

Assessing the Understanding of NOS

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香港考試及評核局
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Curriculum Emphases

- Scientific Inquiry (SI)
- Science-Technology-Society-Environment Connections (STSE)
- Nature and History of Biology



Nature and History of Biology

- Be aware of the dynamic nature of biological knowledge and understand that science is a human endeavour;
- Recognise the contribution of various people to understanding and applying biology;
- Be aware of the biological knowledge and theories are developed through observations, hypotheses, experimentations and analyses; and
- Understand the nature and limitations of scientific activity.



How can we assess students' understanding on NOS?

- Based on a given context, questions are set to assess students' understanding about
 - the biological knowledge / concepts involved
 - the ideas about science demonstrated



Sample questions

- Modified from 2005 CE Bio Paper 1 Q3
- Modified from 2009 AL Bio Paper 1A Q6



Historical events about the discovery of the cause of gastric ulcer

- A People noted a relationship between gastric pain and mealtimes.
- B Some scientists suggested that gastric ulcer was caused by excessive acid secretion in the stomach. Doctors treated ulcer patients with antacids but many patients might develop gastric ulcer again after recovery.
- C Some scientists found the presence of bacteria in human stomach. However, most scientists thought that it was a contamination because they believed that bacteria could not survive in human stomach.
- D John Lykoudis successfully treated his own gastric ulcer with antibiotics. He presented his antibiotic treatment for gastric ulcer at a meeting in Greece and was largely shunned by the medical establishment.
- E Robin Warren observed a bacterium named *Helicobacter pylori* in the stomach of some ulcer patients. Barry Marshall met Warren and they put forward a new hypothesis about gastric ulcer. Based on this hypothesis, they successfully treated ulcer patients with antibiotics.
- F Groups around the world began isolating *H. pylori* and reproduced the study of Warren and Marshall. Warren and Marshall were awarded the Nobel Prize in Physiology or Medicine for their work.



Matching the events with the relevant ideas of NOS

Below are some statements about the nature of science. Select an event listed above to match with each of the following statements. Put the letter of the relevant event in the box provided for this matching. (3 marks)

Observations are theory laden.	
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People make an observation which needs an explanation.	
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Scientists are both collaborative and competitive by nature.	
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Testing Relevant biological knowledge

- (b) In the past, many scientists hold the idea that bacteria could not survive in human stomach. Why do they think so? (1 mark)
- (c) With reference to the treatment used by Marshall, what do you think is his hypothesis about gastric ulcer? (1 mark)
- (d) Suggest a method to test Marshall's hypothesis. What results would be obtained if his hypothesis is correct? (2 marks)



Historical developments in the knowledge of heredity

Year	Scientist(s)	Observation / Finding
1850s	Most scientists	Based on the observation that offspring resemble both parents, they believed that inheritance involved the blending of parental characteristics.
1865	Gregor Mendel	Mendel, an Austrian monk, carried out breeding experiments using pea plants with seven pairs of contrasting characters. He observed that all F_1 offspring were identical to one of the parents without blending and in the F_2 , both characters appeared in a ratio of approximately of 3:1. He worked out the pattern of inheritance mathematically and proposed postulates regarding 'factor' as the units of heredity.
1902	Walter S. Sutton	In grasshopper cells, chromosomes displayed different arrangements during gamete formation



Structured question to probe students' idea about NOS

- (a) Mendel's postulates did not agree with the belief held by people at that time. Because of this, his postulates were ignored by the scientific community of his time. Suggest *two* other reasons why his postulates were not accepted. (2 marks)



Relate the postulates with observations

- (b) As a result of Sutton's observation, Mendel's postulates were given more recognition several decades later. Complete the table below to show how the changes in the arrangements of chromosomes during gamete formation correlate with Mendel's postulates on inheritance. (3 marks)

Mendel's postulates	Changes in chromosome arrangement during gamete formation
Characteristics are controlled by pairs of unit factors	
Members of the paired factors separate from each other during gamete formation	
Each gamete receives one member of the paired factors	



Structured questions

- (c) How did Sutton's observation contribute to the recognition of Mendel's postulates? (1 mark)
- (d) Suggest *one* of the technological advancements between 1865 and 1902 that enabled Sutton to observe chromosomes during gamete formation. (1 mark)



Alternative ways of questioning based on the same context

- (b) Mendel's findings went largely unnoticed for about 35 years. Sutton's observation brought recognition to Mendel's work. This history on the development of the knowledge of heredity demonstrates certain aspects on the nature of science. Complete the following table to show your understanding about the nature of science based on this history. (4 marks)

Nature of science	Justification
	Mendel's ideas were not accepted because they were different from the majority view of the scientific community
Scientific knowledge is based on observations of the natural world	

Other questions in CE past papers

Year/Paper/Q	Context
1995 / 1 / 2b	Edward Jenner – small pox
2000 / 1 / 3b	Mering & Minkowski – diabetes
2003 / 1 / 4a	Van Helmont – photosynthesis
2004 / 1 / 2b	Engelmann – photosynthesis
2005 / 1 / 3	Barry Marshall – gastric ulcer
2006 / 1 / 9b	Strasburger – transport in plant
2009 / 1 / 10b	Frits Went – phototropism



Other questions in AL past papers

Year/Paper/Q	Context
1999 / 2 / 2	Endosymbiosis theory
2002 / 2 / 2	Mass flow hypothesis
2004 / 1 / 9	Discovery of DNA
2005 / 2 / 2	Blending Theory
2006 / 1 / 5	Theory of spontaneous generation
2007 / 2 / 2	Evidence of evolution
2007 / 2 / 3	Koch's postulates
2009 / 1 / 6	Mendel and Sutton



Thank You!

