# *Egg bungee jump* **Teacher background notes**

**In this investigation, motion and energy transformations are investigated in the context of modelling a bungee jump by an egg. There is an emphasis on finding and analysing patterns in data in order to solve a real-world problem.**

## [Australian Curriculum: Science links](http://assist.asta.edu.au/resource/2985/egg-bungee-jump-cle)

## Learning intentions

Students will be able to:

* understand that one or more different forms (or types) of energy can be present at the same time
* explain that one form of energy can be transformed into other forms and vice versa
* identify that the total amount of energy remains constant (total energy is conserved)
* design a fair test investigation
* make accurate measurements
* construct appropriate representations that allow them to interpret and analyse the data
* identify patterns and relationships in data
* draw conclusions based on evidence.

## Suggested time for this CLE

The time needed to complete the *Egg bungee jump* CLE will depend on the depth of the prior knowledge of students and the time taken to:

* perform the 1–4 rubber bands investigation
* complete the Excel analysis
* determine the number of rubber bands for the test drop
* perform the test drop
* follow up with any further student worksheets designed by the teacher and
* follow up with any further extension activities.

Allow 2–4 hours.

## Prior conceptual knowledge

Science / Year 8 / Science Understanding / Physical Sciences

Content description

*Energy appears in different forms including movement (kinetic energy), heat and potential energy, and energy transformations and transfers causes change within systems* [*(ACSSU155)*](http://www.australiancurriculum.edu.au/Curriculum/ContentDescription/ACSSU155)

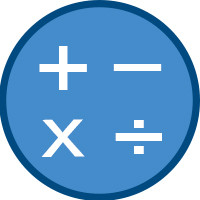
Science / Year 9 / Science Understanding / Physical Sciences

Content description

*Energy transfer through different mediums can be explained using wave and particle models* [*(ACSSU182)*](http://www.australiancurriculum.edu.au/Curriculum/ContentDescription/ACSSU182)

## New concepts to be introduced



*The following maths concepts are highlighted in the teaching and learning plan by this symbol *

Students will have met gravitational potential energy (GPE), kinetic energy (KE) and perhaps elastic potential energy (EPE) in year 8. GPE = mass × acceleration due to gravity (g) x height. When objects are stationary they have zero KE. For moving objects KE = ½ × mass × speed squared, so heavier and faster moving objects have more KE. Elastic potential energy (EPE) or spring potential energy is the energy possessed by a stretched or compressed object. Stretched or compressed springs, stretched rubber bands and compressed balls all possess EPE.

The concept of energy conservation during the motion of an object is most likely a new concept to year 10 students. A video of Wile E. Coyote trying to catch the Road Runner using a bungee cord is an excellent demonstration of the transformation of gravitational potential energy into other forms and one most students would enjoy watching and discussing: ‘Wile E. Coyote and Road Runner – Coyote Falls’, YouTube (3:00 min) <https://youtu.be/IleZWq45jDg>

When discussing forces at year 10 level, students need to know the concept of Newton’s second law whereby a net force results in an acceleration of an object (Fnet = m × a). Additionally, they should recall that acceleration causes a change in velocity. When Wile E. falls from the bridge, the only force acting on him is his weight (W = m × g). This is known as ‘free fall’. Since the net force is downwards, he accelerates at the same rate as acceleration due to gravity, g = 9.8 m/s2 is constant (on Earth). When the bungee cord begins to stretch, it exerts an upward force, which increases as Wile E. continues to fall, slowing him down. At the bottom, this upward force has increased so much that it has counteracted the downward weight force and decelerated Wile E, so that he stops momentarily. At the bottom of Wile E.’s fall, students could identify that there are two forces acting on him—the upward pull of the bungee cord and his downward acting weight force. These forces are momentarily balanced at the very bottom of the fall when he is stationary and his KE is zero. Since the upward force is greater than his weight, he is about to accelerate in an upward direction, beginning his upward rebound. Students may be able to identify when the forces are again balanced and the net force is zero. This analysis can be kept simple by only considering the top and bottom positions, or it can become as complicated as the teacher desires by including several intermediate points in the motion.

An analysis of this type of motion, although challenging, allows students to encounter a variety of situations encompassed within one experiment. When students have completed this analysis and understand the underlying science they will have gained a reasonably sophisticated knowledge of a topic that is quite abstract and difficult to apply.

## Possible misconceptions

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| **STUDENTS MAY THINK…** | **INSTEAD OF THINKING…** |
| A falling object ‘loses’ energy. | The energy lost in one form (e.g., GPE) is simply transformed into another form (e.g., KE) keeping the total amount of energy constant. Energy cannot be lost or created. |
| Mass and weight are the same thing. | Mass is the amount of matter contained in an object, measured in kilograms (kg) and weight is the force of gravity acting on an object, measured in newtons (N). |
| Acceleration and velocity are always in the same direction. | As Wile E. approaches the bottom of his bungee drop, his velocity is downwards, but he is slowing down so his acceleration is upwards (he is decelerating). If his acceleration were downwards, he would continue to speed up. If there were no acceleration, he would continue at a constant velocity. |