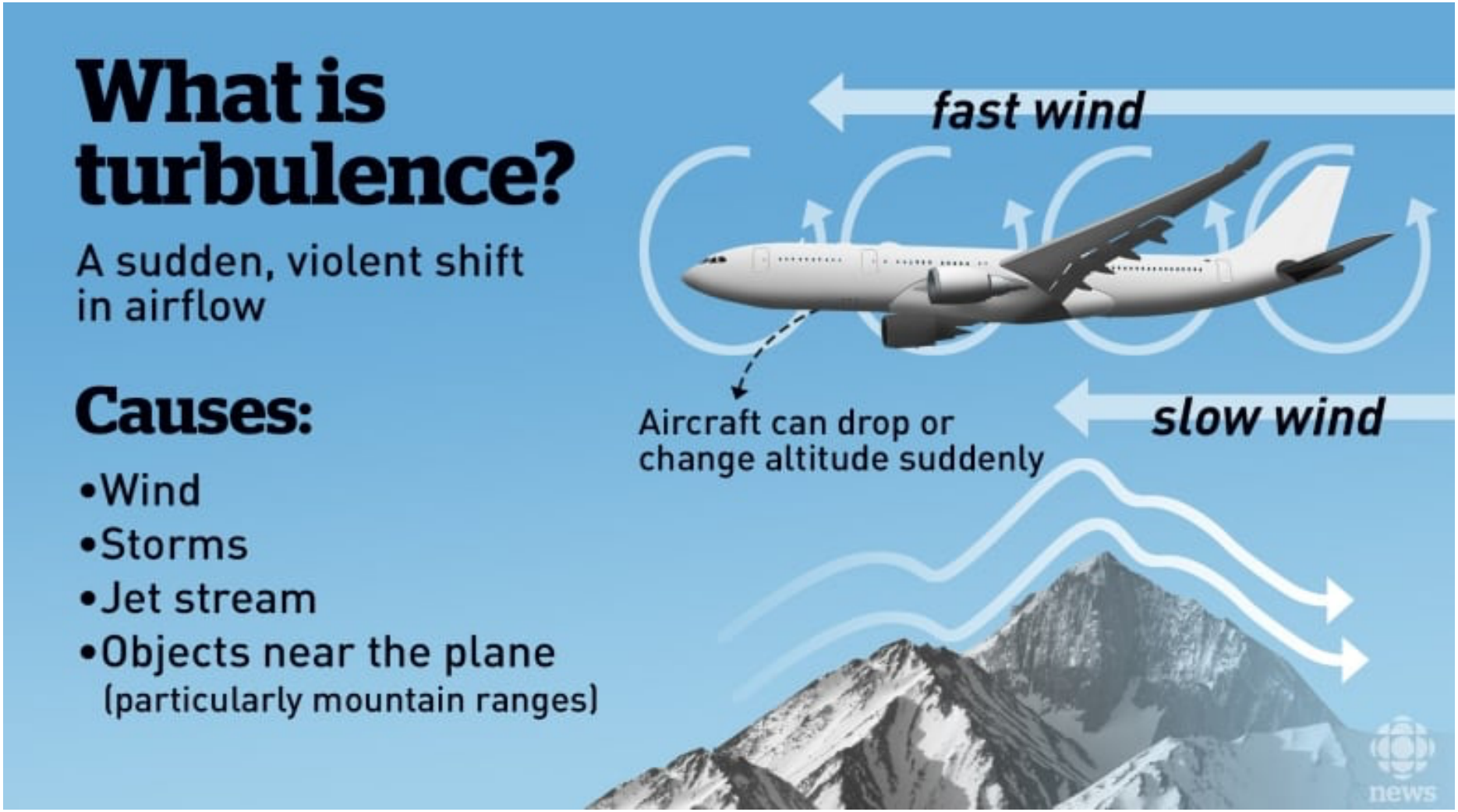
IAC2303 Airline Safety Management

Unit 8
Turbulence/ Decompression

Turbulence is a sudden, violence shift in airflow.



https://blog.klm.com/what-causes-turbulence/

Categories

1.Light Turbulence:

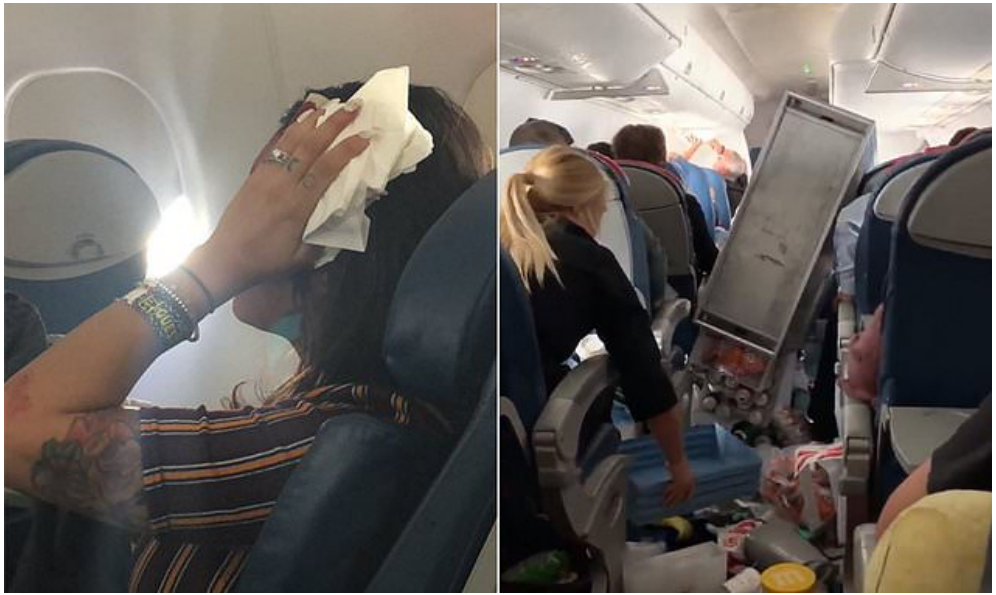
- Slight, erratic changes in altitude and/or attitude (pitch, roll, yaw).
- Liquids are shaking but not splashing out of cups
- Carts can be maneuvered with little difficulty
- Passengers may feel a light strain against seat belt
- At its lowest levels, you might not even notice it.

2.Moderate Turbulence:

- Plane's altitude could change by up to six meters. and/or attitude occur but with more intensity than light turbulence.
- Aircraft remains in control at all times.
- Liquids are splashing out of cups.
- Difficulties to walk or stand without balancing or holding on to something.
- Carts are difficult to maneuver.
- Passengers feel definite strain against seat belt.

3.Severe Turbulence:

- Large, abrupt changes in altitude and/or attitude. Usually causes large variations in airspeed.
- Items are falling over, unsecured objects are tossed about.
- Walking is impossible.
- Passengers are forced violently against seat belts.



Turbulence Intensity

Light

Rise/drop 1 metre

Hardly noticeable to passengers

Moderate

Rise/drop 3-6 metres

Drinks may spill

Severe

Rise/drop up to 30 metres

Occupants can be thrown if not strapped in

AskthePilot.com, FlyingWithConfidence.com

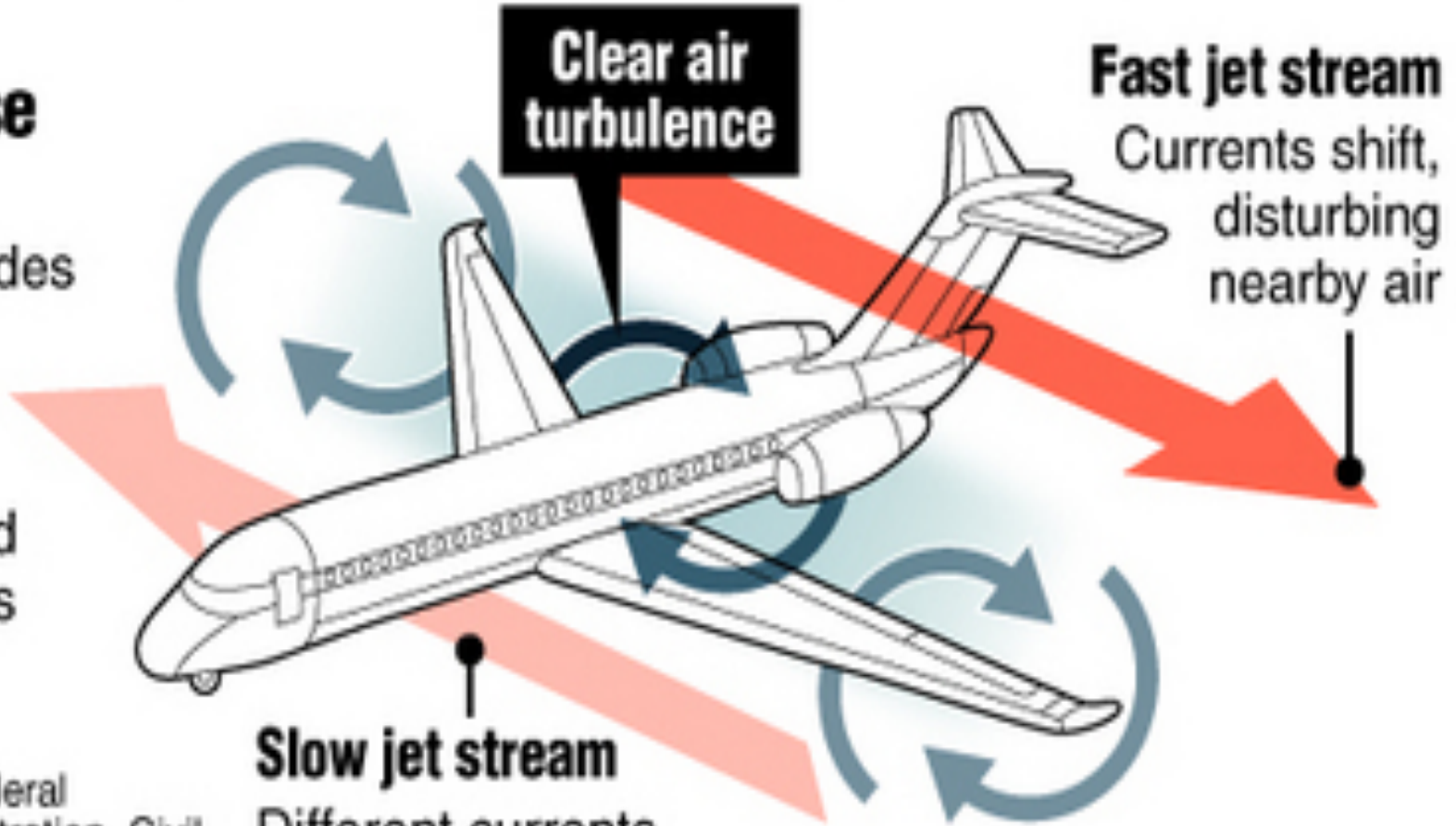
news

Invisible trouble

Clear air turbulence occurs in the space between fast and slow jet streams. It cannot be seen and aircraft radar cannot detect it.

Main cause

Plane flies at high altitudes and moves through air of different densities and temperatures



Source: U.S. Federal Aviation Administration, Civil Aviation Safety Authority
Graphic: Melina Yingling

CAT (Clear Air Turbulence)

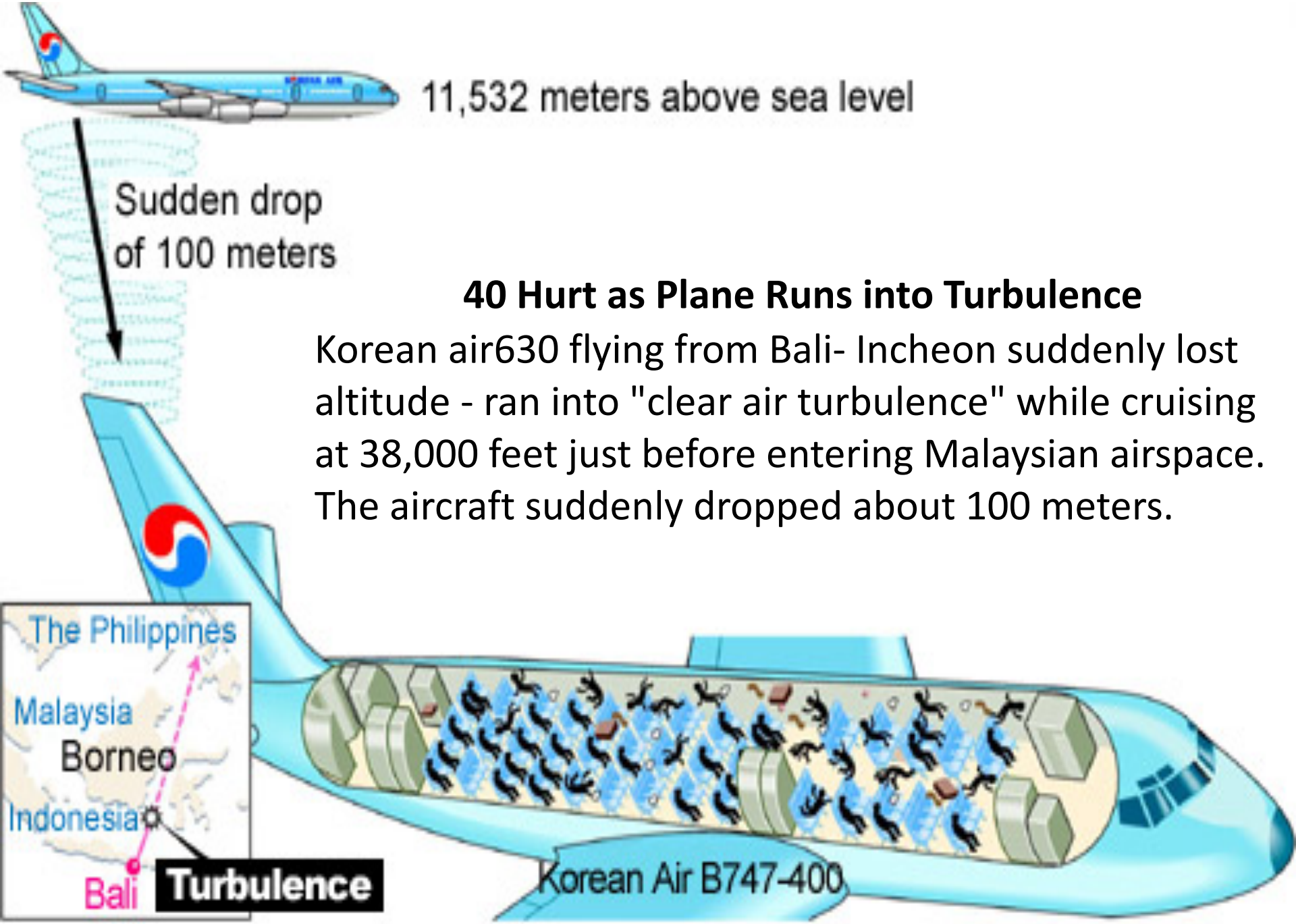
The most common type of turbulence is Clear-air turbulence" which cannot be accurately forecast and is extremely difficult to detect on radar.

It occurs when cold and warm air come together. It's most common at altitudes of 7,000 to 12,000 meters.

To avoid these rough patches, pilots primarily rely on reports from other aircraft.

The aircraft become irregular motion and, the cabin shall be warned by seat belt sign.

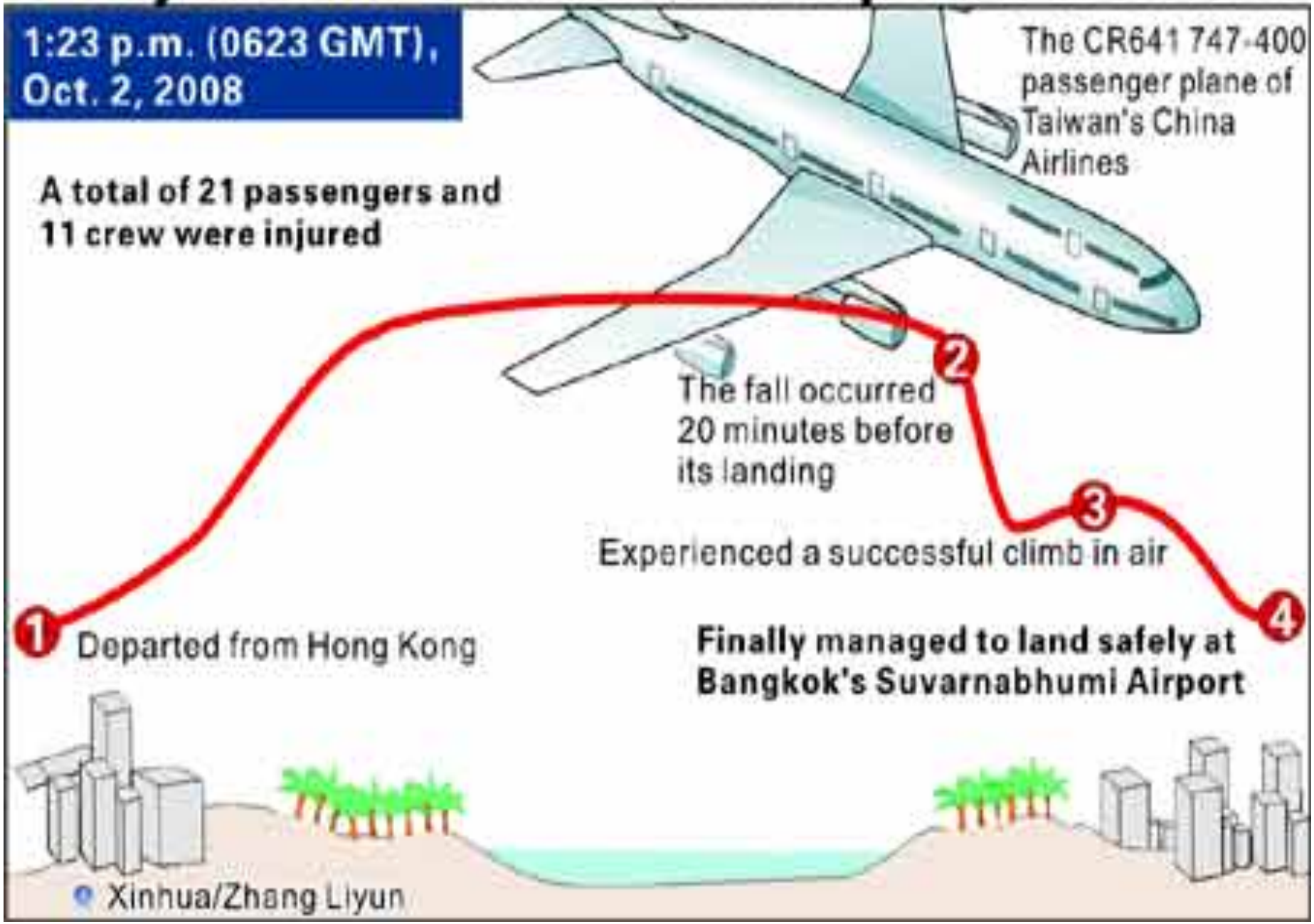
k1689934 www.fotosearch.com



40 Hurt as Plane Runs into Turbulence

Korean air630 flying from Bali- Incheon suddenly lost altitude - ran into "clear air turbulence" while cruising at 38,000 feet just before entering Malaysian airspace. The aircraft suddenly dropped about 100 meters.

32 injured in China Airlines plane accident



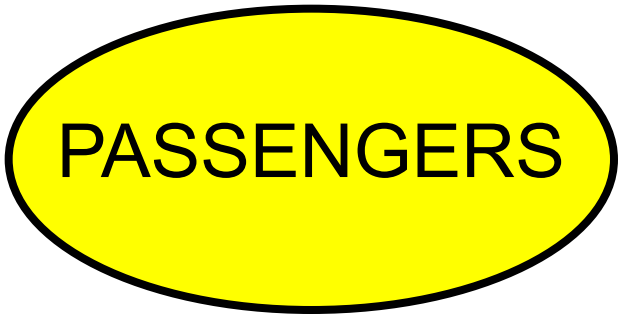
Be reminded that turbulence caused damage & injury

SQ308; SIN-LON A380/Jun,2013

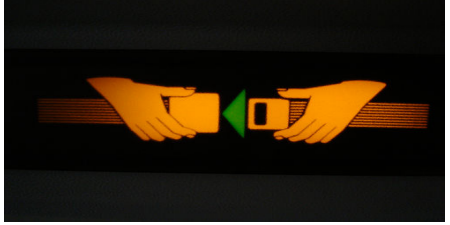
TG600; BKK-HKG A380/Aug,2013

Action during TURBULENCE

- FC advice Purser of turbulence level, duration & when
- Turn on seat belt sign
- Cabin make PA



Turbulence



Cabin Characteristic

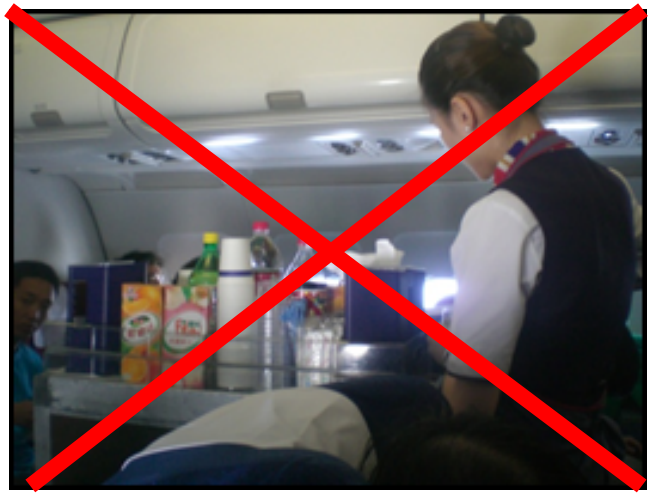
- Coffee shaky, may or may not splashes out of cup.
- Objects fall over
- Standing difficulty or impossible without holding something

Crew Actions

- FC turn on Belt sign
- CC PA request pax, sit and fasten seat belt.
- CC monitor cabin, if…..
- CC secure in the nearest seat or sit on floor.
- Pilot coordinate for further condition

Services

- Stop service
- Return carts to GLY
- If not, brake & secure cart in present place.
- Cover coffee/tea pot and keep inside cart.



Be prepared for turbulence

There are standard precautions to minimize the effects of turbulence:

- Plan where you will sit
- Keep your galley organized and secure at all times.
- Stow all coffee pots and food items when not in use.

- Open what you need, Keep carts, bins, and service supplies stowed in between services.
- If it feels rough to you and may become too turbulent inform the cockpit.

When you hear an announcement from a cockpit informing flight attendants to return to seats :

- **put away your galley service items,**
- **go to your jump seat**
- **strap and remain seated until advised by the captain**

Is turbulence dangerous?

Light turbulence happens almost every flight, and causes little difficulty perform a job.

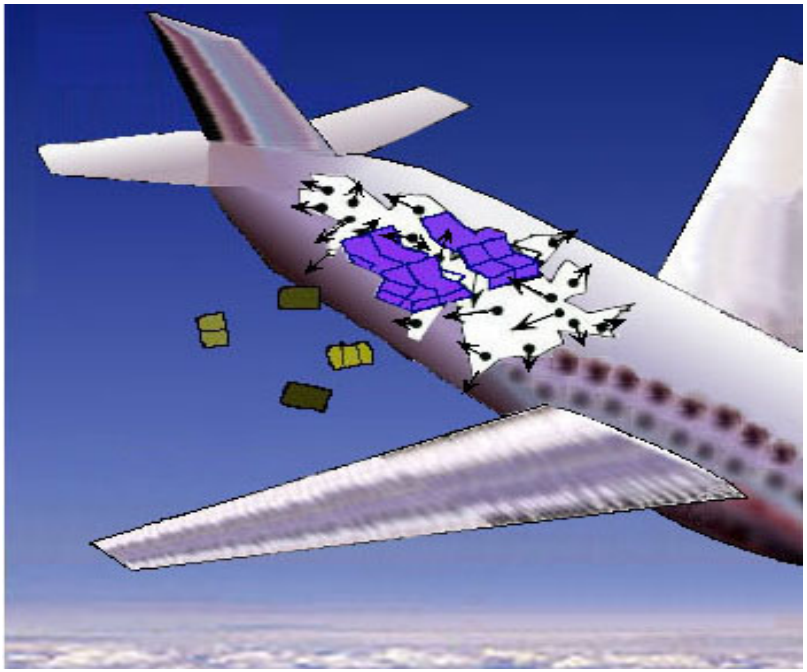
Moderate turbulence or greater can cause injury to both passengers and crew.

Pressurization System

Human body cannot tolerant to be alive over the flying altitude


35,000 feet
30,000-34,000 feet
6,000 feet

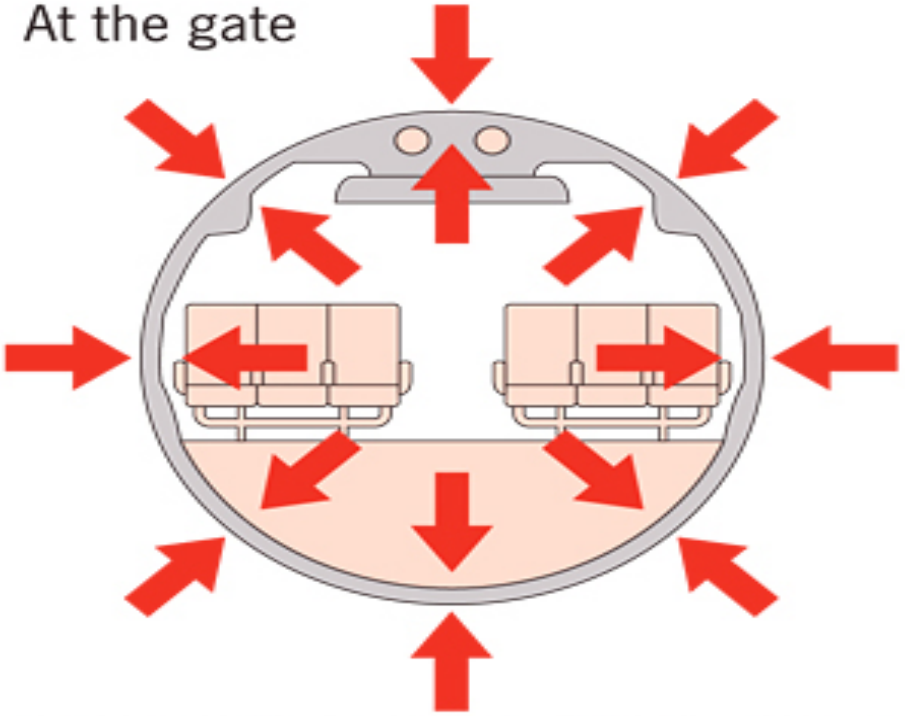
Decompression



AIR PRESSURE INSIDE A PLANE INCREASES DRAMATICALLY WITH ALTITUDE. THIS STRESS CAN WEAKEN THE PLANE'S SKIN OVER TIME.

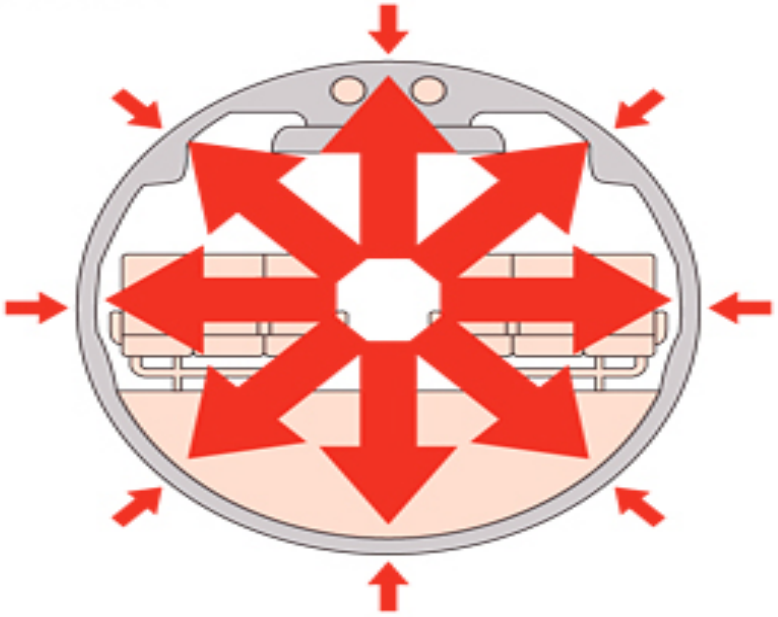
CROSS SECTION OF A 737 FUSELAGE SHOWN BELOW

At the gate



When on the ground, air pressure is equal inside and outside the plane.

At cruise



At 35,000 feet, inside air pressure is greater than outside, like a balloon.

cabin pressurization

- A cabin pressurization system maintains a cabin pressure altitude of approximately 8,000 feet at the maximum designed cruising altitude of an aircraft.

- This prevents rapid changes of cabin altitude that may be uncomfortable or cause injury to passengers and crew.

Decompression

“ The malfunction of aircraft pressurization system to maintain its cabin altitude regularly.”

Decompression(Cont.)

This may caused by

- **A malfunction in pressurization ,**
- **A structural damage to aircraft**

If the cause of the decompression is a structural failure, Ex: failure of a window,

there may be a risk of some crew or passengers being buffeted by strong winds, hit by debris, and extreme cold temperatures or being sucked out of the aircraft.

The consequences of decompression, and its impact on cabin occupants, depend on:

1. **The size of the cabin**: The larger the cabin, the longer the decompression time.

2. **The damage to the aircraft structure**: The larger the opening, the faster the decompression time.

3. **The pressure differential**: The greater the pressure differential between the cabin pressure and the external environmental pressure, the more forceful the decompression.

When cabin pressure decreases, there is an increased risk of hypoxia, decompression, illness, and hypothermia.

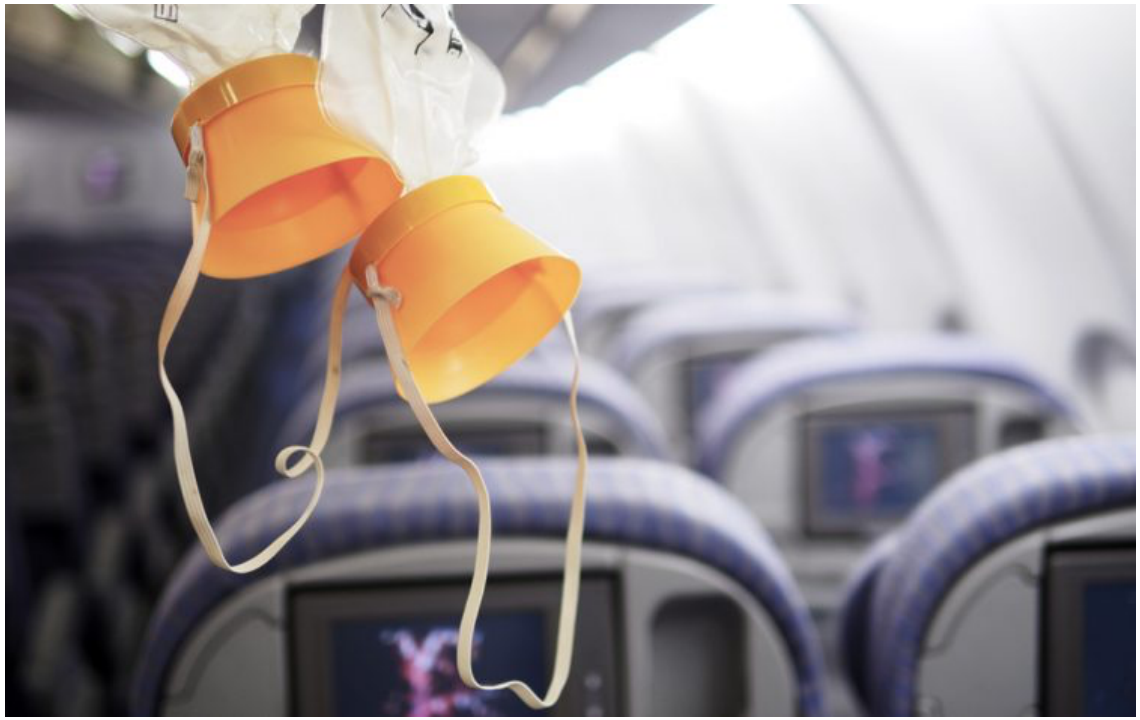
Types of Decompression

1.Rapid/Explosive decompression :a sudden loss in cabin pressure with signs of

- ***Explosive/loud noise :*** **A loud bang results of the sudden contact between the internal and external masses of air.**
- ***Foggy in the cabin :*** **Cloud of fog or mist in the cabin that is due to the drop in temperature, and the change of humidity.**
- ***Rush air toward damage area :*** **Rush of air, as the air exits the cabin**

: A decrease in temperature, as the cabin temperature equalizes with the outside air temperature.

: The release of the cabin oxygen masks, when the cabin altitude reaches 14,000 feet.



2. Slow Decompression

- Slow decompression involves a gradual decrease in cabin pressure. May be the result of a faulty door seal, a malfunction in the pressurization system, or a cracked window.
- Slow decompression may not be obvious. The cabin crew may not notice the changes in the cabin, until the oxygen masks drop down .
- One of the first physiological indications may be ear discomfort or ‘popping’, joint pain, or stomach pain due to gas expansion, headache or dizzy, blurred vision and sleepy

SLOW DECOMPRESSION

Cabin indication

- Noise/whistling from window or door.
- Cabin temperature drops, haze appear.
- If pressure leak is slow, no obvious change until emergency oxygen mask drop.

- Events held on the SKYbrary A&I database which include reference to the oxygen system include:
- B772, Cairo Egypt, 2011
- On 29 July 2011 an oxygen-fed fire started in the flight deck of an Egypt Air Boeing 777-200 about to depart from Cairo with most passengers boarded. The fire rapidly took hold despite attempts at extinguishing it but all passengers were safely evacuated via the still-attached air bridge access to doors 1L and 2L. The flight deck and adjacent structure was severely damaged. The Investigation could not conclusively determine the cause of the fire but suspected that wiring damage attributable to inadequately secured cabling may have provided a source of ignition for an oxygen leak from the crew emergency supply
- A332, en-route, North Atlantic Ocean, 2001
- On 24 August 2001, an Air Transat Airbus A330-200 eastbound across the North Atlantic at night experienced a double-engine flameout after which Lajes on Terceira Island in the Azores was identified as the best diversion and a successful glide approach and landing there was subsequently achieved. The Investigation found that the flameouts had been the result of fuel exhaustion after a fuel leak from the right engine caused by a pre flight maintenance error. Fuel exhaustion was found to have occurred because the flight crew did not perform the QRH procedure applicable to an in-flight fuel leak.
- RJ1H, en-route, South West of Stockholm Sweden, 2007
- On 22 March 2007, climbing out of Stockholm Sweden, the crew of a Malmö Aviation Avro RJ100 failed to notice that the aircraft was not pressurised until cabin crew advised them of automatic cabin oxygen mask deployment.
- B744, en-route, South China Sea, 2008
- On 25 July 2008, a Boeing 747 suffered a rapid depressurisation of the cabin following the sudden failure of an oxygen cylinder, which had ruptured the aircraft's pressure hull. The incident occurred 475 km north-west of Manila, Philippines.

DECOMPRESSION
Indications

'No Smoking' and
'Fasten Seat Belt' signs will come on.

Pre- record announcement
Emergency descent,
sit down & don oxygen mask”

At night: turn on cabin lights fully bright./ auto

Time of Useful Consciousness (T.U.C)

Time of Useful Consciousness		
Altitude	Moderate Activities	Sitting Quietly
42,000	12 sec	18 sec
40,000	18 sec	30 sec
35,000	30 sec	45 sec
30,000	45 sec	75 sec
28,000	60 sec	90 sec
25,000	2 min	3 min
22,000	5 min	10 min

•For a young, healthy, active adult.

***Smoking, alcohol and drugs reduce the tolerance to withstand altitude. Crew engaged in light to moderate activity has less T.U.C. than a non-active passenger to effectively obtain supplemental oxygen after decompression.

Immediate Actions of crew

In the case of decompression, the first actions to be performed by the cabin crew are:

- Immediately don the nearest oxygen mask.
- Sit down fasten your seat belt, or grasp a fixed object.
- Hold on.
- If the cabin crew is not able to sit down or grasp a fixed object, they should wedge themselves between passengers and ask passengers for assistance.

- **The priority of the cabin crew is to consider their personal safety.**
- **Incapacitated or injured cabin crew members will not be able to assist passenger during the post-decompression phase.**

- ***If no seat available ,sit on the floor & hold on to safe self.***
- ***IF Decompression occur at night, switch on the light bright to wake up passenger.***

MANUAL DEPLOYMENT

POST RAPID DECOMPRESSION

PIC PA "Ladies & gentlemen, now we have reached the safe altitude"

Quick Actions

- ***CONSIDER YOURSELF***
- ***CARRY portable oxygen bottle***
- ***CHECK CONDITION AROUND***

At 10,000 ft. or below

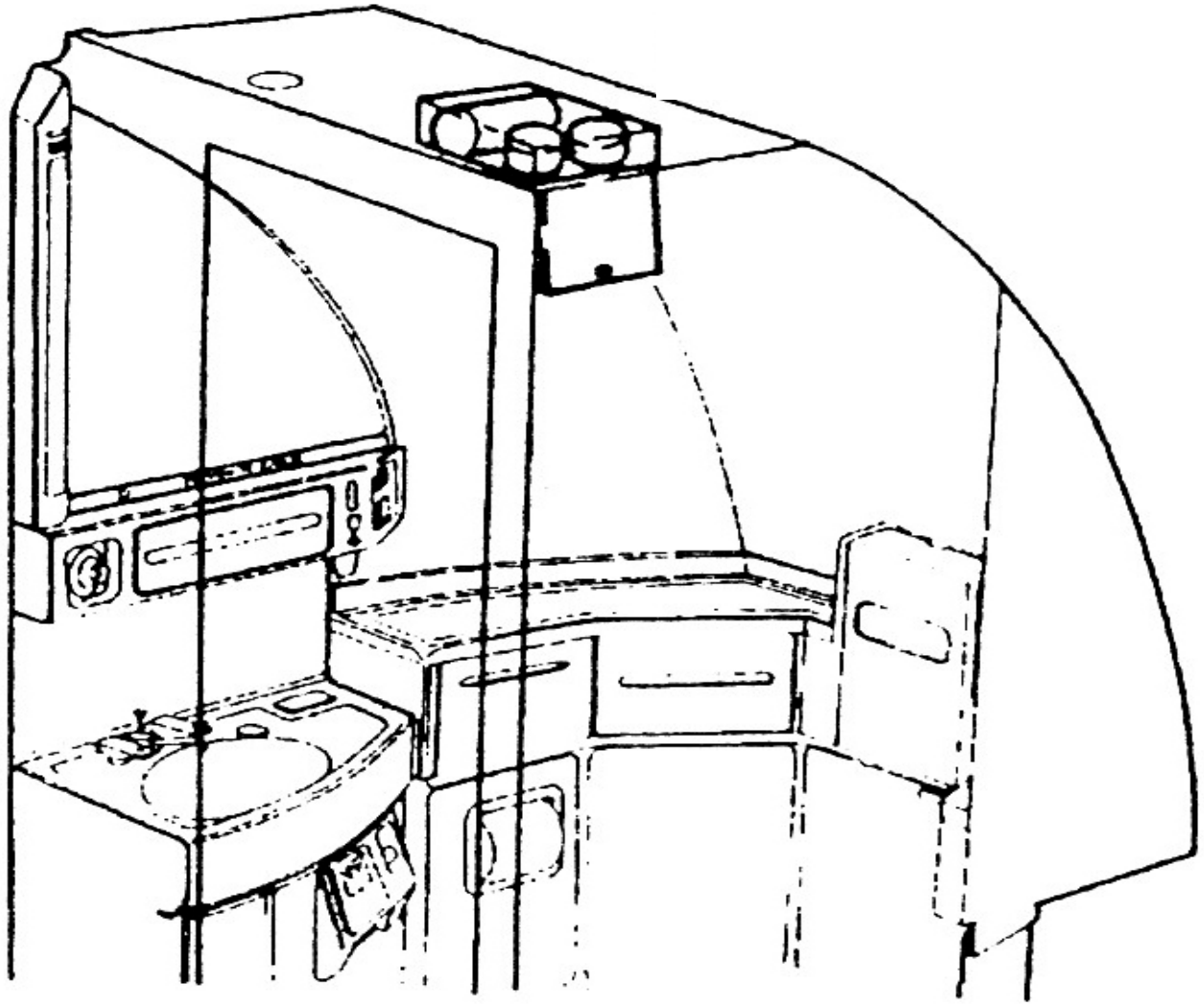
POST RAPID DECOMPRESSION (Cont)

After a decompression, when the aircraft reaches a safe altitude, the crew can and use the portable oxygen cylinders until they can breathe without support , the cabin crew should:

- Check their oxygen requirements. Due to the physical activity at an increased altitude, the cabin crew may still be exposed to hypoxia.
- Check on the flight crew, and be prepared to assist in the case of pilot incapacitation

- **Check passengers** for any injuries
- **Check the cabin** for any damage
  Provide first-aid and oxygen, as necessary
- **Report** the cabin status to the flight crew.

Handle O2 bottle carefully



** Emergency Oxygen Mask
NOT provided in the lavatory

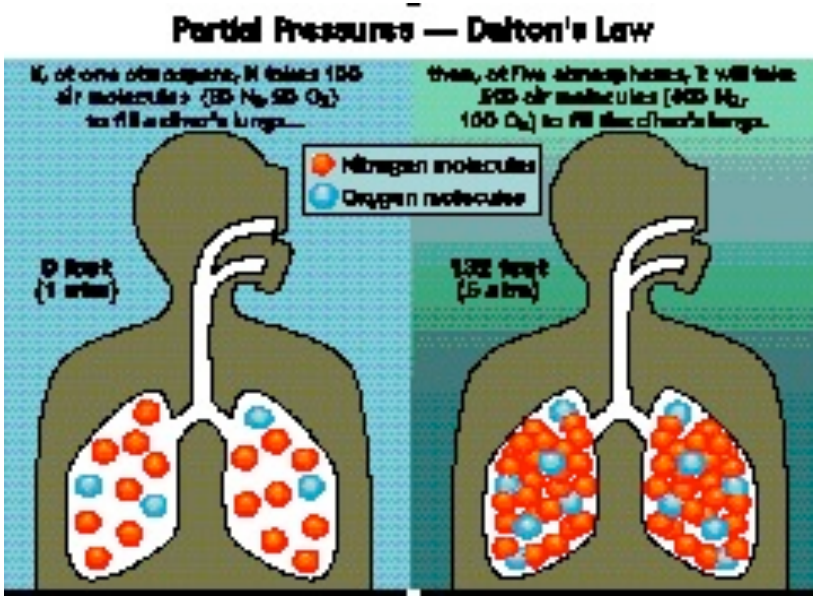
Put on your own oxygen mask before helping those around you.

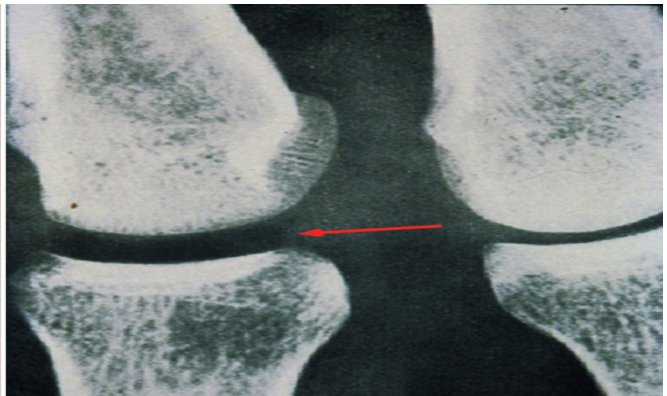
What is Decompression Sickness

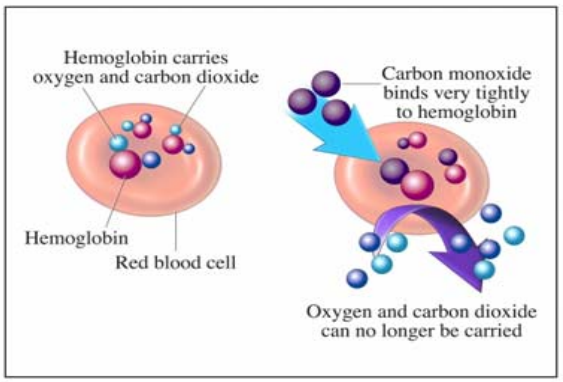
- Known as a gas bubble formation,
- Gas in blood is forced out by decrease atmosphere pressure.
- Crewmembers shall not resume flying duty immediate after deep diving over 30 meters take rest 24 hours, if less 12 hours.

Symptoms of Decompression sickness

- Joint pains
- Chest pains
- Creeps
- Chokes
- Visual impairment
- Hypoxia, Hyperventilation







Hypoxia

1.The first signs include mental and physical effects.

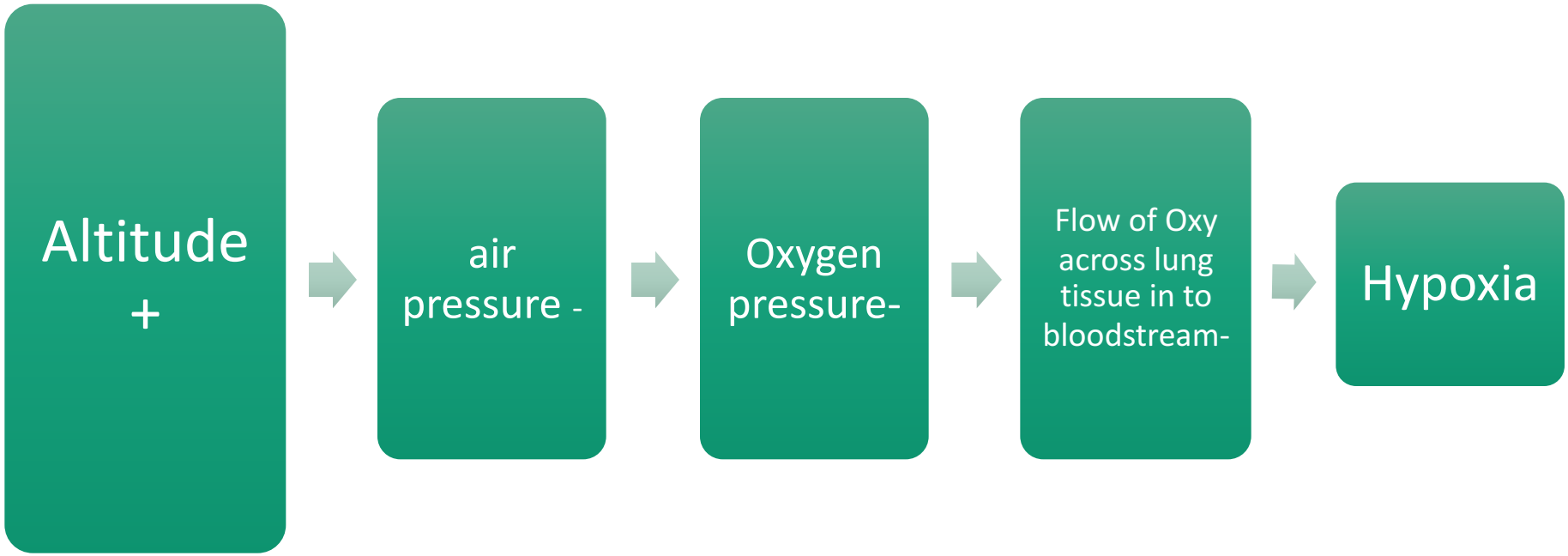
- **Mentally** : a loss of judgement, self-criticism and short-term memory.
- **Physically** : muscular incoordination and an impairment of color, night and peripheral vision. Hearing deteriorates.

2.Rapid breathing or hyperventilation

3.Simple tasks become difficult . As hypoxia continues, you become semiconscious.

After you will lose consciousness entirely.

Malfunction in pressurization



Effects

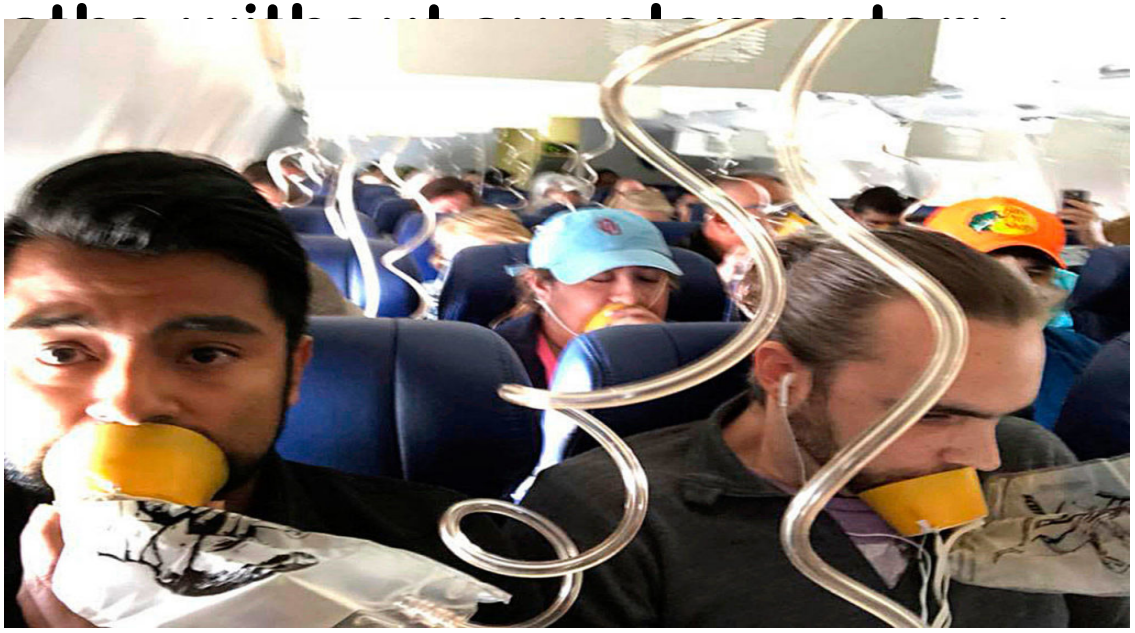
- Crew Incapacitation. Depending on the altitude of the aircraft

Loss of pressurization can very quickly lead to the incapacitation of the crew and passengers unless they receive supplementary oxygen.

Solutions

Oxygen it is essential that the flight crew don oxygen equipment as soon as possible.

- Emergency Descent. In the case of an uncontrolled depressurization, the cockpit crew will descend immediately to an altitude at which they can bre
oxygen.



RAPID DECOMPRESSION

A cargo door failure after its stopover at Honolulu, Hawaii. The resulting Rapid decompression blew out several rows of seats, resulting in the deaths of 9 passengers.

RAPID DECOMPRESSION

Obvious, cabin pressure change suddenly

RAPID DECOMPRESSION

April, 2011: Southwest Airlines 812 (B737-300)

- from Phoenix- Sacramento
- 1.5 m. strip of aircraft's fuselage was torn away
- leading to rapid decompression at 34,000 fts.
- Pilot took aircraft to a lower altitude and land safely at nearby airport.
- similar to Aloha 243 Boeing 737 -200.

These are seriously busy aircraft that take off & land nine times per day.

Reference

http://www.smartcockpit.com/docs/Cabin_Decompressions_Awareness.pdf

https://blog.klm.com/what-causes-turbulence/