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HOT AIR BALLOONS

Facts for Students

The hot air balloon is the oldest successful, human-carrying flight technology. The first manned, untethered (that means it wasn't tied to the ground) balloon flight happened in Paris, France on November 21, 1783. This hot air balloon was created by the Montgolfier brothers, Joseph-Michael and Jacques-Etienne.

How do they fly?

Hot air balloons are fantastic to see in the sky, but there is much more to these balloons than meets the eye!

- 1. The balloon is laid out on the ground and attached to the basket.
- 2. The crew use an 'inflation fan' a small motor turning a propeller that blows air into the balloon (this is called 'cold inflation').
- 3. Once the balloon is partly filled, the pilot ignites the burners and heats the air inside the balloon (this is called 'hot inflation').
- 4. The balloon, which is tethered (tied) to the ground, then begins to stand up as the heated air rises.



5. When fully inflated and upright, the balloon is ready for take-off when the ground tether is released.







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The balloon systems

A hot air balloon has several parts and systems that help it fly.

Envelope

The envelope is the name for the part of the balloon that holds the air. When the air inside the envelope is heated, it expands and becomes lighter and less dense than the cooler air surrounding the balloon. This temperature difference will cause the lighter air, and the balloon containing it, to rise.

Envelopes are mainly constructed from a nylon fabric that is similar to parachute material. The lower sections of the balloon envelope, closer to the burners, are made from flameretardant material (for obvious reasons).

The envelope gets very hot, so there is a sensor at the top that monitors the temperature and sends a signal to the pilot's instrument pack to ensure that the temperature is kept below the safe operating limit of typically 120°C. Temperatures above this could damage the balloon fabric.

Burner system

The burner system is the 'engine' that lifts the balloon into the air. The air in the balloon envelope is heated by igniting burners fuelled by propane gas (this is the same gas used in home BBQs). The gas is stored in cylinders attached to the basket that carries the pilot and passengers.

Basket

The basket is commonly made out of woven wicker (or cane) – a traditional material for balloon baskets. It is flexible and very strong for its weight. The basket has a steel or aluminium frame inside and is supported by cables that attach to the burner frame.











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Avionics

A balloon may be fitted with a variety of instruments to aid the pilot and these commonly include:

- Altimeter: This instrument tells the pilot how high the balloon is above sea level.
- Rate-of-climb indicator: This instrument tells the pilot how fast the balloon is going up.
- **Envelope temperature gauge:** This instrument tells the pilot how hot the air is inside the envelope.
- Ambient air temperature gauge: This instrument tells the pilot the temperature of the air outside the balloon envelope (atmospheric temperature).
- Transponder: When flying in commercial airspace (where all the large passenger aircraft fly), Air Traffic Control provide a unique four-digit code (such as 5643) to the balloon pilot over the radio, which is keyed into the balloon's transponder.



Hot air balloon instrument pack.

Then, when in the air, the transponder will automatically send the code to the Air Traffic Controller's radar screen. This assists the Air Traffic Controller to identify where the balloon is to ensure that it does not collide with other much faster aircraft.

- **VHF (Very High Frequency) radio:** The pilot uses this radio to talk with Air Traffic Controllers when flying in commercial airspace.
- UHF CB (Ultra High Frequency Citizens' Band) radio: The pilot uses this radio to communicate with the ground crew and other balloons in the air. The ground crew may be required to drive to the landing location of the balloon to pick up the balloon envelope and basket, and to provide transport for the passengers.

Flight control systems

The balloon cannot be steered; it can only travel with the direction of the wind. The pilot directs the balloon by moving it up and down to find different wind speeds and directions. To make the balloon go higher, the pilot can control the burners to increase the flame that heats the air in the envelope.





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Air escapes

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Vent

The pilot can make the balloon descend by pulling on a cord that opens a valve to release air from the top of the envelope (this is called venting), or by allowing the air to cool naturally. The balloons have a rapid deflation system that allows a large amount of air to be vented quickly. This system is only used when landing in order to stop the balloon from skipping across the ground in windy conditions.

The balloons can also be rotated either clockwise or anticlockwise by opening vents on the side of the envelope that allow some air to escape, propelling the balloon around.

Hot air balloon fast facts

- The first hot air balloon was launched on 19 September 1783, in France. The passengers were a sheep, a duck and a rooster, and the balloon stayed aloft (in the air) for about 15 minutes.
- The first human hot air balloon flight was made on 21 November 1783, in France. The balloon was made from linen and paper. Straw, chopped wool and dried horse manure were burnt to heat the air in the balloon. It rose to a height of approximately 2,000 metres and stayed aloft for about 20



minutes, making hot air balloons the oldest aircraft to successfully carry people.

- Hot air balloons do not travel with the help of an engine they move at the same speed as the surrounding wind.
- All other aircraft flying in Australian skies must give way to balloons.
- Hot air balloons do not need a runway, they can take off from, and land on, any cleared area such as a football field or a paddock.
- To find out which way the wind is blowing, balloon pilots have been known to drop a small amount of shaving foam overboard and then watch which direction it travels as it falls. Pilots can also work out the direction of the wind near the ground by looking at a flag on a pole, smoke billowing from a chimney, or even the ripples on the surface of the water in a lake. The balloon cannot be steered; it can only travel with the direction of the wind! The pilot directs the balloon by moving it up and down to find different wind speeds and directions.



