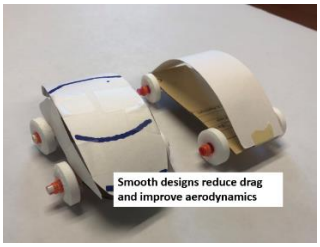
GYSTC
GEORGIA YOUTH SCIENCE & TECHNOLOGY CENTERS




# Title: Smooth Cruise STEM Challenge

**Estimated Time: 1-2 periods**

**Core Ideas (GSE Standard and elements):**

**S2P2. Obtain, evaluate, and communicate information to explain the effect of a force (a push or a pull) in the movement of an object (changes in speed and direction).**

a. Plan and carry out an investigation to demonstrate how pushing and pulling on an object affects the motion of the object.

b. Design a device to change the speed or direction of an object.

c. Record and analyze data to decide if a design solution works as intended to change the speed or direction of an object with a force (a push or a pull).

**S4P3. Obtain, evaluate, and communicate information about the relationship between balanced and unbalanced forces.**

a. Plan and carry out an investigation on the effects of balanced and unbalanced forces on an object and communicate the results.

b. Construct an argument to support the claim that gravitational force affects the motion of an object.

**S8P3. Obtain, evaluate, and communicate information about cause and effect relationships between force, mass, and the motion of objects.**

b. Construct an explanation using Newton's Laws of Motion to describe the effects of balanced and unbalanced forces on the motion of an object.

| **Literacy Connections: Books** | **Literacy Connections: Close Reads** |
|---|---|
| Let's Go for a Drive, Mo Willems<br>Sheep in a Jeep, Darlene Ruth Stille | A Smooth Cruise – Elementary<br>A Smooth Cruise – Middle |
| **Science and Engineering Practices:**<br>**Planning and Carrying Out Investigations:**<br>Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation.<br>**Constructing Explanations and Designing Solutions:**<br>Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system. | **Crosscutting Concepts:**<br>**Structure and Function:**<br>The way an object is structured/designed determines many of its properties and functions.<br>**Stability and Change:**<br>For designed systems, conditions that affect stability and factors that control rates of change are critical to consider and understand. |

**STEM Challenge Overview:**

In this **STEM Challenge**, your task is to build an aerodynamic car that can move down a track as smoothly and quickly as possible.

| | |
|---|---|
| **Ask** | Ask your students if they have ever stuck their head out the window when their car was driving down the road. If so, ask them to describe what they felt while poking out their heads.<br><br>After hearing some responses, ask them to consider how cars are designed to minimize the amount of resistance, or drag, they produce while moving through the air. If time permits, show 1-2 minutes of this cool YouTube video that shows the movement of air over a bunch of cars.<br>https://www.youtube.com/watch?v=E9ZSAX56m0E |
| **Imagine/Brainstorm** | Students **brainstorm** ideas for how they could design and construct their own car. The car should be capable of moving smoothly and quickly down a track. After brainstorming, they should consider the strengths and weaknesses of each idea. |
| **Plan/Design** | In order to learn more about topic, have them read the ***A Smooth Cruise is the Way to Move*** article and discuss how cars are designed to minimize drag in order to improve energy efficiency. To emphasize grade level standards, you should also discuss how forces provide the push needed to move cars around. After learning about cars and energy efficiency, students **plan** and **design** a simple model car that has a smooth body and no sharp corners.<br><br>Depending on the level of your students and the time you have for this challenge, you can make this open-ended or more of a guided inquiry for your students. If you take a more open-ended approach, provide a greater variety of materials that can be used to construct the car and encourage more out of the box designs. |
| **Create/Test** | Students follow their plan, and **create** their model car. Once it is created, students **test** their car in a measureable way to evaluate the effectiveness of their solution. In this case, they test to see if their car can travel smoothly and quickly from one end of the track to the other. Their results should be recorded, organized, and analyzed. |
| **Improve** | After discussing and evaluating their results, students improve their solution and re-test if possible. |

**Teacher Notes:**

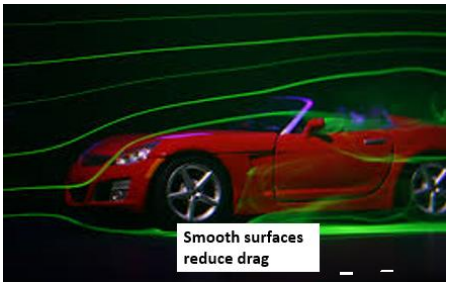
**Forces** are interactions between objects that cause a push or a pull between them. Put simply, forces are the pushes and pulls in our world. By providing pushes and pulls, forces help to get and keep things moving. As you would expect, it also takes **energy** to provide the forces needed to move stuff. For example, it takes energy from your body to provide the push on your legs needed to walk around. It also takes energy for a bird to fly through the air and a ship to push through the ocean.



While it always takes energy to move things, it helps if we can design things in a way to make them as **energy efficient** as possible. This is especially important for things like cars, trucks, and planes that transport things every day. Energy efficiency depends of many things including an objects weight and its aerodynamics.
Since there are over 1 billion cars in the world today, it is super important to make them as cost-effective as possible. Since lighter cars require less push to move, they are usually more energy efficient. As a result, engineers are always trying to find new **materials** that are stronger but lighter.

Engineers also study how air moves over a speeding car. The more air a car has to push out of the way the more **drag** there is and the harder it is to move forward. Cars with smooth surfaces and no sharp corners allow the air to flow smoothly over them by keeping the drag as low as possible.

With advanced elementary or middle school students, you may choose to include a discussion of aerodynamics. **Aerodynamics** is the study of the movement of air including how it interacts with moving objects like cars and airplanes. The **aerodynamics** of a car depends on how much air the car has to move out of the way as it travels. The more air it has to move, the more **drag**, or resistance, there is to the forward motion of the car. Cars with smooth surfaces and no sharp corners allow the air to flow smoothly over them by keeping the drag as low as possible.





One of the keys to this STEM Challenge, is to use two plastic gutters for the race track. The ten foot gutters can be purchased for about $5 each from any home improvement store (we cut two feet off the ends to make them easier to transport and store). You can attach them together with binder clips or tape and then your set to go. The width of each racetrack is usually just over 3 inches so make sure you limit the width of each car to 3 inches or they'll get stuck on the track. While you can use dowel rods or straws for the axels of the wheels, dowel rods are easier for kids to work with and you can use them over and over. You can also make a track out of cardboard.

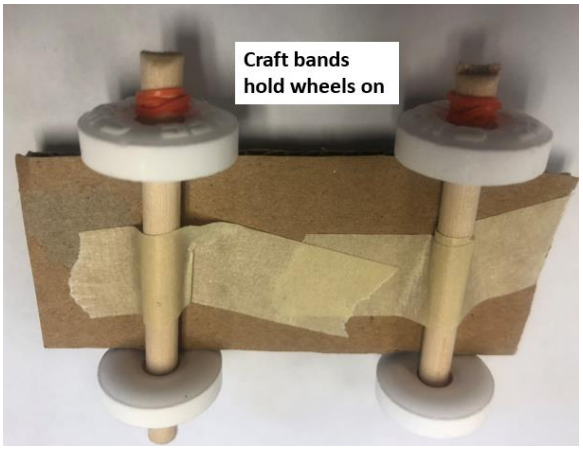
We race the cars two at a time and have the kids measure the time taken to complete the 8 foot track. You can have winners face off in later races if you want to make it a competition. If appropriate, you can have kids calculate the ratio of distance over time to determine the average speed of their car. They also

should discuss and describe what they did to make their car as aerodynamic as possible. Finally, we make sure that they go back and make 1-2 concrete improvements to their design as we emphasize the cyclical nature of the engineering design process.

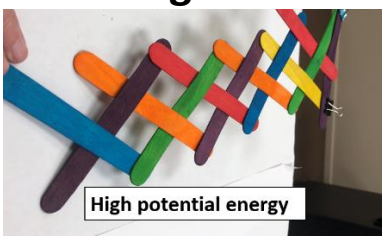
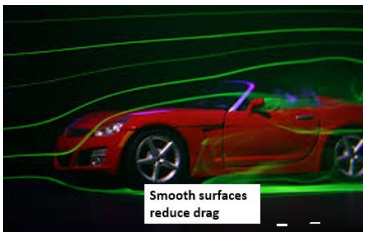
**Suggested materials for students to use: (per group)**

Two 3 inch wood dowel rods (preferred) or straws, 4 larte lifesavers, piece of cardboard cut 1.5 x 4 inches, scotch or masking tape, scissors, colored pens or pencils to decorate.



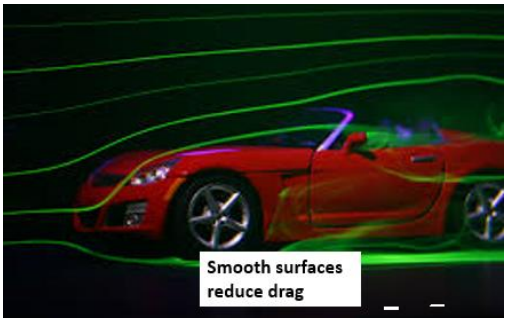
## Vocabulary Cards:

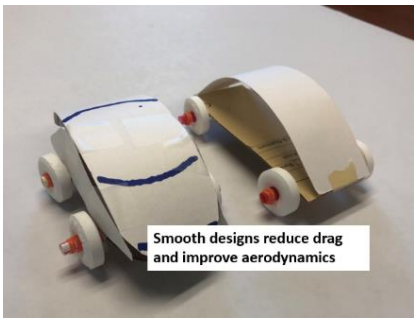
| | |
|---|---|
| **force**<br>**a push or pull**<br>  | **material**<br>**the stuff things are made of**<br>  |
| **energy**<br>**the ability to move or change matter**<br>  | **drag**<br>**force on an object that resists its motion**<br>  |
| **aerodynamics**<br>**the study of the movement of air as it interacts with an object** | **energy efficient**<br>**uses less energy to provide services** |



# Smooth Cruise STEM Challenge:

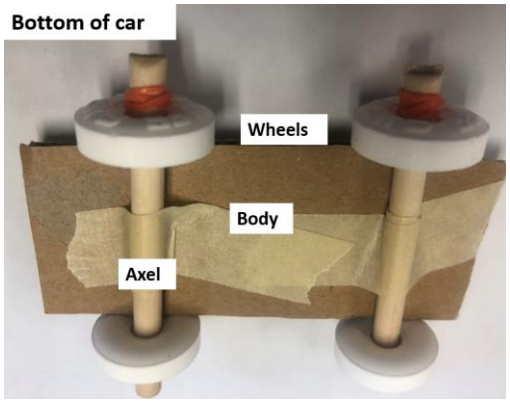
## Can you design, build, and test a model of an aerodynamic car that can move down a track as smoothly and quickly as possible?




### Designing and constructing your car:

1. After learning about aerodynamics, **plan** and **design** a simple car that can move down a track as smoothly and quickly as possible.
2. Using the materials provided and your plan, **construct** your car. Your car should include a body, 4 wheels, 2 axels, and an aerodynamic design.
3. As time permits, decorate your car to make it look as cool as possible.
4. Once the car is constructed, carefully **test** it trying it out on your desk and on the track. Observe and record how it responds.




### Evaluating and Improving:

1. As a group, explain how you designed your car to make it as aerodynamic as possible.

2. As a group, **evaluate** the effectiveness of your design and discuss how you would change your design moving forward to **improve** the performance of your car. If time permits, make these improvements and re-test.