

LIPDOMICS WORKSHOP

LIPID MAPS

Welcome & Introduction

Edward A. Dennis

Departments of Pharmacology and Chemistry/Biochemistry
University of California, San Diego



LIPID MAPS

Lipid Metabolites And Pathways Strategy

GENOMICS

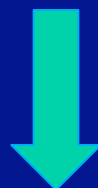
(TRANSCRIPTOMICS)



PROTEOMICS



METABOLOMICS



“LIPIDOMICS”



LIPID MAPS

Lipid Metabolites And Pathways Strategy

GENOMICS

(TRANSCRIPTOMICS)



4 base side chains

PROTEOMICS



20 amino acid side chains

METABOLOMICS



nucleic acids, amino acids,
sugars and fats: $>10^5$?

“LIPIDOMICS”

all the fats: $>10^5$?

“Lipidomics Joins the
Omics Evolution”

Dennis (2009)

PNAS 106, 2089



LIPID MAPS HYPOTHESIS

A systems biology approach to identify the many thousands of lipid molecular species in cells and their quantitative changes in response to cellular stress and challenge will lead us to new methodologies for monitoring lipid changes, and this in turn will lead to breakthroughs in the understanding and treatment of lipid based diseases.



LIPID MAPS

NIGMS Large Scale Collaborative Grant
“Glue Grant” [NIH U54 GM 69338]

Mouse Macrophage:	RAW cell line & primary cell
Environmental Agonist:	initially LPS, then oxidized LDL
HPLC/Mass Spectrometer:	identify known & new, quantify
Synthesis/Characterize:	new ones, MS quantitative standards
Bioinformatics:	informatics and lipid networks
Website:	LIPID MAPS/Nature Lipidomics Gateway http://www.lipidmaps.org



LIPID MAPS CORES

PI

Edward A. Dennis - *UCSD*

Macrophage Biology

Christopher Glass - *UCSD*

LC/Mass Spec

Robert C. Murphy – *Colorado*
Nicholas Winograd – *Penn State*

Lipid Synthesis/Characterization

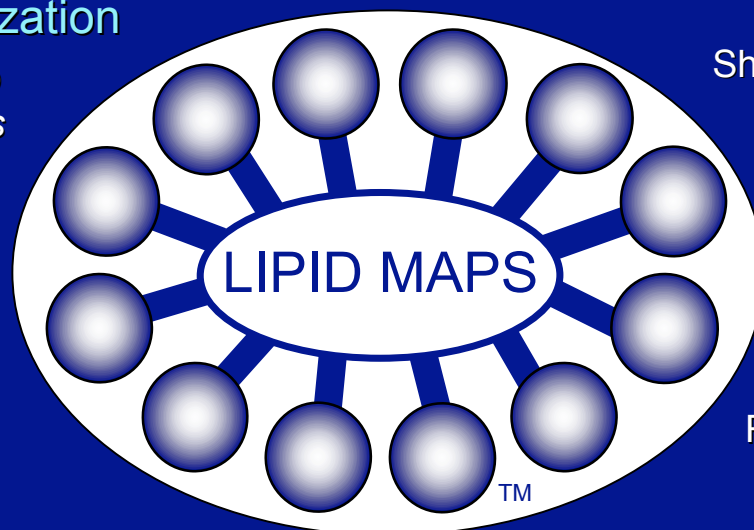
Michael VanNieuwenhze - *UCSD*
Walter Shaw - *Avanti Polar Lipids*

Bioinformatics

Shankar Subramaniam - *UCSD*

Fatty Acyls/Eicosanoids

Edward A. Dennis - *UCSD*



Glycerolipids

Robert C. Murphy - *Colorado*

Glycerophospholipids

H. Alex Brown - *Vanderbilt*

Sphingolipids/Gangliosides

Alfred H. Merrill - *Georgia Tech*

Sterols

David W. Russell - *UTSW*

Prenols/Structural Lipidomics

Christian Raetz - *Duke*

Oxidized Lipids Bridge Joe Witztum - *UCSD*



Kdo₂ Lipid A (LPS species)
A Specific Agonist of TLR-4
on RAW 264.7 macrophages

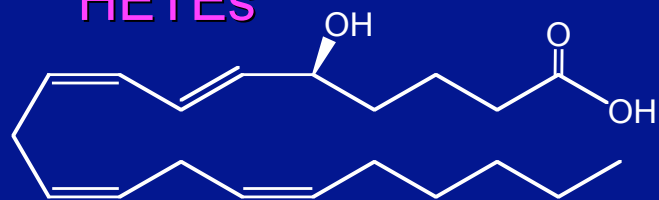
Raetz et al [2006] JLR 47. 1097-1111

Nuclei – DAPI

Mitochondria – MitoTracker Red



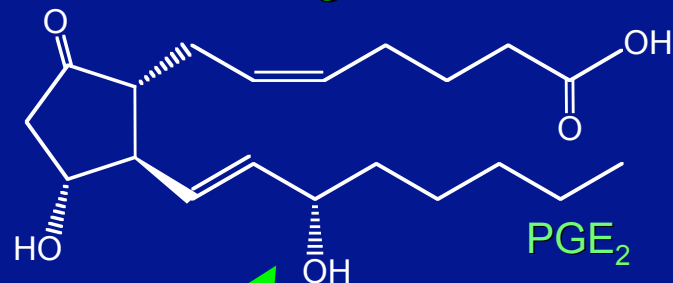
HETEs



15(S)HETE

15 LO

Prostaglandins



PGE₂

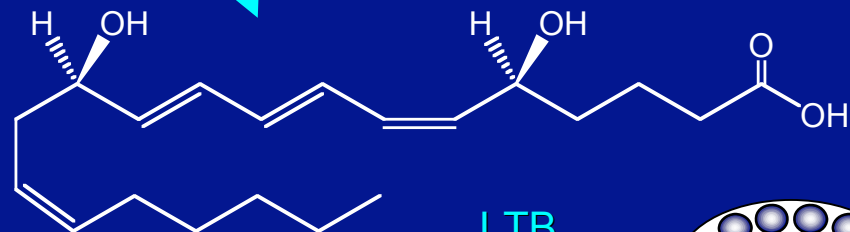
COX

Arachidonic Acid



5 LO

Leukotrienes



LTB₄

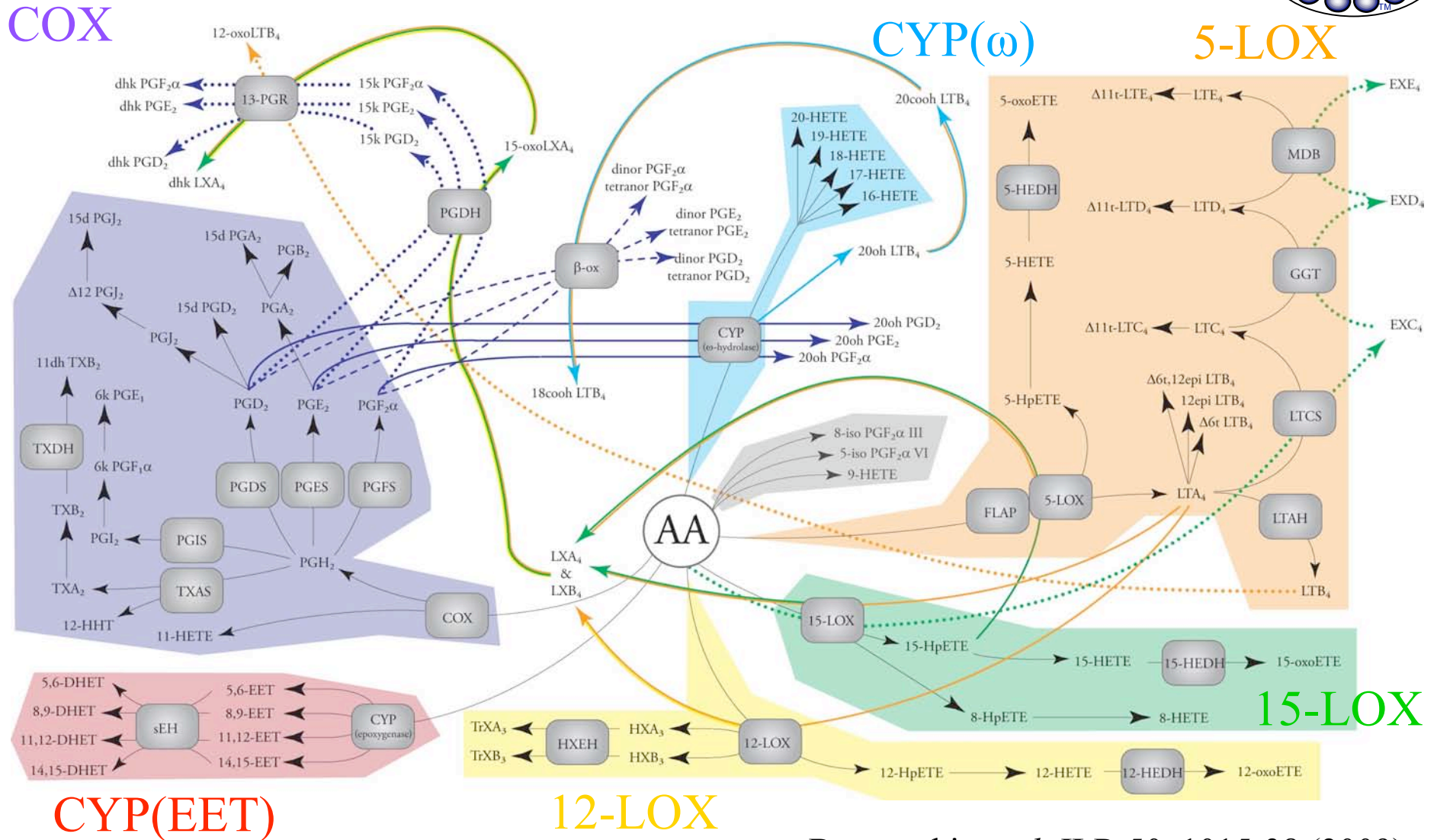
Epoxyeicosatrienoids



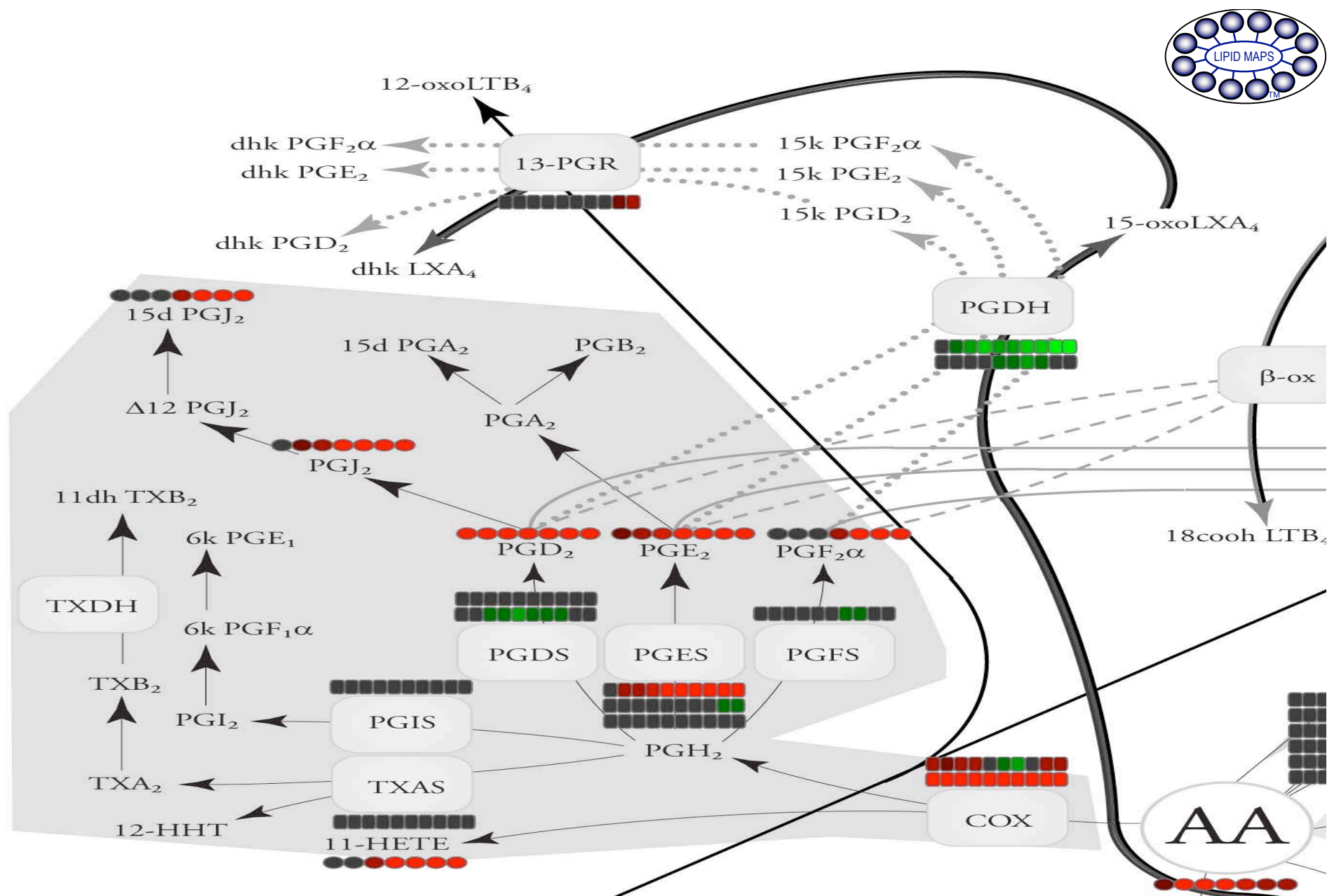
14,15-EET

P450

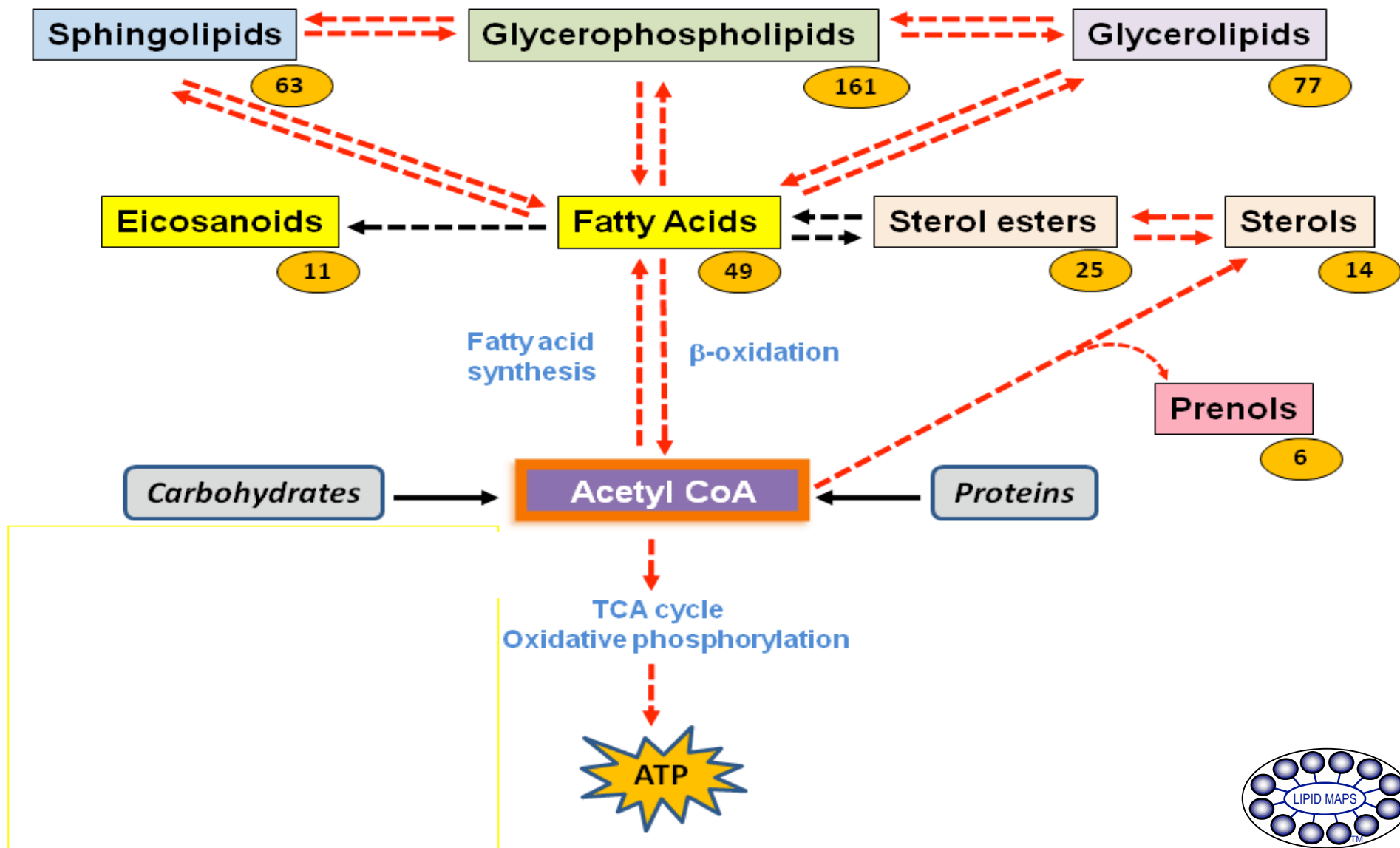




Buczynski *et. al.* JLR 50, 1015-38 (2009)



MACROPHAGE LIPID METABOLISM



Classification, Nomenclature, Structure

J. Lipid Research (2005) 46, 839-862 ; (2009) 50, S9-14 www.lipidmaps.org

A comprehensive classification system for lipids -- Fahy et al., 10.1194/jlr.E400004-JLR200 -- Microsoft Internet Explorer

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JLR JOURNAL OF LIPID RESEARCH VISIT THE JOURNAL OF BIOLOGICAL CHEMISTRY ONLINE

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Papers In Press, published online ahead of print February 16, 2005
J. Lipid Res., doi:10.1194/jlr.E400004-JLR200
Submitted on December 22, 2004
Revised on February 4, 2005
Accepted on February 4, 2005

A comprehensive classification system for lipids

Eoin Fahy, Shankar Subramaniam, H. Alex Brown, Christopher K. Glass, Alfred H. Merrill Jr., Robert C. Murphy, Christian R.H. Raetz, David W. Russell, Yousuke Seyama, Walter Shaw, Takao Shimizu, Frederick Spener, Gerrit van Meer, Michael S. VanNieuwenhze, Stephen H. White, Joseph Witztum, and Edward A. Dennis

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Lipids are produced, transported and recognized by the concerted actions of numerous enzymes, binding proteins and receptors. A comprehensive analysis of lipid molecules, "lipidomics", in the context of genomics and proteomics is crucial to understanding cellular physiology and pathology and consequently, lipid biology has become

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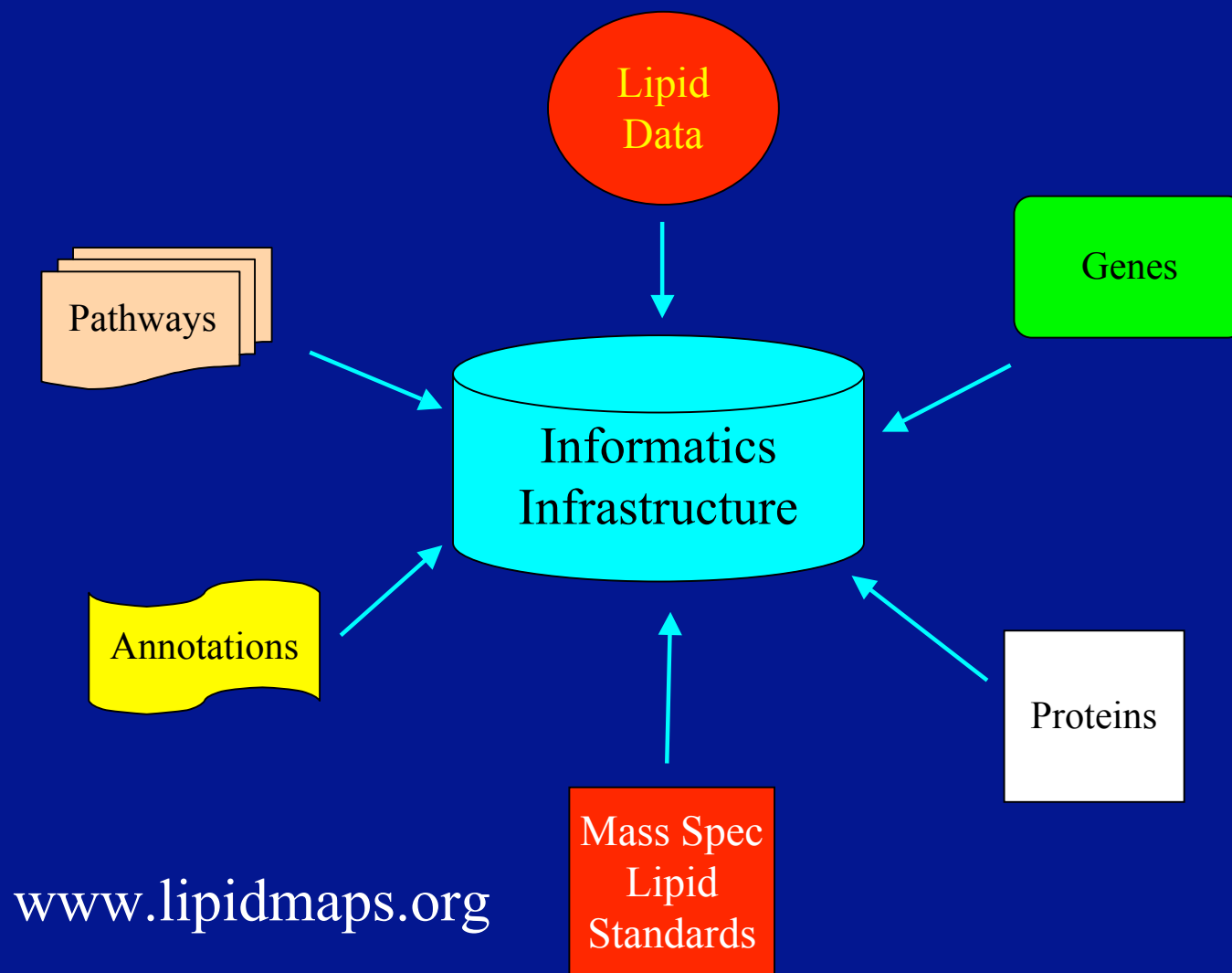
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LIPIDOMICS COMPONENTS



LIPID MAPS MEETING - NOV 2-3, 2002



Michael VanNieuwenhze

Bob Murphy

Ray Deems

Chris Glass

Al Merrill

John Wooley

Shankar Subramaniam

Walt Shaw

Cameron Sullards David Russel

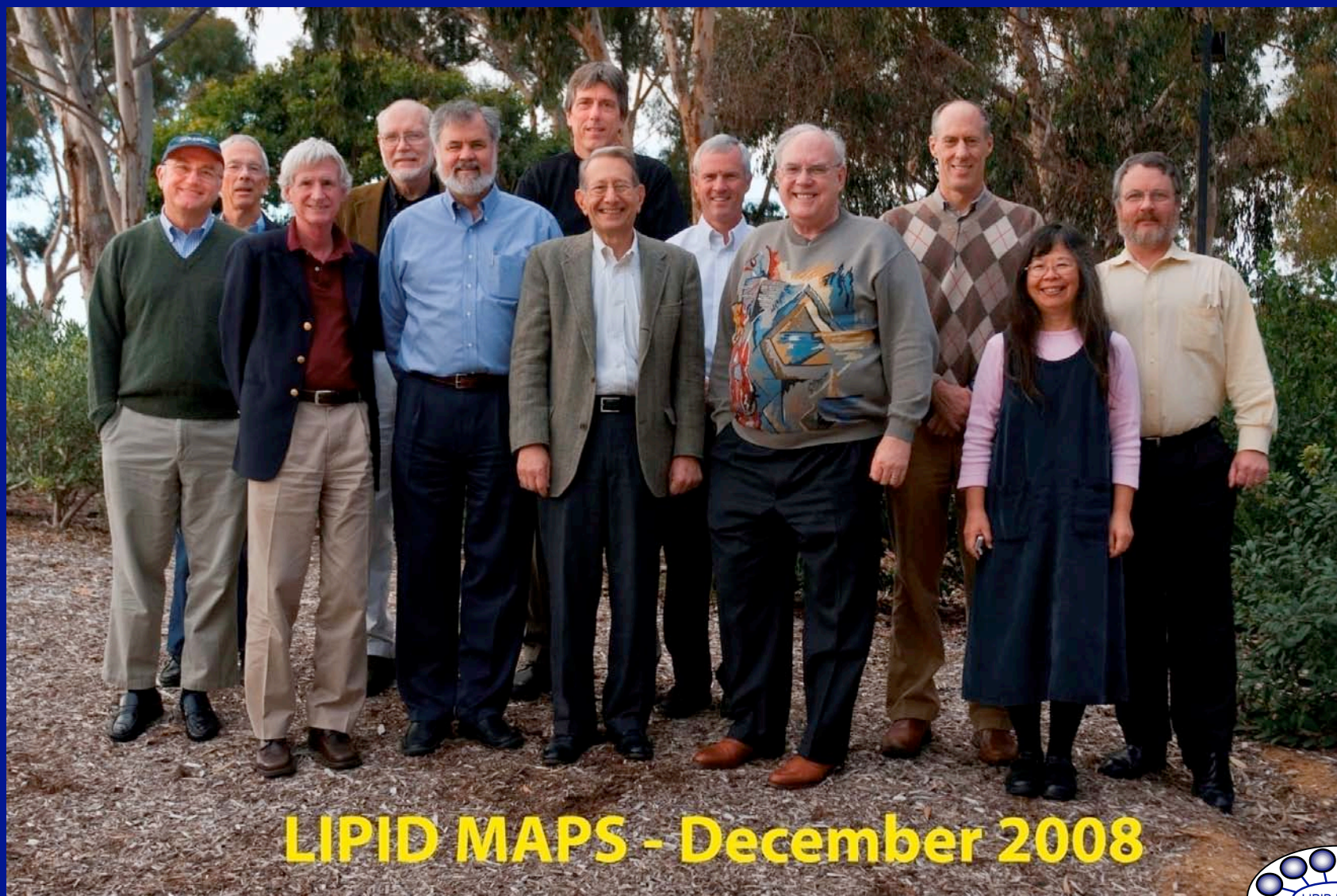
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Chris Raetz

Alex Brown

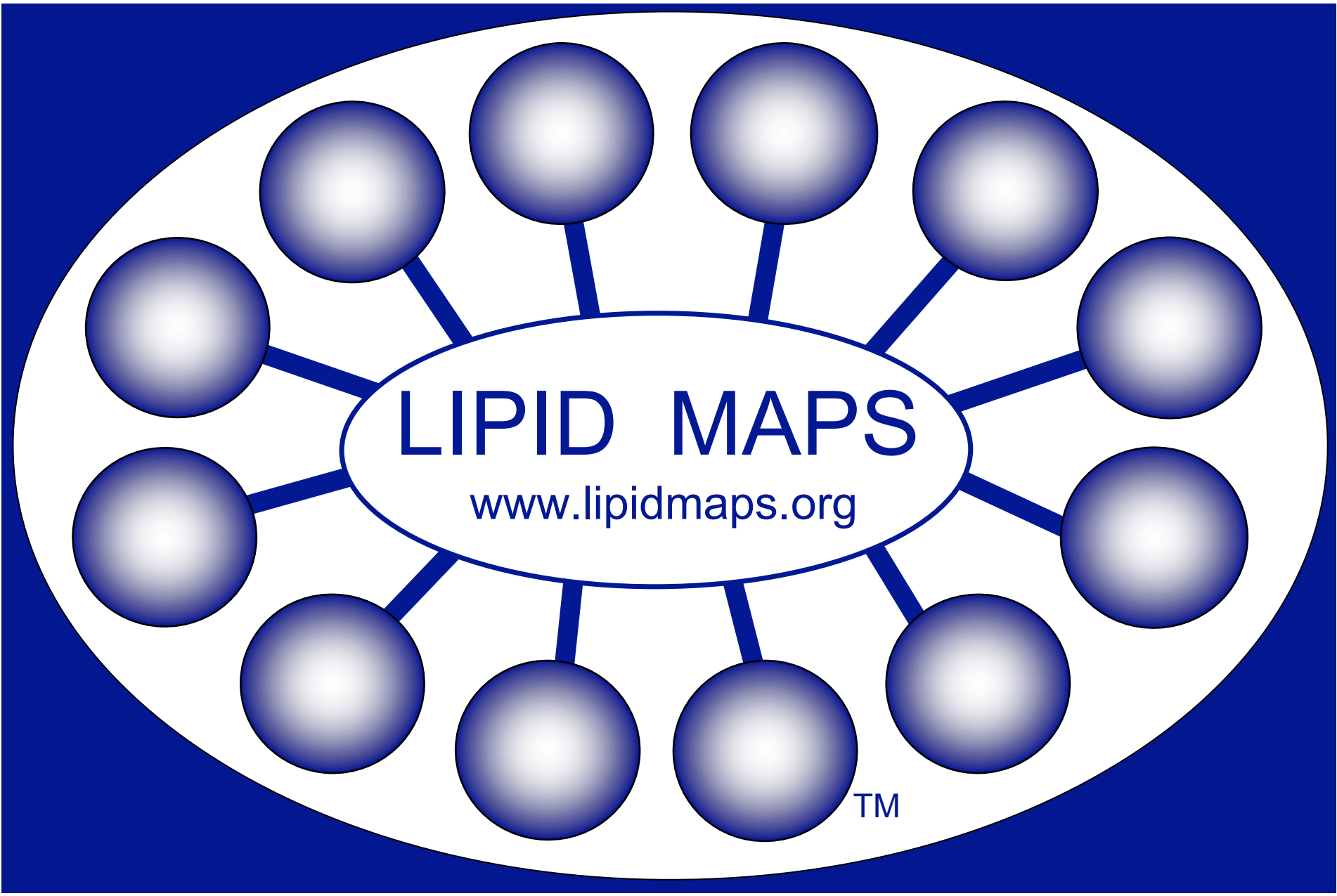
NIH U54 GM 69338





LIPID MAPS - December 2008



The logo features a central white oval with the text "LIPID MAPS" in blue. Below this oval is a larger white oval containing the URL "www.lipidmaps.org". Surrounding the central oval are twelve blue spheres, each with a white highlight, connected to the central oval by blue lines. The entire design is set against a dark blue background.

LIPID MAPS

www.lipidmaps.org

TM