

How the world works when you're sitting on a plane

Level 3 • Advanced

1 Warmer

How often do you travel by aeroplane? Do you enjoy the experience? Why? Why not?

2 Key words

Match key words from the text to the definitions. The section numbers are provided to help you.

1. not solid _____ (section 1)
2. the height of a thing above sea level _____ (section 2)
3. spread over a large area _____ (section 4)
4. full of a lot of people or animals that are moving around quickly _____ (two words, section 5)
5. quick falls from a high position _____ (section 6)
6. hit by a lot of objects many times _____ (section 7)
7. travelling a long distance, especially by air _____ (two words, section 8)
8. not having a strong taste and, therefore, not very interesting to eat _____ (section 8)
9. flavour or smell, especially a pleasant one _____ (section 12)
10. the use of internal instruments to continuously calculate the position, orientation and velocity of a moving object _____ (two words, section 13)
11. a law or a set of laws _____ (section 13)
12. a powerful spinning current of air that pulls everything down inside it _____ (section 17)
13. official permission that allows the pilot of a plane to take off or land _____ (section 17)
14. spread in different directions over a wide area _____ (section 17)
15. moving something in a situation that needs care or skill _____ (section 18)

3 Before reading

Discuss these questions before reading the article.

1. What is jet lag?
2. What is turbulence?
3. What's a time zone and what time zone do you live in?
4. How do planes stay up in the air?
5. What is it possible to see from a plane window?

How the world works when you're sitting on a plane

Level 3 • Advanced

In-flight science: how the world works when you're sitting on a plane

It's the best place to see a rainbow and the worst place to drink tea ... Brian Clegg tells us some surprising plane facts

Brian Clegg

6 July, 2014

1 Passing clouds

One of the pleasures of flying is seeing clouds close up. Even though they seem insubstantial they carry a considerable weight of water – around 500 tonnes in a small cumulus cloud. And water is denser than air. So why don't clouds fall out of the sky like rain? They do. But the droplets take a long time to sink. An average cloud would take a year to fall one metre.

2 On cloud nine

Most of us are happy to label clouds "fluffy ones" or "nasty black ones", but meteorologists identify more than 50 cloud types based on shape and altitude. These fit into categories given numbers from one to nine. Cloud nine is the vast, towering cumulonimbus, so to be "on cloud nine" implies being on top of the world.

3 Around the rainbow

There's no better place to see a rainbow than from a plane. Rainbows are produced when sunlight hits raindrops. We see a bow because the Earth gets in the way, but, from a plane, a rainbow is a complete circle. When passing over clouds, the plane's shadow appears neatly in the centre of the effect.

4 Mr blue sky

Sunlight is white, containing all the colours of the spectrum but, as it passes through air, some of the light is scattered when it interacts with the gas molecules. Blue light scatters more than the lower-energy colours, so the blue appears to come from the sky.

5 There's life out there

Apart from clouds and other planes, we don't expect to see much directly outside a flying aircraft's window, but the air is seething with bacterial life – as many as 1,800 different types of bacteria have been detected over cities and they can reach twice the cruising height of a plane.

6 Turbulence terror

Even the most experienced flyer can be turned green by turbulence. The outcome can be anything from repeated bumping to sudden, dramatic plunges. The good news for nervous flyers is that no modern airliner has ever been brought down by turbulence. People have been

injured and occasionally killed when they are not strapped in, or get struck by poorly secured luggage – but the plane is not going to be knocked out of the sky.

7 In-flight radiation

When body scanners were introduced at airports there were radiation scares but the level produced is the same as passengers receive in one minute of flight. The Earth is constantly bombarded by cosmic rays, natural radiation from space that has more impact at altitude.

8 You can't cure jet lag

The world is divided into time zones. The result is that long-haul travel results in a difference between local time and your body's time, causing jet lag. However, its effects can be minimized by keeping food bland for 24 hours before travel, drinking plenty of fluids and living on your destination time from the moment you reach the aircraft.

9 Supersonic 747s

Many of us have travelled faster than sound. There are a number of jet streams in the upper atmosphere, notably on the journey from the US to Europe, where a temperature inversion causes a corridor of air to move as fast as 250mph. If an airliner with an airspeed of 550mph enters a jet stream, the result can be to fly at 800mph, above sound's 740mph.

10 Flying through time

Time zones provide an artificial journey through time – but special relativity means that a flight involves actual time travel. It's so minimal, though, that crossing the Atlantic weekly for 40 years would only move you 1/1,000th of a second into the future.

11 Terrible tea

Don't blame the cabin attendant if your tea isn't great. Water should be just under 100°C when it is poured on to tea leaves – but that isn't possible on a plane. It's impossible to get water beyond 90°C during flight – so choose coffee.

12 I can't hear my food

Airline food has a reputation for being bland and tasteless. Some of the problem may not be poor catering, though. A plane is a noisy environment and there is evidence that food loses some of its savour when we are exposed to loud noises.

13 Needle in a haystack

With modern technology, it seems strange that Malaysian flight MH370 could disappear without a trace – yet, finding a missing aircraft is a needle-in-a-haystack problem. The plane knows its location, both from GPS and inertial tracking, but

How the world works when you're sitting on a plane

Level 3 • Advanced

this information is not relayed elsewhere in real time. That would be perfectly possible. Ocean-going ships have had tracking since the 1980s – the limitation is not technology but a lack of legislation requiring it.

14 Volcanic fallout

Air travel can be cancelled by volcanic activity. Glass-like ash particles melt in the heat of the engine, then solidify on the rotors. A clear-skies policy in an ash cloud may be inconvenient – but the risks of ignoring the ash are clear.

15 The wing myth

For many years, we taught the wrong explanation for the way wings keep planes in the air. In fact, almost all a plane's lift comes from Newton's Third Law of Motion. The wing is shaped to push air downwards. As the air is pushed down, the wing gets an equal and opposite push upwards, lifting the plane.

16 Forget electric planes

When we see ultra-light, experimental, electric planes, it's easy to assume there will soon be clean, green, electric airliners, but it won't happen any time soon. Aircraft fuel packs in a remarkable amount of energy. Batteries are much less efficient. To provide the same energy as a tonne of fuel would take 100 tonnes of batteries – and

a 747 uses 150 to 200 tonnes of fuel. Unless battery technology is made vastly more efficient, electric airliners won't get off the ground.

17 Beware the vortex

Pilots often wait a long time to get clearance. This is to allow the air to settle after a previous take-off, as a plane's wingtips generate vortices in the air, which can take two or three minutes to disperse. If the following aircraft set off immediately, the rapidly moving air would make the plane difficult to handle. The delay gives the air time to recover from the miniature whirlwinds caused by the preceding plane.

18 The doors aren't locked

In practice, the doors on a plane don't need to be locked. If you watch an aircraft door being opened, it swings in an unusual way. It first has to be opened inwards before manoeuvring it out of the way. Once the plane has taken off, a significant pressure difference soon builds up between the inside of the plane and the outside. This differential forces the door into place. To open it, you would have to pull against the air pressure, well beyond the capabilities of human muscles.

© Guardian News and Media 2014

First published in *The Guardian*, 06/07/14

4 Comprehension check

Discuss the answers to the questions without referring back to the article. What else can you remember?

1. What is the speed of sound?
2. Why can't one plane take off directly after another?
3. How can a volcano cause a plane to crash?
4. How do aircraft doors open and close?
5. Why does coffee taste better than tea on a flight?
6. Which law of physics explains why wings keep planes in the air?
7. What are the main dangers connected with turbulence?
8. How can you minimize the effects of jet lag?
9. What colour is sunlight and why is the sky blue?
10. How many types of clouds are there and how many categories are they divided into?
11. Why don't clouds fall out of the sky?
12. Why won't there be electric passenger flights in the near future?

How the world works when you're sitting on a plane

Level 3 • Advanced

5 Expressions

Find expressions in the article to complete the sentences.

1. Mario Goetze was _____ after he scored the winning goal in the World Cup final.
2. Trying to spot my brother in the crowd was like looking for _____.

Discuss the meanings of the two expressions. Are there similar expressions in your language? Translate them literally.

6 Discussion

a. Complete one of the sentences below. Imagine it is the opening sentence of an article – you want to hook your reader, so make your sentence interesting!

- My best / worst flying experience was _____.
- I remember when I was flying from _____ to _____.
- I'll never forget the flight from _____ to _____.
- If I could fly anywhere in the world, I'd go to _____ because _____.

b. Read out and discuss what you have written with your classmates. Ask questions to find out how their stories continue.

7 Webquest

- Search for images of rainbows and clouds taken from a plane. Choose your favourite and explain what you can see in it and why you like it.
- Read about Newton's Third Law of Motion.

How the world works when you're sitting on a plane

Level 3 • Advanced

KEY

2 Key words

1. insubstantial
2. altitude
3. scattered
4. seething with
5. plunges
6. bombarded
7. long-haul
8. bland
9. savour
10. inertial tracking
11. legislation
12. vortex
13. clearance
14. disperse
15. manoeuvring

3 Before reading

Teacher's note: Answers are given for your reference, although students should be encouraged to attempt their own definitions. They will be able to check their answers in the text.

1. the feeling of being very tired and sometimes confused because you have travelled quickly on a plane across parts of the world where the time is different
2. sudden, violent movements of air
3. one of the areas that the world is divided into for measuring time
4. The wing is shaped to push air downwards. As the air is pushed down, the wing gets an equal and opposite push upwards, lifting the plane.
5. Students' own answers.

4 Comprehension check

Teacher's note: You could turn this into a team quiz.

1. 740mph
2. Vortices generated by the previous plane need time to settle or the following plane would be difficult to handle.

3. Glass-like ash particles melt in the heat of the engine, then solidify on the rotors.
4. They are opened inwards before being manoeuvred out of the way. The pressure difference between inside and outside forces the door into place.
5. because water should be just under 100°C when it is poured on to tea leaves, which isn't possible on a plane
6. Newton's Third Law of Motion
7. You can be injured or killed if you are not strapped in or get struck by poorly secured luggage.
8. Keep food bland for 24 hours before travel, drink plenty of fluids and live on your destination time from the moment you reach the aircraft.
9. Sunlight is white. Blue light scatters more than the lower-energy colours, so the blue appears to come from the sky.
10. There are 50 cloud types and nine categories.
11. They do, but the droplets take a long time to sink.
12. Batteries are not efficient enough.

5 Expressions

1. on cloud nine
2. a needle in a haystack

7 Webquest

Teacher's note: British Airways has an interesting selection of cloud photos taken by passengers, complete with captions.

<http://businesslife.ba.com/News-and-Blogs/Cloudbank/Your-inspirational-cloud-photos.html>

There are lots of websites and videos aimed at children that explain Newton's Third Law of Motion in simpler English. For example, <https://www.youtube.com/watch?v=mn34mnnDnKU> (from 5:05 minutes).