The CSPSC also asks that plans are prefaced with the department’s mission statement, a list of faculty and their areas of expertise, and the department’s vision statement. An abstract or executive summary of the plan would also be appreciated.

Department of Biology Draft Strategic Plan

February 2017

The Biology Department of Case Western Reserve University engaged in a strategic planning process over two weeks in November and December of 2016. In attendance were faculty, instructors, and key staff members of the department. The exercise followed closely the template that had been created by the College of Arts and Sciences. The key questions established in that template were presented to the break-out groups to consider as they worked through the exercises which built a foundation for the final strategic plan.

The three subgroups were Undergraduate Education, Graduate Education, and Research, Scholarship and Creative Activity. Each of these sections begins with a vision statement for that subgroup and is followed by key information and steps to initiate the plan. The final formats differ as each group chose different areas of concentration in addressing the content. Even though each group focused on the issues unique to its charge, a number of key themes emerged across the groups.

Mission: The mission of the Department of Biology is to promote the understanding and appreciation of life and living systems through discovery and teaching, equipping our students and trainees with broad and deep biological knowledge and skills with which to pursue their intellectual interests.

Vision: We will capitalize on the unique opportunities afforded by the intersections between our local scientific and biological environment and our faculty and students’ research expertise and interests to build our department’s reputation for excellence and engagement on the local, national, and international stage.

Department of Biology Faculty and Staff

Tenure-track (19):
Karen C. Abbott, PhD - Associate Professor in the Ecology and Evolutionary Biology group. Dr. Abbott is an award-winning theoretical ecologist who studies the dynamics of natural populations and communities. Currently teaching: BIOL 352 Ecology and Evolution of

**Radhika Atit, PhD** - *Professor* in the Cell, Molecular and Developmental Biology group. Dr. Atit studies the development of skin and associated structures (i.e., hairs) in mammals. Currently teaching: BIOL 216 Development and Physiology; BIOL 365 Evo-Devo: Evolution of Body Plans and BIOL 495 Introduction to Graduate School in the Biological Sciences.

**Sarah C. Bagby, PhD** – *Assistant Professor* expertise spans the Ecology and Evolutionary Biology and Cell, Molecular and Developmental Biology groups. Dr. Bagby studies the molecular genetics and ecology of microbes in aquatic systems. Currently teaching: BIOL 214 Genes, Evolution and Ecology, and BIOL 303 From black box to toolbox: how molecular biology moves forward.

**Michael F. Benard, PhD** - *Associate Professor* in the Ecology and Evolutionary Biology group. Dr. Benard studies the ecology and evolutionary adaptation of reptiles and amphibians. Currently teaching: BIOL 214 Genes, Evolution and Ecology; BIOL 305 Herpetology; BIOL 310 Field Studies in Evolutionary Ecology; and BIOL 364 Research Methods in Evolutionary Biology.

**Jean H. Burns, PhD** - *Associate Professor* in the Ecology and Evolutionary Biology group. Dr. Burns studies how the relatedness of species in a community can influence a plant community’s invasion by species from other areas. Currently teaching: BIOL 351 Principles of Ecology, BIOL 351L Principles of Ecology Laboratory, and BIOL 314. Taming the Tree of Life: Phylogenetic Comparative Methods-from Concept to Practical Application.

**Arnold I. Caplan, PhD** - *Professor; Director, Skeletal Research Center* participates in the Cell, Molecular and Developmental Biology group. Dr. Caplan is an award-winning, world leader in the study of the development of muscle, cartilage, and bone from stem cells. Currently contributing to BIOL 492 and courses in the Department of BioMedical Engineering.

**Hillel J. Chiel, PhD** – *Professor* in the Neurobiology and Behavior group. Dr. Chiel studies the cellular dynamics of neuronal computation underlying feeding behavior in sea slugs. Currently teaching: BIOL 300 Dynamics of Biological Systems: A Quantitative Introduction to Biology and BIOL 373 Introduction to Neurobiology – both in an active learning format.

**K. Nicole Crown Coffey, PhD** (a.k.a. Nicole Crown) – *Assistant Professor* in the Cell, Molecular and Developmental Biology group. Dr. Crown will join the Department in July 2018. She studies mechanisms of meiotic recombination using the fly, *Drosophila melanogaster*. Currently teaching: Dr. Crown’s teaching responsibilities will be developed when she arrives at CWRU.

**Christopher A. Cullis, PhD** - *Francis Hobart Herrick Professor of Biology* in the Cell, Molecular and Developmental Biology group. Dr. Cullis is an award-winning pioneer in studies of the molecular genetics underlying environmental adaptation in plants. He also oversees the Masters program in Entrepreneurial Biotechnology. Currently teaching: BIOL 301 Biotechnology Laboratory: Genes and Genetic Engineering and BIOL 328 Plant Genomics and Proteomics.

**Sarah E. Diamond, PhD** - *George B. Mayer Assistant Professor* in the Ecology and Evolutionary Biology Group. Dr. Diamond studies the evolutionary ecology of global change
often using insects as her subjects. Currently teaching: BIOL 315 Quantitative Biology Laboratory and BIOL 353 Ecophysiology of Global Change.

**Jessica L. Fox, PhD** - Assistant Professor in the Neurobiology and Behavior group. Dr. Fox studies the sensory neurobiology of flight stability and control in insects. Currently teaching: BIOL 322 Sensory Biology. BIOL 321 Design and Analysis of Biological Experiments.

**Stephen E. Haynesworth, PhD** - Associate Professor; Associate Dean, College of Arts and Sciences in the Cell, Molecular and Developmental Biology group. Dr. Haynesworth currently has 100% commitment to the Dean’s office, and has studied the development of stem cells into bone, cartilage and muscle and their aging processes. He has most recently taught BIOL 362 Principles of Developmental Biology.

**Emmitt R. Jolly, PhD** - Associate Professor in the Cell, Molecular and Developmental Biology group. Dr. Jolly studies the molecular biology and genetics underlying development of the parasitic worm that causes schistosomiasis, the number 2 disease behind Malaria worldwide. Currently teaching: BIOL 342 Parasitology and BIOL 491 Contemporary Biology and Biotechnology for Innovation I & II.

**Ryan A. Martin, PhD** - Assistant Professor in the Ecology and Evolutionary Biology group. Dr. Martin studies the role of an animal’s ecology in its evolution often using amphibians and insects. Currently teaching: BIOL 364 Research Methods in Evolutionary Biology and BIOL 472 Foundations of Advanced Evolution.

**Claudia M. Mizutani, PhD** - Associate Professor in the Cell, Molecular and Developmental Biology group. Dr. Mizutani studies the genetics and developmental mechanisms of how embryos determine the axes of their bodies using fruit flies. Currently teaching: BIOL 324 Introduction to Stem Cell Biology and BIOL 327 Functional Genomics.

**Roy E. Ritzmann, PhD** – Professor in the Neurobiology and Behavior group. Dr. Ritzmann studies how the brain controls the connections between the sensors and the body’s movements using insects. Currently teaching: BIOL 357 Backyard Behavior Capstone and BIOL 374 Neurobiology of Behavior.

**Charles E. Rozek, PhD** - Associate Professor; Vice Provost; Dean of Graduate Studies in the Cell, Molecular and Developmental Biology group. Dr. Rozek currently has 100% commitment to the School of Graduate Studies where he serves as dean, and has studied the molecular genetics underlying development using fruit flies.

**Robin Snyder, PhD** - Associate Professor in the Ecology and Evolutionary Biology group. Dr. Snyder is an award-winning theoretical ecologist studying how organisms cope with uncertainty and random variation in their environments. Currently teaching: BIOL 319 Applied Probability and Stochastic Processes for Biology, and BIOL 306 Mathematical Analysis of Biological Models.

**Mark A. Willis, PhD** - Professor; Chair in the Neurobiology and Behavior group. Dr. Willis studies how sensors interact to influence behaviors using flying insects. Currently on teaching release while serving as chair. Typically teaches: BIOL 318 Introductory Entomology and BIOL 358 Animal Behavior.

**Instructors and Lecturers (9):**
Rebecca Benard, PhD – Senior Instructor, education in Plant population ecology, physiology – Currently teaching: BIOL 116 & 117 Introduction to Human Anatomy and Physiology I & II for Nursing students and BIOL 216 Development and Physiology for Biology majors – using a hybrid active learning format.


Richard F. Drushel, PhD - Senior Instructor; Executive Officer, education in Vertebrate anatomy and physiology, kinematic modeling and neural control, autonomous robotics – Currently teaching: BIOL 223 Vertebrate Biology; BIOL 340 Human Physiology, and BIOL 346 Human Anatomy.

Valerie Haywood, PhD - Senior Instructor, education in Plant developmental biology, molecular biology – Currently teaching: BIOL 215 Cells and Proteins both semesters and BIOL 215L in the fall.

Barbara A. Kuemerle, PhD - Senior Instructor, Molecular biology and genetics; developmental neuroscience. Currently teaching: BIOL 216 and 216L Development and Physiology for Biology majors and its lab, and BIOL 302 Human Learning and the Brain (SAGES Department seminar).

Audrey Lynn, PhD, Adjunct Instructor, Human genetics; chromosome behavior during meiosis; mitochondrial disorders. Currently teaching: BIOL 326 Genetics.

Ronald G. Oldfield, PhD - Senior Instructor, Evolutionary ecology of cichlid fishes; ichthyology. Currently teaching: BIOL 309 Biology Field Studies; BIOL 338 Ichthyology; BIOL 340 Human Physiology, and BIOL 346 Human Anatomy.

Deborah L. Harris, MS - Full-time Lecturer, Aquatic biofouling; mycology. Currently teaching: BIOL 215L Cells and Proteins Laboratory, BIOL 336 Aquatic Biology and BIOL 339 Aquatic Biology Laboratory.

Dianne M. Kube, PhD - Full-time Lecturer, Cell biology, cystic fibrosis. Currently teaching: BIOL 333 The Human Microbiome (SAGES department seminar), BIOL 343 & 344 Microbiology and Laboratory for Microbiology.

Adjunct Faculty (13):

James Bader, MS - Adjunct Lecturer; Executive Director, Gelfand STEM Center, STEM education; aquatic biology. Currently not teaching, but has most recently taught BIOL 214 Genes, Evolution and Ecology.

David J. Burke, PhD - Adjunct Assistant Professor, Holden Arboretum. Rhizosphere ecology; plant-microbe interactions; molecular microbial ecology; plant ecology. Has co-advised CWRU undergraduate researchers and served on CWRU graduate student dissertation advisory committees, not currently conducting classroom teaching in Biology at CWRU.
Pam Dennis, PhD, DVM - Adjunct Assistant Professor; Clinical Assistant Professor, Cleveland Metroparks Zoo. Veterinary wildlife epidemiology in zoo and free-ranging animal populations. Not currently doing classroom teaching at CWRU – co-advising PhD students and advising CWRU undergraduate researchers.

Nancy DiIulio, PhD - Adjunct Instructor; Senior Associate Dean, Undergraduate Studies, Cell biology; biochemistry. Not currently teaching in Biology at CWRU.

Yohannes Haile-Salassie, PhD – Adjunct Assistant Professor, Cleveland Museum of Natural History. Not currently teaching in Biology at CWRU.

Diana C. Koester, PhD – Adjunct Assistant Professor, Cleveland Metropark Zoo, Curator of Research; behavioral endocrinologist studying reproductive biology in cheetahs. Not currently teaching at CWRU – serves on CWRU biology graduate student dissertation advisory committees.

Christopher Kuhar, PhD - Adjunct Assistant Professor; Executive Director, Cleveland Metroparks Zoo, Conservation and education program evaluation; experimental psychology; animal behavior. Not currently teaching at CWRU – serves on CWRU biology graduate student dissertation advisory committees.

Ana B. Locci, PhD - Adjunct Assistant Professor; Director, CWRU University Farm, Aquatic ecology and population biology. Not currently teaching at CWRU – hosting CWRU undergraduates.

Kristen E. Lukas, PhD - Adjunct Assistant Professor; Curator, Conservation and Science, Cleveland Metroparks Zoo. Applied animal behavior; behavior and health; visitor attitudes and behavior. Teaches Animal Behavior when Willis is not available. Currently teaching BIOL 358/458 Animal Behavior while Willis serves as chair – serves as primary advisor on CWRU graduate student advisory committees, co-advises PhD students and hosts CWRU undergraduate researchers.

Julianna Mederios, PhD – Adjunct Assistant Professor, Holden Arboretum. Understanding complex relationships between plants and their environment, the evolution of plant adaptations. Not currently conducting classroom teaching in Biology at CWRU, serves as co-advisor on undergraduate research projects.

Katherine Stuble, PhD – Adjunct Assistant Professor; Holden Arboretum. Community ecology, mechanisms responsible for maintaining patterns of biodiversity, understanding how global change may alter communities. Not currently conducting classroom teaching in Biology at CWRU, serves as co-advisor on graduate research projects.

Denise F. Su, PhD - Adjunct Assistant Professor; Curator/Head, Department of Paleobotany and Paleoecology, Cleveland Museum of Natural History. Paleocology; human evolution; functional morphology. Currently teaching BIOL 398 Modern Human Biological Variation.

Gavin J. Svenson, PhD - Adjunct Assistant Professor; Curator/Head, Department of Invertebrate Zoology, Cleveland Museum of Natural History. Phylogenetics and systematics. Currently teaching: BIOL 318 Introductory Entomology, serves as primary research advisor on CWRU graduate student advisory committees.
**Secondary Faculty:**

**Darin Croft, PhD** - *Associate Professor, Department of Anatomy, School of Medicine.*
Vertebrate paleontology and fieldwork; mammals, especially those of South America; paleoecology and ancient ecosystems. Currently teaching BIOL 345 Mammal Diversity and Evolution.

**Brian M. McDermott, PhD** - *Assistant Professor, Department of Otolaryngology, University Hospitals of Cleveland.*
Studies the neurobiology of hearing and deafness using the zebrafish. Currently teaching BIOL 379 Transformative animal models in modern biology.

**Scott W. Simpson, PhD** - *Associate Professor, Department of Anatomy, School of Medicine.*
Hominid paleontology and fieldwork; hominid dentition; locomotor capacities of early *Homo erectus*. Not currently teaching in Biology at CWRU.

**Peter Thomas, PhD** - *Associate Professor, Department of Mathematics, Applied Mathematics, and Statistics.*
Synchronization and reliability of neural activity; gradient sensing, signal transduction and information theory; pattern formation in the visual cortex; malaria informatics. Not currently teaching in Biology at CWRU.

**Peter A. Zimmerman, PhD** - *Professor, Center for Global Health and Diseases, School of Medicine.*
Infectious diseases; genetics; genomic epidemiology and evolution. Not currently conducting classroom teaching in Biology at CWRU, serves as primary research advisor on CWRU graduate student advisory committees.

**Staff:**

**Kathryn Bingman** – *Undergraduate Program Coordinator.* Primary contact person for undergraduate Biology majors, organizes prospective student visits, assists faculty with undergraduate student issues.

**Julia Brown-Allen** – *Graduate Program Coordinator & Graduate Student Recruiter.* Primary staff assigned to oversight and management of the graduate program (including the Masters program in Entrepreneurial Biotechnology), actively recruits and interacts with applicants to the graduate program, supports the work of the Department of Biology’s Graduate Admissions Committee and the Director of Graduate Studies, primary contact point for Biology graduate students, assists faculty with graduate student issues.

**Richard Drushel** - *Executive Officer.* Serves as primary contact person with facilities management in matters that effect the entire department. Also reviews and determines whether courses taken off-campus can be used as transfer credit, verifies and posts our department teaching roster to the Student Information System (SIS), continuously monitors the total enrollment in our courses and the number of majors and minors. Primary supervisor for Ms. To-Thorne, the course coordinator for all laboratory courses in the Department of Biology.

**Susan Kolenz** – *Department Administrative Assistant.* Manages daily appointments for the chair, oversees and assists faculty and students in routine purchasing, assembles schedules for visiting scientists.

**Susan Rozek** – *Department Budget Administrator and Staff Coordinator.* Supports and oversees
all aspects of grant proposal preparation and spending, manages day-to-day finances of the Department of Biology, senior supervisor of other department staff, works closely with the chair on all departmental financial matters.

**Binh To-Thorne – Laboratory Course Coordinator.** Supports and manages all laboratory courses in Biology, assists and mentors graduate and undergraduate teaching assistants, assists the chair and other faculty with specific requests.

**Executive Summary**

**Introduction:** The research and teaching interests of the Department of Biology’s faculty are broad, spanning all levels of biological organization – from molecules and cells to whole organisms, populations and ecosystems. The faculty comprises 19 tenure-track faculty, 7 instructors, 3 lecturers, and 5 full-time staff. Our research faculty use a variety of scientific approaches to answer questions aimed at understanding the mechanisms underlying life at all levels of organization. In the recent history of the department, research-active faculty were organized into three groups based on their areas of interest: 1) Cell, Molecular and Developmental Biology, 2) Ecology and Evolutionary Biology and 3) Neurobiology and Behavior. The Cell, Molecular and Developmental Biology group is made up of 8 faculty with 2 permanently assigned to administration (i.e., research-active faculty). The Ecology and Evolutionary Biology group has 6 faculty, the Neurobiology and Behavior group has 4, and 1 faculty member spans the Cell, Molecular and Developmental and Ecology and Evolutionary Biology groups.

To expand the breadth of research and training experiences available to our undergraduate and graduate students we have sought out opportunities to develop adjunct faculty with primary appointments in other biological institutions in the Cleveland area. We are currently working toward completing an affiliation agreement between the Department of Biology and the three major Biological Institutions in the city of Cleveland: the Cleveland Metropark Zoo, the Cleveland Museum of Natural History and the Holden Arboretum/Cleveland Botanic Garden. This agreement will formalize our existing collaborations with the researchers at these institutions and make it easier for our students and faculty to access the unique resources and facilities of these institutions which are unavailable at CWRU. Adjunct faculty at these institutions currently serve on graduate student qualifying exam and dissertation committees, and supervise CWRU Biology undergraduate students in research projects at their institutions. They also may recruit graduate students who will study and work with them and earn a graduate degree in Biology from CWRU. We currently have 3 adjunct faculty at the Cleveland Metropark Zoo, 4 at the Cleveland Museum of Natural History and 3 at the Holden Arboretum, and we expect to add one or two more from each institution in the next few years. It is hoped that this agreement will also serve as the foundation for the development of unique and attractive programs that will reveal that we are greater than the sum of our parts.

Faculty from departments in other units at CWRU also contribute to the breadth of the
Department of Biology. These secondary appointments, mainly from departments in the School of Medicine, supervise Biology graduate students doing research with them and serve on graduate exams and dissertation advisory committees. A few of these secondary faculty are offering regularly-scheduled upper-division biology courses that have been generally well received by the students enrolled.

The Department of Biology has a large, demanding teaching role in the College of Arts and Sciences. We consistently have one of the largest populations of undergraduate majors in the College, and offer courses required by other majors and schools. In addition, since many CWRU undergraduates, from many academic majors, aim to pursue a career in the healthcare professions, they take our introductory courses as preparation for their MCAT exams and applications to post-graduate schools. 

This results in our faculty teaching roughly 5 times more students in our introductory courses (i.e., BIOL 214, 215 and 216) than the number of Biology majors in our program. Recent statistics from the Office of Institutional Research show that 35-40% of each incoming class will take our introductory-level courses for Biology majors (i.e., BIOL 214, 214L, 215, 215L, 216, and 216L). With most Biology majors and many others across campus identifying themselves as pre-healthcare professionals this is not surprising. The Instructors and Lecturers in the Department are primarily engaged in teaching these introductory-level courses for our majors and service courses for other Schools. Some also contribute to our upper-division electives and the SAGES curriculum. The tenure-track faculty are primarily research focused. Three tenure-track faculty members teach in core courses (Drs. R. Atit - BIOL 216, S. Bagby - BIOL 214 and M. Benard - BIOL 214); otherwise, teaching by the tenure-track faculty is in upper-division elective courses. All faculty in the Department of Biology take our teaching role very seriously. This is reflected in student evaluations of courses and instructors typically being in the “Very Good – Excellent” range and overall being above average for the University. It is also typical for at least one of our faculty, often from our corps of Instructors, to be nominated for the Wittke award for excellence in undergraduate teaching each year. We also have individuals in our faculty who have received the Wittke Award, the Jackson undergraduate mentoring award and the Diekhoff award for graduate teaching. We are very proud of these accomplishments and feel that this is an impressive reputation for a department with one of the largest undergraduate majors in the College, and a research-active tenure-track faculty with substantial external funding.

Finally, we recognize that even though we have spent considerable time and energy discussing and formulating the following strategic plan, opportunities that may not fit these plans may sometimes arise unexpectedly. In those instances, the chair or other faculty persons will introduce that opportunity to the faculty for a discussion of the pros and cons so an informed decision can be made on how to proceed.

**Key Universal Themes from the Planning Process**

During our strategic planning retreats a number of overarching ideas surfaced repeatedly
during our discussions and across our breakout sessions focused on Undergraduate and Graduate Education and Research, Scholarship and Creativity. Since these ideas broadly spanned the department we will mention them separately here.

**Cohesiveness** *(more intentionality in department meetings and programming)*. There is a broad desire for more interaction and communication, and the cohesiveness and community that results. It was agreed that this is a desirable goal in itself, because it could lead to the development of an ongoing theme of *progress and development as a department*, rather than for each of the three sub-groups. To promote this idea and increase everyone’s familiarity with each other’s work, it was suggested that the department increase presentations by our faculty in the weekly department seminar series. We have begun to do this. We are also striving to balance all of the important Department committees with members of each of the three sub-groups. It was also suggested that we increase opportunities for social interactions, and identify a room that could serve as a lunch or coffee room as a common “social space” for the department. The extreme shortage of space in the Department of Biology makes this last possibility particularly difficult. However, we have committed to increasing the opportunities for these sorts of interactions, including “Happy Hours” after our department seminars once a month, celebrating the end of fall and spring semesters at The Corner Alley and re-establishing a fall department picnic at the University farm. In an effort to promote communication across the natural and physical sciences, we have also initiated Chemistry, Physics, Biology Coffee Hour twice a month.

**Curriculum review and development** *(have a curriculum that provides students with skills for both academic and non-academic careers)* – Our current curriculum broadly covers the field of biology and most courses stress not only learning biological facts but how to put those facts into a conceptual framework and pose worthwhile questions. Many of our courses require written assignments and oral presentation of primary scientific papers or the students’ own observational or experimental results. These reports are typically written in scientific paper format. Other classes require written grant proposals submitted in the format of the National Science Foundation or the National Institutes of Health. For these to be successful the students must be able to start with an observation, pose a related hypothesis, and then propose an experiment to test the hypothesis. That is, they must demonstrate that they can use the scientific method. In a broad sense, students in our current curriculum learn to read critically and communicate their ideas clearly in writing and verbally. These are all skills that will support most careers in any field – not just biology. We expect an important result of our ongoing strategic planning process will be to reassess our current curriculum with an eye to developing a logical flow of courses that builds knowledge and expertise in specific core areas. Our current curriculum has developed in a somewhat ad hoc manner with a sequence of three introductory courses and an upper division genetics course, followed by upper division electives added as new faculty join the department. The development of these electives has been more strongly motivated by faculty expertise than by an organizing framework for our educational and training goals.
**Increased awareness and access to novel teaching techniques** (Faculty awareness and access to novel techniques and innovative methods for teaching) – The resources and expertise available through UCITE Fellowships and the Active Learning Fellowships in U[tech] make it possible for any of our faculty to experiment with and incorporate novel methods into their classrooms. A growing number of our faculty have experimented with, and successfully incorporated, novel active learning technology and methods into their classrooms. If possible we would like to use these experienced faculty as a resource for helping others who want to move in this direction. We understand and accept that some may not want to do this. However, there are others who would but cannot because they are so committed to their current teaching and research program they do not have enough time to participate in on-campus teaching fellowships. In these cases, we will need to be creative, possibly rotating teaching assignments to provide those interested the teaching release time necessary to work on new creative teaching initiatives.

**Mentoring for Instructors** – Currently the Department of Biology has no official mentoring policy for our Instructors. This is in contrast to department practice for tenure-track faculty. Each new tenure-track faculty member is assigned a senior faculty member to serve as their official department mentor during their pre-tenure period. That relationship typically lasts beyond the tenure period, and as the new faculty member matures their network of mentors and advisors typically expands. Historically, new Instructors joining the Department of Biology have improvised, often approaching other Instructors with more experience, or discussing best approaches to problems among themselves or with other teaching faculty. The chair of the department has also served as informal mentor on some occasions. An important result of our strategic planning process is that the department chair will meet formally with the Instructors to discuss and develop a mentoring policy for the non-tenure-track faculty to remedy this glaring absence as we move forward as a department.

**The student experience** – Historically the Department of Biology’s primary focus on our students’ experience has been to make sure that we had enough open sections of our popular introductory courses and those required for our majors’ graduation, to satisfy the demand. We have been in “survival mode” for many years, accentuated by the increase in undergraduate enrollment. Please remember that an apparently fixed percentage of each undergraduate class takes our introductory classes (i.e., BIOL 214, 215 and 216). Even as we have been struggling to provide the courses for our majors and minors and the general pre-health undergraduate population, the instructors-of-record for our courses have continued to be nominated and receive campus teaching and mentoring awards. As our faculty has grown over the last 5 years or so we have begun to have more time to consider other ways to connect with our majors and provide an overall positive experience for them. Toward this end we are initiating efforts this year to increase the engagement of our undergraduate majors. We have formed a Chair’s Undergraduate Advisory Committee, made up of undergraduate biology majors. This committee will advise the Chair in developing programs and events that will attract our majors so they have experiences with the Department of Biology that go beyond the classroom and lab. In addition, this year
(2017-18) we will hold a Department Award Ceremony where our undergraduate majors will be recognized for their achievements over their academic careers. An undergraduate alumnus or alumna will also be presented with an award and talk with our graduating majors. Over the longer term, we expect other events or programs to come out of the Chair’s Advisory Committee.

**Three common challenges identified by each working group** *(1. building department cohesiveness, 2. space needs, and 3. the currently understaffed department) –*

**Community cohesion:** When asked about what could make their experience in the Department of Biology better, one of the first things mentioned by many graduate students and faculty is cohesiveness and a sense of community. Building a foundation to begin “cultural” changes that could lead to greater cohesion and community has begun, as has investment of time and department funds. To foster this new culture, we are starting to develop an array of regularly scheduled departmental activities. These include an annual graduate student research showcase associated with our graduate recruitment efforts, department-wide social celebrations at the end of each academic semester, and other lower-key events like happy hours after our department seminars. It is an important goal to maintain these events until they are taken for granted by the department and become an expected and anticipated part of our yearly rhythm. It is also important that their value is so clearly understood that recruiting faculty, staff, and graduate students to organize them is routine.

**Space shortage:** The Department of Biology is landlocked. There are no obvious and easily identifiable spaces to allow for growth of the research-active faculty. In addition, our undergraduate enrollment has increased to the point that our existing laboratory teaching classrooms are just enough to house the laboratory sections of our introductory courses and just a few others. In fact, two of our lab courses (BIOL 223 and 216L) have been sharing a lab classroom for 3 years. Offering a new relatively large laboratory class is essentially impossible. Some smaller lab classes have been conducted in faculty research labs, but lab class enrollments of greater than 5-10 would be impossible or severely hamper the research progress of individual faculty using this approach to offer a lab class. Our lack of space means hiring new faculty and teaching new lab classes are extremely difficult, requiring direct involvement of the dean's office to locate and acquire the space.

In the recent past each new faculty member has received approximately 1000 square feet of space, including their office, in which to establish an independent research laboratory. Currently, the only way we can offer this much space to new faculty recruits is to (1) re-allocate space from our own current faculty, (2) re-allocate space to Biology from another department or (3) wait for our current faculty to retire. Another unexplored possibility is creative consolidation of faculty with similar interests or using similar techniques, into a shared lab space. For the Department of Biology to reach its goals in undergraduate and graduate education and overall national ranking we will need to continue to increase the population of tenure-track faculty to between 25 and 30.

**These goals can only be achieved with additional space for laboratory teaching and research labs.**
Currently understaffed department: As mentioned above, as CWRU’s undergraduate enrollment has increased over the last 5-10 years, the Department of Biology has received an exceptionally large number of these students in our classes because many of them aspire to the health care professions or graduate school. Our steady increase in faculty over those years has allowed us to just keep our heads above water and we are beginning to move out of “survival mode” and think about our trajectory in a more balanced way, aspiring to excellence in our national and international reputation in all areas – i.e., research, graduate training and undergraduate education. For the Department of Biology to continue to blossom to its fullest expression we anticipate a steady state faculty of between 25 and 30. Our aim in increasing to this size is two-fold, first to achieve a rough balance of faculty in our three current focus areas, and hire individuals whose research explicitly spans two or more of these areas. In addition, increasing the faculty size will result in a larger graduate program, making it easier to staff our classes with graduate teaching assistants. Balancing the current focal areas will allow each to achieve the critical mass necessary to initiate or participate in training grant opportunities, and to develop a group dynamic that can attract excellent graduate and postdoctoral trainees. We feel that there is great value in the breadth and depth of educational opportunities we can offer as a broadly based Department of Biology. We also feel that hiring new faculty that span our current focal areas will go a long way toward integrating the faculty into a more cohesive group. According to our group planning sessions this is highly desirable.

**Undergraduate Education**

- **Overview of Current Status.**

  Biology department faculty are strongly dedicated to undergraduate education. Faculty seek to enrich their teaching by sharing with students their love of research, and by giving students the opportunity to experience what it is like to do research within their courses. Furthermore, Biology faculty guide and inspire undergraduate students to do research, both within the Biology department and with faculty in the life sciences in the many organizations affiliated with the Biology department and with CWRU (e.g., CWRU’s Medical School, the Cleveland Clinic, the MetroParks Zoo, the Cleveland Museum of Natural History, and the Holden Arboretum). The Department also has an important facility for ecological research, Squire Valleeveue Farm, which is heavily used by our undergraduate students in their classes and in independent research projects.

  The undergraduate major in Biology is designed to give students a common understanding of the breadth of biology through three core introductory courses, and then to allow them to pursue their interests through more specialized upper level coursework. All courses provide students with the intellectual tools and technical skills needed to perform advanced research in biology. Central to the major are the three core courses, Genes, Evolution and Ecology (BIOL 214 and its associated lab, 214L), Cells and Proteins (BIOL 215 and its associated lab, 215L), and Development and Physiology (BIOL 216 and its associated lab, 216L). As students take these courses, more and more of the upper-level elective courses, for which these courses are
pre-requisites, become available to them. The upper-level courses fall within the three major research focus areas of faculty in the department: ecology and evolution, cell and developmental biology, and neurobiology and behavior. The department offers several Departmental Seminars for the SAGES program, SAGES capstones as independent research credits (BIOL 388S and 389S), and a SAGES capstone class.

The students that we teach in both our core and upper level courses are varied. We teach many students who come to CWRU as pre-medical students who do not major in Biology. We teach students from the Nursing school, Biomedical Engineering, and M.S. and PhD programs in the Medical School. Approximately 40% of the students in each of CWRU’s incoming class take our introductory core classes. About 25% of these students (i.e., about 75 to 100) choose to major in Biology, and we graduate about 75 to 100 Biology majors every year.

• A review of the number of majors over the past five years, the number of courses taught, and the overall enrollment statistics for these courses.

The number of degrees awarded in Biology is shown in the figure since 1993. From 1993 to 2007, the average number of degrees awarded per year was 60 (range: 38 to 84). After the undergraduate class size was increased, the average number of degrees awarded per year has been 99 (range: 78 to 132), a 64% increase.

The Department teaches many courses: 3 at the 100 level, 6 at the 200 level (including the three introductory courses for majors), and 53 at the 300 level. As shown in figure X above, the number of distinct students enrolled in Biology courses on a yearly basis is about 10 to 12 times the number of degrees awarded in Biology on a yearly basis. Once again, the number of students enrolling in Biology courses significantly increased starting in 2008. Thus, the data show that a very significant part of the teaching load of the Biology faculty is focused on meeting the needs
of non-major students (i.e., pre-medical students who do not major in Biology; engineering students, nursing students, and students from other parts of the University who take Biology Department courses).

Largest enrollments occur in the introductory courses for majors. The figure above shows annual fall enrollments in the first of the three core courses, BIOL 214 (Genes, Evolution and Ecology) over the last five years (2011 to 2015). The average enrollment is 362 students (range: 317 to 401).

Here is an alternative Plot of Biol 214 Enrollments

Largest enrollments occur in the core courses. The figure above shows academic year (not including summer) enrollments in the first of the three core courses, BIOL 214 (Genes, Evolution and Ecology) over the last seven years (2011 to 2015). The average enrollment each
The academic year is 466 students (range: 369 to 541). Biol 214 is taught in both the fall and spring semester, although it typically has higher enrollment in the fall.

Students appreciate the enthusiasm and hard work that our faculty dedicate to teaching. Every year, members of the Biology department are nominated for the University-wide Wittke undergraduate teaching and Jackson undergraduate mentoring awards. Dr. Rebecca Benard, one of the instructors of the core courses, won the Wittke award in 2015 and Dr. Richard Drushel was presented the award in 2017.

As described below, the need to teach many courses, including large-enrollment courses, poses challenges to our ability to provide both high-quality learning environments and individual research experiences for our undergraduates.

**A description of programs offered and how their number or scale should be adjusted. Are the existing programs the right ones for the future?**

There are three undergraduate degree programs offered by the Biology department: a B.A. in Biology, a B.S. in Biology, and a B.S. in Systems Biology. The two B.S. degrees are considered professional degrees, and students who opt for these degrees must take additional or more advanced pre-requisite or co-requisite courses in Mathematics, Chemistry and Physics. For the B.S. degree, a year of research is required. A year of research is highly recommended for students in the Systems Biology B.S. program too.

The main difference between the B.S. in Biology and the B.S. in Systems Biology is that Systems Biology students are required to take additional and more advanced Mathematics and Computer Science courses that prepare them to do upper level courses and research in mathematical modeling of biological systems and in bioinformatics.

The B.A. program continues to serve our students well as the basis for most careers in the biological sciences, including medicine, research careers in biology (in academia, industry or in government), and other areas in which biological background can be valuable (e.g., law and public policy, creating new technologies and new companies based on biology).

The two B.S. degrees serve our students well as the basis for a research career in Biology, and thus students who plan to go on to graduate school in Biology, or to obtain an M.D./Ph.D. degree, are often encouraged to use the B.S. option. The Systems Biology B.S. attracts students who have very strong backgrounds in mathematics, computer science, physics and engineering, and is an excellent preparation for a career in academia or industry, especially in areas that involve modeling, bioinformatics, big data analysis, and other growing areas within biology.

**The target number of majors given the current faculty size.**

Currently, there are 19 tenured or tenure track faculty (5 full professors, 9 associate professors and 5 assistant professors), 7 instructors (4 senior instructors, 3 instructors), and 3 lecturers (2 lecturers and 1 adjunct lecturer). Because 17 of the 19 tenure-track faculty members
are highly active in research, and 2 tenure track faculty members have significant administrative roles (Associate Dean of the College of Arts and Sciences, Dean of Graduate School and Vice Provost), teaching loads for tenured or tenure-track faculty are limited to one or at most two courses per semester, depending on the faculty member’s other commitments (e.g., service commitments to the Department). In addition to our core faculty, we have depended on semester-by-semester contracts with Drs. Nancy Dilulio and James Bader to teach introductory courses (BIOL 214 and 216), and our adjunct and secondary faculty to teach upper division electives (BIOL 318/418 Entomology: Dr. Gavin Svenson - Cleveland Museum of Natural History, 358/458 Animal Behavior: Kristen Lukas - Cleveland Metropark Zoo, 345/445, Mammal Diversity and Evolution: Darin Croft - Dept. of Anatomy CWRU SOM, 379/479 Transformative Animal Models in Modern Biology: Brian McDermott - Dept. of Otolaryngology CWRU SOM, 398/498 Modern Human Biological Variation: Denise Su - Cleveland Museum of Natural History). All Biology faculty (tenure-track and instructors) and lecturers participate in teaching the introductory core classes and upper-division classes; however, tenure-track faculty, instructors, and lecturers make different contributions to the Department’s teaching and research missions. Instructors and lecturers have higher teaching loads than tenure-track faculty. In addition to teaching (typically two FTEs per year), tenure-track faculty also supervise their own independent research programs that directly provide undergraduates with important research experiences and capstones. The graduate students working in many of these labs also serve as graduate teaching assistants, without whom teaching many of our courses, especially our introductory labs, would be nearly impossible.

The consensus of the Biology faculty is that, based on experiences in lecture courses, formal laboratories and seminars, the best student to faculty ratio would be roughly 10 to 1. With ratios at that size or smaller, it is possible to learn each student’s name very quickly, to address their questions individually, and to explore new approaches to teaching, such as active learning. As the ratio grows beyond that number, it becomes increasingly difficult to give any student individual attention. In our large and introductory courses, we attempt to approach this ratio by using undergraduate and graduate teaching assistants.

Tenure-track faculty with ongoing research projects in their labs attempt to accommodate research projects for several undergraduate students, but the number is generally 3 to 5 per faculty member or fewer. It takes considerable time (weeks to months) to teach an undergraduate student to perform delicate and complex dissections, properly use sensitive and expensive equipment, properly care for animals, build mathematical models, properly maintain and manipulate cell lines using appropriate sterile technique, and accurately and precisely execute multi-step processes that are crucial for assays and molecular biological techniques. These are valuable learning experiences for the undergraduate students, but may not contribute to the research productivity of a faculty member’s laboratory. If the time that the student can dedicate to research after training is relatively small, especially since many experiments may require multiple consecutive hours of uninterrupted work, then the cost of training is not balanced by the benefit of data obtained from the research. For faculty to be competitive in obtaining grants, they must be productive in producing data and publishable papers, and if undergraduate training takes a disproportionate proportion of their effort - or of the effort of graduate students and
postdoctoral fellows in their laboratory - they cannot succeed. On the other hand, some of CWRU’s best undergraduates are truly outstanding, and faculty are dedicated to ensuring that they do have the opportunity to do research.

Thus, the current number of majors, ranging from about 75 to 100 per year in the last five years, is reasonable given the faculty size. Expanding beyond this number of majors would require an expansion of the faculty.

- **Current effect of admissions practices and results on the department’s undergraduate programs.**

  As illustrated in the figure X, the Department of Biology has borne the brunt of the decision after 2007 to increase the number of undergraduates. As a consequence of this decision, our instructor corps and faculty hires have increased, so that we are now almost able to cope with the number of majors that we have. However, the Biology Department is still feeling the strain of the increased numbers of students. For example, since Fall 2011, the Biology Department has relied on people outside of the Biology Department [i.e., Dr. Nancy DiIulio (Senior Associate Dean of Undergraduate Studies) and Mr. James Bader (Executive Director, Gelfand STEM Center)] to teach a large fraction of the introductory BIOL 214 class each year. An additional difficulty in teaching our large introductory laboratory courses is the requirement to staff them with graduate teaching assistants (GTAs). These GTAs are typically graduate students in our department supported on teaching assistantships. For the last three semesters (i.e., 2017-2018) the number of graduate students available to serve as GTAs and the required number of lab sections to support the introductory courses have fluctuated up and down just enough to reveal that we are on the verge of not being able to meet our GTA requirements with the current size of our graduate program. Our highest priority is to staff the introductory lab courses with GTAs, and over the last few semesters we have had to deny requests for GTAs in our upper division courses to do this.

  We are particularly concerned about the new M.S. and post-baccalaureate programs that are being created by the School of Medicine. Many of the students in these programs are interested in taking, or are required to take, courses in the Department of Biology (including our introductory courses). Without expansion in the number of instructors and faculty, we are very concerned that this large influx of new students, who are not majors or our own graduate students, could degrade the quality of our undergraduate education.

- **A description of challenges faced in educating and advising students, including those associated with SAGES, the college’s breadth requirements, and large service courses.**

  We have been compelled to change the design of our introductory “core” courses and labs in response to the large influx of students, many of whom are not Biology majors. Moreover, some of the students admitted either did not have sufficient background to master course material, or did not have the learning skills needed to do well in college (or both). Originally, we integrated lab and lecture core courses as a single 4 credit course (from Spring 2002 to summer 2008). Often, we found that students would succeed in finishing the laboratory, but would fail the
lecture component of the course, and so had to re-take the entire 4 credit course. We therefore split the introductory labs (each of which is now worth 1 credit) from the introductory core courses (each of which is now worth 3 credits). Even with this split in courses, we could not provide our students with the opportunity to do their own experiments in the introductory laboratory classes because of the large influx of students. The inability to have individual experiences in the lab reduces the students’ excitement of taking these courses and affects retention in STEM majors. Furthermore, students may take these introductory labs in different semesters from the corresponding lecture courses, so that it is no longer possible to integrate lecture and lab experiences across these courses.

Because of the large number of majors, the heavy teaching load of the instructors and lecturers, and the need to allow research active faculty time to do research, we have not been able to offer SAGES University Seminars. For the same reason we have had difficulty offering enough SAGES Departmental seminars to accommodate all of our majors. We do provide several SAGES Departmental seminars (BIOL 302 - Human Learning and the Brain, BIOL 303 – From Black Box to Toolbox: How Molecular Biology Moves Forward, BIOL 333 - The Human Microbiome, BIOL 364- Research Methods in Evolutionary Biology, BIOL 365 - Evo-Devo: Evolution of Body Plans, 374 - Neurobiology of Behavior, 379 - Transformative Animal Models in Modern Biology) and two courses that students can take as a capstone (BIOL 357 - Backyard Behavior, and BIOL 314 - Taming the Tree of Life: Phylogenetic Comparative Methods-from Concept to Practical Application). Our SAGES Department Seminar offerings are increasing as we add new faculty and adjunct and secondary faculty design new courses.

The limitations described above for accommodating students to do research in faculty laboratories also precludes providing SAGES research capstone experiences for all of our majors (and the many other non-majors who approach our faculty to do research) within the laboratories of the faculty of the Department of Biology. Were our faculty to expand to accommodate all of these demands, we estimate that the Department of Biology would essentially be the size of the current College of Arts and Sciences.

Instead, we encourage students to take SAGES Departmental seminars outside of the Department of Biology, and to do research in the laboratories of other Departments (e.g., in CWRU School of Medicine basic science departments, at the Cleveland Clinic, and in affiliated institutions, such as the Cleveland Museum of Natural History, the Cleveland Metroparks Zoo, or the Holden Arboretum). Faculty within the Department of Biology serve as academic advisors for all majors doing research outside of the Department, and work with the research advisors at the other institutions to assure that the expectations for our students’ research, and the evaluation of their work, is both timely and fair.

Our current advising loads range from 12 to 20 students per faculty member, which is large, and can require significant faculty effort, especially as students plan their courses and pre-register for the next semester. Having Ms. Katie Bingman as the Department of Biology’s undergraduate coordinator has been invaluable for helping faculty manage this load and for providing a uniformly high quality advising experience for our undergraduate students.
• Preparation for continuing education and career post-graduation: where are our students going after they leave us, is what we are doing working, and how do we know?

Many of our students go on to medical school or to graduate school. The following table illustrates the Medical School acceptance rates for Biology majors in contrast to the overall acceptance rate for all CWRU students for 2011 through 2015. In 2 of the 5 years shown, student majoring in biology had a better rate of acceptance than students at CWRU overall:

<table>
<thead>
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<tbody>
<tr>
<td>CWRU</td>
<td>60.5%</td>
<td>57.8%</td>
<td>64.2%</td>
<td>63.0%</td>
<td>56.2%</td>
</tr>
<tr>
<td></td>
<td>(472/780)</td>
<td>(85/147)</td>
<td>(104/162)</td>
<td>(102/162)</td>
<td>(86/153)</td>
</tr>
<tr>
<td>Total Biology</td>
<td>62.9%</td>
<td>66.7%</td>
<td>62.3%</td>
<td>62.5%</td>
<td>53.7%</td>
</tr>
<tr>
<td></td>
<td>(151/240)</td>
<td>(30/45)</td>
<td>(33/53)</td>
<td>(25/40)</td>
<td>(22/41)</td>
</tr>
</tbody>
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(Information from Steven Scherger, Pre-Med Dean)

Based on First Destination Surveys from 2011 to 2016 (response rates of about 80%), 60-70% of our graduating students are continuing to advanced study, whereas 20 – 30% are fully employed (see Figure Y):

Again based on First Destination Surveys, employers of our graduates in the last five years include a mix of medical research institutions, companies providing services for medical professionals, other industrial positions, universities, government, and public service positions. For example, recent graduates (last five years) have been hired by the National Institutes of Health, Deloitte Consulting, the Cleveland Clinic, CWRU, Teach for America, Epic Systems, Ohio Department of Agriculture, Nationwide Children’s Hospital, University of Michigan, University of Illinois at Chicago, New York Life Insurance Company, Cargill Inc., The Cleveland Metroparks, Northwestern University Emergency Services, Aerotek, Michigan Health Professionals, Reproductive Diagnostics, MedImmune, University of Texas Epic Systems, University of Texas Southwestern, and Winncomm Technologies Corporation (this is only a partial listing of all employers in the past 5 years).
These data support the argument that students graduating from the Biology Department are successful at acquiring positions in a diverse set of future careers.

**Strategic Vision**

*We will create opportunities for students to seamlessly connect research with teaching by allowing them to experience the excitement of designing, performing and analyzing their own experiments. At the same time, we will enhance skills that will be valuable to them across many future professions.*

The strategic vision for Undergraduate Education has five important elements:

1. Student/faculty ratios should be about 1:10 to allow faculty to directly mentor students as unique individuals.

2. By using novel technologies for teaching, such as simulations and the HoloLens, and by focusing on student-proposed research, students will understand the direct connection between what they learn and how it can be used to answer questions and generate new knowledge.

3. Course work will also improve “soft skills”, (e.g., group collaboration, presentation skills), analytical skills (e.g., the ability to manipulate data), and practical skills (e.g., the ability to write proposals and clearly describe results).

4. Flexible teaching spaces will enhance the use of existing classroom space.

5. Core courses and upper level courses will be revamped or modified to achieve this vision.

**Implementing the Plan – What needs to happen?**

Several key steps will be necessary to implement the plan. *First*, it will be important to establish the position of a Director of Undergraduate Studies, a position that will come with teaching release and summer salary. *Second*, members of the Department will be encouraged to share their teaching experiences so that members of the Department can work to expand their philosophy of teaching to incorporate new approaches (e.g., focused on active learning and a constructivist approach to mastering material). *Third*, holding faculty discussions on advising methods, student advising will be standardized. *Fourth*, we will initiate discussions with other departments to determine what teaching approaches they are using that they find most effective, and how they evaluate success. *Fifth*, we will form an advisory group to solicit input on what makes for a successful (or unsuccessful) student experience. *Sixth*, we will hold focus groups of faculty and instructors within the three areas of the Department to explore these issues, and determine action plans for implementing the strategic vision.

The Chair and faculty will explore and create opportunities for additional faculty training in teaching, coordinated with UCITE. *First*, it would be useful to have workshops that discuss how
we teach, the content, and how this can be better integrated both within the core courses and across the entire curriculum. Second, the Department should take advantage of outside expertise (for example, Discipline-Based Educational Researchers) to help them develop appropriate instruments to assess the efficacy of instruction. Third, there should be workshops that help faculty and instructors, at all levels, develop mentoring skills for fellow faculty members and students. Fourth, workshops on incorporating active learning approaches, and how to integrate simulations and advanced technology, such as the HoloLens, should be created for faculty.

To enhance the focus on student-centered research, developing bio[box] will be essential. By creating a space in which students are encouraged to design and pursue real research questions that they themselves have worked to formulate, students will have a direct sense of ownership for their research, and will much more clearly see how research requires the knowledge they are gaining from their courses. In a sense, this allows us to use the Oxford/Cambridge model in the sciences, in which students are asked to formulate and pursue their own research problems even as undergraduates. If these projects are coordinated with core courses, they will create multiple opportunities for active learning in class and out of class. In addition, it will be important to create common study area spaces where students engaged in these projects can talk to one another and forge strong collaborative relationships with one another.

The Implementation Team.

To make this plan happen, it will be critical to create an implementation team. The team will be led by the Director of Undergraduate Studies, and should have representatives from the three divisions of the Biology department (Cell and Molecular Biology, Neurobiology and Behavior, and Ecology and Evolution) consisting of 3 to 5 faculty members as well as 3 Instructors. Based on the interests of the team members, they should form sub-groups focused on the areas of Faculty Mentoring (balancing research, teaching, service and other important parts of their lives), Instructional Spaces (with a focus on student labs, preparation help, active learning classrooms, and bio[box]), Student Mentoring and Advising, the Core Curriculum, and Co-op Advising. The team should also have staff support. The team will report to the Chair and the faculty, and the Chair will work with the Dean of Arts and Sciences to provide key resources to help implement the plan.

Potential Partners for the Strategic Plan.

As the plan is implemented, the Department should make sure to coordinate some of its components with potential partners, such as UCITE, Educational Services for Students, the Undergraduate Studies Department, and the Career Center. In addition, changes to the curriculum will need to be coordinated with the Departments of Nutrition and Biochemistry. Opportunities for collaborative offerings may exist with other groups at the University, such as the Cleveland Institute of Art, which trains students to be biomedical illustrators, and also has a strong interest in creating animations and simulations for education. Finally, it may be worth
exploring the possible interactions that our graduates could have with the County Health Department.

**Resources Needed.**

Working with the Dean, it will be important for the Chair to explore the possibilities of obtaining more space for teaching labs and for active learning classrooms. These space needs must also be coordinated with more space to hire research faculty. It is urgent for space negotiations to begin as quickly as possible, because many of the key ideas in the strategic plan—common study spaces for students, more effective teaching laboratories, and revamped classrooms that support active learning—cannot be implemented effectively or at all without appropriate teaching spaces, and space for recruiting and retaining research-active faculty who can enthusiastically participate in the research-focused and active-learning approaches proposed in this strategic plan.

By adding faculty to maintain the 1:10 ratio between faculty and students, and by working with experts to help revamp core courses, it will be possible to create an environment that encourages, supports and rewards effective team teaching. It will also be critical to provide faculty release time to develop new active learning approaches, and support for programmers to develop new simulations, and new technology (e.g., HoloLens applications). It may be appropriate to reduce a faculty member’s teaching load for a semester to give him or her the time to develop new approaches and materials for teaching. Finally, the Department needs to work with the appropriate members of the College of Arts and Sciences to market the new teaching approaches, so that students will realize that by attending CWRU they will have an outstanding experience studying and learning Biology.

**Opportunities for Faculty and Staff Development.**

It will be important to provide both faculty and staff opportunities for professional development. Release time that allows instructors a sabbatical-like semester to develop and begin to test new teaching strategies, summer salary for instructors and faculty as they develop new teaching materials, and funds to attend conferences will be critical for helping instructors and faculty become outstanding at creating and using novel approaches and technology in their courses. It will also be critical to provide financial rewards to experienced and outstanding faculty and instructors who serve as mentors to other instructors and faculty who are embarking on the development of these new teaching approaches and materials.

**Relationship to College’s Financial Recovery Plan.**

The proposed plan will provide a significant source of tuition revenue that contributes to the College’s Financial Recovery Plan. By enhancing large enrollment courses, and the Introduction to Nursing courses, we will bring additional tuition revenues that will re-coup the investment that we are requesting in the Department’s resources. Additionally, a high-quality educational
experience that is competitive with peer institutions and uses innovative teaching methods is important for maintaining and improving the retention rates of our undergraduates, which also impacts tuition income.

**Opportunities to Enhance Diversity.**

An important part of the plan will be to increase diversity, with a particular focus on increasing the number of under-represented minorities who succeed as they take Biology courses, as well as choosing to major in Biology. We will partner with Jim Bader’s Leonard Gelfand STEM Center to plan and implement outreach activities to local middle schools and high schools. We will pair students from under-represented groups with faculty members who are committed to mentor such students and ensure their success. We will also facilitate informal group get-togethers among these students, with and without faculty, to provide opportunities for creating a sense of community and for informal advising by senior peers and faculty.

**Assessment – How will we know that we have succeeded?**

From the outset, it will be important to define ways of assessing success. *First*, we should increase student retention in the core courses. *Second*, we should see reduced student repeats of courses. *Third*, we should observe increased student satisfaction with their experience in the Department of Biology (e.g., through exit interviews). *Fourth*, we should find an increase in the number of students interested in majoring in Biology, and the number of actual majors who graduate with degrees in Biology. *Fifth*, we should see a significant increase in faculty engagement in the new instructional approaches and creating new, innovative instructional materials. *Sixth*, we should begin to increase the placement rate of students graduating from our program. *Seventh*, we should solicit feedback from employers and graduate schools who accept our students to determine if they have the appropriate skill levels, and see whether this feedback improves as we implement our plan.

**Graduate Education**

**Overview.**

A strong graduate program is essential to achieving the Biology Department’s research and undergraduate teaching goals. Our department offers several distinct graduate degrees. The Biology Department PhD program awards degrees in recognition of in-depth knowledge of a biological research area together with the demonstrated ability to perform and communicate independent research as part of a dissertation. PhD students conduct research under the supervision of Biology Department primary, secondary and adjunct faculty. Adjunct faculty who advise Biology Department PhD students are full-time researchers at the Cleveland Metroparks Zoo, Cleveland Museum of Natural History, and Holden Arboretum. The MS Plan A degree is a graduate degree program in which students conduct original research under the supervision of Biology Department faculty. The MS Plan A Entrepreneurial Biotechnology degree is a separate MS degree for students who want to study biological and business topics, and their thesis
research includes an internship with a biotechnology company. MS Plan B students are following a non-thesis graduate degree track. These students take advanced coursework to facilitate career goals such as changing or advancing their careers or in preparation for pursing professional studies in the health sciences.

Through the research that they conduct in faculty members’ labs, our PhD and MS Plan A (research thesis) graduate students contribute to the original research produced by the department. Maintaining a high quality of research output is necessary to maintain a national reputation for research excellence and to continue to secure external funding. In the course of conducting their research, our graduate students informally mentor many undergraduate students, and contribute to the undergraduates’ learning and progress toward becoming professional biologists. Without graduate student researchers, far fewer Biology Department undergraduates would be involved in independent laboratory research. As Graduate Teaching Assistants (GTAs), our graduate students interact directly with undergraduate students in introductory and advanced classes. For example, during 2015-16 Academic year, GTAs were needed to teach 53 sections of just our introductory biology labs (BIOL 214L, 215L, and 216L). Additional GTAs were needed to facilitate active learning in our large lectures and in upper-division laboratory courses.

Entrepreneurial Biotechnology MS Plan A students facilitate their career goals while also building connections between CWRU and biotechnology companies. MS Plan B students take advanced courses that facilitate career advancement or further advanced degrees. Some MS Plan B students switch to the Biology Departments MS Plan A or PhD tracks.

As described below, our graduate program has undergone tremendous growth in the last decade. That growth, coupled with the diversity of research within the field of Biology, and the external graduate program review we underwent in 2009, led to the creation in 2015 of a Biology Department Director of Graduate studies. The Director of Graduate Studies (DGS) is a faculty member who is responsible for the oversight of the Department of Biology’s graduate program. The DGS is appointed to a three-year term by the Biology Department Chair, and has three main tasks: 1) assess and promote the graduate program, 2) act as a liaison between graduate students and faculty, and 3) support professional development of our graduate students. The DGS receives one semester’s teaching release and one month of summer salary each year. In accomplishing these tasks, the DGS works closely with the Biology Department’s Graduate Program Coordinator (Ms. Julia Brown), the staff member who administers the graduate program.

As the field of biology becomes increasingly interdisciplinary, it is important for biology graduate programs to combine training in core research skills with the ability to understand, communicate and collaborate across fields.
Strategic Vision

Our major vision is to develop a positive, coherent identity as a Department of Biology Graduate Program that values excellence in research while fostering understanding and connection across subfields of biology.

- Review of the number of students enrolled and graduated over the past five years, the number of courses taught, and the overall enrollment statistics for these courses.

  The size of the Biology Department graduate program has dramatically increased over the last decade. From 2005-2010 only 5 PhD students and 41 MS students graduated from the Biology Department, whereas over the past 5 years (2011-2016), 23 PhD students and 70 MS students have graduated from the Biology Department.

  Over the past 5 years, the Biology Department has offered 25 to 28 formal (i.e. 400-level) graduate classes during each Fall Semester, 34 to 35 formal (i.e. 400-level) graduate classes during each Spring Semester, and 3 to 4 formal graduate classes during each summer session. However, it is important to note that the majority of these classes are co-taught with undergraduates as 300/400 level courses in which graduate students have additional assignments. The Biology Department offers just three graduate-only classes (BIOL 495 [1-credit introduction to graduate school], BIOL 471 and BIOL 472). Our total enrollment for 400-level courses in the last five years was 981 enrollments (note that students enroll in multiple courses per semester, and some students from other departments take Biology classes). A critical part of our PhD and MS-Plan A tracks is research, for which students enroll in as 500-, 600- and 700-level classes. Over the past 5 years there were 735 student enrollments in 500-, 600- and 700-level classes.

- The target number of students given current faculty size.

  The target size of our graduate program is based on the number of students that faculty can successfully mentor. For PhD students, this is approximately 2-4 PhD students per research-active faculty member. We currently have 19 research-active tenure-track faculty with primary appointments in Biology. However, we also have well-established partnerships with researchers at the Cleveland Metroparks Zoo, Holden Arboretum, and Cleveland Museum of Natural History. These researchers have adjunct appointments in the Biology Department and contribute to our goals in many ways, including serving as primary mentors for PhD Students. In the coming decade, we anticipate 6-8 PhD students will be mentored by our adjunct faculty at any one time. Funding for our PhD students is described below, but it arises in part from Graduate Teaching Assistantships offered through the Biology Department’s budget, and in part from external funding.

  We anticipate continuing with approximately 5-10 MS Plan A students per year whose advisors are Biology Department faculty. We also anticipate approximately 5-10 MS Plan A Biotechnology Entrepreneurial students enrolling each year. We also anticipate 5-10 non-thesis MS Plan B students per year.
The graduate education model and its alignment with disciplinary goals and objectives.

Our graduate program prepares students to be independent scientists. Our students must develop discipline-specific research skills, detailed knowledge of the scientific literature, and an ability to think critically. Our graduate students acquire these skills in part through formal classes, but more importantly through active research in a faculty member’s laboratory and intellectual engagement with other members of the biology department.

A major challenge for our Biology Department arises from the large breadth of the field. Questions investigated by Biology Department faculty range in scope from the expression of genes in a developing embryo, to the role of the nervous system in controlling movement, to interactions between species in nature. Although individual faculty have successful research programs, we are seeking to foster a Department-wide identity, or “Esprit de corps” that has been lacking in the department.

To improve community and help students and faculty get to know each other, the Biology Department has begun implementing several relatively easy and cost-effective efforts. One program will be the implementation of an annual Biology Graduate Student Research Symposium that is organized by graduate students and attended by all members of the department. The first symposium organized by Biology Graduate Students took place in 2014, and it was a great success. Additional efforts to build community include scheduling more Biology Department graduate students and faculty to present their research in our weekly seminar series.

Other strategies to foster community in the department will require longer-term planning and investment of funding, space or faculty teaching time. For example, the Biology Department does not have a community space for graduate students, faculty, and staff to interact informally, such as over lunch. Similarly, graduate-student-only classes can build cohesion among incoming graduate students, but the Department has just 3 graduate-student only classes (other graduate classes are either independent research or co-taught with undergraduates). The faculty are exploring options for additional 400-level graduate-student only classes.

Current programs for supporting graduate students. Are they competitive with peer/aspirant institutions?

Biology Department PhD students receive tuition waivers and stipends. Stipends are from a variety of sources, both internal and external. Students supported on Biology Department funds are expected to assist the department’s teaching goals as Graduate Teaching Assistants (GTAs). Externally supported stipends arise from a range of sources, including research grants to faculty, fellowships to graduate students, and training grants to the Biology Department. Doctoral students supported on external funds are typically not expected to assist as GTAs. The Biology Department currently has one training grant, the GAANN grant from the US Department of Education. The GAANN grant provides stipend support to PhD students (six students in the 2016-17 AY), and an institutional payment that covers some tuition expenses. Because the GAANN grant includes the goal of improving training for biology education, PhD students supported on the GAANN grant also act as GTAs. Thus, the GAANN provides support for PhD students while also supplementing the Biology Department’s undergraduate teaching mission. If
the GAANN is not renewed, the Biology Department will need to increase its budget for GTA support to maintain the same number of Graduate Teaching Assistantships in our undergraduate classes.

The most frequent complaint that we have heard from our PhD students is that the Biology Department provides relatively low stipends compared to peer institutions. Our PhD student stipend had been fixed for many years at $20,000 per year, while programs at other universities provided substantially higher stipends. In several cases, we lost top recruits to other PhD programs because of relatively low stipends. In response to student feedback and increasing competition from other universities, and in larger part because our successfully funded GAANN grant allowed the required financial flexibility, we increased our stipends to $22,000 per year in 2016. We will continue to seek modest annual increases in the stipend to bring it to a more competitive level.

MS Plan A students are typically provided with tuition waivers in exchange for research and graduate teaching assistantships, but they are not provided with a stipend. Additionally, MS Plan A Entrepreneurial Biotechnology students pay tuition, but may obtain partial tuition waivers as an incentive to matriculate. MS Plan B students are following a non-thesis graduate degree track. These students take advanced coursework to facilitate career goals such as changing or advancing their careers or in preparation for pursuing professional studies in the health sciences. MS Plan B students pay tuition.

- **The level of, and ambitions for discipline-specific pedagogical training, mentoring, and support for graduate teaching assistants.**

The current pedagogical training of graduate teaching assistants is largely left up to individual faculty who are teaching each class. However, the Biology Department has recently formalized a new committee (Graduate and Undergraduate Assignment Committee, or GUAC) to more actively take into account graduate students’ educational goals when assigning GTAs.

- **Current strategies and ambitions to increase size of graduate applicant pool and quality of matriculating students.**

Our goal for graduate recruitment is to achieve a high enough profile that students apply to our department even without targeted outreach. If we are successful, we will both increase the number and diversity of applicants, and improve the likelihood that the top applicants will choose to matriculate to the CWRU Biology graduate program. Until recently, our main method of attracting applicants to our graduate program was a combination of individual communication with faculty colleagues at other institutions and sending advertisements to a variety of venues. We expanded this approach in the 2016-17 AY by sending faculty and current graduate students to directly recruit new graduate students the Annual Biomedical Research Conference for Minority Students (ABRCMS). ABRCMS is attended by over 3,000 highly-qualified undergraduates seeking graduate programs. This approach has increased our applicant pool, and this year (2017-18) we hope to recruit some of these prospective students to our graduate program.
Once highly qualified students apply to the CWRU Biology graduate program, it is necessary to make focused efforts to attract and enroll them. In previous years, we have lost top applicants to other universities because of comparatively low stipend support, and relatively late notification of admission with funding. We have advanced our application deadline to December 15 from January 15, and are working to ensure early notification of admissions and more competitive stipends. It is standard for the top U.S. biology graduate programs to provide funding for prospective students to visit and interview on campus. We have implemented an on-campus recruitment day in which our strongest applicants from across the US are invited to visit CWRU to meet faculty and staff. This on-campus recruitment event includes formal and informal opportunities for applicants to meet faculty, staff and students. The event is capped-off by a graduate student research symposium. Throughout the recruitment process, our Graduate Program Coordinator (Ms. Julia Brown) plays a key role in communicating with prospective students to encourage their application and provide them with information about CWRU and life in Cleveland.

In summary, a competitive graduate recruitment strategy in biology must include (1) active outreach from faculty and current students to attract top applicants, (2) on-campus recruitment visits with subsidized travel for top applicants, (3) stipends and admission notifications that are competitive with peer institutions and (4) knowledgeable and dedicated graduate program coordinator to communicate directly with applicants. Several of these aspects of graduate recruitment are already included in the Biology Department’s operating budget, or are paid for by individual faculty grants. However, recruitment trips to undergraduate research conferences like ABRCMS may require additional investment.

The long-term outcomes for graduate students and future prospects in your field(s). Where are our students going after they leave us, is what we are doing working, and how do we know? Do we expect this to change in the future?

One of our major goals is to improve our outreach and connections to alumni of the Biology Department Graduate Program. Our Graduate Program Coordinator, Julia Brown, has been developing a database to allow us to keep track of our alumni in a systematic way. We will use this resource to keep our alumni abreast of news from the Department of Biology. This will also allow our current students to more easily build professional networks with Department of Biology alumni.

Career prospects for biologists in the US remain strong, and many of these careers will be outside academia. Career preparation and advice available to graduate students from the Biology Department has largely been specific to the laboratory groups of individual faculty members. Moving forward, we will more strongly encourage our graduate students to participate in CWRU-wide career events like “what can I do with a PhD”. Additionally, we are looking into hosting career panels with PhD scientists outside of academia. We hope to include some recent alumni of the Biology Department.
Research, Scholarship, and Creative Activity

Overview.

As a natural science department at a Research 1 university, research plays a pivotal role in the mission of the CWRU Biology Department. Beyond the direct role in faculty scholarship, research plays a major role in both undergraduate and graduate education. In a Research 1 institution, faculty are hired in their research discipline with the goal of generating an active research laboratory. In the biological sciences, active research laboratories typically require funding in the form of grants from either federal agencies or private foundations. Those funds and the resulting activities then have a direct impact on undergraduate and graduate students who are invited to perform research in those laboratories. Research faculty also bring the excitement of new findings and techniques to their undergraduate course work. Through publications, collaborations and outreach, these endeavors assure the national and international reputation and visibility of the Department of Biology.

As noted in the Executive Summary, the 17 research active laboratories in the department reside in one of three sub-disciplines which the department decided to focus upon during a previous internal review. While this has been a successful strategy, it is not without problems. As mentioned above, we recognize that it creates barriers within the department. As mentioned in our previous strategic plan, a goal going forward is to create bridges to bring the faculty together into a more cohesive department while still maintaining the benefits that derive from the three sub-groups. Other challenges that the department faces revolve around space for growth, and funding. Ultimately, after building to our target size, the department seeks to maintain a new steady state number of active research laboratories. As mentioned above, space presents a major barrier to hiring new faculty, and this will be addressed below. While the faculty in the department have been remarkably successful in obtaining outside funds in recent years, federal budget predictions suggest that these funds will become tighter and tighter in the coming years. We must, therefore, become strategic in identifying other sources of funding to replace federal funds or generate preliminary findings and tools that make us more competitive for those funds.

Strategic Vision

The major vision for our strategic plan is to reach a steady state of 25-30 active research faculty with rough balance in each sub-discipline and “bridging” faculty, take advantage of collaborative efforts with other nearby institutions, position ourselves to take advantage of federal funding initiatives and identify additional funding resources such as foundations and individual donors.

Review current state of research programs.

Several decades ago, the Biology Department made a decision to move away from a plan to cover as many fields of biological sciences as possible with one or a few laboratories in each, and rather concentrate on three sub-disciplines in which the department could excel. Those were 1) Cell, Molecular and Developmental Biology, 2) Ecology and Evolutionary Biology and 3) Neurobiology and Behavior. As noted in the Executive Summary, the Cell, Molecular and Developmental Biology group is made up of 7 faculty members with 2 permanently assigned to administration and, therefore, not active researchers. One additional faculty member has been
hired in this group to start in the July 2018, at which time there will be 6 research active laboratories in that group. Active research laboratories seek out and obtain funding to support their research and most have graduate and undergraduate students and in some cases postdoctoral researchers and technicians who are actively involved in research projects. The Ecology and Evolutionary Biology group has 6 faculty, and the Neurobiology and Behavior group has 4, all of which currently direct active research laboratories. One additional research laboratory studies questions that span our two of our focus areas.

Collaborative relationships with scientists and researchers outside our department augment these research groups. Scientists at the Cleveland Museum of Natural History collaborate with faculty in both the Neurobiology of Behavior and Ecology and Evolutionary Biology cluster. For example, Drs. Gavin Svenson (CMNH) and Roy E. Ritzmann (Biology) received a collaborative grant from NSF in 2016 to examine the effect of insulin in modifying hunting behavior of praying mantises. The neurobiological experiments are being performed in the Ritzmann laboratory while Dr. Svenson’s field studies allow the group to develop new colonies of praying mantises that extend their studies beyond one species. Dr. Svenson has also played a critical role in the group’s broader impacts, by interfacing with CMNH’s distance learning program. Through that effort they are currently developing a new module on the way a modulator such as insulin can alter brain circuits to change behavior. Similar collaborations have occurred between the Ecology and Evolutionary Biology group and the Holden Arboretum, the Cellular and Developmental Biology group and laboratories in the CWRU School of Medicine and between the Neurobiology of Behavior group and the Cleveland Metroparks zoo. Since these relationships expand our coverage while providing opportunities for unique interactions, they position us to compete for funding resources in a unique manner. We are currently working toward formal affiliation agreements between the Department of Biology and the three institutions mentioned to solidify and expand on these relationships.

Funding is critical for any active research laboratory. The primary sources for funding in any biology department are from the National Institutes of Health and the National Science Foundation. Faculty in our Department have also been very successful with Department of Defense sources (i.e., Office of Naval Research, Air Force Office of Scientific Research and Defense Advanced Research Projects Administration). Other funds may come from foundations such as the Simons Foundation or the Howard Hughes Medical Institute. In recent years, biology faculty have been very active in submitting proposals for funding and their success rate has been solid with some increase in the last three years (Fig. X). While this is gratifying, future federal budget predictions suggest that these funds will become tighter in the coming years and may require even more strategic approaches for success. Thus, it is incumbent on biology faculty to explore innovative ways to remain competitive.

In addition to funding, grants to support graduate students also impact our research mission. As graduate students are critical members of any research laboratory, finding support for them is an important goal. Recently we have been supported by a GAANN (Graduate Assistance in Areas of National Need) grant from the Federal Department of Education. Having this external
support for our graduate program has given us the flexibility to increase our graduate student stipends to increase our ability to compete with other universities, and continue to recruit excellent students. We are also encouraging faculty to include graduate student stipends on research proposals to supplement our teaching assistantships from the College of Arts and Sciences.

It is critical that we maintain the visibility of our research accomplishments. Part of our research mission is to reach out to local, national and international communities both in our research disciplines and in lay media and local schools. Many of our recent successes have been featured in local and national publications. Our faculty routinely are invited to give seminars at other institutions and as part of symposia and keynote addresses in national and international conferences. It is critical that funds be available to keep up and expand the current pace of these presentations, since visibility has a direct impact on any laboratory’s ability to attract funding for future research.

● **Target activity for growth.**

The department feels that a steady-state research-active faculty of 25-30 with a rough balance in each of the three research groups creates an exciting environment that will position faculty for program project grants and attract the highest quality graduate students. This target will require additional hires. The Ecology and Evolutionary Biology and Cell and Developmental Biology groups are approaching our goal. Moreover, they are comprised primarily of younger faculty so we expect these groups to remain stable and maintain their current makeup for some time. With its recent hire, the Cellular, Molecular and Developmental Biology group has reached 6 research-active faculty. However, 2 are nearing retirement age. The Neurobiology and Behavior group needs 2 new hires to reach 6. Moreover, 1 current member will be retiring in 3 years and two more will be approaching this age in the next decade. Thus, in order to attain a steady state of 6-7 laboratories in each group, retiring faculty will need to be replaced, and at least 2 new lines added in Neurobiology and Behavior.

Another critical goal identified in recent years involves cohesion. Although the 3 subgroup model has been successful in attracting faculty, students and funding, it creates barriers within the department. Faculty and students tend to remain within their own groups. To function as a more cohesive department, we feel that these barriers must be overcome. This issue goes beyond departmental interactions to the goal of making the department more marketable for future resources. Biology is becoming a much more collaborative discipline with techniques and principles spanning traditional barriers. The powerful molecular techniques that once distinguished researchers using them into separate groups or even departments, have become increasing established as general tools used by biologists in any field.

As such it is critical that we find ways to overcome the barriers that exist between our groups so that we can take advantage of cross-disciplinary expertise. To accomplish this, we will increase the number of in-house seminars so that everyone in the department understands at least the basics of every other laboratory’s research. At the graduate student level, we will encourage cross-disciplinary projects and develop seminar courses that examine biological questions from all three viewpoints. As these efforts come together, we intend to apply for funds from interdisciplinary graduate student programs. In the past, we housed a graduate student training grant in Neuromechanics from NSF’s IGERT program that brought in over $3 million for
students in Biology, Computer Science, Biomedical Engineering and Mechanical Engineering. These efforts will include personnel from our partner institutions (CMNH, SOM, Metroparks Zoo and Holden Arboretum). We believe that this initiative will position the Biology Department to compete successfully for similar funds.

Resources needed to achieve strategic goals.

To achieve our goals, we must target new resources. Our highest priority must be space, both for new faculty labs and teaching labs. Currently, the Department of Biology is locked into three buildings that make up the Pytte Science Center. Two of these buildings are shared with Chemistry. If we want to add faculty lines, we must be able to identify laboratory space for new faculty. With our increasing undergraduate enrollment, that cannot be done by taking space from our teaching laboratories. As mentioned previously, we must have more teaching lab space if we are to be able to offer new upper division elective lab courses. The difficulty in identifying space for the new hire we made last year speaks to the critical need for new facilities.

The ideal solution for this problem would be a new building. The University space plan that was revealed last year pointed to a new Science building to be added to Millis. That would certainly solve the research space issue, as well as providing expanded teaching laboratories and increased space for unique entities such as bio[box], our new undergraduate research facility. It would also allow us to bring laboratories with similar interests physically closer together. The current Neurobiology and Behavior laboratories benefit greatly from all being housed in DeGrace hall. In this group, students, faculty and technicians interact regularly simply by crossing the hall, or going up or down stairs. These spontaneous unplanned interactions foster new and exciting discussions and ideas for new projects. Unfortunately, the other groups' laboratories are scattered throughout Millis and Clapp halls making these sorts of interactions less likely.

The problem with the new building solution is that it will take years to happen. Funds are not currently available for such a building and there is no plan for beginning construction. Meanwhile the space issues for Biology are critical right now. We must, therefore, identify “swing space” until a new building can be constructed. Two possibilities would be developing Morley Hall for teaching laboratories freeing up research space in Millis for new faculty. Alternatively, as the School of Nursing and Dentistry move to new facilities in the new Health Science Campus, their former buildings could be used as temporary sites for teaching and/or research facilities in Biology. It should be recognized that this latter solution would only be a stopgap measure, since having either teaching or research space housed so far from the core of our department would make faculty/student interactions or the support of laboratory courses even more difficult.

Core facilities should also be developed for expensive equipment that can be shared within the Biology Department or among departments within the College of Arts and Sciences (e.g. Chemistry, Mathematics and/or Physics) or with other schools such as the Case School of Engineering and the School of Medicine. An example of such a facility would be the microscopy center in the School of Medicine that houses confocal microscopes that are critical to many of our laboratories. Our new bio[box] facility is a start in this direction. It will serve as a multi-user
molecular biology lab supporting our undergraduate and graduate students working with our active research faculty.

Under the current funding environment, we must recognize that federal funds from the traditional centers of biological research funding (NIH and NSF) may become much more difficult to obtain in the near future. As such, we must work with development personnel to identify other sources of funding. These may include foundations and individual donors to fund specific projects in their early stages. Research funding in the biological sciences requires considerable preliminary studies to demonstrate feasibility. This is often a barrier to successful proposal submissions. If donors can be identified to provide seed money for a novel idea, especially one that crosses disciplinary lines, that could provide the important preliminary data that would put a more substantial proposal into the fundable category.

- **Who will lead this initiative?**

The Biology Department must develop teams that can consistently advocate for developmental initiatives. These fall into two categories: 1) Initiatives that specifically promote one of the individual research groups, and 2) Initiatives that benefit the entire department or beyond. Initiatives that fall into category (1) should certainly be advocated for by personnel in the particular research group in question. This may include all faculty in that group or a subgroup that will be directly impacted by the initiative. For example, if an initiative is to develop tools for studying flying insects, only those faculty involved in that form of research would be involved, perhaps along with personnel from other schools such as the Case School of Engineering. Initiatives in group (2) (benefitting the entire department) should have an advocacy team made up by representatives of the entire department. That should include members of each research group and faculty from each stage of development (Assistant, Associate and Full Professor) as well as (when affecting educational programs) Instructors and Senior Instructors. Assistance and support from the College and University Offices for Development will be critically important to our success.

It is important to include faculty members from each research and age group. Senior faculty may have more experience with the workings of the University and have a better handle on how to work with various administrative groups. However, the needs of younger faculty are the core requirement. They represent the future of the department and have a better understanding of new research and teaching protocols. It is also important that younger faculty members gain experience in these advocacy teams so that they can more effectively act as senior faculty when their time comes.

- **Opportunities for faculty development.**

It is the responsibility of University and College administrations to provide an environment where faculty can develop the skills necessary for success. In the long run, such investments will pay off with more research funding reaching the institution and more prestigious faculty who will attract more and better students. That is, such investment will ultimately pay for itself. Some examples of such investment are listed below.
The Department should create writing retreats for faculty, because faculty retention is critically dependent on both the time spent on writing and the quality of the result. Well-written papers are more likely to be published, and well-written grants are more likely to be funded. These skills are especially important for faculty from under-represented groups who are often asked to do extra committee work and outreach activities, especially for recruiting and retaining minority or under-represented students. In turn, enhancing these skills will allow faculty to more effectively mentor students to become excellent writers.

Proposal development for research funding in the biological sciences is highly competitive. We must provide young faculty with the tools needed for their success. As we attempt to attract funds for large program grants, we recognize several characteristics of successful proposals. They clearly and concisely state what the problem is, why it is important and how the Biology Department is uniquely positioned to address it. That is, success often comes down to effective proposal preparation.

At the most basic level, effective proposal preparation requires mentoring young faculty. All of our new faculty are assigned faculty mentors and they play a critical role in reviewing proposals and making critical suggestions. As we approach the ideal of number of faculty in each group, the number of senior personnel to guide young faculty in this critical endeavor will increase. Beyond that, large project grants at larger institutions benefit from professional writers. Without such input, our faculty are at a distinct disadvantage. Thus, funds should be sought to hire grant writers to strategically to help on such large projects.

The process of submitting proposals and administering funded projects can be cumbersome. It may reflect issues unique to the Biology Department. We must interact with personnel in Research Administration to make them aware of such problems. This interaction should result in more streamlined procedures that benefit both our personnel and theirs. We suggest regular meetings between our faculty and relevant administrators.

Faculty and student success often leads to invitations to present at national and international conferences or preparation of articles in targeted issues of prestigious journals. But these invitations often come with costs that can exhaust grant budgets, such as travel expenses and journal production costs. Funds should be identified to provide travel expenses for faculty and students to national and international conferences. No student or young faculty member should fail to present her or his exciting data at a conference simply because there were insufficient travel funds available at the time. Having our students and faculty at the forefront of their field and recognized by making these presentations starts an upward spiral that brings the kind of visibility that is critical to our reputation as a vibrant research entity.

As our faculty members mature scientifically and personally they may become interested in spending more time in administrative service to the Department, College or University. At some time in their career they also may be in a position to serve as chair of the Department of Biology. To insure some baseline level of success in this, individuals considering this must be supported by exposure to the various new tasks presented by these new jobs. The serving chair can assist in this transition by “sharing” the position with prospective candidates in the months prior to the new chair starting. Since CWRU does not have a “chair training course”, chair candidates should be alerted to, and encouraged to participate in, a chair training course at an off-campus venue. This training should be supported by the dean of the CAS.
• **Opportunities for increasing faculty diversity.**

Having a diverse faculty provides many benefits. A diverse faculty provides unique perspectives in both education and research that benefit everyone in the Department. Underrepresented students face challenges that only faculty from similar groups can understand. From a practical standpoint, a diverse faculty may have access to funds both from federal agencies, foundations and particular donors that a homogeneous faculty would not. Moreover, failure to encourage students and faculty of diverse background could result in waste of human resources. Again, we must encourage young faculty and students of all backgrounds to reach their full potential. It would be a shame if the next young Garrett Morgan failed to reach her or his full potential simply because opportunities that we could provide were not there.

Attracting a diverse faculty presents chicken and egg problems. Faculty members from underrepresented groups are attracted to institutions and departments where members of those groups are already present. Fortunately, the Biology Department already has excellent African-American and female faculty and they should certainly play a role in expanding diversity. However, we must be more proactive in reaching out to organizations that represent these and other underrepresented biologists. We must listen to our current underrepresented faculty members while making hiring and strategic planning decisions. This process will optimize our opportunities to include additional underrepresented candidates in our hiring processes and make sure that excellent candidates are invited to campus. Where they are of equal talent as other top candidates, they should be asked to join our department.

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4. **Describe your department’s potential for and interest in the centralization of common facilities, as appropriate.**

- Identify common research and infrastructure needs.
- Identify potential benefits and drawbacks of the consolidation of common infrastructure and/or facilities in a centralized College location.
  
  Teaching and research…

- Identify opportunities to work with partners to raise funds or share in the acquisition of common infrastructure and/or facilities.

5. **Describe current structures and plans for faculty development at all ranks, as well as staff development.**

As stated previously, newly hired tenure-track faculty are matched with a senior faculty member in the department who serves as their official mentor for the pre-tenure period. There is no official set of departmental guidelines for post-tenure faculty development in the Department of Biology. Since most of our faculty are now associate professors anticipating their eventual promotion to professor, this lack of guidelines and mentoring should be addressed immediately. Currently, any advice on development for individuals in this group are solicited from others by the individual faculty member or delivered by the chair informally or during the Faculty Annual Review each year.
As mentioned above, there is no official framework for mentoring of instructor-level faculty. Like the post-tenure faculty on the tenure track, any mentoring is solicited by the mentee from senior faculty or is delivered to them by the chair once a year at Faculty Annual Review.

There is also no framework for ongoing development of the department staff. Suggestions and assistance are offered by the chair during annual reviews, the senior staff member, Ms. Susan Rozek, and other individuals or colleagues during specific conversations. The department is consistent in its support for instructors and lecturers. Depending on the request, travel to scientific and teaching-related meetings have been paid for in part or full, computers, printers and other teaching-related tools have also been provided from department funds.

This lack of explicit mentoring policies is recognized as a weakness that must be addressed. We have not yet addressed these explicitly, but we will in the future.

6. Describe current opportunities and/or ambitions to collaborate with entities external to the university (public, private, nonprofit, educational and regional, national, international). Describe any barriers to such collaborations.

We currently have a long-standing collaborative relationship with the Cleveland Metroparks Zoo which supports undergraduate and graduate training in animal welfare and behavior. Formalization of this relationship and extension to The Holden Arboretum and the Cleveland Museum of Natural History is ongoing and we hope to finalize this Affiliation Agreement in the coming year. All of the partners are willing and eager to participate in this affiliation and the only barriers appear to be the bureaucratic ones inherent in initiating a formal relationship among four separate institutions.

7. Describe your department’s current collaborations with entities internal to the university. Describe any barriers to such collaborations.

Members of the faculty of the Department of Biology have a long-standing collaboration with members of the Department of Aerospace and Mechanical Engineering. For many years this was led by Drs. Ritzmann (Biology) and Quinn (Mechanical Engineering). Although, these two individuals are not currently working together, Dr. Quinn (and others?) together with Dr. Hillel Chiel and others are actively studying ways to do something cool (?). The newest chapter in this successful Biology-Engineering collaboration is a team comprised of Drs. Jessica Fox (Biology) and Katherine Daltorio (Mechanical Engineering). They have initiated a scientifically productive collaboration to study the control of flight stability and maneuvering in insects. Drs. Karen Abbott (Biology) and Peter Thomas (Math, Applied Math & Statistics) have a collaborative NSF-funded research project on stochastic ecological networks, and co-supervise a PhD student in Applied Math. Dr. Sarah Bagby is collaborating with Drs. Ken Loparo and Soumyajit Mandal (EECS), Dan Scherson (Chemistry), and Kurt Rhoads (Civil Engineering), as well as with the Cleveland Water Alliance, on a proposal to NSF’s Smart & Connected Communities program. If successful, the team will develop and deploy a network of environmental sensors in Lake Erie and its source waters, and then use data from these sensors to study the factors controlling harmful algal blooms. The work’s ultimate goal is a healthier and more sustainable lake, with implications ranging from improved public health to a more robust local economy.
8. Describe the steps your department will take to support the College’s Financial Recovery Plan.

The Department of Biology is committed to doing as much as we can to support the College’s financial recovery plan. Over the last two and half years we have canceled low enrollment classes and re-prioritized how we use the graduate student stipends and tuition waivers we receive from the CAS Dean to try to maximize our tuition inflow from graduate students. It has been our policy to commit all of our PhD students receiving stipends and tuition waivers from the College to graduate teaching assistant positions to maximize the tuition stream from the Masters students, who do not receive college-funded stipends or full tuition waivers. We have been only partially successful. Because of the need for GTAs in our undergraduate courses, we have had to recruit some of these Masters students to serve as GTAs and provide them additional credits of tuition waivers to attract them to these positions.

Input from Department of Biology Instructors has been important in the ongoing implementation of the new PRIME post-baccalaureate program, and two of our instructors are members of the committee developing and then teaching the PRIME’s signal MCAT preparation course.

We will continue to monitor low-enrollment courses and try to maximize tuition inflow from our Department’s programs even as we continue to build the national and international reputation of the faculty and research conducted in the Department of Biology.

9. Describe plans for increasing the diversity of our graduate and undergraduate student body and meeting the needs of underrepresented students.

For the last two years (beginning in 2016-17) we have sent a delegation of faculty and graduate students to the Annual Biomedical Research Conference for Minority Students (ABRCMS). This last year the Department of Biology contributed to a large group from many departments representing CWRU, and we are actively working to recruit new graduate students from under-represented groups to our graduate program through contacts made at this meeting. Prospective graduate students attending the ABRCMS meeting are highly qualified and motivated. We hope to continue to attend this meeting with the aim of establishing a consistent presence. We expect to be able to recruit some of these students soon, perhaps this year.

Increasing undergraduate recruitment is more difficult, and we have relied on assisting university-wide programs in the past. Over the last five years we have had multiple students from Shaw High School, East Cleveland, working in our research labs. At this time, we have no explicit plans to move beyond this approach.

10. Describe plans for increasing the diversity of our faculty and meeting the needs of underrepresented faculty.

We have worked diligently in each of our recent faculty searches to identify interested, qualified candidates from under-represented groups. As a result, we have been successful in increasing and maintaining the diversity of our faculty. We will work hard to continue recruiting underrepresented faculty candidates in the future, and will maintain and foster those currently in our department.