

2.1 Throw the ball

Lesson outcomes

At the end of this activity students will be able to:

- apply the concepts of kinetic and gravitational potential energies to explain the throwing of a ball
- explain how the concept of conservation of mechanical energy accounts for the motion of the ball.

What ideas might your students already have?

- Students may not realise the motion slows on the way up and accelerates on the way down
- Students may believe the motion requires the continuous application of a force on the way up, but not on the way down.

Key vocabulary

Kinetic energy, gravitational potential energy.

Equipment list

The CLASS will need:

- a ball (e.g. tennis ball) for throwing, and a good place to view the throw.

Things to consider

If you have a balcony, you could demonstrate throwing the ball from the ground up to balcony height, then watching it fall, compared to simply dropping the ball from the balcony. Qualitatively, the fall should look the same. A catcher might judge it felt the same in both cases.

Some students could observe from the ground, while others observe from the balcony.

This is an opportunity to engage a student with good throwing and catching skills. A video of this is provided in Science by Doing Student Digital and could be observed in class.

Teacher content information

Kinetic energy (KE) is initially provided to the ball while it is still in contact with the throwing hand. Once the ball leaves the hand there is no input of energy. As the ball rises the KE is transformed to gravitational potential energy (GPE). This GPE is effectively stored in the height of the ball. (Strictly it is stored in the greater distance between the ball and the centre of the Earth.)

At the top of the flight the ball stops momentarily (a difficult concept) at which point it has zero KE and maximum GPE.

An important observation is that the flight up and the flight down are symmetrical; each is a reverse of the other. This relates to the conservation of mechanical energy in this system.

Lesson plan

Step 1: Take the class outside and ask the best thrower to launch a ball vertically as high as possible.

Ask the class to observe the specific sequence of events. They could use their mobile phones to video the activity.

Establish that the ball gets an initial push from the thrower, then gets slower as it rises, picking up speed again as it comes down.

Step 2: Direct Instruction - Describe how the thrower gave the ball an initial energy burst by giving it speed. Establish that this is called kinetic energy. The ball's entire energy during the flight was provided in this throwing phase.

As the ball rose it gained height. Establish that we call this gravitational potential energy.

As the ball falls, and loses height, it picks up kinetic energy again.

Together kinetic and gravitational potential energies are referred to as *mechanical energy*.

Provide students with suitable notes outlining these ideas for their **Notebook**. They will apply these ideas in the **Activity 2.2: Energy skate park**.