PUBLICATIONS

C.A. **Gobrogge,** V.A. Kong, R.A. Walker "Unusual Temperature Dependent Solvation and Partitioning in Phospholipid Membranes" *Journal of Physical Chemistry B* **120** (8), 1805-1812 (2016).

C.A. **Gobrogge,** H.S. Blanchard, R.A. Walker **"**Temperature Dependent Partitioning of C152 in Phosphatidylcholine Lipid Bilayers" *Journal of Physical Chemistry B* (2017), *in press*.

C.A. **Gobrogge,** R.A. Walker "Quantifying C152 and C461 Partitioning in Phosphatidylcholine Lipid Bilayers" *Analytical Chemistry* (2017), *under review.*

C.A. **Gobrogge,** R.A. Walker "Temperature Dependent Partitioning of C152 in Binary Phosphatidylcholine Membranes and Binary Phosphatidylcholine/Phosphatidylethanolamine Membranes." *Journal of Physical Chemistry B* (2017), *in preparation*.

ORAL PRESENTATIONS

2015 *Unusual Temperature Dependent Partitioning and Solvation in Phospholipid Membranes*, Fourth-year graduate student seminar, Bozeman, MT

2015 *Solute Partitioning in Lipid Membranes: Using Time Resolved Spectroscopy to Understand Accumulation,* American Chemical Society Northwest Regional Meeting, Pocatello, ID

2014 *Reversible Partitioning in Model Membrane Systems,* American Chemical Society Northwest Regional Meeting, Missoula, MT

2010 *Lasers, Fluorimetry, and FRET,* Student Seminar Series, Holland, MI

POSTER PRESENTATIONS

2016 *Temperature Dependent Partitioning of Coumarin 152 in Phosphocholine/Phosphoethanolamine Lipid Bilayers,* Materials Science Under the Big Sky Symposium, Bozeman, MT

2015 *Unusual Temperature Dependent Partitioning and Solvation in Phospholipid Membranes*, Optical Technology Center annual meeting, Bozeman, MT

2014 *Using TCSPC and DSC to Investigate Partitioning in Mixed-Lipid Model Membranes,* Optical Technology Center annual meeting, Bozeman, MT

2013 *Using TCSPC to Investigate Coumarin Partitioning in Model Membrane Solutions*, Optical Technology Center annual meeting, Bozeman, MT

MONTANA STATE UNIVERSITY
Mountains & Minds

Department of Chemistry and Biochemistry

Doctor of Philosophy in Chemistry

DISSERTATION DEFENSE

Ms. Christine Ann Gobrogge

B.Sc. Hope College, Holland, MI (2012)

Friday, April 14, 2017 – 9 am
Byker Auditorium
Department of Chemistry and Biochemistry

"Temperature Dependent Partitioning in Phospholipid Membranes"

Graduate Committee

Dr. Robert Walker (Research Advisor)
Dr. Patrick Callis (Chemistry)
Dr. Mary Cloninger (Chemistry)
Dr. Rufus Cone (Physics)
Dr. Bern Kohler (Chemistry)

ABSTRACT

Biological membranes are nature's selective barriers to intra and extracellular environments as they control the exchange of molecules between cells and their surroundings. Membranes can both mediate transmembrane solute movement and act as physical barriers to specific solute diffusion. Membranes also serve as reservoirs where solutes can accumulate. Solute partitioning into biological membranes has profound implications for pharmaceutical activity and the bioaccumulation of toxins. While the principle of membrane partitioning is straightforward, predicting its consequences is not. Membrane solubility reflects a subtle balance of noncovalent forces between the solute and its bulk solution limits versus the solute in the heterogeneous solvation environment created within biological membranes.

Experiments described in this dissertation were designed to systematically investigate solute partitioning in phospholipid membrane systems based on phospholipid identity, solute identity, and lipid membrane phase. Solute partitioning in model membranes was determined using a variety of experimental techniques including time-resolved and steady-state fluorescence, dynamic light scattering, and differential scanning calorimetry.

Summarized in this PhD defense are two experiments that have provided insight to the following questions:

1. *How does phosphatidylcholine acyl chain length affect partitioning?*

   Phosphatidylcholine vesicles were comprised of DLPC (12:0 PC), DMPC (14:0 PC), and DPPC (16:0 PC). In all three lipid systems, coumarin 152 (C152) showed partitioning behavior that was qualitatively similar but quantitatively different: partitioning into a gel phase membrane was slightly exothermic and slightly entropically unfavorable. Partitioning of C152 near the lipid membrane melting temperature was entropically driven and endothermic. Well above the melting temperature, exsolvation of C152 from the membrane back into the aqueous buffer was enthalpically driven but entropically unfavorable. Regardless of solution temperature, relatively little (<20%) C152 partitioned into the hydrophobic core of the membrane.

2. *How does solute structure affect partitioning?*

   C152 and C461 differ solely in the 4-position where C152 has a $-CF_3$ group in place of C461's $-CH_3$ group. Fluorescence amplitudes were used to calculate absolute partition coefficients and average number of solutes per DPPC vesicle. Lipid bilayer affinity is ~10x greater for C152 than for C461, despite both solutes having similar log P values.

BIOGRAPHICAL NOTES

Academic Preparation:

2008-2012 Hope College, Holland, MI (May 2012)
Bachelor of Science in Chemistry
Research: Fluorescent Resonant Energy Transfer in Single and Double Stranded miRNA..
Advisor: Dr. Brent Krueger

2011 Montana State University, Bozeman, MT (Jun.–Aug.)
National Science Foundation- Research Experience for Undergraduates
Research: Structure and Organization of Surfactants at the Water/Air Interface
Advisor: Dr. Rob Walker

Graduate Studies

Field of Study: Biophysical Chemistry

Teaching and Outreach Activities

2012-2016	General Chemistry Lab TA, Montana State University
2015-2016	Graduate Student Association Board Member, Montana State University

Awards

2012	Mildred Livingston Presidential Award
2014	Montana State University Chemistry Department Nomination: Outstanding Graduate Teaching Award
2015	Montana State University Graduate Student Competitive Research Grant
2016	Mares Teaching Award
2016	Montana State University Graduate School PhD Completion Award