

Programme for International Student Assessment

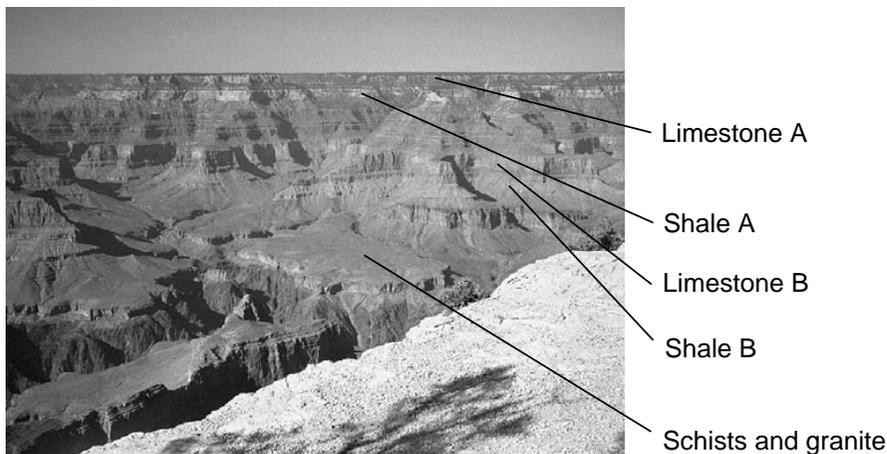


Sample Items
2006

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.

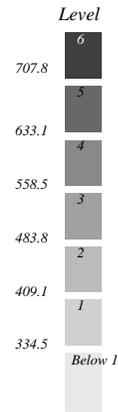
Can the following questions be answered by scientific investigation? Circle "Yes" or "No" for each question.

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: Both correct: Yes, No in that order.

Question type: Complex multiple choice
Competency: *Explaining phenomena scientifically*
Knowledge category: Scientific enquiry
Application area: Environment
Setting: *Social*
Difficulty: 485
Percentage of correct answers: 61.34%



Question 3: THE GRAND CANYON

S426Q03

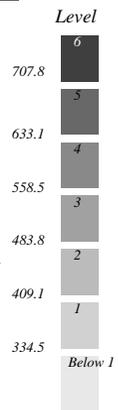
The temperature in the Grand Canyon ranges from below 0 °C to over 40 °C. Although it is a desert area, cracks in the rocks sometimes contain water. How do these temperature changes and the water in rock cracks help to speed up the breakdown of rocks?

- 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: D. Freezing water expands in the rock cracks.

Question type: Multiple choice
Competency: *Explaining phenomena scientifically*
Knowledge category: Earth and Space Systems (*Knowledge of science*)
Application area: Environment
Setting: *Social*
Difficulty: 451
Percentage of correct answers: 67.61%



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

Question type: Multiple choice

Competency: *Explaining phenomena scientifically*

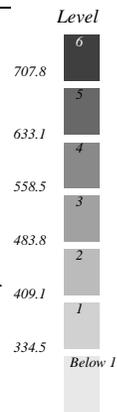
Knowledge category: Earth and Space Systems (*Knowledge of science*)

Application area: Natural Resources

Setting: *Social*

Difficulty: 411

Percentage of correct answers: 75.79%



Question 10S: THE GRAND CANYON

S426Q10S

How much do you agree with the following statements?

Tick only one box in each row.

	<i>Strongly Agree</i>	<i>Agree</i>	<i>Disagree</i>	<i>Strongly Disagree</i>
a) The systematic study of fossils is important.	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄
b) Action to protect National Parks from damage should be based on scientific evidence.	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄
c) Scientific investigation of geological layers is important.	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄

PHYSICAL EXERCISE

Regular but moderate physical exercise is good for our health.



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

Full Credit: All three correct: Yes, No, Yes in that order.

Question type: Complex multiple choice

Competency: *Explaining phenomena scientifically*

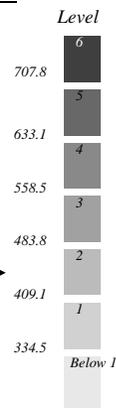
Knowledge category: Living Systems

Application area: “Health”

Setting: *Personal*

Difficulty: 545

Percentage of correct answers: 52.62%



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

Full Credit: Both correct: Yes, No in that order.

Question type: Complex multiple choice
Competency: *Explaining phenomena scientifically*
Knowledge category: Living Systems (*Knowledge of science*)
Application area: “Health”
Setting: *Personal*
Difficulty: 386
Percentage of correct answers: 82.40%



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?

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PHYSICAL EXERCISE SCORING 5

Full Credit:

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.

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.]

Question type: Open-constructed response

Competency: Explaining phenomena scientifically

Knowledge category: Living Systems (Knowledge of science)

Application area: “Health”

Setting: Personal

Difficulty: 583

Percentage of correct answers: 45.16 %



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.

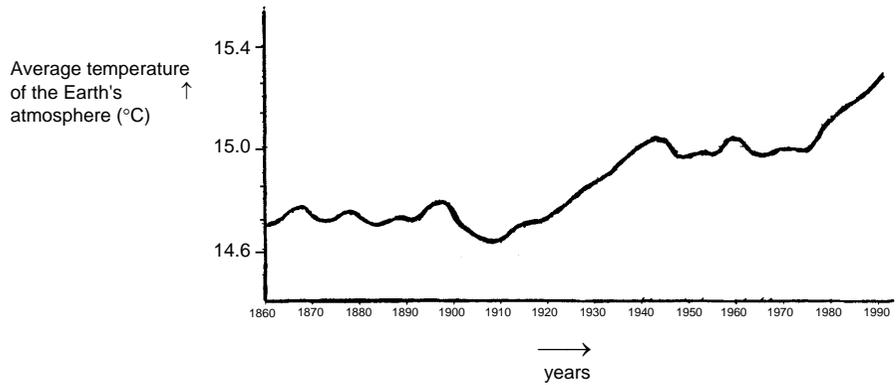
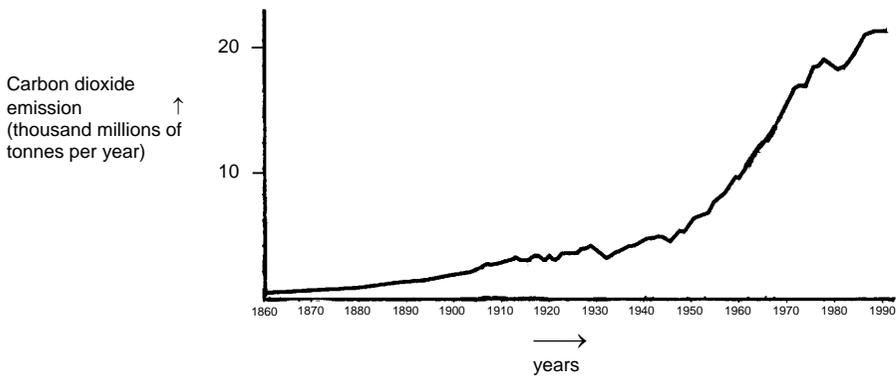
As a result of this the average temperature above the Earth's surface is higher than it would be if there were no atmosphere. The Earth's atmosphere has the same effect as a greenhouse, hence the term *greenhouse effect*.

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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Full Credit: 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 CO₂ is emitted.
- The information lines on the graphs rise together.
- Everything is increasing.
- The more CO₂ emission, the higher the temperature.

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.

Question type: Open-constructed response

Competency: *Using scientific evidence*

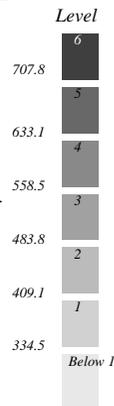
Knowledge category: “Scientific explanations” (*Knowledge about science*)

Application area: Environment

Setting: Global

Difficulty: 529

Percentage of correct answers: 53.95%



Question 4: GREENHOUSE

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: 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) CO₂ 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 CO₂ 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:

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.]

Question type: Open-constructed response

Competency: *Identifying scientific issues*

Knowledge category: "Scientific explanations" (*Knowledge about science*)

Application area: Environment

Setting: Global

Difficulty: Full credit 659; Partial credit 568

Percentage of correct answers: 34.49%



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

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”.*]

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.*]

Question type: Open-constructed response
Competency: *Explaining phenomena scientifically*
Knowledge category: “Earth and space systems” (*Knowledge of science*)
Application area: Environment
Setting: Global
Difficulty: 709
Percentage of correct answers: 18.91%





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Measuring Learning and Skills for the 21st Century