

## Alternative Fuel Sources

**Flight Question:** Is it possible to take algae into space for the purpose of generating fuel to reduce the need of spacecraft to carry large amounts of fossil fuel?

**Long Term Question:** What is the long term potential to manufacture bio fuel in space?

Today, if we travel to space it requires using a large amount of fossil fuel for lift off and to achieve orbit. Then, when we want to come home we need fuel to navigate home. What if we had a way to achieve these objectives but only had to carry enough fuel for lift off? This would free a lot of weight and volume capacity to allow other important items to be carried (oxygen, people, etc.) We can potentially influence future space travel by exploring alternatives to carrying large amounts of fossil fuels on space craft. One possible alternative is to look into a fuel that can be made in space. Algae fuel may be a viable source of biofuel if it can be produced efficiently in space. In July 2011, it was announced that algae-based fuels are finally reaching the commercial stage, and they're being used in aviation fuel and to fuel U.S. Naval ships.

**Background:** Algae biofuel is one of the most exciting and cleanest types of biofuel. Its yield range of producing fuel is higher than other types of biofuel (1,000 – 4,000 gallons per acre). Others such as oil palm, sunflower and soybeans only yield in the hundreds of gallons. The U.S. Department of Energy (DOE) believes algae could meet fuel demands for the country's entire transport network and has invested in algae-focused projects through its Advanced Research Project Agency - Energy, (ARPA-E). There is also interest by other countries in this same product, but they are doing it for different reasons. The Japanese and Indian space agencies have announced that they will collaborate on a new project to research photosynthesis in space. The objective of that mission will be to try and grow the algae spirulina aboard the satellite to study how the conditions of microgravity affect growth, with the ultimate intention of using the data to inform future "space farming" projects.

**Experiment Information:** Sapphire Energy Inc. is a San Diego, California based company with major manufacturing ponds in Orange Country, CA; Las Cruces, NM; and Columbus, NM. With only sunlight and CO<sub>2</sub>, Sapphire Energy is turning algae into Green Crude that can be refined into the three most important liquid fuels we use today: gasoline, diesel and jet fuel (algae will be provided to teams). It is unknown if algae used to produce fuel will survive the launch and re-entry conditions which are required to get the algae to space. Sapphire Energy will provide algae for flight. Students will design an experiment to determine if the Sapphire strain of algae survive space launch and re-entry conditions (temperature, air pressure, G forces, etc.)

## Algae Information

### General information

<http://www.naturegrid.org.uk/biodiversity/plants/crypalga.html>

<http://www.agrra.org/background/algaeback.html>

### Growing and cultivating

<http://www.growing-algae.com/>

[http://www.oakhavenpc.org/cultivating\\_algae.htm](http://www.oakhavenpc.org/cultivating_algae.htm)

### Isolation

[http://www.botany.wisc.edu/courses/botany\\_330/Isolation&Culture.html](http://www.botany.wisc.edu/courses/botany_330/Isolation&Culture.html)

### Types

<http://www.lenntech.com/eutrophication-water-bodies/algae.htm>

Questions to ask:

How do different environments affect algae growth?

How does light affect algae?

Where is algae found?

What do cells look like and how do they function?