



# Kids Learning Resources -

## **HOT-AIR BALLOONING**



Issue 1







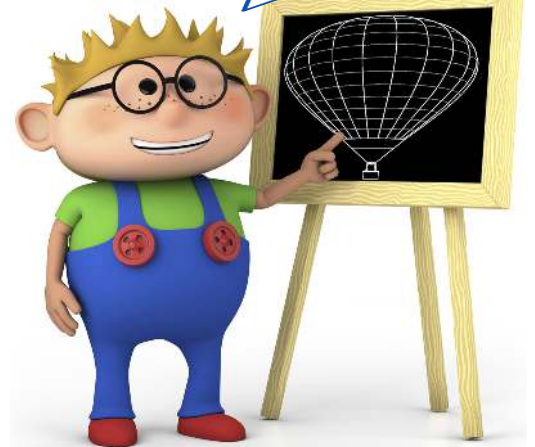
# Here are our mini-balloonists, ready to be your guides...



I'm Freddie



I'm James



I'm Amelia,



I'm Georgia



and I'm Theo



I'm Stella  
Great to see you!  
The adventure awaits...  
Let's get started!





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# 1) What do I need to be a good balloonist?



- \* Gloves – and to begin with, any gloves that are comfortable will be great.
- \* Layers of clothing; it can be cold early in the morning & a waterproof jacket keeps out any cool damp air
- \* Walking boots or wellington boots.
- \* Camera (optional...) *but a really good idea!!*
- \* Water bottle and a little snack
- \* Binoculars - if you have them
- \* Notebook and pen
- \* Fun, excitement, good humour and great listening skills
- \* Little rucksack to put all the bits-and-pieces in

Don't forget boots! I hate soggy feet!



Don't forget 'to pack' your most fun grown-up too!



# 2) Next is the Super, Mega, Important Briefing!

Let's keep safe on the launch field!



## SIX crucial rules for safe ballooning, before we go off, on our lighter-than-air adventures.

- 1) **NEVER** let your feet leave the ground (unless you are IN the basket.)
- 2) **NEVER** tie any of the ropes or control-lines around any part of your body.
- 3) **ALWAYS** wear gloves when handling any part of the balloon.
- 4) **ALWAYS** make sure you look after & keep your adult with you!
- 5) If you are not sure, ASK the Pilot!
- 6) With balloons there are also usually vehicles and trailers – so be very careful of all moving vehicles too.

Right, now we are going to be safe, let's go!



Where can balloons take off from...?



Wow! So a balloon really can take-off from all sorts of places...



Yes, but it is important to know, balloons are not normally allowed (or permitted) to take off from within controlled airspace.



UK CAA Air Chart (Air Map)

Airspace means mapped out areas which usually includes all types of airports and flight paths (corridors) for both passenger (civil) and military aircraft use.

We wouldn't want our big balloon getting in the way of a huge aeroplane!



When compared to aeroplanes, balloons always look much, MUCH bigger than fixed-wing aircraft. Here a passenger aircraft, like the one you would fly in, to go on holiday that carries about 180 people is compared to two passenger-carrying balloons and a small sport balloon (77) which would carry about 2 to 3 people.



Aeroplanes are huge but hot-air balloons look GIGANTIC, don't they?

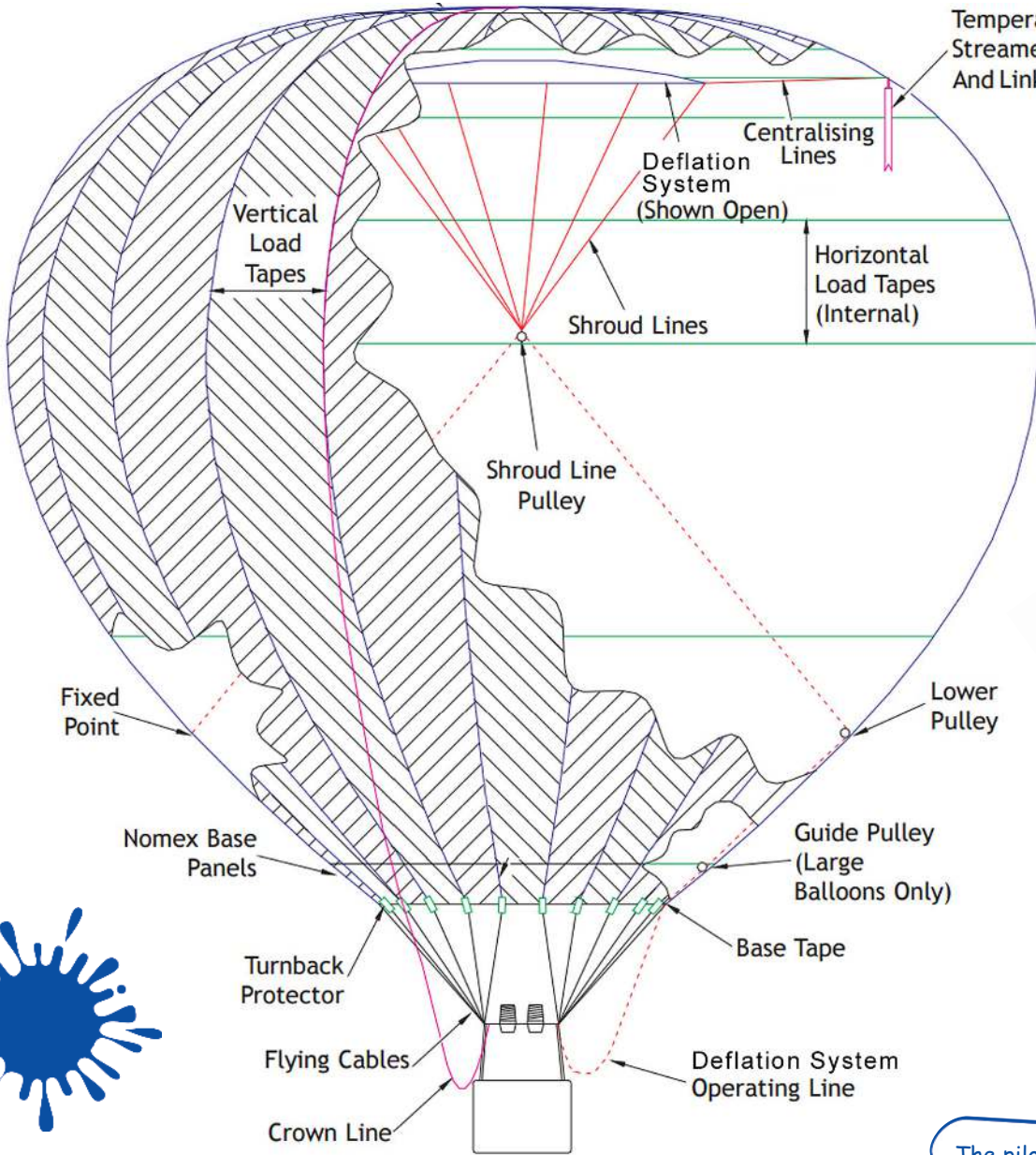






### 3) How does a hot-air balloon work?

Here we can see what it looks like inside a balloon!



**The pilot adds hot-air** – which is made by igniting controlled amounts of gas that’s stored on board during flight as liquid under pressure, in the cylinders (fuel tanks) in the basket.

The heat makes the balloon lighter and gives us lift, so we can float up and off we go - yippee!



The five metre tall flames are controlled safely through the burner system up into the balloon (envelope) and this fire, heats-up the air inside...

The pilot can turn on and off the controls as he or she needs to.



More detail about how a balloon is prepared, is in section 4



# 4) How does it get ready to go up?

**To start** – the balloon equipment is positioned on the launch area from the trailer or vehicle and is laid out in the direction of any breeze.



The basket is rigged.



Do you mean it's put together?



Yes, we simply mean the burner is set up and attached together like this...

The Pilot puts on his gloves and tests the burner and fuel system pre-flight.



Wow, what a lot of gloves!



Then the basket is put on it's side and the fabric part of the balloon (envelope) is attached to the burner frame with karabiners (metal connectors with a screw-opening.) The basket is then attached to the vehicle with the restraint system (the black strap, blue release with the red clip, seen below right) ensuring take-off only occurs when the pilot is totally ready.

The envelope is then pulled out of the bag, into a long 'sausage' shape.



Did you know a normal four-person balloon is about 25m tall from the bottom of the basket, to the very top of the balloon.



Some ballooning friends here, are nearly ready to go!



Once briefings have been done and crew jobs allocated, then the envelope is filled with air from a motorised, cold-air, inflation fan like this.

Then the Pilot has to complete the final checks and confirm with the crew that everyone is ready to start...They can then begin the 'hot-inflation'. The Pilot checks the fuel-system once again and 'fires up' the burner, heating the air inside the balloon with one or sometimes two, 5m long, controllable flames.



The air inside the balloon heats up, expands and rises taking the fabric part of the balloon with it, all to a vertical position... and once the last checks are done, the passengers have climbed aboard and everyone has had their flight-safety briefing, then it is **TIME TO FLY!**



## The Science Bit





## The Science Bit - What makes a hot-air or helium-filled balloon rise up or float in the air?



All gases, liquids and solids take up space and have weight.

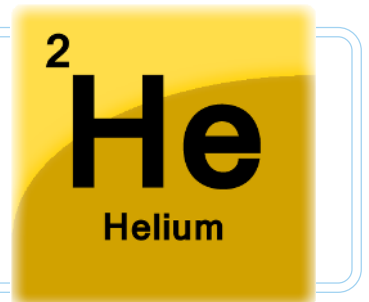
An object will float in water or in air if the object is lighter than the air or the water, it displaces. Air in a balloon envelope that has been heated more than the surrounding air will rise, as will helium gas in a toy balloon as both are lighter-than-the-air displaced, causing the balloon to float and rise.



### Teacher's note

**Helium is one of the lightest elements on Earth and is also lighter-than-air.**

**1 cubic metre of helium will lift approx. 1kg.**  
(Dependant on the pressure and temperature)



## But why does a hot-air balloon float?

A hot-air balloon floats in the atmosphere, whereas, a typical balloon filled with ambient air will not float...

When air is heated, it expands and becomes lighter than the cooler air it displaces (puts out of place).

Hot-air balloons rise rapidly in cooler air.



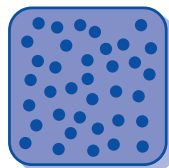
This is why we most often see hot-air balloons in the sky, in the morning or the evening when the surrounding air is cooler, with usually lower wind-speeds and is less thermic (bubbly) .



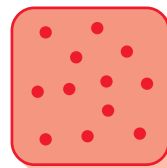
### Teacher's note

One cubic-foot of air weighs about 28 grams. If that air is heated and the temperature is raised to about 100 degrees, that same cubic-foot of air will have a mass of only 21 grams. Therefore, a cubic foot of hot-air lifts about 7grams. That is not much lift per cubic-foot and that explains why hot-air balloons are so large, for example; a hot-air balloon that carries 3 people is about 77thousand cubic-feet or 2,195 cubic-metres. (See section 2 for a balloon size comparison chart).

**Warm-air is less dense than cold-air.** The density of the air is determined by the number of molecules in any unit volume.



**Cold Air**



**Hot Air**

**Temperature is a measure of the average kinetic energy of the air.** In simple terms, that means that hot-air molecules are moving faster than cold ones.

The faster the air molecules are moving, the more often they bounce off each other, and the further apart they become, on average. And, if the molecules are further apart, there are less of them in any given volume – or to put it another way, the air is less dense. And so your hot-air balloon floats.





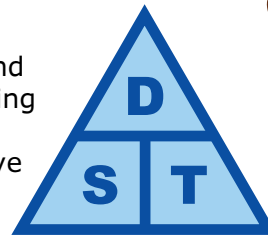
## 5) How do you know where you are going?

The quick answer is, we don't exactly... but what we do know is; where the wind is blowing from and how fast it is blowing, as meteorological (weather) reports can tell us that. We can then use that information to draw an imaginary line from our take-off point, to where the wind is predicted to go on our map and if we take, say 30°, either side of that line we know we are going somewhere that way.



We also know, how much fuel we have at take-off and we know how long that is likely to last, so we can work out (using a simple speed, time, distance calculation) how far we could fly before our fuel runs out and then we have to make sure we have lots of good landing opportunities on the way, so we can land before that happens!

Remember, balloons ALWAYS fly along with the wind - a bit like a sail-boat.



You can work out the speed, distance or time by re-arranging the equation. Which one of these equations (sums) you use depends on the information you know and the information you need to find out...

**Speed = distance ÷ time**  
**Distance = speed x time**  
**Time = distance ÷ speed**

## 6) How does a balloon come back down?

By putting less heat from the burner into the balloon or by releasing heat from the top of the balloon as required in stages, we can look ahead and fly downwind and down to a field. We always look for a field without any growing crops or farm animals with an access gateway where the retrieve vehicle can pop in to pick us and the balloon up. Most fields of course have tractors and farm vehicles in-and-out of them during the course of a normal day, so a small retrieve vehicle usually poses no problem.



Here is our balloon at touchdown.



The basket will then be de-rigged and packed back into the trailer or van – ready to be refuelled and stored.

Ready for the next adventure!



Here, some balloonists 'in training' are helping to pack away the balloon.



The balloon here, has had all the air 'squashed' out (back into a long line) ready to pop back into the envelope bag.







# 7) What is so great about hot-air ballooning?

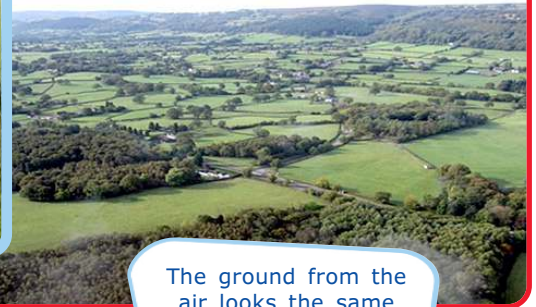
## So many things...

The feeling of moving in the air but of no breeze.

Balloons float along with the breeze.



Seeing such great distances from a magical vantage point.



The ground from the air looks the same as on a map, once you get used to comparing the two.

Aerial map-reading, is always great fun especially flying over places you know from the ground.



Seeing places you have never seen before. Which, is great if you like being a little bit nosy!



Waving hello to people you know and to friends in other balloons



Having a tasty brunch after a morning flight is my favourite. (Brunch is half breakfast and half lunch)



Being out in the countryside with friends, seeing wildlife and new places.

Splashing 'n' dashing



How funny, it is like they are sailing - don't worry though they just turned the burner on, heated up the balloon and took off again



I meant **real** wildlife!







WOW!



AWESOME!





## 8) How can I start to get involved in ballooning?

The best place to start; is by building a model - to help practice your hot-air balloon control. And to read lots of background information which helps to extend your skills. See Section 9 for even more ideas.

Take your most fun grown-up!

In the UK, it's a good idea is to join the British Balloon & Airship Club [www.bbac.org](http://www.bbac.org) as well as the local region of the club. Where you can meet local balloonists and keep informed of training opportunities and fly outs.



## 9) Hot-Air Balloon Project Ideas

### Project Idea A - Taking photos, Collecting, Spotting, Map-reading

Why not take photos of balloons you spot at different events.

You could also collect balloon badges (pins), postcards, make a photo album, use an event programme or an online guide to spot balloons from all over the world.

Spotting is great fun to do at big balloon events.



### Teacher's note

To find out more information about a particular British aircraft including balloons you could type the registration into 'G-INFO'

<http://www.caa.co.uk/application.aspx?catid=60&pagetype=65&appid=1>

## Cameron Balloons have built over 8500 balloons and here are just a few...



This charming Smurf balloon is normally flown in Belgium!



Jolly, Obelix is based in France!



These mischievous Minions can be seen in the summer in the UK!



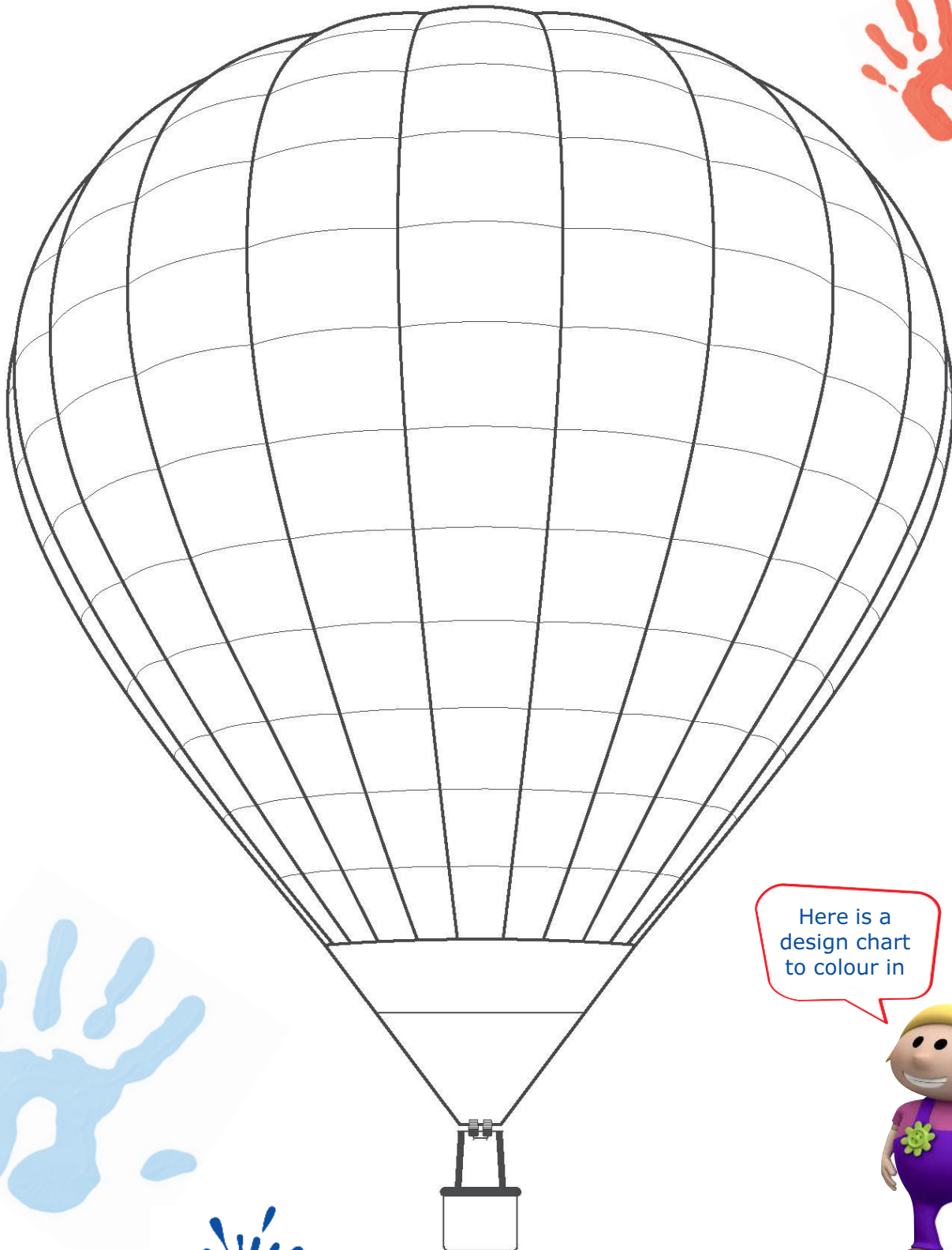
Amazing Asimo is normally based in Japan!







## Project Idea B - What would your balloon look like?



Here is a design chart to colour in





## Project Idea C) Building a model balloon

It's great to start by making a fun and easy tissue-paper model hot-air balloon. Simply cut-out a number of sheets of tissue-paper and glue together to make a big sphere-like envelope attach to some strong thread and you are ready to fly indoors using a portable fan-heater.

*(Tip - Try using different coloured tissue-paper to make an effective design and try it in a big hall at school like this one shown here)*

If you want to build a very accurate, scale model – either a **50m<sup>3</sup>** or **80m<sup>3</sup>** balloon - then here are Cameron Balloons full instructions

<http://www.cameronballoons.co.uk/blog/build-your-own-cameron-hot-air-balloon>

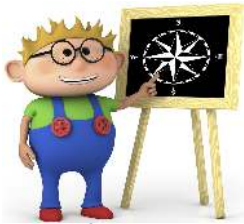


Remember, to ask your fun adult to help! Keep safe!



## Project Idea D) Learn to map read.

This is really useful when you are flying, crewing or retrieving for any hot-air balloon. Knowing the symbols is a great way to start...

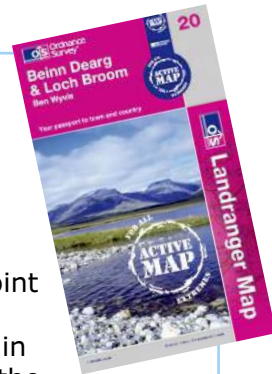


### Teacher's note

Flash-cards and other map resources can be found here, online with the world famous UK Ordnance Survey.

<http://www.ordnancesurvey.co.uk/education-research/index.html>

A Cartesian coordinate system is a coordinate system that specifies each point uniquely in a plane, by a pair of numerical coordinates, which are the signed distances from the point to two fixed perpendicular directed lines, measured in the same unit of length. Each reference line is called a coordinate axis and the point where they meet is, its origin, usually an ordered pair (0, 0). (Ref. Wikipedia.org)



## 10) What are the most complicated special shapes Cameron Balloons have ever built?

Each special-shape hot-air balloon we make has a high level of complication – perhaps the artwork is tricky or the actual shape difficult... But some of our favourites have been our most difficult too...

**Disney Castle** – The clouds were really difficult. Getting them to look realistic yet to actually work, as part of the balloon to provide lift, was tricky...



Photo credit: Daily Mail







# 11) How old do I have to be to be a Pilot?



At **16** you can start training.



## To qualify for a UK Private Pilot's Licence (Balloons), you must:

Have at least 16hrs flying experience  
**16** hours

Have undertaken a minimum of  
**6** flights

Have made a minimum of **4** flights with a BBAC approved Instructor

Be recommended by a BBAC approved Instructor for a flight test.

Kept a flight-log with flight-training records completed by your instructing pilot.

Perform one solo flight under the supervision of the Examiner .

Undertake a flight test examination with a CAA approved Examiner.

Need to attend an approved Landowner Relations Seminar.

Take written examinations in Aviation Law, Navigation, Meteorology, Airmanship & Balloon Systems and Human Performance.

Have a valid medical declaration of fitness, signed by your GP.

And lastly: you have to complete all of the above within a **24** month period

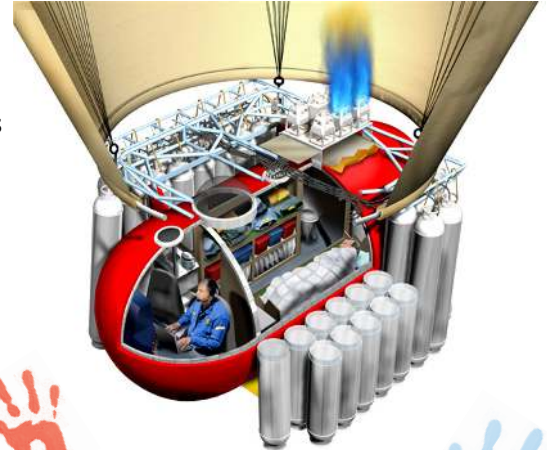


## 12) Have balloons broken any world records?

**Yes lots!!** – everything from highest altitude, to longest duration and furthest distance in lots of different sizes and types of balloons and most of them have been built by Cameron Balloons in Bristol.



(For more details see 'History of Notable Flights' Section 16)

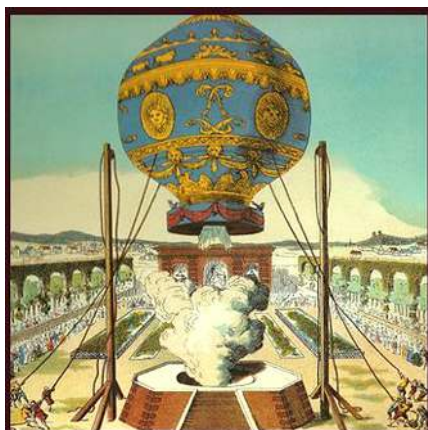


## 13) How did it all start? - Hot-air ballooning history

The first hot-air balloon to carry people flew on the 21<sup>st</sup> November 1783 and was designed by two French brothers taking off from a place called Annonay, in France.

Earlier that year, in June (1783); a test flight, with a sheep, a duck and a cockerel flew for about eight minutes, on landing they were reported to be all fine.

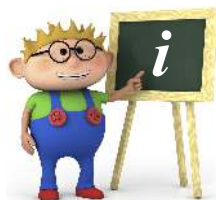
It must have been a bumpy landing as they had no way of controlling the balloon.



(For more detail see 'Origins of Flight' section 17)

## 14) Why can't a hot-air balloon fly in the rain?

The heat inside of the balloon can bring any rain on the surface of the fabric to boiling or steaming temperatures which damages the very thin specially-coated hot-air balloon material, as it can destroy layers in the fabric's coating.



### Teacher's note

This effect of 'super-heated' water can break-down the specialist coatings that make up the balloon fabric. This process known as hydrolysis reduces the balloon's overall working life.







## 15) A few fun facts

A lovely story about why balloonists like to toast their flights with champagne...



Traditionally, each time a hot air balloon lands, champagne is shared. It is said that back in 'olden times', farmers believed that hot-air balloons that were landing in their fields may have been dragons descending from the skies! To soothe the farmers' fears, hot-air balloon pilots would share a bottle with the farmers, whose land they had descended on...

### Actually...

...toasting with Champagne is far more likely to be a celebratory tradition passed down from France, where hot-air ballooning started more than 230years ago.

### How long does a balloon flight take?

Perhaps allow about 3 hours for a balloon experience. This allows time to meet up on the launch field, get the balloon ready, have about an hour in the air, pack up and return back after the flight.

### Is there a toilet on board in a balloon?

So it is best to go-before-you-go!

No, not usually in a hot-air balloon.

In long distance balloons like the around-the-world one - they tend to have a more normal toilet (or a quite basic 'bucket-and-chuck-it' version.) Waste is then jettisoned (thrown out in biodegradable bags) during the flight at night when the balloon usually needs to get rid of ballast to maintain height.

(Some other vehicles intentionally dump waste while in transit. Cruise ships for example, which can be thought of as small cities on the sea, routinely discharge thousands of gallons of human waste each day.)

Although now, we usually toast with a cup of tea, at breakfast - unless it is a very special occasion!

This can take a bit longer if you stop off for a delicious breakfast on the way back to the launch field - yum!



### A bit more of balloonist fun ...

If you fly in winter, you can land in the middle of a field and make marks in the snow. It can work even better if a passenger pops out of the basket and makes footsteps around, then climbs back aboard and we all take off again! The next day you might hear or see news about possible UFO's landing... as the marks cannot be explained easily when viewed from the ground!

### Steve Fossett

...was born on the 22<sup>nd</sup> April 1944, he was the first person to fly solo (on his own) non-stop around-the-world in a Cameron Balloons built combination gas and hot-air balloon. Steve was a fellow of the Royal Geographical Society and the Explorers Club and set 116 records in five different sports. (Balloons, aeroplanes, airships, gliders and sailboats).



# QUIZ



## Student Quick

### Q.1

You fly 14 kilometres in 2hours. What is your average speed?

Answer:

km/hr

### Q.2

You fly for 1½ hours at an average speed of 4miles an hour. How far will you have flown?

Answer:

miles

### Q.3

What is the fabric part of the balloon called?

Answer:

### Q.4

What year was Cameron Balloons founded?

Answer:

### Q.5

What year was the first manned balloon flight?

Answer:

### Q.6

What is Cameron Balloons' Competition hot-air balloon called?

Answer:

### Q.7

How many hot-air and cold-air inflatables to celebrate the 'Despicable Me 2' Movie did Cameron Balloons make?

Answer:

### Q.8

How big is the largest passenger carrying balloon in the world?

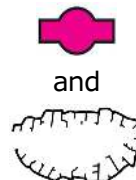
Answer:

,000 cu ft

### Q.9

What do these Ordnance Survey symbols mean?

Answer:



Answer:

### Q.10

Spot SIX differences between these two Cameron Balloons Demonstration Hot-air Balloons.



### Q.11

What are the 6 crucial rules for safe ballooning?

- 1) \_\_\_\_\_
- 2) \_\_\_\_\_
- 3) \_\_\_\_\_
- 4) \_\_\_\_\_
- 5) \_\_\_\_\_
- 6) \_\_\_\_\_





## 16) Ballooning Glossary



- Actuals** The actual weather report at a given time.
- Anabatic Wind** Warm-air flowing uphill as the sun heats up the surface on a mountainside.
- Anti-cyclone** Area of high-pressure on a weather chart, with characteristics of very stable air and light winds, which are generally good for ballooning.
- Artwork** The artwork on balloons takes various forms. At the simplest level it can be stuck onto the balloon. The fabric sections cut by computer are then stuck on and sewn around to keep it in place. Photographic artwork can be printed directly onto balloon fabric which is then sewn together as a single skin which saves weight.
- Balloon Flight** This takes place in the direction of the wind as a balloon cannot be steered, although its altitude or height can be adjusted quite precisely. Therefore pre-flight planning, ensures that there is a safe route and landing place for the balloon downwind and the correct amount of fuel carried considering the size of balloon and the wind speed. (Speed / Distance / Time calculations are very important!).
- Ballast** Heavy material such as sand or water, which can be slowly poured from a gas balloon - reducing weight therefore giving lift.
- Balloon Landowner liaison course** A day study course for all balloonists to learn about the countryside, crops, animals, the law and balloon rules.
- Basket** The basket perhaps needs little explanation! It is made out of cane and willow and woven by craftsman. It has a padded-edge around the top usually made from suede or leather. Despite modern advances in materials the woven basket is still the best material - because of the basket's ability to absorb the shock of any bumpy landings. It also has stainless-steel wires that run from under the burner frame, down the poles, under the basket and up the other side to provide a strong cradle for the occupants.
- BBAC** The British Balloon and Airship Club is the governing body for UK balloonists. It provides bimonthly magazines and training for new and existing pilots and crew.
- Briefing** The pre, during and post flight information and safety instructions.
- Burners** Heat source for a hot-air balloon is a high-output burner fed by liquid propane which passes through a vaporising-coil prior to combustion. Flow is controlled by an on/off valve referred to as a blast or main valve. Most balloons have two controllable burners fuelled by liquid or vaporised propane which is lit by a continually on pilot light.
- Cirrus Clouds** A high cloud, often the first warning of an approaching weather front known as a depression.
- Clouds** When air ascends it expands and cools and if sufficiently moist a cloud will form. Visible clouds can be of several recognisable types depending on the process of their formation.
- Cold front** The cold front is the start of the weather system with the cold-air pushing into the warm front sector, usually associated with heavy showers and large cumulonimbus clouds.
- Commercial Balloons** Balloons operated by paid pilots flying advertising or special-shape balloons for their clients.
- Controlled Airspace** This is a mapped out area which usually includes all types of airports and the corridors that join them together for both passenger transport (civil) and military aircraft.



**Competitions** Local, National and International competitions are run, with rules organised by the British Balloon & Airship club and the FAI - Federation Aeronautique Internationale.

**CPL/Commercial Pilot's Licence** An extra licence, involving more practical and theoretical examinations (most of them are the same as fixed-wing passenger pilots) required to enable you to charge for your services as a pilot.

**Crew** Essential to fly and operate a balloon. Always be nice to your crew as they are the ones who will come and collect you after the flight!

**Cumulonimbus Clouds** Thunderclouds that are likely to generate lightning, hail and fierce convection currents. When the cloud reaches very high levels it is composed of ice crystals which tail off in the upper wind, This 'tail' is known as the anvil.

**Cumulus Clouds** Heaped cloud associated with convection. Typical summer convection will generate a sky with regular patterns of fair-weather cumulus and if these grow bigger they become towering cumulus and often cause rain.

**Depression** Commonly known as low pressure or a low, associated with horrible rainy and stormy weather with warm and cold fronts.

**Elbow** For a competition the Pilot is given two markers. After a certain minimum distance he drops the first, then after a further minimum distance, the second. The score is the greatest change of course between the two legs of the flight, measured in degrees.

**Envelope** The envelope is the part of the balloon that inflates. It is made up of a number of vertical segments called gores, which are themselves made up of a number of smaller panels. Each panel edge is folded back on itself, interleaved with the next folded edge, and then all four thicknesses of fabric are sewn through twice by machine, using a lockstitch known as a French Fell Seam. The gores are attached to heavy duty webbing tapes that pass around the balloon. The envelope has large holes top and bottom. The bottom one the pilot uses to be able to fill the balloon with hot-air. The top one is a valve to enable the pilot to vent air quickly when the pilot wants to descend or land. Envelopes are named by their capacity. For example a '77' holds 77,000 cubic feet of air - this size of balloon usually carries three people.

**Envelope Scoop** This is the small conical section of cloth that hangs below the main envelope and runs about halfway around the 'mouth'. Its purpose is to direct the hot-air into the main envelope and also helps to pressurise the balloon particularly when tethering.

**Fabric** The fabric that is used to make hot-air balloons is known as ripstop nylon and usually weighs 70g/m<sup>2</sup>. It is specially woven with crisscross reinforcement threads to make it extra strong. The fabric is lightweight, colourful and can withstand temperatures in excess of 120 degrees C - well above the boiling point of water. Nomex - fabric that feels like cotton and is very resistant to heat is used round the mouth of the balloon where the radiant heat from the burner could melt the nylon, particularly on a windy day. Nomex is similar fabric to that used for racing-car driver's suits.

**Fly-in** The crews and their balloons go out from the contest field by a certain minimum distance, usually 5km and choose their own take-off point to fly back from. They take-off in a field (after asking the landowner's permission) and fly back to drop their marker on the goal in the contest field. This task is great spectator sport.







**Forecast** The advance report of the likely weather conditions at a given time in the near future e.g. 12 hour/24hour based using knowledge of weather variables and the working out the likely trends.

**Fuel Cylinders and fuel tanks** Aluminium, stainless-steel or titanium containers with valves to release pressurised liquid propane in a controlled manner using tank and burner controls. They normally stand in the corner of the basket leaving room for the pilot and passengers. Padded covers surround each cylinder - just in case of a bumpy landing - while rubber encased metal-armoured pipes carry the fuel up to the burner which is supported above the basket on flexible nylon rods

**Gloves, boots & enthusiasm** Gloves, walking boots and enthusiasm are the most important pieces of equipment for people new to ballooning: Sturdy leather gloves for handling ropes, fabric and the basket are best; Flat lace up boots provide good ankle support and are perfect for walking in dewy fields first thing in the morning and lastly enthusiasm; be also prepared to get up early, we are often on the field preparing for flight just after dawn and in the Summer that can be as early as 04:30am!



**Goal** This is an identifiable, visible from the air competition goal point from which measurements can be made.

**Gradient Wind** Measured in knots and degrees in the direction it is coming from considered to be about 2000ft above ground level. (It also takes into account geostrophic force which is the force of pressure gradient, Coriolis and centripetal forces.)

**Grid North** Is the marked North lines (called Eastings - because each north-south line moves further east as you move across the map) used on maps to split it into easy identifiable chunks.

**Grid references** The letters and numbers to pin-point a position on the map clearly (usually a six figure number). Always use the 'along-the-runway-and-take-off' philosophy to ensure you keep your numbers the correct way round.....

**Hesitation Waltz** A curious name for a task which is really a judge declared goal with a choice of several goals. The Pilot can choose one of the judge's goals to aim for after take-off.

**Hyperlast** A special fabric exclusive to Cameron Balloons used in the top of most balloons. Although a little heavier (90g/m<sup>2</sup>) than nylon it is almost 10 times as strong (it is also available in 23 different colours).

**Inflation Fan** The initial inflation of the envelope is done with a cold-air inflation fan. These fans come in a range of power options depending on the size of envelope that needs to be filled.

**Instruments** The instruments commonly used in ballooning are; for altitude measurement (altimeter), to display climb and descent rate (variometer) and to indicate envelope internal temperature (thermistor).

**Isobar** Lines of equal pressure on a weather chart.

**Isotherm** Lines of equal temperature on a weather chart.

**Judge declared goal competition** The competitors are given a goal somewhere downwind, and they must try to drop their markers on it. The goal is usually marked with a large fabric cross, pinned to the ground with tent pegs and is watched by a group of appointed official observers.





- Karabiners** Metal 'gated' connection points used between the basket and the envelope wires (often also used when climbing - although balloonists tend to use stronger versions).
- Katabatic Wind** Cool wind flowing down the cold mountainside before the sun has heated up the surface, often prevalent at night and early morning.
- Knot** Measurement of nautical miles per hour (but nobody says that, nor do they say knots per hour!).
- Load Calculation** Before each flight the all-up-weight must be calculated, and a check to ensure that this does not exceed the available lift, otherwise the envelope could be damaged by overheating.
- Magnetic North** A compass shows magnetic North which points slightly to one side of northerly direction, measured in degrees magnetic.
- Markers** These are thrown at the targets and must be a streamer of specific-weight, balloon nylon. It has to be 170cm long, 10cm wide and be weighted with 70g of sand. They are usually brightly coloured to make them easier to find, once thrown from the balloon to the target.
- Nautical mile** 1.15 statute (normal) miles or 1.85 kilometres.
- Navigation** Balloonists use a combination of aeronautical charts and ground maps for the flight area which show controlled airspace (airports, flight paths and military airspace.)
- Nightglow** A display of tethered balloons that takes place in the dark, when the pilots turn the burners on, the balloon envelopes glow like huge lanterns..... This although not very good for the life of a balloon can be wonderful, especially if all the pilots operate their burners and light up the balloons while co-ordinated to music.
- Nimbostratus Clouds** A lower, thicker layer of cloud. Often producing long and steady rain at the warm front.
- Official Observers** These are specially trained volunteer balloonists who are responsible for inspecting, verifying and providing evidence for both competition and record-attempt flights according to the given rules. Scoring is taken very seriously, with official observers and a panel of judges computing the score. Major events also appoint a jury of officials to consider any protests.
- Orographic Clouds** The name for clouds caused by the air being forced to rise by high ground.
- Parachute valve** This is the name for the deflation system that is used in most balloons, to vent hot-air to descend as well as release air for the final deflation at point of landing.
- Passenger flights** Paying passengers book a weather dependant, flight with a company that sells balloon flights usually included in the hour long flight, is a champagne celebration at the end of the flight. All passengers are then returned by the crew to the start meeting point. It is advisable to wear: layers of clothes, flat walking boots/shoes and to take your camera.
- Pilot declared goal** A similar task to the judge-declared goal, except that the pilot declares his own goal in writing and hands it in to the officials before take-off.
- Pilots** The licenced person who has completed and passed all the training and examinations to enable them to be in charge of a hot-air balloon.





- PPL/Private Pilot's Licence** The 'driving' test required to operate and fly a hot-air balloon consisting of both practical and theoretical examinations which vary slightly from country to country. This licence is not generally restricted to the local region or country although sometimes there are some country specific regulations to adhere to.
- Preparation** Before starting to prepare the balloon for flight, the pilot should consider the balloon loading (passengers and fuel), the weather and the flight area, to determine suitability for flight.
- Propane** Fuel for hot-air balloons that is stored as liquid, under pressure, in cylinders.
- QNH** Regional pressure setting corrected at sea level - adjusting an altimeter to this setting should indicate height above sea level. (nb - to find out height above ground level you can identify your position on the map and work out a spot height or use a global positioning system (a machine that uses satellites to measure position, altitude and speed) Sea level which is considered to start at zero feet.
- Quick Release Mechanism** (Or Restraint) Used to restrain the balloon during inflation and heating air in the envelope pre-take-off, but should not be used for tethering.
- Rigging/Basket wires Rigged** The control ropes and lines inside the balloon are known collectively as the rigging. The basket wires are stainless-steel wires running down from the burner frame to the basket, around underneath it, then back up to the opposite corners of the burner frame to complete a continuous sling. On even a small Cameron Balloons basket there are four of these slings and the basket sits attached and inside them. Stainless-steel wires also connect the envelope to the burner frame. Means getting the balloon equipment in proper order, ready for use.
- Special-shape balloons** Hot-air balloons manufactured in the shape of products, cartoon character or art - not the natural rounded traditional shape.
- Surface Wind** Measured in knots and degrees in the direction it is coming FROM at about tree-top height.
- Tether Line/Ropes** Perhaps one of the most important extras to come with a balloon! This is used when anchoring the balloon to the ground (to large vehicles) for balloon displays or nightglows when the balloon is fully hot-inflated but not required to fly.
- True North** Actual north according to calculation measured in degrees true.
- Variation** The angle of difference between true north and magnetic north.
- Warm front** A weather system whose characteristics are 500 to 600 miles between the ground-edge and the sloping-into-the-sky-edge, high cirrus clouds developing to form nimbostratus clouds and continuous rain.
- Weather** Balloonists can receive very up-to-date weather reports and forecasts often using tailor-made special weather services which helps planning balloon flights considerably.
- Wind** Measured in knots and degrees in the direction it is coming FROM. e.g. 270 degrees is a wind going towards the East...





## Student Quick Quiz Answers

**Q.1** **Answer:** Speed = distance ÷ time  
Speed =  $14 \div 2$   
**Speed = 7 km/hr**

**Q.2** **Answer:** Distance = Speed × Time  
Distance =  $4 \times 1.5 = 6$  miles  
**Distance = 6 miles**

**Q.3** **Answer:** ENVELOPE

**Q.4** **Answer:** 1971 (1<sup>ST</sup> April)

**Q.5** **Answer:** 1783 (21<sup>st</sup> November)

French brothers Joseph-Michel Montgolfier (1740 – 1810) and Jacques-Étienne Montgolfier (1745 – 1799) were the inventors of the first free (non-tethered) balloon that flew humans. The flight took place on November 21, 1783, flown by science teacher Jean-François Pilâtre de Rozier and François Laurent, Marquis d'Arlandes. The flight began from the grounds of the Château de la Muette in the western outskirts of Paris.





They flew aloft about 3,000 feet (910 m) above Paris for a distance of about 5.6 miles (9 km) for 25 minutes which, was an average speed of 13.44mph or 21.63 km/hr!

**Q.6** **Answer:** RACER  
<http://www.cameronballoons.co.uk/products/leisure-sport/racer>

**Q.7** **Answer:** 29!  
<http://www.cameronballoons.co.uk/inflatable-me>

As part of the project we built 2 new identical special shape balloons known as 'Stuart' and 2 conventional Cameron Z-105 Despicable Me 2 balloons. There are also 25 Cameron Balloons Tims and Toms, 6m (19ft)

**Q.8** **Answer:** 750 thousand cubic feet  
<http://www.cameronballoons.co.uk/blog/the-worlds-largest-passenger-ride-balloon>

**Q.9** **Answer:**  Quarry  
 Bus or Coach Station

**Q.10** **Answers:**



**Q.11**

The 6 crucial rules for safe ballooning are:  
1) NEVER let your feet leave the ground (unless you are IN the basket.)

2) NEVER tie any of the ropes or control lines around any part of your body.

3) ALWAYS wear gloves when handling any part of the balloon.

4) ALWAYS be make sure you look after & keep your adult with you!

5) If you are not sure, ASK the Pilot!

6) With balloons there are usually vehicles and trailers – be very careful of all moving vehicles too.





*Welcome to our  
world of Ballooning*

*Let it be known  
from this day forth that*

---

*ascended in to the exciting  
world of hot-air ballooning.*

*This certificate of outstanding  
achievement was presented by*

---

*On this day \_\_\_ of \_\_\_\_\_*



# Kids Learning Resources - **HOT-AIR BALLOONING**

## About the author



Hannah Cameron has been working for Cameron Balloons since 1993 and is one of the Directors, a hot-air balloon pilot, a hot-air balloon instructor and a theory examination hot-air balloon licence ground examiner, she works full time, is married, has two children and 6 hens!

'I normally have to write a lot of in-depth or serious information for work and so this has been heaps of fun to do - I hope you enjoy it, as well as learn lots of useful things, about our lighter-than-air sport.'



[www.cameronballoons.co.uk](http://www.cameronballoons.co.uk)

[sales@cameronballoons.co.uk](mailto:sales@cameronballoons.co.uk)

+44 (0)117 963 7216

st. john street, bedminster, bristol bs3 4nh