Jaap's Puzzle Page

Hungarian Globe / Equator

This sliding-piece puzzle is a ball with three intersecting rings of moving pieces which divide the ball into eights. There are 12 square shaped pieces each ring, making 30 pieces in all because there are 6 places where the rings intersect. There is no space so the pieces do not move singly. Instead, all 12 pieces of a ring are shifted as one.

Note that the pieces come in inseparable antipodal pairs; pieces on opposite sides of the puzzle will always stay that way. Solving a piece on one side will automatically solve the piece on the other.

There are two versions of this puzzle, which differ only in the colour scheme. The Hungarian Globe simply has a map of the earth on it, like a proper globe. The Equator version has a simple colour scheme. Four quarters of the puzzle have a different colour. Thus the pieces at the poles have 4 colours, the pieces on the vertical rings have two, the remaining pieces only one. The Hungarian Globe and the Equator are both made of plastic with tin metal shells covering all the pieces, which makes it feel quite cool and solid.

This puzzle should not be confused with the Massage Ball 2 which not only has a different colour scheme, it also allows two halves of the ball to rotate with respect to eachother. Another related puzzle is the Mozaika where two halves on any of the three axes can rotate.

The Equator and Hungarian Globe were invented by Ferenc Molnár. It's oriignal patent is HU 186,541, and the equivalent British patent GB 2,088,728 was published on 16 June 1982.

The number of positions:

Let's consider the Hungarian Globe first. There are 15 pairs of pieces, which can be placed in a position in 8 ways, giving a maximum of $15!\cdot 8^{15}$ positions. This limit is not reached because:

- No pair can be twisted a quarter turn in isolation (2)

- The parity of the tile permutation is the same as the parity of the tile pair permutation (2)

This leaves $15!\cdot 8^{15}/4$ = 11,502,425,383,685,056,364,544,000 or about $1.1\cdot 10^{25}$ positions. Note that the second constraint arises from the fact that moving a ring one tile is an odd permutation on the 12 tiles and also an odd permutation on the 6 tile pairs. This means it is impossible for example to swap two antipodal tiles without moving anything else (though on the Equator puzzle that situation does occur because that has identical tile pairs).

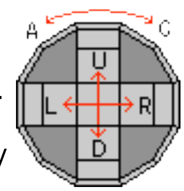
The Equator is simpler. Here the limit of $15!\cdot 8^{15}$ is not reached because:

- Four pairs are monochrome so orientation does not matter (4^4)
- There are several indistinguishable pairs ($2!\cdot 2!\cdot 5!\cdot 5!$)

This leaves $15!/(2!\cdot 2!\cdot 5!\cdot 5!) \cdot 8^{11}\cdot 2^4$ = 3,120,232,580,209,704,960 or $3.1\cdot 10^{18}$ positions.

Notation:

The Hungarian Globe will naturally be held with the North pole on top. On the Equator puzzle the 4-coloured pieces are considered to be the poles, so it is held so that the 4 top triangles have different colours. The equatorial ring and one of the vertical rings intersect on the front and the back of the puzzle. The equatorial ring is moved Left or Right, denoted by L and R. The vertical ring going through the front goes Up or Down, denoted by U and D, while the other one goes Clockwise or Anti-clockwise, denoted by C and A. These letters are followed by a number indicating how many squares to move, so R3 means rotating the equator to the right a quarter turn.



Solution to Equator and Hungarian Globe:

Phase 1: Solve the front vertical ring (except pole/equator pieces).

a. First find a piece that is to be placed on the front vertical ring (a two-coloured piece on the Equator puzzle). If the piece lies on the other vertical ring, then turn it (C or A) to the equator.
b. Hold the puzzle so that the destination of the piece is one of the two places between the front and the top (north pole). Turn the equator (L or R) until the piece is at the front.
c. There are 8 possibilities, depending on the orientation of the piece, and whether it is to move up one or two squares.

Twist needed	Up 1 square	Up 2 squares
None	R1 D1 L1 U1	R1 D2 L1 U2
Clockwise	L3 U2 C3 D2	L3 U1 C3 D1
Half turn	R1 U5 R5 D5	R1 U4 R5 D4
Anti-clockwise	R3 U2 A3 D2	R3 U1 A3 D1

d. Repeat steps a-d until the ring is solved.

Phase 2: Solve the other vertical ring.
This is done exactly the same way as the first vertical ring. Rotate the whole puzzle left or right a quarter turn, and repeat Phase 1. Afterwards the first ring will not have been disturbed except that it may have been rotated by a quarter or a half turn. Simply re-align it when you have solved the second ring.

Phase 3: Solve the poles.

a. If the North and South pole pieces are already at the pole positions but not correctly oriented, then bring them to the equator by D3 R1 U3.
b. Rotate the equator to bring the North pole piece to the front.

c. Now place it on the pole by using a method similar to phase 1:

Twist needed	
None	R1 D3 L1 U3
Clockwise	A3 L3 C3
Half turn	R1 U3 R5 D3
Anti-clockwise	C3 R3 A3

Phase 4: Orient (most of) the equatorial pieces.
In this phase the actual position of the pieces on the equator is ignored.

a. If possible, find any two pieces on the equator (which are NOT an antipodal pair and) which are not in the correct orientation and both need to be twisted the same amount. Note that on the Equator puzzle, you can choose a monochrome piece as one of the two pieces if necessary.
b. Turn the equator to bring one of the two twisted pieces to the front.
c. Do one of the following sequences to twist the pieces:

Clockwise	U3 R3 C3 R? L3 A3 L3 D3
Half turn	U6 R? D6
Anti-clockwise	U3 L3 A3 R? R3 C3 R3 D3

The ? stands for any amount that puts the second piece to be twisted at the front.
d. Repeat steps a-c as often as possible.
e. On the Equator puzzle, all pieces will now be correctly oriented because of the monochrome pieces. On the Hungarian Globe you may still be left with one antipodal pair that needs a half turn. To rectify this, use the first or third sequence above to twist the pair a quarter turn, together with any other pair. You now have two pairs which need a quarter turn, so you can again use the first or third sequence to twist those two pairs correctly.
Alternatively, turn the tile to the front and do the sequence:
C3 D3 A3 U3 L3 U3 R3 C3 D3 A3 L3 A3 R3 C3
Note that this does not disturb any other pieces.

Phase 5: Position the equatorial pieces.
The phase is actually quite easy, but hard to explain.

a. The tile at the front will be used as a reference point, and one by one matching tiles will be placed alongside it until (most of) the equatorial ring is solved. Call this front tile, tile f.
b. Find the tile belonging to the right of the front tile. Call this tile r.
c. Turn the equator to bring r to the front, and do U1 to lift it out of the equator.
d. Turn the equator to bring f to the front, and do L1 D1. This brings down tile r next to tile f, so that they match. The tile below the front will be incorrect, but that will be corrected later.
e. You will now essentially keep repeating steps a-d, lifting up pieces up from one place and dropping them elsewhere in the equator, at the correct position relative to the previously moved tiles. Continue until the equator is (nearly) solved.
f. If it is not solved, then only one antipodal pair on the equator is incorrect, as well as the tile just below the front and its antipode. Examine that tile below the front, find the position in the equator where it should be and turn that to the front. The following simple sequence should now solve the puzzle:
R1 U1 R1 D1 R1 U1 R1 D1 R1 U1 R1 D1.
Note how each tile on the equator is removed and placed back one tile further.

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