Paper Derby

Amount of time Demo takes: **5 minutes**

Try this at home!

Lesson's Big Idea

- Students will design cars to move down the ramp while air from the fan is pushing against them. Based on the surface area of the car/index card, the cars will move at different speeds.
- The larger amount of car/index card exposed to the fan will cause the car to move slower due to air resistance. The lesser area will create a more aerodynamic car that can move faster.
- Not all objects have the same aerodynamics. Wind resistance slows objects.

Materials

- Matchbox cars (4-5 identical)
- Ramp
- 3x5 index cards
- Rubber bands
- Scotch Tape
- Fan
- Laminated pictures of cars (real and derby cars)
- Sewing measuring tape

SAFETY!

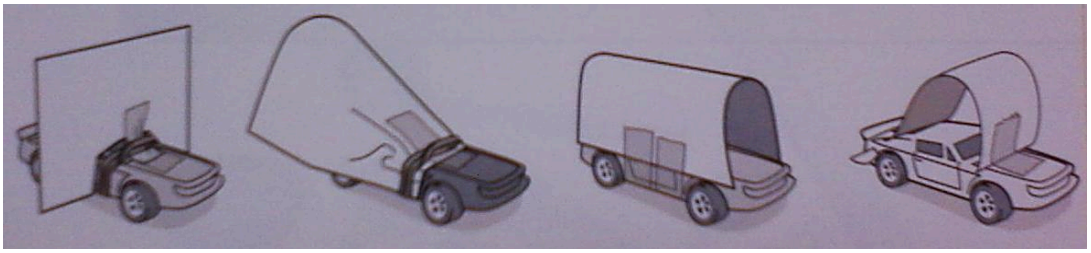
- Keep fingers away from the fan.

Setup Instructions

1. Place the ramp at one end of the table so that if something were to be placed on it, the item would roll the entire way across the table after leaving the ramp.
2. Place the fan at the opposite end of the table facing the ramp.
3. Lay the measuring tape across the table starting at the end of the ramp.

Make sure to put it along the side of the ramp and not the middle so the path of the cars will not be affected.

4. Have a sample car ready and give the participants supplies (Notecard, rubber band (2), car, and some tape, you, the facilitator will hand out pieces of tape as needed).
5. Place the car pictures face down in a stack on the table (out of the way of the ramp).
6. Below are some examples of cars that can be made. **DO NOT** show the students.



Background Information

1. Aerodynamics: having a shape that reduces the drag from air moving past
2. Vehicles are designed to be as aerodynamic as possible, to help reduce drag which leads to an increase in efficiency.

Instructional Procedure

1. Turn the fan on and make sure that it is aimed at the ramp.
2. Let the participants construct a car that they think will have the MOST air resistance, the goal being to have the car that stops the farthest from the fan.
3. The participants may look at examples from the stack of pictures but will receive a ½ inch penalty for each example they look at. There will be a car for the instructor to compete with that is a mid-range car. This will be used as an example or to race against participants.
4. Once all cars are constructed, lead participants to release their cars from the ramp(s) and make a record of the distance that each car goes.
5. After you have done all the cars, have the students explain why some cars went farther than others.
6. Guide a discussion about frontal surface area and aerodynamics.
7. Lay the images of real cars out and ask them to arrange them in order based on how aerodynamic they are.

Tips & Tricks

- Try not to give the students to many hints if they don't need it. Often times if you give hints every vehicle will look the same, really let them think about the problem and how they are going to fix it!

Assessment Questions

1. Why do some cars go a longer distance than others?
    a. The drag on the vehicles are different
2. What causes the cars to stop?
    a. Drag force acting in opposite direction as the vehicles forward motion

Careers & Real World Applications

- **Mechanical engineer -** Work in an environment designing and testing the aerodynamics of vehicles.
- **Physicist** - Work with how forces act on vehicles and how to optimize efficiency.

Clean Up

- Clean up between demos if needed. When completely finished gather all materials listed for this demo and make sure everything is accounted for. If something was used up, broken or damaged. Let someone know so it can get replaced or fixed.

References

- Chadde, Joan, Heil, David, Hutzler, Neil, and Jackson, Mia. *Family Engineering: An Activity and Event Planning Guide.* Foundation for Family Science and Engineering, 2011. Print
- http://familyengineering.org/

Related Next Generation Science Standards

- K-5
    - K-PS2 Motion and Stability: Forces and Interactions
    - K-2-ETS1 Engineering Design
    - 3-PS2 Motion and Stability: Forces and Interactions
    - 3-5-ETS1 Engineering Design
- 6-8
    - MS-PS2 Motion and Stability: Forces and Interactions

    - MS-ETS1 Engineering Design
- 9-12
    - HS-PS2 Motion and Stability: Forces and Interactions
    - HS-ETS1 Engineering Design