## Piecepack Matchsticks

A Public Domain piecepack expansion designed by Dan Burkey. Version 2.0.
The piecepack matchsticks are designed to open up new spatial and geometric possibilities for the piecepack. Uses range from creating connections and barriers on a piecepack board, to forming pathways that go "outside the box" of the square grids that define many piecepack games. Initially inspired by connection and pathway games like Settlers of Catan, Ticket to Ride, and Labyrinth, the piecepack matchsticks provide a wide variety of options beyond (but including) the little colored sticks that form roads, rails, and walls in many published games.

Special thanks to Mary Burkey, Hunter Burkey, Trevor L Davis, and Ron Hale-Evans for their feedback on the design.

## Definition:

Piecepack matchsticks are a set of short sticks with square cross-sections in piecepack-suited colors. The sticks come in 5 different lengths (plus a null cube), which correspond to 5 relationships between points on the grid side of a piecepack tile. A complete set of piecepack matchsticks has 6 pieces in each size and color. There are a total of 144 pieces in a set, 36 pieces of each color, and 24 pieces of each size, which is enough to match one piece of each size to every tile (or coin) in a piecepack set, if desired. The lengths are defined as follows:

Null: Cube representing one point in space
1: One space length orthogonally
2: One space length diagonally
3: Two space lengths orthogonally
4: The diagonal length of a "Knight's move"two spaces up, and one space over
5: Two space lengths diagonally


Figure 1: Tiles with matchsticks illustrating relative matchstick lengths
Note: In reality, each stick is one stick width shorter than the distance it represents, which allows space for pathways to intersect.

Each stick has its rank number printed in the middle of one or two faces to quickly differentiate lengths. Ace may be represented by a spiral or suit symbol. The top end of every stick has a suit
symbol, which gives the stick a binary directionality (Ace end/null end, Positive/negative, North/South, 0/1, forward/backward).

The null of the set is not actually a stick but a small colored cube (or square, if using a printed 2D version), twice as wide as one matchstick. Each cube has its suit symbol printed on one face. Spatially, nulls generally represent a single point in space.

Figure 2a: Piecepack matchstick markings
(Example shows matchsticks cut from 3/16" wooden square dowel)


Figure 2b: A full set of piecepack matchsticks, with 2" piecepack tiles for scale


## Uses of the set and possible mechanics

(note: some images depict an earlier prototype of the matchsticks that used pips instead of numeral and suit markings)

- Making connections and pathways (Figure 3a and 3b)

- Creating barriers between spaces or tiles
- For an asymmetrical strategy game, players could split diagonal and orthogonal connections
- A matchstick's value could be "deactivated" by rolling the matchstick so an unmarked face is visible.
- Partially hidden matchsticks can be used to draw straws
- Stick lengths could represent ranged actions for miniatures style games
- Games with surrounding and enclosure mechanics
- Connections to other systems, such as the HexPack
- Counters for any number of games that involve money, points, or other changing values that need to be represented visually.
- 3-dimensional version can be used as targets or obstacles for dexterity games.
- New geometric possibilities that take the piecepack beyond a rectangular mindset.
(Figure 4a and 4b)

- Three separate axes for connections: orthogonal (1's and 3's), 45 degree diagonal (2's and 5's), and knight's move diagonal (4's) - Figure 5

- Making connections between separated tiles, coins, dice, or pawns in a board-less game
- A diverse set of objects to collect, (i.e. one 3 stick of each color, one stick of each length, one stick of each length in different colors, etc.)
- Null cubes could be a "wild" connection on a pathway, standing in for any direction that may pass through it.
- Each stick has a binary directionality: One end has a number and the other is blank. These could represent Positive/negative, North/South, 0/1, on/off, forward/backward, or other opposing states.
- A face-up tile could be paired with a stick of another color to create a 2-suited tile.
- To adapt games that make connections around hexagons, use 1's horizontally and 3's vertically to represent one side of a hexagon. Horizontal 3's can be used to make change for two 1 's as needed. (Figure 6)

- Place 3D sticks between stacked tiles with just the number exposed and remove one by one for a Jenga-like game
- 3D boards of various kinds become possible, if sometimes precarious...(Figure 7)

- Null cubes with a suit symbol on one face could be rolled en masse to determine a variety of low-probability outcomes

Examples of classic game boards with a piecepack matchstick twist:
Figure 8: 9 men's Morris (pieces are placed at the center of each tile)


Flgure 9: Snakes and ladders (snakes bend, ladders are straight)


Figure 10: An adaptation of Labyrinth (Ravensburger's sliding tile maze game)- matchsticks could become pathways or walls in a shifting maze.


## Making a set of piecepack matchsticks

For a "standard" 2-inch-tile piecepack, a good width for matchsticks is between $1 / 8$ and $3 / 16$ inch, with null cubes being $1 / 4$ to $3 / 8$ inch to a side. These are recommended lengths for each piece, but may certainly be altered for personal preference or use in different games

| Numb <br> er | Length calculation algorithm <br> S= side of one grid square <br> W= width of one matchstick | Length in inches <br> (rounded down to <br> nearest 1/16), where <br> S=1 inch and W=3/16 <br> inch | Length in <br> inches <br> (Decimal) | Metric <br> conversion <br> $(\mathrm{mm})$ |
| :--- | :--- | :--- | :--- | :--- |
| 1 | S - W | $13 / 16$ inch | 0.81 inch | 21 mm |
| 2 | $S^{*} \sqrt{2}-\mathrm{W}$ | $1-3 / 16$ inches | 1.19 inches | 30 mm |
| 3 | $2^{*}$ S - W | $1-13 / 16$ inches | 1.81 inches | 46 mm |
| 4 | $\sqrt{5 * S^{2}-W}$ | $2-1 / 16$ Inches | 2.06 | 52 mm |
| 5 | $2^{*} S^{*} \sqrt{2}-\mathrm{W}$ | $2-5 / 8$ Inches | 2.63 | 67 mm |
| Null | $2^{*} \mathrm{~W}$ | $3 / 8$ inch (cube) | .38 | 10 mm <br> $(c u b e)$ |

Note: For a unified set of lengths, decimal and metric conversions listed above are based on the rounded fractional lengths, not calculated directly from the algorithm. This allows a little more wiggle room. For exact lengths, enter "1" in the black box in the linked spreadsheet below.

## Paper/Cardstock

Materials:

- Image or template: This Google Sheet for example
- Color Printer
- 1-2 sheets cardstock
- Metal straight edge
- Razor blade or Xacto knife

The easiest way to make your first set of piecepack matchsticks is to print one out on cardstock from a PDF template and cut out the pieces. This set is extremely portable (cut from one sheet of letter paper) and great for prototyping, as you can customize your own template using the rectangular spaces in a spreadsheet program like Microsoft Excel or Google Sheets. Microsoft Excel has the advantage of adjusting column width based on inches, rather than pixels. To beef them up and make them a little easier to pick up, you can print two sets and cut the sticks out in pairs, folding them "hot dog" style to make a long narrow tent shape.
If using a cardstock set, use caution on windy days or with players who are prone to sneezing.

## 3D Printing

Materials:

- CAD program such as the free Autodesk TinkerCad,
- 3D printer
- Filament in desired colors for your suits

For a more robust yet easy-to-make set, try 3D printing. Since the set is based on rectangular prisms, it is a quick design job in a 3D CAD program such as the free TinkerCad program. You can customize the length and width of your set instantly with fine-tuned precision.

A full single-color prototype set in $1 / s^{\prime \prime}$ and $3 / 16$ " sizes can be found in the TinkerCad gallery at https://www.tinkercad.com/things/g9S9igHWF6g Feel free to copy and edit to suit your needs.

## Wood

Materials:

- 6 square dowels, $3 / 16$ " $\times 3 / 16$ " x 36 " (or 18 feet total)
- Razor saw and miter box (such as the X-acto razor saw and miter box or Micro-Mark Easy Miter Box Deluxe): see image at right
- Ruler
- Pencil
- Paints in the colors of desired suits
- White paint pen for number and suit markings (and a black
 one if you have yellow or other very light colors in your set)
- Paintbrush (or use spray paint for quicker work)

Wood is the optimal low-tech choice for a classic, sturdy feel. Cut the pieces from square wooden dowels. For a "standard" 2-inch tile set, $3 / 16$ inch sticks are sturdy enough to hold up to many uses and thin enough to keep the sightlines elegant. For precision, use a fine-toothed razor saw and miter box. Line up six square dowels flush against each other in the miter box with the ends aligned. Measure and cut them into $81 / 2$ inch lengths. Each length is long enough to make one run of sticks in one color, Ace-5. Place as many as you can across the base of your miter box. Measure according to the table above, then cut them all at once.
Paint in desired colors (note: in the image above, the sticks were painted before cutting, for efficiency). For efficient number markings, line up the sticks of each size in parallel rows. Use
the paint pen to write number ranks in the center of each stick and a suit symbol at the top end. Spray with acrylic, polyurethane or other sealant.

