# Building SPEED: Energy and Safety

The whole point of racing is going fast and fast means lots of kinetic energy. How does the amount of kinetic energy a car has relate to safety? What happens to all that kinetic energy when a car has to come to a stop?

## Pre-Race Prep

**Watching a NASCAR race is exciting in part because of the high speeds involved. Depending on the track, stock cars can reach up to 200 mph. The extreme speed, however, presents a challenge.**

**A NASCAR stock car is required to have a minimum weight of 3450 lbs (which corresponds to a mass of 1565 kg). With a 150-lb driver, the total weight of car and driver is about 3600 lbs (a mass of 1633 kg). The corresponding passenger cars have the weights (masses) shown in the table below.**

| Car | Weight (lb) | Mass (kg) |
|---|---|---|
| 2009 Toyota Camry | 3680 (1) | 1669 |
| 2009 Ford Fusion | 3160 (2) | 1433 |
| 2008 Dodge Avenger | 3738 (3) | 1696 |
| 2008 Chevy Impala | 3674 (4) | 1667 |

**A NASCAR car going around Texas Motor Speedway can easily reach 180 mph. How does the kinetic energy of a stock car going 180 mph compare to the kinetic energy of a passenger car going 60 mph? Don't do any calculations – just make an estimate.**

### What happens to the kinetic energy of a race car when it comes to stop?

### Why does having more kinetic energy make it harder to stop a race car?



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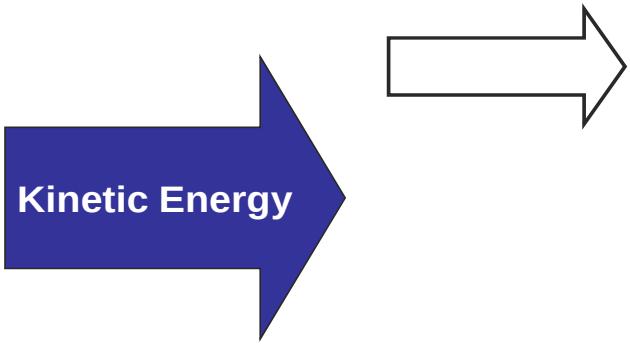
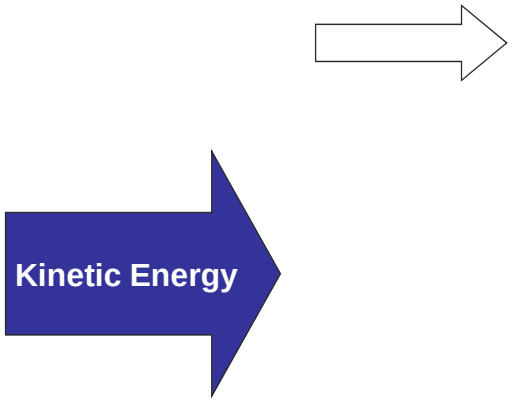
# Start Your Engines…

**A stock car comes off the track onto pit road for a pit stop. Identify as many specific ways to transform the car's kinetic energy as possible from the time the driver is told to pit to the point when the car comes to a stop in the pit stall. A graphical representation of energy flow consists of arrows showing how energy is transformed. Complete the graphical representation after you've made a list. The first arrow is drawn for you, but you should be able to come up with at least two more types of energy**




**When a car collides with another car, or with the track wall, there are additional ways that energy can be transformed. What new ways of transforming energy are available if the car collides with something else? Again, express your answer in a graphical manner as well as in words.**



**When we talk about energy being transformed into forms like light, heat and sound, we often say that energy is 'dissipated'. Explain in your own words what it means for energy to be 'dissipated'. How is energy dissipation consistent with the principle of conservation of energy?**

**You can't change how much energy a race car has. Explain how you can make a collision safer in terms of energy.**

**When a car pulls into the pits to stop, it can dissipate its kinetic energy over a long time. Give an example of how having to stop quickly affects energy dissipation.**

# Extension A: An Atomic View of Sound and Energy Dissipation

**Kinetic energy can be transformed into sound. Trace the process of transformation of energy from the time one car hits another in terms of what happens to the molecules. How is sound generated?**

**Why does the sound get quieter the further away from the collision you are?**



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# Extension B: Heat

**A brake rotor dissipates heat. Explain what happens to the atoms in the brake rotor when the brake pad rubs against the rotor.**


**Why doesn't the brake rotor melt?**

**A brake rotor is a large round metal assembly that rotates with the wheel. The rotor is made up of two disks with a series of vanes in between them. The vanes stretch from the inside hole (the eye) to the outside of the rotor. What is the purpose of these vanes?**

**Your crew chief asks you to come up with a list of ways that they might be able to improve heat dissipation in the brake rotor.**

**In some racing series (not NASCAR), teams drill holes in their rotors to make them lighter. Would this affect how much heat the rotors could transform?**

# Extension C: Is there a "Better" Way of Crashing?

**Which is better for the driver in terms of energy transformation: If the car leaves the ground for 200 feet and then lands, or if the car skids for 200 ft?**