Pentominoes

The 12 distinct shapes formed from 5 connected squares are the *pentominoes* (called *polyominoes* by Solomon W. Golomb, Charles Scribner's Sons, NY, 1965):

Total area is 60, and sizes 6 x 10, 5 x 12, 4 x 15, and 3 x 20 can be formed. There are known to be 2,339 distinct ways to form a 6 x 10 rectangle, excluding rotations and reflections. In contrast, there are 1,010 solutions for 5x12, 368 solutions for 4x15, and 3 x 20 has a unique solution except for rotating a central portion by 180 degrees.

A piece is *landlocked* if it does not touch one of the borders of the rectangle. Eric Harshbarger has determined that there are no 6x10 rectangle solutions with 5 or more landlocked pieces, but there can be solutions with 0, 1, 2, 3, or 4 landlocked pieces (e.g., there are 207 solutions of the 6x10 rectangle with four landlocked pieces, 1,111 with three, 864 with 2, 155 with one, and only a couple with zero).

R. M. Robinson of the University of California at Berkeley proposed the "triplication problem": Given a pentomino, use 9 of the other pentominoes to construct a scale model, 3 times as wide and 3 times as high as the given piece (all 12 are possible).

Pentominoes are traditionally flat pieces that can be arranged to form 2-dimensional patterns. However, if the pieces are made to be 1-unit thick, then fun 3-dimensional patterns can also be made, including a 3 x 4 x 5 solid, and stairs that are 6 wide by 4 deep by 4 high.

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Some Other Pentominoes 6x10 Solutions

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Example Pentomino Solutions That Are Not 6x10
(The shaded area of the 3x20 solution may be rotated by 180 degrees.)
Some Pentomino 3x4x5 Solutions

From the directions sold with the *Yasumi* version:

From the directions sold with the *Interlocking Puzzles* version:

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Pentomino Checkerbox:

Made By B. Cutler, 1989.
(3.25" x 4" x 2.375" clear plastic box and 12 two-color wood pieces with 3/4" cubes)

Can be used like any other pentominoes set. In addition, it is made from light and dark woods so that it can be solved in a 3x4x5 box where colors have a checkerboard pattern on all sides. Here is the pattern of light and dark used for the pieces:

```
ABB5C  A666C  A636C
BB555  A7778  3333C
B9958  A9778  9944C
11111  22228  44428
```

Sold with this puzzle was printout of a number of solutions. Here is the one suggested; the pieces have the names 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, and this figure shows the three planes of the checkerbox:

```
ABB5C A666C A636C
BB555 A7778 3333C
B9958 A9778 9944C
11111 22228 44428
```

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Pentomino Rectangular Shapes With Holes

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Other Fun Pentominoes Shapes

From the directions sold with the *Yasumi* version:

Shown on *Nivasch's Page*:

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Further reading:
Harshbarger's page, from: http://www.ericharshbarger.org/pentominoes
Mathworld page, from: http://mathworld.wolfram.com/Pentomino.html
CIMT page, from: http://www.cimt.plymouth.ac.uk/resources/puzzles/pentoes/pentoint.htm
Gerard's page, from: http://www.xs4all.nl/~gp/pentomino.html
Huttlin's page, from: http://members.aol.com/huttlin/pentominoes.html
Nivasch's page, from: http://yucs.org/~gnivasch/pentomino
Mark's page, from: http://mathsevangelist.wordpress.com/2012/08/24/packing-pentominoes
Jankok's page, from: http://homepages.cwi.nl/~jankok/etc/Polyomino.html
Pentominos Infor. page, from: http://www.theory.csc.uvic.ca/~cos/inf/misc/PentInfo.html
Gottfriedville page, from: http://www.gottfriedville.net/puzzles/colorgame/solutions.htm
Belgium Pentominoe page, from: http://home.scarlet.be/~demeod/indexe.html
Puzzle Will Be Played page, from: http://www.asahi-net.or.jp/~rh5k-isn/Puzzle
Bhat & Fletcher article, from: http://www.andrews.edu/~calkins/math/pentos.htm
Negahban design patent, from: www.uspto.gov - patent no. 385,311

Further reading about some related puzzles:
Lester patent, from: www.uspto.gov - patent no. 1,290,761
Wadsworth patent, from: www.uspto.gov - patent no. 3,964,749
Sakar patent, from: www.uspto.gov - patent no. 5,544,882

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