

# ***RU Audeamus Grant Progress Report***

**TITLE:** Study smart not hard: an alternative method of course delivery of BIOL 322: Human anatomy & Physiology for pre-nursing majors to utilize online pedagogical tools to enhance student success

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**AMOUNT OF AWARD:** \$9,000.00

## **BRIEF PROJECT OVERVIEW**

The goals of this project are two fold 1) to create and assess an alternative delivery method for the semester long, 6 credit, BIOL 322: Human Anatomy & Physiology for Pre-Nursing Majors course, and 2) To bolster higher-level critical thinking skills in our pre-nursing majors. This alternate delivery method of the BIOL 322 course allows for the instructors to deliver background knowledge and general content pertaining to anatomy & physiology outside of the classroom confines and instead employs topic-specific online modules to achieve the foundational basic skills of critical thinking according to Bloom’s Taxonomy: knowledge and comprehension. Time spent in the classroom will be used to master upper level critical thinking skills such as application, analysis, evaluation and synthesis via active learning group work through medical case studies as well as employing “Just in Time Teaching” (JiTT) strategies to clarify any information the students have sequestered on their own time (see table below for teaching methodology breakdown).

<b>Teaching Tool</b>	<b>Delivery Method</b>	<b>Venue</b>	<b>Usefulness: student perspective</b>	<b>Usefulness: Instructor perspective</b>	<b>Critical Thinking Skill Enhanced</b>	<b>Critical Thinking Level Achieved</b>
MasteringA&P™ - with Adaptive Follow-up	Online	Out of class	Self assessment, Self-paced, Ability to review, Individually targeted, Enhances close reading	Focused assessment of misconceptions and topics to be addressed in class, enhanced reading, provides focused individualized remediation	Knowledge, Comprehension	lower levels
Learning Catalytics™	Online	In class	Real-time self-assessment in class, Enhances mastery of topic covered	Immediate individual assessment to display class comprehension real time, Targeting real-time review	Knowledge, Comprehension, Application, Analysis, Synthesis, Evaluation	lower, mid, and higher levels (depending on use)
Lecturettes & Interactive PDFs	Online	Out of class	Self-paced, Ability to review complex topics	Added opportunity to clarify and solidify “tricky” topics	Comprehension, Application, Analysis	mid-levels

Case Studies & Discussion	Student-Student & Student-Instructor Interaction	In class	Fosters group problem solving, Enhances written and oral communication skills	Encouraging group work, discussion, writing, speaking, and fostering higher level thinking skills with real world examples	Application, Analysis, Synthesis, Evaluation	mid to higher levels
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The table above illustrates the teaching tools we will be employing when constructing our course to explore synergistic effects of high impact learning practices on student success. MasteringAandP and Learning Catalytics software is produced by Pearson and demonstrates efficacy. Some, though not all, case studies will be used from the National Collection of Case Studies for Teaching Science (NCCSTS) that contains peer-reviewed and pedagogically accepted cases.

## **RESULTS OF PROJECT**

The results of the project thus far include a design of a hybrid course for Human Anatomy and Physiology (BIOL 322), and are based on three areas for student engagement: online content, video lectorettes, and in-class case studies. The course will be delivered in Fall 2014.

## **ONLINE CONTENT**

There is a substantial online component to the course, and it includes homework, quizzes, and exams. Although not timed, the homework is designed to take approximately 1 hour for students to complete, and is due just prior to lecture on the topic for that day. These interactive, visually-rich, and engaging homework assignments are weighted as part of the to the students' grade to provide incentive to read the relevant chapters and interact with the Mastering Platform from Pearson (Figure 1). Relevant data on the assignment is used by the program to guide individual student understanding through hints, and multiple attempts until mastery. There are typically two chapters of homework per week, culminating in a quiz the following week once student understanding has been evaluated in class by the instructor. This follow up in class is essential to the formative assessment process during the course so instructors can correct misunderstandings along the way.

### Art Activity: Anterior muscles of the neck

Label the anterior muscles of the neck.

#### Part A

Drag the labels onto the diagram to identify the anterior muscles of the neck.

The diagram shows a frontal view of the human neck with various muscles highlighted in red. A list of labels is provided on the left side of the diagram, each in a blue box. The labels are: Stylohyoid, Sternohyoid, Sternohyoid, Digastric, Mylohyoid, Mandible, and Omohyoid (superior belly). There are several empty grey boxes on the right side of the diagram, connected to the neck muscles by thin lines, indicating where the labels should be dragged. At the bottom left of the diagram area is a blue 'Submit' button. At the bottom right are 'reset' and 'help' buttons. Below the diagram area, there is a 'My Answers' section with a 'Give Up' link.

Figure 1. An example question from one of the homework sets (Chapter 10).

The 10-question quizzes are interactive and categorized as “activities” or “coaching activities.” These activities are not timed, and are selected at random from a large pool questions. In the example given below, student view a short video as they answer questions to the right of the video window (Figure 2). Students may work collaboratively on these quizzes since each student will have a unique quiz. After two such quizzes, an exam on the four chapters is also delivered online.

## Cranium Video Questions

Watch the animation, then answer the questions below.



### Part A

Which bone is **NOT** considered to be part of the cranium?

- Ethmoid bone
- Sphenoid bone
- Occipital bone
- Lacrimal bone

[Submit](#) [Hints](#) [My Answers](#) [Give Up](#) [Review Part](#)

### Part B

Identify the suture found between the 2 parietal bones.

- Lamdoidal suture
- Coronal suture
- Squamosal suture
- Sagittal suture

[Submit](#) [Hints](#) [My Answers](#) [Give Up](#) [Review Part](#)

### Part C

Which of the following bones is unpaired?

- Zygomatic
- Frontal
- Temporal
- Parietal

[Submit](#) [Hints](#) [My Answers](#) [Give Up](#) [Review Part](#)

Figure 2. An example of a quiz question from Quiz 4 (Chapters 7&8).

These 50-question, multiple choice, exams are timed at 90 minutes. Questions are selected at random from large pool of possible questions (~ 200 or 300 hundred), and are assigned only after the material for the exam has been reviewed in class, typically the exams are on four chapters (Figure 3).

## Chapter 23 Question 1

### Part A

The sum of all of the biochemical processes going on within the human body at any given time is called

- oxidative phosphorylation.
- metabolism.
- anabolism.
- catabolism.
- glycolysis.

Submit

My Answers [Give Up](#)

Figure 3. An example question from Exam 5 (Chapters 21-25).

To assess student understanding in real time, 26 questions from each chapter were created as Learning Catalytics sessions, and are available to instructors for use during lecture (Figure 4). These questions may count toward participation or for credit, and is at the discretion of the instructor. Depending on the distribution of correct and incorrect answers to such questions, instructors may guide and correct student understanding accordingly.

[My Courses](#) > [Human Anatomy & Physiology \(BIOL 322\)](#) > **Chapter 27: Development and Inheritance**

▶ Start session

✎ Edit

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20. multiple choice

If both parents are heterozygous for a trait, what is the probability of having a child that is homozygous recessive?

- A. 0 percent
- B. 25 percent**
- C. 50 percent
- D. 100 percent

Answer

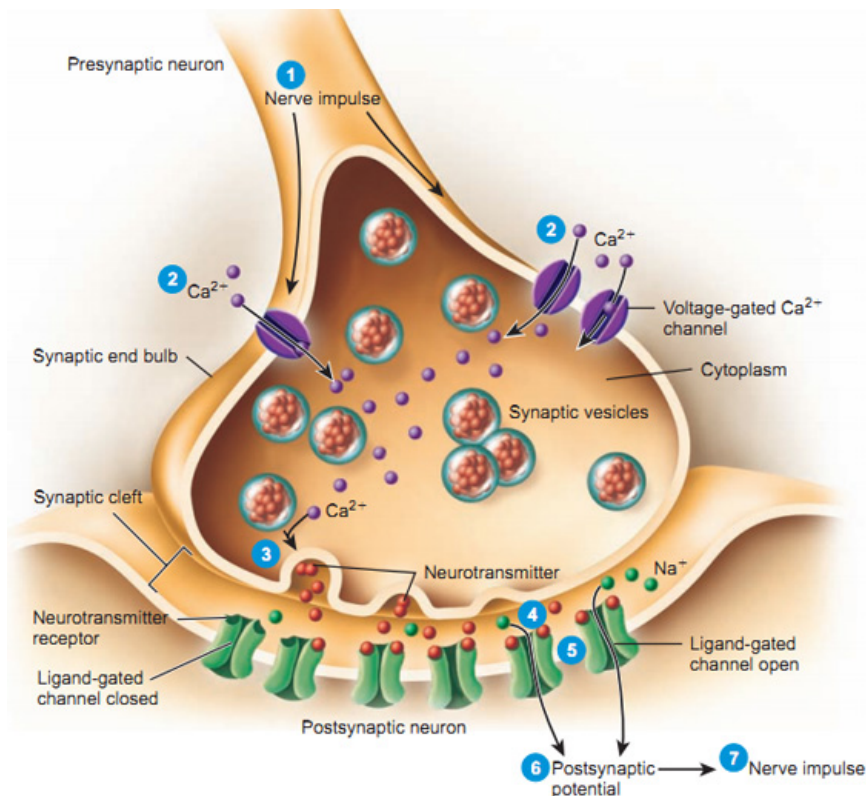
B

Figure 4. An example of a Learning Catalytics question delivered in class

## LECTURETTES

Online study materials will include five “lecturettes:” 20-minute dynamic lectures with associated imagery. The lecturettes cover physiological topics that we have observed to be some of the most challenging topics in the course. The lecturettes will accompany assigned chapter readings and provide students with a convenient, re-playable auditory and visual approach to these specific tough topics. Lecturettes are currently being recorded and integrated into online materials.

- 1) **Microscopic Physiology of Skeletal Muscles**  
(Excitation-Contraction Coupling and Sliding Filament Theory)
  - a. Neuromuscular Junction (\*example image shown\*)
  - b. Action potential movement along muscle fiber
  - c. Calcium ions and regulatory proteins
  - d. Action of myosin heads
  - e. Sarcomere contraction (Sliding filament theory)

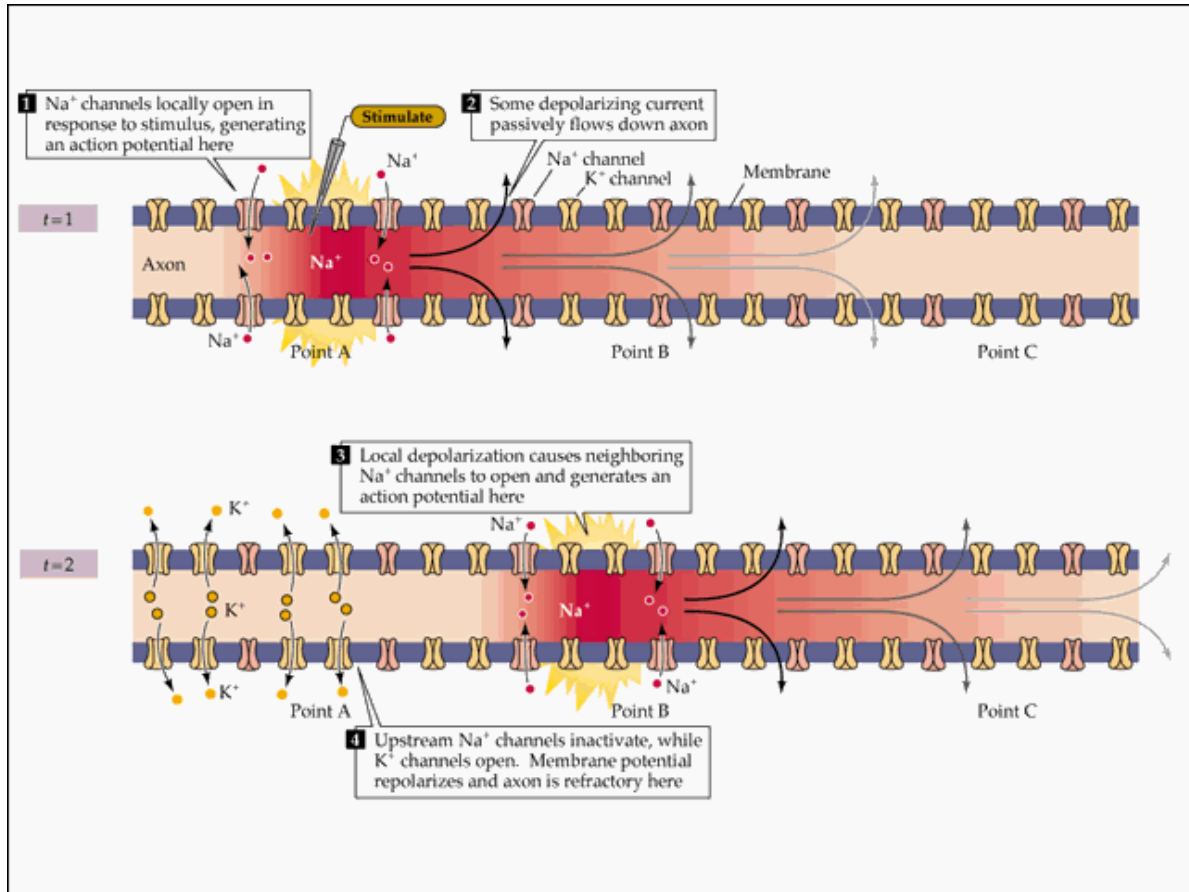


Approach: Lecturer uses powerpoint slides of images and animations to demonstrate concepts, all of which will also be accessible to students online as supplementary material.

Success in mastering this conceptual material requires prerequisite understanding of general cell structure and function and of microscopic anatomical terminology of skeletal muscles.

## 2) The Action Potential

- Neurotransmitter binding leads to graded potentials (Ligand-gated ion channels)
- Action potential formation at axon hillock (Voltage-gated  $\text{Na}^+$  channels)
- Phases of an Action Potential
- Propagation of an Action Potential along an axon (\*example image shown\*)

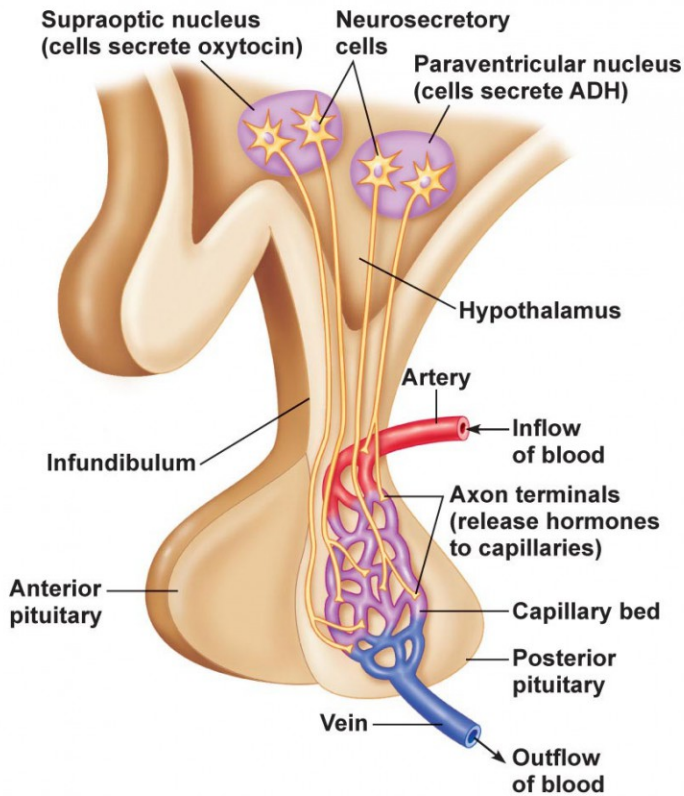


Approach: Lecturer uses powerpoint slides of images and animations to demonstrate concepts, all of which will also be accessible to students online as supplementary material.

Success in mastering this conceptual material requires prerequisite understanding of neuron structure and Resting Membrane Potential.

### 3) Hypothalamic/Pituitary Interaction

- a. Structural arrangement and Histology
- b. Stimulation of anterior pituitary and release of anterior pituitary hormones
- c. Endocrine axes of control (Thyroid, Adrenal, and Gonadal)
- d. Stimulation of posterior pituitary and release of posterior pituitary hormones  
(\*example image shown\*)



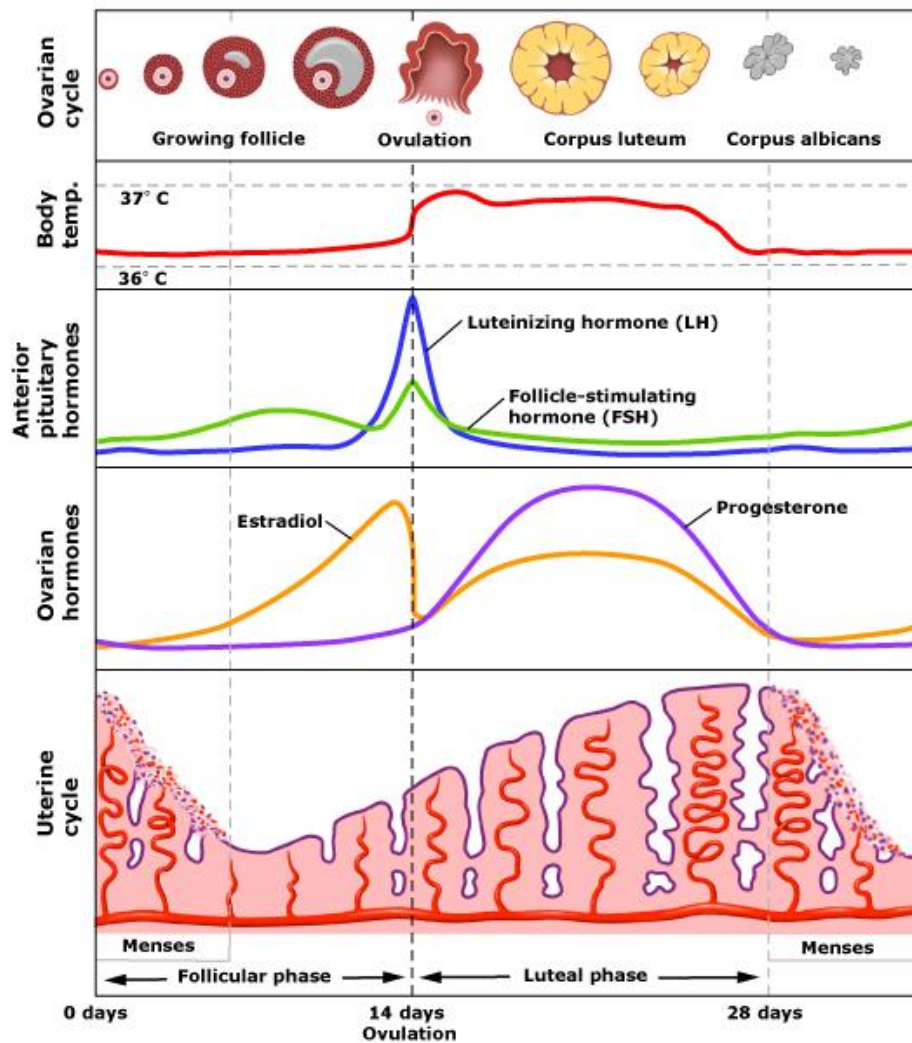
© 2011 Pearson Education, Inc.

Approach: Lecturer uses powerpoint slides of images to demonstrate concepts.  
Success in mastering this conceptual material requires prerequisite understanding of basic endocrine concepts and understanding of neuron structure and function.



#### 4) Female Reproductive Physiology

- a. Menstrual Phase (early follicular phase)
- b. Proliferative Phase (late follicular phase)
- c. Ovulation
- d. Luteal Phase (Secretory phase)
- e. Fertilization and Implantation

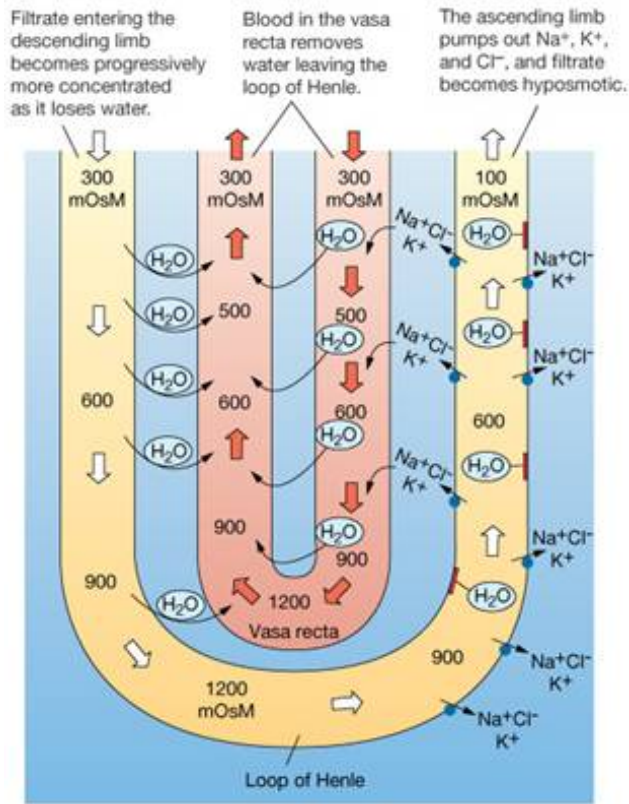


Approach: Lecturer will follow a timeline (via powerpoint slides) including events relating to gonadotropic hormones (LH/FSH), sex hormones (estrogens, progesterone), follicular cells and oocyte development, and changes in endometrium. The slideshow will end with a full complex 'calendar' of phases and events (\*example image shown\*)

Success in mastering this conceptual material requires prerequisite understanding of endocrine anatomy and physiology and understanding of female reproductive anatomy.

## 5) Nephron Physiology

- Glomerulus  $\leftrightarrow$  Glomerular capsule
- Proximal convoluted tubule  $\leftrightarrow$  peritubular capillaries
- Loop of Henle  $\leftrightarrow$  Vasa recta (\*example image shown\*)
- Distal convoluted tubule  $\leftrightarrow$  peritubular capillaries
- Collecting duct



Approach: Lecturer follows filtrate through the anatomical structures of the nephron (via powerpoint slides), discussing the processes of filtration, reabsorption, and secretion and the specific molecules that move into and out of filtrate during that process. There will be specific focus on the countercurrent multiplier. The slideshow will end with a detailed image of the nephron and associated vasculature with processes drawn in.

Success in mastering this conceptual material requires a prerequisite understanding of general urinary system anatomy, understanding of hormones effecting renal function and understanding of osmolarity, active transport, and diffusion.

## CASE STUDIES:

Approach: Students will be required to read a case packet of information pertaining to the A&P topic currently being discussed. This packet will be posted for them to read before attending class and students are encouraged to look over the case and jot down any notes they may have regarding what is being examined. These cases will be delivered both in the laboratory and within the classroom. Traditional “sage on stage” lecturing will be avoided in discussing these cases and instead group work, open-ended questions, and discontinuous delivery of questioning will be utilized.

Success through using this high-impact teaching technique will require students to come to the class prepared to utilize their lower level critical thinking skills, covered online through homework and exams or clarified through lecturettes, such as knowledge and comprehension, and begin to practice honing their higher level critical thinking skills such as analysis, application, and synthesis.

### Example of lab-based case study:

## *Whose bones are these?* Inquiry-based Laboratory Case Study

### Objectives

By the end of the case study students should feel confident in their ability to...

- Identify different bones and their function.
- Identify the surface features of bones and their function.
- Understand, compare and contrast bone development and identify developmental features on specific bones.
- Apply knowledge gained in lecture and in readings on bone anatomy & physiology.
- Synthesize and integrate information on bone anatomy and physiology to apply the knowledge the student has gained (in lecture and in their readings) to a real world scenario.
- Understand the environmental (biotic and abiotic) and pathological factors influencing bone anatomy and physiology.

### Case Study

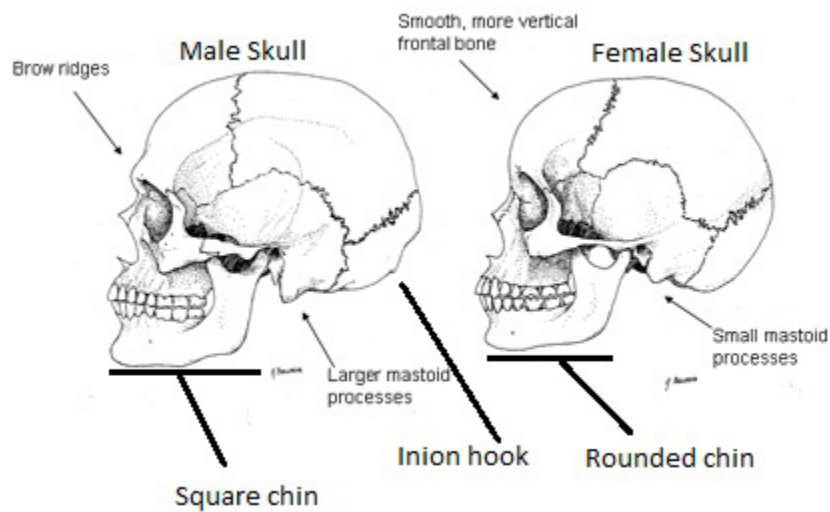
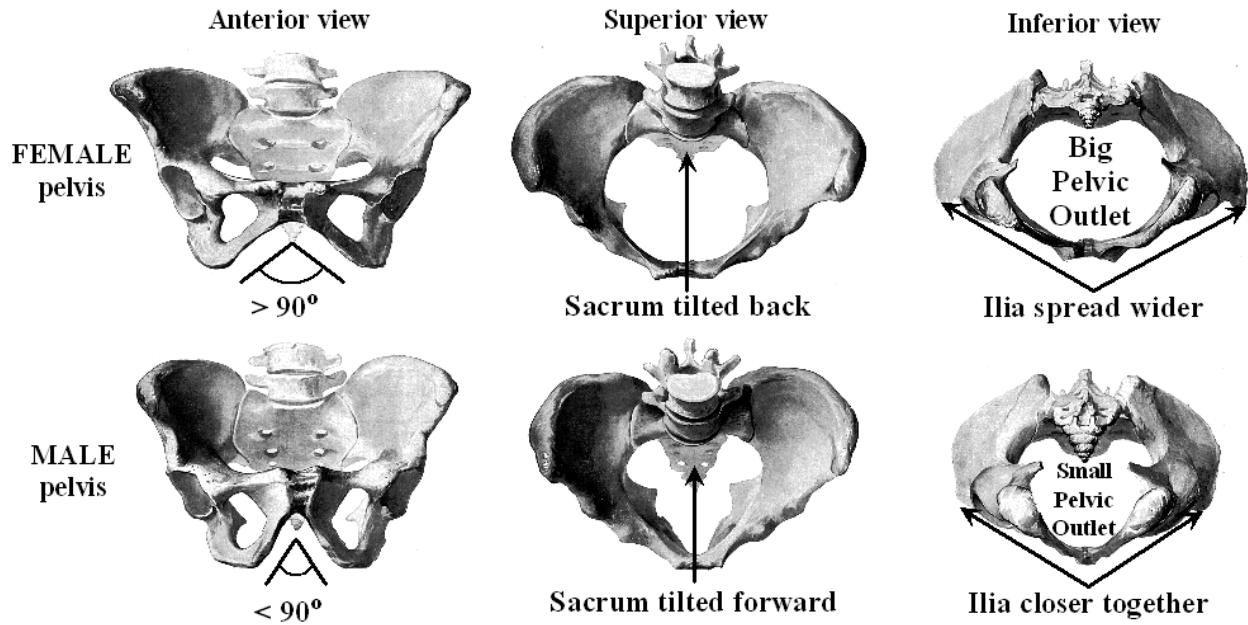
Rashida Johnson, a 20-year-old African American college student, disappeared from campus 2 years ago. She left her dorm room to head out for a run and never returned. The case has remained open with Rashida’s status as that of a “missing person”...until now. A former suspect has just come clean, giving a statement describing the murder of Ms. Johnson by poisoning and the discarding of her body into an ancient ossuary<sup>1</sup> to hide her remains. You and a forensic scientist show up at the ossuary to identify the remains and bring the case of Rashida Johnson’s disappearance to a close. By comparing only the skeletal remains of various bodies located in the ossuary, you must identify which remains are Rashida’s in order to close the case and convict the suspect. You will examine the bones and their surface features for hints of who the remains might belong to...or not belong to.

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<sup>1</sup> An **ossuary** is a chest, building, well, or site made to serve as the final resting place of human skeletal remains. They are frequently used where burial space is scarce. A body is first buried in a temporary grave, then after some years the skeletal remains are removed and placed in an ossuary. The greatly reduced space taken up by an ossuary means that it is possible to store the remains of many more people in a single tomb than if the original coffins were left as is.

## Goals

- Students must identify which collection of bones belong to the victim *and why*.
- Students *must describe why* all the other collections of bones do *not* belong to the victim.
- Thus constructing a spreadsheet comparing and contrasting each collection will be helpful.



Example of a classroom-based case study:

## ***Escape from Planet Soma!***

### ***Mastering the physiological principals of neuronal signaling*** *(National Center for Case Study Teaching in Science)*

#### **Objectives**

Upon completion of the case, students will:

- Be able to apply their knowledge of basic neurophysiology principles to predict the potential effects of altering sodium and potassium ion channel function on neuronal excitability.
- Be able to predict the symptoms produced by alteration of neuron excitability in various regions or parts of the peripheral and central nervous systems.
- Gain an appreciation for the role of ion channel function in a variety of diseases and pathological conditions.

#### **Case Study**

After a valiant but doomed battle in the distant Purkinje Galaxy, you are captured by the Glialiens, the most evil beings in all of the Cerebral Hemisphere. They imprison you in their outpost on the desolate planet Soma, from which no one has ever been known to escape.

Chief Oligodendrog eyes you with glee. “Well, well, if it isn’t the intrepid \_\_\_\_\_ (make up a name for your space alter ego). I’ve heard of your daring deeds, and I must say your bravado impresses even me. However, bravado is nothing if your little earthling neurons can’t produce some obvious intelligence to go along with it. I’ve yet to meet an earthling who possesses both.”

You shrug nonchalantly. “There’s always a first time.”

The chief laughs. “Oh, you’ve got an attitude as well!” His yellow eyes gleam as he leans closer. “Would you care to prove the extent of your intelligence?”

You warily eye his neuron incapacitator gun. “Sure, if it’s a fair test. And if I pass, you have to release me.”

Oligodendrog considers for a moment. “Very well. Let me explain the test. When prisoners try to escape, we use a variety of methods based on neurophysiology principles to, uh, *discourage* them from trying again. My assistant will select several methods at random and you must predict the terrible effects produced when that method is used. Predict correctly and you earn your release. Predict incorrectly and you experience the effects firsthand.” He smiles and clicks his clawed toes on the floor.

Fervently hoping you remember something from those dreaded neurophysiology lectures in A&P, you agree.

“Excellent!” Chief Oligodendrog grins. “Here’s the first method.” He barks into a small radio

and a small Glialien enters with an enormous syringe. Oligodendrog explains that it contains a mutant gene for a voltage-gated sodium channel in nociceptive neurons; injection of the gene will produce channels that are non-functional, with disastrous consequences. He then hands you the card below. “Kindly transcribe your answers so there is no dispute about what you said.”

*Question Set 1: How will the non-functional sodium channels affect the signaling capabilities of a neuron? What type of information do nociceptive neurons carry? Why would having this mutant gene be so terrible?*

Oligodendrog peruses your hastily scribbled answers. “Not bad, earthling. But that was only one technique out of many.” The small alien enters again, this time with a flask of fluorescent orange fluid. “This is one of my favorites. We’ve engineered a synthetic toxin that destroys the myelin covering your optic nerves and motor neurons. Care to have a sip of our special orange juice? It’s really quite tasty.” He hands you another card and swirls the oily fluid.

*Question Set 2: What effect will the destruction of myelin have on the signaling capability of a neuron? Explain why this occurs. What will happen to you if you are forced to drink the alien “orange juice”?*

Oligodendrog narrows his eyes after reading this card, and calls for his assistant again. “Well, well, you’ve got a few neurons firing in that earthling head of yours. But we’re not finished yet.” His assistant enters, holding some sort of arrow with a sticky residue covering the tip. “Sometimes we use a method borrowed from earthlings and prick uncooperative prisoners with an arrow covered in batrachotoxin from a poison-dart frog. This toxin causes voltage-gated sodium channels to open at a more negative membrane potential and also prevents their inactivation. An amount equivalent to a grain of salt will have nasty effects on your motor neurons.”

You smile as you take the card. This one should be a piece of cake.

*Question Set 3: How will the signaling of a neuron be affected if the voltage-gated sodium channels open at a more negative membrane potential?*

*How will preventing the inactivation of sodium channels affect the signaling capability of a neuron?*

*What nasty effects will this toxin have on motor pathways?*

A low growl rises from deep within Oligodendrog. “You think you’ll get them all correct? Don’t be so smug.” This time, the assistant brings in a cage containing an enormous black mamba snake. Oligodendrog rattles the cage, which makes the snake open its inky black mouth and hiss angrily. “We’ve purified dendrotoxin K from the venom, and injecting it will block your voltage-gated potassium channels in no time. That will wipe the smile right off your face....or maybe it won’t.” He laughs and presents yet another card.

You read the questions and smile broadly at Oligodendrog.

*Question Set 4: What effect will the dendrotoxin have on the signaling capability of a neuron? What will happen to you if your motor neurons are exposed to this toxin?*

Once again, the instruction from your fabulous A&P professor pays off. Oligodendroglia roars in frustration and summons his assistant. He enters with a hose and mask attached to a silver canister. "Here we go. How about a little puff of general anesthetic like sevoflurane? It will open more potassium channels in neurons of the reticular formation in the brainstem, and you won't know what hit you. Oh, but be careful...it's not those voltage-gated potassium channels that are affected."

You gulp. *Other potassium channels besides the voltage-gated?? Uhhhhhh...*

*Question Set 5: To what other type of potassium channel is Oligodendroglia referring?*

*What effect will opening more of these channels have on the excitability of a neuron?*

*What will happen to you when sevoflurane reaches the reticular formation neurons that control sleep and consciousness?*

Beads of sweat dot your brow as you return the card. Oligodendroglia notices. "Not so confident on this one, earthling?" However, his brow wrinkles as he reads your answer and crumples the card in disgust. "You got lucky with that one! I'll trip you up yet." He turns to his assistant and roars, "What's next?!"

It's yet another syringe. "OK, tell me what happens when we flood your brain tissue with potassium until extracellular potassium levels are ten times what they should be!" This time Oligodendroglia flings the card angrily in your direction.

A knot forms in your stomach...the questions are getting harder.

*Question Set 6: How will increasing extracellular potassium affect the signaling capability of a neuron? What type of cell normally regulates levels of extracellular potassium in the CNS? What "terror" will this method produce if injected into your brain tissue?*

The answers come to you at the last second, and instead of becoming angry, Oligodendroglia appears almost resigned.

You sense an opportune moment and venture an offer. "Suppose we do one more method, any method of your choice. If I answer it incorrectly, I am your prisoner for the remainder of my days. But if I respond correctly, I earn my freedom and YOU suffer the treatment."

Oligodendroglia considers for a moment, then grins slyly. "I'll accept your challenge. Prepare to make yourself comfortable here on Planet Soma." He leaves the room for a moment and returns with a small vial and a syringe. "This is something entirely new, that no one else in the hemisphere has ever heard of. We've been working on it for months and it looks like you'll be the first earthling to test it!"

Your heart drops to your stomach. You've remembered your A&P material pretty well so far, but something completely new? Perhaps you've overestimated...

Oligodendroglia interrupts your thoughts. "Some types of epilepsy are caused by a genetic mutation that produces a voltage-gated sodium channel with a faster recovery from inactivation. You could probably tell me that this would increase the excitability or firing rate of the neuron and lead to seizure activity in the brain. However, we've created a sodium channel with a different mutation. It alters the voltage sensitivity of the sodium channel so that it only opens at more positive membrane potentials. Amazingly, it also leads to seizures, but we're not sure how. Since you seem to have such a thorough grasp of neurophysiology, perhaps you will enlighten us."

Oligodendroglia hands you the final card. You both stare at the vial and wonder who will be the recipient of its contents.

*Question Set 7: How will the excitability of a neuron be affected by sodium channels that open at more positive membrane potentials?*

*How does this lead to seizure activity in the brain?*

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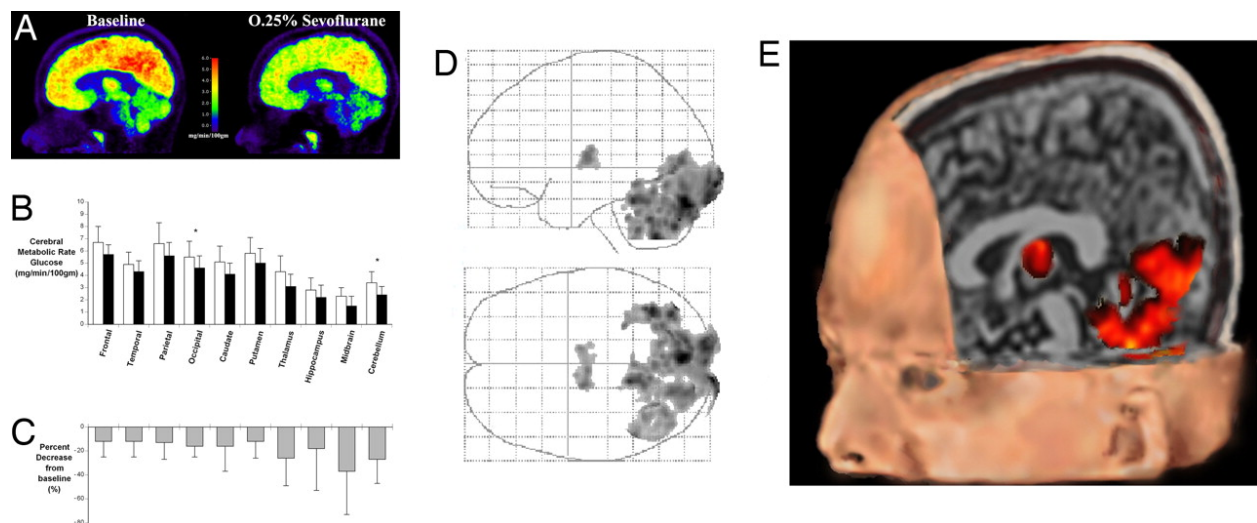


Figure source: <http://mindblog.dericbownds.net/2008/02/watching-anesthetic-block-emotional.html>



**ASSESSMENT:****RTOP Technique:**

The following set of 25 questions is the basis of the Reformed Teaching Observation Protocol (RTOP) (see figure below). We are using this tool in a novel way by allowing the students to respond to these questions based on their overall experience in the course. Based on the responses, we will be able to ascertain if the alternative hybrid course delivery achieves a greater level of high-impact learning techniques when compared to traditional course delivery.

1. The instructional strategies and activities respected students' prior knowledge and the preconceptions inherent therein.
2. The course was designed to engage students as members of a learning community.
3. In this course, student exploration preceded formal presentation.
4. This course encouraged students to seek and value alternative modes of investigation or of problem solving.
5. The focus and direction of the course was often determined by ideas originating with students.
6. The course involved fundamental concepts of the subject.
7. The course promoted strongly coherent conceptual understanding.
8. The teacher had a solid grasp of the subject matter content inherent in the course.
9. Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so.
10. Connections with other content disciplines and/or real world phenomena were explored and valued.
11. Students used a variety of means (models, drawings, graphs, concrete materials, manipulatives, etc.) to represent phenomena.
12. Students made predictions, estimations and/or hypotheses and devised means for testing them.
13. Students were actively engaged in thought-provoking activity that often involved the critical assessment of procedures.
14. Students were reflective about their learning.
15. Intellectual rigor, constructive criticism, and the challenging of ideas were valued.
16. Students were involved in the communication of their ideas to others using a variety of means and media.
17. The teacher's questions triggered divergent modes of thinking.
18. There was a high proportion of student talk and a significant amount of it occurred between and among students.
19. Student questions and comments often determined the focus and direction of classroom discourse.
20. There was a climate of respect for what others had to say.
21. Active participation of students was encouraged and valued.
22. Students were encouraged to generate conjectures, alternative solution strategies, and ways of interpreting evidence.
23. In general the teacher was patient with students.
24. The teacher acted as a resource person, working to support and enhance student investigations.
25. The metaphor "teacher as listener" was very characteristic of this classroom.

**BBT Technique:**

In order to assess the level of critical thinking achieved, we are utilizing the Blooming Biology Tool (BBT) (Crowe, *et al.* 2008). This tool allows us to code each homework, Learning Catalytics & exam question by level of critical thinking being assessed, which will in turn allow us to see if those students in our alternative hybrid delivery course do better or worse than a traditional course. Our prediction is that students in the hybrid course will be required to do online homework assignments which stress knowledge and comprehension while case studies and lecturettes will strengthen upper level critical thinking skills such as analysis, application and synthesis. BBT coding has been successfully used and implemented in course design at the University of Washington to better align their undergraduate core biology courses with the skills deemed necessary to enhance how their students master the material and prepare for post-baccalaureate training (Crowe, *et al.* 2008). Thus we will use the BBT coding both as a guide in constructing the material for the course (quiz, exam, and case study questions) as well as a tool to assess the students' mastery of each level of critical thinking.

Example BBT coded Question 1:

Hormones known as "catecholamines" are

- A) lipids.
- B) peptides.
- C) steroids.
- D) amino acid derivatives.
- E) derivatives of reproductive glands.

Answer: D

Bloom's Taxonomy: Knowledge (lowest level critical thinking achieved mainly by identification and recall)

Example BBT coded Question 2:

Norepinephrine and epinephrine are considered to be \_\_\_\_\_ when released into the bloodstream, but \_\_\_\_\_ when released at synapses.

- A) hormones; neurotransmitters
- B) neuropeptides; neurotransmitters
- C) neurotransmitters; hormones
- D) neurotransmitters; neuropeptides
- E) neuropeptides; neurohormones

Answer: A

Bloom's Taxonomy: Comprehension (lower level critical thinking skill achieved mainly by identification and recall of not only definition by function)

Example BBT coded Question 3:

After brain surgery, a patient receiving postoperative care in an intensive care unit began to pass large volumes of very dilute urine. The ICU nurse administered a medicine that mimics one of the following hormones. Which one?

- A) aldosterone
- B) epinephrine
- C) renin
- D) ADH
- E) cortisol

Answer: D

Bloom's Taxonomy: Application (mid level critical thinking skill achieved mainly by applying knowledge into a particular context)

Example BBT coded Question 4:

What does it mean to say that the pancreas is both an endocrine and an exocrine organ?

Answer: The pancreas contains both exocrine and endocrine cells. Cells of the endocrine pancreas form clusters called *pancreatic islets (islets of Langerhans)* and the exocrine cells cluster in structures called *pancreatic acini*. The endocrine cells secrete at their basal surfaces into the interstitial space, exactly opposite to the exocrine gland cells, which secrete fluid and digestive enzymes out of their apical surfaces into tiny ducts. The pancreatic islets secrete the hormones glucagon, insulin, somatostatin, and pancreatic polypeptide, which diffuse into nearby capillaries and then reach cells throughout the body via the circulation. The pancreatic exocrine secretions enter the intestine during digestion and play a key role in both protecting the epithelium and dissolving food particles into their constituent building blocks.

Bloom's Taxonomy: Analysis (mid to upper level critical thinking skill achieved by not only applying but analyzing a scenario in which a question is asked)

Example BBT coded Question 5:

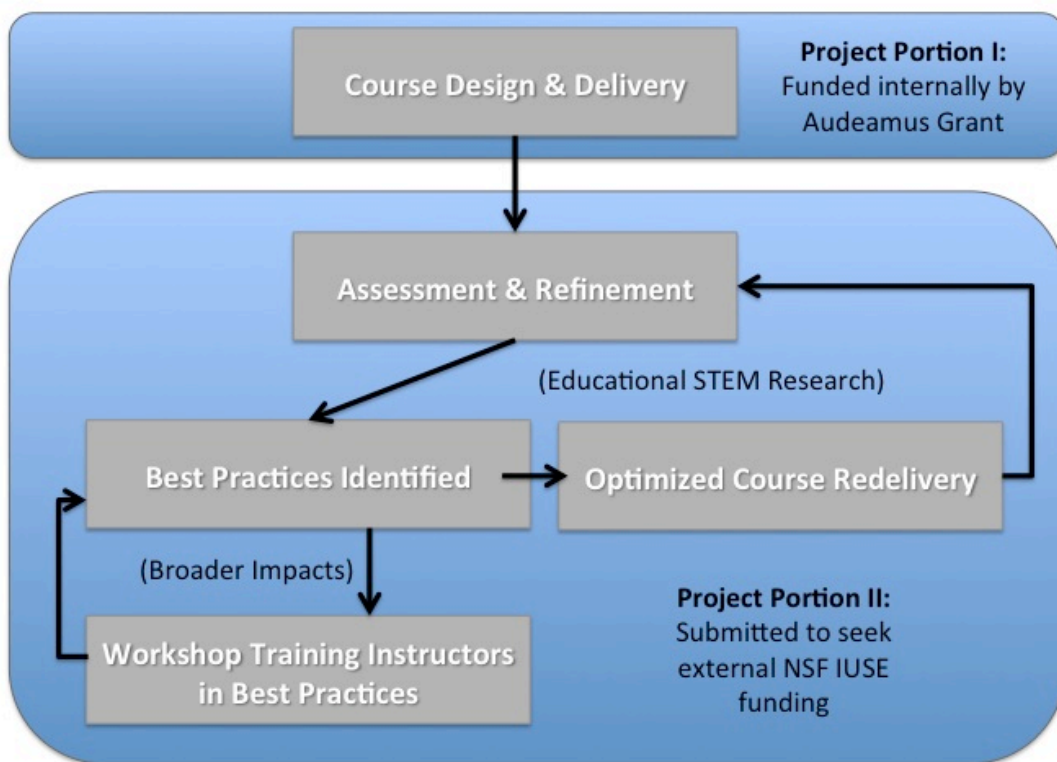
Jane lives in Appalachia and suffers from hypothyroidism. Her thyroid gland is enlarged, her body temperature is low, and her hair and skin look brittle and dry. Blood tests show very low levels of circulating iodine, T3, and T4, but high levels of TSH. What is your diagnosis? What treatment would you recommend?

Answer: Jane appears to suffer from nutritional goiter due to insufficient iodine intake. This explains the low thyroid levels, the enlarged thyroid, and the high level of TSH. The recommended treatment would be iodized salt or iodide supplements.

Bloom's Taxonomy: Synthesis (upper level critical thinking skill achieved by utilizing new knowledge, comprehension, application and analysis synthetically to comment on a particular scenario)

### STIMULUS GOALS (seeking external funding):

In order to meet the mission of the Audeamus Grant acting as a stimulus to apply for external funding, we were able to submit a full proposal to the National Science Foundation (NSF) Improving Undergraduate STEM Education (IUSE) program in order to apply for additional funds to assess and refine this new alternate course delivery (see figure below).



While we did not successfully garner NSF IUSE funding, we did receive helpful feedback and we do plan on resubmitting in the Spring 2015 after running the course this Fall 2014 and collecting preliminary data. Briefly NSF reviewers highlighted that we would need better statistical assessment to determine which methods (online homework, Learning Catalytics or case studies) produced which outcomes. Additionally, reviewer feedback also highlighted that we need to better focus the novelty of the hybrid course as a whole on fostering student success and retention rather than individual teaching methods...we need to do a better job “pitching” our main idea. We plan on partnering and/or utilizing the expertise in the RU Statistics Department to explore methods such as Principal Component Analysis (PCA) to elucidate the influence of each teaching method on student success. Additionally, the Co-PI Sara O’Brien will be attending an NSF grant writing workshop through RU SPGM in October 2014.