## MirrorLand

Let us remember what we did last time: we have a circle with each of its 4 sectors are colored differently. How can we make it look like a circle with only 2 distinct colors? We can simply put a mirror on it along the middle line so that only blue and orange sectors are visible. How about a circle with only one color? For this, we would need 2 mirrors. We can put the 2 circles around one of the sectors, flanking it from both sides: we can put the mirrors at a right angle to each other, so that they meet at the center of the circle. But is this the only way to get a circle with one color? What if we made the angle between the mirrors smaller? Do we still have a circle of one color?


| Angle | \# of |
| :---: | :---: |
| $180^{\circ}$ | 2 |
| $120^{\circ}$ | 3 |
| $90^{\circ}$ | 4 |
| $60^{\circ}$ | 6 |
| $45^{\circ}$ | 8 |
| $30^{\circ}$ | 12 |
| 20 | 18 |
| 10 | 36 |
| 5 | 72 |
| 1 | 360 |

I have a different type of question for everyone: if I have a single object on my whiteboard, and if I put down my foldable mirror at a right angle, how many objects will I see in total? 2, 3, 4 or 5? Danya counted 4 objects for us. Let us figure out which angles between the mirror give which number of objects. We have a sheet
 with table of angles and number of images, let us measure the angles, put the mirrors next to the object, and count how many objects we will see. Do we see any patterns? 180 degree angle gives 2 objects, 120 degree angle - 3 objects, and 90 degree angle - of course gives 4 objects, then it must be that the number of objects multiplied by the angle gives 360! Who can then tell me how many objects we will see when the angle is 10 degrees wide? $360 / 10=36$ objects! Now if I wanted to get 72 objects, which angle should I put the mirrors at? Quite simple: 360/72=5 degree angle!


Now we have a very different task: we want to see what kind of symmetric images we can get using a foldable mirror and picture with 3 simple objects: a green triangle, a red hexagon and a blue square. Can we obtain an image of 4 separate blue squares in a 2-by-2 grid arrangement? Of course we can, simply put the mirror at a right angle around the square so that all other objects are behind the mirror and not visible to us. How about an image of 6 green triangles in a circle arrangement pointing towards the center? Let us try to make it. And let us make all the other arrangements on the blackboard.
Who can tell me which of the images is impossible to get using our 3 simple shapes and a foldable mirror?
Let us now see if anyone can make any interesting images that aren't on the board using the mirror. If you think you have made a very interesting new image, then go ahead and draw it for us, we will be very interested where you put the mirror and at what angle.



Who knows how kaleidoscopes work?

Let us make a square-shaped tube out of 2 of our foldable mirrors. Let us then put an animal inside the tube and see how many images of the animal we will get.
Can you count the total number of animal you will see inside the tube? The "real" animal will reflect once at each of the 4 mirrors. That is already 5 animals. But then each animal will again reflect at each of the mirrors except the mirror it is already on. And this will happen many-many times. So is possible to count how many animals we will see even if there is just one "real" animal inside the tube?


