

***Title: Cooling cups***

<b>Topics:</b> Energy transfer, graphical representation, power and discussion of results.	<b>Time:</b> 120 minutes	<b>Age:</b> 13-14
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**Differentiation:**

More able students should be able to calculate the energy lost per second during the experiment and hence power.

Differentiated work sheets allow pupils to focus on skills and subject knowledge as appropriate.

**Guidelines, ICT support etc.:**

There is no specialist requirement for equipment or IT facilities to carry out this activity,

The main feedback from teachers who have carried this activity out is that plenty of space is needed for groups to work in undisturbed. It is possible for students to fill in the document using word then print off to hand draw graphs.

**Equipment needed for this activity:**

4 cups per group

Thermometer per group

Timer/stopwatch

Graph paper

Materials to construct insulation

Graph paper

Calculator

Paper to record results

**Required knowledge:**

Basic operations with numbers

**Health and Safety:**

Health and Safety:

During this experiment hot water will be used, care needs to be taken.

**Learning outcomes for this activity:**

Students should be able to design an experiment which is a fair test, allowing different member of the group to contribute ideas.

Students should unaided be able to construct tables and produce graphs accurately.

Students will unaided be able to calculate the amounts of energy lost using the concept of specific heat capacity.

## **Lesson description**

### *Starter Activity (20 minutes)*

Pupils should have met the concepts of conduction, convection and radiation before. A brief recap of this would be an advantage.

A disposable coffee cup can be used to demonstrate the concepts;

It has a raised bottom causing minimum contact with the surface hence reducing conduction.

Its inner coating is white reducing the effects of radiation.

Its lid reduces the effects of convection.

Having the cup filled with hot water and a digital display showing the reducing temperature during this initial introduction might be particularly helpful in stimulating discussion.

### *Main Activity (80 minutes)*

Pupils working in mixed ability groups will be asked to design an experiment and prepare materials which can be used in the second half of this activity.

They will be asked the question;

When a cup cools down, does it lose most energy through conduction, convection and radiation?

Pupils must

Construct a base to stop conduction and measure the effects.

Construct a jacket to stop radiation and measure the effects.

Construct a lid to reduce the effects of convection and measure the effects.

Pupils must also construct a suitable table for recording their results and decide upon the type of graph they will use to illustrate them.

A worksheet is supplied to assist lower ability pupils, this might be altered in anyway which is helpful to the rest of the class.

An extension work sheet is supplied which it is hoped might be used by more able pupils, this asks pupils to convert temperature drop to actual energy loss.

***Plenary Activity (20 minutes)***

Pupils are asked to demonstrate their results, identifying any odd results and suggesting improvements which can be made to their procedure.

Results are compared between groups and pupils are asked to explain any differences in results. This evaluation of work and results can be used to highlight the scientific approach.

Finally can any group identify the major source of heat loss from a cooling cup, can they justify their answer.

# Cooling cups work sheet 1

What are you investigating? (In your own words explain why you are doing this investigation)

Plan

Make a list of the equipment you will use. Add to the list if required.

	Equipment list
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Plan (explain what it is you are going to do in this investigation)

1	
2	
3	
4	
5	
6	
7	

8	
9	
10	

Take some photographs of each of your investigations.

Naked Cup

Lid (convection)

Jacket (Radiation)

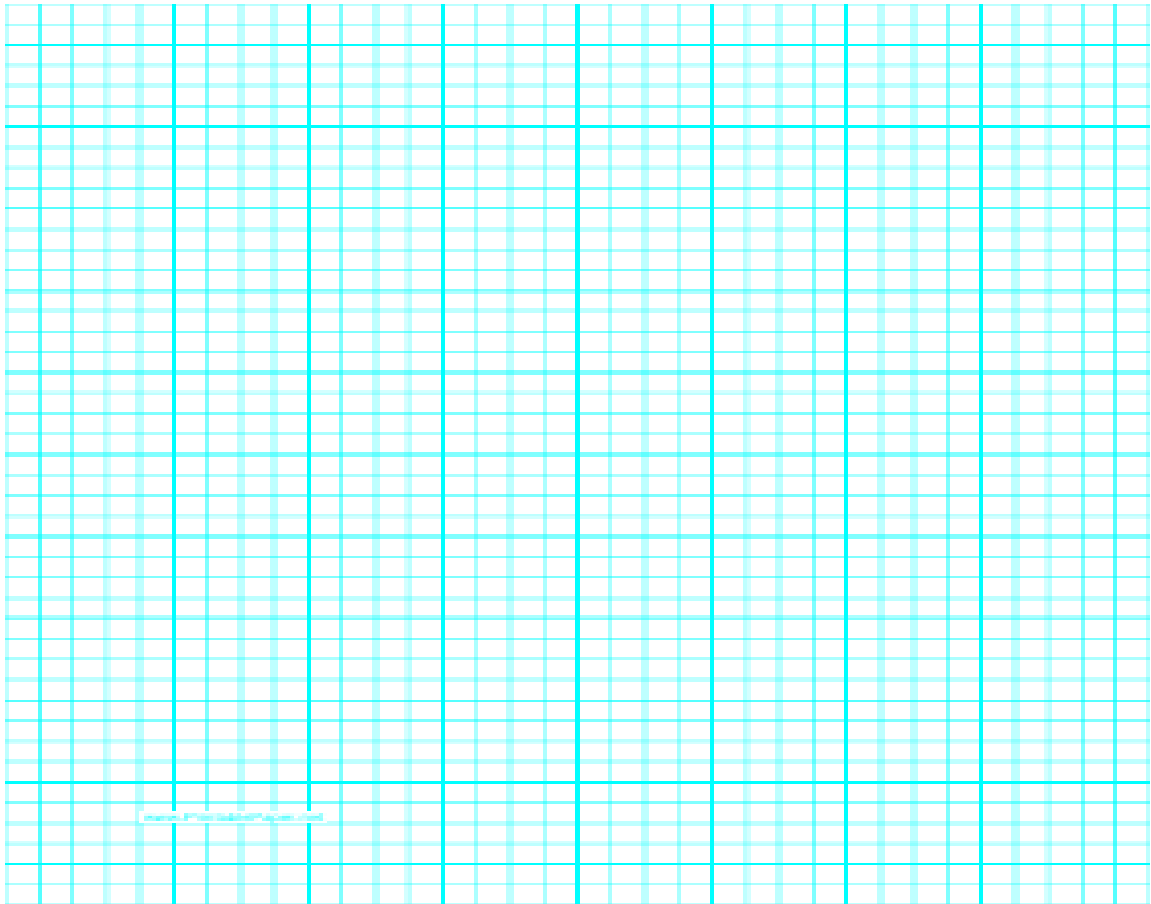
Base (conduction)

Results

	Start temperature	End Temperature	Difference
Naked Cup			
Lid			
Jacket			

Base			
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Graph (describe your results graphically)



Conclusion (Explain what you have found out, refer to your results)

Evaluation (Explain what you would change in your experiment to make it better)

## Cooling cups - Worksheet 2

Explain what it is you are investigating.

List your equipment here (Please add more rows if needed)

1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Describe the plan (Using bullet points explain how you will carry out your

investigation)

**How are you going to ensure everyone's safety during this experiment?**

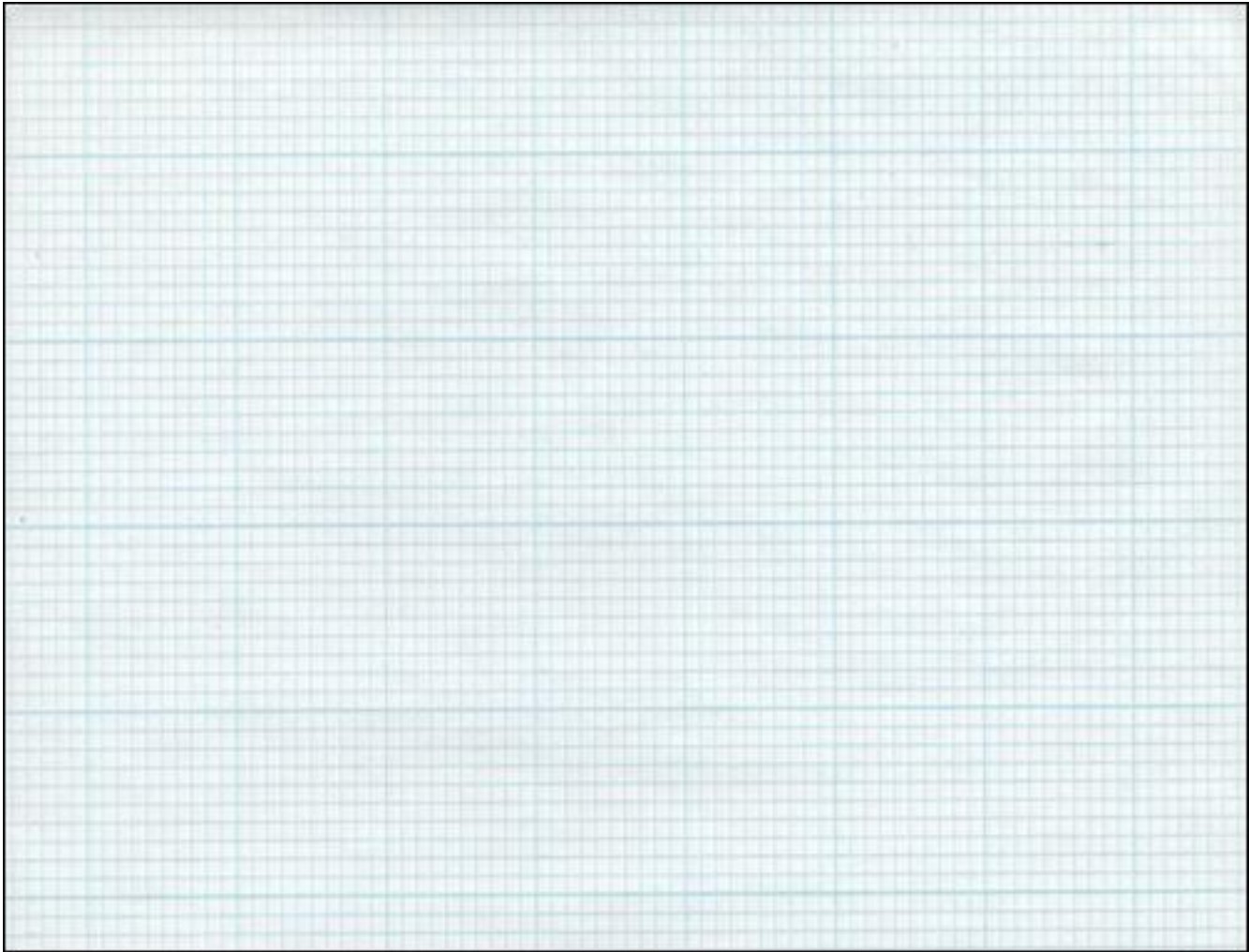
**Results**

Table of results

50 ml of water	Naked Cup	Reduced Conduction	Reduced Radiation	Reduced Convection
Start Temperature				
Finish Temperature				
Change in Temperature				
Loss in energy				
Least energy lost				

Graph





Conclusion (Using the information from your table and graph explain what you have found out using this investigation)

Evaluation (Can you make some simple suggestions which would improve this experiment; you need to explain how your suggestion would improve the results?)

Evaluation