

BIOL 639, Fall 2019. Seminar in Plant Molecular and Cell Biology

Focus topic: Dynamics of membranes and their interacting proteins

Jason W. Reed

305 Coker Hall (104 Coker Hall)

Email: jreed@email.unc.edu

Telephone: (919) 962-5640

Time and Location: probably Wednesdays 12:00-1:00 in 1377 GSB

This is a primary scientific literature seminar course for graduate and advanced undergraduate students. The course will meet weekly in an interactive seminar format. Each week, we will discuss the background, methods, and results of a paper from the recent scientific literature, and interpret these in the light of current knowledge. Students will practice reading and interpreting scientific papers, and present information to the group. Each week, one student will have primary responsibility for presenting to the group the background needed to understand the paper, and the main points presented in the paper figures. All students should read the assigned paper before class, and be prepared to discuss it.

For students taking the course for credit (1 hr.), grades will be based on attendance and class participation (45%); preparation and presentation of a topic (45%), and a short take-home exam (10%) to be handed in by 12:00 on Friday, Dec. 13th. This will be handed out in the last class, and will consist of a written analysis and interpretation of a paper chosen from the literature.

This semester, we will focus on how proteins interact with membranes to regulate cell biological or signaling events, an important area throughout biology. Topics may include how organelles maintain their shapes, how proteins recognize and bind to membranes, control of endocytosis and exocytosis, organization of signaling protein complexes at the plasma membrane, lipid dynamics, contacts among different cellular membranes or compartments, and others to be chosen (see separate list of possible papers). During the organizational meeting, we will choose from among these or other topics and assign students to present on particular dates.

August 21 – organizational meeting

August 28 –

September 4 –

September 11 –

September 18 –

September 25 –

October 2 –

October 9 –

October 16 –

October 23 –

October 30 –

November 6 –

November 13 –

November 20 –

December 4 –

(Exam, hand in by Friday December 13th, 12:00)

Course readings will be chosen from the following papers or others that we discover

Lipids in signaling

- Barnett KC, Coronas-Serna JM, Zhou W, Ernandes MJ, Cao A, Kranzusch PJ, Kagan JC** (2019) Phosphoinositide Interactions Position cGAS at the Plasma Membrane to Ensure Efficient Distinction between Self- and Viral DNA. *Cell* **176**: 1432-1446 e1411
- Chen J, Chen ZJ** (2018) PtdIns4P on dispersed trans-Golgi network mediates NLRP3 inflammasome activation. *Nature* **564**: 71-76
- Gronnier J, Crowet JM, Habenstein B, Nasir MN, Bayle V, Hosy E, Platre MP, Gouguet P, Raffaele S, Martinez D, Grelard A, Loquet A, Simon-Plas F, Gerbeau-Pissot P, Der C, Bayer EM, Jaillais Y, Deleu M, Germain V, Lins L, Mongrand S** (2017) Structural basis for plant plasma membrane protein dynamics and organization into functional nanodomains. *Elife* **6**
doi:10.7554/eLife.26404

Lipids recruiting signaling proteins

- Barbosa IC, Shikata H, Zourelidou M, Heilmann M, Heilmann I, Schwechheimer C** (2016) Phospholipid composition and a polybasic motif determine D6 PROTEIN KINASE polar association with the plasma membrane and tropic responses. *Development* **143**: 4687-4700
- Gerganova V, Floderer C, Archetti A, Michon L, Carlini L, Reichler T, Manley S, Martin SG** (2019) Multi-phosphorylation reaction and clustering tune Pom1 gradient mid-cell levels according to cell size. *Elife* **8** doi:10.7554/eLife.45983
- Kang JK, Kim OH, Hur J, Yu SH, Lamichhane S, Lee JW, Ojha U, Hong JH, Lee CS, Cha JY, Lee YJ, Im SS, Park YJ, Choi CS, Lee DH, Lee IK, Oh BC** (2017) Increased intracellular Ca²⁺ concentrations prevent membrane localization of PH domains through the formation of Ca²⁺-phosphoinositides. *Proc Natl Acad Sci U S A* **114**: 11926-11931

PM-organelle dynamics

- Jia PF, Xue Y, Li HJ, Yang WC** (2018) Golgi-localized LOT regulates trans-Golgi network biogenesis and pollen tube growth. *Proc Natl Acad Sci U S A* **115**: 12307-12312
- Lee E, Vanneste S, Perez-Sancho J, Benitez-Fuente F, Strelau M, Macho AP, Botella MA, Friml J, Rosado A** (2019) Ionic stress enhances ER-PM connectivity via phosphoinositide-associated SYT1 contact site expansion in Arabidopsis. *Proc Natl Acad Sci U S A* **116**: 1420-1429
- Stefano G, Renna L, Wormsbaecher C, Gamble J, Zienkiewicz K, Brandizzi F** (2018) Plant Endocytosis Requires the ER Membrane-Anchored Proteins VAP27-1 and VAP27-3. *Cell Rep* **23**: 2299-2307

Organelle curvature

- Armbruster U, Labs M, Pribil M, Viola S, Xu W, Scharfenberg M, Hertle AP, Rojahn U, Jensen PE, Rappaport F, Joliot P, Dormann P, Wanner G, Leister D** (2013) Arabidopsis CURVATURE THYLAKOID1 proteins modify thylakoid architecture by inducing membrane curvature. *Plant Cell* **25**: 2661-2678
- Miller SE, Mathiasen S, Bright NA, Pierre F, Kelly BT, Kladt N, Schauss A, Merrifield CJ, Stamou D, Honing S, Owen DJ** (2015) CALM regulates clathrin-coated vesicle size and maturation by directly sensing and driving membrane curvature. *Dev Cell* **33**: 163-175

- Pribil M, Sandoval-Ibanez O, Xu W, Sharma A, Labs M, Liu Q, Galgenmuller C, Schneider T, Wessels M, Matsubara S, Jansson S, Wanner G, Leister D** (2018) Fine-Tuning of Photosynthesis Requires CURVATURE THYLAKOID1-Mediated Thylakoid Plasticity. *Plant Physiol* **176**: 2351-2364
- Breeze E, Dzimitrowicz N, Kriechbaumer V, Brooks R, Botchway SW, Brady JP, Hawes C, Dixon AM, Schnell JR, Fricker MD, Frigerio L** (2016) A C-terminal amphipathic helix is necessary for the in vivo tubule-shaping function of a plant reticulon. *Proc Natl Acad Sci U S A* **113**: 10902-10907

Charged lipid organization and metabolism

- Zewe JP, Wills RC, Sangappa S, Goulden BD, Hammond GR** (2018) SAC1 degrades its lipid substrate PtdIns4P in the endoplasmic reticulum to maintain a steep chemical gradient with donor membranes. *Elife* **7** doi: 10.7554/eLife.35588
- Platre MP, Noack LC, Doumane M, Bayle V, Simon MLA, Maneta-Peyret L, Fouillen L, Stanislas T, Armengot L, Pejchar P, Caillaud MC, Potocky M, Copic A, Moreau P, Jaillais Y** (2018) A Combinatorial Lipid Code Shapes the Electrostatic Landscape of Plant Endomembranes. *Dev Cell* **45**: 465-480 e411
- Platre MP, Bayle V, Armengot L, Bareille J, Marques-Bueno MDM, Creff A, Maneta-Peyret L, Fiche JB, Nollmann M, Miege C, Moreau P, Martiniere A, Jaillais Y** (2019) Developmental control of plant Rho GTPase nano-organization by the lipid phosphatidylserine. *Science* **364**: 57-62

PI(4,5)P₂ functions

- Hempel F, Stenzel I, Heilmann M, Krishnamoorthy P, Menzel W, Golbik R, Helm S, Dobritzsch D, Baginsky S, Lee J, Hoehenwarter W, Heilmann I** (2017) MAPKs Influence Pollen Tube Growth by Controlling the Formation of Phosphatidylinositol 4,5-Bisphosphate in an Apical Plasma Membrane Domain. *Plant Cell* **29**: 3030-3050
- Hirano T, Konno H, Takeda S, Dolan L, Kato M, Aoyama T, Higaki T, Takigawa-Imamura H, Sato MH** (2018) PtdIns(3,5)P₂ mediates root hair shank hardening in Arabidopsis. *Nat Plants* **4**: 888-897

Lipid droplets

- Prevost C, Sharp ME, Kory N, Lin Q, Voth GA, Farese RV, Jr., Walther TC** (2018) Mechanism and Determinants of Amphipathic Helix-Containing Protein Targeting to Lipid Droplets. *Dev Cell* **44**: 73-86 e74

Exocytosis, vesicle sorting

- Zhu X, Li S, Pan S, Xin X, Gu Y** (2018) CSI1, PATROL1, and exocyst complex cooperate in delivery of cellulose synthase complexes to the plasma membrane. *Proc Natl Acad Sci U S A* **115**: E3578-E3587
- Ahmed SM, Nishida-Fukuda H, Li Y, McDonald WH, Gradinaru CC, Macara IG** (2018) Exocyst dynamics during vesicle tethering and fusion. *Nat Commun* **9**: 5140
- Ketel K, Krauss M, Nicot AS, Puchkov D, Wieffer M, Muller R, Subramanian D, Schultz C, Laporte J, Haucke V** (2016) A phosphoinositide conversion mechanism for exit from endosomes. *Nature* **529**: 408-412