

# Enhancing Nephron Physiology in Medical Education through an Interactive Manipulative: Validation Study

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## Background

The complexity of renal physiology, including the processes of secretion and absorption across different nephron segments, often poses significant learning challenges for medical students, leading to difficulties in retaining key concepts such as ion movements. To address gaps in educational methods, we previously developed a hands-on Nephron Manipulative aimed at enhancing retention of renal physiology through innovative education strategies<sup>1</sup>. Our present study updates the previous nephron manipulative to a digital format, extends its application to clinical settings, and incorporates additional data collection to assess long-term learning.

## Objective

Validate the updated digital nephron manipulative by evaluating knowledge acquisition of students in both short-term and long-term settings.

## Methods

Our previous paper model of the nephron manipulative was updated into a user-friendly, interactive PowerPoint design (Fig 1 and 2). Each slide in the PowerPoint prompted learners to drag and correctly place the various electrolytes and molecules onto the specific transporters in each nephron segment. Medical students completed pre- and post-manipulative quizzes.

## Methods Cont.

The pre-manipulative quiz served as a baseline control and a primer on key concepts, while the post-quiz to correct any possible misconceptions. The quiz included 12 knowledge questions, and 3 questions gathering feedback on student satisfaction and suggestions for improvement. Initial data collection occurred during a teaching session midway through the first-year renal physiology block at VTCSOM. A second data collection will occur midway through the renal pathology block once medical students enter second year.

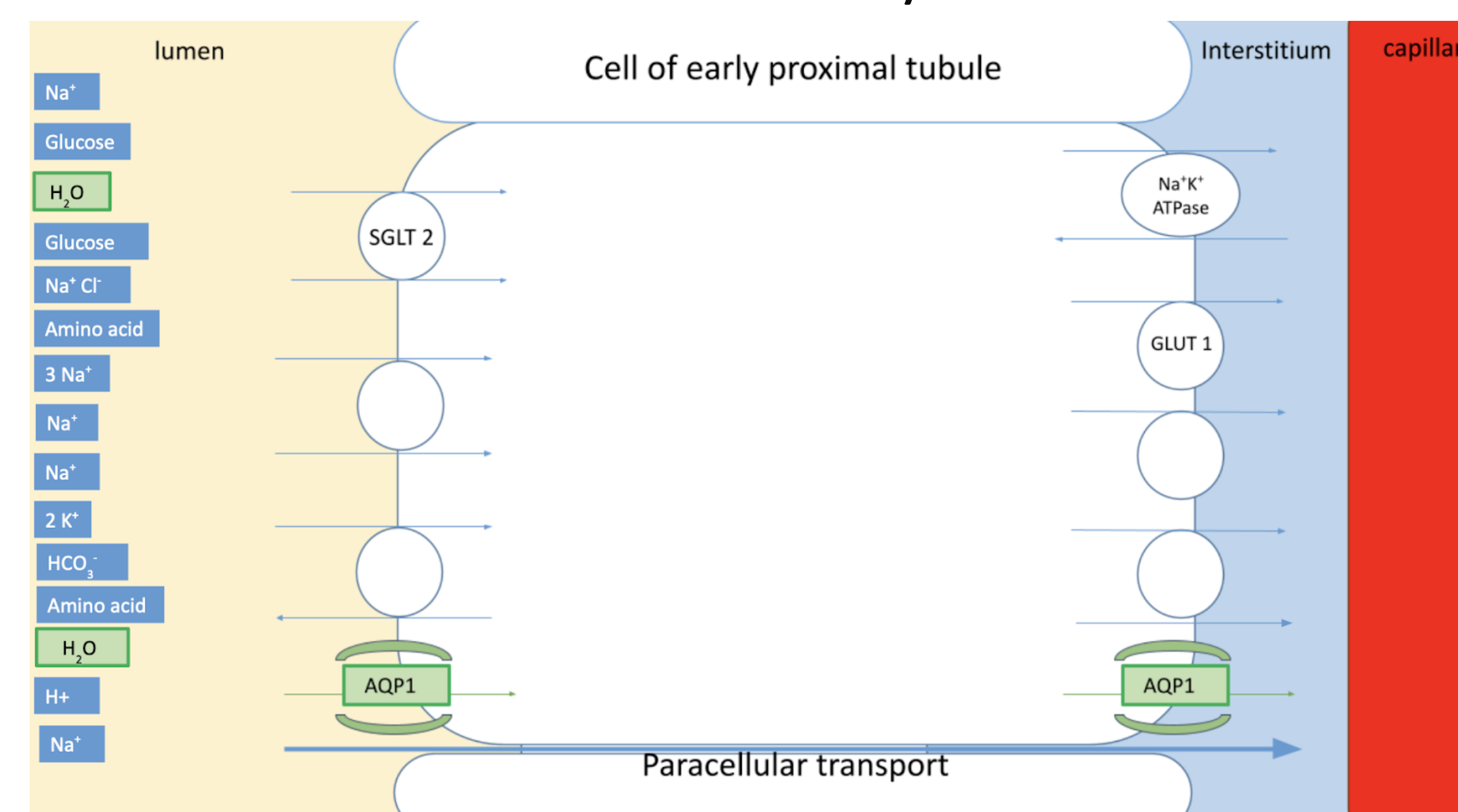


Fig 1. Example slide from updated manipulative before student use

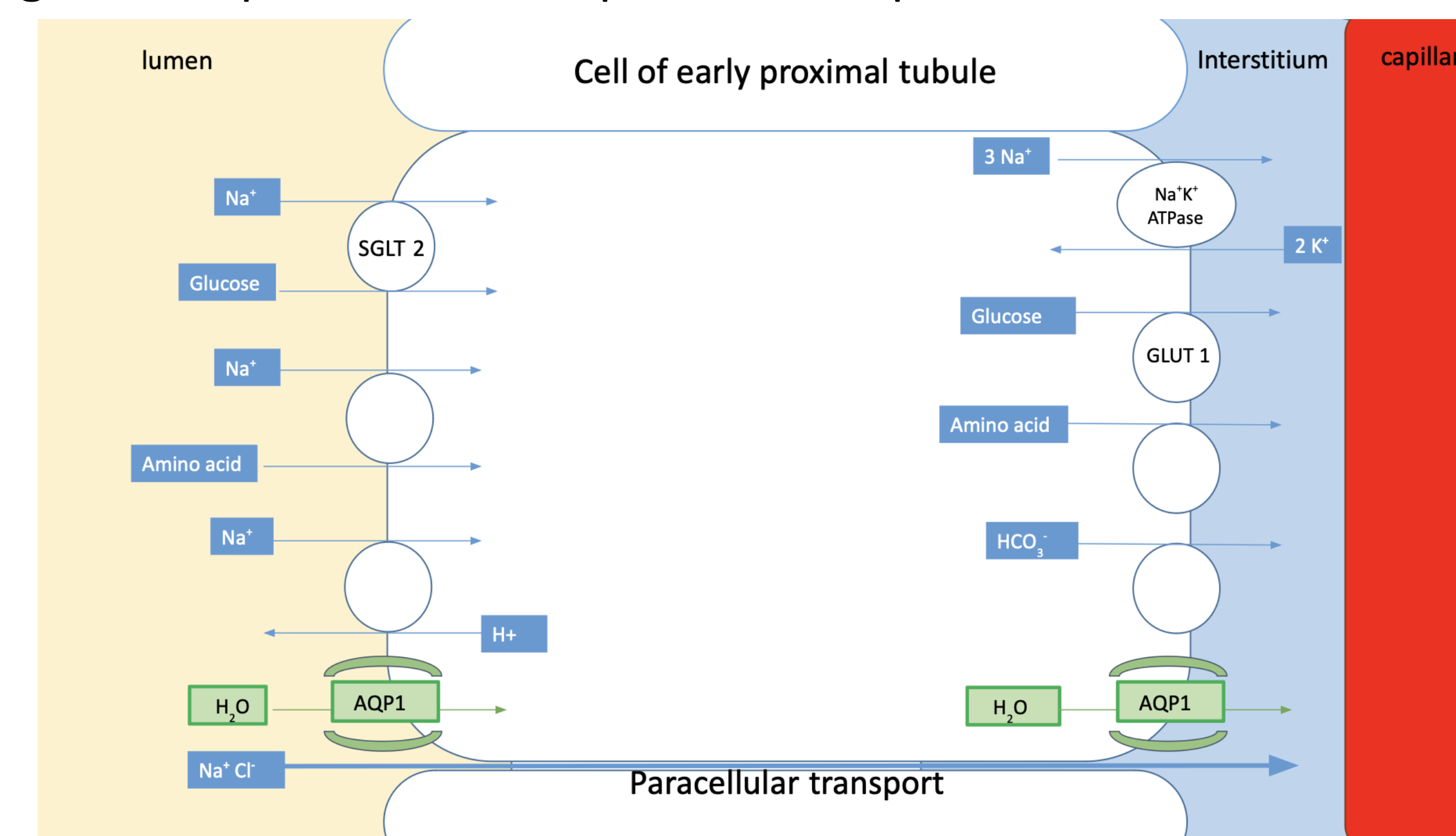


Fig 2. Example slide from updated manipulative after student use

## Results

20 first-year medical students participated in the manipulative and completed both quizzes. There was a statistically significant change ( $p=0.017$ ), with an overall knowledge improvement from 64.2% correct responses to 71.9% after the activity. Student feedback reported a better understanding of the course material and an appreciation for the interactive nature of the tool.

## Conclusion

Our data shows knowledge acquisition and student satisfaction using the updated digital nephron manipulative. The revised nephron manipulative is an efficient educational tool that can potentially enhance the way medical students grasp complex nephron physiology concepts. Further research will assess long-term retention, as students advance to more complex renal pathology topics in their second year, thereby validating the manipulative role in fostering enduring knowledge acquisition.

## References

1. Giffen, Z., & Carvalho, H. (2015, March 1). *Development of a manipulative for nephron physiology education*. *Advances in Physiology Education*. <https://doi.org/10.1152/advan.00087.2013>