

# Student Model 1

Research Report Read the report. Evaluate it for development of ideas.

## Where Are You? A History of GPS

Humans have always wanted to know where they are, where they're going, and how to get home. But it's been difficult to get accurate answers. Early navigators plotted their course by the sun and the stars. The compass and the sextant were major developments. But the compass showed only what direction they were going. The sextant measured only latitude. (Latitude is location on an east-west axis. Longitude is location on a north-south axis.) It was not until the 1740s that a man named John Harrison figured out how to measure longitude (Sobel 16-17). His invention could tell you where you were within 30 miles. Radio navigation was developed about 100 years ago. It was accurate to within a few miles. Satellite navigation began in 1957. But these were all mere warm-ups for GPS (global positioning system). GPS can find your location within a few hundred feet.

GPS was designed and built by the U.S. military. The earliest version was brainstormed at the Pentagon in 1973. The first working GPS satellite was launched in 1978. By 1991, the system was far enough along to be part of the first Gulf War. Ground troops used it to navigate through the desert. Fighter planes used it for missile guidance and bomb targeting.

In June 1993, the U.S. Air Force launched the twenty-fourth and final satellite in the GPS network. The secret to its success was the invention of atomic clocks that are accurate to within a billionth of a second. The clocks were created by physicists whose goal was to understand the nature of the universe. They were trying to study relativity and Einstein's physics. Inventing the most precise navigation system ever known was just a by-product. "Basic scientific research made possible first a vital defense technology and then a variety of important commercial applications," wrote Daniel Kleppner (5).

The twenty-four satellites in the GPS network are each the size of a large car. They weigh 1,900 pounds. Their orbit is 11,000 miles above Earth. Each satellite orbits Earth every 12 hours. Every point on the planet is always in radio contact with at least four satellites. "Each satellite continuously broadcasts a digital radio signal that includes both its own position and the time" (National 16). A GPS receiver uses this information to calculate its location to within an area the size of a football field.

Many cars now have GPS receivers. They give the driver exact directions to anywhere, from hospitals to restaurants. They also tell rescue workers the car's location after an accident. GPS is used to locate ships lost at sea and to track shipped packages. Pilots use it to dust crops, survey, and take aerial photos. Scientists use it to measure Earth, find oil and gas deposits, and monitor earthquakes. They also use it to fight forest fires and track the migration routes of endangered species. Hikers use

handheld GPS receivers to avoid getting lost. As computer chips get smaller, GPS receivers will shrink to the size of credit cards. That will make them even easier to carry.

Have you ever been lost? If so, you can see what a gift GPS technology is to society. It has already saved millions of lives and millions of dollars.

#### Works Cited

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# Student Model 2

Research Report Read the report. Evaluate it for development of ideas.

## Breathe Easily with Hybrid Cars

Hybrid cars are not quite an everyday technology yet. But with more than a million of them on the roads, they're getting very close. Did you know that gas-saving cars have been around for two centuries?

An astronomer came up with the idea for the first steam car in 1665. It was never built. But in 1769, a French inventor built a steam-powered carriage. It could go 6 miles an hour. In 1825, a British inventor built a steam car. It could go 8.5 miles an hour.

In 1839, Robert Anderson of Scotland built the first electric car. Several other inventors improved on it over the years. But real improvement waited until the 1890s. In 1897, the London Electric Cab Co. began service. Its cabs could travel 50 miles before needing a recharge. The Pope Manufacturing Co. of Hartford, Connecticut, built 500 electric cars from 1897 to 1899.

In 1898, Ferdinand Porsche built the first front-wheel-drive car. He was only 23 at the time. His second car was a hybrid. It used an internal combustion engine to spin a generator. That generator powered electric motors in the wheel hubs. That car could travel 40 miles on battery power alone (hybridcars.com 2). That same year, a New York company unveiled a fleet of 12 electric cars.

In 1900, American car companies made 1,681 steam cars and 1,575 electric cars. They also made 936 gasoline cars. The first National Automotive Show took place in New York City. In a poll there, consumers said electric power was their first choice for cars. Gas ran a distant third. During the next few years, thousands of electric and hybrid cars were produced. If carmakers had continued that trend, far less pollution would have been generated over the next 100 years. But in 1904, Henry Ford overcame the biggest objections to gas-powered cars: noise, vibration, and smell. He started assembly-line production of low-priced gas cars. He drove most of the electric and hybrid companies out of business. In 1913, the self-starter was invented. Drivers no longer had to crank their gas engines. Ford sold 183,000 Model Ts. Sales of electric cars dropped to only 6,000.

In 1916, the Woods Co. of Chicago built a hybrid car that could go 35 miles an hour. It got 48 miles to the gallon. Its speed was competitive, but it cost more than a gas car. It sold poorly. Gas cars took over the market almost completely.

In 1966, Congress introduced a bill supporting electric cars. Its goal was to reduce air pollution. In 1969, GM came up with a lightweight hybrid. But it couldn't go faster than 40 miles an hour. The Arab oil embargo drove up gas prices in the 1970s. The U.S. Department of Energy tested many hybrid cars. Congress passed a hybrid vehicle

research act in 1976. The government encouraged companies to come up with hybrids. General Motors alone invested \$20 million in research and development.

The first modern hybrid didn't come out until 1997. It got 70 miles per gallon. A hybrid car produces a pound of smog particles for every 15,000 miles you drive it. An all-gas car produces 67 pounds of smog in that distance. Sales have increased in each of the past 10 years.

#### Works Cited

"History of Hybrid Vehicles." 2007. 27 Jul. 2007 <<http://www.hybridcars.com/history.html>>