# *The Penguin Project* **Teacher background notes**

**In this investigation, heat transfer and heat insulators are investigated in the context of emperor penguins who huddle together to reduce heat lost from their bodies to the surrounding cold air.**

## [Australian Curriculum: Science links](http://assist.asta.edu.au/resource/2984/penguin-project-cle)

## Learning intentions

Students will be able to:

* observe and explain that heat can transfer from one object to another
* understand that scientists search for patterns in data and use these observations to explain everyday phenomena
* make accurate observations
* record and represent observations
* identify patterns from observations.

## Suggested time for this CLE

The time needed to complete *The Penguin Project* CLE will depend on the depth of the prior knowledge of students, the time to perform the two investigations – ‘The penguin huddle’ and the insulator test ‘What should a penguin “wear” to keep warm? – and follow up with any further extension activities. Allow 2–4 hours.

## Prior conceptual knowledge

Science / Year 1 / Science Understanding / Biological Sciences

Content description

*Living things have a variety of external features* [*(ACSSU017)*](http://www.australiancurriculum.edu.au/curriculum/contentdescription/ACSSU017)

## New concepts to be introduced

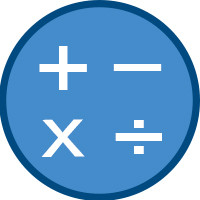
The concepts of energy and heat are challenging for primary students. Because young students are not ready to delve into the kinetic theory of matter and molecular motion, much of the explanation of heat and energy transfer is inaccessible to them. In addition, the use of the word ‘energy’ in popular culture may interfere with the development of scientific understanding. Nevertheless, primary students are capable of exploring heat through observations and qualitative developmentally appropriate explanations. **For age-appropriate definitions of heat and heat transfer see the table below.** In fact, the idea that heat is transferred from one object to another via conduction is a well-known concept by most people and develops from a young age, especially in places with cold winters. During these initial explorations, teachers will encounter various student misconceptions. Purposeful teaching will help prepare students to tackle more advanced concepts as they come across them in the upper primary grades and beyond.

## Possible misconceptions

Students may hold a variety of misconceptions about heat, temperature, and energy. A common misconception is that some objects such as blankets produce their own heat. Students may believe this because they have experienced feeling warmer after covering themselves with a blanket or putting on a jumper. Another misconception relates to the words ‘hot’ and ‘cold’. Students often believe that heat and cold are different and that they are substances rather than energy. Students may also believe that ‘cold’ is transferred from one object to another – their experience with air conditioners and refrigerators seems to confirm this misconception.

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| **STUDENTS MAY THINK…** | **INSTEAD OF THINKING…** |
| Heat is a substance. Heat is not energy. | Heat is a form of energy. |
| Temperature is a property of a particular material or object. For example, students may believe that metal is naturally colder than plastic. | Temperature is not a property of materials or objects. Objects exposed to the same ambient conditions will have the same temperature. For example, cold water is usually at room temperature rather than colder than that. |
| The temperature of an object depends on its size. | Temperature does not depend on size. |
| Heat and cold are different. | Cold is the absence of heat. Heat and cold can be thought of as opposite ends of a continuous scale. |
| Cold is transferred from one object to another. | Heat is transferred from one object to another. Heat moves from a warmer object to a colder object. |
| Objects that keep things warm (jumpers, gloves, blankets) are sources of heat. | Objects that act as insulators keep things warm by trapping heat. |
| Some substances (flour, sugar, air) cannot heat up. | All substances heat up, although some gain heat more easily than others. |
| Objects that readily become warm (conductors of heat) do not readily become cold. | Conductors gain and lose heat easily. |

## Exploring the mathematics

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

Spatial awareness is a key skill that children need to develop in order to identify positional placing of objects. Being able to describe where objects are placed and what affect this may have on outcomes, is important. This information is to be communicated to others, so having a common understanding of the language is important, for example, the A can is **directly behind** the G can, the B can is **to the right of** the G can, etc.

Being aware of symmetry will allow the students to place the cans in an appropriate way around the central can. This will also give them some language in which they can use to communicate their ideas.

As children develop their understanding of measurement, the importance of reading scaled instruments is developed. Students need to be familiar with the iteration of scale, what the scale is measuring and what units are being used, in this case a thermometer.

*(Please be aware that the science and maths curriculum are inconsistent in year 3. The science curriculum requires the students to use formal measurements while the maths curriculum only requires the use of informal measurements.)*

Skip counting is a useful skill when reading scaled instruments since it is unlikely that every increment of degrees (cm, L, g, etc) will be marked. While reading the scale on the thermometer, students will need to analyse what the increment of the markings are and what the numbers represent. Students will also need an understanding of how to handle a thermometer so that the measurement is not influenced by the way the instrument is handled.

The students will need to be familiar with the operation of a stopwatch—what each button does and what the numbers represent. Some sense of the length of five minutes is important. What benchmarks from their own life can they relate to? For example, it takes 5 minutes to do the dishes and it takes 10 minutes to get ready for bed. Using a clock instead of a stopwatch would help develop the skills of reading the time on both a digital and analogue clock.

Students need to have an understanding of using a table to record data. Where does the data go? They should realise the importance of giving a title to the columns to make sure they have put the information in the correct place. They also need to understand the kinds of pictorial displays or graphs that can be used to represent the data from the table, what kind of display will show the data the best. These different displays represent data in different ways for different purposes.

Students need to be familiar with different data displays to enable them to be able to read information from a table or from a graph or some other data display.

* What does each column in a table represent and where would I find the heading to tell me?
* What do each of the axes in a graph represent?
* In a picture graph, what do each of the symbols mean? Is there a key that gives me this information?
* What is the scale of each axis?
* What does the title of the graph tell me about the information?
* Using this information, what patterns can I see in the data?
* Do things stand out as not fitting in?

With knowledge of this information, the student can use a graph to making an informed judgement based on data collected and presented.

Throughout the CLE basic number skills are needed for students to perform addition and subtraction to find differences in scales of measurement.

## Links to further information

Fries-Gaither, Jessica 2009, ‘Lessons and activities about heat and insulation’, Beyond Penguins and Polar Bears, The Ohio State University website [http://beyondpenguins.ehe.osu.edu/issue/keeping-warm/lessons-and-activities-about-heat-and-insulation](http://beyondpenguins.ehe.osu.edu/issue/keeping-warm/lessons-and-activities-about-heat-and-insulation" \t "_blank)