**ACTIVITY: Making model alloys**

**Activity idea**

In this activity, students use plasticine and sand to explore how adding other elements can alter the ductility of a metal.

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

* define what an alloy is
* relate the physical properties of a metal to its internal structure
* appreciate the use of models in helping to explain scientific phenomena
* describe some of the physical properties that are characteristic of metals.

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**Introduction/background**

An alloy is a mixture of a metal with one or more other elements. The physical properties of this mixture are still metallic but are modified as a result of the presence of the other elements.

Alloying can be used to change the properties of a metal. For example, if a small amount of tin is added to lead, the alloy formed has a lower melting point than lead but an improved hardness.

Ductility is that physical property of a material that allows it to be drawn out into a thin wire. Most metals have high ductility. For example, when subjected to sufficient pulling force, a cylinder of copper metal can be pulled out into a long thin wire.

When a metal is alloyed, the added material interferes with the neat packing at the atomic level of the original, pure metal. This prevents the layers from sliding over each other and reduces the malleability and ductility.

In this experiment, the presence of sand in the plasticine interferes with the regular internal structure of the plasticine. This has the effect of altering some of the physical properties of the plasticine such as ductility.

**What you need**

* Copies of the student instructions: [Investigating alloys](#Investigating)
* Different coloured plasticine
* Fine-grained sand
* Magnifying lens
* Top pan balance
* Suitable container to weigh the sand in

**What to do**

1. Hand out copies of the student instructions [Investigating alloys](#Investigating) and discuss.
2. Assist small groups of students to gather the equipment and materials they need and conduct the experiment.
3. Discuss results.

**Extension ideas**

Watch the video clip [Microstructure and mechanical properties](https://www.sciencelearn.org.nz/videos/1072-microstructure-and-mechanical-properties) in which Dr Brian Gabbitas explains how the microstructure of a metal can affect its mechanical properties. Alloying titanium with aluminium and vanadium alters the crystalline microstructure, which results in a change in mechanical properties.

Read the article [Titanium – metal of the future](https://www.sciencelearn.org.nz/resources/1803-titanium-metal-of-the-future) to find out more about titanium.

**Investigating alloys**

1. Using different coloured plasticine, weigh out four 35 g portions.
2. Using fine-grained sand, weigh out 2 g, 4 g and 6 g portions.
3. Work one of the plasticine portions into a cylinder shape about 6 cm long and 1.5 cm in diameter.
4. Holding the ends of the cylinder, firmly pull with a small steady force until the cylinder breaks.
5. Examine the fracture surface of the plasticine with a magnifying glass.
6. To a second portion of plasticine (different colour), mix in the 2 g sand sample. Make sure the sand is evenly distributed and fashion the lump into a cylinder as before.
7. Hold the ends of the cylinder firmly and pull with a steady force until it breaks.
8. Examine the fracture surface of the plasticine with a magnifying glass and compare with the plasticine only sample.
9. Repeat with the remaining lumps so that plasticine with 4 g of sand and plasticine with 6 g of sand can be tested in the same way.
10. Record all of your observations/examinations in the results table.

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| **Trial** | **Plasticine mixture** | **Observations on pulling** | **Fracture surface appearance/comparison** |
| **1** | Plasticine only |  |  |
| **2** | 2 g of sand added |  |  |
| **3** | 4 g of sand added |  |  |
| **4** | 6 g of sand added |  |  |