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Creating Core Concepts in Animal Physiology

Patricia A. Halpin
University of New Hampshire, Manchester, Patricia.Halpin@unh.edu

PECOP Blog

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What happens if you put together a group of instructors who teach animal physiology and ask them to generate core competencies for their particular sub-discipline? Well, Dee Silverthorn found out when we assembled ourselves in her workshop on Core Competencies at last summer's APS Institute on Teaching and Learning in Bar Harbor, Maine. What our group produced in that short session was a list of distinctive core concepts in animal physiology that we believe are essential for student learning in animal physiology (see Table 1). It is important to note that these concepts are fundamentally applicable to the teaching and learning of ALL of physiology and are most easily distinguished through the study of comparative animal physiology. By using a comparative approach toward these core concepts, students can be successful in their learning.

Table 1. Core Concepts in Animal Physiology

AP1. Animals use diverse physiological mechanisms/strategies to solve similar environmental challenges.

AP2. Animals inhabit diverse habitats and some possess unique physiology (adaptations) allowing for survival in so-called extreme environments.

AP3. The evolutionary and developmental origin and history of an animal constrains anatomical structures and physiological processes.

AP4. The capabilities of interacting physiological systems represent dynamic **trade-offs** in function and efficiency.

AP5. Body size influences the behavior of physiological systems.

AP6. Physiological phenotype is a product of genotype and environment.

AP7. Life cycles and life history traits influence physiological processes.

AP8. Comparative physiology informs the medical physiology of humans.

AP9. Comparative physiology brings to light how body systems interact to meet environmental challenges and promotes an understanding of integrative physiology

AP10. Physiological phenomena can be explained in multiple, compatible ways that involve different levels of functional complexity and different scales of time (molecular, cellular, developmental, organismal, environmental/ecological, evolutionary)

Motivated by this rationale, our group has begun to elaborate and fill in our original brainstormed list. Following the pattern set by **AAAS/Vision and Change (2011)** and **AAMC/HHMI SFFP (2009)**, we've used our core concepts to produce a matching set of student competencies. For each competency we have created specific learning objectives that would demonstrate student level mastery of concepts in different areas of animal physiology. We have started to unpack some of the concepts (e.g. tradeoffs) into their constitutive ideas and sub-concepts (see Table 2). We have also begun to examine the introductory chapters of commonly used textbooks in animal physiology to determine the extent to which these concepts are presented and explained. All of this has involved an interactive collaboration among instructors who teach animal physiology to a diverse group of students in a variety of educational settings. And it all got its start during a 60-minute workshop at the APS ITL!

Table 2. Core Concept of "Trade-Offs" Unpacked

AP4. The capabilities of interacting physiological systems represent dynamic trade-offs in function and efficiency.

1. Optimal operation of a body system may adversely impact the homeostasis achieved by other body systems and/or the optimal operations of these systems.

2. Body systems may work below optimal capacity in order to reduce or avoid disturbances in homeostasis and/or adverse changes in other body systems. The activities of individual body systems are adjusted to achieve a trade-off in the combined actions of different body systems. This trade-off favors overall homeostasis and results in the most efficient operation of the body under the existing system constraints.

3. Trade-offs in body system activities are prioritized according to the importance of each activity to the immediate survival of the animal. Less commonly, the animal will compromise immediate survival in order to increase reproductive success.

4. A number of factors interact to determine the balance point for physiological tradeoffs. These include:
   - Body size of the animal
   - Life history of the animal
   - Phenotypic plasticity of the animal
   - Environmental conditions

APS ITL – Animal Physiology Group

Beth Beason-Abmayr (Rice University)	Patricia
Halpin (Univ. New Hampshire)	
Jason Blank (Cal Poly San Luis Obispo)	Kerry
Hull (Bishop's University)	
Sydella Blatch (Stevenson University)	Patricia
Schulte (Univ. British Columbia)	
Bill Cliff (Niagara University)	Alice
Villalobos (Texas A&M)	

Have we missed major concepts/competencies that faculty expect from their animal physiology students? Please share your comments and questions below.

Patricia Halpin is an Assistant Professor of Biology and the University of New Hampshire at Manchester. She teaches Principles of Biology, Cell Biology, Animal Physiology, Medical Terminology, Biotechnology & Society, and Diseases of the 21st Century. She also teaches in the summer EXCELL program at UNHM for middle and high school English language learners. Her current research focus is on adding technology and active learning to her teaching as well as bringing science to elementary and middle school students. Patricia is a LifeSciTRC Scholar, PECOP Fellow, and a member of the American Physiological Society (APS). She serves on the APS Education Committee and is active in the APS Teaching Section.

Posted in **Core Concepts & Competencies** on **November 17, 2014 [https://blog.lifescitrc.org/pecop/2014/11/17/creating-core-concepts-in-animal-physiology/]**
by **Miranda Byse** (**Posts**|**Profile**)
6 Comments

6 thoughts on "Creating Core Concepts in Animal Physiology"

Patricia,
Thank you for writing this great blog and demonstrating how valuable and productive attendance at an APS meeting can and should be!
Best,
Mike

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Posted on **November 18, 2014 [https://blog.lifescitrc.org/pecop/2014/11/17/creating-core-concepts-in-animal-physiology/]** by **Michael Ryan** (**Posts**|**Profile**)

Mike thank you for your comment. We hope that the discussions that begin at APS meetings will be continued long after the meeting had ended. As these discussions develop they might provide new ideas for sessions at future meetings as well.
Best,
Patricia

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Posted on **November 21, 2014 [https://blog.lifescitrc.org/pecop/2014/11/17/creating-core-concepts-in-animal-physiology/]** by **Patricia A. Halpin** (**Posts**|**Profile**)

There is a very interesting review article in the Physiology journal this month (vol. 29) on the Tibetans' and Sherpas' physiological adaptations to high altitudes. Has anyone read it? Comments to share?

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Posted on **November 28, 2014 [https://blog.lifescitrc.org/pecop/2014/11/17/creating-core-concepts-in-animal-physiology/]** by **Patricia A. Halpin** (**Posts**|**Profile**)

Patricia,

Thanks for making this blog happen! I applaud the group for articulating some excellent ideas!

Two things to consider (although these are just thoughts, not necessary changes):

1) Should evolution and common ancestry (as the fundamental basis of biology) have a larger role in these concepts? This may be particularly important for this comparative work, with maybe a lesser role in other physiological core concept lists constructed by other groups.

2) Are there connections between physiology and behavior that need to be considered?

Just thoughts. Great work!

Thanks,
Katie

Posted on **November 29, 2014 [https://blog.lifescitrc.org/pecop/2014/11/17/creating-core-concepts-in-animal-physiology/]** by **Karhyn Johnson** (**Posts**|**Profile**)

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Katie,
thank you for your comments and participation. Evolution and common ancestry are always concepts that should be brought into many of our undergraduate science classes so that students can see it is not just a one-time topic presented in Principles of Biology. By taking the comparative approach in Animal Physiology the concept of evolution can be demonstrated and reinforced with every system studied. It is also very effective to demonstrate when investigating animals that survive and thrive in extreme conditions. For your second comment on physiology and behavior that is one area that could enhance any animal physiology course and should be considered.
Patricia

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Posted on **December 1, 2014 [https://blog.lifescitrc.org/pecop/2014/11/17/creating-core-concepts-in-animal-physiology/]** by **Patricia A. Halpin** (**Posts**|**Profile**)

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