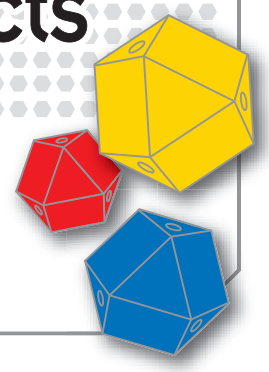
HGS

Product ID #1009

Crystal Objects



Instruction Manual

MARUZEN
TOKYO JAPAN

Safety Guidelines

1. Do not put the parts into orifices such as mouths, nostrils, ears, etc.
2. Keep the parts away from small children.
3. Do not give the parts to small children as misuse could result in permanent injury to the child.
4. Do not use the parts near fire, flame, or hot surfaces.
5. Recycle the plastic rather than dispose of it in the garbage.
6. Protect our environment; do not throw the kit and its parts into a river, sea or body of water.

MARUZEN
TOKYO, JAPAN

A Message from the Manufacturer

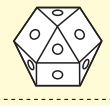
"Symmetry" is a very important concept in art and science. The word “symmetry” has been used for describing something that is “bilaterally-symmetric,” “beautiful,” or “well-balanced” since a long time ago. Therefore, it is obviously an important concept for paintings, sculpture, and even music. This word is also a very essential concept in math, physics, chemistry, and biology.

The purpose of this model is to allow you to learn automatically the concept of symmetry by just making various crystal and molecular models with high symmetry. The reason why crystal models look beautiful is because they have symmetrical structures. The parts “balls” used for this model are actually highly symmetrical polyhedrons, because it is necessary to use symmetrical parts for constructing symmetrical objects. You can use the “balls” and "sticks" to make various models, such as diamond and ice crystals. As you connect "balls" having holes in symmetrical positions by using "sticks" to make models, you will become more familiar to the symmetry of parts and objects.

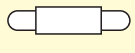
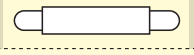
We believe that you will be learning the concept of symmetry by simply making the models of crystal objects that you feel are beautiful. Let's try to make various models.

Parts list

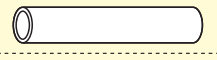
▸ Ball

No.	Name	Color	No. of holes	Shape	Q’ty	Application
3	Ball	Blue	4		20	Ice Group (Hexagonal)
4	Ball	Red	4		12	Diamond Structure (Cube)
7	Ball	Yellow	4		20	Pentagonal Dodecahedron (Gas hydrate)
16	Ball	Red	14		8	Diamond Structure (Cube)

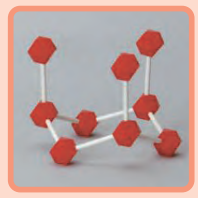
▸ Stick

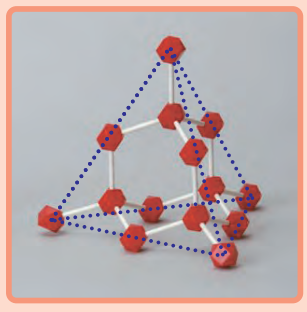
No.	Name	Color	How to use	Shape	Q’ty	Application
#6	Stick	White	Triangular surface		90	Pentagonal Dodecahedron (Gas hydrate) Diamond Structure (Cube) Ice Group (Hexagonal)
#17	Stick	Yellow	Quadrangular surface		12	Diamond Structure (Cube)

▸ Stick puller

Name	Material	Shape	Q’ty	Application
Stick puller	Rubber		1	For pulling out

Diamond Structure





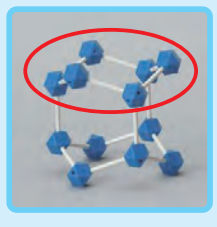
1 Interestingly diamonds are made of carbon atoms only, which are represented by red polyhedrons here. Each atom has four bonds (sticks) in tetrahedral positions, and hence the four atoms connected to the same atom make a regular tetrahedron.

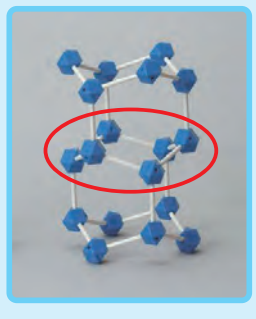
2 Note that all polyhedrons are arranged in the exactly same direction, except the position of holes.

3 You may find that the solid lines also show a regular tetrahedron of larger size.

4 When you make a larger model of the diamond structure by using supplementary parts, you will see the beautiful shape of a much larger regular tetrahedron or a regular octahedron.

Ice Group





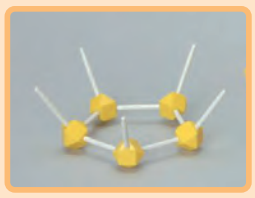
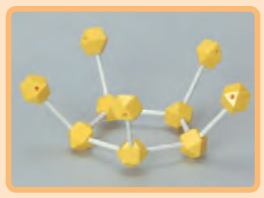
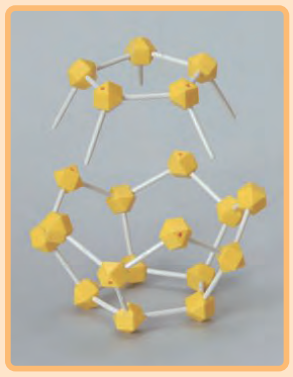
1 Blue polyhedrons with the same shape as the above red polyhedrons are used. Note that the top six-membered ring (marked with red circle) is rotated 60 degrees against the bottom six-membered ring. Therefore, each polyhedron part of the top six-membered ring is also rotated 60 degrees compared to that of the bottom six-membered ring.

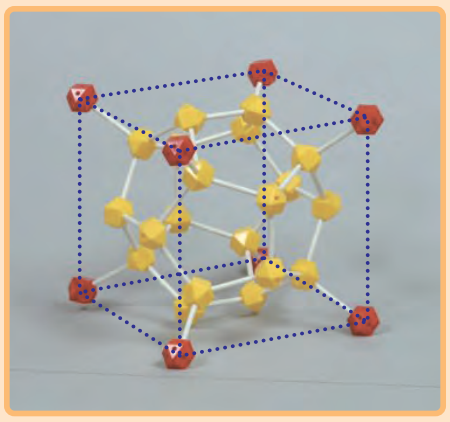
2 The ice crystal belongs to this group, and each blue polyhedron approximately represents a water (H_2O) molecule.

3 See also HGS catalog at https://hgs.maruzen.info/pages/catalogs-manuals

Pentagonal Dodecahedron

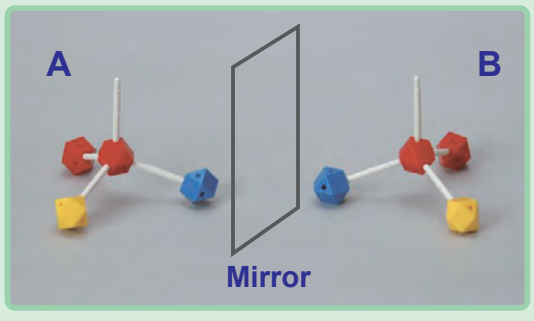




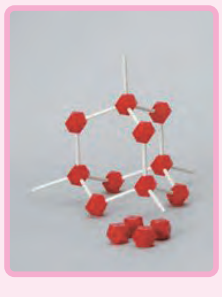
Let's make a pentagonal dodecahedron using yellow polyhedrons, and attach red ones as shown. If you make lines between the red polyhedrons as shown in the picture, you will find that the pentagonal dodecahedron touches internally the cube formed.

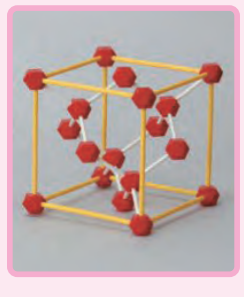
Mirror Image



Can you superimpose **A** and **B**? **A** and **B** are mirror images of each other, but are not identical. This is a very important concept in chemistry and biology.

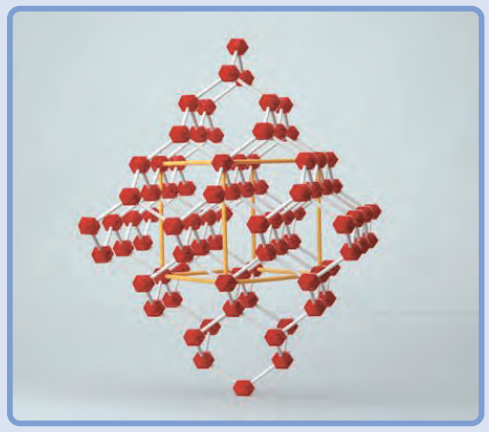
Unit Cell of Diamond



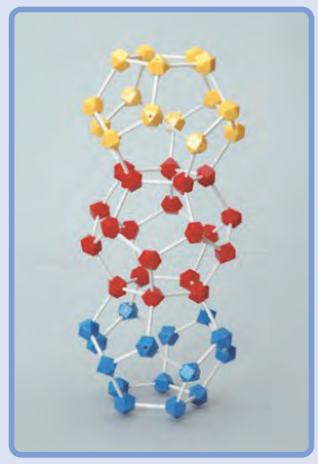


Unit cell is the minimum unit of crystal. See also HGS catalog at https://hgs.maruzen.info/pages/catalogs-manuals

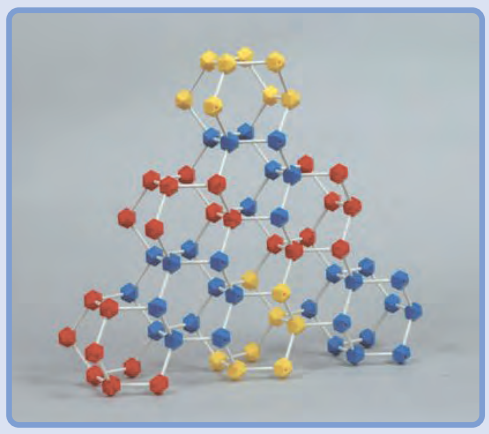
Examples of Models Made with Several Kits or Supplementary Parts



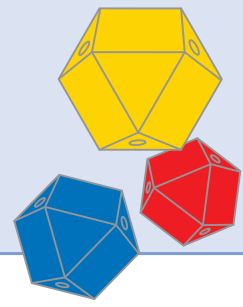
Diamond
(Regular Octahedron)



Three-Tiered
Regular Pentagonal Dodecahedron



Triangle Object of Ice Group
(Hexagonal)

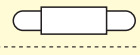
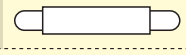


Supplementary parts

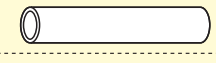
Ball

No.	Name	Color	No. of holes	Shape	Small set	Large set
3	Ball	Blue	4		10 pcs	100 pcs
4	Ball	Red	4		10 pcs	100 pcs
7	Ball	Yellow	4		10 pcs	100 pcs
15	Ball	Blue	14		5 pcs	50 pcs
16	Ball	Red	14		5 pcs	50 pcs
15-Y	Ball	Yellow	14		5 pcs	50 pcs

Stick

No.	Name	Color	How to use	Shape	Small set	Large set
#6	Stick	White	Triangular surface		10 pcs	100 pcs
#17	Stick	Yellow	Quadrangular surface		10 pcs	100 pcs

Stick puller

Name	Material	Shape	Set
Stick puller	Rubber		1 pcs