

ACT 2: Prevention of Infection Transmission

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Infection Transmission

Risk factors and onset of communicable diseases following natural disasters

Major risk factors following natural disasters	Onset of communicable diseases					
	Water-borne diseases	Air-borne/droplet diseases	Vector-borne diseases	Contamination from wounded injuries	Clinical phase of natural disasters	
Population displacement from nonendemic to endemic areas			▼ ▼			▼
Overcrowding (close and multiple contacts)	▼	▼ ▼ ▼ ▼				▼
Stagnant water after flood and heavy rains	▼ ▼		▼ ▼			▼
Insufficient/contaminated water and poor sanitation condition	▼ ▼					▼
High exposure and proliferation to disease vectors			▼ ▼			
Insufficient nutrient intake/malnutrition	▼	▼ ▼ ▼				▼
Low vaccination coverage		▼				
Injuries				▼ ▼		▼ ▼
	Diarrhea (cholera; dysentery) Leptospirosis Hepatitis ARI (pneumonia/influenza) Meningococcal meningitis	TB Measles	Dengue fever Malaria	Tetanus Cutaneous mucormycosis	Impact phase (0-4 days) Postimpact phase (4 days- 4 weeks) Recovery phase (>4 weeks)	



Source: United Nations University

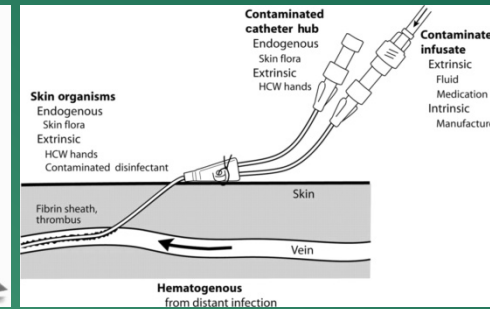


Surface-mediated Transmission

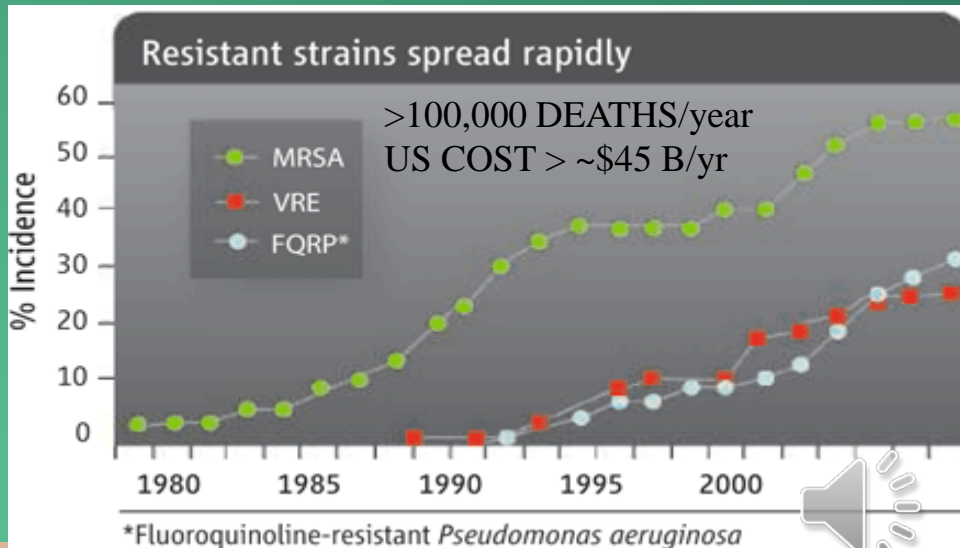
“Dirty” Surfaces



Medical Surfaces



MRSA

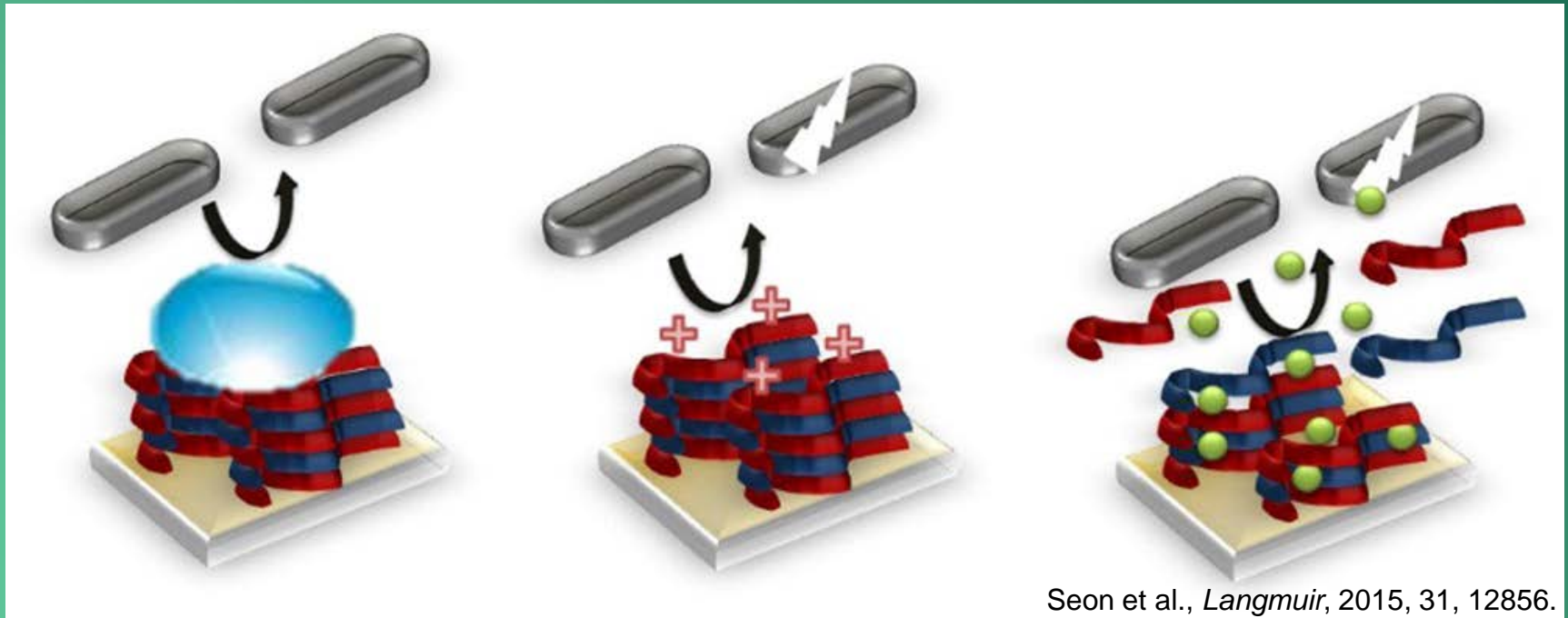


Antimicrobial Coatings

Anti-Adhesive

Contact-Killing

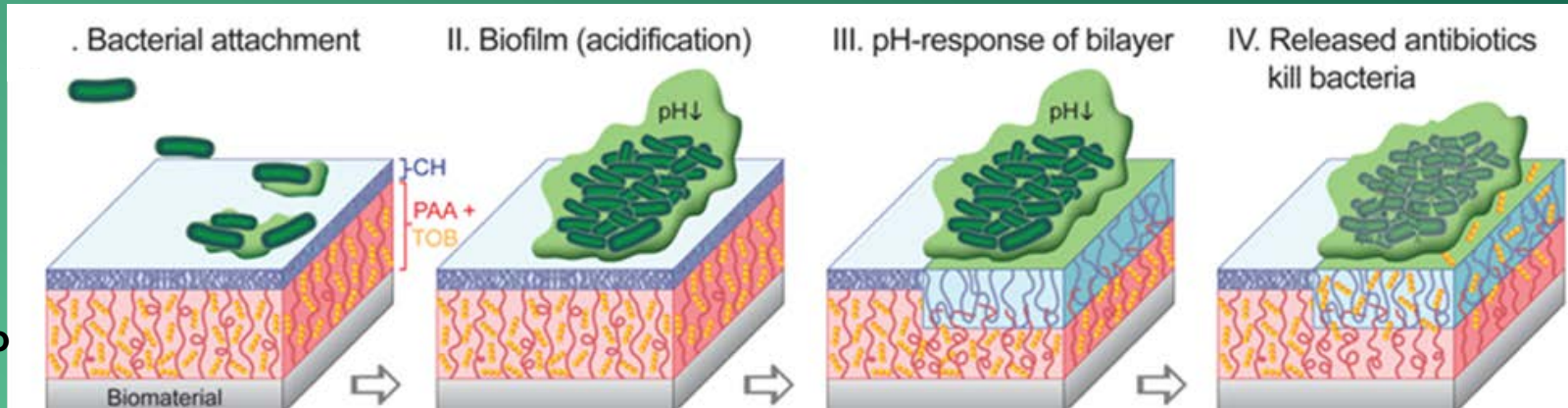
Release-Killing



Our Approaches (ACTs)



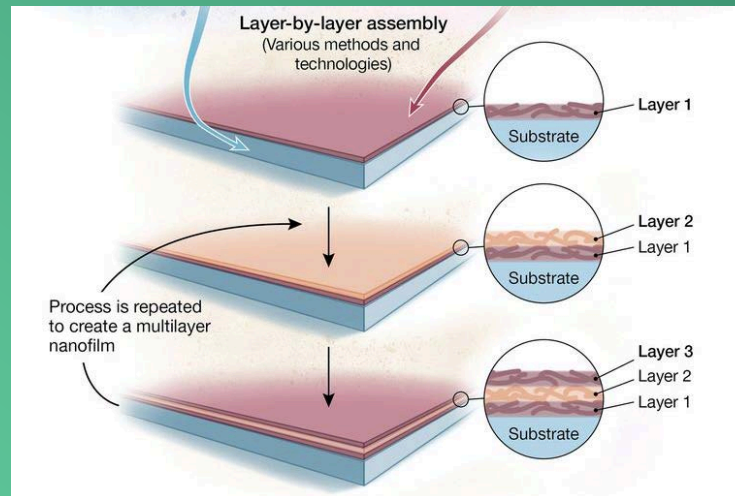
Russ Compston
(Penn)



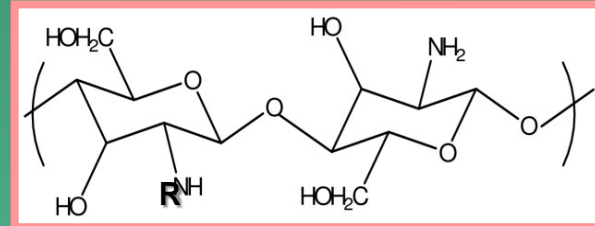
Catherine Picart
(GIANT)



(Penn)



Chitosan (CHI)



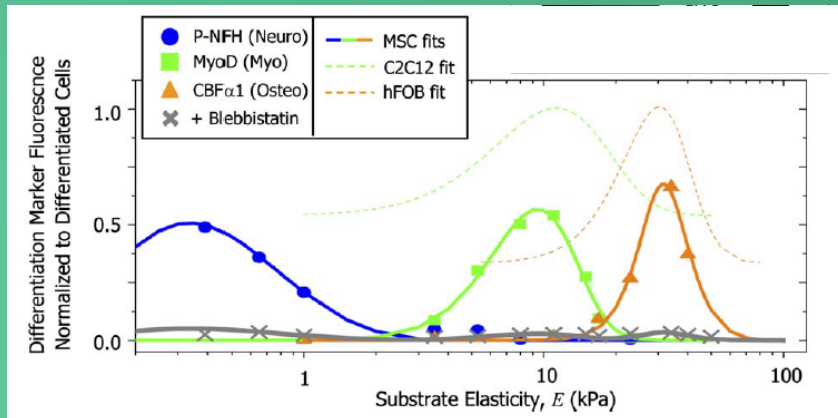
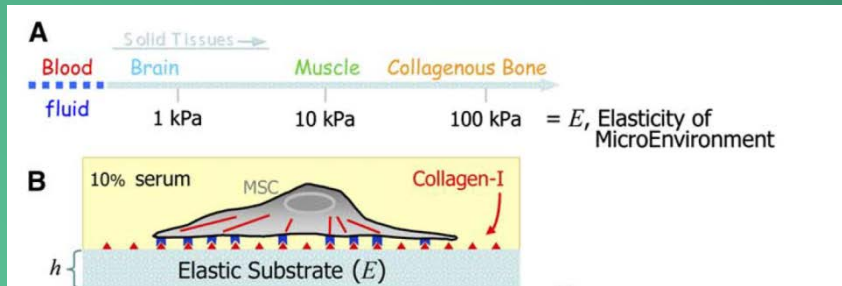
N-acetyl-D-glucosamine-β(1,4)-
glucosamine copolymer

Fundamental Questions

- How does the **viscoelasticity** of surfaces/coatings affect cell adhesion and proliferation?
- How does the **surface texture** affect cell adhesion and proliferation?
- How does **(de)hydration** affect antimicrobial properties of surface?
- How do **microorganisms respond** and adapt to engineered surfaces?

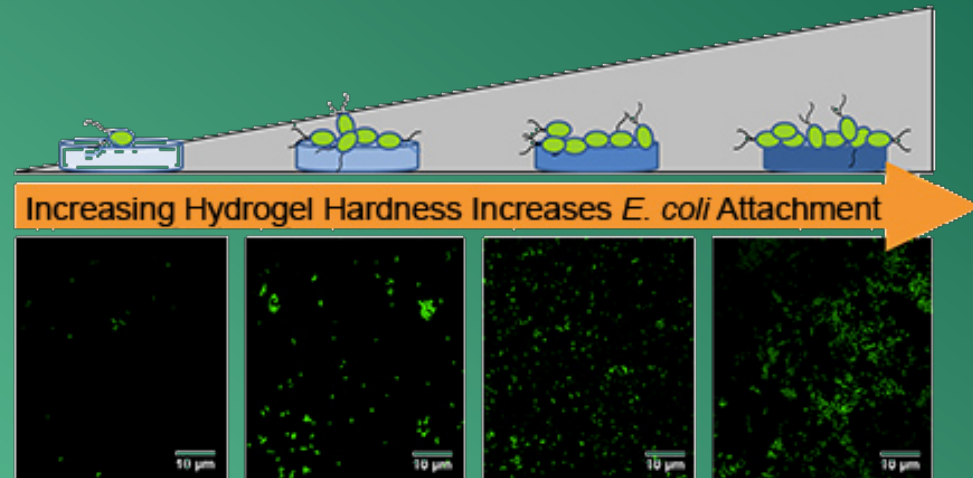
Surface Mechanics

Matrix Elasticity Directs Stem Cell Lineage Specification



Engler et al., Cell, 2006, 126, 677.

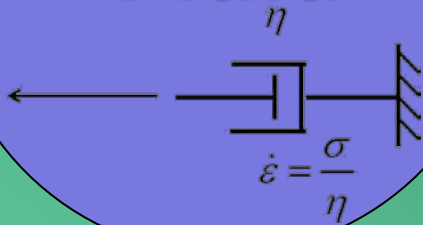
Fewer bacteria adhere to softer hydrogels



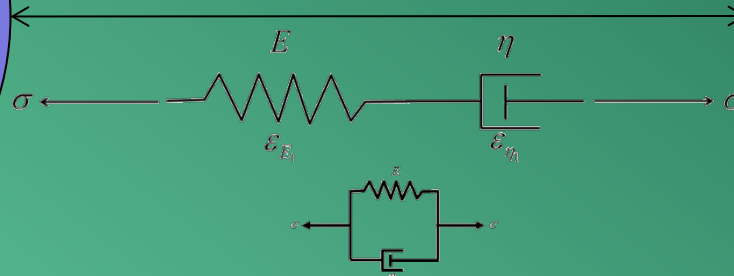
Kolewe et al., ACS Applied Mater Interfaces, 2015, 7, 19562.

Viscoelasticity

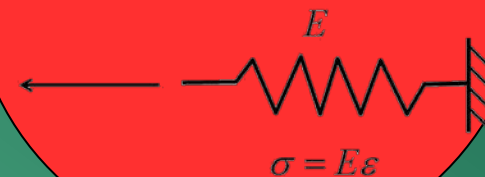
**Viscous
Fluid**



**Viscoelastic
material**



**Elastic
Solid**



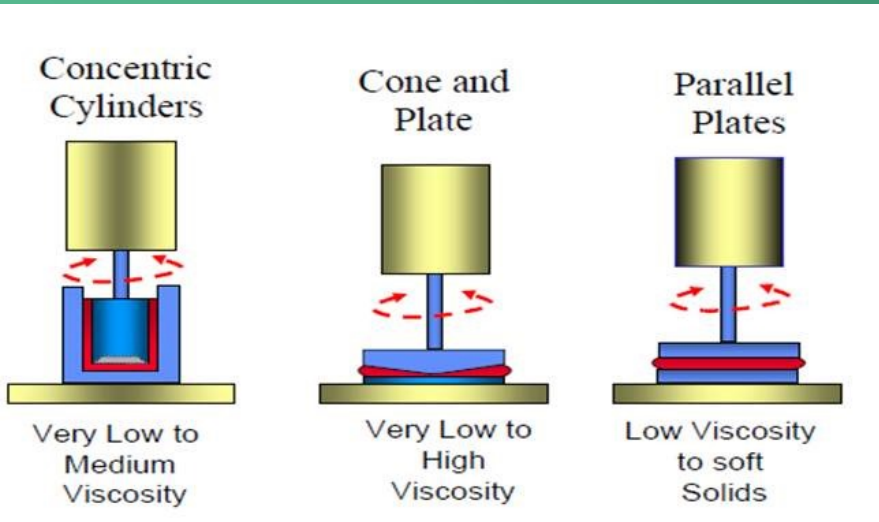
Is corn starch solution

+ water) solid or fluid?



Viscoelasticity Characterization

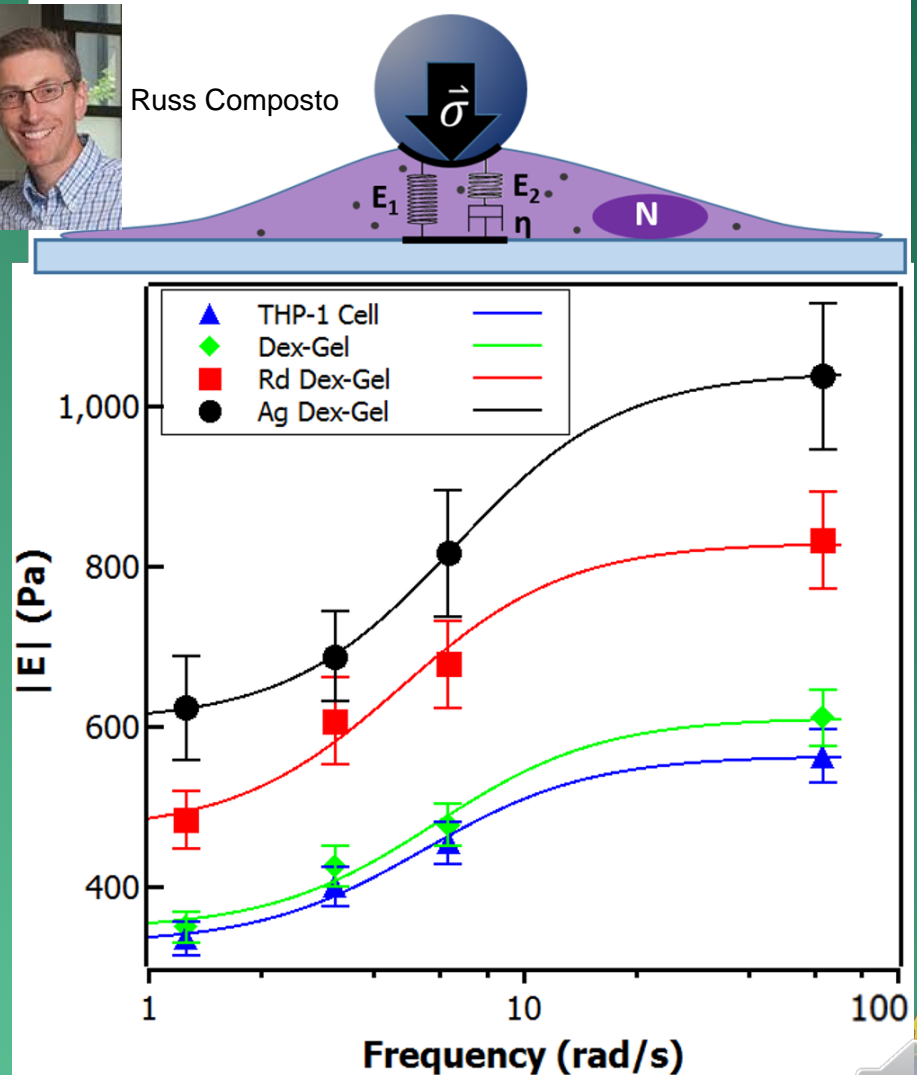
Conventional Viscoelasticity Characterization



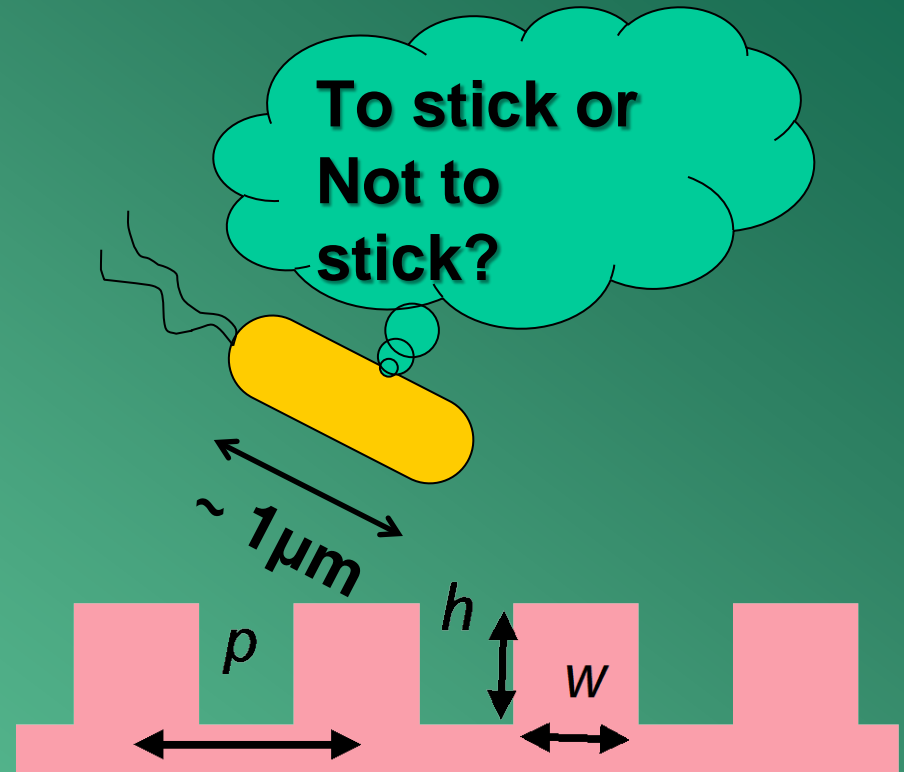
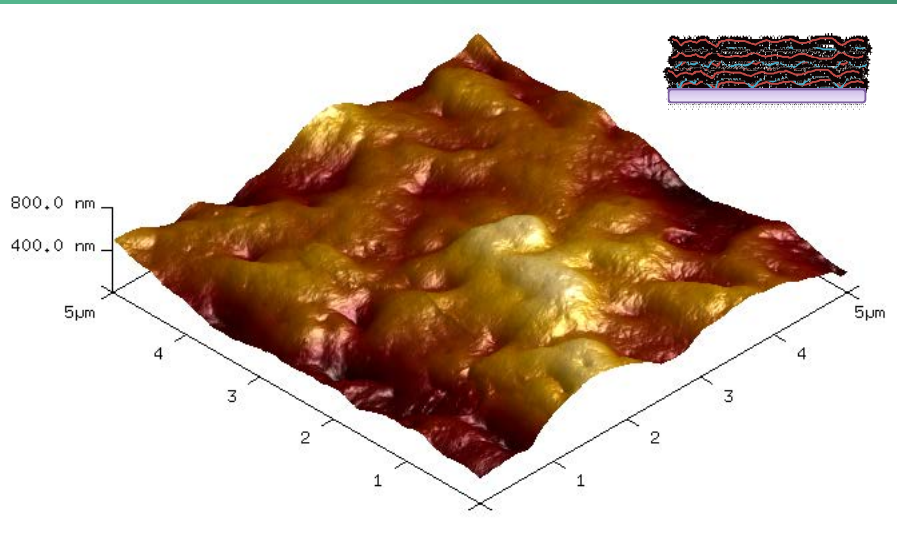
UNSUITABLE



Russ Composto

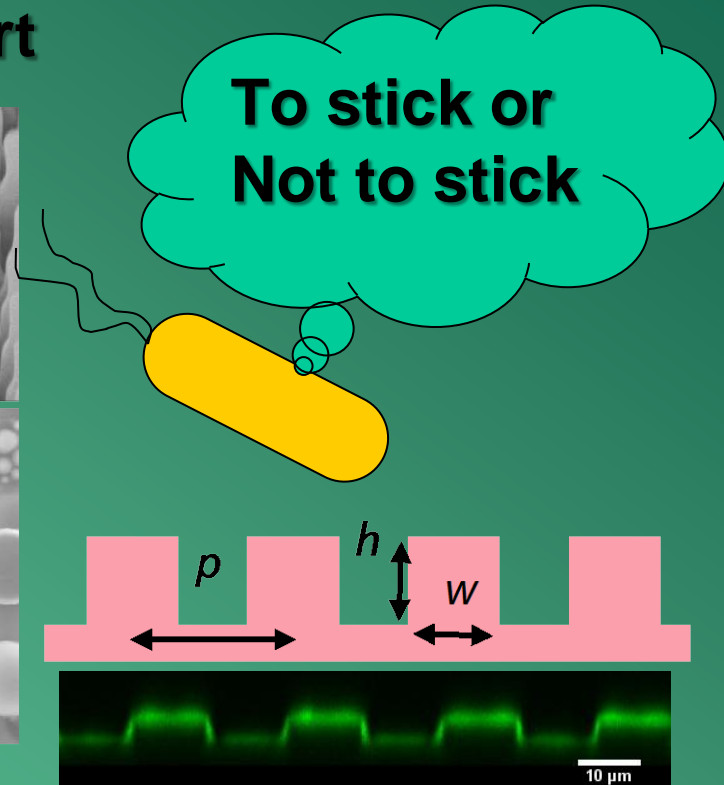
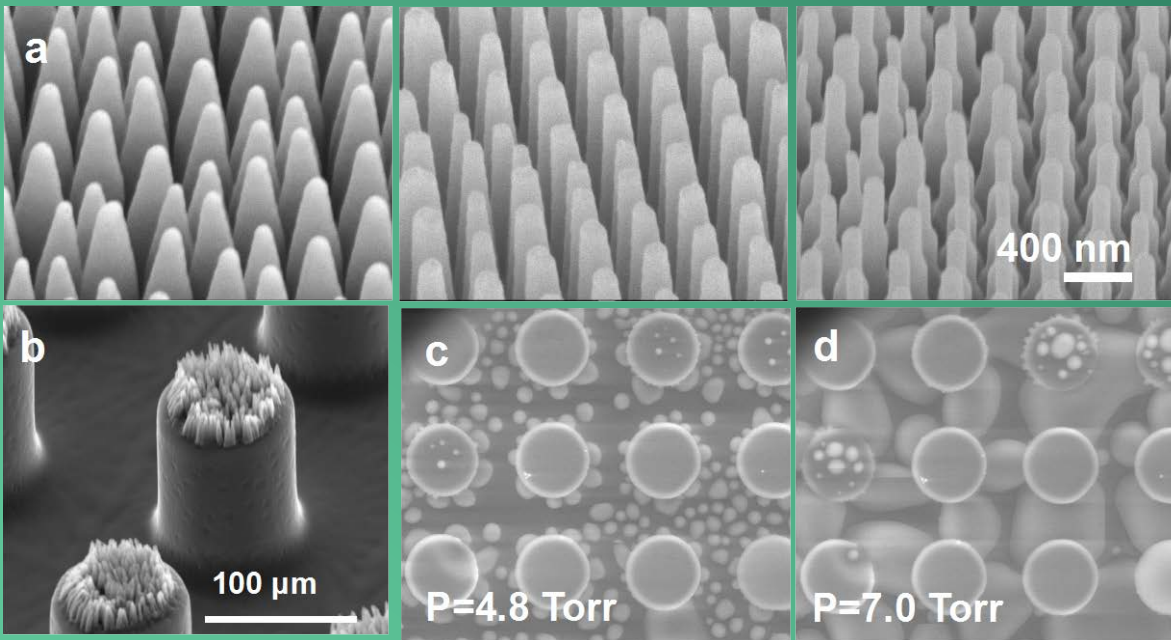


Surfaces Are Rough



Surface Texture

ACT 1 studies the effect of Surface Texture on Wetting and Water Transport

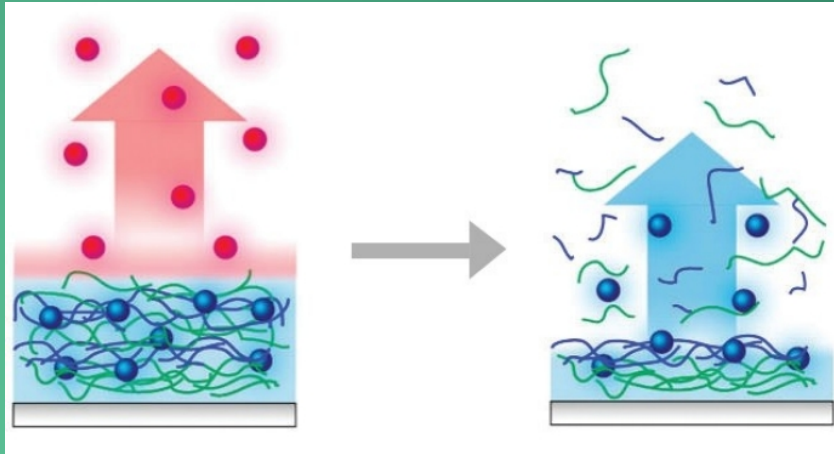


Shu Yang
(ACT 1)

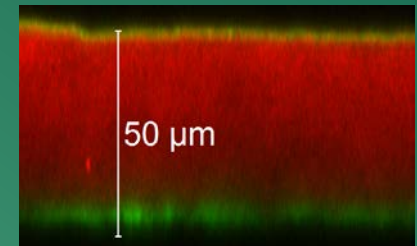
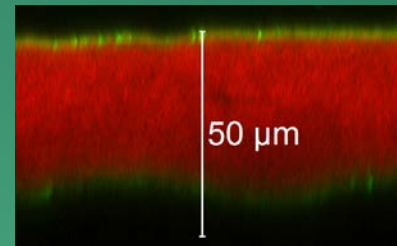


Catherine Picart

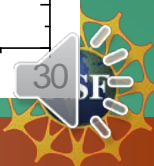
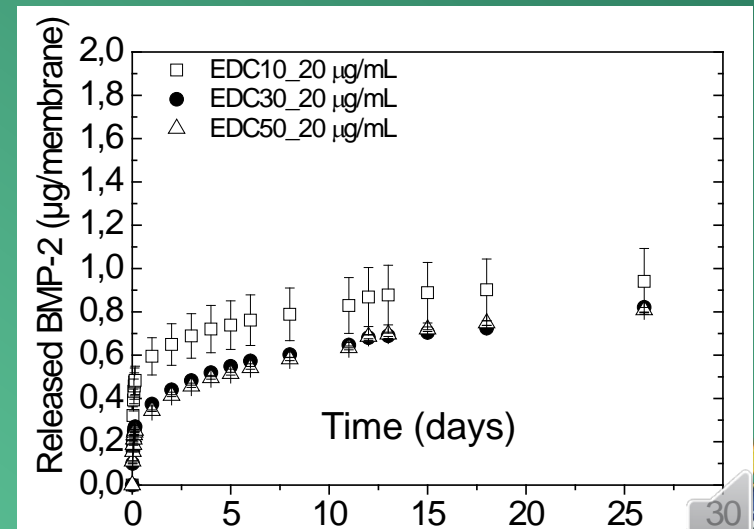
Hydration/Dehydration



Growth factor
in free-standing LbL membrane
 $t = 0$ $t = 8$ months



Quantification of release
by fluorescence spectroscopy



How to Quantify Cell Adhesion



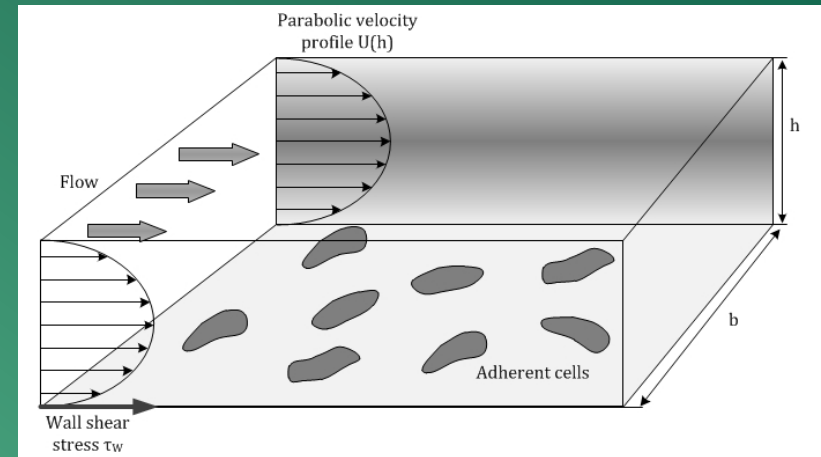
Marianne Weidenhaupt
(GIANT)



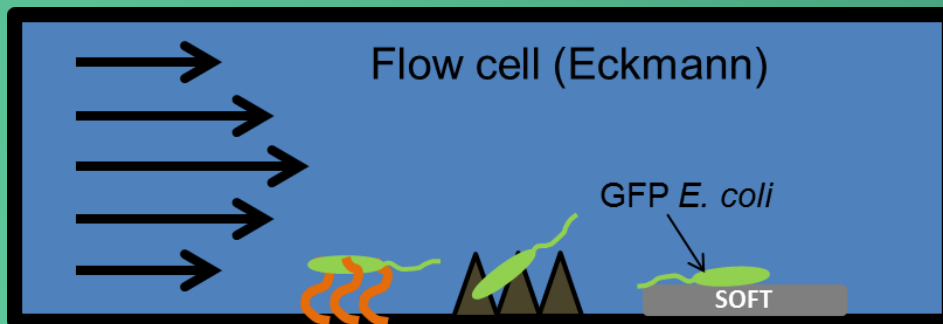
David Eckmann
(Penn SOM)



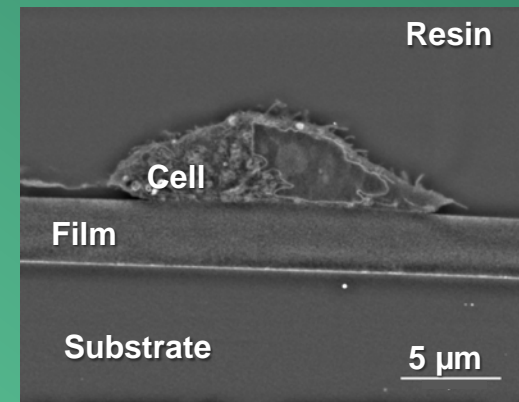
Franz Bruckert
(GIANT)



$$\text{Shear stress } \tau = \frac{12\mu Q}{h^3 w}$$



Chemistry (Picart) Texture (ACT1) Viscoelasticity (Composto, Lee)



How Do Cells Respond?

REACT-resistant bacteria



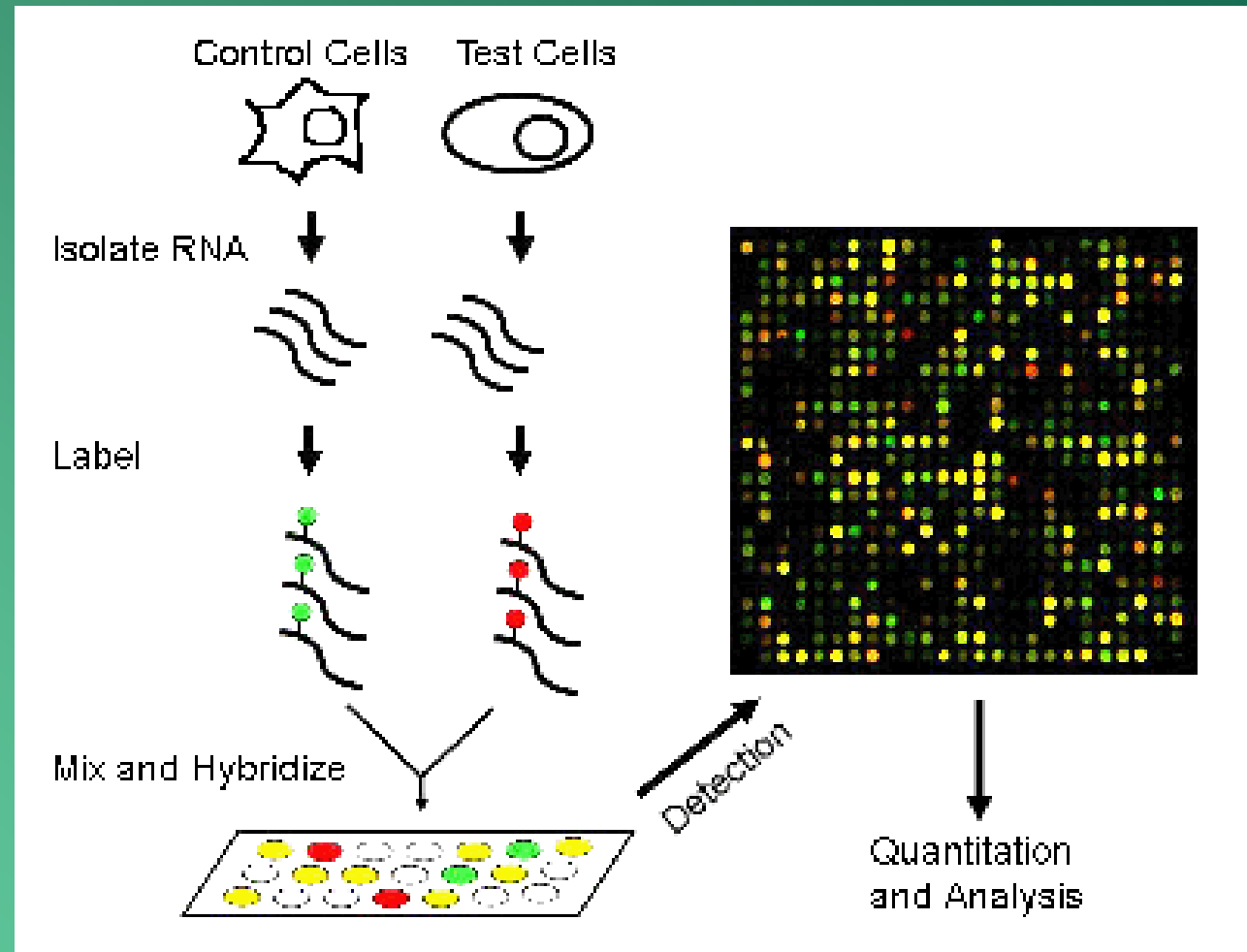
Gene Expression



Mamie Coats
Microbiology
ASU



Shree Singh
Biology
ASU



ACT2 Fellows



Dr. Tagbo H. R. Niepa (Penn)

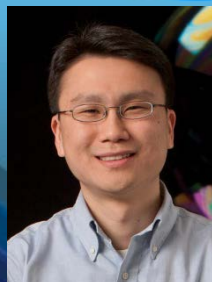
- **Bacterial Stress Response**
- **Biofilms & Biointerfaces**
- **Leadership**

Stephanie Barrow (ASU)

- **Nasopharyngeal normal flora response to nanoformulated medicines**

Prevention of Infection Transmission

**Materials
Development**



EDUCATION

**Surface-Cell
Interactions**



**Molecular/C
Biology**



**Scalable
Manufacturing**

