SCIENTIFIC AMERICAN FRONTIERS

TEACHING GUIDE

www.pbs.org/saf/1403

Future Car

Activity 1: Grades 5-8

Model Car Design

As you observed in this segment of Scientific American Frontiers, engineers are continually trying to improve the efficiency and environmental sustainability of automobiles. Radical changes such as a hybrid engine that uses both gasoline and electric fuel help on both fronts. New materials used in both engine design and chassis construction not only improve mileage, but also insure a safer ride.

This activity page will offer:

- A hands-on experience in model car design
- An opportunity to engage critical thinking, analysis and process skills
- An experience for engineering application, critique and improvement

Model Racers

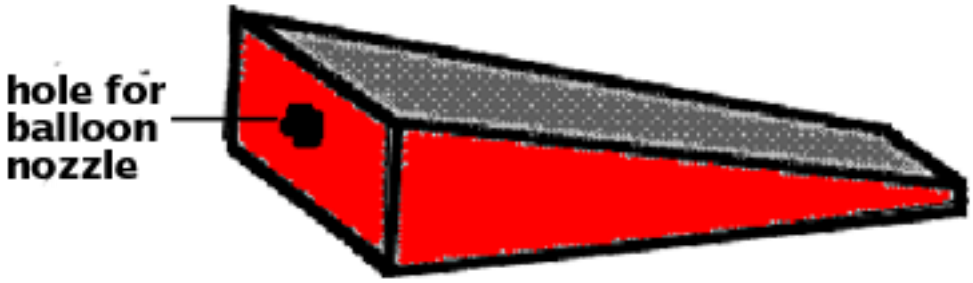
Before a new car makes it to the showroom, various prototypes must be tested and evaluated. In this activity, you'll get a chance to design your own model car. You'll use a variety of materials to construct a vehicle that travels the greatest distance on balloon power. During your trials, you'll use what you observe to update and improve your design and understanding of model car mechanics.

Materials

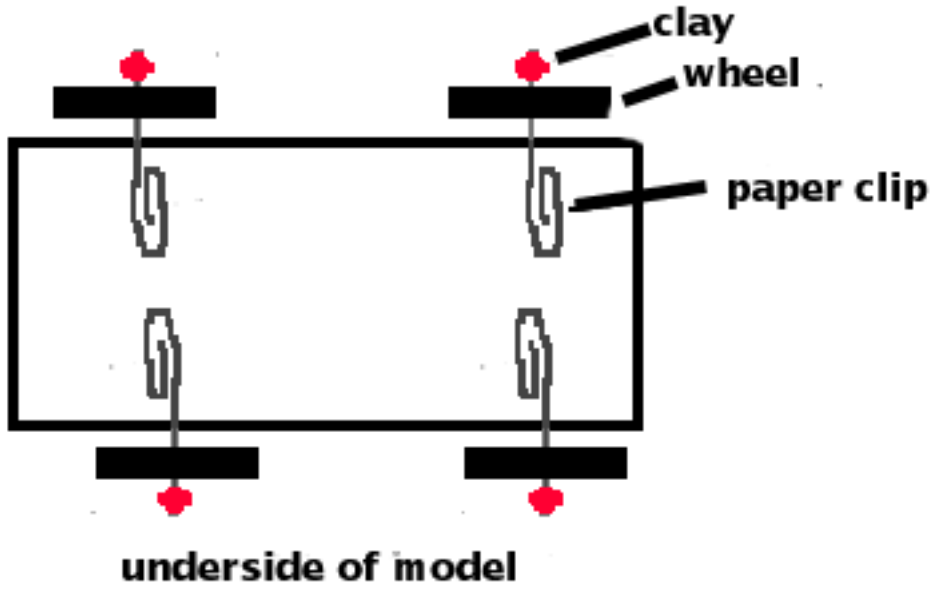
- Milk carton
- Balloon
- Scissors
- Wheels from a toy car (or heavy stock paper disks)
- Paper clips
- Clay
- Tape
- Assortment of construction materials

Procedure
Basic Prototype

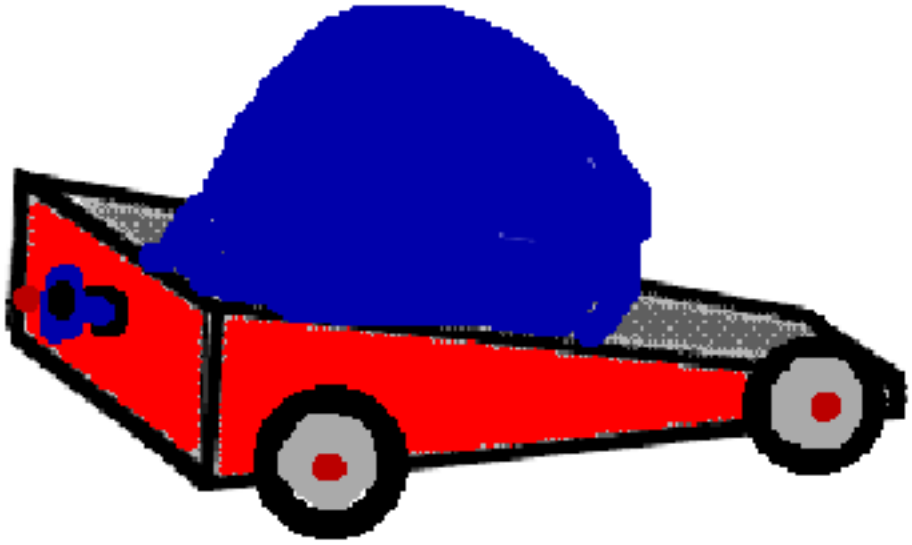
1. Work in teams of two. Use a scissors to cut away the sides of a milk cartoon to form a basic chassis design that resembles the illustration show here. Punch a hole at the center of the rear end of the chassis. The nozzle of the inflated balloon will be inserted and secured in this opening.



2. Use tape to attach four paper clips to the underside of the chassis. The extended "arms" of the clips will be used as axles on which to attach wheels.
3. After slipping on the wheels, place a pea-sized lump of clay on the tip of each clip. The clay will prevent the spinning wheels from moving off the paper clip axle.



4. Blow up a balloon and insert its neck through the nozzle hole. Position your car on a test track and release the balloon nozzle. Observe and analyze its progress along the floor.



5. How could you improve the efficiency of your model? What design changes would improve its performance? With your instructor's approval, update your design. Analyze the new model's performance. Did the changes help? If so, how?

Questions

1. What is the stored source of power for your model car?
2. What are the three most important factors that affect the performance of your vehicle?
3. What design factors are least applicable for transfer between your scale model and a full-sized vehicle? Explain.

Critical Stretch

Does a reused balloon have the same energy storage potential as a new balloon? Considering the challenges of balloon reuse, how can you best insure that your testing is not affected by changes in the balloon's stored energy?

Solar Extension

1. Suppose your next design challenge is to replace balloon power with solar power. What new components would you need for your model vehicle? How would they affect the design of your current car? Create a set of blueprints that illustrate your new solar car and share them with classmates. With your teacher's approval and available classroom materials, assemble your new vehicle.

Submersible Connection

Like the proposed hybrid engines for cars, the power plants of pre-nuclear submarines included both diesel and electric engines. Use Internet and print resources to learn more about these dual power sources for submersible boats.

Compare and contrast their use with the proposed hybrid engines for cars. How were they similar? How were they different? Are hybrid engines used in nuclear submarines? Explain.

Transfer of Energy

Although the model car got its immediate thrust from the rush of air that raced out of the balloon nozzle, where did this energy first originate? Trace back the steps of energy conversion. Identify each step of the transfer and identify any energy losses associated with that change.

Sexy Sales

How would you best describe print and broadcast advertisements used to sell new cars? Do they focus more on the mechanics or the appearance of the vehicle? Do they target a specific gender? In the "eyes" of Madison Avenue, what features make an automobile a guys' or gals' car? Do you think that gender-specific ads reinforce stereotypes or do they cater to new markets? In an open classroom forum, discuss and debate these issues.

Web Connection

National Middle School Science Bowl

http://www.scied.science.doe.gov/nmsb/default.htm

Science Bowl information that includes solar power and hydrogen fuel car competitions for students.

Mousetrap Car

http://users.bigpond.net.au/mechtoys/mouse.html

Basic overview of the construction of a model car that is powered by a mousetrap engine.

Rocket-Science Museum of Minnesota

http://www.smm.org/sln/tf/r/rocket/rocket.html

A site that illustrates how to use balloon power to move a rocket along a string.

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Questions

1. What is the stored source of power for your model car?
   (The stretched rubber skin of the balloon.)
2. What are the three most important factors that affect the performance of your vehicle?
   (Accept all reasonable answers such as larger balloon, bigger wheels, etc.)
3. What design factors are least applicable for transfer between your scale model and a full-sized vehicle? Explain.
   (Accept all reasonable answers such as balloon engine, no passenger load, etc.)

Critical Stretch

Does a reused balloon have the same energy storage potential as a new balloon? Considering the challenges of balloon reuse, how can you best insure that your testing is not affected by changes in the balloon's stored energy?
(Run trials with balloons of equal usage history.)

Transfer of Energy

Although the model car got its immediate thrust from the rush of air that raced out of the balloon nozzle, where did this energy first originate? **(The sun.)** Trace back the steps of energy conversion. Identify each step of the transfer and identify any energy losses associated with that change.