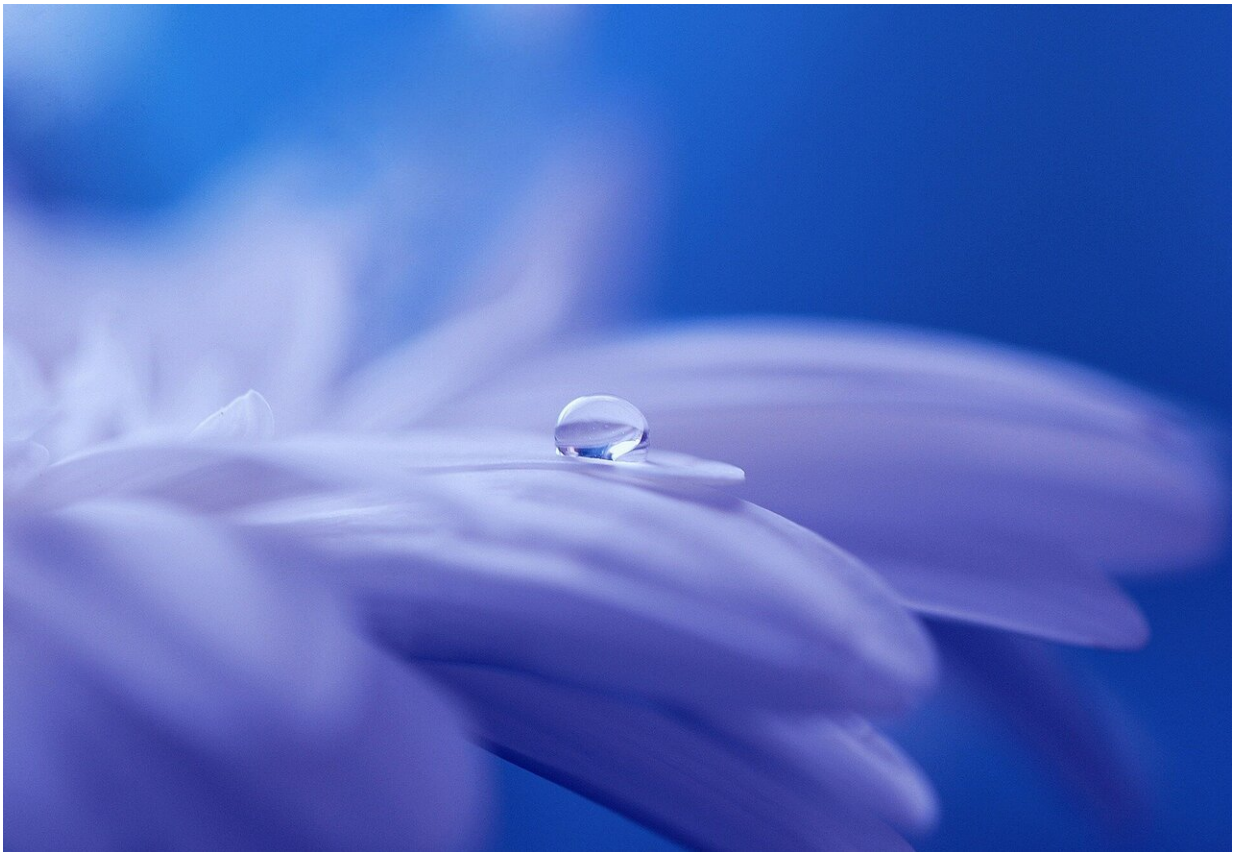


Yellow pond-lily prefers cyclic flowers to spiral ones

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Biologists from Lomonosov Moscow State University and HSE University have studied the patterns of flower development in yellow water-lily (*Nuphar lutea*). They found out that all the floral organs are

arranged in cycles (whorls) rather than inserted sequentially in a spiral, as is the case in some other basal angiosperms. The ancestors of yellow pond-lily were among the first to diverge from the root of the angiosperm evolutionary tree, which is why it can be used to hypothesize about the structure of the first flowers. The study has been published in *Frontiers in Cell and Developmental Biology* journal.

The flower is one of the key evolutionary innovations of angiosperms. It helps attract various pollinators, protect the seeds inside the fruit, and adds some new means of distribution that do not exist in gymnosperms. Thanks to these advantages, flowering plants have settled across the planet and have become the most numerous group of land plants.

How [flowers](#) evolved and how they looked initially remains a mystery. The appearance of the ancestral flowers can be inferred with the help of plants that have preserved the greatest degree of similarity to the first angiosperms. It makes sense to look for them among the basal groups, whose ancestors diverged from the phylogenetic root of flowering plants earlier than the others. It is highly probable that the flower structure in such organisms will be similar to the initial one.

Among extant flowering plants, Nymphaeales are rather close to the root of angiosperms. Yellow pond-lily (*Nuphar lutea*) is widespread in Eurasia; it is also sometimes seen in North America, which is why it could be a convenient model object. But detailed studies of its flower structure using modern research methods are lacking.

Researchers from Lomonosov Moscow State University and HSE University have collected several dozen rhizomes of *Nuphar lutea* with leaves and flowers. Some of them were dissected to prepare specimens for light and scanning electron microscopy.

The researchers focused on shoot tips, where new leaves and flowers

form. Young flowers at different stages of development were selected for the study. To determine their architecture, the researchers measured the angles between similar organs of the flower.

Elements of shoots in plants—leaves, flowers, lateral buds and lateral branches developing from them—are frequently arranged in a spiral. It had previously been assumed that [plants](#) similar to basal [angiosperm](#) type, including Nuphar, have a similar arrangement of organs. But the researchers discovered that in Nuphar lutea, the angles between the sepals differed from the spiral insertion (85° and 55° , rather than 137.5°). It looked like sepals and petals form cycles—two whorls for sepals and a single whorl for petals—although they are not always initiated simultaneously within a whorl.

Nuphar lutea develops five sepals. If they all were in one whorl, the angle between adjacent sepals would be 72° . In fact, they were placed at such angles that de-facto formed two circles: three elements in the external circle, and two in the internal one. The number of petals usually varied from 14 to 15, but they also formed a cycle rather than a spiral. And even the numerous stamens tended to arrange in alternating whorls.

More information: Elena S. El et al, Developmental Flower and Rhizome Morphology in Nuphar (Nymphaeales): An Interplay of Chaos and Stability, *Frontiers in Cell and Developmental Biology* (2020). [DOI: 10.3389/fcell.2020.00303](#)

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