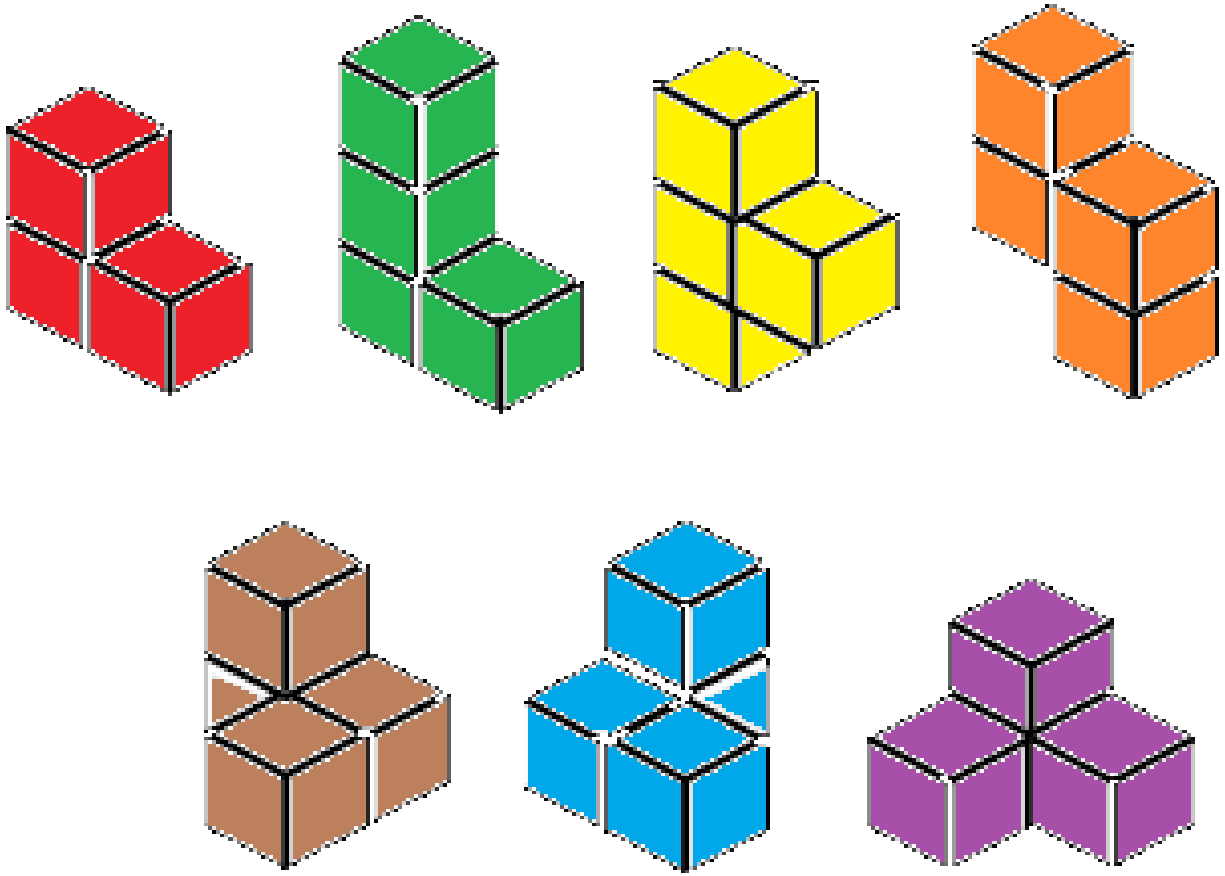
BLOKL

Building Blocks, Puzzles and Games



Ages 3+

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Acknowledgements

First and foremost my parents who encouraged my interest in mathematics and science. The SOMA Cube puzzle for Christmas of course being integral to this work.

Thorleif Bundgaard the web master of “Thorleif's SOMA page” who has been an inspiration to forge ahead since 1999 https://www.fam-bundgaard.dk/SOMA/SOMA.HTM

Merv Eberhardt for his wonderful work on the SOMAP.

https://www.fam-bundgaard.dk/SOMA/NEWS/N030518.HTM
http://artisticapproach2math.blogspot.com/2016/05/somap-tips-tricks-and-other-stuff.html

Elwyn R. Berlekamp, John H. Conway, Richard K. Guy for their seminal work showing the mathematics behind the SOMA Cube puzzle Winning Ways for your mathematical plays. Academic Press. ISBN: 0-12-091102-7 and https://www.fam-bundgaard.dk/SOMA/NEWS/N990201.HTM

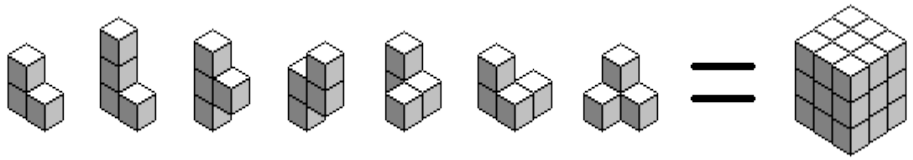
What is BLOKL?

BLOKL is eight SOMA Cube puzzles made with color coded pieces. This makes for a nice set of colorful fifty six building blocks and for more advanced play a way to record and categorize puzzle solutions and larger constructions. That leaves the question of "What is SOMA?"

Piet Hein conceived the idea of the SOMA cube in the 1930s during a Quantum physics lecture by Werner Heisenberg. The lecture included dividing a room into cubes as part of a larger idea about how to apportion space time as a lattice. Piet imagined this geometric theory.

> •*If you take all irregular shapes that can be formed by combining no more than four cubes, all the same size and joined at their faces. - These shapes can be combined to form a larger cube*.

Piet Hein convinced himself that seven shapes of 27 cubes, could be combined into a larger cube of 3 x 3 x 3. When the lecture was over, he glued 27 dice together to form the 7 shapes, and discovered this indeed was the case.



It is important to note that Mr. Hein did not begin with a cube and cut it up to form the puzzle. He visualized the pieces first, then considered whether they would form a cube. Piet Hein called his set of figures SOMA.

I received a SOMA Puzzle for Christmas in 1968 and soon discovered that there is more than one way to make the cube. This being before the time of computer spreadsheets I was at a loss to come up with a way to record, sort and categorize solutions. Many years later while volunteering with Leonardo's Basement in Minneapolis we started using SOMA cubes as part of hands on math activities and discussion began about how to find the solutions as both a pure mathematics exploration and an entry point into computer applications and computer science. Importantly it needed to be fun as well.

Color Scheme

Red, Orange, Yellow, Green, Blue, Violet and Auburn (Brown). These colors can be represented by a single first intial which is handy for recording solutions and structures into spreadsheets. Also easy to get matching colored pencils such as Crayola Erasables.

Color	**Shape**
Red	little Vee
Orange	Zee
Yellow	Tee
Green	big L
Blue	Helix1
Auburn	Helix2
Violet	Crystal

Building Blocks

BLOKL has seven basic shapes that are color coded and there are enough of them to build eight SOMA cubes. There is of course so much more you can do. Some of the pieces of the same color combine to make a 2x2x2 cube. Some will take four of the same color to build a rectangular prism. Another will take five. . .it is kind of like the pieces are “atomic” and you can build molecules with them.

There is of course just building things in general, buildings of course but the green “L” piece makes great legs for animals.

There are also a myriad of figures you can build with single SOMA cube you can find here: https://www.fam-bundgaard.dk/SOMA/FIGURES/ALLFIGS.HTM

Puzzles

a. Cube – there are 240 unique cube solutions as determined by Guy and Conway in the ealry 1960s and later by others using computers. How to find, record and categorize the solutions has been of interest to me for sometime. You can read more about that here:
http://artisticapproach2math.blogspot.com/2016_09_01_archive.html
There are also solution cards to record your solutions on.

b. Giant Cube – You have eight cubes so you can build a big cube out of solved SOMA cubes. That being said you can also build several of the SOMA cube pieces as larger pieces from pieces of the same color. . .not all of them though. It makes for some thoughtful play

Games

BLOK-TOK – 2 to 4 players build objects with BLOKL pieces until someone decides they have built something that the others can guess what it is when provided hints. For some formal rules you can consider the object the first clue in a game of “20 Questions”:

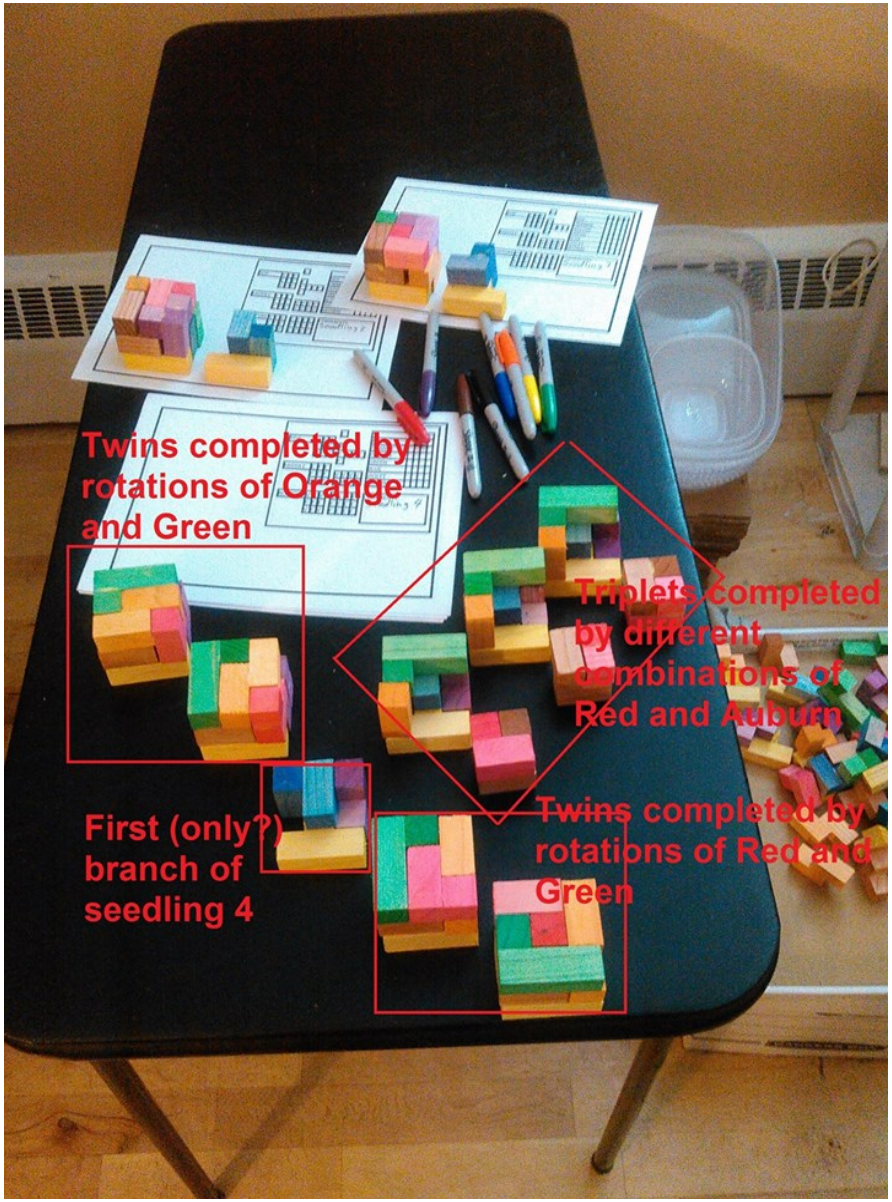
https://en.wikipedia.org/wiki/Twenty_Questions

Or it can be simple conversation with no rules on hints or score keeping.

How Tall – 2 to 4 players build an object of increasing height with BLOKL pieces until it collapses.

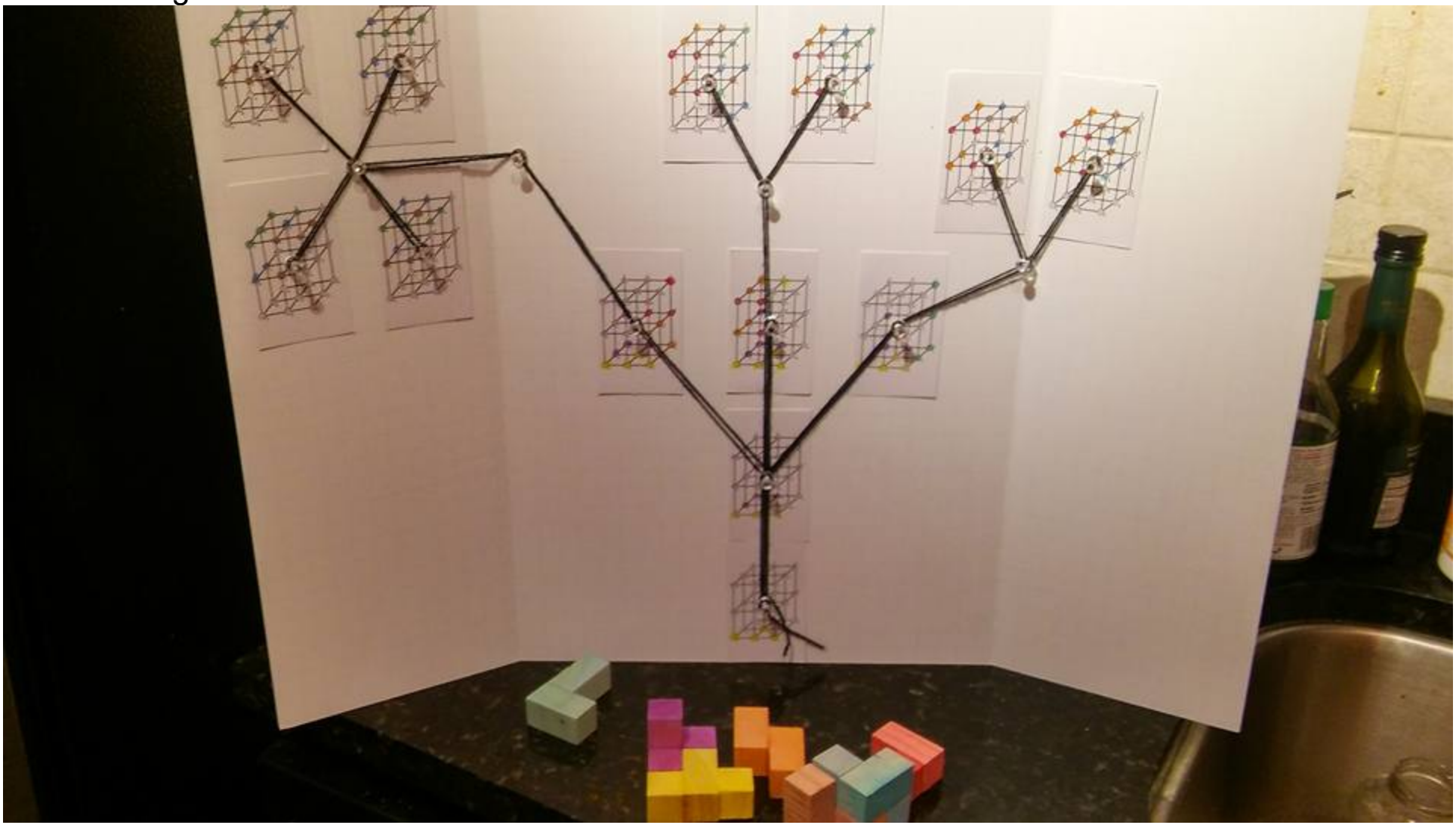
Hands on Mathematics

Discovering sets is certainly doable(see more in “Further Reading”) the “Triplets” show up in several unique cube puzzle solutions:



a. Solution Cards – BLOKL sets contain cards for recording solutions on a numbered cube grid using colored pencils or crayons

b. Graphs – The solution cards can be sorted and arranged into Tree Graphs:
https://en.wikipedia.org/wiki/Tree_(graph_theory)
Foam board, pushpins and yarn make building graphs with the solution cards quick and easily reconfigurable.



c. Groups – some of the cube solutions demonstrate symetrical features that provide insights into Group Theory:
https://en.wikipedia.org/wiki/Group_theory
The tree graph above contains four leaves that have properties that might be said to be described

by the Klein 4 Group:
https://en.wikipedia.org/wiki/Klein_four-group

d. Computer Science – the solution of the the cube puzzle is an example of exact cover which is at the root of many computer algorithms for solving complex problems:
https://en.wikipedia.org/wiki/Exact_cover
http://www.cs.mcgill.ca/~aassaf9/python/algorithm_x.html
I am working on a version of this that will be compatible with the online computing environment CodeSkulptor:
http://www.codeskulptor.org/

Further Reading

Visual Group Theory by Nathan Carter - Group theory is the branch of mathematics that studies symmetry, found in crystals, art, architecture, music, and many other contexts. Its beauty is often lost on students because it is typically taught in a technical style that is difficult to understand.

http://www.maa.org/press/ebooks/visual-group-theory

The Fascinating World of Graph Theory by Arthur Benjamin, Gary Chartrand & Ping Zhang - Graph theory goes back several centuries and revolves around the study of graphs—mathematical structures showing relations between objects. With applications in biology, computer science, transportation science, and other areas, graph theory encompasses some of the most beautiful formulas in mathematics—and some of its most famous problems.

http://press.princeton.edu/titles/10314.html

Exploring Attributes by Maria Marolda - “describe and classify shapes, determine differences and patterns, and engage in loop activities.” This book is for “Attribute Blocks” but many of the activitiescan be adopted for the BLOKL pieces. Loops of strings to capture similar objects to make sets, intersecting loops make Venn Diagrams. Also “Follow the Arrows” which is a hands on primer for graphs and groups. https://g.co/kgs/pfOAZc

This is a very early rough draft for BLOKL. Questions and commments are most welcome please send me an email ed_vogel@yahoo.com