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# Biology of the Neonate

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# The Neonate

- ◆ Newborn = the first 24 hours of life
- ◆ Neonate = the first 28 days after birth
- ◆ Infant = The first year of life
- ◆ A period of transition for both baby and the family. Survival is now extrauterine which poses a physiological challenge
- ◆ *Life tasks at birth*: independent breathing, change from fetal to neonatal circulation, establishment of early feeding, thermal and glucose control and changes to fluid balance
- ◆ (File adapted from Petty, 2011- a,b and c)

## *First week of life*

- ◆ Stabilisation of body temperature
- ◆ Feeding
- ◆ Bladder and bowel function
- ◆ Red blood cell breakdown / homeostasis



## *First year of life & beyond*

- ◆ Immune response develops further
- ◆ Digestive function matures
- ◆ Adult haemoglobin (Hb) is produced by 6 months
- ◆ Neuro-endocrine function matures further
- ◆ Respiratory – alveolar growth continues up to 3-5 years
- ◆ Kidney function matures up to 2 years

# Physical Features

- ◆ Weight = average birth weight 3.5kg.  
Lose 5-10% birthweight in the 1st week of life and regains by day 10. Steady gain at 180-210 g per week thereafter.  
Length = 51 cm average (50<sup>th</sup> centile)
- ◆ Head circumference (occipito-frontal) = 35-36 cm and grows 2cm in first month appearing larger than the chest

# Birth weight on 50<sup>th</sup> 'centile'



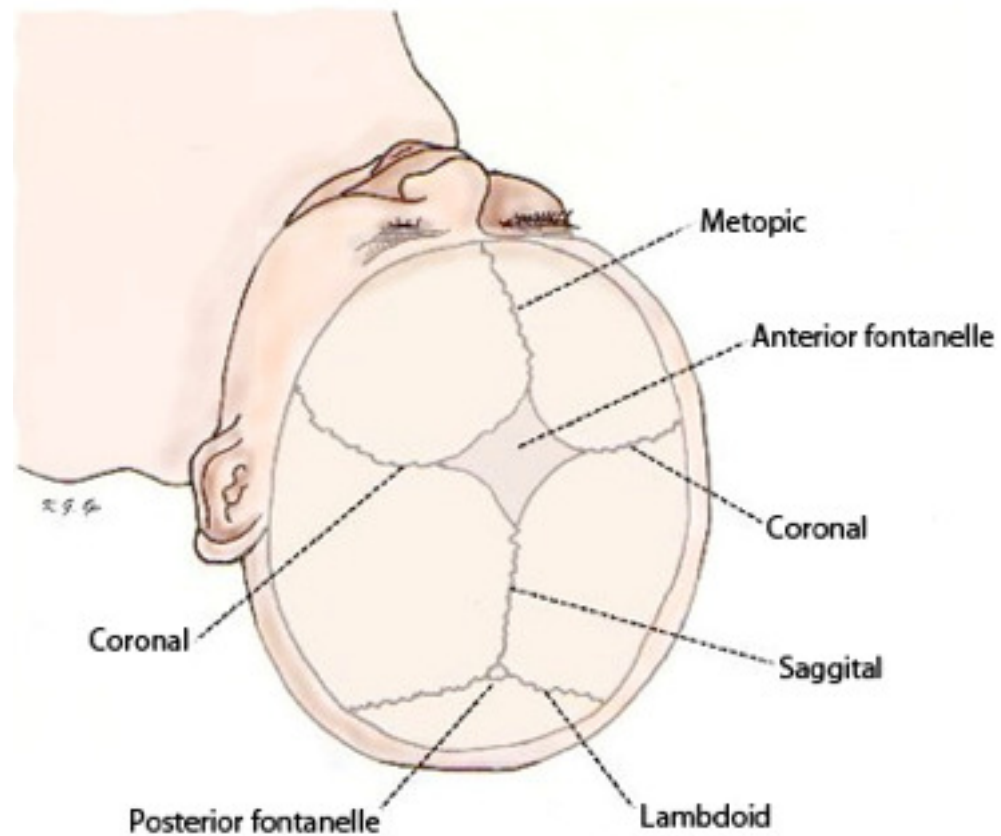
# The Head & face



- ◆ Unfused cranial (skull bone) sutures for first 12-18 months
- ◆ Posterior fontanelle closes at approx. 6-8 weeks and anterior fontanelle at approx. 18 months
- ◆ Skin should be clear, soft and silky and may be covered with vernix and lanugo
- ◆ Jaundice may be evident at 3 - 10 days in a significant proportion of neonates.

# Cranial Sutures

*View from top of head*





## Normal skin—with milia (small white spots)

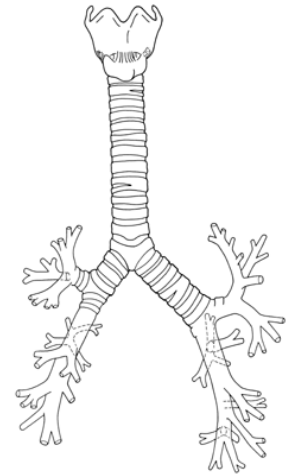


# The Trunk & Limbs

- ◆ Should be well aligned with a relatively large abdomen
- ◆ Umbilical cord separates 7-10 days
- ◆ Limbs equal in length with correct number of digits
- ◆ Good movement & tone - 'physiological flexion'
- ◆ Hips checked for dislocation

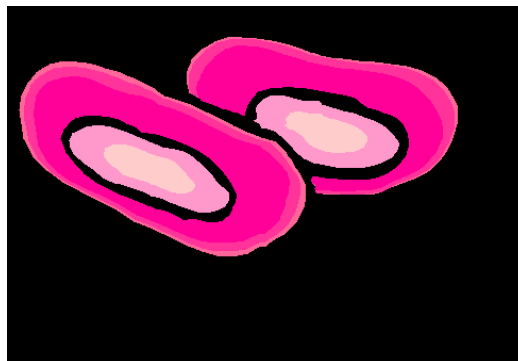
# Respiratory system

- ◆ Shorter, narrower airways –
- ◆ Large tongue and large floppy epiglottis
- ◆ High epiglottis
- ◆ Airway shape more like a cone
- ◆ Nose breathers
- ◆ Diaphragm is the main respiratory muscle



# Cardiovascular system

- ◆ Circulating blood volume 85ml/kg
- ◆ Higher Hb and haematocrit in early days
- ◆ 75-84% of Hb is fetal until 6 months when adult Hb is produced

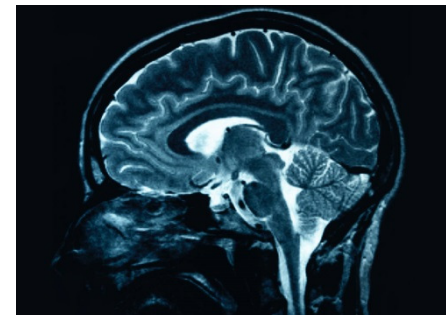


# Metabolic

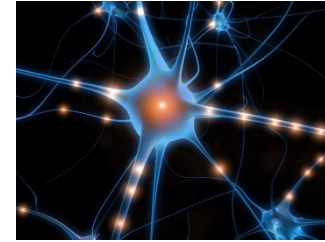
- ◆ High metabolic rate
- ◆ High oxygen and energy needs
- ◆ Limited nutrient storage
- ◆ Glycogen stores easily depleted
- ◆ Less able to mount metabolic response to stress
- ◆ High energy need for growth

# Neurological

- ◆ The normal neonate is expected to react to certain stimuli in a particular way which gives an indication of normality
- ◆ Reflexes - abnormal, absent or delayed OR prolonged ? May be significant



# The Senses



- ◆ Sight = Eyes open and attention to visual stimulus. Prefer faces and brightness. Fix & follow at 6 weeks with full 20- 20 vision at approx. 4-6 months.
- ◆ Hearing =head turns, prefers human voices
- ◆ Touch =responsive, rooting, hand-to-mouth
- ◆ Smell =breast milk and mother's skin
- ◆ Taste =differentiates sweet / sour
- ◆ Pain =perception is present

# Normal neonatal behavioural states

- 5 behaviours

- 1= asleep

- 2=awake / fussy

- 3= awake and quiet

- 4= awake and focusing / alert

- 5 – crying

- <http://www.centreforperinatalpsychology.com.au/states-of-alertness/>



# Behaviour 1- Asleep



## Behaviour 2 – awake & fussy





# Behaviour 3- awake and quiet



# Behaviour 4- awake and alert / focusing





# Behaviour 5- Crying

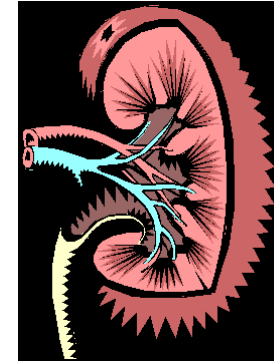


[http://commons.wikimedia.org/wiki/File:Crying\\_newborn.jpg](http://commons.wikimedia.org/wiki/File:Crying_newborn.jpg)

# The gut & feeding

- ◆ Meconium passage in 12 - 24 hours, changing stools from Day 3
- ◆ Sucking coordinated at 34 weeks gestation
- ◆ Stomach capacity increases rapidly in first few weeks
- ◆ Enzyme function matures in 1<sup>st</sup> year
- ◆ Lower oesophageal sphincter (muscle) is weak (reflux common)

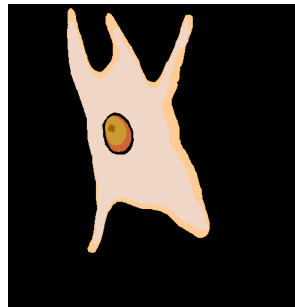
## Renal / Fluids



- ◆ Total body water is 75 %
- ◆ High proportion of extra cellular fluid
- ◆ High surface area to volume ratio
- ◆ Functionally immature kidneys
- ◆ First urine should be passed at birth or within the first 24 hours
- ◆ Build fluid intake up gradually - normally the neonates guages this naturally

# Immune System

- ◆ Low levels of specific immunoglobulins
- ◆ Reduced antigen recognition
- ◆ Local bacterial infections can easily progress
- ◆ Passive immunity for a given period





# Thermoregulation

- ◆ Immature hypothalamus along with high surface area predisposes to poor temperature control
- ◆ Subcutaneous & brown fat reduced (in preterm)- thermogenesis from brown fat occurs instead of shivering
- ◆ Sweat mechanism is poor and ability to spontaneously generate heat.

# Further Reading



- ◆ Petty, J. (2011a). Fact Sheet; Neonatal Biology – An Overview Part 3. *Journal of Neonatal Nursing*, 17(4), 128-131.
- ◆ Petty, J. (2011b). Fact Sheet; Neonatal Biology – An Overview Part 2. *Journal of Neonatal Nursing*, 17(3), 89-91.
- ◆ Petty, J. D. (2011c). Fact Sheet; Neonatal Biology – An Overview Part 1. *Journal of Neonatal Nursing*, 17(1), 8-10.
  
- ◆ For further detail and more resources, go to the online resource Units 2D and 2E
- ◆ [http://www.cetl.org.uk/learning/neonatal/unit\\_2d/player.html](http://www.cetl.org.uk/learning/neonatal/unit_2d/player.html)
- ◆ [http://www.cetl.org.uk/learning/neonatal/unit\\_2e/player.html](http://www.cetl.org.uk/learning/neonatal/unit_2e/player.html)