



Conceptual Physics - Unit 2 - Forces and Energy

Unit Focus

Students will explore the relationship between forces on an object and the motion of that object. Students will examine how physics operates in everyday life as well as the objects they create in class. Students will engage in lessons that challenge them to use the scientific process as they perform several inquiry-based experiments to uncover and investigate fundamental principles of physics, such as acceleration and velocity. Students will practice important science skills such as metric system measurements and conversions as well as creating and analyzing free body diagrams. These topics will carry over into further Physics classes.

Stage 1: Desired Results - Key Understandings

Standard(s)	Transfer	
Common Core Mathematics: 9-12 - Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions. (CCSS.MATH.CONTENT.HSA.CED.A.1) - Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law $V = IR$ to highlight resistance R. (CCSS.MATH.CONTENT.HSA.CED.A.4) Next Generation Science Standards Performance Expectations: High School Physical Sciences - Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. (HS-PS2-1) Performance Expectations: Middle School Physical Sciences - Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. (MSPS2-2) Next Generation Science Standards (DCI) Science: 10 - Newton's second law accurately predicts changes in the motion of macroscopic objects. (PS2.9.A1) Madison Public Schools Profile of a Graduate	<i>Students will be able to independently use their learning to...</i> T1 Use the scientific process to generate evidence that addresses the original questions. T2 Analyze qualitative and quantitative data to interpret patterns, draw conclusions, and/or make predictions.	
	Meaning	
	Understanding(s)	Essential Question(s)
	<i>Students will understand that...</i> U1 Newton's laws describe how the motion of an object relates to the forces acting on it U2 Free body diagrams are one way to represent the forces acting on an object U3 Mass and weight are different measurements even though on Earth they seem to be used interchangeably U4 Objects in motion remain in straight-line motion at constant speed, and objects at rest remain at rest unless acted upon by unbalanced forces. (Newton's 1st law). U5 The acceleration of an object depends upon its mass and the net force acting on it. (Newton's 2nd Law) U6 Forces between objects come in pairs that are equal in magnitude but opposite in direction (Newton's 3rd law) U7 The faster a given object is moving, the more energy it possesses. U8 While energy within a system is continually changing forms, and being transferred, the total energy of the system is conserved.	<i>Students will keep considering...</i> Q1 How do forces effect the motion of an object? Q2 How can we represent forces? Q3 How does energy change forms without being lost?

Stage 1: Desired Results - Key Understandings

- Design: Engaging in a process to refine a product for an intended audience and purpose. (POG.2.2)

Acquisition of Knowledge and Skill

Knowledge

Students will know...

K1 Inertia is the tendency of an object at rest to stay at rest or an object in motion to remain in motion unless acted upon by an outside force. (Newton's 1st law)

K2 $F = ma$ (Newton's 2nd law)

K3 Friction is a force that opposes motion and depends on the characteristics of the surfaces in contact

K4 The normal force is the force on an object from a surface

K5 A free body diagram is a representation of the forces acting on an object at one instance

K6 In a free body diagram, the length of the vector arrow corresponds to the magnitude of the force

K7 weight is the force of gravity on an object (vector)

K8 mass is the amount of matter (scalar)

K9 unit for mass is kilograms, unit for weight is Newtons

K10 the mass of an object is the same everywhere, the weight of an object is different when the acceleration due to gravity is different

K11 kinetic energy is the energy of motion

K12 potential energy is stored energy and can be gravitational

K13 the total energy of an object is conserved if only conservative forces act on the object

Skill(s)

Students will be skilled at...

S1 solving for the force, mass, or acceleration in a scenario ($F = ma$)

S2 identifying force pairs

S3 creating free body diagrams to represent the forces acting on an object

S4 calculating the weight of an object

S5 calculate gravitational potential energy and kinetic energy of an object

S6 use the conservation of energy to solve problems