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FUELED BY: NASCAR KIDS

How Does Air Affect the Motion of a NASCAR Race Car?

Grade Level	Topic	NGSS
K-2	Properties of Materials	PS2.A

Phenomenon

Wind blowing against people as they are trying to walk

Materials

- Video Clip—People Walking in the Wind
- Fan—1 per group
- Standard 8 ½ x 11 inch paper - 1 sheet per student
- transparent tape

Safety

NSTA encourages K–12 teachers and school leaders to promote and support the use of science activities in science instruction and work to avoid and reduce injury. Additionally, NSTA recommends teachers and school leaders visit the NSTA Safety Resource page for up-to-date information on safety issues and guidelines.

SCIENCE AND ENGINEERING PRACTICE(S)	**Planning and Carrying Out an Investigation** Collect and produce data to serve as the basis for evidence to answer scientific questions. **Constructing Explanations and Designing Solutions** Construct an explanation that includes qualitative or quantitative relationships that predict and/or describe phenomena.
DISCIPLINARY CORE IDEAS Targeted Science Ideas and Engineering Ideas (when applicable)	**PS2.A—Forces and Motion.** The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change.
CROSSCUTTING CONCEPTS	**Patterns** Graphs, charts, and images can be used to identify patterns in data. **Scale, Proportion, and Quantity** Phenomena that can be observed at one scale may not be observable at another scale.

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SUPPORTING EQUITABLE PARTICIPATION

Interactions

One-to-one | One-to-small group | One-to-many | Small group-to-many

Modalities

How students communicate their ideas

Talk • Text • Visual: Drawing, Symbols, Table, Graph, Chart, and Gesture

EXPERIENCE PHENOMENON

Students experience the phenomenon or problem. The teacher creates an **opportunity for students to connect** with this specific event or problem (through prior experience, interests, and curiosities) and **raise or identify a student question** to investigate.

T What is the teacher doing to support students' sensemaking?	S What are students doing to make sense of the phenomenon? (Includes teacher look-fors)
1. Introduce the Phenomenon	
Have students create a T-chart and label one side Notice and the other side Wonder. Tell students you are going to play a video clip, and they will have time afterward to fill out their charts. If needed, play the clip a second time so students can add more observations.	
Show students the Video Clip—People Walking in the Wind	Students watch a video clip and make some observations about wind interacting with people as they are walking.
Have students share their noticings and wonderings in small groups, then ask them to think about the question, **"Could wind affect a race car in the same way?"** Have students brainstorm ideas about how wind could affect how a stock car moves along a track.	Students share their ideas with a partner, then brainstorm connections between air and stock cars.

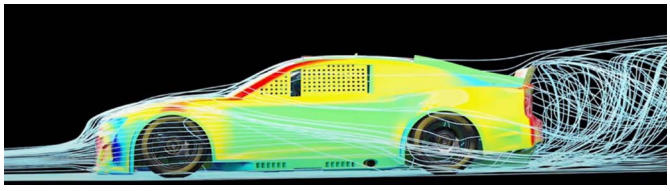
T	S
After students discuss their ideas, have student groups create a list of questions they have about how air could interact with a stock car. Have student groups share their questions during a whole-class discussion; as students share, record their questions in a visible space. Questions will vary, but common student questions include these: • Does air/wind affect a race car because they are heavier than a person? • Do race cars make their own wind when they go really fast? • Could wind blow over a race car or flip it over? • Could wind make the car go faster if it was blowing in the right direction?	Students create a list of questions they have about how air could interact with a stock car.

Acknowledge all student questions, then explain that NASCAR teams spend a lot of time figuring out how air affects the car's speed. Tell students that the way air moves around objects is called aerodynamics. Explain that studying and figuring out aerodynamics is an important part of racing.

2. Gathering Student Ideas and Questions

Show students the picture below, and tell them the lines represent how air flows around the car. Give students 1–2 minutes in their "alone zone" to think about what they are looking at and to notice any patterns.

Students analyze and interpret data to look for patterns. Students notice that air moves around the car in different ways.



Chevy MyWay: Meet The All-New NASCAR Next Gen Camaro | Chevrolet Screenshot from https://www.youtube.com/watch?v=VLSrtjacvIE

T	S
Have students share their noticings with a shoulder partner or small group. Common student noticings include these: • The air in the front of the car looks different from the air in the back. • The air goes up and over the car and along the sides of the car. • Some air looks like it goes under the car. • Air appears to be going around the wheels. • The air looks like it stays close to the car until it gets to the back.	Students share their noticings.
Now that students have noticed some air patterns around the car, prompt them to think more about air: what it is and how it affects different objects. Students should remember that air is "something," meaning it occupies space and has weight. *Note—If students have done the lessons (Why can air affect movement?), prompt them to think about what they figured out about air when looking at air pressure in tires. You could also prompt students to think about other observations and experiences with wind. For example, ask them to remember being outside on a really windy day; if they have ridden in a car on a windy day and felt the car jerk; or if they extended their arm out of the car window when the car was moving.*	
Ask students to brainstorm ideas about how they could investigate the relationship between air and the car. Give students a few minutes in their small groups to formulate some ideas, then have them share them. Ideas will vary, but focus on the ideas that include using a fan to figure out more about how air affects objects. If students mention placing objects outside on a windy day, help get them to the idea of using a fan by asking them what they could use to mimic the wind.	Students work in small groups to brainstorm ideas about how they could investigate how air interacts with a car.

T S

INVESTIGATE

Students engage in the practices of scientists and engineers to build understanding of targeted science ideas (and engineering ideas) needed to explain the phenomenon or solve the problem.

3. Investigating Aerodynamics

(Note—This can be done as a demonstration or in small groups, depending on the availability of the fans and time.)

Tell students that to better understand aerodynamics, they will need to observe how differently shaped objects of the same weight interact with air. Say, "For this investigation, we will be using a small fan and some sheets of computer paper, folded in different ways."

Have students create a 3-column chart in their science notebooks (pictured below).

Students create a chart to record their data.

Paper Shape	Observations	Explanation

Tell students that they will be working in groups and that each group member will get a sheet of paper that they will need to fold. Each group member will need to fold the paper differently, then make observations about how it moves when it is placed in front of the fan.

Tell students to make sure the test is always the same; they will need to use the masking tape to mark where the fan is on the table/floor and where they put their folded paper before turning on the fan. (Examples pictured below)

Students engage in an investigation to make observations of what happens when air interacts with different shapes of paper.

Students should also use the lowest setting on the fan.

T	S
After students make their observations, tell them to work together to complete the Explanation column of their table. Explain that in this column, they should use pictures and words to explain how they think the air moves or doesn't move the folded paper. Prompt students to explain what is happening at the air particle level by asking, "If you could see the individual air particles moving, how do you think they would be interacting with the different paper objects?" Also encourage students to refer to the picture of how the air flows over the stock car.	Students work in small groups to explain what they think is happening at the air particle level.

As students work, walk around the room and look for students to explain that air particles colliding with the paper push it and make it move. The larger the surface of the paper, the more air particles can hit it, causing it to move. If the air particles only hit a small part of the paper, it only moves a little. When students are finished, have each group share their idea of how air makes the paper move or not move.

REFLECT

Students use the new or revised science ideas they developed to help explain how or why the phenomenon occurs and/or to identify solutions to the problem.

4. Making connections to aerodynamics

Based on their investigation, students should conclude that the shape of the car matters in how it interacts with the air. Explain that NASCAR stock cars today all have similar shapes and have to weigh the same amount. Ask students to think about why these things would be important. Student ideas will vary, but should conclude that having the same shape and weight would allow air to move around the cars in similar ways.

T	S
Next, prompt students to think about how moving air could affect the car differently depending on the different variables. Prompt students to consider the following scenarios and make predictions about how the stock car could be affected. 1. How could wind speed affect the car (a light breeze versus a strong wind)? 2. How could wind direction affect the car (air moving with the car/air moving against the car)? 3. How does the speed of the car affect how the air hits it? Student predictions will vary, but students should reach the conclusion that air can "help" or "hurt" a NASCAR team depending on how the air moves around the car.	Students think about how air could interact with stock cars in different ways.
Last, tell students that NASCAR teams have some ways they can use air to their advantage regarding different adjustments they are allowed to make to certain parts of the car, like the rear spoiler, for example.	
Before ending the lesson, ask students if there is anything else about air and how it could affect a stock car they could investigate. Student ideas could include these: • Could air moving around one car affect another car? • Does the air coming from the back of the car move differently because it looks all swirly? • Does air blowing against a car make it go slower?	Students brainstorm other ways knowing about air would be important for a NASCAR driver and their crew.

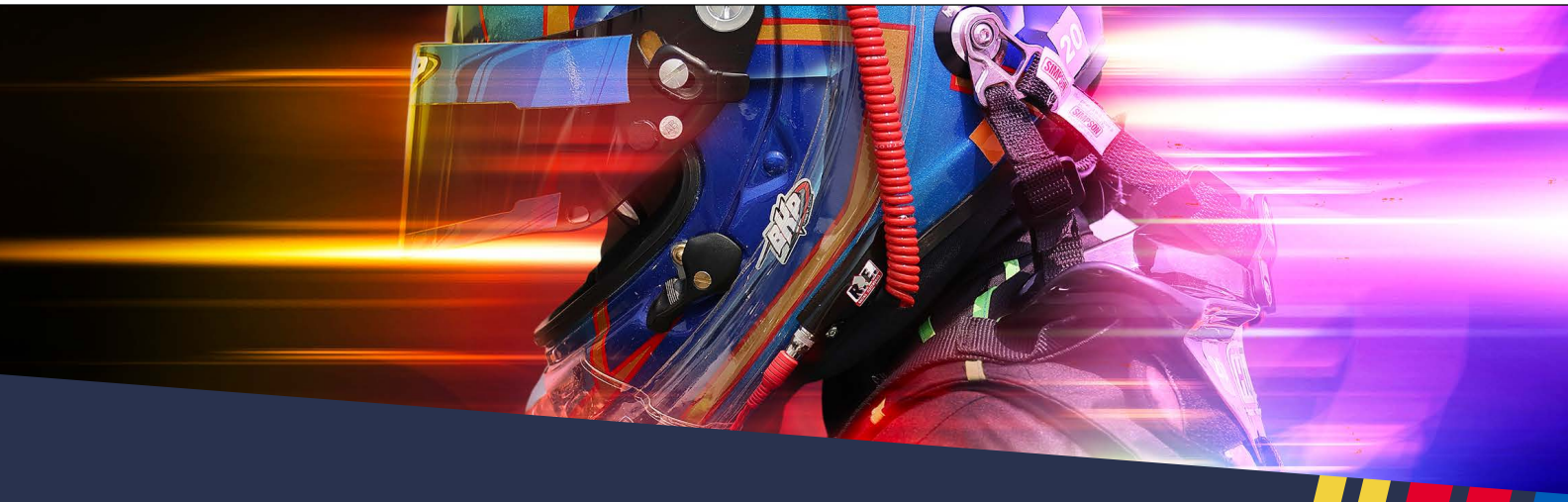
This lesson could be one in a series of lessons building toward the following:

MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.

[Clarification Statement: Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle.] [Assessment Boundary: Assessment is limited to vertical or horizontal interactions in one dimension.]

MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

[Clarification Statement: Emphasis is on balanced (Newton's First Law) and unbalanced forces in a system; qualitative comparisons of forces, mass, and changes in motion (Newton's Second Law); frame of reference; and specification of units.] [Assessment Boundary: Assessment is limited to forces and changes in motion in one dimension in an inertial reference frame and to change in one variable at a time. Assessment does not include the use of trigonometry.]



AT THE RACE TRACK

Is it windy at the track on race day?

If it's windy at the track, watch for the team to be making adjustments to improve the aerodynamics of the cars.

- One thing you can look for is duct tape. How could duct tape help teams improve the aerodynamics of a stock car?
- Also look for other small adjustments teams do to improve how the car interacts with air.

To learn more about aerodynamics, consider watching the following video:

Testing NASCAR Race Car Aerodynamics

https://www.nbcsports.com/video/testing-nascar-race-car-aerodynamics