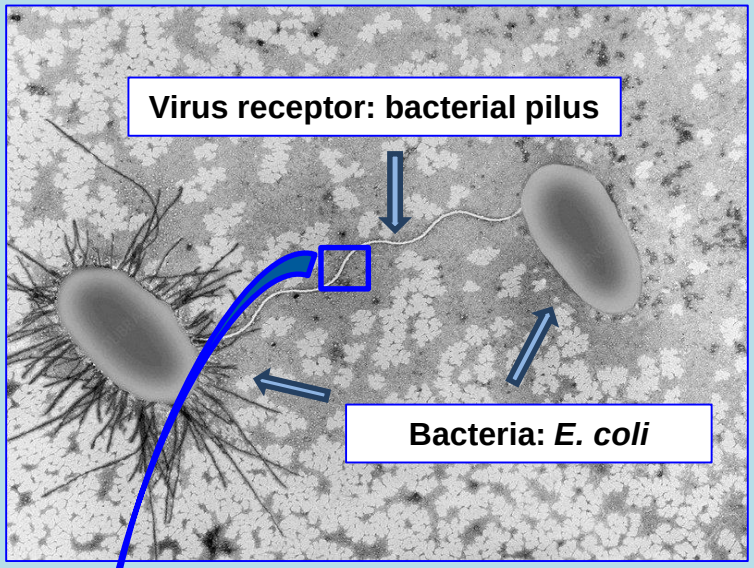
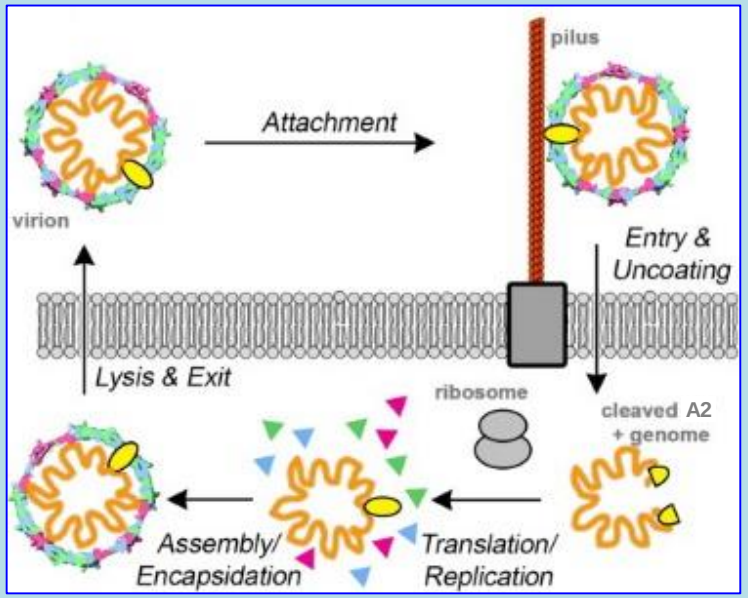
The balance between fitness advantages and costs drives adaptation of bacteriophage Qβ to changes in host density at different temperatures

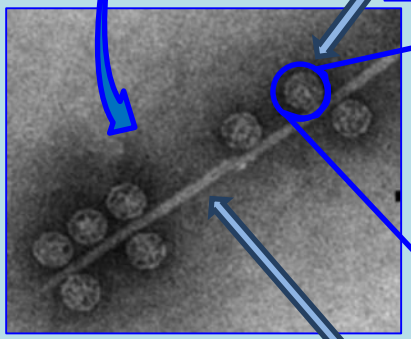
CENTRO DE ASTROBIOLOGÍA · CAB
ASOCIADO AL NASA ASTROBIOLOGY PROGRAM
CSIC INTA



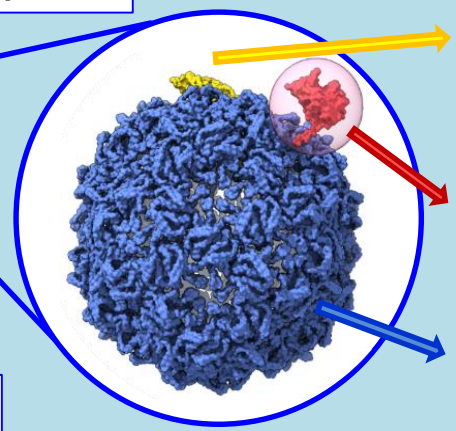
Dennis Kunkel Microscopy/science Photo Library, 2018



Rolfsson et al, 2016



Wong et al, 2014



A2 protein: for binding to receptor, starting virus assembly, and lysing the bacteria and releasing the new viruses

A1 protein: for initial binding to receptor

Coat protein: for building the capsid shell

Mutants

- U830C (in A2)
- C2011A (in A1)

Host density is one of the main factors affecting the infective capacity of viruses. When host density is low, it is more difficult for the virus to find a susceptible cell, which increases its probability of being damaged by the physicochemical agents of the environment. Nevertheless, viruses can adapt to variations in host density through different strategies that depend on the particular characteristics of the life cycle of each virus. We found that, at optimal temperature (37 °C) and lower-than-optimal bacterial density, bacteriophage Qβ increased its capacity to penetrate into the bacteria through a mutation (C2011A) in the minor capsid protein (A1) (Laguna-Castro and Lázaro 2022). The same mutation was selected when temperature was decreased to 30 °C. However, when temperature increased to 43 °C, the mutation selected (U830C) was located in a different protein (A2), which is involved both in the interaction with the cell receptor and in the process of viral progeny release. The new mutation also increased phage entry into bacteria at the three temperatures assayed. However, it also considerably increased the latent period at 30 °C and 37 °C. The conclusion is that the adaptive strategies followed by bacteriophage Qβ, and probably other viruses, in the face of variations in host density depend on the balance between advantages and fitness costs, which can change as a function of other environmental conditions.

Laguna-Castro M, Rodríguez-Moreno A, Llorente E and Lázaro E (**2023**). *Frontiers in Microbiology*. 14:1197085 https://doi.org/10.3389/fmicb.2023.1197085