

THREE DS OF SPEED

LESSON PLAN 2: DOWNFORCE

UNDER PRESSURE

TIME REQUIRED: 45 minutes, plus optional extension activity

MATERIALS: Recycled or reused paper (1 sheet per student), straws (1 per student), spools (1 per student), index cards (1 per student), card stock (1 sheet per student), rulers, scissors, pencils, markers, completed cars. *Note: Students will need one whole straw, plus the piece of straw left over from Lesson 1. Students will reuse the card stock from Lesson 1.*

ACTIVITY AND RESOURCE SHEETS: Assembly Sheet B, Downforce Activity Sheet, Resource Sheet A, Resource Sheet C (optional). [Download additional sheets as needed at scholastic.com/nascarspeed.](http://scholastic.com/nascarspeed)



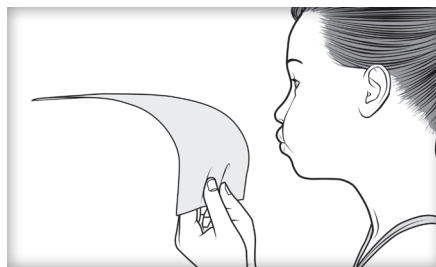
Central question:
How are the aerodynamics of racing and flight similar?

1. Explain that because NASCAR racecars can reach speeds of more than 200 miles per hour, they rely on air pressure and special racecar adaptations to stick to the track. Air pressure—a key element of aerodynamics—is a force caused by the weight of air molecules pushing against an object's surface.
2. Fast-moving air causes low air pressure, and slow-moving air creates high air pressure. **Downforce** is created when high pressure pushes down on an object from above and there is low pressure below. **Lift**—the opposite of downforce—is created when there is low pressure above an object and high pressure below.
3. Downforce pushes NASCAR racecars downward so they stay on the track. Lift pushes the wings of airplanes upward so that the planes fly.

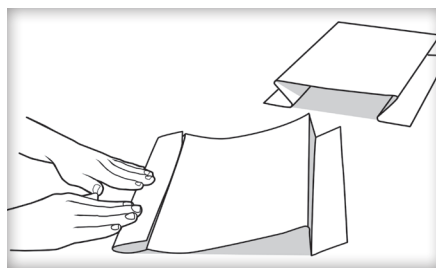


Central question:
How does air pressure cause an object to rise or fall?

1. To demonstrate how air pressure works, have each student hold the short end of a sheet of paper with his or her hands pointing up. The paper should curve down over the back of his or her hands. Tell the students to blow forcefully over the curve of the paper. What happens? (*Faster-moving air over the top of the paper creates lower pressure above in contrast to higher pressure below. That creates lift, causing the paper to rise.*)



2. Next, have students fold 1-inch flaps along the two shorter edges of the paper. Have them turn the paper over and fold two more 1-inch flaps along those same edges. Finally, have them sit the paper on a tabletop so that there is a gap between the paper and the table. Ask them to blow forcefully through the gap. What happens? (*Faster-moving air below the paper creates an area of low pressure. The high pressure above pushes downward, creating downforce and causing the paper to sag.*)



Central question:
What is the relationship between air speed and air pressure?

1. Pass out *Assembly Sheet B*, the *Downforce Activity Sheet*, and experiment materials. Have pit crews complete the experiment. If students have trouble, make sure the straws

are not taped at an angle and the top of the spool is completely covered.

2. After groups complete the Conclusion questions, challenge them to think of other objects that rely on lift or downforce to operate. (*Answers: Experiment: fast/low; slow/high; low/fast; high/slow; low/high/lift. Racecar: slow/high; fast/low; high/slow; low/fast; high/low/downforce.*)



Central question:
How do racecar modifications influence downforce on the vehicle?

PIT CREW CHALLENGE (OPTIONAL)

1. Pass out copies of *Resource Sheet A*. Point out the racecar's splitter and skirting. Explain that these adaptations enhance the car's downforce by directing fast-moving air underneath it (splitter) and preventing slow-moving air from slipping underneath its sides (skirting).
2. Pass out card stock, scissors, and the completed cars from Lesson 1. Have pit crews use *Resource Sheet A* to guide them in adding spoilers, splitters, and other features to their cars. After they have adapted their racecars, ask students to write two or three paragraphs explaining:
 - how the speed of airflow creates air pressure, drag, and downforce
 - how a racecar's spoiler increases drag and creates downforce
 - how a racecar's splitter and skirting help keep the car on the track

You may choose to share *Resource Sheet C* with students for a visual illustration of where racecars experience air pressure.