Health Science–Training Guide (05)
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This event encompasses the **physiology of the Respiratory, Urinary and Endocrine Systems in health and disease.**

Note: No recourses will be allowed in the competition this year!!!

Facts and Concepts

Respiratory System

- Basic anatomy of the respiratory system — nose to lungs.
- Oxygen-transportation from lungs to muscle tissues, at rest and during exercise (breathing, gas exchange, red blood cell uptake and release).
- Effects of smoking (primary and secondary) carbon monoxide, nicotine, and air quality on emphysema, asthma, and lung cancer.
- Problems: graph interpretation and epidemiological risk eg. odds ratio.
- **Formulas**: partial pressure of gases, oxygen saturation curve analysis, respiratory volumes.

Urinary System

- Basic anatomy of the urinary system including kidneys, ureters, bladder, and urethra.
- Formation of urine, GFR calculation, concepts of tubular secretion and absorption, and the effects of ADH.

Endocrine System

- Basic anatomy and physiology of the human endocrine system
- Definition of hormones
- Types of endocrine glands and their hormonal effects
- Concepts of Half-life
- Synergism
- Antagonism
- Diseases such as
  - Diabetes,
  - Cushing Syndrome,
  - Graves Disease,
  - Giantism,
  - Myxedema

Health Science (C) - Relevant Formulas

Respiration:

Partial pressure of gases – the amount of pressure exerted by each gas in a mixture.

- It is equal to the total pressure x fractional composition of a gas in the mixture.
- It affects the diffusion of oxygen and carbon dioxide.
- Based on the original Torricelli barometer design, one atmosphere of pressure will force the column of mercury (Hg) in a mercury barometer to a height of 760 millimeters. A pressure that causes the Hg column to rise 1 millimeter is called a torr (you may still see the term 1 mm Hg used; this has been replaced by the torr).
- ***Partial Pressure of oxygen*** **=** Sea level atmospheric Pressure of 760 torr or (mm Hg) x 21% oxygen =760 torr (mm Hg) x .21 = 160 mm Hg

Total Lung capacity **(TLC) – (**5700 to 6200 mL (cm^3) for adults and 2690 to 3600 mL for Junior High Youth) - the amount of air that the lungs can hold

Vital capacity **(VC)** – (4500 to 5000 mL) - the largest amount of air that can be in and out of the lungs in one inspiration and expiration

VC = TV + IRV + ERV

Tidal volume **(TV)** – (500 mL)**-** the amount of air exchanged during normal breathing

Expiration reserve volume **(ERV)** – (1000 to 1200 mL) - the amount of air forcibly exhaled after expiring of tidal volume

Inspiration reserve volume **(IRV)** – (3000 to 3300 mL) - the amount of air forcibly inspired over and above normal inspiration

Residual volume **(RV)** – (1200 mL) - the amount of air left in the lungs after expiration

Urinary System:

Glomerular Filtration Rate (GFR– amount of filtrate formed per minute in all nephrons *of both kidneys)* The amount of fluid filtered from the glomeruli into Bowman's space per unit of time. Renal capillaries are much more permeable than others. The flow rate is 180 L/day (125 ml/min) compared to 4 L/day in the other capillaries. The entire plasma volume is filtered about 60 times a day! Most is reabsorbed!.

GFR = UV = Urine concentration x Rate of Urine Flow = g/ml x ml/min = ml/min
P Blood Plasma Concentration g

HEALTH SCIENCE - SAMPLE PROBLEMS (05)

- Given a data sheet, calculate the inspiratory reserve of an individual.

- Name three major cellular and biochemical effects nicotine has on the efficiency of breathing and gas delivery to the muscles of the body.

- Given the composition of a gas, calculate the partial pressures of each component.

- What effect will chronically high carbon dioxide levels in the blood have on the respiratory rate?

- Given the blood plasma and urine concentrations of a substance, and the urinary output per hour, calculate the GFR.

- If a patient has a blood glucose level of 200 mg %, what is the glucose level of their urine?

- Given a graph indicating estrogen and progesterone levels, select the expected time of LH release.

- Which hormones will increase the blood glucose level of an individual?