

Greater Long Island



Fun Fueled ACTIVITY BOOK

ACKNOWLEDGEMENTS

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DISCLAIMER

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The Greater Long Island Clean Cities Coalition's fun-fueled activity book.

1. Fuel switching
2. Energy conservation
3. Games

Key words: activity book, air, alcohol, alternate, biodiesel, clean, electric vehicle, fuel, fuel cell, games, natural gas, New York, Long Island, pollution, propane, vehicle.

January 2009 edition

Welcome!

This Fun-Fueled Activity Book was created by The Greater Long Island Clean Cities Coalition to provide accurate, reliable information on “alternative fuels” (also called “clean fuels”) in a fun and interesting way. (An “alternative fuel” is any vehicle fuel that’s not gasoline or diesel — examples are biodiesel, electricity, ethanol, hydrogen, methanol, natural gas, and propane fuel.)

Alternative fuels — and cars & trucks that use them — are becoming more and more widely used. Federal agencies, State governments, and electric and gas companies across the U.S. **are required by law** to purchase alternative fuel vehicles.

The vehicles are available. Automakers (for example, Daimler-Chrysler, Ford, General Motors, Honda, Nissan, Solectria, Toyota, and U.S. Electricar, to name a few) are already producing and selling alternative fuel vehicles. Researchers and engineers are excited about the new technologies, cleaner fuels, and better vehicles.

The fuels are sold on Long Island. Several alternative fuel fueling stations are already here on Long Island, and more will soon follow.

Still, many people are not aware of the reasons for switching to alternative fuels, the differences between the fuels, or even that these fuels and vehicles exist!

There are several good reasons to be excited about the opportunities. Alternative fuels are good for the **environment** and can provide **new jobs** and high-tech industries for Long Island and all across the United States.

For example, some Long Island companies are leaders in new **alternative fuel** technology! Alternative Fuel Vehicles are being purchased by Long Island companies and municipalities, that are being funded by the U.S. Department of Energy and the State of New York.

Important research on renewable fuels, including **biomass** and **hydrogen**, has been conducted at Brookhaven National Laboratory on Long Island and at many learning institutes.

This book can help you to be more knowledgeable about these new fuels & vehicles.

If you have questions, or if you’d like to see the vehicles, please call the resource people listed inside. They’d love to talk with you, and might even visit your class! (If the teacher invites them.)

**** Did you know in 2009 the Greater Long Island Clean Cities Coalition displaced over 11.5 million gallons of diesel fuel through their projects on Long Island.**

Have fun!

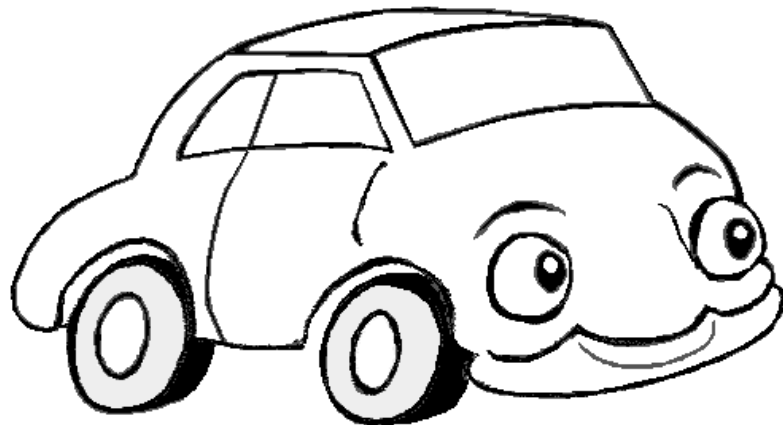
Transportation

Let's **EXPLORE** the world of **NEW FUELS** and the high-tech **CARS** and **TRUCKS** that use them!

First we'll start off with **TRANSPORTATION**.
Then, we'll do activities about **POLLUTION**.
Finally, we'll cover **CLEAN FUELS**.

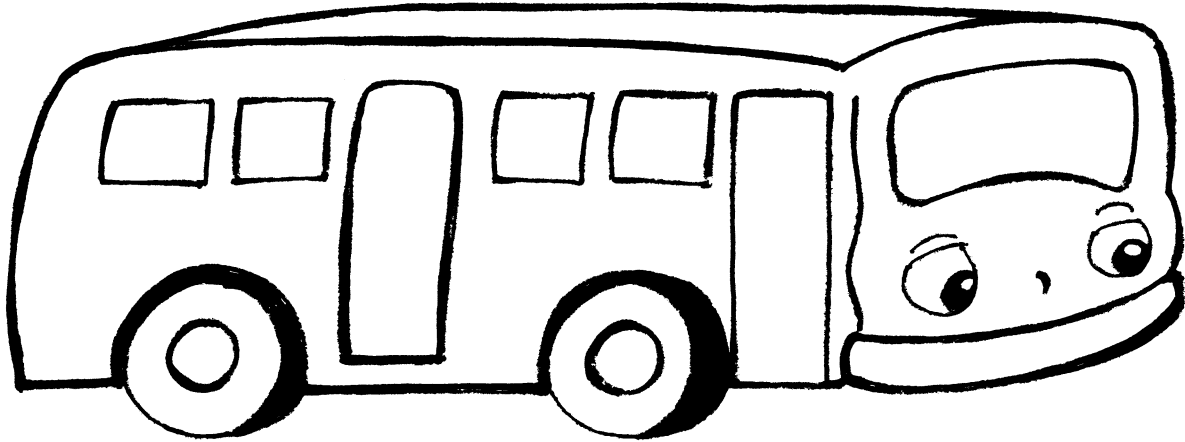
Some of the games are easy. Some are hard.
But try them all – and don't be afraid to ask questions!

Let's **GO!**



Color Joe the Alternative Fuel Car your favorite color!

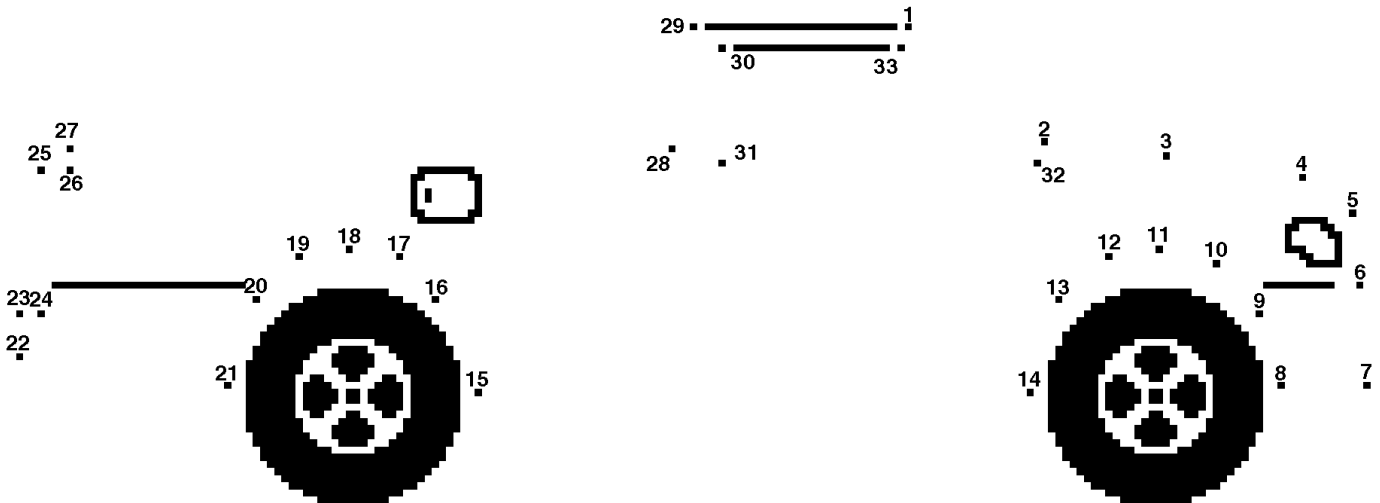
COLORING



Most buses and large trucks use DIESEL fuel. So does this one. Can you color Dominick the Diesel Bus to look like a bus you've seen?

ROLLING DOTS

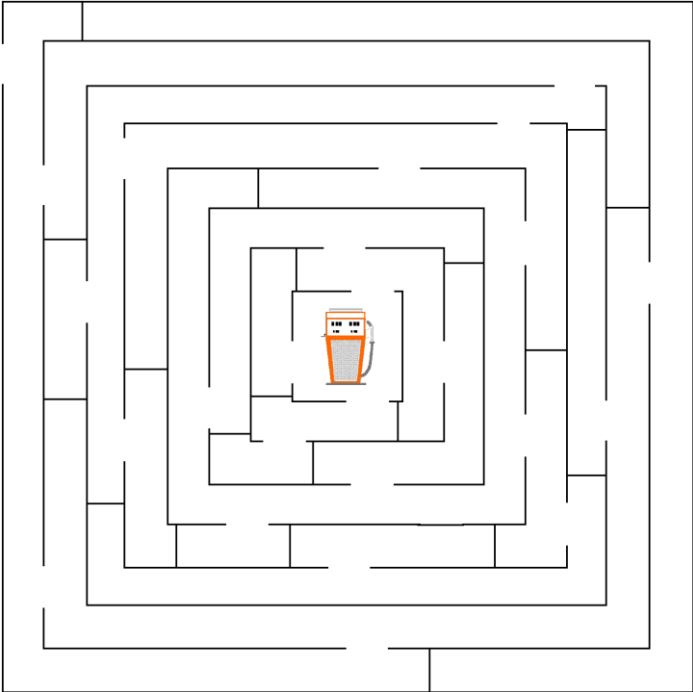

Connect the dots to make a picture of something Dennis drives to work.



It's a- Maz-ing!

**Help
Fillmore
Car find
his way
to the gas
pump...
BEFORE
he runs
out of
fuel!**

START



The maze is a square with a complex internal structure of paths and dead ends. At the center of the maze is a gas pump icon. The car starts at the top-left corner of the maze, labeled 'START'.

*The average
car or
pickup truck
uses about
500 gallons
of gasoline
each year
- over a
gallon a
day!*



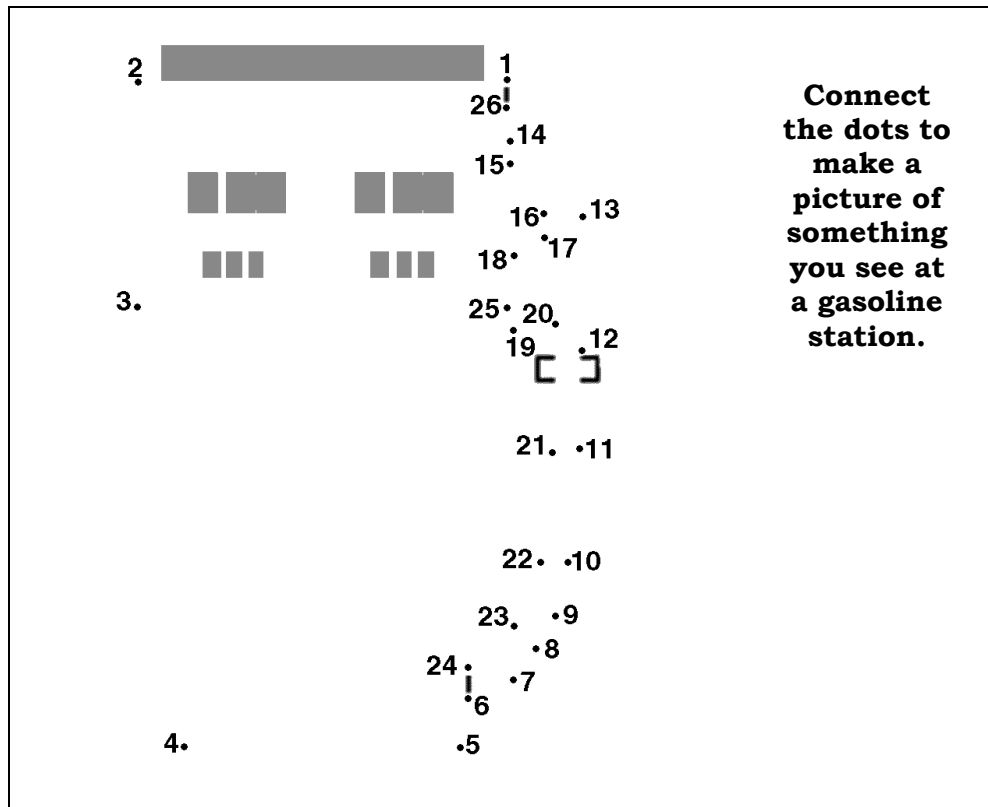
Connect the Dots

How often does your family go to the gas station?

What do you see there?

Where do you think the fuel is stored?

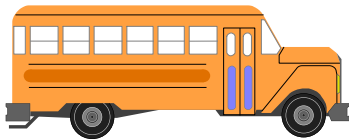
Gasoline and diesel fuel storage tanks are usually under the ground.



Connect the dots to make a picture of something you see at a gasoline station.

WHEELS AWAY

Can you fill in the letters of where these vehicles are going?



Rita rides a bus to

o o .



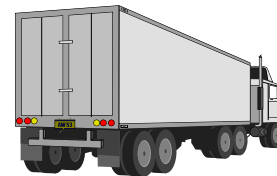
David's parents drive a car to

o .



Frank takes an airplane to the state of

a i o n .



Russ's truck delivers juice to the

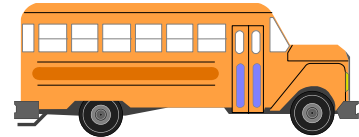
u e a e t .

MATCH-UP #1

Transportation fuels, such as gasoline, diesel, and jet fuel, are used by vehicles to move people and things every day. Can you match the fuels to the vehicles?

A. GASOLINE

Rita's bus ___.



B. JET FUEL

David's parents' car ___.



C. DIESEL

Frank's airplane ___.



TRANSPORTATION FUEL SCRAMBLE

Cars, trucks, vans, buses, and motorcycles use "transportation fuels."
Can you unscramble the names of two common fuels?

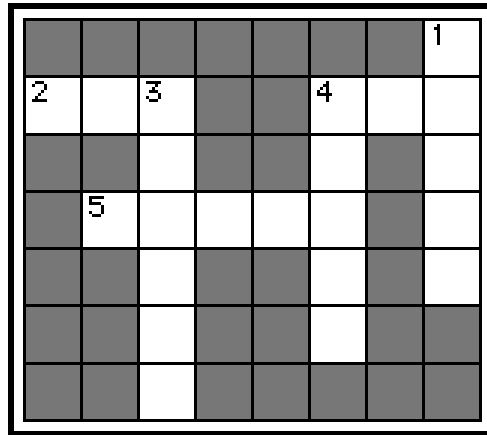
NEGALSIO

LEDISE

CROSSWORD #1

ACROSS

2. When we go on a field trip, my class rides in a big yellow ____.
4. A ____ is a vehicle with four tires and a trunk.
5. You must be at least 16 years old before you can ____.



DOWN

1. A pickup ____ has space for people in the front and space for things in the back.
3. People use the sidewalk; cars use the ____.
4. ____ air is better than dirty air.

WORD SEARCH #1

Can you find the words? They might go up, down, diagonally, or backwards!

K	C	U	R	T	E
B	E	D	B	N	V
U	Z	N	I	Z	R
S	Q	G	A	B	A
S	N	E	P	L	C
E	F	U	E	L	P

BUS
CAR
ENGINE


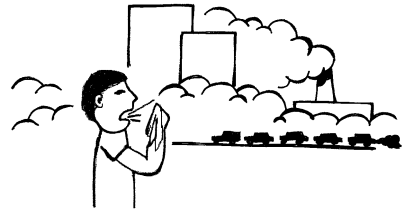
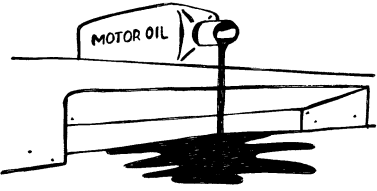
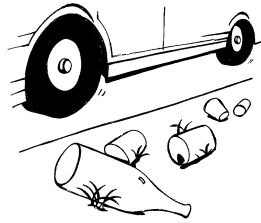

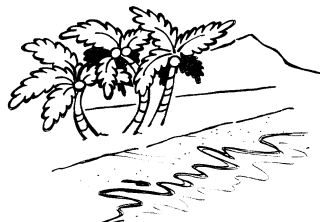
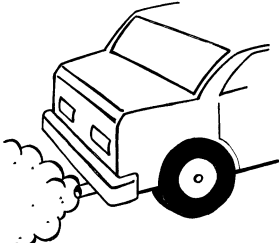
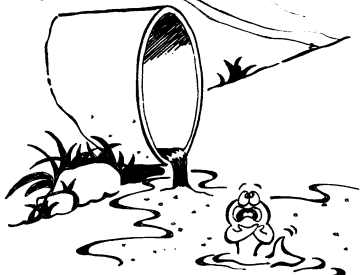
FUEL
PLANE
TRUCK

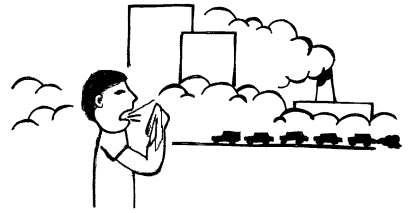
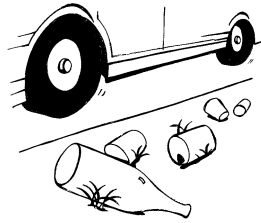
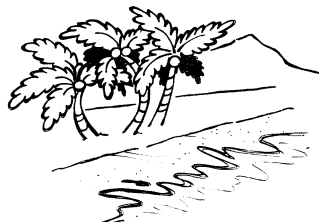
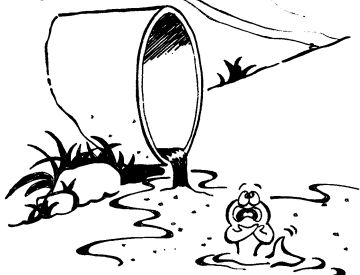
Pollution

POLLUTION is when the air, water, or land becomes dirty through the actions of people. Some types of pollution – such as litter along the beach – are easy to see. Other types of pollution, such as chemicals in the water or air, are not as easy to see but can be very harmful.

CAUSE - AND - EFFECT

Can you match a pollution source to its result?
Write the letter of the cause (left column) next to its effect (right column).

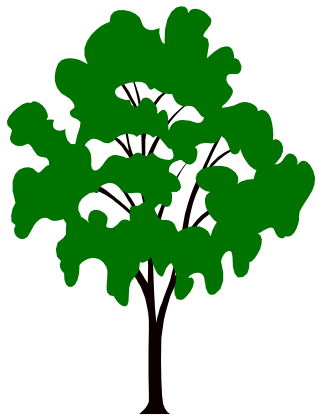
<p>A.</p>  <p>oil tanker</p>	<p>_____</p> 
<p>B.</p>  <p>pollution going into storm drain</p>	<p>_____</p> 
<p>C.</p> 	<p>_____</p>  <p>oil spill washing up on the beach</p>
<p>D.</p> 	<p>_____</p> 

<p>_____</p> 
<p>_____</p> 
<p>_____</p>  <p>oil spill washing up on the beach</p>
<p>_____</p> 

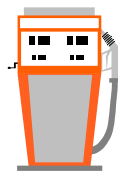
Pollution

Here are some ways that can cause problems:

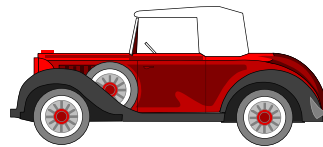
- Pollution is bad for our health. It can make us s _ _ _ and in some cases can even cause death.
- Pollution is harmful to the environment. Toxic chemicals in the air, water, soil, and food chain harm p _ _ _ _ _ and a _ _ _ _ _ .
- It costs a lot of money to clean up damage from p _ _ _ _ _ .



AIR +



FUEL =



ENERGY +



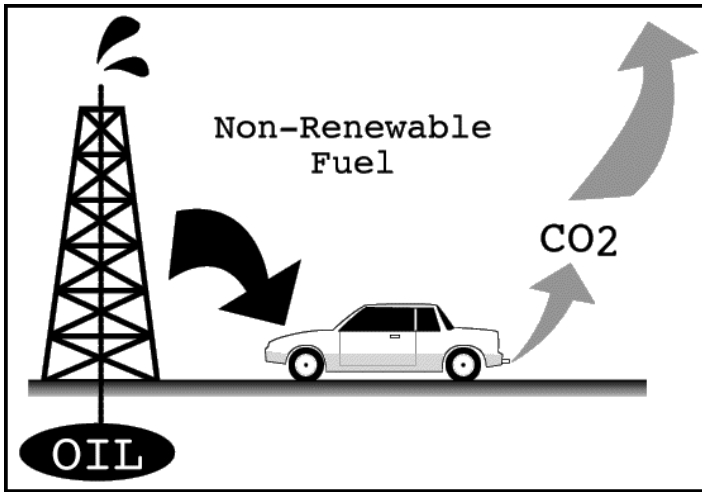
EMISSIONS

When fuels are burned, they produce heat (energy), carbon dioxide (CO₂), water (H₂O), and small amounts of other chemicals, such as carbon monoxide (CO), unburned hydrocarbons, oxides of nitrogen (NO_x), soot, and particulates.

- Carbon monoxide (CO) can cause headaches and place additional stress on people with heart disease. In higher doses, it binds to red blood cells and can cause carbon m _ _ _ _ _ poisoning.
- “Smog” contains ozone, which is created by oxides of n _ _ _ _ _ (NO_x) and hydrocarbons. It can cause shortness of breath and lung damage.
- Other fuel e _ _ _ _ _ s, such as particulates, may cause cancer.

Carbon d _ _ _ _ _ (CO₂) is a major contributor to “global climate change.” Effects of global climate change include rising sea levels, changes in rainfall patterns, and increased severity of major storms

Extra Tricky Quiz



Most transportation fuels – gasoline and diesel fuel, for example – are made from oil. Oil is considered a **non-renewable** fuel. When oil is burned, CO₂ is added to the atmosphere. But nature can't make CO₂ back into oil very quickly, so the amount of CO₂ in the air keeps increasing. (And the amount of oil in the ground keeps decreasing.)

Transportation fuels account for about one-third of the United States' CO₂ emissions. The increasing emission of CO₂ worries people concerned about “g l _ _ _ _ c l _ _ _ _ c h _ _ _ _ ,” also known as the “greenhouse effect.”

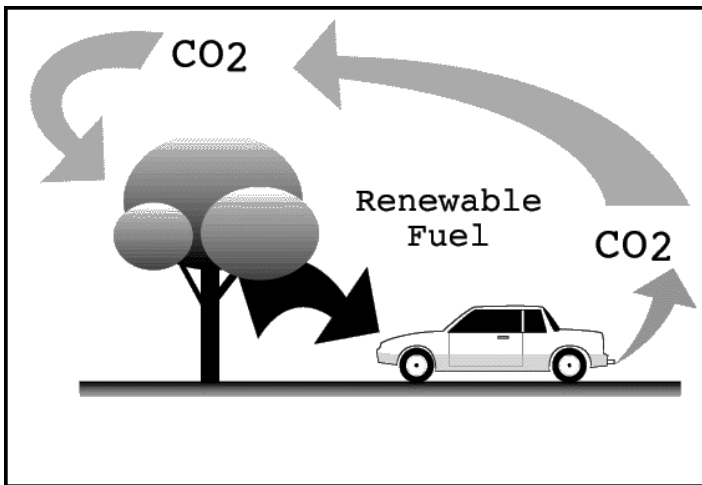
Every time fossil fuel (like petroleum, also known as “crude o _ _”) is taken out of the ground and burned for fuel, CO₂ is released into the atmosphere (air).

? - ? - ? - ? - ? - ? - ? - ? - ? - ? - ? - ? - ? - ? - ? - ?

One gallon of gasoline weighs about **6.5 pounds**.
But when it's burned, about **20 pounds** of carbon dioxide
(CO₂) are produced! **How can this be?**

Even college students get stumped by this one. But don't give up too soon!

? - ? - ? - ? - ? - ? - ? - ? - ? - ? - ? - ? - ? - ? - ? - ?



When plants are used to make fuels, these fuels are r _____. When renewable fuels are burned, CO₂ is added to the atmosphere, but in this case there **is** a balance, since growing plants remove CO₂. In a perfectly renewable system, the same number of plants that are harvested are replanted. This way, the amount of CO₂ being added to the atmosphere is the same amount that the growing plants are using, and there is no net increase.

Using **renewable** fuels instead of non-renewable fuels could help to reduce the total amount of CO₂ added to the atmosphere.

Biodiesel and **alcohol fuels** made from plant matter are examples of renewable fuels.

Electricity can also be considered a renewable fuel - **IF** it is produced from renewable energy sources such as wind, sun, plants (“biomass”), or hydropower.

Math Teaser #2

One gallon of gasoline produces about 20 pounds of carbon dioxide (CO₂). Every year, vehicles on Long Island use about 400,000,000 gallons of fuel. How many pounds of carbon dioxide (CO₂) are produced?

- About 1,000,000 pounds (500 tons)
- About 1,000,000,000 pounds (500 thousand tons)
- About 8,000,000,000 pounds (4 million tons)

Clean Fuels

Alternative fuels are also called “clean fuels.” They produce less air pollution than non-alternative (gasoline and diesel) fuels.

True or False:

We have no choice – we have to use fuels that can damage our environment and our health.

Answer:

False; we can use cleaner fuels. Some can be made right here in Long Island!

Some types of Clean Fuels are:

Alcohol - There are 2 types: “ethanol” and “methanol.” Historically, **ethanol** has been made from corn or sugarcane. New processes can make ethanol from paper, yard trimmings or sawdust. **Methanol** is usually made from natural gas but could also be made from wood or sugarcane. Alcohol fuels produce less carbon monoxide than gasoline does.

Biodiesel - Made from vegetable (corn, soybean, etc.) oils, including used cooking oil (such as oil used in frying French fries). Its lubricating qualities are good for engines. Biodiesel produces less smoke and particulates than regular diesel fuel does.

Electricity - Not really a “fuel” like gasoline or diesel; rather, a form of energy. Electrical energy can be made by burning oil, biomass, or other fuels. Or, electricity can be made (from wind, water, or sunshine) without burning anything.

Electric vehicles run on electricity stored in rechargeable batteries (the batteries are re-charged by plugging into an electrical outlet). Electric vehicles are “zero emission” vehicles – nothing is burned on-board the vehicle. All emissions are at the powerplant, and are less than would be produced if the vehicle used gasoline or diesel fuel.

“**Fuel cell**” cars are another type of electric vehicle – they run on the electricity produced by fuel cells.

Propane - Also known as “LPG” (Liquefied Petroleum Gas). Made from fossil fuel. Propane produces less carbon monoxide than gasoline does, and helps engines last longer.

Compressed Natural Gas - (CNG) is a fossil fuel substitute for gasoline (petrol), diesel, or propane fuel. Although its combustion does produce greenhouse gases, it is a more environmentally clean alternative to those fuels, and it is much safer than other fuels in the event of a spill (natural gas is lighter than air, but disperses quickly when released).

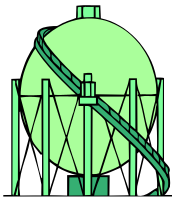
CNG is made by compressing natural gas (which is mainly composed of methane [CH₄]), to less than 1% of its volume at standard atmospheric pressure. It is stored and distributed in hard containers, at a normal pressure of 200–220 bar (2900–3200 psi), usually in cylindrical or spherical shapes.

PICTURE THE FUELS

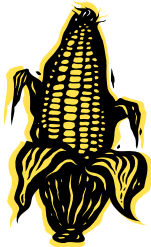
Can you match the fuels (left) with their vehicles (right)?



A.
Traditional fossil fuel for cars



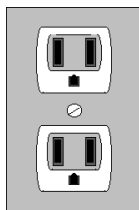
B.
Liquefied petroleum gas (LPG)



C.
Corn to make alcohol fuel



D.
Used cooking oil



E.
Recharging station

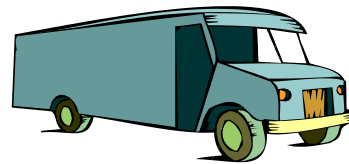
____. **ETHANOL**



____. **ELECTRIC**



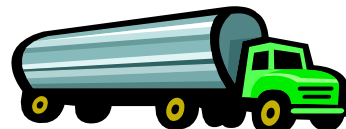
____. **PROPANE**



____. **GASOLINE**



____. **BIODIESEL**



Clean air is not the only benefit from alternative fuels.

Alternative fuels can help with national concerns too:

BALANCE OF TRADE, JOB CREATION,
and **NATIONAL ENERGY SECURITY.**



Because of issues such as job creation, balance of trade, and energy security, Congress passed the National Energy Policy Act in 1992. This law **requires** fleets of more than 20 centrally-fueled light duty vehicles located in large cities to purchase **alternate fueled vehicles** capable of using “alcohol fuels, natural gas, liquefied petroleum gas, hydrogen, biodiesel, coal derived fuels, biological materials derived fuels, or electricity.” In Hawaii, only fleets on Oahu are covered.

Beginning in September 1996, Federal government agencies, fuel providers (such as electric utilities, gas companies, and alternative fuel producers) and State government fleets (including State Government agencies) were required to begin purchasing alternative fuel vehicles. Hawaii State agencies have purchased alcohol, electric, and propane vehicles.

Beginning in 2001, City and County governments and large private fleets may also be required to purchase alternative fueled vehicles.



GO U.S.A.

*Can you fill in
the blanks?*

Transportation is an important part of our lives. And our trucks, buses, and cars need f ___ s to run. Right now, the only fuels used by most vehicles are gasoline and diesel, made from oil imported from other c _ _ _ _ _ s .

Sending all this money out of the U.S.A. is not good for the B _ _ _ _ _ OF T _ _ _ _ . And it doesn't keep the money here to CREATE J _ _ _ . And every time there's a war involving (or near) countries that produce the oil we need, it becomes a threat to our N _ _ _ _ _ ENERGY S _ _ _ _ _ .

By a law passed by the U.S. C _ _ _ _ _ in 1992, alternative fuels are now part of the official National Energy Policy of the United States.

TRUE or FALSE?

Indicate whether the following statements are "TRUE" or "FALSE." You may need to refer to the fact sheets in the back.

T or F

1. _____ The speed record for an electric vehicle is over 200 miles per hour.
2. _____ Neither General Motors nor Ford produces a propane truck.
3. _____ Biodiesel fuel is produced in United States.
4. _____ Alcohol fuels are most commonly made from grapes.
5. _____ Alternative fuel vehicles are used in Federal and State fleets.
6. _____ Vehicle emissions can be harmful to your health.
7. _____ The distance record for an electric vehicle is 100 miles.

Find the Phrase

Use the clues below to find the motto of the Greater Long Island Clean Cities Coalition (the organization that prepared this Activity Book).

1. Washing hands gets them _____ (1)
2. Food _____ my body. (2)
3. Electricity is _____ cars too. (3)
4. We like to breathe _____ (4) _____ (5)

Find the phrase: Greater Long Island Clean Cities Coalition' Motto is:

“ _____ (1) _____ (2) _____ (3) _____ (4) _____ (5) ”

Word Search

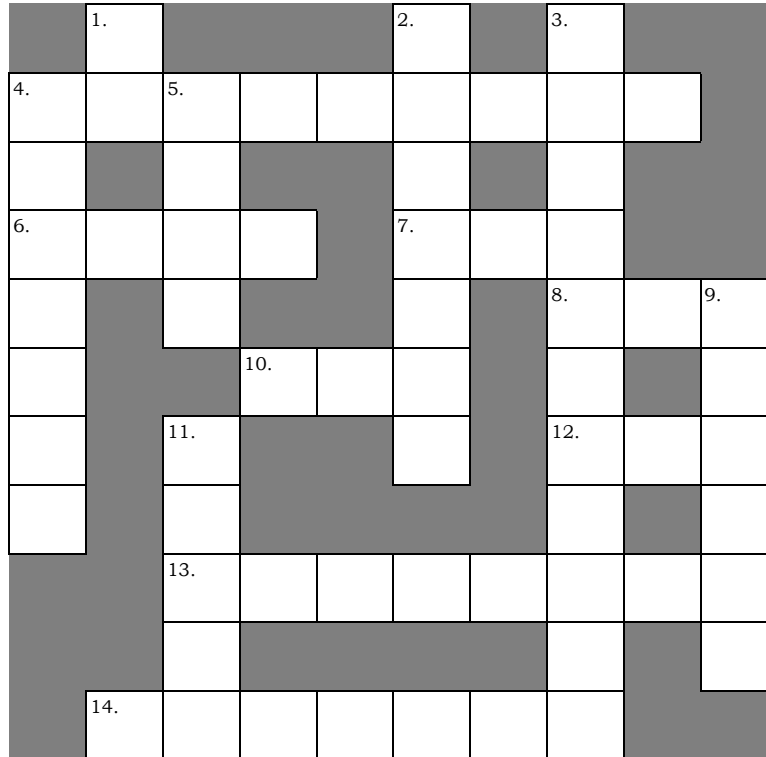
Can you find the words? They might go up, down, diagonally, or backwards!

A	T	R	U	C	K	C	L	E	S	E	I	D	O	I	B
T	L	A	O	Y	C	A	L	O	E	N	S	M	B	H	U
C	V	T	P	Q	A	R	G	K	L	J	P	I	A	Z	S
A	N	E	E	B	Y	B	V	D	E	F	K	L	T	E	L
Y	L	P	G	R	T	A	U	X	C	W	J	O	T	V	R
C	K	C	M	E	N	I	Z	P	T	S	D	H	E	C	E
I	L	V	O	B	T	A	J	L	R	G	M	O	R	F	S
L	S	Y	T	N	A	A	T	Z	I	O	U	C	Y	X	N
O	R	R	U	Q	V	P	B	I	C	W	P	L	H	V	O
P	O	I	C	T	N	E	O	L	V	M	L	A	K	J	I
Y	W	A	R	F	Y	E	R	G	E	E	I	D	N	I	S
G	S	N	T	G	S	G	D	S	H	O	F	H	B	E	S
R	X	A	R	U	D	C	H	F	I	E	I	U	N	O	I
E	P	E	Q	R	F	L	E	G	C	O	X	L	E	B	M
N	N	L	M	K	Q	V	I	H	L	J	N	A	P	L	E
E	N	C	H	A	R	G	E	R	E	W	Y	A	Z	C	S

ALTERNATIVE FUELS
ALCOHOL
BATTERY
BIODIESEL
BUS
CAR
CHARGER
CLEAN AIR
CONVERSION

ELECTRIC VEHICLE
EMISSIONS
ENERGY
ENERGY POLICY ACT
LPG
PROPANE
TRUCK
VAN
VEGETABLE OIL

CROSSWORD PUZZLE



ACROSS

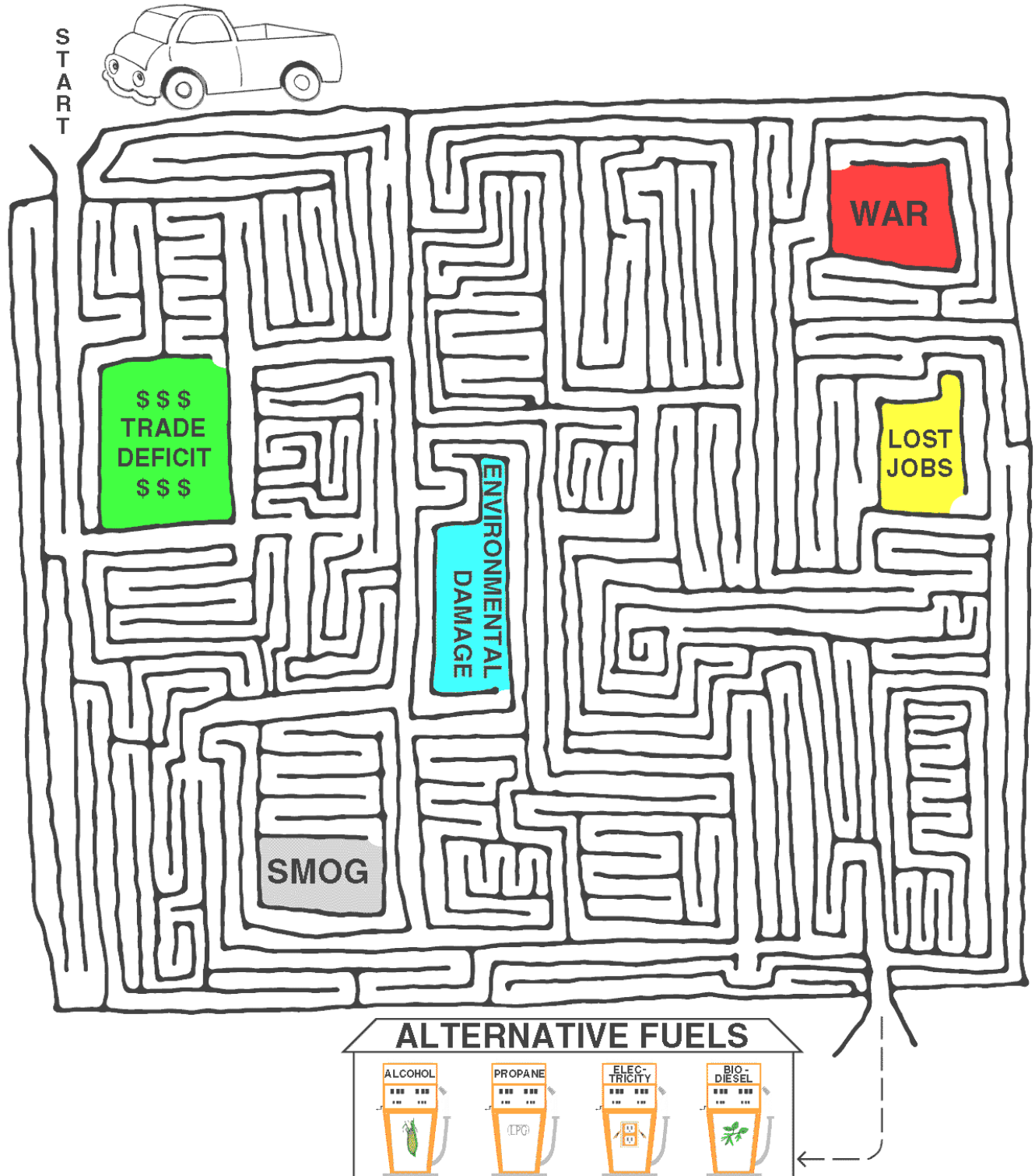
4. Biodiesel fuel is made from _____ oil.
6. Clean fuels can ____ us to have clean air.
7. Solar cars get energy from ____ sun.
8. A ____ light means "stop."
10. Vehicle exhaust pollutes the ____ .
12. Michael ____ the French fries.
13. Most cars use ____ for fuel.
14. ____ is also used in barbecue grills.

DOWN

1. Propane can ____ used as a vehicle fuel.
2. Electric vehicles have more than one ____.
3. Alcohol is an ____ fuel.
4. A car or truck is a ____.
5. Electric carts are used on the ____ course.
9. Most large trucks and buses use ____ fuel.
11. A really *wild* ride would be catching a ____ (large striped black-and-orange animal) by the tail.

a-MAZE-ing Fuels!

Can you help Tommy Truck find his way to the alternate fuels?
Avoid the dead ends!



SUMMARY (extra credit!)

Fill in the blanks below and use the letters in the squares to spell one of the topics of this Activity Book. (Hint: **read the whole sentence** before trying to fill in the missing word.)




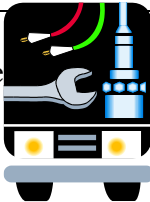

1. Transportation is an I M _ _ _ _ _ T part of our lives.
2. F _ _ _ are essential to our transportation system.
3. We use a L _ of fuel.
4. Millions of gallons of fuel are used on Long Island _ _ _ year.
5. These fuels P _ _ _ C E many pollutants.
6. But C L _ _ _ _ fuels are becoming available.
7. L _ _ _ _ _ fuel is renewable.
8. Biodiesel is made R I _ _ here in New York.
9. E L _ _ _ _ _ vehicles are “zero-emission vehicles.”
10. Propane has been used in E _ _ _ _ _ in New York for over 25 years.
11. New Federal laws require government F L _ _ S to purchase alternative fuel vehicles.
12. Automobile and truck M A N _ _ _ _ _ _ _ _ have designed engines to use the cleaner fuels.
13. Some of the vehicles can U _ _ two kinds of fuel.
14. In addition to C _ _ N air, there are other benefits from these fuels.
15. National energy security, more jobs, and improved B A _ _ _ _ of trade are some of the other benefits.
16. Someday, a car you drive may be powered by one of T H _ _ fuels!

Solve the puzzle using the letters in the boxes above:

1 2 3 E/4 5 6 A/7 8 9 V/10 11 12 U/13 14 15 16

Fact Sheet

An “alternative fuel” is pretty much anything that’s not gasoline or diesel. You may have heard of:

<p>Biodiesel *</p> 	<p>A substitute for diesel fuel, made from vegetable oil (including used cooking oil). Used in boats, buses, and large trucks. Made in New York.</p>
<p>Electricity * (for “electric vehicles”)</p> 	<p>An electric vehicle has an electric motor instead of an internal combustion engine. Electricity for the motor comes from batteries or fuel cells. Since there’s no combustion happening on the vehicle, electric vehicles are “zero emission,” quiet, and cool. Made on Long Island.</p>
<p>Ethanol (an alcohol* fuel)</p> 	<p>An alcohol fuel made from corn or sugarcane. It could also be made from waste paper, sawdust, or other low-cost materials. Ethanol is a liquid fuel that can be used in an internal combustion engine or a fuel cell. That is made in New York.</p>
<p>Fuel Cells</p>	<p>Fuel cell vehicles are the best of both worlds, in theory – they’re electric vehicles that could be re-fueled with alternative fuels (ethanol, methanol, or hydrogen, for example). This is attractive since re-fueling is faster than re-charging. The first hydrogen fuel station on Long Island is now being built in Point Lookout.</p> 
<p>Hydrogen (not commercially available)</p>	<p>Hydrogen is being considered for use in fuel cells and has been used in internal combustion engines. The main obstacle is fuel distribution and storage, both on and off the vehicle. Vehicles are now being made and will be available for sale in the near future. Hydrogen fuel could be made on Long Island.</p>
<p>Methanol (an alcohol* fuel)</p> 	<p>An alcohol fuel made from natural gas. It could also be made from landfill gas, sugarcane bagasse, or wood chips. Methanol is a liquid fuel that can be used in an internal combustion engine or a fuel cell.</p>
<p>Natural gas (also known as “compressed natural gas” or “CNG”)</p>	<p>Commercially available in areas on Long Island. Some people have natural gas in their homes for heating, cooking, and to refuel their cars.</p>
<p>Propane * (also known as “LPG,” “liquefied petroleum gas”)</p>	<p>Propane, which is made from refinery byproducts on Long Island. Propane vehicles are in use on Long Island.</p>
<p>Solar Cars (this is a type of electric vehicle)</p>	<p>Solar cars are being made but not for commercial use yet. The solar car doesn’t have to carry solar cells with it – an electric car can plug into solar panels installed on a carport or garage roof, and charge up while it’s parked in the shade!</p>

Alcohol Fuels

What are they?

Alcohol fuels are made from renewable resources like locally grown crops and even waste products such as waste paper or grass and tree trimmings. Methanol and Ethanol are two types of alcohol fuels used in cars. Ethanol can be produced from a variety of renewable* resources, most commonly corn and sugarcane. Methanol can be made from renewable resources also, but today, methanol is primarily made from natural gas.

Why Alcohol Fuels?

- Alcohol fuels burn cleaner than regular gasoline and produce less carbon monoxide emissions.
- Supporting local business keeps dollars in the state and contributes to a healthier state economy.
- Production of fuels in state provides energy self-sufficiency.

Did you know?

- Methanol has been used as a racing fuel at the Indianapolis 500 Motor Speedway (for reasons of safety and performance) for the past 20 years!
- Ethanol was the fuel preferred by Henry Ford back in the early days of the Model T.
- Alcohol fuels have high octane. Unleaded gasoline usually has an octane rating between 86 and 94; alcohol fuels' octane ratings are over 100!
- "Flexible fuel" alcohol vehicles can use both alcohol and gasoline -- at the same time, in any mixture from 100% gasoline to 85% alcohol! A special sensor on the fuel line senses the ethanol/gasoline mixture, sends the information to the engine's computer, and the air: fuel ratio and timing are instantaneously adjusted. A digital readout on the dashboard shows the driver what the alcohol fuel percentage is at that moment!
- Ethanol flexible-fueled vehicles are available for the same price as gasoline vehicles.
- Chrysler makes ethanol flexible-fueled Town & Country, Caravans, and Voyagers.
- Ford makes ethanol flexible-fueled Ranger trucks and Taurus sedans.
- Mazda makes ethanol flexible-fueled B3000 pickup trucks.

Biodiesel

What is it?

Biodiesel is a liquid fuel that can replace regular diesel fuel. It's made from vegetable oil. Biodiesel can run diesel engines that are commonly found in big vehicles such as trucks, buses, or boats. Biodiesel is used in boats, trucks, and even in diesel-fueled electricity generators.

Why Biodiesel?

- Regular diesel fuel particulates may be carcinogenic (can cause cancer). Using biodiesel fuel, or blending it with regular diesel fuel, can reduce the production of these cancer-causing emissions. In other words, it's better for our health!
- Biodiesel can be made from waste vegetable oil (such as used oil from deep fryers at restaurants). This waste oil can be difficult to dispose of. Making fuel out of it can put it to a good use, and at the same time, reduce disposal problems.
- Biodiesel is a renewable fuel.
- Biodiesel can help create new jobs; also, keeping our air clean helps everybody enjoy Long Island more.

Did you know?

- Biodiesel can be used in pure form or blended with regular diesel in any proportion.
- Biodiesel can even make engines smell better. An engine powered by biodiesel actually smells like French fries!
- Biodiesel fuel is a good lubricant, which helps engines to last longer. It also has a high cetane rating,* which improves engine operation.
- Adding just 20% biodiesel to regular diesel improves the diesel's cetane rating by 3 points, which makes a blend of 80% diesel and 20% biodiesel a "premium" fuel.
- In addition to being used on Long Island, biodiesel fuel is used in buses in Europe and in the Midwestern United States.
- Biodiesel is used in sensitive wetland areas to reduce the danger of fuel spills to endangered wildlife.

* A "cetane rating" indicates the ability of a fuel to ignite in a diesel engine. (Not to be confused with an "octane rating," which indicates the ability of a fuel to avoid "knocking" in a gasoline engine). A higher number may improve performance, depending on the engine.

Electric Vehicles

What are they?

Electric vehicles run on ELECTRICITY (see "electricity" fact sheet, next page). Electric vehicles can be one of the most environmentally harmless means of motorized transportation that we can choose from.

Why Electric?

- Electricity is our most familiar source of energy. It can be made from clean, renewable energy sources such as wind, water, or solar power.
- "Refueling" (recharging) at home is more convenient for people on the go.
- The cost of electricity for recharging is about 1/3 less than the cost of gasoline.
- Special "rapid chargers" can recharge electric vehicles in just 15 minutes.
- Electric vehicles are "Zero Emission Vehicles." They have absolutely zero tailpipe emissions. (In fact, they don't even have tailpipes!)

Did you know?

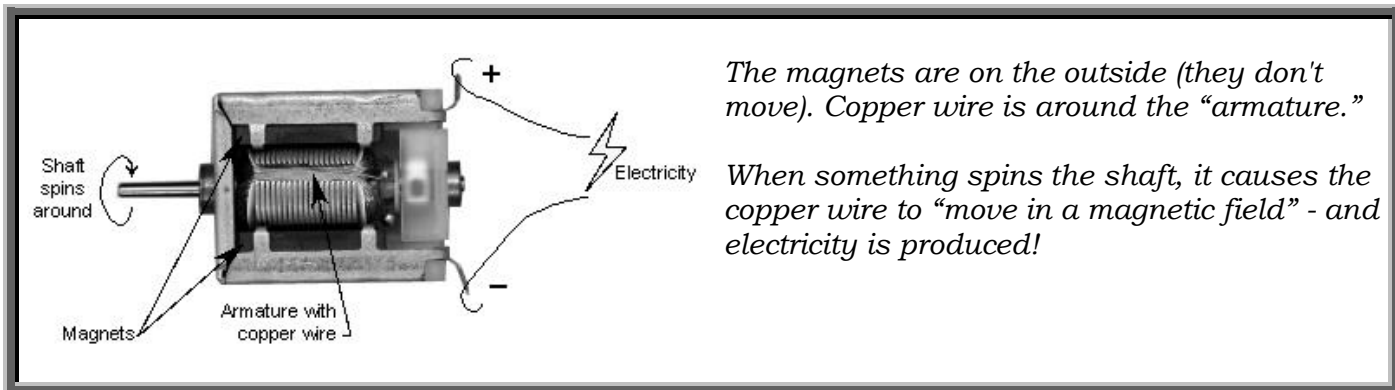
- The top **speed record** for an electric car is over 200 miles per hour! (**215 mph** record held by "Lightning Rod," owned by the Rannbergs, driven by Eric Luebben, 1998.)
- The longest **distance** traveled by an electric car **on a single charge** is **1043 miles!**
- Batteries store the energy for today's electric vehicles. Future batteries are expected to be lighter, smaller, more efficient, and cheaper - hundreds of scientists and engineers are developing and testing new batteries right now! They are also developing flywheels, capacitors, and other exotic energy storage devices.
- Some electric vehicles are even more energy-efficient -- they use regenerative braking. This means that the energy from braking is captured and returned to the batteries!

Electricity

**"When a wire is moved in a magnetic field,
an ELECTRIC CURRENT is generated in that wire."**

Large-scale electricity generation - whether from fossil fuels, renewable fuels, or other sources - is usually based on the fact that:



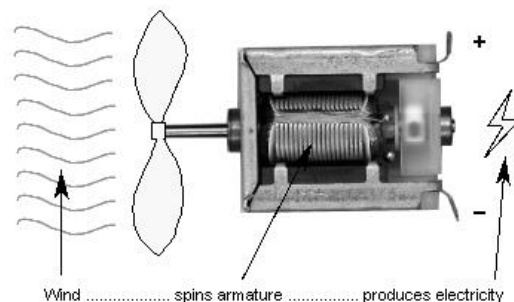


A "generator" and "motor" are essentially the same thing: what you call it depends on whether the unit is producing or using electricity.

A **generator** produces electricity. In a generator, something causes the shaft and armature to spin. An electric current is generated, as shown in the picture (lightning bolt).

Lots of things can be used to make a shaft spin - a crank, pinwheel, windmill, bicycle, water wheel, diesel engine, jet engine, or steam turbine. They're different sizes but it's the same general idea.

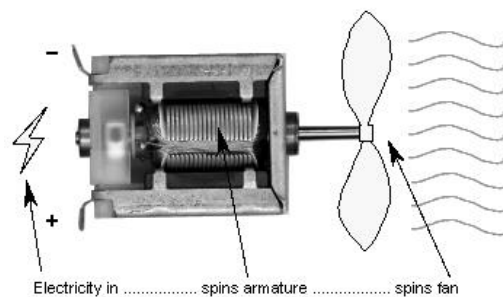
Generator produces electricity



A **motor** uses electricity. In a motor, the electricity comes in through wires attached to the positive (+) and negative (-) terminals. The electric current causes the armature and shaft to spin.

If there's just a little current and it's a small motor, it won't do very much work (i.e. it can only spin a small fan). If it's a large motor and it's using a lot of electricity, it can do a lot of work (i.e. spin a large fan very fast ... or, turn the wheels of a car, bus, or truck).

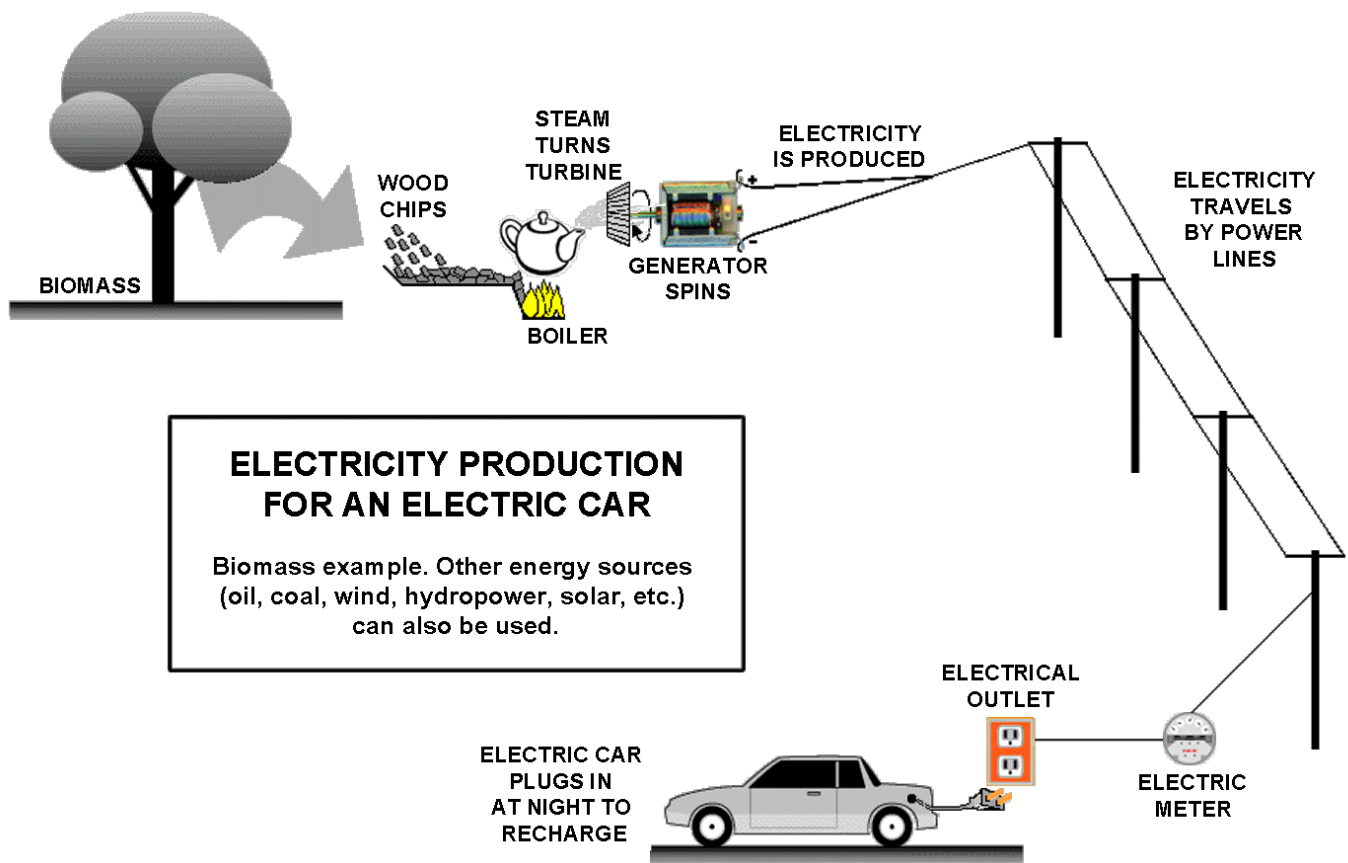
Motor uses electricity



Electric power plants are essentially the same thing - just LOTS BIGGER!

The different energy sources all do the same basic thing: **spin something** (connected to a generator made of copper wire and magnets). In a steam power plant, fuel (oil, wood, etc.) is burned to heat water into steam, which spins a turbine (connected to a generator). In a combustion turbine, burned fuel turns the turbine. In a hydropower plant, flowing water spins the turbine. The electricity is the same, regardless of energy source.

Then, the electricity flows from the generator into the powerlines and into your home, school, office, or garage (where it can charge an electric car). **That's it!**



ELECTRICITY PRODUCTION FOR AN ELECTRIC CAR

Biomass example. Other energy sources (oil, coal, wind, hydropower, solar, etc.) can also be used.

The electro-mechanical approach described here (**electromagnetic induction** generating an **alternating current**) is just one way to produce electricity. There are also electrostatic, electro-chemical, photoelectric, and thermoelectric phenomena (just to name a few) which can be used to produce an electric charge or direct-current electricity. For example, you can generate an electric charge just by wearing leather-soled shoes and shuffling your feet on carpet (if the weather is dry enough). Chemical reactions can be used to produce electricity (batteries and fuel cells are based on this). Light waves can generate an electric current in certain materials (such as photovoltaic cells). A temperature difference can generate a current in a thermocouple. And there are many more examples. Nevertheless, the electricity at your wall outlet -- that powers your toaster, blender, television, lights, etc., (or charges an electric vehicle) -- is usually produced by spinning a generator made of magnets and wires, as described above.

Fuel Cell Vehicles

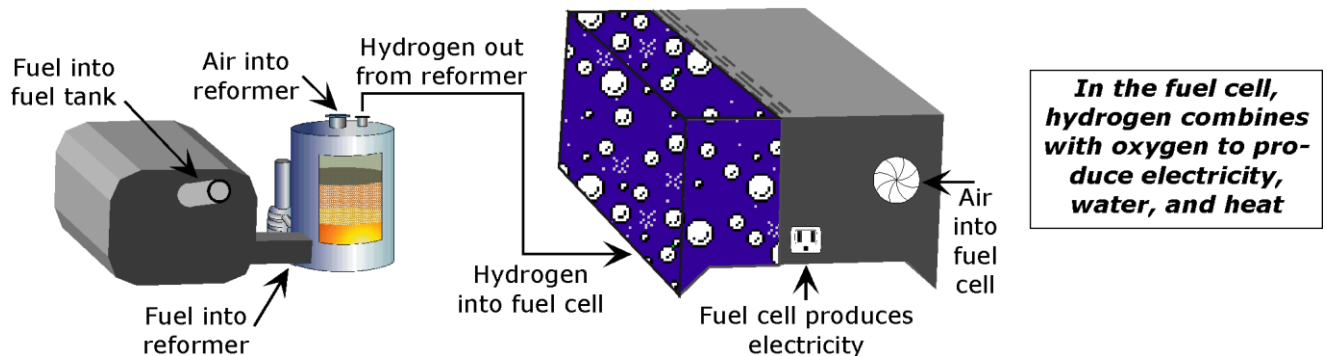
What are they?

Fuel Cell vehicles are still in the developmental stage. From a technical point of view, they are electric vehicles, since electricity (generated by the fuel cell) is used to drive an electric motor. But the vehicle doesn't have to re-charge as an electric vehicle does – the fuel cell is filled up with a liquid (or gaseous) fuel, in the same way that an internal combustion engine vehicle (such as gasoline or diesel) fuel tank is filled up.

Why Fuel Cells?

- Fuel cells are cleaner and much more efficient than internal combustion engines. For example, if a 40-miles-per-gallon gasoline-fueled internal combustion engine vehicle had its engine replaced by a fuel cell, it could get (theoretically) 60 to 100 miles per gallon! (The systems are still under development, so there's some uncertainty as to EXACTLY how much more efficient they would be in large scale use – but there's no disagreement that they would be more efficient.)
- So, if fuel cell vehicles should someday replace internal combustion engine vehicles, the existing gasoline, alcohol, or propane *fueling infrastructure* (stations, pipelines, pumps, etc.) could still be used. And, if fuel cell vehicles were to replace electric vehicles, the *electric vehicle technology* (motors, batteries, controllers, etc.) would also still be used!

Fuel Cell



Did you know?

- On the space shuttle, fuel cells are used to provide electricity and water.
- DaimlerChrysler, Ford, General Motors, Honda, Mazda, Nissan, Toyota, Volvo, Volkswagen, and others have announced plans to sell fuel cell cars, vans, or buses.
- Fuel cell buses are in use in Ontario, Canada and Chicago, Illinois.

Propane

What is it?

Propane is the name commonly used for Liquefied Petroleum Gas (LPG). It's made from petroleum refining and natural gas processing. Propane is normally a gas, but it's stored in liquid form on a vehicle. Once the propane enters the engine, it becomes a gas again, which helps this fuel to burn so cleanly. The propane fuel grade used in vehicles is called HD-5.

Why Propane?

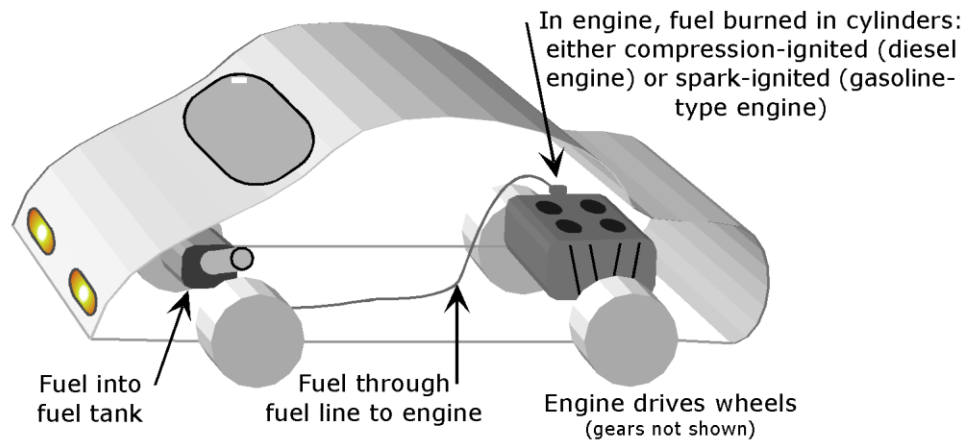
- Propane is widely available.
- Propane fuel tanks are 20 times more puncture resistant than conventional gasoline tanks.
- "Closed" fueling systems prevent leaking and vapor emissions.
- Propane emits 60% lower carbon monoxide and 50% lower reactive hydrocarbons than gasoline.
- Engines run by propane are cleaner and last longer. Propane vehicles can have as much as double the engine life of gasoline vehicles. Propane reduces lubricant contamination by fuel and produces less carbon build up in combustion chambers and pistons.
- "Premium" gasoline has octane ratings of 91-92. Propane's octane rating is 104.

Did you know?

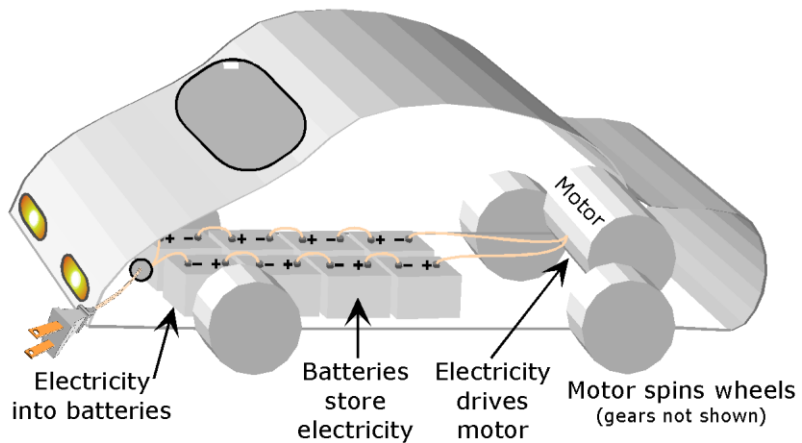
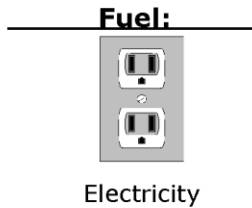
- Both General Motors and Ford manufacture propane vehicles.
- The oil, oil filter, and spark plugs in a propane vehicle last up to three times longer than in a vehicle running on gasoline.
- There are 3.5 million propane vehicles worldwide. In the U.S., more than 350,000 vehicles are fueled by propane.

Internal Combustion Engine Vehicles

- Fuels:**
- Alcohol Fuels (SI/CI)
 - Biodiesel (CI)
 - Diesel (CI)
 - Gasoline (SI)
 - Hydrogen (SI/CI)
 - Natural Gas (SI/CI)
 - Propane (SI)
- SI = Spark Ignition
Required
- CI = Compression
Ignition
Required

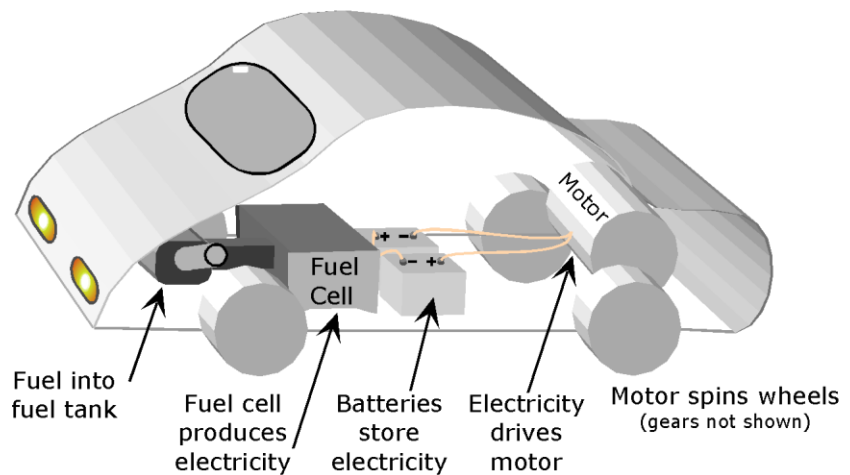


Electric Vehicles



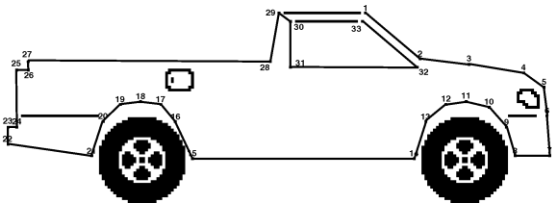
Fuel Cell Vehicles

- Fuels:**
- Alcohol Fuels
 - Gasoline
 - Hydrogen
 - Natural Gas
 - Other fuels ("energy carriers") are under development

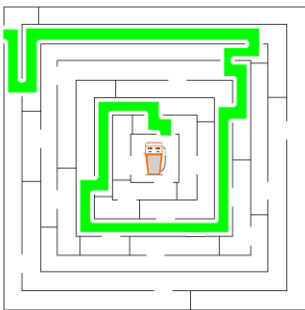


ANSWERS

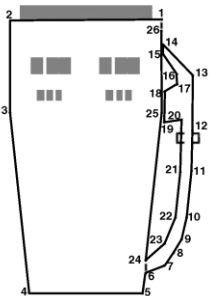
Rolling Dots



It's a-MAZE-ing!



Puzzle Dots



Wheels Away

Rita rides a bus to s c h o o l.
 David's parents drive a car to w o r k.
 Frank takes an airplane to the state of W a s h i n g t o n.
 A Russ's truck delivers juice to the s u p e r m a r k e t.

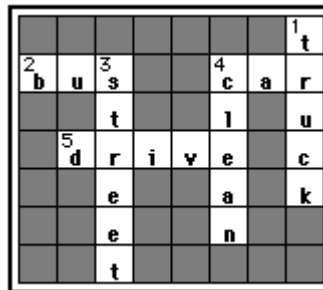
Match-up #1

Rita's bus C (diesel).
 David's parents' car A (gasoline).
 Frank's airplane B (jet fuel).

Transportation Fuels Scramble

GASOLINE
DIESEL

Crossword #1



Word Search #1



Cause-and-Effect

D, C, A, B

Pollution problems

Pollution ... can make us **sick** ...
Pollution ... (can) harm **plants and animals**.
It costs a lot ... damaged by **pollution**.
Carbon monoxide ... **monoxide** poisoning.
“Smog” is created ... oxides of **nitrogen**.
Other fuel **emissions** ...
Carbon **dioxide** is a major contributor ...

Fill-in-the blanks

Transportation ... **global climate change** ...
Every time ... crude **oil** ...

Fill-in-the blanks

When plants ... **renewable**.

Math Teaser #1

c. About **8,000,000,000** pounds (4 million tons) And that’s just on Long Island - 29 -- and just for one year!

Picture the fuels

C (corn to make alcohol fuel): ETHANOL
E (recharging station): ELECTRIC
B (liquefied petroleum gas): PROPANE
A (traditional fossil fuel): GASOLINE
D (used cooking oil): BIODIESEL

Go U.S.A.

Transportation is a very important part of our everyday lives. And our trucks, buses, and cars need **fuels** to run. Right now, the only fuels used by most of our vehicles are gasoline and diesel, which are made from oil imported from other **countries**.

But sending all this money out of the USA is not good for the **balance of trade**. And it doesn’t keep the money here to create **jobs**. And every time there’s a war involving (or near) countries that produce the oil we need, it becomes a threat to our **national energy security**.

By a law passed by the U.S. **Congress** in 1992, alternative fuels are now part of the official National Energy Policy of the United States.

True or False

1. **T** (215 mph record set in 1998.) 2. **F** (Ford offers several propane-powered vehicles.) 3. **T** 4. **F** (corn & sugarcane are used to produce fuel-grade ethanol. Grapes could be used – after all they’re used to make wine, which has ethanol in it – but it’s too expensive to be practical for fuel.) 5. **T** 6. **T** 7. **F** (In 1997, a 5-passenger vehicle powered by zinc-air batteries went 1043 miles without a recharge.)

Find the Phrase

The phrase is “**clean fuels for clean air.**”

Extra Credit

The letters spell:
ALTERNATIVE FUELS

1. Transportation is an **important** part of our lives.
2. **Fuels** are essential to our transportation system.
3. We use a **lot** of fuel.
4. Millions of gallons of fuel are used on Long Island **each** year.
5. These fuels **produce** many pollutants.
6. But **cleaner** fuels are becoming available.
7. **Alcohol** fuel is renewable.
8. Biodiesel is made **right** here in New York.
9. **Electric** vehicles are “zero-emission vehicles.”
10. Propane has been used in **vehicles** in New York for over 25 years.
11. New Federal laws require government **fleets** to purchase alternative fuel vehicles.
12. Automobile and truck **manufacturers** have designed engines to use the cleaner fuels.
13. Some of the vehicles can **use** two kinds of fuel.
14. In addition to **clean** air, there are other benefits from these fuels.
15. National energy security, more jobs, and improved **balance** of trade are some of the other benefits.
16. Someday, a car you drive may be powered by one of **these** fuels!

For More Information

Alt. Fuels Data Center	www.eere.energy.gov/afdc
Alternative Fuel Locator	http://afdc.energy.gov/afdc/stations/find_station.php
AFDC Hotline	Phone (800) 423-1363
AFV Buyer's Guide	www.fleets.doe.gov
American Coalition for Ethanol	www.ethanol.org
Clean Air New York	www.cleanairny.org
Clean Cities Website	www.eere.energy.gov/cleancities
Clean Cities Hotline	Phone (800) 224-8437
Clean Vehicle Education Foundation	www.cleanvehicle.org
Electric Drive Transportation Assoc.	www.electricdrive.org
Energy Information Admin.	www.eia.doe.gov
EPA	www.epa.gov
Federal Funding	www.grants.gov
Greater Long Island Clean Cities	www.gliccc.org
Int'l Council for Local Environ. Initiatives	www.ICLEI.org
Long Island Forum for Technology	www.lift.org
National Biodiesel Board	www.biodiesel.org
National Ethanol Vehicle Coalition	www.e85fuel.com
National Hydrogen Association	www.hydrogenassociation.org
National Propane Gas Assoc.	www.npga.org
National Renewable Energy Lab.	www.nrel.gov
Natural Gas Organization	www.naturalgas.org
NGV America	www.ngva.org
NYS Clean Fueled Vehicle Council	www.ogs.state.ny.us
NYS Energy Research Dev. Authority	www.nyserda.org
Propane Education & Research Council	www.usepropane.com
Sierra Club/Cool Cities	www.coolcities.us

Need a science project idea? Or, need help with a project you're already working on? Want a tour of an alternate fuel facility, or want to see an alternative fuel vehicle? Want someone to make a presentation to your class or community organization? These people can help!

Go to the Greater Long Island Clean Cities **WEBSITE:** <http://www.GLICCC.org> or the U.S. Department of Energy's Website, <http://www.afdc.nrel.gov>

CALL TOLL-FREE the U.S. Department of Energy's Alternative Fuels Data Center, 1-800-423-1363. Hours of operation: Monday through Friday, 9AM – 6 PM Eastern Standard Time. If nobody's there, you can leave a message and they'll call you back.

Comments or questions? Please send them to:

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This Activity Book was created by the Greater Long Island Clean Cities Coalition,
a voluntary partnership between private, and public sector organizations:

U.S. Department of Energy
American Lung Association of New York
Cummins Westport
New York State Department of Education
New York State Transportation Association
State of Hawaii Department of Business, Economic Development & Tourism
U.S. Electricar
U.S. General Services Administration, Fleet Management Branch

For more information on the Clean Cities program, to provide suggestions, or to obtain
additional copies of this Activity Book, please call: (631) 504-5771

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