Research on Student Learning

Students tend to think of force as a property of an object ("an object has force," or "force is within an object") rather than as a relation between objects. [1] In addition, students tend to distinguish between active objects and objects that support or block or otherwise act passively. Students tend to call the active actions "force" but do not consider passive actions as "forces". [2] Teaching students to integrate the concept of passive support into the broader concept of force is a challenging task even at the high-school level. [3]

Students believe constant speed needs some cause to sustain it. In addition, students believe that the amount of motion is proportional to the amount of force; that if a body is not moving, there is no force acting on it; and that if a body is moving there is a force acting on it in the direction of the motion. [4] Students also believe that objects resist acceleration from the state of rest because of friction -- that is, they confound inertia with friction. [5] Students tend to hold on to these ideas even after instruction in high-school or college physics. [6] Specially designed instruction does help high-school students change their ideas. [7]

Research has shown less success in changing middle-school students' ideas about force and motion. [8] Nevertheless, some research indicates that middle-school students can start understanding the effect of constant forces to speed up, slow down, or change the direction of motion of an object. This research also suggests it is possible to change middle-school students' belief that a force always acts in the direction of motion. [9]

Students have difficulty appreciating that all interactions involve equal forces acting in opposite directions on the separate, interacting bodies. Instead they believe that "active" objects (like hands) can exert forces whereas "passive" objects (like tables) cannot. [10] Alternatively, students may believe that the object with more of some obvious property will exert a greater force. [11] Teaching high-school students to seek consistent explanations for the "at rest" condition of an object can lead them to appreciate that both "active" and "passive" objects exert forces. [12] Showing high-school students that apparently rigid or supporting objects actually deform might also lead them to appreciate that both "active" and "passive" objects exert forces. [13]

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