Morphogenesis

03:47:20

Instruction versus self-organization
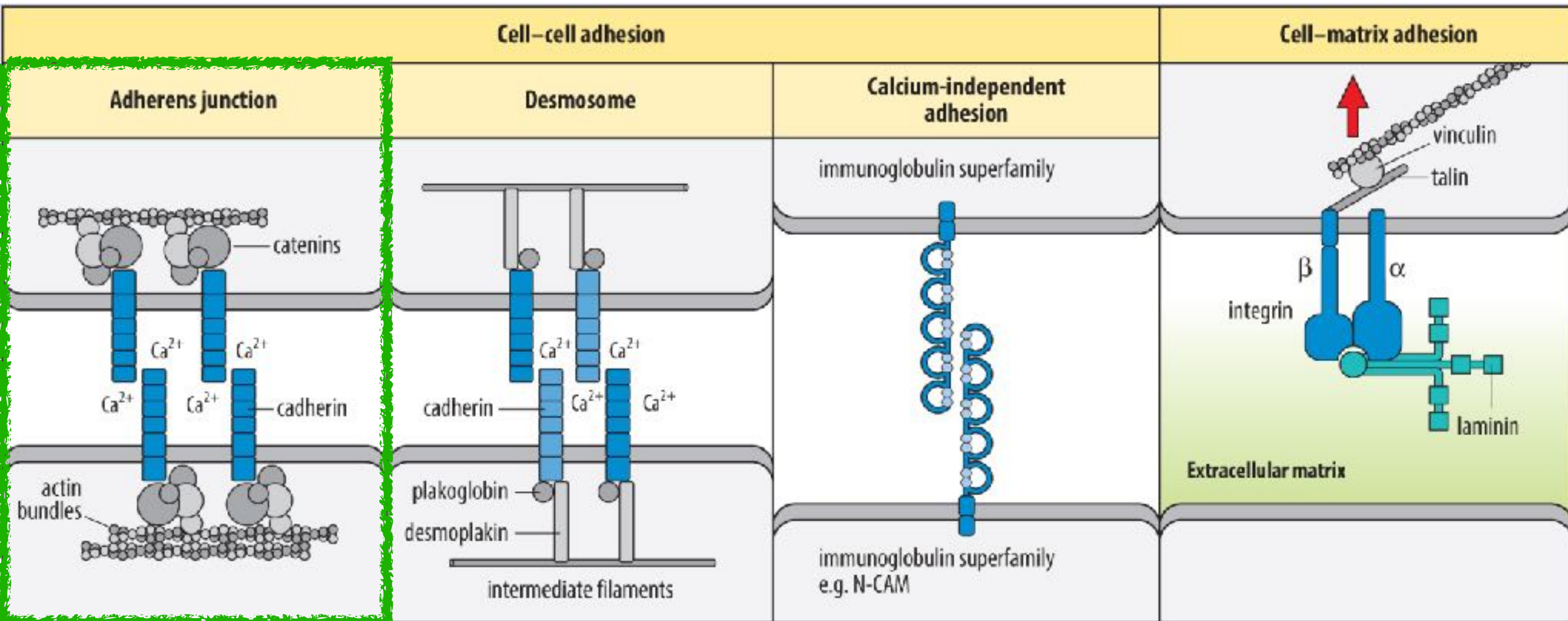

Johannes Holtfreter

"selective affinity" 1955


Fig. 15. When neural fold and medullary plate are combined with endoderm, invagination of the medullary material is incomplete and the developing epidermis and mesectoderm prevent isolation of the neural tissue. Figure 16. When dissociated cells of medullary plate and endoderm are mixed, the former move centripetally to produce a core of neural tissue lacking a neurocoel. Figure 17. The addition of neural fold produces epidermis and mesenchyme which prevent central allocation of the neural tissue and promote neurocoel formation.

Cell-cell and cell-matrix adhesion systems

Cell–cell adhesion			Cell–matrix adhesion
Adherens junction	Desmosome	Calcium-independent adhesion	

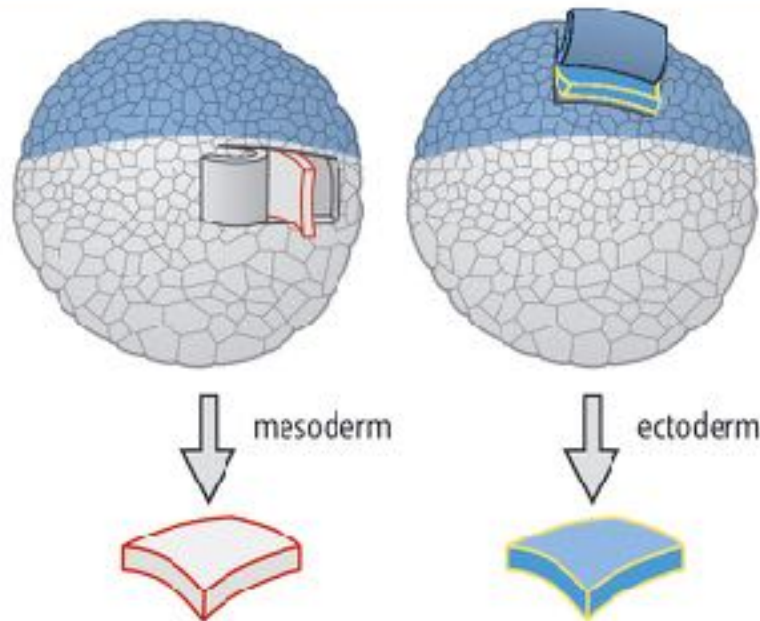# Cadherin *type* and *level* can drive cell sorting
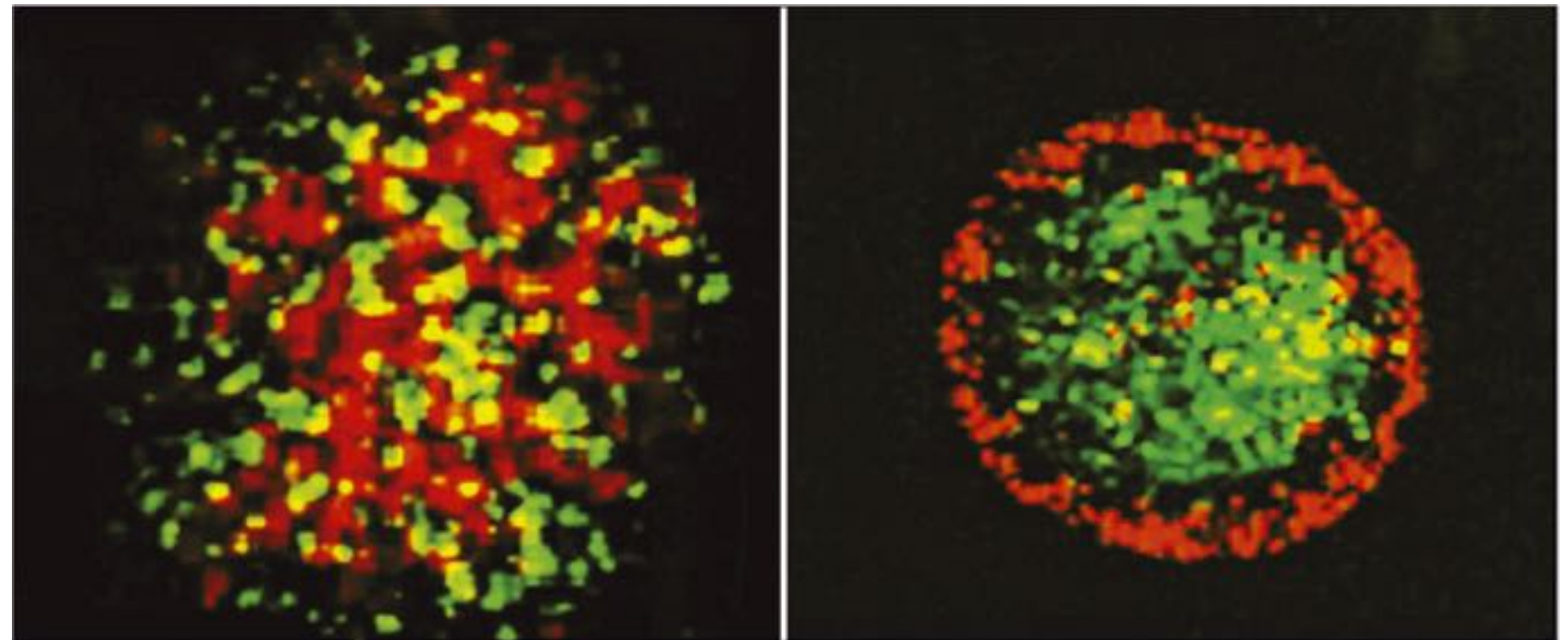
Early →→→→ Late

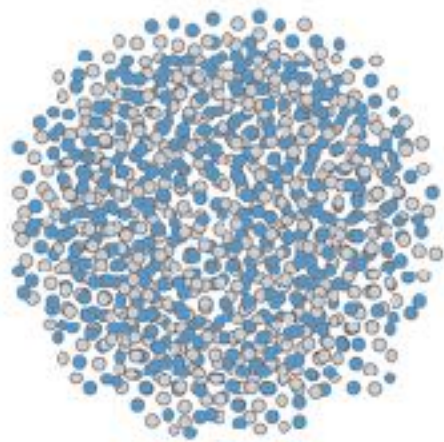**High N-cadherin**
Low N-cadherin
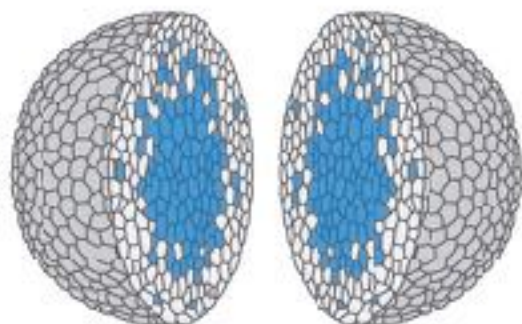
Malcolm Steinberg

"differential adhesion hypothesis" 1964

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Tissues taken from amphibian early gastrulas

mesoderm   ectoderm

Tissues disaggregated into single cells
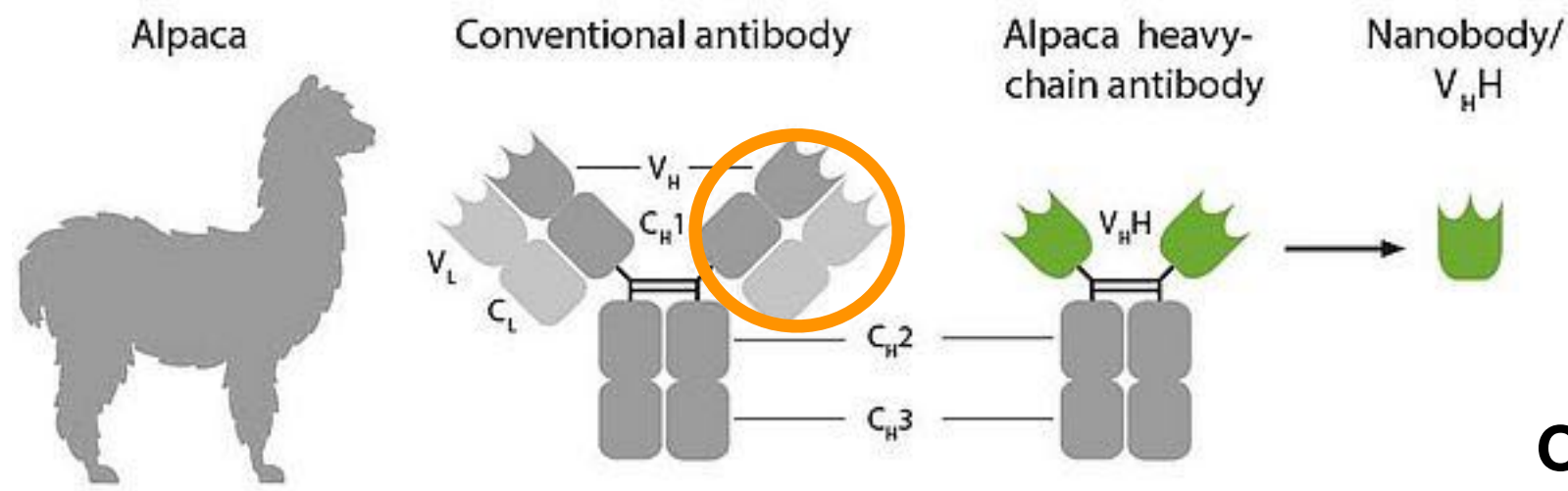
Spontaneous reaggregation. Cells sort
out with mesodermal cells outermost

Cell sorting driven by differential surface tension and differential adhesion

N-cadherin

E-cadherin

- Surface tension: oil-water

- Surface tension modified by adhesion

- Cells with strongest interactions form inner layer

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Single chain antibodies - Nanobody

One gene, 12-15 KDa peptide, simple production

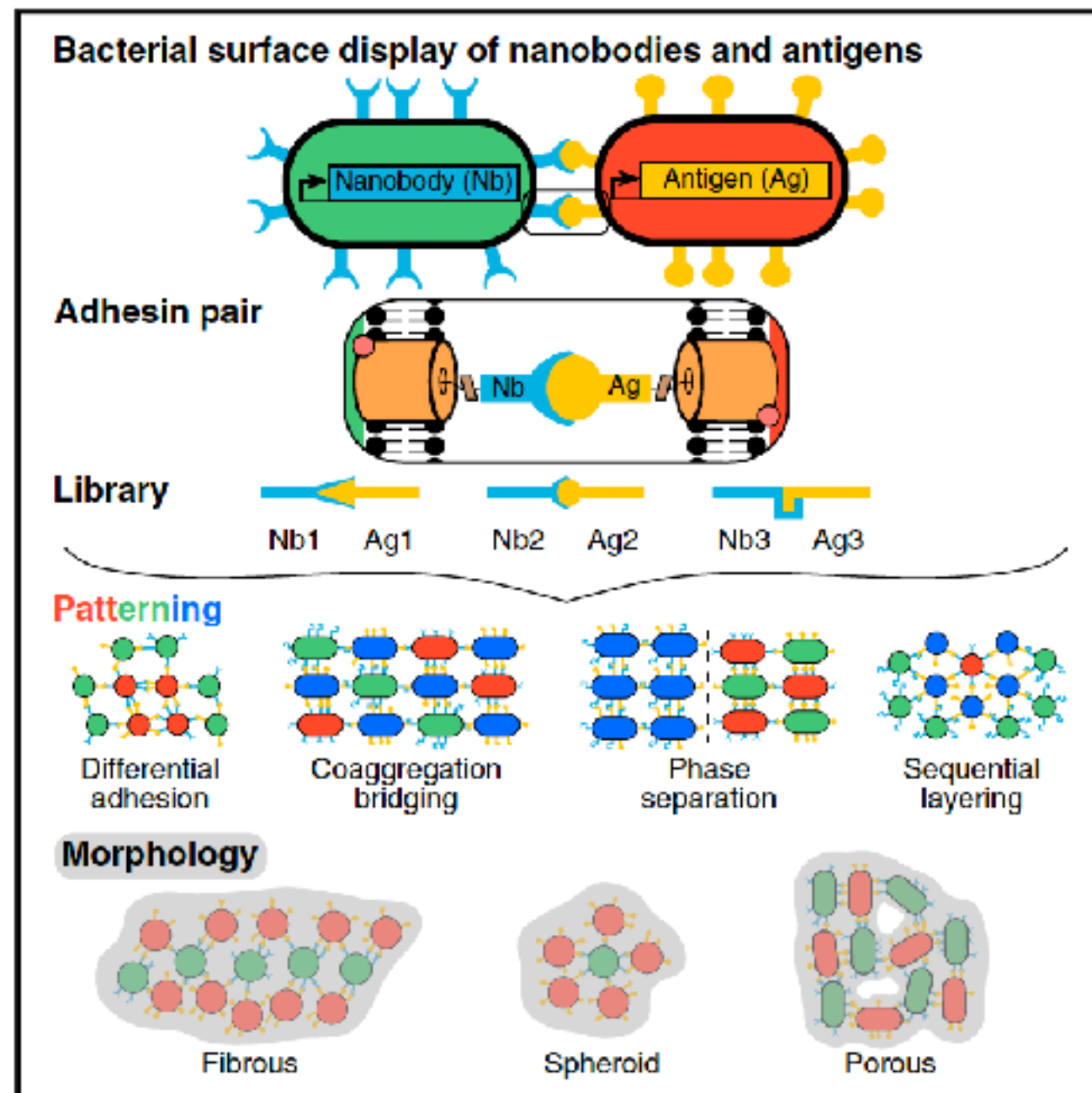Two genes, complex peptide folding and secretion 150-160 KDa

Fab - 50 Kda

A Synthetic Bacterial Cell-Cell Adhesion Toolbox for Programming Multicellular Morphologies and Patterns

Graphical Abstract

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In Brief

The development of a genetically encoded toolkit of surface-bound nanobodies and antigens in *E. coli* allows for precise manipulation of cell-cell adhesion and rational design of diverse self-assembled multicellular patterns and morphologies.

Balance of forces at contact point
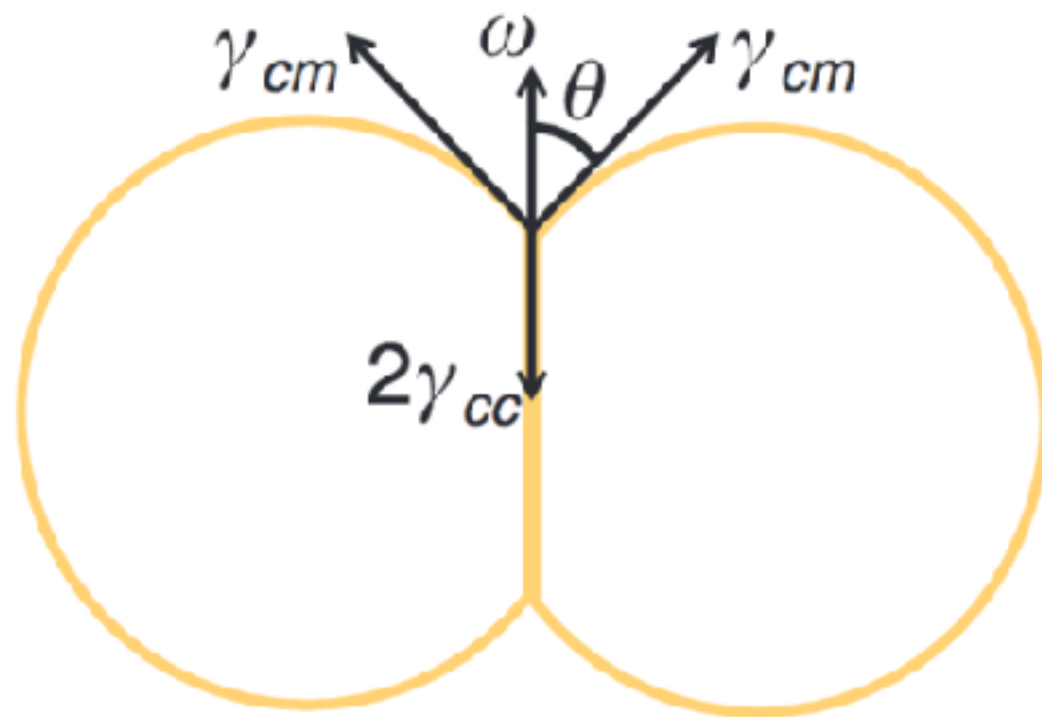
$$\cos \theta = \frac{2\gamma_{cc} - \omega}{2\gamma_{cm}}$$

- Tension from cortex contact with medium (γ_{cm})

- Tension from cortex contact with cell (γ_{cc})

- Tension from adhesion between cells (ω)