

## 6<sup>th</sup> Grade: HUMAN BODY (Reproductive System and Body Changes in Adolescence)

### Rational of this unit

At this age, children's height and weight will suddenly increase as internal organs develop. Secondary sexual characteristics will develop and reproductive organs will also start to mature. Some of these children will also experience menstruation (periods) or ejaculation. Such new experiences can be a shocking event, and there will be those who will have concerns and worries or view their own sexuality negatively, not knowing how to react. Additionally, sudden growth in certain individuals' bodies and gender differences will affect them mentally. This can result in them showing great interest in their own bodily development and changes or possibly feeling a sense of inferiority. These secondary sexual characteristics are accompanied by mental states of insecurity particular to adolescence.

Therefore, in order to deepen understanding about secondary sexual characteristics with a focus on the reproductive system, our aim is for pupils to understand the differences in name and function of male and female reproduction, reduce their anxiety and worries associated with menstruation(periods) and ejaculation, and be able to adapt to their own sexuality. Hope is that they will also actively deal with emotional changes associated with secondary sexual characteristics, handle their own sexuality and develop an attitude of understanding and consideration for those of the opposite sex.

### Objectives: what pupils are expected to achieve in this unit

- Know the names and functions of the various male and female reproductive organs, and become capable of actively dealing with their own sexuality while correctly understanding secondary sexual characteristics.
- Realize the anxiety and worries that will come with secondary sexual characteristics and become capable of adapting to their own sexuality.
- Have mutual respect between girls and boys and develop an attitude that respects those of the opposite sex the same as oneself.

### Interrelation of contents of each grade

\* The order below is as shown in the syllabus.

Grade	What to teach (Human Body)
1 <sup>st</sup> Grade	<ul style="list-style-type: none"> <li>• Exterior parts of the human body – head (eyes, ears, nose, hair, mouth), neck, chest, arms (hands, elbows, fingers, nails), legs (knees, feet, toes, toenails))</li> </ul>
2 <sup>nd</sup> Grade	<ul style="list-style-type: none"> <li>• The five senses – smell, taste, touch, sight and hearing</li> <li>• Using sensory organs</li> </ul>
3 <sup>rd</sup> Grade	<ul style="list-style-type: none"> <li>• Sight – eyesight and far, close, big, and small objects</li> <li>• Using proper body language for your community including facial expression and hand signals</li> </ul>
4 <sup>th</sup> Grade	<ul style="list-style-type: none"> <li>• Types of teeth – incisors, canines, premolars and molars</li> <li>• The function of different tooth types</li> <li>• Development of teeth (losing baby teeth, eruption of permanent teeth)</li> </ul>
5 <sup>th</sup> Grade	<ul style="list-style-type: none"> <li>• Respiratory system names – nose, trachea, bronchi, lungs, diaphragm</li> <li>• Function of the respiratory system – nose, trachea, lungs, diaphragm</li> <li>• Digestive system names – mouth (teeth and tongue), oesophagus, stomach, small intestine, liver, pancreas, colon, rectum, anus</li> <li>• Function of the digestive system – teeth, oesophagus, stomach, small intestine, colon</li> </ul>
6 <sup>th</sup> Grade (This unit)	<ul style="list-style-type: none"> <li>• Organs of the reproductive system – female (ovaries, oviducts, womb, vagina) and male (testes, urethra, penis)</li> <li>• Various functions of the reproductive system</li> <li>• Adolescent changes – bodily changes, male and female</li> </ul>
7 <sup>th</sup> Grade	<ul style="list-style-type: none"> <li>• Organs of the circulatory system – heart, blood, blood vessels</li> <li>• Components and function of blood – plasma, red blood cells, white blood cells, platelets</li> <li>• Types and function of blood vessels – arteries, veins, capillaries</li> <li>• Structure and function of the heart –atrial auricle (atriaums), ventricles, blood vessels (aorta, vena cava, pulmonary vein, pulmonary artery)</li> </ul>
8 <sup>th</sup> Grade	<ul style="list-style-type: none"> <li>• Fertilisation</li> <li>• Foetal development – zygote, embryo, foetus</li> <li>• The process of birth</li> <li>• Excretory organs and waste products – skin (epidermis, dermis, sweat glands, sweat as a waste product), lungs (nose, trachea, and carbon dioxide as a waste product), kidneys (kidney's appearance, urethra, bladder, waste products from</li> </ul>

the urethra as urine

## Before starting this unit

### Current learning status of the pupils

To a certain extent 6<sup>th</sup> grade children already know about the differences between the male and female body, but they do not have a correct understanding of things like menstruation (periods) and ejaculation that come with the maturation of reproductive organs. They also do not understand that emotional changes accompany development of secondary sexual characteristics.

### Preparatory Notes

- Pupils are to write on their worksheets and move through their study while confirming details such that each one of them properly understands the differences in the male and female body as well as the names and function of the reproductive organs.
- Teachers are to give warm advice and guidance to let pupils understand that there are differences in the phenomena of how male and female reproductive organs mature, but that these are proof that they are growing up into adults. Also give advice such that they can accept their own sexuality and understand each other.

## Objectives to be achieved by competency

### Interest, motivation, and attitude

1. To willingly investigate questions they may have with their interest in male and female bodily development.
2. To willingly investigate questions they may have with their interest in adolescent bodily changes.

### Scientific thinking and communication activities

1. Ability to relate and examine the structure and function of reproductive organs, enter them in the worksheet and explain them.
2. Ability to examine bodily changes that will occur to them while comparing to their current bodies.

### Knowledge, understanding, and skills in observation and experimentation

1. Ability to know the names of the female reproductive organs (vagina, womb, endocervix, ovum, ovaries and oviducts).
2. Ability to understand the function of the female reproductive organs (ovaries, oviducts, womb, vagina).
3. Ability to know the names of the male reproductive organs (penis, urethra, scrotum, testes, spermatic duct).

4. Ability to understand the function of the male reproductive organs (testes, spermatic duct, penis, urethra and scrotum).
5. Ability to understand the physical and emotional changes boys and girls go through.
6. To know about HIV/AIDS and other sexually transmitted diseases and the importance of preventing them.

## Ideas behind the structuring the unit

Structural illustrations to investigate and activities aiming at better understanding of the names and functions of male and female reproductive organs have been included. In these activities, we make pupils realize things like how the names and functions of reproductive organs may be different but they are proof that they are growing up into adult men and women, and that reproduction has the important function of bringing a new life into the world. Teachers should attempt to create a classroom environment in which pupils understand each other and can accept their own sexuality.

Illustrations have been prepared such that pupils can perceive the bodily changes of the male and female body and compare them, and also enter what they have figured out on worksheets.

## Unit teaching plan

### (9 periods + 1 period for the Final Unit Evaluation Test)

\* The numeric value in parentheses represents the corresponding period (e.g. 1) means the first period).

\* (Evaluation: *Knowledge and Skills 1*), (Evaluation: *Interest 1*), etc. indicate the points at which teachers can check whether the pupils have attained the goals specified in the section *Objectives based on the viewpoint*.

Sub-Unit	Description
<b>1. Names and Function of Female Reproductive Organs</b> (3 periods)	1) Find out the names of female reproductive organs needed to pass on new life and record them in the worksheet. • Understand the names of the female reproductive organs (vagina, womb, endocervix, ovum, ovaries and oviducts).  2-3) Find out the functions of female reproductive organs and record them in the worksheet. • Understand the function of the female reproductive organs (ovaries, oviducts, womb and vagina).  <i>(Evaluation: Interest 1, Knowledge and Skills 1)</i>
<b>2. Names and Function of Male Reproductive Organs</b>	4) Find out the names of male reproductive organs needed to pass on new life and record them in the worksheet.  <i>(Evaluation: Thinking and Representation 1, Knowledge and Skills 2)</i>

(2 periods)	<ul style="list-style-type: none"> <li>Understand the names of the male reproductive organs (penis, urethra, scrotum, testes and spermatic duct). <i>(Evaluation: Interest 1, Knowledge and Skills 3)</i></li> </ul> <p>5) Find out the functions of male reproductive organs and record them in the worksheet.</p> <ul style="list-style-type: none"> <li>Understand the function of the male reproductive organs (testes, spermatic duct, penis, urethra and scrotum). <i>(Evaluation: Thinking and Representation 1, Knowledge and Skills 2)</i></li> </ul>
Intermediate Review (No time allotted)	Give the "1 <sup>st</sup> and 2 <sup>nd</sup> Sub-Unit Review Test." (Homework can be given depending on the progress of the class.)
3. Adolescent Body Changes (4 periods)	<p>6) Discuss the changes of the male and female body during adolescence. <i>(Evaluation: Interest 2)</i></p> <p>7) Discuss emotional changes during adolescence. <i>(Evaluation: Thinking and Representation 2)</i></p> <p>8) Make and understand connections between the physical and emotional changes during adolescence and record findings in the worksheet.</p> <ul style="list-style-type: none"> <li>Understand the physical and emotional changes boys and girls go through. <i>(Evaluation: Knowledge and Skills 5)</i></li> </ul> <p>9) Warn pupils about pregnancy while affirming the importance of prevention for sexually transmitted diseases like HIV/AIDS. <i>(Evaluation: Knowledge and Skills 6)</i></p>
Intermediate Review (No time allotted)	Give the "3 <sup>rd</sup> Sub-Unit Review Test" (Homework can be given depending on the progress of the class.)
Unit End Review (1 period)	10) Teacher gives the "Final Unit Evaluation Test."

## Lesson Plan

**1. Names and Function of Female Reproductive Organs (3 Periods: 1<sup>st</sup> -3<sup>rd</sup> period)**

**2. Names and Function of Male Reproductive Organs (2 Periods: 4<sup>th</sup> -5<sup>th</sup> period)**

### Goals of this sub-unit

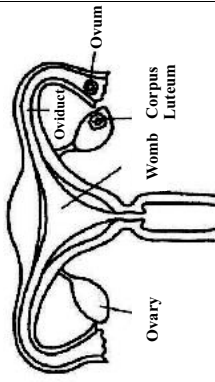
- Gain the ability to willingly investigate questions they may have with their interest in male and female

- bodily development.
- Ability to relate and examine the structure and function of reproductive organs and explain them.
- Ability to know and understand the names and function of the female reproductive organs.
- Ability to know and understand the names and function of the male reproductive organs.

### Material Preparations

- Materials, textbook and worksheet about the names and function of male and female reproductive organs.

### Period 1: Names of Female Reproductive Organs

	Learning flow and activity	Teaching Hints and Advice
<p><b>Introduction</b></p> <p>5 mins.</p>	<ul style="list-style-type: none"> <li>Human men and women have children and pass on new life into the world. How do our bodies change when we become adults to allow this to happen? Are there differences depending on whether you are a boy or girl?</li> </ul>	<ul style="list-style-type: none"> <li>Make the pupils think about the differences between male and female bodies while showing figures of male and female silhouettes.</li> <li>After discussing the differences in male and female bodies, advise the pupils in finding out about female reproductive organs.</li> </ul> <p><i>(Evaluation: Interest 1)</i> To willingly investigate questions they may have with their interest in male and female bodily development.</p>
<p><b>Questions</b></p>	Find out the names of the female reproductive organs related to having children and record them on your worksheet.	
<p><b>Investigative Study</b></p> <p>20 mins.</p>	<ul style="list-style-type: none"> <li>Using the materials provided, find out the names of the female reproductive organs (vagina, womb, endocervix, ovum, ovaries and oviducts), and record them in your worksheet.</li> </ul> <p>→The part that produces eggs is called the ovary.</p> 	<p><i>(Refer to pg. 42 regarding worksheet)</i></p> <ul style="list-style-type: none"> <li>Guide the pupils in confirming the names and positions while looking at the materials and textbook.</li> <li>Have them record their findings in the worksheet.</li> </ul> <p><i>(Evaluation: Knowledge and Skills 1)</i> Ability to know the names of the female reproductive organs (vagina, womb, endocervix, ovum, ovaries and oviducts).</p>
<p><b>Presentation</b></p> <p>10 mins.</p>	<ul style="list-style-type: none"> <li>Present the names of female reproductive organs that you investigated and recorded in your worksheet.</li> </ul>	<ul style="list-style-type: none"> <li>Letting pupils discuss in groups and present a summary is acceptable.</li> <li>Instruct the pupils to bring the worksheets next period as they will be used again. Having them turn</li> </ul>

	them in is fine, as this will allow you to avoid pupils forgetting their sheets in the next period.
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**Period 2-3: Function of Female Reproductive Organs**

	Learning flow and activity	Teaching Hints and Advice
<b>Review Introduction</b> 5 mins.	<ul style="list-style-type: none"> <li>Confirm the names of the female reproductive organs (vagina, womb, endocervix, ovum, ovaries and oviducts) that you found out in the last period.</li> </ul>	<ul style="list-style-type: none"> <li>Recheck the names using the worksheet from the last period.</li> <li>Tell the children that in this period you will continue by finding out the functions of the female organs named and recording them.</li> </ul>
<b>Questions</b>	Find out the functions of the female reproductive organs.	
<b>Investigative Study</b> 55mins.	<ul style="list-style-type: none"> <li>Using the materials provided, find out the functions of the female reproductive organs (ovaries, oviducts, womb, vagina), and record them in your worksheet.</li> <li>The womb is where the egg becomes a baby.</li> <li>The ovaries are where the eggs come from.</li> <li>The vagina is where the baby comes through when it is born.</li> </ul>	<ul style="list-style-type: none"> <li>Guide the pupils in confirming the functions while looking at the materials and textbook.</li> <li>Have them record their findings in the worksheet.</li> </ul> <p><i>(Evaluation: Thinking and Representation 1)</i> Ability to relate and examine the structure and function of reproductive organs, enter them in the worksheet and explain them.</p> <p><i>(Evaluation: Knowledge and Skills 2)</i> Ability to understand the function of the female reproductive organs (ovaries, oviducts, womb, vagina).</p>
<b>Presentation</b> 10 mins.	<ul style="list-style-type: none"> <li>Present the functions of female reproductive organs that you investigated and recorded in your worksheet.</li> </ul>	<ul style="list-style-type: none"> <li>Letting pupils discuss in groups and present a summary is acceptable.</li> <li>This worksheet will be used in the next period as well to compare to male reproductive organs, so instruct the pupils to bring the worksheets next period as well. Having them turn them in is fine, as this will allow you to avoid pupils forgetting their sheets in the next period.</li> </ul>

**Period 4: Names of Male Reproductive Organs**

	Learning flow and activity	Teaching Hints and Advice
<b>Introduction</b> 5 mins.	<ul style="list-style-type: none"> <li>From female reproductive organs, we continue studying this time with the male body.</li> </ul>	<ul style="list-style-type: none"> <li>After discussing the differences in male and female bodies, this time advise the pupils in finding out about</li> </ul>

	→ How do male reproductive organs differ from female ones?	male reproductive organs. <i>(Evaluation: Interest 1)</i> To willingly investigate questions they may have with their interest in male and female bodily development.
<b>Questions</b>	Find out the names of male reproductive organs and record them in the worksheet.	
<b>Investigative Study</b> 20 mins.	<ul style="list-style-type: none"> <li>Using the materials provided, find out the names of the male reproductive organs (penis, urethra, testes, scrotum and spermatic duct), and record them in your worksheet.</li> <li>The testes (singular <i>testis</i>) produce sperm.</li> </ul>	<ul style="list-style-type: none"> <li>Guide the pupils in confirming the names and positions while looking at the materials and textbook.</li> <li>Have them record their findings in the worksheet.</li> </ul> <p><i>(Evaluation: Knowledge and Skills 3)</i> Ability to know the names of the male reproductive organs (penis, urethra, scrotum, testes and spermatic duct).</p>
<b>Presentation</b> 10 mins.	<ul style="list-style-type: none"> <li>Present the names of male reproductive organs that you investigated and recorded in your worksheet.</li> </ul>	<ul style="list-style-type: none"> <li>Letting pupils discuss in groups and present a summary is acceptable.</li> <li>Instruct the pupils to bring the worksheets next period as they will be used again. Having them turn them in is fine, as this will allow you to avoid pupils forgetting their sheets in the next period.</li> </ul>

**Period 5: Function of Male Reproductive Organs**

	Learning flow and activity	Teaching Hints and Advice
<b>Review Introduction</b> 5 mins.	<ul style="list-style-type: none"> <li>Confirm the names of the male reproductive organs (penis, urethra, scrotum, testes and spermatic duct) that you found out in the last period.</li> </ul>	<ul style="list-style-type: none"> <li>Recheck the names using the worksheet from the last period.</li> <li>Tell the children that in this period you will continue by finding out the functions of the male organs named and recording them.</li> </ul>
<b>Questions</b>	Find out the functions of the male reproductive organs.	

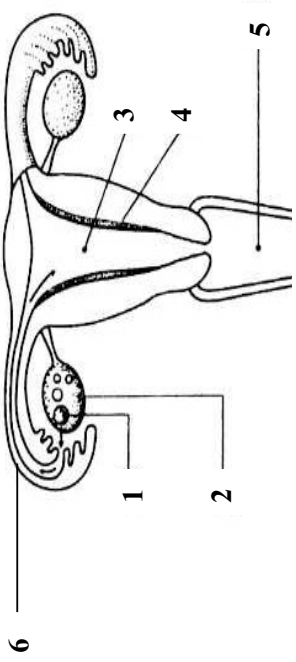
<p><b>Investigative Study</b> 20 mins.</p>	<ul style="list-style-type: none"> <li>Using the materials provided, find out the functions of the male reproductive organs (testes, spermatic ducts, penis, urethra and seminal vesicles), and record them in your worksheet.</li> </ul>	<ul style="list-style-type: none"> <li>Guide the pupils in confirming the functions while looking at the materials and textbook.</li> <li>Have them record their findings in the worksheet.</li> </ul> <p><i>(Evaluation: Thinking and Representation 1)</i> Ability to relate and examine the structure and function of reproductive organs, enter them in the worksheet and explain them.</p> <p><i>(Evaluation: Knowledge and Skills 4)</i> Ability to understand the function of the male reproductive organs (testes, spermatic duct, penis, urethra and seminal vesicles).</p>
<p><b>Presentation</b> 10 mins.</p>	<ul style="list-style-type: none"> <li>Present the functions of male reproductive organs that you investigated and recorded in your worksheet.</li> </ul>	<ul style="list-style-type: none"> <li>Letting pupils discuss in groups and present a summary is acceptable.</li> <li>Announce that they will learn about bodily and emotional changes during adolescence in the next period.</li> </ul>

**[Worksheet]** ----- \* To be used in 1<sup>st</sup>-3<sup>rd</sup> Periods

## Names and Functions of the Female Reproductive Organs

**Date:** \_\_\_\_\_ **Class:** \_\_\_\_\_ **Name:** \_\_\_\_\_

- Find out the names and functions of the female reproductive organs and enter them below.



**Female Reproductive Organs**

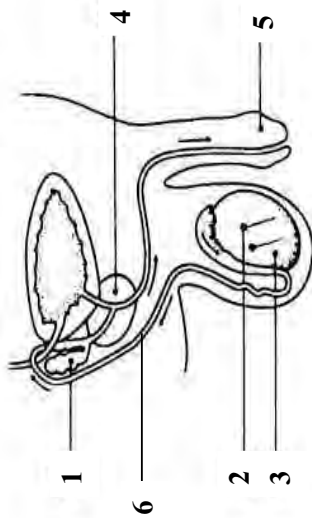
Number	Name	Function
1	Ovum (pl.: ova)	The female reproductive cell. This develops into a baby.
2	Ovary	This produces ova. Produces one ovum every 28 days.
3	Womb	Where the ovum develops into a baby.
4	Uterine Lining (Uterine Mucous Membrane)	Where the baby absorbs nutrients from.
5	Vagina	Where the baby comes out. Also known as the birth canal.
6	Oviduct (Fallopian Tube)	Tubes which move the eggs from ovary to the womb.

\* Keep this worksheet for the next class.

### Names and Functions of the Male Reproductive Organs

**Date:** \_\_\_\_\_ **Class:** \_\_\_\_\_ **Name:** \_\_\_\_\_

- Find out the names and functions of the male reproductive organs and enter them below.



Male Reproductive Organs

Number	Name	Function
1	Seminal Vesicles	Where the liquid sperm swim in is produced.
2	Sperm	The male reproductive cells.
3	Testicles or Testis (pl.: Testes)	Where sperm are produced.
4	Prostate Gland	Where the liquid from the seminal vesicles and sperm are mixed to make semen.
5	Penis	Where sperm are introduced into the female body from.
6	Sperm Duct	Tubes which move sperm from the testes to the urethra.

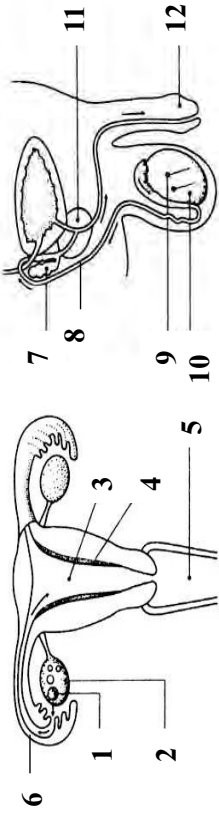
\* Keep this worksheet for the next class.

### 1<sup>st</sup> and 2<sup>nd</sup> Sub-Unit Review Test

\* To be used at the end of 5<sup>th</sup> Period

**Class:** \_\_\_\_\_ **Name:** \_\_\_\_\_

Enter the names of the female and male reproductive organs.



Female Reproductive Organs

Male Reproductive Organs

Number	Name	Number	Name
1	Sperm	7	Seminal Vesicles
2	Ovary	8	Sperm Duct
3	Womb	9	Sperm
4	Uterine Lining (Uterine Mucous Membrane)	10	Testicles or Testis (pl.: Testes)
5	Vagina	11	Prostate Gland
6	Oviduct (Fallopian Tube)	12	Penis

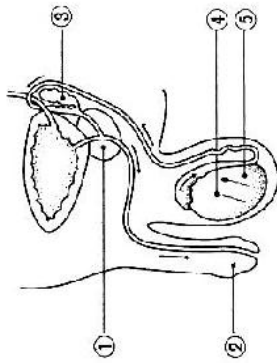
### Final Unit Evaluation Test

\*Done at Unit End

Class: \_\_\_\_\_ Name: \_\_\_\_\_

1. Answer the following questions about reproductive organs.

(i) The figure below has cross-section diagrams of male and female reproductive organs. Give the names of items 1 – 10 below using the letters of the answers a - j, below the figure.

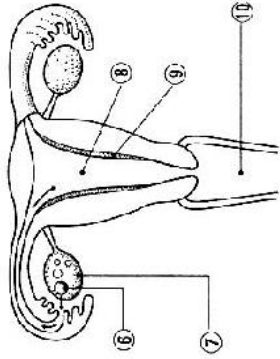


Male Reproductive Organs

- a. Vagina    b. Ovum    c. Seminal Vesicles    d. Ovary    e. Testis
- f. Sperm    g. Prostate Gland    h. Uterine Lining (Uterine Mucous Membrane)    i. Penis    j. Womb

- 1 ( **g.** )    2 ( **i.** )    3 ( **c.** )    4 ( **f.** )
- 5 ( **e.** )    6 ( **b.** )    7 ( **d.** )    8 ( **j.** )
- 9 ( **h.** )    10 ( **a.** )

Female Reproductive Organs



- (ii) About how long is the cycle on which the ovaries produce ova? ( **28 days (about 1 month)** )
- (iii) What is it called when you ejaculate in your sleep when seeing a sexual dream? ( **Wet dream** )
- (iv) What is it called when a fertilized egg moves down the oviduct to the womb and slips into the uterine lining? ( **Implantation** )
- (v) What is the organ which moves the eggs from ovary to the womb called? ( **Oviduct (Fallopian Tube)** )

2. Enter the appropriate words in the blanks below about changes from adolescence.

- (i) The bodily changes in girls and boys that appear during puberty are called ( **physical changes** ). During this period, reproductive organs begin to mature. ( **Ova** ) begin to mature in the ovaries, and ( **sperm** ) are produced in the testes.
- (ii) Changes in feelings and behaviour that appear during puberty are called ( **emotional changes** ).
- (iii) In (ii) above, chemical substances produced by the body called ( **hormones** ) bring about changes in your ( **feelings** ) that you cannot explain. This can bring about feelings of tension between youths and the people around them.





**2. When you learned each unit for the above test problems, did you become interested in the material?**

- 0. None at all
  - 1. No
  - 2. Average
  - 3. Yes
  - 4. Absolutely yes
- This was true 10% of the time for all problems.
- This was true 30% of the time for all problems.
- This was true 50% of the time for all problems.
- This was true 70% of the time for all problems.
- This was true over 90% of the time for all problems.

**Interest and Motivation**

- 1. I was very interested in science lessons.
  - 2. I became more motivated to learn.
  - 3. I was interested in what we were learning from start to finish.
0. 1. 2. 3. 4.
0. 1. 2. 3. 4.
0. 1. 2. 3. 4.

**Concentration and Involvement**

- 4. I was actively engaged in learning the topic.
  - 5. I enjoyed learning the topic so much I lost track of time.
  - 6. I was very focused on learning topic material but at the same time, I was also very excited and enjoyed myself.
0. 1. 2. 3. 4.
0. 1. 2. 3. 4.
0. 1. 2. 3. 4.

**Cooperation and Collaboration**

- 7. I enjoyed the learning process while collaborating with friends.
  - 8. I was able to learn through cooperation and mutual support with my friends.
  - 9. I shared my experiments and ideas with my friends and we all had a fun time learning together.
0. 1. 2. 3. 4.
0. 1. 2. 3. 4.
0. 1. 2. 3. 4.

**Level of Earnestness and Enjoyment during Experiments**

- 10. The experiments were very enjoyable.
  - 11. Since experiments need five senses, I carefully moved my hands and eyes when collecting the data.
  - 12. During the experiments, I recorded my observations accurately and carefully.
0. 1. 2. 3. 4.
0. 1. 2. 3. 4.
0. 1. 2. 3. 4.

**Spirit of Inquiry**

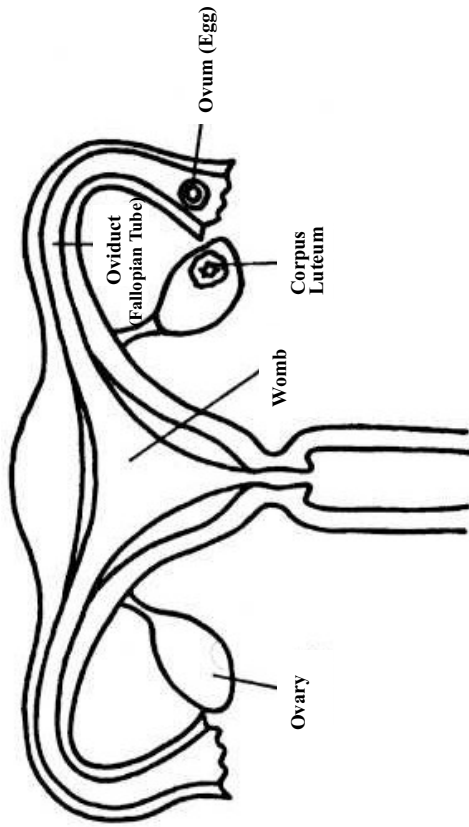
- 13. I began to have more an inquiring mind toward new discoveries.
  - 14. I became very excited and curious about challenging the unknown.
  - 15. I made a strong effort to learn what is known by trying to find examples, drawing illustrations, and through discussions and experiments.
0. 1. 2. 3. 4.
0. 1. 2. 3. 4.
0. 1. 2. 3. 4.

**Logic and Objectivity**

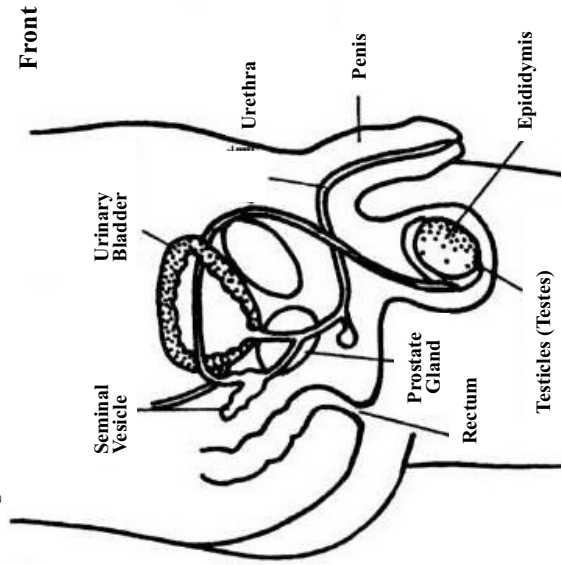
- 16. I attempted to find plenty of evidence and facts to check whether my hypothesis held true.
  - 17. I was able to confirm that the principles and concepts were true by applying them to actual life.
  - 18. The explanations were very convincing and easy to understand for the entire class. I was very satisfied with the interpretations which were logical and accorded with the truth.
0. 1. 2. 3. 4.
0. 1. 2. 3. 4.
0. 1. 2. 3. 4.

### Appendix Names of Reproductive Organs

#### Female reproductive organs



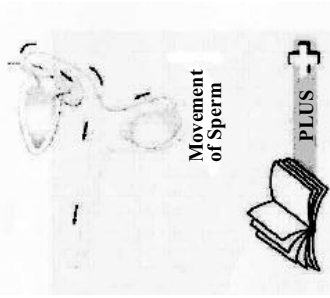
#### Male reproductive organs



### Appendix Menstruation (periods) and Ejaculation

#### Menstruation (periods) and Ejaculation

When girls reach puberty their ovaries develop, and a mature ovum is let out of the ovary at a period of about once every 25-36 days. This process is called ovulation, and it is during this period that pregnancy is possible. If the ovum is not fertilised, the thickened portion of the uterine lining comes off and is evacuated outside the body along with blood. This process is called menstruation (periods). Also for boys, their testes develop and sperm are actively produced within them. When semen filled with sperm passed through the urethra and are expelled from the body, this is called ejaculation. The first menstruation (periods) and ejaculation are known as the first menstruation (periods) (period) and wet dreams. The age for onset of first menstruation (periods) in girls and first ejaculation in boys will differ between individuals.

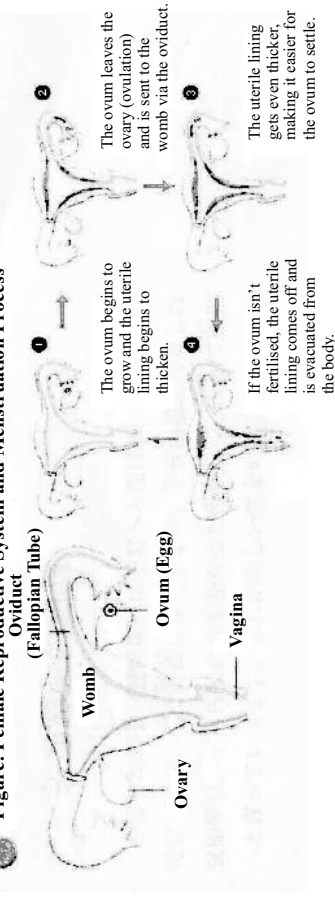


● Internal Secretion – P. 132

#### ● Menstruation Periods

Refers to the period from the day menstruation begins to the day before the next menstruation begins. This is usually between 26 – 30 days.

● **Figure: Female Reproductive System and Menstruation Process**



### Appendix

#### Growth and Development in Puberty

\* to be used in 6<sup>th</sup>-8<sup>th</sup> Periods

Tokyo Shoseki JHS Health Education, 2007 Ed. (p.7)



\* Puberty - see pg. 132

#### Growth and Development of Organs during Puberty

Our bodies grow and develop with age as they are influenced by experience from the various exercises and activities we do.

There are two periods before adulthood in which our muscles, lungs, heart, and most organs experience rapid growth, and around middle school age is exactly where the second of these periods, which is called puberty .

During puberty, reproductive organs such as the ovaries and testes develop rapidly due to gonadotropic hormones. This makes bodily changes and male or female characteristics not seen before\* become clearly visible. Due to these hormones, the preparations to grow into an adult are finally beginning as these male and female characteristics become more defined.

\* Such characteristics are referred to as *secondary sexual characteristics*.

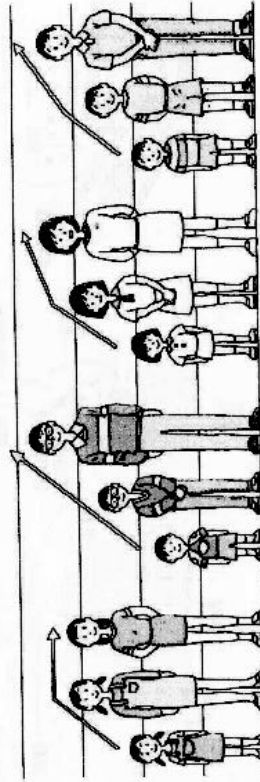
#### Growth and Development in Puberty

During the period of transition from childhood to adulthood, known as puberty, height and weight will rapidly increase with influence by growth and sex hormones\*. This corresponds with the second period of rapid growth in our lives. Girls enter puberty an average of 2 years earlier than boys, and also finish their growth earlier than boys do.

● **Growth Hormones**  
There is a substance that comes from a place in your chest called the pituitary gland that works to accelerate growth.

\* Refer to p. 11 on sex hormones.

#### Differences in Individuals and Sexes for Growth and Development (height example)



### Appendix

Examples of assessment questions which is used in Kenyan text books

One of the following is a function of the uterus.

- A produces ova
- B allows fertilisation
- C is the place where sperm are deposited
- D provides a growing space for the baby

(Macmillan; Macmillan Primary Science, Pupil's book 6 P.7)

Fertilisation of the female reproductive cell takes place in the \_\_\_\_\_.

- A uterus
- B oviduct
- C ovary
- D vagina

Which one of the following is a function of the urethra in the male reproductive system?

- A produces sperm
- B produces ova
- C a passage for the ova
- D a passage for the sperm

(Macmillan; Macmillan Primary Science, Pupil's book 6 P.8)

When an ovum has been fertilized, it grows into a foetus in a part called \_\_\_\_\_.

- A. ovary.
- B. oviduct.
- C. uterus.
- D. ureter.

The function of the sperm duct is \_\_\_\_\_.

- A. to receive the fertilized ovum.
- B. to allow sperms to travel to the ovaries.
- C. to allow sperms to flow from the testes to the urethra.
- D. to produce sperms.

(Oxford; Science in Action 6 P.6)

State five physical changes that take place in adolescent boys.  
State five physical changes that take place in adolescent girls.

(JKF; Primary Science Education Foundation Science 6 P.5)

8. Draw arrows to match the reproductive parts to their functions:

Table 1.2: Some human reproductive parts and their functions

Reproductive part	Function
Testis	Produce fluids.
Sperm duct	Allow eggs to move from the ovary to the uterus.
Oviduct	Produce sperms.
Glands	Allow passage of sperms to the urethra.

9. Changes that affect the feelings and behaviour of an adolescent are called:

- A. Physical changes
- B. Chemical changes
- C. Emotional changes
- D. Bodily changes

(KLB; Primary Science Pupils' Book for Standard Six P.7)

Through which part does the egg travel to reach the uterus?

Through which parts does the sperm travel to reach the outside?

In which organ are the eggs produced?

In which organ are the sperms produced?

Which organ is used to transfer sperms from male to female?

(Longhorn; Understanding Science, Pupil's Book 6 P.6)

### Appendix

Examples of materials which is used in Kenyan text books

The male reproductive system

#### Parts of the male reproductive system

The male reproductive system consists of the testes, sperm ducts, urethra and penis.

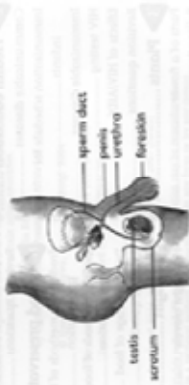


Figure 1.1: Side view of the parts of the male reproductive system

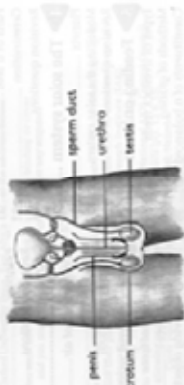


Figure 1.2: Front view of the parts of the male reproductive system

(Oxford; Science in Action 6 P.2)

#### Testes

These are two glands that produce sperms. Sperms are the male reproductive cells. Testes also store the sperms. Testes lie below the penis in a sac called **scrotum**. The singular of testes is **testis**.

#### Sperm duct

The sperm duct is a tube that runs from the testis to the urethra. It allows sperms from the testes to pass to the urethra. Each testis has a sperm duct.

#### Urethra

This is like a tube. It runs through the centre of the penis. Its function is to allow sperms and urine to pass out of the body.

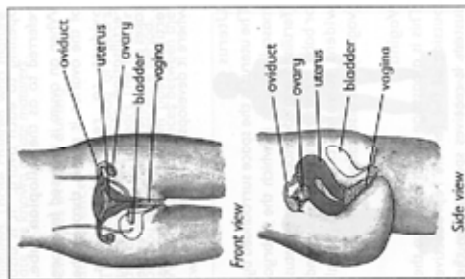
#### Penis

This is an external sex organ which discharges urine from the bladder. It introduces sperms into the vagina. The penis is made up of tissues which have many blood vessels.

(Oxford; Science in Action 6 P.3)

The female reproductive system

The diagrams below show parts of the female reproductive systems.



A female reproductive system

(Longhorn, Understanding Science, Pupil's Book 6 P.1)

The male reproductive system has two testes which produce the male reproductive cells called sperm.



Figure 1.2 A human sperm

The female reproductive system has two ovaries, one on the left and one on the right. The function of the ovaries is to produce eggs. These eggs are known as ova. One egg is called an ovum.

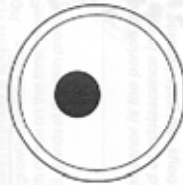


Figure 1.3 A human egg (ovum)

(Macmillan, PP. 2-3)

(Macmillan; Macmillan Primary Science, Pupil's book 6 PP.2-3)

**Ovary**

The female body has two ovaries. In each ovary there are several eggs called ova (one is called ovum). At puberty (about 12 to 16 years) the ova begin to mature. Usually one ovum matures every month. It is then released from the ovary into the oviduct. The release of the ovum from the ovary is called ovulation.

**Oviduct (Fallopian tube)**

This is a tube leading from the ovary to the uterus. There are two oviducts, one from each ovary. The ovum is released into this tube.

**Uterus**

It is a bag-like structure. Every month the wall of the uterus develops a thick lining. If the ovum is fertilized it attaches itself to this lining and develops into a baby. If there is no fertilization, the lining is shed off. It will flow out together with the unfertilized ovum through the vagina in a process called menstruation.

**Vagina**

It is a canal leading from the uterus to the outside. This is where the sperms are deposited during sexual intercourse. Also, it is the canal through which the new-born baby passes at birth.

(JKF; Primary Science Education Foundation Science 6 P.2)

Physical changes during adolescence

**Physical changes in boys**

- Chest and shoulders become broader.
- Voice breaks and becomes deeper.
- Hair grows on the chest, face (beards) and armpits. Hair also grows around the sex organs. This hair is called pubic hair.
- Sperms begin to mature in the testis. Boys can experience ejaculation (releasing of sperms through the penis). This can happen during sleep and is referred to as wet dreams.
- Height and weight increases and boys become more muscular. Due to this rapid growth, they tend to eat more.
- Pimples may develop on the face.

(JKF; Primary Science Education Foundation Science 6 P.5)

### Physical changes in girls

- hip bones. The girls also put on weight.
- The face of most girls becomes smooth. Some girls however develop pimples.
- Hair grows under the armpit and on the pubis.
- Much more hair starts to grow on the head and may become more silky.
- The uterus develops and the ovaries mature. As the mature eggs are released by the ovary and passed out, blood comes out of the vagina every month. This coming out of the blood through the vagina is known as **menstruation** or **monthly periods**. This lasts 3 to 6 days.

At first the periods can be irregular but later on they occur every month hence the name monthly periods.

Girls should avoid sexual intercourse because they can become pregnant and/or contract sexually transmitted infections such as gonorrhoea, syphilis and **HIV/AIDS**.

(Longhorn; Understanding Science, Pupil's Book 6 P:4)

### Do you remember these new words?

- ovary** - part of the female reproductive system that produces the egg (ovum)
- oviduct (fallopian tube)** - part of the female reproductive system that connects the ovary and the uterus. This is where fertilisation takes place
- uterus (womb)** - part of the female reproductive system where the baby develops
- vagina (birth canal)** - part of the female reproductive system where sperm are deposited during sexual intercourse. The baby passes through here during birth
- testis** - part of the male reproductive system that produces the sperm
- urethra** - part of the male reproductive system through which the sperm pass to the outside. Urine also passes through the urethra
- penis** - part of the male reproductive system which deposits sperm into the vagina during sexual intercourse
- sperm** - the male reproductive cell
- ovum (egg)** - the female reproductive cell
- ova** - plural for ovum
- fertilisation** - this is the joining of the sperm and the ovum
- zygote** - this is what is formed when the sperm and ovum join. A zygote develops into an embryo

(Macmillan; Macmillan Primary Science, Pupil's book 6 P:6)

## 7th Grade: HUMAN BODY (The Circulatory System)

### Rational of this unit

In plants, water and nutrients drawn up from the root go along a conduit, then the nutrients go along the phloem bundle and are carried to the various parts of the plant. In animals, however, oxygen taken in from breathing and nutrients absorbed from foods are carried to the entire body by the blood. Also, in cases where much blood has been lost due to injury or other causes, it can be a life-threatening affair. So just how does blood, which plays such an important role in animals, circulate through the body? And how does it work to maintain life?

In this unit, our goal is to understand that blood circulation maintains life while being interconnected with the various organs of the body, and to realize the splendour that makes the human body work. We shall have the pupils observe and feel the circulation of blood to realize its magnificence.

We expect that by rethinking how the common makings of the human body work, pupils will deepen understanding of their own bodies and make use of this knowledge in leading healthy lifestyles day to day.

### Objectives: what pupils are expected to achieve in this unit

- Understand that there is a system of transporting substances in animal's bodies through observation of the components and circulation of blood.
- Understand that flowing blood has different characteristics through various observations and experiences with the types of blood vessels and their functions.
- Understand the functions of the heart and the route of blood circulation, concentrating on the human body.

### Interrelation of contents of each grade

\* The order below is as shown in the syllabus.

Grade	What to teach (Human Body)
1 <sup>st</sup> Grade	<ul style="list-style-type: none"> <li>• Exterior parts of the human body – head (eyes, ears, nose, hair, mouth), neck, chest, arms (hands, elbows, fingers, nails), legs (knees, feet, toes, toenails)</li> </ul>
2 <sup>nd</sup> Grade	<ul style="list-style-type: none"> <li>• The five senses – smell, taste, touch, sight and hearing</li> </ul>

	<ul style="list-style-type: none"> <li>• Using sensory organs</li> <li>• Sight – eyesight and far, close, big, and small objects</li> <li>• Using proper body language for your community including facial expression and hand signals</li> </ul>
3 <sup>rd</sup> Grade	<ul style="list-style-type: none"> <li>• Types of teeth – incisors, canines, premolars and molars</li> <li>• The function of different tooth types</li> <li>• Development of teeth (losing baby teeth, eruption of permanent teeth)</li> </ul>
4 <sup>th</sup> Grade	<ul style="list-style-type: none"> <li>• Respiratory system names – nose, trachea, bronchi, lungs, diaphragm</li> <li>• Function of the respiratory system – nose, trachea, lungs, diaphragm</li> <li>• Digestive system names – mouth (teeth and tongue), oesophagus, stomach, small intestine, liver, pancreas, colon, rectum, anus</li> <li>• Function of the digestive system – teeth, oesophagus, stomach, small intestine, colon</li> </ul>
5 <sup>th</sup> Grade	<ul style="list-style-type: none"> <li>• Organs of the reproductive system – female (ovaries, oviducts, womb, vagina) and male (testes, urethra, penis)</li> <li>• Various functions of the reproductive system</li> <li>• Adolescent changes – bodily changes, male and female</li> </ul>
6 <sup>th</sup> Grade	<ul style="list-style-type: none"> <li>• Organs of the circulatory system – heart, blood, blood vessels</li> <li>• Components and function of blood – plasma, red blood cells, white blood cells, platelets</li> <li>• Types and function of blood vessels – arteries, veins, capillaries</li> <li>• Structure and function of the heart –atrial auricle (atriums), ventricles, blood vessels (aorta, vena cava, pulmonary vein, pulmonary artery)</li> </ul>
7 <sup>th</sup> Grade (This unit)	<ul style="list-style-type: none"> <li>• Fertilisation</li> <li>• Foetal development – zygote, embryo, foetus</li> <li>• The process of birth</li> <li>• Excretory organs and waste products – skin (epidermis, dermis, sweat glands, sweat as a waste product), lungs (nose, trachea, and carbon dioxide as a waste product), kidneys (kidney's appearance, urethra, bladder, waste products from the urethra as urine</li> </ul>
8 <sup>th</sup> Grade	

## Before starting this unit

### Current learning status of the pupils

Regarding the human body, 7<sup>th</sup> grade pupils have already learned the organs of the respiratory system, digestive system and reproductive system and their functions. Through these studies they understand that the human body lives by taking in oxygen and nutrients, and that blood is related to the function of these organs. However, there are some students that perceive blood to be a uniformly red liquid or think that there are a multitude of blood vessels going out from the heart to the entire body. Therefore, we shall make pupils think about the role of blood and the function of organs related to circulation by observing the main elements of blood and viewing images of its flow.

### Preparatory Notes

- Try to give the pupils ample chance to experience the flow of blood one by one through sight and touch.
- Actively introduce activities such as making pattern diagrams and models to let the pupils realize that the role of the circulatory system is related to the various organs of the body and influences the entire human body.

## Objectives to be achieved by competency

### Interest, motivation, and attitude

1. Take an interest in the circulation of blood and ambitiously investigate the aspects of blood flow.
2. Take an interest in how the circulation of blood carries the oxygen and nutrients needed for human activity and the unneeded substances resulting from those activities, and willfully consider the importance of blood circulation.

### Scientific thinking and communication activities

1. Ability to deduce from observing blood that it has a liquid component and blood cells.
2. Ability to deduce the various characteristics of blood from the circuit of lung circulation and body circulation.
3. Ability to consider blood flow relating to one's own heartbeat and pulse.
4. Ability to summarize the state of human blood circulation in a pattern diagram joining lung circulation and body circulation.

### Knowledge, understanding, and skills in observation and experimentation

1. Understanding the meaning of blood circulation and ability to give examples of names of the various organs of the circulatory system and explain.

2. Ability to observe capillaries and the blood cells that flow through them.
3. Ability to explain that blood is made up of plasma and blood cells such as red blood cells, white blood cells and platelets, and also the functions of each of these components.
4. Ability to explain that blood has the function of carrying the oxygen and nutrients needed by the body as well as carrying unneeded substances.
5. Ability to observe that there are various thicknesses in blood vessels covering the entire body, becoming capillaries at the extreme fringes of the body.
6. Ability to explain that within blood vessels there are arteries, veins and capillaries, and that there is a relation between characteristics of the various blood vessels and blood circulation.
7. Ability to investigate the change to heartbeat and pulse when doing exercise.
8. Ability to observe that the heart is made up of thick muscle so that it can send blood out to the entire body.
9. Ability to explain that the heart is made up of four chambers in the right ventricle, right atrium, left ventricle, left atrium, and also that the heart functions as a pump to circulate blood throughout the entire body.

## Ideas behind the structuring the unit

The human body is extremely familiar to us all, but we cannot actually observe it from the inside. For this reason, we will try to advance studies by observing other animals, realisation through experience, and utilisation of audio-visual materials and diagrams.

Upon learning the names and functions of the various organs of the circulatory system, we expand to grasping how blood circulation connects the organs of the human body and maintains life. Visually arranging blood circulation in a pattern diagram makes it easier to grasp the circulation of blood.



## Unit teaching plan

### (14 periods + 2 periods for the Final Unit Evaluation Test)

\* The numeric value in parentheses represents the corresponding period (e.g. 1) means the first period).  
 \* (Evaluation: Knowledge and Skills 1). (Evaluation: Interest 1), etc. indicate the points at which teachers can check whether the pupils have attained the goals specified in the section *Objectives based on the viewpoint*.

Sub-Unit	Description
<b>1. Blood Circulation and the Circulatory System</b> (2 periods)	1-2) Observe parts of the body where you can see the flow of blood, and know the meaning of blood circulation. Know the names and major roles of the organs of the circulatory system. • Organs of the circulatory system → heart, blood, blood vessels (Evaluation: Interest 1, Knowledge and Skills 1)
Intermediate Review	• Give the "1 <sup>st</sup> Sub-Unit Review Test". (Homework can be given depending on the progress of the class.)
<b>2. The Components and Function of Blood</b> (4 periods)	3-4) Know that blood has a liquid component and blood cells by observing actual blood flow and checking with visual materials. Know the main elements of blood. • Main elements of blood – plasma, red blood cells, white blood cells, platelets (Evaluation: Thinking and Representation 1, Knowledge and Skills 2) 5-6) Investigate the properties and function of blood's elements. Know that blood functions to carry oxygen and nutrients needed to even the furthest reaches of the body, and also carries the body's unneeded substances to the organs that expel them out of the body. (Evaluation: Knowledge and Skills 3, Knowledge and Skills 4)
Intermediate Review	• Give the "2 <sup>nd</sup> Sub-Unit Review Test". (Homework can be given depending on the progress of the class.)
<b>3. Types and Functions of Blood Vessels</b> (3 periods)	7-8) Know that within blood vessels there are arteries, veins and capillaries, and that the blood that flows through them has different characteristics. Also, observe capillaries in a piece of meat along with the aorta and vena cava of an animal and confirm their characteristics. (Evaluation: Knowledge and Skills 5) 9) Investigate the types and characteristics of blood vessels and their connection with blood circulation. Know that within blood circulation there is pulmonary circulation and main circulation, and about the characteristics of the blood that flows through the pulmonary and main routes. (Evaluation: Thinking and Representation 2, Knowledge and Skills 6)
Intermediate Review	• Give the "3 <sup>rd</sup> Sub-Unit Review Test".

(No time allotted)	(Homework can be given depending on the progress of the class.)
<b>4. Structure and Function of the Heart</b> (3 periods)	10) Understand by measuring pulse that blood is sent throughout the entire body, and know that pulse rate gets faster when you exercise. (Evaluation: Knowledge and Skills 7) 11-12) Experience where and how the heart sends blood throughout the body through heart beat and pulse, and think about the structure and role of the heart. • Structure of the human heart → 4-chambers: right ventricle, right atrium, left ventricle, left atrium • Role of the human heart → acts as a pump to circulate blood (Evaluation: Thinking and Representation 3, Knowledge and Understanding 8 and 9)
Intermediate Review	• Give the "4 <sup>th</sup> Sub-Unit Review Test". (Homework can be given depending on the progress of the class.)
<b>5. Importance of Blood Circulation</b> (2 periods)	13-14) Show the state of blood circulation in a pattern diagram and relate blood to the organs of the body, summarising how it maintains life. Know about diseases for which blood acts as a medium for infection (HIV). (Evaluation: Interest 2, Knowledge and Skills 4)
Intermediate Review	• Give the "5 <sup>th</sup> Sub-Unit Review Test". (Homework can be given depending on the progress of the class.)
Unit End Review	15-16) Teacher gives the "Final Unit Evaluation Test"
(2 periods)	

## Lesson Plan

### 1. Blood Circulation and the Circulatory System (2 Periods: 1<sup>st</sup> -2<sup>nd</sup> period)

#### Goals of this sub-unit

- Take an interest in the circulation of blood and observe parts where blood flows.
- Know the meaning of blood circulation, names and major roles of the circulatory system.

#### Material Preparations

- Investigative study books, recording worksheet

#### Periods 1-2: Investigating Blood Circulation

	Learning flow and activity	Teaching Hints and Advice
<b>Introduction</b> 10 mins.	<ul style="list-style-type: none"> <li>• Present what you know about blood.</li> <li>→ Blood comes out when you injure parts of your body.</li> <li>→ There are places on your hands and feet where you can see the flow of blood.</li> <li>→ Blood carries the oxygen taken in through respiration throughout the body.</li> <li>→ I heard that blood carries the nutrients absorbed by the small intestine to different parts of the body.</li> </ul>	<ul style="list-style-type: none"> <li>• Aim for a common understanding that blood flows to every end of the body and through the various organs by having pupils present bodily organs they have studied with a relation to blood and places they know that blood flows from daily experience, and having them show where on their own bodies they can know that blood is flowing.</li> </ul>
<b>Questions</b>	Where in the body does blood flow?	
<b>Observation and Material Investigation</b> 30 mins.	<ul style="list-style-type: none"> <li>• Look for parts on your own body where blood is flowing.</li> <li>→ Blood is flowing in various parts of the body.</li> <li>→ Blood flows through vessels in your hands and feet.</li> <li>• Organs related to blood circulation</li> <li>→ Heart – Sends blood out throughout the body</li> <li>→ Blood – Liquid that carries oxygen and nutrients</li> <li>→ Blood vessels – tubes which blood flows through</li> </ul>	<ul style="list-style-type: none"> <li>• Have pupils search for where on their own body they can see the flow of blood and compare with their friends.</li> </ul> <p><i>(Refer to pg. 59 regarding worksheet)</i></p> <ul style="list-style-type: none"> <li>• Pin down the meaning of blood circulation and the circulatory system, as well as the names of the parts of the circulatory system based on the textbook and materials.</li> <li>• Have them record their findings in the worksheet.</li> </ul> <p><i>(Evaluation: Interest 1)</i> Take an interest in the circulation of blood and ambitiously investigate the</p>

Presentation Summary 30 mins.	Summarize what you found and things you thought were strange in the worksheet and present it to the class.	aspects of blood flow.
<ul style="list-style-type: none"> <li>→ Blood circulation is blood flowing throughout the body from the heart and then coming back to the heart.</li> <li>→ The organs related to circulation are called the circulatory system. The human circulatory system includes the heart, blood and blood vessels.</li> <li>→ Blood carries oxygen and nutrients demanded by various parts of the body as well as unneeded waste products.</li> <li>→ Are blood vessels everywhere in the body?</li> <li>→ How does blood carry oxygen?</li> <li>→ How does the heart send out blood?</li> </ul>	<ul style="list-style-type: none"> <li>• Letting pupils discuss in groups and present a summary is acceptable.</li> </ul>	<p><i>(Evaluation: Knowledge and Skills 1)</i> Understanding the meaning of blood circulation and ability to give examples of names of the various organs of the circulatory system and explain.</p>

## 2. The Components and Function of Blood (4 periods: 3<sup>rd</sup> -6<sup>th</sup> period)

#### Goals of this sub-unit

- Know from observation of blood and audio-visual materials that blood is made up of a liquid component and blood cells, and that the main components of blood are plasma, red blood cells, white blood cells and platelets.
- Investigate the properties and function of plasma, red blood cells, white blood cells and platelets, and be able to explain that blood functions to carry oxygen and nutrients needed to even the furthest reaches of the body, and also carries the body's unneeded substances to the organs that expel them out of the body.

#### Material Preparations

- A small fish that can be used for observing its fins and blood flow, microscope, glass slides, and wrap sheet. If a small fish cannot be acquired, prepare audio-visual materials on mammals.
- Investigative study books and audio-visual materials (on blood flow of mammals)
- *If possible:* internet environment for investigative study
- Recording worksheet

#### Periods 3-4: Observing Blood

	Learning flow and activity	Teaching Hints and Advice
<b>Introduction</b> 10 mins.	<ul style="list-style-type: none"> <li>Why can blood carry oxygen and nutrients?</li> <li>Is there a secret in the red colour?</li> <li>Do oxygen and nutrients mix not well with blood?</li> <li>Is there some kind of secret in blood?</li> </ul>	<ul style="list-style-type: none"> <li>Let pupils think about the function of blood from the roles of blood already learned.</li> </ul>
<b>Questions</b>	What kind of liquid is blood? Try to observe it.	
<b>Observation and Material Investigation</b> 30 mins.	<ul style="list-style-type: none"> <li>Observe how blood is made up of liquid and blood cells by observing the blood of a small fish and audio-visual materials, and enter in the worksheet.</li> <li>When actually observing blood, first explain how to use the microscope before observation. Have pupils observe at 150x magnification.</li> <li>When observing living creatures like a small fish, make pupils aware that they are observing a living creature and advise them to handle the subject creature gently.</li> <li>When observing audio-visual materials, pausing the video midway will make it easier to see the elements of blood.</li> <li>Have pupils investigate the grains they saw observing blood using materials.</li> </ul>	<p>(Refer to pg. 60 regarding worksheet)</p> <ul style="list-style-type: none"> <li>Have them record their findings in the worksheet.</li> <li>When actually observing blood, first explain how to use the microscope before observation. Have pupils observe at 150x magnification.</li> <li>When observing living creatures like a small fish, make pupils aware that they are observing a living creature and advise them to handle the subject creature gently.</li> <li>When observing audio-visual materials, pausing the video midway will make it easier to see the elements of blood.</li> <li>Have pupils investigate the grains they saw observing blood using materials.</li> </ul>
<b>Presentation Summary</b> 30 mins.	<ul style="list-style-type: none"> <li>Present what you noticed and had questions about.</li> <li>What are the grains in the liquid?</li> <li>What role do the grains play?</li> <li>Does the direction of flow ever change?</li> <li>Is the thickness of all blood vessels the same in all places?</li> <li>Find out the main elements of blood and add them to your worksheets.</li> <li>In blood, there are red blood cells, white blood cells and platelets flowing in the liquid called plasma.</li> </ul>	<ul style="list-style-type: none"> <li>Have pupils write down the results in their worksheets and present the results.</li> <li>Letting pupils discuss in groups and present a summary is acceptable.</li> <li>Picking up questions connected to upcoming lessons later is acceptable.</li> </ul> <p>(Evaluation: Thinking and Representation 1) Ability to deduce from observing blood that it has a liquid component and blood cells.</p>

**Periods 5-6: Components of Blood and Their Function**

	Learning flow and activity	Teaching Hints and Advice
<b>Introduction</b> 10 mins.	<ul style="list-style-type: none"> <li>What elements of blood are related to the functions of blood that we learned studying the digestive and respiratory systems?</li> </ul>	<ul style="list-style-type: none"> <li>Remind pupils that blood carries oxygen and nutrients to different parts of the body and have them investigate how the main elements of blood relate to this knowing each element's properties.</li> </ul>
<b>Questions</b>	What are the functions of the main elements of blood?	
<b>Material Investigation</b> 30 mins.	<ul style="list-style-type: none"> <li>Using books and other materials, investigate the properties and functions of blood's main elements.</li> <li>Plasma – liquid comprised mostly of water</li> <li>Nutrients, carbon dioxide and ammonia all blend in with it.</li> <li>Red blood cells – many are found in blood, but they are smaller than white blood cells. Haemoglobins within these cells are red in colour and attach to oxygen easily.</li> <li>White blood cells – are fewer in number but larger in size than red blood cells. They remove foreign substances and bacteria.</li> <li>Platelets – make blood clot.</li> </ul>	<ul style="list-style-type: none"> <li>Try to make it so that the names of the elements you investigate relate to the grains and liquid observed on the small fish's fin.</li> <li>Based on what was investigated, let pupils deduce the functions of blood circulating our bodies.</li> </ul>
<b>Discussion Summary</b> 30 mins.	<ul style="list-style-type: none"> <li>Discuss the functions of blood based on what you know from your investigation.</li> <li>Oxygen connects to haemoglobins within red blood cells and is carried throughout the body.</li> <li>White blood cells exist to protect us from sickness.</li> <li>Platelets stop bleeding when we get injured.</li> <li>Plasma not only carries nutrients all over the body, but also functions to carry unneeded substances like carbon dioxide and ammonia to organs which expel them from the body.</li> </ul>	<p>(Evaluation: Knowledge and Skills 3) Ability to explain that blood is made up of plasma and blood cells such as red blood cells, white blood cells and platelets, and also the functions of each of these components.</p> <ul style="list-style-type: none"> <li>Grasp that blood serves the important roles of delivering things needed to maintain life all over the body and expelling unneeded substances.</li> </ul> <p>(Evaluation: Knowledge and Skills 4) Ability to explain that blood has the function of carrying the oxygen and nutrients needed by the body as well as carrying unneeded substances.</p>

**3. Types and Functions of Blood Vessels (3 periods: 7<sup>th</sup> -9<sup>th</sup> period)**

**Goals of this sub-unit**

- Ability to explain that within blood vessels there are arteries, veins and capillaries, and that there is a relation between characteristics of the various blood vessels and blood circulation.
- Know that within blood circulation are pulmonary circulation and main circulation, and become able to

explain the characteristics of the blood running through these systems.

### Material Preparations

- Kid goat – to observe the blood vessels on the inside of an ear
- Books for investigative study, piece of meat (to observe blood vessels), the aorta and vena cava of an animal, mirror
- *If possible:* internet environment for investigative study
- Recording worksheet

### Periods 7-8: Observing Blood Vessels

	Learning flow and activity	Teaching Hints and Advice
<b>Introduction</b> 10 mins.	<ul style="list-style-type: none"> <li>• Do blood carrying oxygen and nutrients and blood carrying unneeded substances not mix?</li> <li>→ Do they flow through different blood vessels?</li> </ul>	<ul style="list-style-type: none"> <li>• Let pupils sufficiently discuss their predictions, then after raising their interest have them investigate.</li> </ul>
<b>Questions</b>	What types of blood vessels are there? And are the characteristics of these vessels and blood circulation related?	
<b>Observation</b> 35 mins.	<ul style="list-style-type: none"> <li>• Observe an animal's arteries and veins, and enter your findings in the worksheet.</li> <li>→ Observe the difference in arteries and veins in goats and other animals.</li> <li>→ Observe the blood vessel distribution and capillaries on the inside of the kid goat's ear.</li> <li>→ Observe the inside of the arm, back of the palm and back of the palm when making a fist.</li> <li>→ Observe how capillaries reach to all parts of the body by looking at the whites of your friend's eye.</li> <li>→ Observe capillaries using a piece of meat.</li> </ul>	<p>(Refer to pg. 60 regarding worksheet)</p> <ul style="list-style-type: none"> <li>• Have them record their findings in the worksheet.</li> <li>• Direct attention to the differences in construction of arteries and veins.</li> <li>• Grasp that there are various thicknesses in blood vessels, becoming capillaries at the extreme fringes of the body.</li> </ul> <p>(Evaluation: Knowledge and Skills 5) Ability to observe that there are various thicknesses in blood vessels covering the entire body, becoming capillaries at the extreme fringes of the body.</p>
<b>Presentation</b>	<ul style="list-style-type: none"> <li>• Discuss capillaries and the differences between arteries and veins based on what is recorded in your worksheet.</li> </ul>	<ul style="list-style-type: none"> <li>• Have pupils write down the results in their worksheets and present the results.</li> </ul>
<b>Summary</b> 25 mins.	<ul style="list-style-type: none"> <li>• Discuss investigating the characteristics of blood vessels, giving special attention to discoveries and questions that arose during observation.</li> </ul>	<ul style="list-style-type: none"> <li>• Letting pupils discuss in groups and present a summary is acceptable.</li> <li>• Tell pupils that you will take all the discoveries and questions that arose during observation to investigate the characteristics of blood vessels in the next period.</li> </ul>

### Period 9: Types and Functions of Blood Vessels

	Learning flow and activity	Teaching Hints and Advice
<b>Introduction</b> 5 mins.	<ul style="list-style-type: none"> <li>• Confirm the blood vessel characteristics you discussed last period to learn and investigate these using references and the textbook.</li> <li>→ Why do veins have valves?</li> </ul>	<ul style="list-style-type: none"> <li>• This period is for investigative study, so prepare many reference materials regarding blood and blood vessels.</li> </ul>
<b>Questions</b>	Investigate the types of blood vessels and their characteristics.	
<b>Material Investigation</b> 20 mins.	<ul style="list-style-type: none"> <li>• Using books and other materials, investigate the types of blood vessels and their characteristics as well as their relation to blood circulation.</li> <li>→ Arteries – vessels flowing out from the heart and carrying different blood. They have thick walls and are flexible.</li> <li>→ Veins – vessels in which blood flows back to the heart from the rest of the body. Walls are thinner than those of arteries, and there are valves interspersed to prevent backward flow.</li> <li>→ Capillaries – at the fringe ends of arteries, vessels will branch out into narrow capillaries. Capillaries come together again and form veins.</li> </ul>	<ul style="list-style-type: none"> <li>• Summarize the circulation of blood.</li> <li>• heart → arteries → capillaries → veins → heart</li> <li>• Make pupils aware of the characteristics of the different vessels and their relation to blood circulation.</li> <li>• Let them know that the arteries which carry oxygen and nutrients cannot be seen because they are not near the skin so they cannot be readily cut due to injury.</li> <li>• Reconfirm the characteristics of veins and capillaries.</li> </ul> <p>(Evaluation: Knowledge and Skills 6) Ability to explain that within blood vessels there are arteries, veins and capillaries, and that there is a relation between characteristics of the various blood vessels and blood circulation.</p>
<b>Discussion Summary</b> 10 mins.	<ul style="list-style-type: none"> <li>• Consider the types of vessels and the characteristics of the blood flowing through the paths of main circulation, which circulates through the entire body, and pulmonary circulation, which circulates blood through the lungs.</li> <li>→ The vessels in which oxygenated blood flow in pulmonary circulation are opposite of those in main circulation (blood flowing into the lungs does not yet have oxygen in it).</li> </ul>	<ul style="list-style-type: none"> <li>• Tell pupils that there is main circulation, which circulates blood to the entire body, and pulmonary circulation, which circulates blood to the lungs. Let them consider the characteristics of the blood flowing through these systems based on the path of circulation.</li> </ul> <p>(Evaluation: Thinking and Representation 2) Ability to deduce the various characteristics of blood from the circuit of lung circulation and body circulation.</p>

## 4. Structure and Function of the Heart (3 periods: 10<sup>th</sup> -12<sup>th</sup> period)

**Goals of this sub-unit**

- Experience blood flow through investigative activities involving pulse and become able to explain the role of arteries to deliver oxygenated blood throughout the body.
- Ability to explain that the human heart is made up of four chambers in the right ventricle, right atrium, left ventricle, left atrium, and also that the heart functions as a pump to circulate blood throughout the entire body.
- Ability to explain the structure of the heart and its relation to main and pulmonary circulation.

**Material Preparations**

- Stethoscope
- Stopwatch
- Materials for investigative study, such as diagrams of the human body
- Arrangements for a tour of a meat processing plant
- Drawing paper

**Period 10: Function of the Blood-Pumping Heart**

	Learning flow and activity	Teaching Hints and Advice
<b>Introduction</b> 10 mins.	<ul style="list-style-type: none"> <li>• How can you investigate how blood flows through the body?</li> </ul> <p>→ Can you not measure your heart beat on your wrists?</p> <ul style="list-style-type: none"> <li>• Look for parts on your body other than your heart where you can feel your heart beat.</li> </ul> <p>→ You can also feel it on the inside of your arm and your neck.</p>	<ul style="list-style-type: none"> <li>• Have pupils put their palm on the left side of their chests and count their heart beats for 1 minute.</li> <li>• Have them compare their heart beat to the movement of their arteries.</li> <li>• Let them know that the movement of their arteries, measured by the number of beats, is called a <i>pulse</i>.</li> </ul>
<b>Questions</b>	Is the rate that blood is sent out of the heart always the same?	
<b>Observation</b> 20 mins.	<ul style="list-style-type: none"> <li>• Measure the number of beats (pulse) before and after exercising, and examine the difference.</li> <li>• Find out your heart beat when sitting still and compare it to your heart beat after running 100 metres.</li> <li>• Find out your friends' heart beat (pulse) through their wrists and compare it to their heart beat after running 100 metres.</li> </ul>	<ul style="list-style-type: none"> <li>• Have pupils record their heart beat (pulse) before running and just after running.</li> </ul> <p>(<i>Evaluation: Knowledge and Skills 7</i>) Ability to investigate the change to heartbeat and pulse when doing exercise.</p>
<b>Presentation Summary</b>	<ul style="list-style-type: none"> <li>• Discuss the reason behind the change in heart beat (pulse).</li> </ul>	<ul style="list-style-type: none"> <li>• Make pupils aware of blood's function of carrying oxygen.</li> </ul>

5 mins.	→ You need a lot of oxygen when you do exercise, so your heart rate increases to send out blood more quickly.	<ul style="list-style-type: none"> <li>• Make them take interest in the heart pumping blood and tie it in to the next period.</li> </ul>
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**Periods 11-12: Structure of the Heart**

	Learning flow and activity	Teaching Hints and Advice
<b>Introduction</b> 10 mins.	<ul style="list-style-type: none"> <li>• How does the heart send out blood to the rest of the body, and from where?</li> </ul>	<ul style="list-style-type: none"> <li>• Have pupils imagine the structure of the heart based upon their experiencing heart beat and pulse and what they have investigated to this point. If there is time, have them draw a picture.</li> </ul> <p>(<i>Evaluation: Thinking and Representation 3</i>) Ability to consider blood flow relating to one's own heartbeat and pulse.</p>
<b>Questions</b>	What kind of structure does the heart have? And how does it send out blood?	
<b>Investigative Activity</b> 20 mins.	<ul style="list-style-type: none"> <li>• Investigate the structure of the human heart and how it is connected to blood vessels.</li> </ul> <p>→ It has four chambers.</p> <p>→ Veins are connected to atriums and arteries are connected to ventricles. Blood enters the atriums and is sent out from the ventricles.</p> <p>→ Due to valves present in the heart, blood cannot flow in reverse even if sent out with great force.</p> <p>→ Blood sent out to the lungs leaves the right ventricle and returns through the left atrium.</p>	<ul style="list-style-type: none"> <li>• Make pupils aware of how blood vessels are connected to the heart and how things move when blood is sent out from the heart.</li> <li>• Have them investigate using references and the textbook.</li> <li>• Have them investigate the flow of pulmonary and main circulation along with their roles, as well as the characteristics of the blood that flows through them, and relate them to the heart's structure.</li> </ul>
<b>Observation</b> 20 mins.	<ul style="list-style-type: none"> <li>• At a meat processing plant, actually observe a mammal's heart and sketch it.</li> </ul> <p>→ The heart is made of muscle.</p>	<ul style="list-style-type: none"> <li>• Make them grasp that the heart is made of thick muscles so that it can send blood out to the body with great force.</li> </ul> <p>(<i>Evaluation: Knowledge and Skills 8</i>) Ability to observe that the heart is made up of thick muscle so that it can send blood out to the entire body.</p>
<b>Presentation Summary</b> 20 mins.	<ul style="list-style-type: none"> <li>• Present what you have observed and confirmed.</li> </ul>	<p>(<i>Evaluation: Knowledge and Skills 9</i>) Ability to explain that the heart is made up of four chambers in the right ventricle, right atrium, left ventricle, left atrium, and also that the heart functions as a pump to circulate blood throughout the entire body.</p>

## 5. Importance of Blood Circulation (2 periods: 13<sup>th</sup> - 14<sup>th</sup> period)

### Goals of this sub-unit

- Show the state of blood circulation in a pattern diagram, then show how blood relates to the organs of the body and summarize how it maintains life.

### Material Preparations

- Drawing paper

### Periods 13-14: Importance of Blood Circulation

	Learning flow and activity	Teaching Hints and Advice
<b>Introduction</b> 10 mins.	<ul style="list-style-type: none"> <li>Summarize facts about blood circulation and the circulatory system.</li> </ul>	<ul style="list-style-type: none"> <li>Let pupils discuss the summary of what they have learned up until now about the circulatory system, focusing on blood.</li> </ul>
<b>Questions</b>	Summarize the circulation of blood.	
<b>Presentation</b> 40 mins.	<ul style="list-style-type: none"> <li>While discussing the circulation of blood, show how the heart, lungs, small intestine, liver, kidneys as well as blood vessels in the hands and legs connect in the given figure.</li> <li>Write in the characteristics of the blood flowing through the different blood vessels.</li> <li>Consider why blood circulation is important in addition to maintaining life.</li> <li>Know about diseases for which blood acts as a medium for infection (HIV).</li> </ul>	<ul style="list-style-type: none"> <li>Based on what they have learned to this point, have pupils consider the importance of blood circulation.</li> <li>Explain about HIV and know about the things to be careful with in daily life to prevent infection.</li> <li>Blood transfusions, bodily fluids, open wounds, and sharing of unsterilized tools that have touched blood.</li> </ul> <p><i>(Evaluation: Interest 2)</i> Take an interest in how the circulation of blood carries the oxygen and nutrients needed for human activity and the unneeded substances resulting from those activities, and willfully consider the importance of blood circulation.</p> <p><i>(Evaluation: Thinking and Representation 4)</i> Ability to summarize the state of human blood circulation in a pattern diagram joining lung circulation and body circulation.</p>
<b>Summary</b> 20 mins.	<ul style="list-style-type: none"> <li>Review the words and phrases you have learned until now.</li> </ul>	

## [Worksheet] ----- \* To be used in 1<sup>st</sup> - 2<sup>nd</sup> periods

### Investigating Blood

**Date:** \_\_\_\_\_ **Class:** \_\_\_\_\_ **Name:** \_\_\_\_\_

#### 1. Material Preparations

Textbooks and picture books and other references about blood. Mirrors, for use in observing the white in one's own eyes. *Note: when observing the eye, take care not to injure yourself.*

#### 2. Observation Procedure

- Investigate blood using the textbook and picture books, and summarize your findings.

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- Look for parts on your own body where blood is flowing.

Where you looked

What you realized

Where you looked

What you realized

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- Write down what you thought was strange or things you would like to investigate further.

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*\* Keep this worksheet for the next class.*

**[Worksheet]** ----- \* To be used in 3<sup>rd</sup> - 4<sup>th</sup> periods

## Observing the Flow of Blood

**Date:** \_\_\_\_\_ **Class:** \_\_\_\_\_ **Name:** \_\_\_\_\_

### 1. Material Preparations for Observation

Small fish (guppy, etc.), microscope, small polystyrene bag with fastener

### 2. Observation Procedure

- \* If you do not have a fish, use audio-visual materials (can be changed to observation of part of a fish fin or the flow of blood in mammals)



Try not to touch the fish too much in observation. Return the fish into the aquarium immediately after viewing.



- a. Put the fish and some water in a polystyrene bag and place it on the stage.
- b. Observe the fin at 100-150x magnification.



- c. Sketch the flow of blood in the frame on the right.

*Note: wash hands well after observing.*

- d. Write down what you thought was strange or things you would like to investigate further below.

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*\* Keep this worksheet for the next class.*

**[Worksheet]** ----- \* To be used in 7<sup>th</sup> - 8<sup>th</sup> periods

## Observing Veins and Capillaries

**Date:** \_\_\_\_\_ **Class:** \_\_\_\_\_ **Name:** \_\_\_\_\_

### 1. Material Preparations for Observation

Fresh piece of meat to observe blood vessels, magnifying glass, mirror

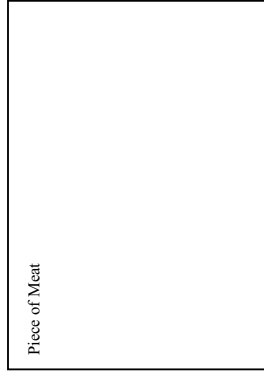
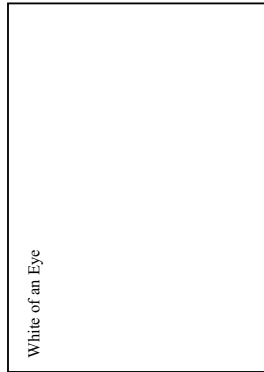
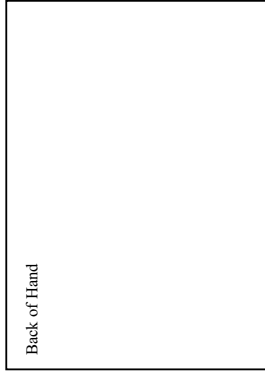
### 2. Observation Procedure

- a. Look for a place you can see veins, like the back of your hand, and sketch the blood vessels.
- b. Observe the blood vessels in the white of your friend's eye or your own eye (using a mirror) and sketch it.

*Note: Take care not to injure the eye when observing.*

- c. Observe the blood that oozes to the surface and the state of capillaries on a fresh piece of meat.

*Note: wash hands well after observing.*



- d. Write down what you thought was strange or things you would like to investigate further below.

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*\* Keep this worksheet for the next class.*

### 1<sup>st</sup> Sub-Unit Review Test

\* given after end of 2<sup>nd</sup> period

Class: \_\_\_\_\_ Name: \_\_\_\_\_

Answer the following questions about the circulatory system.

1. Explain the following terms.

Blood Circulation

**How blood flows from the heart to all parts of the body and then back to the heart.**  
*Acceptable as long as the above is included. "Organs of the body" can be substituted for "all parts of the body."*

Circulatory System

**The organs related to blood circulation.**

2. Write down the 3 organs of the circulatory system and their roles below.

- Organ: ( **Heart** )  
 Role: (                      ) **sends blood out to all parts of the body**
- Organ: ( **Blood** )  
 Role: (                      ) **To transport necessary and unnecessary waste products throughout the body**
- Organ: ( **Blood vessels** )  
 Role: (                      ) **tubes which blood flows through**

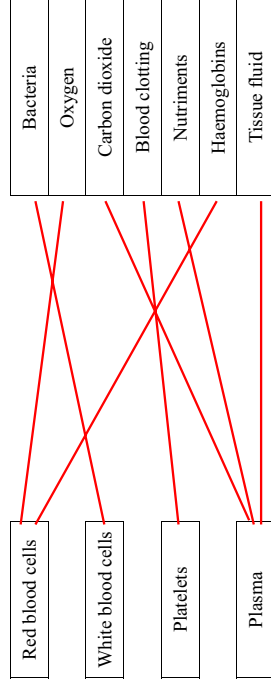
### 2<sup>nd</sup> Sub-Unit Review Test

\* given after end of 6<sup>th</sup> period

Class: \_\_\_\_\_ Name: \_\_\_\_\_

Answer the following questions about the components of blood.

1. Draw lines between the terms on the left and their related terms on the right.



2. Due to a substance in blood that at times attaches to and releases oxygen, the colour of blood will go between being bright red and a darker brown colour.  
 What is this substance called? ( **Haemoglobins** )
3. If your body is low on the substance given in 2. *above* you become sick. What is this sickness called? ( **Anaemia** )
4. When one injures their arm they will sometimes tie a small string around the arm tightly in order to stop the bleeding, but leaving things like this for extended periods is dangerous. Tell why this is.  
 ( **If you bind a small string around something to stop the bleeding then blood cannot flow past that point, meaning no oxygen is being carried to the cells. If you leave things in this state then the cells will become gangrenous (die off)** )  
*Anything saying that the oxygen goes away and cells will die off if they do not get oxygen is acceptable.*



### 3<sup>rd</sup> Sub-Unit Review Test

\* given after end of 9th period

Class: \_\_\_\_\_ Name: \_\_\_\_\_

Answer the following questions about blood vessels in the body.

1. Explain the characteristics and roles of the blood vessels shown below:

Arteries:

**Vessels that send blood out to the body from the heart. Because they carry blood from the heart at high pressure, they have thick walls and no valves. Pulse beats at the same tempo of the heart's beat.**

Veins:

**Vessels that send blood from the body into the heart. They flow at lower pressure, and thus have valves to prevent reverse flow.**

Capillaries:

**The narrowest vessels, found branching out from the end of arteries. Because they help carry blood to every part of the body, they widely cover the surface of the body.**

Pulmonary artery:

**Carries non-oxygenated blood from the heart to the lungs.**

Pulmonary vein:

**Sends highly oxygenated blood back to the heart from the lungs.**

2. Explain the differences in circulation to the lungs and that to the rest of the body.

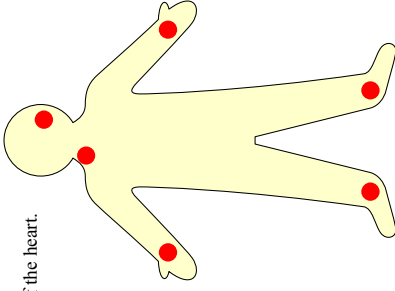
**In pulmonary circulation, the blood sent to the lungs from the heart expels carbon dioxide, then becomes oxygenated and flows back to the heart. In main circulation, highly oxygenated blood sent out from the heart provides oxygen to cells and becomes filled with carbon dioxide, circulating within the entire body. Blood then flows back to the heart.**

### 4<sup>th</sup> Sub-Unit Review Test

\* given after end of 12th period

Class: \_\_\_\_\_ Name: \_\_\_\_\_

Answer the following questions about the structure and function of the heart.



1. Write in the figure to the right the parts on the human body where you can detect a pulse.
2. When would your pulse have more beats, before or after exercising? Also give your reason for this answer.

( **before** **after** )

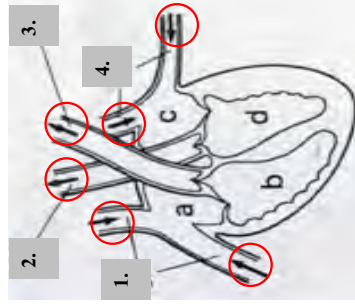
Reason:

( **The heart tries to send out large amounts of blood to compensate for the oxygen used in exercising.** )

3. Write in the names of the parts of the heart labelled **a – d** in the figure on the right.

Also give the names of the blood vessels labelled **1 – 4**.

Next, draw arrows on the figure to show the direction of blood flow for items **1 – 4** as given above.



- a. ( **right atrium** )    b. ( **right ventricle** )  
 c. ( **left atrium** )    d. ( **left ventricle** )  
 1. ( **vena cava** )    2. ( **aorta** )  
 3. ( **pulmonary artery** )    4. ( **pulmonary veins** )

### 5<sup>th</sup> Sub-Unit Review Test

\* given after end of 6th period

Class: \_\_\_\_\_ Name: \_\_\_\_\_

Answer the following questions about the importance of blood circulation.

1. Choosing between **a - g**, below, put the appropriate term in the blanks below.

Blood has many functions within the body. One of these is transportation. Blood transports the following things:

- Digested food is carried from the ( **g** ) to all parts of the body.
  - ( **d** ) is carried from the lungs to cells all over the body.
  - ( **c** ) is carried from cells all over the body to the lungs.
  - Waste products such as urea are carried to the ( **a** ).
- a. kidneys    b. liver    c. carbon dioxide    d. oxygen    e. nitrogen  
f. lungs    g. small intestine

2. HIV is a disease that can be contracted through the blood. Write down the following items to avoid being infected through blood shown below:

#### Warnings about blood transfusions

- ( **Only use utensils tested to confirm they are not infected with HIV.** )

#### Warnings about open wounds

- ( **Protect yourself by covering the wound or wearing gloves. You should never come in contact with blood from a wound.** )

#### Tools that cut skin and razors

- ( **Do not share these with others, and if you do share then only use after disinfecting.** )

### Final Unit Evaluation Test

\* Done at Unit End

Class: \_\_\_\_\_ Name: \_\_\_\_\_

1. Figure 1 below is a pattern diagram of the elements of human blood. Figure 2 shows the arrangement of cells in the human body. Answer the following questions.

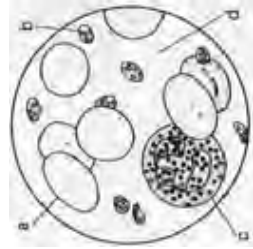


Figure 1

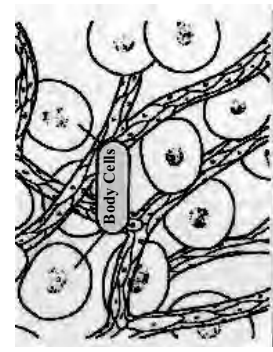


Figure 2

- (i) In Figure 1, which of **a - d** performs the function of removing bacteria? Also give the name.  
Symbol: ( **c** )    Name: ( **White blood cells** )

- (ii) In Figure 1, which of **a - d** has red-coloured pigment? Also give the name.  
Symbol: ( **a** )    Name: ( **Red blood cells** )

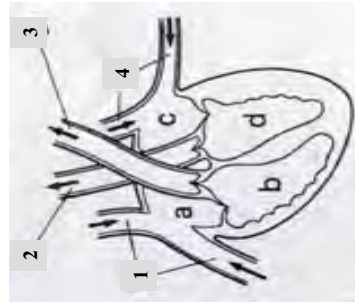
- (iii) In Figure 1, which of **a - d** carries carbon dioxide and ammonia given off by cells. Also give the name.  
Symbol: ( **d** )    Name: ( **Plasma** )

- (iv) What is the name of the liquid surrounding the cell in Figure 2? The blood element that forms this liquid is which of **a - d** from Figure 1?  
Name: ( **Tissue fluid** )    Symbol: ( **d** )

2. Enter the appropriate words in the blanks below from the choices in the box following the questions.
- (i) ( **Oxygen** ) is carried to all parts of the body by red blood cells.  
 (ii) Blood flows from the heart to the lungs through the ( **pulmonary artery** ), and returns to the heart from the lungs through the ( **pulmonary vein** ).  
 (iii) The blood vessels that send blood out from the heart to the far corners of the body are called ( **arteries** ), and the small blood vessels which reach to the far corners carrying blood are called ( **capillaries** ).  
 (iv) Blood circulating through the body returns to the heart through ( **the vena cava (veins also acceptable)** ).  
 (v) Valves in the ( **vena cava** ) and ( **veins** ) are to prevent ( **reverse flow** ) of blood.  
 (vi) The chambers on the top half of the heart are called ( **atria** ), and the chambers on the bottom half are called ( **ventricles** ).  
 (vii) Plasma has the function of carrying the ( **oxygen** ) and ( **nutrients** ) needed by the body, and also carrying unneeded substances like ( **urea** ) and ( **carbon dioxide** ).

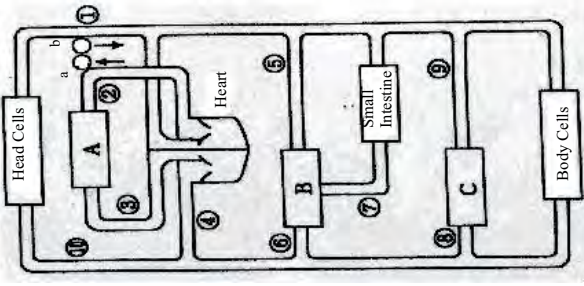
Arteries	Veins	Aorta	Vena Cava	Pulmonary Artery	Pulmonary Vein
Blood Vessels	Capillaries	Clotting	Reverse Flow	Atrium	Ventricle
Oxygen	Carbon Dioxide	Urea	Nutrients	Heart	Lungs

3. The figure on the right shows a cross section of the human heart. Answer the following questions about the figure.



- (i) Give the name of **part a**, in the figure. ( **right atrium** )  
 (ii) Name **blood vessel 1**, in the figure. ( **Vena cava** )  
 (iii) Between **parts a – d**, give all parts into which blood returns to the heart. ( **a, c** )  
 (iv) Between **parts a – d**, give all parts of the heart with blood that is leaving the heart. ( **b, d** )  
 (v) Between **blood vessels 1 – 4**, tell which flows to the lungs. ( **3** )  
 (vi) Between **parts a – d**, give all parts of the heart with oxygenated blood in them. ( **c, d** )

4. The figure on the right is a pattern diagram showing human blood circulation. The letters A – C are internal organs and the numbers 1 – 10 refer to different blood vessels. Answer the questions below.



- (i) Give the names for organs **A** and **B** in the figure.  
**A** ( **Lungs** ) **B** ( **Liver** )
- (ii) **a**, and **b**, in the figure show direction of flow. Which direction is blood flowing in blood vessels **1** and **2** respectively? Answer using the letters **a**, or **b**.  
**1** ( **a.** ) **2** ( **b.** )
- (iii) Give the name of blood vessel **3**. ( **Pulmonary artery** )
- (iv) What are the blood circulation patterns that flow in the following sequences called?  
 a. Heart → Organ **A** → Heart ( **Pulmonary circulation** )  
 b. Heart → Body Cells → Heart ( **Main circulation** )
- (v) Using numbers **1 – 10**, choose the one blood vessel with blood flowing as described.  
 a. Blood here is the most oxygenated. ( **1** )  
 b. After eating, blood here has the most glucose and amino acids. ( **9** )  
 c. Blood here has the most carbon dioxide. ( **4** )
- (vi) The blood vessel with the least amount of urea in the blood flow is **number 8** in the figure. Give the name of **Organ C**. ( **Kidneys** )
- (vii) What is the substance which plasma oozes from the walls of capillaries called? ( **Tissue fluid** )

5. Explain blood circulation.

**Blood is an important liquid to the life of animals that carries oxygen and nutrients throughout the body and also handles transport of waste materials like carbon dioxide and urea for disposal. Blood flowing from the heart to all parts of the body and then back to the heart is referred to as blood circulation.**

**The path of circulation can be divided into two main parts.**

**The first of these circulates centred around the lungs, sending blood from the heart to the lungs and then returning back to the heart.**

**The other circulates around the entire body, with blood being sent out from the heart going to all parts of the body except the lungs and then returning back to the heart.**

### Student Questionnaires

#### 1. What kinds of studying have you done in the past for the above test problems?

- 0. None at all
  - 1. No
  - 2. Average
  - 3. Yes
  - 4. Absolutely yes
- This was done 10% of the time for all problems.  
 This was done 30% of the time for all problems.  
 This was done 50% of the time for all problems.  
 This was done 70% of the time for all problems.  
 This was done over 90% of the time for all problems.

#### Answering Questions using Pictures and Diagrams in the Textbook or Illustrations Drawn on the Blackboard

- 1. The Students answered the questions by walking up to the board and drawing diagrams or writing words.
  - 2. The teacher asked and answered the questions by drawing diagrams or writing words on the board.
  - 3. Questions were answered using pictures and diagrams in the textbook.
0. 1. 2. 3. 4.  
 0. 1. 2. 3. 4.  
 0. 1. 2. 3. 4.

#### Experiments

- 1. Did the students conduct any experiments or observations?
  - 2. The teacher conducted the experiments.
  - 3. The students conducted the experiments by following the teacher's instructions.
0. 1. 2. 3. 4.  
 0. 1. 2. 3. 4.  
 0. 1. 2. 3. 4.

#### Discussion and Thinking

- 4. We talked with friends in the class and thought about the problems.
  - 5. We thought about the problems carefully with friends and stated our ideas logically.
0. 1. 2. 3. 4.  
 0. 1. 2. 3. 4.

- 6. We thought about the problems carefully when coming up with a hypothesis and after the experiment.
0. 1. 2. 3. 4.

#### Understanding Ideas

- 7. I was able to understand new ideas.
  - 8. I was able to see new viewpoint of looking at and thinking about science.
  - 9. I was able to grasp the principles hidden beneath the facts.
0. 1. 2. 3. 4.  
 0. 1. 2. 3. 4.  
 0. 1. 2. 3. 4.

#### Application of Knowledge

- 10. I was able to apply the new knowledge that I learned in school in my daily life.
  - 11. The teacher has explained that the new knowledge things the students are learning in school are connected with actual life.
  - 12. I was able to learn that the new principles and viewpoints toward science can be applied to a variety of different phenomena.
0. 1. 2. 3. 4.  
 0. 1. 2. 3. 4.  
 0. 1. 2. 3. 4.

#### Pursuing Knowledge through Problem Solving

- 13. We were first given a problem and then were to solve that problem.
  - 14. We made predictions, put them to the test, formulate scientific explanations, and put them to practical use.
  - 15. The students were asked to verify through the experiment that they had created a hypothesis as well as a plan for the observation.
0. 1. 2. 3. 4.  
 0. 1. 2. 3. 4.  
 0. 1. 2. 3. 4.

**2. When you learned each unit for the above test problems, did you become interested in the material?**

- 0. None at all
  - 1. No
  - 2. Average
  - 3. Yes
  - 4. Absolutely yes
- This was true 10% of the time for all problems.
- This was true 30% of the time for all problems.
- This was true 50% of the time for all problems.
- This was true 70% of the time for all problems.
- This was true over 90% of the time for all problems.

**Interest and Motivation**

- 1. I was very interested in science lessons.
  - 2. I became more motivated to learn.
  - 3. I was interested in what we were learning from start to finish.
0. 1. 2. 3. 4.
0. 1. 2. 3. 4.
0. 1. 2. 3. 4.

**Concentration and Involvement**

- 4. I was actively engaged in learning the topic.
  - 5. I enjoyed learning the topic so much I lost track of time.
  - 6. I was very focused on learning topic material but at the same time, I was also very excited and enjoyed myself.
0. 1. 2. 3. 4.
0. 1. 2. 3. 4.
0. 1. 2. 3. 4.

**Cooperation and Collaboration**

- 7. I enjoyed the learning process while collaborating with friends.
  - 8. I was able to learn through cooperation and mutual support with my friends.
  - 9. I shared my experiments and ideas with my friends and we all had a fun time learning together.
0. 1. 2. 3. 4.
0. 1. 2. 3. 4.
0. 1. 2. 3. 4.

**Level of Earnestness and Enjoyment during Experiments**

- 10. The experiments were very enjoyable.
  - 11. Since experiments need five senses, I carefully moved my hands and eyes when collecting the data.
  - 12. During the experiments, I recorded my observations accurately and carefully.
0. 1. 2. 3. 4.
0. 1. 2. 3. 4.
0. 1. 2. 3. 4.

**Spirit of Inquiry**

- 13. I began to have more an inquiring mind toward new discoveries.
  - 14. I became very excited and curious about challenging the unknown.
  - 15. I made a strong effort to learn what is known by trying to find examples, drawing illustrations, and through discussions and experiments.
0. 1. 2. 3. 4.
0. 1. 2. 3. 4.
0. 1. 2. 3. 4.

**Logic and Objectivity**

- 16. I attempted to find plenty of evidence and facts to check whether my hypothesis held true.
  - 17. I was able to confirm that the principles and concepts were true by applying them to actual life.
  - 18. The explanations were very convincing and easy to understand for the entire class. I was very satisfied with the interpretations which were logical and accorded with the truth.
0. 1. 2. 3. 4.
0. 1. 2. 3. 4.
0. 1. 2. 3. 4.

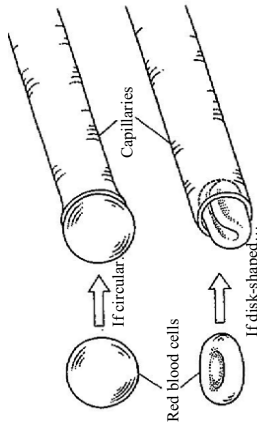
## Appendix

### Elements and Functions of Blood

#### Red Blood Cells

##### 3. Shape Advantages

Red blood cells are not circular, but rather are disk-shaped with an indented centre as shown in the figure on the right. This shape makes the cells highly flexible, allowing them to change shape by folding to pass through narrow passages such as capillaries. This shape also enlarges the surface area, allowing efficient transport of oxygen.



##### 4. Where Cells are Made

Red blood cells are made in the marrow of bones. While in the foetus blood is also made in the liver and spleen, but after birth it is made in the marrow of the sternum, ribs, vertebrae, pelvis and femurs.

Marrow is the soft tissue that fills bones' bone-marrow canal and the spongy bone tissue of their inner cavities. Red blood cells are made from blood blast cells found here in marrow. A giant mother cell, also called a giant erythroblast, is made from these blood blast cells. After the mother cell divides several times, disk-shaped red blood cells are produced.

White blood cells and platelets are also made in bone marrow. Just as with red blood cells, blast cells form the base for these cells as well.

#### White Blood Cells

##### 5. Types of White Blood Cells

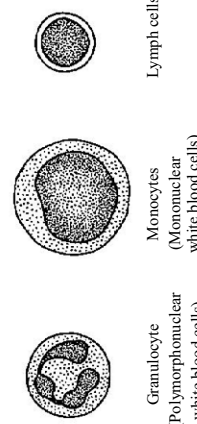
The figure on the right shows some of the types of white blood cells found in the blood of vertebrates such as human beings.

Granulocytes, which have nuclei that can change shape, comprise 65-70% of all white blood cells and have granules within the cells.

These cells have a diameter of about 10µm, and are the cells normally referred to when speaking of white blood cells. White blood cells are divided into three types by differences in the staining properties with respect to the colouring of the granule, known as neutrophils, acidophiles and basophiles.

Monocytes, which are white blood cells with a single nucleus, are the largest of blood cells with a diameter of 13-21µm.

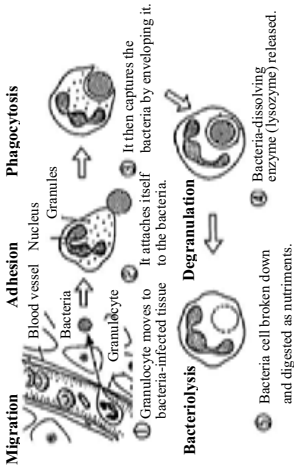
Lymphocytes comprise nearly 100% of all cells found in lymph. These cells have a diameter of 7-12µm and are circular when in lymph or blood, but are amorphous in shape when found in tissue. These cells help in acquiring immunities.



##### Types of White Blood Cells

#### 6. Granulocyte Phagocytosis

When bacteria invade the body, this information is passed on to the granulocytes, which migrate using amoeboid movement to move from blood vessels to the tissue where the bacteria are. This phenomenon is called *migration*. The granulocytes attack the bacteria immediately upon arriving in the tissue. First they attach themselves to the enemy, referred to as *adhesion*, then capture it by enveloping it, referred to as *phagocytosis*. When



phagocytosis completes, an enzyme called *lysozyme*, which helps to dissolve the bacterium, is released within the granulocyte in a process called *degranulation*. This enzyme breaks down the bacterium's cell walls, and the cell ruptures when it can no longer bear the osmotic pressure. This sequence is known as *bacteriolysis*.

#### 7. Why Pus is Generated

When one is injured, pus gathers around the wound. This pus is the remains of white blood cells that died fighting bacteria.

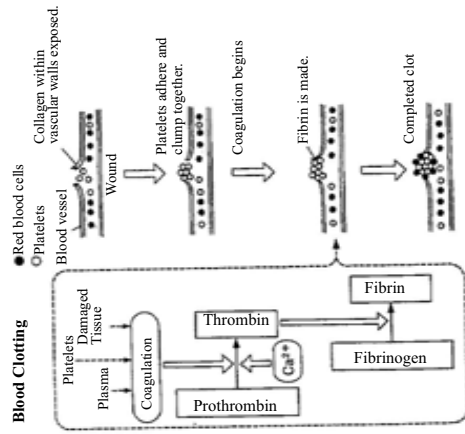
When tissue becomes inflamed with injury, white blood cells will gather around that area. White blood cells will die one after the other fighting bacteria, but they are replenished by the circulatory system. Concurrently, bone marrow will produce and send out more white blood cells than normal. In this fashion, white blood cells within the body increase suddenly in order to deal with an inflammation when one occurs.

#### Platelets

Platelets are thin circular or elliptical cells with a diameter of 2-3µm, with about 200,000-400,000 platelets in every 1mm<sup>3</sup> of blood. As with red blood cells, they are made in the marrow and put out into circulating blood. A platelet's life span is between 7-10 days.

#### 8. Function of Platelets

A small cut or abrasion will stop bleeding in a matter of minutes if left alone. This is because blood coagulates due to the blood-coagulation factor appearing in the platelets, plasma and damaged tissue, resulting in a curdled mass of blood called a clot. A blood clot is formed by the following sequence.



- When injured and the blood vessels of the damaged tissue are torn, materials such as collagen within the vascular walls become exposed. If blood touches these materials, platelets will adhere to such areas, clumping together to cause tissue degeneration and releasing its coagulation factor. A separate coagulation factor appears in plasma and the damaged tissue.
- These coagulation factors work together with calcium ion ( $\text{Ca}^{2+}$ ) to change prothrombin in plasma into thrombin.
- Thrombin changes a protein called fibrinogen into fibre-shaped fibrin, also called cellulose.
- Fibrin makes red blood cells adhere to the area, producing a clot.

In addition, materials separated and refined using thrombin and fibrin are used as styptics to stop bleeding.

#### Animals with no Red Blood Cells

Other than vertebrates, there are approximately 100 varieties of invertebrate animals living in the seas such as red clams and spoonworms that have red blood flowing through them like humans. These animals have red blood cells just like humans do.

However, annelids such as the sandworm and leech, as well as midge larvae have red blood with no red blood cells. In such creatures, haemoglobin is dissolved into plasma to make the blood red.

Furthermore, the blood of crustaceans such as prawns and crabs, and molluscs like the squid and octopus is blue, not red. This is because their blood has a pigment called haemocyanin in place of haemoglobin.

## Appendix

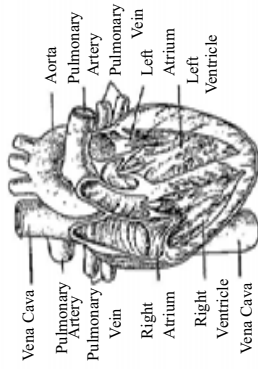
### Structure and Function of the Heart

#### The Heart

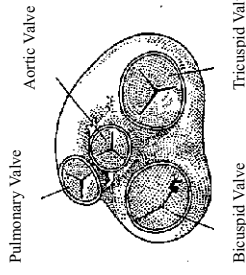
The heart is located in the chest cavity between the lungs, situated slightly to the left of centre. The heart is about the size of a closed fist, weighing 200-300g.

#### Cardiac Muscles: Muscles of the Heart

The walls of the heart are made of a special muscle tissue called cardiac muscle fibre. The walls of atriums are not particularly thick, but as the ventricles use great pressure to push blood out to the body, their walls are made of thick muscle. The wall of the left ventricle in particular, which pumps blood out to the cells of the entire body, is 3 times as thick as that of the left ventricle.



#### Make-up of the Human Heart



#### Heart Valves

The human heart has the following 4 valves.

#### Atrioventricular Valves: Between Atriums and Ventricles

- Tricuspid valve: three-flapped valve between the right atrium and right ventricle
- Bicuspid valve: two-flapped valve between the left atrium and left ventricle

#### Valves at the Base of Arteries

- Aortic valve
- Pulmonary valve

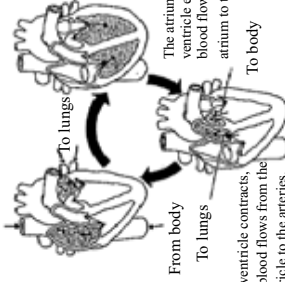
These valves are called *semilunar valves* as they have three half-moon shaped cusps.

#### Atriums and Ventricles

The human heart is made up of two atriums, left and right, which take in blood from the veins, and two ventricles which send blood out to the arteries. Blood

always flows from the atriums to the ventricles. In a state of rest, the amount of 5l of blood is sent out by each of the left and right ventricles per minute for a total of 14,400 litres of blood per day.

The atrium expands, and blood flows from the veins into the atrium.



The atrium contracts as the ventricle expands, and blood flows from the atrium to the ventricle.

The ventricle contracts, and blood flows from the ventricle to the arteries.

### Heartbeat and Pulse

- **Heartbeat**

The heartbeat can be heard by placing a stethoscope below the left nipple. There are two types of heart sounds, often described as a lub and a dub. This regular beating sound is given off when the valves of the heart open and close. The first heart sound is that of the atrioventricular valves closing, at which time the pulmonary valve and aortic valve are open, pushing blood out of the heart. The second heart sound is that of the semilunar valves closing, in which blood is sent from the atriums into the contracted ventricles.

- **Pulse**

Because of the high flexibility of arteries, the heart's beat is momentarily transmitted throughout the body due to contraction of the ventricles. This is called a *pulse*, and is normally around 65-70 beats per minute.

### Heart-Maintaining Coronary Arteries

#### Arteries

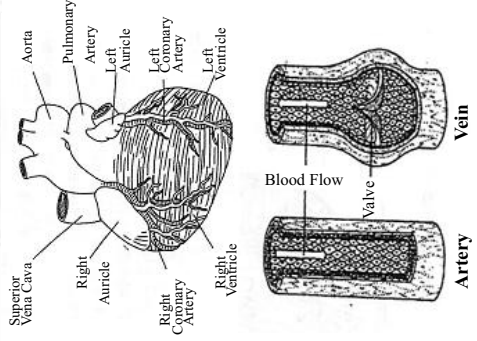
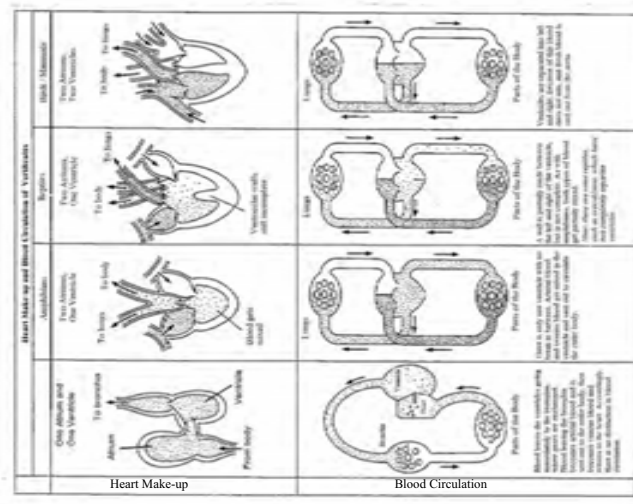
The muscular cells making up the heart need to exchange substances with blood just like the rest of the body in order to sustain life. This does not mean, however, that the heart can simply use the enormous amounts of blood flowing through it.

The blood vessels maintaining the heart branch off immediately after leaving the left ventricle to distribute blood to the heart's surface and are called coronary arteries.

### Make-up of Blood Vessels

- **Difference Between Arteries and Veins**

Arterial walls are made of 3 layers. The middle layer, or *media*, is made of smooth muscle and is very thick. The innermost layer, known as the *intima*, and the media both have connective tissue made of elastic fibres, making them flexible and able to withstand the high pressure of blood with little change.



### Appendix

#### Blood Components Seen Through an Electron Microscope



Picture from electron microscope (2200x magnification)

#### Blood Components




Element	Form	Function
Red Blood Cells 	Elliptical with indentation in centre.	Carries oxygen. <i>The body becomes anemic without enough red blood cells.</i>
White Blood Cells 	Circular <i>Shape changes when foreign object / bacteria is captured.</i>	Breaks down foreign objects and bacteria.
Platelets 	Small and amorphous	Hardens blood when bleeding occurs.
Plasma	Liquid	Dissolves nutrients and unneeded substances.

Figure 25 Human Blood



### Appendix Cells and Tissue Fluids of the Body

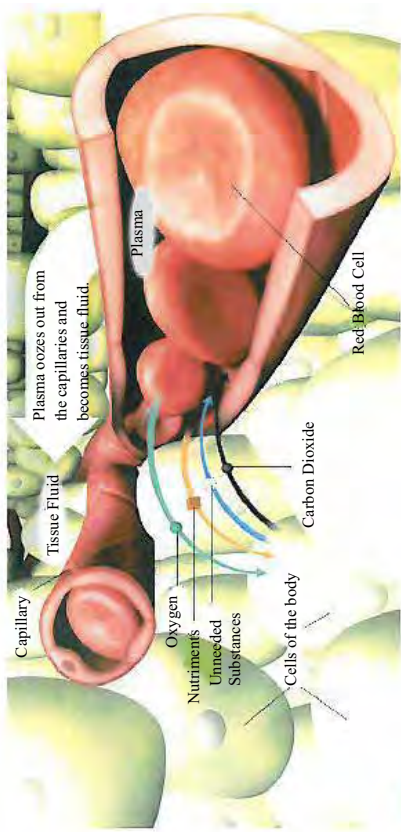


Fig. 26 Pattern Diagram: Cells and tissue fluids of the body

### Appendix Structure of the Human Heart

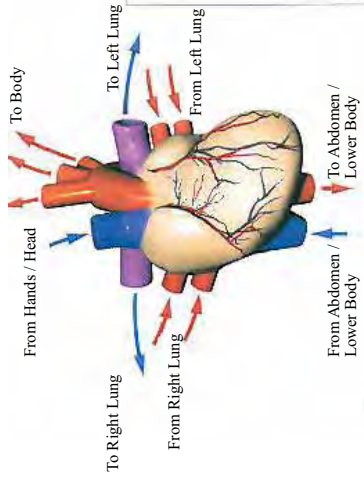
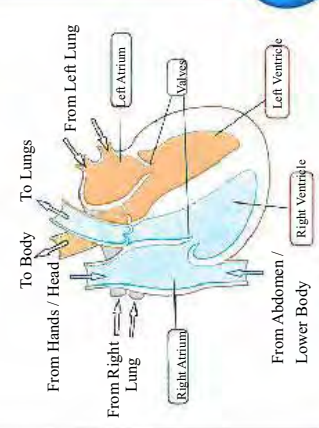


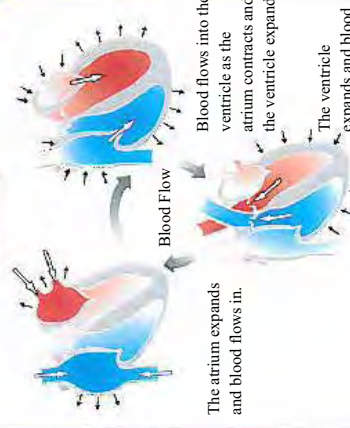
Fig. 27 The Human Heart

Additional Learning

#### Heart Make-up and Functions – Pattern Diagram

The heart is broken into four chambers.





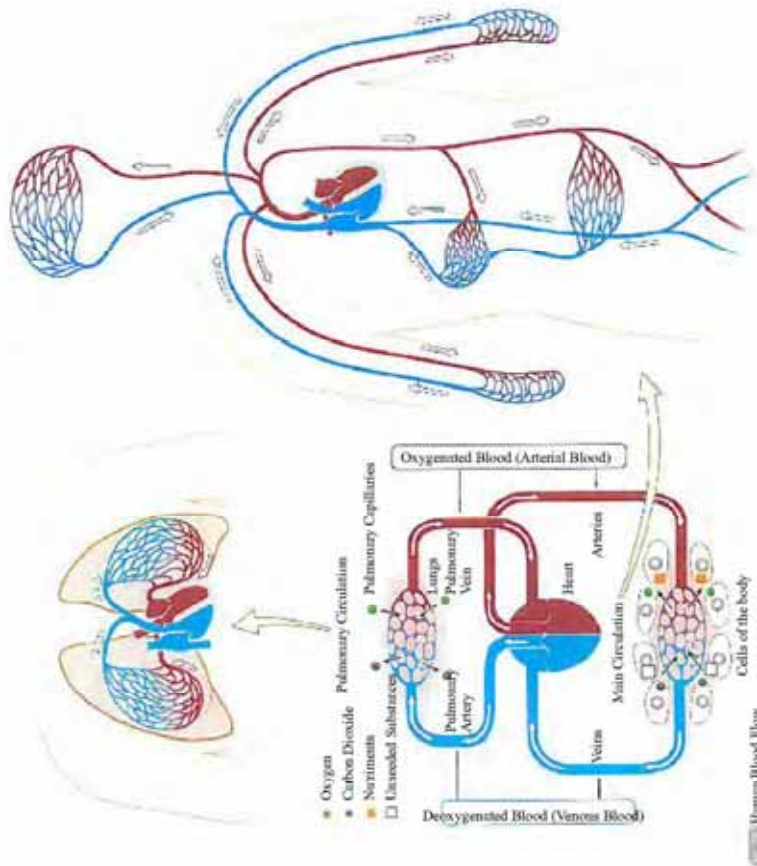
Blood Flow

The atrium expands and blood flows in.

Blood flows into the ventricle as the atrium contracts and the ventricle expands.

The ventricle expands and blood flows out.

### Appendix Human Blood Flow



### Appendix

Examples of assessment questions which is used in Kenyan text books

The component of blood that transports digested food is \_\_\_\_\_.

- The component of blood that transports oxygen is \_\_\_\_\_.
- A. White blood cells
  - B. Red blood cells
  - C. Plasma
  - D. Platelets

(JKF; Primary Science Education Foundation Science 7 P.8)

Which of the following statements are true about the heart?

- (i) The heart has four chambers.
  - (ii) The auricles pump blood out of the heart.
  - (iii) The ventricles receive blood into the heart.
  - (iv) The left ventricle is connected to the aorta.
  - (v) The right auricle is connected to the vena cava.
- A. (i), (iv) and (v) only.
  - B. (i), (ii), (iii), (iv), (v).
  - C. (iv) and (v) only.
  - D. (ii) and (iii) only.

(Oxford; Science in Action 7 P.12)

Which of the following statements are correct?

- (i) Red blood cells are formed in the red bone marrow.
  - (ii) White blood cells are formed in the bone marrow and the lymph.
  - (iii) Red blood cells are fewer in number than white blood cells.
  - (iv) The white blood cells are part of the body's defence mechanism against diseases.
  - (v) A drop of blood may contain several millions of red blood cells.
- A. (i), (ii), (iv) and (v) only.
  - B. (iii) only.
  - C. (v) only.
  - D. (iv) only.

(Oxford; Science in Action 7 P.13)

Solve the crossword puzzle. Fill in the blank spaces after reading the instructions below. An example has been done for you. The example is Number 4 across.

Question: What is the colour of blood? The answer is RED.

Across

- These blood vessels allow materials to pass in and out of the blood.
- The liquid part of blood.
- \_\_\_\_\_ carry oxygen in the blood.
- They carry oxygenated blood to the body.

Down

- Oxygen is carried in the red blood.
- The liquid part of blood.
- \_\_\_\_\_ carry oxygen in the blood.

(Longhorn; Understanding Science, Pupil's Book 7 pp.9-10)

6. The main artery in the body is the:  
 (A) aorta  
 (B) pulmonary vein  
 (C) pulmonary artery  
 (D) vena cava

Use the following diagram to answer questions 7 and 8.

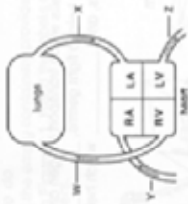


Figure 1.10 A simplified diagram of the heart and blood vessels

7. Which blood vessels carry deoxygenated blood?  
 (A) W and X  
 (B) W and Y  
 (C) X and Z  
 (D) Y and Z
8. Which combination shows the two main blood vessels in a mammal's body?  
 (A) W and X  
 (B) W and Y  
 (C) X and Z  
 (D) Y and Z

(Macmillan; Macmillan Primary Science, Pupil's book 7 P.11)

7. Which one of the following statements is correct?

The blood vessel marked W carries:

- Blood from the lungs
- Blood to the lungs
- Blood to the body organs
- De-oxygenated blood

8. The blood vessel marked X is the:

- Aorta
- Vena cava
- Pulmonary vein
- Pulmonary artery

(K.L.B; Primary Science Pupils' Book for Standard Seven P.12)

Which one of the following statements is **not** correct?  
The blood vessel marked Y:

- A. Carries deoxygenated blood
- B. Is the major artery in the circulatory system
- C. Carries blood from the heart to the body organs
- D. Is the aorta

The blood vessel marked Z:

- A. Carries blood from the lungs
- B. is the pulmonary artery
- C. Is the aorta
- D. Carries deoxygenated blood

(KLB; Primary Science Pupils' Book for Standard Seven P.12)

### Appendix

Examples of materials which is used in Kenyan text books

#### 1. Counting the heartbeat

Now place one funnel on your friend's chest and the other next to your ear.



Figure 1.1 Using a homemade stethoscope

(Macmillan; Macmillan Primary Science, Pupil's book 7 P.1)



(Macmillan; Macmillan Primary Science, Pupil's book 7 P.3)



Figure 1.7: Checking the pulse

(Oxford; Science in Action 7 P.6)

#### 2. Blood components and functions

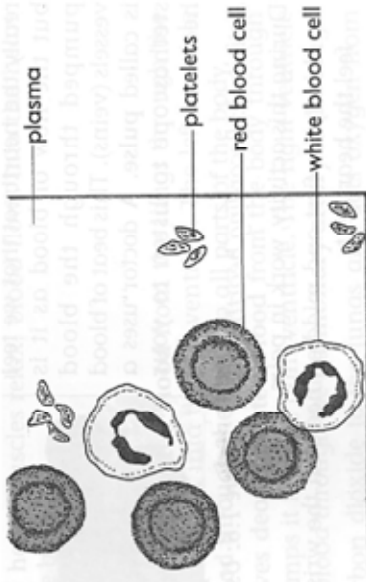


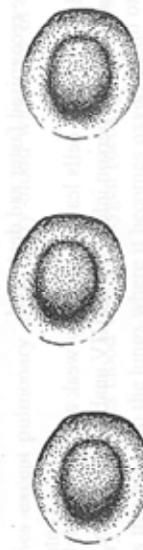
Figure 1.8: The components of blood

(Oxford; Science in Action 7 P.6)



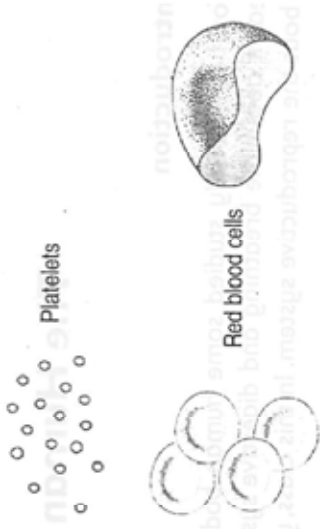
White blood cells

(JKF; Primary Science Education Foundation Science 7 P.3)



Red blood cells

(JKF; Primary Science Education Foundation Science 7 P.3)



(KLB; Primary Science Pupils' Book for Standard Seven P.2)

Blood is composed of liquid and solid parts. The liquid part of blood is called **plasma**. Plasma is a pale yellow liquid, which transports digested food and other useful substances around the body. It also transports waste products like carbon dioxide. Plasma constitutes the largest percentage of the blood volume. The solid part of the blood is made up of **red blood cells**, **white blood cells** and **platelets**.



Figure 1.5 Blood contains plasma, cells and platelets

- **Red blood cells** are shaped like discs and are made in the bone marrow. They contain a red pigment, **haemoglobin**, which makes the blood red in colour. They transport oxygen from the lungs to all parts of the body.
- **White blood cells** are the soldiers of the body. They fight disease-causing germs and help you get better when you are sick.
- **Platelets** are very small particles that help your blood to clot when you are injured. Clotting of blood helps bleeding to stop.

(Macmillan; Macmillan Primary Science, Pupil's book 7 P.5)

3. Types of blood vessels and their functions



Figure 1.16: Capillaries in the eye

(Oxford; Science in Action 7 P.10)



Figure 1.15: Capillaries connecting arteries and veins

(Oxford; Science in Action 7 P.9)

Comparison of the blood vessels  
The table below shows a comparison of the structure and functions of the arteries, veins and capillaries.

Arteries	Veins	Capillaries
They carry blood away from the heart.	They carry blood to the heart.	They carry blood to all the body cells.
They have thick elastic walls with a narrow space in the middle.	They have thin, less elastic walls with a wide space in the middle.	They have very thin walls. The walls are one-cell thick.
They all carry oxygenated blood except the pulmonary artery.	They all carry deoxygenated blood except the pulmonary vein.	They carry oxygen and digested food to the body cells. They also allow carbon dioxide and waste products out of the body.
Blood in the arteries is forced forward by the pumping of the heart. This gives it a pulse.	There is no pressure from the heart on the blood in the veins. The blood is propelled by the action of the body muscles.	Blood in capillaries has no pulse. It flows under low pressure.
Arteries have no valves.	Veins have valves to prevent backflow of blood.	Capillaries have no valves.
When arteries are cut, the blood comes out in spurts.	When veins are cut, the blood flows out steadily.	When capillaries are cut, there is minimal bleeding.
Arteries are usually located deep in the body.	Veins are superficial. That is, they are close to the surface of the body.	Capillaries are found all over the body.

(Oxford; Science in Action 7 P.10)

4. Structure and functions of the heart

The heart is a pump that moves blood through the circulatory system.

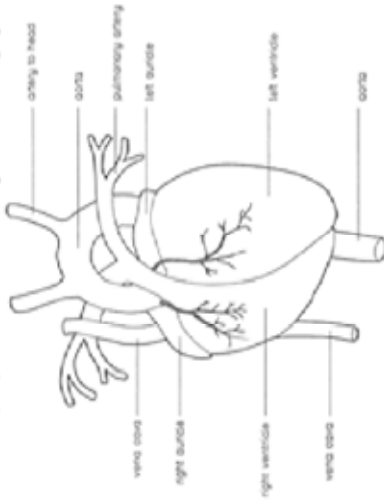


Figure 1.8 The external parts of the heart

(Macmillan; Macmillan Primary Science, Pupil's book 7 P.7)

Identify, draw and label the parts you can see.

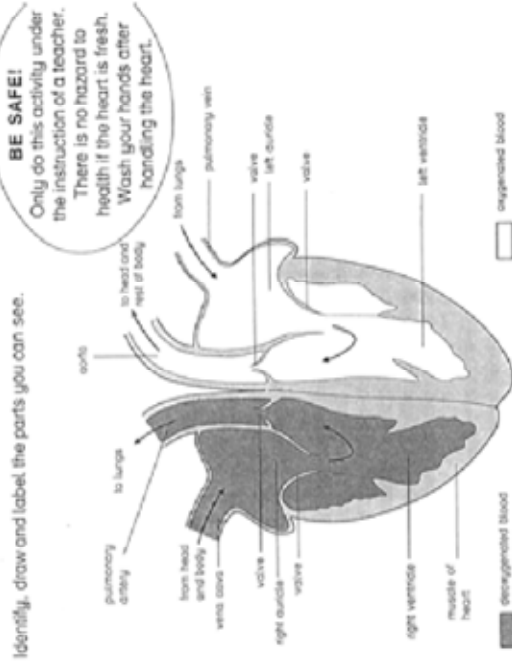


Figure 1.9 Diagram of a heart cut down through the middle

(Macmillan; Macmillan Primary Science, Pupil's book 7 P.8)

### The heart

The heart is a muscular organ situated in the left side of the chest cavity. It pumps blood to all parts of the body. The heart is divided into the right and the left parts. These parts are in turn divided into upper chambers called **auricles** and lower chambers called **ventricles**. Therefore, the heart has four chambers.



Figure 1.2: The chambers of the heart

The ventricles pump blood out of the heart to the rest of the body. Auricles receive blood into the heart. The walls of ventricles are thicker than those of auricles because more force is needed to pump blood to the whole body than the force needed to receive blood in the heart. The left ventricle has a thicker wall than the right ventricle. The left ventricle pumps blood to all parts of the body. The right ventricle pumps blood to the lungs.

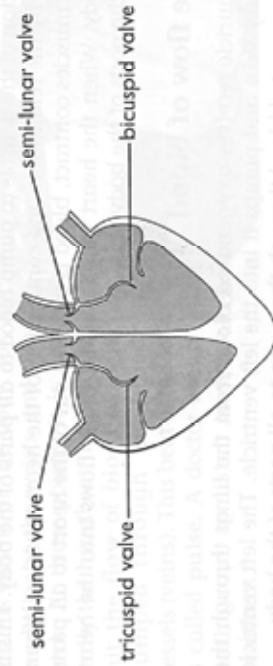


Figure 1.3: The valves of the heart

(Oxford, Science in Action 7 P.3)

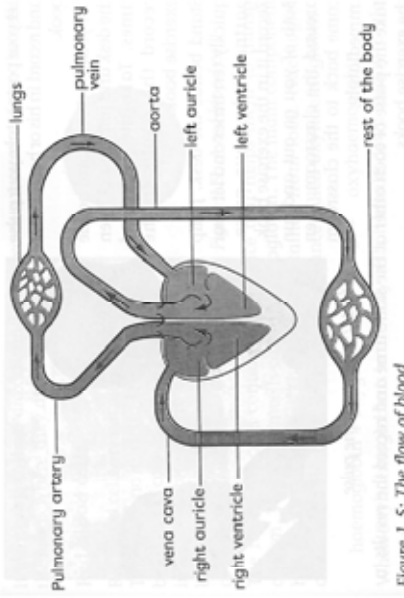
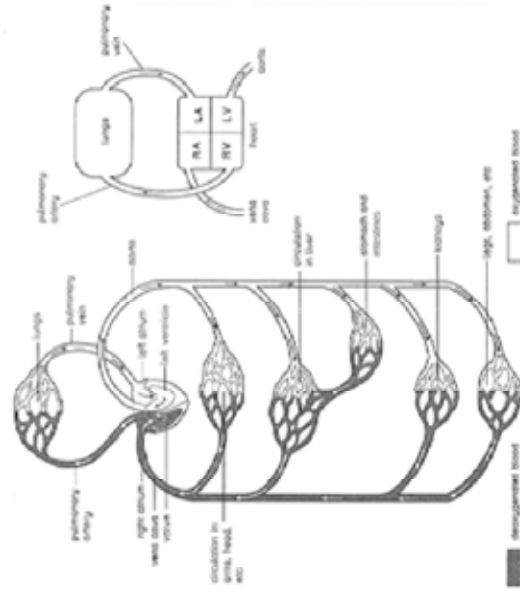


Figure 1.5: The flow of blood

(Oxford, Science in Action 7 P.5)



(Macmillan; Macmillan Primary Science, Pupil's book 7 P.4)

### The Circulation of Blood

The heart pumps the blood to all parts of the body. The blood leaves the heart and flows to the body parts through the arteries. The blood returns to the heart from the body parts through the veins. The steps involved in the circulation are as follows:

1. Blood from all parts of the body flows into the **right auricle (RA)** of the heart through the **vena cava**. This blood is deoxygenated as the parts of the body have already used up the oxygen; it also contains carbon dioxide collected from the body organs. This blood then passes from the right auricle into the right ventricle through a valve.
2. The muscular right ventricle then pumps this blood into the lungs through the **pulmonary artery**.
3. In the lungs, oxygen is added to the blood and carbon dioxide is removed. The carbon dioxide is then breathed out.
4. The oxygenated blood flows to the left auricle of the heart through the **pulmonary vein**. The left auricle then pumps the oxygenated blood down into the left ventricle through a valve.
5. The muscular left ventricle then pumps the blood to all parts of the body through the **aorta**. Once the blood circulates to all parts of the body, it flows back to the heart and the cycle begins once more.

(K.L.B, Primary Science Pupils' Book for Standard Seven P.7)