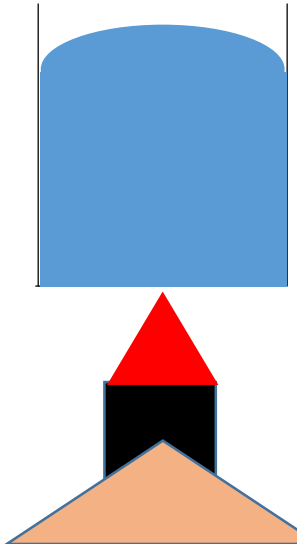
Thermal Expansion of water

When heated water expands this is a commonly known fact.
But by how much
How linier is this expansion?

In this exsperiment I seek to answer this question with only the minor advantages of a father with acess to collage equipment who knows how to use it



What was used

- A 1L conical flask
- Two very poor bungs
- Capilary tube
- Flouracine
- Tempreature probe
- Ruler
- Celetape
- 2 containers
- A drill
- A drill clamp
- A data harvester
- Bowl
- Kettle/ sink
- One weekend
- Weighing scale

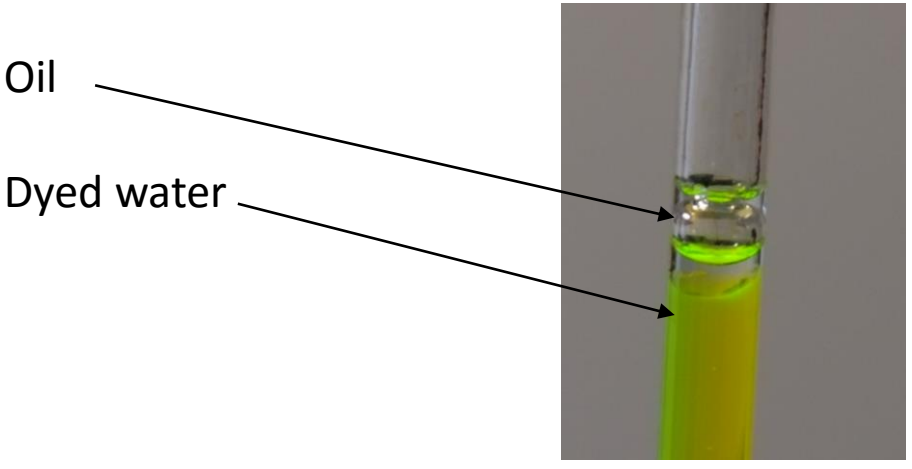
How would this be tested?

Yes we got the point you want to test how much water exspands but how can that be done?

How it can be done

The premis

First you just fill a conical flask and put a capillary tube in the end. When you heat the flask all the water in the flask exspands but it con only move up the tube making the expansion noticeable



- Dye the water with a powerful dye to make it more visible

The controlls

- Evaportation could effect the results but putting a bit of oil in the water will stop evaportation. Oil flots to the top creating a layer which stops evaporation
- Measure the total amount of water by weight so it isn’t effected by the temperature
- Make shure the temperature change is slow so it is that temperature throughout when doing a reading

The Making part 1

The first thing that had to be done was to measure the total volume of the capillary tube and it's length. This will be used later in a mysterious part of this power point.

These measurements were taken by first

Sucking wat into The tube from a basin

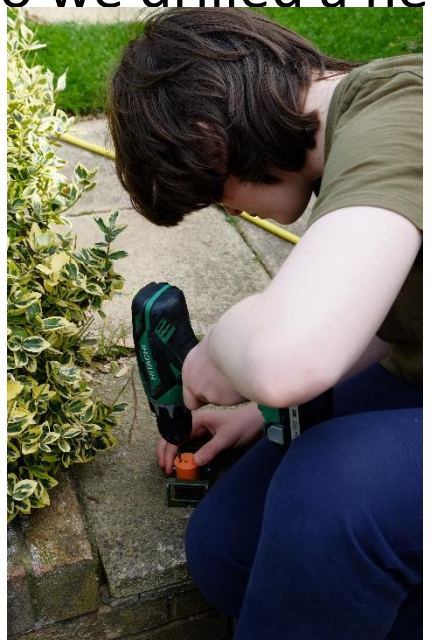
using my finger to make a seal

pour the water into a measuring cylinder

And using a tape measure as a ruler

Then to get a more accurate temperature representation we used a temperature probe (a metal rode which is a thermomiter).

Sadly the bung to the conical flask only has one hole which would be used for the tube so we drilled a new one



P.S there was some messing around to find the right drill bit size locig mixed with trial and error

Last time on the presentaion

Our hero bung had a brush with death at the hands of the Drillzer but he escaped with only minor brain damage

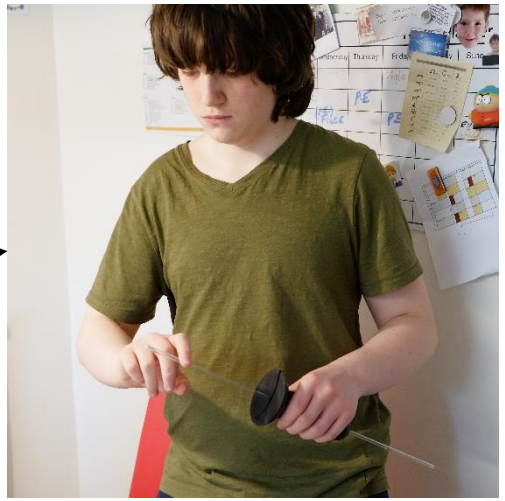
The making part 2

Now we put the temperature probe in but there was Still more to be done.

First we inserted the capillary tube into the bung. My father wanted to show me how because of the stupid fear of dangerous laseration from a shatter glass tube- turns out the the pre made hole in the bung was the exact right size for the tube.

Random photo to fill the page

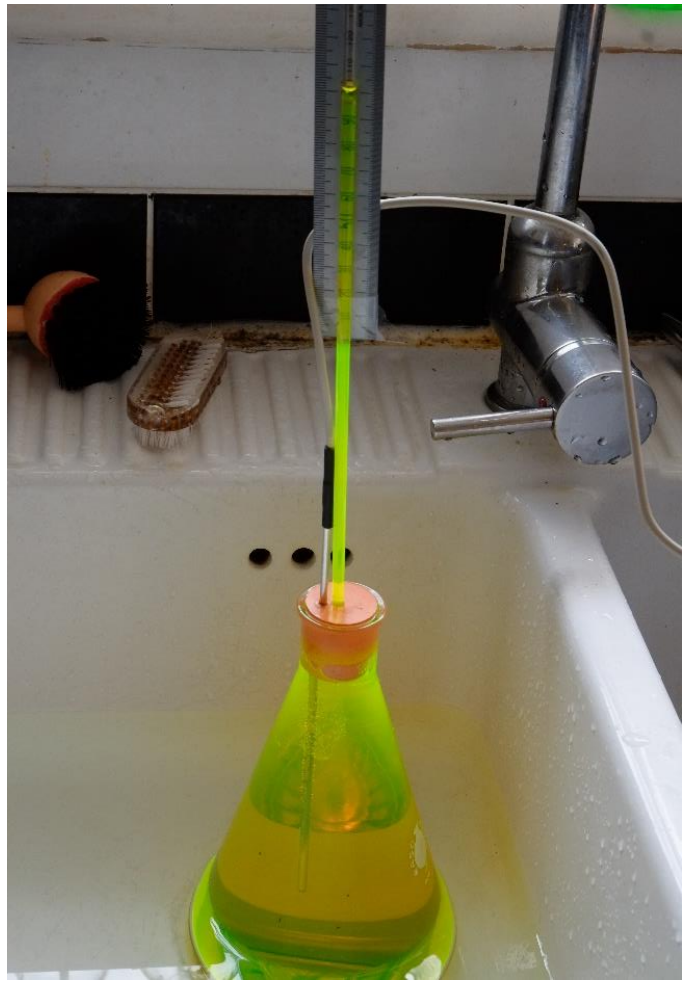
Me looking disinterested



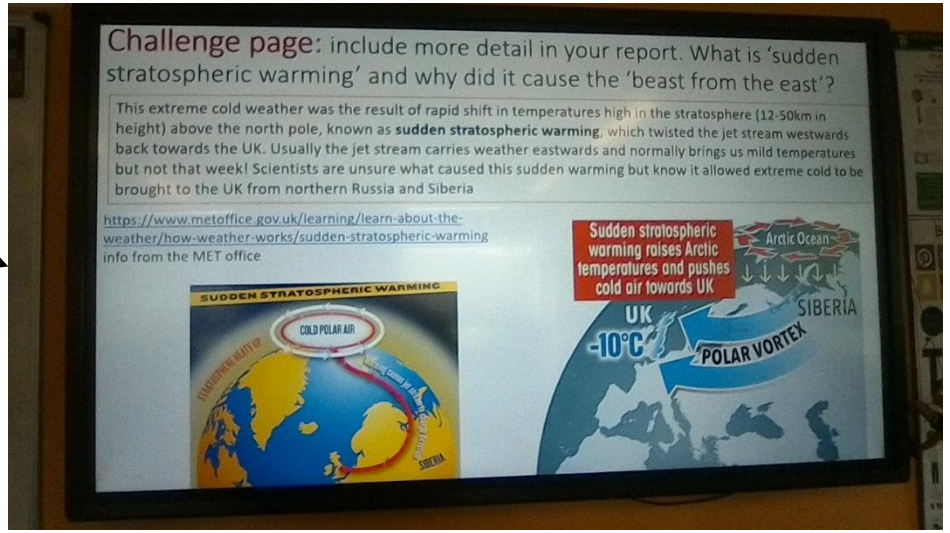
Now tape a ruler to the glass tube for measurements tape it so the 30cm mark and the end of the tube line up then weight the equipment without water Weigh all the equipment even the wires from the temperature probe (except for the data harvester) and record the result

Part 2.5 the reckoning

Of now that the bung was constructed we filled the conical flask and added a dye called flourascine to make the water more visable. We used flourascine because it was VERY potent so we needed little dye so it would affect the results less (p.s it never washes out of cloths). Because of it's reluctance to leave cloths me filing my water gun with flourascine water was not sillie and definitely a responsible action with furtherd human knowlage

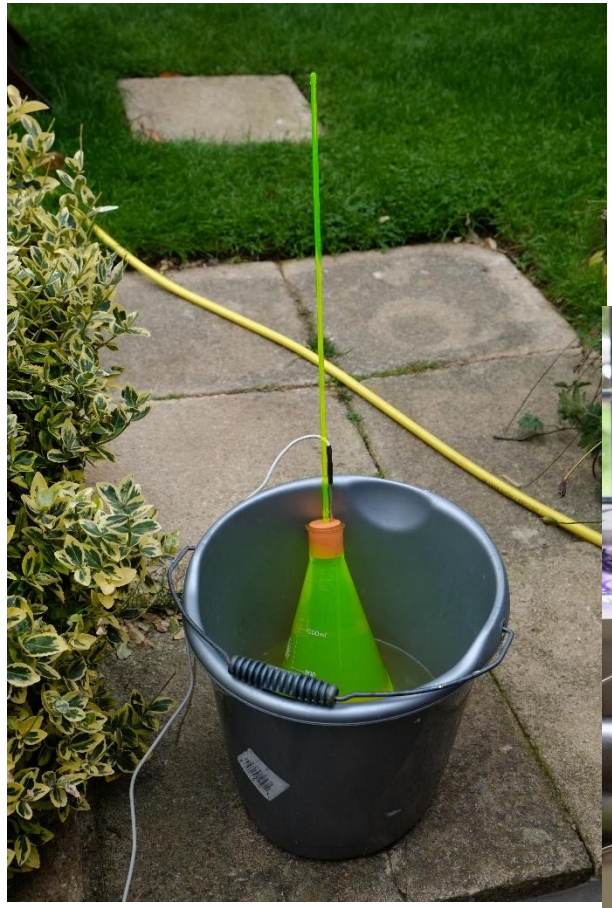


Stock photo



Yes I’m making it a 3 parter

Me and my daddyo looked at the tube. There was too much water if it got much hotter the water would come out the top. So we decided to heat it. My father wanted to use hot water and a bucket. I wanted to use the blowtorch usally reserved for melting silver/ slversmithing. My father won…



Me and my daddyo looked at the tube… there was too little water. Since due to the air tight seal any water added would float we decided to add a other bung on the end (after carving a biggle funnel into it) heat it to fill the bung and add water to the bung to get sucked down when it cooled. P.S. also added the oil here.

Taking Measurements

How to take measurements for dummies

1. First hook up the temperature probe to the data logger
2. Then if necessary heat the experiment up or cool it down
3. Then turn the data logger and note down the temperature which will be shown on the screen
4. Then use the ruler taped to the test to measure the height (can be cheaked for accuracy by taking a photo and zooming in
5. Feel pride and drink water
6. Relaise the water is from the bath
7. Repreat 2-6 for 4 hours
8. Repeat 2-7

Who is this handsome and genius young specimen

Note for the teachers

First go to exel and look at my spreadsheet and go to the sheet data then exsplain to the class. Now the rest of this is for the teachers coming in to actually judge our projects Saulieoooo you may skip this slide.

Ignore the sheet chart 2 and go to the sheet called data. The first four colloms should be pretty self explanatory. Now for the slides volume change is how much the volume of the water has changed used the measurements of the tube to find the vol per cm and multiplied that by the height change. The change per gram is volume change devided by the weight of the water (equipment weight (wet)- equipment weight (dry). Height per gram same as change per gram but volume change is replaced with height. Relative change is not useful but it is change (H)/ change (T) might have been useful turns out it was not. Fractional change this time it is volume change/ water weight. Teachers now next slide also what is a paragraph break.

The results

Go to the spread sheet and go to the sheet called chart 1. rolling in 3 2 1

As you can see here we have 3 copies of basically the same table sorry my father wanted to work out by what is the water expanding the long way because he thought a the class wouldn't understand (don't take it as a insult we alrady have enough bricks in the living room).

The gradient of the bottom graph is the fractional change by temperature. To figue out the change /degree basically change per degree you

Do the odvious and divide the fractional change by degrees and advage the points. As litrally shown there

Also as you can see by the charts the expansion is quite linier but it seems to curve aroung a straight line and at about 26^{o}C it starts to curve upwars but if we made it any hotter water would come out the end of the tube

Conclusion

First the thermal exspansion of water we calculated was 215 parts per million per degree C (basically per degree hotter the water expands by 0.0215%). Wikipedia says it is 0.0207% but as shown in the last slide the expansion doesn't seem to be entirely linier so you can't boil it down to one number basically a sucess

If I were to do it again

If I were to do it again I would boil the water to remove gas. It didn't seem to affect our results but the day after I finished collecting the results bubble of gas started escaping which could affect the results if taking measurements over a long period of time. Also I put in a bit too much flouracing as can be told by the small grains of the stuff at the bottom of the experiment (it comes as powder)

Credits

Initial idea- me the perfect lifeform

Spreadsheet me, wasn’t use to libre office calc so dad taught me how to use and helped with calculating the thermal expansion

Doing stuff me

Assistant stuff doer my dad the second most perfect lifeform

Special thanks my dad for having acess to collage equipment and knowloage of how to use it and do special calculations in the most long winded way

My Little Brudda Ezra the least perfect lifeform for letting be use/ mutilate 2 pipets