

# Compass Cube Design

## Introduction

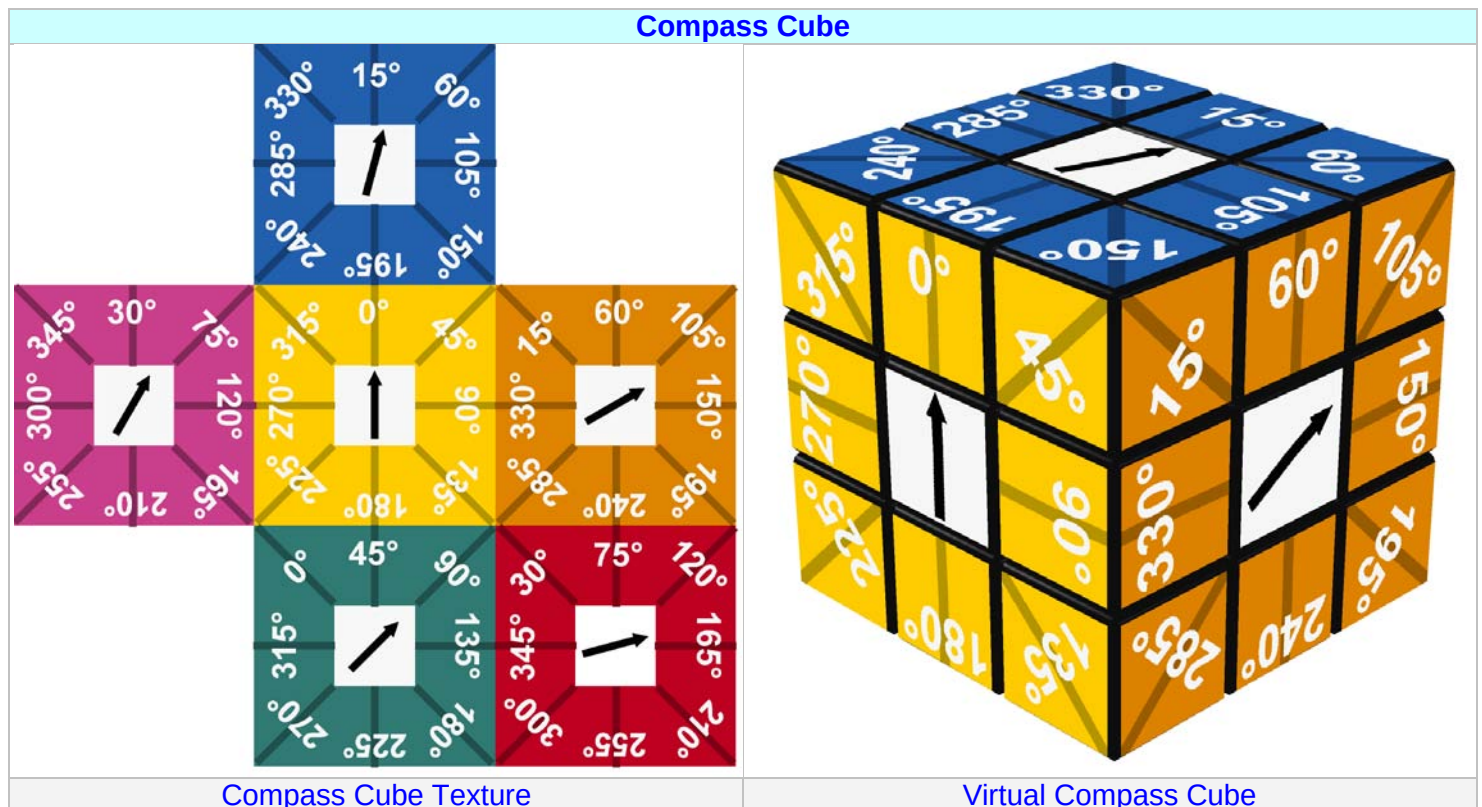
A **Compass Cube** is a 3x3x3 **Rubik's Cube** used for determining direction relative to the Earth's magnetic North. The cube has a circular scale of 360° and a single pointer, which can mark either North or direction every 15°.

### Compass – Useful Links

<http://en.wikipedia.org/wiki/Compass>

[http://en.wikipedia.org/wiki/Cardinal\\_direction](http://en.wikipedia.org/wiki/Cardinal_direction)

There are **Virtual Cubes** that can be *virtually* rotated and twisted on a computer screen and **Real Cubes** that can only be *physically* rotated and twisted by hand. A **Texture** is laid down on a Virtual Cube whereas real **Stickers** are stuck down on a Real Cube (see <http://www.randelshofer.ch/> for more details). A Compass Cube is designed by placing numerals and pointers on a texture which is then laid down on a Virtual Cube. The following example shows the *initial* state of the Cube where the pointer on the front face is lined up with the magnetic North (0°). On each face, the *initial* pointer direction is indicated on the **Top Center** facelet.

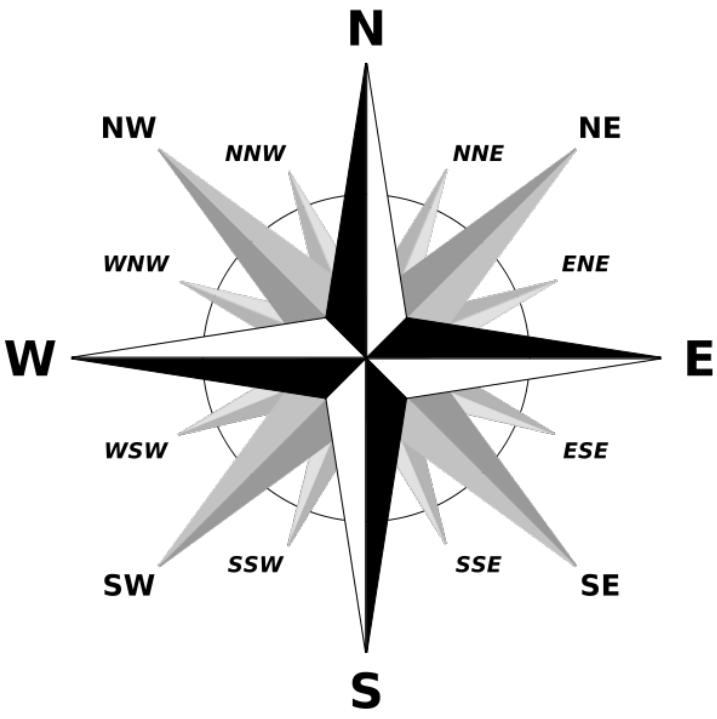
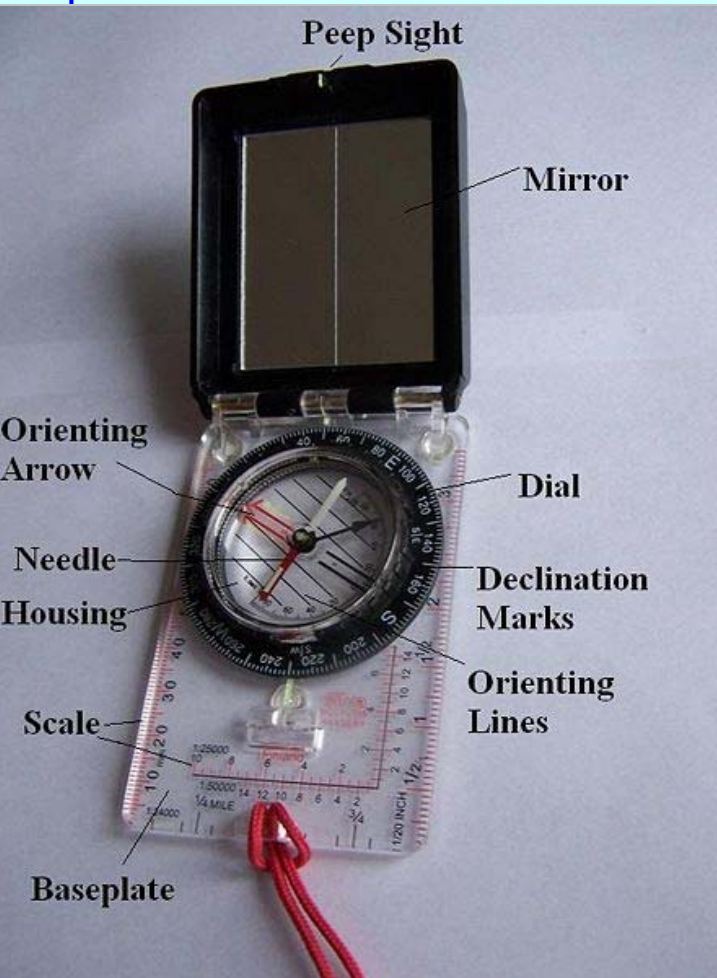


## Compass Cube Features

As there are 6 center cubes, 6 different pointers can be displayed on the cube. This interesting feature is used to mark direction in 15° intervals from 0° to 360°. All pointer orientations can be obtained from 6 basic orientations [0°, 15°, 30°, 45°, 60°, 75°] by adding multiples of 90°, i.e. by rotating center cubes. By using [center swap](#) algorithms, numerals stay in place on each face, because centers are the only cubes that seem to move. The combination of pointer + orientation can be used to display one of the following directions:

- 1- The direction of the magnetic North (0°)
- 2- The heading (direction of a vessel, plane, vehicle or pedestrian)
- 3- A change of direction

# Examples of Compasses

| Examples of Compasses                                                            |                                                                                     |
|----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|  |  |
| A compass rose showing the cardinal directions                                   | Hand compass                                                                        |

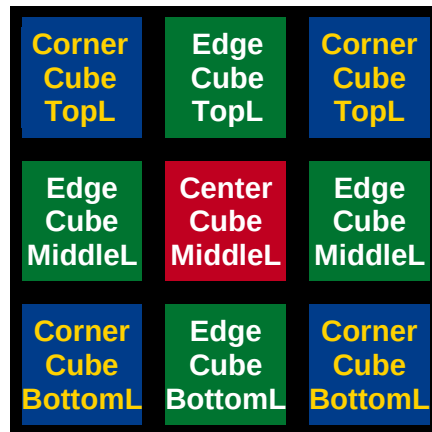


Examples of Compass Cube Center Swap Algorithms

| Compass Cube Center Swap Algorithms                                                |                                                                                      |
|------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| Heading 45° (North-East)                                                           | Heading 15°                                                                          |
|    |    |
| Center Swap Algorithm<br>ML MF ML' MF' CR                                          | Center Swap Algorithm<br>ML' MF' ML MF CR'                                           |
| Changing Direction from 120° to 165°                                               | Heading 15° – Pointing 0° (magnetic North)                                           |
|  |  |
| Center Swap Algorithm<br>MF MU MF' MU' CU' CF'                                     | Center Swap Algorithm<br>MF MU MF' MU' CR'                                           |

## Terminology

In a 3x3x3 **Rubik's Cube**, there are 8 *Corner Cubes*, 12 *Edge Cubes*, 6 *Center Cubes* and 6 *Cube Faces*. There are also 4 Corner Cube faces, 4 Edge Cube faces and 1 Center Cube face *per Cube Face*, as shown below.



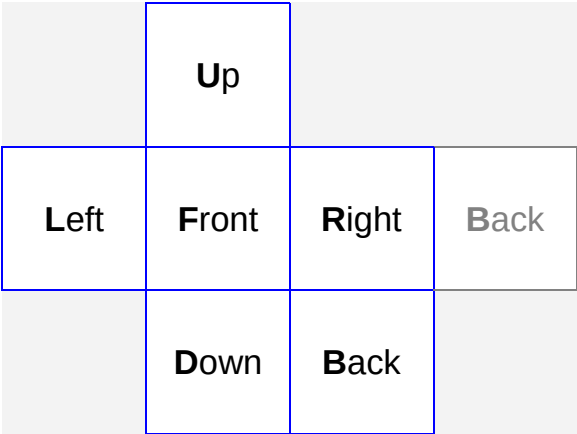
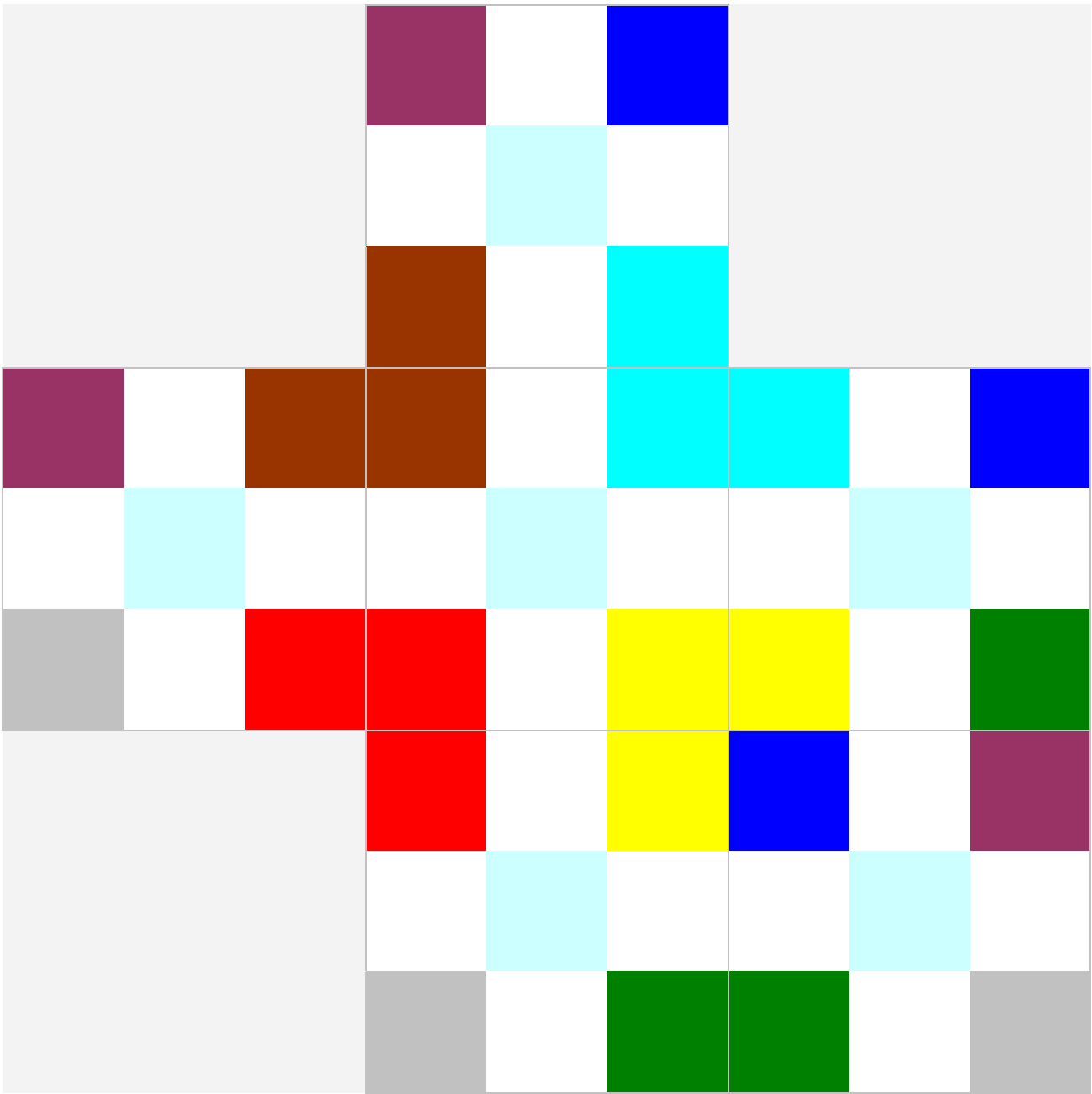
There are 1 face per Center Cube, 2 faces per Edge Cube and 3 faces per Corner Cube.

There are also 3 horizontal *Layers* called *Top*, *Middle* and *Bottom* Layers.

| Cube Lexicon                     |                                     |                                                                  |
|----------------------------------|-------------------------------------|------------------------------------------------------------------|
| English                          | Français                            | Deutsch                                                          |
| Cube                             | Cube                                | Würfel                                                           |
| cube, cube                       | cube, petit cube                    | Würfelteil, Teil des Würfels                                     |
| face                             | face                                | Seite, Seitenfläche                                              |
| front face                       | face avant                          | vordere Seite, vorne                                             |
| back face                        | face arrière                        | hintere Seite, hinten                                            |
| left face                        | face gauche                         | linke Seite, links                                               |
| right face                       | face droite                         | rechte Seite, rechts                                             |
| top face                         | face supérieure                     | obere Seite, oben                                                |
| bottom face                      | face inférieure                     | untere Seite, unten                                              |
| sticker                          | étiquette (autocollante), plaquette | Kleber, Farbkleber                                               |
| tile                             | tuile, plaquette                    | Plättchen, Farbplättchen                                         |
| center cube, center              | cube central, centre                | Mittelwürfel, Mittelstein, Mitte                                 |
| edge cube, edge                  | cube-arête, arête                   | Kantenwürfel, Kantenstein, Kante                                 |
| corner cube, corner              | cube de coin, coin                  | Eckwürfel, Eckstein, Ecke                                        |
| layer                            | couronne                            | Schicht, Scheibe                                                 |
| top layer                        | couronne supérieure                 | obere Schicht, obere Scheibe                                     |
| middle layer                     | couronne intermédiaire              | mittlere Schicht, mittlere Scheibe, Mittelschicht, Mittelscheibe |
| bottom layer                     | couronne inférieure                 | untere Schicht, untere Scheibe                                   |
| orientation, direction           | orientation                         | Orientierung                                                     |
| to solve                         | résoudre                            | lösen, zusammen drehen                                           |
| to twist                         | pivoter                             | drehen                                                           |
| to rotate                        | tourner, effectuer une rotation     | drehen                                                           |
| clockwise                        | dans le sens horaire                | im Uhrzeigersinn                                                 |
| anticlockwise, counter-clockwise | dans le sens anti-horaire           | im Gegenuhrzeigersinn                                            |

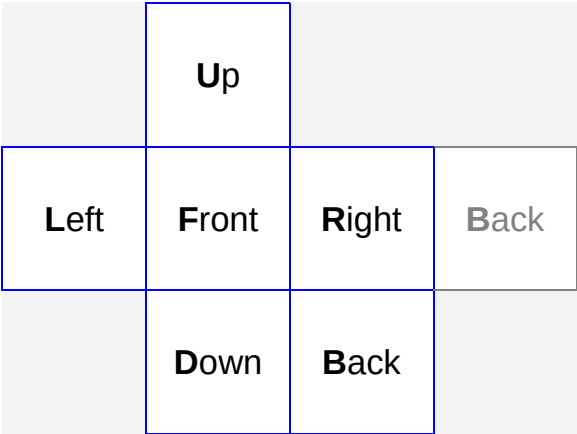
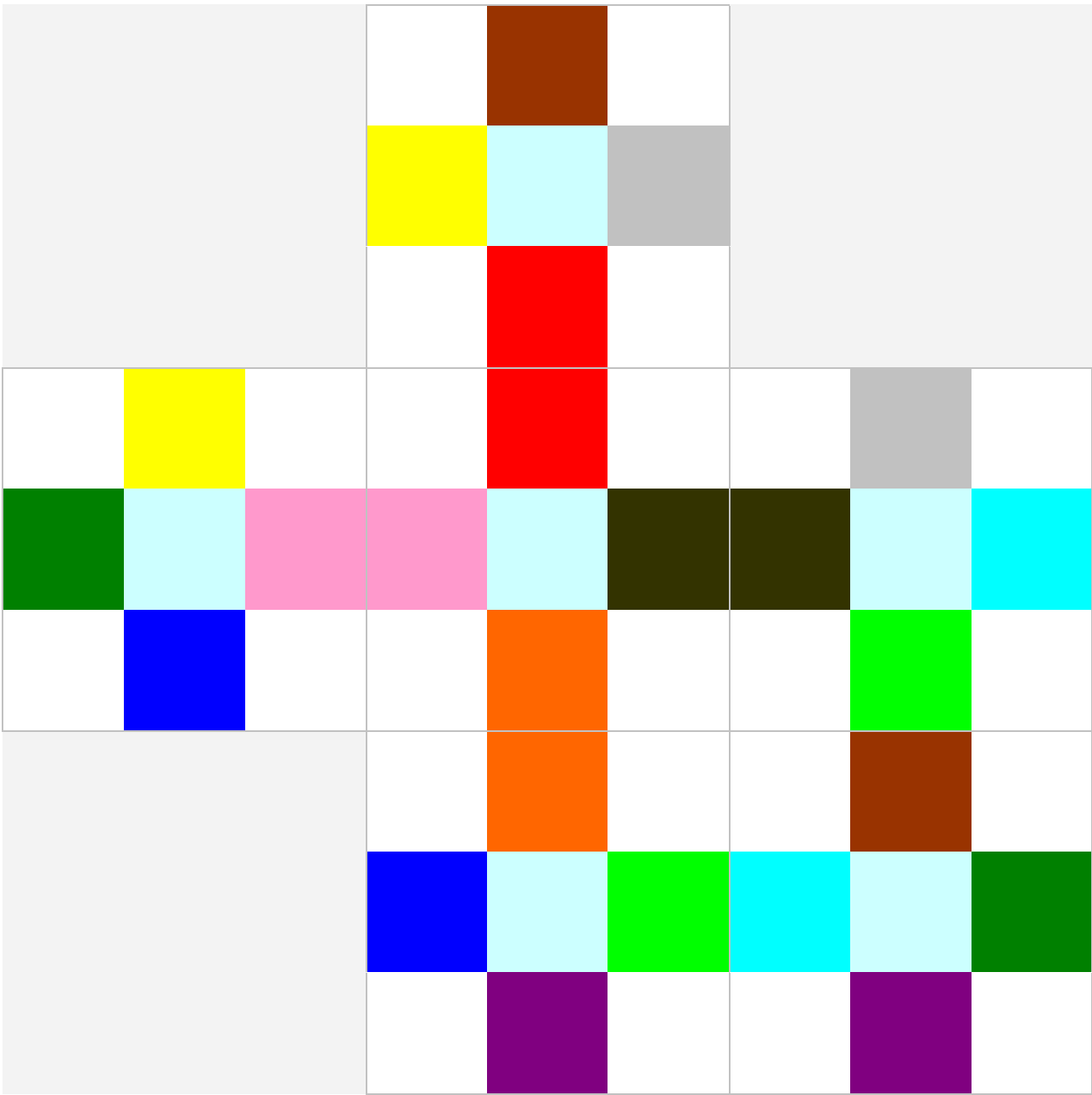
# Corner Cubes Final Check

There are 8 Corner Cubes and 3 faces per Corner Cube. In the diagram below, each Corner Cube is displayed in 8 different colors and with the same color applied to each of its 3 faces. This diagram can be used as a convenient *visual aid* to check Design Rules (DRC).



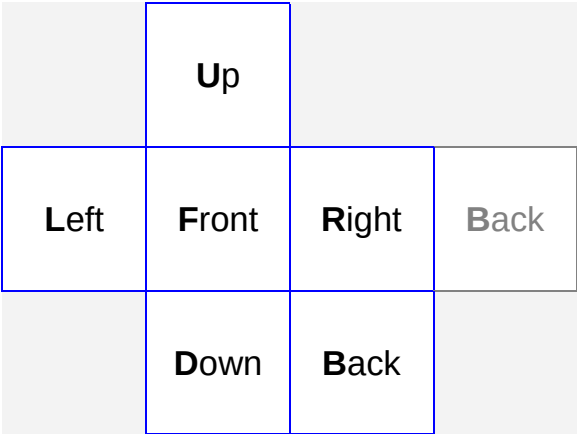
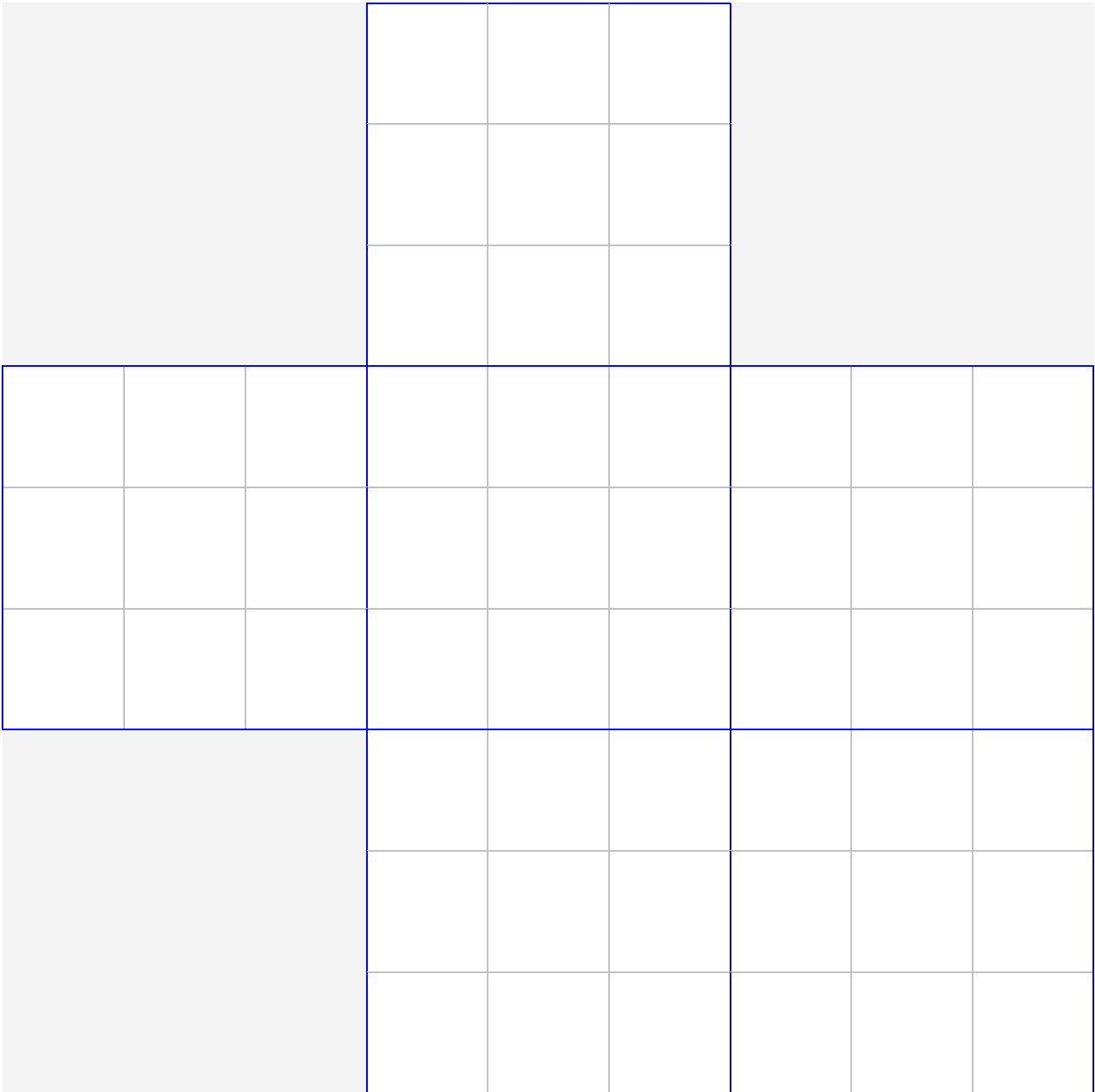
# Edge Cubes Final Check

There are 12 Edge Cubes and 2 faces per Edge Cube. In the diagram below, each Edge Cube is displayed in 12 different colors and with the same color applied to each of its 2 faces. This diagram can be used as a convenient *visual aid* to check Design Rules (DRC).



# Texture Template

This is a texture template that can be printed out and used for writing down numbers and letters by hand *prior to* texture design. All is needed are pencil, rubber...and time.



|      |       |       |      |
|------|-------|-------|------|
|      | Up    |       |      |
| Left | Front | Right | Back |
|      | Down  | Back  |      |