

Physics

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Physics Overview

- Types of matter
- Properties of matter
- Buoyancy
- Light underwater
- Sound underwater
- Components of air
- Pressure
- Pressure calculations
- The gas laws

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Types of Matter

- Types:
 - Solids
 - Liquids
 - Gases
- Properties:
 - volumes, density, mass, shape, incompressibility / compressibility
 - temperature
- Fresh vs. Salt Water
 - density, mass

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Buoyancy

- Archimedes Principle
 - any object wholly or partially immersed in a liquid is buoyed up by a force equal to the mass of the volume of liquid the object displaces.
 - Negative Buoyancy
 - if the mass of the object is greater than the mass of the volume of water displaced, the object will sink
 - Positive Buoyancy
 - if the mass of the object is less than the mass of the volume of water displaced, the object will float
 - Neutral Buoyancy
 - if the mass of the object is equal to the mass of the volume of water displaced, the object will neither sink nor float

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Factors Affecting Buoyancy

- Body Type/Density
- Lung Volume
- Equipment
 - exposure suits/lifejackets
 - full/empty scuba cylinders
 - buoyancy compensating devices
 - weight belts
 - carried items (e.g., lights, camera, backpack, etc.)
- Type of Water
 - fresh/salt/brackish

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Determining Buoyancy

- Purpose
- Practical Methods
- Theoretical Methods

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Altering Buoyancy

- Purpose
- Advantages and use of a B.C.D.
 - achieving neutral buoyancy
- Dangers in the use of a B.C.D.
 - Over-inflation causing increased rate of ascent
 - increased rate of ascent with expansion
- Inflation/deflation principles:
 - inflation
 - power/oral inflation
 - deflation
 - dump valves (manual & over-inflation valves), oral inflation hose

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Light Underwater

- Refraction
- Magnification
- Color perception / absorption
 - absorption of the spectrum
- Turbidity
 - causes of

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Sound Underwater

- Speed in water vs. speed in air
- Difficulties caused
 - distance determination
 - locating source

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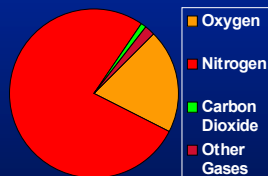
Components Of Air

- Oxygen: O₂
 - 20.94% of the total
 - role in metabolic process
 - consumption during normal respiration
 - dangers of pure oxygen
- Nitrogen: N₂
 - 78.08% of total
 - inert gas
 - role in breathing
- Carbon Dioxide: CO₂
 - .03% of total, metabolic product, trigger mechanism for respiration

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Pressure

- Types:
 - atmospheric pressure
 - absolute pressure
 - ambient pressure
 - gauge pressure
- Effects of altitude
- Pressure Calculations
 - 1 atm for every 33 fsw
 - 1 cuft of salt water weighs 64 lb.

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||||| The Gas Laws

- Boyle's Law
- Charles' Law
- Dalton's Law
- Henry's Law
- The General Gas Law

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||||| Boyle's Law

- Boyle's Law:
 - the volume of a gas varies inversely as the absolute pressure while the density varies directly as the absolute pressure, providing the temperature remains constant.
 - OR: pressure is inversely proportional to volume and directly proportional to density.
- Significance:
 - on the body, air spaces, and equipment
 - effects on given volumes of air at varying depths

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||||| Charles' Law

- Charles' Law:
 - Temperature is directly related to volume
 - ✦ $V/T=K$
 - ✦ $V_1/T_1=V_2/T_2=V_3/T_3=...$
- Significance:
 - of burst discs
 - 2-300 PSI / minute speed of filling cylinders
 - change in tank pressure when entering the water
 - storage of cylinder, i.e. trunk of car or in direct sunlight

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||||| Dalton's Law

- Dalton's Law
 - The total pressure of a mixture of gasses is equal to the sum of the partial pressures of each gas.
 - ✦ $P_{total}=ppA+ppB+ppC+...$
 - ✦ $ppA=P_{total} \times \%VolA$
- Significance:
 - oxygen toxicity
 - nitrogen toxicity
 - relationship between Dalton's Law and Boyle's Law

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||||| Henry's Law

- Henry's Law:
 - The amount of a gas that will dissolve in a liquid is in direct proportion to the partial pressure of the gas, providing the temperature remains constant.
- Significance:
 - in decompression sickness
 - relationship between Henry's law and Dalton's law

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||||| The General Gas Law

- The General Gas Law combines all of the other laws:
 - $P_1 V_1 / T_1 = P_2 V_2 / T_2$
- Significance
 - relates all gas laws into one expression
 - if you have two components, you can find the third
 - you can predict what will change if one of the variables is altered

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