduate programs around the country so that our program retains the brightest, competitive students.
- Problem or project-based learning: Parts of the curriculum focused on more open-ended problems that students engage by doing. This is particularly appropriate for upper division courses and could enhance the “theory” courses (Quantum Mechanics, Classical Mechanics, Electricity and Magnetism, Thermal). We need to support this so students learning the skills in coherent manner across several courses.
- Flexible scheduling: Rigid day/time patterns for instruction needs to be reexamined. Requiring students to learn physics MWF 10:10am-11am, for example, is an antiquated proposition with today’s students, particularly with videos and other technologies for delivering content. Serious attention should be given to hybrid or online approaches as appropriate.
- Laptops: All students should be required to have laptops.

How does the teacher/scholar model fit in physics?

There is a sense that the teacher/scholar model fits well in the physics department. But in many ways, at Cal Poly, the model is ill defined and problematic. What it means in practical terms is not clearly elucidated. In addition, it does not seem to be implemented in a consistent and equitable fashion within and across departments and colleges. Faculty members find it difficult when trying to do both teaching and scholarship, and it can be difficult to do justice to either with quality. If there is to be sustainable scholarship there needs to be an infusion of resources to adjust teaching responsibilities, as currently many faculty feel stretched thin.

- Support of scholarship: Physics faculty members engage in a wide range of scholarly activities. This should continue to be encouraged and support should be enhanced. Processes and accountability mechanisms need to adjust for the reality of Cal Poly’s significant teaching responsibilities with little time allocated for scholarship.
- Release/assigned time: Some faculty members are able to use grant money to reduce their teaching in a manner that fits their research and teaching goals. The ability of faculty to custom tailor their teaching/research emphasis is a strength of the department and college and should continue. However, there should be mechanisms to provide support for those without grant funding. The senior
project and summer research program provide additional opportunities for students and faculty to engage in scholarly activity and we have been successful doing so.

- Flexible approach to scholarship: Individual faculty should play to their strengths. This leads some faculty to supervise lots of students and engage them in research. Other faculty put more of their energy into the classroom. Expectations should be adjusted in relation to faculty.

Learning Environments

*What learning environments should Cal Poly develop or modify for: i) new modes of teaching and learning; ii) Learn by Doing; iii) teacher/scholar model? Respond in terms of qualitative characteristics of spaces and facilities, including technology.*

On the whole the physics faculty are pleased with the office, teaching and student/faculty research spaces in the new building (180). If the current situation is any indication, looking forward it appears that we will need even more space as the university grows and more faculty continue to be active.

**Formal, scheduled or organized instruction**

- Flexible scheduling patterns: There may some value in loosening the strict adherence to time patterns and rooms usage. With video and technology, perhaps some lower division lectures could meet once a week for discussion.
- Studio: Continued (and expanded) use of alternate time patterns (2 hrs/day, 3 days/week) in studio classrooms. Technologically capable spaces like these will be important (projection, student responses, multimedia).
- Flexible physical spaces: Classrooms with readily movable desks/tables/chairs would be an improvement. Even without technology, having students face each other, face front, move around, and work together all in the same class period would be helpful.
- Improve layouts in existing spaces: Move computer projectors that block the blackboards, project in the corner or somewhere less obtrusive.
- Flexible lab spaces: Movable (on a quarterly basis) lab benches. Even in some labs we like it is clear that more flexibility (power, internet, etc.) would make the space more efficient.
- Laptop computers: Requiring students to have laptops would make almost any space a technology-enhanced space.

**Informal student learning outside of classroom or laboratory**

- Real problems: Offer more opportunities for solving real-world problems with actual data beyond the laboratory situation.
- Informal study spaces: Building 180 has demonstrated the high demand for students to have excellent spaces to work – near to faculty. Office hours can overflow into these spaces and students can continue helping each other after
the official office hour is over. Any new buildings should have this feature and perhaps some modifications could be made to older buildings to facilitate such interactions.

Supporting the teacher/scholar model

- **Student/faculty space:** In general, there needs to be more space for scholarship, senior projects, and independent student projects. If we are going to hire research-active faculty, as we are now, we need create high quality, flexible physical space for their work. Faculty doing experiments obviously need space, but those doing computational or theoretical projects need it as well.
- **Faculty/faculty space:** It is also important for faculty to have collaborative spaces, similar to the types of spaces that are being created in the library, but for dedicated faculty collaborations.
- **Space allocation:** The space we do have in the department and college needs to be allocated in an equitable fashion and monitored to assure best use.
- **Funds for students:** Allow students to apply for funds to support the purchase of instruments and materials for summer/school-year research.
a. Teaching, Learning, Scholarship
   1) What effective approaches to teaching and learning are emerging in your field and related interdisciplinary areas?
   2) How should Learn by Doing incorporate new learning needs, opportunities, and technologies?

   In Chemistry, we have had a 20-year experiment with integrated lecture-laboratory courses (aka "studio chemistry"). We have seen statistically significant improvements in student learning and attitudes in this environment. Part of this program includes a “Learn by Teaching” component that allows undergraduates to participate in pedagogical development and implementation. This Learning Assistant program has also shown a synergistic learning effect, with both the advanced and novice undergraduates benefiting from the experience.

   Student involvement in research is a tried-and-true high impact, Learn by Doing practice. Creative ways to increase research opportunities for students continue to emerge. For example, integrating research into the curriculum provides engaging student experiences and provides faculty members with an opportunity to integrate their scholarship with their teaching.

   Computational chemistry, a robust field unto itself, is finding applications across the subdisciplines of chemistry and providing tools to visualize and understand the discipline in new ways.

   Real-world, applied chemistry also provides a venue for student engagement and learning. For example, systems chemistry, wherein a cradle-to-grave look at the sustainability of chemical practices, could provide an entry into a holistic view of chemistry as an integral part of society—producing both challenges and solutions. Other applied chemistry areas, such as wine chemistry and food chemistry, afford the opportunity for Learn by Doing and bring an otherwise often esoteric subject into a manageable, applicable sphere for students.

   3) How does the teacher-scholar model fit?
   A teacher-scholar model that embraces research that brings together faculty from across campus and industry from across California and the nation will be able to anticipate future needs and be innovative. A close relationship with the employers of our future alumni—be they industrial or academic—will help inform and refresh our curriculum. Collaborative research with those same
stakeholders will insure professionally-current faculty, student learning, and financial stability.

b. Learning Environments
What learning environments should Cal Poly develop or modify to accommodate (1) new modes of teaching and learning, (2) Learn by Doing, and (3) the teacher-scholar model in the future? Please respond in terms of the qualitative characteristics of the facilities and other spaces (including technology) critical to your programs and students: 1) Formal, scheduled, or organized instruction; 2) Informal student learning outside the classroom or laboratory; and 3) The teacher-scholar model

Flexible space and flexible curricula that can take advantage of emerging trends will help Learn by Doing thrive on campus. Being able to easily 1) introduce new courses into the curriculum and 2) create interdisciplinary experiences will be critical. Older modes of funding that encourage silo-formation need to be eradicated in favor of flexible, easy-to-use policies that encourage faculty from different colleges to collaborate. Fantastic facilities won’t function if these administrative obstacles aren’t removed.

Having recently moved into state-of-the-art facilities, it’s a little odd to discuss more new facilities, but in fact, we will shortly have significant need for additional chemistry studio space, as demand for general chemistry has grown substantially over the last 10 years (see graph to the right). The success of the studio experiment, and its popularity with students, faculty, and administrators, has put a strain on our studio capacity. We are finding the rooms are popular also as active-learning lecture rooms. It may be possible to create a space that serves the latter function but doesn’t require the increased complexity and cost of also serving as a laboratory.

Some of the best design features of the Baker Center are the collaborative learning spaces that are abundant throughout the building. The opportunities for students to interact with peers and with faculty in comfortable, appropriate areas have blossomed into excellent learning opportunities. Those design features
should be incorporated at every opportunity as the university designs and redesigns space.

We need more research space! From the start, there wasn’t enough space in the Baker Center to accommodate the research needs of the students and faculty. Given the increasing role research plays on campus and in our department, we have a critical need for more research space. To support both Learn by Doing and the teacher-scholar model, substantial new research space devoted to chemistry and its related interdisciplinary fields is critical.

To provide the flexibility required for a changing educational landscape, I’d like to espouse the philosophy of Gertrude Elion, a Nobel Laureate in medicine who founded an industrial department I once worked for. She believed that fixtures and furniture, even walls, be moveable and adaptable. Working in a space built to that philosophy was invigorating. The ability to rearrange a work environment results in a noticeable increase in enthusiasm, in creativity, and in camaraderie. I’d be in favor of a similar design philosophy in all new or redesigned facilities, to the extent possible, in both formal and informal instruction spaces. We’ve seen this work well at Cal Poly: in the 48-person chemistry studio in the Baker Center, having moveable benches allowed the instructors in the room to reconfigure the setup to optimize collaboration among the students. The flexibility designed into the room allowed such optimization to occur.

Finally, “people gather in the kitchen” is a truism for private parties as well as for public gatherings. Having accessible, nutritious dining options integrated into learning spaces, both formal and informal, can help creates community and a desire to come to the learning space.
a. Teaching, Learning, Scholarship

For the academic programs you expect to offer and the students you expect to serve:

1) What effective approaches to teaching and learning are emerging in your field and related interdisciplinary areas?

Current initiatives between the School of Education, College of Science and Mathematics, College of Engineering, and College of Architecture point to our interconnectedness across campus. We expect this interconnectedness to continue and we look forward to being of service to a broad range of innovations.

The School of Education has always placed a high premium on partnerships, both across campus, with the local K-12 community, and with higher ed institutions such as Hancock College and Cal State Monterey Bay. We believe that our partnerships will help us to respond to the evolution of the field and to have the flexibility to make changes that are responsive to political and cultural influences. This is particularly true in that we are a graduate unit; our students are, for the most part, working professionals who can also be professional partners. The Counseling and Guidance program, for example, lives in the shifting world of higher education. The program needs to, and does, stay agile in maximizing opportunities for students.

Our K-12 and higher education partners look to us as leaders in Common Core, Next Generation Science Standards (NGSS), English Language Development (ELD), and the content areas. Our teacher candidates can become conduits to K-12 and higher education, carrying information to and from the field. We expect our scholarship to continue to be strongly field based, drawing from and adding to a variety of collaborations.

2) How should Learn by Doing incorporate new learning needs, opportunities and technologies (in your field, etc.)?

Having available, current, up to date technologies is vital to supporting Learn by Doing. In education particularly, we need an infrastructure that at least mirrors, and if possible leads, the infrastructure found in the K-12 and higher education environments in which our graduates are employed.

We have a vision of a lab school that would allow us to better support learning needs and implement evidence-based practices. Such a school might be funded through grants, community partnerships, development, or some mix of funding. Having such a school would allow us to increase Learn by Doing opportunities for our students.
3) How does the teacher-scholar model fit (again in your field, etc.)?

The teacher-scholar model fits well with Cal Poly’s aims at present and seems likely to do so in the future. A key question when considering the programs that we would like to offer and the students we would like to serve is how we support the teacher-scholar model and how we evaluate faculty who work within it.

Our support of the teacher-scholar model seems, at this time, disjointed. Some instructional facilities on campus are in desperate need of updating; they reflect a system in which instruction takes place in a vacuum from both discipline and scholarship. A classroom in which students learn about both business and sociology, for example, is a classroom that doesn’t support either particularly well.

The teacher-scholar model calls on faculty to integrate their instruction with their research and other scholarly practices, but the current evaluation system does not necessarily reward them for doing so. We evaluate faculty in instruction, scholarship, and service, but could do more in evaluating how well faculty bring these aspects of their professional practice together.

b. Learning Environments

*What learning environments should Cal Poly develop or modify to accommodate (1) new modes of teaching and learning, (2) Learn by Doing, and (3) the teacher-scholar model in the future? Please respond in terms of the qualitative characteristics of the facilities and other spaces (including technology) critical to your programs and students:*

1) Formal, scheduled or organized instruction,

The current CSU curriculum development process, which is essentially an undergraduate model, presents challenges in program development for a unit that is graduate and answers to external bodies. In addition to Cal Poly and CSU organizations, we answer to state and national bodies in developing curriculum.

Of particular interest are new fields that should emerge based on research into the needs of early childhood education. Programs to address these should be developed by the School of Education, Child Development, and others at the institution.

Within the context of the teacher licensing in California and to better serve the San Luis Obispo region, we are interested in expanding our credentials to include computer science, world languages, and early childhood. The K-12 community has expressed interest in expanding our Special Education offerings, considering offering Physical Education again, and exploring performing arts credentials such as Music. Other fields may emerge as well.

Student mental health is an increasing concern throughout higher education. As an academic community, we need to be more sophisticated in our approaches
to supporting students with mental challenges. There may be program development opportunities in this area.

2) Informal student learning outside the classroom or laboratory, and

As a professional unit that uses a cohort system, the School of Education has the advantage of a student body with goals and outlook that are more closely aligned than might be the case with non-professional undergraduate majors. Cal Poly as a whole might consider supporting an ecosystem of formal and informal learning by moving to more of a cohort system in some of its undergraduate majors. Students who move through programs together may be more inclined to also interact informally.

Design of infrastructure is important in this regard. The Baker Center has demonstrated that a building can be designed and outfitted deliberately to nurture informal interactions. Future building plans and remodeling of existing structures should be done with an eye to informal learning.

In addition, Cal Poly could do more to support informal online environments. Platforms such as Yik Yak demonstrate both that students will interact informally and that such interactions can reach for the lowest common denominator. We have recognized as a campus that physical structures can support positive informal student learning; online structures can do so as well.

3) The teacher-scholar model.

The learning environments that we develop are and should be generative for both students and teachers. Effective teaching and effective scholarship are both self-reflective activities; our learning environments should be supportive of reflection in and reflection on instructional and scholarly action. This is an aspect of K-12 teaching and learning environments—particularly at the elementary level—that we could learn from. Elementary teachers by and large have their own classroom. High school teachers, particularly in STEM areas, often have departmental office space that adjoins instructional areas. This gives teachers the ability to have a consistent space that can be used in part to reflect on and document their teaching.

We could build on this. For physical learning environments, building in capacity physically and through scheduling for instructors to store materials in instructional spaces would support the teacher scholar model. For online environments, we could do more to support instructor journaling and other archival activities.
Introduction

The foundation of kinesiology is interdisciplinary and as an academic discipline, kinesiology is experiencing profound change and evolution of content knowledge in its sub-disciplines. As this evolution continues the way that teaching and research occurs in kinesiology is also evolving. Between now and 2030, kinesiology as a field of inquiry will be engaged in studying human movement from various perspectives and in a multitude of contexts, in particular the domain of “Physical Activity” will be critical (Blair & Powell, 2014) to our understanding of human health and how to achieve positive health outcomes.

Given the broad realization that public health will be a critical consideration in 2030 our Department Vision to address societal needs through our programs, curriculum and research is appropriately focused. As the department continues to evolve we will need considerably more lab space and access to an increasing diversity of instructional technology and health-focused devices. The use of technology for data gathering with applications to health behavior change is increasing exponentially. As technology evolves and becomes more prevalent there will be increased need for dedicated teaching and research space to work with this technology and teach kinesiology students to use it, there will also be a significant need for appropriately trained support staff.

Approaches to Teaching and Learning

With an increasing emphasis on public health outcomes and the expanding knowledge base within kinesiology, approaches to teaching and learning that are focused on practical authentic experiences will be critically important in the future. We see the value of internships, either clinical or community-based, becoming an increasingly important component of quality instruction.

Communication is the bedrock of behavior change and in the context of public health this involves listening as well as messaging. Our students will need to learn techniques associated with conducting surveys, focus groups, community-based research and key informant interviews. These are the skills being used for needs assessment and data collection and they will be critical skills to our graduates in the coming years. Collaborative learning and team-based approaches to instruction will become increasingly important as the world becomes smaller and the demand for professionals to work in evermore-diverse groups continues.
In the next 15-20 years, mobile technology and computer applications that facilitate active learning, engagement through social media, interactive classroom instruction and online learning will all become even more important than they are today. Technology in all these forms will be used to encourage increased learning outside of the classroom, leaving class time for discussion and group work. As new modes of teaching and learning become more prevalent, it will be evermore important to provide support for these developments in terms of equipment, facilities and staffing.

Given the nature of kinesiology as a multi-disciplinary collection of applied social, behavioral and natural sciences it is intuitively appealing to suggest that flipped classroom instruction will be more valuable than on-line instruction. There is likely to be great value in students gathering disciplinary knowledge outside the classroom to facilitate in-class discussion and application of knowledge to the context of kinesiology. In addition to flipped classroom instruction there is a wide range of emerging interactive technologies with potential to significantly enhance student engagement in kinesiology classrooms. There is great scope for the use of mobile devices such as tablet computers, laptops, and e-readers with health and fitness apps or software; the use of devices that interface with a smart phone are still in their infancy, devices such as pedometers, accelerometers, and GIS technology.

As we integrate more technology into our curriculum, the university will need to update classrooms with technology such as “clickers” or an alternative, a strong and reliable wireless network and solid technical support. In the absence of support on a university wide level we will need to secure new staff to provide support at the college or department level. If students and faculty are to become more dependent on teaching and learning through technology then access to support for that technology will rapidly become a determinant of student success. With support for Information Technology (IT) currently limited to a student-staffed help desk with limited availability, this will constitute a significantly increased investment.

The Teacher-Scholar Model

As Cal Poly develops its focus on the Teacher-Scholar model and deepens its commitment to Learn by Doing and student research, there is ever more need for labs and research space that will accommodate this important work. Within Kinesiology, our commitment to meeting societal needs through research and teaching has led to a profound need for space to house our rapidly expanding externally funded research team.

Kinesiology’s commitment to addressing societal needs through scholarship and teaching led to the development of STRIDE as an interdisciplinary team of students, faculty, and community partners. STRIDE students and faculty represent every College at Cal Poly and work together with a wide range of community organizations across San Luis Obispo County to provide health promotion programming and assessment. As STRIDE’s research and programming continues to grow, we have reached capacity in building 43A and we’re looking for solutions to our space shortage.
A significant portion of the ongoing research within STRIDE is being conducted by faculty in our department through funding from the National Institutes for Health (NIH). We have several faculty who are implementing plans to expand on their current levels of funded research and as this work continues we will need more space for both Kinesiology and STRIDE. Our space needs encompass but are not limited to:

- **Conference Rooms** – we use our conference rooms for meetings associated with our community programs; our research teams; telephone conferences; students clubs and department programs; faculty committee; staff meetings; and graduate student classes, exams and research meetings.

- **Student research space** – we have ongoing student research projects that cannot currently be left unattended because we have no secure space to leave them.

- **Research labs** – Our lab space is currently designed for teaching but is increasingly needed for faculty research. We are sharing a great of our space between teaching and research but the reality is we need research labs, teaching labs and then mixed use labs.

- **Storage** - We need additional storage throughout our facility so that equipment and supplies can be stored in the room where they are actually utilized.

**Family Health Research**

Department faculty members working within STRIDE have a highly successful research arm in Family Health Research, studying methods to prevent and treat obesity in the time surrounding pregnancy and early childhood. Three large scale and several small scale, NIH-funded grants are being conducted in this area. These studies are funding 10 full time staff, 6 part time staff, 1 phlebotomist, 3 interns, and 4 students; the studies are also engaging 10 part-time student volunteers and 7 graduate thesis and senior project students. Funded co-Investigators include Cal Poly faculty in Statistics, Modern Languages, Computer Science, Psychology, Nutrition, and community practitioners in obstetrics and gynecology. These studies are enrolling a total of 800 pregnant or postpartum women and children, and 350 fathers.

Large funded research grants provide significant indirect costs to the university but they are accompanied by an obligation to provide appropriate facilities and space to successfully complete the funded studies. We are struggling to provide this space and with anticipated growth in the number of ongoing studies we anticipate needing more space. Current and planned future research will necessitate adequate space for conducting project activities, including private staff offices, conference rooms, private observation spaces, a phlebotomy lab, clinical exam rooms, private interview rooms, and a research kitchen. Proximal parking is also a priority to accommodate participants attending for assessment visits at our Center. We are currently being forced to house research that should have its own space in dual-use facilities that were designed for teaching.

So far we have managed to house our full time staff at Cal Poly, but clinical facilities and space are extremely limited, so many of our study functions must be offered off campus at nearby hospital facilities, clinics, and rented office facilities. The increasing reliance on off-campus space creates a "scattered" atmosphere for study functions and
undermines our ability to build multi-disciplinary collaboration across the University. Given that campus can no longer meet our needs, with additional large-scale grants currently under review and new faculty arriving with grants in this area, our need for additional research space is rapidly becoming dire. A core campus facility for STRIDE researchers would lessen burden on KINE facilities and promote university wide collaboration.

Specifically for this work to continue, our space needs encompass but are not limited to:

- **Medical Exam Rooms** – we have two exam rooms for STRIDE but we will need at least two more and as other space needs go unmet the exam rooms have become “dual use” with student workstations being installed.
- **Office Space** – large funded research projects involve hiring staff members who need to be housed close to the principal investigators.
- **Interview Rooms** – adjacent to the exam rooms we are in need of dedicated interview space for data collection, we are currently using shared space and off-campus rented space.

**Cal Poly Human Motion Biomechanics (HMB) Lab**

We are currently in need space to house a biomechanics research lab and as such we are lending support to an initiative on campus to establish the Cal Poly Human Motion Biomechanics (HMB) Lab. The HMB Lab is being developed by a group of professors and students from Departments across the university and local medical professionals with the goal of creating a truly multi-disciplinary research lab. Biomechanics is a multi-disciplinary field of study that spans Departments and Colleges including Mechanical and Biomedical Engineering, Kinesiology and potentially also Physics, and Biology.

The HMB lab is a good example of the kind of research space that Cal Poly, and certainly the Kinesiology Department, will need in the coming years to fulfill its potential in research. As research in kinesiology becomes more specialized it connects with the underlying sub-disciplines, if budgets will not allow stand-alone labs for our work we hope to leverage space through collaboration. Steve Klisch from Mechanical Engineering is leading the HMB Lab initiative with planned collaborators including Hemanth Porumamilla and Brian Self from Mechanical Engineering; Scott Hazelwood and Saikat Pal from Biomedical Engineering; Bob Clark, Todd Hagobian and Christie O’Hara from Kinesiology; Aydin Nazmi from Food Science and Nutrition, Otto Schueckler (M.D., Central Coast Orthopedic Medical Group), David Tuttle (M.D., Radiology Associates), and Matt Robinson (C.P.O., Hanger Orthopedic Group). This concept is offered as an example of potential to draw teams of researchers together in the development of new facilities.

Dr. Klisch has raised in the region of $120,000 to purchase equipment that will serve as the foundation for research conducted in the HMB lab. This is an example of a public/private partnership playing out in support of developing a research lab, there is need for further support which further serves as an example of the challenges associate with funding the teacher-scholar model. The mission of the HMB Lab is to benefit society through clinically relevant, multi-disciplinary biomechanics research while enriching student-learning experiences at Cal Poly and enhancing students’ success in
their careers. In short there is a teaching goal and a research goal; but make no mistake, high quality research cannot be conducted in teaching spaces with equipment that is also used for teaching.

Specifically for this work to continue, our space needs encompass but are not limited to:

- **Lab Space** – the current space for the HMB lab is temporary and insufficient to meet the long-term goals. The lab requires a high ceiling with room to simulate various kinds of human movement.
- **Dressing rooms** – with athletes and participants engaging in physical activity in the lab there is a need for an on-site changing room.

**Public Health Physical Activity Lab**

The Kinesiology Department is in need of a lab to support physical activity research in the context of public health. The Public Health Physical Activity Lab, conceived of by Kinesiology Professor Heather Starnes, would be a joint teaching and research lab that could accommodate students in a lab class in addition to students collaborating on faculty research. The lab would contain GIS enabled computers with a host of devices capable of gathering data on physical activity patterns, students would learn how to gather, analyze and apply data toward increasing physical activity levels.

As with other research labs proposed in this report, the Public Health Physical Activity Lab could serve multiple departments through multi-disciplinary collaboration. Department collaborations with City and Regional Planning (CRP) have been ongoing for sometime through STRIDE and CRP would be a natural partner in this endeavor. Other partners could include Statistics and Computer Science to help analyze the resulting data; Computer Science recently interviewed a tenure track candidate with interest in public health applications of big data from labs such as the one being proposed.

Specifically for the Public Health Physical Activity Lab to begin work we need space that includes but is not necessarily limited to:

- **Lab Space** – a large lab space with 24 GIS computer systems each with dual monitors
- **Storage** – on-site built in storage for mobile devices and equipment for use in teaching and by students and faculty for research.

**Applied Learning in Exercise Science**

Kinesiology is looking to build on the success of STRIDE with the development of programs to provide applied learning experiences in Exercise Science. Kinesiology majors recently started providing exercise-testing services to the Cal Poly Men’s Soccer team. With additional exercise testing labs these services could be more widely available to Athletic Department coaches and potentially to local elite athletes to help them prepare for competition in ways that will help prevent of injuries and enhance performance.
For many years now students in Kinesiology have volunteered in a program called PolyFit that provides an opportunity for students to gain learn-by-doing experiences and practice in the process of administering health assessments. We are in the process of revamping this program with the aim of increasing opportunity for students to gain experience in data collection through administering a wide variety of exercise tests. A significant challenge in building this program and expanding opportunity is the capacity to house these activities in our dual use labs that are heavily utilized for teaching and research. PolyFit has been a hugely successful program having continued now for over 15 years, we need a “PolyFit Club Room” to support this valuable extra-curricular activity. Programs like PolyFit are “mission critical” for Cal Poly if we are to truly embody our Learn by Doing philosophy.

To support the evolution of the Teacher-Scholar model and protect our identity as the campus of Learn by Doing we need to develop student work areas adjacent to faculty research space and teaching labs. In departments like Kinesiology we need to have space for basic and applied multi-disciplinary research. We have biology students doing their senior projects with faculty in kinesiology and visa versa, this kind of exchange will likely become more common place in the future as students see the value in working across disciplines. To support this evolution to increased levels of multi-disciplinary collaboration we need more meeting spaces and

Specifically to increase our capacity to provide applied learning opportunities in exercise science, our space needs encompass but are not limited to:

- **Lab Space** – our existing lab space is very heavily scheduled and is insufficient to meet our long-term goals in this area. We will need an additional lab with treadmills, metabolic carts and space for blood draws.

- **Dressing rooms** – with athletes and participants engaged in exercise testing, there is clear need for on-site changing rooms; clients currently change in a toilet.

**Student Success – What our students will need to be able to do in the future**

We were asked to address the skills, knowledge and abilities that our students will need in the future. Our students will need to understand the fundamental reasons for health disparities and be able to design programs and services based on evidence. Clearly to accomplish this aim our students will need to be skilled in data collection, they will also need to be able to translate scientific evidence into the creation of effective programs to prevent disease and promote health. Students will need to be proficient in policy and understand the relationship of policy to health determinants. They will need to be skilled in policy advocacy. They will need to be skilled in a variety of strategies to communicate about health. They will need to understand the relationship between climate change and health.

Our students will need to understand the connections between local, national and global health because an in-depth appreciation for cultural differences and diversity will be critical. Ideally, in the future our students will be multi-lingual or bi-lingual (e.g., Spanish); they will practice ethical and professional behavior; they will be skilled at systems-level thinking and problem solving; they will have the ability to critically appraise evidence and apply that knowledge; further more they will have the
entrepreneurial skills to develop new enterprises or activities that promote health, fitness and wellbeing.

We would like our students to demonstrate empathy for populations that are in need of basic access to opportunities for healthful physical activity; they will need to have compassion for others less privileged; as they will need to apply their knowledge to help these populations. Our graduates will need to be excellent collaborators as the societal needs they are being trained to address will increasingly require multi-disciplinary solutions.

We are well placed to meet the challenge of developing the skills necessary for our students to be successful designing and implementing evidence-based programs, particularly with our existing commitments to community based learning. Our students are exposed to a lot of great tools and I think we have an innovative array of courses for them to take that really considers both the fundamentals they will need but also the people and practical skills they will need. I think we can work on ensuring that we are making our current offerings and experiences the best they can possibly be.

They will need to be able to design programs and services based on evidence. They need to be able to translate the scientific evidence to create effective programs to prevent disease and promote health. Students will need to be proficient in policy and understand the relationship of policy to health determinants. They will need to be skilled in policy advocacy. They will need to be skilled in a variety of strategies to communicate about health. They will need to understand the relationship between climate change and health.

**Environments to Support Learning Outside the Classroom in Kinesiology**

Our students would be served by the provision of gathering spaces for students and faculty to work together. The library now provides collaborative workspaces but they are heavily utilized and it’s hard to rely on a space being available when it’s needed. The installation of similar collaboration spaces in departments and colleges across campus would support student learning through collaboration outside the classroom. If such spaces were adjacent to faculty office spaces then “office hours” could be more instructive, efficient and supportive of student learning.

Given the focus of our work in Kinesiology, as campus infrastructure grows we would like to see growth in campus infrastructure include healthy and diverse food options and an enhanced health center. In serving our students we might also guide them by tempering our commitment to a 24/7 campus with a commitment toward promoting healthy sleep habits. As our Health Science degree comes on-line we hope to build on existing collaborations between student affairs and academic affairs and work with Health and Counseling services on health promotion, health education and campus wellness. It would be a big step forward to admit faculty and staff to the campus recreation center and increase efforts to promote outdoor physical activity through walking/running trails, but also through the provision of additional facilities like tennis courts.
Learning outside the classroom would also be enhanced by more connections with community organizations that could use help from students and in return offer valuable life experiences to our students. The provision of more faculty-student events would also enhance learning outside the classroom and the establishment of a speaker series to regularly bring prominent speakers to our campus. Prominent speakers coming to campus has the potential to increase our focus on diverse perspectives, challenge us all to think outside our disciplines and it would significantly enhance campus discourse by bringing faculty, staff, students and community members together around thought provoking topics.

Summary and Conclusions

There is ample opportunity within Kinesiology to integrate research into teaching and service. We currently make very efficient use of our space and will continue to do so but it is clear that we are desperately in need of additional space. Our research topics and the issues that work is addressing are prominent in society, culture, and media. It is clear from the demographic trends that our work will continue to address critical social needs for many years to come. To serve the citizens of California Cal Poly needs to train and graduate students who are ready to make a positive impact on health outcomes in our state.

Our faculty has been highly successful in securing external research funds and there is great potential for funding to increase. As STRIDE and our own research efforts continue to grow, there is an ever-increasing need for additional support space in the form of offices and conference rooms, in addition to the need for dedicated research laboratories. With students getting more involved with ongoing faculty research there is also a need for research space for collaborative student and faculty research/project space.

In addition to new space, unless our current space is completely replaced, we will need to remodel building 43A before 2030. The current facilities’ are outdated and insufficient; the layout of building 43A does not make sense and is a challenge for visitors, guest and students to navigate. We have no collaborative workspace for students and faculty that is not already heavily utilized for research and instruction. As we continue to grow our research program, the security of our equipment and supplies will also become a very much larger issue between now and 2030, particularly in building 43A given the way space is laid out.

In meeting our evolving space needs in the Kinesiology Department, there is great potential for us to partner with other departments and colleges on campus to create multi-disciplinary research labs and multi-disciplinary project space. We are open to the concept of establishing shared spaces with some of our collaborators to make new facilities more achievable on our tight budgets. A new “applied sciences” building to mirror building 180 might include a floor for Kinesiology, a floor for Nutrition and have a floor for STRIDE sandwiched in between. Last year we put in a proposal for remodeled space in Crandall Gymnasium, that project is another possibility to meet our evolving space needs.
a. Teaching, Learning, Scholarship

For the academic programs you expect to offer and the students you expect to serve:

1) What effective approaches to teaching and learning are emerging in your field and related interdisciplinary areas?

We have seen an increased number of pedagogies that are student centered and are very important for future teachers. Students are empowered to be an observer, discoverer, active constructor, and transformer of knowledge while developing 21st century skills (critical thinking and problem solving, communication, collaboration, creativity, information literacy, as well as social and cross cultural skills, among others.

For example:

a. **Problem-based learning**: students learn the domain knowledge and thinking strategies while working on solving a problem

b. **Flipped Classrooms**: students prepare by reading materials, watching videos and/or solving problems ahead of meeting for discussion or other active learning in the classroom. Ex. Some English course, BIO 211, LS 410

c. **Team-Based (cooperative) learning**: studio labs and group projects; each student has a particular job to do the task.

d. **Modeling**: knowledge is jointly constructed by teacher and student based on inquiry- Socratic approach. Constructing understanding. Instructor turns to students.

e. **Integrated Approach** (cross-curriculum): projects cut across more than one class (history and literature) or interdisciplinary class- using multiple methods or lenses to look at an issue. Example: pollution (chemistry, climate, psychological perspective to motive people to play a role, etc.) BIO 211- science, history, politics; PSC 103 US environmental book-mining

f. **Experiential learning**: internships/field work or senior projects or projects in general; lab assignments.

g. **Place-based Learning** – working with our community partners; early field experiences

h. **Case Studies**: incorporation of case studies in the teaching of the subject matter. Some of this is being introduced in some of our courses.

i. **Mind/Body/Integrated**: extracurricular and curricular to contribute to students learning. Appeal to all learners.

Current K-12 reforms are helping us incorporate them in a visible way in our curriculum. We anticipate that our major will be in the early adoption of K-12 reforms in the future.
A target to develop well grounded future teachers,
n. Reflective Teaching Practices
o. Evidence-based Teaching
p. CPK as you teach

2) How should Learn-by-Doing incorporate new learning needs, opportunities and technologies (in your field, etc.)?
a. Increased of Use of Technology in education to solve problems, communicate, collaborate, access information, create, produce
b. Service Learning
c. Lab school
d. Co-Teaching

3) How does the teacher-scholar model fit (again in your field, etc.)?
Integration of faculty scholarship focus in teaching is key for an undergraduate university like Cal Poly and central to our Department mission. Our courses need to be central to innovation and transparent. Students learn while they can also see the fundamental design of a course or an activity. Students are learning strategies that are innovative, clearly focus on research based practices. Faculty members are creators or adopters of innovative practices that clearly fit into the teacher’s scholar model.

b. Learning Environments

What learning environments should Cal Poly develop or modify to accommodate (1) new modes of teaching and learning, (2) Learn by Doing, and (3) the teacher-scholar model in the future? Please respond in terms of the qualitative characteristics of the facilities and other spaces (including technology) critical to your programs and students:

1) Formal, scheduled or organized instruction,
Classrooms promote collaboration and there is room for both hands on activities and seamless integration of technology. Learning spaces are all comfortable, aesthetically pleasing, smart room that allow for flexibility. Tables can be moved easily and required Internet or electrical connections are readily available. Spaces for K-12 interactions are available in Cal Poly: Learn-by-Doing, K-8 lab schools with observation areas; and well established partnerships with local schools allowing us to have a strong component for community service while engaging in learning.

2) Informal student learning outside the classroom or laboratory, and
Numerous spaces outside the formal classroom are available for the students to interact with each other and prepare for their courses

3) The teacher-scholar model.
Faculty have access to implement innovations and structure courses or scholarship in the discipline.
What effective approaches to teaching and learning are emerging in Biology and related interdisciplinary areas that should be adopted at Cal Poly by 2030?

- Integration of new and emerging technology
- Integrating real world research into classes
  - Problem / project based learning
  - Teaching process and principle, not content
  - Research and class projects with pure and applied science deliverables
  - Small-group learning opportunities
  - Interdisciplinary and collaborative research and training
  - Bringing collaborators into classes
  - Bringing the class to the real world (field or project site)
  - Embedding classes (or students) into research labs
- Professionalism
  - Application of professional standard to course content
  - Publication quality quantitative analysis of real data
  - Manuscripts and reporting
  - Require that the textbook be read
- Asynchronous lecture (on-line or video)
  - Synchronous (in-person) lecture for the development of understanding
  - Recitation or discussion sections instead of lecture time
- Resources
  - Time
    - Research project and outreach coordinators
    - Development of classes that teach through research, which would, by definition, be innovated regularly
  - Connectivity
    - Travel or teleconference funds
    - Transportation for students/classes
  - Space and equipment
    - Up to date equipment and technology
    - Professional (writing and reporting) lab

How should Learn by Doing at Cal Poly incorporate new learning needs, opportunities and technologies in Biology and related interdisciplinary fields by 2030?
• Technology
  o Computer literacy and web scholarship will be essential
  o Make use of student-provided technology (laptops etc.)
  o Use state-of-the-art equipment so that students are up to date
  o More interactive class spaces
  o Live organisms for use in classes or labs to see live organisms
  o Small group e-learning stations for in-class activities and assessment

• Business/Industry/Agency partnerships
  o Field trips to show students future work environments, situations and opportunities.
  o Industry-academic internships or collaborations as part of an education (contextualization)
  o Industry acceptance of fee-for-service student enterprise projects
  o Employer input on new technologies that students need to know/use, with a mechanism for to responding to input
  o Human Biology program for pre-health students coupled with local medical groups such as Dignity Health-Marion Hospital to provide an integrated experiential learning environment

• Curriculum
  o One-unit short course for rapid response to timely topics:
    ▪ Immerging Topics in Biology (BIO 499?).
  o Greater number and greater use of research based courses with professional outcomes
    ▪ Extended field activity (Bio 330)
    ▪ Extended research activity (Bio 331?)
    ▪ Current research (Bio 464 (?)) – new course in the Bio 462/463 series
  o Mapping the curriculum to eliminate redundancy and identify & fill gaps
  o Integrate assessment into modernization
  o Comprehensive exam (challenge a course) that is textbook based, and allows students to convert units to AAE or by-arrangement
  o Culture of and funds for technological modernization and experimenting with new technologies
  o Creativity time for interdisciplinary groups of faculty – time to read, reflect, and conceive of new ideas.

• Resources
  o Space
    ▪ Classes that have the most current teaching, research, and computing technology (and support staff) and can hold 48-50 students.
    ▪ New building (or spaces) that embody teacher-scholar (faculty) and engaged-learner (student) models
    ▪ Modular classrooms (lect/discussion/lab)
    ▪ Core technology facilities with technical support
    ▪ Connectivity with each other and with students
    ▪ E-connectivity between Business/Industry/Agency and remote teaching/research sites with campus core
How does the teacher-scholar model fit into what is necessary for Biology and related interdisciplinary fields at Cal Poly in 2030?

- Teacher-scholar (vis a vis higher education and scientific research) embodies modern learn-by-doing and is a cornerstone of Cal Poly’s education
- Teach science by spinning off portions of current real world research into the class/lab.
  - Experimental design and real world constraints
  - Data collection
  - Analytical methods
  - Conforming the learning experience to the reality of doing science
- Creating scholarship and new knowledge takes resources, especially when integrating students into the process.
- The experiential class/lab with scientists highly active in their research fields will be the new draw to a learn-by-doing educational institutions.
- Faculty need to maintain close personal interactions with students, and not slide too far into the project director or facilitator mode
- Faculty need to work with students and be out in the field exploring, in the lab discovering, and working with industry partners to create marketable students through meaningful experiences.
- Need to resist becoming too “efficient” since individualized experiences are inherently inefficient but high impact.
- We will maintain our status by continual enhancement and application of learn-by-doing, though this is readily countered by increasing workloads, high SCU requirements, and sub-standard budgets.
- Learn-by-doing is a unique niche for generating a high quality education.

**Resources**

- **Space**
  - *New building (or spaces) that embody teacher-scholar (faculty) and engaged-learner (student) models*
  - Additional lab space
  - Additional Office space
  - *Current teaching, research, and computing equipment (and support staff)*

- **Time**
- **Support for curriculum development**
- Support for course improvement (active learning, projects, embedded research)
- Support for providing research opportunities while also keeping the “teacher” first in teacher-scholar.
- Support for scholarship and the creation of knowledge (change weight of by-arrangement), while also meeting demand (more lecturers).
- Support for additional hires.
- Rotating faculty-research-fellowship of 1 quarter (or full term of by-arrangement/"research courses") to maintain vigor in research and allow for innovation.
- Expand the role of graduate students (though not to the degree that faculty are entirely facilitators), for example by allowing them by-arrangement units.
- Reductions in the time faculty spend on “logistical paperwork”, especially forms to justify mission critical activities (such as travel), because they consume time that could be devoted more directly to education. Think electronic form workflows.