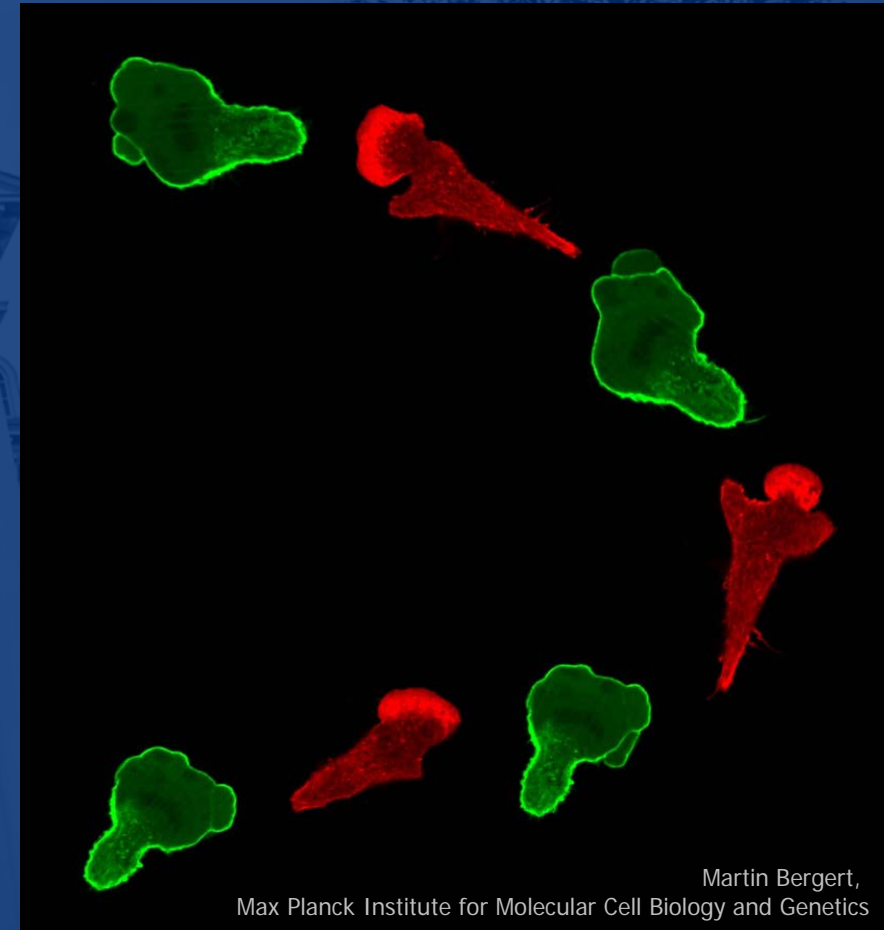




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Cell and Tissue Engineering

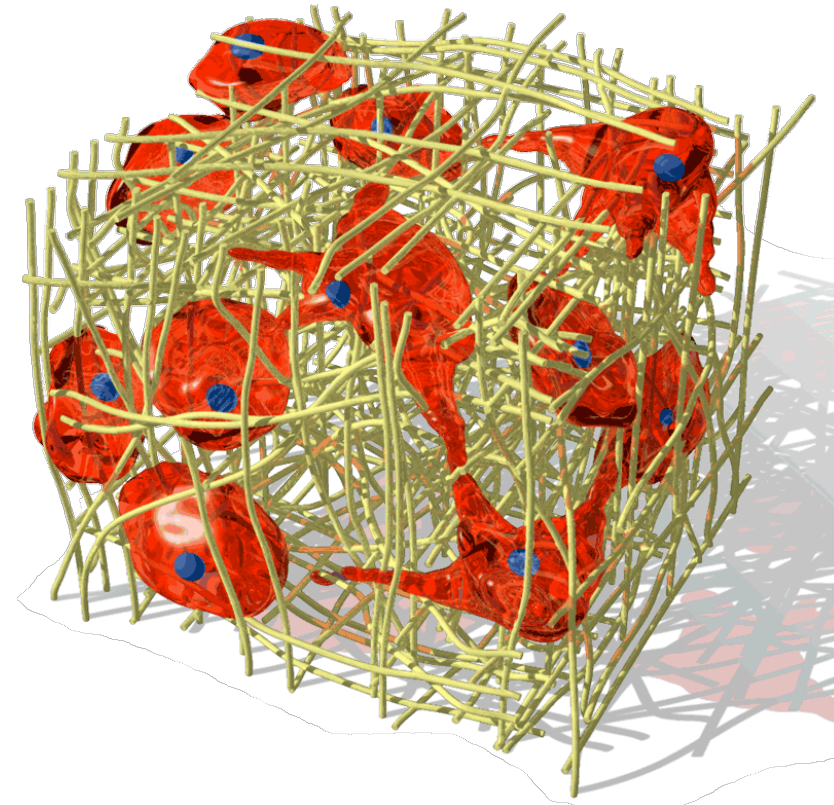
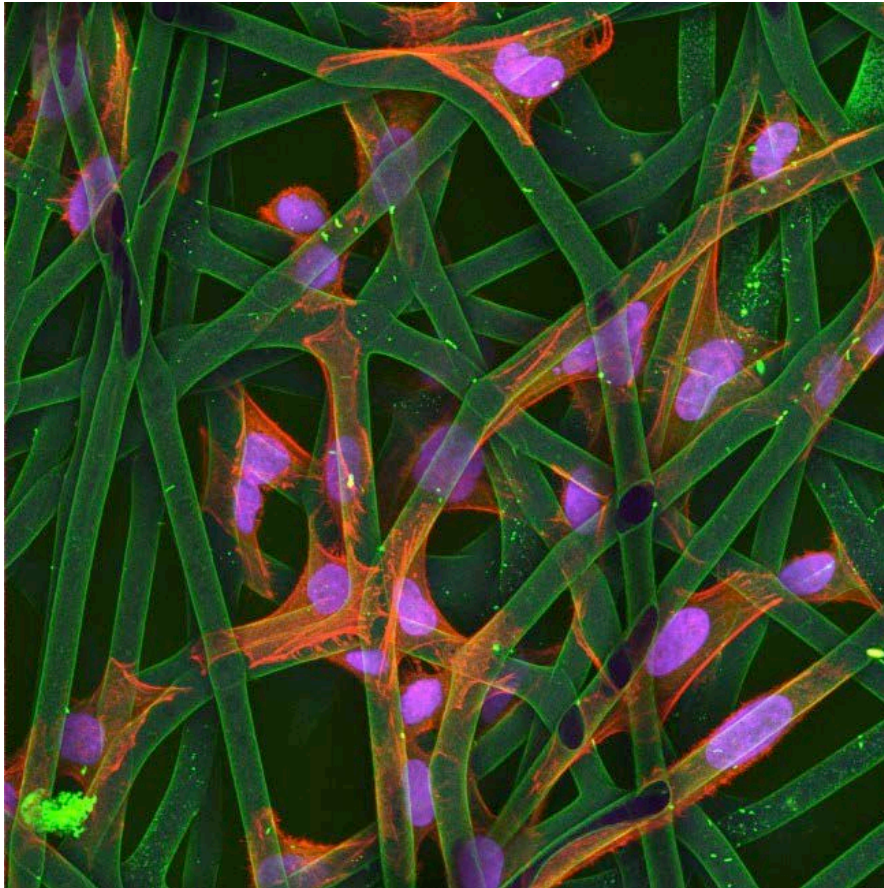
Cell Migration, Part 2



Martin Bergert,
Max Planck Institute for Molecular Cell Biology and Genetics

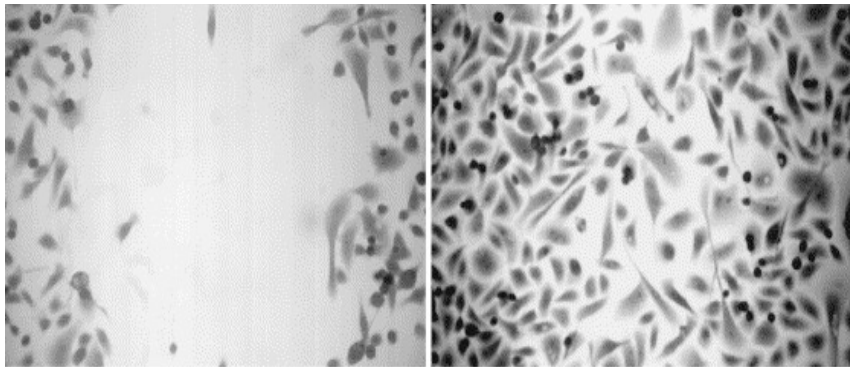
Martin Bergert,
Max Planck Institute for Molecular Cell Biology and Genetics

How do you measure cell migration?

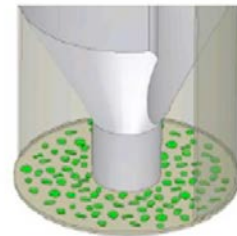


How do you measure cell migration?

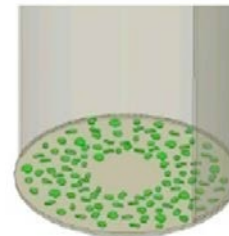
Scratch assay



Cell exclusion zone assay

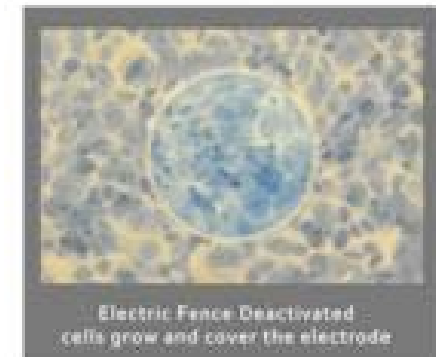
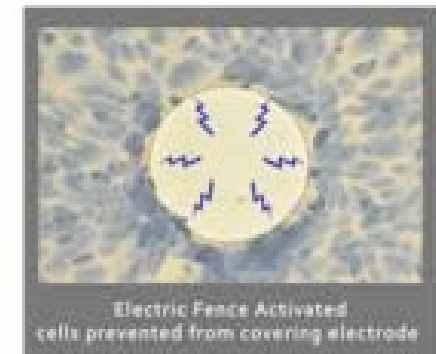


Coat plate,
insert stoppers
& seed cells



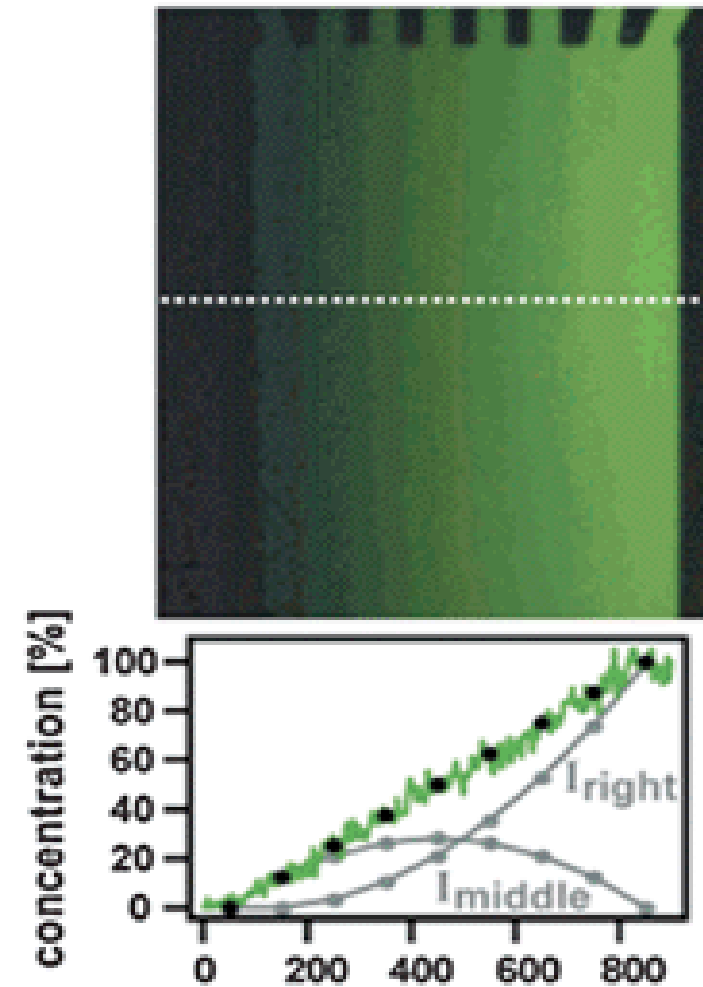
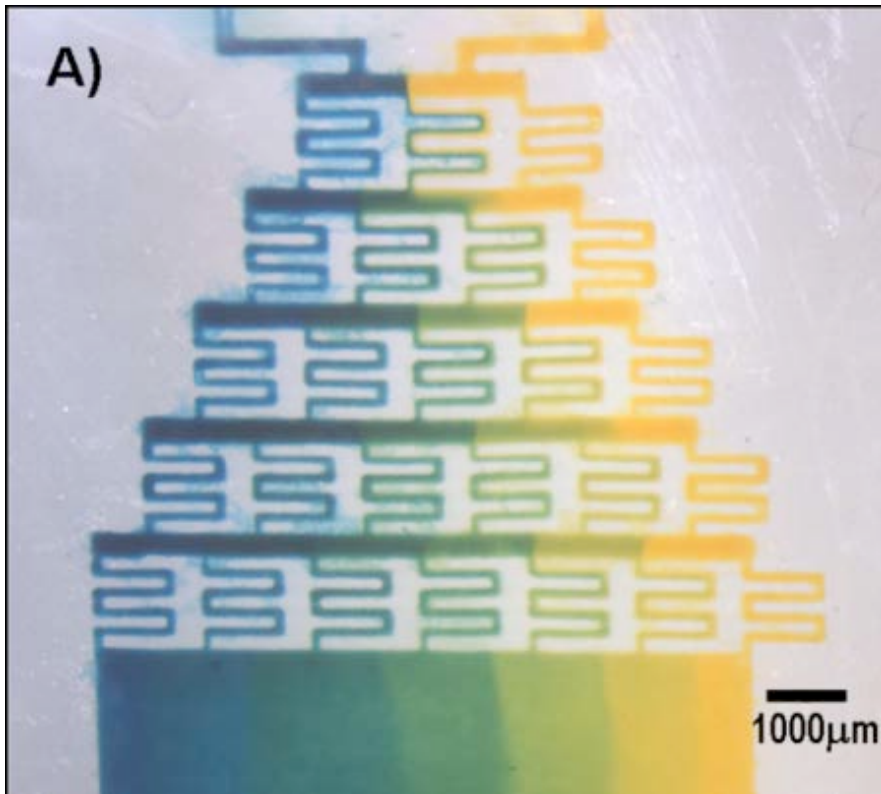
Remove stoppers to
reveal detection zone

ECIS



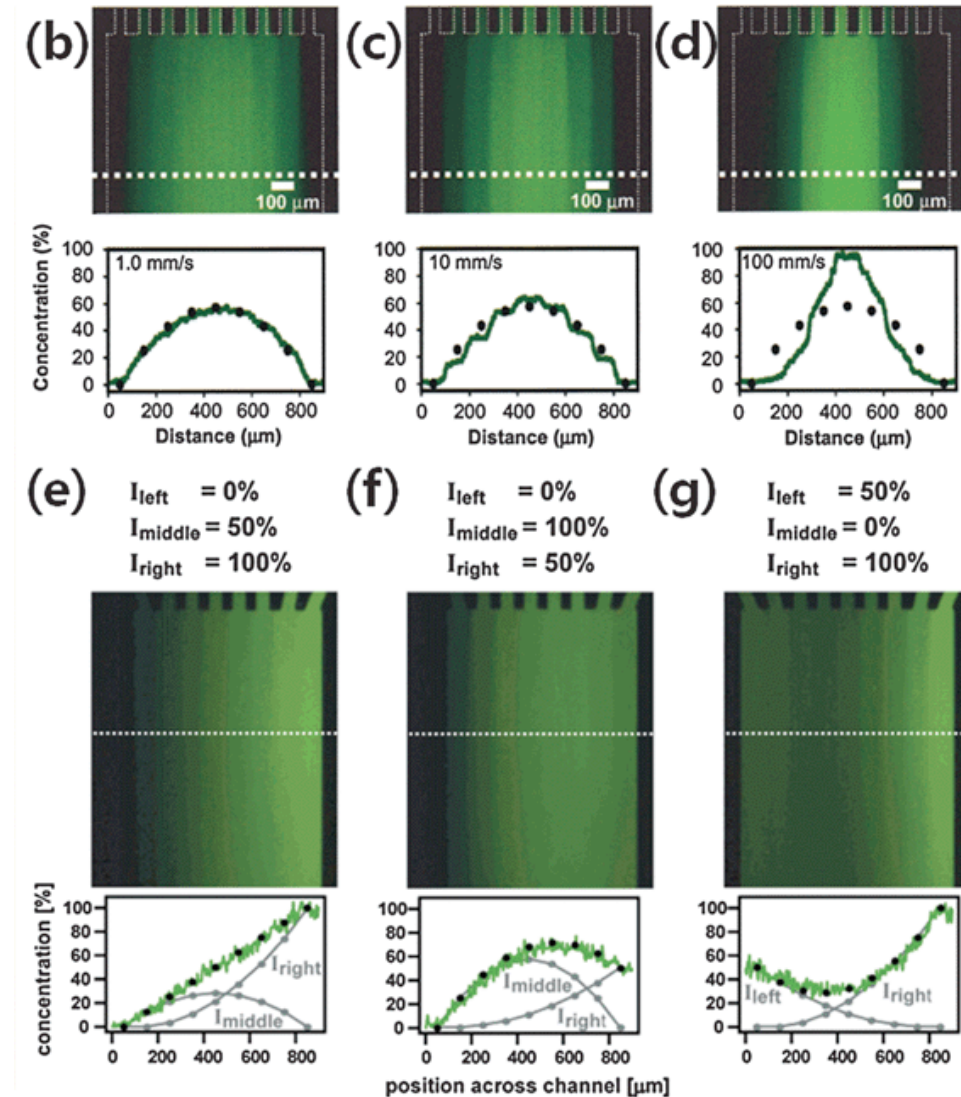
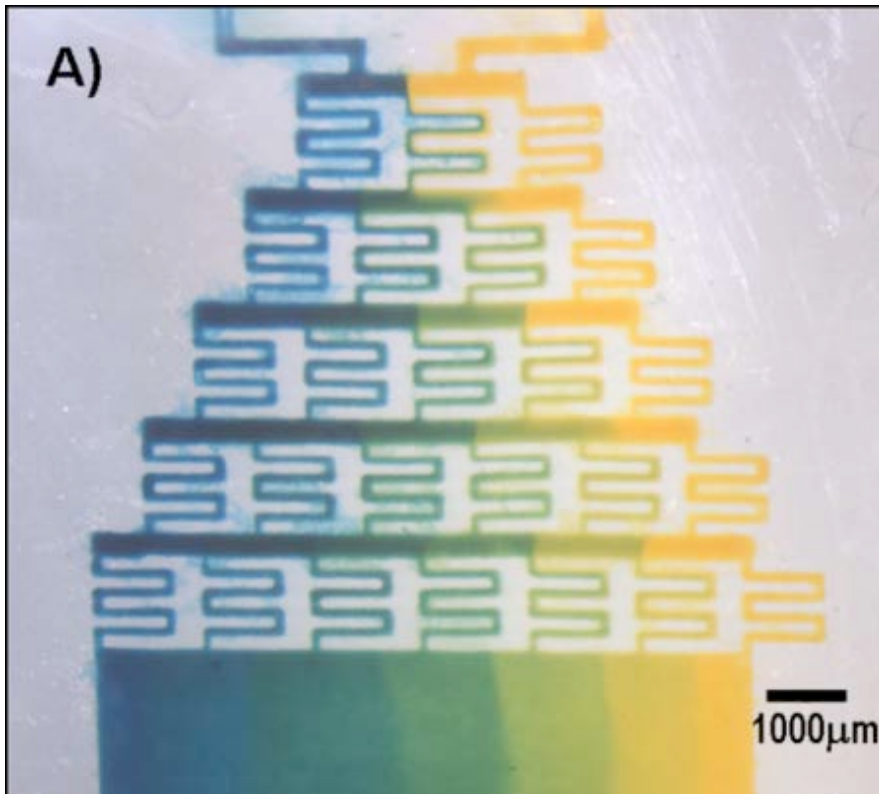
How do you measure cell migration?

Microfluidics



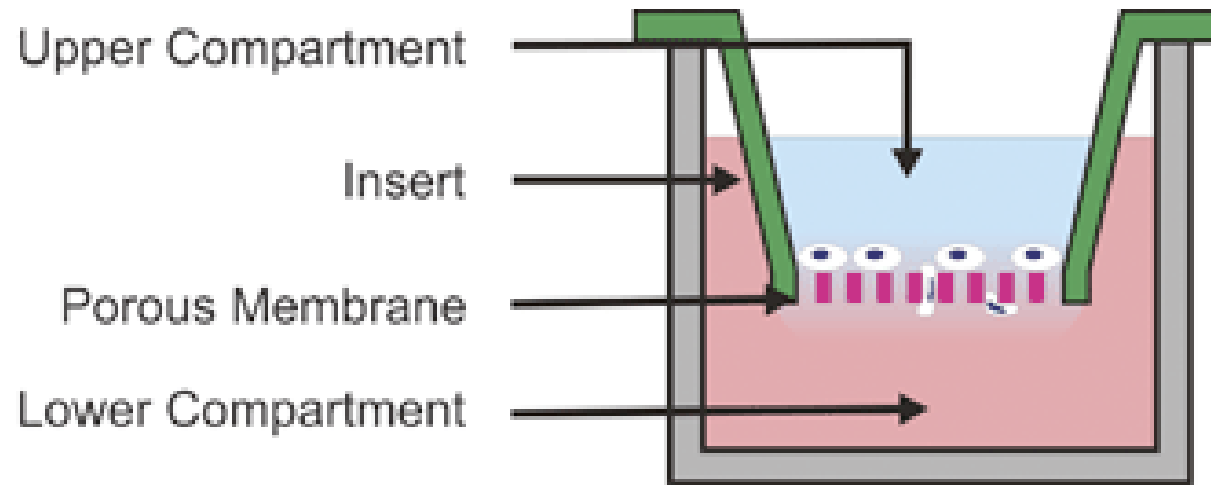
How do you measure cell migration?

Microfluidics



How do you measure cell migration?

Boyden chambers (transwell assay)



How do you measure cell migration?

Gel invasion assay

(a) 3D matrix invasion assays

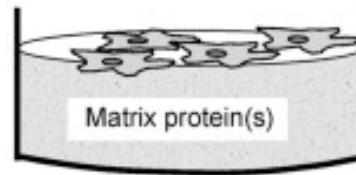
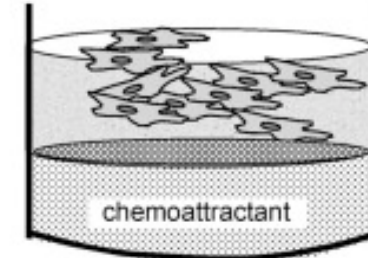


Plate cells on top of matrix

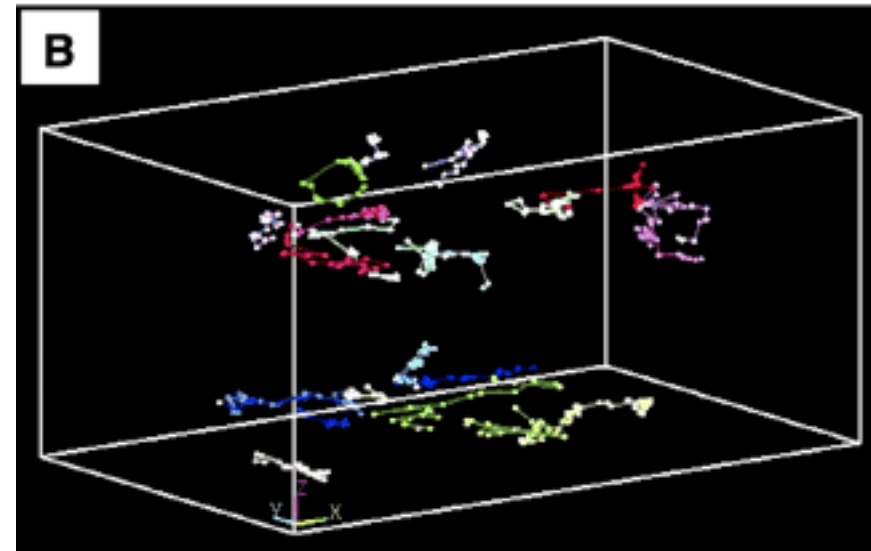


Measure depth of invasion



Combined with chemotaxis

Time lapse imaging
gives kinetic data



How do you measure cell migration?

Gel invasion assay

(a) 3D matrix invasion assays

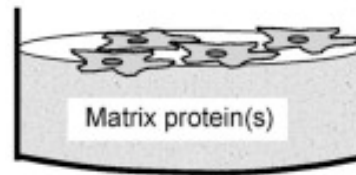
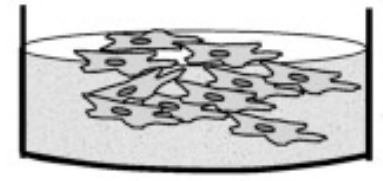
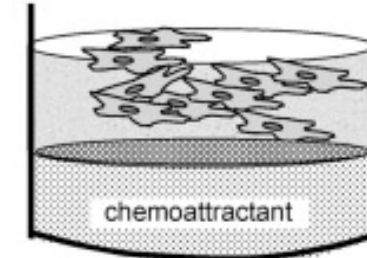


Plate cells on top of matrix

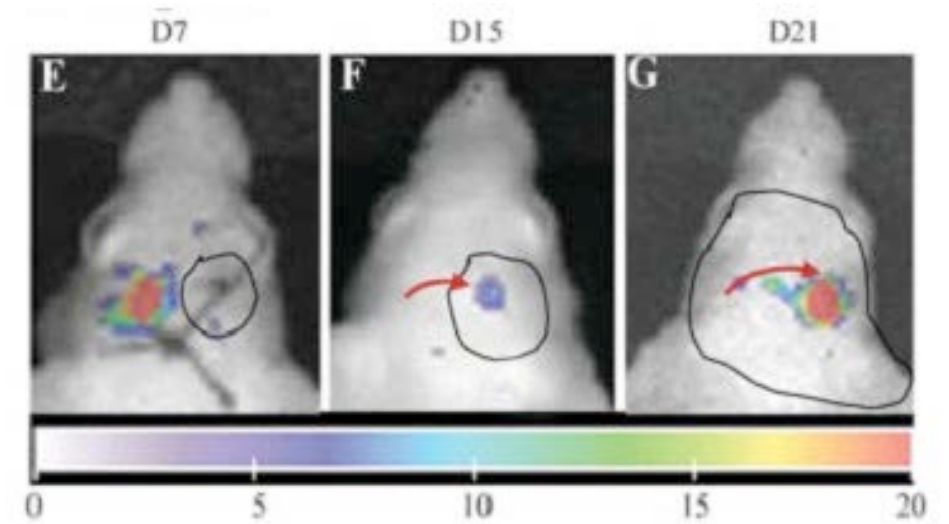
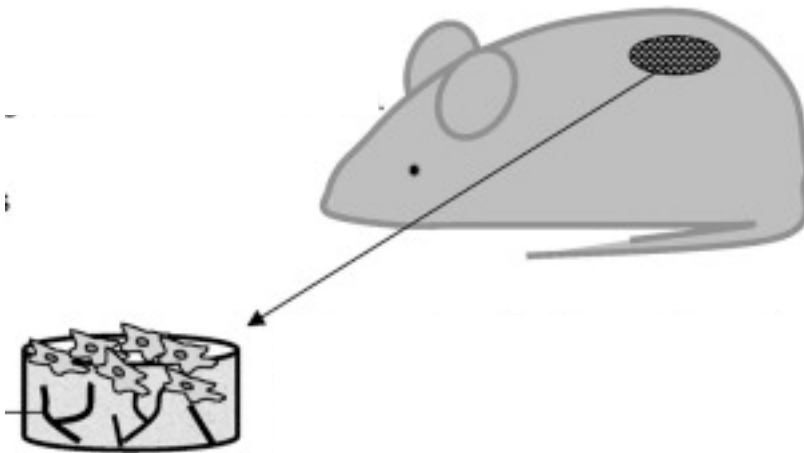


Measure depth of invasion



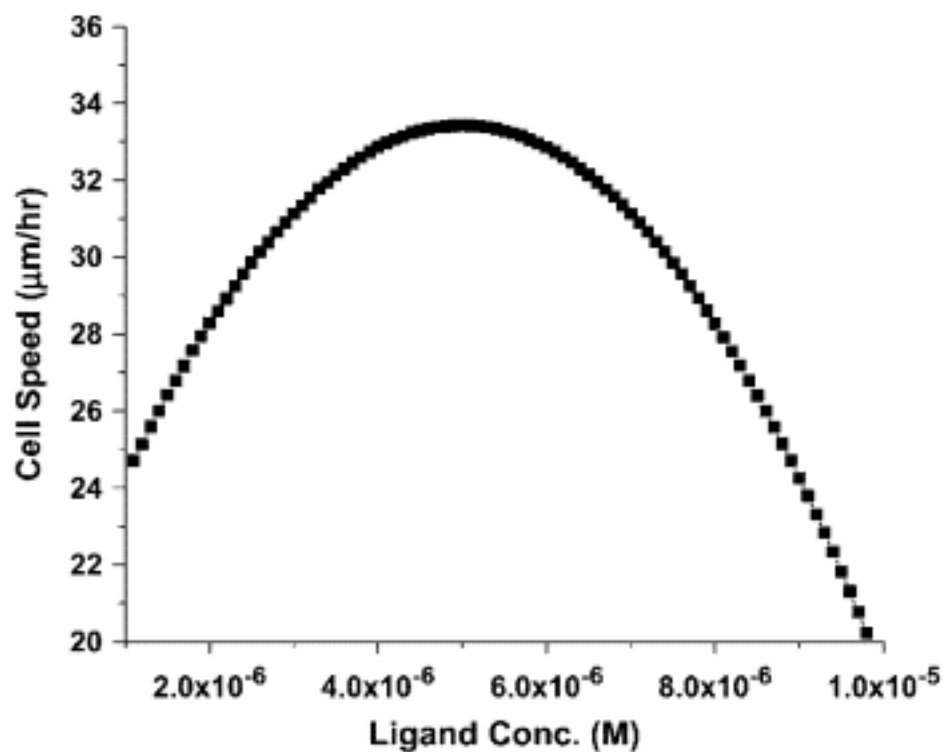
Combined with chemotaxis

These can be



Migration speed

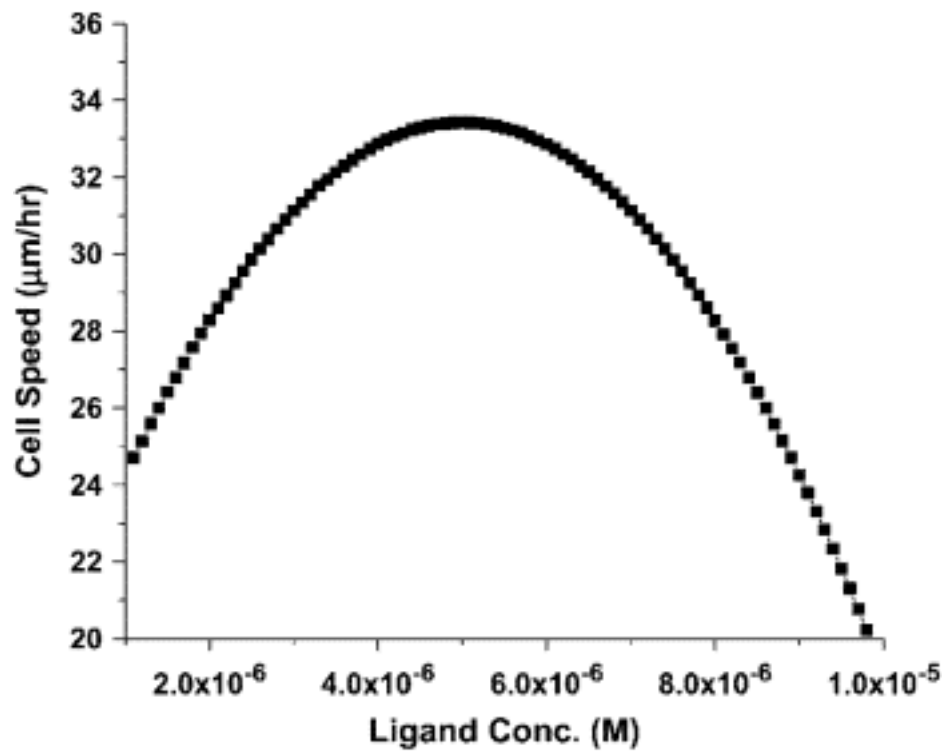
Migration is **biphasic** with highest speeds at intermediate receptor-ligand binding



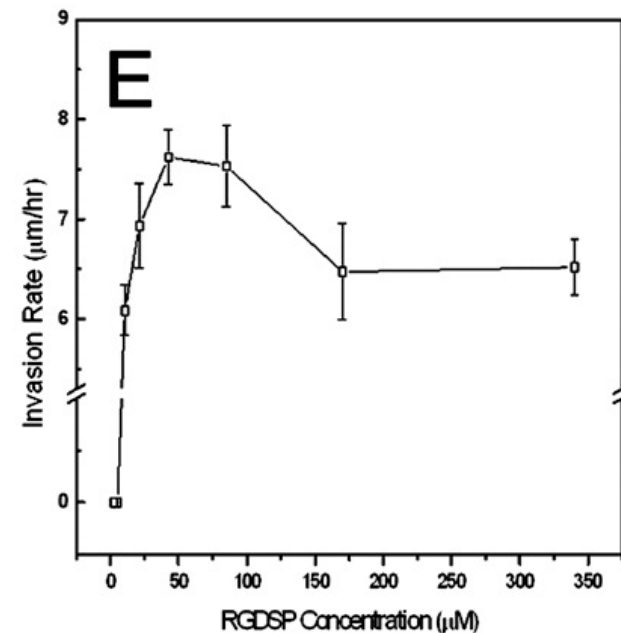
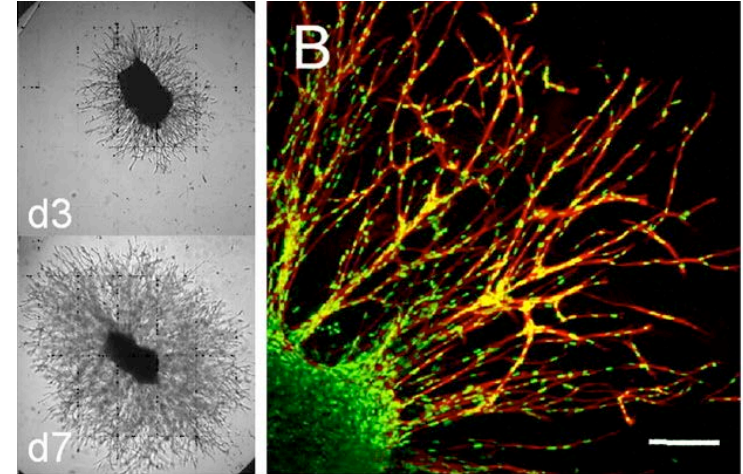
Concentration!!

Migration is **biphasic** with highest speeds at intermediate receptor-ligand binding

Migration speed

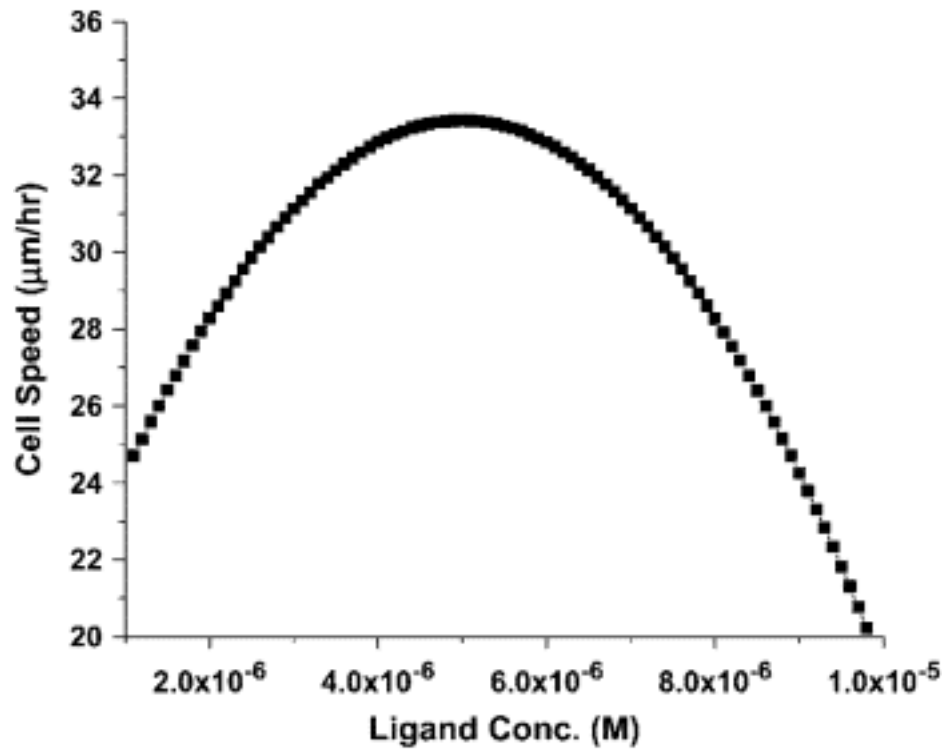


Concentration!!

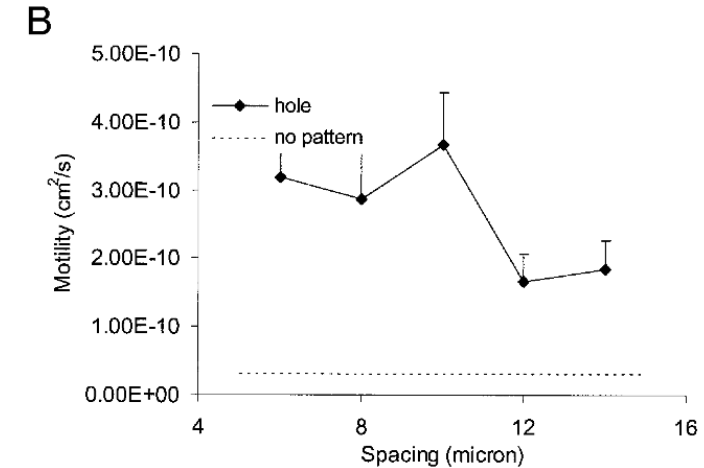


Migration is **biphasic** with highest speeds at intermediate receptor-ligand binding

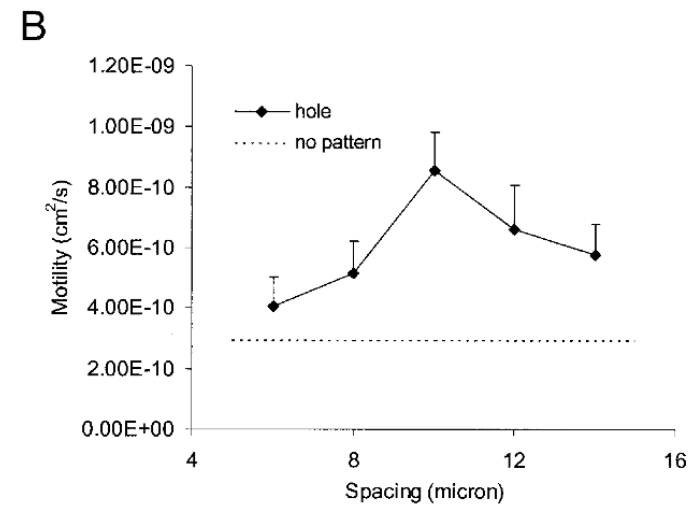
Migration speed



Concentration!!



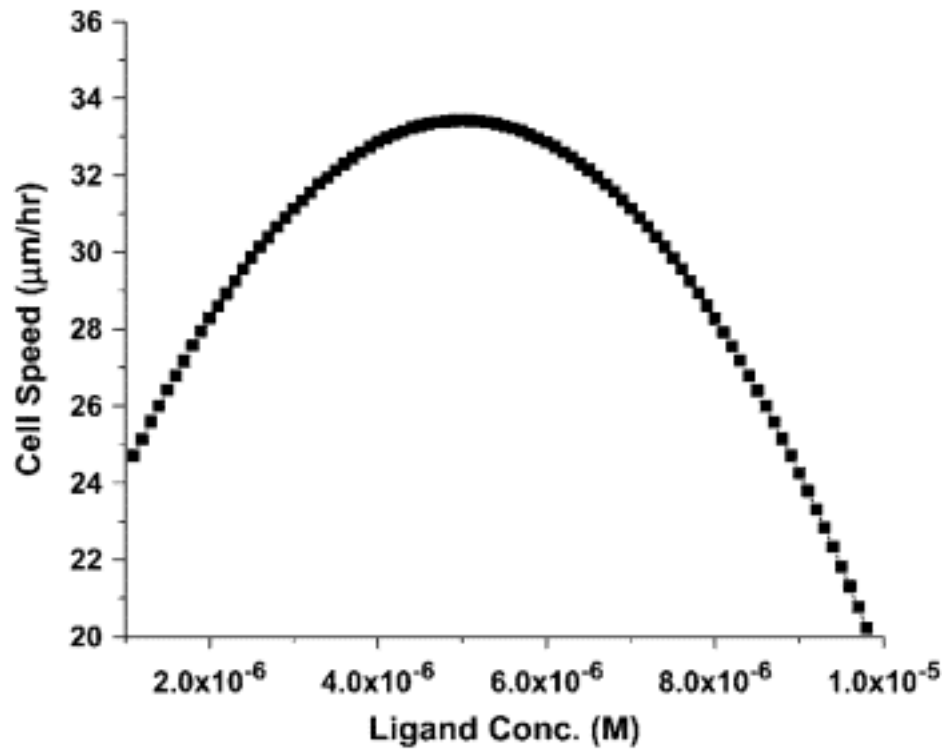
Quartz



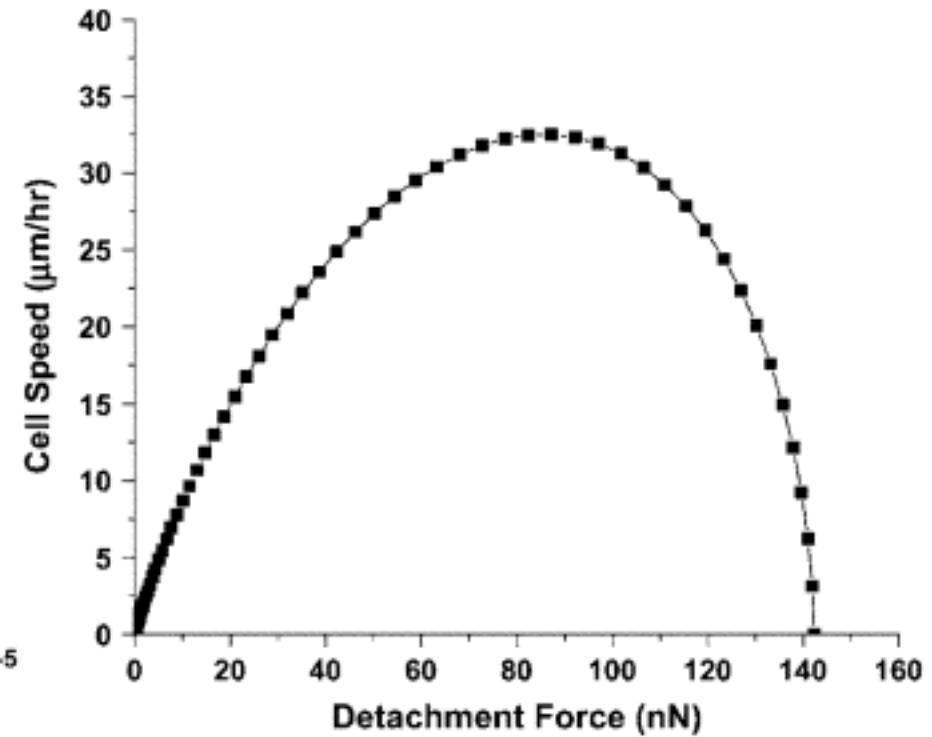
Collagen

Migration speed

Migration is **biphasic** with highest speeds at intermediate receptor-ligand binding



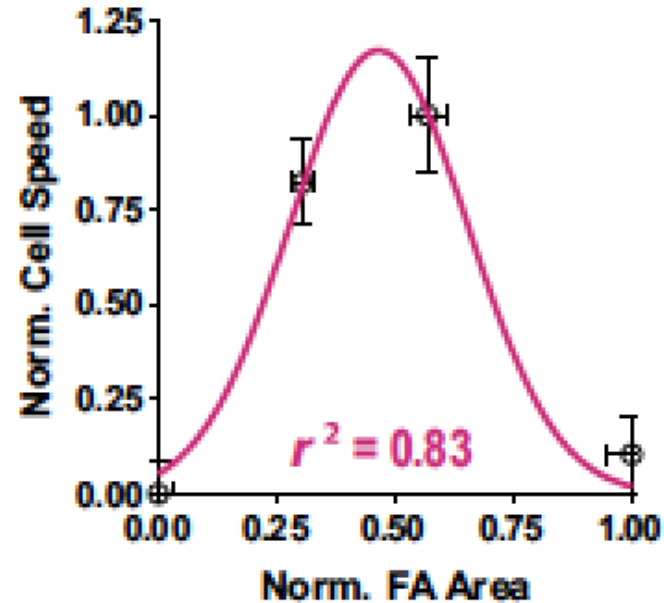
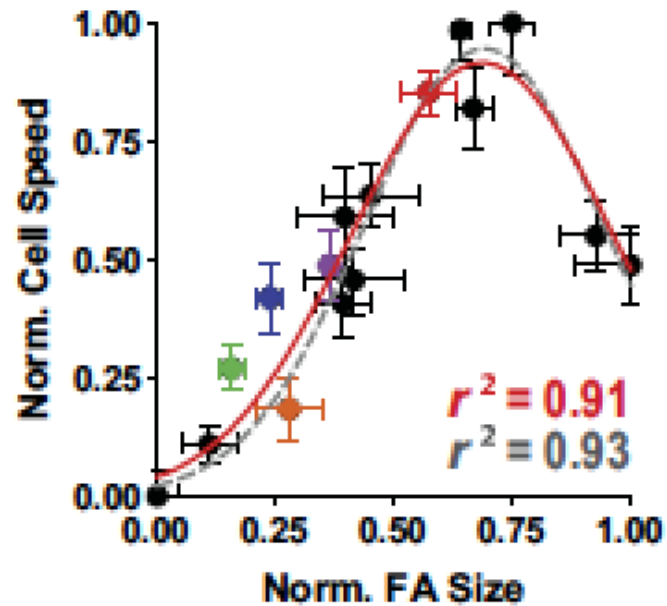
Concentration!!



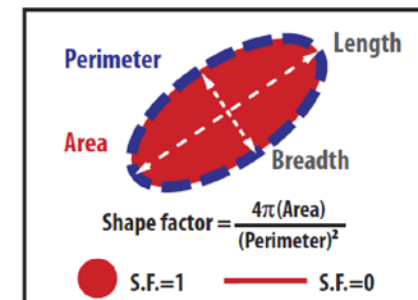
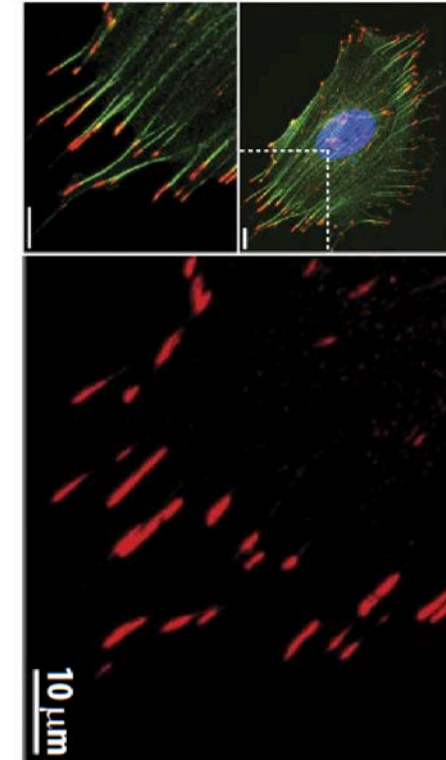
Strength!!

Migration speed

Migration is **biphasic** with highest speeds at intermediate receptor-ligand binding





Focal adhesion size and total adhesion area!!



How fast do cells migrate?



Cell type	Speed um/min
Neutrophil	20
Macrophage	2
Fibroblast	0.5
Endothelial cell	0.4
Smooth muscle tissue	0.5
Neuron on laminin	1-3

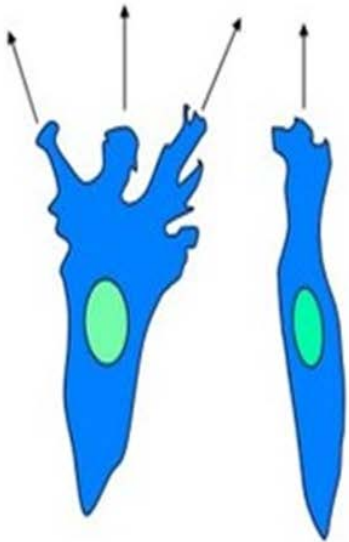


How fast do cells migrate?



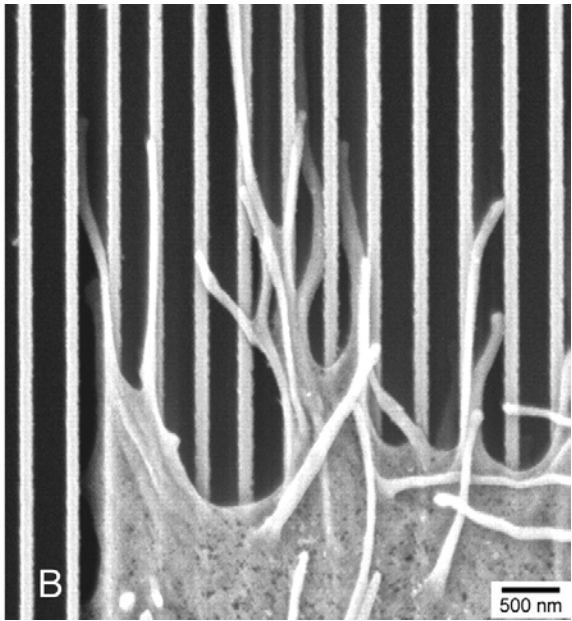
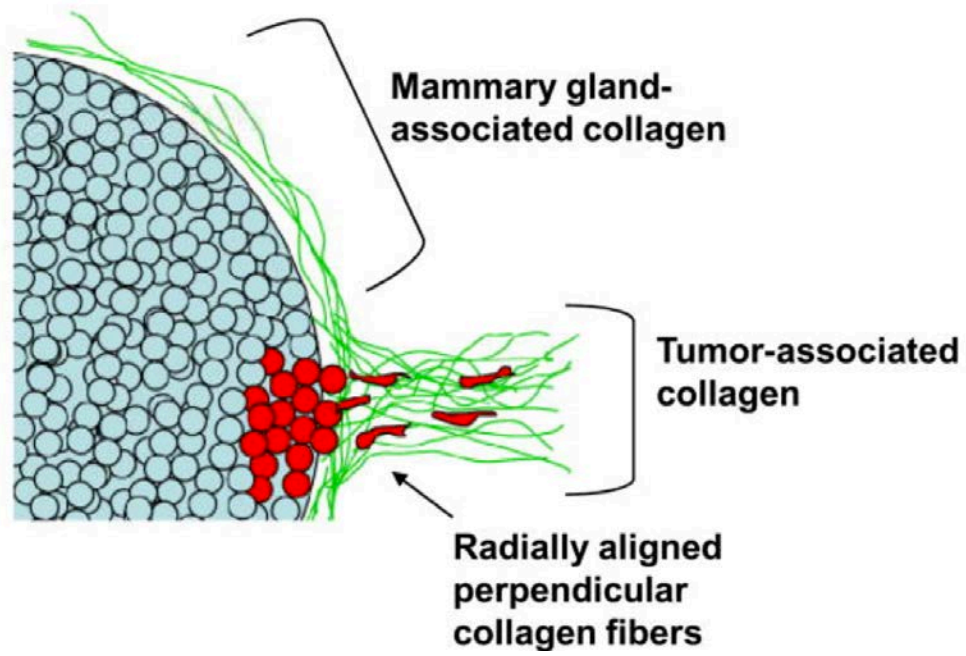
Cell type	Speed $\mu\text{m}/\text{min}$	Persistence time (min)
Neutrophil	20	1-4
Macrophage	2	30
Fibroblast	0.5	60
Endothelial cell	0.4	300
Smooth muscle tissue	0.5	240-300
Neuron on laminin	1-3	--

Multiple lamellipodia
Random migration

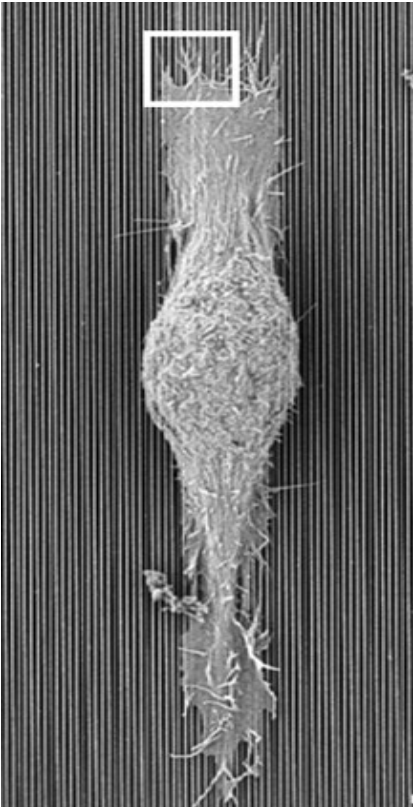


Single lamellipodia
Directed migration

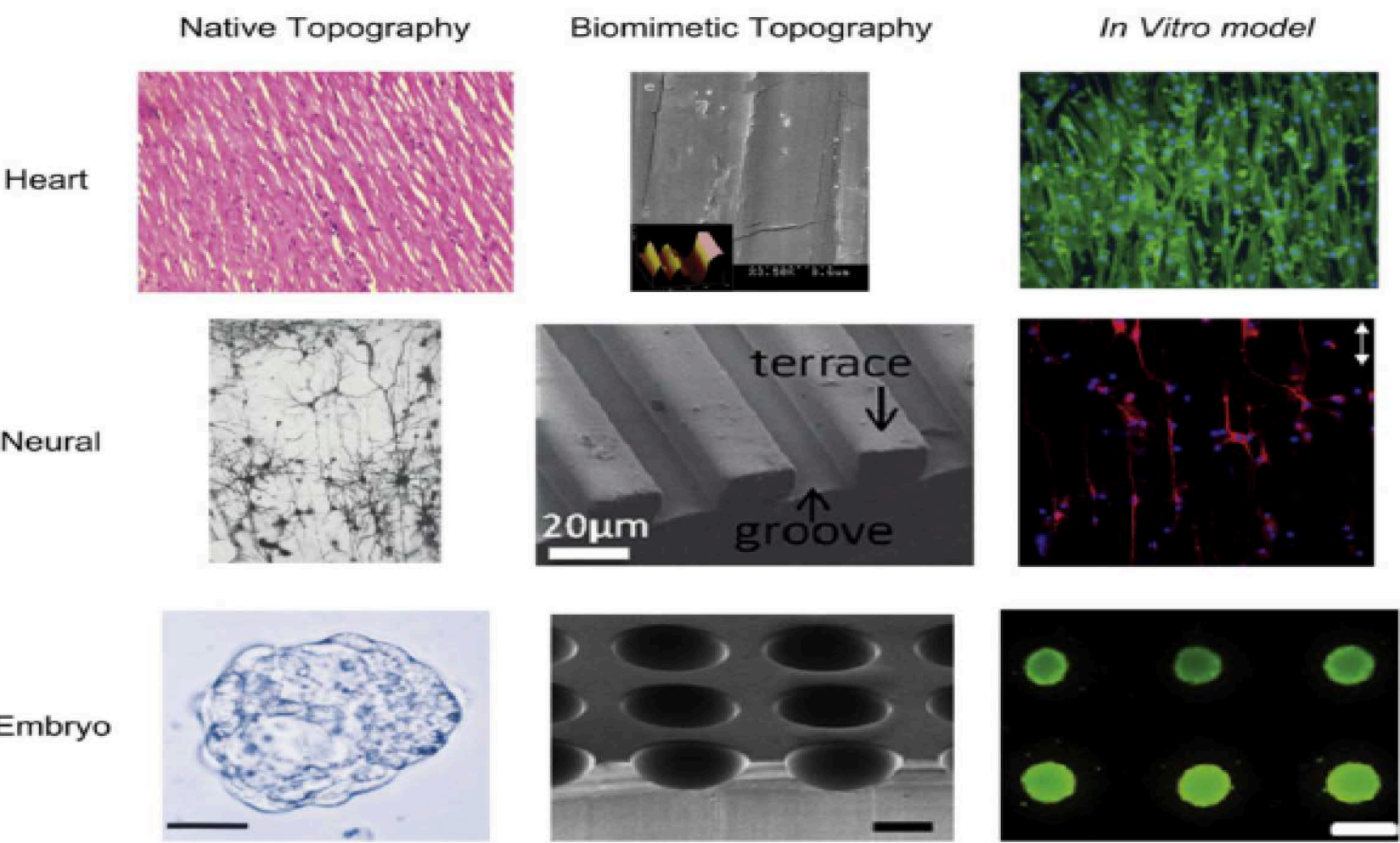
Directed migration is not always desired



Contact guidance
Surface topology

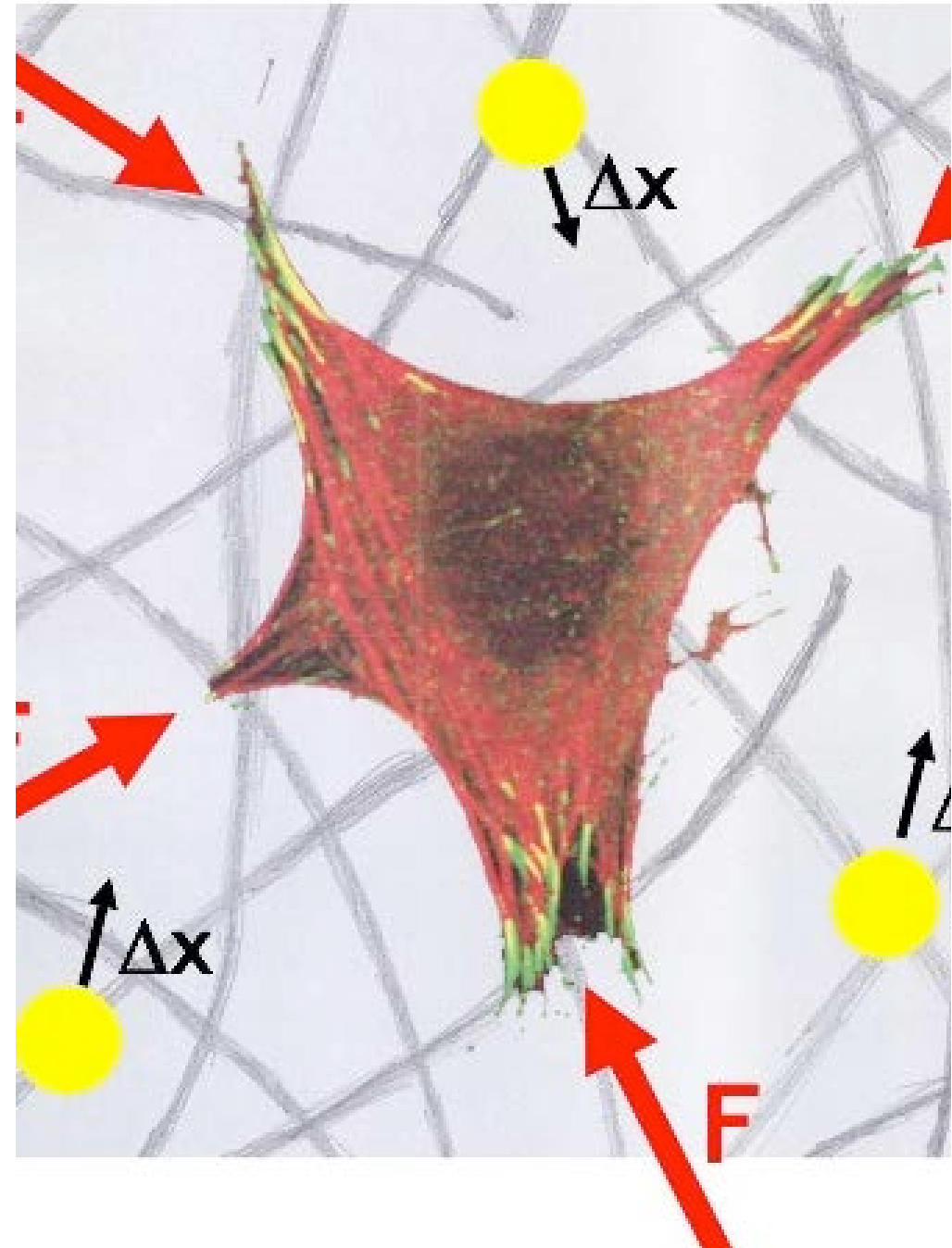


Contact guidance for the design of in vitro models and scaffolds



Looking ahead

- Cell and tissue mechanics
- Cell and tissue engineering





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