teachers guide

Geothermal energy 6: Using geothermal energy

Components

	NAME	DESCRIPTION	AUDIENCE
	*Using geothermal energy* teachers guide	The teacher guide explains how to use an interactive learning object and accompanying worksheet to explain latent heat.	teachers
	*Using geothermal energy* learning object	This learning object explains how the concept of latent heat is applied in three devices.	students
	*Three devices* worksheet	This three-part worksheet accompanies the learning object and includes calculations about latent heat.	students

Purpose

To consolidate students' understanding of latent heat, using geothermal energy, within the contexts of refrigeration, desalination and chilling water for air conditioning.

Outcomes

Students:

- identify situations where latent heat is a factor when heating and cooling liquids;
- describe, using kinetic theory, the process of change of state from liquid to vapour;
- understand that heat energy is absorbed and produced when solids and liquids change state, but there is no temperature change during the process;
- explain that geothermal energy from underground water can be used to provide fresh water, through a desalination process;
- explain that geothermal water from underground can be used to provide chilled water that can be used to air condition buildings; and
- perform calculations involving the formula for latent heat, Q = m L.

Activity summary

ACTIVITY	POSSIBLE STRATEGY
Students use the learning object in conjunction with the worksheet.	individually or small groups
The class discusses issues raised by the activity.	teacher-led, whole class

Technical requirements

The learning object requires Adobe Flash Player version 8 or later (this is a free download from www.adobe.com). It can be placed on a web or file-server and run either locally or remotely in a web browser.

The guide and worksheet require Adobe Reader (version 5 or later), which is a free download from adobe.com. The worksheet is also provided in Microsoft Word format.

Teacher notes

Desalinator

Desalination plants currently operating in Western Australia use reverse osmosis technology. The proposed geothermal desalination plant described here uses underground water at a temperature of 70–80 °C to heat seawater which is circulated in a low pressure environment.

Refrigerator

A refrigerator is used to cool food, but when compressed the refrigerant becomes hot. Two factors contribute to this:

- work done on the refrigerant (just as a hand pump becomes hot when pumping air into bicycle tires); and
- conversion of refrigerant from gas to liquid, which releases latent heat.

This heat has to be removed to enable the gas to condense into a liquid easily.

Chiller

The chiller depends upon the presence of lithium bromide (or similar substance) that has a large affinity for water. By absorbing large quantities of water, lithium bromide produces a low pressure environment where water boils at a reduced temperature. The boiling process still requires large quantities of energy, in the form of latent heat, to change phase from liquid to gas. The chiller operates using relatively low temperature geothermal water (45 °C) from the Perth Basin.

A demonstration or activity may use silica gel to show water being driven off and re-absorbed onto the gel as a model for what happens to lithium bromide solution in the chiller.

Associated SPICE resources

Geothermal energy 6: Using geothermal energy may be used in conjunction with related SPICE resources to investigate specific heat and latent heat.

DESCRIPTION	LEARNING PURPOSE
Geothermal energy (overview) This learning pathway shows how a number of SPICE resources can be combined to assist with teaching the topics of specific heat and latent heat.	
Geothermal energy 1: Heat beneath your feet A video engages student interest in recent developments and future possibilities for the use of geothermal energy.	Engage
Geothermal energy 2: Specific heat capacity Students investigate the specific heat capacity of water in laboratory and problem-solving activities.	Explore
Geothermal energy 3: Heating a pool Students' understanding of specific heat is developed through data analysis in the context of heating swimming pools using geothermal energy.	Explain
Geothermal energy 4: Sustainable energy sources Students reinforce and deepen their understanding of specific heat and geothermal energy through problem-solving activities.	Elaborate
Geothermal energy 5: Latent heat Students investigate latent heat through practical and problem-solving activities.	Explore
Geothermal energy 6: Using geothermal energy Students use an interactive learning object to develop an understanding of how latent heat is used in a number of devices.	Explain
Geothermal energy 7: The geothermal alternative Students use concepts developed throughout this sequence to analyse two case studies that involve use of geothermal energy.	Elaborate

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SPICE resources and copyright

All SPICE resources are available from the Centre for Learning Technology at The University of Western Australia ("UWA"). Selected SPICE resources are available through the websites of Australian State and Territory Education Authorities.

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