The Colour of Stars – They're Stellar

Student Notes

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Introduction

Throughout the universe, stars of many different sizes and colours exist. Our sun is a yellow colour but some stars can even be blue! The colour of a star gives astrophysicists important information about that star.

What can a racing car tell us about the colour of a star? How can a lightbulb help us work out what that colour means? Find out below…

Part 1 – Racing Car

Question

What do pictures from a thermal imaging camera look like and what do they mean?

Plan

This investigation has been planned for you.

Conduct

You will be shown two short video clips of racing cars. Watch the video clips carefully and write down your observations.

Analysis

What colours can you see?
What colour are the tires, road, car body?
In the second video, how does the colour of the tires change?

Problem Solving

Discuss with the class:
Does the thermal imaging show you details you can't see on a normal camera? What do the colours represent?

Conclusion

What are the coloured areas showing you? What do the different colours represent?

Part 2 – Heating Metal

Question

Aim

Investigate colour and temperature changes when heating nichrome wire.

Plan

This investigation has been planned for you.

Materials

- Nichrome wire
- Infrared thermometer or thermocouple to measure temperature
- Tongs
- Bunsen burner and heat mat

Conduct

1. Hold the nichrome wire in the tongs and heat the end of it in the Bunsen burner flame.
2. Record the temperature change in the wire and any changes you observe in colour.

Analysis

Summarise your results in a table.

Temperature	Observations

Problem Solving

Answer these questions and then discuss your answers with the class.

1. What happened to the piece of wire as its temperature was increased?
2. What do you think you would see with a thermal imaging camera?
3. How do the conditions and results vary from the video of the racing car tires?
4. If a piece of steel was to be heated to the same temperature as the nichrome wire, do you think it would look like the same colour?

Conclusion

How are heat and light related?
How are colour and temperature related?

Part 3 – Filament of an Incandescent Bulb

Question / Aim
What are the colour changes when an incandescent lightbulb turns on?
("Incandescent" means emitting light as a result of being heated.)

Plan
You need to plan this experiment yourself using the following equipment:

Equipment

- Battery pack
- Light bulb
- Variable resistor ("rheostat")
- Wires

Think about how you will record "colour changes", and what other values you need to record.

WARNING: do not connect a wire directly from one battery terminal to the other – this will run your battery down and the wire may get very hot.

Conduct
Carry out your planned experiment, taking careful measurements.

Analysis
Do you have data you can plot?
What qualitative (descriptive) analysis can you make?

Problem Solving
Discuss your findings with the other groups in the class.

In part 2 you have discussed the electromagnetic spectrum with your teacher. You may already know that white light is made up of a mixture of different wavelengths of light. Considering this and the fact that light bulbs can produce white light, is the electromagnetic radiation emitted from objects ever just one wavelength?

What energy changes are happening here?

Conclusion
What can you conclude about the colour of the wire in the light globe?

Part 4 – Blackbody Radiation Simulation <Advanced/Year 11-12>

Question / Aim
Use a computer simulation to investigate the radiation emitted by hot objects.
This is called “Blackbody Radiation”.

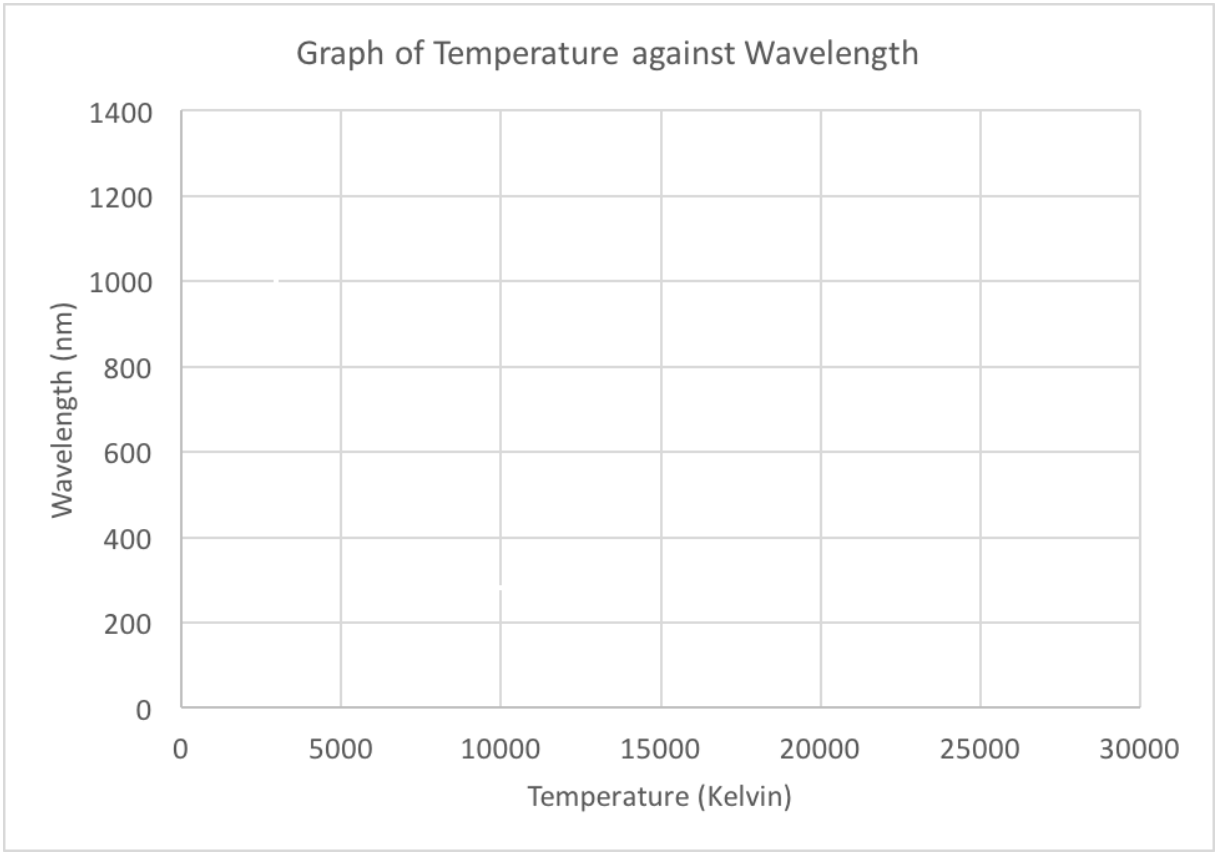
Plan
Use the Blackbody Spectrum Simulator available at
https://phet.colorado.edu/en/simulation/legacy/blackbody-spectrum

Use the following table of colour, temperature and mass values of a range of different stars found in our galaxy, the Milkyway

Star	Colour	Temperature (^oC)	Mass of star (in solar masses)	Wavelength (nm)
Sun	Yellow	5,700	1	
Proxima Centauri	Red	2,300	0.1	
Barnard’s Star	Red	3,000	0.1	
Epsilon Eridani	Orange	4,600	0.1	
Alpha Centauri	Yellow	6,000	1	
Altair	White	8,000	3	
Vega	White	9,900	3	
Sirius	White	10,000	3	
Rigel	White	10,000	3	
Regulus	White	11,000	8	
Hadar	Blue	25,500	20	
Alnilam	Blue	27,000	20	

Conduct
Use the Simulator to fill in the Wavelength column in the table above.

Analysis
Plot the wavelength of the emitted light against temperature for the stars listed in the table. Label the stars as you plot them and find a way to indicate their colour.



Problem Solving

1. From the graph, what is the relationship between the temperature and the wavelength of light emitted from the stars?
2. Looking at the table, what is the relationship between the temperature, colour and mass of stars?

The wavelength of electromagnetic radiation also tells us about the frequency and the photon energy.

For photons, $c = f\,\lambda$ and also $E = h\,f$

Using these two formulae, complete the following:

As the temperature increases, the frequency of electromagnetic radiation emitted…

……

As the temperature increases, the wavelength of electromagnetic radiation emitted…

……

As the temperature increases, the photon energy of electromagnetic radiation emitted…

……

Conclusion

What can you conclude about “Blackbody Radiation”?