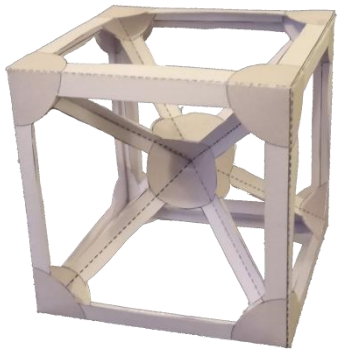
The body centred cubic structure (bcc)

As the name itself suggests, the body centred cubic structure has a cube-shaped unit cell. The length of each edge is given by the lattice parameter 'a'. There is an atom at each corner of the cube, similar to the simple cubic structure. However, there is also another atom at the centre of the cube. Each atom is positioned at a lattice point.



With this model sheet and instructions, you can make your own 3D paper model of a body centred cubic crystal, similar to one shown in the image. Once you are done, see if the 3D model makes it easier for you to answer the questions at the end.

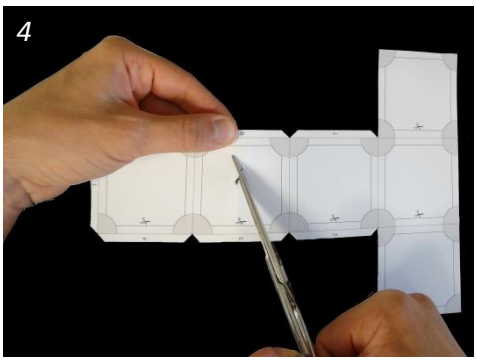
To make this paper crystal you will need:

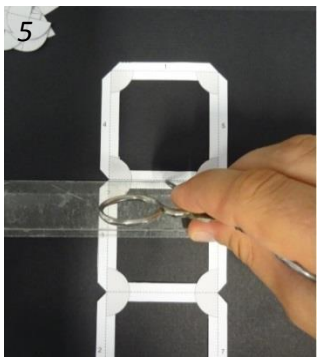
- *2 sheets of paper card (A4 size), 150-200 gsm*
- *Crayons, colours pencils*
- *Scissors or paper knife*
- *Ruler*
- *Craft glue, or a glue stick*

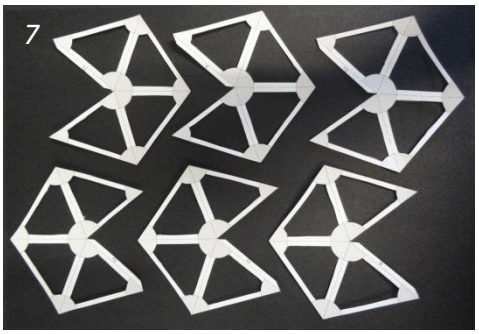
Paper cards, crayons, ruler, and scissors needed for the paper model

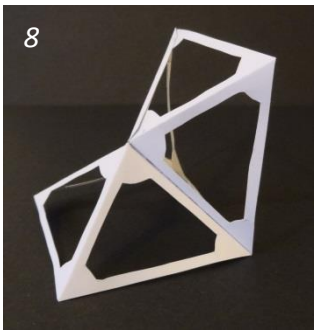
Instruction

1. *Download the model sheet from our homepage, and print it one-sided on the white A4 paper cards.*
2. *Colour the grey shaded regions in your favourite colour. Use the same colour for all the grey fields.*
3. *Cut along the solid lines, and start with the outer shape. Cut out all pieces.*
4. *To remove the inner parts, make a small hole in each field with the tip of your scissor. Then use a fine, small scissor and cut carefully along the inner solid lines.*
5. *Put your ruler on the dashed lines, and score gently with the scissor tip along these lines. Fold along these lines.*

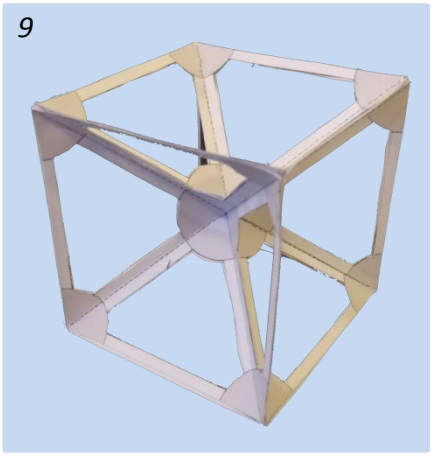






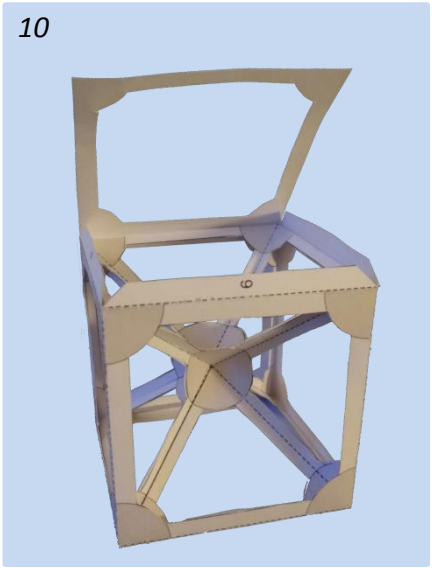


6. *Make a cube, and stick the sections with the same number (only 1, 2, 3 and 4) together. Let the lid open.*
7. *Cut out the pieces of the second sheet. Fold them, and glue the edges together, so that they form pyramids.*
8. *Stick the sides of two pyramids together as shown above.*
9. *Then glue the other pyramids on the sides of each other, so that the whole construction forms a cube.*
10. *Insert this construction into the outer frame of the cube, which you have constructed in step 6.*
11. *Close the lid and glue the sections 5, 6, and 7.*
12. *Finished!*



Can you answer the questions on the crystal properties?

1. *How many nearest neighbours does each atom have? Take into account that each cubic unit cell is surrounded by several similar unit cells.*
2. *How many atoms are in each body centred cubic unit cell?*
3. *What is the distance between nearest neighbours? (Use the length of the cube edge 'a' as a scaling parameter.)*
4. *The packing efficiency describes the ratio of the maximal volume occupied by the atoms and the volume of the cubic unit cell. In your 3D paper model, now assume that the neighbouring atoms are touching each other, then, what will be the packing efficiency for the body centred cubic structure? Compare the result with the values of other crystal structures.*



Enjoy your new 3D paper crystal!

For more learning resources from our group, visit
http://www.gan.msm.cam.ac.uk/resources