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CS 39 Project Report
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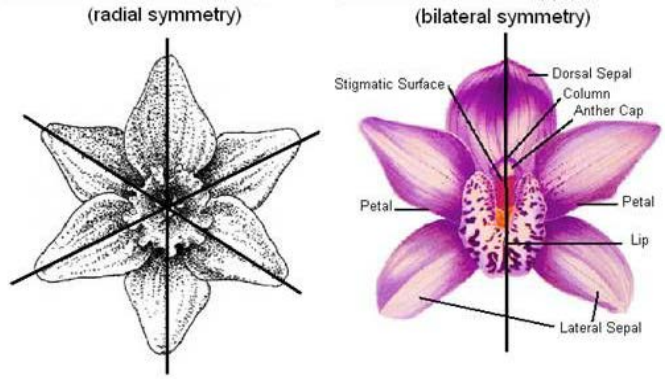
The Symmetry of Flora

For years, my family has tended to our garden and grown diverse plants from roses to mint. When we received this prompt to combine something we are passionate about with the concepts of this class, I immediately decided to discuss the symmetry of flowers and other plants.

To refer back to class, we learned that a two dimensional object with a rotational center is either C_n-symmetric, if a rotation through 360/n degrees places it back onto itself, or D_n-symmetric if in addition it also has reflective mirror symmetry on the n axes going through the center. I kept this in mind in my analysis of various flowers and plants I researched. In floral symmetry, there are two important terms to remember: actinomorphic and zygomorphic; actinomorphic flowers have rotational symmetry, while zygomorphic flowers have bilateral symmetry.



As I continued my research, I learned that flowers commonly have a minimum of 3 fold symmetry if they are actinomorphic, and many actinomorphic flowers have two layers of petals or more. This became complicated with certain flowers that I was looking at, such as lilies. I was looking at reference photos of lilies, wondering if they could technically be considered 3 fold or 6 fold.

Lilies

I was conflicted because in some photos, like the one on the left, you can clearly see a double layer of petals, so it can be considered 3 fold symmetry, but in others, such as the one in the middle, the petals look to be about the same size, so it could be considered 6 fold symmetry as well. I concluded that the assumption that most lilies are 3 fold symmetry, and with certain species they would be multiples of 3. The third photo, a particularly complex variation of lily, is an example of a species with some multiple of 3 fold symmetry.

Another example of a particularly complex actinomorphic flower is the dahlia. Although in the below photo, the clearest visible symmetry is 6 fold, I believe that dahlias, if we take into account some irregular petals, have up to 10 fold symmetry as well.

Dahlia

Dahlias have about 6 or 7 layers of petals, and rather than stacking up on one another, they form a pattern in which the gap between two petals shows a petal from the layer below.

White pim and Clematis

In the white pim and clematis flowers, we can see the high amounts of symmetry that actinomorphic flowers can have, with the white pim displaying 18 fold symmetry and the clematis, despite its double layer, having 8 fold symmetry.

As for bilateral symmetry, we see it best in the particular example of tulips. Tulips, from the side if regarded as 2D objects, have clear bilateral symmetry. If observed from the top, however, one can see a 3 fold symmetry, which is an interesting characteristic.

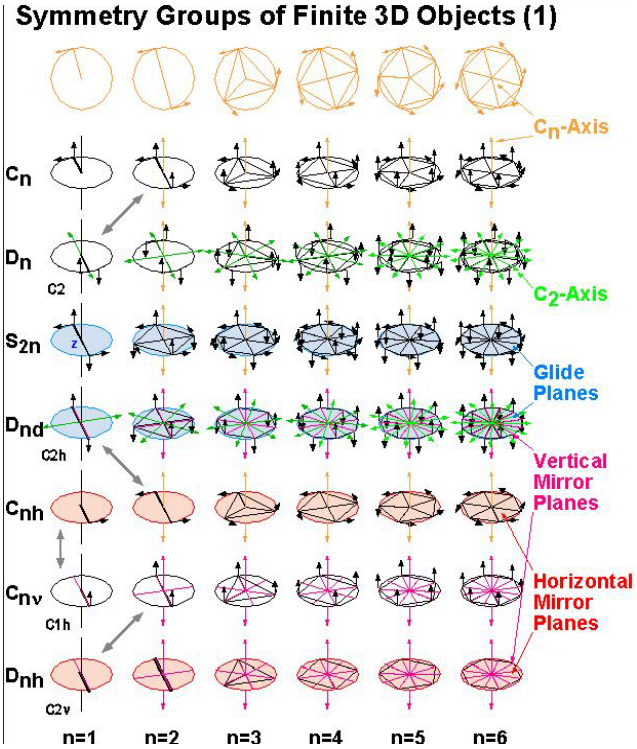
Tulip: side view and top view

Moving on to plants, my initial idea was to discuss the symmetry of succulents. However, as I researched them, I realized most of them demonstrate the idea of *phyllotaxy*, which is the arrangement of leaves on an axis or stem. I realized that phyllotactic arrangements of succulents cannot be considered symmetric, such as the examples below:

Succulents displaying phyllotaxy

However, not all succulents can be excluded. I found a succulent called the Buddha's temple succulent, which I felt demonstrated the symmetry of a finite 3D object, almost looking like a cylinder with horizontal mirror planes.

Buddha's temple succulent



Symmetry Groups of 3D Objects

With this interesting example, I concluded my observation of the symmetry of flora, learning that flowers demonstrate rotational and bilateral symmetry, and while many succulents show phyllotaxy, there are some examples like the Buddha's temple that show the symmetry of finite 3D objects.