Educator's Guide to

PROGRESSIVE AUTOMOTIVE X PRIZE

U.S. DEPARTMENT OF ENERGY

CISCO

with hands-on activities for school groups and families

SAINT LOUIS sciencenter

The goal of the Progressive Insurance Automotive X PRIZE is to inspire a new generation of viable, safe, affordable and super fuel efficient vehicles that people want to buy. $10 million in prizes will be awarded in September 2010 to the teams that win a rigorous stage competition for clean, production-capable vehicles that exceed 100 MPG energy equivalent (MPGe). Visit progressiveautoxprize.org for more information.

DASH+
Drive Change Today

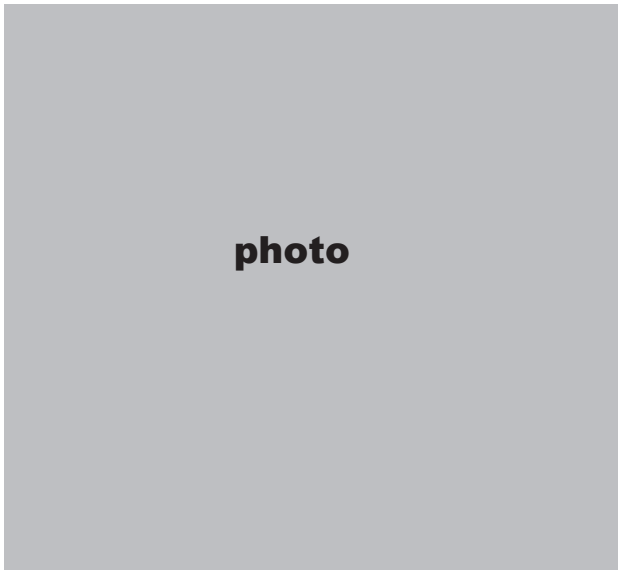
High school teams from across the country competed to design, describe and pitch the dashboard of the future. The three finalists are DASH Tech from Dearborn, Michigan, EDV Technologies from Santa Barbara, California and Harker Innovation Team from San Jose, California. Visit fuelourfuturenow.com/contest to check out the teams' designs.

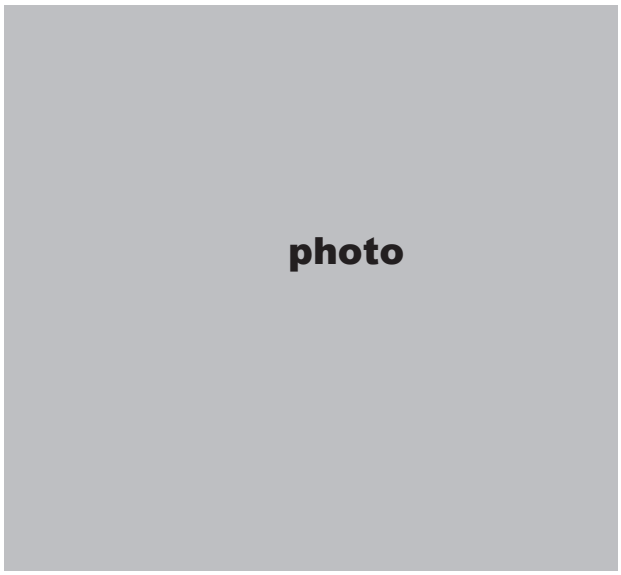
This guide is designed for museum staff displaying the *Under the Hood* hands-on science cart and *Drive Change Today* exhibit, or for designing your own programs to follow the Progressive Insurance Automotive X PRIZE.

Activities by the
Saint Louis Science Center
Written by Jennifer Boxer
Illustrated by Dennis Smith

Under the Hood Hands-On Science Cart

Under the Hood activities are designed by the Saint Louis Science Center to help visitors understand the science and engineering factors that affect a car's fuel-efficiency and the changes being considered to improve cars of the future. Maybe we can't get 100 MPGe like the X PRIZE cars yet, but we can improve our fuel efficiency with good maintenance and driving behavior. The cart itself is from an actual auto mechanic's shop, adapted for hands-on science demonstrations. It will be on display at science centers around the country from June to October 2010.





This cart includes inquiry-based, open-ended activities on the following topics:
1. Brakes and Friction
2. Gears
3. Filters
4. CO2
5. Aerodynamics
6. Batteries and Electricity
7. Biofuels

Pull-Out Sections of this Guide

On the following pages are two pull-out family/school activity guides designed to accompany *Under the Hood – Fuel and Energy* and *Forces and Motion*. Feel free to copy these and share with museum visitors. Copies of the activity cards for the *Under the Hood* cart are attached at the end of this guide.

Drive Change Today Exhibit

This 400 sq-ft exhibit will be on display at science centers around the country from July to October 2010. The five components of the exhibit and their educational messages are:

1. Build A Dashboard. Today's dashboard primarily gives the driver information about the car's operations. Dashboards of the future will give feedback to encourage driver behavior that is good for fuel efficiency and for the environment.

2. Hi, Hybrid. A hybrid is a car that runs on both a gasoline engine and an electric motor.

3. 100 MPGe. The miles per gallon a car gets are affected by different factors such as its size, shape and weight. Today's most fuel-efficient cars get about 40 MPG. To win the Progressive Insurance Automotive X PRIZE, a car must get 100 MPGe. (The "e" stands for energy equilavent.)

4. Fuel Our Future. Car fuels can be made from many different sources. X PRIZE competitors' cars run on gasoline, biodiesel, hydrogen, electricity and even steam! You can make your own car more fuel-efficient by some simple maintenance like changing your oil and keeping your tires inflated.

5. Gear Up. Gear ratios allow a car or bike to reach a high rate of speed or climb a steep hill. Visitors experiment with different sizes of gears, find out what happens when you link large gears with small gears and see how this applies to bicycles and cars.

For more information about the exhibit, cart, activity instructions and supplies, email jboxer@slsc.org.

The Drive Change Today Exhibit was created by Pili Dressel, Susan Morris, Dennis Smith and Jennifer Boxer of the Saint Louis Science Center.

Under the Hood – Drive Change Today Programs Around the Country

Under the Hood participants are members of Science Beyond the Boundaries[SM], an international network of museums, large and small, reaching over 39 million visitors annually and still growing. The network's purpose is to connect museum visitors with the advancing frontiers of science and facilitate the connection between scientific research and their lives. Following is a list of *Under the Hood* participants and our programs. All participants are sharing event plans and hands-on activities with museums all over the country. If you would like us to send them to you, just email jboxer@slsc.org.

Arizona Science Center, Phoenix, AZ
Summer Science Camp (dates TBD)
Weekend Summer Community Science Day (dates TBD)
Hands-on Activity Stations
Drive Change Today Exhibit, July 15 – Sep 30

California Science Center, Los Angeles, CA
Science Live, Jul 1, 2010 – Jun 30, 2011
Under the Hood Cart, Jun 1 – Sep 30

Center of Science & Industry (COSI), Columbus, OH
Community Science Day, Aug 27 – 29, 2010
Under the Hood Cart, June 11 – Sep 30

Detroit Science Center, Detroit, MI
Future Cruisin' Event, Aug 19 – 22, 2010

Discovery Center Museum, Rockford, IL
Family Fridays, Jun 18 – Aug 13

Discovery Center of Springfield, Springfield, MO
Vehicles of the Future, Jul 6 – 10, 2010
Under the Hood Cart, Jul 30 – Sep 30

The Discovery Museums, Acton, MA
Meet the TriHy, Jul 23
Summer Scientists Camp, Jul 12 – 30
Green Designs, Aug 3, Aug 12
Inventors Workshop, Auto Design, Jun 18 – Sep 10

Edgerton Explorit Center, Aurora, NE
Energy of the Future, May 30 – Sep 27
Summer Camp Program (dates TBD)

Emerald Coast Science Center, Fort Walton Beach, FL
June 17, Kids Day
Summer Camp Program (dates TBD)

Edgerton Explorit Center, Aurora, NE
Energy of the Future, May 30 – Sep 27
Summer Camp Program (dates TBD)

Emerald Coast Science Center, Fort Walton Beach, FL
June 17, Kids Day
Summer Camp Program (dates TBD)

The Henry Ford Museum, Dearborn, MI
Maker Faire, July 31 – Aug 1
Old Car Festival, Sep 11 – 12
Drive Change Today Exhibit, July 15 – Sep 30

Liberty Science Center, Jersey City, NJ
Under the Hood Cart, June 11 - Sep 20

Museum of Life & Science, Durham, NC
Crash Test Dummy activities, June 22 – Aug 14
Under the Hood Cart, June 11 – Sep 30

Museum of Science & Industry, Chicago, IL
"Future Car" program, July 15 – Aug 15
Future Car culminating weekend Community Science Day (date TBD)
Under the Hood Cart, June 11 – Sep 30

Museum of Science & Industry (MOSI), Tampa, FL
"Fuel the Future" activities, June 1 – Sep 30
Fuel the Future Community Science Day (date TBD)
Under the Hood Cart, June 11 – Sep 30

Oregon Museum of Science & Industry (OMSI), Portland, OR
Segways & High-Mileage Vehicles, June 1 – Sep 6, 2010
Drive Change Today Exhibit, July 15 – Sep 30

Saint Louis Science Center, St. Louis, MO
May 29, Opening Event
July 29, Community Science Day
Aug 20, Camp-In
Sep 25, Community Science Day
Closing Event (date TBD)

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6. Batteries and Electricity
7. Biofuels

Activities by the Saint Louis Science Center. Written by Jennifer Boxer. Illustrated by Dennis Smith.

AERODYNAMICS

Experiment with the different cars on the track. What happens when you add weight? What if you tape a folded index card to the top like a luggage rack? Use the hairdryer to simulate the force of the air against the car as it moves forward. You can also adjust the track to different angles to simulate going up and down hill.

What's Going On? When you drive, air pushes against your car, creating resistance. A car that is aerodynamic (in a stream-lined shape) is more fuel-efficient because it slides through the air more easily. A light-weight car is more fuel-efficient than a heavy car. If you put a luggage rack on your roof (like the index card) your car becomes less aerodynamic and, therefore, less fuel-efficient.

Supplies: toy cars, track (made from 2 yardsticks), hair dryer, small washers or weights, index cards, tape

UNDER THE HOOD

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BATTERIES and ELECTRICITY

Complete a simple circuit using a battery, wires and bulb. Try different combinations until you get the bulb to light. Use the kit to see what's happening inside a battery.

What's Going On? After a battery is used for a while, the energy stored there decreases because electric current flows out of the battery to operate a car, cell phone or whatever the battery powers. A battery charger sends electric current into a battery and restores the chemical reaction and the charge stored there. An electric car or a Segway needs to be plugged in after use, to restore its charge.

Supplies: batteries, wires, bulbs, rechargeable batteries, battery charger, phone charger, kit to make a battery

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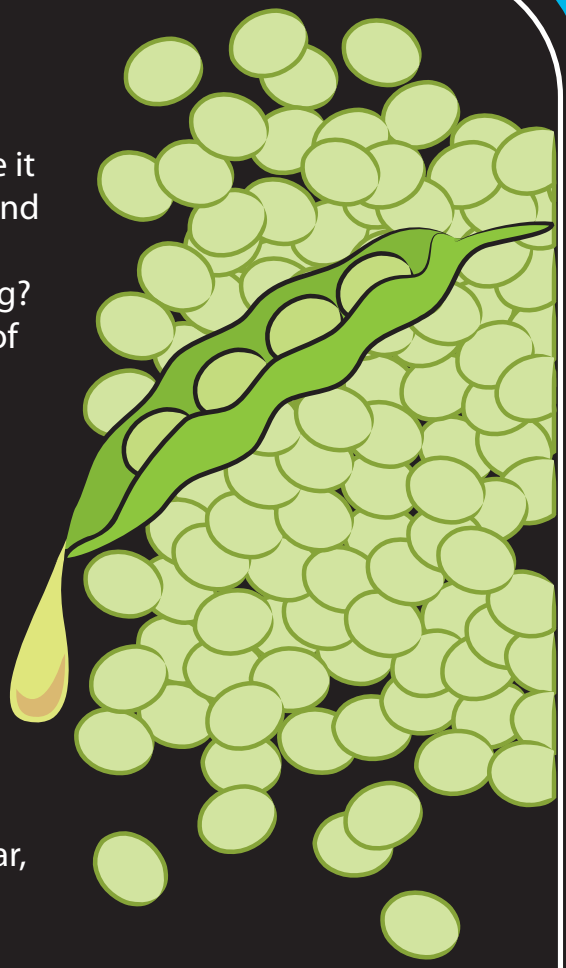
BIOFUELS

Seal ½ cup of soybeans in the bag, place it between layers of newspapers, and pound it with the hammer until the beans are crushed. What do you see inside the bag? Pour the crushed soybeans into the jar of hot water and observe.

What's Going On? Scientists are experimenting with making fuels from corn, algae and soybeans. Using renewable biofuels helps decrease our reliance on fossil fuels. Crushing the soybeans produces oil which can be separated out using hot water.

Supplies: soybeans, gallon resealable plastic bag, newspaper, hammer, clear jar, hot water



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BRAKES and FRICTION

Experiment with the brake on a scooter and with the friction created by an inflated tire or a flat tire. Measure the surface area with the road for one tire and then the other. Turn the scooter upside down and observe how its brakes work.

What's Going On? Brakes work by applying friction to the wheels, which is transferred to the road and slows the car down. If you apply your brakes too often, your car becomes less fuel-efficient because it has to use more gas to overcome the friction and keep moving forward. If you don't keep your tires inflated you create too much friction between the tire and the road, which also slows you down.

Supplies: inflated tire, flat tire, "Razor" scooter, ruler

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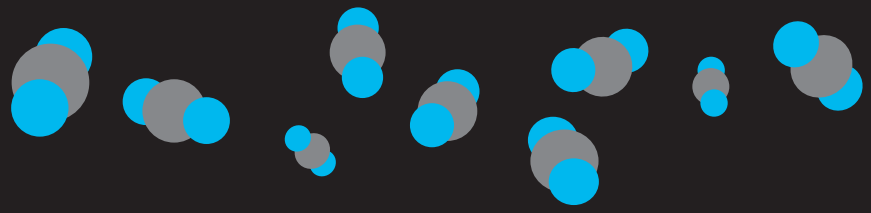
CO_2



You can create CO_2, carbon dioxide, using baking soda and vinegar, or observe how yeast produce it when they grow. Even though it's invisible, you can tell it's there. To start the yeast growing in the first bottle, mix 1 T. dry yeast with ¼ c. warm water. Seal the top of the bottle with a balloon. To start the chemical reaction in the second bottle, put 1 T. baking soda in the bottom of the bottle and add vinegar. Quickly seal the second bottle with another balloon. What happens to the balloons?

What's Going On? When fossil fuels (like the gasoline in your car) are burned to produce energy, they also give off carbon dioxide, an invisible gas, as part of that chemical reaction. Animals (like us) give off carbon dioxide when we breathe. Plants use carbon dioxide in photosynthesis. Too much carbon dioxide in the atmosphere contributes to climate change.

Supplies: two 2-liter bottles, warm water, dry yeast, sugar, baking soda, vinegar, balloons

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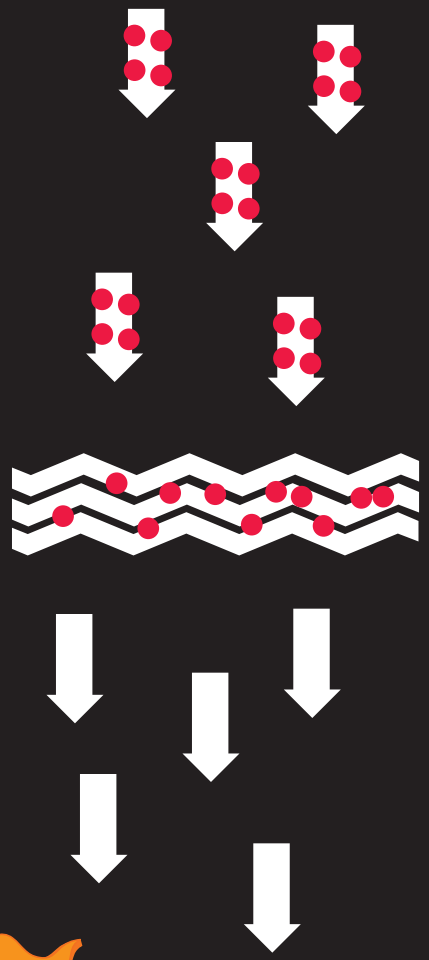
FILTERS

Compare the dirty and clean car air filters. Examine filters with the magnifier to see how they work.

What's Going On? Filters help keep air flowing through your car by collecting dirt from the air so that dirt doesn't get mixed in with the fuel. If your filter is too dirty, dirt gets through into your fuel system and decreases your fuel efficiency. That's why you need to check your air filter and change it regularly. You can find filters in your dryer, your fish tank and other places around your house too.



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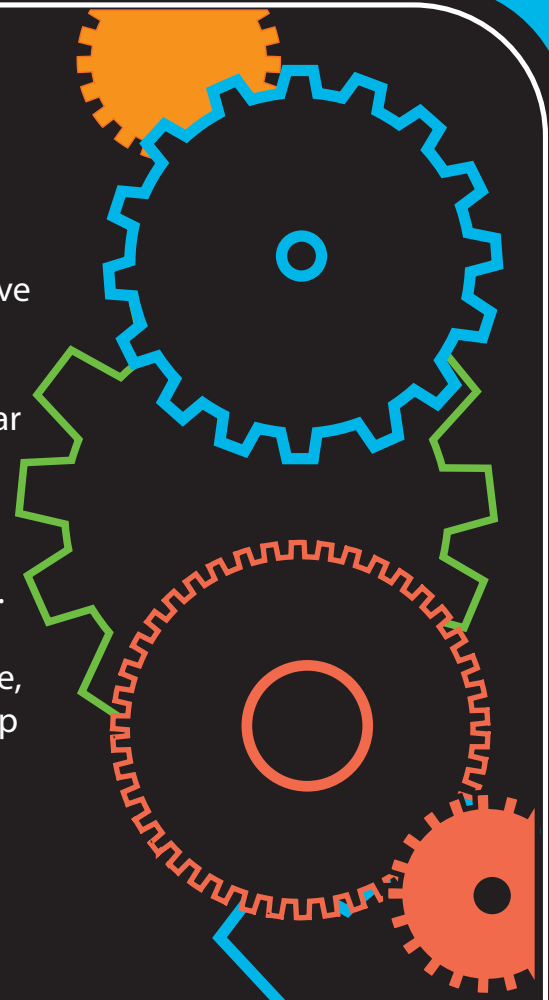
GEARS

Connect the gears in different patterns, using both small and large gears. Observe the difference in how fast they turn.

What's Going On? Gear ratios allow a car or bike to reach a high rate of speed or climb a steep hill. When you connect a larger gear to a smaller one, the smaller gear turns faster, giving you more speed. That's why when you shift to a higher number (smaller) gear on your car or bike, you go faster. If you need power to go up a hill, you shift back down to the lower (larger) gear.

Supplies: interlocking gears of different sizes



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Science Beyond the Boundaries[SM] is an international network of over 100 science centers, large and small, reaching over 39 million visitors annually and still growing. It was founded in October 2006 by the Saint Louis Science Center. The network's purpose is to connect science center visitors with the advancing frontiers of science and facilitate the connection between scientific research and their lives. The Saint Louis Science Center takes a central leadership role in responding to the needs of the field, facilitating the development of materials, providing a conduit for sharing best practices, evaluating impact and coordinating activities. There are no costs associated with membership in the network or materials created for network projects. Current programs to share include: Breakthroughs in Science, *DASH+* High School Contest, DNA Day, Google Lunar X PRIZE, Xtreme Everest, and much more. For further information, or to join the network, email jboxer@slsc.org.

SCIENCE BEYOND the BOUNDARIES
a program of the
Saint Louis Science Center

PROGRESSIVE AUTOMOTIVE X PRIZE

CAUDWELL XTREME EVEREST
HUMAN PHYSIOLOGY AT EXTREME ALTITUDE

1. New Moon
2. Crescent Moon
3. First Quarter Moon
4. Gibbous Moon
5. Full Moon
6. Gibbous Moon
7. Third Quarter Moon
8. Crescent Moon

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