



**1 \* Diver**





# CMAAS

CONFÉDÉRATION MONDIALE  
DES ACTIVITÉS SUBAQUATIQUES

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WORLD UNDERWATER FEDERATION

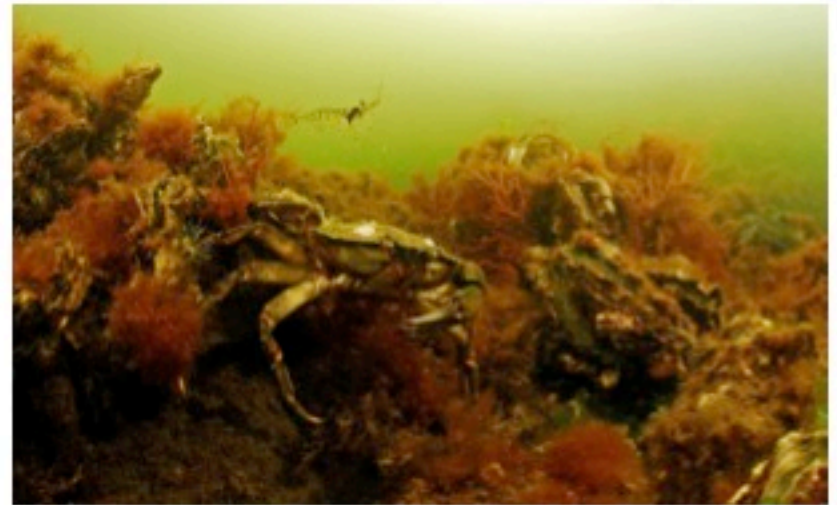
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## INTRODUCTION

- ♦ What are the diving motivation factors?
- ♦ Is it the deep blue sea appeal only?
- ♦ Scuba diving : a growing passion





# 2. Administration



## 2. ADMINISTRATION

### 2.1 HOW TO BECOME A DIVER

- Affiliation to a Federation.
- Approved by CMAS



# CMAS

CONFÉDÉRATION MONDIALE  
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WORLD UNDERWATER FEDERATION

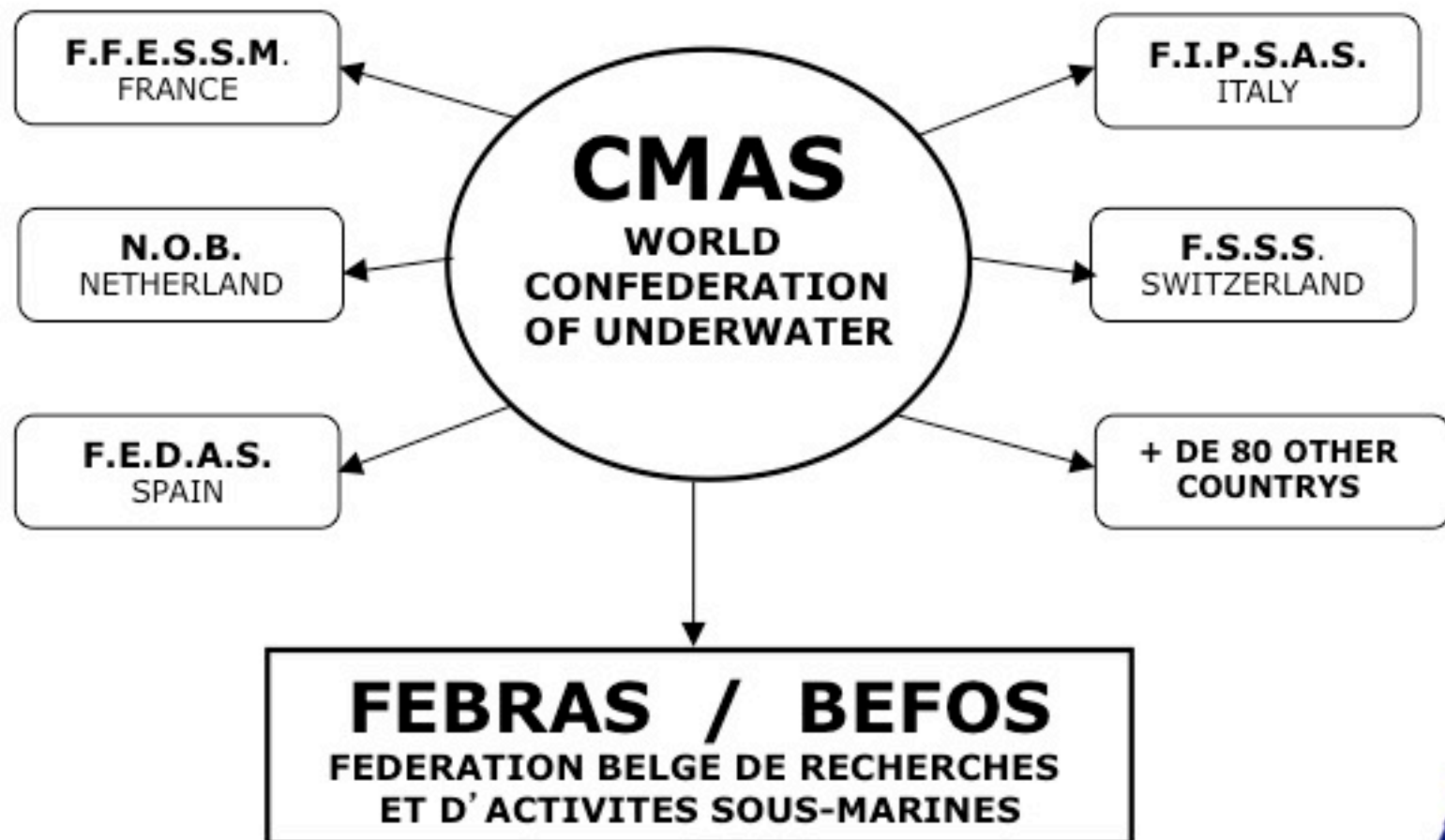
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## 12. ADMINISTRATION

### WORLDWIDE ORGANIZATION





## 2. ADMINISTRATION

### 2.2 LEVELS

- ♦ 3 levels of divers:
  - ✓ D 1 \* Diver
  - ✓ D 2 \* Diver
  - ✓ D 3 \* Diver
  - ✓ D 4 \* Diver
  
- ♦ 3 levels of instructors :
  - ✓ Instructor CMAS \*
  - ✓ Instructor CMAS \*\*
  - ✓ Instructor CMAS \*\*\*





## 2. ADMINISTRATION

### 2.3 ADMINISTRATIVE REQUIREMENTS

- ♦ **14 years** at least (increasing parental consent).
- ♦ Being a member to CMAS.
- ♦ Medical certificate of non-cons-indication to diving
- ♦ The card :
  - Card holder's name
  - First names
  - Nationality
  - CMAS number

The following numbering system should be used on all C-cards

"XXX / Y00 / ZZ / 99/888888"







## 2. ADMINISTRATION

### Why CMAS ?

- Patent recognized all over the world.
- Quality of teaching
- Quality of supervision.





## 2. ADMINISTRATION

### 2.4 INSURANCE

#### Mandatory

highly recommended to have an insurance cover for the practice of scuba diving activity





## 2. ADMINISTRATION

### 2.5 PREROGATIVES OF THE DIVER 1\*

- ◆ Diving AIR
- ◆ NO deco
- ◆ Daylight
- ◆ Direct veertical access
- ◆ Diving conditions equal or better as the training
- ◆ Maximum 20 meters/diver same level minimum





## **2. ADMINISTRATION**

### **2.6 HOMOLOGATION**

2.6.1 INTERNATIONAL CERTIFICATE

2.6.2 WHY THIS SYSTEM ?





## 2. ADMINISTRATION

### 2.7 10 GOLD RULES

1. Never enter the water through the reeds, live coral or water plants.
2. Keep away from corals, other animals and do not tamper with the sediment.
3. Check the inflatable vest
4. During dives, pay attention to where we dropped anchor.
5. Do not tickle, touch or feed wild animals.
6. Do not fish in underwater gun for fun; and not to buy or collect souvenirs
7. such as coral or shells.
8. Be careful when diving in caves. The bubbles can damage their fragile existence.
9. Respect the cleanliness of dive sites
10. Learn to know the underwater life and avoid its destruction.



The background of the slide is a photograph of two divers in a coral reef. The divers are wearing full scuba gear, including tanks, regulators, and masks. They are surrounded by a large school of yellowish fish and various types of coral. The water is clear and blue. The text '3. Parameters' is overlaid in white at the bottom of the image.

# 3. Parameters



## **3. PARAMETERS**

### **PRACTICAL TRAINING PARAMETERS**

**3.1 SWIMMING POOL**

**3.2 NATURAL ENVIRONMENT**





# 4. Obligatory materiel







## **4. OBLIGATORY MATERIEL**

**4.1 BASIC MATERIEL**

**4.2 DIVING EQUIPMENT**

**4.3 ADDITIONAL EQUIPMENT**

**4.4 EMERGENCY EQUIPMENT**



The background of the slide is a photograph of two divers in a vibrant coral reef. The divers are wearing full scuba gear, including tanks, regulators, and masks. They are surrounded by a large school of yellowish fish. The water is clear and blue, with sunlight filtering through. The text '5. Equipment' is overlaid in the bottom left area of the image.

# 5. Equipment



## 5. EQUIPMENT

### 5.1 SMALL EQUIPMENT

#### 5.1.1 FINS





# 5. EQUIPMENT

## 5.1 SMALL EQUIPMENT

### 5.1.2 MASK

One or two glasses



Transparent skirt



Opaque skirt





## 5. EQUIPMENT

### 5.1 SMALL EQUIPEMENT

#### 5.1.3 SNORKEL





# 5. EQUIPMENT

## 5.1 SMALL EQUIPEMENT

### 5.1.4 WEIGHTBELT



### 5.1.5 WEIGHTS





## 5. EQUIPMENT

### 5.2 THE DIVING EQUIPMENT

#### 5.2.1 THE TANK

- ◆ Capacity:
  - ✓ 3 L
  - ✓ 5 L
  - ✓ 7 L
  - ✓ 10 L
  - ✓ 12 L
  - ✓ 15 L
  - ✓ 18 L
  - ✓ 20 L
  - ✓ Bi-tank





## 5. EQUIPMENT

### 5.2 THE DIVING EQUIPMENT

#### 5.2.1 THE TANK

- ♦ Tank check list:

##### **O-JA-MOU-PRE-FUN**

- ✓ O'ring **O**
- ✓ Jacket **JA**
- ✓ Mount the regulator on the tank **MOU**
- ✓ Tank pressure **PRE**
- ✓ Proper functioning of the regulator out of the water **FUN**







## 5. EQUIPMENT

### 5.2 THE DIVING EQUIPMENT

#### 5.2.1 THE TANK

- ◆ Safety rules:
  - ✓ Don't leave the tank standing or without support.
  - ✓ Don't leave it unattended.
  - ✓ Avoid high temperatures exposure.
  - ✓ Store it vertically.
  - ✓ Avoid to store it for a long period without using it
  - ✓ Do not breathe if the full tank has not been used for a month
  - ✓ Do not store a completely empty tank





## 5. EQUIPMENT

### 5.2 THE DIVING EQUIPMENT

#### 5.2.2 THE REGULATOR



  
**1<sup>st</sup> stage**



  
**2<sup>nd</sup> stage**





## 5. EQUIPMENT

### 5.2 THE DIVING EQUIPMENT

#### 5.2.2 THE REGULATOR

- ♦ Goal = reduces pressurized breathing gas to ambient pressure and delivers it to the diver
- ♦ Two air source but better with 2 regulators
- ♦ Don't hesitate to ask more information to your instructor





## 5. EQUIPMENT

### 5.2 THE DIVING EQUIPMENT

#### 5.2.3 GAUGE





## 5. EQUIPMENT

### 5.2 THE DIVING EQUIPMENT

#### 5.2.4 THE BCD





## 5. EQUIPMENT

### 5.2 THE DIVING EQUIPMENT

#### 5.2.4 THE BCD

- ♦ inflator





## 5. EQUIPMENT

### 5.2 THE DIVING EQUIPMENT

#### 5.2.4 THE BCD

- ◆ Good use of the BCD
  - ✓ Adapt the buoyancy with the depth.
  - ✓ do not overuse the inflator.
  - ✓ Empty= BCD must be vertical
  - Inflator in high position
  - progressive purge

Warning 

- Important volume variation when close to surface





# 5. EQUIPMENT

## 5.2 THE DIVING EQUIPMENT

### 5.2.5 DIVING SUITS

- ◆ Suit.
- ◆ Gloves.
- ◆ Hood.
- ◆ Under suit.
- ◆ Booties.







# 5. EQUIPMENT

## 5.2 THE DIVING EQUIPMENT

### 5.2.6 MEASURING INSTRUMENTS

watch



Timer



computer

Compas



The background of the slide is a photograph of two divers underwater. They are positioned in the center-right of the frame, swimming towards the left. The diver on the left is pointing towards a large school of yellowish fish that is gathered around a coral reef on the left side of the image. The water is clear and blue, with some bubbles visible. The divers are wearing full scuba gear, including tanks, regulators, and masks. The overall scene is vibrant and captures a moment of marine life observation.

# 6. Physics



## 6. PHYSICS

### AIR COMPOSITION

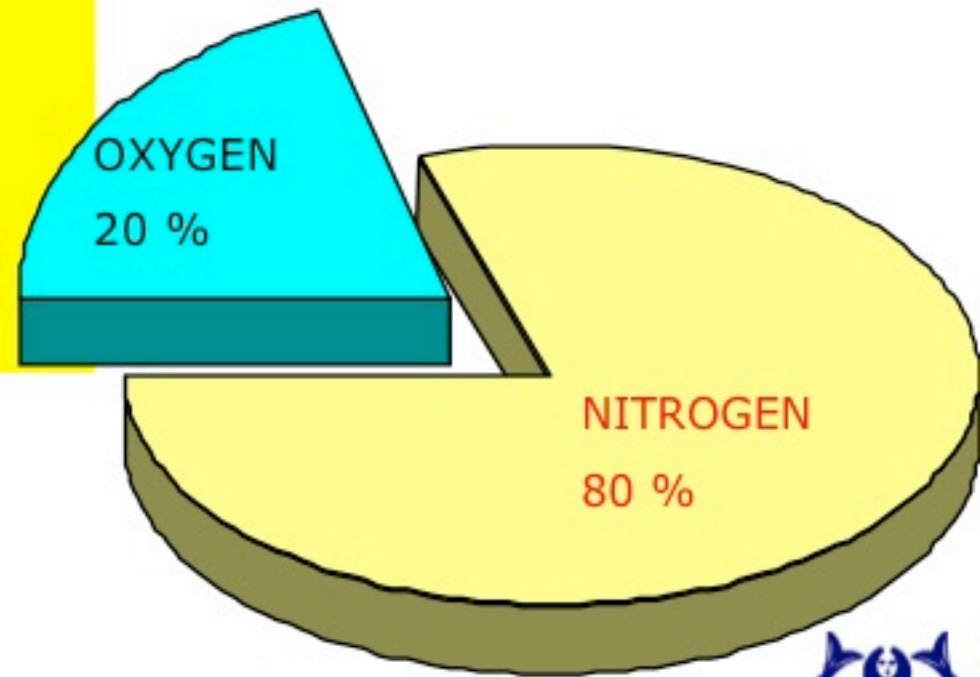
#### AIR = MIX OF GASES

20,9 % OXYGEN ( $O_2$ )

79 % NITROGEN ( $N_2$ )

0,04 % CARBON DIOXYDE ( $CO_2$ )

0,06 % RARE GASES





## 6. PHYSICS

### 6.1 ARCHIMEDE PRINCIPLE

Any object, wholly or partially immersed in a fluid, is buoyed up by a force equal to the weight of the fluid displaced by the object.

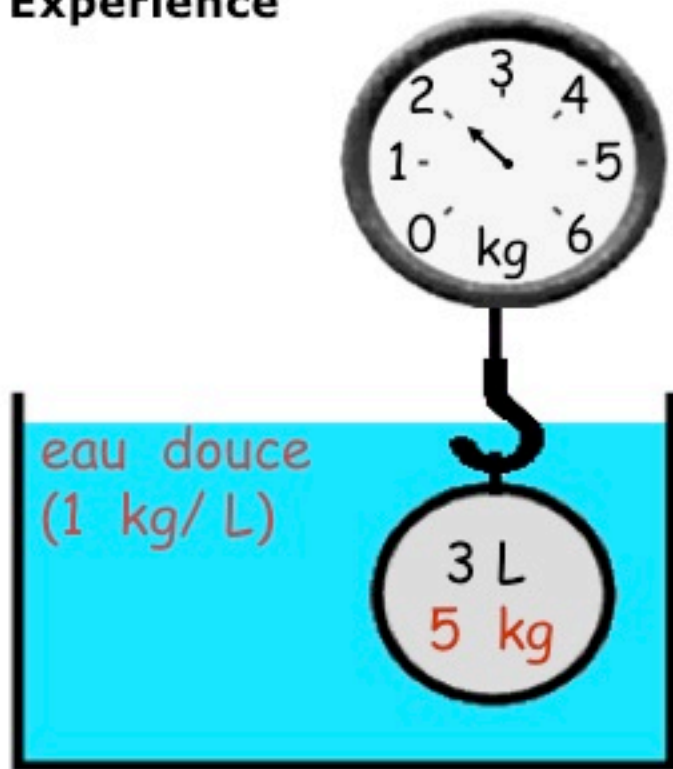




## 6. PHYSICS

### 6.2 ARCHIMEDE PRINCIPLE

#### Experience



for a sunken object the volume of displaced fluid is the volume of the object

for a floating object on a liquid, the weight of the displaced liquid is the weight of the object.



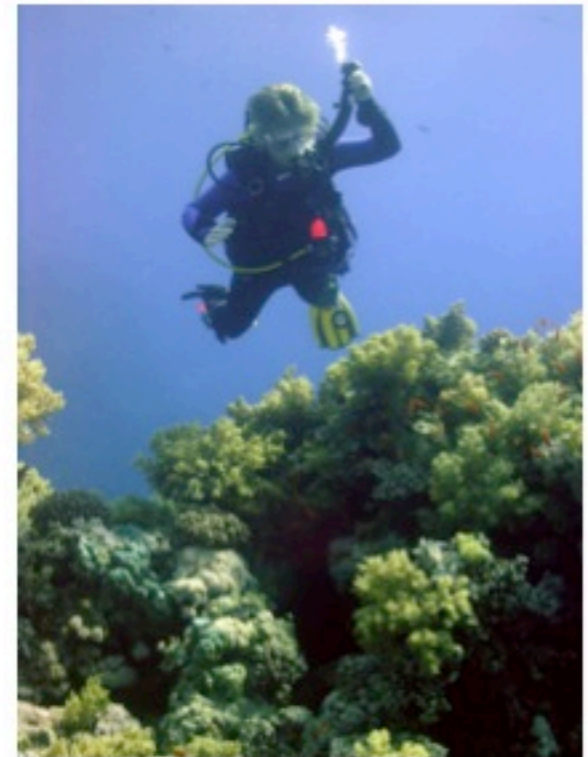


## 6. PHYSICS

### 6.1 ARCHIMEDE PRINCIPLE

#### 6.1.1 DIVING APPLICATION

- ✓ Weight.
- ✓ Water entry.
- ✓ Buoyancy variation in function of the diver volume
- ✓ Use of the BCD as a buoyancy device





## 6. PHYSICS

### 6.2 PRESSURE

- Force applied perpendicular to the surface expressed in pascal
- The Pascal (Pa), for example, is one newton per square metre
- For high pressures, we use the Bar

$$\mathbf{1\ bar = 100.000\ Pa}$$

- The atmospheric pressure is expressed with different units :

$$\mathbf{1\ kg/cm^2 = 1\ atm = 760\ mm\ Hg = 1013\ mbar = 1013\ hPa}$$





## 6. PHYSICS

### 6.2 PRESSURE

- ♦ The unit used by the Anglo-Saxon is the p.s.i. (Pound per square inch).
- ♦ This unit can be connected to the bar as follows

$$1 \text{ p.s.i.} = 0,07 \text{ bar}$$

- ♦ We almost always use the bar.







## 6. PHYSICS

### 6.2 PRESSURE

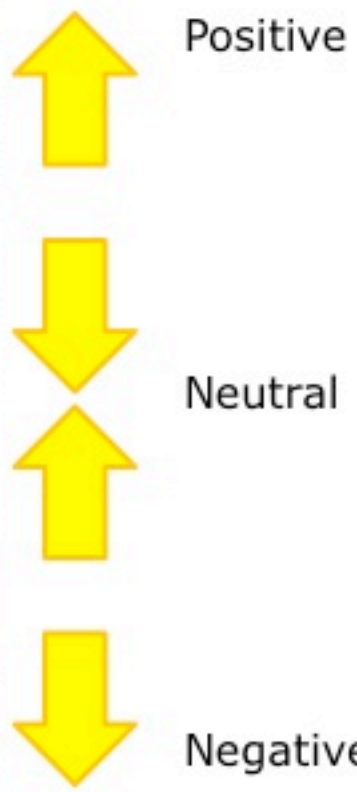
- 3 Pressures
  - Atmospheric pressure / barometric pressure
  - Hydrostatic pressure
  - Absolute pressure
  
- $P_{abs} = P_{atm} + P_{hydr}$





# 6. PHYSICS

## Buoyancy control





## 6. PHYSICS

### 6.3 CONSEQUENCE OF BREATHING COMPRESSED GAS

♦ The human body is facing the following difficulties underwater :

✓ Underwater life

○ Tuba use till 0,4m depth max.

○ Compressed air breathing in ambient pressure

○ Apnea.

✓ Pressure phenomenon

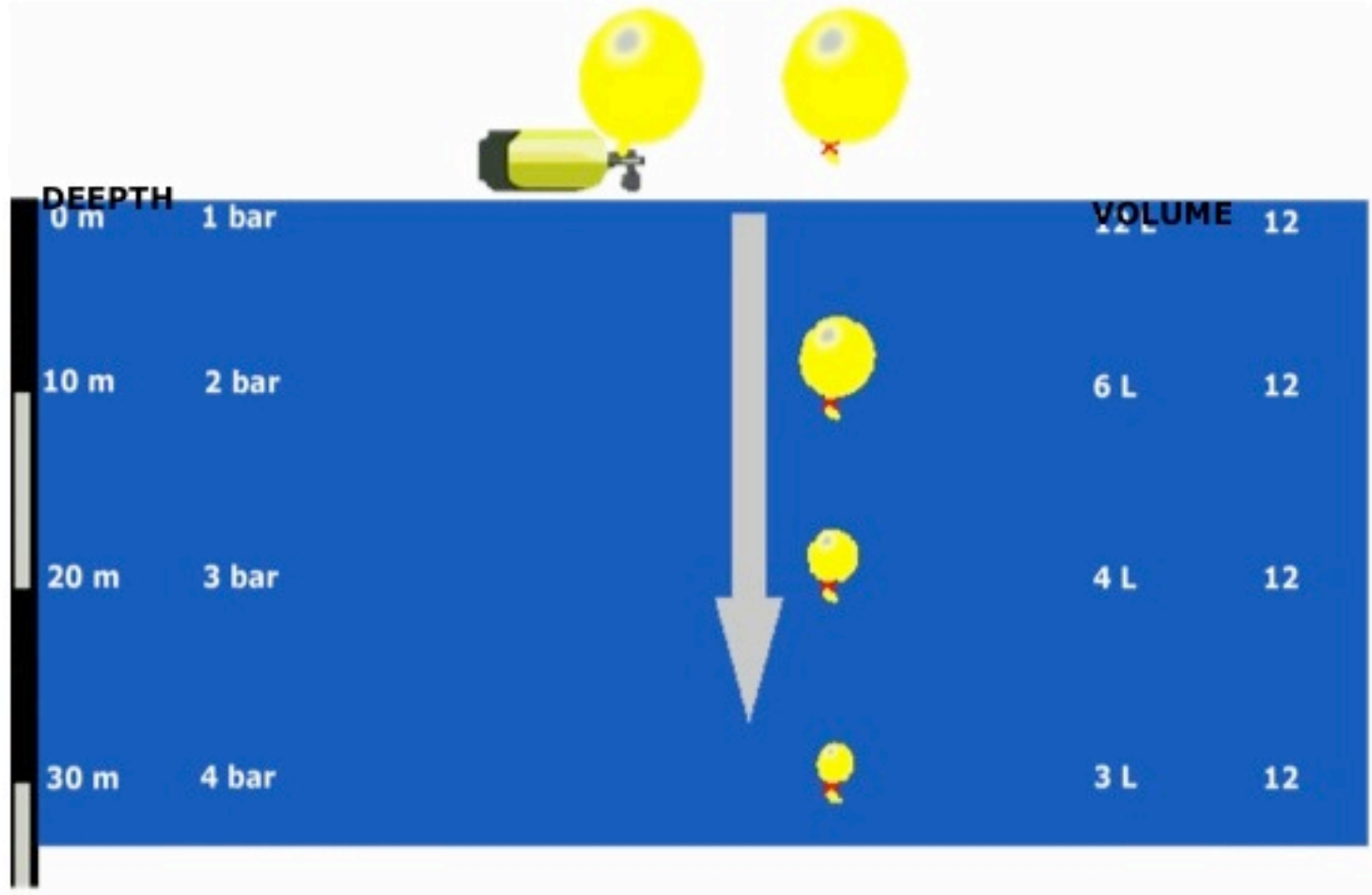
○ Boyle-Mariotte' law **Pressure X Volume = unchanged.**





# 4. PHYSICS

## The descend



PRESSURE

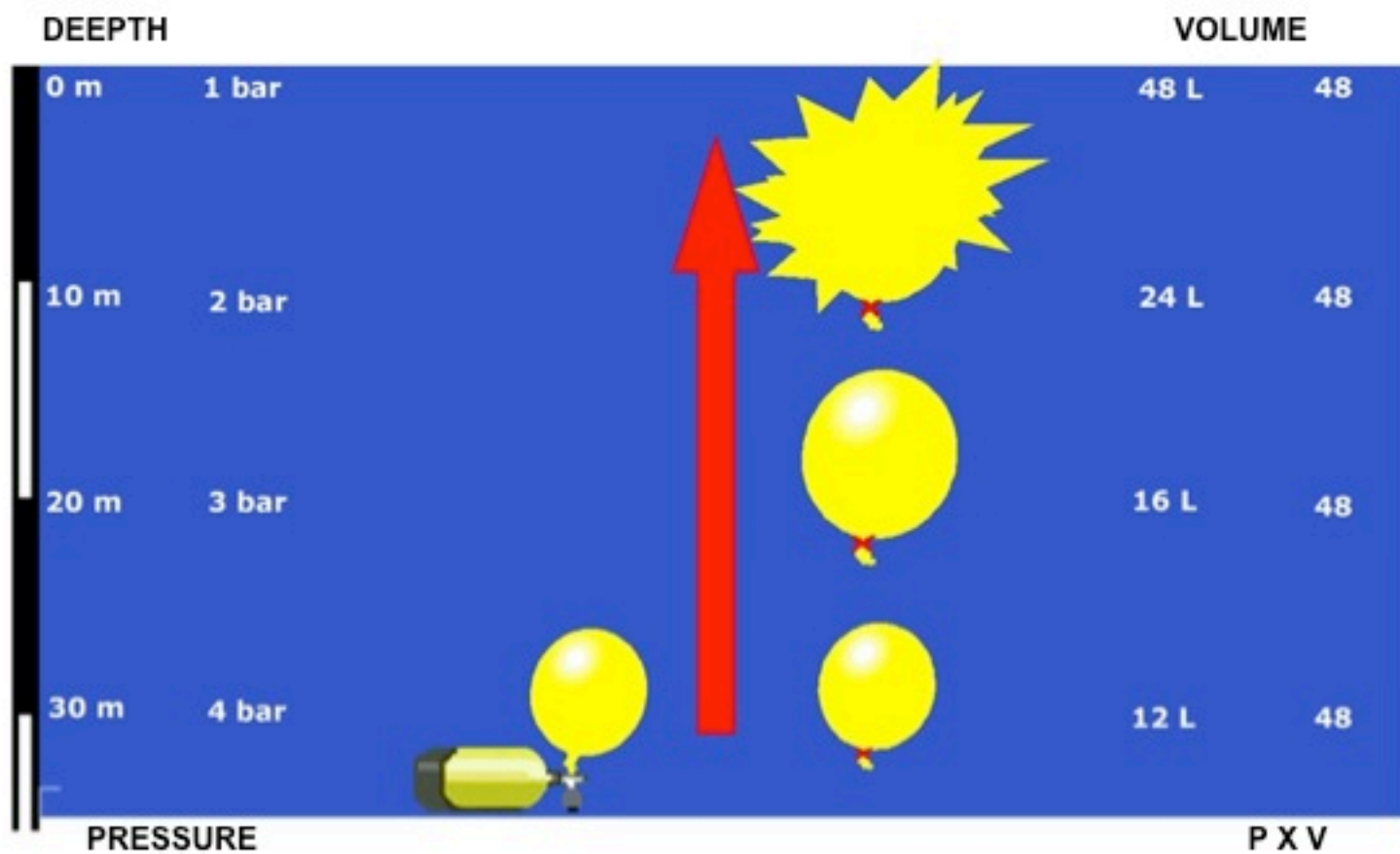
P X V





## 6. PHYSICS

### Surfacing





## 6. PHYSICS

- ◆ Pressure x Volume= Constant
- ◆ Applications to diving
  - Ascents
  - Consumption





# 7. Medical problems



## 7.1 ANATOMY OF THE HUMAN BODY

### 7.1 THE BREATHING

Air contains approximately

- ♦ 21% d'O<sub>2</sub>
  - ✓ Gaz essential to live.
  - ✓ Allows normal cell metabolism
  
- ♦ 78% d'N<sub>2</sub>
  - ✓ Inert gas.
  - ✓ Diluent gas.
  
- ♦ 1% remaining
  - ✓ CO<sub>2</sub>
  - ✓ Water vapor.
  - ✓ Rares gases.



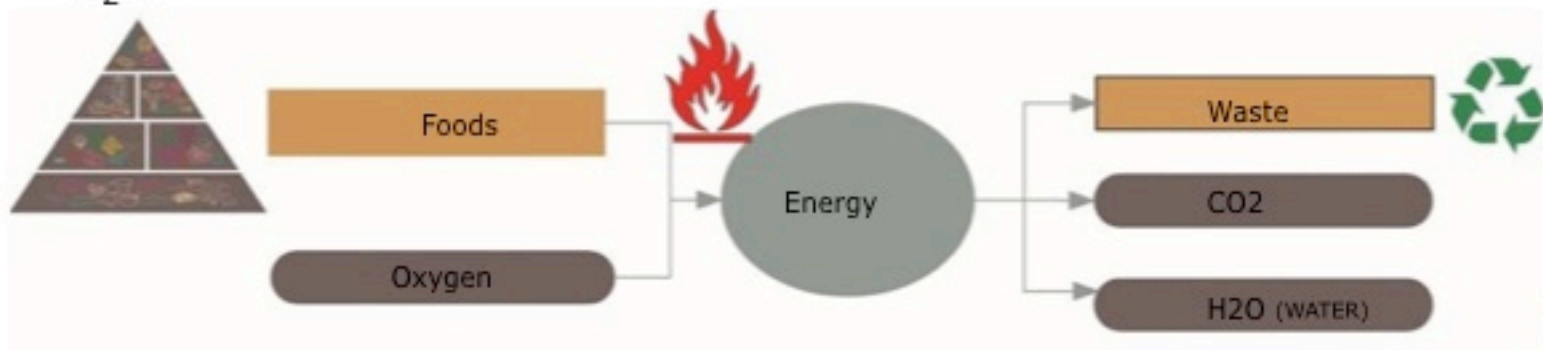




## 7.1 ANATOMY OF THE HUMAN BODY

### 7.1.2 THE METABOLISM

- ◆ Muscles and organs need energy to function.
- ◆ Maintaining our optimum temperature at 36 ° C requires energy..
- ◆ Energy production by combustion (sugars, fats and proteins).
  - ✓ Combustible (sugars, fats and proteins).
  - ✓ Oxidizer(O<sub>2</sub>).
- ◆ Waste production.
  - ✓ CO<sub>2</sub>
  - ✓ H<sub>2</sub>O



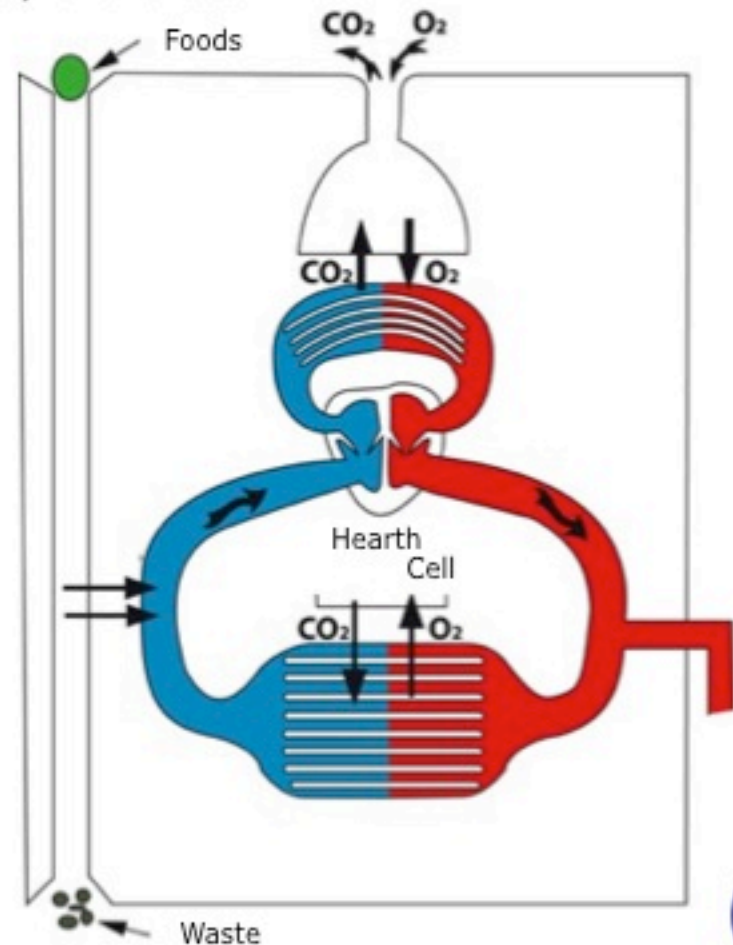


## 7.1 ANATOMY OF THE HUMAN BODY

### 7.2 THE METABOLISM

- ◆ Combustible,  $O_2$ , wast,  $CO_2$  transported by the blood.
- ◆  $CO_2$  eliminated by the lungs.
- ◆  $H_2O$  product eliminated by
  - ✓ Urine.
  - ✓ Expired gases.
  - ✓ Sweat.

Consumption of  $O_2$   
Production of  $CO_2$  } increase the effort



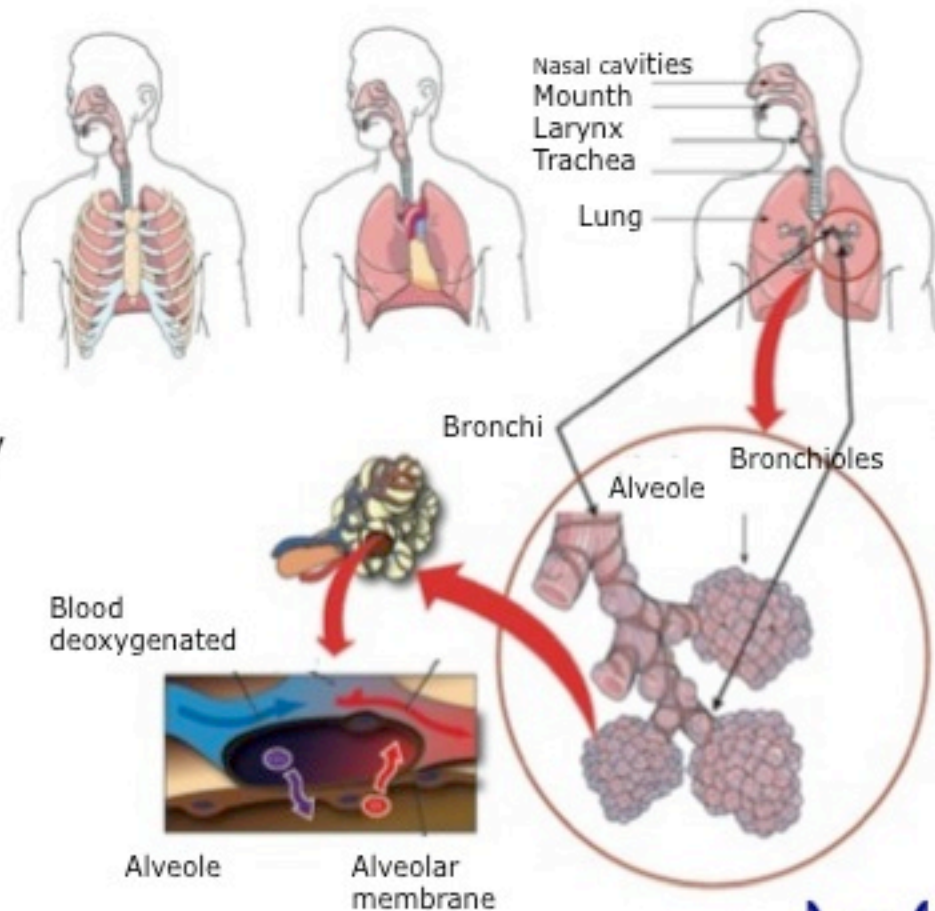


## 7.1 ANATOMY OF THE HUMAN BODY

### 7.3 SUPERIOR RESPIRATORY WAY

Dead space = no gas exchange

- ♦ mouth and nasal cavities
- ♦ Larynx
  - ✓ Glottis
  - ✓ Separated from the esophagus by the epiglottis
- ♦ Trachea
- ♦ Bronchi and bronchioles.
- ♦ Sinus.
- ♦ Eustachian tubese.

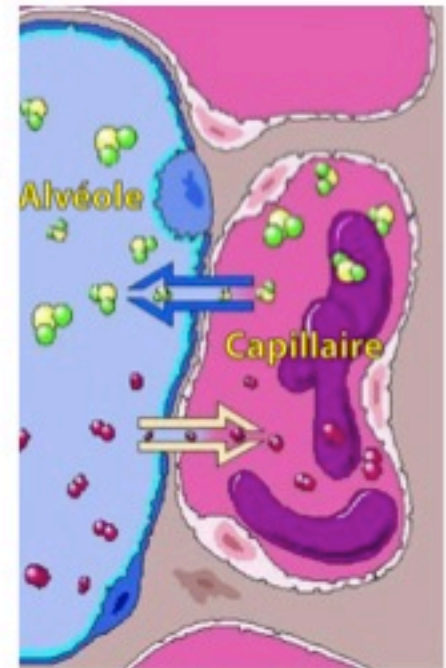




## 7.1 ANATOMY OF THE HUMAN BODY

### 7.4 LUNGS

- Pulmonary alveoli
  - ✓ 300 million / lung.
  - ✓ gas exchange through of the alveolar-capillary membrane.
  - ✓ surfactant coated which keeps them open.
- Each lung is surrounded by a pleural sac (pleura)
  - ✓ the relative depression that prevails maintains solidarity lungs ribcage.



© DAN





## 7.1 ANATOMY OF THE HUMAN BODY

### 7.1.5 RESPIRATORY MOVEMENT

#### 7.1.5.1 INSPIRATION

- Active movement
  - ✓ Respiratory muscles : diaphragm ...
  - ✓ Insufficient muscle power to inspire + 40 cm depth.

It is therefore essential to breathe the air at ambient pressure.

#### 7.1.5.2 EXPIRATION

- Passive movement
  - ✓ Relaxation of the respiratory muscles.

Automatic respiratory rate and regulated by the respiratory center

(In the medulla) sensitive to CO<sub>2</sub> levels in the blood.





## 7.1 ANATOMY OF THE HUMAN BODY

### 7.1.6 CIRCULATION

The circulatory system is a closed system

Pump

- ✓ Heart.

- ◆ tubing

- ✓ Arteries.

- ✓ Capillaries.

- ✓ Veins.

- ◆ Transport fluid

- ✓ Blood.

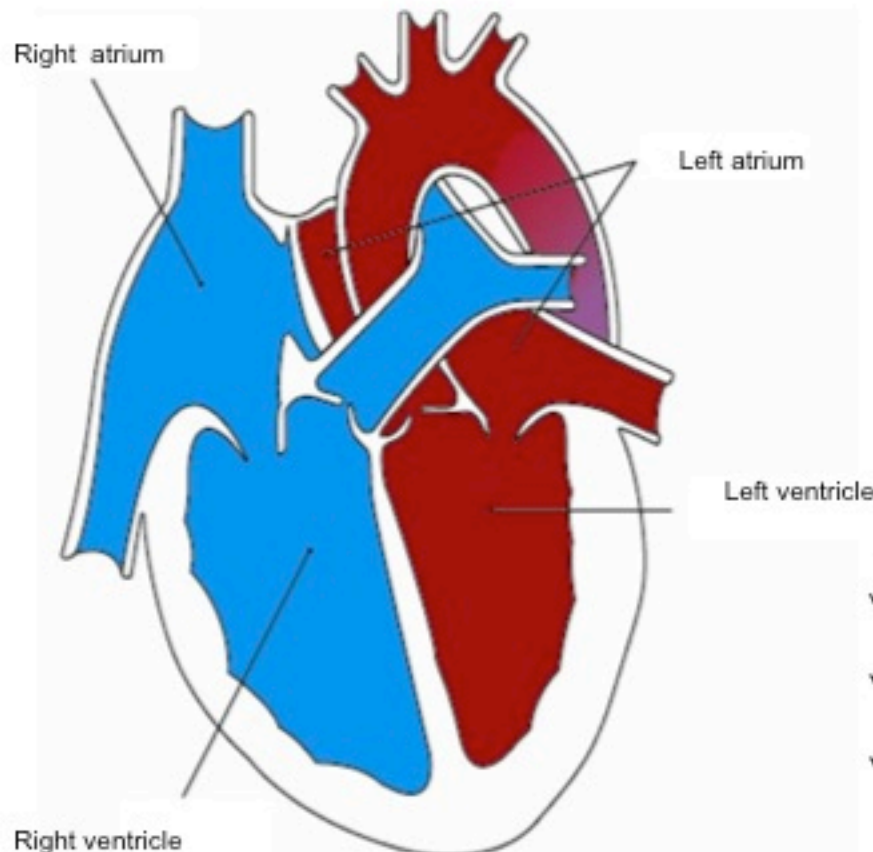




## 7.1 ANATOMY OF THE HUMAN BODY

### 7.1.6 CIRCULATION

#### ◆ Hearth



- ✓ the most powerful muscle in the body.
- ✓ Heart left.
- ✓ Right heart.





## 7.1 ANATOMY OF THE HUMAN BODY

### 7.1.6 CIRCULATION

- Small circulation
  - ✓ Between the heart (OD and VD) and lungs
- high circulation
  - ✓ Between the heart (OG and VD) and the rest of the body.

1. lungs
2. Right Atrium
3. right ventricle
4. Left ventricle
5. Vein SVC
7. Vein IVC
8. Pulmonary artery
9. Aorta
10. Pulmonary vein
11. brain and members superiors
12. abdomen and lower limbs



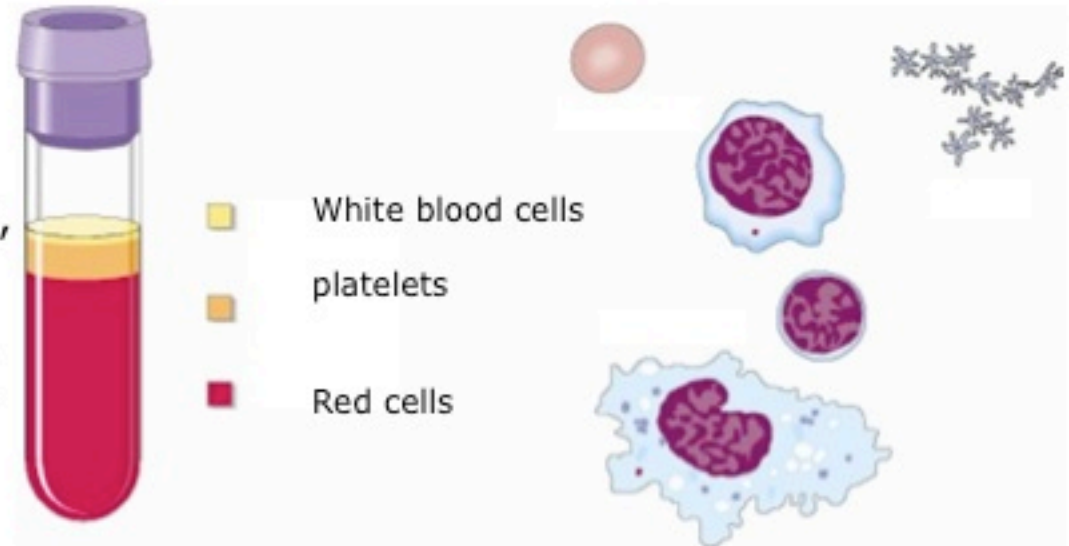




## 7.1 ANATOMY OF THE HUMAN BODY

### 7.1.6 CIRCULATION

- The blood
- Plasma
  - ✓ dissolved gases ( $O_2$ ,  $CO_2$ ,
  - ✓ nutrients.
  - ✓ residue metabolism and
  - ✓ eliminate toxins.
- Red cells
  - ✓  $O_2$  and  $CO_2$  transportation (hemoglobin).
- White blood cells
  - ✓ Defense against bacteria and viruses.
- Platelets
  - ✓ Coagulation.

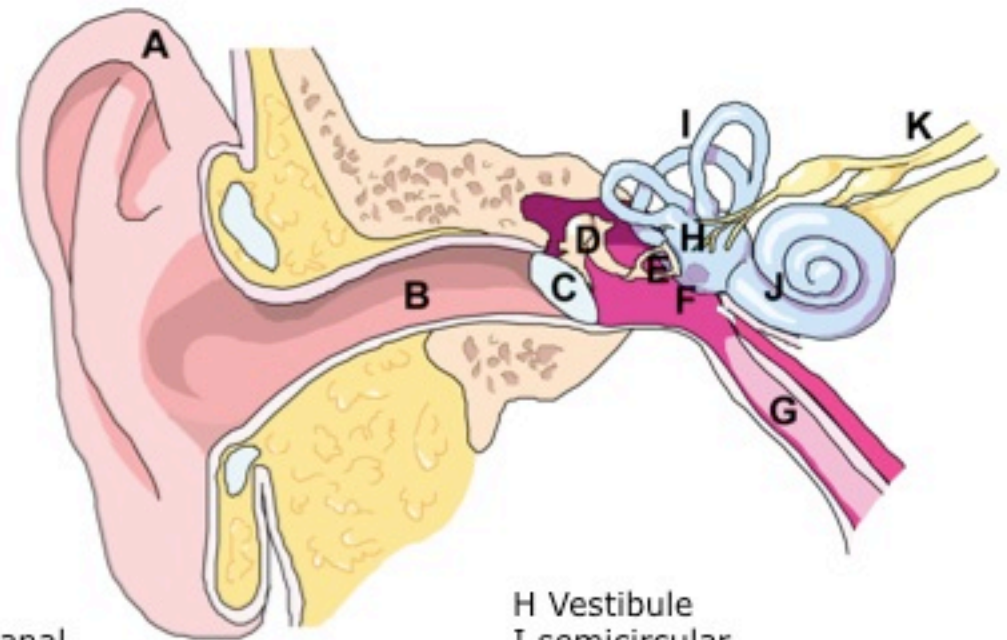




## 7.1 ANATOMY OF THE HUMAN BODY

### 7.1.7 DESCRIPTION DE L'OREILLE ET FONCTIONNEMENT

- Organ of hearing  
(Cochlear device)
  - ✓ External ear.
  - ✓ Middle ear.
- Organ of balance  
(vestibular)
  - ✓ Inner ear.



A Pavilion  
B Auditory canal  
C Eardrum  
D Bones  
E Oval window  
F Round window  
G Eustachian tube

H Vestibule  
I semicircular  
canals  
J Cochlaeus  
K Auditory nerve





# 7.1 ANATOMY OF THE HUMAN BODY

## 7.1.7 DESCRIPTION AND FUNCTIONING OF THE EAR

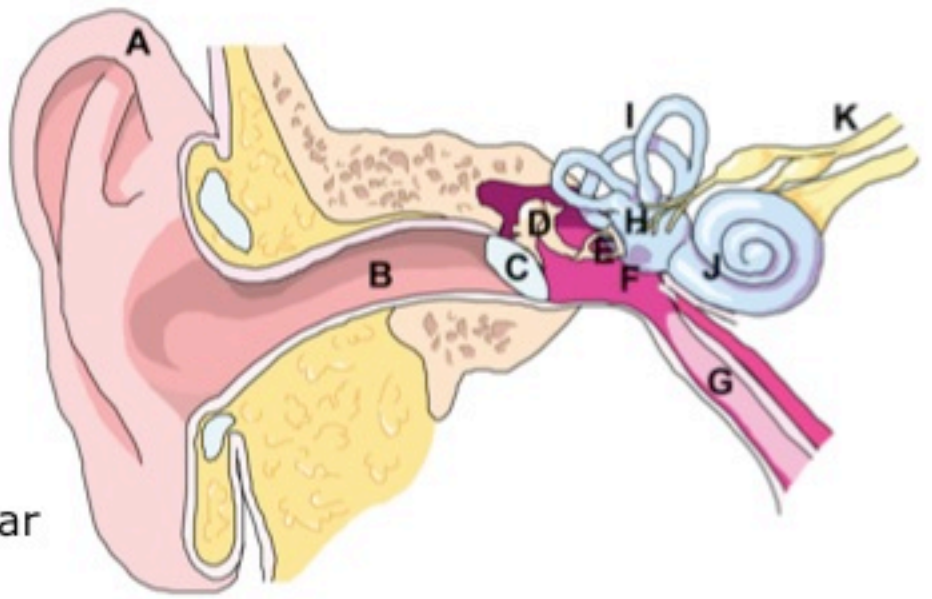
outer ear picks up sound waves

Vibration of the eardrum

String vibration of the ossicles

Vibration transmitted to the inner ear

nerve impulses decoded by the brain



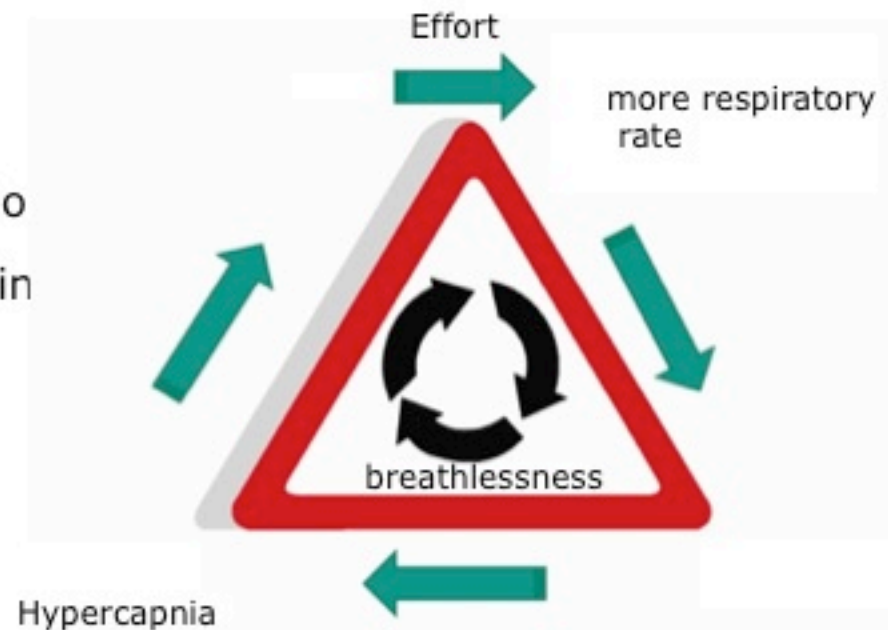


## 7.2 DIVING ACCIDENTS

### 7.2.1.1 THE BREATHLESSNESS

The respiratory movement asks more efforts during the dive than normal.

- ♦ CO<sub>2</sub> Poisoning
  - ✓ Intense effort.
  - ✓ Cold.
- ♦ Stress and anxiety aggravate the situation
  - ✓ → Superficial and ineffective breathing
  - ✓ → Poor ventilation of the alveoli.
  - ✓ → Vicious circle. breathlessness





## 7.2 DIVING ACCIDENTS

### 7.2.1.1 THE BREATHLESSNESS

- Causes
  - ✓ Effort.
  - ✓ Stress, emotion, fear, panic.
  - ✓ Regulator problems.
  - ✓ Poor filling of the bottle (air enriched with CO<sub>2</sub>).
- Signs and symptoms
  - ✓ Rapid breathing.
  - ✓ Panting.
  - ✓ Shallow breathing.
  - ✓ Anxiety.
  - ✓ Headache.
  - ✓ « The regulator does not give enough air ! »





## 7.2 DIVING ACCIDENTS

### 7.2.1.1 THE BREATHLESSNESS

- Prevention
  - ✓ Good kicking.
  - ✓ Good weighting.
  - ✓ No reckless effort.
  - ✓ Deep breathing and good expiration.
  - ✓ No air savings !





## 7.2 DIVING ACCIDENTS

### 7.2.1.1 THE BREATHLESSNESS

- ◆ From the 1<sup>st</sup> signs
  - ✓ Stop any effort.
  - ✓ Find support.
  - ✓ Control beathing.
  - ✓ Report the incident to the buddy.
  - ✓ Ascend slowly.
  - ✓ Check of the opening of the bottle.
  - ✓ Calm, reassuring.



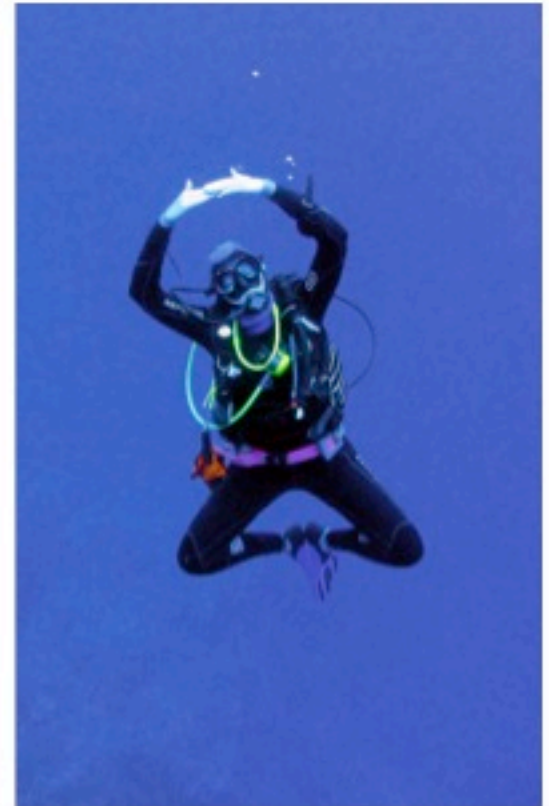


## 7.2 DIVING ACCIDENTS

### 7.2.1.2 NITROGEN NARCOSIS

Or "Drunkenness depths"

- Troubles  $\approx$  alcohol abuse.
- An inaccessible depths within your prerogatives ...
- Troubles noticeable from -30 to 40 m deep.



© G. Jones







## 7.2 DIVING ACCIDENTS

### 7.2.2 MECHANICAL ACCIDENTS

#### 7.2.2.1 MECANISM

- The gas cavities of our body are in contact with the air breathed by communications  $\pm$  free. These cavities must be in balance with the air breathed both downhill that ascent.

Barotrauma is a pressure imbalance that causes pain or even damage to the bodies concerned.



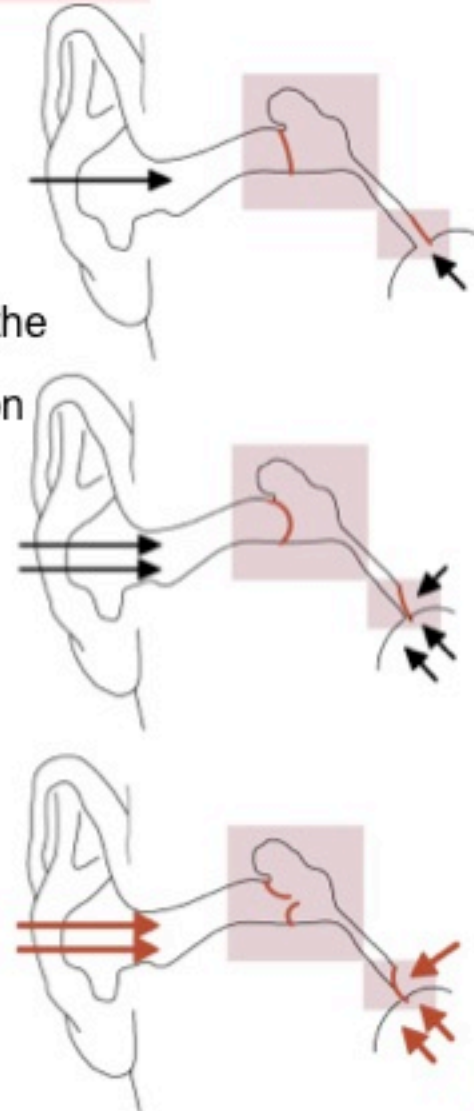


## 7.2 DIVING ACCIDENTS

### 7.2.2 MECHANICAL ACCIDENTS

#### 7.2.2.2 EAR BAROTRAUMA

- Barotrauma of the middle ear
- ✓ Deformation and / or breaking the painful eardrum. Offset the pressure exerted by the water on the eardrum in immersion
- Gentle valsalva.
- Swallowing.
- Voluntary tubal patency.
- ✓ Do not expect the pain to compensate !
- ✓ Do not dive with a cold or an ear infection.





## 7.2 DIVING ACCIDENTS

### 7.2.2 MECHANICAL ACCIDENTS

#### 7.2.2.2 EAR BAROTRAUMA

- Barotrauma of the inner ear
- ✓ Serious accident.
- ✓ Possible when sudden and untimely compensation maneuvers .
- ✓ Causes deafness, "whistling" or less often dizziness.





## 7.2 DIVING ACCIDENTS

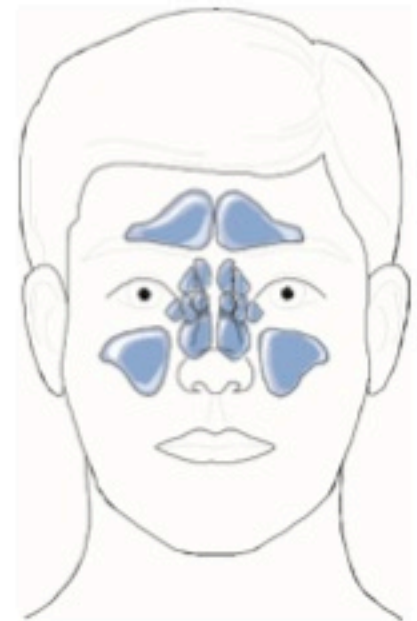
### 7.2.2 MECANICAL ACCIDENTS

#### 7.2.2.3 BAROTRAUMA SINUS

- Aeric cavities in the bones of the face.
  - Causes deafness, "whistling" or less often dizziness
  - Compensation is made without the intervention of the diver.
  - Sometimes compensate could be impossible in case of infection.
- ✓ During the descent → interruption of the dive.
- ✓ During the ascent → very slowly to obtain a spontaneous equilibration.

**No Valsalva !**

**Do not dive with a cold.**





## 7.2 DIVING ACCIDENTS

### 7.2.2 MECHANICAL ACCIDENTS

#### 7.2.2.4 MASK SUCTION

- ◆ During the descent- risk of unpleasant suction effect.
- ◆ Risk of eye damage.
- ✓ Conjunctival hemorrhage.
- ✓ Bruising and swelling of eyelids.
- ◆ Just breath into the mask through the nose.
- ◆ Possible effect with sucker (semi) dry sweat
- ✓ Tweezers.
- ✓ Bruises on the skin.



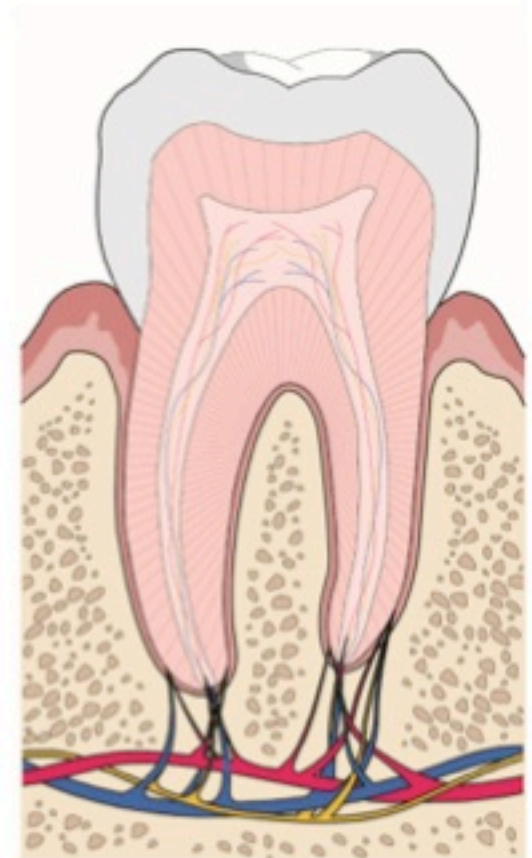


## 7.2 DIVING ACCIDENTS

### 7.2.2 MECHANICAL ACCIDENTS

#### 7.2.2.5 TEETH BAROTRAUMA

- ◆ No aeric cavity in the teeth..
- ◆ Cavities appear in
  - ✓ Decayed teeth.
  - ✓ If incomplete or inhomogeneous filling.
- ◆ Impossible compensation ...
- ◆ → Good essential dental hygiene !





## 7.2 DIVING ACCIDENTS

### 7.2.2 MECHANICAL ACCIDENTS

#### 7.2.2.6 DIVER 'S COLIC

- ◆ Normally our digestive cavities are crashing on the descent and resume their usual volume ascent.
- ◆ Abdominal pain may appear to rise
  - ✓ If gas produced (by fermentation).
  - ✓ If air is swallowed (faulty regulator).
- ◆ Gas products to evacuate oral or anal ...
- ◆ Avoid meals high in carbohydrates and excess soft drink before diving.





## 7.2 DIVING ACCIDENTS

### 7.2.2 MECHANICAL ACCIDENTS

#### 7.2.2.7 PULMONARY BAROTRAUMA

- ◆ Mechanism
  - ✓ During apnea lung volume will be the same on emersion than in early diving.
  - ✓ Scuba
    - The regulator delivers air at ambient pressure.
    - At the ascent  $p \downarrow$  and  $\uparrow$  air will volume in the lungs.
    - If the airways are free and open glottis the air will escape without problem.
    - If obstacle in the airways, alveoli distension and rupture during ascent or emergence.







## 7.2 DIVING ACCIDENTS

### 7.2.2 MECHANICAL ACCIDENTS

#### 7.2.2.7 PULMONARY BAROTRAUMA

- Causes
  - ✓ Quick lift causes without breathing.
  - ✓ Blocking the expiry to the rise during exertion, stress or panic.
  - ✓ Reflex spasm of the glottis during inrush of water or ice in the throat.
- Air trapping
- Malformation of the bronchi.

Bronchitis.

Sequelae of lung disease.






## 7.2 DIVING ACCIDENTS

### 7.2.2 MECHANICAL ACCIDENTS

#### 7.2.2.7 PULMONARY BAROTRAUMA

- Prevention
  - ✓ Being in medical order
  - ✓ Do not dive with lung disease or asthma.
- Do not immerse cold ...
  - ✓ Do not Apnea air saving worries
  - ✓ In case of failure of air, exhale and look up (Clears airways)

 A pulmonary overpressure may arise in the pool : the alveoli strength limit is low.

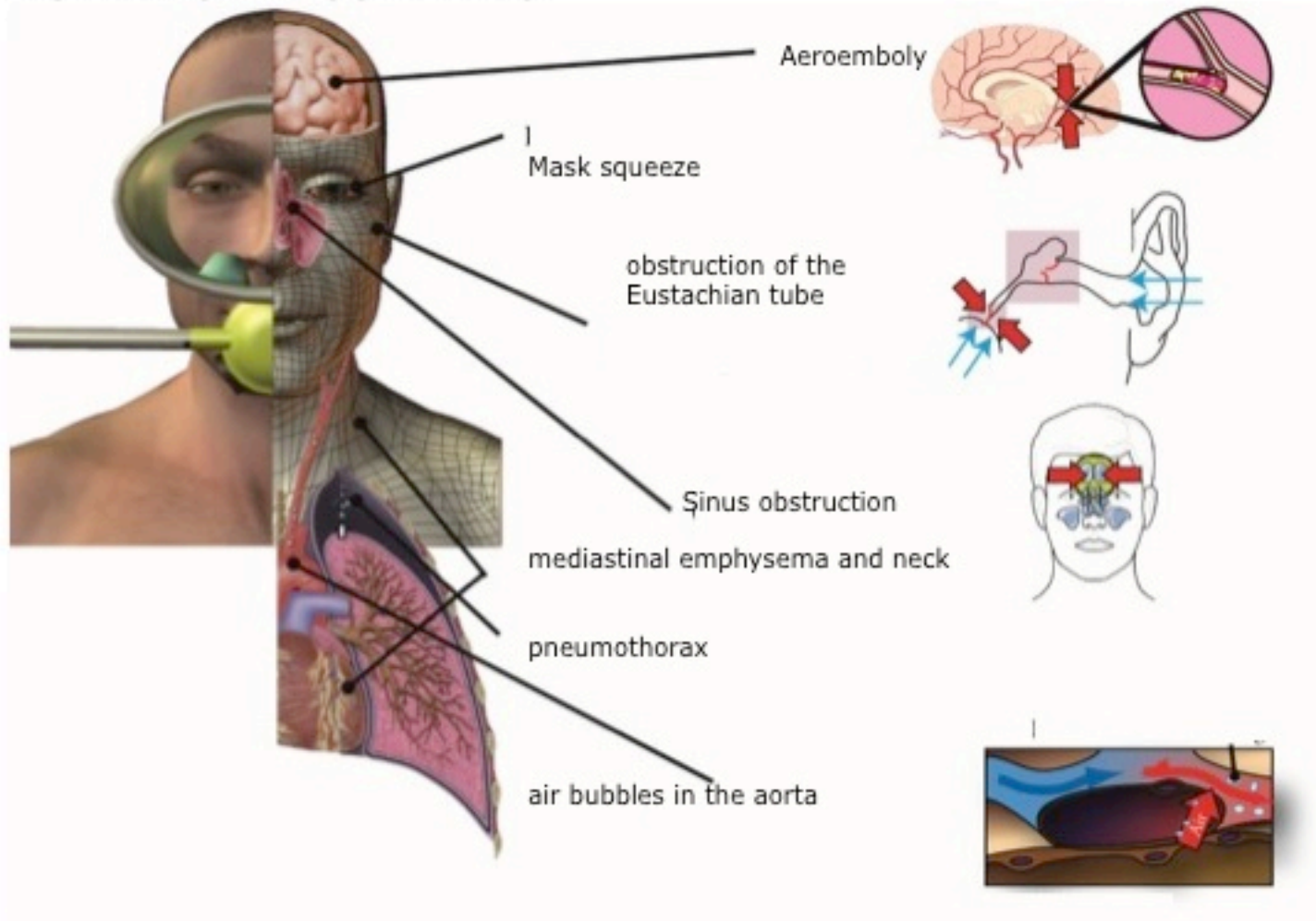
**In the pool as it is essential to expire back.**





## 7.2 DIVING ACCIDENTS

### 7.2.2 MECHANICAL ACCIDENTS





## 7.2 DIVING ACCIDENTS

### 7.2.3 DECOMPRESSION SICKNESS

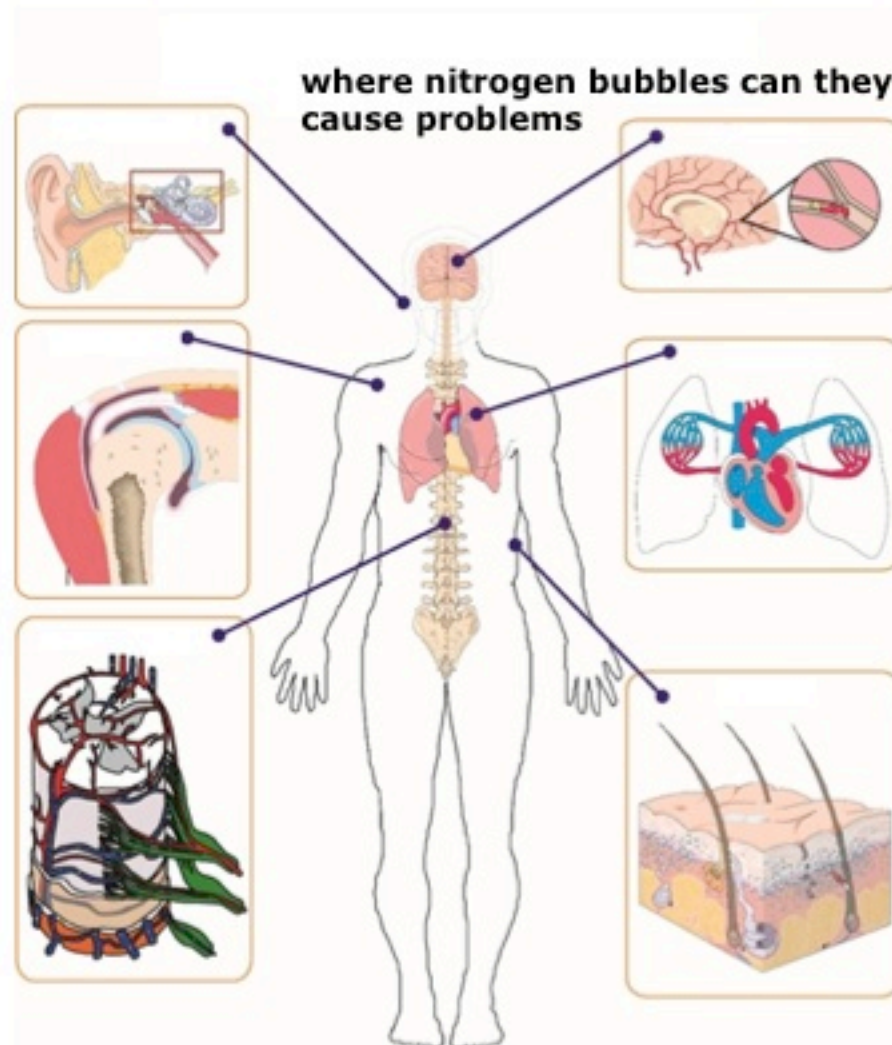
- In scuba diving, the  $N_2$  (inert gas) is dissolved in the body.
- The amount = depth/dive time
- Elimination of the  $N_2$ 
  - = respect the ascent rules (speed)
- Explosive removal  $N_2$  : eventually accident .
- Degas different tissues via the bloodstream
- When the disposal capacity of the lungs  $N_2$  is exceeded,  $N_2$  excess accumulates in the vessels and tissues.





## 7.2 DIVING ACCIDENTS

### 7.2.3 DECOMPRESSION SICKNESS





## **7.2 DIVING ACCIDENTS**

### **7.2.3 DECOMPRESSION SICKNESS**

#### **7.2.3.1 BENIGN INCIDENTS**

- ♦ Generalized malaise
- ♦ Severe fatigue, abnormal, unrelated to the work done.





## 7.2 DIVING ACCIDENTS

### 7.2.3 DECOMPRESSION SICKNESS

#### 7.2.3.2 SERIOUS ACCIDENTS

- ◆ Skin accidents
  - ✓ Fleas.
  - ✓ Sheep.
- ◆ Bends
- ◆ Vestibular accidents
  - ✓ Severe dizziness.
  - ✓ Nausea.
  - ✓ Vomiting.
- ◆ Cochlear accidents
  - ✓ Hearing loss.
  - ✓ Decreased hearing.





## 7.2 DIVING ACCIDENTS

### 7.2.3 DECOMPRESSION SICKNESS

#### 7.2.3.2 SERIOUS ACCIDENTS

- ♦ Cerebrovascular accidents
  - ✓ Weakness or paralysis
  - ✓ Altered sensation.
  - ✓ Visual abnormalities.
  - ✓ Confusion or memory loss.
  - ✓ Seizures.
  - ✓ Coma.







## 7.2 DIVING ACCIDENTS

### 7.2.3 DECOMPRESSION SICKNESS

#### 7.2.3.2 SEVERE ACCIDENTS

- ♦ Accident of the spinal cord
  - ✓ Stab in the back.
  - ✓ Tingling in the legs.
  - ✓ Weakness membres inférieurs.
  - ✓ Paralysis membres inférieurs.
  
- ♦ Lung DS
  - ✓ Chest pain.
  - ✓ Breathing difficulties.
  - ✓ Cough.
  - ✓ No bloody sputum.





## 7.2 DIVING ACCIDENTS

### 7.2.3 DECOMPRESSION SICKNESS

#### 7.2.3.3 ONSET

- ♦ 50 % of accident occur within 30 min after the dive.
- ♦ 90 % in the first hour.
- ♦ 99 % within 12 - 24 h.

No relationship between the onset and severity.





## 7.2 DIVING ACCIDENTS

### 7.2.3 DECOMPRESSION SICKNESS

#### 7.2.3.4 FAVORING FACTORS

- ◆ Health
- ✓ Age.
- ✓ Obesity.
- ✓ Physical and mental fatigue.
- ✓ Impaired general condition.
- ✓ Overwork.
- ✓ Alcohol.
- ✓ Tabagism.
- ✓ Recent fractures
- ✓ Certain diseases.
  - Lung.
  - Cardiovascular.





## 7.2 DIVING ACCIDENTS

### 7.2.3 DECOMPRESSION SICKNESS

#### 7.2.3.4 FAVORING FACTORS

- ◆ Related to diving conditions
- ✓ Diving after scuba diving.
- ✓ Efforts before, during and after the dive.
- ✓ Shortness of breath.
- ✓ Stress.
- ✓ Cold.
- ✓ Multilevel dive (yo-yo).
- ✓ Apnea during the deco stop.
- ✓ Deshydration.
- ✓ Fly after the dive.
- ✓ Short interval between the dives.





## 7.2 DIVING ACCIDENTS

### 7.2.3 DECOMPRESSION SICKNESS

#### 7.2.3.4 CONTRIBUTING FACTORS

- ◆ Prevention

- ✓ strict ascent rate.
- ✓ strict compliance levels.
- ✓ Avoid yo-yo diving.
- ✓ Safety Stop state if & t ° water permit.
- ✓ No snorkeling within 3 hours before or after a dive with compressed air.
- ✓ Avoid unnecessary intense efforts.
- ✓ **Proper hydration before and after the dive.**
- ✓ Do not take flight within 12 hours after diving unit, 24 hours after repetitive dives.



© J.P. Legrand





## 7.2 DIVING ACCIDENTS

### 7.2.3 DECOMPRESSION SICKNESS

#### 7.2.3.5 TRAETMENT

- ♦ Administration O2 quickly as possible.
- ♦ Hydration: 1l water in 1 hour if able to drink
- ♦ Independently ... Call for help
- ♦ Evacuate to a hyperbaric center.

*Voir § Secourism*



© E. Van Lier



Caisson HM Reine Astrid - © R. Houman



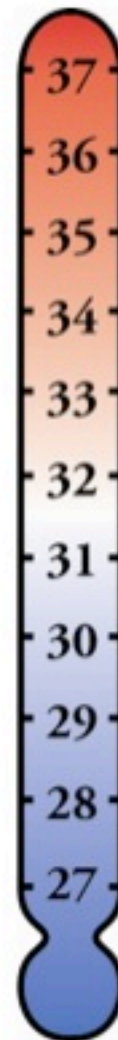


## 7.2 DIVING ACCIDENTS

### 7.2.4 HYPOTHERMIA

#### 7.2.4.1 MECHANISM

- ♦ The water duct 23 x heat better than air
  - ✓ → + it cools rapidly in water.
- If central  $t^{\circ} < 37^{\circ} \text{C}$ 
  - ✓ heat production (shivering).
  - ✓ → ↑ metabolism.
  - ✓ → ↑ O<sub>2</sub> consumption and air of the bottle!
- Central hypothermia if  $t^{\circ} < 35^{\circ} \text{C}$ 
  - ✓ Syncope.
  - ✓ ↓ Metabolism.
  - ✓ Numbness.
  - ✓ ↓ cardiac and respiratory rhythms if  $t^{\circ} < 30^{\circ} \text{C}$ .





## 7.2 DIVING ACCIDENTS

### 7.2.4 HYPOTHERMIA

#### 7.2.4.2 PREVENTION

- ♦ Dress according to diving conditions.
- ♦ Adapted dive time conditions.
- ♦ Prevent his partner from the onset of cold 1st signs.



© E. Van Dijck - Vodelée 1963



© PPO2Max- [www.ppo2maxteam.fr](http://www.ppo2maxteam.fr)







## 7.2 DIVING ACCIDENTS

### 7.2.5 DROWNING

Death by suffocation in water (suffocation) - Definition of 'near-drowning.

- Water into the airways is enough to affect the transfer of O<sub>2</sub> to the tissues.
- Ultimate cause of death in the majority of fatal diving accidents.
- Syncope by
  - ✓ Hypoxia.
  - ✓ Exhaustion.
  - ✓ Cold.
  - ✓ Medical cause (cardiac arrest).
  - ✓ Diving equipment failure.





# 8. Introduction to first aid



## 8. INTRODUCTION TO FIRST AID

As a citizen you must know the lifesaving

- ◆ Save a life involves a series of steps ≠.
- ◆ Each step influences survival.





## 8. INTRODUCTION TO FIRST AID

« Chain of survival »



1. Early recognition of the seriousness with call-out.
2. Early CPR by a witness to save time.
3. Early defibrillation.
4. Resuscitation by specialized health professionals to restore life quality.





## 8. INTRODUCTION TO FIRST AID

Even without aid skills you can help

- ◆ Calling properly, calmly and quickly rescue.
- ◆ By locating and providing O2 and first aid kit.
- ◆ By identifying and marking out the path.



© Ch; De Greef





# 8. INTRODUCTION TO FIRST AID

## 8.1 CALL THE RESCUE

### Essential!

- ◆ Call clear, concise and structured
  - ✓ Caller's name.
  - ✓ Street address and means of access.
  - ✓ Nature of the accident.
  - ✓ State and number of victims.
  - ✓ Age (adult, child, baby).
  - ✓ Potential danger?
  - ✓ Blocked people?
  - ✓ Confirmation of the call.



© J; Servais





## 8. INTRODUCTION TO FIRST AID

### 8.1 EMERGENCY CALLING

- ◆ At sea rescue boat captain called by VHF radio channel 16.



© M. Van Espen



- ◆ On suspicion of ADD call local emergency
  - ✓ For medical advice.
  - ✓ Coordinating the evacuation.
  - ✓ Preparation of the hyperbaric center.





## 8. INTRODUCTION TO FIRST AID

### 8.2 ADMINISTRATION OXYGENE

- ♦ **100%** 15 l / min if minimum continuous flow.
- ♦ Better still **100%** with demand valve.
- ♦ Without interruption.
- ♦ objectives

Facilitate breathing.

- ✓ ↑ disposal N<sub>2</sub>
- ✓ ↓ volume of bubbles.
- ✓ Improve tissue oxygenation.
- ✓ ↓ risk of sequelae after hyperbaric treatment.







## 8. INTRODUCTION TO FIRST AID

### 8.3 HYDRATATION

- ♦ If conscious and able to drink independently.
- ♦ 1 to 1.5 the flat water (or isotonic drink) over 1 hour.
- ♦ objectives
  - ✓ Combat dehydration due to immersion.
  - ✓ Improve circulation.
  - ✓ Improve the N<sub>2</sub> removal



© DAN





## 8. INTRODUCTION TO FIRST AID

### 8.4 BASIC LIFE SUPPORT CONCEPTS (BLS)



Concepts and summarized for reference

Do not replace training in RCP !

According to the recommendations of the ERC 2015



*Text and photos kindly provided by Guy Thomas DAN Training*





## 8. INTRODUCTION TO FIRST AID

### 8.4 BASIC LIFE SUPPORT CONCEPTS (BLS)

#### 8.4.1 EVALUATE THE SAFETY OF THE ACCIDENT (S-A-F-E)

##### **S STOP**

- ✓ Stop, then act

##### **A ASSESS SCENE** (Evaluate the situation)

- ✓ Location sure?
- ✓ Suitable for processing secure?
- ✓ Dangers?
- ✓ Risks to the rescuer?

##### **F FIND & LOCATE 1<sup>st</sup> AID KIT**

- ✓ Find 1st aid kit, O2, AED.

##### **E EXPOSURE PROTECTION**

- ✓ Gloves, face protection, Pocket Mask.



© Ch. De Greef





## 8. INTRODUCTION TO FIRST AID

### 8.4 BASIC LIFE SUPPORT CONCEPTS (BLS)

#### 8.4.2 ASSESS THE STATE OF THE CONSCIOUSNESS

- ◆ Answer
  - ✓ Lay the victim in the comfort position.
- ◆ No answer
  - ✓ Cry help.
  - ✓ Victim onto the back.
  - ✓ Clear the airway.





## 8. INTRODUCTION TO FIRST AID

### 8.4 BASIC LIFE SUPPORT CONCEPTS (BLS)

#### 8.4.3 ASSESS BREATHING

- ♦ S.H.F Max 10 seconds.
- ♦ Breath normaly
  - ✓ PLS.
  - ✓ Calle the rescue.
- ♦ No breath normaly or doubt
  - ✓ Calle the rescue.
  - ✓ RCP 30 compressions /2 insufflations.

**Rythm 100 - 120/min.**

**No break.**



© DAN





## 8. INTRODUCTION TO FIRST AID

### 8.4 BASIC LIFE SUPPORT CONCEPTS (BLS)

#### 8.4.3 ASSESS BREATHING

- ♦ Using the Pocket Mask.



© DAN

- ♦ 30/2 it's too much! If you're more than one change every 2 min if possible.

**For near drowning victims: give 5 initial breaths followed with 1 minute of CPR before calling for help.**





## 8. INTRODUCTION TO FIRST AID

### 8.5 CARE ADMINISTRATION WITH DEA (IF AVAILABLE)

#### 8.5.1 S-A-F-E

#### 8.5.2 NO RESPONDING

#### 8.5.3 NO BREATH NORMALY

- Screaming for help.
- DEA or fetch request.
- CPR until attached electrodes.
- Leave DEA analyze the heart rhythm.
- Do not touch the victim.
- Follow the instructions of DEA
  - ✓ Not indicated shock
    - Resume CPR 30/2 m.
  - ✓ necessary Shock
    - Shock 30/2 then resume CPR.



© DAN



The background of the slide is a photograph of two divers in a coral reef. The divers are wearing full scuba gear, including tanks, regulators, and masks. They are surrounded by a large school of yellowish fish and various types of coral. The water is clear and blue. The text '9. Psychology' is overlaid in the bottom center of the image.

# 9. Psychology





## 9. PSYCHOLOGY & DIVING

### 9.1 DIVING, MEDECINES, DRUGS OR ALCOHOL

- Alcoholism and toxicomany

- ✓ → Inability to diving!
- ✓ Risk of panic.
- ✓ Risk taking behavior.



Danger to the life of the diver and the dive group!

- Some medicines

- ✓ possible effect on the central nervous system.



in doubt advice from a doctor with expertise in medicine diving.





## 9. PSYCHOLOGY & DIVING

### 9.1 ANXIETY & STRESS

- ◆ Water is an unusual environment
  - ✓ → Anxiety common before and during the dive.
  - ✓ Anxiety can alertness ↑ = Positive stress.
  - ✓ Harmful stress can lead to panic.
    - More communication with the pair.
    - The diver thinks only go up and out of the water.
      - Rapid ascent.
      - Non-compliance.



Danger for the diver and for the group !





## 9. PSYCHOLOGY & DIVING

### 9.1 ANXIETY & STRESS

In case of :

- ◆ Physical problem

- ✓ Ears.
- ✓ Cold.
- ✓ Shortness of breath.
- ✓ Tired.
- ✓ Pain ...

- ◆ Psychic tension

- ✓ Lack of info.
- ✓ Feel uncomfortable or threatened.
- ✓ Egarement.
- ✓ Too much to handle.
- ✓ binomial with problems or binomial reckless behavior.





## 9. PSYCHOLOGY & DIVING

### 9.1 ANXIETY & STRESS

- ◆ Unsuitable equipment
  - ✓ Confidence in lost equipment.
- ◆ Environmental factors
  - ✓ Current.
  - ✓ Poor visibility.
  - ✓ Darkness.
  - ✓ Cold.
  - ✓ Swell.
  - ✓ Lack of landmarks.
  - ✓ strange animal or unknown.
- ◆ Accumulation of small problems.





## 9. PSYCHOLOGY & DIVING


### 9.1 ANXIETY & STRESS

- ♦ Managing stress by talking with the buddy.
- ♦ Adapt diving.
- ♦ Macho behavior is incompatible with safe diving.
- ♦ One goal: make a nice diving together



Link mandatory trust between buddy



A photograph of two divers in a reef environment. The diver on the left is pointing towards a school of fish. The diver on the right is holding a flashlight. The background is a vibrant blue with many small fish and coral structures.

# 10. Tables and dive computer





## 10. DECOMPRESSION

### 10.2 DECOMPRESSION TABLES

- ♦ Way to avoid deco accident

**BUT zero risk does not exist!**

- ♦ Computer is better than a table but the choice is yours
- ♦ Different kinds of tables : US Navy, MN 90, Buhlman, ...







## 10. DECOMPRESSION

### 10.2 DECOMPRESSION TABLES

- ◆ Several models / same general rule.

#### **Learn the instructions**

- ◆ Obligation to dive **NO DECO**
  - ✓ depth/time max. without obligatory stop.
  - ✓ Back to the surface immediately
  - ✓ Respect the ascent speed





## 10. DECOMPRESSION

### 10.2 Decompression table

- ◆ Couple time / depth.
- ◆ Depth = max. if not in the table = prof. Higher.
- ◆ Time = immersion time until the rise  
if not in the table = greater time.
- ◆ ascent speed 10 m / min.

Example: Diving in 16 m for 25 minutes.

In the Table: 18 m - 28 min.

15 m		18 m	
15	B	12	B
21	C	17	C
28	D	22	D
34	E	28	E
41	F	33	F
48	G	39	G
56	H	45	H
63	I	51	I
71	J	57	J
		60	K





## 10. DECOMPRESSION

### Decompression table

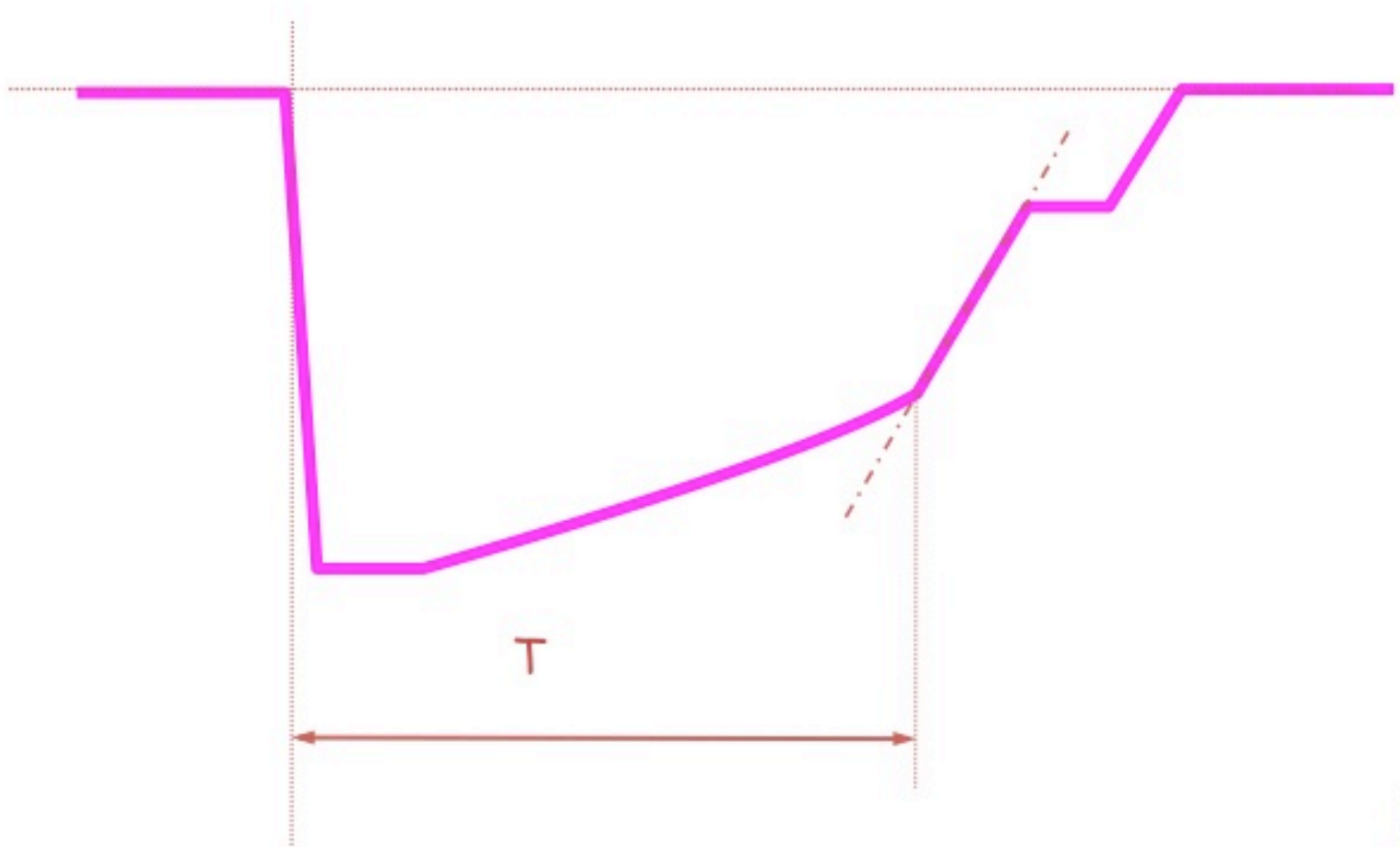
9 m		12 m		15 m		18 m		21 m	
17	A	12	A	15	B	12	B	10	B
27	B	20	B	21	C	17	C	14	C
38	C	27	C	28	D	22	D	19	D
50	D	36	D	34	E	28	E	23	E
62	E	44	E	41	F	33	F	28	F
76	F	53	F	48	G	39	G	32	G
91	G	63	G	56	H	45	H	37	H
107	H	73	H	63	I	51	I	42	I
125	I	84	I	71	J	57	J	47	J
145	J	95	J	80	K	60	K		
167	K	108	K	89	L				
193	L	121	L						
260	N	135	M						
307	O	151	N						
371	Z	163	O						





# 10. DECOMPRESSION

## Dive profile





## **10. DECOMPRESSION**

### **10.2.1 DIVE WITHOUT STOP**

- ♦ Back to the surface without obligatory stop

### **10.2.2 REPETITIVE DIVE**

- ♦ Second dive after 10 minutes the first dive'





## 10. DECOMPRESSION

### 10.2.3 SAFETY STOP

- ◆ LEVEL = STOP.
- ◆ **NO DECO.**
- ◆ SAFETY STOP =  
STOP 5 min. at 5 meter.
- ◆ Recommended  
If good execution condition.





# 10. DECOMPRESSION

## 10.3 DIVE COMPUTER





## 10. DECOMPRESSION

### 10.3 DIVE COMPUTER

#### Decompression electronic device including

- Permanent internal clock.
- Sensors (local pressure, air pressure, temperature, ...).
- A fixed memory containing the program (algorithm).
- A microprocessor.
- A power supply.
- A rudimentary keyboard.
- A display screen.
- Sound / visual devices.







## 10. DECOMPRESSION

### 10.3 DIVE COMPUTER

- ✓ minimum display the following information:
- ✓ The immersion time.
- ✓ Current depth.
- ✓ The maximum depth reached.
- ✓ NDL TTS.
- ✓ The time and depth of the first level or the next level.

**No Decompression = Same as table**

**Attention to the dive profile**





## 10. DECOMPRESSION

### 10.3 DIVE COMPUTER

additional useful displays

- ✓ ascent rate.
- ✓ alarms.
- ✓ The environmental temperature.

At the exit of the water, it can display:

- ✓ The output hour.
- ✓ The dive interval.
- ✓ Total desaturation time.
- ✓ Time No Fly.



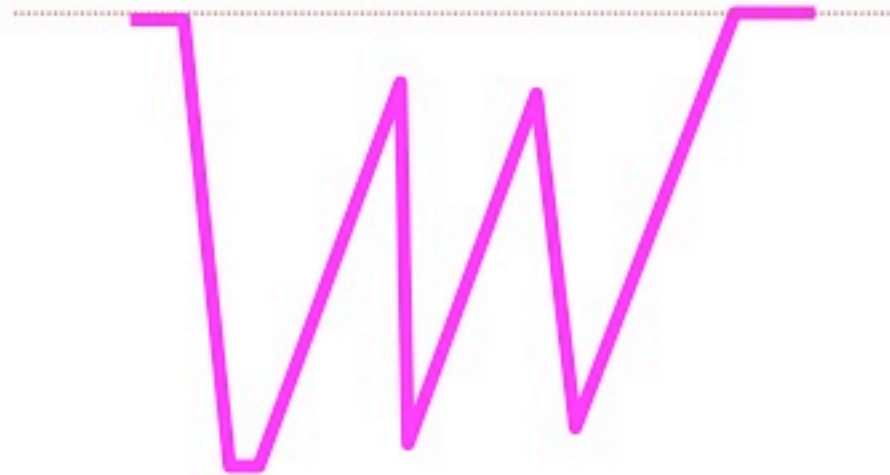


## 10. DECOMPRESSION

### «Yo-yo» Profil

Major adverse effects if:

- Large number by diving.
- Large amplitude.
- Speed of ascent / descent important.
- Distance of the surface.
- Movement to end of dive.
- risk: management by computers ??





## 10. DECOMPRESSION

### « Border Line » Profil

- ♦ Dive profile that keeps the time displayed without bearing (NDL) to the limit zero or near zero.
- ♦ Difference profile "no bearing" and "borderline".
- ♦ Dive profile strongly discouraged due the risk of accident





# 11. Organisation and planification of the dive



## 7. ORGANISATION

### 7.1 INTERNATIONAL CODE OF COMMUNICATION

#### 7.1.1 UNDER WATER

**Ascend**



**Go down**





## 7. ORGANISATION

### 7.1 INTERNATIONAL CODE OF COMMUNICATION

#### 7.1.1 UNDER WATER



**OK**



**No**



**SMEHTING  
WRONG**





## 7. ORGANISATION

### 7.1 INTERNATIONAL CODE OF COMMUNICATION

#### 7.1.1 UNDER WATER



**ME**



**YOU**



**I don't understand**







## 7. ORGANISATION

### 7.1 INTERNATIONAL CODE OF COMMUNICATION

#### 7.1.1 UNDER WATER



**Join us**



**Stop**





## 7. ORGANISATION

### 7.1 INTERNATIONAL CODE OF COMMUNICATION

#### 7.1.1 UNDER WATER



**Inflate**



**Pressure**





## 7. ORGANISATION

### 7.1 INTERNATIONAL CODE OF COMMUNICATION

#### 7.1.1 UNDER WATER



**Accelerate**



**Slow donw**





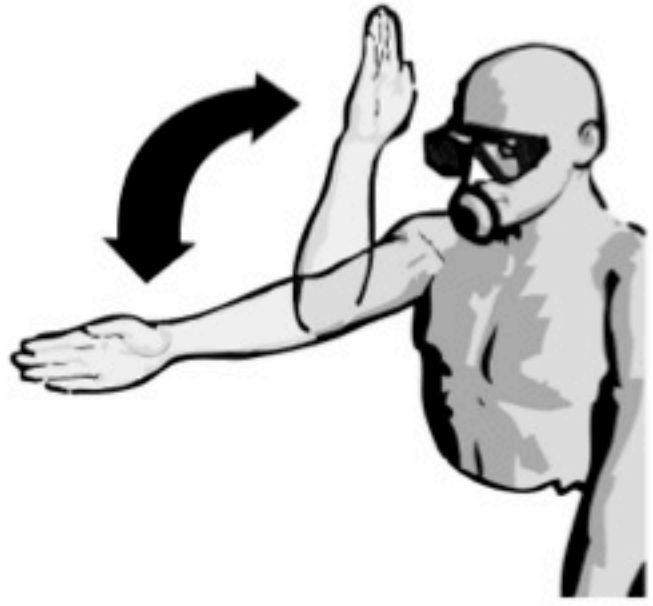
## 7. ORGANISATION

### 7.1 INTERNATIONAL CODE OF COMMUNICATION

#### 7.1.1 UNDER WATER



**Cold**



**This direction**





## 7. ORGANISATION

### 7.1 INTERNATIONAL CODE OF COMMUNICATION

#### 7.1.1 UNDER WATER



**Half tank**



**Reserve**





## 7. ORGANISATION

### 7.1 INTERNATIONAL CODE OF COMMUNICATION

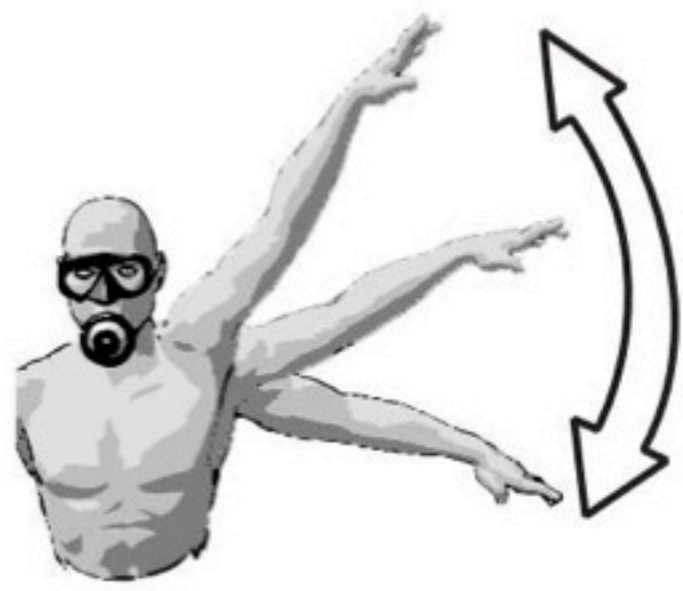
#### 7.1.2 OUT OF THE WATER



**OK (near)**



**OK (far)**



**Warning signal**





## 7. ORGANISATION

### 7.1 INTERNATIONAL CODE OF COMMUNICATION

#### 7.1.3 DURING THE NIGHT



**Sign OK**



**Sign Problème**





## 7. ORGANISATION

### 7.2 DIVING SYSTEM : BUDDY

- ♦ Minimum two.
- ♦ Mutual.
- ♦ Sharing experiences and sensations.
- ♦ Increase the safety.







## 7. ORGANISATION

### 7.3 BEHAVIOR AND SECURITY UNDER WATER

- ♦ Appropriate equipment.
  - ✓ Knowledge and skills.
  - ✓ Framing.
  - ✓ Good health.
  - ✓ Average swimmer.
  - ✓ Good physical condition





## 7. ORGANISATION

### 7.4 UNDERSTANDING

- ◆ Goals and wishes of each.
  - ✓ Experience
  - ✓ Limits of each.
  - ✓ Communication Code.





## 7. ORGANISATION

### 7.5 THE FIRST DIVE

- ♦ Maximum depth between 5 to 20 meter during min. 15 minutes
- ♦ The five first dive with a instructor





## **7. ORGANISATION**

### **7.6 YOUR BEHAVIOUR BEFORE DIVING**

- ♦ Be capable physically and mentally
- ♦ Be careful.





## 7. ORGANISATION

### 7.7 YOUR BEHAVIOUR DURING THE DIVE

- ◆ Attention to the important information
- ◆ Your position.
- ◆ No deeper than the dive leader.
- ◆ Limit the inflate of the jacket
- ◆ Communication with your dive leader with the good signs





## 7. ORGANISATION

### 7.7 COMSUMPTION

The quantity of air in a cylinder

Cylinder capacity x Loading pressure

Consumption in litres

20 x Ambient pressure x Dive time

Autonomy time in minutes

Volume of the air in the cilinder / 20 x Ambient pressure





## 7. ORGANISATION

### 7.8 DEBRIEFING

- ♦ Fill logbook
- ♦ be improved.



The background of the slide is an underwater photograph. Two divers in full scuba gear are swimming in clear blue water. The diver on the left is pointing towards a large school of yellowish fish. The diver on the right is holding a flashlight. To the left, there is a large, dark coral reef structure. Bubbles are visible around the divers.

# 12.Environment





## 12. ENVIRONMENT

### 12.1 INTRODUCTION

- ♦ Water : a different environment.
- ♦ Scuba preparation
- ♦ Respect of the environment





## 12. ENVIRONMENT

### 12.2 WEATHER

- ◆ Impact of the weather conditions on scuba diving
- ◆ Guarantee safety

### 12.3 TIDES - CURRENTS

- ◆ Knowledge
- ◆ Directions
- ◆ Intensity
- ◆ ...





## 12. ENVIRONMENT

### 12.4 FAUNA AND FLORA

- ♦ Scuba goal : discovery of another world.





## 12. ENVIRONMENT

### 12.5 ECOLOGY

- ◆ Rich but fragile ecosystem
- ◆ You're a guest...it's not a conquest.



The background of the slide is a photograph of two divers in a reef environment. The diver on the left is pointing towards a school of fish. The diver on the right is holding a flashlight. The scene is filled with coral and a large group of yellowish fish.

# 13. Competences



## 13. COMPETENCES

### 5.1 FINNING

- ♦ Do not use your arms : slow down your progression
- ♦ Refrain from « pedalling » : inefficient movements
- ♦ The finning : your hips
- ♦ Finning with a tank : hard but close to real « diving » conditions
- ♦ A good exercise that should be practiced on a regular basis





## 13. COMPETENCES

### 5.2 TUBA

- ◆ Allow to swim in surface
- ◆ The body is under the Archimedian buoyancy force
- ◆ Avoid to:
  - ✓ Inhale while the tube is still underwater
  - ✓ Remove the tuba from the mouth





## 13. COMPETENCES

### 5.3 FREE DIVING

- Do not practice it alone : Risk of syncope
- Learn the right way to breathe : to reduce CO<sub>2</sub> in the lungs
- After the free dive, remove the weight belt
- Exhale while surfacing.







## 13. COMPETENCES

### 5.4 BREATHING ON A REGULATOR

- Breathe normally
- Do not hold your breath
- Blow into the regulator before breathing in case you removed it





## 13. COMPETENCES

### 5.5 MASK CLEARING

- Fill the mask and look up
- Blow out of your nose .
- Seal the mask...it's empty





## 13. COMPETENCES

### 5.6 VALSALVA MANEUVER

- The descent
- Ears and sinus cavities are full of gases
- Internal and external pressure must be equalized.
- Varius methods
- This method:
  - ✓ Pinching one's nose shut while pressing out as if blowing up a balloon
  - P Eardrums normal position = " compensate "

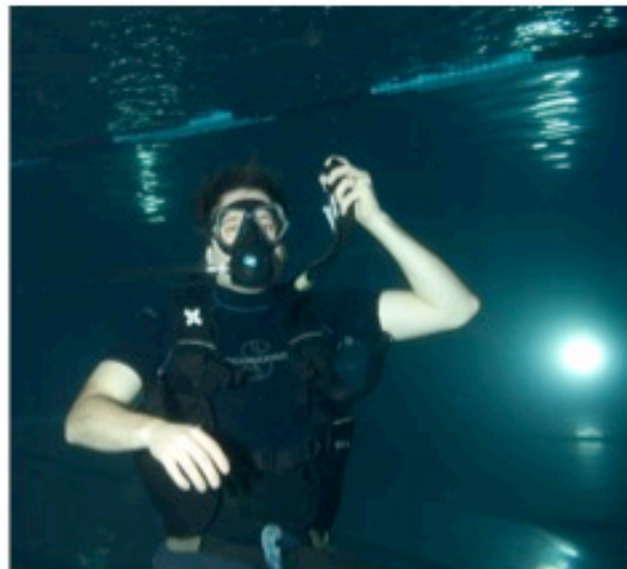




## 13. COMPETENCES

### 5.7 CORRECT USE OF THE BCD

- ♦ slowly down
- ♦ On sign: introduce air into your vest 'inflator' or mouth into the corrugated tube.
- ♦ From the first movement of ascent - purge the vest and remain in two waters without finning, without dripping or back.
- ♦ buoyancy control with the lungs.
- ♦ Lung-ballast.





Have nice dives