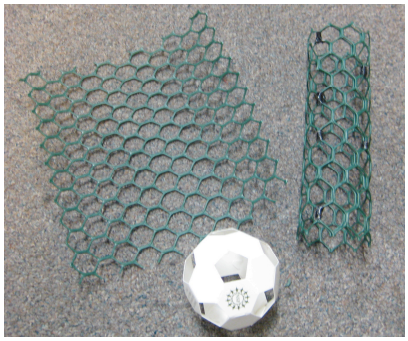


Tiny Tubes

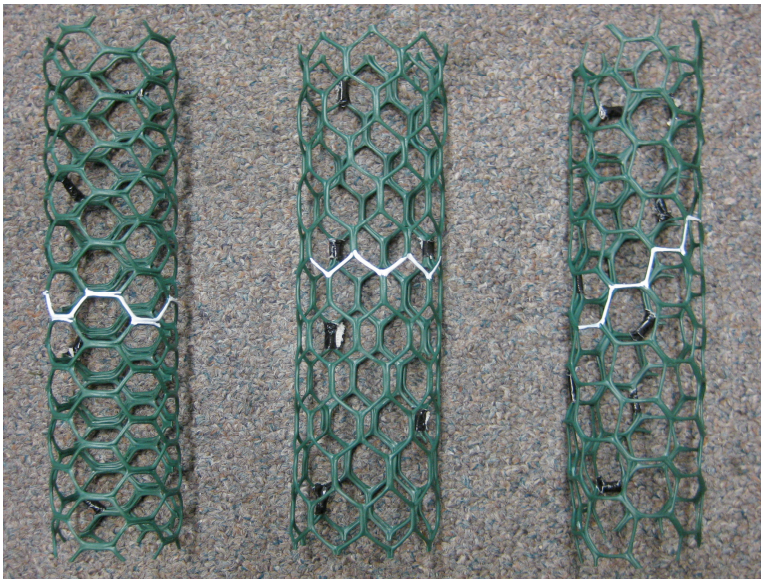
Make totally tubular forms of carbon

Or contain very small chickens.

Materials
chicken wire (aka poultry netting) - plastic is easier on the hands
tape
scissors
(optional) paint pen

To do and notice
1. Cut an 8" x 8" piece of the poultry netting.
2. Roll it into a tube. What does the pattern of the hexagons look like?
3. Can you roll up the tube in a different way to get other patterns?

What's going on?
Each vertex in the hexagonal lattice of the poultry netting represents a carbon atom. When carbon exists like this in a sheet, it's called graphene. When this sheet is rolled into a tube, it's called a **carbon nanotube**. Depending on how you roll the sheet of chicken wire, you should be able to get three different patterns representing the three forms of carbon nanotubes. They look like this:



armchair zig-zag chiral

If you roll the square end-to-end the way the roll of chicken wire was rolled, you'll probably get the armchair configuration. If you roll it end-to-end the opposite direction (join the other ends), you'll get the zig-zag configuration, where there is a zig-zag pattern along the circumference of the tube. If you roll it corner to corner, or any other way that doesn't make a perfect cylinder,

you'll get a chiral configuration. Since the hexagons don't line up perfectly along the axis or circumference, you'll notice they form a spiral along the length of the tube. You can distinguish between armchair, zig-zag, and chiral nanotubes by looking for their defining pattern along the hexagonal matrix (highlighted in white in the picture). You can mark the different configurations on your tubes with a paint pen or masking tape. The slight difference in carbon configuration results in different properties for each type of nanotube. Carbon nanotubes are valued for their high strength-to-weight ratio and have been constructed to have a length-to-diameter ratio of 10^8 to 1, which makes them potentially useful in physical and mechanical systems. Also, like graphite, the movement of electrons in the carbon-carbon double bonds of a nanotube makes them good conductors of electricity. Since they are so small, they have a very high surface area-to-volume ratio, which is useful for chemical reations. These unique features make carbon nanotubes attractive candidates for a large number of applications.

The buckyball is a form of carbon that is in the shape of a hollow sphere. Its carbons are in an array of hexagons and pentagons (like a soccer ball), so it's difficult to make one out of chicken wire. You can make a paper version with a template found here:

http://www.nisenet.org/catalog/topics/buckyball

References

This activity is based on one by the University of Wisconsin MRSEC group. Check out their site for other activities and great information about carbon nanotubes.

http://mrsec.wisc.edu/Edetc/nanoquest/carbon/index.html

Why does carbon take the shape of chicken wire? Check out the Carbon Configurations activity at www.exo.net/~jyu/activities/carbonconfigurations.