

# Conceptual Physics Unit Overview

## *Unit VI – Physics in Action (Chapter 1)*

### **Chapter Summary**

To gain understanding of science principles necessary to meet this challenge, students work collaboratively on activities in which they continue their exploration of the conservation of energy and uncover the concepts described by Newton's laws of motion. In the process of this exploration they will observe the constant interaction of force and mass that surrounds them. Students will also describe how forces, such as gravity and friction, can do work and cause an object's energy to transfer from potential to kinetic and vice versa. As a final component of the chapter, students will examine the concept of momentum and how momentum, like energy, is conserved.

### **Chapter Challenge**

The challenge for this unit will require students to demonstrate their understanding of energy, forces, and momentum by designing a working catapult. Working with a design team, students will build a prototype and modify their original design to increase the accuracy or distance of the catapult. The students will utilize their knowledge of forces and motions to maximize the results. They will present and defend their findings through a presentation for the class.

### **Skills and Knowledge**

Following this unit, students will know that...

- inertia is a measure of an object's tendency to resist a change in motion
- massive objects have more inertia than non-massive objects
- every object has a point, called its "center of mass," where all of its mass can be considered to be located
- a force can be anything that exerts a push or a pull on an object
- a net force is simply the sum of all the forces acting on an object
- when forces are "balanced" it means that all forces acting on an object cancel each other
- an object will remain stationary or will move in a straight line at a constant speed when there is no net force acting on it
- an object will accelerate when acted upon by net force
- acceleration means to speed up, slow down, or change direction
- gravity is a force that attracts any two objects in the universe
- weight and mass are related, but are not the synonyms
- when one object exerts a force on a second object, the second object exerts an equal force on the first object, but in the opposite direction
- friction is a force that acts between any two objects that are trying to slide past each other
- the amount of friction acting between two objects depends on the characteristics of the surfaces in contact as well as the amount of force pushing the surfaces together
- work is done when a force acts on an object in the direction in which the object is moving

- when work is done, energy can be transferred from one form to another
- kinetic energy is determined by the mass and speed of an object
- gravitational potential energy is determined by the mass and height of an object
- energy cannot be created or destroyed, but it can change forms
- momentum is the product of an object's mass and its speed
- the total momentum in a system of objects cannot change (it is conserved)
- a net force is required to cause an object to move in a circular path
- the force that moves an object in a circular path is directed toward the center of the curved path and is called a "centripetal" force.
- a "centrifugal" force does not force an object into a circular path

Following this unit, students will be able to...

- define the term "inertia"
- explain the relationship between an object's mass and its inertial characteristics
- describe the term "center of mass"
- explain how an object's center of mass can be located
- define the term "force" and give examples of forces that can be experienced in everyday activities
- explain what is meant by the term "net force" and demonstrate how to calculate a net force
- describe the difference between balanced and unbalanced forces
- describe the conditions that cause an object to remain at rest or to move in a straight line at a constant speed
- define the term "acceleration" and explain what can happen to an object that is accelerating
- describe the relationship among force, mass, and acceleration and explain how that relationship can be observed in everyday activities
- describe how the gravitational force affects objects near the surface of the earth
- explain the difference between weight and mass
- describe the forces and masses involved in the idea that every action causes an equal and opposite reaction
- explain the factors that determine the amount of friction acting between two objects
- explain what it means to "do work" in a physics sense
- explain how doing work can affect the amount of energy possessed by an object
- define "kinetic energy" and list the factors that determine the amount of kinetic energy an object possesses
- define "potential energy" and list the factors that determine the amount of potential energy an object possesses
- explain what it means to say that energy is "conserved"
- define the term "momentum" and explain how it is calculated
- observe a collision between two common objects and then describe how momentum was conserved during the collision
- list and explain the requirements to make an object move in a circular path
- compare the words "centripetal" and "centrifugal" by explaining which describes a "real" force and which describes a "perceived" force

## **Essential Questions**

- What is a force?
- What is inertia?
- Will a force have the same effect on different masses?
- What is the relationship among the quantities: force, mass, and acceleration?
- How is an object's "center of mass" located?
- How can the amount of gravitational force acting on an object be determined?
- What's the difference between weight and mass?
- What is meant by "balanced" and "unbalanced" force?
- What is a "net" force?
- What does it mean to say that an object is "accelerating"?
- What causes a stationary object to remain stationary?
- Under what conditions will an object in motion continue to move?
- What is truly meant by the statement: "For every action there is an equal and opposite reaction"?
- What determines the amount of friction acting between two objects?
- How is the kinetic energy of an object determined?
- How is the potential energy of an object determined?
- What does it mean to say that energy is "conserved"?
- How can "doing work" cause energy to be transferred from one form to another?
- What is momentum?
- What does it mean to say that momentum is "conserved"?
- Is a force required to make an object move in a circular path?

## **Vocabulary & Terms**

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|-----------------------|---------------------------|----------------------------|
| ● <i>force</i>        | ● <i>balanced</i>         | ● <i>friction</i>          |
| ● <i>mass</i>         | ● <i>center of mass</i>   | ● <i>coefficient</i>       |
| ● <i>inertia</i>      | ● <i>potential energy</i> | ● <i>momentum</i>          |
| ● <i>motion</i>       | ● <i>kinetic energy</i>   | ● <i>collision</i>         |
| ● <i>speed</i>        | ● <i>work</i>             | ● <i>circular motion</i>   |
| ● <i>acceleration</i> | ● <i>conservation</i>     | ● <i>centripetal force</i> |