**ACTIVITY: Calculating potential and kinetic energy**

**Activity idea**

In this activity, students calculate the kinetic and potential energy of a specific object.

By the end of this activity, students should be able to:

* identify two forms of kinetic energy
* identify two forms of potential energy
* use formulae to calculate the kinetic and potential energy of an object.

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**Introduction/background**

Science classifies energy into two categories – kinetic (moving) and potential (stored) energy. Examples of kinetic energy include electrical energy, radiant energy, sound energy and motion energy. Examples of potential energy include gravitational energy, elastic energy, chemical energy and nuclear energy.

The student handout explains how potential and kinetic energy are calculated and provides examples for the students to work through.

**What you need**

* Access to the Science Ideas and Concepts article [What is energy?](https://www.sciencelearn.org.nz/resources/1572-what-is-energy)
* Copies of the student handout [Potential and kinetic energy](#handout).

**What to do**

1. Read through the article [What is energy?](https://www.sciencelearn.org.nz/resources/1572-what-is-energy)
2. Discuss the categories – kinetic and potential – and identify examples of each.
3. Work through the student handout [Potential and kinetic energy](#handout), discussing the concepts and vocabulary as appropriate.
4. Ask students to complete the questions and discuss (see [Potential and kinetic energy – answers](#answers)).
5. Once students are familiar with the two formulae, they may wish to compose their own questions for their peers to complete.

**Student handout: Potential and kinetic energy**

***How is energy measured?***

* In the International System of Units (the SI system), the unit of energy is the joule.
* The specific heat capacity (or just specific heat) of a material is defined as the amount of heat required to raise the temperature of 1 gram (g) of the material 1 degree Celsius (°C). It takes 4.18 joules to raise the temperature of 1 g of water 1°C (at a temperature of 25°C).
* One kilojoule (kJ) equals 1,000 joules (J) and is the amount of the heat required to raise the temperature of 239 g of water by 1°C. As an example, a piece of buttered toast contains about 315 kilojoules, which gives you enough energy to ride your bike for 10 minutes or run for 6 minutes.
* It requires 1 joule to lift a small apple 1 metre straight up, and the same amount of energy is released when the same apple falls to the ground.

The Law of Conservation of Energy states:

Although energy can change its type or location, the total amount of energy after the change is the same as the total amount before the change.

***Calculating kinetic energy***

You can determine the kinetic energy of an object if you measure its mass (in kilograms, kg) and speed (in metres per second, ms-1).

Knowing this, you can use these characteristics in the following formula:

The kinetic energy of an object equals half of its mass, times the square of its velocity.

**Ek = ½ m v2**

1. If a student whose mass is 50 kg was travelling at 5 ms-1, what would his kinetic energy be?

***Calculating potential energy***

You can also determine an object’s gravitational potential energy on Earth if you know its mass (in kilograms, kg), its height (in metres, m) and the acceleration towards the Earth due to gravity (9.8 ms-2 or approximately 10 ms-2).

You can now use this formula:

The gravitational potential energy of an object equals the product of its mass, its height and the acceleration due to gravity.

**Ep = mgh**

1. If a student whose mass is 50 kg was at the top of a 50 m high cliff, what would her potential energy be?

**Potential and kinetic energy – answers**

1. If a student whose mass is 50 kg was travelling at 5 ms-1, what would his kinetic energy be?

|  |  |  |
| --- | --- | --- |
| m | = | 50 kg |
| v | = | 5 ms-1 |
| Ek | =  =  =  = | ½ m v2  ½ x 50 x (52)  25 x 25  625 J |

The student possesses 625 J of kinetic energy.

1. If a student whose mass is 50 kg was at the top of a 50 m high cliff, what would her potential energy be?

|  |  |  |
| --- | --- | --- |
| m | = | 50 kg |
| h | = | 50 m |
| g | = | 10 ms-2 |
| Ep | =  =  = | mgh  50 x 10 x 50  25,000 J |

The student would possess 25,000 J or 25 kJ of potential energy.