Flipping & Rotating Cubes

This activity follows on from other activities you have completed where you had to remember shapes and patterns. Now you have to imagine how patterns would look when they are turned over or turned around.

Step 1. Working with cubes

Use the six different coloured cubes (or Lego blocks) you used earlier for matching cubes and flashing cubes. Use all six cubes and use the same hierarchy you used for the earlier cube activities starting with patterns with no offset (the whole of one side of each cube touches the whole side of another cube).

Your helper will make a pattern using all six of the cubes on a transparent plastic or Perspex sheet. (The top of a CD case makes a good transparent plate) You now have to imagine that the pattern of cubes you see is transformed, flipped or rotated in a specific way. Your helper can flip or rotate a blank card to show you the direction of the flip or rotation.

Flip top to bottom
Imagine the pattern of cubes is **flipped over so the top goes to the bottom**. Imagine how it would look after it was flipped top to bottom. Try to "see it in your head". You are now going to show how the pattern of cubes would look if it was flipped over top to bottom using another set of cubes. Your helper will give you two cubes at a time which ideally you should place on the table in the position you think they will be when the pattern is flipped over. Try not to just turn them over in your hand - try to see how they would be positioned when flipped over.

Then your helper will give you another two cubes which you should then place with the first two cubes in the relative positions you think they would be when the pattern is flipped over. When the four cubes are positioned if you feel any cube is in the incorrect position you can change the position of any of the cubes. Finally your helper will give you the last two cubes which you should then place in the relative position you think they will be when the pattern is flipped over top to bottom. Again if you think any cube is in the incorrect position you can move the cube.

Check
When you are satisfied with your pattern, your helper will pick up the plastic sheet and begin to flip it over top to bottom. Watch the cube pattern as it is flipped, so you can see the transformation of the pattern.

As the pattern is flipped and you see something that makes you want to change your pattern, you may realise you are not correct. If so, your helper returns the plastic sheet to its original position while you make your change. This can be repeated several times if necessary, until you are sure your pattern is right. After this, the plastic sheet is flipped and placed over the top of your pattern of cubes to see if they match.

Repeat with another pattern.

Flip Sideways
Now you must imagine that the pattern of cube is **flipped sideways** left to right.

Go through the same procedure as you did above. Also try sideways flips right to left.

> **Notes for helpers:**
> Flipping a pattern from left to right, or right to left, is really doing the same thing, i.e. the pattern will end up the same no matter whether it is flipped left to right or right to left. Eventually they will realise this - but don't tell them - let them discover this for themselves.

Rotate one quarter turn or half turn
Now you must imagine that the pattern of cubes is rotated **1/4 turn clockwise**.

Then try **1/4 turn anti-clockwise**.

Finally try rotating **1/2 turn**. Remember to always follow the same procedure so that you imagine the change in your mind and make it. Putting a spot in the middle of the top edge of the clear plastic sheet will make it easier for your helper to describe how the pattern is to be rotated.

Reverse roles
Exchange roles with your helper. Now your helper makes the pattern of cubes how they think it would look when flipped or rotated. You must now say whether your helper's pattern is correct, or not, before the pattern is flipped or rotated to verify the result.

If you disagree with your helper, you must tell them how you think it should look.

Flip and rotate other patterns at the same level

Continue working with patterns at the same level until your flips or rotations are always correct.

Step 2. More difficult patterns

Now use more difficult patterns with at least two offsets - only 1/2 of one side of a cube touches another cube. Your helper can also increase the difficulty by giving you the first two cubes so that these two cubes do not touch each other - you will have to imagine the other cubes around the two cubes you have been given and imagine how they would look when flipped or rotated.

Then try patterns of cubes with more offsets and then with one or two cubes tilted.