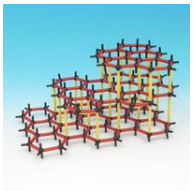


Teaching resource 6

Forms of Carbon: Graphite

You will need:		
23 black carbon C	26 grey straws	10 white straws

Graphite is made up of planar sheets of carbon atoms. Within the sheets the carbon atoms are arranged in a hexagonal mesh with each atom bonded to three others. The four bonding electrons of each carbon are fully employed in these three bonds. Bonding is therefore strong within the sheets but between the sheets only weak bonding exists called van de Waal's forces.

The layer structure of graphite can be seen in natural slate where it's easy to slip one sheet over the other.

Graphite differs from diamond in that the carbon atoms are bonded trigonally. To create a model of graphite take 23 trigonal carbon centres and construct two planar lattices as shown in Figure 1 and one as shown in Figure 2. Use grey straws to connect the atoms.

Take one layer 1 and place layer 2 on top as shown in Figure 3. Take 5 white straws and connect the layers together by passing the straws vertically though the central holes of the atom centres.

Add five more white straws pointing vertically up from layer 2 to the five carbon atom centres that are not already connected to a white straw. Finally add a second Layer 1 as show in Figure 5.

There are two known forms of graphite – the commonest is the one in which the layers alternate ABABAB. The model shown is the other form in which the layer sequence is ABCABC.

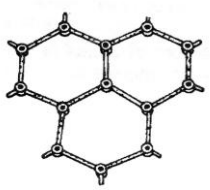


Figure 1 – Layer 1

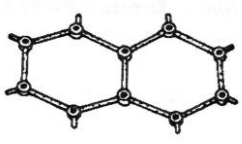


Figure 2 – Layer 2

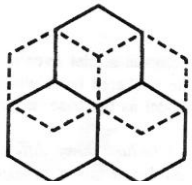


Figure 3 – Layers 1 and 2

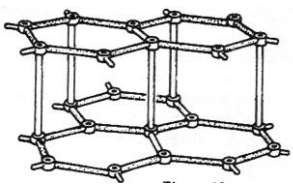


Figure 4 – Layers 1 & 2

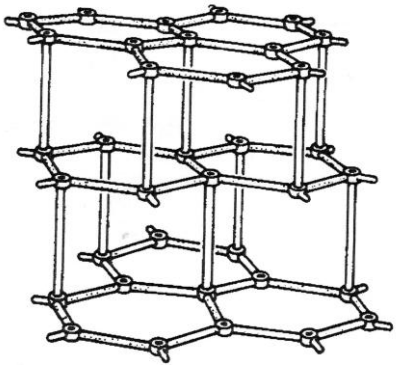


Figure 5

No 6. Forms of Carbon - Graphite

Study questions

6.1 *How many near neighbours does each carbon atom have?*

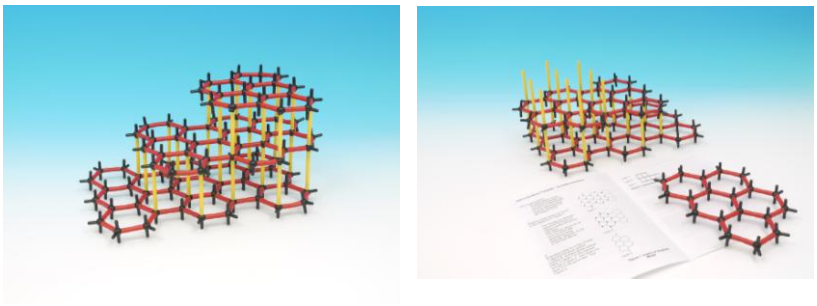
6.2 *Why is graphite a good lubricant and much softer than diamond?*

6.3 *Which substance would you expect to be denser: diamond or graphite?*

6.4 *What happens to graphite if it is compressed very hard? Do your models explain this effect?*

➔ Look out for related teaching aids for other forms of carbon to compare structure.

Further insight into the structure of graphite can be gained by making larger models using the Colourwave and Proview crystal building kits.



Graphite Colourwave model

Products which can be used for this demonstration:

0046 Orbit Basic Structures Class Set | 0026 Orbit Basic Structures Individual Set
0048 Orbit Lattices Class Set | 0028 Orbit Lattices Individual Set
0047 Orbit Organic/Inorganic Class Set | 0049 Orbit Biochemistry Class Set
0041 Large Class Set
1246 Graphite Colourwave model | 0088 Graphite Minit Proview model

Or you can order sufficient individual atoms from the Orbit, Minit or Unit systems for your individual needs.

Answer to study questions: 6.1 Three 6.2 Because the relatively weak van der Waals forces between the layers can be more easily broken 6.3 Diamond is denser (Graphite 2.26g cm^{3}Diamond 3.51 g cm^3) 6.4 Extreme conditions of pressure convert graphite into diamond. Examination of the structure of diamond reveals hexagonal layers within the tetrahedral arrangement.