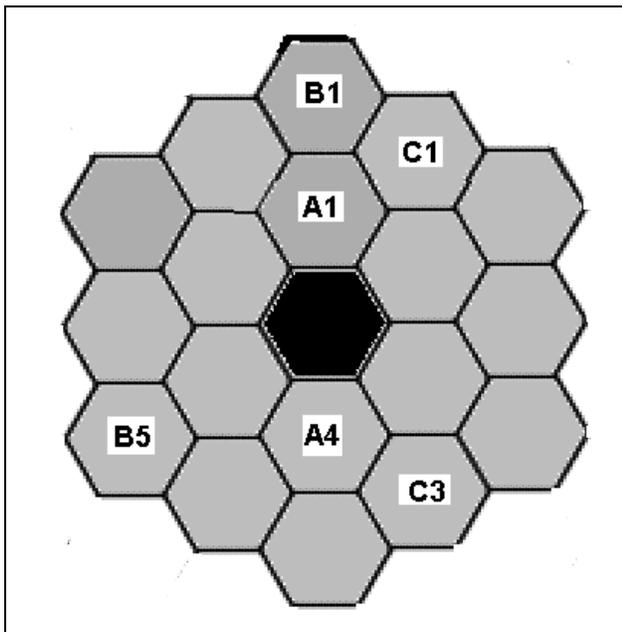


The Webb Space Telescope segmented mirror consists of 18 hexagonal mirror tiles assembled to make a larger mirror just over 6 meters in diameter. The placement of these tiles is not random, however.

Tiles located at a specific distance from the center of the mirror are manufactured with exactly the same optical properties. For example, in the drawing to the left, each of the inner ring of 6 tiles has an identical 'twin' to each of the other tiles in this ring.



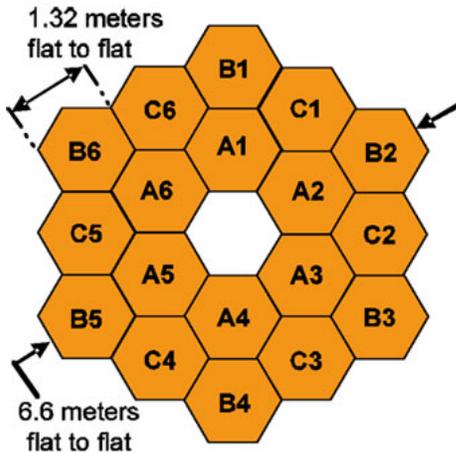
Another property of regular hexagons is that, when you rotate them by 60 degrees, the pattern looks identical to the one you started with. Suppose you labeled one of the six sides, Side A, and placed it at the top of the pattern. If you rotate the hexagon in steps of 60 degrees, it will take exactly 6 shifts to bring Side A back to the top of the pattern. The assembled Webb Space telescope mirror shows this same pattern among the tiles.

**Problem 1** - Using the tile labeling shown above, find all other tiles that follow 6-fold symmetry and label them using the same scheme. How many classes can you identify, and how many tiles per class?

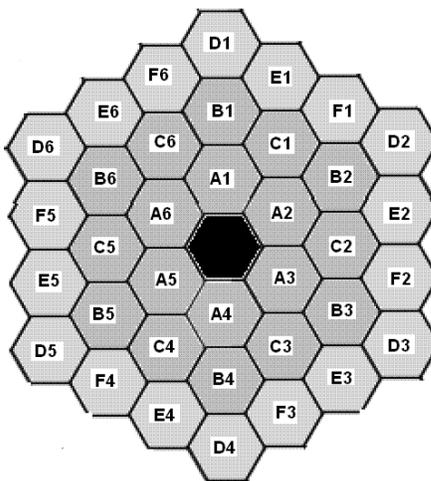
**Problem 2** - If you were to add one more ring of hexagonal tiles to the outer edge of the Webb Space Telescope mirror, how many different kinds of mirror tiles would there be, and in each class, how many identical mirror tiles would be present with the same optical properties?

**Problem 1** - Using the tile labeling shown above, find all other tiles that follow 6-fold symmetry and label them using the same scheme. How many classes can you identify, and how many tiles per class?

Answer: See figure below. **There are exactly three different tile classes, A, B and C, and 6 tiles per class.**



**Problem 2** - If you were to add one more ring of hexagonal tiles to the outer edge of the Webb Space Telescope mirror, how many different kinds of mirror tiles would there be, and in each class, how many identical mirror tiles would be present with the same optical properties?



**There are 6 unique mirror classes (A, B, C, D, E, F) and six identical mirror per class. Each mirror class is at a unique distance from the center of the mirror and has the same optical properties. This means that A1 can be interchanged with A5, but that A1 cannot be swapped for B1, C1 etc.**