

Curso de Ciências Biológicas
Disciplina BMI0296 – Imunologia (Integral)

Princípios da Imunologia

Componentes do Sistema Imune

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Departamento de Imunologia
Instituto de Ciências Biomédicas
Universidade de São Paulo

Tópicos Essenciais da Aula

- 1. Aspectos históricos da Imunologia.**
- 2. Células do sistema imunológico, onde elas se originam e suas principais funções.**
- 3. Entender a distribuição das células do sistema imune no organismo. Por que elas estão nesses locais?**
- 4. Órgãos linfóides primários e secundários e sua função.**

Sistema Imunológico

- **Sistema: conjunto de elementos interconectados e organizados, com um objetivo geral comum**
- **Função: reconhecimento do próprio (*self*) e não próprio (*non-self*)**
 - imunidade
 - tolerância
 - lesão tecidual e patologia (hipersensibilidades)
 - doenças auto-imunes

Definições

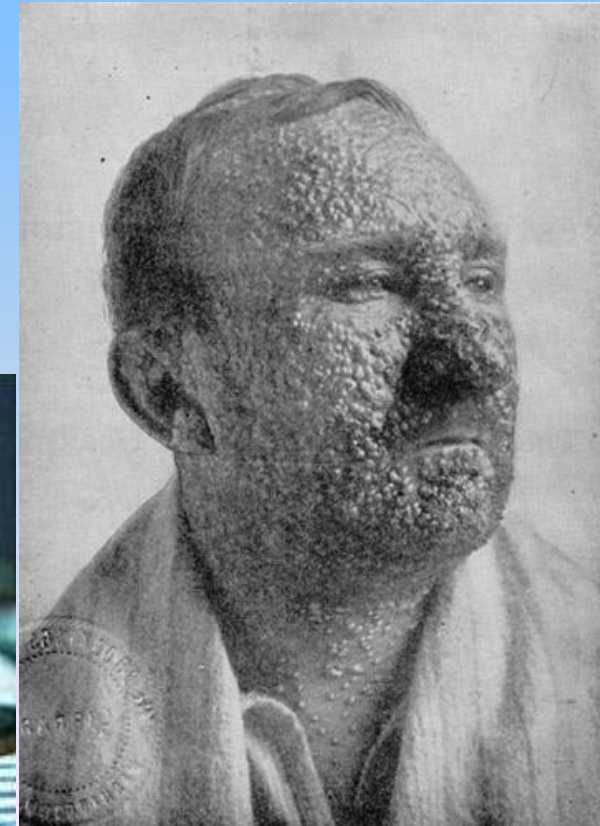
- **Antígenos (“anti” = contra / “gen” = gerar)**
 - qualquer elemento, molécula ou substância capaz de ser reconhecido pelo sistema imunológico (definição imprecisa)
- **Quanto à imunidade:**
 - antígenos imunogênicos (imunógenos)
 - antígenos tolerogênicos (tolerógenos)
 - antígenos que causam alergia (alérgenos)
- **Quanto à origem:**
 - autoantígeno: próprio
 - aloantígeno: indivíduos diferentes da mesma espécie
 - xenoantígeno: espécies diferentes

Edward Jenner (1749-1823)



Varíola humana (smallpox): grave problema de saúde pública
- 1/3 dos infectados morriam
- sobreviventes desfigurados

<http://www.mytimemachine.co.uk/jenner.htm>



<http://www.bizarremedical.com/things-you-didnt-know-about-smallpox/>

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Varíola bovina (cowpox):

- ordenhadeiras tinham uma versão branda
- pus das feridas no úbere foi usado



<http://www.mytimemachine.co.uk/jenner.htm>

<http://bioexchange.blogspot.com/2014/04/historia-viva-vacas-e-vacinas.html>

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Vacca: latim para “vaca”

- Vaccinius: derivado das vacas
- Vaccination = Vacinação

<http://www.mytimemachine.co.uk/jenner.htm>

➤ **Vacinação de James Phipps**



<http://www.med.umich.edu/opm/newspage/2007/paintings.htm>

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Varíola humana (smallpox): grave problema de saúde pública

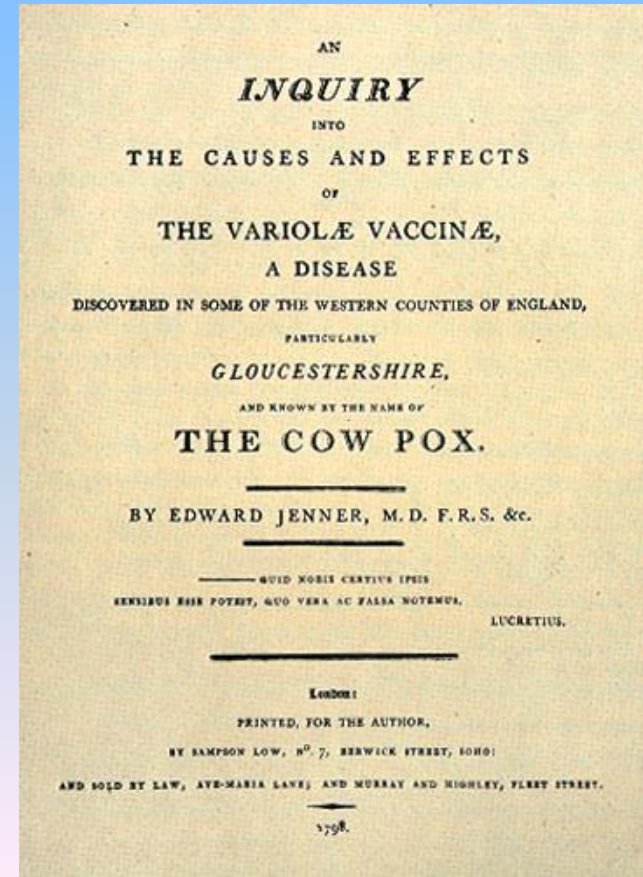
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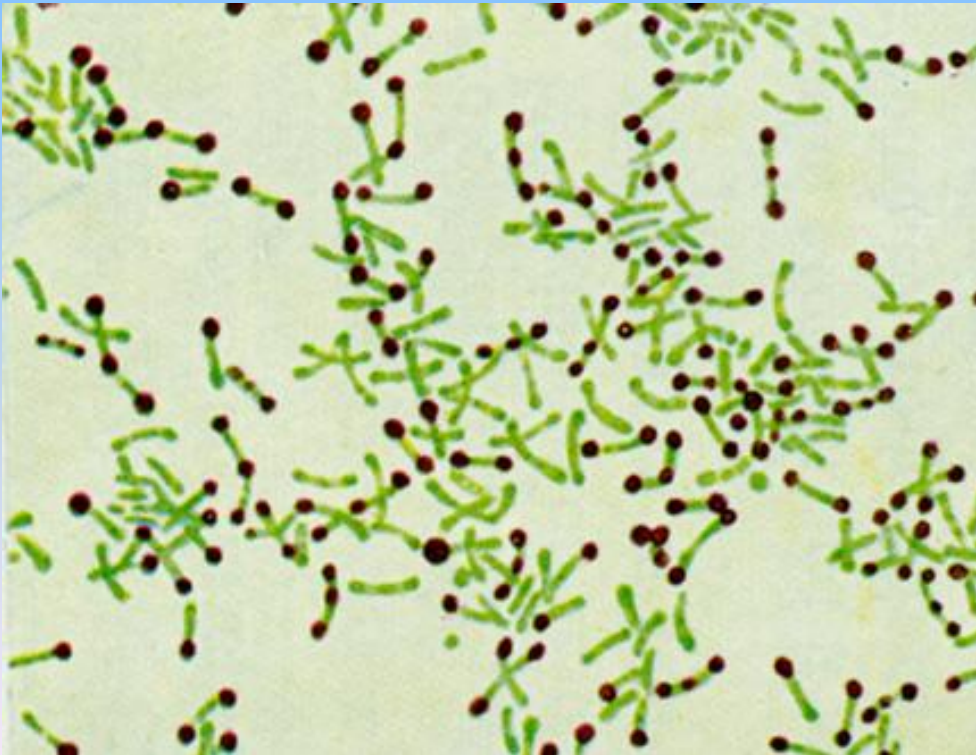


<http://www.mytimemachine.co.uk/jenner.htm>

- **Erradicação da Varíola em 1979 (OMS)**
- **Algumas cepas permanecem estocadas nos EUA e na Rússia**

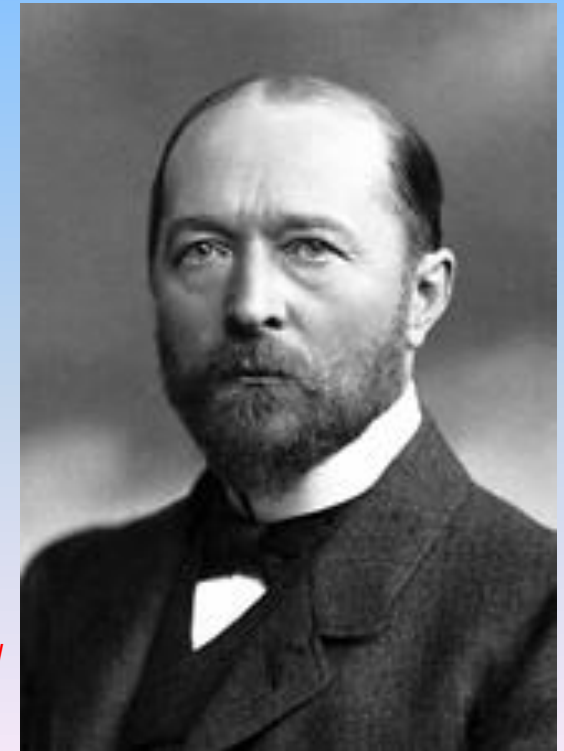
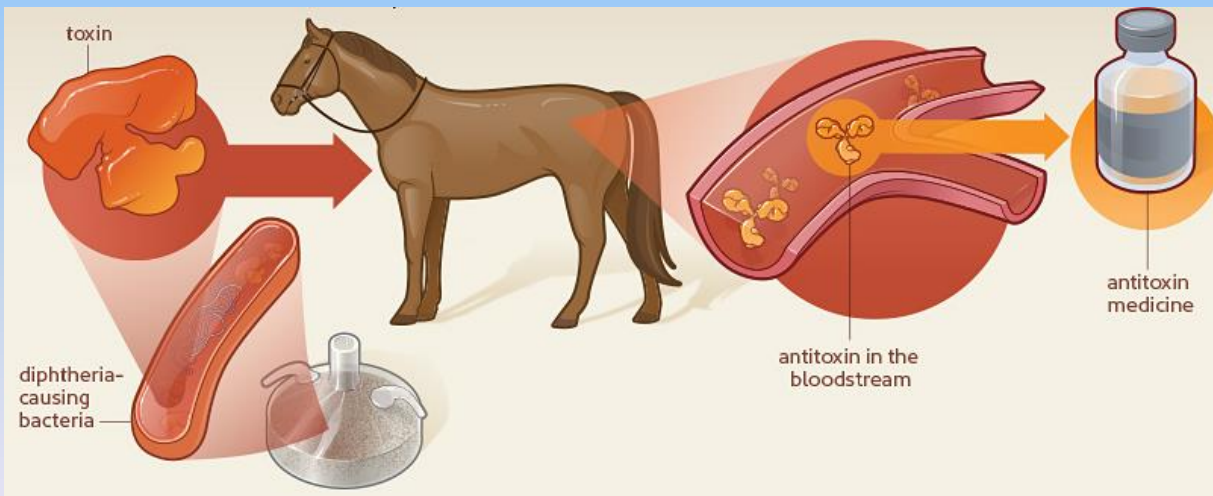
Emil Adolf von Behring (1854-1917)

- Filtrados de cultura de *Corynebacterium diphtheriae*:
 - bacilo diftérico (bactéria Gram positiva)
 - causavam os sintomas da doença: “toxina”



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 - inoculação da cultura esterilizada em animais: antitoxinas
 - antitoxinas = proteção

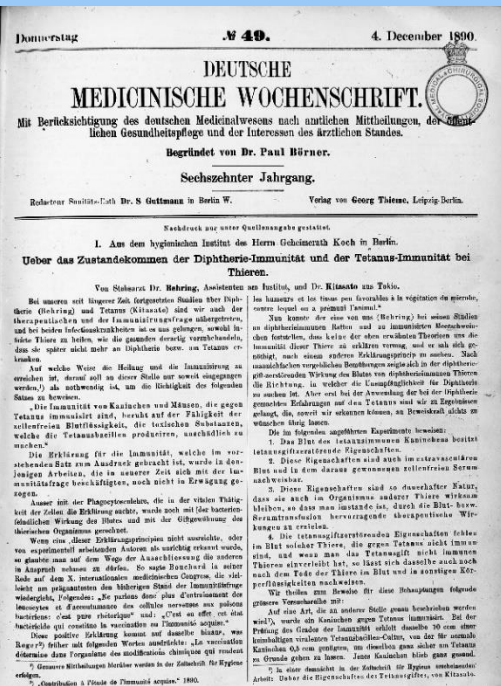
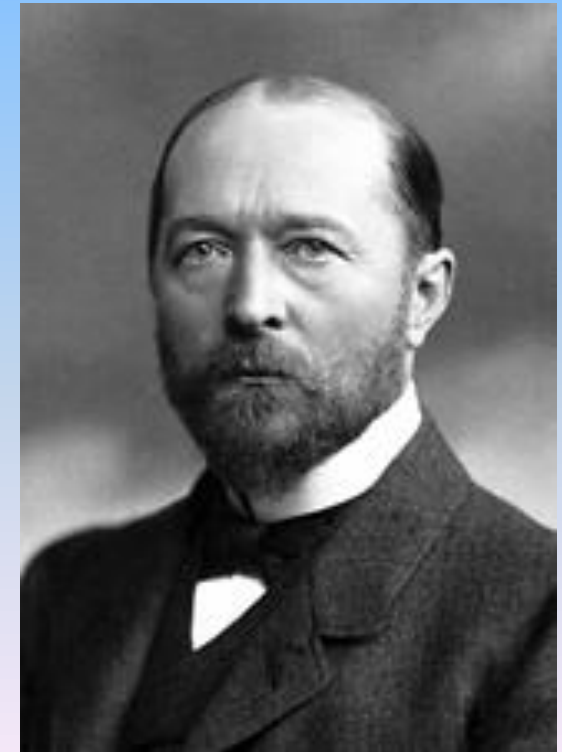


<https://www.nlm.nih.gov/exhibition/fromdnatobeer/exhibition-interactive/illustrations/diphtheria-alternative.html>

http://nobelprize.org/nobel_prizes/medicine/laureates/1901/

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- Soro de animais contendo antitoxina transferem proteção
 - soro anti-diftérico
 - criou uma companhia e ficou rico



<https://en.wikipedia.org/wiki/Antitoxin>

Frasco de 1895

http://nobelprize.org/nobel_prizes/medicine/laureates/1901/

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 - criou uma companhia e ficou rico
- Foi laureado com o 1º Prêmio Nobel

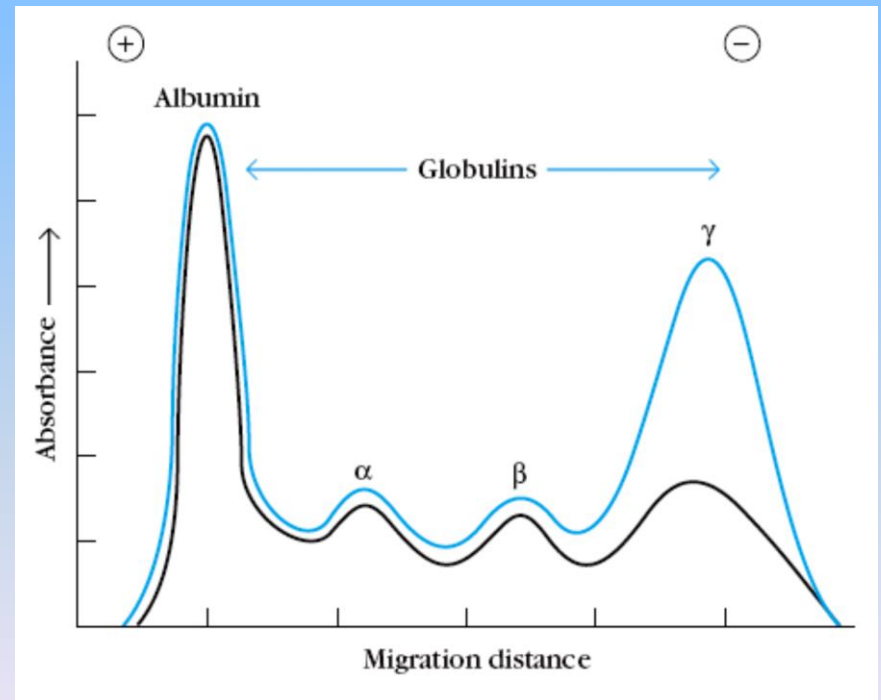
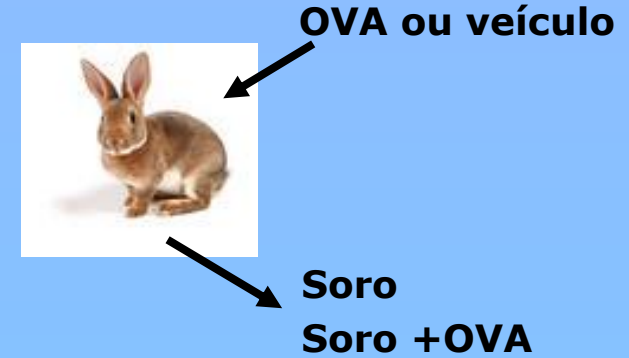
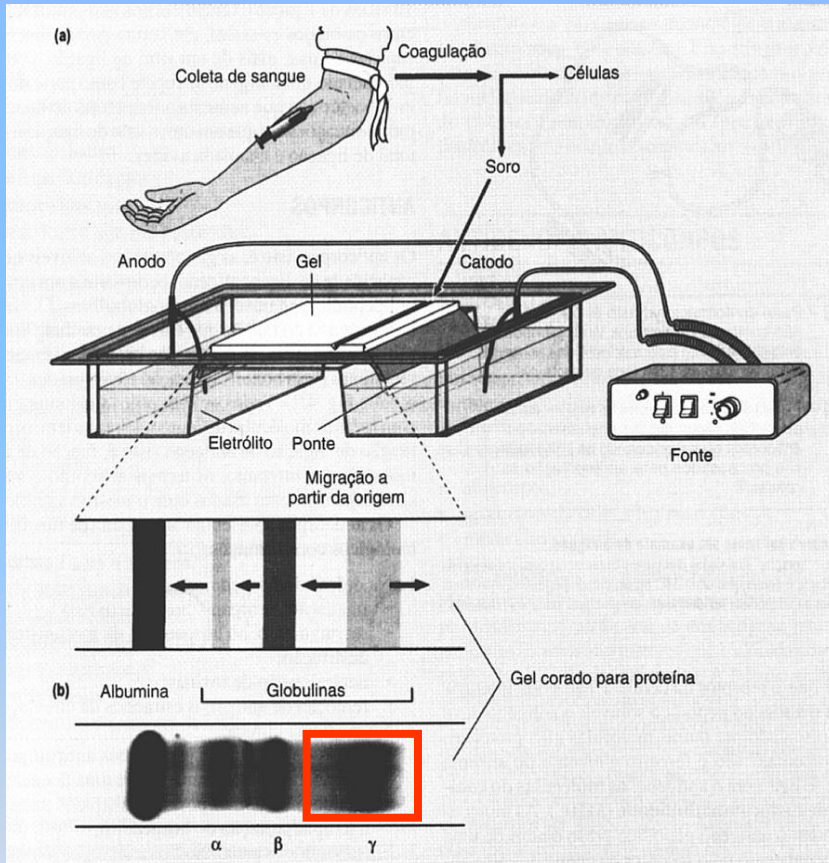


The Nobel Prize in Physiology or
Medicine 1901

"for his work on serum therapy, especially its application against diphtheria, by which he has opened a new road in the domain of medical science and thereby placed in the hands of the physician a victorious weapon against illness and deaths"



Técnica de Eletroforese



- **γ-globulinas (gamaglobulinas)**
- **imunoglobulinas**
- **anticorpos**

Arne Tiselius & Elvin Kabat
The Journal of Experimental Medicine, 1939

Eficácia da Vacinação

Doença	Número Máximo de Casos (Ano)	Número de Casos em 2014	Mudança na Porcentagem
Difteria	206.939 (1921)	0	-99,99
Sarampo	894.134 (1941)	669	-99,93
Caxumba	152.209 (1968)	737	-99,51
Coqueluche	265.269 (1934)	10.631	-95,99
Pólio (paralisia infantil)	21.269 (1952)	0	-100,00
Rubéola	57.686 (1969)	2	-99,99
Tétano	1.560 (1923)	8	-99,48
<i>Haemophilus influenza</i> tipo B	~ 20.000 (1984)	34	-99,83
Hepatite B	26.611 (1985)	1.098	-95,87

Controvérsia: vacinas e autismo



Dr. Andrew J. Wakefield

https://www.forbes.com/sites/kavinsenapathy/2016/03/28/no-andrew-wakefield-youre-not-being-censored-and-you-dont-deserve-due-process/#69a5dc3a297a

- **Publicou artigos associando o vírus do sarampo com a Doença de Crohn**
- **Posteriormente associou a doença à vacina contra o sarampo**
- **Grupo de especialistas britânicos revisaram artigos na área em 1998 e não confirmaram essa hipótese**
- **Publicou artigo no The Lancet sobre 12 crianças com autismo, sendo que em 8 delas descreveram uma síndrome chamada enterocolite autística, associando enteropatias, autismo e a vacina MMR (sarampo, caxumba e rubéola)**
- **Estudos independentes nunca confirmaram essa relação. Como o autor se recusou a incluir controles no seu estudo, o artigo foi retratado**

Early report

Ileal-lymphoid-nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children

A J Wakefield, S H Murch, A Anthony, J Linnell, D M Casson, M Malik, M Berelowitz, A P Dillon, M A Thomson, P Harvey, A Valentine, S E Davies, J A Walker-Smith

Summary

Background We investigated a consecutive series of children with chronic enterocolitis and regressive developmental disorder.

Methods 12 children (mean age 6 years [range 3–10], 11 boys) were referred to a paediatric gastroenterology unit with a history of normal development followed by loss of acquired skills, including language, together with diarrhoea and abdominal pain. Children underwent gastroenterological, neurological, and developmental assessment and review of developmental records. Haecolonoecology and biopsy sampling, magnetic-resonance imaging (MRI), electroencephalography (EEG), and lumbar puncture were done under sedation. Barium follow-through radiography was done where possible. Biochemical, haematological, and immunological profiles were examined.

Findings Onset of behavioural symptoms was associated by the parents, with measles, mumps, and rubella vaccination in eight of the 12 children, with measles infection in one child, and dicit media in two. All 12 children had intestinal abnormalities ranging from lymphoid nodular hyperplasia to atrophic ulceration. Histology showed patchy chronic inflammation in 11 children and reactive ileal lymphoid hyperplasia in seven, but no granulomas. Behavioural disorders included autism (nine), disintegrative psychosis (one), and possible postviral or vaccinal encephalitis (two). There were no focal neurological abnormalities and EEG tests were normal. Abnormal laboratory results were significantly raised urinary thymaline acid compared with age-matched controls (p=0.03), low haemoglobin in four children, and low serum IgA in two children.

Interpretation The idiopathic associated gastrointestinal disease and developmental regression in a group of previously normal children, which was generally associated in time to a possible environmental trigger.

Lancet 1998; **351**: 637–41
See Commentary page

Inflammatory Bowel Disease Study Group, University Departments of Medicine and Histopathology (A J Wakefield ¹, A Anthony ², J Linnell ³, D M Casson ⁴, M Malik ⁵, M Berelowitz ⁶, A P Dillon ⁷, M A Thomson ⁸, P Harvey ⁹, A Valentine ¹⁰, S E Davies ¹¹ and the University Departments of Paediatric Gastroenterology (S H Murch ¹², D M Casson ¹³, M Malik ¹⁴, M A Thomson ¹⁵), (J A Walker-Smith ¹⁶), **Child and Adolescent Psychiatry** (M Berelowitz ¹⁷), **Neurology** (P Harvey ¹⁸), and **Radiology** (A Valentine ¹⁹), **Royal Free Hospital and School of Medicine, London NW2 2QG, UK**
Correspondence to: Dr A J Wakefield

THE LANCET • Vol 351 • February 28, 1998

EARLY REPORT

Introduction

We saw several children who, after a period of apparent normality, lost acquired skills, including communication. They all had gastrointestinal symptoms, including abdominal pain, diarrhoea, and vomiting and, in some cases, food intolerance. We describe the clinical findings, and gastrointestinal features of these children.

Patients and methods

12 children, consecutively referred to the department of paediatric gastroenterology with a history of a regressive developmental disorder with loss of acquired skills and intestinal symptoms (abdominal pain, bloating and food intolerance), were investigated. All children were admitted to the ward *fast-track*, according to their parents.

Clinical investigations

We took histories, including details of immunisations and exposure to infectious diseases, and assessed the children. In 11 cases, the history was obtained by the senior clinician (JW-S). Neurological and psychiatric assessments were done by consultant paediatricians (PH, MD) with HMS-4 criteria.²⁰ Developmental records included a review of prospective developmental records from parents, health visitors, and general practitioners. Four children did not undergo psychiatric assessment in hospital; all had been assessed professionally elsewhere, so these assessments were used as the basis for their behavioural diagnosis.

After bowel preparation, haecolonoecology was performed by SRM or MAT under sedation with midazolam and pethidine. Paired frozen and formalin-fixed mucosal biopsy samples were taken from the terminal ileum; ascending, transverse, descending, and sigmoid colons, and from the rectum. The procedure was recorded by video or still images, and were compared with images of the previous seven consecutive paediatric colonoscopies (four normal colonoscopies and three on children with ulcerative colitis), in which the physician reported normal appearances in the terminal ileum. Barium follow-through radiography was possible in some cases.

Also under sedation, cerebral magnetic resonance imaging (MRI), electroencephalography (EEG) including visual, brain stem auditory, and sensory evoked potentials (where compliance made these possible), and lumbar puncture were done.

Laboratory investigations

Thyroid function, serum long-chain fatty acids, and cerebrospinal-fluid lactate were measured to exclude known causes of childhood neurodegenerative disease. Urinary methylmalonic acid was measured in random urine samples from eight of the 12 children and 14 age-matched and sex-matched normal controls, by a modification of a technique described previously.²¹ Chromatograms were scanned digitally on computer, to analyse the methylmalonic-acid zones from cases and controls. Urinary methylmalonic-acid concentrations in patients and controls were compared by a two-sample *t* test. Urinary creatinine was estimated by routine spectrophotometric assay.

Children were screened for antidiomysal antibodies and boys were screened for fragile-X if this had not been done

637

Wakefield et al., *The Lancet*, v. 351, p. 637-641, 1998

Mercado de Vacinas no Mundo

Global Market Insights
Insights to Innovations

VACCINES MARKET

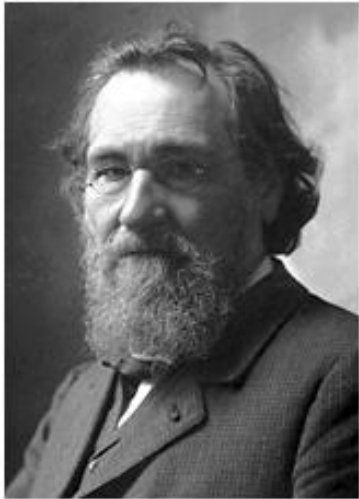


Elie Metchnikoff (1845-1916)



The Nobel Prize in Physiology or
Medicine 1908

"in recognition of their work on immunity"



Ilya Ilyich Mechnikov



Paul Ehrlich

http://nobelprize.org/nobel_prizes/medicine/laureates/1908/

Larva de estrela do mar



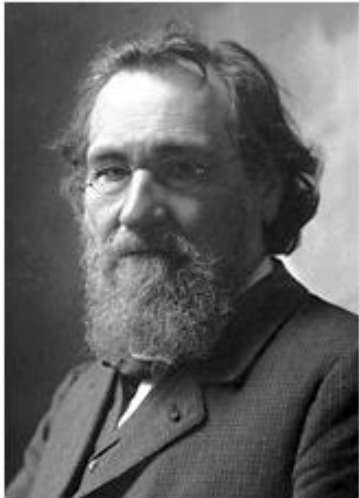
http://www.iwu.edu/news/2006/fac_AntarcWrap_0606.html

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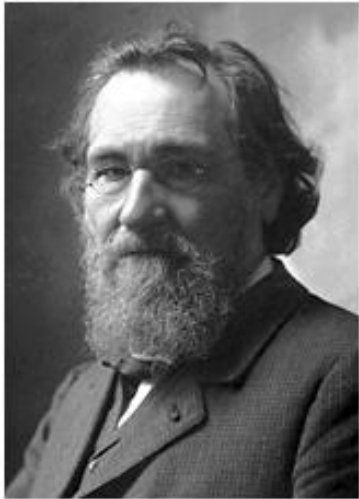
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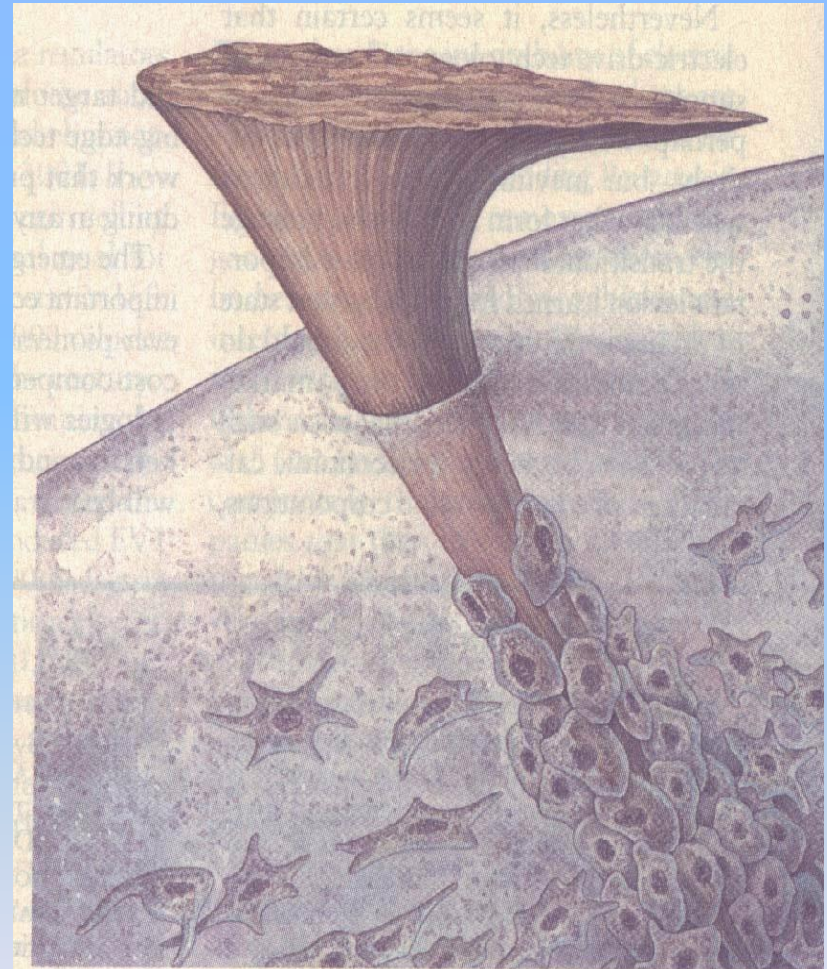
"in recognition of their work on immunity"



Ilya Ilyich Mechnikov

http://nobelprize.org/nobel_prizes/medicine/laureates/1908/

• **fagócitos**



PHAGOCYTES attempt to engulf a rose thorn inserted into the transparent larva of a starfish. In 1882 the Russian zoologist Élie Metchnikoff (*photograph at right*) first noted this example of an innate host defense response. His subsequent studies established the field of cellular immunology.

Respostas Imunes: divisões e geração

RESPOSTA IMUNE HUMORAL

Mediada por moléculas solúveis presentes nos fluídos corporais

RESPOSTA IMUNE CELULAR

Mediada por células

**RESPOSTAS IMUNES ATIVAS
RESPOSTAS IMUNES PASSIVAS**

Respostas Imunes: divisões e geração

**RESPOSTA IMUNE INATA OU NATURAL
(PRÉ-FORMADA)**

Barreiras biológicas

Inflamação aguda

**RESPOSTA IMUNE ADAPTATIVA OU ADQUIRIDA
(NEO-FORMADA)**

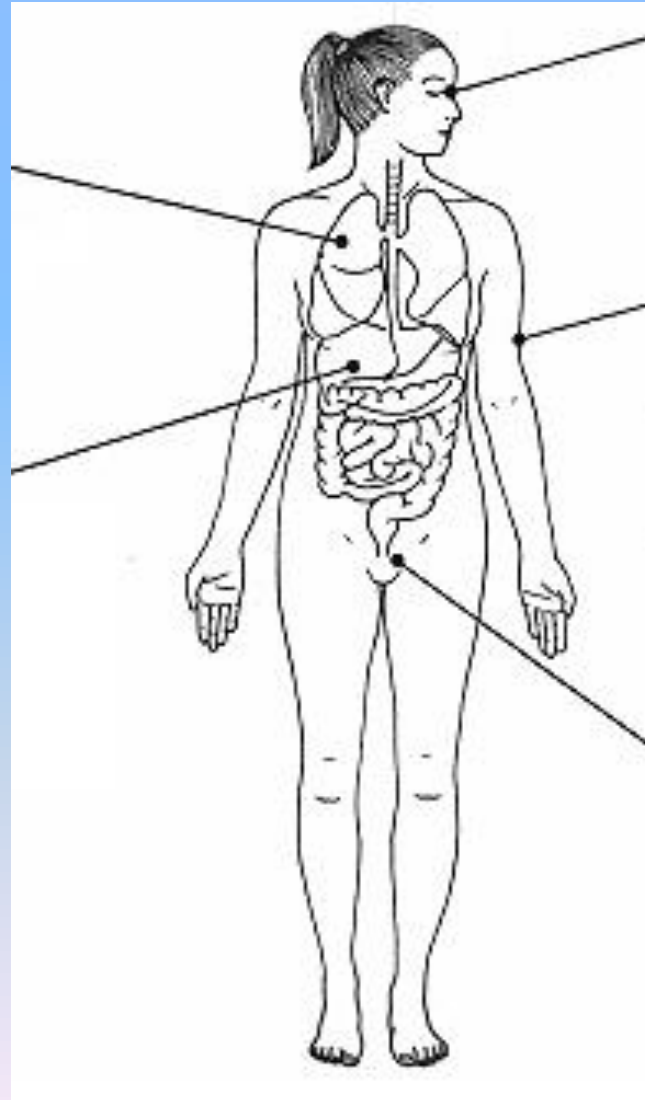
Geração de memória

Imunidade Natural

Barreiras Físicas e Bioquímicas

Trato respiratório

- 1. Muco**
- 2. Epitélio ciliado**
- 3. Fagocitose**



Olhos

- 1. Fluxo das lágrimas**
- 2. Lisozima**

Pele

- 1. Barreira anatômica, suor, sebo**
- 2. Secreções antimicrobianas, ácido láctico, ácidos graxos livres**
- 3. pH ácido (glândulas sudoríparas)**
- 4. Microbiota comensal**

Trato genito-urinário

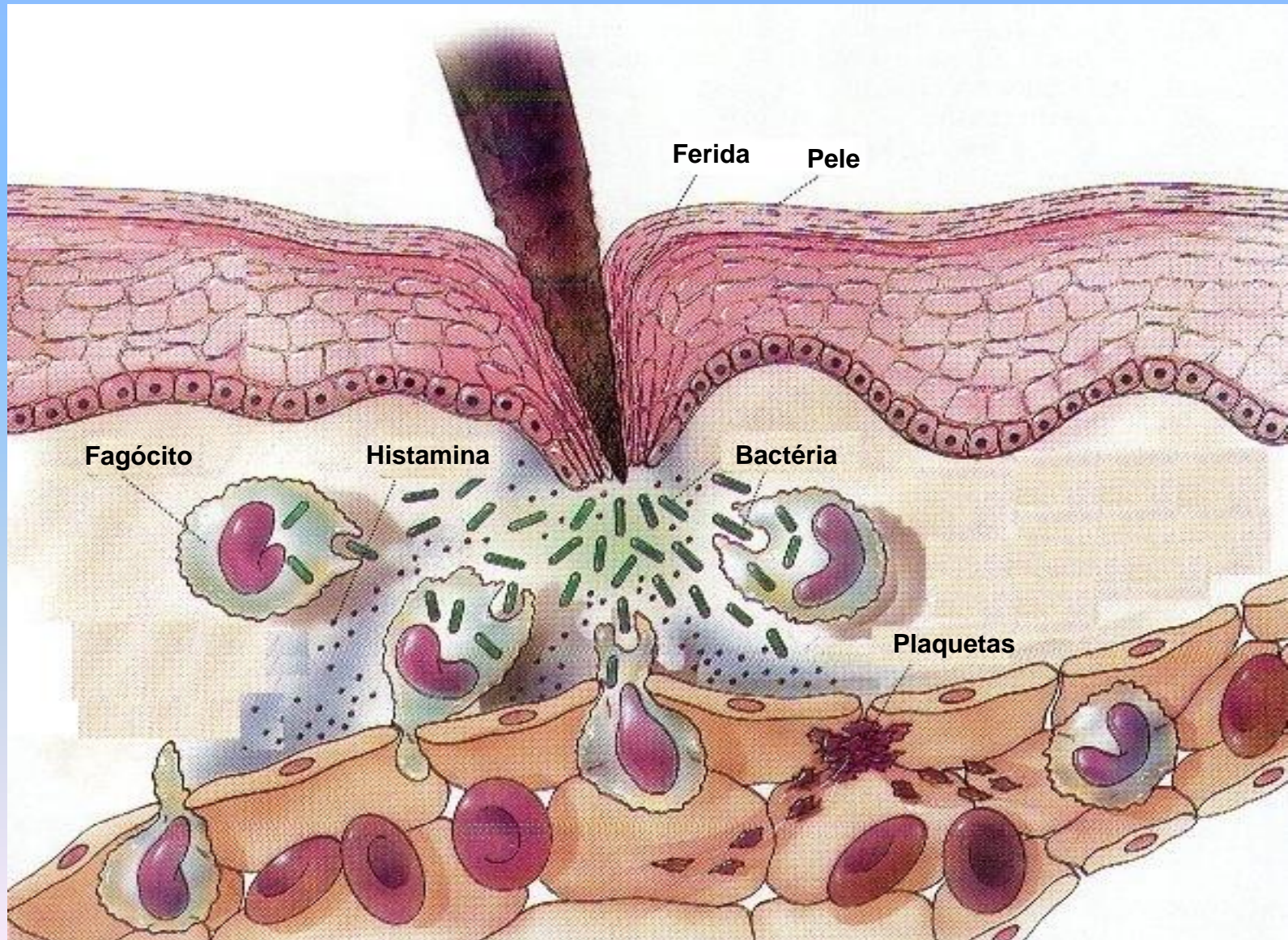
- 1. Fluxo urinário**
- 2. pH ácido – urina**
- 3. Lisozima**
- 4. Ácido láctico vaginal**

Trato digestório

- 1. pH ácido - estômago**
- 2. Microbiota normal**
- 3. pH alcalino - intestino**
- 4. Fluxo mecânico**
- 5. Enzimas**
- 6. Moléculas bactericidas**

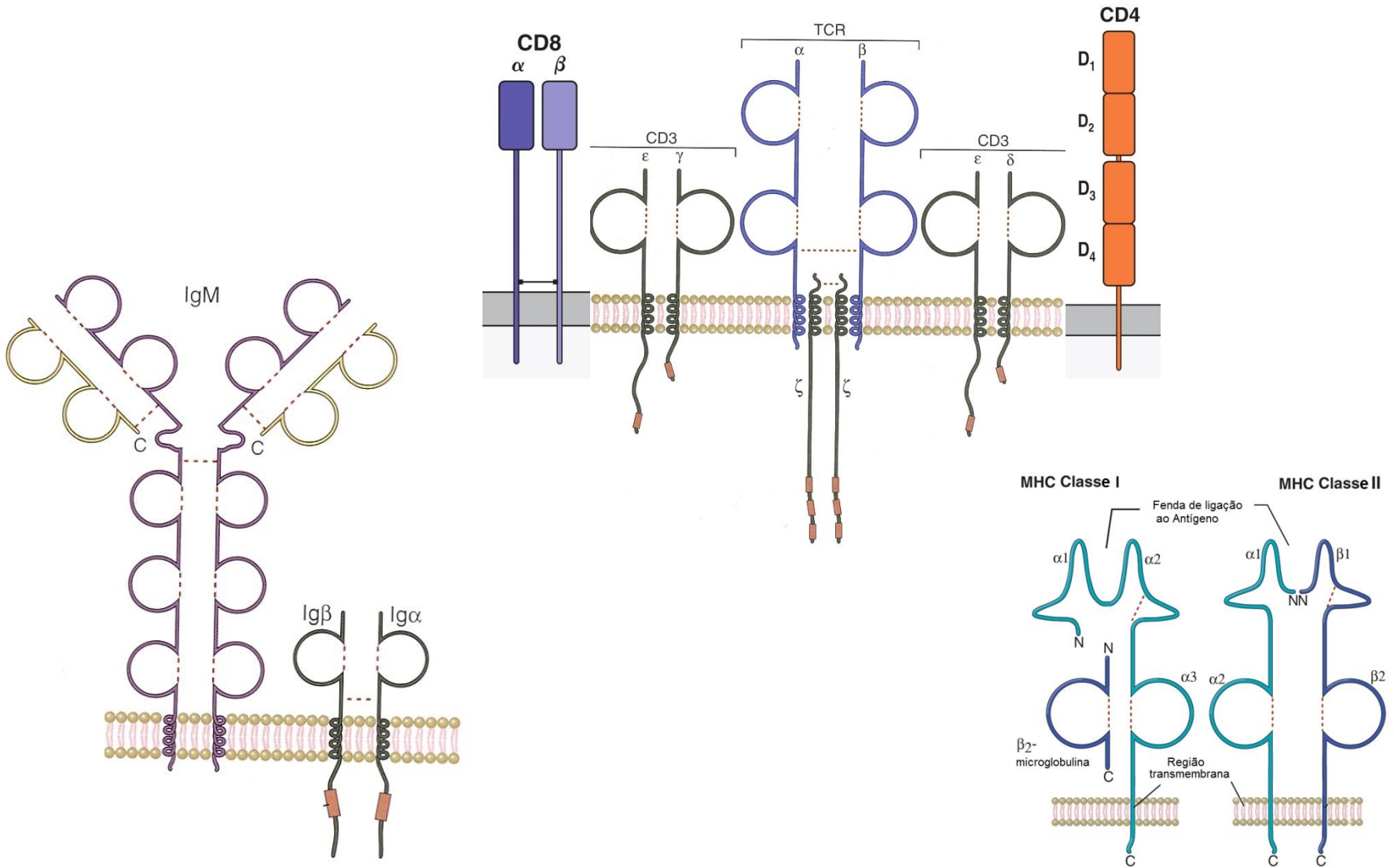
Imunidade Natural

Inflamação



Imunidade Adaptativa

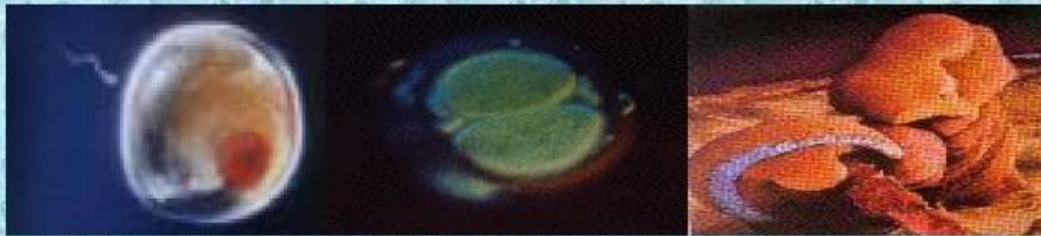
Memória Imunológica



Hematopoiese

Período fetal

Pré – hepática -saco vitelino (3ª semana)



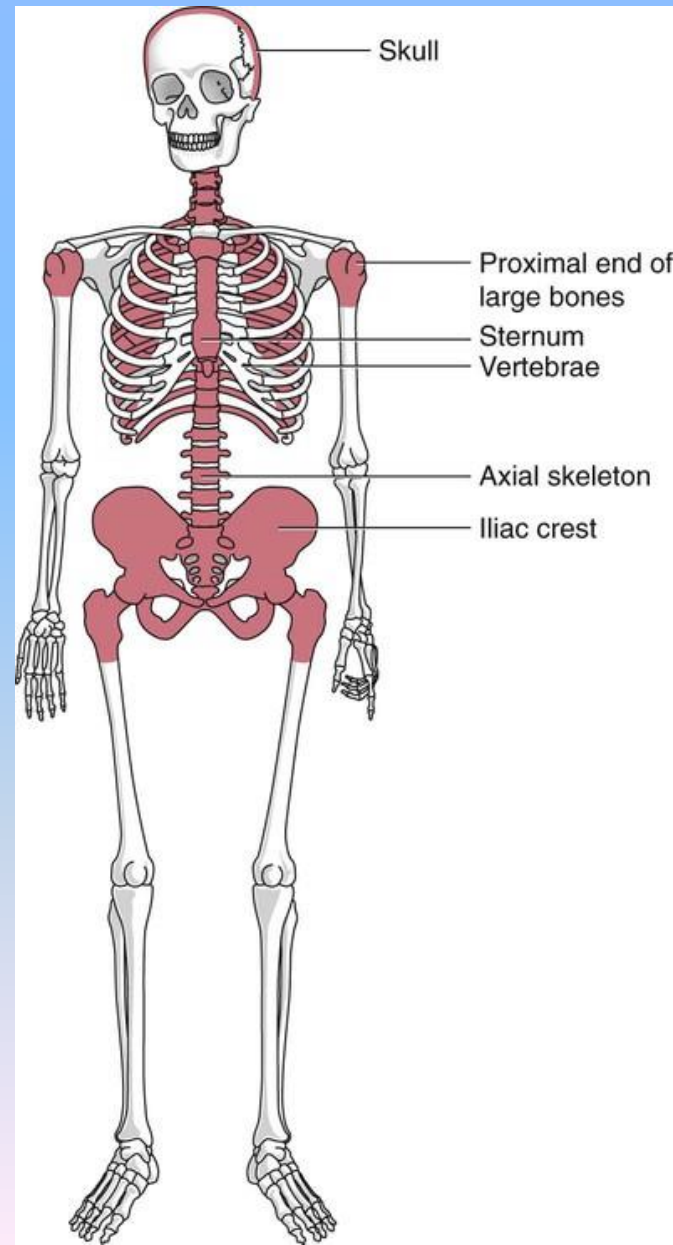
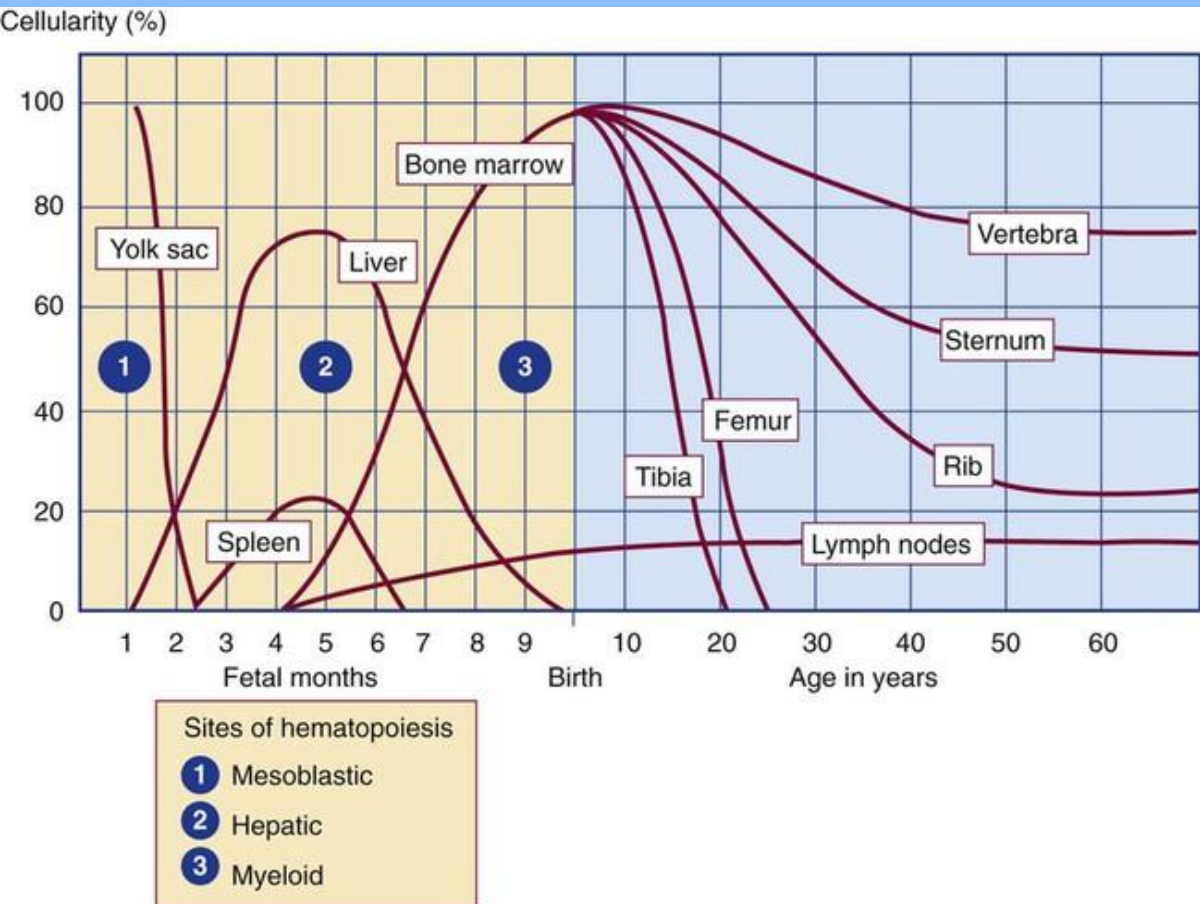
Hepato – esplênica (6ª semana)



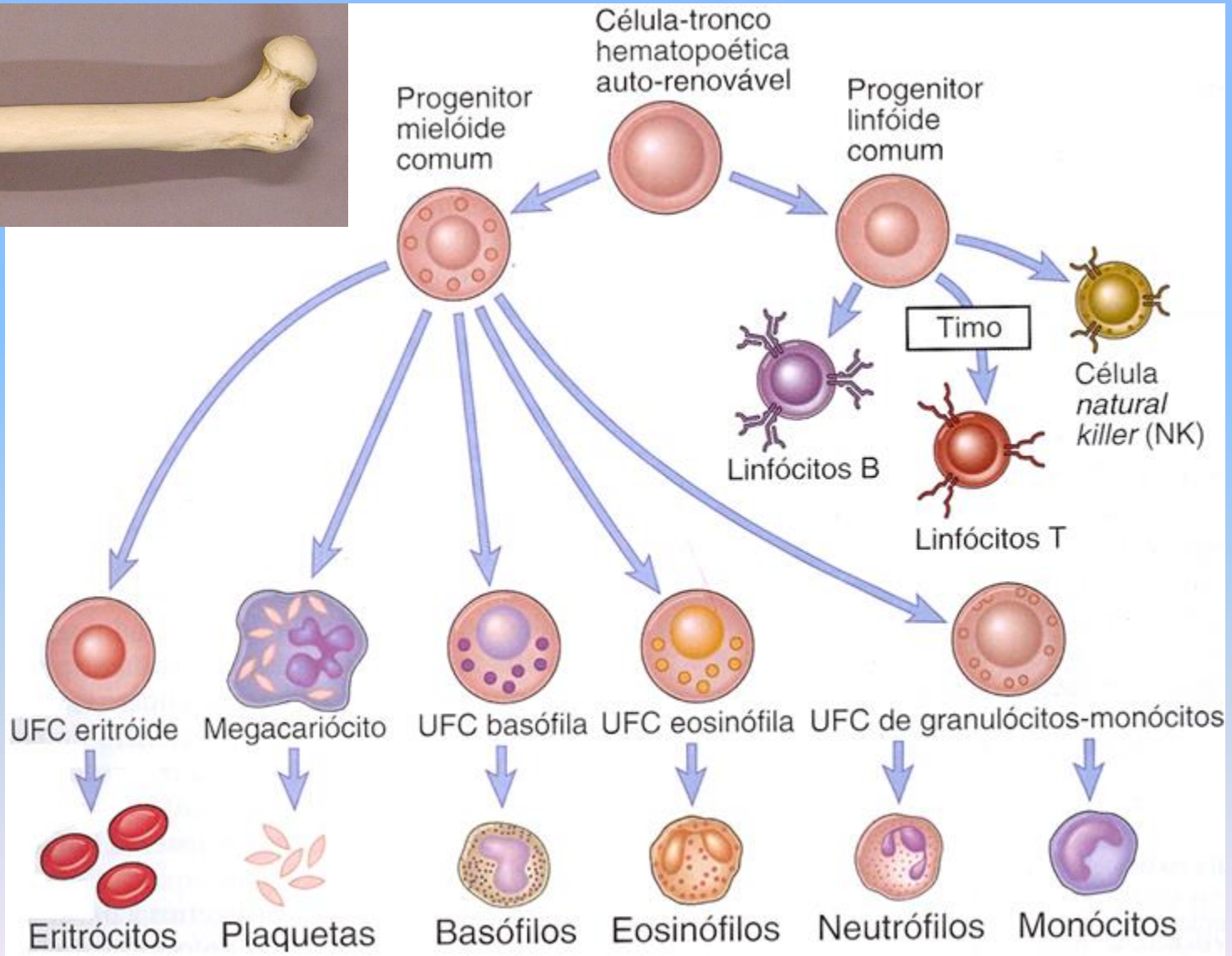
Espleno – mielóide (5º mês)



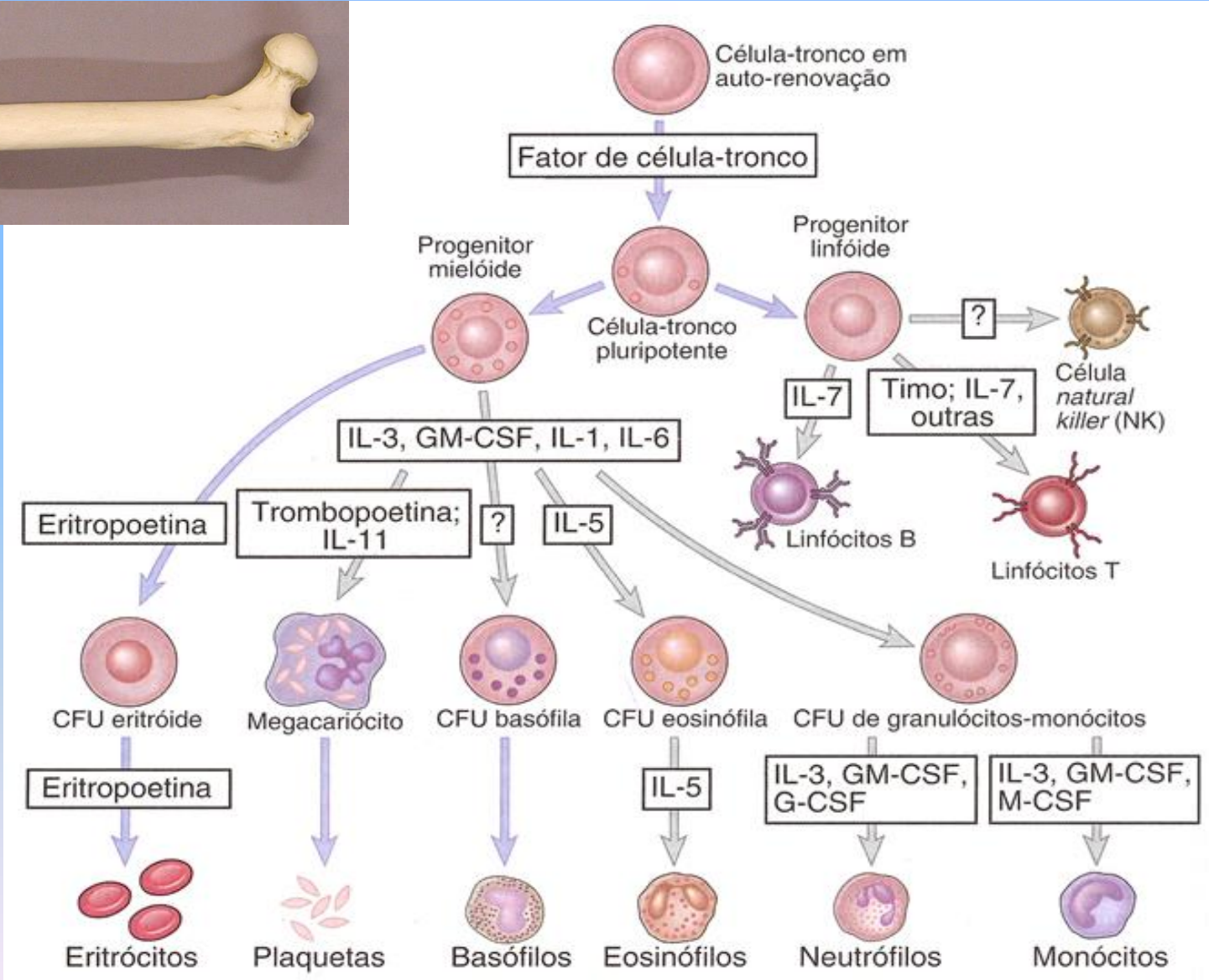
Hematopoiesis



Elementos Celulares do Sangue

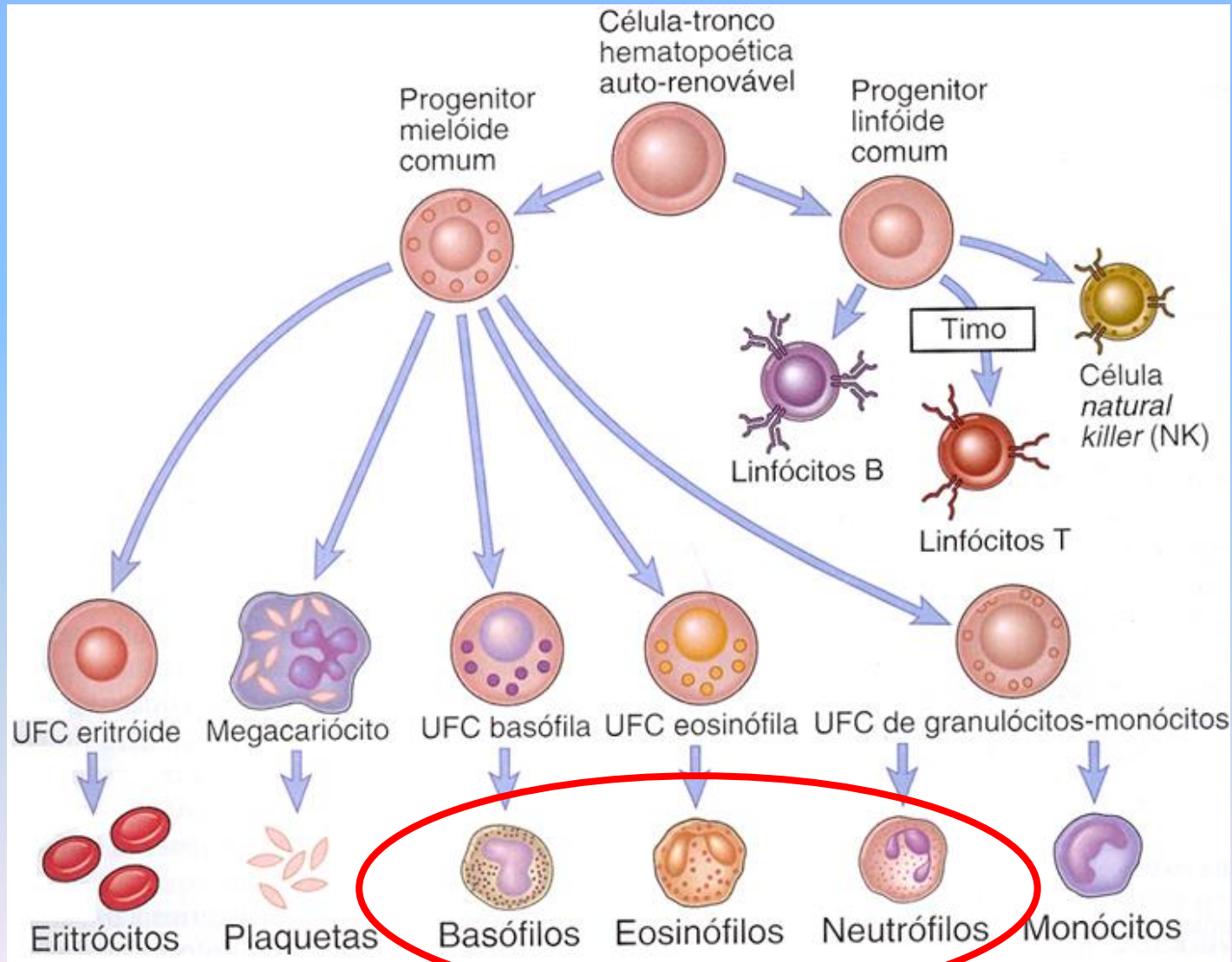


Citocinas Estimulam a Hematopoese

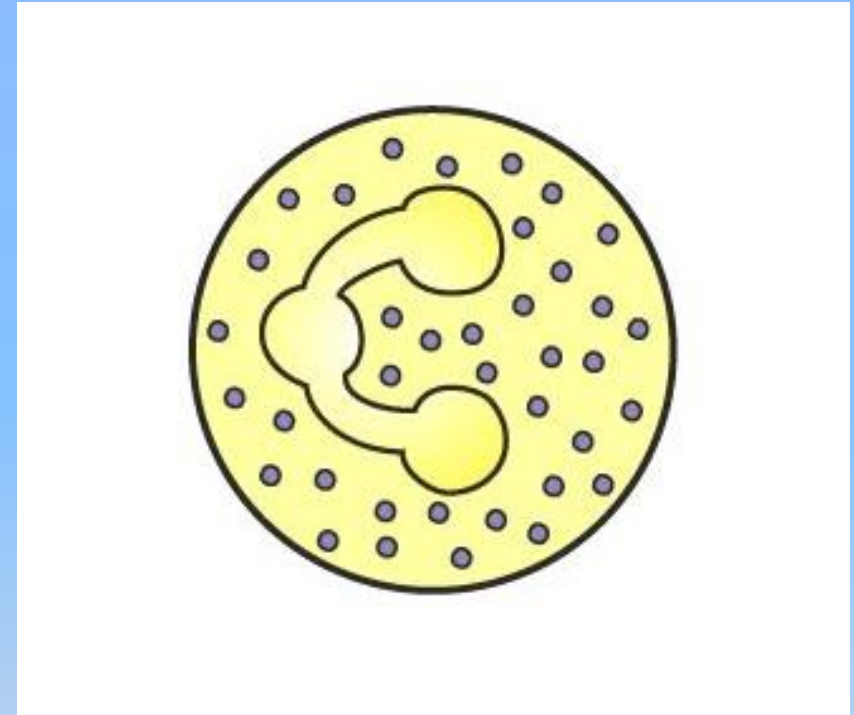
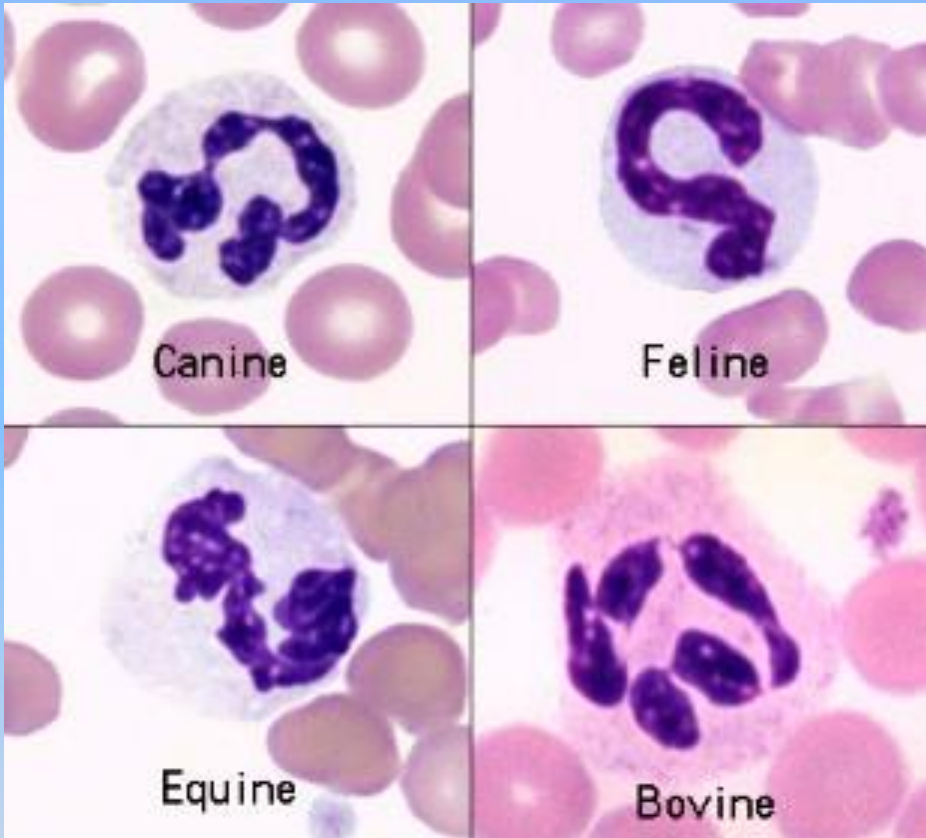


Elementos Celulares do Sangue

Linhagem Mielóide: Polimorfonucleares



Neutrófilos



- **núcleo apresenta de 3 a 5 lóbulos**
- **40-70% das células sanguíneas**
- **indivíduos saudáveis: 10^{11} /dia**
- **inflamação e/ou infecção : 10^{12} /dia (neutrofilia)**
- **tempo de vida no sangue**
- **tempo de vida no tecido**
- **sinônimos**

Neutrófilos: grânulos e produtos microbicidas

Grânulos azurófilos (primários)

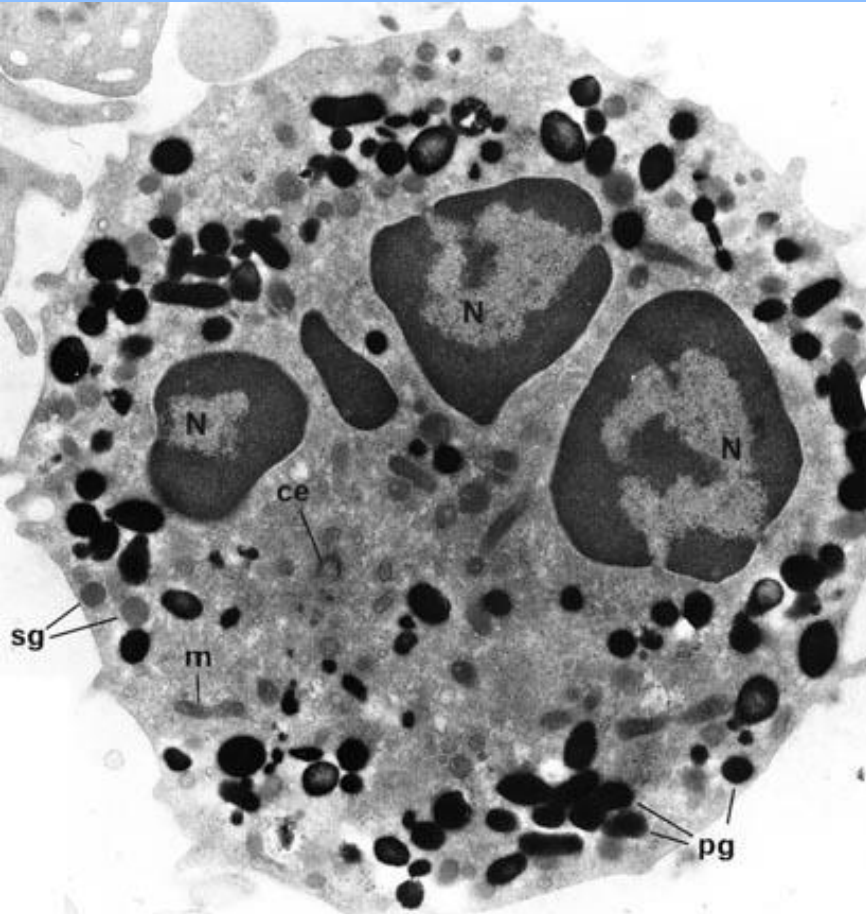
- **mieloperoxidase**
- **serino proteases**
- **defensinas**

Grânulos específicos (secundários)

- **lisozima**
- **colagenase**
- **elastase**

Espécies reativas (radicais livres)

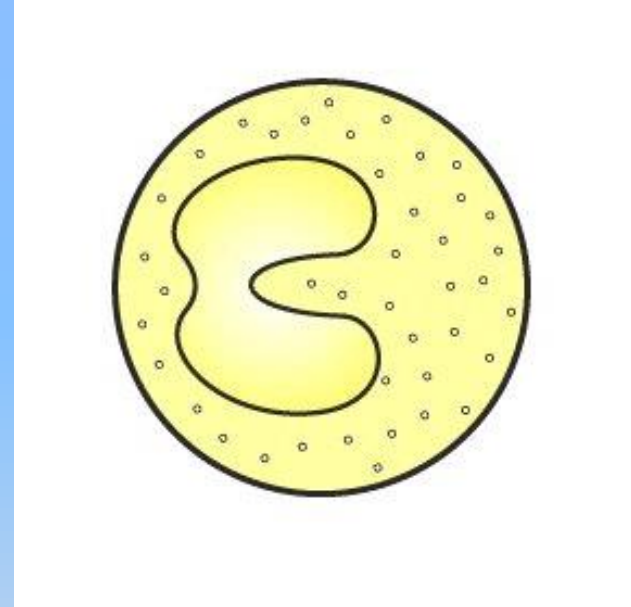
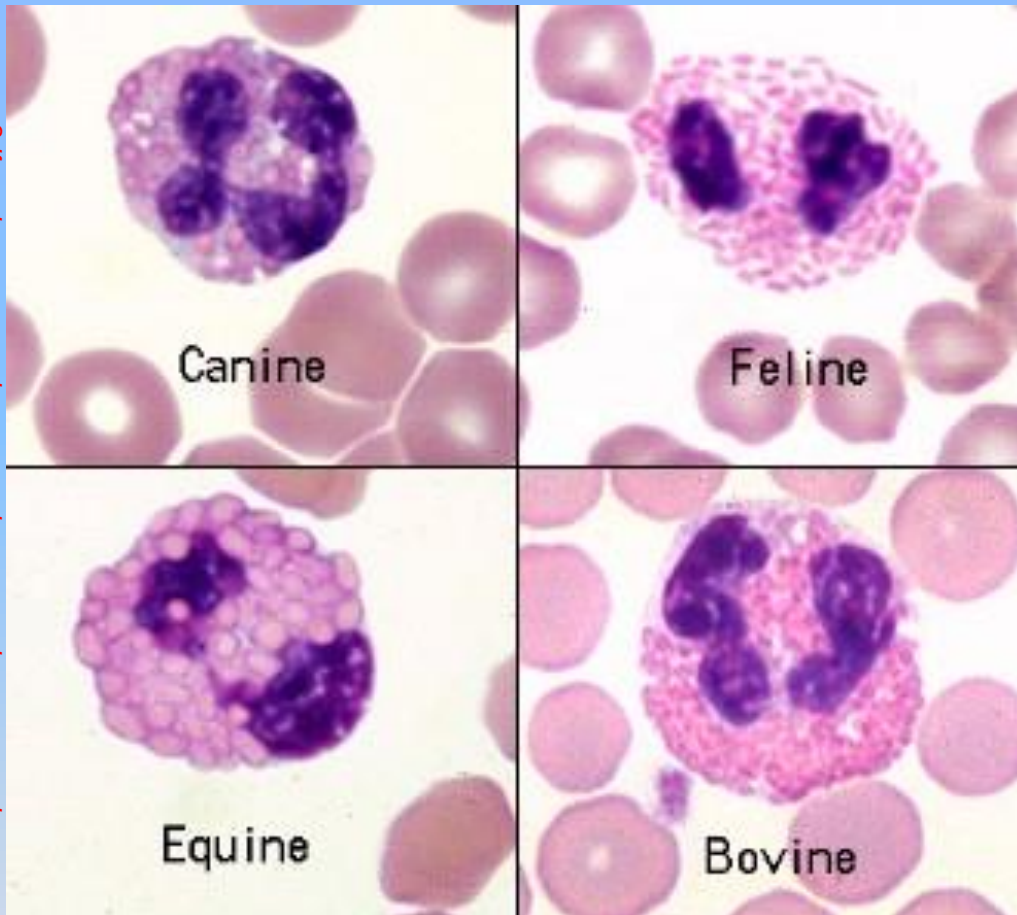
- **intermediários reativos do oxigênio**
- **intermediários reativos do nitrogênio**



http://www.nature.com/labinvest/journal/v80/n5/fig_tab/3780067f2.html

Electron microscopy showing the various intracytoplasmic granules of a resting neutrophil. Resting neutrophils were first fixed in 1.25% glutaraldehyde in 0.1 m phosphate buffer followed by an incubation in diaminobenzidine to label peroxidase-positive granules. Neutrophils were then post-fixed with OsO₄. Peroxidase-positive granules are azurophil granules (or primary granules, pg), which appear as large dark granules. Specific granules (or secondary granules, sg) are smaller in size. Nucleus (N); centriole (ce); mitochondri (m). (Courtesy of Dr Elizabeth Cramer, INSERM U474, Cochin Hospital, Paris.)

Eosinófilos



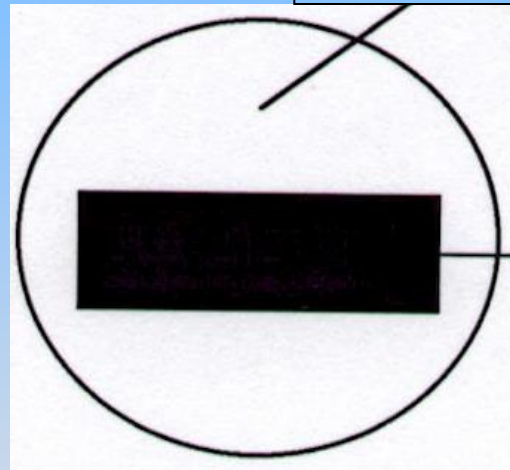
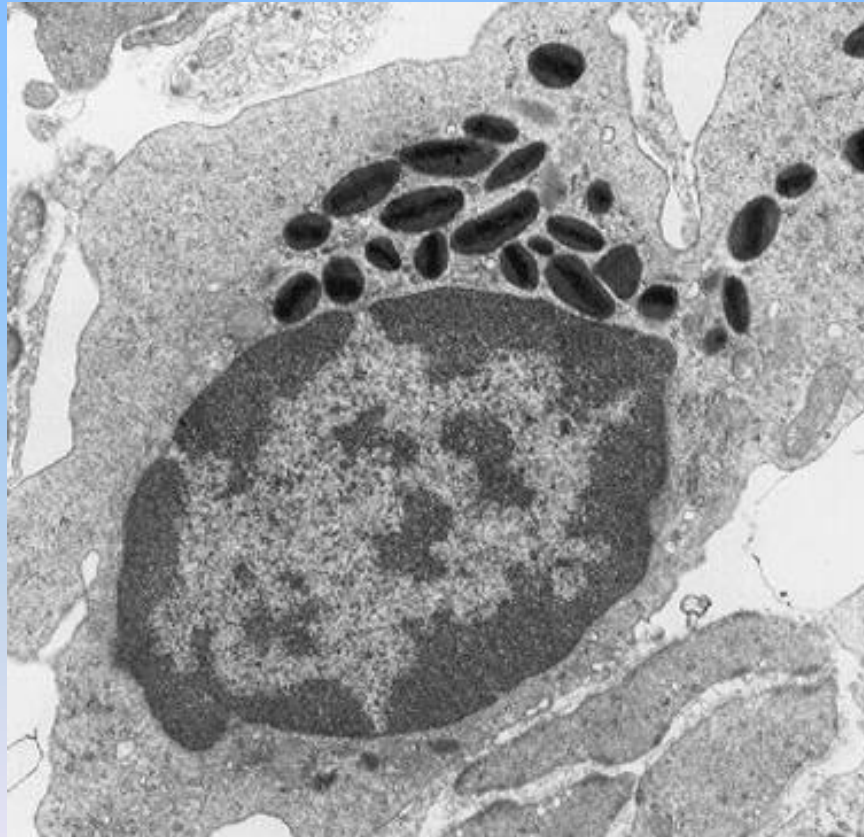
- **núcleo apresenta 2-3 lóbulos**
- **1-5% das células sanguíneas**
- **células teciduais: 1:100 / 1:200**
- **tempo de vida no tecido: semanas?**
- **alergia e parasitoses: eosinofilia**
- **sinônimos**

Eosinófilos: grânulos

Grânulos cristalóides

Matriz (Matrix):

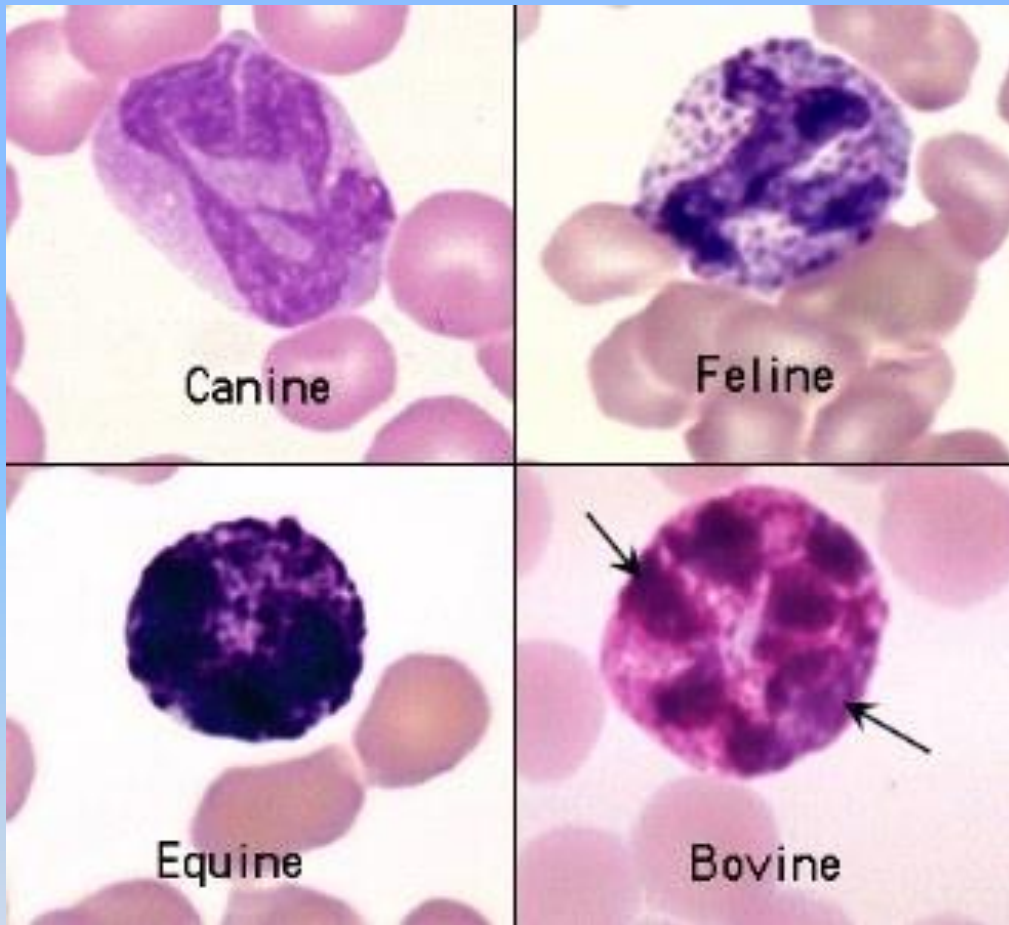
- Proteína Catiônica do Eosinófilo (ECP)
- Neurotoxina Derivada do Eosinófilo (EDN)
- Peroxidase do Eosinófilo (EPO)
- Citocinas



Centro (Core):

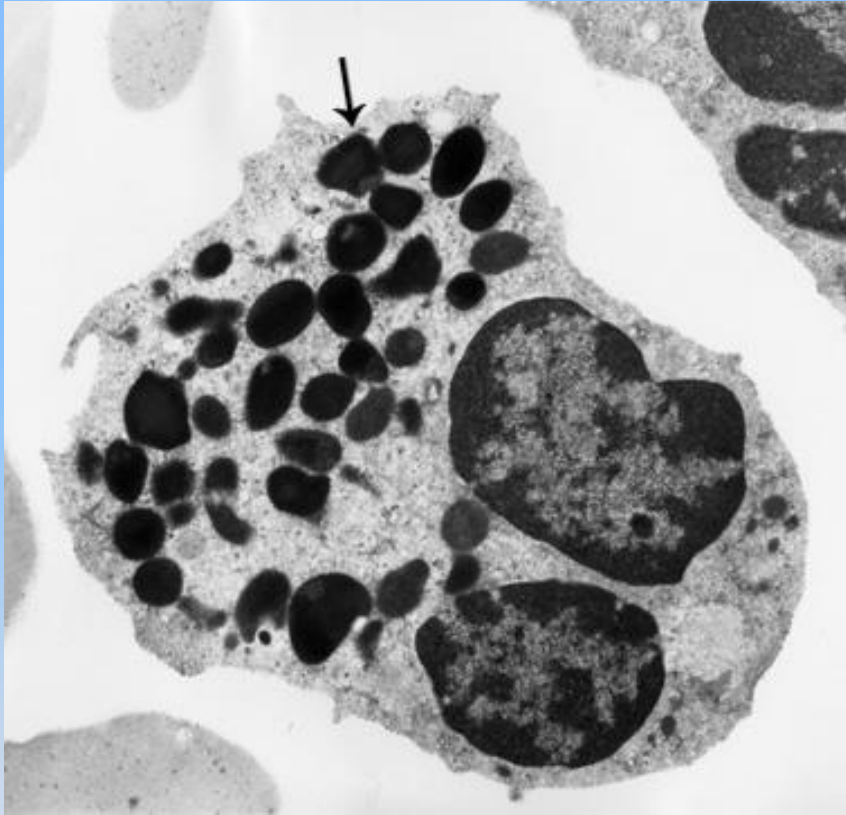
- Proteína Básica Principal (MBP)

Basófilos



- **núcleo apresenta 2 lóbulos**
- **0.5% das células sanguíneas**
- **tempo de vida: dias**
- **alergia e parasitoses (carrapatos):
basofilia**

Basófilos: grânulos



Grânulos

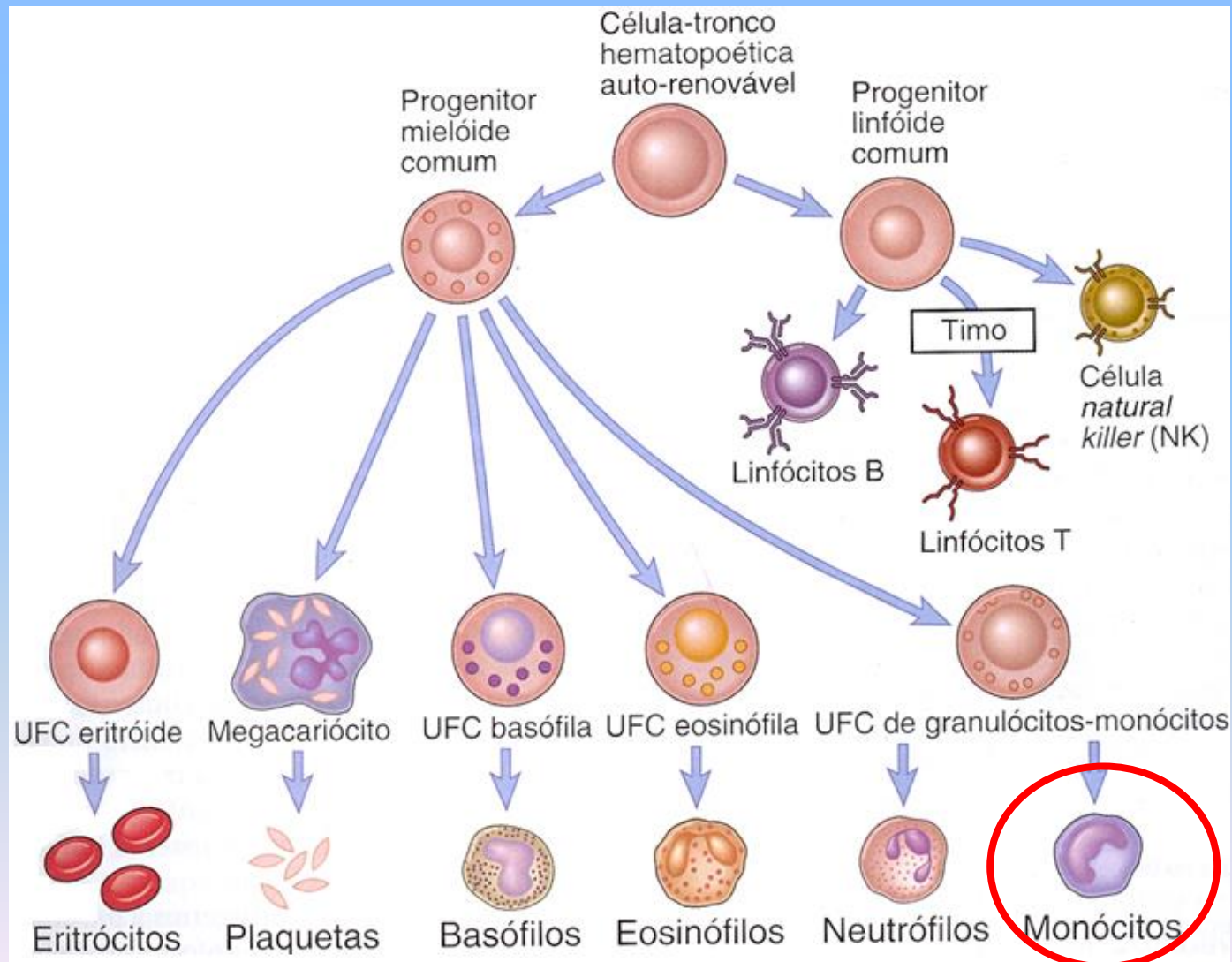
- heparina***
- histamina***
- peroxidase***
- citocinas***

Lichtman's Atlas of Hematology
<http://www.accessmedicine.com>

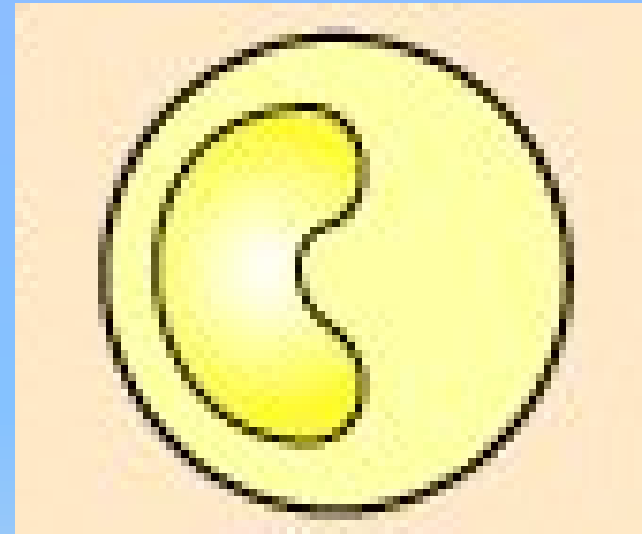
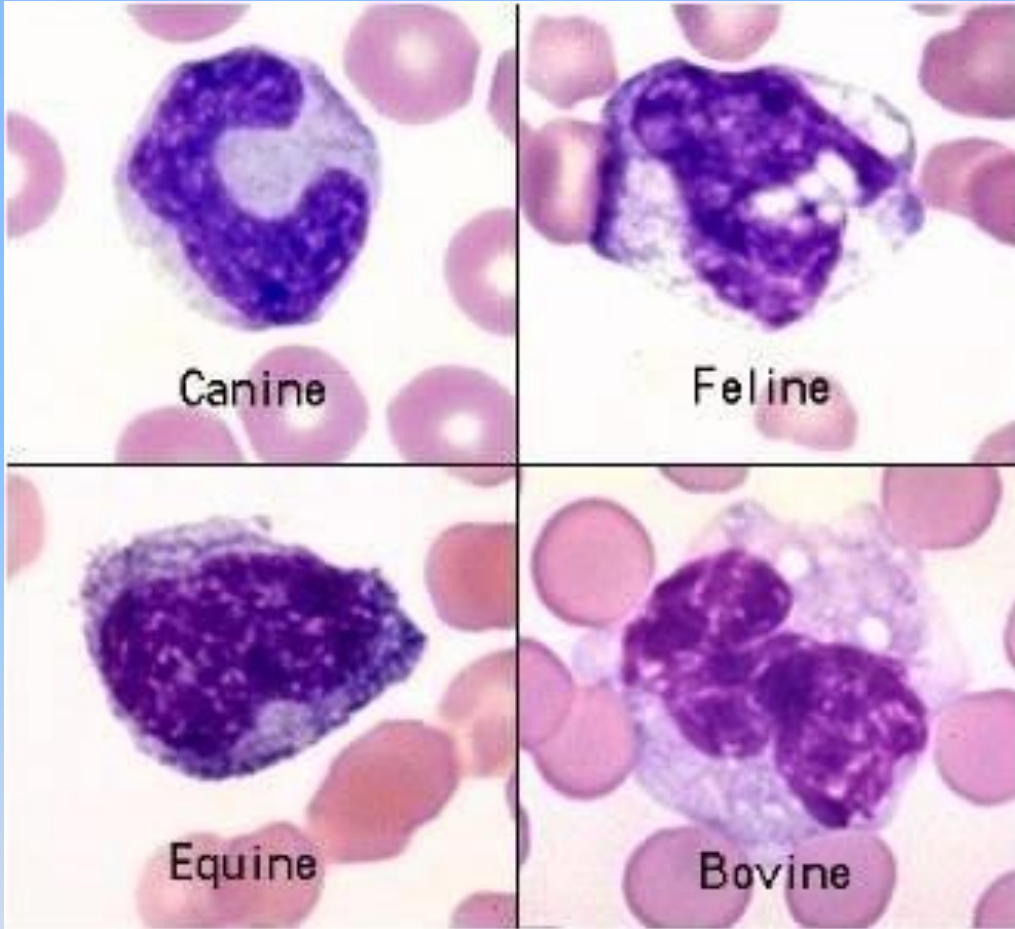
Basophil. Transmission electron micrograph. This section transected the two nuclear lobes of this characteristically bilobed cell. The distribution of euchromatin and heterochromatin is similar to that of neutrophils and eosinophils. Heterochromatin is principally condensed along inner nuclear membrane. The cytoplasmic specific granules are electron-dense and are considerably larger than those of neutrophils. At higher magnification, basophilic granules contain evenly distributed particles and sometimes membrane-like inclusions, simulating myelin figures (see arrow).

Elementos Celulares do Sangue

Linhagem Mielóide: Mononucleares

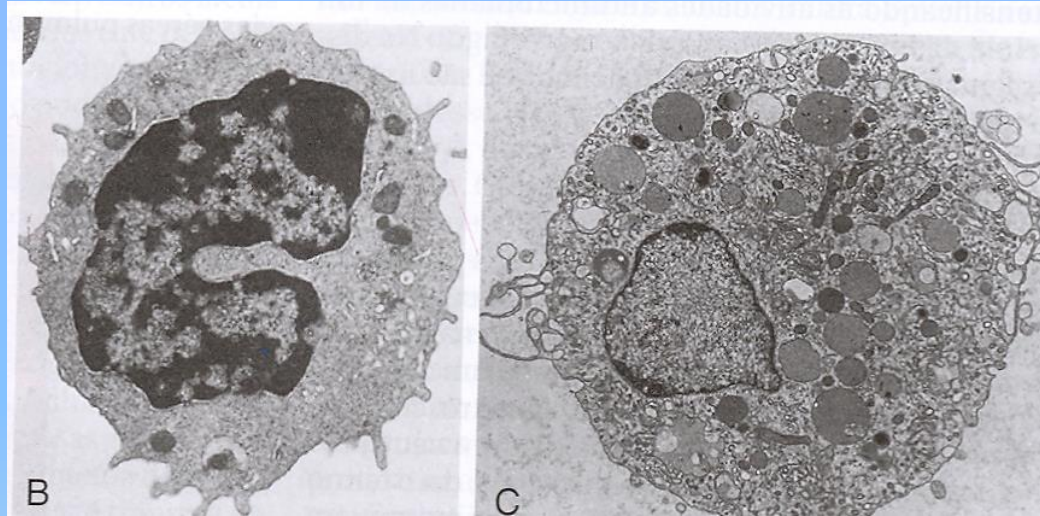


Monócitos



- **núcleo arredondado ou em forma de feijão**
- **relação núcleo-citoplasma**
- **2-10% das células sanguíneas**
- **migração e diferenciação nos tecidos: macrófagos**

Macrófagos



Abbas, Lichtman, Pillai, 6a. Edição, 2008.

- ***células teciduais***
- ***fagocitose***
- ***produção de radicais livres***
- ***diferentes nomes:***

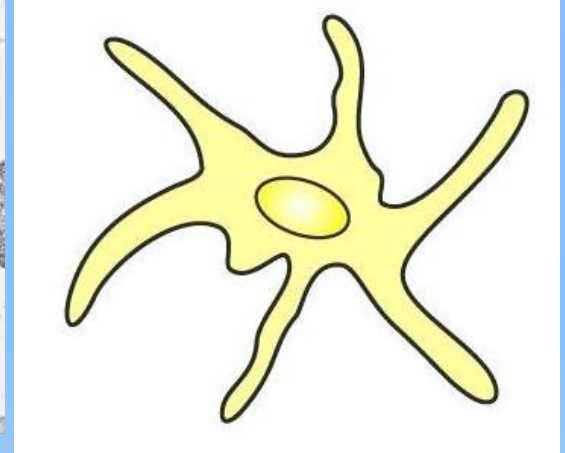
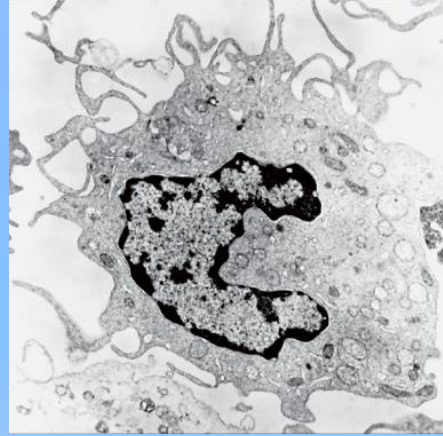
Micróglia: SNC

Células de Küpffer: fígado

Macrófagos alveolares: pulmões

Osteoclastos: ossos

Células Dendríticas

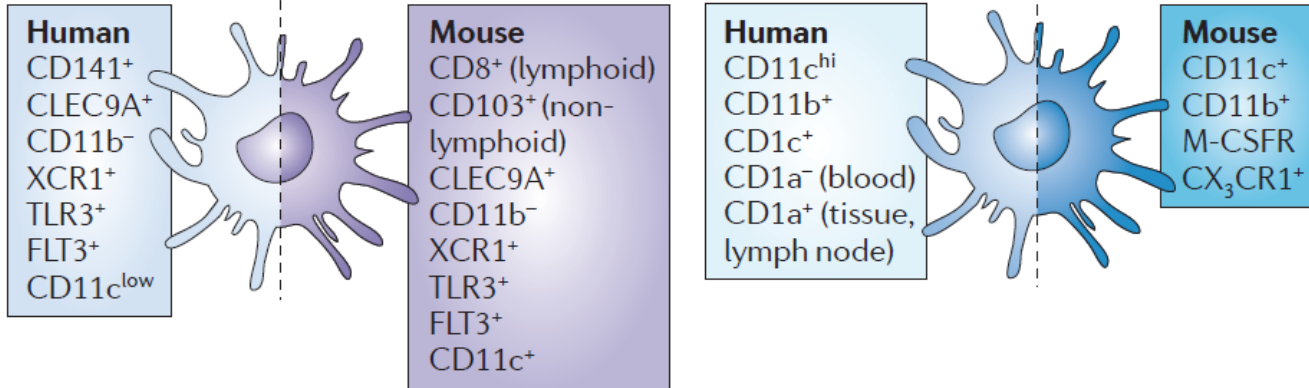


Janeway, Travers, Walport, Shlomchik, 6th Edition, 2005.

- ***origem***
- ***frequência***
- ***tecidos: imaturas***
- ***migração e maturação: inflamação***
- ***função: apresentação de antígenos***

Subpopulações de Células Dendríticas

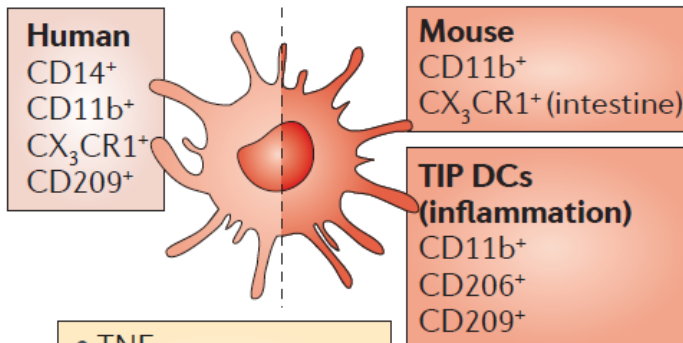
Myeloid DCs



- MHC class I-restricted antigens
- Cross-presentation
- CD8⁺ T cell responses

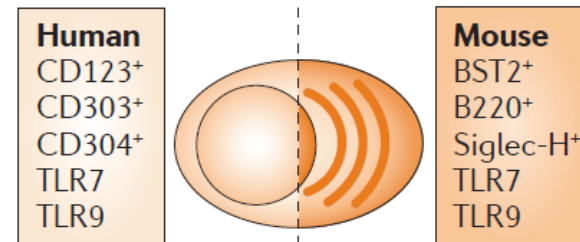
- MHC class II-restricted antigens
- CD4⁺ T cell responses

Monocyte-derived DCs



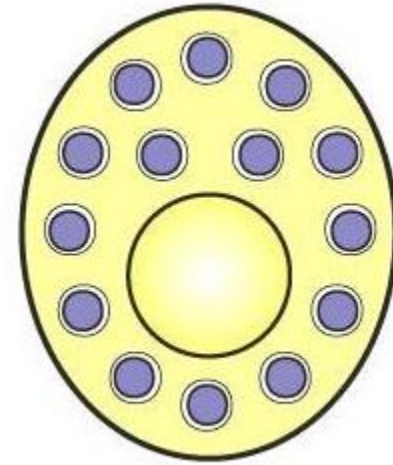
- TNF
- iNOS
- Bacterial antigens
- Secondary immune responses

Plasmacytoid DCs



- Type I interferons
- Durable memory responses

Mastócitos: introdução



Janeway, Travers, Walport, Shlomchik, 6th Edition, 2005.

- ***núcleo arredondado ou em forma de feijão***
- ***precursor sanguíneo não-identificado***
- ***tempo de vida: meses***
- ***migração e diferenciação nos tecidos***

Vasos sanguíneos e linfáticos

Tecido conjuntivo subepitelial

Nervos periféricos

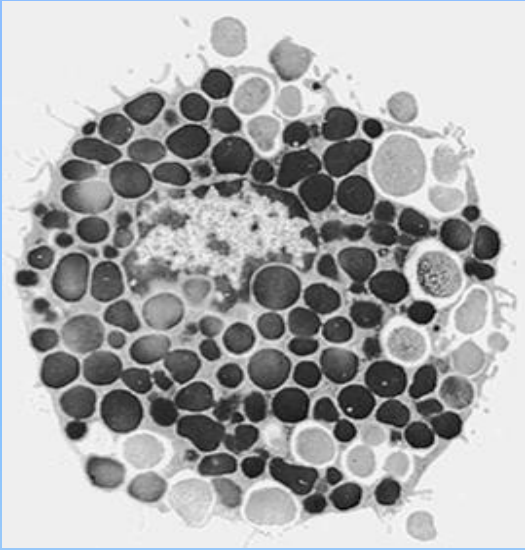
Trato gastrointestinal

Trato respiratório

Trato genito-urinário

Coração

Mastócitos: grânulos e subtipos



Principais constituintes dos grânulos

- aminas biogênicas (vasoativas): histamina e serotonina
- serina proteases neutras: triptase e quimase
- outras enzimas: carboxipeptidase A e catepsina G
- proteoglicanas
- citocinas

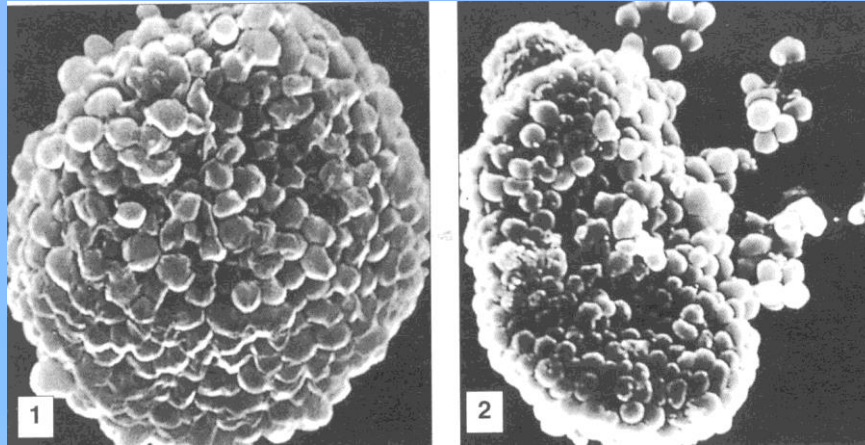
Mastócitos do tecido conjuntivo:

- pele, cavidade peritoneal, submucosa intestinal

Mastócitos das mucosas:

- alvéolos pulmonares, mucosa intestinal

Mastócitos: desgranulação

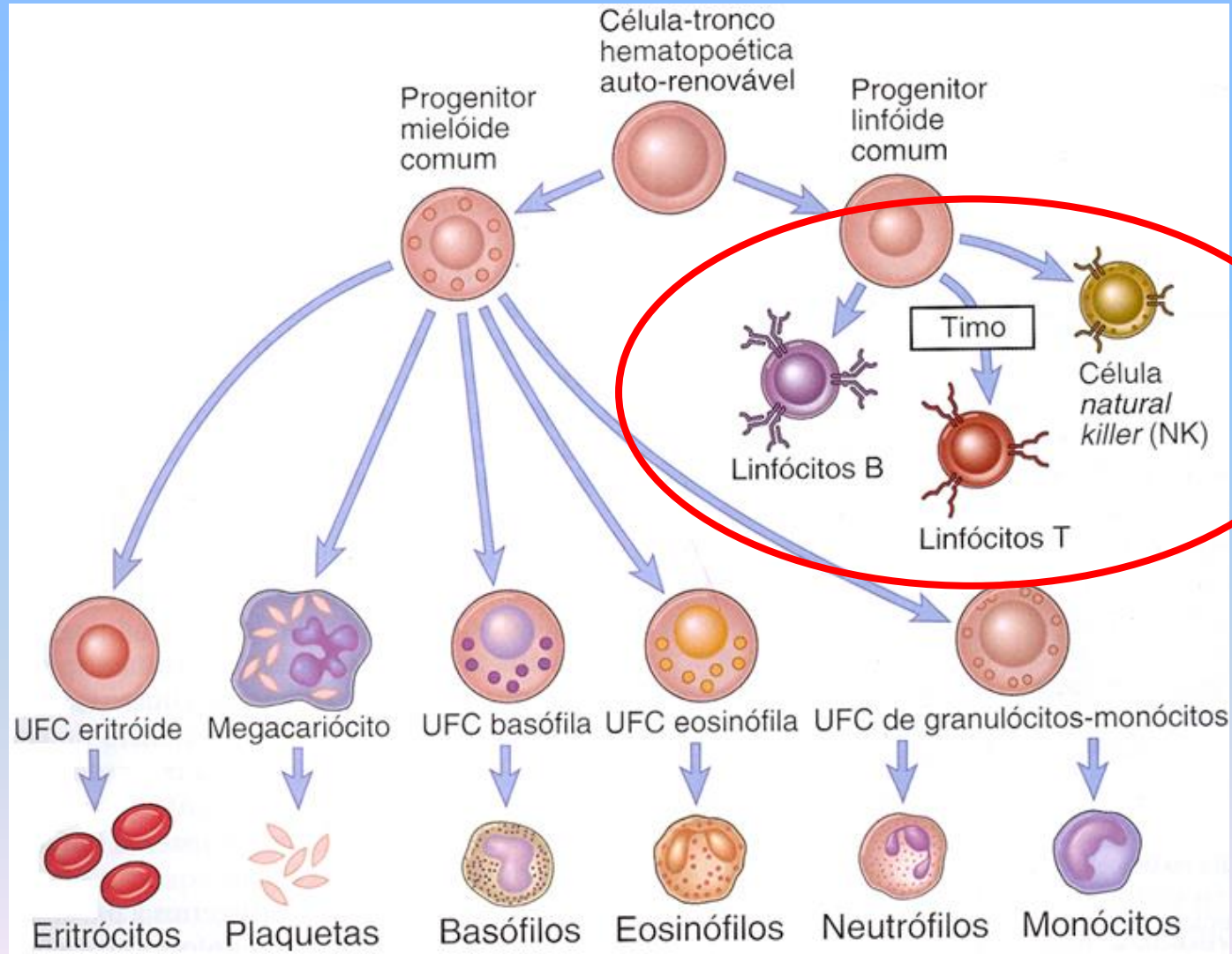


Roitt, 4th Edicao, 1997.

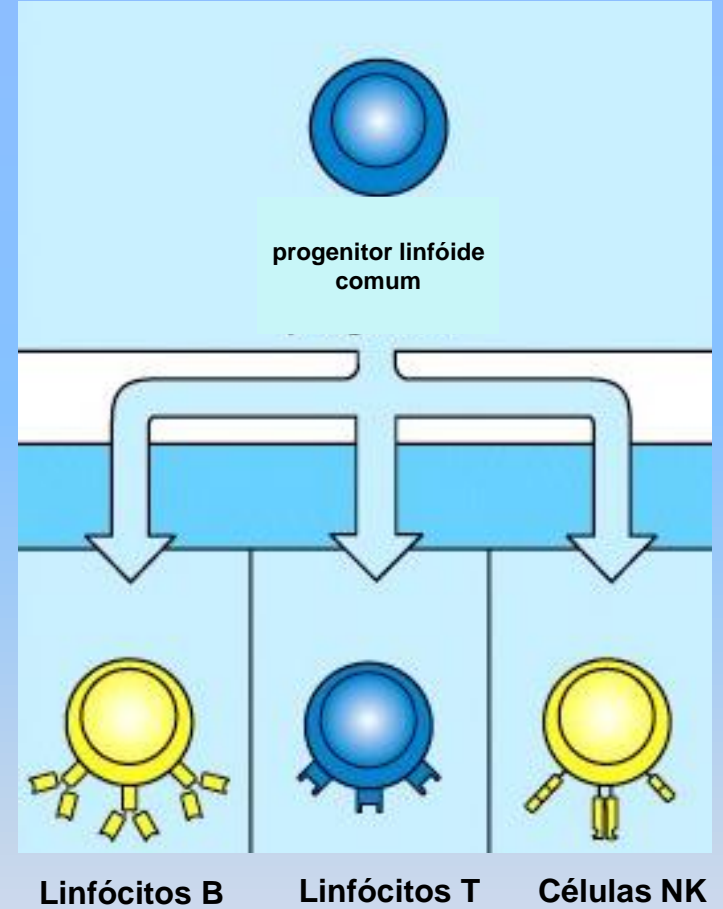
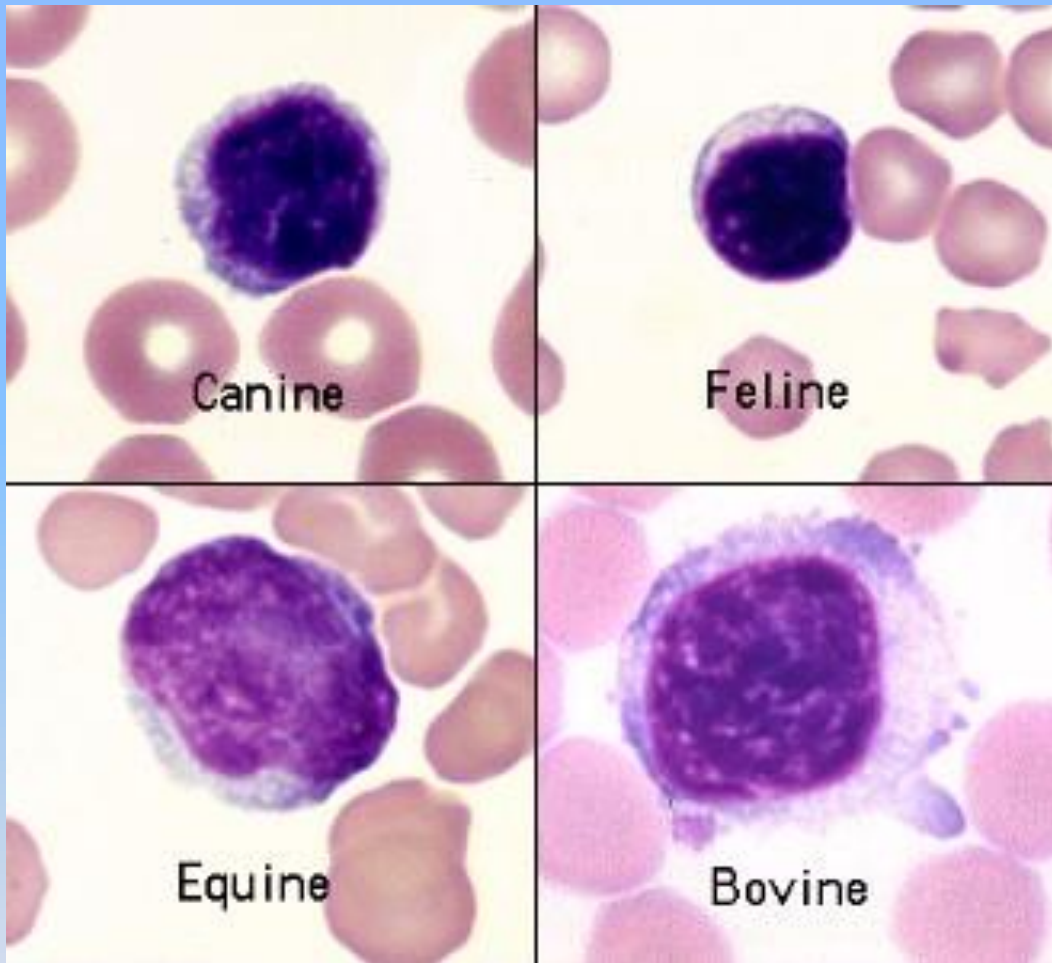
Tipo	Característica	Exemplos
Não-imunológica		
Não seletiva	Ruptura da membrana Dano celular	Água destilada Detergentes, Sais biliares, Lisolecitina Estímulos físicos
Seletiva	Excitose não-citotóxica Ativação	C3a, C5a, Ionóforo de cálcio Neuropeptídeos, Citocinas, Neurotransmissores Venenos, Lectinas
Imunológica	Seletiva/ Ativação	Imunoglobulina E

Elementos Celulares do Sangue

Linhagem Linfóide

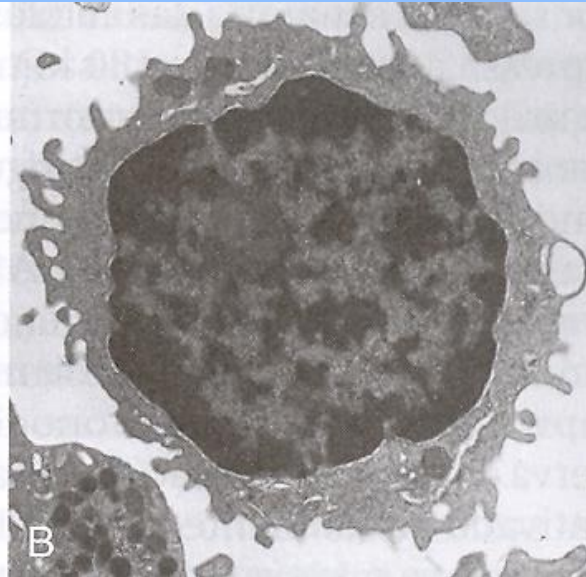
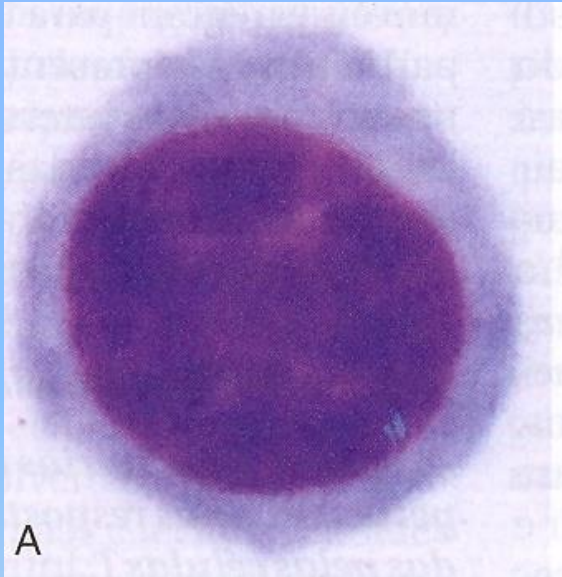


Linfócitos



- **núcleo arredondado**
- **relação núcleo-citoplasma**
- **20-40% das células sanguíneas**
- **seleção e maturação nos órgãos linfóides primários**

Linfócitos T



- ***origem e maturação***

- ***subtipos α/β :***

Linfócitos T auxiliares

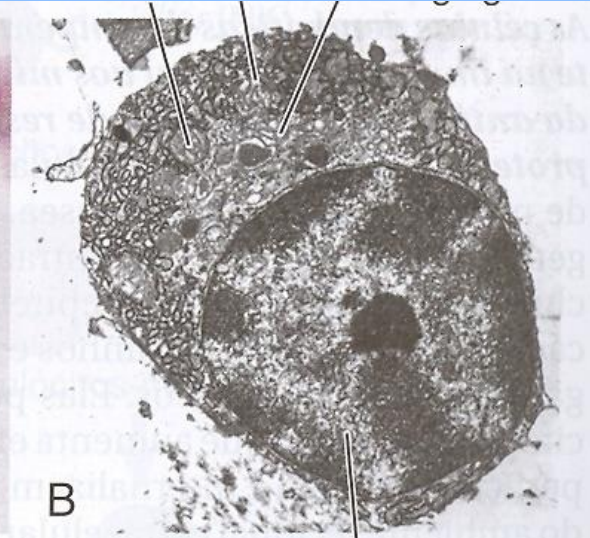
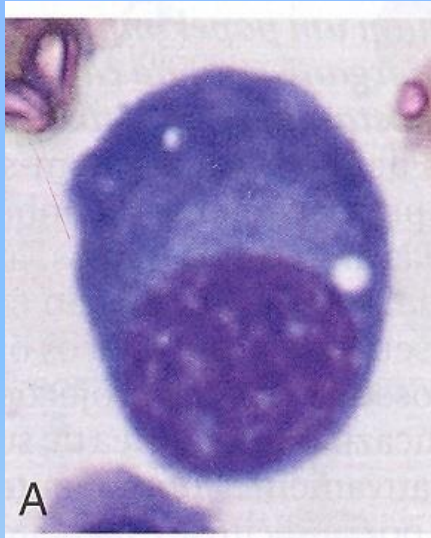
Linfócitos T citotóxicos

Linfócitos T reguladores

- ***Linfócitos γ/δ***

- ***funções: não reconhecem antígenos diretamente***

Linfócitos B



- origem e maturação

- subtipos:

Células B1 ou B naturais

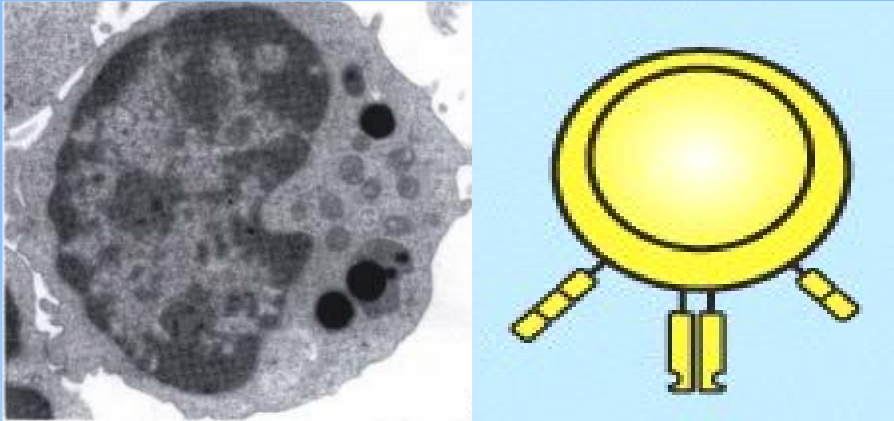
Células B2 ou foliculares

Células B da zona marginal (BZM)

- produção de anticorpos: plasmócitos

- outras funções: APC, secreção de citocinas

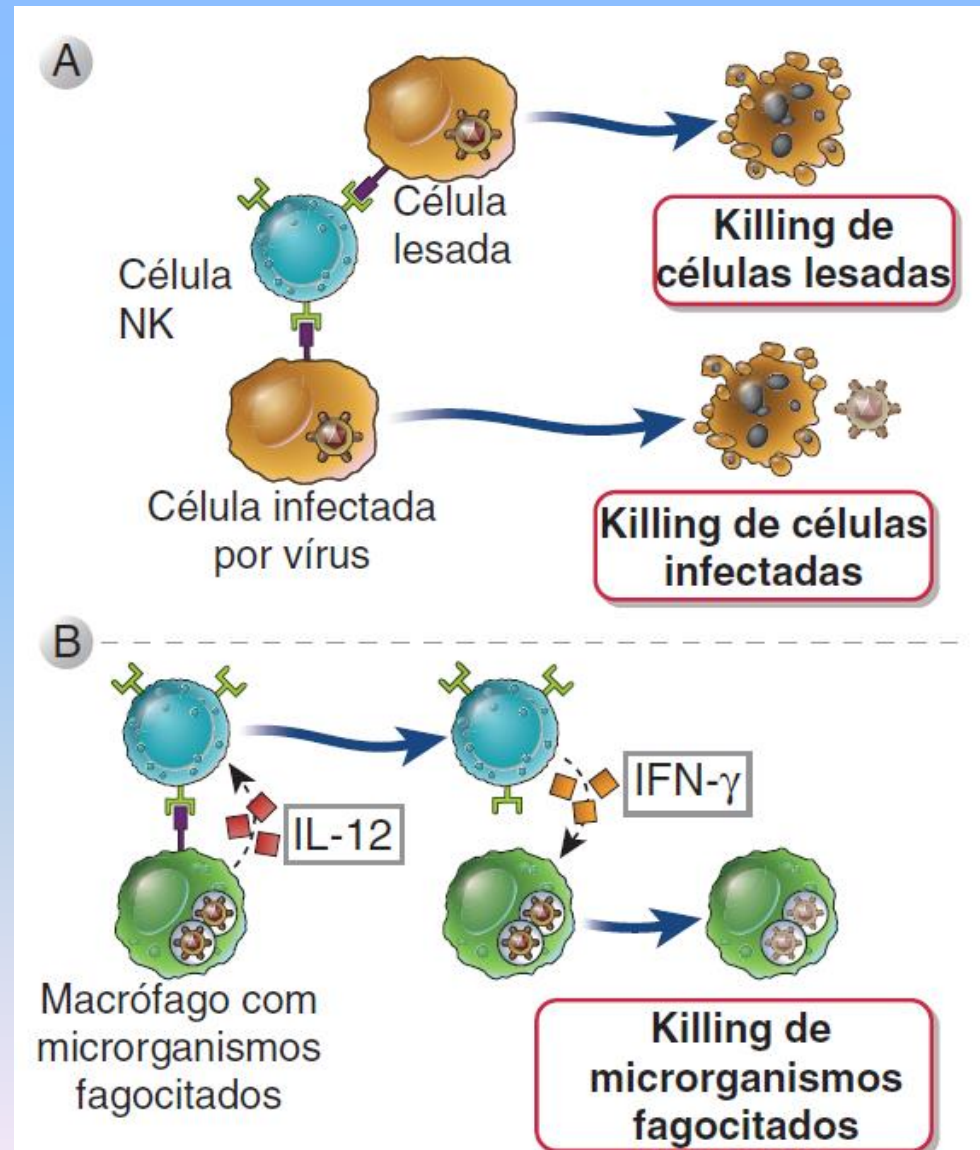
Células NK (“Matadoras Naturais”)



População de linfócitos que atua na imunidade inata

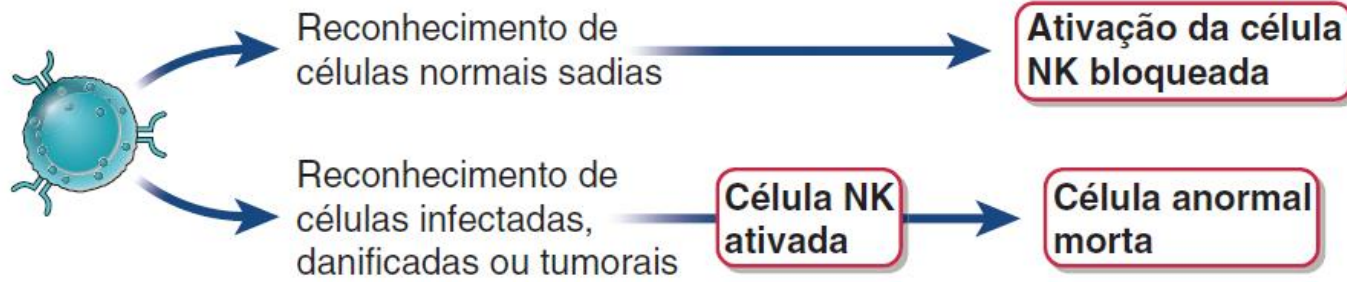
- origem e maturação

- funções: citotóxica e vigilância imunológica

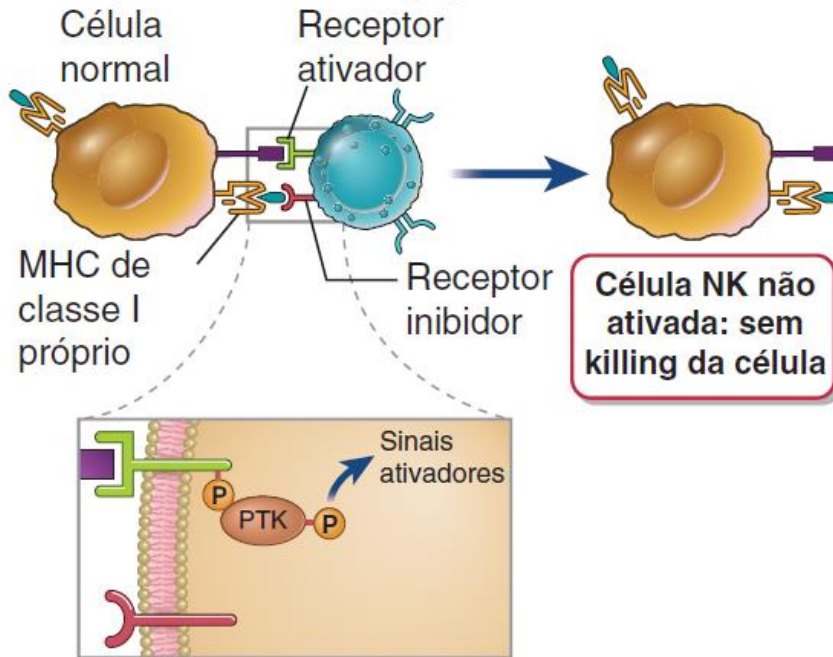


Células NK (“Matadoras Naturais”)

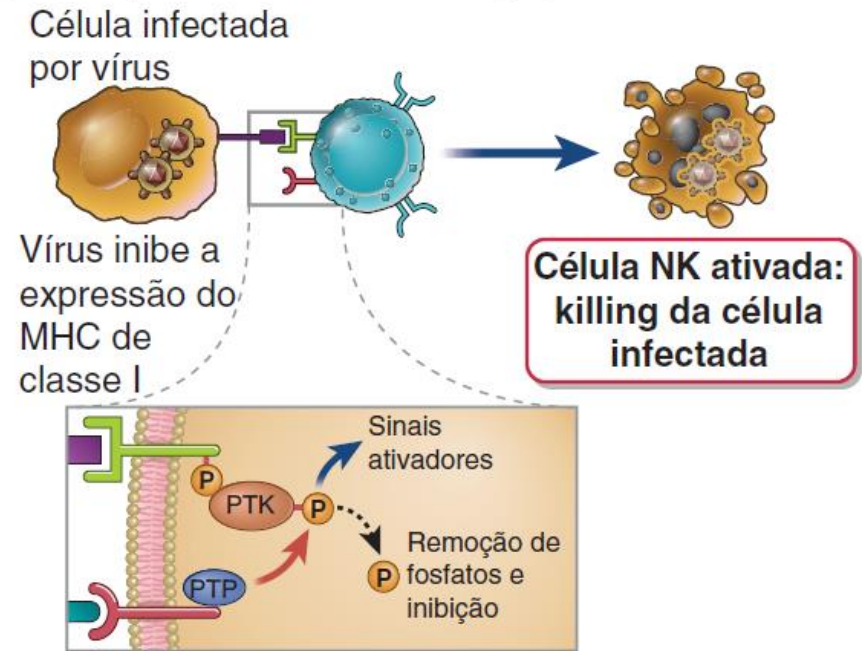
A Visão geral da ativação da célula NK



B Receptor inibidor engajado



C Receptor inibidor não engajado



Leucograma: Valores de referência para humanos adultos

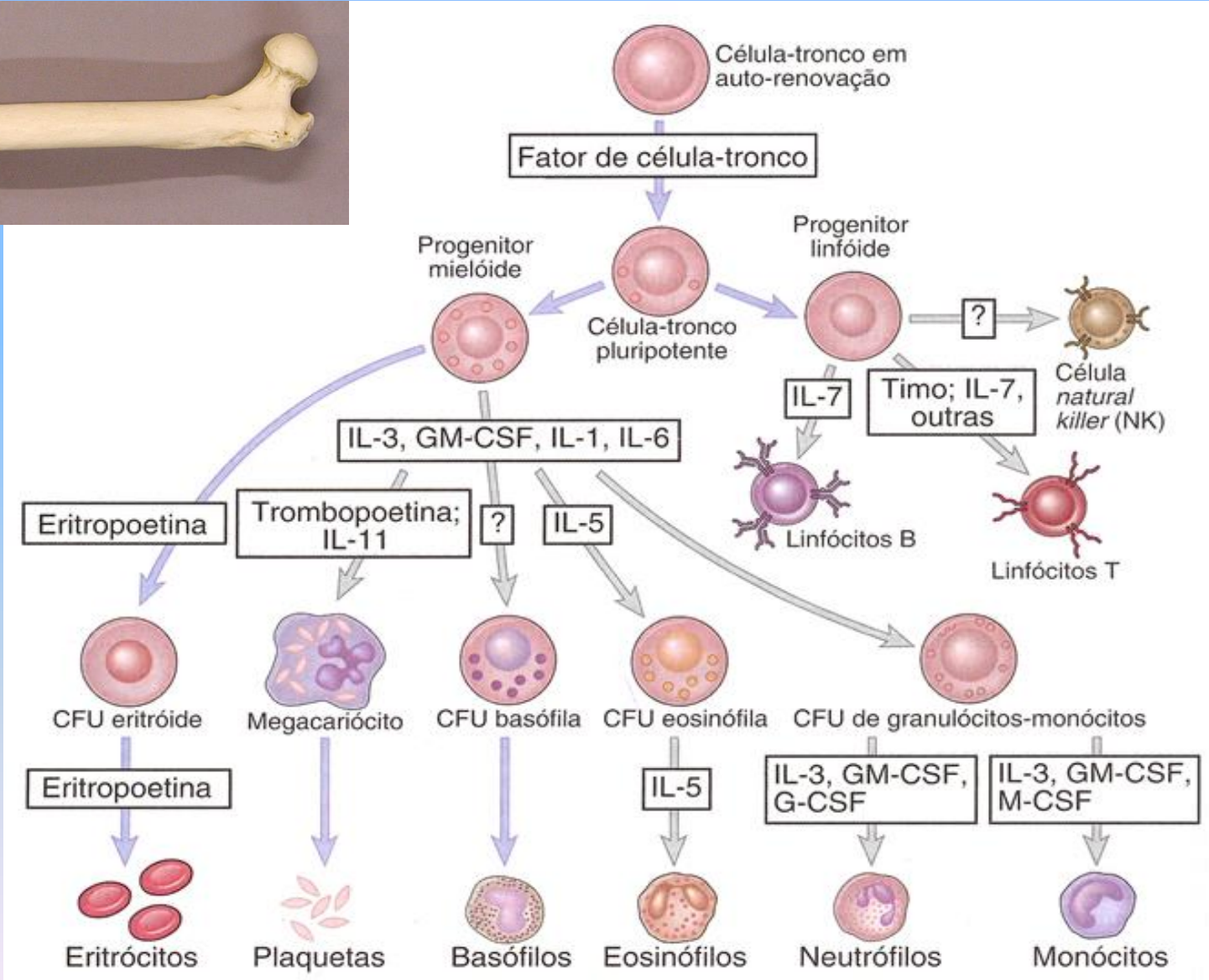
Leucometria global:

- 4000 a 11000 células/mm³

Contagem diferencial:

- Neutrófilos: 40 a 70% (1600 a 7700)**
- Eosinófilos: 1 a 5 % (40 a 550)**
- Basófilos: 0 a 1% (0 a 110)**
- Linfócitos: 20 a 40% (1000 a 4400)**
- Monócitos: 2 a 10% (80 a 1100)**

Citocinas Estimulam a Hematopoese



Fármacos e Medicamentos

- **G-CSF (filgrastima/lenograstima) e GM-CSF (molgramostima):**
 - Câncer (após quimioterapia)
 - Transplante de medula
 - Anemia aplástica
 - Síndromes mielodisplásicas
 - Neutropenias (doses terapêuticas diminuídas e aumento do risco de infecção)
 - Sepses neonatais
 - Neutropenia por toxemia gravídica (mães hipertensas)
 - Neutropenias congênitas raras
 - Neutropenia associada à AIDS
 - Melhora da função neutrofílica

- **Eritropoetina (expres, hemax, hemoprex, recormon)**
 - Anemia da prematuridade
 - Anemia da AIDS
 - Anemia da insuficiência renal crônica (pacientes sob diálise)
 - Anemia do câncer
 - Outras Anemias

- **Trombopoetina (eltrombopag olamina, revolade)**
 - Trombocitopenia neonatal
 - Púrpura trombocitopênica imune (idiopática)
 - Tratamento com corticóides
 - Esplenectomia

Tecidos e Órgãos Linfoides

Órgãos Linfoides Primários (Centrais ou Geradores)

- **Medula Óssea**
- **Timo**
- **Bursa de Fabricius**

Órgãos Linfoides Secundários (Periféricos)

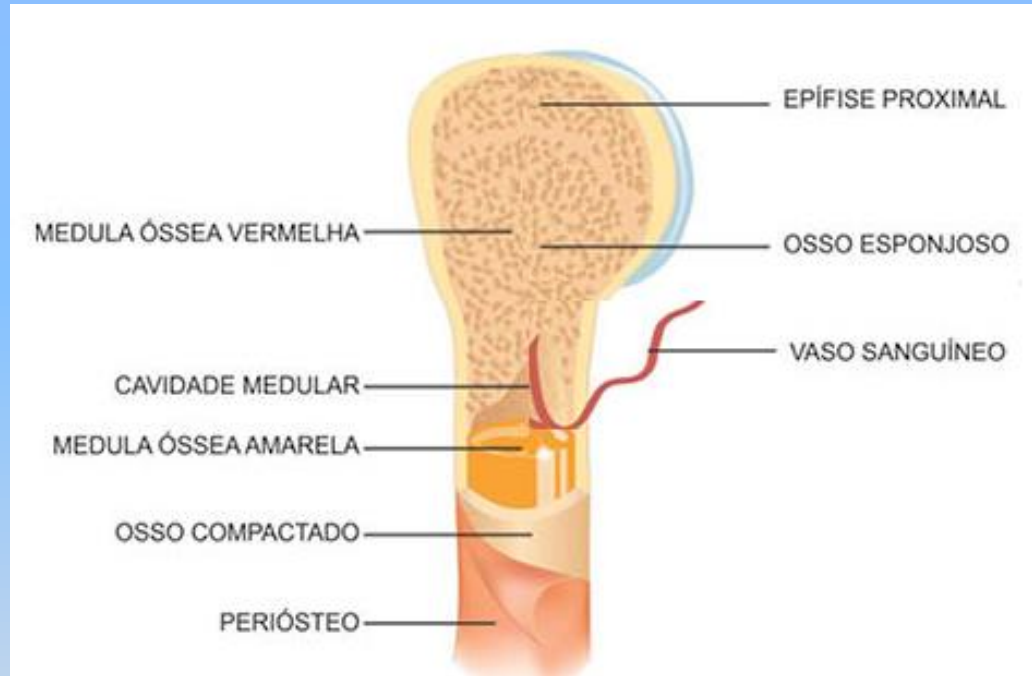
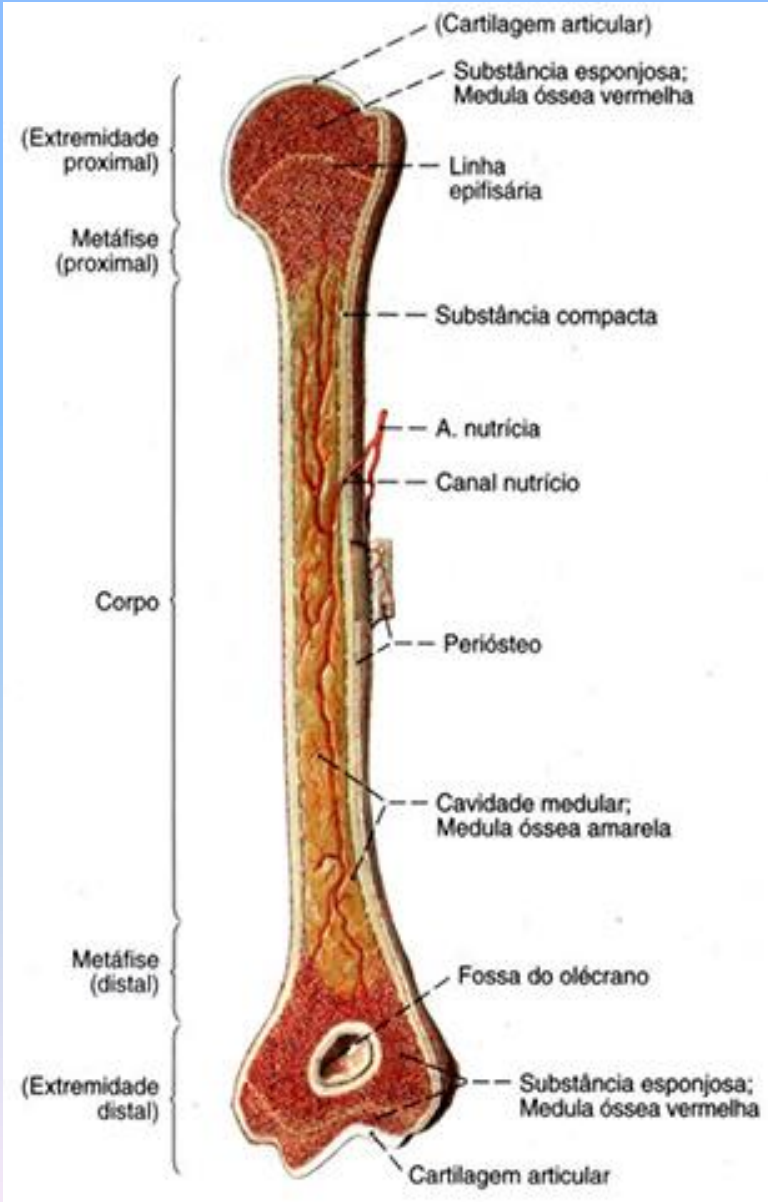
- **Baço**
- **Linfonodos**
- **Tecido Linfoide Associado às Mucosas**

Tecidos e Órgãos Linfoides

Órgãos Linfoides Primários (Centrais ou Geradores)

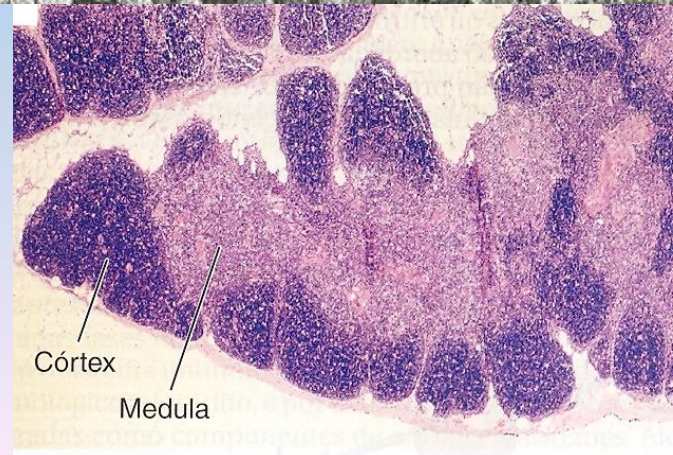
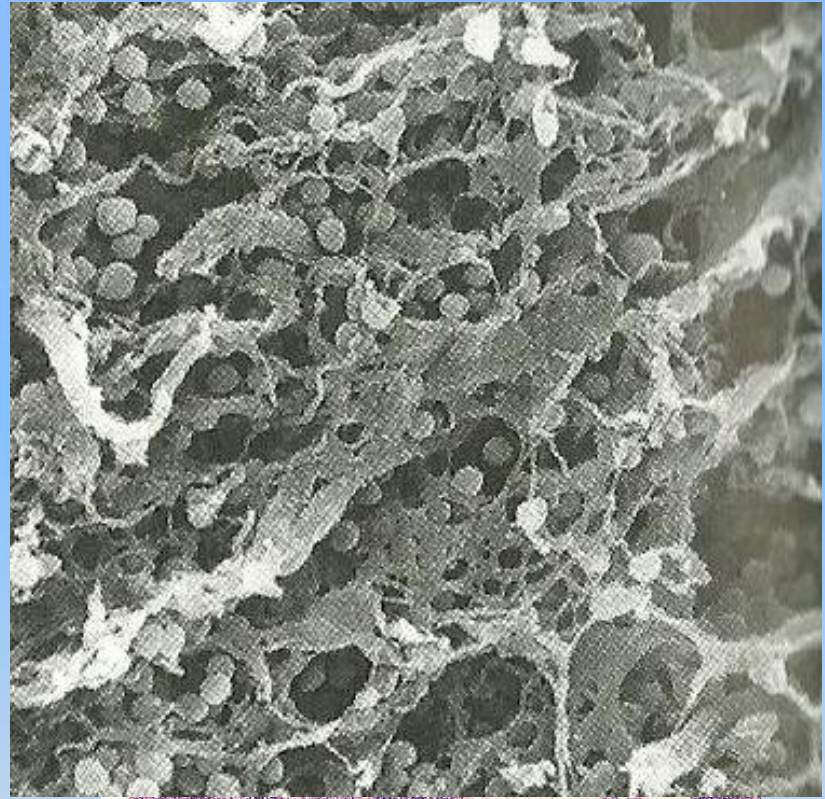
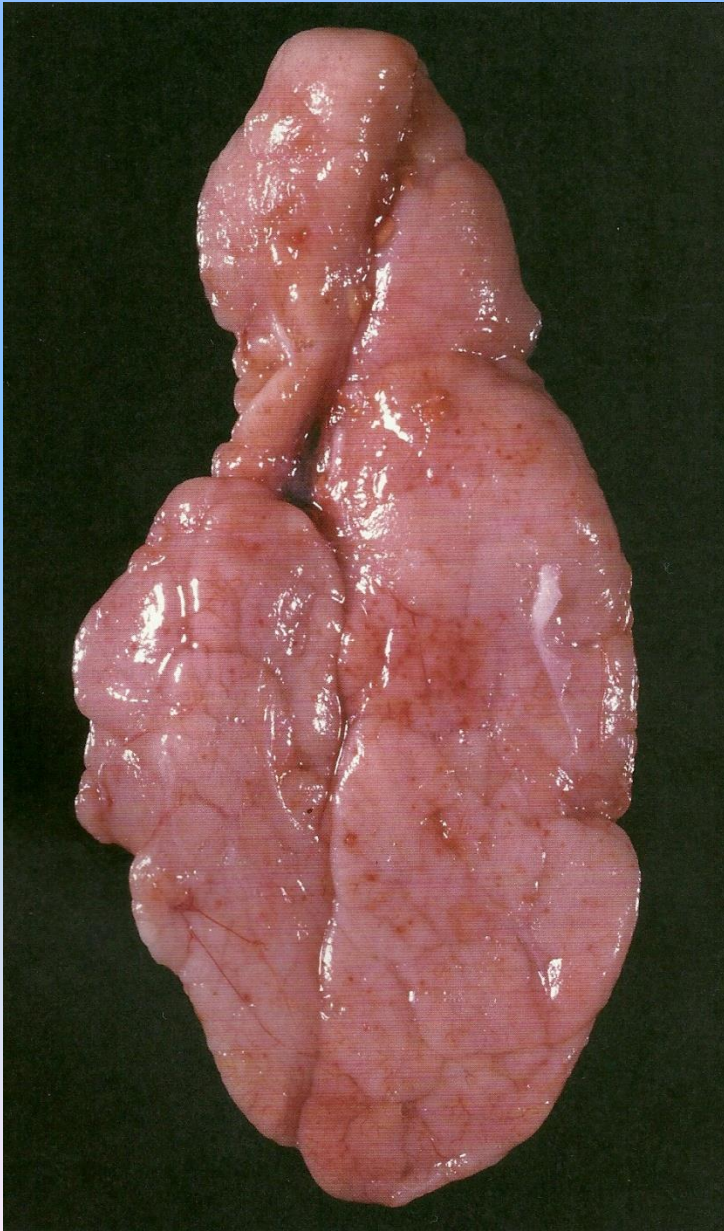
- **Medula Óssea**
- **Timo**
- **Bursa de Fabricius**

Medula Óssea

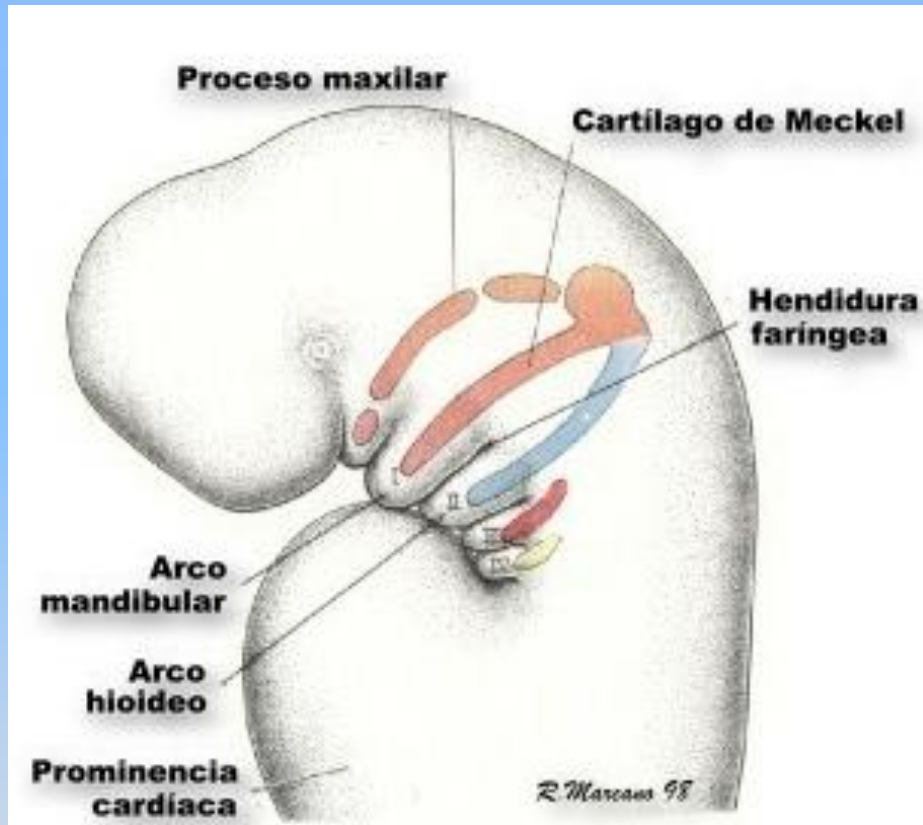


Adaptado de: <http://aureliaguilherme.com.br/boavida/guia-de-saude/transplante-de-medula-ossea/>

Timo: anatomia e histologia



Síndrome DiGeorge



Prevalência:
- 1:4000 (humanos)

Camundongos “nude”



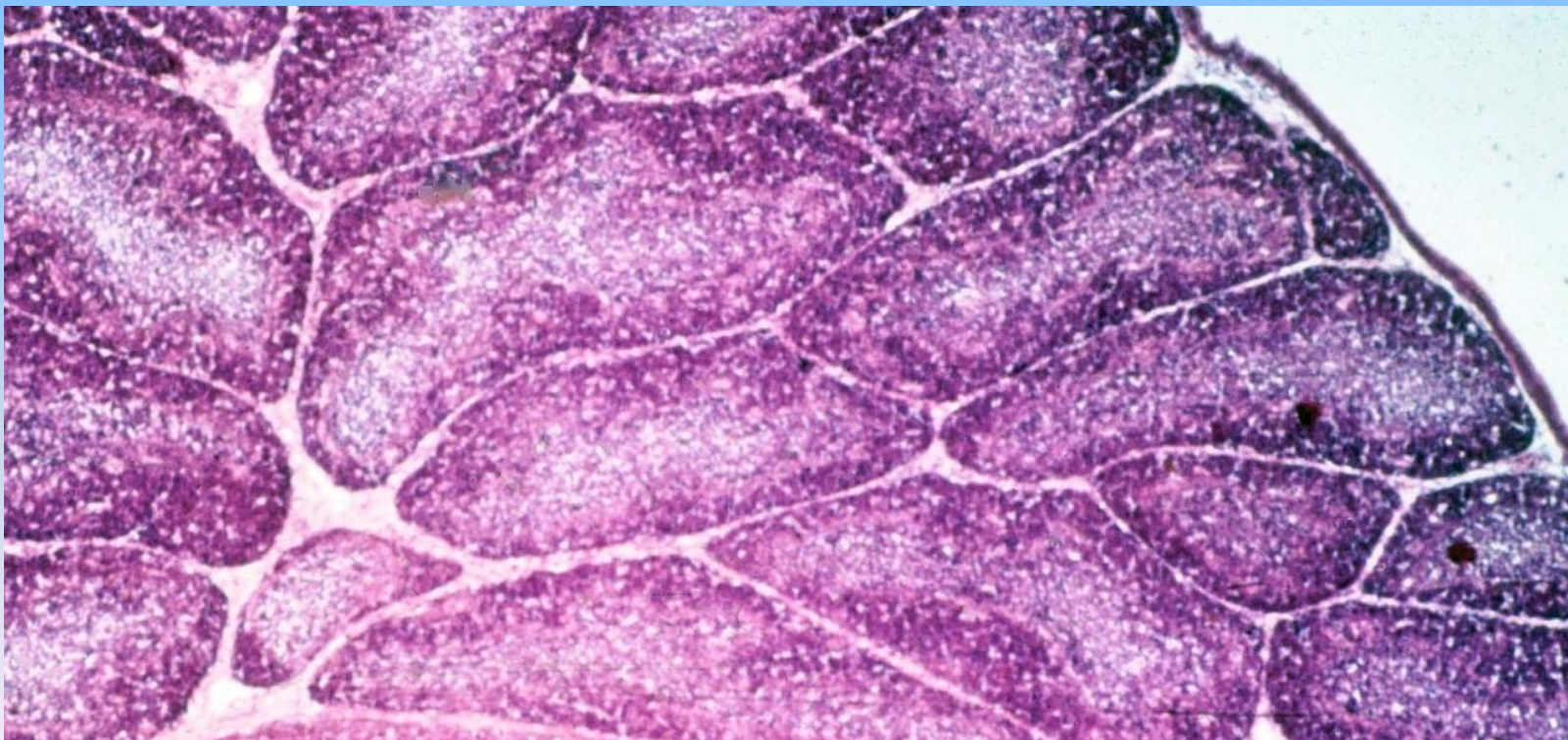
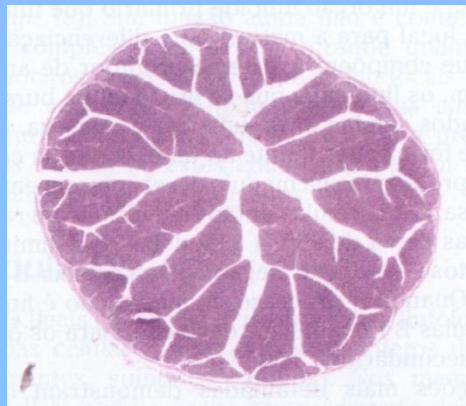
Bursa de Fabricius



Bruce Glick e Timothy Chang: Ohio State University

Bursa de Fabricius

Tizard, *Imunologia Veterinária*,
Sauders-Elsevier, 2009.

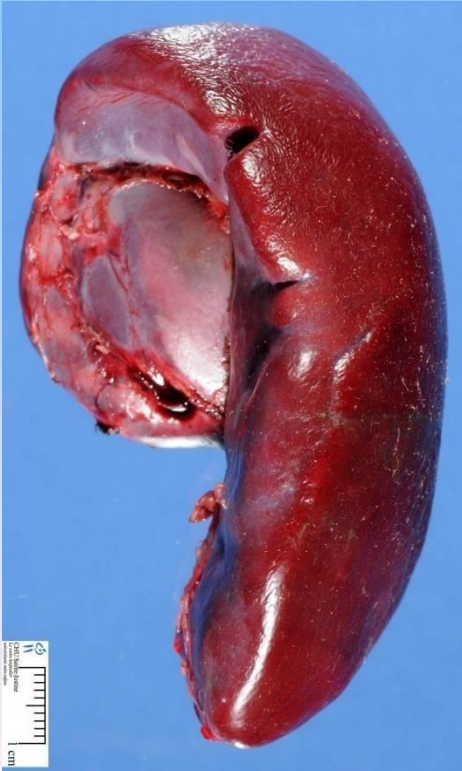
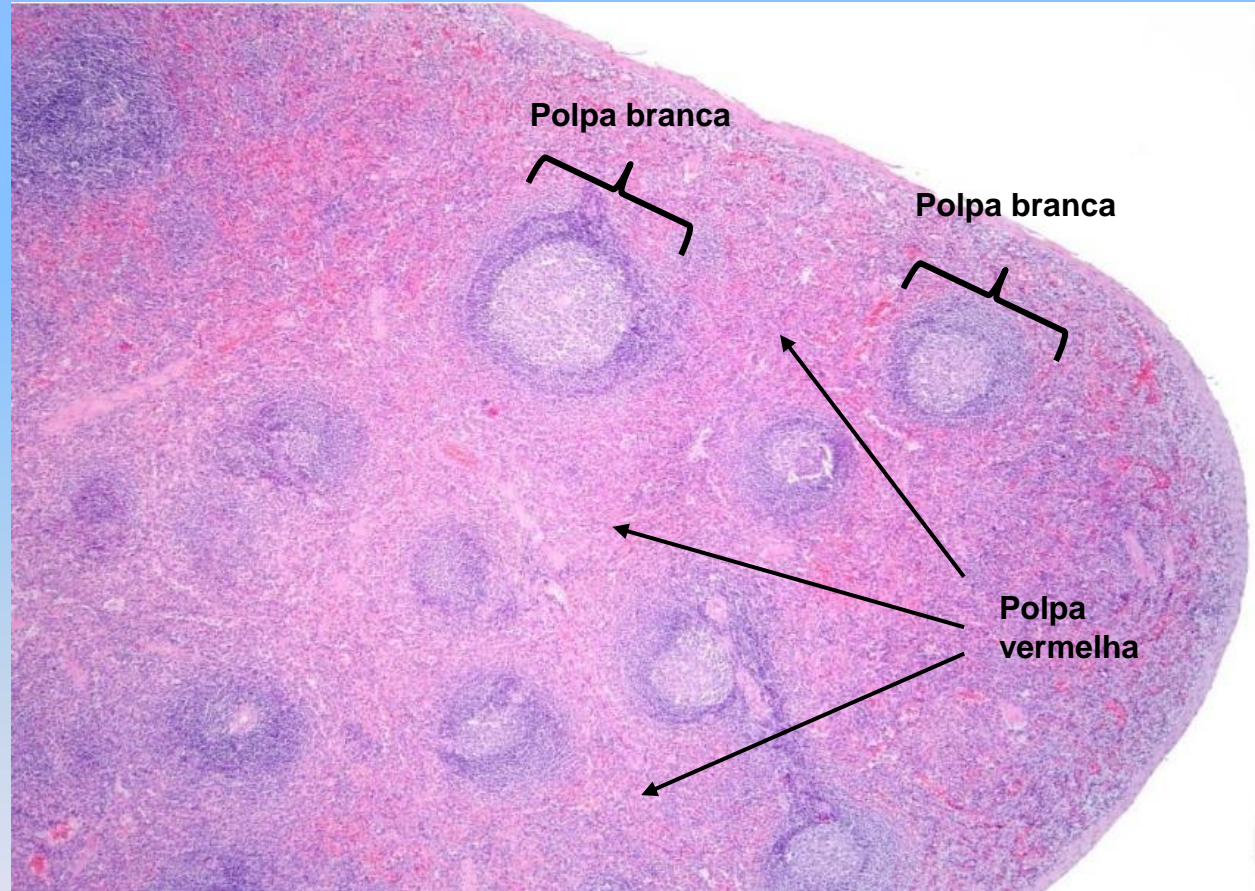
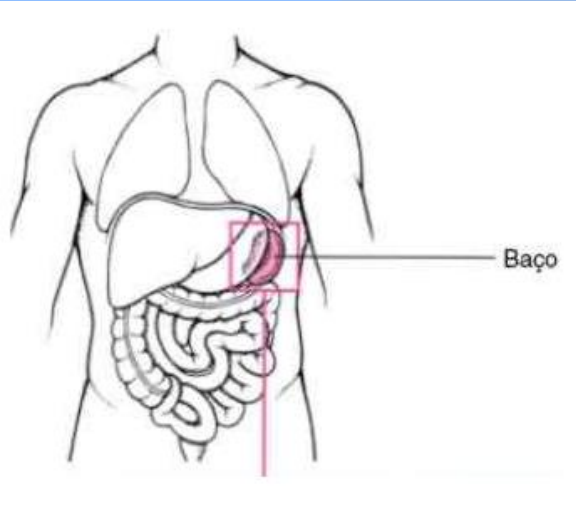


Tecidos e Órgãos Linfoides

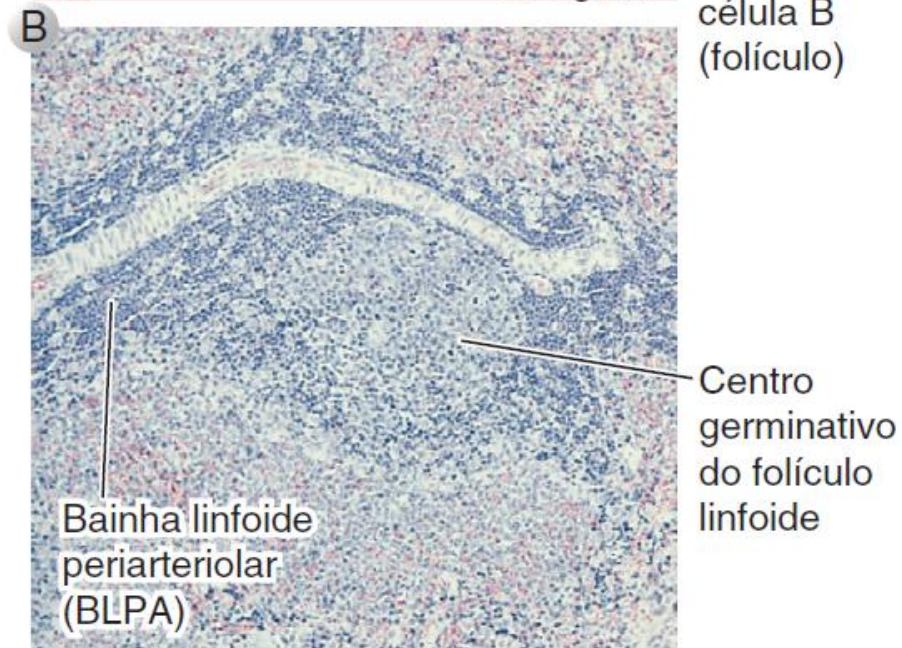
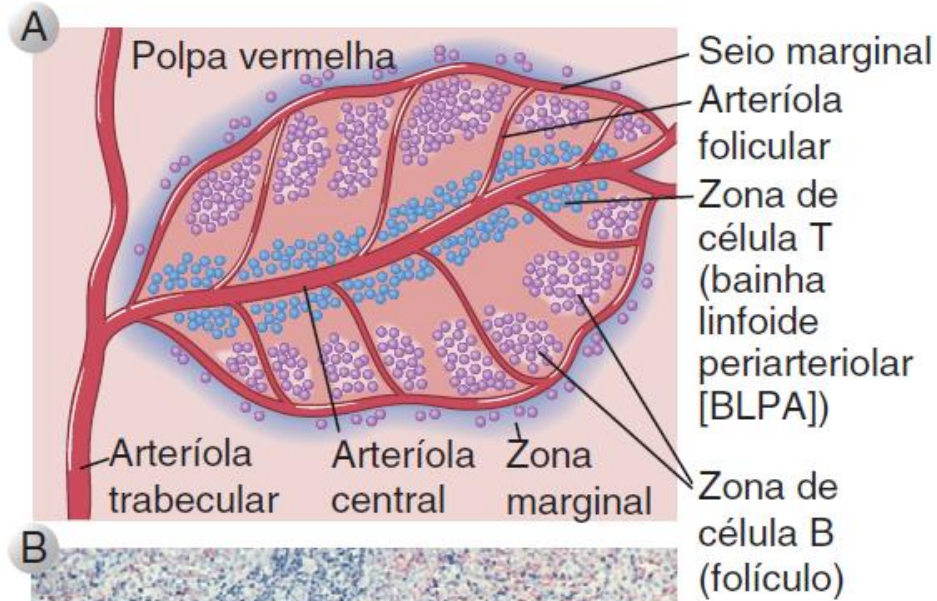
Órgãos Linfoides Secundários (Periféricos)

- **Baço**
- **Linfonodos**
- **Tecido Linfóide Associado às Mucosas**
- **Medula Óssea***

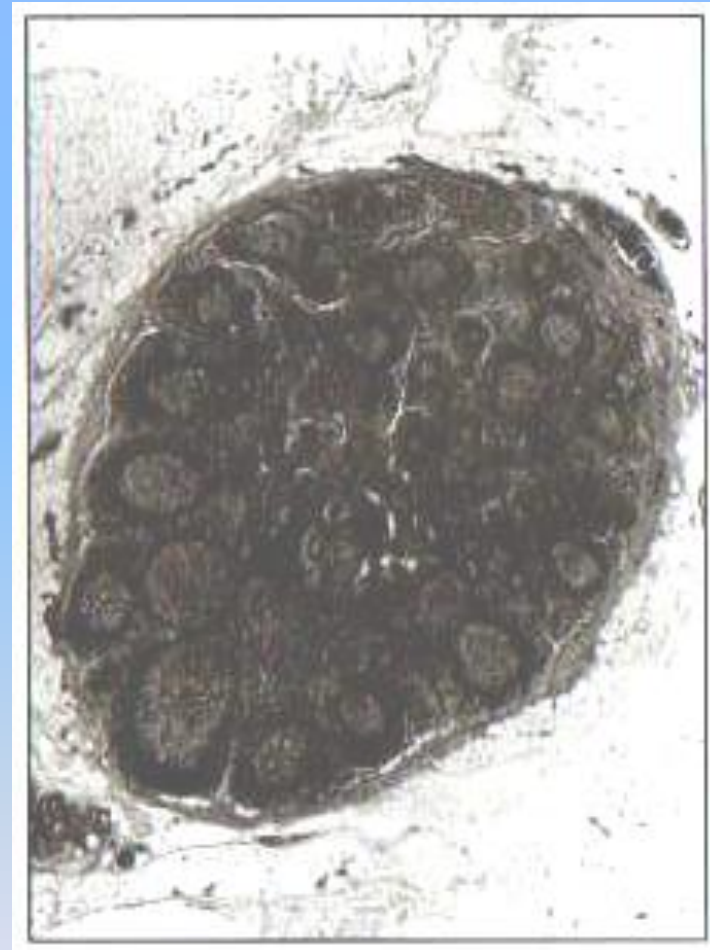
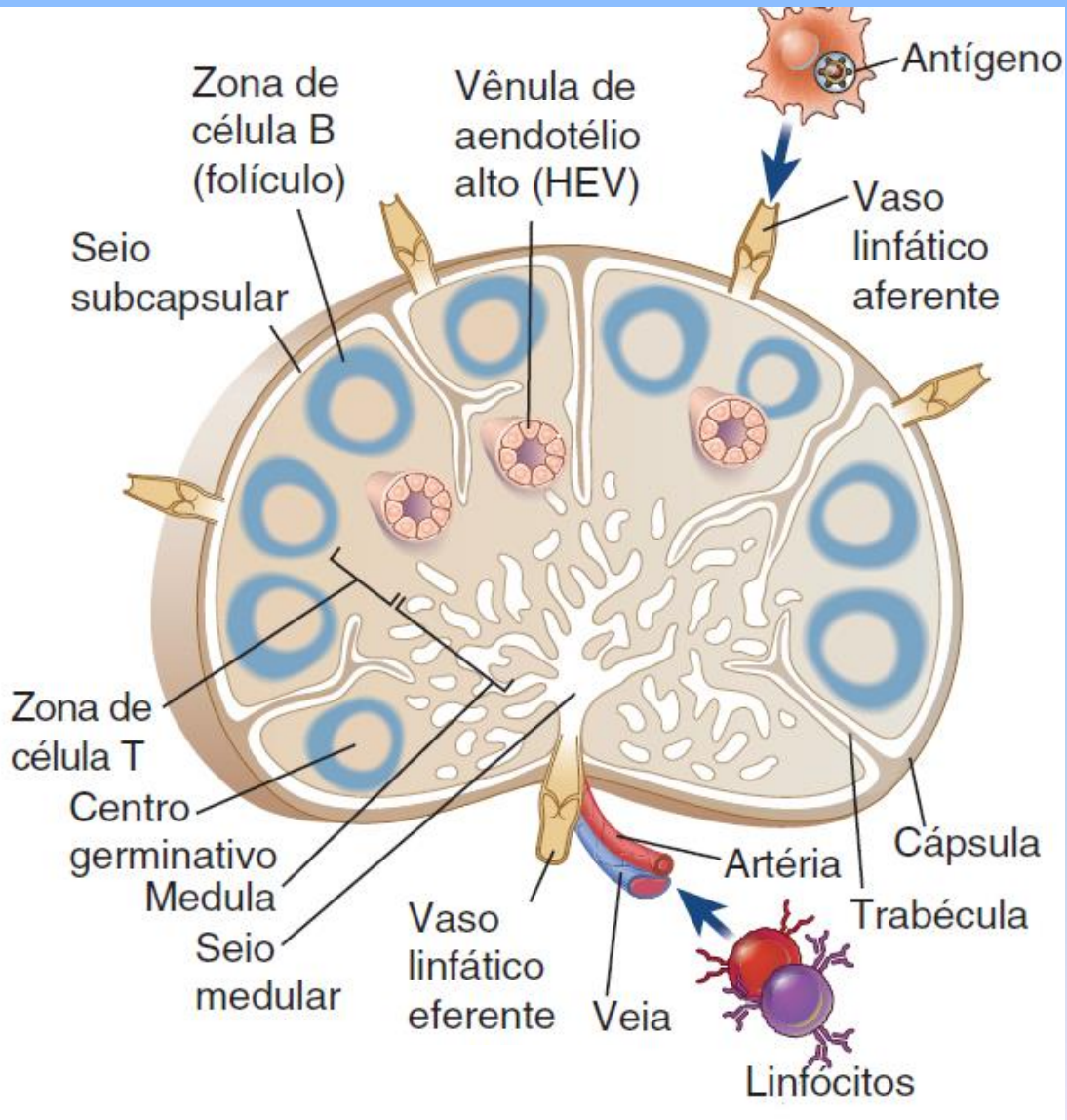
Baço



Baço

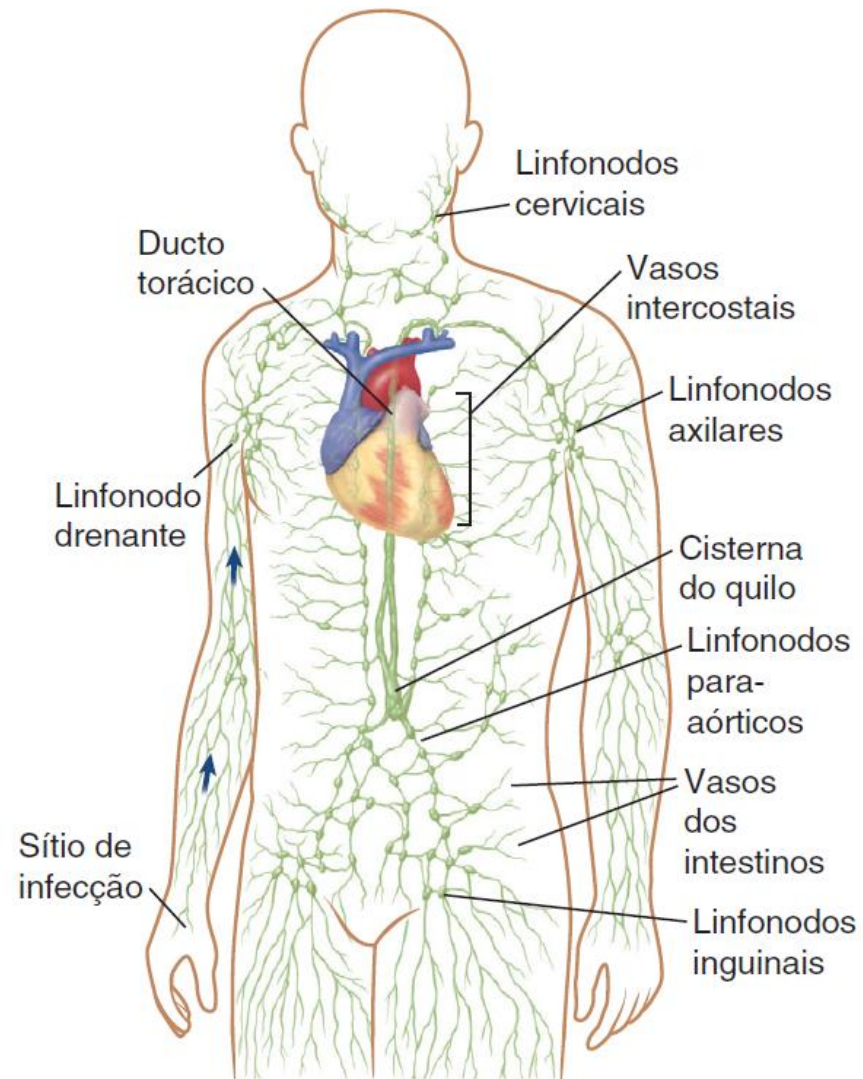
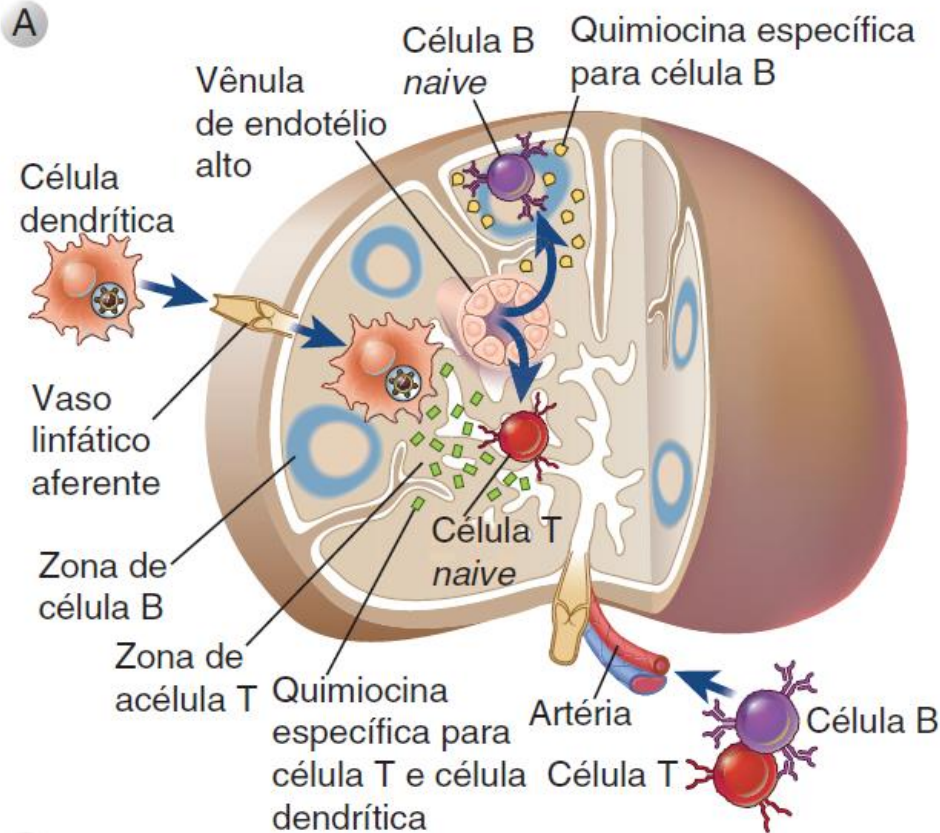


Linfonodos

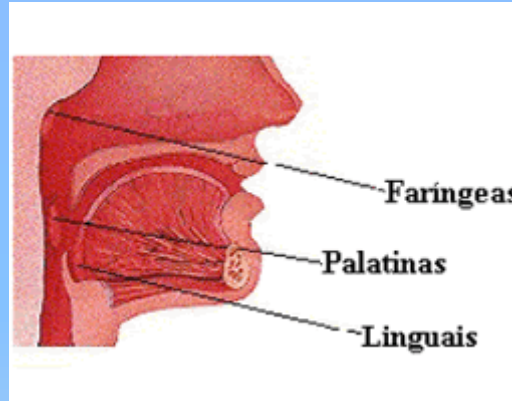


Abbas, Lichtman, Pillai, 6a. Edição, 2008.

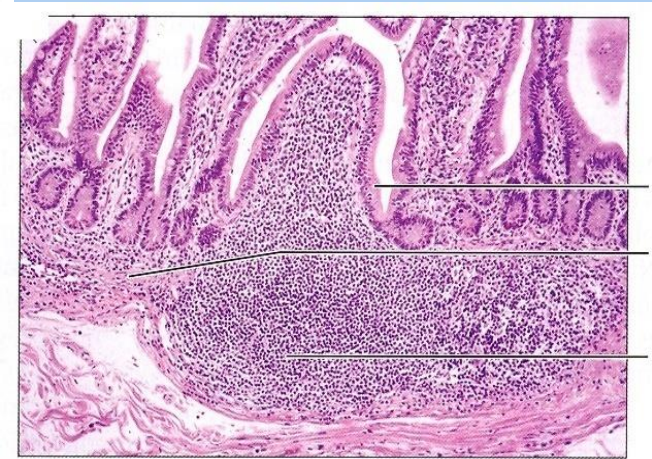
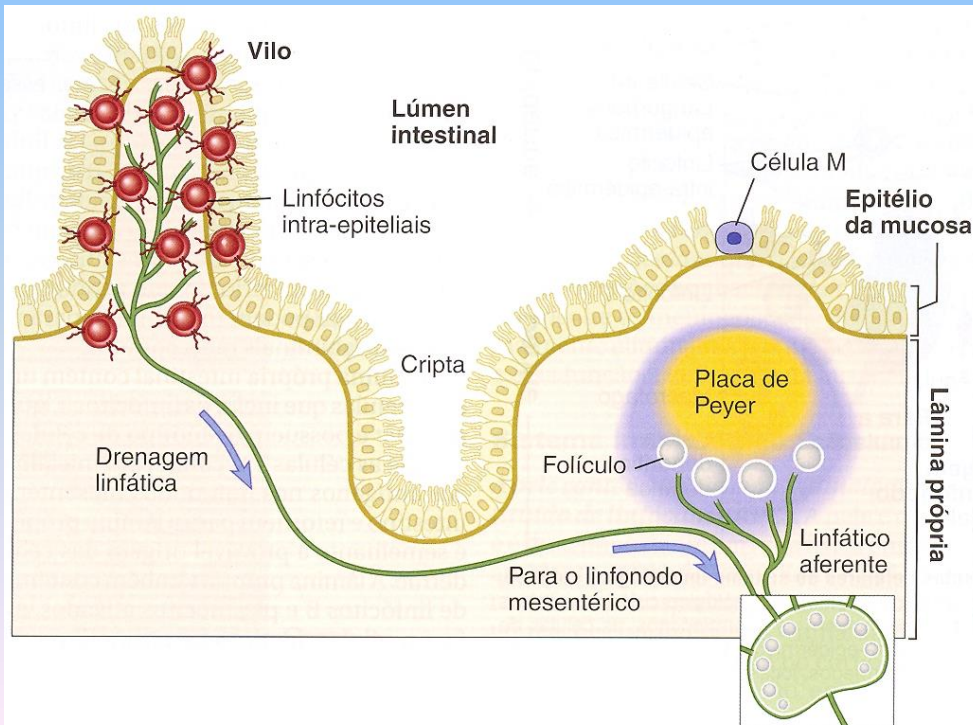
Linfonodos e Rede Linfática



Tecidos Linfóides Associados à: Mucosa (MALT) / Intestino (GALT) Nasal (NALT) / Brônquios (BALT)



Tonsilas ou Amídalas



Amidelite



Placas de Peyer

Grupo I:

- Ruminantes
- Suínos
- Equinos
- Caninos
- Humanos

Proeminentes e alongadas no íleo (80-90%), atingem tamanho máximo e maturidade antes do nascimento e desaparecem após alguns meses

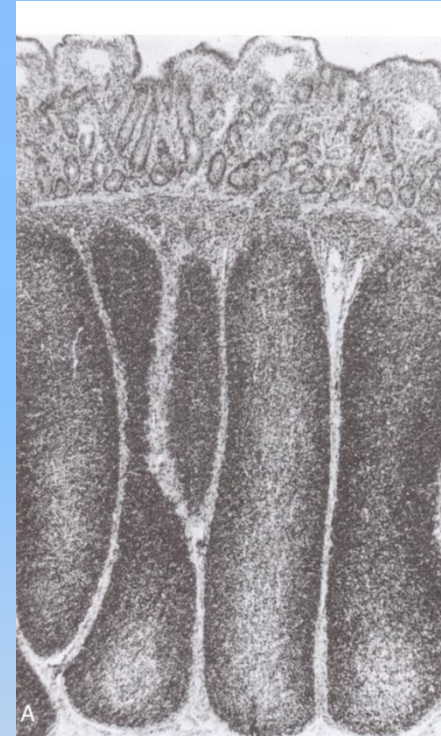
Menos comuns e em formato de pera no jejuno, permanecem durante toda a vida do animal (contêm principalmente linfócitos B e até 30% de linfócitos T)

Grupo II:

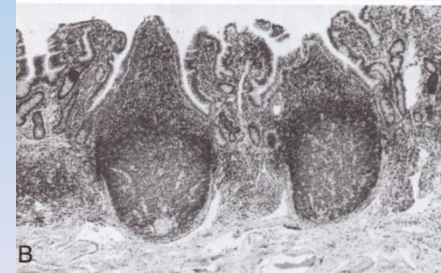
- Coelhos
- Roedores
- Outros primatas

Localizadas aleatoriamente no jejuno e no íleo, desenvolvem-se após o nascimento (estímulo da microbiota)

OVELHA



Íleo



Jejuno

Microscopia on line (MOL)

HISTOLOGIA

Histologia. Histologia interativa. Histologia online. MOL – Microscopia on line. Versão 3.0

Início

Modo de usar

Glossário

Informações técnicas

Acesso aos módulos

Acesso aos módulos

	MÓDULO		MÓDULO
1-A	Conceitos básicos	11	Sistema circulatório
1-B	Células, tecidos, órgãos	12	Órgãos linfoides
2	Tecido epitelial de revestimento	13	Histologia oral
3	Tecido epitelial glandular	14	Glândulas endócrinas
4	Tecido conjuntivo propriamente dito	15	Pele
5	Tecido adiposo	16	Tubo digestivo
6	Tecido cartilaginoso	17	Glândulas anexas ao tubo digestivo
7	Tecido ósseo	18	Sistema respiratório
8	Tecido muscular	19	Aparelho urinário
9	Tecido nervoso	20	Aparelho reprodutor feminino
10	Sangue e hemocitopoese	21	Aparelho reprodutor masculino

<https://mol.icb.usp.br/index.php/acesso-aos-modulos/>