

Day 3: Revisiting the Bacterial Pan-Genome

Jordan Eizenga, Erik Garrison and Tobias Marschall

CPANG18 @ Instituto Gulbenkian de Ciência
March, 2018

What is a Pan-Genome?

Term **pan-genome** popularized in microbiology in 2005.

Definition (gene-based pan-genome)

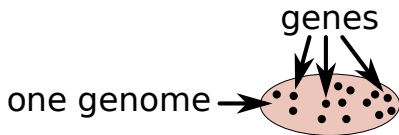
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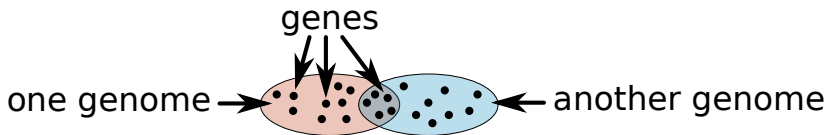


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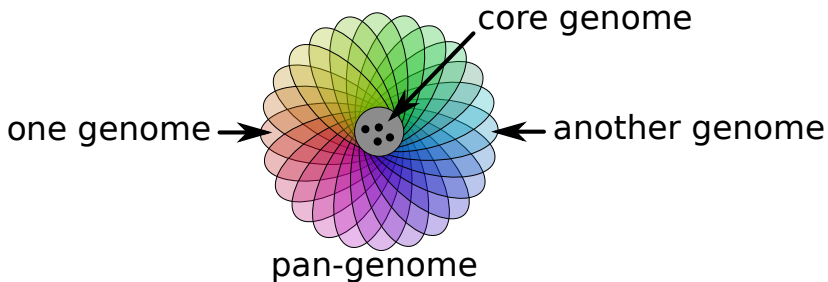


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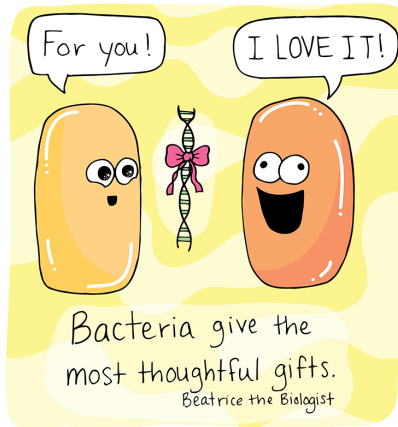
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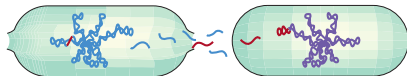


Pan-Genomes arise through Horizontal Gene Transfer (HGT)

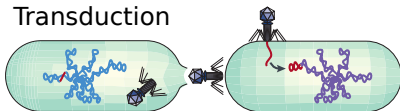


Mechanisms of Horizontal Gene Transfer

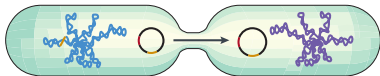
Transformation



Transduction



Conjugation

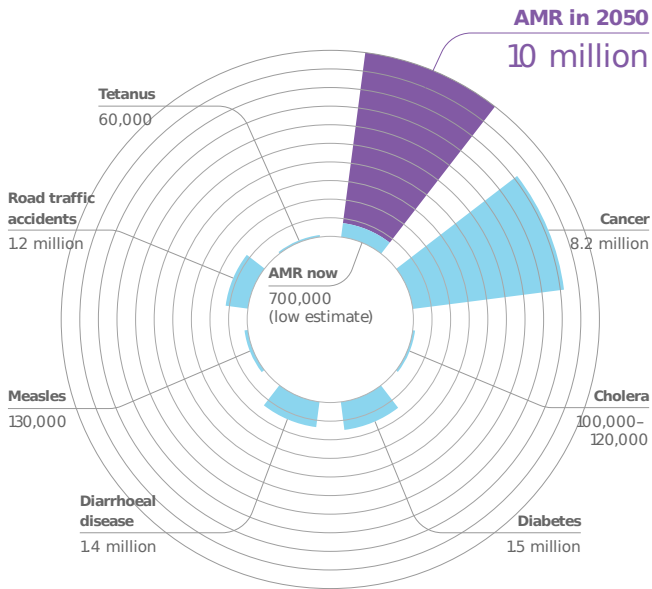


[Adapted from Furuya and Lowy, Nat Rev Micro, 2006]

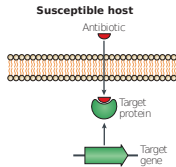
Relevance of HGT

- Outbreaks involving HGT (e.g. EHEC outbreak in Germany 2011)
- Transgenic and genetically modified organisms
- Antibiotic resistance can be acquired via HGT

Resistant Bacteria are Problem

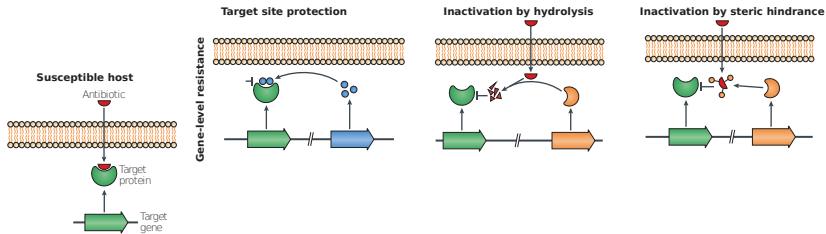


Mechanisms of Resistance



Source: Adapted from Blair et al., Nature Reviews Microbiology, 2015,

Mechanisms of Resistance

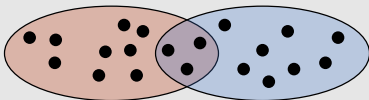


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From Gene-Based to Sequence-Based Pan-Genomes

Question

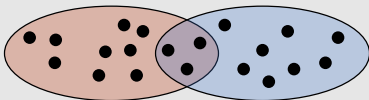
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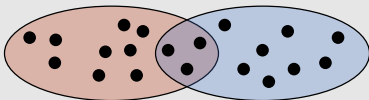
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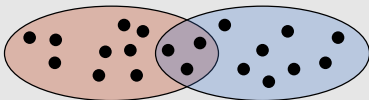
genome

CAGAATCTGCCCGAA...

From Gene-Based to Sequence-Based Pan-Genomes

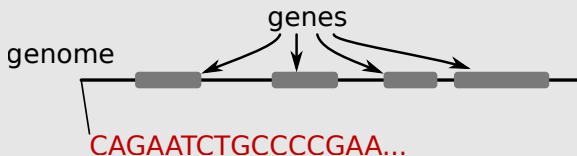
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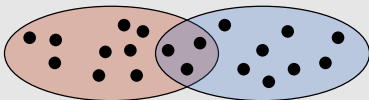
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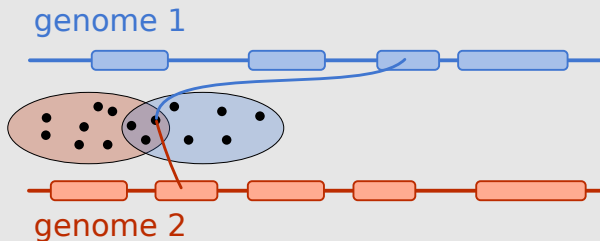
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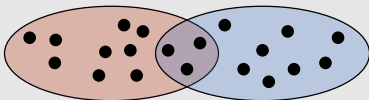
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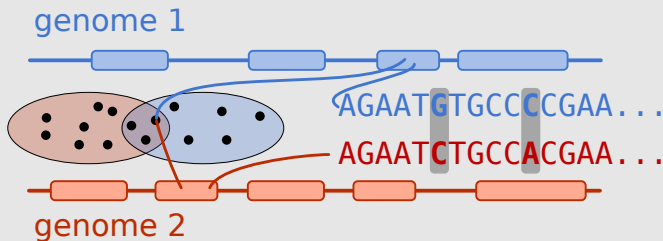
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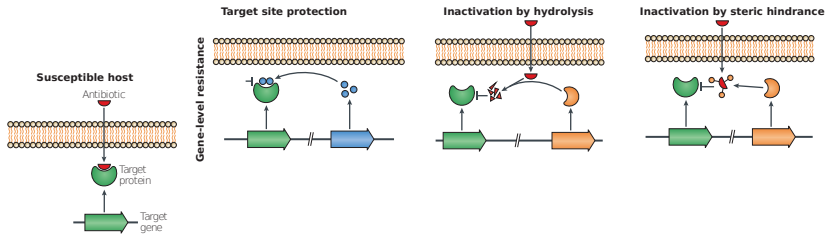
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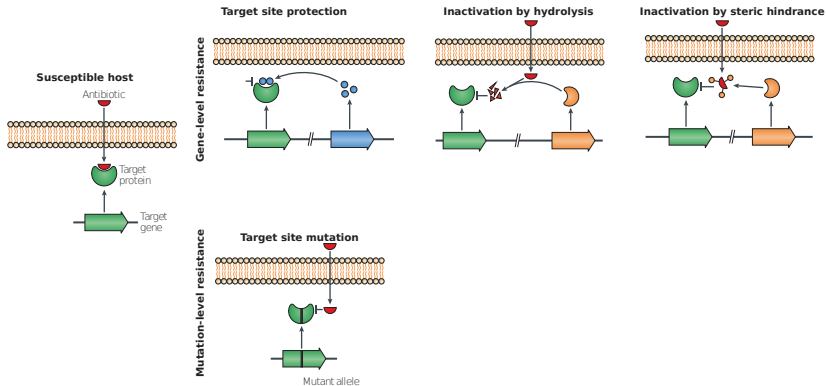


Mechanisms of Resistance



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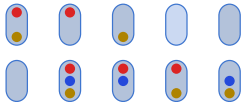
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Building a Bacterial Pan-Genome

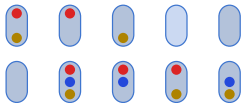
Bacterial strains
with phenotypes



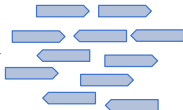
+ many more

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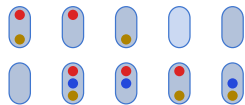
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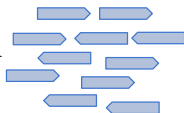
NGS reads

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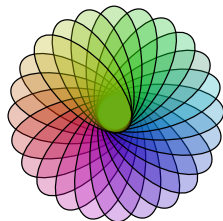
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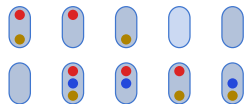
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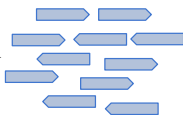
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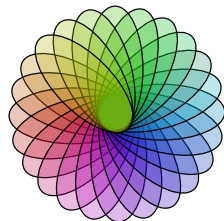
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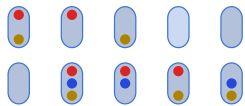


Sequence graph for each gene:

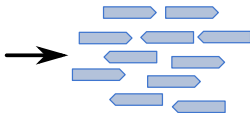


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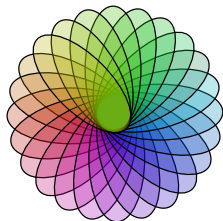
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Towards Bacterial (Pan-)Genome-Wide Association Studies

