Grasping the tree of life: There is an app for that, too

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With the TimeTree iPhone app, users can gain an understanding of species divergence in the palm of their hand. Credit: Janelle Lynch, The Biodesign Institute at Arizona State University

Towering over the mightiest sequoia, nature's tree of life holds the totality of the living world on its bountiful branches and limbs. Now, an innovative new application lets anyone with an iPhone tap into this astonishing abundance of life. Download it from Apple Store for free by using TimeTree as a search term.

The TimeTree app harnesses a vast Internet storehouse of data on life forms ranging from fungi to foxhounds, putting this information in the palm of one's hand. The intuitive interface is designed to answer a simple question, quickly and authoritatively: when did species A and species B share a common ancestor?

The new iPhone software is the latest extension of a project conceived by Sudhir Kumar, director of the Biodesign Institute's Center for Evolutionary Medicine and Informatics at Arizona State University and

Blair Hedges, professor of biology at Penn State University.

As Kumar explains, the evolutionary tree of life has two critical components—phylogeny and timescale. Phylogeny shows the branching relationships between species or other higher level groups within a particular kingdom, providing crucial information for understanding the inheritance of traits and for erecting schemes of classification. But pure branching order lacks a time component.

Timescale, on the other hand, identifies when species emerged. It provides a way to compare species evolution in one group directly with the evolution of other groups, and to relate these with geologic history, climate, extraterrestrial influences, and other features. When phylogeny and timescale are combined, the result is a timetree—a powerful tool for understanding the interrelationships and diversity of living things.

Timetrees are critical for evolutionary biology, as well as for other fields. In the realm of human health for example, they can be used to track the development and migration of disease-causing organisms through time. Climatologists and atmospheric scientists use timetrees to compare the effects of various organisms on the early planet. Astrobiologists pondering the origin and development of life in the universe, construct timetrees to explore chemical changes in ancient rocks, which may be associated with primitive life.

Although the TimeTree iPhone app provides a sophisticated means of mining scientific literature, using it is easy. Simply type the names of two organisms—for example, swordfish and sardine—into the iPhone interface. TimeTree searches its cavernous web archive and within seconds, returns its findings. Swordfish (*Xiphias gladius*) and sardine (*Sardina pilchardus*) shared a common ancestor some 245 million years ago, before swimming their separate ways. This app also works on other Apple devices, including iPAD and iPod Touch.

Along the left margin of the iPhone display, a geological timescale is provided, with data points marking each scientific study TimeTree used to reach its result. “One of the most important things about this knowledgebase,” Kumar says, “is that it makes it possible for anyone to see the current agreements and disagreements in the field—immediately.”

The ultimate goal of the Timetree of Life initiative, according to Hedges, is “to chart the timescale of life—to discover when each species and all their ancestors originated, all the way back to the origin of life some four billion years ago." The first phase of this ambitious undertaking appeared last year with the simultaneous release of an online resource called "TimeTreeWeb" (www.timetree.org), and an accompanying book, titled "The Timetree of Life" (Oxford University Press).

Hedges and Kumar were the editors of the voluminous TimeTree text, written by 105 leading authorities and covering a profusion of living forms, from primitive bacteria all the way up to humans. Just like the TimeTree book and the web resource, which are freely available on timetree.org, the new iPhone app draws on The National Center for Biotechnology Information’s comprehensive taxonomy browser, which contains the names and phylogenetic lineages of more than 160,000 organisms.

The TimeTree resources form a public knowledgebase, accumulating and cataloging thousands of divergence times for organisms available in the peer-reviewed scientific literature. TimeTree is both easier and more versatile than traditional means of searching for information on the divergence of species. As Kumar explains, one of the key advantages is TimeTree’s ability to access graphical information like tables and trees, that had previously been locked away in scientific studies, inaccessible to traditional methods of data retrieval that are primarily text based.

Another advantage of a knowledgebase like TimeTree over a static database, is TimeTree's highly dynamic character. On the one hand, existing divergence times for taxa are continually updated, refined and improved in terms of accuracy. On the other hand, newer dating methods allow researchers to estimate divergence times for an ever-widening assortment of species, not merely those for which a detailed fossil record exists. In particular, the technique of using "molecular clocks" to estimate rates of species change and points of divergence is becoming more commonplace. Such clocks rely on identifying gene mutations and using these to evaluate molecular change over time.

The team stresses that the TimeTree will grow and flourish as the scientific community continually updates the existing knowledgebase with the results of new studies.

Timetree building is still in its infancy, Kumar and Hedges note, with millions and millions of species yet to be fully represented. Nevertheless, the new iPhone app allows anyone to explore an area at the forefront of comparative biology and find his or her place in the timetree of life.

Provided by Arizona State University