

ESSA 2008 Extended response task marking report

The ESSA 2008 test contained three extended response tasks:

- 1 Animal footprints
- 2 Behaviour of magnets
- 3 Earth and its moon.

The following examination reports were provided by the task leaders for marking.

TASK 1 – Examination report for ‘Animal footprints’

This task assessed students’ knowledge and understanding that animals have different adaptations that increase their chances of surviving in their environment.

Responses in cycle 1 of SOLO compared features of koalas and kangaroos or identified a reason for their different features. Many responses compared the footprints using vague terms such as ‘big’ or ‘wide’ but, since there is no scale provided, this comparison was unjustified. Most responses correctly identified some differences but many did not relate these differences to how the animals lived. At U_1 and M_1 , responses only included a list of observations.

Responses that related non-specific features to survival in the environment were deemed to be at first cycle relational level (R_1). For example:

The koala and kangaroo have different features because they live in different habitats. The koala lives in trees and the kangaroo lives on the ground.

Responses in cycle 2 of SOLO linked a specific physical feature with how it helps the animal to survive. For example:

The kangaroo has a long tail for balance.

A common shortfall in responses was the lack of a specific qualified feature linked to survival. For example:

A koala has feet to wrap around the branches and help it climb.

‘Feet to wrap’ is a non-specific feature.

Responses were also judged to be cycle 2 by the correct use of the term ‘adaptation’. Whilst some responses correctly identified feet (footprints) as adaptations, there was confusion about the process of ‘adapting’ with responses implying that the environment induces the adaptation in the animal. This showed a misconception about how animals develop their adaptations. It is strongly recommended that teachers use the terms ‘adapt’ and ‘adaptation’ precisely when addressing students.

A response at the relational level of cycle 2 (R_2) identified a specific adaptation related to how it helped the animal to survive, which was extended into a generalisation that differences in adaptations increase the chance of survival in a particular environment.

TASK 2 – Examination report for ‘Behaviour of magnets’

Most students described the behaviour of the magnets without successfully explaining it. Their responses were in cycle 1 of SOLO. While many responses demonstrated a sound understanding of the interaction of like and unlike poles, the behaviour of the magnets was described without using correct scientific language such as ‘attract’, ‘repel’ and ‘poles’.

A common misconception in cycle 1 responses was that magnets are charged and that the behaviour of magnets is caused by the interaction of positively and negatively charged particles. A number of responses stated that the ‘N’ symbol on the magnets referred to negative charge.

Another problem evident in cycle 1 responses was a limited ability to clearly generalise from experimental results. Responses frequently described the specific observations correctly but did not provide a generalisation or contained a jumbled or inaccurate generalisation.

Many responses did not refer to magnetic fields or explain the behaviour of the magnets in terms of the interaction of magnetic fields. Some responses demonstrated confusion about the difference between energy and force.

Only a small proportion of responses identified that gravitational force also affected the magnets; very few of these demonstrated understanding that gravitational and magnetic forces are balanced in Diagram B in this task.

Suggested teaching strategies

Students’ understanding of magnets and magnetic fields would be improved by ensuring that appropriate metalanguage and correct scientific terminology are used during teaching and when students produce written work and assessment tasks. By drawing terminology to students’ attention, they will be more likely to identify that their understandings conflict or are unclear and so be challenged to develop a more accurate and deeper understanding.

Care should be taken with the use of analogies (such as comparisons between charge and magnetism), as these can be a source of misconception. Science teachers who marked this task suggested that, in future, they will teach magnetism and electrostatics in different topics and different contexts so that the differences between them can be emphasised. They will also emphasise the differences between like charges and like poles.

Whatever the contexts in which these concepts are taught, it is important to ensure that students can apply their knowledge to new situations, through discussion and analysis of first-hand and secondary observations. For example, the concepts of magnetic and gravitational fields can be analysed in atypical or unconventional situations, such as in this task, where the magnets are arranged vertically instead of horizontally.

Providing students with the opportunity to investigate the behaviour of magnets by designing their own experiments in a range of situations could also assist students

in improving understanding of these concepts, especially if they are required to write explanations of their observations using scientific terminology.

Possible strategies to increase students' grasp of this concept include:

- mapping the field lines around pairs of bar and horseshoe magnets, using iron filings or compasses
- a Predict-Observe-Explain (POE) activity on magnet behaviour
- observing and explaining the interaction between charged rods and between poles of magnets, and comparing this to the interaction between a charged rod and a pole of a magnet
- observing the behaviour of circular magnets when placed over a wooden dowel
- teaching students about balanced and unbalanced forces and net forces
- providing students with opportunities to observe and discuss a variety of types of fields.

TASK 3 – Examination report for 'Earth and its moon'

The task required students to account for differences in temperature data from the surface of the Moon and Earth. The task was structured to encourage students to follow a typical linguistic pattern in science of describing data and phenomena to form generalisations, then accounting for that pattern with an explanation.

Most responses in cycle 1 of SOLO included simple comparisons of the data. However, fewer responses included the generalisation from the data that the Moon's temperature range was more extreme than Earth's.

Most responses in cycle 2 of SOLO identified Earth's atmosphere as a significant factor when accounting for the different ranges in temperatures on the Moon and Earth. Responses demonstrated considerable confusion about the role (and structure/composition) of the atmosphere and/or of greenhouse gases and the ozone layer. Very few responses explained the role of ozone in protecting Earth's surface from UV rays or explained the role of greenhouse gases in trapping heat.

Common misconceptions in responses

- The Moon is further from the Sun than Earth (which is why it is colder).
- The Moon has less atmosphere than Earth.
- The Moon is in the shadow of Earth.
- Gravity holds heat on Earth.
- 'Atmosphere', 'ozone' and 'greenhouse gases' are interchangeable words. They do not have different meanings or roles.

Many students appeared not to have the linguistic resources to provide coherent comparisons or generalisations. That is, their responses did not distinguish between conjunctions that show addition (such as 'and', 'also', 'as well') and conjunctions that show comparison (such as 'but' and 'however').

Many students stumbled over the analysis of data that contained negative (directed) numbers.