Swimming pool explorer

This worksheet is to be used in conjunction with the interactive learning object, *Swimming pool explorer*. In some cases answers can be typed directly into the learning object. In other cases answers are to be written into this worksheet.

Locate and open the learning object *Swimming pool explorer*. Select **Start** to display the screen titled *Introduction*.

1. Operators of outdoor pools like to keep the temperature between 26 °C and 28 °C. Why is this range of temperatures considered ideal?

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- Select **Next** to display the screen titled *Geothermal heating*, then select **Play** and observe the animation.

2. Why is the reinjection bore drilled to a shallower depth than the extraction bore?

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- Select **Next** to display the screen titled *Plan of attack*.
- Select **Next** to display the screen titled *Heat loss from the pool*.

3. How much heat has to be added to the pool to maintain it at a constant temperature?

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4. Suggest ways in which heat is being lost from the pool.

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5. The figures in the table indicate that heat loss from the pool is at its greatest in October. Suggest reasons why this might be the case, rather than other times of the year.

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- Select **Next** to display the screen titled *Keeping a balance*.

  In the table below record correct values for flow rates in the pool circuit.

TEMPERATURE (°C)	MASS (kg)	REQUIRED FLOW RATE (kg s^{-1})
40		
43		
46		
49		

6. By referring to the previous slide, *Heat loss from the pool*, write down the maximum rate of heat loss shown in the swimming pool model.

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7. What pump rate is required to deal with the maximum rate of heat loss for:

   a) the highest ground water temperature available from the above table?

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   b) the lowest ground water temperature available from the above table?

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- Select **Next** to display the screen titled *Heat exchanger*.

8. Follow the instructions on screen and enter values in the table below.

   Note: energy transformed in this case study is calculated in kJ s^{-1}. 1 kJ s^{-1} is equivalent to 1 kW.

BORE DEPTH (m)	ENERGY SUPPLIED FROM GROUND WATER (kW)	ENERGY TRANSFERRED TO POOL WATER (kW)

9. Use the efficiency formula to calculate efficiency of energy transfer for any bore depth that you have selected.

   Efficiency = energy output/energy input x 100 %

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10. List factors that contribute to energy transfer through the heat exchanger being less than 100% efficient.

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11. Why is it necessary to consider flow rate values for the maximum rate of heat loss, rather than average heat loss?

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12. Explain why calculated values for the required flow rate for the pool circuit in *Keeping a balance* screen are different to those in the energy transferred column of the data table for the *Heat exchanger* screen.

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- Select **Next** to display the screen titled *Choosing bore depth*.

13. Calculate values for the groundwater circuit pump cost in the second table. Transfer values to the table below.

	GROUNDWATER CIRCUIT	
BORE DEPTH (m)	PUMP POWER (kW h)	PUMPING COST ($)
750	190 926	
850	128 526	
950	81 636	
1050	62 758	

14. Why is the cost of pumping pool water not considered in cost comparisons for the three systems (geothermal, electricity and gas)?

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- Select **Next** to display the screen titled *Ten year costs*.

15. Calculate values for empty columns in the table. Suggest which bore depth geothermal system is the most economical, over a 10 year period.

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- Select **Next** to display the screen titled *Comparison*.

16. It is obvious from figures in the table that a geothermal heating system to heat the swimming pool is the cheapest to run over 10 years. However there are other advantages that geothermal energy has over heating by gas or electricity. Suggest what these other advantages may be.

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