Issue 43

Newton's Second Law ($F = ma$) in Athletics

Without protective padding, a prize fighter's wallop or a collision on a football field can exert a force of 1000 pounds for a very brief time. Such a force, F, can deform bones. The acceleration, a, it produces in limbs, trunk, or skull can twist, stretch, or rupture nerves and blood vessels.
$F = ma$ may be written as

$$F = mv/t \text{ or } Ft = mv$$

where m and v describe the fighter's fist or the football player's body as the collision takes place. Newton's second law!

Protective clothing spreads the action of the force over a longer period of time, t. In the product Ft, if t is increased by padding, the average force, F, must decrease (since the product Ft equals the unchanged and therefore constant mv), thereby reducing the resulting bodily damage.

Cyclists, motorcyclists, construction workers, football players, and hockey players are protected by helmets because $F = ma$.

Professional boxers do not wear helmets, and their padded gloves weigh only 8 ounces. Should laws require them to wear gloves heavier than 8 ounces?

Are jogging shoes designed with $Ft = mv$ in mind? In what ways?

Why do elastic poles permit higher pole vaults than the older rigid poles?

Why do automobile seat belts reduce injuries? A passenger's mv is the same in a collision with or without a seat belt.

A majority of states now have mandatory child-restraint laws for automobiles.