

Key Elements: Forces**Estimated Time: 14–16 hours**

By the end of this course, students will understand the nature of various forces, notably gravity and friction.

Vocabulary

acceleration, average velocity, change in length, coefficient of friction, constant acceleration, displacement, final velocity, force, friction, gravitational field strength, gravity, initial velocity, instantaneous velocity, kinetic, mass, scalar, static, universal gravitational constant, vector, velocity, weight

Knowledge

- mass
- force
- force due to gravity (weight)
- force due to friction (static and kinetic)
- normal force
- coefficient of friction
- inverse square law
- Newton's law of universal gravitation
- universal gravitational constant
- gravitational field strength
- Hooke's law
- spring constant
- change in length

Skills and Attitudes

- conduct appropriate experiments
- systematically gather and organize data from experiments
- produce and interpret graphs (e.g., slope and intercept)
- verify relationships (e.g., linear, inverse, square, and inverse square) between variables
- apply models (e.g., physics formulae, diagrams, graphs) to solve a variety of problems
- use appropriate units and metric prefixes

FORCES

Prescribed Learning Outcomes	Suggested Achievement Indicators
<p><i>It is expected that students will:</i></p>	<p><i>The following set of indicators may be used to assess student achievement for each corresponding prescribed learning outcome.</i></p> <p><i>Students who have fully met the prescribed learning outcome are able to:</i></p>
<p>D1 solve problems involving the force of gravity</p>	<ul style="list-style-type: none"> <input type="checkbox"/> recognize the relationship between <ul style="list-style-type: none"> – mass and attractive force due to gravity (e.g., force due to gravity on the Earth’s surface is proportional to Earth’s mass) – the force of gravity between two objects and their distance of separation (i.e., the inverse square law) <input type="checkbox"/> define <i>gravitational field strength</i> <input type="checkbox"/> solve a variety of problems involving the relationship between <ul style="list-style-type: none"> – mass – gravitational field strength – force due to gravity (weight) <input type="checkbox"/> use Newton’s law of universal gravitation to solve problems involving <ul style="list-style-type: none"> – force – mass – distance of separation – universal gravitational constant
<p>D2 analyse situations involving the force due to friction</p>	<ul style="list-style-type: none"> <input type="checkbox"/> define <i>static friction</i> and <i>kinetic friction</i> <input type="checkbox"/> define <i>normal force</i> <input type="checkbox"/> with teacher support, conduct experiments investigating force due to friction, involving <ul style="list-style-type: none"> – normal force – various types of material – surface area – speed <input type="checkbox"/> define <i>coefficient of friction</i> <input type="checkbox"/> recognize the relationship between force due to friction and the strengths of normal force and coefficient of friction <input type="checkbox"/> solve problems with objects sliding on horizontal surfaces, involving <ul style="list-style-type: none"> – force of friction – coefficient of friction – normal force
<p>D3 apply Hooke’s law to the deformation of materials</p>	<ul style="list-style-type: none"> <input type="checkbox"/> state Hooke’s law <input type="checkbox"/> define <i>spring constant</i> <input type="checkbox"/> with teacher support, conduct experiments to verify Hooke’s law <input type="checkbox"/> use Hooke’s law to solve problems that involve <ul style="list-style-type: none"> – force – spring constant – change in length

Key Elements: Newton's Laws

Estimated Time: 9–11 hours

By the end of this course, students will be able to use an understanding of Newton's laws to describe the effects of forces on objects.

Vocabulary

acceleration, action/reaction forces, free-body diagram, inertia, mass, net force

Knowledge

- inertia
- net force
- action/reaction forces
- Newton's three laws of motion

Skills and Attitudes

- conduct appropriate experiments
- systematically gather and organize data from experiments
- produce and interpret graphs (e.g., slope and intercept)
- create free-body diagrams in one dimension
- verify relationships (e.g., linear, inverse, square, and inverse square) between variables
- apply models (e.g., physics formulae, diagrams, graphs) to solve a variety of problems
- use appropriate units and metric prefixes

NEWTON'S LAWS

Prescribed Learning Outcomes	Suggested Achievement Indicators
<i>It is expected that students will:</i>	<p><i>The following set of indicators may be used to assess student achievement for each corresponding prescribed learning outcome.</i></p> <p><i>Students who have fully met the prescribed learning outcome are able to:</i></p>
E1 solve problems that involve application of Newton's laws of motion in one dimension	<ul style="list-style-type: none"> <input type="checkbox"/> state Newton's three laws of motion <input type="checkbox"/> illustrate Newton's first and third laws with examples <input type="checkbox"/> create free-body diagrams in one dimension for use in solving problems (e.g., elevator problems) <input type="checkbox"/> use Newton's second law to solve problems that involve <ul style="list-style-type: none"> – net force – mass – acceleration <input type="checkbox"/> apply Newton's laws and the concepts of kinematics to solve problems