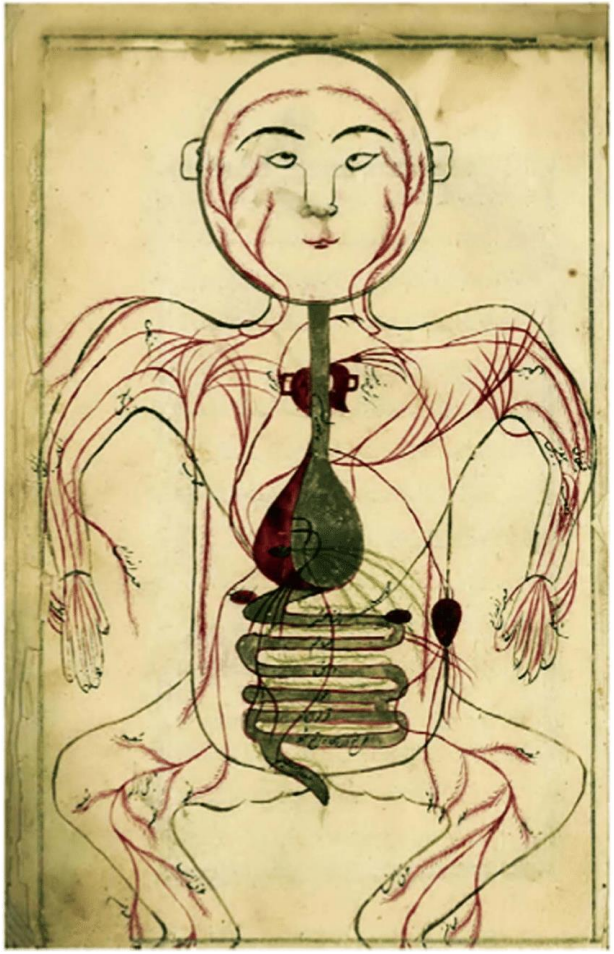
Autonomy pathways to compare active teaching methods in undergraduate Physiology classes

Faadiel Essop

Department of Physiological Sciences
Stellenbosch University

The discipline of Physiology

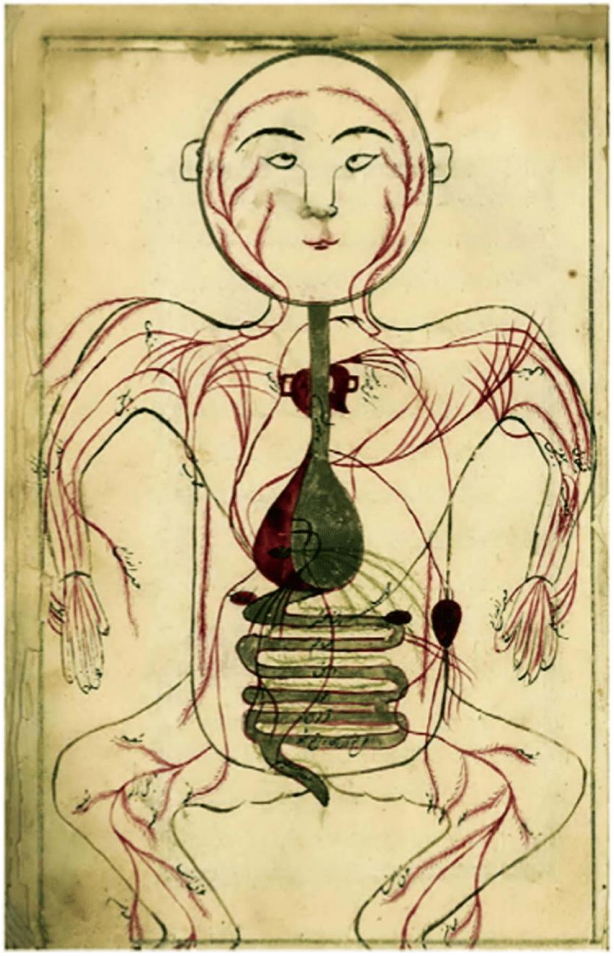


Mansur ibn Ilyas: 1394-1409 AD

‘’Physiology is the study of life, specifically, how cells, tissues, and organisms function. Physiologists are constantly trying to answer key questions in areas ranging from the functions of single cells to the interactions between human populations and our environment..’’.

aps® American Physiological Society

The discipline of Physiology



Mansur ibn Ilyas: 1394-1409 AD

Physiology is focused on:

a) the ‘’bigger’’ concepts such as ‘’homeostasis’’
b) integration and communication between various organ systems

Joyner 2011; Nobel 2018

Physiology T & L challenges - #1: the discipline

Physiology is ”hard” – some student surveys

”difficult to comprehend or explain”

”with a great deal of effort”

Factors making Physiology ”hard” for students to learn

- **Nature of the discipline**
- **Ways we teach**
- **What students bring**

Michael, Adv Physiol Educ 2007;31:34-40

Physiology T & L challenges - #1: the discipline

How We Learn

Adv Physiol Educ 31: 34–40, 2007;
doi:10.1152/advan.00057.2006.

What makes physiology hard for students to learn? Results of a faculty survey

- Requires the students to reason causally (mechanistically)
- Fail to appreciate integrative nature of physiological mechanisms
- Students compartmentalize (pigeon-hole) everything
- Students think learning = memorization of facts (content ⬆)
- Teachers talk too much and students talk too little (ranked #13 out of 17 factors)

11			No stress on commonalities of function across organ systems
12	214		Teachers expect too many memorized facts and too little understanding
13	211	15 (T)	Teachers talk too much and students talk too little
14	208	5 (D)	Encourages the tendency to teleological thinking
15	196	10 (T)	Poor job of defining and communicating learning performance objectives
16	189	12 (T)	Teachers and authors use language imprecisely
17	173	17 (S)	Students assume ALL physiological responses benefit organism

D, properties of domain; T, teaching; S, what students bring to class.

Physiology T & L challenges - #2: the ‘’transfer”

Worldviews of Baby Boomers (born: 1946-1964) & Gen X (born: 1965-1976)

Career = priority

Hard worker

Optimism

Loyalty to company

Optimism

Sacrifice family

Independent

Multi-tasking

Pragmatic

Self-sufficient

Hard worker

Skepticism

Baby Boomers

Gen X

Physiology T & L challenges - #2: the ‘’receivers’’
The world according to Gen Z (born: 1995-2000)

Less focused

Multi-taskers

Teamwork

Inadequacy

Instant gratification

Global generation

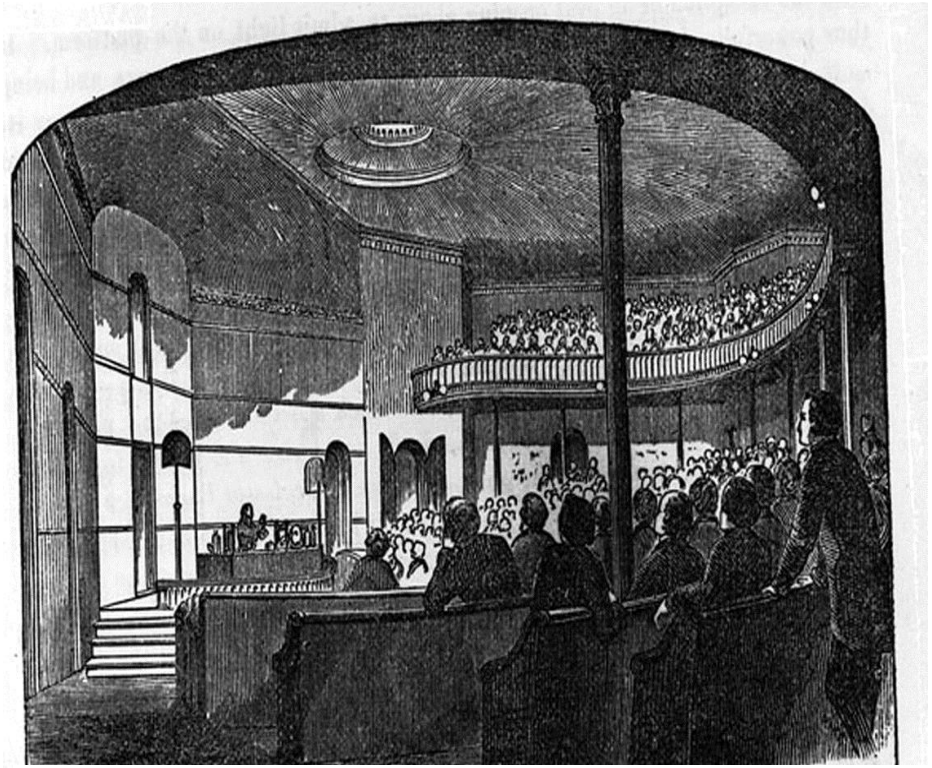
Relevance – individual, world

Entitlement

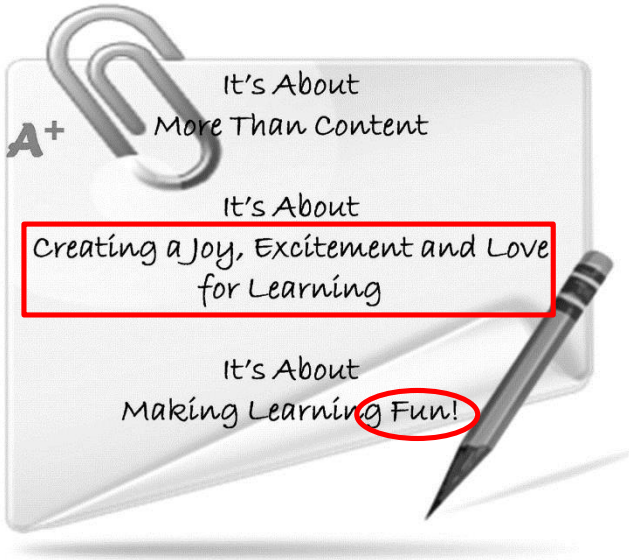
Aspire to change, globally

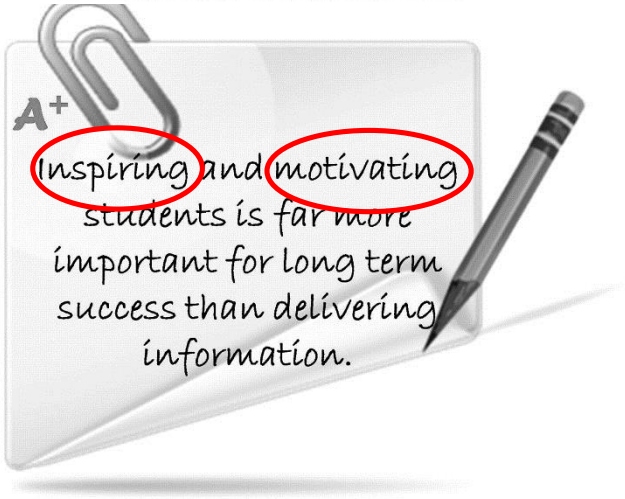
Authority: world = flat

Active learning strategies to begin to counter Physiology T & L challenges



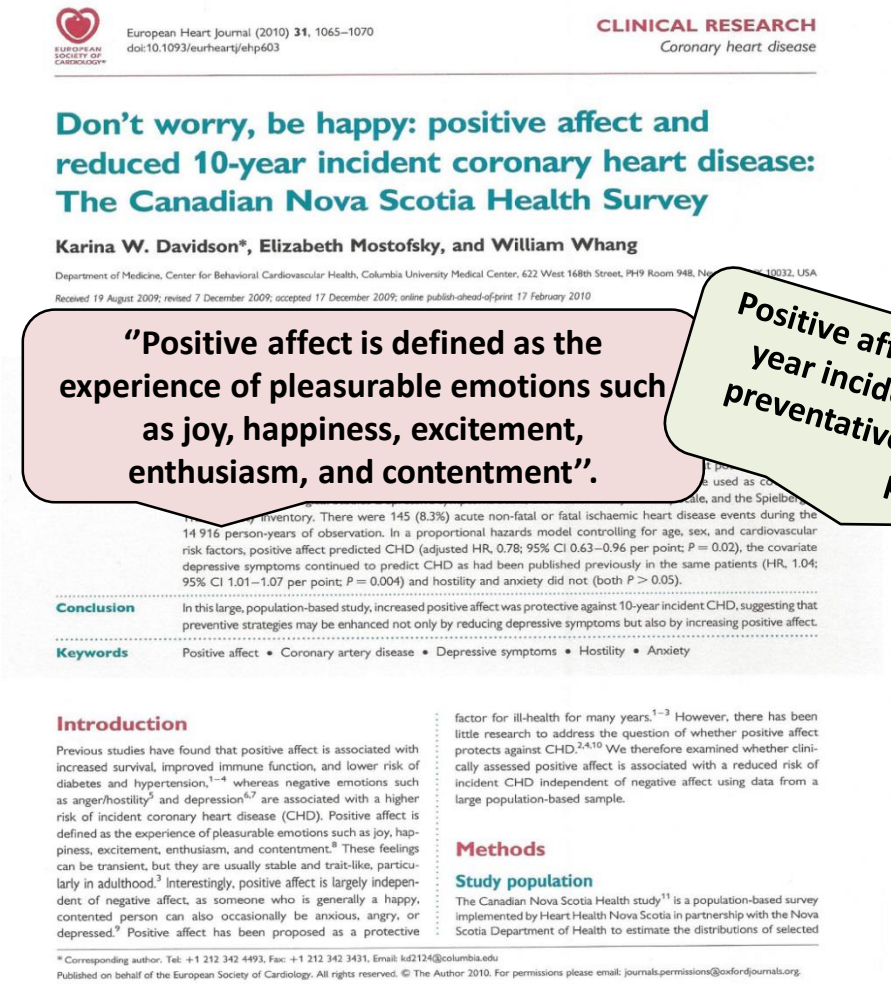
Smithsonian Institute lecture hall; 1859





DiCarlo, Adv Physiol Educ 2009;33:257-264

Essop's reflections: behavior & heart disease



European Heart Journal (2010) **31**, 1065–1070
doi:10.1093/eurheartj/ehp603

CLINICAL RESEARCH
Coronary heart disease

Don't worry, be happy: positive affect and reduced 10-year incident coronary heart disease: The Canadian Nova Scotia Health Survey

Karina W. Davidson*, Elizabeth Mostofsky, and William Whang

Department of Medicine, Center for Behavioral Cardiovascular Health, Columbia University Medical Center, 622 West 168th Street, PH9 Room 948, New York, NY 10032, USA

Received 19 August 2009; revised 7 December 2009; accepted 17 December 2009; online publish-ahead-of-print 17 February 2010

''Positive affect is defined as the experience of pleasurable emotions such as joy, happiness, excitement, enthusiasm, and contentment''.

Positive affect was protective against 10-year incident coronary heart disease; preventative strategies should increase positive affect.

...ale, and the Spielberger ... inventory. There were 145 (8.3%) acute non-fatal or fatal ischaemic heart disease events during the 14 916 person-years of observation. In a proportional hazards model controlling for age, sex, and cardiovascular risk factors, positive affect predicted CHD (adjusted HR, 0.78; 95% CI 0.63–0.96 per point; $P = 0.02$), the covariate depressive symptoms continued to predict CHD as had been published previously in the same patients (HR, 1.04; 95% CI 1.01–1.07 per point; $P = 0.004$) and hostility and anxiety did not (both $P > 0.05$).

Conclusion In this large, population-based study, increased positive affect was protective against 10-year incident CHD, suggesting that preventive strategies may be enhanced not only by reducing depressive symptoms but also by increasing positive affect.

Keywords Positive affect • Coronary artery disease • Depressive symptoms • Hostility • Anxiety

Introduction

Previous studies have found that positive affect is associated with increased survival, improved immune function, and lower risk of diabetes and hypertension,[1–4] whereas negative emotions such as anger/hostility[5] and depression[6,7] are associated with a higher risk of incident coronary heart disease (CHD). Positive affect is defined as the experience of pleasurable emotions such as joy, happiness, excitement, enthusiasm, and contentment.[8] These feelings can be transient, but they are usually stable and trait-like, particularly in adulthood.[3] Interestingly, positive affect is largely independent of negative affect, as someone who is generally a happy, contented person can also occasionally be anxious, angry, or depressed.[9] Positive affect has been proposed as a protective factor for ill-health for many years.[1–3] However, there has been little research to address the question of whether positive affect protects against CHD.[2,4,10] We therefore examined whether clinically assessed positive affect is associated with a reduced risk of incident CHD independent of negative affect using data from a large population-based sample.

Methods

Study population

The Canadian Nova Scotia Health study[11] is a population-based survey implemented by Heart Health Nova Scotia in partnership with the Nova Scotia Department of Health to estimate the distributions of selected

* Corresponding author. Tel: +1 212 342 4493, Fax: +1 212 342 3431, Email: kd2124@columbia.edu

Eur Heart J 2010; 31: 1065-1070

Active and student-centered learning in Physiology

Table 1. *The big ideas: a map between two big-picture categorizations of the important conceptual ideas our students should be learning*

Core Concepts of Physiology [Michael et al. (38)]
Evolution
Cell theory
Genes to proteins
Homeostasis
Interdependence
Levels of organization
Cell-cell communication
Cell membrane
Mass balance
Flow down gradients
Physics/chemistry
Energy
Structure/function

Goals to support student-centered learning

- Selectively reducing body of knowledge required
- Focusing on generalities that are transferable
- Providing foundational scaffolding for learning new content later

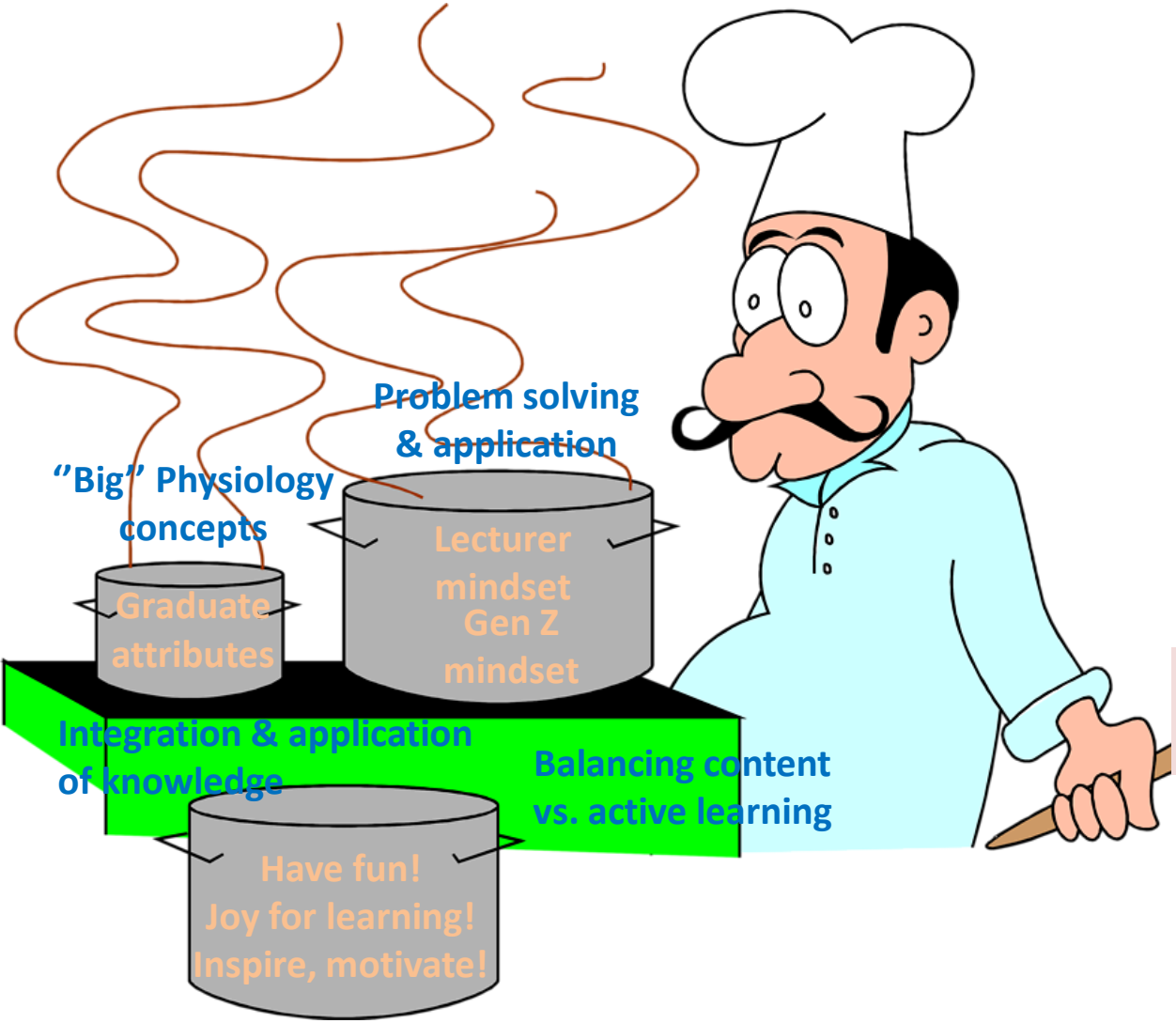
Goodman et al., Adv Physiol Educ 2018;42:417-423

Active and student-centered learning in Physiology

- **“students learn more … from courses that implement active approaches rather than traditional lecture”**
- **“meaningful learning … students can solve appropriate problems”**
- **“The instructor … is to help the student by creating environments in which learning is likely to occur.”**

Goodman et al., Adv Physiol Educ 2018;42:417-423

Introducing active learning strategies into Physiology classes: cooking up the perfect storm?



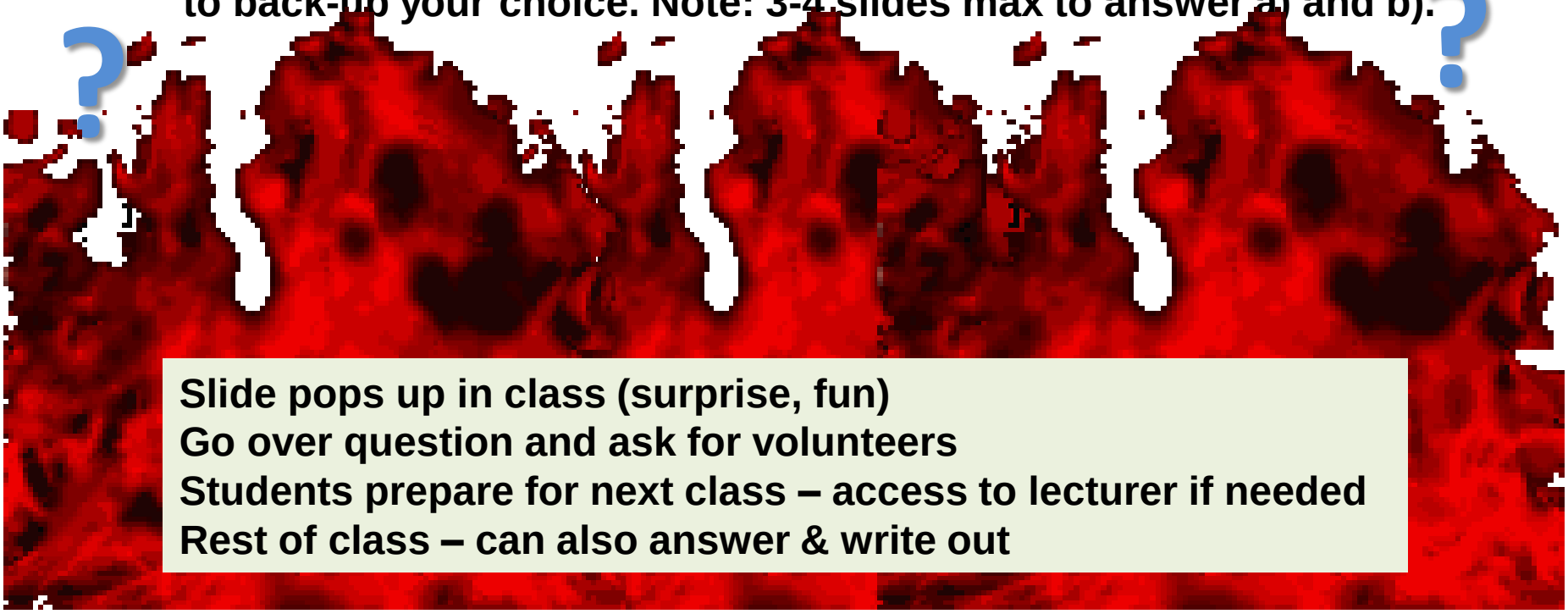
Class size: ~225 students
Nature of venue: not ideal

Active learning strategy #1: Burning Questions

An elderly South African lady (75 years old) fainted at the (crowded) airport while you are waiting for your flight (some delay). She has some medical information on a bracelet: heart rate irregular & high, hypertensive, coronary artery disease.

a) Based on what <u>discussed in our classes</u>, explain to bystanders what could be wrong with her (in terms of her heart & electrical system). Focus on normal & abnormal states.

b) What course of action(s) would you suggest – provide scientific reasons to back-up your choice. Note: 3-4 slides max to answer a) and b).



Slide pops up in class (surprise, fun)
Go over question and ask for volunteers
Students prepare for next class – access to lecturer if needed
Rest of class – can also answer & write out

Active learning strategy #1: Burning Questions

HWW Principle

How: e.g. how does this happen?
What: what causes it e.g. risk factors
Why: why is a certain response initiated; why is it important to know?
Ability to explain to laypersons

''Spine'' of Critical Reflexivity and Reflection for all lectures, tests/exams & post-assessment discussions

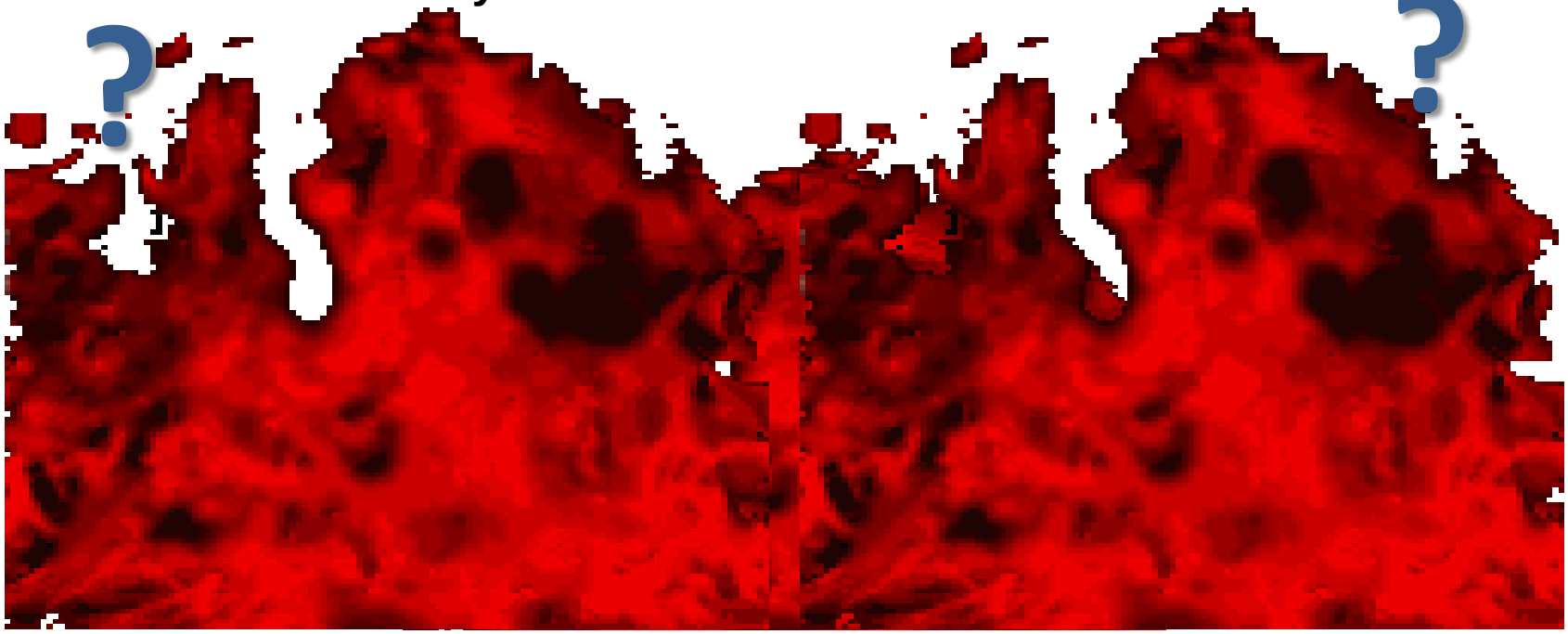
''..from this perspective, teaching focuses on enabling students to think more critically about themselves, their assumptions, actions, and situations they encounter'' (Ann Cunliffe p.411 [2004]).

Active learning strategy #1: Burning Questions

Burning question #2

Earlier this morning, your res room mate (art student) stumbled while getting up from her bed. You are not the prying type but have vaguely heard before that she has some ‘’blood pressure trouble’’ and also a diabetic (using ‘’water’’ pills). You also know that she spends prolonged times lying down whilst busy on Instagram and What’s app – literally hours at a time. Since you are a final year Physiology student, she requested you to explain why she felt dizzy and tumbled down (quite few times now).

Any advice how to deal with this?



Active learning strategy #1: Burning Questions - immediate feedback in same lecture

Atrial or ventricular fibrillation (arryhthmia)? – discuss normal pathway of electrical conductance in the heart (e.g. SA node, inter-atrial & inter-nodal pathways, Bundle of His, Purkinje fibers, AV node delay, normal ECG pattern, tachycardia).

Discuss atrial fibrillation – what happens (atria contract too fast, insufficient time for atria to contract properly, blood pooling, ectopic firing, AV node increased firing, ventricles increase contraction but cannot match atria, abnormal ECG) & why this could have happened (why in this individual?). She is old, hypertensive – impact on cardiac function in this case? Crowded airport, delayed flight = stress! Hypertension, coronary artery disease, stress – linked to atrial fibrillation. Familial/genetic?

Outcomes? Blood clots, stroke, edema, fainting due to insufficient oxygen delivery to the brain by the heart.

What can be done? CPR, defibrillator (if available), β-blockers, ECG, pacemaker.

Philosophy of answering questions: Spend time reading the question to determine what exactly is required. Good questions to pose to yourself: remember the HWW Principle -How? What? Why? Integration of information (think ''across slides'' or lectures). Invitation for assessment of next Burning Question(s).

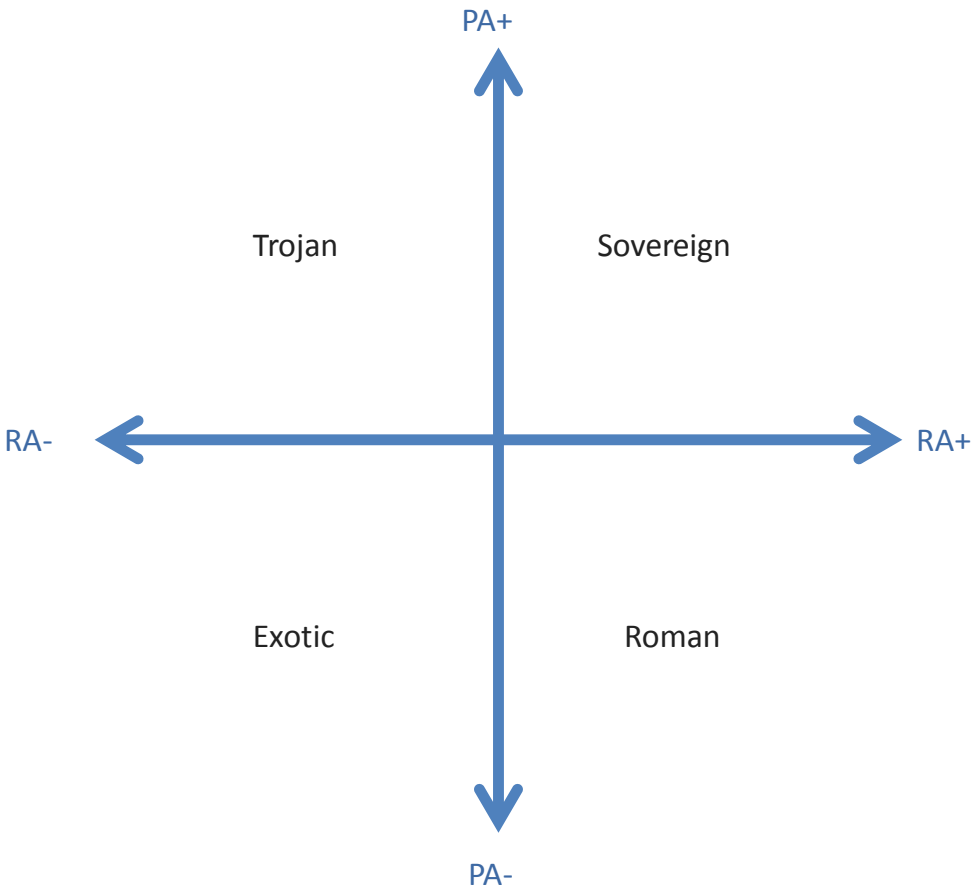
Legitimation code theory

Uncovering/making explicit knowledge practices or organizing the principles underlying them

Maton & Howard, 2018

Legitimation code theory

Uncovering/making explicit knowledge practices or organizing the principles underlying them



Positional Autonomy (PA):

Relations between positions (the things within it: actors, ideas, objects, theories, practices, ways of doing) within a context and positions from outside it.

Relational Autonomy (RA):

Relations between the principles (ways things are arranged, what they are for) from within the context and from elsewhere.

Maton & Howard, 2018

Positional autonomy

Refers to the *objects* included in the teaching

PA+
Teaching theories, objects, methods and/or concepts from inside the curriculum

PA-
Teaching theories, objects, methods and/or concepts from outside the curriculum

Relational autonomy

Refers to the *purpose* of the pedagogy/curriculum

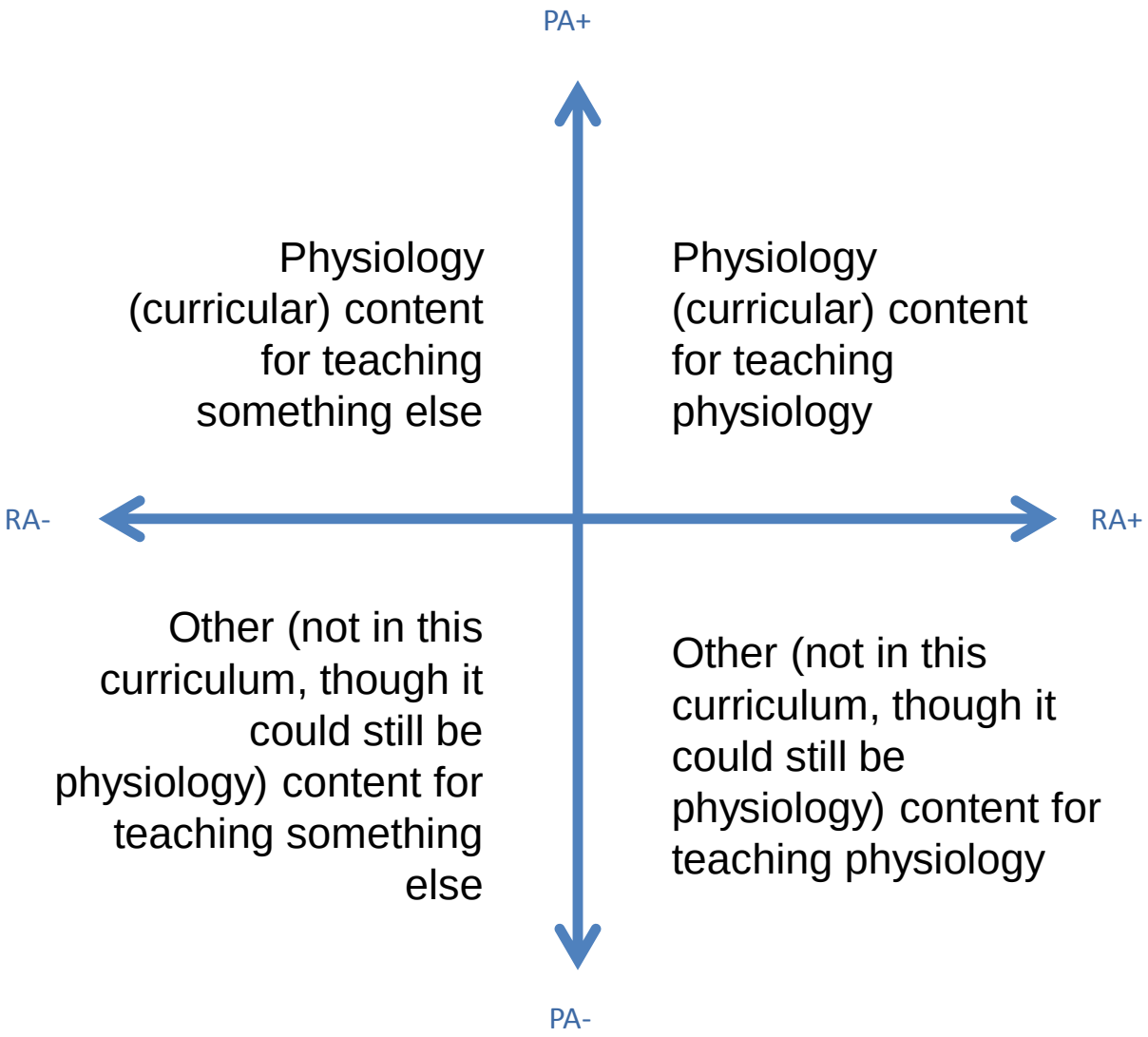
RA+

To learn Physiology

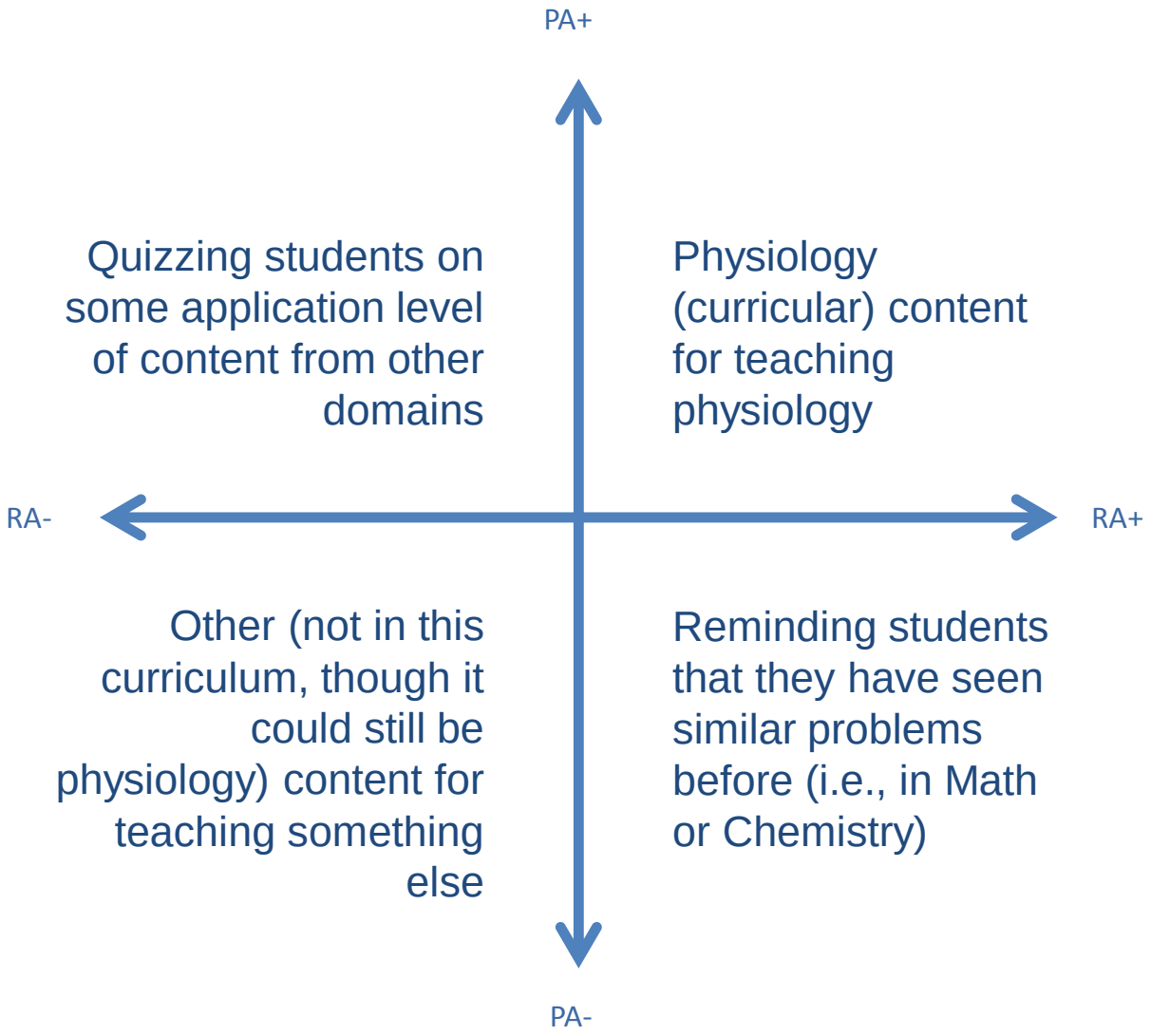
RA-

To learn something other than Physiology

Towards integration..

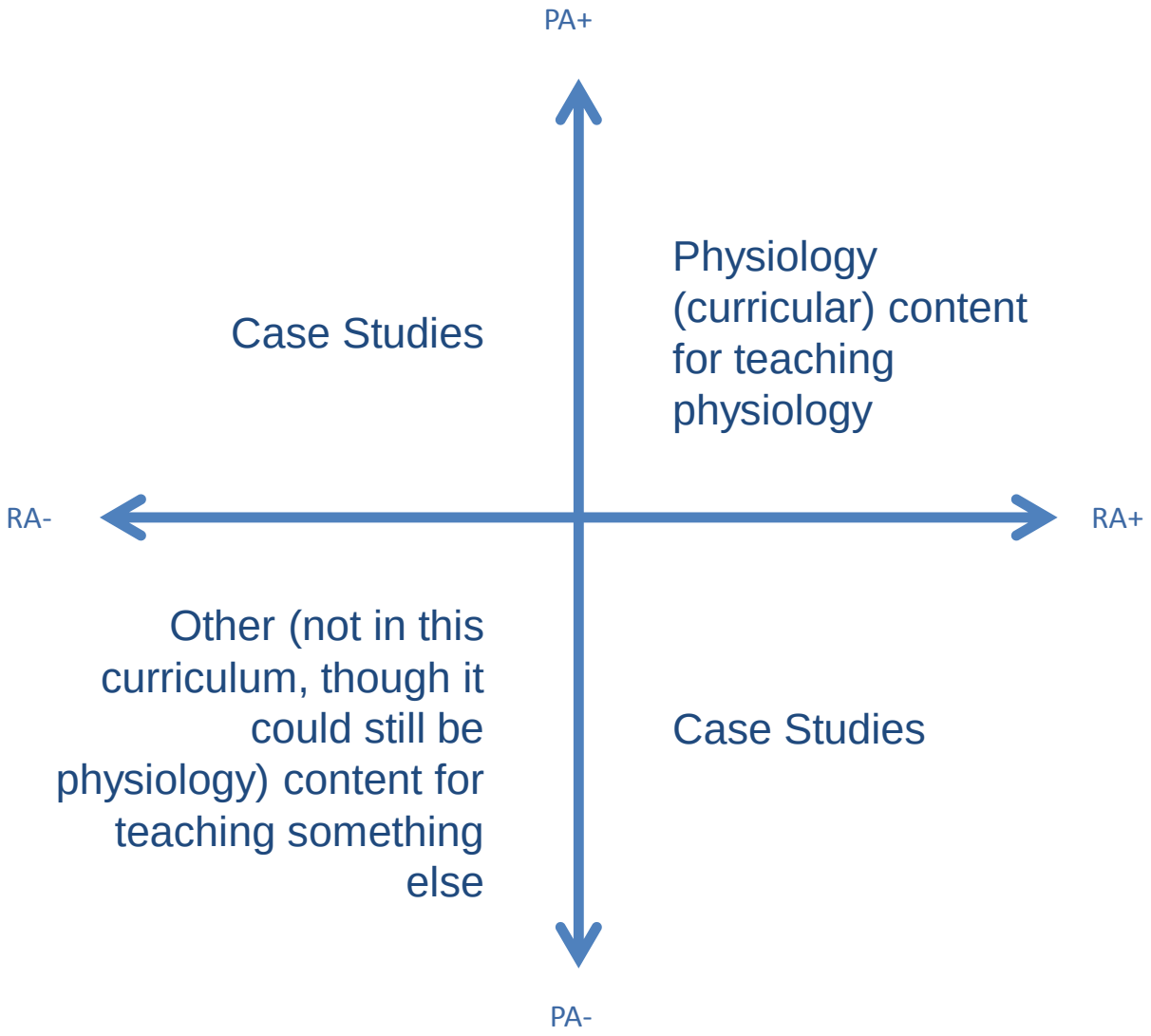


Best practices in Physiology teaching: the ideal



Goodman et al., Adv Physiol Educ 2018;42:417-423

Best practices in Physiology teaching: the ideal



Goodman et al., Adv Physiol Educ 2018;42:417-423

Legitimation code theory: translational device

Positional autonomy

3rd year Physiology curriculum at SU

-cardiovascular module content

-content from other Physiology modules

Legitimation code theory: translational device

Relational autonomy

Learning to integrate 3rd year Physiology topics to solve real-world problems

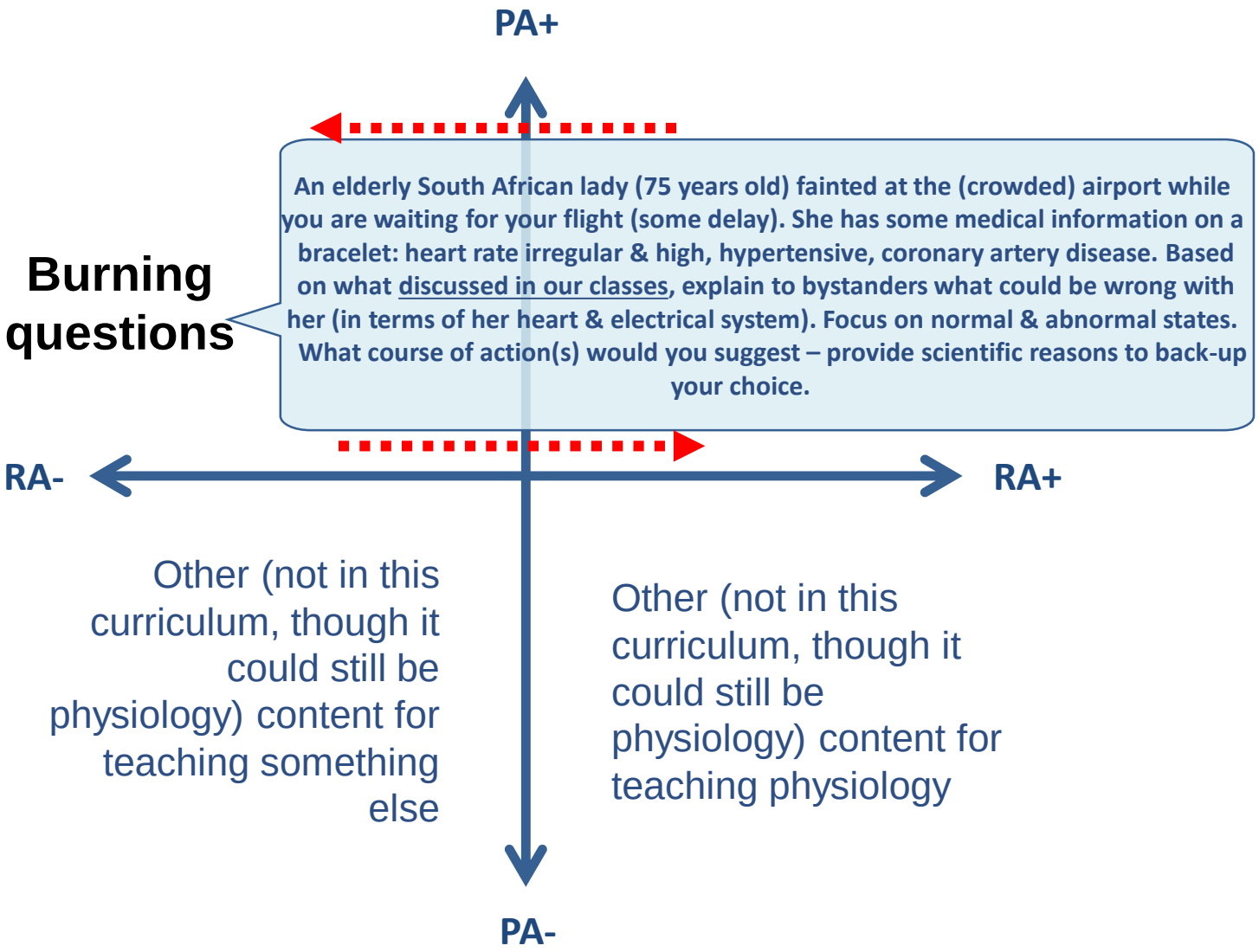
-integrate to solve real-world problems

-integrate to solve simplified problems

-principles of problem solving in Physiology

-principles of solving problems

Autonomy tours: integration & application



Burning Questions: some student feedback

- ‘’..good way of forcing oneself to read..”
- ‘’..forced me to do additional research..”
- ‘’The burning questions were a way for me to comprehend what is taught in class and apply it to real life examples”.
- ‘’It is not about parrot studying the theory but actually understanding it”.
- ‘’I also love the idea of *applying* the knowledge we learn in class”.
- ‘’The prospect of the research work to be completed excited me more than anything else”.
- ‘’Burning Questions activate your brain and forces you to look at the information given in class critically. Through this, you learn a lot more than sitting in a lecture for 50 minutes. It also...promotes integrative learning”.

Burning Questions: some student feedback

- ‘’In terms of the research methodology itself, I learnt that you need to try understand everything that you read in the article or in the lecture notes before moving on to research.”
- ‘’It required us as students to think about the topic critically, engage and to formulate one’s own ideas, as opposed to being given all of the information.”
- ‘’It taught me that everything I communicate has to be backed up by relevant and accurate knowledge.”
- ‘’This exercise made me realise that you must start by analyzing the question – what exactly is being asked.”
- ‘’It taught me that we have access to such an immense amount of information, that it is sometimes more difficult to figure out where to start, rather than actually formulating an answer.”

Active learning strategy #2: CSI-type problem

Eight-year-old Finnish girl on visit to Cape Town has gone missing while walking in Jonkershoek valley – 30 mins ago. Two Stellenbosch University Physiology friends are around and volunteer to assist to help find her..

Active learning strategy #2: CSI-type problem

Active learning strategy #2: CSI-type problem

What does a reading of 18.8 mean?? This may help us..

By the way, the Physiology 364 class will also assist us in our little adventure!

Hang on laddie, let me bring a little clarity to help in your quest..

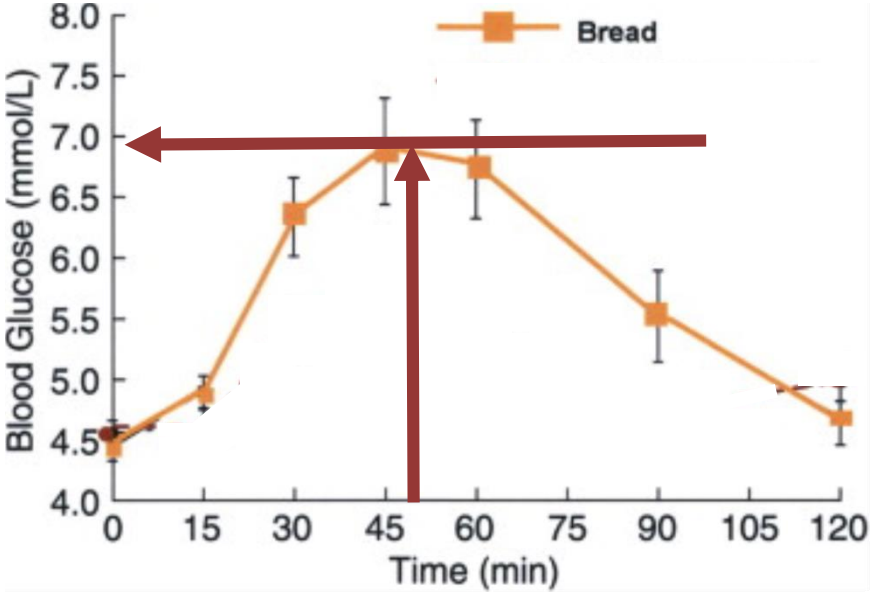
Prof

Active learning strategy #2: CSI-type problem

Dietary intake

Post-meal rise in circulating blood glucose levels

Postprandial glucose test – amount glucose in blood following a meal

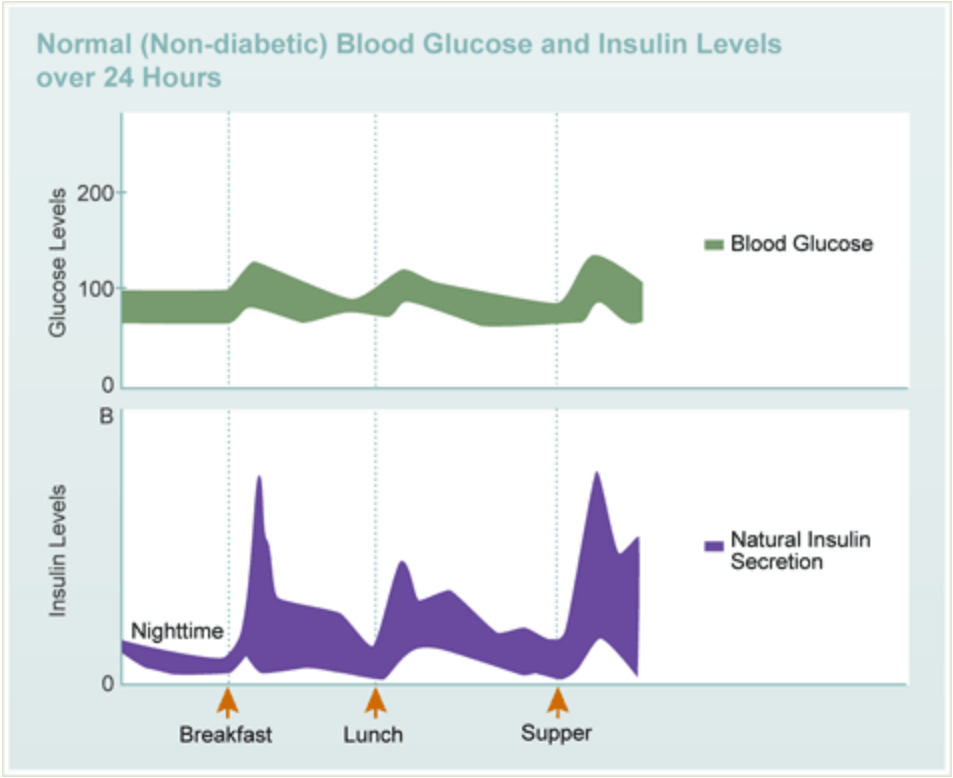


- **Magnitude & time of peak plasma glucose varies**
- **Non-diabetics usually peaks at 60 mins; rarely exceeds 7.7 mmol/L**
- **Returns to preprandial levels 2-3 hr**

JACC 2008; 51: 249-255

Active learning strategy #2: CSI-type problem

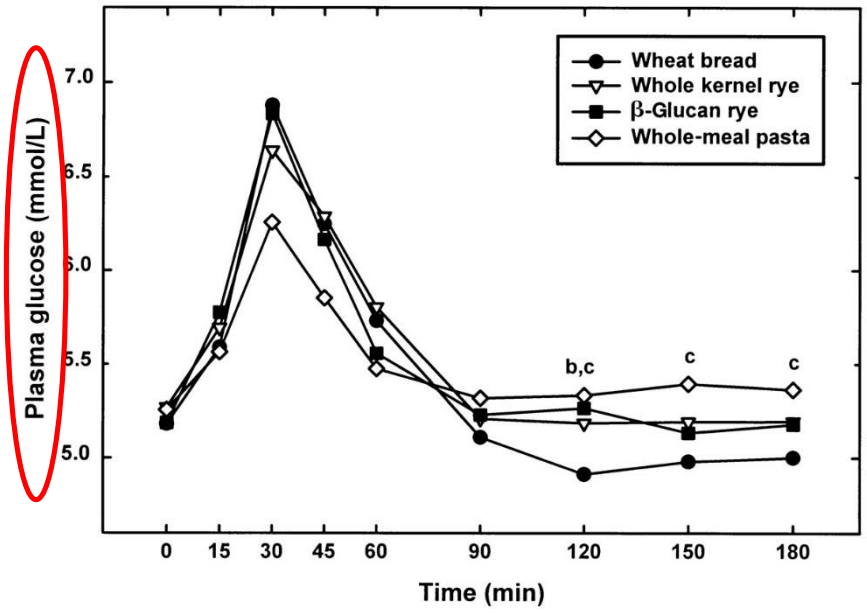
Active learning strategy #2: CSI-type problem

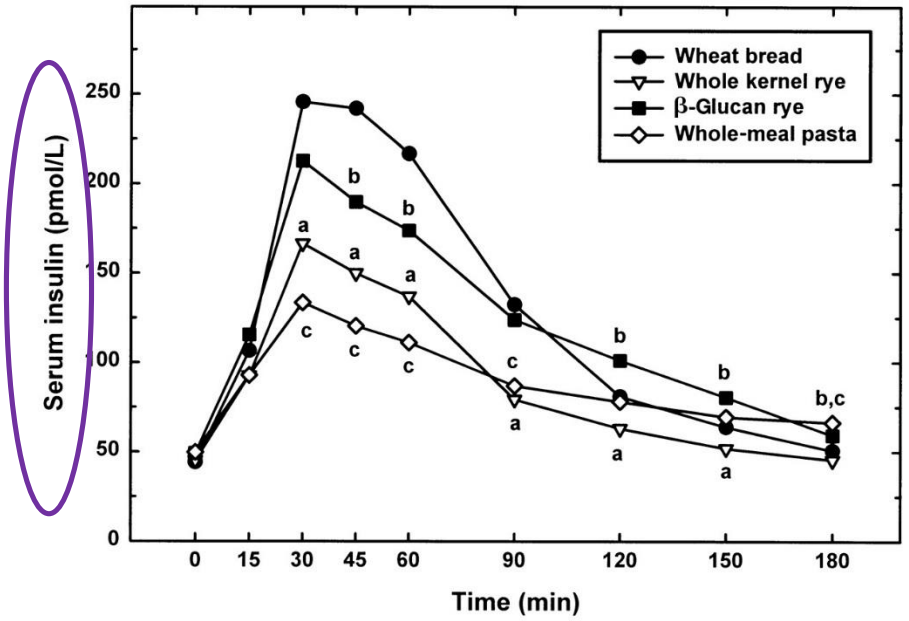


Diabetes Care 1997; 20(8): 1279-1286

Active learning strategy #2: CSI-type problem

Am J Clin Nutr 2002;75:254-262



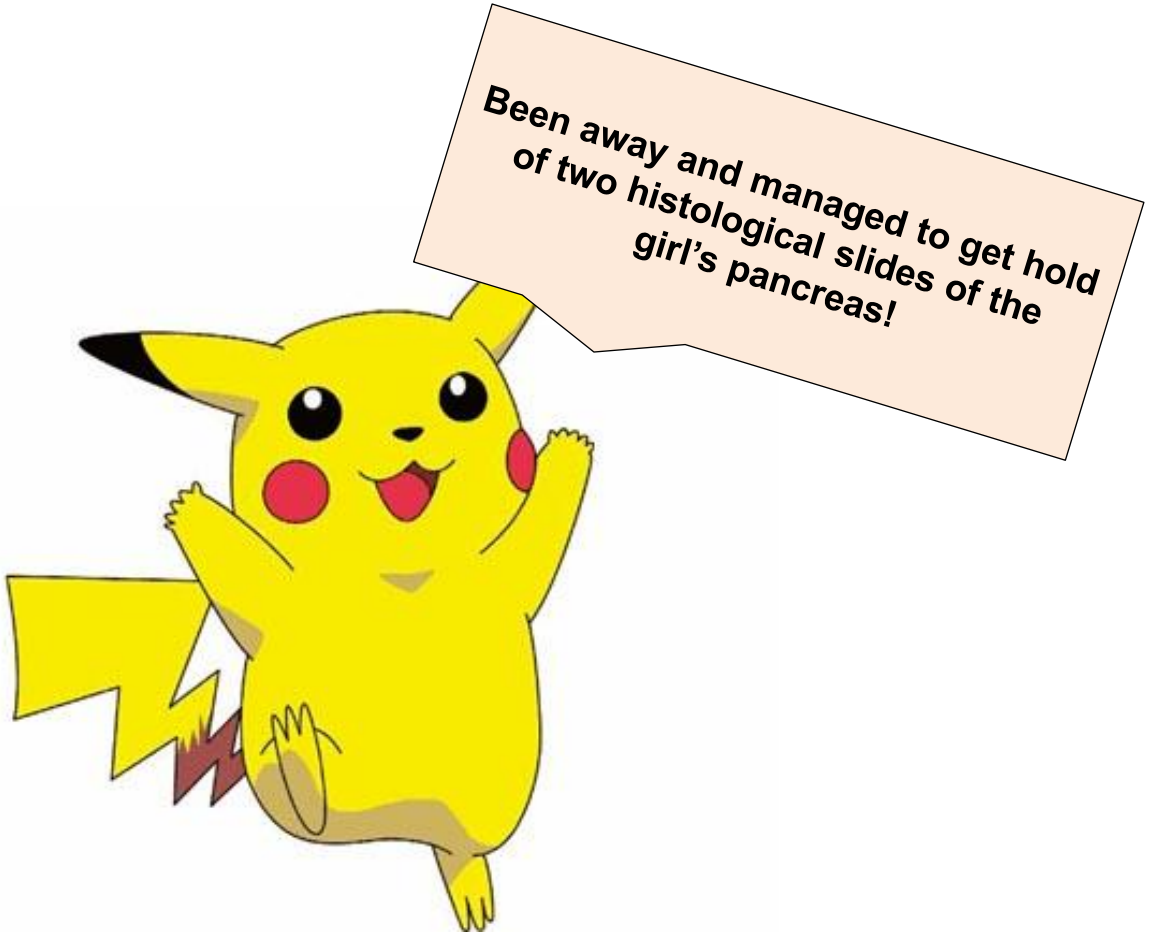


Insulin values usually given as μIU/mL (micro international units/mL) or pmol/L
To convert pmol/L values: divide it by a factor of 7.715

NHANES III Study: mean fasting level 60 pmol/L (n=17, 319 US individuals) Diabetes Metab Res Rev 2002; 18(2): 149-155

Mixed data re ideal fasting insulin levels: some suggest below 8.4 μIU/mL are optimal

Active learning strategy #2: CSI-type problem



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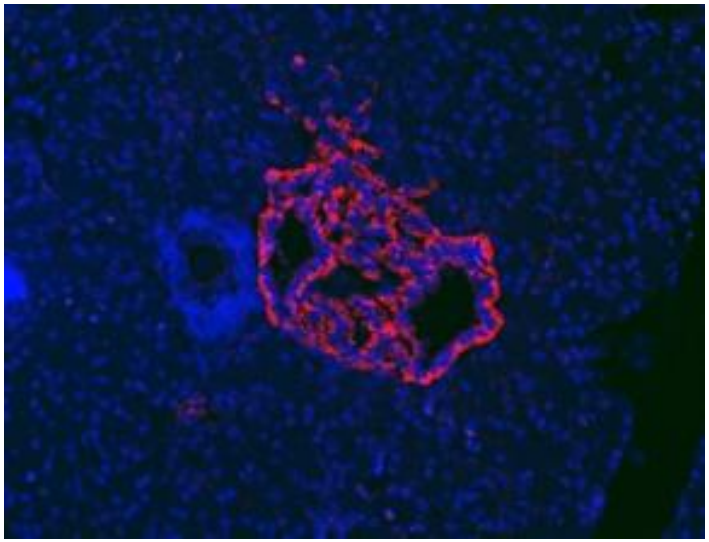
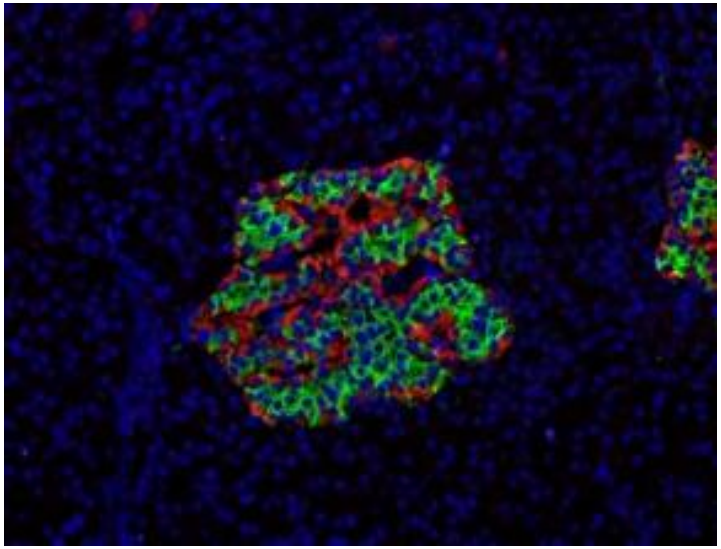


Islets 2011; 3: 131-138

Islet of Langerhans
Red: alpha cells
Green: beta cells



Diabetologia 1987; 30: 757-762

Active learning strategy #2: acknowledging contributions of others (not from the ‘’West’’)

- **1552 BC: Hesy-Ra, a physician in the 3rd Egyptian Dynasty documents frequent urination (polyuria)**

Figure 1.1 The Ebers papyrus. Courtesy of the Wellcome Library, London.

Active learning strategy #2: acknowledging contributions of others (not from the ‘’West”)

- **1552 BC: Hesy-Ra, a physician in the 3rd Egyptian Dynasty documents frequent urination (polyuria).**

- **500-400 BC: Charak & Sushrut, Hindu physicians – ‘’madhumeha” (sweet urine); also noticed ants congregated around urine of sick individuals; noticed most prevalent in those overweight and indulging in sweet & fatty foods.**

Active learning strategy #2: acknowledging contributions of others (not from the ‘’West’’)

•**980-1037 AD: Avicenna, provided detailed account in his ‘’Canon of Medicine’’ describing abnormal appetite, decline of sexual function and emphasized taste i.e. sweet urine; urine tasters.**

Some clinical outcomes of type 1 diabetes

↑ Breakdown muscle protein

Tissue loss

Hyperglycemia

↓ Absorption of glucose by kidney

Excess glucose secreted in urine

Osmotic diuresis – increased urination

Dehydration, thirst

↓ Blood pressure

Circulatory failure

↑ Ketone bodies

Metabolic acidosis

↑ Lipolysis

Tissue loss

Silverthorn, Figure 22-16, p737 - adapted

The case is solved, well done!

Two relatively easy articles on type 1 diabetes onset:
BMJ 2004;328:750-754 & Lancet 2014; 383: 69-82

Will make articles available on Sunlearn!

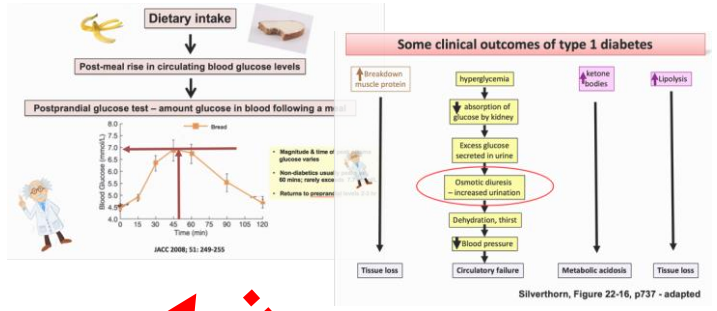
Autonomy tours: integration & application

PA+

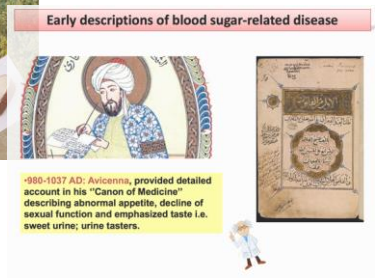
RA-

RA+

PA-



An eight-year-old Finnish girl on visit to Cape Town has gone missing while walking in Jonkershoek valley – 30 mins ago. Two Stellenbosch University Physiology friends are around and volunteer to assist to help find her.



Burning question: a real life scenario!

‘’Recently, my hyper-health conscious Aunt and Uncle had my 16 year old cousin do a 7 day juice cleanse to “make her body more alkaline”. This concerned me because none of them are medical professionals or physiologists and I was not sure upon what they were basing this cure-all-vegan diet. I also know that the pH of the body has a very fine range within it should stay; or else you die.

So, I read from my textbook and other sources and quickly realised that what they were measuring (the pH of the urine) is not a reflection of the pH of the blood. I also read that although there is little to no science backing the wonder of a juice cleanse, it should not do too much harm if a person is healthy. And alas, my cousin is still around (and I realized I don’t really need to intervene). A real life burning question.”

Assessments: tests, assignments, exams

Your father is saddled with two partly blocked arteries, an enlarged heart and is scheduled for a percutaneous coronary intervention (PCI) at the Stellenbosch General Hospital. He is 70 year-old diabetic, BMI is 33, blood pressure is 150/100, ejection fraction is 32% and his ankles quite swollen. He has recently changed his diet but for most of his life has enjoyed a lot of processed foods. A family meeting is called to discuss the impending surgical procedure and to help clarify any queries/uncertainties that may still exist. As a final year Physiology student at Stellenbosch University, you are now expected to play a vital role in the ensuing family discussions and to provide insight regarding the following questions:

1. Your mom indicated that the doctor used the term ''myocardial ischemia'' but that she did not really follow what he was trying to convey. Define ''myocardial ischemia'' and further explain the meanings of the terms ''hypoxia'' and ''myocardial infarction''. In addition, provide <u>an opinion</u> whether hypoxia is associated (or not) with myocardial ischemia – provide rationale. [4]

2. ''What does the ejection value indicate in your father's case - in terms of his heart functional ability'' enquires Uncle Sifiso. Explain to the family what disease state is likely associated with his low ejection fraction. Provide <u>a motivation</u> for your choice (refer case study for clues). [3]

Assessments: tests, assignments, exams

3. ''How did his heart become enlarged?" your mom enquires. Explain how this may have occurred in your father's case. What is the medical term for this condition? [4]

4. ''Does Dad suffer from high or low blood pressure?" your youngest brother Pietie asks. Answer his question by comparing your father's blood pressure data with the normal values and then describe how the baroreceptor reflex regulates blood pressure by focusing on the sympathetic nervous system – use high blood pressure as an example. [8]

5. Your aunt notices some tablets for blood pressure on the table – ''ACE inhibitors" and now seeks clarification. Explain which reaction ACE inhibitors targets. You then proceed to explain the various downstream, physiological effects of such inhibition that should lead to a beneficial outcome in your father's case. [6]

Active learning strategies - bringing it all together..

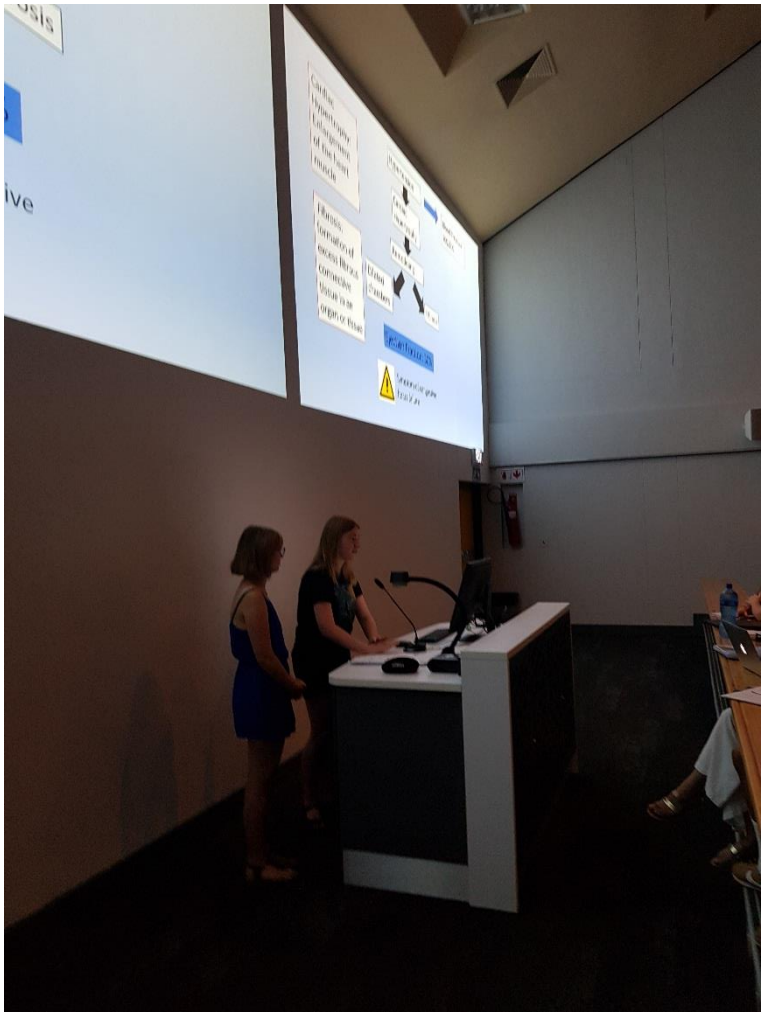
Outcomes

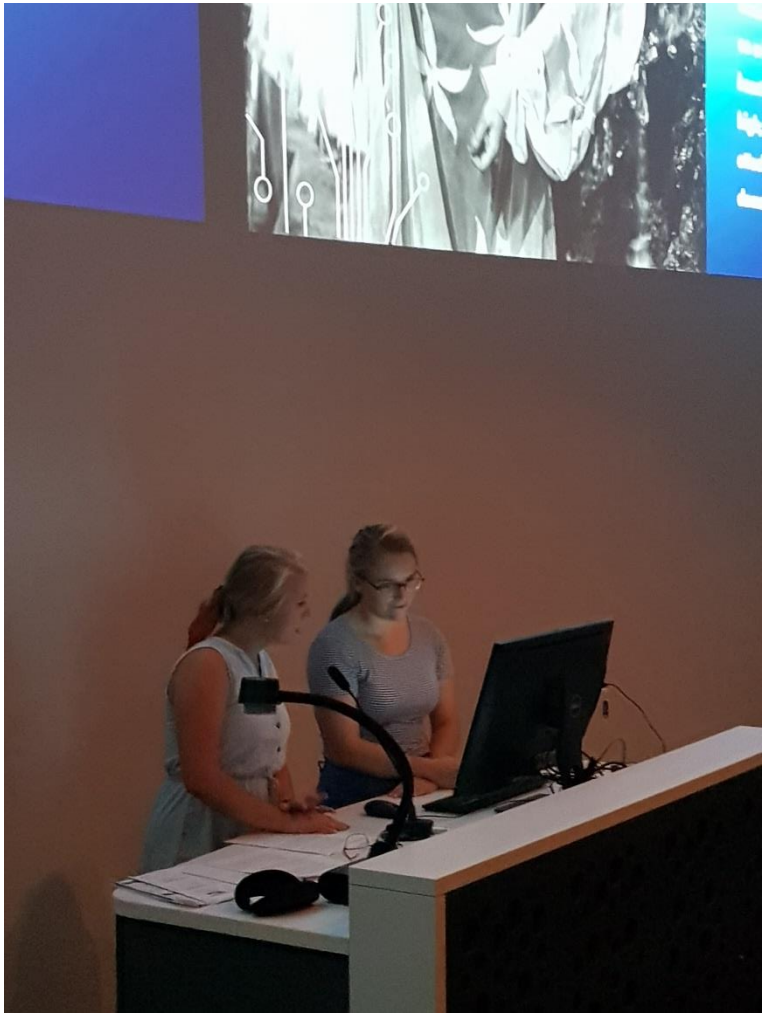
- LCT a valuable tool for planning & analyzing research
- LCT can help explain the value of various teaching methods
- Student-centered approach – can be widely applied
- Real world contexts – social aspects of learning emphasized
- Promotes integration, critical thinking & problem solving skills
- Spine of critical reflexivity & self-reflection (class, mentor, assessments & post-assessment) to enhance Gen Z's class experience

For lecturer

- Create calm & safe climate, respect, inclusivity
- Requires minimal amount of resources
- Act as mentor – set example, sincerity, care, share (authenticity)
- Aim to make it a transformative & inspirational experience
- Balance between content & active learning opportunities
- Need to dedicate significant amount of time (in-class and outside)
- Have fun (everyone) – always!

Thank you!





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