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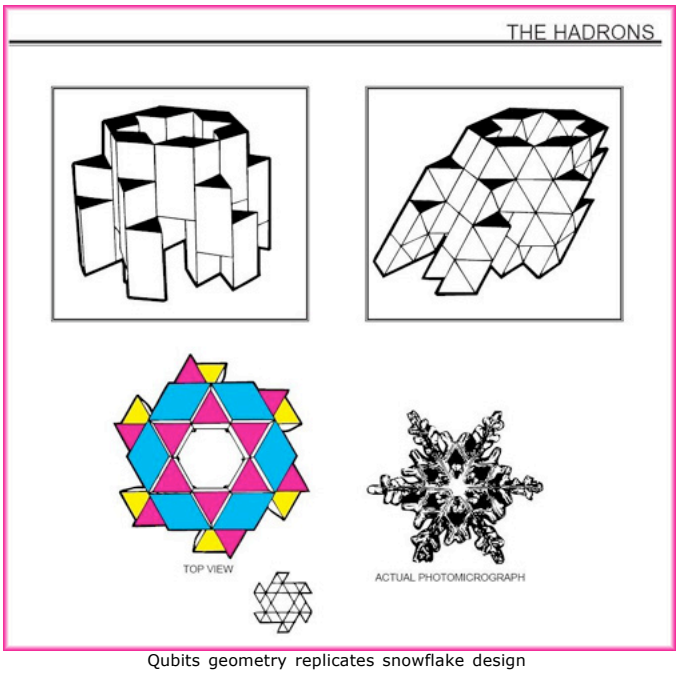
Qubits? Nature?s Building Blocks

Article by Marsha Carlson - Guest Columnist

Qubits? Nature?s Building Blocks

Mark Burginger, architect/inventor has been fascinated by the geometries behind the emerging field of nanoscience, since a college art project brought him in touch with the work of architect/inventor, Buckminster Fuller.

While continuing to design residential and commercial projects in the city of Poway, (San Diego County), California, and the surrounding areas, Burginger pulled his cardboard model out of the closet and went to work on his modular form building element named ?Qubits?, which is now patented.



Qubits geometry replicates snowflake design

Nanoscientists in industry and academia understand that Burginger has a model that deserves further exploration. They also agree that diverse structures could be built from Burginger?s simple crystalline shapes.

Says Burginger, ?When I show it to biologists and scientists they see it as some sort of molecular building block. The physical ability of the modules to connect, matches exactly with the spherical geometry of the *buckyballs*. It will take more and more research to prove that there is an actual structure to the atom that relates to what?s going on with this form.?

Just recently discovered, the C60 carbon atoms were named buckminsterfullerenes or *buckyballs* for Fuller, whose work as a ?comprehensive anticipatory design scientist? anticipated the structures we?ve come to know as *nanotubes*. Nanotubes are used as molecular components for nanotechnology.

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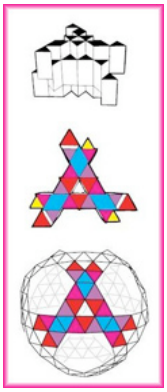


Modular element in construction of a sphere

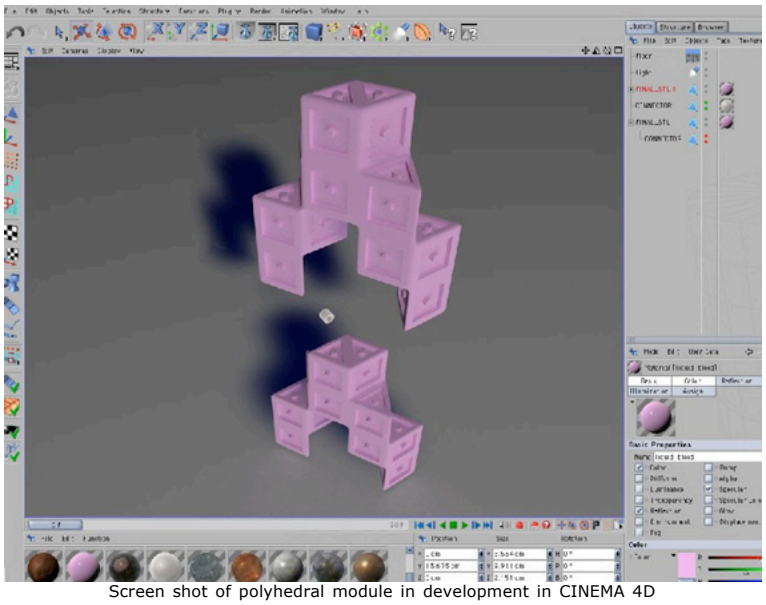
The inspiration to develop Burginger?s invention as the ***Qubits*** toy came from Professor James Gimnewski of the Nanoscience Institute at UCLA. Gimnewski, along with Professor Victoria Vesna, Department Chair of Design and Media Arts at UCLA, have been collaborating on a series of projects addressing the impact of nanoscience on culture and consciousness. Recently they opened a large exhibition, NANO, at the Los Angeles County Museum of Art. Both Gimneski and Vesna understand the value of a physical model like Burginger?s Qubits to understanding the invisible quantum world.

Qubits ? Wins $10,000 Award From Elwood Norris, American Technology Corp.

To help him move forward with his invention, Elwood Norris, the chairman of American Technology Corporation, as well as a renowned inventor and recipient of the prestigious $500,000 Lemelson-MIT Prize for Invention, has given Burginger $10,000 for his Qubits project. Norris, who lives in Poway, said he has used his prize money to establish a foundation to fund fledgling inventors and college students. Burginger is one of three people to receive a grant so far, Norris said. The Qubits, Norris said, "was really creative; it might be a learning tool, besides a plain old toy. I think it stimulates your thinking about different ways you can put things together and solve puzzles.?

Qubits ? Development Process And Tools

To take his model from cardboard to prototype Burginger explained his process: ?I built the 3D model first in ArchiCAD. I had people who would build the polyhedral parts, the octahedron and the tetrahedron. They built me little GDL pieces so that I could actually put together the models. The tetrahedron and octahedrons are so basic, yet nobody makes those pieces for some reason. From there I exported the models into CINEMA 4D. Once they are in C4D you can start working with them at a more elaborate level by using the HyperNurbs and rounding of the objects. I was able to make a much better looking model in C4D and then also it allowed me to export it as an STL file which I used to make a physical hard model.?



Screen shot of polyhedral module in development in CINEMA 4D

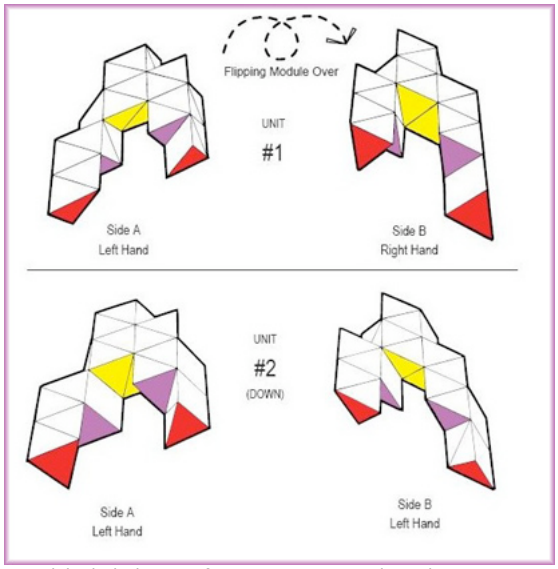
Burginger has been using CINEMA 4D from MAXON Computer since it first hit the market as he has always been interested in the three dimensional qualities of drafting.

Burginger would like to be able to spend more time learning the new tools in C4D. Burginger says, ?My artistic tool, C4D has allowed me to become like an engineer. I?d also like to explore the Dynamics tool, which allows you to do physical simulations. For me that would really be fascinating to be able to build a computer simulation of my modules and subject them to different types of physical activities and see how they react.?

Why the name Qubits?

Burginger explains, ?I wanted to think about a small name that was catchy. Also I have been very interested in nanotechnology, actually I?m pretty deep with that. In the future Qubits is going to be our new measure of computer data?.

A qubit is a quantum bit that could be a 0, a 1 or somewhere in-between or even a superposition of many different numbers at once. Burginger?s toy Qubits actually demonstrates these various possibilities of position or what?s called *topology*. The purpose of this toy is to help children understand the concept of any 3D image or object.



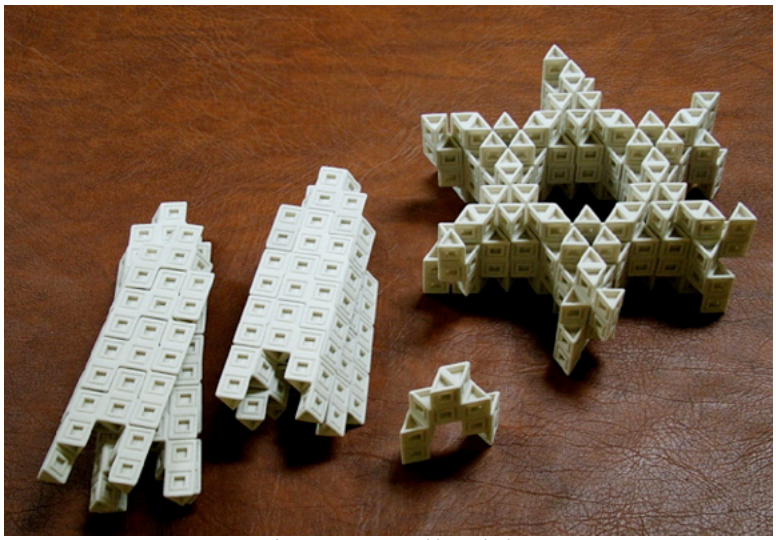
Polyhedral showing first generation topological patterning

Why A Toy Like Qubits Matters

Qubits helps children to understand that the position of an object is important. This is a critical concept in molecular manufacturing. Rearranged coal makes diamonds. Rearranged sand with a few impurities makes computer chips. Playing with the Qubits toy can help children understand the tremendous possibilities in re-arranging the basic building blocks of nature.

When we try to think about this tiny world it is too abstract for most of us (A nanometer is one billionth of a meter). Since we have no experience, it is hard to visualize and understand. But what if we had a physical model of this tiny world and could manipulate it as we would any of our other toys? This is what Qubits accomplishes. It makes something invisible to the eye, visible. That?s exciting!

Buckminster Fuller in particular believed the lack of popularity of mathematics was due to its lack of proof in tangible experience. Manipulating physical models changes that. Playing with this geometry allows for conceptual modeling that is real science. Children don?t need to know abstract formulas to think like a molecular chemist or biologist; they have a toy that allows them to do that. Qubits puts the fundamental building blocks of nature into children?s hands.


Qubits? Nature?s Building Blocks

It is widely acknowledged by the science community that creating a visual expression of the concepts behind nanotechnology is essential to understanding them.

Dr.Gregory Damian Allis shared his thoughts on teaching polyhedral geometry to children at length. Allis is a quantum chemist/molecular nanotechnologist affiliated with Syracuse University, Nanorex, Inc. and the Molecular Engineering Research Institute.

Says Allis: ?There's one side of chemistry that's reactions and mechanisms and all the really complicated stuff that scares organic students in college. Then there's the structure and shape of molecules that results from how atoms connect to one another, which is the side of chemistry that gets less attention, but which is ultimately the most important part.

?Atoms and Legos are conceptually the same thing. They're both building blocks that connect in specific ways to make larger structures, and the shape or strength of those structures depends on what's being connected to one another and how many connections are being made. That's what made playing with Legos so important to what I do today, and that's the really important quality I see in Mark's Qubits. As a chemist, I think that playing with these simple structures would help any person to understand something important about structure in chemistry, even if they didn't want to have anything to do with chemistry!?

What?s Next?

Buckminster Fuller himself often talked about the importance of his kindergarten experience in developing his ideas. He described being so myopic as a child that when his teacher showed the class how to make cubes with peas and toothpicks, he instead had to resort to his imagination. The result was the four-faced triangle or tetrahedron.

Similarly Burginger looks forward to observing his Qubits toy in action. ?Watching children use it will teach me what I really need to know about developing this as a toy. I really need to see what they do with it.?

A child with a simple toy is a powerful thing!

We invite you to visit:
- The Qubits web site
- And links to animated studies of the form:

~Star Configuration
~Polyhedra

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Member Opinions:
By: **psion005** on 2/6/06
Looks like its the "mechano" or "lego" of the future... and loving it!

By: **infinity10** on 2/9/06
Great reading! More articles like this, please, Renderosity.

By: **matrixmode** on 2/9/06
Wish I had this when I was a kid. Legos and erector sets were big fun. This looks like the next step. Very nice!

By: **nickcharles** on 2/12/06
Thanks, Marsha for a fantastic article. What a cool read! I just wish I could have taken my college chemistry tests with Qubits, lol :D

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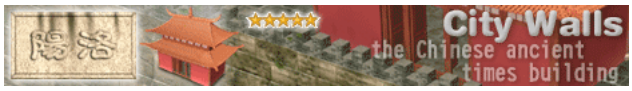

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