

Project Title  
Project Subtitle  
Document Title

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DRAFT

00:28 GMT - 22<sup>nd</sup> of February, 2019

# Outline

- 1 A section
- 2 Another section

# DRAFT: NOTES

- Write sections

# Outline

- 1 A section
  - Subsection
  - Another subsection
- 2 Another section

# A section

“Movement of a motile cell or organism, or part of one, in a direction corresponding to a gradient of increasing or decreasing concentration of a particular substance.”

- Directed movement of cells tends to be in response to signalling molecules, released by other cells in minuscule amounts
  - E.g. Development of tissue and organs, Immune system cell response to pathogens

Do cells respond in a similar way to electrical fields?

# Subsection

E.g. E. Coli 'run and tumble' motion

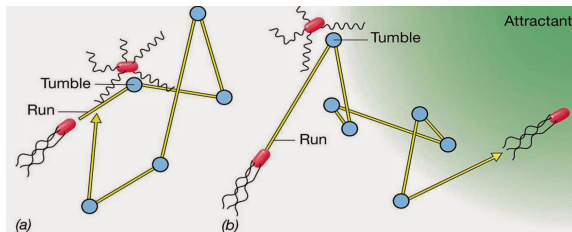


Figure: E. Coli chemotaxis

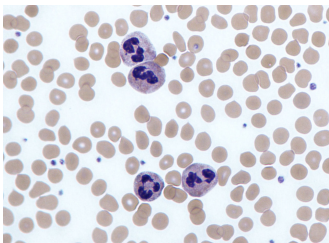
- Cell swims in a direction and randomly change direction after 'tumbling' at random times
  - Direction chosen is biased towards positive nutrient gradients

## THINGS TO TALK ABOUT :

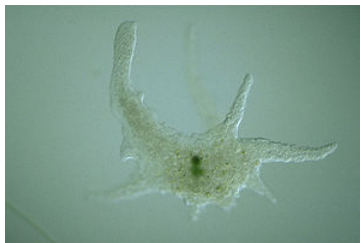
- CELLS AND STUFF
- E.COLI AND RUN-AND-TUMBLE

# Another subsection

But not all motile cells have flagella..



(a) White blood cells



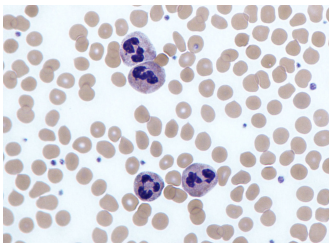
(b) Amoeba

Source: Wikipedia entries, *Neutrophil*, and *Chaos* (genus),  
<https://en.wikipedia.org/wiki/File:Neutrophils.jpg>  
[https://en.wikipedia.org/wiki/File:Chaos\\_carolinense.jpg](https://en.wikipedia.org/wiki/File:Chaos_carolinense.jpg)

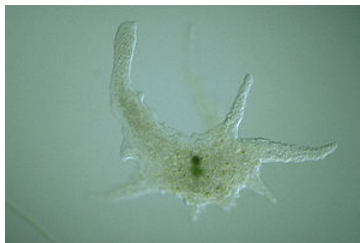


# Differently named frame

But not all motile cells have flagella..



(a) White blood cells



(b) Amoeba

Source: Wikipedia entries, *Neutrophil*, and *Chaos* (genus),  
<https://en.wikipedia.org/wiki/File:Neutrophils.jpg>  
[https://en.wikipedia.org/wiki/File:Chaos\\_carolinense.jpg](https://en.wikipedia.org/wiki/File:Chaos_carolinense.jpg)

# Outline

- 1 A section
- 2 Another section
  - Yet another subsection

## Yet another subsection

Let  $\{\mathbf{r}_1, \dots, \mathbf{r}_n\}$  be positions of nodes on cell surface and let  $\mathcal{N}_i(t)$  denote the neighbouring nodes of node  $i$  at time  $t$ .

Assume inertial terms are small enough to be inconsequential compared to dissipative terms in equation of motion:

$$\eta \frac{d\mathbf{r}_i}{dt} = \mathbf{B}_i(t) + \sum_{j \in \mathcal{N}_i(t)} \mathbf{F}_{ij}(t),$$

where  $\eta$  is a drag coefficient,  $\mathbf{F}_{ij}$  denotes the force on node  $i$  from node  $j$  and  $\mathbf{B}_i(t)$  is the sum of other forces on node  $i$  at time  $t$ .

# References

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2012. The origin of extracellular fields and currents-EEG, ECoG, LFP and spikes. *Nature Reviews Neuroscience*, 13(6):407–420.

Niedermeyer, E.

1972. *The generalized epilepsies: a clinical electroencephalographic study*. Charles C. Thomas Publisher.

Thank you for your time!



# Backup slide

Backup stuff