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Seeing the Forest and the Trees: Research on Plant Science Teaching and Learning
Diane Ebert-May and Emily Holt 361–362

In this editorial we link the articles published in this Special Focus section with the practical utility of using plants in education to transform and transcend traditional botany classes. We suggest current and future implications of research in this area.

FEATURES

WWW.Life Sciences Education

Plant Behavior
Dennis W. C. Liu 363–368

Plants are a huge and diverse group of organisms ranging from microscopic marine phytoplankton to enormous terrestrial trees. Stunning, and yet some of us take plants for granted. In this plant issue of *LSE*, *WWW.Life Sciences Education* focuses on a botanical topic that most people, even biologists, do not think about—plant behavior.

Book Review

Plant Biology for Young Children
Jeffrey Scott Coker and Mary Gorman 369–370

My Life as a Plant is an activity book targeted toward helping young children see the importance, relevance, and beauty of plants in our daily lives. The book succeeds at introducing children to plant biology in a fun, inquiry-based, and appropriately challenging way.

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Interactions Are Critical
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A Web Application for Generation of Random DNA Sequences with a Single Open Reading Frame: Exemplars for Genetics and Bioinformatics Education
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PLANT SCIENCE ARTICLES

Understanding Early Elementary Children’s Conceptual Knowledge of Plant Structure and Function through Drawings
Janice L. Anderson, Jane P. Ellis, and Alan M. Jones 375–386

We present the results of an early elementary study (K–1) that used children’s drawings to examine children’s understanding of plant structure and function.

Effects of a Research-Infused Botanical Curriculum on Undergraduates’ Content Knowledge, STEM Competencies, and Attitudes toward Plant Sciences
Jennifer Rhode Ward, H. David Clarke, and Jonathan L. Horton 387–396

This research-infused botanical curriculum increased students’ knowledge and awareness of plant science topics, improved their scientific writing, and enhanced their statistical knowledge.

Connections between Student Explanations and Arguments from Evidence about Plant Growth
Jenny M. Dauer, Jennifer H. Doherty, Allison L. Freed, and Charles W. Anderson 397–409

In an analysis of 22 middle and high school student interviews, we found that many students reinterpret the hypotheses and results of standard investigations of plant growth to match their own understandings. Students may benefit from instructional strategies that scaffold their explanations and inquiry about how plants grow.

Beyond Punnett Squares: Student Word Association and Explanations of Phenotypic Variation through an Integrative Quantitative Genetics Unit Investigating Anthocyanin Inheritance and Expression in *Brassica rapa* Fast Plants
 Janet M. Batzli, Amber R. Smith, Paul H. Williams, Seth A. McGee, Katalin Dósa, and Jesse Pfammatter 410–424

This study explores shifts in student word association and explanations of phenotypic variation through an integrative quantitative genetics unit using *Brassica rapa* Fast Plants.

Optimizing Learning of Scientific Category Knowledge in the Classroom: The Case of Plant Identification
 Bruce K. Kirchoff, Peter F. Delaney, Meg Horton, and Rebecca Dellinger-Johnston 425–436

The software program Visual Learning—Plant Identification offers a solution to problems in category learning, such as plant identification. It uses well-established learning principles, including development of perceptual expertise in an active-learning format, spacing of practice, interleaving of examples, and testing effects to train conceptual learning.

Attention “Blinks” Differently for Plants and Animals
 Benjamin Balas and Jennifer L. Momsen 437–443

We use an established paradigm in visual cognition, the “attentional blink,” to demonstrate that our attention is captured more slowly by plants than by animals. This suggests fundamental differences in how the visual system processes plants, which may contribute to plant blindness considered broadly.

GENERAL ARTICLES

Promoting Inquiry-Based Teaching in Laboratory Courses: Are We Meeting the Grade?
 Christopher Beck, Amy Butler, and Karen Burke da Silva 444–452

The authors reviewed the current literature on inquiry-based learning in laboratory courses and found that most exercises were guided inquiry. The majority of studies included assessment data showing learning gains. Few exercises were assessed in multiple courses or at multiple institutions. Therefore, whether results can be generalized is unclear.

Getting Under the Hood: How and for Whom Does Increasing Course Structure Work?
 Sarah L. Eddy and Kelly A. Hogan 453–468

The authors explore the transferability of an active-learning intervention and expand upon the original studies by 1) disaggregating student populations to identify for whom the intervention works best and 2) exploring possible proximate mechanisms (changes in student behaviors and perceptions) that could mediate the observed increase in achievement.

Identifying Key Features of Effective Active Learning: The Effects of Writing and Peer Discussion
 Debra L. Linton, Wiline M. Pangle, Kevin H. Wyatt, Karli N. Powell, and Rachel E. Sherwood 469–477

This study compared the effectiveness of three different methods of implementing active-learning exercises in an introductory biology course. The results suggest that individual writing should be implemented as part of active learning whenever possible and that instructors may need training and practice to become effective with active learning.

Gender Gaps in Achievement and Participation in Multiple Introductory Biology Classrooms
 Sarah L. Eddy, Sara E. Brownell, and Mary Pat Wenderoth 478–492

Although females outnumber males in biology, this study of 23 different introductory biology classrooms reveals systematic gender disparities in student performance on exams and student participation when instructors ask students to volunteer answers to instructor-posed questions.

An Evaluation of Two Hands-On Lab Styles for Plant Biodiversity in Undergraduate Biology
 John M. Basey, Anastasia P. Maines, Clinton D. Francis, and Brett Melbourne 493–503

Two formats of plant biodiversity labs were evaluated: a learning cycle format and an expository format. Each had a prelab, a hands-on lab, and a write-to-learn postlab. Bloom’s lower- and higher-order cognition and attitudes were assessed. Results showed that the two styles had different costs and benefits. Evidence indicates that a blended style may be best.

Investigating the Effectiveness of an Educational Card Game for Learning How Human Immunology Is Regulated TzuFen Su, Meng-Tzu Cheng, and Shu-Hua Lin	504–515
This study is being conducted in an attempt to investigate the effectiveness of an educational card game we developed for learning about human immunology. The obtained results indicate that students did learn from the educational card game and generally had positive perceptions of the game-based instruction and its learning efficiency.	
Identification of Threshold Concepts for Biochemistry Jennifer Loertscher, David Green, Jennifer E. Lewis, Sara Lin, and Vicky Minderhout	516–528
This study describes an iterative process involving faculty and students to identify potential threshold concepts for biochemistry.	
Introductory Biology Students’ Conceptual Models and Explanations of the Origin of Variation Elena Bray Speth, Neil Shaw, Jennifer Momsen, Adam Reinagel, Paul Le, Ranya Taqieddin, and Tammy Long	529–539
Introductory biology students struggle to incorporate the molecular genetic origin of variation in their evolutionary reasoning framework. Meaningful learning of this concept may require 1) multiple cycles of instruction, assessment, and feedback; and 2) assessment forms, such as conceptual models, that promote and reveal mechanistic and causal reasoning.	
Development of the Biological Experimental Design Concept Inventory (BEDCI) Thomas Deane, Kathy Nomme, Erica Jeffery, Carol Pollock, and Gülnur Birol	540–551
The Biological Experimental Design Concept Inventory (BEDCI) is a carefully designed diagnostic tool. The process of development and assessment of reliability and validity of the instrument are documented. BEDCI can be used to identify non-expert-like conceptions, inform teaching practices, and measure the effectiveness of targeted instruction.	
The Teaching Practices Inventory: A New Tool for Characterizing College and University Teaching in Mathematics and Science Carl Wieman and Sarah Gilbert	552–569
The teaching practices inventory characterizes the teaching methods used in university science and mathematics courses, including the extent of use of research-based teaching practices. Data from many courses across five departments are presented.	

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Student Perceived and Determined Knowledge of Biology Concepts in an Upper-Level Biology Course Brittany Ziegler and Lisa Montplaisir	571

On the Cover

Plant identification is an essential skill for many environmental, agricultural, and veterinary science careers. Learning to identify plants involves not just memorization, but conceptual learning, as a taxon is a concept. The conceptual nature of taxa is demonstrated by the fact that species’ definitions and names change over time. However, the large number of taxa to be mastered, variability within each taxon, and lack of student familiarity with plants engender low student motivation and make plant identification extraordinarily difficult to master. In this issue, Kirchoff, Delaney, Horton, and Dellinger-Johnston report the results of a controlled experimental test of a new method of teaching plant identification. The method uses a software implementation of the spacing, retrieval, and interleaving mechanisms for category learning as a way of developing visual expertise. The software presents multiple examples of plant taxa using standardized images so that the students cannot use extraneous cues to identify the plants. The software makes use of quizzes to teach students to discriminate among taxa. The study found that the software use improved final exam scores and produced better retention of plant identification skills. The cover shows photographs of *Quercus rubra* (Northern Red Oak), similar to those used in the software. Photographs by David Gallagher.