

Identity Preservation has Many Uses

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Ötzi was found at 37 25' 19N 122 05' 06"W

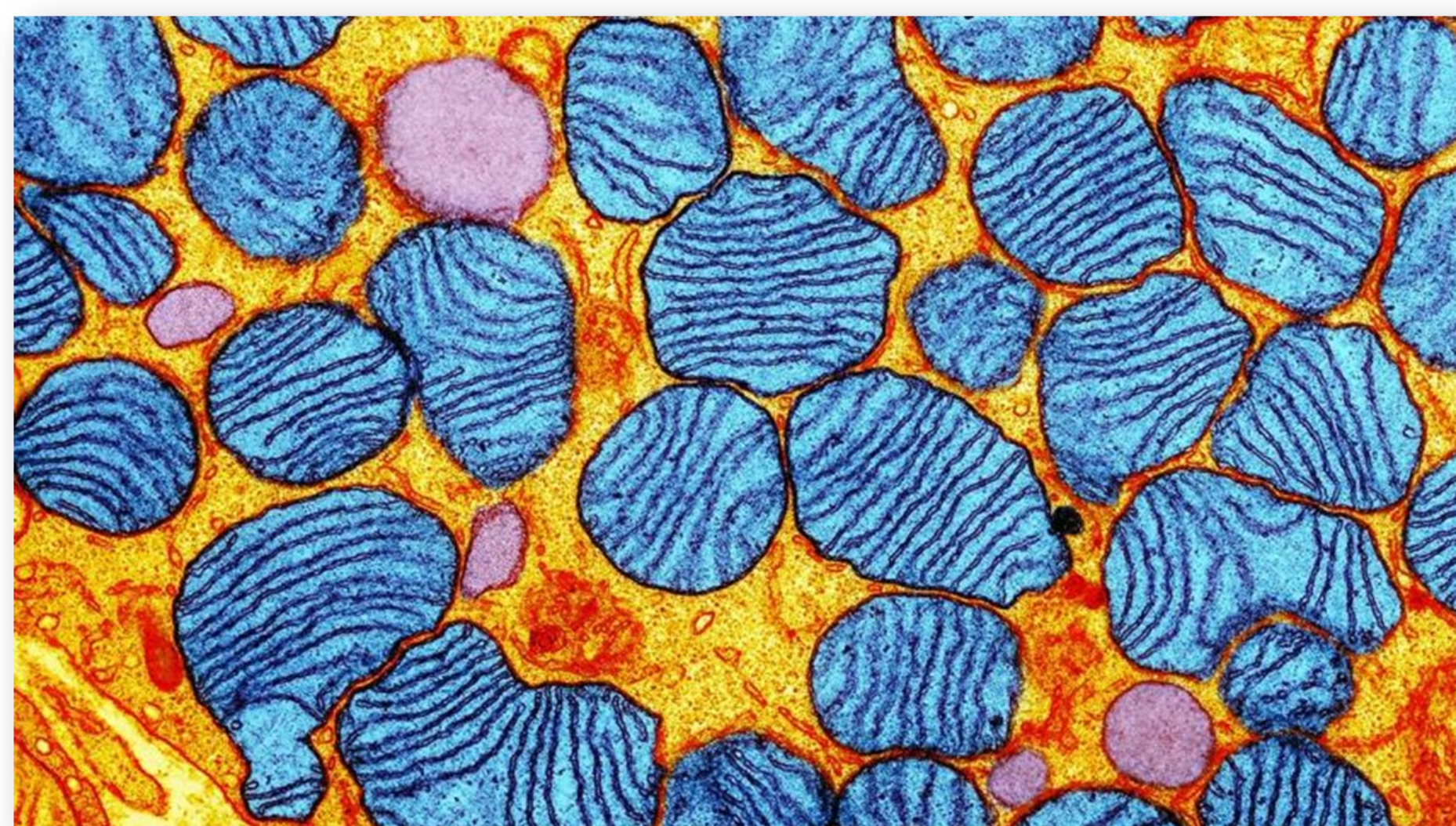
Global Positioning Satellites (GPS) provide precise locations around the world which was used to site Ötzi's body 92.56 meters inside the Italian/Austrian border. Modern cotton harvesters also record GPS that can connect the precise rows of cotton picked with a tag on each bale and the yarn produced from those bales.



Ötzi left few descendants

Cell's organelles contain 1,000's of DNA strands that are passed intact to the next generation. By sequencing Ötzi's mitochondria we learned that they are rarely found in modern humans. Cotton fibers are single cells that contain mitochondria and plastids in high enough copies to test whether the fiber is *Gossypium hirsutum* (Upland) or *Gossypium barbadense* (Pima).

Gen. & Mol. Res. 2015 14:11924 (cotton chloroplast markers)



picture from Science 25-2-2016

Ötzi did not drink milk

The nuclear DNA provides detailed descriptions of our genetic potential, such as lactase persistence. Children can digest lactose but in adults this trait was just spreading throughout Europe during Ötzi's life. Since only 2 copies of nuclear DNA exist in each cotton fiber, and thousands in leaf trash, leaf in baled cotton is used for this level of DNA analysis. Both the variety and GMO traits can be determined if the reference samples are available.

PNAS 2007 104:3736 (lactase persistence)
J. AOAC Intl. 2009 92:765 (cotton GMOs)



Ötzi was born in Feldthurns

Trace minerals in Ötzi's teeth match the soil in a small town near Bolzano. Cotton fiber contains 1% minerals that could be used to determine what soil types were used to grow the cotton. This technology has already been used to determine where a boll weevil came from or what a bollworm fed on.

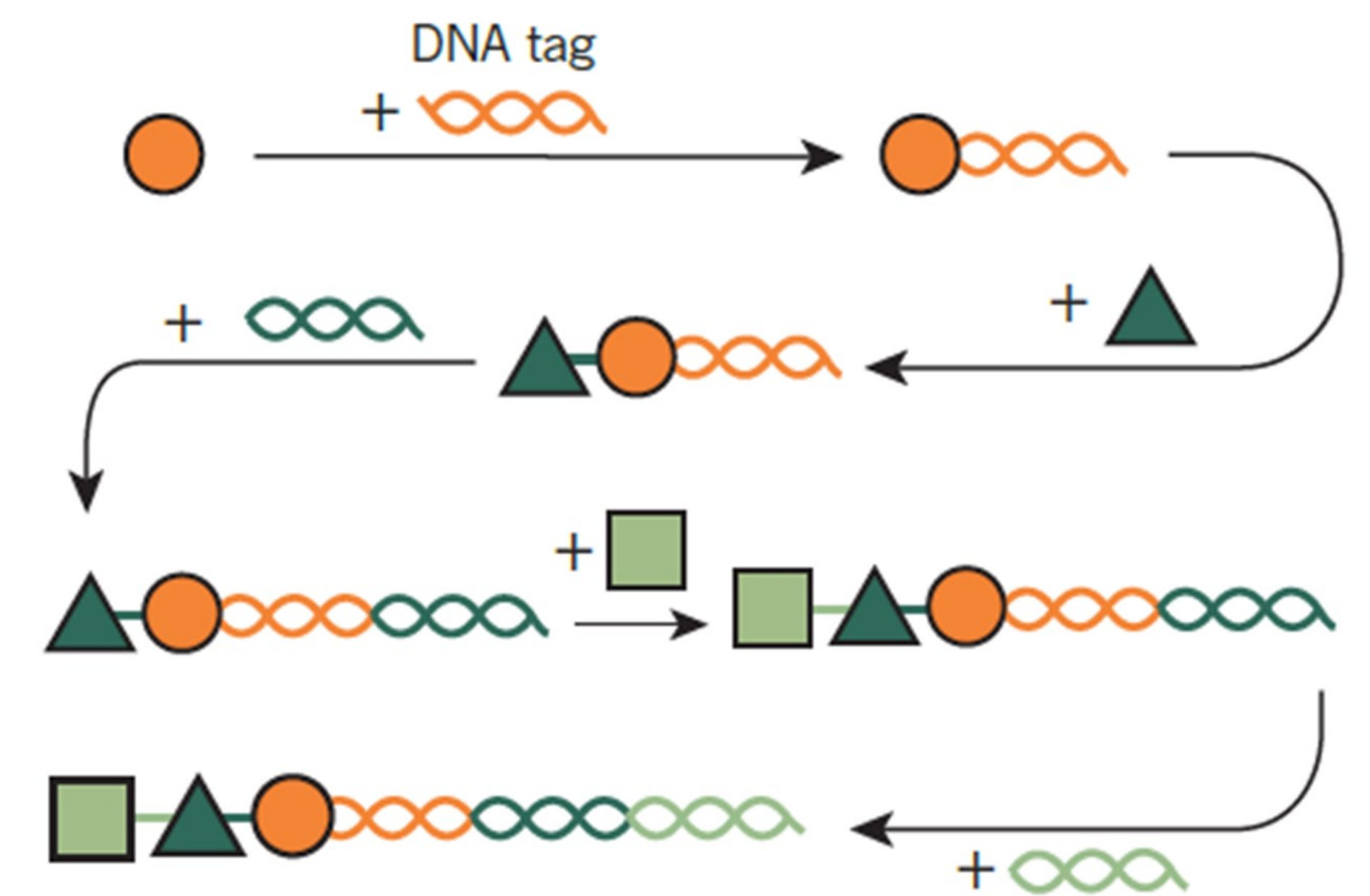
J. Environ. Stud. 2016 2:9 (biogeochemistry)
Evol. Applic. 2012 5:53 (cotton bollworm)



Ötzi fought with strangers

Blood on Ötzi's leather garments came from a brother he carried on his back and from two strangers, likely a deadly fight. Precise DNA sequence tags can be attached to many molecules, to wool and to cotton fiber at harvest, in the gin and in textile processing to track the fiber all the way to garments. Multiple tags can be added at each step and since DNA is everywhere, only by knowing the precise sequence can one even detect a tag's presence.

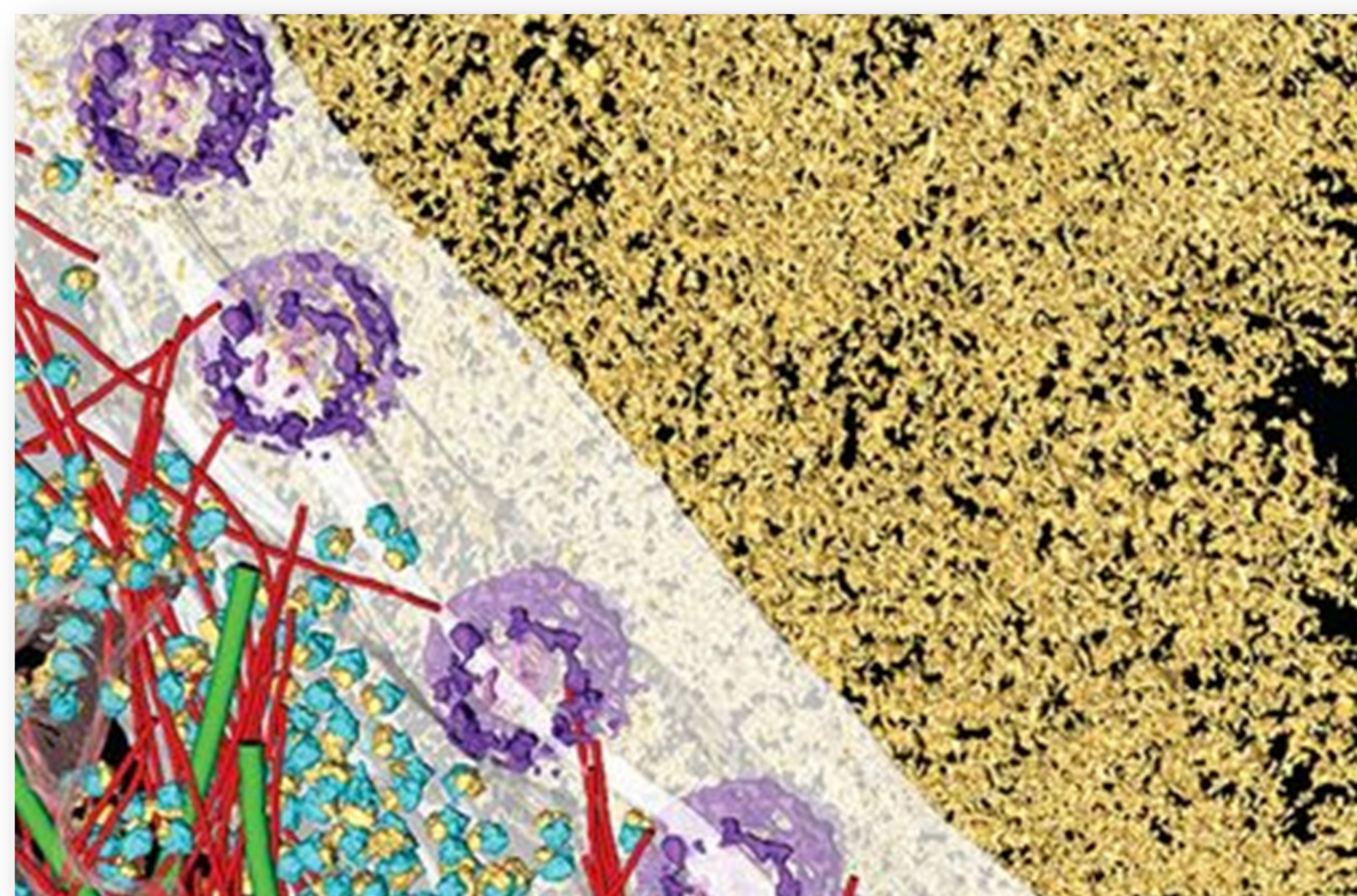
Nature 18-2-2016 (DNA tags used in chemistry)



Ötzi died ~5,200 years ago

Carbon dating techniques (with carbon isotopes) help estimate when Ötzi stopped consuming food. More recent events can be determined by other isotopes. Sugar grown within the last 150 years can be dated to a 10 year precision based on the deuterium isotope and the historic CO₂ level in the air. This should also work for cotton fiber. Nitrogen isotopes can indicate whether the plant's fertilizer was synthetic or organic. A combination of isotopes can determine if a crop was grown with rain water or ground water and whether dust comes from fossil fuels or burning wood.

PNAS 22-12-2015 (sugar)
Critical Rev. in Food Sci. & Nut. 2015 55:1206 (fertilizer)
Nature 3-9-2015 (Irrigation)
Atmospheric Env. 24-12-2014 (dust)



nuclear DNA in upper right from Science 26-2-2016

