Chapter 5

5.2: Forces and Equilibrium
5.3: Friction

Welcome to Physics First I Cycle 7 Lesson 3

OBJECTIVE: Use Hooke's Law to describe and predict the action of springs. Define friction in terms of systems and equilibrium.

VOCAB: Hooke's Law, spring constant, friction, sliding friction, static friction, lubricant

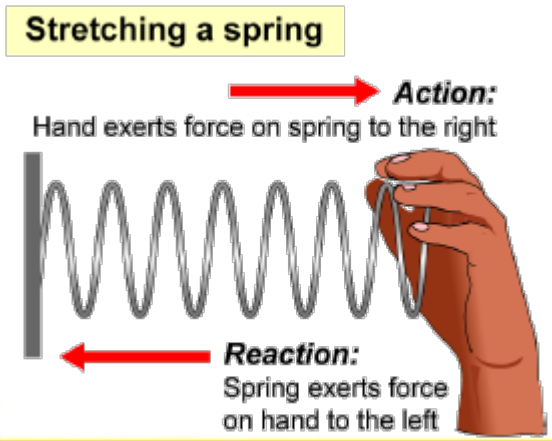
CLASSWORK:

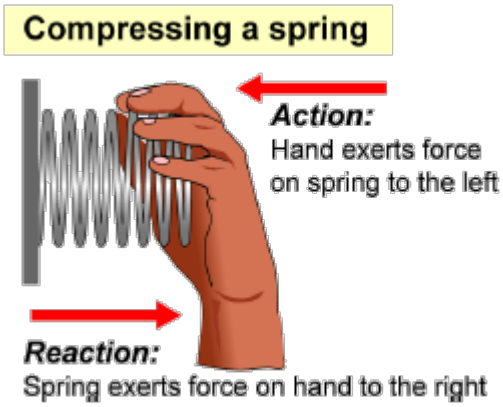
p. 130 "Understanding Vocabulary" #8, #10-12
p. 130 "Reviewing Concepts" #10-12, #14, #15
p. 131 "Solving Problems" #7
p. 131 "Solving Problems" #8-9

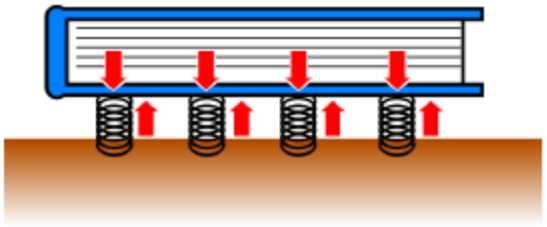
The Force from a Spring

Springs are used in many devices to keep systems in **equilibrium**. Springs can also store **potential energy** when compressed or stretched..

The **normal force** of a surface works like a spring. How does a surface 'know' how much reaction force to exert on an object? Because it is slightly compressed until it reaches **equilibrium** – **normal force** is the 'spring' pushing back.







The normal force exerted by a surface is similar to that of a compressed spring.

Hooke's Law and Springs

The relationship between a spring's change in length and the force it exerts is called **Hooke's Law**.

Some springs are very flexible, while others are very stiff. We say that a spring which is more stiff has a higher **spring constant**.

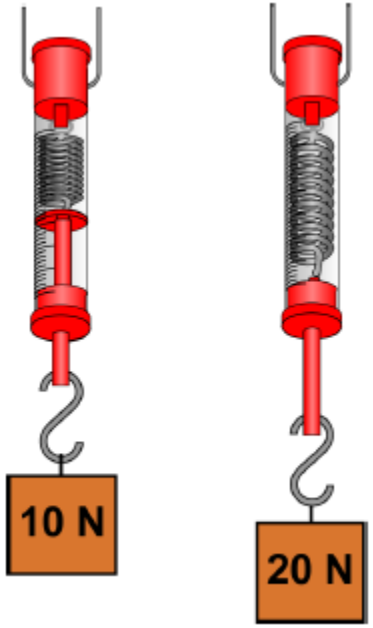
HOOKE'S LAW

Force (newtons)

$$F = -kx$$

Spring constant (newtons/meters)

Extension or compression (meters)



The change in length of a spring is often used in the operation of a scale. Measuring the change in length of the spring allows calculation of the **force** measured.

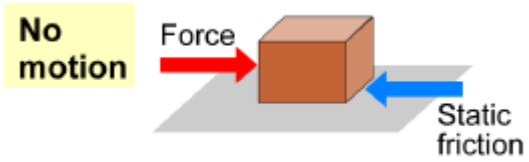
What is Friction?

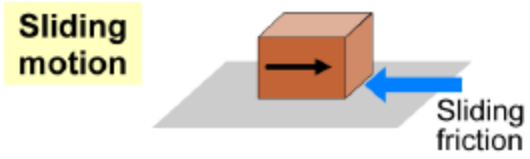
Friction is a force which resists the motion of objects or surfaces. It is caused by microscopic 'hills' and 'valleys' on surfaces of objects.

Because **friction** exists in many different situations, it is classified into multiple types.

Sliding Friction is present when 2 objects or surfaces slide across each other.

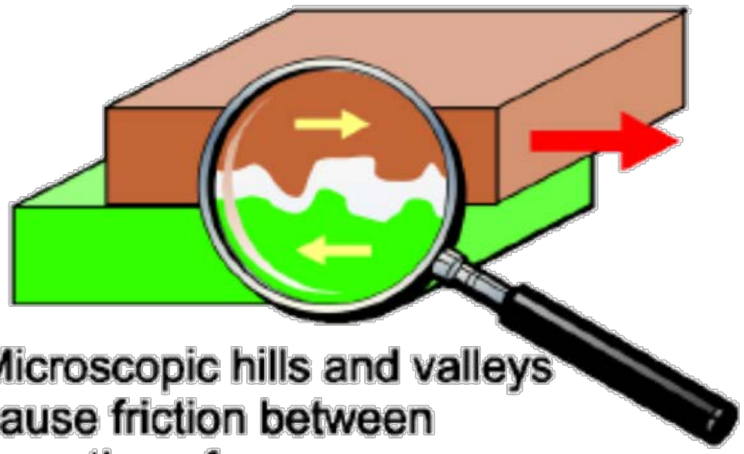
Static Friction is present when forces are acting to cause an object to move, but friction prevents the object from moving. **Static Friction** is often present at **equilibrium**.



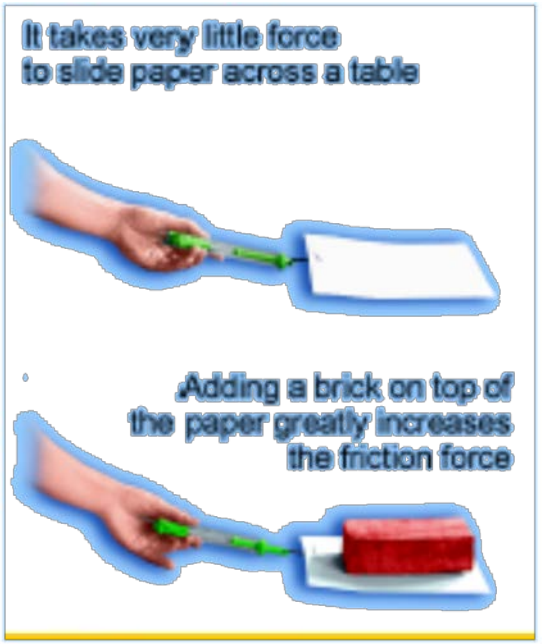


Causes of Friction

Friction is caused by surface roughness. A greater **normal force** between 2 surfaces will cause increased **friction** by pushing the microscopic hills & valleys together.



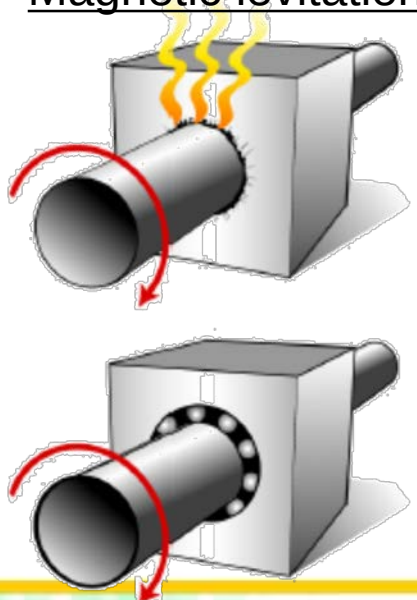
Microscopic hills and valleys cause friction between smooth surfaces



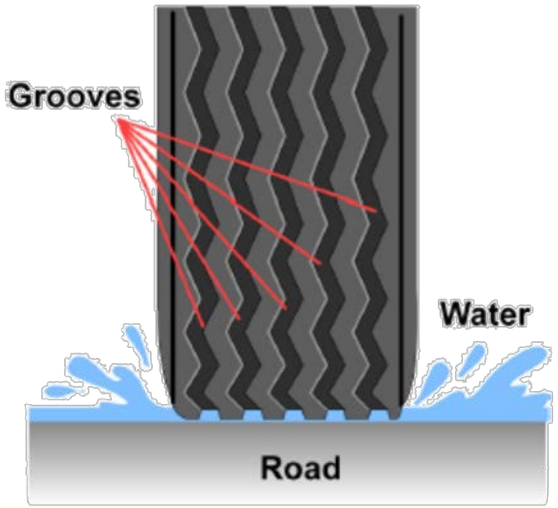
Reducing Friction

A fluid used to reduce friction between surfaces is called **a lubricant**. A lubricant works by preventing the hills & valleys from contacting each other. This is good in a machine. This is bad when it involves a tire on wet pavement. This is why tires have grooves.

A ball bearing reduces mechanical friction. Magnetic levitation is used in bullet trains.

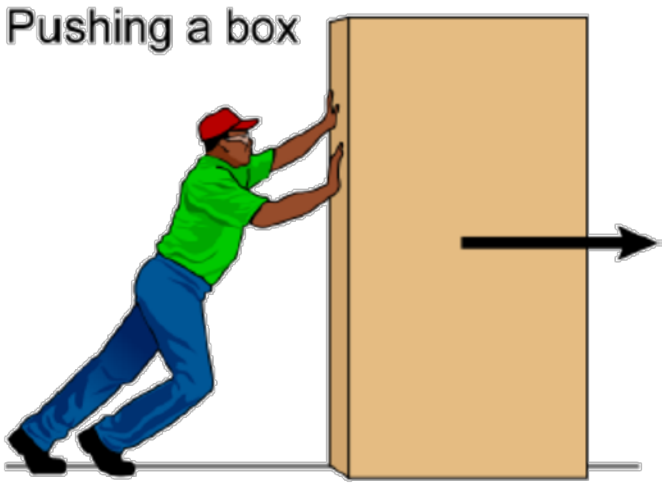


Grooves in tires allow water to not be trapped, so that it will not act as a lubricant.



Static Friction > Sliding Friction

Static Friction is generally higher than **Sliding Friction** – it takes a larger push to start an object moving.



Free body diagram