The Fascination of Crystals and Symmetry

Unit 1.7

by Frank Hoffmann & Michael Sartor
The Concept of the Unit Cell

Task

Divide a space/volume into \textit{identical} building blocks

- use only blocks that are \textit{geometrically regular}
- use only \textit{a single sort} of blocks

\begin{itemize}
\item cube
\item (\(\alpha = \beta = \gamma = 90^\circ\))
\item cube
\end{itemize}
The Concept of the Unit Cell

Task

Divide a space/volume into *identical* building blocks

- use only blocks that are *geometrically regular*
- use only *a single sort* of blocks

Cube

\[ \alpha = \beta = \gamma = 90° \]

Square plate

\[ a \]
The Concept of the Unit Cell

Task

Divide a space/volume into identical building blocks

- use only blocks that are geometrically regular
- use only a single sort of blocks

![Diagram of a cube divided into identical blocks to form a rectangular prism.]

- Cube
- Rectangular prism

$(\alpha = \beta = \gamma = 90^\circ)$
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6 faces hexahedra

8 faces
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**Task**

Divide a space/volume into *identical* building blocks

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1.

2.
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- **voids**
  - not completely space-filling

- **completely space-filling**
  - but two orientations

- no voids
  - completely space-filling
The Concept of the Unit Cell

- Which geometrical regular bodies fill the space completely (without gaps) by joining them together only by translation along all three spatial directions?

  parallelepipeds!

- A parallelepiped (epipedo = Greek for face) is a geometric body, which is confined by six parallelograms, of which two of each are congruent (superimposable) and lie in parallel planes.
The unit cell is the unit, which builds up the whole crystal structure by repeated translations along all three spatial directions.