National 5 Biology

Scientific Literacy Type Questions - ANSWERS

Note:

Answers given in brackets indicate suitable additional information that is **not** required to gain a mark.

Answers separated by a / indicate alternative acceptable answers.

Both answers are not required, each is acceptable on its own.

Adapted from, Herald, Saturday 19th September 2015

1. **Beetroot juice**

Scientists have a theory that drinking nitrate-rich beetroot juice has an effect on both sprint performance and decision making during sports.

In a study, 16 male rugby and football players drank 140 ml of a nitrate-rich beetroot juice every day for seven days.

The players then completed a sprint test on an exercise bike. This consisted of repeated sessions of two minute blocks - a 10 second sprint, 80 seconds of slow pedalling and 30 seconds of rest. At the same time, they were given thinking tasks designed to test how accurately and quickly they made decisions.

The players completed these tests again after drinking 140ml of the same juice, with the nitrate removed, every day for another seven days.
When they had taken the nitrate-rich juice, the players saw a 3·5% improvement in sprint performance and a 3% increase in their speed of their decision making.

The improvement may seem small, but it could mean the players are able to make important decisions faster and cover more ground than their opponents in the seconds when it matters most.

(a) Suggest the aim of the research described in the passage. (1)

To find out if drinking beetroot/nitrate-rich juice affects sprint **and** decision making performance (both parts needed)

(b) A dependent variable is what scientists measure or observe as a result of the changes they make in their investigation.
Identify the dependent variable in this investigation. (1)

(sprint and decision making) performance

(c) Draw a table, with suitable headings, to show the activities and timings of the two minute sprint test.(2)

Sprint test / Activities	Time / Timing (seconds)
sprint	10
Slow pedalling	80
rest	30

1 mark for heading including units
1 mark for correct information in columns

(d) What conclusion did the scientists draw from this study? (1)

Drinking nitrate-rich (beetroot) juice gives an (3·5%) improvement in sprint performance and an (3%) increase in their speed of making decisions.

(e) Give a reason why it could be suggested that the results of the investigation might be unreliable.(1)

Only used males/too small a sample/ only tested on people involved in two sports

Adapted from Biological Sciences Review, Volume 30(1), September 2017

2. Peanut allergy

Allergy to peanuts is one of the most common allergies in the world and there is no cure. Scientists have a theory that if individuals are exposed to peanuts they will build up tolerance and not develop an allergy.

In a recent trial 600 babies were given a skin test to see if they reacted to peanuts. Babies who had a negative reaction were split into two groups. Group 1 avoided eating peanuts completely and group 2 ate 6 grams of peanuts per week.

Babies were retested for their reaction to peanuts when they were 5 years old. When they were retested 3% of the children who had eaten the 6g of peanuts per week had developed an allergy to peanuts compared with 17% of children who had avoided eating peanuts completely.

This result shows that children in group 2 had developed tolerance to peanuts and that regular exposure to peanuts could be used as a preventative treatment for peanut allergies.

(a) Suggest the aim of the research described in the passage. (1)

To investigate whether/to find out if exposure to peanuts prevents children developing a peanut allergy at age 5

(b) An independent variable is one that scientists change so they can measure or observe the effect of the change.

Identify the independent variable in this investigation. (1)

Whether the babies were given peanuts to eat or not

(c) Draw a table, with suitable headings, to show the results of the investigation. (3)

Mass of peanuts eaten per week as a baby (g)	% of children that developed a peanut allergy by age 5
0	17
6	3

1 mark for **each** heading (2)
1 mark for data entered correctly (1)

(d) State the conclusion the scientists drew from this study. (1)
Eating (6 grams of) peanuts (each week)/regular exposure to peanuts reduces the chances of a child developing a peanut allergy at age 5 (from 17% to 3%)

(e) Give a reason why it could be suggested that the results of the investigation are reliable. (1)
600/many babies were tested

3. ATP

ATP is an energy rich molecule produced by respiration to fuel all cell reactions. Muscles in our bodies use ATP to enable them to contract and do work. If fresh muscle tissue fibres are removed from an organism and soaked in ATP solution they will still contract.

A pork chop was purchased from a shop to investigate the effect of ATP concentration on muscle tissue. Three thin strips of muscle 12mm long were cut from the chop and each strip placed on a separate microscope slide. 10% ATP solution was added to one strip of muscle from a chop and the length measured again and found to be 8mm.

The experiment was repeated using a 5% ATP solution and the final length was 11mm. The final strip of muscle was soaked in distilled water and no change in length occurred. The final strip acted as a control.

(a) Suggest the aim of this investigation.(1)

To investigate effect of ATP concentration on muscle (length/contraction)

(b) A dependent variable is what scientists measure or observe as a result of the changes they make in their investigation.

What is the dependant variable in this experiment? (1)

(difference in) Length of Pork (chop)/muscle/strip

(c) Name one variable, not already mentioned, which must controlled in order to carry out a fair test. (1)

Temperature/pH/volume of ATP solution/Soak Time/Reaction Time/length of meat/species/freshness/age of pork (or other appropriate)/same pig/organism (any 1)

(d) Complete the following table to show the results of this experiment under appropriate headings. (2)

Concentration of ATP Solution (%)	Initial Length of Muscle (mm)	Final Length (of Chop/strip/muscle) (mm)	Difference in Length of Muscle (mm)
0	12	12	0
5	12	11	1
10	12	8	4

1 mark for correct heading including units

1 mark for entering the correct data

(e) What conclusion did the scientists draw from this study? (1)

The higher the ATP concentration, the more muscle contraction/decreases/ strip/muscle becomes smaller

(f) Give a reason why it could be suggested that the results of the investigation might be unreliable. (1)

Not many/too few tested/Only tested on pork/only one strip at each concentration tested

(g) The strip that was soaked in distilled water was set up as a control experiment. State the purpose of having a control in **this** investigation. (1)

To prove/show that it was the ATP (solution) that causes muscle contraction/decrease in length/smaller muscle

New Scientist Dec 9, 2017

4. Why Hummingbirds are so big-hearted

Birds fly better if they have big hearts. The best flyers, like hovering hummingbirds, have the largest.

When a hummingbird hovers, it beats its wings in a figure-of-eight pattern up to 80 times per second, much like a helicopter. This is energetically costly, says Roberto Nespolo at the Austral University of Chile.

But most birds don't fly this way. Some flap their wings up and down, like geese. Others, like eagles, soar on updraughts of hot air, while some ground dwellers, like pheasants, undergo only short bouts of flapping.

In theory, birds using more costly forms of flying should have larger hearts. The bigger the heart, the more blood a bird can pump to its flight muscles.

To find out, Nespolo and his team grouped 915 bird species by flight type and compared their hearts.

Hummingbirds had the biggest hearts for their body size at 3 percent of their mass.

The sizes of birds' hearts matched their flight mode. The optimal size for hovering was 2.43 times that for flapping and 3 times higher than gliding (journal of Experimental Biology, DOI: 10.1242/jeb.162693).

It is surprising that flapping fliers had similar hearts to gliders, says Rebecca Kimball at the University of Florida. "I would have assumed that flapping flight would have required a lot more energy."

(a) What is the relationship between the size of bird's heart and the volume of blood that can be pumped in a set time?

The larger the bird's heart the more blood can be pumped in a set time.

(b) What was the aim of Nespolo's investigation?

To see if flight type had an effect on the size of a bird's heart.

(c) If a hummingbird has a mass of 120g what would we expect the mass if its heart to be?

120g x 3/100 = 3.6 grams

(d) A bird that flies by flapping had a heart of mass 12g. What mass would we expect the heart to be if it was a hovering bird?

12g x 2.43 = 29.16 grams

(e) How did Nespolo make sure his investigation was reliable?

He used (data from) 915 bird species.

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5. Children who sleep less may age faster

A lack of sleep doesn't just turn children into a grumpy handful, it may also accelerate their cellular aging - a process that could have long-term health effects.

Telomeres - the caps at the ends of our chromosomes - get shorter every time our cells divide, and when they get too short it is thought that cells are no longer able to divide to repair and replenish the body - a sign of aging. Some small studies in adults have suggested that sleep might be linked to telomere length.

To find out if it is also the case in children, Sarah James and Daniel Notterman at Princeton University and their team dug into a database. It included information on average sleep duration collected from 1567 9 year-old children from cities across the US. The team extracted DNA from saliva samples from the children, and examined the length of their telomeres.

They found that telomeres were shorter in children who slept less (*Journal of Pediatrics*, doi.org/b87r). "Telomere length is 1.5 percent shorter for each hour less that children sleep per night", says James.

Short telomeres have been linked to cancer, heart disease and cognitive decline, but these children showed no signs of these diseases - probably because of their young age. However, they may have a higher risk of developing these disorders in later life, says James. "It raises concerns."

(a) What was the aim of this investigation?

To see if children who sleep less at night age faster.

(b) What did the investigators use as an indicator of aging?

Length of telomeres.

(c) The recommendation is that 9 year-old children get 11 hours sleep a night. A telomere from a child that gets 11 hours sleep a night is 8,000 nucleotides long.

How long would you expect a telomere to be in a child that gets 9 hours sleep a night?

8000 x .97 = 7760 telomeres

(d) What evidence from the passage suggests the results will be reliable?

The study involved 1567/a large number of 9 year olds.

(e) What conclusion did the investigators draw from this study?

Children who sleep less at night age faster.