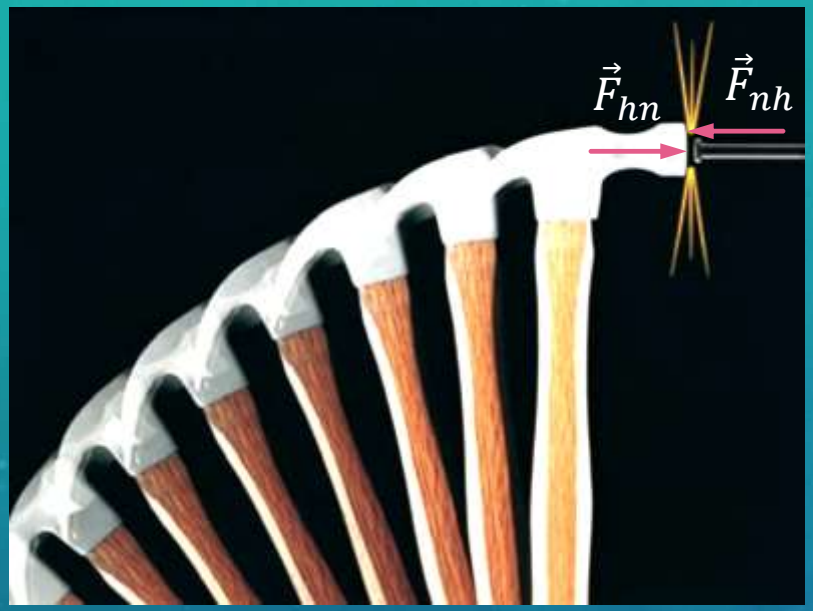
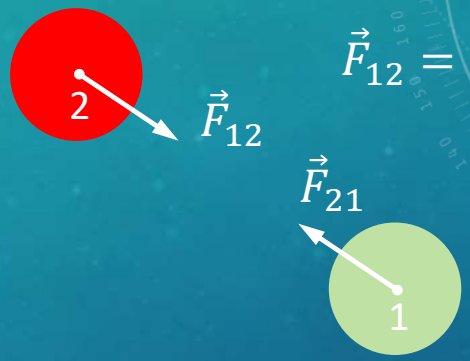
Newton's 3rd Law of Motion

NEWTON'S THIRD LAW

We found that a force is exerted on an object when it comes into contact with some other object



(a) The force exerted by the hammer on the nail is equal in magnitude and opposite in direction to the force exerted by the nail on the hammer.



(b) The force $\vec{F}_{12}$ exerted by object 1 on object 2 is equal in magnitude and opposite in direction to the force $\vec{F}_{21}$ exerted by object 2 on object 1.

Consider the task of driving a nail into a block of wood, for example, as illustrated in picture (a). To accelerate the nail and drive it into the block, the hammer must exert a net force on the nail. Newton recognized, however, that a single isolated force (such as the force exerted by the hammer on the nail) couldn't exist. Instead, **forces in nature always exist in pairs**. According to Newton, as the nail is driven into the block by the force exerted by the hammer, the hammer is slowed down and stopped by the force exerted by the nail.

Newton described such paired forces with his **third law**:

If object 1 and object 2 interact, the force $\vec{F}_{12}$ exerted by object 1 on object 2 is equal in magnitude but opposite in direction to the force $\vec{F}_{21}$ exerted by object 2 on object 1.

This law, which is illustrated in picture (b), states that **a single isolated force can't exist**.

The force $\vec{F}_{12}$ exerted by object 1 on object 2 is sometimes called the **action force**. The force $\vec{F}_{21}$ exerted by object 2 on object 1 is called the **reaction force**.

In reality, either force can be labeled the action or reaction force. **The action force is equal in magnitude to the reaction force and opposite in direction**. **In all cases, the action and reaction forces act on different objects**.

Newton's third law constantly affects our activities in everyday life.. When walking, for example, we exert a frictional force against the ground. The reaction force of the ground against our foot propels us forward. In the same way, the tires on a bicycle exert a frictional force against the ground, and the reaction of the ground pushes the bicycle forward.

Flying gracefully through the air, birds depend on Newton's third law of motion. As the birds push down on the air with their wings, the air pushes their wings up and gives them lift.