NANO HIGHLIGHT
Stacking Oranges with Gold Nanoparticles

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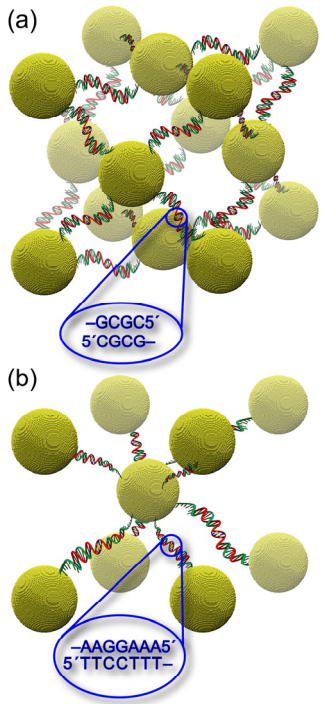
PI: **George Schatz**
Northwestern University

When oranges are carefully stacked in a grocery store, they naturally produce what is called a closest-packed pattern, in which each orange is in close contact with 12 other oranges: six sit in the plane around the orange, with three above and three below. This structure can also be found in many atomic crystal structures; for example when silver or gold atoms form crystals, they pack like oranges to form what is called a face-centered cubic lattice. Recent studies have discovered that similar structures can be made by packing gold nanoparticles that are coated with DNA, which links the particles together. One possible pattern manifests as a face-centered cubic lattice, formed when a large number for gold particles are coated with self-complementary strands of DNA – that is, strands capable of forming base pairs to other identical strands. It is also possible for the DNA to be asymmetric, meaning that it will bind to its complement, but not to itself; the structure that develops when asymmetric linking structures of DNA are used leads to what is called a body-centered cubic lattice. Of course, other lattice structures are also possible because DNA strands associated with complementary DNAs and particles do not have to be the same size. This allows for the potential to make new kinds of materials in which the structures vary over a wide range.



DNA-functionalized gold nanoparticles are assembled into different crystallographic arrangements by changing the linker sequence, shown (a) facing centered cubic arrangement induced by a self-complementary sequence; and (b) in a body-centered cubic arrangement induced by an asymmetric linker sequence

Credit: George Schatz, Northwestern University

Amorphous structures involving DNA-linked particles have been made in the past, but the crystalline structures are new, and the ability to model such structures is new. This research reports a fundamental discovery concerning nanoparticle structures, which could be explained using simple concepts and which can be applied to improving chemical and biological sensing.

[1] One-Sun Lee, Tatiana R. Prytkova, George C. Schatz. *J. Phys. Chem. Lett.*, **1** (12), 2010.