8th Grade: HUMAN BODY

(Human reproductive system, excretory system)

Rational of this unit

It is during this developmental stage that the pupils start to become curious about or interested in their existence before birth and by helping them understand that human development starts in the mother's body, even before birth, will ensure self-esteem and enhance the spirit of respect for life.

When the pupils reach puberty, the girls will start to experience menstruation (period) and the boys will experience ejaculation. By guiding the pupils to appreciate the human reproductive system during this stage of mounting curiosity, interest, and questions regarding the beginning of life and the reproductive process, they will be able to strengthen their decision-making skills concerning sexual health.

Furthermore, humans breathe to absorb oxygen and to expel carbon dioxide and excrete waste substances in order to maintain life. It is also important for the pupils in this developmental stage to recognize the organs involved in the excretion of waste substances and to understand their functions.

Objectives: what pupils are expected to achieve in this unit

- Learn about human birth, fertilization and growth in the mother's body, and foster an attitude of respect for life through a correct understanding of the beginning of life.
- Learn about the structure and functions of the skin, lungs and kidneys, which discharge internal waste substances to the outside of the body, and foster an attitude of appreciation for life-sustaining organs through a correct understanding of respiration and excretion mechanisms.

Interrelation of contents of each grade

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

Grade	What to teach (Human body)
1st grade	• External parts of the human body (head (eyes, ears, nose, hair, mouth), neck, breasts, upper limbs (hands, elbows, fingers, nails), lower limbs (knees, feet, toes, toenails))
2nd grade	• Senses (olfactory sense, gustatory sense, tactile sense, visual sense, auditory sense) • Using the sensory organs
3rd grade	• Visual sense (far/near, large/small, visual power) • Suitable gestures to be used in the community, including facial and body expressions
4th grade	• Types of teeth (incisors, cuspids, premolars, molars) • Functions of the different types of teeth • Growth of new teeth (loss of teeth, permanent teeth)
5th grade	• Names of the respiratory organs (nose, trachea, bronchi, lungs, diaphragm) • Functions of the respiratory organs (nose, trachea, lungs, diaphragm) • Names of the digestive organs (mouth (teeth and tongue), oesophagus, stomach, small intestine, liver, pancreas, large intestine, rectum, anus) • Functions of the digestive organs (teeth, oesophagus, stomach, small intestine, large intestine)
6th grade	• Organs of the reproductive system (female (ovaries, fallopian tubes, uterus, vagina), male (testes, urethra, penis)) • Functions of some of the reproductive organs • Changes in adolescence (changes in the body (male and female))
7th grade	• Organs of the circulatory system (heart, blood, blood vessels) • Blood components and their functions (plasma, red blood cells, white blood cells, blood platelets) • Types of blood vessels and their functions (arteries, veins, capillaries) • Structure and functions of the heart (atrial auricle (atrium), ventricles, blood vessels (aorta, vena cava, pulmonary veins, pulmonary arteries))
8th grade (this unit)	• Fertilization • Fetal development (zygote, embryo, fetus) • The beginning of life • Excretory organs and waste substances (skin (epidermis, dermis, sweat glands, and sweat as a waste substance), lungs (nose, trachea, and carbon dioxide as a waste substance), kidneys (external view of the kidneys, urethra, urinary bladder, and urine as a waste material discharged from the urethra))

（HUMAN BODY／8th grade）

Before starting this unit

Current learning status of the pupils

The pupils have learned the names and functions of the male and female reproductive organs in the sixth grade. They have learned almost all the names of the organs, but their knowledge of the functions are limited to brief descriptions of the organs (e.g. sperm cells are produced in the testes); therefore, the details of “fertilization”, “fetal development” after fertilization, and “the process of childbirth” are studied in the eighth grade.

The pupils in the eighth grade have reached puberty, and many of them have already experienced menstruation (period) and ejaculation. From previous studies, they have some understanding that menstruation (period) and ejaculation are linked to the birth of life, but have not yet gained accurate knowledge of the detailed mechanism and the functions.

The topic of the digestive system had been covered in the fifth grade. However, the pupils have not yet studied the excretory organs and it will be the first opportunity for them to study how and through which organs the internal waste substances are excreted from the body.

Preparatory Notes

- Since “fertilization”, “fetal development” and “the structures of excretory organs” cannot be studied based on actual observation, it will be necessary to prepare reference books, presentation materials and worksheets for research-type lessons.

Objectives to be achieved by competency

Interest, motivation, and attitude

1. The pupils are intrigued and interested in fertilization, childbirth and the beginning of life, and are actively seeking answers to their own questions.
2. The pupils gain knowledge about pregnancy and the possibility of transmitting sexually transmitted infections and HIV to the fetus, and are committed to adopting a safe lifestyle.
3. The pupils are intrigued and interested in the excretion of internal waste substances, and are actively seeking answers to their own questions.

Scientific thinking and communication activities

1. The pupils are able to conduct their own research by making linkages between the structures of the reproductive organs and the fertilization mechanism or fetal development, and are able to make reports on study cards or explain about their findings.

（HUMAN BODY／8th grade）

2. The pupils are able to conduct their own research about the organs involved in the excretion of internal waste substances, including their functions, by making linkages between each organ.

Knowledge, understanding, and skills in observation and experimentation

1. The pupils are able to understand the functions of sperm cells and the ovum as well as the mechanism of fertilization.
2. The pupils are able to understand the process of pregnancy and childbirth.
3. The pupils are able to understand the issues related to pregnancy.
4. The pupils are able to recognize the names of the excretory organs (skin, lungs, kidneys) and to understand their functions.

Ideas behind the structuring the unit

As a follow-up to the lessons in the sixth grade, in which the pupils learned the names and functions of the male and female reproductive organs, some activities have been added to enhance the pupils’ understanding of the role and significance of fertilization, by consulting the reference materials.

Furthermore, studies about fetal development have enabled the pupils to recognize the significance of fertilization, pregnancy and childbirth in the succession of a new life, and to understand the importance of having respect for life.

Regarding the names and functions of the organs involved in the excretion of waste substances, the unit was organized so that the pupils can conceptualize them by reviewing their daily lives and learn by recording their findings.

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
1. **Learning about fertilization** (3 periods)	1) Find out about the functions of the male and female reproductive organs, sperm cells and the ovum that are necessary in the succession of a new life, and make a record in a study card. *(Evaluation: Interest 1)* 2 - 3) Find out about the mechanism of fertilization and make a record in a study card. *(Evaluation: Thinking and Presentation 1, Knowledge and Skills 1)*
2. **Learning about fetal development** (4 periods)	4 - 5) Find out how a fertilized ovum develops in the mother's body, and make a record in a study card. *(Evaluation: Knowledge and Skills 2)* 6 - 7) Find out the roles of the placenta and umbilical cord, and make a record in a study card. *(Evaluation: Thinking and Presentation 1)*
Intermediate review (No time allotted)	Give the "1st and 2nd **Sub-Unit Review Test**." (Homework can be given depending on the progress of the class.)
3. **Learning about the beginning of life** (2 periods)	8) Find out about the process of childbirth and make a record in a study card. *(Evaluation: Knowledge and Skills 2)* 9) Discuss important issues related to AIDS, abortion and pregnancy. *(Evaluation: Interest 2, Knowledge and Skills 3)*
termediate review (No time allotted)	Give the "3rd **Sub-Unit Review Test**." (Homework can be given depending on the progress of the class.)
4. **Learning about the excretory organs and the waste substances** (6 periods)	10- 11) Observe the skin and how sweat comes out of the pores, and make a record of the findings in a study card. *(Evaluation: Interest 3, Knowledge and Skills 4)* 12- 13) Find out about the mechanism of respiration and make a record of the names and functions of the different parts of the nose and trachea. *(Evaluation: Thinking and Presentation 2, Knowledge and Skills 4)* 14 - 15) Find out about the kidneys and urinary organs, and make a record of the relevant names and functions in a study card. *(Evaluation: Knowledge and Skills 4)*

Lesson Plan

4. Learning about the excretory organs and the waste substances (6 periods: 10th -15th period)

Goals of this sub-unit

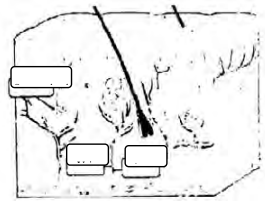
- The pupils are intrigued about and interested in the excretory mechanism of internal waste substances, and are actively seeking answers to their own questions.
- The pupils are able to conduct their own research about the organs involved in the excretion of internal waste substances, including their functions, by making linkages between each organ.
- The pupils are able to recognize the names of the excretory organs (skin, lungs, and kidneys) and to understand their functions.

Material Preparations

- Documents, textbooks and study cards from which the pupils can learn about the names and functions of the excretory organs (skin, lungs, kidneys).

Periods 10-11: Structure and functions of the skin

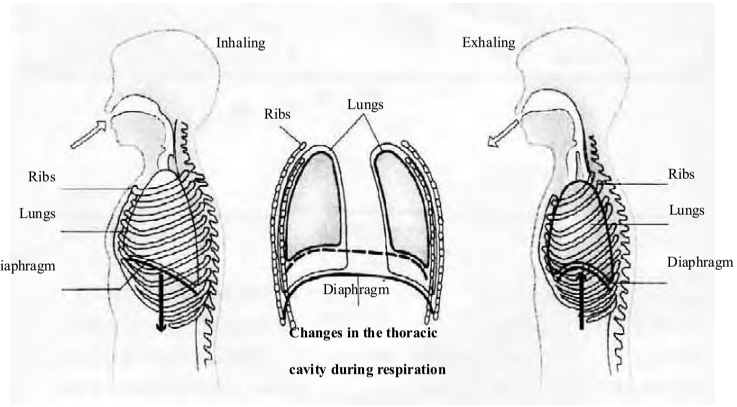
	Learning flow and activity	Teaching hints and advice
Introduction 10 mins.	・ How are the unnecessary materials produced in the body expelled to the outside?	・ Advise the pupils to reflect upon the phenomena in their daily lives.

	→ as sweat. → as exhaled air. → as urine.	・ Encourage the pupils to discuss from which part of the body sweat, breath, urine and other waste substances are discharged. *(Evaluation: Interest 3)* The pupils are intrigued and interested in the excretory mechanism of internal waste substances, and are actively seeking answers to their own questions.
Question	Observe the skin and find out about its functions.	
Investigative Study 50 mins.	・ Observe how sweat comes out of the pores, by actually running. ・ Use the reference materials to find out that the skin has sweat glands and is composed of two layers, etc., and make a record in the study card. → Sweat is produced by the sweat glands and discharged from the body through pores in the skin.  **The structure of the skin and the distribution of the sweat glands**	・ Advise the pupils to look closely around the pores of the skin and to observe how the sweat comes out. ・ Advise the pupils to refer to the documents and textbooks to check the functions. ・ Get the pupils to make a record of their findings in the worksheet. *(Evaluation: Knowledge and Skills 4)* The pupils are able to recognize the names of different parts of the skin, as an excretory organ, and understand their functions.
Presentation 10 mins.	・ Find out about the function of the skin and make a presentation from the records in the study card.	・ Get the pupils to make a presentation from their records in the worksheet.

Periods 12 - 13: Structure and functions of the lungs

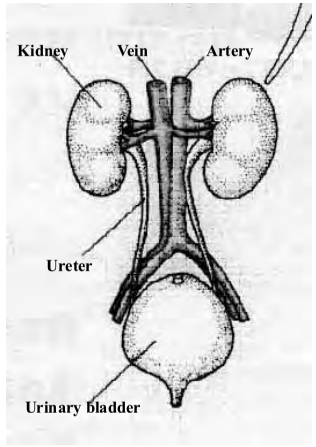
	Learning flow and activity	Teaching hints and advice
Introduction 10 mins.	・ Humans cannot survive without breathing. What is happening? → Oxygen is taken into the body and carbon dioxide is expelled out of the body. → Respiration occurs in the lungs.	・ Advise the pupils to reflect upon the phenomena in their daily lives. ・ Encourage the pupils to discuss where respiration occurs. → The names and functions of the respiratory organs have been covered in the fifth grade.
Question	Find out about the structure and functions of the lungs.	
Investigative Study 50 mins.	・ Put the hands on the chest and check the movement of the chest as you breathe. ・ Use the reference materials to find out about the structure and functions of the lungs, and make a record in the study card. → Air is inhaled and enters into the lungs by passing through the trachea. Oxygen is absorbed in the lungs. → Carbon dioxide is passed out of the lungs through the trachea and is exhaled out of the body as a waste material.	*(Refer to pg. 83 regarding worksheet)* ・ Allow the pupils to think about the respiratory mechanism by actually checking the movement of their own chest. ・ Advise the pupils to refer to the documents and text books to check the structure and functions of the lungs. ・ Get the pupils to make a record of their findings in the worksheet.

(HUMAN BODY／8th grade)

	 **Changes in the thoracic cavity during respiration**	
		(Evaluation: Thinking and Presentation 2) The pupils are able to conduct their own research on the organs involved in the excretion of internal waste substances, including their functions, by making linkages between each organ. *(Evaluation: Knowledge and Skills 4)* The pupils are able to recognize the names of different parts of the lungs, as an excretory organ, and understand their functions.
Presentation 10 mins.	Find out about the structure and function of the lungs and make a presentation from the records in the worksheet.	Get the pupils to make a presentation from their records in the worksheet.

Periods 14 - 15: Structure and functions of the kidneys

	Learning flow and activity	**Teaching hints and advice**
Introduction 10 mins.	・ Humans discharge excess products in the body as urine, but where is urine produced? → It is probably produced somewhere in the body. → Urine is produced in the body.	・ Advise the pupils to reflect upon the phenomena in their daily lives. ・ Encourage the pupils to discuss where urine is produced.
Question	Find out about the structure and functions of the kidneys.	
nvestigative Study 50	・ Use the reference materials to find out about the structure and functions of the kidneys, and	・ Advise the pupils to refer to the documents and textbooks to check the structure and functions

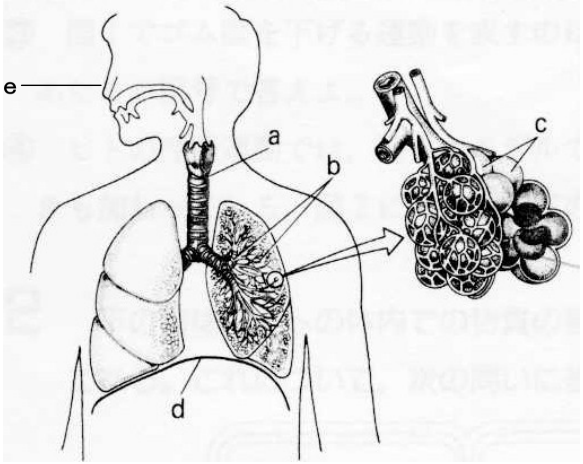
mins.	make a record in the study card. → Humans have two kidneys. Waste substances and excess water are converted into urine. → Urine is transferred from the urinary bladder through the urethra to be discharged from the body.	of the kidneys. ・ Get the pupils to make a record of the findings in the study card.
		*(Evaluation: Knowledge and Skills 4)* The pupils are able to recognize the names of different parts of the kidneys, as an excretory organ, and understand their functions.
Presentation 10 mins.	・ Find out about the structure and functions of the kidneys and make a presentation from the records in the worksheet.	・ Get the pupils to make a presentation from their records in the worksheet.

Worksheet ----------* To be used in 12nd-13rd Periods

Learning about the structure and functions of the lungs

Date: **Class:** **Name:**

○ Find out the names and functions of different parts of the lungs that produce carbon dioxide.



Alphabetic letter	Name	Function
a	**Trachea**	**This is the tube that transfers air from the mouth to the lungs.**
b	**Bronchi**	**There are airways branching off from the trachea.**
c	**Alveoli**	**They are found at the end of the bronchi, and oxygen and carbon dioxide are exchanged with the blood vessels.**
d	**Diaphragm**	**Its upward and downward movements enable the lungs to intake air.**
e	**Nose**	**It is the organ that makes it possible to breathe in air.**

* Please bring this worksheet to the next lesson.

4th Sub-Unit Review Test

* To be used at the end of 15th Period

Class: Name:

1. Answer the following questions regarding the respiratory organs.

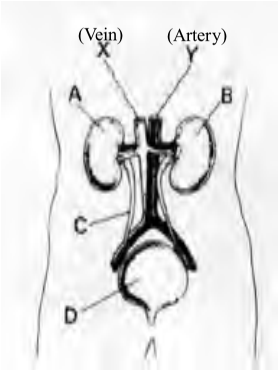
(1) What organs do fish living under water use for respiration? (**gills**)

(2) Fill in the spaces (a) to (g) with the appropriate words.

- Humans use (a) to breathe. (a) is made up of minute sacs, called (b), covered by a thin membrane.
- (b) are surrounded by (c), like a net.
- An exchange of (d) and (e) takes place between the air in (b) and the blood in (c).
- Human lungs are located in the (f) and the (g) and the rib muscles work together to change the volume of the thoracic cavity, allowing the air to move in and out of the lungs.

(a) (**lungs**) (b) (**alveoli**) (c) (**capillaries**) (d) (**oxygen**)
(e) (**carbon dioxide**) (f) (**thoracic cavity**) (g) (**diaphragm**)

2. The diagram on the right shows the kidneys and some of the related structures. Answer the following questions.



(1) Which alphabetic letter indicates the kidneys?

(**A,B**)

(2) Select a function of the kidneys from (a) to (d) listed below. Reply with an alphabetic letter.

(**(c)**)

(a) Absorb water.
(b) Reduce the harm of toxic substances.
(c) Filter out unnecessary substances.
(d) Absorb nutrients.

(3) Select all the substances removed by the action of the kidneys, from (a) to (e) listed below. Reply with an alphabetic letter.

(**(b), (d)**)

(a) carbon dioxide (b) water (c) glycerin (d) urea (e) amino acids

(4) What is stored in D to be discharged from the body? (**Urine**)

(5) What is the name of the organ that produces urea? (**Liver**)

(6) In which blood vessel, X or Y, is blood with less waste substances flowing? Reply with the appropriate alphabetic letter.

(**X**)

(7) Waste substances in the blood are also discharged from the skin. In what form are they discharged? Is it more or less concentrated compared to what is stored in D?

(**Sweat**) More or less concentrated (**Less concentrated**)

Final Unit Evaluation Test

*Done at Unit End

Class: Name:

1. Select the missing words from the box below. Write in the corresponding alphabetic letter.

(1) Male and female physical characteristics that appear at puberty are called the (**(e)**).

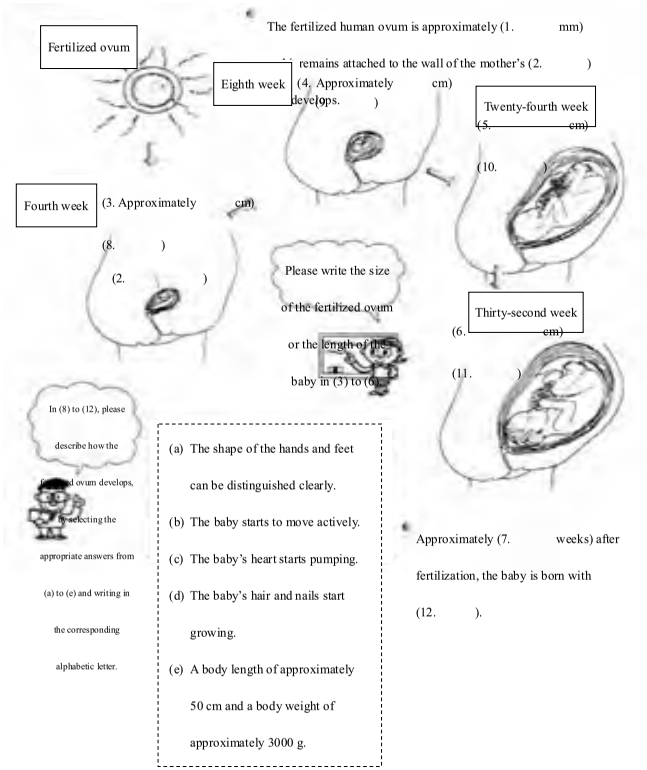
(2) The release of an ovum from the cells in the ovary is called (**(f)**). If the ovum is not fertilized, the uterine endometrium is shed. This phenomenon is (**(h)**), and it is repeated approximately once a month.

(3) (**(d)**) produced in the testes are mixed with the secretory fluids from the seminal vesicles and the prostate gland to make up a fluid called (**(b)**), which is projected out of the body through the urethra when stimulated by physical or psychological sexual excitement. This is called ejaculation.

(4) When ejaculation takes place in the vagina, sperm cells swim up the uterus toward the fallopian tubes. If an ovum is in the fallopian tube at that moment, it is possible for (**(g)**) to occur. The fertilized ovum repeats cell divisions and moves toward the uterus until (**(a)**) on the uterine endometrium. The state in which a life dwells in a woman's body, starting from the fertilization of an ovum to the birth of the baby, is called (**(c)**).

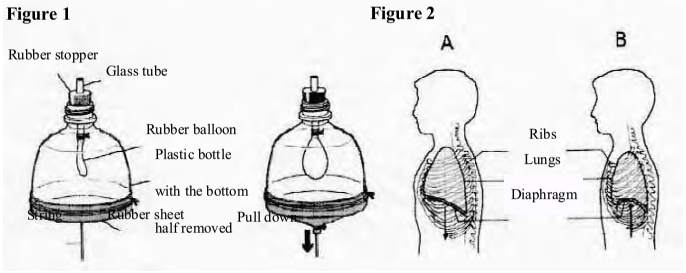
(a) implantation	(b) semen	(c) pregnancy	(d) sperm cells
(e) secondary sexual characteristics	(f) ovulation	(g) fertilization	(h) menstruation

2. Fill in the spaces with the appropriate words.



(1) (**0.14**)
(2) (**Uterus**)
(3) (**0.4**)
(4) (**3**)
(5) (**30-35**)
(6) (**40-45**)
(7) (**38**)
(8) (**(c)**)
(9) (**(a)**)
(10) (**(b)**)
(11) (**(d)**)
(12) (**(e)**)

3. Figure 1 shows a model of the human thoracic cavity, made using a plastic bottle. Figure 2 shows the human respiratory movement. Answer the following questions about them.



(1) Which parts of the human body in Figure 2 do the rubber balloon and the rubber sheet in Figure 1 represent? Look at Figure 2 and fill in the spaces below.

Rubber balloon (**Lungs**) Rubber sheet (**Diaphragm**)

(2) In Figure 1, the rubber balloon inflates as the rubber sheet is pulled down. Explain the reason.

(**When the rubber sheet is pulled down, the internal volume of the container is increased and the pressure is reduced, causing the air to be sucked inside the rubber balloon.**)

(3) Which diagram in Figure 2, A or B, does the movement of pulling down the rubber sheet in Figure 1 represent? Answer with either alphabetic letter.

(**A**)

(4) In the human respiratory movement, there is another movement that is not demonstrated by the model in Figure 1. Which body part in Figure 2 is involved in that movement?

(**Ribs**)

Student Questionnaires

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

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

0. 1. 2. 3. 4.

2. The teacher asked and answered the questions by drawing diagrams or writing words on the board.

0. 1. 2. 3. 4.

3. Questions were answered using pictures and diagrams in the textbook.

0. 1. 2. 3. 4.

Experiments

1. Did the students conduct any experiments or observations?

0. 1. 2. 3. 4.

2. The teacher conducted the experiments.

0. 1. 2. 3. 4.

3. The students conducted the experiments by following the teacher's instructions.

0. 1. 2. 3. 4.

Discussion and Thinking

4. We talked with friends in the class and thought about the problems.

0. 1. 2. 3. 4.

5. We thought about the problems carefully with friends and stated our ideas logically.

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.

0. 1. 2. 3. 4.

8. I was able to see new viewpoint of looking at and thinking about science.

0. 1. 2. 3. 4.

9. I was able to grasp the principles hidden beneath the facts.

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.

0. 1. 2. 3. 4.

11. The teacher has explained that the new knowledge things the students are learning in school are connected with actual life.

0. 1. 2. 3. 4.

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.

Pursuing Knowledge through Problem Solving

13. We were first given a problem and then were to solve that problem.

0. 1. 2. 3. 4.

14. We made predictions, put then to the test, formulate scientific explanations, and put them to practical use.

0. 1. 2. 3. 4.

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.

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

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

Interest and Motivation

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

Concentration and Involvement

4. I was actively engaged in learning the topic.
0. 1. 2. 3. 4.
5. I enjoyed learning the topic so much I lost track of time.
0. 1. 2. 3. 4.
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.

Cooperation and Collaboration

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

Level of Earnestness and Enjoyment during Experiments

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

Spirit of Inquiry

13. I began to have more an inquiring mind toward new discoveries.
0. 1. 2. 3. 4.
14. I became very excited and curious about challenging the unknown.
0. 1. 2. 3. 4.
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.

Logic and Objectivity

16. I attempted to find plenty of evidence and facts to check whether my hypothesis held true.
0. 1. 2. 3. 4.
17. I was able to confirm that the principles and concepts were true by applying them to actual life.
0. 1. 2. 3. 4.
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.

Appendix

Structure and functions of the placenta

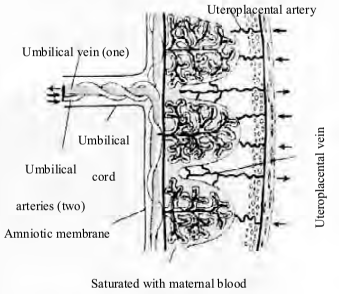
Keirinkan Primary School Science Teachers Manual 2005 Ed. (P. 65)

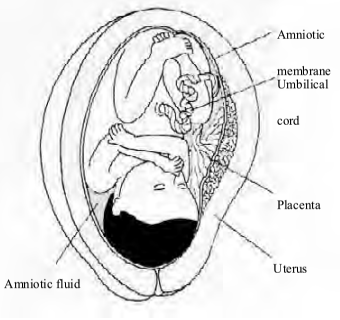
Most mammals, including humans, are viviparous and a fertilized ovum develops into a fetus within the uterus, until it is delivered. Hence, there is a need for a system to exchange substances in order to ensure a long-term supply of oxygen and nutrients in the uterus. For the mother, however, the fetus is not part of herself but a foreign body.

Therefore, the fetus must be isolated from the maternal system. The system that developed in order to fulfill these two conflicting functions, the exchange of substances and isolation, was the placenta.

The maternal blood and the fetal blood are separated from each other by the trophic membrane of the placenta. This membrane allows for the exchange of substances so that oxygen and nutrients are supplied to the fetus and carbon dioxide and waste substances are removed, while preventing the maternal and fetal blood from being mixed together.

<The structure of the placenta>





The umbilical cord connects the fetus to the placenta. There are two arteries and one vein running through the umbilical cord, together with the yolk sac linked to the digestive canal and a part of the allantoic membrane is likened to the urinary bladder.

Until delivery, the fetus is connected to the placenta via the umbilical cord and is immersed in the amniotic fluid which fills the amniotic cavity.

Appendix

Roles of the amniotic fluid

Keirinkan Primary School Science Teachers Manual Ed. 2005 (p.65)

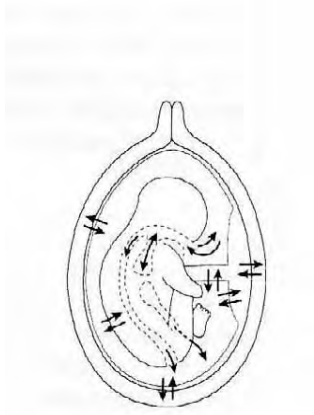
The amniotic fluid is a liquid that fills the amniotic cavity, and it contains various substances including electrolytes, lipids, proteins, several enzymes, bilurin, and hormones. The amniotic fluid has the following functions.

During pregnancy

- Attenuates impacts from outside
- Retains heat
- Allows free movement of the fetus
- Prevents the adhesion of fetal body parts
- Supplies nutrients

During delivery

- Expands the birth canal until the water breaks, making delivery more smooth



Circulation of amniotic fluid

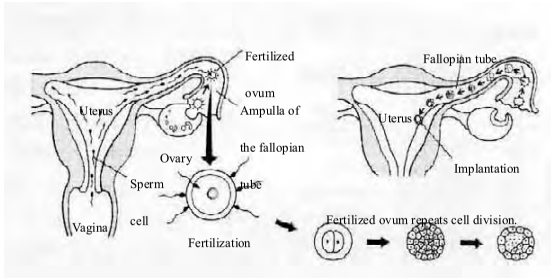
Reference: "Igaku/ Igaku Souron (Medicine/ Overview of medical care) II", Ishiyaku Publications

The volume of the amniotic fluid is not constant. It is approximately 20 mL by the seventh week after fertlization, but increases up to approximately 700 mL between the twenty-third and twenty-sixth week after fertilization. Then the volume gradually decreases until it is about 500 mL near the due date. Moreover, old amniotic fluid is constantly being replaced by new amniotic fluid.

From ovulation to implantation

Keirinkan Primary School Science Teachers Manual Ed. 2005 (p.63)

On about the fourteenth day in the menstrual cycle, an ovum is released from the ovary and transported to the fallopian tube by the fimbria of the fallopian tube. If, by chance, sperm cells are present, the ovum may be fertilized.



The fertilized ovum will spend the first few days moving slowly down the fallopian tube, while the number

of cells multiplies. By the time it reaches the uterus, it will have become a mass of cells with an internal lining forming a spherical shape. This mass of cells buries itself in the uterine endometrium. This process is called implantation.

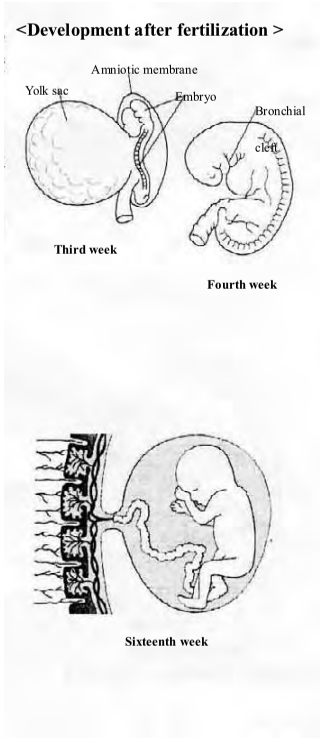
The external layer of the fertilized ovum, implanted in the uterine endometrium, consists of cells called trophoblasts. Trophoblasts secrete a proteolytic enzyme called trypsin, enabling the fertilized ovum to enter deeply into the uterine endometrium. (Reference: “Igaku/ Igaku Souron (Medicine/ Overview of medical care) II”, Ishiyaku Publications)

（HUMAN BODY／8th grade）

Appendix

Development of the fertilized ovum

Keirinkan Primary School Science Teachers Manual Ed. 2005 (p.63)



- **Four weeks after fertilization**
  The size is approximately 7 mm. It has a head, body and a tail. The heart can be identified. The yolk sac, where blood cells are being produced, is visible. Blood vessels are developing in the placenta.

- **Six weeks after fertilization**
  The size is approximately 1.5 cm. The head, body and the yolk sac are approximately the same size. The bone marrow is still to be developed; therefore, the yolk sac is still the major source of blood cells.

- **Eight weeks after fertilization**
  The size is approximately 4 cm. By this stage, all the features in a fully developed human will have been established. The muscles have just begun their first movements.

- **Between twelve to fifteen weeks after fertilization**
  During this period, the body length of the fetus reaches approximately 16 cm, it has a more human-like appearance, and its sex can be clearly identified. The placenta is completed and the exchanges through the umbilical cord become smooth.

- **Between sixteen to nineteen weeks after fertilization**
  The body length is approximately 25 cm and the body weight approximately 250 g. The hair and nails start to grow and the fetus can move the limbs and make active fetal movements.

- **Between twenty-four to twenty-seven weeks after fertilization**
  The body length is approximately 35 cm and the body weight approximately 1000 g. Lanugo hair grows over the whole body. An oily secretion from the sebaceous glands and the cells shed from the skin form a sticky embryonum that protects the skin.

● **Between thirty-six to thirty-eight weeks after fertilization**

The body length is approximately 50 cm and the body weight approximately 3000 g. Its appearance is now more baby-like, and it starts to actively drink the amniotic fluid. It is thought that this prepares the stomach and the intestines for digestion and absorption. Pulmonary respiration begins upon birth, and the baby will be able to adapt to the external world.

Appendix

Examples of assessment questions which is used in Kenyan text books

1. The reproductive cells produced by the male are called:
   A. Semen B. Amniotic fluid
   C. Sperms D. Ovum
2. In females, reproductive cells are produced in the:
   A. Cervix B. Ovaries
   C. Oviduct D. Uterus
3. In females, the fallopian tube is also known as the:
   A. Uterus B. Ovaries
   C. Cervix D. Oviduct
4. The ring of muscle which lies between the uterus and the vagina is called the:
   A. Cervix B. Oviduct
   C. Birth canal D. Womb
5. The fluid that protects the developing foetus is called the:
   A Menstrual period B. Excretory fluid
   C. Semen D. Amniotic fluid

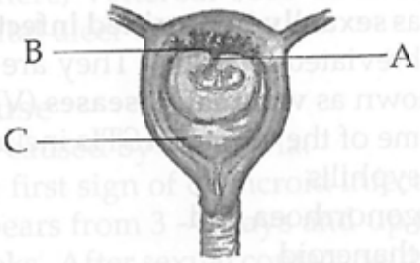
(KLB; Primary Science Pupils' Book for Standard Eight P.16)

Which one of the following is the correct order of the foetal development?
(A) foetus ——> zygote ——> embryo ——> baby
(B) zygote ——> embryo ——> foetus ——> baby
(C) embryo ——> zygote ——> foetus ——> baby
(D) zygote ——> foetus ——> embryo ——> baby

Which one of the following is a function of the amniotic fluid?
(A) provides the foetus with food and oxygen
(B) protects the foetus from shock
(C) helps in the removal of wastes from the foetus
(D) connects the foetus to the uterus

(Macmillan; Macmillan Primary Science, Pupil's book 8 P.11)

The figure below shows a foetus of about 5 months. Use it to answer questions 16 and 17.



16. Name the part labelled A and B.

17. What is the function of the part labelled C.

18. In which part does exchange of blood nutrients, oxygen and waste products between the mother and the foetus take place?

(Longhorn; Understanding Science, Pupil's Book 8 P.9)

Which of the following is true about the skin?

A. The skin cannot protect us from strong sunlight.
B. The dermis has a layer of dead cells .
C. The skin is an excretory organ that gets rid of water and salt.
D. The sweat pores of the skin produce sweat and release it.

The lungs help us to

A. take in oxygen and get rid of carbon dioxide.
B. take in carbon dioxide and get rid of oxygen.
C. take in water vapour and get rid of oxygen.
D. take in carbon dioxide and give out water vapour.

(Oxford; Science in Action 8 P.11)

The two main components of urine are

A. water and salt.
B. water and carbon dioxide.
C. urea and water.
D. urea and salts.

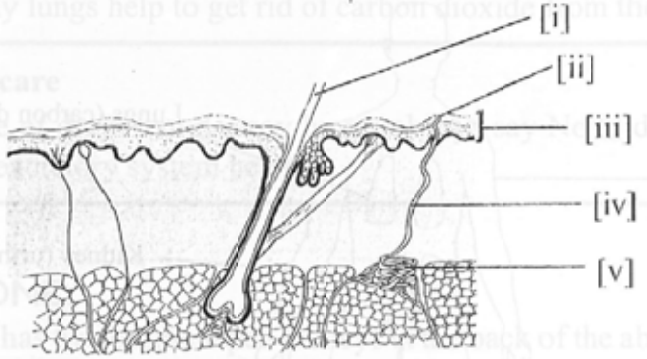
(Oxford; Science in Action 8 P.11)

Complete the table below

Excretory Organ	Waste Product
	Carbon dioxide
Skin	
Kidney	

(JKF; Primary Science Education Foundation Science 8 P.15)

Name the parts of the skin shown in this diagram.



(JKF; Primary Science Education Foundation Science 8　P.14)

Appendix

Examples of materials which is used in Kenyan text books

Reproduction in human beings

The male reproductive system

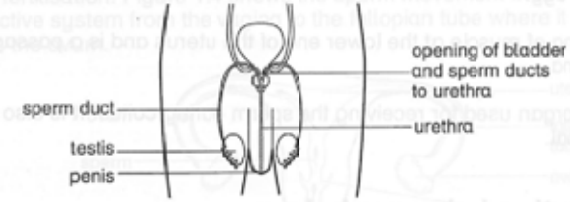


Figure 1.1 *The male reproductive system*

- **Testes (singular - Testis)**

These are two and are round in shape. Testes produce the male reproductive cell also known as the sperm.

- **Sperm duct**

The sperm duct is a tube or channel through which the sperms flow from the testes to the urethra. They are two, each connected to a testis.

- **Urethra**

This is a tube that carries sperms out of the body from the sperm ducts.

- **Penis**

This is the organ used by the male body to transfer sperms to the female reproductive system during coitus or sexual intercourse.

The female reproductive system

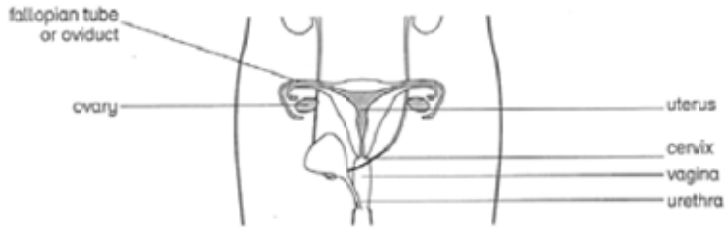


Figure 1.2 *The female reproductive system*

- **Ovaries**

These are two in number. Eggs or ova (singular - ovum) are produced in the ovaries.

- **Fallopian tube (oviduct)**

This is a tube through which the ovum leaves the ovary. It is connected to the uterus and the ovary. There are two of these in the female reproductive system. This is where fertilisation takes place.

- **Uterus (womb)**

This is where the foetus or baby develops after the egg has been fertilised by the sperm. The uterus has a lining that becomes thick, whenever the ovary releases an egg. This lining provides a good environment for fertilisation and implantation of the egg.

- **Cervix**

This is a circular ring of muscle at the lower end of the uterus and is a passage leading to the vagina.

- **Vagina**

This is the female organ used for receiving the sperm during coitus. It is also called the birth canal.

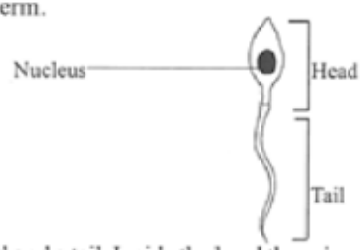
(Macmillan; Macmillan Primary Science, Pupil's book 8 PP.1-2)

There are two ovaries. They produce ova alternately. When one ovary produces the ovum in one month, the other ovary produces the following month. The release of the ovum is called **ovulation**.

The diagram below shows an ovum.

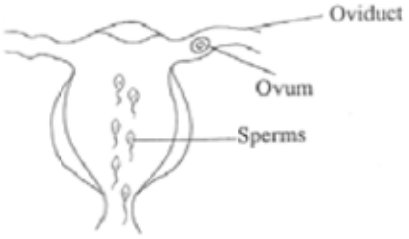
There is a part inside the ovum called the **nucleus**.

The male sex cells are called sperms. They are produced in the testes. The diagram shows a sperm.



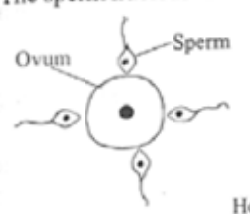
The sperm has a head and a tail. Inside the head there is a part called **nucleus**.

(JKF; Primary Science Education Foundation Science 8 P.2)

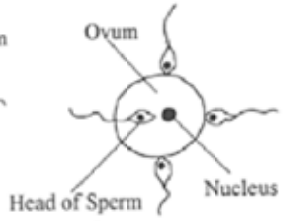


Sperms moving up the uterus

It there is an ovum in the oviduct, one sperm gets into contact with the ovum. The head of the sperm penetrates into the ovum leaving the tail behind. The sperm nucleus and the ovum nucleus **fuse** (unite). See diagrams below.



Sperms moving towards ovum



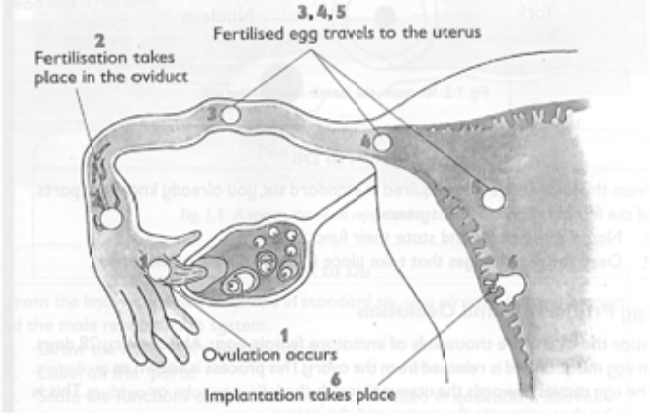
One sperm penetrates

Fusion of nuclei (plural of nucleus)

This process is called **fertilization**.

(JKF; Primary Science Education Foundation Science 8 P.3)

At the time of ovulation, the uterus prepares to receive the zygote by building up the walls of the uterus, also known as the uterine wall.



(KLB; Primary Science Pupils' Book for Standard Eight P.4)

ACTIVITY

What you need
exercise book
pen

What to do
What happens after fertilisation?
Write this down in your exercise book.
Look at Figure 1.5.

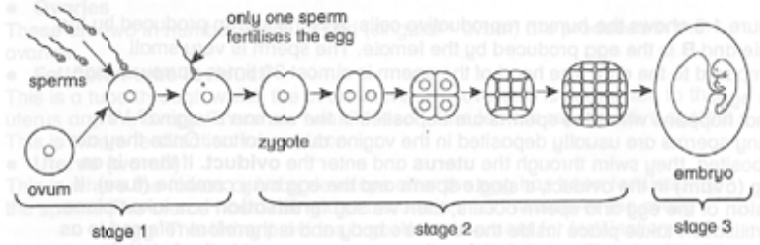


***Figure 1.5** Development of the embryo*

Draw these stages in your exercise book.

Figure 1.5 shows some stages that the egg goes through as it is fertilised.

Figure 1.5 shows some stages that the egg goes through as it is fertilised.

Stage 1
The sperm and the egg meet and fuse to form a **zygote**. A zygote is a fertilised egg. It is formed in the oviduct or fallopian tube.

Stage 2
Once the zygote is formed, it moves along the oviduct to the uterus. As it moves, it undergoes a series of rapid division and growth.

Stage 3
After the zygote divides itself many times, an **embryo** is formed. An embryo is a zygote that has undergone division and growth. The embryo then continues to move along the oviduct to the uterus.

Once the embryo reaches the uterus it fixes itself in the thick lining of the uterus. This is called **implantation**. It is from here that the embryo develops further within a couple of months to become a **foetus**.

REMEMBER
Life begins after fertilisation. A foetus has the right to live.

(Macmillan; Macmillan Primary Science, Pupil's book 8 P.4)

Connecting the placenta to the embryo is a tube-like structure called the **umbilical cord**. This cord contains the **umbilical artery** and **umbilical vein** which run from the placenta to the abdomen of the embryo.

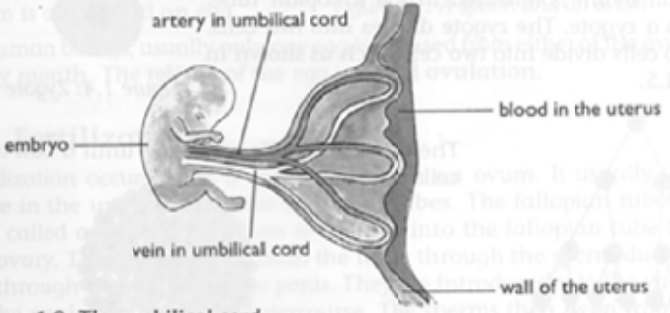
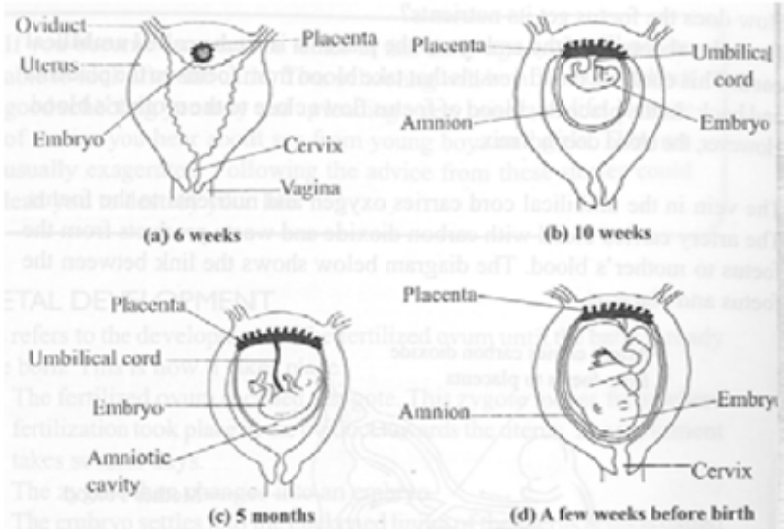


Figure 1.8: The umbilical cord

As the cells of the embryo continue to multiply, organs such as the heart, lungs, limbs, blood and blood vessels begin to form. When the embryo is about two months old, all the body organs are formed although they are still very small. At this stage the embryo is referred to as a **foetus**.

Figure 1.9: A developing foetus

(Oxford; Science in Action 8　P.4)



The period between fertilization and birth is called **gestation**. It lasts about 9 months or 40 weeks.

(JKF; Primary Science Education Foundation Science 8　P.6)

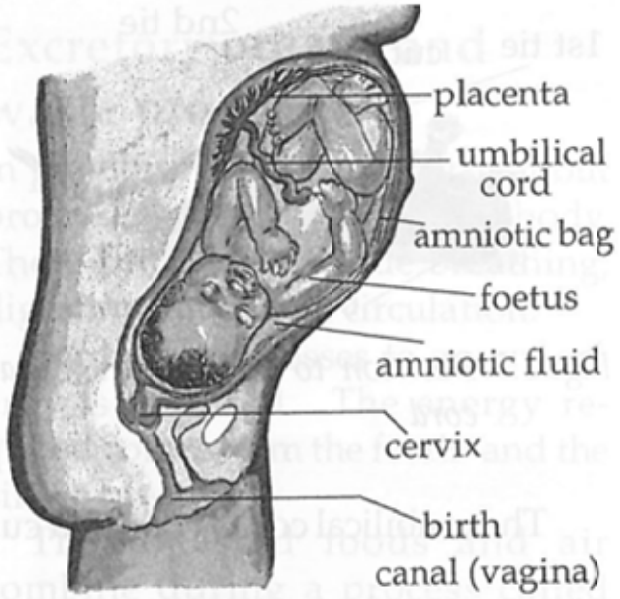


Fig 1.6: Foetus ready for birth

(Longhorn; Understanding Science, Pupil's Book 8 P.3)

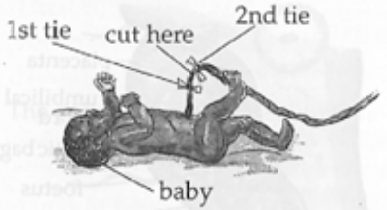


Fig. 1.7: Position to cut the umbilical cord

The umbilical cord is tied and cut to:

- separate the baby from the mother.
- prevent excessive bleeding from the mother and baby after cutting.

The uterus muscles continue to contract and this helps to push out the placenta and the collapsed bag.

Care has to be taken during the birth process to avoid infection to the baby, mother and the birth attendants. The baby should be born in a clean environment.

For example:

- Only sterilised instruments should be used.
- The birth attendants should use sterilised protective wear.

If the mother is not infected with HIV, she is allowed to breastfeed the baby. In case the mother is infected with HIV, she is advised not to breastfeed the baby as this may lead to the baby getting infected. In such a case the doctor advises the mother on how to take care of the baby and herself.

HIV/AIDS

Remember HIV/AIDS can be transmitted through contact with body fluids.
Birth attendants must wear protective gloves when attending to pregnant women.

During the process of birth:

Baby: The baby can get infected with HIV when:

- The body fluids from the mother, if infected, mix with the baby's body fluids.
- The body fluids of the attendants, if infected, mix with the baby's body fluids.
- The cutting tools used are shared without sterilising.

Mother: The mother can get infected with HIV if the body fluids of the birth attendants, if infected, mix with the fluids of the mother.

Birth attendants: The birth attendants can get infected with HIV if the fluids of the mother, if infected, mix with attendant's body fluid.

Premature birth and miscarriage

The normal gestation period in human beings is nine-months. Sometimes, a baby may be born before the expiry of the nine months. It may not be ready for birth. In such a case, the baby is said to be born prematurely.

(Longhorn; Understanding Science, Pupil's Book 8 P.4)

Important Issues to Think About

Untimely or unplanned pregnancy

Pregnancy, birth and child rearing are great responsibilities for adults who are ready to bring up the child and provide for all his or her needs. Engaging in sexual intercourse may lead to untimely pregnancy, which may disrupt your education.

At your age, you are still young and should aim at advancing in your education. You should, therefore, abstain from premarital sex.

Contraction of AIDS and other Sexually Transmitted Infections (STIs)

The Human Immunodeficiency Virus (HIV) that causes Acquired Immune Deficiency Syndrome (AIDS) is present in the blood, semen and vaginal secretions of infected persons. Infection mainly occurs through sexual intercourse. Engaging in sex can, therefore, lead to contraction of AIDS or other sexually transmitted infections such as syphilis and gonorrhoea. More information on STIs and HIV/AIDS is provided in *Unit* 2. (See pages 20–29.)

Abortion

Once fertilisation takes place, the life of an individual starts developing. Interference with the development of the foetus is abortion. Abortion leads to loss of life of the foetus. It can also lead to health complications or even loss of life of the mother.

Safe pregnancy

Harmful substances such as tobacco, alcohol, medicines, and other addictive drugs are harmful to the health of the baby. They interfere with the development of the foetus and may lead to miscarriage. Any medication to be taken by the mother must be prescribed by the doctor.

Pregnancy, STIs and HIV/AIDS

HIV and STIs can be passed from the mother to the foetus during pregnancy. They can also be passed from the mother to the baby during birth. A pregnant woman must attend ante-natal clinic since doctors can give her treatment which may reduce the risk of her child getting STIs or HIV/AIDS.

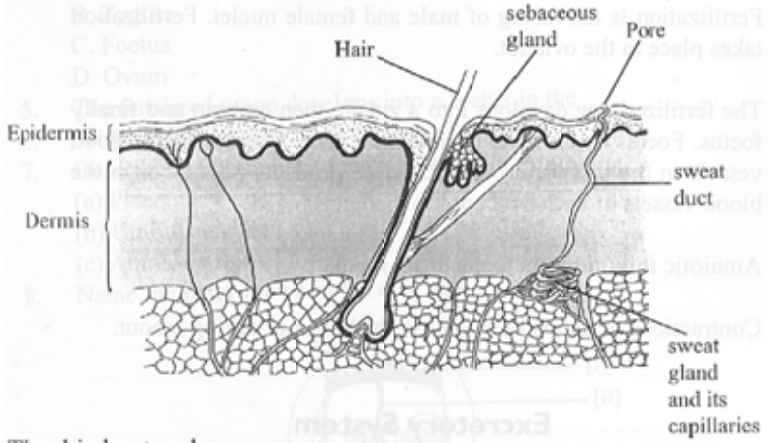
(KLB; Primary Science Pupils' Book for Standard Eight: P.8)

The excretory system

Activity: Observing the skin

- Look at your skin
- Can you see some hair?
- What comes out of our skin when it is too hot or when we do exercises?

The diagram below shows parts of a skin:



The skin has two layers:

(a) The outer layer is called **epidermis**.

(b) The inner layer is called **dermis**.

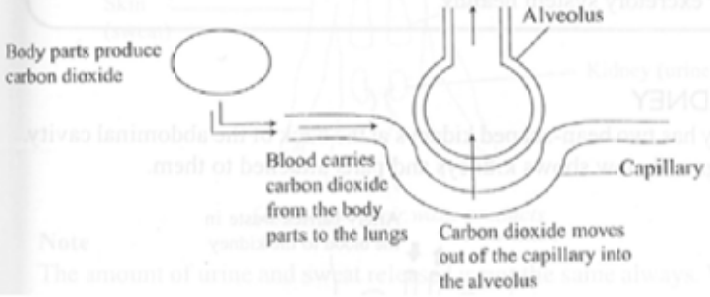
The dermis has **blood vessels**, **sweat glands** and **sebaceous glands**. The sweat gland is a tube that is coiled. It receives water and mineral salts from parts surrounding it. These salts and water are passed to a sweat duct that takes them to an opening on the surface of the skin. This opening is called sweat pore. The salts and water that leave the body through sweat pore is what we see as sweat. In this way, the body gets rid of excess water and salts. This sweat evaporates from the surface of the skin, thus keeping the body cool. Therefore, the waste product of the skin is sweat which contains water and salts.

Activity: Breathing in and out

- Breathe in.
- Now breathe out.
- What moves into your body through the nose when you breathe in?
- What are the parts the air passes through to get to the lungs?

When we breathe in air, it passes through the nose, trachea and into the lungs. From lungs, the oxygen component of air is absorbed into the blood and is used by the body. As different parts of the body work they use food to release energy and produce carbon dioxide as a waste product.

This carbon dioxide moves from body parts into blood vessels. Thus the blood becomes **deoxygenated**. This deoxygenated blood is taken to the lungs. In the lungs there are blood capillaries surrounding the **alveoli** (singular: alveolus). The carbon dioxide moves out from these capillaries into the alveoli. See the diagram below.



(JKF; Primary Science Education Foundation Science 8　PP.10-11)

The lungs

The lungs are an important part of the breathing system. They help us to take in oxygen and get rid of carbon dioxide. Air flows in and out through the trachea, bronchi and bronchioles. At the end of the brochioles are tiny air sacs called **alveoli** that are surrounded by blood vessels. It is in the air sacs that oxygen is absorbed and **carbon dioxide** is removed from the blood. Carbon dioxide is the main waste product given out from the lungs. **Water vapour** is also removed from the lungs.

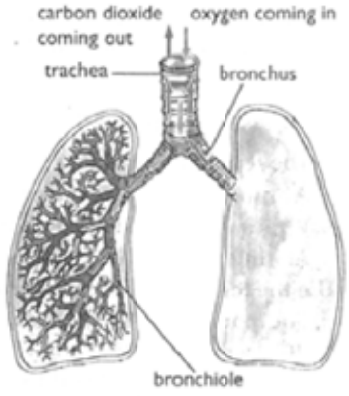


Figure 2.2: The lungs

Activity 1: Observing water vapour in breath

You need a mirror.

1. Clean the mirror with a dry piece of cloth.
2. Hold the mirror in front of you. Open your mouth and breathe onto the surface of the mirror. Do this several times.
3. Observe the surface of the mirror.
   What do you see?

The droplets formed on the mirror prove that the air we breathe out contains water vapour.

(Oxford; Science in Action 8　P.9)

The kidneys

The liquid is urine from a domestic animal. It is excreted from the kidneys. There are two kidneys in a human being. These are usually named depending on which side of the body the kidney lies. Our kidneys remove urea, nitrogenous wastes and excess water from the blood. This combination of urea, nitrogenous waste and water make up urine. Urine travels from each kidney down a tube called ureter into the urinary bladder. When the bladder gets full, we feel the urge to pass it out of the body (urinate). Urine then flows into another tube known as urethra from where it flows out of the body. Figure 1.9 shows the movement of urine from the kidney through the ureter, to the urethra and out of the body.

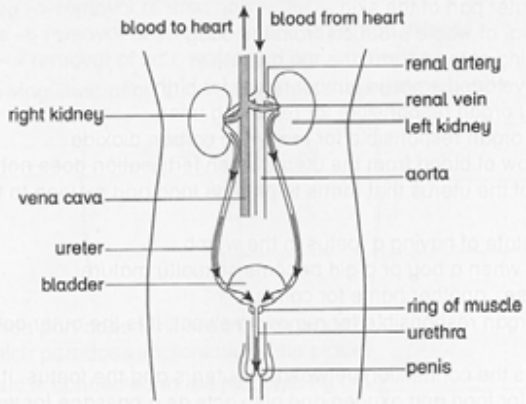


Figure 1.9 *The kidney*

► ***The kidney is the organ used for excreting urea, other nitrogenous waste and excess water from the body***

(Macmillan; Macmillan Primary Science, Pupil's book 8　P.9)

Appendix

PISA-type questions, prepared by Dr. Takemura

Every three years, an international survey on trends in science studies is conducted in many countries. There are an increasing number of African countries participating in this survey. This survey is called the Program for International Student Assessment (PISA) survey. It is a survey to assess scientific knowledge and the skills for applying this knowledge to problems in daily life, as well as scientific methodology and logic. Reading comprehension of long scientific documents is also assessed. The survey targets fifteen-year-old pupils. Kenya will also be participating in the near future, and by putting the national education standard under international comparison, it will be able to contribute to the improvement of quality of educational services.

Some PISA-type questions, which an eighth grade pupil should be able to solve, have been prepared here. Please use these questions as a reference when developing similar questions by yourselves. Typical case examples have also been shown.

This unit will only have illustrations and explanations, so it will be preferable to include the following questions in the lessons, not only to foster scientific competencies, but also to make the linkages between biological knowledge and practical issues related to childbirth.

PISA-type Scientific Competencies

(I) To clarify what the scientific problems are

1. Carefully examine whether a scientific investigation is possible, and find a problem to investigate.

Case example 1　　which of the following is a scientific problem?

A. Regarding the mortality rates of parturient women hospitalized in the obstetrics department of Hospital A and Hospital B, both located in large cities, a large difference between the two hospitals was reported. What is the reason for this difference?

B. Why does menstruation occur periodically, almost every month?

C. Among the patients who are hospitalized for a long time, how many patients are thinking about their death?

D. What percentage of all women, think that menstruation is unavoidable, unpleasant, painful but must be tolerated?

2. To determine the keywords to for searching for scientific information

Case example 2

Artificial insemination is a method of enhancing the fertilization of an ovum by artificially injecting semen into the uterus of a woman suffering from infertility due to the difficulty of sperm cells moving toward the fallopian tubes, in order to help the woman to become pregnant. The procedure must be conducted during the woman's ovulation period.

You wish to know more about artificial insemination. In order to search for information on the internet or in the library, select from the above paragraph the words that may be useful in finding the necessary information.

A. Sperm cells and ovum
B. Ovulation period
C. Pregnancy
D. Artificial insemination

3. To clarify the characteristics of survey methods in scientific research

Case example 3

The following list summarizes the important points in daily life that should be taken into consideration throughout the whole pregnancy period.

(1) Ensure adequate sleep and rest is taken, and avoid overworking.
(2) Wear low-heeled shoes with slip-resistant soles.
(3) Avoid lifting heavy objects and reaching out for objects in high places, as you may lose your balance and fall.
(4) Avoid long hours of travel.
(5) When you sit in a chair, sit upright with your spine against the back of the chair, as the large abdomen tends to arch forward.
(6) Maintain the cleanliness of your body.
(7) Take less staple foods and salt, plenty of protein and calcium, more iron and vitamins, and have a balanced diet. Beware of any increase in weight and cut down on staple foods if your weight increases excessively.
(8) Go on walks and undertake some activities that make you move your body moderately.

（HUMAN BODY／8th grade）

A researcher, who is also a physician, recommends an "exercise for pregnant and parturient women". The physician thought that the exercise would prevent fatigue caused by the increase in weight and change in the center of gravity, and help to maintain flexible muscles and joints for an easier delivery. A study design was formulated in order to prove this hypothesis. The plan was to conduct a survey over a five-year period. Which of the following is the most appropriate study design?

A. Teach the "exercise for pregnant and parturient women" to all the eligible women, and monitor every year if the proportion of women experiencing easier delivery is increasing.
B. In order to prevent miscarriages from occurring, instruct the eligible women to adhere to (2), (3), and (4), and then conduct the study design A.
C. Give instructions on (1) to (8), to all the pregnant women. Teach the "exercise for pregnant and parturient women" to half of the pregnant women and instruct them do the exercise. The whole group of pregnant women should be separated into two groups; one half performing the exercise, and the other half not performing the exercise. Compare the number of women experiencing easy delivery, in both groups.
D. Conduct the study design C, targeting only the primiparous women expecting their first baby.

Case example 4

Miscarriages occur when the fetus in the uterus has a weakened power to live, and is expelled out of the body after its death, or when the fetus is delivered in a premature stage where it is still incapable of sustaining its own life and dies after birth. There are also some cases where miscarriages occur as a result of external factors, including overwork, long-hours of travel, working without sitting down, or falls.

The physicians of a large hospital formulated a study designed to determine which of the three major causes of miscarriage accounted for the highest percentage of miscarriages. Choose the most appropriate study design from the list below.

A. Ask all the pregnant women whether they have ever had a miscarriage. From those who have had a miscarriage, obtain detailed information about their lifestyle at the time, classify the lifestyles, and determine the pattern of miscarriages.
B. Select pregnant and parturient women who have had several miscarriages and check their diagnostic data, including the position and the size of the uterus, any abnormalities, and whether any malformation of the uterus or ovarian anomalies have been found.
C. Select pregnant and parturient women who have had several miscarriages and check the diagnostic data of the fetus lost due to its weakened power to live for reasons such as genetic disorders or

severe malformation.

D. Organize a research group to investigate the causes of miscarriages, and determine the number of cases by cause: number of miscarriages induced by mother-related causes, number of miscarriages induced by fetus-related causes, and the number of miscarriages induced by the living environment, mainly of pregnant and parturient woman. Calculate the percentage of each category from the total number of cases in all three categories.

(II) To give a scientific explanation of a phenomenon

1. To scientifically describe and analyze a phenomenon, and state the changes

Case example 5

In addition to water and food, humans are constantly inhaling and exhaling air. Are there any differences between the air that is breathed in and the air that is breathed out? Prepare two polyethylene bags and fill one bag with exhaled air, and the other bag with air from the surrounding atmosphere. In each bag, put a small amount of lime water, shake well, and observe how it becomes cloudy. Lime water has a characteristic of becoming cloudy when mixed with carbon dioxide. The result of the experiment showed that a small amount of exhaled air and a large amount of exhaled air gave different degrees of cloudiness in the lime water. Furthermore, a comparison between a bag of air and a bag of exhaled air resulted in a significant difference in the cloudiness of the lime water. State your analysis of these experimental results.

2. To be able to apply the knowledge of natural science, in any given situation (one must already have an understanding of the given scientific information)

Case example 6

Excretion is a mechanism for removing unnecessary substances in the body and expelling them out of the body. The kidneys not only have excretory functions, but also maintain a homeostatic balance of the body water and maintain constant levels of salt composition in the body fluids. Moreover, the kidneys have the role of strictly maintaining a constant blood composition.

Give a scientific explanation of the functions of the other excretory organs.

3. To be able to differentiate scientifically (pathologically) appropriate statements and explanations from those that are not

Case example 7

Which of the following statements is not a scientific explanation of HIV/AIDS?

A. Human-to-human transmission of AIDS occurs when blood, semen or vaginal fluid containing a high concentration of HIV comes into contact with wounds or mucous membranes and enters the body.

B. AIDS is a disease caused by HIV infection. When the HIV enters the human body, it invades and destroys the lymphocytes that promote the immune system. This is the moment of the onset of the disease.

C. The body loses its immune function, the resistance to diseases is greatly reduced and the patient becomes susceptible to various infectious diseases (induced by pathogens, such as viruses and bacteria, entering the body) that would not have affected a person in a healthy state, as well as a series of other diseases, including cancers.

D. Since the first reported case of an AIDS patient in the United States in 1981, the number of infected persons in the world has continued to increase even among the general public. They are infected through heterosexual sex, and the number of patients is rising, especially in Africa, leading to a decrease in the average life expectancy in some countries.

(III) To be able to use scientific evidence

1. To be able to communicate (in a statement or dissertation) the conclusions drawn from scientific evidences

Case example 8

In the animal world, fertilization starts from the mating displays of males and females. During the breeding season, a male bird of a certain species will spread its wings in front of a female bird and perform a dance-like mating display. As an experiment, the mating displays of a male bird were observed using different kinds of stuffed birds: a male bird; a colorful, small, female bird; and a colorful, mature, female bird. The number of mating displays performed by the male bird within a fixed period of time was monitored. The male bird performed no mating displays in response to the male stuffed bird, three times to the small, female stuffed bird, and nine times to the mature female stuffed bird. The same experiment was repeated on the following day, but the frequencies were approximately the same as the preceding day. State the conclusion that can be drawn from the above scientific evidence.

2. Determine the background hypotheses, evidence and inferences (State in the order of conclusion, evidence 1, 2, 3, and the logical consequence)

Case example 9

Since humans have soft skin, mosquitoes are able to penetrate the skin to suck the blood. In Asia and Africa, situated in the tropical and subtropical regions, very large numbers of people die of malaria. This communicable disease is transmitted when a person is bitten by anopheles. This is a disease in which the malarial plasmodium, transmitted by this mosquito, enters into the human blood and lives and multiplies in the red blood cells until their destruction. The malarial plasmodium has four life-cycles. Firstly, when a mosquito bites a human, the malarial plasmodium enters the human body. Secondly, the malarial plasmodium multiplies in the human body. The red blood cells are destroyed and the infected human develops a high fever of approximately forty degrees centigrade. Thirdly, the malarial plasmodium is transmitted by another mosquito when it bites the infected human. Hence, the infection is transmitted by the mosquitoes. Fourthly, the malarial plasmodium can also multiply in the body of a mosquito. However, mosquitoes do not develop the disease. Humans use pesticides to kill the mosquitoes to avoid being infected. The mosquitoes are killed in the first, third and fourth stages mentioned above. From this conclusion, determine the underlying evidence and explain why the conclusion was the first, third and fourth stages, and not the second stage.