



LESSON: Thermal Expansion & Contraction of Gases

OBJECTIVE: To visibly demonstrate thermal expansion and contraction of air

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## Materials

Conical Pyrex flask (500 ml), 12" balloon, hotplate, thermometer, container for placing the conical flask into, ice cubes

## Instructions

1. Use the neck end of the balloon and place it over the neck of the conical flask, attempt to keep the balloon as flat as possible so no excess air is inside the balloon
2. Place some water and ice into a bucket or large beaker and place the conical flask inside the bucket (or large beaker)
3. Measure the temperature and observe the balloon inversely deflate into the flask
4. Once the temperature has stabilized, estimate what volume of the flask the balloon occupies (or fill the top of the balloon using a measuring cylinder to estimate the volume the air has contracted)
5. Remove the flask and place it onto the hotplate
6. Set the hotplate to 50 degrees and let the temperature stabilise
7. Holding the neck of the balloon, remove the balloon and dip it into a measuring jug full of water to estimate the volume of air expansion
8. Plot a graph of room temperature using 500ml + neck of flask, cold temperature and hot temperature volumes

## Calculations

Air temperature oC	-46	-40	-34	-28	-23	-18	-9	-5	-1	4	10	18	22	27	32	38	43	49
Vol. correction factor	0.77	0.79	0.81	0.83	0.85	0.87	0.89	0.91	0.93	0.94	0.96	0.98	1	1.02	1.04	1.06	1.08	1.1

At 4 degrees, 500ml volume should decrease to  $500 \text{ ml} \times 0.94 = 470 \text{ ml}$  air

At 49 degrees, the 500 ml volume of gas should increase to  $500 \text{ ml} \times 1.1 = 550 \text{ ml}$  air

## Conclusion

As air cools down, the energy levels decrease, and they occupy less space. As the temperature increases, the air particles occupy more space and the volume of air increases.

To make this experiment even more dramatic, you could do the same experiment with some water in the flask and explain solid  $\rightarrow$  liquid  $\rightarrow$  gas phase changes.

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