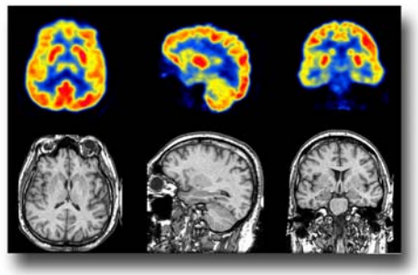
9. Demonstrates value of collections. Compiling the library of barcodes begins with the multimillions of specimens in museums, herbaria, zoos and gardens, and other biological repositories. The spotlight that barcoding shines on these institutions and their collections will strengthen their ongoing efforts to preserve Earth's biodiversity.

The National Museum of Natural History has over 600,000 bird specimens representing more than 80% of the world's known species.

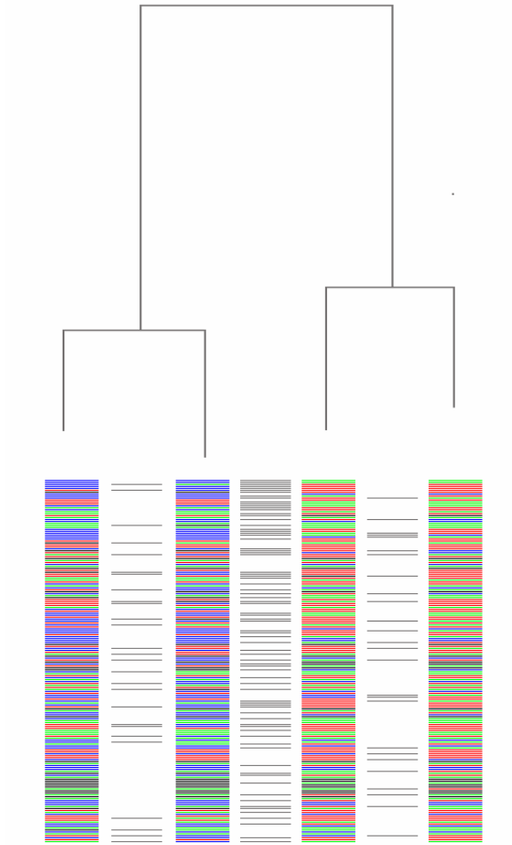
10. Speeds writing the encyclopedia of life. Compiling a library of barcodes linked to vouchered specimens and their binomial names will enhance public access to biological knowledge, helping to create an on-line encyclopedia of life on Earth, with a web page for every species of plant and animal.

Earth is home to an estimated 10 million species of plants and animals.



The human brain can learn to identify a few thousand species, a small fraction of life's diversity.

Differences in DNA barcodes help create trees showing genetic distances between species.




Hermit Thrush


American Robin


Bumblebee


Honey Bee

More information is available at:
http://barcoding.si.edu/
and
http://phe.rockefeller.edu/BarcodeConference/index.html

BARCODING LIFE: TEN REASONS

IDENTIFYING SPECIES BY DNA

CONSORTIUM FOR THE BARCODE OF LIFE

CONSORTIUM FOR THE BARCODE OF LIFE (CBOL) is an international collaboration of natural history museums, herbaria, biological repositories, and biodiversity inventory sites, together with academic and commercial experts in genomics, taxonomy, electronics, and computer science. The initial organizational support for CBOL is provided by a 2.5 year grant from the Sloan Foundation.

The mission of CBOL is to rapidly accelerate compiling of DNA barcodes of known and newly discovered plant and animal species, establish a public library of sequences linked to named specimens, and promote development of portable devices for DNA barcoding.

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Paul Waggoner Connecticut Agricultural Experiment Station
Jesse Ausubel Alfred P. Sloan Foundation

v3.0 September 18, 2004

BARCODE OF LIFE: A short DNA sequence, from a uniform locality on the genome, used for identifying species.

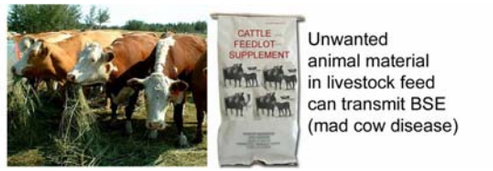
DNA sequences from a uniform locality on genomes can be a *barcode of life* for identifying species, always the front line in discovery, monitoring and research. Since Linnaeus, biologists have used distinguishing features in taxonomic keys to apply binomial species names, such as *Homo sapiens*. Then, as a master key opens all the rooms in a building, the binomial species name accesses all knowledge about a species.

From insects to birds, evidence now shows that short DNA sequences from a uniform locality on genomes can also be a distinguishing feature. As a Linnaean binomial is an abbreviated label for the morphology of a species, the short sequence is an abbreviated label for the genome of the species.

The *barcode of life* thus provides an additional master key to knowledge about a species. Compiling a public library of sequences linked to named specimens, plus faster and cheaper sequencing, will make this new barcode key increasingly practical and useful.

What additional power does barcoding offer?

1. Works with fragments. Barcoding can identify a species from bits and pieces. When established, barcoding will quickly identify undesirable animal or plant material in processed foodstuffs and detect commercial products derived from regulated species. Barcoding will help reconstruct food cycles by identifying fragments in stomachs and assist plant science by identifying roots sampled from soil layers.

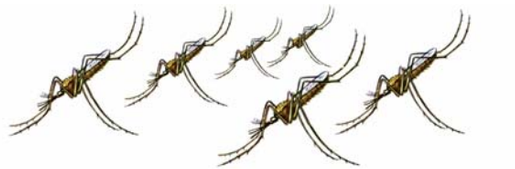


Unwanted animal material in livestock feed can transmit BSE (mad cow disease)

2. Works for all stages of life. Barcoding can identify a species in its many forms, from eggs and seed, through larvae and seedlings, to adults and flowers.

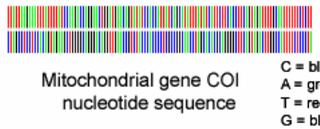
Life stages of Spicebush Swallowtail Butterfly

3. Unmasks look-alikes. Barcoding can distinguish among species that look alike, uncovering dangerous organisms masquerading as harmless ones and enabling a more accurate view of biodiversity.



Anopheles mosquitoes are vectors for human malaria. Only a few of the 430 known species transmit infection.

4. Reduces ambiguity. Written as a sequence of four discrete nucleotides - CATG – along a uniform locality on genomes, a barcode of life provides a digital identifying feature, supplementing the more analog gradations of words, shapes and colors. A library of digital barcodes will provide an unambiguous reference that will facilitate identifying species invading and retreating across the globe and through centuries.



Honey Bee
American Robin

Mitochondrial gene COI nucleotide sequence

C = blue
A = green
T = red
G = black

5. Makes expertise go further. The bewildering diversity of about 2 million species already known confines even an expert to morphological identification of only a small part of the plant and animal kingdoms. Foreseeing millions more species to go, scientists can equip themselves with barcoding to speed identification of known organisms and facilitate rapid recognition of new species.

Known species:

>150,000	>250,000	>300,000	>30,000
flies, mosquitoes	flowering plants	beetles	crabs, lobsters

6. Democratizes access. A standardized library of barcodes will empower many more people to call by name the species around them. It will make possible identification of species whether abundant or rare, native or invasive, engendering appreciation of biodiversity locally and globally.

7. Opens the way for an electronic handheld field guide, the Life Barcoder. Barcoding links biological identification to advancing frontiers in DNA sequencing, miniaturization in electronics, and computerized information storage. Integrating those links will lead to portable desktop devices and ultimately to hand-held barcoders. Imagine the promise of a schoolchild with a barcoder in hand learning to read wild biodiversity, the power granted to a field ecologist surveying with a barcoder and global positioning system, or the security imparted by a port inspector with a barcoder linked to a central computer!

A handheld barcoder, such as the one envisioned here, would have many uses. Promoting technology development of portable devices for field use is a major goal of this initiative.

8. Sprouts new leaves on the tree of life. Since Darwin, biologists seeking a natural system of classification have drawn genealogical trees to represent evolutionary history. Barcoding the similarities and differences among the nearly 2 million species already named will provide a wealth of genetic detail, helping to draw the tree of life on Earth. Barcoding newly discovered species will help show where they belong among known species, sprouting new leaves on the tree of life.