Review: Molecular modelling kits

Tinkering with the Invisible

3D modelling kits appeal to every scientist's inner child. Your *Lab Times* reporter checked out three common systems, each with a rather different character.

Your *Lab Times* reporter needed less than five minutes to construct a novel, highly contagious animal virus. The secret genetic engineering took place in the editorial office, late at night. No lab gloves, no sterile equipment and no laminar flow cabinet were used, and afterwards, the careless reporter transmitted the lethal virus to his innocent children.

To become such an unscrupulous virologist, there's no need to be a daredevil. You need neither a laboratory nor expensive devices, not even a scientific education (though, it will make your experiments easier!). All you need is a little money to buy the reagents provided by a supplier of scientific teaching materials: a collection of plastic balls and sticks, wrapped inside a commercially available molecular modelling kit.

Such a kit contains a number of small pierced balls (the "atoms"), as well as coloured chopsticks (the "atomic bonds"), both made from plastic and permanently falling off the table when the experimenter performs his first promising synthesis processes. In addition, instruction notes are supplied (a naked slip of paper rather than a full-blown manual). Your *Lab Times* reporter checked out three common molecular modelling kits. Each has its benefits and drawbacks.

The ***Orbit Molekülbaukasten Chemie*** (photo) provides multiple building possibilities but its parts are not of the best quality.

Photo: wk

On the hippy trail

To create the animal virus mentioned above, we used a kit of the same name, provided by the building-block toymaker Zometool. The Zometool system was invented by the American mathematician and designer Steve Baer, who since the 1960s has experimented with constructing buildings of unusual geometries (calling them "zomes"). Maybe the most memorable example of Baer's extravagant architectural ideas was the artists' commune Drop City, founded in Colorado in 1965 (later designated as the world's first hippy commune).

Today's Zometool construction system hasn't anything in common with former hippy ideals. The system's hub is a spherical plastic connector node with 62 geometric holes. These nodes (each as big as a cherry) are connected to each other with shape- and colour-coded plastic sticks. According to Zometool, all lengths are, "mathematically precise and enable users to build thousands of geometric structures". Due to the many holes, it is possible to build more kinds of models than with any other construction system.

The Drop City hippy commune (above) was inspired by Steve Baer's "zome" geometrics. Today's Zometool kits (right) are inspired by off-the-wall marketing.

Oversized screw cap jam jar

The *Animal Virus Kit* is delivered in what looks like an oversized screw cap jam jar, containing 146 coloured plastic parts (red, blue, white and orange) and a short description in simple words directed at six-year-olds. At certain points, the cautionary, politically correct and typical American tone got on the *Lab Times* editor's nerves ("…tiding up your mess, contributes to making the world a better place" – phew!)

Irritation flows away immediately when it comes to assembling the kit. The single elements look valuable and are high quality; plugging the balls and links together is a real haptic pleasure; the finished molecule has a stable spine. And even if a clumsy molecule builder breaks the tip off a stick – no problem, "Accidentally damaged parts are replaced by the manufacturer free of charge".

Not so great is the kit's instruction "booklet", consisting of a single slip of paper with just one indistinct building instruction on it. That's a little sparse.

Marble-like gizmos in tidy boxes

While the Zometool kits are made primarily for kids (but also used by advanced research scientists), most other molecular modelling kits are made solely for scientific purposes. One such "adult" kit is the *Molymod Biochemistry Teacher's Set*, manufactured in England and sold by the German distributor 3B Scientific. This set contains (separated in two large storage boxes) 262 colour-coded atoms, 160 links and 2 link remover tools. Compared with the concave and featherlight Zometool connectors, the heavy, marble-like Molymod "atoms" look as if they were built for the eternity. People with weak fingers should stay away from the Molymod marbles, given the fact that they are hellishly difficult to plug together and release.

The Molymod Teacher's Set contains sufficient parts to build most of the basic structures in biochemistry and molecular biology in semi-space-filling ("compact") style, such as amino acids, polypeptides, phospholipids, nucleotides, coenzymes, an alpha helix, nucleic acids and polysaccharides (but not all of them at the same time, of course). The handling is unequivocal, the enclosed instructions short but sufficient and the resulting molecules nearly indestructible.

The Molymod building blocks look as if they were made for eternity, however, they are difficult to plug together.

The same adjectives (heavy, intractable, unequivocal) also apply to the *Molymod Atomic Orbital Set*, that can be used to build 14 different atomic orbitals.

Not just top-quality

The "professional edition" of the *Orbit Molekülbaukasten Chemie* (chemisty molecular modelling kit), distributed by Wiley-VCH, was our third candidate. It contains 460 small atomic nuclei and connecting links, together with a detailed instruction leaflet. All the parts are mixed up together in a cheap-looking blister pack, which means that if you want to assemble a molecule, you have to get through an irritating search procedure (or invest additional money in a sorting system). Moreover, the links have to be separated before use, and some links must be cut further to defined lengths with a knife. To make things worse, the low-grade plastic atomic nuclei are anything but burr-free.

Even if the kit provides nearly endless possibilities for the construction of chemical molecules and given that the rest of the kit gives no cause for complaint, the purchase price of nearly €43 is far too high for a kit of such a poor quality.

WINFRIED KOEPPELLE

➤ Zometool *Buckyball Project Kit*. 150 parts (to build a model 23cm in diameter). Ages 6 to adult. *www.zometool.com*. €25.
➤ Zometool *DNA Kit*. 71 parts. Ages 6 to adult. *www.zometool.com*. €25.
➤ Zometool *Animal Virus*. 146 parts. Ages 6 to adult. *www.zometool.com*. €39.
➤ Molymod *Atomic Orbitals* (manufactured by Spiring Enterprises, UK). 14 Model Collection Kit, to make 14 easy to assemble atomic orbitals; in storage box. *www.3bscientific.de*. €38.
➤ Molymod *Biochemistry Teacher's Set* (manufactured by Spiring Enterprises, UK). 262 colour-coded atoms, 160 links, 2 link remover tools (in 2 storage boxes). *www.3bscientific.de*. €94.
➤ *Orbit Molekülbaukasten Chemie* (Profi-Set). 460 parts, with coloured booklet. Wiley-VCH, 2009. €42.90.

December's calendar quiz

Lucky Winners

11 percent. That was, from a statistical point of view, the chance of guessing correctly at random the answers to our December issue's brainteaser. *Lab Times* readers, however, didn't want to guess blindly. They wanted to get it right, as an impressive 81 percent rate of correct answers prove. To stand a chance of winning one of six wall calendars, provided by the Palazzi publishing house (Bremen, Germany), three questions had to be answered successfully.

The first concerned the vertebrate with the highest metabolism: How fast can a hummingbird's heart beat? Nearly all submissions were right, quoting the answer of **1,250 beats per minute**. Secondly, we wanted to know how fast bamboo grows. While bamboo has been observed surging 100 cm skywards in 24 hours, the answer was **4 meters or more** (a week). Many a participant stumbled on this question. Thirdly, we were interested in the genomic consensus sequences between *Camelus dromedarius* and *Homo sapiens*, asking, "What percent of camel genes are shared with the human genome? Here, the right answer was **57 percent**, published just a few months ago by an Saudi Arabian/Chinese team (*PLoS ONE*. 2010; 5(5): e10720).

Because the harsh exterior of every *Lab Times* editor belies a soft heart beneath, we turned a blind eye to PhD Student Jutta Petschenka from the University Hospital Mainz, who missed the deadline by a couple of days while being, "totally busy in the lab trying to ligate an insert into a vector". Petschenka's three answers were right. However, she had bad luck in the final draw (as did a lot of other participants). Another year, another chance, Jutta!

The following six winners were selected at random: **Anna-Maria Knorn** (University of Manchester, UK); **Walter Graewe** (Hamamatsu Photonics, GER); **Thiru Prasath** (Universität Düsseldorf, GER; photo 1); **Emanuela Cazzaniga** (University Milano Bicocca, Monza, ITA; photo 2); **Charlotte Uetrecht** (University of Utrecht, NED); **Christophe Ramière** (Université Claude Bernard, Lyon, FRA).