

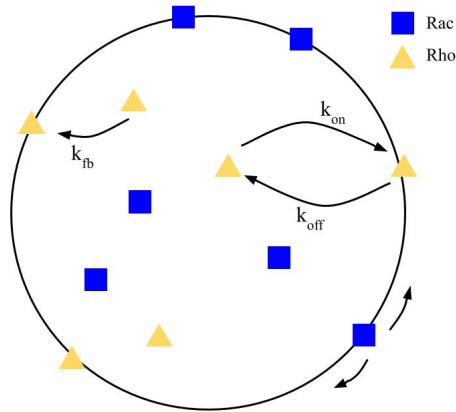
# LAB MEETING 1

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## SINGLE CELL

- ▶ Rac and Rho particles inside the cell and on the cell membrane
- ▶ Bind to the membrane with rate  $k_{on}$
- ▶ Unbind from the membrane with rate  $k_{off}$
- ▶ Recruit particles with rate  $k_{fb}$
- ▶ Particles can also diffuse along the membrane



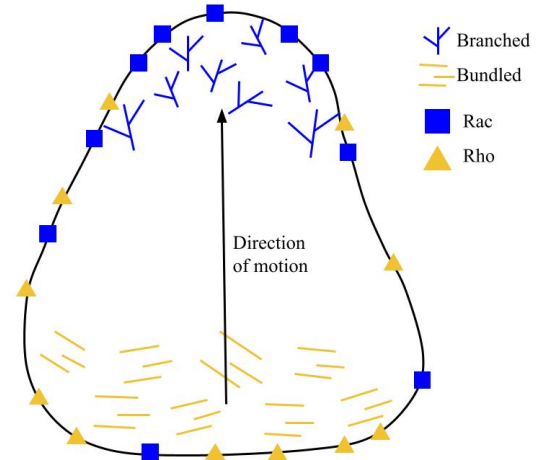
## SINGLE CELL

- ▶ Branched and bundled actin networks
- ▶ Rac forms branched networks with actin
- ▶ Rho forms bundled networks with actin
- ▶ Branched actin is protrusive and bundled actin is contractile

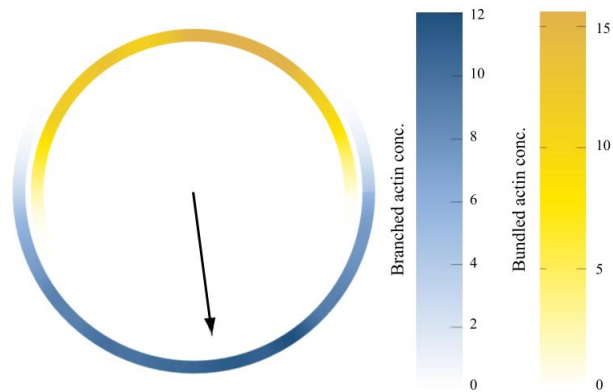
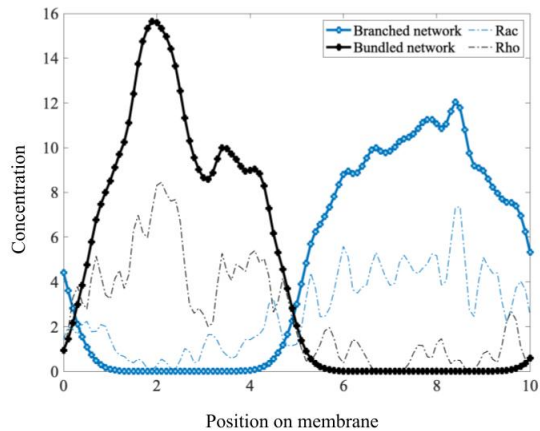
Equations for branched actin ( $a$ )  
and bundled actin ( $b$ ):

$$\frac{\partial a(s, t)}{\partial t} = K_a(a(1 + \alpha n_{rac}(s, t)) - a^2) - m_0 ab + D_a \Delta a$$

$$\frac{\partial b(s, t)}{\partial t} = K_b(b(1 + \alpha n_{rho}(s, t)) - b^2) - m_0 ab + D_b \Delta b$$

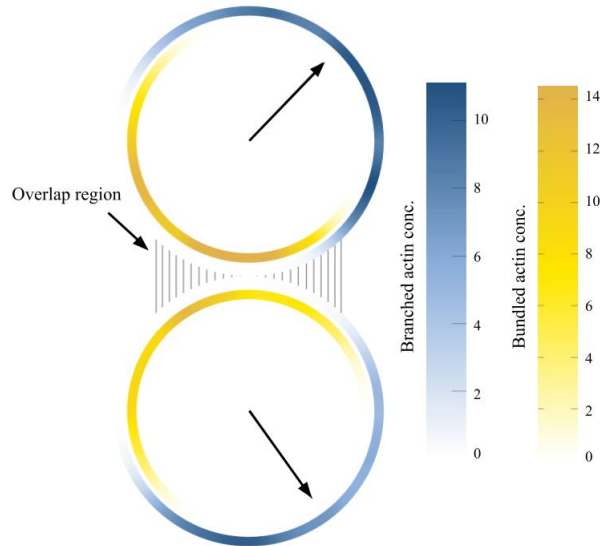


# SINGLE CELL



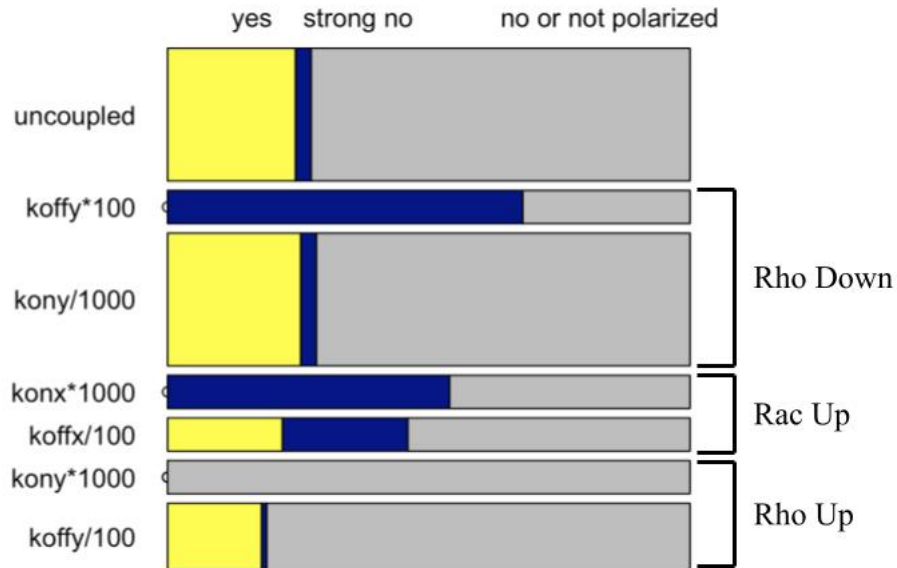
## TWO CELLS

- ▶ Define a contact region between the two cells
- ▶ Uncoupled: nothing different happens at the contact region
- ▶ Determine if the cells are going in the same direction; within 45 degrees = yes

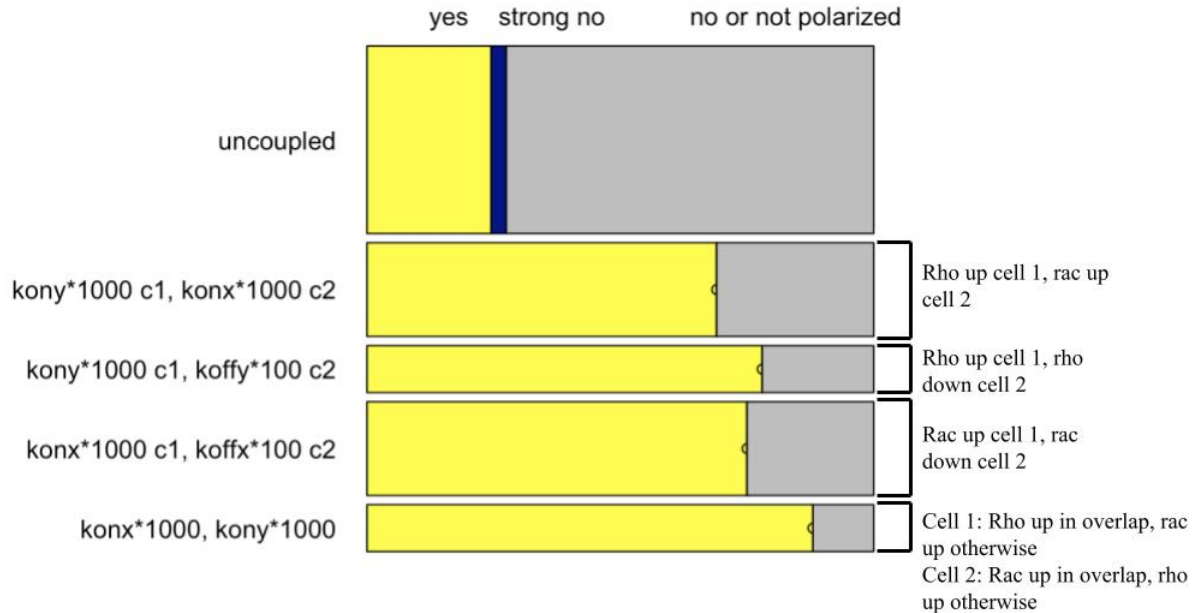


## RAC/RHO BINDING AND UNBINDING

Change binding rate ( $k_{on}$ ) or unbinding rate ( $k_{off}$ ) for rac ( $x$ ) or rho ( $y$ ) in the contact region.

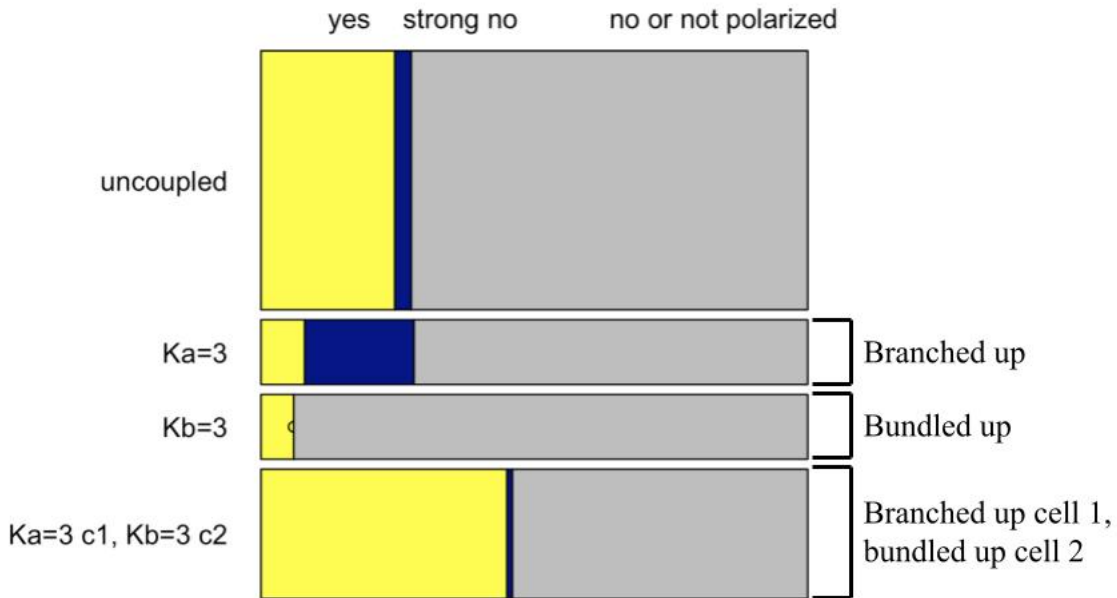


## RAC/RHO BINDING AND UNBINDING



## BRANCHED/BUNDLED ACTIN FORMATION

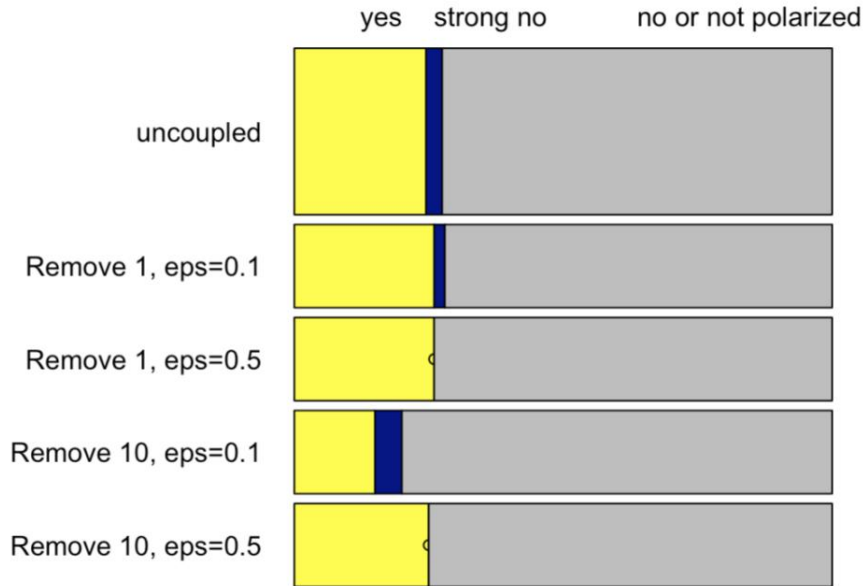
Change the rate of branched or bundled actin formation by changing the coefficient  $K_a$  or  $K_b$  in the contact region.





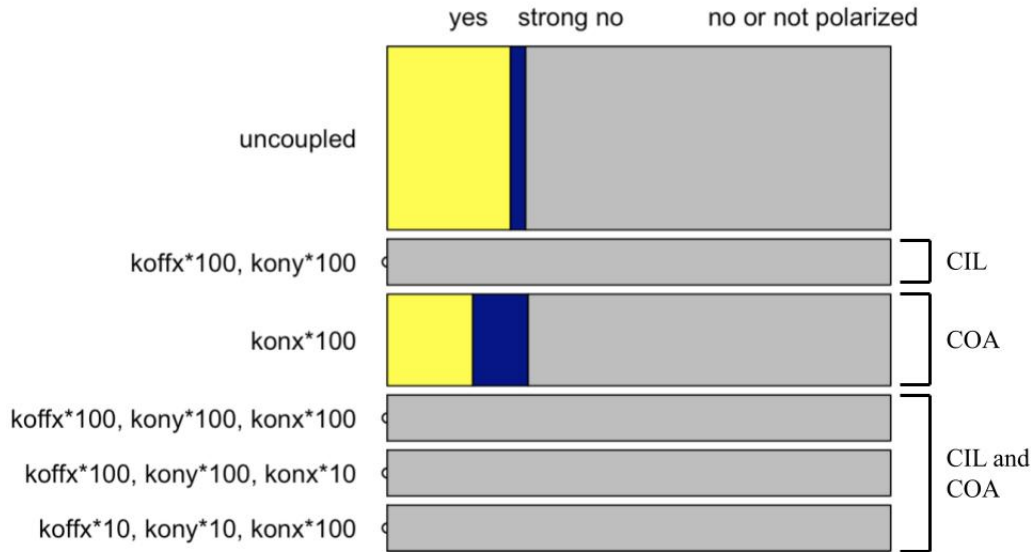
## INCREASED ANTAGONISM BETWEEN RAC AND RHO

When a rac particle binds in the overlap region in cell 1, remove 1 or more nearby ( $\varepsilon = 0.1, 0.5$ ) rho particles in cell 1. Do the same for cell 2.



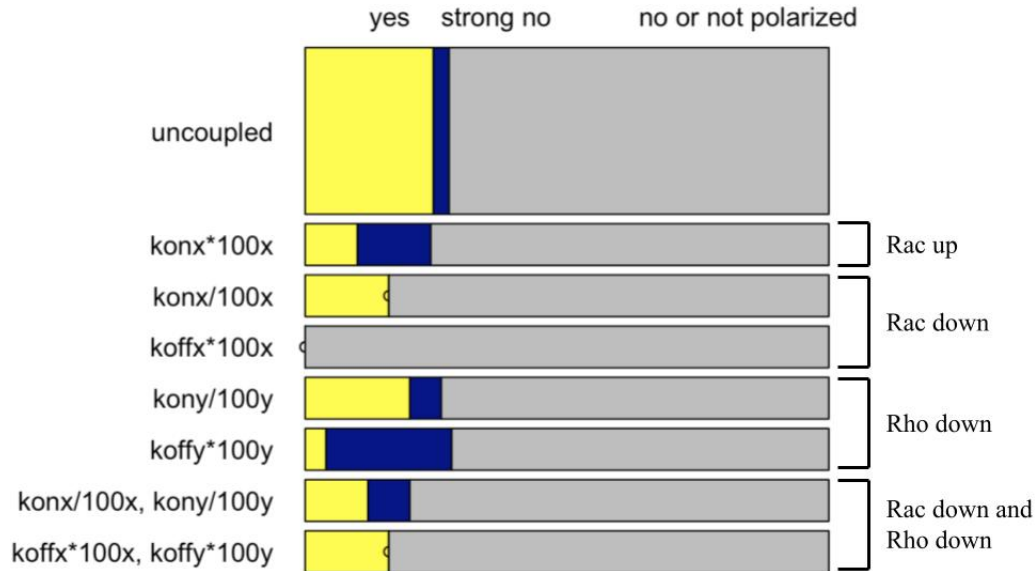
## CIL AND COA

- CIL = Contact Inhibition of Locomotion; when cells are in contact, down-regulate rac and up-regulate rho so cells move away from each other
- COA = Co-attraction; when cells are nearby, up-regulate rac so cells move towards each other



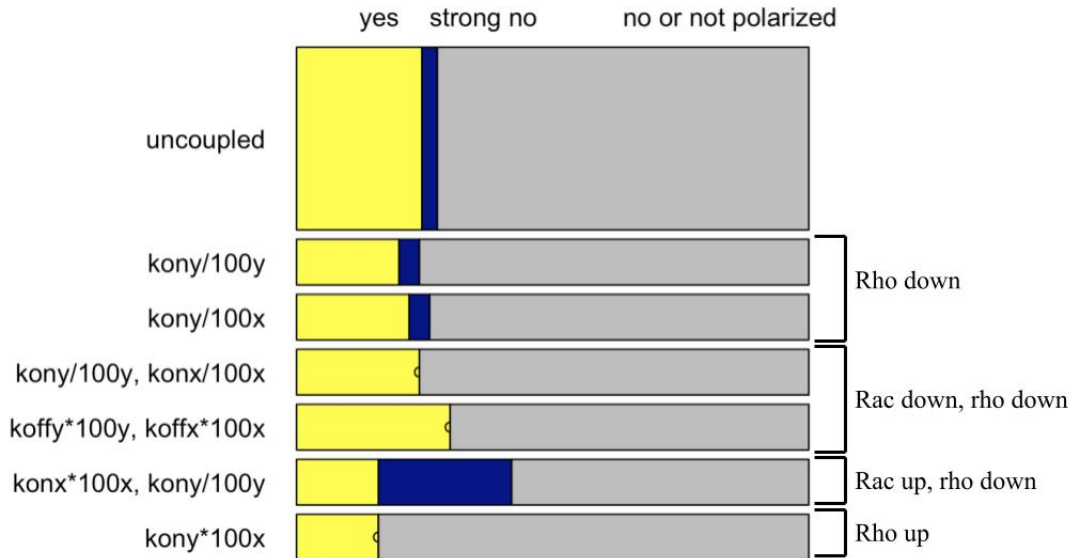
## RAC/RHO PROPORTIONAL TO OTHER CELL

At each point in the contact region of cell 1, change the rac/rho binding/unbinding rate depending on the amount of rac/rho nearby in cell 2. Do the same for cell 2.



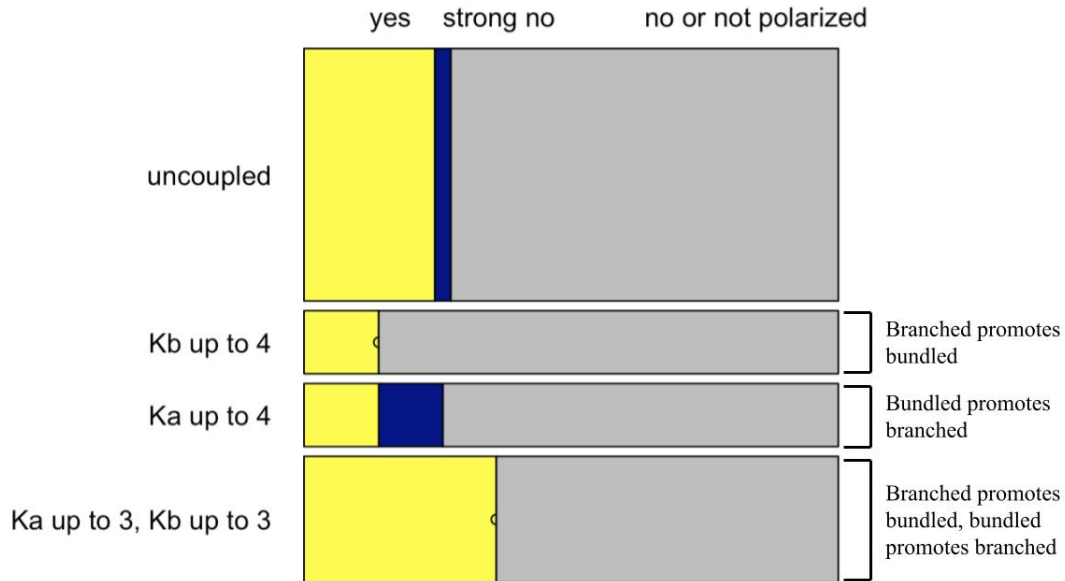
## RAC/RHO PROPORTIONAL TO ITSELF

At each point in the contact region of cell 1, change the rac/rho binding/unbinding rate depending on the amount of rac/rho nearby in cell 1. Do the same for cell 2.



## BRANCHED/BUNDLED PROPORTIONAL TO OTHER CELL

At each point in the contact region of cell 1, change the branched/bundled coefficient depending on the amount of branched/bundled actin nearby in cell 2. Do the same for cell 2.



## NEXT: ADDING CADHERINS

- ▶ Add cadherins to incorporate more interaction between the two cells
- ▶ Cadherins will also bind and unbind from the cell membrane like rac and rho
- ▶ They will stabilize when both cells place cadherins near each other in the contact region
- ▶ Cells will place more rac in the areas with cadherins, so implement CIL in those spots

