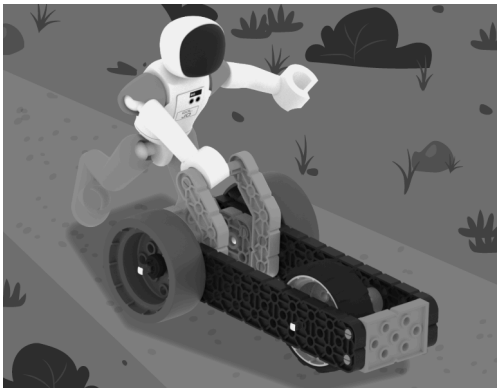
Introduction



Science, Technology, Engineering, and Mathematics (STEM) education provides students with the opportunity to explore the physical world around them. Students will explore the effects of balanced and unbalanced forces throughout the different builds within this Unit. They will build an Unpowered Super Car, introduce a rubber band to the build, replace the rubber band with a motor, connect two cars together to allow a combined car to turn, and then introduce a Brain to the build to allow a program to set the velocity of the motors. Students will have the opportunity throughout the labs to investigate patterns and how they can be used to make predictions.

Please keep this letter for your reference as your student works through the Physical Science Unit. It contains information that you can use to keep up to date on what students are learning and to spark discussions about STEM at home.

Look Inside the VEX GO STEM Lab Unit

In **Lab 1: Unpowered Super Car**, students will experiment with how their actions impact forces on the Unpowered Super Car. Students will compare that data and observations to the impact of gravitational force on the car when it is placed on an inclined surface. Students will begin to understand how accurate data collection can prepare them to make predictions.

In **Lab 2: Super Car**, students will power their Super Car by introducing a rubber band to the build. They will connect their own actions of turning the knob on the rubber band to the success of the car by building, observing, predicting, and measuring its movements. Students will begin to understand how variables, such as the number of times the rubber band is turned by the knob, can affect the data of how far the Super Car travels. Students will also explore how accurate data collection can make them better able to understand complex reactions and numerical relationships.

In **Lab 3: Motorized Super Car**, students will explore how energy can be converted into a force by comparing the Motorized Super Car to the Super Car powered by rubber

bands. Students will test three different gear configurations to determine which one gives their car the most speed. Each group will use their data to discuss how the gear configurations affect speed.

In **Lab 4: Steering Super Car**, students in groups will pair up to combine their Super Cars into a dual Super Car with two switches. Groups will predict, test, and observe the movement of the combined car by observing all 9 different permutations of the left and right motors' movements (forward, off, reverse) to better understand robotic movement, pattern recognition, and unbalanced forces. Students will use their observations in order to make predictions and then test those predictions.

In **Lab 5: Code Super Car**, students will build a VEXcode GO project to drive the Code Super Car forward. Then, students will work in groups to investigate how different levels of velocity affect the force of the car. First, the groups collect evidence of this by setting the velocity to the level of 25%, 50%, 75%, and 100% and measuring how far the car drives in three seconds.

Vocabulary

General notes on encouraging vocabulary usage with children:
The vocabulary words offered are not meant for students to memorize terminology, but to give them language to use to talk about the activities and learning they are doing throughout the Unit. Work these terms into conversations naturally, and positively reinforce this for students as well.

- **Balanced Forces** - Forces that do not change the motion of an object.
- **Data** - Gathered facts.
- **Energy** - The ability to do work.
- **Estimation** - A prediction or value that is not exact.
- **Force** - A push or pull that can change an object's motion.
- **Gravity** - A force that pulls objects toward the earth.
- **Investigation** - How we collect data to know how things work.
- **Motion** - The act of moving.

- **Power** - The ability to do or act.
- **Speed** - Rate of motion.
- **Stability** - The state of being unchanged.
- **Strategizing** - Making a plan.
- **Unbalanced Forces** - Forces that change the motion of an object.
- **Velocity** - How fast and the direction an object is moving.

Connection to Daily Life

Forces are all around us. Whether we are opening or closing a door, throwing a ball, playing tug-of-war, or riding a bike, we are experiencing or exerting force. Students will be given the opportunity throughout the Unit to observe patterns and predict motion in the context of forces. The students will be able to make connections between how the Super Car moves due to force and how other objects move. The push or pull of forces that the students experience on a daily basis can also be applied to other objects such as cars, busses, bikes, and even people.

Follow-up questions to ask at home

Use these questions to discuss the activities that your student is participating in with their group. Included here are questions that address the trial and error that is an essential part of building and coding. It will likely take several tries for your student to create their VEX GO Builds and create successful coding projects. Asking process-oriented questions and celebrating mistakes can encourage learners to embrace making mistakes and help them build resilience and confidence to persist when confronted with challenges.

1. Which of the builds in the Unit was your favorite and why?
2. What challenges did you face with your builds or coding project? How were you a problem solver?
3. What was something that your group didn’t get right the first time, that you had to figure out and try again?
4. What interesting patterns did you notice during your experimentation in this Unit?

5. Can you describe what a force is, using your own words?
6. What is something that you learned with the builds or test trials that you want to find out more about?