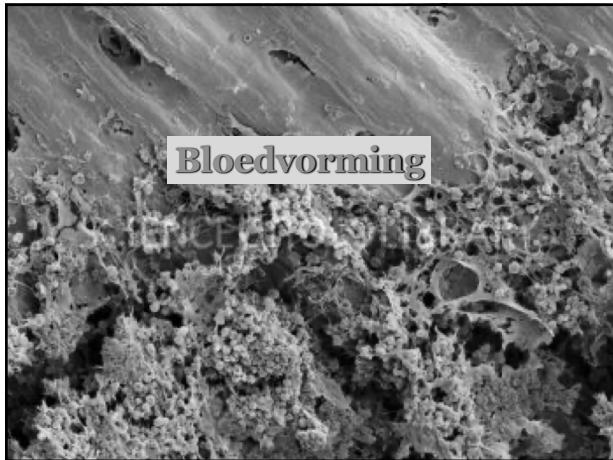


# Bloedvorming



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Inleiding						
Cell type	Erythrocyte	Lymphocyte	Neutrophil	Eosinophil	Basophil	Monocyte
Size	6.7 – 7.7 $\mu\text{m}$	6 – 15 $\mu\text{m}$	12 – 14 $\mu\text{m}$	12 – 17 $\mu\text{m}$	14 – 16 $\mu\text{m}$	16 – 20 $\mu\text{m}$
Number per litre	3.9 – 6.5 $\times 10^{12}$	0 – 0.1 $\times 10^9$	2 – 7.5 $\times 10^9$	1.3 – 3.5 $\times 10^9$	0 – 0.44 $\times 10^9$	0.2 – 0.8 $\times 10^9$
Differential leucocyte count	—	20 – 50 %	40 – 75 %	1 – 6 %	< 1 %	2 – 10 %
Duration of development	5 – 7 days	1 – 2 days	6 – 9 days	6 – 9 days	3 – 7 days	2 – 3 days
Lifespan of mature cell	120 days	?	6 hours to a few days	8 – 12 days	?	Months to years
						8 – 12 days

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**Inleiding**

Hemopoëse, hematopoëse, hematocytopoëse

Proces waarbij zeer sterk gedifferentieerde bloedcellen ontwikkelen uit ongedifferentieerde stamcellen

**Vervanging bloedcellen is nodig omdat:**

- Cellen in bloed zijn in hoge mate gedifferentieerd (cfr thrombocyten en erythrocyten)
- Cellen zijn gemigreerd naar de plaats waar ze hun functie uitoefenen (cfr leukocyten)
- 'Oude' cellen worden afgebroken

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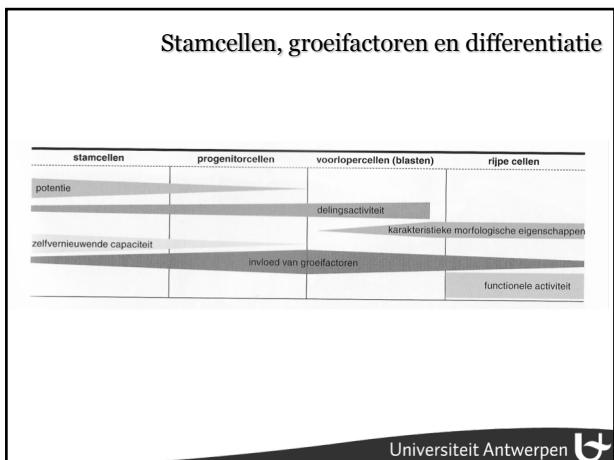
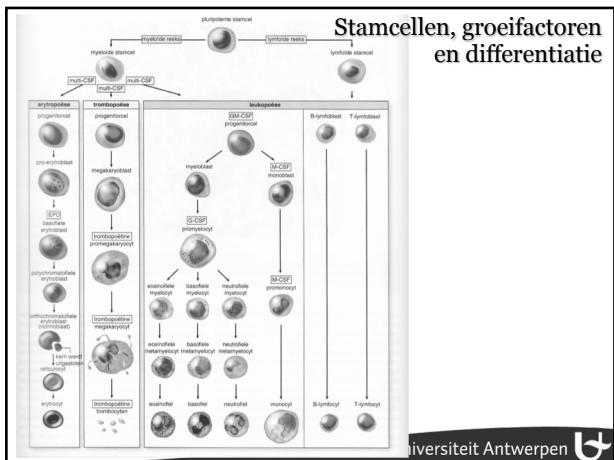
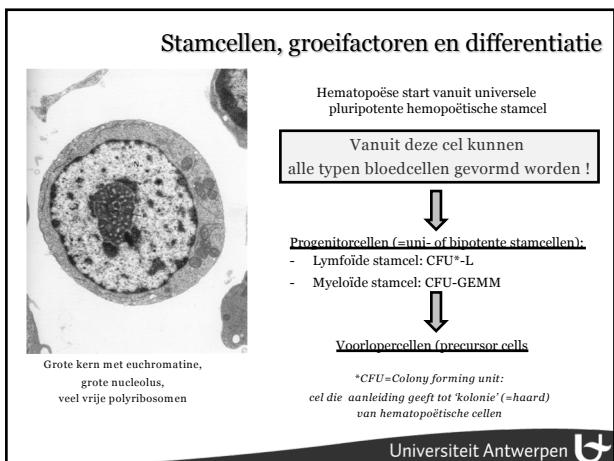
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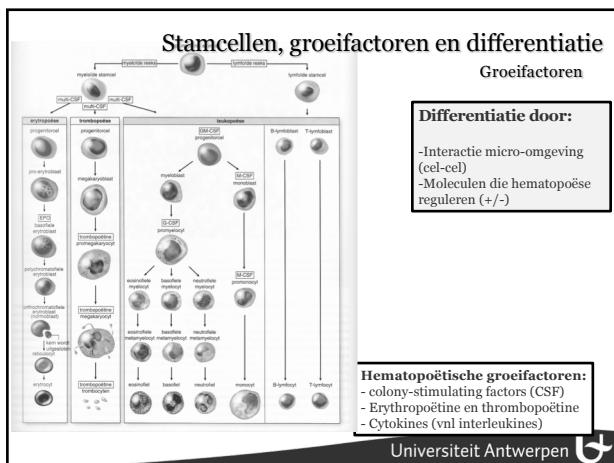
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# Bloedvorming



# Bloedvorming



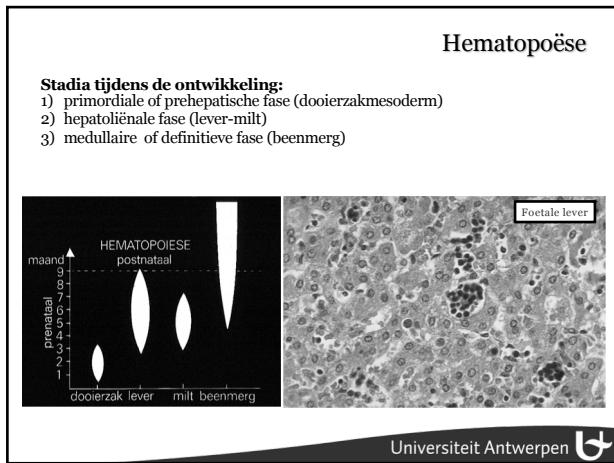
**Stamcellen, groefactoren en differentiatie**

**Groeifactoren**

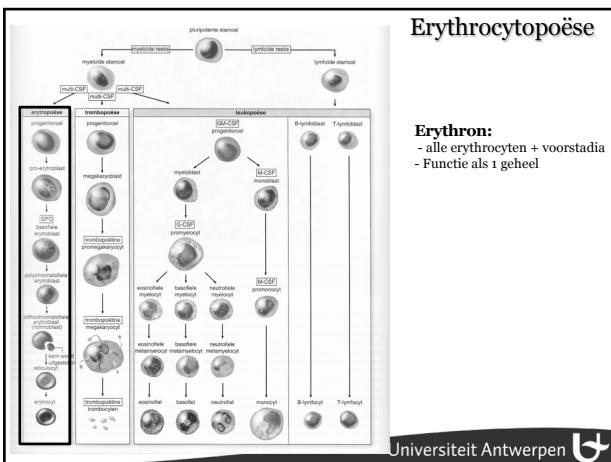
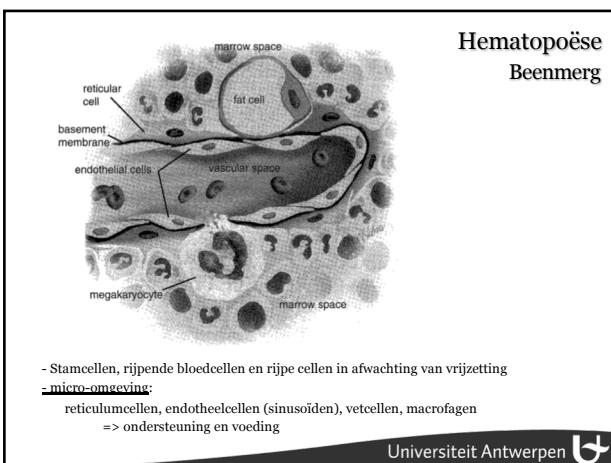
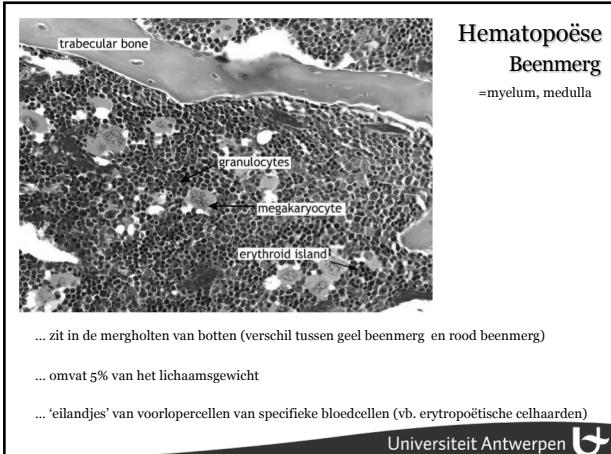
Naam	factorproducerende cellen	betrekking tot biologische activiteit en doelen
stamcelfactor (SCF)	stomale cellen beenmerg	stimuleert de celiding van hematopoïetische voorlopercellen
erytropoetine (EPO)	peritubulaire endothelialcellen in de nier; hepatocyten	stimuleert de celiding en differentiatie van erytrocyt voorlopercellen en erythroblasten
thrombopoetine (TPO)	nier en lever	stimuleert de celiding van megakaryoblasten en megakaryocyten voorlopercellen
granulocyt- en macrofaagkoloniestimulerende factor (GM-CSF)	endothelialcellen in het beenmerg en T-lymfocyten	stimuleert de celiding van alle myeloid voorlopercellen
granulocytenstimulerende factor (G-CSF)	endothelialcellen in het beenmerg en macrofagen	stimuleert de celiding van granulocyten voorlopercellen; stimuleert leukemicellcel
macrofaagkoloniestimulerende factor (M-CSF)	endothelialcellen in het beenmerg en macrofagen	stimuleert de celiding van macrofag voorlopercellen; verhoogt de antitumoractiviteit van macrofagen
interleukine-1 (IL-1)	macrofagen en T-helppercellen	reguleert de activiteit en cytokineproductie van verschillende typen leucocyten en andere celltypen
interleukine-2 (IL-2)	T-helpper cellen	stimuleert de celiding van geactiveerde T- en B-lymfocyten; stimuleert de celiding van T-helppercellen
interleukine-3 (IL-3)	T-helpper cellen	stimuleert de celiding van granulocyten voorlopercellen; verhoogt de antitumoractiviteit van macrofagen
interleukine-4 (IL-4)	T-helpper cellen	stimuleert de ontwikkeling van basofilen en mescalinen en de activiteit van eosinofilen
interleukine-5 (IL-5) of eosinofiel differentiatiefactor (EDF)	T-helpper cellen	stimuleert de celiding en activering van eosinofilen
interleukine-6 (IL-6)	macrofagen, neutrofalen, endotheelcellen	stimuleert de celiding van verschillende leucocyten; stimuleert de activering van B-lymfocyten en regulatoire T-lymfocyten
interleukine-7 (IL-7)	stomale cellen in het beenmerg	stimuleert de celiding van alle lymphoïde stamcellen

Hemopoëtische groefactoren ('Colony-stimulating factors') -> bevorderen proliferatie van de CFU's en de ontstane voorlopercellen -> terminale differentiatie

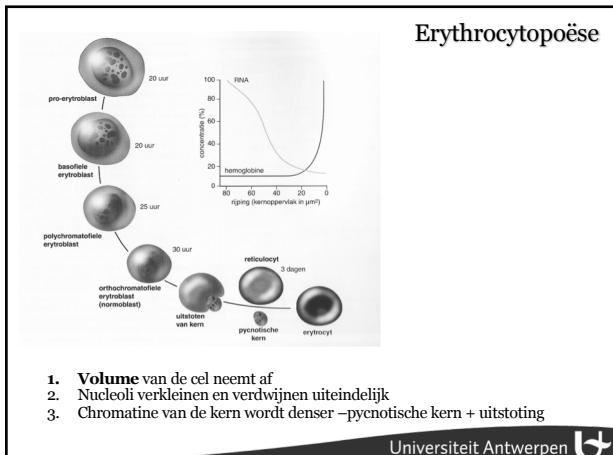
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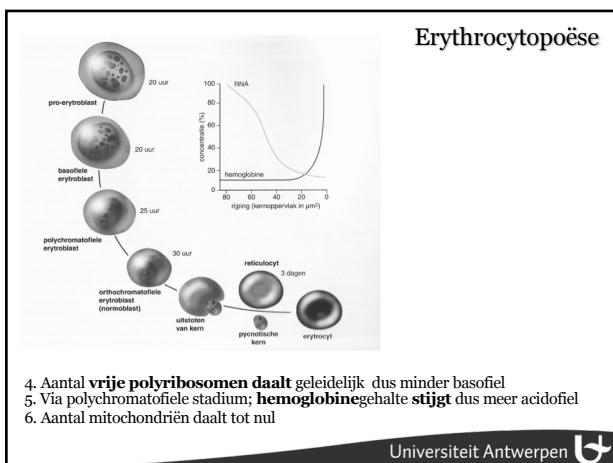
# Bloedvorming



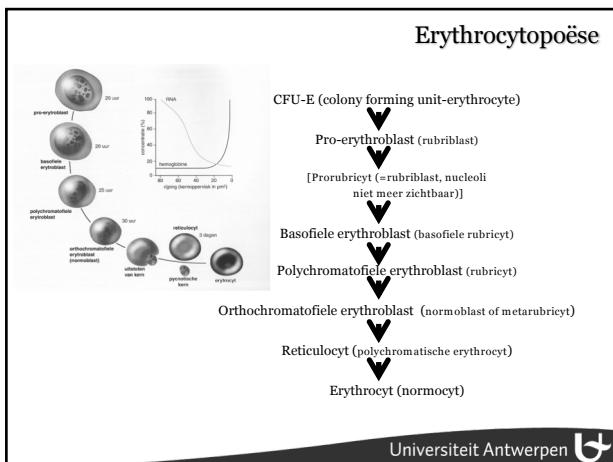
# Bloedvorming



1. **Volume** van de cel neemt af
2. Nucleoli verkleinen en verdwijnen uiteindelijk
3. Chromatine van de kern wordt denser –**pycnotische kern** + uitstoting



4. Aantal **vrije polyribosomen** daalt geleidelijk dus minder basofiel
5. Via polychromatofiele stadium; **hemoglobinegehalte stijgt** dus meer acidofiel
6. Aantal mitochondriën daalt tot nul



# Bloedvorming

## Erythrocytopoëse

**Pro-erythroblast:**

- 14-17 µm in doormeter
- Grote kern (beslaat 80% van de cel)
- Fijn en geklonterd chromatin
- Eén of meerdere, bleek gekleurde nucleoli
- Vele organelen, vooral **poliribosomen**
- Intens basofiel cytoplasma
- Start hemoglobinesynthese
- In cytoplasma en in organellen: ijzertoever (via transferrine)

**Basofiele erythroblast:**

- 13-16 µm in doormeter
- Meer gecondenseerde nucleus
- Chromatine in de vorm van spaken van wiel
- Variabel aantal, doch duidelijke nucleoli
- Basofiel cytoplasma met ferritine (siderosomen en vrij)
- Vele organelen, vooral poliribosomen (verspreid)
- Kenmerkende, zwak-kleurende perinucleaire halo

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## Erythrocytopoëse

**Polychromatofiele erythroblast**

- 12-14 µm in doormeter
- Gecondenseerde nucleus
- Korrelig chromatine met regelmatiger verdeling
- Nucleoli afwezig
- Polychromatisch cytoplasma
- (basofile tgv polyribosomen en eosinofiele tgv hemoglobine)**
- Perinucleaire halo nog zichtbaar; nog één of twee delingen

Orthochromatic erythroblast (Normoblast)

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## Erythrocytopoëse

**Orthochromatische erythroblast:**

- 8-10 µm in doormeter
- Zeer gecondenseerde nucleus, excentrisch gelegen
- Pyknotisch uitzicht chromatine
- Meer acidofiel cytoplasma
- Eliminatie van de meeste organelen, vooral de ribosomen en de mitochondria.

Polychromatic erythrocyte <sup>1)</sup> (Reticulocyte)

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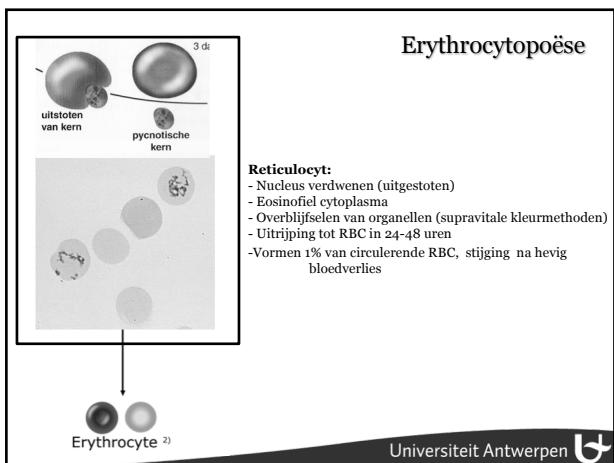
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# Bloedvorming



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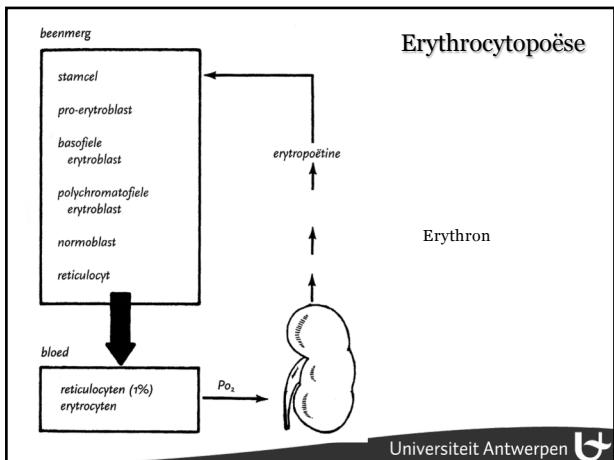
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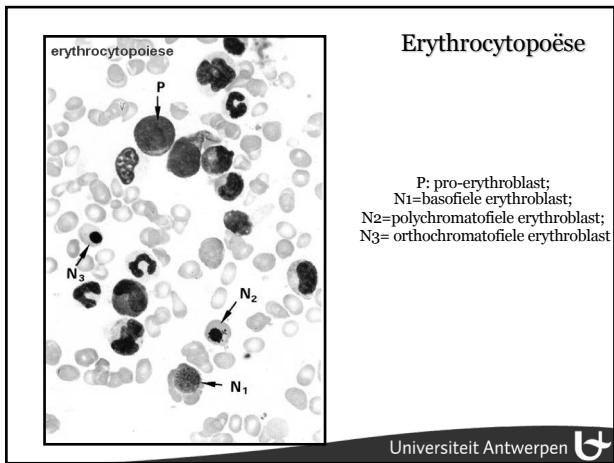
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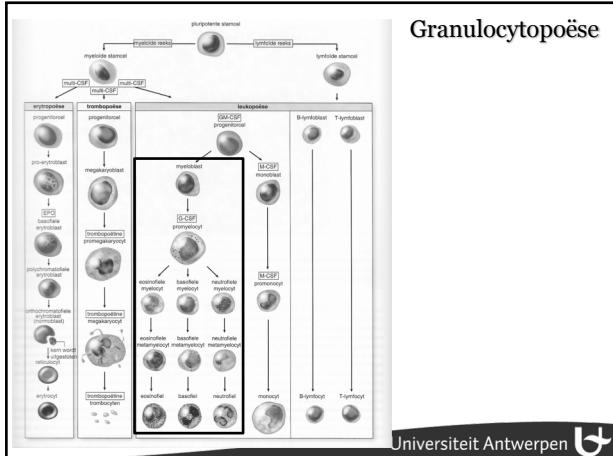
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# Bloedvorming



## Granulocytopoëse

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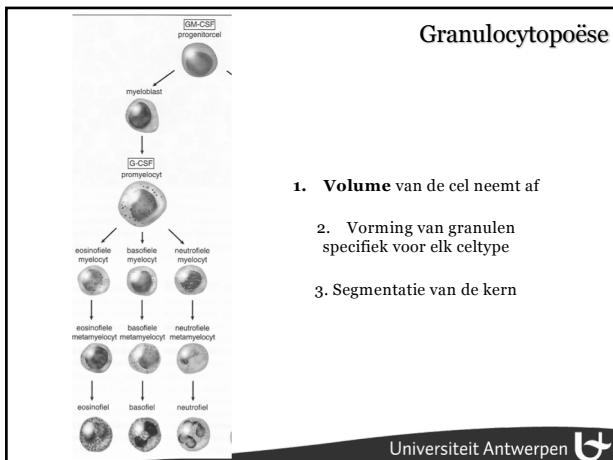
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1. Volume van de cel neemt af
2. Vorming van granulen specifiek voor elk celtype
3. Segmentatie van de kern

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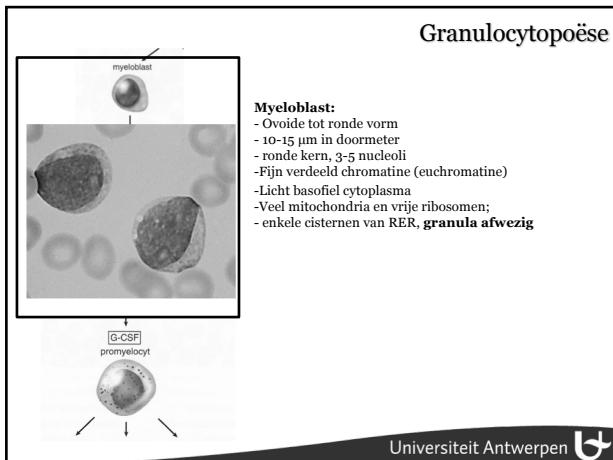
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## Granulocytopoëse

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# Bloedvorming

## Granulocytopoëse

The diagram illustrates the process of granulocytogenesis. It starts with a 'promyelocyt' at the top left, which differentiates into three types of myelocytes: 'eosinofiele myelocyt', 'basofiele myelocyt', and 'neutrofiele myelocyt'. Below these, three small circular images show the resulting mature cells: an 'eosinofiele myelocyt' with prominent red granules, a 'basofiele myelocyt' with dark blue granules, and a 'neutrofiele myelocyt' with small, scattered grey granules. At the bottom left, a larger circular image shows a neutrophil with a large, central, multi-lobed nucleus and numerous granules. An arrow labeled 'G-CSF' points to the promyelocyte stage.

**Promyelocyt:**

- Meestal groter dan myeloblast (tot 20 µm in doorsnede);
- is na mega-karyocyt de grootste cel in beenmerg;
- kern doorgaans rond tot nierzichtig, grover chromatin, opvallende nucleoli;
- goed ontwikkeld GA & RER
- primaire (azurofiele grana)**: gevormd aan transzijde van GA, lysosomale enzymen
- Basofieel cytoplasma dan myeloblast

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## Granulocytopoëse

The diagram illustrates the process of granulocytogenesis. It starts with a 'myelocyte' at the top left, which differentiates into 'metamyelocyt' cells. Below these, three small circular images show the resulting mature cells: an 'eosinofiele metamyelocyt' with prominent red granules, a 'basofiele metamyelocyt' with dark blue granules, and a 'neutrofiele metamyelocyt' with small, scattered grey granules. At the bottom left, two larger circular images show a myeloblast and a neutrophil with a large, central, multi-lobed nucleus and numerous granules. A box at the bottom right contains the text: 'Basofiele, neutrofiele en eosinofiele myelocyt'.

**Myelocyt:**

- Wisselende Ø: 10-15 µm
- Ovalen kern meestal excentrisch gelegen met grof chromatinepatroon
- geen nucleoli (itt monocyten die hun nucleoli ook in mature stadium behouden)
- vorming van azurofiele grana stopt vanaf dit stadium **en vorming van specifieke grana** start (peroxidase -) aan cisiszijde van GA
- Te onderscheiden van lymfocyten door kleinere K/C en ijler chromatine-verdeling in kern.

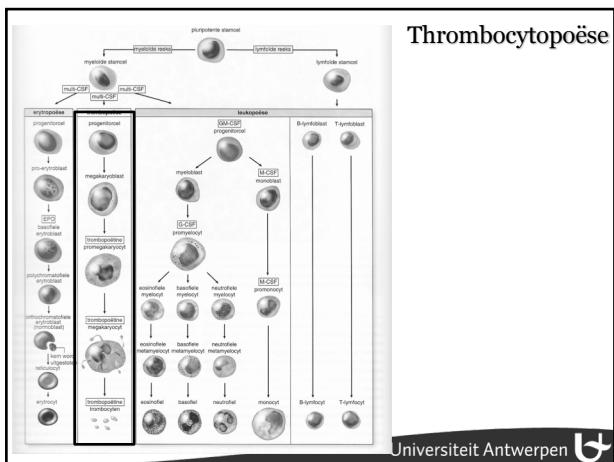
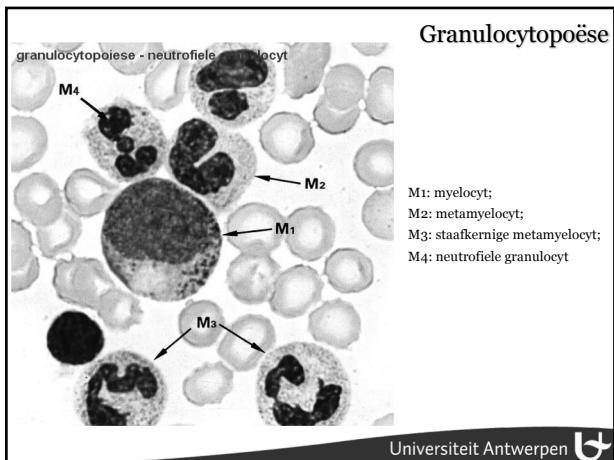
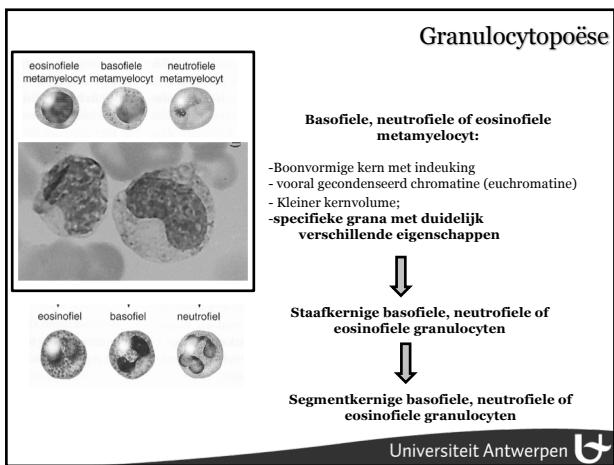
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## Granulocytopoëse

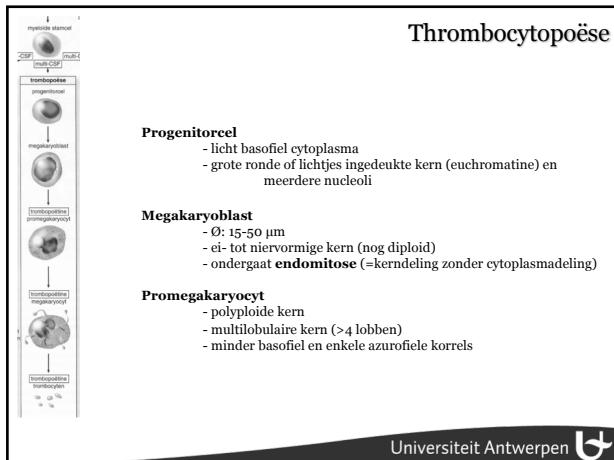
The diagram illustrates the ultrastructure of neutrophils during granulocytogenesis. It shows two cross-sections of neutrophils. The left section shows a neutrophil with a large, central, multi-lobed nucleus and numerous small, electron-dense granules. The right section shows a more advanced neutrophil with a large, central, multi-lobed nucleus and many large, electron-dense granules. Labels indicate 'basofiele myelocyt' and 'eosinofiele myelocyt' at the top left, and 'neutrofiele myelocyt' at the top right. A caption at the bottom left reads: 'Aanmaak specifieke grana geeft mogelijkheid tot onderscheid.' (Formation of specific granules provides the opportunity for differentiation).

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# Bloedvorming



# Bloedvorming



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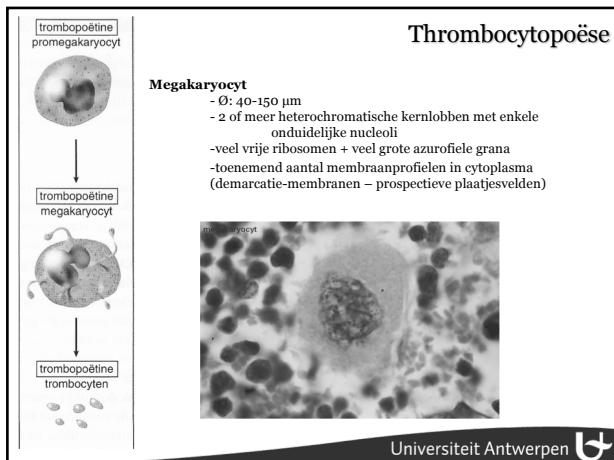
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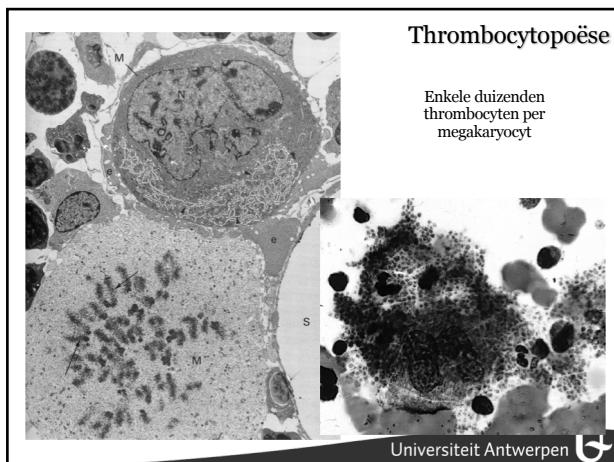
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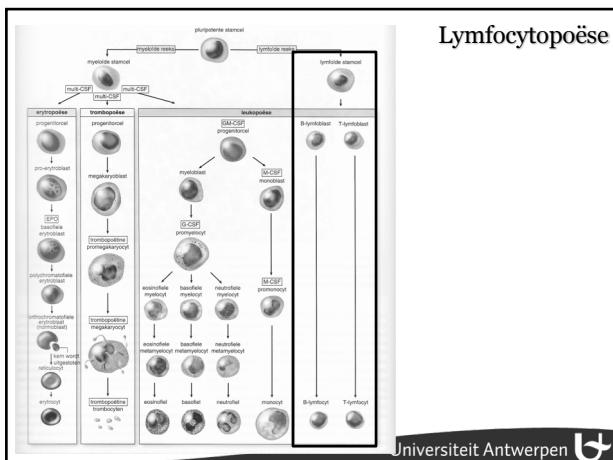
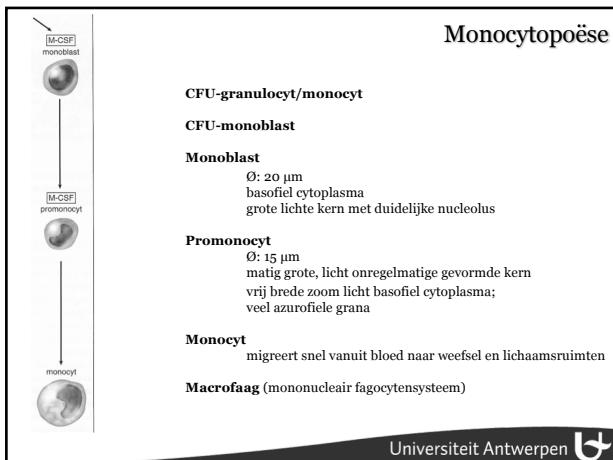
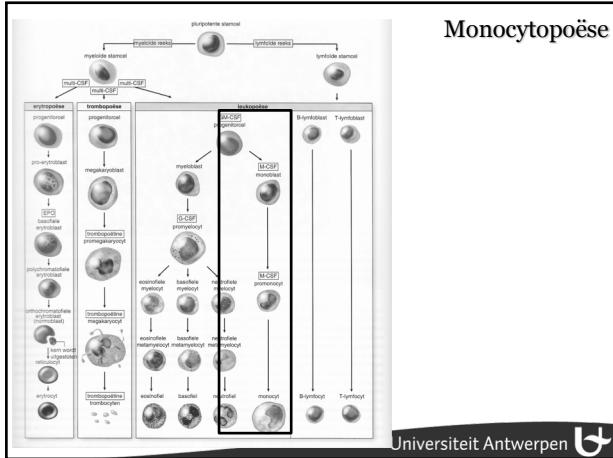
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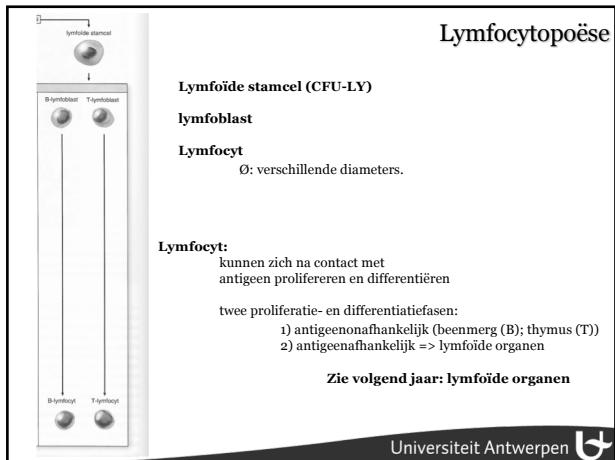
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# Bloedvorming



# Bloedvorming



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