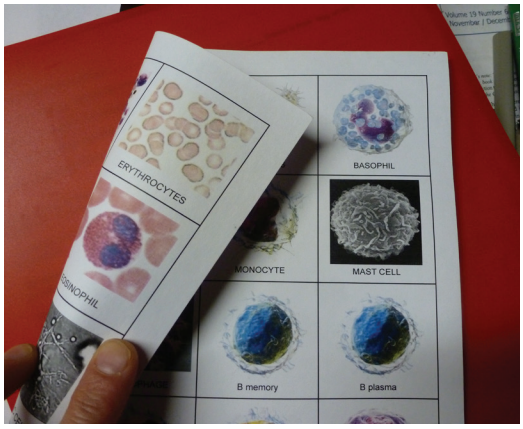
BLOOD CELL BINGO

Target age group: 10 and up
Number of players: any number
Time needed to play: at least 15-20 minutes, but more if you want to play multiple rounds and use all the clues
You will need:

- A set of cell pictures for each player, printed onto card stock (or regular paper if you can't get card stock)
- Small plastic baggies, one for each set of cards
- A copy of the cheat sheets for each player (can make them double-sided)
- Tokens of some kind, to be placed on the squares (coins, paper squares, candies—your choice)
- One copy of the clues
- OPTIONAL: The clues written onto paper cards or squares so they can be drawn out randomly (for this option you will also need a container to draw them out of)

How to prepare:

The cell picture pages can be printed on the opposite sides of one page. This will give you pictures cards that have two different images of the same cell. It will not matter which side you choose, as both pictures are of the same cell. If you prefer actual microscope slide (histology) images, you can choose those. If you prefer spiffy artwork, you can choose those. If you want to mix and match some of each, you can do that, too. If you want to start with one type of image, then turn them over between rounds, that is also an option.



If you don't want to print double-sided copies, you can just choose one set of pictures. You don't have to use both sets of images. This gives you flexibility and choices.

NOTE: See the note at the bottom of the picture pages. These images are not intended to break copyright. Mostly they are from Wikipedia or they are anonymous pictures from university websites. You can find them yourself using Google image search. I just saved you the time and trouble. Since this game is not for sale, this use of the images should be considered "fair use" for educational purposes.

After you have the picture pages copied, cut apart the pictures and put them into separate plastic baggies. Make one set for each player. Provide the players with tokens of some kind, to place on the pictures as clues are given. You can choose edible tokens such as raisins or nuts, or inedibles such as paper squares or coins.

If you will be using an adult "caller" to read the clues, you may want to use the clues in order as they are printed on the clue pages. However, the clues can also be written on cards and put into a box or bag so they can be drawn out randomly. If you are going to use clue set 1 multiple times (to make use of repetition) you will probably want to go with drawing out cards. If you are working with an older group and want to get through all the clues, just read them off the page in order.

How to play:

Give each player a set of cards and 15 tokens. They will choose 16 of their 18 cards and lay them out in a 4x4 square. Between rounds, the cards may be moved and other cards substituted in, but during a single round the cards must stay in place.

Also give each player a copy of one or both "cheat sheets." They will help make the game a learning process, not a total guessing game. (Erythrocytes and platelets are easy in comparison to keeping track of all the leukocytes.)

Begin reading clues. Players put down tokens on the pictures that they think match the clues. If you are drawing clues randomly, make sure the drawn cards are in a neat pile so that you can refer to them when someone calls "Bingo."

As soon as a player has a "Bingo," pause the game, but tell the players not to remove their tokens or mess up their boards. If the would-be-winner has incorrect answers, the game will keep going. If the winner does indeed have the correct cards marked, you can decide whether to end that round right there, or whether you'd like to keep the round going a bit longer. You can make the winner be the caller until there is a second winner.

After you decide a round is over, you can start the next round with the next set of clues, or, if you are reading the clues in order, you can pick up right where you left off. This option might be preferable if you happen to have a very short round where you get a Bingo very early on. If you don't want to waste the rest of the clues, just keep going. When you get to the end of that section of clues (and you are still in the middle of that round) you can either go back to the first clues in that clue set, or you can start into the next set.

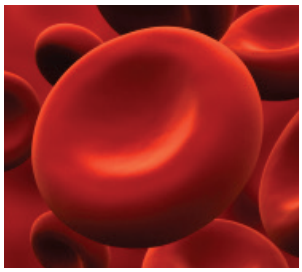
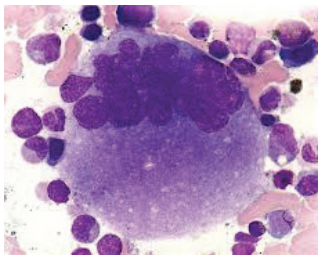
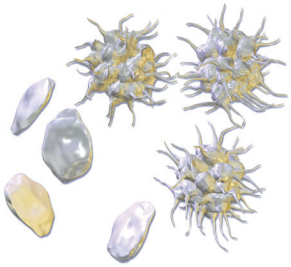
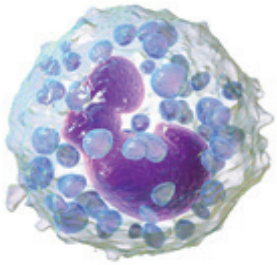
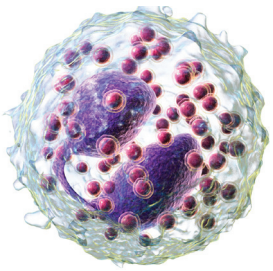
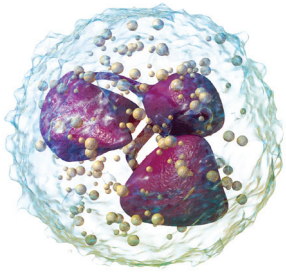
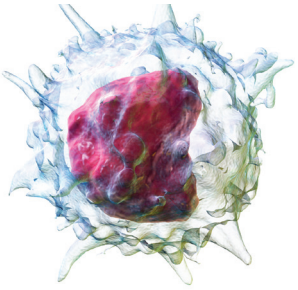
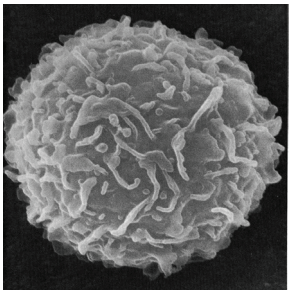
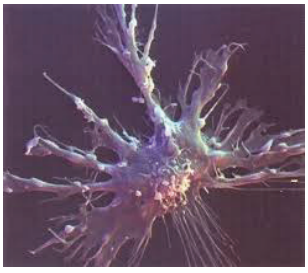
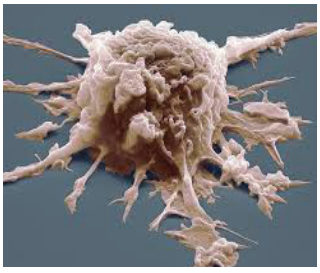
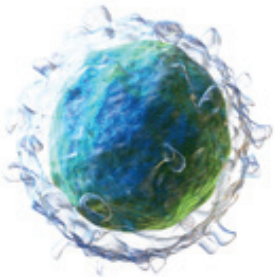
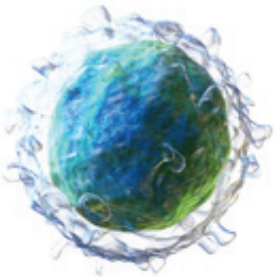
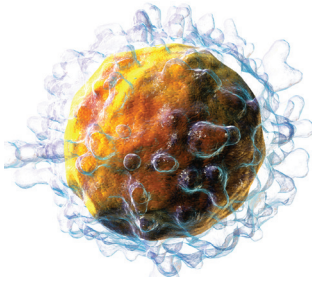
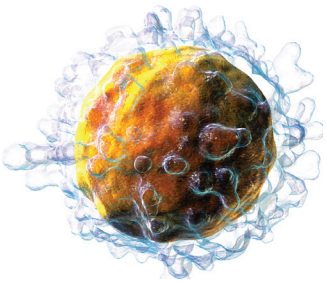
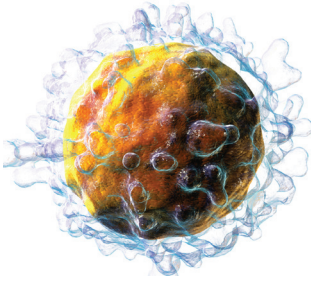
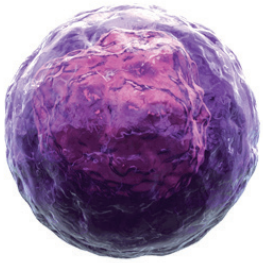
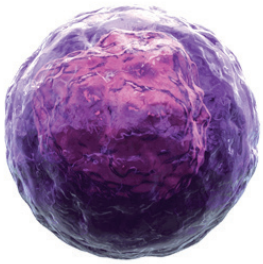
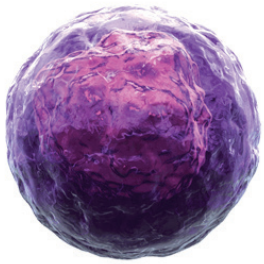
Prizes?

You can decide if you want to offer prizes to the winners. If you are working with older students who have been studying these cells, you can make them play without the cheat sheet and give token prizes to the winners. If you have a group that is enthusiastic about learning, prizes might be totally unnecessary.

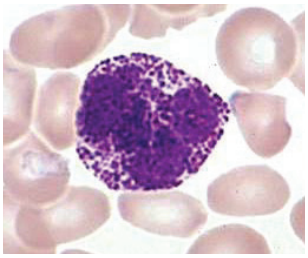
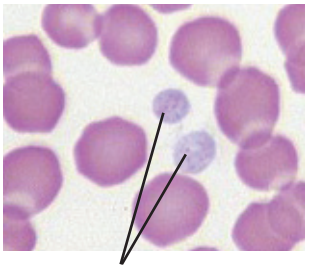
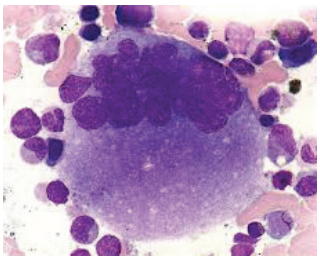
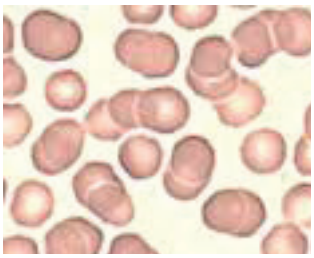
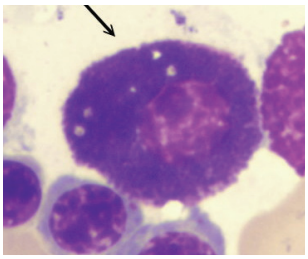
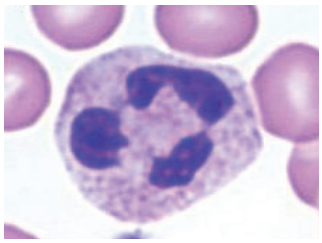
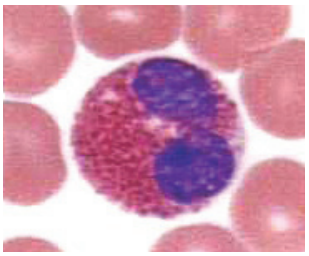
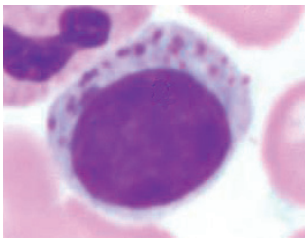
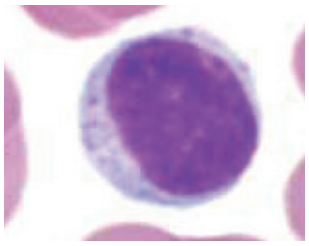
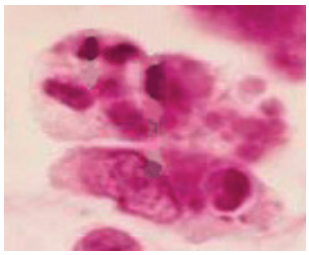
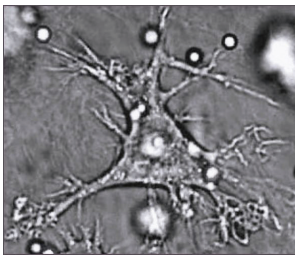
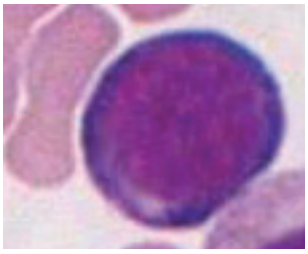
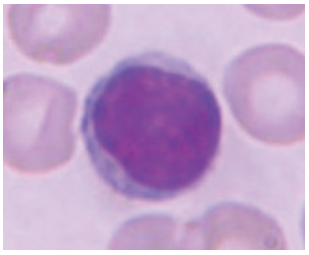
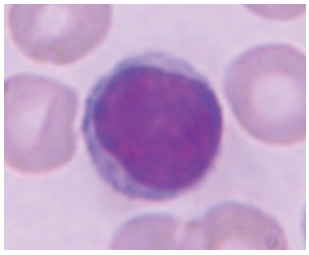
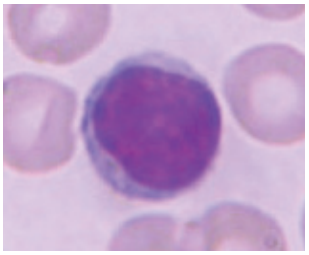
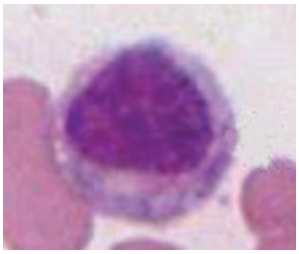
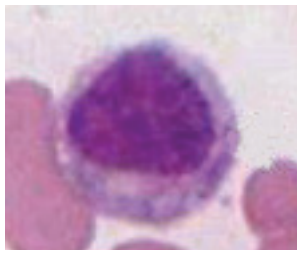
ANOTHER NOTE ABOUT THE PICTURES:

Real cells are not colorful, except for red blood cells. Cells are generally transparent. The cells on the histology slides (the flat images) were stained so that they would be visible. The artists' images of cells also have false color (except for the red blood cell, though even that was enhanced). The color is very nice, but we need to remember that it was added by the artist.

Also, please note that these pictures/photos might be very unlike many drawings you see in textbooks. (This is likely to be true especially for macrophages which are usually drawn as blobby "amebas.") These cells are so tiny (and so complicated) that no one image can accurately convey what they are like. Seeing several different types of pictures can be helpful so that we can see different aspects of the cells (for example, their 3D shape and texture as well as how they take stain).

 ERYTHROCYTE	 MEGAKARYOCYTE	 PLATELETS	 BASOPHIL
 EOSINOPHIL	 NEUTROPHIL	 MONOCYTE	 MAST CELL
 DENDRITIC CELL	 MACROPHAGE	 B memory	 B plasma
 NK (natural killer) cell	 T helper	 T killer (cytotoxic)	 HEMATOPOIETIC stem cell
 LYMPHOID stem cell	 MYELOID stem cell		

These are either artists' renditions, or SEM electron micrographs. (This is NOT what you will see under an ordinary microscope. The other page shows compound microscope images.) This game does not intend to break copyright. Since it is not for sale, it should be considered "fair use" for educational purposes. The colored images are from Wikipedia, uploaded by BruceBlaus. Please consider making a donation to Wikipedia. :)

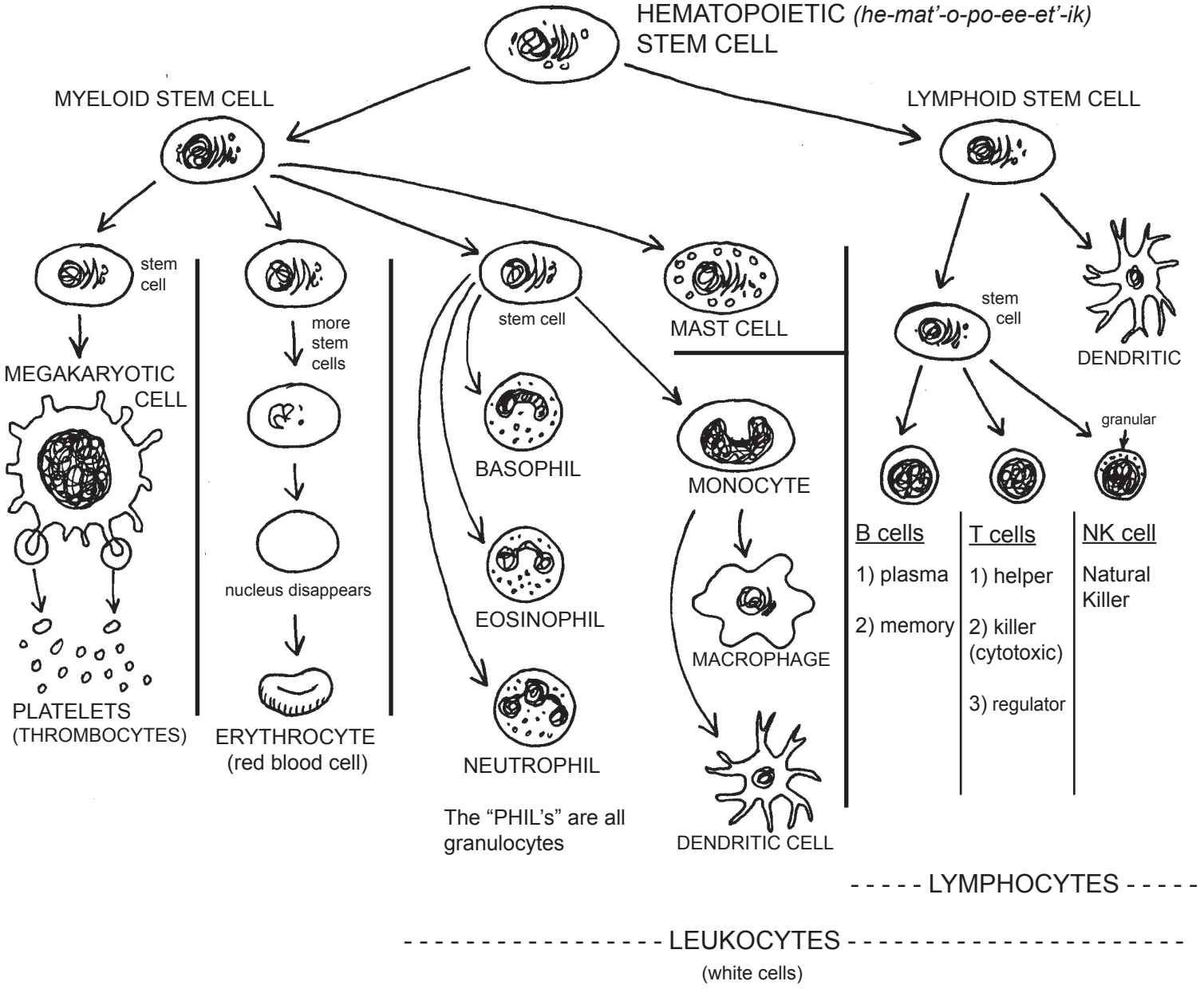
 BASOPHIL	 PLATELETS	 MEGAKARYOCYTE	 ERYTHROCYTES
 MAST CELL	 MONOCYTE	 NEUTROPHIL	 EOSINOPHIL
 B plasma	 B memory	 MACROPHAGE	 DENDRITIC CELL
 HEMATOPOIETIC stem cell	 T killer (cytotoxic)	 T helper	 NK (natural killer) cell
		 MYELOID stem cell	 LYMPHOID stem cell

These are photographs of samples viewed under a regular (compound) microscope (not an electron microscope). These images are easily found on the Internet, and you can view and download them yourself. No explicitly copyrighted images were used.
NOTE: Yes, the T cells are all the same photo. It is almost impossible to find pictures of separate cells because they look alike.

LEUKOCYTE CHEAT SHEET

	Size	Nucleus	Visible granules	approx % among white cells	Innate or Adaptive	Lifespan	Normal location	Main target	Main role it plays	Other facts
Basophil	8-10 microns	2 lobes U-shape	Yes	.5%	Innate	few days	in blood	allergens, venoms	Releases histamine in response to allergens, fights venoms, and sends cytokine messages to other white cells.	Is responsible for life-threating allergic reactions (anaphylaxis)
Eosinophil	10-12 microns	2 lobes U-shape	Yes	2%	Innate	8-12 days	in blood and in tissue, esp. lungs	worms	Attacks parasitic worms and their eggs. Also releases histaminase, which neutralizes histamine.	People with asthma have too many eosinophils in lungs, trachea
Neutrophil	12-15 microns	2 to 5 lobes	Yes	60-65%	Innate	5 days or up to 20 meals	blood	bacteria and fungal spores	Is a "first responder" and migrates from blood into damaged tissue. Kills pathogens by phagocytosis.	1) Can suck iron out of bacteria, thus killing them. 2) Women have extra bump on one lobe of nucleus.
Mast cell	15-20 microns	oval	Yes	not in blood	Innate	few days	loose connective tissue	allergens, venoms	Releases histamine in response to allergens or when body cells are damaged. Also fights venoms.	Mast cells are almost identical to basophils except that they are found in tissues instead of in blood.
Monocyte	12-15 microns	kidney-shaped	No	5%	Innate	10-20 hours in the blood	blood	none, until it differentiates	Differentiates into either a macrophage or a dendritic cell.	A viral infection called Epstein-Barr causes the number of moncytes in the blood to rise.
Macrophage	40-50 microns	large, round	No	not in blood	Innate	100 meals	throughout body	all pathogens, plus old or sick body cells	Eats pathogens by phagocytosis, presents antigens to T cells, gets rid of sick/old red ad white blood cells, secretes many cytokines which are messages to other cells	1) They clean up all cellular messes, dirt and debris 2) They make 3 types of poisons to kill pathogens.
Dendritic cell	12-15 microns	average	No	not in blood	Innate	weeks	lymph nodes, but some go to tissues	all pathogens	Eats pathogens by phagocytosis then presents pieces of those pathogens to T helper cells.	Most dendritic cells come from myeloid stem cells, but there is another type that comes from lymphoid.
Natural Killer	12-15 microns	very large	Yes	2%	Innate	weeks	throughout body	virus-infected cells and tumor cells	Detects and destroys abnormal cells, both infected cells and cancerous cells. (Senses MHC I receptor on cell)	NK cells are related to killer T cells. The difference is that NK cells are not specific like T cells are.
B cell (memory)	10-12 microns	very large	No	6%	Adaptive (Acquired)	years	lymph nodes, but some go to tissues	pathogens outside of cells	Maintains the ability to produce one spedific antibody, in the event that it is ever needed again.	Memory cells can live for decades (possible lifelong in some cases)
B cell (plasma cell)	10-12 microns	very large	No	6%	Adaptive (Acquired)	weeks	lymph nodes, but some go to tissues	pathogens outside of cells	Secretes antibodies against a specific pathogen. Each B cell can only make one type of antibody.	Antibodies can cause pathogens to clump together, making them easier for macrophages to eat.
T cell (helper) (CD4)	10-12 microns	very large	No	12%	Adaptive (Acquired)	weeks	lymph nodes, but some go to tissues	pathogens inside cells	Gets information from antigen-presenting cells, then activates B cells to produce spedific antibodies. Also, sends out chemical "alarm" signals that alert other cells.	1) Some helper T cells will become memory cells. 2) The HIV AIDS virus attacks T helper cells.
T cell (killer) (CD8)	10-12 microns	very large	No	6%	Adaptive (Acquired)	weeks	lymph nodes, but some go to tissues	pathogens inside cells	Kills both pathogen-infected cells (most with viruses) and tumor cells. (Senses MHC I receptor on cells.)	Another name for killer T's is "cytotoxic" T cells.

BLOOD CELL LINEAGE CHEAT SHEET



LEVEL ONE clues

1) This cell delivers oxygen to the other cells of the body. *(erythrocyte)*
2) This cell is involved in the clotting process. *(platelets or megakaryocyte)*
3) This cell is the "big eater." *(macrophage)*
4) This cell gives rise to all the different types of blood cells. *(hematopoietic stem cell)*
5) This cell is found in loose connective tissue and releases histamine. *(mast cell)*
6) This cell makes lots of antibodies. *(B plasma cell)*
7) This cell gives rise to all B cells, T cells, and NK cells. *(lymphoid stem cell)*
8) This is a lymphoid cell, but unlike other lymphoid cells, it is part of the innate immune system. *(NK cell)*
9) This cell attacks parasitic worms and their eggs. *(eosinophil)*
11) This cell uses a chemical weapon (notably perforin) to punch holes in virus-infected cells. It is part of the adaptive/acquired system. *(T killer/cytotoxic)*
11) This cell gives rise to red cells, platelets, macrophages and the granular cells. *(myeloid stem cell)*
12) This cell is a "first responder" because it is part of the innate system. Over 60% of our white cells are of this type. *(neutrophils)*
13) This cell releases histamine like a mast cell but it is found in the blood, not in connective tissue. *(basophil)*
14) These are actually fragments of cells, not whole cells. *(platelets)*
15) This cell is named for its long, branch-like pseudopods. *(dendritic cell)*
16) This cell can live for decades, or perhaps even for a lifetime. *(B memory cell)*
17) This cell activates B cells. *(T helper)*

LEVEL TWO clues

1) This granulocyte uses phagocytosis to eat pathogens, but it does not present antigens. *(neutrophil)*
2) This is the largest phagocytic cell. In the liver it eats old erythrocytes. *(macrophage)*
3) This cell never kills pathogens. It can also be called a CD4 cell. *(T helper)*
4) This cell makes both B and T cells. *(lymphoid stem cell)*
5) This cell has a large kidney-shaped nucleus. (monocyte)
6) This cell fights against venom from insect or animal bites. *(basophil or mast cell)*
7) This cell releases a chemical that can stop the action of histamine. *(eosinophil)*
8) This cell is part of the innate system because it eats pathogens. It is also a link to the adaptive system because it presents pieces of pathogens to T cells. It is about 15 microns in diameter. *(dendritic cell)*
9) This cell matures in the thymus. It kills cells that are infected with viruses. *(T killer/cytotoxic)*
10) This cell contains hemoglobin and iron. *(erythrocyte)*
11) This cell lives primarily in lymph nodes. When activated by a T cell it begins producing massive amounts of antibodies that circulate in the blood, creating the "humoral response." *(B plasma cell)*
12) This cell lives primarily in the germinal centers of lymph nodes. Oddly enough, when it is activated by a T cell, it does NOT become very active. Its job is simply to remember that its unique antibody shape matched a pathogen that the body encountered. If the pathogen comes back, the body will be ready! *(B memory)*
13) This stem cell can make more than a dozen different kinds of cells. *(Hematopoietic stem cell)*
14) When these are activated, their name does not change, but their shape sure does! *(platelets)*
15) This cell is never found in blood, only in tissues. It is responsible for starting inflammation. *(mast cell)*
16) This cell can produce both erythrocytes and platelets. *(myeloid stem cell)*
17) This killer cell is not a T cell, but it did come from a lymphoid stem cell. *(NK)*

LEVEL THREE clues

1) This cell is the most abundant of the lymphoid cells. *(T helper)*
2) This cell is the least abundant of the white cells. Less than 1% of white cells are of this type. *(basophil)*
3) This cell fragment has lots of vesicles that contain things like calcium and clotting factors. *(platelets)*
4) This cell stays in the bone marrow. Its job is to duplicate itself millions of times. Most of these clones will then turn into differentiated cells such as macrophages or T cells, but a few clones will stay undifferentiated and become new stem cells. *(hematopoietic stem cells)* *(clue: makes both macrophages and T cells)*
5) This cell can kill bacteria by sucking iron out of them. It also makes oxygen-based toxins. *(neutrophil)*
6) This type of cell is a killer but does not react to a specific antigen like cytotoxic T cells do. It checks for "self" proteins on the cell's outer membrane. If there are not enough "self" tags, the cell will be killed. *(NK)*
7) This cell cleans up any and all messes in tissues. It will even eat microscopic bits of dirt. *(macrophages)*
8) This cell attacks body cells that have become infected with viruses. It looks for viral antigens on the cell's MHC 1 receptor. This cell will also kill cancer cells. *(T killer/cytotoxic)*
9) This cell contributes to asthma attacks. *(eosinophils)*
10) The Epstein-Barr virus causes a higher than normal amount of this cell in the blood. *(monocyte)*
11) This cell secretes antibodies that can cause pathogens to clump together (agglutination). *(B plasma)*
12) This cell makes the granulocytes whose names end in "-phil." *(myeloid stem cell)*
13) This cell has a huge nucleus but it is not a leukocyte. *(megakaryocyte)*
14) This cell is not found in blood. It helps to stop venom from spreading throughout the body. *(mast cells)*
15) This cell lost its nucleus and organelles. Its lifespan is about 120 days. *(erythrocyte)*
16) This cell can produce its own version of dendritic cells. *(lymphoid stem cell)*
17) This cell does not interact with pathogens directly. It can live for many years. *(B memory)*
18) This cell eats pathogens and presents their pieces, but does not secrete as many cytokine messages as a macrophage does. *(dendritic cell)*

LEVEL FOUR clues

1) This cell is not much larger than an erythrocyte and only lives a few days in the blood. *(basophil)*
2) The kidneys give the signal to produce more of these cells. The signal is called erythropoietin. *(erythrocyte)*
3) This granulocyte can be used to determine whether the blood is from a male or female. In females there is an extra bit sticking out of one of the lobes. This is called the "drumstick." *(neutrophil)*
4) This cell is the target of the HIV AIDS virus. *(T helper)*
5) This cell is part of the humoral response. It was activated by a T cell, but produces very few antibodies. *(B memory)*
6) This cell makes IgG's. *(B plasma)*
7) This cell interacts with the MHC I receptor on body cells. It is also called the CD8 cell. *(T killer/cytotoxic)*
8) About 5% of the leukocytes in our blood are this type of cell. *(monocyte)*
9) About 2% of the leukocytes in our blood are this type of cell. *(eosinophil)*
10) This cell might get the award for having the greatest number of functions. It eats pathogens, presents antigens, makes three kinds of toxins plus for killing pathogens internally, secretes a large number of cytokines (messenger molecules), and also acts as the body's clean up crew for all cellular messes. *(macrophage)*
11) These cell fragments are responsible for starting the blood clotting cascade. *(platelets)*
12) The name of this cell contains a Greek word that means "to make." *(hematopoietic stem cell)* *("poiein")*
13) This cell might be considered a type of T cell except that it is part of the innate system, not the adaptive system. It kills both virus-infected cells and cancer cells. *(NK)*
14) This cell is made by the myeloid stem cell, but it is not a leukocyte or an erythrocyte. *(megakaryocyte)*
15) This is the only cell that is listed as both lymphoid and myeloid. *(dendritic)*
16) This is the largest granulocyte. *(mast cell)*
17) This stem cell produces natural killer (NK) cells. *(lymphoid stem cell)*
18) This stem cell produces both red and white cells. *(myeloid stem cell)*