Empowering Hong Kong STEM Secondary Students' Reading Abilities through a School-based Reciprocal Reading Programme and An Online Learning Platform

City University of Hong Kong, Department of English
&
Quality Education Fund

QEF project no. 2019/1239

Tutorial 2: What is STEM reading? (Part two)

Student's handout

Introduction

- STEM fields
- The scientific method, seven steps: Field, question, hypothesis, background research, testing, analyzing, and conclusion
- Practice: Asking questions and writing summaries

Section 2: Introduction to STEM texts

I. Warming up: Identifying different types of scientific texts

Compare texts A, B and C. Highlight verbs and conjunctions that you think are unique to each text. Identify which type of scientific writing, i.e., news, textbook, or research article, each text belongs to and learn their respective features by completing the table that follows the last text.

Text A[1]

Introduction

[1] It has been two years since the beginning of the COVID-19 pandemic. However, even now many of us are still wearing face masks and distancing ourselves from others. Why is that?

[2] SARS-CoV-2, the virus that causes COVID-19, spreads through small droplets. We produce them during coughing, sneezing, speaking, and even when we breathe. If we carry the virus (even when we do not realise it), there will be virions in these droplets. Thus, we can infect others. The droplets can be big in size (above 50 microns), and then they fall quickly to the ground. In this case, we have to be pretty close to another person to infect them. But droplets can also be smaller, meaning that they can stay and travel in the air for quite some time. When they travel so far, they may shrink as evaporation takes away some of the moisture.

[3] It is alarming that SARS-CoV-2 can spread with such ease! This is why wearing face masks in public places is **mandatory** in many countries. Governments also often encourage or require social distancing. But do these measures stop SARS-CoV-2 from spreading? How much do masks and social distancing reduce the risk of infection with the virus? This is what we wanted to find out.

[1] Adapted from *How well do masks protect against COVID-19?* (2022, February). Science Journal for Kids. https://www.sciencejournalforkids.org/articles/how-well-do-masks-protect-against-covid-19/

Text B[2]

[1] Laboratory tests aboard NASA's Phoenix Mars Lander have identified water in a soil sample. The lander's robotic arm delivered the sample Wednesday to an instrument that identifies vapours produced by the heating of samples.

[2] "We have water," justified William Boynton of the University of Arizona, lead scientist for the Thermal and Evolved-Gas Analyzer, or TEGA. "We've seen evidence for this water ice before in observations by the Mars Odyssey orbiter and in disappearing chunks observed by Phoenix last month, but this is the first time Martian water has been touched and tasted."

[3] But not everyone was happy. Unlike every previous craft sent to Mars, this car – and the mannequin called Starman sitting behind the wheel – had not been sterilised. And for this reason, some scientists described it as the "largest load of earthly bacteria to ever enter space". It was believed that if humans do eventually land on Mars, they would not arrive alone. They would carry with them their earthly microbes. Trillions of them.

[4] The soil sample came from a trench approximately 2 inches deep. When the robotic arm first reached that depth, it hit a hard layer of frozen soil. Two attempts to deliver samples of icy soil on days when fresh material was exposed were foiled when the samples became stuck inside the scoop. Most of the material in Wednesday's sample had been exposed to the air for two days, letting some of the water in the sample vaporize away and making the soil easier to handle.

Text C[3]

The morphospecies concept

[1] How do biologists identify species when the criterion of reproductive isolation cannot be applied? Under the morphospecies ("form-species") concept, researchers identify evolutionarily independent lineages by differences in size, shape, or other **morphological** features.

[2] The logic behind the morphospecies concept is that distinguishing features are most likely to arise if populations are independent and isolated from gene flow. The morphospecies concept is compelling simply because it is so widely applicable. It is a useful criterion when biologists have no data on the extent of gene flow, and it is equally applicable to sexual, asexual or fossil species.

[3] However, its disadvantage is that the features used to distinguish species are subjective. In the worst case, different researchers working on the same populations disagree on the characters that distinguish species. For example, some researchers who work on the fossil record of humans argue that the specimens currently named Homo habilis and Homo rudolfensis actually belong to the same species. Disagreements like these often end in a **stalemate**, because no independent criteria exist for resolving the conflict.

[2] Adapted from *NASA spacecraft confirms Martian water, mission extended*. (2008, July 31). NASA. https://www.nasa.gov/mission_pages/phoenix/news/phoenix-20080731.html

[3] Adapted from *How are species defined and identified?* (2022, November, 22). Course Hero. https://www.coursehero.com/file/179252412/study-notespdf/

	News: Text _____	Textbook: Text _____	Research Article: Text _____
How can you tell?			
Topic area			
Purpose?	To explain the rationale for a health protective measure	To present contrasting claims and supporting evidence	To report a piece of scientific discoveries
Target audience?	The general public	Students	Scientists, researchers, students

II. Think critically about the nature of science in scientific texts

When we read a scientific text, we have to consider four characteristics of science:

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Scientific knowledge is not always true and can be challenged.</td>
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Scientific knowledge needs to be justified by evidence and experiments.</td>
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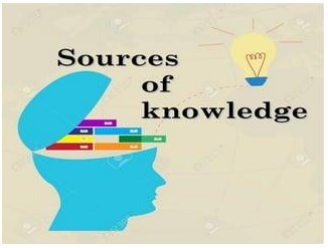
Scientific knowledge changes.</td>
<td> 

Not everything said by scientists is true.</td>
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Now read critically text B again. Try to answer the questions that follow:

[1] Laboratory tests aboard NASA's Phoenix Mars Lander have identified water in a soil sample. The lander's robotic arm delivered the sample Wednesday to an instrument that identifies vapours produced by the heating of samples.

[2] "We have water," justified William Boynton of the University of Arizona, lead scientist for the Thermal and Evolved-Gas Analyzer, or TEGA. "We've seen evidence for this water ice before in observations by the Mars Odyssey orbiter and in disappearing chunks observed by Phoenix last month, but this is the first time Martian water has been touched and tasted."

[3] But not everyone was happy. Unlike every previous craft sent to Mars, this car – and the mannequin called Starman sitting behind the wheel – had not been sterilised. And for this reason, some scientists described it as the "largest load of earthly bacteria to ever enter space". It was believed that if humans do eventually land on Mars, they would not arrive alone. They would carry with them their earthly microbes. Trillions of them.

1. How does William Boynton know that water is present on Mars?
2. Can we trust everything said by the lead scientist William Boynton? Why or why not?
3. Can we be sure that we cannot live on Mars now? Why or why not?
4. Does our knowledge about the possibility to live on Mars stay the same? Why or why not?

III. Writing a Grammatical Research Question

Speed questions (2 mins): Write four **"wh-" questions** (e.g., "who," "what," "where," "when", "why", "how") to ask your classmates about anything relating to STEM (i.e., Science, Technology, Engineering, and Mathematics) in their daily life. You will be invited to ask and answer the questions as fast as possible. DO NOT repeat the same questions other classmates have asked! Make an effort to answer your classmate's questions **in complete sentences**.

Example: What do you use to keep vegetables fresh at home?
Who will help your father repair his car?

1. (Start with a wh- word) _____

2. (Start with a wh- word) _____

3. (Start with a wh- word) _____

4. (Start with a wh- word) _____

Exercise 1: Work in small groups. Study the writing tips below and rewrite the

statements on the following page into research questions using **"wh-" questions** (e.g., "who," "what," "where," "when", "why", "how").

Tips: Subject-verb agreement and "wh-" questions

	Statement Form	Question Form
1.	Marie Curie ***is*** the most famous female scientist in western history.	Who ***is*** the most famous female scientist in western history?
2.	I ***am reading*** a book about Marie Curie.	Why ***are*** you ***reading*** a book about Marie Curie?
3.	I ***admire*** Marie Curie.	Why ***do*** you ***admire*** Marie Curie?
4.	Marie Curie ***taught*** at the University of Paris.	Where ***did*** Marie Curie ***teach*** as a university professor?
5.	Marie Curie ***was awarded*** the Nobel Prize twice.	How many times ***was*** she ***awarded*** the Nobel Prize?
6.	Our teacher ***will show*** us a film about Marie Curie.	When ***will*** your teacher ***show*** you the film about Marie Curie?

***Note the use of the auxiliary verb (i.e., be, do, will) and the subject-auxiliary verb inversion in Nos. 1-6.**

	Statement	Possible Research Question
1.	The application of technologies improves teaching and learning effectiveness.	
2.	Governments use big data to track and monitor the spread of infectious diseases.	
3.	The reduction in biodiversity affects human health.	
4.	Bionic limbs are important to people with disabilities.	

Exercise 2: Writing questions based on the text

Read the following text about animals' grooming behavior. On your own, **underline** the key information and **circle** the key vocabulary items. As a class, **write** three questions using the key information and vocabulary.

Do animals have friends?

[1] Baboons are a type of large monkey from Africa. Baboons spend a lot of time grooming each other, but why do they do this?

[2] Researchers used to believe that baboons only groomed their family members, such as parent baboons grooming their children baboons. However, researchers in New York have found that baboons will also groom their baboon friends. In fact, baboons' grooming behaviors are similar to humans giving hugs to one another.

[3] Further, baboons in the wild will listen for the sound of their friend's voice, then meet up with them to groom and **bond**. Therefore, grooming is a way for baboons to bond with one another in the group.

Questions

1.

2.

3.

Exercise 3: Quiz your teammates! Independently read text A or B and **underline** the main idea or problem AND the important information in the text. As a group, **write** five questions based on the text. Quiz your partner group with the questions your group made. Write your answers to your partner group's questions.

Text A: **Pigs' emotions in sounds**	**Text B:** **What emotions are animals feeling?**
[1] In the present time, humans consume more food than ever before, including the **slaughtering** and eating of animals. While animal meat consumption is at an all-time high, it is important to think about animal **welfare**. [2] Researchers in Europe discovered that the sounds pigs make can show their emotions. Pigs make three types of sounds: grunts, oinks, and **squeals**. The researchers wanted to learn about pigs' sounds to help pigs live happier lives and improve their welfare while living in **captivity**.	[1] On the Internet, videos of cute or funny animals spark joy for many people. People may even believe they are experts at reading animals' emotions when they watch these videos or play with their pet. [2] However, this may not be true. In fact, most people cannot understand animals' emotions and often **misinterpret** what animals are feeling. As a result, animals' **welfare** may be affected. [3] In recent research, animal scientists noted several examples of humans misinterpreting animal behavior or

[3] First, the researchers studied 7,000 recordings of pig sounds from 411 pigs. The researchers compared the sounds pigs made while doing different activities, like eating versus being slaughtered. [4] Second, the researchers analyzed happy and **distressed** sounds. Pigs made grunting sounds when they were happy, but made longer squealing sounds when they were slaughtered. [5] The findings showed that pigs' are sensitive to changes in their environment. Moreover, pigs' stress levels increase when they are slaughtered. Therefore, the researchers encouraged scientists to explore more **humane** methods of slaughtering animals for food.	emotions. First, people often misinterpreted the emotions of their pets. For example, many people believed that when a horse played, it meant the horse was happy. Unfortunately, this was not the case. **Neuroscience research** showed that horses play to relieve stress as a result of living in a **confined** space. [4] Second, people misinterpreted the emotions of animals in **captivity**, like those in research **facilities** or zoos. For example, scientists have proven that octopuses can feel pain, even though they do not show emotion. As a result, some scientists argued that animals, like octopuses, are **sentient** beings and should not live in captivity.
Your Group's Questions 1. 2. 3. 4. 5.	**Your Partner Group's Questions** 1. 2. 3. 4. 5.

IV. Group discussion

1. Circle five **past tense** verbs in text A or B. When is the past tense usually used in a scientific text?
2. Circle the **signpost words** in texts A and B. Do you think these words make the texts easier for you to read? Why?
3. What are the main ideas of texts A and B? What do texts A and B have **in common in terms of the content**?
4. Why are researchers and animal scientists studying animals' emotions?
5. How may learning about animals' emotions change the way people **interact** with animals?
6. Do you think our knowledge about animals' emotions will change? Why or why

not?

7. Do you think it is **moral** or **immoral** to use animals for food or research? Why or why not?

V. Writing summaries

	Organization	Information
	Sentence 1: Introductory sentence	What is the main idea or problem?
	Sentence 2: Research details	Who did the research? What did they study? Who **participated in** the research?
Level 1	Sentence 3: Finding 1	What did the researchers find out?
	Sentence 4: Clarification 1	What does the finding mean?
Level 2	Sentence 5: Finding 2	What more did the researchers find out?
	Sentence 6: Clarification 2	What does the finding mean?
	Sentence 7: Concluding sentence	What is the **bigger picture**? What do the researchers **predict** will happen in the future?

***Key concepts:**

Research findings are the numeric, narrative, or analytic results based on the research data, i.e., any information that was collected, observed, generated, or created during a research process.

Examples:

- Research data, e.g.: The questionnaire results about the sleep quality collected from 1,000 male and female adults at the age of 30-35.
- Research findings, e.g.: (1) White-collar adults, despite their gender, are more likely to suffer from sleep disorders; (2) Overweight men are more likely to suffer from sleep deprivation.

Tip 1: Double-check

- ✔ **Findings sentences** support the **introductory sentence**.
- ✔ **Clarification sentences** support the **findings sentences**.
- ✔ **The concluding sentence** expands on the **introductory sentence**.
- ✔ Use **past tense verbs** to describe the research or findings.
- ✔ Use the **key vocabulary** to present and highlight the main idea.
- ✔ Use **transition words** to structure the writing in an organized manner.

Tip 2: How to write *supporting* sentences

There are two types of supporting sentences in scientific writing, which are:

1. Finding sentence, e.g.: First, the researchers discovered that there are 1.8 trillion pieces of plastic garbage in the Pacific Ocean's "Great Garbage Patch"[4].

2. Clarification sentence, e.g.: This suggests that a lot of humans' plastic garbage ends up in the Pacific Ocean and may harm the ocean's wildlife. Even though we recycle plastic at home, this may not be enough to prevent plastic waste in the ocean.

VI. Group writing practice

As a class, answer the questions in full sentences to make **a complete summary of text A**.

What is the main idea or problem?	Recently,
Who did the research? What did they study? Who participated in the research?	
What did the researchers find out?	First,
What does the finding mean?	This suggests that
What more did the researchers find out?	Second,
What does the finding mean?	This implies that
What is the bigger picture? What do the researchers predict will happen in the future?	In conclusion,

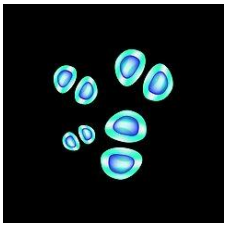
[4] Lebreton, L., Slat, B., Ferrari, F., Sainte-Rose, B., Aitken, J., Marthouse, R., Hajbane, S., Cunsolo, S., Schwarz, A., Levivier, A., Noble, K., Debeljak, P., Maral, H., Schoeneich-Argent, R., Brambini, R., & Reisser, J. (2018). Evidence that the Great Pacific Garbage Patch is rapidly accumulating plastic. *Scientific Reports, 8*(1), 4666.

VII. Independent writing practice

Use text B to write your own summary individually. Raise your hand to ask for help whenever necessary.

What is the main idea or problem?	Recently,
Who did the research? What did they study? Who participated in the research?	
What did the researchers find out?	First,
What does the finding mean?	This suggests that
What more did the researchers find out?	Second,
What does the finding mean?	This implies that
What is the bigger picture? What do the researchers predict will happen in the future?	In conclusion,

Glossary

<table>
<tr><td colspan="2"> 
Bigger Picture
(n.) 較大的圖景</td></tr>
<tr><td> 
Bond
(n.) 關係</td><td> 
Morphological
(adj.) 形態學的</td></tr>
<tr><td> 
Captivity
(n.) 囚禁</td><td> 
Neuroscience research
(n.) 神經科學研究</td></tr>
<tr><td> 
Confined
(adj.) 局限的</td><td> 
Participate in
(v.) 參與</td></tr>
<tr><td> 
Distressed
(adj.) 煩亂的/ 焦慮的</td><td> 
Predict
(v.) 預計/ 預料</td></tr>
</table>

 Facility (facilities [plural]) (n.) 設施	 Sentient (adj.) 有感知能力的
 Humane (adj.) 人道的	 Stalemate (n.) 僵持局面
 Interact (v.) 互動/ 交流	 Slaughter (n.) 宰殺/ 屠殺
 Mandatory (adj.) 強制的	 Squeal (v.) 尖叫/ 長嚎
 Misinterpret (v.) 誤解	 Welfare (n.) 福利