

## Description of Additional Supplementary Files

**File name:** Supplementary Data 1

**Description:** Source data to Figures 1b, 1e, 2g, 2h, 3b.

**File name:** Supplementary Movie 1

**Description:** PS-GUVs labeled with Marina Blue™ were incubated with FITC-labeled recombinant CPn0677 (1 μM) and imaged for 15 min. Images were acquired every 1 min.

**File name:** Supplementary Movie 2

**Description:** CPn0677 recruits G-actin to GUV membranes. PS-GUVs labeled with Marina Blue™ were incubated with 3 μM G-actinAtto647 for 10 min. Then 3 μM FITC-labeled CPn0677 was added and images were acquired at 1-min intervals for 10 min every 1 min.

**File name:** Supplementary Movie 3

**Description:** PS-GUVs labeled with Marina Blue™ were incubated with 3 μM G-actinAtto647, 3 μM NHS-rhodamine-labeled mini-WASP and the unlabeled Arp2/3 complex (100 nM) for 10 min. Images were acquired at 1-min intervals.

**File name:** Supplementary Movie 4

**Description:** PS-GUVs labeled with Marina Blue™ were incubated with 3 μM G-actinAtto647 for 10 min. Then 3 μM NHS-rhodamine-labeled mini-WASP, 100 nM unlabeled Arp2/3 complex, 3 μM FITC-labeled CPn0677, and 1x polymerization buffer were added and images were acquired at 1-min intervals for 10-15 min.