PISA RELEASED ITEMS – SCIENCE

Project Consortium:

Australian Council For Educational Research (ACER)

Netherlands National Institute for Educational Measurement (CITO)

National Institute for Educational Policy Research (NIER, Japan)

Westat

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GREENHOUSE

Read the texts and answer the questions that follow.

THE GREENHOUSE EFFECT: FACT OR FICTION?

Living things need energy to survive. The energy that sustains life on the Earth comes from the Sun, which radiates energy into space because it is so hot. A tiny proportion of this energy reaches the Earth.

The Earth's atmosphere acts like a protective blanket over the surface of our planet, preventing the variations in temperature that would exist in an airless world.

Most of the radiated energy coming from the Sun passes through the Earth's atmosphere. The Earth absorbs some of this energy, and some is reflected back from the Earth's surface. Part of this reflected energy is absorbed by the atmosphere.

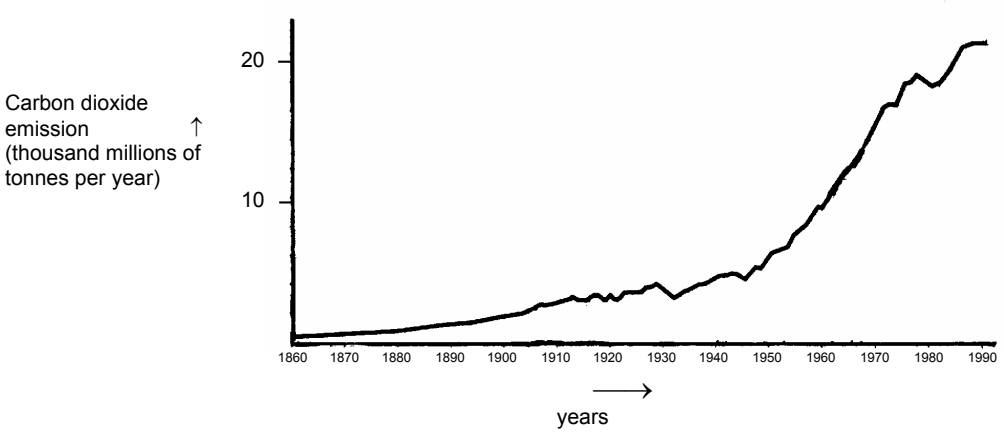
As a result of this the average temperature above the Earth's surface is higher than it would be if there were no atmosphere. The Earth's atmosphere has the same effect as a greenhouse, hence the term *greenhouse effect.*

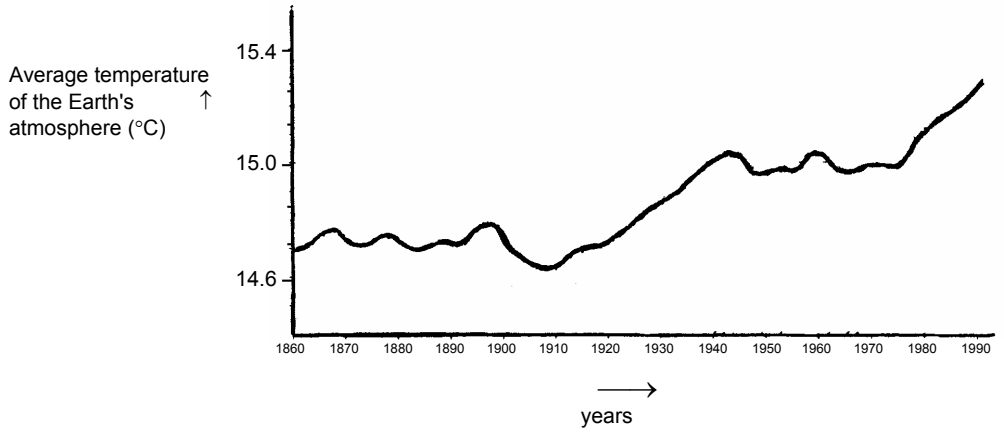
The greenhouse effect is said to have become more pronounced during the twentieth century.

It is a fact that the average temperature of the Earth's atmosphere has increased. In newspapers and periodicals the increased carbon dioxide emission is often stated as the main source of the temperature rise in the twentieth century.

A student named André becomes interested in the possible relationship between the average temperature of the Earth's atmosphere and the carbon dioxide emission on the Earth.

In a library he comes across the following two graphs.





André concludes from these two graphs that it is certain that the increase in the average temperature of the Earth's atmosphere is due to the increase in the carbon dioxide emission.

Question 3: GREENHOUSE

S114Q03 – 01 02 11 12 99

What is it about the graphs that supports André's conclusion?

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GREENHOUSE SCORING 3

Full Credit

Code 11: Refers to the increase of both (average) temperature and carbon dioxide emission.
- As the emissions increased the temperature increased.
- Both graphs are increasing.
- Because in 1910 both the graphs began to increase.
- Temperature is rising as CO_2 is emitted.
- The information lines on the graphs rise together.
- Everything is increasing.
- The more CO_2 emission, the higher the temperature.

Code 12: Refers (in general terms) to a positive relationship between temperature and carbon dioxide emission.
[Note: This code is intended to capture students' use of terminology such as 'positive relationship', 'similar shape' or 'directly proportional'; although the following sample response is not strictly correct, it shows sufficient understanding to be given credit here.]
- The amount of CO2 and average temperature of the Earth is directly proportional.
- They have a similar shape indicating a relationship.

No Credit

Code 01: Refers to the increase of either the (average) temperature or the carbon dioxide emission.
- The temperature has gone up.
- CO_2 is increasing.
- It shows the dramatic change in the temperatures.

Code 02: Refers to temperature and carbon dioxide emission without being clear about the nature of the relationship.
- The carbon dioxide emission (graph 1) has an effect on the earth's rising temperature (graph 2).
- The carbon dioxide is the main cause of the increase in the earth's temperature.

OR

Other responses.
- The carbon dioxide emission is greatly rising more than the average Earth's temperature. *[Note: This answer is incorrect because the extent to which the CO_2 emission and the temperature are rising is seen as the answer, rather than that they are both increasing.]*

- The rise of CO_2 over the years is due to the rise of the temperature of the Earth's atmosphere.
- The way the graph goes up.
- There is a rise.

Code 99: Missing.

Question 4: GREENHOUSE

S114Q04 – 0 1 2 9

Another student, Jeanne, disagrees with André's conclusion. She compares the two graphs and says that some parts of the graphs do not support his conclusion.

Give an example of a part of the graphs that does not support André's conclusion. Explain your answer.

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GREENHOUSE SCORING 4

Full Credit

Code 2: Refers to one particular part of the graphs in which the curves are not both descending or both climbing and gives the corresponding explanation.
- In 1900–1910 (about) CO_2 was increasing, whilst the temperature was going down.
- In 1980–1983 carbon dioxide went down and the temperature rose.
- The temperature in the 1800's is much the same but the first graph keeps climbing.
- Between 1950 and 1980 the temperature didn't increase but the CO_2 did.
- From 1940 until 1975 the temperature stays about the same but the carbon dioxide emission shows a sharp rise.
- In 1940 the temperature is a lot higher than in 1920 and they have similar carbon dioxide emissions.

Partial Credit

Code 1: Mentions a correct period, without any explanation.
- 1930–1933.
- before 1910.

Mentions only one particular year (not a period of time), with an acceptable explanation.
- In 1980 the emissions were down but the temperature still rose.

Gives an example that doesn't support André's conclusion but makes a mistake in mentioning the period. *[Note: There should be evidence of this mistake – e.g. an area clearly illustrating a correct answer is marked on the graph and then a mistake made in transferring this information to the text.]*
- Between 1950 and 1960 the temperature decreased and the carbon dioxide emission increased.

Refers to differences between the two curves, without mentioning a specific period.

- At some places the temperature rises even if the emission decreases.
- Earlier there was little emission but nevertheless high temperature.
- When there is a steady increase in graph 1, there isn't an increase in graph 2, it stays constant. *[Note: It stays constant "overall".]*
- Because at the start the temperature is still high where the carbon dioxide was very low.

Refers to an irregularity in one of the graphs.

- It is about 1910 when the temperature had dropped and went on for a certain period of time.
- In the second graph there is a decrease in temperature of the Earth's atmosphere just before 1910.

Indicates difference in the graphs, but explanation is poor.

- In the 1940's the heat was very high but the carbon dioxide very low. *[Note: The explanation is very poor, but the difference that is indicated is clear.]*

No Credit

Code 0: Refers to an irregularity in a curve without referring specifically to the two graphs.

- It goes a little up and down.
- It went down in 1930.

Refers to a poorly defined period or year without any explanation.

- The middle part.
- 1910.

Other responses.

- In 1940 the average temperature increased, but not the carbon dioxide emission.
- Around 1910 the temperature has increased but not the emission.

Code 9: Missing.

Question 5: GREENHOUSE

S114Q05 – 01 02 03 11 12 99

André persists in his conclusion that the average temperature rise of the Earth's atmosphere is caused by the increase in the carbon dioxide emission. But Jeanne thinks that his conclusion is premature. She says: "Before accepting this conclusion you must be sure that other factors that could influence the greenhouse effect are constant".

Name one of the factors that Jeanne means.

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GREENHOUSE SCORING 5

Full Credit

Code 11: Gives a factor referring to the energy/radiation coming from the Sun.
- The sun heating and maybe the earth changing position.
- Energy reflected back from Earth. *[Assuming that by "Earth" the student means "the ground".]*

Code 12: Gives a factor referring to a natural component or a potential pollutant.
- Water vapour in the air.
- Clouds.
- The things such as volcanic eruptions.
- Atmospheric pollution (gas, fuel).
- The amount of exhaust gas.
- CFC's.
- The number of cars.
- Ozone (as a component of air). *[Note: for references to depletion, use Code 03.]*

No Credit

Code 01: Refers to a cause that influences the carbon dioxide concentration.
- Clearing of rain forest.
- The amount of CO_2 being let off.
- Fossil fuels.

Code 02: Refers to a non-specific factor.
- Fertilisers.
- Sprays.
- How the weather has been.

Code 03: Other incorrect factors or other responses.
- Amount of oxygen.
- Nitrogen.
- The hole in the ozone layer is also getting bigger.

Code 99: Missing.

BIODIVERSITY

BIODIVERSITY TEXT 1

Read the following newspaper article and answer the questions which follow.

BIODIVERSITY IS THE KEY TO MANAGING ENVIRONMENT

An ecosystem that retains a high biodiversity (that is, a wide variety of living things) is much more likely to adapt to human-caused environment change than is one that has little.

Consider the two food webs shown in the diagram. The arrows point from the organism that gets eaten to the one that eats it. These food webs are highly simplified compared with food webs in real ecosystems, but they still illustrate a key difference between more diverse and less diverse ecosystems.

Food web B represents a situation with very low biodiversity, where at some levels the food path involves only a single type of organism. Food web A represents a more diverse ecosystem with, as a result, many more alternative feeding pathways.

Generally, loss of biodiversity should be regarded seriously, not only because the organisms that have become extinct represent a big loss for both ethical and utilitarian (useful benefit) reasons, but also because the organisms that remain have become more vulnerable (exposed) to extinction in the future.

Question 3: BIODIVERSITY

S126Q03

In lines 9 and 10 it is stated that "Food web A represents a more diverse ecosystem with, as a result, many more alternative feeding pathways."

Look at FOOD WEB A. Only two animals in this food web have three direct (immediate) food sources. Which two animals are they?

A Native Cat and Parasitic Wasp
B Native Cat and Butcher Bird
C Parasitic Wasp and Leaf Hopper
D Parasitic Wasp and Spider
E Native Cat and Honeyeater

BIODIVERSITY SCORING 3

❖ QUESTION INTENT: Process: Demonstrating knowledge and understanding
Theme: Ecosystems
Area: Science in life and health

Full credit

Code 1: A. Native Cat and Parasitic Wasp

No credit

Code 0: Other responses.

Code 9: Missing.

Question 4: BIODIVERSITY

S126Q04

Food webs A and B are in different locations. Imagine if Leaf Hoppers died out in both locations. Which one of these is the best prediction and explanation for the effect this would have on the food webs?

A The effect would be greater in food web A because the Parasitic Wasp has only one food source in web A.
B The effect would be greater in food web A because the Parasitic Wasp has several food sources in web A.
C The effect would be greater in food web B because the Parasitic Wasp has only one food source in web B.
D The effect would be greater in food web B because the Parasitic Wasp has several food sources in web B.

BIODIVERSITY SCORING 4

- QUESTION INTENT: Process: Drawing/evaluating conclusions
  - Theme: Biodiversity
  - Area: Science in life and health

Full credit

Code 1: C. The effect would be greater in food web B because the Parasitic Wasp has only one food source in web B.

No credit

Code 0: Other responses.

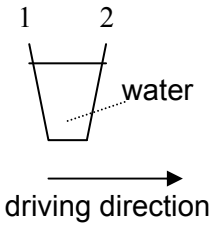
Code 9: Missing.

BUSES

Question 1: BUSES

S127Q01

A bus is driving along a straight stretch of road. The bus driver, named Ray, has a cup of water resting on the dashboard:



Suddenly Ray has to slam on the brakes.

What is most likely to happen to the water in the cup?

A The water will stay horizontal.
B The water will spill over side 1.
C The water will spill over side 2.
D The water will spill but you cannot tell if it will spill at side 1 or side 2.

BUSES SCORING 1

❖ QUESTION INTENT: Process: Demonstrating knowledge and understanding
Theme: Forces and movement
Area: Science in technologies

Full credit

Code 1: C. The water will spill over side 2.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 4: BUSES

S127Q04- 0 1 8 9

Ray's bus is, like most buses, powered by a petrol engine. These buses contribute to environmental pollution.
Some cities have trolley buses: they are powered by an electric engine. The voltage needed for such an electric engine is provided by overhead lines (like electric trains). The electricity is supplied by a power station using fossil fuels.
Supporters for the use of trolley buses in a city say that these buses don't contribute to environmental pollution.

Are these supporters right? Explain your answer. .....

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BUSES SCORING 4

❖ QUESTION INTENT: Process: Demonstrating knowledge and understanding
Theme: Energy transformations
Area: Science in Earth and environment

Full credit

Code1: Gives an answer in which it is stated that the power station also contributes to environmental pollution:
- No, because the power station causes environmental pollution as well.
- Yes, but this is only true for the city itself; the power station however causes environmental pollution.

No credit

Code 0: No or yes, without a correct explanation.

Code 8: Off task.

Code 9: Missing.

Example responses

Code 1:
- Yes and No. The buses don't pollute the city which is good, but the power station does pollute and that's not very good.
- The buses do contribute to the environmental pollution by using fossil fuels but they're not as harmful as normal buses with all their gases. *[Note: This answer can be given the benefit of the doubt.]*

Code 0:
- Well they have no outlet so no harmful smoke goes into the air which can damage the O-zone layer, and having electricity created by fossil fuels is also more environmental friendly.
- Yes, they are. Because electricity isn't harmful for the environment we only use up our Earth's gas.

CLONING

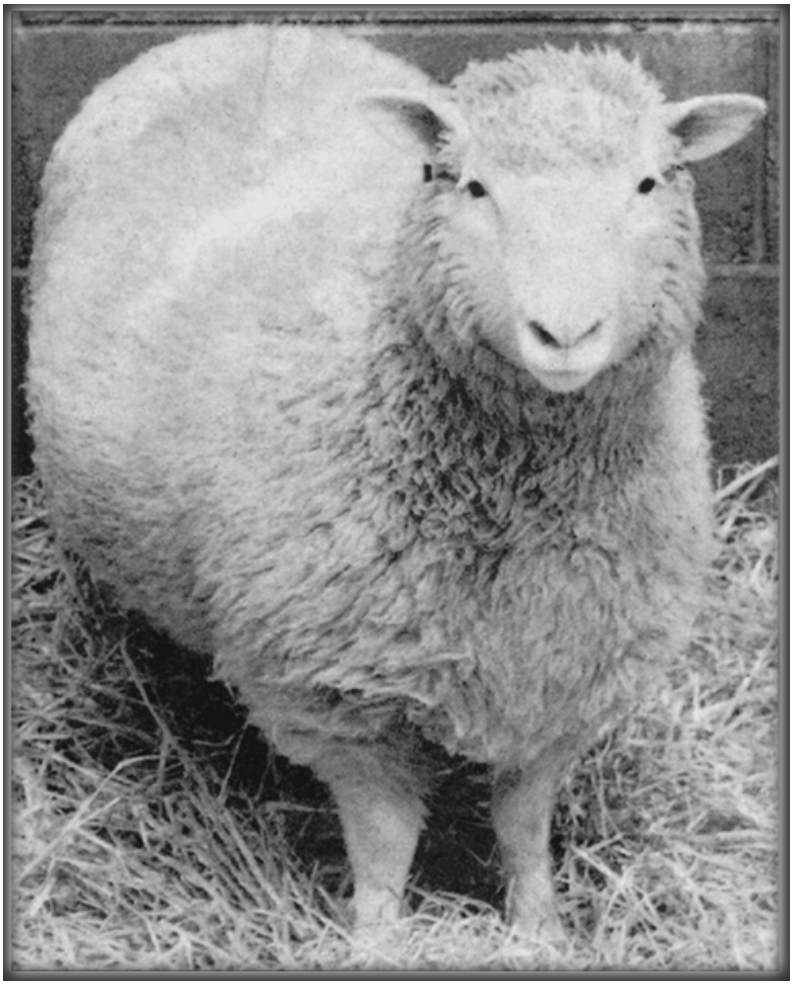
Read the newspaper article and answer the questions that follow.

A copying machine for living beings?

Without any doubt, if there had been elections for the animal of the year 1997, Dolly would have been the winner! Dolly is a Scottish sheep that you see in the photo. But Dolly is not just a simple sheep. She is a clone of another sheep. A clone means: a copy. Cloning means copying 'from a single master copy'. Scientists succeeded in creating a sheep (Dolly) that is identical to a sheep that functioned as a 'master copy'.

It was the Scottish scientist Ian Wilmut who designed the 'copying machine' for sheep. He took a very small piece from the udder of an adult sheep (sheep 1). From that small piece he removed the nucleus, then he transferred the nucleus into the egg-cell of another (female) sheep (sheep 2). But first he removed from that egg-cell all the material that would have determined sheep 2 characteristics in a lamb produced from that egg-cell. Ian Wilmut implanted the manipulated egg-cell of sheep 2 into yet another (female) sheep (sheep 3). Sheep 3 became pregnant and had a lamb: Dolly.

Some scientists think that within a few years it will be possible to clone people as well. But many governments have already decided to forbid cloning of people by law.



Question 1: CLONING

S128Q01

Which sheep is Dolly identical to?

A Sheep 1
B Sheep 2
C Sheep 3
D Dolly's father

CLONING SCORING 1

Full credit

Code 1: A. Sheep 1

No credit

Code 0: Other responses.

Code 9: Missing.

Question 2: CLONING

S128Q02

In line 14 the part of the udder that was used is described as "a very small piece". From the article text you can work out what is meant by "a very small piece".

That "very small piece" is

A a cell.
B a gene.
C a cell nucleus.
D a chromosome.

CLONING SCORING 2

Full credit

Code 1: A. a cell.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 3: CLONING

S128Q03

In the last sentence of the article it is stated that many governments have already decided to forbid cloning of people by law.

Two possible reasons for this decision are mentioned below.

Are these reasons scientific reasons?

Circle either “Yes” or “No” for each.

Reason:	**Scientific?**
Cloned people could be more sensitive to certain diseases than normal people.	Yes / No
People should not take over the role of a Creator.	Yes / No

CLONING SCORING 3

Full credit

Code 1: Yes, No, in that order.

No credit

Code 0: Other responses.

Code 9: Missing.

DAYLIGHT

Read the following information and answer the questions that follow.

DAYLIGHT ON 22 JUNE 2002

Today, as the Northern Hemisphere celebrates its longest day, Australians will experience their shortest.

In Melbourne*, Australia, the Sun will rise at 7:36 am and set at 5:08 pm, giving nine hours and 32 minutes of daylight.

Compare today to the year's longest day in the Southern Hemisphere, expected on 22 December, when the Sun will rise at 5:55 am and set at 8:42 pm, giving 14 hours and 47 minutes of daylight.

The President of the Astronomical Society, Mr Perry Vlahos, said the existence of changing seasons in the Northern and Southern Hemispheres was linked to the Earth's 23-degree tilt.

*Melbourne is a city in Australia at a latitude of about 38 degrees South of the equator.

Question 1: DAYLIGHT

S129Q01

Which statement explains why daylight and darkness occur on Earth?

A The Earth rotates on its axis.
B The Sun rotates on its axis.
C The Earth's axis is tilted.
D The Earth revolves around the Sun.

DAYLIGHT SCORING 1

Full credit

Code 1: A. The Earth rotates on its axis.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 2: DAYLIGHT

S129Q02 - 01 02 03 04 11 12 13 21 99

In the Figure light rays from the Sun are shown shining on the Earth.

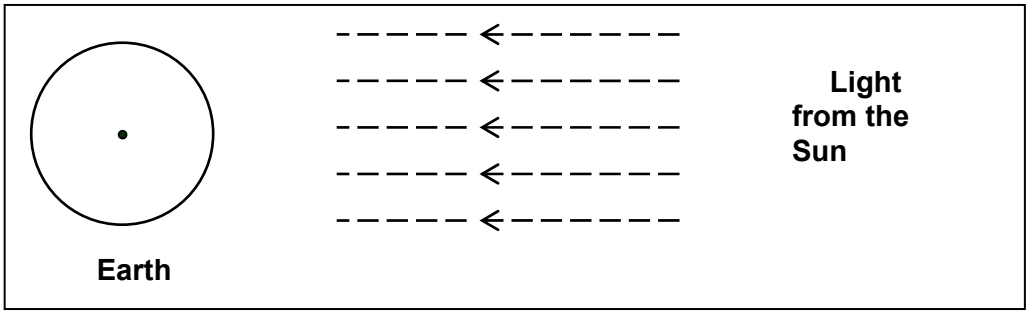


Figure: light rays from Sun

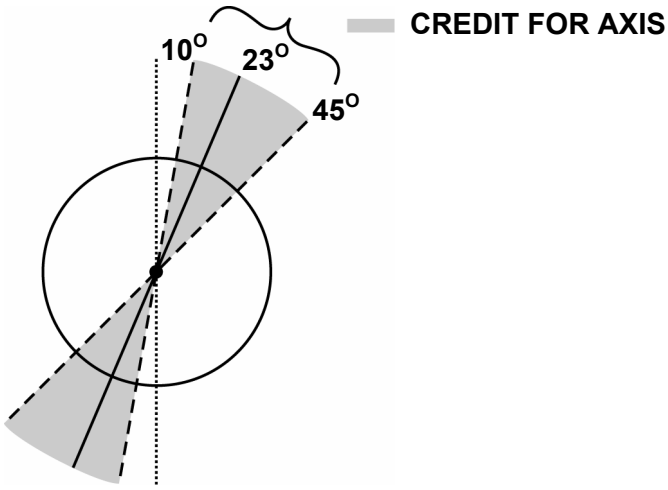
Suppose it is the shortest day in Melbourne.

Show the Earth's axis, the Northern Hemisphere, the Southern Hemisphere and the Equator on the Figure. Label all parts of your answer.

DAYLIGHT SCORING 2

Note: the important features when marking this question are:

1. The Earth's axis is drawn tilted towards the Sun within the range 10° and 45° from vertical for credit: refer to the following diagram:

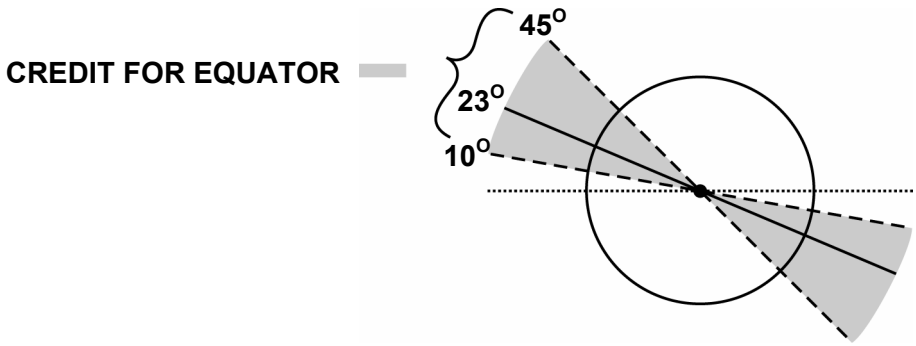


Outside of 10° and 45° to vertical range: no credit.

2. The presence or absence of clearly labelled Northern and Southern Hemispheres, or one Hemisphere only labelled, the other implied.

3. The equator is drawn at a tilt towards the Sun within the range 10° and 45° above horizontal for credit: refer to the following diagram:

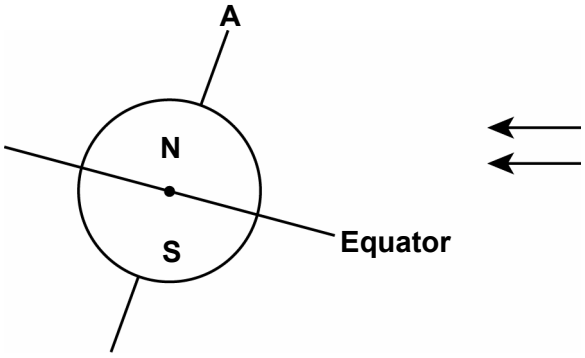
The equator may be drawn as an elliptical line or straight line.



Outside of 10° and 45° to horizontal range: no credit.

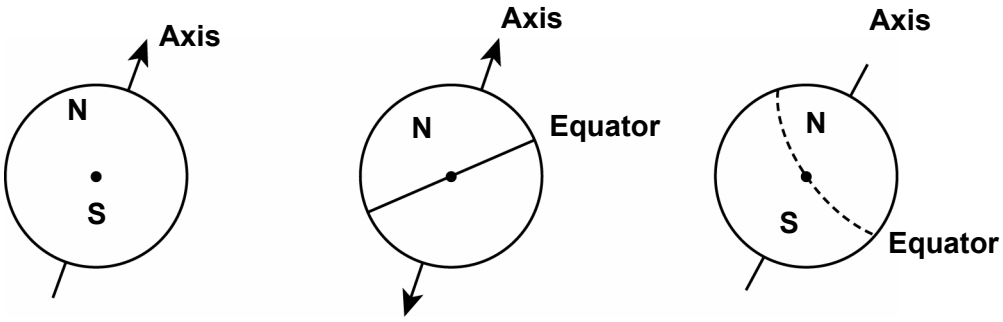
Full credit

Code 21: Diagram with Equator tilted towards the Sun at an angle between 10° and 45° and Earth's axis tilted towards the Sun within the range 10° and 45° from vertical, and the Northern and or Southern Hemispheres correctly labelled (or one only labelled, the other implied).

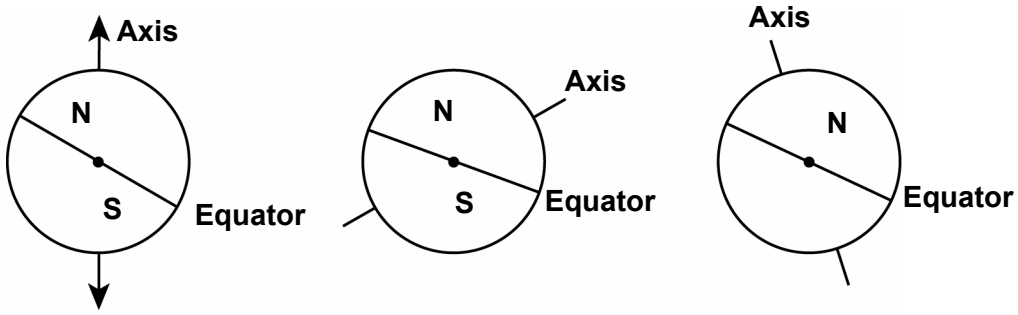


Partial credit

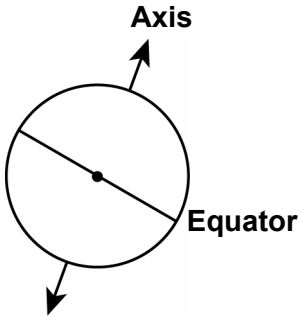
Code 11: Angle of tilt of axis between 10° and 45°, Northern and / or Southern Hemispheres correctly labelled (or one only labelled, the other implied), but angle of tilt of Equator not between 10° and 45°; or Equator missing.



Code 12: Angle of tilt of Equator between 10° and 45°, Northern and / or Southern Hemispheres correctly labelled (or one only labelled, the other implied), but angle of tilt of axis not between 10° and 45°; or axis missing.

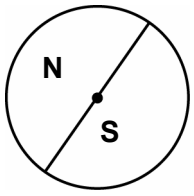


Code 13: Angle of tilt of Equator between 10° and 45°, and angle of tilt of axis between 10° and 45°, but Northern and Southern Hemispheres not correctly labelled (or one only labelled, the other implied, or both missing).

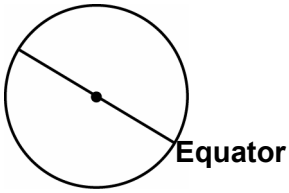


No credit

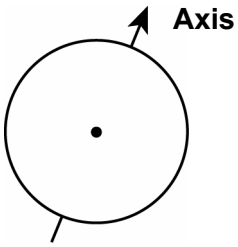
Code 01: Northern and or Southern Hemispheres correctly labelled (or one only, the other implied) is the only correct feature.



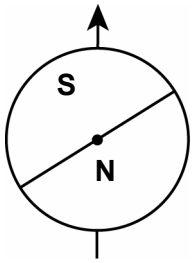
Code 02: Angle of tilt of Equator between 10° and 45° is the only correct feature.



Code 03: Angle of tilt of axis between 10° and 45° is the only correct feature.



Code 04: No features are correct, or other responses.



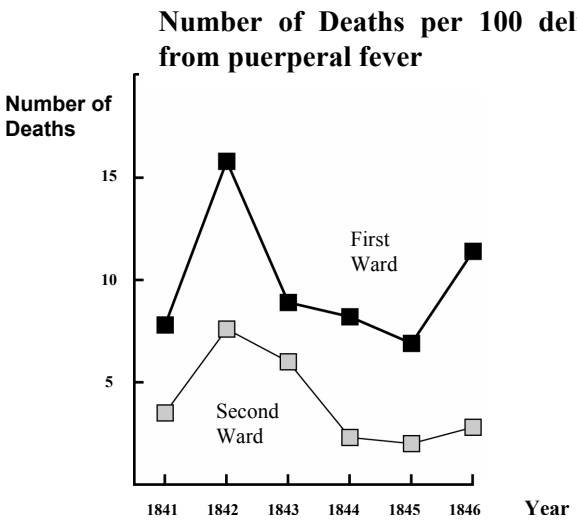
Code 99: Missing.

SEMMELWEIS' DIARY

SEMMELWEIS' DIARY TEXT 1

'*July 1846. Next week I will take up a position as "Herr Doktor" at the First Ward of the maternity clinic of the Vienna General Hospital. I was frightened when I heard about the percentage of patients who die in this clinic. This month not less than 36 of the 208 mothers died there, all from puerperal fever. Giving birth to a child is as dangerous as first-degree pneumonia.'*

These lines from the diary of Ignaz Semmelweis (1818-1865) illustrate the devastating effects of puerperal fever, a contagious disease that killed many women after childbirth. Semmelweis collected data about the number of deaths from puerperal fever in both the First and the Second Wards (see diagram).



Diagram

Physicians, among them Semmelweis, were completely in the dark about the cause of puerperal fever. Semmelweis' diary again:

'December 1846. Why do so many women die from this fever after giving birth without any problems? For centuries science has told us that it is an invisible epidemic that kills mothers. Causes may be changes in the air or some extraterrestrial influence or a movement of the earth itself, an earthquake.'

Nowadays not many people would consider extraterrestrial influence or an earthquake as possible causes of fever. But in the time Semmelweis lived, many people, even scientists, did! We now know it has to do with hygienic conditions. Semmelweis knew that it was unlikely that fever could be caused by extraterrestrial influence or an earthquake. He pointed at the data he collected (see diagram) and used this to try to persuade his colleagues.

Question 2: SEMMELWEIS' DIARY

S195Q02- 01 02 03 04 11 12 13 21 99

Suppose you were Semmelweis. Give a reason (based on the data Semmelweis collected) why puerperal fever is unlikely to be caused by earthquakes.

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SEMMELWEIS' DIARY SCORING 2

❖ QUESTION INTENT: Process: Drawing/evaluating conclusions
Theme: Human biology
Area: Science in life and health

Full credit

Code 21: Refers to the difference between the number of deaths (per 100 deliveries) in both wards.
- Due to the fact that the first ward had a high rate of women dying compared to women in the second ward, obviously shows that it had nothing to do with earthquakes.
- Not as many people died in ward 2 so an earthquake couldn't have occurred without causing the same number of deaths in each ward.
- Because the second ward isn't as high, maybe it had something to do with ward 1.
- It is unlikely that earthquakes cause the fever since death rates are so different for the two wards.

Partial credit

Code 11: Refers to the fact that earthquakes don't occur frequently.
- It would be unlikely to be caused by earthquakes because earthquakes wouldn't happen all the time.

Code 12: Refers to the fact that earthquakes also influence people outside the wards.
- If there were an earthquake, women from outside the hospital would have got puerperal fever as well.
- If an earthquake were the reason, the whole world would get puerperal fever each time an earthquake occurs (not only the wards 1 and 2).

Code 13: Refers to the thought that when earthquakes occur, men don't get puerperal fever.
- If a man were in the hospital and an earthquake came, he didn't get puerperal fever, so earthquakes cannot be the cause.
- Because girls get it and not men.

No credit

❖ Code 01: States (only) that earthquakes cannot cause the fever.

- An earthquake cannot influence a person or make him sick.
- A little shaking cannot be dangerous.

Code 02: States (only) that the fever must have another cause (right or wrong).
- Earthquakes do not let out poison gases. They are caused by the plates of the Earth folding and faulting into each other.
- Because they have nothing to do with each other and it is just superstition.
- An earthquake doesn't have any influence on the pregnancy. The reason was that the doctors were not specialised enough.

Code 03: Answers that are combinations of Codes 01 and 02.
- Puerperal fever is unlikely to be caused by earthquakes as many women die after giving birth without any problems. Science has told us that it is an invisible epidemic that kills mothers.
- The death is caused by bacteria and the earthquakes cannot influence them.

Code 04: Other responses.
- I think it was a big earthquake that shook a lot.
- In 1843 the deaths decreased at ward 1 and less so at ward 2.
- Because there aren't any earthquakes by the wards and they still got it. *[Note: The assumption that there were no earthquakes at that time isn't correct.]*

Code 99: Missing.

SEMMELWEIS' DIARY TEXT 2

Part of the research in the hospital was dissection. The body of a deceased person was cut open to find a cause of death. Semmelweis recorded that the students working on the First ward usually took part in dissections on women who died the previous day, before they examined women who had just given birth. They did not pay much attention to cleaning themselves after the dissections. Some were even proud of the fact that you could tell by their smell that they had been working in the mortuary, as this showed how industrious they were!

One of Semmelweis' friends died after having cut himself during such a dissection. Dissection of his body showed he had the same symptoms as mothers who died from puerperal fever. This gave Semmelweis a new idea.

Question 4: SEMMELWEIS' DIARY

S195Q04

Semmelweis' new idea had to do with the high percentage of women dying in the maternity wards and the students' behaviour.

What was this idea?

A Having students clean themselves after dissections should lead to a decrease of puerperal fever.
B Students should not take part in dissections because they may cut themselves.
C Students smell because they do not clean themselves after a dissection.
D Students want to show that they are industrious, which makes them careless when they examine the women.

SEMMELWEIS' DIARY SCORING 4

❖ QUESTION INTENT: Process: Recognising questions
Theme: Human biology
Area: Science in life and health

Full credit

Code 1: A. Having students clean themselves after dissections should lead to a decrease of puerperal fever.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 5: SEMMELWEIS' DIARY

S195Q05- 01 02 11 12 13 14 15 99

Semmelweis succeeded in his attempts to reduce the number of deaths due to puerperal fever. But puerperal fever even today remains a disease that is difficult to eliminate.

Fevers that are difficult to cure are still a problem in hospitals. Many routine measures serve to control this problem. Among those measures are washing sheets at high temperatures.

Explain why high temperature (while washing sheets) helps to reduce the risk that patients will contract a fever.

.....

.....

SEMMELWEIS' DIARY SCORING 5

❖ QUESTION INTENT: Process: Demonstrating knowledge and understanding
Theme: Human biology
Area: Science in life and health

Full credit

❖ Code 11: Refers to *killing* of *bacteria* .
- Because with the heat many bacteria will die.
- Bacteria will not stand the high temperature.
- Bacteria will be burnt by the high temperature.
- Bacteria will be cooked. *[Note: Although "burnt" and "cooked" are not scientifically correct, each of the last two answers as a whole can be regarded as correct.]*

Code 12: Refers to *killing* of microorganisms, germs or viruses.
- Because high heat kills small organisms which cause disease.
- It's too hot for germs to live.

Code 13: Refers to the *removal* (not killing) of bacteria.
- The bacteria will be gone.
- The number of bacteria will decrease.
- You wash the bacteria away at high temperatures.

Code 14: Refers to the *removal* (not killing) of microorganisms, germs or viruses.
- Because you won't have the germ on your body.

Code 15: Refers to sterilisation of the sheets.
- The sheets will be sterilised.

No credit

❖ Code 01: Refers to killing of disease.
- Because the hot water temperature kills any disease on the sheets.
- The high temperature kills most of the fever on the sheets, leaving less chance of contamination.

Code 02: Other responses.
- So they don't get sick from the cold.
- Well when you wash something it washes away the germs.

Code 99: Missing.

Question 6: SEMMELWEIS' DIARY

S195Q06

Many diseases may be cured by using antibiotics. However, the success of some antibiotics against puerperal fever has diminished in recent years.

What is the reason for this?

A Once produced, antibiotics gradually lose their activity.
B Bacteria become resistant to antibiotics.
C These antibiotics only help against puerperal fever, but not against other diseases.
D The need for these antibiotics has been reduced because public health conditions have improved considerably in recent years.

SEMMELWEIS' DIARY SCORING 6

❖ QUESTION INTENT: Process: Demonstrating knowledge and understanding
Theme: Biodiversity
Area: Science in life and health

Full credit

Code 1: B. Bacteria become resistant to antibiotics.

No credit

Code 0: Other responses.

Code 9: Missing.

CLIMATE CHANGE

CLIMATE CHANGE TEXT 1

Read the following information and answer the questions which follow.

WHAT HUMAN ACTIVITIES CONTRIBUTE TO CLIMATE CHANGE?

The burning of coal, oil and natural gas, as well as deforestation and various agricultural and industrial practices, are altering the composition of the atmosphere and contributing to climate change. These human activities have led to increased concentrations of particles and greenhouse gases in the atmosphere. The relative importance of the main contributors to temperature change is shown in Figure 1. Increased concentrations of carbon dioxide and methane have a heating effect. Increased concentrations of particles have a cooling effect in two ways, labelled 'Particles' and 'Particle effects on clouds'.

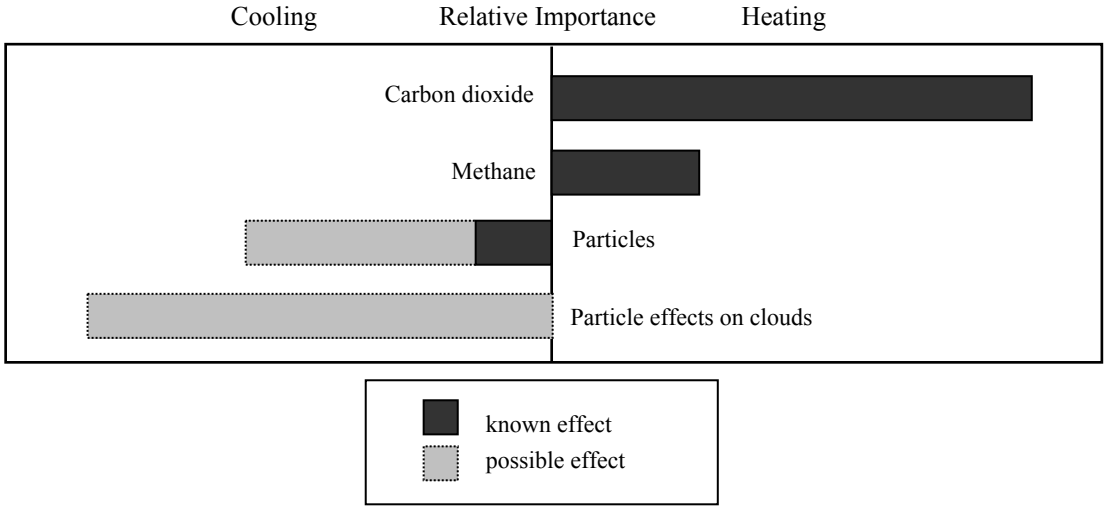

Figure 1: Relative importance of the main contributors to change in temperature of the atmosphere.

Bars extending to the right of the centre line indicate a heating effect. Bars extending to the left of the centre line indicate a cooling effect. The relative effect of 'Particles' and 'Particle effects on clouds' are quite uncertain: in each case the possible effect is somewhere in the range shown by the light grey bar.

Question 1: CLIMATE CHANGE

S210Q01- 0 1 2 8 9

Use the information in Figure 1 to develop an argument in support of reducing the emission of carbon dioxide from the human activities mentioned.

.....

.....

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CLIMATE CHANGE SCORING 1

❖ QUESTION INTENT: Process: Communicating
Theme: The Earth and its place in the universe
Area: Science in Earth and environment

Full credit

Code 2: Carbon dioxide is the main factor causing an increase in atmospheric temperature/causing climatic change, so reducing the amount emitted will have the greatest effect in reducing the impact of human activities.

Partial credit

Code 1: Carbon dioxide is causing an increase in atmospheric temperature/causing climatic change.

No credit

❖ Code 0: Other responses, including that an increase in temperature will have a bad effect on the Earth.

❖ Code 8: Off task.

Code 9: Missing.

Example responses

Code 2:

- The emission of CO_2 causes significant heating to the atmosphere and therefore should be lessened. *[Note: The term "significant" can be considered as equivalent to "most".]*
- According to figure 1 reduction in the emission of carbon dioxide is necessary because it considerably heats the earth. *[Note: The term "considerable" can be considered as equivalent to "most".]*

Code 1:

- The burning of fossil fuel such as oil, gas and coal are contributing to the build up of gases in the atmosphere, one of which is carbon dioxide (CO_2). This gas affects the temperature of the earth which increases causing a greenhouse effect.

Code 0:

- The way that humans could help control carbon dioxide levels to drop would be by not driving a car, don't burn coal and don't chop down forests. *[Note: No consideration given to the effect of carbon dioxide on temperature.]*

FLIES

FLIES TEXT 1

Read the following information and answer the questions which follow.

FLIES

A farmer was working with dairy cattle at an agricultural experiment station. The population of flies in the barn where the cattle lived was so large that the animals' health was affected. So the farmer sprayed the barn and the cattle with a solution of insecticide A. The insecticide killed nearly all the flies. Some time later, however, the number of flies was again large. The farmer again sprayed with the insecticide. The result was similar to that of the first spraying. Most, but not all, of the flies were killed. Again, within a short time the population of flies increased, and they were again sprayed with the insecticide. This sequence of events was repeated five times: then it became apparent that insecticide A was becoming less and less effective in killing the flies.

The farmer noted that one large batch of the insecticide solution had been made and used in all the sprayings. Therefore he suggested the possibility that the insecticide solution decomposed with age.

Question 1: FLIES

S212Q01- 0 1 2 3 4 5 8 9

The farmer's suggestion is that the insecticide decomposed with age. Briefly explain how this suggestion could be tested.

.....

.....

.....

FLIES SCORING 1

- QUESTION INTENT: Process: Identifying evidence
  Theme: Chemical and physical changes
  Area: Science in life and health

Full credit

- Code 5: Applies to answers in which three variables (type of flies, age of insecticide, and exposure) are controlled eg. Compare the results from a new batch of the insecticide with results from the old batch on two groups of flies of the same species that have not been previously exposed to the insecticide.

Partial credit

Code 4: Applies to answers in which two of the three variables (type of flies, age of insecticide, and exposure) are controlled eg. Compare the results from a

new batch of the insecticide with the results from the old batch on the flies in the barn.

Code 3: Applies to answers in which one variable only of three variables (type of flies, age of insecticide, and exposure) is controlled eg. (Chemically) analyse samples of the insecticide at regular intervals to see if it changes over time.

Code 2: Spray the flies with a new batch of insecticide, but without mentioning comparison with old batch.

Code 1: (Chemically) analyse samples of the insecticide but without mentioning comparison of analyses over time.
Note: Code 1 if sending samples of the insecticide to a laboratory is mentioned.

No credit

Code 0: Other responses.

Code 8: Off task.

Code 9: Missing.

Example responses

Code 5:

- Some flies could be taken. If they would both be put in a separate box you could use a new spray and an older spray and see what the results are. *[Note: Although the same species is not mentioned, it is implied that the flies are the same type, and that the flies have not been previously exposed.]*
- Make one big batch of spray. Have 2 groups of flies and spray each group every six months. Spray groups one with the big batch, and group 2 a new batch each time. *[Note: Although the same species is not mentioned, it is implied that the flies are the same type, and that the flies have not been previously exposed.]*

Code 4:

- Try a new bottle of it, then wait till it gets a bit older and the flies come back and then try again. *[Note: Reproduction of what the farmer experienced, controlling the age of the insecticide and type of flies ("the flies" is interpreted to mean the same flies).]*

Code 3:

- Take batches of the insecticide to a laboratory every few months and have its strength tested.

Code 2:

- Do the same thing but buy new insecticide each time, hence proving if his theory is right or wrong.

Code 1:

- Maybe if he sent a fresh batch of the poison to the lab with a batch of the old stuff and get them retested the results may prove his theory.

Code 0:

- He could test it every year to see if it is not old and would still work. *[Note: Does not indicate how the insecticide would be tested.]*
- Get a fly from his shed and another shed and spray them each with the insecticide.

Question 2: FLIES

S212Q02- 0 1 2 8 9

The farmer's suggestion is that the insecticide decomposed with age. Give two alternative explanations as to why "insecticide A was becoming less and less effective …"

Explanation 1: .....

.....

Explanation 2: .....

.....

FLIES SCORING 2

❖ QUESTION INTENT: Process: Recognising questions
Theme: a. Physiological change
b. Chemical/physical changes
Area: Science in life and health

Full credit

Code 2: Gives as one explanation a) that flies with resistance to the insecticide survive and pass on that resistance to later generations (also credit for "immunity" although it is recognised that it is not strictly analogous to "resistance"), as well as one of these b): a change in the environmental conditions (such as temperature), or a change in the way the insecticide was applied.

Partial credit

Code 1: Gives one explanation: type a) example or one example from b). Do not code 2 for two type b) examples.

No credit

Code 0: Other responses, including new flies moving to the barn from nearby (unsprayed) areas.

Code 8: Off task.

Code 9: Missing.

Example responses

Code 2:

- Explanation 1: With the repeated use of the same insecticide the flies were becoming immune to the formula.
  Explanation 2: Over time chemicals in the insecticide rose to the top of spray can leaving water diluted (ineffective) at the bottom.
  [Note: Immunity is allowed as alternative to resistance.]
- Explanation 1: The flies were becoming immune to the spray.

Explanation 2: Heat may make it decompose and temperature change.

- Explanation 1: Maybe the flies developed a defence gene so the insecticide would not work.
  Explanation 2: He (the farmer) used less each time.
  [Note: Defence gene is allowed as an alternative to resistance.]

Code 1:

- He might not have sprayed it properly.
- The flies could have built up an immunity.
- There were different types of flies each time. *[Note: A clear distinction is made between different types of flies in this example; it is not referring to new flies coming into the area.]*
- Explanation 1: The temperature got very hot and affected the insecticide.
  Explanation 2: the farmer did not spray the insecticide on the flies properly
  [Note: Two type b) explanations given, credit Code 1 only.]

Code 0:

- The flies could have been breeding.
- Because everytime he sprayed it it became less and less effective.
- When there is more of it in the can it is stronger. *[Note: A clear relationship between volume and concentration is not given.]*

CLOTHES

Read the text and answer the questions that follow.

CLOTHES TEXT

A team of British scientists is developing “intelligent” clothes that will give disabled children the power of “speech”. Children wearing waistcoats made of a unique electrotextile, linked to a speech synthesiser, will be able to make themselves understood simply by tapping on the touch-sensitive material.

The material is made up of normal cloth and an ingenious mesh of carbon-impregnated fibres that can conduct electricity. When pressure is applied to the fabric, the pattern of signals that passes through the conducting fibres is altered and a computer chip can work out where the cloth has been touched. It then can trigger whatever electronic device is attached to it, which could be no bigger than two boxes of matches.

“The smart bit is in how we weave the fabric and how we send signals through it – and we can weave it into existing fabric designs so you cannot see it’s in there,” says one of the scientists.

Without being damaged, the material can be washed, wrapped around objects or scrunched up. The scientist also claims it can be mass-produced cheaply.

Source: Steve Farrer, `Interactive fabric promises a material gift of the garb’, *The Australian*, 10 August 1998.

Question 1: CLOTHES

S213Q01

Can these claims made in the article be tested through scientific investigation in the laboratory?

Circle either “Yes” or “No” for each.

The material can be	Can the claim be tested through scientific investigation in the laboratory?
washed without being damaged.	Yes / No
wrapped around objects without being damaged.	Yes / No
scrunched up without being damaged.	Yes / No
mass-produced cheaply.	Yes / No

CLOTHES SCORING 1

Full Credit

Code 1: Yes, Yes, Yes, No, in that order.

No Credit

Code 0: Other responses.

Code 9: Missing.

Question 2: CLOTHES

S213Q02

Which piece of laboratory equipment would be among the equipment you would need to check that the fabric is conducting electricity?

A Voltmeter
B Light box
C Micrometer
D Sound meter

CLOTHES SCORING 2

Full Credit

Code 1: A. Voltmeter.

No Credit

Code 0: Other responses.

Code 9: Missing.

CALF CLONES

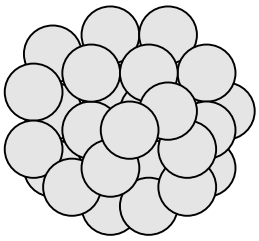
CALF CLONES TEXT

Read the following article about the birth of five calves.

In February 1993 a research team of the National Institute for Agricultural Research in Bresson-Villiers (France) succeeded in producing five clones of calves. The production of the clones (animals with the same genetic material, even though born of five different cows), was a complicated process.

First the researchers removed about thirty egg cells from a cow (let us say the cow's name was Blanche 1). The researchers removed the nucleus from each of the egg cells taken from Blanche 1.

Then the researchers took an embryo from another cow (let us say Blanche 2). This embryo contained about thirty cells.



The researchers separated the ball of cells from Blanche 2 into individual cells.

Then they removed the nucleus from each of these individual cells. Each nucleus was injected separately into each of the thirty cells that came from Blanche 1 (cells from which the nuclei had been removed).

Finally the thirty injected egg cells were implanted into thirty surrogate cows. Nine months later, five of the surrogate cows gave birth to the calf clones.

One of the researchers said that a large scale application of this cloning technique could be financially beneficial for cattle breeders.

Question 1: CALF CLONES

S251Q01- 0 1 8 9

The main idea tested in the French experiments on cows was confirmed by the results. Which main idea could have been tested in the French experiment?

.....

.....

CALF CLONES SCORING 1

❖ QUESTION INTENT: Process: Recognising questions
Theme: Genetic control
Area: Science in life and health

Full credit

Code 1: Gives an acceptable main idea.
- The idea of whether cloning of calves is possible.
- The determination of the number of calf clones that could be produced.

No credit

❖ Code 0: Gives an answer without mentioning calves or cloning OR repeats "a large scale application of this cloning technique could be financially beneficial for cattle breeders".

❖ Code 8: Off task.

Code 9: Missing.

Example responses

Code 1:
- That cloning was possible. *[Note: The fact that calves/cows have not been mentioned should be disregarded.]*

Code 0:
- That all cells of cows are the same.
- Mass cloning could be achieved. *[Note: The word "mass" in this context is not correct.]*

Question 4: CALF CLONES

S251Q04

Which of the following statements is/are true? Circle Yes or No for each.

Statement:	
All five calves have the same type of genes.	Yes/No
All five calves have the same sex.	Yes/No
The hair of all five calves has the same colour.	Yes/No

CALF CLONES SCORING 4

❖ QUESTION INTENT: Process: Drawing / evaluating conclusions
Theme: Genetic control
Area: Science in life and health

Full credit

Code 1: Yes, Yes, Yes.

No credit

Code 0: Other responses.

Code 9: Missing.

OZONE

OZONE TEXT

Read the following section of an article about the ozone layer.

The atmosphere is an ocean of air and a precious natural resource for sustaining life on the Earth. Unfortunately, human activities based on national/personal interests are causing harm to this common resource, notably by depleting the fragile ozone layer, which acts as a protective shield for life on the Earth.

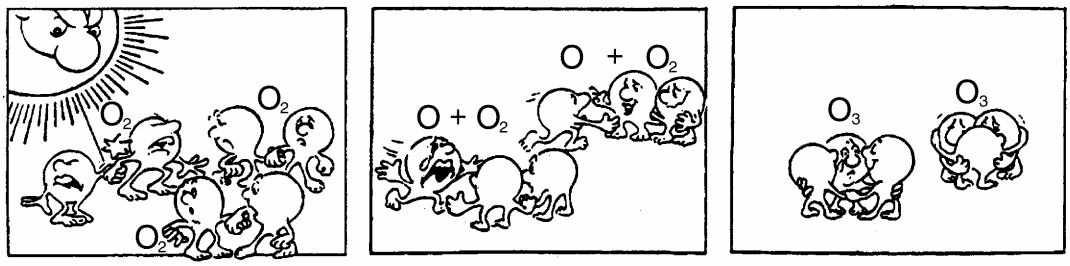
Ozone molecules consist of three oxygen atoms, as opposed to oxygen molecules which consist of two oxygen atoms. Ozone molecules are exceedingly rare: fewer than ten in every million molecules of air. However, for nearly a billion years, their presence in the atmosphere has played a vital role in safeguarding life on Earth. Depending on where it is located, ozone can either protect or harm life on Earth. The ozone in the troposphere (up to 10 kilometres above the Earth's surface) is "bad" ozone which can damage lung tissues and plants. But about 90 percent of ozone found in the stratosphere (between 10 and 40 kilometres above the Earth's surface) is "good" ozone which plays a beneficial role by absorbing dangerous ultraviolet (UV-B) radiation from the Sun.

Without this beneficial ozone layer, humans would be more susceptible to certain diseases due to the increased incidence of ultra-violet rays from the Sun. In the last decades the amount of ozone has decreased. In 1974 it was hypothesised that chlorofluorocarbons (CFCs) could be a cause for this. Until 1987, scientific assessment of the cause-effect relationship was not convincing enough to implicate CFCs. However, in September 1987, diplomats from around the world met in Montreal (Canada) and agreed to set sharp limits to the use of CFCs.

Question 1: OZONE

S253Q01- 01 11 12 13 21 22 23 31 99

In the text above nothing is mentioned about the way ozone is formed in the atmosphere. In fact each day some ozone is formed and some other ozone disappears. The way ozone is formed is illustrated in the following comic strip.



Suppose you have an uncle who tries to understand the meaning of this strip. However, he did not get any science education at school and he doesn't understand what the author of the strip is explaining. He knows that there are no little fellows in the atmosphere but he wonders what those little fellows in the strip stand for, what those strange notations O_2 and O_3 mean and which processes the strip represents. He asks you to explain the strip. Assume that your uncle knows:

that O is the symbol for oxygen;
what atoms and molecules are.

Write an explanation of the comic strip for your uncle.

In your explanation, use the words atoms and molecules in the way they are used in lines 5 and 6.

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OZONE SCORING 1

❖ QUESTION INTENT: Process: Communicating
Theme: Chemical and physical changes
Area: Science in Earth and environment

Full credit

Code 31: Gives an answer in which the following three aspects are mentioned:
First aspect: an oxygen molecule or some oxygen molecules (each consisting of two oxygen atoms) are split into oxygen atoms (picture 1).

Second aspect: the splitting (of oxygen molecules) takes place under the influence of sunlight (picture 1).

Third aspect: the oxygen atoms combine with other oxygen molecules to form ozone molecules (pictures 2 and 3).

Remarks on each of the three aspects:

First aspect:

- The splitting should be described using the correct words (see lines 5 and 6) for O (atom or atoms) and O_2 (molecule or molecules).
- If O and/or O_2 have been described only as "particles" or "small parts" no credit should be given for this aspect.

Second aspect:

- The Sun's influence should be related to the splitting of O_2 (an oxygen molecule or oxygen molecules).
- If the Sun's influence is related to the forming of an ozone molecule from an oxygen atom and an oxygen molecule (pictures 2 and 3) no credit should be given for this second aspect.

Note: Aspects 1 and 2 may typically be given in the one sentence.

Third aspect:

- This aspect should be given credit (one point) if the answer contains any description of an O combining with an O_2.
  If the formation of O_3 is described as combining of (three, separate) O atoms this third aspect should not be given credit.
- If O_3 is not described as a molecule or molecules but for example as "a group of atoms" this can be tolerated for the third aspect.

Examples of Code 31:

- When the sun shines on the O_2 molecule the two atoms separate. The two O atoms look for other O_2 molecules to join with. When the O_1 and O_2 join they form O_3 which is ozone.
- The strip illustrates the formation of ozone. If an oxygen molecule is affected by the sun, it breaks into two separate atoms. These separate atoms, O, float around looking for a molecule to link up to; they line up to existing O_2 molecules and form an O_3 molecule, as three atoms are now joined together; O_3 forms Ozone.
- The little guys are O, or oxygen atoms. When two are joined they make O_2 or oxygen molecules. The Sun causes this to decompose into Oxygen again. The O_2 atoms then bond with an O_2 molecule creating O_3 which is ozone. *[Note: The answer can be regarded as correct. There is only a slip of the pen ("O_2 atoms" after having mentioned "oxygen atoms" previously).]*

Partial credit

Code 21: First and second aspects only correct.

- The sun decomposes the oxygen molecules into single atoms. The atoms fuse into groups. The atoms form groups of 3 atoms together.

Code 22: First and third aspects only correct.

- Each of the little fellows stand for one atom of oxygen. O is one oxygen atom, O_2 is an oxygen molecule and O_3 is a group of atoms all joined together. The processes shown are one pair of oxygen atoms (O_2) getting split and then each joining with 2 other pairs forming two groups of 3 (O_3).
- The little fellows are oxygen atoms. O_2 means one oxygen molecule (like a pair of little fellows holding hands) and O_3 means three oxygen atoms. The two oxygen atoms of one pair break apart and one joins each of the other pairs and out of the three pairs, two sets of three oxygen molecules (O_3) are formed.

Code 23: Second and third aspects only correct.

- The oxygen is broken up by the sun's radiation. It splits in half. The two sides go and join other oxygen "particles" forming ozone.
- Most of the time in pure oxygen (O_2) environments oxygen comes in pairs of 2 so there are 3 pairs of 2. 1 pair is getting too hot and they fly apart going into another pair making O_3 instead of O_2. *[Note: Although "one pair is getting too hot" is not a very good description for the sun's influence, credit for the second aspect should be given; the third aspect can also be regarded as correct.]*

Code 11: First aspect only correct.

- Oxygen molecules are breaking down. They form O atoms. And sometimes there are ozone molecules. The ozone layer remains the same because new molecules are formed and others die.

Code 12: Second aspect only correct.

- O represents an oxygen molecule, O_2 = oxygen, O_3 = ozone. Sometimes both oxygen molecules, joining each other, are separated by the sun. The single molecules join another pair and form ozone (O_3).

Code 13: Third aspect only correct.

- The 'O' (oxygen) molecules are forced to bond with O_2 (2 x oxygen molecules) to form O_3 (3 x oxygen molecules), by the heat of the Sun. *[Note: The underlined part of the answer shows the third aspect. No credit can be given for the second aspect, because the Sun is not involved in the formation of ozone from O + O_2 but only in breaking down bonds in O_2.]*

No credit

Code 01: None of the three aspects correct.

- The sun (ultraviolet rays) burns the ozone layer and at the same time is destroying it as well. Those little men are the ozone layers and they run away from the sun because it is so hot. *[Note: No point can be awarded, not even for mentioning something about the Sun's influence.]*
- The sun is burning the ozone in the first boxes. In the second boxes they are running away with tears in their eyes and in the third box they are cuddling each other with tears in their eyes.
- Well uncle Herb it's simple. 'O' is one oxygen particle, the numbers next to 'O' increases the amounts of particles in the group.

Code 99: Missing.

Question 2: OZONE

S253Q02

Ozone is also formed during thunderstorms. It causes the typical smell after such a storm. In lines 9–13 the author of the text distinguishes between “bad ozone” and “good ozone”.

In terms of the article, is the ozone that is formed during thunderstorms “bad ozone” or “good ozone”?

Choose the answer and the explanation that is supported by the text.

	Bad ozone or good ozone?	**Explanation**
A	Bad	It is formed during bad weather.
B	Bad	It is formed in the troposphere.
C	Good	It is formed in the stratosphere.
D	Good	It smells good.

OZONE SCORING 2

❖ QUESTION INTENT: Process: Drawing/evaluating conclusions
Theme: Atmospheric change
Area: Science in Earth and environment

Full credit

Code 1: B. Bad. It is formed in the troposphere.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 5: OZONE

S253Q05- 0 1 9

Lines 14 and 15 state: “Without this beneficial ozone layer, humans would be more susceptible to certain diseases due to the increased incidence of ultra-violet rays from the Sun.”

Name one of these specific diseases.

.....

OZONE SCORING 5

❖ QUESTION INTENT: Process: Demonstrating knowledge and understanding
Theme: Physiological change
Area: Science in life and health

Code 1: Refers to skin cancer or other sun-related disease
- Skin cancer.

- Melonoma *[Note: This answer can be regarded as correct, despite the fact it has a spelling mistake.]*
- Cataracts.

No credit

Code 0: Refers to other specific type of cancer.
- Lung cancer.

OR: Refers only to cancer
- Cancer.

OR: Other responses.

Code 9: Missing.

Question 3: OZONE

S270Q03

At the end of the text, an international meeting in Montreal is mentioned. At that meeting lots of questions in relation to the possible depletion of the ozone layer were discussed. Two of those questions are shown in the table below.

Can the questions listed below be answered by scientific research?

Circle either Yes or No for each.

Question:	**Answerable by scientific research?**
Should the scientific uncertainties about the influence of CFCs on the ozone layer be a reason for governments to take no action?	Yes / No
What would the concentration of CFCs be in the atmosphere in the year 2002 if the release of CFCs into the atmosphere takes place at the same rate as it does now?	Yes / No

OZONE SCORING 3

❖ QUESTION INTENT: Process: Recognising questions
Theme: Atmospheric change
Area: Science in Earth and environment

Full credit

Code 1: No and Yes, in that order.

No credit

Code 0: Other responses.

Code 9: Missing.

CORN

Consider the following newspaper report.

DUTCHMAN USES CORN AS FUEL

Auke Ferwerda's stove contains a few logs burning quietly with low flames. From a paper bag next to the stove he takes a handful of corn and puts it onto the flames. Immediately the fire flares up brightly. "Look here," Ferwerda says, "The window of the stove stays clean and transparent. Combustion is complete." Ferwerda talks about the fact that corn can be used as fuel as well as cattle food. As far as he is concerned, this is the future.

Ferwerda points out that corn, in the form of cattle food, is in fact a type of fuel too. Cows eat corn to get energy out of it. But, Ferwerda explains, the sale of corn for fuel instead of for cattle food might be much more profitable for farmers.

Ferwerda has become convinced that, in the long run, corn will be widely used as fuel. He imagines what it will be like harvesting, storing, drying and packing the grains in bags for sale.

Ferwerda is currently investigating whether the whole corn plant could be used as fuel, but this research has not been completed yet.

What Ferwerda also needs to consider is the amount of attention being focused on carbon dioxide. Carbon dioxide is regarded as the main cause of the increase of the Greenhouse effect. The increase of the Greenhouse effect is said to be the cause of the increasing average temperature of the Earth's atmosphere.

In Ferwerda's view, however, there is nothing wrong with carbon dioxide. On the contrary, he argues, plants absorb it and convert it into oxygen for human beings.

However, Ferwerda's plans may clash with those of the government, which is actually trying to reduce the emission of carbon dioxide. Ferwerda says, "There are many scientists who say that carbon dioxide is not the main cause of the Greenhouse effect."

Question 2: CORN

S307Q02

Ferwerda compares corn used as fuel to corn used as food.

The first column of the table below contains a list of things that happen when corn burns.

Do these things also happen when corn works as a fuel in an animal body?

Circle Yes or No for each.

When corn burns:	**Does this also happen when corn works as a fuel in an animal body?**
Oxygen is consumed.	Yes / No
Carbon dioxide is produced.	Yes / No
Energy is produced.	Yes / No

CORN SCORING 2

Full credit

Code 1: Yes, Yes, Yes.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 5: CORN

S307Q05 - 0 1 9

In the article a conversion of carbon dioxide is described: "…plants absorb it and convert it into oxygen …".

There are more substances involved in this conversion than carbon dioxide and oxygen only. The conversion can be represented in the following way:

carbon dioxide + water → oxygen + ☐

Write in the box the name of the missing substance.

CORN SCORING 5

Full credit

Code 1: One of the following names:
- glucose

- sugar(s)
- carbohydrate(s)
- saccharide(s)
- starch

No credit

Code 0: Other responses.

Code 9: Missing.

Question 7: CORN

S307Q07

At the end of the article Ferwerda refers to scientists who say that carbon dioxide is not the main cause of the Greenhouse effect.

Karin finds the following table showing the relative Greenhouse effect caused by four gases:

Relative Greenhouse effect per molecule of gas			
Carbon dioxide	Methane	Nitrous oxide	Chlorofluorocarbons
1	30	160	17 000

From this table Karin cannot conclude which gas is the main cause of the increase of the Greenhouse effect. The data in the table need to be combined with other data for Karin to conclude which gas is the main cause of the increase of the Greenhouse effect.

Which other data does Karin need to collect?

A Data about the origin of the four gases.
B Data about the absorption of the four gases by plants.
C Data about the size of each of the four types of molecules.
D Data about the amounts of each of the four gases in the atmosphere.

CORN SCORING 7

Full credit

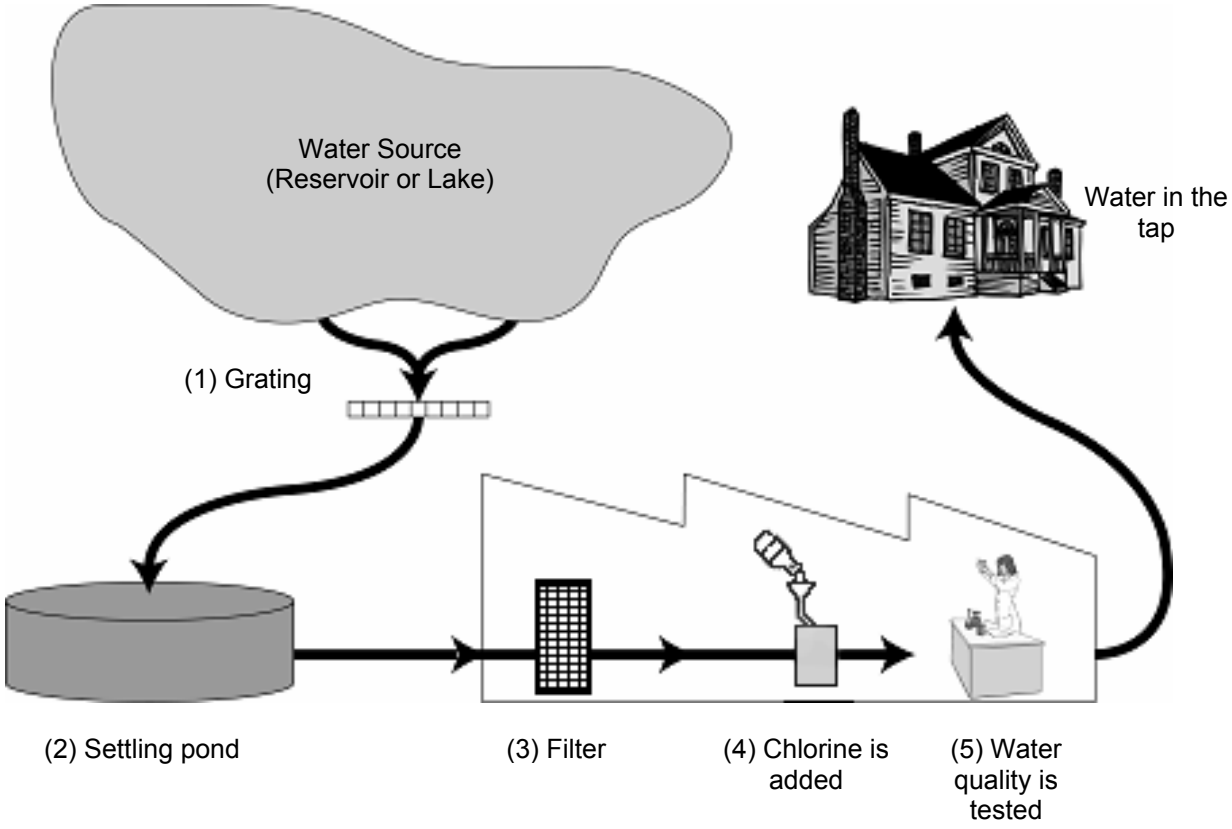
Score 1: D. Data about the amounts of each of the four gases in the atmosphere.

No credit

Score 0: Other responses.

Code 9: Missing.

FIT FOR DRINKING



The figure above shows how water supplied to houses in cities is made fit for drinking.

Question 1: FIT FOR DRINKING

S409Q01 – 01 02 03 11 12 13 99

It is important to have a source of good drinking water. Water found underground is referred to as **ground water**.

Give one reason why there is less bacteria and particle pollution in ground water than in water from surface sources such as lakes and rivers.

.....

.....

FIT FOR DRINKING SCORING 1

Full credit

Code 11: Responses referring to ground water being filtered through the ground.
- When it goes through sand and dust the water is cleaned.
- It has been naturally filtered.
- Because when water goes down through the ground it will be strained by rocks and sand.

Code 12: Responses referring to the ground water being encapsulated and therefore protected from possible pollution; OR that surface water is more easily polluted.
- Ground water is inside the earth and therefore air pollution cannot make it dirty.
- Because ground water isn't open, it is located under something.
- Lake and rivers can be polluted by the air and you can swim in it and so on, that's why it is not clean.
- Because lakes and rivers are polluted by people and animals.

Code 13: Other correct responses.
- Ground water is water without much food for bacteria so they will not survive there.
- Ground water is not in the Sun. There is blue-green algae.

No credit

Code 01: Responses referring to ground water being very clean (information already given).
- Because it has been cleaned.
- Because there is rubbish in lakes and rivers. *[Note: Does not explain why.]*
- Because there is less bacteria.

Code 02: Responses obviously referring to the cleaning process provided in the figure given in the stimulus.
- Because ground water passes through a filter and chlorine is added.
- The ground water passes through a filter that cleans it absolutely.

Code 03: Other responses.
- Because it's always moving.
- Because it is not stirred and therefore don't bring mud from the bottom.

Code 99: Missing.

Question 2: FIT FOR DRINKING

S409Q02

The cleaning of water often happens in several steps, involving different techniques. The cleaning process shown in the figure involves four steps (numbered 1–4). In the second step, the water is collected in a settling pond.

In what way does this step make the water cleaner?

A The bacteria in the water die.
B Oxygen is added to the water.
C Gravel and sand sink to the bottom.
D Toxic substances are broken down.

FIT FOR DRINKING SCORING 2

Full credit

Code 1: C. Gravel and sand sink to the bottom.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 4: FIT FOR DRINKING

S409Q04 – 0 1 9

In the fourth step of the cleaning process, chlorine is added to the water.

Why is chlorine added to the water?

.....

.....

FIT FOR DRINKING SCORING 4

Full credit

Code 1: Responses referring to removing, killing or breaking down bacteria (or microbes or viruses or germs).
- To make it free from bacteria.
- Chlorine kills bacteria.
- To kill all the algae.

No credit

Code 0: Other responses.
- The water gets less acid and there will be no algae.
- It is like fluoride.

- To clean out the water a bit more and kill the left over things. *[Note: "Things" is not specific enough.]*
- To keep it clean and drinkable.

Code 9: Missing.

Question 6: FIT FOR DRINKING

S409Q06 – 01 02 11 12 99

Suppose that the scientists involved in the testing of water at the water plant discover that there are some dangerous bacteria in the water **after** the cleaning process is completed.

What should people at home do with this water before drinking it?

.....

.....

FIT FOR DRINKING SCORING 6

Full credit

Code 11: Responses that refer to boiling the water.
- Boil it.

Code 12: Responses that refer to other methods of cleaning that are possible to do safely at home.
- Treat the water with chlorine tablets (e.g., Puratabs).
- Use a micropore filter.

No credit

Code 01: Responses that refer to "professional" methods of cleaning that are impossible to carry out safely at home, or impractical to carry out at home.
- Mix it with chloride in a bucket and then drink it.
- More chloride, chemicals and biological devices.
- Distil the water.

Code 02: Other responses.
- Purify it again.
- Use a coffee filter.
- Buy bottled water until the cleaning process is fixed. *[Note: Avoids the question being asked.]*

Code 99: Missing.

Question 7: FIT FOR DRINKING

S409Q07

Can drinking polluted water cause the following health problems? Circle "Yes" or "No" in each case.

Can drinking polluted water cause this health problem?	**Yes or No?**
Diabetes	Yes / No
Diarrhoea	Yes / No
HIV / AIDS	Yes / No

FIT FOR DRINKING SCORING 7

Full credit

Code 1: All three correct: No, Yes, No, in that order.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 10N: FIT FOR DRINKING

S409Q10N

How much interest do you have in the following information?

Tick only one box in each row.

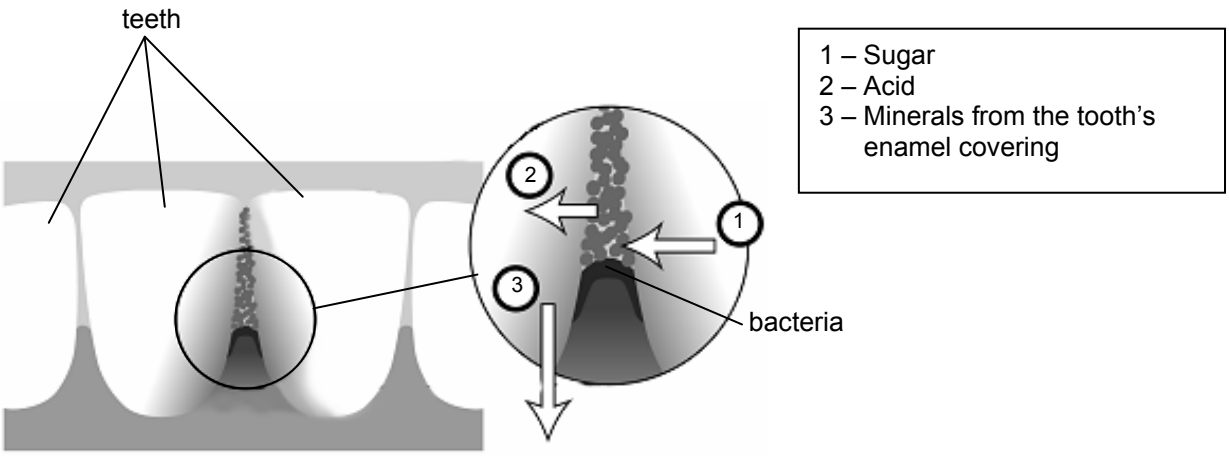
	High Interest	*Medium Interest*	*Low Interest*	*No Interest*
a) Knowing how water is tested for bacterial contamination	☐ 1	☐ 2	☐ 3	☐ 4
b) Learning more about the chemical treatment of water supplies	☐ 1	☐ 2	☐ 3	☐ 4
c) Learning which diseases are transmitted in drinking water	☐ 1	☐ 2	☐ 3	☐ 4

TOOTH DECAY

Bacteria that live in our mouths cause dental caries (tooth decay). Caries has been a problem since the 1700s when sugar became available from the expanding sugar cane industry.

Today, we know a lot about caries. For example:

- Bacteria that cause caries feed on sugar.
- The sugar is transformed to acid.
- Acid damages the surface of teeth.
- Brushing teeth helps to prevent caries.



Question 1: TOOTH DECAY

S414Q01

What is the role of bacteria in dental caries?

A Bacteria produce enamel.
B Bacteria produce sugar.
C Bacteria produce minerals.
D Bacteria produce acid.

TOOTH DECAY SCORING 1

Full credit

Code 1: D. Bacteria produce acid.

No credit

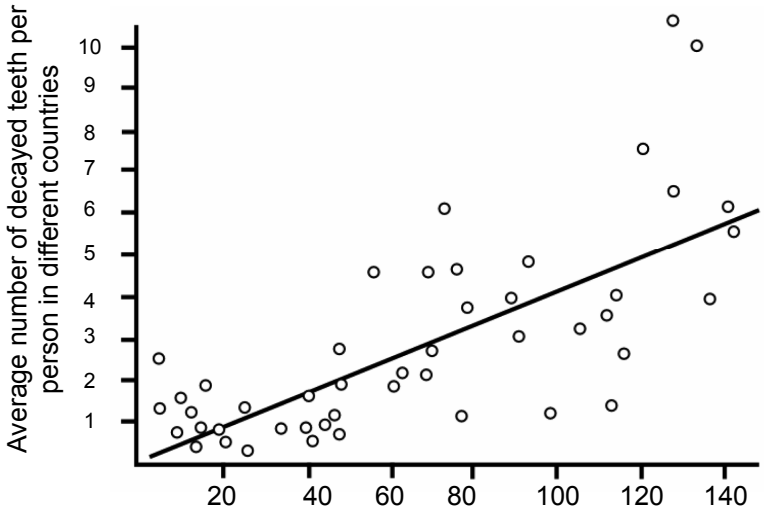
Code 0: Other responses.

Code 9: Missing.

Question 4: TOOTH DECAY

S414Q04

The following graph shows the consumption of sugar and the amount of caries in different countries. Each country is represented by a dot in the graph.



Which one of the following statements is supported **by the data given in the graph**?

A In some countries, people brush their teeth more frequently than in other countries.
B The more sugar people eat, the more likely they are to get caries.
C In recent years, the rate of caries has increased in many countries.
D In recent years, the consumption of sugar has increased in many countries.

TOOTH DECAY SCORING 4

Full credit

Code 1: B. The more sugar people eat, the more likely they are to get caries.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 8: TOOTH DECAY

S414Q08

A country has a high number of decayed teeth per person.

Can the following questions about tooth decay in that country be answered by scientific experiments? Circle "Yes" or "No" for each question.

Can this question about tooth decay be answered by scientific experiments?	**Yes or No?**
What would be the effect on tooth decay of putting fluoride in the water supply?	Yes / No
How much should a visit to the dentist cost?	Yes / No

TOOTH DECAY SCORING 8

Full credit

Code 1: Both correct: Yes, No, in that order.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 10N: TOOTH DECAY

S414Q10N

How much interest do you have in the following information?

Tick only one box in each row.

		High Interest	*Medium Interest*	*Low Interest*	*No Interest*
d)	Knowing what tooth decay bacteria look like under a microscope	☐ 1	☐ 2	☐ 3	☐ 4
e)	Learning about the development of a vaccine to prevent tooth decay	☐ 1	☐ 2	☐ 3	☐ 4
f)	Understanding how sugar-free foods can cause tooth decay	☐ 1	☐ 2	☐ 3	☐ 4

HOT WORK

Question 1: HOT WORK

S420Q01

Peter is working on repairs to an old house. He has left a bottle of water, some metal nails, and a piece of timber inside the boot of his car. After the car has been out in the sun for three hours, the temperature inside the car reaches about 40 ºC.

What happens to the objects in the car? Circle "Yes" or "No" for each statement.

Does this happen to the object(s)?	**Yes or No?**
They all have the same temperature.	Yes / No
After some time the water begins to boil.	Yes / No
After some time the metal nails begin to glow red.	Yes / No

HOT WORK SCORING 1

Full credit

Code 1: All three correct: Yes, No, No, in that order.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 3: HOT WORK

S420Q03

For drinks during the day, Peter has a cup of hot coffee, at a temperature of about 90 ºC, and a cup of cold mineral water, with a temperature of about 5 ºC. The cups are of identical type and size and the volume of each drink is the same. Peter leaves the cups sitting in a room where the temperature is about 20 ºC.

What are the temperatures of the **coffee** and the **mineral water** likely to be after 10 minutes?

A 70 ºC and 10 ºC
B 90 ºC and 5 ºC
C 70 ºC and 25 ºC
D 20 ºC and 20 ºC

HOT WORK SCORING 3

Full credit

Code 1: A. 70 ºC and 10 ºC

No credit

Code 0: Other responses.

Code 9: Missing.

Question 10N: HOT WORK *S420Q10N*

How much interest do you have in the following information?

Tick only one box in each row.

		High Interest	*Medium Interest*	*Low Interest*	*No Interest*
a)	Understanding how the shape of the cup influences the speed at which coffee cools	☐ 1	☐ 2	☐ 3	☐ 4
b)	Learning about the different arrangements of atoms in wood, water and steel	☐ 1	☐ 2	☐ 3	☐ 4
c)	Knowing why different solids conduct heat differently	☐ 1	☐ 2	☐ 3	☐ 4

MOUSEPOX

There are many types of pox viruses that cause pox diseases in animals. Each type of virus usually infects only one animal species. A magazine has reported that a scientist has used genetic engineering to modify the DNA of mousepox. The altered virus kills all the mice it infects.

The scientist says research on modifying viruses is necessary in order to control pests that damage human food. Critics of the research say viruses could escape from laboratories and infect other animals. They are also worried that a modified pox virus for one species could infect other species, especially humans.

Humans are infected with a pox virus called smallpox. Smallpox kills most people it infects. While it is thought that this disease has been eliminated from the general population, smallpox virus samples are kept in laboratories around the world.

Question 1: MOUSEPOX

S423Q01

Critics have expressed concern that the mousepox virus could infect species other than mice. Which one of the following reasons is the **best** explanation for this concern?

A The genes of smallpox virus and the genes of modified mousepox virus are identical.
B A mutation in mousepox DNA might allow the virus to infect other animals.
C A mutation could make the mousepox DNA identical to smallpox DNA.
D The number of genes in mousepox virus is the same as in other pox viruses.

MOUSEPOX SCORING 1

Full credit

Code 1: B. A mutation in mousepox DNA might allow the virus to infect other animals.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 2: MOUSEPOX

S423Q02

A person who criticised the research was worried that the modified mousepox virus might escape from a laboratory. This virus could cause the extinction of some species of mice.

Are the following outcomes likely if some species of mice become extinct? Circle "Yes" or "No" in each case.

Is this outcome likely if some species of mice become extinct?	**Yes or No?**
Some food chains could be affected.	Yes / No
Domestic cats could die for lack of food.	Yes / No
Plants whose seeds are eaten by mice could temporarily increase in number.	Yes / No

MOUSEPOX SCORING 2

Full credit

Code 1: All three correct: Yes, No, Yes, in that order.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 3: MOUSEPOX

S423Q03

One company is trying to develop a virus that will make mice sterile (i.e., unable to have babies). Such a virus could help control the number of mice.

Suppose the company is successful. Should the following questions be answered by research before releasing the virus? Circle "Yes" or "No" in each case.

Should this question be answered before releasing the virus?	**Yes or No?**
What is the best method for spreading the virus?	Yes / No
How soon will mice develop immunity to the virus?	Yes / No
Will the virus affect other animal species?	Yes / No

MOUSEPOX SCORING 3

Full credit

Code 1: All three correct: Yes, Yes, Yes.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 10N: MOUSEPOX *S423Q10N*

How much interest do you have in the following information?

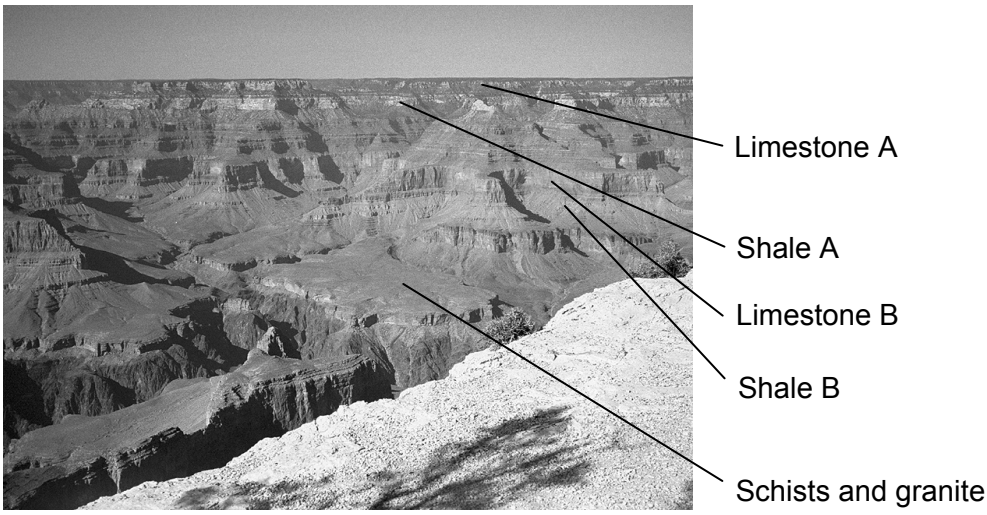
Tick only one box in each row.

		High Interest	*Medium Interest*	*Low Interest*	*No Interest*
a)	Learning about the structure of viruses	☐ 1	☐ 2	☐ 3	☐ 4
b)	Knowing how viruses mutate (change)	☐ 1	☐ 2	☐ 3	☐ 4
c)	Understanding better how the body defends itself against viruses	☐ 1	☐ 2	☐ 3	☐ 4

THE GRAND CANYON

The Grand Canyon is located in a desert in the USA. It is a very large and deep canyon containing many layers of rock. Sometime in the past, movements in the Earth's crust lifted these layers up. The Grand Canyon is now 1.6 km deep in parts. The Colorado River runs through the bottom of the canyon.

See the picture below of the Grand Canyon taken from its south rim. Several different layers of rock can be seen in the walls of the canyon.



Question 7: THE GRAND CANYON

S426Q07

About five million people visit the Grand Canyon national park every year. There is concern about the damage that is being caused to the park by so many visitors.

Can the following questions be answered by scientific investigation? Circle "Yes" or "No" for each question.

Can this question be answered by scientific investigation?	**Yes or No?**
How much erosion is caused by use of the walking tracks?	Yes / No
Is the park area as beautiful as it was 100 years ago?	Yes / No

THE GRAND CANYON SCORING 7

Full Credit

Code 1: Both correct: Yes, No in that order.

No Credit

Code 0: Other responses.

Code 9: Missing.

Question 3: THE GRAND CANYON

S426Q03

The temperature in the Grand Canyon ranges from below 0 °C to over 40 °C. Although it is a desert area, cracks in the rocks sometimes contain water. How do these temperature changes and the water in rock cracks help to speed up the breakdown of rocks?

A Freezing water dissolves warm rocks.
B Water cements rocks together.
C Ice smoothes the surface of rocks.
D Freezing water expands in the rock cracks.

THE GRAND CANYON SCORING 3

Full Credit

Code 1: D. Freezing water expands in the rock cracks.

No Credit

Code 0: Other responses.

Code 9: Missing.

Question 5: THE GRAND CANYON

S426Q05

There are many fossils of marine animals, such as clams, fish and corals, in the Limestone A layer of the Grand Canyon. What happened millions of years ago that explains why such fossils are found there?

A In ancient times, people brought seafood to the area from the ocean.
B Oceans were once much rougher and sea life washed inland on giant waves.
C An ocean covered this area at that time and then receded later.
D Some sea animals once lived on land before migrating to the sea.

THE GRAND CANYON SCORING 5

Full Credit

Code 1: C. An ocean covered this area at that time and then receded later.

No Credit

Code 0: Other responses.

Code 9: Missing.

Question 10S: THE GRAND CANYON

S426Q10S

How much do you agree with the following statements?

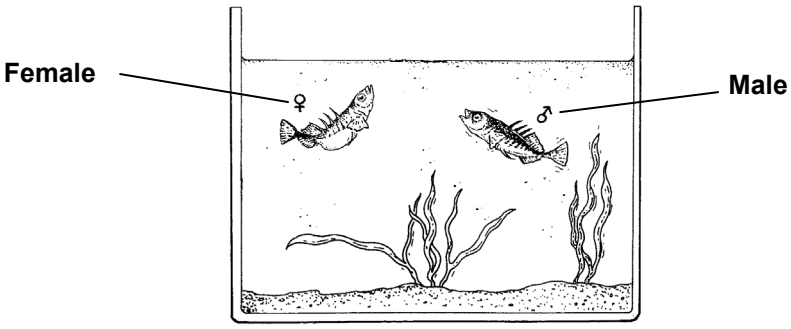
Tick only one box in each row.

		Strongly Agree	*Agree*	*Disagree*	*Strongly Disagree*
a)	The systematic study of fossils is important.	☐ 1	☐ 2	☐ 3	☐ 4
b)	Action to protect National Parks from damage should be based on scientific evidence.	☐ 1	☐ 2	☐ 3	☐ 4
c)	Scientific investigation of geological layers is important.	☐ 1	☐ 2	☐ 3	☐ 4

Translation Note: In Question 10S, "National Parks" should be replaced with the most common term used in the country for nature or scenic reserves.

STICKLEBACK BEHAVIOUR

The stickleback is a fish that is easy to keep in an aquarium.

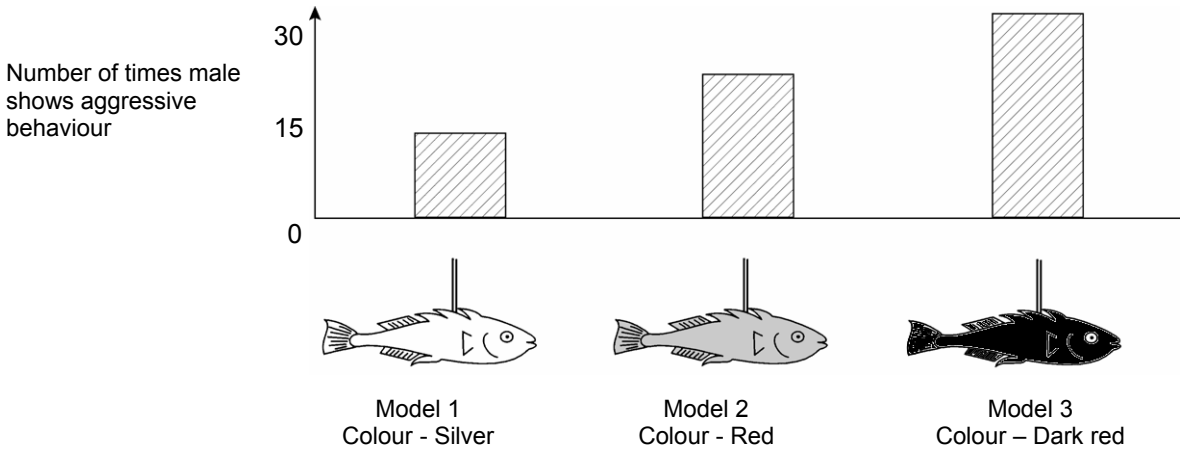


- During the breeding season the male stickleback's belly turns from silver-coloured to red.
- The male stickleback will attack any competing male that comes into his territory, and try to chase it away.
- If a silver-coloured female approaches, he will try to guide her to his nest so she will lay her eggs there.

In an experiment a student wants to investigate what will make the male stickleback show aggressive behaviour.

A male stickleback is alone in the student's aquarium. The student has made three wax models attached to pieces of wire. He hangs them separately in the aquarium for the same amount of time. Then the student counts the number of times the male stickleback reacts aggressively by pushing against the wax figure.

The results of this experiment are shown below.



Question 1: STICKLEBACK BEHAVIOUR

S433Q01 – 0 1 9

What is the question that this experiment is attempting to answer?

.....

.....

.....

STICKLEBACK BEHAVIOUR SCORING 1

Full credit

Code 1: What colour elicits the strongest aggressive behaviour by the male stickleback?
- Does the male stickleback react more aggressively to a red-coloured model than to a silver-coloured one?
- Is there a relationship between colour and aggressive behaviour?
- Does the colour of the fish cause the male to be aggressive?
- What fish colour does the stickleback find most threatening?

No credit

Code 0: Other responses, including all responses that do not refer to the *colour* of the stimulus/model/fish.
- What colour will elicit aggressive behaviour in the male stickleback. *[Note: No comparative aspect.]*
- Does the colour of the female stickleback determine the aggressiveness of the male? *[Note: The first experiment is not concerned with the gender of the fish.]*
- Which model does the male stickleback react to most aggressively? *[Note: Specific reference must be made to the <u>colour</u> of the fish/model.]*

Code 9: Missing.

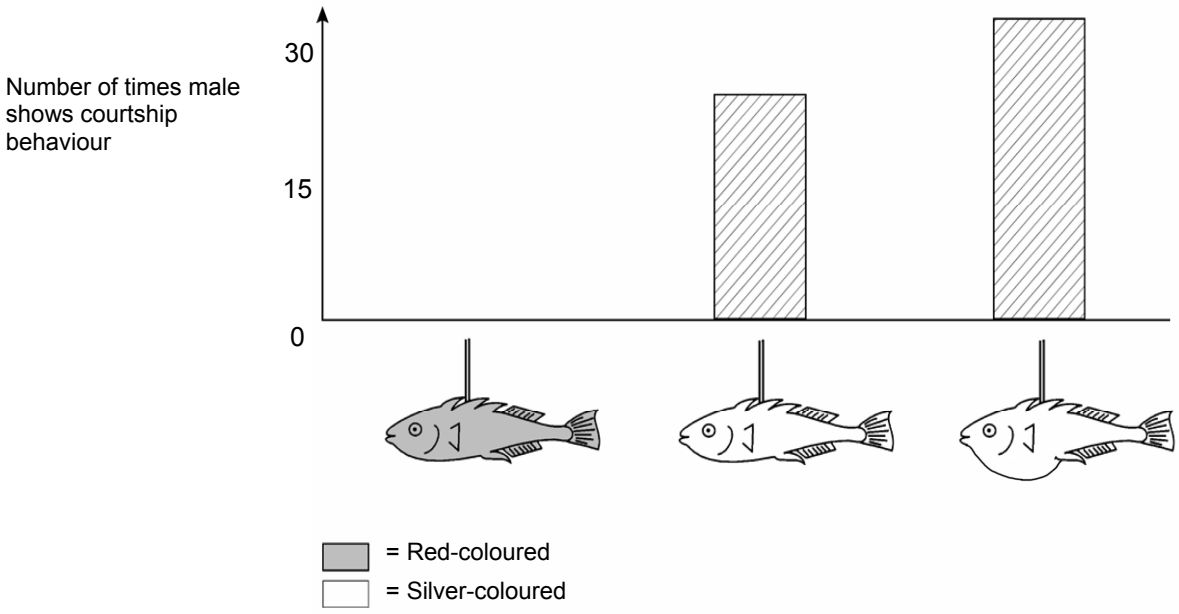
Question 2: STICKLEBACK BEHAVIOUR

S433Q02

During breeding time, if the male stickleback sees a female he will try to attract the female with courtship behaviour that looks like a little dance. In a second experiment, this courtship behaviour is investigated.

Again, three wax models on a piece of wire are used. One is red-coloured; two are silver-coloured with one having a flat belly and the other a round belly. The student counts the number of times (in a given amount of time) that the male stickleback reacts to each model by showing courtship behaviour.

The results of this experiment are shown below.



Three students each draw a conclusion based on the results of this second experiment.

Are their conclusions correct according to the information given in the graph? Circle "Yes" or "No" for each conclusion.

Is this conclusion correct according to the information in the graph?	**Yes or No?**
The red colour causes courtship behaviour by the male stickleback.	Yes / No
A flat-bellied female stickleback causes most courtship behaviour from a stickleback male.	Yes / No
The male stickleback shows courtship behaviour more often to a round-bellied female than to a flat-bellied female.	Yes / No

STICKLEBACK BEHAVIOUR SCORING 2

Full credit

Code 1: All three correct: No, No, Yes, in that order.

No credit

Code 0: Other responses.

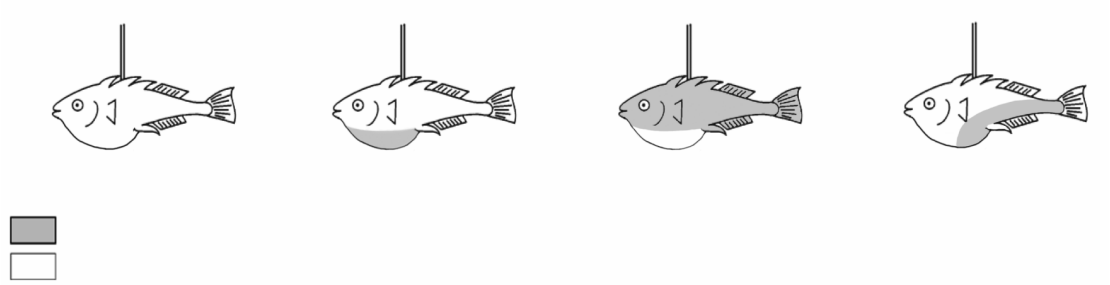
Code 9: Missing.

Question 3: STICKLEBACK BEHAVIOUR

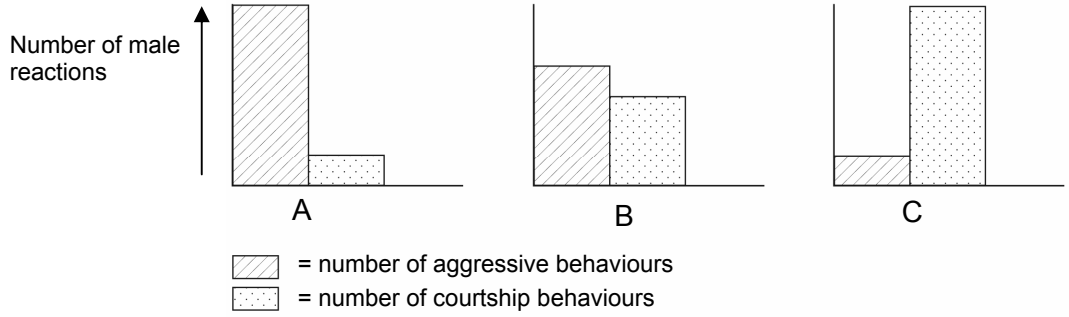
S433Q03 – 0 1 2 9

Experiments have shown that male sticklebacks react with aggressive behaviour to models with a red **belly**, and with courtship behaviour to models with a silver **belly**.

In a third experiment, the following four models were used in turn:



The three diagrams below show possible reactions of a male stickleback to each of the above models.



Which one of these reactions would you predict for each of the four models?

Fill in either A, B or C as the result for each model.

	Reaction
Model 1	
Model 2	
Model 3	
Model 4	

STICKLEBACK BEHAVIOUR SCORING 3

Full credit

Code 2: All four correct: C, A, C, B, in that order.

Partial credit

Code 1: Three of the four entries correct.

No credit

Code 0: Other responses.

Code 9: Missing.

TOBACCO SMOKING

Tobacco is smoked in cigarettes, cigars and pipes. Research shows that tobacco-related diseases kill nearly 13 500 people worldwide every day. It is predicted that, by 2020, tobacco-related diseases will cause 12% of all deaths globally.

Tobacco smoke contains many harmful substances. The most damaging substances are tar, nicotine and carbon monoxide.

Question 1: TOBACCO SMOKING

S439Q01

Tobacco smoke is inhaled into the lungs. Tar from the smoke is deposited in the lungs and this prevents the lungs from working properly.

Which one of the following is a function of the lungs?

A To pump oxygenated blood to all parts of your body
B To transfer some of the oxygen that you breathe to your blood
C To purify your blood by reducing the carbon dioxide content to zero
D To convert carbon dioxide molecules into oxygen molecules

TOBACCO SMOKING SCORING 1

Full credit

Code 1: B. To transfer oxygen from the air that you breathe to your blood

No credit

Code 0: Other responses.

Code 9: Missing.

Question 2: TOBACCO SMOKING

S439Q02

Tobacco smoking increases the risk of getting lung cancer and some other diseases.

Is the risk of getting the following diseases increased by tobacco smoking? Circle "Yes" or "No" in each case.

Is the risk of contracting this disease increased by smoking?	**Yes or No?**
Bronchitis	Yes / No
HIV/AIDS	Yes / No
Chicken pox	Yes / No

TOBACCO SMOKING SCORING 2

Full credit

Code 1: All three correct: Yes, No, No, in that order.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 5: TOBACCO SMOKING

S439Q05

Some people use nicotine patches to help them to give up smoking. The patches are put on skin and release nicotine into the blood. This helps to relieve cravings and withdrawal symptoms when people have stopped smoking.

To study the effectiveness of nicotine patches, a group of 100 smokers who want to give up smoking is chosen randomly. The group is to be studied for six months. The effectiveness of the nicotine patches is to be measured by finding out how many people in the group have not resumed smoking by the end of the study.

Which one of the following is the **best** experimental design?

A All the people in the group wear the patches.
B All wear patches except one person who tries to give up smoking without them.
C People choose whether or not they will use patches to help give up smoking.
D Half are randomly chosen to use patches and the other half do not use them.

TOBACCO SMOKING SCORING 5

Full credit

Code 1: D. Half are randomly chosen to use patches and the other half do not use them.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 6: TOBACCO SMOKING

S439Q06

Various methods are used to influence people to stop smoking.

Are the following ways of dealing with the problem based on **technology**? Circle "Yes" or "No" in each case.

Is this method of reducing smoking based on technology?	**Yes or No?**
Increase the cost of cigarettes.	Yes / No
Produce nicotine patches to help make people give up cigarettes.	Yes / No
Ban smoking in public areas.	Yes / No

TOBACCO SMOKING SCORING 6

Full credit

Code 1: All three correct: No, Yes, No, in that order.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 10N: TOBACCO SMOKING

S439Q10N

How much interest do you have in the following information?

Tick only one box in each row.

		High Interest	*Medium Interest*	*Low Interest*	*No Interest*
a)	Knowing how tar in tobacco reduces lung efficiency	☐ 1	☐ 2	☐ 3	☐ 4
b)	Understanding why nicotine is addictive	☐ 1	☐ 2	☐ 3	☐ 4
c)	Learning how the body recovers after stopping smoking	☐ 1	☐ 2	☐ 3	☐ 4

STARLIGHT

Toshio likes to look at stars. However, he cannot observe stars very well at night because he lives in a large city.

Last year Toshio visited the countryside where he observed a large number of stars that he cannot see when he is in the city.

Question 1: STARLIGHT

S441Q01

Why can many more stars be observed in the countryside than in large cities?

A The moon is brighter in cities and blocks out the light from many stars.
B There is more dust to reflect light in country air than in city air.
C The brightness of city lights makes many stars hard to see.
D The air is warmer in cities due to heat emitted by cars, machinery and houses.

STARLIGHT SCORING 1

Full credit

Code 1: C. The brightness of city lights makes many stars hard to see.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 2: STARLIGHT

S441Q02

Toshio uses a telescope with a large diameter lens in order to observe stars of low brightness.

Why does using a telescope with a large diameter lens make it possible to observe stars of low brightness?

A The larger the lens the more light is collected.
B The larger the lens the more it magnifies.
C Larger lenses allow more of the sky to be seen.
D Larger lenses can detect the dark colours in stars.

STARLIGHT SCORING 2

Full credit

Code 1: A. The larger the lens the more light is collected.

No credit

Code 0: Other responses.

Code 9: Missing.

SUNSCREENS

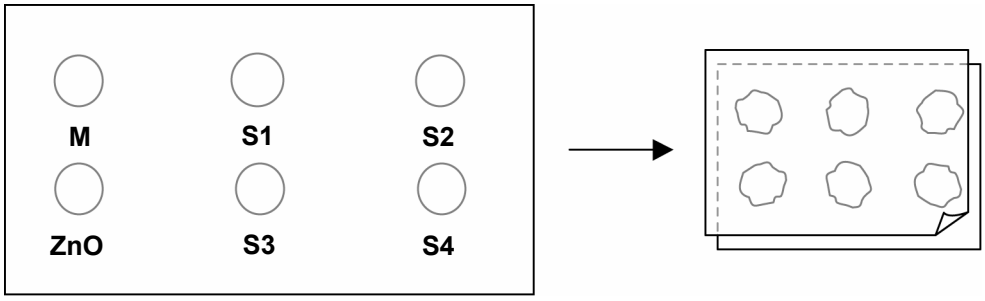
Mimi and Dean wondered which sunscreen product provides the best protection for their skin. Sunscreen products have a *Sun Protection Factor (SPF)* that shows how well each product absorbs the ultraviolet radiation component of sunlight. A high SPF sunscreen protects skin for longer than a low SPF sunscreen.

Mimi thought of a way to compare some different sunscreen products. She and Dean collected the following:

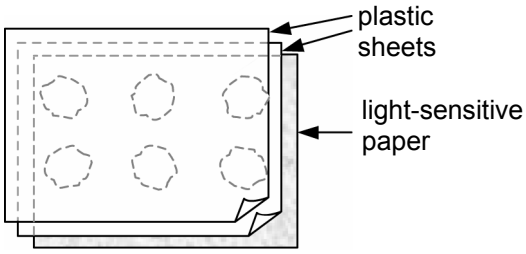
- two sheets of clear plastic that do not absorb sunlight;
- one sheet of light-sensitive paper;
- mineral oil (M) and a cream containing zinc oxide (ZnO); and
- four different sunscreens that they called S1, S2, S3, and S4.

Mimi and Dean included mineral oil because it lets most of the sunlight through, and zinc oxide because it almost completely blocks sunlight.

Dean placed a drop of each substance inside a circle marked on one sheet of plastic, then put the second plastic sheet over the top. He placed a large book on top of both sheets and pressed down.



Mimi then put the plastic sheets on top of the sheet of light-sensitive paper. Light-sensitive paper changes from dark grey to white (or very light grey), depending on how long it is exposed to sunlight. Finally, Dean placed the sheets in a sunny place.



Translation Note: If necessary, use the explicit translation "paper sensitive to light", for "light-sensitive" paper. Do not use "photo-sensitive paper" as the translation.

Question 2: SUNSCREENS

S447Q02

Which one of these statements is a scientific description of the role of the mineral oil and the zinc oxide in comparing the effectiveness of the sunscreens?

A Mineral oil and zinc oxide are both factors being tested.
B Mineral oil is a factor being tested and zinc oxide is a reference substance.
C Mineral oil is a reference substance and zinc oxide is a factor being tested.
D Mineral oil and zinc oxide are both reference substances.

SUNSCREENS SCORING 2

Full Credit

Code 1: D. Mineral oil and zinc oxide are both reference substances.

No Credit

Code 0: Other responses.

Code 9: Missing.

Question 3: SUNSCREENS

S447Q03

Which one of these questions were Mimi and Dean trying to answer?

A How does the protection for each sunscreen compare with the others?
B How do sunscreens protect your skin from ultraviolet radiation?
C Is there any sunscreen that gives less protection than mineral oil?
D Is there any sunscreen that gives more protection than zinc oxide?

SUNSCREENS SCORING 3

Full credit

Code 1: A. How does the protection for each sunscreen compare with the others?

No credit

Code 0: Other responses.

Code 9: Missing.

Question 4: SUNSCREENS

S447Q04

Why was the second sheet of plastic pressed down?

A To stop the drops from drying out.
B To spread the drops out as far as possible.
C To keep the drops inside the marked circles.
D To make the drops the same thickness.

SUNSCREENS SCORING 4

Full Credit

Code 1: D. To make the drops the same thickness.

No Credit

Code 0: Other responses.

Code 9: Missing.

Question 5: SUNSCREENS

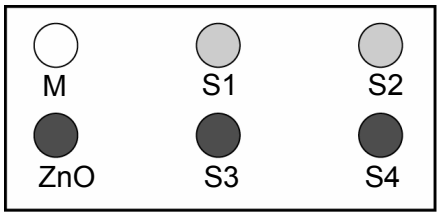
S447Q05 – 0 1 2 9

The light-sensitive paper is a dark grey and fades to a lighter grey when it is exposed to some sunlight, and to white when exposed to a lot of sunlight.

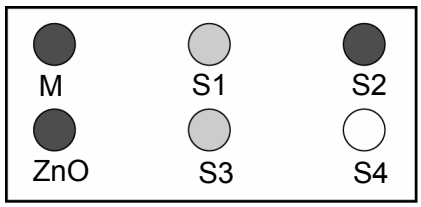
Translator's Note: The graphic used in the Field Trial MUST be replaced with the one below. Diagram C has been changed and the two grey shadings in all the diagrams have been modified so that they will be more distinct when printed.

Which one of these diagrams shows a pattern that might occur? Explain why you chose it.

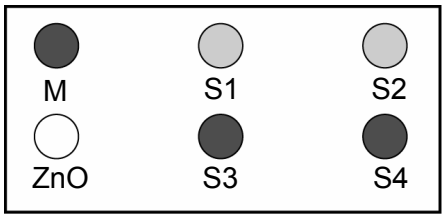
A



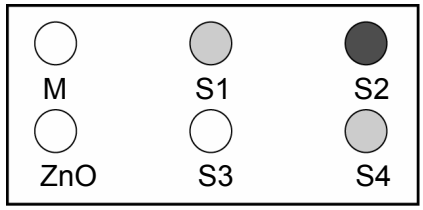
C



B



D



Answer: .....

Explanation: .....

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SUNSCREENS SCORING 5

Translator's Note: The layout of the scoring guide has been changed. It is no longer in table format.

Full Credit

Code 2: A. With explanation that the ZnO spot has stayed dark grey (because it blocks sunlight) **and** the M spot has gone white (because mineral oil absorbs very little sunlight).
*[It is **not** necessary (though it is sufficient) to include the further explanations that are shown in parentheses.]*
- A. ZnO has blocked the sunlight as it should and M has let it through.
- I chose A because the mineral oil needs to be the lightest shade while the zinc oxide is the darkest.

Partial Credit

Code 1: A. Gives a correct explanation for either the ZnO spot **or** the M spot, but **not** both.
- A. Mineral oil provides the lowest resistance against UVL. So with other substances the paper would not be white.
- A. Zinc oxide absorbs practically all rays and the diagram shows this.
- A because ZnO blocks the light and M absorbs it.

No Credit

Code 0: Other responses.
- A. *[No reason given.]*
- B. ZnO blocks the sunlight and mineral oil lets it through.

Code 9: Missing.

ULTRASOUND

In many countries, images can be taken of a foetus (developing baby) by ultrasound imaging (echography). Ultrasounds are considered safe for both the mother and the foetus.

The doctor holds a probe and moves it across the mother's abdomen. Ultrasound waves are transmitted into the abdomen. Inside the abdomen they are reflected from the surface of the foetus. These reflected waves are picked up again by the probe and relayed to a machine that can produce an image.

Question 3: ULTRASOUND

S448Q03 – 0 1 9

To form an image the ultrasound machine needs to calculate the **distance** between the foetus and the probe.

The ultrasound waves move through the abdomen at a speed of 1540 m/s. What measurement must the machine make so that it can calculate the distance?

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ULTRASOUND SCORING 3

Full credit

Code 1: It must measure the time the ultrasound wave takes to travel from the probe to the surface of the foetus and reflect back.
- The time of travel of the wave.
- The time.
- Time. Distance = speed / time. *[Note: Although the formula is incorrect, the student has correctly identified "time" as the missing variable.]*
- It must find when the ultrasound finds the baby.

No credit

Code 0: Other responses.
- The distance.

Code 9: Missing.

Question 4: ULTRASOUND

S448Q04 – 0 1 9

An image of a foetus can also be obtained using X-rays. However, women are advised to avoid having X-rays of their abdomens during pregnancy.

Why should a woman avoid having her abdomen X-rayed during pregnancy **in particular**?

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ULTRASOUND SCORING 4

Full credit

Code 1: X-rays are harmful to the foetus.
- X-rays hurt the foetus.
- X-rays might cause a mutation in the foetus.
- X-rays can cause birth defects in the foetus.
- Because the baby could get some radiation.

No credit

Code 0: Other responses.
- X-rays do not give a clear picture of the foetus.
- X-rays emit radiation.
- The child can get Down syndrome.
- Radiation is harmful. *[Note: This is not enough. Potential harm to the foetus (baby) must be explicitly mentioned.]*
- They may make it harder for her to have another baby. *[Note: This is a reason for avoiding over-exposure to X-rays in general.]*

Code 9: Missing.

Question 5: ULTRASOUND

S448Q05

Can ultrasound examinations of expectant mothers provide answers to the following questions? Circle "Yes" or "No" for each question.

Can an ultrasound examination answer this question?	Yes or No?
Is there more than one baby?	Yes / No
What colour are the baby's eyes?	Yes / No
Is the baby about the right size?	Yes / No

ULTRASOUND SCORING 5

Full credit

Code 1: All three correct: Yes, No, Yes, in that order.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 10N: ULTRASOUND

S448Q10N

How much interest do you have in the following information?

Tick only one box in each row.

		High Interest	*Medium Interest*	*Low Interest*	*No Interest*
a)	Understanding how ultrasound can penetrate your body without harming it	☐ 1	☐ 2	☐ 3	☐ 4
b)	Learning more about the differences between X-rays and ultrasound	☐ 1	☐ 2	☐ 3	☐ 4
c)	Knowing about other medical uses of ultrasound	☐ 1	☐ 2	☐ 3	☐ 4

LIP GLOSS

The table below contains two different recipes for cosmetics you can make yourself.

The lipstick is harder than the lip gloss, which is soft and creamy.

Lip gloss	Lipstick
Ingredients: 5 g castor oil 0.2 g beeswax 0.2 g palm wax 1 teaspoon of colouring substance 1 drop of food flavouring	**Ingredients**: 5 g castor oil 1 g beeswax 1 g palm wax 1 teaspoon of colouring substance 1 drop of food flavouring
Instructions: Heat the oil and the waxes in a container placed in hot water until you have an even mixture. Then add the colouring substance and the flavouring, and mix them in.	**Instructions:** Heat the oil and the waxes in a container placed in hot water until you have an even mixture. Then add the colouring substance and the flavouring, and mix them in.

Question 1: LIP GLOSS

S470Q01 – 0 1 9

In making the lip gloss and lipstick, oil and waxes are mixed together. The colouring substance and flavouring are then added.

The lipstick made from this recipe is hard and not easy to use. How would you change the proportion of ingredients to make a softer lipstick?

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LIP GLOSS SCORING 1

Full credit

Code 1: Responses indicating that you would add less wax AND/OR add more oil.
- You could use a bit less beeswax and palm wax.
- Add more castor oil.
- Put in 7g of oil.

No credit

Code 0: Other responses.
- Heat the mixture for longer which will soften it.
- By not heating the waxes as much. *[Note: The question asks how you would change the proportion of ingredients.]*

Code 9: Missing.

Question 2: LIP GLOSS

S470Q02

Oils and waxes are substances that will mix well together. Oils cannot be mixed with water, and waxes are not soluble in water.

Which one of the following is most likely to happen if a lot of water is splashed into the lipstick mixture while it is being heated?

A A creamier and softer mixture is produced.
B The mixture becomes firmer.
C The mixture is hardly changed at all.
D Fatty lumps of the mixture float on the water.

LIP GLOSS SCORING 2

Full credit

Code 1: D. Fatty lumps of the mixture float on the water.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 3: LIP GLOSS

S470Q03

When substances called emulsifiers are added, they allow oils and waxes to mix well with water.

Why does soap and water remove lipstick?

A Water contains an emulsifier that allows the soap and lipstick to mix.
B The soap acts as an emulsifier and allows the water and lipstick to mix.
C Emulsifiers in the lipstick allow the soap and water to mix.
D The soap and lipstick combine to form an emulsifier that mixes with the water.

LIP GLOSS SCORING 3

Full credit

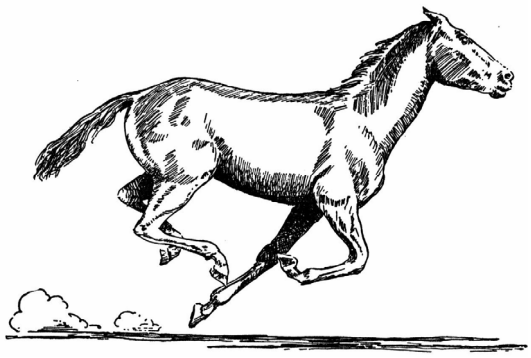
Code 1: B. The soap acts as an emulsifier and allows the water and lipstick to mix.

No credit

Code 0: Other responses.

Code 9: Missing.

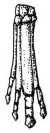
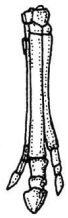
EVOLUTION



Most horses today are streamlined and can run fast.

Scientists have found the fossil skeletons of animals that are similar to horses. They consider them to be the ancestors of the present-day horse. The scientists have also been able to determine the period during which the fossil species were living.

The table below provides information on three of these fossils and on the present-day horse.

ANIMAL NAME:	HYRACOTHERIUM	MESOHIPPUS	MERYCHIPPUS	EQUUS (present-day horse)
Period of existence:	55 to 50 million years ago	39 to 31 million years ago	19 to 11 million years ago	2 million years ago to the present day
Skeleton of the leg (same scale):				

Question 1: EVOLUTION

S472Q01 – 0 1 9

What information **in the table** is strong evidence that present-day horses may have evolved over time from the other three animals?

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EVOLUTION SCORING 1

Full credit

Code 1: Responses that refer to gradual change (progression) in leg skeleton structure over time.
- The leg skeletons are much the same but have gradually changed.
- The digits/toes fused during the period 55 to 2 million years ago.
- The number of digits has decreased.

No credit

Code 0: Other responses.
- The leg has changed. *[Note: Not specific enough.]*
- They are called *Hippus*.
- Genetic mutations have caused the transformations. *[Note: Correct, but does not answer the question].*
- The leg bones are similar. *[Note: Need to mention or imply "gradual change".]*

Code 9: Missing.

Question 2: EVOLUTION

S472Q02

What further research can scientists undertake to find out how horses have evolved over time?

Circle "Yes" or "No" for each of these statements.

Would this research help find out how horses have evolved over time?	**Yes or No?**
Compare the number of horses living at different periods.	Yes / No
Search for skeletons belonging to ancestors of the horse that lived 50 to 40 million years ago.	Yes / No

EVOLUTION SCORING 2

Full credit

Code 1: Both correct: No, Yes, in that order.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 3: EVOLUTION

S472Q03

Which one of the following statements best applies to the scientific theory of evolution?

A The theory cannot be believed because it is not possible to see species changing.
B The theory of evolution is possible for animals but cannot be applied to humans.
C Evolution is a scientific theory that is currently based on extensive evidence.
D Evolution is a theory that has been proven to be true by scientific experiments.

EVOLUTION SCORING 3

Full credit

Code 1: C. Evolution is a scientific theory that is currently based on extensive evidence.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 10N: EVOLUTION

S472Q10N

How much interest do you have in the following information?

Tick only one box in each row.

		High Interest	*Medium Interest*	*Low Interest*	*No Interest*
a)	Knowing how fossils can be identified	☐ 1	☐ 2	☐ 3	☐ 4
b)	Learning more about the development of the theory of evolution	☐ 1	☐ 2	☐ 3	☐ 4
c)	Understanding better the evolution of the present-day horse	☐ 1	☐ 2	☐ 3	☐ 4

MARY MONTAGU

Read the following newspaper article and answer the questions that follow.

THE HISTORY OF VACCINATION

Mary Montagu was a beautiful woman. She survived an attack of smallpox in 1715 but she was left covered with scars. While living in Turkey in 1717, she observed a method called inoculation that was commonly used there. This treatment involved scratching a weak type of smallpox virus into the skin of healthy young people who then became sick, but in most cases only with a mild form of the disease.

Mary Montagu was so convinced of the safety of these inoculations that she allowed her son and daughter to be inoculated.

In 1796, Edward Jenner used inoculations of a related disease, cowpox, to produce antibodies against smallpox. Compared with the inoculation of smallpox, this treatment had less side effects and the treated person could not infect others. The treatment became known as vaccination.

Question 2: MARY MONTAGU

S477Q02

What kinds of diseases can people be vaccinated against?

A Inherited diseases like haemophilia.
B Diseases that are caused by viruses, like polio.
C Diseases from the malfunctioning of the body, like diabetes.
D Any sort of disease that has no cure.

MARY MONTAGU SCORING 2

Full Credit

Code 1: B. Diseases that are caused by viruses, like polio.

No Credit

Code 0: Other responses.

Code 9: Missing.

Question 3: MARY MONTAGU

S477Q03

If animals or humans become sick with an infectious bacterial disease and then recover, the type of bacteria that caused the disease does not usually make them sick again.

What is the reason for this?

A The body has killed all bacteria that may cause the same kind of disease.
B The body has made antibodies that kill this type of bacteria before they multiply.
C The red blood cells kill all bacteria that may cause the same kind of disease.
D The red blood cells capture and get rid of this type of bacteria from the body.

MARY MONTAGU SCORING 3

Full Credit

Code 1: B. The body has made antibodies that kill this type of bacteria before they multiply.

No Credit

Code 0: Other responses.

Code 9: Missing.

Question 4: MARY MONTAGU

S477Q04 – 0 1 9

Give one reason why it is recommended that young children and old people, in particular, should be vaccinated against influenza (flu).

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MARY MONTAGU SCORING 4

Full Credit

Code 1: Responses referring to young and/or old people having weaker immune systems than other people, or similar.

Scoring Comment: The reason(s) given must refer to young or old people *in particular* – not to everyone in general. Also, the response must indicate, directly or indirectly, that these people have weaker immune systems than other people– not just that they are generally "weaker".

- These people have less resistance to getting sick.
- The young and old can't fight off disease as easily as others.
- They are more likely to catch the flu.
- If they get the flu the effects are worse in these people.
- Because organisms of young children and older people are weaker.
- Old people get sick more easily.

No Credit

Code 0: Other responses.
- So they don't get the flu.
- They are weaker.
- They need help to fight the flu.

Code 9: Missing.

Question 10S: MARY MONTAGU

S477Q10S

How much do you agree with the following statements?

Tick only one box in each row.

		Strongly Agree	*Agree*	*Disagree*	*Strongly Disagree*
a)	I am in favour of research to develop vaccines for new strains of influenza.	☐ 1	☐ 2	☐ 3	☐ 4
b)	The cause of a disease can only be identified by scientific research.	☐ 1	☐ 2	☐ 3	☐ 4
c)	The effectiveness of unconventional treatments for diseases should be subject to scientific investigation.	☐ 1	☐ 2	☐ 3	☐ 4

ACID RAIN

Below is a photo of statues called Caryatids that were built on the Acropolis in Athens more than 2500 years ago. The statues are made of a type of rock called marble. Marble is composed of calcium carbonate.

Translator's Note: For the Main Study, the photo should be placed *after* the next paragraph, *not* before it as in the Field Trial.

In 1980, the original statues were transferred inside the museum of the Acropolis and were replaced by replicas. The original statues were being eaten away by acid rain.

Question 2: ACID RAIN

S485Q02 – 0 1 9

Normal rain is slightly acidic because it has absorbed some carbon dioxide from the air. Acid rain is more acidic than normal rain because it has absorbed gases like sulfur oxides and nitrogen oxides as well.

Where do these sulfur oxides and nitrogen oxides in the air come from?

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Translator's Note: The names "sulfur oxides" and "nitrogen oxides" refer to the family of oxides made with sulfur and nitrogen - not to any one oxide in particular.

ACID RAIN SCORING 2

Full Credit

Code 1: Any one of car exhausts, factory emissions, *burning* fossil fuels such as oil and coal, gases from volcanoes or other similar things.
- Burning coal and gas.
- Oxides in the air come from pollution from factories and industries.
- Volcanoes.
- Fumes from power plants. *["Power plants" is taken to include power plants that burn fossil fuels.]*
- They come from the burning of materials that contain sulfur and nitrogen.

Responses that include an incorrect as well as a correct source of the pollution.
- Fossil fuel and nuclear power plants. *[Nuclear power plants are not a source of acid rain.]*
- The oxides come from the ozone, atmosphere and meteors coming toward Earth. Also the burning of fossil fuels.

Responses that refer to "pollution" but do not give a source of pollution that is a significant cause of acid rain.
- Pollution.
- The environment in general, the atmosphere we live in – e.g., pollution.
- Gasification, pollution, fires, cigarettes. *[It is not clear what is meant by "gasification"; "fires" is not specific enough; cigarette smoke is not a significant cause of acid rain.]*
- Pollution such as from nuclear power plants.

Scoring Comment: Just mentioning "pollution" is sufficient for Code 1.

No Credit

Code 0: Other responses, including responses that do not mention "pollution" *and* do not give a significant cause of acid rain.
- They are emitted from plastics.
- They are natural components of air.
- Cigarettes.
- Coal and oil. *[Not specific enough – no reference to "burning".]*
- Nuclear power plants.
- Industrial waste. *[Not specific enough.]*

Code 9: Missing.

The effect of acid rain on marble can be modelled by placing chips of marble in vinegar overnight. Vinegar and acid rain have about the same acidity level. When a marble chip is placed in vinegar, bubbles of gas form. The mass of the dry marble chip can be found before and after the experiment.

Question 3: ACID RAIN

S485Q03

A marble chip has a mass of 2.0 grams before being immersed in vinegar overnight. The chip is removed and dried the next day. What will the mass of the dried marble chip be?

A Less than 2.0 grams
B Exactly 2.0 grams
C Between 2.0 and 2.4 grams
D More than 2.4 grams

ACID RAIN SCORING 3

Full Credit

Code 1: A. Less than 2.0 grams

No Credit

Code 0: Other responses.

Code 9: Missing.

Question 5: ACID RAIN

S485Q05 – 0 1 2 9

Students who did this experiment also placed marble chips in pure (distilled) water overnight.

Explain why the students included this step in their experiment.

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ACID RAIN SCORING 5

Full Credit

Code 2: To show that the acid (vinegar) is necessary for the reaction.
- To make sure that rainwater must be acidic like acid rain to cause this reaction.
- To see whether there are other reasons for the holes in the marble chips.
- Because it shows that the marble chips don't just react with any fluid since water is neutral.

Partial Credit

Code 1: To compare with the test of vinegar and marble, but it is not made clear

that this is being done to show that the acid (vinegar) is necessary for the reaction.

- To compare with the other test tube.
- To see whether the marble chip changes in pure water.
- The students included this step to show what happens when it rains normally on the marble.
- Because distilled water is not acid.
- To act as a control.
- To see the difference between normal water and acidic water (vinegar).

No Credit

Code 0: Other responses.

- To show the distilled water wasn't an acid.

Code 9: Missing.

Question 10N: ACID RAIN *S485Q10N*

How much interest do you have in the following information?

Tick only one box in each row.

		High Interest	*Medium Interest*	*Low Interest*	*No Interest*
a)	Knowing which human activities contribute most to acid rain	☐ 1	☐ 2	☐ 3	☐ 4
b)	Learning about technologies that minimise the emission of gases that cause acid rain	☐ 1	☐ 2	☐ 3	☐ 4
c)	Understanding the methods used to repair buildings damaged by acid rain	☐ 1	☐ 2	☐ 3	☐ 4

Question 10S: ACID RAIN *S485Q10S*

How much do you agree with the following statements?

Tick only one box in each row.

		Strongly Agree	*Agree*	*Disagree*	*Strongly Disagree*
a)	Preservation of ancient ruins should be based on scientific evidence concerning the causes of damage.	☐ 1	☐ 2	☐ 3	☐ 4
b)	Statements about the causes of acid rain should be based on scientific research.	☐ 1	☐ 2	☐ 3	☐ 4

PHYSICAL EXERCISE

Regular but moderate physical exercise is good for our health.

Translator's Note: Field Trial graphic has been enhanced. It MUST be replaced with the above graphic.

Question 1: PHYSICAL EXERCISE

S493Q01

What are the advantages of regular physical exercise? Circle "Yes" or "No" for each statement.

Is this an advantage of regular physical exercise?	**Yes or No?**
Physical exercise helps prevent heart and circulation illnesses.	Yes / No
Physical exercise leads to a healthy diet.	Yes / No
Physical exercise helps to avoid becoming overweight.	Yes / No

PHYSICAL EXERCISE SCORING 1

Full Credit

Code 1: All three correct: Yes, No, Yes in that order.

No Credit

Code 0: Other responses.

Code 9: Missing.

Question 3: PHYSICAL EXERCISE

S493Q03

What happens when muscles are exercised? Circle “Yes” or “No” for each statement.

Does this happen when muscles are exercised?	Yes or No?
Muscles get an increased flow of blood.	Yes / No
Fats are formed in the muscles.	Yes / No

PHYSICAL EXERCISE SCORING 3

Full Credit

Code 1: Both correct: Yes, No in that order.

No Credit

Code 0: Other responses.

Code 9: Missing.

Question 5: PHYSICAL EXERCISE

S493Q05 – 01 11 12 99

Why do you have to breathe more heavily when you're doing physical exercise than when your body is resting?

.....

.....

.....

PHYSICAL EXERCISE SCORING 5

Full Credit

Code 11: To remove *increased* levels of carbon dioxide **and** to supply *more* oxygen to your body. *[Do not accept "air" instead of "carbon dioxide" or "oxygen".]*
- When you exercise your body needs more oxygen and produces more carbon dioxide. Breathing does this.
- Breathing faster allows more oxygen into the blood and more carbon dioxide to be removed.

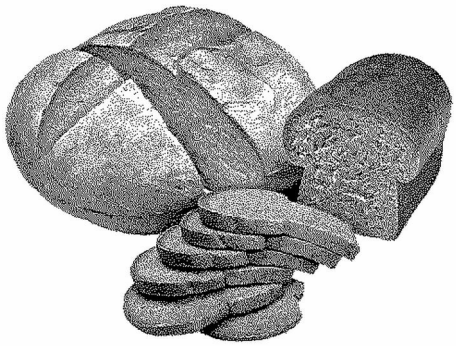
Code 12: To remove *increased* levels of carbon dioxide from your body **or** to supply *more* oxygen to your body, but not both. *[Do not accept "air" instead of "carbon dioxide" or "oxygen".]*
- Because we must get rid of the carbon dioxide that builds up.
- Because the muscles need oxygen. *[The implication is that your body needs more oxygen when you are exercising (using your muscles).]*
- Because physical exercise uses up oxygen.
- You breathe more heavily because you are taking more oxygen into your lungs. *[Poorly expressed, but recognises that you are supplied with more oxygen.]*
- Since you are using so much energy your body needs double or triple the amount of air intake. It also needs to remove the carbon dioxide in your body. *[Code 12 for the second sentence – the implication is that more carbon dioxide than usual has to be removed from your body; the first sentence is not contradictory, though by itself it would get Code 01.]*

No Credit

Code 01: Other responses.
- To get more air in your lungs.
- Because muscles consume more energy. *[Not specific enough.]*
- Because your heart beats faster.
- Your body needs oxygen. *[Does not refer to the need for more oxygen.]*

Code 99: Missing.

BREAD DOUGH



To make bread dough, a cook mixes flour, water, salt and yeast. After mixing, the dough is placed in a container for several hours to allow the process of fermentation to take place. During fermentation, a chemical change occurs in the dough: the yeast (a single-celled fungus) helps to transform the starch and sugars in the flour into carbon dioxide and alcohol.

Question 1: BREAD DOUGH

S505Q01

Fermentation causes the dough to rise. Why does the dough rise?

A The dough rises because alcohol is produced and turns into a gas.
B The dough rises because of single-celled fungi reproducing in it.
C The dough rises because a gas, carbon dioxide, is produced.
D The dough rises because fermentation turns water into a vapour.

BREAD DOUGH SCORING 1

Full credit

Code 1: C. The dough rises because a gas, carbon dioxide, is produced.

No credit

Code 0: Other responses.

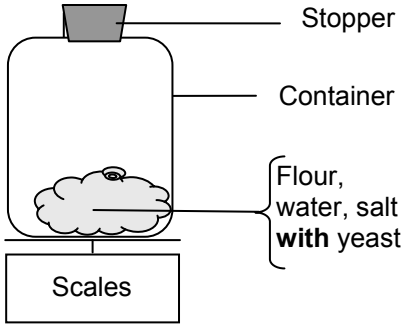
Code 9: Missing.

Question 2: BREAD DOUGH

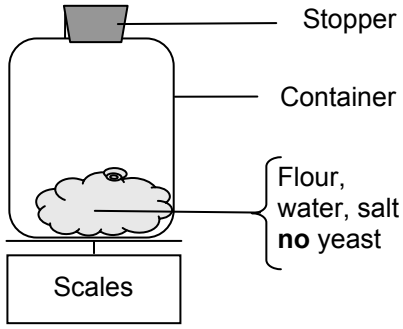
S505Q02

A few hours after mixing the dough, the cook weighs the dough and observes that its weight has decreased.

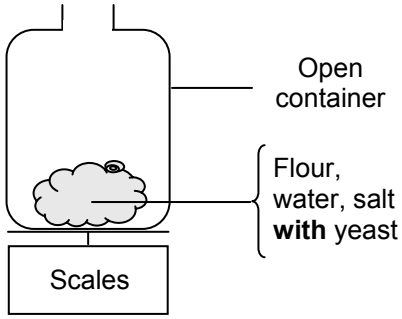
The weight of the dough is the same at the start of each of the four experiments shown below. Which **two** experiments should the cook compare to test if the **yeast** is the cause of the loss of weight?



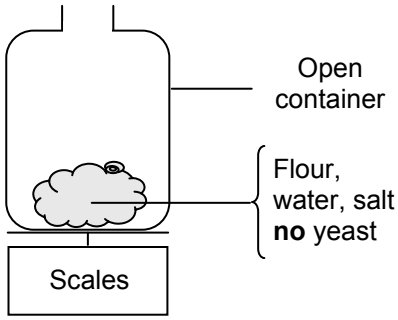
Experiment 1



Experiment 2



Experiment 3



Experiment 4

A The cook should compare experiments 1 and 2.
B The cook should compare experiments 1 and 3.
C The cook should compare experiments 2 and 4.
D The cook should compare experiments 3 and 4.

BREAD DOUGH SCORING 2

Full credit

Code 1: D. The cook should compare experiments 3 and 4.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 3: BREAD DOUGH

S505Q03

In the dough, yeast helps to transform starch and sugars in the flour. A chemical reaction occurs during which carbon dioxide and alcohol form.

Where do the **carbon atoms** that are present in carbon dioxide and alcohol come from? Circle "Yes" or "No" for each of the following possible explanations.

Is this a correct explanation of where the carbon atoms come from?	**Yes or No?**
Some carbon atoms come from the sugars.	Yes / No
Some carbon atoms are part of the salt molecules.	Yes / No
Some carbon atoms come from the water.	Yes / No

BREAD DOUGH SCORING 3

Full credit

Code 1: All three correct: Yes, No, No, in that order.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 4: BREAD DOUGH

S505Q04

When the risen (leavened) dough is placed in the oven to bake, pockets of gas and vapours in the dough expand.

Why do the gas and vapours expand when heated?

A Their molecules get bigger.
B Their molecules move faster.
C Their molecules increase in number.
D Their molecules collide less frequently.

BREAD DOUGH SCORING 4

Full credit

Code 1: B. Their molecules move faster.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 10S: BREAD DOUGH

S505Q10S

How much do you agree with the following statements?

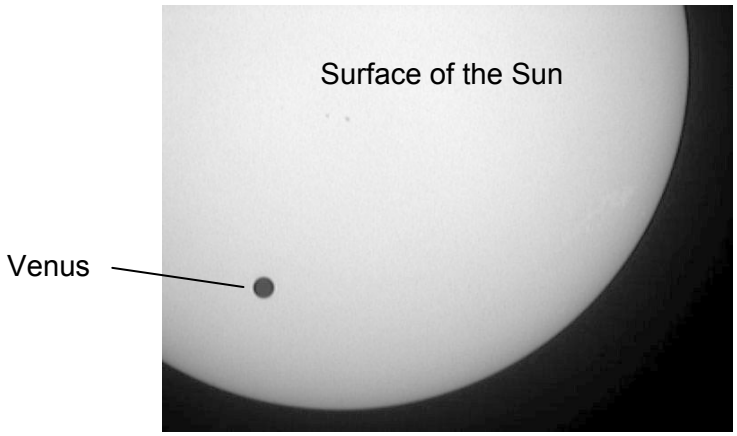
Tick only one box in each row.

		Strongly Agree	*Agree*	*Disagree*	*Strongly Disagree*
a)	I would trust a scientific report more than a baker's explanation of the weight loss in dough.	☐ 1	☐ 2	☐ 3	☐ 4
b)	Chemical analysis is the best way to identify the products of fermentation.	☐ 1	☐ 2	☐ 3	☐ 4
c)	Research into the changes that occur when food is prepared is important.	☐ 1	☐ 2	☐ 3	☐ 4

TRANSIT OF VENUS

On 8 June 2004, the planet Venus could be seen passing in front of the Sun when viewed from many places on Earth. This is called a “transit” of Venus and happens when its orbit takes Venus between the Sun and Earth. The previous transit of Venus occurred in 1882 and another is predicted to occur in 2012.

Below is a picture of the transit of Venus in 2004. A telescope was pointed at the Sun and the image projected onto a white card.



Question 1: TRANSIT OF VENUS

S507Q01

Why was the transit observed by projecting the image onto a white card, rather than by looking directly through the telescope?

A The Sun’s light was too bright for Venus to show up.
B The Sun is big enough to see without magnification.
C Viewing the Sun through a telescope may damage your eyes.
D The image needed to be made smaller by projecting it onto a card.

TRANSIT OF VENUS SCORING 1

Full credit

Code 1: C. Viewing the Sun through a telescope may damage your eyes.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 2: TRANSIT OF VENUS

S507Q02

When viewed from Earth, which one of the following planets can be seen in transit across the face of the Sun at certain times?

A Mercury
B Mars
C Jupiter
D Saturn

TRANSIT OF VENUS SCORING 2

Full credit

Code 1: A. Mercury

No credit

Code 0: Other responses.

Code 9: Missing.

Question 4: TRANSIT OF VENUS

S507Q04 – 0 1 9

Several words have been underlined in the following statement.

Astronomers predict that, as seen from Neptune, there will be a transit of Saturn across the Sun's face later this century.

Which **three** of the underlined words would be most useful in an internet or library search to find out when this transit might occur?

.....

.....

.....

TRANSIT OF VENUS SCORING 4

Full credit

Code 1: Responses referring to transit/Saturn/Neptune only.
- Saturn/Neptune/transit.

No credit

Code 0: Other responses such as those that include 4 words.
- transit/Saturn/Sun/Neptune.
- Astronomers/transit/Saturn/Neptune.

Code 9: Missing.

GENETICALLY MODIFIED CROPS

GM CORN SHOULD BE BANNED

Wildlife conservation groups are demanding that a new genetically modified (GM) corn be banned.

This GM corn is designed to be unaffected by a powerful new herbicide that kills conventional corn plants. This new herbicide will kill most of the weeds that grow in cornfields.

The conservationists say that because these weeds are feed for small animals, especially insects, the use of the new herbicide with the GM corn will be bad for the environment. Supporters of the use of the GM corn say that a scientific study has shown that this will not happen.

Here are details of the scientific study mentioned in the above article:

- Corn was planted in 200 fields across the country.
- Each field was divided into two. The genetically modified (GM) corn treated with the powerful new herbicide was grown in one half, and the conventional corn treated with a conventional herbicide was grown in the other half.
- The number of insects found in the GM corn, treated with the new herbicide, was about the same as the number of insects in the conventional corn, treated with the conventional herbicide.

Translator's Note: Corn is *Zea mays* and is referred to as maize in some countries.

Question 2: GENETICALLY MODIFIED CROPS

S508Q02

What factors were deliberately varied in the scientific study mentioned in the article? Circle "Yes" or "No" for each of the following factors.

Was this factor deliberately varied in the study?	Yes or No?
The number of insects in the environment	Yes / No
The types of herbicide used	Yes / No

GENETICALLY MODIFIED CROPS SCORING 2

Full Credit

Code 1: Both correct: No, Yes in that order.

No Credit

Code 0: Other responses.

Code 9: Missing.

Question 3: GENETICALLY MODIFIED CROPS

S508Q03

Corn was planted in 200 fields across the country. Why did the scientists use more than one site?

A So that many farmers could try the new GM corn.
B To see how much GM corn they could grow.
C To cover as much land as possible with the GM crop.
D To include various growth conditions for corn.

GENETICALLY MODIFIED CROPS SCORING 3

Full Credit

Code 1: D. To include various growth conditions for corn.

No Credit

Code 0: Other responses.

Code 9: Missing.

Question 10N: GENETICALLY MODIFIED CROPS

S508Q10N

How much interest do you have in the following information?

Tick only one box in each row.

		High Interest	*Medium Interest*	*Low Interest*	*No Interest*
a)	Learning about the process by which plants are genetically modified	☐ 1	☐ 2	☐ 3	☐ 4
b)	Learning why some plants are not affected by herbicides	☐ 1	☐ 2	☐ 3	☐ 4
c)	Understanding better the difference between cross-breeding and genetic modification of plants	☐ 1	☐ 2	☐ 3	☐ 4

HEALTH RISK?

Imagine that you live near a large chemical factory that produces fertilisers for use in agriculture. In recent years there have been several cases of people in the area suffering from long-term breathing problems. Many local people believe that these symptoms are caused by the emission of toxic fumes from the nearby chemical fertiliser factory.

A public meeting was held to discuss the potential dangers of the chemical factory to the health of local residents. Scientists made the following statements at the meeting.

Statement by scientists working for the chemical company

"We have made a study of the toxicity of soil in the local area. We have found no evidence of toxic chemicals in the samples we have taken."

Statement by scientists working for concerned citizens in the local community

"We have looked at the number of cases of long-term breathing problems in the local area and compared this with the number of cases in an area far away from the chemical factory. There are more incidents in the area close to the chemical factory."

Question 1: HEALTH RISK?

S515Q01 – 0 1 9

The owner of the chemical factory used the statement of the scientists working for the company to argue that "the emission fumes from the factory are not a health risk to local residents".

Give one reason, other than the statement by scientists working for the concerned citizens, for **doubting** that the statement by scientists working for the company supports the owner's argument.

.....

.....

HEALTH RISK? SCORING 1

Full credit

Code 1: An appropriate reason is given for doubting that the statement supports the owner's argument.

- The substance causing the breathing problems may not have been recognised as toxic.
- Breathing problems may have been caused only when chemicals were in the air, not in the soil.
- Toxic substances may change/break down with time and show up as non-toxic substances in soil.
- We do not know if the samples are representative of the area.
- Because the scientists are being paid by the company.
- The scientists feared losing their jobs.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 3: HEALTH RISK?

S515Q03 – 0 1 9

The scientists working for the concerned citizens compared the number of people with long-term breathing problems close to the chemical factory with those in an area far away from the factory.

Describe one possible difference in the two areas that would make you think that the comparison was not a valid one.

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.....

.....

HEALTH RISK? SCORING 3

Full credit

Code 1: Responses should focus on possible relevant differences between the areas investigated.
- The number of people in the two areas might be different.
- One area could have better medical services than the other.
- There could be different proportions of elderly people in each area.
- There might be other air pollutants in the other area.

No credit

Code 0: Other responses.
- The differences between the areas might be big.

Code 9: Missing.

Question 10N: HEALTH RISK?

S515Q10N

How much interest do you have in the following information?

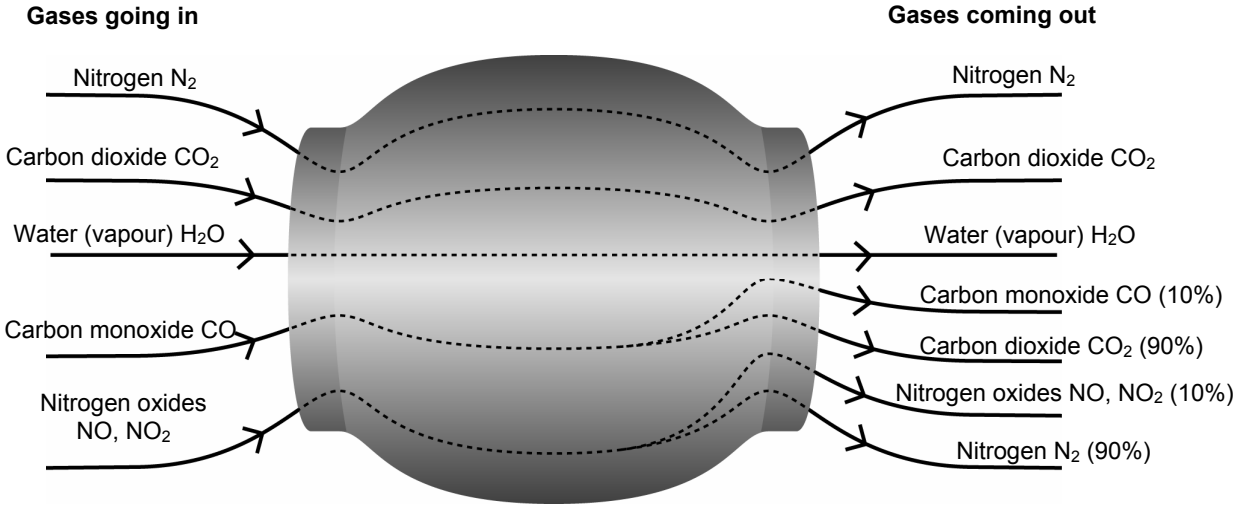
Tick only one box in each row.

		High Interest	*Medium Interest*	*Low Interest*	*No Interest*
a)	Knowing more about the chemical composition of agricultural fertilisers	☐ 1	☐ 2	☐ 3	☐ 4
b)	Understanding what happens to toxic fumes emitted into the atmosphere	☐ 1	☐ 2	☐ 3	☐ 4
c)	Learning about respiratory diseases that can be caused by chemical emissions	☐ 1	☐ 2	☐ 3	☐ 4

CATALYTIC CONVERTER

Most modern cars are fitted with a catalytic converter that makes the exhaust fumes of the car less harmful to people and to the environment.

About 90% of harmful gases are converted into less harmful ones. Here are some of the gases that go into the converter and how they come out of it.



Catalytic converter

Question 1: CATALYTIC CONVERTER

S516Q01 – 0 1 9

Use the information in the diagram above to give **an example** of how the catalytic converter makes exhaust fumes less harmful.

.....

.....

CATALYTIC CONVERTER SCORING 1

Full credit

Code 1: The conversion of carbon monoxide, or nitrogen oxides, to other compounds is mentioned.
- Carbon monoxide is changed into carbon dioxide.
- Nitrogen oxides are changed into nitrogen.
- It changes harmful fumes into non-harmful fumes. E.g., CO into CO_2 (90%).
- Carbon dioxide and nitrogen are not as harmful as carbon monoxide and nitrogen oxides.

No credit

Code 0: Other responses.
- The gases become less harmful.
- It purifies the carbon monoxide and nitrogen oxides. *[Note: Not specific enough.]*

Code 9: Missing.

Question 2: CATALYTIC CONVERTER

S516Q02 – 0 1 2 9

Changes take place to gases inside the catalytic converter. Explain what is happening in terms of **atoms** AND **molecules**.

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CATALYTIC CONVERTER SCORING 2

Full credit

Code 2: Expresses the essential idea that atoms are rearranged to form different molecules, using **both** of these words.
- Molecules break up and atoms are re-combined to form different molecules.
- Atoms rearrange to make different molecules.

Partial credit

Code 1: Expresses the essential idea of rearrangement, but does not refer to both atoms and molecules OR does not distinguish sufficiently between the roles of atoms and molecules.
- Atoms rearrange to make different substances.
- Molecules are changing into other molecules.
- Atoms and molecules are combining and separating to make less harmful gases. *[Note: The different roles of atoms and molecules are not sufficiently distinguished.]*
- $2(NO_2) = N_2 + 2O_2$.

No credit

Code 0: Other responses, including those that state no more than is given in the stimulus.
- Carbon dioxide is changed into carbon monoxide.
- The molecules are being broken down into smaller atoms. *[Note: No indication that atoms are rearranged.]*

Code 9: Missing.

Question 4: CATALYTIC CONVERTER

S516Q04 – 0 1 9

Examine the gases emitted by the catalytic converter. What is one problem that engineers and scientists working on the catalytic converter should try to solve to produce less harmful exhaust fumes?

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CATALYTIC CONVERTER SCORING 4

Full credit

Code 1: Acceptable responses should relate to achieving a reduction in harmful gases entering the atmosphere.
- Not all the carbon monoxide is converted into carbon dioxide.
- Not enough conversion of nitrogen oxides to nitrogen is taking place.
- Improve the percentage of carbon monoxide being converted to carbon dioxide and the percentage of nitrogen oxides being converted to nitrogen.
- The carbon dioxide produced should be captured and not allowed to escape into the atmosphere.

No credit

Code 0: Other responses.
- More complete conversion of the harmful gases to less harmful ones. *[At least one of the harmful exhaust gases must be identified.]*
- They need to try and have less fumes coming out.
- They should find a way to re-use harmful exhaust gases.
- They should try and make a vehicle that runs on a different liquid fuel.

Code 9: Missing.

Question 10N: CATALYTIC CONVERTER

S516Q10N

How much interest do you have in the following information?

Tick only one box in each row.

	High Interest	*Medium Interest*	*Low Interest*	*No Interest*
a) Knowing how car fuels differ in the amounts of toxic fumes they produce	☐ 1	☐ 2	☐ 3	☐ 4
b) Understanding more about what happens inside a catalytic converter	☐ 1	☐ 2	☐ 3	☐ 4
c) Learning about vehicles that do not emit toxic exhaust fumes	☐ 1	☐ 2	☐ 3	☐ 4

MAJOR SURGERY

Major surgery, performed in specially equipped operating theatres, is necessary to treat many diseases.

Question 1: MAJOR SURGERY

S526Q01

While undergoing major surgery, patients are anaesthetised so they don't feel any pain. The anaesthetic is often administered as a gas through a face mask that covers the nose and mouth.

Are the following human systems involved in the action of anaesthetic gases? Circle "Yes" or "No" for each system.

Is this system involved in the action of anaesthetic gases?	**Yes or No?**
Digestive system	Yes / No
Nervous system	Yes / No
Respiratory system	Yes / No

MAJOR SURGERY SCORING 1

Full credit

Code 1: All three correct: No, Yes, Yes, in that order.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 2: MAJOR SURGERY

S526Q02 – 01 11 12 21 99

Explain why surgical instruments used in operating theatres are sterilised.

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MAJOR SURGERY SCORING 2

Full credit

Code 21: Student mentions both the need to ensure that there are no bacteria/germs on the instruments AND that this stops the spread of disease.
- To stop bacteria getting in the body and infecting the patient.
- So that no germs get into the body of another person going in for major surgery.

Partial credit

Code 12: Student mentions the need to ensure that there are no bacteria, BUT not that this stops the spread of disease.
- To kill the germs on them.

Code 11: Student mentions that this stops the spread of disease, BUT not that it is because any bacteria on the instruments are killed.
- So the patient is not infected.
- To prevent any transfer of disease.

No credit

Code 01: Other responses
- To keep them clean.
- Because patients are vulnerable during surgery.

Code 99: Missing.

Question 3: MAJOR SURGERY

S526Q03

Patients may be unable to eat and drink after surgery and so they are put on a drip (infusion) that contains water, sugars and mineral salts. Sometimes antibiotics and tranquillisers are also added to the drip.

Why are the sugars that are added to the drip important for the post-operative patient?

A To avoid dehydration
B To control post-operative pain
C To cure post-operative infections
D To provide necessary nutrition

MAJOR SURGERY SCORING 3

Full credit

Code 1: D. To provide necessary nutrition

No credit

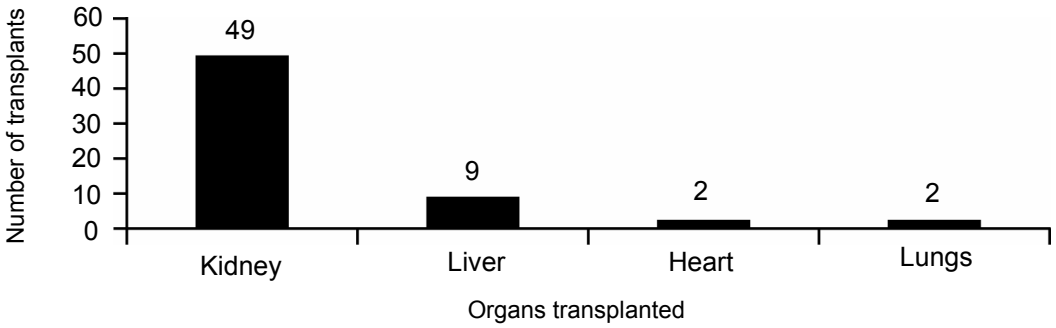
Code 0: Other responses.

Code 9: Missing.

Question 4: MAJOR SURGERY

S526Q04

Organ transplants involve major surgery and are becoming more and more common. In the graph below, the numbers of transplants carried out in a particular hospital during 2003 are given.



Can the following conclusions be drawn **from the graph above**? Circle "Yes" or "No" for each conclusion.

Can this conclusion be drawn from the graph?	**Yes or No?**
If the lungs are transplanted, the heart must be transplanted too.	Yes / No
Kidneys are the most important organs in the human body.	Yes / No
Most of the patients that have a transplant have suffered from a kidney disease.	Yes / No

MAJOR SURGERY SCORING 4

Full credit

Code 1: All three correct: No, No, Yes in that order.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 10N: MAJOR SURGERY

S526Q10N

How much interest do you have in the following information?

Tick only one box in each row.

		High Interest	*Medium Interest*	*Low Interest*	*No Interest*
a)	Learning how surgical instruments are sterilised	☐ 1	☐ 2	☐ 3	☐ 4
b)	Knowing about the different types of anaesthetics that are used	☐ 1	☐ 2	☐ 3	☐ 4
c)	Understanding how a patient's level of consciousness is monitored during surgery	☐ 1	☐ 2	☐ 3	☐ 4

WIND FARMS

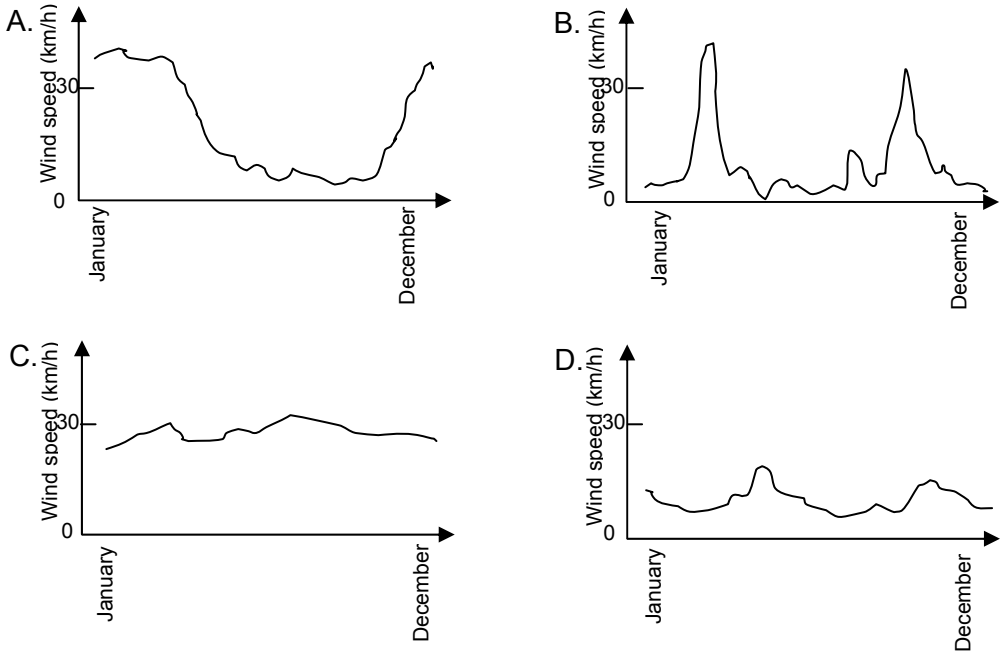
Many people believe that wind should replace oil and coal as a source of energy for producing electricity. The structures in the picture are windmills with blades that are rotated by the wind. These rotations cause electricity to be produced by generators that are turned by the windmills.

A wind farm

Question 1: WIND FARMS

S529Q01

The graphs below show the average wind speeds in four different places throughout a year. Which one of the graphs indicates the most appropriate place to establish a wind farm for generating electricity?



WIND FARMS SCORING 1

Full credit

Code 1: C

No credit

Code 0: Other responses.

Code 9: Missing.

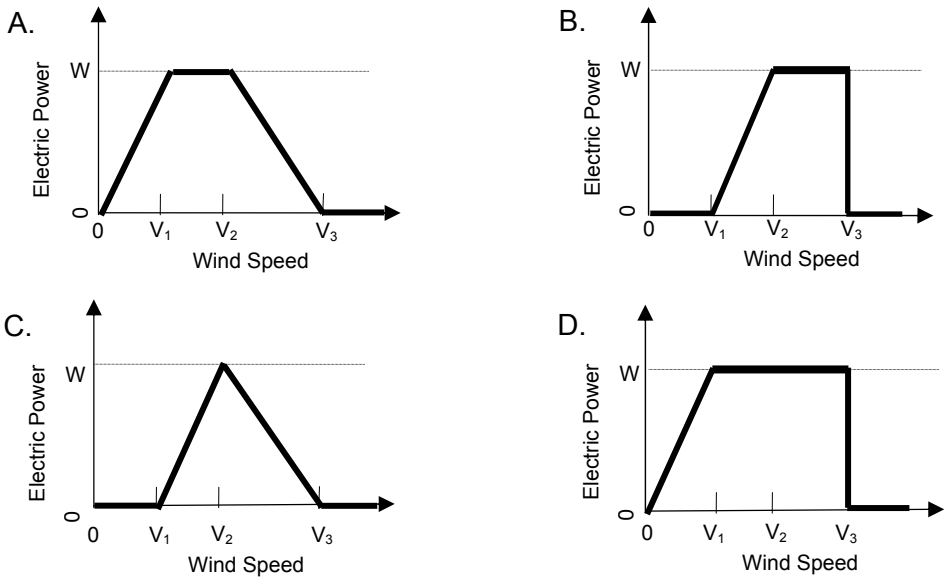
Question 2: WIND FARMS

S529Q02

The stronger the wind, the faster the windmill blades rotate and the greater the electric power output. However, there is not a direct relationship between wind speed and electric power in a real setting. Below are four working conditions of electricity generation in a real wind farm.

- The windmill blades start rotating when the wind speed reaches V_1.
- The electric power output reaches a maximum (W) when the wind speed is V_2.
- For safety reasons, the blades are prevented from rotating faster than they do when the wind speed is V_2.
- The blades stop rotating when the wind speed reaches V_3.

Which one of the following graphs best represents the relationship between wind speed and electric power output under these working conditions?



WIND FARMS SCORING 2

Full credit

Code 1: B

No credit

Code 0: Other responses

Code 9: Missing

Question 3: WIND FARMS

S529Q03

The higher the altitude the more slowly windmills rotate at the same wind speed.

Which one of the following is the best reason why the blades of windmills rotate more slowly in higher places at the same wind speed?

A The air is less dense as altitude increases.
B The temperature is lower as altitude increases.
C Gravity becomes less as altitude increases.
D It rains more often as altitude increases.

WIND FARMS SCORING 3

Full credit

Code 1: A. The air is less dense as altitude increases.

No credit

Code 0: Other responses

Code 9: Missing

Question 4: WIND FARMS

S529Q04 – 0 1 2 9

Describe one specific advantage, and one specific disadvantage, of using wind to generate electricity compared with using fossil fuels like coal and oil.

An advantage.....

.....

A disadvantage.....

.....

WIND FARMS SCORING 4

Full credit

Code 2: One **specific** advantage and one **specific** disadvantage are described.

Scoring Comment: It is possible for the cost of wind farms to be seen as an advantage or disadvantage depending on what aspect is considered (e.g., establishment costs or running costs). Hence, mentioning “the cost” involved, without further explanation, is not sufficient to gain credit as either an advantage or a disadvantage.

[Advantage]
- Do not discharge carbon dioxide (CO_2).
- Do not consume fossil fuels.

- The wind resource will not be used up.
- After the wind generator is established, the cost for electric generation is cheap.
- No waste and/or no toxic substance will be emitted.
- Using natural forces or clean energy.
- Environmentally friendly and will last for a very long time.

[Disadvantage]
- Generation on demand is not possible. *[Because the wind speed cannot be controlled.]*
- Good places for windmills are limited.
- The windmill could be damaged by too strong wind.
- The amount of power generated by each windmill is relatively small.
- Noise pollution occurs in some cases.
- Birds are sometimes killed when they crash into the rotors.
- Natural views are altered *[Visual pollution]*.
- Expensive to set up

Partial credit

Code 1: Either a correct advantage or a correct disadvantage is described (as shown in the full credit examples) but not both

No credit

Code 0: No correct advantage or correct disadvantage is described. Individual examples of unacceptable advantages or disadvantages are given below.
- Good for the environment or nature. *[This answer is a general value statement.]*
- Bad for the environment or nature
- It costs less to build a wind power generator than to build a fossil fuel power plant. *[This ignores the fact that a great number of wind power generators would be needed to produce the same amount of power as a fossil fuel power plant.]*
- It wouldn't cost as much.

Code 9: Missing.