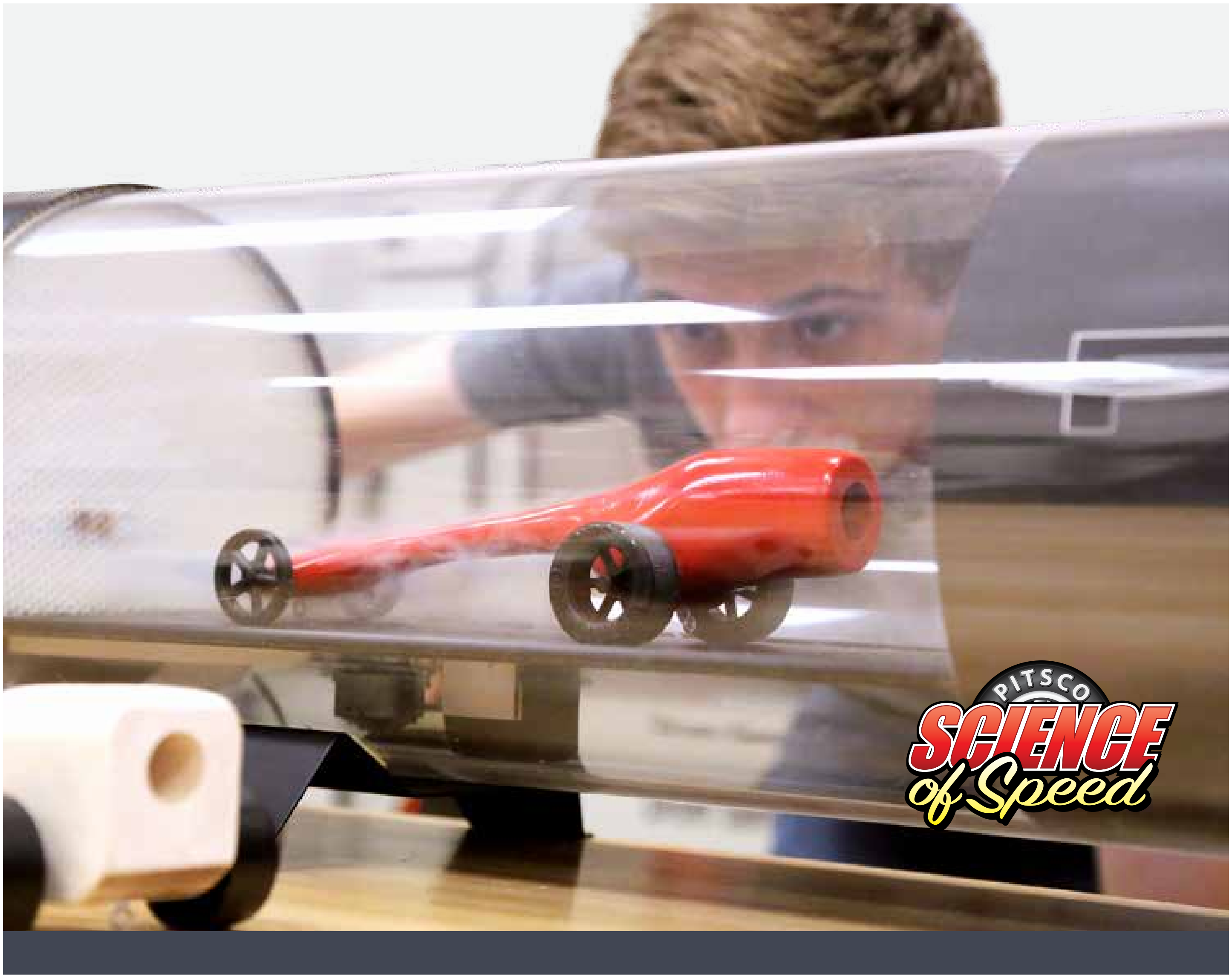
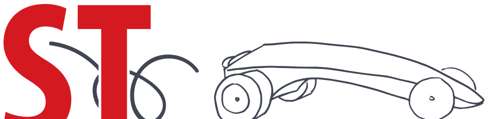


THE ENGINEERING OF GOING FAST



Making a fast vehicle is not a happy accident – it takes effort and an understanding of how physics and engineering work together to create the fastest and the finest.

In the dragster activity, students not only learn about but also experience engineering firsthand as they design, build, and race their cars. This includes the design process, working with specifications, and much more. Students might think they are just having fun, but if they have a real desire to create a dragster that performs well, they will learn plenty of engineering along the way!

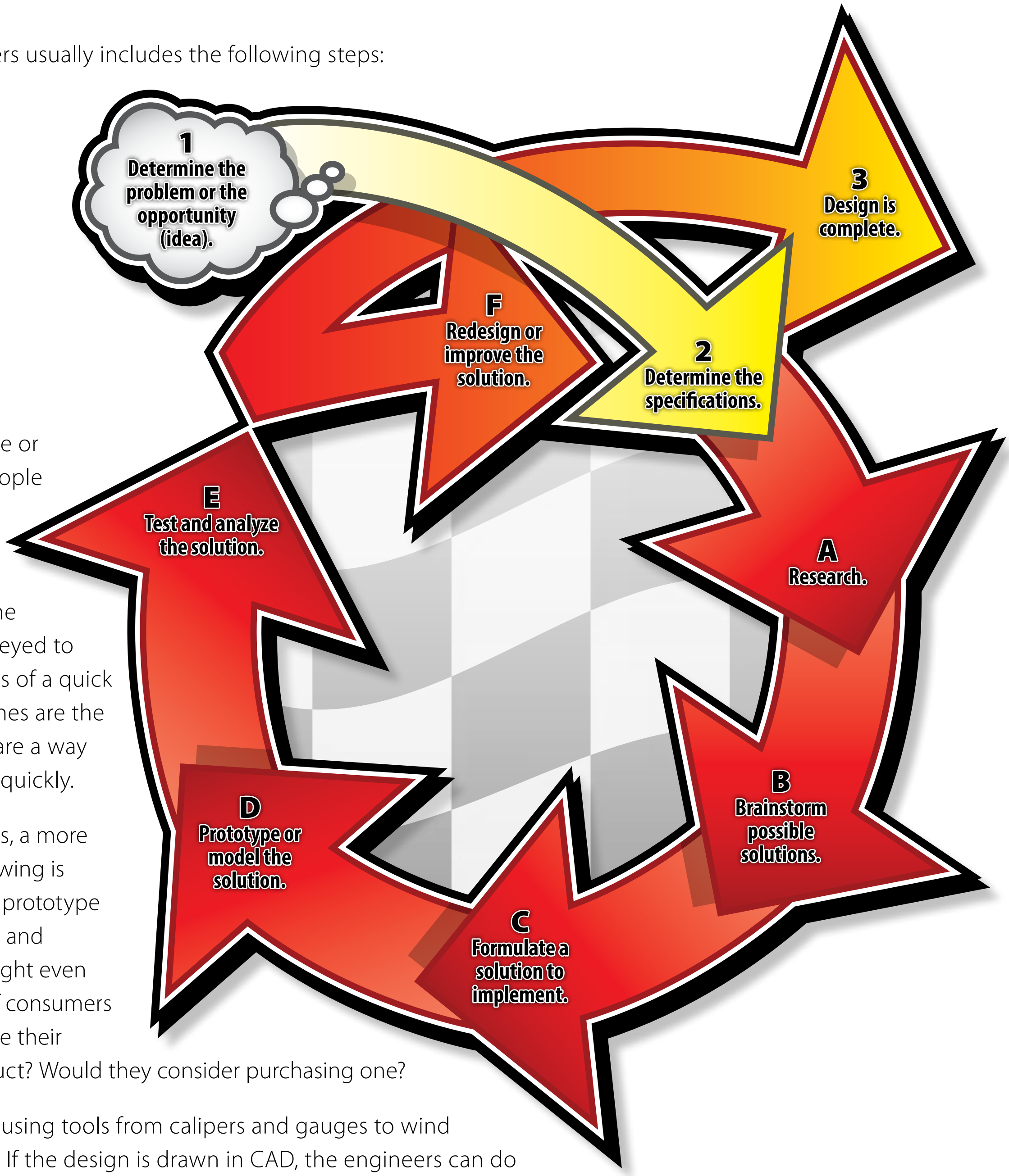
PITSCO EDUCATION

THE DESIGN PROCESS

Whether it's passenger cars, food processors, or toys, the process employed for product design is very similar to the one used by students creating CO_2 cars.

The design process for dragsters usually includes the following steps:

- Research
- Sketch
- Draw the design
- Prototype
- Test
- Redesign (if needed)
- Production



Every design starts with an understanding of the challenge or problem; research will help people find an engineered solution as opposed to a lucky guess solution. This is quickly followed by an idea to meet the challenge, which is often conveyed to other team members by means of a quick sketch. These thumbnail sketches are the ideas in their rough form and are a way to explore several possibilities quickly.

As the design concept develops, a more formal, or technical, design drawing is made. Then, it's time to build a prototype to test the design's appearance and functionality. The prototype might even be exposed to a small group of consumers so the design team can evaluate their reaction: Do they like the product? Would they consider purchasing one?

Testing the prototype follows, using tools from calipers and gauges to wind tunnels large enough for a car. If the design is drawn in CAD, the engineers can do some testing using CFD (computational fluid dynamics) testing on computers.

After the first round of testing is complete, necessary design changes are made. This might require the construction of a second prototype and further testing – so this part of the process might be like a small repeated cycle within the larger cycle. The prototype testing process is repeated until the design team has developed the idea into a viable product that they think will have the outcomes they want.

If the design concept survives to this point, the product enters the production phase. A manufacturing plant must be tooled to produce the product. In the same way that students use a band saw or a drill to build their race cars, manufacturers need special tools to make products. Often, special molds (for making plastic parts) and dies (for stamping metal) must be built.

If all the steps, from the initial design idea to final production, have been executed well, the product will be a success. Following this process will help make student dragsters a success, and students can use this valuable process for other future projects.

TESTING TOOLS

A vital part of engineering is testing. A design that is researched but untested isn't a solid design.

Following are some common tools for measurement and where they might be used in determining if a CO_2 dragster is within specifications:

Ruler

Typically measures within a millimeter or within 1/16" or 1/32". Rulers are a good tool choice when measuring distances on your dragster such as the overall body length, the wheelbase length, the overall body width, and so forth.

CHECK OUT: 12" Flexible Stainless Steel Ruler

CHECK OUT: High-Impact Plastic Dial Calipers

Caliper

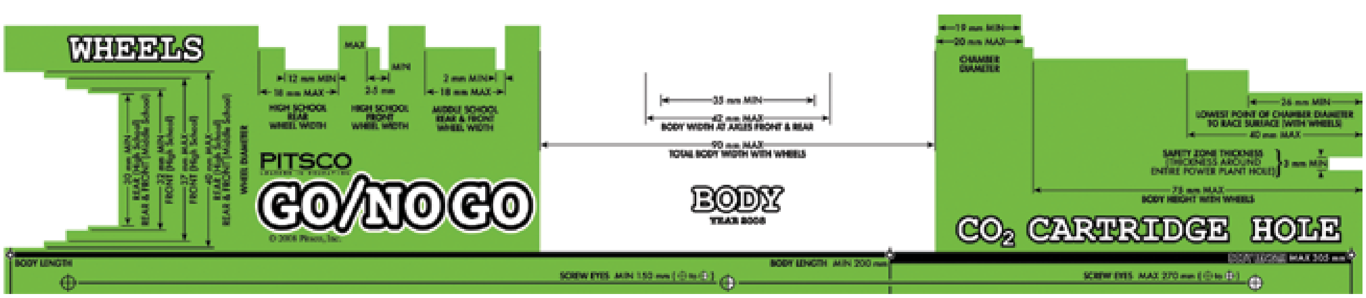
Typically measures to the nearest 0.05 mm and can measure items up to 15 cm long. Calipers have parallel jaws that can make interior measurements, such as the diameter inside a hole. The jaws can also measure the outsides of objects, such as the width of a wood block or the outside diameter of a wheel. Many calipers also have depth measurement capabilities, such as measuring the depth of the CO_2 cartridge hole.

Balance

Balances are sometimes referred to as scales. Balances determine the mass of an object in grams or the weight of an object in ounces. There are many different types of balances, and they typically measure to the nearest gram, 0.1 gram, or even 0.01 gram. Balances are good for determining the mass of a body blank, wheels, axles, other dragster components, or even a completed dragster.

CHECK OUT: CJ300 Digital Scale

Every item that goes into producing your dragster matters – each adds to the total mass of the dragster. Each coat of paint or finish is a trade-off, adding mass to the dragster but potentially reducing the aerodynamic drag of the dragster. Knowing the amount of mass each coat of paint or finish adds will also help in getting the dragster to the exact minimum mass specification.



Go/No Go Gauge

This is a device that has preset minimums and maximums built into a physical device – a gauge. If an item being measured falls between the minimum and maximum specifications, it is "good to go" or "a go." If the item falls outside of the minimum and maximum specifications, it is a "no go," meaning it should not move on to further steps until it can meet the specifications. Go/No Go Gauges are usually not as precise as other measuring devices, but they provide quick determinations to see if a product meets specifications.

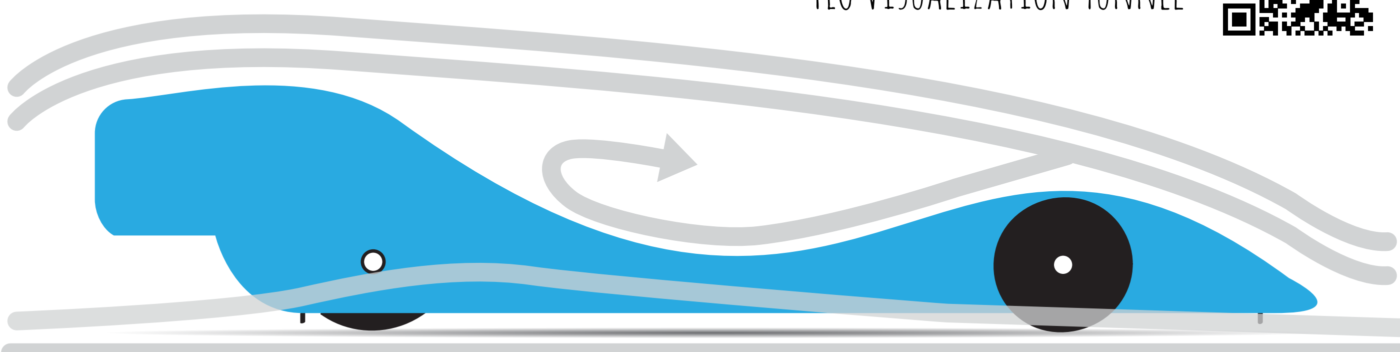
CHECK OUT: Metric Dragster Go/No Go Gauge

AERODYNAMICS

There are many keys to a dragster that performs well, and aerodynamics is one of the top ones. Plus, it gives teachers an opportunity to show students how to apply physics principles in their design.

Aerodynamics of a dragster can be tested with computational fluid dynamics (CFD) if the dragster was designed in a CAD program. Traditionally, a wind tunnel is used. Though automotive engineers also use CFD, they test their designs in wind tunnels to see where drag might occur. A wind tunnel simulates road airflow conditions by moving a stream of air around a stationary car. Luckily, there are smaller wind tunnels than what the pros use, including some priced for the classroom, though they might not have all the same features. For example, wind tunnels used by automotive companies often have a rolling road created by a movable floor, which lets them measure the friction between the rolling wheel and the ground.

CHECK OUT:
FLO VISUALIZATION TUNNEL



Laminar Flow

Well-designed wind tunnels produce a laminar airflow. Laminar flow is a straight, layered flow of air without turbulent air pockets known as eddies – this is usually visualized by using a fogger with the wind tunnel and looks like a tumbling or swirling motion by the fog. It is desirable for a car in the tunnel to disturb the laminar flow of air as little as possible.

On a regular car, features such as large side mirrors stick out and cause turbulence. The presence of turbulence increases the aerodynamic drag, which resists the car's forward motion. The amount of turbulence depends on the shape of the car, paint job, and wheel placement, which is why some people create shell cars – to keep the wheels out of the air stream.

Drag

Who wants a force that pushes back against their dragster? No one who wants to beat the competition! That's exactly what drag does – it's a force that pushes your car in the opposite direction of what you want.

However, it can't be avoided completely; it's just what occurs when an object moves through the air. You can reduce it, once again, by designing your car for a laminar flow when in the wind tunnel.

Also, a design that encourages laminar flow to return back into one stream after hitting a spot that creates turbulence – as opposed to continuing out behind the car in a turbulent fashion – helps reduce drag by creating a force that pushes back to counteract some of the drag. Visualize the top view of a fish in the water. They are smaller at the front and back and bigger in the middle – this allows the fluid to flow around them in a way that doesn't pull the back too much. We are mimicking nature with design that reduces drag.