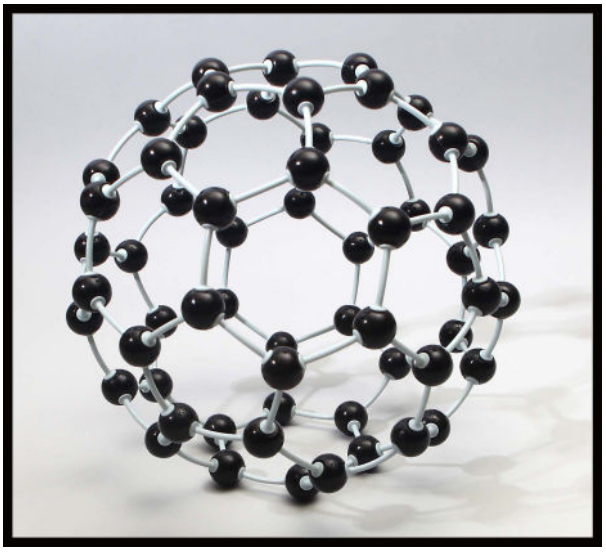
Super Models



C_{60} Buckminsterfullerene Molecular Model Kit

Ryler Enterprises, Inc.

Recommended for ages 10 – adult.

Caution: Atom centers and connectors are choking hazards. Do not eat or chew model parts.

Kit contents:
62 black 3-hole carbon atom centers (2 spares)
92 grey, 43 mm connectors (2 spares)

Replacement and expansion parts available
Custom kits available

Related Kits Available:
Buckytube Molecular Model Kit
Graphite Molecular Model Kit
Diamond Molecular Model Kit

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General Information

Allotropes are different forms of any one element. Carbon, is one of those elements that can be found existing, naturally, in a variety of allotropes.

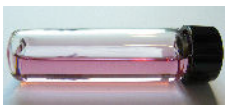
These include 1) diamond, 2) graphite (stacked layers of graphene), 3) amorphous carbon (soot and charcoal), 4) fullerenes which can contain large numbers of carbon atoms arranged as spheres, ellipsoids, or tubes, and 5) several less common forms as well. Each allotrope has its own distinct chemical and physical property.

Spherical fullerenes are also known as Buckminsterfullerenes or buckyballs. The 60 in the name C_{60} buckminsterfullerene, means that 60 carbon atoms make up the sphere. Fullerenes were named for the architect, R. Buckminster Fuller, due to the resemblance buckyballs have with Fuller's geodesic design for buildings. The C_{60} buckyball also resembles a soccer ball.

Originally discovered in interstellar space by Harry Kroto and others, using a radiotelescope, fullerenes have also been found in meteorites and the mineral, shungite, mainly from Russia. Study of vaporized carbon at Rice University by Kroto, Richard Smalley, and Robert Curl in 1985 lead to the elucidation of the structure of the C_{60} and C_{70} fullerenes and netted the three researchers Nobel Prizes.

Buckyballs and related structures such as nanotubes are made of layers of carbon atoms similar to graphene (single, flat layers of graphite) except that buckyballs have 12 cyclopentene (five atom) rings interspersed among 20 cyclohexene (six atom) rings, and they have a curved surface.

Two methods currently used to make buckyballs, are passing a spark between two very pure carbon electrodes or focusing a laser on a graphite target. The soot that is produced is then purified by chromatography. Pictured below is C_{60} in an organic solvent.



Some applications of buckyball technology are storage of hydrogen to be used as a fuel, treatment of HIV, blocking the inflammation process, delivering anticancer medications, inhibiting bacterial growth, photovoltaics, switches in computers, solar cells, lubricants, antioxidants, fiber optics, steel production, and many others.

C_{60} Buckyball Assembly Instructions

1. Construct a hexagon with six of the 3-hole carbon atom centers and six grey connectors. (Fig. 1)

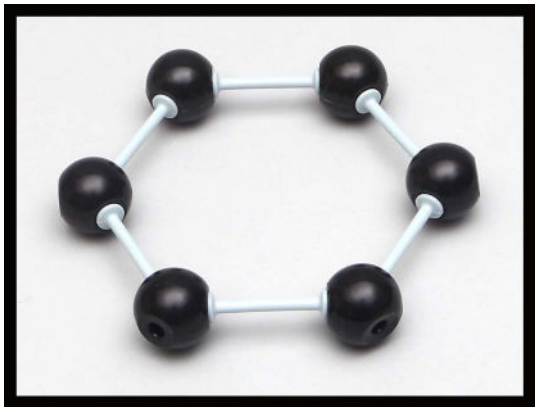


Fig. 1 A hexagon of carbon atoms.

2. Attach four connectors and three atoms between a and b of the hexagon to form a pentagon. Repeat with atoms c and d, and then with e and f. (Fig. 2)

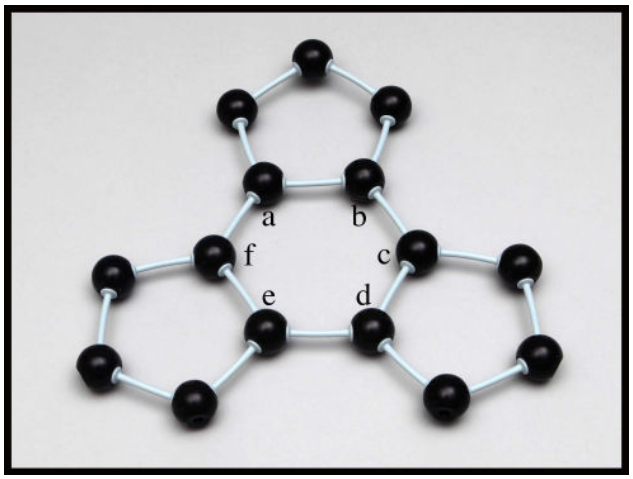


Fig. 2 Completing step 2.

3. Insert grey connectors into atoms g, h, i, j, k, and and l. (Fig. 3).

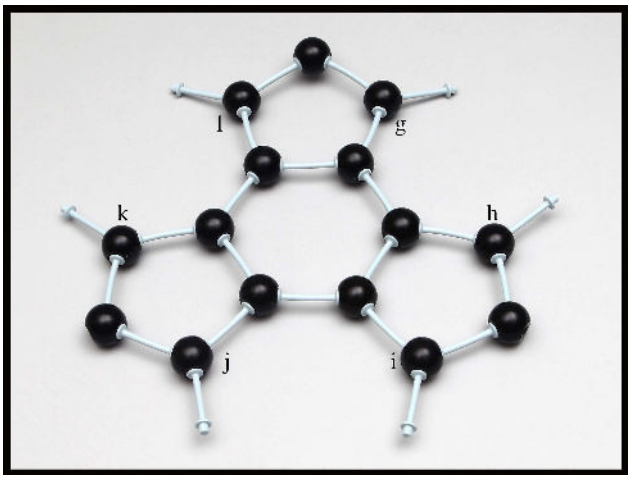


Fig. 3 Atoms g, h, I, j, k, and l with attached connectors.

4. Connect atom g to atom h using two more atoms and three connectors to form a hexagon. Repeat with atoms i and j and then k and l. The model should now have a slight cup shape (Fig. 4).

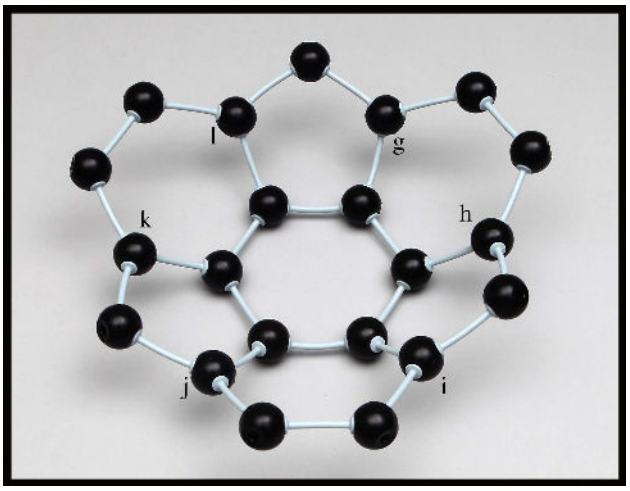


Fig. 4 Model with a slight cup shape.

5. Insert a grey connector, into each atom center at the outer periphery of the model. Examine the photo in the next figure for the proper location of the nine atoms that get the connectors. (Fig. 5)

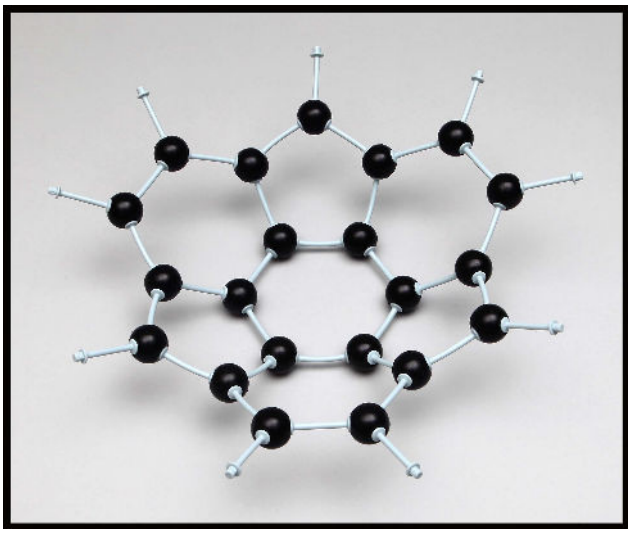


Fig. 5 Nine connectors attached to the nine atoms at the outer edge of the model.

6. Attach atoms to all of the free ends of the grey connectors just added in step 5. (Fig. 6)

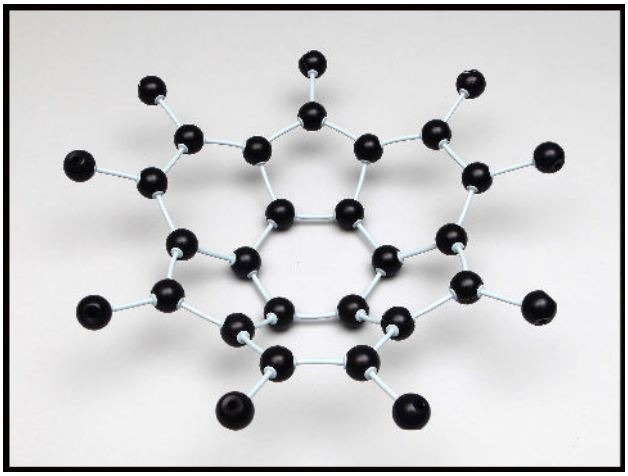


Fig. 6 Nine atoms added to the periphery of the model. One half of the Buckyball.

7. Repeat steps 1 through 6 to make a second layer of the model, which looks like Fig. 6.

8. Insert two connectors in the outer atoms of **just one** of the layers. (Fig. 7)

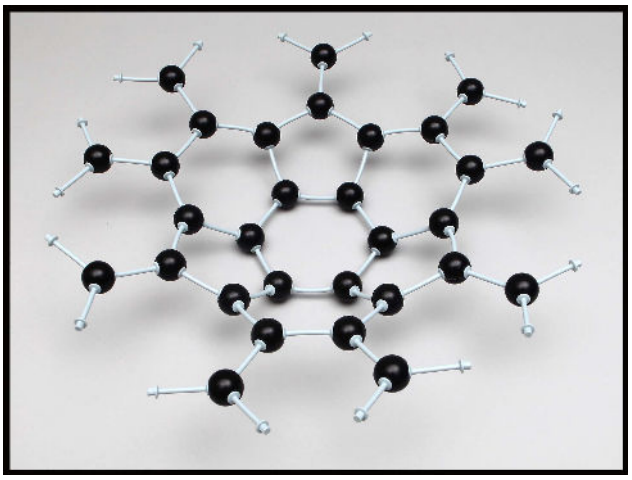


Fig. 7 Nine outer atoms with connectors attached. Second half of the Buckyball.

9 Place the first half you made, (Fig. 6), close to you and the second half, (Fig. 7), further away. Join connectors a and b to atom c. (Figs. 8 and 9)

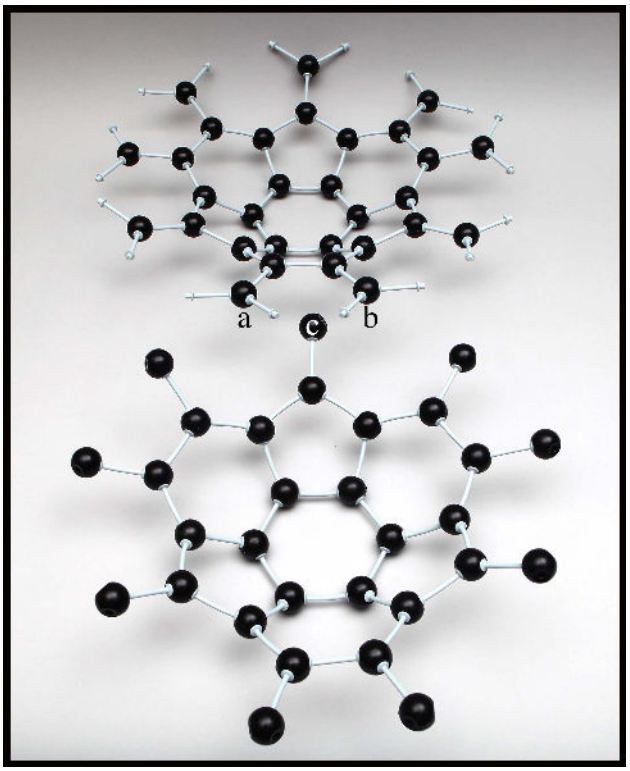


Fig. 8 Aligning both halves of the model for joining.

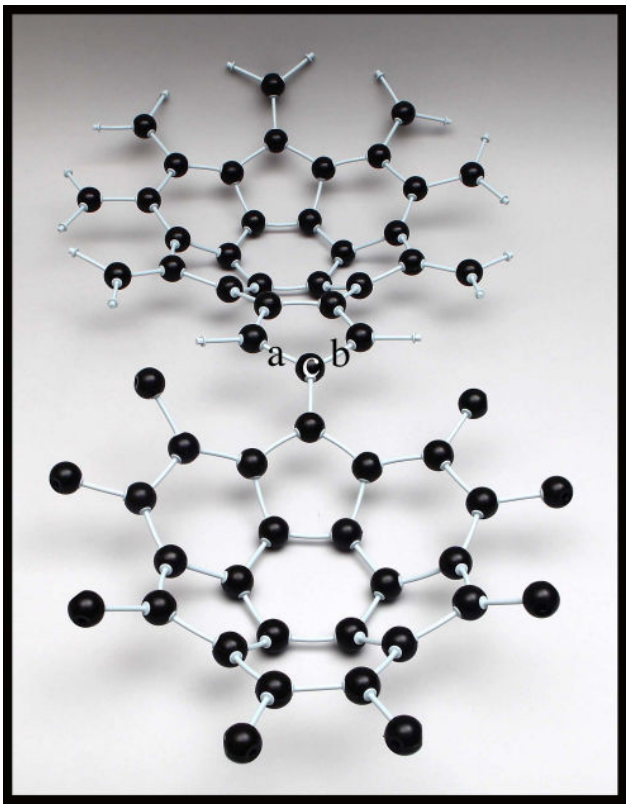


Fig. 9 Bonds a and b joined with atom c.

Fig. 10 shows the completed model.

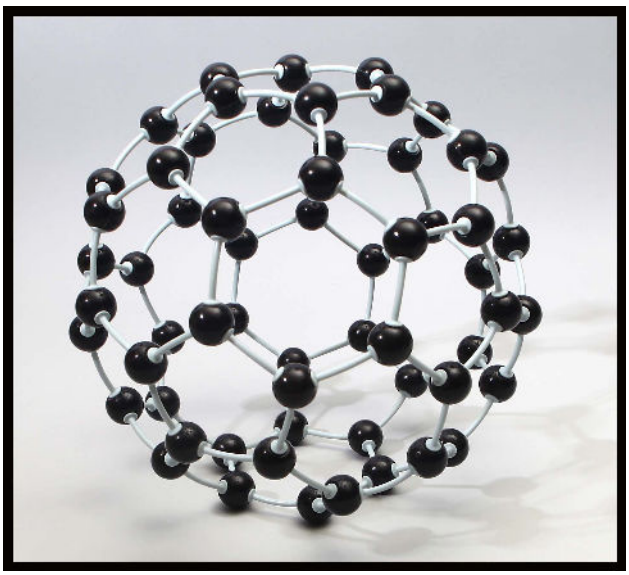


Fig. 10 The completed Buckyball.

TEACHING TIPS

1. Insert a tennis ball in the buckyball to simulate a caged atom of another element.

2. Compare the buckyball to diamond (Ryler kit DIA-1) and graphite (Ryler kit GRA-1) to show:

   a. aromatic bonds in graphite vs. single bonds in diamond, conjugated bonds in buckyball;

   b. definite number of carbons in buckyball vs. indefinite number in graphite and diamond;

   c. crystalline form of all three allotropes;

   d. graphite layers slip; diamond is rigid with cleavage planes; buckyball is cage-like;

   e. simulation of forming buckyballs and buckytubes by rolling a sheet of graphite (a small section of chicken wire can be used as graphite;

   f. different applications of the three allotropes.

3. Diamond is usually colorless, graphite is black, and buckyballs are red in solution.