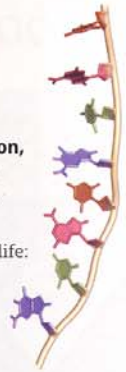
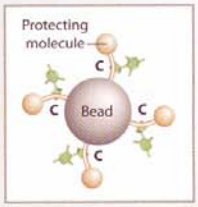
how to make DNA

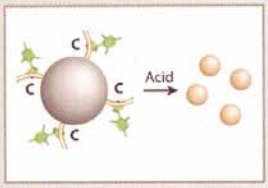


Custom-built DNA may sound like the stuff of science fiction, but it's a common tool for many genetics labs. Tiny and non-functional, these pieces of code are useful in experiments to check or sequence other genes. Here's how UW-Madison's Biotechnology Center goes about building the ingredients of life:

Write the code. Every piece of DNA contains a unique combination of bases—the four building-block molecules, abbreviated A, T, C and G. To order a custom-built strand, all a researcher needs is to spell out the desired sequence.

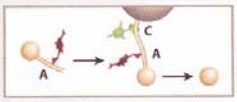
Attach the last letter in the sequence to a polystyrene bead. The Biotechnology Center's DNA synthesis lab stocks boxes full of tiny vials for each base, which contain beads coated with billions of copies of that base. To start a new strand, technicians start at the bottom, inserting a vial containing the last base in the sequence into a $200,000 synthesis machine.

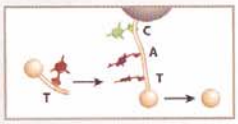


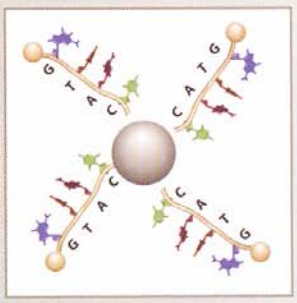


Inject acid into the vial. Acid releases a large molecule that protects the reactive site on the bases, priming them to bond with the next base. This protective molecule keeps the bases from bonding with anything except the next link in the chain.

Add the next base. Subsequent letters are injected into the vial in a solution. Activating molecules help the bases bond to the DNA chain. This process is repeated for each letter in the sequence until the strand is complete. Common lab experiments usually call for strands about 20 bases long, but the lab has created chains with up to 150 letters.







When all the bases are in, flush the vial with basic solution. This causes the polystyrene beads to release the completed DNA molecules, which are collected in a tube.

Check for typos. Using mass spectrometry, lab technicians measure the molecular weight of their finished DNA molecule and compare it to a predicted total, calculated from the known weights of each base. Any difference means there's likely an error in the code, and the whole process has to be redone.

Illustrations by H. Adam Steinberg