

American Journal of Physiology- Endocrinology and Metabolism®

Editor: André Marette

Associate Editors:

Patrice Carni
Hari Hundal

Anna Krook
Patrick MacDonald
Gary J. Schwartz

Rebecca Simmons
Cynthia Smas
Matthew Watt

Editorial Board:

Steven Abcouwer
Matthew Anderson
Younès Anini
Russell V. Anthony
Tracy Anthony
Philip Atherton
Keith Baar
Eugene J. Barrett
Rita Basu
Stephen Benoit
Ernesto Bernal-Mizrachi
Philip J. Bilan
Gustavo Blanco
Stephen Borst
George A. Brooks
Holly Brown-Borg
Christoph Buettner
Ralph Burkhardt
Dongsheng Cai
Lu Cai
Wenhong Cao
Gregory Cartee
Patrick Catalano
Bandana Chatterjee
Naibehya Chattopadhyay
Alex F. Chen
Alexander V. Chibalin
Edward Chien
Streamson C. Chua, Jr.
Kirk P. Conrad
Robert Considine
Greg Cooney
John A. Corbett
David D'Alessio
Sandra Davidge
Nicolaas EP Deutz
Henry Donahue
Cumming Duan
Charles A. Ducas
Daniel Dumesic
Jeffrey S. Elmendorf
Sarah K. England
Shereen Ezzat
Asgerally Fazleabas
Mark Febbraio
William Festuccia
Jorge P. Figueroa
James D. Fluckey

Mao Fu
Patrick T. Fueger
J. David Furlow
Adolfo Garcia-Ocaña
Nori Geary
Adria Giacca
Benjamin Glaser
Ira J. Goldberg
Bret Goodpaster
Laurie J. Goodyear
George H. Greeley
Lisa Halvorson
Victor Han
Chad Hancock
Mark Hargreaves
John A. Hawley
William W. Hay, Jr.
Jennifer W. Hill
Carol Huang
Mahmood Hussain
Yumi Imai
Jørgen Jensen
Tianru Jin
Caleb Kallen
Gerard Karsenty
Maureen Keller-Wood
Jason K. Kim
Jeong-a Kim
Young-Bum Kim
Scot R. Kimball
Hilla Knobler
Daniel Konrad
Anjan Kowluru
Graciela Krikun
Anna Krook
George Kunos
Irwin Kurland
Kyriakos E. Kypreos
Sergio Lavandero
Kuk-Wha Lee
Todd Leff
Gil Leibowitz
Po Sing Leung
Barry Levin
Gary F. Lewis
Hung-Mo Lin
Dongmin Liu
Feng Liu

Gary Lopaschuk
Xin-Liang Ma
Patrick MacDonald
Robert G. MacKenzie
Daniel J. MacPhee
Daniel Marks
Glenn McConell
Owen McGuinness
Joseph Messina
Benjamin F. Miller
Raghu Mirmira
William E. Mitch
Jane A. Mitchell
Subburaman Mohan
Patricia E. Molina
Monica Montagnani
Genie (Mary) Courtney Moore
Christopher Morrison
Heike Münzberg-Grüning
Ranganath Muniyappa
Amy Murtha
Jan Nedergaard
Margaret Neville
Kevin Niswender
Silvana Obici
Robert O'Doherty
Donal O'Gorman
Youngman Oh
Ann Louise Olson
Kutluk Oktay
David Olson
Rudi Ortiz
Jingsong Ou
Michael Pagliassotti
Kyong Soo Park
Antonio Pellicer
Gianluca Perseghin
Kitt Falk Petersen
Daniele Piomelli
Scott Pletcher
Stephen Plymate
Lucilla Poston
Marc Prentki
Jerry Radziuk
Sasanka Ramanadham
Michael Roden
Michael Rosenbaum
Richard A. Roth

Assaf Rudich
Liangyou Rui
Mario J.A. Saad
Kei Sakamoto
Toshiyasu Sasaoka
Leslie Satin
David Savage
Rosario Scalia
Jonathan Schertzer
James Segars
Utpal Sen
Colin Sibley
Cynthia Smas
Gregory R. Steinberg
Jacqueline Stephens
Naftali Stern
XiaoJian Sun
Gary Sweeney
J. David Symons
Nobuhiko Takahashi
André Tchernof
Karen Teff
Debbie Thurmond
Amir Tirosch
Michael J. Toth
Frederic Tremblay
Matthias H. Tschöp
Robert Tsushima
Rupangi Vasavada
Allen Volchuk
Anton Wagenmakers
Hong Wang
Qinghua Wang
Rennian Wang
Matthew J. Watt
Ram Weiss
Monte S. Willis
William Winder
Minna Woo
Toru Yamaguchi
Peixin Yang
Kevin E. Yarasheski
Jianping Ye
Yiyang Zhang
Yeheil Zick
Teresa Zimmers
Antonio Zorzano

Publications Committee

Curt D. Sigmund, *Chair*
Hershel Raff, *Vice Chair*
Catherine E. Carr
David Ellison
Andrew Greene
Paul Insel
Alicia A. McDonough
Lynette K. Rogers
Susan M. Wall
Loren Wold

Rita Scheman
Director of Publications
and *Executive Editor*
Jane F. Reckelhoff, *President*
Dennis Brown, *President-Elect*
Patricia E. Molina, *Past President*
Martin. Frank, *Executive Director*

Audra E. Cox
Editorial Manager
Stephanie Demma
Journal Supervisor
T. Christensen
L. Kanaskie
J. Marquez
D. Udoff
Copy Editors

Gilbert Ebner
Peer Review Manager
Eric Pesanelli
Editorial Art Manager
Karen Dodson
Editor's Assistant

The *American Journal of Physiology-Endocrinology and Metabolism* (ISSN-0193-1849) is published online at www.ajpendo.org (ESSN 1522-1555) 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>. Non-member individuals (online only): \$415.00, 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, \$45 each; Nonsubscriber, \$90. Periodicals postage paid at Bethesda, MD and at additional mailing offices.

The *American Journal of Physiology-Endocrinology and Metabolism*® is a registered trademark of the American Physiological Society.

Copyright © 2017 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-Endocrinology and Metabolism, 9650 Rockville Pike, Bethesda, MD 20814-3991.

Disclaimer: The statements and opinions contained in the articles of the *American Journal of Physiology-Endocrinology and Metabolism* 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.