From Green Slime to Green Fuel

How scientists at the Ames Laboratory in Iowa created tiny spheres to harvest oil from algae

You've probably heard of dairy farms, corn farms and maybe even wind farms. But how about algae farms? Yep, algae – the same green slimy stuff that floats atop a stagnant pond. In fact, that green slime is actually billions of individual algal organisms. Now, scientists at the U.S. Department of Energy's Ames Laboratory in Iowa have found a new way to make fuel from algae using tiny particles. Thanks to these particles someday, you could be riding in a car powered by biodiesel made from algae.

Why make fuel from algae? For starters, algae grow quickly, and since the earliest days of life on earth, different algae species have adapted to many different environments, including salty ocean water. For that reason, farms that grow algae could be located just about anywhere, and they could begin producing fuel rapidly.

How algae make fuel

Though algae cells aren't quite as complex as the cells found in plants, algae and plants share one important trait: the ability to use sunlight to make food. In fact, each algal cell is like a tiny factory that's dedicated to making food for itself. The food created by algae is a kind of oil. Algal oil is fairly similar to sunflower and other vegetable oils we buy in supermarkets for use in cooking. From a molecular standpoint, oil produced by algae is very similar to the diesel fuel we use to run our cars and trucks.

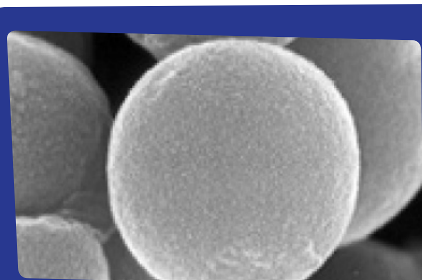
Algae can produce oil quickly, and they can make lots of it. They store this oil just inside their cell walls. Though tiny, those cell walls are fairly thick, which has made extracting the oil from algae expensive. Getting at the oil inside algae cells meant destroying the organisms. As a result, new algae cells had to be grown each time algae oil was harvested.

Now you can understand why supporters of alternative fuels the world over became excited when Ames Laboratory chemist Victor Lin and his team of researchers announced they had

Photo courtesy of Oak Ridge National Laboratory

Microscopic in size, individual algal cells like the ones above can reproduce in a matter of hours.

Algae can be grown in simple open vats like the ones shown here.



Because the Ames Lab nanospheres are just billionths of a meter wide, they can only be seen close up with an electron microscope. The spheres' golf-ball-like outer texture increases their available surface area, which allows them to extract more oil from algae cells. The oil is later converted into biodiesel fuel.

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figured out a way to extract algae oil without harming the algae cells. Their discovery meant the same algae organisms could now produce oil for harvest over and over again.

Nanotechnology to the rescue

To harvest the algae oil, Ames Lab scientists designed tiny spheres called nanospheres. These nanospheres are so small that each one is just a few billionths of a meter wide. That's many times smaller than individual algae cells. However, like algae cells, each of the Ames Lab nanospheres is actually a tiny factory dedicated to harvesting oil from algae cells. How the nanospheres are created and then sent off to do their work is an example of the many marvels of nanotechnology – the science of the very small.

The nanospheres contain miniscule tunnels that run through each sphere. These tunnels are especially important, since the Ames Lab scientists fill them with chemicals that allow the spheres to do their work.

The process begins when the newly created spheres are placed inside a pond or tank that's already full of algae. Chemicals on the spheres enable them to come in contact with algae cell walls and then extract the oil found inside of algae. Once extracted, minute quantities of the oil are then stored inside the tunnels of each sphere.

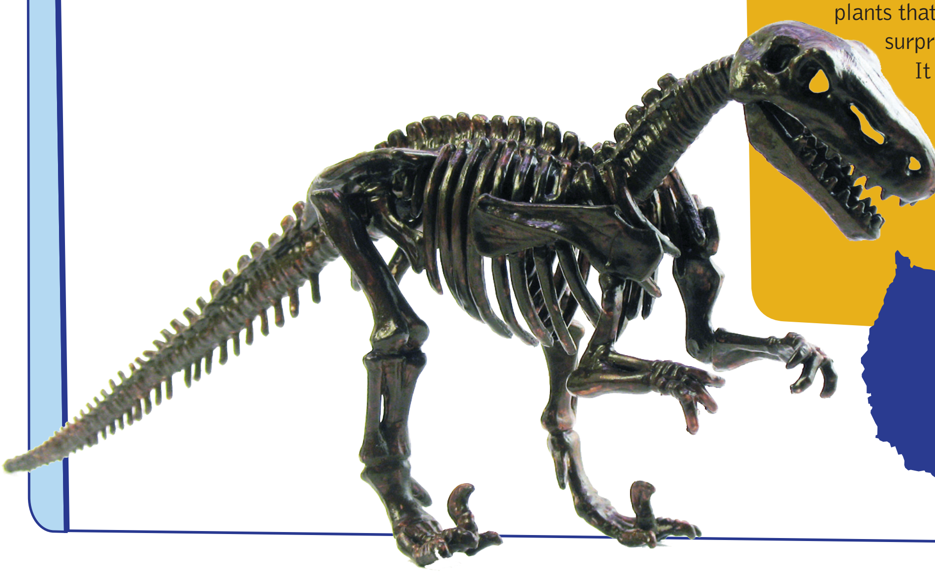
Fortunately, the nanospheres do only minimal damage to the algae, so the organisms are able to begin making fresh batches of oil almost immediately. As a next step, the algae and the spheres are separated. All that's left to do now is convert the algae oil into biodiesel fuel.

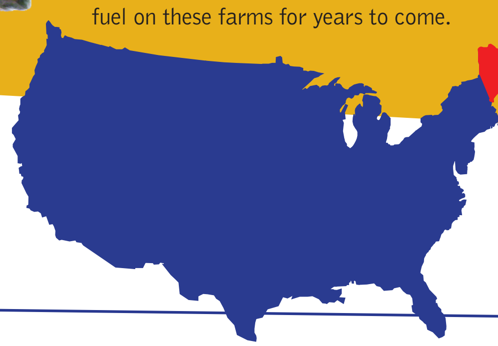
The age of algae

Someday large algae farms that produce biodiesel fuel might be as common a site as electricity-generating windmills are today. A single acre farm – about the size of a city block – could produce enough algae to create 10,000 gallons of fuel. And if an area of land roughly the size of the state of Maine was used for algae farming, we could grow all the fuel needed to run every car and truck on America's highways – and at a reasonable price, too, thanks to the discoveries made at the Ames Laboratory.

FUEL FROM THE DAWN OF TIME

The oil we get from the ground comes from the decayed remains of plants that grew millions of years ago. And it should come as no surprise that this naturally produced oil will run out someday. It takes 200,000 pounds of ancient plant matter to create a single gallon of gasoline. By contrast, if we created algae farms covering an area about the size of the **state of Maine** we could produce enough fuel to power all the cars and trucks on America's highways. And we could raise fresh crops of algae for fuel on these farms for years to come.





The state of Maine