Key Physics Concepts

Section Summaries	Physics Principles
Section 1 Newton's First Law: A Running Start Students release a ball to roll down and then up the sides of a track. They first record its starting height and then the recovered height. From this, they are introduced to the concept of inertia.	Inertia and mass Newton's first law of motion Force Velocity and speed Acceleration Frame of reference
Section 2 Constant Speed and Acceleration: Measuring Motion A timer and paper tape is used to record the motion of various objects. Distance, time, instantaneous and average velocities, and accelerations are calculated from the data.	Instantaneous speed Average speed Positive acceleration Negative acceleration
Section 3 Newton's Second Law: Push or Pull Students calibrate and use a simple force meter to explore the variables involved in accelerating an object. They then connect their observations and data to a study of Newton's second law of motion.	Newton's second law of motion Weight Free-body diagrams Gravitational attraction between masses
Section 4 Projectile Motion: Launching Things into the Air Students explore the motion of objects that are projected in a gravitational field. Differences between objects being dropped, launched horizontally, and launched at an angle are explored in relation to the landing position of objects dropped straight down to those with projected motion.	Gravity Independence of vertical acceleration and constant horizontal velocity for objects in free fall Trajectory of a projectile
Section 5 The Range of Projectiles: The Shot Put Students compare mathematical and physical models of projectile motion to that of a shot put. They apply this to describe the vertical and horizontal motion of the projected object, and predict its trajectory.	Acceleration due to gravity Range of a projectile Mathematical versus physical models
Section 6 Newton's Third Law: Run and Jump Thinking about the direction in which they apply force to move in a desired way introduces students to the concept that every force has an equal and opposite force. They test this concept and then apply it to a variety of motions observed in sports.	Normal force Newton's third law Action-reaction pair forces Free-body diagrams Center of mass
Section 7 Frictional Forces: The Mu of the Shoe Students measure the amount of force necessary to slide athletic shoes on a variety of surfaces. From this and the weight of the shoe, they learn to calculate friction coefficients. They then consider the effect of friction on an athlete's performance.	Friction Coefficient of friction Normal force Weight
Section 8 Potential and Kinetic Energy: Energy in the Pole Vault Students use a penny launched from a ruler to model motion during the pole vault. They connect their observations to the concept of energy conservation.	Gravitational potential energy Kinetic energy Energy conversion Law of conservation of energy Work Spring potential energy
Section 9 Conservation of Energy: Defy Gravity Students learn to measure hang time and analyze vertical jumps of athletes using slow-motion videos. This introduces the concept that work when jumping is force applied against gravity.	Gravitational potential energy Kinetic energy Energy conversion Force and weight Law of conservation of energy Work Spring potential energy