

Sejtek önszerveződése



Czirók András, ELTE Biológiai Fizika Tanszék

Önszerveződés: kapcsolat szerveződési szintek között

“**Mikroszkopikus**” szint: objektumok és kölcsönhatások



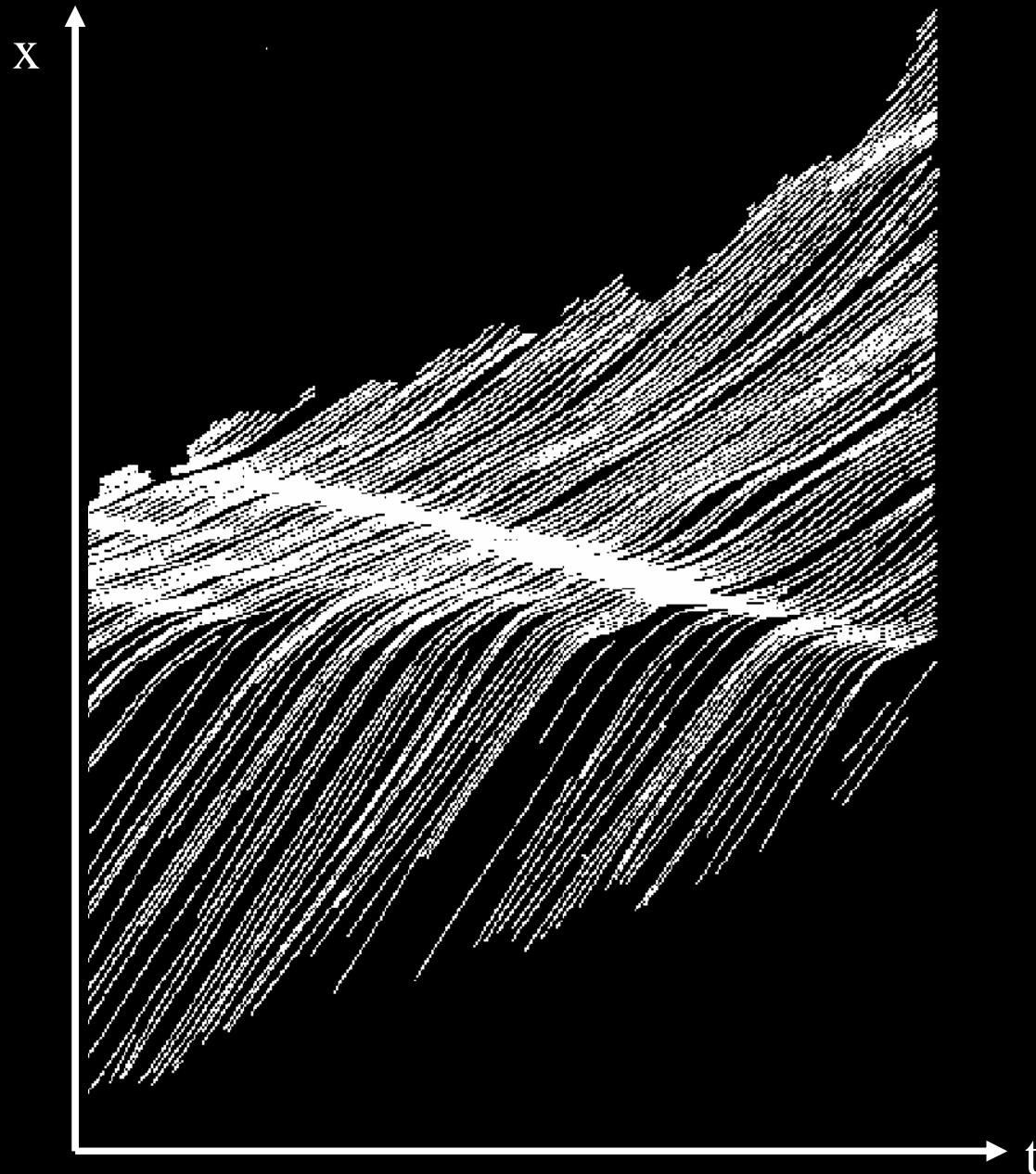
“**Makroszkopikus**” szint: mintázatok, rendszerszintű viselkedés

Klasszikus fizikai példa: halmazállapot változások

molekulák közti kölcsönhatás: van der Waals (Lennard-Jones)

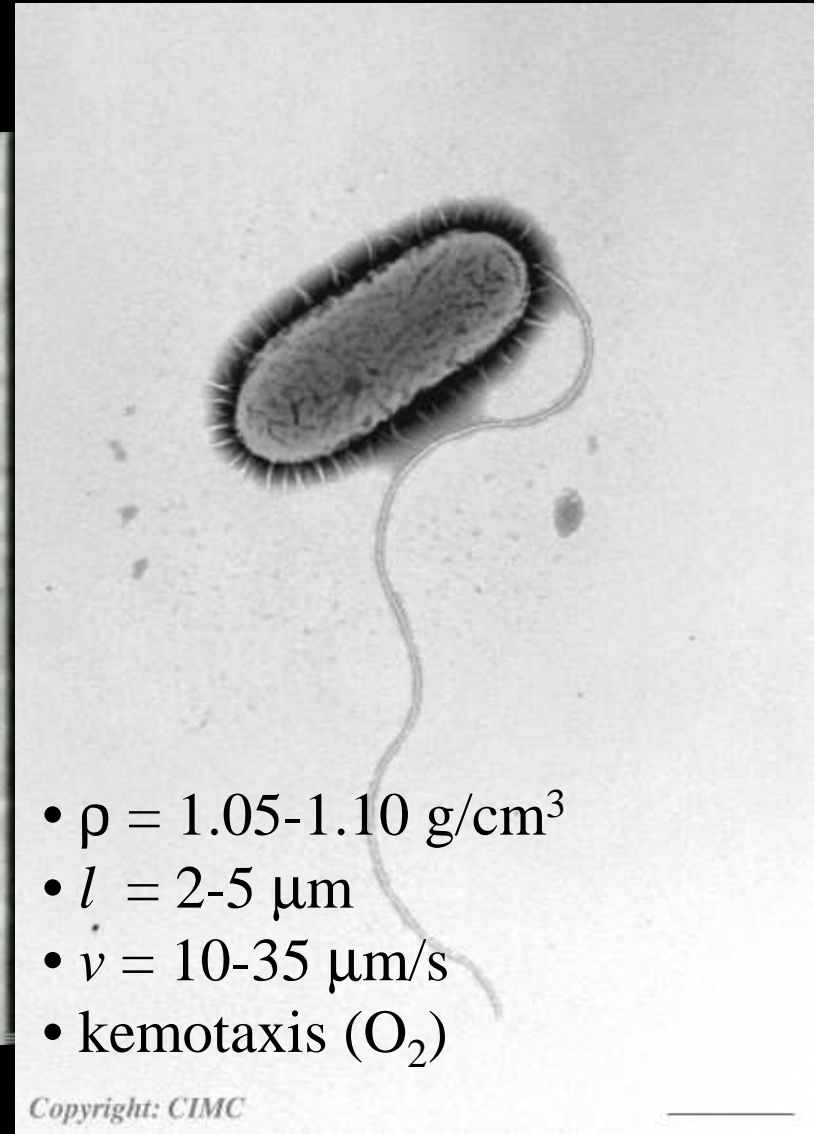
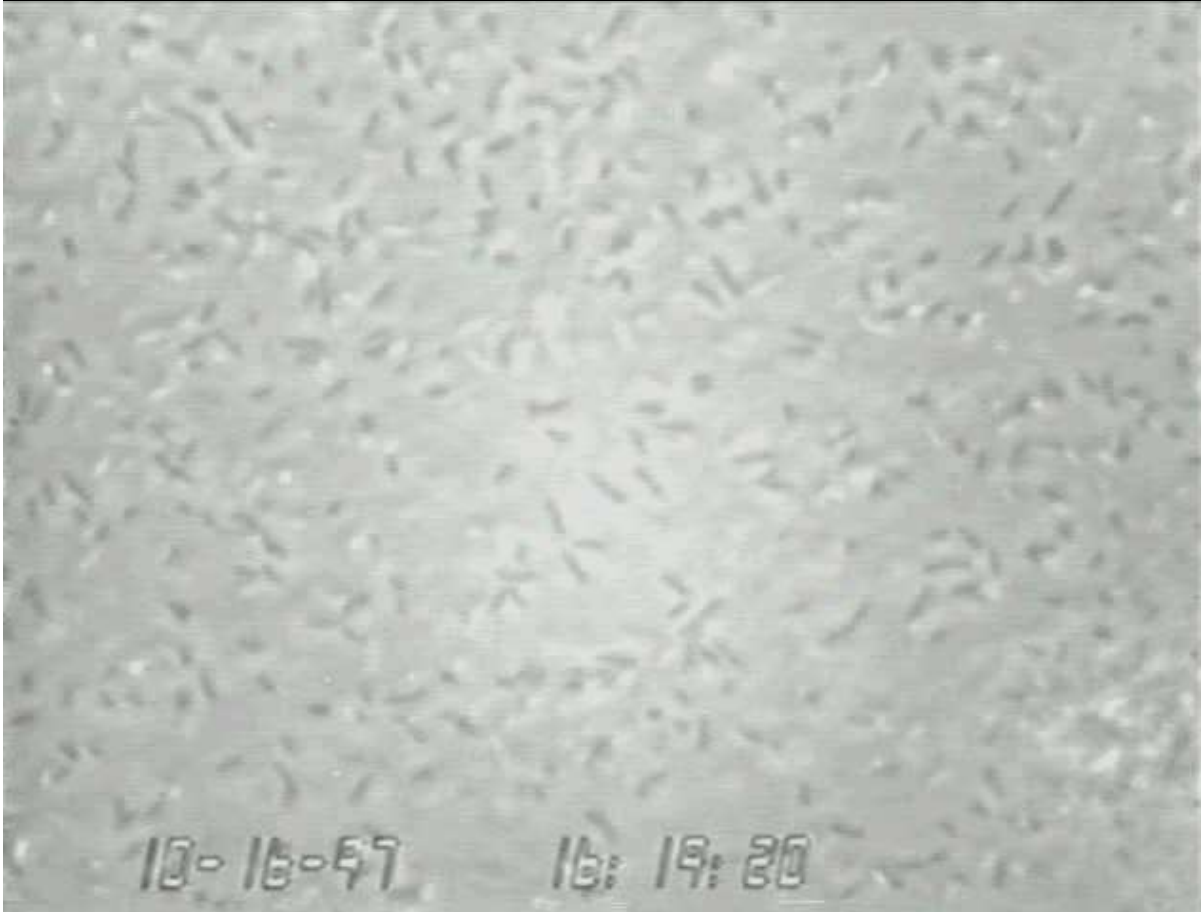
halmazállapotok: állapotegyenletek, mechanikai tulajdonságok, stb.

Közlekedési dugók: Önszerveződés dinamikai (nemeqyensúlyi) rendszerben

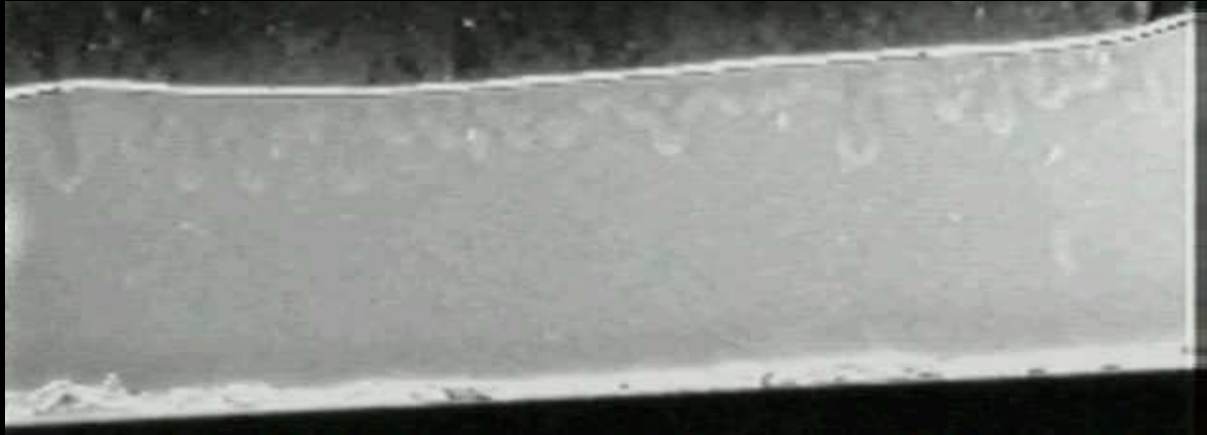


Treiterer & Myers
1974

Mikroorganizmusok úszása:



Biokonvekció: Mikroorganizmusok által hajtott folyadékáramlás



Hajtóerők:

- mikroorganizmusok úszása
- kemotaxis (oxigén)
- sűrűségkülönbség

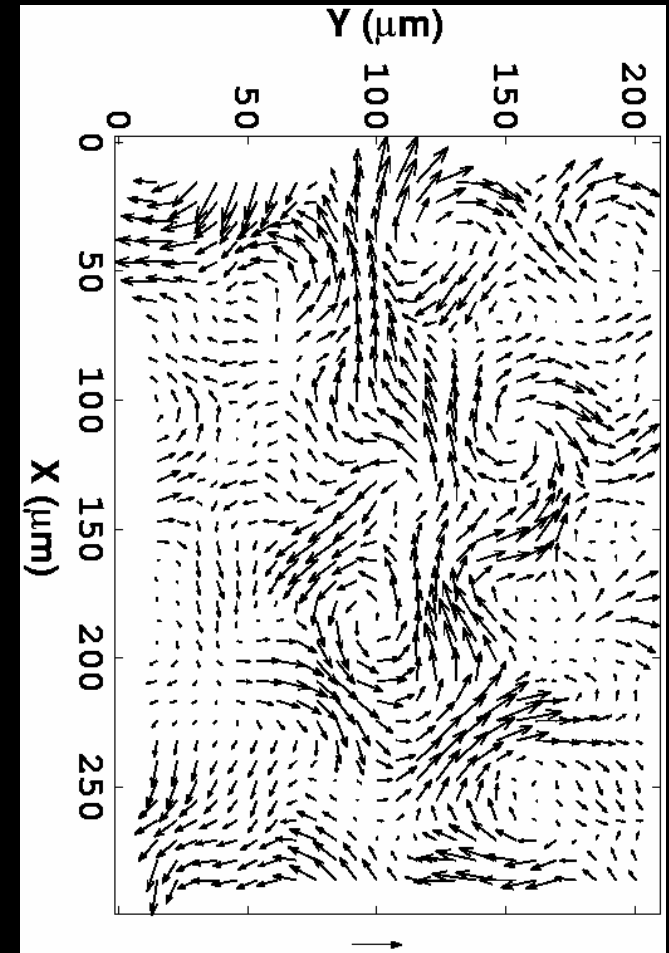
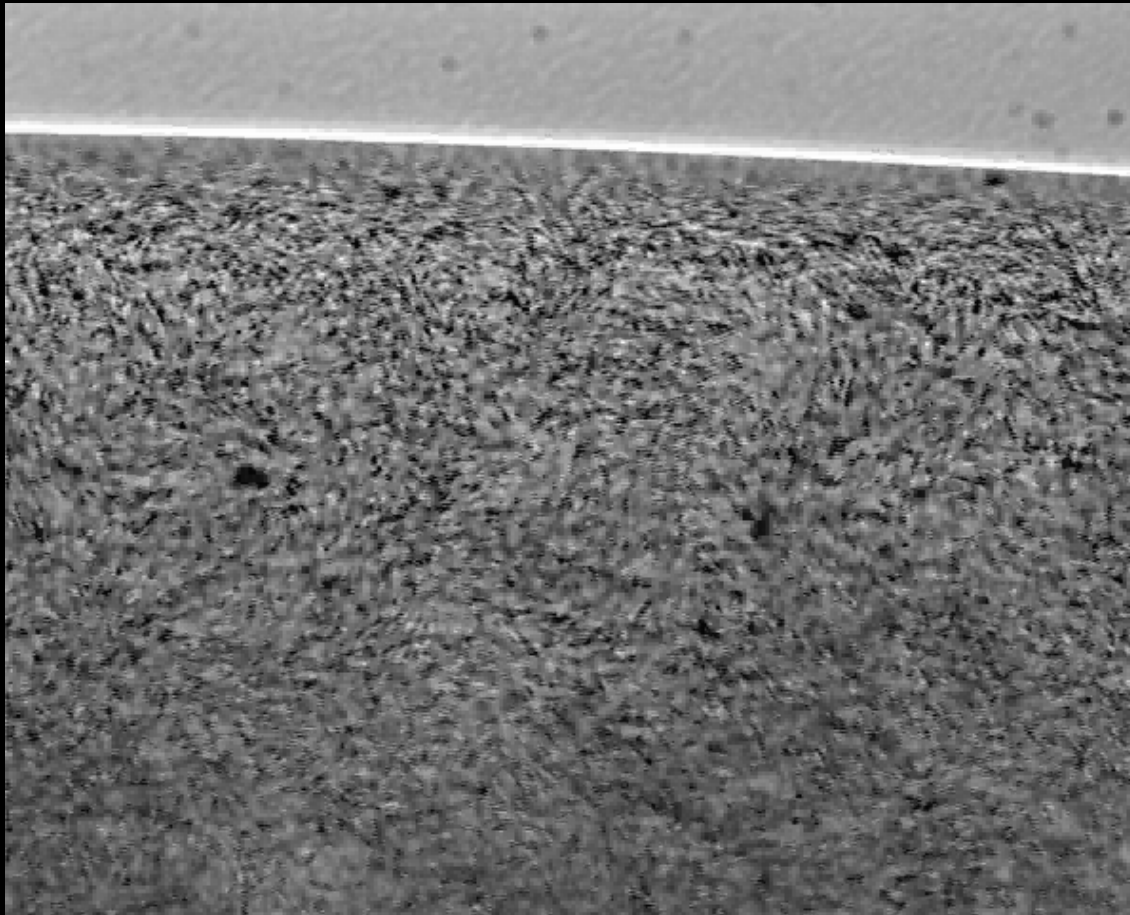
Jánosi Imre, ELTE
John Kessler, U Arizona

Biokonvekció -- felülnézet



Jánosi Imre, ELTE
John Kessler, U Arizona

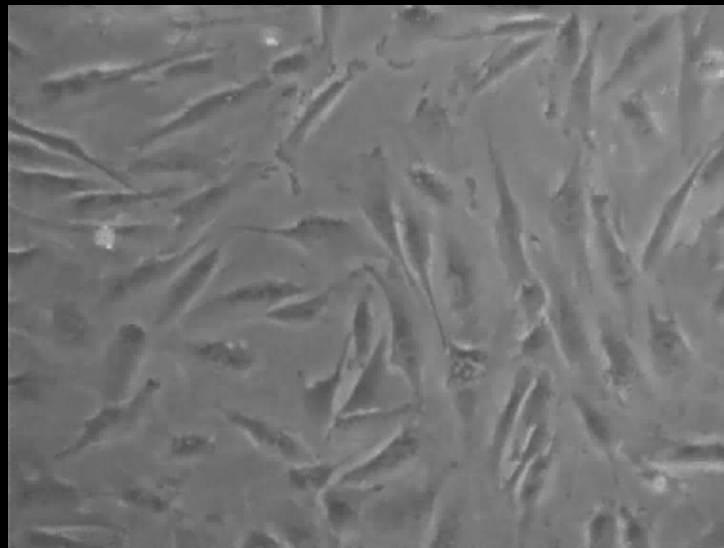
Nagy sűrűség – önhajtott, turbulens folyadék



Raymond Goldstein, U Arizona

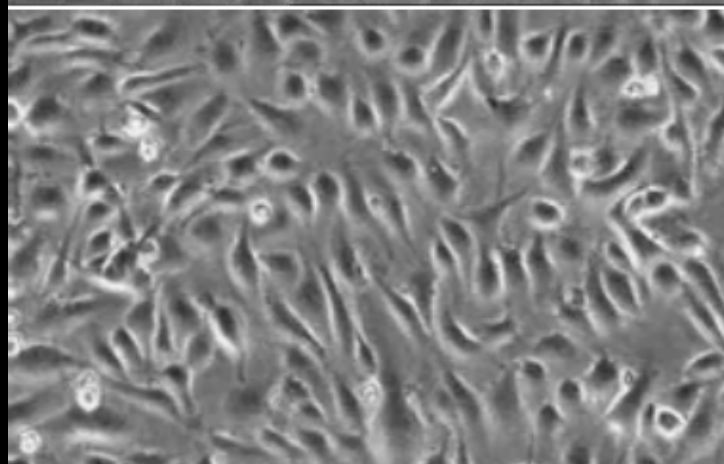
Szöveti sejtek áramlása

Emberi
glioblasztóma
sejtek



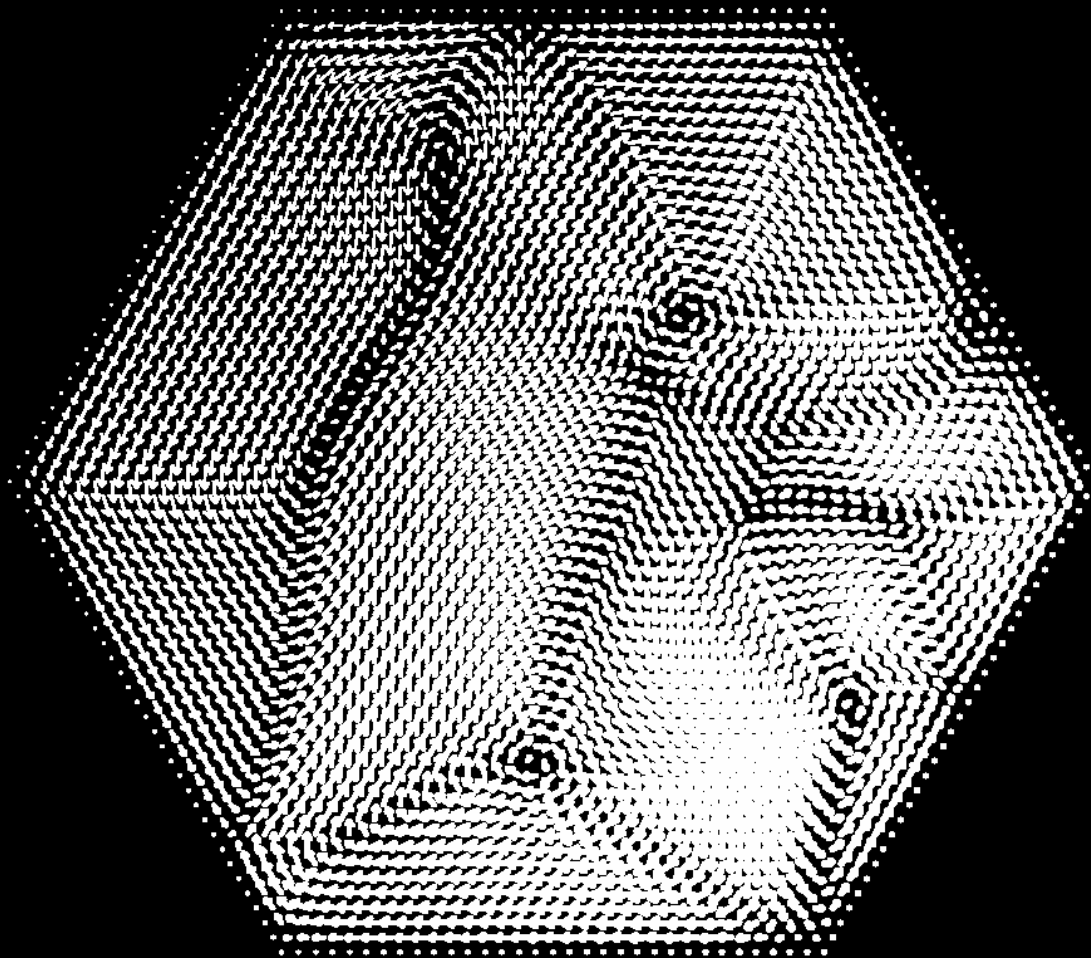
Hegedűs Balázs, ELTE

Aorta sejtek



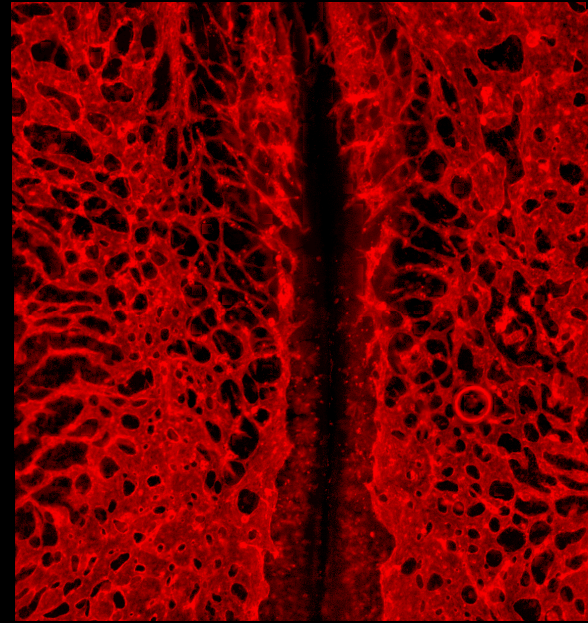
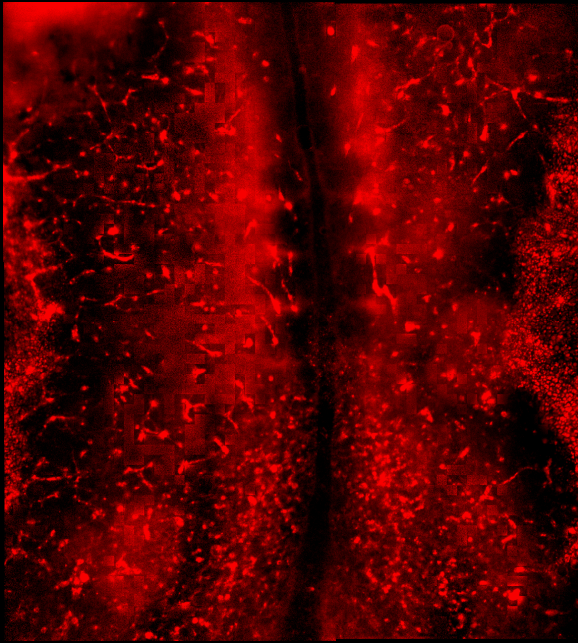
Waleed Twal, MUSC

Önhajtott folyadék
(hidrodinamikai modell)

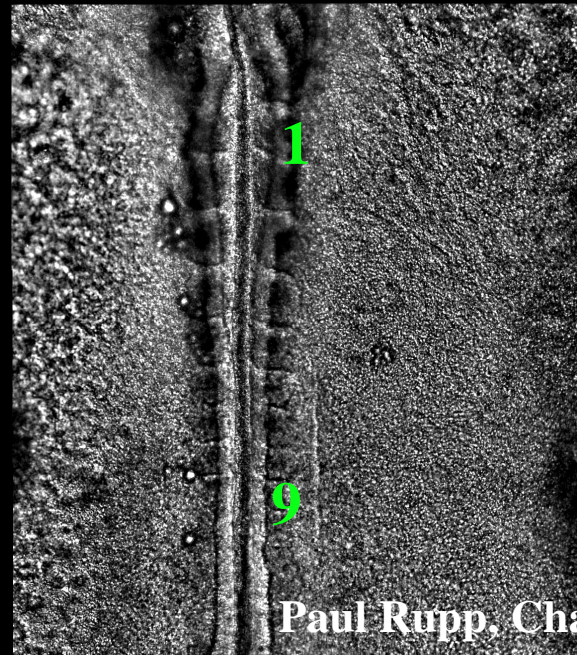
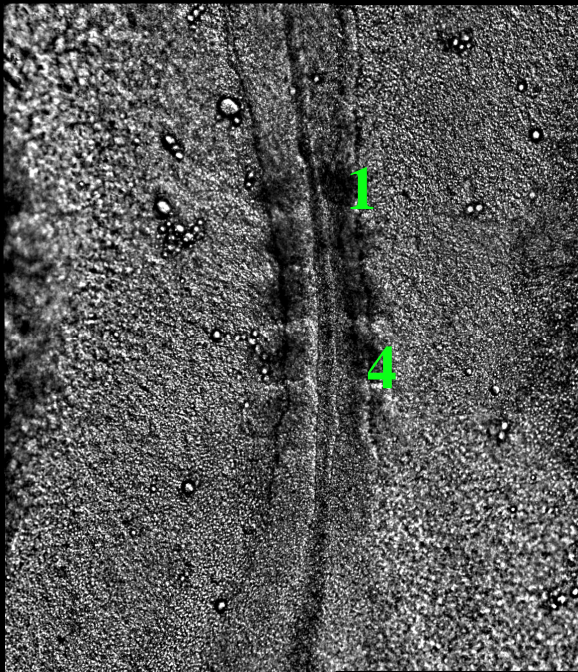
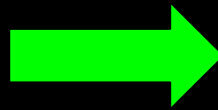


Csahók Zoltán, Vicsek Tamás
ELTE

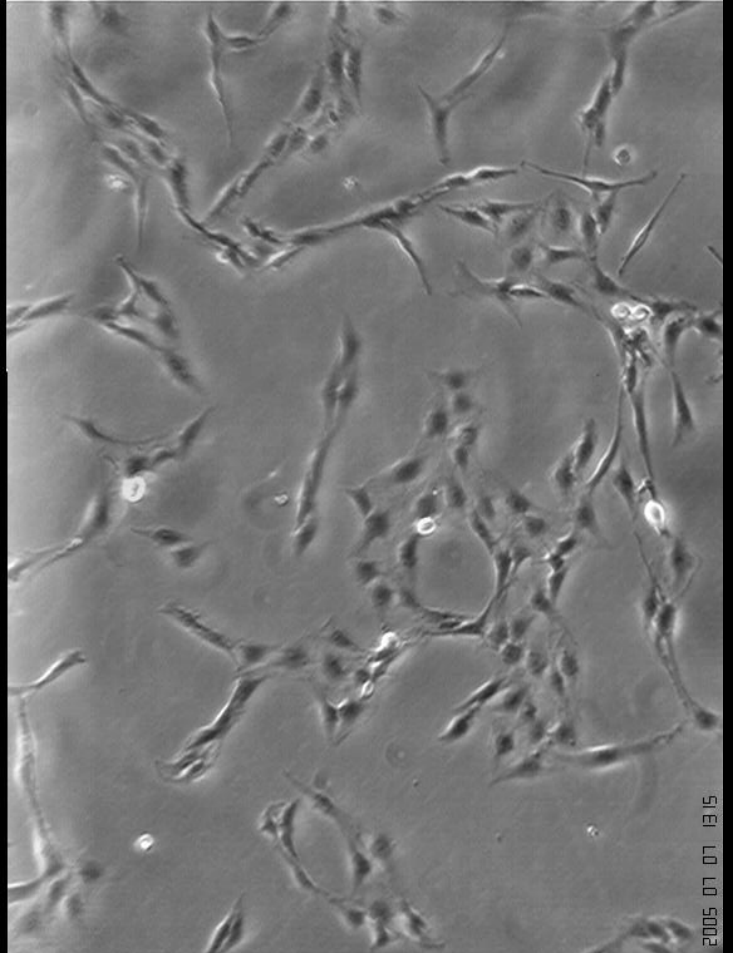
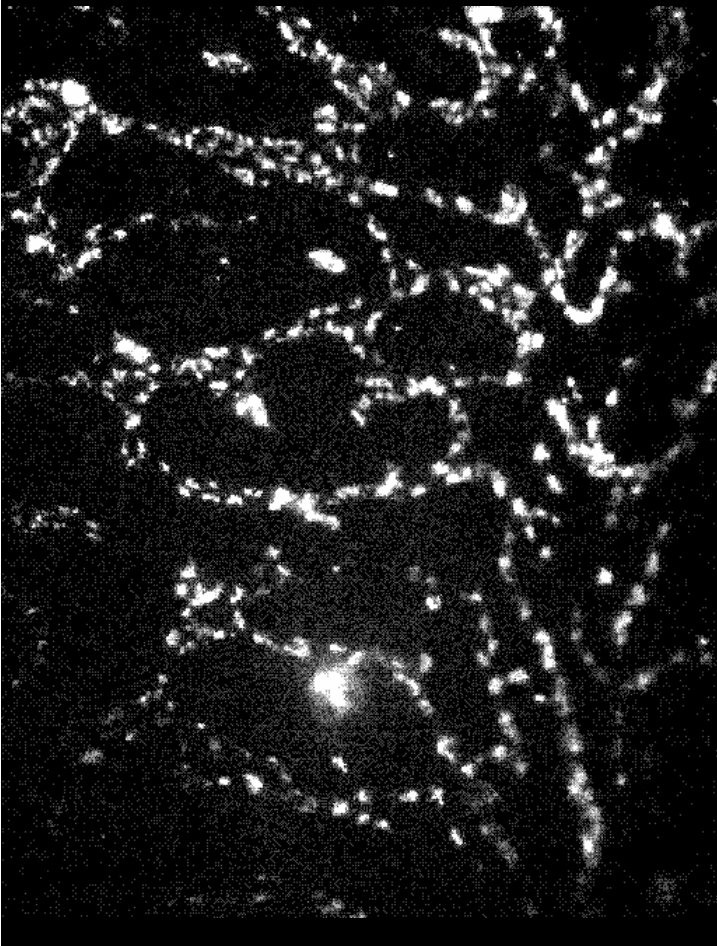
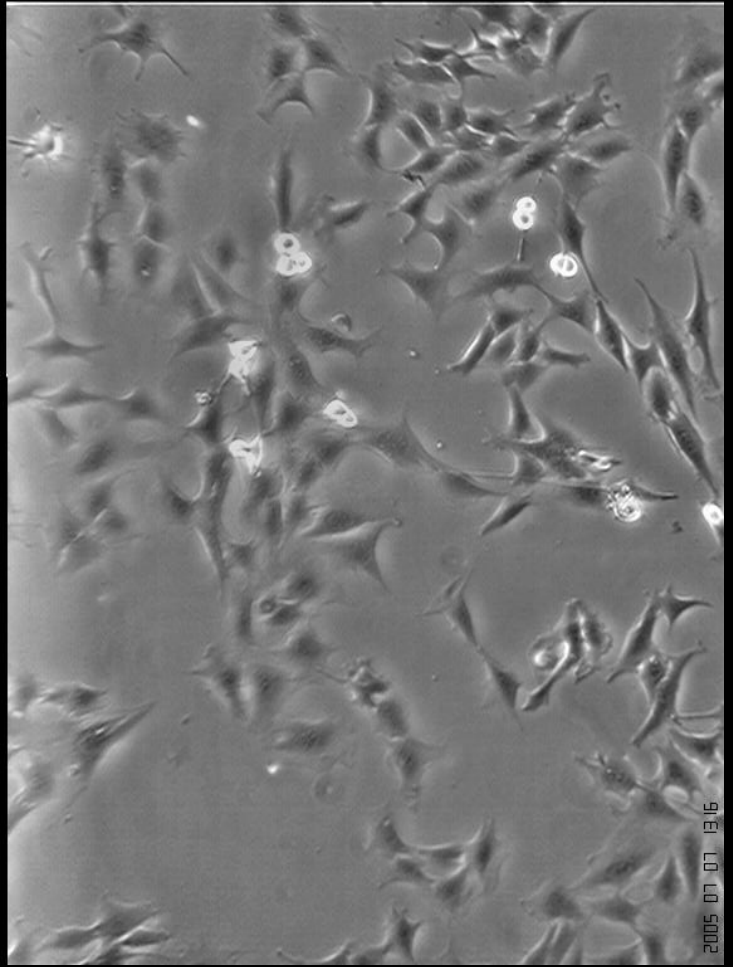
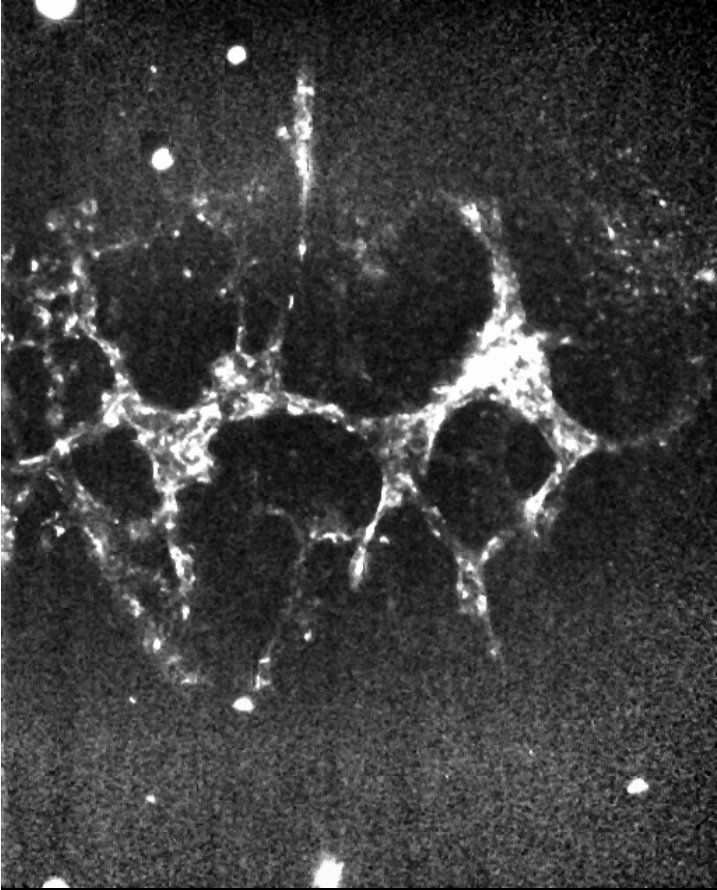
Érhálózat önszerveződés



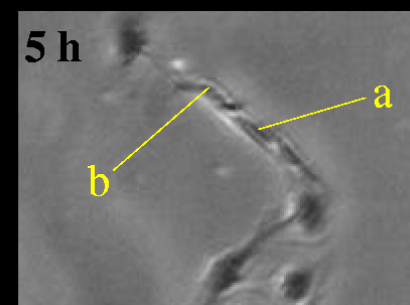
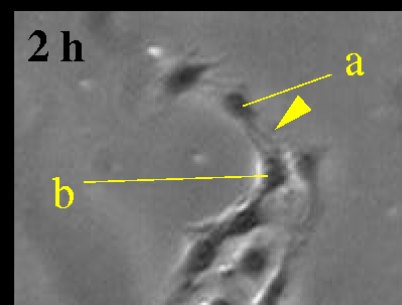
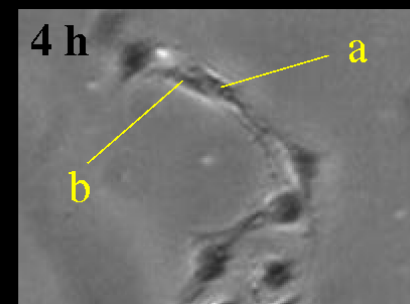
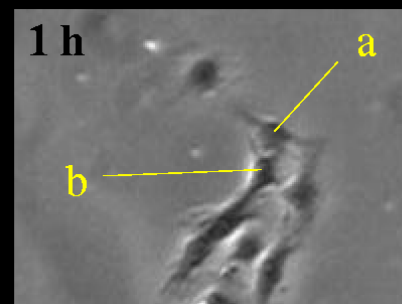
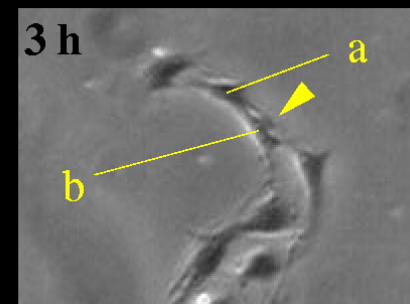
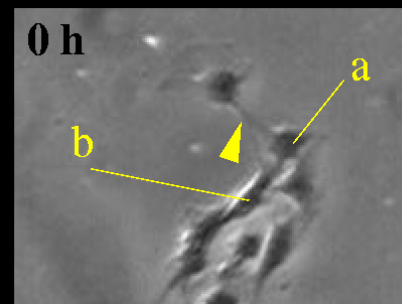
?



Paul Rupp, Charles Little
U Kansas

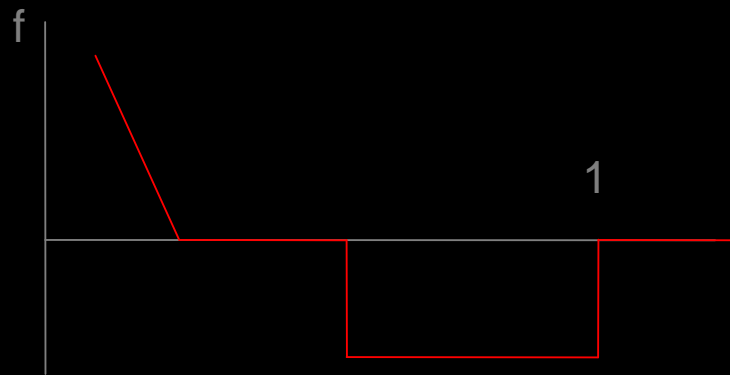


Hálózat-formálás tenyészetben



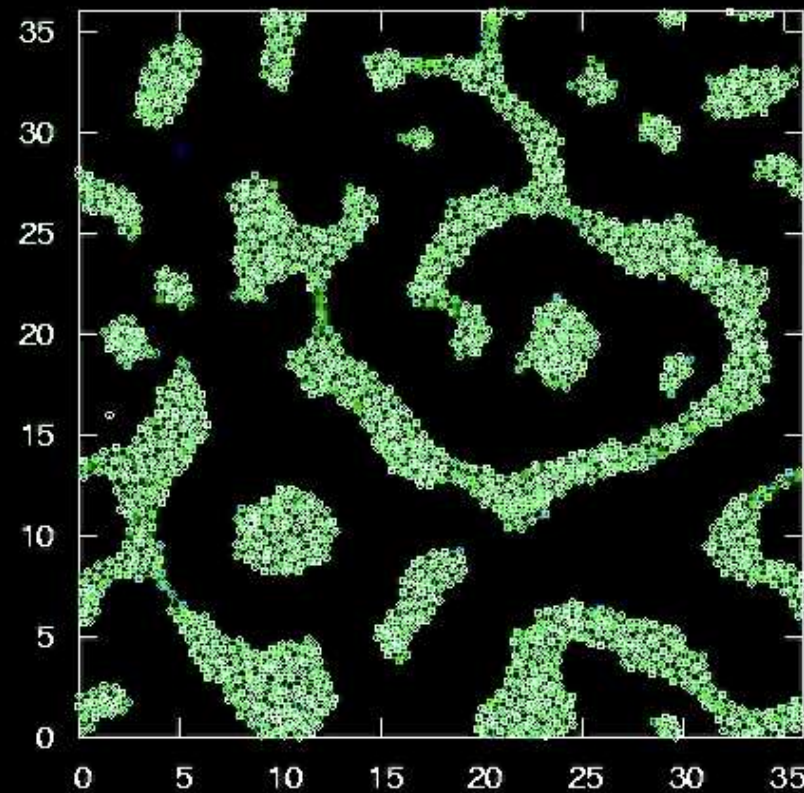
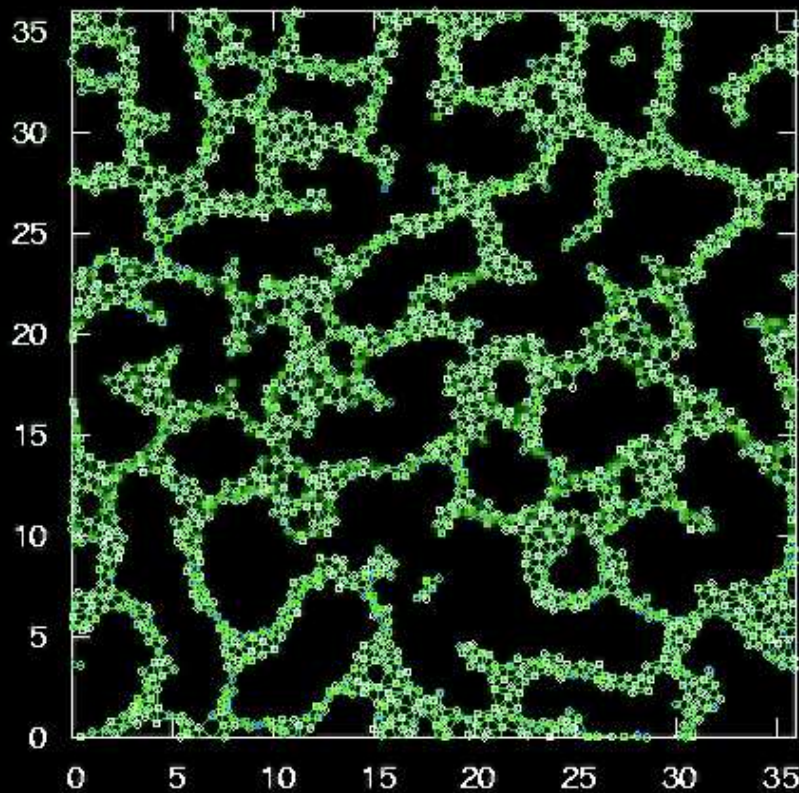
Szabó András, Méhes Előd
ELTE

Hálózat-formálás modellje

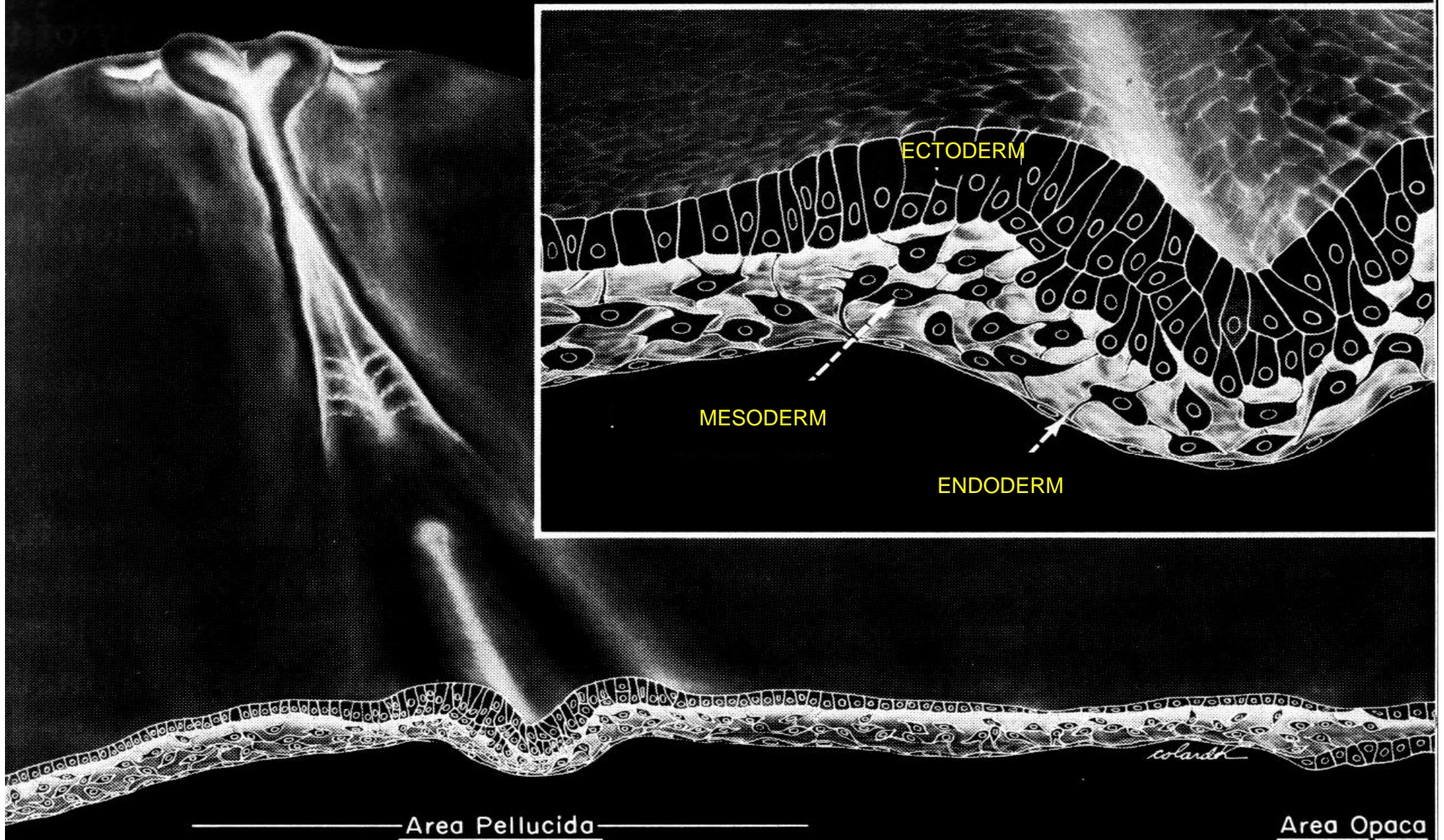


Erőhatás a szomszédos részecskék között.

Vonzás arányos a részecske környezetének anizotropiájával



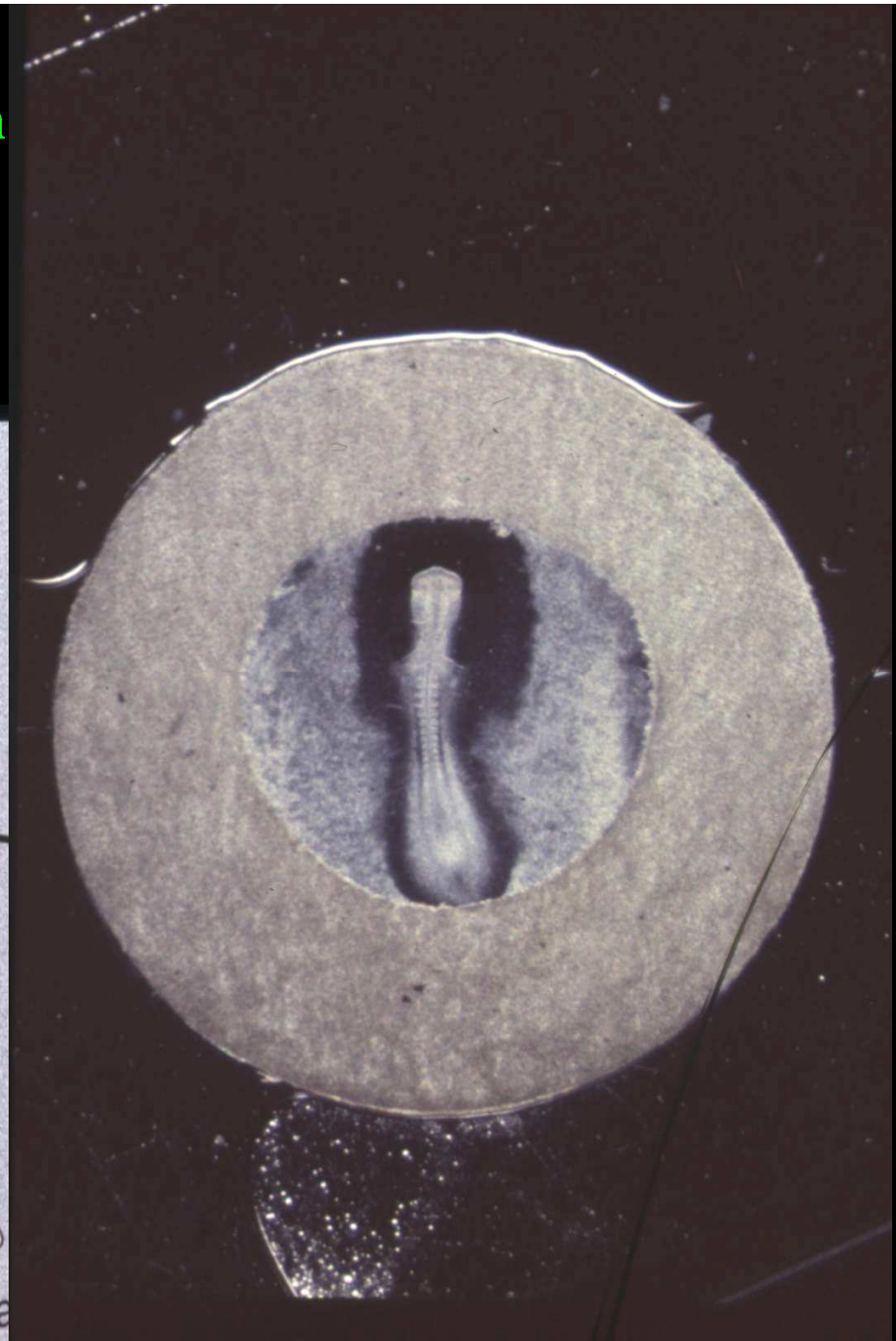
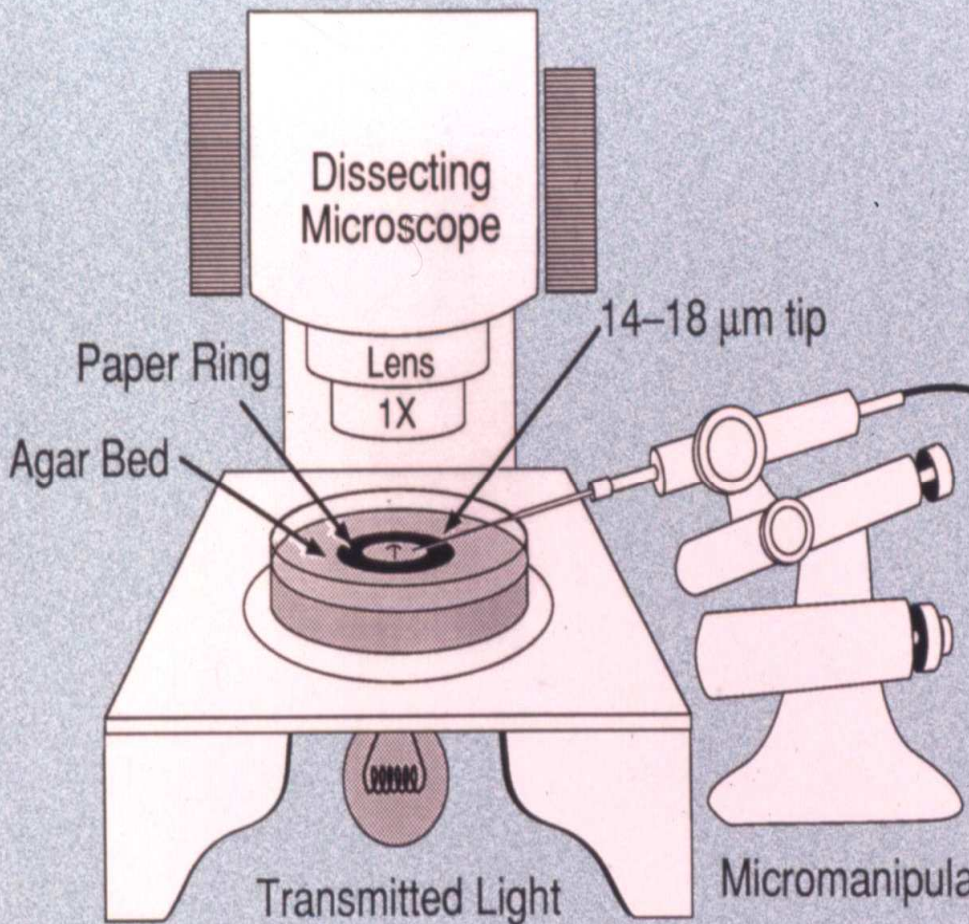
Korai madárembriók szerkezete



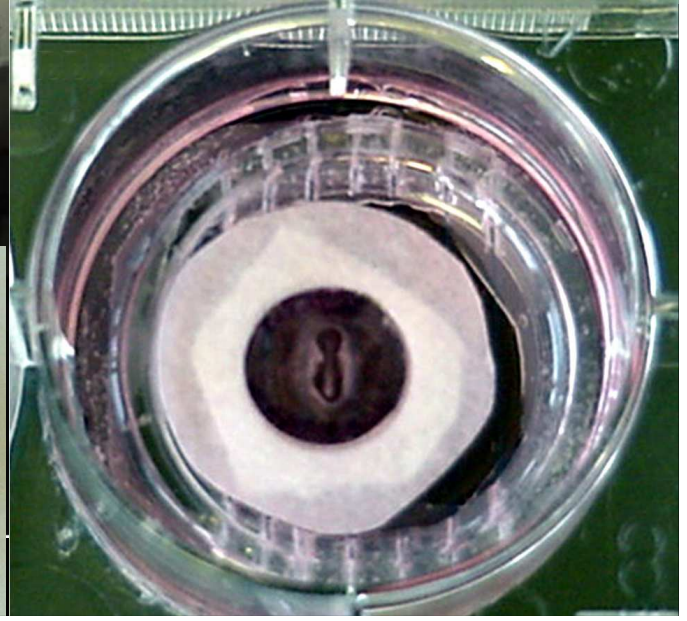
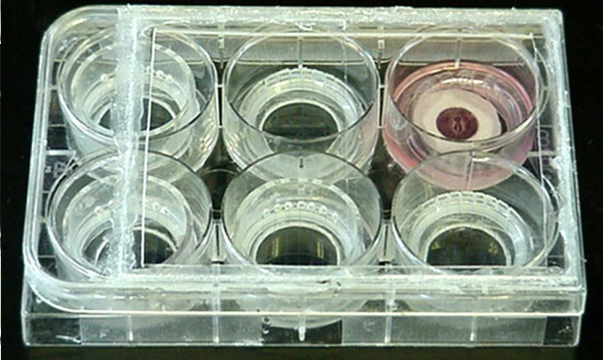
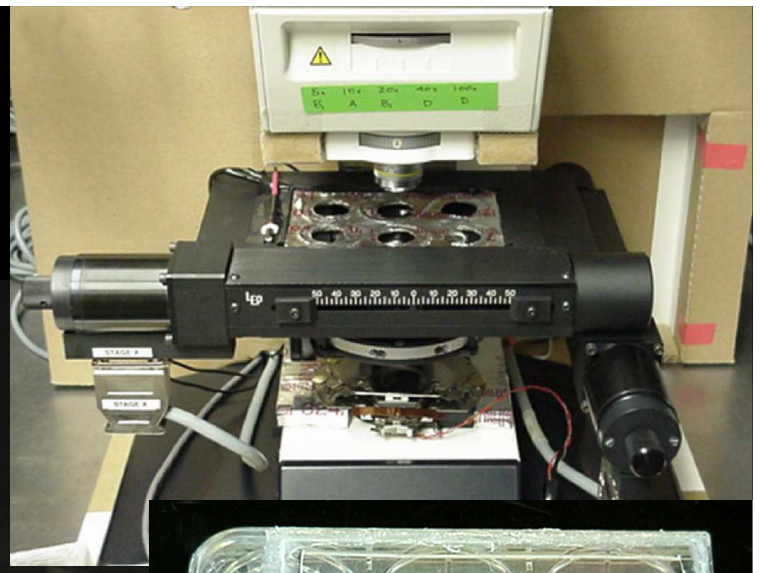
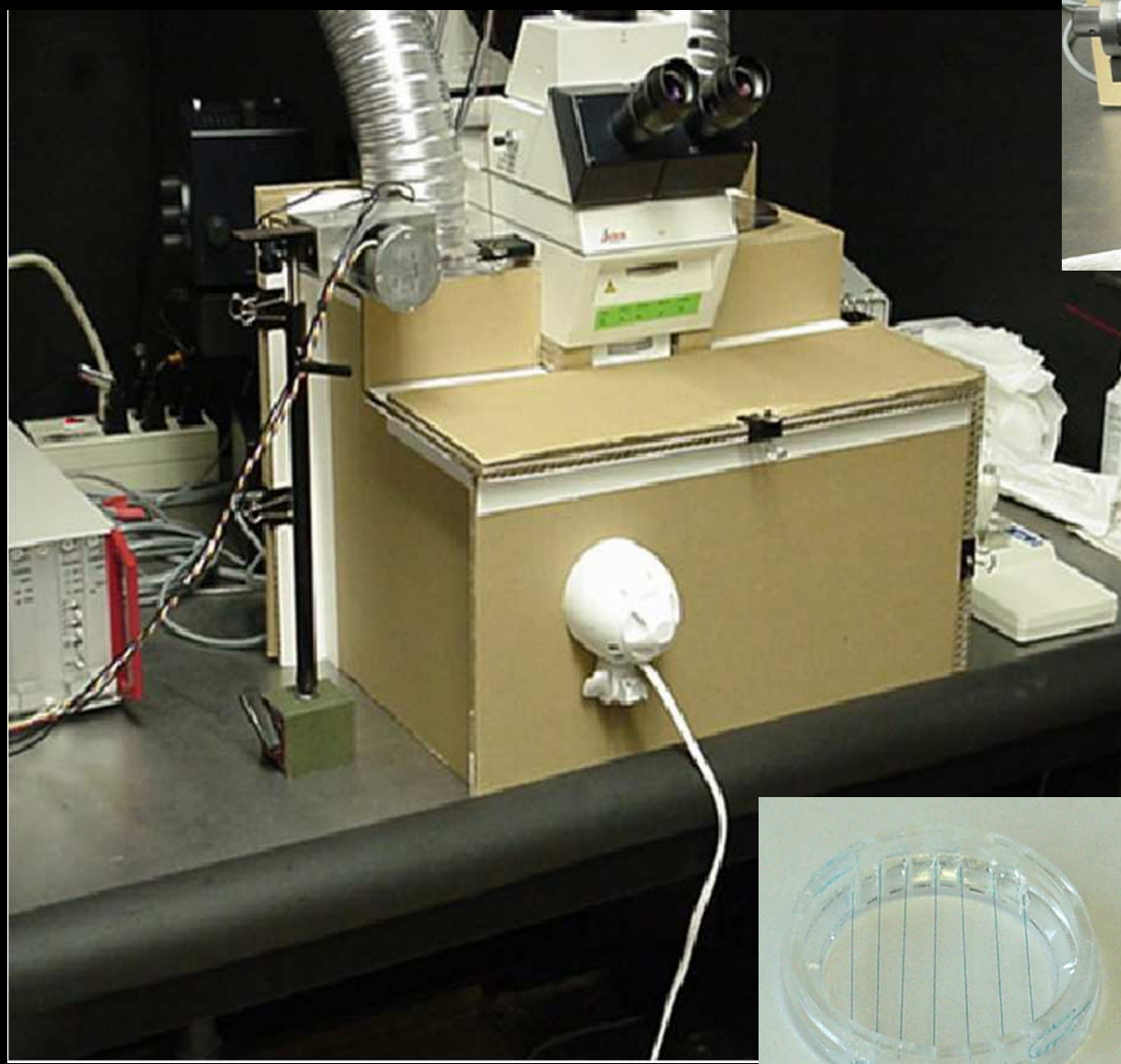
E. Hay, 1968

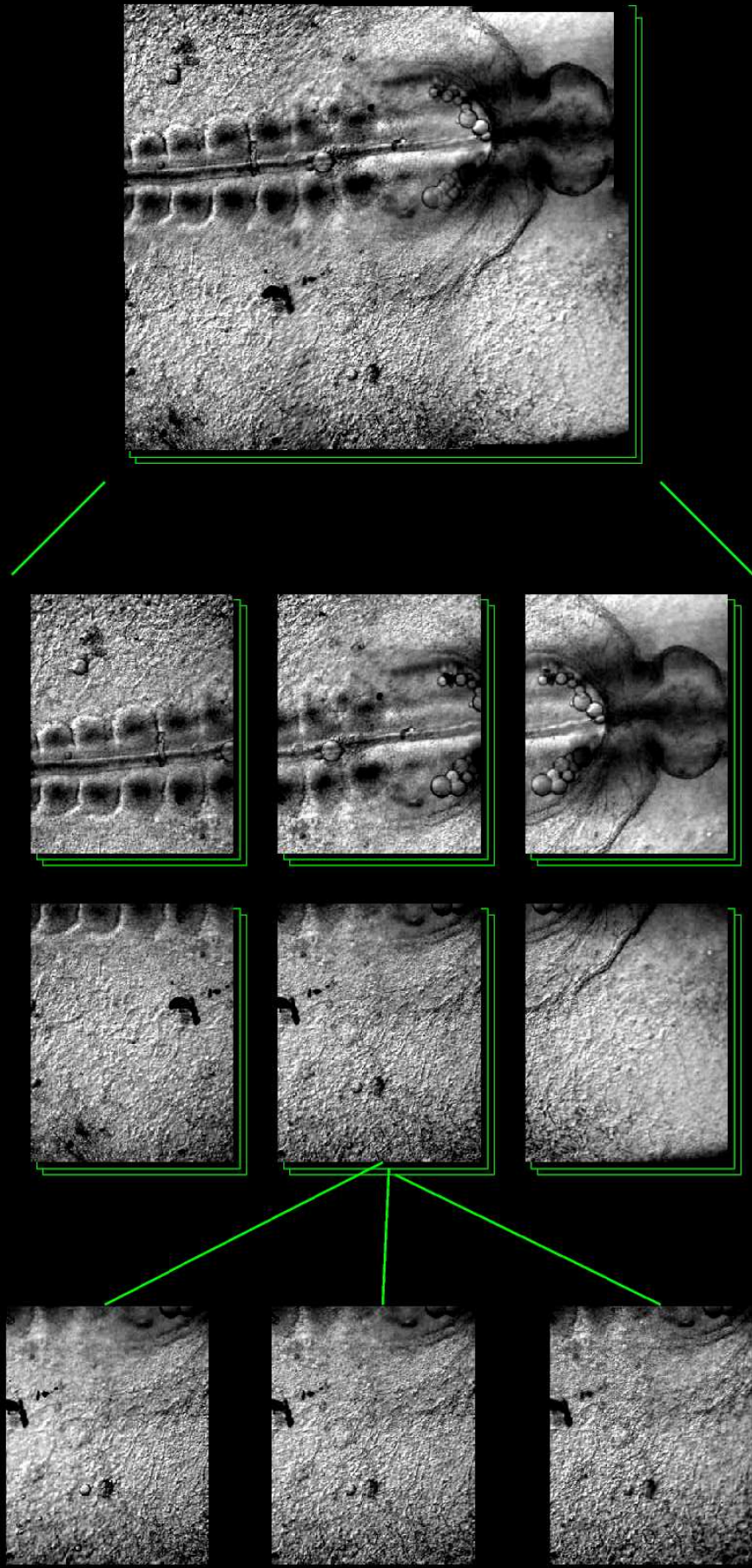
Vizsgálati módszerek:

1. Embriók életben tartása a tojáson kívül
2. Mikroinjektált reagensek
3. Automatizált mikroszkópia
4. Adatelemzés



Mikroszkópia:





merged image

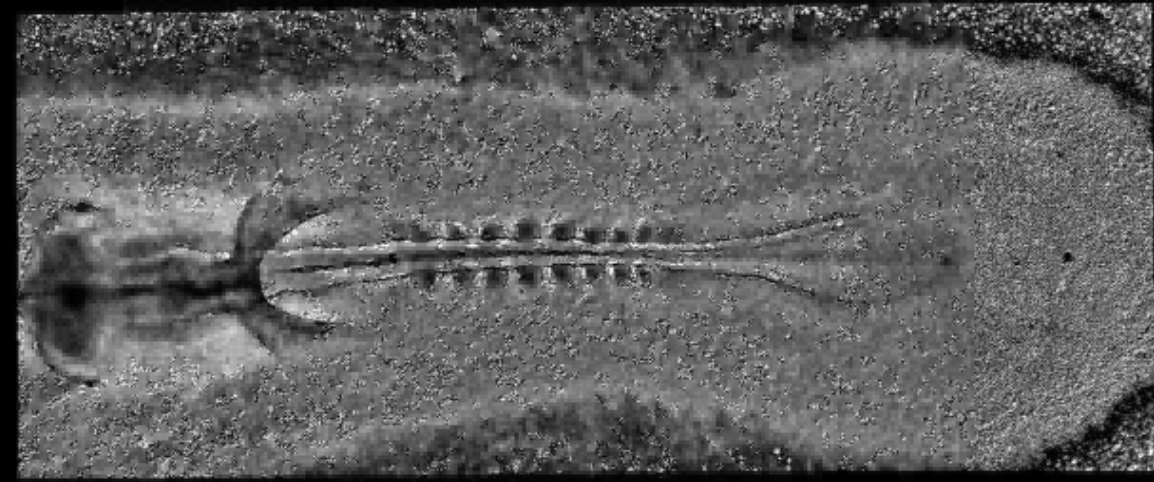
overlapping microscopic fields

z-stack

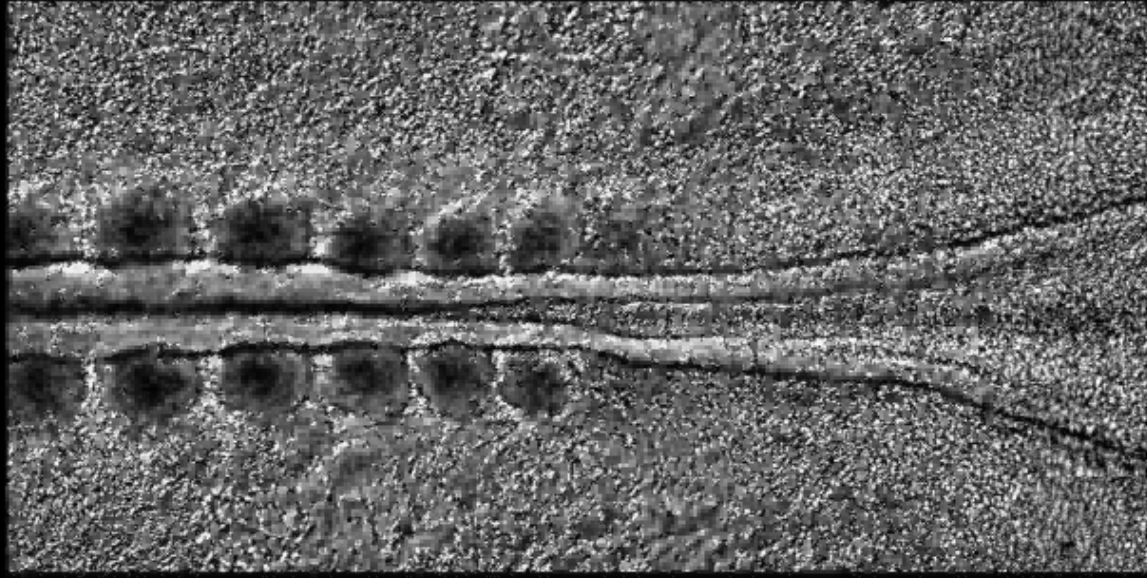
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$z = 0 \mu\text{m}$

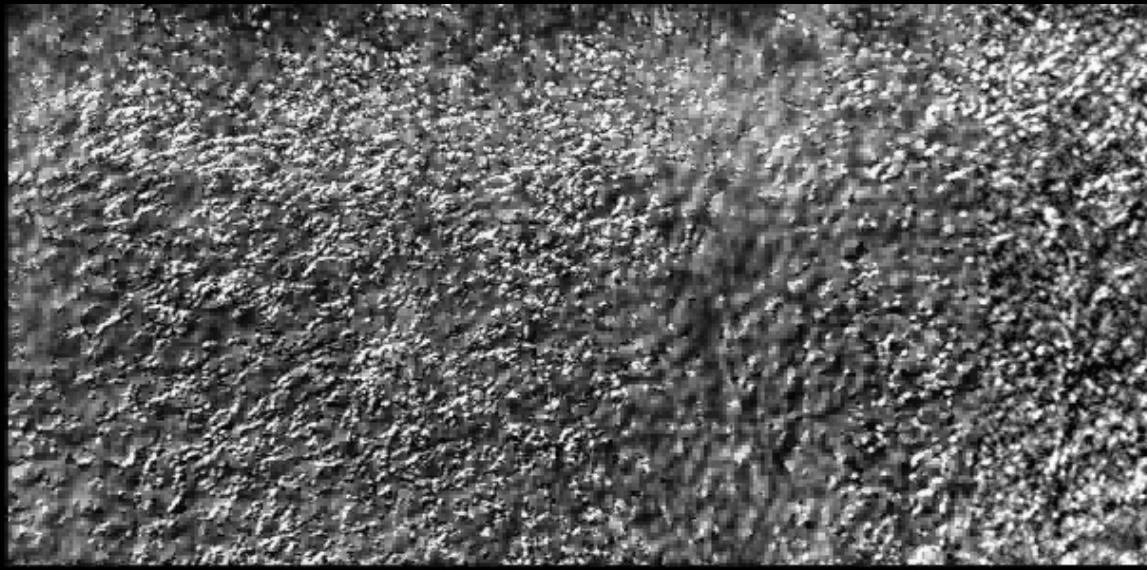
$z = -10 \mu\text{m}$



0.2mm: —



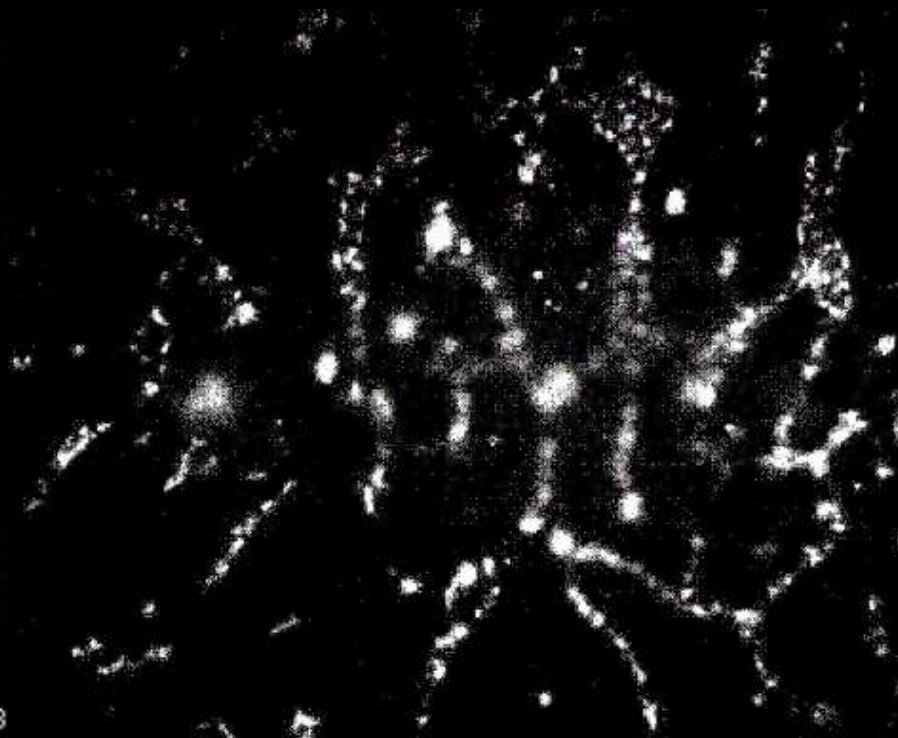
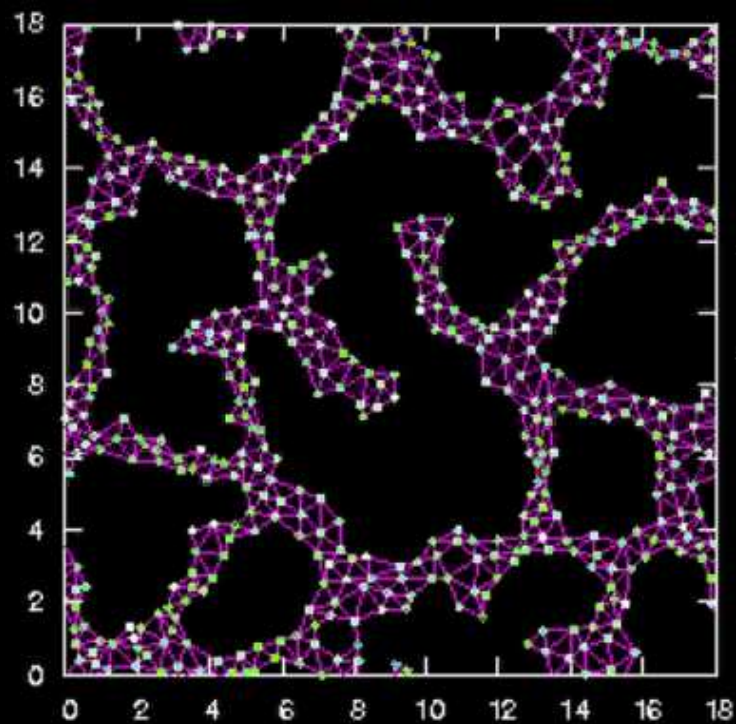
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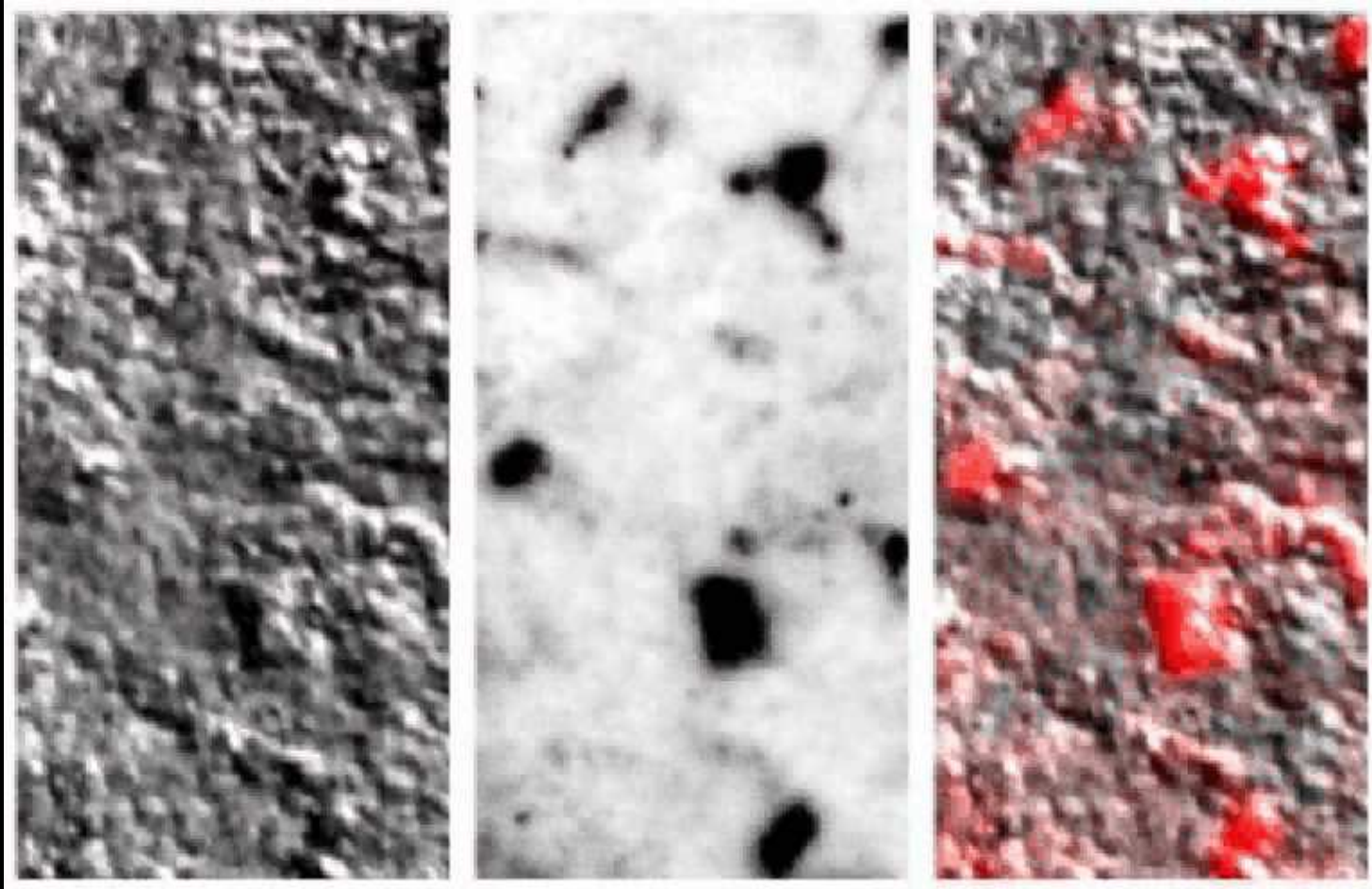
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Time : 00.0 hours

Az embrionális érhálózat kialakulása



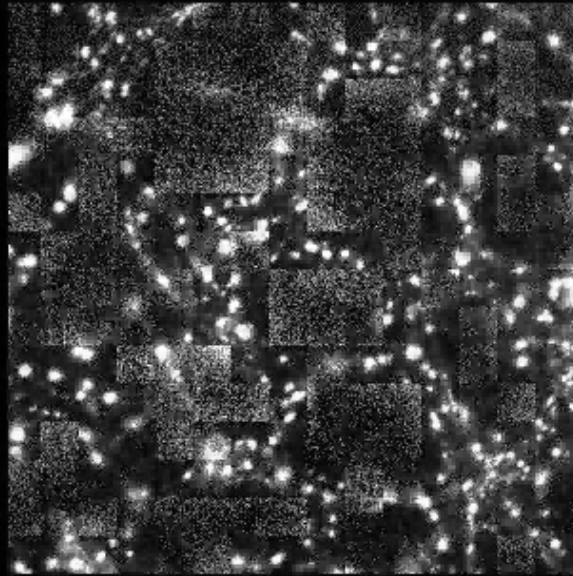
Az embrionális érhálózat kialakulása



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A sejtmozgás intenzitása szabályozható

VEGF

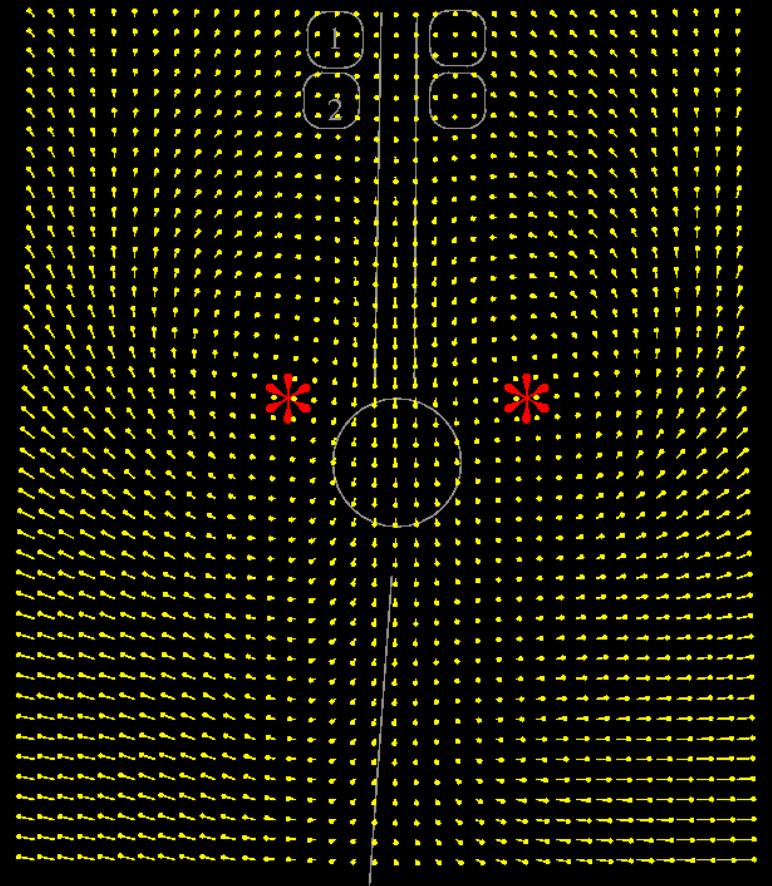
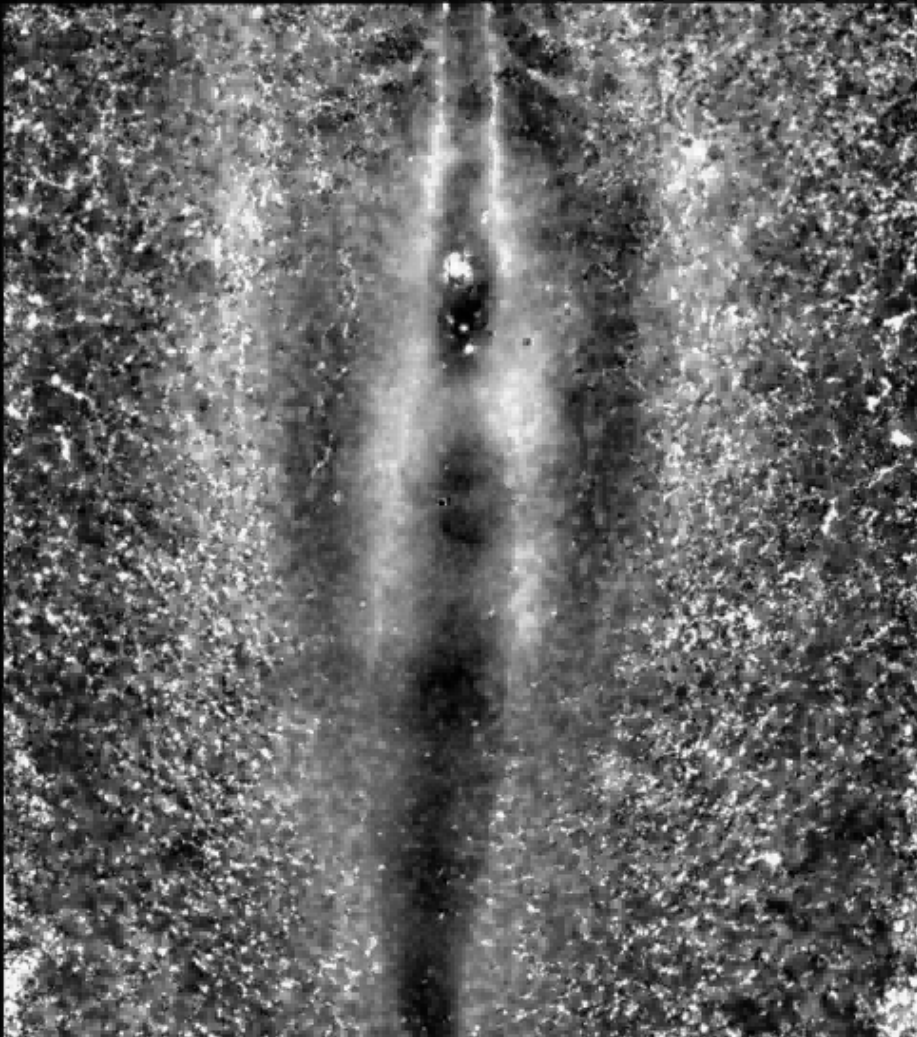


CONTROL



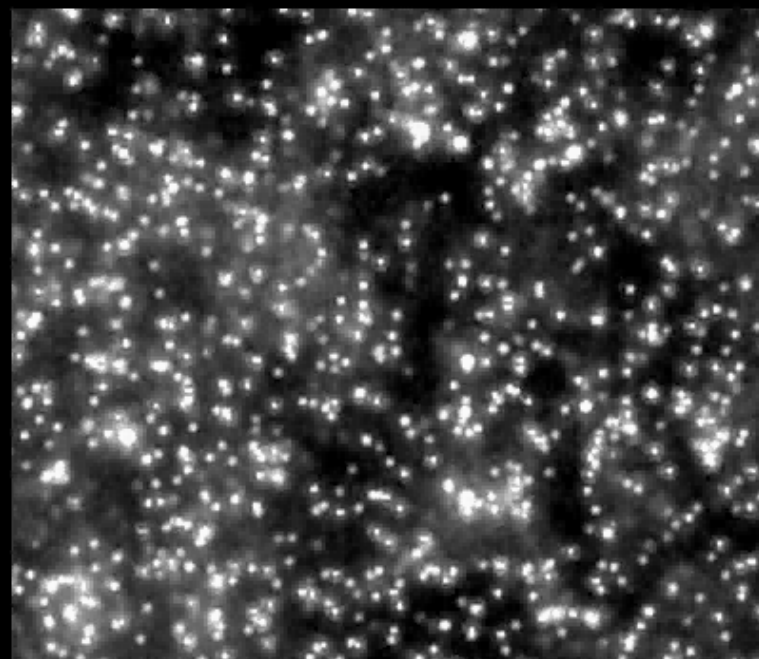
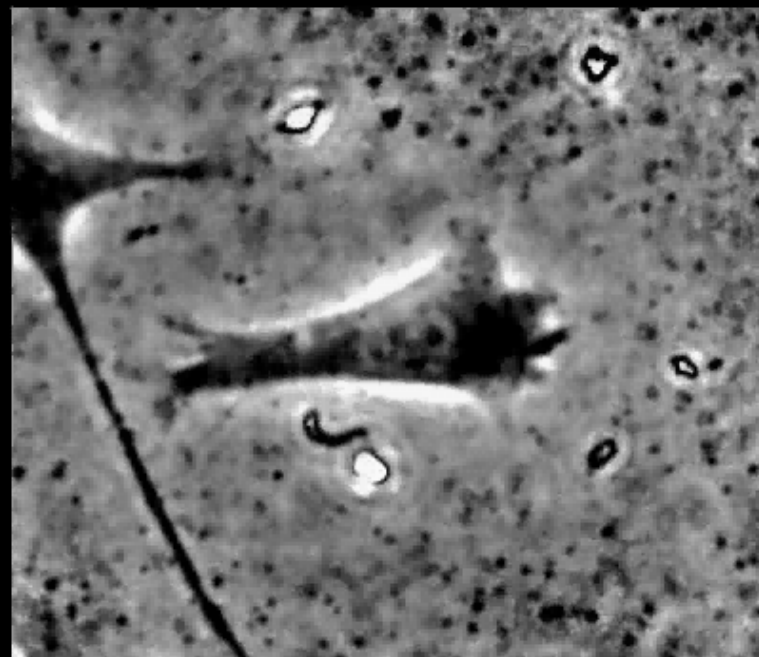
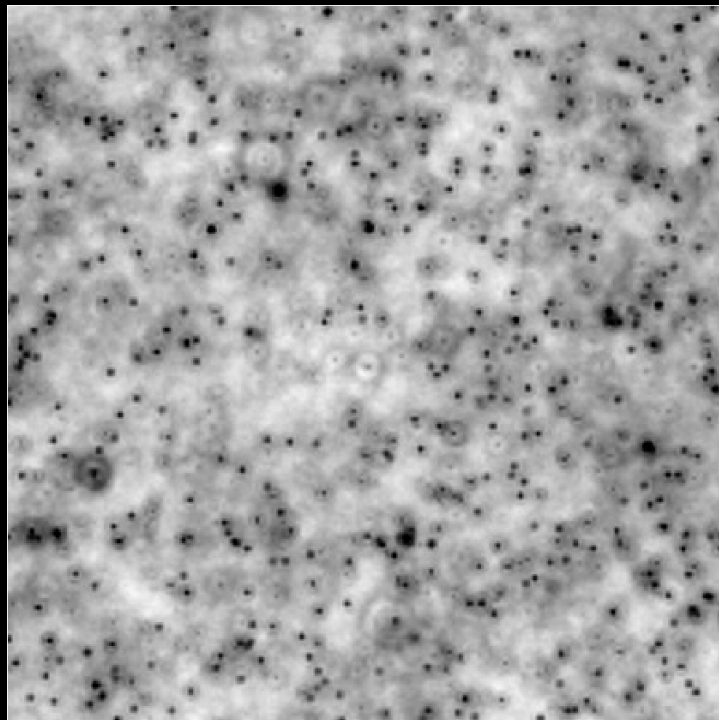
Paul Rupp, Charles Little
U Kansas

Áramlások az embriófejlődés során

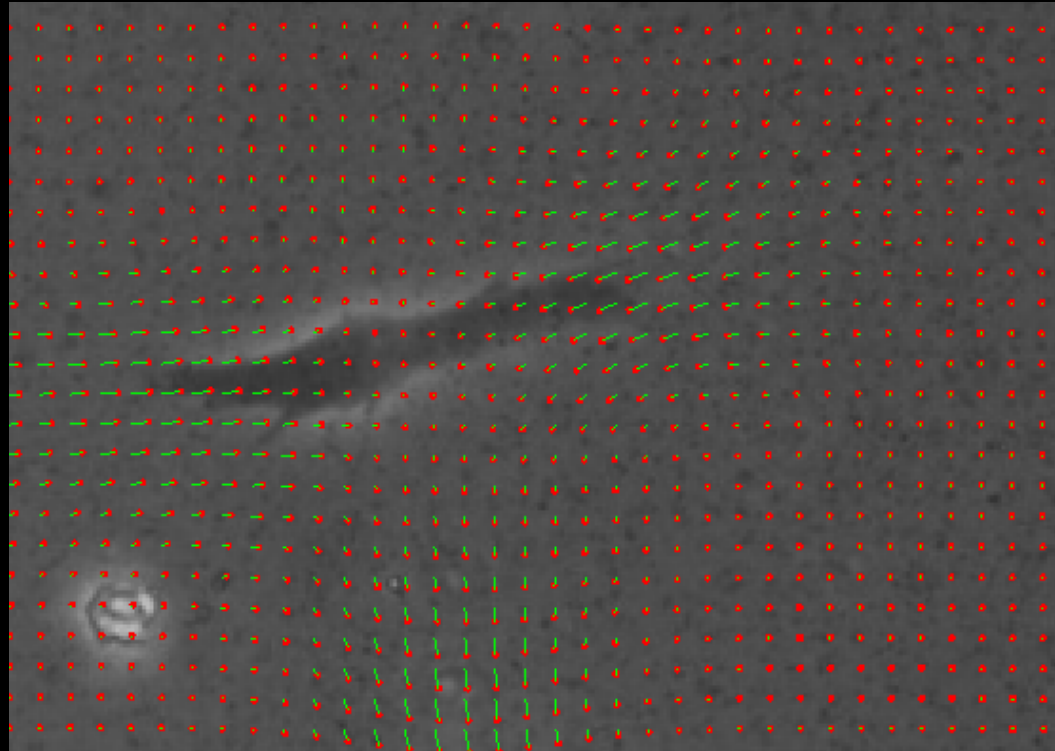


Brenda Rongish, Evan Zamir, Charles Little
Univ. of Kansas

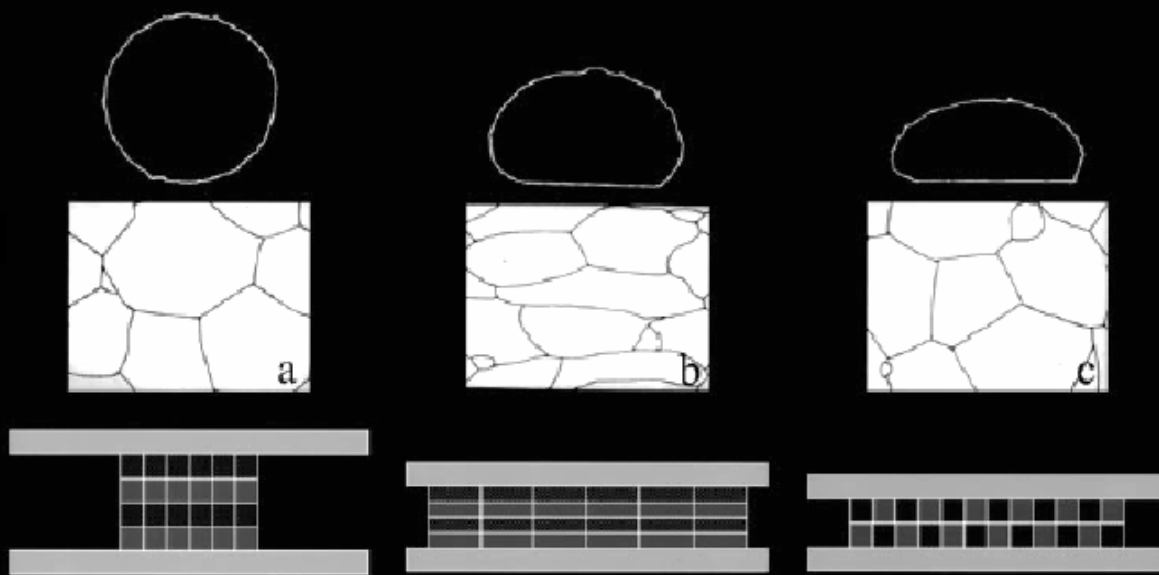
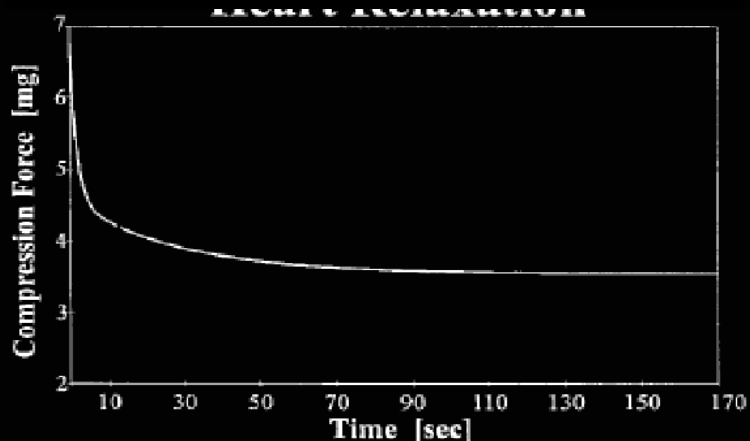
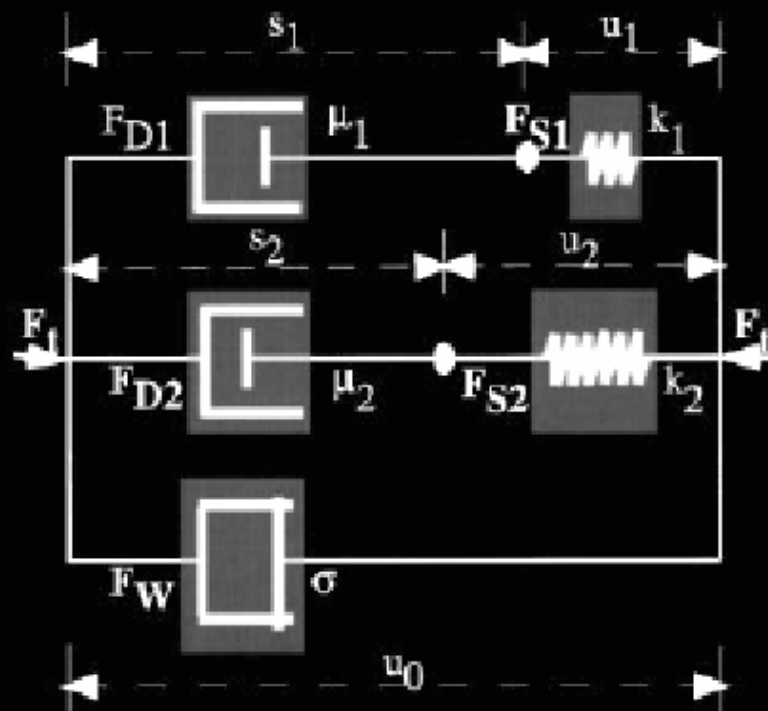
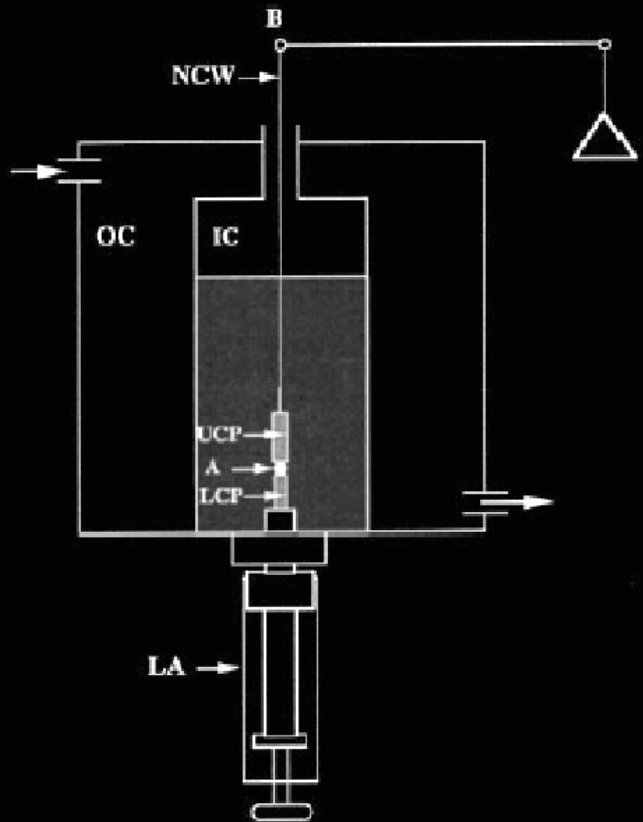
Erők mérése



Géldeformációk sejtmozgás közben

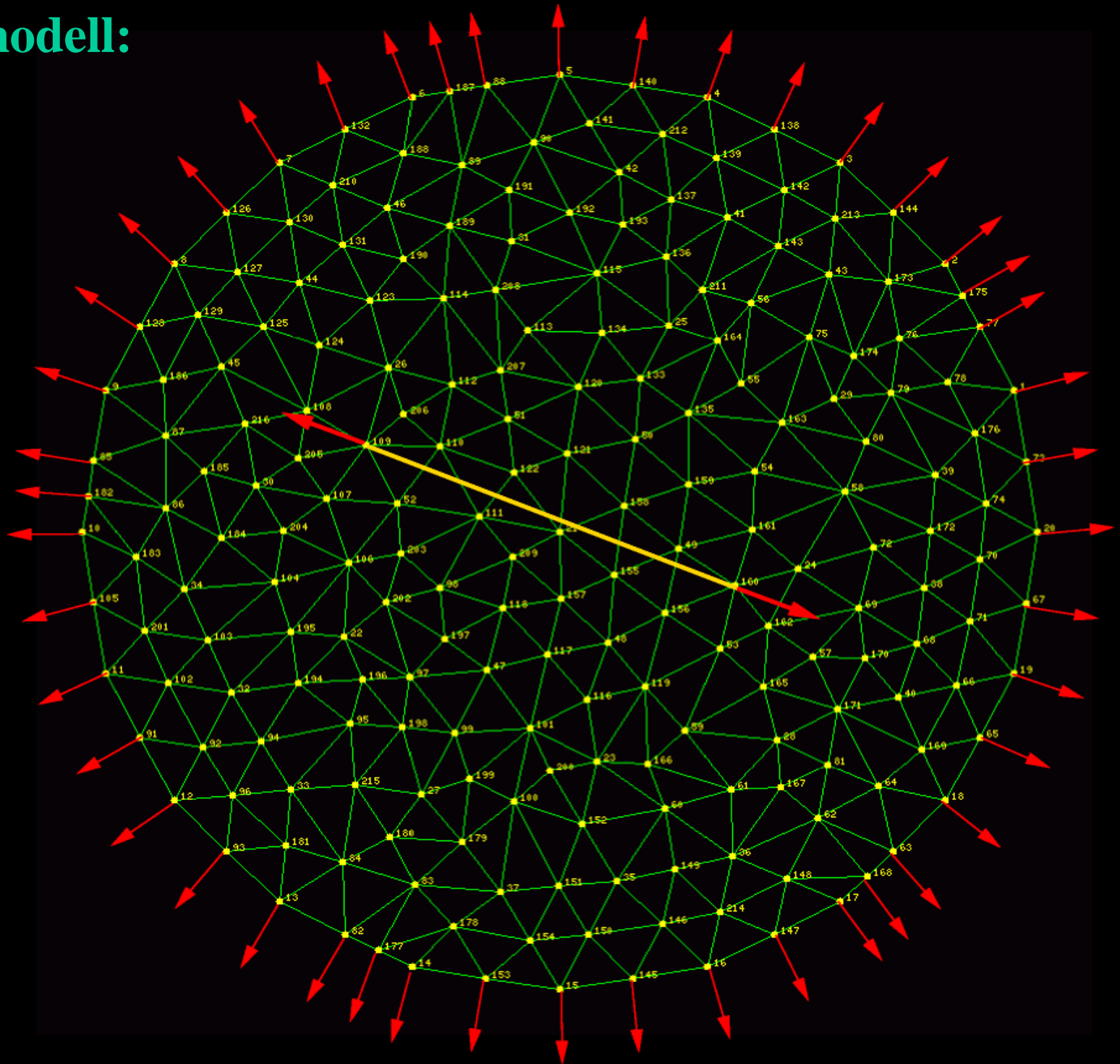


Az embrionális szövetek folyadékok: relaxálni tudják a nyiróerőket

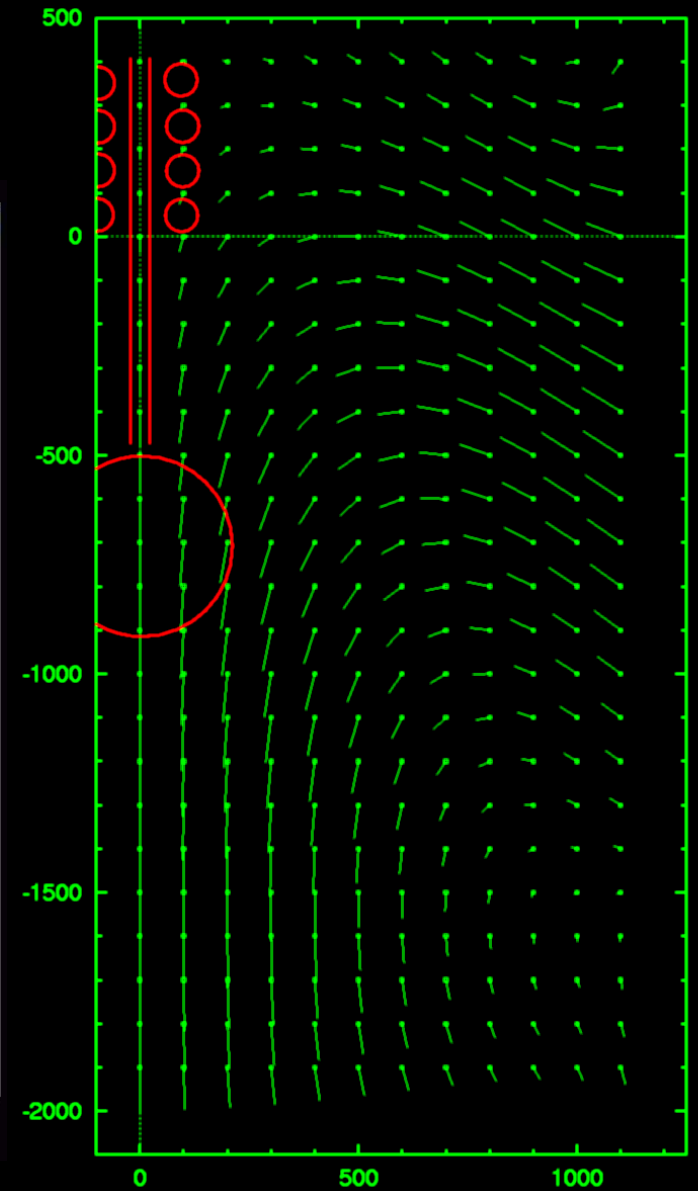
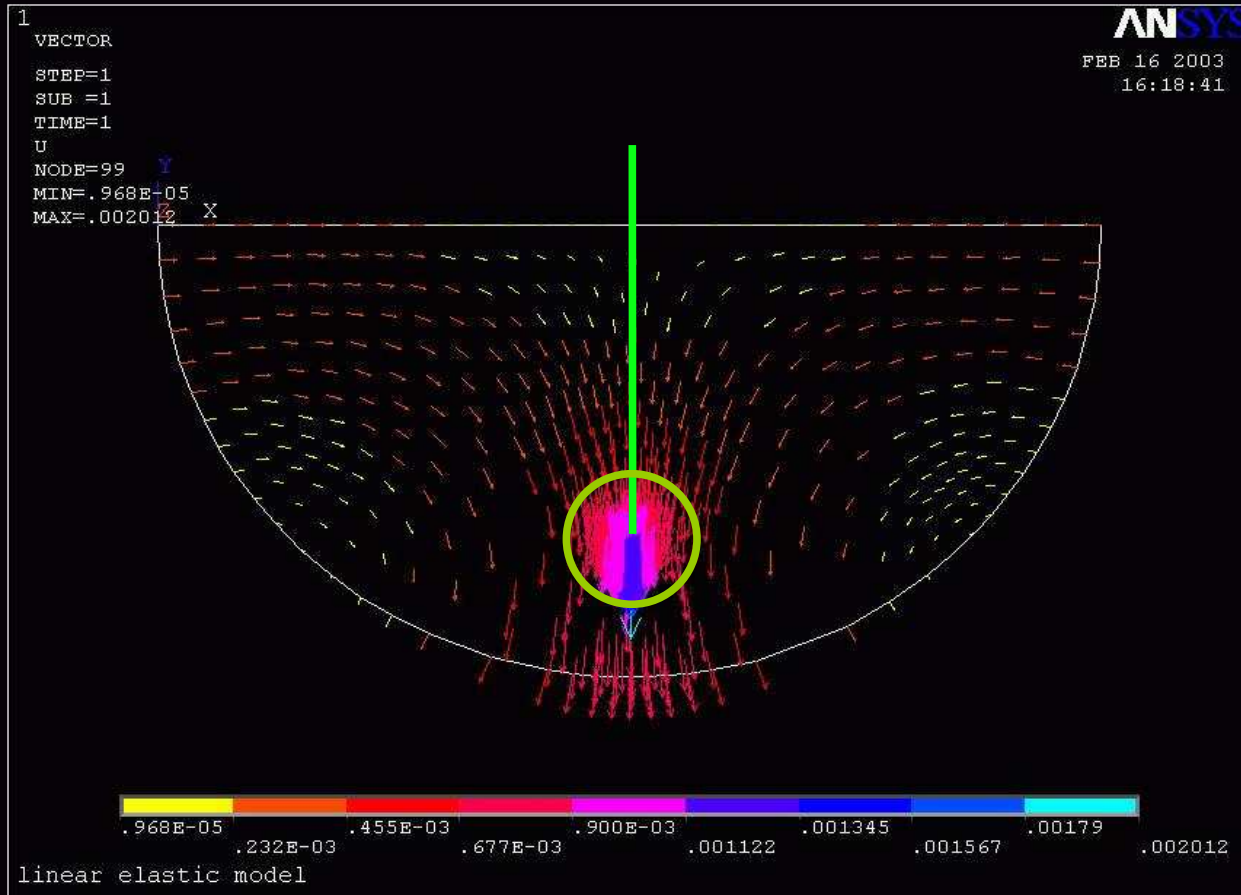


Forgacs et al., 1998

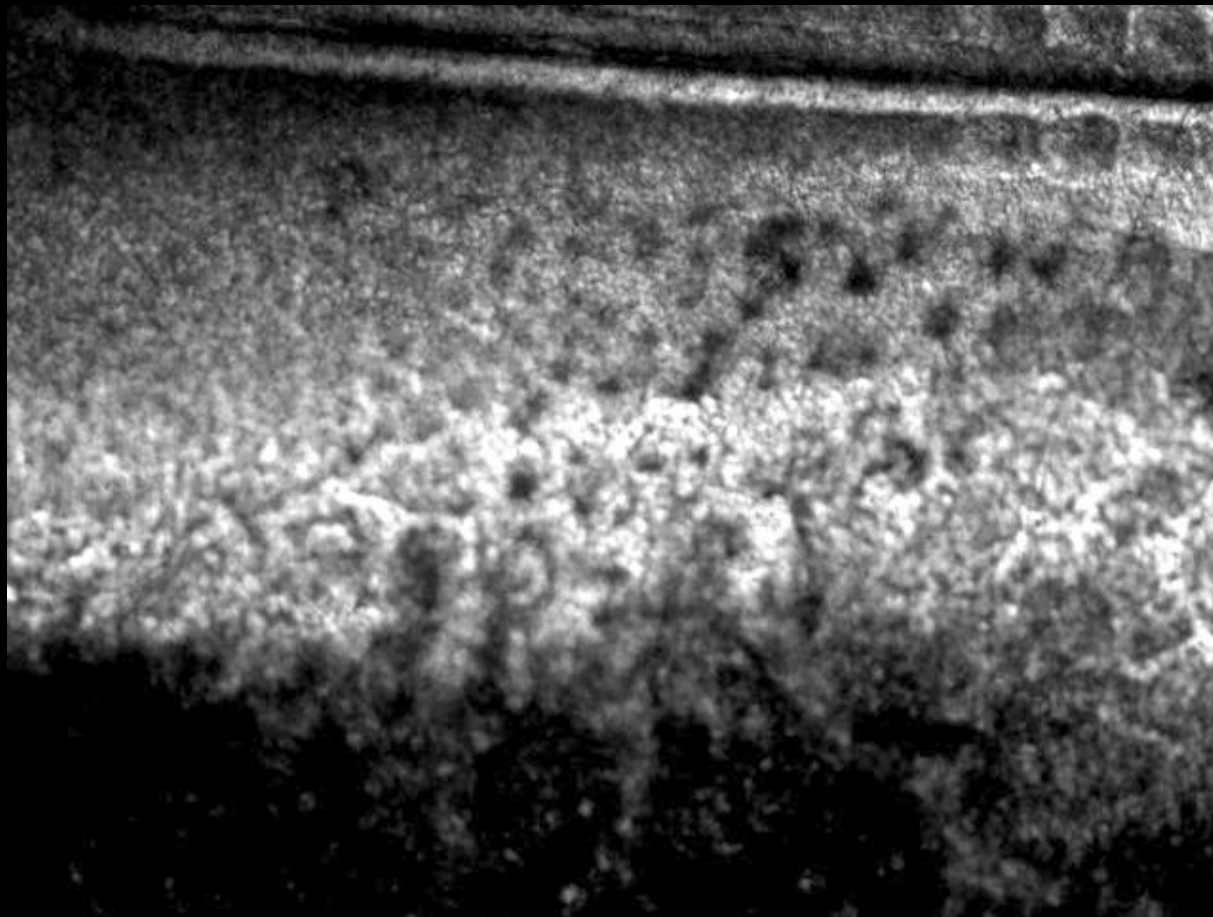
Mechanikai modell:



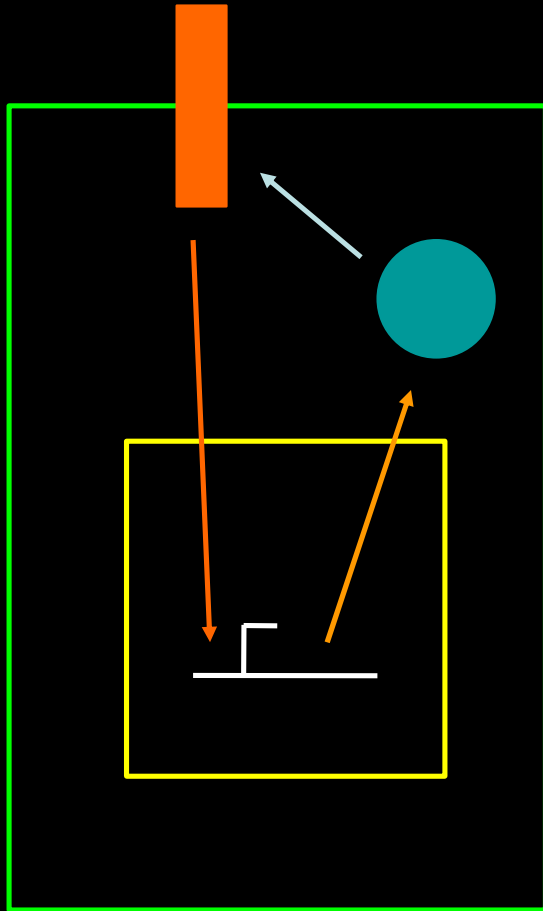
Deformációk számolása



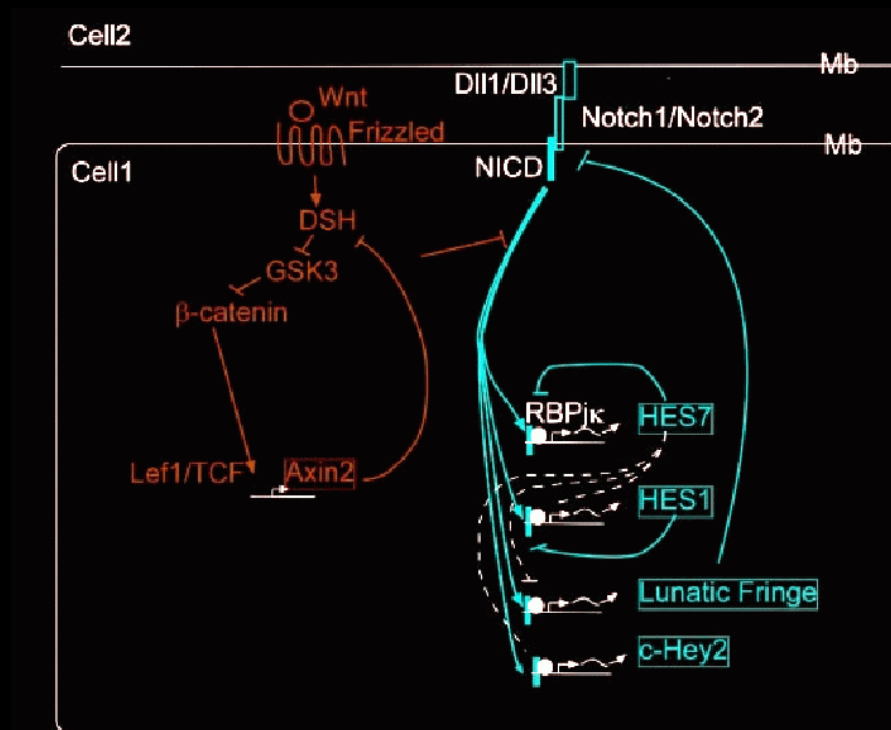
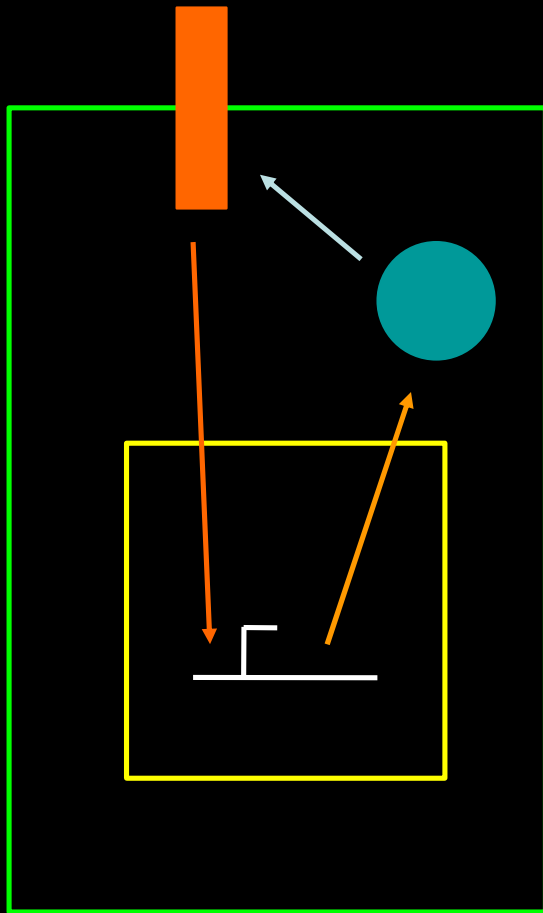
A jövő: mesterséges szövetek?



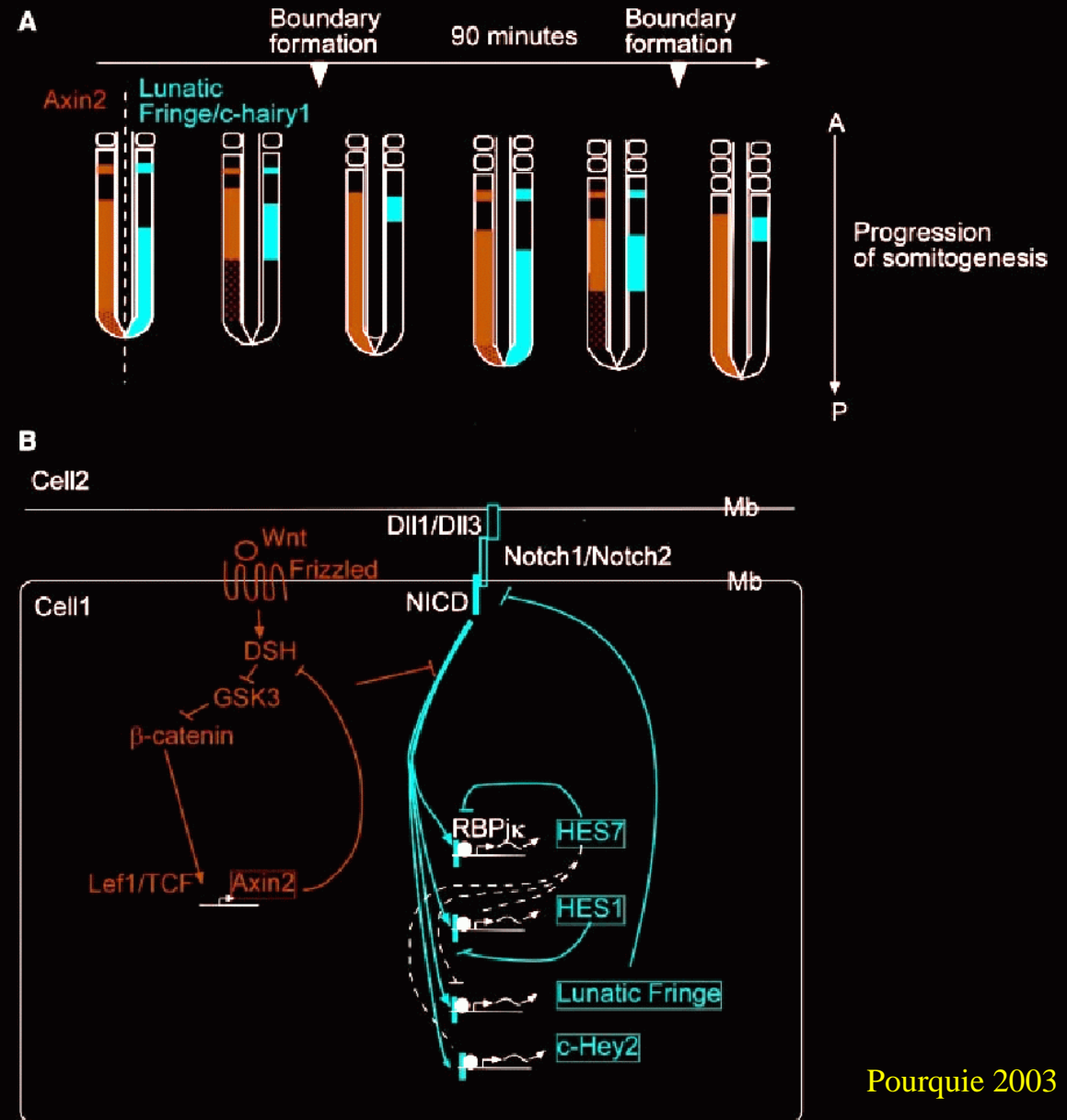
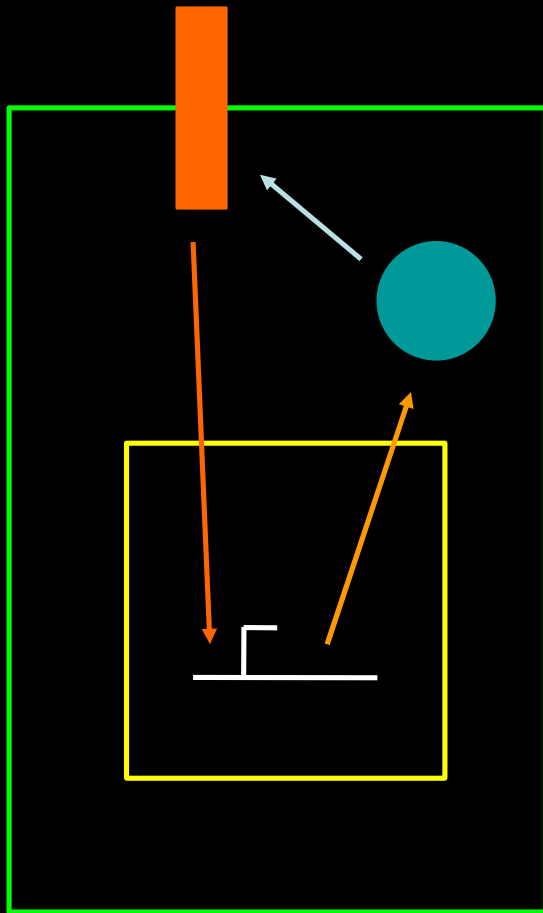
Somitogenesis core oscillator: “excitable medium”



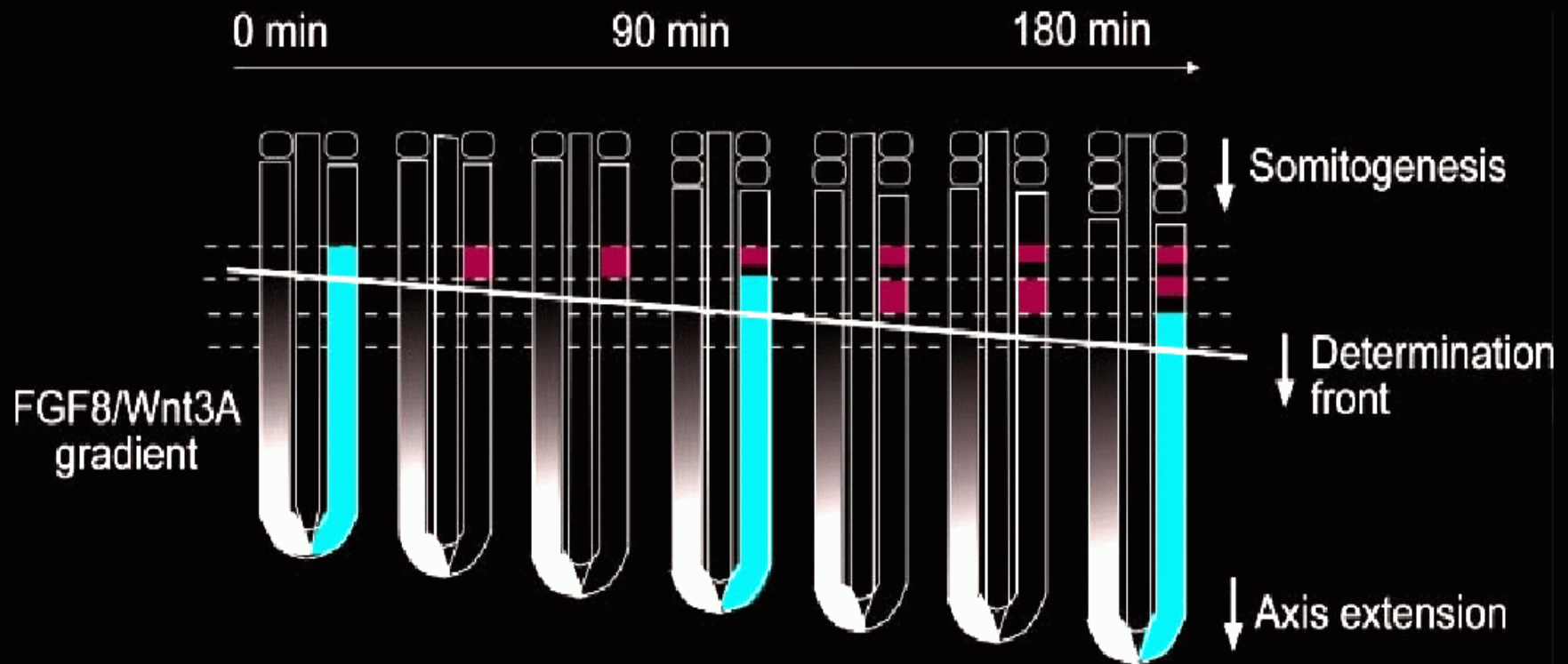
Somitogenesis core oscillator: “excitable medium”



Somitogenesis core oscillator: “excitable medium”



Spatial positioning: FGF8 gradient



Gene expression monitoring in individual cells

