

Evolutionary engineer Frances Arnold wins €1m tech prize

- By Jonathan WebbScience reporter, BBC News 24 May 2016 [Science & Environment](#)



Prof Arnold works in the department of chemical engineering at Caltech

US engineer Frances Arnold has won the Millennium Technology Prize for pioneering "directed evolution".

By driving a sped-up version of natural selection in the lab, the method has created new enzymes for industrial catalysts, household detergents, and even to make rocket fuel from sugar.

The €1m (£0.8m) prize is awarded biennially and Prof Arnold is the first female winner in its 12-year history.

It recognises developments that "change people's lives for the better".

The Technology Academy Finland, which presents the prize, said the deliberations began in November 2015 but that "there was only one outstanding candidate".

Prof Arnold, from the California Institute of Technology (Caltech), spoke to the BBC before travelling to Helsinki for Tuesday's ceremony.

She said the "basic concept" of using evolution to create better enzymes emerged from her laboratory more than 20 years ago.

"Evolution, to me, is the best designer of all time. And I figured out that this should be the algorithm for forward design, for making new biological code that is useful to humans," Prof Arnold said.

"I came in... from basically nowhere. That research was being done by biochemists and protein scientists - molecular biologists. And I was a chemical engineer.

"I basically knew nothing about the field. Otherwise I probably wouldn't have done it, because I would have known how hard it was."



The prize was awarded on Tuesday in Helsinki

With her engineering background, Prof Arnold wanted to make new, useful, problem-solving proteins. So she took her cue from the way nature does the same thing.

"I looked at it and said, well, nature didn't actually design enzymes... How does this happen? You make mutations randomly, you look through a large number of things for the ones that have the properties you're interested in, then you repeat the process.

"And you iterate, accumulating beneficial changes over multiple generations - pretty much like we've done for cats, dogs, cows, chickens, you name it."

But instead of breeding animals, the directed evolution process works directly with small stretches of DNA and the proteins they encode.

It is now used in laboratories worldwide and has produced many valuable enzymes, including one used in manufacturing Januvia, a popular drug for type 2 diabetes, which would otherwise be produced using heavy metals.

"They replaced a chemical process with an enzymatic process, thereby completely eliminating toxic metals that were needed... and getting solvent waste reduction of 60%," said Prof Arnold.

"We're talking tonnes of material."

Directed evolution has also produced catalysts that allow industrial chemicals and fuels to be made from renewable sources.

Prof Arnold is a leading proponent of this such "green" chemistry and has co-founded a company, Gevo, that works in this area.

"Isobutanol is not a natural product, but we evolved an enzyme that makes it possible to convert plant sugars to this precursor to jet fuel," she said. "So this company is producing jet fuel from renewable resources."

Previous winners of the Millennium Technology Prize have included British computer pioneers Stuart Parkin, whose research radically expanded the capacity of computer hard drives, and Tim Berners-Lee, who invented the world wide web.