NPL

Measurement At Home

What is the difference between heat and temperature?

#MeasurementAtHome
npl.co.uk/measurement-at-home

How does your object's heat compare with that of NPL's hottest pudding?

- NPL heated a 'Christmas pudding' (made from carbon) to 2,200 ºC. npl.co.uk/is-this-the-hottest-christmas-pudding
- You may be surprised how our pudding's **heat** compares to that of a snowman, a cooked turkey and a candle flame.
- What information do you need to calculate the heat of an object?

Estimated time: 20 minutes. No prior knowledge needed.

Instructions

Watch the video **(You Tube i08XUy59R3o)**

1. Choose an object. At the time of writing it's Christmas so ours are seasonal. It's best if your object is made of just one material (like iron or water), though you can simplify (e.g. a person = 100% water).
2. Measure or estimate the mass (in kg) and temperature of your object. Convert °C temperature value to K (kelvin) by adding 273.
3. Find your material's 'specific heat capacity' value. As living things are mostly water, for them, you could use the value for water = 4,200 J/kg/K. (engineeringtoolbox.com) (material-properties.org)
4. Calculate the heat (total thermal energy) of your object = mass (in kilogram) x temperature (in kelvin) x specific heat capacity.
5. Repeat for other objects and share your results with us, or compare them with our festive object heat vs temperature plot on the webpage: npl.co.uk/measurement-at-home/heat-and-temperature

Equipment required

- optional thermometer
- optional weighing scales
- paper and pencil for calculations.

Risks

- take care when handling hot, cold or heavy objects.

SI measurement units

- kelvin (K) for temperature
- kilogram (kg) for mass.

Challenge topics

- Measurement science, maths, specific heat capacity.

Thoughts, tips and information

- Temperature measures hotness/coldness of a body while heat is a type of energy.
- We calculate heat (thermal energy, unit joule (J)) transferred to change an object's temperature. Temperature change depends on the object's mass and a property called 'specific heat capacity'.

Example calculations

Object	large cooked turkey	Candle flame	Snowman made of snow	NPL's hottest pudding
Mass (in kg)	**6**	0.000001	60	0.00075
Temperature (in degrees Celsius, °C)	50	727	-5	2,200
Temperature (in kelvin, K)	50 °C + 273 = **323** K	1000	268	2,473
Specific heat capacity (in J/kg/K)	**4,200**	855	2,090	720
Heat (in joule, J)	6 x 323 x 4,200 **= 8,138,600 = 8,100,000 (2 sig. fig.)**	**1.0**	**34,000,000**	**1,300**

Adult direction or supervision is required. All experiments are carried out at your own risk. For more experiments, visit NPL Measurement at Home.