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Encyclopedia of Life

Scientists to Explore Life's Mysteries Through Encyclopedic 'Macroscope'

First 30,000 EOL pages unveiled online for public "alpha" test and feedback; placeholder pages for 1 million species built in 1st year of 10-year project

Rapid progress fosters confidence massive project can be done; Scientists, educators, hail 1st version of online resource; public asked for its say

The first 30,000 pages of a massive online Encyclopedia of Life were unveiled today at the prestigious Technology, Entertainment and Design (TED) Conference in Monterey, California.

Intended as a tool for scientists and policymakers and a fascinating resource for anyone interested in the living world, the EOL is being developed by a unique collaboration between scientists and the general public.

By making it easy to compare and contrast information about life on Earth, the resulting compendium has the potential to provide new insights into many of life's secrets.

In essence, EOL will be a microscope in reverse, or "macroscope," helping users to discern large-scale patterns. By aggregating for analysis information on Earth's estimated 1.8 million known species, scientists say the EOL could, for example, help map vectors of human disease, reveal mysteries behind longevity, suggest substitute plant pollinators for a swelling list of places where honeybees no longer provide that service, and foster strategies to slow the spread of invasive species.

Most importantly, the EOL will be a foundational resource for helping to conserve the species already known and to identify millions of additional species that haven't yet been described or named. At its core is the knowledge about the world's species that has been discovered by

scientists over the last 250 years. By putting this information all together in one place, EOL hopes to accelerate our understanding of the world's remaining biodiversity.

EOL will illuminate patterns in biodiversity, promising knowledge comparable in impact to that gained after the microscope's invention in the 1600s. The EOL "macroscope" will have a catalytic effect on comparative biology, ecology and related fields. It will also be the ultimate online field guide, complete with links to DNA barcoding and other information of interest and use to everyone from professional scientists to birdwatchers and gardeners.

Among many potential applications of the EOL:

- Tracing the relation between changes in animal and plant populations and climate;
- Mapping the distribution of human disease vectors, such as crows, mosquitoes and the West Nile virus;
- Comparison of the life spans of related species – a prelude to lab research into reasons for human aging;
- Port inspections of ballast water for invasive species, assisted by links to molecular DNA barcode reference information;
- Assist in field research and dramatically shorten the time required to authenticate or describe new mammals, birds, bugs, plants, bacteria and other species discovered by scientists anywhere in the world;
- Revolutionize teaching and learning of the life sciences for all ages;
- Contribute to timely and informed environmental management decisions by professionals and citizen environmental managers alike.

Initiated last spring, EOL's infrastructure now includes placeholder pages for 1 million species, of which 30,000 have been populated with detailed information derived from comprehensive, authoritative compilations available for some taxonomic groups (e.g., FishBase, AmphibiaWeb). In addition, about two dozen highly developed multimedia pages are presented as examples of what to expect in time throughout the EOL.

Feedback on the first 30,000 pages will shape the ultimate design and functionality of all 1.8 million pages, scheduled for completion by 2017. It will also help inform priorities for content development.

The rapid progress to date was congratulated by Harvard's E.O. Wilson, University Professor Emeritus, who articulated the need for a dynamic modern portrait of biodiversity in a widely read essay in 2003. His letter in 2005 to the John D. and Catherine T. MacArthur Foundation resulted

in a \$10 million seed grant to start the EOL, soon complemented by a further \$2.5 million from the Alfred P. Sloan Foundation.

“The launch of the Encyclopedia of Life will have a profound and creative effect in science,” says Prof. Wilson. “It aims not only to summarize all that we know of Earth’s life forms, but also to accelerate the discovery of the vast array that remain unknown. This great effort promises to lay out new directions for research in every branch of biology.”

The basic design of the EOL species pages that were launched today also owes its genesis to the TED Conference and to Professor Wilson. In March 2007 Wilson was one of the recipients of a coveted TED prize for his work in documenting and understanding the world’s biodiversity. In his acceptance speech, Wilson asked TED attendees to help him develop an encyclopedia of life. Avenue A | Razorfish, an innovative web design firm, took up the challenge and helped to create an award winning video and the basic template for EOL species pages.

The pages launched today include:

- Two dozen **exemplar pages**, illustrating the kinds of rich multi-media information to be provided for all well-known species. Content on these pages has been verified by relevant experts;
- 30,000 **species pages**, covering a small number of taxonomic groups. These pages contain authenticated content but are not as fully developed as the exemplars;
- 1 million **minimal pages**, in most cases providing the species’ scientific and common names, limited information about its taxonomic position and distribution, and links to

The screenshot shows the EOL website interface for the American Burying Beetle. At the top, there is a navigation bar with links for HOME, PREFERENCES, LANGUAGE: EN, FEEDBACK, PRESS ROOM, USING THE SITE, and ABOUT EOL. A search bar is present with the text "Name of organism" and a "FIND" button. Below the navigation bar, the page title "AMERICAN BURYING BEETLE" is displayed in large, bold letters, followed by the scientific name "Nicrophorus americanus". A "BOOKMARK" button is located to the right of the title. Below the title, there is a "RICH RED LIST STATUS: CRITICALLY ENDANGERED (CR)" label. The page is divided into several sections: "IMAGES" (with a large main image and a grid of smaller images), "CLASSIFICATION" (listing taxonomic groups like Animals, Arthropods, Insects, Beetles, etc.), "INTRODUCTION" (providing a detailed description of the beetle's life cycle and conservation status), and "EXPLORER" (listing related species like Sigambra rivulatus, Psephenus, etc.). A "TABLE OF CONTENTS" is also visible on the left side of the page.

other sources of information. These pages are, in effect, placeholders to be populated with information validated by specialist content editors. Content will also be generated via the Biodiversity Heritage Library, other web-based resources, and by professional and ‘citizen scientists’;

- Several thousand **linking pages** to help users traverse the taxonomic hierarchy.

Simply listing in one place all 1.8 million species known to science will be unprecedented. Today, knowledge about biodiversity gleaned over 250 years is scattered across databases, books, and journals worldwide. Researchers are often overwhelmed by lists of sites found by search engines or by lack of easy access to libraries, museums, and other storehouses of knowledge.

EOL will create ‘one-stop shopping’ for authoritative information, offering the world at large a better understanding of the planet and all its inhabitants. It is being assembled by a growing partnership of individual scientists, international organizations, technology leaders, and prestigious research institutions. But soon anyone will be able to provide information for consideration, too.

"It is exciting to anticipate the scientific chords we might hear once 1.8 million notes are brought together through this instrument," says Jim Edwards, Executive Director of the EOL. "Potential EOL users are professional and citizen scientists, teachers, students, media, environmental managers, families and artists. The site will link the public and scientific community in a collaborative way that's without precedent in scale."

"There are very many species for which we do not have high quality images or text. Think of these pages as invitations to contribute to EOL," says Dr. Edwards.

Starting later this year, the public will be able to contribute text, videos, images, and other information about a species. The best of this information will be incorporated into the authenticated pages.

The authenticated pages also include a wealth of other materials, including peer-reviewed articles and access to DNA barcodes, all freely available. While most pages are now in English, eventually, they will be available in several other languages for teaching and learning.

"EOL is a good example of the way the World Wide Web can be used innovatively to assemble diverse kinds of information in an easy-to-use, ever-growing compendium. It can accommodate

almost any kind of information about species and, unlike a published book, can be updated instantly,” says Dr. Edwards.

"The Encyclopedia of Life can raise our sights and expand our view of life on Earth," said Jonathan F. Fanton, president of the John D. and Catherine T. MacArthur Foundation. "Just as a microscope reveals and helps us better understand the small and particular, the EOL will allow us to discern patterns previously unseen, illuminating relationships, identifying gaps in our knowledge, and suggesting opportunities for new avenues of inquiry. What was once viewed by many as ‘wishful thinking’ is now entirely possible and underway.”

“While it will take 10 years to assemble at least basal information on all 1.8 million known species, the EOL will be a functional, organized, highly valuable resource in three to five years,” says Prof. James Hanken, director of Harvard’s Museum of Comparative Zoology, who also chairs the EOL Steering Committee. “The cooperation between the many world-leading biodiversity and technology institutions partnered in this project is both unprecedented and exciting.”

“At its launch last May, we said the EOL can be done,” says Jesse Ausubel, of the Alfred P. Sloan Foundation. “The remarkable progress made in the few months since has fostered confidence it will be done. The EOL canvas now has a million sketch lines and we have painted a small corner in full color. We look forward to public reviews that will shape the final product.”

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Background

The EOL Steering Committee is comprised of senior authorities from Harvard University, Smithsonian Institution, the Field Museum of Chicago, the Marine Biological Laboratory at Woods Hole, the Biodiversity Heritage Library consortium, Missouri Botanical Garden, and the MacArthur and Sloan Foundations.

The EOL Institutional Council contains more than 25 institutions from around the world and provides EOL with global perspectives and outreach capabilities. The Distinguished Advisory Board consists of 13 global leaders from the scientific and policy communities.

Driving the EOL forward as well are several working groups:

The **Species Sites Group** works with scientists and other contributors to assemble and authenticate the species pages content. It recruits diverse data providers and engages expert page “curators” of information on the species pages. The group is also implementing a robust intellectual property regime that ensures open access to EOL materials. Finally, the team is developing portals for specialized audiences.

The **Biodiversity Informatics Group** is responsible for the software establishing a single portal to reach volumes of species information scattered worldwide, seamlessly aggregating data from thousands of sites using novel tools to capture, organize, and reshape biodiversity knowledge. In collaboration with data providers, the group is obtaining, indexing, and recombining information for expert and non-expert users alike. The next step involves deploying a suite of tools and services to index, organize, and associate data elements or create new elements.

Technology giants, including Adobe, Microsoft and the Wikimedia Foundation, are providing active support.

The **Scanning and Digitization Group** is led by the Biodiversity Heritage Library, a consortium of 10 natural history and botanical libraries, which have already digitized more than 2.5 million pages of biodiversity literature and made them available as part of a public commons. Citizens of all nations have access to this wealth of information free of charge and of most copyright and licensing restrictions. This combination of access to primary texts and literature and the ability to use it freely enables individuals everywhere to participate locally in the global effort to catalogue new species and protect existing biodiversity.

The **Education and Outreach Group** works to insure widespread awareness of the EOL, and to explore and promote new and exciting uses of this extraordinary resource in diverse global settings. The group strives to make EOL relevant, usable and interesting to a broad range of potential users and to encourage their participation by providing tools to organize and contribute observations, media and data about the species they study.

The **Biodiversity Synthesis Group** supports EOL’s growth and use by facilitating cross-disciplinary involvement of the scientific and academic community and by contributing to its educational and conservation uses. Its ultimate goal is to ask, and attempt to answer, new questions about biodiversity by supporting working groups to explore integrative topics, including taxonomy, evolution, biogeography, phylogenetics and biodiversity informatics.

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About the John D. and Catherine T. MacArthur Foundation

The John D. and Catherine T. MacArthur Foundation (www.macfound.org) is a private, independent grant-making institution helping to build a more just, sustainable, and peaceful world. Through the support it provides, the Foundation fosters the development of knowledge, nurtures individual creativity, strengthens institutions, helps improve public policy, and provides information to the public, primarily through support for public interest media. With assets of \$6.8 billion, the Foundation makes approximately \$260 million in grants annually

About the Alfred P. Sloan Foundation

The Alfred P. Sloan Foundation (www.sloan.org), established in 1934, makes grants in science, technology, and the quality of American life. Major science initiatives of the Foundation in recent years include the Sloan Digital Sky Survey (the most ambitious astronomical survey ever undertaken, to provide detailed optical images covering more than a quarter of the sky and a 3-dimensional map of about a million galaxies and quasars); the Census of Marine Life (a decade-long program to culminate in 2010 to assess and explain the diversity, distribution, and abundance of ocean life from microbes to mammals); and the Barcode of Life Initiative (to develop short DNA identifiers for all plants, animals, and fungi).

Some of EOL's data partners include:

FishBase (www.fishbase.org), a global information system with all you ever wanted to know about fishes. FishBase is a relational database with information to cater to different professionals such as research scientists, fisheries managers, zoologists and many more. The FishBase Website contains data on practically every fish species known to science. The project was developed at the WorldFish Center in collaboration with the Food and Agriculture Organization of the United Nations and many other partners, and with support from the European Commission. FishBase is serving information on more than 30,000 fish species through the EOL.

The Catalogue of Life Partnership (CoLp) (www.catalogueoflife.org), an informal partnership dedicated to creating an index of the world's organisms. The Catalogue of Life provides different forms of access to an integrated, quality, maintained, comprehensive consensus species checklist and taxonomic hierarchy, presently covering more than one million species, and intended to cover all known species in the near future. They contain substantial contributions of taxonomic expertise from more than fifty organizations around the world, integrated into a single work by the ongoing work of the CoLp partners. The EOL currently uses CoLp as its taxonomic backbone.

Tree of Life web project (ToL) (www.tolweb.org), a collaborative effort of biologists from around the world. On more than 9,000 World Wide Web pages, the project provides information about the diversity of organisms on Earth, their evolutionary history (phylogeny), and characteristics. ToL pages are linked to one another hierarchically, in the form of the evolutionary tree of life. Starting with the root of all life on Earth and moving out along diverging branches to individual species, the structure of the ToL project thus illustrates the genetic connections between all living things. In the future, ToL Web will concentrate on supra-specific species pages and EOL on species-level pages.

The Global Biodiversity Information Facility (GBIF) (www.gbif.org), the world's premiere source for information on biological specimen and observational data, providing on-line access to more than 135 million data records from around the world. GBIF is providing range maps for the EOL species pages.

AmphibiaWeb (<http://amphibiaweb.org>), an online system enabling anyone with a Web browser to search and retrieve information relating to amphibian biology and conservation. This site was inspired by the global declines of amphibians, the study of which has been hindered by the lack of multidisciplinary studies and a lack of coordination in monitoring, in field studies, and in lab studies. One of its major goals is to encourage a shared vision for the study of global amphibian declines and the conservation of remaining amphibians.

The Solanaceae Source Web site (www.nhm.ac.uk/research-curation/projects/solanaceaesource), the product of an ongoing five year project: Planetary Biodiversity Inventory (PBI) Solanum: A worldwide treatment. The aim of the project is to produce a worldwide taxonomic monograph of the species occurring within the plant genus Solanum (the potato and tomato family), organized by a robust phylogenetic framework. The project began in January 2004 and is just one of four inventories funded by the U.S. National Science Foundation at that time. The project is made possible through collaborations between Solanaceae specialists worldwide, with principal investigators from four research institutions in England and the United States.

All of these resources rely on the world's taxonomists, the scientists who study and name species. It is only through their heroic efforts that a resource like the EOL could even be contemplated.

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