TEACHER GUIDE

Sonoma Raceway
Race Car Challenge

SONOMA RACEWAY

Kid Scoop News®

Friedman's HOME IMPROVEMENT

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Sonoma Raceway, *Kid Scoop News* and Friedman's Home Improvement have partnered up to challenge students with a gravity-powered car challenge. The STEM Race Car Challenge looks at something fun—race cars—from a scientific perspective, and gives students a hands-on chance to experiment with science, math and engineering, and build their own racing vehicle. All vehicles will compete on a sloped track, in a succession of elimination rounds that could take them to NASCAR weekend at Sonoma Raceway for the final round.

LETTER TO TEACHERS

Dear Educator,

Children are natural born engineers. Watch them play, and you will observe their innate curiosity to build things and take them apart to see how they work. From linking blocks emerge colorful towers, sturdy houses or imaginative zoos to showcase a collection of stuffed animals. Sand transforms into a magical castle on the beach. A shoe box or discarded wood scraps become backyard birdhouses or mighty ships floating in a tub. When children have a chance to construct and solve problems using objects, they are engineering!

21st Century classrooms all over the country are building on this natural curiosity by ramping up the focus on science, technology, engineering and mathematics—known as "STEM"—to make learning fun and connected to the world. Engineering at school happens best when children combine math and science and apply what they know to a project. Learning becomes a joyful by-product of student motivation to resolve a challenge.

"WHEN CHILDREN HAVE A CHANCE TO CONSTRUCT AND SOLVE PROBLEMS USING OBJECTS, THEY ARE ENGINEERING!"

Jumping on board with STEM, *Kid Scoop News,* Sonoma Raceway and Friedman's Home Improvement have formed a partnership to encourage and excite students using car building as the medium. The STEM Race Car Challenge looks at something fun—race cars—from a scientific perspective, and connects students to life and occupations in a way that is instructive and engaging. As part of the project, students will gain first-hand knowledge of careers with a scientific, engineering, technical and mathematical focus.

Most children learn best through touching, and hands-on project-based learning is at the heart of the STEM Race Car Challenge. (A Project-Based Learning unit of study created by our teacher participants at Napa Junction Elementary School is available at *www.kidscoopnews.com/downloads/NJ4thNASCARPBL.pdf*) From cardboard, rubber bands, straws, buttons or an array of other objects will emerge a car powered by gravity alone. Design features to address efficient aerodynamics, reduce drag, minimize friction, increase speed and maximize distance will make lessons in physics stick.

In addition, this project is a practical venue for developing and reinforcing 21st Century skills essential for career success in today's workplace. As students work in teams to answer questions like "What is the best design to make our car move faster?" or "What materials should we use that are durable but allow for maximum speed?" they have to be critical, creative and collaborative thinkers who can communicate well orally and in writing to solve the challenge. Working together through the creative problem solving process is the essence of successful 21st Century careers.

LETTER TO TEACHERS

By drafting designs, constructing and assembling race cars, students become mechanical engineers. When conducting experiments to discover how well their design works, students take on the role of scientists using methods to test hypotheses and record information. Technical adjustments, researching terms and using the right tools to gauge speed and performance introduce young learners to the world of technology. Collecting, analyzing and interpreting data gives a real context to mathematics.

STEM is also playing a critical role in helping our country compete in a global economy. America's leaders have voiced concerns over the supply and availability of STEM careers. Over the past 10 years, demand for STEM jobs was three times greater than demand for non-STEM jobs. If the U.S. is going to create the kind of workforce our country needs for a healthy future, STEM careers must be nurtured and encouraged in today's youth.

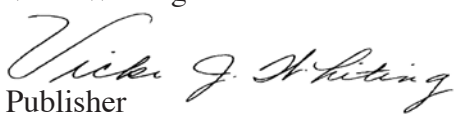
- In 2010, there were 7.6 million STEM workers in the United States, representing about 1 in 18 workers.
- STEM occupations are projected to grow by 17 percent from 2008 to 2018, compared to 9.8 percent growth for non-STEM occupations.
- STEM workers command higher wages, earning 26 percent more than their non-STEM counterparts.
- More than two-thirds of STEM workers have at least a college degree, compared to less than one-third of non-STEM workers.
- STEM degree holders enjoy higher earnings, regardless of whether they work in STEM or non-STEM occupations.

Source: U.S. Department of Commerce, Economics & Statistics Administration

Activities in the STEM Race Car Challenge are designed to introduce and reinforce both national common core standards and 21st century skills. We know you and your students will enjoy this unique combination of race cars and STEM. When construction and problem solving are included as part of classroom learning, students naturally become more aware of options for technical, science or engineering careers—and seeing themselves in these roles early on is one way to encourage all students—especially females and minorities—to pursue a career in STEM fields.

So rev up your engines and drop the checkered flag as we take off and drive home the value of STEM in a student's education, and its potential impact on a career choice and our nation's future!

Vicki Whiting



Publisher
Kid Scoop News

LETTER TO PARENTS

Dear Parents,

Sonoma Raceway has presented our students with an exciting challenge. They have asked our students, and students at nine other schools, "Who can build the fastest gravity-powered car?"

The fastest two cars and one "Most Creative" car from our school will move on to the STEM Race Car Challenge at Sonoma Raceway at 10 a.m. on June 27th, during NASCAR Weekend.

In addition, each participant will get two adult general admission tickets to the Saturday NASCAR day to cheer on their classmates and to enjoy a day at the races. Children 12 and under are admitted free.

Our class is ready to take on this challenge. We will be studying a variety of STEM subjects, including friction, aerodynamics and gravity, in order to use science, technology, engineering and math (STEM) to help us in this task.

The cars will be built from recycled materials. We are looking for "clean trash" that we can use to build our cars. Here are some things we could use to stock our classroom "Pit Stop Area":

cardboard	*wheels*	*plastic bottles*
construction paper	*glue*	*bottle caps*
tissue paper	*tape*	*cds*
milk cartons	*small weights*	*lids*
1/4" dowels	*styrofoam trays*	*meter sticks*
paper clips	*spools*	*inclined ramp*
pipe cleaners	*scissors*	*sandpaper*
fat plastic straws	*craft sticks*	*wooden wheels*

axel & wheels from a toy car

IMPORTANT: In order to qualify for the Finals at Sonoma Raceway, the cars must be entirely built by students at school.

Activities in the STEM Race Car Challenge are designed to introduce and reinforce both national common core standards and 21st Century skills. We know that your child will enjoy this unique combination of race cars and STEM. When construction and problem-solving are included as part of classroom learning, students naturally become more aware of options for technical, science or engineering careers.

So we are ready to rev up our engines and drop the checkered flag as we take off and drive home the value of STEM and its potential impact on a career choice and our nation's future!

OVERVIEW

TRACK SPECIFICATIONS

Sonoma Raceway and Friedman's Home Improvement will provide each school with plywood to use as a practice and qualifying rounds track. If you have a volunteer at your school who would like to build a track that is more like the track that will be used for the STEM Race Car Challenge finals at NASCAR Weekend, please contact *vicki@kidscoop.com* and we can set up a meeting with your volunteer and someone at Sonoma Raceway.

To adapt the plywood as a track that is close to the length and height of the track used for the finals, the plywood should be propped up so that the high end is 50" high. At the end of the plywood ramp, extend the Finish Line out 188" to match the flat part of the Raceway track. If you are doing practice rounds in the classroom, you may want to make the flat part shorter.

ADDITIONAL RESOURCES PROVIDED

Along with your track, you will receive checkered flags and other auto racing goodies for decorating your classroom and school during the challenge. We are not providing any materials for the cars, which should be made completely of recycled materials. The Teacher Guide will provide suggestions for materials.

All participating students will receive two adult general admission tickets for Saturday, June 27, at the Toyota/Save Mart 350 NASCAR event weekend at Sonoma Raceway. Kids 12 and under are admitted free!

TIMELINE

March	Schools complete participation forms. Participating teachers get Tool Kit via email. *Kid Scoop News* publishes page on Friction.	
April 1	Sonoma Raceway will distribute a promotional kit for teachers.	
April–June	Students create and test their cars at their school sites.	
May	*Kid Scoop News* publishes a page on Aerodynamics.	
June TBD	Friedman's Kids Worx Day; Students can test their cars on the official STEM Race Car Challenge ramp.	
June 1	Schools submit information about their top two cars. Form included in Tool Kit.	
June 27th	Final Round	*Sonoma Raceway, Winner's Circle*
	10:00–10:15 a.m.	Registration/Check-in
	10:15–10:20 a.m.	Welcome from Sonoma Raceway
	10:20–10:35 a.m.	NASCAR Driver Q&A (15 min)
	10:35–10:55 a.m.	Qualifying Rounds
	10:55–11:00 a.m.	Final round
	11:00–11:10 a.m.	Award Ceremony

RULES/REGULATIONS

GENERAL RULES

All cars must start by gravity from a standstill, at the starting point. No pushing is allowed. The car whose nose crosses the finish line first is the winner. Race official(s) will decide the winner, and if the result is too close to call, a second race will be run. If any car leaves the track, the race can be restarted. If the same car leaves again, the car is eliminated.

SPECIFICATIONS FOR VEHICLES

WIDTH: Overall width of the vehicle is not to exceed 9 inches.
LENGTH: Overall length of the vehicle is not to exceed 12 inches.
HEIGHT: Clearance between the chassis and the track should be a minimum of 3/8th of an inch.
WEIGHT: The weight of the vehicle is not to exceed 5 pounds.

RESTRICTIONS

The car shall not ride on springs.

Decorations and attachments should be added providing they are securely fastened and do not exceed the maximum length, and width specifications. Vehicles are subject to inspection by an official inspection committee to determine eligibility and safety. Non-secure decorations may be removed by judges.

BUILDING GUIDELINES

1. The vehicles should be built by a team of 3 to 5 student engineers. One student will be nominated the official driver of the vehicle and will be the one to race the vehicle.
2. Vehicles should either have wheels securely attached to the body or have the body securely attached to a wheeled platform. Make sure that the overall size of the car meets the requirements.
3. Decorate your vehicle!
4. Have fun! After all, fun is what this is all about.
5. Measure your car! Being disqualified can be very embarrassing.
6. Safety first!
7. Cars must be entirely student built and built at school. Cars made or improved upon at home will be disqualified. Teachers/adults may assist with drilling and electrical tools used in the making of the cars.

NOTE: The School Contact person will be required to sign off on the **final registration form** that the car was entirely student built, at school.

PRIZES

Each participant will receive two adult general admission tickets to cheer on their classmates at the STEM Race Car Challenge Finals on Saturday, June 27, at Sonoma Raceway. Kids 12 and under are admitted free! Participants will also receive a **participation certificate.**

FASTEST CARS AT EACH SCHOOL SITE

The two fastest cars at each school site will move on to the STEM Race Car Challenge Finals on Saturday, June 27 at Sonoma Raceway. Members of the team who designed the two fastest cars will each get two adult general admission tickets to NASCAR Saturday. Each student will also receive a Sonoma Raceway die cast car.

The winner of the STEM Race Car Challenge will receive a trophy and become the Grand Marshal for the NASCAR Saturday race and participate in pre-race introductions and give the start command to kick off the race, "Drivers, start your engines!"

ART CARS

Each school may also submit a "Most Creative" or "Best Designed" car. This car will be showcased at the NASCAR STEM Race Car Challenge Finals. One overall "Best in Show" car will receive a trophy and four tickets to Sunday's NASCAR race!

THE FINALS

The final round will take place at Sonoma Raceway on Saturday, June 27 at 10:00 a.m. At a minimum, a student-engineer from each team must be present to qualify their vehicle in the race.

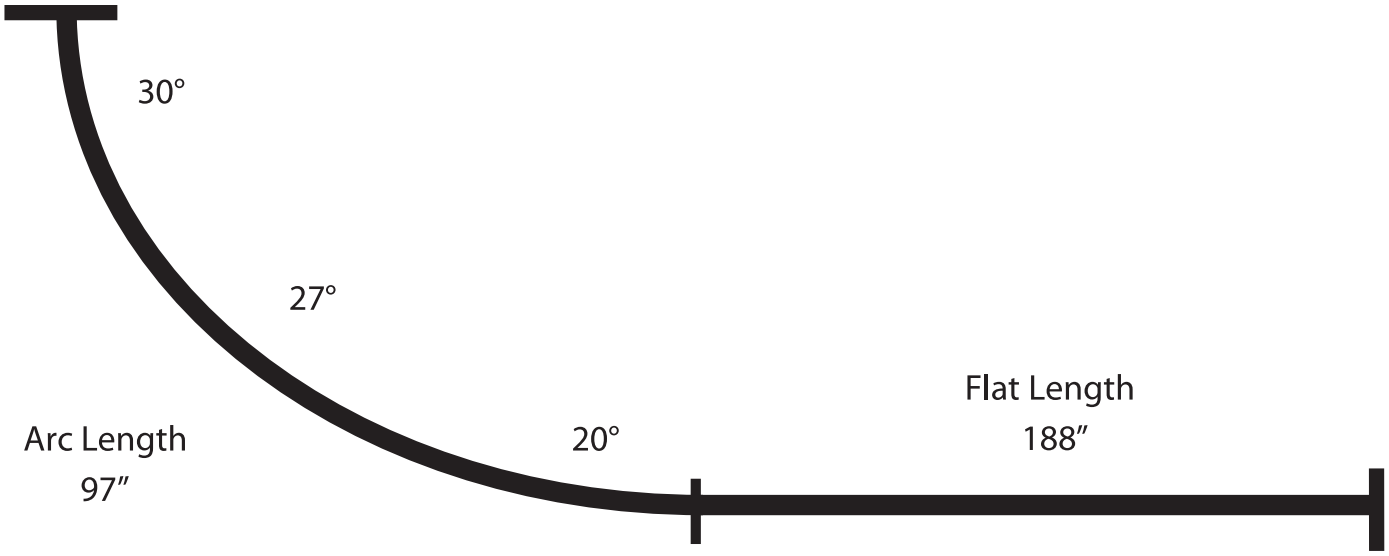
There will be four elimination races. Each race will have an entry from each participating school. The four winners of the elimination races will be qualified for the finals. The final round will determine the winner of the 2015 Sonoma Raceway-Friedman's STEM Race Car Challenge. Get the timeline on page 6 for complete schedule.

The winning student-engineers of the 2015 Sonoma Raceway-Friedman's STEM Race Car Challenge will each receive a trophy and tickets to Sunday's Toyota/Save Mart 350 NASCAR Sprint Cup Series event on June 28th.

TRACK INFORMATION

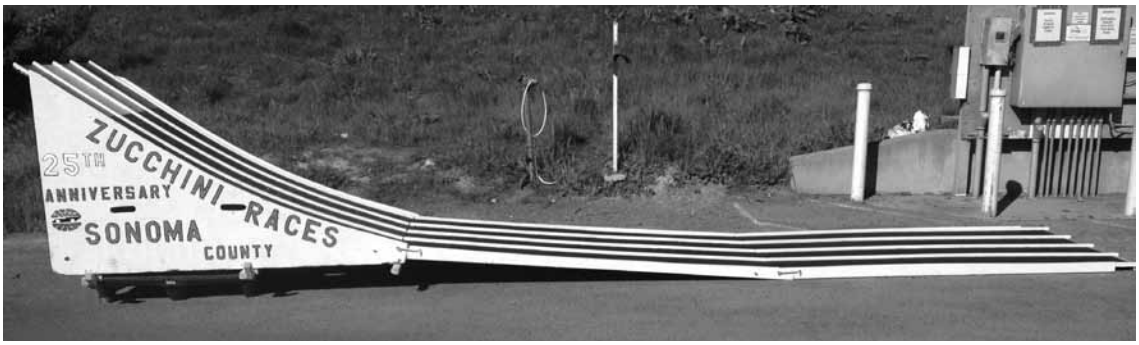
The gravity powered race car ramp that will be used at Sonoma Raceway for the finals is 48” wide and 285” long. There are four lanes (each 11” wide) with each lane sectioned off by a divider. The lanes each have a small pole, which holds the cars in place and in line at the top of the lane. When the race starts, these poles, which are controlled simultaneously by a lever, are dropped to release the cars. See attached graphics with the dimensions and images of the ramp.

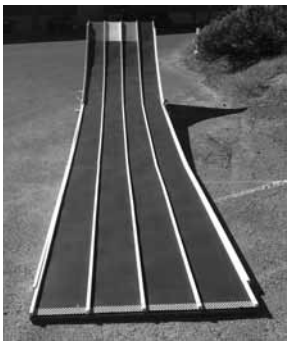
Each Lane’s Width
11″



Total Width of Track (4 lanes including dividers)
48″

Total Length of Ramp
285″





LESSON 1: Gravity Power

OBJECTIVES

Students will:

- Discover the Sonoma Raceway STEM Activity through an Entry Document
- Build content vocabulary (gravity, drag, friction) and oral language skills
- Determine accuracy of text-dependent claims
- Calculate sums and differences
- Think critically about physical forces
- Practice letter writing

You will need:

- Entry Document (Letter from Sonoma Raceway and *Kid Scoop News*)
- Gravity Power *Kid Scoop News* Worksheet—one per student
- Engineer's Journal—one per student

START YOUR ENGINES!

ASK: *If I told you we were going outside today to have "races" for recess, what kind of races might we have?* (Chart responses—relay races, running races, hopping races, jumping races, skipping races, etc.)

SCAFFOLD: Create a **WHO, WHAT, WHEN, WHERE, WHY** chart on the board (see below).

SAY: *I have received an interesting letter from the President and General Manager of Sonoma Raceway and the Publisher of Kid Scoop News that has a challenge for our class for a different kind of race. Listen carefully for the answers to "WHO, WHAT, WHEN, WHERE and WHY," while I read their letter to you.*

	SAMPLE ANSWERS FROM ENTRY DOCUMENT
WHO	Student engineers
WHAT	Design and build the fastest car that runs only on gravity
WHEN	May and June
WHERE	At school (May qualifying round) and at Sonoma Raceway (June final)
WHY	Race against other schools; chance to win a prize

ASK students to help you complete the chart. Review responses. **SAY:** *Are you ready to start your engines and take up the challenge?*

GO!

SAY: *Here is a question to guide your work: How can you—as teams of engineers—design and build the fastest gravity-powered car?*

SAY: *Let's begin by finding out what you already KNOW about NASCAR racing and gravity and what you NEED to KNOW to complete this project.* (Allow time to brainstorm; chart responses on board. The "Need to Know" elements will be answered during the project.)

KNOW	NEED TO KNOW
Example: *NASCAR race cars are low to the ground.*	Example: *Why are they built so low?*

LESSON 1: Gravity Power

DISTRIBUTE Gravity Power Worksheet

SCAFFOLD: Write the following claims on the board.

SAY: *As you read the worksheet, decide if these claims from the reading are TRUE or FALSE.* (Answers shown)

CLAIMS	TRUE	FALSE
a. Gravity can pull a car down a ramp.	X	
b. Gravity has the same pull on all cars in a race.	X	
c. Friction causes gravity.		X
d. A car moving through air causes friction.	X	
e. A car shaped like a box has less drag than a car that is streamlined and smooth.		X
f. Sonoma Raceway is a "road course" with hills and different directions.	X	
g. Race cars are designed to have more drag.		X

WINNER'S CIRCLE!

1. **Chat it UP!** Working with a partner, explain the difference between *gravity* and *drag*. Discuss why it is important to understand these forces to design the best race car.

2. **Imagin-eer!** In your Engineer's Journal, draw two cars—one with lots of drag and another with very little drag. Describe the features of your car with less drag. What makes it a better design?

3. **Write On!** Write a letter in reply to the President and General Manager of Sonoma Raceway and the Publisher of *Kid Scoop News*. Tell them your feelings about the project and some of your initial plans.

LESSON 1: Gravity Power

STUDENT NAME:

Race cars without engines?

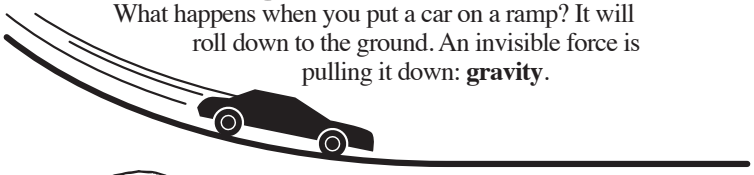
"Racers start your engines!" is something you normally hear at an automobile race like NASCAR or the Indy 500.

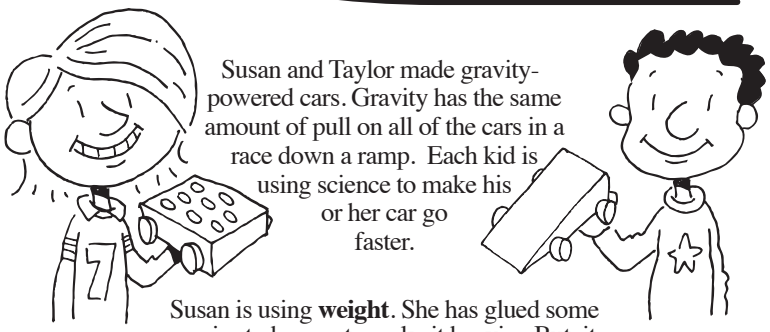
But, what if a car had no engine? How would it move? Could it still be a race car?

The answer is "YES!" if you know your science!

Gravity Power

What happens when you put a car on a ramp? It will roll down to the ground. An invisible force is pulling it down: **gravity**.

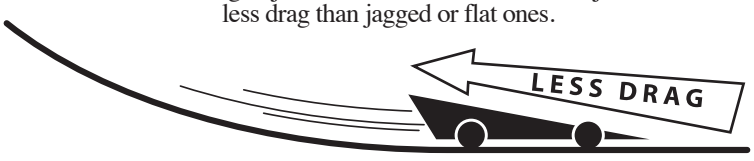




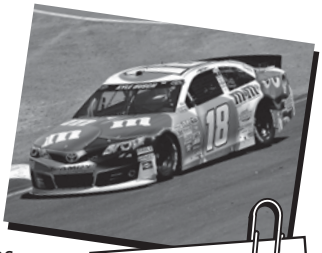
Susan and Taylor made gravity-powered cars. Gravity has the same amount of pull on all of the cars in a race down a ramp. Each kid is using science to make his or her car go faster.

Susan is using **weight**. She has glued some pennies to her car to make it heavier. But, its shape has drag which slows it down.

Taylor has engineered his car to have less **drag**. When a car moves through the air, it causes **friction**. Friction causes drag, a force that slows a moving object. Streamlined and smooth objects have less drag than jagged or flat ones.



Science at Sonoma Raceway



The track at Sonoma Raceway is different from other race tracks. Other tracks are large, flat ovals. Sonoma Raceway is a "road course." That means it turns in different directions and travels up and down over small hills. This makes understanding gravity a part of how a driver decides to drive the course.

A Note to Parents

Discuss with your child how understanding gravity is important for a race car driver on a track that changes elevation.

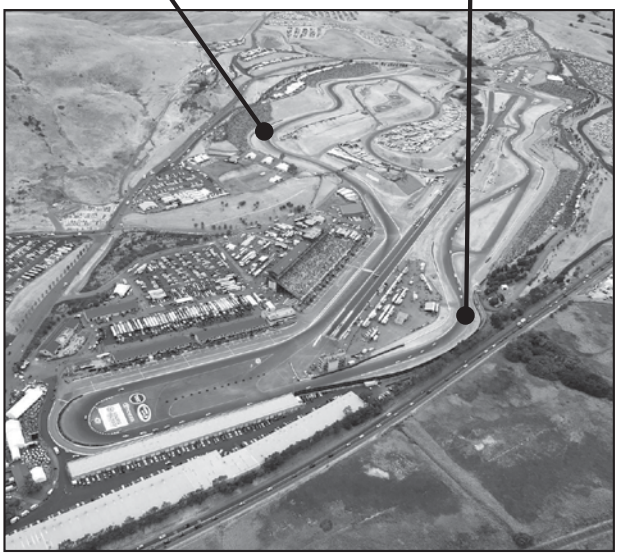
Sonoma Raceway Fast Facts

Do the math to discover the facts about the unique track at Sonoma Raceway!

Sonoma Raceway features more than 100 + 20 + 40 = ____ feet of elevation change from its highest to lowest points.

The highest point is Turn 3a. It is 75 + 25 + 74 = _____ feet in elevation.

The lowest point, Turn 10, is just 7 + 7 = _____ feet in elevation.



What is the difference between Turn 3a and Turn 10?
_____ feet!

LESSON 2: Friction

OBJECTIVES

Students will:

- Understand the relationship between friction and motion
- Compare smooth and rough surfaces
- Build content vocabulary (friction, burnout)
- Determine cause and effect
- Think critically about physical forces

You will need:

- Balls (playground, tennis, golf, etc.) One for each team
- Friction *Kid Scoop News* Worksheet—one per student
- Engineer's Journal—one per student

START YOUR ENGINES!

ASK: *Will a ball roll farther on the grass, on the playground or on the sidewalk?* (Take a classroom poll.) *Let's go outside and experiment*. Distribute one ball to each group and allow time for teams to experiment rolling balls on different surfaces. *Why is there a difference how far the ball rolls?* (Allow time to speculate.)

SAY: *The ball rolled farther and faster on the sidewalk because there was less friction between the ball and the surface. This is an important principle to understand in drag racing. Let's learn more about friction and what it means for our gravity-powered race cars.*

GO!

DISTRIBUTE "Friction" Worksheet

SAY: *Look at the two ramps—"A" and "B"—at the top of the page*. **ASK:** *How are the ramps alike? How are they different? Why will the car travel faster down the smooth ramp?* (A: less surface friction)

SCAFFOLD: Create a chart on the board (see below) to help guide the discussion.

SAY: *Read the section "What is Friction?" and look for answers to the questions while you read.*

QUESTIONS	SAMPLE ANSWERS FROM TEXT
What is friction?	*Friction is when two things rub against each other.*
What does it do to moving things?	*Friction slows or stops moving things.*
Why does a rolling ball eventually stop?	*Friction between the ball and the ground make it stop.*

LESSON 2: Friction

SAY: *Read the Section "Fun with Friction." Why would race drivers complete a burnout BEFORE the race?*

WRITE *"Cause" phrases on the board in a "T-Chart."* **ASK** students to help you complete the "Effect" side. (Answers are shown.)

CAUSE	EFFECT
Because Ramp B has a rough uneven surface …	*… it creates more friction when the car travels over it*
Because there is friction when two moving things rub against each other …	*… moving things will eventually slow or stop.*
Because the drag racers spin the car's wheels while the car stays still (a "burnout") …	*… the tires heat up and smoke.*

WINNER'S CIRCLE!

1. **Chat it UP!** Working with a partner, explain the relationship between friction and motion. How will this information make you a better engineer?

2. **Imagin-eer!** In your Engineer's Journal, design two ramps with very unique and different surfaces (e.g., mirror vs. eggshells, gravel vs. tin foil, etc.) Describe which surface will be better for racing your car and why. Use all five of these words in your explanation: smooth, rough, friction, ramp, gravity.

3. **Write On!** Imagine you're a news reporter covering your first burnout at the drag strip. Describe what happens before, during and after. Use *who, what, when, where* and *why* format.

LESSON 2: Friction

STUDENT NAME:

THE SCIENCE OF RACING

FRICTION: IT CAN REALLY SLOW YOU DOWN

Compare these two gravity race car ramps.

Ramp A has a **smooth** flat surface.

Ramp B has a **rough** uneven surface.

On which ramp would a race car go faster?

When a car goes down a smooth surface like ramp A, it will travel more quickly because it has less surface friction.

Ramp B has a rough surface, which creates more friction when the car travels over it, making it go much slower than the car on ramp A.

What is friction?

Friction is what happens when two things rub against each other. Friction slows or stops moving things. A rolling ball eventually stops because friction between the ball and the ground brings it to a stop.

See Friction in Action!

Roll a ball from one end of a basketball court to the other. Pretty easy, right?

Now try to roll the ball that same distance on grass or gravel. Friction makes that a lot harder to do!

FUN WITH FRICTION

Before racing down the **Sonoma Raceway** drag strip, drag racers complete a **burnout**, which spins the car's wheels while the car stays still. This causes the tires to heat up and smoke due to friction.

Drag racing tires perform better at higher temperatures. A burnout is the quickest way to raise tire temperature immediately prior to a drag race.

Photo: RCrampton.MFinnegan

Have you ever fallen and scraped your knee? Ouch! Friction between the skin on your knee and the hard ground is what made it hurt!

LESSON 3: Aerodynamics

OBJECTIVES

Students will:

- Understand the basic concept of aerodynamics and Greek origin of the word
- Practice "close reading"
- Compare similarities and differences in race car designs
- Build content vocabulary (aerodynamics, drag, wind resistance)
- Complete simple cause and effect statements

You will need:

- Aerodynamics *Kid Scoop News* Worksheet—one per student
- Engineer's Journal—one per student

START YOUR ENGINES!

ASK: *How many different kinds of man-made objects can you name that move quickly through the air?* (e.g., balls, jets, helicopters, drones, kites, rockets, etc.)

SAY: *One thing these objects all have in common is they are designed to move through the air efficiently. The study of how objects move through air is called "aerodynamics." Engineers think about aerodynamics when designing objects that move quickly through air—including race cars!*

GO!

DISTRIBUTE "Aerodynamics" Worksheet

SAY: *Today we are going to practice "close reading" for the section "What a Drag" because scientific reading requires paying close attention to the words and sentences in order to understand the meaning.*

SAY: *Read the Section "What is Drag" three times following this pattern:*
1. *First read: Read to "get the gist."*
2. *Second read: Circle new words; underline interesting parts or make notes in the margin.*
3. *Third read: Read smoothly and fluently and think about the meaning.*

SCAFFOLD: Write "Cause" phrases on the board in a "T-Chart." **ASK** students to help you complete the "Effect" side after the third read. (Answers are shown.)

CAUSE	EFFECT
Moving air …	*… can slow you down.*
Very strong moving air …	*… can stop you.*
A race car uses gasoline …	*… to speed up.*
A car with less drag …	*… moves faster.*

LESSON 3: Aerodynamics

Golf on the Moon:
SAY: *The air on the moon is very, very thin. What do you PREDICT would happen if you hit a golf ball on the moon?* (Record answers). *Read the next section to find out.*

Science at the Sonoma Raceway:
SAY: *Look at the three different shaped cars for NASCAR, INDYCAR and NHRA Drag Racing. Complete the chart comparing similarities and differences among the three designs:*

SIMILARITIES	DIFFERENCES

WINNER'S CIRCLE!

1. **Chat it UP!** Take a field trip to the parking lot. Observe the different shapes and designs of cars. Discuss with a small group which cars you claim are more aerodynamic. Defend your claim with evidence. Use these words to describe your observations: aerodynamics, drag, wind resistance.

2. **Imagin-eer!** Use the computer and a search engine to research "aerodynamics for kids." Find and conduct a simple experiment. Write up your findings in your Engineer's Journal using the scientific format: hypothesis, materials, process, findings, and conclusion.

3. **Write On!** How many words can you make from the letters in A-E-R-O-D-Y-N-A-M-I-C-S? Record your list in your Engineer's Journal.

LESSON 3: Aerodynamics

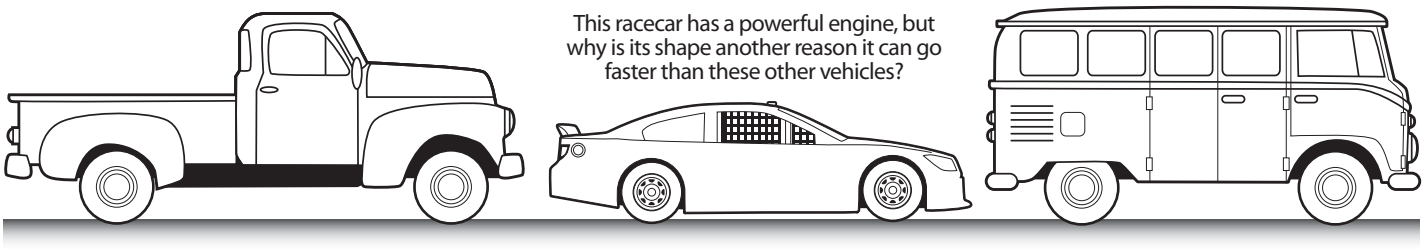
STUDENT NAME:

AERODYNAMICS

THE POWER OF AIR

The word aerodynamics comes from two Greek words:

aeros: of the air
dynamis: power, strength, force



This racecar has a powerful engine, but why is its shape another reason it can go faster than these other vehicles?

What is aerodynamics?

Aerodynamics is about the power of air and the way it moves around an object. Understanding the power of air is how engineers have learned to make airplanes fly and racecars go faster!

What a drag!

Have you ever felt the wind on your face when running or riding a bike? That is the power of air moving against you. Moving air slows you down. It can even stop you in your tracks, if it is strong enough. This is called **wind resistance** or **drag**.

A racecar uses the energy of gasoline in its engine to speed up. But moving through the air slows it down. This is the force called drag. In order to go faster, a car should have less drag.

Look at the car shapes at the top of the page again. Which ones do you think will have the least drag?

This car's smooth, aerodynamic shape allows air to flow over it easily with very little drag.

This van's boxy shape creates more drag.

Golf on the Moon

Air slows down moving objects. So what would happen if you hit a golf ball on the moon where the air is much thinner than on earth?

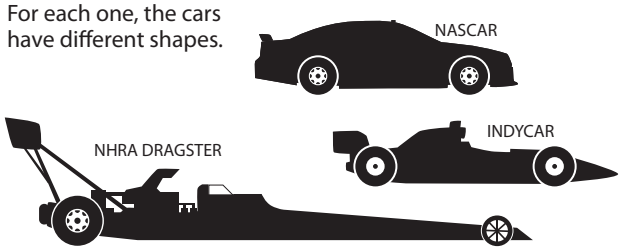
Astronaut Alan Shepard got the chance to find out when he walked on the moon on Feb. 6, 1971. Even wearing a bulky space suit, he hit a ball that traveled 400 yards (366 meters). On earth the average golfer can hit a ball about 200 yards (183 meters).

SCIENCE AT SONOMA RACEWAY:

Which cars are more aerodynamic?

There are three big car race events at Sonoma Raceway. They are NASCAR, INDYCAR and NHRA Drag Racing. For each one, the cars have different shapes.

Look at the three cars. Which one is the most aerodynamic?



LESSON 4: Make Your Own Gravity Racer

OBJECTIVES

Students will:

- Follow written directions and illustrations to build a race car
- Assess effect of weight on distance and speed
- Build content vocabulary (engineering, weight)
- Think critically, problem solve, collaborate and communicate

You will need:

- Materials for constructing Gravity Racer (see worksheet)—DO NOT DISTRIBUTE MATERIALS until students have reviewed the worksheet
- "Make Your Own Gravity Racer" *Kid Scoop News* Worksheet—one per student
- Engineer's Journal—one per student
- Teams of 3-4 students

START YOUR ENGINES!

ASK: *What kind of car do you have in your family?* (Chart answers.) *What parts of all cars are the same? What parts are different?* **Option:** Bring students to the school parking lot and identify things that are the same/different about the cars they see.

SAY: *There are certain features that are the same for all cars—a body, engine, wheels and windows—and things that are different—size, color, shape and style. Today your team will begin building your Gravity Racer. Some things will be the same for all Gravity Racers, but each team Racer will also be different!*

GO!

DISTRIBUTE "Make Your Own Gravity Racer" Worksheet. Do not distribute materials yet! Write the choices—this is one kind of car.

SCAFFOLD: Create a chart on the board (see below) to guide the discussion.

SAY: *Read the first section with your team "Make Your Own Gravity Racer," and look for answers to the following guiding questions:*

QUESTIONS	SAMPLE ANSWERS FROM TEXT
What do *engineers* do?	*Invent, design and create things*
What materials do you need?	*See list*
How many steps to build your Racer?	*Seven*
What can you use to add weight to make your car roll farther down the ramp?	*Pennies or other weights*

REVIEW: Responses with students to check for understanding.

ASSIGN: Roles to team members:

- Supply Engineer: Gathers materials from the supply station to build the Gravity Racer
- Chief Engineer: Reads directions
- Design Engineer: Lays out all the pieces for construction and selects materials
- Construction Engineer: Makes sure all steps are followed in the right order

All Team Members:

- Take turns building the Gravity Racer
- Collaborate on a NAME for the Gravity Racer

PROVIDE: 45-60 minutes to complete the initial design and testing.

LESSON 4: Make Your Own Gravity Racer

WINNER'S CIRCLE!

1. **Chat it UP!** Work with your team to solve the "STEM at Sonoma Raceway" math problems.

2. **Imagin-eer!** In your Engineer's Journal, draw a sketch or two of different ideas for decorating your car. Share with your team.

3. **Write On!** In your Engineer's Journal, describe your experience including all the steps you followed to build your Gravity Racer. Use one of these sentences to begin your description:
   a. Today was no ordinary day at school.
   b. Learning something new can be both challenging and exciting.
   c. I never thought I would build a car at school, but today we did exactly that!
   d. It's one thing to ride in a car, and something entirely different to build one!

Note to Instructor:
Here are some ideas for a successful workshop:

- Have all materials gathered in a Supply Center.
- Have extra supplies on hand including pennies to add weight.
- Assign students to teams and roles in advance.
- Allow parent volunteers, aides or teachers only to use hot glue guns.
- Allow for experimentation, innovation and mistakes! Students will have opportunities to make adjustments to designs.
- Have a timer or signal to quiet class for instructions when needed—it will get noisy!
- Have ramps set up for test runs.
- Provide time for cleanup and a space to display Gravity Racers.

LESSON 4: Make Your Own Gravity Racer

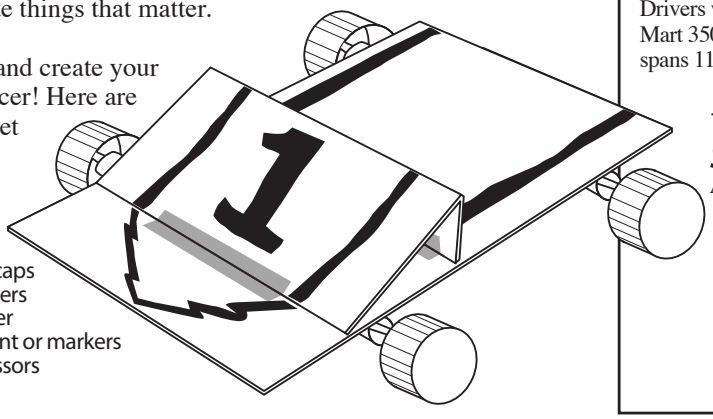
STUDENT NAME:

THE SCIENCE OF RACING

Make your own Gravity Racer!

The **E** in **STEM** is for **engineering**. Engineers are changing the world all of the time. They dream up creative, practical solutions and work with other smart, inspiring people to invent, design and create things that matter.

Be an engineer and create your own Gravity Racer! Here are instructions to get you started.



YOU'LL NEED:

- ❑ cereal box
- ❑ 4 plastic bottle caps
- ❑ 2 bamboo skewers
- ❑ 2 straws
- ❑ ruler
- ❑ hot glue
- ❑ paint or markers
- ❑ tape
- ❑ scissors

STEM at Sonoma Raceway

A Note to Parents
Help your child build Gravity Racers for the whole family and have a night of races.

The **M** in **STEM** stands for **math**. Race car drivers think a lot about math. Here is a race car driver challenge for you, straight from Sonoma Raceway!

Drivers who complete the Toyota/Save Mart 350 will make 1,100 turns around the road course. The race spans 110 laps. **How many turns is that per lap?**

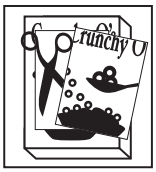
_____ turns per lap

Sonoma Raceway Math Challenge

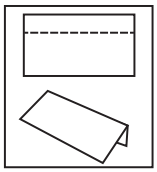
A driver will travel nearly 220 miles by the end of the race. If the average speed was 80 mph, about how long will it take to complete the race?

_____ hours _____ minutes

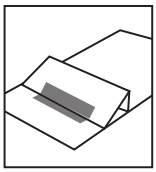
In 2012, Clint Bowyer set a new course record, finishing in 2 hours, 39 minutes and 55 seconds.



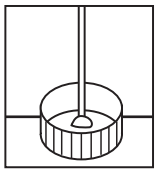
Cut a 6″ x 9″ rectangle out of a cardboard cereal box.



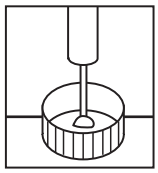
Cut another rectangle, 6″ x 4″ and fold as shown.



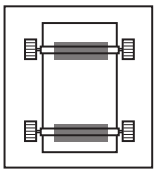
Tape the angled hood onto the larger rectangle.



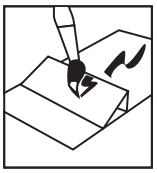
Hot glue a bamboo skewer to the inside center of a plastic bottle cap.



Insert skewer through straw to create an axle. Hot glue bottle cap to other end of skewer.



Tape straw axles to bottom of car body. Make sure the wheels spin freely.



Decorate your Gravity Racer.

Engineering Success

Roll your gravity racer down a ramp. Measure how far it rolls. What happens if you add weight to your racer, such as taping pennies to it? What else can you do to make it roll farther?

LESSON 5: Drafting

OBJECTIVES

Students will:

- Understand the physics behind racecar drafting
- Build content vocabulary
- Illustrate drafting principle
- Practice "close reading"
- Answer "text dependent" questions

You will need:

- Drafting *Kid Scoop News* Worksheet—one per student
- Engineer's Journal—one per student

START YOUR ENGINES!

ASK: *What does it feel like on your hands or face when driving with the windows down?* (Chart responses)

SAY: *The wind blowing your face and hands has force as your car moves through the air. The same thing happens at Sonoma Raceway as cars move around the track. As cars push through clean air, the "draft" passes over the car and creates turbulent—or "dirty air"—behind the car. This dirty air can slow down the driver in the rear. But if he can "piggyback" on the car in front of him, he can get caught in the "draft" and move faster. Let's read more to see how this works.*

GO!

Write the following guiding questions on the board.

SAY: *As you read "closely" today, underline the answers to these questions in the following sections. Notice how the section headers make it easier to locate information.*

SECTION	QUESTIONS	ANSWERS
Drafting – Not Tailgating	What two things does drafting do to help racecar drivers?	*Drafting helps cars get more speed and better gas mileage.*
Replace the Missing Vowels	What does the front car do?	*The front car reduces resistance on the car behind it.*
	What does the trailing car do?	*The trailing car pushes high-pressure forward.*
	What two things happen to both cars as a result?	*Both cars have less drag and go faster.*

SAY: *Racecar driving is not the only sport that can take advantage of "drafting." What other kinds of races might benefit from this principle?* (Answers: bicycle, motorcycle, motocross, speed skaters, cross country skiers and swimmers are examples.)

LESSON 5: Drafting

WINNER'S CIRCLE!

1. **Chat it UP!** Working with a partner, explain the aerodynamic relationship between "clean air," "resistance," "drafting" and "dirty/turbulent air." How does this knowledge make racecar drivers behave on the track?

2. **Imagin-eer!** In your Engineer's Journal, illustrate the concept of drafting. Draw one car and label with "clean air," "draft," and "dirty air/turbulent air." Then draw three cars "drafting" and show how the front car cuts through the clean air with the draft passing over all three before becoming turbulent. Under your illustration, write the explanation.

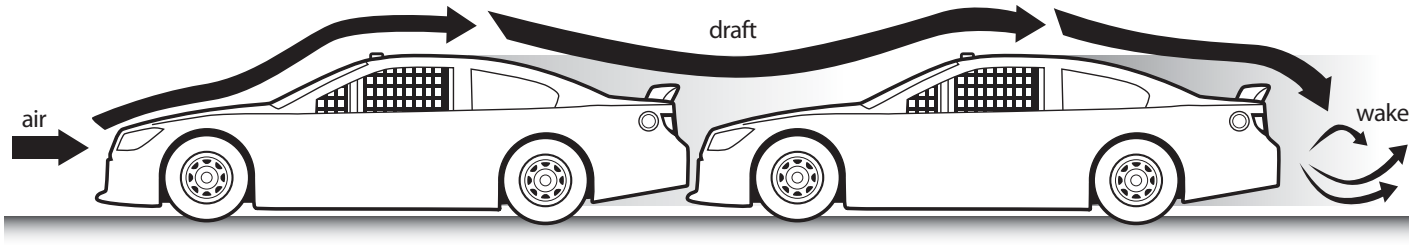
3. **Write On!** Imagine you're Jeff Gordon holding off Mark Martin in 1999 by 0.197 seconds. You have been asked to write a statement for the newspaper telling about your feelings during the last part of the race. What might Jeff Gordon say in his statement?

LESSON 5: Drafting

STUDENT NAME:

NASCAR DRAFTING

NASCAR drivers race around Sonoma Raceway's track at 180 miles per hour. It takes a lot more than a heavy foot on the gas pedal to be a winner. ***It takes an understanding of science!***



Wake Up!

When a car in front of a pack in a race speeds down the track, it pushes through and disturbs the air, creating a wake behind it.

Drafting – Not Tailgating

A talented driver will slip a car into the wake of the car in front of it. It may look like the car is tailgating, but it is actually doing something called **drafting**. Drafting helps cars to get more speed and better gas mileage.

Does drafting make a difference?

It sure does! When two cars remain bumper to bumper, they can both travel faster than if they were alone.

The low pressure behind the car in front reduces the aerodynamic resistance on the car behind it. The trailing car pushes high-pressure forward.

Both cars have less drag and both cars go faster. How much faster? Replace the missing vowels to reveal the answer!

Dr_ft_ng all_ws r_cec_rs to tr_vel thr_ _ to f_ve m_les p_r h_ _r f_st_r!

SCIENCE AT SONOMA RACEWAY:

Raceway Records

The Sonoma Raceway record for the closest margin of victory in an NASCAR race occurred in 1999 when Jeff Gordon held off Mark Martin by just .197 seconds.

Photo: Joe Jacobson

NASCAR Sprint Cup Series driver Jamie McMurray holds the track qualifying record at Sonoma Raceway. McMurray covered the 10-turn, 1.99-mile road course in just one minute, 14.354 seconds!

CHALLENGE LETTER

APPENDIX A

Dear Students,

Sonoma Raceway is looking for young engineers to help design the ultimate fuel efficient race car—so efficient that it runs on no fuel, only gravity! Are you ready for this?

We are looking for student teams to invent and make a small gravity-powered car which will be raced on our Sonoma Raceway STEM Track. We have sent your teacher the details about the challenge, so listen carefully, follow the rules and use your creativity!

The team that has the fastest car at your school's qualifying race in May will get to go to Sonoma Raceway on Saurday, June 27th—NASCAR Weekend—to race against the winners of other schools in the North Bay. The team that wins that race will get a special trophy and tickets to watch NASCAR drivers like Dale Earnhardt Jr, Jimmie Johnson and Jeff Gordon at the Toyota/Save Mart 350 NASCAR Sprint Cup race on Sunday, June 28th!

We look forward to seeing your cars, discovering your clever ideas on how to make a gravity-powered car zip down the track and hosting many of you at Sonoma Raceway during the NASCAR weekend in June.

Rev up your engines as you discover how much fun the combination of creativity, science and engineering can be and how it is a part of our lives each and every day!

Sincerely,

Steve Page
President and General Manager
Sonoma Raceway

FINAL ROUND REGISTRATION FORM

2015 Sonoma Raceway STEM Gravity-Powered Car Challenge presented by Friedman's Home Improvement

Final Round Registration Form

School:	
School Mailing Address:	
School Contact Name:	
Contact Phone: *must be able to contact race day	
Contact Email: *must be available prior to the race	

Final Round Registration Information:

The top two teams in the qualifying round of the STEM Race Car Challenge presented by Friedman's Home Improvement are invited out to the final round held at Sonoma Raceway on Saturday, June 27th at 10:00 a.m. The most creative car from each school will also be invited out to Sonoma Raceway to compete for the title of "Best in Show."

Check-in starts at 10:00 a.m., racing begins at 10:15 a.m. Make sure to allow for ample time to park and get to the winners circle, as Sonoma Raceway is a large facility.

At a minimum, one student engineer from each team must be present to qualify their vehicle in the race. The race will be held in the winner's on Saturday of the Toyota/Save Mart 350.

Please list out all the kids who will attend the final round on Saturday, June 27th at Sonoma Raceway.

Teachers will be responsible for returning the registration form by Monday, June 1st to Melissa Lamb at *mlamb@racesonoma.com* to ensure registration for the final race.

(page 1)

FINAL ROUND REGISTRATION FORM

APPENDIX B

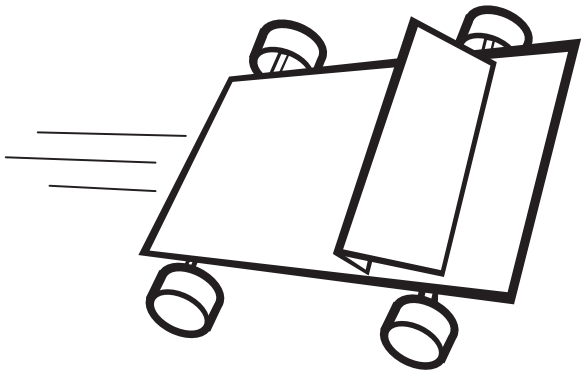
1st Place Car	
Team Name:	
Student Name:	
Student Name:	
Student Name:	
Student Name:	
Student Name:	

2nd Place Car	
Team Name:	
Student Name:	
Student Name:	
Student Name:	
Student Name:	
Student Name:	

Most Creative Car	
Team Name:	
Student Name:	
Student Name:	
Student Name:	
Student Name:	
Student Name:	

The deadline to register for the 2015 STEM Race Car Challenge is Monday, June 1st. Sign-up sheet should be emailed to Melissa Lamb at *mlamb@racesonoma.com*.

(page 2)



Watch Out! I'm Accelerating!

This Certifies that

_____

Has completed participating in the 2015 STEM Race Car Challenge.

Presented by

SONOMA RACEWAY

Kid Scoop News®

Friedman's HOME IMPROVEMENT