

# American Journal of Physiology- Lung Cellular and Molecular Physiology®

**Editor:** Sadis Matalon

---

**Deputy Editors:**

Y. S. Prakash

Rory E. Morty

---

**Associate Editors:**

James F. Collawn  
Mark N. Gillespie  
Lester Kobzik

Wolfgang M. Kuebler  
Dolly Mehta  
Bethany Moore

Irina Petrache  
Larissa Akimi Shimoda

---

**Consulting Editors:**

Rachel C. Chambers  
Augustine M. K. Choi  
Oliver Eickelberg

Susan S. Margulies  
Rakesh P. Patel  
Paul T. Schumacker

Theodore J. Standiford  
Kurt Stenmark

---

**Editorial Board:**

Steven H. Abman  
Kenneth B. Adler  
Takaaki Akaike  
William A. Altemeier  
Cristina M. Alvira  
Namasivayam Ambalavanan  
Richard L. Auten  
Julie A. Bastarache  
Brent L. Berwin  
Konstantin G. Birukov  
Janette K. Burgess  
Carolyn S. Calfee  
John Catravas  
Shampa Chatterjee  
Yoshihiko Chiba  
Judy Creighton  
Bruno Crestani  
Vrushank Dave  
Ian C. Davis  
Ana Denicola  
Dale A. Dickinson  
David Dockrell  
Barbara Driscoll  
Steven M. Dudek  
Charles W. Emala  
Alexey V. Fedulov  
Jeffrey R. Fineman

James A. Frank  
Charles W. Frevert  
Stavros Garantziotis  
William T. Gerthoffer  
Mark T. Gladwin  
Andrew J. Gow  
Susan J. Gunst  
Angela Haczu  
Andrew J. Halayko  
Kevin S. Harrod  
My N. Helms  
Susanne Herold  
John W. Hollingsworth  
Rolf D. Hubmayr  
Machteld N. Hylkema  
Yvonne M. Janssen-Heininger  
Ilona Jaspers  
Roger A. Johns  
Mathur S. Kannan  
Eric E. Kelley  
Alan J. Knox  
Melanie Konigshoff  
B. Paige Lawrence  
William E. Lawson  
Tim LeCras  
Jae-Woo Lee  
Patty J. Lee

Gang Liu  
Mark R. Looney  
Rama K. Mallampalli  
Peter Mancuso  
Thomas Mariani  
Richard J. Martin  
Robin McNulty  
Ivan F. McMurry  
Marilyn P. Merker  
Herman Meurs  
Evangelos D. Michelakis  
Gokhan M. Mutlu  
Viswanathan Natarajan  
Eva Nozik-Grayck  
Michael A. O'Reilly  
Caroline A. Owen  
Christina M. Pabelick  
Robert Paine  
Annie Pardo  
William C. Parks  
Raymond Penn  
Sem H. Phan  
Claude A. Piantadosi  
Edward M. Postlethwait  
Lawrence S. Prince  
Lee J. Quinton  
Arshad Rahman

Scott H. Randell  
Karen M. Ridge  
Steven Mark Rowe  
Michael J. Sanderson  
Stephanie A. Shore  
Gary C. Sieck  
Patricia J. Sime  
Julian Solway  
Bruce A. Stanton  
Chad Steele  
Troy Stevens  
Barry R. Stripp  
J. T. Sylvester  
Masao Takata  
Daniel J. Tschumperlin  
Rubin M. Tuder  
Stefan Uhlig  
Albert Van der Vliet  
Jeremy P. Ward  
Christopher M. Waters  
Carl W. White  
Paul J. Wolters  
Reen Wu  
Jason X. Yuan  
Sotirios G. Zarogiannis

---

**Publications Committee**

Curt D. Sigmund, *Chair*  
Hershel Raff, *Vice Chair*  
Paul A. Insel  
Alicia A. McDonough  
Linda C. Samuelson  
Susan M. Wall  
Loren Wold

**Ex officio**

Rita Scheman  
*Director of Publications  
and Executive Editor*  
Patricia E. Molina, *President*  
Jane F. Reckelhoff, *President  
Elect*  
David M. Pollock, *Past President*  
Martin Frank, *Executive  
Director*

Mark L. Goodwin  
*Editorial Manager*  
Ellyn Kestnbaum  
*Journal Supervisor*  
Gilbert Ebner  
*Peer Review Manager*  
Mona Trang  
*Peer Review Coordinator*

Eric Pesanelli  
*Editorial Art Manager*  
Amy McEver  
*Editor's Assistant*

---

The *American Journal of Physiology-Lung Cellular and Molecular Physiology* (ISSN-1040-0605) is published online at [www.ajplung.org](http://www.ajplung.org) (ISSN-1522-1504) twice monthly (two volumes a year) by the American Physiological Society, 9650 Rockville Pike, Bethesda, MD 20814-3991. *Subscription Prices (postpaid):* For institutional print and online pricing, please see <http://www.the-aps.org/publications/subs/>. Nonmember individuals (online only): \$385.00. APS members: online is free. Subscriptions from outside the United States are payable in US currency or full equivalent. Subscriptions are accepted on a calendar-year basis only. Print back issues, when available, through December 2011: Subscriber, \$40 each; Nonsubscriber, \$75 each. Periodicals postage paid at Bethesda, MD and at additional mailing offices.

The *American Journal of Physiology-Lung Cellular and Molecular Physiology*® is a registered trademark of the American Physiological Society.

Copyright © 2015 by the American Physiological Society. Printed in the United States of America by Cadmus Communications—Lancaster Division, Lancaster, PA 17601. The code at the bottom of the first page of an article indicates the copyright owner's consent that copies of that article may be made beyond that permitted by sections 107 and 108 of the US Copyright Law—unless the copies are for general distribution, for advertising, for creating new works, or for resale—provided the per-copy fee is paid through the Copyright Clearance Center, Inc., 222 Rosewood Dr., Danvers, MA 01923.

*Editorial and Business Correspondence:* AJP-Lung Cellular and Molecular Physiology, 9650 Rockville Pike, Bethesda, MD 20814-3991.

**Disclaimer:** The statements and opinions contained in the articles of the *American Journal of Physiology-Lung Cellular and Molecular Physiology* are solely those of the individual authors and contributors and not of the American Physiological Society. The appearance of advertisements in the journal is not a warranty, endorsement, or approval of the products or their safety. The American Physiological Society disclaims responsibility for any injury to persons or property resulting from any ideas or products referred to in any article or advertisement.