Weather Station Cube Design

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Introduction

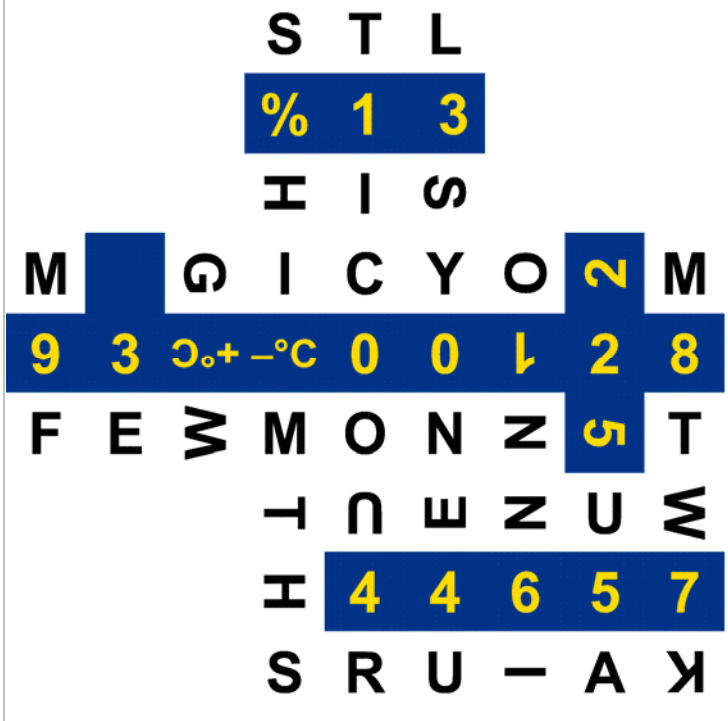
A **Weather Station Cube** is a 3x3x3 **Rubik's Cube** used to display *selected* atmospheric conditions. Air Temperature (°C), Air Moisture (%) and Wind Speed (knots) can be displayed on the Cube. Moreover, some *selected* atmospheric conditions, weekdays and days of the month can also be displayed. This is a *Combo* Cube combining *both* a Weather Station *and* a Perpetual *Monthly* Calendar.

Weather Station – Useful Links	
http://en.wikipedia.org/wiki/Weather_station	http://en.wikipedia.org/wiki/Thermometer
http://en.wikipedia.org/wiki/Hygrometer	http://en.wikipedia.org/wiki/Anemometer

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. A Weather Station Cube is designed by placing letters, symbols and numbers on a texture which is then laid down on a Virtual Cube (see http://www.randelshofer.ch/ for more details).

Many Weather Conditions can be displayed on a *selected* Cube face by rotating and twisting some parts of the Cube. When this has been achieved, we say that the Cube has been *solved*.

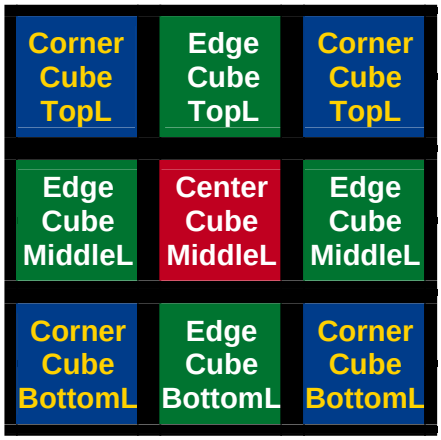
The following example shows the initial state of the cube, where 'ICY' conditions, 0°C temperature and 'MON' (for MONday) are displayed on the front face.

Weather Station Cube	
	
Weather Station Cube Texture	Weather Station Cube
Download **CubeTwister** from: http://www.randelshofer.ch/	

Designing a Weather Station Cube that *works* is definitely not a trivial task but **Design Rules** exist that should be applied. Because it is nearly impossible to test all configurations, the placement of letters, symbols and numbers on a texture should be carefully checked at *the end* of the design process. This is carried out by applying a **Design Rules Check** (**DRC**) in the final design stage.

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
cubie, 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

Weather Station Cube Design

Units

Units for Air Temperature, Air Moisture and Wind Speed are as follows:

1- Air Temperature in Degrees Celsius (°C)
2- Air Moisture in percent (%)
3- Wind Speed in knots (kts): 1 knot = 1 Nautical Mile (NM) per hour = 1.852 km/hour

Range of Values

The Range of Values for Air Temperature, Air Moisture, Wind Speed and Days of the Months are as follows:

1- Air Temperature (°C): –59 to +59
2- Air Moisture in percent (*%): 0 to 59, 60 to 65, **80 to 85, 90 to 95
3- Wind Speed in knots (kts): 0 to 59, 60 to 65, **80 to 85, 90 to 95
4- Days of the Month: 01 to 31

* Symbol '**%**' remains the *same* when 180° rotated
** Number '**8**' should be *redrawn* if used 180° rotated

Cube Layout

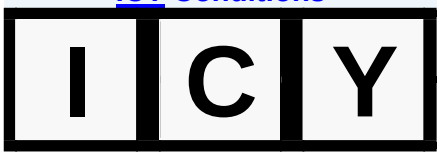
After many attempts, the best layout that I have designed is as follows:

1- Weather Conditions on Top Layer
2- Air Temperature, Air Moisture, Wind Speed and Days of the Month on Middle Layer
3- Weekdays on Bottom Layer

Top Layer Layout

Top Layer Layout Examples

ICY Conditions



SUNny Day

GUSty Wind

The *abbreviated* Weather Conditions that can de displayed on the Top Layer are as follows;

Abbreviated Weather Conditions				
GUSty	MINimum	SCOrching heat	STY (STationarY)	WILd
HUMid	MISty	SIMoon	SUStained	WINdy
ICY	MULtiple	SINking	SUMmer	WINter
MILd	NIL	STOrmy	SUNny	
Additional Letters available when 'WIN' is displayed on Bottom Layer				
KTS (KnoTS)	MONsoon	MOSt of the time	SHOwer	

Letters on the Top Layer are sorted out as follows:

1- 7 **T**op **L**eft letters on corner cubes: G, H, I, M, S, W, **K**
2- 6 **T**op **R**ight letters on corner cubes: L, M, N, O, S, Y
3- 4 **T**op **C**enter letters on edge cubes: C, I, T, U

Letters are now *logically* combined on corner and edge cubes:

1- 2 **T**op **L**eft corner cubes: (G,H,I), (M,S,W)
2- 2 **T**op **R**ight corner cubes: (L,M,N), (O,S,Y)
3- 2 **T**op **C**enter edge cubes: (C,I), (T,U)
4- 1 **L**eft corner cube with *mixed* letters: (**F** **B**ottom **L**eft, **S** **B**ottom **L**eft, **K** **T**op **L**eft)

So, now there are 3 corner and 10 edge cubes left that can be used for the 2 remaining layers.

Middle Layer Layout

Middle Layer Layout Examples

Temperature: – 10 °C	Air Moisture: 59 %	Day of the Month: 01
–°C 1 0	% 5 9	0 1
Temperature: + 20 °C	**Air Moisture: 90 %**	**Day of the Month: 31**
+°C 2 0	9 0 %	3 1
Wind Speed: 10 kts	**Wind Speed: 50 kts**	**Wind Speed: 90 kts**
3 0	5 0	9 0

Symbols and numbers on the Middle Layer are sorted out as follows:

1- 3 **M**iddle **L**eft symbols on edge cubes: %, –°C, +°C, blank
2- 6 **M**iddle **C**enter numbers on center cubes: 0, 1, 2, 3, 4, 5
3- 10 **M**iddle **R**ight numbers on edge cubes: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9

Symbols and numbers are now *logically* combined on edge cubes:

1- 2 **M**iddle **L**eft edge cubes: (%,blank), (–°C,+°C)
2- 5 **M**iddle **R**ight edge cubes: (0,1), (2,3), (4,5), (6,7), (8,9)

So, now there are 3 corner and 3 edge cubes left that can be used for the Bottom Layer.

Bottom Layer Layout

The *abbreviated* Weekdays that can de displayed on the Bottom Layer are as follows;

Abbreviated Weekdays			
MONday	TUEsday	WEDnesday	THUrsday
FRIday	SATurday	SUNday	***WINd

*** By using an '**I**' 180° rotated from the Top Layer, the word 'W**I**N' can also be displayed on the Bottom Layer.

Bottom Layer Layout Examples

MONday	TUEsday	WINd
M O N	T U E	W I N

Letters on the Bottom Layer are sorted out as follows:

1- 5 **B**ottom **L**eft letters on corner cubes: M, T, W, F, S
2- 6 **B**ottom **C**enter letters on edge cubes: O, U, E, H, R, A
3- 6 **B**ottom **R**ight letters on corner cubes: N, E, D, U, I, T

Letters are now *logically* combined on corner and edge cubes:

1- 1 **B**ottom **L**eft corner cube: (M,T,W)
2- 1 **L**eft corner cube with *mixed* letters: (**F** **B**ottom **L**eft, **S** **B**ottom **L**eft, **K** **T**op **L**eft)
3- 3 **B**ottom **C**enter edge cubes: (O,U), (E,H), (R,A)
4- 2 **B**ottom **R**ight corner cubes: (N,E,D), (U,I,T)

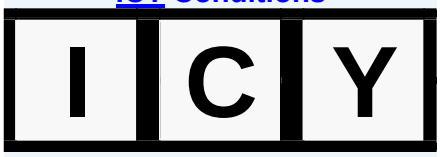
Note 1 – An 'N' on a **T**op **R**ight Corner can be transformed into a 'Z' on a **T**op **L**eft corner if it is redrawn. This applies equally to an 'O' if redrawn. This would lead to the addition of more letters to be used on **90°** rotated cubes.

Note 2 – Due to Cube symmetry properties, an 'H' or an 'N' on a cube is transformed into the same 'H' or 'N' on the *opposite* cube. This applies equally to letters 'I', 'O' and 'X' and to symbol '%'. This would lead to the addtion of more letters and symbols to be used on **180°** rotated cubes.

Additional Letters, Numbers and Symbols (Some may have to be redrawn)		
Top **L**eft – Corner cubes	**T**op **C**enter – Edge cubes	**T**op **R**ight – Corner cubes
G, H, I, M, S, W, **K**	C, I, T, U	L, M, N, O, S, Y
N, O, Z	O, H	
Middle **L**eft – Edge cubes	**M**iddle **C**enter – Center cubes	**M**iddle **R**ight – Edge cubes
%, blank, –°C, +°C	0, 1, 2, 3, 4, 5	0, 1, 2, 3, 4, 5, 6, 7, 8, 9
0, 6, 8, 9		%, blank
Bottom **L**eft – Corner cubes	**B**ottom **C**enter – Edge cubes	**B**ottom **R**ight – Corner cubes
M, T, W, F, S	O, U, E, H, R, A	N, E, D, U, I, T
N, O, S, Z	I	H, S
Letters in red are 180° rotated		Letters in blue are 90° rotated
Letters, Numbers and Symbols Orientation – Recap		
Top **L**eft – Corner cubes	**T**op **C**enter – Edge cubes	**T**op **R**ight – Corner cubes
G, H, I, M, S, W, **K**	C, I, T, U	L, M, N, O, S, Y
Middle **L**eft – Edge cubes	**M**iddle **C**enter – Center cubes	**M**iddle **R**ight – Edge cubes
%, blank, –°C, +°C	0, 1, 2, 3, 4, 5	0, 1, 2, 3, 4, 5, 6, 7, 8, 9
Bottom **L**eft – Corner cubes	**B**ottom **C**enter – Edge cubes	**B**ottom **R**ight – Corner cubes
M, T, W, F, S	O, U, E, H, R, A	N, E, D, U, I, T

Examples

ICY Conditions



SUNny Day

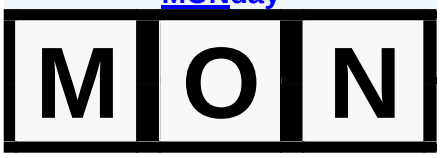
GUSty Wind

Temperature: – 10 °C

Air Moisture: 30 %

Day of the Month: 03

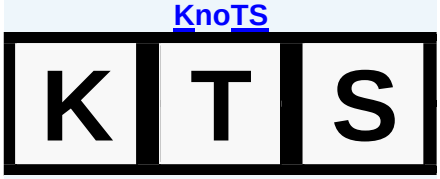
MONday



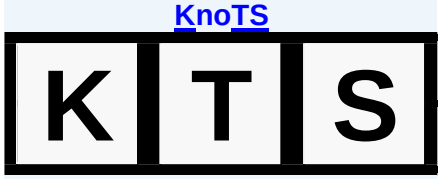
TUEsday

THUrsday

KnoTS



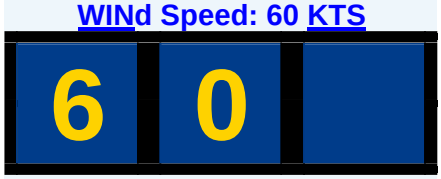
KnoTS



GUSty WINd

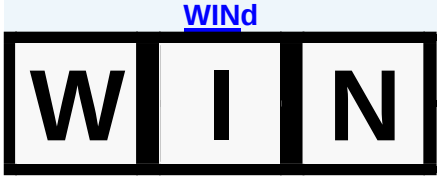
WINd Speed: 10 KTS

WINd Speed: 60 KTS

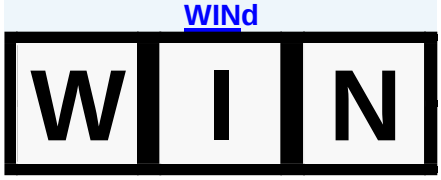


GUSty WINd: 40 knots

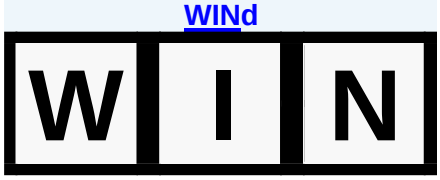
WINd



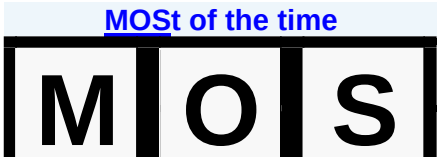
WINd



WINd



MOSt of the time



HUMid Day

SCOrching Heat

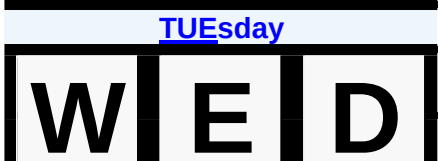
WINd MOStly: 30 knots

Air Moisture: 90 %

Air Temperature: 40 °C

MONday

TUEsday

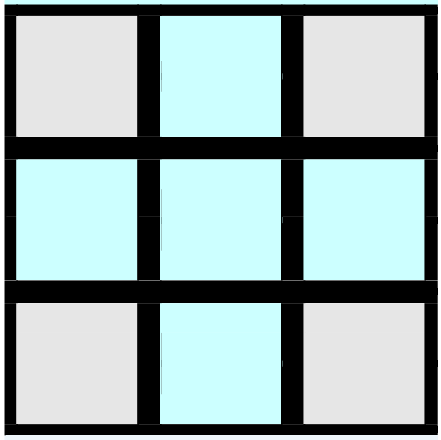


FRIday

Solving a Weather Station Cube Step by Step

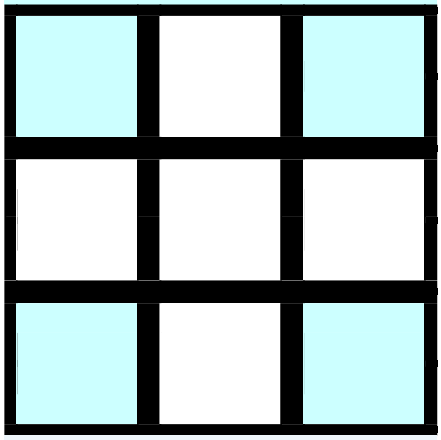
In this example, a step by step solving process is applied to the Weather Station Cube, just described before. Note that we only need to solve a *single* Face out of six. We will solve a Face for the initial state of the Cube.

Solve the Cross First



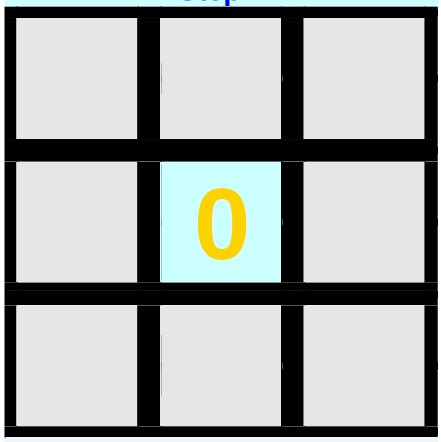
Standard Rubik's Cube Solving

Then Solve the Corner Cubes



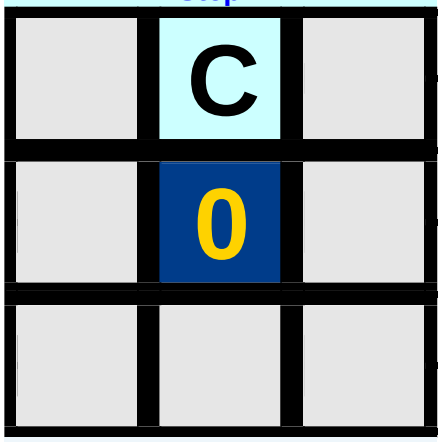
Standard Rubik's Cube Solving

Step 1



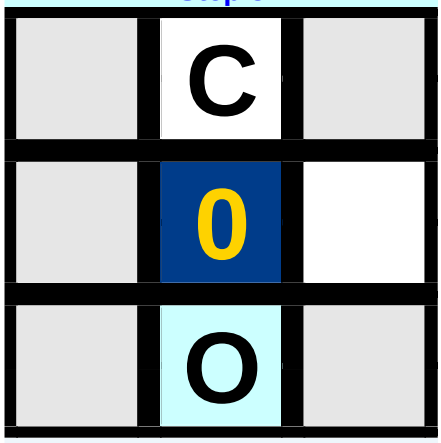
Center 0 on Front Face

Step 2



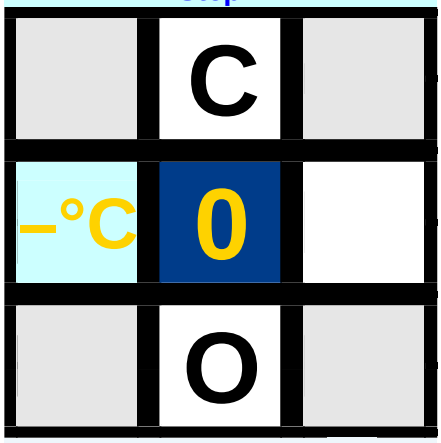
Top Layer: Edge Cube **C**

Step 3



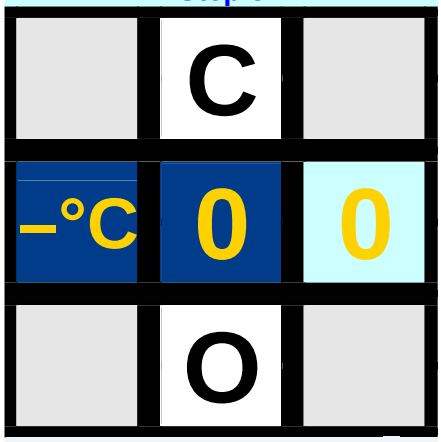
Bottom Layer: Edge Cube **O**

Step 4



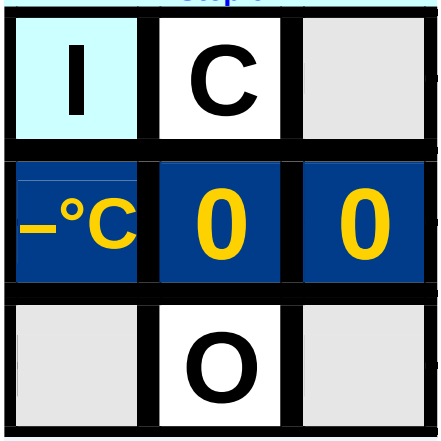
Middle Layer: Edge –°C

Step 5



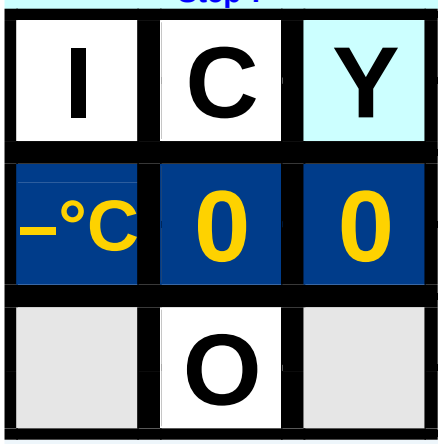
Middle Layer: Edge Cube **0**

Step 6



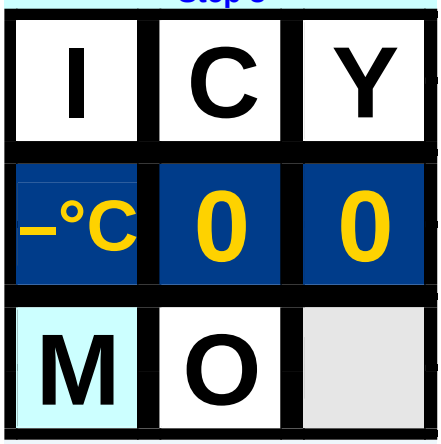
Top Layer: Corner Cube **I**

Step 7



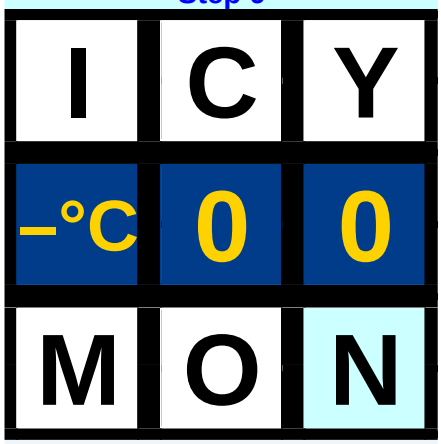
Top Layer: Corner Cube **Y**

Step 8



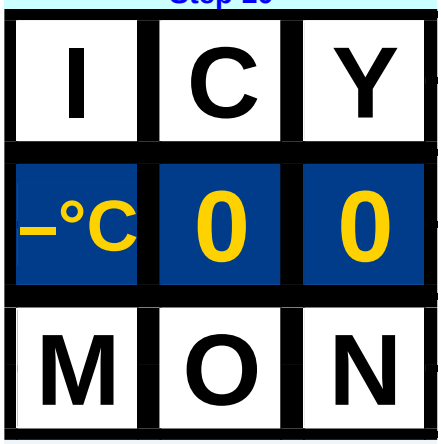
Bottom Layer: Corner Cube **M**

Step 9



Bottom Layer: Corner **N**

Step 10



That's it !

Print out this page and fill in the blank faces with *your* data. Then try to design your *own* Cube.

TL	TC	TR
ML	MC	MR
BL	BC	BR

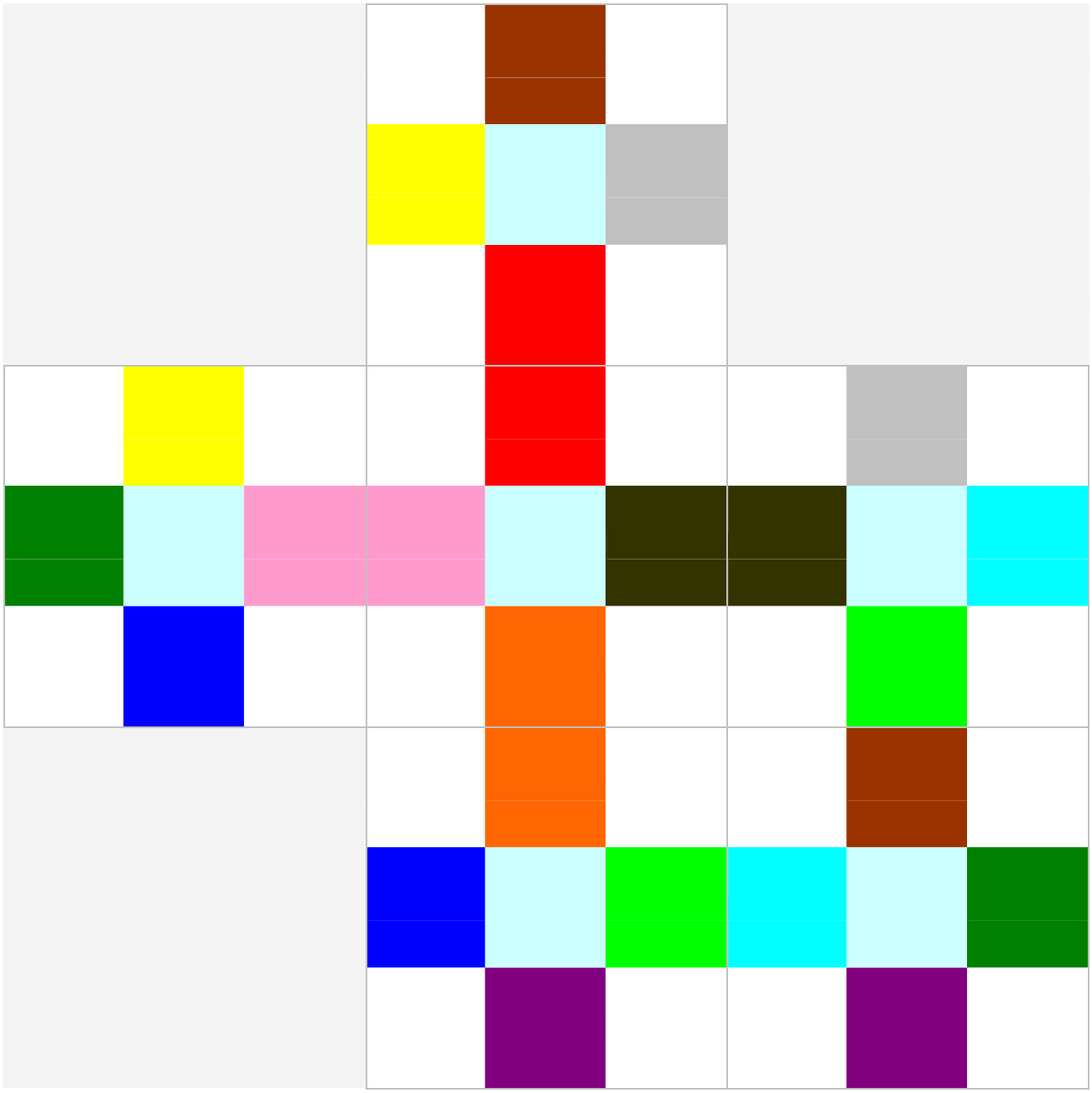
Corner Cubes Final Check

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).

	Up		
Left	**F**ront	**R**ight	**B**ack
	Down	**B**ack	

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).



	Up		
Left	**F**ront	**R**ight	**B**ack
	Down	**B**ack	

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.