Physics
Chapter 4: Forces and the Laws of Motion

Section 4.4

Everyday Forces

Weight and Gravity

--The force of gravity acting on an object is the <u>weight</u> of the object; since weight is a force its unit is the newton (N).

--The SI unit of mass is the kilogram, and mass remains constant everywhere in the universe.

--The weight of an object changes as the gravitational force on that object changes.

--The mass of an object on the moon is the same as its mass on Earth, but its weight is 1/6 of that on Earth.

	Mass (kg)	Weight (N)
Earth	70.0	686.7
Moon	70.0	114.5

Normal Force and "Weightlessness"

--The <u>normal force</u> is the upward force exerted by the Earth, etc., on objects in contact with the surface of the Earth or to another object in contact with the surface of the Earth.

--The force is called the normal force because it acts perpendicular (normal) to the Earth's surface.

--What we experience as weight is due to the normal force that acts on us <u>unless we are falling</u>.

--A spacecraft in orbit around the Earth, and the astronauts in it, are still under the influence of the Earth's gravitational field (otherwise they would fly off into space!).

--The astronauts still have weight, since weight is defined as the force of gravity acting on an object.

--The acceleration of gravity at the normal altitude of the space shuttle (400 miles or 640 km) is about 85% of what it is on the Earth's surface, or about 8.3 m/s^2.

--What some people sometimes refer to as weightlessness is really a state of <u>free fall</u>.

--Both the astronaut and the spacecraft are falling and accelerating at the same rate, and the astronauts floats because of the absence of a normal force.

Friction

--The resistance to the motion of an object caused by the contact of that object with the Earth is called <u>friction</u>.

--The force of friction always acts opposite to the direction of motion of the object.

--Objects at rest experience a <u>static friction</u>, since it takes a force to overcome their inertia and cause them to start moving.

--The friction experienced by an object that is moving is called <u>kinetic friction</u> or <u>sliding friction</u>.

--The amount of friction opposing the motion of an object can be decreased by:

--using a smoother surface

--using a lubricant

--using wheels

Air Resistance

--An object moving through the air experiences friction from the air, known as <u>air resistance</u>.

--Air resistance, like friction, always acts opposite the direction of motion of the object.

--The air resistance depends upon the velocity of the object (greater velocity, greater air resistance), its mass, and surface area.

Terminal Velocity

--The air resistance acting on an object falling through the air increases as the velocity of the object increases.

--Eventually, the force of air resistance acting on a falling object equals the force of gravity acting on the object. This produces a <u>net force</u> of <u>0 N</u>, which in turn means the acceleration of the object becomes <u>zero</u>.

--Since the acceleration of the object becomes zero, it falls with a constant velocity, known as its terminal velocity.

--A parachute helps a person jumping out of an airplane to land safely because it produces more air resistance, which leads to a lower terminal velocity.

--A skydiver will fall “spread eagle” before opening their parachute to increase the air resistance acting on them and give their body a lower terminal velocity.