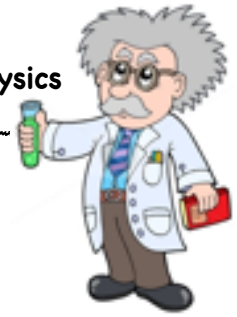

3-2-1, Contact! (Contact Forces)

You've learned that a force is a push or pull. It can actually also be a twist, such as turning on a faucet or unscrewing a lid on a jar. That push, pull, or twist can cause an object to start or stop moving, speed up, slow down, change direction, and even change shape. In lesson 16, I mentioned that forces can be divided into two main categories, contact and non-contact, and although we have mentioned several forces and the effects of force on motion, we have not talked about these types of individual forces in detail. So, before we move onto our lessons on energy and work, my young Jedi, I would like to use the next two lessons to discuss the two groups of forces in detail. Remember, forces are always with you!

Let's start with contact forces. A contact force is just like it sounds, it requires physical **contact** between two surfaces. Contact forces include applied, spring, tension, frictional, drag, and normal.

Applied Force is putting pressure on an object through a push, pull, or twist. A person or another object can exert an applied force. If a person applies the force it is sometimes called a **muscular force** since they are using their muscles to apply it. We have talked about many examples of applied forces in our study of Newton's laws of motion. Sports are the perfect example of applied forces: hitting a baseball with a bat, kicking a soccer ball with your foot, throwing a basketball into a hoop, striking a golf ball with a club, or tackling a football player carrying the ball.

Spring Force can occur one of two ways, but always ends with the spring returning to its natural shape or resting position. One way to create spring force is to compress or push an object together, usually in a coil shape, and then when the pressure of the push is taken away, the object will pop back into shape. The same is true for pulling on the spring. When the spring is released from its stretched position it will return to its resting position. A great example is a Jack-in-the-Box toy. You have to compress or push the spring in the toy to make the clown go down into the box and shut the lid. When the handle is turned, the lid opens at an unexpected time and the clown pops out with the force of the released spring. Springs are used in pens, mattresses, and cars (shock absorbers) to name just a few.

Tension Force is a pulling force transmitted through a rope or wire when it is pulled tight by forces at opposite ends. The objects at both ends of the rope are pulled on equally. A chandelier hanging from a ceiling is an example of a tension force where the chandelier and the ceiling are pulled on equally and the chain in between is tight.

Frictional Force is EVERYWHERE and we wouldn't be able to live without it. We need it to walk or run, and to hold things in our hands. When in a car or on a bike, we need friction to have working brakes. Friction is necessary and nearly impossible to completely eliminate. We have already talked a little about friction in lesson 17 when discussing Newton's second law of

motion. You were told that anytime two objects rub against each other there is friction. It resists or works against motion, in the opposite direction. Although we need friction to live, it is sometimes necessary to reduce friction between objects, such as using oil in the engine of a car so its moving parts don't grind together and stop working or cause a fire. We also need to reduce friction to be able to more easily move large objects from one place to another.

Drag Force is a type of frictional force but specifically in dealing with air or water (liquid). With air, it is often called **air resistance**. You feel drag when you run your hand through water or when you put your hand out the window of a moving vehicle. You feel the water or air moving in the opposite direction of the way your hand is moving. Drag can be a useful force such as in the case of an open parachute slowing a fall to the point of landing safely on the ground after jumping from an airplane. Drag can also be a force that needs to be reduced or eliminated. Professional swimmers wear tight swim caps to reduce their drag through the water and make them swim faster than their competitors. Aircraft designers reduce the drag force to make it easier for planes to travel through the air by shaping the planes in a way to make them aerodynamic. The same is true for submarines. Who first designed this aerodynamic shape that is able to reduce drag? God did! Look at the shape of a bird compared to a plane! Look at the shape of a shark compared to a submarine!

Normal Force is not very "normal." At least not in the way that you normally understand the word normal to mean! A normal force in physics is a force that always acts perpendicular to the surface of contact, no matter what the angle of that surface. Normal means perpendicular (90-degree angle to the surface). Confused? Me too! (At least in terms of how to explain it to you!) A normal force is most simply understood with the example of a book sitting on a table. As the book rests on the table it is pushing on the surface of the table just as the table is pushing back on the book with equal force. If you were to pick up one side of the table surface to form an angle, the book would still be perpendicular to the table's surface although it may start to slide downward due to gravity's pull. At no point does the book go through the table. It stays in contact, resting on the table's surface.

Still not clear on normal force? What did I mean by the book NOT going through the table's surface? Of course it wouldn't! But the question is, why not? If gravity pulls everything towards the earth's center, what is stopping everything from reaching that center? The normal force is what keeps us from being pulled to the earth's center of gravity! We have contact with the earth's surface and are perpendicular to it. Gravity is always pulling us towards it's center which keeps us from floating off into space, but it is the normal force that keeps our feet on the ground and not through it, towards the earth's core. Where gravity is a pulling force, the normal force, in this case, is a pushing force. As you push down on the ground, the ground, because of normal force, pushes back with equal force which prevents you from penetrating the surface. Normal force prevents solid objects from passing through each other. Now, that's a pretty handy force to have!

We had to discuss gravity now to explain the contact force of normal force, but the next lesson will tell you more about gravitational force and two other non-contact forces. More forces? Oh My! Hang in there young Jedi! You are doing great!