

Mechanics and Thermodynamics of Capsid Maturation.

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Maturation is the crucial final step in the assembly of many kinds of viruses. Maturation converts an innocuous ensemble of macromolecules - the procapsid - into an infectious, replication-competent, particle - the virion. Maturation generally involves major structural changes in a pre-assembled particle, including large-scale rigid-body rotations of the capsid protein subunits; in some cases, the shedding of scaffolding proteins; and in other cases, the binding of stabilizing "clamp" proteins. Maturation is often triggered by limited proteolysis and proceeds through a succession of discreet, icosahedrally symmetric, structures. The energetic basis of maturation is not ATP hydrolysis but progression through a sequence of progressively lower local minima in the free energy landscape. We have been studying maturation in several systems, primarily by combining cryo-electron microscopy, image reconstruction with differential scanning calorimetry. This talk will review data from a number of systems, including tailed bacteriophages and their distant relatives, the herpesviruses, and the cystoviruses, enveloped bacteriophages with dsRNA genomes. It will focus on the structural basis and regulatory aspects of maturation.

A.C. Steven, J.B. Heymann, N. Cheng, B.L. Trus & J.F. Conway

Curr. Opin. Struct. Biol. 15, 27-236 (2005)

Virus Maturation: Dynamics and Mechanism of a Stabilizing Structural Transition that Leads to Infectivity.

P.D. Ross, J.F. Conway, N. Cheng, L. Dierkes, B.A. Firek, R.W. Hendrix, A.C. Steven & R.L. Duda

J. Mol. Biol. 364, 512-525 (2006).

A Free Energy Cascade with Locks Drives Assembly and Maturation of Bacteriophage HK97 Capsid.

R.L. Duda, P.D. Ross, N. Cheng, B.A. Firek, R.W. Hendrix, J.F. Conway & A.C. Steven

J. Mol. Biol. 391, 471-83 (2009)

Structure and Energetics of Encapsidated DNA in Bacteriophage HK97 Studied by Scanning Calorimetry and Cryo-electron Microscopy.

D. Nemecek, N. Cheng, J. Qiao, L. Mindich, A.C. Steven & J.B. Heymann

J. Mol. Biol. 414, 260-271 (2011)

Stepwise Expansion of the Bacteriophage phi6 Procapsid: Possible Packaging Intermediates.

G. Cardone, J.B. Heymann, N. Cheng, B.L. Trus & A.C. Steven

In *Viral Molecular Machines*, M.G. Rossmann and V. Rao, Eds. pp. 324-449 (2011). Springer.

Procapsid Assembly, Maturation, Nuclear Exit: Dynamic Steps in the Production of Infectious Herpesvirions.