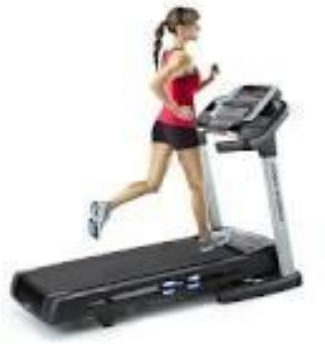
PISA Style Scientific Literacy Question

Exercise

Read the text about exercise.

Sioned and Nia are exercising at the gym. They will each spend 30 minutes on their exercise programmes. Sioned is walking at a steady pace on the treadmill. Nia is also on the treadmill but she is completing an interval training programme where she alternates between bursts of fast running and periods of steady jogging.



Question 1 : EXERCISE

When you exercise, certain changes happen in your body. Different levels of exercise will bring about different changes.

Circle 'yes' or 'no' to each of the following statements.

Changes that will happen in each girls body during their exercise session.	**Sioned Yes or No?**	**Nia Yes or No ?**
Heart rate will increase	Yes / No	Yes / No
Breathing rate will increase	Yes / No	Yes / No
Aerobic respiration will take place	Yes / No	Yes / No
Anaerobic respiration will take place	Yes / No	Yes / No
Lactic acid will build up in the muscles	Yes / No	Yes / No
Blood flow to the muscles will increase	Yes / No	Yes / No

Question 2 : EXERCISE

Whilst they are doing their workouts, a friend decides to investigate some of the effects that their individual exercise programmes have on each girl's body. She will measure heart rate and breathing rate.

Some variables will need to be controlled during the test. Give one variable that will be controlled, and explain how this can be done.

Control variable _____

Explanation

_____

_____

_____

One thing will be different about the workouts of the two girls. This is the independent variable. Name the independent variable for this investigation.

_____

Question 3 : EXERCISE

Complete the word equation for the process of aerobic respiration. Write the correct word into the box.

Glucose + [ ] → Carbon Dioxide + Water + Energy

Question 4 : EXERCISE

Two types of respiration can take place in your body during exercise – aerobic and anaerobic.

Circle 'yes' or 'no' for each of the following statements.

	Aerobic Respiration Yes or No ?	**Anaerobic Respiration Yes or No ?**
Respiration that involves oxygen	Yes / No	Yes / No
Respiration that produces lots of energy	Yes / No	Yes / No
Respiration that leads to a build up of lactic acid	Yes / No	Yes / No
Respiration that produces an 'oxygen debt'	Yes / No	Yes / No

Question 5 : EXERCISE

Lactic acid is poisonous if it builds up in the body, so it must be broken down quickly. Oxygen is needed for this.

Which organ is responsible for breaking down the lactic acid ?

A Lungs
B Heart
C Liver
D Kidneys

Read the text about glucose and glycogen

Some of the glucose from the food we eat can be stored in our muscles as glycogen. Glycogen can be converted back into glucose when it is needed for respiration, for example during exercise.

Question 6: EXERCISE

Which of these nutrients will have been used to supply the body with glucose ?

A Proteins
B Vitamins
C Minerals
D Carbohydrates

Question 7 : EXERCISE

The nutrient that supplies the body with glucose does not do it directly. It has to be broken down first. This happens during the process of digestion.

Which chemicals are responsible for breaking down the food we eat into useful molecules during the process of digestion ?

A Hormones
B Neurotransmitters
C Enzymes
D Plasma

Question 8 : EXERCISE

Nia is training for a half marathon. She will need to build up stores of glycogen in her muscles that can be broken down to supply her with energy during the race.

Suggest three foods that she should eat which will provide her with correct nutrient to increase her glycogen stores.

_____
_____
_____

Question 9 : EXERCISE

The rate at which chemical reactions happen in our cells is known as the metabolic rate. This can vary from person to person. A number of factors can affect the metabolic rate, and in turn how fast we use up energy in our bodies.

Circle 'yes' or 'no' for each of the statements.

Factor which can determine metabolic rate	**Yes or No ?**
How old you are	Yes / No
The proportion of your body that is muscle	Yes / No
The metabolic rate of your parents	Yes / No
Taking stimulant drugs	Yes / No

SCORING : EXERCISE

Question 1

Full credit

Sioned : Yes, Yes, Yes, No, No, Yes, in that order

Nia : Yes, Yes, Yes, Yes, Yes, Yes, in that order

No credit

Other responses

Missing

Narrative :
Both heart rates will increase in order to increase blood flow to the muscles (providing them with glucose and oxygen for respiration).
Both breathing rates will increase in order to increase the amount of oxygen (for respiration) being taken into the body.
Aerobic respiration will take place in both girls as their muscles will use glucose and oxygen to produce energy.
Anaerobic respiration is likely to take place in Nia's body during her intense periods of workout (fast jogging) as during this time her body may not be able to supply her muscles with enough oxygen to maintain aerobic respiration. It is unlikely this will happen in Sioned's body as she is walking steadily and not undertaking any intense periods of exercise.
Lactic acid will build up in Nia's body only as she is the only one whose body will be carrying out anaerobic respiration.
Blood flow to the muscles will increase in both girls in order to supply them with more glucose and oxygen for respiration. Increased blood flow will happen as a result of the heart beating faster.

Framework Categories	2015 Framework
Knowledge Type	*Knowledge of the content of science*
Competency	*Explain phenomena scientifically*
Context	*Health and disease - personal*
Cognitive demand	*Low*

Question 2 part 1

Full credit

Climate / temperature in the gym – workout on adjacent treadmills in the same area of the gym

Incline (running on the flat or up hill) – set the two treadmills at the same incline

Length of workout – time how long each girl exercises for

Partial credit

Suitable control variable given, but no explanation of how to control

No credit

Other responses

Missing

Narrative:
The investigator will need to ensure that the only variable that changes is the independent variable – the intensity of the exercise. The investigator has to show that the difference in the results obtained will be due to the difference in intensity of exercise and not any other factors.

Question 2 part 2

Full credit

The speed they are running / how fast they are moving / intensity of workout / how hard they are working

No credit

Other responses

Missing

Narrative:
The independent variable is the factor / variable that will be changed. The factor that is changed in this investigation is the effort used by each of the girls whilst exercising. Sioned will be working at a lower level of effort than Nia.

Framework Categories	2015 Framework
Knowledge Type	*Procedural*
Competency	*Evaluate and design scientific enquiry*
Context	*Health and disease - personal*
Cognitive demand	*Medium*

Question 3

Full credit

Oxygen should be inserted into the box (can accept 0_2 although this is a word equation)

No credit

Other responses

Missing

Narrative :
Oxygen is needed along with glucose for the process of aerobic respiration to take place in order to produce energy.

Framework Categories	2015 Framework
Knowledge Type	*Knowledge of the content of science*
Competency	*Explain phenomena scientifically*
Context	*Health and disease - personal*
Cognitive demand	*Low*

Question 4

Full credit

Aerobic respiration : Yes, Yes, No, No, in that order

Anaerobic respiration : No, No, Yes, Yes, in that order

No credit

Other responses

Missing

Narrative:
Aerobic respiration is the process of respiration involving oxygen. It takes place in body cells most of the time. When a person is exercising vigorously, anaerobic respiration takes place as the body is unable to supply the muscles with enough oxygen to maintain aerobic respiration. Anaerobic respiration produces less energy and leads to a build up of lactic acid in the muscles. After exercise, oxygen is needed to break down the lactic acid. The term oxygen debt refers to the amount of oxygen that is needed to remove the lactic acid. This is why a person continues to breathe heavily (to obtain extra oxygen) for a while after exercise stops.

Framework Categories	2015 Framework
Knowledge Type	*Knowledge of the content of science*
Competency	*Explain phenomena scientifically*
Context	*Health and disease - personal*
Cognitive demand	*Low*

<u>Question 5</u>

Full credit

C Liver

No credit

Other responses

Missing

Framework Categories	2015 Framework
Knowledge Type	*Knowledge of the content of science*
Competency	*Explain phenomena scientifically*
Context	*Health and disease - personal*
Cognitive demand	*Low*

Question 6

Full credit

D Carbohydrates

No credit

Other responses

Missing

Narrative:
Carbohydrates are broken down into glucose during the process of digestion in the body.

Framework Categories	2015 Framework
Knowledge Type	*Knowledge of the content of science*
Competency	*Explain phenomena scientifically*
Context	*Health and disease - personal*
Cognitive demand	*Low*

Question 7

Full credit

C Enzymes

No credit

Other responses

Missing

Narrative:
Enzymes are biological catalysts which speed up reactions, including the breakdown of food, in our bodies.
(Hormones are chemical messengers. Neurotransmitters carry nerve impulses across synapses – gaps between neurones. Plasma is the liquid part of blood).

Framework Categories	2015 Framework
Knowledge Type	*Knowledge of the content of science*
Competency	*Explain phenomena scientifically*
Context	*Health and disease - personal*
Cognitive demand	*Low*

Question 8

Full credit

Any foods rich in complex carbohydrates e.g pasta, rice, cereals, potato, bread,

Also acceptable are simple carbohydrate foods and foods high in sugars, such as sweets, biscuits, cakes, chocolate, sugary drinks, sports drinks, fruits e,g bananas, as sugary foods also lead to glycogen storage in the body

No credit

Other responses

Missing

Narrative:
The liver converts excess glucose in the blood to glycogen. During exercise glycogen can be converted back into glucose to supply the body's increased demand for glucose for respiration. Therefore, Nia should eat foods which contain glucose, or carbohydrates which can be broken down into glucose molecules that can be converted to glycogen.

Framework Categories	2015 Framework
Knowledge Type	*Knowledge of the content of science*
Competency	*Explain phenomena scientifically*
Context	*Health and disease - personal*
Cognitive demand	*Low*

Question 9

Full credit

Yes, yes, yes, yes, in that order

No credit

Other responses

Missing

Narrative :
Metabolic rate varies due to several factors. These include the age of the person, gender, and inherited factors. Metabolic rate is affected by the proportion of muscle to fat in a person's body. The metabolic rate increases during exercise and remains high for a while afterwards. For these two reasons, people who exercise usually have higher metabolic rates than those who don't.

Framework Categories	2015 Framework
Knowledge Type	*Knowledge of the content of science*
Competency	*Explain phenomena scientifically*
Context	*Health and disease - personal*
Cognitive demand	*Low*