

Using Forces and Energy to Understand the Magnetic Cannon

ACTIVITY 8.1 – REVISITING AND SUMMARIZING THE SCIENTIFIC PRINCIPLES

What Will We Do?

We will revisit and summarize the Scientific Principles we have learned during the unit.

Procedure

Your teacher will list the scientific principles learned in the unit. List the phenomena that you investigated that provide evidence in support of some of these principles.

Principle 1: All forces come in pairs, in opposite directions.

1. List the supporting phenomena:

high fives, pushing the wall, a ladder leaning against a wall, a shoe on a shelf, sitting in a chair, the world's greatest sandwich, chin-ups, pairs of magnets, Earth and the moon, a rubbed balloon and small pieces of paper, CO₂ molecule

Principle 2: For every force an object applies, there is an equal and opposite force acting on the object.

2. Summarize these two principles as one.

Newton's third law of motion: For every force an object applies, there is an equal and opposite force acting on it.

3. When a hammer hits a nail, what force makes the nail dig into the wood?

The force the hammer applies to the nail every time it hits it makes the nail dig into the wood.

4. What makes the hammer stop when it hits the nail?

The force the nail applies to the hammer every time the hammer hits it makes the hammer stop.



5. What is the relation between these two forces?

According to Newton's third law of motion, they are equal in magnitude and opposite in direction.

Principle 3: Forces that are applied to an object in opposite directions counteract each other.

6. List the supporting phenomena:

pushing a tennis ball from opposite sides, a ball being held and then dropped, the Floating Magnets

Principle 4: Forces that are applied to an object in the same direction reinforce one another.

7. List the supporting phenomena:

pushing a ball down rather than just dropping it, lifting a heavy carton by yourself or with the help of another person

8. Summarize these two principles as one.

Multiple forces acting on an object along a straight line reinforce or counteract one another, depending on their direction.

9. Why does a parachutist not fall, as in free fall? Add arrows to the drawing if it helps clarify your answer.

The parachutist is subjected to two forces—weight [down] and the pull of the parachute [up]. These two forces act in opposite directions, so they counteract one another.



Principle 5: Forces that are applied to an object in opposite directions counteract each other.

10. List the supporting phenomena:

Just about any possible phenomenon used in the unit supports this principle.

Principle 6: An object will continue to remain at rest or move at a constant speed and in a straight line unless it is subjected to unbalanced forces.

11. List the supporting phenomena:

a bouncing basketball, a kicked soccer ball, an arrow being shot by a bow

Principle 7: Unbalanced forces acting on an object change its speed or direction of motion, or both.

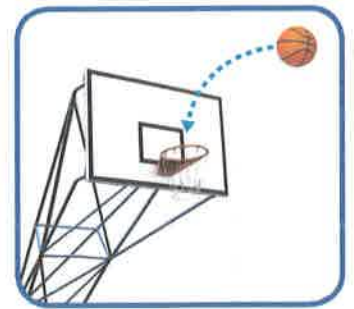
12. List the supporting phenomena:

a marble being shot with a rubber band, a tennis ball being dropped, the Air-Powered Car, the Flying Balloon, a book sliding across the table, the recoil in the Magnetic Cannon, a bouncing basketball, a kicked soccer ball, an arrow being shot, a ball being tapped from the side while rolling, a ball bearing being pulled or pushed by magnets while rolling, a marble rolling in a spiral

An object will change its speed of motion or direction or both if it is subjected to unbalanced forces, otherwise it will continue to remain at rest or move at a constant speed in a straight line.

13. When you throw a basketball at the basket, why does it move in an arc rather than in straight line?

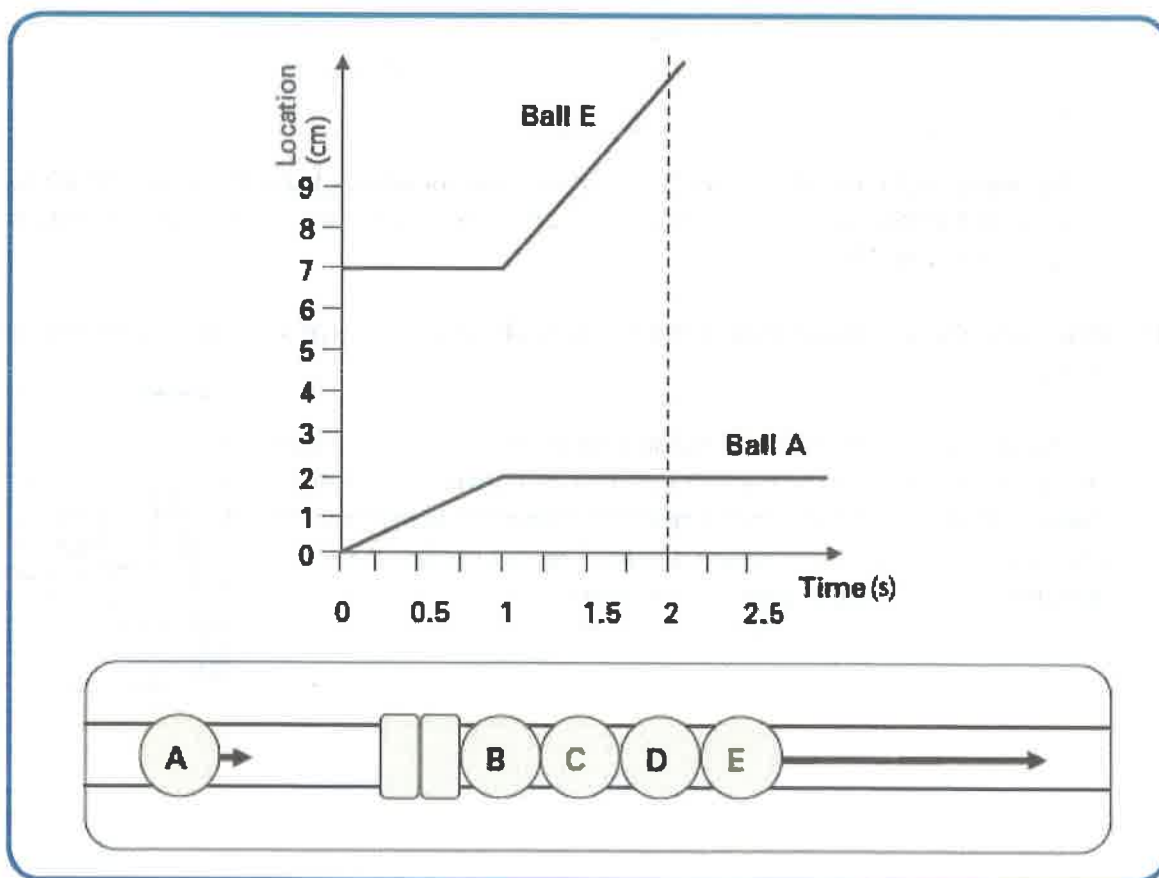
The force of gravity that acts on the basketball during its motion does not act in the direction of the ball's motion or against it. Instead, it always acts straight down, which is typically at an angle to the direction of the ball's motion. For this reason, this force makes the ball change its direction of motion, making the ball move in an arc.





Homework 8.1 – Motion Graph

The following graph is the motion graph of the Magnetic Cannon that was developed in Lesson 6. This graph is the starting point for the next activity in which you will use the principles summarized in today's lesson to give an explanation of how the Magnetic Cannon works.



Closely observe the graph and drawing and try to answer the questions that follow.

1. During the first second:

- Was each ball moving or motionless?

Ball A was moving to the right. Ball E was motionless.

- Which forces acted on each ball?

Ball A was subjected to magnetic attraction to the right. Ball E was subjected to magnetic attraction to the left and the contact force with Ball D to the right.

- Did these forces reinforce or counteract each other?

Ball A is subjected to only one force. The two forces applied to Ball E act in opposite directions, so they counteract each other.