Will we ever… photosynthesize like plants? *By* Ed Yong

HULK GREEN BUT NO CAN FIX OWN CARBON. THAT MAKE HULK ANGRY!

Humans have to grow, hunt, and gather food, but many living things aren't so constrained. Plants, algae and many species of bacteria can make their own sustenance through the process of photosynthesis. They harness sunlight to drive the chemical reactions in their bodies that produce sugars. Could humans ever do something similar? Could our bodies ever be altered to feed off the Sun's energy in the same way as a plant?

As a rule, animals cannot photosynthesize, but all rules have exceptions. The latest potential deviant is the pea aphid, a foe to farmers and a friend to geneticists. Last month, Alain Robichon at the Sophia Agrobiotech Institute in France reported that the aphids use **pigments** called **carotenoids** to harvest the sun's energy and make ATP, a molecule that acts as a store of chemical energy. The aphids are among the very few animals that can make these **pigments** for themselves, using genes that they stole from fungi. Green aphids (with lots of **carotenoids**) produced more **ATP** than white aphids (with almost none), and orange aphids (with intermediate levels) made more **ATP** in sunlight than in darkness.

Another insect, the Oriental hornet, might have a similar trick, using a different **pigment** called **xanthopterin** to convert light to electrical energy. Both insects could be using their ability as a back-up generator, to provide energy when supplies are low or demand is high. But both cases are controversial, and the details of what the pigments are actually doing are unclear. And neither example is true photosynthesis, which also involves transforming carbon dioxide into sugars and other such compounds. Using solar energy is just part of the full conversion process.

There are, however, animals that photosynthesise in the fullest sense of the word. All of them do so by forming partnerships. Corals are the classic example. They're a collection of hundreds and thousands of soft-bodied animals that resemble sea anemones, living in huge rocky reefs of their own making. They depend upon microscopic algae called **dinoflagellates** that live in special compartments within their cells. These residents, or **endosymbionts**, can photosynthesize and they provide the corals with nutrients.

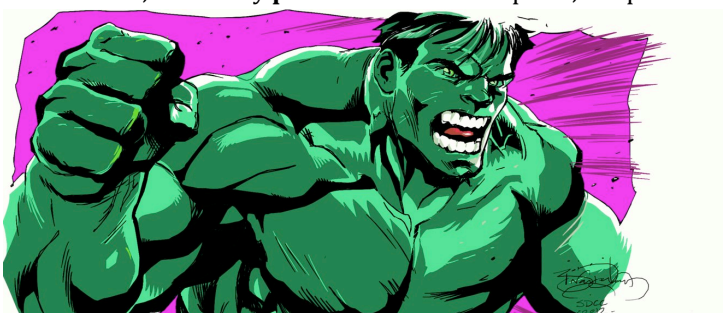
But maybe the seeds of such relationships aren't as difficult to plant as they might seem. In 2011, Christina Agapakis, a synthetic biologist from the University of California, Los Angeles got baby zebrafish to accept photosynthetic bacteria, simply by injecting them into the fish when they were **embryos**. As she wrote on her blog, "The biggest surprise was that *nothing happened.*" The fish cannot photosynthesize, but they didn't reject the bacteria either. Agapakis' experiment showed that backboned animals can, at the very least, tolerate the presence of photosynthetic microbes, and with a little tweak, she even persuaded the bacteria to invade **mammalian** cells.

Within the cells of plants and algae, photosynthesis takes place within tiny structures called chloroplasts. Chloroplasts are the remnants of a free-living photosynthetic bacterium that was swallowed by a larger **microbe** billions of years ago. Unlike many such events, this fateful encounter didn't end with the **engulfed** bacterium being digested. Instead, the two cells formed a permanent partnership that fuels the cells of plants and algae to this day. So rather than teaming up with a **symbiont**, why not cut out the middle-man and take its chloroplasts for yourself?

At least one group of animals has done this – the *Elysia* sea slugs. These beautiful green creatures graze on algae, and co-opt their chloroplasts for themselves. The **pilfered** chloroplasts line the slug's digestive tract, provide it with energy, and allow it to "live as a plant", as *Elysia* expert Mary Rumpho describes it. This association is vital to the slug, which cannot reach adulthood without it.

For now, Chris Howe from the University of Cambridge says, "If you wanted to set up a relationship between a chloroplast and a new animal host, you'd need all that extra support machinery. You'd have to put those genes in the host's **genome**." And with hundreds of such genes, turning a human cell into a compatible home for chloroplasts would involve genetic engineering on a vast scale.

And to what end? Even if the **symbionts** took, even if the controlling genes were successfully added, would this make a difference to us? Probably not. Photosynthesis is a useless ability without some way of exposing yourself to as much of the Sun's energy as possible. That requires a large surface area, relative to their volume. Humans, on the other hand, are pretty much opaque columns. Even if our skin was riddled with working chloroplasts, they would only manufacture a fraction of the nutrients we need to survive. "If you imagine a person who had to get all of their energy from the sun, they'd have to be very still. Then, they'd need a high surface area, with leafy **protrusions**. At that point, the person's a tree."



Science in the News #5

Name: **Period:**

1. Read and 'talk' with the text on the back of this page ☐

2. Complete all of the sentences below ☐

To 'talk' with the text on back:

1. underline : important facts
2. ☆ : interesting ideas
3. ◯ : vocabulary
4. **?** : What you want to know more/ don't

The article that I just read is about_____

_____

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I think I am reading this article because in _____ class we are/were studying_____

_____

_____.

One word from the article I did not know the meaning of was_____. When I looked this word up in the dictionary I find out it meant _____

_____.

The most important sentence in the article to me is "_____

_____."

This quote means _____

_____.

I think this quote is the most important sentence in the article because _____

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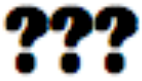


After reading the article I wonder _____?

Another question I still have after reading the article is _____

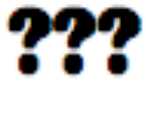
_____?

summarizing

making connections

Research

Important details



questioning