



Alternative H-R Diagram

Understanding Hertzsprung-Russell Graphs with Everyday Objects

Classroom Activity

Material List:

- Pencil
- Ruler
- Graph Paper
- Internet Access
- Excel (optional)
- 'Everyday Objects' table

Outline

Learn about the Hertzsprung-Russell diagram, by creating a version of the graph using everyday objects, adding some of your own items to the diagram.

The Hertzsprung–Russell diagram is a scatterplot showing absolute luminosities of stars against its effective temperature or colour. It is generally used to understand a star's age.

This activity can be done by hand, but there are instructions on using excel to create the graphs in the further resources section.

Procedure:

1

Your teacher will provide your group with a table of everyday things/items, for example you might get 'animals', 'electrical products', 'solar objects' or 'vehicles'.

2

Trying creating a scale and plotting the items in your table on a graph.

Online Observatory: onlineobservatory.eu

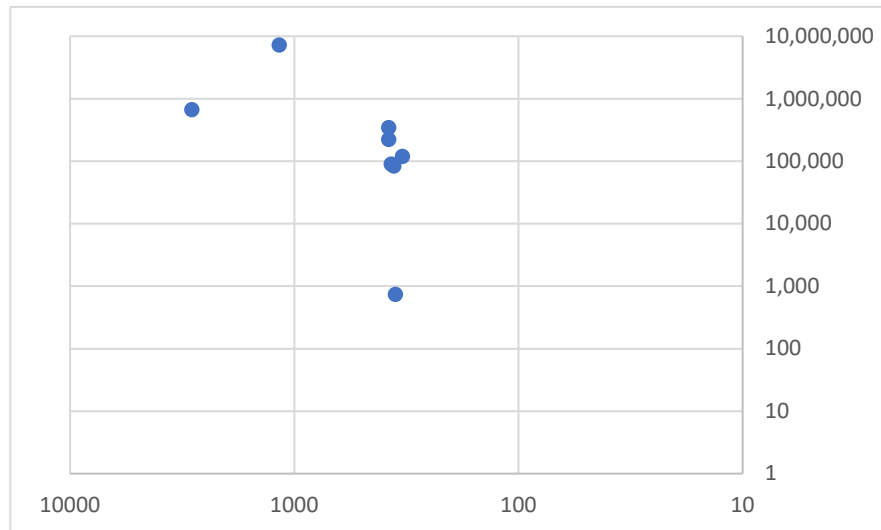
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3

You may have found it difficult to include all the items on to a standard scale. Now try plotting the graph using a logarithmic scale, where the points increase by a factor each time (e.g. 1, 10, 100, 1000, etc.). Note that temperature is plotted in reverse order on a Hertzsprung-Russell diagram. Take a look at the scale example below.



4

OPTIONAL: Do some research of your own and add two more everyday objects to your diagram. You might need to do some conversion of your numbers, for example if you are looking at a car or animal, you may find their horsepower, convert this to Watts by multiplying by 746 (745.7).

5

Now you have practised creating Hertzsprung-Russell diagrams, re-create the real thing using the list of stars below, it might help you to colour code the graph as you make it.

Star/Star Type	Temperature (K)	Luminosity (W)
Sun (yellow)	5,800	3.6E+26
Betelgeuse (orange)	3,200	1.6E+31
Vega (blue-white)	10,000	1.8E+28
White Dwarf 1	12,000	1.2E+23
White Dwarf 2	10,000	5.0E+22
Brown Dwarf	2,200	5.4E+22
Proxima Centauri (red)	2,700	2.0E+23
Giant (orange)	2,800	6.0E+27
Super Giant 1 (red)	4,500	1.6E+31
Super Giant 2 (blue)	10,000	5.0E+30
Main Sequence 1 (red)	2,500	6.10E+21
Main Sequence 2 (yellow)	8,000	7.00E+26
Main Sequence 3 (blue)	45,000	8.40E+31

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Star 1 (red)	3,000	3.80E+24
Star 2 (red)	2,800	1.10E+24
Star 3 (orange)	4,100	3.80E+25
Star 4 (yellow)	5,770	3.80E+26
Star 5 (yellow)	6,100	4.60E+26
Star 6 (blue-white)	7,000	3.80E+27
Star 7 (blue)	20,000	1.90E+30

Find a Hertzsprung-Russell diagram online and compare your graph with it.

6

Follow the Sun through its lifecycle across the Hertzsprung-Russell diagram.

Stage	Temperature (K)	Luminosity (W)
Birth (protostar)	2,500	3.6×10^{27}
Now (main sequence)	5,800	3.6×10^{26}
1.1 Billion years (m.s)	7,000	4.0×10^{26}
3.5 billion years (m.s)	9,000	1.0×10^{27}
Red Giant (4.5 billion years)	4,000	3.0×10^{27}
White Dwarf	10,500	1.0×10^{23}

7

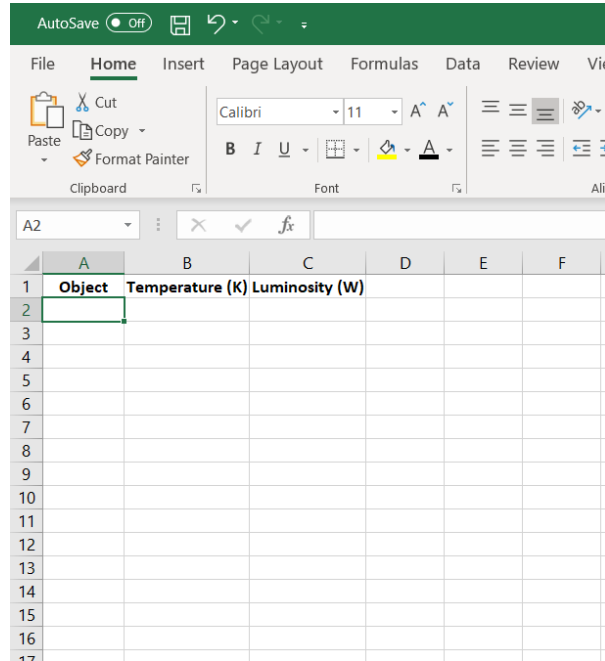
Combine the data from all of the tables to make an expanded version of the H-R diagram, excel is recommend to create this graph and how to use excel to make H-R diagrams is explained in the further resources section. Can you recognise where your selection of 'everyday items' fits on the graph.



Further Resources:

Making Hertzsprung-Russell diagrams on Excel:

1. Open Excel and set out your table:



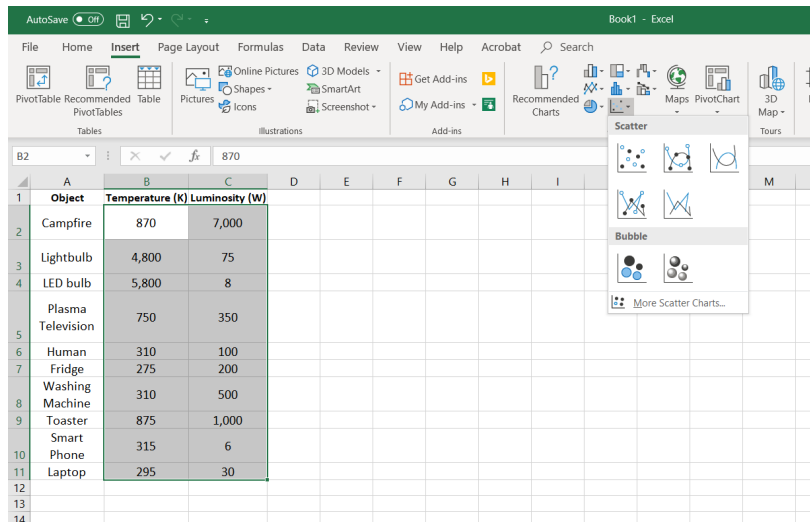
2. Enter values:

	A	B	C	D	E
1	Object	Temperature (K)	Luminosity (W)		
2	Campfire	870	7,000		
3	Lightbulb	4,800	75		
4	LED bulb	5,800	8		
5	Plasma Television	750	350		
6	Human	310	100		
7	Fridge	275	200		
8	Washing Machine	310	500		
9	Toaster	875	1,000		
10	Smart Phone	315	6		
11	Laptop	295	30		
12					
13					
14					

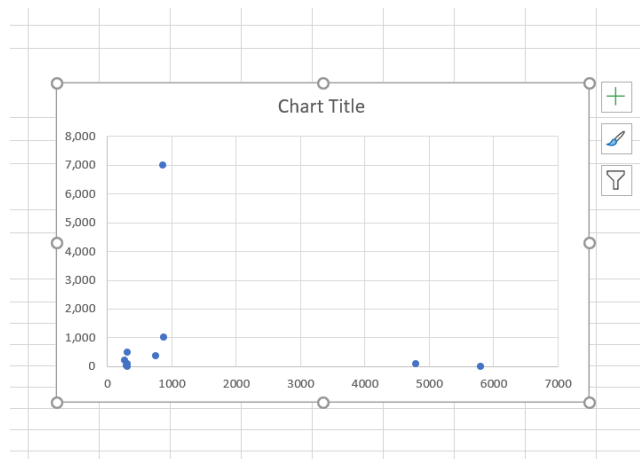
3. Highlight data and select 'Insert' 'Scatter Graph':

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4. A graph will appear:

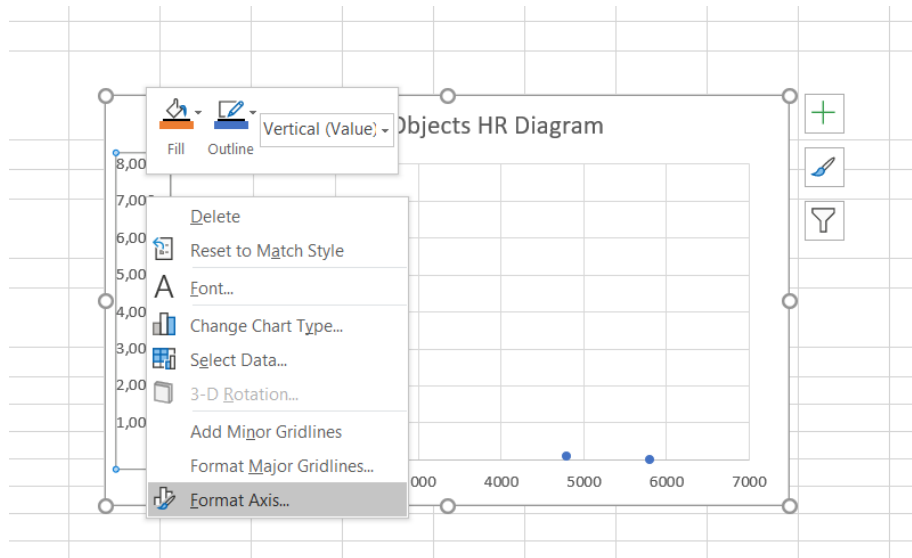


5. Add a title for your graph e.g. 'Everyday Objects HR Diagram'

6. Notice how the plots are laid out, making the graph hard to read. You will need to change the axis to set them up as a proper Hertzsprung-Russell diagram. Right click on the luminosity (x) axis and select 'format axis':

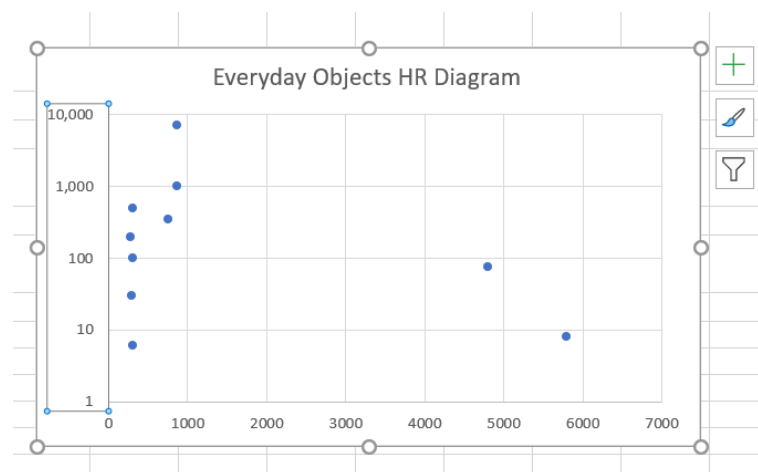
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7. The 'format axis' panel will appear, tick the box next to 'logarithmic scale', you will see your graph change straight away:

The "Format Axis" panel is shown with the "Axis Options" tab selected. Under "Axis Options", the "Logarithmic scale" checkbox is checked, and the "Base" is set to 10. Other options include "Automatic", "Axis value", "Maximum axis value", "Display units", "Show display units label on chart", "Values in reverse order", "Tick Marks", "Labels", and "Number".



8. Now right click on the temperature (y) axis, and once again open the 'Format Axis' panel. This time you will need to select both the 'logarithmic scale' and 'values in reverse' order boxes:

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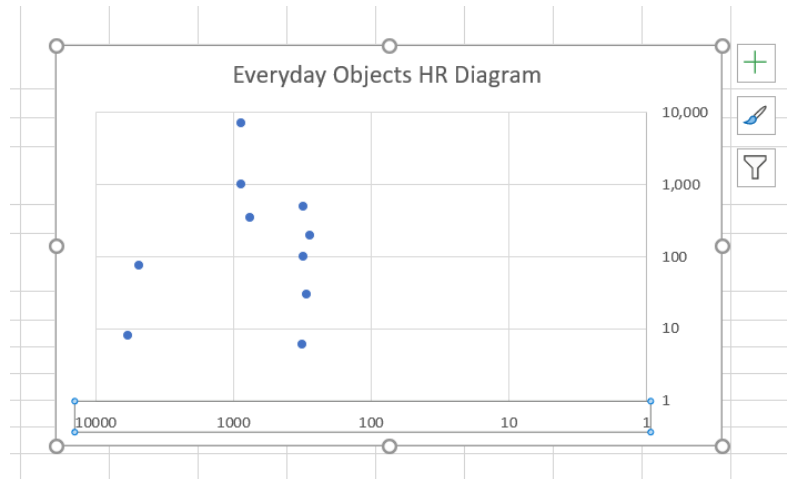


Display units None ▾

Show display units label on chart

Logarithmic scale Base 10

Values in reverse order

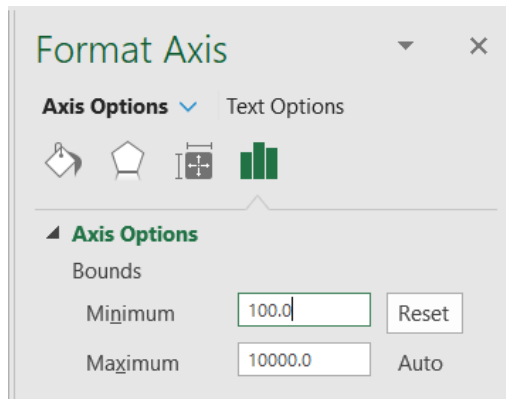


9. Take a look at your graph, you need to label your axis and can change your starting value for temperature from 1 to 100:

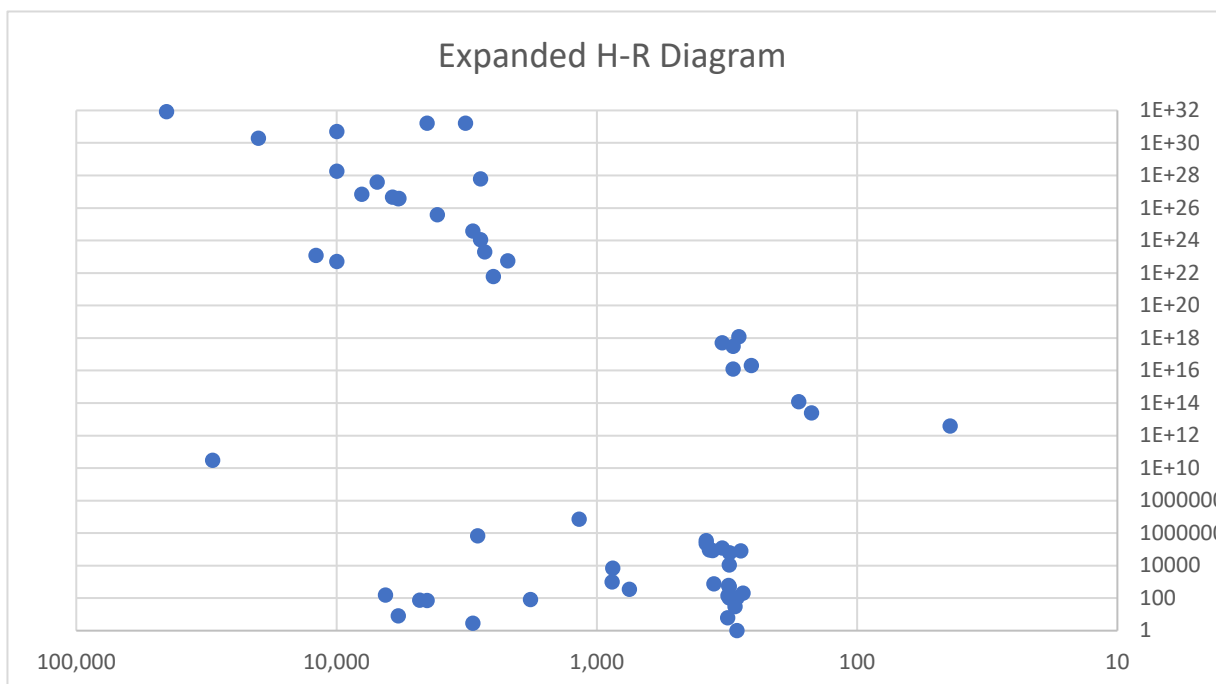
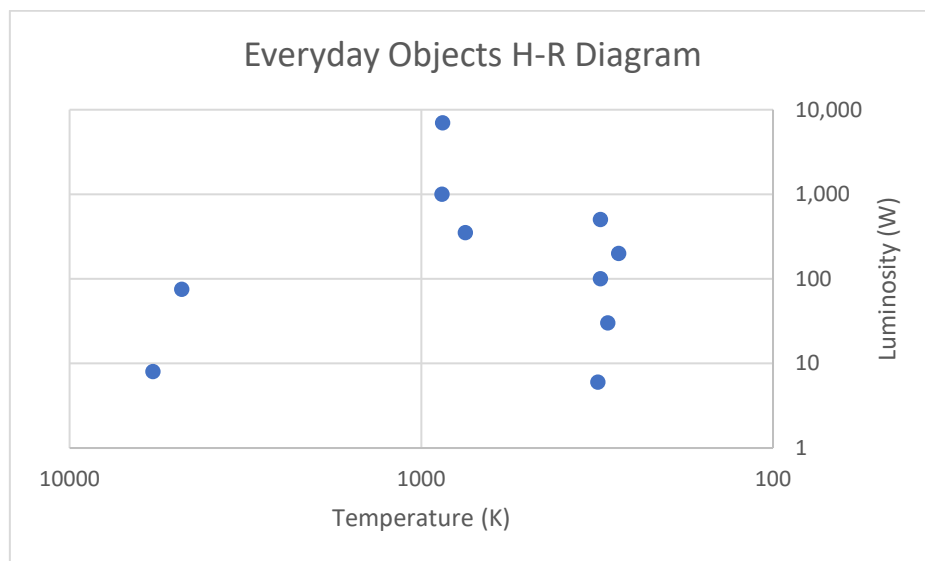
6	Human	310	100
7	Fridge	275	200

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10. You now have your final graph, you will need to repeat the process to create each of the diagrams in this activity and one that is a combination of all of them:



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