**ACTIVITY: Exploring states of matter**

**Activity idea**

In this activity, students develop a concept map to summarise current ideas about states of matter.

Most students are familiar with three states of matter – solid, liquid and gas. This activity introduces them to two new states – plasma and Bose-Einstein condensates.

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

* identify key ideas about states of matter from a written article
* display the ideas in a concept map
* identify and discuss similarities and differences between concept maps
* recognise that concept maps are a useful method to communicate scientific knowledge.
* appreciate that science knowledge about states of matter has changed over time.

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**Introduction/background**

Teachers traditionally teach students that there are three states of matter, but scientists have known for some time that matter exists in more than three states. This activity is useful for teachers to develop their current understandings on the states of matter as well as to show how science ideas change and develop over time. Through this activity, students are also learning about the development of concept maps as a representation to communicate scientific knowledge.

A sample concept map is shown below, but try doing one yourself on states of matter.

***About concept maps***

Concept maps are a way of representing things, ideas or words and the relationships between them. They are a tool to organise and represent knowledge. The concepts/ideas/words are represented in boxes/circles and connected with labelled rows that explain the links/cross links.

As students construct concept maps, they make sense of the ideas and the relationships between them. The concept maps also create a shared vision and understanding within a group and can provide an initial conceptual frame that may later be modified as further learning occurs. They are useful for promoting meaningful learning and provide a record of students’ conceptual understanding.

White, R. and Gunstone, R. (1992). *Probing understanding*. London: Falmer Press (ISBN 0750700475) is useful to read (Chapter 2 on concept mapping), and if students have not done concept mapping previously, there are suggestions for modelling them to students, using simple science examples.

***About the activity***

Students work in pairs or small groups to develop their concept maps using A3 sheets, sticky notes and coloured felt-tipped pens.

Key words may be given to assist them to develop their concept maps. Encourage them to write words or short phrases above the arrows as these are important to develop meaningful learning.

Presentation of the concept maps and seeing how other groups developed them is also an important part of the activity.

**What you need**

* Access to [States of matter](http://www.sciencelearn.org.nz/Science-Stories/Strange-Liquids/States-of-matter) (printed copies or online)
* A3 sheets of paper or newsprint
* Sticky notes
* Coloured felt-tipped pens

**What to do**

1. Have students work in pairs to read [States of matter](http://www.sciencelearn.org.nz/Science-Stories/Strange-Liquids/States-of-matter) and write key words from the article on small sticky notes.
2. Ask students to:
* arrange the sticky notes on an A3 sheet of paper in a way that makes sense
* draw lines between the words/ideas that seem to be similar – some arrows can cross over each other and/or be different colours
* put an arrowhead on the line showing how you can read the relationship
* write above each line a word or phrase that explains the relationship.
1. Have students share their concept map with another pair.

**Discussion questions**

* In what ways are the concept maps similar?
* In what ways are the concept maps different?

**Sample concept map**

