

DEDICATED TO HELPING BUSINESS ACHIEVE ITS HIGHEST GOALS.



High Altitude Concerns

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PRESENTED BY:

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DEDICATED TO HELPING BUSINESS ACHIEVE ITS HIGHEST GOALS.



Welcome Aviators!



Question 1: _____

To what altitude may you fly with **passengers** on passenger oxygen masks (*continuous use*)?

Please write down your answers!



Question 2: _____

To what altitude may you fly with **CREW** on EROS oxygen masks (continuous use)?

Please write down your answers!



Answers:

To what altitude may you fly with **passengers** on passenger oxygen masks (*continuous use*)?

25,000'

To what altitude may you fly with **CREW** on EROS oxygen masks (*continuous use*)?

40,000' (41,000')

Typical Aircraft Flight Manuals

You are over the equal time point mid-ocean no passengers when you begin to lose pressurization (assume 7 + 20 Oxygen available).

What do you do?

To what altitude will you descend?

Please write down your answers!



You are over the equal time point (ETP) mid-ocean with two passengers when you begin to lose pressurization (assume 4 + 30 of Oxygen available).

What do you do?

To what altitude will you descend?

Please write down your answers!



Decompression Sickness (DCS)

Nitrogen Narcosis

Definition: “A reversible alteration in consciousness that occurs while diving at depth...Narcosis produces a state similar to alcohol intoxication or nitrous oxide inhalation and can occur during shallow dives but does not usually become noticeable at depths less than 30 meters (100 ft.)”.

This is not decompression sickness!

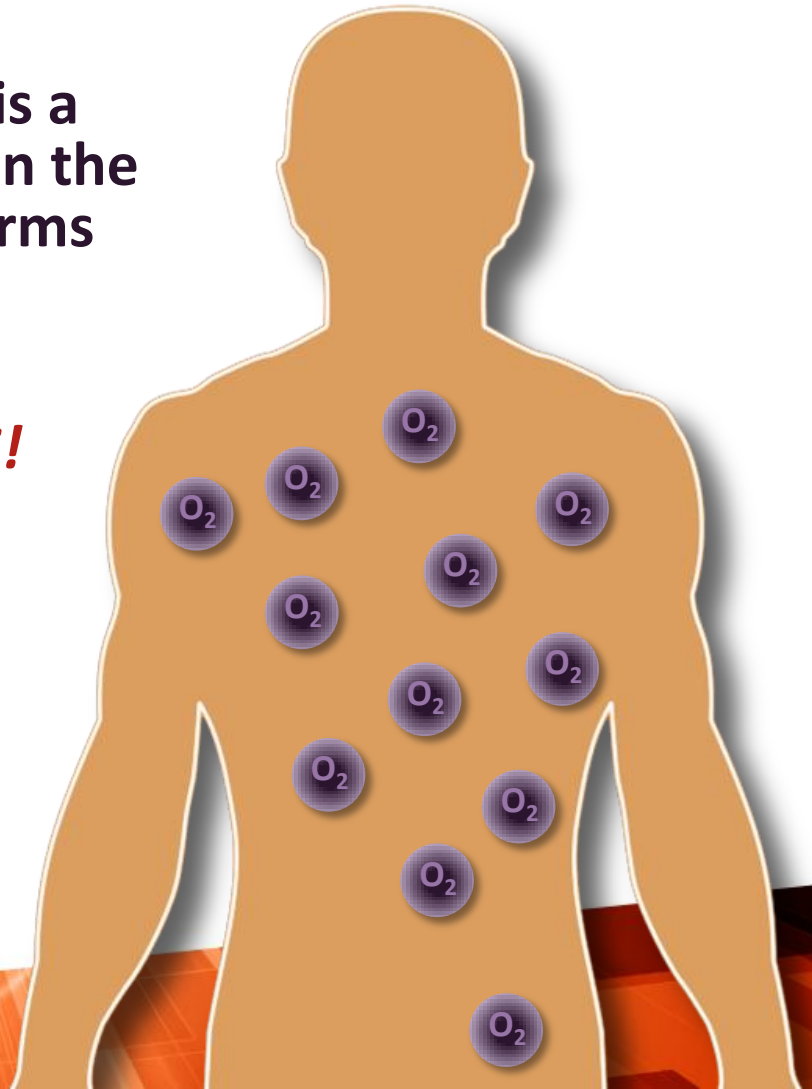
(Naval Safety Center, 2013)

The Bends (Caisson Disease)

Definition: “Decompression sickness is a disorder in which nitrogen dissolved in the blood and tissues by high pressure forms bubbles as pressure decreases”

This is decompression sickness or DCS!

(Naval Safety Center, 2013)



Henry's Law

“At a constant temperature, the amount of a given gas that dissolves in a given type and volume of liquid is directly proportional to the partial pressure of that gas in equilibrium with that liquid”. *(William Henry, 1803)*

**Pop open a bottle of soda.
Carbon dioxide is under pressure.**



**Once pressure is released, the gases come out of solution in the form of bubbles.
These tiny bubbles (if nitrogen) can be deadly.**

Consider...

**A diver enjoying a mid-Atlantic 100'
dive below you.**





**A shark arrives
on the scene...**

***Where does
the diver go?***

**UP!!!
Quickly!!!**

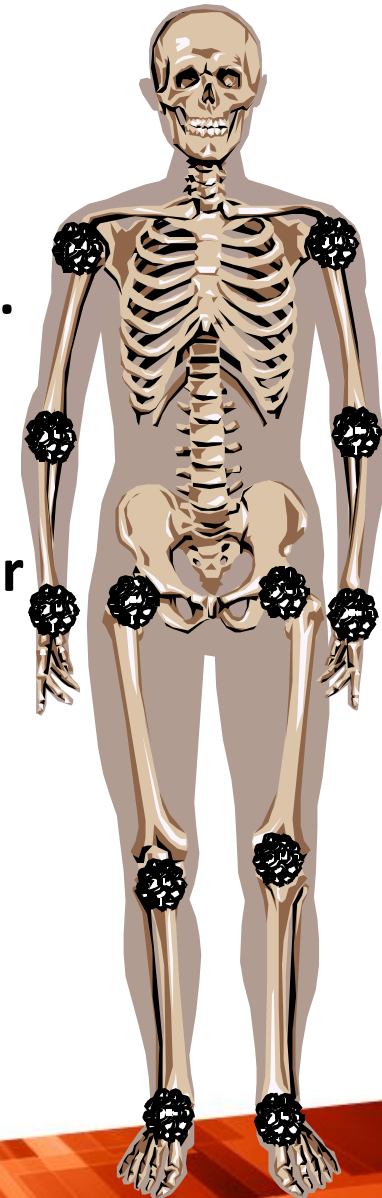




If he goes to the surface too fast, what does he get?

Nitrogen bubbles become trapped in the joints.

- **Deep pain will occur in the muscles and joints.**
- **Joints which have had previous injuries or surgeries are more susceptible.**



- **Are Pilots susceptible to the bends?**
- **Do aircraft encounter rapid or explosive decompressions?**

Decompression Sickness

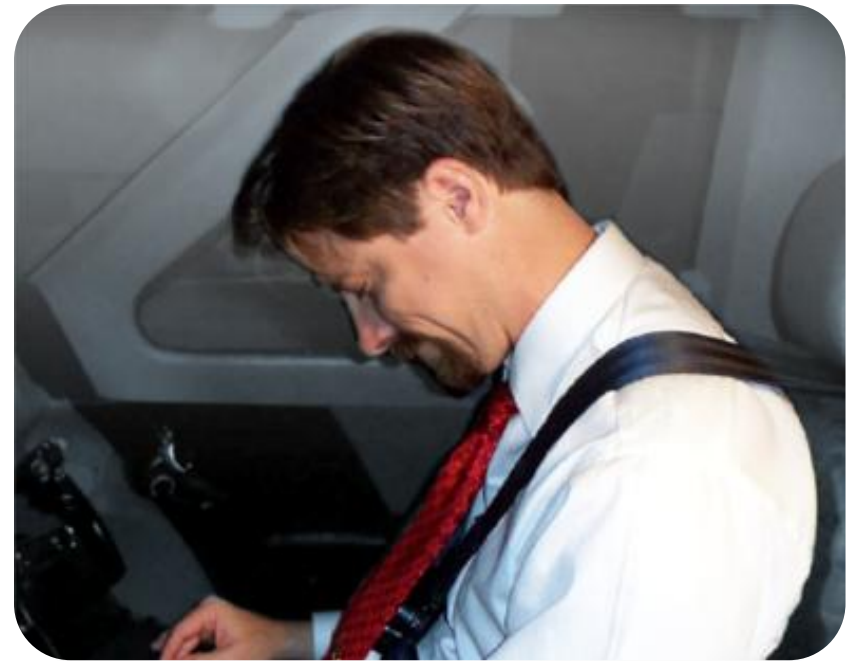
Aircraft	Date	Fatalities/# on board	Cause
AA Flight 96 DC-10	1972	0/67	Rapid Decomp. Cargo door failure
Far Eastern 103 B-737	1981	110/110	Expl. Decomp. Corrosion
Japan Airlines 123 B-747	1985	520/524	Expl. Decomp. Struct. Failure
Aloha airlines B-737	1988	1/95	Expl. Decomp. Metal Fatigue
Helios Airways 522 B-737	2005	121/121	Gradual Decomp. Crew Error
Southwest 812 B-737	2011	0/123	Rapid Decomp. Metal Fatigue

Explosive – Less than .1 to .5 seconds

Rapid – More than .1 to .5 seconds

Gradual – Unnoticed by crew
(can be detected only by instruments)

(FAA, 2013)

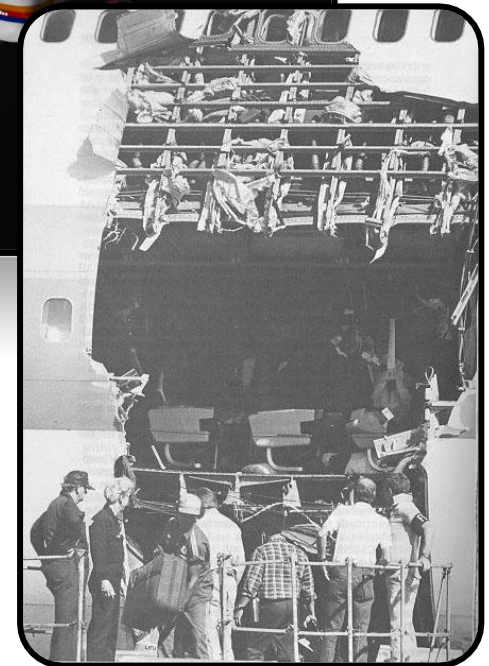


Less than .1 to .5 seconds

- Risk for lung trauma – **very high**
- Very rapid onset of Hypoxia
- Projectiles in the cockpit/cabin
- Similar to a bomb explosion
- Cabin will fog; dust will fly
- Pilot incapacitation – **PROBABLE!**



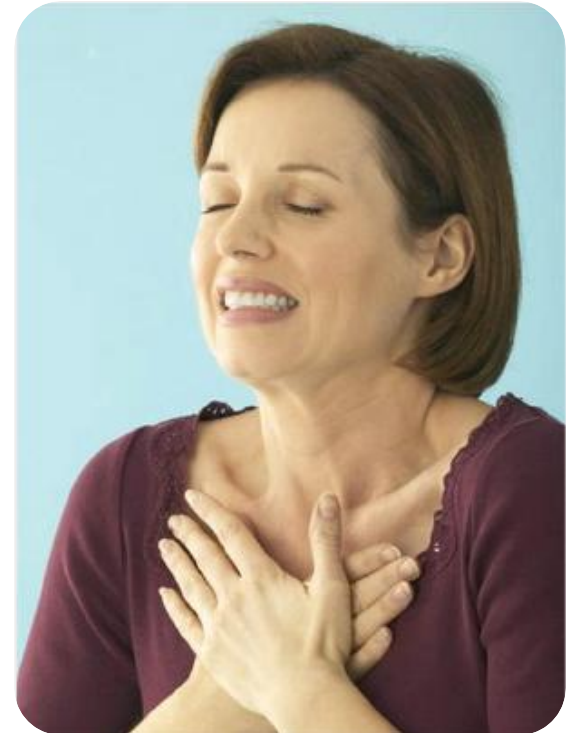
United 811



Rapid Decompression

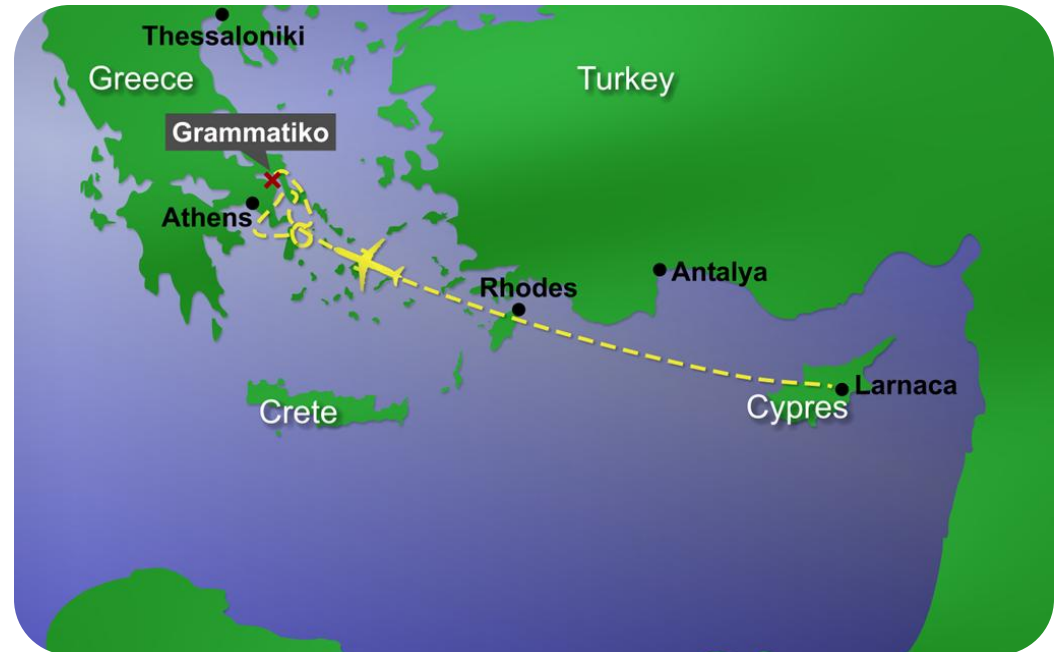
Greater than .1 to .5 seconds

- Risk for lung trauma – remains **possible**
- Rapid onset of **Hypoxia**
- Could lead to **decompression sickness**
- Pilot incapacitation – **POSSIBLE**



Undetected by crew

- Hypoxia could lead to **decompression sickness** if crew does not detect error or malfunction.
- Pilot incapacitation & Hypoxia – **insidious onset**



Helios Airways Flight 522

Crew left pressurization off/manual

121 fatalities

Helios Airways Flight 522

- Maintenance on right aft service door – Pressurization set to **MANUAL** by mechanics.
- Crew CRM/checklist usage – **3 times did not reset pressurization to AUTO**
- Crew misdiagnosed pressurization warning horns as take-off configuration horns
- Aircraft entered holding over Athens and ran out of gas – Crew observed by F-16 to be incapacitated
- Passenger masks (chemical generators) only good for 12 minutes at altitude



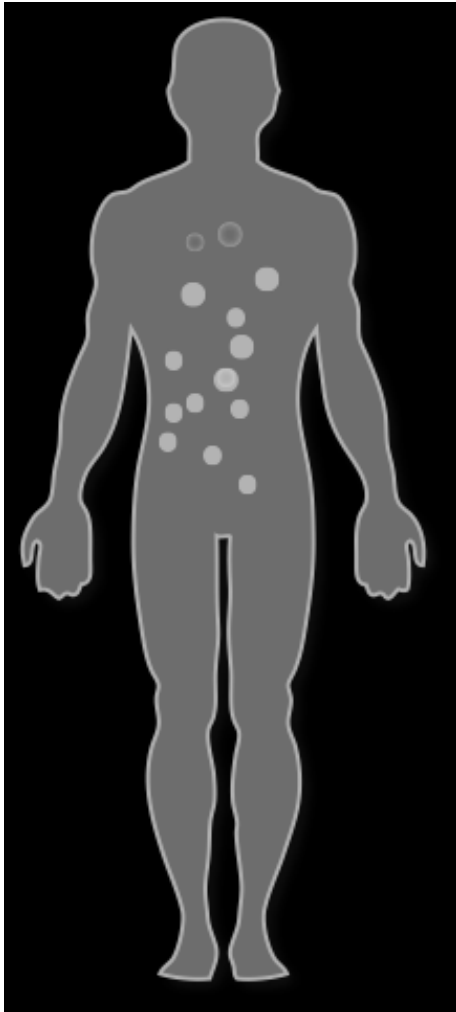
**Could you make a
similar mistake?
Never say never!**

*Consider distractions, fatigue,
personal problems, strange
environments...*



Definition: “A condition characterized by a variety of symptoms resulting from exposure to low barometric pressures that can cause inert gases (mainly nitrogen), normally dissolved in body fluids and tissues, to come out of physical solution and form bubbles.”

(FAA, 2013)



TYPE I

Less Severe

Typically called the bends, producing pain.

TYPE II

More Severe

Results in neurological symptoms ranging from mild numbness to paralysis and death

(FAA, 2013)

High Altitude Concerns

DCS Type	Bubble Location	Signs and Symptoms
Bends Type I	Elbows, wrists, shoulders, hips, etc.	Localized deep pain from mild to excruciating; occurs at altitude, during descent, or many hours later
Neurologic Type II	Brain, spinal chord, peripheral nerves	Confusion; memory loss, headaches, seizures, dizziness, vertigo, nausea, urinary or rectal incontinence, burning, tingling, stinging in lower chest and back, death
Chokes Type I	Lungs	Burning deep chest pain, shortness of breath, dry constant cough
Skin Bends Type I	Skin	Itching of ears, face, neck, arms, and upper torso; crawling insect sensation; marbled skin; swelling of skin; scar-like skin depressions (pitting edema)

- **Altitude: the higher the altitude, the greater the risk**
- **Rate of ascent (explosive/rapid decompression)**
- **Time at attitude: Longer the duration at altitude, the greater the risk**
- **Age: higher risk with increasing age**
- **Body type: high fat content = greater the risk**
- **Temperatures : Colder temps = greater risk**
- **Activity: Increased cockpit activity = greater risk**
- **Alcohol : After-effects of consumption increases risk**
- **SCUBA diving increases risk**
- **Stress; increased stress = greater risk**

(FAA, 2013; Air & Space Magazine, 2012)

Time is the critical factor!!!

(FAA, 2013; Air & Space Magazine, 2012)

1. **Perform Action Items: Oxygen masks, communicate; descend ASAP**
2. **Emergency descent to 10,000 ft. or MEA using the Doc4444 Maneuver (airlines use 14,000 ft.)**
3. **Remain on Oxygen to purge Nitrogen from tissues**
4. **Use FMS to determine ability to make it to an alternate airfield (slow climb may be required)**
5. **Once on the ground, check everyone into the hospital for observation!!!!!!
*Why??***



(FAA, 2013, Navy, 2013)

“Many symptoms of DCS don’t show up until after the pilot has landed, sometimes days later”.

“In the human body, bubbles can cause extreme pain, bruising, brain damage, and, without treatment, **death”.**

In USAF U-2 Program, there were 16 severe cases between 2002-2009; 5 were life-threatening; **9 had permanent brain damage**

(Air & Space Magazine, 2012)

1. **Aircrews should never treat a rapid (explosive) decompression as trivial. “Although you may not instantly feel the symptoms of DCS...they can debilitate your cognitive skills to the point that you aren’t thinking clearly, and you can’t make timely, accurate decisions” ...Even with your Oxygen masks on!!!!**
2. **Maintain crew integrity and watch each other for signs in flight and once on the ground**
3. **Symptoms vary with physiology and other factors**
4. **Always seek medical attention**
5. **Be proactive and attend an altitude chamber for regular hypoxia and DCS training**

(Approach Magazine, 2012)

Thank you and Fly Safely!

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