CHAPTER 3
FUELS (page76); **SHARING GOALS: PHOTO-SYNTHESIS** (pages 79–80)

BEFORE YOU START
Have you heard of any alternatives to gasoline-powered cars? If so, can you mention them?

The next generation of biofuels

Companies are ready to go commercial with gasoline substitutes made from grass, algae and the ultimate source: engineered micro-organisms.

The world's fuel needs, particularly in the USA, are expected to increase widely as a consequence of dramatic increases in car and aeroplane use. Which is why, in addition to developing solar, wind and geothermal energy, policy makers, including President Barack Obama, are advocating biofuels to transform the transportation culture.

On a commercial scale, today's main biofuel is ethanol, also known as grain alcohol. It is made by fermenting corn kernels[1], a biological process similar to the one that gives us beer and wine. Put corn and yeast[2] together in a big vat[3], and the yeast eats sugar in the corn, producing ethanol and water. Today more than 40 percent of the gasoline sold in the U.S. contains ethanol, typically premixed with gasoline to make a blend[4] called E10 that is 90 percent gasoline, 10 percent ethanol.

Policy makers, however, are not talking about ethanol from corn. Their eyes are on a handful of high-tech labs around the U.S. that are perfecting ways to make the equivalent of gasoline and diesel from the lowest life-forms such as yeast, algae and bacteria. The challenge is to make enough of these fuels economically and in a form compatible with today's vehicles.

Once the next generation of biofuels becomes available, you could swing by the local energy station and fill up on a liquid that is virtually identical to gasoline. It would be made by U.S. companies, not shipped from the Middle East. And even though biofuels release carbon dioxide when they are burned, the organisms they are made from draw an equivalent amount of carbon dioxide from the air, making biofuels essentially carbon-neutral.

Going beyond corn

Most researchers agree that it's time to dump[5] corn-based ethanol. One of these scientists J. Craig Venter, the entrepreneur and biologist whose Institute for Genomic Research in Rockville,Md., played a key role in mapping the human genome[6], promotes a bolder approach.

He believes that the 'most exciting' biofuel will be made from microbes that, when exposed to sunlight, consume carbon dioxide and turn it into energy directly. The idea might sound too good to be true, but Venter, who is known for his restless ambition, says it is possible.

Venter and other scientists are experimenting with photosynthetic microbes such as algae and cyanobacteria (sometimes referred to as blue-green algae). Not only do these microbes remove carbon dioxide from the air, they also grow quickly – some forms double in just twelve hours, whereas grasses and other large plants can take weeks or months to do so. Photosynthetic microbes also store plenty of fat, which forms the basis for fuel.

Algae and cyanobacteria are complicated critters[7]: although they can grow in open ponds, the water can be easily contaminated. Venter's alternative is to grow algae in transparent, outdoor vessels called photobioreactors, but these containers are expensive to build and maintain.

Whoever produces abundant biofuels could end up making more than just a lot of money, they will make history. " The companies, the countries that succeed in this will be the economic winners of the next age to the same extent that the oil-rich nations are today," Venter says. He even suggests that those companies and nations could end up igniting a second industrial revolution – one fuelled by the need to undo the environmental consequences of the first.

Welcome to gasoline substitutes!

Regardless of the method, several scientists promise that by 2011 they'll have made gasoline or diesel substitutes that can be pumped directly into cars. And although these biofuels will probably first be supplied

preblended with traditional gasoline or diesel – much the way E10 is today- one day we may use them alone and say goodbye to petroleum-based gasoline forever.

Adapted from *Scientific American EARTH 3.0* volume 19, Number 1, 2009

Notes

1. **Corn kernels**: the parts inside corn
2. **yeast**: an ingredient used to make beer and bread (*lievito*)
3. **vat**: a large barrel or tank in which liquids can be stored;
4. **blend**: mixture or combination;
5. **to dump**: to leave something because it is no longer needed;
6. **human genome**: the number and combination of certain chromosomes necessary to form the single nucleus of a human cell;
7. **critters**: living creatures

→ EXERCISES

A Decide if these statements are true or false. Correct the false ones

1. Biofuels are necessary to meet the world's fuel needs. (T) (F)
2. Thanks to gasoline or diesel substitutes we will be able to abandon petroleum-based gasoline in the future. (T) (F)
3. E10 is a mixture of gasoline and grain alcohol. (T) (F)
4. J. Craig Venter is creating a corn-based gasoline. (T) (F)
5. Photobioreactors are cheap and easy to maintain. (T) (F)
6. Biofuels are carbon-neutral (T) (F)

B Match these words from the text and their definitions

1. gas produced by animals and people breathing out, and by chemical reactions [....]
2. fuel obtained by the industrial treatment of large quantities of animal or vegetable matter [....]
3. a blend of ethanol and gasoline [....]
4. any material burned to release heat or energy [....]
5. a type of plant that grows in water or damp surfaces [....]
6. very small living things only visible with a microscope [....]
7. transparent containers to grow algae [....]
8. grain alcohol [....]

[a] fuel
[b] biofuel
[c] ethanol
[d] carbon dioxide
[e] microbes
[f] algae
[g] photobioreactors
[h] E10

C Here is an interview to J.Craig Venter. Read the researcher's answers and complete with the questions.

Q .....
VENTER: Not exactly. There are other researchers who are seeking to produce hydrocarbon fuels from algae and microbes, instead of from crop plants.

Q .....
VENTER: The process of making biofuels from microbes is possible with those plantlike microbes that exposed to sunlight, consume carbon dioxide and turn it into energy directly.

Q .....
VENTER: They turn sunlight into energy through photosynthesis.

Q .....
VENTER: Fat is the basis for fuel and plenty of fat is stored in photosynthetic microbes

Q .....
VENTER: Photosynthetic microbes, such as algae and cyanobacteria, remove carbon dioxide from the air and grow quicker than grasses and other large plants.

Q .....
VENTER: The main difference is that photosynthetic microbes produce nearly 250 times more fat per acre,

Q .....
VENTER: No, the concept of making biofuels from algae is not new. A programme started in 1978 and ended 18 years later because it wasn't economically feasible.

D **Fill each of the blanks using only one word in each space**

Americans burn through 140 billion gallons of gasoline (1) ..... year. And even (2) ..... drivers switch to more fuel-efficient cars (3) ..... trucks, the nation's needs (4) ..... expected to increase (5) ..... a fifth over the next twenty years, thanks (6) ..... dramatic increase in car and airplane use. Gasoline (7) ..... refined from crude oil. Do-it- yourself people who don't want (8) ..... depend on the oil companies (9) ..... gone to elaborate lengths to run (10) ..... old cars on biofuels, often by processing used vegetable oil salvaged (11) ..... restaurant deep fryers and storing the result in (12) ..... tank in the garage.

Oral Practice

E **First re-arrange the following sentences correctly and then give a short oral description of the process which generates biofuel diesel.**

1. When they are exposed to sunlight and carbon dioxide,
2. genetically engineered photosynthetic cells.
3. rich fats, which can then be refined
4. Fats grow inside
5. they can produce and secrete energy –
6. directly into biodiesel fuel.

Class debate

F **Surf the Net and find out about Jay Keasling, a promoter of a different method from Venter's. Then send a short email to the class where you compare similarities and differences between the two theories (Venter's and Keasling's). It will be interesting to open a class debate about the results of this research.**