



## **Aerodynamics Remote Lesson Plan:**

**Objective:** Introduce students to aerodynamics and help them understand how an object interacts with the air as it moves through it.

**Time:** 1 hour

**Materials:** Aerodynamics PowerPoint and paper, tape, a straw, and candy wheels to make a paper test car. Make copies of car template and assembly directions shown here: <https://www.scholastic.com/nascarspeed/index.html>. Students will need a ruler, yard stick, or tape measure for the test as well.

**Procedure:** Introduce the concept of aerodynamics, the study of the movement of air, specifically how it flows around objects like cars. The aerodynamics of a car depends on how much air the car has to move out of the way as it travels; moving more air makes it more difficult to travel and moving less air makes it easier. Illustrate this by dropping a flat sheet of paper which falls slowly and then a sheet of paper wadded up into a ball. The sheet of paper has a large surface, so it has to move more air and drops slowly. The wadded paper ball has a smaller surface, so less air has to move, and it drops more quickly. Remote students can try this themselves at home.

1. Ask students if they can think of how aerodynamics applies to sports. Are there sports where people might want to bend to move less air out of the way and improve their aerodynamics? Examples: speed skating, bicycling. What about the opposite and move more air out of the way and decrease their aerodynamics? Examples: hang gliding, sky diving.
2. Show students a force diagram and explain that there are forces acting on a car including the weight of the car, lift from under the car, thrust pushing the car forward, and drag working against the car. If students know about Newton's Laws of Motion, you can make a connection between the forces and Newton's 3<sup>rd</sup> Law.
3. Weight and lift forces: The weight of the car acts down toward the ground. The heavier the car is, the greater the force, and the more difficult it becomes to move the car. Of course, some weight is necessary in order to keep the wheels in good contact with the ground, so it is a balance between weight and lift.
4. Thrust and drag forces: Drag is the force of air resisting the thrust forcing the car to move forward. For a better understanding of drag, show students the NASCAR video called Drag: <https://www.scholastic.com/nascarspeed/index.html> (Scroll down to the Videos section at the bottom of the page.)

**Activity:**

1. To better understand how the aerodynamics of a car affects how much drag it has acting on it, we will build a model car and test it by running it down a ramp.
2. Distribute copies of paper car template or have students print out template. Students can decorate (if there is time) and cut out the template. Note: Students do not need to cut out the semicircles on the template in order to build the car successfully.
3. Make a ramp for the test car out of card stock with the edges folded up to make a “U” shape or use a piece of cardboard. Lift one end of the ramp onto a small stack of books and leave the other end on the floor. This will be used to test the car.
4. Each student places a car at the top of the ramp and lets it roll forward (No pushing it!). Use a ruler to measure the distance the car traveled from the end of the ramp to where it stopped. Repeat for a second run.
5. Now tape an index card or a piece of paper folded into a square the width of the car onto the back of the car so that it sticks up above the car’s roof. Repeat step 4 two times and record the results.
6. Discuss which car traveled farther and why. How did the added index card affect the drag of the test car?
7. Relate aerodynamics back to the design of students’ EV Challenge vehicles. How will their design change to improve the aerodynamics of their vehicles?

**Lesson in a Box Wind Tunnel:**

To illustrate aerodynamics, goHunterdon can furnish a small, portable wind tunnel with a variable power supply and two test cars. The teacher can place each of the test cars into the wind tunnel and then slowly increase the power until each car moves inside the tunnel. The round shaped test car will move at a lower power level and fan speed than the more aerodynamic shaped test car.