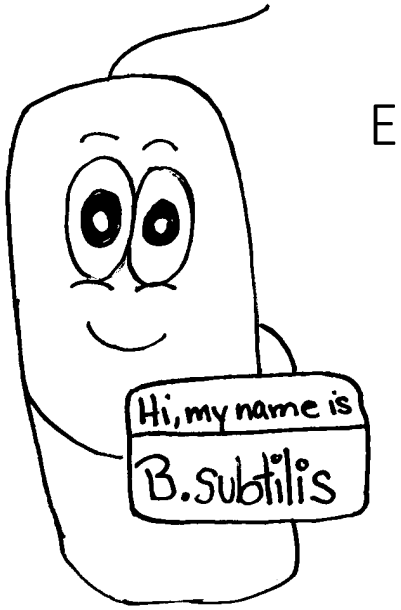
Bakterielle Biofilme



Einblicke in Struktur, Antibiotikaresistenz und Kommunikation

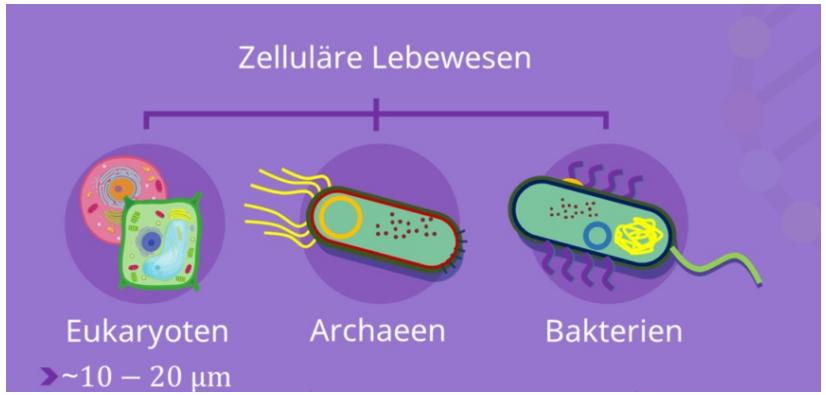
Albert-Einstein-Schule, Schwalbach a. Ts.

Michael F. Fuss

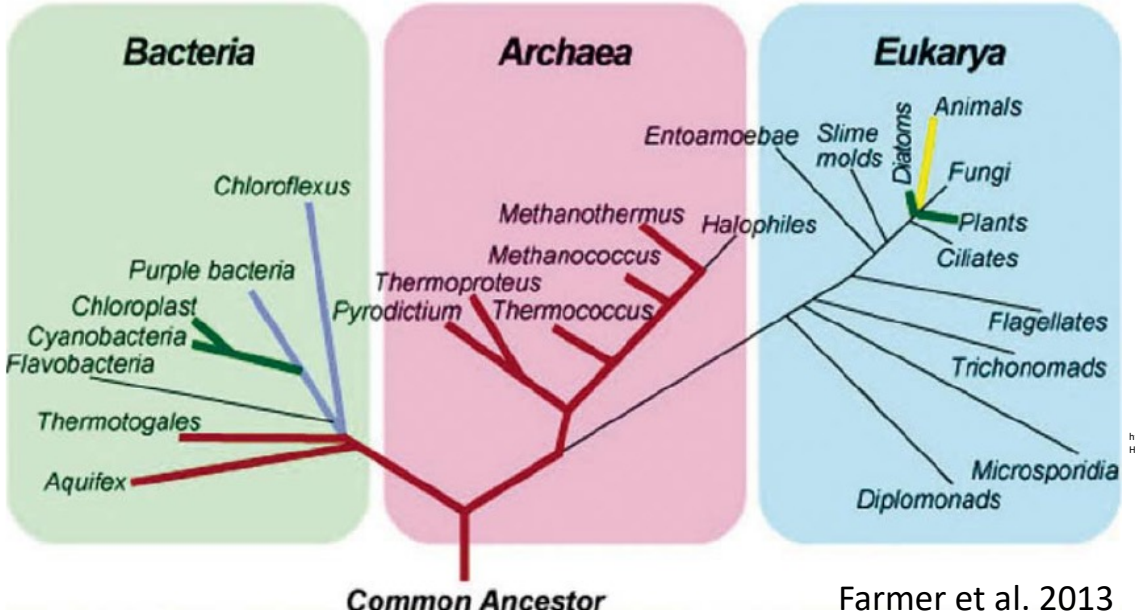
09.11.2022

Ein Überblick über Bakterien

- Domänen des Lebens: Bacteria, Archaea und Eukaryota
- ~30 000 Arten



Escherichia coli
1,4 Mio Basenpaare
4400 Gene

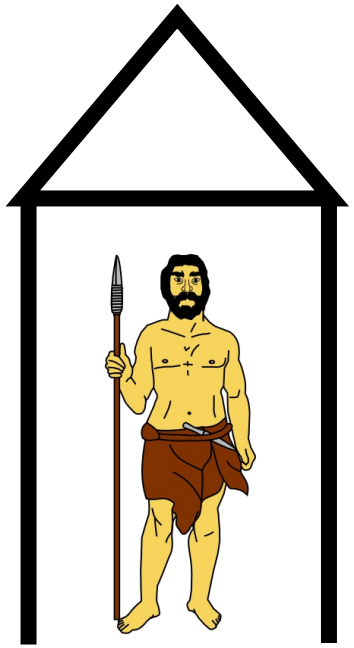


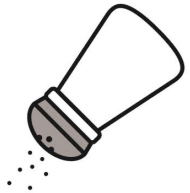
Farmer et al. 2013

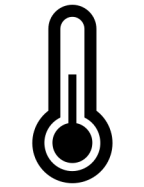
https://upload.wikimedia.org/wikipedia/commons/thumb/0/00/Homosapiens.svg/291px-Homosapiens.svg.png?20150125124055

Homo sapiens
3,2 Mrd Basenpaare
25000 Gene

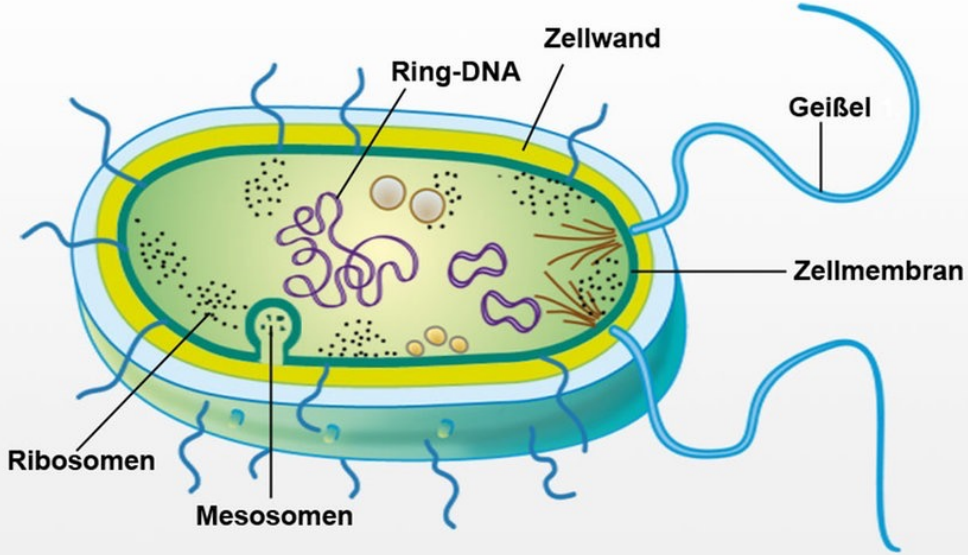
Überlebenskünstler Bakterium



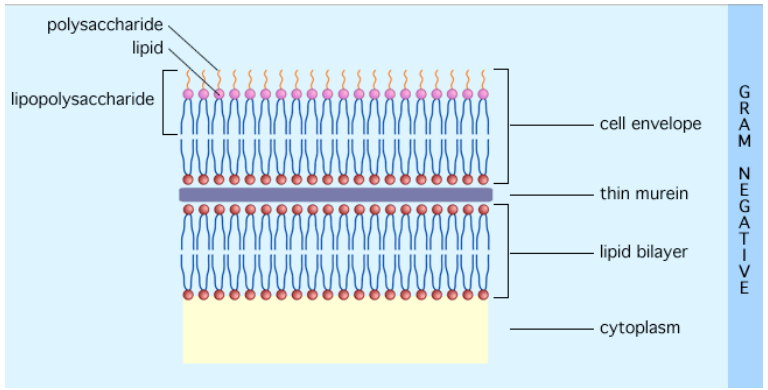




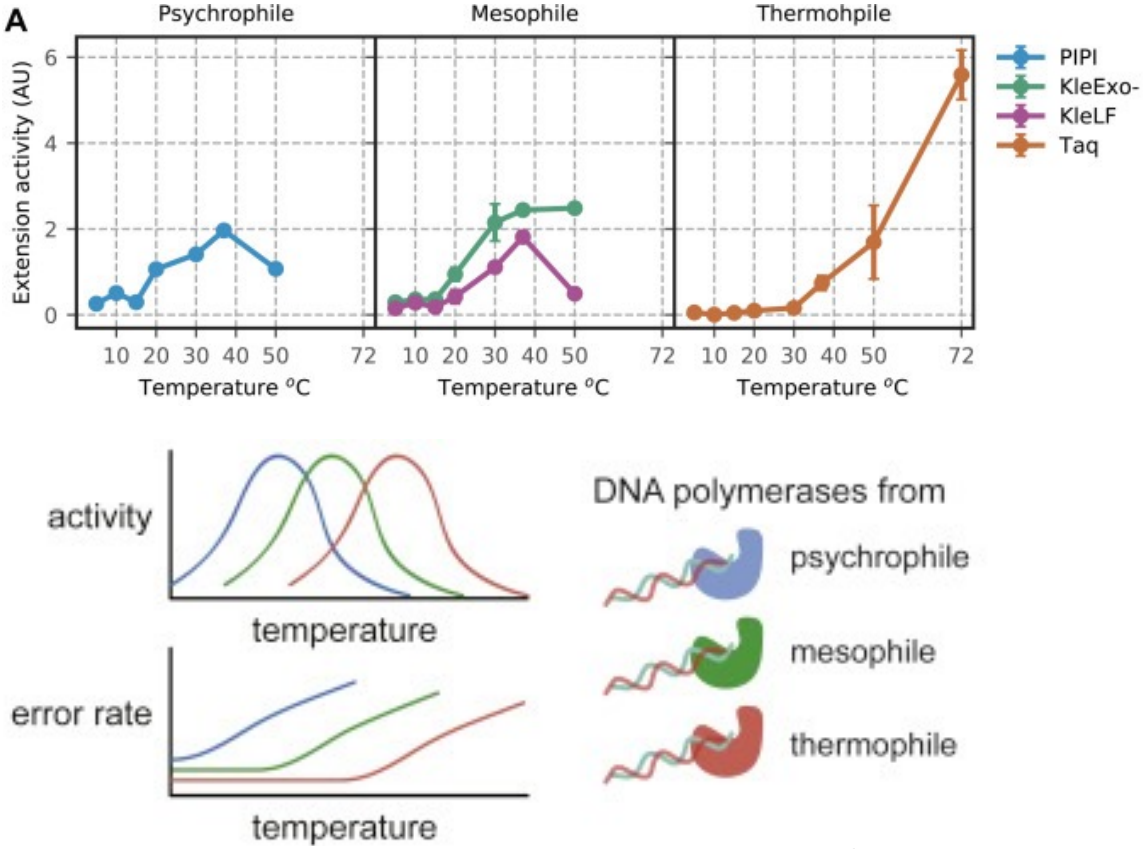
Anpassungsfähigkeit von Bakterien



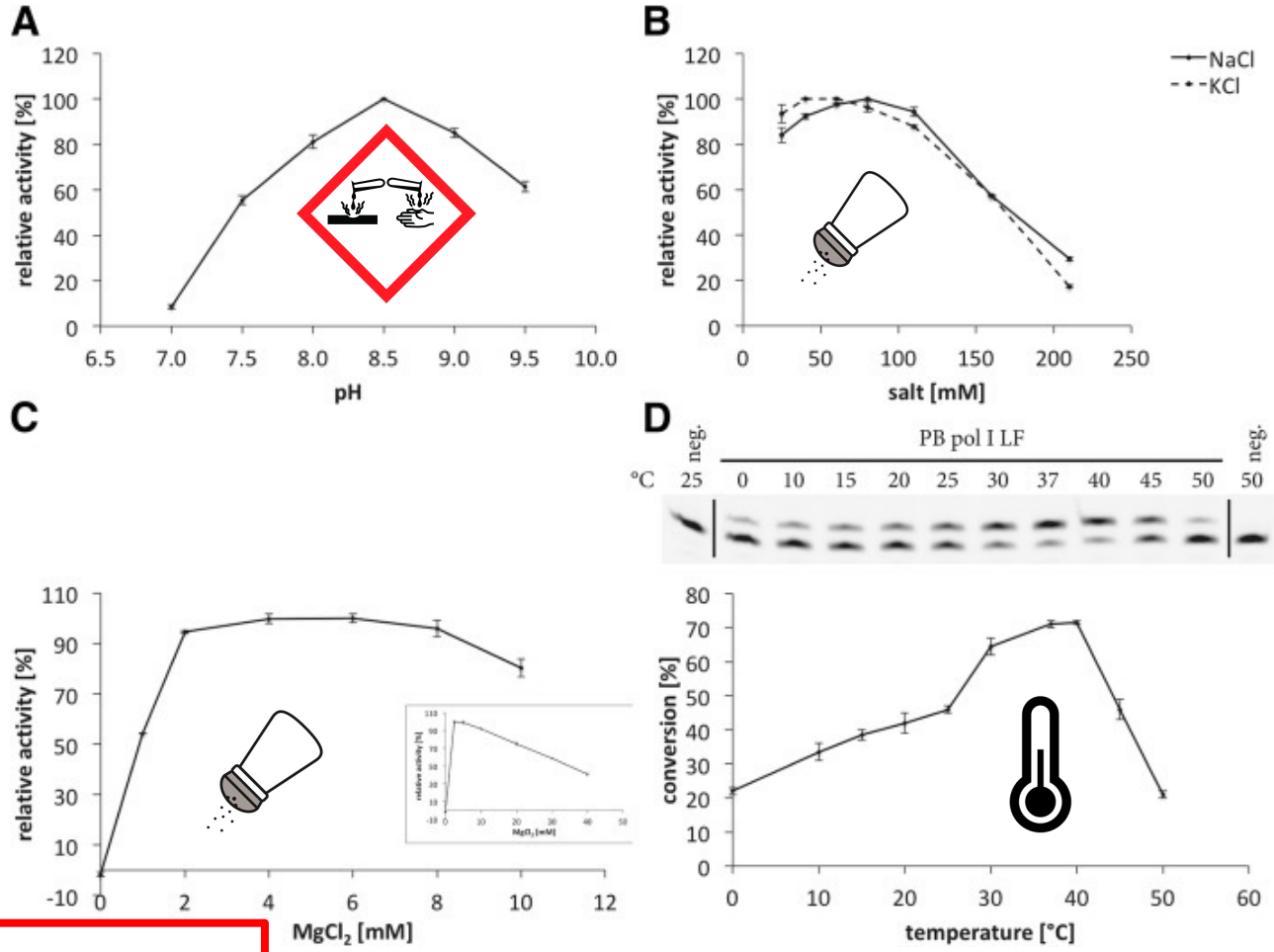
- Zellmembran und Zellwand
- Proteinstruktur und Enzyme
- Stoffwechsel (chemotroph/phototroph, autotroph/heterotroph)



Anpassungsfähigkeit von Bakterien



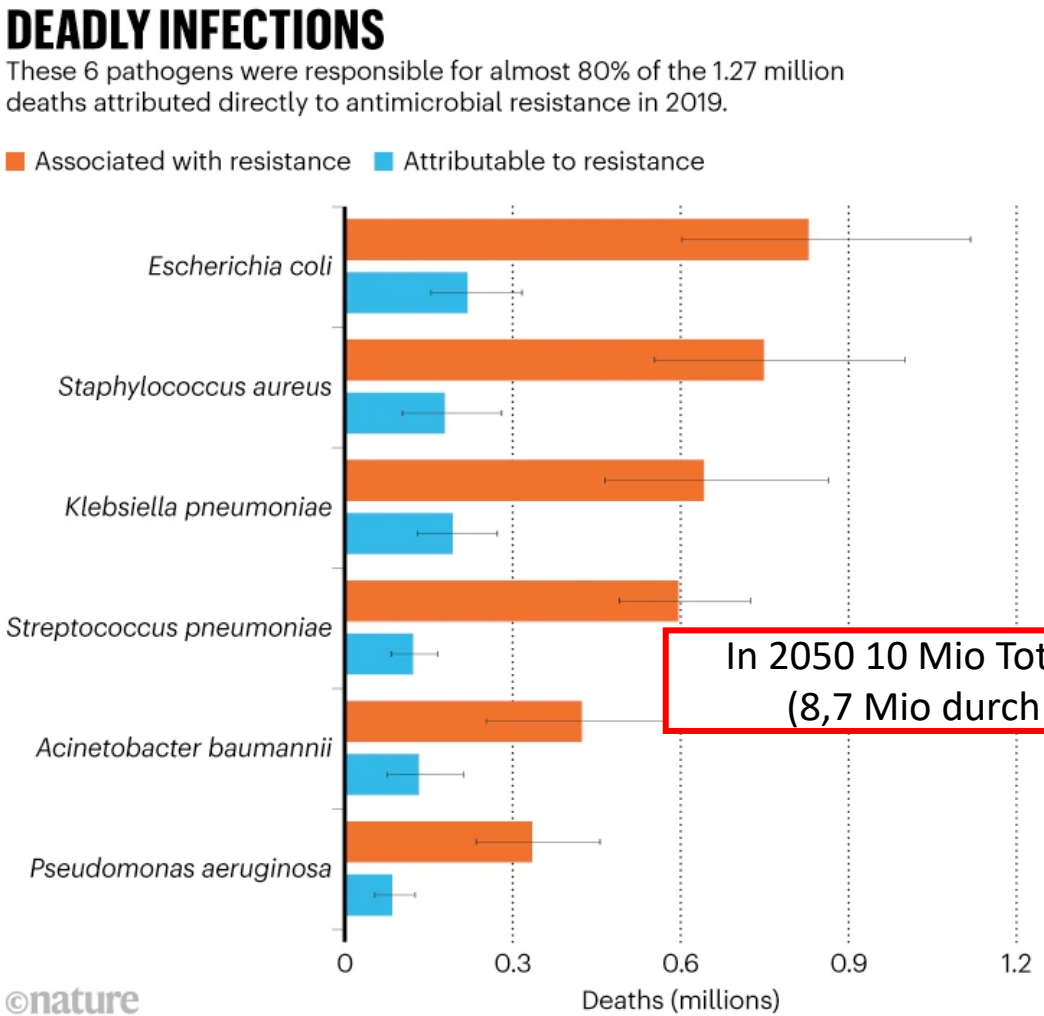
Xue et al. 2021



Piotrowski et al. 2019

Generationszeit (~20 min *E. coli*/ 8 min *C. perfringens*)
→ 657 000 Generationen/25 Jahren

Bakterien als Pathogene



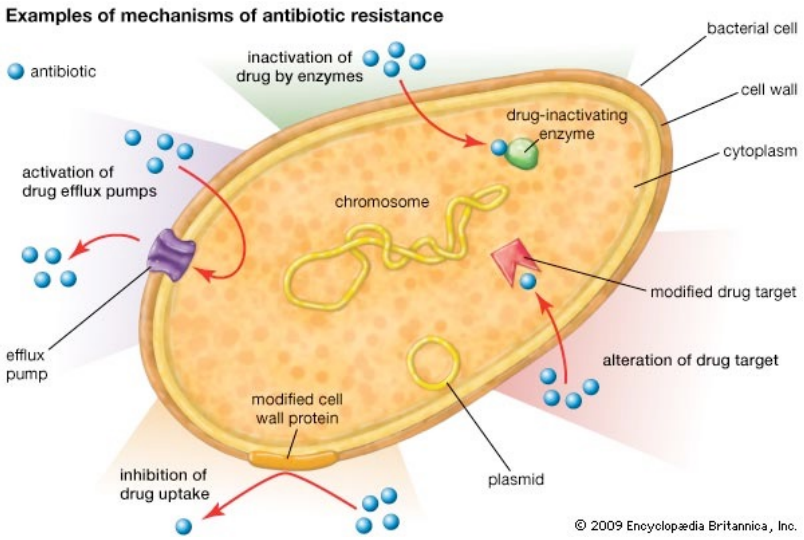
In 2050 10 Mio Tote pro Jahr
(8,7 Mio durch Krebs)

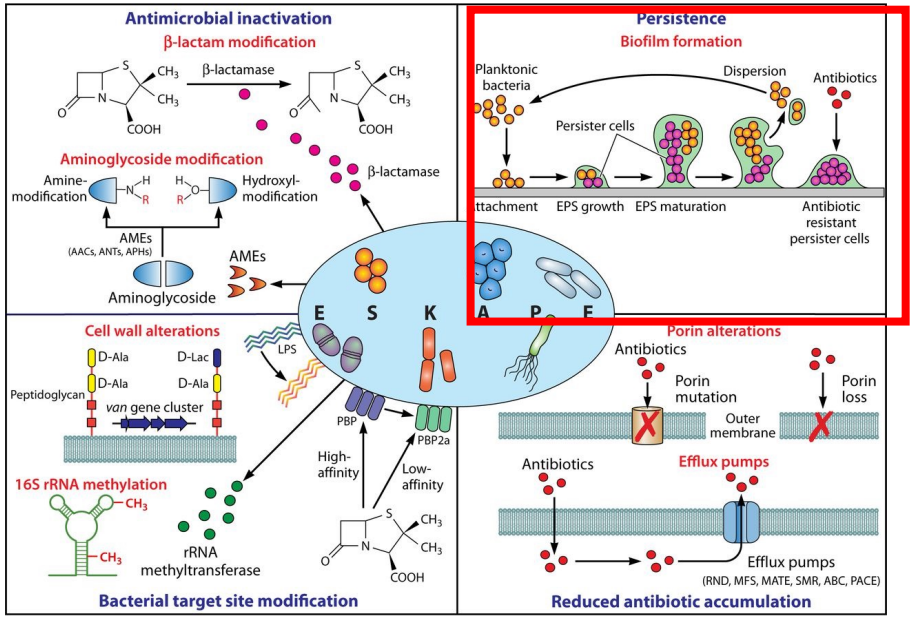
HIV 864 000 Tote/Malaria 643 000 Tote

The Review on Antimicrobial resistance (2016)

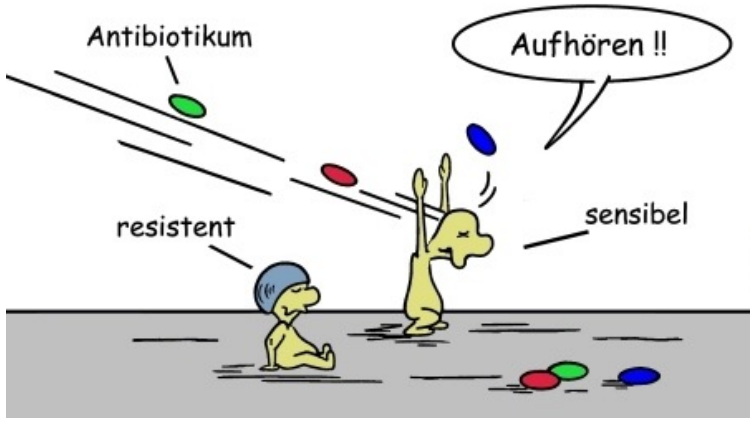
https://cloverbiosoft.com/the-eskape-bacteria-group-and-its-clinical-importance/

Mechanismen der Resistenz



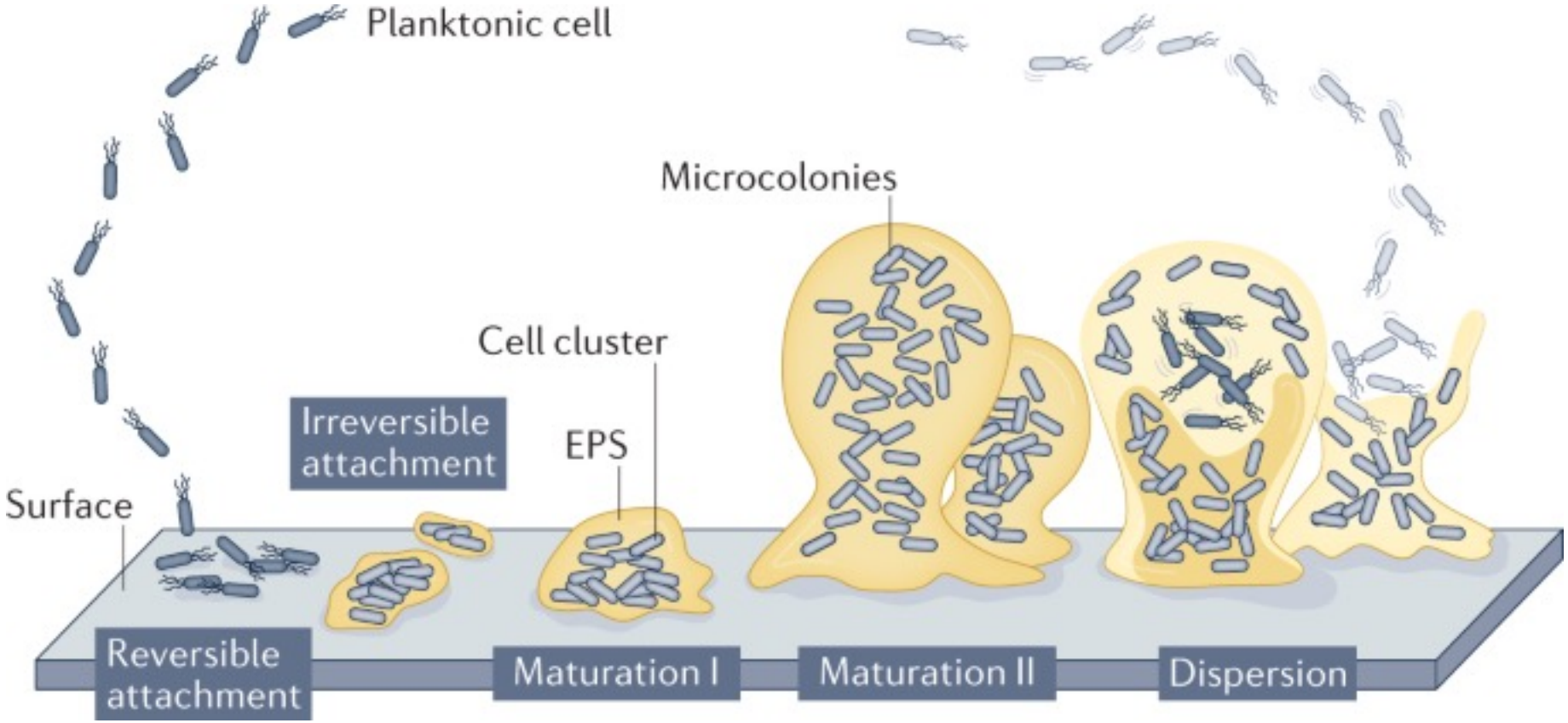


De Oliveira *et al*. ASM 2020



©Joachim Czichos

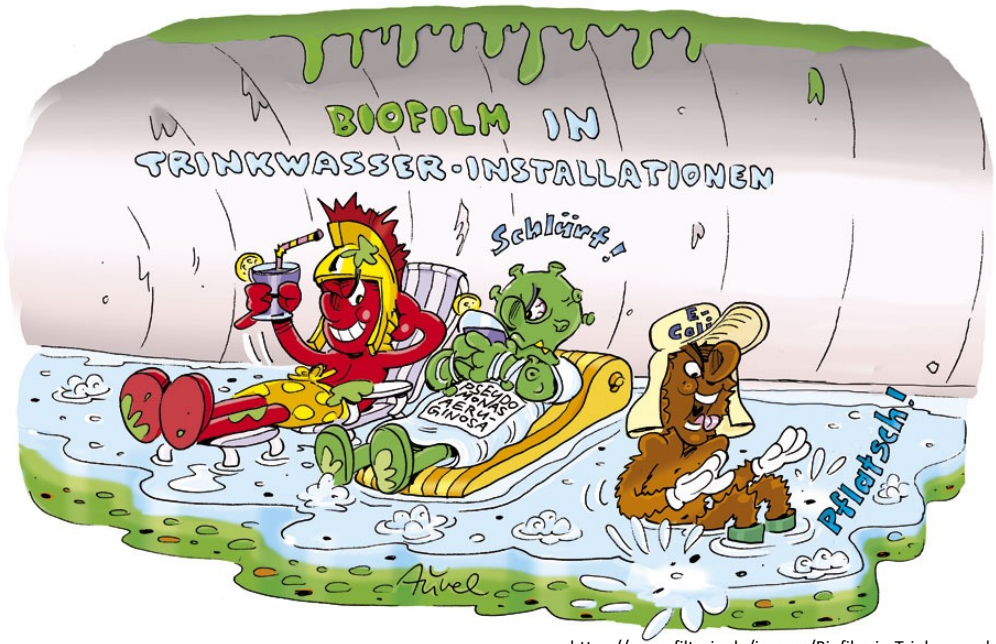
Formation von Biofilmen



Sauer et al. 2022

©Joachim Czichos

Wo findet man Biofilme?

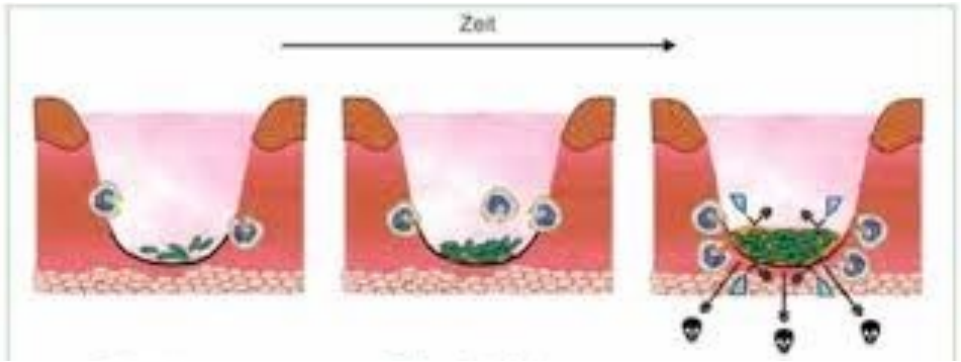


https://www.filteria.de/images/Biofilm-in-Trinkwasserleitungen.jpg

Boden
Abfluss
Rohrleitungen
Schiffe
Wüsten
Gesteinen
Kernkraftwerken

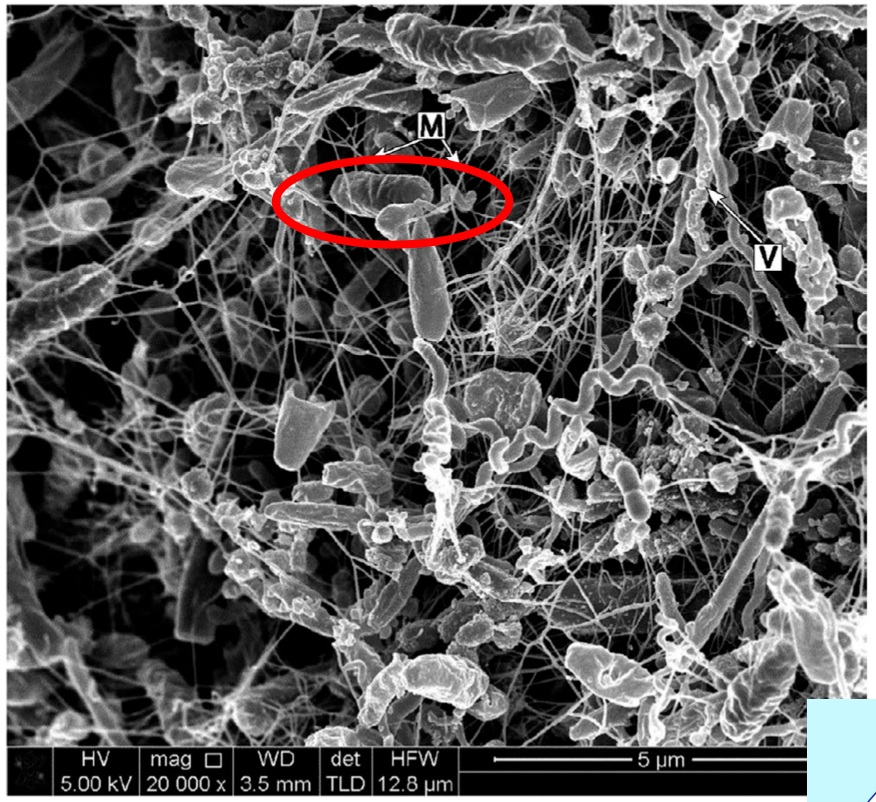
Zähnen
Schleimhäuten
Lunge
Wunden
Medizinischen Apparaturen
Trinkwasserinstallationen

Lösen Mineralien
Säubern Gewässer
Binden CO_2
Stoffkreisläufe (N, P, S)

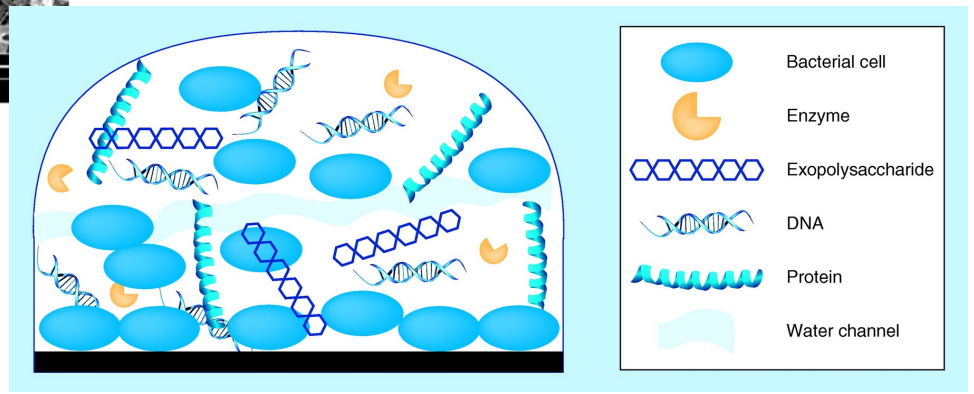


Lundberg et al. 2013

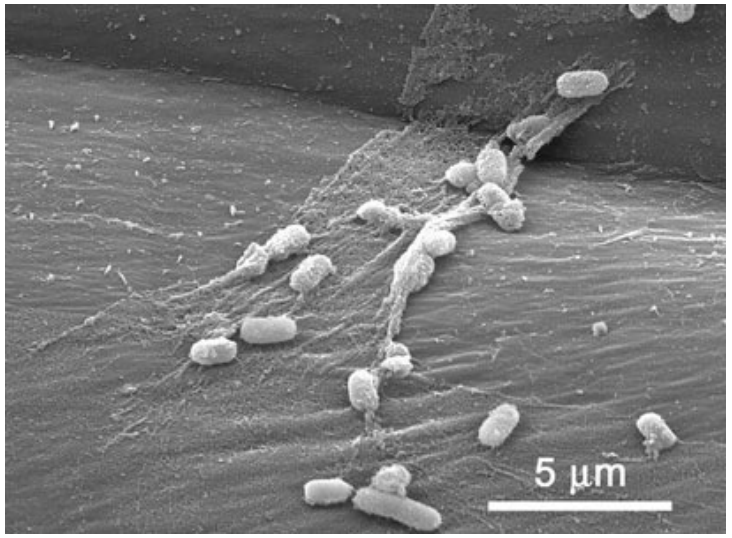
Aufbau eines Biofilms



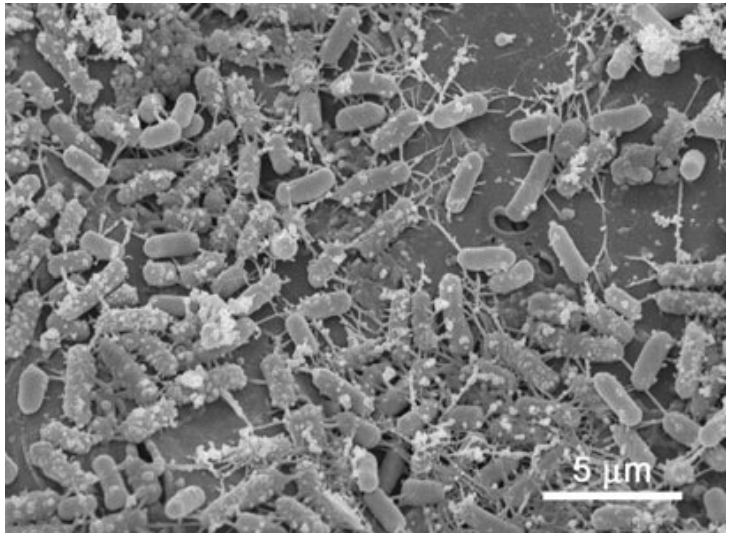
Dental Plaque Biofilm Jakubovics et al. 2021



Rabin et al. 2015



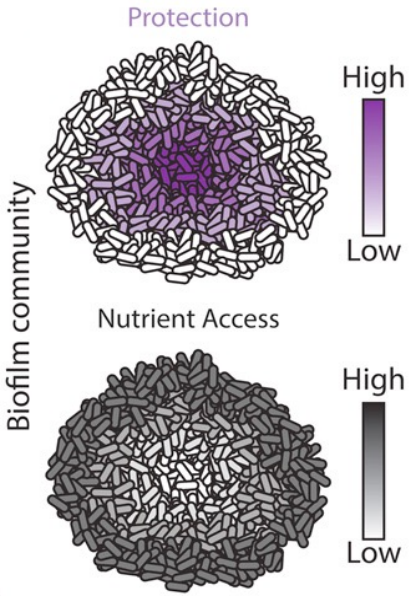
Shigella boydii Biofilm

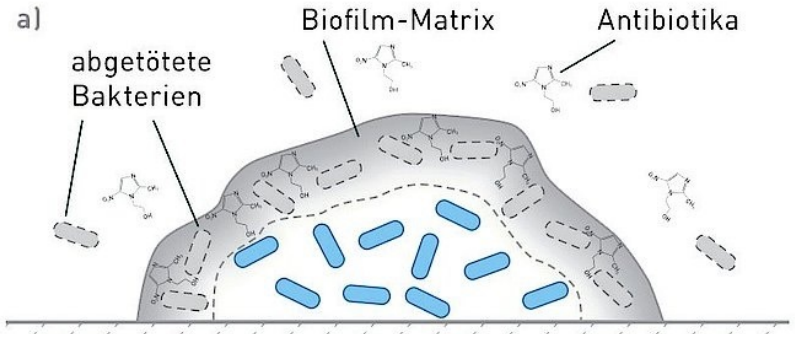


E. coli Biofilm

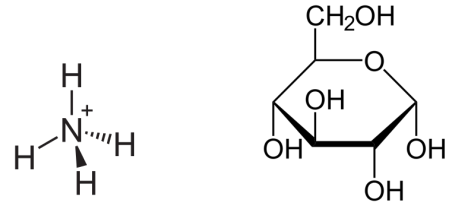
Annous et al. 2009

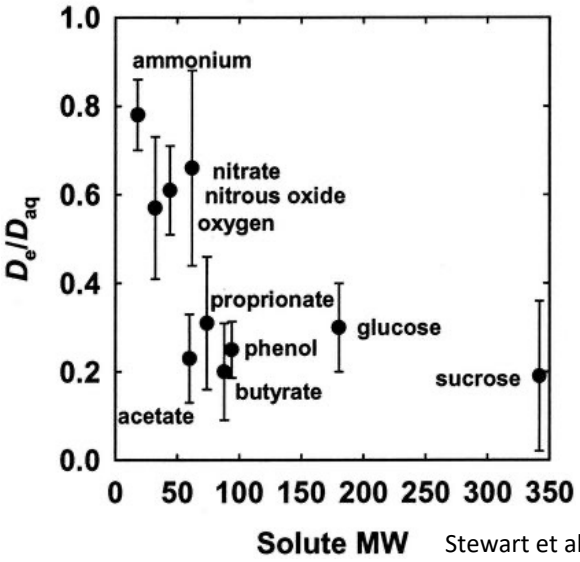
Vorteile eines Biofilms



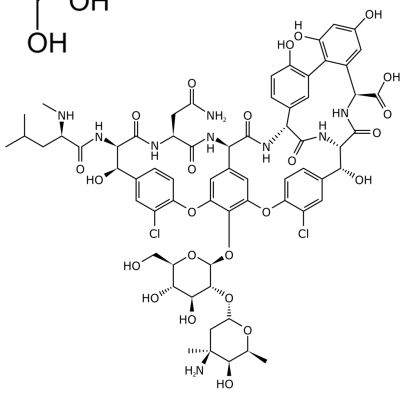


Verändert nach Sylke Dombrowa 2016

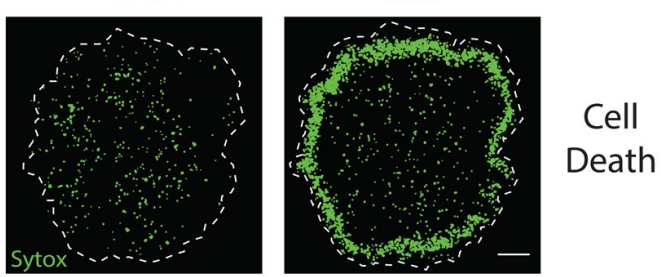




Stewart et al. 1998



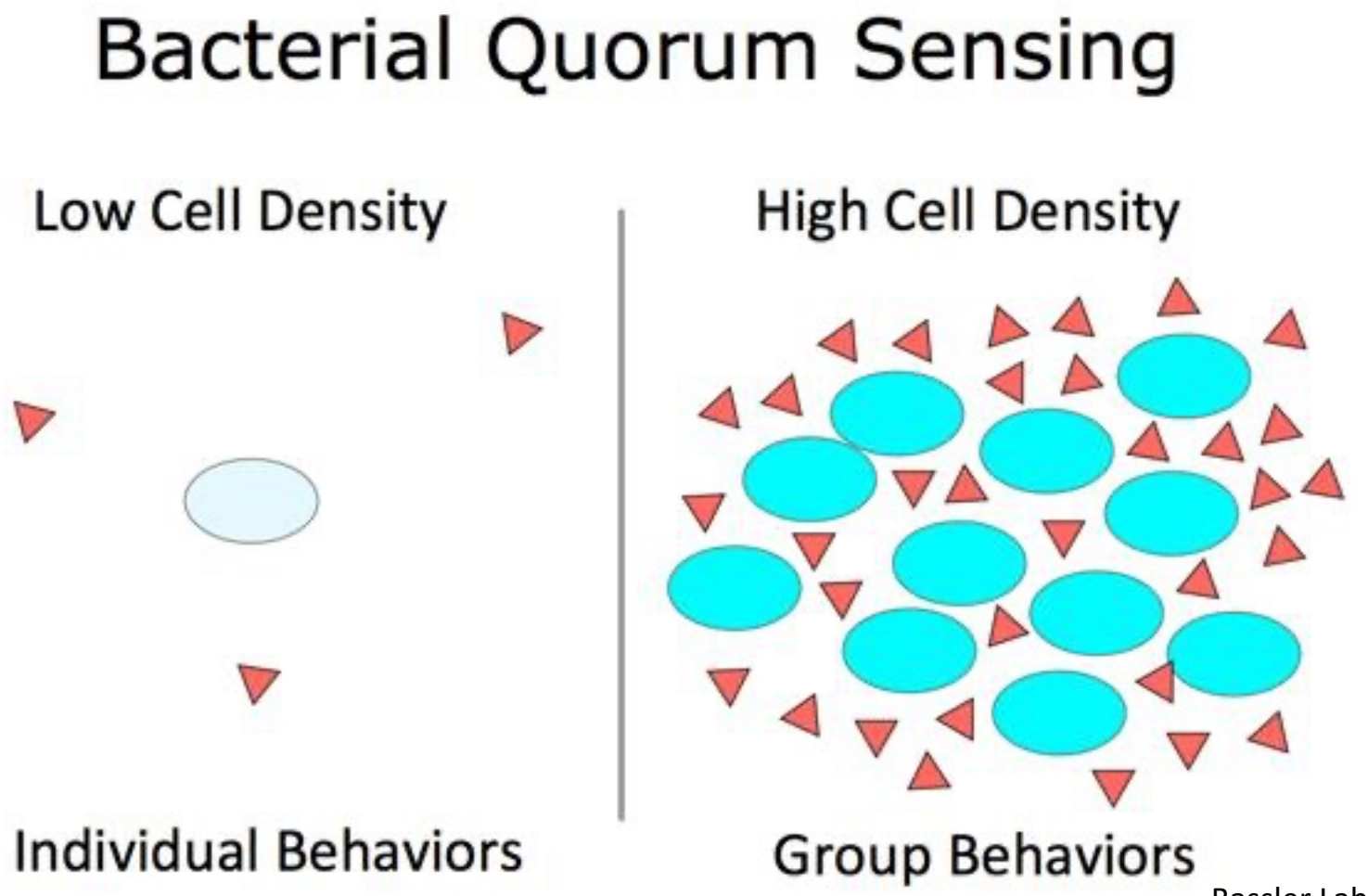
Vancomycin
MR *S. aureus*



Liu et al. 2015

Beeinflusste Diffusion innerhalb der Matrix
D in m^2/s

Bakterielle Kommunikation



Bassler Lab

Autoinduktoren

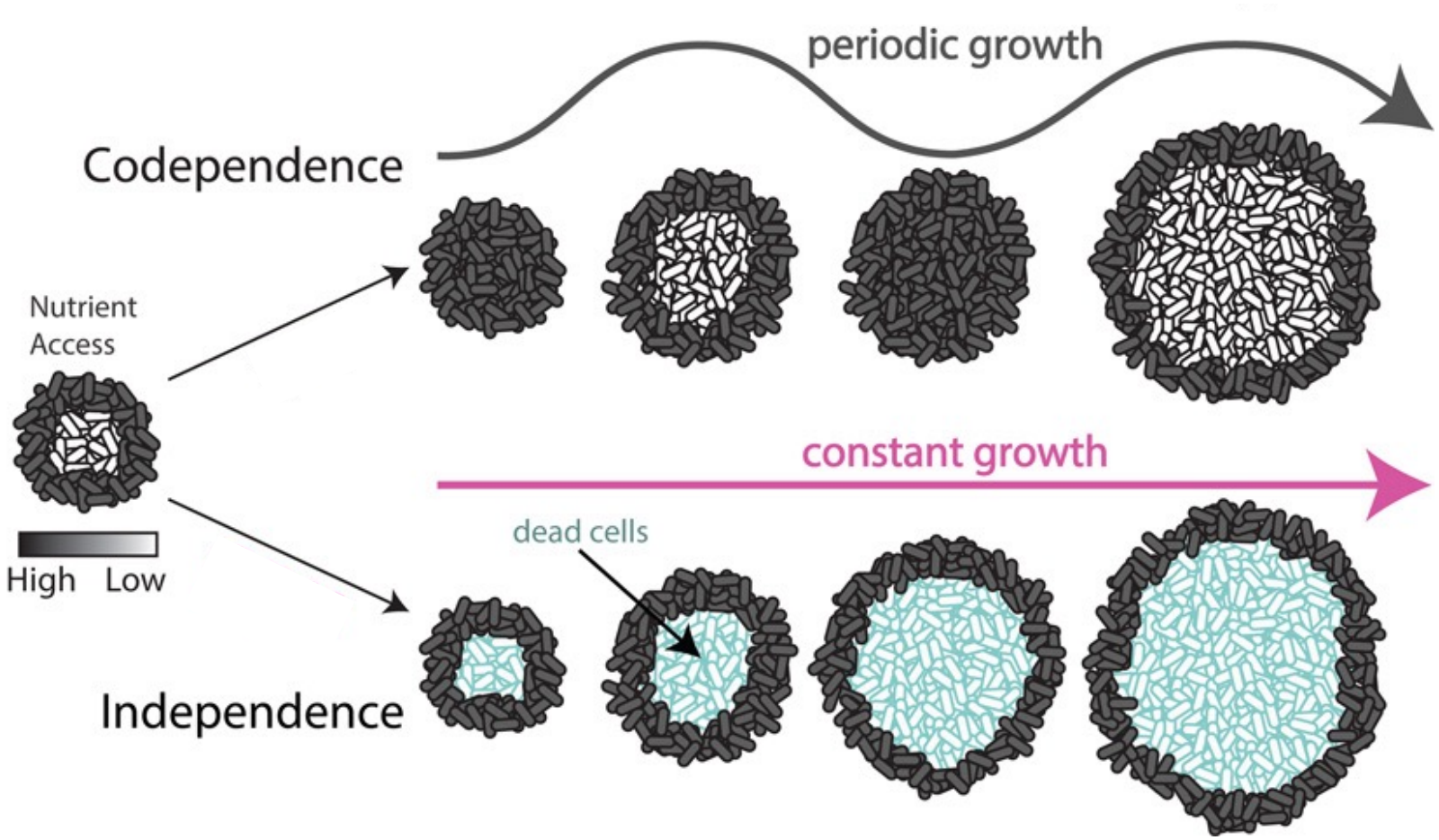
Eingeschränkte Diffusion in Biofilmen!

Kommunikation in (großen) Biofilmen

Bacillus subtilis
Gram positiv
Heubacillus

Liu *et al.* 2015

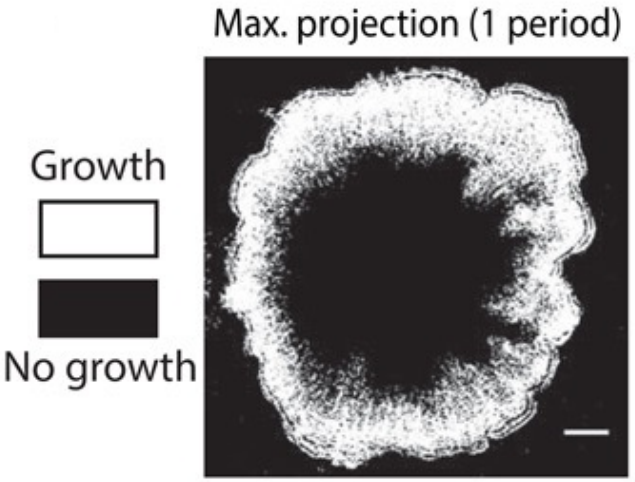
Oszillierendes Wachstum von Biofilmen

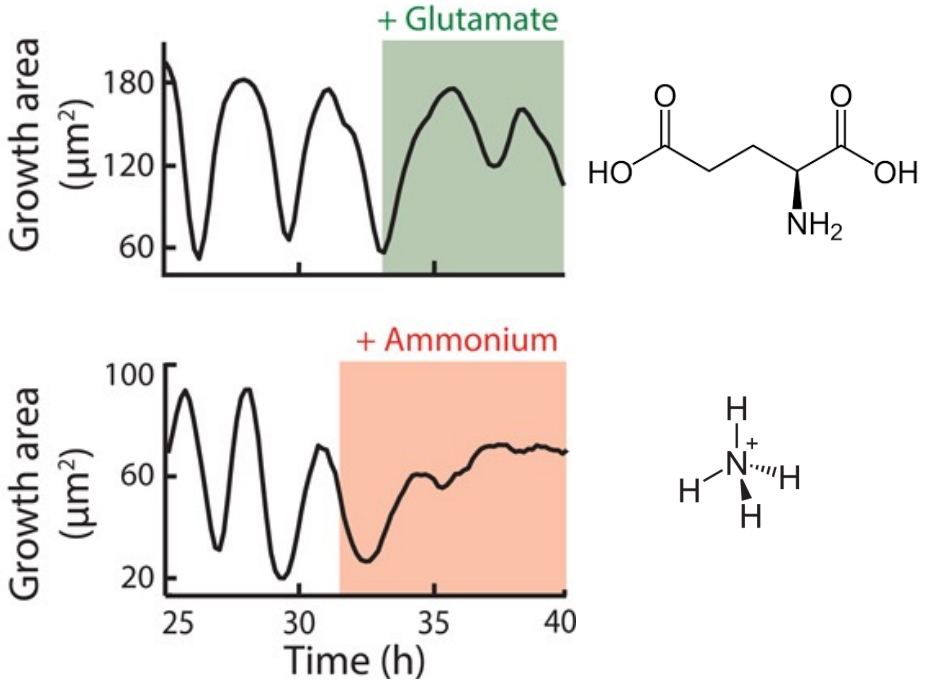


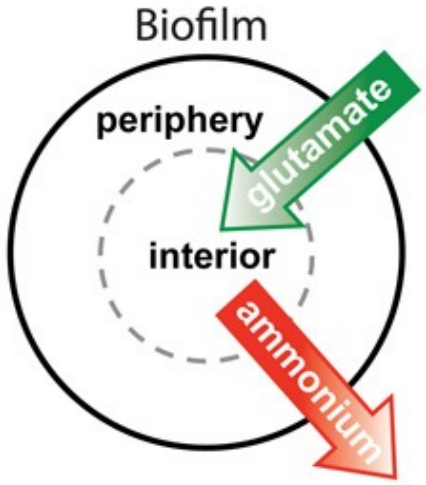
Warum wollen die äußeren Zellen, dass die inneren Zellen überleben?
Wie wird dies kommuniziert?

Liu *et al.* 2015

Metabolitische Abhängigkeit in Biofilmen







Liu *et al.* 2015

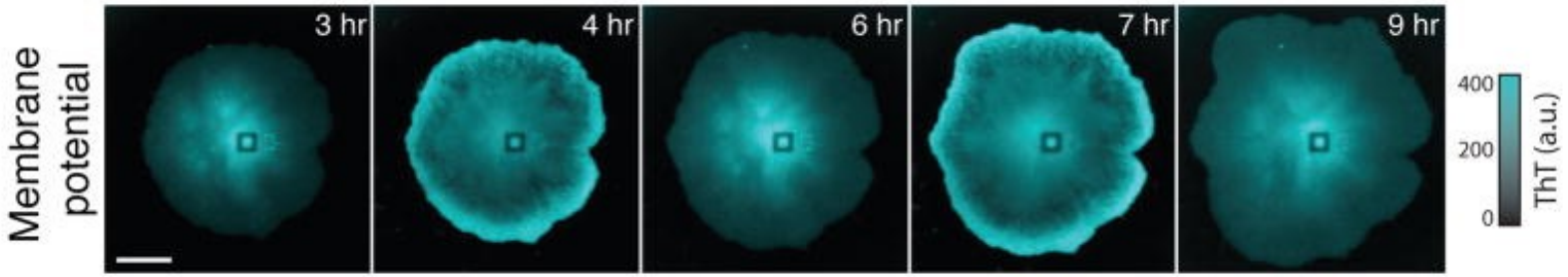
Innere Zellen = Stoffwechsel
Äußere Zellen = Wachstum

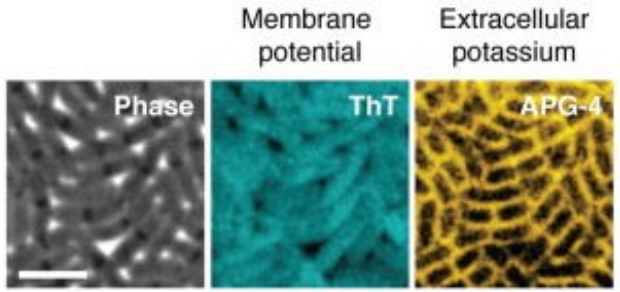
Elektrische Reizweiterleitung in Biofilmen

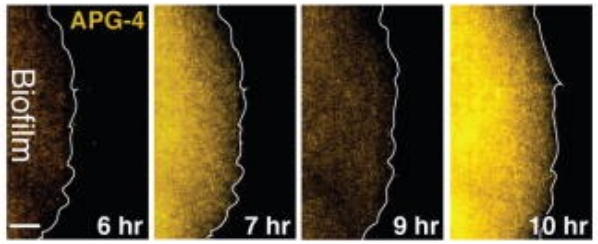
Thioflavin T
Fluoreszenter Farbstoff
für Membranpotential

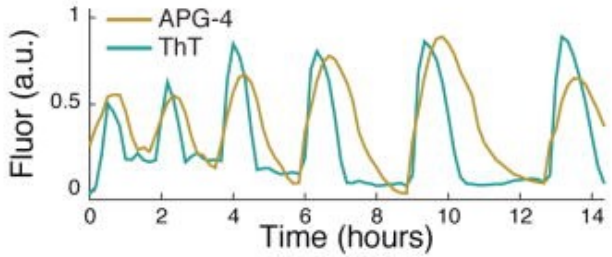
Prindel *et al.* 2015

Elektrische Reizweiterleitung in Biofilmen

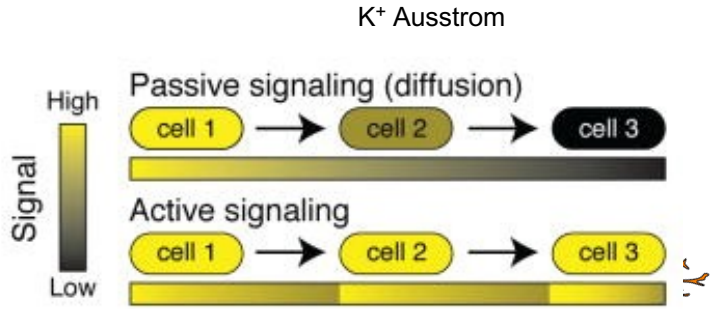


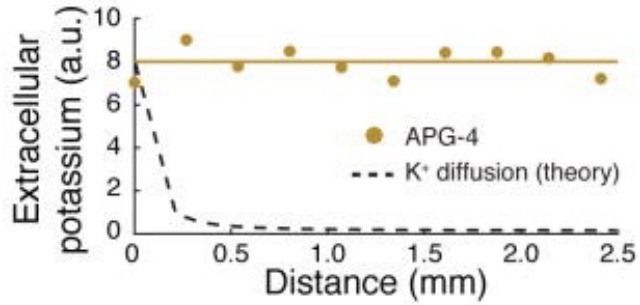






APG-4: Kalium sensitives Fluorophor

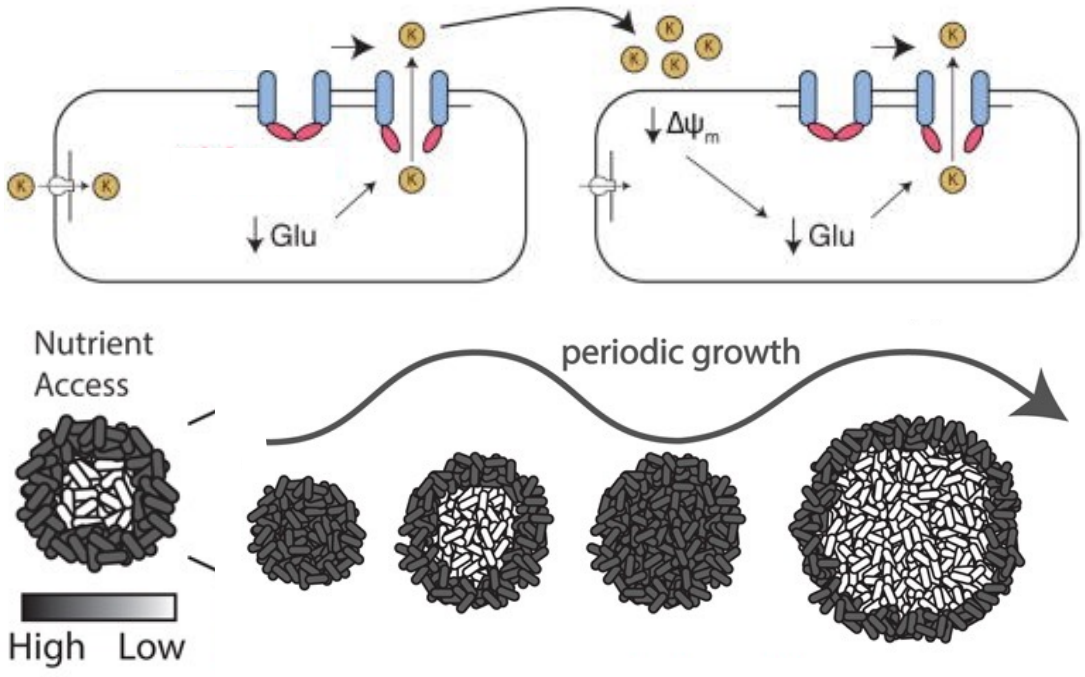




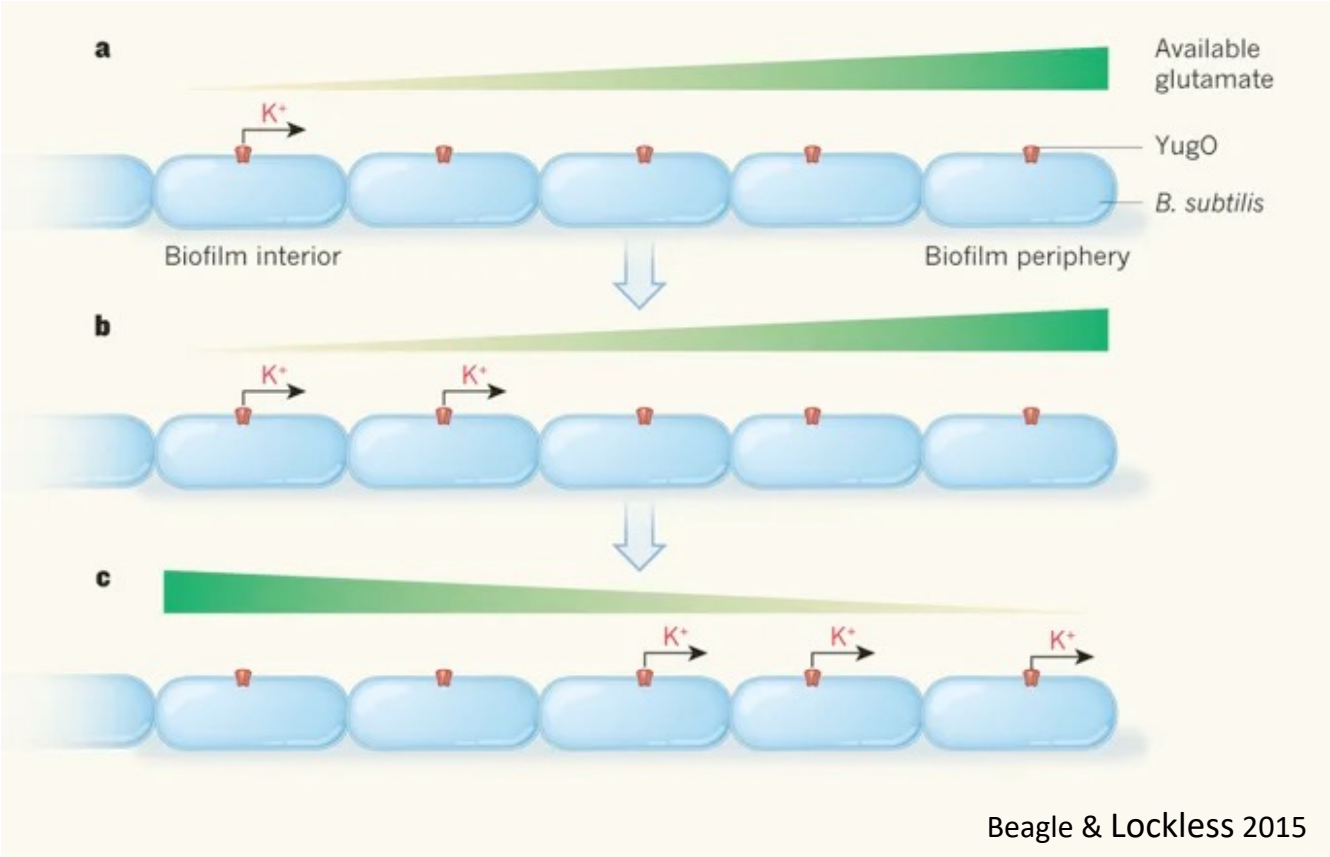
Prindel *et al.* 2015

Aktive Reizweiterleitung im Biofilm

Aufnahme von Glutamat Membranpotential abhängig!

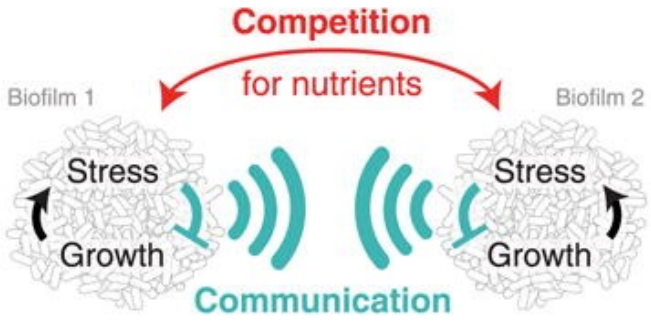


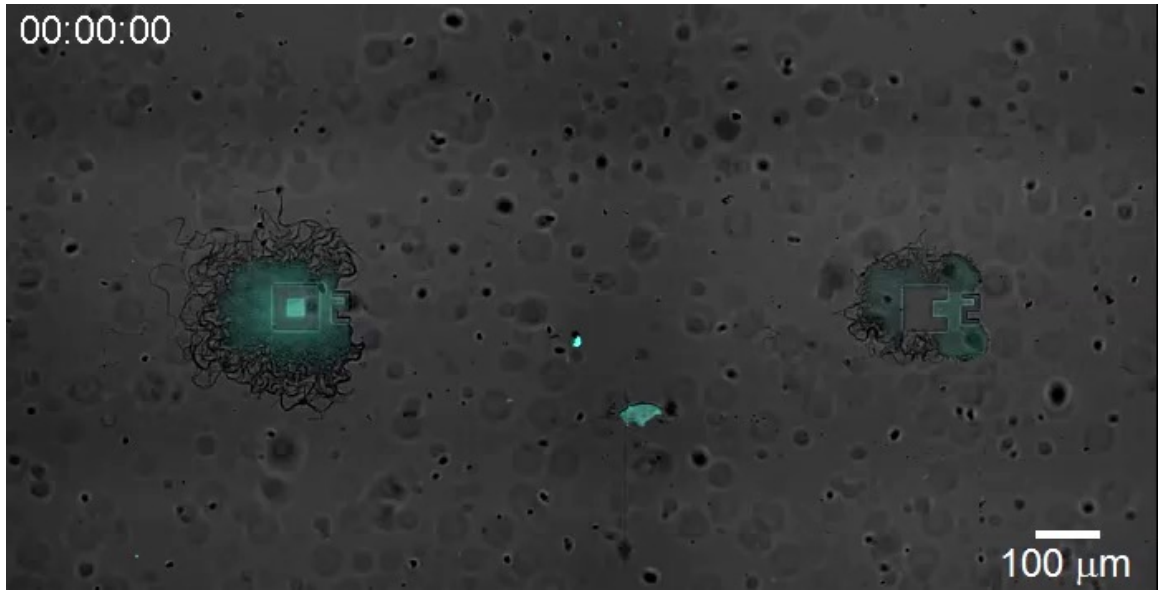
Prindel *et al.* 2015



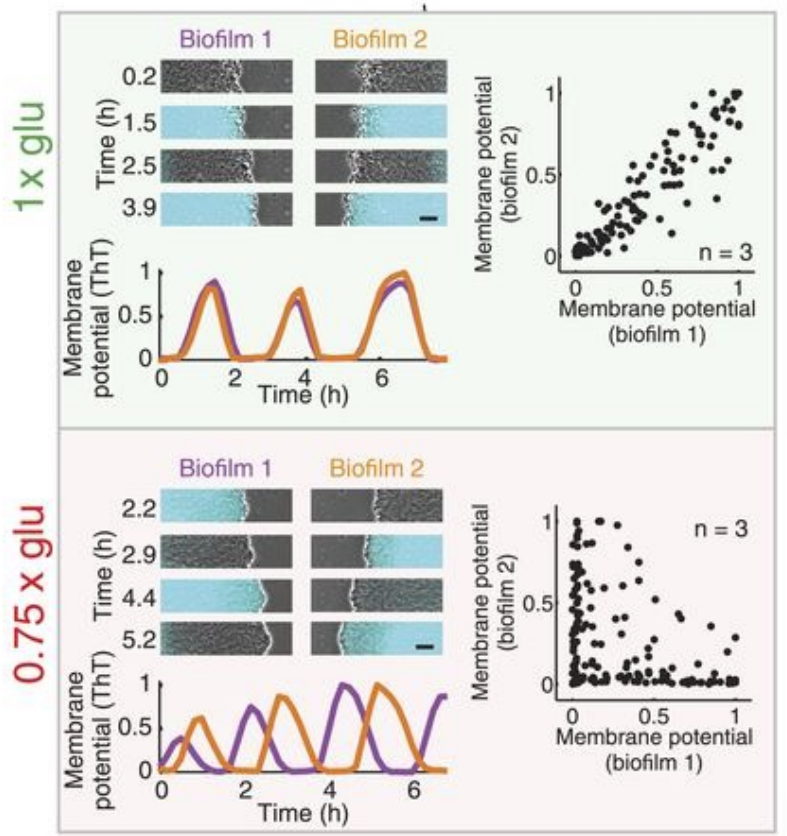
Beagle & Lockless 2015

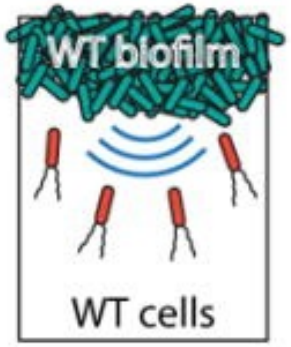
Ein universelles Prinzip





Liu *et al.* 2017





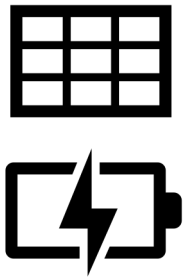
Humphries *et al.* 2017

Kommunikation:

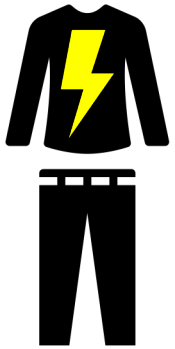
1. Biofilmen
2. Motilen und sessilen
3. Spezien
4. Wirt und Biofilm?

Möglichkeiten in Zukunft

Neue Ziele für Medikamente



Strom als Behandlung



“wireless electroceutical dressing”

Danke für Ihre Aufmerksamkeit!

Bildquellen

- https://d1g9li960vagp7.cloudfront.net/wp-content/uploads/2020/06/Bild-1-Klassifizierung-1024x576.png
- By Yellowstone National Park from Yellowstone NP, USA - Aerial view of Grand Prismatic, Public Domain, https://commons.wikimedia.org/w/index.php?curid=50245111
- https://www.planet-wissen.de/natur/mikroorganismen/bakterien_urkeime_helfer_erreger/bakbakterienzellewdrgjpg100~_v-ARDFotogalerie.jpg
- https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.stern.de%2Fgenuss%2Fessen%2Foel--welches-gut-zum-braten-ist-und-welches-besser-fuer-salat-ist-8918440.html&psig=AOvVaw2qVJmEIbZTrsh4FGk7QriX&ust=1667740538083000&source=images&cd=vfe&ved=0CAoQjRxqFwoTCOCl3uWPl_sCFQAAAAAdAAAAABAE
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