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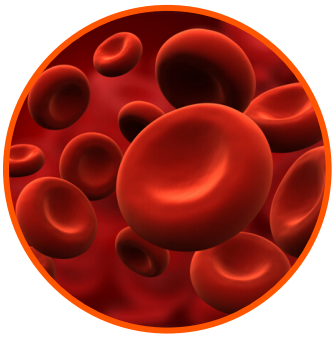
Introduction to Circumference, Area, and Diameter of Circles

Hematologists are scientists that study blood. Today, you will be a hematologist and learn about different blood cells. Then, you will calculate the circumference, and area of blood cells of different patients. Finally, you will figure out if patients might have a blood disorder based on the size of their blood cells.

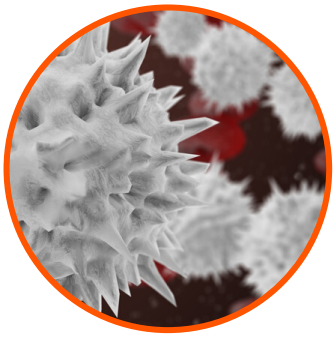
Step 1: Learn about Blood Cells

The blood in your body is made up of plasma, a fluid that has nutrients in it, and blood cells. There are 3 different types of blood cells and each blood cell has a different job.



Red blood cells (RBCs):

These blood cells are shaped like disks with a tiny indent. RBCs contain a substance called hemoglobin that carries oxygen. As RBCs move through the body, hemoglobin releases oxygen to different body areas. RBCs are about 6-8 micrometers (μm) in diameter.



White blood cells (WBCs):

These blood cells are shaped like a round ball and are very large. The are about 12-17 μm in diameter, three times the size of red blood cells. WBCs help the human body defend itself against infection. They protect the body from germs, like bacteria and viruses. Some WBCs make antibodies, which are proteins that recognize unhealthy substances in the body and help get rid of them.

Platelets:

These blood cells are very small, only 2-3 μm in diameter. They help blood clot. If a blood vessel breaks, platelets gather in the area and stop the blood from leaking out.

Step 2: Learn about Blood Cell Disorders

A blood cell disorder occurs when a person has a problem with their blood cells. There are many blood disorders that affect the shape of the blood cell. When the shape of blood cells are affected, the function of the blood cells can also be affected. Below are 3 types of blood cell disorders that affect the size and function of blood cells.

Microcytic anemia:

This disorder occurs when red blood cells are too small. When this happens, your body may cannot properly transport oxygen. Symptoms of microcytic anemia include feeling tired, dizzy, or weak.

Macrocytosis:

This disorder occurs when red blood cells are too big. When this happens, it is not usually life threatening. However, this disorder could suggest that a person has a thyroid disease, lung disease, or liver disease.

Giant Platelets:

This disorder occurs when platelets abnormally clump together and cause giant platelets. Giant platelets do not stick well to injured blood vessels and can actually cause more bleedin

Atypical White Blood Cells:

This disorder occurs when white blood cells are too big or too small. When this occurs, it is not usually life-threatening, but can indicate that a person has another type of disease.

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Step 3: Review Area and Circumference of Circles

One way that hematologists can figure out if a person has a blood disease is by calculating the area and circumference of cells. If cells are too small or too big, a blood disorder may be present.

Note: Blood cells are not perfect circles. However, for the purpose of learning, we will think about blood cells as 2-dimensional circles.

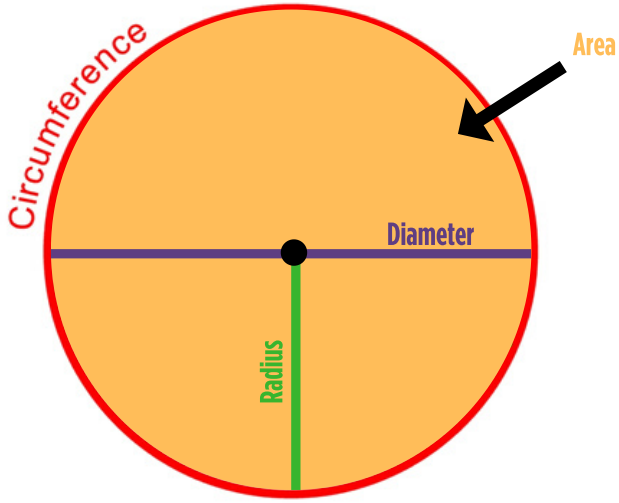
Formulas to calculate area and circumference:

Note:
r = radius d = diameter $\pi = 3.14$

Diameter
Diameter = $2r$

Circumference
Circumference = πd
or
Circumference = $2 \pi r$

Area:
Area = πr^2



Step 4: Identify Blood Cell Disease in Patients

On the next page, you will see medical information on 5 patients. For each patient, the area or circumference for blood cells has been provided. As a hematologist, it is your job to figure out if these patients have a blood disease or not by calculating the diameter of the blood cells. You will need to use a calculator.

Range of normal diameter of blood cells:

Red Blood Cell: 6-8 μm
White Blood Cell: 12-17 μm
Platelet: 2-3 μm

Blood disorder summary:

Microcytic anemia: Red blood cells are smaller than normal
Macrocytosis: Red blood cells are bigger than normal
Giant Platelets: Platelets are bigger than normal
Atypical white blood cells: White blood cells are bigger or smaller than normal

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Introduction to Circumference, Area, and Diameter of Circles

Here is an example!

Information on Patient:

- Area of red blood cells: 29 μm^2
- Area of white blood cells: 300 μm^2
- Circumference of platelets: 7 μm

Calculate the diameter of each type of blood cell. Show your work below.

- Red Blood Cell:

  $A = \pi r^2$

  $\frac{29}{\pi} = \frac{\pi r^2}{\pi}$

  $9.24 = r^2$

  $\sqrt{9.24} = \sqrt{r^2}$

  $3.03 = r$

  $(2)\ 3.03 = d$

  $6.06 = d$

  Healthy

- White Blood Cell:

  $A = \pi r^2$

  $\frac{300}{\pi} = \frac{\pi r^2}{\pi}$

  $95.54 = r^2$

  $\sqrt{95.54} = \sqrt{r^2}$

  $9.77 = r$

  $(2)\ 9.77 = d$

  $19.54 = d$

  Unhealthy - too large

- Platelets:

  $C = \pi d$

  $\frac{7}{\pi} = \frac{\pi d}{\pi}$

  $2.23 = d$

  Healthy

Does this patient have a blood disorder? (YES) NO

If yes, which disorder(s) and why?

This patient has atypical white blood cells. When we compare each of the three types of blood cells to the healthy ranges, the red blood cells and the platelets are both within healthy ranges, but the white blood cells are too large. The disorder that includes white blood cells that are too large is atypical white blood cells.

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Introduction to Circumference, Area, and Diameter of Circles

Patient #1

Information on Patient:

- Area of red blood cells: 52 μm^2
- Area of white blood cells: 7 μm^2
- Area of platelets: 8 μm^2

Calculate the diameter of each type of blood cell. Show your work below.

- Red Blood Cell:

- White Blood Cell:

- Platelets:

Does this patient have a blood disorder? YES ☐ NO ☐

If yes, which disorder(s) and why?

Name: _____

Introduction to Circumference, Area, and Diameter of Circles

Patient #2

Information on Patient:

- Circumference of red blood cells: 15 μm
- Circumference of white blood cells: 42 μm
- Circumference of platelets: 8 μm

Calculate the diameter of each type of blood cell. Show your work below.

- Red Blood Cell:

- White Blood Cell:

- Platelets:

Does this patient have a blood disorder? YES ☐ NO ☐

If yes, which disorder(s) and why?

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Introduction to Circumference, Area, and Diameter of Circles

Patient #3

Information on Patient:

- Area of red blood cells: 24 μm^2
- Circumference of white blood cells: 50 μm
- Circumference of platelets: 7 μm

Calculate the diameter of each type of blood cell. Show your work below.

- Red Blood Cell:

- White Blood Cell:

- Platelets:

Does this patient have a blood disorder? YES ☐ NO ☐

If yes, which disorder(s) and why?

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Introduction to Circumference, Area, and Diameter of Circles

Patient #4

Information on Patient:

- Circumference of red blood cells: 20 μm
- Circumference of white blood cells: 55 μm
- Area of platelets: 5 μm^2

Calculate the diameter of each type of blood cell. Show your work below.

- Red Blood Cell:

- White Blood Cell:

- Platelets:

Does this patient have a blood disorder? YES ☐ NO ☐

If yes, which disorder(s) and why?

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Introduction to Circumference, Area, and Diameter of Circles

Patient #5

Information on Patient:

- Area of red blood cells: 47 μm^2
- Area of white blood cells: 120 μm^2
- Circumference of platelets: 7 μm

Calculate the diameter of each type of blood cell. Show your work below.

- Red Blood Cell:

- White Blood Cell:

- Platelets:

Does this patient have a blood disorder? YES ☐ NO ☐

If yes, which disorder(s) and why?