WeDo 2.0 Science

Speed

Investigating what factors can make a car go faster to help predict future motion.

Science, Engineering, STEM, Coding

Grades 3-5 **120+ min.** **Intermed.**

LESSON PLAN

1. PREPARATION (15-30 MINUTES)

- Read the general preparation in the "Classroom Management" chapter.
- Read about the project so you have a good idea of what to do.
- Define how you want to introduce this project: Use the video provided in the project in the WeDo 2.0 Software, or use material of your own choice.
- Determine the end result of this project: the parameters to present and produce the document.
- Make sure timing allows for expectations to be met.

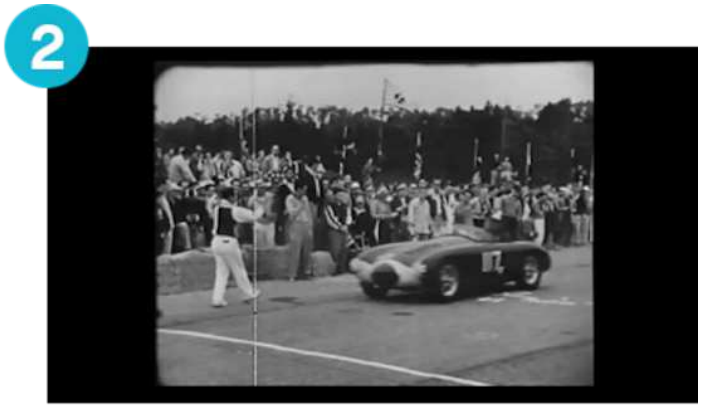
2. EXPLORE PHASE (30-60 MINUTES)

The introductory video may set the stage for the following ideas to be reviewed and discussed with students for this project.

Introductory video

Here are some suggested talking points for the video:

1. Cars allow us to move from one point to another faster. But there was once a time when cars were slower than horses.
2. In a quest for improvement, car engineers searched for elements that could influence a car's speed.
3. Engineers looked at all parts of the car to design stronger engines and mechanisms.
4. Engineers improved the wheels and tires and changed the size and materials.
5. Today, cars can go as fast as 250 mph (400 km/h).



Questions for discussion

1. What are some ways that cars have been improved to become faster?
There are many factors that can influence the speed of a car. Size of the wheels, motor power, gears, aerodynamics, and weight would be the most common ones. The color of the car, brand, or driver experience should not be considered as potential elements for study.
2. What elements can influence the time required for a car to travel a certain distance as fast as possible?
This answer should provide prior knowledge regarding comprehension of the content. This means that at the beginning of the lesson, students' answers can be incorrect. However, by the end of the lesson, students should be able to provide an accurate answer to the question.
3. What can you infer about the relationship between wheel size and the time it takes the car to move a distance?
The bigger the size of the wheel is, the faster the car will travel the distance, if all the other parameters are kept constant.
4. What did you notice about the configuration of the pulley and its effect of the car's speed over the distance?
One of the pulley configurations makes the car go faster and the other reduces the speed of the car.
5. How can you measure the speed of an object?
Speed is measured by dividing the time required to travel a distance by the measure of that distance. A unit of speed is always distance for a specific period of time.

Have your students collect their answers with text or pictures in the Documentation tool.

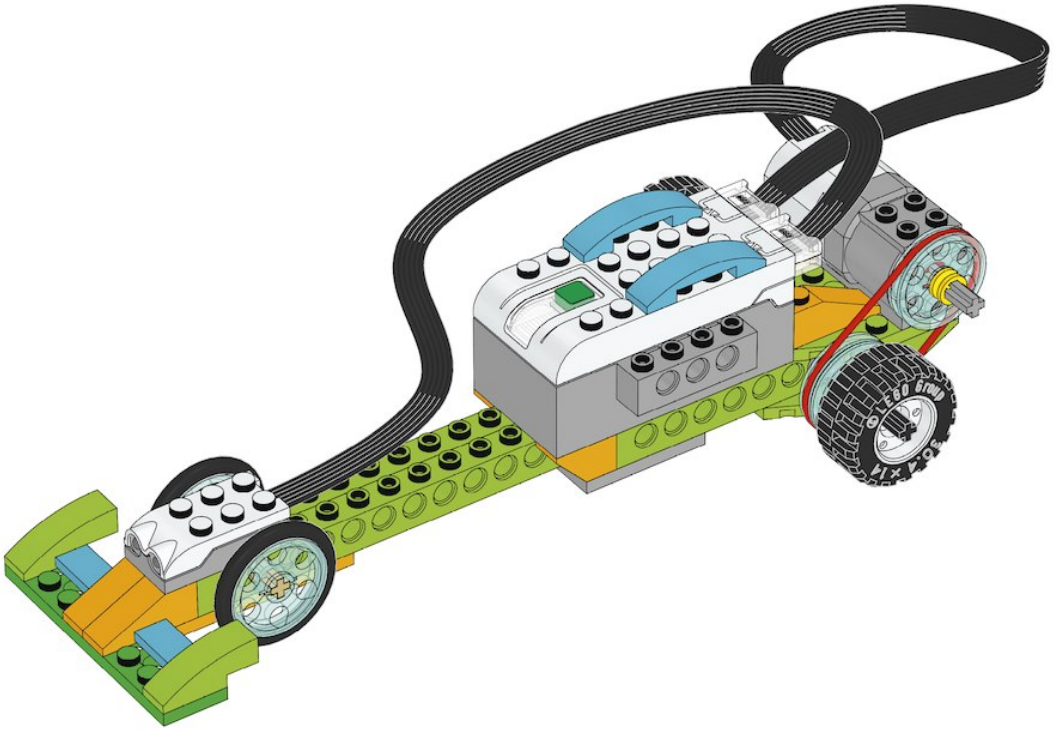
3. CREATE PHASE (45-60 MINUTES)

Build and program a race car

Students will follow the building instructions to create a race car. These types of vehicles are optimized to go as fast as possible.

1. Build a race car.

The drive module used in this project uses a pulley. This pulley system can be assembled in two different positions: the reduced speed position (small pulley and large pulley) or the normal speed position (large pulley to large pulley).

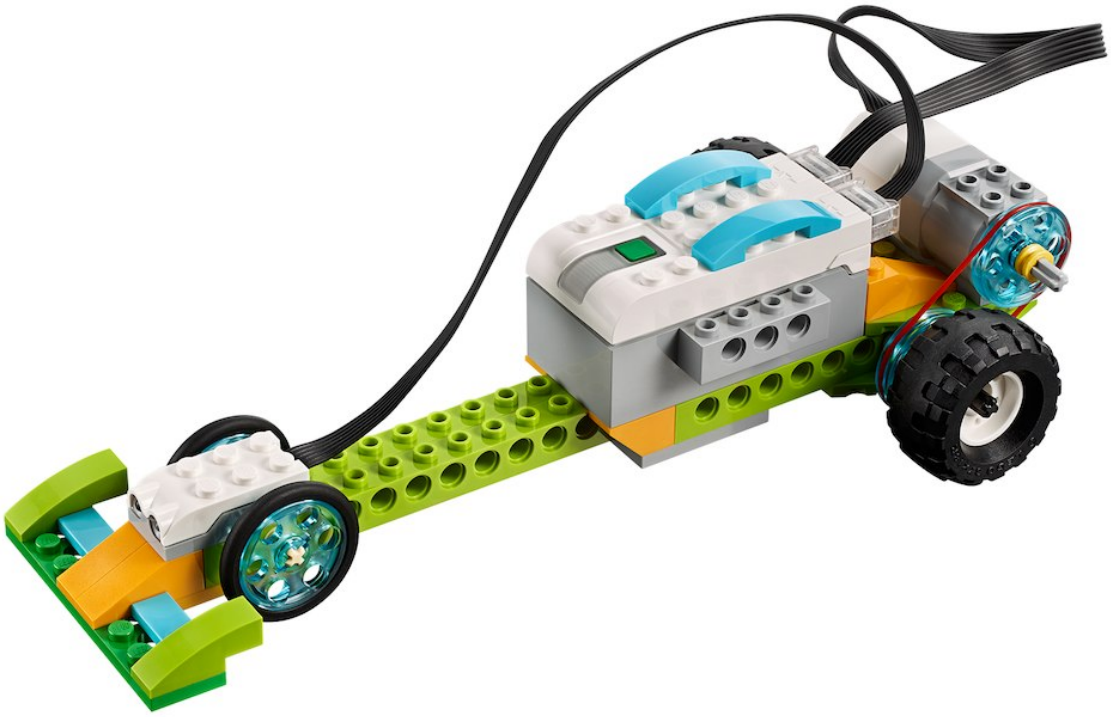


2. Program the race car to calculate time.
Students need to have a hand in front of the race car before the start of the program. This program will start by displaying no. 0 and wait for the start signal. When your students remove their hands, the program will turn the motor on, go to maximum power, and repeat, adding no. 1 to the display. The loop will repeat until it reaches the end of the race. Then the motor will turn off.

Important
For this program, students need to put their hands in front of the car before they execute the program string. When they remove their hands, the car will start its race.

Important
For this investigation, it is crucial that you have the same setup throughout the test. It is the only way students can isolate one element at a time:

- The start line should always be at the same distance from the finish line, which is a wall or a box.
- The distance between the start and finish line is greater than 2.5 yd. (2 m).



Investigate speed factors
From this model, students should be able to test different factors, one at a time. They should test a distance greater than 2.5 yd. (2 m) to see results.

1. Run the race with SMALL wheels at motor power 10.
When running this test, students should record the number on the display. They should repeat the test three times to make sure it is consistent.
If the value in one of the three tests is disproportionate, repeat the test for a fourth time. This value is the approximate number of seconds it took for the race car to travel the distance.

2. Run the race with BIG wheels at motor power 10.
By changing the wheels, the race car should take less time to travel the same distance, and therefore, have a greater speed. Repeating the test three times will make sure it is consistent. If the value of one of the three tests is disproportionate, repeat the test for a fourth time.

Suggestion
Other options could be considered to reach a more precise result, including increasing the number of trials or finding the average.

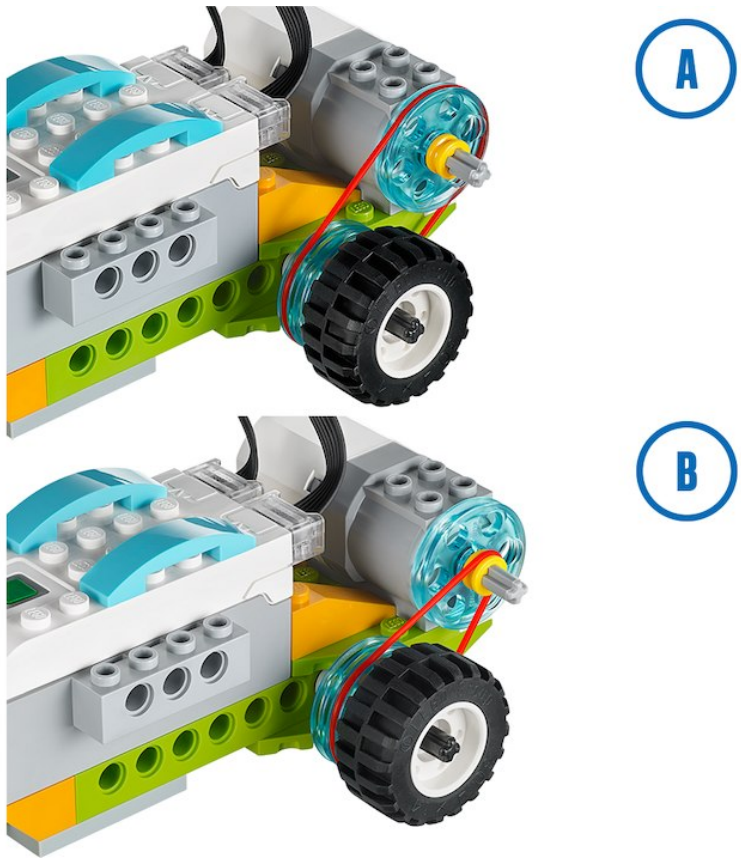
3. Predict the time it will take to travel twice the distance.
When the distance doubles and the motor power level and size of tires are the same as the previous test, the number of seconds should also double.

Investigate more (optional, 45-60 minutes)
Use the "Investigate more" section of the student project as an optional extension. Keep in mind that these tasks extend upon those in the "Investigate" section and are designed for older or more advanced students.

With the same race car model and the same setup, students can hypothesize and test other factors that may influence the speed of the car.

1. Change the motor power.
Changing the motor power level from no. 10 to no. 5 will make the race car take more time to travel the same distance.

2. Change the drive mechanism (pulley configuration).
Changing the drive mechanism from the normal position to the reduced speed position will make the race car take more time to travel the same distance.



3. Investigate another element.
Have students do the test based on another factor they think could influence the speed of the race car: the width, the length, the height, the weight, or another factor of their own choosing.

Collaboration suggestion
Allow your students time to design and build their own ultimate race cars so that they can apply their findings and make them as fast as possible. Get the teams back together, organize a race, and see whose car is the fastest.

4. SHARE PHASE (45+ MINUTES)

Complete the document
Have students document their project in a range of ways (suggestions may include):

- Ask them to take a screen capture of their results.
- Get them to compare these images with real-life images.
- Invite students to record a video of them describing their project to the class.

Suggestions
Students may collect data in a chart format or on a spreadsheet.
Students may also graph the results of their tests.

Present results
At the end of this project, students should present which elements influence a car's speed. Conclusions should reflect the fact that larger tires, stronger motors, and greater motor power generate much higher speeds.

To enhance students' presentations:

- Ask them to put their explanation in context.
- Ask them to analyze situations in real life in which they have observed speed as an element.
- Discuss the connection among their findings and these particular situations.

PROJECT ASSESSMENT

NGSS project assessment rubrics
You can use these assessment rubrics with the observation rubrics grid, which you will find in the "Assess with WeDo 2.0" chapter.

Explore phase
During the Explore phase, make sure the student is actively involved in the discussions and asking and answering questions and can describe factors that
affect speed in cars.

1. The student is unable to adequately provide answers to questions or participate in discussions or describe factors that affect speed.
2. The student is able, with prompting, to adequately provide answers to questions or participate in discussions or, with help, describe factors that affect speed.
3. The student is able to provide adequate answers to questions and participate in class discussions or describe the factors that affect speed, though not in detail.
4. The student is able to extend the explanations in discussions or describe in detail the factors that affect speed.

Create phase
During the Create phase, make sure the student is able to work as part of a team, test one factor at a time to determine its influence on speed, and use the information collected in the Explore phase.

1. The student is unable to work well on a team and complete the testing of each factor affecting speed in order to use the information.
2. The student is able to work in a team and complete the testing, with help, of each factor affecting speed in order to use the information.
3. The student is able to work on a team, contribute to the team discussions, and complete the testing of each factor in order to use the information.
4. The student is able to work on a team, serve as the leader, and extend the testing of factors affecting speed beyond the required elements.

Share phase
During the Share phase, make sure the student can engage in discussions about the investigation, explain their findings, and use important information from their project to create a final report.

1. The student is unable to engage in discussions about the investigation and use the information to create a final project.
2. The student is able, with prompting, to engage in discussions about the investigation and use limited information to create a basic final project.
3. The student is able to engage in discussions about the investigation and use the information gathered to produce a final project.
4. The student is able to engage extensively in class discussions about the topic and use the information gathered to create a final project that includes additional required elements.

ELA project assessment rubrics
You can use these assessment rubrics with the observation rubrics grid, which you will find in the "Assess with WeDo 2.0" chapter.

Explore phase
During the Explore phase, make sure the student can effectively explain his/her own ideas and comprehension related to the questions posed.

1. The student is unable to share his/her ideas related to the questions posed during the Explore phase.
2. The student is able, with prompting, to share his/her ideas related to the questions posed during the Explore phase.
3. The student adequately expresses his/her ideas related to the questions posed during the Explore phase.
4. The student uses details to extend explanations of his/her ideas related to the questions posed during the Explore phase.

Create phase
During the Create phase, make sure the student makes appropriate choices (i.e., screen capture, image, video, text) and follows the established expectations for documenting findings.

1. The student fails to document findings throughout the investigation.
2. The student gathers documentation of his/her findings, but the documentation is incomplete or does not follow all of the expectations established.
3. The student adequately documents findings for each component of the investigation and makes appropriate choices in selections.
4. The student uses a variety of appropriate methods for documentation and exceeds the established expectations.

Share phase
During the Share phase, make sure the student uses evidence from his/her own findings during the investigation to justify his/her reasoning and adheres to established guidelines for presenting findings to the audience.

1. The student does not use evidence from his/her findings in connection with ideas shared during the presentation. The student does not follow established guidelines.
2. The student uses some evidence from his/her findings, but the justification is limited. Established guidelines are generally followed but may be lacking in one or more areas.
3. The student adequately provides evidence to justify his/her findings and follows established guidelines for presenting.
4. The student fully discusses his/her findings and thoroughly utilizes appropriate evidence to justify his/her reasoning while following all established guidelines.

5. DIFFERENTIATION

To ensure success, consider giving more guidance on building and programming, such as:

- Explain how to conduct an investigation.
- Define factors your students will focus on, such as the size of wheels, motor power, or type of pulley setting.

Also, be specific in establishing expectations for students to present and document their findings.

Investigate more

As an added challenge, allow extra time to investigate with student-created designs and programs. This will allow them to explore additional factors that influence speed.

Students' misconceptions

Students often have trouble distinguishing between speed and acceleration.
A common misconception held by learners is the idea that if speed is constant, then acceleration is also constant. Speed and acceleration are two different concepts that are linked to each other, but if there is no change in the speed, then there is no acceleration or deceleration.

TEACHER SUPPORT

KEY OBJECTIVES

Students will:
Explore race car features.
Create and program a race car to investigate what factors would make it go faster.
Document and present ways to make your car go the fastest.

THINGS YOU'LL NEED

LEGO® Education WeDo 2.0 Core Set
WeDo 2.0 Software or Programming App

ADDITIONAL RESOURCES

Introduction to WeDo 2.0
Curriculum Links
Assessment

COMPATIBILITY

This lesson works on the following operating systems:

EDUCATIONAL STANDARDS

NGSS
3-PS2-2
4-PS3-1

CCSS
CCSS.ELA-Literacy.W.3.8
CCSS.ELA-Literacy.SL.3.1.a
CCSS.ELA-Literacy.SL.3.1.d