

Hop On the Bus, Gus!



Target Grade Levels

Sixth - Twelfth

Time

Two class periods

Materials

- paper
- drawing supplies

Knowledge and Skills (TEKS)

- Science:
 - Use scientific inquiry methods to plan and implement investigative procedures including asking questions, formulating testable hypotheses, collecting data, making measurements with precision, organize, analyze, predict trends, and communicate valid conclusions;
- Language Arts:
 - Plans, prepares, organizes, and presents oral messages with attention to thesis statement, valid evidence, effective appeals, appropriate language, and purpose fitted to the audience;
 - Organizes and records new information in systematic ways; and
 - Uses effective listening strategies to provide appropriate feedback in a variety of situations such as informal conversations; formal debates; class discussions; and informative, persuasive, or artistic presentations.

Overview

Students will identify structures of a typical school bus that have high air resistance and will be able to suggest alternative structures with lower air resistance.

Background Information

There are two kinds of air resistance (drag) that are important in car design. Form drag occurs when airflow breaks away completely from the car's surface. Mirrors, fenders, hood ornaments and other features that stick out from the car's surface all cause the air to swirl around them. This swirling air saps energy from the moving car, slowing it down.

Friction drag acts along the surface of a car. Air moves over a hood causing winds to build in thin layers. The layer closest to the car's surface moves the slowest. Other layers of airflow slide over this slow boundary layer causing friction. It requires extra energy to overcome this friction.

Procedure

1) Vocabulary

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|-------------------|--------------------|
| a) air resistance | d) form drag |
| b) drag | e) fuel efficiency |
| c) friction drag | |

2) Activities

- Begin by explaining to students the two types of drag explained in the Background section. It will be the form drag, which plays the largest role in reducing fuel efficiency in vehicles.
- Here in Texas, a great deal of energy is used each year transporting students to and from school by bus. Students also make many trips each year by school bus for athletic events and other school-related events. A lot of the energy and money that could be saved each year if school buses could use energy more efficiently.

- c) One way to increase fuel efficiency would be to redesign school buses to be more aerodynamic. This is where your challenge comes in. Your challenge is to design a new style school bus. The bus saves fuel due to its special low-drag features.
- d) One way to approach this task is to think about those structures on a typical bus that stick out from the car, increasing air resistance. These would be good targets for reducing air resistance. Think about different ways and places to attach license plate numbers, headlights, windows and side mirrors. Don't be afraid to come up with a totally new look. Since you do not need to worry about details such as the material of which the body is composed or the size of the engine, you can concentrate on an innovative design. Don't be afraid to try something new!
- e) The bus must conform to these guidelines: Guidelines for Low Resistance School Bus
 - i) Prepare detailed drawings of your school bus. Show both the front and side views. Include close-up sketches of some special features on your vehicle.
 - ii) Specify the actual length, width, and height of your vehicle. Indicate how passengers and freight enter and exit the vehicle. Show this in your drawing and also explain it in words. Remember, a school bus must have at least two main exits.
 - iii) List the features on the bus that help to reduce air resistance. Try to incorporate into your vehicle, at least six different design features for reducing air resistance. Be sure to explain each of these and point them out in your drawings.
 - iv) Devise a catchy name for your bus. To be really creative, you may develop an advertising slogan designed to interest other schools in purchasing your vehicle.
- f) Ask students to hypothesize about the relationship between the amount of drag on a vehicle and its fuel consumption. (The lower the drag, the less fuel consumption.) With this in mind, challenge students to create a design for a new style school bus. The challenge is outlined on the student page. Once students have made their designs on paper, you may wish to challenge students to build a model of their bus. The model could be made from cardboard and would not need to be a working model (in terms of actually rolling).
- g) Home/Community Connection
 Challenge students to go out to the parking lot and find the five most aerodynamically designed cars and the five least aerodynamic vehicles. Ask students to design their own checklist with an appropriate rating scale. Include a brief explanation of the important aerodynamic features written so the general public can easily understand it. Give the completed checklist to the car owners.

3) Review

Have students go home and search through the magazines their family has to find pictures of different vehicles. Each student must bring in a picture of a vehicle, along with that vehicle's descriptive statistics (make, model, production year, weight, number of passengers, and EPA rated fuel efficiency) and present to the class their vehicle and their ideas on why the vehicle gets the fuel efficiency it gets. This can lead to a comparative discussion of vehicles. Students can be grouped based on the type of vehicle they brought (sports car, sedan, minivan, SUV, etc.) to discuss the different factors that affect fuel

efficiency and how the vehicles might be redesigned for better fuel efficiency. Results of group discussion should also be presented to the class. These review exercises can also be performed as graded activities or as extension activities.

4) Evaluation

a) Questions

- i) Make a list of the special low drag features of your bus. Present your design to the class. Be sure to point out the low drag features as part of your presentation.
- ii) While listening to all of the ideas of their classmates, pool your favorite ideas for a "super bus". Make a drawing of this revised bus.

b) Sample Answers Questions

- i) Once students have completed their drawings, ask the students to present their designs to the class. Ask each student to include mention of the low drag features as part of their presentation.
- ii) After listening to all of the ideas of their classmates, ask for suggestions for a "super bus". If students pool the best ideas from everyone, they should be able to make a truly unique design.

5) Extension

- a) Invite a representative from a bus manufacturing company to visit with your class about bus designs and fuel efficiency.
- b) Prior to their coming, ask each student to write three questions to ask the bus manufacturer. Remind students to inquire about bus designs, as well as fuel efficiency.