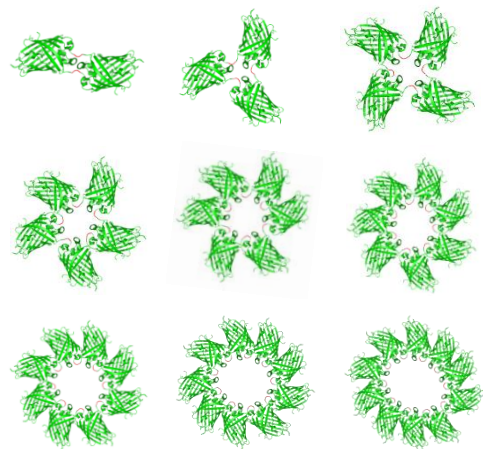


생체막과 단백질 밀집 간 역학 연구

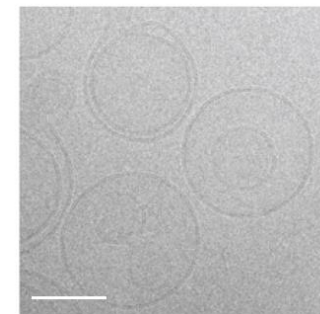
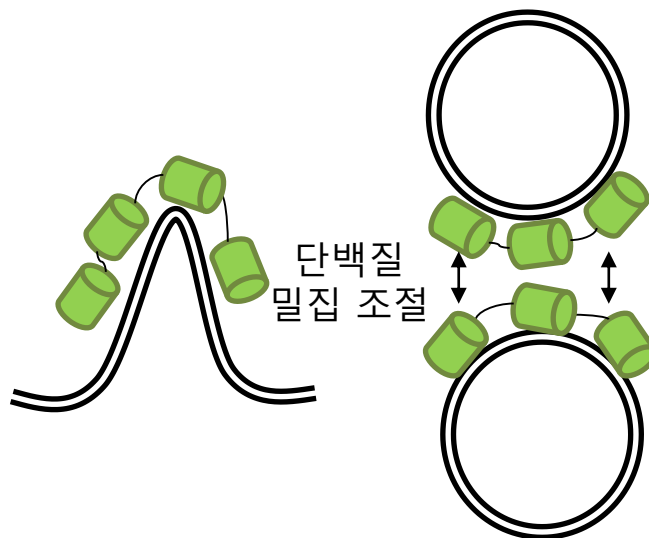
(Dynamics between bio-membrane and protein crowding)

Yongwon Jung

KAIST, Department of Chemistry



단백질 조립체



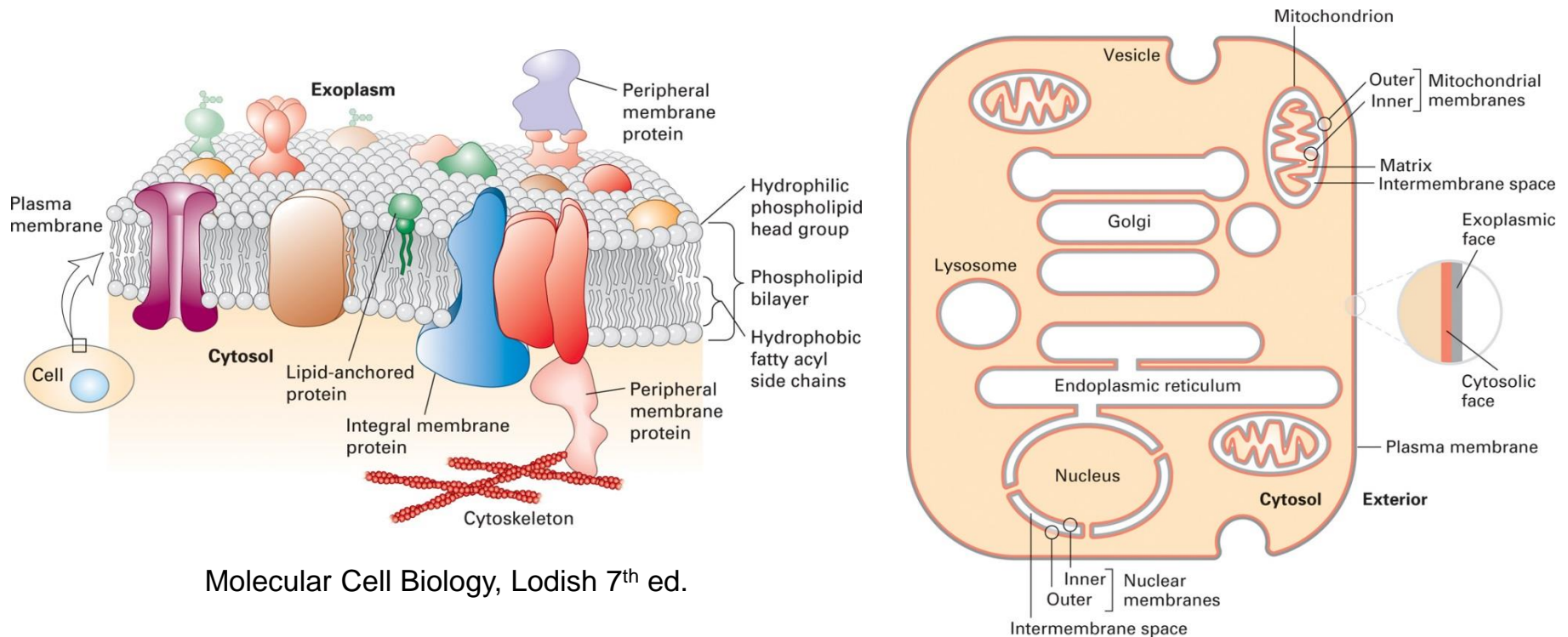
생체막 역학 관찰

Bio-membrane dynamics

Cellular organization by bio-membrane

Bio-membrane dynamics for controlled delivery of materials/signals

- Controlled membrane bending, curvature, fission, fusion, ...
- Question: How to control these dynamic processes?

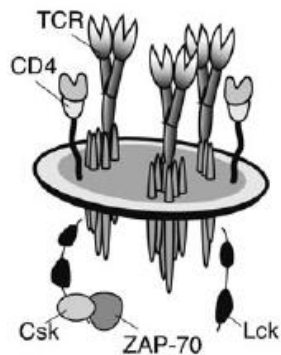


Protein crowding on Bio-membrane

Protein crowding & membrane dynamics

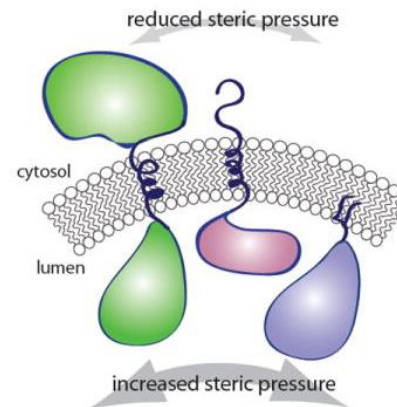
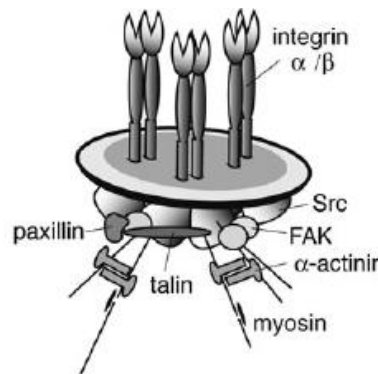
- Protein/receptor clustering for better signal transduction on membrane
- Protein crowding can cause membrane bending/fission
- Question: Roles of protein clustering on membrane dynamics

T-cell receptors:
Immune synapse

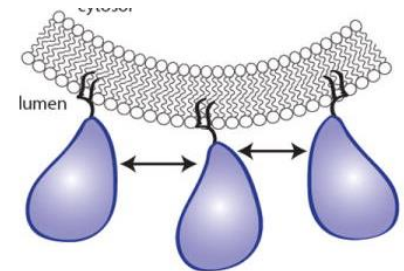
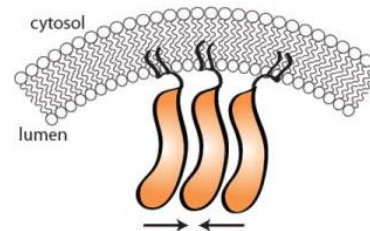


Angew. Chem. **45**, 2348 (2006)

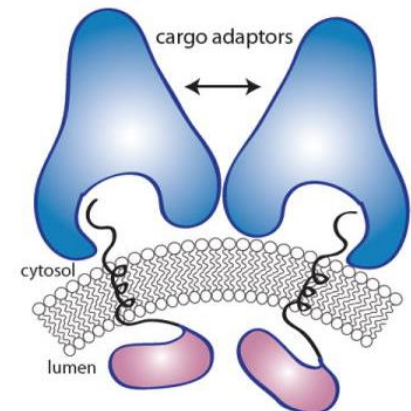
Integrins:
focal adhesions



C. Oligomerization induces curvature towards cargoes

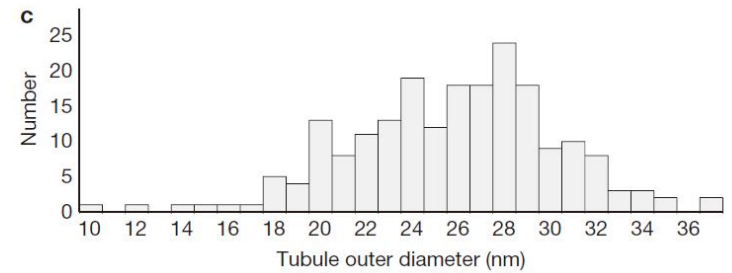
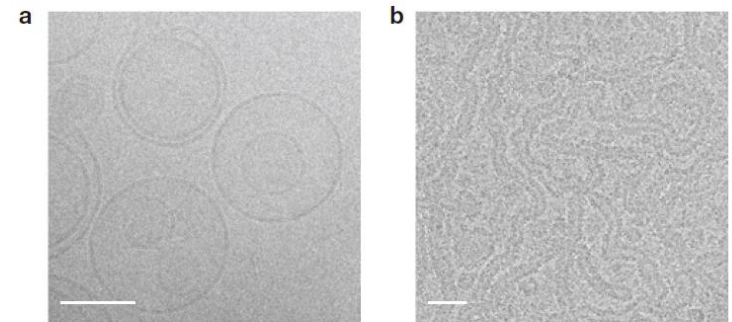
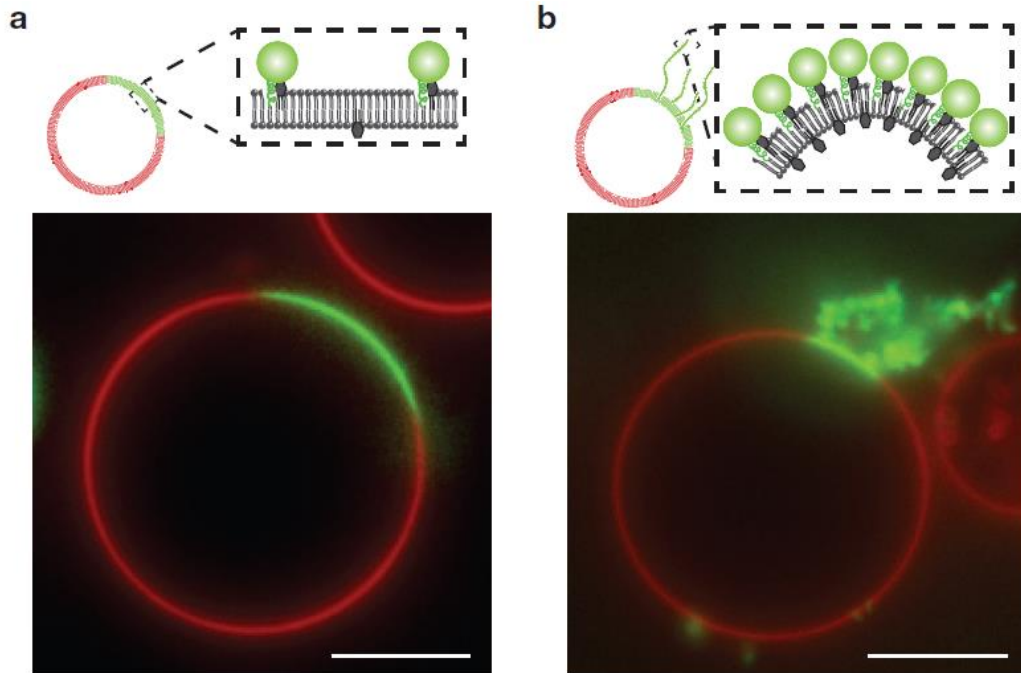


D. Combined mass of cargo plus adaptor creates steric pressure



Lack of spatial & temporal resolution

- Confocal microscopy analysis with **GUV** (spatial limitation > 200 nm)
- TEM analysis for liposome deformation
- Needs: Ways to control protein crowding & monitor membrane dynamics



Nature Chem. Biol. **14**, 944 (2012)

Purpose: theme & goals

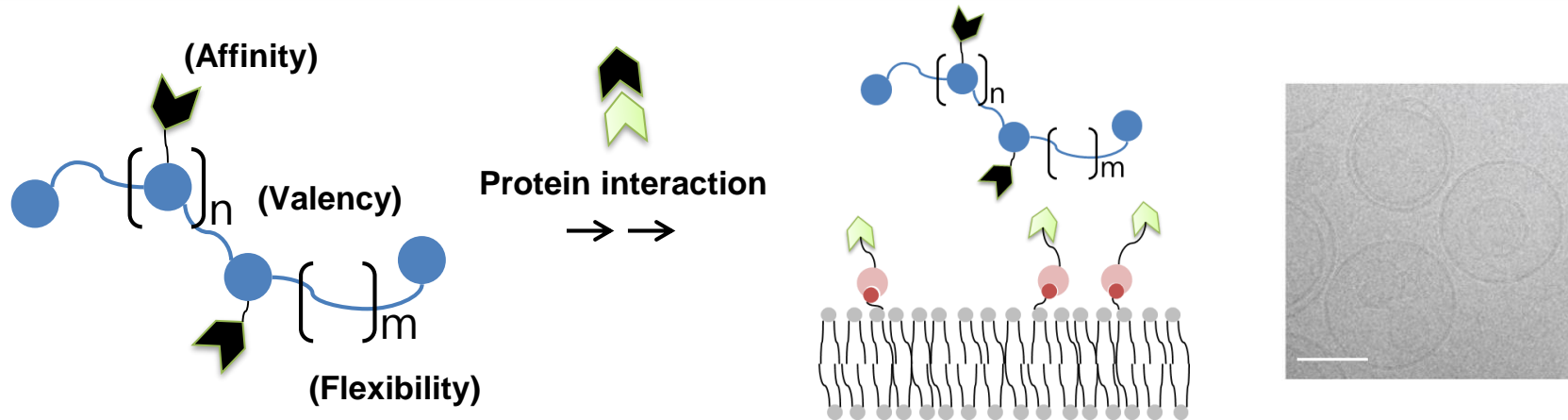
› Goals

- Understand fundamental principles of dynamics between bio-membrane & protein crowding
- Follow spatial & temporal behavior of (model) bio-membranes
- Develop strategies to control bio-membrane dynamics with protein assemblies

› Approaches

Precise control of multivalent protein membrane interaction

- Tailor-made multivalent protein assemblies (to fully control protein crowding)
- CryoEM based monitoring of bio-membrane dynamics (snapshot)

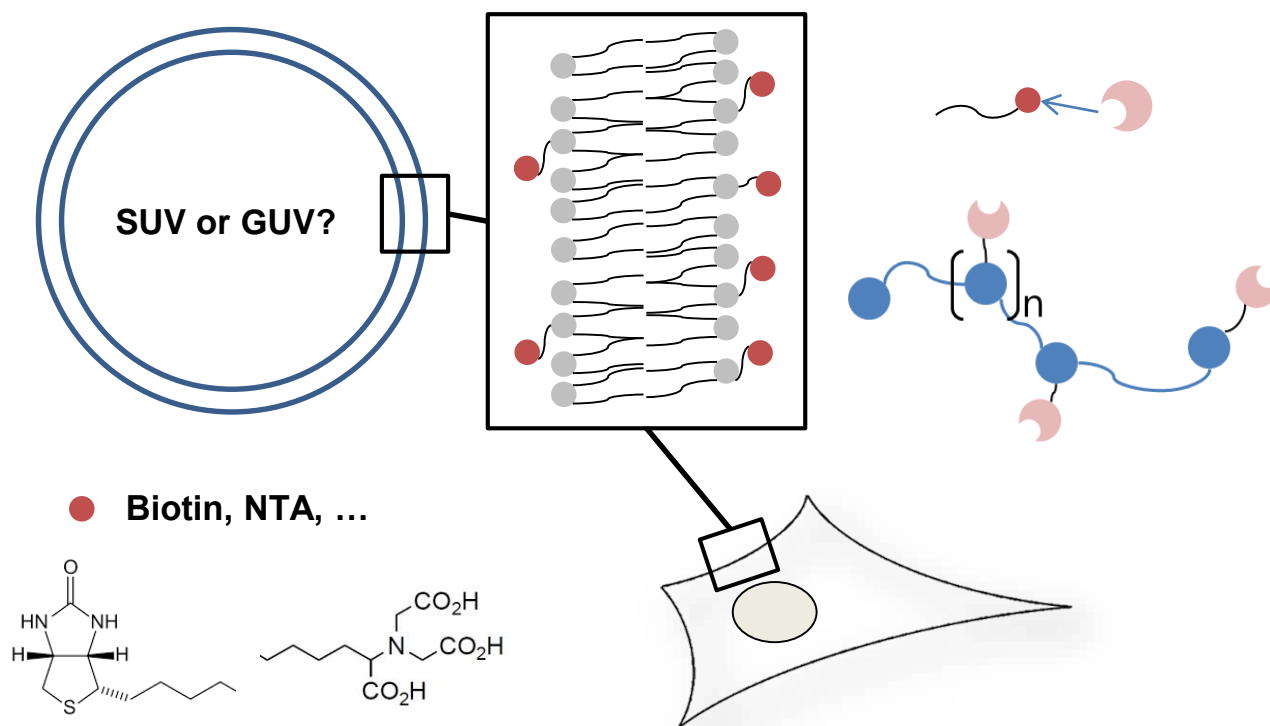


Key Strategic Approach I

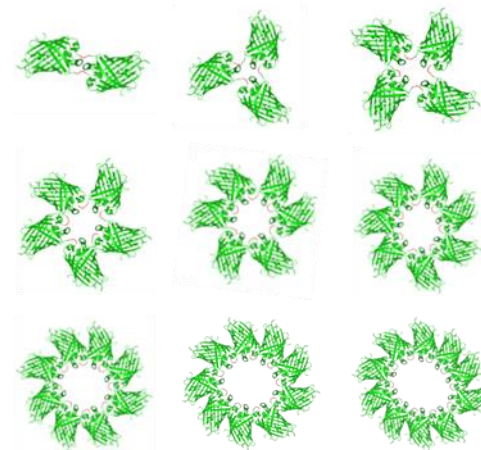
▶ Tailor-made multivalent protein assemblies on model bio-membrane

To control protein crowding at a single protein resolution

- Program: Multi-valency & Affinity & Flexibility & ...
- Previously : A series of monodisperse protein assemblies with defined valency



A set of assemblies



- Spatial orientation
- Functionalization
- Flexibility

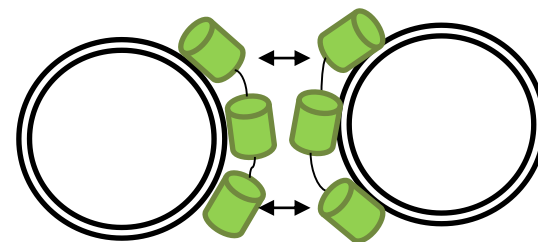
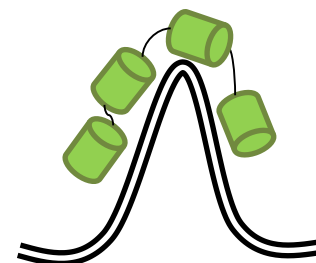
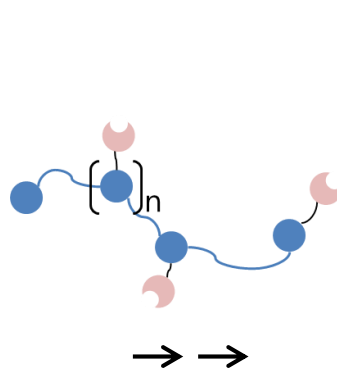
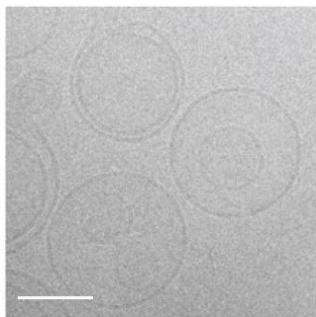
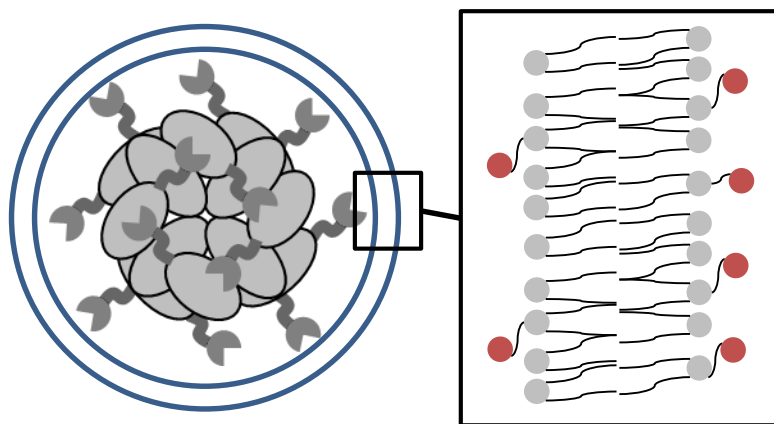
Nature Commun. **6**, 7134 (2015)

Key Strategic Approach II

› CryoEM analysis of bio-membrane dynamics

To image diverse bio-membrane dynamic states at a protein cluster resolution?

- Model bio-membranes: Monodisperse & Functional & ... (e.g., on protein template)
- Find ideal conditions: Size, temperature, composition, ...



Project Contents and Structure

Research contents

- I.** Fabrication of monodisperse protein assemblies with defined multi-valency and functionality for bio-membrane introduction
- II.** Reconstitution of monodisperse/functional model bio-membranes
- III.** Induction of bio-membrane dynamics with protein assemblies
- IV.** Study on bio-membrane dynamics with CryoEM

[Structure]

Year 1, 2, 3, 4, 5, ...

Tailor-made protein assemblies for protein crowding (Jung Lab)

Monodisperse/functional model bio-membranes

Bio-membrane dynamics with protein assemblies

CryoEM analysis of bio-membrane dynamics by protein crowding