
VMX
2025
VETERINARY MEETING & EXPO
Festival of the HeARTS
Presented By:
NAVC
YOUR VETERINARY COMMUNITY
JANUARY 25-29
ORLANDO, FLORIDA
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Blood Morphology Matters:

The most common clinically significant findings you might miss if you don't smear!

Candice Chu, DVM, PhD, DACVP
Assistant Professor at Texas A&M University

Conflict of Interest Disclosure

I have financial interest, arrangement or affiliation with:

Name of Organization	**Relationship**
EveryCat Health Foundation	Grant/Research Support
IDEXX	Speaker & Honorarium

VMX 2025 VETERINARY MEETING & EXPO

TEXAS A&M UNIVERSITY
Veterinary Medicine
& Biomedical Sciences

Candice Chu, DVM, PhD, DACVP

Experience

2008-2013 DVM, National Taiwan University
2014-2018 PhD, Texas A&M University
2018-2021 Clinical Pathology Residency, Texas A&M
2021-2023 Assistant Professor, University of Pennsylvania

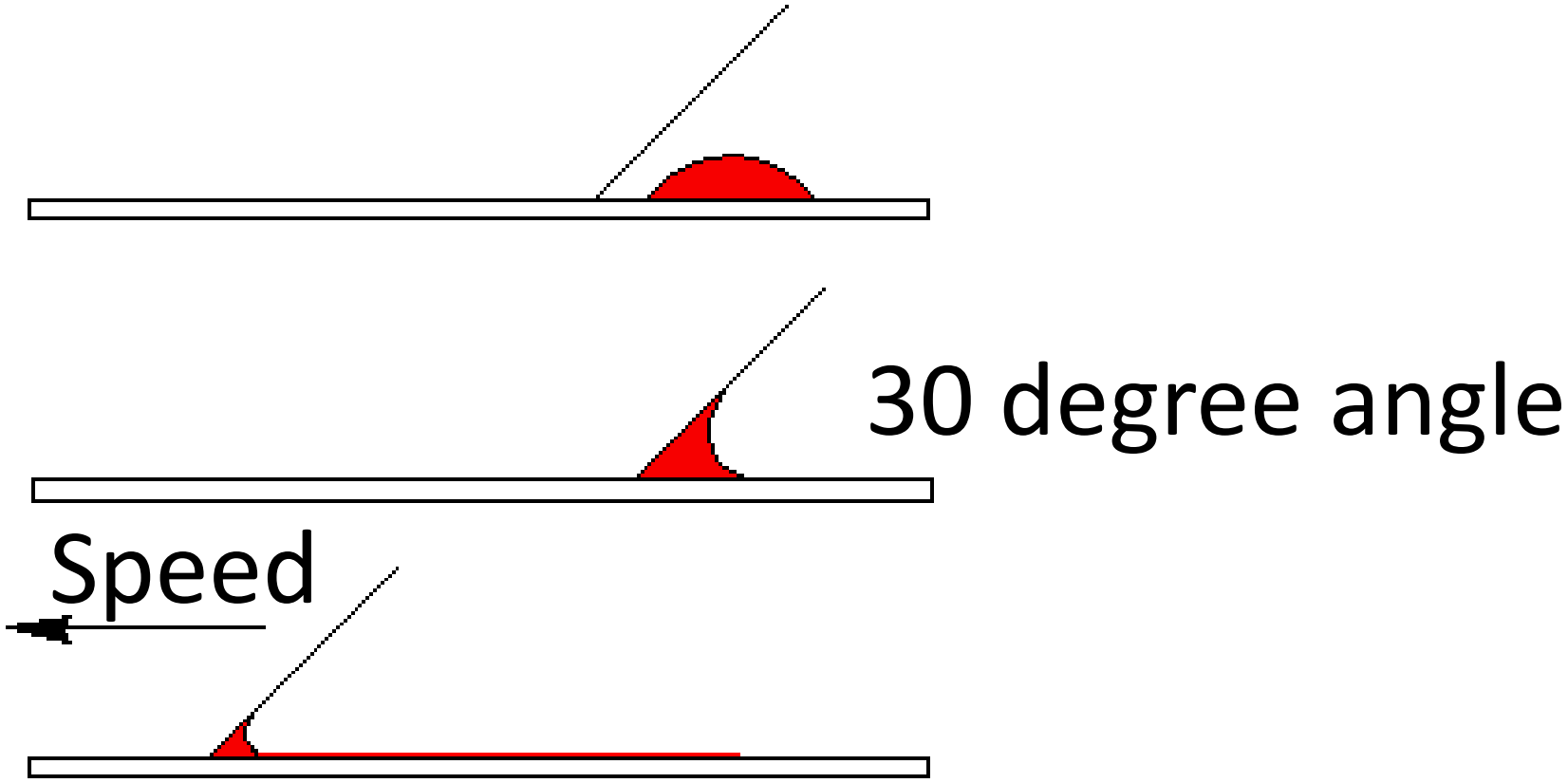
Current position

2024- Assistant Professor, Texas A&M University

Thank You

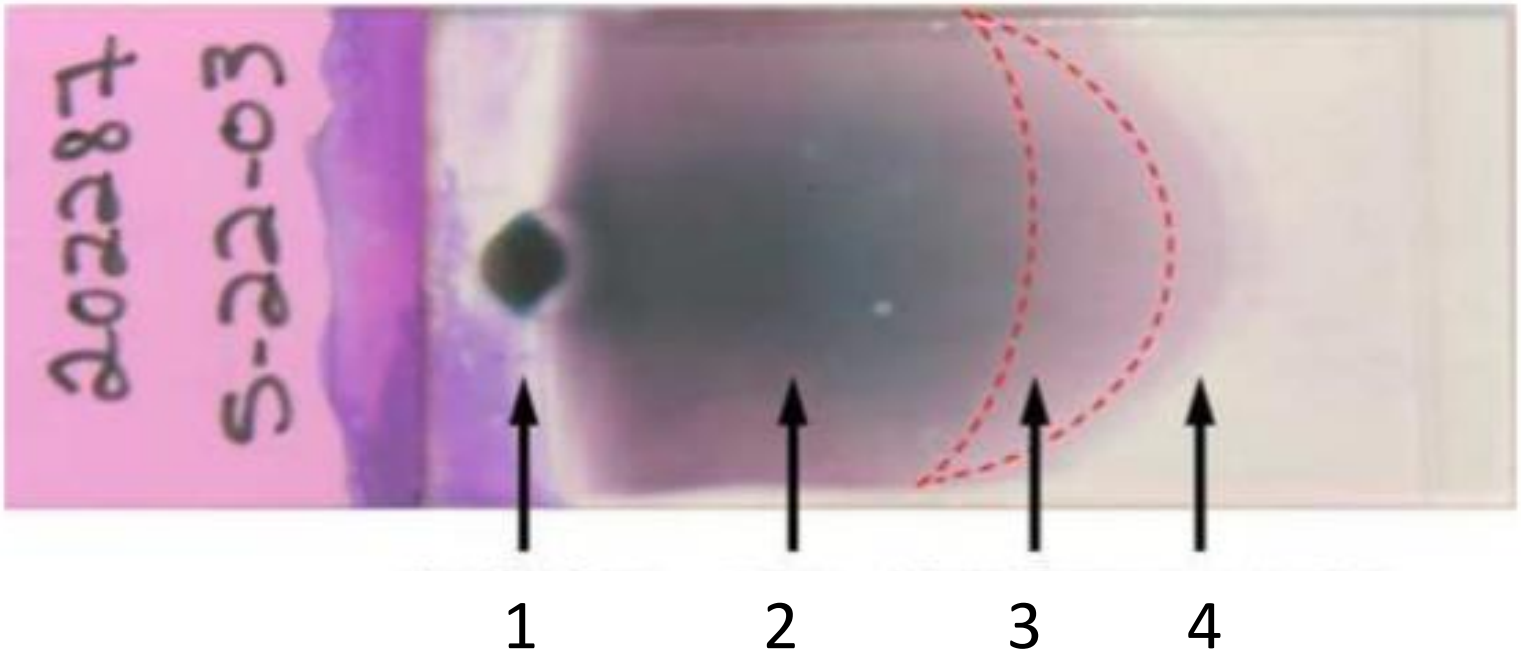
Blood smear review

Blood smear preparation



Blood smear

What are the two main areas to evaluate?



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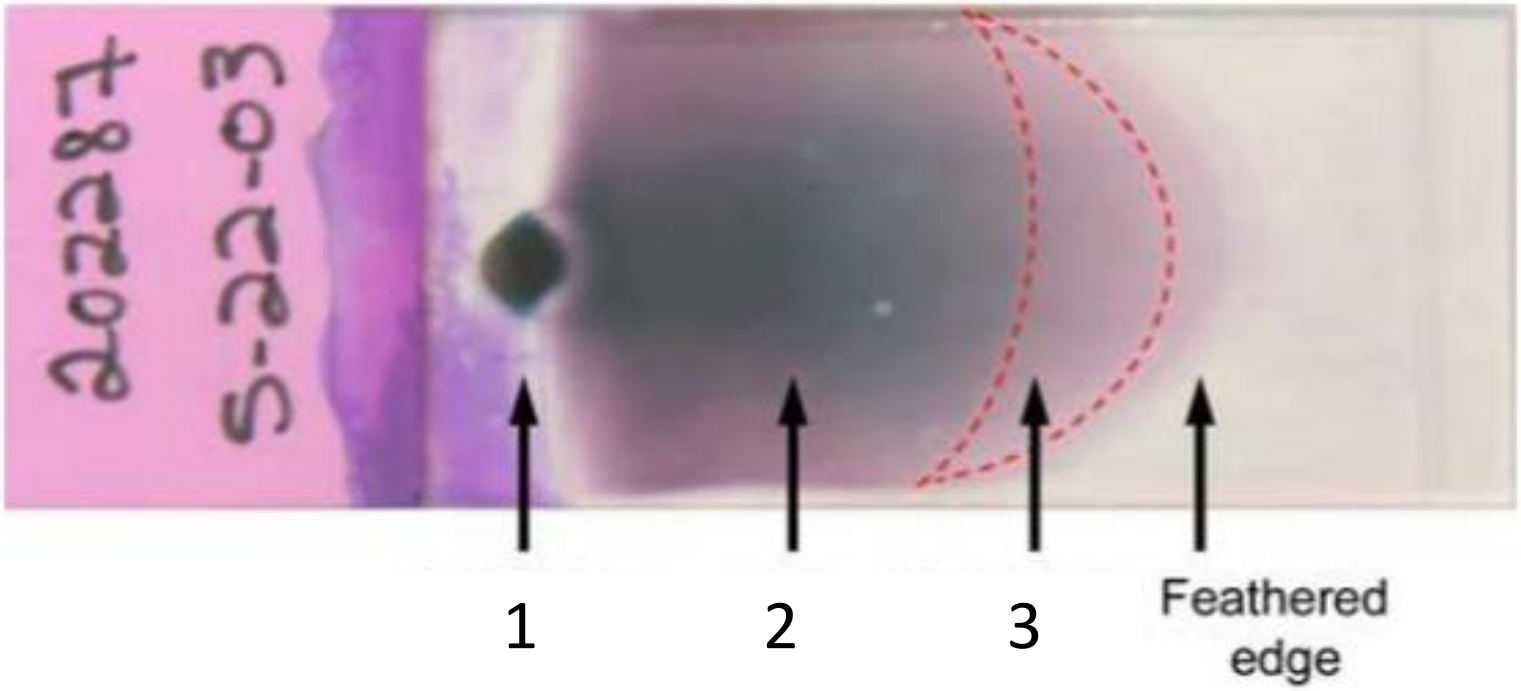

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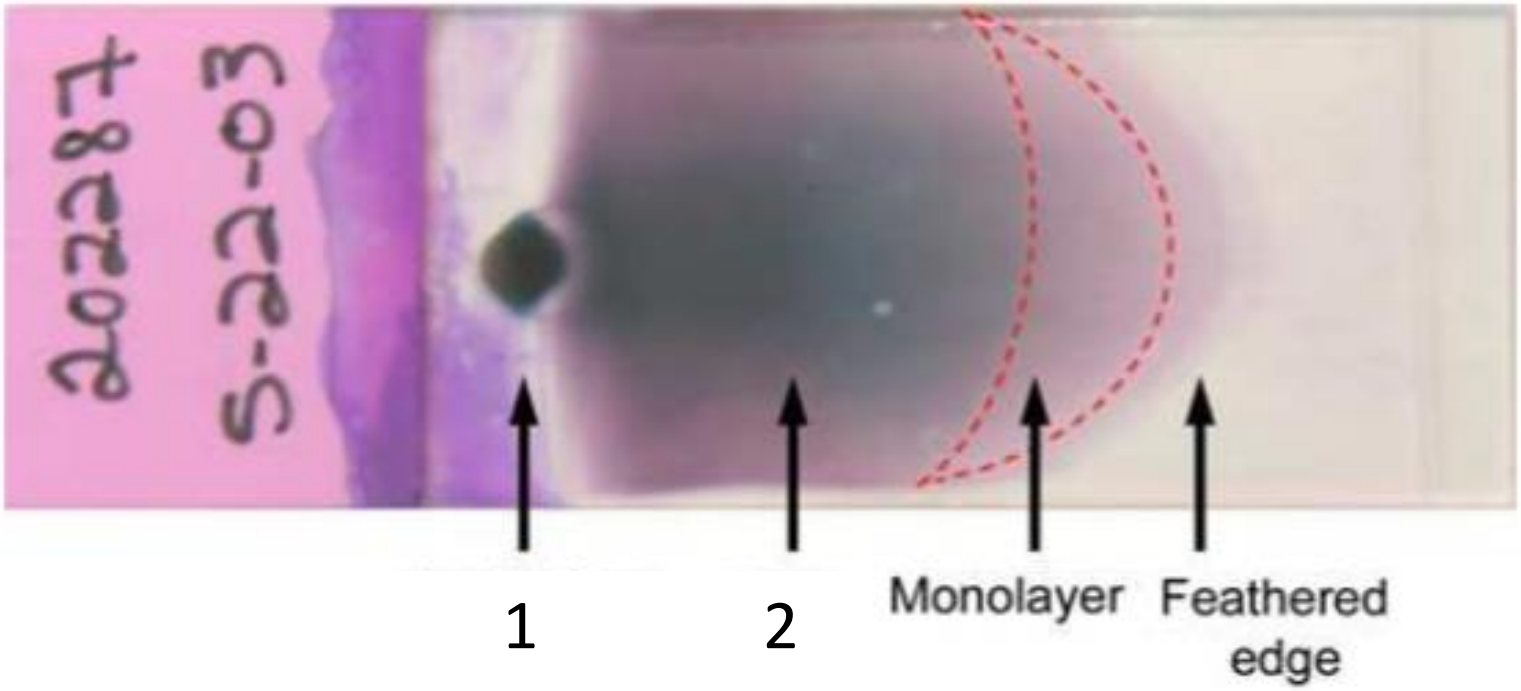
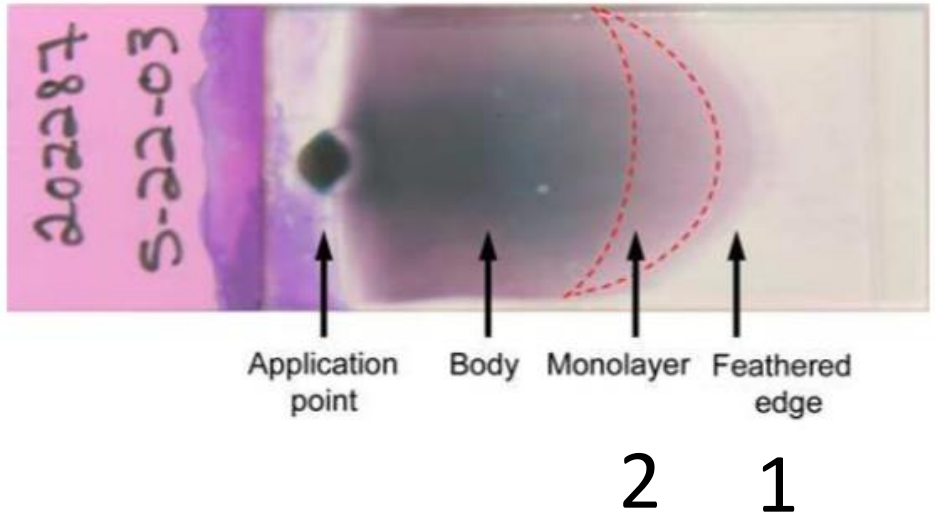


Comprehensive blood smear review

1. Feathered edge (10, 20x objectives)
    1. Platelet clumps
    2. Mast cells
    3. Fungal organisms
2. Monolayer (40, 50, 60, 100x objectives)
    1. WBC differential count
    2. WBC morphology
    3. RBC morphology
    4. Platelet estimate



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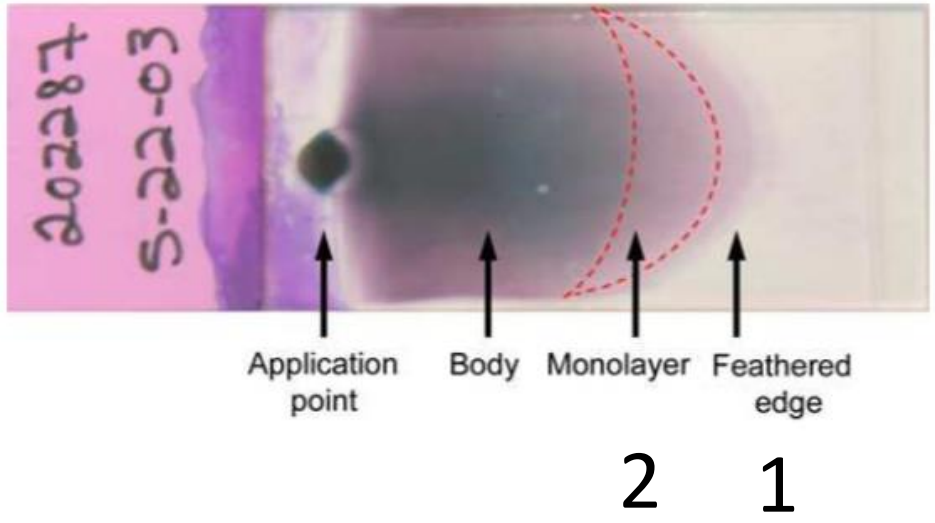
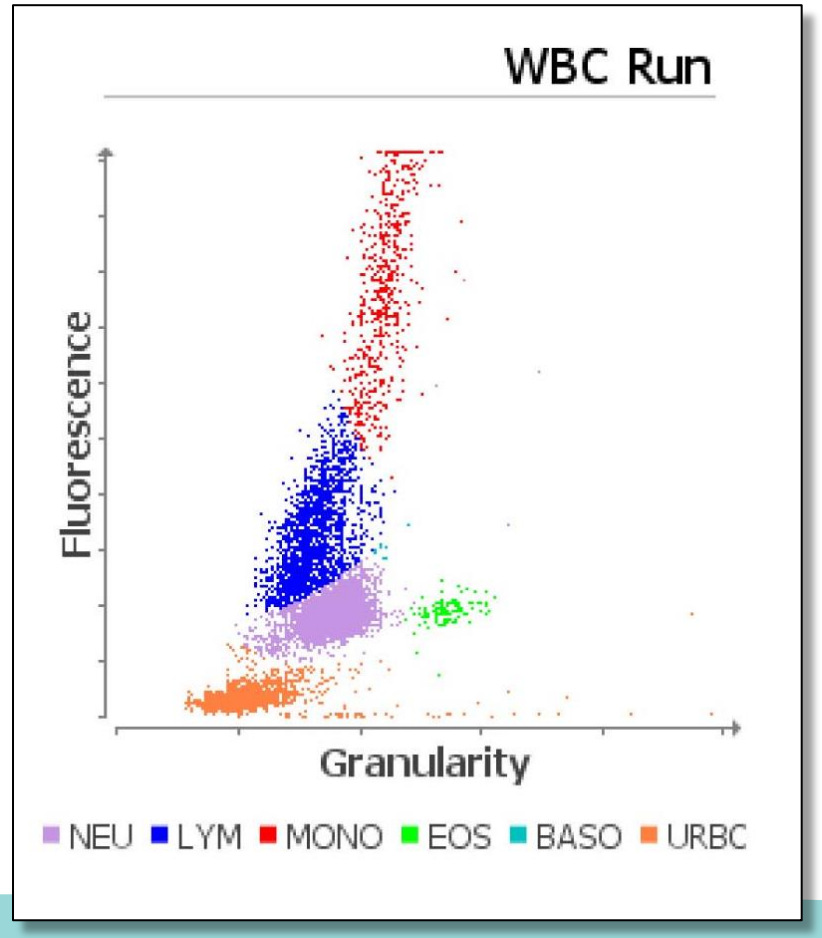


Platelet clumps

Can the analyzer help?

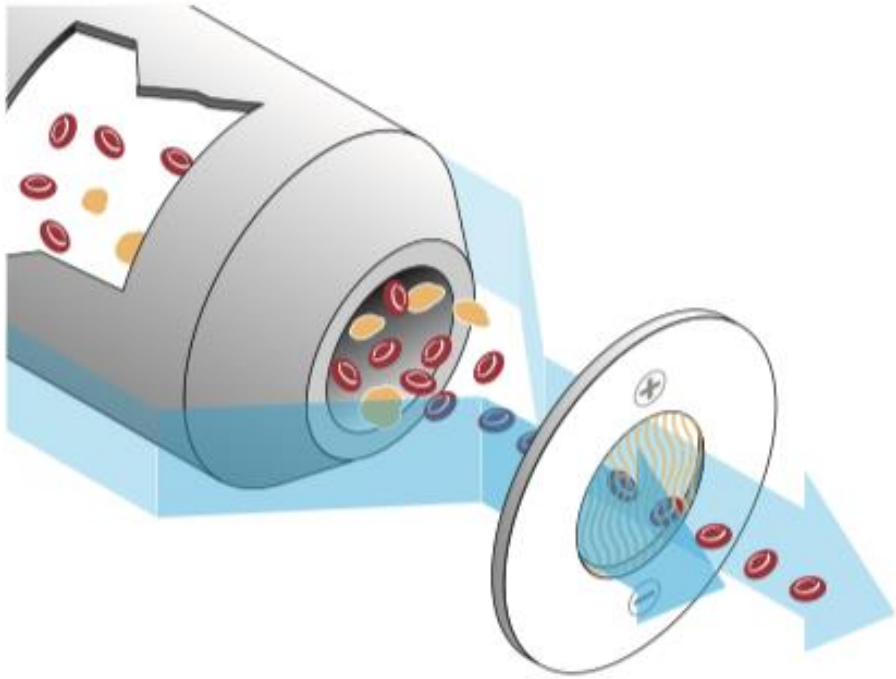
Test	Results	Reference Interval	LOW / NORMAL / HIGH
ProCyte Dx (September 30, 2016 9:20 AM)			
RBC	3.12 M/µL	5.65 - 8.87	LOW
HCT	23.3 %	37.3 - 61.7	LOW
HGB	7.8 g/dL	13.1 - 20.5	LOW
MCV	74.7 fL	61.6 - 73.5	HIGH
MCH	25.0 pg	21.2 - 25.9	
MCHC	33.5 g/dL	32.0 - 37.9	
RDW	18.0 %	13.6 - 21.7	
%RETIC	10.9 %		
RETIC	338.8 K/µL	10.0 - 110.0	HIGH
WBC	* 11.56 K/µL	5.05 - 16.76	
%NEU	* 72.7 %		
%LYM	* 20.3 %		
%MONO	* 5.7 %		
%EOS	* 1.2 %		
%BASO	* 0.1 %		
NEU	* 8.40 K/µL	2.95 - 11.64	
LYM	* 2.35 K/µL	1.05 - 5.10	
MONO	* 0.66 K/µL	0.16 - 1.12	
EOS	* 0.14 K/µL	0.06 - 1.23	
BASO	* 0.01 K/µL	0.00 - 0.10	
nRBC	* Suspected		
PLT	238 K/µL	148 - 484	
MPV	12.1 fL	8.7 - 13.2	
PDW	22.0 fL	9.1 - 19.4	HIGH
PCT	0.29 %	0.14 - 0.46	

nRBCs suspected



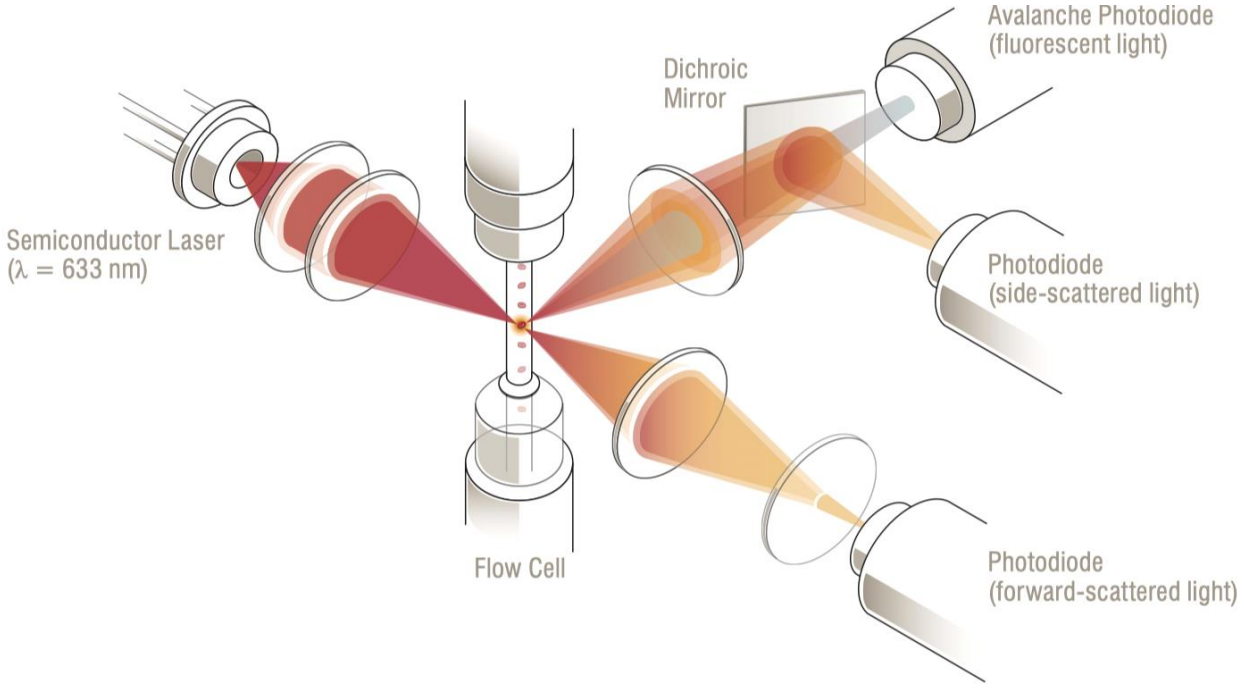
How ProCyte Dx™ works

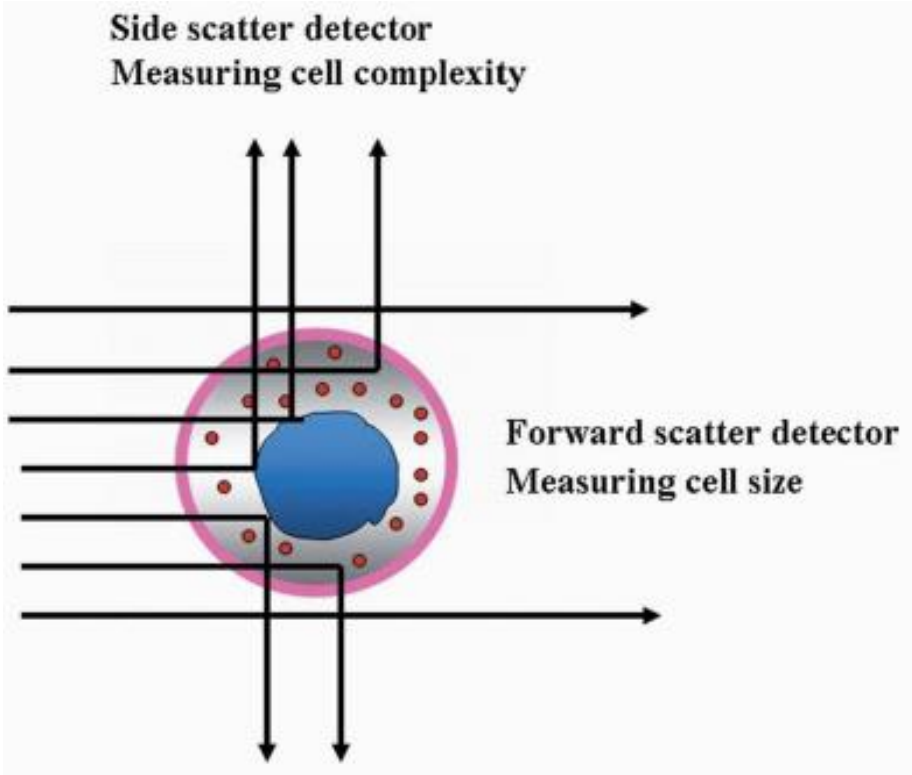
1. Laminar Flow Impedance



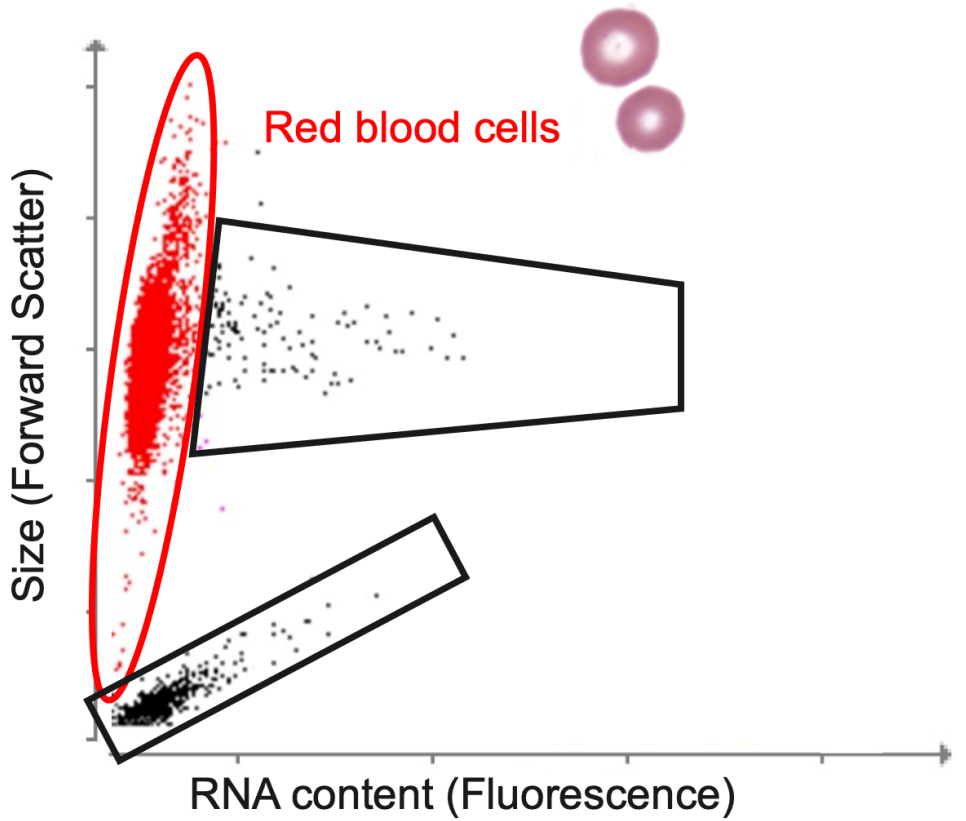
How ProCyte Dx™ works

2. Laser Flow Cytometry





ProCyte Dx™: RBC dot plot



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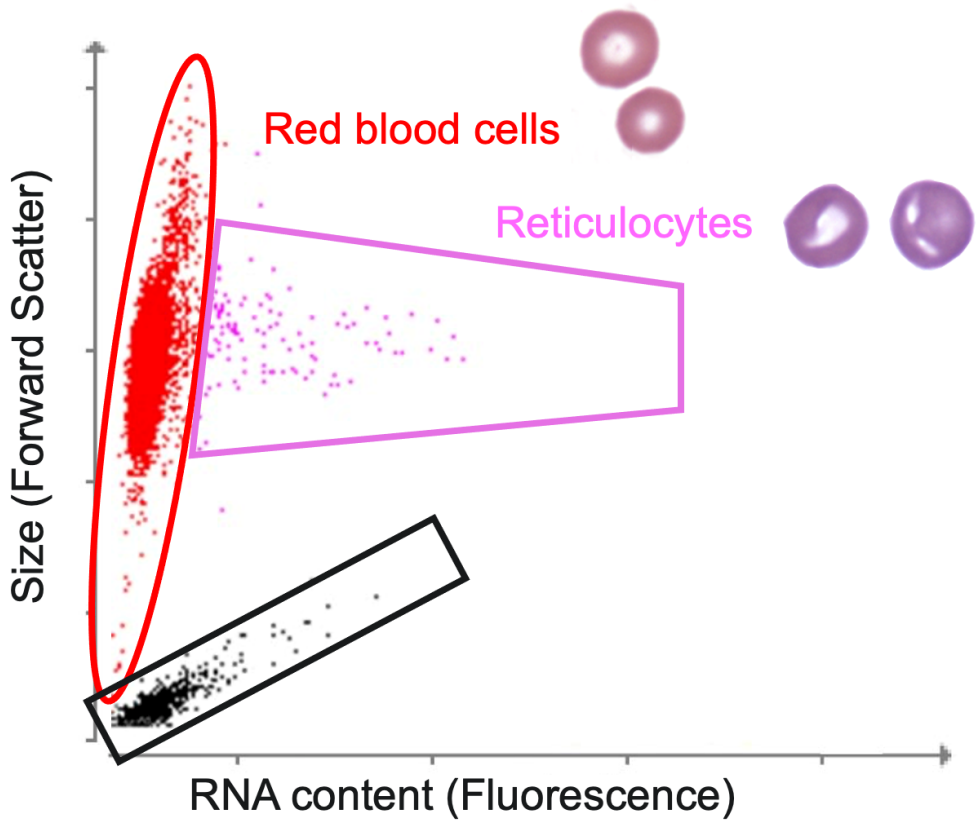

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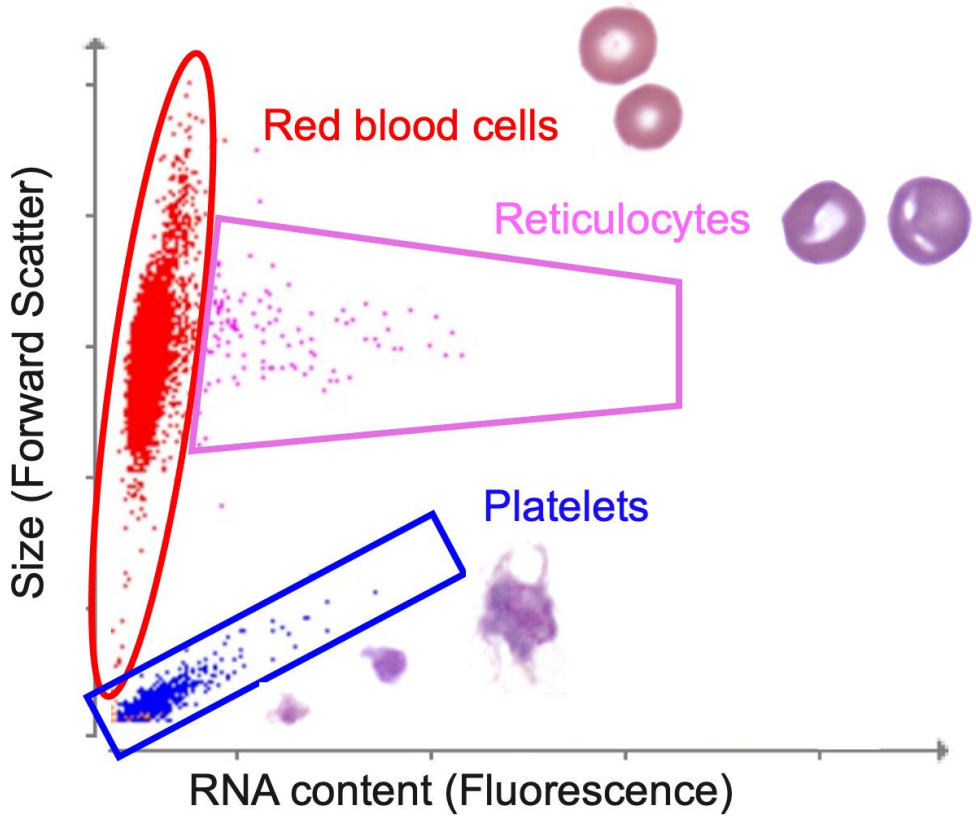
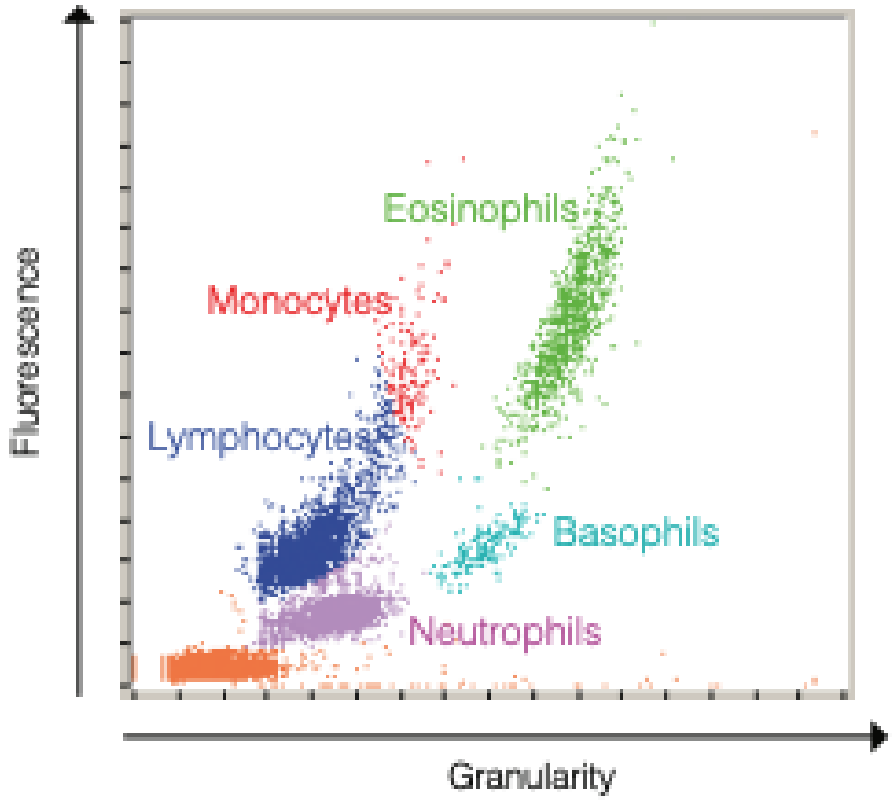
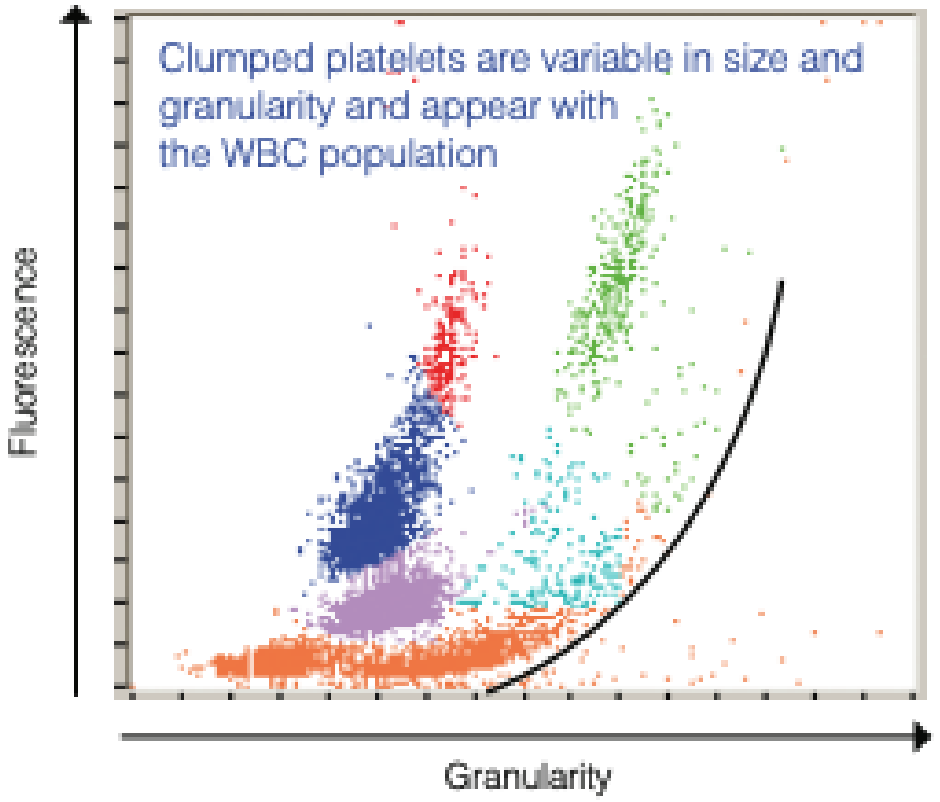
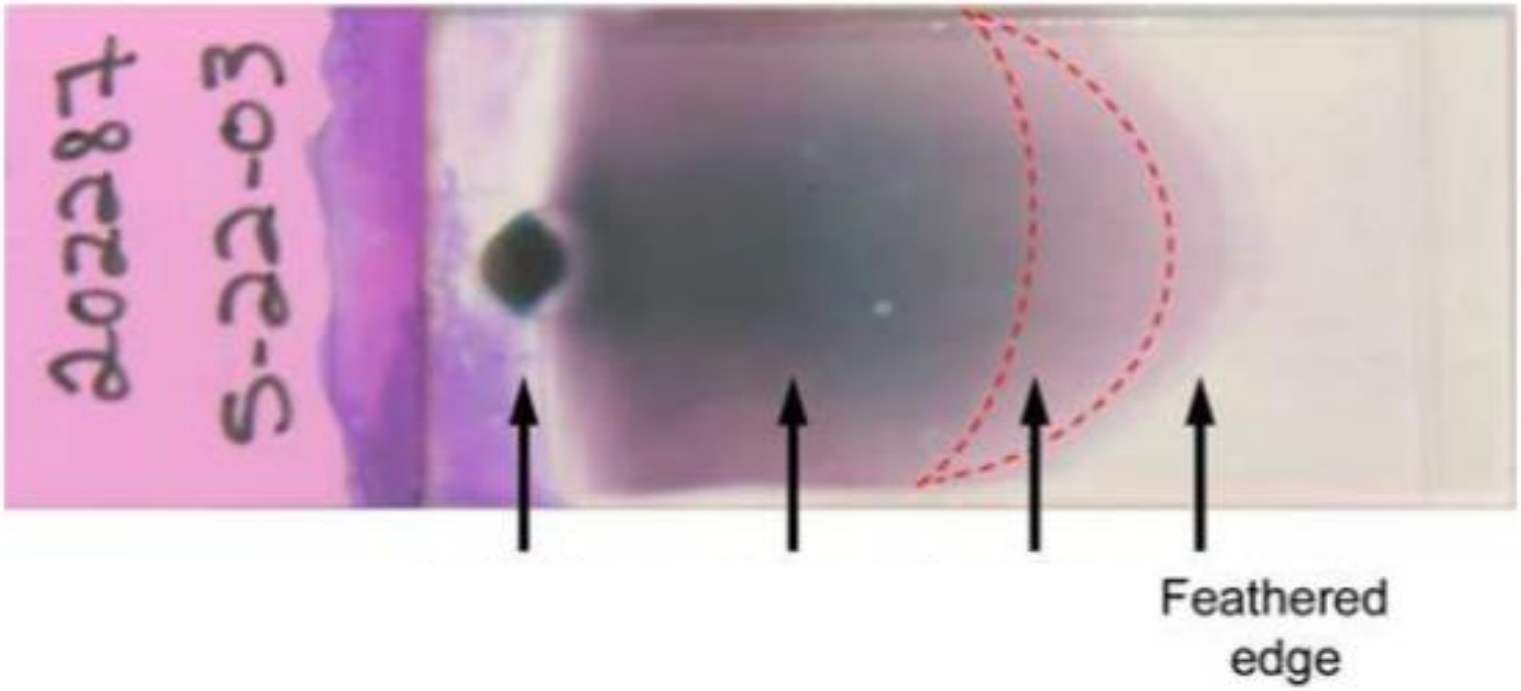


ProCyte Dx™: WBC dot plot





Is it truly thrombocytopenic?



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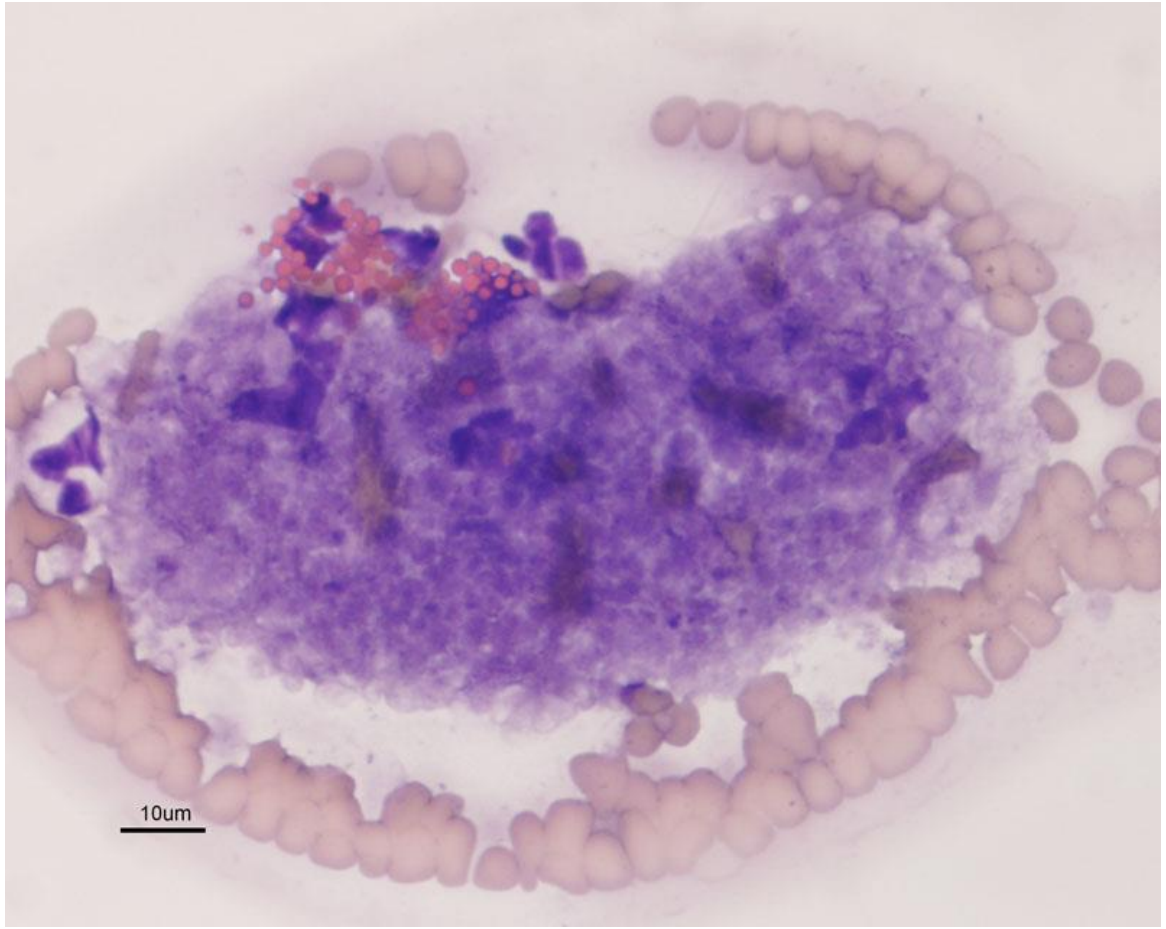


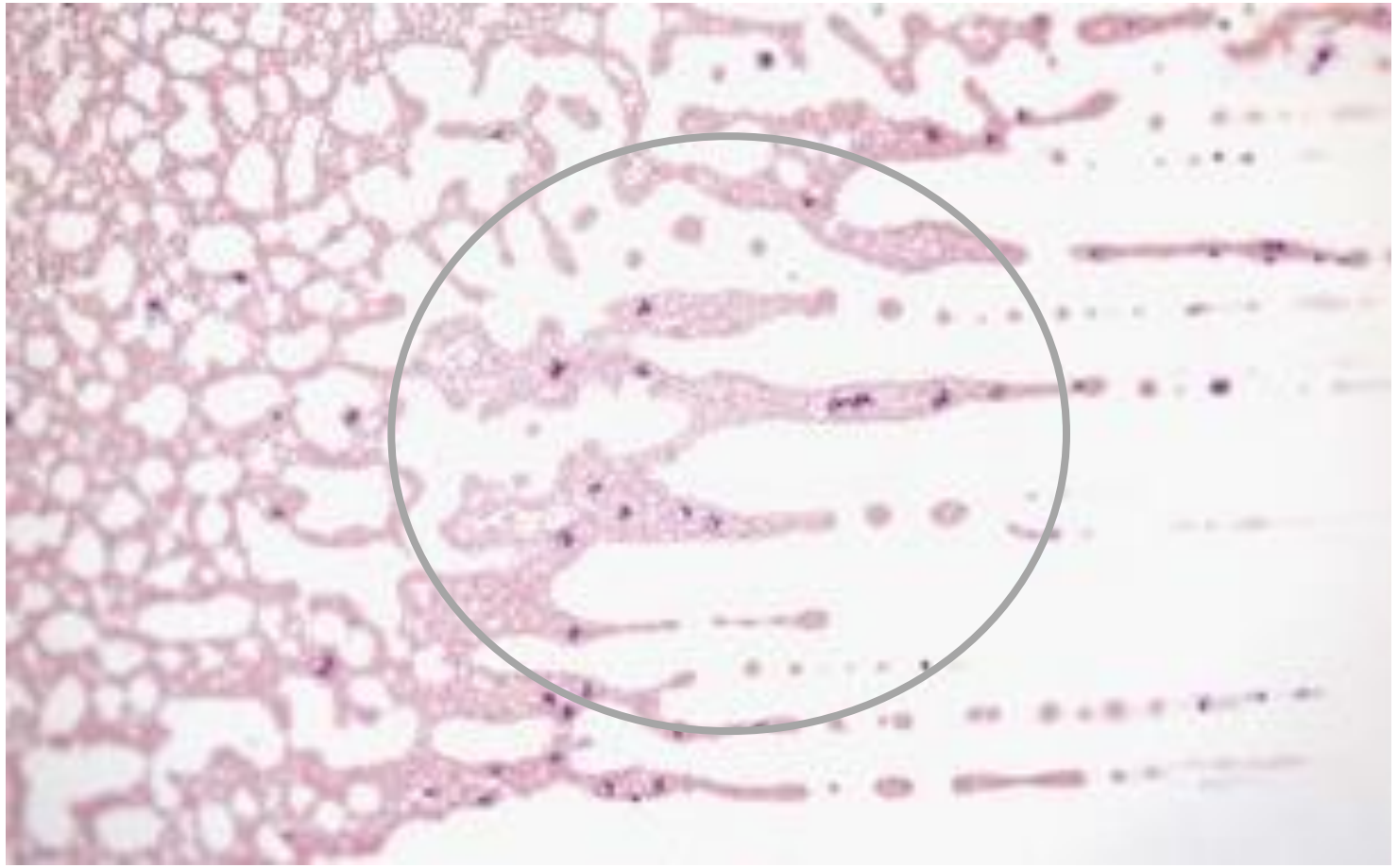
Platelet estimate

1. 100x oil objective
2. Count the number of platelets in 5 **monolayer** fields
3. Get an average number of platelets x 15,000-20,000

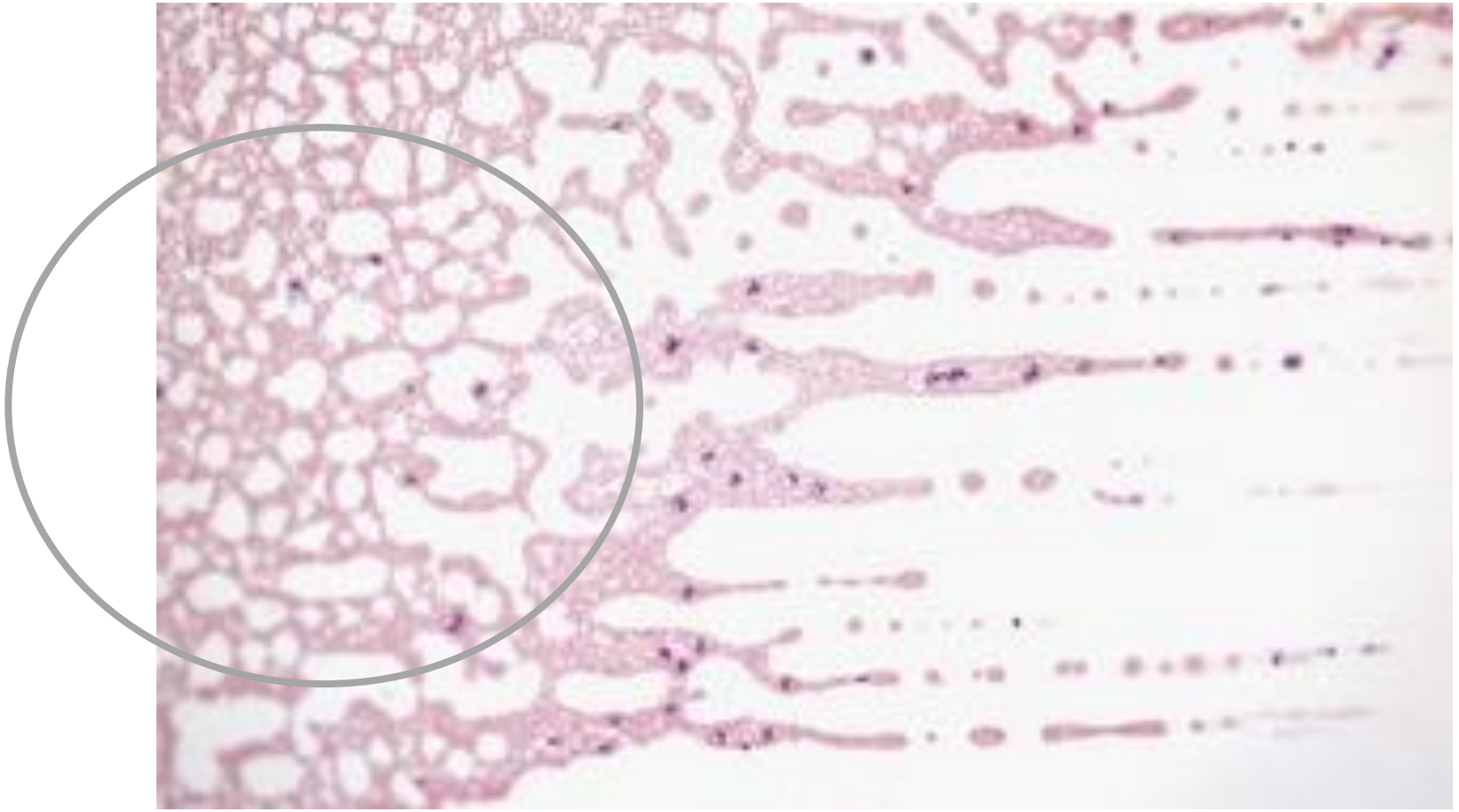
- For example:
- I saw 1, 2, 2, 1, 4 in 5 fields
- (1+2+2+1+4)/5 = 10/5 = 2
- 2*15,000 = 30,000
- 2*20,000 = 40,000
- Platelet estimate: 30,000-40,000

Normal platelet count: At least 200,000
= Roughly 13 per 100x field

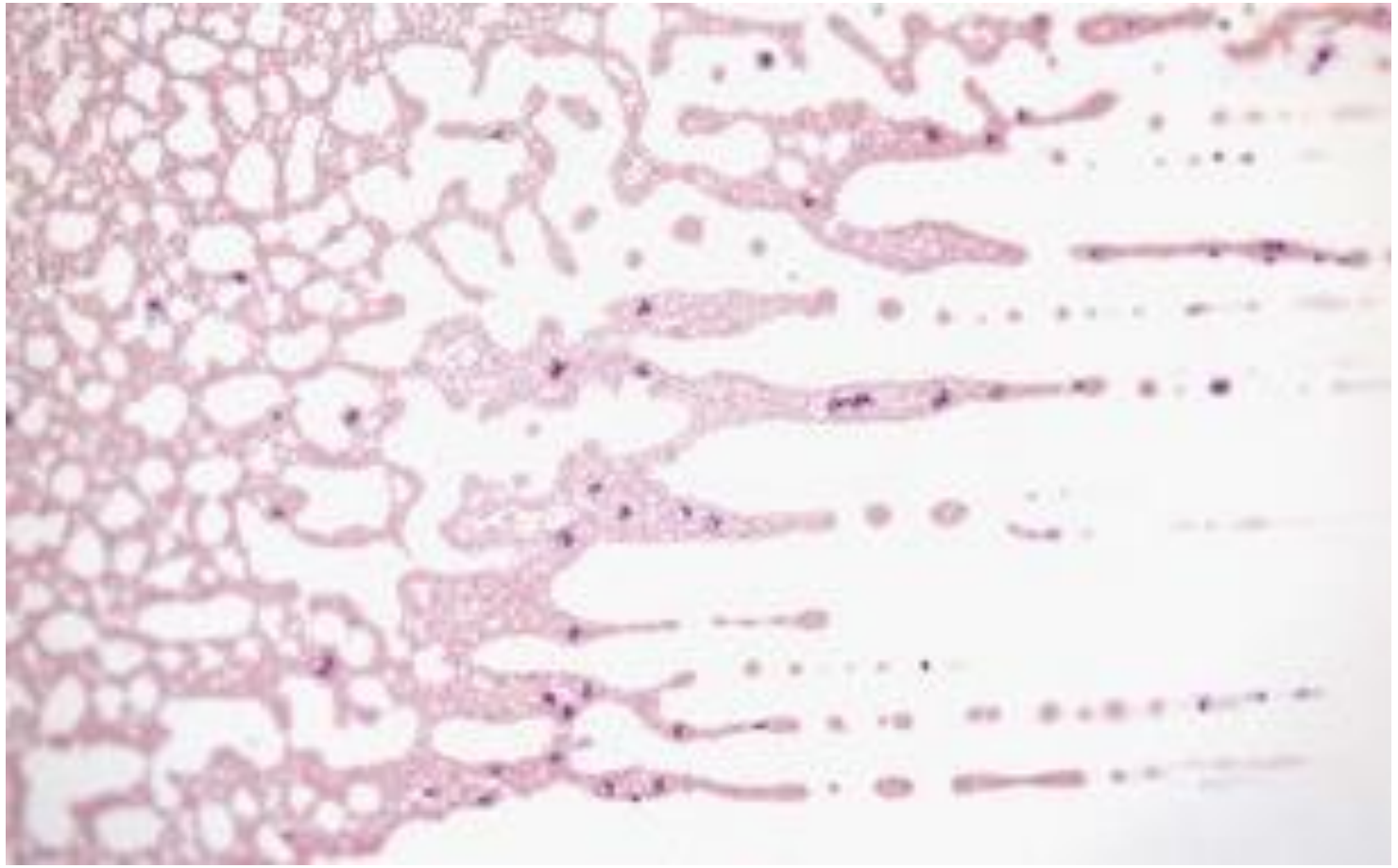
Finding the monolayer



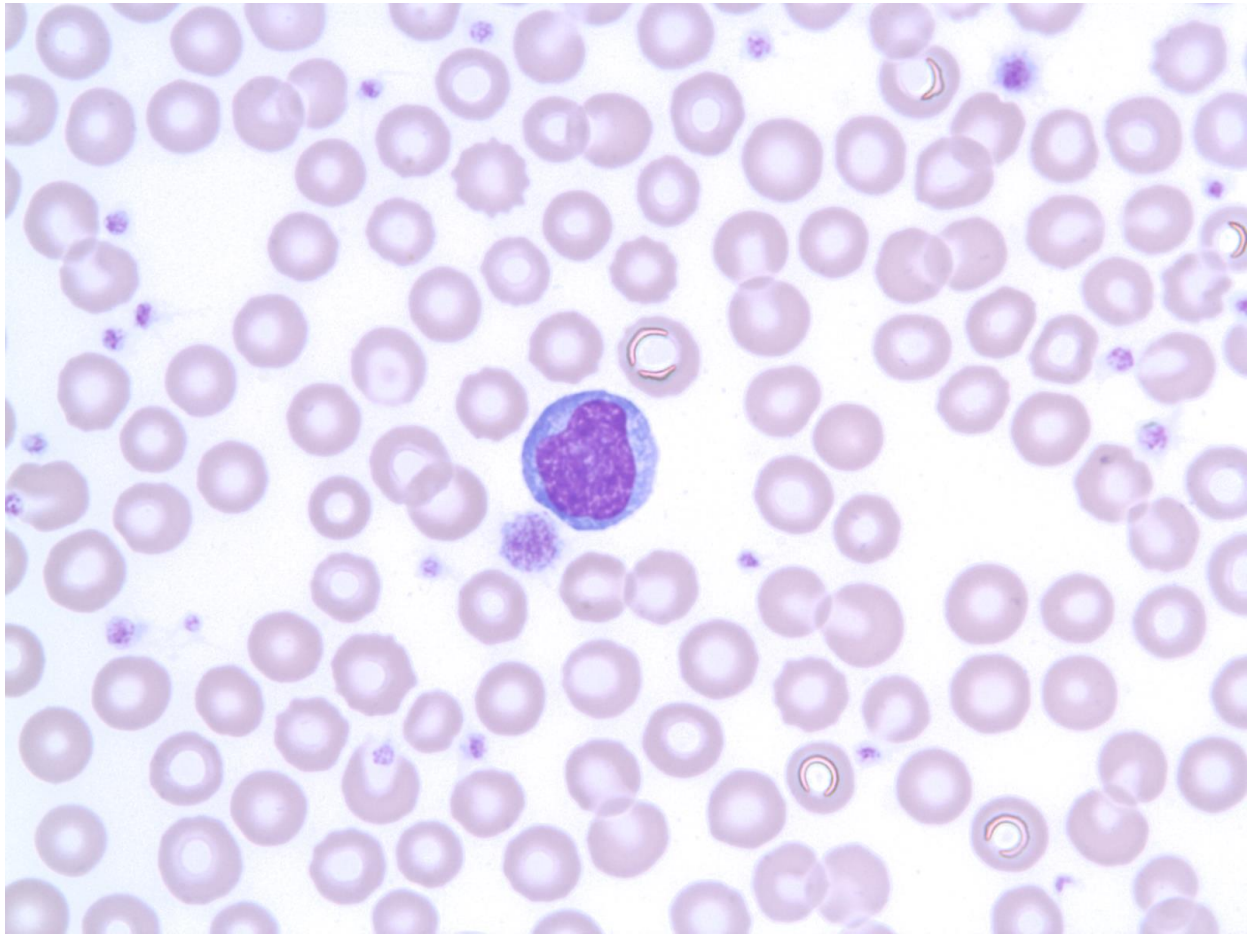
Finding the monolayer



Finding the monolayer

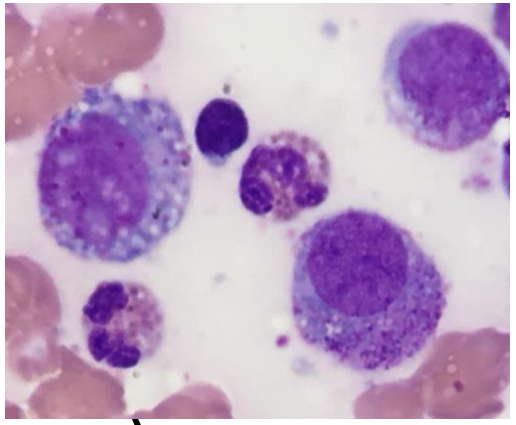


Platelet estimate in monolayer



Mast cells

Mast cells



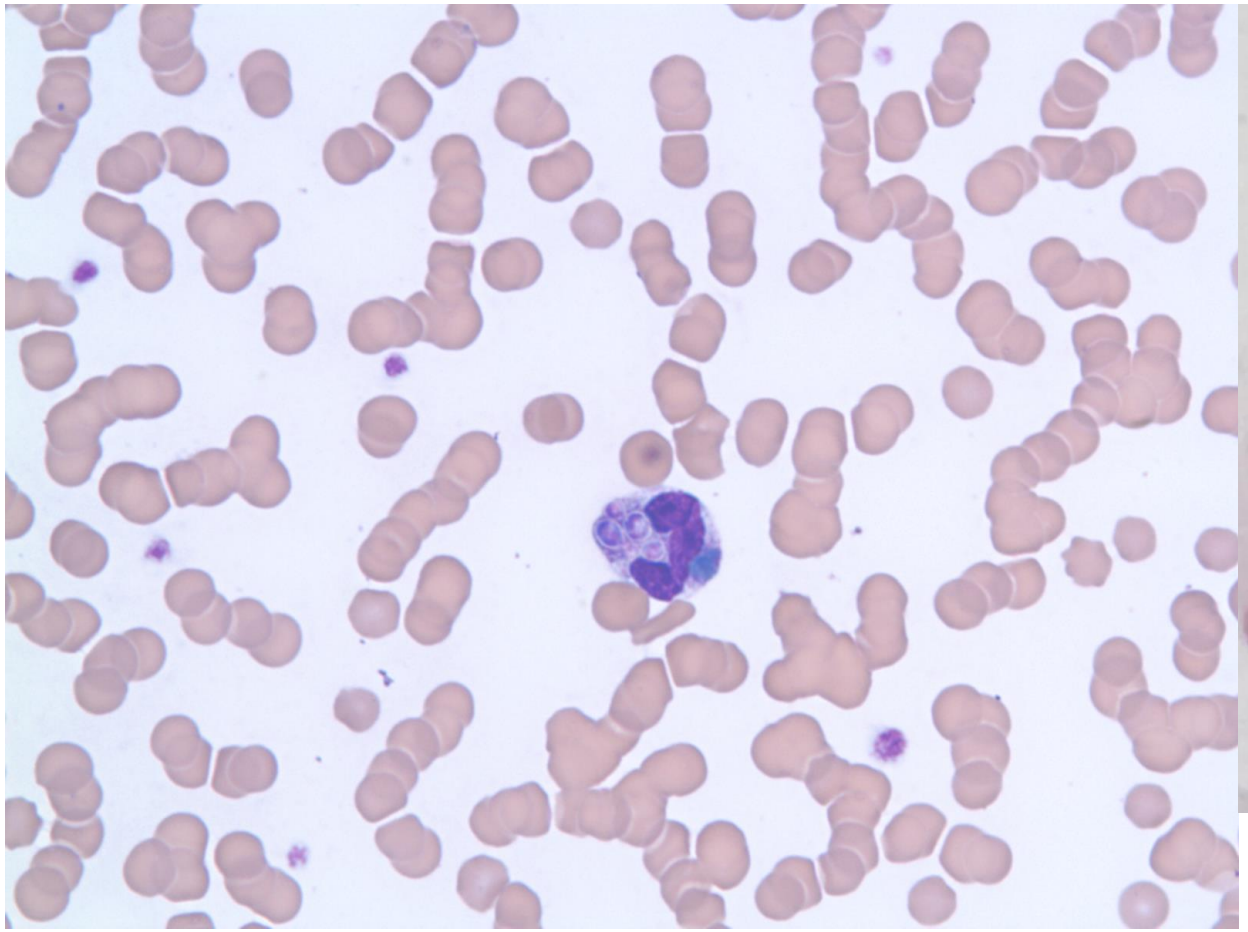
- Dog:
  - Acute inflammatory disease (parvoviral infections), inflammatory skin disease, regenerative anemias, neoplasia (MCT or others), and trauma
  - **Nonspecific**: No longer routinely performed for MCT staging
- Cat:
  - No mast cells seen in healthy or non-MCT ill cats (n=80)
  - 43% of cats with MCT had positive buffy coats, and most of these cats have splenic/visceral MCT
  - If circulating mast cells are seen, **do a cancer hunt!**

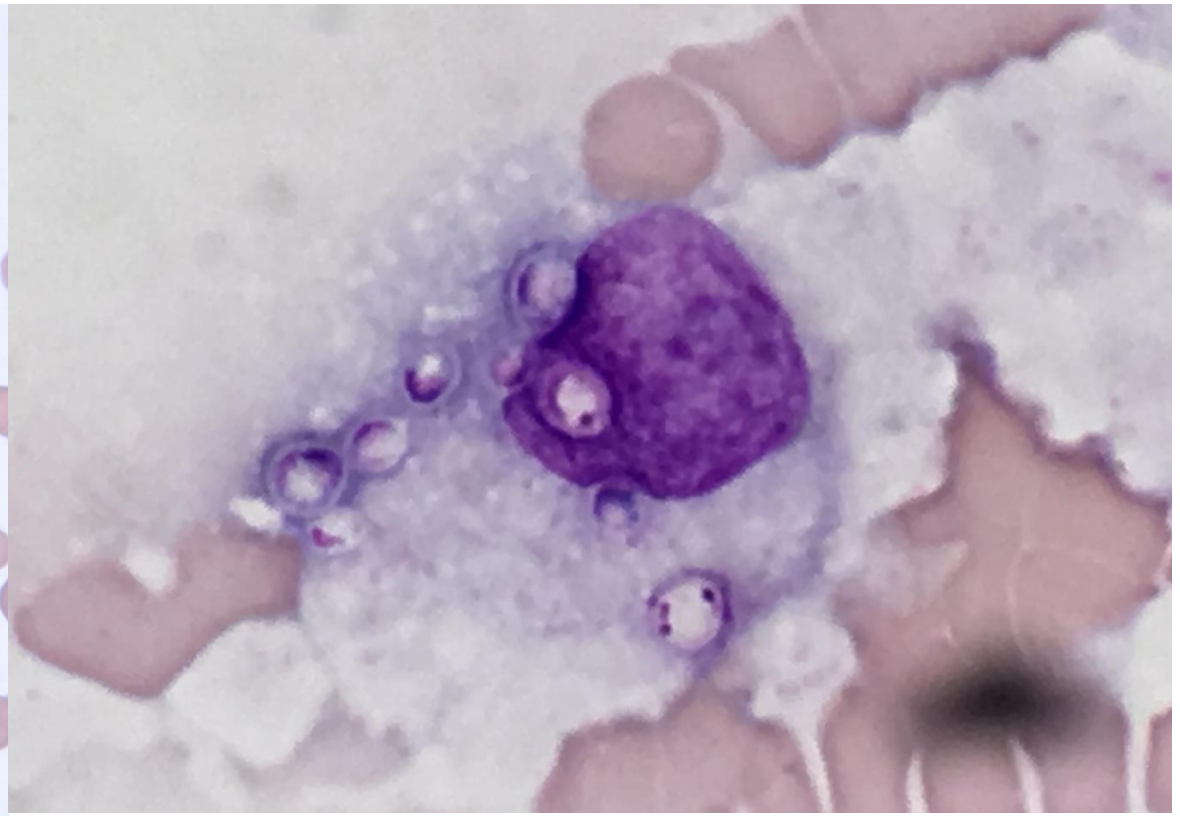
Something unexpected...

7 y/o MC Blue Point Siamese

	Result	Flag	Reference	Unit
WBC	4.1	L	5.5 - 19.5	x10^
Red Blood Cell Count	7.76		5.00 - 10.00	x10^
Hemoglobin	12.2		8.0 - 15.0	g/dl
Hematocrit (automated)	36.5		24.0 - 45.0	%
Packed Cell Volume (Spun)	37			%
Mean Corpuscular Volume	47.0		39.0 - 55.0	fl.
Mean Corpuscular Hemoglobin Concentration	33.4		31.0 - 35.0	g/dl
Plasma Protein	8.6	H	6 - 8	TS-g/
Fibrinogen (heat precipitation)				mg/dl
Platelet Count (Automated)	126000	L	300000 - 800000	/ul
Segmented Neutrophils	59		35 - 75	%
Absolute Neutrophil	2419	L	2500 - 12500	
Band	2		0 - 3	%
Absolute Bands	82		0 - 300	
Metamyelocyte				%
Absolute Metamyelocyte				
Lymphocytes	30		20 - 55	%
Absolute Lymphocyte	1230	L	1500 - 7000	
Monocytes	7	H	1 - 4	%
Absolute Monocyte	287		0 - 850	
Eosinophil	2		2 - 12	%
Absolute Eosinophil	82		0 - 1500	

7 y/o MC Blue Point Siamese - Histoplasma





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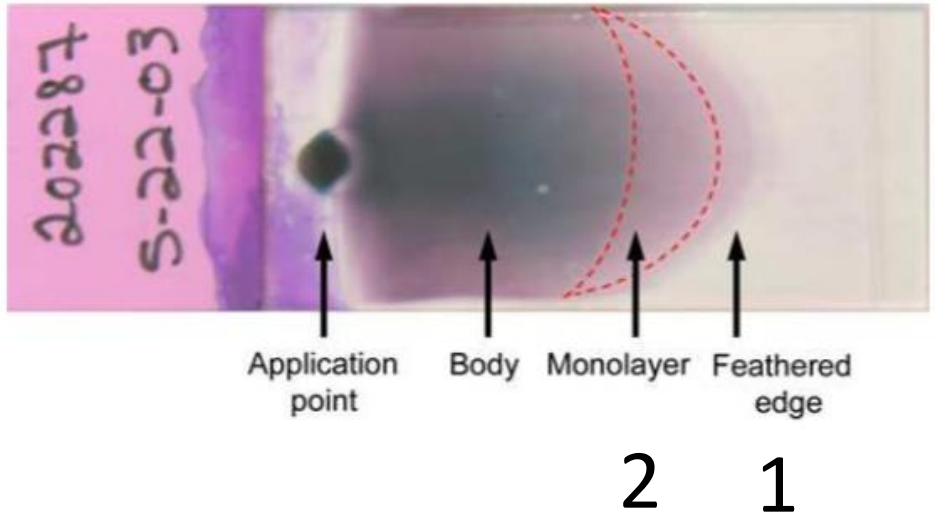
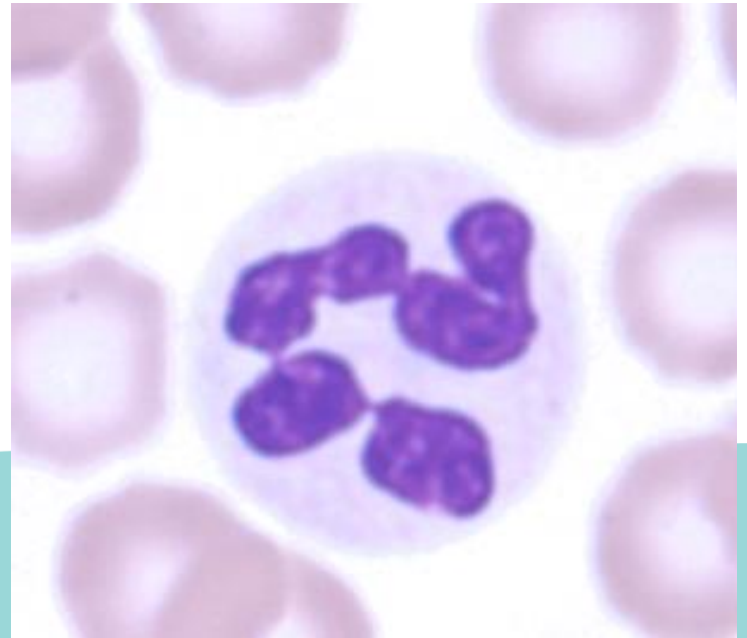


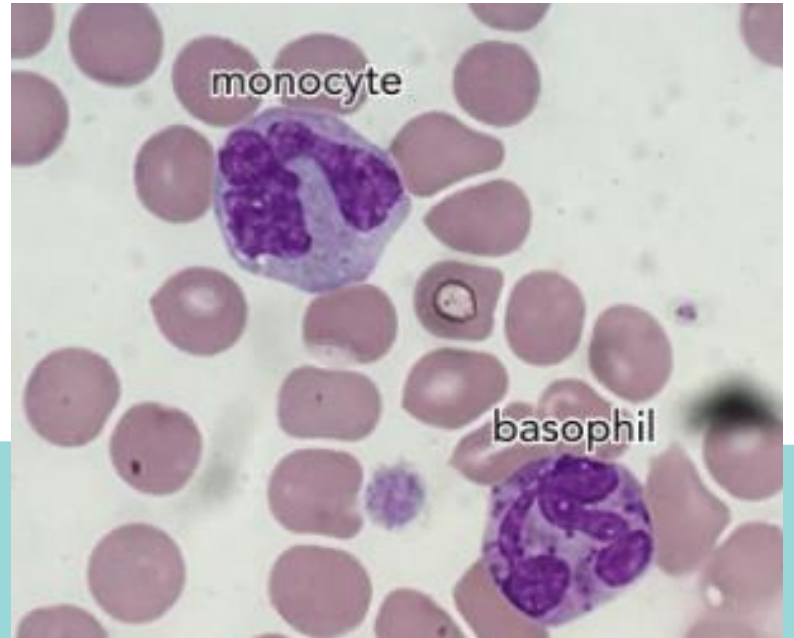
White blood cells

WBC differential count (100 cells)

- **Neutrophil**
- Most numerous
- Colorless cytoplasm
- Segmented nucleus

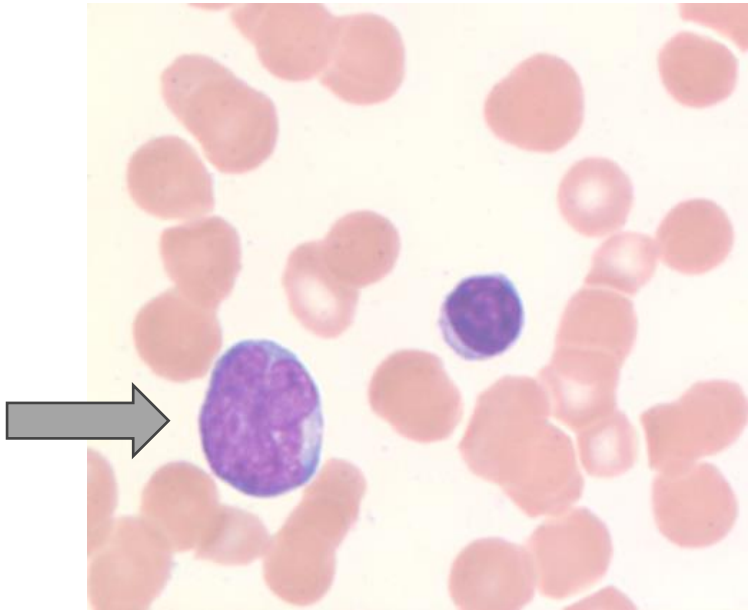


- **Monocyte**
- Bigger than neutrophils
- Gray-blue cytoplasm
- Pleomorphic nucleus

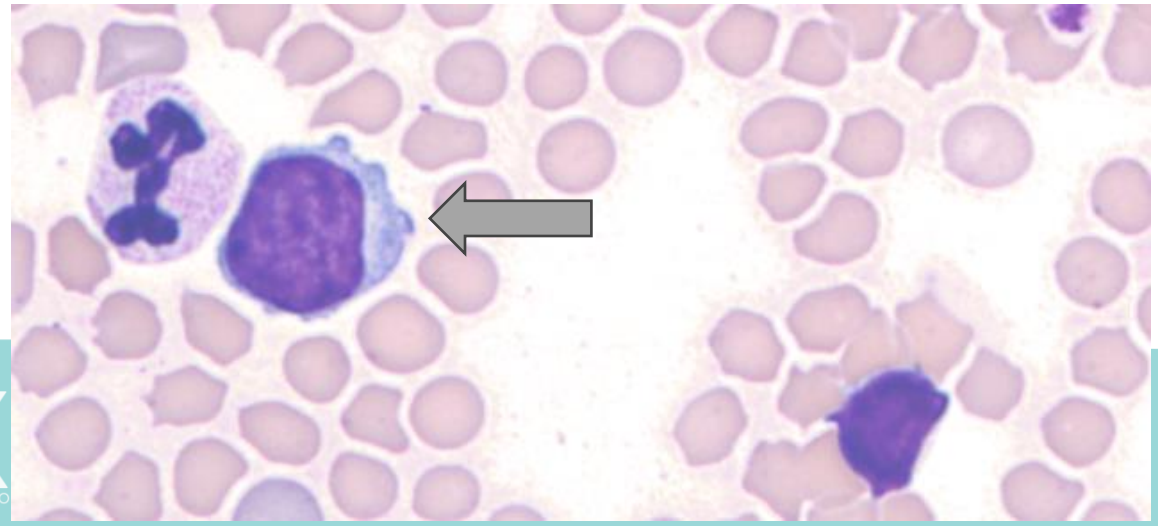


WBC differential count (100 cells)

- **Lymphocyte**
- Single, round nucleus
- Minimal cytoplasm

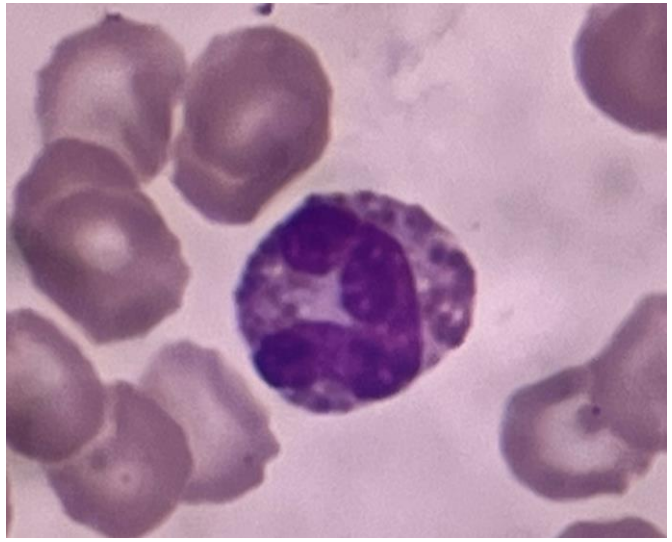


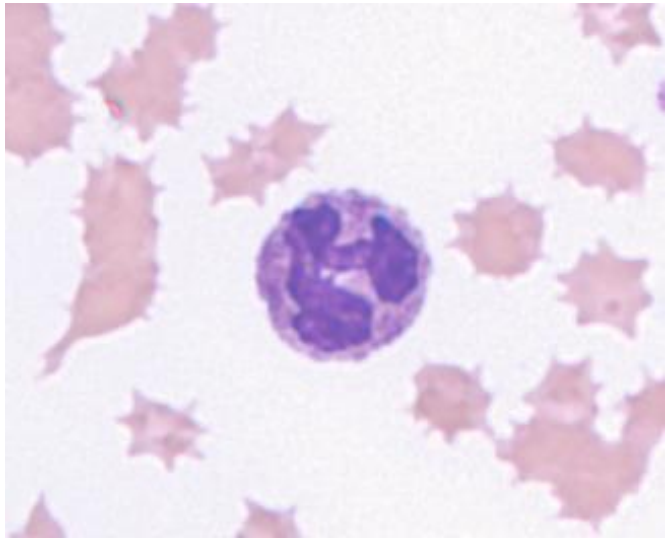
- **Neoplastic lymphocyte**
- Larger
- Basophilic cytoplasm
- More numerous
- Nucleolar ring



WBC differential count (100 cells)

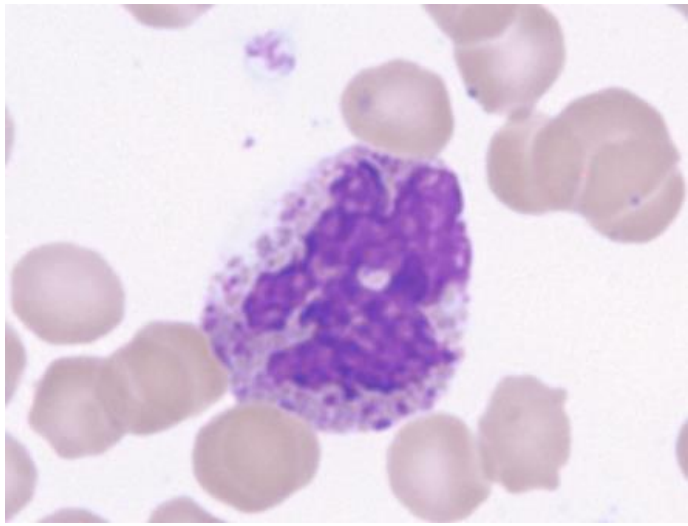
- **Eosinophil**
- Eosinophilic granules
- Lobulated nucleus



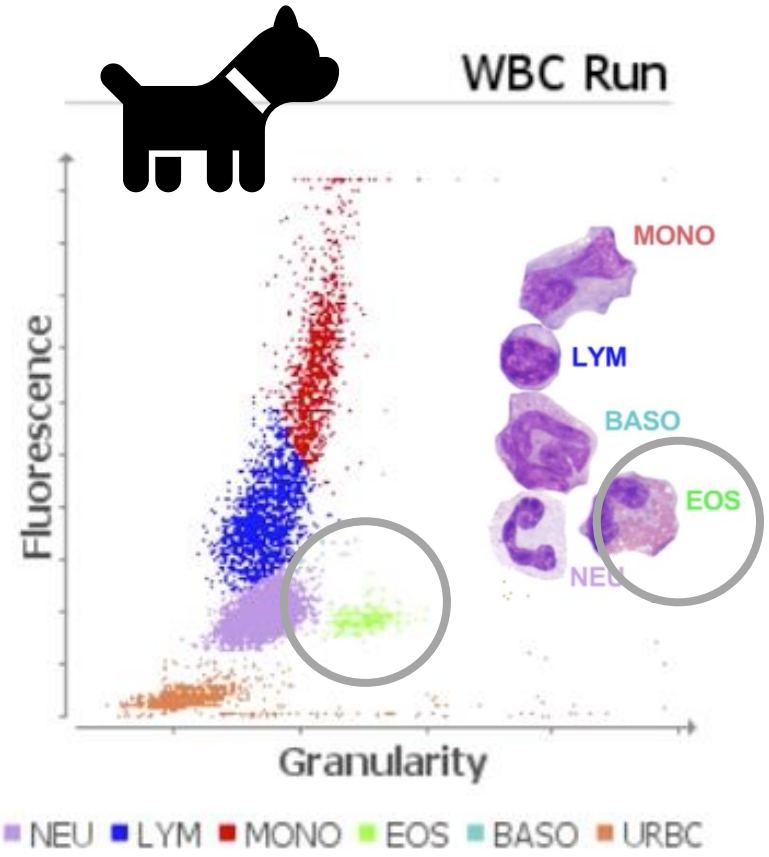


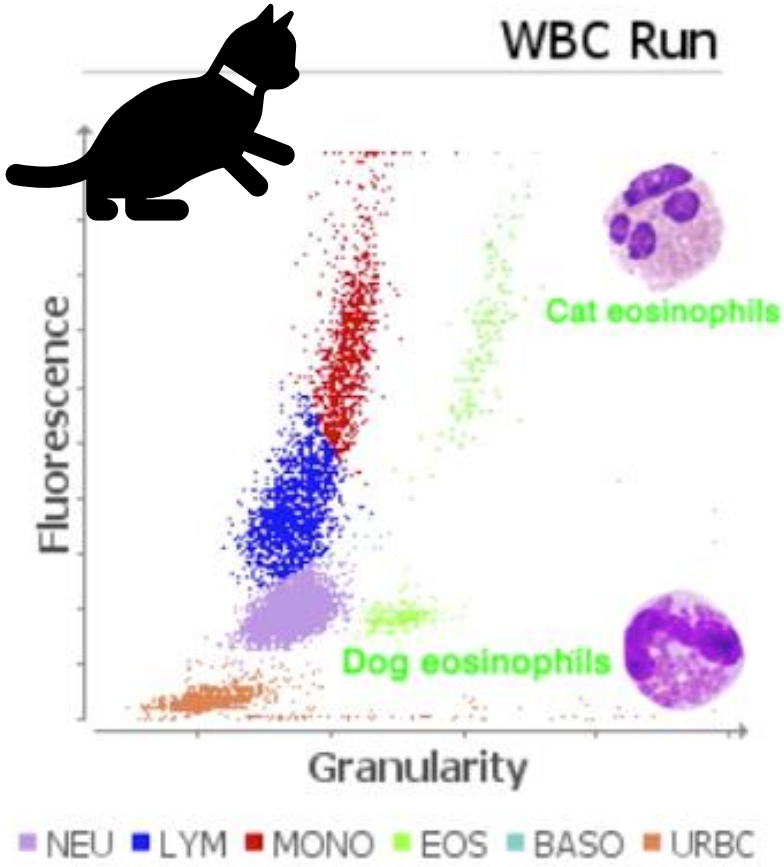
WBC differential count (100 cells)

- **Basophil**
- Basophilic granules
- Lobulated nucleus



ProCyte Dx™: WBC dot plot





White blood abnormalities

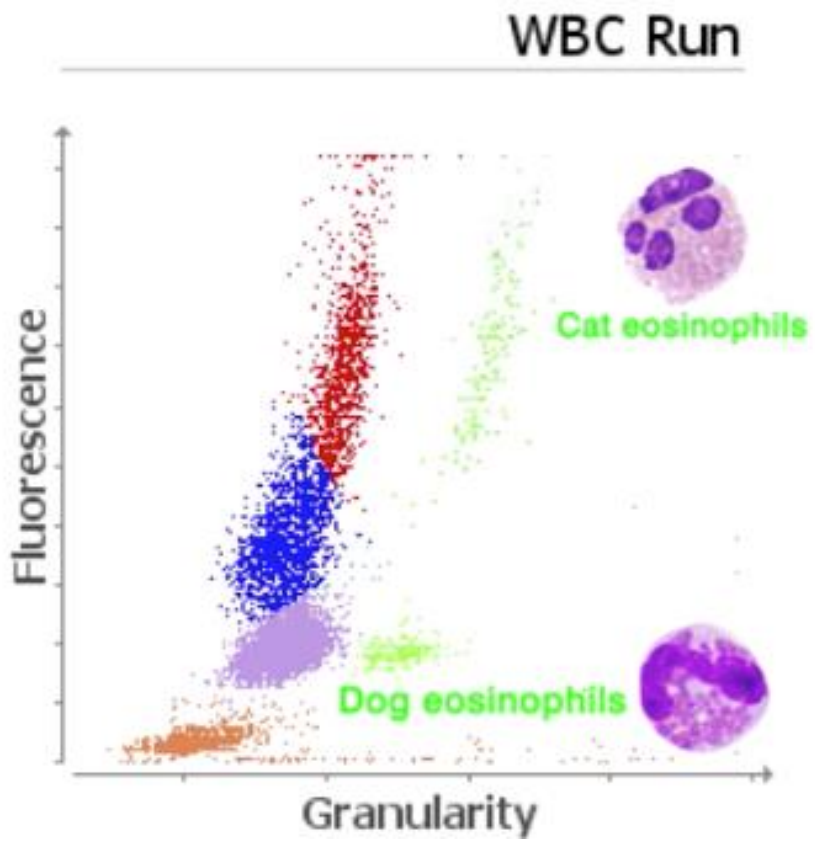
10-year-old, female spayed, DSH cat

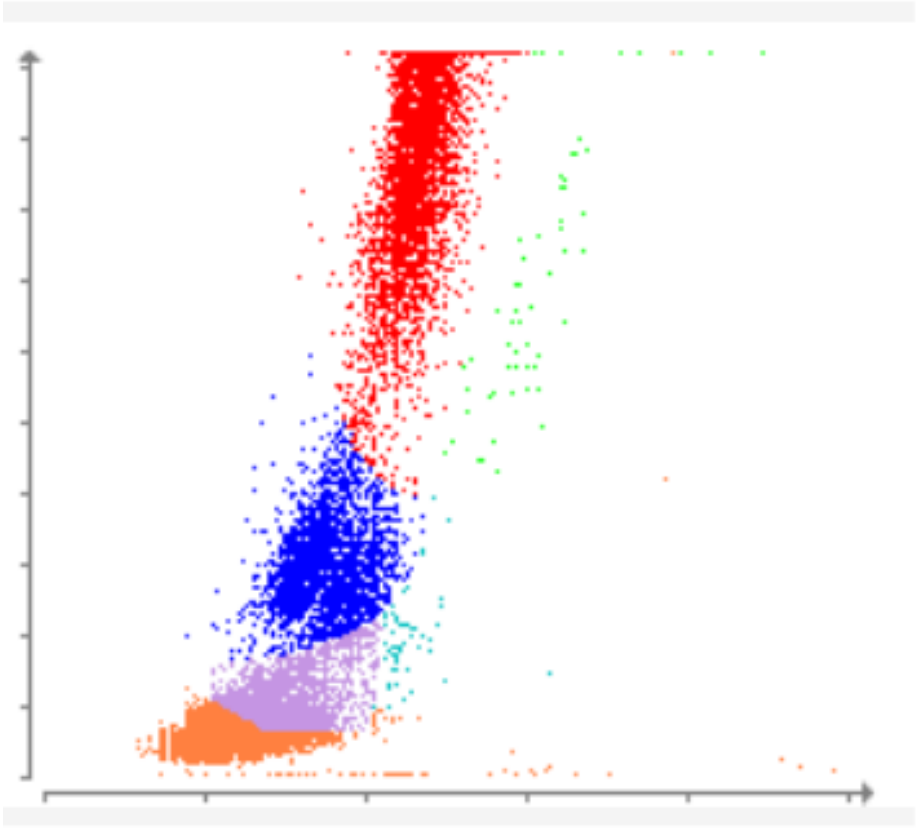
- Ongoing issue D+, V+ Occasionally, lethargic, hair loss, weight loss.
- Primary thinks cancer was waiting on u/s but worsened tonight - not eating, hardly moving, isolating

10-year-old, female spayed, DSH cat

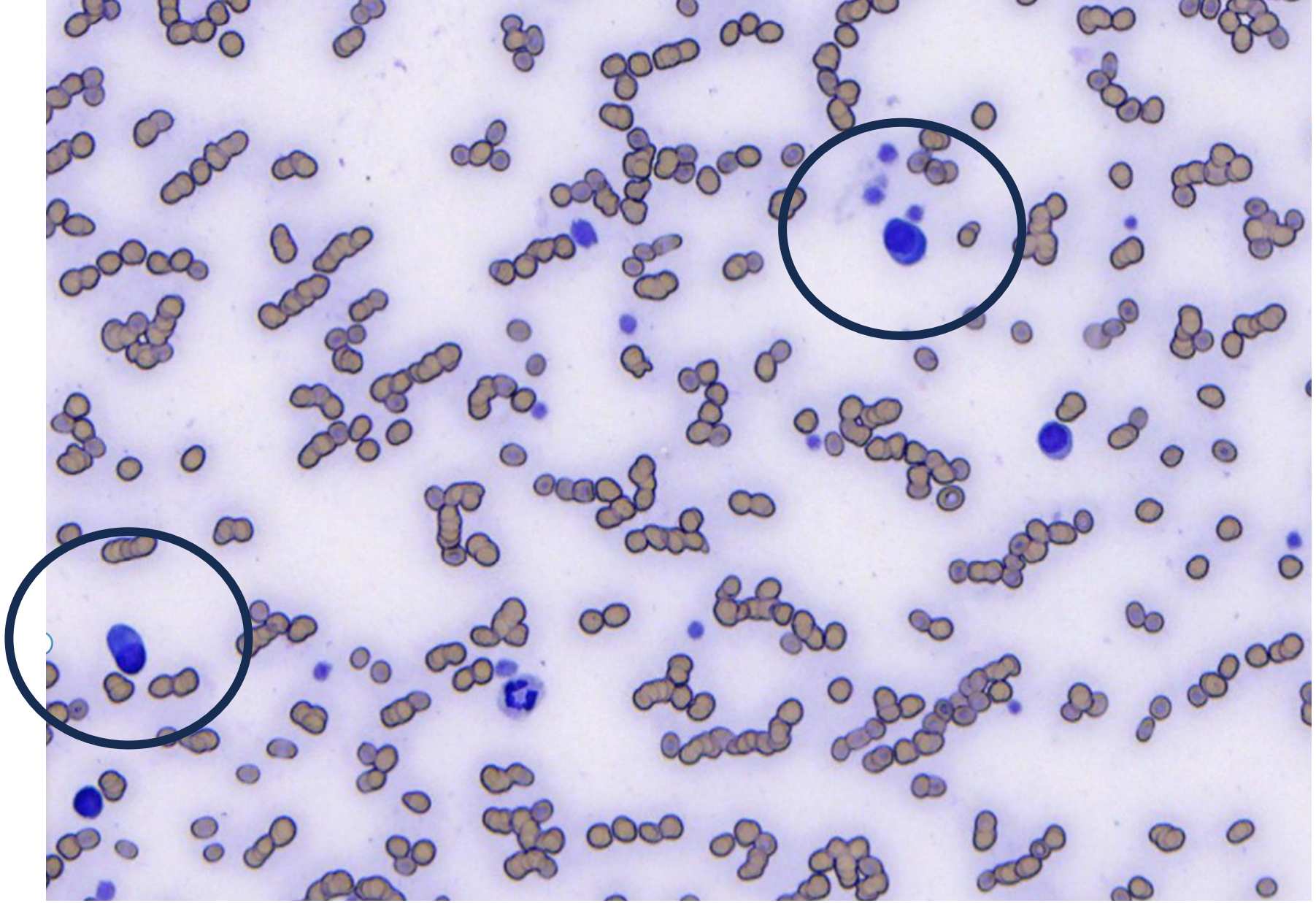
- Severe nonregenerative anemia (HCT 10.4%, Retic 0.4%)
- Bands suspected
- Severe monocytosis (5.71 K/uL)
- Eosinopenia (0.06 K/uL)
- Thrombocytopenia (PLT 34 K/uL)

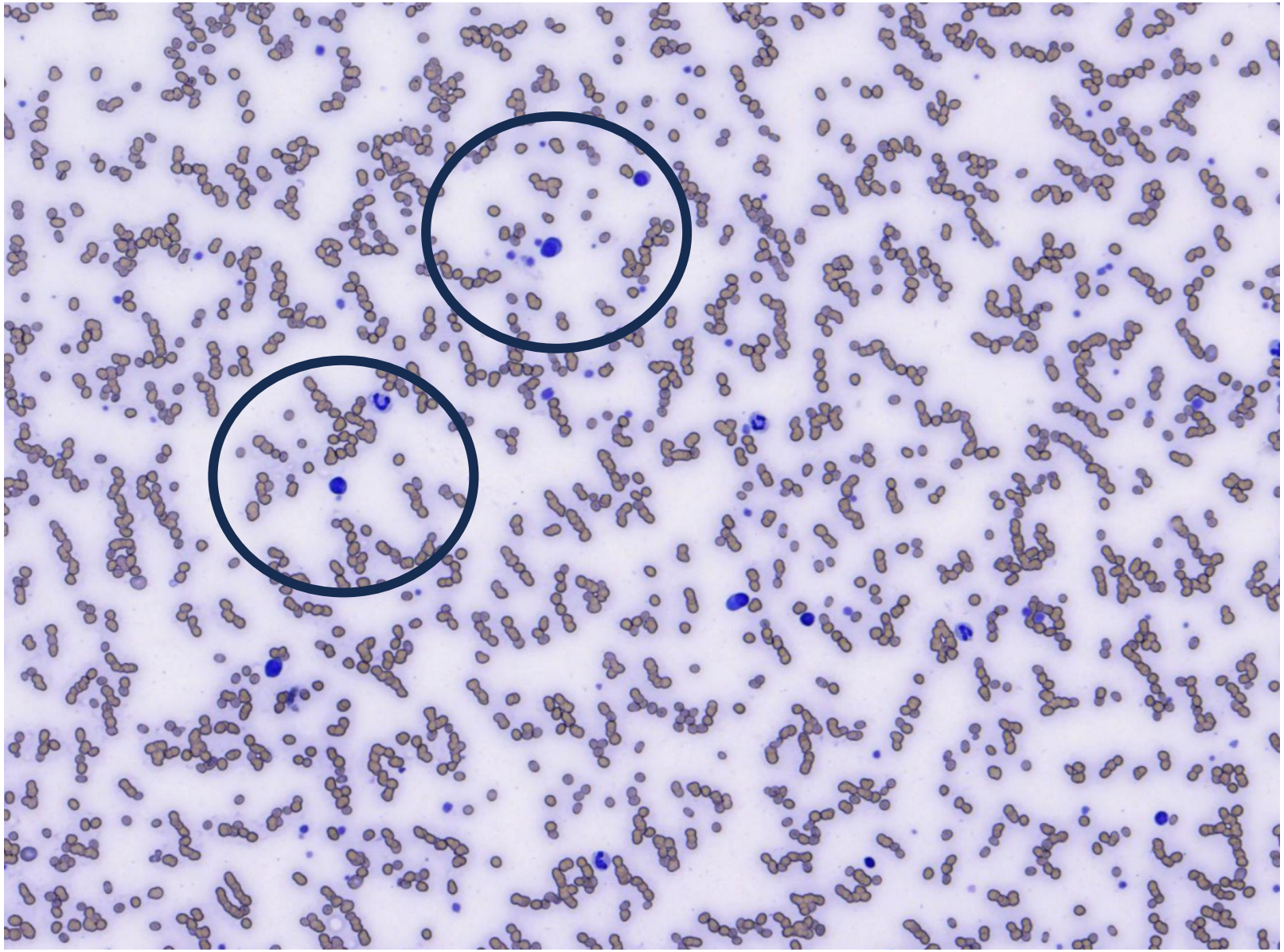
10-year-old, female spayed, DSH cat

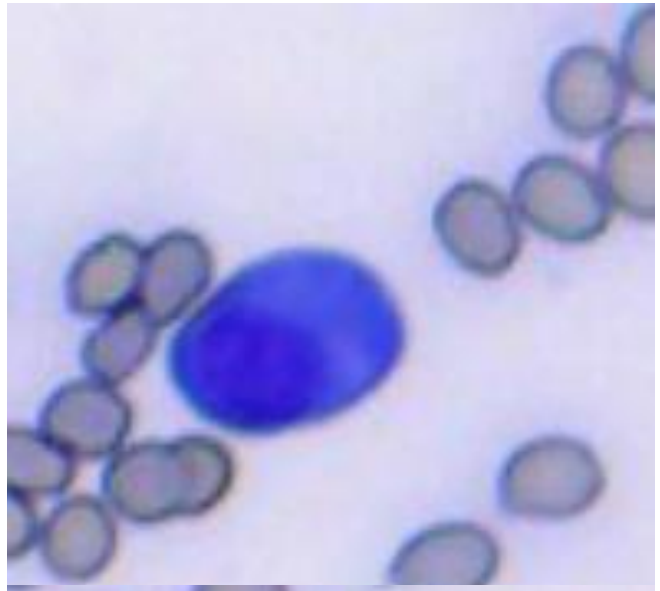


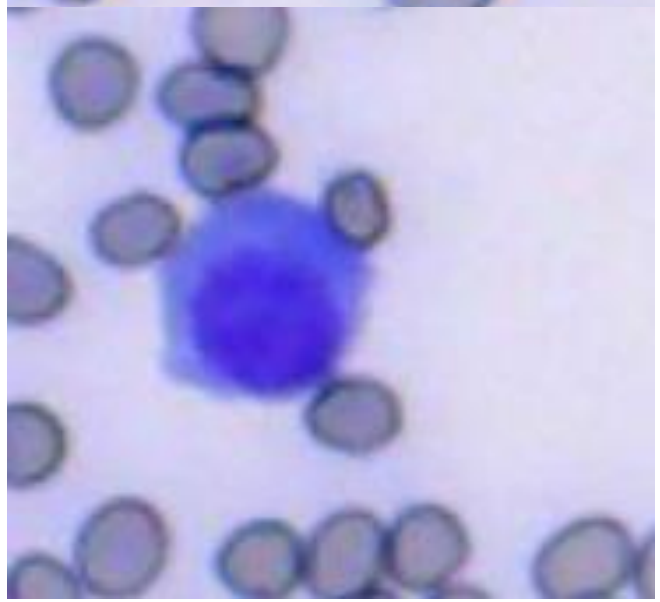


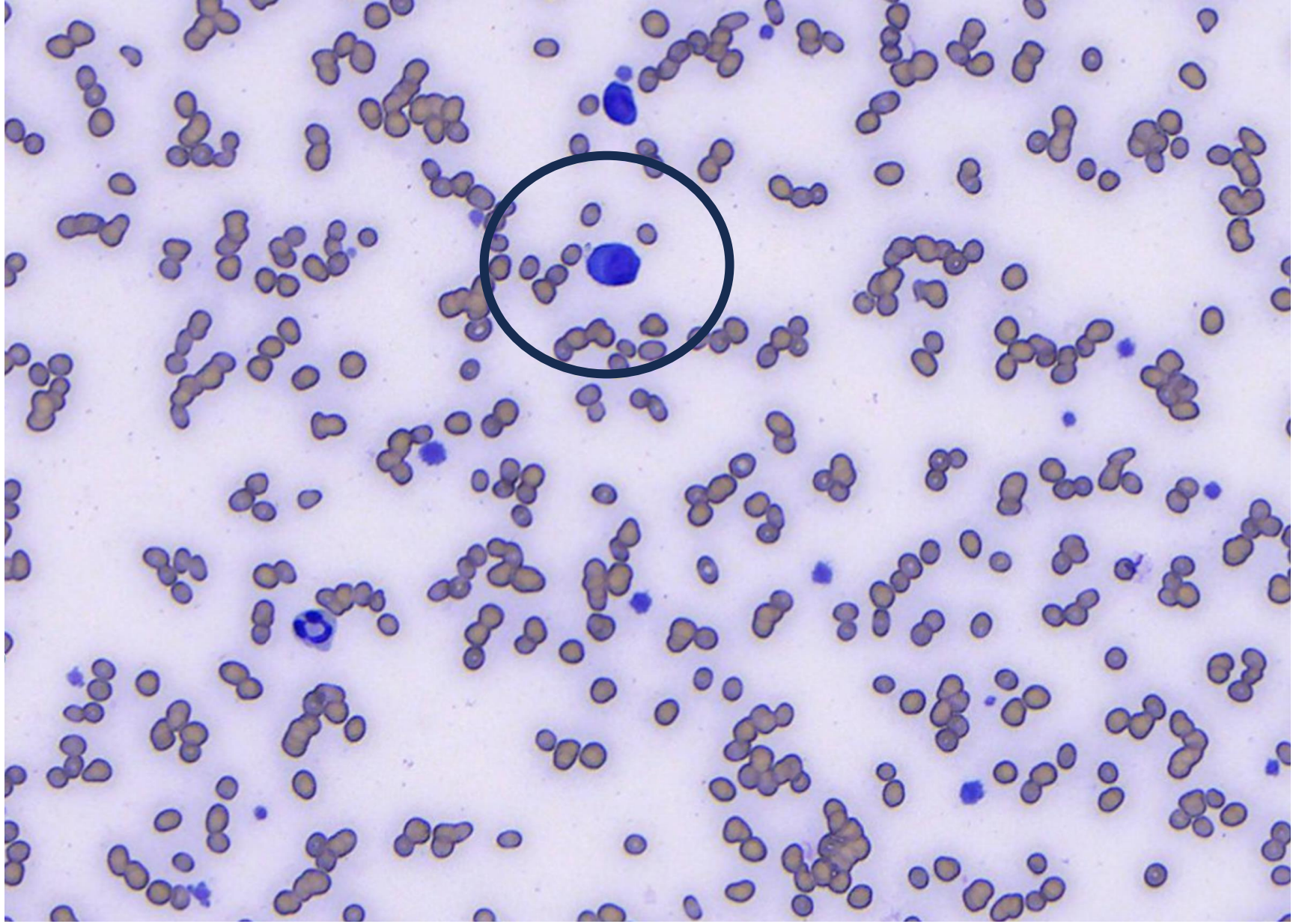
MONO
URBC
NEU
EOS
LYM
BASO

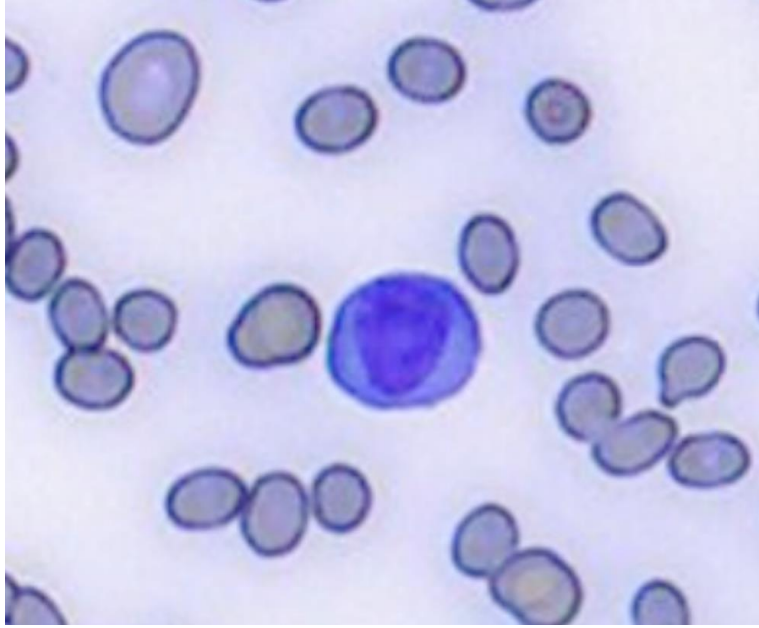


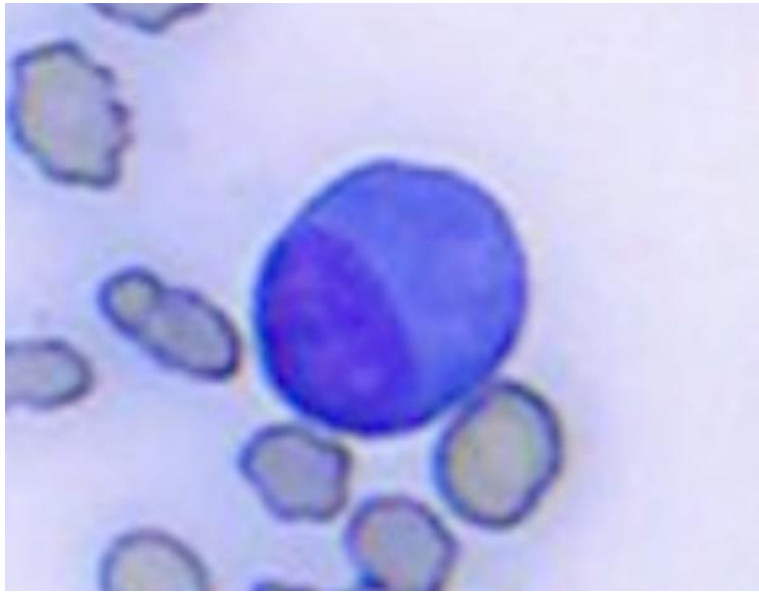


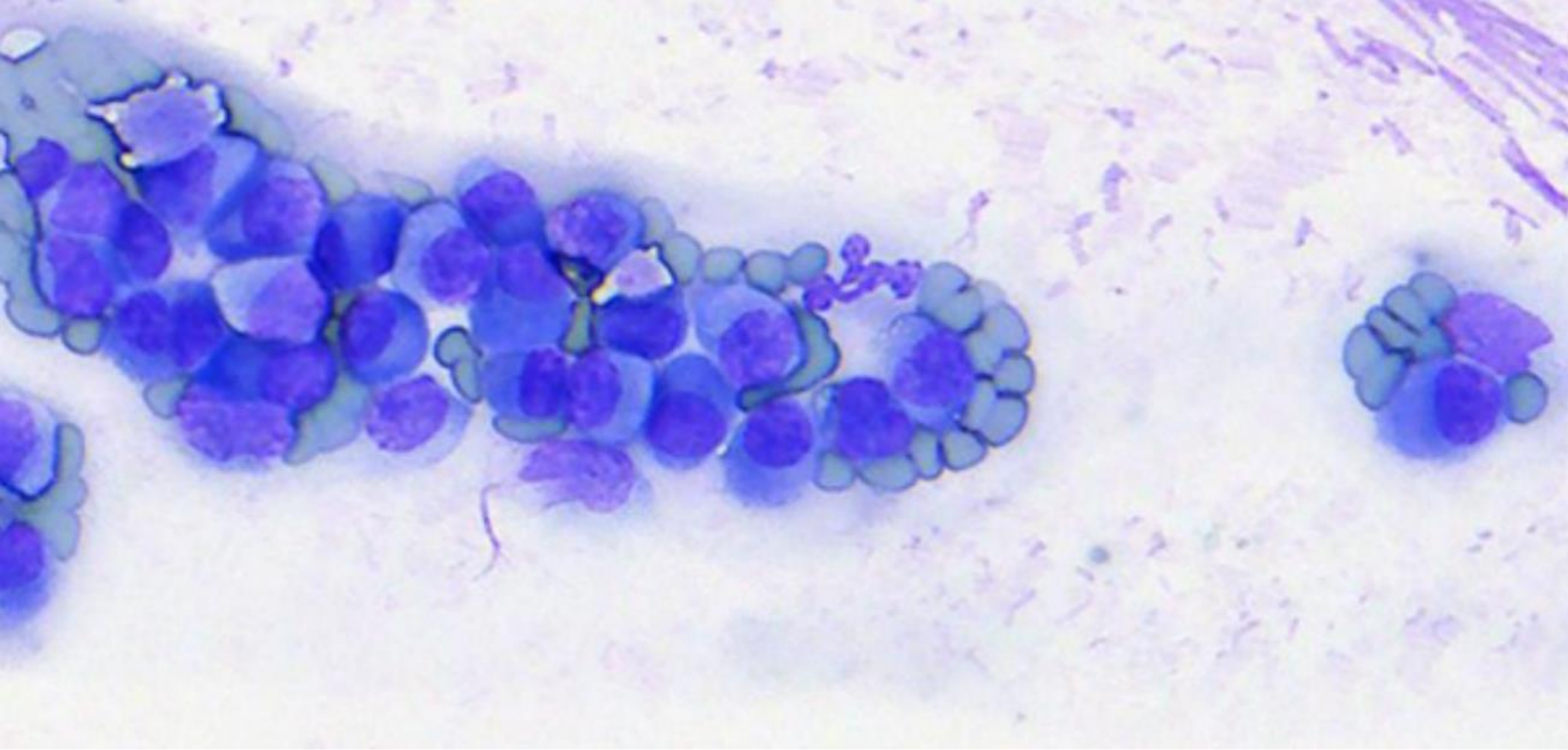




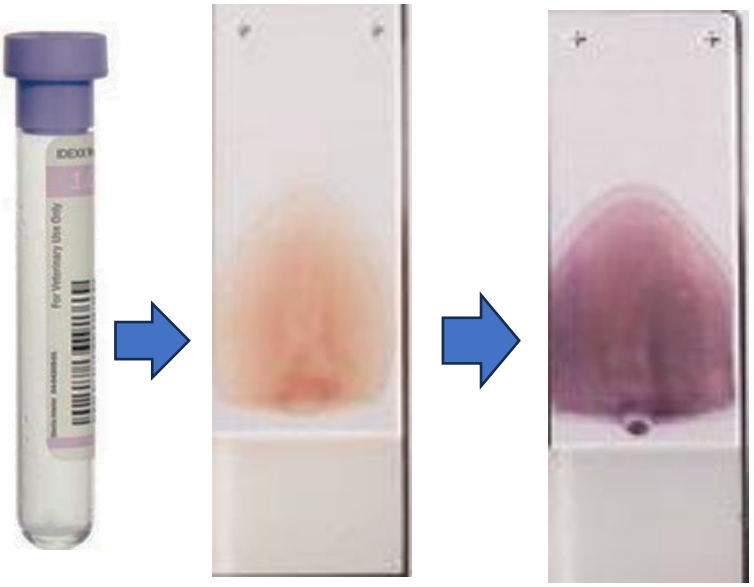


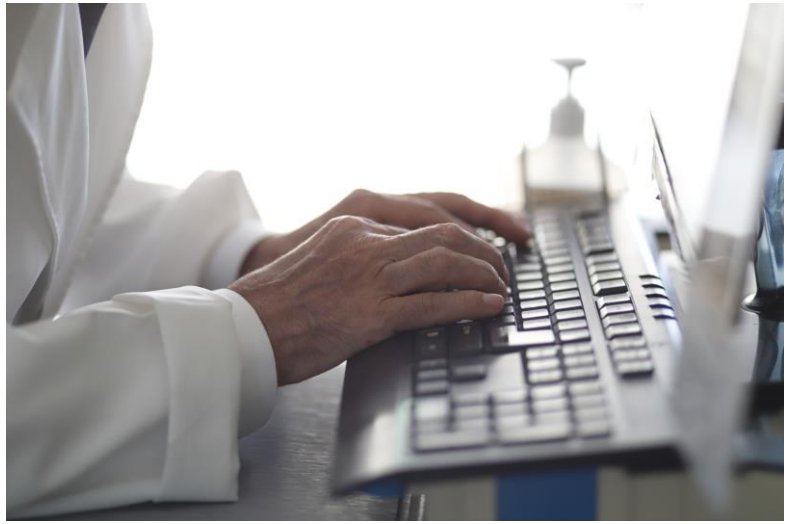


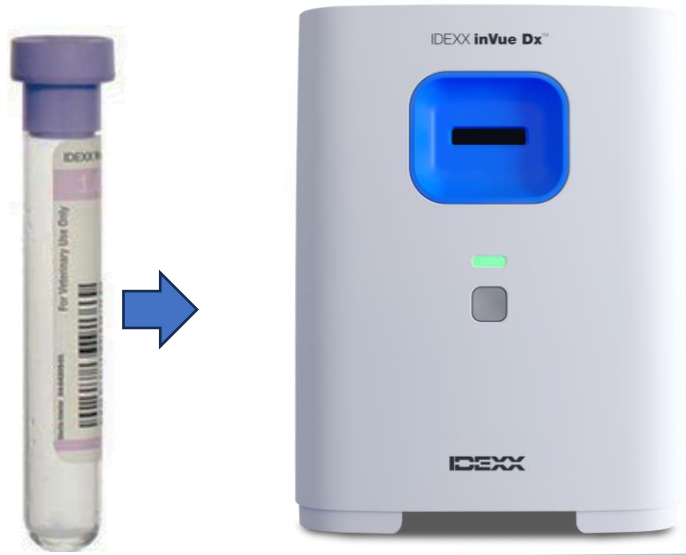


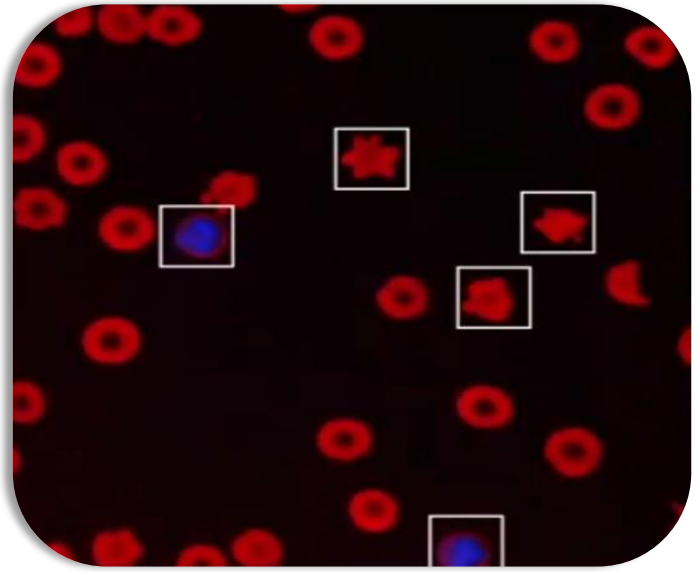


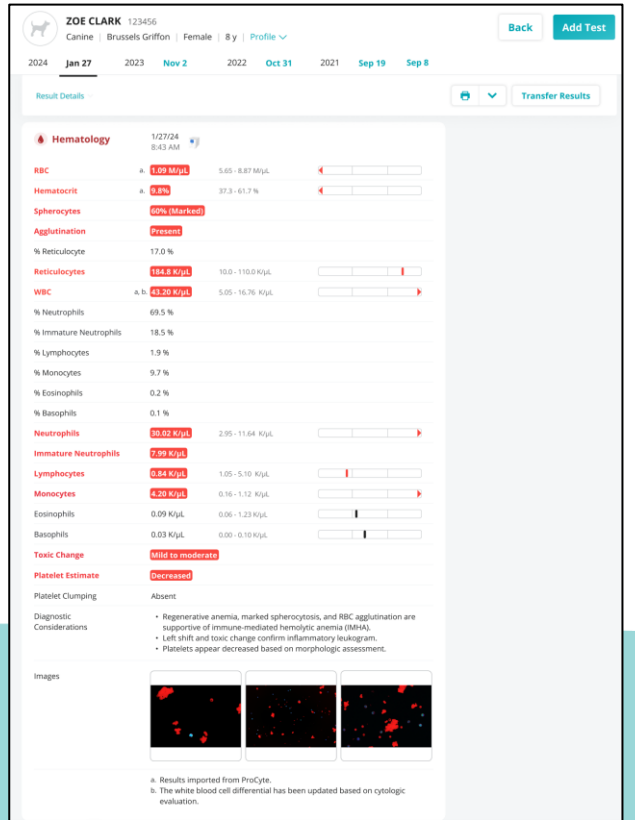
IDEXX inVue Dx™ Cellular Analyzer







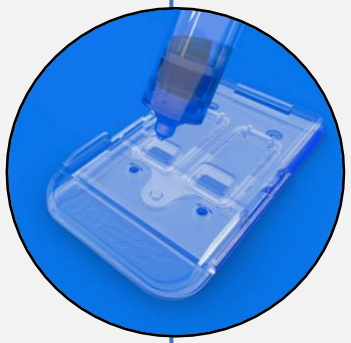




IDEXX inVue Dx™ Cellular Analyzer

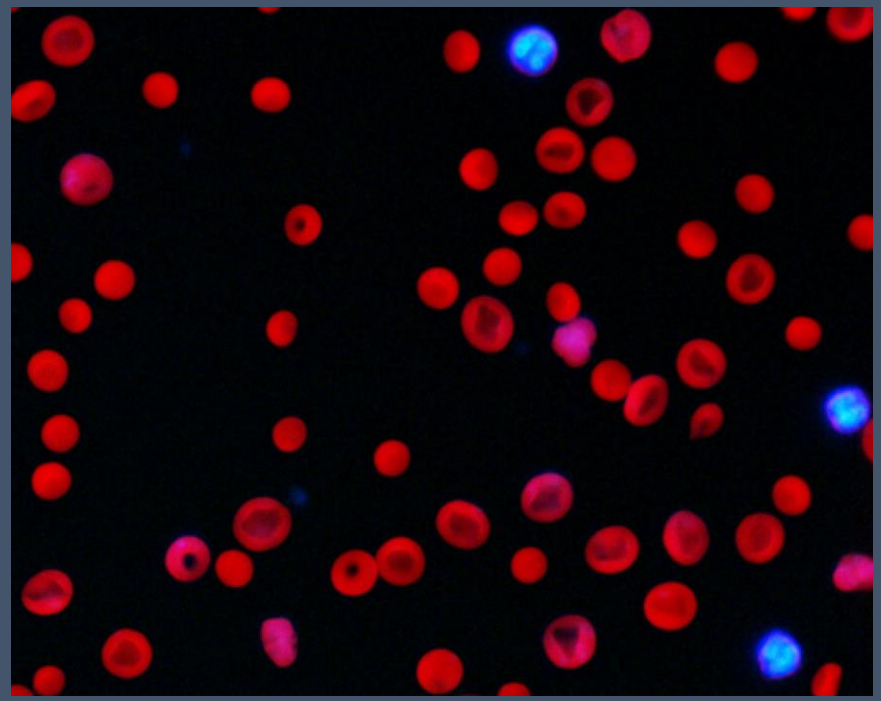
1. **Pipette sample into diluent tube**
   20 uL

2. **Drop sample into cartridge**

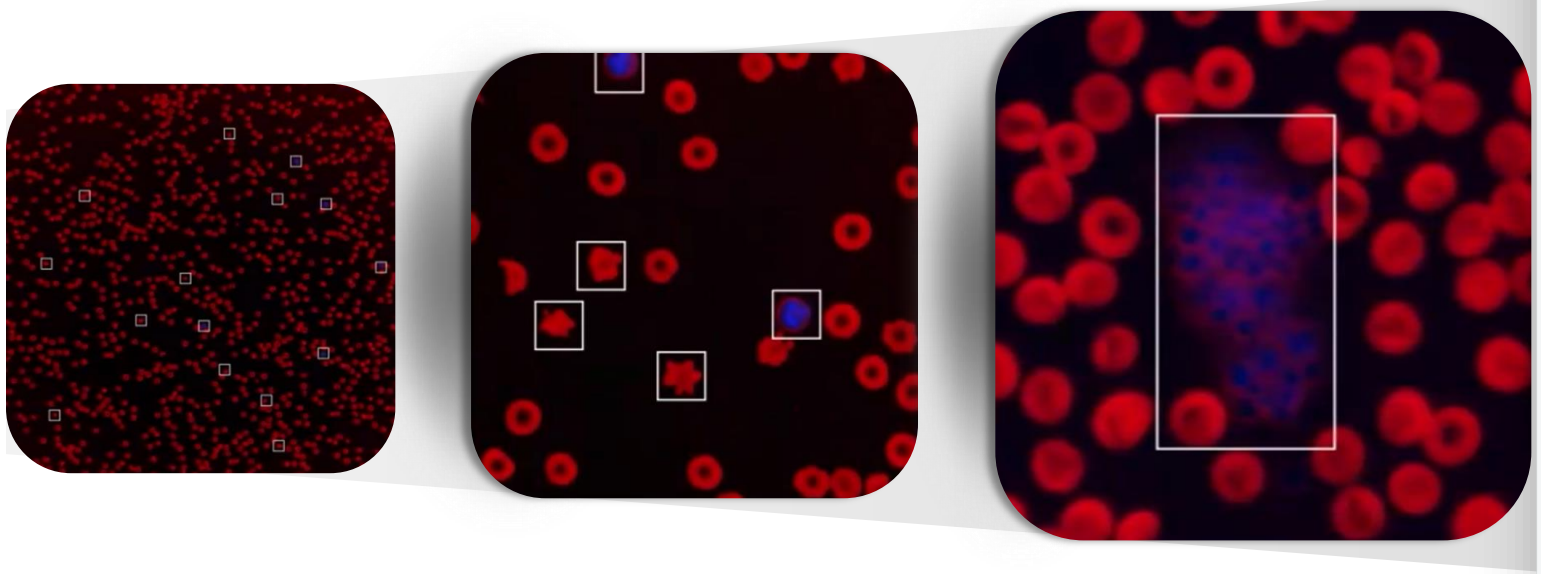


10 mins

3. **Insert and press the Start button**



inVue Dx Provides: automated quantification, classification, and interpretation of blood morphology



Delivering reference lab-quality results in a real-time environment

IDEXX VetConnect PLUS | Home | Directory of Services | Imaging | Telemedicine | James Herriot, All Creatures Animal Hospital | Sign out

ZOE CLARK 203AB Patient Management
Canine | Brussels Griffon | Female | 8y

Order New Diagnostics

2024 | Jan 27 | Jan 27

Result Details | Add to Order

Hematology	1/27/24 9:43 AM			1/27/24 9:43 AM
RBC	a. 1.09	5.65 - 8.87 M/µL		1.09
Hematocrit	b. 9.8	37.3 - 61.7 %		9.8
Spherocytes	60% (Marked)			
Agglutination	Present			
% Reticulocyte	17.0	%		17.0
Reticulocytes	184.8	10.0 - 110.0 K/µL		184.8
WBC	c. 43.20	5.05 - 16.76 K/µL		43.20
% Neutrophils	69.5	%		*69.2
% Immature Neutrophils	18.5	%		
% Lymphocytes	1.9	%		*21.6
% Monocytes	9.7	%		*8.9
% Eosinophils	0.2	%		0.2
% Basophils	0.1	%		0.1
Neutrophils	30.02	2.95 - 11.64 K/µL		*29.89
Immature Neutrophils	7.99	K/µL		
Lymphocytes	0.84	1.05 - 5.10 K/µL		*9.34
Monocytes	4.20	0.16 - 1.12 K/µL		*3.85
Eosinophils	0.09	0.06 - 1.23 K/µL		0.09
Basophils	0.03	0.00 - 0.10 K/µL		0.03
Platelet Estimate	50-100 K/µL (Moderately decreased)			

Diagnostic Considerations: The presence of regenerative anemia, spherocytosis, and RBC agglutination are strongly suggestive of immune-mediated hemolytic anemia. Other clinical features include icterus, hyperbilirubinemia/bilirubinuria (in the absence of liver dysfunction), or hemoglobinemia/uria. Investigate for underlying causes such as infection, neoplasia, concurrent inflammatory conditions, or history of recent drugs/vaccines.

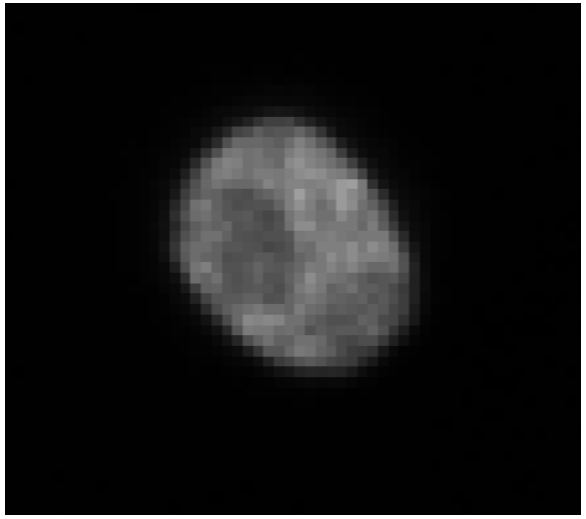
This platelet estimate incorporates enumeration of individual platelets and platelets within clumps. Moderately decreased platelets may be seen with platelet consumption, immune-mediated destruction, decreased production from the bone marrow, and sequestration in the spleen. If this finding is unexpected, please redraw a new sample to rule out artifactual thrombocytopenia (e.g., clot in the blood tube).

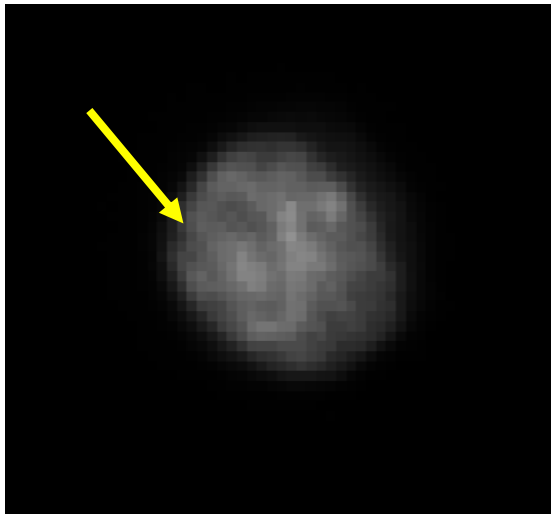
Images

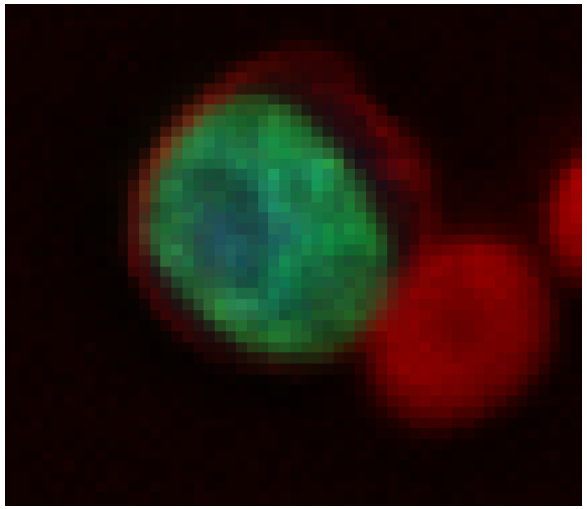
a. RBC results imported from ProCyte.
b. HCT results imported from ProCyte.
c. WBC results imported from ProCyte. The white blood cell differential has been updated based on cytologic evaluation.

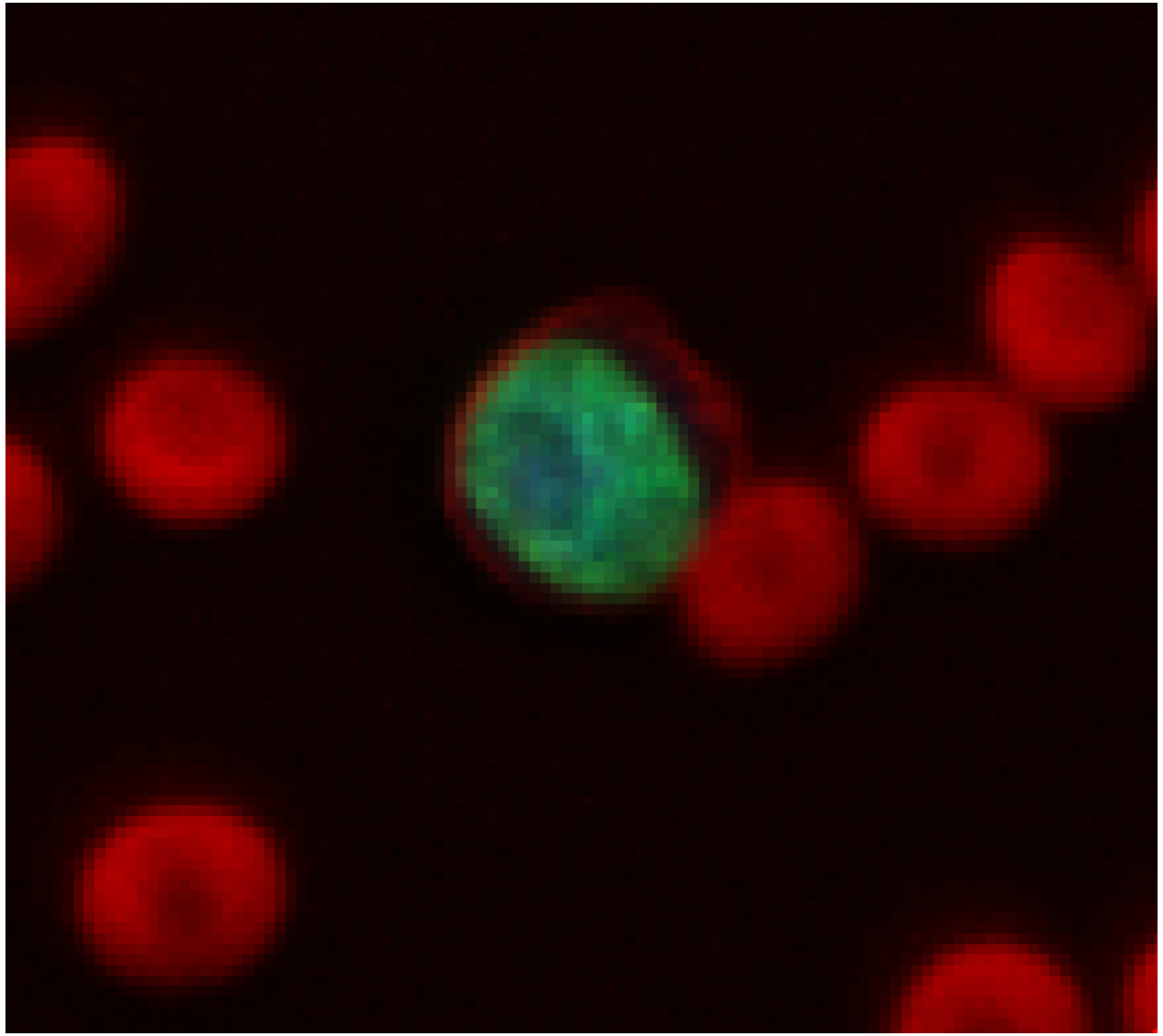
IDEXX inVue Dx™ Cellular Analyzer Different light channels

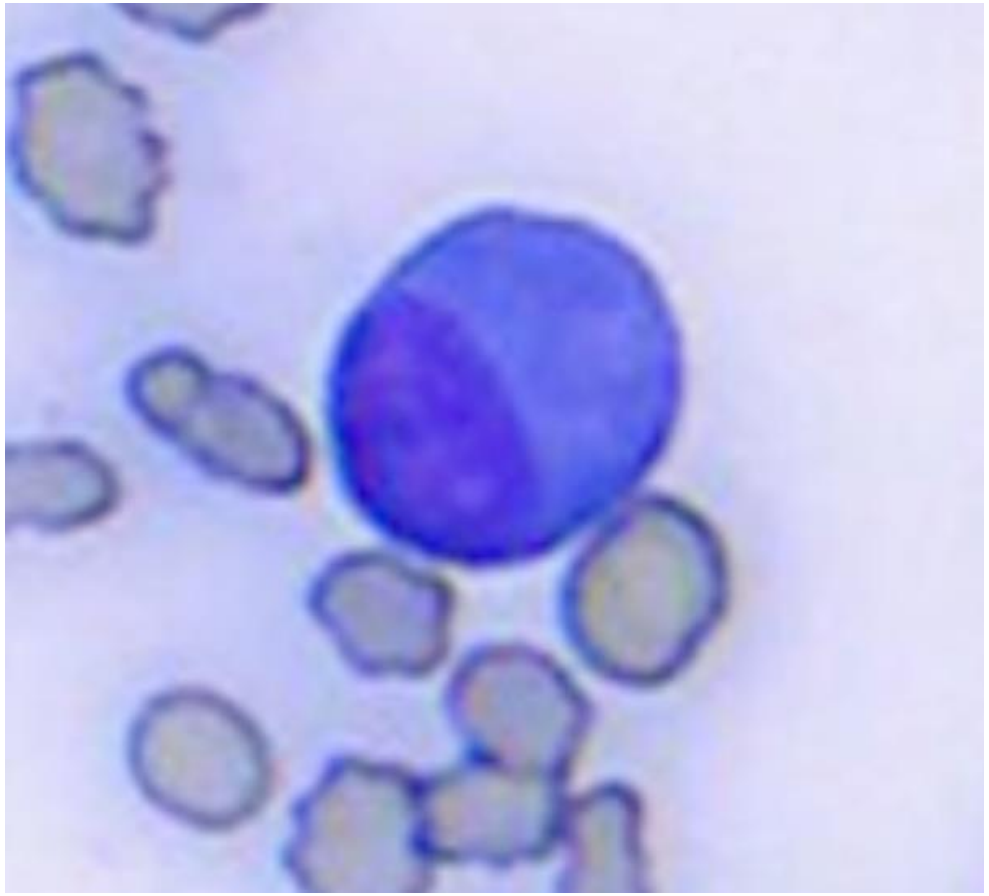
- Large immature mononuclear cell
- Bottom left: see nuclear chromatin features
- Bottom right: arrow points to nucleolus

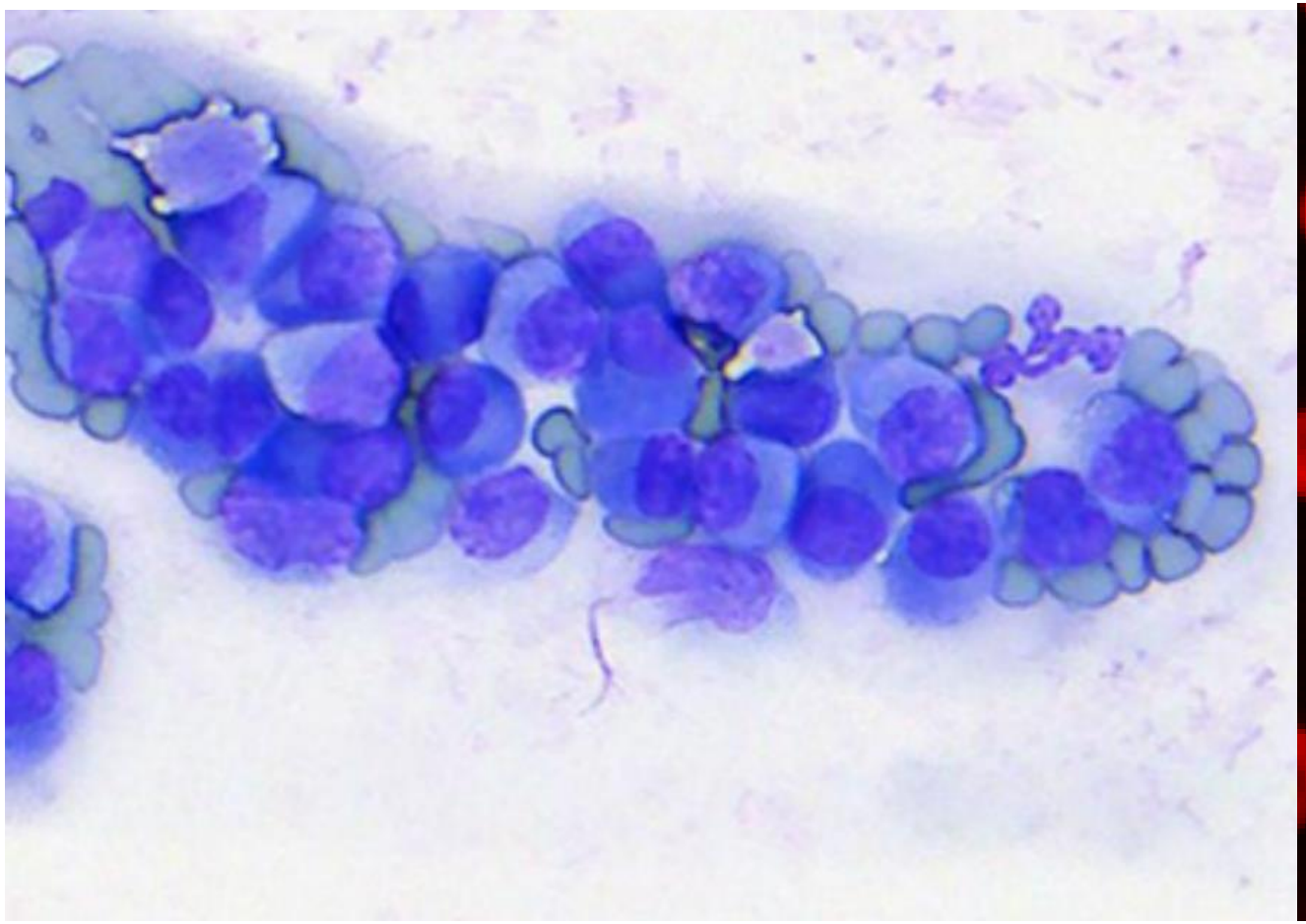


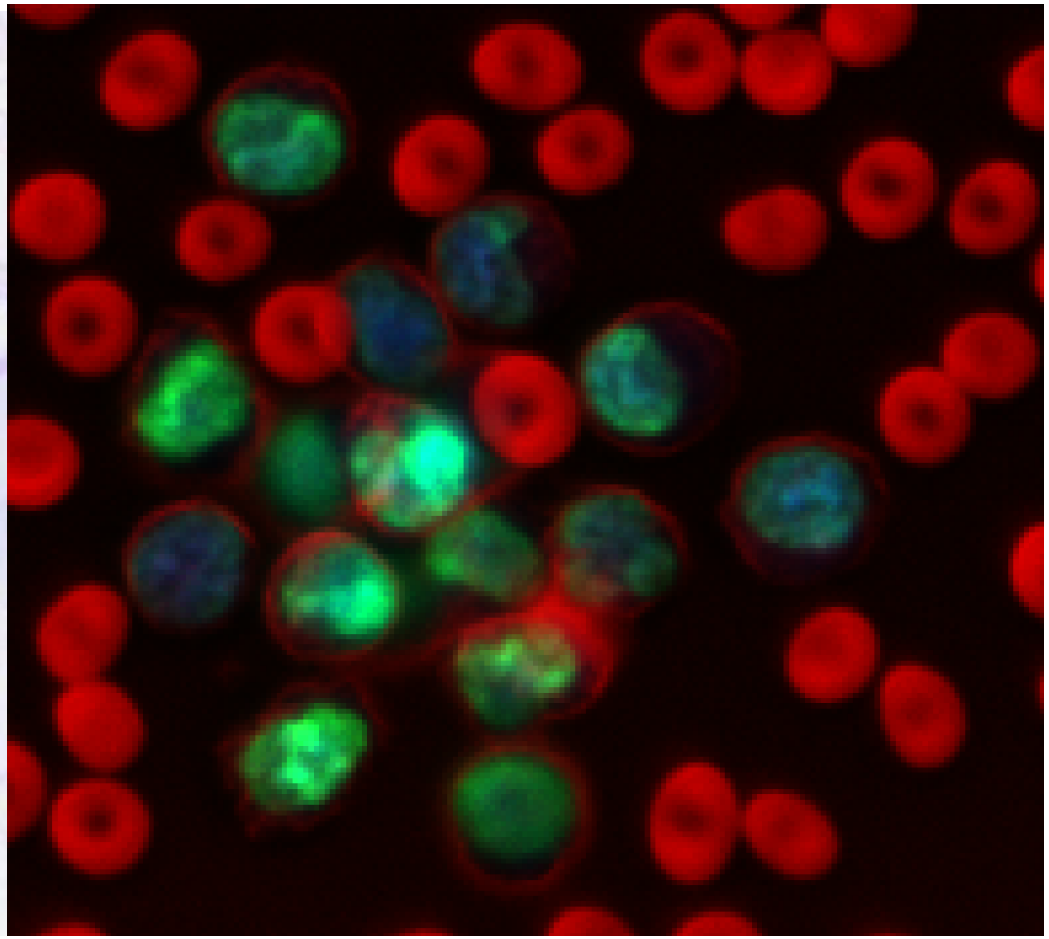












Red blood cell abnormalities

8-year-old, spayed female Brussels griffon

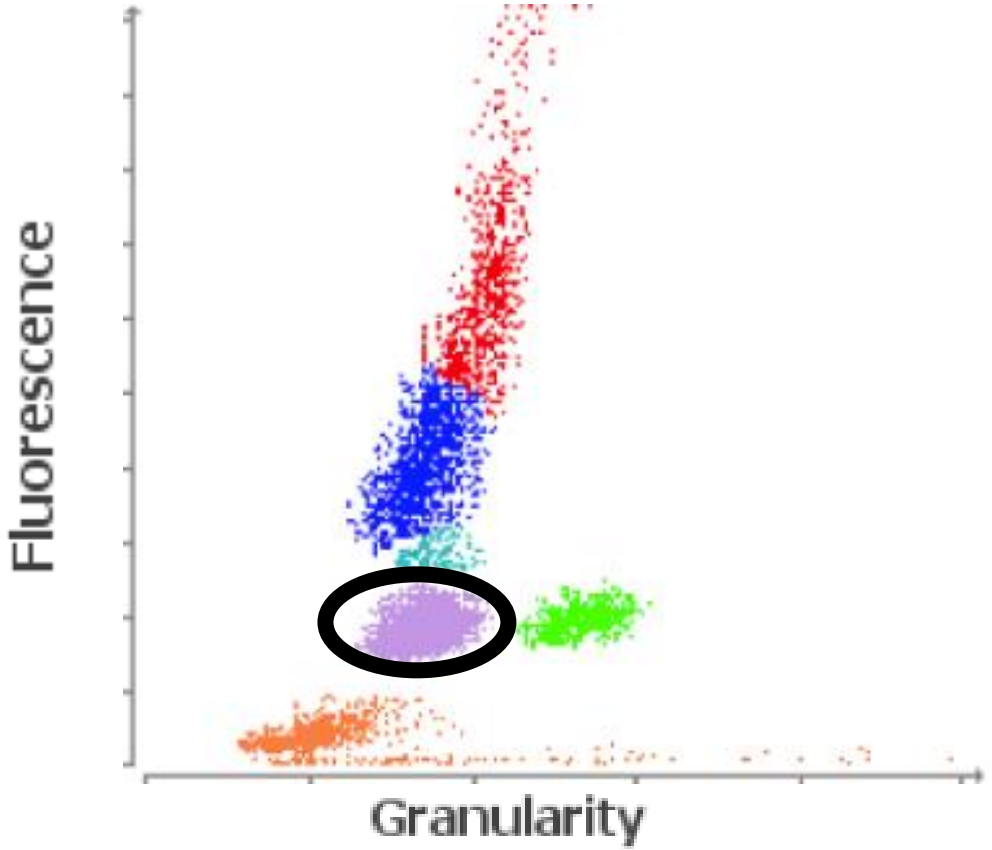
- Presents for lethargy and poor appetite
- Exam findings:
  - Quiet, alert, and responsive
  - Pale and icteric
  - Tachycardic

8-year-old, spayed female Brussels griffon

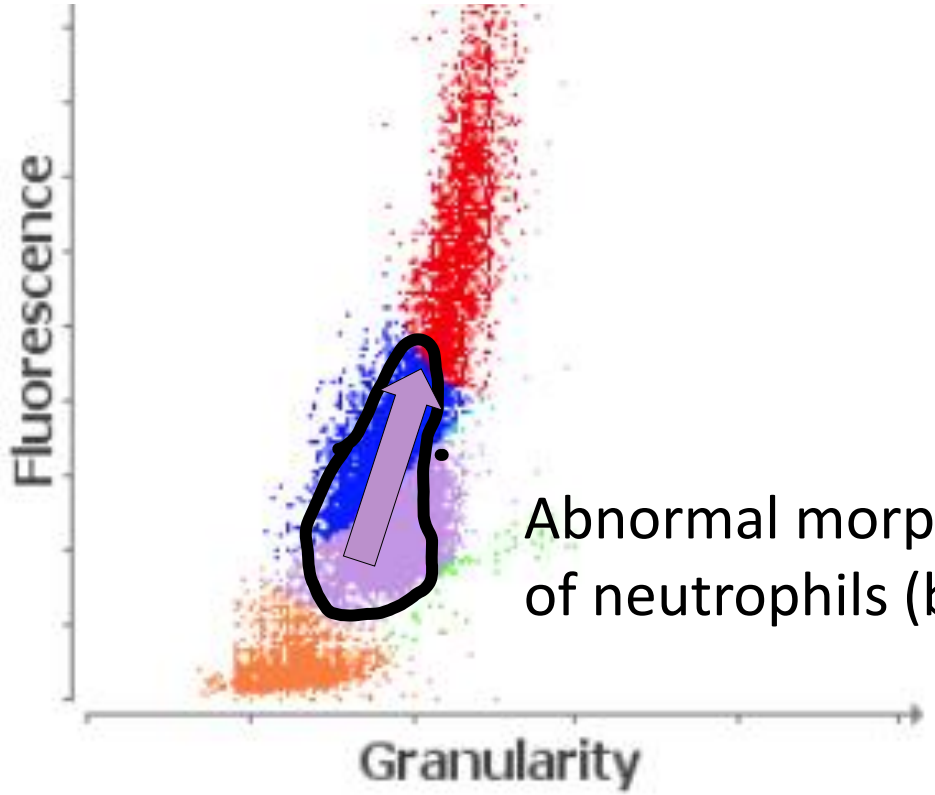
- Severe regenerative anemia (HCT 9.8%, Retic 17% = 184.8 K/uL)
- Marked leukocytosis (43.2 K/uL)
  - Neutrophilia (30 K/uL)
  - Suspected Band
  - Lymphocytosis (9.34 K/uL)
  - Monocytosis (3.85 K/uL)
- Thrombocytopenia (PLT 60 K/uL)

8-year-old, spayed female Brussels griffon

Normal

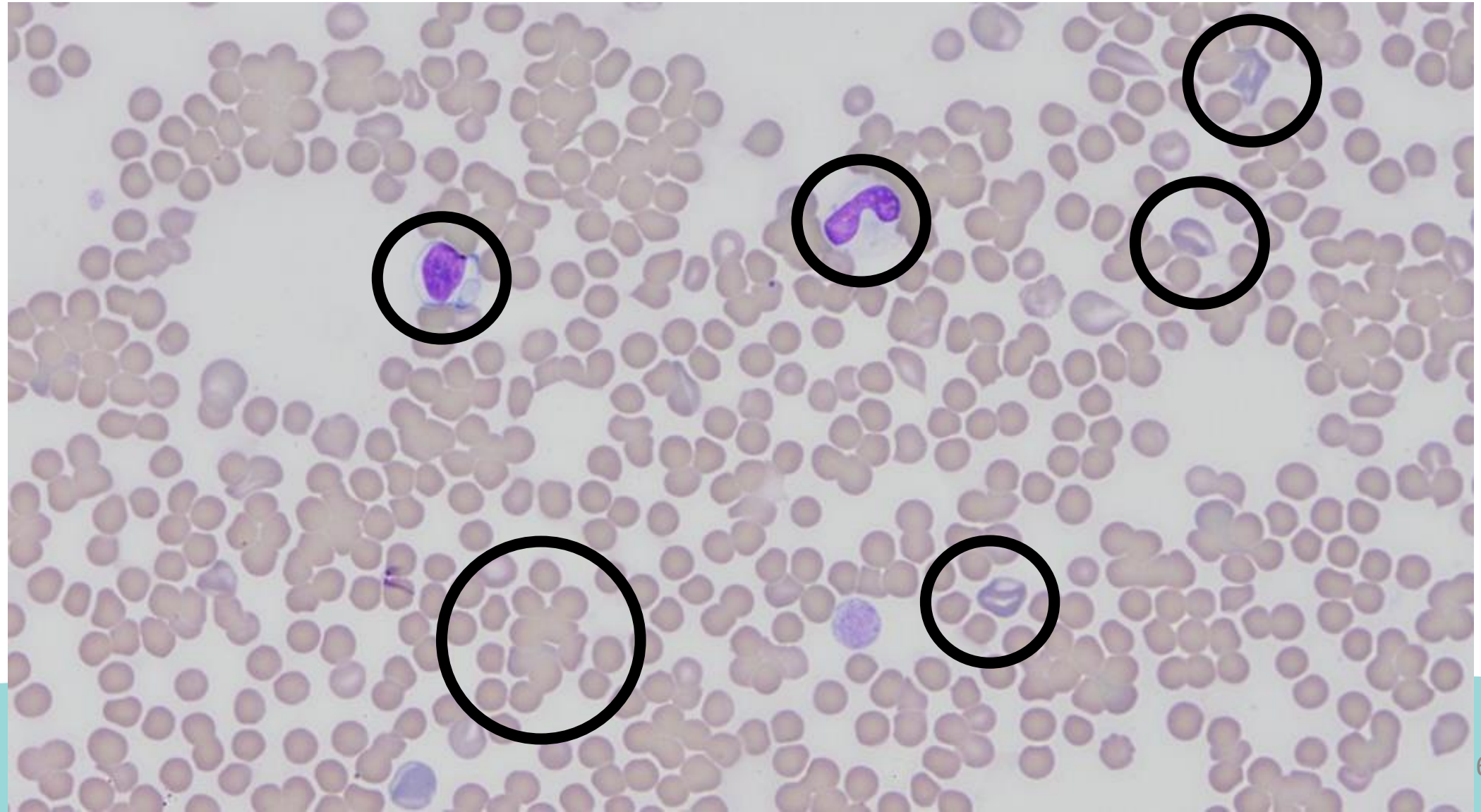


* Confirm with dot plot and/or blood film review.

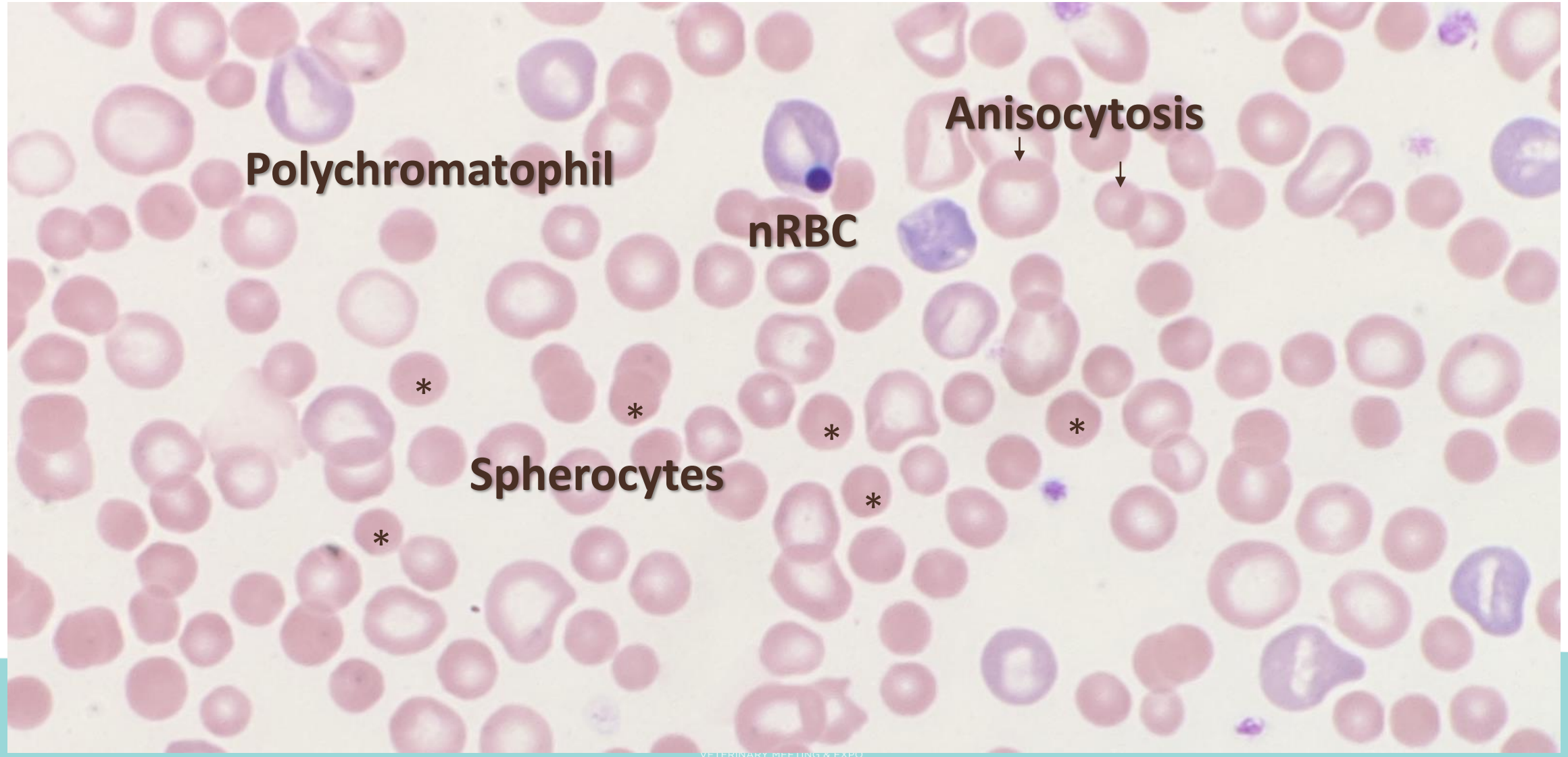


Abnormal morphology of neutrophils (bands)

8-year-old, spayed female Brussels griffon

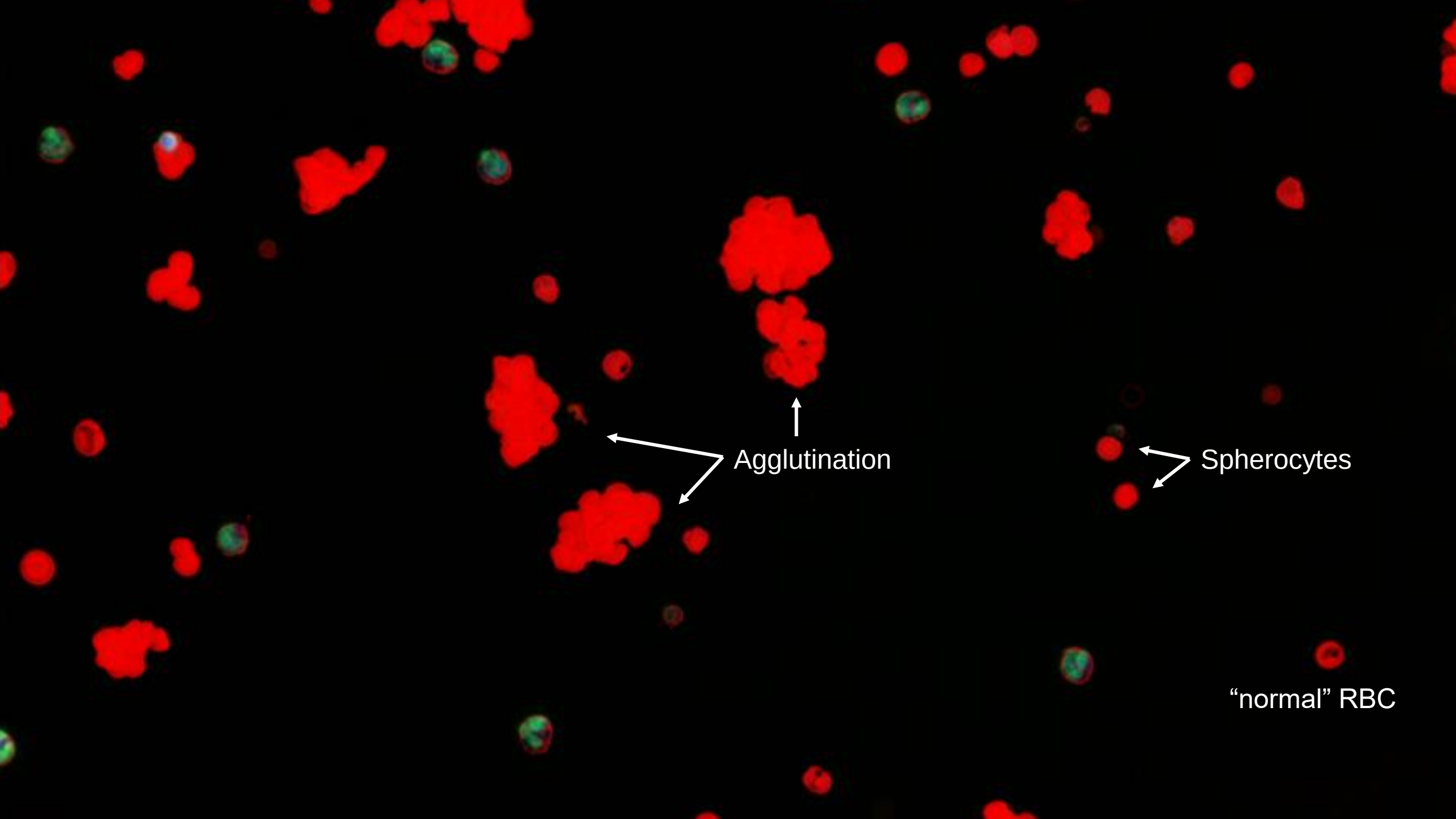


Immune-mediated hemolytic anemia (IMHA)

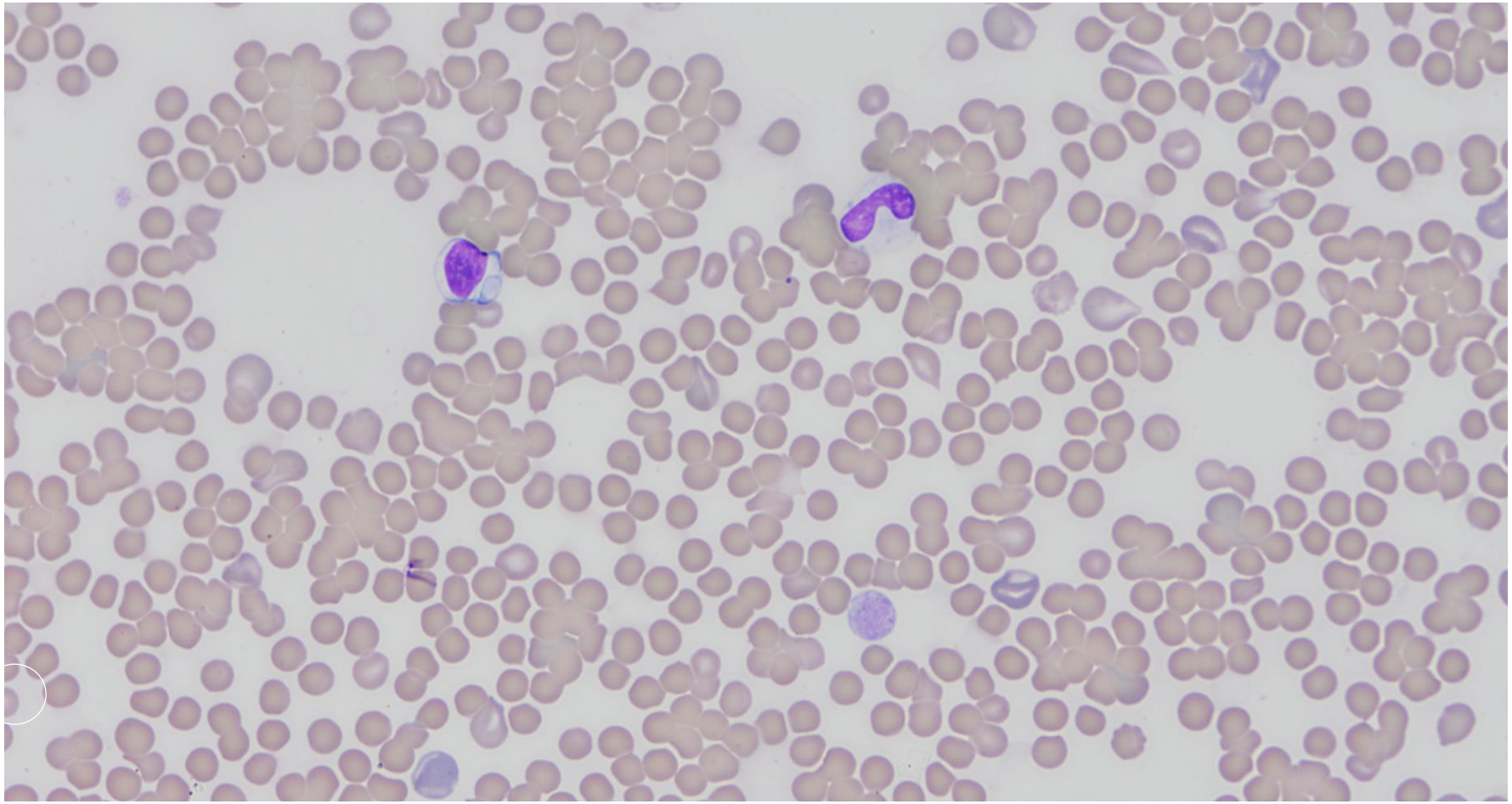


IDEXX inVue Dx™ Cellular Analyzer

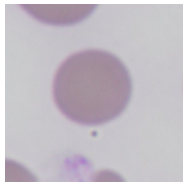
?


Agglutination
Spherocytes
“normal” RBC

IDEXX inVue Dx™ analyzer: IMHA



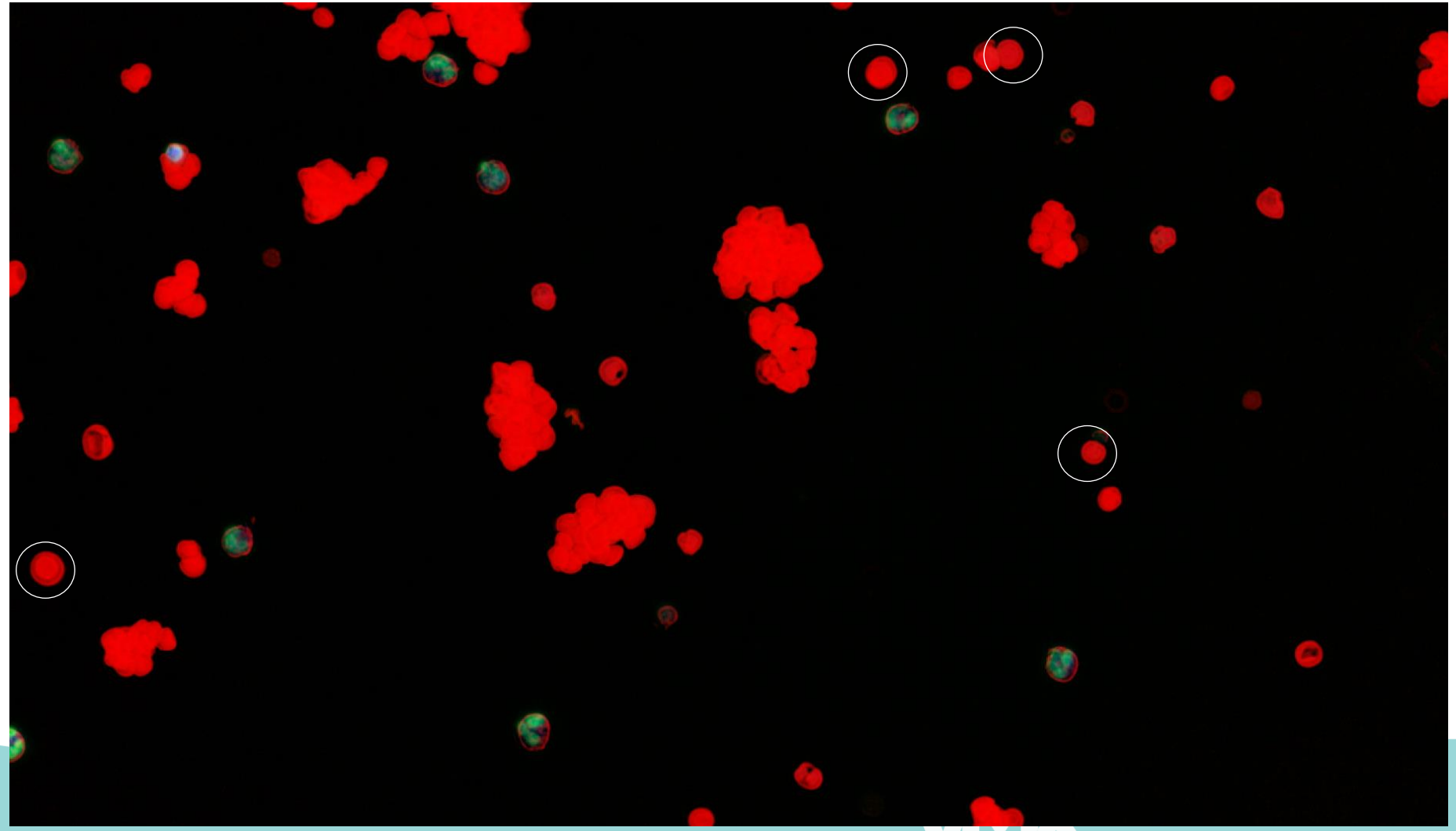
Spherocytes



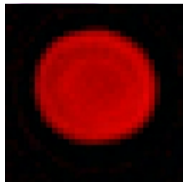
Spherocyte

Normal canine RBC

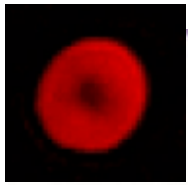
IDEXX inVue Dx™ analyzer: IMHA



Spherocytes



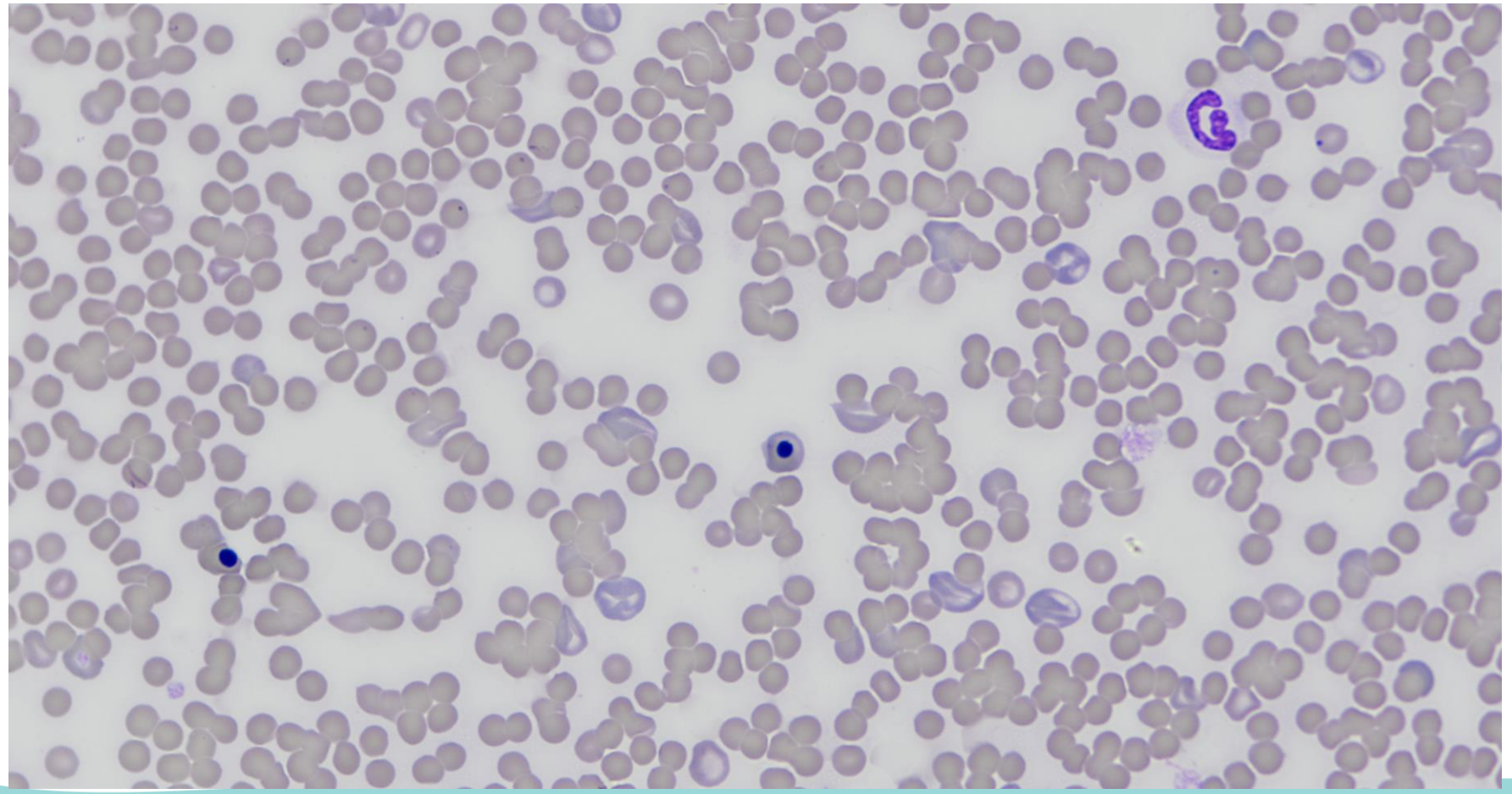
Spherocyte



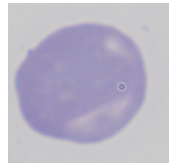
Normal canine RBC

microscope

IDEXX inVue Dx™ analyzer: IMHA



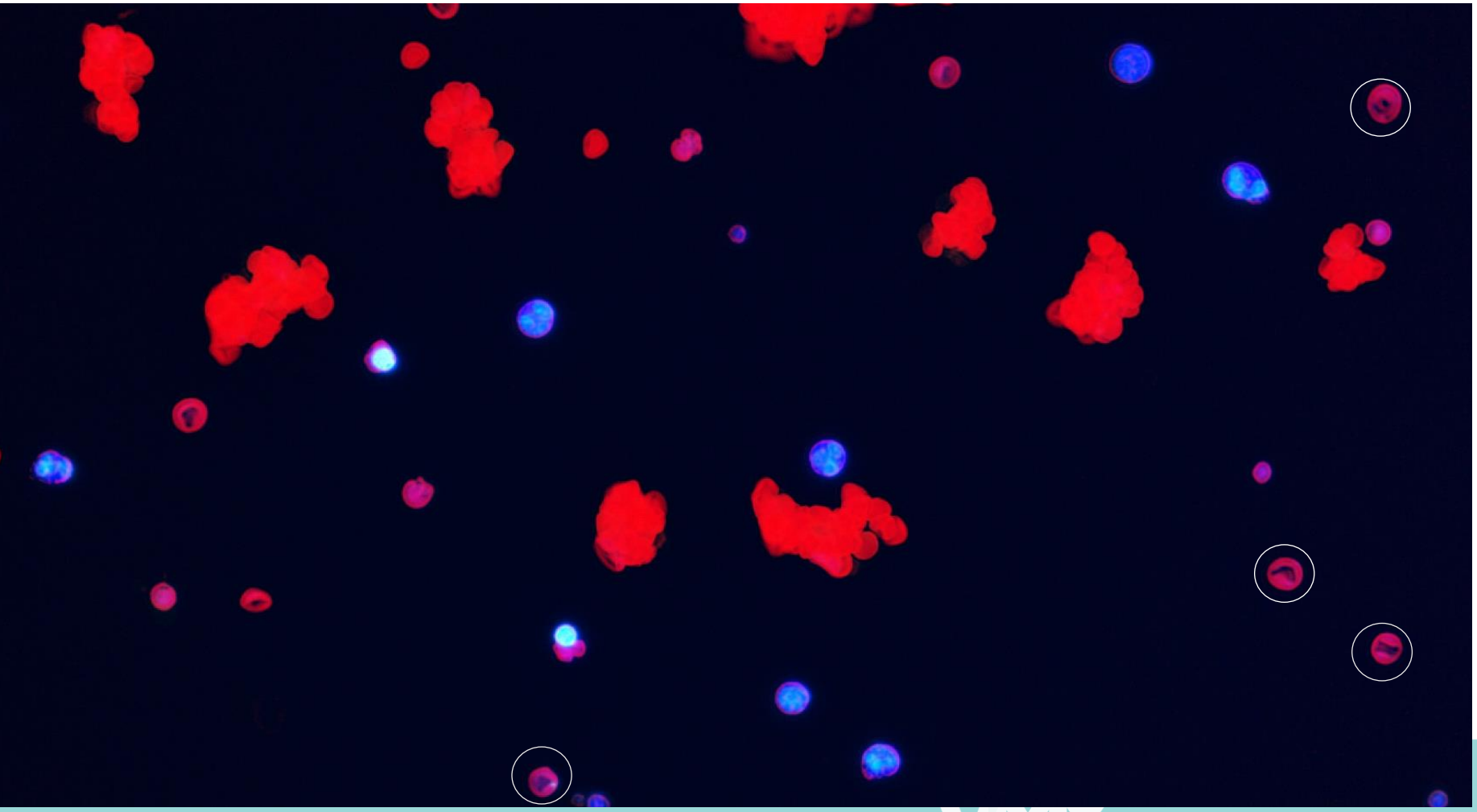
Reticulocytes



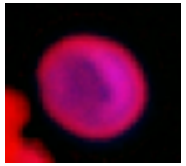
Reticulocyte

Normal canine RBC

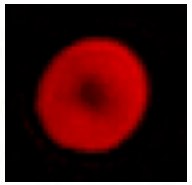
IDEXX inVue Dx™ analyzer: IMHA



Reticulocytes



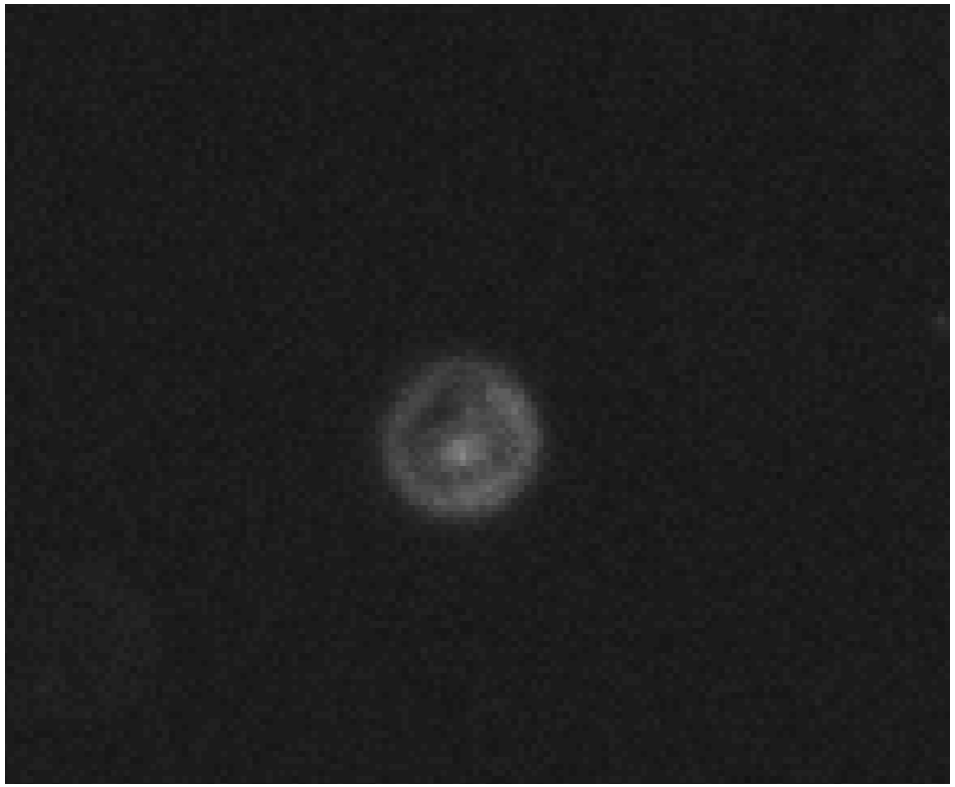
Reticulocyte



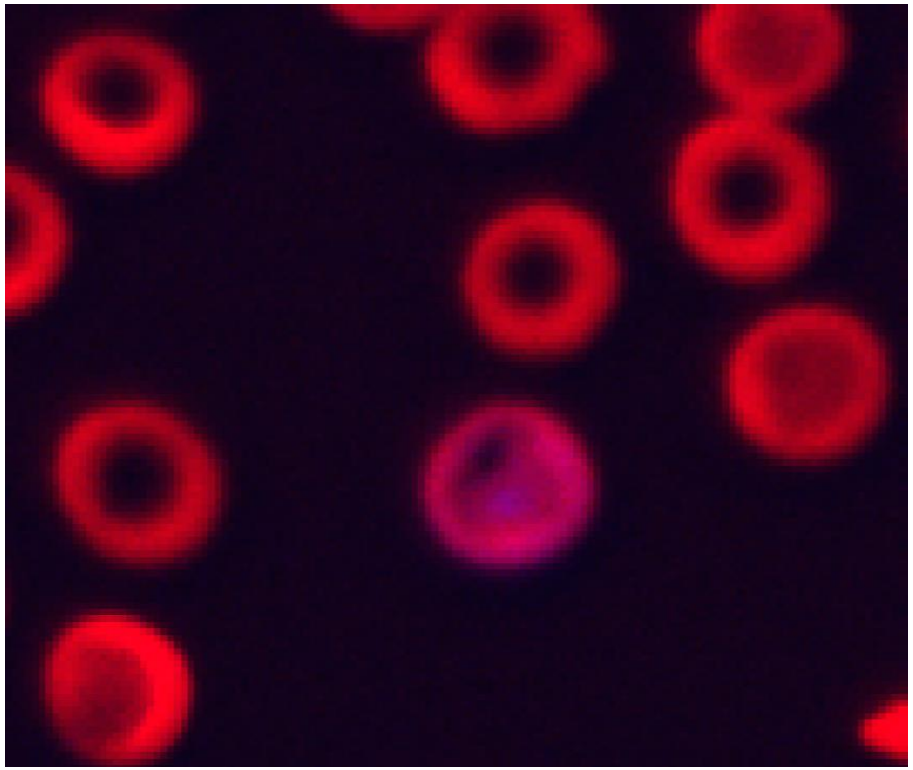
Normal canine RBC

IDEXX inVue Dx - Reticulocyte

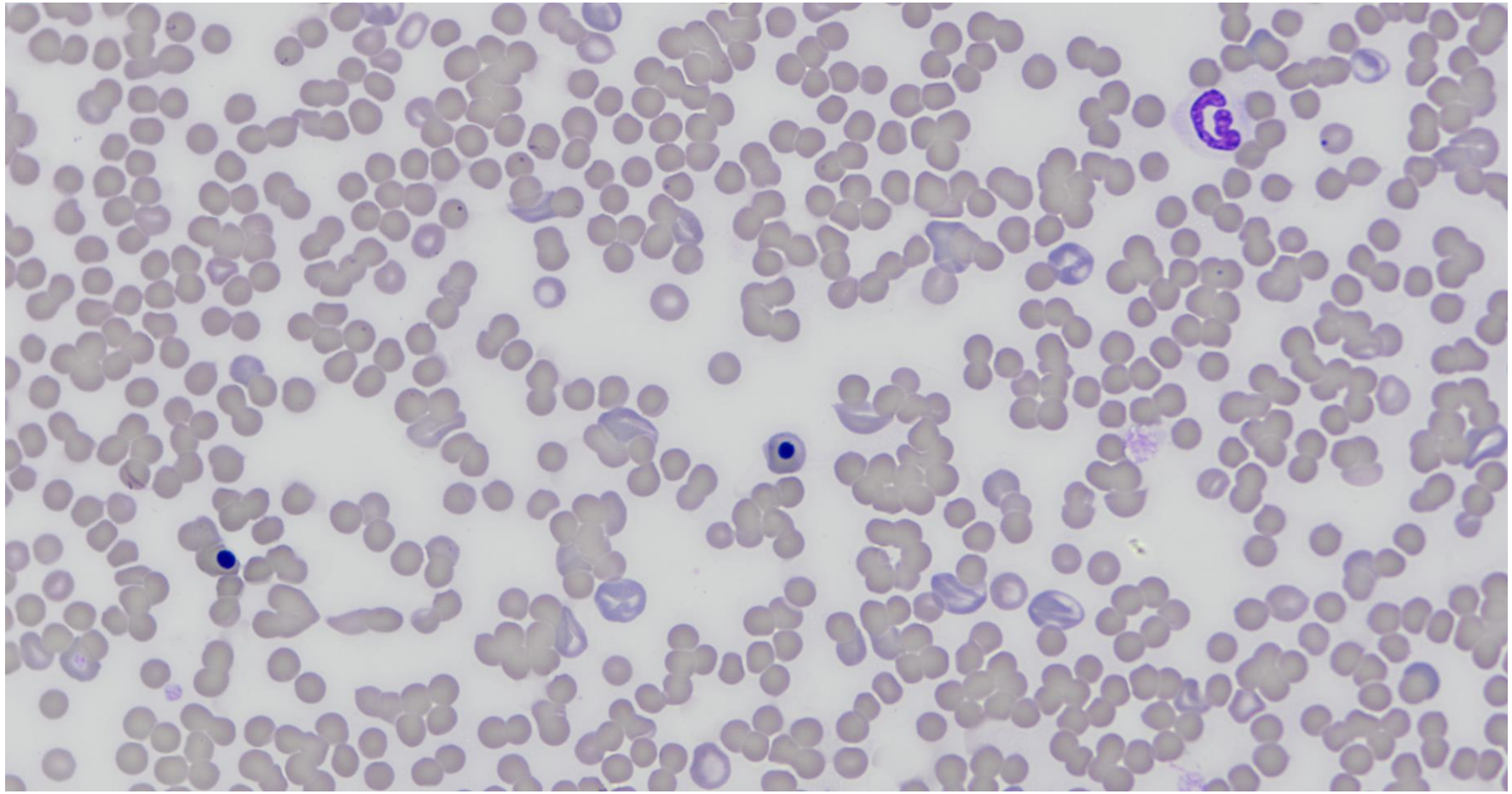
Florescent – RNA



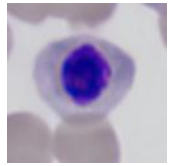
Composite



IDEXX inVue Dx™ analyzer: IMHA



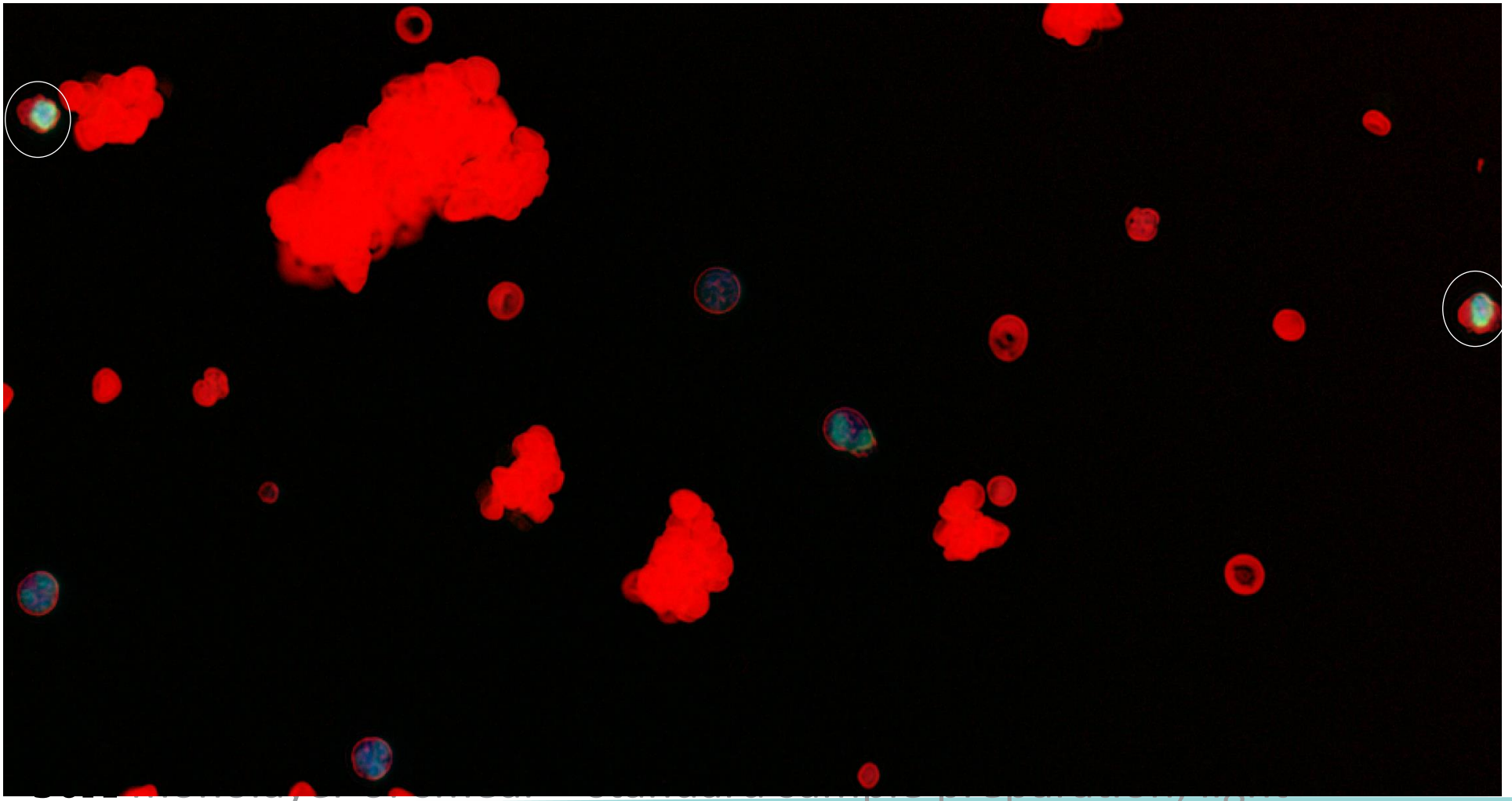
nRBC



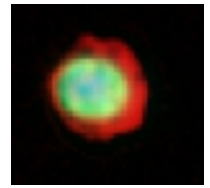
nRBC

Normal canine RBC

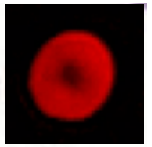
IDEXX inVue Dx™ analyzer: IMHA



nRBC



nRBC

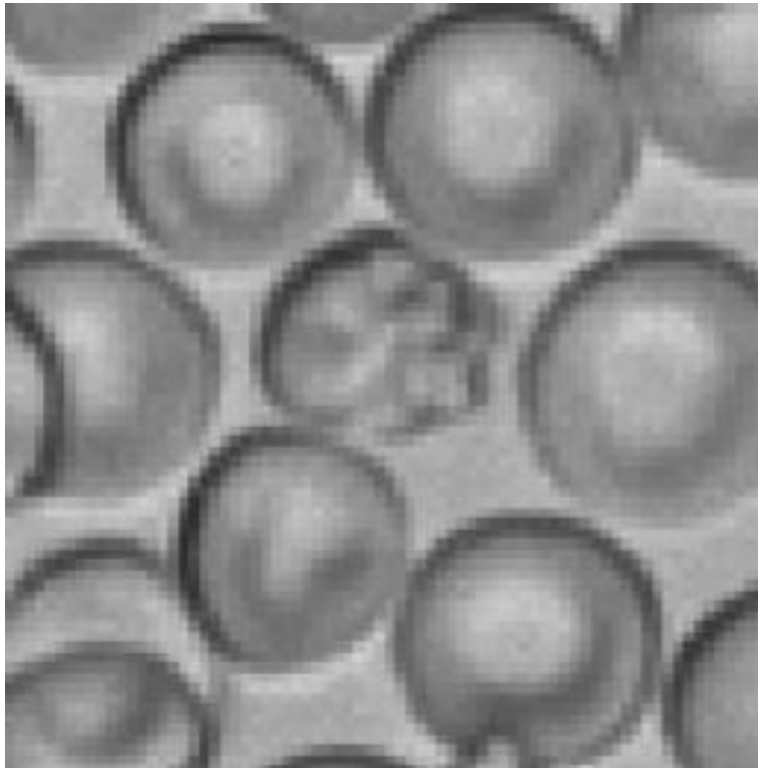


Normal canine RBC

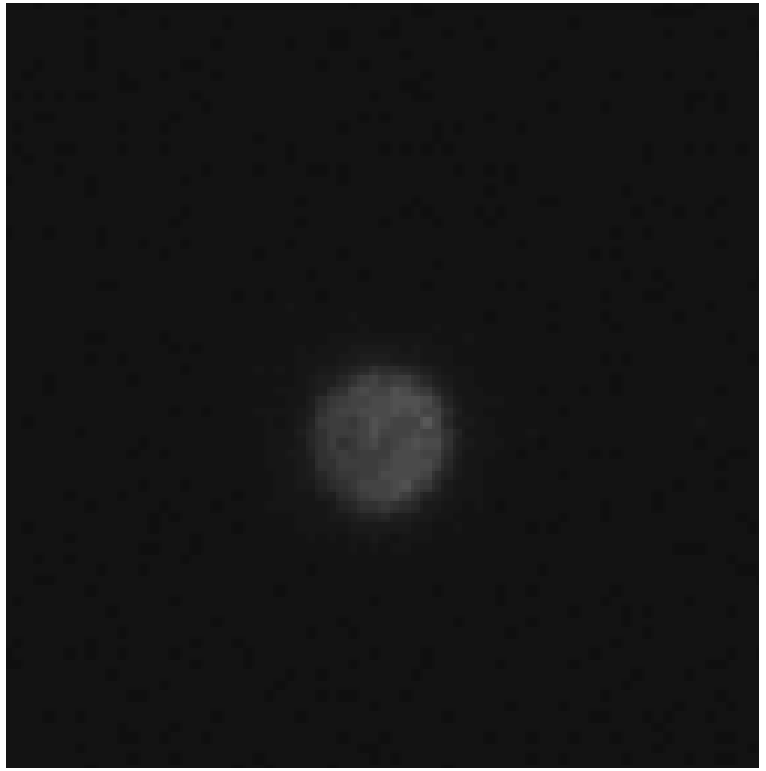
microscope

IDEXX inVue Dx - Reticulocyte

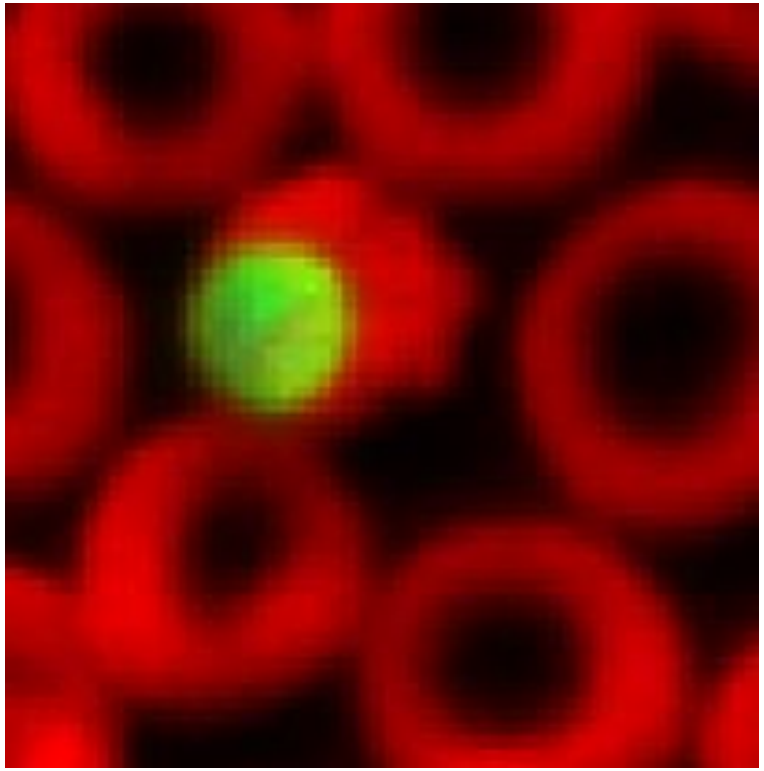
Bright



Florescent – DNA

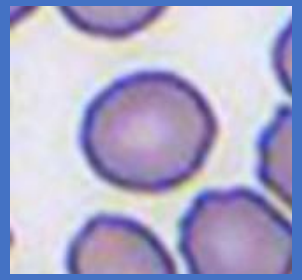
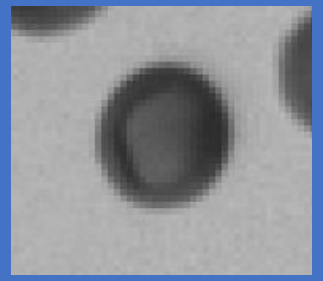
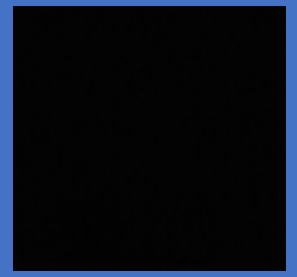
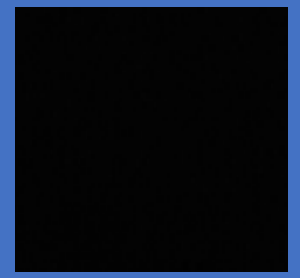
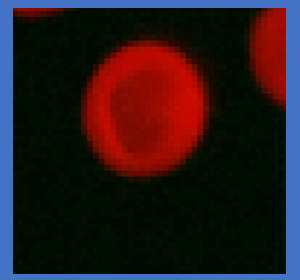
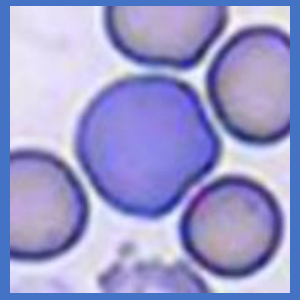
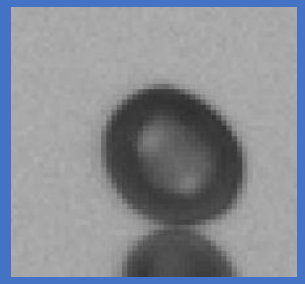
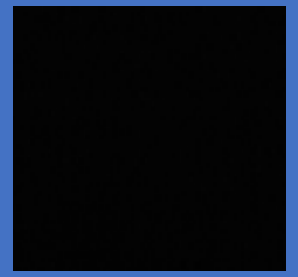
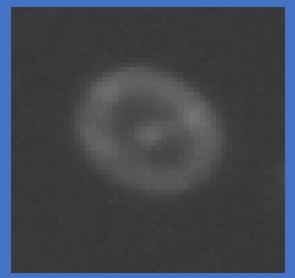
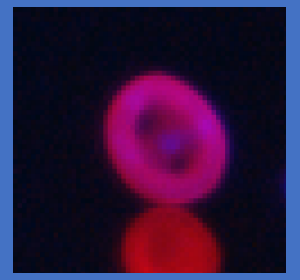
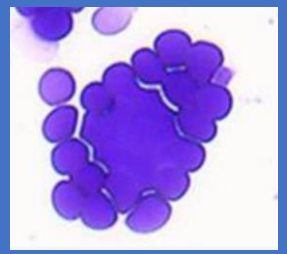
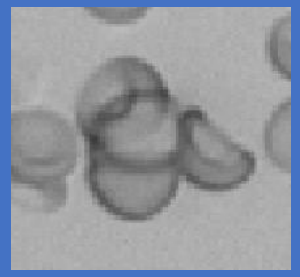
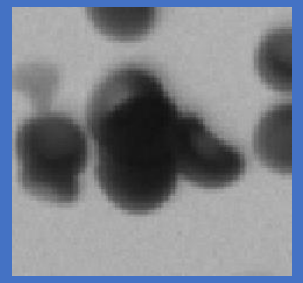
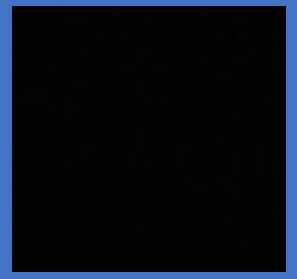
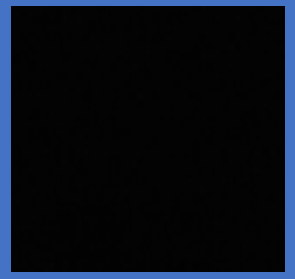
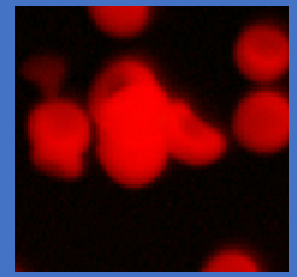


Composite



Red Blood Cells

CREATING CLARITY

	Reference (Blood Smear)	Bright 1	Bright 2	Fluorescent 1	Fluorescent 2	Composite
Normal Red Blood Cell						
Reticulocytes						
Agglutinated RBC's						

Case study

Phil: 8-year-old MN French bulldog

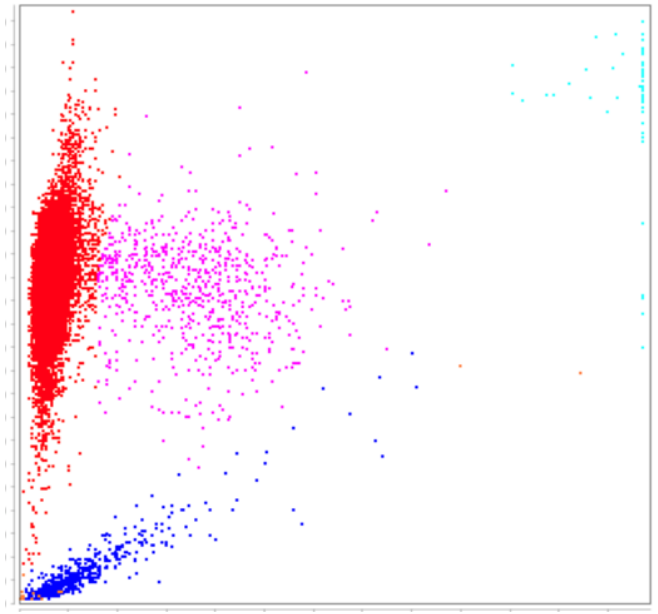
- Presents for vomiting and collapsing

- Exam findings:
  - Muffled heart sounds

CBC Results - RBC

- Mild regenerative anemia
- Small pathologic RBCs
- Mild thrombocytopenia

Phil



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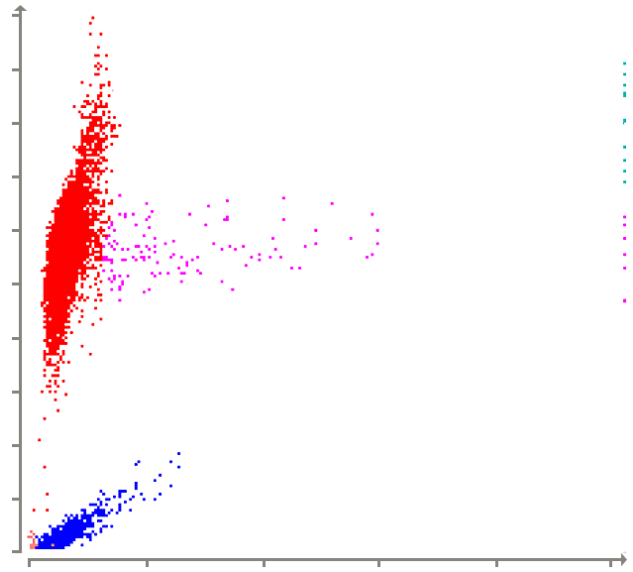
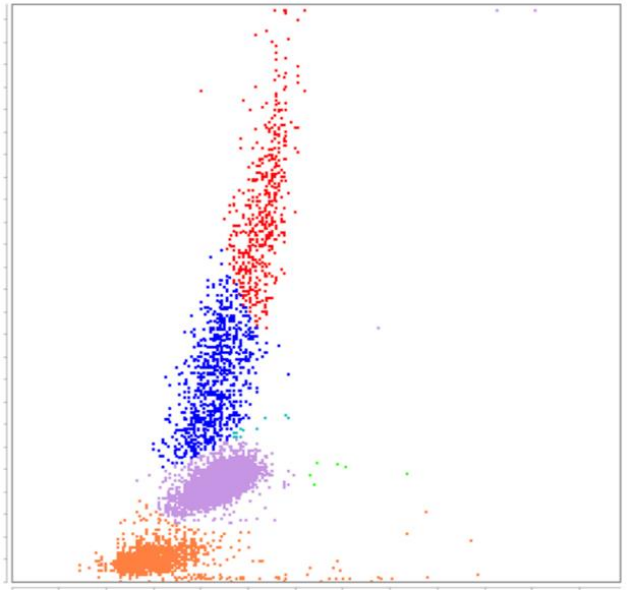


CBC Results - WBC

- Mild regenerative anemia
- Small pathologic RBCs
- Mild thrombocytopenia

- Mild lymphopenia
- Mild eosinopenia
- nRBCs suspected

Phil



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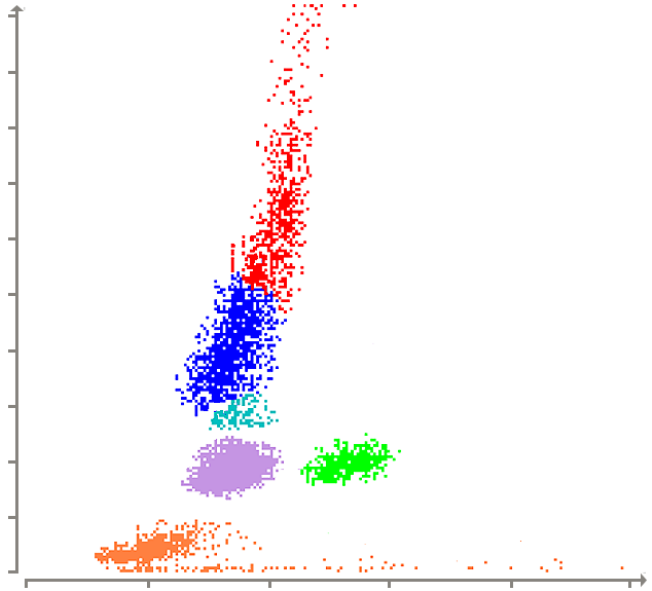
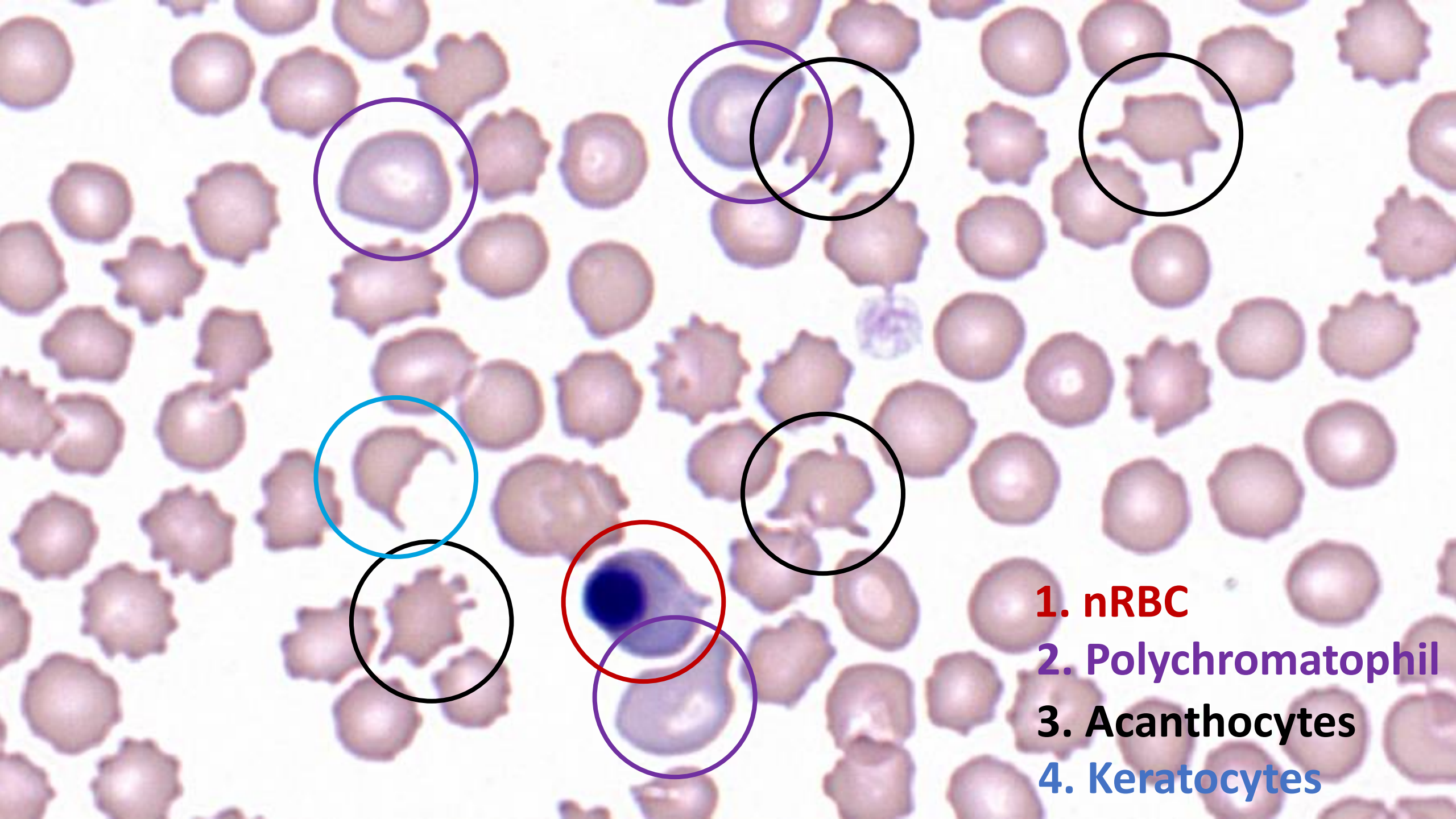
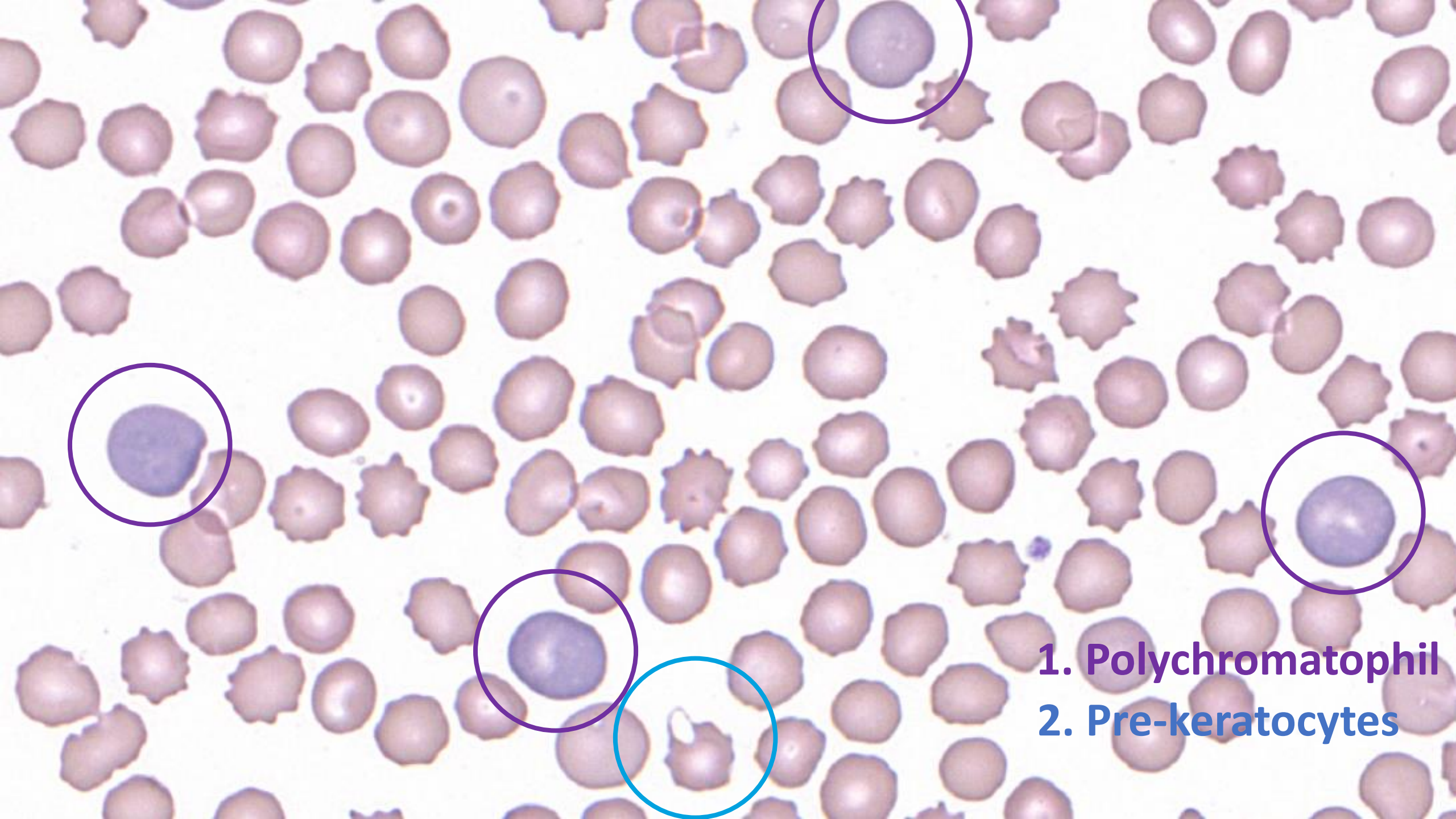


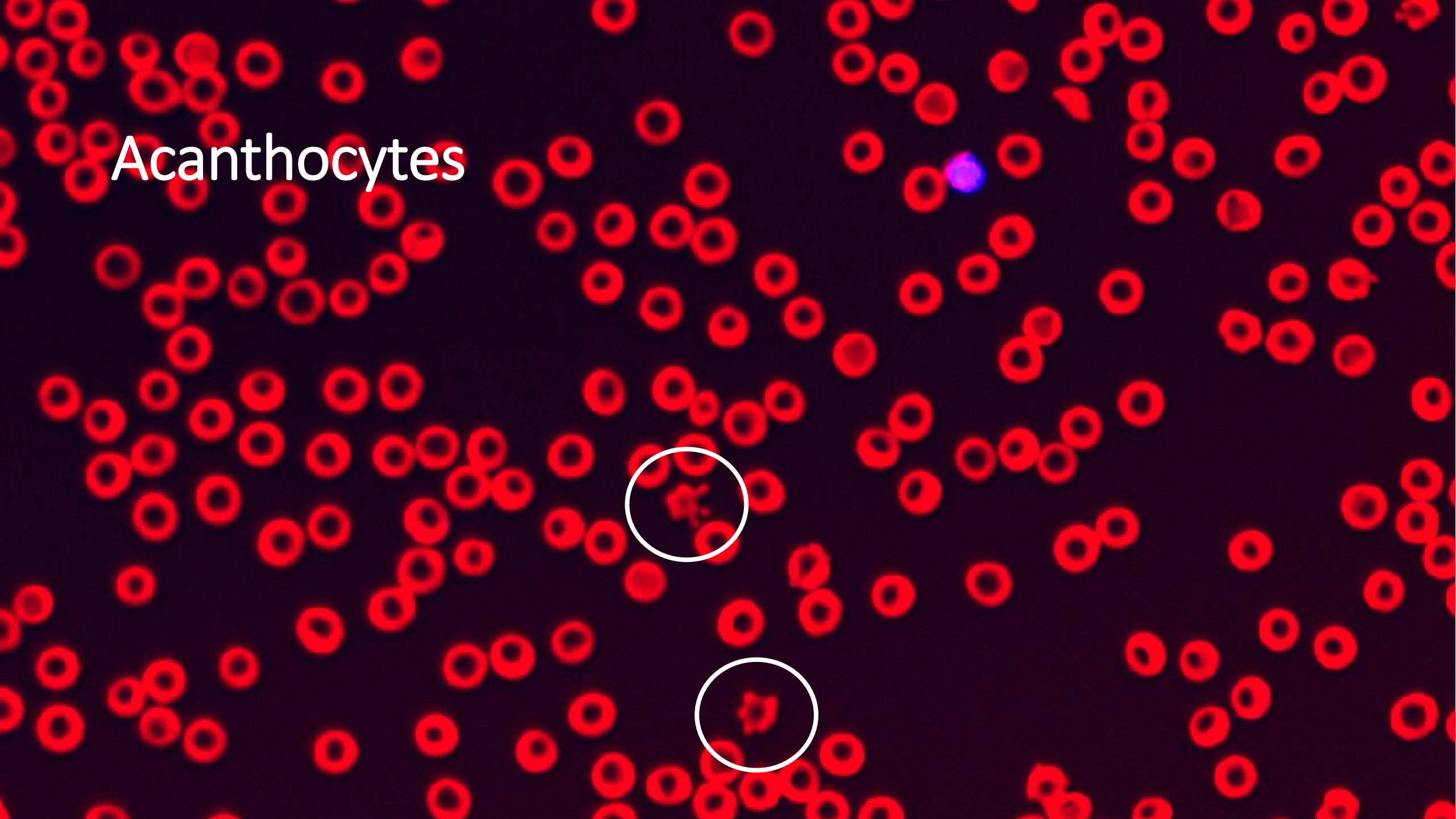

1. nRBC
2. Polychromatophil
3. Acanthocytes
4. Keratocytes

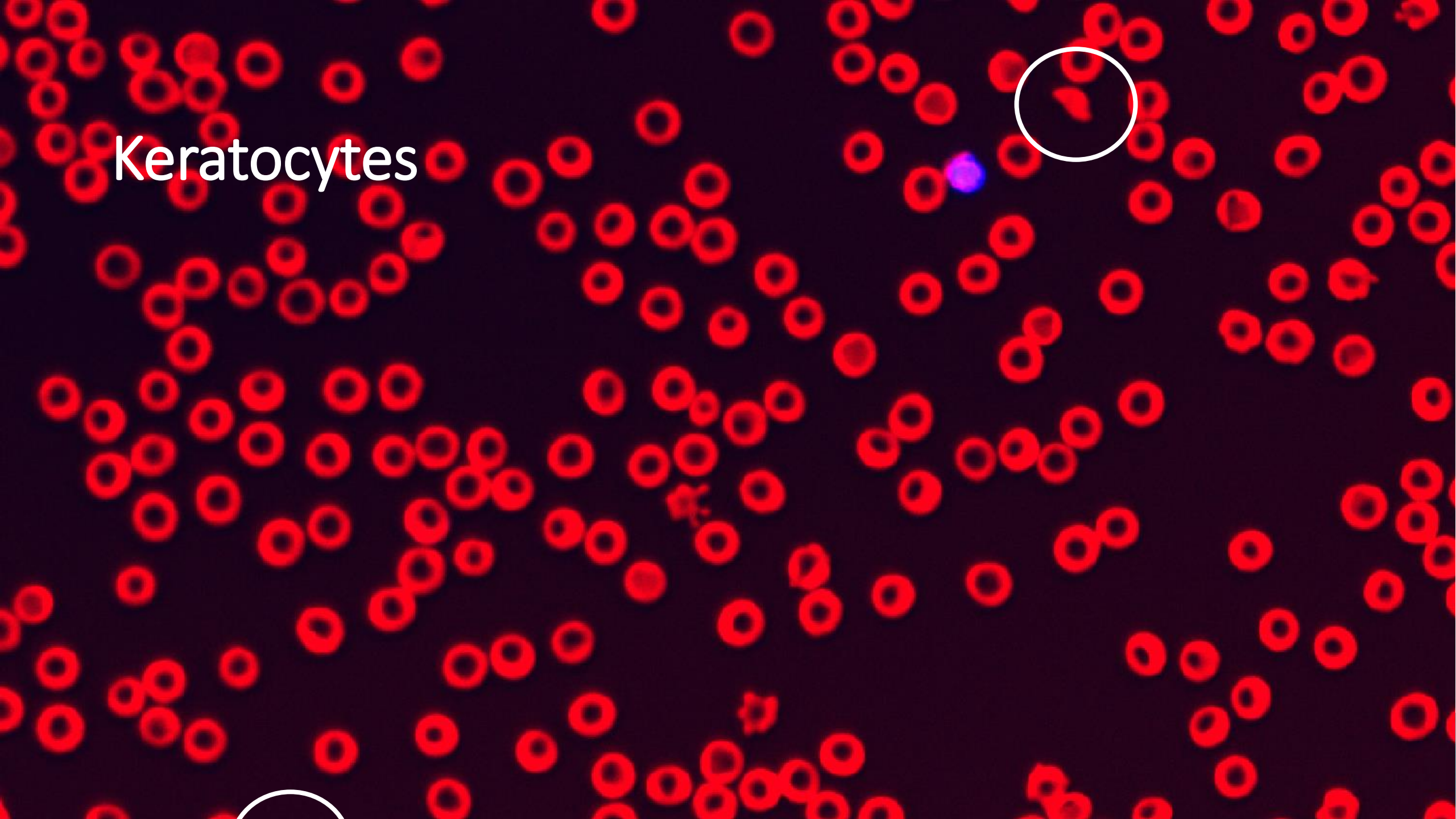

1. Polychromatophil
2. Pre-keratocytes

IDEXX inVue Dx™ Cellular Analyzer

?

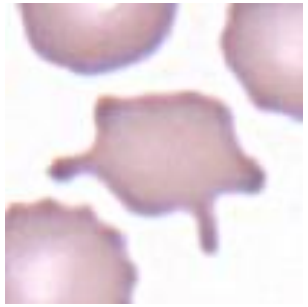
Acanthocytes

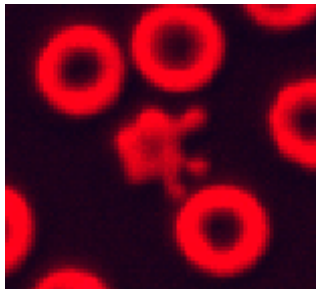



Keratocytes

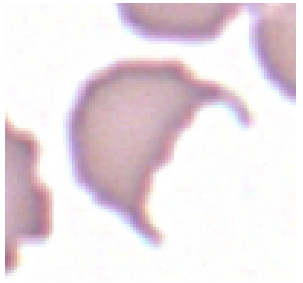
RBC fragmentation

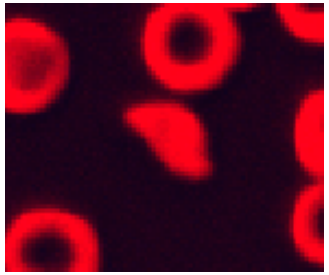
Acanthocytes





Keratocytes





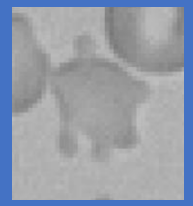
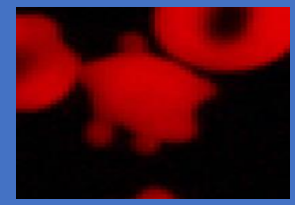
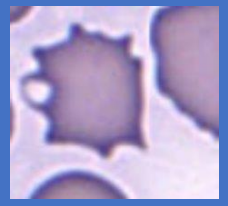
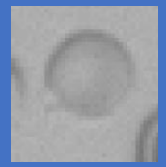
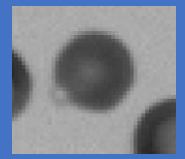
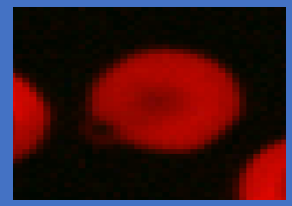
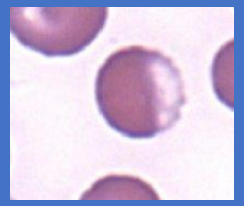
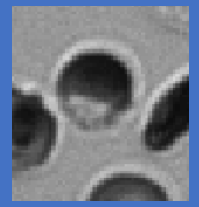
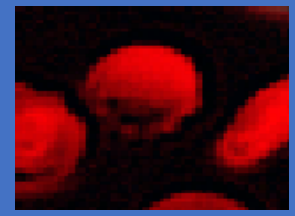
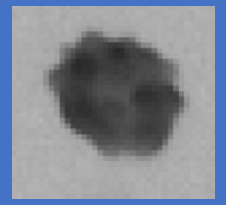
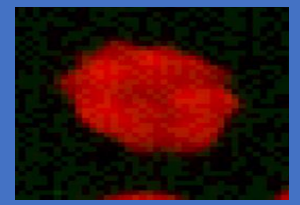
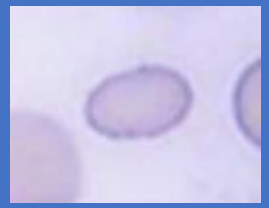
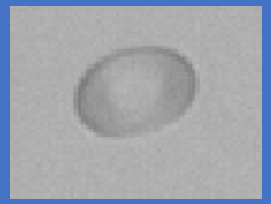
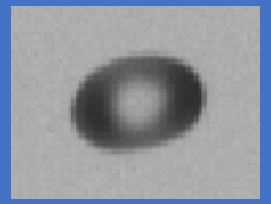
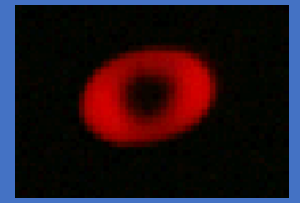
- Liver disease
  - Liver index
- Iron deficiency
  - Microcytosis, Low MCHC, Target cells
- Microangiopathies
  - Hemangiosarcoma
  - Disseminated intravascular coagulation (DIC)
  - Glomerulonephritis
- Various other diseases (renal, gastrointestinal, cardiac)

Phil Case Summary

- Exam findings:
  - CFAST – mild pericardial effusion and heart based mass

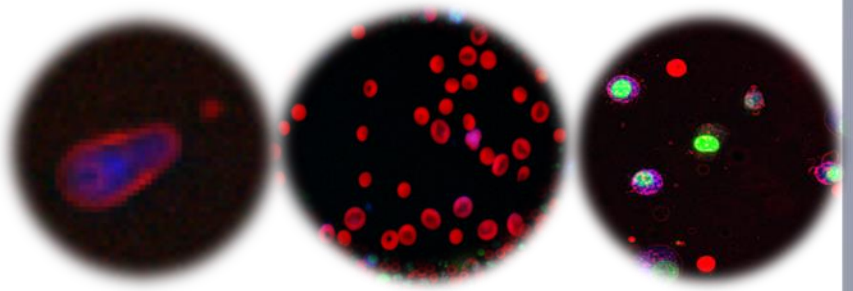
Red Blood Cells

CREATING CLARITY

	Reference (Blood Smear)	Bright 1	Bright 2	Fluorescent 1	Fluorescent 2	Composite
Acanthocytes						
Blister Cells						
Eccentrocyte						
Echinocyte						
Elliptocyte						

IDEXX inVue Dx- Innovating Point of Care Cytology

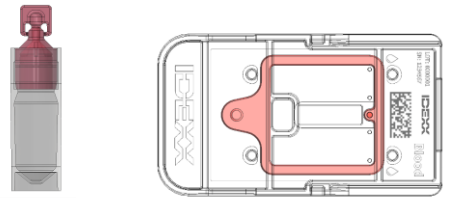
Results
in **10 min**



Ear Cytology | Blood Morphology | FNA Cytology

Launch | Coming Next

Revolutionary Workflow

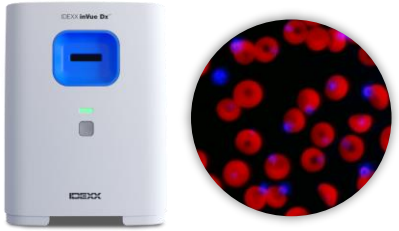


+ Slide free
+ Load-and-go

Expanded Insights

+ Pathologists trained AI
+ Technology for Life

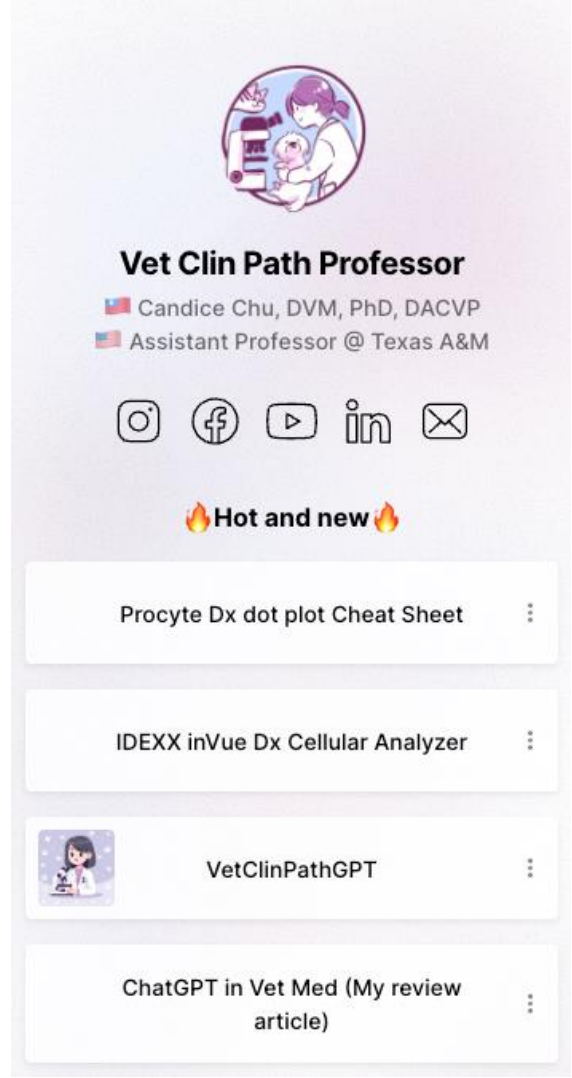
Conclusion – Blood morphology is important!



PLT/WBC	RBC	IDEXX inVue Dx
• Platelet clumps • Mast cells • Histoplasma • Neoplastic cells	• Autoagglutination • Reticulocytes • Spherocytes • nRBC • Acanthocytes • Keratocytes	• Florescent images • Integrated report • Ready in 10 mins

QUESTIONS?

- Candice P. Chu, DVM, PhD, DACVP
- Assistant Professor, Texas A&M University
- cchu@cvm.tamu.edu

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