# Virus Symmetry Helpful Information & Links

Words/phrases to know:

Virus- a non-living microbe composed of genetic material surrounded by a protein coat

Icosahedron- a 20-sided polyhedron (3D shape)

Caspar-Klug Theory- how scientists classify icosahedral viruses based on their shape

Protein Databank Website: rscb.org

Quasisymmetry in icosahedral viruses: http://pdb101.rcsb.org/learn/paper-models/quasisymmetry-in-icosahedral-viruses

Links to individual virus models:

T=1: https://cdn.rcsb.org/pdb101/learn/resources/quasisymmetry/T=1.pdf

T=3: https://cdn.rcsb.org/pdb101/learn/resources/quasisymmetry/T=3.pdf

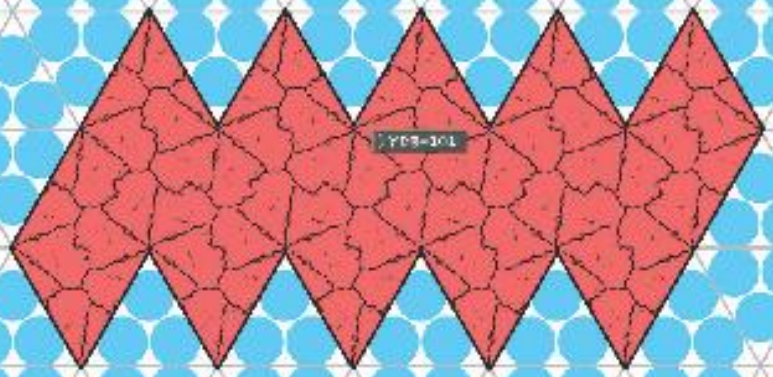
T=7: https://cdn.rcsb.org/pdb101/learn/resources/quasisymmetry/T=7.pdf

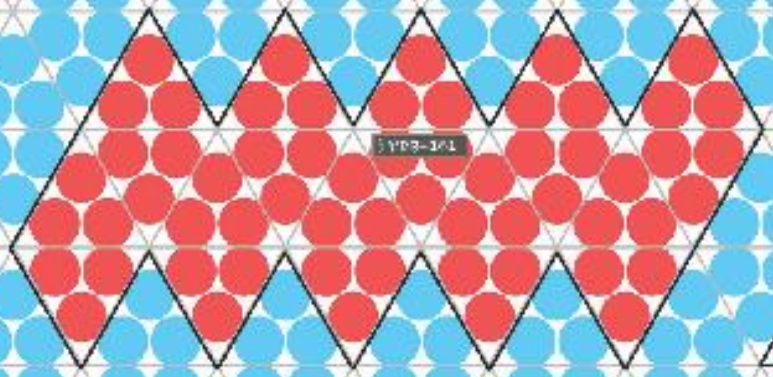
Caspar-Klug Theory:
https://viralzone.expasy.org/8577#:~:text=The%20Caspar%2DKlug%20Theory%20(CK,center%20of%20each%20triangular%20face.

## T=1

**Satellite Tobacco Necrosis Virus**

PDB entry **2buk**




Subunits are in perfect icosahedral symmetry.

# Viral Quasisymmetry

Viruses are faced with a challenge: their genomes need to encode all of their proteins, but at the same time, these genomes need to fit into the tiny space of a viral capsid. In the 1960s, Donald Caspar and Aaron Klug discovered that viruses solve this problem using quasisymmetry.

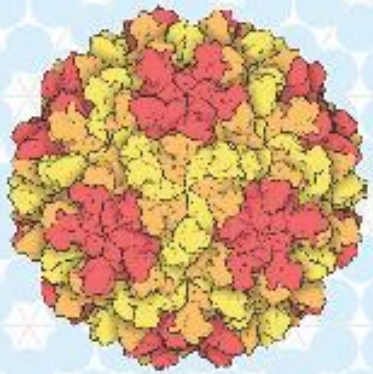
Viral capsids are built using many identical copies of one or a few capsid proteins, arranged to form a shell with icosahedral symmetry. Some viruses, such as Satellite Tobacco Necrosis Virus, build a tiny capsid with perfect symmetry. Other viruses need more room, so they build larger capsids, but still only using one type of building block.With small changes in shape, the subunits form pentamers and hexamers, and these pack into larger, quasisymmetrical capsids.

These paper models show a few examples of how quasisymmetry is used to build viruses of different sizes. The subunits are represented as circles, with ones that form pentamers in red and ones that form hexamers in shades of yellow and orange. For each virus, a model of the atomic structure is also included.

Cut out the models and tape the edges together to form the icosahedral virus.

Learn more at **pdb101.rcsb.org**

200 PDB-101

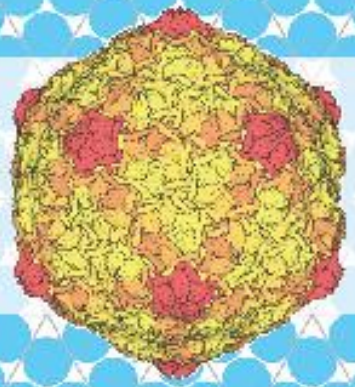


# T=3

## Tomato Bushy Stunt Virus

PDB entry 2tbv

Subunits occupy three different positions: one type forms a five-fold interaction at the vertices of the icosahedron (shown in red), and two other types form a pseudo-six-fold interaction in the center of each icosahedral face (shown in yellow and orange).

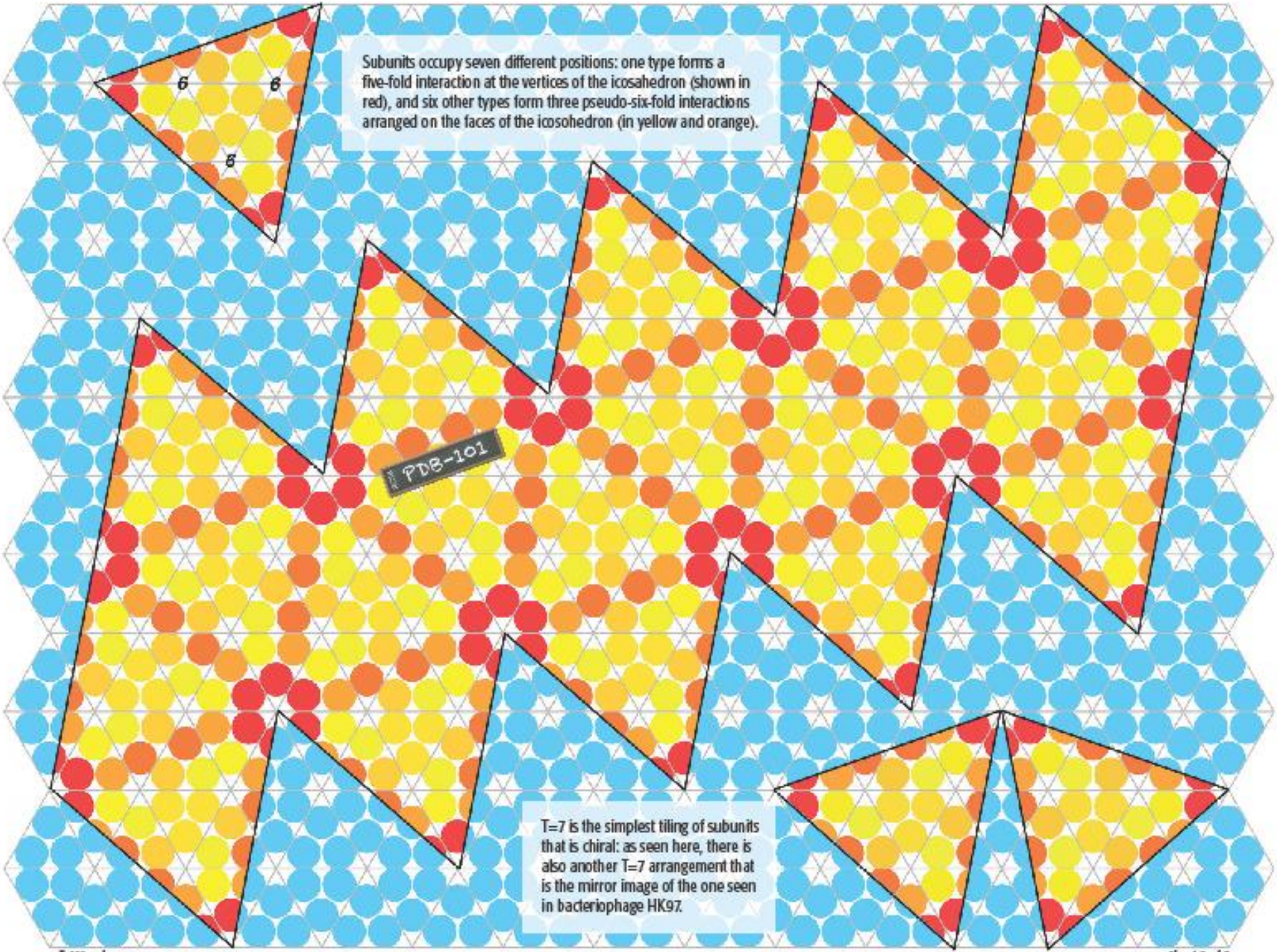


# T=7

## Bacteriophage HK97

PDB entry **1ohg**

PDB-101




Subunits occupy seven different positions: one type forms a five-fold interaction at the vertices of the icosahedron (shown in red), and six other types form three pseudo-six-fold interactions arranged on the faces of the icosohedron (in yellow and orange).

T=7 is the simplest tiling of subunits that is chiral: as seen here, there is also another T=7 arrangement that is the mirror image of the one seen in bacteriophage HK97.