springboard

teaching materials
the changing face of the automobile

SUMMARY

The invention and proliferation of the automobile during the 20th century has perhaps had the greatest impact on human modern lives in terms of transportation. Automobiles, for most Americans, are not a luxury, but rather a necessity. We think nothing of jumping in the car and driving sometimes hundreds of miles on a trip or for our jobs. Traveling this far was rare even 60 years ago. The consequences to our ways of life and to our planet are great; and, indeed, we cannot go back. But looking to the future, researchers are constantly trying to find better ways of transporting humans with more fuel efficient vehicles by altering car mass, shape and engine design.

SUBJECT

Physical Science (motion, air resistance, friction, forces)
Social Science (economics, consumer choices)

Grade levels 5 through 8

TIME REQUIREMENTS

2 – 50 minute periods for experiments and sharing results
1 or 2 – 50 minute periods for Social Science extension (fuel efficiency), depending on length of discussion.

STANDARDS

Can be adapted for High School level physics

Grades 5-8

Physical Science
Content Standard B
As a result of their activities in grades 5-8, all students should develop an understanding of Motions and Forces.

- The motion of an object can be described by its position, direction of motion, and speed. That motion can be measured and represented on a graph.
- If more than one force acts on an object along a straight line, then the forces will reinforced or cancel one another, depending on their direction and magnitude. Unbalanced forces will cause changes in the speed or direction of an object's motion.

Science and Technology
Content Standard E
As a result of activities in grades 5-8, all students should develop abilities of technological design and understandings about science and technology

- Students should review and describe any completed piece of work and identify the stages of problem identification, solution design, implementation, and evaluation.
- Technological solutions have intended benefits and unintended consequences. Some consequences can be predicted, others cannot.

Science in Personal and Social Perspectives
Content Standard F
As a result of activities in grades 5-8, all students should develop understanding of science and technology in society

- Technology influences society through its products and processes. Technology influences the quality of life and the ways people act and interact. Technological changes are often accompanied by social, political, and economic changes that can be beneficial or detrimental to individuals and to society. Social needs, attitudes, and values influence the direction of technological development.

LEARNING OBJECTIVES

To test automobile aerodynamics and the impact of shape on distance traveled
To figure the financial and environmental impacts of fuel efficient vehicles

MATERIALS FOR EACH GROUP (OF 2 OR 3)

- ☐ **Copies of The Changing Face of the Automobile Activity sheets**
- ☐ **A piece of Masonite or cardstock, approximately 1foot by 1 foot to be used as a ramp (a piece of plastic toy car track can also be used)**
- ☐ **Several books or other objects used to set up the ramps**
- ☐ **One small toy car about 3 inches in length**
- ☐ **5 foam cups**
- ☐ **Scissors**
- ☐ **Meter sticks**

Note – toy cars should be pre-tested for consistency. For best results, choose cars that travel the most consistent distances when released from the top of the ramp.

PROCEDURES

1. Distribute materials to groups and explain procedures.
2. Students set up ramps using a piece of Masonite and 2 books (or another object which will establish a set height for the ramp.)
3. Students should establish base-line data by releasing the car from the top of the ramp 5 times and recording the distance traveled.
4. Now, students should design their own test cars to see if shape affects distance traveled. Using one foam cup for each test, which students can cut and tape, teams should alter the shapes of the vehicle body and test the effect their new shape has on the distance traveled. (hint: think obvious, major changes. Small changes on this scale will not produce measurable results. Some student designs might look like a car with a sail on the top or a car with a cup taped to its hood. That is the kind of large -scale tests that students should try to get measurable results.

Instructors may even want to assign students to find the design that makes the car go the farthest AND that makes the car the travel the shortest distance.)

5. Teams should try 5 different car designs, each using the same base car, same mass of foam cup and same mass of tape. Each car design should be released from the same point at the top of the ramp and its travel distance measured. Each design should be tested 5 times, as with the base-line car.

6. Students should now analyze collected data, finding the average distance each car design traveled.

7. Students should share their altered designs and results with the class. Which design of car traveled the farthest? Which traveled the shortest distance? Did any designs change the direction of motion?

SOCIAL SCIENCE EXTENSION

Which cars do your students dream of getting on their 16th birthday? Do they take the gas mileage of the vehicle into consideration? Have students list five cars that they would like to own. Using the Internet, instruct students to find each car's rated gas mileage. Assuming they will travel an average of 100 miles per week and using current gasoline prices, students should figure out the money they could expect to spend on gas per year for each vehicle. Have students discuss their findings.

Possible extension questions:

Did the amount of money students could expect to spend on gasoline affect the type of car the students wanted the most?

What if gasoline went up to $3.00/ gallon? $5.00/gallon? Would these changes in operating cost affect car choice?

For those students who claim to not care about the operating cost of the vehicle, at what point would they consider gas mileage in their choice.

How would consumers purchasing more fuel efficient vehicles help the environment and planet Earth?

How has car design changed during the 20th century? What about fuel efficiency?

Finally, the students can visit the Springboard Web site (http:///www.pbs.org/springboard) to vote in the poll asking: "Is the U.S. doing enough to encourage the use of low-emission cars and buses?"

WEB RESOURCES

At their own pace, students can explore more about transportation developments on the Springboard Web site "Research" area. They can also vote in a poll concerning low-emission vehicles and read on commentary from a bicycle activist who believes that pedal power is still the best technological innovation to date. Send them to:
http://www.pbs.org/springboard

Locate official government MPG ratings of vehicles (along with other fuel efficiency information) at:
http://www.fueleconomy.gov/

For tips on increasing a car's gas mileage (without altering the vehicle itself):
http://www.ehow.com/eHow/eHow/0,1053,6193,00.html
http://www.casema.net/~kroone/gas/gas.html

For information on alternative vehicles, visit:
http://www.howstuffworks.com/hybrid-car.htm?printable=1
http://members.iinet.net.au/~ando1/elec_car/index.htm

For interesting images and information on alternative autos from around the world, visit:
http://home.clara.net/peterfrost/index.html

SUGGESTIONS FOR GRADING "THE CHANGING FACE OF THE AUTOMOBILE" ACTIVITY SHEET

In this inquiry-based activity, there are no right or wrong answers. However, students need to carefully collect and analyze data and clearly present their findings to their fellow classmates. Teams receiving the best grades would be those that correctly analyze their data, clearly present information, and effectively describe their test and design process to the class.

QUESTIONS & ANSWERS

1. What was the shortest average distance traveled? What was the longest?
   Answers will vary, depending on data.

2. How do you think that car design could affect a car's gas mileage?
   If a car has a bad design so that it has high wind resistance, it would need to use more fuel to go the same distance as a car that was more aerodynamic.

3. What other aspects of a car could scientists test and alter in order to design a car with better gas mileage?
   Mass and engine efficiency. (Note: these two areas are the most responsible for increasing a car's fuel efficiency; but aerodynamics does play a small role in gas efficiency. Car shape also can affect car handling.)

4. Why should people care about the gas mileage they are getting from the car they are driving?
   Aside from caring about the environment as a whole, driving a more fuel-efficient car is far cheaper.

5. Besides driving a car with better gas mileage, what other things can people do to help conserve gasoline?
   Answers will vary, but could include suggestions such as "drive less," "ride a bicycle," "car pool" and "take public transportation."

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PURPOSE

To test automobile aerodynamics and the impact of shape on distance traveled

PROCEDURES

1. Set up ramps according to your teacher's instructions.

2. Establish base-line data by releasing the team's car from the top of the ramp 5 times and recording the distance traveled.

3. Now, design your own test cars to see if shape affects distance traveled. Using one foam cup for each test, which you can cut and tape, change the shape of the vehicle body and test the effect its new shape has on the distance traveled. (hint: think obvious, major changes. Small changes on this scale will not produce measurable results.)

4. Try 5 different car body designs, each using the same base car, 1 foam cup and same mass of tape. Each car design should be released from the same point at the top of the ramp and its distance measured. Each design should be tested 5 times, as with the base-line car.

5. Analyze collected data, finding the average distance traveled for each car design.

6. Prepare your data to share with the class using appropriate graphs or charts. Share your data with the class, showing altered designs and results. Which design of car traveled the farthest? Which traveled the shortest distance?

QUESTIONS

1. What was the shortest average distance traveled? What was the longest?
2. How do you think that car design could affect a car's gas mileage?
3. What other aspects of a car could scientists test and alter in order to design a car with better gas mileage?
4. Why should people care about the gas mileage they are getting from the car they are driving?
5. Besides driving a car with better gas mileage, what other things can people do to help conserve gasoline?