The Telegraph

The science of Christmas: we could grow our own fairy lights, say the tree wise men

Thanks to genetic modification, we may soon be putting our presents under a self-illuminating Christmas tree, writes Roger Highfield.

Now we just need one that glows in the dark.

By Roger Highfield (http://www.telegraph.co.uk/science/roger-highfield/)
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I was struggling to put fairy lights on my Christmas (http://www.telegraph.co.uk/topics/christmas/) tree a few days ago, when it struck me that I was continuing a tradition that goes back thousands of years.

Imagine what it must have felt like long ago when the hours of daylight got shorter as today's winter solstice drew closer. What was needed, as the sun ebbed away, was some kind of ritual to stop it from departing altogether. Of course, whatever our ancestors tried always succeeded in persuading the sunshine to return, leading almost every culture to develop a form of sun worship.

This is why candles and burning yule logs are so important at this time of year, and why I found myself untangling a mass of wires and bulbs. And it is also why I was hanging those lights not on the walls, but on a fir tree. To a primitive mind in a deciduous world, an evergreen such as a fir suggested permanence and a magical ability to thrive without much help from the sun. The same goes for plants with winter berries, such as holly or mistletoe.

But having spent years thinking about the science (http://www.telegraph.co.uk/science/) of Christmas – indeed, having written a book on the subject (http://books.telegraph.co.uk/BerteShopWeb/viewProduct.do?ISBN=9780753813669) – it struck me that wrestling with the lights is one of the less joyful tasks of the celebrations, particularly when you find, after all your toil and trouble, that half the bulbs don't work.

So, now that we are able to use a combination of cloning and genetic modification to produce a fir that is fast-growing, resistant to insects and frosts, and whose needles don't drop off, the next step is clear: a tree that grows its own lights.

Stonehenge winter solstice (http://www.telegraph.co.uk/news/picturegalleries/uknews/8219063/Druids-gather-in-the-snow-and-ice-at-Stonehenge-for-the-winter-solstice-sunrise.html)

Science of Christmas: the First Noel (http://www.telegraph.co.uk/topics/christmas/8189078/The-Science-of-Christmas-the-First-Noel.html)

Science explains Christmas goodwill (http://www.telegraph.co.uk/science/science-news/3350064/Science-explains-Christmas-goodwill.html)

Father Christmas, in figures (http://www.telegraph.co.uk/topics/christmas/6859529/Father-Christmass-Christmas-Eve-in-figures.html)

Pimp My Sleigh (http://www.telegraph.co.uk/topics/christmas/6880222/Pimp-My-Sleigh-Santas-ride-gets-a-makeover.html)

Santa and the science of Christmas (http://www.telegraph.co.uk/topics/christmas/8188997/The-science-of-Christmas-Santa-Claus-his-sleigh-and-presents.html)

As it happens, genetic engineers routinely create glowing creatures, partly because it's an excellent and obvious way to determine whether you have succeeded in transferring genes from one place to another. Genes from fireflies and jellyfish have been used to make luminescent mice and monkeys; in America, it is even possible to buy GloFish, fluorescent zebrafish with bright red, green, yellow and orange colouring.

And, over the past few months, a team at the University of Cambridge has been working on a similar technique that could be applied to trees, as part of the annual International Genetically Engineered Machines competition (iGEM). The nine-strong group has identified genes that can be transported by a harmless bacterium into a plant's cells, without the need for the expensive Luciferins pigments (from the Latin lucifer, "light-bringer"), which are found in most bioluminescent organisms.

The researchers started out with a gene from a marine bacterium called *Vibrio fischeri*. These bacteria live on the underside of the Hawaiian bobtail squid, *Euprymna scolopes*, creating a helpful blue glow that means, from the point of view of a predator lurking underneath, that the squid blends into the background sky.

Knowing the combination of genes that generates light, they introduced the same machinery into some *E. coli* bacteria, a bottle of which then cast enough blue light to read by. The team – and other researchers – should be able to build on this to make other colours, converting the naturally blue light by adding fluorescent proteins. They have also changed the sequence of fireflies' DNA to produce a range of colours, including red and green.

If these glowing bacteria can be introduced to trees, the team calculates that only 0.02 per cent of the energy absorbed for photosynthesis would need to be diverted into the production of light for firs to glow as brightly as a street light. By adding other protein machinery, it might even be possible to make the hue and brightness vary over the course of the day. Just imagine what those shivering pagans would have made of that.

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