**ACTIVITY: Superconductivity – Bob Buckley interview**

**Activity idea**

In this activity, students listen to a podcast of IRL superconductivity scientist Bob Buckley talking about this work and then answer a series of graded questions related to the content.

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

* define the term superconductivity
* give at least 5 applications for superconductive wires/cables
* list 2 advantages and 2 disadvantages superconductive wires have over conventional copper wire
* briefly explain how superconductive cables are fabricated
* describe why the term ‘high temperature’ is used in a relative way.

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**Introduction/background**

Superconductors are materials that lose all resistance to electric current when cooled to a certain temperature. This temperature, known as the critical temperature, depends on the structure and composition of the material. The advantage is that larger electric currents can be carried through thinner wire, with minimal energy losses.

One of the focus stories that featured in *Our changing world* (Thursday 16 July 2009) is an interview with Bob Buckley, a high-temperature superconductivity scientist based at Industrial Research Limited (IRL) in Wellington.

Bob talks about superconductivity and the work his unit at IRL in Wellington is currently involved with.

The activity requires students to listen to the podcast and then answer a series of graded questions related to the content.

**What you need**

* Access to the podcast: [www.radionz.co.nz/national/programmes/ourchangingworld/20090716](http://www.radionz.co.nz/national/programmes/ourchangingworld/20090716)
* Copies of the student worksheet

**What to do**

1. Access the podcast and click on ‘High temperature superconductors’.
2. Have students listen carefully to the podcast (21’ 30’’) and then answer the sets of graded questions on the student worksheet.
3. Discuss the students’ responses.

**Student worksheet – Questions about superconductivity and Bob Buckley**

***A. Facts and figures***

1. Who is Bob Buckley?
2. What is superconductive material?
3. When did research work on superconductivity at IRL commence?
4. Where would superconductor wire be used?
5. What temperatures are needed for high temperature superconductors to work?
6. How is high temperature superconductive tape made?
7. List at least 5 applications for superconducting cable.

1. What is happening under the streets of the American city New York?
2. Describe how a superconducting levitating train operates.

***B. Analysis***

1. Superconducting wire costs about 10 times more to make and install than conventional copper wire, so why would a manufacturer of electrical equipment, like generators, consider a switch from using copper wire to using superconducting wire in the electromagnet windings of the generator?
2. What do you think the difficulties could be in converting electrical transmission line cables from conventional cable to superconducting cable?
3. One of the properties that superconductors show is known as the Meissner effect. This is where an ordinary magnet can be levitated above a superconductor cooled with liquid nitrogen. Apart from levitated transport such as high-speed trains, what other applications of this property of superconductors can you foresee?

***C. Find out more***

1. What is meant by the term ‘critical temperature’?
2. How is the electrical resistance of a length of conventional copper wire measured?
3. How does dc electricity differ from ac electricity? Do superconductors operate only on dc?
4. A 15 stranded 12mm wide superconducting cable can take electric currents up to 1000A. An equivalent copper cable would need to be 2–3cm in diameter. What is electric current and how is it measured?
5. Cryogenics is the study of what?
6. In the production of the superconducting tape, a specially designed ceramic material known as BSCCO 2223 is loaded onto a 40mm wide nickel alloy tape. What chemical elements are present in this ceramic? What is an alloy?