

Challenges encountered when integrating case studies across the foundational IPHY curriculum

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Background & Rationale

Integrative Physiology (IPHY) majors are required to take a foundational, 3-course introductory sequence (Human Anatomy, Physiology 1, Physiology 2) before they can take specialized upper division courses. One challenge is that students often see these as isolated course experiences, and can fail to recognize how concepts fit together within the courses, and also across the courses. Students can also have difficulty appreciating the real world relevance of the course material. To address these challenges, we proposed to incorporate case studies into the 3-course sequence with the goal of illustrating the integrative nature of concepts within each course throughout the semester, and across the 3-course sequence.

The initial plan was to have the researchers beta-test the case studies in the summer session, and in the fall involve the rest of the teaching faculty in refining and expanding the case studies. However, in this process we uncovered that faculty had different ways in which they were using learning goals. So we had to take a step back and revisit the learning goals for each class, and find out how faculty were using them.

Methodology & Data Collection

In spring 2016, we began developing the case studies. We decided to focus on two case studies: one that followed a patient with celiac disease and another an individual experiencing stress. These cases were referenced throughout the semester, and across the three courses. We chose these two conditions because together they allow us to address the key learning objectives in the three courses.

In summer 2016, we implemented sections of the celiac case study; more in some classes than others. Student attitude and preliminary pre/post-case study clicker question data were collected.

In fall 2016, we created three course-specific working groups, and began meeting with faculty to further develop and refine case studies for incorporation in AY16-17, to revisit the course learning goals, and to discuss active learning.

Faculty working groups included teaching faculty and the curriculum coordinators for:

- **Human Anatomy:** Ruth Heisler and Leif Saul
- **Human Physiology I:** Janet Casagrand and Todd Gleeson
- **Human Physiology II:** Bill Byrnes and Heidi Bustamante

The IPHY learning goals can be found online at: www.colorado.edu/sei/departments/integrative-physiology_learning.htm

Data Collection

- Student attitude surveys – collected during summer, & to be collected AY16-17
 - To assess student reactions to case studies
- Faculty survey on learning goals - administered in spring 2016
- Pre/post assessments & learning gains
 - To assess whether case studies improve learning of key concepts, we are administering a set of questions right before the case study and after the normal lecture on a topic ('pre'), and again after the case study ('post'). These questions test the same general concepts, but are not tied directly to the case study. (E.g., the case study might illustrate the importance of glucose transporters in the kidney, while pre/post questions relate to calcium transport in the thyroid.)
- Classroom Observation Protocol for Undergraduate STEM (COPUS)
 - This protocol allows STEM faculty to reliably characterize how faculty and students are spending their time in the classroom. We are using it to assess whether there are changes in how faculty use classroom time after incorporating case studies.

Sample Case & Pre/Post Questions

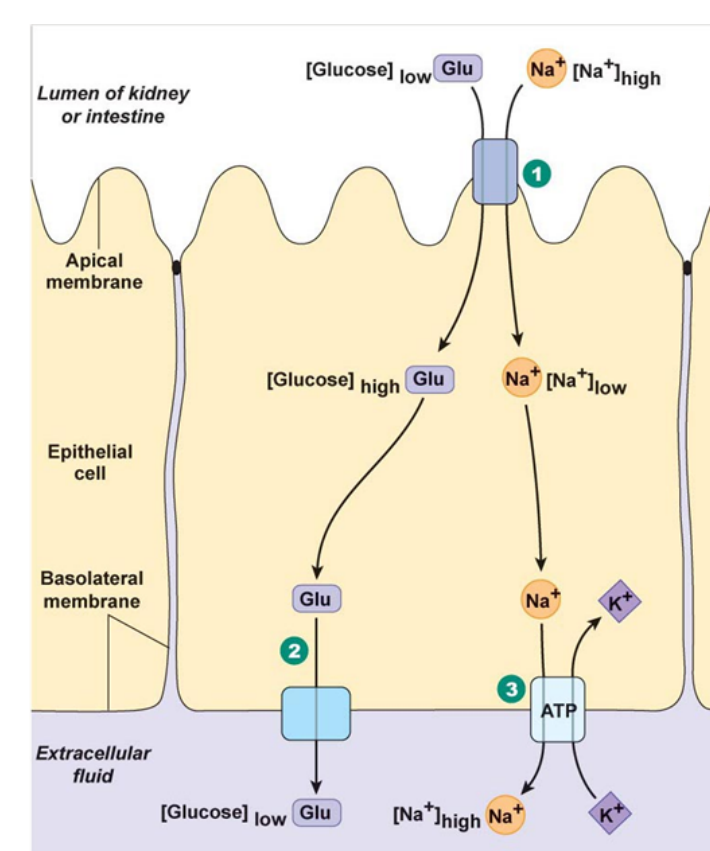


Celiac Disease

- We saw expression of transporters is altered in the small intestine in celiac disease. Let's consider absorption of glucose into the small intestine.

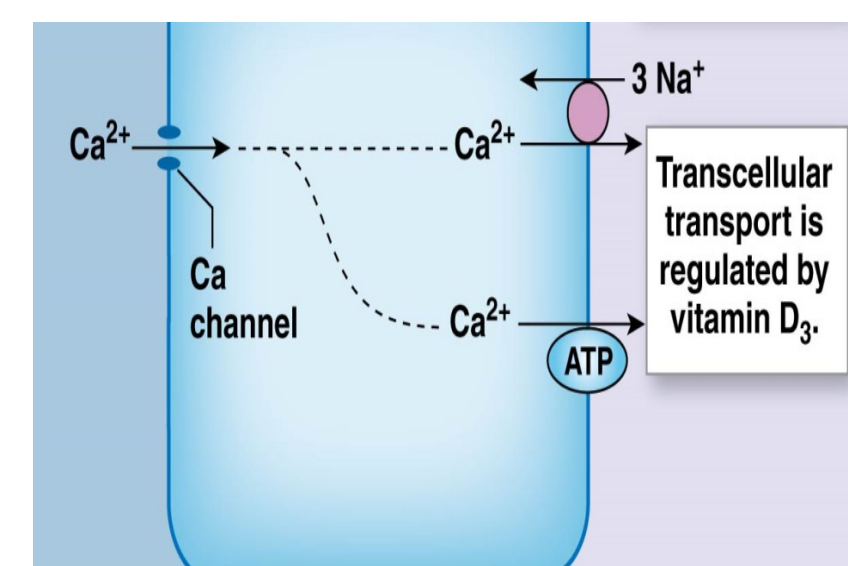
Worksheet Questions:

- Does Na⁺ & glucose transport across apical membrane require ATP (i.e., is it active or passive)? Why/why not?
- Does Na⁺ & K⁺ transport across basolateral membrane require ATP? Why/why not?
- Does glucose transport across basolateral membrane require ATP? Why/why not?
- For each:
 - Based on energy requirements, how would you classify the transporter?
 - Based on physical requirements, how would you classify the transporter?
 - What is the function of this transporter?



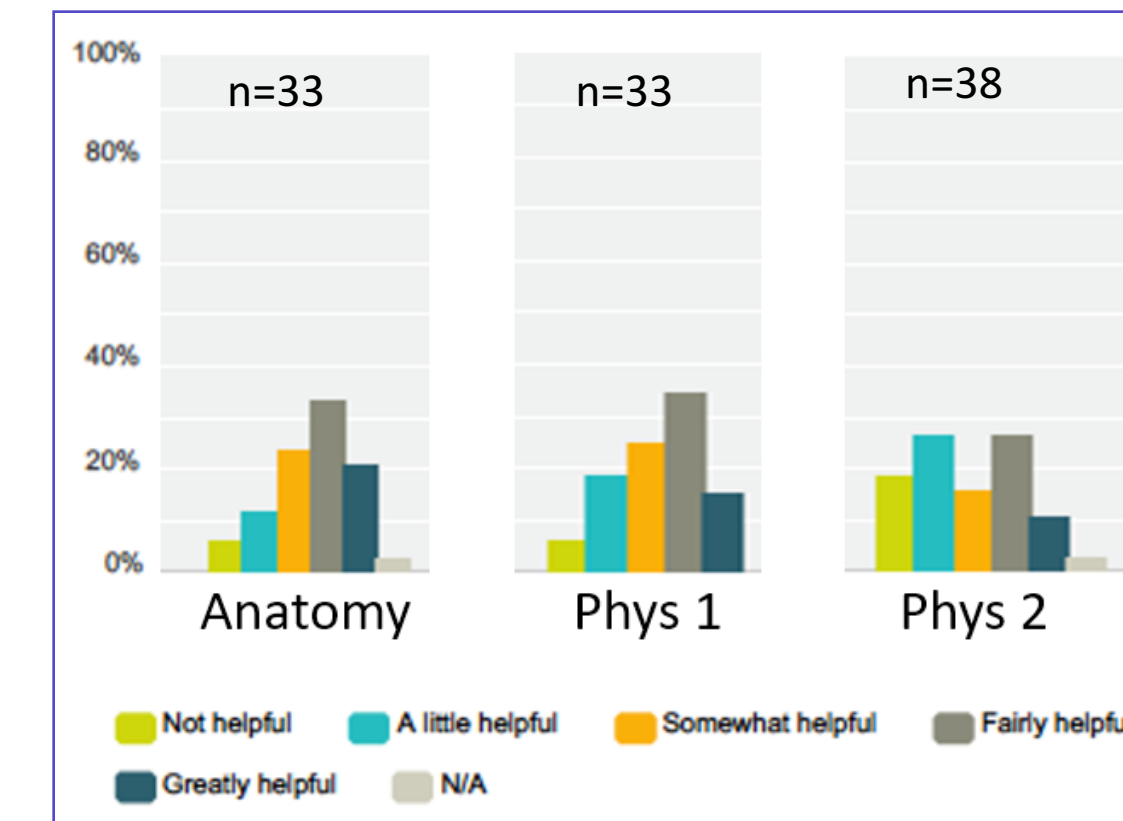
Pre/Post Clicker Questions

- The figure (below) illustrates calcium transport (absorption), which is regulated by vitamin D₂.
- 1) Why type of transport is occurring on the left?
 - 2) What type of transport is occurring on the top right?
 - 3) What type of transport is occurring on the bottom right?
 - 4) How would you classify the transporter in the upper right?
 - 5) Transport in the upper right occurs by what mechanism?



Student Reactions

Initial results were positive with students recognizing the value and importance of case studies, and often requesting more. We also saw learning gains on some key concepts after the case study. However, some students felt the case study disrupted the flow of lecture and did not aid learning.



How helpful were case studies to your learning?

Topic	Question & sample sizes	Pre-CS % Correct	Post-CS % Correct	Class Average Normalized Gain	p-value (Chi-square)
Homeostasis	Effector (n=33,34)	63 (n=21)	82 (n=28)	*51.35	0.011
	Integrator (n=33,34)	88 (n=29)	82 (n=28)	-50	0.31
	Sensor (n=33,34)	88 (n=29)	91 (n=31)	25	0.53
mRNA	Where find (n=34,34)	65 (n=22)	91 (n=31)	*74.29	0.001
	Purpose (n=34,34)	68 (n=23)	86 (n=29)	*56.25	0.028
Transport	Happens to (n=34,34)	79 (n=27)	63 (n=21)	*-76.2	0.011
	Facilitated diffusion (n=35,35)	60 (n=28)	94 (n=33)	*85	0.00004
	Secondary active (n=35,35)	66 (n=23)	91 (n=32)	*73.53	0.0014
	Primary active (n=35,35)	71 (n=25)	94 (n=33)	*79.31	0.003
	Antiporter (n=35,35)	74 (n=26)	91 (n=32)	*65.38	0.02
Carrier-mediated (n=35,35)	63 (n=22)	71 (n=25)	21.62	0.29	

Class average learning gains on pre/post questions in Physiology 1.

"...looking at case studies was very helpful for realizing how concepts can be applied in many different situations."
–IPHY Anatomy student

"The case studies made me learn even more because they are real life situations and students learn better that way cause they feel like they're in charge for that person's health."
–IPHY Physiology 1 student

"I wish more case studies were incorporated into the course."
–IPHY Physiology 2 student

"I did not like the case studies in this course or my Phys 1 course. I understand the purpose is an attempt at making the knowledge more integrative and engaging yet I think they take away from the class learning. I felt that they interrupted the flow of lecture and they are unnecessary for learning the topics."
–IPHY Physiology 2 student

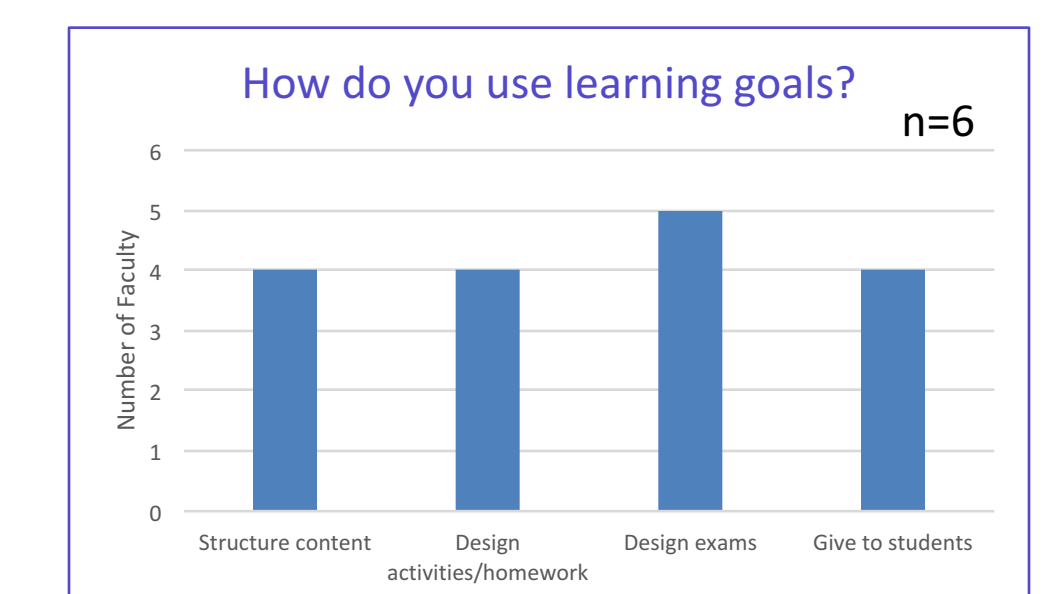
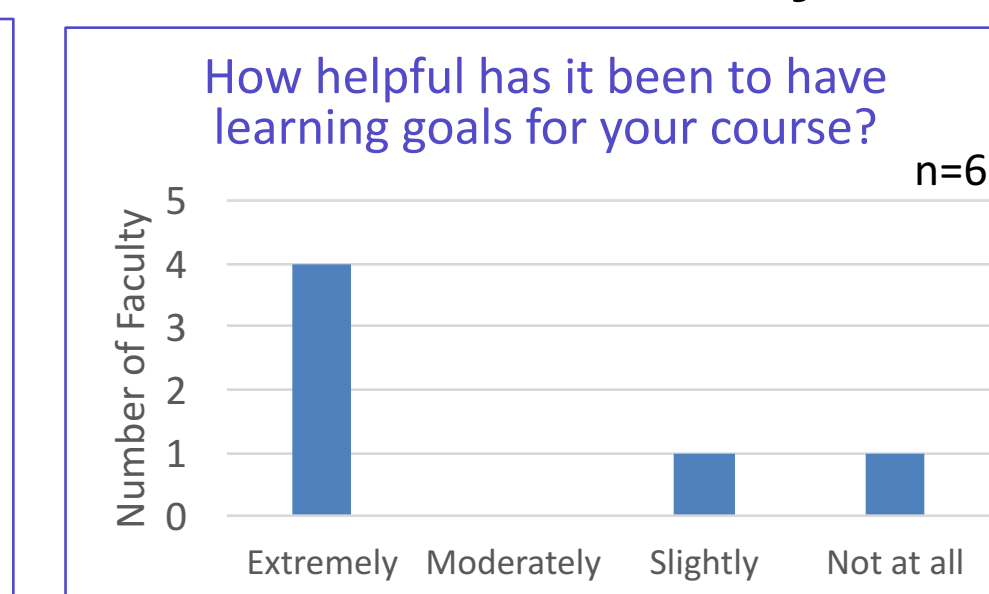
Faculty Feedback & Issues Encountered

Designing case studies for multiple courses taught by multiple instructors presented some unanticipated challenges. Although faculty initially seemed to want a case study they could just plug into their course with minimal effort, it later became clear that their input and guidance would be necessary to create case studies that everyone would be comfortable using in their course. Two of the biggest concerns were:

1. Faculty vary considerably in how they use the learning goals; their views on the importance of learning goals; and how the learning goals should shape their lectures. Observationally, we can say that:
 - Faculty originally involved in development of learning goals 7-9 years ago are more likely to: (1) find them valuable/helpful, (2) give them to students, (3) use them to design activities and write exams, and (4) look at the learning goals of prerequisite courses than faculty not involved in learning goal development.
 - Faculty who tend not to find learning goals helpful, also view them as lists of content to know, rather than skills to learn.

Faculty differ in their definition of learning goals:

- what students are **expected to learn** in course.
- an expression of **key concepts** and relationships we hope to structure courses around, and for students to focus upon.
- **topics to be covered in depth.**
- a **topic-related competency** required for understanding a key learning concept.
- a **piece of content** students need to learn, and **level** at which they will be assessed on that content.
- what I'd like a student to **know or be able to do** at end of course.



2. Faculty vary in their level of comfort in implementing a case study. Some of the road blocks are varying levels of comfort in implementing new active learning techniques; lack of appreciation for interactive learning in the classroom; and concerns about spending too much of class time on one thing and/or having to learn the background material for the case study.
 - Consequently, we decided to take a step back and approach the case study implementation differently. The faculty working groups provide a mechanism by which faculty who teach similar courses can meet to discuss the learning goals, differences in approaches to the material, terminology, and expectations of the case studies, and how to implement interactive approaches in the classroom. We are finding it beneficial to revisit the goals, have a discussion about how they are being used, and make changes as needed. This is a needed and natural progression to discussing where a case study might be helpful to the student. Faculty seem to enjoy having a venue to talk about teaching, and one faculty member has been encouraged to begin using active learning in class.

Future Directions

STUDENTS: Student feedback was mainly positive, however, several students indicated they felt the case studies interrupted the flow of lecture. We plan to work with faculty to help them better integrate the case studies into their lectures to address this potential issue. Nonetheless, preliminary data indicate the case studies are improving learning.

FACULTY: Our experience has illuminated the need to be more inclusive in our approach to the case studies. Each working group has its own personality, yet all involved faculty seem engaged in and eager to be a part of the process. Moving forward, our intent is to:

1. **STAY CURRENT:** Continue to work with the course specific groups to revisit learning goals and update them as needed.
2. **LISTEN, LEARN AND STAY FLEXIBLE:** Work within the parameters of each faculty member and course, to see what they are comfortable with, and what they hope to get out of the project.
3. **INCENTIVIZE:** Explore the need for further incentives to use and be guided by learning goals.
4. **ASSESS:** Work on further assessing the case studies to demonstrate the effectiveness of their use in the classroom.