# 11 Physics Step Up Effect of colour of a material on the temperature of a roof

## Task outline

In this task you will investigate the effect of black, white and silver on the temperature of a roof. You will identify the variables and hypothesis, collect and analyse the data and summarise your results in a report.

### Foundational key knowledge

* describe electromagnetic radiation emitted from the Sun as mainly ultraviolet, visible and infrared
* compare the wavelength and frequencies of different regions of the electromagnetic spectrum, including radio, microwave, infrared, visible, ultraviolet, x-ray and gamma, and compare the different uses each has in society
* apply concepts of energy transfer, energy transformation, temperature change and change of state to climate change and global warming.

### Introduction

The Sun emits a broad spectrum of electromagnetic radiation. While high energy gamma and X-rays, are blocked by the atmosphere, the sunlight that reaches Earth is composed of; some of the infrared (IR) range (40%), all the visible light (50%), some of the ultraviolet (UV) range (5%, of which 95% is UVA) and low energy radio waves.

All of the energy from the Sun that reaches the Earth is part of a large collection of energy called the electromagnetic radiation spectrum.

Watch: [Introduction to Electromagnetic waves](https://www.youtube.com/watch?v=cfXzwh3KadE) (5.19 min)

In this investigation you will focus on the effect of visible radiation on the temperature of a roof. You will investigate how colour influences the amount of absorbance of visible radiation and in particular, how the house roof colour influences the indoor temperatures.

This is a formative task which is based on the first SAC you will complete in Unit 1. The assessment rubric for this task has been included below for your reference.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** |
| **Conducts experiment** | reads procedure and allocates tasks to team members | follows steps in procedure | records data in table | explains how to complete calculations  |
| **Reports data** | includes relevant data | summarises data | evaluates the quality of the data |  |
| **Analyses data** | identifies a key finding related to one aim | devises key finding related to the overall aim |  |  |
| **Explains key findings** | explains key finding using a science theory | applies understanding of science theories to explain key finding | makes links between own data and other science studies |  |
| **Evaluates method** | lists equipment or steps which contribute to errors | categorises random and systematic errors | explains why errors occurred | evaluates how errors affect quality of data |
| **Modifies method** | identifies steps or equipment which can be modified | explains how modifications improve design | predicts the effect of modifications on the quality of data |  |
| **Bibliography** | includes references | follows required style |  |  |

### Research Question

What is the effect of colour (black, white and silver) of a material on the temperature of a roof?

### Aim

**Aim Checklist**

|  |  |
| --- | --- |
| States what will be done and measured  |   |
|  Uses a verb to begin sentence |   |

The aim states the purpose of the experiment. In the aim, you need to explain what will be done, and how it will be measured. The sentence should also start with a verb, such as “to investigate, to measure, to verify, to determine, to compare or to calculate.”

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### Variables

Identify the independent, dependent and controlled variables. Use the table below as a guide.

You need to include one continuous independent variable.

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| --- | --- | --- |
| **Independent Variable**(what will you be changing?) | **Dependent variable**(what change will you be measuring? Include units) | **Controlled variables**(What will you keep constant? – You will need at least 5 controlled variables) |
|  |  |   |

### Hypothesis

A hypothesis is a prediction about the relationship that you expect to occur between your IV and DV. It must be written using the following sentence structure.   If independent variable *increases/decreases* then dependent variable *increases/decreases* because….insert theory to justify your hypothesis

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### Hypothesis Checklist

|  |  |
| --- | --- |
|    | Show the link between independent and dependent variables  |
|    | Includes theory to justify your hypothesis  |

### Materials

* temperature sensor probe placed inside straw
* Sparkvue app (Search in Google Sparkvue download).
* black paper
* white paper
* alfoil (wrap around white card)
* stopwatch

### Method

1. Connect the temperature sensor to your laptop using Sparkvue.

2. Set up the experiment outside in a sunny position.

3. Place the temperature probe inside the plastic straw. This will insulate the temperature probe from the ground.

4. Place the temperature probe under the black paper and press start. Record the change in temperature for two minutes.

5. Repeat steps 1 - 3 for two more replicates.

6. Repeat the experiment for the white and silver.

### Results

Design a table to record your results.

### Graph

Use excel to graph your results.

## Discussion and Conclusion

Only use dot points to summarise your results, identify your key findings, identify your errors and write a conclusion.

## Reporting Data

### Summarise the data (1-2 sentences)

Compare the important results and include numbers, e.g. the highest and lowest averages. DO NOT LIST YOUR VALUES. Describe any trends or patterns you may observe. Do not discuss key findings.

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### Evaluates the quality of the data - accuracy and precision (2-3 sentences)

Use selected measurement terms, such as precision and accuracy to evaluate the quality of the data.

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### Key finding - related to aim (1 sentence)

Simply state what you found out by looking at your data or your observations.

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**Theory to explain key finding with in-text citations (3-4 sentences)**

Use science theories to explain your key finding. Insert an intext citation to reference where you obtained the scientific information. Include the reference in your bibliography.

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## Errors in method

### Random error (2 sentences)

Identify an error in the measurement which causes the values to vary.

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**Effect on quality of data (1 -2 sentences)**

Explain how the error affected your collected data. Did the error result in the values being more variable (data points are further apart)? Random errors affect the reliability of the experiment.

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### Modification to address random error (1-2 sentences)

Identify a modification that could be made to the method/equipment to overcome the random error.

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**Effect of modification on quality of data (1 sentence)**

Explain how the modification would affect the reliability of your data.

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### Systematic error (2 sentences)

Identify an error which created bias in the data. That is, the practical value differed from the true value by the same amount each time.

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**Effect of error on quality of data (1 sentence)**

Explain how the error affected your data. Would the error make the data higher (overestimation) or lower (underestimation) than the theoretical value? Systematic errors affect the validity of the experiment.

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### Modification to address systematic error (1-2 sentences)

Identify a modification that could be made to the method/equipment to overcome the systematic error and ensure the practical value is closer to the theoretical value.

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## Conclusion

### Summarise key finding

Clearly state the overall finding as a bold confident sentence.

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