



UNIVERSITY OF COLORADO AT BOULDER
DEPARTMENT OF INTEGRATIVE PHYSIOLOGY

November 30, 2015

Stephanie Chasteen
Center for STEM Learning
393 UCB
Boulder, CO 80309-0393
303-492-9546

Dear Dr. Chasteen,

This letter is in support of the proposal submitted by our future Curriculum Coordinators (Teresa Foley, Janet Casagrand, and Ruth Heisler) for a Type II TRESTLE grant. The SEI program in the Department of Integrative Physiology (IPHY) was successful in transforming science education in many of our courses. Sustainability of these achievements has been challenging, and the department is striving to build on these accomplishments by implementing Curriculum Coordinators who will function in a similar capacity to the Science Teaching Fellows (STFs) who are no longer a part of our departmental community.

The submitted proposal *Development and implementation of case studies across the foundational IPHY curriculum --- a continuation of the SEI effort* strives to build on the accomplishments of the SEI effort by creating case studies that will be implemented into the IPHY introductory courses that serve as a foundation for our upper division courses. Case studies in particular have been shown to be a viable way to improve student learning and are an active learning approach that students enjoy. All seven faculty members involved in the Human Anatomy, Human Physiology I and Human Physiology II courses have agreed to use these case studies in their courses. We feel this is an important step in furthering science education in our department as it will better prepare students for our upper division courses, improve critical thinking skills, and help us to achieve curricular alignment. In addition, this will provide the Curriculum Coordinators the opportunity to work with faculty to develop active learning tools for their courses.

I feel that Janet, Teresa, and Ruth have the skills and experience necessary to successfully complete this project. Between the three of them, they have taught the majority of our introductory and core courses; and have experience with curricular reform including case studies. We appreciate your consideration of these efforts.

Sincerely,

A handwritten signature in blue ink, appearing to read "Pei-San Tsai".

Pei-San Tsai Ph.D.

Professor and Chair

1. Project title and person submitting.

Development and implementation of case studies across the foundational IPHY curriculum – a continuation of the SEI effort

Teresa Foley, Ph.D, Instructor, Integrative Physiology, Teresa.Foley@colorado.edu

Ruth Heisler, M.A., Senior Instructor, Integrative Physiology, Ruth.Heisler@colorado.edu

Janet Casagrand, Ph.D, Senior Instructor, Integrative Physiology, Janet.Casagrand@colorado.edu

The three of us will be working together on this project as part of the continued commitment of the Department of Integrative Physiology (IPHY) to improve our undergraduate curriculum. Building on the successes of the Science Education Initiative (SEI) in IPHY, the department has recently approved the development of three Curriculum Coordinator positions (see Appendix) that will allow us to work together to develop and align our curriculum, and engage in science education research. As explained below, we would like to pilot case studies over the summer session before these positions officially begin in Fall 2016.

2. Courses to be changed and rationale.

What courses will be changed?

We are proposing to develop **case studies** for the three introductory IPHY courses: Introduction to Human Anatomy (IPHY 3410), Human Physiology 1 (IPHY 3470), and Human Physiology 2 (IPHY 3480). We chose these three courses for our project several reasons. First, all of these courses have learning goals that were developed in collaboration with the Science Teaching Fellows of the SEI. From these goals we can identify potential troublesome/challenging concepts for students that can be taught and assessed using case studies. Second, these are the first IPHY courses our majors must complete. Therefore, this project has the potential to impact several hundred students each year: 750 students in IPHY 3410, 430 students in IPHY 3470, and 430 students in IPHY 3480. Third, these three courses serve as the foundational courses for our upper-division courses. By introducing case studies into the introductory courses, students will be better prepared for the challenges of the upper-division courses. Finally, the current faculty members teaching these courses recognize the need for additional activities for their students, and quickly agreed to participate in this project.

What are the changes being contemplated?

Case studies are a type of problem-based learning in which carefully designed problems challenge students to apply and synthesize what they have learned to a real world situation. In physiology, these often take the form of a medical/clinical scenario. Good case studies reinforce learning goals, are student-centered, engaging, and have real-world relevance (McFarlane, 2015).

For each of the courses, we plan to develop and implement four cases studies, one per exam, as formative assessments. For each successive course, the Bloom's level of the questions will increase. Case studies will be administered either in-class or online (via Desire 2 Learn), depending on instructor preference and comfort. Research suggests students find case studies effective in both face-to-face and online formats (Saleh, Asi and Hamed, 2013).

How will this course transformation improve student learning, or contribute to the teaching and learning needs in your unit or in your college?

In incorporating case studies into the introductory courses, we hope to accomplish three main goals:

(1) Improve student learning, engagement and participation, and critical thinking skills.

Case study teaching has been extolled for its ability to engage students and develop analytical and critical-thinking skills (Herreid and Schiller, 2013), make facts and concepts easier to learn and retain (Herreid, 2007), help students make connections between what might otherwise be considered separate

topics (Herreid, 2007), and shift emphasis from teacher-centered to student-centered activity (Grant, 1997).

Case studies can thus be a way to better prepare IPHY students for the upper division courses, as well as their future professions, by helping them to develop critical thinking skills. Furthermore, in a recent survey of students in an IPHY upper division course that uses case studies taught by Teresa Foley, the majority found case studies helpful for their learning. When asked about their interest in the course, these same students also frequently made reference to the case studies as the feature that made the course interesting and adding relevance for them.

(2) Align these foundational classes so that we are developing and building on students' skills as they progress through the sequence.

When the SEI worked with these three courses in the past, the emphasis of the reform was at the individual course level to develop learning goals. The SEI presence in our department ended before there was an opportunity to align the learning goals across courses, and consider how learning could build upon itself as students progressed through the major. We would like to pick up where the SEI left off, to look more globally at these IPHY foundational courses and their goals, and to work on developing higher level, cross-course goals (e.g., problem-solving, integration of concepts across courses). We will use an active learning tool to help accomplish these goals.

(3) Reestablish an SEI-like presence and provide a resource and support system for faculty

IPHY faculty have expressed interest in incorporating case studies into their courses, mainly because most of our majors are planning on entering the Allied Health Professions, and case studies provide a way to show the real world relevance of the material they are teaching. However, many faculty have hesitated to implement case studies on their own for a variety of reasons, including time and lack of knowledge in how to implement case studies or other active learning tools. This interest thus provides us an opportunity to begin working with faculty in developing active learning tools for their courses. As newly appointed Curriculum Coordinators for IPHY, this is an ideal way for us to establish a working relationship with other faculty, and begin to serve as a resource and support system for their courses. Furthermore, many faculty fail to recognize where students struggle, and what students are capable of accomplishing. So part of our goal is to use case studies to help faculty move beyond traditional lecture, and to realize the value of active learning tools and assist with overcoming the fear or discomfort in trying something new.

3. Course development plan.

a. **Timeline** - What is the approximate timeline for making these course changes? What are the staffing plans for those courses (who will be teaching the course, and when)?

May 2016 – May 2017

May 2016

- Survey faculty in IPHY 3410, 3470 and 3480 about their perceptions of active learning tools (case studies, etc.), what barriers they perceive in using active learning tools (e.g., lack of comfort, time, technology concerns), and what problem areas they typically see with students (e.g., where students struggle, lack of participation).

Summer 2016

- Develop case studies for each of the courses, pilot and troubleshoot case studies in summer session, and conduct student and faculty surveys of perceived effectiveness.
 - IPHY 3410: taught by Heidi Bustamante
 - IPHY 3470: taught by Janet Casagrand
 - IPHY 3480: taught by Heidi Bustamante

Fall 2016 and Spring 2017

- Full rollout of case studies, data collection (including pre/post assessments, and student attitude surveys) and analysis.
 - Fall 2016
 - IPHY 3410: taught by Ruth Heisler and Leif Saul
 - IPHY 3470: taught by Chris DeSouza
 - IPHY 3480: taught by Bill Byrnes
 - Spring 2017
 - IPHY 3410: taught by Ruth Heisler and Leif Saul
 - IPHY 3470: taught by Todd Gleeson and Heidi Bustamante
 - IPHY 3480: taught by Heidi Bustamante

May 2017

- Resurvey faculty

b. **Leadership Plan** - Who will lead the project, including oversight of timelines and deliverables, and supervision of any personnel (e.g., graduate students or postdocs) who might be hired? How will you ensure that commitments made in this proposal are fulfilled?

Teresa Foley, Ruth Heisler and Janet Casagrand will lead and be directly responsible for all aspects of the project. We have commitments from the faculty teaching the courses to participate in the project, as well as support from our chair, Pei-San Tsai. We will also lead the development of the case studies, and provide faculty with any support (e.g., technological, pedagogical, emotional, etc.) they require, including administering the pre/post assessments and surveys. The three of us will be responsible for all data analysis.

c. **Assessment Plan** - How will you assess whether the course changes have the impact you desire (e.g., concept tests, exam questions, student surveys, etc.)? Will you assess impact on student retention and engagement, if such impact is expected?

We plan to assess the impact of these changes in four ways:

(1) Student surveys

- At the beginning and end of each course, we plan to survey students about their attitudes towards the case studies using Survey Monkey (to which IPHY has a yearly subscription), including how effective students found the case studies for their learning; engaging their interest; and ability to apply, connect and synthesize concepts.
- We also plan to incorporate select questions from the biology CLASS (<http://www.colorado.edu/sei/class/CLASS-Bio.html>), which assesses student attitudes and beliefs about biology. E.g.,:
 - i. Knowledge in biology consists of many disconnected topics.
 - ii. To learn biology, I only need to memorize facts and definitions.
 - iii. The subject of biology has little relation to what I experience in the real world.

(2) Faculty surveys

- At the beginning and end of the project, we plan to survey involved faculty about their attitudes towards active learning tools (e.g., case studies) using Survey Monkey, including whether faculty like them; found them effective for increasing student engagement and participation, or identifying and dealing with problem areas; and any benefits or challenges related to using case studies.

(3) Bloom's analysis

- To help us develop case studies that build on students' problem-solving skills across the three courses, we plan to assess the Bloom's level of the questions for all case studies. Bloom's taxonomy is a well-established tool for characterizing the cognitive level of

questions. The three of us are familiar with Bloom's taxonomy, and two of us have previously used a dichotomous key to Bloom course materials.

(4) Pre/post assessment of student learning gains

- We plan to assess student learning in using a pre/post assessment for each case study. A set of questions will be given to students (either as in-class clicker questions, or as part of a D2L assignment) after they complete a traditional lecture but before completing the case study, and then again after they complete the case study, to assess any learning gains as a result of the case study. When case studies are implemented online, they will be given as graded homework assignments; this should help ensure students take the assignment seriously.

d. Faculty and instructor Involvement - How will other faculty/instructors be involved in this work, and to what extent? How will that faculty effort be recognized or rewarded?

The other IPHY faculty involved in this project (Bustamante, Byrnes, DeSouza, Gleeson, and Saul) will help us identify problem areas where case studies could be helpful, refine case studies to meet their needs, and complete surveys about their attitudes on case studies and experiences with the project. This will involve meeting occasionally with the three of us. Faculty will be acknowledged in faculty meeting, as well as any presentations or publications, and rewarded with home-baked goods.

e. Sustainability - How will changes in this course be sustained, especially if new instructors will be teaching it in the future? Be specific about these plans, as this is a common failure-point for course transformation efforts.

In IPHY, we realized that once the SEI presence in our department ended, the changes implemented in these courses became harder to maintain. This was primarily due to changes in faculty assignments and loss of the support personnel. As a result, IPHY has recently assigned three standing faculty members the responsibility to maintain and build on the efforts of the SEI. The IPHY chair and Teaching Committee established the development of these positions, and support the long-term continuance of these positions. Consequently, the three of us will be able to sustain these efforts by providing the continued support and resources for faculty to implement active learning techniques in their classroom, even when new faculty are assigned to teach these courses. Furthermore, by discussing this project and its outcomes at faculty meetings, we can build on these efforts by educating other faculty in these techniques, and we can begin to help other faculty develop case studies in future including training them on learning goals and the pedagogy behind case studies. We also feel that this particular tool will be sustainable because a national faculty survey on case studies in science demonstrated that faculty say case studies have a positive impact on student learning, critical thinking, and participation (Yadav et al., 2007), and many IPHY faculty have expressed interest in utilizing case studies.

f. Coordination across the department - How do changes in this course relate to the curriculum as a whole? Are there ways that this effort will be coordinated with other courses or instructors? At a minimum, the proposal should include a letter from the Chair supporting the work.

The very nature of our project relates to the IPHY curriculum as a whole. The courses that we are proposing to work with are the introductory classes for our majors and feed into all of the upper division courses. Thus, if students are better prepared and have developed better critical thinking and analytical skills, all of the upper division courses will be impacted and all of our faculty will benefit. As far as we are aware, this project is the first of its kind at CU Boulder to intentionally make an effort to integrate skills across a curriculum, and build a long-term mechanism to sustain the changes.

4. Broader impacts - Are there ways in which this work will impact faculty and practices in your department, or other departments? For faculty who are proposing a project solo, without strong departmental integration, this is an excellent place to argue how your project will likely have impacts beyond your own personal professional development.

This project will directly involve nearly a third of the IPHY teaching faculty (8 of 31). Three of these faculty members (DeSouza, Gleeson, Saul) did not work with SEI, so this project will be the first time they are being exposed to the development of active learning and student-centered learning techniques. If we can assist these faculty in effectively implementing case studies, and demonstrate the effectiveness of this approach to them, they may change how they teach and approach teaching. For the other five faculty members, this project will provide the support and resources necessary to implement another teaching approach that they currently do not have the time, ability, or comfort to add to their courses.

This project also has the potential to impact at least another third of the faculty (10) who teach the upper division IPHY courses. For faculty who currently incorporate critical thinking skills in their courses, this foundation will allow them to push students even further. For faculty not currently incorporating critical thinking skills, as students are better prepared for their classes, they may come to realize they can incorporate critical thinking and that case studies are a tool that students like and are effective for their learning.

Furthermore, not all faculty recognize the value of formative assessments (e.g., clicker questions, homework assignments, practice quizzes, etc.). We will, therefore, be utilizing the IPHY website and monthly faculty meetings to advertise the project, show results, and distribute materials to faculty. We hope by making the process open to faculty that it can spur interest in other faculty utilizing formative assessments to assist student learning. We anticipate holding workshops on formative assessments and/or case studies for interested faculty to meet their needs.

Because this project is unique and can have a more global, curricular impact, we also plan to present our results at CU's Discipline-Based Education Research (DBER) weekly meeting, the Annual Center for STEM Learning symposium, and the *Human Anatomy and Physiology Society* annual conference. We will also publish our results in a science education journal.

5. Evidence of expertise - What prior experience do the faculty leader(s) have in course transformation that will be leveraged for this proposal? How will the proposed work further their learning?

Ruth Heisler has been interested in education reform since working with the SEI Science Teaching Fellows to create coherent learning goals for the Human Anatomy course she instructs. A primary goal of Ruth's throughout her 20 years at the University of Colorado-Boulder has been to help students learn to not just memorize anatomy, but develop their critical thinking skills so that they can see the logical way in which the human body is organized. She has participated in ASSETT Hybrid Design and Teaching with Technology workshops, and in 2013 was awarded the ASSETT Outstanding Teacher for Technology in Teaching award. Ruth has co-authored an online learning tool Practice Anatomy Lab 3.0 (PAL); developed 38 screencasts for students in the IPHY 3415 Human Anatomy lab as part of an effort to flip the classroom; and helped to develop learning goals, online homeworks, and clicker questions for her large Human Anatomy lecture course. As a member of the Human Anatomy and Physiology Society, Ruth has developed and presented workshops at their national conferences on how to use PAL to create online assessments, and how to use the "jigsaw" approach to flip the learning environment in a human anatomy lab. As a member of the AAU Departmental Action Team, she has worked to continue the efforts of teaching reform in the department. The proposed project would allow her to gain experience in educational research, further her interest in implementing case studies into a Human Anatomy course, and provide a mechanism to further help students learn.

Janet Casagrand has been actively involved with education research and reform since 2008, when she started working with the SEI Science Teaching Fellows. She has presented more than 25 workshops and poster presentations at local and national conferences on topics ranging from Bloom's taxonomy, case studies, screencasts (video mini-lectures), and worksheet activities, and attended and presented research at two national case study conferences. Janet has been the recipient of a President's Teaching and Learning Collaborative award, a Chancellor Award for Excellence in STEM Education, an ASSETT Development Award, the and Human Anatomy and Physiology Foundation *ADInstruments Sam Drogo Technology in the Classroom* Award. She has participated in numerous FTEP and ASSETT workshops including ASSETT's Teaching with Technology, and Hybrid Course Design workshops, and FTEP's Assessment Institute- Achieving Course Goals, Gathering Evidence about Student Learning. She is currently a member of the IPHY AAU Departmental Action Team. The proposed project would enhance her learning by allowing her to work extensively with other faculty to develop and implement active learning tools in their classrooms, and integrate skills across the curriculum.

Teresa Foley has extensive experience in education research and reform. She was a SEI Science Teaching Fellow in IPHY from 2008 to 2011, and she continues to work with IPHY faculty on educational projects since joining the department as an instructor in 2011. Over the last seven years she has helped convert 15 IPHY courses from a teacher-centered to a student-centered approach. This work includes developing learning goals for each of these courses, creating assessments that align with the learning goals, surveying students about their attitudes towards the course, and helping faculty implement instructional approaches that improve student learning. Her work has been presented at local and national conferences. Teresa has been the recipient of two Chancellor Awards for Excellence in STEM Education, one ASSETT Development Award, and she is the current IPHY representative for the AAU STEM Education Initiative. For this project, Teresa can provide expertise in implementing a new teaching tool (case studies), assessing the effectiveness of the tool, troubleshooting potential issues, and sustaining these changes in the classroom. The proposed work would further enhance her learning by allowing her to pick up where she left off as a Science Teaching Fellow and integrate skills across the IPHY curriculum rather than at the individual course-level.

6. Resources requested:

a. **Budget** - How will funds be used? A maximum of \$10,000 is available, which may be used for course buyout to facilitate faculty time spent on course development or team teaching, summer salary, graduate teaching assistant or postdoctoral fellow time; learning assistants, equipment, etc. Travel, food, and administrative salary are not allowable. The budget needs only to include project expenses; benefits and overhead charges incurred will be covered separately by TRESTLE.

The three of us are instructors and on 9 month contracts. We are requesting \$10,000 to be used as summer support for us to develop the case studies, surveys, and pre/post assessments.

b. **Non-financial resources requested** - Project participants do not need to have all the expertise required to successfully undertake the project, CSL expects to provide additional learning opportunities for participants. Broadly speaking, what non-monetary support would be helpful? For example, we can provide (1) facilitation of a learning community –a group of faculty/instructors (within or across departments) meeting regularly to get real-time feedback as they work on course development and educational projects --and (2) CSL educational advisors who can consult on the project individually in a variety of areas.

We anticipate forming a learning community within the department, and acting as co-facilitators of that community. We would appreciate the opportunity to learn more about successful implementation of such learning communities. We have made connections with faculty involved in the Carl Wieman Science Education Initiative (CWSEI) at the University of British Columbia in order to seek advice in this area.

It would be helpful to meet with an educational advisor to discuss the steps necessary to publish our data.

7. Resources leveraged - Grants that propose leveraging existing internal or external resources are preferred—such as financial resources, awards, or collaborations with other units or programs. If you request a faculty learning community, will participating faculty be provided with incentive (such as committee or service release), and can the department supply modest refreshments?

Our department has committed to the development of three Curriculum Coordinator positions starting in Fall 2016. We each will receive a course release each semester to provide educational assistance and support to faculty in IPHY to help sustain and expand the efforts of the SEI. Thus, we are leveraging the previous SEI efforts in IPHY to further enhance and align our curriculum.

Since the Curriculum Coordinator positions are 9-month appointments at 25% FTE, they will not exist in the summer. We would like to use the summer to develop and pilot this project, but this is outside the scope of our normal responsibilities. Funding for this project is crucial because the summer is an ideal time to pilot this project in all three courses. Furthermore, the faculty teaching these courses (Bustamante, Casagrand) have experience implementing and troubleshooting active learning techniques. Therefore, having them work out the kinks *before* implementation in larger, regular-semester courses taught by faculty members inexperienced with active learning is critical.

8. Agreement to expectations - Do you agree to fulfill the "expectations of successful applicants," as described below?

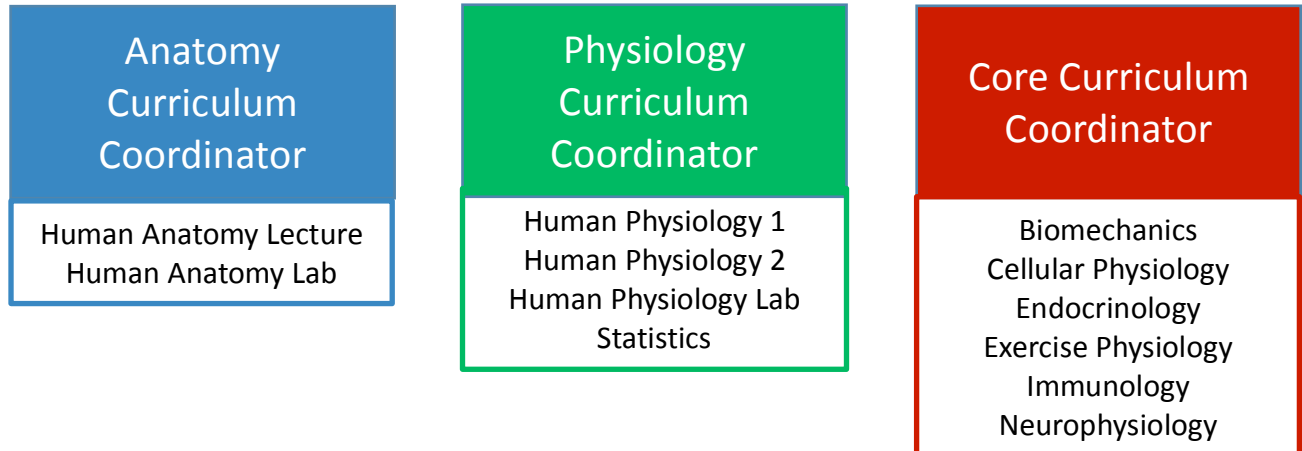
Yes.

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APPENDIX

Anatomy, Physiology, and Core Coordinator Team



SEI accomplishments to sustain and build on:

- development of standardized learning outcomes for IPHY courses and assessments to test whether students are meeting those objectives
- wider adoption of active learning activities and assessment of the effectiveness of these practices
- faculty training in new teaching/learning approaches
- establishment of IPHY as a recognized leader in STEM education.

Goals:

1. develop a process by which the individual course transformations resulting from the SEI initiative can be sustained and grow.
2. think more holistically across our curriculum about what it means to be an IPHY major, and what we want an IPHY major to be able to do at the completion of the major.

Benefits:

- Mechanism for coordinating and aligning our courses
- Learning goals maintained, and regularly updated
- Opportunities to stay current with the latest pedagogies / teaching technologies (e.g., through workshops).
- Assess student learning experience and course alignment
- Sustain IPHY's role as a model for STEM education