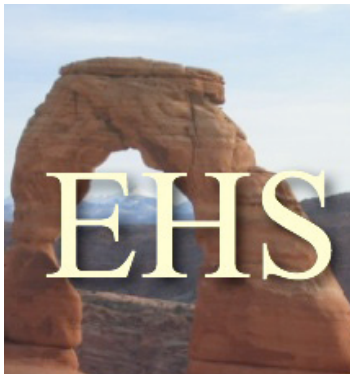


Utah State Electronic High School

Driver Education

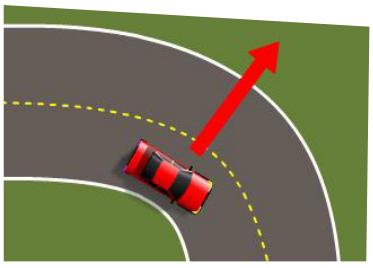
Natural Laws and Driving

In this unit we're going to talk about several other types of laws that come into play when we're driving a vehicle. They're called natural laws. '

Key fact #1 ***Natural Law enforce themselves !!***

With respect to natural laws, it does not matter how skilled a driver you are. It does not matter what kind of vehicle you drive. These natural laws trump everything. Some of things you do can affect how strongly the enforcement is, but natural laws will always affect your driving. If you drive a truck that is raised way up, then you have raised the center of gravity and the truck will flip or overturn easier. If you buy good tires then you increase the friction on the road. If you slow down in icy conditions, you reduce the effect of inertia and lesson the force of impact. These laws are very important ! If you can learn about natural laws and apply the basic concepts in your driving will help drive safe and avoid collisions. This introduction is a brief summany, these topics will be covered in greater detail later. The first law that we want to introduce you to is gravity. Gravity is what keeps us from flying off into space--at least that's what it's supposed to do. Just when we get a little cocky, though, gravity has a way of bringing us back down to earth, unless, of course, you're an astronaut. A lot of times we only think of gravity as it relates to something being dropped or falling. Remember, that gravity is the force that holds your car to road. It's not a good idea to defy the laws of gravity when you're driving a car.

Next is Centrifugal force. This is another natural law we have to contend with when driving. It's the force that pulls an object out from the center. This force is one that moves your car to outside. It, too, is a force to be reckoned with when you're driving.



Then, there's a thing called the law of inertia. It says that a body in motion tends to stay in motion; that is, if you're in a moving vehicle that stops suddenly, you'll keep right on going at the same rate of speed you were going before the vehicle stopped, even if you don't want to.

Now lets talk about how we control the motion of our cars while we are driving them. There are three basic ways that we control the motion of our cars. They are (1) speed, (2) braking, and (3) steering. Each of these functions is affected by the laws of gravity, centrifugal force, inertia, kinetic energy, and friction.

Key fact #2 ——— ENERGY=SPEED

When you accelerate your car, you are increasing the car's energy. Keep in mind, the faster the car is moving, the longer it will take for the vehicle to stop. Your car will respond differently at faster speeds, so you must adjust the way you accelerate, decelerate and steer. There are some interesting things to remember about the car you drive. First of all, a vehicle's energy of motion doubles when its weight doubles. When a vehicle's weight doubles, it needs about twice the distance to stop.

Next (now here is some techspeak) A vehicle's energy of motion is proportional to the square of its increased speed. Wow, that is a mouthful, but what it means to you is that when your vehicle's speed doubles, it needs about four times the distance to stop. When the vehicle's speed triples, it needs about nine times the distance to stop. Lets say you are traveling at 20 miles per hour and it takes you 100 feet to come to a complete stop. If you double your speed to 40 miles per hour, then it will tak 400 feet to stop!! and if you triple your speed to 60 miles per hour, it will take 900 feet to stop your car! Can you say "Don't tailgate?" Keep your stopping distance.

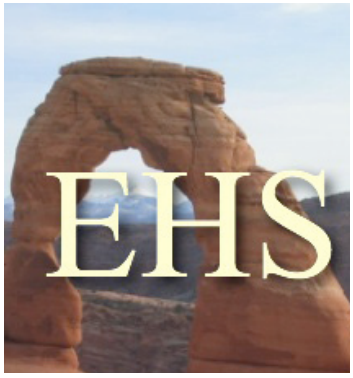
All of which means, the faster you're driving, the longer it takes you to stop, and the less time you have to react to a situation. You also have increased difficulty steering in the intended path of travel and an overall decrease in car control. Also its a money thing.....along with those safety considerations, speeding also causes decreased fuel efficiency, increased engine wear, and increased tire wear. Driving fast is harder on your wallet.

By reducing speeds, or slowing down, you will have more time to react, shorten your braking distance, have less difficulty steering in your intended path of travel, and have an overall increase in car control. You'll enjoy better fuel efficiency, less engine wear, and less wear and tear on your tires. It's hard to make an argument for driving that extra 10 mph faster. Speed kills (or wrecks your car).

Key fact #3 Natural Laws determine
how much control you have over the operation of your vehichle !!

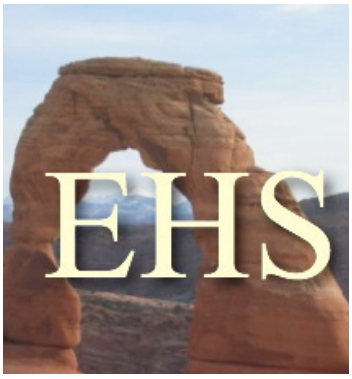
FRICTION

Friction affects the driving task in two ways. If it weren't for friction, you couldn't stop your car in an emergency. Your bakes stop the car by using friction. Without friction, you'd have to wait for it to stop itself, by coasting . Friction is critically affected by your brakes, tires, the road surface, and speed. The brakes on your car have to be strong enough to lock the wheels into a skid. Next, the friction of your tires on the roadway gives you greater control of your car. Your tires must have enough tread to create good traction, and the road must have a good enough surface to provide the gripping power. Traction is the friction of the gripping power of the tire as it moves on the roadway. If the road is wet, or icy, or snowy, then your car loses gripping power and traction. If your tires are bald, then you ALSO lose traction. Imagine driving on that slick road with bald tires! Ouch! No friction equals no control. Tires with good tread are necessary for good traction on our roadways. The purpose of tread is to increase frictional contact with the road to give us greater stopping power.



Good friction is required for proper traction on the roadway--so is a good road surface. The type of road surface greatly influences the amount of friction our tires create with the roadway. A dry, concrete road provides the best friction, while dirt roads are one of the worst. On dirt roads, our tires are literally rolling across small stones that have a ball bearing effect.

Needless to say, you need a lot more room to stop on a dirt road than you do on dry pavement.
On wet pavement, most of the friction is lost due to hydroplaning. The mixture of oil and water on a concrete or asphalt road causes the tires to "float" on an emulsion. The tires, in effect, lose their contact with the pavement, and thus, lose the benefit of friction.



However, the most difficult surface for maintaining any type of friction is on an icy road. It will take you three times farther to stop than under ordinary conditions.

OTHER FACTORS AFFECTING TRACTION

- Friction
- Stopping distance
- Centrifugal force
- Hydroplaning

As was mentioned previously, traction is affected in one way or another by friction. For instance, consider the effect of these factors: stopping distance, centrifugal force, and/or hydroplaning. An increase in any or all of these factors will decrease the amount of traction that your car will have because there is a corresponding decrease in the opportunity for friction. By decreasing a car's traction, you are thereby decreasing the amount of control you have over the vehicle.

When your car goes into a full skid, you don't get maximum braking. Sometimes a driver will slam on his brakes and slide right into the object he was trying to avoid. When you're in a full skid, your front wheels are sliding and you lose control over the steering. The direction of your car won't change, even if you turn the steering wheel. Sometimes you can regain steering control by releasing the brake enough so the wheels are not skidding, then steering around the object you're trying to avoid hitting.

SPEED AND KINETIC ENERGY

Keep in mind also that every time you stop your car, you have to overcome a force that is known as kinetic energy. This force is the energy developed by an object while it's in motion. In very simple terms, the law of kinetic energy means that when you double your speed, the kinetic energy of your car is four times as great! And that means the braking distance is four times as great. When you triple or quadruple your speed, the stopping distance is even greater.

Let's say you're driving at 20 mph on dry concrete pavement. At that rate of speed, you'll need 20 feet to stop your car, or one foot for each mile per hour.

Now you've doubled your speed to 40 mph. You'll need four times the stopping distance, or 80 feet, to bring your car to a safe stop.

So you can see, kinetic energy has a direct bearing on speed versus stopping distance.

CENTRIFUGAL FORCE

Another force you need to understand is centrifugal force. A simple definition is the force that pulls an object out from the center of a curve.

Centrifugal force comes into play when you're rounding a curve. It tends to pull your vehicle out away from the inside edge, regardless of which direction you're traveling If a car on the "inside" lane of a curve tries to navigate with too much speed, centrifugal force will pull it away from the center and, potentially, into the path of oncoming traffic. It doesn't matter how good a driver you are, or how good the performace of your car or anything else..... if you take a corner at too great a speed, then centrigal force takes over and you either roll the car, or crash off the roadway.

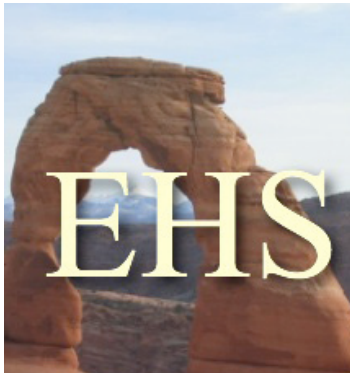
INERTIA

Humans experience the Law of Inertia every time they drive in a car. When the driver makes a quick turn or stops suddenly, the passengers' bodies jolt and try to keep moving in the direction the car was just going. Because of inertia, it is very important that passengers in a car wear their seat belts while driving. In the case of an accident, seat belts provide an opposing force that can prevent a passenger from being thrown from the vehicle. You can understand a lot about inertia by considering it as it works in cars. First, as you're driving, as long as you're not using cruise control, you have to carefully decide when to use your brakes, when to depress the accelerator and when to ease off the accelerator to maintain the same speed. But shouldn't the car stay in motion at a constant rate once you've got it up to the right speed? Actually no it shouldn't, and no it can't.

This is because of the second part to the principle of inertia that no force acts on the moving object. You have many forces acting on your car when your drive. We will talk about some later. Strong winds blowing at you may mean having to use more gas in order to try to maintain a constant speed. The more aerodynamic the car, the less wind speed and air pressure act as a force, so shape can be important.

You can notice how friction affects a car's speed/inertia if you drive off a paved road onto an unpaved one. The less smooth surface of the unpaved road will slow the car down, and might ultimately bring it to a halt if you do not apply your foot to the accelerator. Further, the car itself comes with its own friction devices, chiefly brakes, which when they are applied to tires slow down the motion of the car. However, even if your brakes suddenly failed, your car would eventually come to a stop.

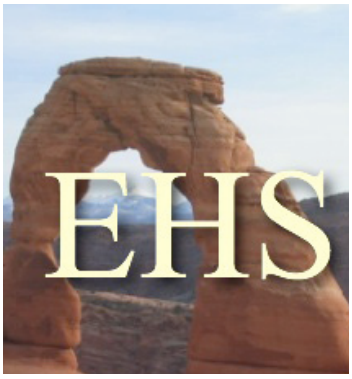
In terms of constant speed and motion, you'll note what occurs when you start descending a hill. The car even without your using the gas will speed up, which may be counteracted by using your brakes or if you drive a manual transmission by downshifting. Speed would seem to increase, thereby violating inertia rules. It's helpful to understand that there is external force acting on your car, gravity, and further the very weight of your car will increase speed when descending a hill.



Understanding inertia as it applies to a car is also helpful in designing cars that are safe. If the car comes to an abrupt stop for instance, it's quite possible that you and any passengers would keep moving. Head on collisions can result in people flying forward out of front windows. This is where your seatbelt, and possibly airbag help provide opposite friction to stop this movement, and why it is so important to wear a seatbelt. By providing a counterforce, your body is restrained from moving, which helps to keep you from getting terribly injured if you have an accident.

Anybody who has ever survived a serious car crash can tell you about this force. If a vehicle is traveling at 40 mph and hits an object that stops its motion, everybody

and everything in that vehicle keeps traveling at 40 mph until they hit something that stops them. Hopefully, the "something" that stops you is the seatbelt and not the windshield!! This is the force called inertia.



Inertia is the force that causes the second and third collisions in an automobile crash. Bodies hitting bodies, and objects in the car hitting bodies. There are some links to watch crash test dummies in a series of collisions. In one, a driver is going 40 mph without his safety belt on. His vehicle hits a stationary object and stops

But the driver keeps moving at 40 mph--until he hits the windshield, that is.

GRAVITY

Gravity is another force that affects car handling. It is a force that pulls objects downward. When a vehicle is going downhill, gravity is one of the forces pulling it down. In mountain driving, gravity plays a major role. On any upgrade, gravity slows you down. The steeper the grade, the longer the grade, and/or the heavier the load, the more you will have to use lower gears to climb hills or mountains. In coming down long steep downgrades, gravity causes the speed of your vehicle to increase. You must select an appropriate safe speed, then use a low gear, and use proper braking techniques.

You should plan ahead and obtain information about any long steep grades along your planned route of travel. If possible, talk to other drivers who are familiar with the grades to find out what speeds are safe. You must go slow enough so your brakes can hold you back without getting too hot. If the brakes become too hot, they may start to "fade." This means you have to apply them harder and harder to getthe same stopping power. If you continue to use the brakes hard, they can keep fading until you cannot slow down or stop at all. Select a "Safe" Speed

Conversely, when your vehicle is going uphill, gravity helps slow it down.

FORCES AFFECTING CONTROL AND VEHICLE PERFORMANCE

- INERTIA
- KINETIC ENERGY
- CENTRIFUGAL FORCE
- GRAVITY

Inertia, kinetic energy, centrifugal force, and gravity all affect driver control and vehicle performance. They affect stopping distance, car control, and the force of an impact.

FACTORS AFFECTING IMPACT

Force of impact is the force generated when objects meet. The faster you drive, the greater the impact or striking power of your vehicle. Again remember that the laws of physics state that the force of impact increases with the square of the increase in speed. So, if you double the speed of a car, you increase its force of impact four times. If you triple the speed, the impact is nine times as great. So striking something at these speeds is like driving off a one, four, and nine story building respectively. When two vehicles moving at the same rate of speed are involved in a collision, the vehicle that weighs less will take the greater impact; the larger and heavier the vehicle, the greater the energy and momentum. The smaller and lighter vehicle will have greater deceleration and may even be pushed in the reverse direction of travel.

It is impossible for a person NOT wearing a seatbelt to protect themselves against the force of impact in a collision. No one is strong enough to counter the affect of inertia if the speed is high enough. A lot of times students will say, " If I can see the collision coming, I can brace myself against the impact and keepfrom getting injured" Not so !!! . Without the seat belt system, they will hit the car interior or anything in their way with a tremendous amount of force. Buckle up! It is the smart thing to do and its the law in Utah.

SPEED

Speed is one of the factors affecting impact. When you increase the speed at which you hit an object, you directly increase the force of the impact. When you increase the force of impact, you increase the risk of injury or death in a collision.

WEIGHT

When you increase the weight of an object, whether it is the vehicle you are driving or the object you are about to hit, you increase the force of the impact, and conversely, the risk of injury or death.

DISTANCE

When you increase the distance your car has to travel between the time you put on the brakes and the time you reach impact, you increase the ability of your car to slow down before reaching the point of impact. You are, therefore, decreasing the force of impact, which decreases the risk of injury or death in a collision.

GREATER SPEED AND WEIGHT:

- *INCREASE YOUR STOPPING DISTANCE*
- *REDUCE YOUR CONTROL OF YOUR CAR*
- *INCREASE THE FORCE OF IMPACT*

Greater speed and weight increase your stopping distance, reduce your control, and increase the force of impact. These are all bad things.

DON"T BE A DUMMY !!