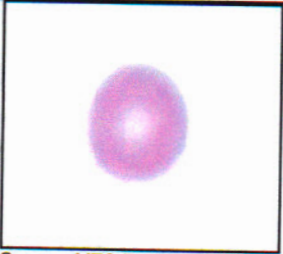
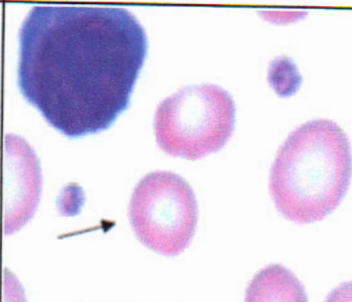
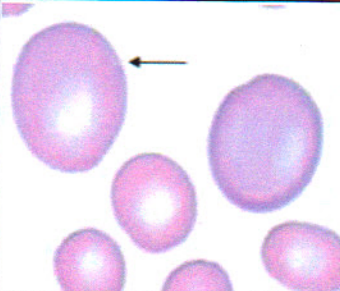
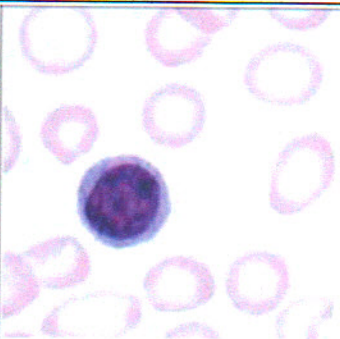
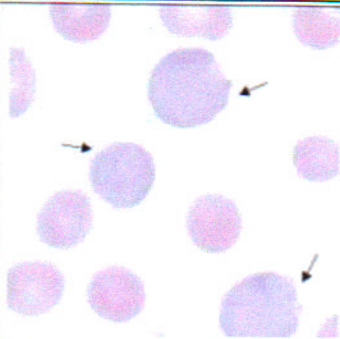



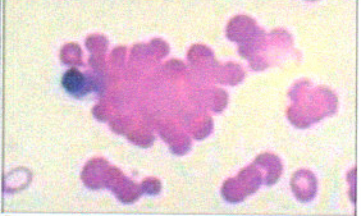
**Reference
Tables**

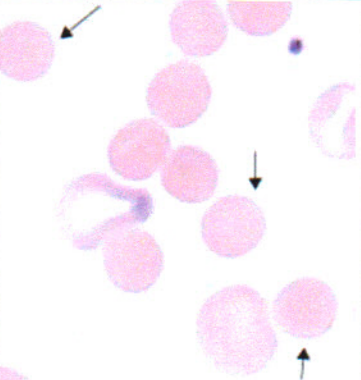
Refer to the tables below for normal and abnormal red blood cell morphology.

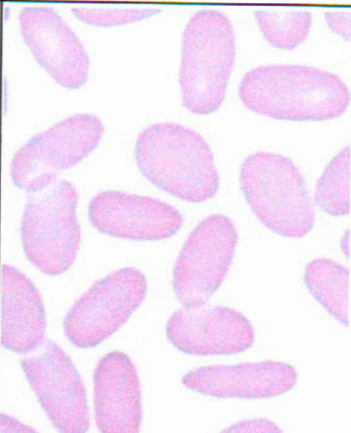
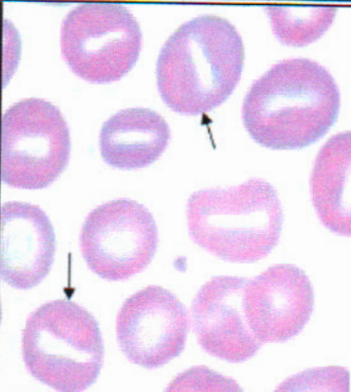

Normal Red Blood Cell			
Size	<ul style="list-style-type: none"> • 6-8 microns in diameter • About the same size as the nucleus of a small lymphocyte 	Shape	<ul style="list-style-type: none"> • Round biconcave disc • High surface to volume ratio • Allows for change of shape as it passes through capillaries • Allows for swelling in hypotonic solution
Color	<ul style="list-style-type: none"> • Pink to reddish-orange in color when stained with Wright's stain. • Have normal size central pallor • Central pallor is the central light staining area of the RBC. • Normal size central pallor is about 2-3 um in diameter. 	Inclusion Bodies	<ul style="list-style-type: none"> • No inclusion bodies • Content is 90% hemoglobin
Image	 <p>Source: MTS Peripheral Blood Lesson</p>		

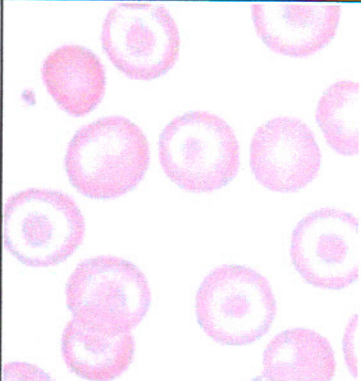
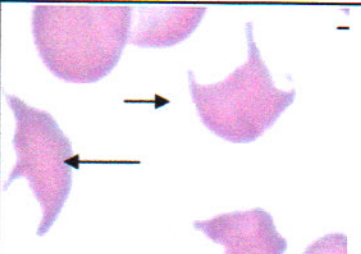
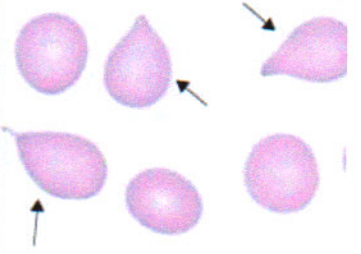
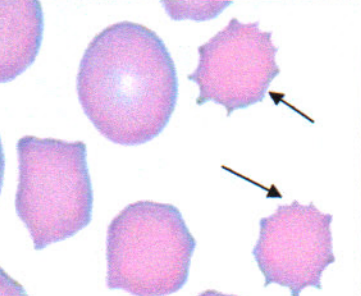
Anisocytosis (Abnormal Size Variations) and Color Variations			
RBC Abnormality	Cell Description	Associated Disease States	Image
Microcytes	<ul style="list-style-type: none"> • Smaller than normal • < 6 um in diameter • Decreased MCV 	<ul style="list-style-type: none"> • Iron deficiency • Thalassemia • Lead poisoning • Anemia of chronic disorders 	 <p>Source: MTS Peripheral Blood Lesson</p>

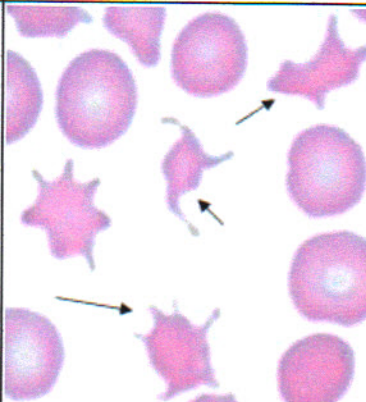
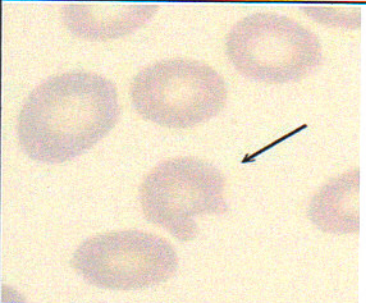
Anisocytosis (Abnormal Size Variations) and Color Variations			
RBC Abnormality	Cell Description	Associated Disease States	Image
Macrocytes	<ul style="list-style-type: none"> • Larger than normal • >8 um in diameter • Increased MCV 	<ul style="list-style-type: none"> • Severe anemia (megaloblastic, iron deficiency) • Liver disease • Hemolytic anemia • Hypothyroidism • Common in newborns 	 <p>Source: Clinical Laboratory Science 5th Edition, Mary Louise Turgeon</p>
Hypochromic (Hypo-chromasia)	<ul style="list-style-type: none"> • Pale cell with increased central pallor • Result of decreased hemoglobin and iron content • Decreased MCHC • Often accompanied by decreased cell size 	<ul style="list-style-type: none"> • Particularly characteristics of iron deficiency anemia 	 <p>Source: Clinical Laboratory Science 5th Edition, Mary Louise Turgeon</p>
Polychromic (Poly-chromasia)	<ul style="list-style-type: none"> • Show faint blue or blue-orange color after Wright's stain • Larger than normal (actually reticulocytes) 	Seen in various hemolytic anemias	

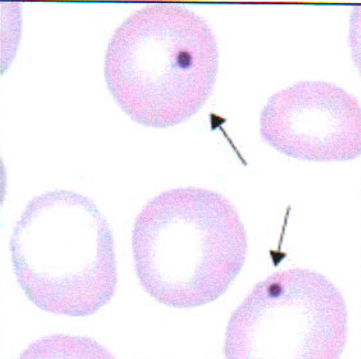
Abnormal Cell Distribution			
RBC Abnormality	Cell Description	Associated Disease States	Image
Rouleaux Formation	RBCs arranged in stacks like coins evenly dispersed	<ul style="list-style-type: none"> Increased plasma protein Multiple Myeloma Macroglobulinemia 	 <p>Source: Navy 2-4 PPT</p>
Agglutination	Clumping of RBCs	<ul style="list-style-type: none"> Presence of a cold agglutinin (antibody) in patient's serum Autoimmune hemolytic state Anemia 	 <p>Source: Navy 2-4 PPT</p>

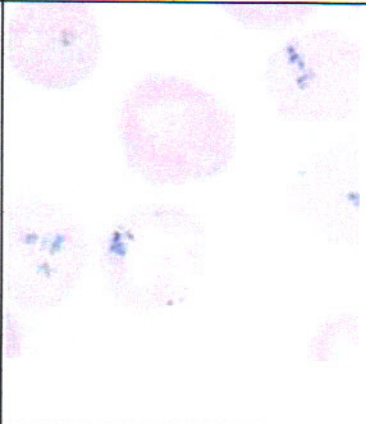
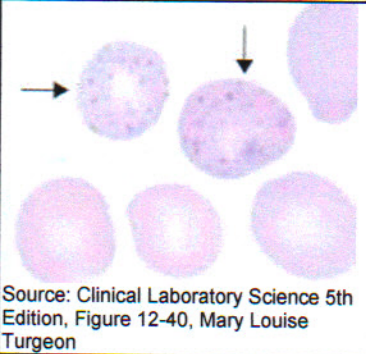
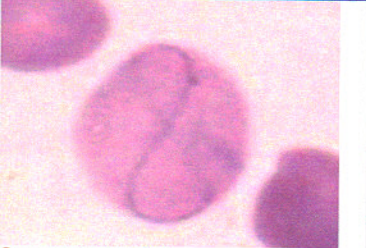
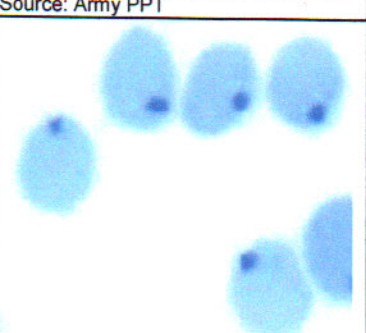
Poikilocytosis (Shape Variations)			
RBC Abnormality	Cell Description	Associated Disease States	Image
Spherocytes	<ul style="list-style-type: none"> Small, round dense cells with lack of central pallor Elevated MCHC Increased hemoglobin content 	<ul style="list-style-type: none"> Hereditary spherocytosis Hemolytic anemia Post transfusion 	 <p>Source: Clinical Laboratory Science 5th Edition, Mary Louise Turgeon</p>

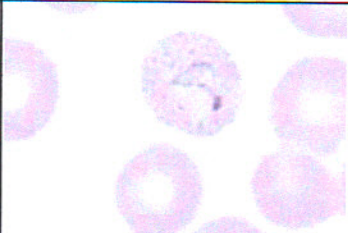
Poikilocytosis (Shape Variations)			
RBC Abnormality	Cell Description	Associated Disease States	Image
Ovalocytes (elliptocytes)	<ul style="list-style-type: none"> Ovalocytes: More egg-shaped Elliptocytes: More pencil-shaped 	<ul style="list-style-type: none"> Ovalocytes Thalassemia Megaloblastic anemia Elliptocytes Hereditary elliptocytosis Iron deficiency anemia 	 <p>Source: Clinical Laboratory Science 5th Edition, Mary Louise Turgeon</p>
Stomatocytes	<ul style="list-style-type: none"> RBCs with slit-like area of central pallor Lack biconcave shape to the cell 	<ul style="list-style-type: none"> Chronic liver disease Hereditary stomatocytosis Obstructive liver disease Alcoholism, cirrhosis 	 <p>Source: MTS Peripheral Blood Lesson</p>
Sickle cells	<ul style="list-style-type: none"> Crescent-shaped cells No central pallor Cells are rigid and inflexible 	Sickle cell anemia HB SC	 <p>Source: Clinical Laboratory Science 5th Edition, Mary Louise Turgeon</p>

Poikilocytosis (Shape Variations)			
RBC Abnormality	Cell Description	Associated Disease States	Image
Target cells	<ul style="list-style-type: none"> Hypochromic cell with central area of hemoglobin pigment Thin cell Resemble targets 	<ul style="list-style-type: none"> Hallmark cell of liver disease Hb SS, SC, C disease Thalassemia Iron deficiency Post splenectomy 	 <p>Source: Clinical Laboratory Science 5th Edition, Mary Louise Turgeon</p>
Schistocytes	<ul style="list-style-type: none"> Extremely fragmented cells Presence should alert immediate medical evaluation. 	<ul style="list-style-type: none"> Disseminated intravascular coagulation (DIC) Hemolytic anemia Artificial heart valves 	 <p>Source: MTS Peripheral Blood Lesson</p>
Dacryocytes (Teardrop cell)	<ul style="list-style-type: none"> Cell with one pointed extremity (in shape of drop) Seen when cells pass through the spleen 	<ul style="list-style-type: none"> Thalassemia Megaloblastic anemia (iron deficiency) Meylofibrosis with myeloid metaplasia 	 <p>Source: Clinical Laboratory Science 5th Edition, Mary Louise Turgeon</p>
Echinocytes (Crenated RBC or burr cell)	<ul style="list-style-type: none"> Rounded spicules evenly distributed over entire surface of RBC Often formed due to increased hypertonic solutions of saline 	<ul style="list-style-type: none"> Liver disease Uremia Hemolytic anemia Hypernatremia 	 <p>Source: MTS Peripheral Blood Lesson</p>

Poikilocytosis (Shape Variations)			
RBC Abnormality	Cell Description	Associated Disease States	Image
Acanthocytes	<ul style="list-style-type: none"> Small cell with few, irregularly spaced spicules of varying length Similar to echinocytes but spicules are irregularly spaced, not uniform spaced, and projections are blunt not pointed 	<ul style="list-style-type: none"> Liver diseases Alcoholism Post-splenectomy Vitamin E deficiency 	 <p>Source: MTS Peripheral Blood Lesson</p>
Keratocyte (Also called bite cells or helmet cells)	<ul style="list-style-type: none"> Cell fragment in shape of football helmet Normal MCV normal 	<ul style="list-style-type: none"> Glucose-6-Phosphate Dehydrogenase (G6PD) deficiency Pulmonary embolism Disseminated intravascular coagulation 	 <p>Source: Army Cell Morphology PPT</p>

RBC Inclusions			
RBC Abnormality	Cell Description	Associated Disease States	Image
Howell-Jolly Bodies	<ul style="list-style-type: none"> Dense, round blue granule Granules are remnants of DNA Eccentrically located in the cytoplasm Seen when RBC maturation is rushed 	<ul style="list-style-type: none"> One: Seen after the spleen is removed Multiple: Megaloblastic anemia 	 <p>Source: Clinical Laboratory Science 5th Edition, , Mary Louise Turgeon</p>

RBC Inclusions			
RBC Abnormality	Cell Description	Associated Disease States	Image
Pappenheimer Bodies (Siderotic granules)	<ul style="list-style-type: none"> Small, beaded blue-purple granules of free iron (not bound by hemoglobin) Located along RBC periphery 	<ul style="list-style-type: none"> Hereditary hemochromatosis Iron loading anemias Thalassemia Following splenectomy 	
Basophilic Stippling	<ul style="list-style-type: none"> Dark blue granules located throughout cytoplasm Have either a dustlike or coarse appearance Appear as a result of RNA and mitochondrial remnants 	<ul style="list-style-type: none"> Lead poisoning Thalassemia 	 <p>Source: Clinical Laboratory Science 5th Edition, Figure 12-40, Mary Louise Turgeon</p>
Cabot's Ring	<ul style="list-style-type: none"> Thin, twisted figure 8 threadlike strands Found in reticulocytes 	<ul style="list-style-type: none"> Seen in lead poisoning Very rare 	 <p>Source: Army PPT</p>
Heinz Body	<ul style="list-style-type: none"> Round, blue granule Not visible in Wright's stain, only in phase contrast 	<ul style="list-style-type: none"> Glucose-6 phosphate dehydrogenase deficiency Hemolytic anemia 	 <p>Source: MTS Peripheral Blood Lesson</p>

RBC Inclusions			
RBC Abnormality	Cell Description	Associated Disease States	Image
Parasites (Malaria)	<ul style="list-style-type: none"> Plasmodium species (parasite) develop within RBCs Might be confused with Cabot's rings, basophilic stippling, Howell-Jolly Bodies, or overlapping platelets 	Malaria	 <p>Source: Clinical Laboratory Science 5th Edition, Mary Louise Turgeon</p>

Lesson Review

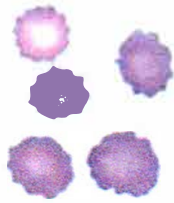
Key Points

- Lesson activity

Write the name of each RBC abnormality *beneath* each of the 12 images.



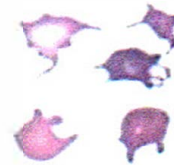
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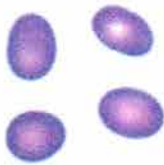
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4. _____



5. _____



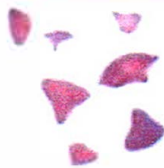
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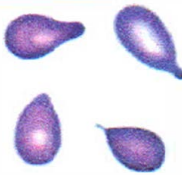
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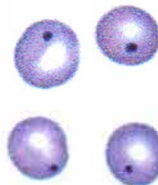
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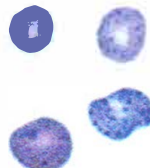
9. _____



10. _____



11. _____



12. _____

Source: Hematology Clinical Principles and Applications, 3rd edition, Bernadette Rodak